LAKE PONTCHARTRAIN, LA.
AND VICINITY

LAKE PONTCHARTRAIN HIGH LEVEL PLAN

US CE-C PROPERTY OF THE
UNITED STATES GOVERNMENT

DESIGN MEMORANDUM NO. 20

GENERAL DESIGN

ORLEANS PARISH
JEFFERSON PARISH
17th. St. Outfall Canal (Metairie Relief)

IN TWO VOLUMES
VOLUME I

US Army Corps of Engineers
New Orleans District

DEPARTMENT OF THE ARMY
NEW ORLEANS DISTRICT, CORPS OF ENGINEERS
NEW ORLEANS, LOUISIANA
MARCH 1990

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EXPERIMENT STATION
VICKSBURG, MISSISSIPPI

SERIAL NO.

CELMV-ED-PG (CELMN-ED-SP/15 May 90) (1105-2-10c) 3d End
Mr. Eckenrod/ts/5925
SUBJECT: Lake Pontchartrain, Louisiana and Vicinity, High Level Plan, Design Memorandum No. 20 - General Design, 17th Street Outfall Canal

CDR, Lower Mississippi Valley Division, Vicksburg, MS 39181-0080

26 NOV '90

FOR Commander, New Orleans District, ATTN: CELMN-ED-SP

The responses in the enclosed 2d endorsement are satisfactory subject to the following comments:

Para c, 2d End. In view of the information presented, we concur in your proposal to utilize the 2.5:1 minimum penetration ratio for the floodwall penetrations on this project. In addition, analyses performed by this office indicate that in most cases the penetrations derived using the 2.5:1 ratio appear about the same as those required using the conservative "S" case, F.S. = 1.5 criteria. However, during the 1994 capping of the Orleans side floodwall, the sheetpile between B/L stations 554+00 and 614+00 should be driven deeper to achieve a tip elevation of -15. This will ensure that these walls will have an "S" case factor of safety of 1.5 for the bulkhead analysis.

FOR THE COMMANDER:

for William R. Hill
FRED H. BAYLEY III
Chief, Engineering Division

Encl
nc

CF:
CECW-EP

1990 NOV 28 AM 9:52
RECEIVED
CELMN-IM-SM
USACE, NOLA

CELMN-ED-SP (CELMN-ED-SP/15 May 90) (1110-2-1150a) 2d End
Mr. Stutts/mn/2614
SUBJECT: Lake Pontchartrain, Louisiana and Vicinity, High Level Plan, Design Memorandum No. 20 - General Design, 17th Street Outfall Canal

DA, New Orleans District, Corps of Engineers, P. O. Box 60267, New Orleans, LA 70160-0267 22 Oct 90

FOR Commander, Lower Mississippi Valley Division, ATTN: CELMV-ED-PG

The following are our responses to comments contained in the 1st Endorsement.

a. Comment a. Para. 7k. Concur. The per annum interest rate is 3.125 percent.

b. Comment b. Para. 14 and Appendix DD, page DD-9. The design computations for the Veterans Highway Bridge are adequate to develop the GDM scope cost estimate. During preparation of plans and specifications we will prepare a more punctilious design that addresses all conventional loading including hydraulic loads (horizontal and uplift) as recommended by American Association of State Highway and Transportation Officials (AASHTO). In addition, CELMV's recommendation on establishing pile fixity is noted and we will comply in the detailed design phase.

c. Comment c. Para. 29b. Do not concur. Reference CEMRC-ED-GS memorandum dated 24 July 89, para. 3. A penetration to head ratio of 2.5 to 3:1 is recommended in the referenced memorandum. For certain projects a penetration to head ratio of less than 2.5 was authorized. The factors stated in the memorandum which cause the tip to be arbitrarily increased by a penetration to head ratio are unknown variations in ground surface elevations and soil conditions. The 2.5:1 penetration to head ratio was used because of the following:

(1) The ground surface elevations are based on surveys at 100 ft. intervals.

(2) Two surveys along the canal were done in the last 10 years.

(3) The velocities in the canal are too low to cause scour.

(4) Borings were taken at 350 ft. intervals by the A/E on both sides of the canal and were supplemented by USACE check borings.

(5) The existing levee is over 30 years old.

All hurricane protection in urban areas is critical in nature; however, no other hurricane protection project has had the level of borings or surveys as the 17th St. Canal project. The 3 to 1 minimum ratio was used on other New Orleans projects because of the CEMRC-ED-GS memorandum dated 23 Dec 87 which required the 3 to 1 ratio. No GDM has been submitted for a 3 to 1 ratio in an existing levee since the July 89 criteria.

The sheetpile sections on plates 101 through 103 and 111 have penetration ratios of 2.8 to 1 and an S-CASE F.S. of 1.2 for canal water level of 0.0. Sections on plates 104 through 105 and 112 have tip elevations deeper than required for an S-CASE F.S. = 1.5 or 3:1 ratio for the bulkhead case. The sheetpile sections on plates 110 and 113 have an S-CASE F.S. of 1.4 for canal water level of 0.0 (see Encl 2). Additionally, the existing sheetpile wall has served as a permanent bulkhead retaining as much as 4 ft. of soil for at least 19 years (Orleans Levee Board 1971 Surveys). We will monitor the sheetpile wall being constructed by the local interests on the Orleans side of the canal. We will consider driving the sheetpile deeper instead of cutting the sheetpile in 1994 during capping.

d. Comment d. Para. 29c. The analyses presented were for the Q-CASE soil strengths, a canal level at EL. -5.0 and a factor of safety of 1.5. For plates 121, 122, and 124 the actual design (completed before Dec 87) was controlled by the S-CASE, F.S. = 1.5, and canal level at EL -5.0. The design on plate 123 (completed after Dec 87) was based on the S-CASE F.S. = 1.2 with canal level at EL -5.0; S-CASE F.S. = 1.5 with canal level at EL 0.0; or the 3:1 penetration to head ratio. All the braced walls and tieback walls have been constructed. The tip penetrations shown on plates 122-124 are deeper than the minimum required tip penetration (Encl 3). Intermediate tip penetrations were used to reduce the anchor forces.

e. Comment e. Para. 39. Concur.

f. Comment f. Para. 41b. Reference Para. 3 of CEMRC-ED-GS dated 24 July 89. The Q-CASE F.S. = 1.25 applies only for waveloads on hurricane protection levees. No waveloads occur in the canal.

g. Comment g. Para. 68.

(1) Concur. The narrative description and explanation of the cost estimates is added as follows:

The unit prices and estimated costs were obtained with the use of a personal computer software system developed within NOD. This is the same computer software system utilized in preparing Government estimates for advertised construction projects.

The contingency percentage for each item was established by evaluating the uncertainty of both the quantity and costs for each item with the appropriate design engineer and cost engineer. Such evaluation was further assisted by the historical data on many cost items as this project incorporates a majority of items commonly found on hurricane protection projects within NOD.

Since the project is located in the metropolitan New Orleans area, accessibility presents no problem. Similarly, the materials for this project (including the steel and concrete products) are readily available. And as mentioned previously, the construction work is conventional and similar to such work throughout NOD which results in no unusual pricing.

(2) We incorporated the project contingencies in the cost estimate for account 30 and 31 and the work for Pumping Station No. 6. The net project contingency for the east and west floodwall work is approximately 13 percent. The total project contingency is 15 percent.

h. Comment h. Para. 69.

(1) Concur. The east-side work is currently under construction. The Orleans Levee Board's contractor is driving the piling to the depths specified in the DM. Approximately 6 to

7 feet of sheetpile stick-up above the levee crown is incorporated in the design to provide interim protection.

(2) See response c. above.

(3) The levee board elected to take the lead and commit these expenditures at this time to achieve savings because the New Orleans Sewerage and Water Board (NOSWB) planned to deepen and widen the canal to meet their drainage needs. The work proposed by NOSWB required modification to the existing levees and floodwalls. Under their permit, NOSWB is required to maintain the status quo for the existing levees including overall stability and level of protection. Since this involved pulling and driving new sheetpiling, it is obviously more cost effective to combine the two projects and replace the sheetpiling to the High Level Plan criteria. OLB elected to expend these funds even though they currently have credits in excess of those required. However, they see no reason to cap the sheetpiling at this time since it would only increase their share of the project cost. With the remaining work in the Orleans unit, it appears likely that OLB will have contributed in excess of their 30 percent share.

i. Comment i. Table 1. Concur. We will furnish the final design watersurface profile when the bridge designs conditions are known. In developing the designs for the bridges, we will insure that bridge losses are not excessive so as to cause the flowline to encroach into the floodwall freeboard.

j. Comment j. Plate 15. The stress levels in this portion of the concrete cap are below 8 ksi. We designed the lower section of the concrete cap with sufficient reinforcement to prevent cracking.

k. Comment k. Plates 60, 82, 84, 92 and 97. The minimum spacing between active and passive failure wedges is based on engineering judgment. We generally use a distance equal to about 0.7 and 1.0 of the height of the wedge, whichever is more prudent.

l. Comment l. Plates 94, 95, 117, 118 and 122. Concur. The W/L stationing on these plates applies to the area between B/L Station 670+00 and the pumping station. We will revise the stationing.

CELMN-ED-SP (1110-2-1150a)
SUBJECT: Lake Pontchartrain, Louisiana and Vicinity, High Level Plan, Design Memorandum No. 20 - General Design, 17th Street Outfall Canal

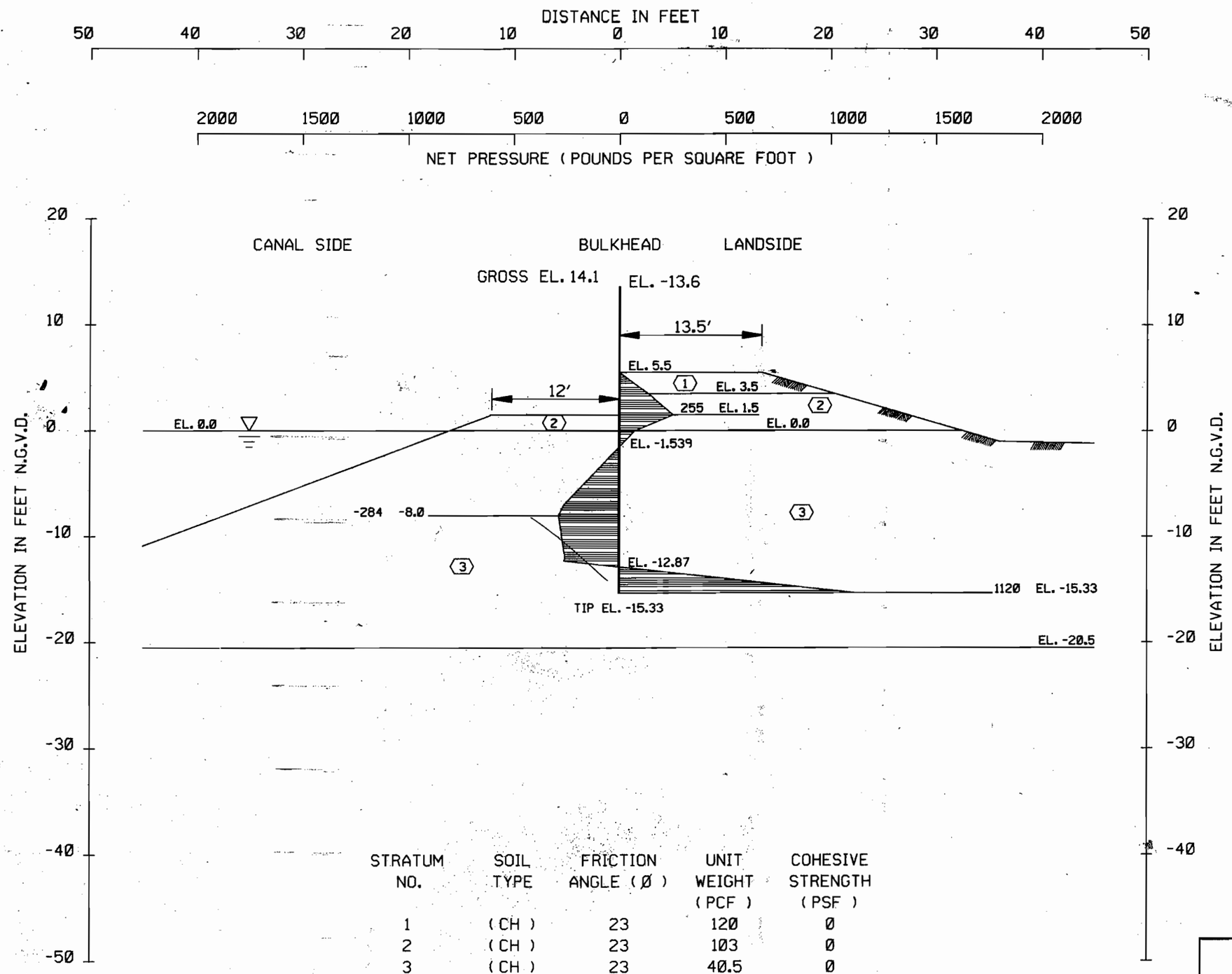
m. Comment m. Plates 121 through 124. Concur. Revised plates 121 through 124 are enclosed as Encl 3.

n. Comment n. Appendix D. The 27 percent contingency is listed as a project contingency. This contingency rate represents a weighted average of all the contingencies in the estimate. The 30 and 31 accounts have their respective contingencies built in to the summarized figures given in the table. We do not think that a more detailed presentation is necessary since the table is for an alternative plan which is not recommended. The rather high overall project rate is supportable owing to the more complex phased construction necessary to build the butterfly valve structure in the canal and at the same time not interrupt pumping operations.

FOR THE COMMANDER:

W. EUGENE TICKNER
Chief, Engineering Division

3 Encls
Added 2 encls
2-3. as



ELEVATION	PRESSURE
5.50	0.0
3.50	137.3
1.50	255.1
0.00	73.3
-1.54	0.0
-7.00	-260.2
-8.00	-284.4
-12.00	-254.6
-12.29	-259.4
-12.87	0.0
-15.33	1119.9
-15.33	0.0

STRATUM NO.	SOIL TYPE	FRICTION ANGLE (Ø)	UNIT WEIGHT (PCF)	COHESIVE STRENGTH (PSF)
1	(CH)	23	120	0
2	(CH)	23	103	0
3	(CH)	23	40.5	0

SEE PLATE 64 FOR STABILITY ANALYSIS
NET DIAGRAM

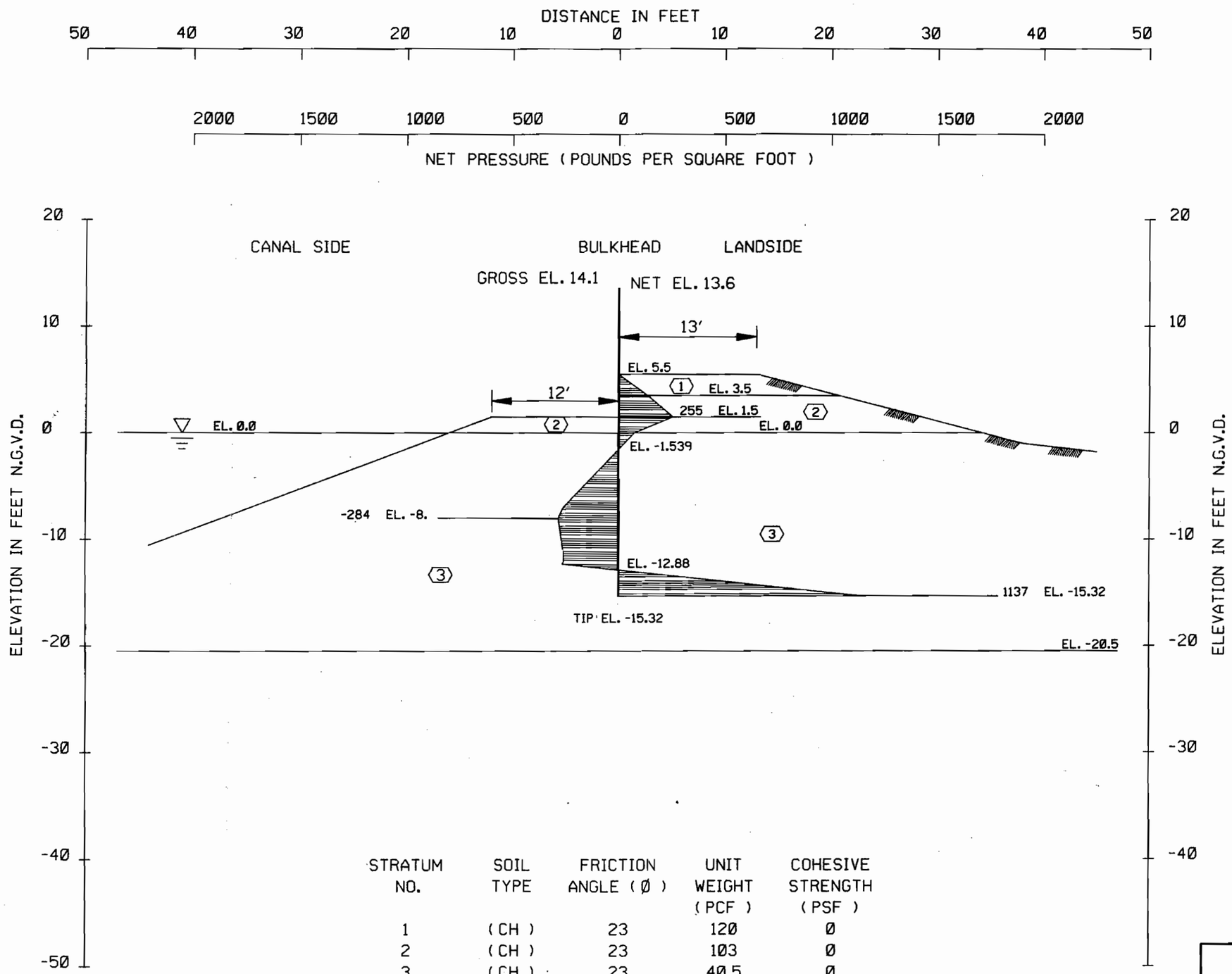
(S) CASE F.S. = 1.5

ENCL. 2,

LAKE PONTCHARTRAIN, LA. AND VICINITY
HIGH LEVEL PLAIN
DESIGN MEMORANDOM NO. 20 GENERAL DESIGN
ORLEANS PARISH - JEFFERSON PARISH
17TH. STREET OUTFALL CANAL
(METAIRIE RELIEF)

I-WALL ANALYSIS
B/L STA. 554+00 TO
B/L STA. 589+00 ORLEANS

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
DATE: SEPTEMBER 1990 FILE NO. H-2-30300



ELEVATION	PRESSURE
5.50	0.0
3.50	137.3
1.50	255.1
0.00	73.3
-1.54	0.0
-7.00	-260.2
-8.00	-284.4
-11.00	-262.1
-12.00	-258.1
-12.31	-264.7
-12.88	0.0
-15.32	1137.4
-15.32	0.0

STRATUM NO.	SOIL TYPE	FRICTION ANGLE (Ø)	UNIT WEIGHT (PCF)	COHESIVE STRENGTH (PSF)
1	(CH)	23	120	0
2	(CH)	23	103	0
3	(CH)	23	40.5	0

SEE PLATE 64 FOR STABILITY ANALYSIS

NET DIAGRAM

(S) CASE F.S. = 1.5

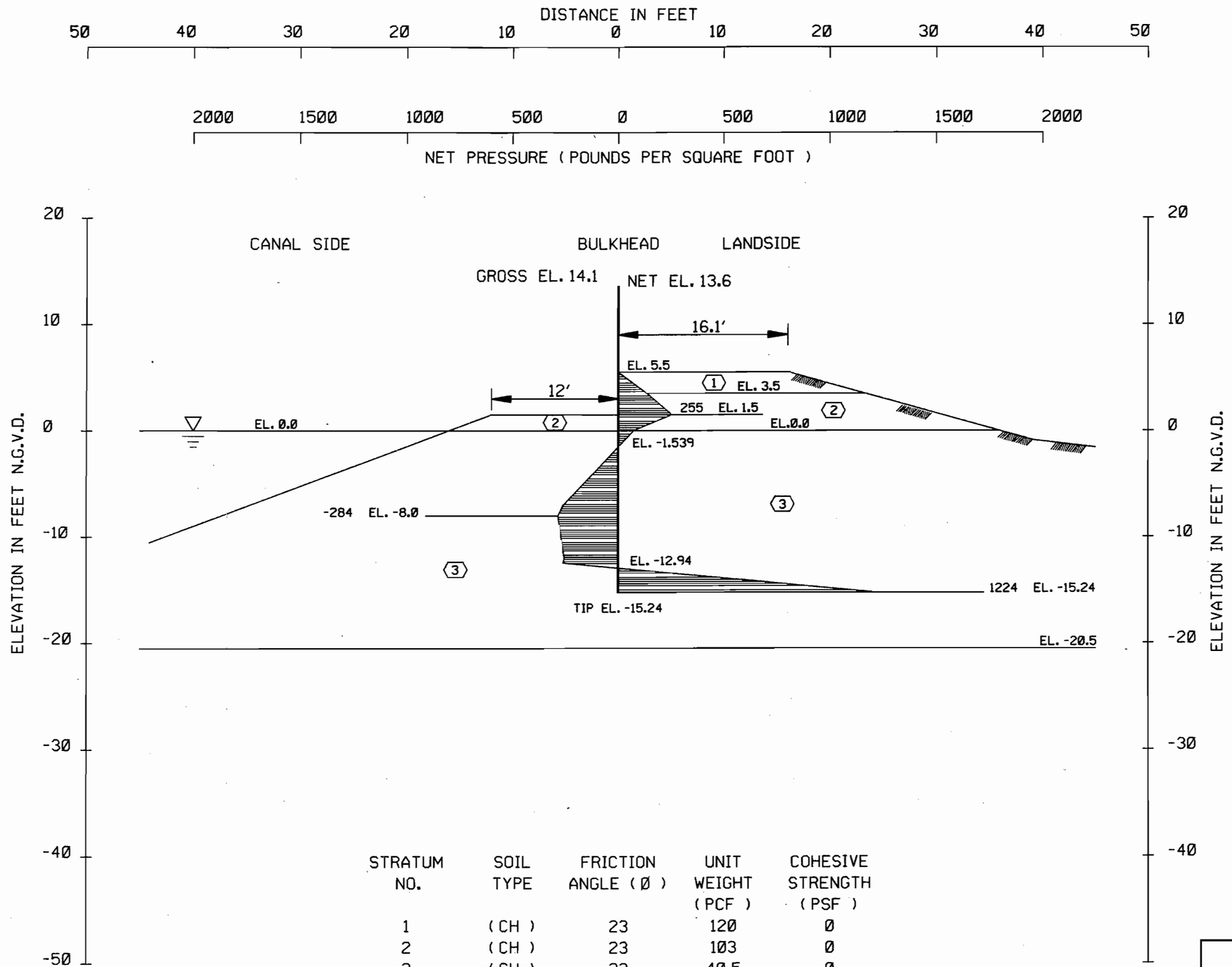
ENCL 2₂

LAKE PONTCHARTRAIN, LA. AND VICINITY
HIGH LEVEL PLAIN
DESIGN MEMORANDOM NO. 20 GENERAL DESIGN
ORLEANS PARISH - JEFFERSON PARISH
17TH. STREET OUTFALL CANAL
(METAIRIE RELIEF)

I-WALL ANALYSIS
B/L STA. 568+00 TO
B/L STA. 589+00 ORLEANS

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

DATE: SEPTEMBER 1990 FILE NO. H-2-30300



ELEVATION	PRESSURE
5.50	0.0
3.50	137.3
1.50	255.1
0.00	73.3
-1.54	0.0
-7.00	-260.2
-8.00	-284.4
-12.00	-254.6
-12.45	-259.1
-12.94	0.0
-15.24	1224.2
-15.24	0.0

STRATUM NO.	SOIL TYPE	FRICTION ANGLE (Ø)	UNIT WEIGHT (PCF)	COHESIVE STRENGTH (PSF)
1	(CH)	23	120	0
2	(CH)	23	103	0
3	(CH)	23	40.5	0

SEE PLATE 66 FOR STABILITY ANALYSIS
NET DIAGRAM

(S) CASE F.S. = 1.5

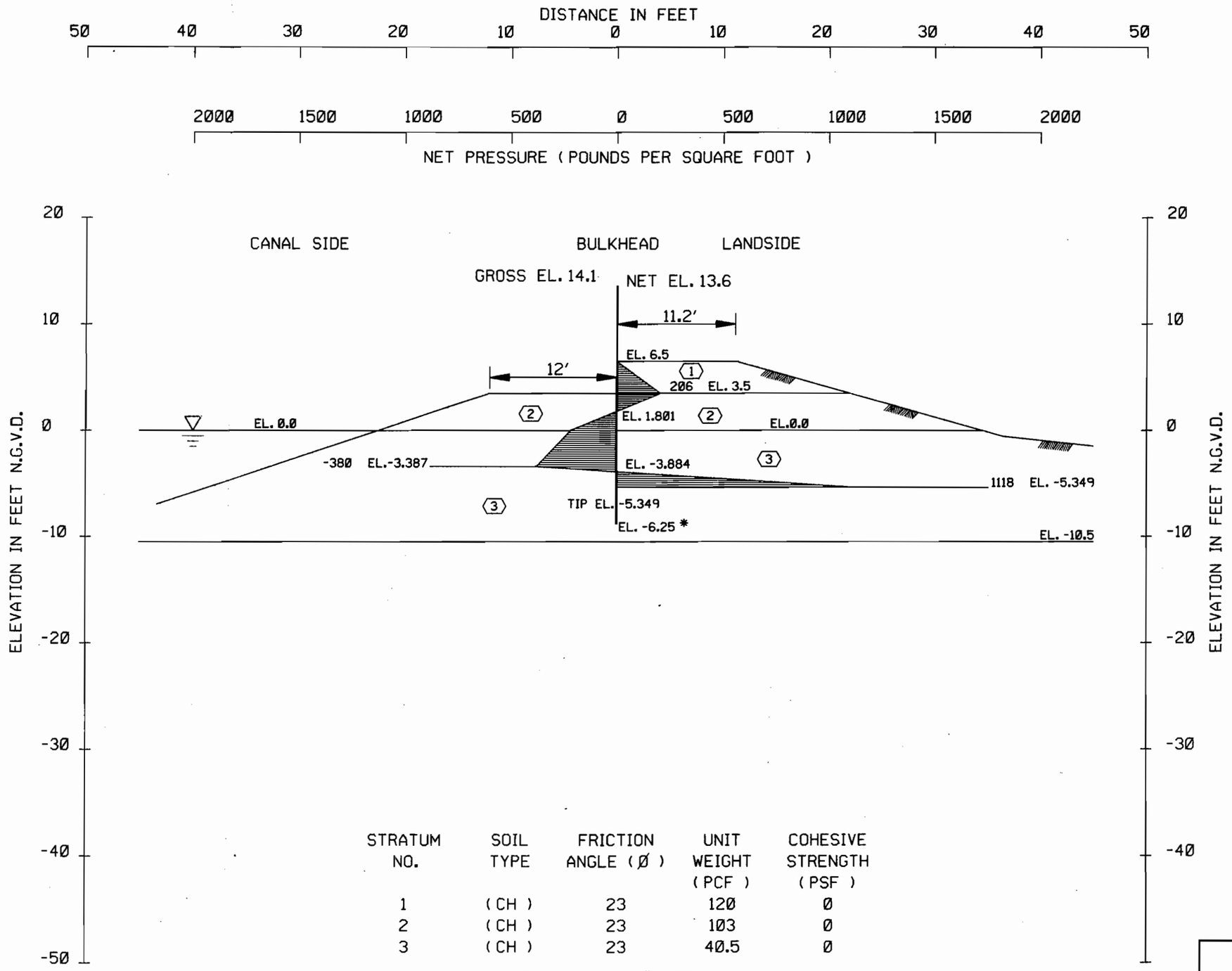
ENCL 23

LAKE PONTCHARTRAIN, LA. AND VICINITY
HIGH LEVEL PLAIN
DESIGN MEMORANDOM NO. 20 GENERAL DESIGN
ORLEANS PARISH - JEFFERSON PARISH
17TH. STREET OUTFALL CANAL
(METAIRIE RELIEF)

I-WALL ANALYSIS
B\L STA. 589+00 TO
B\L STA. 614+00 ORLEANS

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

DATE: SEPTEMBER 1990 FILE NO. H-2-30300



ELEVATION	PRESSURE
6.50	0.0
3.50	205.9
1.80	0.0
0.00	-218.2
-3.39	-379.5
-3.88	0.0
-5.35	1117.9
-5.35	0.0

STRATUM NO.	SOIL TYPE	FRICTION ANGLE (Ø)	UNIT WEIGHT (PCF)	COHESIVE STRENGTH (PSF)
1	(CH)	23	120	0
2	(CH)	23	103	0
3	(CH)	23	40.5	0

SEE PLATE 68 FOR STABILITY ANALYSIS

*2.5 TO 1 HEAD TO PENETRATION RATIO HURRICANE LOADING

NET DIAGRAM

(S) CASE F.S. = 1.5

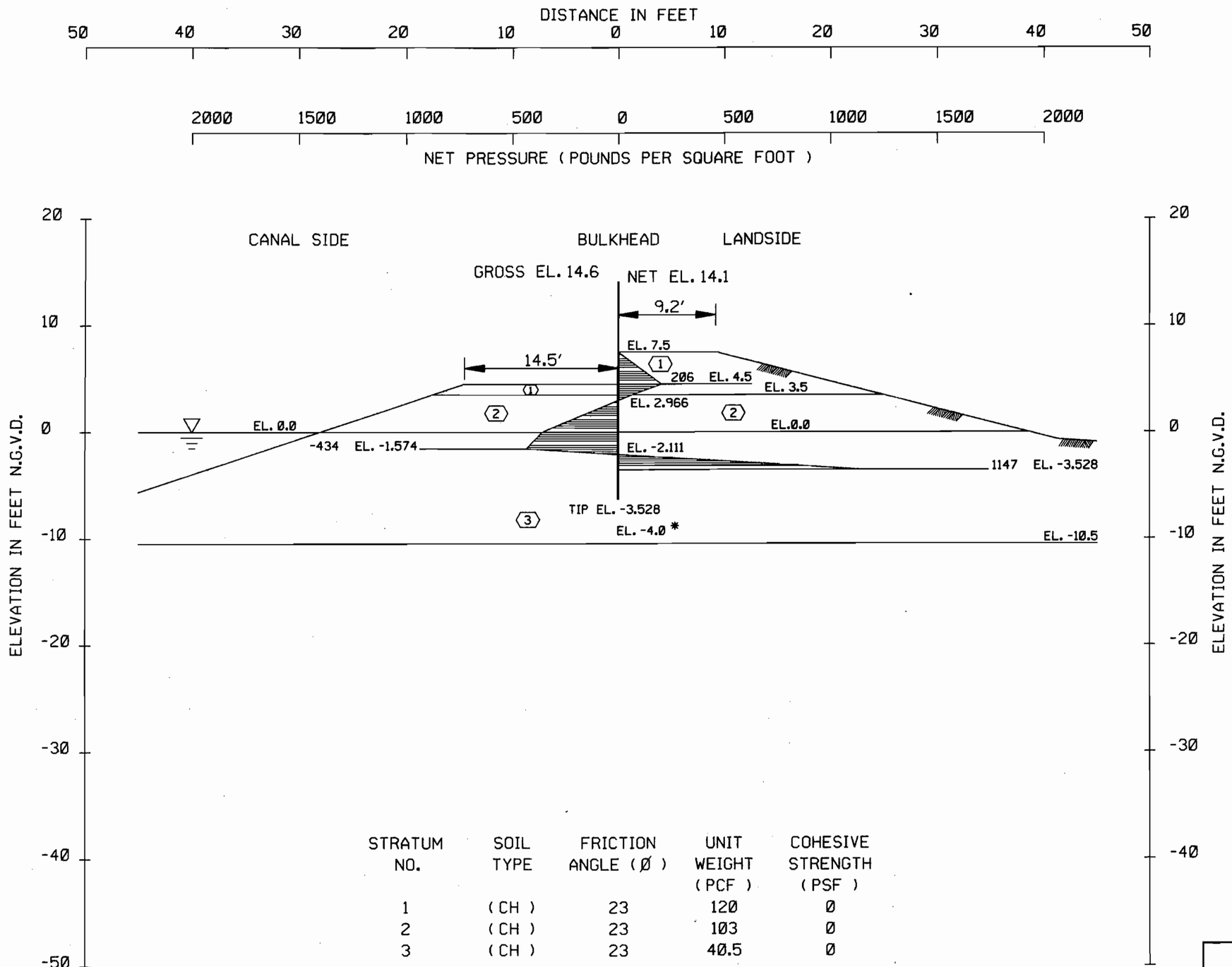
ENCL. 24

LAKE PONTCHARTRAIN, LA. AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDOM NO. 20 GENERAL DESIGN
ORLEANS PARISH - JEFFERSON PARISH
17TH. STREET OUTFALL CANAL
(METAIRIE RELIEF)

I-WALL ANALYSIS
B\L STA. 614+00 TO
B\L STA. 625+00 ORLEANS

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

DATE: SEPTEMBER 1990 FILE NO. H-2-30300



ELEVATION	PRESSURE
7.50	0.0
4.50	205.9
3.50	64.7
2.97	0.0
0.00	-359.3
-1.57	-434.3
-2.11	0.0
-3.53	1146.5
-3.53	0.0

STRATUM NO.	SOIL TYPE	FRICTION ANGLE (Ø)	UNIT WEIGHT (PCF)	COHESIVE STRENGTH (PSF)
1	(CH)	23	120	0
2	(CH)	23	103	0
3	(CH)	23	40.5	0

SEE PLATE 70 FOR STABILITY ANALYSIS

*2.5 TO 1 HEAD TO PENETRATION RATIO HURRICANE LOADING

NET DIAGRAM

(S) CASE F.S. = 1.5

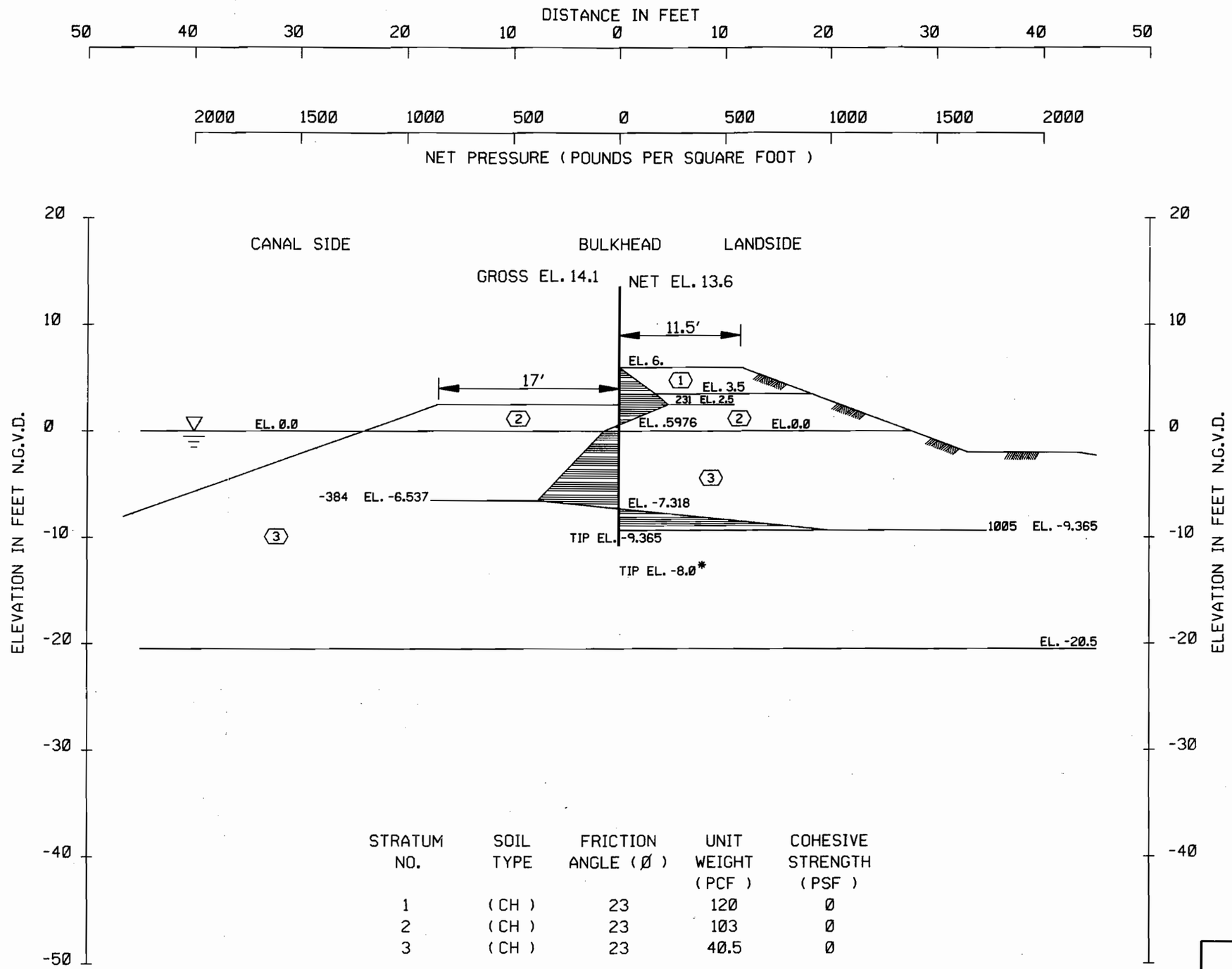
ENCL. 2₅

LAKE PONTCHARTRAIN, LA. AND VICINITY
HIGH LEVEL PLAIN
DESIGN MEMORANDOM NO. 20 GENERAL DESIGN
ORLEANS PARISH - JEFFERSON PARISH
17TH. STREET OUTFALL CANAL
(METAIRIE RELIEF)

I-WALL ANALYSIS
B\L STA. 625+00 TO
B\L STA. 635+00 ORLEANS

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

DATE: SEPTEMBER 1990 FILE NO. H-2-30300



ELEVATION	PRESSURE
6.00	0.0
3.50	171.6
2.50	250.5
0.60	0.0
0.00	-72.4
-6.54	-383.9
-7.32	0.0
-9.36	1005.0
-9.36	0.0

STRATUM NO.	SOIL TYPE	FRICTION ANGLE (Ø)	UNIT WEIGHT (PCF)	COHESIVE STRENGTH (PSF)
1	(CH)	23	120	0
2	(CH)	23	103	0
3	(CH)	23	40.5	0

SEE PLATE 80 FOR STABILITY ANALYSIS

*2.5 TO 1 HEAD TO PENETRATION RATIO HURRICANE LOADING

NET DIAGRAM

(S) CASE F.S. = 1.5

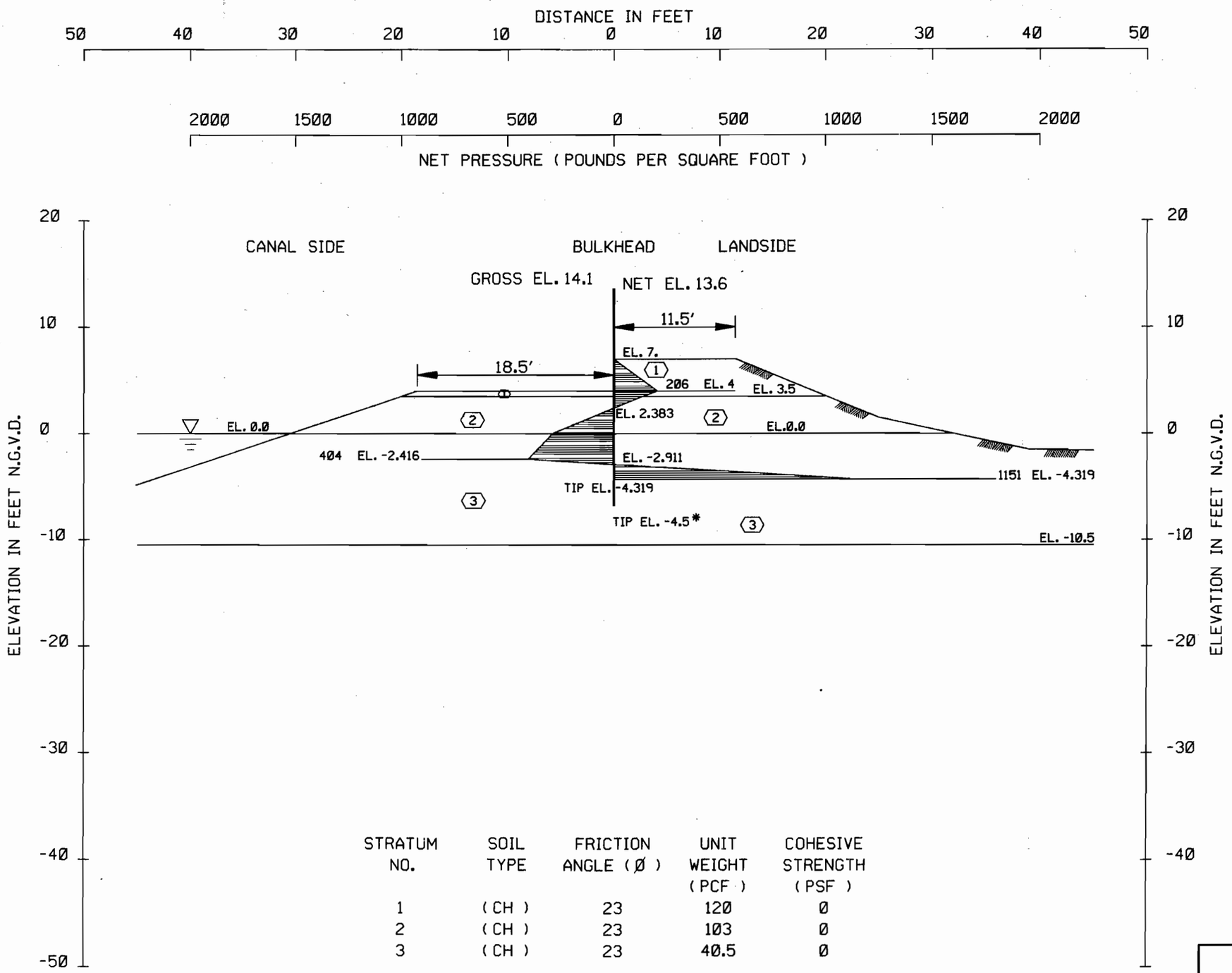
ENCL. 26

LAKE PONTCHARTRAIN, LA. AND VICINITY
HIGH LEVEL PLAIN
DESIGN MEMORANDOM NO. 20 GENERAL DESIGN
ORLEANS PARISH - JEFFERSON PARISH
17TH. STREET OUTFALL CANAL
(METAIRIE RELIEF)

I-WALL ANALYSIS
B\L STA. 554+00 TO
B\L STA. 589+00 JEFFERSON

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

DATE: SEPTEMBER 1990 FILE NO. H-2-30300



ELEVATION	PRESSURE
7.00	0.0
4.00	205.9
3.50	135.3
2.38	0.0
0.00	-288.8
-2.42	-403.9
-2.91	0.0
-4.32	1151.4
-4.32	0.0

STRATUM NO.	SOIL TYPE	FRICTION ANGLE (Ø)	UNIT WEIGHT (PCF)	COHESIVE STRENGTH (PSF)
1	(CH)	23	120	0
2	(CH)	23	103	0
3	(CH)	23	40.5	0

SEE PLATE 82 FOR STABILITY ANALYSIS

*2.5 TO 1 HEAD TO PENETRATION RATIO HURRICANE LOADING

NET DIAGRAM

(S) CASE F.S. = 1.5

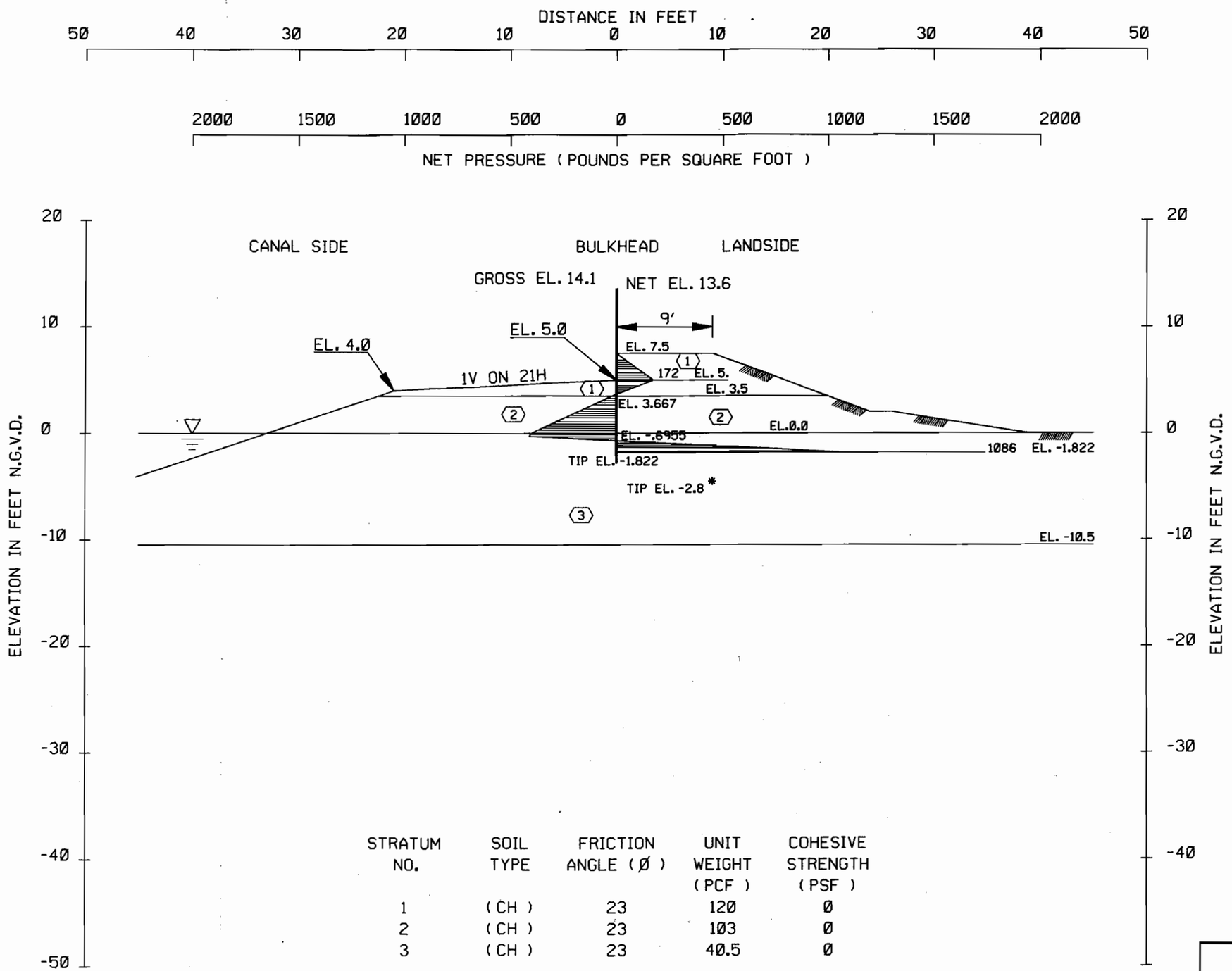
ENCL. 27

LAKE PONTCHARTRAIN, LA. AND VICINITY
HIGH LEVEL PLAIN
DESIGN MEMORANDOM NO. 20 GENERAL DESIGN
ORLEANS PARISH - JEFFERSON PARISH
17TH. STREET OUTFALL CANAL
(METAIRIE RELIEF)

I-WALL ANALYSIS
B\L STA. 589+00 TO
B\L STA. 614+00 JEFFERSON

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

DATE: SEPTEMBER 1990 FILE NO. H-2-30300



ELEVATION	PRESSURE
7.50	0.0
5.00	171.6
3.67	0.0
3.50	-21.5
0.00	-402.1
-0.27	-411.6
-0.70	0.0
-1.82	1085.5
-1.82	0.0

STRATUM NO.	SOIL TYPE	FRICTION ANGLE (Ø)	UNIT WEIGHT (PCF)	COHESIVE STRENGTH (PSF)
1	(CH)	23	120	0
2	(CH)	23	103	0
3	(CH)	23	40.5	0

SEE PLATE 84 FOR STABILITY ANALYSIS

*2.5 TO 1 HEAD TO PENETRATION RATIO HURRICANE LOADING

NET DIAGRAM

(S) CASE F.S. = 1.5

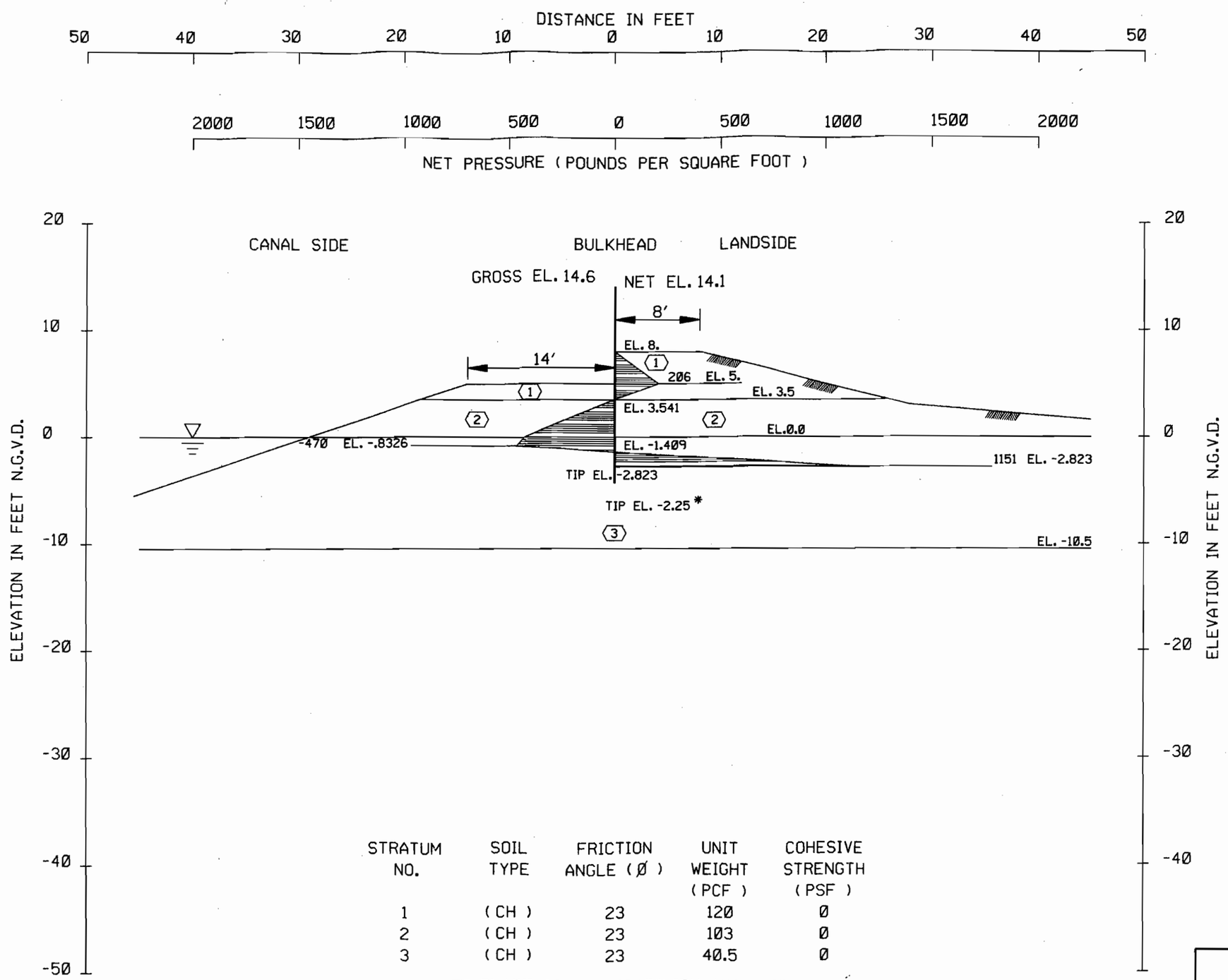
ENCL. 28

LAKE PONTCHARTRAIN, LA. AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDOM NO. 20 GENERAL DESIGN
ORLEANS PARISH - JEFFERSON PARISH
17TH. STREET OUTFALL CANAL
(METAIRIE RELIEF)

I-WALL ANALYSIS
B\L STA. 614+00 TO
B\L STA. 625+25 JEFFERSON

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

DATE: SEPTEMBER 1990 FILE NO. H-2-30300



ELEVATION	PRESSURE
8.00	0.0
5.00	205.9
3.54	0.0
3.50	-5.8
0.00	-429.9
-0.83	-469.6
-1.41	0.0
-2.82	1151.0
-2.82	0.0

STRATUM NO.	SOIL TYPE	FRICTION ANGLE (Ø)	UNIT WEIGHT (PCF)	COHESIVE STRENGTH (PSF)
1	(CH)	23	120	0
2	(CH)	23	103	0
3	(CH)	23	40.5	0

SEE PLATE 86 FOR STABILITY ANALYSIS

*2.5 TO 1 HEAD TO PENETRATION RATIO HURRICANE LOADING

NET DIAGRAM

(S) CASE F.S. = 1.5

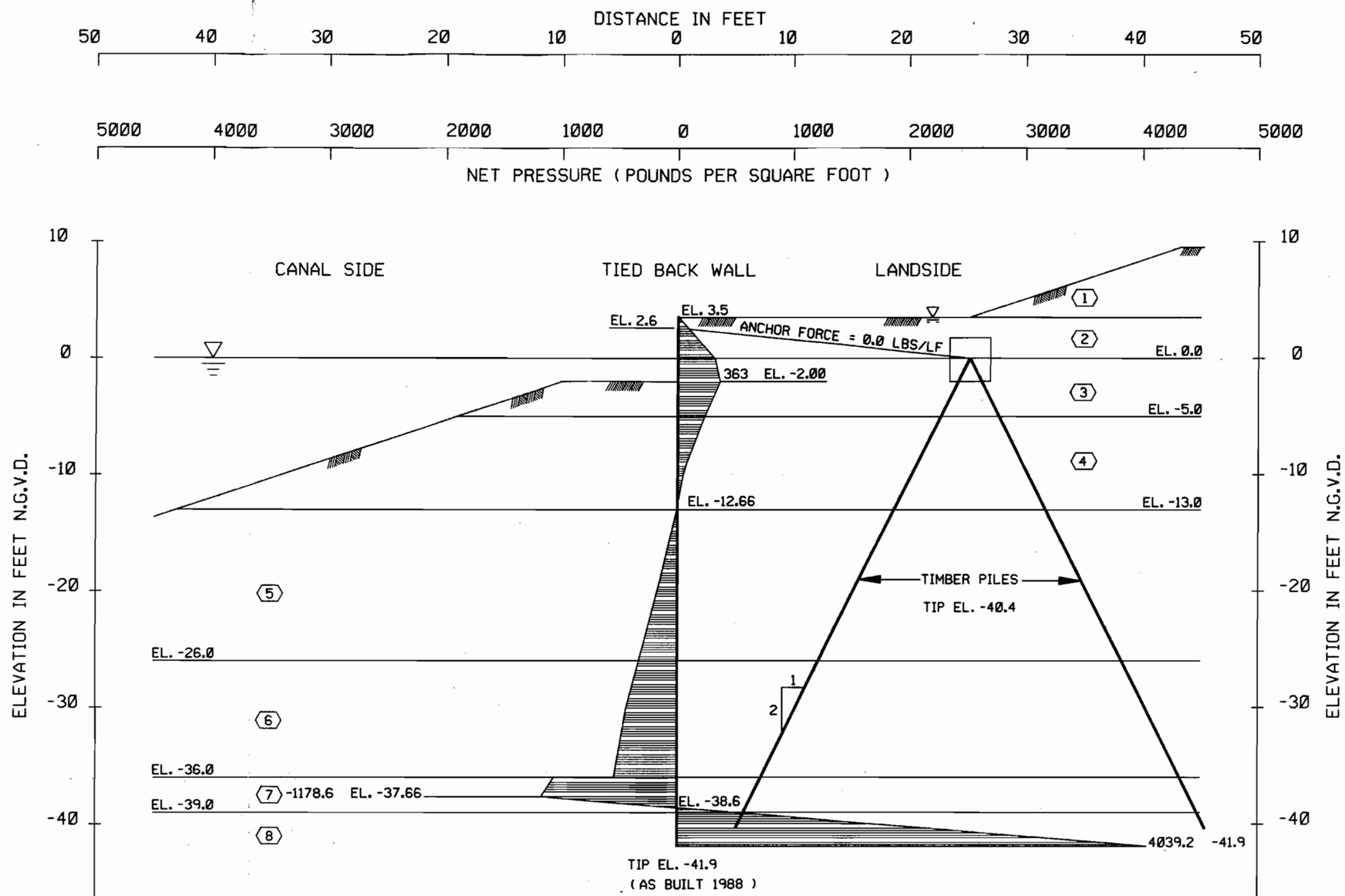
ENCL. 29

LAKE PONTCHARTRAIN, LA. AND VICINITY
HIGH LEVEL PLAIN
DESIGN MEMORANDUM NO. 20 GENERAL DESIGN
ORLEANS PARISH - JEFFERSON PARISH
17TH. STREET OUTFALL CANAL
(METAIRIE RELIEF)

I-WALL ANALYSIS
B\L STA. 625+25 TO
B\L STA. 635+00 JEFFERSON

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

DATE: SEPTEMBER 1990 FILE NO. H-2-30300



ELEVATION	PRESSURE
3.60	0.0
0.00	320.1
-2.00	363.0
-5.00	230.7
-9.00	77.8
-10.00	48.3
-11.00	30.1
-12.66	0.0
-13.00	-6.2
-19.00	-150.5
-26.00	-336.7
-30.00	-442.3
-36.00	-549.0
-36.00	-1065.0
-37.66	-1178.6
-38.60	0.0
-41.90	4039.2
-41.90	0.0

NOTE : FOR A F.S. = 1.0 THE CORRESPONDING ANCHOR FORCE IS 0.0 LBS/LF

STRATUM NO.	SOIL TYPE	FRICTION ANGLE (Ø)	UNIT WEIGHT (PCF)	COHESIVE STRENGTH (PSF)
1	(CH)	23	110	0
2	(CH)	23	47.5	0
3	(CH)	23	37.5	0
4	(CH)	23	32.5	0
5	(CH)	23	37.5	0
6	(CH)	23	37.5	0
7	(SM)	30	59.5	0
8	(CH)	23	54.5	0

SEE PLATE 79 FOR STABILITY ANALYSIS

NET DIAGRAM

(S) CASE F.S. = 1.5

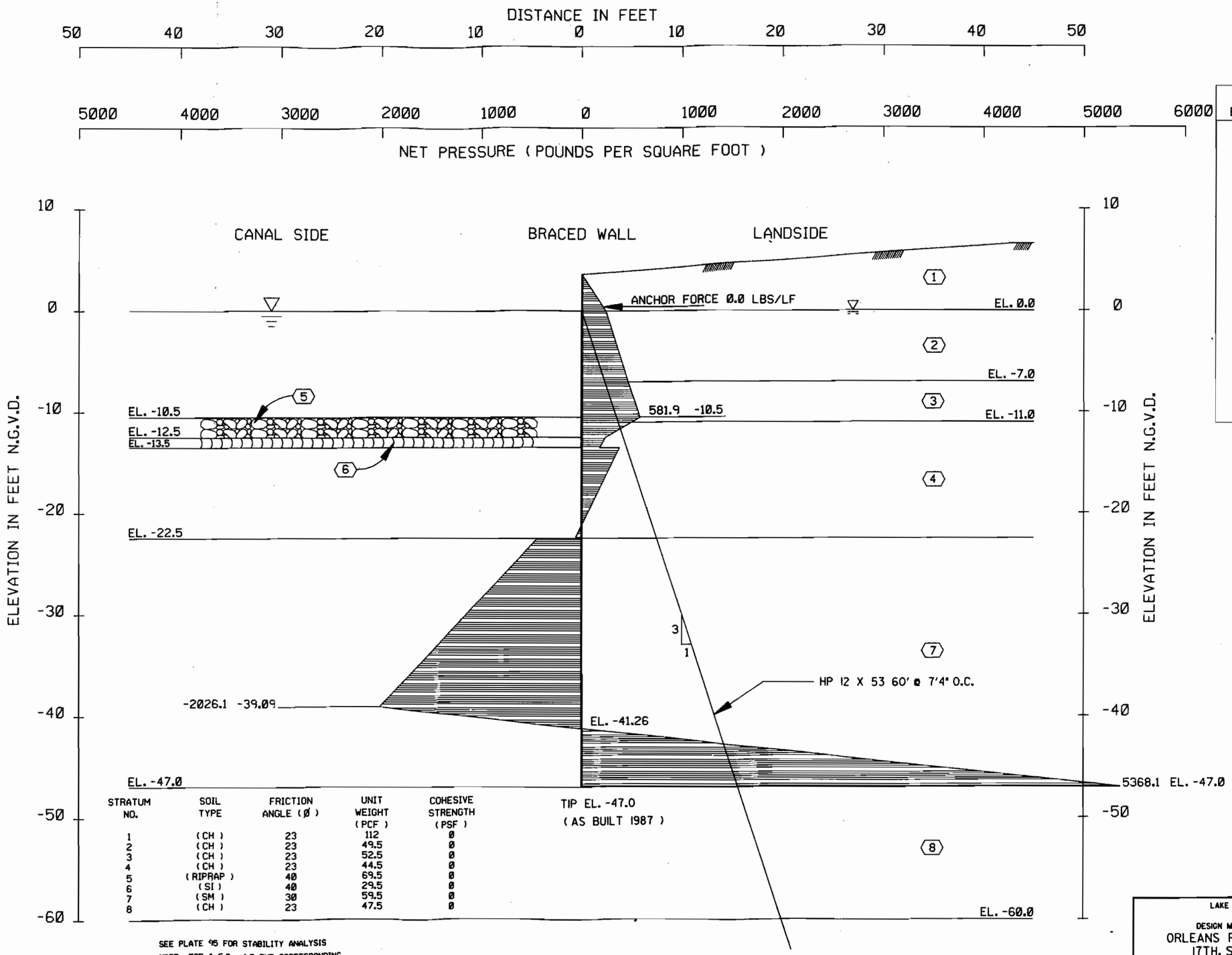
ENCL 3.

LAKE PONTCHARTRAIN, LA. AND VICINITY
HIGH LEVEL PLAIN
DESIGN MEMORANDOM NO. 20 GENERAL DESIGN
ORLEANS PARISH - JEFFERSON PARISH
17TH. STREET OUTFALL CANAL
(METAIRIE RELIEF)

TIED BACK WALL ANALYSIS
B\L STA. 549+22 TO
B\L STA. 552+70 JEFFERSON

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

DATE: SEPTEMBER 1990 FILE NO. H-2-30300



ELEVATION	PRESSURE
3.60	0.0
0.00	242.9
-5.00	401.4
-7.00	464.9
-10.50	581.9
-11.00	497.5
-12.00	324.3
-12.50	237.7
-13.50	180.7
-13.50	376.1
-22.50	-64.4
-22.50	-440.1
-39.09	-2026.1
-41.26	0.0
-47.00	5368.1
-47.00	0.0

STRATUM NO.	SOIL TYPE	FRICTION ANGLE (Ø)	UNIT WEIGHT (PCF)	COHESIVE STRENGTH (PSF)
1	(CH)	23	112	0
2	(CH)	23	49.5	0
3	(CH)	23	52.5	0
4	(CH)	23	44.5	0
5	(RIPRAP)	40	69.5	0
6	(SI)	40	29.5	0
7	(SM)	30	59.5	0
8	(CH)	23	47.5	0

SEE PLATE 95 FOR STABILITY ANALYSIS
NOTE : FOR A F.S. = 1.0 THE CORRESPONDING ANCHOR FORCE IS 0.0 LBS/LF

NET DIAGRAM

(S) CASE F.S. = 1.5

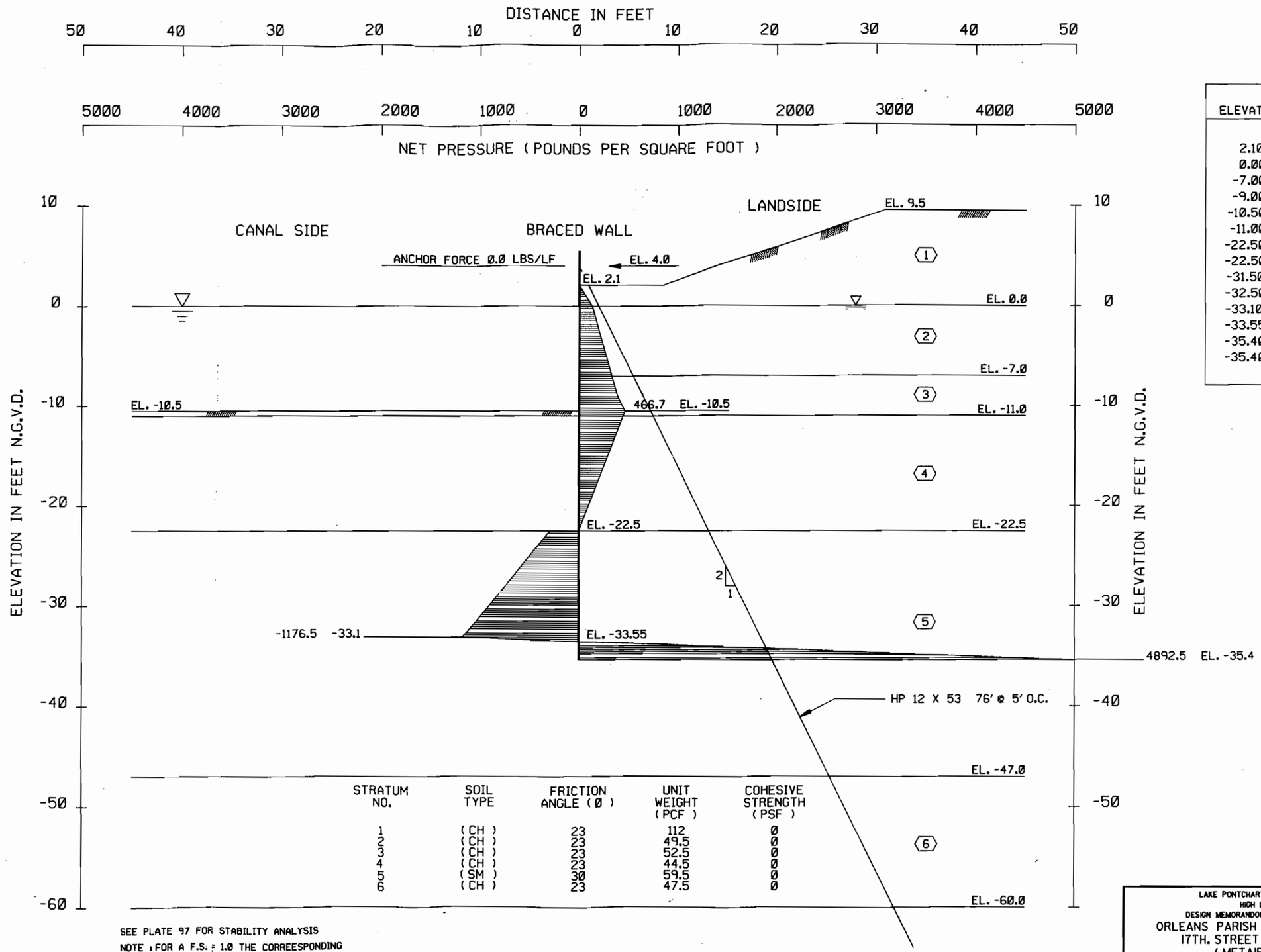
ENCL 32

LAKE PONTCHARTRAIN, LA. AND VICINITY
HIGH LEVEL PLAIN
DESIGN MEMORANDUM NO. 20 GENERAL DESIGN
ORLEANS PARISH - JEFFERSON PARISH
17TH. STREET OUTFALL CANAL
(METAIRIE RELIEF)

BRACED WALL ANALYSIS
B/L STA. 670+00 TO
PUMPING STATION JEFFERSON SIDE

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

DATE: SEPTEMBER 1990 FILE NO. H-2-30300



STRATUM NO.	SOIL TYPE	FRICTION ANGLE (Ø)	UNIT WEIGHT (PCF)	COHESIVE STRENGTH (PSF)
1	(CH)	23	112	Ø
2	(CH)	23	49.5	Ø
3	(CH)	23	52.5	Ø
4	(CH)	23	44.5	Ø
5	(SM)	30	59.5	Ø
6	(CH)	23	47.5	Ø

ELEVATION	PRESSURE
2.10	Ø.Ø
Ø.ØØ	134.5
-7.ØØ	332.7
-9.ØØ	392.8
-10.5Ø	466.7
-11.ØØ	446.4
-22.5Ø	Ø.Ø
-22.5Ø	-293.1
-31.5Ø	-1033.7
-32.5Ø	-1117.5
-33.1Ø	-1176.5
-33.55	Ø.Ø
-35.4Ø	4892.5
-35.4Ø	Ø.Ø

SEE PLATE 97 FOR STABILITY ANALYSIS

NOTE : FOR A F.S. = 1.Ø THE CORREESPONDING ANCHOR FORCE IS Ø.Ø LBS/LF

NET DIAGRAM

(S) CASE F.S. = 1.5

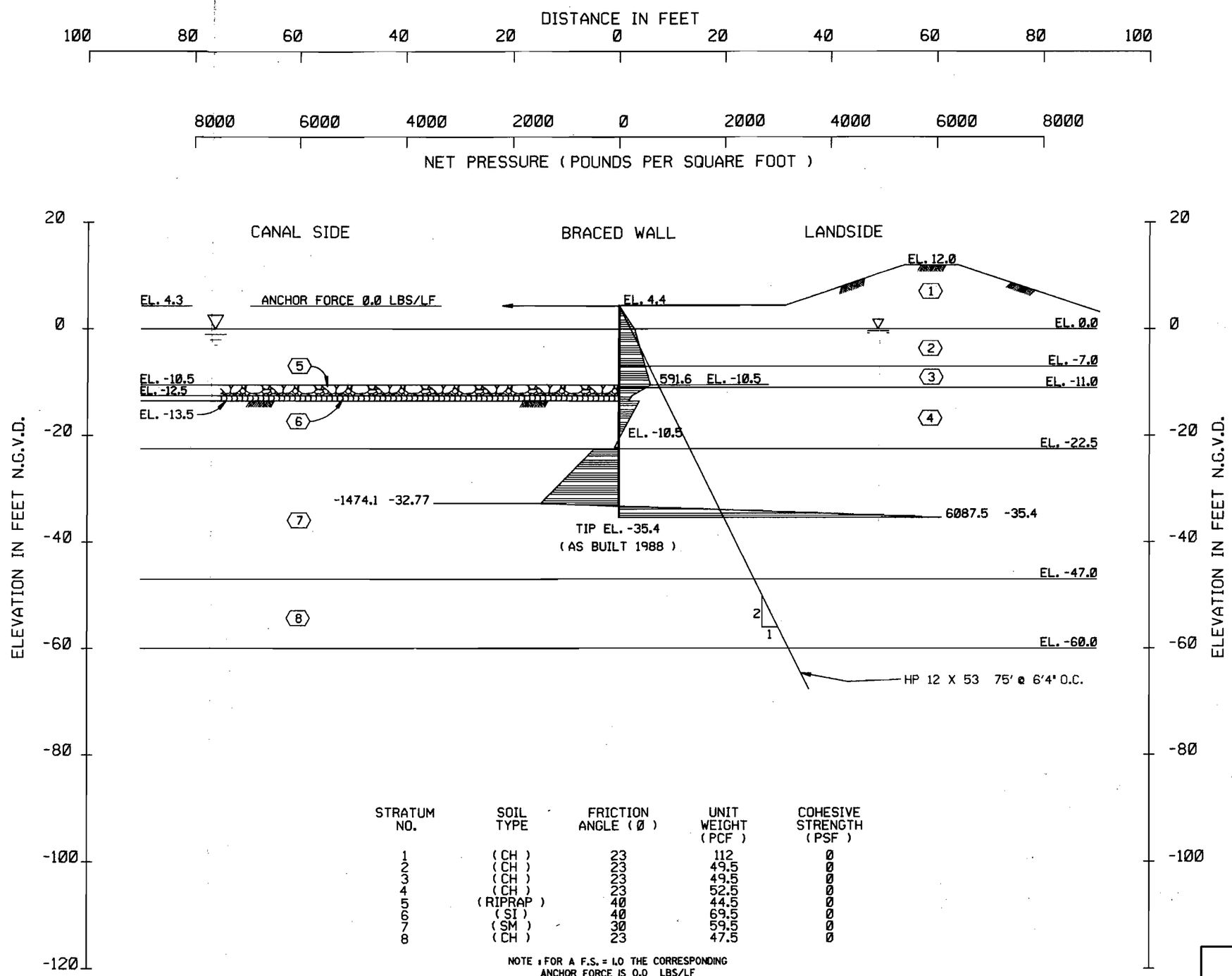
ENCL. 3 3

LAKE PONTCHARTRAIN, LA. AND VICINITY
HIGH LEVEL PLAIN
DESIGN MEMORANDOM NO. 20 GENERAL DESIGN
ORLEANS PARISH - JEFFERSON PARISH
17TH. STREET OUTFALL CANAL
(METAIRIE RELIEF)

BRACED WALL ANALYSIS
ORLEANS SIDE OF PUMPING STATION
TO SOUTH OF SOUTHERN R.R.

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

DATE: SEPTEMBER 1990 FILE NO. H-2-30300



ELEVATION	PRESSURE
4.50	0.0
4.40	0.0
0.00	288.3
-7.00	486.5
-10.50	591.6
-11.00	505.5
-12.50	240.6
-13.50	180.2
-13.50	375.6
-20.68	0.0
-22.50	-95.5
-22.50	-465.7
-32.77	-1474.1
-35.40	6087.5
-35.40	0.0

STRATUM NO.	SOIL TYPE	FRICTION ANGLE (Ø)	UNIT WEIGHT (PCF)	COHESIVE STRENGTH (PSF)
1	(CH)	23	112	0
2	(CH)	23	49.5	0
3	(CH)	23	49.5	0
4	(CH)	23	52.5	0
5	(RIPRAP)	40	44.5	0
6	(SI)	40	69.5	0
7	(SM)	30	59.5	0
8	(CH)	23	47.5	0

NOTE : FOR A F.S. = 1.0 THE CORRESPONDING ANCHOR FORCE IS 0.0 LBS/LF

SEE PLATE 99 FOR STABILITY ANALYSIS

NET DIAGRAM

(S) CASE F.S. = 1.5

ENCL. 34

LAKE PONTCHARTRAIN, LA. AND VICINITY
HIGH LEVEL PLAIN
DESIGN MEMORANDUM NO. 20 GENERAL DESIGN
ORLEANS PARISH - JEFFERSON PARISH
17TH. STREET OUTFALL CANAL
(METAIRIE RELIEF)

BRACED WALL ANALYSIS
SOUTH OF SOUTHERN R.R.
TO B/L STA. 673+63 ORLEANS

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

DATE: SEPTEMBER 1990 FILE NO. H-2-30300

CELMV-ED-PG (CELMN-ED-SP/15 May 90) (1105-2-10c) 1st End Bardwell/ts/5925
SUBJECT: Lake Pontchartrain, Louisiana and Vicinity, High Level Plan, Design Memorandum No. 20 - General Design, 17th Street Outfall Canal

CDR, Lower Mississippi Valley Division, Vicksburg, MS 39181-0080

08 AUG '90
FOR Commander, New Orleans District, ATTN: CELMN-ED-SP

The subject DM is approved subject to the satisfactory resolution of the following comments.

a. Para 7k. The interest rate shown as 3.225 percent per annum should be 3.125 percent per annum.

b. Para 14 and Appendix DD, page DD-9. It is not clear from this paragraph and the design computations in Appendix DD whether a horizontal load condition will exist at the Veterans Highway Bridge similar to that described in the Lake Pontchartrain, Louisiana and Vicinity, High Level Plan, Design Memorandum No. 19 - General Design, Orleans Outfall Canal, 11 Aug 1988, for the Robert E. Lee Bridge modification. If such a loading condition does in fact exist, it should be addressed and the design computations should be furnished for review. In addition, the guidance contained in paragraph c of the 3rd endorsement to DM No. 19, dated 10 Mar 89, should be evaluated for possible applicability in determining pile fixity for the Veterans Highway Bridge if a similar horizontal loading exists.

c. Para 29b. Due to the critical nature of this project and the close proximity of the adjacent canal, a minimum penetration to head ratio of 3 to 1 should be used for sheet pile design for this project. We note that the 3 to 1 minimum ratio has been used on less critical projects in the New Orleans area. In addition, the sheet piles shown on I-wall penetration analysis Plates 101 to 105 and 110 to 113 will serve as permanent bulkheads retaining as much as 4 ft of soil. To ensure adequate bulkhead stability toward the floodside, these sheet pile bulkheads should be analyzed using the "S" case soil strengths, a factor of safety of 1.5, and a canal level of el 0.0. Based on the above, the sheet pile penetration in this DM should be increased as necessary. If there is a potential for erosion at the floodside toe of the bulkheads, stone protection should be considered.

d. Para 29c. Also refer to the tied back and braced wall analyses on Plates 121-124. These analyses are based on the "Q" case soil strengths, a canal level at el -5.0, and a factor of safety of 1.5. Since these sheet pile bulkheads permanently retain soil, they should also be analyzed using "S" soil strengths, a factor of safety of 1.5, and at the normal canal level of el 0.0.

e. Para 39. CECW-ED Circular No. 1110-2-267, subject: Strength Design for Reinforced Concrete Hydraulic Structures, 31 Jan 90, has superseded ETL 1110-2-312 referenced in this paragraph. For work not previously completed, the guidance in the circular should be followed.

RECE
CELMN-
USACE,
1990 AUG 13 P

f. Para 41b. Provide the rationale for not considering the Q-case with F.S. = 1.25, as shown in paragraph 29b. If this case is applicable, wave loads should be incorporated into the loadings for the floodgates and gate monoliths.

g. Para 68.

(1) The text does not contain a narrative description and explanation of the cost estimate. This description should immediately precede the cost estimate and should contain the cost engineers methods of cost estimate preparation; i.e., means of establishing unit prices, quantities, etc.; the rationale for establishing contingencies; areas of uncertainties in the estimate, etc.

(2) The chosen plan has a net project contingency of less than 10 percent on the east and west side levees and floodwalls and no contingencies identified for Accounts 30 and 31 and the work for Pumping Station No 6. A project contingency level of 10 percent is normally acceptable only when the estimate was based on completed plans and specifications. You should identify contingencies on Accounts 30 and 31 and the work at Pumping Station No. 6 and review the contingencies set on the remaining project. A total contingency of less than 15 percent for this project should not be used unless plans and specifications are completed. The setting of contingencies should be fully explained in the cost estimate write-up discussed in comment g(1) above.

h. Para 69.

(1) This schedule indicates that the construction contract for the east side floodwall will be awarded in Oct 95. However, we understand that the Orleans Levee Board has already awarded a contract to drive sheet pile for the east bank floodwall and also to perform some dredging work, and the work under this contract was to commence in early Jul 90. These sheet piles are to be driven full length and not capped with concrete until the scheduled contract award in Oct 95. We understand the plans and specifications for the current sheet pile contract were reviewed and approved by you and the sheet pile lengths specified are the same as shown in this DM.

(2) Compliance with comment c above will result in additional sheet pile penetrations in some reaches over that shown in this DM. The fact that a construction contract was awarded for the east side sheet pile work prior to our review of this DM results in an undesirable situation for this office and the Corps. The current Orleans Levee Board contract should either be modified to provide the additional lengths or the sheet piles should be driven as shown in the DM and later driven to the revised penetration just prior to capping. The Orleans Levee Board should be advised that there is some risk involved with waiting 5 years to achieve the revised sheet pile penetrations. The sheet pile lengths for the west side floodwall should be revised prior to preparation of plans and specifications.

(3) It is not clear why the sheet piles are being driven full length and not capped under the current Orleans Levee Board floodwall contract. Since the existing levee is either being degraded or left intact, no settlement should occur after driving the sheet pile. Therefore, the considerable additional expense incurred by driving the sheet piles full length at this time would not appear justified. If you conclude that it is not possible to cap the floodwall under the current Orleans Levee Board floodwall contract, action should be taken to cap the floodwall as soon as possible in order to reduce the period in which the floodwall will be exposed to the risk mentioned in the paragraph above.

i. Table 1. The water surface elevations and head losses are shown for the various bridge conditions under existing and future pump discharge capacities; however, the design flowline and freeboard are not indicated. These should be presented when the final bridge conditions are known.

j. Plate 15. If not previously accomplished suggest you check to ensure by analysis that cracking in the lower portion of the concrete I-wall section shown in the center of the plate will not occur. Our concern with cracking stems from the restraint that will be encountered in the lower section, the abrupt change in width of the concrete between the lower section and upper section, and our unfamiliarity and inexperience with this particular wall design configuration. In addition consider seeking the advice of the concrete experts at WES for their opinions pertaining to this potential cracking and possible remedies that could economically be incorporated in the design to alleviate this concern.

k. Plates 60, 82, 84, 92, and 97. Some of the active and passive wedges shown on these plates are too close together to represent any possible failure planes which might develop. In future reports, the active and passive wedges should be separated at least by a distance equal to the height of the active wedge.

l. Plates 94, 95, 117, 118 and 122. The soil strengths and stratification used on these plates appear to be based on that shown on Plate 56 for the reach "Pumping Station to Sta 670+00." However, the W/L stationing on these plates seem to represent areas lakeside of Hammond Highway. We understand that the W/L stationing on these plates is in error and will be revised as necessary.

m. Plates 121 through 124. The walls shown on these plates should be evaluated for the anchor forces and resulting stresses on the anchors and the sheet piling should be checked using the conditions shown except change the water level on the canal side to el 0.0 NGVD and use soil properties for the 'S' case and a F.S. = 1.5.

CELMV-ED-PG

08 AUG '90

SUBJECT: Lake Pontchartrain, Louisiana and Vicinity, High Level Plan, Design Memorandum No. 20 - General Design, 17th Street Outfall Canal

n. Appendix D. The construction cost contingency is shown as 27 percent with no contingency shown on Accounts 30 and 31. This cost estimate should have some explanation of the assumptions made, use of contingencies, etc.

FOR THE COMMANDER:

Encl wd

for William R. Hill
FRED H. BAYLEY III
Chief, Engineering Division

CF (w/10 cys encl 1):
CECW-EP

DEPARTMENT OF THE ARMY
NEW ORLEANS DISTRICT, CORPS OF ENGINEERS
P.O. BOX 60267
NEW ORLEANS, LOUISIANA 70160-0267

REPLY TO
ATTENTION OF:
CELMN-ED-SP (1110-2-1150a) 15 May 90

MEMORANDUM FOR Commander, Lower Mississippi Valley Division,
ATTN: CELMV-ED-PG

SUBJECT: Lake Pontchartrain, Louisiana and Vicinity, High Level Plan, Design Memorandum No. 20 - General Design, 17th Street Outfall Canal

1. The subject design memorandum is submitted for review and approval, and has been prepared generally in accordance with the provisions of ER 1110-2-1150, dated November 1984.

2. A summary of the current status of the Clean Water Act, endangered species, Environmental Impact Statement (EIS), and cultural resources investigations is as follows:

a. Since the tentatively selected plan will not require the deposition of dredged and fill materials into the waters of the U.S., a Section 404(b)(1) Evaluation is not necessary.

b. Based on studies and investigations at this stage of designs, the proposed action is not likely to jeopardize the continued existence of any endangered species or result in the destruction or adverse modification of the critical habitats of such species.

c. A final EIS for the barrier plan for the subject project was filed with Council on Environmental Quality (CEQ) on 17 January 1975. A final supplement to this EIS was filed with the Environmental Protection Agency (EPA) on 7 December 1984. An environmental Assessment addressing the recommended plan (parallel protection) was mailed to the public on 27 March 1990.

d. The project area consists of an existing levee corridor on Post-1930 reclaimed land, and the artificial channel of the 17th Street Outfall canal. No cultural resources are recorded in the vicinity of the proposed work and no cultural resource surveys are warranted.

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

CELMN-ED-SP (1110-2-1150a)
SUBJECT: Lake Pontchartrain, Louisiana and Vicinity, High Level Plan, Design Memorandum No. 20 - General Design, 17th Street Outfall Canal

4. Reference CECW-EP, multiple memorandum dated 16 February 1990: GDM Review Process. No adverse issues were raised in the Administration's clearing process or no known policy changes have occurred which would concern OMB relative to the planning and designs presented in this DM. The status of the LCA's for the project feature addressed in this DM is discussed in paragraph 8, Volume I. Cost sharing for the project remains as originally authorized i.e., 70% Federal and 30% non-Federal. Preparation of this DM is in compliance with the most recent guidelines and policies covering plan formulation and engineering design. House Document No. 231, 89th Congress served as the basis for the feasibility report on the Lake Pontchartrain project and the subsequent project authorization, Public Law 298, 89th Congress, 1st Session. Higher authority approval of the July 1984 reevaluation report entitled, "Lake Pontchartrain, Louisiana and Vicinity Hurricane Protection Project", is the vehicle which authorized the current "High Level Plan". That document now serves as the feasibility report for the Lake Pontchartrain project.

5. This report was scheduled to be submitted to LMVD by 31 March 1990. This delay will not cause a delay in the start of construction.

6. Approval of this Design Memorandum as a basis for preparation of plans and specifications is recommended.

FOR THE COMMANDER:

W. EUGENE TICKNER
Chief, Engineering Division

Encl
(30 cys fwd sep)

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. 20 - GENERAL DESIGN
17TH STREET OUTFALL CANAL
(METAIRIE RELIEF)

EXECUTIVE SUMMARY

The 17th Street Outfall Canal is a feature of the Lake Pontchartrain, Louisiana and Vicinity Hurricane Protection Project. This Design Memorandum (DM) covers the detail designs for providing flood protection to the developed areas on each side of the 17th Street Outfall Canal. The 17th Street Outfall Canal is one of the three major outfall canals that convey storm water drainage from the City of New Orleans and a portion of Jefferson Parish to Lake Pontchartrain. Rainfall runoff which falls on the developed areas behind the protective levees must be pumped by a system of low head pumping stations into these canals. Most of this land area is below sea level. The source of storm water flow in the 17th Street Outfall Canal is Pumping Station No. 6. The pumping station is located 2.4 miles south of the canal's outfall at Lake Pontchartrain. The existing parallel levees and floodwalls on each side of the canal do not have sufficient height to prevent overtopping during the design hurricane. Also, bridges crossing the canal have insufficient deck elevations to prevent inflow into the developed areas via the road approaches to these bridges.

This DM examines two alternative plans for providing Standard Project Hurricane protection. The two plan concepts discussed are fronting protection and parallel protection. The fronting protection structure would be located near the lake end of the canal. The fronting protection plan employs a system of self activating butterfly valves (gates) that are especially designed to sense the direction of flow in the canal. As long as flow in the canal is from the pumping station to the lake, the structure remains open. If a flow reversal occurs, the valves are designed to close automatically. A mechanical override is also incorporated into the design. The structure remains closed until the lake stage recedes and then opens automatically in response to the lower lake stage, similar to a conventional flapgate. No pumping can occur while the gates are closed. The parallel protection plan requires raising the height of the floodwalls on both sides of the canal and floodproofing the bridges over the canal. Positive closures are also needed at the oldest pumps located in Pumping Station No. 6.

The total first cost of the two plans was found to be about the same: parallel protection ($20.7 million) and fronting protection ($20.5 million). Parallel protection maximizes overall area benefits and has the least operation and maintenance cost. Therefore, the recommended Federal plan is the parallel protection plan. This plan has the acceptance of the local sponsors and the Sewerage and Water Board of New Orleans.

LAKE PONTCHARTRAIN, LOUISIANA AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO. 20 - GENERAL DESIGN
17TH STREET OUTFALL CANAL
(METAIRIE RELIEF)

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, 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 Sep 69
2	Lake Pontchartrai[illegible] Barrier Pla[illegible] GDM, Supplement No. 3, Lake Pontc[illegible]in Barrier, Chef Menteur Pass Complex	Approved 19 Sep 69
2	Lake Pontchartrain Barrier Pl[illegible] GDM, Supplement No. 4, New Orleans East Back Levees	Approved 18 Aug 71
2	Lake Pontchartrain Barrier Plan, GDM, Supplement No. 5, Orleans Parish Lakefront Levees - West of IHNC	1/
2	Lake Pontchartrain Barrier Pla[illegible] GDM, Supplement No. 5A, Citrus Lakefront Levees - IHNC to Paris Road	Approved 12 Jul 76

STATUS OF DESIGN MEMORANDUMS (Continued)

Design Memo No.	Title	Status
2	Lake Pontchartrain Barrier Plan, GDM, Supplement No. 5B, New Orleans East Lakefront Levees - Paris Road to South Point	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. 9, New Orleans East Levee from South Point to GIWW	Approved 1 May 73
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

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 MEMORANDUMS (Continued)

Design Memo No.	Title	Status
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	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/

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 (Continued)

Design Memo No.	Title	Status
12	Lake Pontchartrain and Vicinity, Louisiana, Sources of Construction Materials (Revised)	Approved 23 Oct 79
13	Lake Pontchartrain, La. & Vicinity, High Level Plan, Orleans Parish Lakefront Levee West of IHNC	Approved Feb 85
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	Approved 11 Oct 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
15	Lake Pontchartrain, La. & Vicinity, High Level Plan, New Orleans East Lakefront Levee, Paris Road to South Point	Approved 19 Jun 85
16	Lake Pontchartrain, La. & Vicinity, High Level Plan, New Orleans East Levee, South Point to GIWW	Approved 6 Nov 87
17	Lake Pontchartrain, La. & Vicinity, High Level Plan, Jefferson Parish Lakefront Levee	Approved 8 Feb 88
17A	Lake Pontchartrain, La. & Vicinity, High Level Plan, Jefferson - St. Charles Return Levee	Approved 26 Aug 87

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 (Continued)

Design Memo No.	Title	Status
18	Lake Pontchartrain, La. & Vicinity, High Level Plan, St. Charles Parish Levee (North of Airline Highway Alignment)	Approved 9 May 89
19	Lake Pontchartrain, La. & Vicinity, High Level Plan, Orleans Avenue Outfall Canal	Approved 2 Dec 88
19A	Lake Pontchartrain, La. & Vicinity, High Level Plan, London Avenue Outfall Canal	Approved 13 Apr 89
20	Lake Pontchartrain, La. & Vicinity, High Level Plan, 17th Street Outfall Canal	Scheduled Mar 90
20	Lake Pontchartrain, La. & Vicinity High Level Plan, 17th Street Outfall Canal Supplement No. 1	Scheduled Apr 93
21	Lake Pontchartrain, La. & Vicinity High Level Plan, Orleans Parish Outfall Canal, Detailed Design Memorandum (London Avenue Canal)	Scheduled Jan 91

LAKE PONTCHARTRAIN, LOUISIANA AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO. 20 - GENERAL DESIGN
17TH STREET OUTFALL CANAL
(METAIRIE RELIEF)

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LAKE PONTCHARTRAIN, LOUISIANA AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO. 20 - GENERAL DESIGN
17TH STREET OUTFALL CANAL
(METAIRIE RELIEF)

PERTINENT DATA

Location of Project:

Southeastern Louisiana in Jefferson Parish, along south shore of Lake Pontchartrain Orleans/Jefferson Parish line.

Datum Plane	Vertical Datum (NGVD)1/
Hydrologic Data	
Temperature:	
Maximum monthly	90.6 degrees Fahrenheit
Minimum monthly	45.3 degrees Fahrenheit
Average annual	69.5 degrees 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-minute avg. wind speed	100 m.p.h.
Radius of maximum winds	30 miles
Average forward speed	6 knots
Still water level	11.5 feet
Floodwall in Existing Levees	
Type of floodwall	
I-Wall length East side	2.38 miles
I-Wall length West side	2.27 miles
Elevation (varies)	14.0 to 16.0 feet

1/ Elevations throughout this DM are in feet referenced to National Geodetic Vertical Datum (NGVD) unless otherwise noted.

PERTINENT DATA (Continued)

Gates

Location	
No. 1, Sta. 2+93.10 W/L & No. 2, Sta. 3+78.00 W/L West Bank; No. 3, Sta. 7+83.09 W/L East Bank	No. 1 swing gate; Nos. 2 & 3 roller gates

Rights-of-Way

Permanent rights-of-way (Existing prior to 1965)	approx. 50 acres
Permanent new rights-of-way	none

Estimated First Cost

Federal	$14,490,000
Non-Federal	$ 6,210,000
Total	$20,700,000

Economics

Remaining Benefit to Remaining Cost Ratio (3.125%)	5.0 to 1
Remaining Benefit to Remaining Cost Ratio (current)	1.9 to 1

Estimated Operations and Maintenance Cost

Average Annual Cost	$17,000

LAKE PONTCHARTRAIN, LOUISIANA AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO. 20 - GENERAL DESIGN
17TH STREET OUTFALL CANAL
(METAIRIE RELIEF)

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; enlargement 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."

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. General design of the Lake Pontchartrain High Level Plan, Orleans Parish Lakefront Levee, was presented in Design Memorandum (DM) No. 13. The plan, assumed no barriers in the Chef Menteur and Rigolets Passes, recommended the least costly method of modifying the existing lakefront levee so that a high level of protection can be achieved. DM No. 13 did not cover the lakefront protection at the junction of three Orleans Parish outfall canals.

This memorandum presents the essential data, assumptions, criteria and computations for developing project plan, design and cost estimate for protection of the developed areas on each side of the 17th Street Outfall Canal. Detailed designs for the Orleans Avenue Outfall Canal and the London Avenue Outfall Canal were presented in Design Memorandum No. 19 and 19a, respectively. Scope of this memorandum involves developing a project plan which cost-effectively protects the development on each side of the 17th Street Outfall Canal from a Standard Project Hurricane, SPH, as authorized under the Public Law discussed in Paragraph 1. In conjunction with hurricane protection, the plan must also provide optimum conditions for storm drainage through the outfall canal into the lake.

This design memorandum covers in detail two alternative plans for providing hurricane protection at the 17th Street Outfall Canal. The two plans employ different concepts for achieving the desired protection. One plan concept uses the butterfly valved structure to provide fronting protection near the lakefront. Because of the high potential for wave transmission from the lake into the canal, an integral part of this plan places a breakwater lakeward of the canal's confluence with the lake. The butterfly valve structure was the recommended Federal plan for both London and Orleans Outfall canals.

The second plan, parallel protection, employs parallel floodwalls on each side of the canal tieing into the lakefront levee just north of Hammond Highway and running south approximately 2.5 miles to Pumping Station No. 6. Because of their low deck elevations, remedial works are required at each of the bridges crossing the canal. Details of each of the two plan concepts are given in subsequent paragraphs.

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 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 interest 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, 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. 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 three volume report entitled "Lake Pontchartrain, Louisiana, and Vicinity Hurricane Protection Project, Reevaluation Study", dated July 1984. The reevaluation report recommended a "tentatively selected" high level plan of protection. This recommendation necessitated the preparation of the Orleans Parish Lakefront Levee West of IHNC report and this report as part of the Lake Pontchartrain Hurricane Protection Project, and the engineering and environmental studies discussed herein. Surveys and studies accomplished in preparing this DM 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; and

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 DM, an additional detailed Engineering Designs and Specifications will be prepared to support construction of this project feature. Some additional field surveys are anticipated at this time to support these designs. Planned future investigations for features not covered in this Design Memorandum will include the necessary field surveys required to develop remedial measures for SPH protection to Pumping Station No. 6. Modifications to the pumping station will be the subject of a supplement to this DM.

7. Local Cooperation Requirements. The 17th Street Outfall Canal and the existing parallel levees are situated next to the Orleans Parish-Jefferson Parish boundary line. The canal and existing levees are located entirely in Jefferson Parish, Louisiana. However, the canal and its associated water bottom are owned, maintained and operated by the New Orleans Sewerage and Water Board. The levee and floodwalls located on the east bank of the Canal are the property and responsibility of the Orleans Levee District. The west bank levee is a segment of the East Jefferson Levee District's flood control system. The conditions of local cooperation as specified in the authorizing laws are quoted in Paragraph 3. These conditions are applicable to the "Barrier Plan." A post authorization report for a "High Level Plan" recommended that assurances be amended. A complete list of local assurance items (as amended) are set forth as follows:

a. Provide all lands, easements, and rights-of-way, including borrow and spoil-disposal areas necessary for construction, operation, and maintenance of the project; and

b. Accomplish all necessary alterations and relocations to roads, railroads, pipelines, cables, wharves, drainage structures, and other facilities required by the construction of the project; and

c. Hold and save the United States free from damages due to the construction works; and

d. Bear 30 percent of the first cost, to consist of the fair market value of the items listed in subparagraphs (a) and (b) above and a cash contribution as presently estimated below, 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:

COST TO ORLEANS LEVEE DISTRICT
($1,000,000's)

	FIRST COST 1/	LOCAL SHARE
ORLEANS LEVEE DISTRICT		
Citrus New Orleans East	112.5	33.8
New Orleans	249.1	74.7
TOTAL	361.6	108.5

COST TO JEFFERSON LEVEE DISTRICT
($1,000,000's)

	FIRST COST 1/	LOCAL SHARE
Jefferson	142.1	42.6

1/ Cost to complete after October 1979; October 1981 price levels.

e. This item has been deleted in full:

Orleans Levee District. Provide an additional cash contribution equivalent to the estimated capitalized value of maintenance and operation of the Rigolets navigation lock and channel to be undertaken by the United States, presently estimated at $3,816,000, the final determination to be made after construction is complete, 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, and

East Jefferson Levee District. Provide an additional cash contribution equivalent to 30.4% of the estimated capitalized value of maintenance and operation of the Rigolets navigation lock and channel to be undertaken by the United States, the cash consideration is estimated at $2,805,900, the final determination to be made after construction is complete, 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; and

f. Provide all interior drainage and pumping plants required for reclamation and development of the protected areas; and

g. Maintain and operate all features of the project in accordance with regulations prescribed by the Secretary of the Army, including levees, floodgates and approach channels, drainage structures,

drainage ditches or canals, floodwalls, and stoplog structures (the remainder of this item is deleted); and

h. 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; and

i. Comply with the applicable provisions of the "Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970", Public Law 91-646; and

j. Assume the responsibility to pay its share of the non-Federal project costs (the remainder of this item is deleted); and

k. As a minimum, adhere to the payment schedule of the deferred payment plan, the apportionment of costs to be made as actual costs, values, and schedules are determined. The first payment under the deferred payment plan was due on 1 October 1976, with subsequent payments being due on 1 October of each succeeding year, up to and including 1 October 1990. Interest is charged on the unpaid balance during this period at the rate of 3.225 percent per annum. Cash contributions required subsequent to 30 September 1991 shall be computed in accordance with the basic 30 percent requirement stipulated in Section 204 of the Flood Control Act of 1965, Public Law 89-298 and House Document 231, 89th Congress; and

l. Recognizes that subsections (b), (c), and (e) of Section 221 of the "Flood Control Act of 1970", Public Law 91-611 shall apply to paragraph (k) above. This agreement is subject to and shall become effective upon the approval of the Secretary of the Army; and

m. Comply with Section 601 of Title VI of the Civil Rights Act of 1964, Public Law 88-352, that no person shall be excluded from participation in, denied the benefits of, or subjected to discrimination in connection with the Project on the grounds of race, creed, or national origin.

While the above requirements reflect the present agreements of local assurance as signed in June 85, they do not address the need for mitigation as required by the Fish and Wildlife Coordination Act of 1958, 16 U.S.C. 661 et seq. (PL 85-624, Aug 58).

8. Status of Local Cooperation. Amended assurances for the High Level Plan were executed by the Orleans Levee District on 29 May 1985, and accepted by the United States on 21 June 1985. The East Jefferson Levee District executed the amended assurances for the High Level Plan on 16 January 1987 and the United States accepted the assurances on 21 December 1987.

9. Views of Local Interests. Details of the several plans investigated were coordinated with the Orleans Levee District's and the East

Jefferson Levee District's respective engineering staffs. The recommended plan, parallel protection plan, is the preferred plan by each of the assuring agencies as well as that preferred by the New Orleans Sewerage and Water Board. The Orleans Levee Board has entered into contracts with several local Architectural Engineering firms to design and initiate construction work on parallel protection for the 17th Street Outfall Canal.

LOCATION OF PROJECT AND TRIBUTARY AREA

10. Project Location. The Orleans Parish Outfall canals segment of the Lake Pontchartrain, Louisiana and Vicinity Hurricane Protection Project as shown on Plate 1 is located in southeastern Louisiana on the south side of Lake Pontchartrain in Orleans Parish. There are three outfall canals which transport storm water drainage from the major urbanized areas of Orleans Parish on the east bank of the Mississippi River. The 17th Street Outfall Canal lies to the west of the other two canals, 17th London Avenue Canal and Orleans Avenue Canal. The three canals run parallel to each other and are oriented in the north-south direction. Plate 1 shows the location of all three outfall canals.

PROJECT PLAN

11. General. The need for project work at the three outfall canals in Orleans Parish was identified subsequent to the authorization of the Lake Pontchartrain, Louisiana and Vicinity Hurricane Protection Project. The adoption of more severe hurricane parameters by the U.S. Weather Bureau necessitated upward revisions to the levee grades under that project.

The canals provide the main pumped drainage outfalls for the City of New Orleans. As can be seen on Plate 1, the pumping stations located on each of these canals are situated interior to the city some 2.5 to 3.1 miles from the shoreline of Lake Pontchartrain. Protection from tidal inundation via the lake-canal connection is presently achieved by locally constructed lateral parallel levees along each side of the canals. The existing lateral levees along each of the outfall canals do not meet the design height or design sectional stability required for the Lake Pontchartrain project under either the previously authorized Barrier Plan or the currently approved High Level Plan. Much of the New Orleans and Jefferson Parish Area served by the Outfall Canals is well below sea level. Average topographic elevations in the drainage area are -6.0 ft. NGVD 1/ with some areas as low as -10.0 ft NGVD. Although each of the outfall canals is similar in function and appearance, the hydrologic requirements for conveyance are quite different. This memorandum addresses the proposed hurricane plan of protection for the 17th Street Outfall Canal only.

1/ Elevations throughout this DM are in feet referenced to National Geodetic Vertical Datum (NGVD) unless otherwise noted.

12. 17th Street Outfall Canal. The 17th Street Outfall Canal has served as one of the major drainage canals for the city of New Orleans and a portion of Jefferson Parish since it was dug in 1871. The original canal was fed by gravity drainage and was only 50 feet wide with a length of about 16,500 feet. As the area developed the first portion of Pumping Station No. 6 was built in 1898. The capacity of the station was 1,000 cfs. Increasing development and the need for additional drainage for the protected area necessitated increases in station capacity. The station was expanded and more pumps were added in May 1914, May 1929, July 1967 and again in 1986. The current nominal capacity of Pumping Station No. 6 is 9,630 cfs, making it one of the largest low head lift stations in the world. The canal has over the years been enlarged and deepened to accommodate the increased pump capacity. Current work on the canal will increase its dimensions to a top width of about 200 feet and a bottom width of 40 to 50 feet. When complete, the bottom invert elevation of the canal will be -18.0 feet NGVD. The current work on the canal is being accomplished by the New Orleans Sewerage and Water Board.

Because deepening and widening the canal will impact the stability of the lateral parallel levees, the drainage improvement plan required that the levee and floodwalls be modified to insure that stability requirements were met. It was apparent to the Orleans Levee Board that any improvement to the level of flood protection needed to meet the high level plan for hurricane protection could most cost-effectively be achieved if coupled with the work planned by the New Orleans Sewerage and Water Board. Therefore the two agencies have, from the outset of the drainage improvement project, worked together to insure that the replacement floodwall and associated levee modifications were designed and built to satisfy the hurricane protection project. The objective in mind was to achieve the design level of protection at the lowest possible cost and also insure that the work be creditable to the authorized project. This joint effort has been for work only on the Orleans Parish side of the canal. The westside existing levee (Jefferson Parish side) was built under the F.C.M.R. and T. project by authority of the Flood Control Act of 1950. The west side levee was completed on 28 Aug 1962 and turned over to the Levee District for operation and maintenance. The East Jefferson Levee District has taken a wait and see attitude to the Sewerage and Water Board project as far as upgrading the existing hurricane protection levee is concerned. As previously discussed, widening and deepening the canal require that remedial work be done to the levee and floodwalls to maintain the required stability and height of protection. The existing levee heights are insufficient for the high level plan design water levels. Since the Sewerage and Water Board is required only to replace in kind the existing protection (1950 Authorized Project), work on the westside levee has been limited to maintaining the status quo.

The recommended plan of protection presented in the DM is the Parallel Protection Plan. The Parallel Protection Plan calls for raising the height of protection on each side of the canal from the Lakefront south to Pumping Station No. 6, a distance of 12,587 feet on

the east side and 11,995 feet on the west side. The top of wall elevation on each side of the canal will transition from elevation 14.0 NGVD at the lake end of the canal to elevation 16.0 feet NGVD at Pumping Station No. 6. The Parallel Protection Plan calls for bottom roller road gates at the Old Hammond Highway bridge; floodproofing the Veterans Boulevard bridges and swing gates at the Southern Railroad bridge. Work on the Interstate bridges is being accomplished by the Louisiana Department of Transportation and Development as part of their capitol replacement program. See Appendix C, Volume I for information concerning the I-10, I-610 bridges.

HYDROLOGY AND HYDRAULICS

13. General. Design Memorandum No. 13, General Design Orleans Parish Lakefront Levee West of I.H.N.C. presents the essential data, assumptions, and computations for developing the plan design. Tidal hydraulic criteria applicable to the High Level Plan is provided in Appendix A of that document.

Construction of the proposed levee/floodwall system and/or Butterfly Gates will not significantly affect existing surface drainage patterns. Minor modifications to existing area storm and sanitary utilities are required.

14. Water Surface Elevations Using Nominal Pump Capacities. A hydraulic analysis was performed for the 17th Street Outfall Canal to determine the required levee/floodwall height for hurricane protection. Water surface profiles were computed using the HEC-2 Computer Program. For flow through the bridges, HEC-2's special bridge routine was implemented. The existing bridges crossing the canal are at elevations lower than the existing levee grades. Therefore, under existing conditions, pressure flow or both pressure and weir flow is probable under design conditions. It was assumed that flow would be contained within the levee cross sections at the bridge sites.

Cross section information was taken from Modjeski and Masters drawings dated December 1981, which were used in a study for the Orleans Levee Board. Values used for Manning's "n" were as follows:

n=.024 main channel
n=.060 channel overbank

Dredging of the canal, as well as the modification of the levees to meet existing levels of flood protection, is considered to be the New Orleans Sewerage and Water Board Base Project (since dredging of the canal is considered necessary to alleviate flooding in portions of Orleans and Jefferson Parishes). Therefore the existing conditions flowline, Profile 1, is based on a HEC-2 computer model that assumes the canal dredged according to the Base Project, with the exception of areas under the bridges.

Flow rates in the canal were based on nominal pump capacities. Sewerage and Water Board Pump Station No. 6 consists of four vertical pumps; two, twelve-foot pumps; four, fourteen-foot pumps; and one single 1,000 cfs pump resulting in a 6650 cfs capacity. Computer runs were also made for 9,630 cfs (future flow) as well as 6,650 cfs (existing flow).

A starting water surface elevation of 11.5 ft. NGVD was used at the lake. This is the still water surface elevation of Lake Pontchartrain for the Standard Project Hurricane.

Various alternatives were developed to prevent the flow of water onto the bridge decks and into residential areas during periods of extreme high water. Raising bridges, floodproofing and road gates were all considered. The following profiles show the water surface elevations for the various bridge conditions for both existing and future pump nominal capacities. The computed water surface elevations at the upstream side of the bridges and the respective bridge head losses are shown in Table 1.

The optimum alternative for reductions in stage is the plan which raises all the bridges above the flowline, Profile 2, Plate 129. The resulting water surface elevation at the railroad is 11.71 NGVD for existing pumping capacity and 11.94 ft. NGVD for future pumping capacity.

The current state of deterioration of the I-10/610 bridge decks has become critical to the Department of Transportation and Development. Since replacement is being planned, consideration was given to raising the I-10/610 bridges with various conditions for the other bridges. Profile 3, Plate 130, raises I-10/610, while the other bridges remain in existing conditions.

Consideration was given to the alternative of floodproofing the bridges by extending solid guardrails to a height above the anticipated water surface elevation. This modification prevents storm water from escaping into residential areas via the bridge and allows the passage of traffic in hurricane situations. Profiles 4, 5 and 6, Plates 131, 132 and 133, respectively, show flowlines for three floodproofing alternatives. The model for Profile 4 raise the I-10/610 to a low chord elevation of 11.1 ft. NGVD (which provides clearances of the 100-year event) and also floodproofs above that. Due to the open-deck type construction of the Southern Railway Bridge, floodproofing is not a practical solution at that location.

Floodproofing of a bridge causes all the flow to pass under the bridge deck, i.e., pressure flow. The inundation, as well as any entrapment of air under the deck, reduces the effective weight of the bridge. The horizontal forces due to unbalanced hydrostatic pressure, plus the energy from the moving mass of water, increases the dynamic forces acting on the bridge deck. The likelihood of the structure being lifted or pushed off the abutments and piers is greatly increased. Therefore, any floodproofed bridge must be sufficiently anchored.

TABLE 3

17TH STREET OUTFALL CANAL
DESIGN FLOWLINES AND BRIDGE HEAD LOSSES
FOR HIGH LAKE LEVEL (11.5 FT. NGVD)
WITH CHANNEL DREDGED

Bridge Condition	Canal Flow (cfs)	Lake Pont.	CANAL WATER SURFACE ELEVATION (FT. NGVD) Bucktown	Hammond Highway	Veterans (2 bridges)	I-10/610 (3 bridges)	Railroad
1) Existing-Gated Openings Dredged except under Bridges	6650	11.5	11.53	11.61	12.09	12.57	12.80
Bridge Head Loss			0.03	0.08	0.36	0.46	0.15
	9630	11.5	11.56	11.73	12.64	13.54	13.92
Bridge Head Loss			0.07	0.18	0.67	0.86	0.24
2) All Bridges Raised	6650	11.5	11.50	11.51	11.62	11.65	11.71
Bridge Head Loss			0.00	0.00	0.00	0.01	0.00
	9630	11.5	11.49	11.52	11.75	11.81	11.94
Bridge Head Loss			0.00	0.00	0.00	0.01	0.00
3) I-10/610 Raised Others = Existing	6650	11.5	11.53	11.57	11.83	11.87	12.07
Bridge Head Loss			0.03	0.04	0.14	0.01	0.17
	9630	11.5	11.56	11.65	12.16	12.22	12.62
Bridge Head Loss			0.07	0.09	0.16	0.01	0.33
4) All Bridges Flood Proofed Except Railroad = Existing	6650	11.5	11.53	11.58	11.92	12.01	12.21
Bridge Head Loss			0.03	0.05	0.22	0.06	0.16
Bridge Head Loss	9630	11.5	11.56	11.66	12.39	12.59	12.95
			0.07	0.10	0.48	0.15	0.30
5) I-10/610 Raised Hammond = Flood Proofed Vets & RR = Existing	6650	11.5	11.53	11.58	11.84	11.87	12.07
Bridge Head Loss			0.03	0.05	0.14	0.00	0.16
	9630	11.5	11.56	11.66	12.16	12.23	12.63
Bridge Head Loss			0.07	0.10	0.25	0.01	0.33
6) I-10/610 Raised Hammond & Vets = Flood Proofed Railroad = Existing	6650	11.5	11.53	11.58	11.92	11.95	12.15
Bridge Head Loss			0.03	0.05	0.22	0.00	0.16
	9630	11.5	11.56	11.66	12.39	12.45	12.82
Bridge Head Loss			0.07	0.10	0.48	0.01	0.30

15. Structure Analysis. The U. S. Army Engineer Waterways Experiment Station (WES) conducted a model study on the use of butterfly gates on the London Avenue Outfall Canal. The butterfly gates were designed to remain open during pumping to the lake and close with an incoming surge due only to the direction of flow. The model test results showed head losses through the structure were very small and for hydraulic analysis were considered to be insignificant. With the butterfly gates in place, levees/floodwalls are required on the lake side of the structure to contain an 11.5 ft. NGVD stage and would allow the water surface between the structure and the pumping station to be maintained within the existing levee height by shutting down the pumps. If, however, the gates remained open, nominal pump capacities were maintained and flow was confined to the channel, the water surface profiles would be represented by profiles 2 through 6 since head losses through the structure were insignificant.

GEOLOGY

16. Physiography. The project site is located on the Deltaic Plain portion of the Mississippi River Alluvial Plain. Specifically, the project is located on the southern edge of the Lake Pontchartrain Basin and east of the Mississippi River. Dominant physiographic features include natural levee ridges, crevasse-splay deposits, marsh, swamps and lakes. Elevations vary from approximately +10 to +15 feet NGVD along the natural levee of the Mississippi River to 0 feet NGVD in the backswamp and marsh areas.

17. General Geology. Only the geologic history since the end of the Pleistocene Epoch is pertinent to the project. At the close of the Pleistocene, sea level was approximately 360 to 400 feet below present sea level and the Mississippi River was entrenched into the older Pleistocene sediments west of the project area. As sea level rose to its present stand, the entrenched valley was filled with sediment by the Mississippi River, resulting in an increase in meandering and channel migration. This meandering and channel migration has resulted in a series of deltas extending into the Gulf of Mexico. Seven Holocene deltas are recognized in the lower Mississippi River Valley; however, only four are relevant to the project area. The oldest of the four deltas in the vicinity of the project was the Cocodrie Delta whose distal ends extended across the New Orleans area from west to east.

Following the Cocodrie Delta in the vicinity of the project was the St. Bernard Delta which followed the same general course as the Cocodrie Delta but extended further to the east. It was during this period that maximum sedimentation into the project area occurred via the Metairie/Bayou Savage Distributary. A shifting of the river course upstream in response to a shorter route to the Gulf resulted in the formation of the Lafourche Delta southwest of the project. A final shift of the river brought the flow into its present course, forming the Plaquemine Delta just south of New Orleans and the present Balize Delta

below the Plaquemine Delta. Development of the deltas below New Orleans coupled with the restriction of floodwaters, resulted in the gradual degradation of the study area through subsidence and shoreline retreat.

18. Investigation. Preliminary investigations of the project area consisted of the utilization of aerial photographs, topographic maps, geologic maps, engineering and geologic reports and other literature. An actual on-site subsurface investigation was conducted along the proposed centerline of the project. Ninety-three total borings were drilled at various stations along the proposed centerlines. Fourteen 5 inch undisturbed borings and two 1-7/8 inch I.D. general type borings were drilled by the COE. Nineteen 5 inch undisturbed borings and fifty-eight 3 inch undisturbed borings were drilled by an A-E for the New Orleans Sewerage and Water Board.

19. Subsidence and Seismic Activity. The project area is located in a region of active subsidence. Although actual subsidence rates for the area vary considerably, estimated subsidence rates for the area in the vicinity of the project average .23 ft/100 yrs, and increase towards the south of the project area. Seismically, the site is located in an area of low seismicity.

20. Groundwater Resources. Shallow freshwater aquifers are found in the vicinity of the project and extend to depths of up to 700 to 800 feet below sea level. Below these freshwater aquifers, brackish and saline water aquifers occur. The project will have no effect on these shallow aquifers and will not adversely affect their water quality or yields.

21. Mineral Resources. Several hydrocarbon reservoirs are located in the region. However, no reservoirs are near the project. Shell dredging within Lake Pontchartrain and sand dredging in the Mississippi River will not be affected by the project.

22. Foundation Conditions. The engineering properties of the sediment beneath the project vary greatly. Generally, the subsurface consists of Holocene deposits varying in depth to approximately 60 feet and underlain by Pleistocene deposits (Plates 35 through 39). Specifically from Station 670+00 to Station 540+00 the surface is comprised of marsh-swamp deposits which vary in thickness between 5 and 10 feet. The marsh-swamp deposits area characterized by high wood and organic material contents and high water contents. Beneath the marsh-swamp deposits is a sequence of deposits which include bay-sound, lacustrine, beach and prodelta deposits. From Station 672+00 to Station 660+00, the marsh-swamp deposits are underlain by prodelta deposits which vary in thickness to 10 feet. The prodelta deposits are comprised predominantly of fat clays. Between Station 617+00 and Station 540+00 the marsh-swamp deposits are underlain by lacustrine deposits which vary in thickness to 20 feet. These lacustrine deposits are comprised predominantly of fat clays. Underlying the marsh-swamp deposits from Station 660+00 to Station 617+00 are beach deposits which vary in thickness to 40 feet or more. These beach deposits consist of sands and silty sands and extend

beneath the prodelta deposits to the south and the lacustrine deposits to the north. The thickness of the beach deposits remains constant towards the south; however, the thickness of the beach deposits decrease to the north until they terminate near Station 540+00. Underlying the beach deposits throughout the project are bay-sound deposits which vary in thickness from 15 to 20 feet. The bay-sound deposits consist generally of fat clays with some lean clays. Underlying the Holocene deposits in the project area are the Pleistocene lean clays, fat clays, silty sands and sands. These Pleistocene deposits are oxidized and exhibit a marked decrease in water content when compared to the overlying Holocene deposits. Moreover, the Pleistocene deposits, which vary in consistency from stiff to very stiff, normally yield unconfined compressive strengths that exceed those in the Holocene.

FOUNDATION INVESTIGATION AND DESIGN

23. General. This section includes the soils investigations and foundations design for both the parallel protection plan and the valve structure plan. Both plans consist of I-walls, levees, and pile supported structures.

24. Field Exploration. Fourteen continuous undisturbed 5 inch diameter soil borings were made in the project area. Borings 13-U, 5-MUW, 2-MUG, 3-MUG, 4-MUG and 2-MUE were made at the levee C/L. Borings 12-U, 6-MUE, 4-MUE, 3-MUW and 1-MUW were made at the levee protected side toe. Borings 12-U and 13-U were made in the Orleans Lakefront Levee perpendicular to the canal levee. Boring 51-U located in Lake Pontchartrain and boring 1-MUG located in the 17th St. Canal are for the valve structure plan. The individual logs of these 14 undisturbed borings are shown on plates 40 through 53. Two general type borings (1-MP and 2-MP) were made using either a 1-7/8 inch ID core barrel or a 1 3/8 inch split spoon sampler. Borings 1-MP and 2-MP were made at the floodside and protected side toe of the canal levee. The locations of the undisturbed and general type borings are shown on Plates 2 through 5. The boring logs are shown in profile on plates 54 and 55. Seventy-seven borings taken by an A-E for the New Orleans Sewerage and Water Board (NOS&WB) were used in conjunction with the COE borings in the foundation design. Nineteen borings were made with a 5 inch diameter Shelby tube sampling barrel and 58 borings were made with a 3 inch diameter Shelby tube sampling barrel. The locations of borings taken by the A-E along with the boring logs are shown in Appendix E, Volume II.

25. Laboratory Tests.

a. COE. All samples obtained from the borings were visually classified. Water content determinations were made on all cohesive soil samples. Unconfined compression (UC) shear tests and Atterberg tests were made on selected samples of cohesive soils. Grain size analyses were made on selected samples of granular soils. Water content determinations, (UC) test results and the D_{10} determined from grain size analysis are shown adjacent to the logs on the boring profiles presented

on Plates 40 through 55. Unconsolidated - Undrained (Q), Consolidated - Undrained (R), and Consolidated Drained (S) shear tests and Consolidation (C) tests were made on representative soil samples. These tests are summarized on the boring logs shown on Plates 40 through 53. The individual shear strength data sheets are shown in Appendix F, Volume II.

b. A-E. Laboratory tests consisting of natural water content, unit weight, and either Unconfined Compression (UC), or Unconsolidated - Undrained (Q) one point or 3 point shear tests were performed by the A-E on samples obtained from the A-E borings. Liquid and plastic limit tests were made on selected samples. Laboratory test results are shown in Appendix F, Volume II. (UC) tests, one point and three point (Q) tests in silts and sands were not plotted on the design shear strength profiles.

c. Design Shear Strengths. Design shear strength parameters are shown on Plates 56 and 57.

PARALLEL PROTECTION PLAN

26. Design Problems considered are:

a. Stability of the floodwalls to the protected side because of limited rights of way with property lines at the levee toe.

b. The stability of the floodwall into the canal for the low water case EL-5.0 NGVD.

c. Flood protection at Pumping Station No. 6.

d. The buried beach sand and its possible connection to the canal.

e. Pile capacities for floodproofing Veterans Highway Bridge.

f. Maintaining wall alignment parallel to B/L within existing levee section for varying channel bottom width and varying levee sections.

27. Hydrostatic Pressure Relief and Underseepage.

a. Hydrostatic Pressure Relief. B/L Sta. 614+00 to 663+00. A piezometric headline of EL-2.4 independent of the canal water elevation was used for the buried beach sand. The buried beach sand is highest between B/L Sta. 614+00 to B/L Sta. 663+00 (EL-6.5 at Sta. 657+00 is highest point of buried beach sand). Dredging of the canal by the New Orleans Sewerage and Water Board (NOS&WB) will lower the existing channel bottom by approximately 10 ft. between B/L Sta. 614+00 to B/L Sta. 663+00 (New channel bottom is EL-16.5 to EL-18.5). A test section in 1983 was dredged at B/L Sta. 643+00 to expose the buried beach sand to the canal. Piezometers were installed around the test section and readings were taken before and after the dredging. The piezometer tip

elevations are in the buried beach sand and are shown in Appendix E, Volume II. The gage readings and piezometer readings are also shown in Appendix E, Volume II . There was no significant changes in the piezometer readings due to dredging. Rainfall had an influence on the piezometer readings. Neither the water level in the canal nor the dredging of the test section affected the piezometer readings. The surface of the sand underlying the canal bottom has become intermixed with fines to some depth below the future channel bottom. The layer of contaminated sand prevents the water in the canal from causing the hydrostatic head in the buried beach sand to fluctuate with canal water levels. Also, sedimentation deposits covered the bottom of the excavation shortly after the test section was completed. When the canal is dredged sedimentation will cover the bottom of the canal further sealing the water pressure in the canal from the groundwater in the buried beach sand. As mentioned in the A-E's report on the test section in Appendix E, Volume II, the sedimentation on the canal bottom suggests that the canal bottom was as deep or deeper than the proposed canal bottom. During meetings on the permit to deepen the canal representatives of the NOS&WB have said that the canal had been dredged previously.

b. Underseepage.

1. B/L Sta. 545+80 to B/L Sta. 552+70, Orleans Parish. The sheetpile tip penetration was extended to EL-17.5 to cutoff peat layers shown in the geological profile (Plate 36). A Lane's creep ratio analysis is shown in Appendix A, Volume I. The owners of apartments adjacent to the levee in this area had complained of seepage problems on their patios (Plate 60). The existing levee had no sheetpile floodwall, but an anchored bulkhead was located on the floodside levee berm with a tip EL of 27.9. The NOS&WB's plan was to remove the old bulkhead and enlarge the channel. The NOS&WB decided the I-wall tip elevation should be the same as the old anchored bulkhead.

2. B/L Sta. 625+25 to B/L Sta. 670+00, Orleans and B/L Sta. 635+00 to B/L Sta. 670+00 Jefferson side. The sheet pile tip elevations were extended because of seepage cutoff requirements. Seepage analyses for these areas are shown in Appendix A, Volume I.

3. Pumping Station. Seepage analysis for the floodwall fronting the pumping station is shown in Appendix A, Volume I.

28. Pile Foundations.

a. Ultimate compression and tension pile capacities versus tip elevations developed for 12" square prestressed concrete piles for the Hammond Highway floodgate are shown on Plate 58. For the Veterans Highway Bridge floodproofing, ultimate tension and compression pile capacities versus tip elevations developed for 20" square prestressed concrete piles at the bridge abutments and in the C/L of the canal (canal bottom EL-18.5) are shown on Plates 59 and 59A. Values of soil to pile frictional resistance, lateral earth pressure coefficients for compression and tension, and bearing capacity factors used to compute

pile capacities are shown in Table 2. The tip elevations for cost estimating purposes are based on applying the factors-of-safety shown in Table 3.

b. Subgrade moduli curves for estimating lateral resistance of the soil beneath the structure and pile supported floodgate and bridge are shown on plates 58, 59 and 59A.

c. Settlement. No settlement is estimated for the floodgate at Hammond Highway built on natural ground, nor for the floodproofing of Veterans Highway bridge which will utilize additional piles for tension loads. The T-wall fronting Pumping Station No. 6 was built in 1985 and shows no evidence of settlement.

TABLE 2

PILE CAPACITIES FOR Q AND S CASES

	Q-Case						S-Case					
	ϕ	K_c	K_t	N_c	N_q		ϕ	K_c	K_t	N_c	N_q	
Clay	0°	1	0.7	9	1.0	0°	23°	1.0	0.7	0	10.5	23°
Silt	15°	1	0.5	12.9	4.4	15°	30°	1.0	0.5	0	22.5	30°
Sand	30°	1.25	0.5	0	22.5	30°	30°	1.25	0.5	0	22.5	30°

TABLE 3

RECOMMENDED FACTORS OF SAFETY
FOR PILE CAPACITY CURVES

	WITH PILE LOAD TEST	W/O PILE LOAD TEST
Q-CASE	2.0	3.0
S-CASE	2.0 (Dead Load Only)	3.0 (Dead Load Only)
	1.0 (Total Load)	1.5 (Total Load)

d. Pile load tests were furnished by representatives of the NOS&WB for review of their projects. Pile load tests for Class B timber piles (tested 1984), Steel H 12X53 piles (tested 1986) and 12" square prestressed concrete piles (tested 1986) were conducted by the New Orleans Sewerage and Water Board's contractors. The timber piles were used for the floodwall fronting the new pumps at Pumping Station No. 6. The steel H-piles were used for the sheet pile braced wall in the discharge basin while the concrete piles were used for the Southern Railroad floodgates on the east and west side. The above pile load tests data are shown in Appendix E, Volume II.

29. Shear Stability.

a. Levees. Stability was determined by the LMVD Method of Planes analysis for a minimum factor of safety of 1.3 with respect to the design shear strength. The borings used to develop a design shear

strength profile for the lateral protection plan are shown on Plates 56 and 57. Plates 60 and 61 show protected side and floodside levee stabilities for Sta. 545+80 to Sta. 552+70 on the Orleans Parish side. Plates 78 and 79 show protected side and floodside levee stabilities for Sta. 549+22 to Sta. 552+70 on the Jefferson Parish side. The landside levee enlargement shown on Plate 78 is less than 200 ft. in length. Plates 62 through 71 and 80 through 87 show floodside and protected side analyses from B/L Sta. 554+00 to B/L Sta. 635+00. Subreaches were incorporated because of (1) SWL change from 11.5 to 12.1 from B/L Sta. 625+00 to B/L Sta. 635+00, (2) varying elevations of buried beach sand from B/L Sta. 554+00 to B/L Sta. 589+00, B/L Sta. 589+00 to B/L Sta. 614+00 and B/L Sta. 614+00 to B/L Sta. 625+00, (3) varying ground surface profiles from B/L Sta. 554+00 to B/L Sta. 568+00 and B/L Sta. 568+00 to B/L 589+00 Orleans Parish side. Plates 72 through 77 and 88 through 93 show protected side and floodside analyses for B/L Sta. 635+00 to B/L Sta. 670+00. Subreaches were incorporated because of (1) SWL change from 12.1 to 12.6 from B/L Sta. 635+00 to I-10 bridges (B/L Sta. 642+00), (2) varying buried beach sand elevations from B/L Sta. 635+00 to B/L Sta. 663+00 and from B/L Sta. 663+00 to B/L Sta. 670+00. In 1984 the NOS&WB dredged the canal between B/L Sta. 643+00 and B/L Sta. 670+00. According to the after survey sections, some of the slopes and channel bottoms were cut below the theoretical sections. The overdredging has caused the DM sections to be slightly lower in crown elevation or setback further to the protected side to maintain a factor of safety equal to 1.3 for floodside stability with a canal low water elevation of -5.0. Plates 94 through 99 show floodside and protected side analyses for the area adjacent to the pumping station. These sections have already been built by local interest. A piezometric headline of El-2.4 was used for the buried beach sand from B/L Sta. 554+00 to the pumping station. At the Lake Pontchartrain end of the project from B/L Sta. 545+00 to Sta. 554+00 (Hammond Highway) a piezometric headline of El 0.0 was used in the buried beach sand.

b. I-Walls. The required penetration of the steel sheet piling below ground surface was determined by the method of planes using "Q" shear case design strengths based on data shown on Plates 56 and 57. The factors of safety were applied to the design shear strengths as follows: ϕ developed = arctan ϕ (tan ϕ available/factor-of-safety) and C/factor-of-safety. Using the resulting shear strengths, net lateral soil and water pressure diagrams were developed for movement toward each side of the sheet pile. With these pressure distributions, the summation of horizontal forces was equated to zero for various tip penetrations and the overturning moments about the tip of the sheet pile were determined. The required depth of penetration to satisfy the stability criteria was determined where the summation of moments was equal to zero. Following is sheet pile wall design criteria used for this hurricane protection project levee:

TIP PENETRATIONS

Q-CASE

F.S. = 1.5 with water to SWL
F.S. = 1.25 with water to SWL and waveload
F.S. = 1.0 with water to SWL + 2 ft. freeboard

DEFLECTIONS

Q-CASE, F.S. = 1.0 with water to SWL + 2 ft. freeboard

BENDING MOMENTS

Governing Tip Penetration Case

If the penetration to head ratio is less than 2.5 to 1, it is increased to 2.5 to 1. The SWL is used to calculate head, for penetration to head ratio.

A stability analysis for the I-wall for B/L Sta. 545+80 to 552+70 on the Orleans Parish side is shown on Plate 100. The sheet pile was driven in 1988. The sheet pile tip was extended for underseepage as previously discussed. Plate 109 shows the stability analysis for B/L Sta. 549+22 to B/L Sta. 552+70 Jefferson Parish side. The I-wall will be overbuilt 1 ft. between B/L Sta. 551+00 to B/L Sta. 552+25 because of settlement of the new levee. From B/L Sta. 549+22 to B/L Sta. 551+00, only a 6" overbuild is necessary due to the sheet pile being driven into the existing Jefferson Parish return levee. Plates 101 through 108 and 110 through 116 show I-wall stability analyses for flood protection from B/L Sta. 554+00 to B/L 670+00. Plates 117 through 124 show I-wall stability analyses from adjacent area to the pumping station. The I-walls shown on Plates 117 through 120 were constructed between 1987 and 1989.

c. Tied Back and Braced Walls. Plate 121 shows a tied back sheet pile wall anchored by a concrete block supported on timber batter piles. The tied back wall was constructed in 1988 between B/L Sta. 549+22 to B/L Sta. 552+70 on the Jefferson Parish side. Plate 122, 123, and 124 show sheet pile walls braced with HP 12X53 steel H-piles. The braced wall shown in Plate 122 was constructed in 1987. The braced wall shown in Plates 123 and 124 were constructed in 1988. The four different segments of tied back and braced wall were constructed by two different contractors under three separate contracts for two different design engineers.

30. T-Walls. A deep seated analysis utilizing a 1.3 factor of safety incorporated into the soil properties was performed for various potential failure surfaces for the T-wall at Pumping Station No. 6, the

Southern Railroad floodgates and Hammond Highway floodgates. The analyses is shown on Plates 125, 126 and 127. The summation of horizontal driving and resisting forces results in a value that is positive at the base and negative as the elevation of the failure surface is lowered. Since the net driving forces are less than the net at rest force, the structure is assumed to be stable and all loads (vertical and horizontal) must be developed in pile capacity below the slip plane.

31. Levee Settlements. The only areas where levees will be raised more than 1 ft. are B/L Sta. 551+00 to B/L Sta. 552+25 and B/L Sta. 635+00 to B/L Sta. 641+50, Jefferson Parish side. At both of these areas the levees will be enlarged in one lift. The settlement of the levee at B/L Sta. 551+00 to B/L Sta. 552+25 is estimated at 3.5 ft. The settlement of the levee at B/L Sta. 635+00 to B/L Sta. 642+08 is estimated at 0.5 ft. The settlement estimates were based on empirical data and a theoretical analysis.

SOURCES OF CONSTRUCTION MATERIALS

32. Sources of Construction Materials.

a. Concrete.

(1) Quantities and Qualities.

	Structural Feature	Concrete Quantity	28 Day* Compressive Strength (psi)
Cast-in-Place	Floodwalls	11,915 CY	3,000
	Gates	214 CY	3,000
	Bridge Abutments and piers	270 CY	3,000
	Bridge Deck, Curbs and Parapet Wall	830 CY	4,000
Precast Concrete	Piles, 12"x12"	4,020 LF	5,000
	Piles, 20"x20"	2,300 LF	5,000

* 90 days if pozzolan used

(2) Environmental conditions. The concrete will not be subjected to any critical environmental or functional conditions.

(3) Specification requirements. Concrete construction will be specified using CW-03301, entitled "Cast-In-Place Structural Concrete"

as a guide. Because of the nature of local aggregates, low alkali cementitious materials will be specified.

(4) Commercial Ready Mix. Ready mix concrete meeting the requirements of this project and produced from batch plants meeting the guidelines of Cast-in-Place Structural Concrete (CW-03301) is available from several area ready mix companies.

(5) Sand and Gravel. For this project, 3/4" and either 1-1/2" or 1" nominal maximum size coarse aggregate will be used. Several area sources are capable of furnishing sand and/or gravel meeting ASTM quality and ASTM or Louisiana State Department of Transportation and Development gradation requirements.

b. Other Materials.

(1) Rip-Rap. Stone is available from Corps approved sources in Arkansas, Missouri, Kentucky and Illinois for the 1000 tons of rip-rap needed.

(2) Shell. The 340 cubic yards of clam shell required can be provided by at least three local suppliers from adjacent Lake Pontchartrain. At the present time, shell dredging is in a legal battle with environmentalists. The availability of shell in the immediate future could be jeopardized by upcoming court rulings.

(3) Soil. Existing levee material will be used to fill the few areas requiring fill.

DESCRIPTION OF PROPOSED STRUCTURES AND IMPROVEMENTS

33. Floodwalls. I-type floodwalls will be provided at the following locations:

a. Station 0+00.00 W/L (E/B) to Station 125+87.45 W/L (E/B). This floodwall is located on the east bank of the 17th Street Outfall Canal. At Station 0+00.00 W/L (E/B), the new floodwall will tie into the existing Orleans Parish Lakefront Levee. At Station 125+87.45 W/L (E/B), the new floodwall will tie into the existing flood protection along the east side of the New Orleans Sewerage and Water Board (NOS&WB) Drainage Pumping Station No. 6. The new floodwall will replace the existing deficient levees and floodwalls on the Orleans Parish side of the 17th Street Outfall Canal. The elevation of the top of floodwall varies from elevation 14.00 to elevation 15.00 NGVD. The detailed alignment and profile of the floodwall and feature contiguous thereto are presented on Plates 2 through 7 and 16. The typical design sections are shown on Plate 15.

b. Station 0+00.00 W/L (W/B) to Station 119+95.49 W/L (W/B). This floodwall is located on the west bank of the 17th Street Outfall Canal. At Station 0+00.00 W/L (W/B), the new floodwall will tie into the

existing Jefferson Parish Lakefront Levee. At Station 119+95.49 W/L (W/B) the floodwall will tie into the existing flood protection along the west side of the NOS&WB Drainage Pumping Station No. 6. The new floodwall will replace the existing deficient levees and floodwalls on the Jefferson Parish side of the 17th Street Outfall Canal. The elevation of the top of the floodwall varies from elevation 14.00 to elevation 16.50 NGVD. The detailed alignment and profile of the floodwall and features contiguous thereto are presented on Plates 2 through 5, 8, 9 and 16. The typical design sections ares shown on Plate 15.

34. Bridges. Eight bridges cross the 17th Street Outfall Canal. They are Hammond Highway Bridge, Veterans Highway Bridges (2 each), Interstate 10 Bridges (2 each), Interstate 610 Bridges (2 each) and the Southern Railroad Bridge. All of the bridges are below the required level of flood protection. During the event of an approaching hurricane, the Veterans Highway, the Interstate 10 and the Interstate 610 bridges will function as primary evacuation routes. Therefore, it is necessary to maintain these bridges open to traffic at all times. Information regarding the existing bridges were taken from available "as built" data. The following modifications are proposed:

a. Hammond Highway Bridge. This bridge will be widened by the locals in the future. Since Hammond Highway is not a major evacuation route, no modification to the bridge is proposed under the project. However, bottom roller type steel floodgates will be provided at each end of the bridge where it crosses the proposed floodwall alignment.

b. Veterans Highway Bridges. The existing Veterans Highway Bridges are below the required level of flood protection and, therefore, these bridges will be modified to make them watertight and stable under high flood level conditions. Modifications of the bridges will include replacing the existing superstructures (decks, girders, curbs and railings) and replacing part of the substructures (pile bent caps and two pile bents per bridge). A continuous seal will be provided to maintain all joints watertight. Stabilizing the bridge structure will be attained by tying down deck to girder, girders to pile bent cap and pile bent to ground against uplifting forces. See Appendix DD Volume II for typical bridge span computations.

c. Interstate 10 and Interstate 610 Bridges. The replacement of these bridges is under study by local authorities. The required flood protection at these bridges will be addressed under a supplement to this DM.

d. Southern Railroad Bridge. The required flood protection at this bridge will be addressed under a supplement to this DM.

35. Floodgates. Bottom roller type steel floodgates will be provided at each end of the Hammond Highway Bridge crossing. A swing type steel floodgate will be provided at Orpheum Avenue near Hammond Highway. These gates will tie into the proposed levees and floodwalls and will be closed during a hurricane event.

36. Drainage Facilities. NOS&WB Drainage Pumping Station No. 6 is located on the southern end of the 17th Street Outfall Canal, just south of the Southern Railroad Bridge. The required flood protection at the pumping station will be addressed under a supplement to this DM.

STRUCTURAL DESIGN

37. Criteria for Structural Design. The structural design presented herein complies with standard engineering practice and criteria set forth in engineering manuals and engineering technical letters for civil work construction published by the Office of the Chief Engineers, subject to modification indicated by engineering judgement and experience to meet local conditions. The floodwall design is similar to the design presented in the Lake Pontchartrain, La. and Vicinity, High Level Plan, Orleans Parish Lakefront Levee west of IHNC Design Memorandum No. 13, General Design approved February 1985.

38. Basic Data. Basic data relevant to the design of the protective work are shown in the following table:

TABLE 4

RELEVANT STRUCTURAL DESIGN DATA

a. Water Elevations	Elevations (feet NGVD)
Wind tide level (Lake Pontchartrain)	11.50
Wind tide level (17th St. Outfall Canal)	11.50 to 12.50
b. Floodwall Gross Grade	
Orleans side (Stationings refers to W/L, East Bank)	
I-Wall (Sta. 0+00.00 to Sta. 80+10.00)	14.00
I-Wall (Sta. 80+10.00 to Sta. 80+40.00)	14.00 to 14.50
I-Wall (Sta. 80+40.00 to Sta. 100+86.00)	14.50
I-Wall (Sta. 100+86.00 to Sta. 102+06.00)	14.50 to 15.00
I-Wall (Sta. 102+06.00 to Sta. 25+87.45)	15.00
Jefferson Parish Side (Stationings refers to W/L, West Bank)	
I-Wall (Sta. 0+00.00 to Sta. 0+10.00)	16.50
I-Wall (Sta. 0+10.00 to Sta. 0+43.60)	16.50 to 14.00
I-Wall (Sta. 0+43.60 to Sta. 75+70.00)	14.00
I-Wall (Sta. 75+70.00 to Sta. 76+00.00)	14.00 to 14.50
I-Wall (Sta. 76+00.00 to Sta. 92+50.00)	14.50
I-Wall (Sta. 92+50.00 to Sta. 93+50.00)	14.50 to 15.00
I-Wall (Sta. 93+50.00 to Sta. 119+95.49)	15.00

c. Unit Weight	Lb. per cu. ft.
Water	64
Steel	490
Concrete	150
Earth	See Plates 56 and 57

d. Design Loads	
Wind loads	50 psf
Water loads	See Plates 128 through 133

39. Design Methods. Reinforced concrete: The design of reinforced concrete structures is in accordance with the requirements of the strength design method of the current ACI Building Code, as modified by the guidelines of "Strength Design Criteria for Reinforced Concrete Hydraulic Structures", ETL 1110-2-312 dated 10 March 1988. The basic minimum 28-days compressive strength concrete will be 3,000 psi except for bridge superstructure and for prestressed concrete piling, where the minimum will be 4,000 psi and 5,000 psi, respectively. For convenient reference, pertinent stresses are tabulated below:

TABLE 5

PERTINENT STRESSES FOR REINFORCED CONCRETE DESIGN

Reinforced Concrete

fc	3,000 psi
fy (Grade 60)	48,000 psi
Maximum flexural reinforcement ratio	0.25 x balance ratio
Minimum flexural reinforcement ratio	200/fy
fc (for bridge super structure concrete)	4,000 psi
fc (for prestressed concrete piles	5,000 psi
fy (for prestressing strand grade 250)	250,000
fy (for prestressing strand grade 270)	270,000

40. Location and Alignment. The floodwall protection will consist of I-wall as described in paragraph 41 below. Generally, the new flood protection on both sides of the 17th Street Outfall Canal follows the alignment of the existing levees. The location of the new floodwall is shown on Plate 1. At the north end, the floodwalls will tie into the Lakefront levee system. At the south end, these floodwalls will tie into the existing flood protection constructed by the local authorities. (The details of the existing flood protection will be addressed in a supplement report to this DM.) The detailed location and alignment of the proposed floodwalls are shown on Plates 1 through 5. The detailed profile of the floodwall and features contiguous thereto are shown on Plates 9 through 16.

41. I-Type Floodwall.

a. General. The I-wall will consist of steel sheet piling (new or existing) driven into the degraded existing levee embankment. The existing sheet piling will be pulled out from its present locations and will be redriven to its new locations shown in Plates 2 through 5. The upper portion of the sheet piling will be capped with concrete. The sheet piling will be driven to the required depth with 9 inches of the sheet piling extending above the protected side finished net grade. The concrete portion of the floodwall will extend from 2 feet below the finished levee crown (flood side and protected side).

b. Loading Cases. In the design of the I-wall, the following loading cases were considered.

Case I: Water to SWL, Q case F.S. = 1.5
Case II: Water to SWL + 2 feet free board, Q case F.S. = 1.0

Refer to Appendix DD, Volume II for I-wall analyses.

c. Joints. Expansion joints in the I-wall will be spaced approximately 30 feet apart, adjusted to fall at sheet pile interlocks. To compensate for expansion, contraction, or displacement, three-bulb waterstops and premolded expansion joint fillers will be provided. Where the I-wall joins the gate monoliths, the deflection of the I-wall will produces a lateral displacement. To compensate for this displacement, a special seal located in a notch in the I-wall has been designed to prevent water from flowing through this joint (see Plate 16 for details).

42. Floodgates and Gate Monoliths.

a. General. One swing gate and two bottom roller gates will be constructed at Orpheum Avenue and on both ends of the Hammond Highway Bridge (Station 2+93.50 W/L (W/B, 3+78.00 W/L (W/B) and 7+83.03 W/L (E/B), respectively). The gates will be constructed of structural steel and the gate monoliths will consist of reinforced concrete column on a monolithic concrete base slab supported on prestressed concrete piles. A continuous steel sheet pile seepage cutoff wall will be provided beneath the base slab for seepage cutoff purposes. See Plates 6, 8, 19 through 24 for details. For typical gate design computations, see Appendix DD, Volume II.

b. Loading Cases. The foundation piles for the gate monoliths were designed with a factor of safety (F.S. = 3). Because of the small number of piles, pile tests were not considered to be economical for this work. The following load cases were used for the preliminary design of these gates.

Case I: Gate closed, static water pressure to SWL, no wind, impervious sheet pile cutoff, no dynamic wave force (100% forces used).

Case II: Gate closed, static water pressure to SWL, no wind, pervious sheet pile cutoff, no dynamic wave force (100% forces used).

Case III: Gate closed, static water pressure with water level 2 feet above SWL, no wind, impervious sheet pile cutoff, no dynamic wave force (75% forces used).

Case IV: Gate closed, static water pressure with water level 2 feet above SWL, no wind, pervious sheet pile cutoff, no dynamic wave force (75% forces used).

Case V: Gate open, no wind, truck on protected side edge of base slab (100% forces used).

Case VI: Gate open, no wind, truck on flood side edge of base slab (100% forces used.

Case VII: Gate open, wind from protected side, truck on floodside edge of base slab (75% forces used).

Case VIII: Gate open, wind from floodside, truck on protected edge of base slab (75% forces used).

43. Cathodic Protection and Corrosion Control.

a. Cathodic Protection. Cathodic protection for steel sheet piling. All steel sheet piling will be bonded together to obtain electrical continuity, and no corrosion protection measures will be provided. Cathodic protection can be installed in the future if the need arises. The sheet piles will be bonded together with No. 6 reinforcing bar welded to the top of each sheet pile. Flexible jumpers insulated with cross-linked polyethylene will be welded or grazed to adjacent sheet piles at the monolith joints 3 inches below the bottom of the concrete.

b. Corrosion Control. All exposed ferrous metal components will be either galvanized, painted with a vinyl paint system or will be stainless steel to provide for corrosion control.

METHOD OF CONSTRUCTION

44. Method of Construction. Construction of the I-wall type floodwall on both sides of the 17th Street Outfall Canal will be accomplished by degrading and reshaping the existing levee, pulling, cutting, and redriving existing sheet piling or driving new sheet piling to the required depth, and constructing the I-wall as shown in Plate 15.

OTHER PLAN CONSIDERED

45. Butterfly Valve Structure Alternative. A butterfly valve structure was considered for providing hurricane protection at the 17th Street Outfall Canal. The proposed structure would consist of reinforced concrete components and steel butterfly valves (gates). Operation of the structure is based on the theory of vertical self-operating, eccentrically pinned, butterfly valves. Under normal circumstances, the valves would be maintained in a passive, open position to allow pumping of interior drainage into Lake Pontchartrain. When a hurricane approaches, the valves would be placed in the active (automatic) mode. In this case, the valves would remain open when the water level in the outfall canal exceeds that on the lake side of the structure but would close when the water level on the lake side of the structure is greater than that in the outfall canal. Closure of this type would normally be in response to the lake side water level rising due to a hurricane driven surge. In the open (trimmed) position, the axis of each valve would be rotated 12 degrees from the center line of its gate bay. During a surge flow, the eccentricity of the pin and the 12 degree offset (trim) would induce closure. This self-operating feature would permit continuous operation of the pumping station during a hurricane. This would be possible because the valves would prevent surge flows from entering the outfall canal and would automatically reopen when the water level on the lakeside of the control structure recedes to a level below that in the outfall canal. When the threat of further hurricane induce surge has passed, the valves would be returned to their passive, open condition. Along with the above described self-operating feature, machinery would be provided to permit manual operation of the valves. This would only be required in the event of a malfunction of the proposed automatic operating system.

46. Butterfly Valve Structure Features. The butterfly valve structure alternative would contain the following features:

a. Gate Bays. The structure would be located just south of the Hammond Highway Bridge and would have six gate bays. They would be constructed in three monoliths, two abutments and one interior, founded on 14"x14" prestressed concrete piles. Each gate bay would provide a 28' wide x 23' high opening with a sill elevation of -18.4 NGVD. One set of steel sheet pile dewatering bulkheads and structural steel needle girders would be provided and each gate bay would have recesses for their installation to allow dewatering for maintenance and/or repairs. Protection against seepage under the structure would be provided by a steel sheet pile cutoff extending to elevation -35.0. For details see Plates 28, 29 and 32. A dewatering system for construction of the butterfly valve along with pile capacity curves for the structure are contained in Appendix B, Volume 1. See Plates 1 through 3.

b. Approach Aprons. The aprons would be reinforced concrete monoliths extending 25 feet on either side of the gate bay monoliths.

The interior monoliths would be soil founded slab with underslab drainage blankets. The drainage blankets would consist of a perforated pipe and layers of gravel and sand that are designed to relieve and protect against the building of excess uplift pressure under the soil founded slabs. The exterior monoliths would be inverted T type walls founded on 14"x14" prestressed concrete piles. Protection against erosion under the aprons would be provided by steel sheet pile cut-off extending to elevation -35.0. For details see Plates 28 and 29.

c. Floodwalls. I-type floodwalls consisting of steel sheet piling capped with reinforced concrete would be provided as follows:

(1) Sta. 0+00.00 W/L (E/B) to Sta. 11+19.81 W/L (E/B). This reach of floodwall would be located on the east bank of the 17th Street Outfall Canal. At Station 0+00.00 W/L (E/B), the new floodwall would tie into the existing Orleans Parish Lakefront Levee. At Station 10+05.31 W/L (E/B), the new floodwall would tie into the butterfly valve structure. At Sta. 11+19.81 W/L (E/B), the floodwall would tie into the existing levee system on the east bank of the 17th Street Outfall Canal, southside (protected side) of the butterfly valve structure.

(2) Sta. 0+00.00 W/L (W/B) to Sta. 6+57.23 W/L (W/B). This reach of floodwall would be located on the west bank of the 17th Street Outfall Canal. At Station 0+00.00 W/L (W/B), the new floodwall would tie into the existing Jefferson Parish Lakefront Levee. At Station 5+67.45 W/L (W/B), the floodwall would tie into the butterfly valve structure. At Sta. 6+57.23 W/L (W/B) the floodwall would tie into the existing levee system on the west bank of the 17th Street Outfall Canal.

d. Breakwater System. To assure a smooth operation of the butterfly valve structure, a breakwater system would be provided in Lake Pontchartrain near the north end of the 17th Street Outfall Canal where it discharges into Lake Pontchartrain. The details of the breakwater system are shown on Plates 26 and 33. The cantilever wall stability analysis for the breakwater is shown in Appendix B, Volume I Plate 4.

A breakwater system is needed not only to prevent wave action from funneling up the canal and striking the butterfly valve gates, but is needed to protect the extensive riparian development at the lake end of the canal along with the numerous small boats in the "Bucktown fishing fleet." During the extreme lake levels the buildings located in this area would be inundated and subject to direct wave attack. The buildings and boats would most likely become debris which could lodge against the gates. Therefore, to insure proper operating conditions for the butterfly valve structure, a breakwater system was developed.

e. Operating Machinery. The machinery is designed for automatic and manual gate operation. In the automatic mode the gate is powered by the water hydraulic forces acting on the gate. In this mode the machinery acts as a damper and shock absorber. Damping time would be field adjustable and accomplished with two hydraulic cylinders and a set of parallel adjustable nonpressure compensated and pressure compensated

flow control valves. The nonpressure compensated flow control valves would provide for low pressure damping, below 200 psi, while the pressure compensating valves would provide for a control rate of damping above a system pressure of 200 psi.

Manual operation of the gate would be accomplished by powering the damping cylinders with a hydraulic power unit consisting of a hydraulic pump driven by an electric motor. In this manner approximately 417 to 513 kips-ft of torque can be imparted to the gate at the hinge for swinging the gate in either direction.

Incorporated with the machinery is a spring. The spring is designed to assist the gate's closing forces generated by tidal flow from the lake into the canal by providing the gate with preliminary closing torque when the gate is fully open. Lesser torque would be applied as the gate moves towards the closed position. Because the opening forces due to drainage pumping is less than the spring loading the gate will fully open and will not increase the head across the structure.

f. Gate Bearings. The pintle would be a spherical bearing. The ball would be stainless steel and the bearing would be a high lead bronze such as ASTM B584-932. The top bearing or hinge would be a commercially available spherical roller bearing. Plate No. 34 illustrates the proposed machinery layout and the proposed design of the hinge and pintle.

ACCESS ROADS

47. Access Roads. Vehicular access to the project site from both the east and west sides of the canal is available via many public roads. The following streets are listed as potential access roads:

East Side Levee	West Side Levee
Conrad Blvd.	Hammond Highway
West End Blvd.	Lake Ave. and connecting streets
Bellaire Drive	West Esplanade Ave.
West Harrison Ave.	Bonnabel Blvd.
W. Kenilworth Drive	Orpheum Ave.
Academy Drive	Veterans Blvd.
	N. Frontage Road
	Canal St. (Metairie)

RELOCATIONS

48. General. Under the authorizing law, local interest are responsible for the accomplishment of ". . . all necessary alteration and relocations to roads, railroads, pipelines, cables, wharves, drainage structures and other facilities made necessary by the construction work . . . ." There are no relocations necessary for the east side

levee/floodwall construction. The East Jefferson Levee District will relocate a 12" diameter water line in the vicinity of Station 0+02 W/L and a 2" diameter high pressure gas line located near 0+13 W/L (see Plate 8).

The only other relocations required by the floodwall construction on the west side consists of resurfacing a portion of Orpheum Avenue near Gate No. 1 and replacement of about 1.5 miles of bicycle paths from the vicinity of Station 590+00 B/L to 669+00.

REAL ESTATE REQUIREMENTS

49. General. All rights-of-way needed to construct the levees and floodwalls for the recommended parallel protection plan are currently within the existing rights-of-way owned by the Orleans Levee District and the East Jefferson Levee District. Reconstruction of the Veterans Highway Bridges and work at Orpheum Avenue will require the East Jefferson Levee District to obtain construction right-of-entry from Jefferson Parish for this work.

AFFECTED ENVIRONMENT

50. Biological. Mammals other than small rodents, rabbits, and opossums are not likely to frequent the area. The canal is lined in some areas with marsh grasses, which provide limited cover, feeding, and resting habitat for various songbirds, seabirds, and some ducks. Various reptiles and amphibians are common in the project area. Least terns and seagulls are commonly seen feeding on the canal.

The water quality in the 17th Street Outfall Canal is generally poor; therefore, the canal has minimal value as habitat for fishery resources although some fishery exists at the canal mouth.

The canal is classified as "water quality limited." This classification is given a stream segment where it is known that water quality does not meet all applicable water quality standards and/or is not expected to meet all applicable standards, even after application of the effluent limitations required by the Federal Water Pollution Control Act. For additional information on water quality see the Environmental Assessment, Appendix C, Volume 1.

The marsh grasses that fringe portions of the canal provide nursery habitat. Due to the poor water quality, the benthos of the canal is limited to worms, blue crabs, clams, and gastropods. Most benthic species in the area are tolerant of prolonged periods of low dissolved oxygen and are not the benthics primarily utilized as fish food organisms by commercially important fish species.

51. Endangered Species. No threatened or endangered species or their critical habitat are found in the project area.

52. Recreation. There are more opportunities for levee walking, jogging and biking on the Jefferson Parish side of the 17th Street Outfall Canal because of numerous public access points. However, on the Orleans Parish side, these activities are limited due to few public access points and its semi-private status with private properties (backyards) being contiguous to most of the level reach.

53. Esthetics. Two parallel levees line the 17th Street Canal its entire length. On the Jefferson Parish side between Orpheum Avenue and the levee crown, no trees exist. This reach consists of a grass levee, some floodwall, and limited shade. However, on the opposite side (Orleans), a completely different esthetic environment exists. Backyards border the right-of-way and, in places, heavy tree cover exists within this corridor.

54. Cultural. Only one cultural resource is recorded in the vicinity of the work. Archeological site 16JE4 is located west of, and outside, the project area along the Jefferson Parish lakefront. No cultural resources are known to exist in the project impact areas, and none are expected due to prior ground disturbance along this corridor.

55. Noise. The background noise levels for the project area are estimated to range from 70 dBA in the project reaches located in residential areas, intermixed with light commercial on the west side of the canal, to 50 dBA in the quieter park-like residential areas on the east side of the canal.

56. Community Cohesion. The residents of Orleans Parish and Jefferson Parish are in favor of protection provided by the hurricane protection project and have voted for a bond issue that assists in funding the work.

ENVIRONMENTAL EFFECTS

57. Biological. Approximately 37 acres of low-value wildlife habitat would be impacted by degrading, earth moving and shaping operations. Minimal temporary displacement of habitat for songbirds and tree-dwelling animals would occur in association with tree removal. While these trees would be replaced, habitat in the immature trees would be of only moderate value for some species. This impact would only be short term. In the long term, habitat for tree dwellers would be increased.

Runoff during construction would slightly increase turbidity in the canal and would also increase the amount of airborne dust in the project area. Once the levee becomes vegetated, this impact would be eliminated.

58. Endangered Species. There are no impact to endangered species.

59. Recreation. South of Hammond Highway, the existing floodwall would be raised. Installation of these taller walls would further inhibit

recreational access toward the water's edge. Due to the higher floodwalls, a visual as well as a physical barrier would be created. Recreational use, such as walking, would continue along the protected side of the new wall.

60. Esthetics. Replacement of floodwalls with earthen levee and raising height of existing floodwall would create visual barriers. This would alter the esthetics of what has been a traditionally open, linear green space. Proposed surface treatment of the floodwall on the protected side would increase the esthetic appeal.

61. Cultural. No impacts to significant cultural resources are anticipated and no cultural surveys are warranted.

62. Noise. This method of construction results in increases in noise levels produced from degrading and upgrading existing levees and floodwalls. The noise levels expected would range from95-105 dBA when measured 50 feet from the center of the noise source.

Therefore, during construction the noise levels would increase a maximum of 35-45 dBA above ambient. This level of increase is not expected to interfere with residential activity since most of the work would be done during daylight hours, and exposure levels inside the homes would be further reduced.

63. Community Cohesion. Some temporary disruption in traffic patterns would result from the project due to the hauling required to dispose of the degraded levee material. Increased levels of noise would be expected during the entire two-year construction period somewhere along the canal from the lakefront to Interstate 10. This method of construction is not localized to a specific area, for the impacts are mobilized down the canal as each work segment is completed.

COMPLIANCE WITH ENVIRONMENTAL LAWS

64. Compliance with Environmental Laws. Compliance with the Endangered Species Act has been achieved. Cultural compliance has been achieved. The parallel protection alternative would not affect wetlands or coastal waters; therefore, Section 404(b)(1) Evaluation or Coastal Zone Management Consistency Determination would not be necessary.

COORDINATION WITH OTHER AGENCIES

65. General. The Orleans Levee District and the East Jefferson Levee District provided the local cooperation agreements for this feature of the hurricane protection project. The recommended project plan has the approval of each of these levee boards. The entire Lake Pontchartrain 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 coordination required for input to the Draft Supplemental Environmental Impact Statement (DSEIS) of the Lake Pontchartrain as a whole. The Environmental Assessment (EA) for work on the 17th Street Outfall Canal will be provided to the various local, state and Federal agencies for review and comments.. A copy of the EA and the finding of no significant impacts (FONSI) is contained in Appendix C, Volume 1 of this report. Also contained in Appendix C, Volume 1 is a copy of the Fish and Wildlife Coordinations Act Report Supplement.

ALTERNATIVE PLAN CONSIDERED

66. General. The two major alternatives that exist for the 17th Street Outfall Canal are Fronting Protection and the Parallel Protection. Both plans have previously been described in detail in earlier sections of this report.

a. Parallel Protection: The parallel protection plan, recommended plan, includes floodwall along each bank of the 17th Street Canal from the Lakefront to Pumping Station No. 6. For the seven bridges with road approaches and decks below the design grades, five of the bridges for this plan would be flood proofed. The remaining two (Hammond Highway and the Southern Railroad bridges) would be designed to have road gates at each side of the bridge approach. The I-10 and I-610 bridges are to be replaced by the Louisiana Department of Transportation and Development (LADOTD) under their five year replacement program. These bridges were built using lightweight concrete and presently are in need of replacement. For details, refer to Appendix C, Volume 1 concerning the LADOTD position in this matter. The New Orleans District is currently working with LADOTD to determine the most cost effective replacement plan which satisfies the hurricane protection project. Fronting protection and/or modification to Pumping Station No. 6 is also necessary for the parallel protection plan. As stated earlier in this report, a supplement to this DM will cover details for work at Pumping Station No. 6.

b. Fronting Protection. DM No. 19, Orleans Avenue Outfall Canal Discuss in some detail the full range of other gates i.e. vertical lift, sector, etc. that could be used in lieu of the butterfly valve type of gate. Each of these gates types have unacceptable operational requirements that make their use undesirable for the outfall Canals. Specifically the lead time necessary to safely operate the more conventional gates would necessitate stoppage of the pumping stations pumps to close the gates well in advance of the hurricane highest winds. This is unacceptable to the New Orleans Sewerage and Water Board, the agency responsible for operating the pumping stations.

c. Other Plans. Other plans that would satisfy project objective included: gravity drainage structures with supplemental pumping at

lakefront; U-shaped reinforced concrete channel; and total replacement of existing pumping stations and construction of a new station near the lakefront. All of the plans were dropped because of excessive costs.

67. Plan Selection. The task of providing hurricane protection at the 17th Street Outfall Canal presents some unique problems. Unlike Orleans and London Avenue Outfall Canals, the 17th Street Canal is straight from its source, Pumping Station No. 6, to its outfall at Lake Pontchartrain. The canal thus has an unobstructed path for wave transmission from the lake into the canal. There is also considerable raparian development at or near the outfall end of the canal. This development consists primarily of wood framed construction which was built at an elevation below the elevation of the design hurricane. If this development is subjected to the conditions that could occur during a Standard Project Hurricane, it would most likely be destroyed by high water and wave action. The resulting debris, given the direction of wave attack, would pile up at the proposed fronting protection structure. Model study of the proposed structure conducted for London Avenue showed that proper gate operations were very sensitive to entry and exit conditions. Debris could prevent proper operation of the structure. Recognizing this potential the fronting protection plan was designed with a breakwater as an integral part of the plan. The fronting protection structure was formulated and designed with the same objectives as those considered for Orleans and London Avenue Outfall Canals. The structure must provide for maximum flexibility for pumping interior drainage. These objectives were described earlier in this report. The objectives are best accomplished with the use of the butterfly valve gated structure. Detailed cost estimates for the fronting protection plan are contained in Appendix D, Volume I. The total cost for the Butterfly Valve Fronting Protection Plan is estimated to be $20.5 million. This cost is about 1 percent less than the estimated cost for the parallel protection plan. Given the degree of accuracy of a DM scope design and cost estimate, one can consider the plans to have essentially the same cost. The fronting protection plan has inherently a higher maintenance and operational cost than does the parallel protection plan. The parallel protection plan is the preferred plan of the Orleans Levee District and the East Jefferson Levee District. The Sewerage and Water Board of New Orleans prefers the parallel protection plan since it fully accommodates their needs and also has an additional benefit in that work of the Veterans Highway, I-10 and I-610 bridges will improve the conveyance characteristics of the canal. Given all of the factors above, the tentatively recommended Federal plan for the 17th Street Outfall Canal is the Parallel Protection Plan.

ESTIMATE OF COST

68. General. Based on October 1989 price levels, the total estimated first cost for constructing the 17th Street Outfall Canal Parallel Protection Plan is $20,700,000. A cost of $15,975,000 is for the levees and floodwalls feature, $2,247,000 is for Engineering and Design and

$2,332,000 is for Supervision and Inspection. A cost for relocations of $173,000 is estimated for work on the westside of the canal. Detailed cost estimates for the design work described in this DM are contained in Table 6. The floodwall work and fronting protection works at Pumping Station No. 6 represent $6.9 million of the $20.7 million total. Based on the percentage breakout of E&D and S&I cost for work described in this report, the estimated E&D and S&I cost for Pumping Station No. 6 is $564,000 and $698,000 respectively. These amounts for E&D and S&I area contained in the total E&D and S&I figures above.

TABLE 6
17TH STREET OUTFALL CANAL
DETAILED COST ESTIMATES

VETERANS HIGHWAY BRIDGES							
Code	Item	Quantity	Unit	Unit Price	Amount	Cont.	Project Cost
08.-.-.-	Roads, Railroads, and Bridges						
08.2.-.-	Veterans Hwy. Bridges (East & West Bound)						
08.2.A.-	Mob. & Demob.	Lump Sum	LS	$100,000.00	$100,000	$15,000	$115,000
08.2.1.-	Care of Traffic:						
08.2.1.B	Site Work						
08.2.1.B	Detour Roads (const. & removal) (4" thick asphalt, 330 SY)	Lump Sum	LS	35,000.00	35,000	7,000	42,000
08.2.3.-	Road Surfacing						
08.2.3.B	Site Work						
08.2.3.B	Removal of Existing Asphalt Pavement (9" thick)	935	SY	4.00	3,740	748	4,488
08.2.3.B	Asphaltic Concrete Pavement	935	SY	12.00	11,220	2,244	13,464
08.2.J.-	Bridges, Foundations						
08.2.J.B	Site Work						
08.2.J.B	Demolition & Removal of Existing Bridges (decks & pile caps)	700	CY	130.00	91,000	27,300	118,300
08.2.J.B	Pull Existing Concrete Piles 20" X 20" (50' long)	28	EA	200.00	5,600	1,400	7,000
08.2.J.B	Piling:						
08.2.J.B	Piling, 12" Prstrd Conc.	640	LF	18.00	11,520	1,728	13,248
08.2.J.B	Piling, 20" Prstrd Conc.	2,300	LF	28.00	64,400	9,660	74,060
08.2.K.-	Bridges, Abutments & Piers:						
08.2.K.C	Concrete (3000 PSI)						
08.2.K.C	Concrete, in Place						
08.2.K.C	Abutments	154	CY	330.00	50,820	7,623	58,443
08.2.K.C	Piers	116	CY	330.00	38,280	5,742	44,022
08.2.L.-	Bridges, Superstructure & Deck:						
08.2.L.C	Concrete (4000 PSI)						
Subtotal, Veterans Hwy. Bridges							$490,025

TABLE 6 (CONT'D)
17TH STREET OUTFALL CANAL
DETAILED COST ESTIMATES

VETERANS HIGHWAY BRIDGES Cont'd							
Code	Item	Quantity	Unit	Unit Price	Amount	Cont.	Project Cost
08.2.L.C	Concrete, in Place:						
08.2.L.C	Concrete in Bridge Deck, Curb & Parapet Wall	830	CY	$350.00	$290,500	$43,575	$334,075
08.2.L.C	Waterproof Finish (Parapet Walls)	10,000	SF	1.00	10,000	1,000	11,000
08.2.L.C	Waterstops						
08.2.L.C	Preformed Compression Seal Expansion Joints	570	LF	2.00	1,140	171	1,311
08.2.L.C	9" Dumpbell Waterstops	680	LF	10.00	6,800	1,020	7,820
08.2.L.C	J-Type Waterstops	680	LF	35.00	23,800	3,570	27,370
08.2.L.E	Metals						
08.2.L.E	Removal of Existing WF33 Steel Bridge Girders	Lump Sum	LS	40,000.00	40,000	6,000	46,000
08.2.L.E	Miscellaneous Metals	29,500	LBS	1.00	29,500	4,425	33,925
08.2.L.E	New Bridge Girders						
08.2.L.E	W33 X 130	152,900	LBS	.65	99,385	9,939	109,324
08.2.L.E	W33 X 152	326,200	LBS	.55	179,410	17,941	197,351
	Subtotal, Construction Costs				$1,092,000		
08.0.Z.-	Contingencies					$166,000	
08.-.-.-	Total, Veterans Hwy. Bridges						$1,258,000

TABLE 6 (CONT'D)
17TH STREET OUTFALL CANAL
DETAILED COST ESTIMATES

LEVEES AND FLOODWALLS (EAST SIDE)							
Code	Item	Quantity	Unit	Unit Price	Amount	Cont.	Project Cost
11.-.-.-	Levees and Floodwalls (East Side)						
11.0.A.-	Mob. & Demob.	Lump Sum	LS	$40,000	$40,000	$6,000	$46,000
11.0.1.-	Levees:						
11.0.1.B	Site Work						
11.0.1.B	Clearing	11	Acre	1,000.00	11,000	1,650	12,650
11.0.1.B	Excavation & Embankment:						
	Degrade Existing Levee & Haul to Stockpile Area	33,560	CY	3.00	100,680	20,136	120,816
11.0.1.B	Semicompacted Fill (Adjacent Borrow)	335	CY	1.50	503	101	603
11.0.1.B	Riprap Slope Prot.	1,000	Tons	22.00	22,000	4,400	26,400
11.0.1.B	Shell Bedding	340	CY	20.00	6,800	1,360	8,160
11.0.1.B	Slope Treatment:						
11.0.1.B	Seeding, Fertilizing & Mulching	11	Acre	500.00	5,500	825	6,325
11.0.2.-	Floodwalls						
11.0.2.B	Site Work						
11.0.2.B	Foundation Work:						
11.0.2.B	Structural Excavation	3,700	CY	4.00	14,800	2,960	17,760
11.0.2.B	Structural Backfill	1,850	CY	10.00	18,500	3,700	22,200
11.0.2.B	Steel Sheet Pile, PZ-22	81,000	SF	12.00	972,000	97,200	1,069,200
11.0.2.B	Pull & Redrive Existing PMA-23 Sheet Pile	47,140	SF	5.00	235,700	35,355	271,055
11.0.2.B	Pull, Haul & Redrive Existing PMA-23 Sheet Pile	43,045	SF	6.00	258,270	38,741	297,011
11.0.2.B	Pull & Stockpile PMA-23 Sheet Pile	71,875	SF	2.50	179,688	26,953	206,641
11.0.2.B	Prstd. Conc. Piles 12" X 12"	1,340	LF	18.00	24,120	3,618	27,738
11.0.2.B	12" Treated Timber Piles	1,000	LF	10.00	10,000	1,500	11,500
11.0.2.C	Concrete						
	Concrete, in Place Including Cement						
Subtotal, Levees & Floodwalls (East Side)							$2,144,059

TABLE 6 (CONT'D)
17TH STREET OUTFALL CANAL
DETAILED COST ESTIMATES

LEVEES AND FLOODWALLS (EAST SIDE) Cont'd							
Code	Item	Quantity	Unit	Unit Price	Amount	Cont.	Project Cost
11.0.2.C	Demolition of Existing Sheet Pile Conc. Cap	1,050	CY	$130.00	$136,500	$27,300	$163,800
11.0.2.C	I-Wall Stem	6,265	CY	330.00	2,067,450	206,745	2,274,195
11.0.2.C	Gate Stab. Slabs	11	CY	70.00	770	77	847
11.0.2.C	Gate Walls	3	CY	330.00	990	99	1,089
11.0.2.C	Gate Base Slab	104	CY	200.00	20,800	2,080	22,880
11.0.2.C	Waterproof Finish	234,190	SF	1.00	234,190	23,419	257,609
11.0.2.E	Metals						
11.0.2.E	Roller Gate No. 3 (Size 38' X 4')	Lump Sum	LS	48,000.00	48,000	4,800	52,800
	Subtotal, Construction Costs				$4,408,000		
11.0.Z.-	Contingencies					$509,000	
11.-.-.-	Total, Levees & Floodwalls (East Side)						$4,917,000

TABLE 6 (CONT'D)
17TH STREET OUTFALL CANAL
DETAILED COST ESTIMATES

SUMMARY OF COST ESTIMATES (1ST CONTRACT) EAST SIDE							
Code	Item	Const. Time	Unit	Unit Price	Amount	Cont.	Project Cost
08.-.-.-	Veterans Hwy. Bridges	1	Yrs		$1,092,000	$166,000	$1,258,000
11.-.-.-	Levees and Floodwalls (East Side)	3	Yrs		4,408,000	509,000	4,917,000
Totals, Parallel Prot. at 17th St. Canal DM (1st Contract)					$5,500,000	$675,000	$6,175,000
30.-.-.-	Planning, Engineering and Design						
30 H -	Plans and Specifications						
30 H Y	All Other						$587,000
30 J	Engineering During Construction (EDC)						
30 J H	All Other EDC						31,000
31.-.-.-	Construction Mgmt. (S&I)						
31 B							261,000
31 E							105,000
31 F							423,000
Total Cost, Parallel Prot. at 17th St. Canal DM (1st Contr)							$7,582,000

TABLE 6 (CONT'D)
17TH STREET OUTFALL CANAL
DETAILED COST ESTIMATES

RELOCATIONS (WEST SIDE)							
Code	Item	Quantity	Unit	Unit Price	Amount	Cont.	Project Cost
02.-.-.-	Relocations West Side						
02.-.-.-	Mob. & Demob.	Lump Sum	LS	$40,000.00	$40,000	$8,000	$48,000
02.1.-.-	Roads, Construction Activities						
02.1.3.-	Road Surfacing						
02.1.3.B	Site Work						
02.1.3.B	Removal & Replacement of Asphalt Road at Orpheum Ave (3-1/2" Asphalt Over 8-1/2" Sand/Shell/Cement)	900	SY	30.00	27,000	5,400	32,400
02.1.3.B	Asphalt Bicycle Path (3" Asphalt)	4,180	SY	10.00	41,800	8,360	50,160
02.3.-.-	Cemeteries, Utilities & Structures, Const. Activities						
02.3.2.-	Utilities						
02.3.2-	12" Dia. Cast Iron Water Line (Relocate over Levee, 50')	Lump Sum	LS	15,000.00	15,000	3,000	18,000
02.3.2.-	2" Dia. H.P. Gas Line thru "I"-Wall with Sleeve	Lump Sum	LS	20,000.00	20,000	4,000	24,000
	Subtotal, Construction Costs				$144,000		
02.0.Z.-	Contingencies					$29,000	
02.-.-.-	Total, Relocations (West Side)						$173,000

TABLE 6 (CONT'D)
17TH STREET OUTFALL CANAL
DETAILED COST ESTIMATES

LEVEES AND FLOODWALLS (WEST SIDE)							
Code	Item	Quantity	Unit	Unit Price	Amount	Cont.	Project Cost
11.-.-.-	Levees & Floodwalls (West Side)						
11.0.A.-	Mob. & Demob.	Lump Sum	LS	$40,000.00	$40,000	$6,000	$46,000
11.0.1.-	Levees:						
11.0.1.B	Site Work						
11.0.1.B	Clearing	18	Acre	1,000.00	18,000	2,700	20,700
11.0.1.B	Excavation & Embankment:						
11.0.1.B	Degrade Existing Levee & Haul to Stockpile Area	39,100	CY	3.00	117,300	23,460	140,760
11.0.1.B	Semicompacted Fill (Adjacent Borrow)	5,400	CY	1.50	8,100	1,620	9,720
11.0.1.B	Slope Treatment:						
11.0.1.B	Seeding, Fertilizing & Mulching	18	Acre	500.00	9,000	1,350	10,350
11.0.2.-	Floodwalls						
11.0.2.B	Site Work						
11.0.2.B	Foundation Work:						
11.0.2.B	Structural Excav.	3,520	CY	4.00	14,080	2,816	16,896
11.0.2.B	Structural Backfl	1,760	CY	10.00	17,600	3,520	21,120
11.0.2.B	Steel Sheet Pile, PZ-22	61,670	SF	12.00	740,040	74,004	814,044
11.0.2.B	Pull & Redrive Existing Frodingham 1B Sheet Pile	57,490	SF	5.00	287,450	43,118	330,568
11.0.2.B	Pull, Haul, & Redrive Existing Frodingham 1B Sheet Pile	35,580	SF	6.00	213,480	32,022	245,502
11.0.2.B	Pull & Stockpile Existing Frodingham 1B Sheet Pile	30,480	SF	2.50	76,200	11,430	87,630
11.0.2.B	Prstd. Conc. Piles, 12" X 12"	2,040	LF	18.00	36,720	5,508	42,228
11.0.2.B	12" Treated Timber Piles	1,000	LF	10.00	10,000	1,500	11,500
11.0.2.C	Concrete						
	Concrete, In Place Including Cement						
11.0.2.C	I-Wall Stem	5,650	CY	330.00	1,864,500	186,450	2,050,950
11.0.2.C	Gate Stab. Slabs	14	CY	70.00	980	98	1,078
11.0.2.C	Gate Walls	3	CY	330.00	990	99	1,089
11.0.2.C	Gate Base Slab	104	CY	200.00	20,800	2,080	22,880
Subtotal, Levees & Floodwalls (West Side)							$3,873,015

TABLE 6 (CONT'D)
17TH STREET OUTFALL CANAL
DETAILED COST ESTIMATES

LEVEES AND FLOODWALLS (WEST SIDE) Cont.							
Code	Item	Quantity	Unit	Unit Price	Amount	Cont.	Project Cost
11.0.2.C	Waterproof Finish	203,000	SF	$1.00	$203,000	$20,300	$223,300
11.0.2.E	Metals						
	Swing Gate No. 1 (Size 24' X 4')	Lump Sum	LS	12,000.00	12,000	1,200	13,200
	Roller Gate No. 2 (Size 38' X 4')	Lump Sum	LS	48,000.00	48,000	4,800	52,800
	Subtotal, Construction Costs				$3,738,000		
11.0.Z.-	Contingencies					$424,000	
11.-.-.-	Total, Levees & Floodwalls (West Side)						$4,162,000

TABLE 6 (CONT'D)
17TH STREET OUTFALL CANAL
DETAILED COST ESTIMATES

SUMMARY OF COST ESTIMATES (2ND CONTRACT) WEST SIDE							
Code	Item	Const. Time	Unit	Unit Price	Amount	Cont.	Project Cost
11.-.-.-	Levees and Floodwalls (West Side)	3	Yrs		3,738,000	424,000	4,162,000
02.-.-.-	Relocations (West Side)	*			144,000	29,000	173,000
	* Relocations to be performed concurrently with the floodwall const.						
Totals, Parallel Prot. at 17th St. Canal DM (2nd Contract)					$3,919,000	$453,000	$4,335,000
30.-.-.-	Planning, Engr., and Design						
30. H-.-	Plans & Specifs.						
30. H Y-	All Other						$412,000
30. J-.-	Engineering During Construction (EDC)						
30. J Y-	All Other EDC						22,000
31.-.-.-	Const. Mgmt. (S&I)						
31. B	Contract Admin.						273,000
31. E	Inspection and Quality Assurance						149,000
31. F	Project Office Oper.						423,000
Total Cost, Parallel Prot. at 17th St. Canal DM (2nd Contr)							$5,614,000

TABLE 6 (CONT'D)
17TH STREET OUTFALL CANAL
DETAILED COST ESTIMATES

SUMMARY OF ESTIMATE OF COST TO PREPARE DM			
Code	Item		Project Cost
30.-.-.-	Planning, Engineering and Design		
30.B.2.			$ 2,651
30.B.4.			349,628
30.FB			23,155
30.FY			1,500
30.FY			254,066
Total for DM Preparation			$631,000

ESTIMATE COST FOR WORK AT PUMPING STATION NO. 6 NOT COVERED BY THIS DM TO BE COVERED BY A SUPPLEMENT	
TOTAL	$6,900,000

GRAND TOTAL PARALLEL PROTECTION	
TOTAL	$20,727,600
(Rounded)	$20,700,000

SCHEDULE FOR DESIGN AND CONSTRUCTION

69. Schedule for Design and Construction. Preparation of the supplement to this report for work at Pumping Station No. 6 is scheduled to start in October 1991 and take 18 months to complete. Estimate cost to prepare the supplement is $224,000. The sequence for design and construction contracts is listed as follows:

TABLE 7

SCHEDULE FOR DESIGN AND CONSTRUCTION

ACTIVITY 1/	PLANS & SPEC. START	PLANS & SPEC. COMPLETE	CONSTRUCTION ADVER.	CONSTRUCTION AWARD	CONSTRUCTION COMPLETE	ESTIMATED COSTS $ 2/
West Bank Floodwall & Levee	Oct 92	Oct 93	Mar 94	Jul 94	Sep 97	5,441,000
East Bank Floodwall & Vet. Hwy. Bridges	Jul 93	Feb 95	Aug 95	Oct 95	Jan 2000	5,082,000 3/
Protection at Pumping Sta. #6	Oct 95	Mar 97	Aug 97	Oct 98	Sep 99	6,676,000

1/ West-side relocations to be accomplished prior to Mar 1994.
2/ Cost includes construction cost plus contingencies, E&D and S&I costs.
3/ Cost shown in table reflects remaining costs to cap with concrete the East Bank floodwall and floodproofing the Veterans Highway bridges. Steel sheetpiling on the East Bank will be placed by OLD.

70. Comparison of Estimates. The current estimate of $20,700,000 for the high level plan 17th Street Outfall Canal represents a decrease of $11,656,000 when compared to the current PB-3 estimate. The largest part of the decrease in cost is in the estimated cost for the levees and floodwalls. The current PB-3 estimate is based on a survey scope estimate made for the 1984 reevaluation report for the Lake Pontchartrain project. That estimate called for a fronting protection structure which employed conventional gates and higher contingencies in the estimate. The 1984 estimate has been indexed for price levels in determining the currently approved PB-3 estimate. The plans are not directly comparable since the DM plan recommends parallel protection instead of the fronting protection plan, as contained in the PB-3 estimate. Similarly, the reduction in cost for Engineering and Design

and Supervision and Administration is also not directly comparable since the recommended plan is different from the PB-3 plan. The recommended plan requires a much less complex design and construction procedure than would a fronting protection plan.

TABLE 8

COMPARISON OF ESTIMATES
(Incremental Costs)

Feature Feature	PB-3 (Eff. Oct 89)	DM[1]/	Difference DM & PB-3
	($)	($)	($)
11 Levees & Floodwalls	26,539,000	15,975,000	-10,564,000
30 Engineering & Design	2,600,000	2,247,000	-413,000
31 Supervision & Administration	3,184,000	2,332,000	-852,000
01 Lands & Damages	---	---	---
02 Relocations	---	173,000	+173,000
TOTAL PROJECT COST	$32,383,000	20,727,000	-11,656,000

1/ Includes estimated cost for work at Pumping Station No. 6.

71. Federal and Non-Federal Cost Breakdown. The breakdown of Federal and non-Federal costs needed to construct the 17th Street Outfall Canal parallel protection plan described in the DM is shown in Table 9 below:

TABLE 9

FEDERAL AND NON-FEDERAL COST BREAKDOWN
OCT 89 PRICE LEVELS

Item	Federal	Non-Federal	Total
	($)	($)	($)
Fronting Protection & Levees	14,490,000	6,210,000	20,700,000 (R)

OPERATION AND MAINTENANCE

72. General. The 17th Street Outfall Canal parallel protection plan would be operated at the expense of the local interests. The estimate

of the annual operation and maintenance costs for the levees, floodwalls and road gates which are detailed in the DM are as follows:

a. Levee Maintenance. (Involves mowing approximately 50 acres of levee 12 times/yr.)	$ 7,200
b. Floodwall Maintenance. (Involves mowing or spraying grass adjacent to wall and removal of graffiti, etc. for 4.8 miles of floodwall 4 times/yr.)	$ 4,000
c. Floodgate Operations. (Involves operating roller gates 4 times/yr.)	$ 800
d. Floodgate Maintenance. (Involves spot painting 2 times/yr., miscellaneous routine maintenance 4 times/yr., and complete repainting every 10 years of 3 floodgates.)	$ 2,400
Subtotal	$14,400
20% Contingency	$ 2,600
TOTAL ANNUALIZED COST	$17,000

ECONOMICS

73. 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 1981 price levels, and the project interest rate of 3 1/8 percent, the benefit-cost ratio for the project as a whole was 4.2 to 1. The 17th Street Outfall Canal reach is part of the New Orleans-Jefferson SPA. An update of the project's economics using the latest guidelines contained in EC 11-2-156 dated March 31, 1989 yields a Benefit-to-Cost ratio (B/C ratio) of 8.1 to 1 at the project interest rate (3.125%) and 3.0 to 1 at the current Federal discount rate. Remaining benefits versus remaining costs are 5.0 to 1 for the project interest rate and 1.9 to 1 for the current Federal discount rate.

74. Funds Required by Fiscal Year. To maintain the schedule for design and construction of the 17th Street Outfall Canal Parallel Protection Plan, total Federal and non-Federal funding required by fiscal year are tabulated as follows:

TABLE 10

TOTAL FEDERAL AND NON-FEDERAL
FUNDING BY FISCAL YEAR

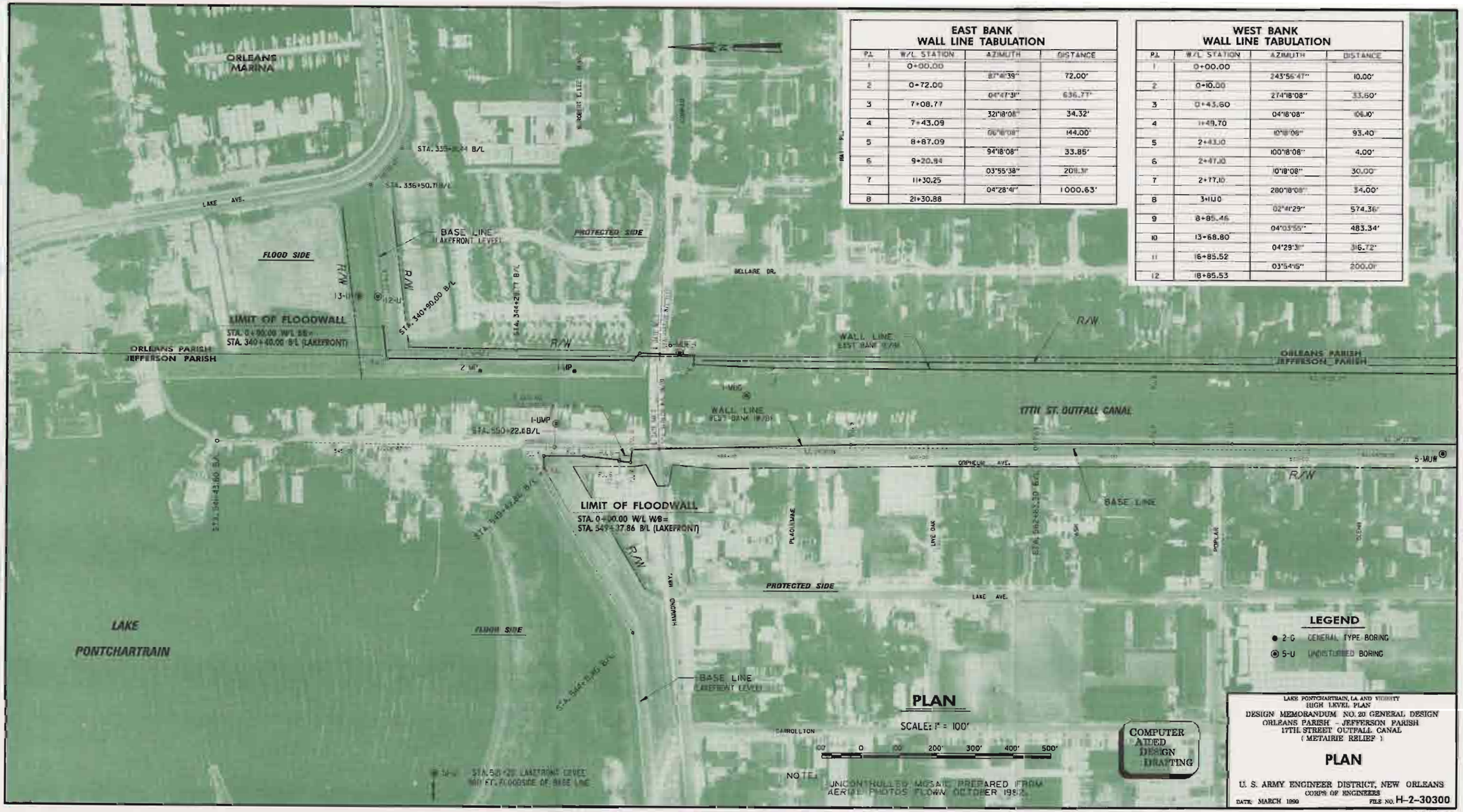
Sunk Funds Thru	FY 89	$ 375,000
	FY 90	255,600
	FY 91	---
	FY 92	150,000
	FY 93	777,000
	FY 94	694,000
	FY 95	1,825,000
	FY 96	3,595,500
	FY 97	3,069,500
	FY 98	4,890,500
	FY 99	4,890,500
	FY 00	204,000

75. Need for Further Investigations. Flood protection at Pumping Station Number 6 will be addressed in a supplement to this DM. The Orleans Levee Board and the Sewerage and Water Board of New Orleans have already completed much of the flood protection work required at Pumping Station No. 6. The purpose of the supplement will be to identify those items of work which are creditable to the hurricane protection project and to determine the most cost effective means of providing positive closures for the very oldest pumps located at the station. The estimated total cost for the levee, floodwalls and work at Pumping Station No. 6 is $6.9 million. It was necessary to develop this estimate for purposes of establishing the total cost for the parallel protection plan.

RECOMMENDATIONS

76. Recommendations. The plan of protection recommended herein calls for parallel protection. This protection consists of a floodwall in levees on each side of the 17th Street Outfall Canal. The parallel protection plan accomplishes, at essentially the same cost as the fronting protection plan, the hurricane protection project objectives. The recommended plan also accommodates the interior drainage needs of the Sewerage and Water Board of New Orleans. By fully accommodating these needs, overall benefits to the protected area are maximized. It is recommended that this report be approved as the basis for preparation of Plans and Specifications for the design works described herein.

LAKE PONTCHARTRAIN
LAKESHORE DR.
ROBERT E. LEE BLVD.
FILMORE AVE.
HARRISON AVE.
VETERANS MEMORIAL HWY.
METAIRIE RD.
BONNABEL BLVD.
PONTCHARTRAIN BLVD.
WEST END BLVD.
CANAL BLVD.
ORLEANS AVE. OUTFALL CANAL
MARCONI DR.
CITY PARK
BAYOU ST. JOHN
WISNER BLVD.
LONDON AVE. OUTFALL CANAL
ELYSIAN FIELDS AVE.
FRANKLIN AVE.
UNIVERSITY OF NEW ORLEANS
DILLARD UNIVERSITY
New Orleans
METAIRIE RELIEF OUTFALL CANAL
PLATE 2
PLATE 3
PLATE 4
PLATE 5
JEFFERSON PARISH
ORLEANS PARISH
10
610
90
ARKANSAS
LOUISIANA
MISSISSIPPI
TEXAS
SHREVEPORT
MONROE
VICKSBURG
NATCHEZ
ALEXANDRIA
LOCATION OF WORK
BATON ROUGE
LAKE CHARLES
LAFAYETTE
NEW ORLEANS
MORGAN CITY
GULF OF MEXICO
VICINITY MAP
SCALE OF MILES
N
INDEX MAP
SCALE IN FEET
4000 0 4000 8000 12000
LAKE PONTCHARTRAIN, LA. AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO. 20
GENERAL DESIGN
ORLEANS PARISH - JEFFERSON PARISH
17TH. STREET OUTFALL CANAL
METAIRIE RELIEF
INDEX AND VICINITY MAP
U. S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
DATE MARCH 1990
FILE NO. H-2-30300



EAST BANK WALL LINE TABULATION

PI	W/L STATION	AZIMUTH	DISTANCE
1	0+00.00		
		87°46'39"	72.00'
2	0+72.00		
		04°47'31"	636.77'
3	7+08.77		
		321°18'08"	34.32'
4	7+43.09		
		06°18'08"	144.00'
5	8+87.09		
		94°18'08"	33.85'
6	9+20.94		
		03°55'38"	209.31'
7	11+30.25		
		04°28'41"	1000.63'
8	21+30.88		

WEST BANK WALL LINE TABULATION

PI	W/L STATION	AZIMUTH	DISTANCE
1	0+00.00		
		243°56'47"	10.00'
2	0+10.00		
		274°18'08"	33.60'
3	0+43.60		
		04°18'08"	106.10'
4	1+49.70		
		10°18'08"	93.40'
5	2+43.10		
		100°18'08"	4.00'
6	2+47.10		
		10°18'08"	30.00'
7	2+77.10		
		280°18'08"	34.00'
8	3+11.10		
		02°41'29"	574.36'
9	8+85.46		
		04°03'55"	483.34'
10	13+68.80		
		04°29'3"	316.72'
11	16+85.52		
		03°54'15"	200.01'
12	18+85.53		

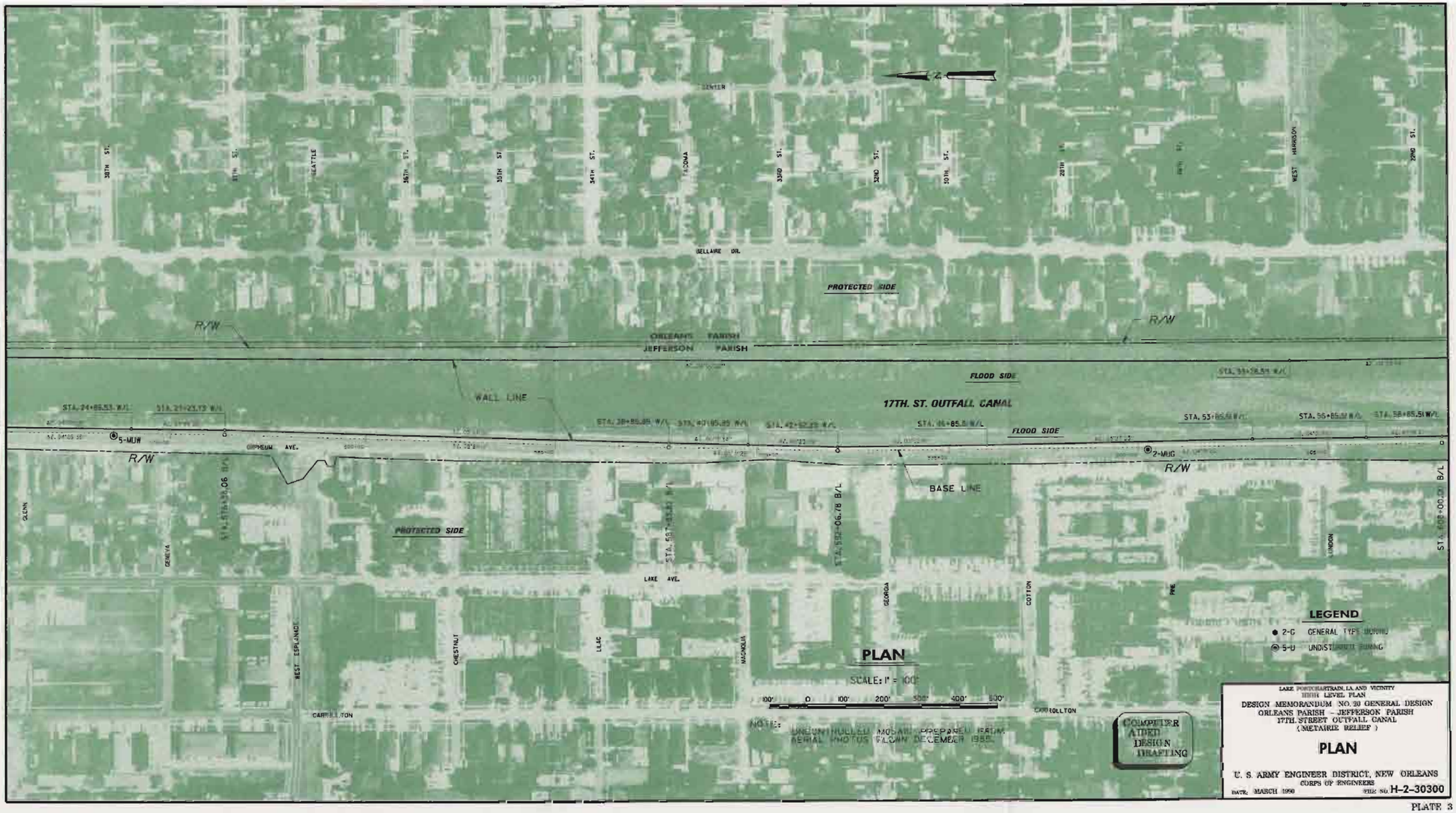
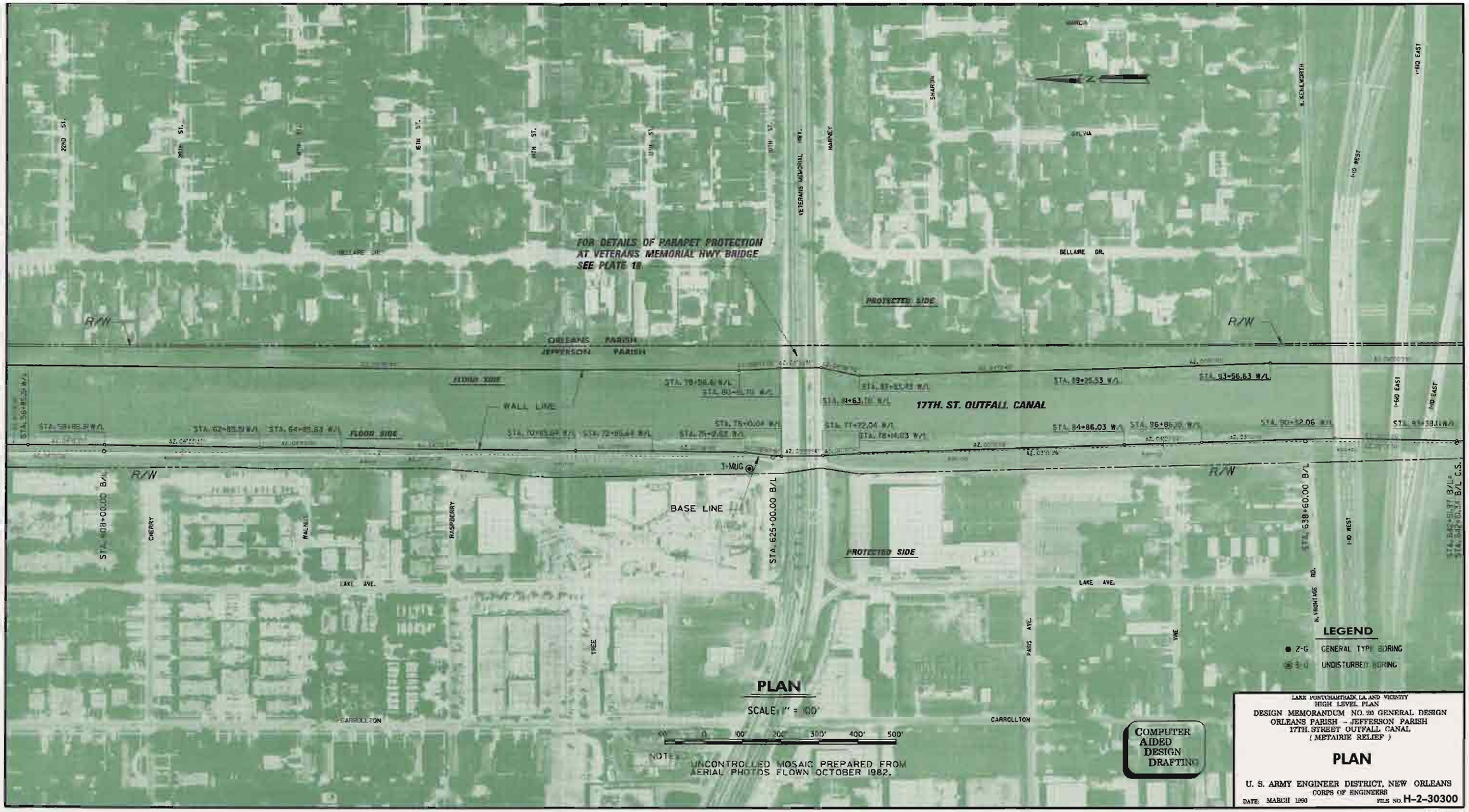
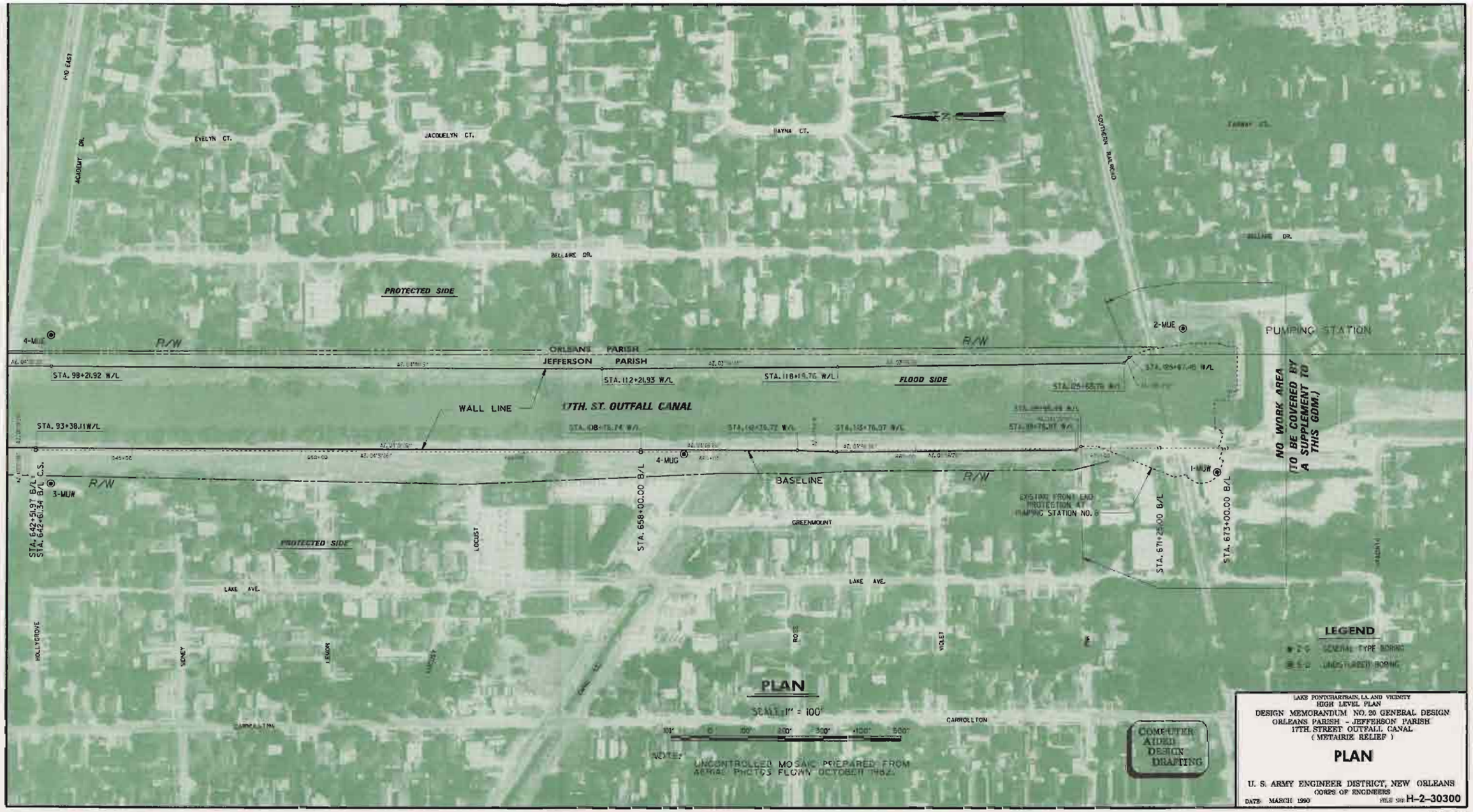
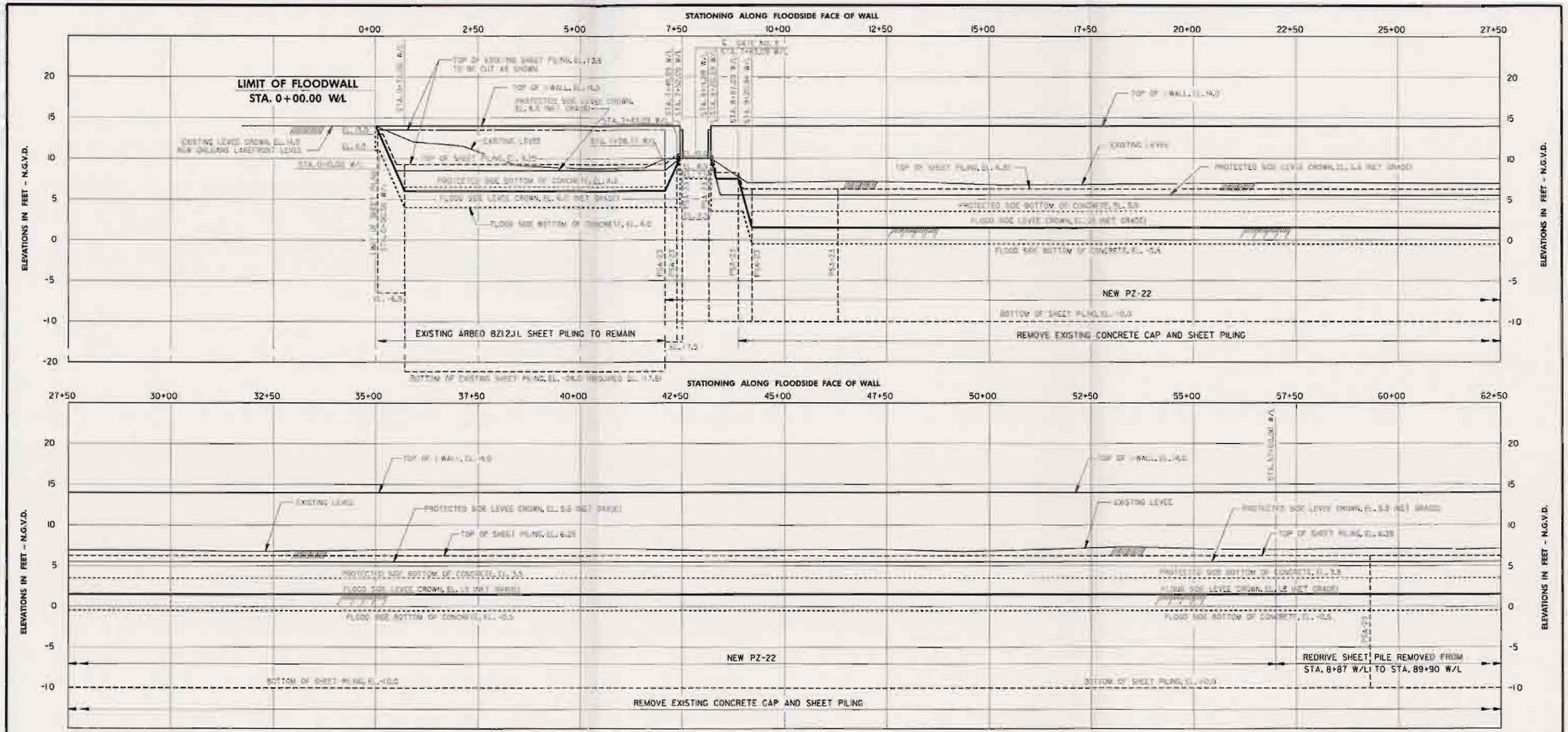

CENTER
BELLAIRE DR.
PROTECTED SIDE
R/W
ORLEANS PARISH
JEFFERSON PARISH
FLOOD SIDE
WALL LINE
17TH. ST. OUTFALL CANAL
5-MUW
2-MUG
ORPHEUM AVE.
BASE LINE
LAKE AVE.
CARROLLTON
PLAN
SCALE: 1" = 100'
100' 0 100' 200' 300' 400' 500'
NOTE: UNCONTROLLED MOSAIC PREPARED FROM AERIAL PHOTOS FLOWN DECEMBER 1985.
COMPUTER AIDED DESIGN DRAFTING
LEGEND
2-G GENERAL TYPE DRAWING
5-U UNDISTURBED DRAWING
LAKE PONTCHARTRAIN, LA. AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO. 20 GENERAL DESIGN
ORLEANS PARISH - JEFFERSON PARISH
17TH. STREET OUTFALL CANAL
(METAIRIE RELIEF)
PLAN
U. S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
DATE: MARCH 1990
FILE NO. H-2-30300

PLATE 3


FOR DETAILS OF PARAPET PROTECTION
AT VETERANS MEMORIAL HWY. BRIDGE
SEE PLATE 18
PROTECTED SIDE
FLOOD SIDE
WALL LINE
17TH. ST. OUTFALL CANAL
BASE LINE
R/W
ORLEANS PARISH
JEFFERSON PARISH
VETERANS MEMORIAL HWY.
HARNEY
SHARON
SYLVIA
BELLARE DR.
22ND ST.
20TH ST.
18TH ST.
17TH ST.
16TH ST.
15TH ST.
N. KENILWORTH
I-10 WEST
I-10 EAST
I-610 EAST
CHERRY
WALNUT
RASPBERRY
LAKE AVE.
TREE
PARIS AVE.
VINE
N. FRONTAGE RD.
CARROLLTON
STA. 625+00.00 B/L
STA. 638+60.00 B/L
T-MUG
LEGEND
Z-G GENERAL TYPE BORING
UNDISTURBED BORING
PLAN
SCALE: 1" = 100'
100' 0 100' 200' 300' 400' 500'
NOTE: UNCONTROLLED MOSAIC PREPARED FROM AERIAL PHOTOS FLOWN OCTOBER 1982.
COMPUTER AIDED DESIGN DRAFTING
LAKE PONTCHARTRAIN, LA. AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO. 20 GENERAL DESIGN
ORLEANS PARISH - JEFFERSON PARISH
17TH. STREET OUTFALL CANAL
(METAIRIE RELIEF)
PLAN
U. S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
DATE: MARCH 1990
FILE NO. H-2-30300


I-10 EAST
ACADEMY DR.
EVELYN CT.
JACQUELYN CT.
HAYNA CT.
SOUTHERN RAILROAD
BELLAIRE DR.
PROTECTED SIDE
FLOOD SIDE
R/W
4-MUE
2-MUE
PUMPING STATION
ORLEANS PARISH
JEFFERSON PARISH
STA. 98+21.92 W/L
STA. 112+21.93 W/L
STA. 118+19.76 W/L
WALL LINE
17TH. ST. OUTFALL CANAL
STA. 93+38.11 W/L
4-MUG
1-MUW
3-MUW
BASELINE
STA. 642+51.97 B/L
STA. 642+61.34 B/L C.S.
STA. 658+00.00 B/L
STA. 671+25.00 B/L
STA. 673+00.00 B/L
EXISTING FRONT END PROTECTION AT PUMPING STATION NO. 6
NO WORK AREA (TO BE COVERED BY A SUPPLEMENT TO THIS GDM.)
GREENMOUNT
LOCUST
LAKE AVE.
HOLLYGROVE
SIDNEY
LEMON
ROSE
VIOLET
CARROLLTON
LEGEND
GENERAL TYPE BORING
UNCLASSIFIED BORING
PLAN
SCALE: 1" = 100'
NOTE: UNCONTROLLED MOSAIC PREPARED FROM AERIAL PHOTOS FLOWN OCTOBER 1982.
COMPUTER AIDED DESIGN DRAFTING
LAKE PONTCHARTRAIN, LA AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO. 20 GENERAL DESIGN
ORLEANS PARISH - JEFFERSON PARISH
17TH. STREET OUTFALL CANAL
(METAIRIE RELIEF)
PLAN
U. S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
DATE: MARCH 1990
FILE NO. H-2-30300



PROFILE

SCALE: HOR. 1" = 100'
VERT. 1" = 5'

COMPUTER AIDED DESIGN DRAFTING

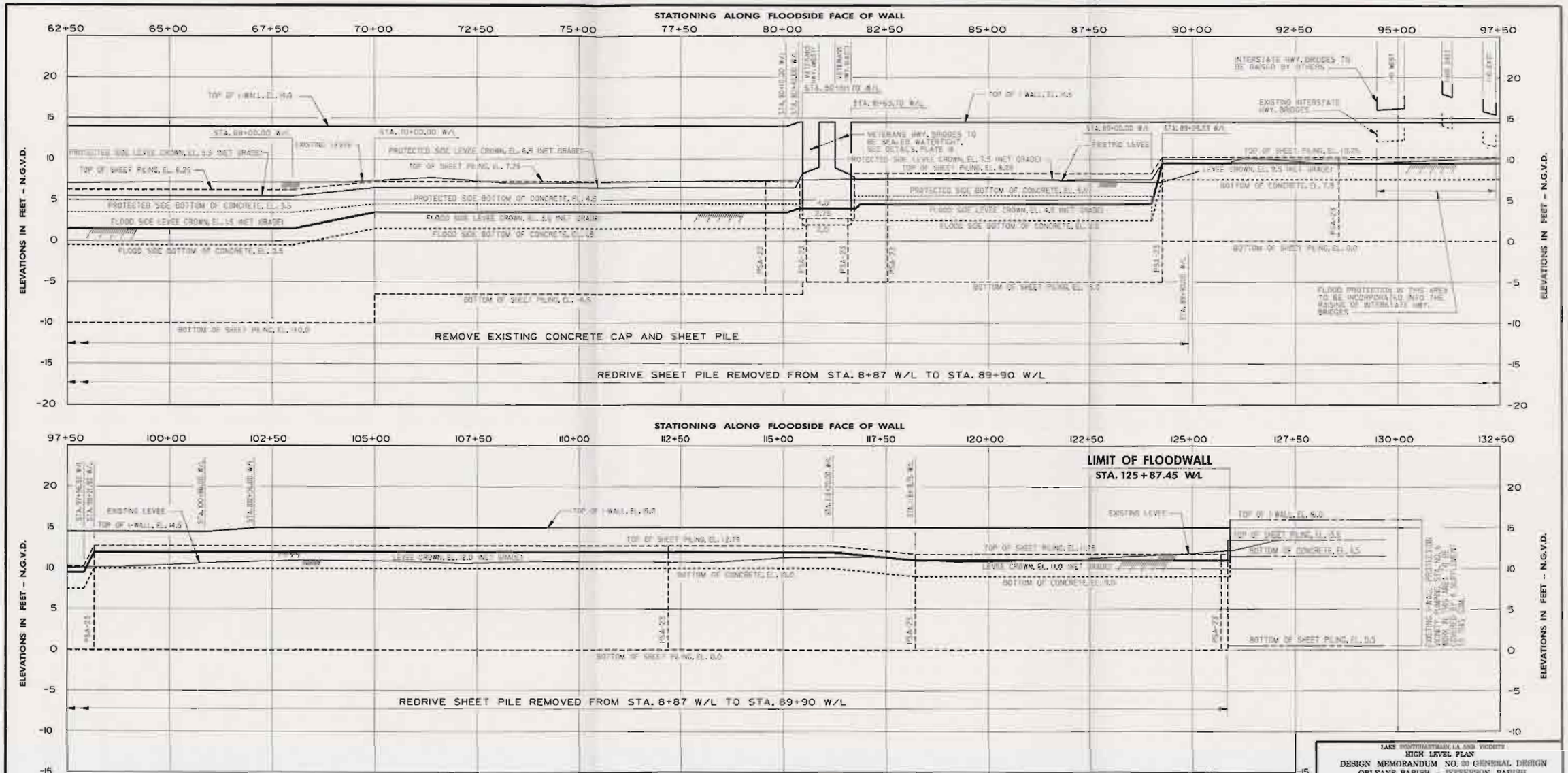
LAKE PONTCHARTRAIN, LA. AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO. 20 GENERAL DESIGN
ORLEANS PARISH - JEFFERSON PARISH
17TH. STREET OUTFALL CANAL
(METAIRIE RELIEF)

PROFILE

STA. 0+00.00 W/L TO STA. 62+50.00 W/L
(EAST BANK)

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

DATE: MARCH 1990 FILE NO. H-2-30300



PROFILE

SCALE: HOR. 1" = 100'
VERT. 1" = 5'

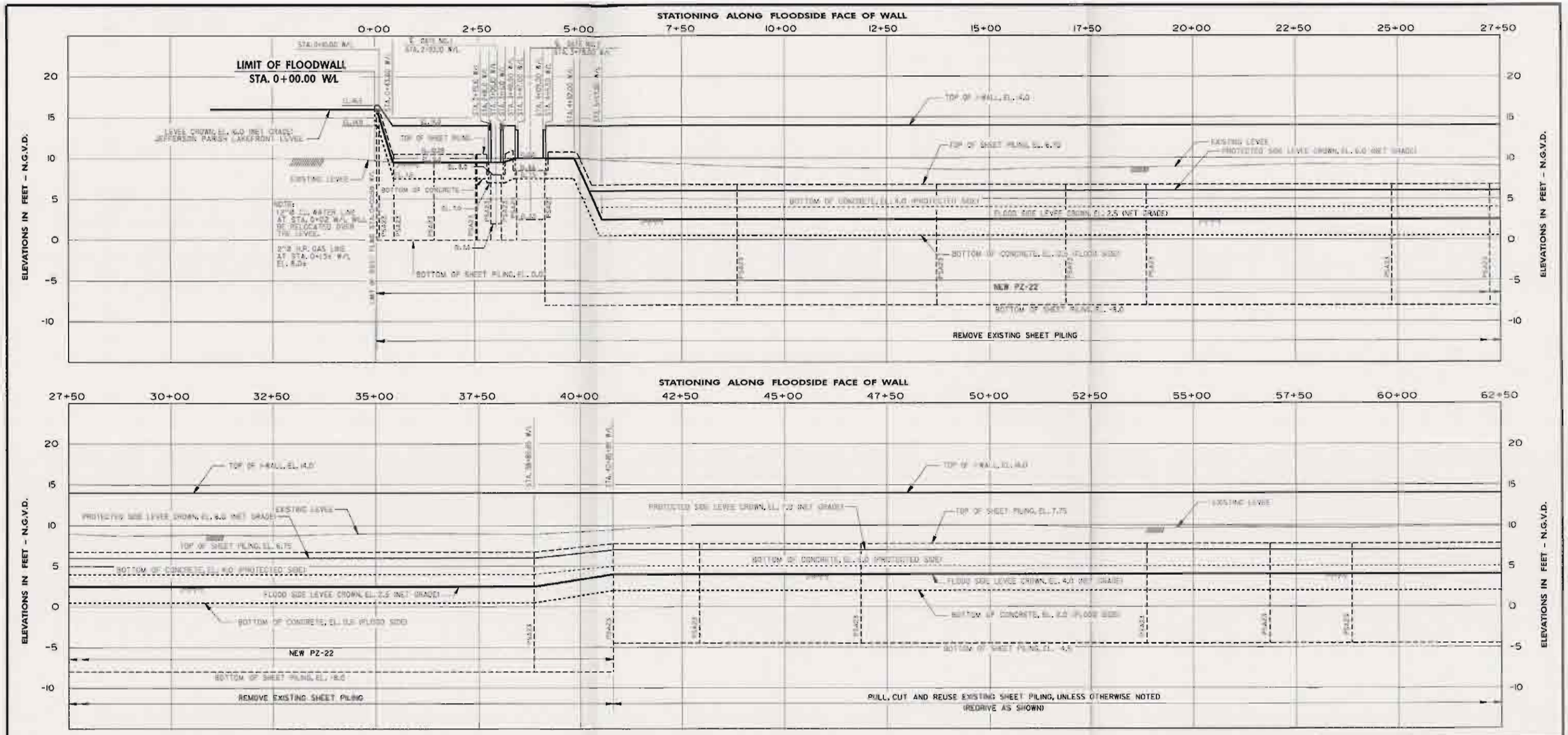
COMPUTER AIDED DESIGN DRAFTING

LAKE PONTCHARTRAIN, LA. AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO. 23 GENERAL DESIGN
ORLEANS PARISH - JEFFERSON PARISH
17TH STREET OUTFALL CANAL
(METAIRIE RELIEF)

PROFILE

STA. 62+50.00 W/L TO STA. 125+75.20 W/L
(EAST BANK)

U. S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
DATE: MARCH 1980 FILE NO. H-2-30300



PROFILE

SCALE: HOR. 1" = 100'
VERT. 1" = 5'

COMPUTER AIDED DESIGN DRAFTING

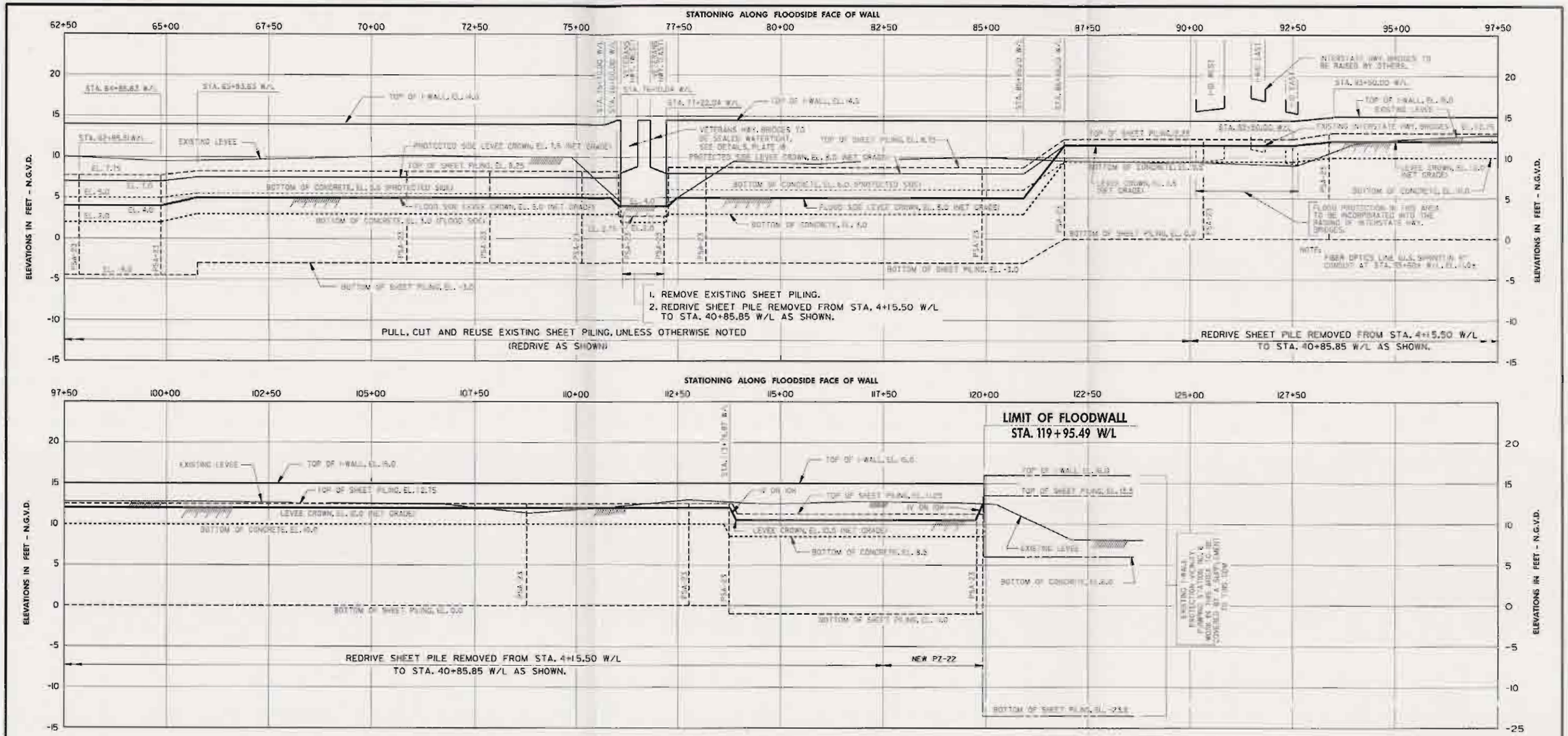
LAKE PONTCHARTRAIN, LA. AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO. 20 GENERAL DESIGN
ORLEANS PARISH - JEFFERSON PARISH
17TH STREET OUTFALL CANAL
(METAIRIE RELIEF)

PROFILE

STA. 0+00.00 W/L TO STA. 62+50.00 W/L
(WEST BANK)

U. S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
DATE: MARCH 1969 FILE NO. H-2-30300

PLATE 8



PROFILE

SCALE: HOR. 1" = 100'
VERT. 1" = 5'

COMPUTER AIDED DESIGN DRAFTING

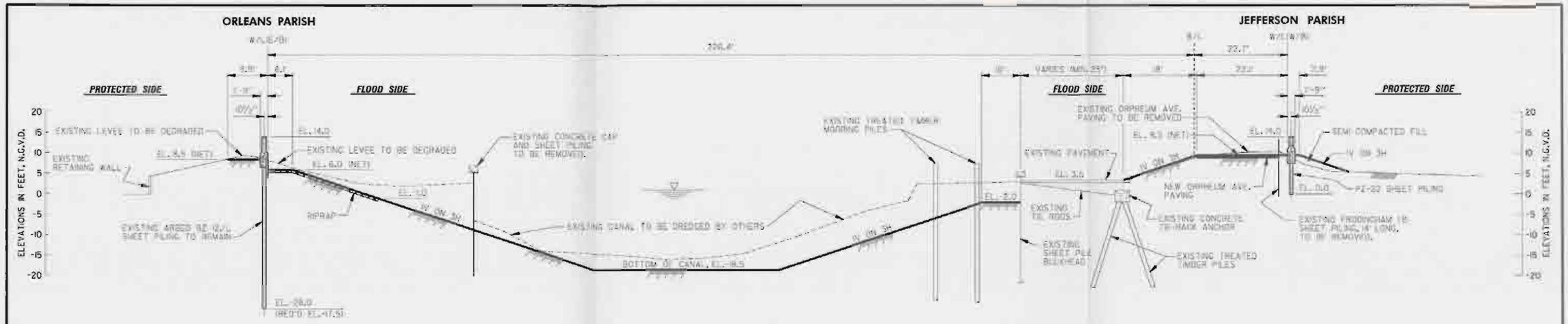
LAKE PONTCHARTRAIN, LA. AND VICINITY
HIGH LEVEE PLAN
DESIGN MEMORANDUM NO. 20 GENERAL DESIGN
ORLEANS PARISH - JEFFERSON PARISH
17TH STREET OUTFALL CANAL
(METAIRIE REACH)

PROFILE

STA. 62+50.00 W/L TO STA. 130+00.00 W/L
(WEST BANK)

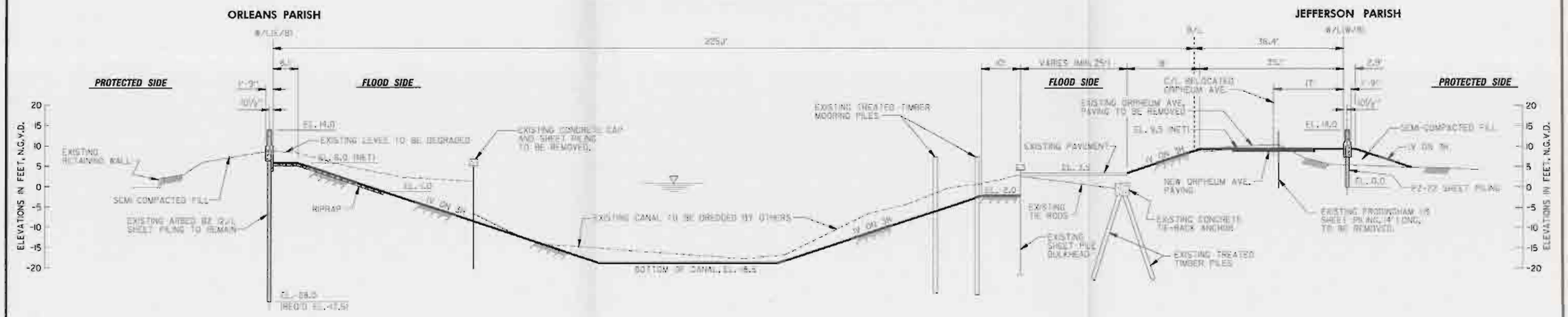
U. S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

DATE: MARCH 1990 FILE NO. H-2-30300



TYPICAL SECTION

VICINITY STA. 4+92.00 W/L (E/B) AND STA. 0+50.00 W/L (W/B)



TYPICAL SECTION

VICINITY STA. 6+92.00 W/L (E/B) AND STA. 2+55.00 W/L (W/B)

SCALE: 1" = 10'

10' 0 10' 20' 30' 40'

COMPUTER AIDED DESIGN DRAFTING

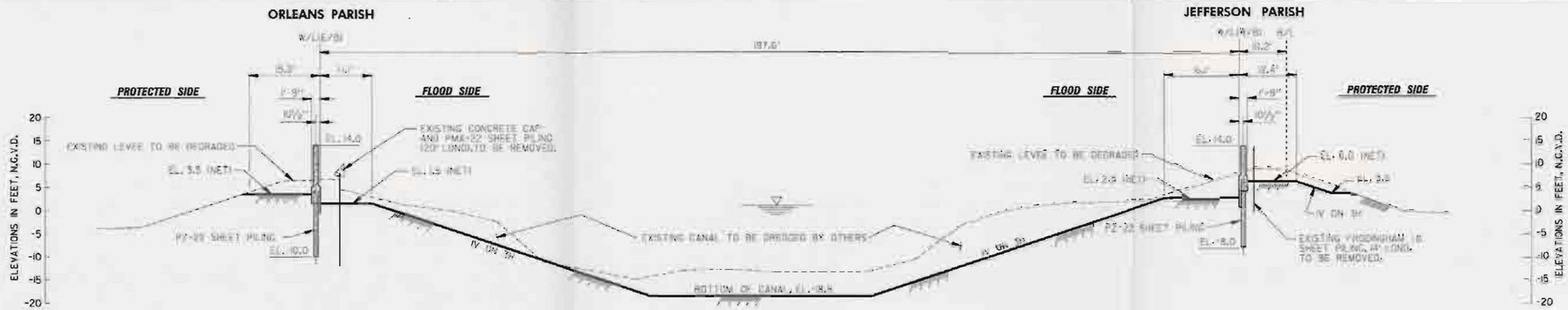
LAKE PONTCHARTRAIN LA. AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO 20 GENERAL DESIGN
ORLEANS PARISH - JEFFERSON PARISH
17TH STREET OUTFALL CANAL
(METAIRIE RELIEF)

TYPICAL SECTIONS

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

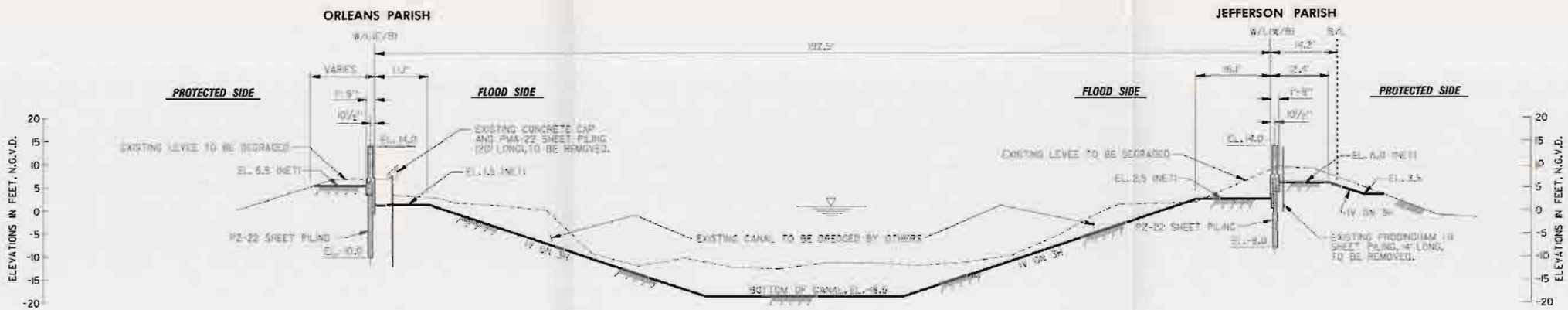
DATE MARCH 1990 FILE No H-2-30300

PLATE 10



TYPICAL SECTION

VICINITY STA. 15+40.00 W/L (E/B) AND STA. 10+85.00 W/L (W/B)



TYPICAL SECTION

VICINITY STA. 25+40.00 W/L (E/B) AND STA. 20+85.00 W/L (W/B)

SCALE: 1" = 10'

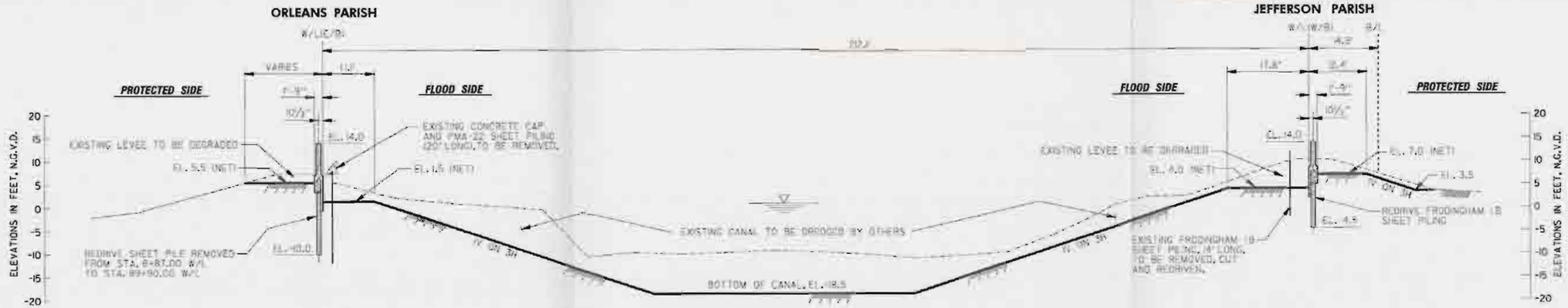
COMPUTER AIDED DESIGN DRAFTING

LAKE PONTCHARTRAIN, LA. AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO. 20 GENERAL DESIGN
ORLEANS PARISH - JEFFERSON PARISH
17TH STREET OUTFALL CANAL
(METAIRIE RELIEF)

TYPICAL SECTIONS

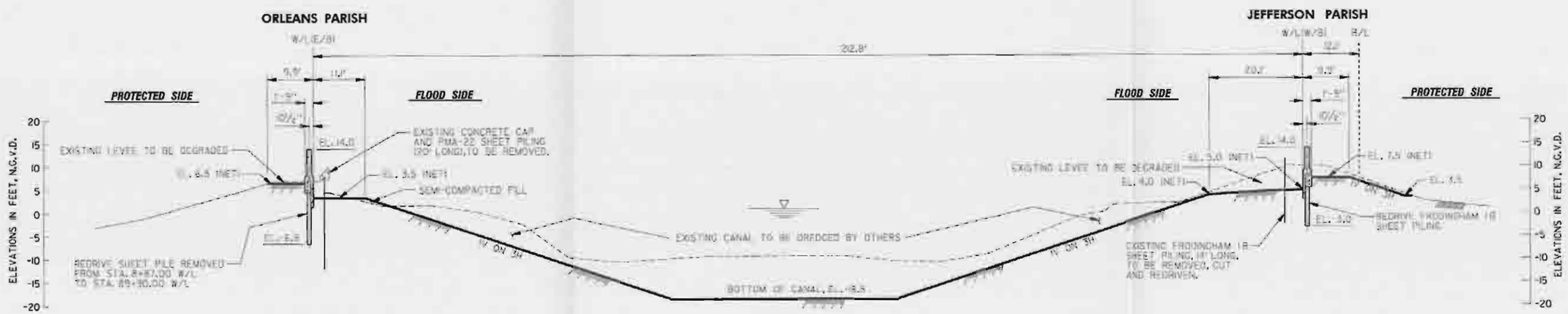
U. S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

DATE: MARCH 1990 FILE NO. H-2-30300



TYPICAL SECTION

VICINITY STA. 67+10.00 W/L (E/B) AND STA. 62+85.00 W/L (W/B)



TYPICAL SECTION

VICINITY STA. 73+35.00 W/L (E/B) AND STA. 68+85.00 W/L (W/B)

SCALE: 1" = 10'

10' 0 10' 20' 30' 40'

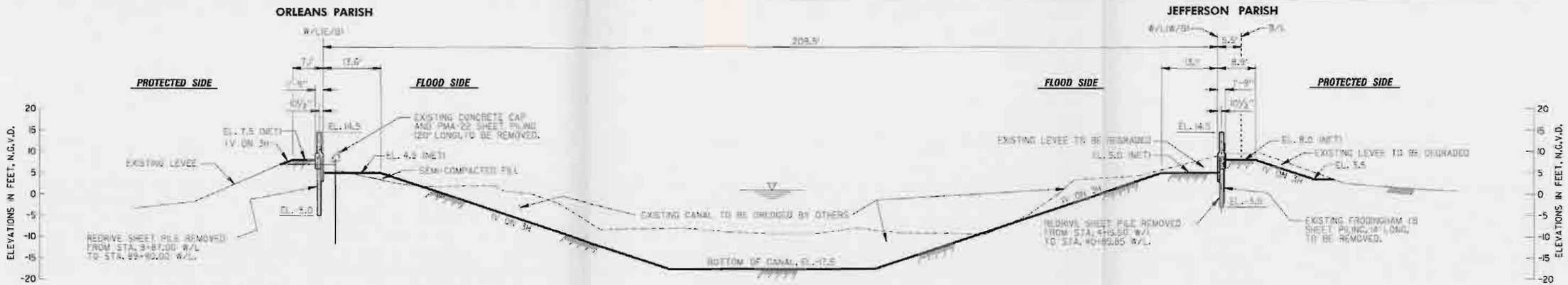
COMPUTER AIDED DESIGN DRAFTING

LAKE PONTCHARTRAIN, LA AND VICINITY
HIGH LEVEE PLAN
DESIGN MEMORANDUM NO. 20 GENERAL DESIGN
ORLEANS PARISH - JEFFERSON PARISH
17TH STREET OUTFALL CANAL
(METAIRIE RELIEF)

TYPICAL SECTIONS

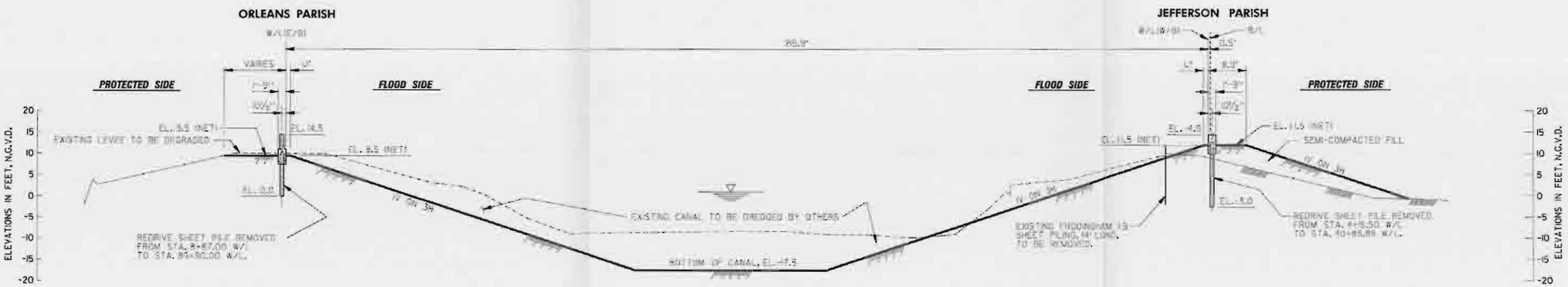
U. S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

DATE: MARCH 1990 FILE NO. H-2-30300



TYPICAL SECTION

VICINITY STA. 85+33.00 W/L (E/B) AND STA. 81+00.00 W/L (W/B)



TYPICAL SECTION

VICINITY STA. 93+90.00 W/L (E/B) AND STA. 88+96.00 W/L (W/B)

SCALE: 1" = 10'

10' 0 10' 20' 30' 40'

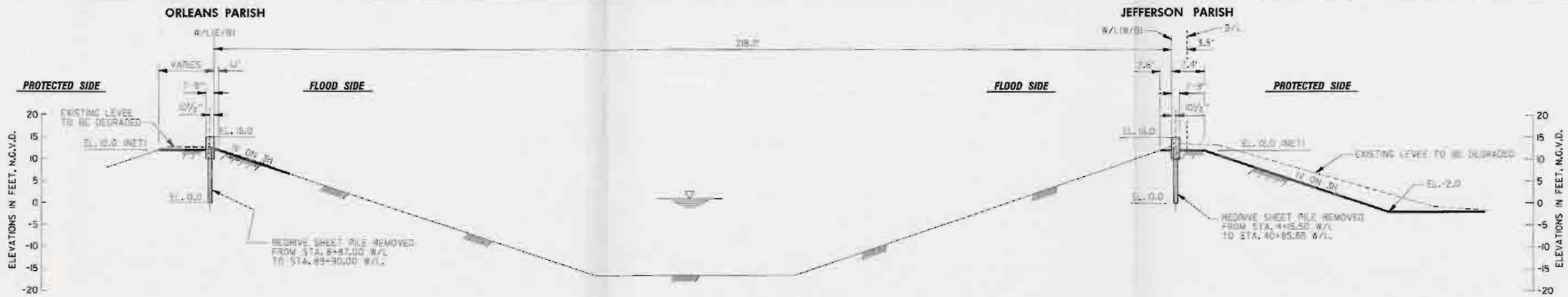
COMPUTER AIDED DESIGN DRAFTING

LAKE PONTCHARTRAIN, LA AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO. 20 GENERAL DESIGN
ORLEANS PARISH - JEFFERSON PARISH
17TH STREET OUTFALL CANAL
(METAIRIE RELIEF)

TYPICAL SECTIONS

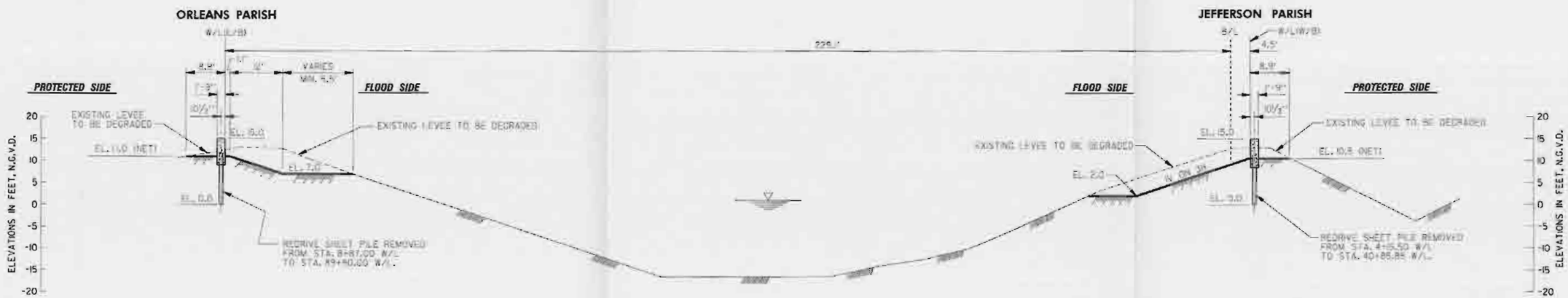
U. S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

DATE MARCH 1999 FILE NO. H-2-30300



TYPICAL SECTION

VICINITY STA. 103+30.00 W/L (E/B) AND STA. 98+90.00 W/L (W/B)



TYPICAL SECTION

VICINITY STA. 123+20.00 W/L (E/B) AND STA. 118+80.00 W/L (W/B)

SCALE: 1" = 10'

10' 0 10' 20' 30' 40'

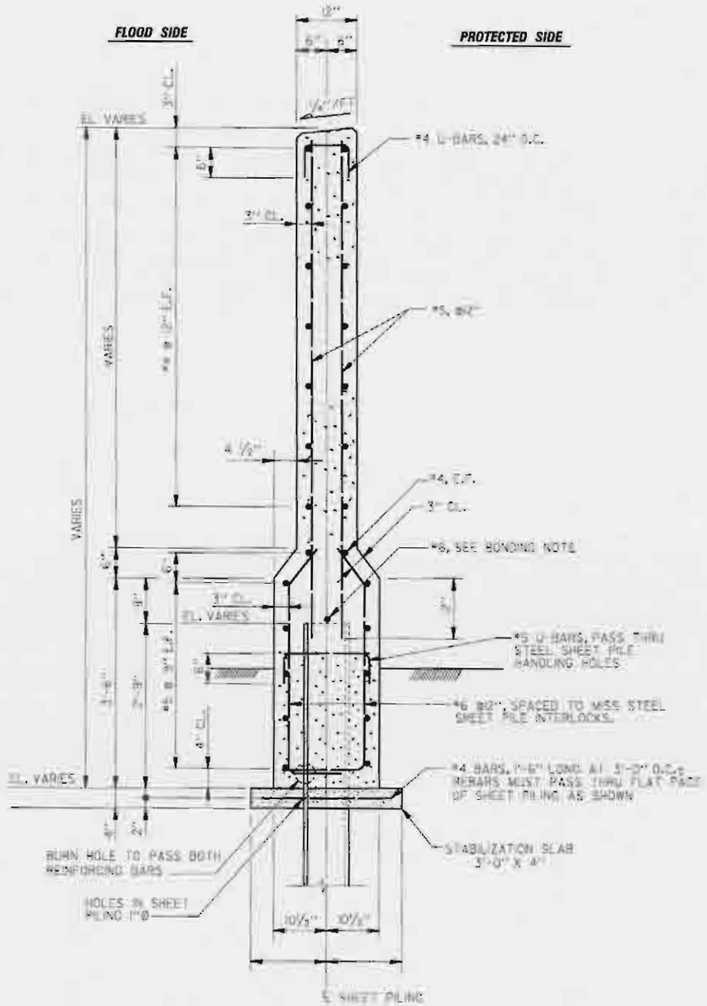
COMPUTER AIDED DESIGN DRAFTING

LAKE PONTCHARTRAIN, LA AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO. 20 GENERAL DESIGN
ORLEANS PARISH - JEFFERSON PARISH
17TH. STREET OUTFALL CANAL
(METAIRIE RELIEF)

TYPICAL SECTIONS

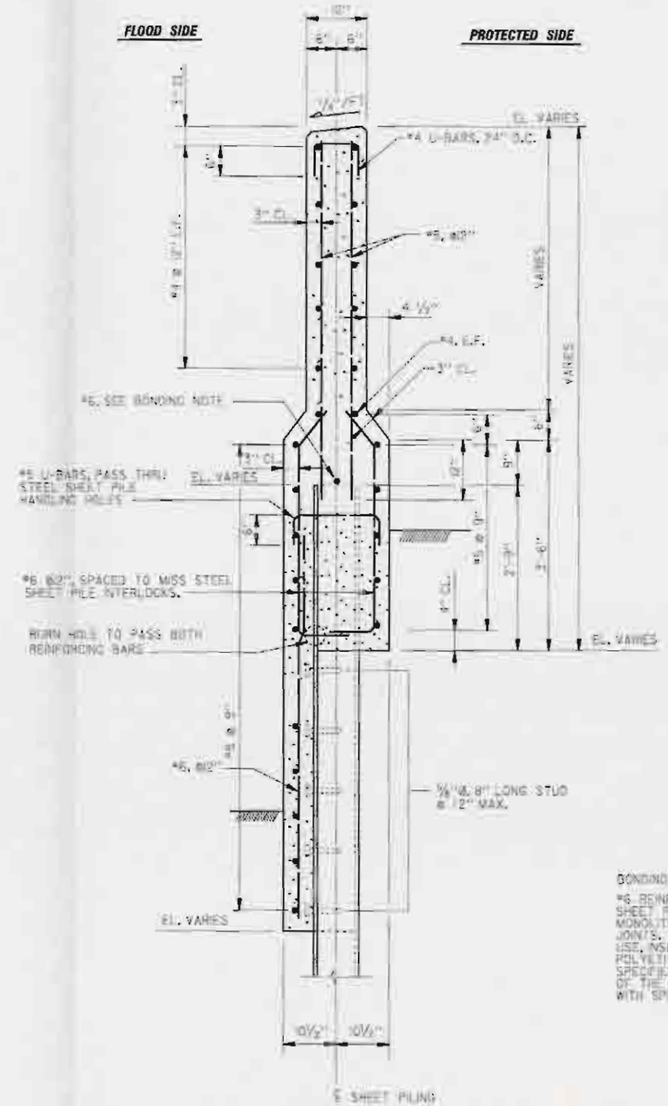
U. S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

DATE: MARCH 1990 FILE NO. H-2-30300



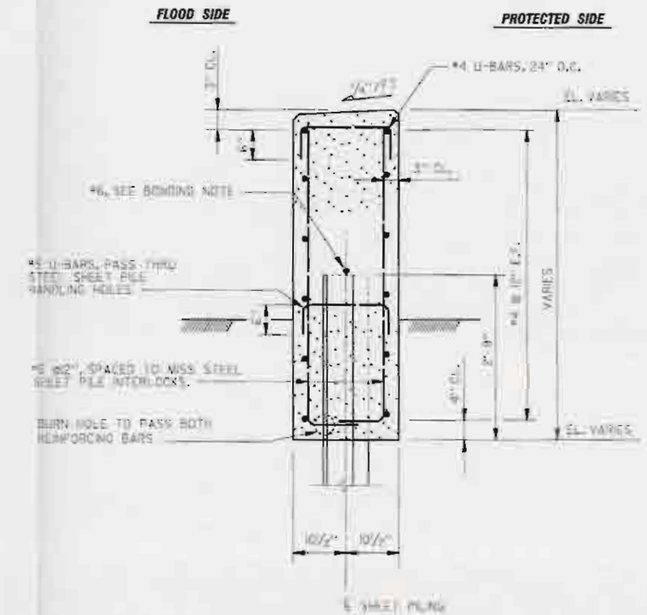
TYPICAL I-WALL SECTION

SCALE: 1" = 1'-0"



TYPICAL I-WALL SECTION

SCALE: 1" = 1'-0"



TYPICAL I-WALL SECTION

SCALE: 1" = 1'-0"

BONDING NOTE:

*6 REINFORCING BAR SHALL BE WELDED ACROSS THE TOP OF EACH SHEET PILE. *6 REINFORCING BAR SHALL NOT EXTEND ACROSS THE MONOLITH JOINT. INSTALL FLEXIBLE JUMPER AT ALL MONOLITH JOINTS. JUMPERS SHALL BE INSULATED NO. 1/0 AWG COPPER TYPE USE, INSULATED WITH A MINIMUM OF 55 MILS OF CROSS LINKED POLYETHYLENE IN A 8" DIA. LOOP. JUMPERS SHALL BE WELDED AS SPECIFIED TO ADJACENT STEEL SHEET PILES 3" BELOW THE BOTTOM OF THE CONCRETE CAP. WELDED CONNECTIONS SHALL BE COATED WITH SPLICING EPOXY TO OBTAIN MOISTURE PROOF JOINTS.

SCALE: 1" = 1'- 0"

2" 0 1' 2' 3' 4' 5'

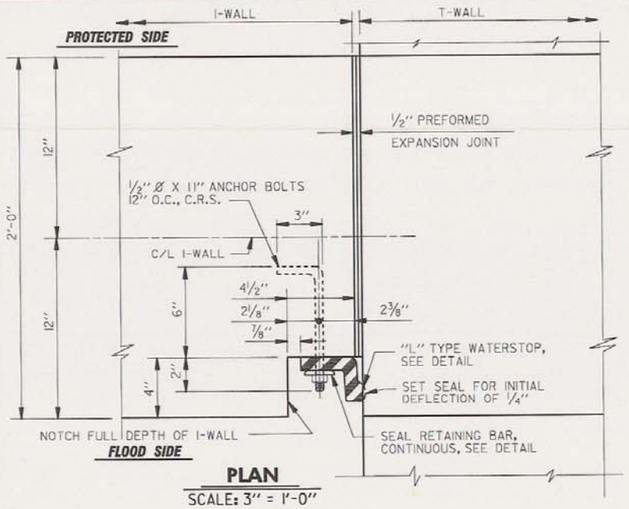
COMPUTER AIDED DESIGN DRAFTING

LAKE PONTCHARTRAIN, LA. AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO. 20 GENERAL DESIGN
ORLEANS PARISH - JEFFERSON PARISH
17TH. STREET OUTFALL CANAL
(METAIRIE RELIEF)

TYPICAL WALL SECTIONS

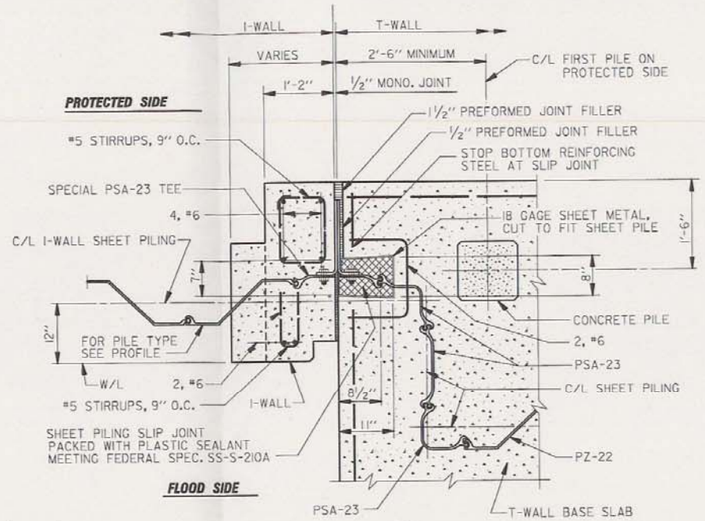
U. S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

DATE: MARCH 1990 FILE NO. H-2-30300



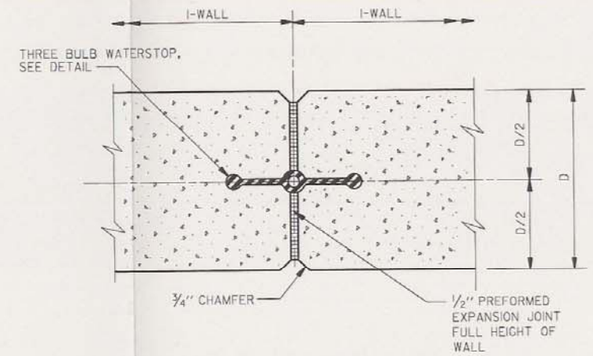
PLAN

SCALE: 3" = 1'-0"



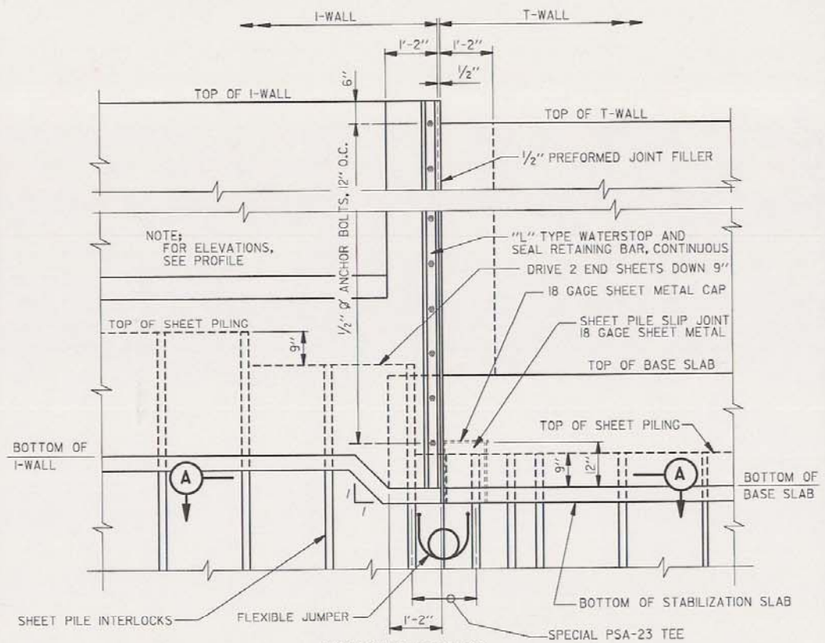
SECTION (A)

SCALE: 1" = 1'- 0"



TYPICAL I-WALL JOINT

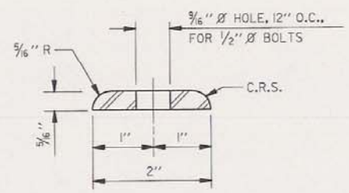
SCALE: 3" = 1'-0"



FLOOD SIDE ELEVATION

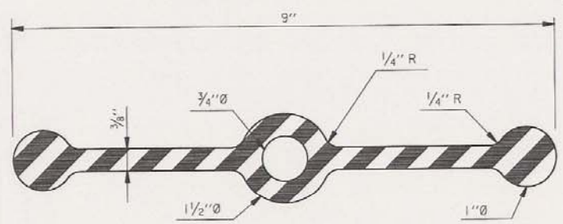
I-WALL TO T-WALL

SCALE: 3/4" = 1'- 0"



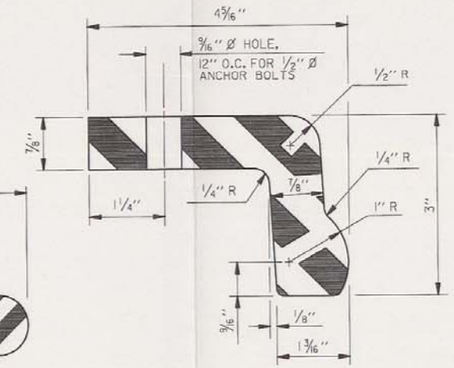
SEAL RETAINING BAR

SCALE: 12" = 1'-0"



THREE BULB WATERSTOP

SCALE: 12" = 1'-0"



"L"-TYPE WATERSTOP

SCALE: 12" = 1'-0"

SCALE: 3/4" = 1'-0"

12" 0 1' 2' 3' 4'

SCALE: 3" = 1'-0"

12" 0 1'

SCALE: 12" = 1'-0"

6" 3" 0

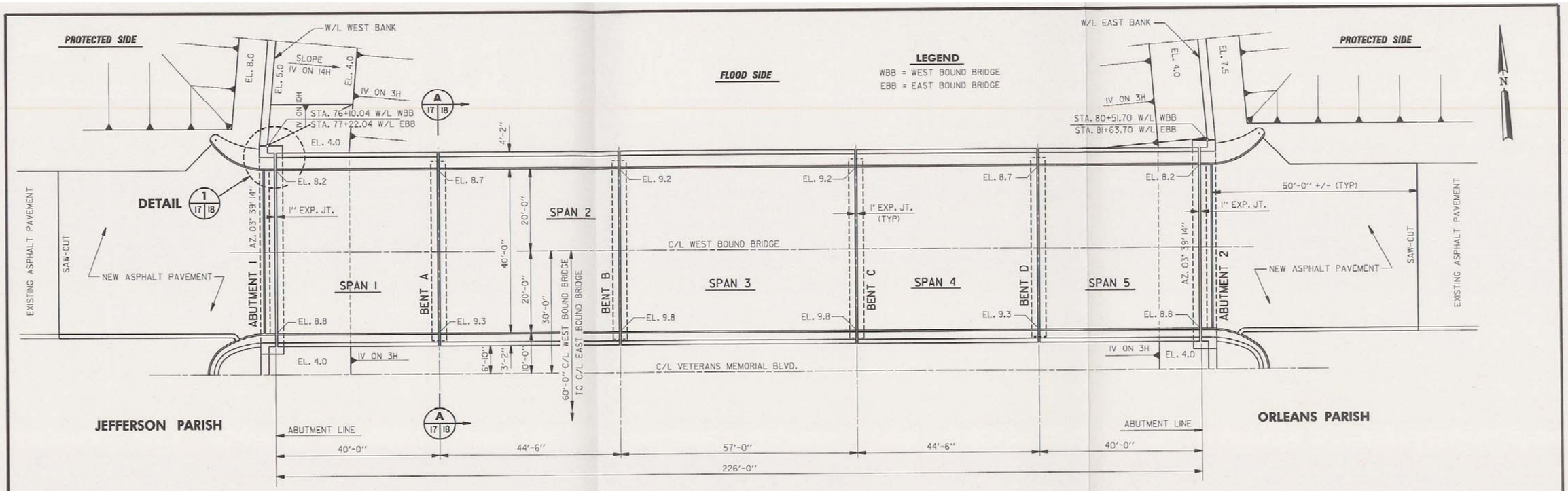
COMPUTER AIDED DESIGN DRAFTING

LAKE PONTCHARTRAIN, LA. AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO. 20 GENERAL DESIGN
ORLEANS PARISH - JEFFERSON PARISH
17TH. STREET OUTFALL CANAL
(METAIRIE RELIEF)

TYPICAL JOINT DETAILS

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

DATE: MARCH 1990 FILE NO. H-2-30300

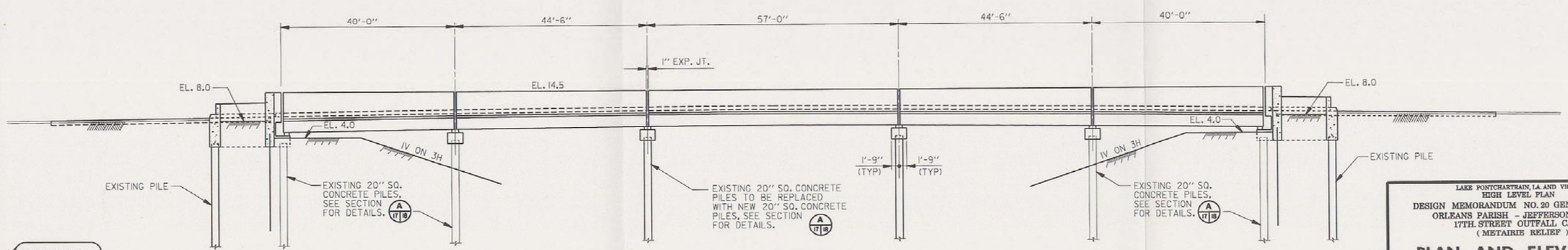


PLAN
WEST BOUND BRIDGE – SHOWN
EAST BOUND BRIDGE – OPP. HAND

NOTES:

STUD ANCHORS WILL BE PROVIDED TO SECURE BRIDGE DECK AGAINST UPLIFT FORCES.

THE SUPERSTRUCTURE WILL BE SECURED TO THE SUBSTRUCTURE WITH ANCHOR RODS.



ELEVATION

SCALE: 1" = 10'

10' 0 10' 20' 30' 40' 50'

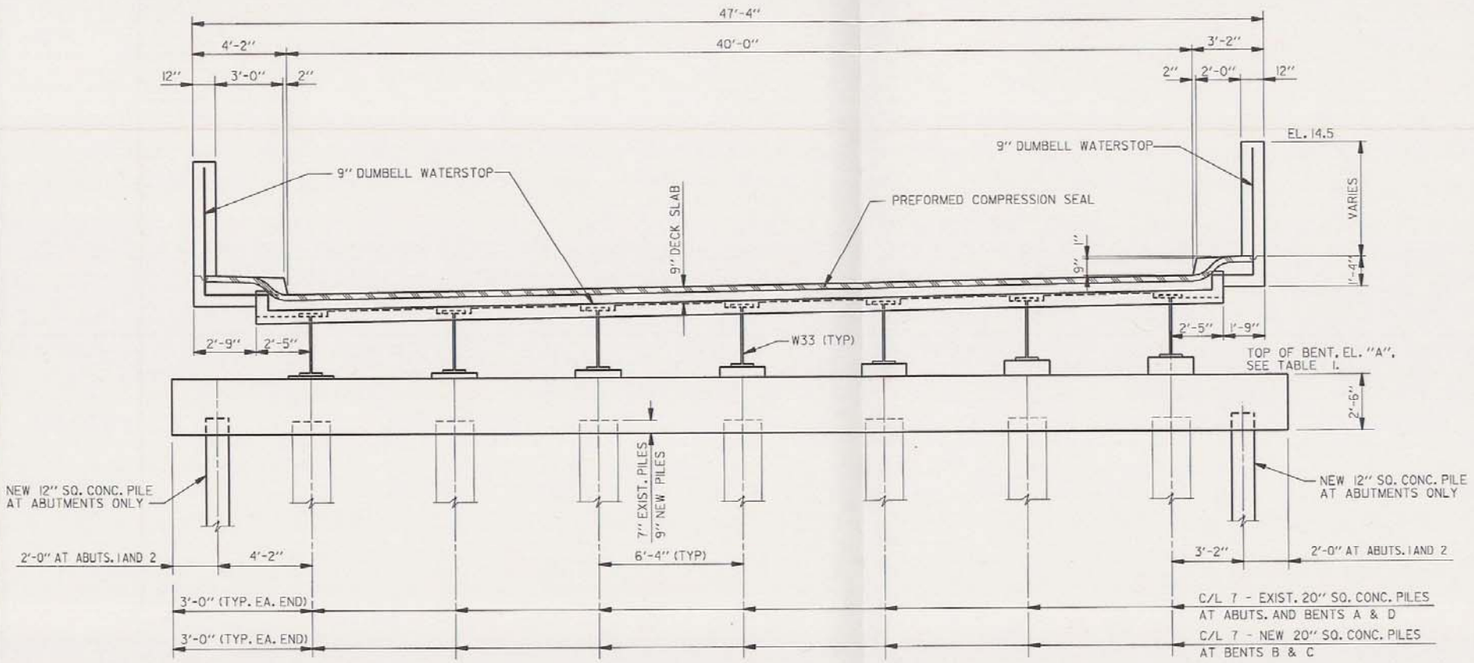
COMPUTER AIDED DESIGN DRAFTING

LAKE PONTCHARTRAIN, LA. AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO. 20 GENERAL DESIGN
ORLEANS PARISH – JEFFERSON PARISH
17TH. STREET OUTFALL CANAL
(METAIRIE RELIEF)

PLAN AND ELEVATION
VETERANS MEMORIAL BLVD. BRIDGE

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

DATE: MARCH 1990 FILE NO. H-2-30300



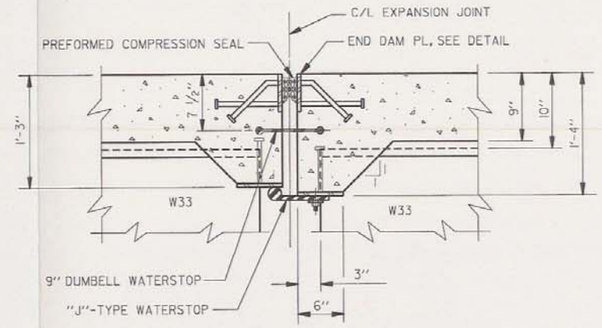
SECTION A (17/18)

WEST BOUND ROADWAY - SHOWN
EAST BOUND ROADWAY - OPP. HAND

TYPICAL SECTION THRU EXPANSION JOINT

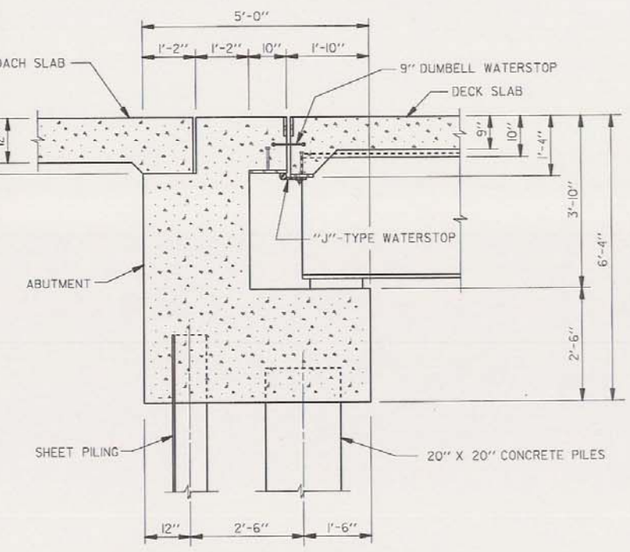
SCALE: 3/8" - 1'-0"

TABLE 1		
MEMBER	LOCATION	EL. "A"
ABUTMENT 1 & 2	WBB	EL. 4.40
	EBB	EL. 4.50
BENT A	WBB	EL. 5.25
	EBB	EL. 5.00
BENT B	WBB	EL. 5.35
	EBB	EL. 5.55
BENT C	WBB	EL. 5.40
	EBB	EL. 5.40
BENT D	WBB	EL. 5.00
	EBB	EL. 5.00



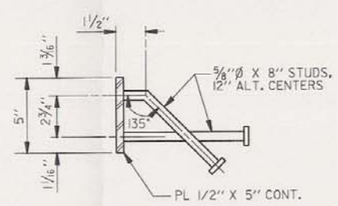
TYPICAL BRIDGE EXPANSION JOINT DETAIL

SCALE: 1 1/2" - 1'-0"



TYPICAL ABUTMENT SECTION

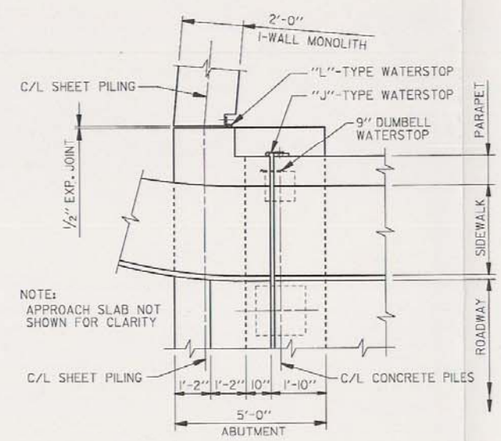
SCALE: 3/4" = 1'- 0"



END DAM PLATE

SCALE: 3" = 1'-0"

STUDS SHALL BE 5/8"Ø X 8" ANCHOR WELDED STUDS (1 1/8"Ø MIN. HEAD). STUDS ARE TO BE OF THE AUTOMATIC END WELDED TYPE. ALL BENDS ARE TO BE MADE PRIOR TO WELDING.



PLAN

DETAIL 1 (17/18)

SCALE: 1/2" = 1'- 0"

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

12" 0 2' 4' 6' 8' 10'

SCALE: 1 1/2" = 1' - 0"

12" 0 1' 2' 3'

SCALE: 1/2" = 1'- 0"

12" 0 2' 4' 6' 8'

SCALE: 3" = 1" - 0"

12" 0 1'

SCALE: 3/4" = 1'- 0"

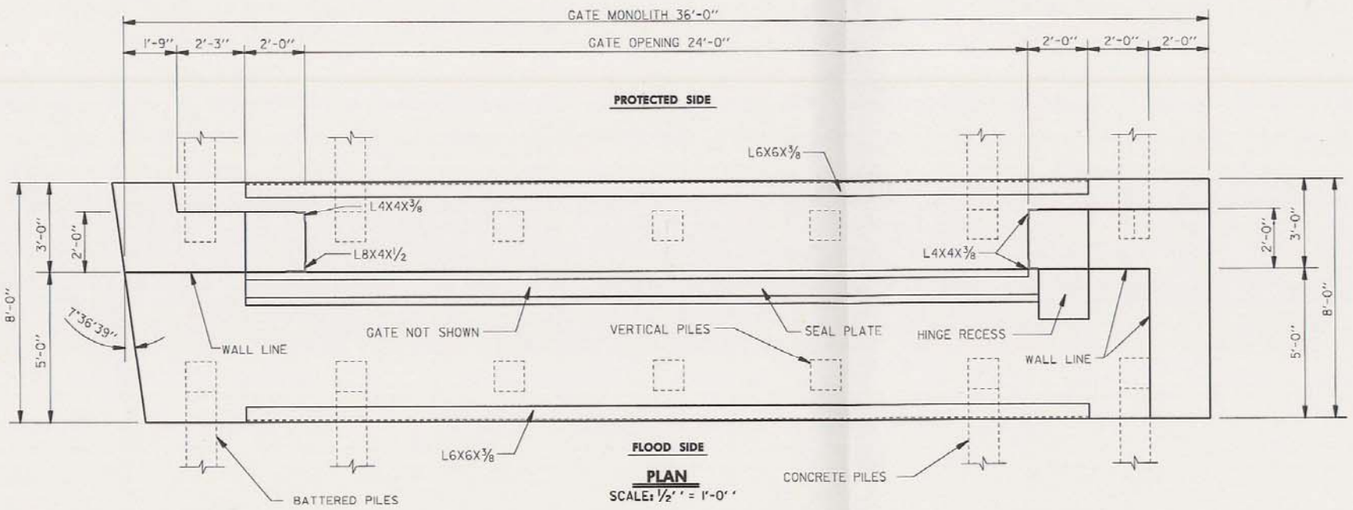
12" 0 1' 2' 3' 4' 5'

COMPUTER AIDED DESIGN DRAFTING

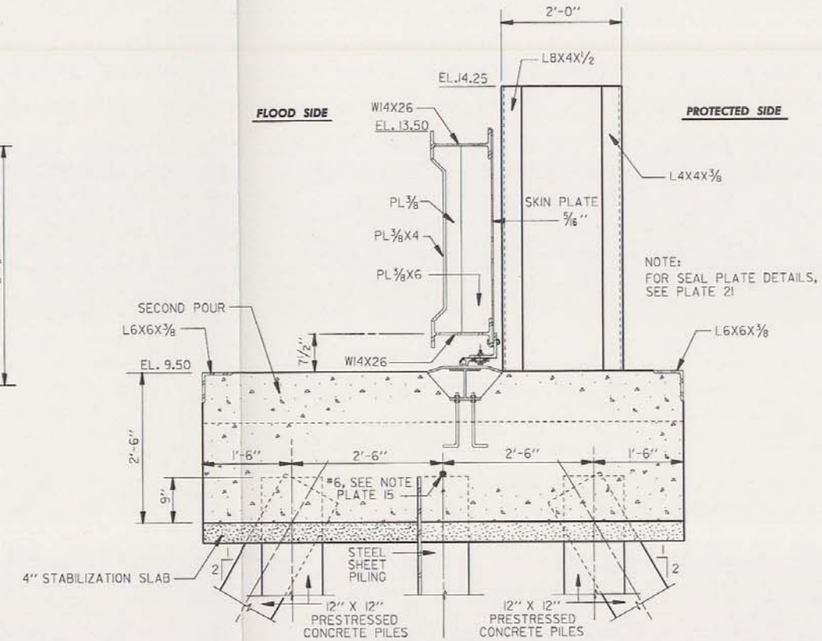
LAKE PONTCHARTRAIN, LA. AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO. 20 GENERAL DESIGN
ORLEANS PARISH - JEFFERSON PARISH
17TH. STREET OUTFALL CANAL
(METAIRIE RELIEF)

SECTION AND DETAILS
VETERANS MEMORIAL BLVD. BRIDGE

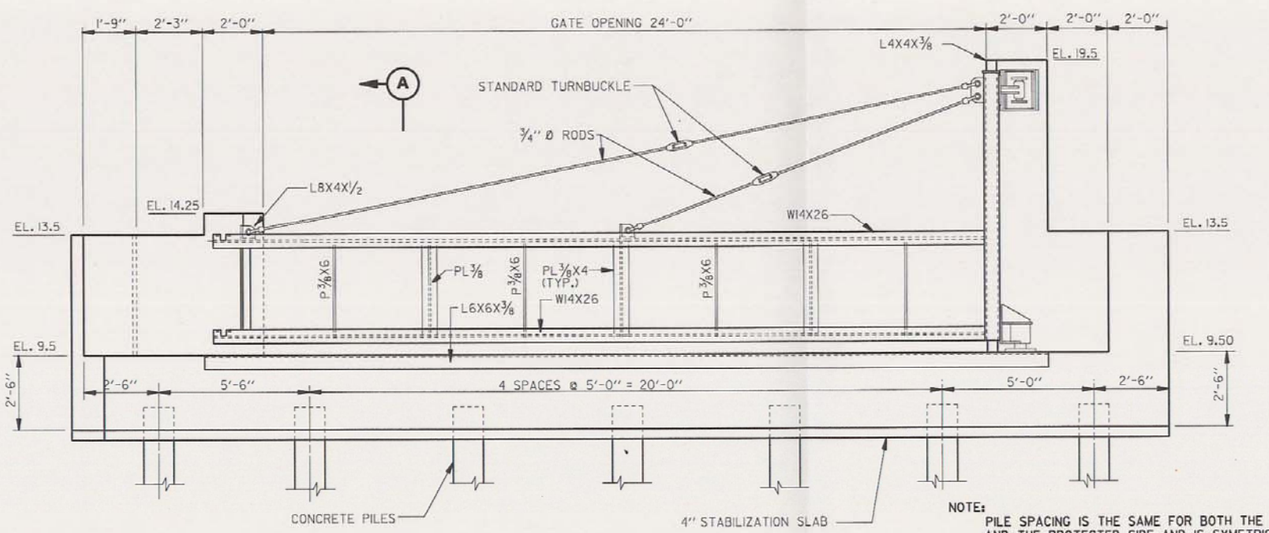
U. S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
DATE: MARCH 1990 FILE NO. H-2-30300



PLAN
SCALE: 1/2" = 1'-0"



TYPICAL SECTION (A)
SCALE: 1" = 1'-0"



FLOOD SIDE ELEVATION
SCALE: 1/2" = 1'-0"

NOTE:
PILE SPACING IS THE SAME FOR BOTH THE FLOOD SIDE AND THE PROTECTED SIDE AND IS SYMETRICAL ABOUT C/L GATE MONOLITH.

COMPUTER AIDED DESIGN DRAFTING

SCALE: 1/2" = 1'-0"

2' 0 2' 4' 6' 8'

SCALE: 1" = 1'-0"

1' 0 1' 2' 3' 4'

LAKE PONTCHARTRAIN, LA. AND VICINITY
HIGH LEVEL PLAN
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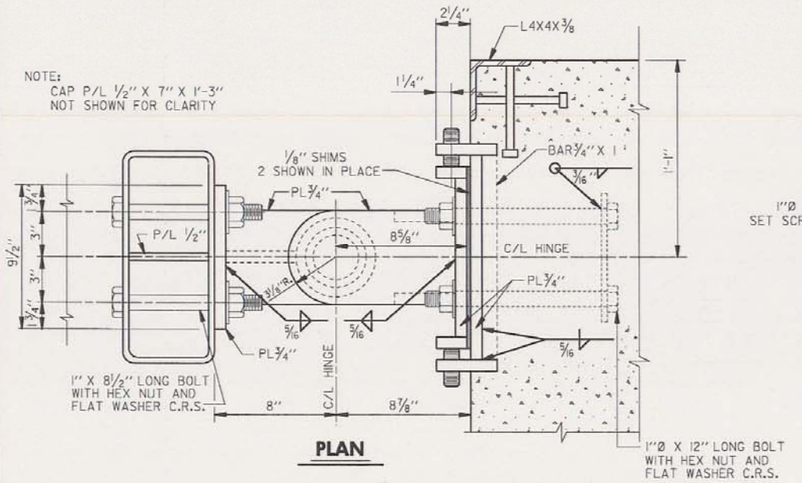
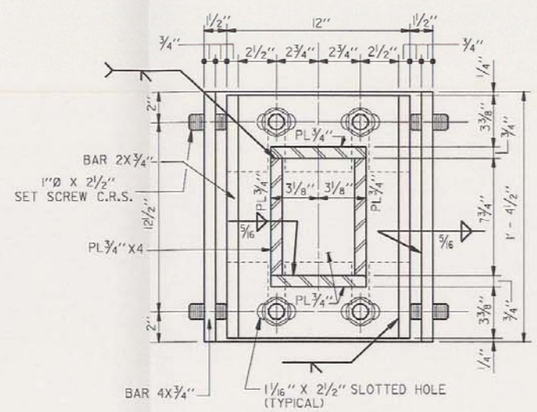
ORLEANS PARISH - JEFFERSON PARISH
17TH. STREET OUTFALL CANAL
(METAIRIE RELIEF)

SWING GATE DETAILS

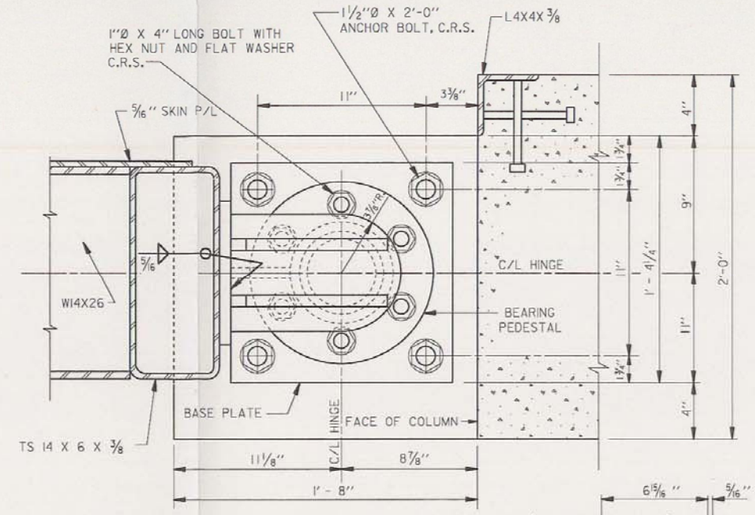
U. S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
DATE: MARCH 1990 FILE NO. H-2-30300



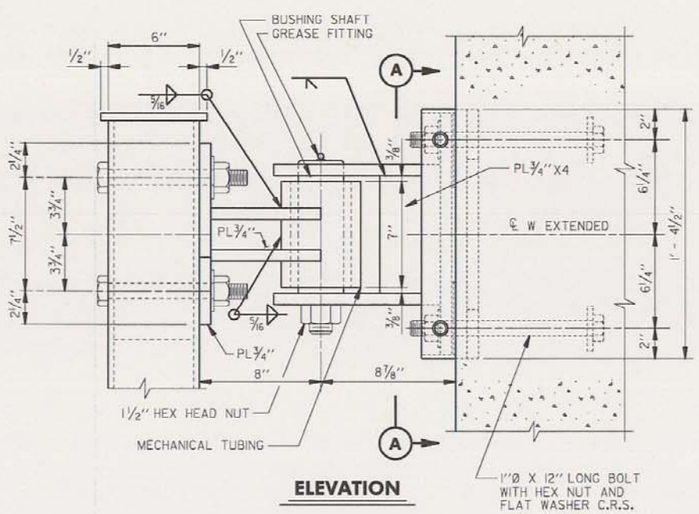
PLAN



SECTION (A)



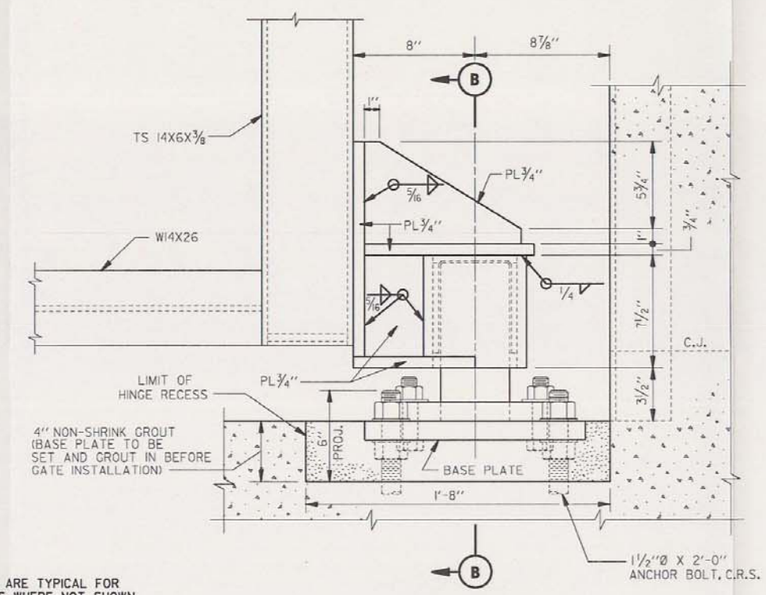
PLAN



ELEVATION

UPPER HINGE

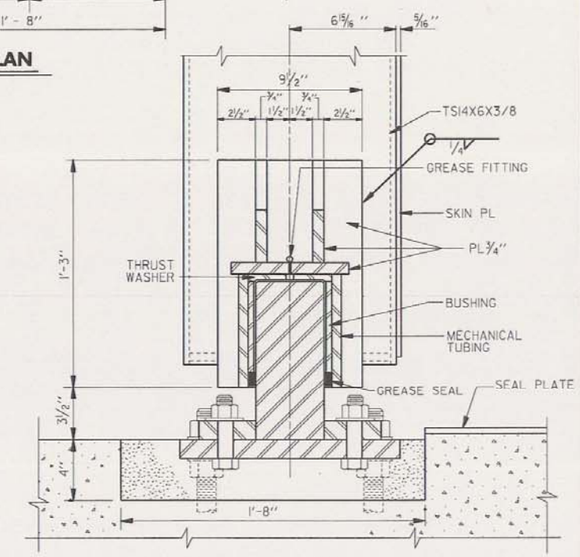
SCALE: 3" = 1'-0"



ELEVATION

LOWER HINGE

SCALE: 3" = 1'-0"



SECTION (B)

NOTE:
WELDS SHOWN ARE TYPICAL FOR
SIMILAR JOINTS WHERE NOT SHOWN.

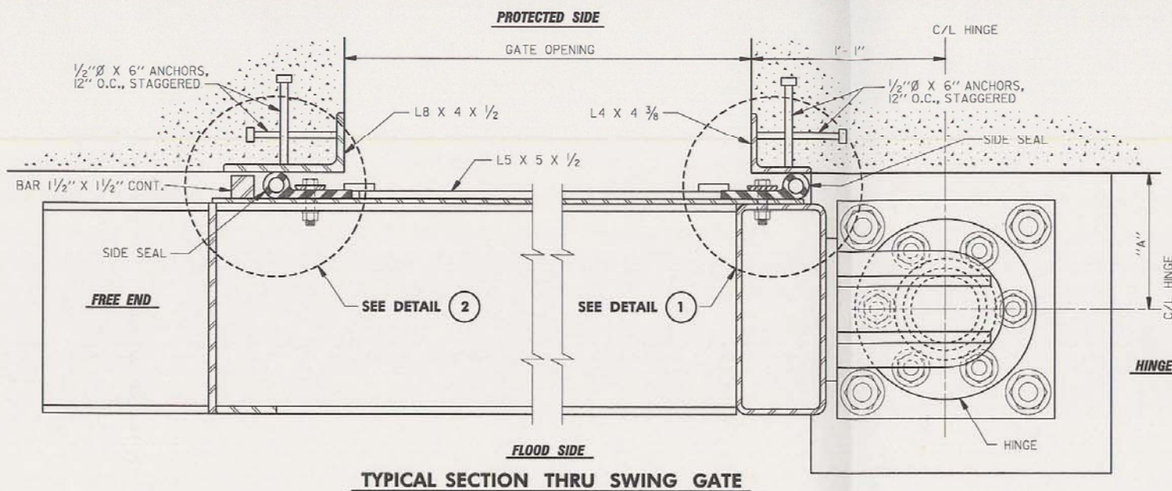
SCALE: 3" = 1' - 0"

COMPUTER AIDED DESIGN DRAFTING

LAKE PONTCHARTRAIN, LA. AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO. 20 GENERAL DESIGN
ORLEANS PARISH - JEFFERSON PARISH
17TH. STREET OUTFALL CANAL
(METAIRIE RELIEF)

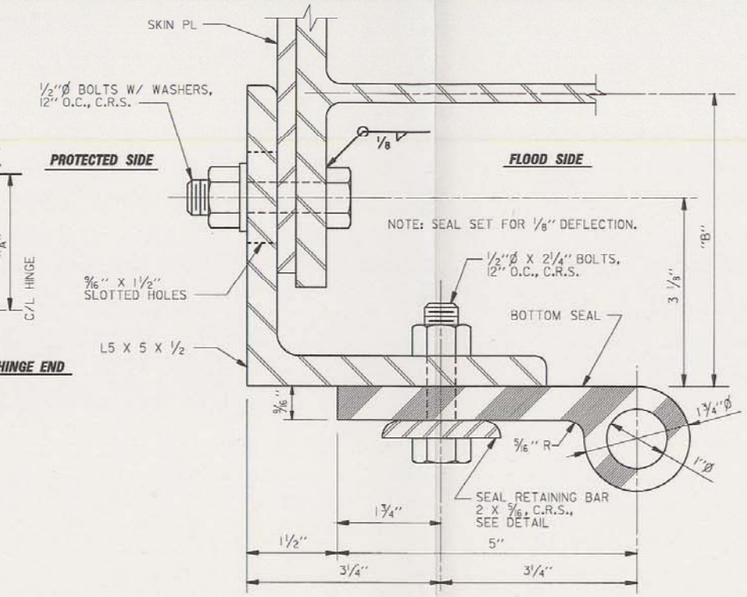
SWING GATE HINGE DETAILS

U. S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
DATE: MARCH 1990 FILE NO. H-2-30300



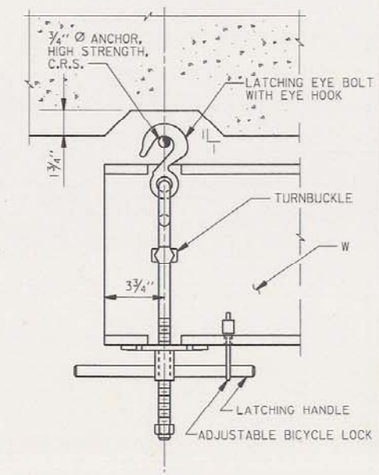
TYPICAL SECTION THRU SWING GATE

SCALE: 3" = 1' - 0"



SECTION THRU BOTTOM SEAL

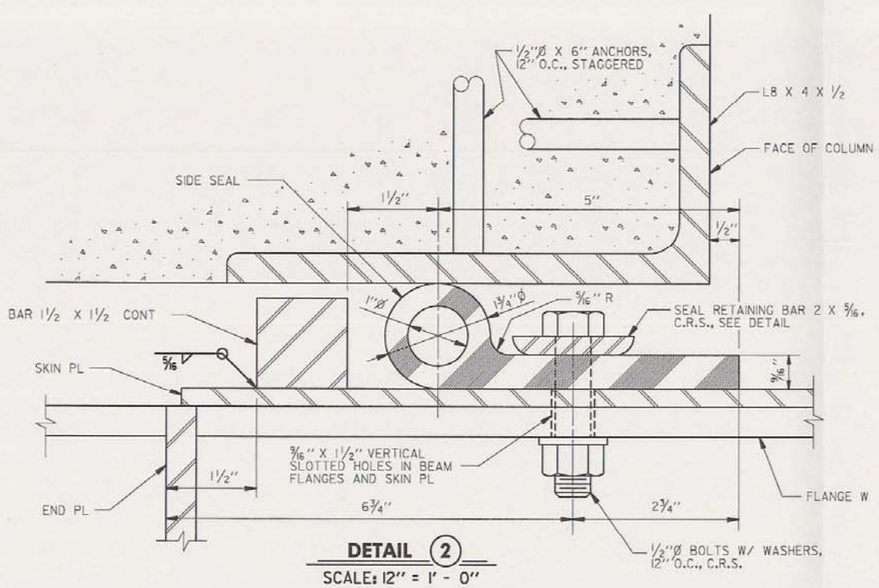
SCALE: 12" = 1' - 0"



PLAN

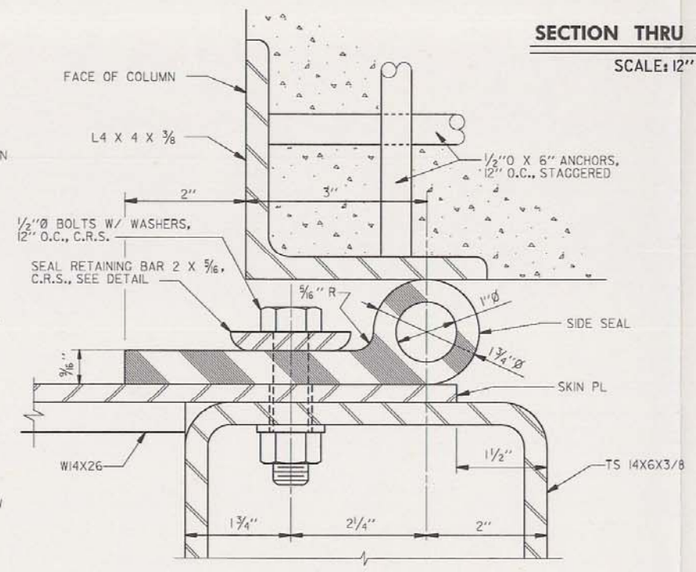
LATCHING DEVICE

SCALE: 3" = 1' - 0"



DETAIL 2

SCALE: 12" = 1' - 0"



DETAIL 1

SCALE: 12" = 1' - 0"

SCALE: 3" = 1' - 0"

12" 0 1'

SCALE: 12" = 1' - 0"

6" 3" 0

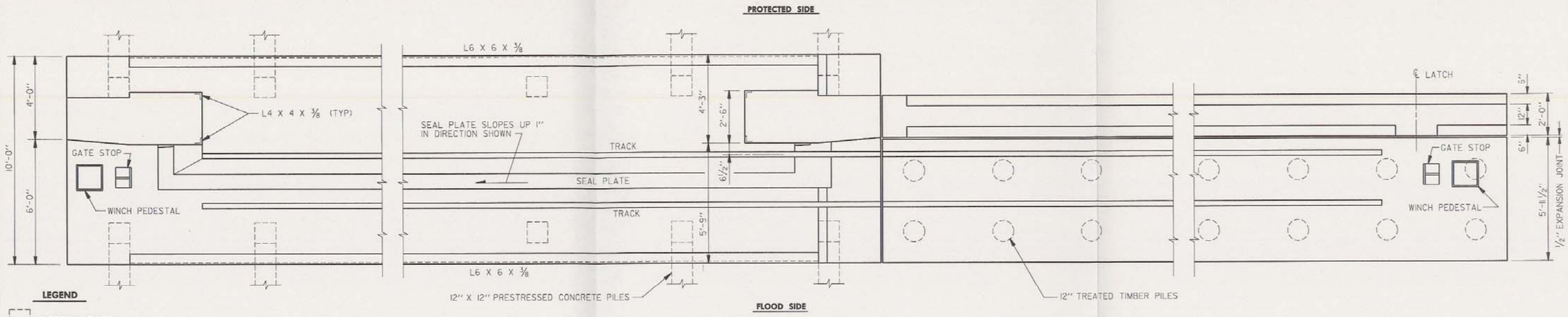
COMPUTER AIDED DESIGN DRAFTING

LAKE PONTCHARTRAIN, LA. AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO. 20 GENERAL DESIGN
ORLEANS PARISH – JEFFERSON PARISH
17TH. STREET OUTFALL CANAL
(METAIRIE RELIEF)

SWING GATE SEAL DETAILS AND LATCHING DEVICE

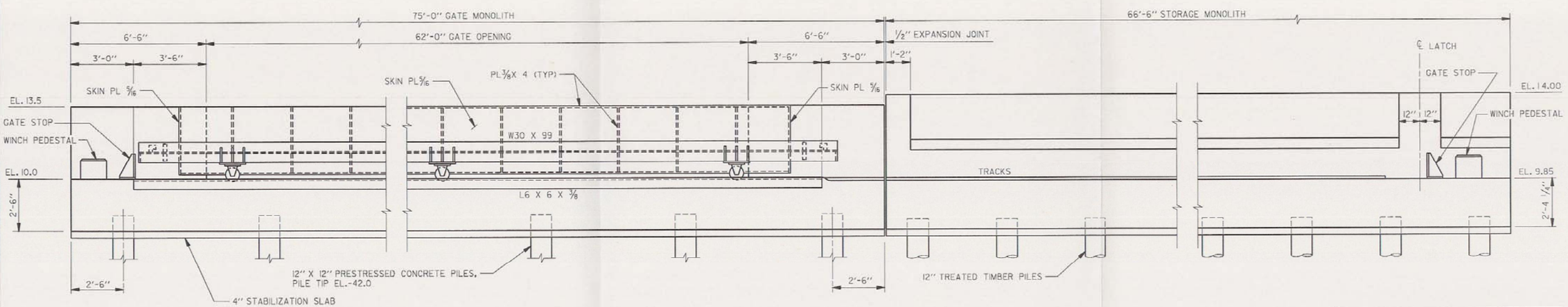
U. S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

DATE: MARCH 1990 FILE NO. H-2-30300



PLAN AT TOP OF WALL

GATE NO. 2 – SHOWN
GATE NO. 3 – OPPOSITE HAND



FLOOD SIDE ELEVATION

GATE NO. 2 – SHOWN
GATE NO. 3 – OPPOSITE HAND

SCALE: 1/2" = 1'- 0"

12" 0 2' 4' 6' 8'

COMPUTER AIDED DESIGN DRAFTING

LAKE PONTCHARTRAIN, LA. AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO. 20 GENERAL DESIGN
ORLEANS PARISH – JEFFERSON PARISH
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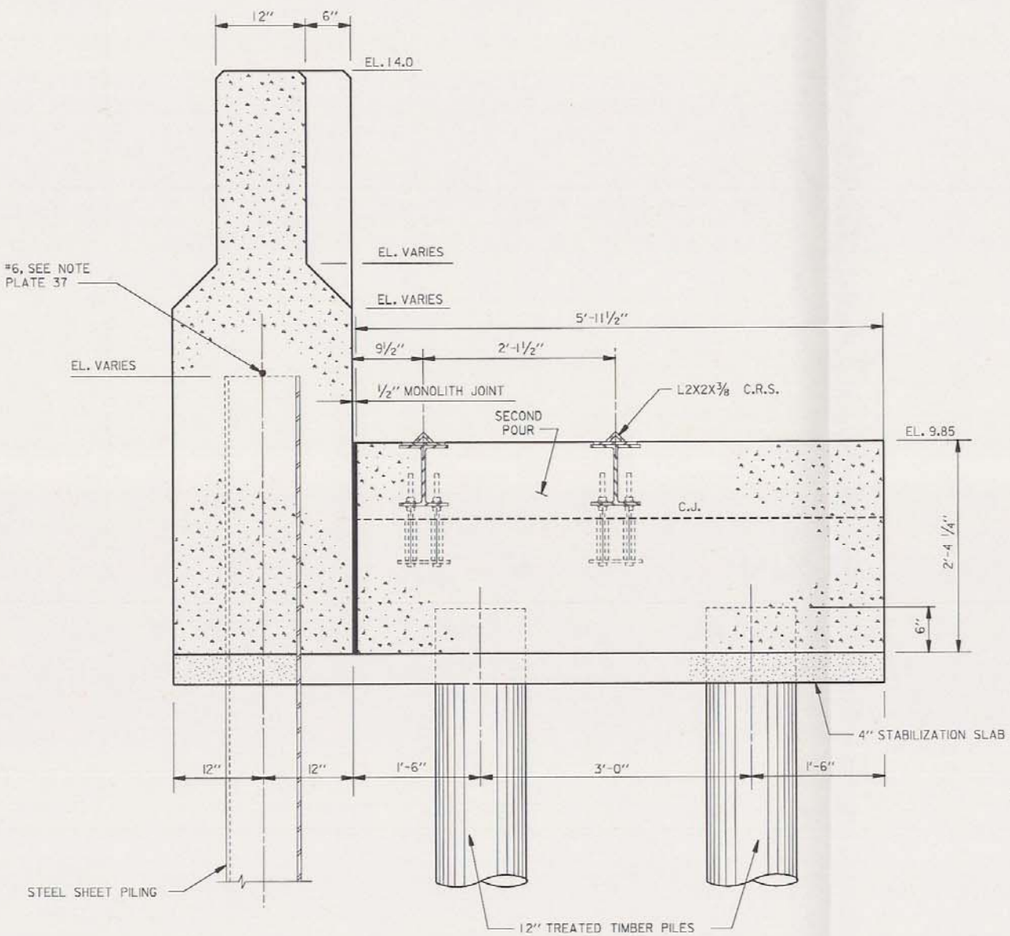
(METAIRIE RELIEF)

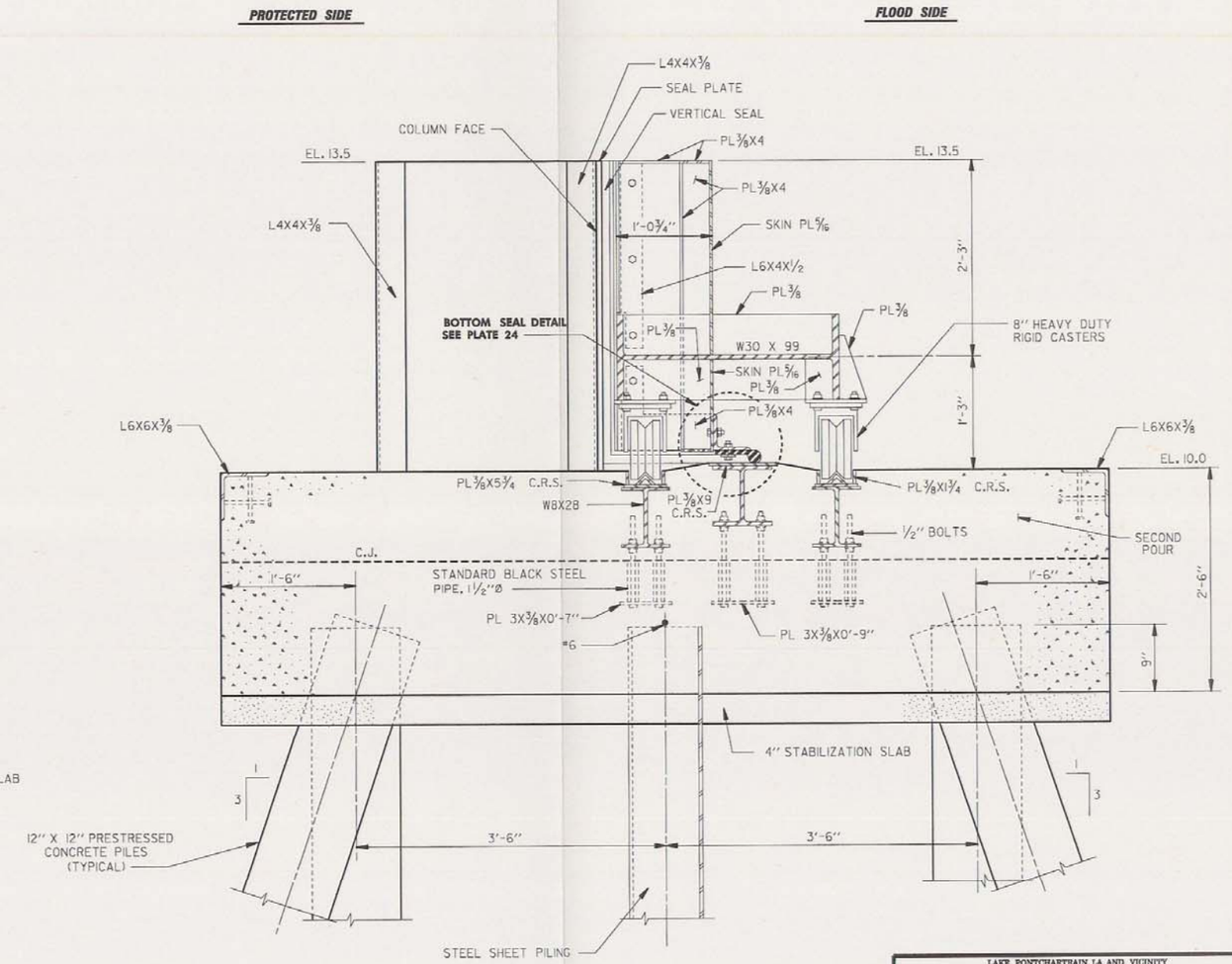
BOTTOM ROLLER GATE

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

DATE: MARCH 1990 FILE NO. H-2-30300



STORAGE MONOLITH



GATE MONOLITH

COMPUTER AIDED DESIGN DRAFTING

SCALE: 1½" = 1' - 0"

12" 0 1' 2' 3'

LAKE PONTCHARTRAIN, LA. AND VICINITY
HIGH LEVEL PLAN
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ORLEANS PARISH - JEFFERSON PARISH
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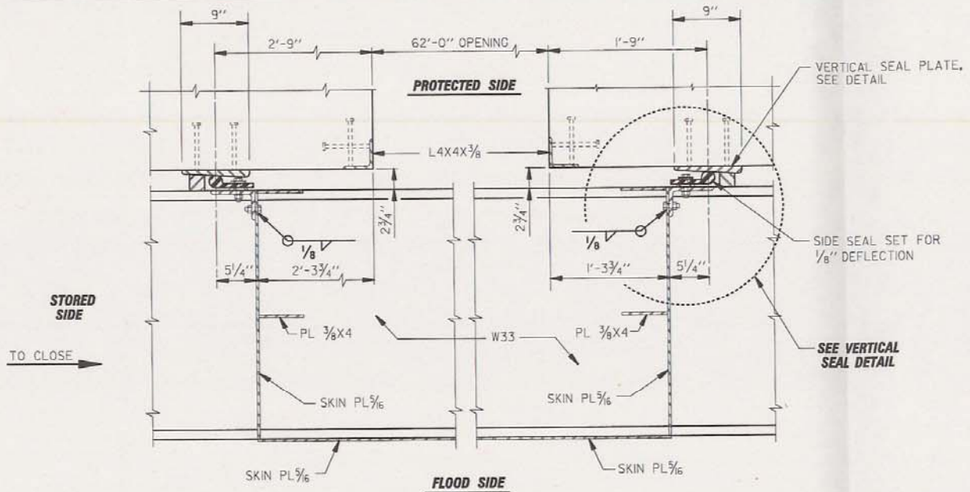
(METAIRIE RELIEF)

BOTTOM ROLLER GATE DETAILS

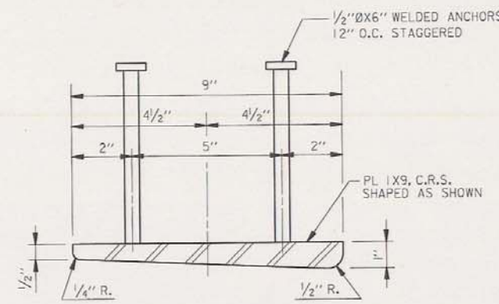
U. S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

DATE: MARCH 1990 FILE NO. H-2-30300



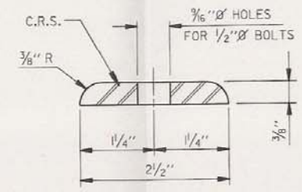
SECTION THRU ROLLER GATE

SCALE: 1½" = 1' - 0"



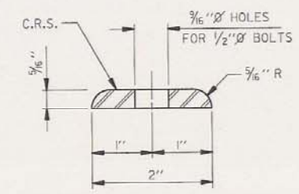
VERTICAL SEAL PLATE DETAIL

SCALE: 6" = 1' - 0"



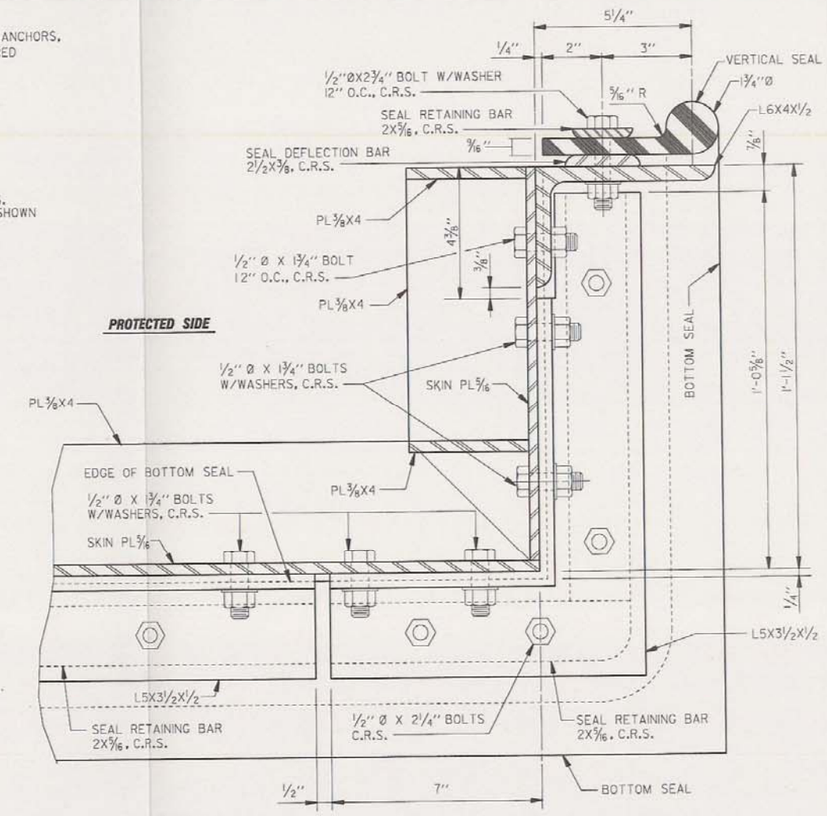
SEAL DEFLECTION BAR

SCALE: 12" = 1' - 0"



SEAL RETAINING BAR

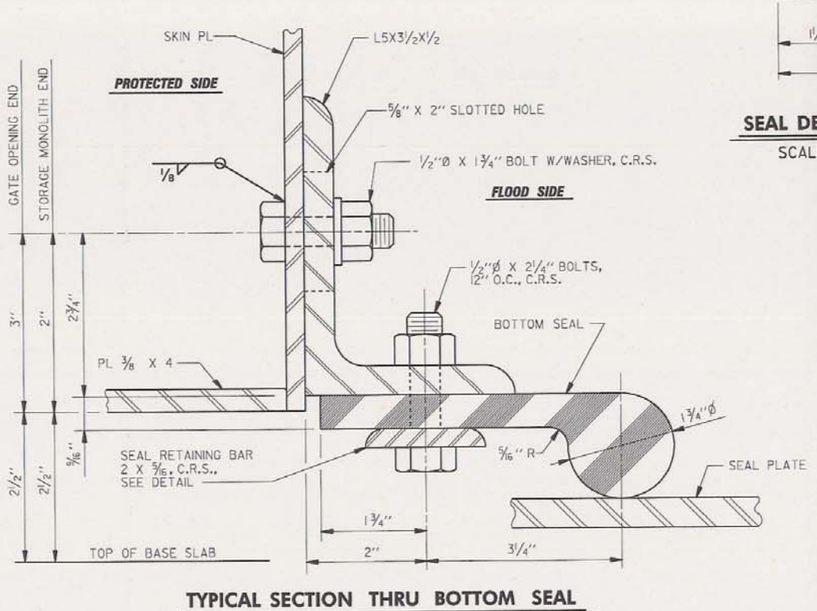
SCALE: 12" = 1' - 0"



VERTICAL SEAL

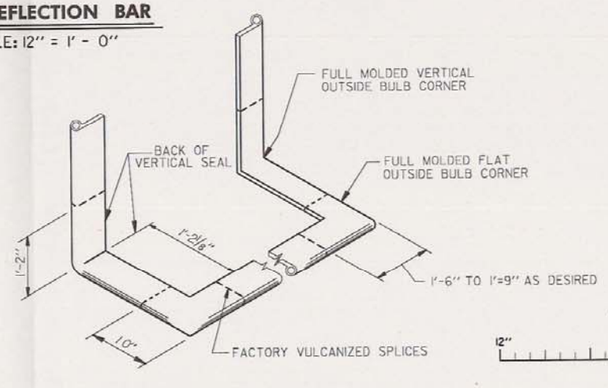
PLAN AT END OF GATE BELOW W

SCALE: 6" = 1' - 0"



TYPICAL SECTION THRU BOTTOM SEAL

SCALE: 12" = 1' - 0"



CORNER DETAIL, TYPICAL EACH SIDE

TYPICAL GATE SEAL

NOT TO SCALE

SCALE: 3" = 1' - 0"

12" 0 1'

SCALE: 6" = 1' - 0"

12" 6" 0

SCALE: 12" = 1' - 0"

6" 3" 0

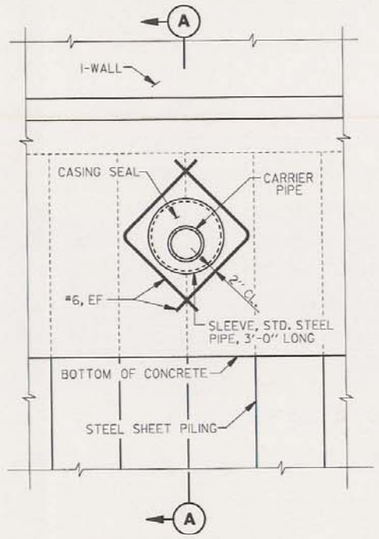
COMPUTER AIDED DESIGN DRAFTING

LAKE PONTCHARTRAIN, LA. AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO. 20 GENERAL DESIGN
ORLEANS PARISH – JEFFERSON PARISH
17TH. STREET OUTFALL CANAL
(METAIRIE RELIEF)

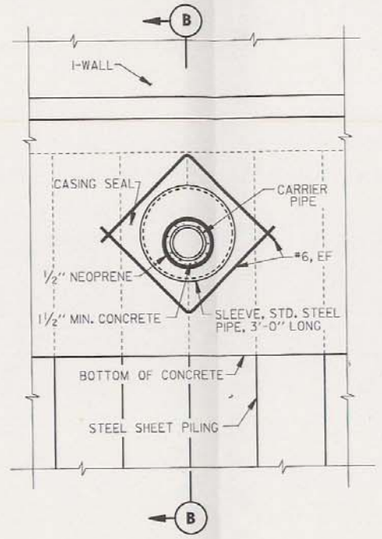
BOTTOM ROLLER GATE SEAL DETAILS

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

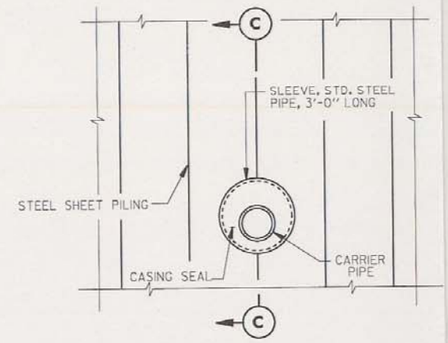
DATE: MARCH 1990 FILE NO. H-2-30300



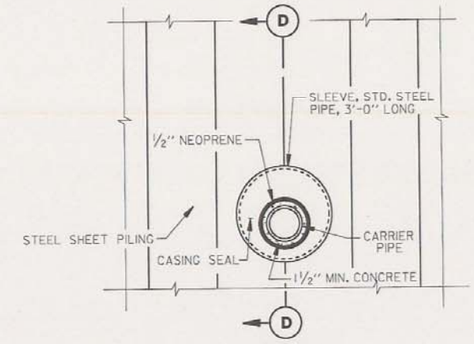
ELEVATION



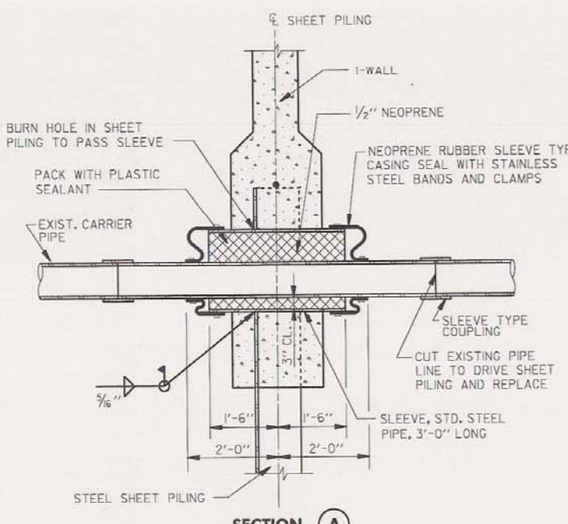
ELEVATION



ELEVATION

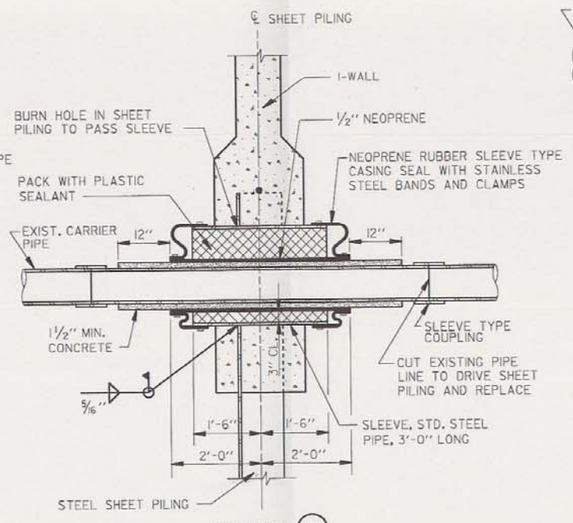


ELEVATION



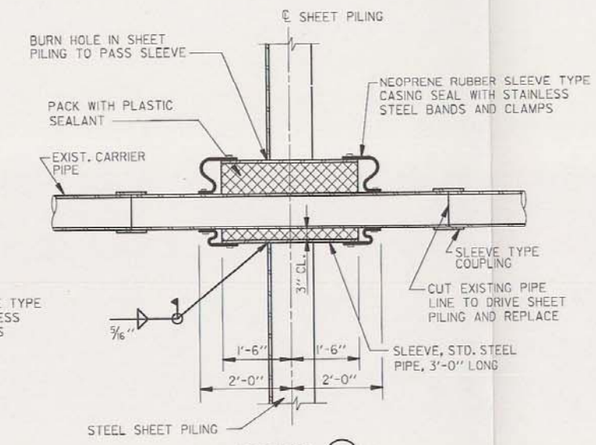
SECTION (A)

TYPICAL PIPE THRU I-WALL



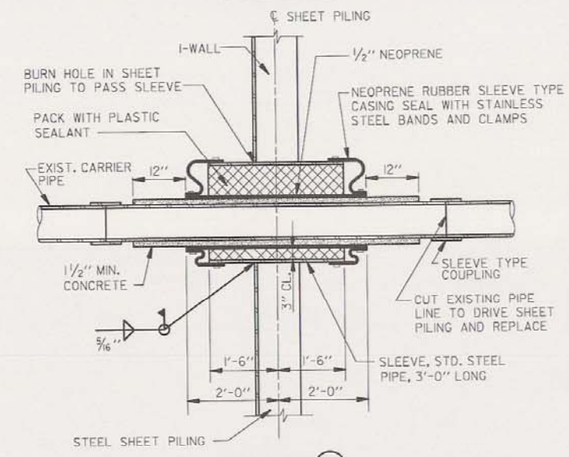
SECTION (B)

TYPICAL GAS PIPE THRU I-WALL



SECTION (C)

TYPICAL PIPE THRU STEEL SHEET PILING

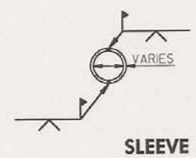


SECTION (D)

TYPICAL GAS PIPE THRU STEEL SHEET PILING

SCALE: 3/4" = 1'- 0"

12" 0 1' 2' 3' 4' 5'



IF CONDITIONS PERMIT, AN ALTERNATE METHOD OF PASSING A UTILITY LINE THROUGH SHEET PILE CAN BE ACCOMPLISHED WITHOUT CUTTING THE UTILITY LINE. THIS METHOD CONSIST OF LATERALLY DISPLACING THE UTILITY LINE, DRIVING THE SHEET PILING, NOTCHING THE SHEET PILE AND INSTALLING SLEEVES IN HALVES.

SLEEVE INSTALLATION IN HALVES

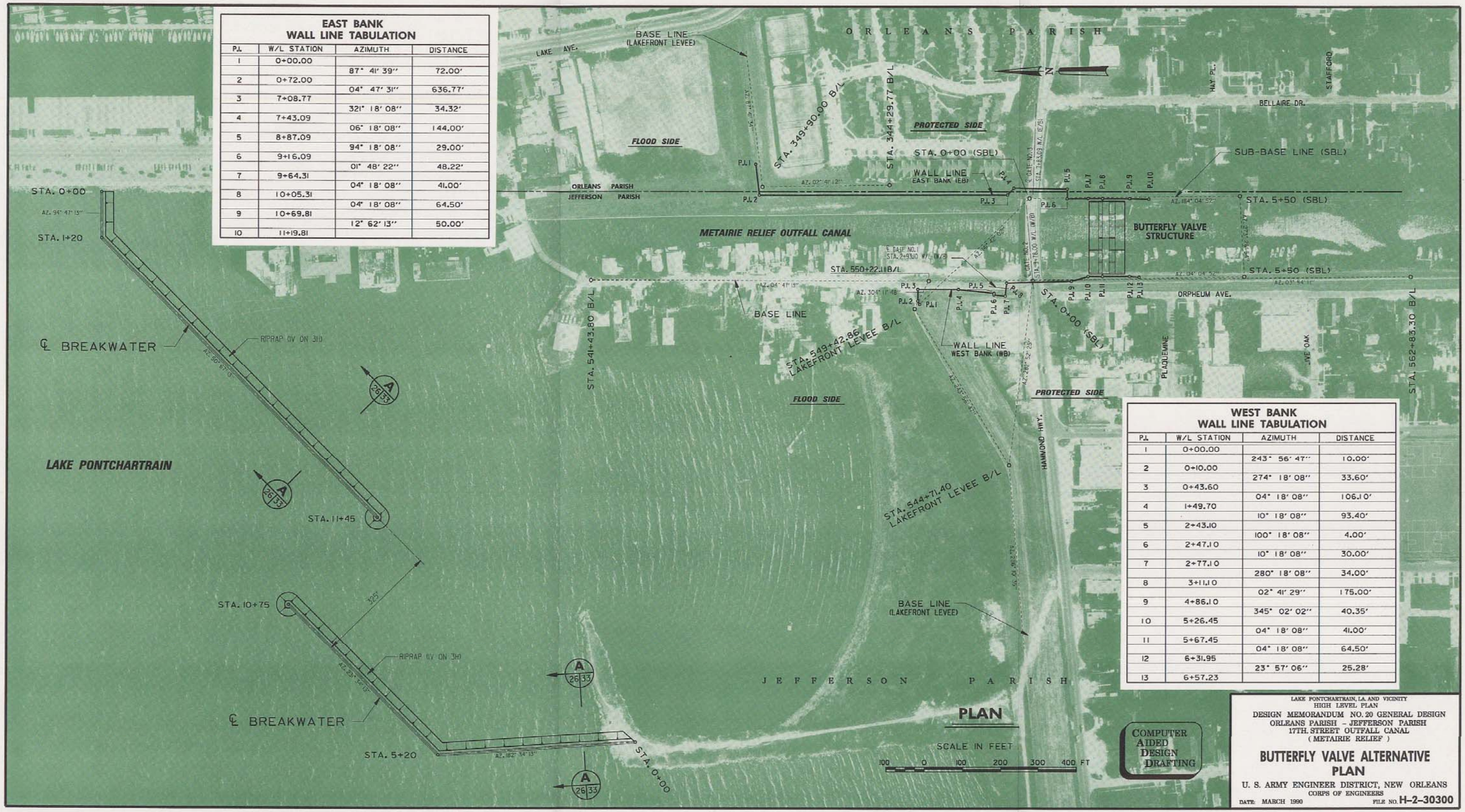
COMPUTER AIDED DESIGN DRAFTING

LAKE PONTCHARTRAIN, LA. AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO. 20 GENERAL DESIGN
ORLEANS PARISH - JEFFERSON PARISH
17TH. STREET OUTFALL CANAL
(METAIRIE RELIEF)

UTILITY CROSSING DETAILS

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

DATE: MARCH 1990 FILE NO. H-2-30300



EAST BANK WALL LINE TABULATION

PI.	W/L STATION	AZIMUTH	DISTANCE
1	0+00.00		
		87° 41' 39"	72.00'
2	0+72.00		
		04° 47' 31"	636.77'
3	7+08.77		
		321° 18' 08"	34.32'
4	7+43.09		
		06° 18' 08"	144.00'
5	8+87.09		
		94° 18' 08"	29.00'
6	9+16.09		
		01° 48' 22"	48.22'
7	9+64.31		
		04° 18' 08"	41.00'
8	10+05.31		
		04° 18' 08"	64.50'
9	10+69.81		
		12° 62' 13"	50.00'
10	11+19.81		

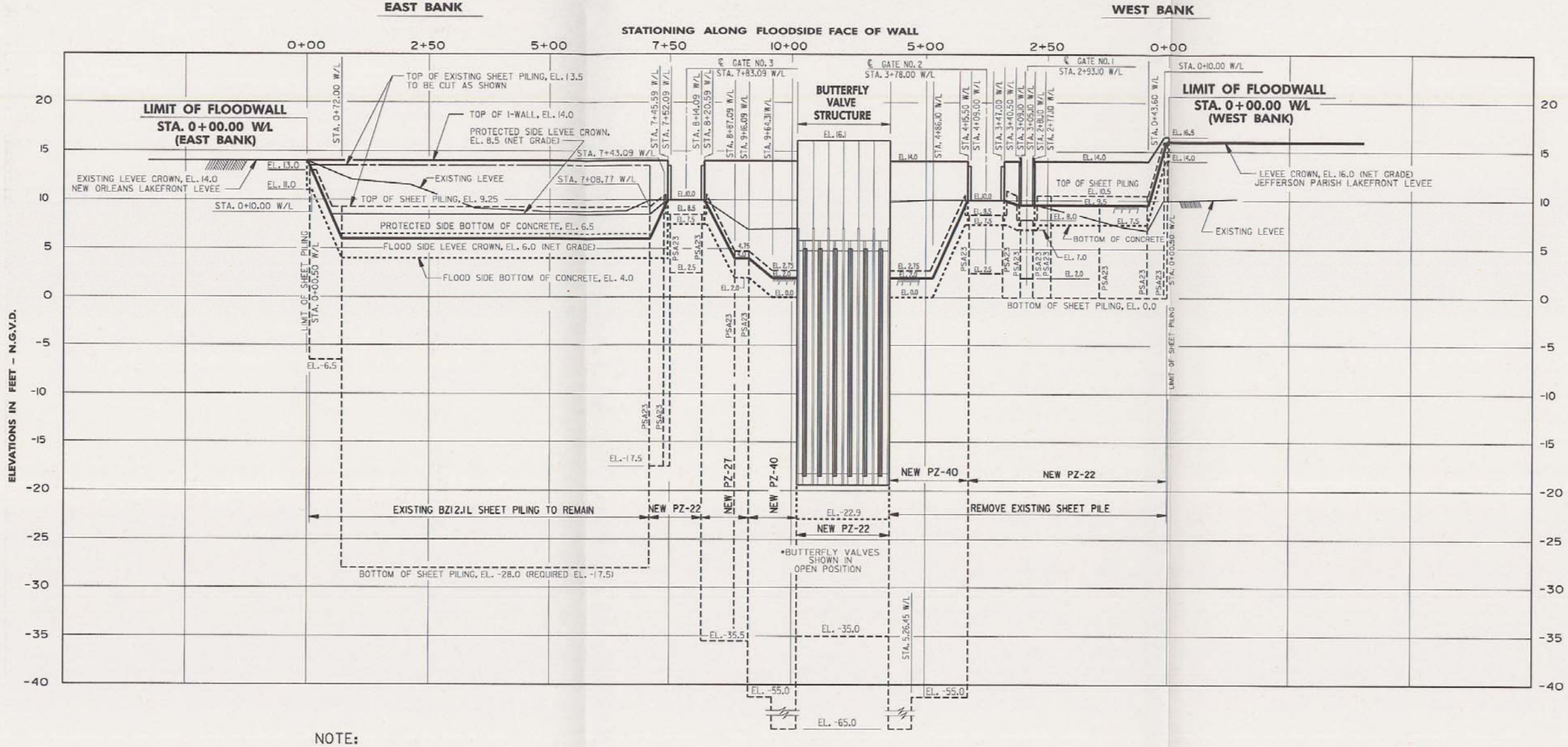
WEST BANK WALL LINE TABULATION

PI.	W/L STATION	AZIMUTH	DISTANCE
1	0+00.00		
		243° 56' 47"	10.00'
2	0+10.00		
		274° 18' 08"	33.60'
3	0+43.60		
		04° 18' 08"	106.10'
4	1+49.70		
		10° 18' 08"	93.40'
5	2+43.10		
		100° 18' 08"	4.00'
6	2+47.10		
		10° 18' 08"	30.00'
7	2+77.10		
		280° 18' 08"	34.00'
8	3+11.10		
		02° 41' 29"	175.00'
9	4+86.10		
		345° 02' 02"	40.35'
10	5+26.45		
		04° 18' 08"	41.00'
11	5+67.45		
		04° 18' 08"	64.50'
12	6+31.95		
		23° 57' 06"	25.28'
13	6+57.23		

LAKE PONTCHARTRAIN, LA. AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO. 20 GENERAL DESIGN
ORLEANS PARISH - JEFFERSON PARISH
17TH. STREET OUTFALL CANAL
(METAIRIE RELIEF)

BUTTERFLY VALVE ALTERNATIVE PLAN

U. S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
DATE: MARCH 1990 FILE NO. H-2-30300



NOTE:

SEE PLAN AND SECTIONS FOR TIE-IN WALLS ON THE PROTECTED SIDE OF THE BUTTERFLY VALVE STRUCTURE.

PROFILE

SCALE: HOR. 1" = 100'
VERT. 1" = 5'

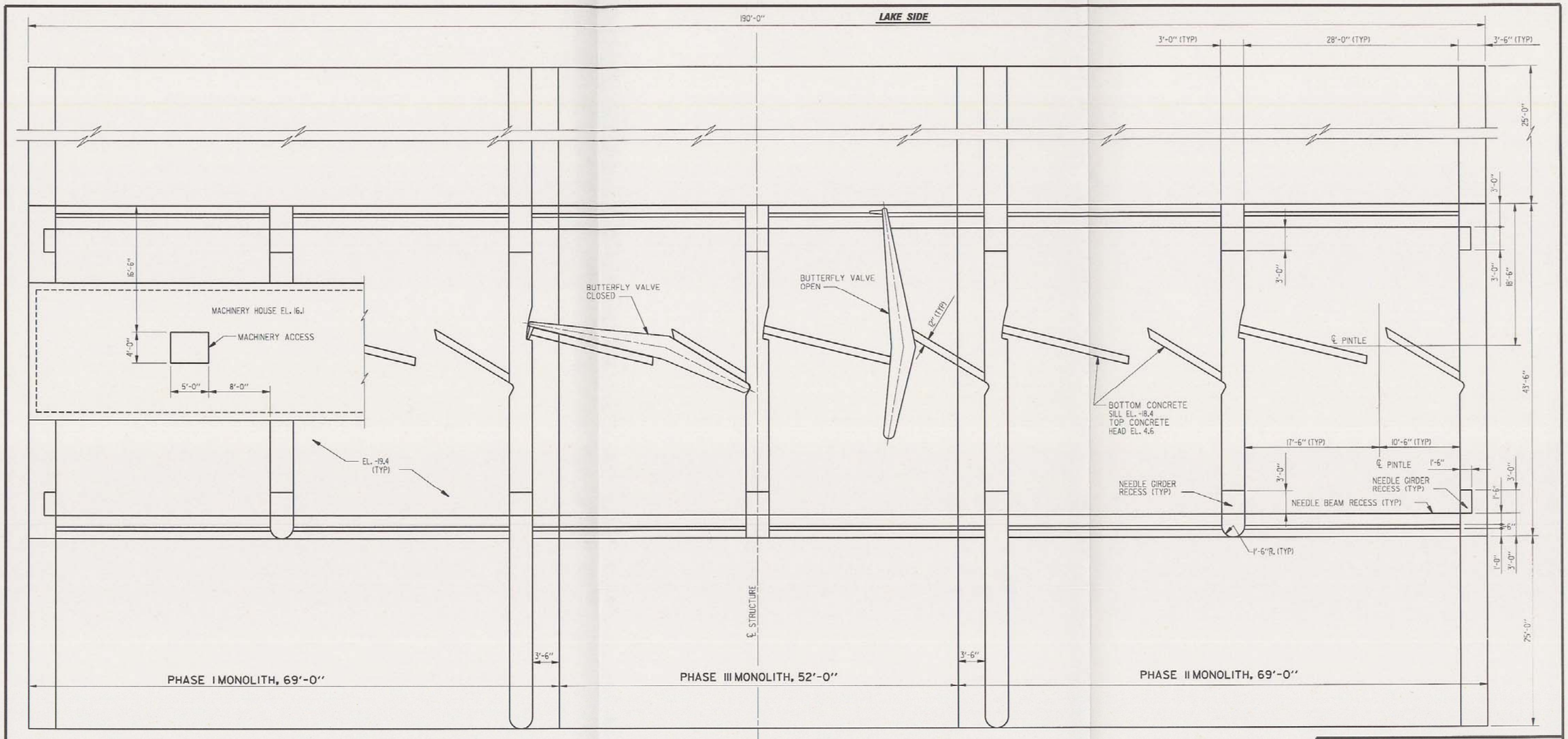
COMPUTER AIDED DESIGN DRAFTING

LAKE PONTCHARTRAIN, LA. AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO. 20 GENERAL DESIGN
ORLEANS PARISH – JEFFERSON PARISH
17TH. STREET OUTFALL CANAL
(METAIRIE RELIEF)

PROFILE
BUTTERFLY VALVE ALTERNATIVE

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

DATE: MARCH 1990 FILE NO. H-2-30300



PLAN

BUTTERFLY VALVE STRUCTURE

SCALE: 3/16" = 1'-0"

12" 0 4' 8' 12' 16'

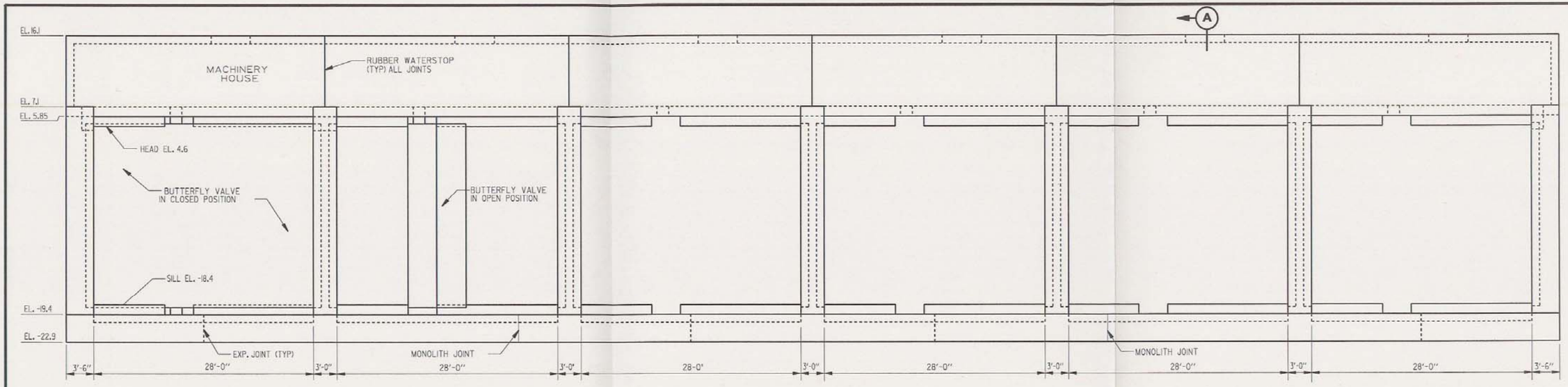
COMPUTER AIDED DESIGN DRAFTING

LAKE PONTCHARTRAIN, LA. AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO. 20 GENERAL DESIGN
ORLEANS PARISH – JEFFERSON PARISH
17TH. STREET OUTFALL CANAL
(METAIRIE RELIEF)

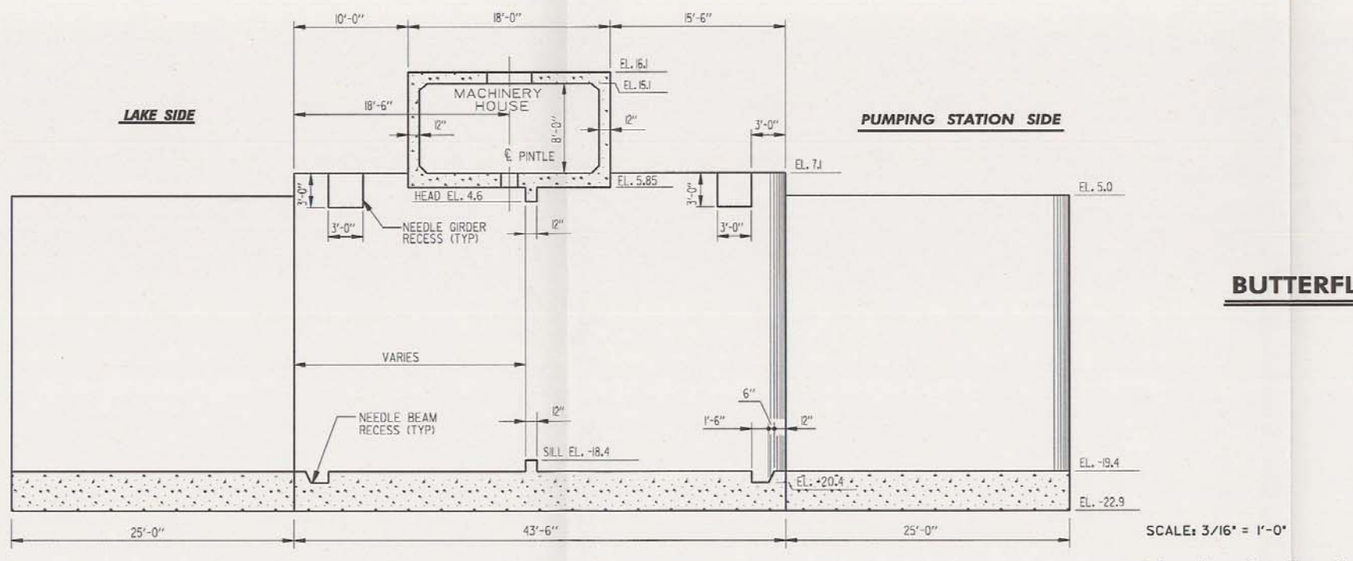
BUTTERFLY VALVE STRUCTURE

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

DATE: MARCH 1990 FILE NO. H-2-30300



LAKE SIDE ELEVATION



SECTION A

BUTTERFLY VALVE STRUCTURE

SCALE: 3/16" = 1'-0"

12' 0 4' 8' 12' 16'

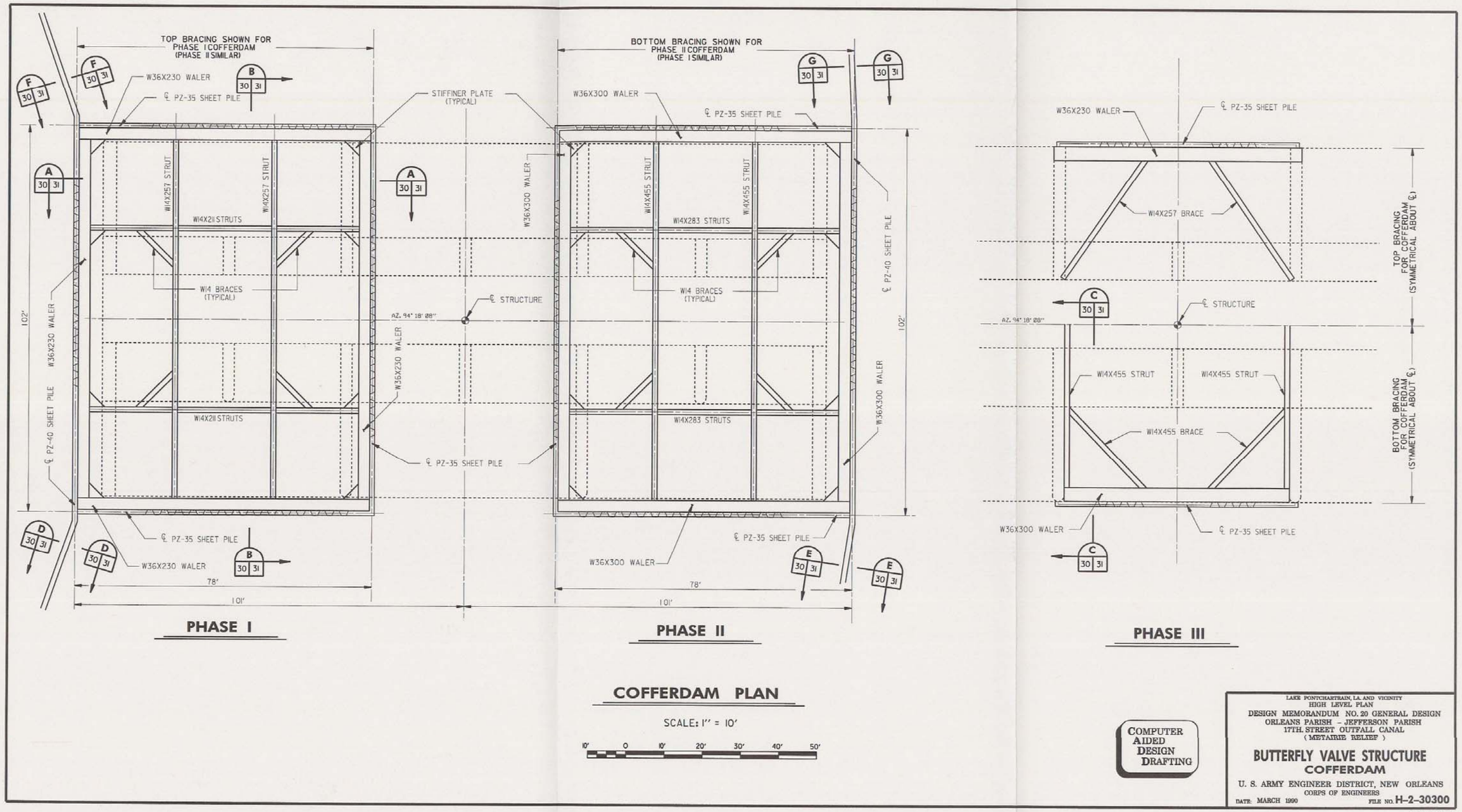
COMPUTER AIDED DESIGN DRAFTING

LAKE PONTCHARTRAIN, LA. AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO. 20 GENERAL DESIGN
ORLEANS PARISH - JEFFERSON PARISH
17TH. STREET OUTFALL CANAL
(METAIRIE RELIEF)

BUTTERFLY VALVE STRUCTURE
ELEVATION AND SECTION

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

DATE: MARCH 1990 FILE NO. H-2-30300



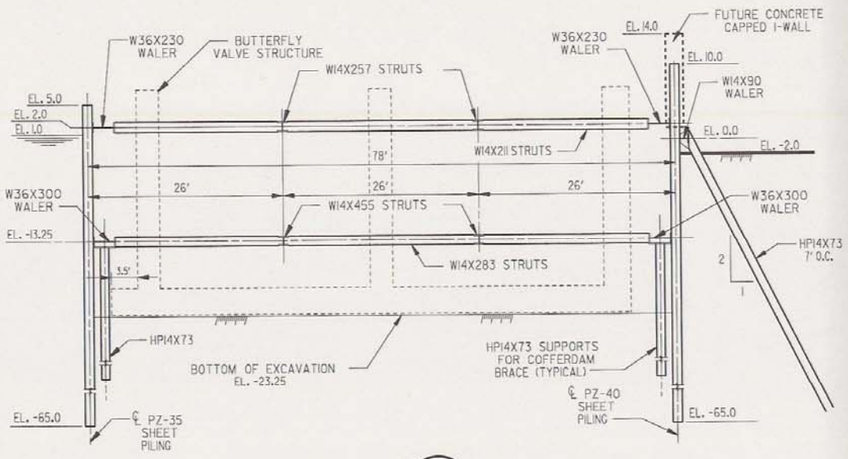
COMPUTER AIDED DESIGN DRAFTING

LAKE PONTCHARTRAIN, LA. AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO. 20 GENERAL DESIGN
ORLEANS PARISH – JEFFERSON PARISH
17TH. STREET OUTFALL CANAL
(METAIRIE RELIEF)

BUTTERFLY VALVE STRUCTURE
COFFERDAM

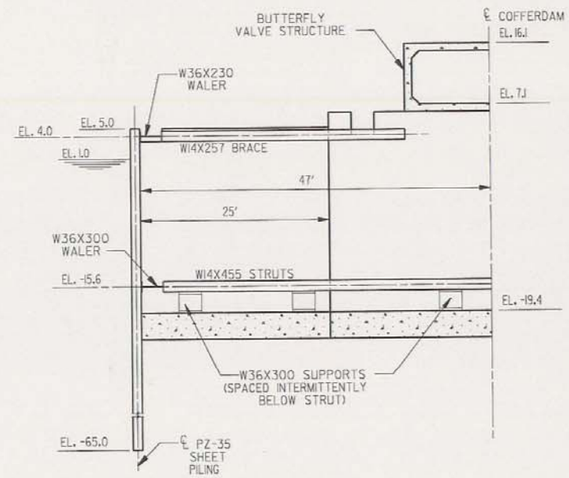
U. S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

DATE: MARCH 1990 FILE NO. H-2-30300



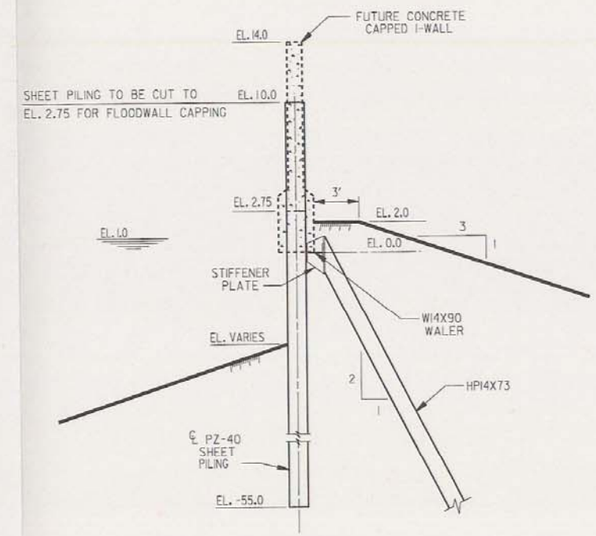
SECTION A 30 31

SCALE: 1/8" = 1'-0"



SECTION C 30 31

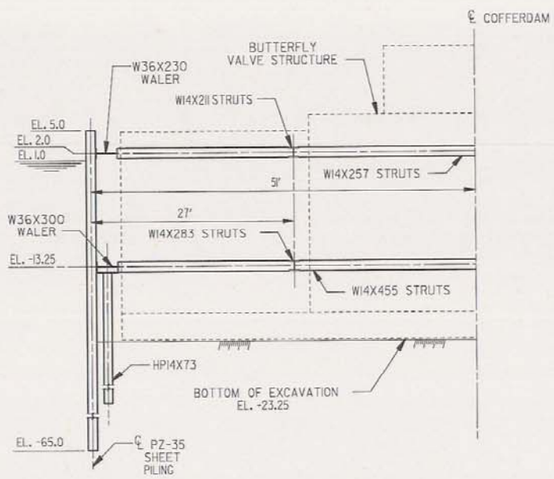
SCALE: 1/8" = 1'-0"



SECTION F 30 31

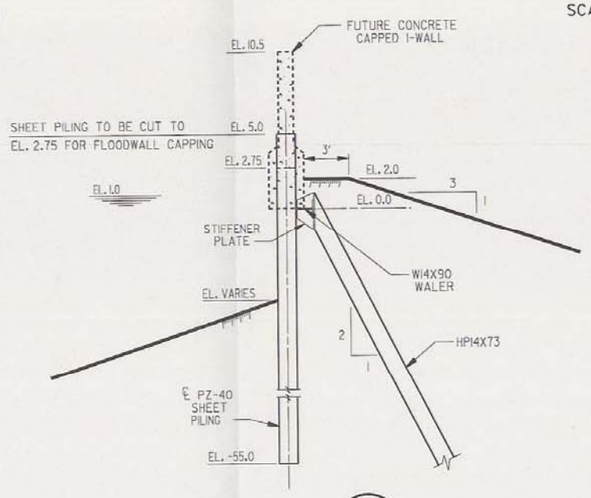
SECTION (G) **SIMILAR**

SCALE: 1/4" = 1'-0"



SECTION B 30 31

SCALE: 1/8" = 1'-0"



SECTION D 30 31

SECTION (E) **SIMILAR**

SCALE: 1/4" = 1'-0"

SCALE: 1/8" = 1'- 0"

0 5' 10' 15' 20' 25'

SCALE: 1/4" = 1'- 0"

12" 0 5' 10' 15' 20'

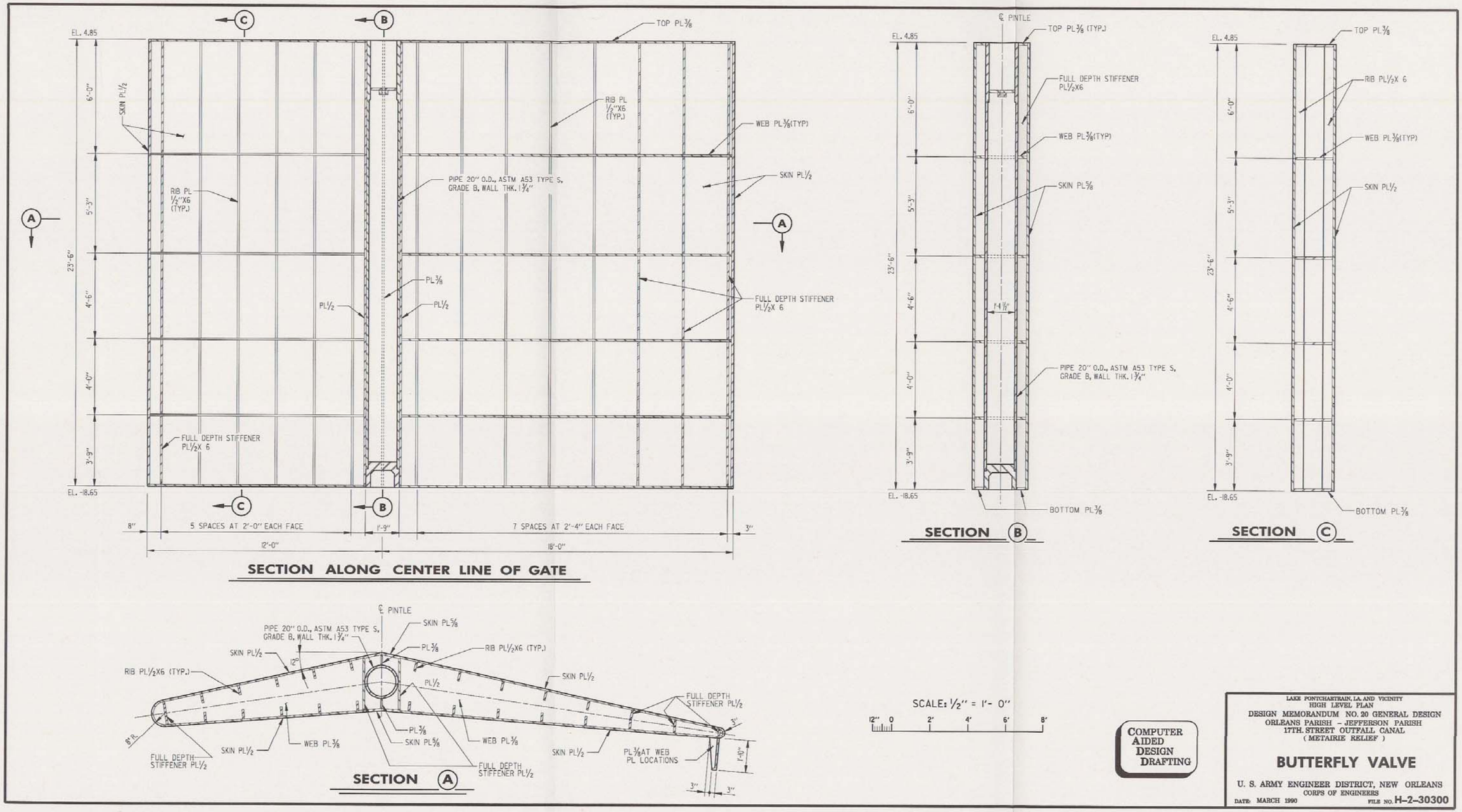
COMPUTER AIDED DESIGN DRAFTING

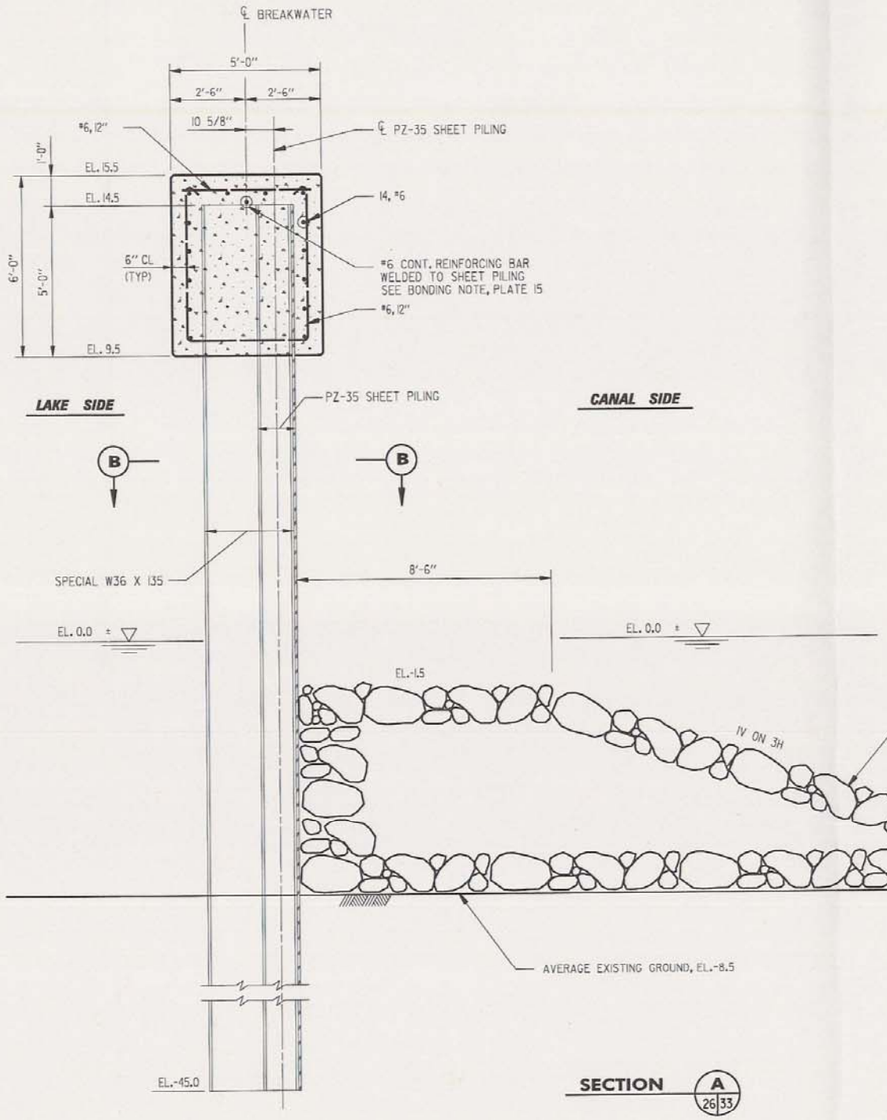
LAKE PONTCHARTRAIN, LA. AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO. 20 GENERAL DESIGN
ORLEANS PARISH - JEFFERSON PARISH
17TH. STREET OUTFALL CANAL
(METAIRIE RELIEF)

BUTTERFLY VALVE STRUCTURE
COFFERDAM SECTIONS

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

DATE: MARCH 1990 FILE NO. H-2-30300

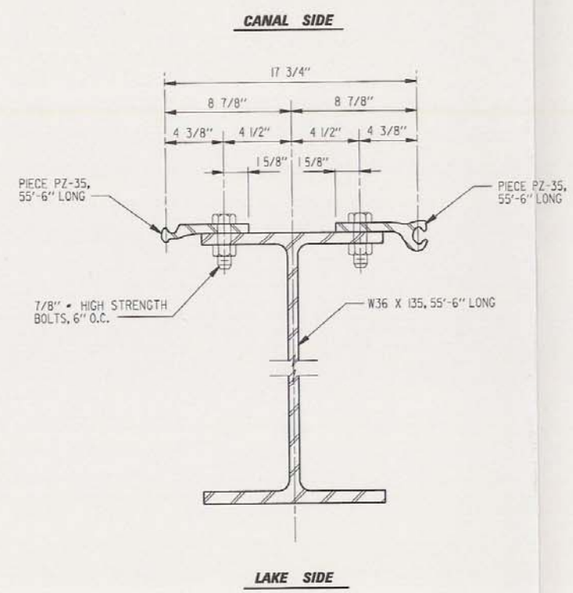

EL. 4.85
EL. -18.65
23'-6"
6'-0"
5'-3"
4'-6"
4'-0"
3'-9"
SKIN PL1/2
RIB PL 1/2"X6 (TYP.)
TOP PL3/8
WEB PL3/8(TYP)
SKIN PL1/2
PIPE 20" O.D., ASTM A53 TYPE S, GRADE B, WALL THK. 1 3/4"
PL3/8
PL1/2
FULL DEPTH STIFFENER PL1/2X 6
8"
5 SPACES AT 2'-0" EACH FACE
1'-9"
7 SPACES AT 2'-4" EACH FACE
3"
12'-0"
18'-0"
SECTION ALONG CENTER LINE OF GATE
℄ PINTLE
TOP PL3/8 (TYP.)
FULL DEPTH STIFFENER PL1/2X6
WEB PL3/8(TYP)
SKIN PL5/8
1'-4 1/2"
PIPE 20" O.D., ASTM A53 TYPE S, GRADE B, WALL THK. 1 3/4"
BOTTOM PL3/8
SECTION B
RIB PL1/2X 6
SECTION C
℄ PINTLE
PIPE 20" O.D., ASTM A53 TYPE S, GRADE B, WALL THK. 1 3/4"
SKIN PL5/8
PL3/8
RIB PL1/2X6 (TYP.)
SKIN PL1/2
12°
PL1/2
FULL DEPTH STIFFENER PL1/2
8" R.
WEB PL3/8
PL3/8AT WEB PL LOCATIONS
1'-10"
3"
SECTION A
SCALE: 1/2" = 1'- 0"
12" 0 2' 4' 6' 8'
COMPUTER AIDED DESIGN DRAFTING
LAKE PONTCHARTRAIN, LA. AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO. 20 GENERAL DESIGN
ORLEANS PARISH - JEFFERSON PARISH
17TH. STREET OUTFALL CANAL
(METAIRIE RELIEF)
BUTTERFLY VALVE
U. S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
DATE: MARCH 1990
FILE NO. H-2-30300



SECTION A 26/33

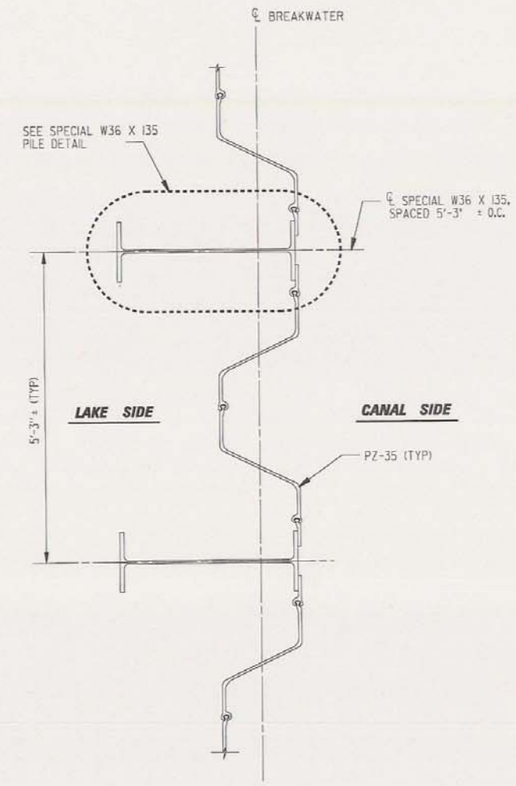
SECTION THRU BREAKWATER

SCALE: 1/2" = 1'-0"



SPECIAL W36 X 135 PILE DETAIL

SCALE: 3" = 1'-0"



SECTION B

SCALE: 1" = 1'-0"

SCALE: 1/2" = 1'-0"

12" 0 1' 2' 3' 4' 5' 6'

SCALE: 1" = 1'-0"

12" 0 1' 2' 3'

SCALE: 3" = 1'-0"

12" 0 1'

COMPUTER AIDED DESIGN DRAFTING

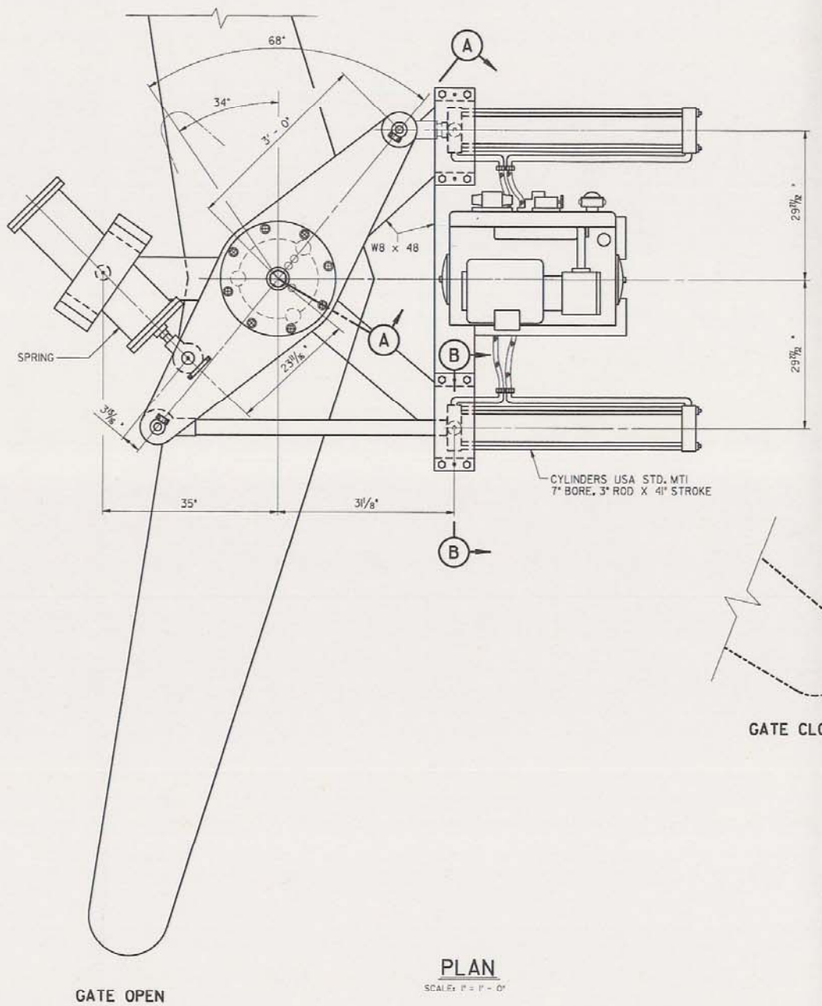
LAKE PONTCHARTRAIN, LA. AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO. 20 GENERAL DESIGN
ORLEANS PARISH - JEFFERSON PARISH
17TH. STREET OUTFALL CANAL
(METAIRIE RELIEF)

BREAKWATER SECTION AND DETAILS

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

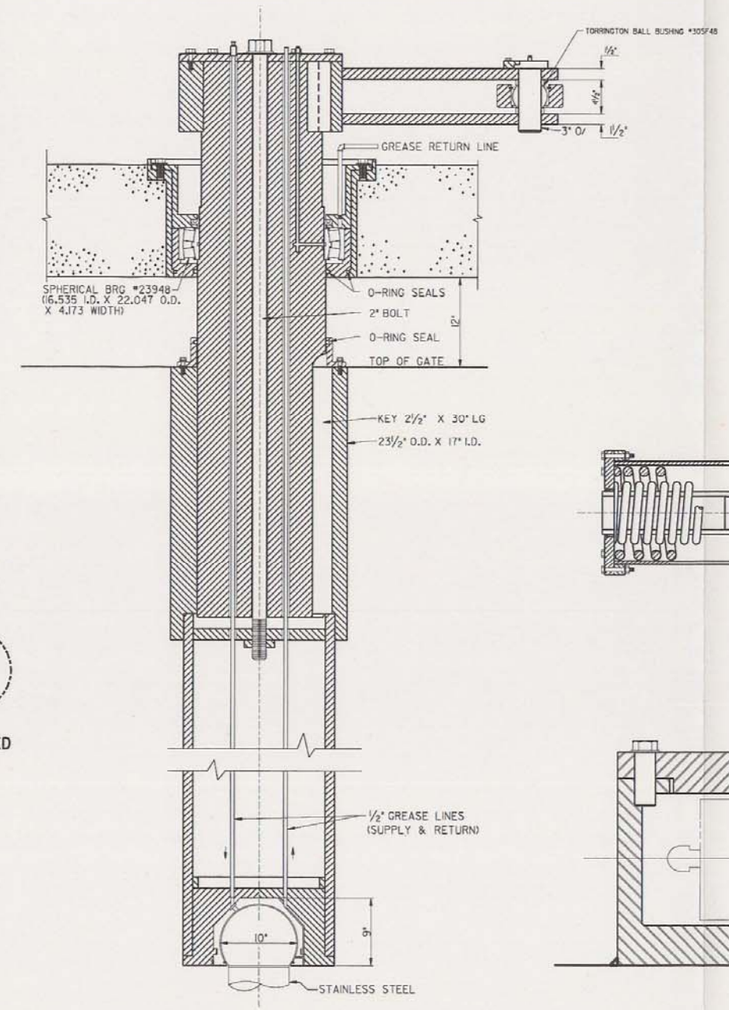
DATE: MARCH 1990 FILE NO. H-2-30300

COMPUTER AIDED DESIGN DRAFTING



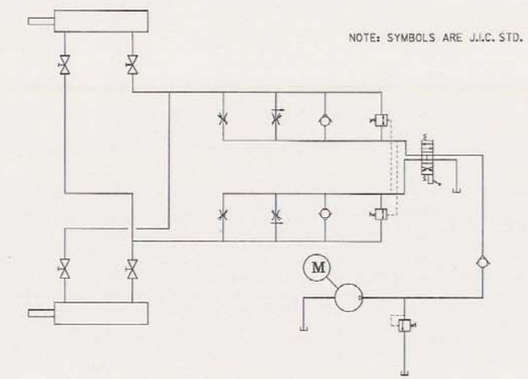
PLAN

SCALE: 1" = 1' - 0"



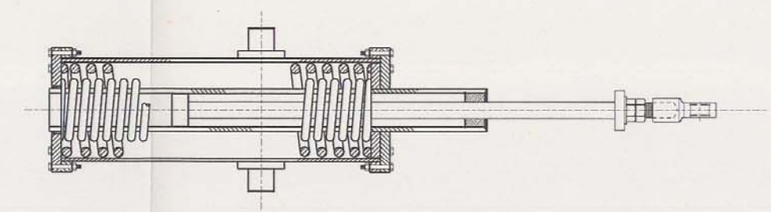
SECTION A-A

SCALE: 1/8" = 1"



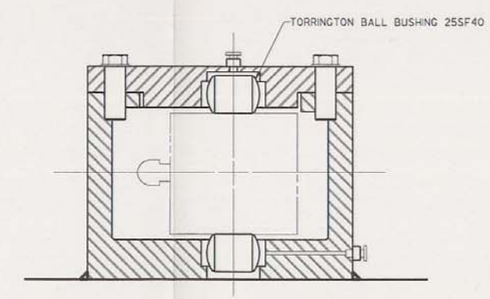
HYDRAULIC SCHEMATIC

N.T.S.



SPRING

SCALE: 1 1/2" = 1' - 0"



SECTION B-B

SCALE: 3/4" = 1' - 0"

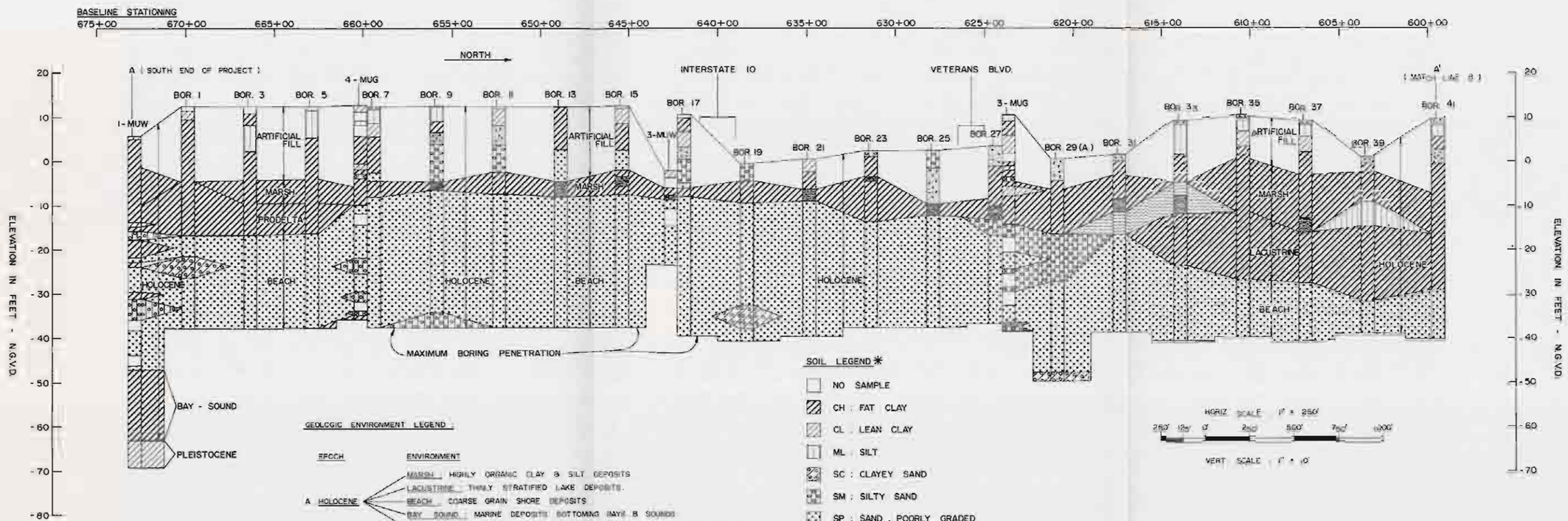
LAKE PONTCHARTRAIN, LA. AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO. 20 GENERAL DESIGN
ORLEANS PARISH - JEFFERSON PARISH
17TH STREET OUTFALL CANAL
(METAIRIE RELIEF)

MACHINERY LAYOUT

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

DATE: MARCH 1990 FILE NO. H-2-30300

17TH STREET OUTFALL CANAL - WEST LEVEE (SOUTHERN HALF)



GEOLOGIC ENVIRONMENT LEGEND :

EPOCH	ENVIRONMENT
A HOLOCENE	MARSH : HIGHLY ORGANIC CLAY & SILT DEPOSITS
	LACUSTRINE : THINLY STRATIFIED LAKE DEPOSITS.
	BEACH : COARSE GRAIN SHORE DEPOSITS
	BAY - SOUND : MARINE DEPOSITS BOTTOMING BAYS & SOUNDS
	PRODELTA : PROGRADING PORTION OF DELTA FRONT TYPICALLY FAT CLAYS.
B PLEISTOCENE	ANCIENT FORMER MISSISSIPPI RIVER DELTAIC & NEAR SHORE DEPOSITS. OLDEST DEPOSITS ENCOUNTERED

BORINGS 1 THRU 41 SAMPLED & CLASSIFIED BY EUSTIS ENGINEERING

BORINGS 1-MUW , 4-MUG , 3-MUW AND 3-MUG SAMPLED & CLASSIFIED BY U.S. ARMY CORPS OF ENGINEERS

SEE FIG. 1 APPENDIX A VOL. 1 FOR LOCATION OF EUSTIS ENGINEERING SOIL BORINGS.

* 2 NOV 81 LETTER

SOIL LEGEND *

- NO SAMPLE
- CH : FAT CLAY
- CL : LEAN CLAY
- ML : SILT
- SC : CLAYEY SAND
- SM : SILTY SAND
- SP : SAND , POORLY GRADED
- WD : WOOD
- PT : PEAT
- FILL - BRICK , SHELLS , ORGANICS , ETC. - ARTIFICIALLY PLACED
- SL : SHELLS

* EUSTIS ENGINEERING COMBINED SOIL SYMBOLS WERE MODIFIED TO ACCOMMODATE THE PREDOMINANT SOIL TYPE AND THE APPROPRIATE UNIFIED SOIL CLASSIFICATION SYMBOL .

A. BOR. 29 - SIEVE ANALYSIS INDICATED SM AT DEPTHS OF 26.0' TO 27.5' . THE SP SYMBOL WAS CHANGED TO ACCOMMODATE THE DATA

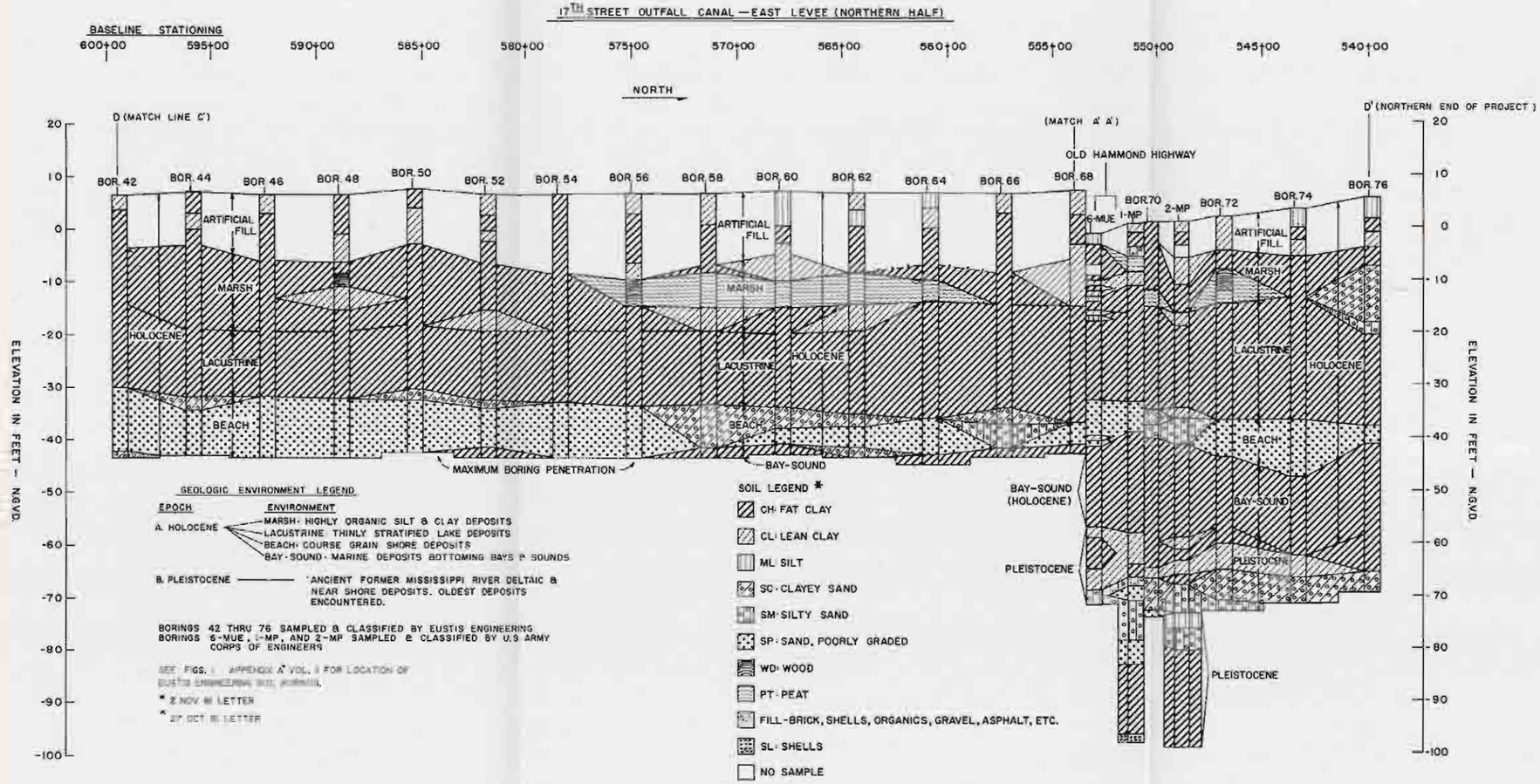
HORIZ SCALE 1" = 250'
250' 125' 0' 250' 500' 750' 1000'
VERT SCALE 1" = 10'

LAKE PONCHARTRAIN, LA. AND VICINITY
HURRICANE PROTECTION
DESIGN MEMORANDUM NO. 10 GENERAL DESIGN
ORLEANS PARISH - JEFFERSON PARISH
17 TH. STREET OUTFALL CANAL
(METAIRIE RELIEF)

SOIL AND GEOLOGICAL PLATE

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

DATE: March 1980 FILE NO. H-2-20300



LAKE PONTCHARTRAIN, LA. AND VICINITY
HURRICANE PROTECTION
DESIGN MEMORANDUM NO. 20 GENERAL DESIGN
ORLEANS PARISH - JEFFERSON PARISH
17 TH STREET OUTFALL CANAL
(METAIRIE RELIEF)

SOIL AND GEOLOGICAL PLATE

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

DATE: March 1990 FILE NO. H-2-30360

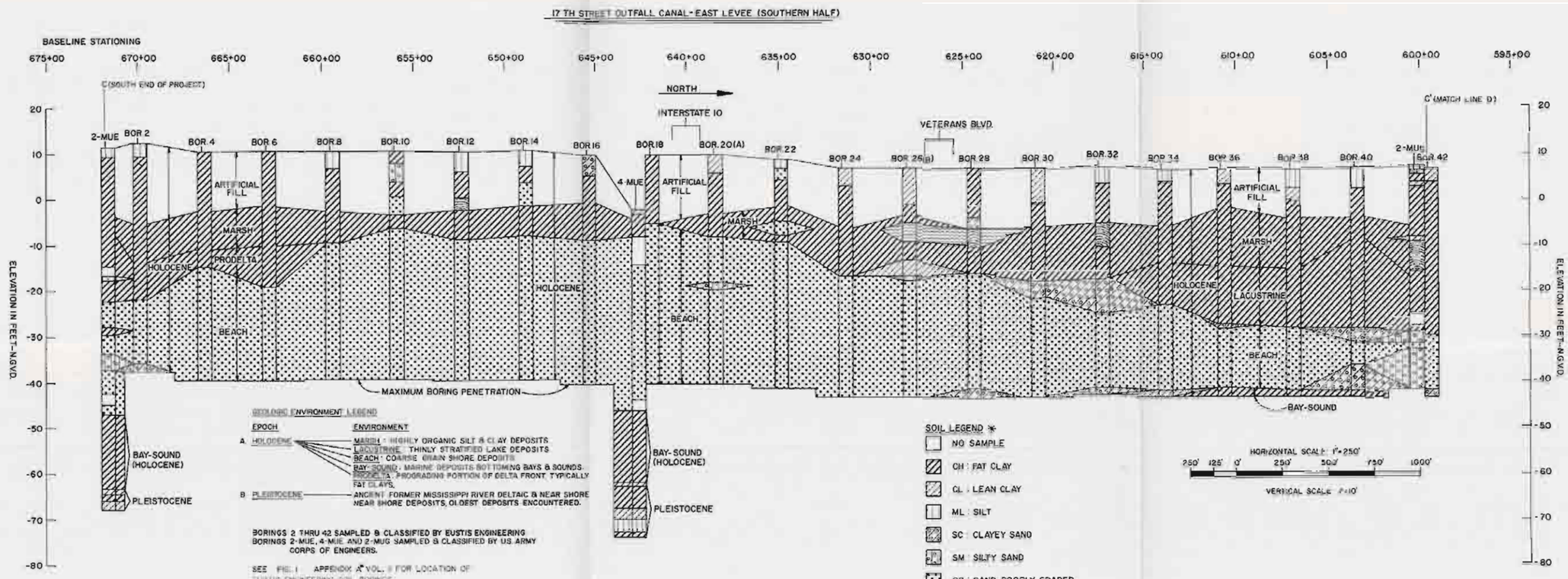
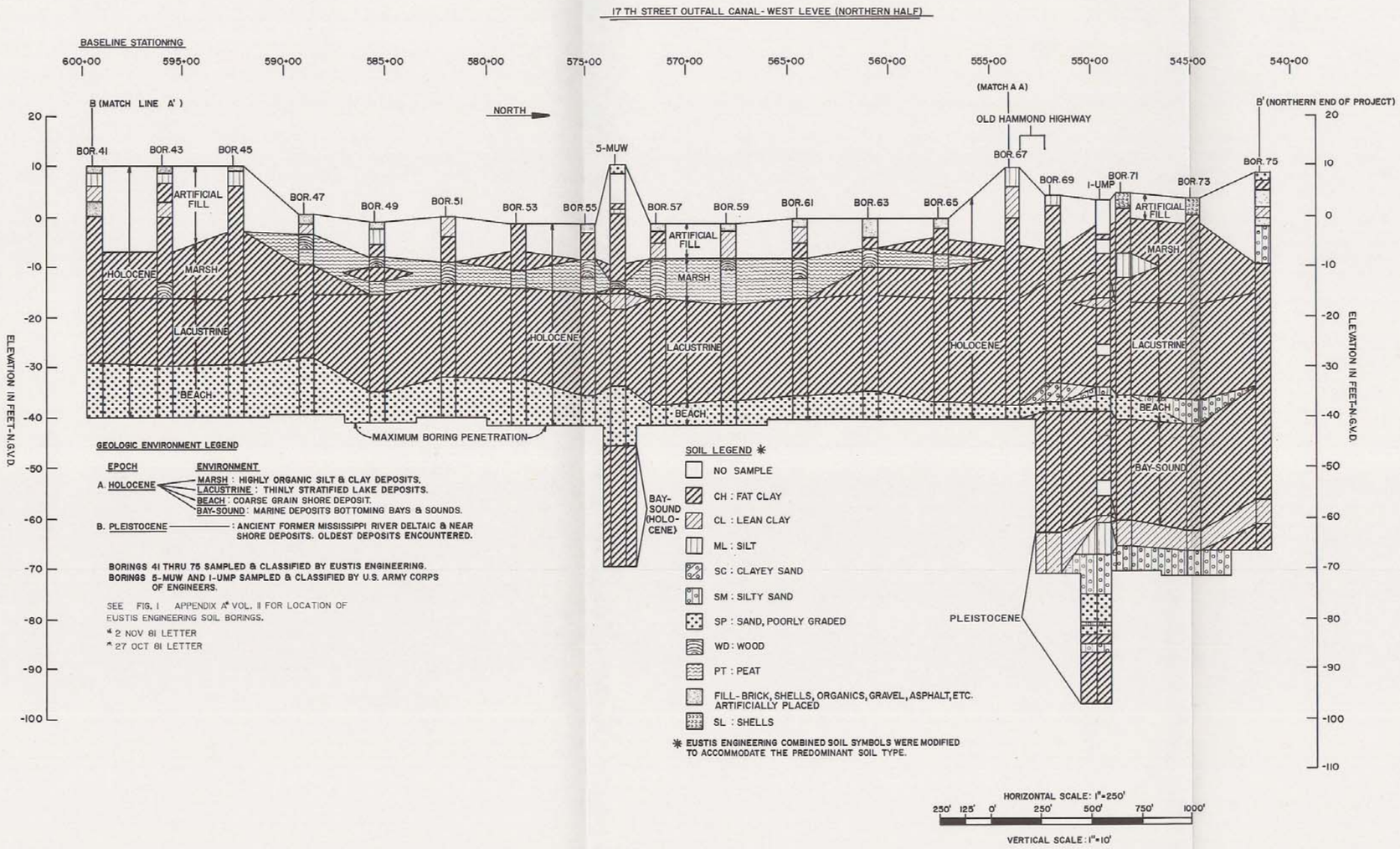

17 TH STREET OUTFALL CANAL - EAST LEVEE (SOUTHERN HALF)
BASELINE STATIONING
675+00
670+00
665+00
660+00
655+00
650+00
645+00
640+00
635+00
630+00
625+00
620+00
615+00
610+00
605+00
600+00
595+00
C (SOUTH END OF PROJECT)
C' (MATCH LINE D)
NORTH
INTERSTATE 10
VETERANS BLVD.
2-MUE
BOR. 2
BOR. 4
BOR. 6
BOR. 8
BOR. 10
BOR. 12
BOR. 14
BOR. 16
BOR. 18
BOR. 20(A)
BOR. 22
BOR. 24
BOR. 26(B)
BOR. 28
BOR. 30
BOR. 32
BOR. 34
BOR. 36
BOR. 38
BOR. 40
BOR. 42
4-MUE
ARTIFICIAL FILL
MARSH
PRODELTA
HOLOCENE
BEACH
LACUSTRINE
MAXIMUM BORING PENETRATION
BAY-SOUND (HOLOCENE)
PLEISTOCENE
BAY-SOUND
ELEVATION IN FEET-N.G.V.D.
20
10
0
-10
-20
-30
-40
-50
-60
-70
-80
GEOLOGIC ENVIRONMENT LEGEND
EPOCH
ENVIRONMENT
A. HOLOCENE
MARSH : HIGHLY ORGANIC SILT & CLAY DEPOSITS
LACUSTRINE : THINLY STRATIFIED LAKE DEPOSITS
BEACH : COARSE GRAIN SHORE DEPOSITS
BAY-SOUND : MARINE DEPOSITS BOTTOMING BAYS & SOUNDS.
PRODELTA : PROGRADING PORTION OF DELTA FRONT, TYPICALLY FAT CLAYS.
B. PLEISTOCENE
ANCIENT FORMER MISSISSIPPI RIVER DELTAIC & NEAR SHORE NEAR SHORE DEPOSITS, OLDEST DEPOSITS ENCOUNTERED.
BORINGS 2 THRU 42 SAMPLED & CLASSIFIED BY EUSTIS ENGINEERING
BORINGS 2-MUE, 4-MUE AND 2-MUG SAMPLED & CLASSIFIED BY U.S. ARMY CORPS OF ENGINEERS.
SEE FIG. 1 APPENDIX A* VOL. II FOR LOCATION OF EUSTIS ENGINEERING SOIL BORINGS.
* 2 NOV 81 LETTER
SOIL LEGEND *
NO SAMPLE
CH : FAT CLAY
CL : LEAN CLAY
ML : SILT
SC : CLAYEY SAND
SM : SILTY SAND
SP : SAND, POORLY GRADED
WD : WOOD
PT : PEAT
FILL- BRICK, SHELL, ORGANICS, ETC.-ARTIFICIALLY PLACED
SL : SHELLS
* EUSTIS ENGINEERING COMBINED SOIL SYMBOLS WERE MODIFIED TO ACCOMMODATE THE CONCENTRATE SOIL TYPE AND THE ACCOMPLIATE UNIFIED SOIL CLASSIFICATION SYMBOL.
A. BOR. 20-SIEVE ANALYSIS INDICATED SM AT DEPTHS OF 28.0' TO 30.0' THE SP SYMBOL WAS CHANGED TO ACCOMODATE THE DATA.
B. BOR. 26-SIEVE ANALYSIS INDICATED SM AT DEPTHS OF 23.5' TO 25.0' THE SP SYMBOL WAS CHANGED TO ACCOMODATE THE DATA.
HORIZONTAL SCALE: 1"=250'
250' 125' 0' 250' 500' 750' 1000'
VERTICAL SCALE: 1"=10'
LAKE PONTCHARTRAIN, LA. AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO. 20 GENERAL DESIGN
ORLEANS PARISH - JEFFERSON PARISH
17 TH STREET OUTFALL CANAL
(METAIRIE RELIEF)
SOIL AND GEOLOGICAL PLATE
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
March 1990
FILE NO. H-2-20300

PLATE 37



GEOLOGIC ENVIRONMENT LEGEND

EPOCH	ENVIRONMENT
A. HOLOCENE	MARSH : HIGHLY ORGANIC SILT & CLAY DEPOSITS.
	LACUSTRINE : THINLY STRATIFIED LAKE DEPOSITS.
	BEACH : COARSE GRAIN SHORE DEPOSIT.
	BAY-SOUND : MARINE DEPOSITS BOTTOMING BAYS & SOUNDS.
B. PLEISTOCENE	: ANCIENT FORMER MISSISSIPPI RIVER DELTAIC & NEAR SHORE DEPOSITS. OLDEST DEPOSITS ENCOUNTERED.

BORINGS 41 THRU 75 SAMPLED & CLASSIFIED BY EUSTIS ENGINEERING.
BORINGS 5-MUW AND I-UMP SAMPLED & CLASSIFIED BY U.S. ARMY CORPS OF ENGINEERS.

SEE FIG. 1 APPENDIX A* VOL. II FOR LOCATION OF EUSTIS ENGINEERING SOIL BORINGS.

* 2 NOV 81 LETTER
^ 27 OCT 81 LETTER

SOIL LEGEND *

- NO SAMPLE
- CH : FAT CLAY
- CL : LEAN CLAY
- ML : SILT
- SC : CLAYEY SAND
- SM : SILTY SAND
- SP : SAND, POORLY GRADED
- WD : WOOD
- PT : PEAT
- FILL - BRICK, SHELLS, ORGANICS, GRAVEL, ASPHALT, ETC. ARTIFICIALLY PLACED
- SL : SHELLS

* EUSTIS ENGINEERING COMBINED SOIL SYMBOLS WERE MODIFIED TO ACCOMMODATE THE PREDOMINANT SOIL TYPE.

HORIZONTAL SCALE: 1" = 250'

250' 125' 0' 250' 500' 750' 1000'

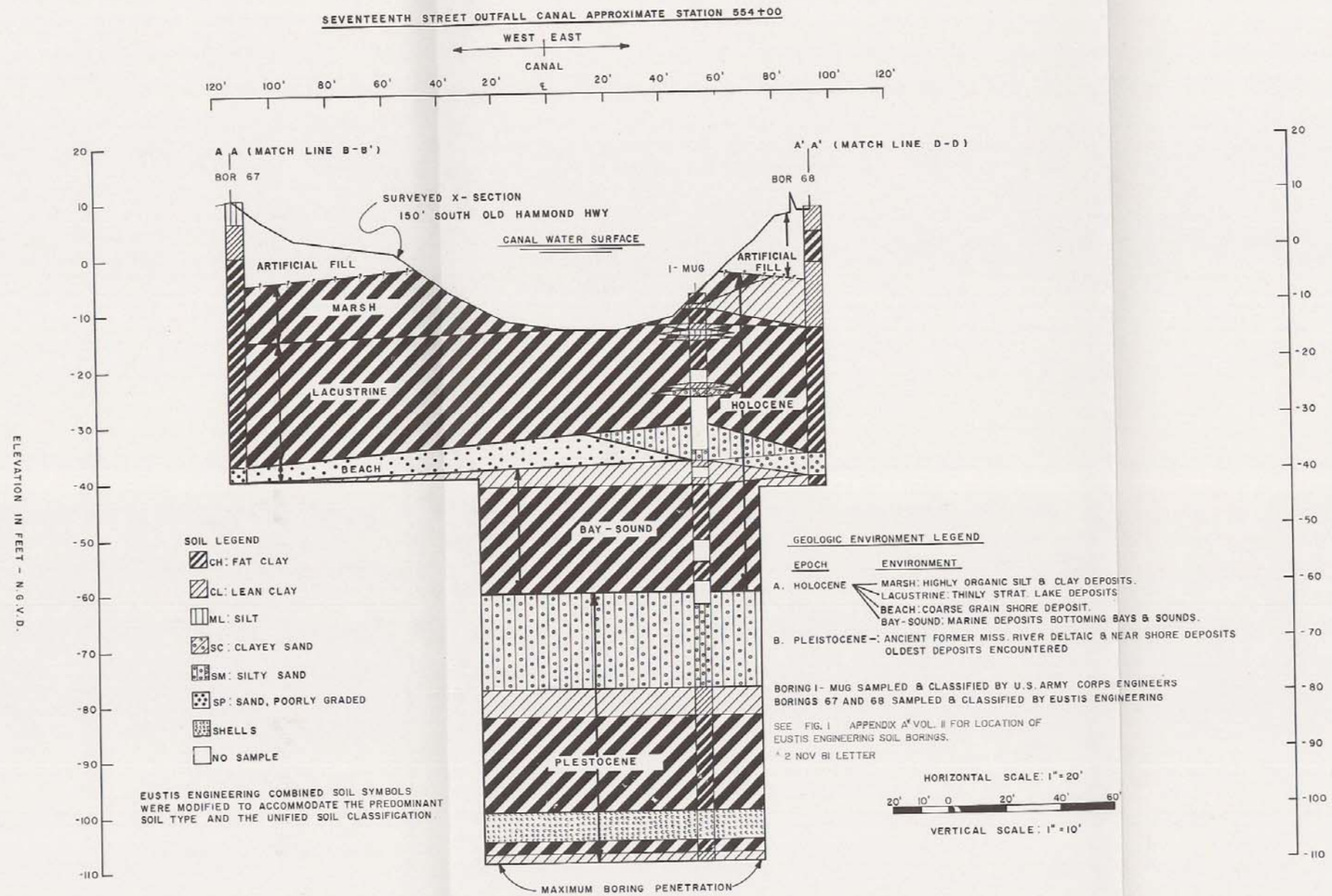
VERTICAL SCALE: 1" = 10'

LAKE PONTCHARTRAIN, LA. AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO. 20 GENERAL DESIGN
ORLEANS PARISH - JEFFERSON PARISH
17 TH. STREET OUTFALL CANAL
(METAIRIE RELIEF)

SOIL AND GEOLOGICAL PLATE

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

DATE: MARCH 1990 FILE NO. H-2-30300



LAKE PONTCHARTRAIN, LA. AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO. 20 GENERAL DESIGN
ORLEANS PARISH - JEFFERSON PARISH
17 TH. STREET OUTFALL CANAL
(METAIRIE RELIEF)

SOIL AND GEOLOGICAL PLATE

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

DATE: MARCH 1990 FILE NO. H-2-30300

BOR. 13-U

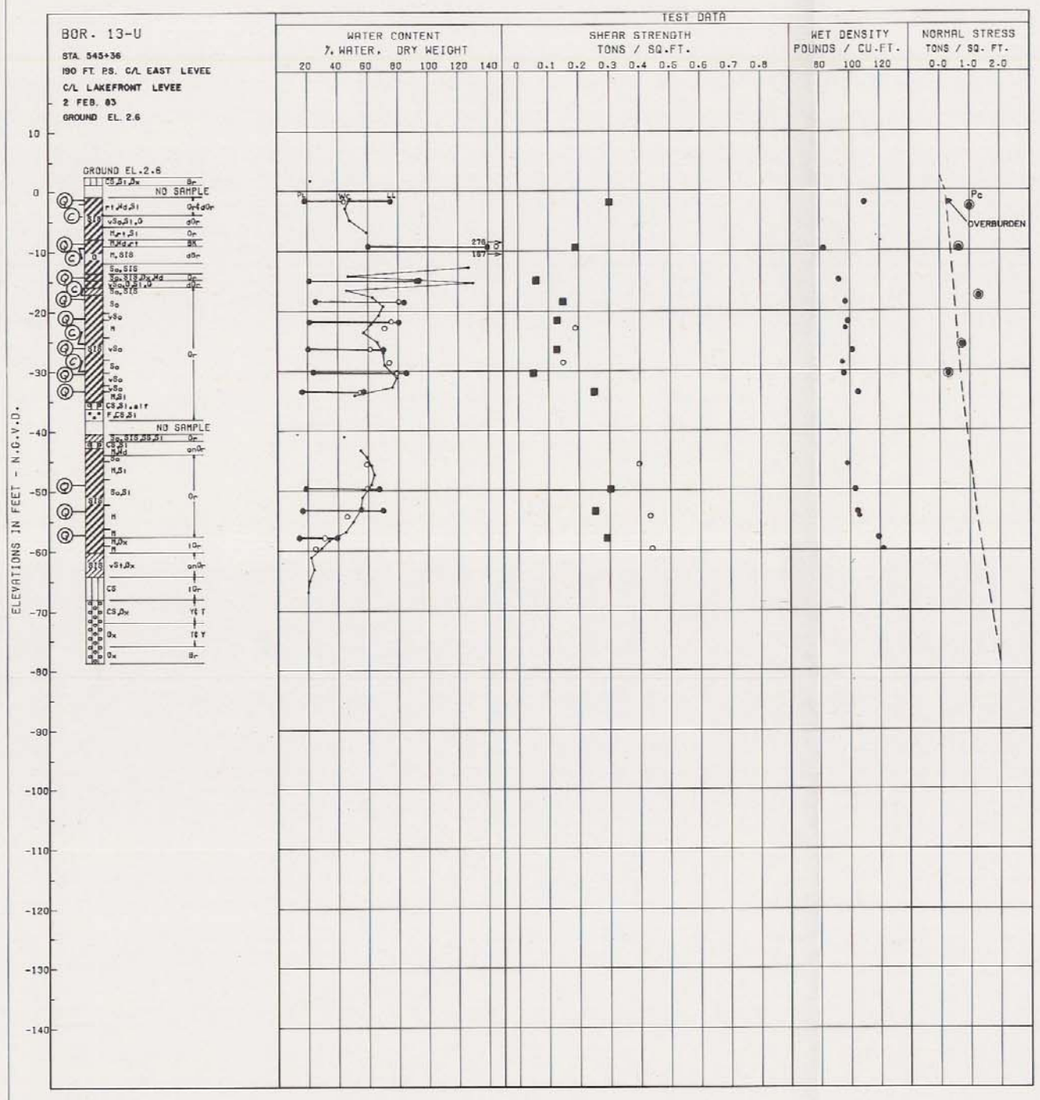
STA. 545+36

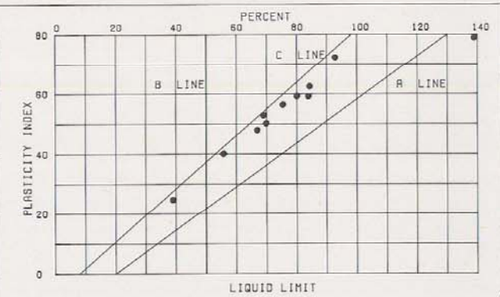
190 FT. P.S. C/L EAST LEVEE

C/L LAKEFRONT LEVEE

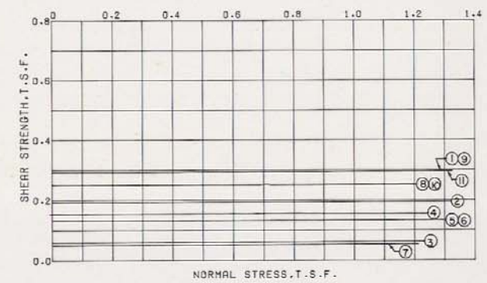
2 FEB. 83

GROUND EL. 2.6



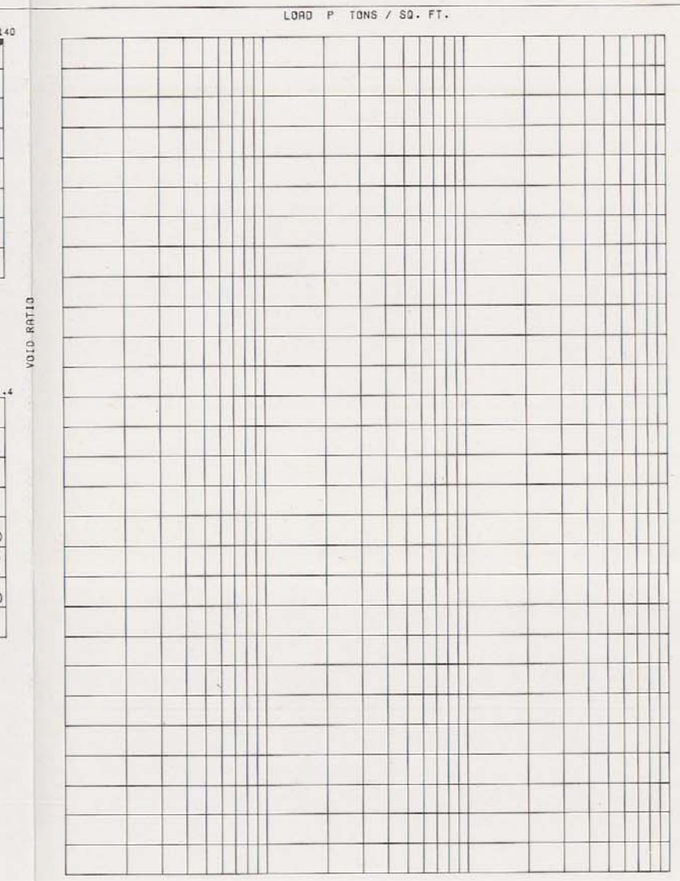


PLASTICITY CHART



SHEAR STRENGTH DATA

ENVELOPE		TYPE	STRENGTH		CLASS
NO.	EL.		Φ	C - TSF	
1	-1.9	Q	0	0.30	CH
2	-9.2	Q	0	0.19	CH
3	-14.7	Q	0	0.06	CH
4	-18.3	Q	0	0.15	CH
5	-21.5	Q	0	0.13	CH
6	-26.4	Q	0	0.13	CH
7	-30.4	Q	0	0.05	CH
8	-33.6	Q	0	0.25	CH
9	-49.7	Q	0	0.30	CH
10	-53.6	Q	0	0.25	CH
11	-57.8	Q	0	0.29	CL



CONSOLIDATION DATA

O- (UC) UNCONFINED COMPRESSION TEST

■- (Q) UNCONSOLIDATED - UNDRAINED SHEAR TEST

- (R) CONSOLIDATED - UNDRAINED SHEAR TEST

- (S) CONSOLIDATED - DRAINED SHEAR TEST

BORINGS WERE TAKEN WITH A 3 INCH DIAMETER STEEL TUBE PISTON TYPE SAMPLER

FOR SOIL BORING LEGEND SEE PLATE A

FOR LOCATION OF BORING SEE PLATE 2

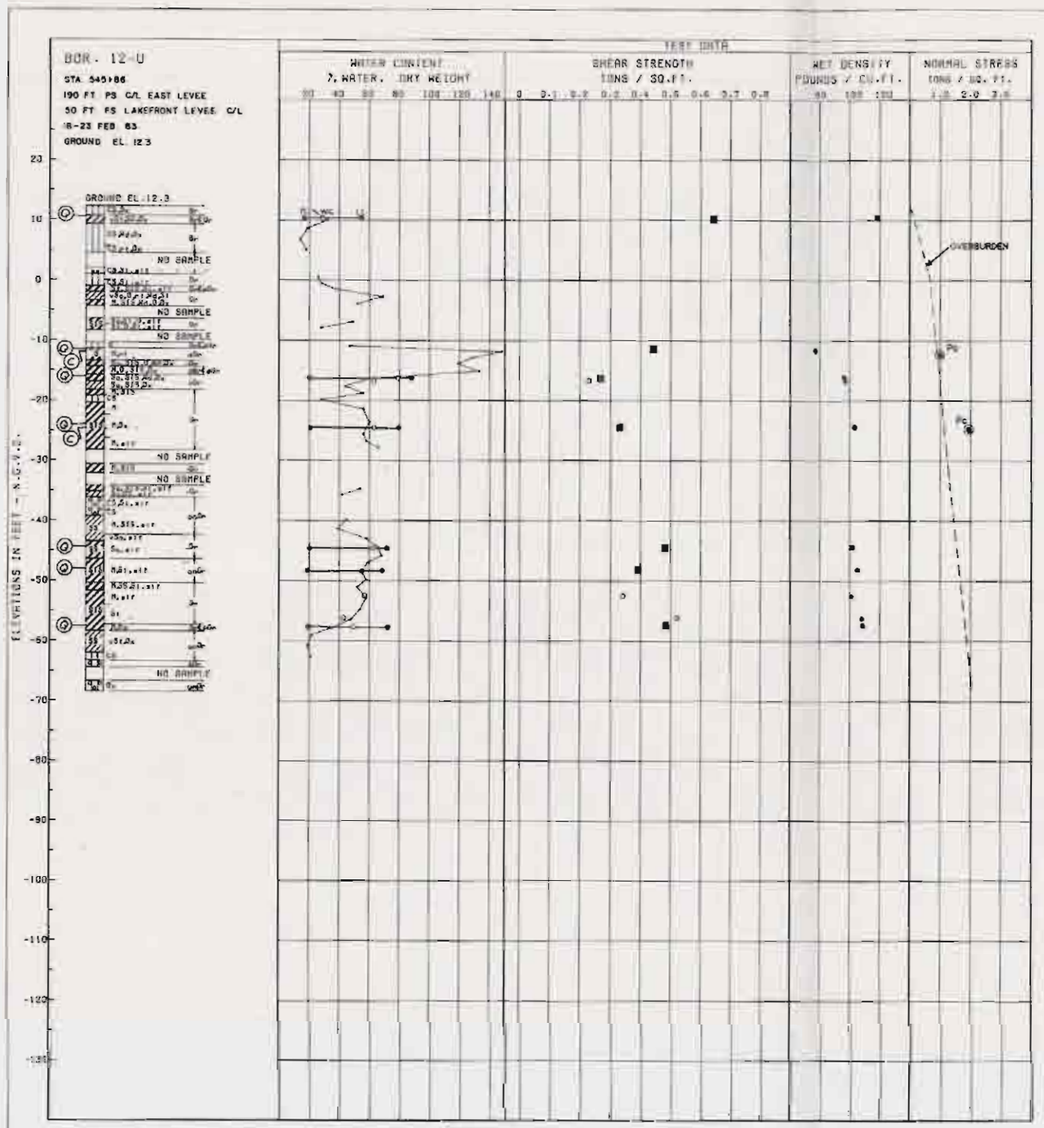
LAKE PONTCHARTRAIN, LA. AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO. 20 GENERAL DESIGN
ORLEANS PARISH - JEFFERSON PARISH
17 TH. STREET OUTFALL CANAL
(METAIRIE RELIEF)

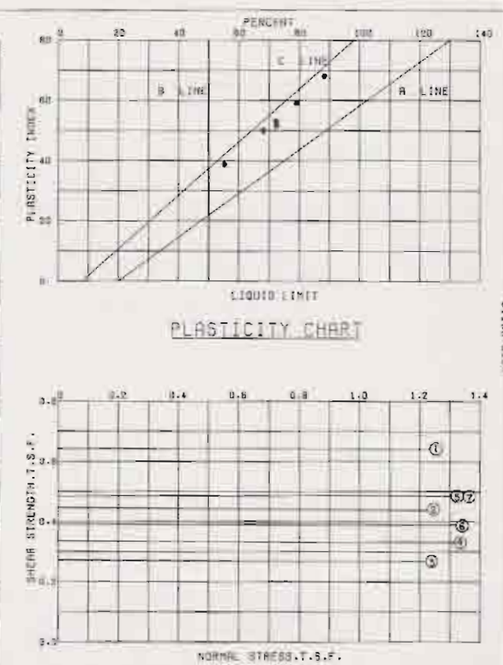
UNDISTURBED BORING 13-U

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

DATE: MARCH 1990

FILE NO. H-2-30300

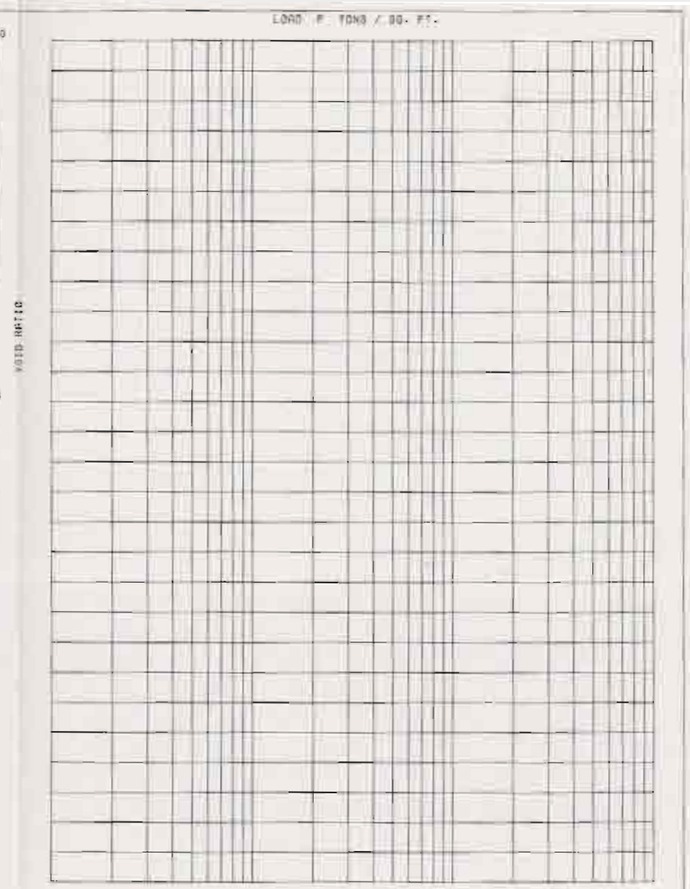




PLASTICITY CHART

SHEAR STRENGTH DATA

ENVELOPE NO.	EL.	TYPE	STRENGTH Φ	STRENGTH C TSF	CLASS
1	+10.3	Q	0	0.64	CH
2	-11.8	Q	0	0.44	PT
3	-18.1	Q	0	0.27	CH
4	-24.3	Q	0	0.33	CH
5	-44.7	Q	0	0.48	CH
6	-48.1	Q	0	0.39	CH
7	-57.7	Q	0	0.48	CH



CONSOLIDATION DATA

O- (UC) UNCONFINED COMPRESSION TEST
● - (CU) UNCONSOLIDATED - UNDRAINED SHEAR TEST
- (R) CONSOLIDATED - UNDRAINED SHEAR TEST
- (S) CONSOLIDATED - DRAINED SHEAR TEST

HORIZONTAL WERE TAKEN WITH A 3 INCH DIAMETER STEEL TUBE PISTON TYPE SAMPLER

FOR SOIL BORING LEGEND SEE PLATE 8

FOR LOCATION OF BORING SEE PLATE 2

LAKE PONTCHARTRAIN, LA. AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO 20 GENERAL DESIGN
ORLEANS PARISH – JEFFERSON PARISH
17 TH. STREET OUTFALL CANAL
(METAIRIE RELIEF)

UNDISTURBED BORING 12-U

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

DATE: MARCH 1980 FILE NO. H-2-30300

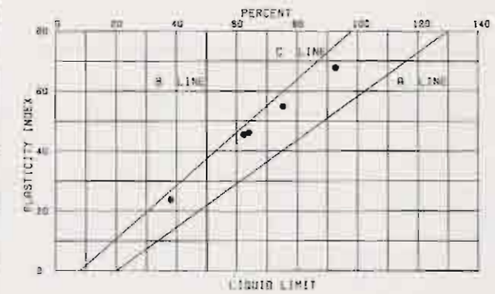
BOR. 51-U
2880 FT ± RIGHT
OF STA 347+40 ±
13-20 FEB. 85
GROUND EL. -6.4

ELEVATIONS IN FEET - N.G.V.D.

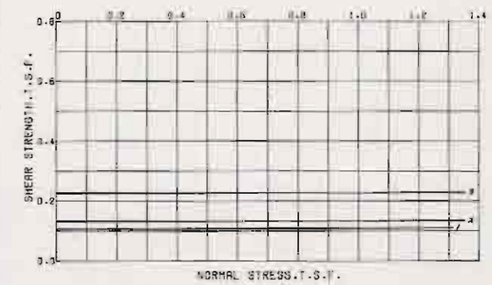
TEST DATA

WATER CONTENT % WATER. DRY WEIGHT | SHEAR STRENGTH TONS / SQ.FT. | WET DENSITY POUNDS / CU.FT. | NORMAL STRESS TONS / SQ. FT.

DESIGN SHEAR STRENGTHS
BREAKWATER



PLASTICITY CHART



SHEAR STRENGTH DATA

ENVELOPE NO.	EL.	TYPE	STRENGTH φ	STRENGTH c - TSF	CLASS
1	-20.6	Q	0°	0.107	CH
2	-32.3	Q	0°	0.132	CH
3	-45.6	Q	0°	0.228	CH

VOID RATIO

LOAD P TONS / SQ. FT.

CONSOLIDATION DATA

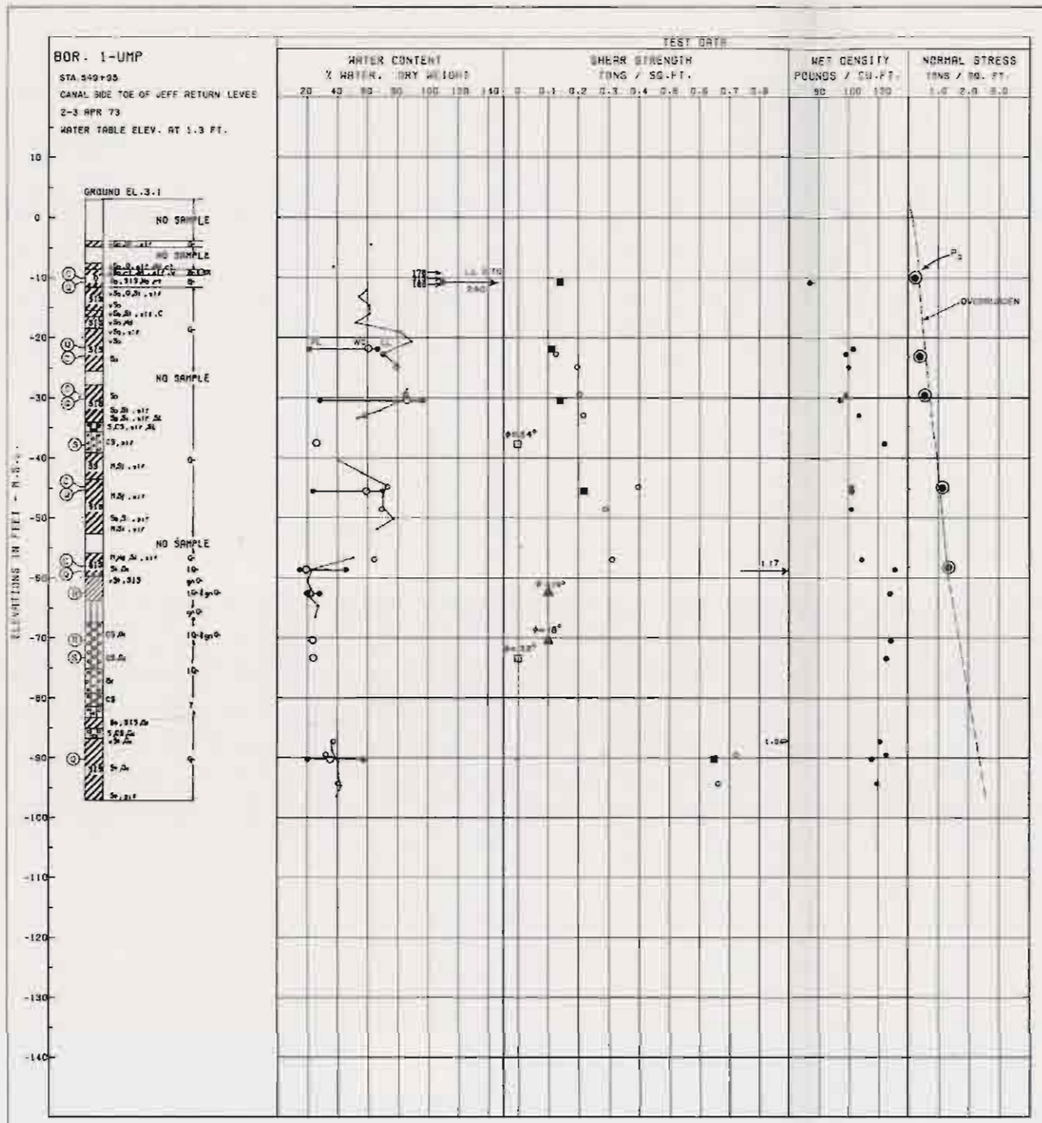
○ - (UC) UNCONFINED COMPRESSION TEST
■ - (Q) UNCONSOLIDATED - UNDRAINED SHEAR TEST
▲ - (R) CONSOLIDATED - UNDRAINED SHEAR TEST
□ - (S) CONSOLIDATED - DRAINED SHEAR TEST
BORINGS WERE TAKEN WITH 3.5 INCH DIAMETER STEEL TUBE PISTON TYPE SAMPLER
FOR SOIL BORING LEGEND SEE PLATE A
FOR LOCATION OF BORING SEE PLATE 2

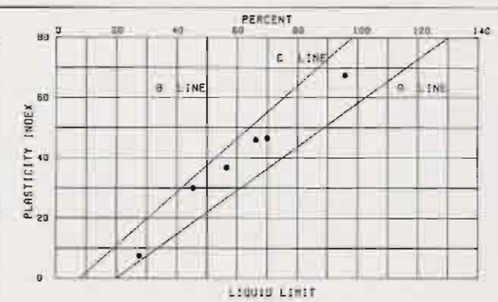
LAKE PONTCHARTRAIN, LA. AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO 20 GENERAL DESIGN
ORLEANS PARISH - JEFFERSON PARISH
17 TH. STREET OUTFALL CANAL
(METAIRIE RELIEF)

UNDISTURBED BORING 51-U

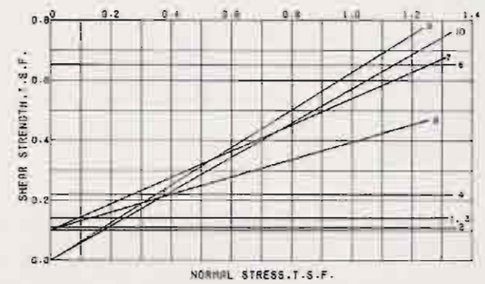
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

DATE MARCH 1990 FILE NO. H-2-30300



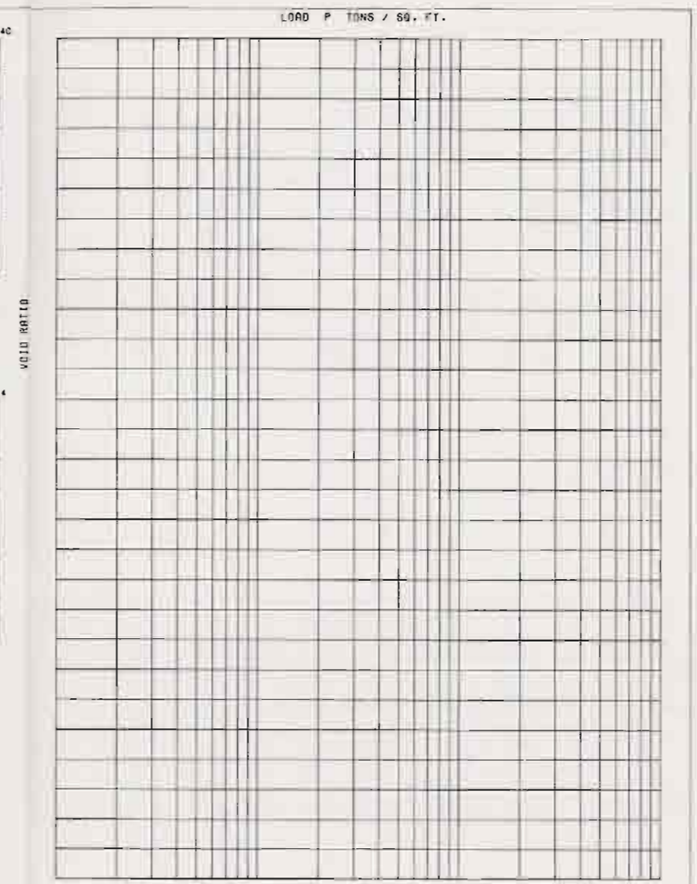


PLASTICITY CHART



SHEAR STRENGTH DATA

ENVELOPE NO.	EL.	TYPE	STRENGTH ϕ^T	STRENGTH C - TSF	CLASS
1	-10.0	U	0	0.14	OH
2	-21.8		0	0.11	CH
3	-30.3		0	0.14	CH
4	-45.7		0	0.22	CH
5	-58.7		0	1.17	CL
6	-50.2		0	0.65	CH
7	-62.7	R	24	0.10	CL
8	-70.3		18	0.10	ML
9	-37.8	S	34	0.0	SM
10	-73.8		32	0.0	SP



CONSOLIDATION DATA

o - (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

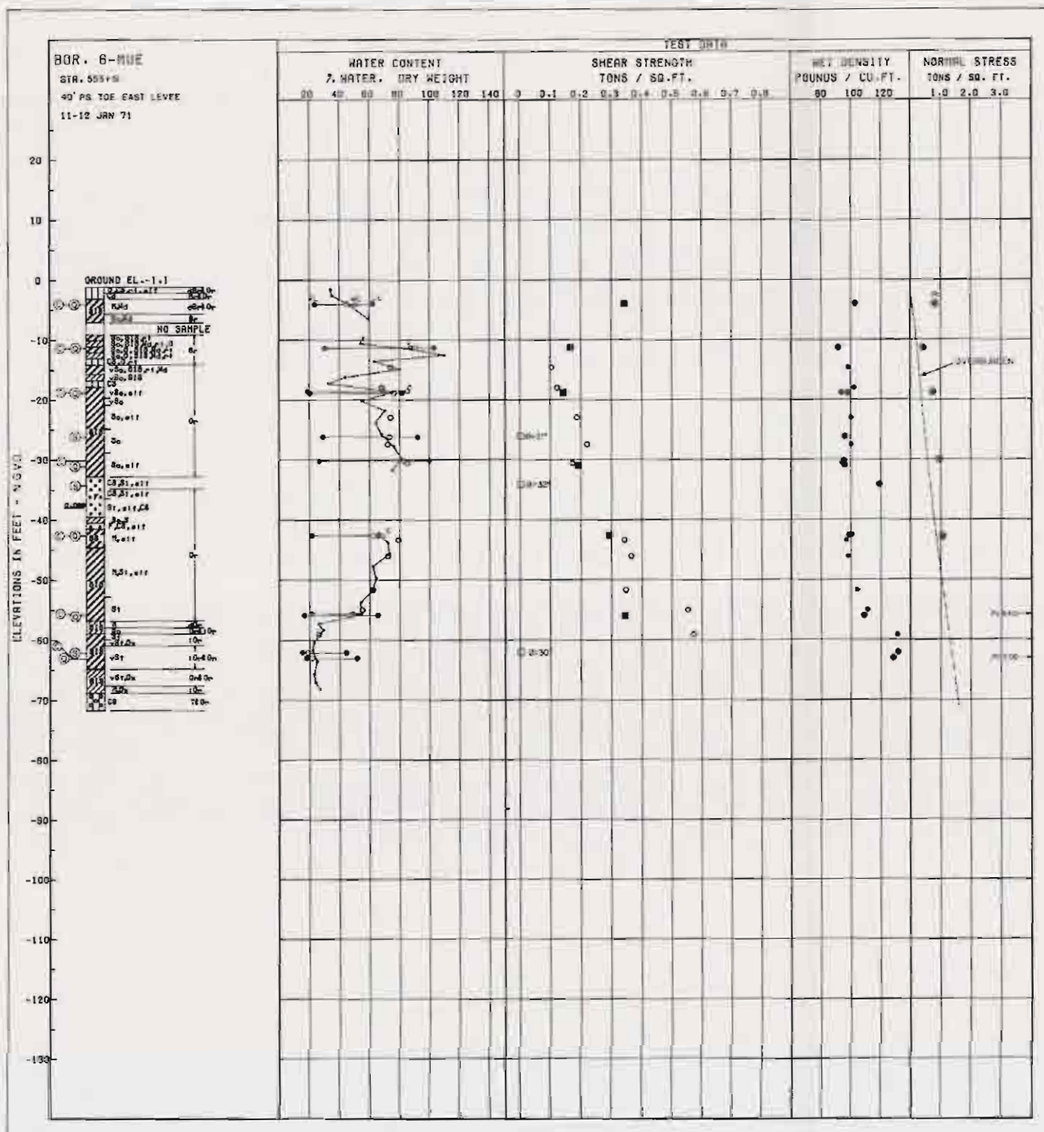
FOR LOCATION OF BORINGS SEE PLATE 2

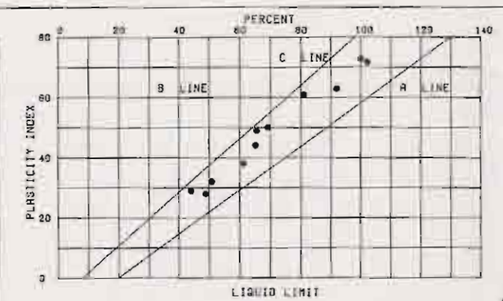
LAKE PONTCHARTRAIN, LA. AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO. 20 GENERAL DESIGN
ORLEANS PARISH - JEFFERSON PARISH
17 TH. STREET OUTFALL CANAL
(METAIRIE RELIEF)

UNDISTURBED BORING 1-UMP

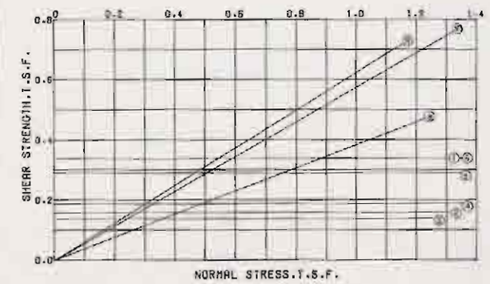
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

DATE: MARCH 1990 FILE NO. H-2-30300



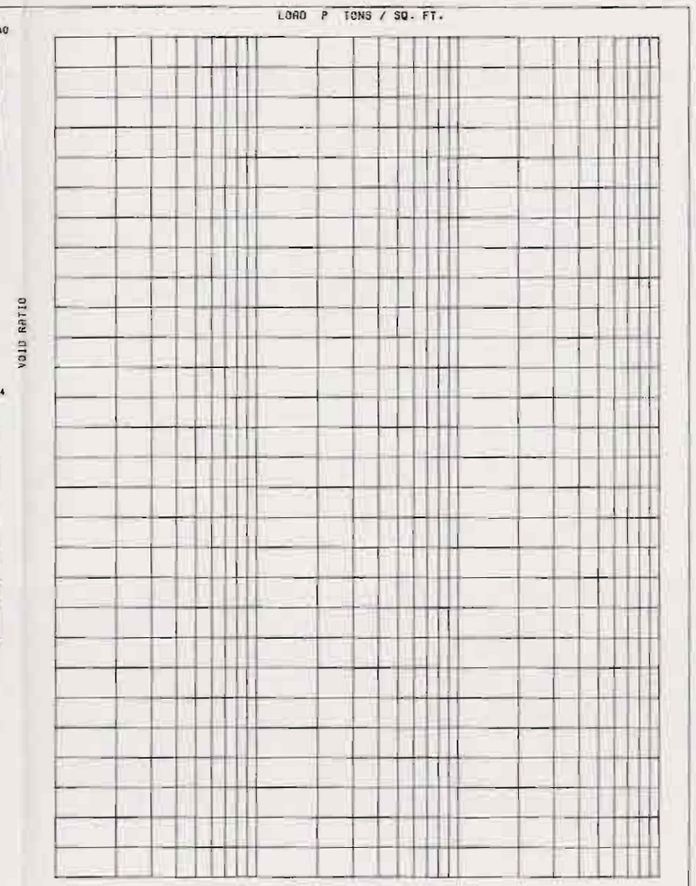


PLASTICITY CHART



SHEAR STRENGTH DATA

ENVELOPE		TYPE	STRENGTH		CLASS
NO.	EL.		φ	C - TSF	
1	[illegible]	Q	0	0.34	CH
2	[illegible]	Q	0	0.16	CH
3	[illegible]	Q	0	0.14	CH
4	[illegible]	Q	0	0.19	CH
5	[illegible]	Q	0	0.29	CH
6	[illegible]	Q	0	0.34	CH
7	[illegible]	Q	0	1.68	CH
8	[illegible]	S	[illegible]	0	CH
9	[illegible]	S	[illegible]	0	SM
10	[illegible]	S	[illegible]	0	CL



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

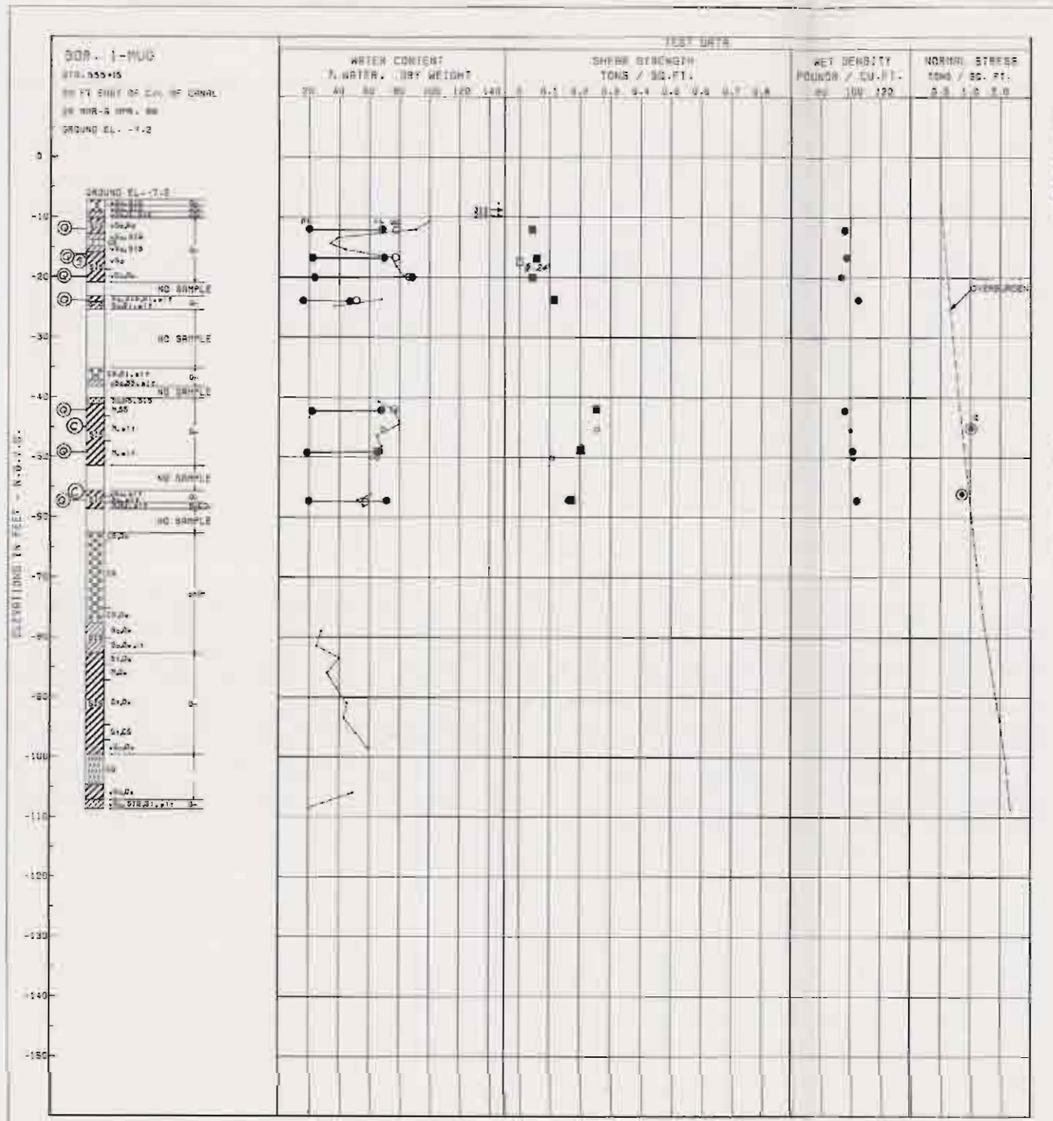
FOR LOCATION OF BORINGS SEE PLATE 2

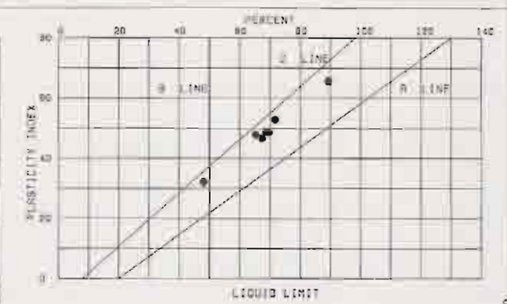
LAKE PONTCHARTRAIN, LA. AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO 20 GENERAL DESIGN
ORLEANS PARISH – JEFFERSON PARISH
17 TH. STREET OUTFALL CANAL
(METAIRIE RELIEF)

UNDISTURBED BORING 6-MUE

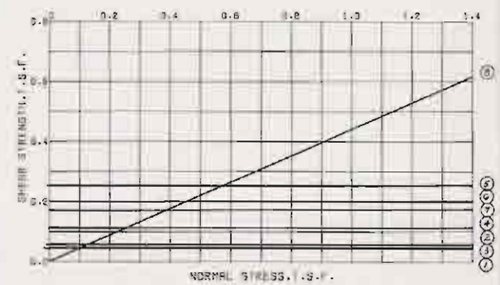
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

DATE MARCH 1990 FILE NO. H-2-30300



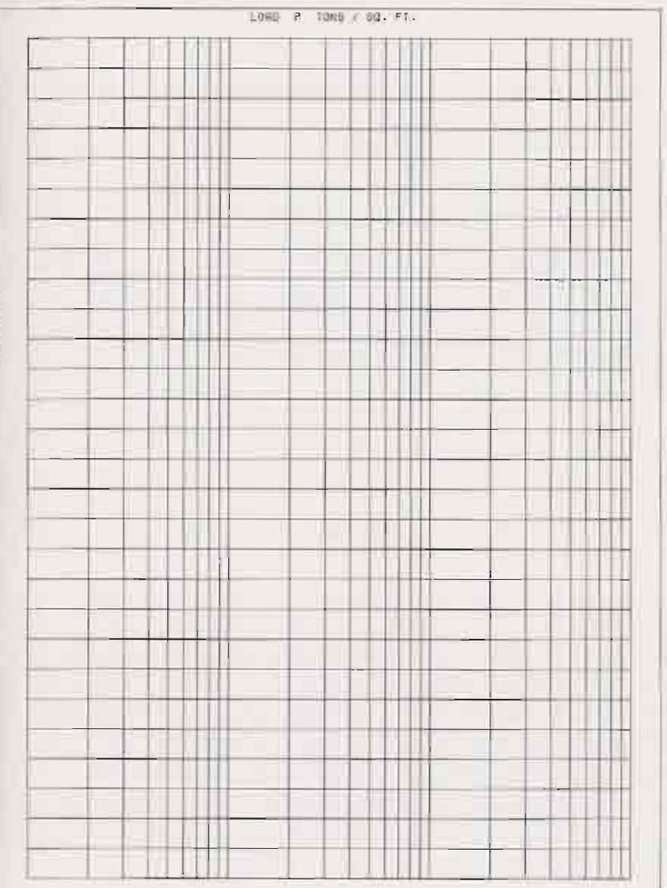


PLASTICITY CHART



SHEAR STRENGTH DATA

ENVELOPE NO.	EL.	TYPE	STRENGTH ϕ	C - TSF	CLASS
1	-12.0	Q	0	0.042	CH
2	-16.8	Q	0	0.055	CH
3	-20.2	Q	0	0.049	CH
4	-23.8	Q	0	0.110	CH
5	-42.2	Q	0	0.340	CH
6	-99.2	Q	0	0.200	CH
7	-117	Q	0	0.170	CH
8	-17.8	S	24°	0.0	CH



CONSOLIDATION DATA

- (UC) UNCONFINED COMPRESSION TEST
- (U) 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 LOGS SEE PLATE 4

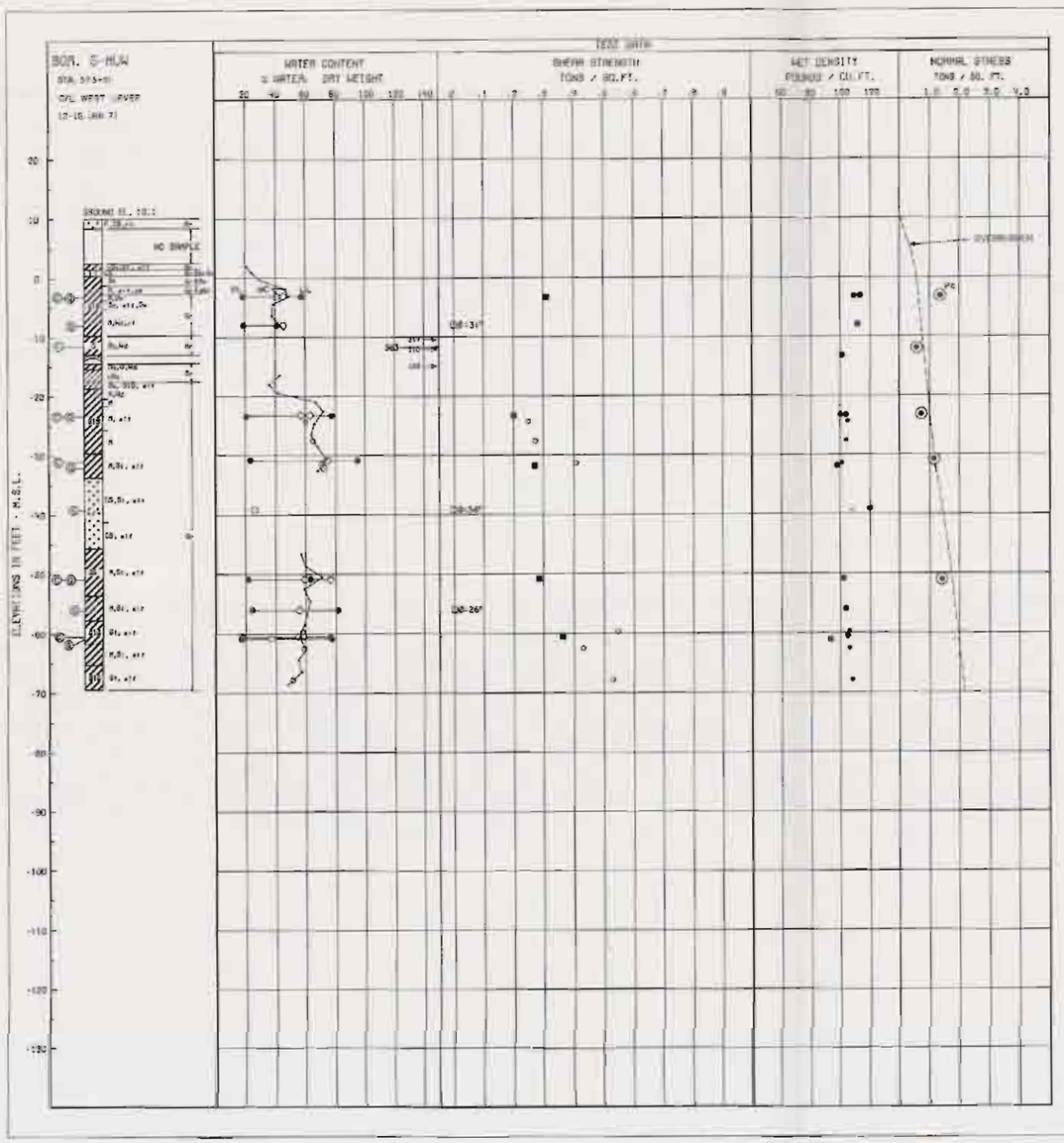
FOR LOCATION OF BORING SEE PLATE 2

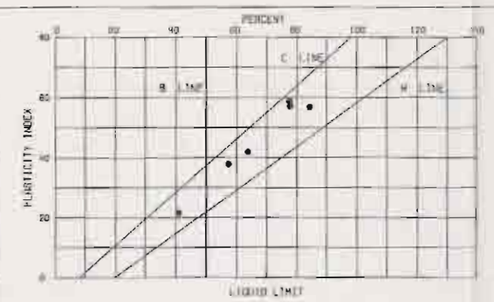
LAKE PONTCHARTRAIN, LA. AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO. 20 GENERAL DESIGN
ORLEANS PARISH - JEFFERSON PARISH
17 TH STREET OUTFALL CANAL
(METAIRIE RELIEF)

UNDISTURBED BORING I-MUG

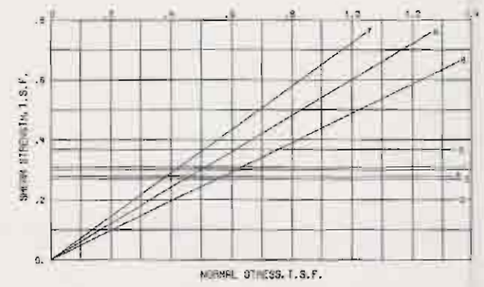
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

DATE MARCH 1990 FILE NO. H-2-30300



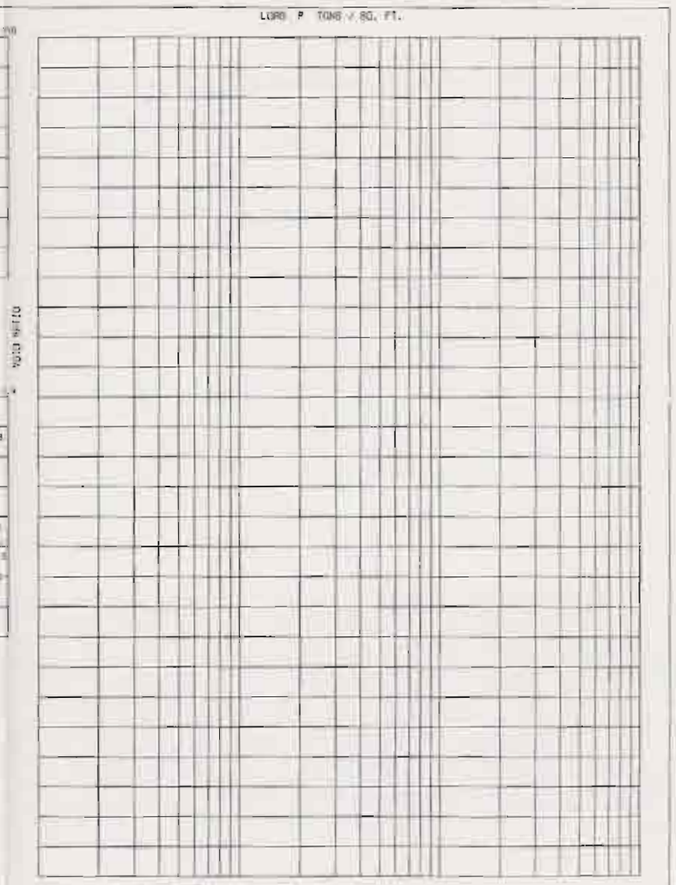


PLASTICITY CHART



SHEAR STRENGTH DATA

BORING NO.	SAMPLE NO.	SAMPLE EL.	TYPE	STRENGTH φ°	STRENGTH C TSF	CLASS
	1	-3.1	U	0	0.31	CH
	2	-23.1	U	0	0.20	CH
	3	-31.8	U	0	0.27	CH
	4	-50.8	U	0	0.28	CH
	5	-60.8	U	0	0.37	CH
	6	-8.0	S	31	0	CL
	7	-55.1	S	38	0	SP
	8	-56.0	S	26	0	CH



CONSOLIDATION DATA

O - (UC) UNCONFINED COMPRESSION TEST
■ - (CU) UNCONSOLIDATED - UNDRAINED SHEAR TEST
▲ - (R) CONSOLIDATED - UNDRAINED SHEAR TEST
⊙ - (S) CONSOLIDATED - DRAINED SHEAR TEST
BORINGS WERE TAKEN WITH A 3 INCH DIAMETER STEEL THIN WALL PISTON TYPE SAMPLER
FOR SOIL BORING LEGEND SEE PLATE 6
FOR LOCATION OF BORINGS SEE PLATE 2

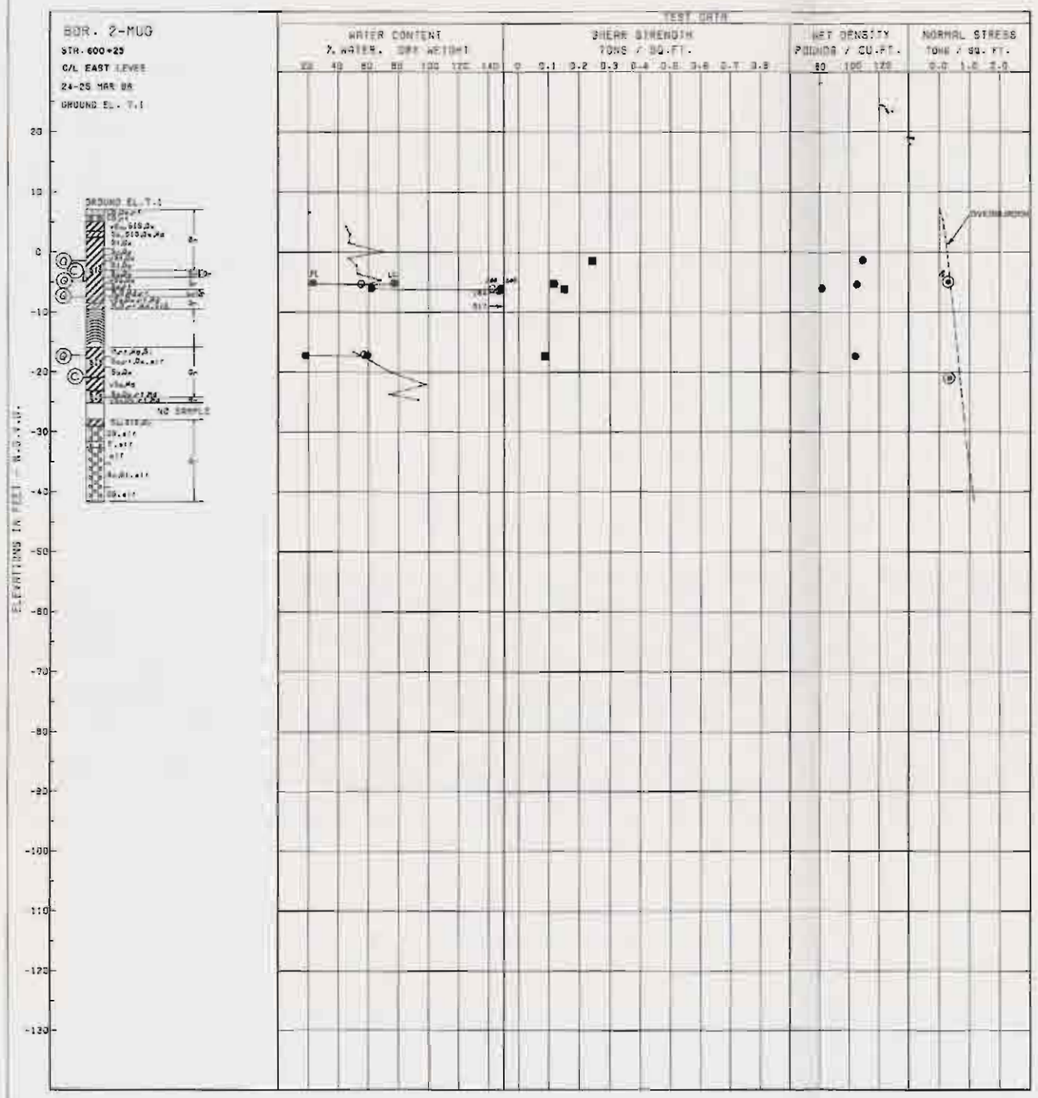
LAKE PONTCHARTRAIN, LA. AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO 20 GENERAL DESIGN
ORLEANS PARISH JEFFERSON PARISH
17 TH STREET OUTFALL CANAL
(METAIRIE RELIEF)

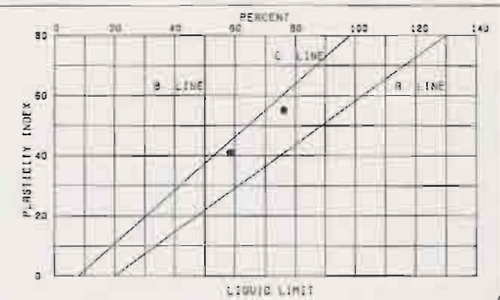
UNDISTURBED BORING 5-MUW

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

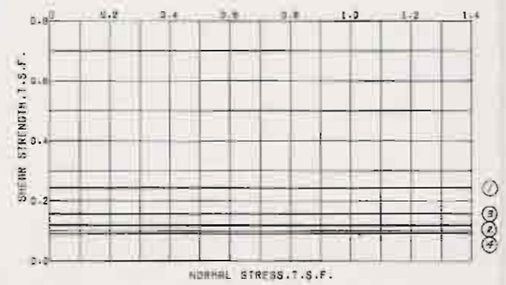
DATE: MARCH 1990 FILE NO. H-2-30,300

BOR. 2-MUG
STA. 600+25
C/L EAST LEVEE
24-25 MAR 88
GROUND EL. 7.1



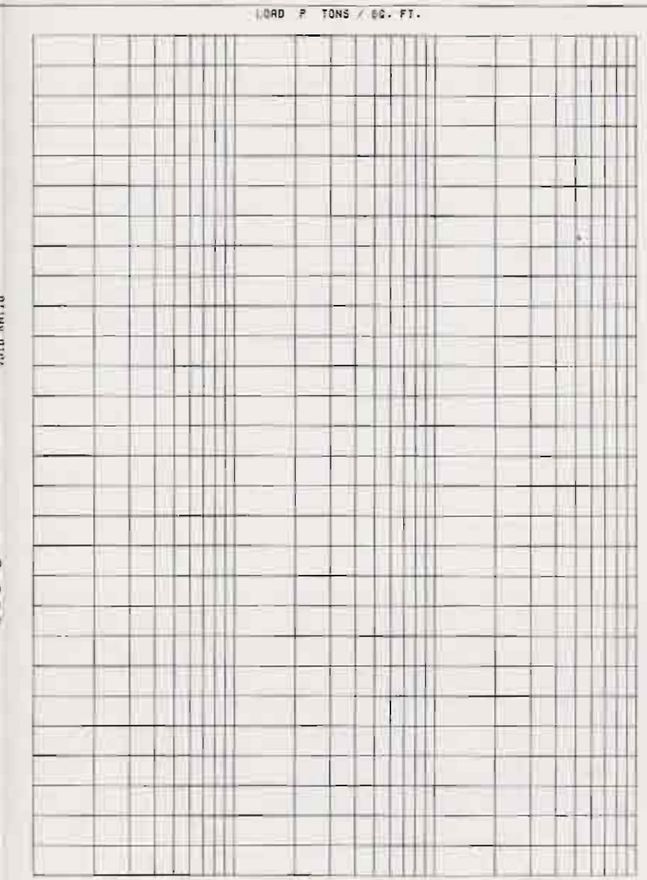


PLASTICITY CHART



SHEAR STRENGTH DATA

ENVELOPE NO.	EL.	TYPE	STRENGTH φ	STRENGTH C - TSF	CLASS
1	-18	G	0	0.140	CH
2	-53	G	0	0.115	CH
3	-63	G	0	0.150	CH
4	-175	G	0	0.090	CH



CONSOLIDATION DATA

- (UC) UNCONFINED COMPRESSION TEST
- (U) UNCONSOLIDATED - UNDRAINED SHEAR TEST
- (R) CONSOLIDATED - UNDRAINED SHEAR TEST
- (S) CONSOLIDATED - DRAINED SHEAR TEST

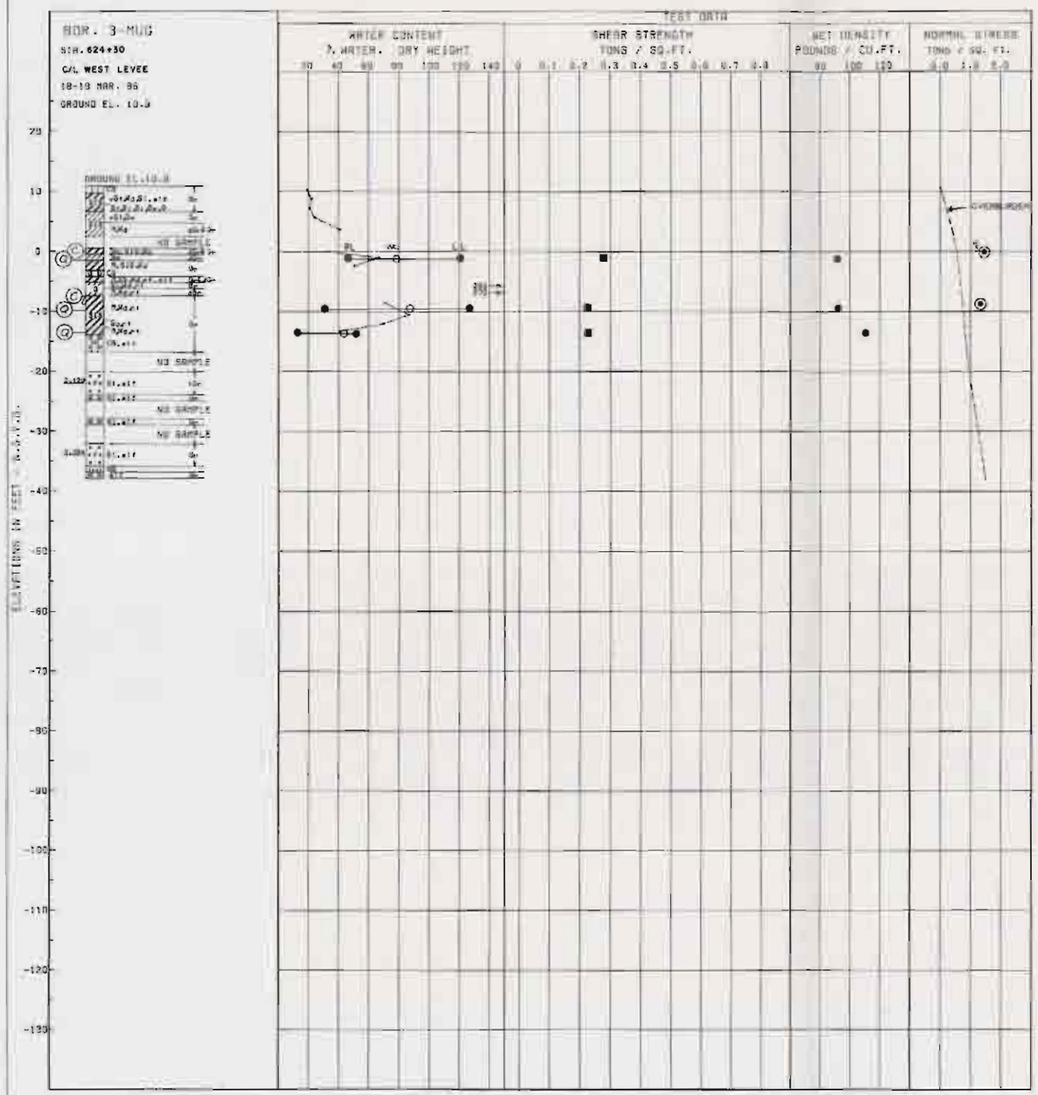
BORINGS WERE TAKEN WITH A 5 INCH DIAMETER STEEL TUBE PISTON TYPE SAMPLER
FOR SOIL BORING LEGEND SEE PLATE A
FOR LOCATION OF BORING SEE PLATE 3

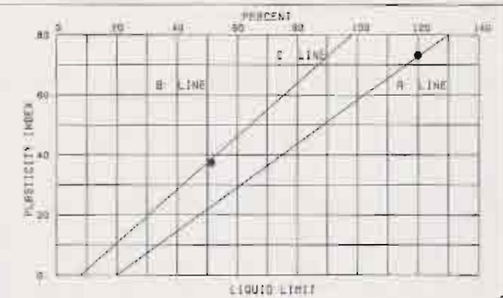
LAKE PONTCHARTRAIN, LA. AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO 20 GENERAL DESIGN
ORLEANS PARISH - JEFFERSON PARISH
17 TH STREET OUTFALL CANAL
(METAIRIE RELIEF)

UNDISTURBED BORING 2-MUG

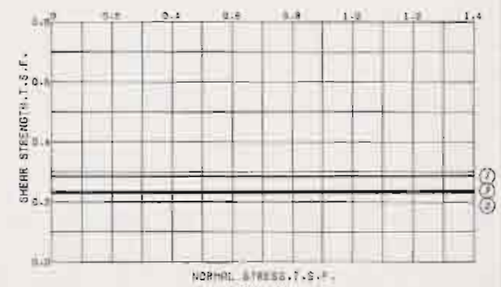
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
DATE: MARCH 1990
FILE NO. H-2-30300

BOR. 3-MUG
STA. 624+30
C/L WEST LEVEE
18-19 MAR. 86
GROUND EL. 10.5



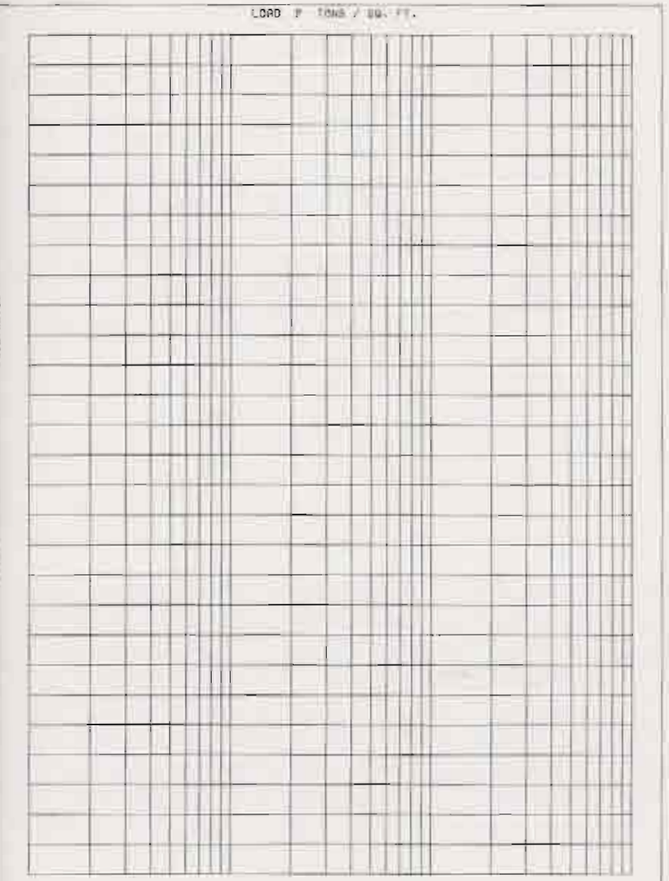


PLASTICITY CHART



SHEAR STRENGTH DATA

ENVELOPE NO.	EL.	TYPE	STRENGTH ϕ	STRENGTH c - TSF	CLASS
1	-11	Q	0	0.280	CH
2	-99	Q	0	0.225	CH
3	-133	Q	0	0.227	CH



CONSOLIDATION DATA

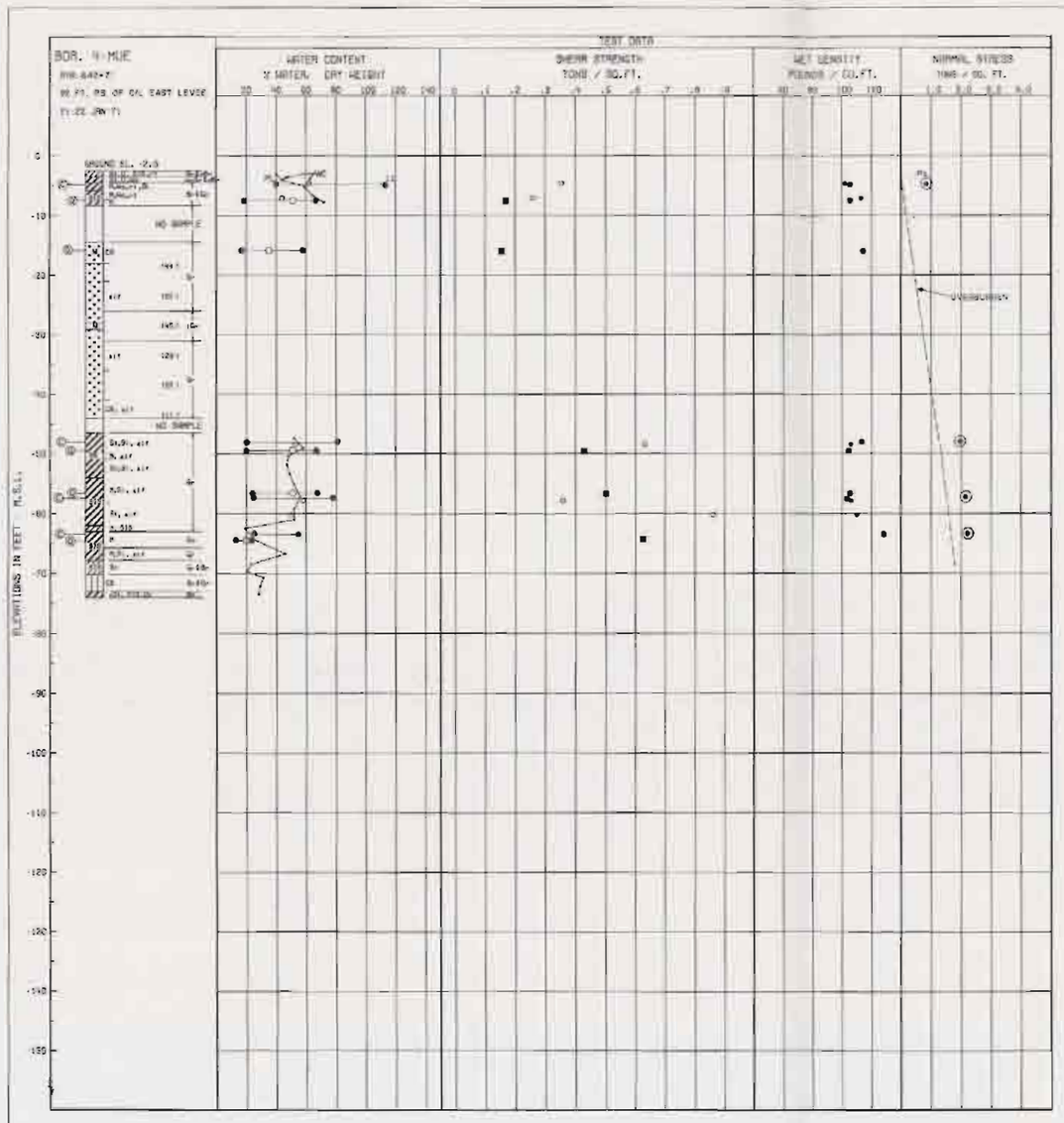
- (UC) UNCONFINED COMPRESSION TEST
- (Q) UNCONSOLIDATED - UNDRAINED SHEAR TEST
- (R) CONSOLIDATED - UNDRAINED SHEAR TEST
- (S) CONSOLIDATED - DRAINED SHEAR TEST

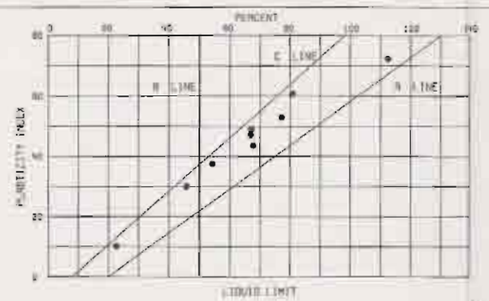
BORINGS ARE TAKEN WITH A 3 INCH DIAMETER STEEL TUBE PISTON TYPE SAMPLER.
FOR SOIL BORING LEGEND SEE PLATE 6
FOR LOCATION OF BORING SEE PLATE 4

LAKE PONTCHARTRAIN, LA AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO 20 GENERAL DESIGN
ORLEANS PARISH JEFFERSON PARISH
17 TH STREET OUTFALL CANAL
(METAIRIE RELIEF)

UNDISTURBED BORING 3-MUG

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
DATE: MARCH 1990 FILE NO. H-2-30300





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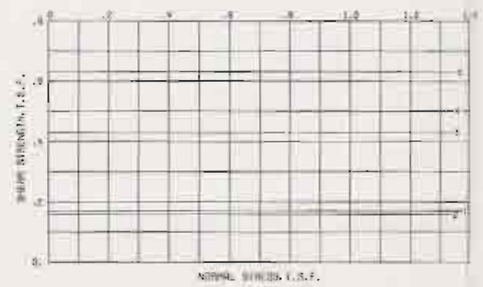
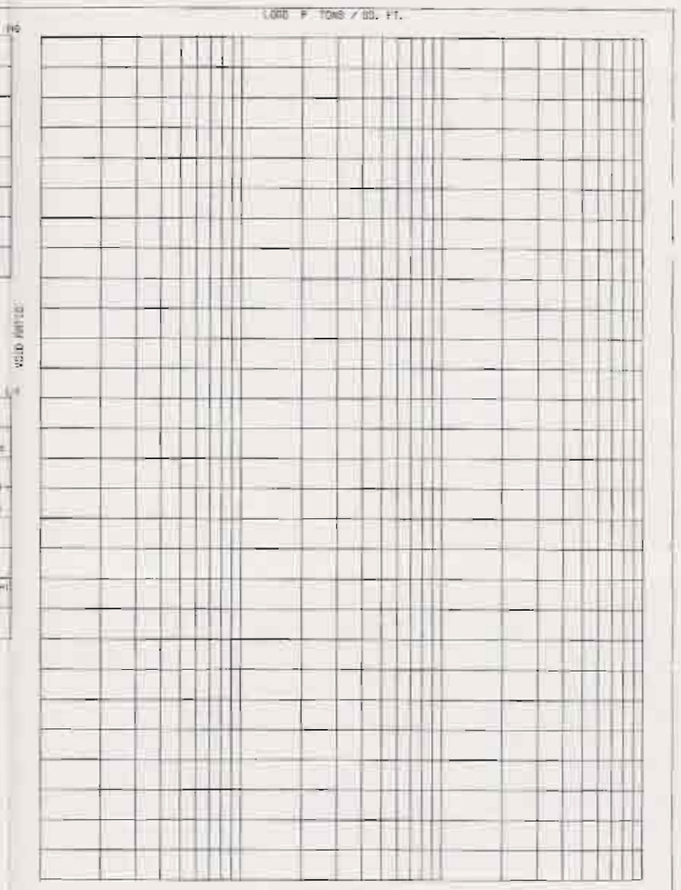


SHEAR STRENGTH DATA

BORING NO.	ENVELOPE NO.	ENVELOPE EL.	TYPE	STRENGTH ϕ	STRENGTH C - TSF	CLASS
	1	-7.5	Q	0	0.07	CH
	2	-15.5		0	0.16	CH
	3	-49.5		0	0.45	CH
	4	-56.6		0	0.50	CH
	5	-64.4		0	0.63	CL



CONSOLIDATION DATA

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

BORINGS HERE TAKEN WITH 3 & INCH DIAMETER STEEL TUBE PISTON TYPE SAMPLER

FOR SOIL BORING LEGEND SEE PLATE 8

FOR LOCATION OF BORINGS SEE PLATE 5

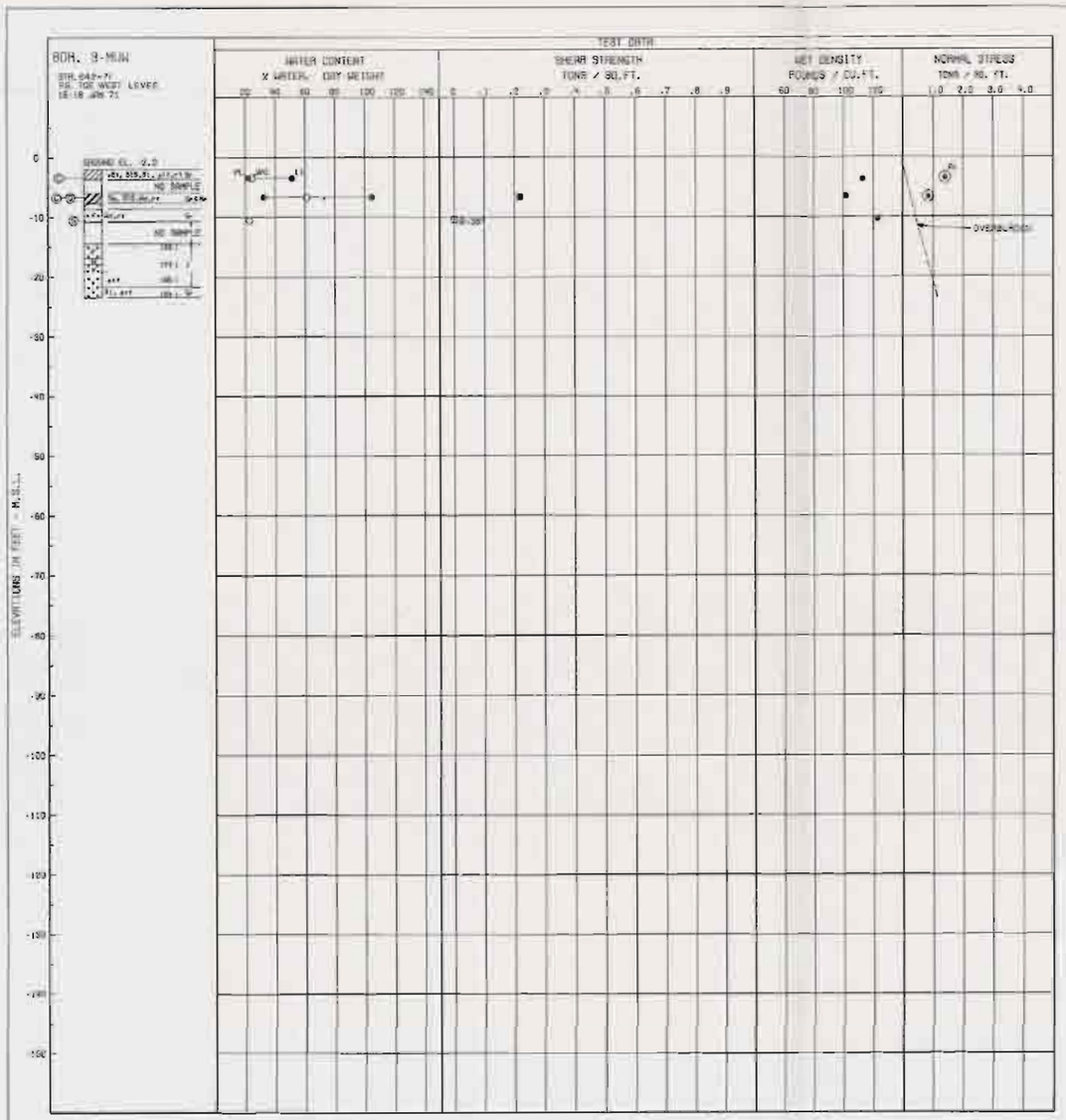
LAKE PONTCHARTRAIN, LA. AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO.20 GENERAL DESIGN
ORLEANS PARISH - JEFFERSON PARISH
17 TH. STREET OUTFALL CANAL
(METAIRIE RELIEF)

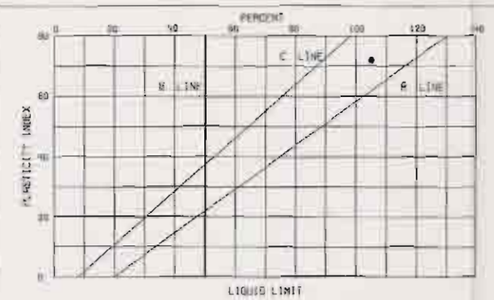
UNDISTURBED BORING 4-MUE

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

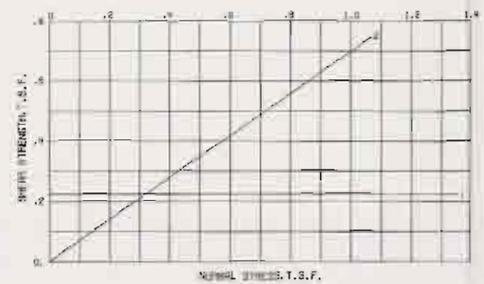
DATE: MARCH 1990

FILE NO. H-2-30506



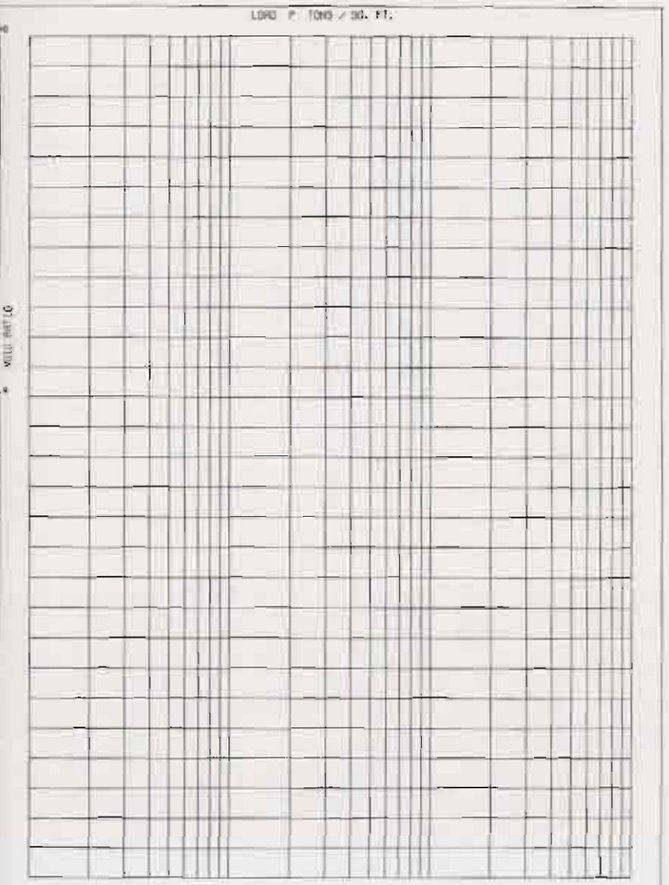


PLASTICITY CHART



SHEAR STRENGTH DATA

BORING NO.	ENVELOPE NO.	ENVELOPE EL.	TYPE	STRENGTH ϕ	STRENGTH C - TSF	CLASS
	1	-5.7	Q	0	0.22	CH
	2	-10.4	S	32	0	SM



CONSOLIDATION DATA

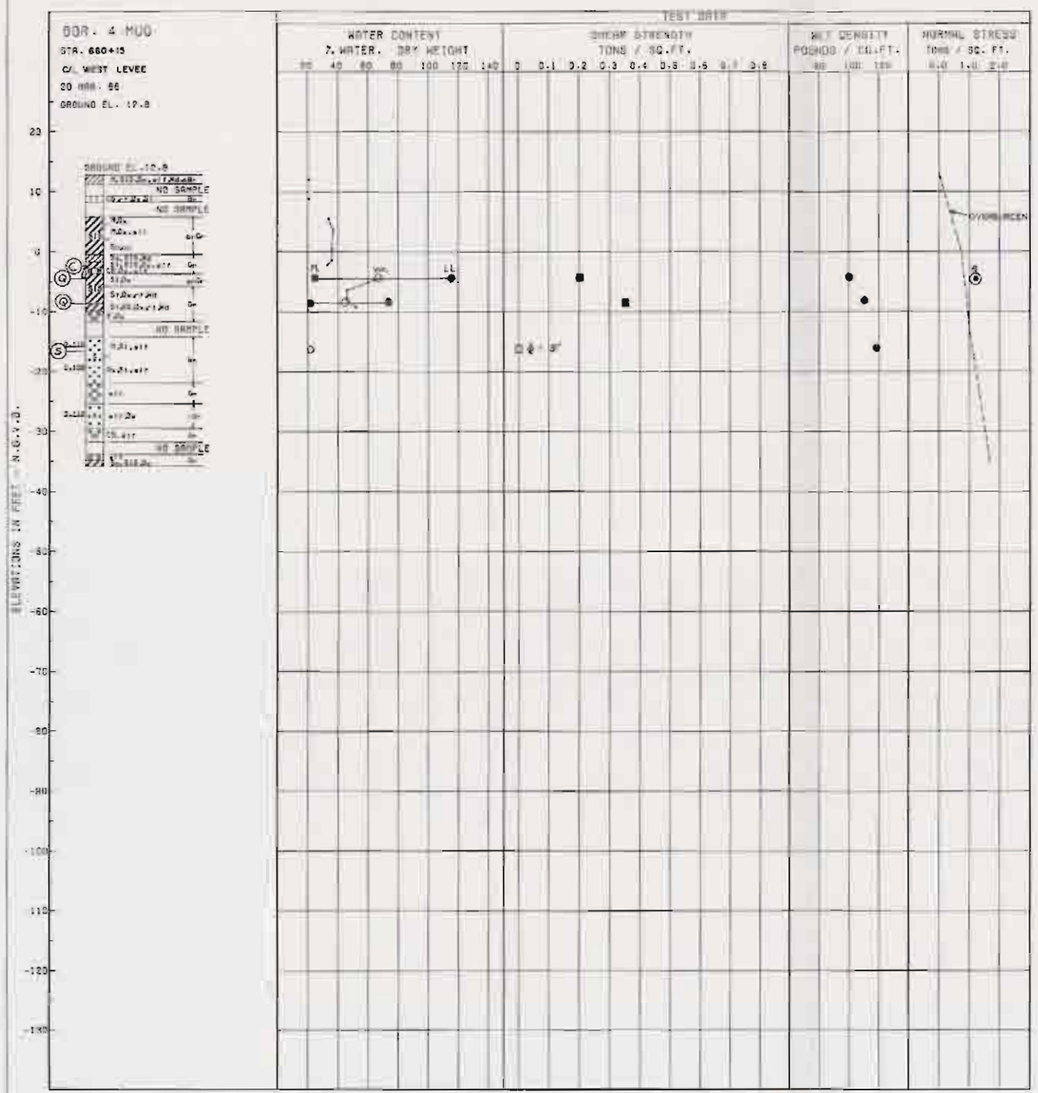
O - (UC) UNCONFINED COMPRESSION TEST
■ - (U) UNCONSOLIDATED - UNDRAINED SHEAR TEST
▲ - (R) CONSOLIDATED - UNDRAINED SHEAR TEST
□ - (S) CONSOLIDATED - DRAINED SHEAR TEST
BORINGS WERE TAKEN WITH A 5 INCH DIAMETER STEEL TUBE PISTON TYPE SAMPLER
FOR SOIL BORING LEGEND SEE PLATE A
FOR LOCATION OF BORINGS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

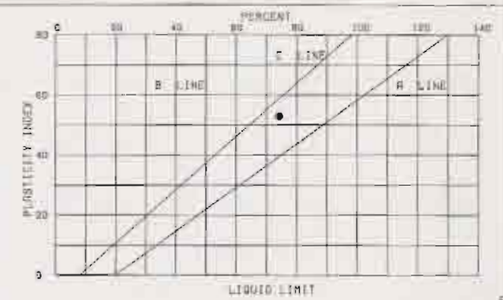
LAKE PONTCHARTRAIN, LA. AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO. 20 GENERAL DESIGN
ORLEANS PARISH – JEFFERSON PARISH
17 TH. STREET OUTFALL CANAL
(METAIRIE RELIEF)

UNDISTURBED BORING 3-MUW

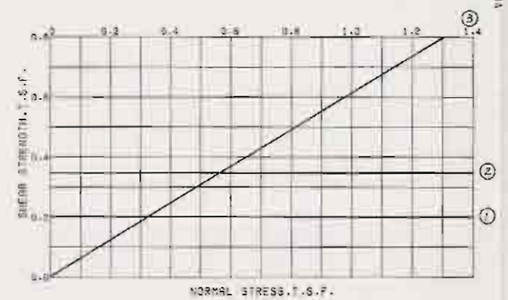
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
DATE: MARCH 1990
FILE NO. H-2-30300

BOR. 4 MUG
STA. 660+15
C/L WEST LEVEE
20 MAR. 86
GROUND EL. 17.8



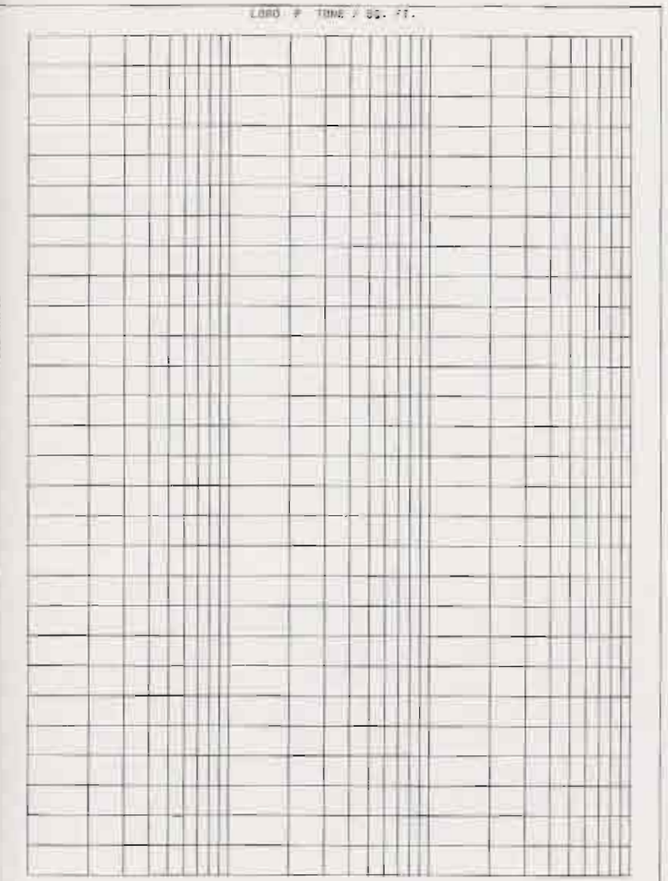


PLASTICITY CHART



SHEAR STRENGTH DATA

ENVELOPE NO.	EL.	TYPE	STRENGTH φ	STRENGTH c - TSF	CLASS
1	-43	Q	0	0.200	CH
2	-81	Q	0	0.650	CH
3	-112	Q	31°	0.0	SP



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 4.0 INCH DIAMETER STEEL TUBE PISTON TYPE SAMPLER

FOR SOIL BORING LEGEND SEE PLATE 8

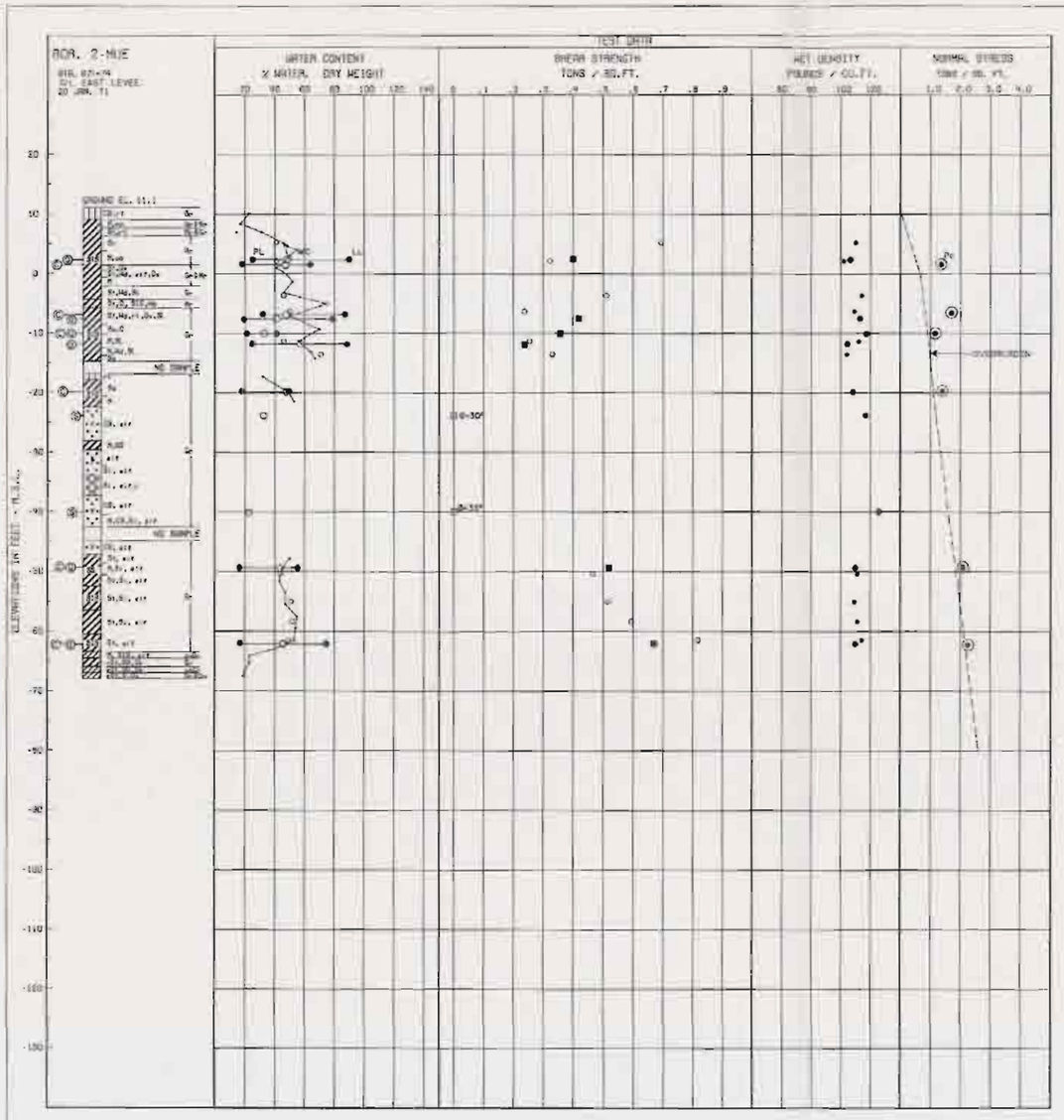
FOR LOCATION OF BORING SEE PLATE 5

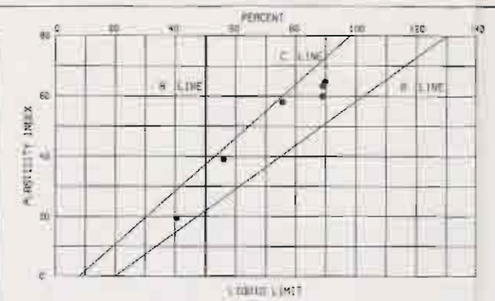
LAKE PONTCHARTRAIN, LA. AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO 20 GENERAL DESIGN
ORLEANS PARISH - JEFFERSON PARISH
17 TH. STREET OUTFALL CANAL
(METAIRIE RELIEF)

UNDISTURBED BORING 4-MUG

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

DATE: MARCH 1990 FILE NO. H-2-30300





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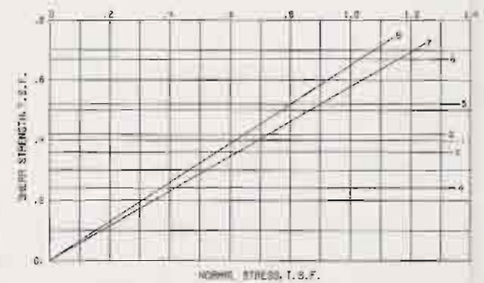
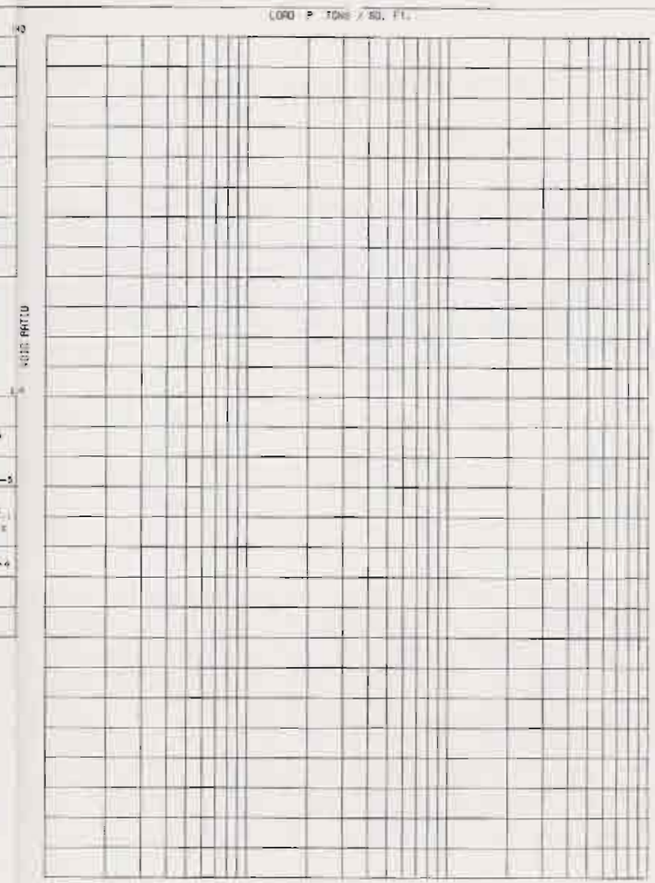


SHEAR STRENGTH DATA

BORING NO.	ENVELOPE No.	ENVELOPE EL.	TYPE	STRENGTH ϕ°	STRENGTH c TSF	CLASS
	1	2.5	Q	0	0.40	CH
	2	-7.4		0	0.42	CH
	3	-10.0		0	0.46	CH
	4	-11.8		0	0.24	CH
	5	-49.3		0	0.52	CH
	6	-60.3		0	0.67	CH
	7	-23.8	S	30	0	SM
	8	-40.0		33	0	SM



CONSOLIDATION DATA

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

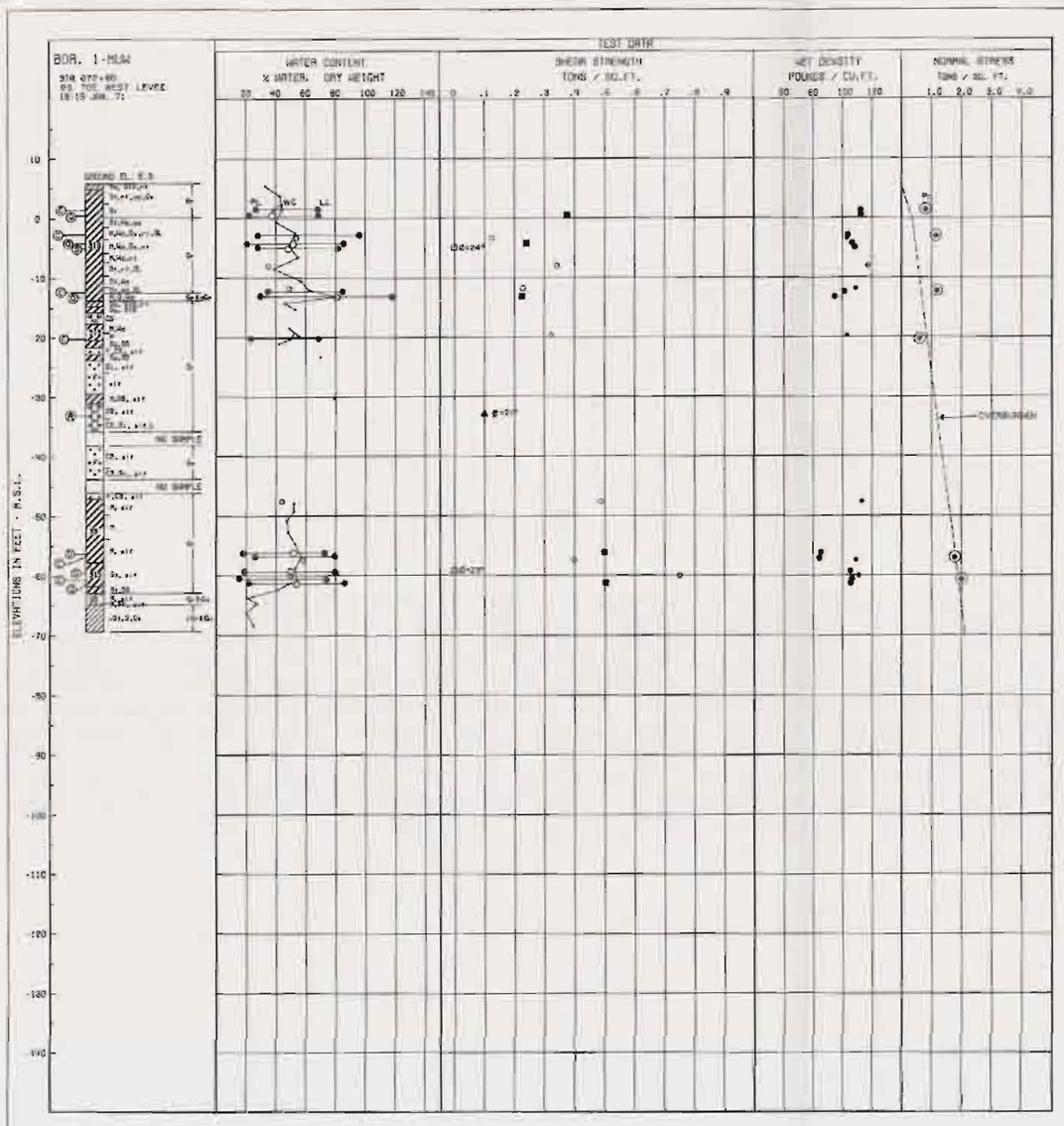
BORINGS WERE TAKEN WITH A 3 INCH DIAMETER STEEL TUBE PISTON TYPE SAMPLER
FOR BOR. BORING LEGEND SEE PLATE 8
FOR LOCATION OF BORINGS SEE PLATE 3

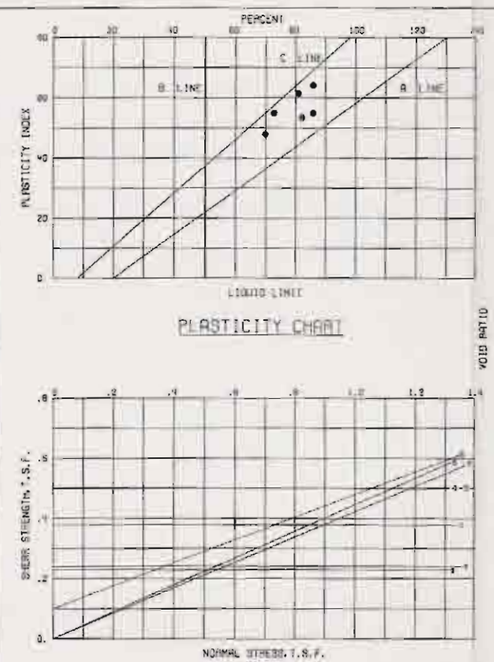
LAKE PONTCHARTRAIN, LA. AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO. 20 GENERAL DESIGN
ORLEANS PARISH - JEFFERSON PARISH
17 TH. STREET OUTFALL CANAL
(METAIRIE RELIEF)

UNDISTURBED BORING 2-MUE

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

DATE: MARCH 1990 FILE NO. H-2-30300

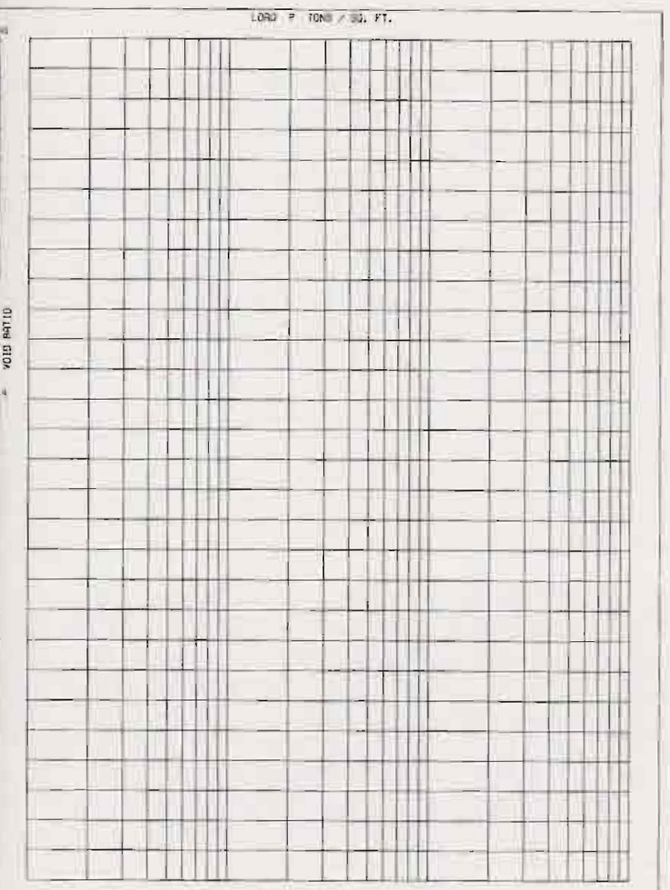




PLASTICITY CHART

SHEAR STRENGTH DATA

BORING NO.	ENVELOPE NO.	ENVELOPE EL.	TYPE	STRENGTH ϕ°	STRENGTH C - TSF	CLASS
	1	0.4	Q	0	0.38	CH
	2	-4.0		0	0.24	CH
	3	-15.0		0	0.33	CH
	4	-36.2		0	0.50	CH
	5	-61.2		0	0.50	CH
	6	-4.8	S	24	0	CH
	7	-59.3		23	0	CH
	8	-33.0	R	1	81	SM



CONSOLIDATION DATA

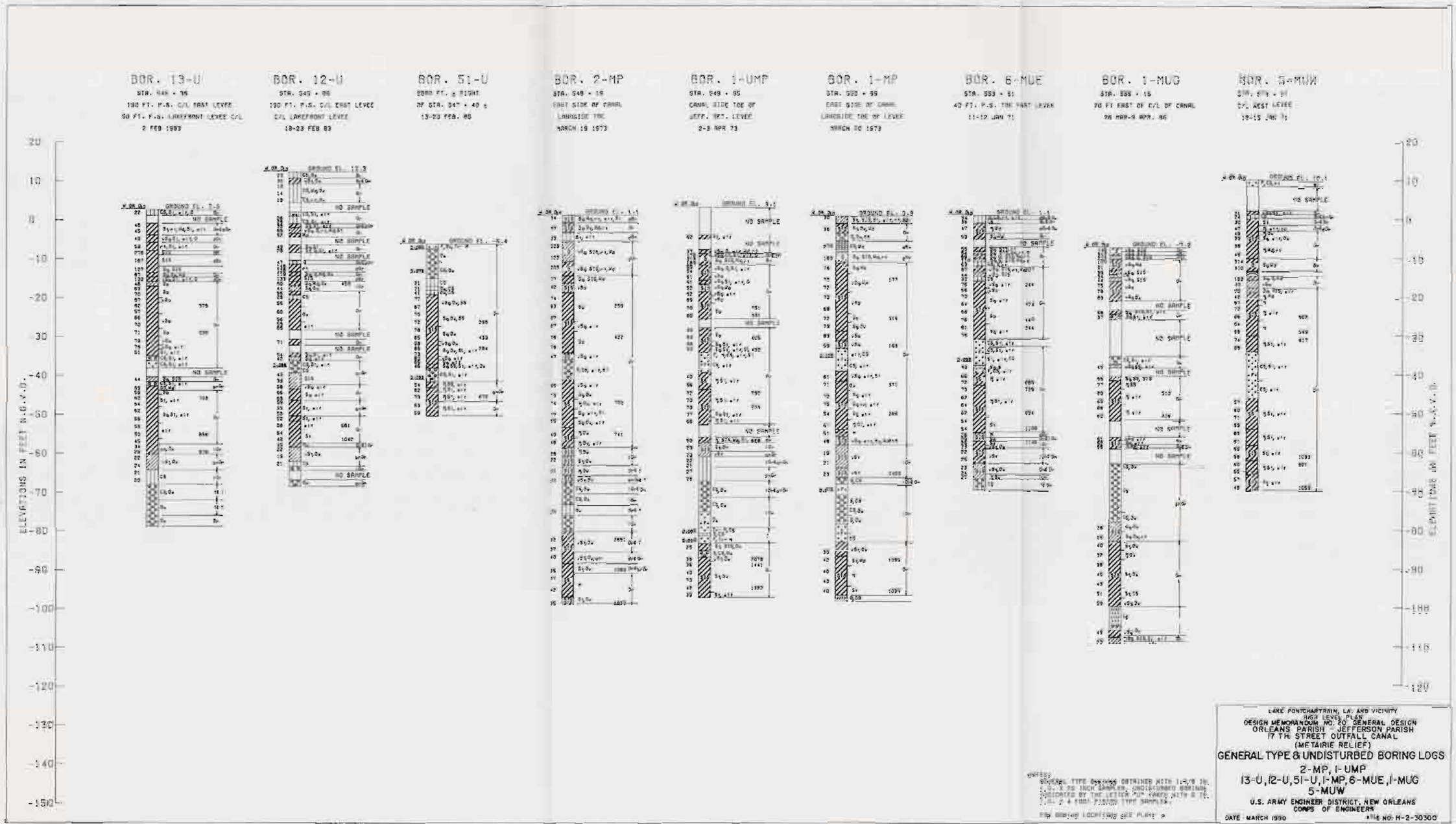
O - (UC) UNCONFINED COMPRESSION TEST
■ - (U) UNCONSOLIDATED - UNDRAINED SHEAR TEST
▲ - (R) CONSOLIDATED - UNDRAINED SHEAR TEST
□ - (S) CONSOLIDATED - DRAINED SHEAR TEST
BORINGS WERE TAKEN WITH 8.5 INCH DIAMETER STEEL TUBE PISTON TYPE SAMPLER
FOR SOIL BORING LEGEND SEE PLATE 6
FOR LOCATION OF BORINGS SEE PLATE 5

LAKE PONTCHARTRAIN, LA. AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO.20 GENERAL DESIGN
ORLEANS PARISH – JEFFERSON PARISH
17 TH. STREET OUTFALL CANAL
(METAIRIE RELIEF)

UNDISTURBED BORING I-MUW

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

DATE: MARCH 1990 FILE NO. H-2-30300



LAKE PONTCHARTRAIN, LA. AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO. 20 GENERAL DESIGN
ORLEANS PARISH – JEFFERSON PARISH
17 TH. STREET OUTFALL CANAL
(METAIRIE RELIEF)

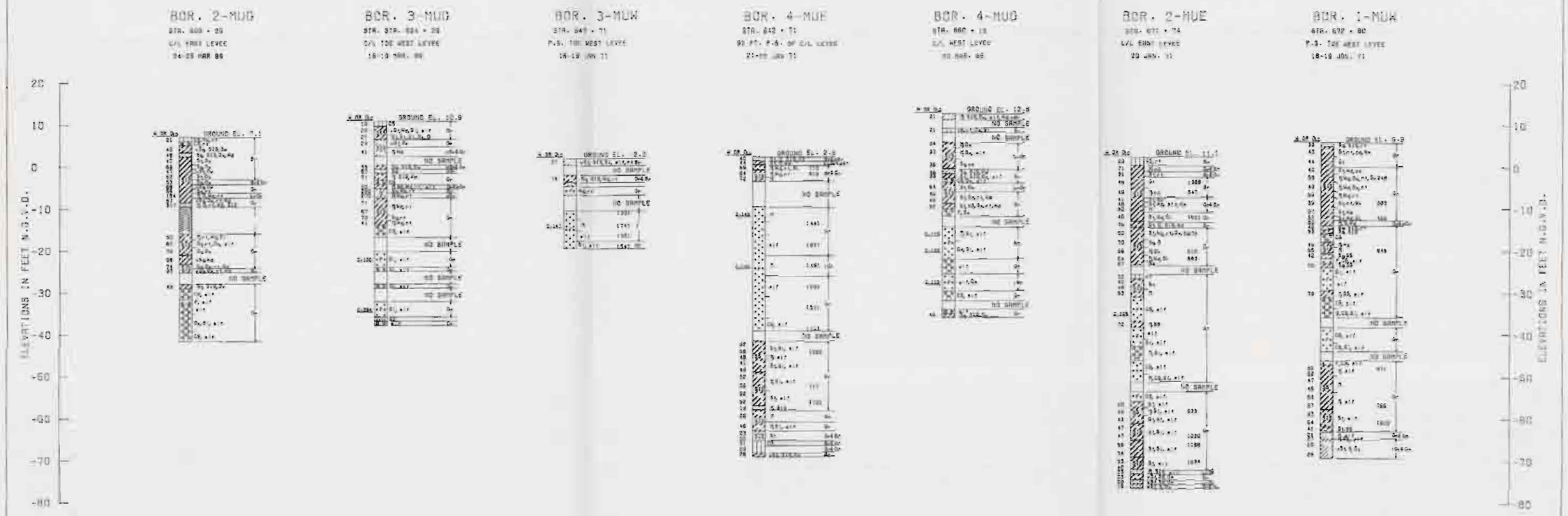
GENERAL TYPE & UNDISTURBED BORING LOGS

2-MP, 1-UMP
13-U, 12-U, 51-U, 1-MP, 6-MUE, 1-MUG
5-MUW

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

DATE: MARCH 1990 FILE NO. H-2-30300

PLATE 54



NOTES:-
GENERAL TYPE BORINGS OBTAINED WITH 1-TUBE IN-SIDE 4.25 INCH SAMPLER. UNDISTURBED BORINGS INDICATED BY THE LETTER "U" TAKEN WITH 3 IN-SIDE 4 FOOT PISTON TYPE SAMPLER.

FOR BORING LOCATIONS SEE PLATES 2-5

LAKE PONTCHARTRAIN, LA. AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO. 20 GENERAL DESIGN
ORLEANS PARISH - JEFFERSON PARISH
17 TH. STREET OUTFALL CANAL
(METAIRIE RELIEF)

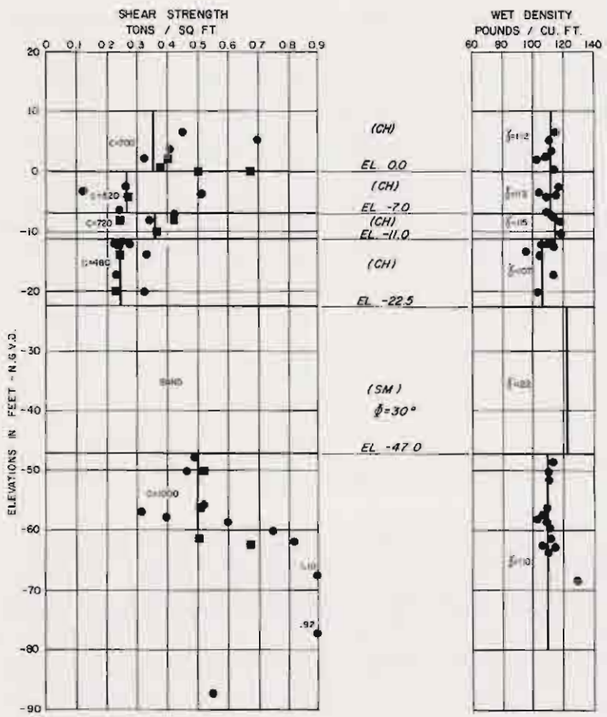
GENERAL TYPE & UNDISTURBED BORING LOGS

2-MUG, 3-MUG, 3-MUW, 4-MUE, 4-MUG, 2-MUE, 1-MUW

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

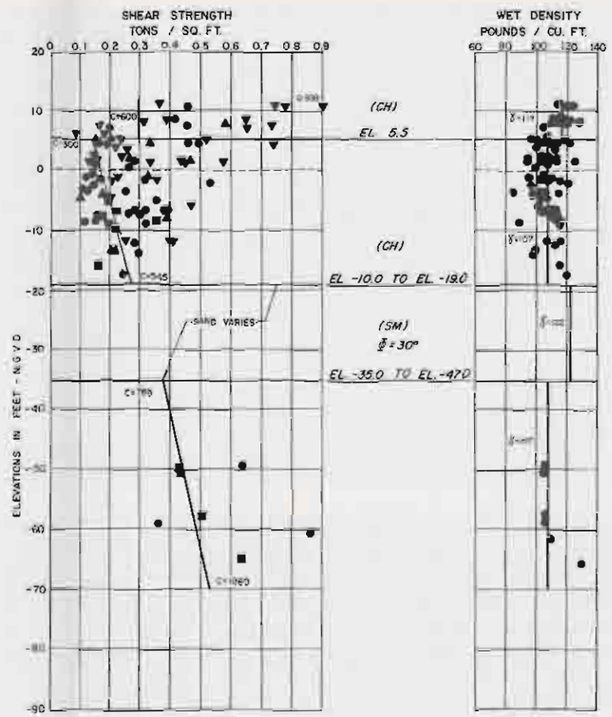
DATE MARCH 1990 FILE NO. H-2-50300

PUMPING STATION TO STA. 670+00



BORING LEGEND
SHEAR STRENGTHS
● ■ 1-MUW, 2-MUE, PLATES 53, 52
● 5A APPENDIX A VOL. II

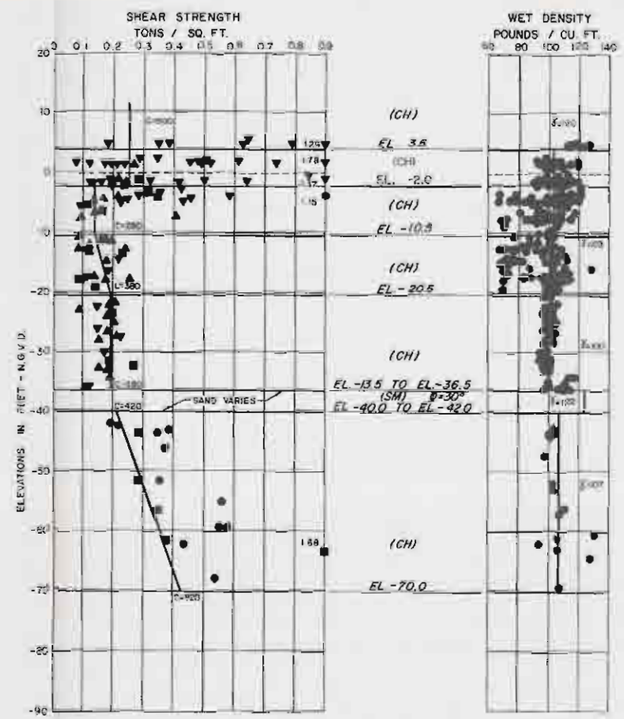
STA. 635+00 TO STA 670+00



BORING LEGEND:
SHEAR STRENGTHS
● ■ 3-MUW, 4-MUE, 4-MUG, PLATES 50, 49, 51
▲ ▼ 1-22 APPENDIX A VOL. II

4,7,12,15,20. 5" I.D. BORING
1-3,5,6,8-11,13,14,16-19,21 3" I.D. BORING

STA. 552+70 TO STA. 635+00



BORING LEGEND:
SHEAR STRENGTHS
● ■ 5-MUW, 6-MUE, 2-MUG, 3-MUG, PLATES 46, 44, 47, 48
▲ ▼ 23-68 APPENDIX A VOL. II

23,28,[illegible],36,39,44,47,52,55,60,63,66 5" I.D. BORING
24-27,29,30,32-35,37,38,40-43,45,46,48-51,53,54,56-59
[illegible] 3" I.D. BORING

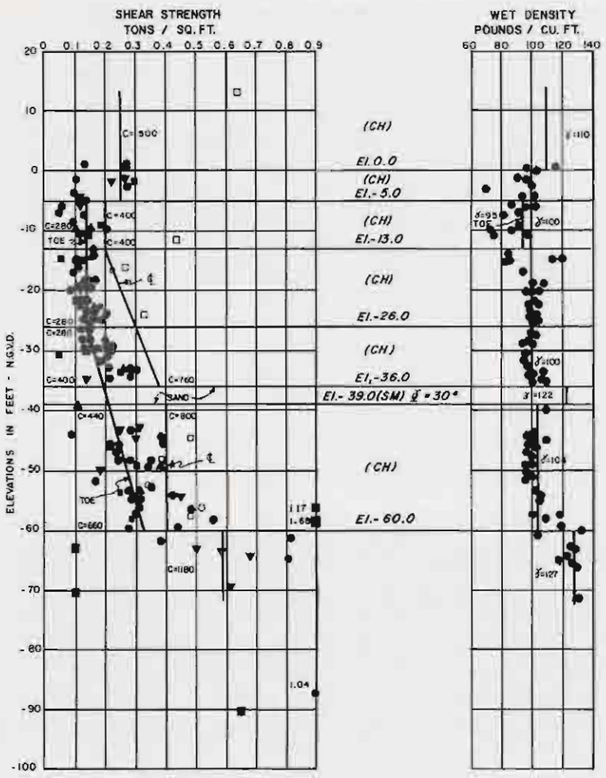
● UNCONFINED COMPRESSION TESTS
■ UNCONSOLIDATED UNDRAINED TRIAXIAL COMPRESSION TESTS
▲ UNCONSOLIDATED UNDRAINED TRIAXIAL COMPRESSION TESTS 3-PT EUSTIS ENGINEERING
▼ UNCONSOLIDATED UNDRAINED TRIAXIAL COMPRESSION TESTS 1-PT EUSTIS ENGINEERING
SEE APPENDIX A VOL. II FOR EUSTIS ENGINEERING BORINGS AND LABORATORY TESTS.

LAKE PONTCHARTRAIN, LA. AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO. 20 GENERAL DESIGN
ORLEANS PARISH - JEFFERSON PARISH
17 TH. STREET OUTFALL CANAL
(METAIRIE RELIEF)

SOIL DESIGN PARAMETERS

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
DATE MARCH 1990 FILE NO. H-2-30300

STA 552+70 TO STA 545+00



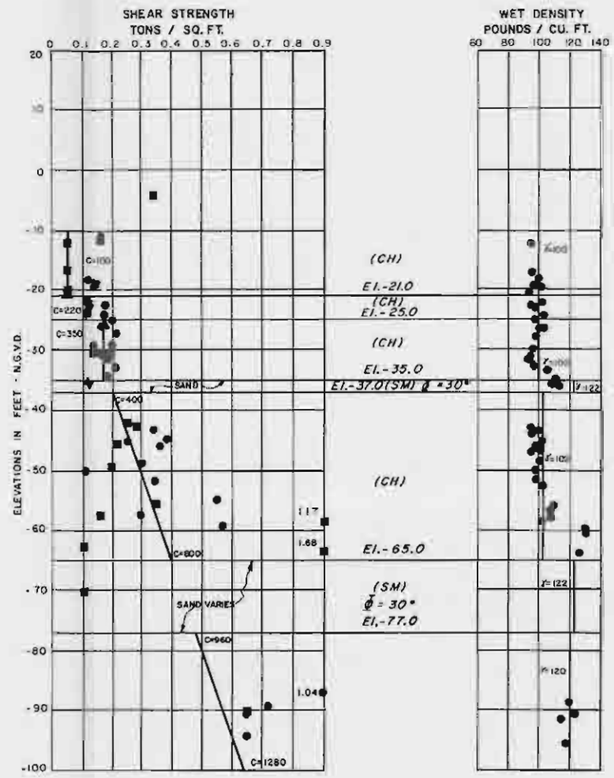
BORING LEGEND
SHEAR STRENGTHS
● ■ 1-UMP, 13-U TOE PLATES 43, 40
○ □ 12-U ℄ PLATE 41
● ▲ ▼ 69 - 76 APPENDIX A VOL. II

GENERAL TYPE BORINGS ALSO USED FOR STRATIFICATION AND CLASSIFICATION ARE 1MP & 2MP

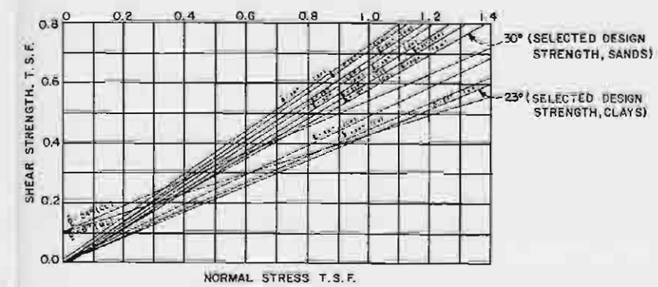
71, 74 3" I.D. BORING

66, 70, 72, 73, 75, 78 3" I.D. BORING

VALVE STRUCTURE



BORING LEGEND
SHEAR STRENGTHS
● ■ 1-MUG, 6-MUE, 1-UMP PLATES 45, 44, 43
● ▲ 67, 68 APPENDIX A VOL. II



SHEAR STRENGTH DATA

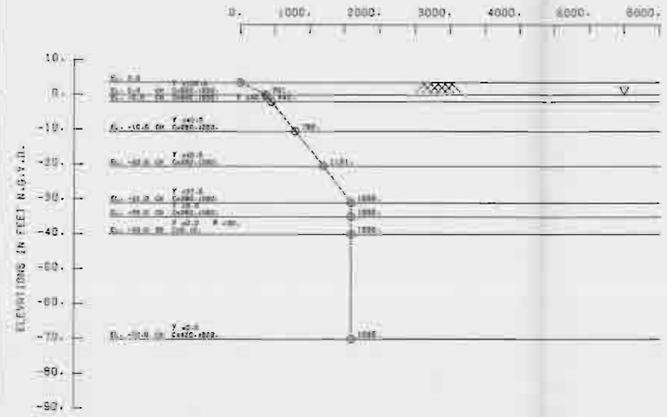
● UNCONFINED COMPRESSION TESTS
□ ■ UNCONSOLIDATED UNDRAINED TRIAXIAL COMPRESSION TESTS
▲ " " " " " 3 PT EUSTIS ENGINEERING
▼ " " " " " 1 PT " "
SEE APPENDIX A VOL. II FOR EUSTIS ENGINEERING BORINGS AND LABORATORY TESTS

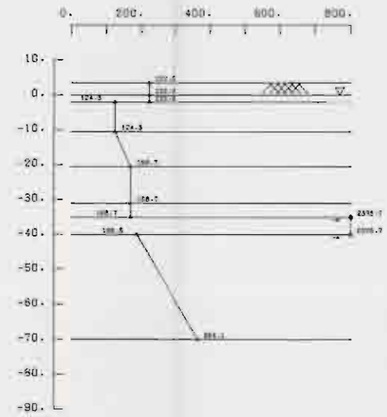
LAKE PONTCHARTRAIN, LA. AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO. 20 GENERAL DESIGN
ORLEANS PARISH - JEFFERSON PARISH
17 TH. STREET OUTFALL CANAL
(METAIRIE RELIEF)

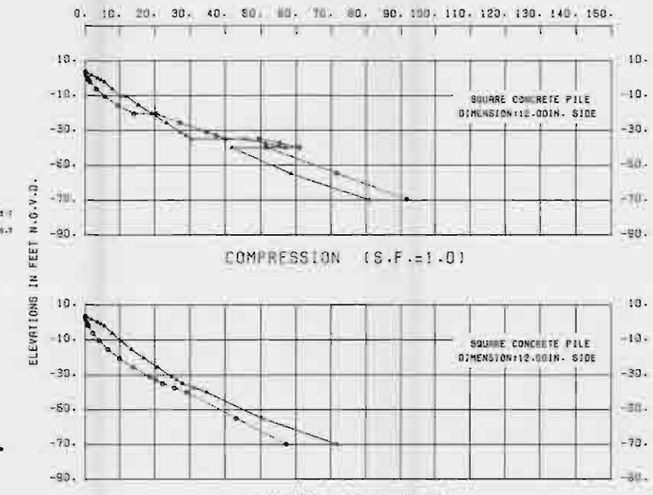
SOIL DESIGN PARAMETERS

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

DATE: MARCH 1990 FILE NO. H-2-30300







S-CASE
CH.CL- ϕ=23°
ML- ϕ=30°
SM.SP- ϕ=30°,33°

TYPICAL SOIL PROFILE

SOIL STRATIFICATION IS BASED ON GEOLOGIC PROFILE

SHEAR STRENGTH AND WET DENSITIES SEE PLATE 56

D	PILE SPACING IN DIRECTION OF LOADING
1.00	9D
0.85	7D
0.70	6D
0.55	5D
0.40	4D
0.25	3D

C	LOADING CONDITION
1.00	INITIAL LOADING
0.30	CYCLIC LOADING

NOTES: $K_H = \frac{4K_1}{B}(1.6 - 2222\,qu/B)(C)(D)$ COHESIVE

K = 0.4 = Factor of material properties of soil and pile

K_1 = Modulus of subgrade reaction for test plate (psi)

B_1 = Width or diameter of test plate (in)

$K_1 = K_1 B_1$ = 90 qu (psf) x 0.5000 qu (psi)

qu = 2·c = Unconfined compressive strength (psf)

C = Reduction for cyclic loading-not applicable

D = Group effect reduction factor

B = Width of pile measured at right angles to the direction of displacement (in)

K_H = $(K_1B_1)/B$ (C)(D) COHESIONLESS

n_h = Coefficient of horizontal subgrade reaction (pci)

Z = Depth below equivalent ground surface (in)

THE FACTOR QKHBN, (MODULUS OF HORIZONTAL SUBGRADE K_H TIMES THE PILE WIDTH IN INCHES (B), MEASURED AT RIGHT ANGLES TO THE DIRECTION OF DISPLACEMENT) MUST BE MODIFIED BY A REDUCTION FACTOR FOR THE EFFECT OF GROUP ACTION (D) AND A REDUCTION FACTOR FOR CYCLIC LOADING (C) EX: $K_H = \frac{(1)(1)(1)}{(B)}$ (S-CASE)

------ S-CASE
——— Q-CASE

NOTE: ALLOWABLE CAPACITIES SHOULD BE DETERMINED INCORPORATING F.S.=2.0 WITH PILE TEST OR F.S.=3.0 WITHOUT PILE TEST

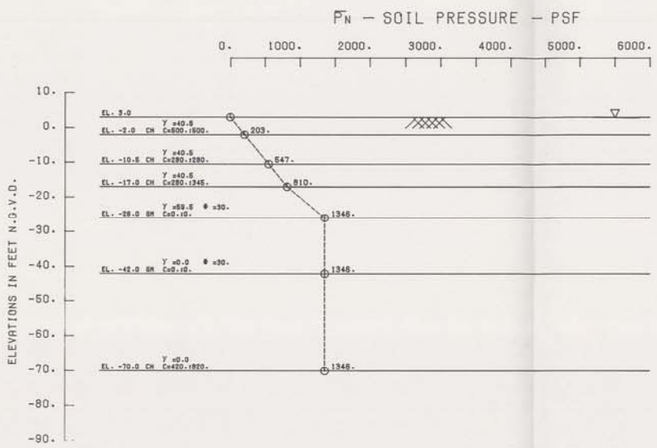
LAKE PONTCHARTRAIN, LA. AND VICINITY
NEW ORLEANS, LOUISIANA
HURRICANE PROTECTION PROJECT
ORLEANS PARISH — JEFFERSON PARISH
17TH STREET OUTFALL CANAL
(METAIRIE RELIEF)

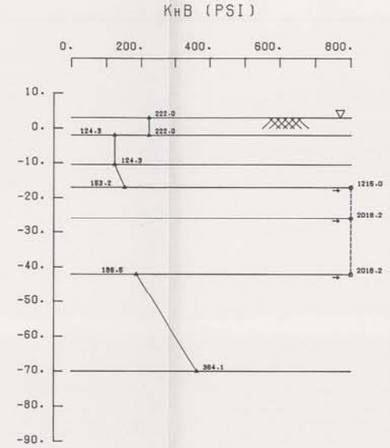
HAMMOND HIGHWAY FLOODGATE
12" SQ. PRESTRESSED CONCRETE PILES
PILE CAPACITY CURVES

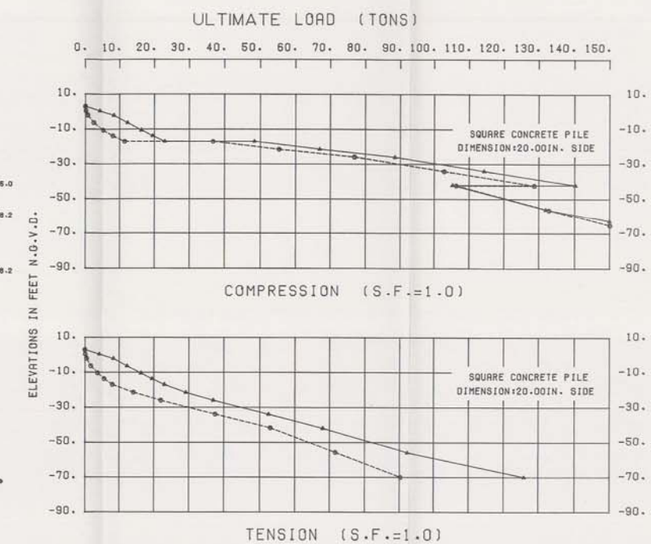
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

DATE: MARCH 1977 FILE NO. K-2-33300

PLATE 59







S-CASE
CH.CL- Φ=23°
ML- Φ=30°
SM.SP- Φ=30°

TYPICAL SOIL PROFILE

SOIL STRATIFICATION IS BASED ON GEOLOGIC PROFILE

SHEAR STRENGTH AND WET DENSITIES SEE PLATE 56

D	PILE SPACING IN DIRECTION OF LOADING
1.00	8B
0.85	7B
0.70	6B
0.55	5B
0.40	4B
0.25	3B
C	LOADING CONDITION
1.00	INITIAL LOADING
0.30	CYCLIC LOADING

NOTES: $K_H = \alpha K_1/B = (0.2222\,qu/B)(C)(D)$ COHESIVE

α = 0.4 = Factor of material properties of soil and pile

k_1 = Modulus of subgrade reaction for test plate (psi)

B_1 = Width or diameter of test plate (in)

$K_1 = k_1 B_1$ = 80 qu (psf) = 0.5556 qu (psi)

qu = 2·c = Unconfined compressive strength (psf)

C = Reduction for cyclic loading-not applicable

D = Group effect reduction factor

B = Width of pile measured at right angles to the direction of displacement (in)

$K_H = (nh)(Z/B)(C)(D)$ COHESIONLESS

nh = Coefficient of horizontal subgrade reaction (psi)

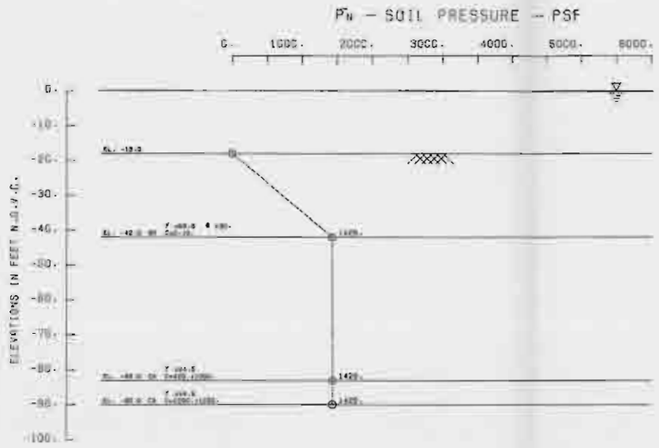
Z = Depth below equivalent ground surface (in)

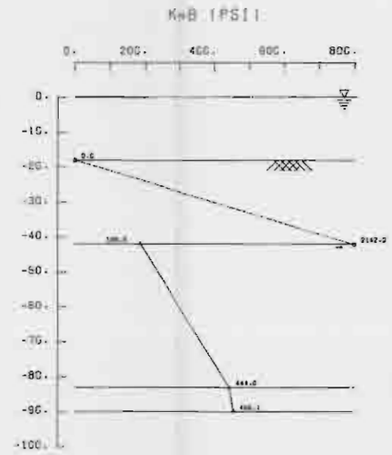
THE FACTOR SHOWN, (MODULUS OF HORIZONTAL SUBGRADE K_H, TIMES THE PILE WIDTH IN INCHES (B), MEASURED AT RIGHT ANGLES TO THE DIRECTION OF DISPLACEMENT) MUST BE MODIFIED BY A REDUCTION FACTOR FOR THE EFFECT OF GROUP ACTION (D) AND A REDUCTION FACTOR FOR CYCLIC LOADING (C) EX: $K_h = \frac{0.2222\,qu\,(C)(D)}{(B)}$

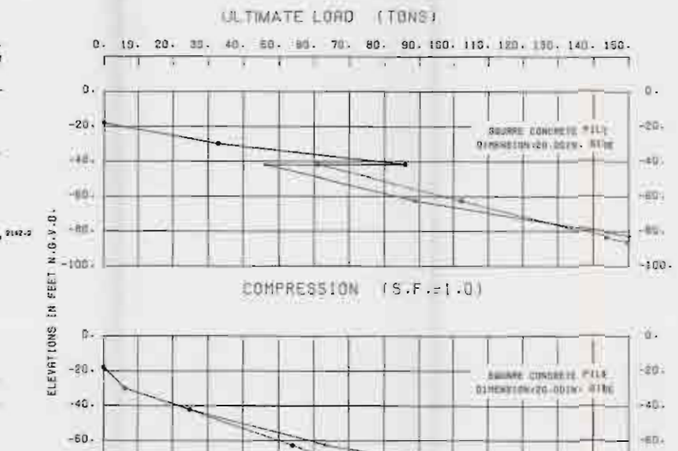
NOTE: ALLOWABLE CAPACITIES SHOULD BE DETERMINED INCORPORATING F.S. = 2.0 WITH PILE TEST OR F.S. = 3.0 WITHOUT PILE TEST.

----- S-CASE
——— Q-CASE

LAKE PONTCHARTRAIN, LA. AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO. 20 GENERAL DESIGN
ORLEANS PARISH – JEFFERSON PARISH
17 TH. STREET OUTFALL CANAL
(METAIRIE RELIEF)
VETERANS BLVD. BRIDGE ABUTMENTS AND INTERIOR BENTS
20" SQ. PRESTRESSED CONCRETE PILES
PILE CAPACITY CURVES
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
DATE: MARCH 1990 FILE NO. H-2-30300







S-CASE
SH.CL- ϕ=23°
ML- ϕ=30°
SH.SP- ϕ=30°

TYPICAL SOIL PROFILE

SOIL STRATIFICATION IS BASED ON GEOLOGIC PROFILE

SHEAR STRENGTH AND WET DENSITIES SEE PLATE 58

D	PILE SPACING IN DIRECTION OF LOADING
1.00	88
0.85	78
0.70	68
0.55	58
0.40	48
0.25	38
C	LOADING CONDITION
1.00	INITIAL LOADING
0.30	CYCLIC LOADING

NOTES: Kn = $\alpha K_1 B/(1+0.2222\alpha B/(1+2z))$ COHESIVE

α = 0.4 = Factor of material properties of soil and pile

K1 = Modulus of subgrade reaction for test plate (pci)

B1 = Width or diameter of test plate (in)

S1 = K1 B1 = 80 qu (psf) = 0.5555 qu (psf)

qu = 2-c = Unconfined compressive strength (psf)

C = Reduction for cyclic loading-not applicable

D = Group effect reduction factor

B = Width of pile measured at right angles to the direction of displacement (in)

Kn = 1440/B(1+0.2222B) COHESIONLESS

nh = Coefficient of horizontal subgrade reaction (pci)

Z = Depth below equivalent ground surface (in)

THE FACTOR SHOWN, (MODULUS OF HORIZONTAL SUBGRADE RX. TIMES THE PILE WIDTH IN INCHES (B)) MEASURED AT RIGHT ANGLES TO THE DIRECTION OF DISPLACEMENT) MUST BE MODIFIED BY A REDUCTION FACTOR FOR THE EFFECT OF GROUP ACTION (D) AND A REDUCTION FACTOR FOR CYCLIC LOADING (C) EX: $K_n = \frac{0.2555\,\alpha\,(C)(D)}{(B)}$

NOTE: ALLOWABLE CAPACITIES SHOULD BE DETERMINED INCORPORATING F.S. = 2.0 WITH PILE TEST OR F.S. = 3.0 WITHOUT PILE TEST.

- - - - S-CASE
——— Q-CASE

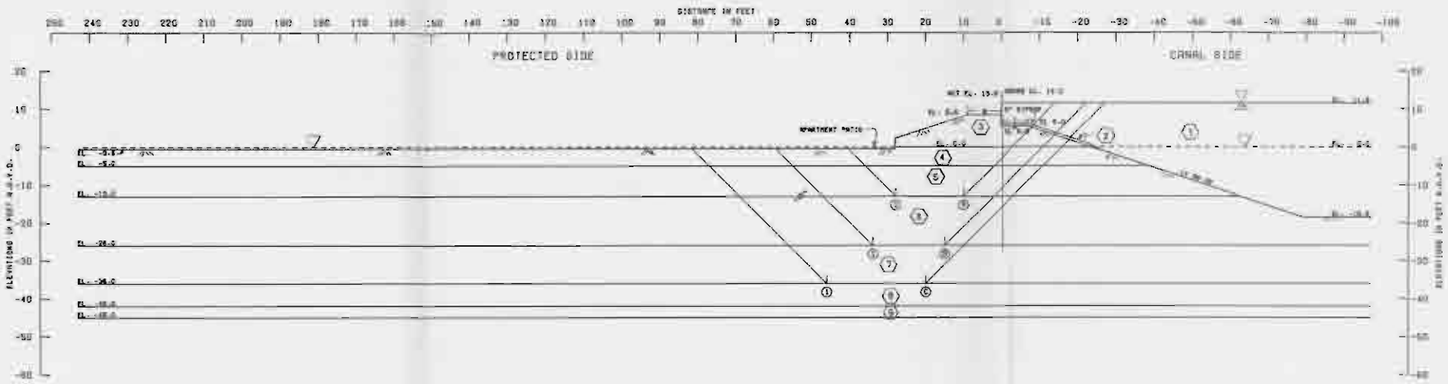
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

NEW ORLEANS DISTRICT – JEFFERSON PARISH
(I-10, WEST JEFFERSON CANAL
SANITARY RELIEF)
VETERANS BLVD. BRIDGE
PILE BENTS IN CANAL CHANNEL
20" SQUARE PRESTRESSED CONCRETE PILES
PILE CAPACITY CURVES

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

DATE MARCH 1996

PLATE 59 A



AS BUILT 1986-1989

FAILURE SURFACE NO.	FAILURE SURFACE ELEV.	RESISTING FORCES R_x	R_y	R_z	DRIVING FORCES D_x	$-D_z$	COMPUTATION OF FORCES RESISTING	DRIVING	FACTOR OF SAFETY
③ ①	-12.0	16700	6010	9675	25883	7747	33357	18110	1.84
③ ①	-24.0	27102	9110	17084	52840	13983	54825	30882	1.78
② ①	-30.0	30003	14664	23387	101556	21948	77214	30949	1.49

STATION NO.	MAT. TYPE	EFFECTIVE UNIT WT. P.C.F. MOIST	SAT.	C - UNIT COHESION - P.S.F. CRITICAL MOMENT	CRITICAL MOMENT	PHI - ANGLE OF INTERNAL FRICTION - DEGREES CRITICAL MOMENT	CRITICAL MOMENT	PORTION MAKE DEGREES
①	CONCRETE	80.0	80.0	0.0	0.0	0.0	0.0	0.0
	FOUNDATION	100.0	102.0	0.0	0.0	0.0	0.0	40.0
②	SOIL	110.0	110.0	800.0	800.0	800.0	800.0	0.0
③	SOIL	100.0	100.0	800.0	800.0	800.0	800.0	0.0
④	SOIL	100.0	99.0	400.0	380.0	400.0	380.0	0.0
⑤	SOIL	100.0	100.0	800.0	800.0	800.0	800.0	0.0
⑥	SOIL	100.0	100.0	370.0	340.0	700.0	400.0	0.0
⑦	SOIL	122.0	122.0	0.0	0.0	0.0	0.0	30.0
⑧	SOIL	117.0	117.0	870.0	870.0	870.0	870.0	0.0

GENERAL NOTES:

ELEVATIONS, DIMENSIONS, MATERIALS, WATER STRENGTH, AND UNIT WEIGHT OF THE SOIL WERE BASED ON THE RESULTS OF INVESTIGATIONS BORINGS. SEE BORING DATA PLATES.

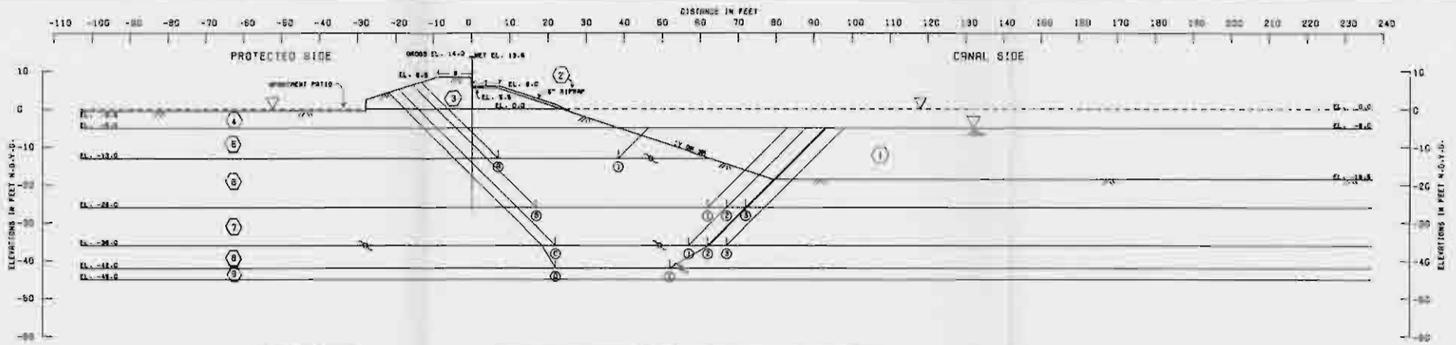
NOTES

θ — ANGLE OF INTERNAL FRICTION (DEGREES)
C — UNIT COHESION, P.S.F.
W — STATIC WATER PRESSURE
D — HORIZONTAL DRIVING FORCE IN POUNDS
X — HORIZONTAL RESISTING FORCE IN POUNDS
a — AS A DIMENSION, REFERS TO WATER HEIGHT
B — AS A DIMENSION, REFERS TO CENTERS BLOCK
F — AS A DIMENSION, REFERS TO DRAINAGE HEIGHT

FACTOR OF SAFETY = $\frac{R_x + R_z + W_x}{D_x - W_z}$

ORLEANS PARISH - JEFFERSON PARISH
17TH STREET OUTFALL CANAL
(METAIRIE RELIEF)
PROTECTED SIDE LEVEE
STABILITY ANALYSIS
B/L STA. 545 + 80 TO
B/L STA. 552 + 70 ORLEANS

PLATE 9C



AS BUILT 1986-1989

MATERIALS FAILURE SURFACE NO.	CLASS.	RESISTING FORCES R_x	R_y	R_z	DRIVING FORCES D_x	$-D_z$	SUMMATION OF FORCES HORIZONTAL	VERTICAL	FACTOR OF SAFETY
⑤ ①	-13.0	18927	10867	3636	22199	2784	[illegible]	[illegible]	1.70
⑥ ①	-26.0	29754	16788	5630	54785	10218	51293	16889	1.02
⑥ ②	-30.0	29754	17189	4930	54785	15640	51783	20158	1.02
⑥ ⑤	-26.0	29754	16829	4200	54785	18142	52557	20544	1.03
⑦ ①	-36.0	40624	18314	11030	90092	39978	58488	51419	1.03
⑦ ②	-36.0	40624	17996	11000	90092	37579	[illegible]	[illegible]	1.32
⑦ ⑤	-36.0	40624	19611	11000	90092	40572	[illegible]	53420	1.33
⑧ ①	-42.0	47922	[illegible]	20429	[illegible]	58936	[illegible]	59354	1.42

STRATUM NO.	SOIL TYPE	EFFECTIVE UNIT WT. P.C.F. TOP. 1	TOP. 2	C - UNIT COHESION - P.S.F. TOP OF STRATUM TOP. 1	TOP. 2	BOTTOM OF STRATUM TOP. 1	TOP. 2	FRICTION ANGLE DEGREES
①	MATERIAL	80.0	80.0	0.0	0.0	0.0	0.0	0.0
②	SLIPPAGE	102.0	102.0	0.0	0.0	0.0	0.0	30.0
③	CLAY	110.0	110.0	900.0	900.0	900.0	900.0	0.0
④	CLAY	120.0	120.0	500.0	500.0	500.0	500.0	0.0
⑤	CLAY	100.0	98.0	400.0	380.0	400.0	380.0	0.0
⑥	CLAY	120.0	120.0	500.0	280.0	500.0	280.0	0.0
⑦	CLAY	120.0	120.0	870.0	540.0	780.0	400.0	0.0
⑧	CLAY	102.0	102.0	0.0	0.0	0.0	0.0	30.0
⑨	CLAY	117.0	117.0	870.0	870.0	870.0	870.0	0.0

GENERAL NOTES:

CLASSIFICATION, STRATIFICATION, SHEAR STRENGTH, AND UNIT WEIGHT OF THE SOIL HERE BASED ON THE RESULTS OF UNDISTURBED BORINGS. SEE BORING DATA PLATES.

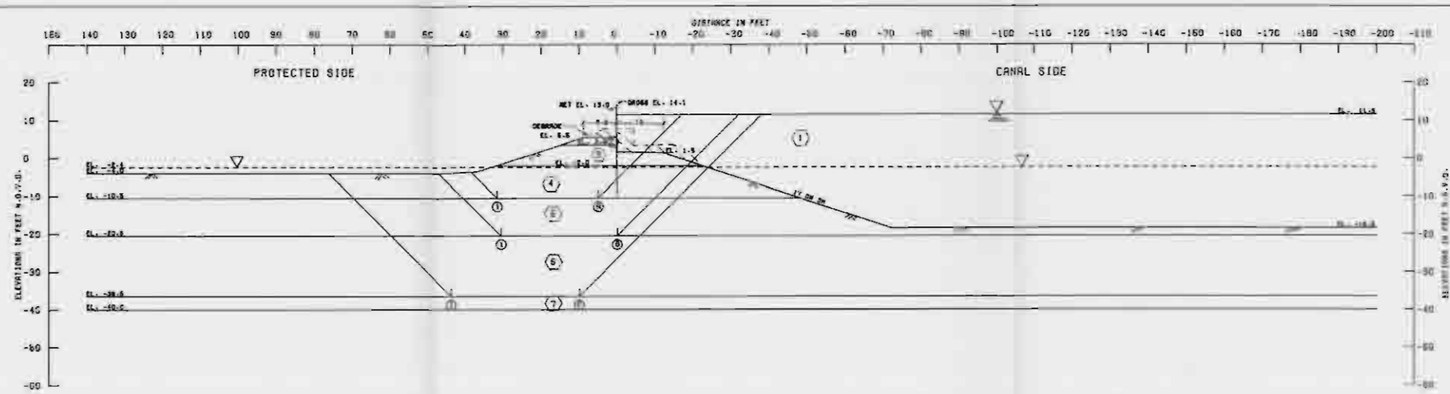
NOTES

Φ -- ANGLE OF INTERNAL FRICTION, DEGREES
C -- UNIT COHESION, P.S.F.
$\underline{\nabla}$ -- STATIC WATER SURFACE
D -- HORIZONTAL DRIVING FORCE IN POUNDS
R -- HORIZONTAL RESISTING FORCE IN POUNDS
a -- AS A SUBSCRIPT, REFERS TO ACTIVE WEDGE
c -- AS A SUBSCRIPT, REFERS TO CENTRAL BLOCK
p -- AS A SUBSCRIPT, REFERS TO PASSIVE WEDGE

$$\text{FACTOR OF SAFETY} = \frac{R_x + R_y + R_z}{D_x - D_z}$$

LAKE PONTCHARTRAIN, LA. AND VICINITY
HPH LEVEL PLAN
DESIGN MEMORANDUM NO. 20 (GENERAL DESIGN)
ORLEANS PARISH – JEFFERSON PARISH
17 TH STREET OUTFALL CANAL
(METAIRIE RELIEF)
FLOODSIDE LEVEE
STABILITY ANALYSIS
B/L STA. 545 + 80 TO
B/L STA. 552 + 70 ORLEANS
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
DATE: MARCH 1990 FILE NO. [illegible]

PLATE 61



[illegible]			RESISTING FORCES			DRIVING FORCES		[illegible]		FACTOR OF SAFETY
[illegible]	[illegible]	[illegible]	R_x	R_y	R_z	D_x	$-D_z$	RESISTING	DRIVING	
Ⓐ	①	-10.5	8334	7420	3834	17322	2928	19589	14334	1.38
Ⓑ	①	-20.5	12382	11590	10246	41638	18166	34192	29389	1.30
Ⓒ	①	-38.5	13241	12808	22400	50814	54230	68447	44024	1.33

STRENGTH NO.	SOIL TYPE	EFFECTIVE UNIT WT. P.C.F.		F - UNIT TENSION - P.S.F.				FRICTION ANGLE
				CENTER OF STRENGTH		BOTTOM OF STRENGTH		
		VERT. 1	VERT. 2	VERT. 1	VERT. 2	VERT. 1	VERT. 2	DEGREES
①	[illegible]	[illegible]	[illegible]	0.0	0.0	0.0	0.0	0.0
②	[illegible]	[illegible]	120.0	800.0	800.0	800.0	800.0	0.0
③	[illegible]	[illegible]	[illegible]	800.0	800.0	800.0	800.0	0.0
④	[illegible]	[illegible]	[illegible]	280.0	280.0	280.0	280.0	0.0
⑤	[illegible]	[illegible]	103.0	280.0	280.0	280.0	280.0	0.0
⑥	[illegible]	[illegible]	[illegible]	280.0	280.0	280.0	280.0	0.0
⑦	[illegible]	122.0	122.0	0.0	0.0	0.0	0.0	30.0

GENERAL NOTES:

CLASSIFICATION, STRATIFICATION, SHEAR STRENGTH, AND UNIT WEIGHT OF THE SOIL WERE BASED ON THE RESULTS OF UNDISTURBED BORINGS. SEE BORING DATA PLATES.

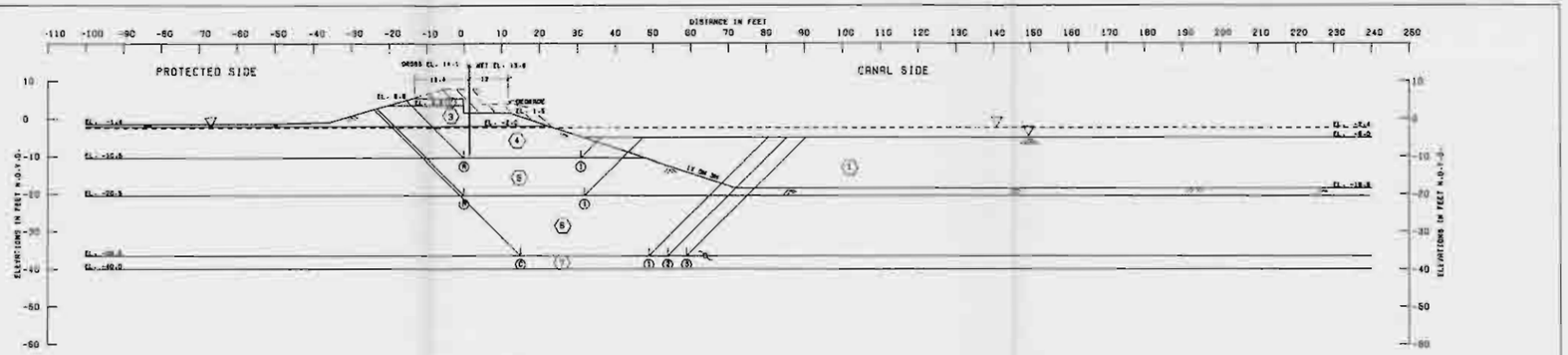
NOTES

Φ — ANGLE OF INTERNAL FRICTION, DEGREES
C — UNIT COHESION, P.S.F.
Σ — STATIC WATER SURFACE
D — HORIZONTAL DRIVING FORCE IN POUNDS
R — HORIZONTAL RESISTING FORCE IN POUNDS
R — 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 = $\frac{R_x + R_y + R_z}{D_x - D_z}$

LAKE PONTCHARTRAIN, LA. AND VICINITY
HURRICANE PROTECTION
DESIGN MEMORANDUM NO. 2.0 GENERAL DESIGN
ORLEANS PARISH — JEFFERSON PARISH
17 TH. STREET OUTFALL CANAL
(METAIRIE RELIEF)
PROTECTED SIDE LEVEE
STABILITY ANALYSIS
B/L STA. 564+00 TO
B/L STA. 568+00 ORLEANS
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
DATE: MARCH 1980 PLATE H-3-20.000

PLATE 62



ANALYSIS FAILURE NO.	ANALYSIS SURFACE ELEV.	RESISTING FORCES R_A	RESISTING FORCES R_B	RESISTING FORCES R_C	DRIVING FORCES D_B	DRIVING FORCES $-D_C$	SUMMATION OF FORCES MERIDIAN	SUMMATION OF FORCES DRIVING	FACTOR OF SAFETY
Ⓐ ①	-10.5	11721	9890	[illegible]	13421	1436	22760	11986	1.90
Ⓑ ①	-20.5	16076	12180	7433	33420	11077	28874	22543	1.90
Ⓒ ①	-35.5	28010	12920	14305	82687	40885	55235	41804	1.32
Ⓒ ②	-35.5	28010	14800	13480	82687	[illegible]	55310	43001	1.31
Ⓒ ③	-35.5	28010	16720	13480	82687	38580	58210	44107	1.32

STRATUM NO.	SOIL TYPE	EFFECTIVE UNIT WT. P.C.F. TEST. 1	EFFECTIVE UNIT WT. P.C.F. TEST. 2	C - UNIT COHESION - P.S.F. STATION OF STRATUM TEST. 1	C - UNIT COHESION - P.S.F. STATION OF STRATUM TEST. 2	C - UNIT COHESION - P.S.F. BOTTOM OF STRATUM TEST. 1	C - UNIT COHESION - P.S.F. BOTTOM OF STRATUM TEST. 2	FRICTION ANGLE DEGREES
①	(WATER)	62.4	62.4	0.0	0.0	0.0	0.0	0.0
②	(CH)	120.0	120.0	500.0	500.0	500.0	500.0	0.0
③	(CH)	103.0	103.0	500.0	500.0	500.0	500.0	0.0
④	(CH)	103.0	103.0	280.0	280.0	280.0	280.0	0.0
⑤	(CH)	103.0	103.0	330.0	330.0	330.0	330.0	0.0
⑥	(CH)	102.0	102.0	380.0	380.0	380.0	380.0	0.0
⑦	(CH)	122.0	122.0	0.0	0.0	0.0	0.0	30.0

GENERAL NOTES:

CLASSIFICATION, STRATIFICATION, SHEAR STRENGTH, AND UNIT WEIGHT OF THE SOIL WERE BASED ON THE RESULTS OF UNDISTURBED BORINGS. SEE BORING DATA PLATES.

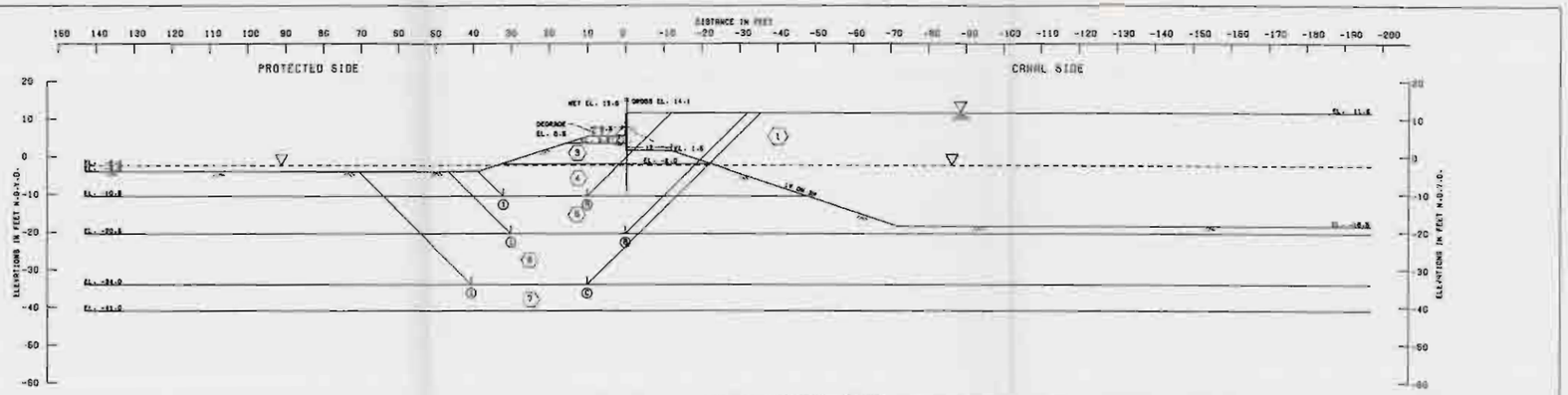
NOTES

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

FACTOR OF SAFETY = $\frac{R_A + R_B + R_C}{D_B - D_C}$

LAKE PONTCHARTRAIN, LA. AND VICINITY
NEW LEVEE, FLAG
DESIGN MEMORANDUM NO. 20 GENERAL DESIGN
ORLEANS PARISH - JEFFERSON PARISH
17 TH STREET OUTFALL CANAL
(METAIRIE RELIEF)
FLOODSIDE LEVEE
STABILITY ANALYSIS
B/L STA. 554 + 00 TO
B/L STA. 568 + 00 ORLEANS
U.S. ARMY ENGINEER DISTRICT NEW ORLEANS
CORPS OF ENGINEERS
DATE: MARCH 1990 FILE NO. N-2-36588

PLATE 63



SLIDING SURFACE NO.	SLIDING SURFACE ELEV.	REGISTING FORCES R_A	R_B	R_F	DRIVING FORCES D_A	$-D_B$	SUMMATION OF FORCES MINIMUM	MAXIMUM	FACTOR OF SAFETY
⑥ ①	-10.0	8400	6100	5730	10940	2021	19300	19957	1.35
⑥ ①	-20.0	10082	11400	10840	41641	10520	24092	20215	1.30
⑥ ①	-34.0	21147	11000	20650	57864	16170	53837	41400	1.30

STRATUM NO.	SOIL TYPE	EFFECTIVE UNIT WT. P.C.F. VERT. 1	VERT. 2	C - UNIT COHESION - P.S.F. CENTER OF STRATUM VERT. 1	VERT. 2	BOTTOM OF STRATUM VERT. 1	VERT. 2	FRICTION ANGLE DEGREES
①	(PEAT)	80.0	80.0	0.0	0.0	0.0	0.0	0.0
②	(CLAY)	100.0	100.0	600.0	600.0	600.0	600.0	0.0
③	(CLAY)	100.0	100.0	600.0	600.0	600.0	600.0	0.0
④	(CLAY)	100.0	100.0	300.0	300.0	300.0	300.0	0.0
⑤	(CLAY)	105.0	105.0	350.0	350.0	350.0	350.0	0.0
⑥	(CLAY)	102.0	102.0	500.0	500.0	500.0	500.0	0.0
⑦	(SAND)	120.0	120.0	0.0	0.0	0.0	0.0	30.0

GENERAL NOTES:

CLASSIFICATION, STRATIFICATION, SHEAR STRENGTH, AND UNIT WEIGHT OF THE SOIL WERE BASED ON THE RESULTS OF UNDISTURBED BORINGS. SEE BORING DATA PLATES.

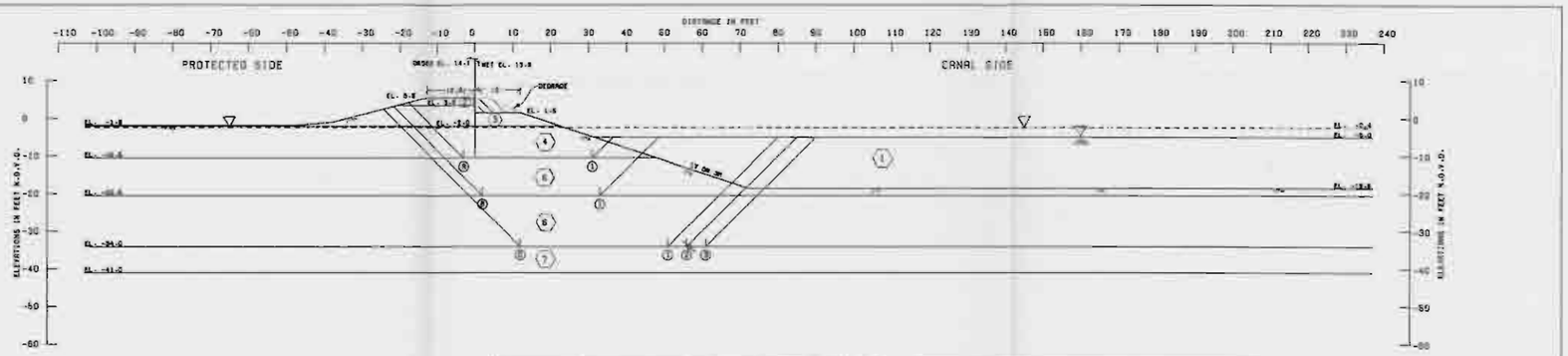
NOTES

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

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

LAKE PONTCHARTRAIN, LA. AND VICINITY
HURRICANE PROTECTION, NEW ORLEANS, LA.
DESIGN MEMORANDUM NO.20 GENERAL DESIGN
ORLEANS PARISH - JEFFERSON PARISH
17 TH STREET OUTFALL CANAL
(METAIRIE RELIEF)
PROTECTED SIDE LEVEE
STABILITY ANALYSIS
B/L STA.568 + 00 TO
B/L STA 589 + 00 ORLEANS
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
DATE MARCH 1990

PLATE 64



FAILURE NO.	SURFACE ELEV.	RESISTING FORCES R_a	R_s	R_p	DRIVING FORCES D_a	$-D_p$	SUMMATION OF FORCES RESISTING	DRIVING	FACTOR OF SAFETY
③ ①	-10.5	11004	9520	2378	13249	1435	22923	11814	1.94
③ ①	-20.5	16804	11780	7289	33189	10923	36873	22276	1.66
③ ①	-34.0	26131	14820	12487	73677	33877	53438	39700	1.36
③ ②	-34.0	26131	16720	11863	73677	32780	54614	40787	1.34
③ ③	-34.0	26131	18548	11680	73677	31971	56259	41706	1.36

STRATUM NO.	SOIL TYPE	EFFECTIVE UNIT WT. P.C.F. VERT. 1	VERT. 2	C - UNIT COHESION - P.S.F. CENTER OF STRATUM VERT. 1	VERT. 2	ABOVE OF STRATUM VERT. 1	VERT. 2	FRICTION ANGLE DEGREES
①	(METER)	80.0	80.0	0.0	0.0	0.0	0.0	0.0
②	(CH)	120.0	120.0	500.0	500.0	500.0	500.0	0.0
③	(CH)	100.0	100.0	500.0	500.0	500.0	500.0	0.0
④	(CH)	100.0	100.0	250.0	250.0	250.0	250.0	0.0
⑤	(CH)	100.0	100.0	350.0	350.0	350.0	350.0	0.0
⑥	(CH)	100.0	100.0	350.0	350.0	350.0	350.0	0.0
⑦	(SH)	102.0	102.0	0.0	0.0	0.0	0.0	30.0

GENERAL NOTES:

CLASSIFICATION, STRATIFICATION, SHEAR STRENGTH, AND UNIT WEIGHT OF THE SOIL WERE BASED ON THE RESULTS OF UNDISTURBED BORINGS. SEE BORING DATA PLATES.

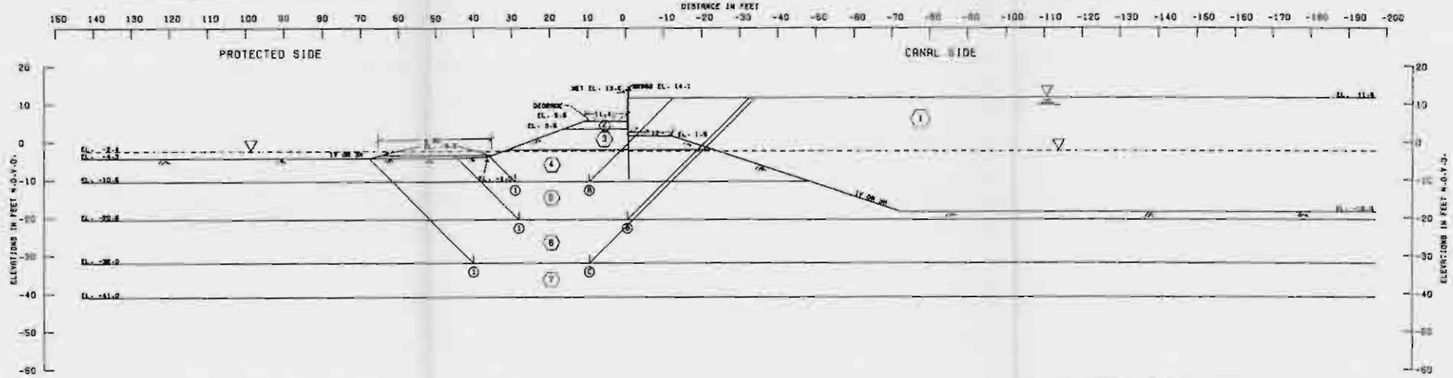
NOTES

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 = $\frac{R_a + R_s + R_p}{D_a - D_p}$

LAKE PONTCHARTRAIN, LA. AND VICINITY
[illegible] LEVEL, 1A AND 1B
DESIGN MEMORANDUM NO. 20 GENERAL DESIGN
ORLEANS PARISH - JEFFERSON PARISH
17 TH STREET OUTFALL CANAL
(METAIRIE RELIEF)
FLOODSIDE LEVEE
STABILITY ANALYSIS
B/L STA. 568+00 TO
B/L STA. 589+00 ORLEANS
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
DATE: MARCH 1980 FILE NO. N-E-20303

PLATE 65



* BERM ONLY AT B/L STA 604+00 (VACANT LOT)

FAILURE SURFACE NO.	FAILURE SURFACE ELEV.	RESISTING FORCES R_x	R_y	R_z	DRIVING FORCES D_x	$-D_z$	SUMMATION OF FORCES HORIZONTAL	VERTICAL	FACTOR OF SAFETY
⑧ ①	-10.6	8409	5463	3977	16563	3241	17845	13112	1.56
⑧ ①	-20.6	12392	10830	10605	41641	15091	33880	25656	1.32
⑥ ①	-32.0	20727	11550	18912	79465	41623	61129	37843	1.35

STRATUM NO.	SOIL TYPE	EFFECTIVE UNIT WT. P.C.F. FULL	SAT.	C - UNIT COHESION - P.S.F. CENTER OF STRATUM SAT.	FULL	BOTTOM OF STRATUM SAT.	FULL	FRICTION ANGLE DEGREES
1	(WATER)	62.4	62.4	0.0	0.0	0.0	0.0	0.0
2	(CH)	120.0	120.0	600.0	600.0	600.0	600.0	0.0
3	(CH)	125.0	125.0	800.0	800.0	800.0	800.0	0.0
4	(CH)	125.0	125.0	250.0	250.0	250.0	250.0	0.0
5	(CH)	125.0	125.0	330.0	330.0	340.0	340.0	0.0
6	(CH)	125.0	125.0	280.0	280.0	280.0	280.0	0.0
7	(SP)	125.0	125.0	0.0	0.0	0.0	0.0	30.0

GENERAL NOTES:

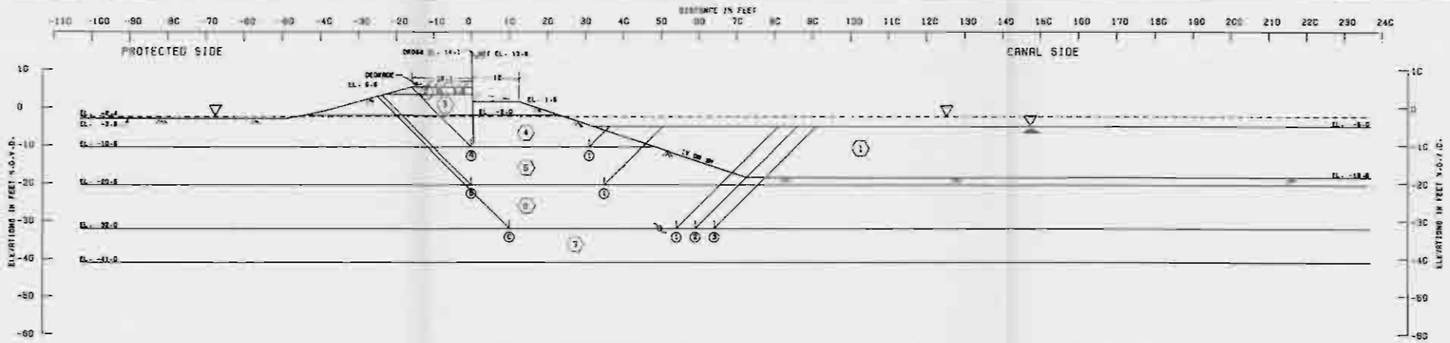
CLASSIFICATION, STRATIFICATION, SHEAR STRENGTH, AND UNIT WEIGHT OF THE SOIL WERE BASED ON THE RESULTS OF UNDISTURBED BORINGS. SEE BORING DATA PLOTTED.

NOTES

φ -- ANGLE OF INTERNAL FRICTION, DEGREES
C -- UNIT COHESION, P.S.F.
W -- 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 = $\frac{R_x + R_y + R_z}{D_x - D_z}$

LAKE PONTCHARTRAIN BASIN, LOUISIANA
NEW LEVEE BLOCK
DESIGN MEMORANDUM NO.22 GENERAL DESIGN
ORLEANS PARISH — JEFFERSON PARISH
17 TH STREET OUTFALL CANAL
(METAIRIE REACH)
PROTECTED SIDE LEVEE
STABILITY ANALYSIS
B/L STA 589+00 TO
B/L STA 614 + 00 ORLEANS
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
DATE: MARCH 1970



Assumed Failure Surface No.	Assumed Failure Surface Elev.	Resisting Forces R_a	Resisting Forces R_s	Resisting Forces R_p	Driving Forces D_s	Driving Forces $-D_p$	Summation of Forces Resisting	Summation of Forces Driving	Factor of Safety
Ⓐ ①	-10.5	12217	8680	2449	13684	1472	23345	15102	1.91
Ⓑ ①	-20.5	16644	13300	7085	34280	10686	37033	19581	1.67
Ⓒ ①	-32.0	25058	16646	10885	67367	29456	52589	38911	1.35
Ⓒ ②	-32.0	25058	18279	10060	67367	27502	53397	39865	1.34
Ⓒ ③	-32.0	25058	18717	10060	67367	29750	54835	40827	1.35

Stratum No.	Soil Type	Effective Unit Wt. P.C.F. Vert. 1	Effective Unit Wt. P.C.F. Vert. 2	C - Unit Cohesion - P.S.F. Center of Stratum Vert. 1	C - Unit Cohesion - P.S.F. Center of Stratum Vert. 2	C - Unit Cohesion - P.S.F. Bottom of Stratum Vert. 1	C - Unit Cohesion - P.S.F. Bottom of Stratum Vert. 2	Friction Angle Degrees
1	(WATER)	62.0	62.0	0.0	0.0	0.0	0.0	0.0
2	(CH)	120.0	120.0	500.0	500.0	500.0	500.0	0.0
3	(CH)	105.0	105.0	500.0	500.0	500.0	500.0	0.0
4	(CH)	105.0	105.0	280.0	280.0	280.0	280.0	0.0
5	(CH)	103.0	103.0	330.0	330.0	380.0	380.0	0.0
6	(CH)	100.0	100.0	380.0	380.0	380.0	380.0	0.0
7	(SP)	120.0	120.0	0.0	0.0	0.0	0.0	30.0

GENERAL NOTES:

CLASSIFICATION, STRATIFICATION, SHEAR STRENGTH, AND UNIT WEIGHT OF THE SOIL WERE BASED ON THE RESULTS OF UNDISTURBED BORINGS. SEE BORING DATA PLATES.

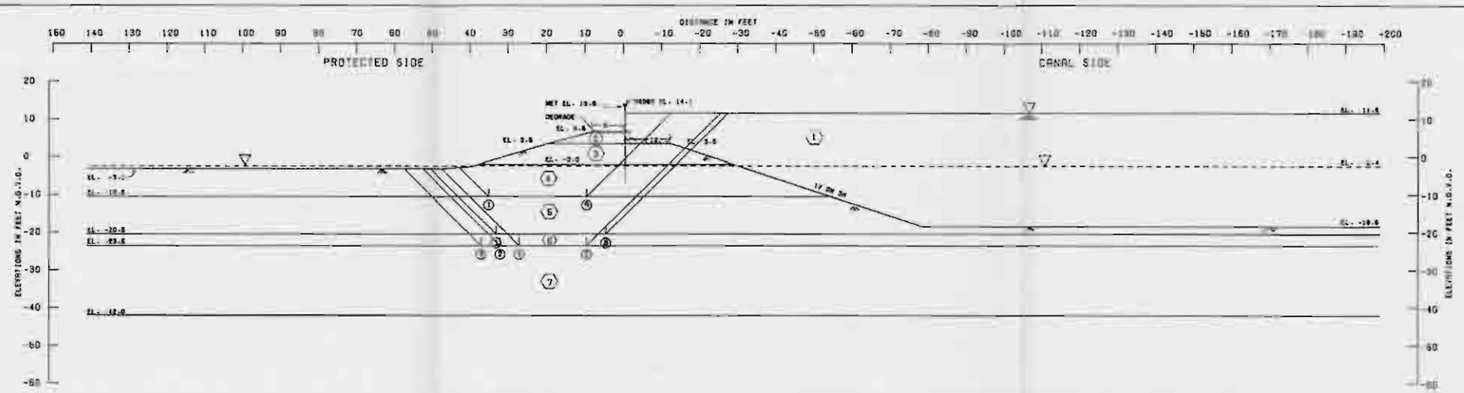
NOTES

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

$$\text{FACTOR OF SAFETY} = \frac{R_a + R_s + R_p}{D_s - D_p}$$

LAKE PONTCHARTRAIN, LA. AND VICINITY
NEW LEVEE FLAG
DESIGN MEMORANDUM NO 20 GENERAL DESIGN
ORLEANS PARISH - JEFFERSON PARISH
17 TH STREET OUTFALL CANAL
(METAIRIE RELIEF)
FLOODSIDE LEVEE
STABILITY ANALYSIS
B/L STA. 589+00 TO
B/L STA. 614+00 ORLEANS
U.S. ARMY ENGINEER DISTRICT NEW ORLEANS
CORPS OF ENGINEERS
DATE MARCH 1990 FILE NO. E-50800

PLATE 67



FAILURE SURFACE NO.		ELEV.	RESISTING FORCES R_v	R_h	R_r	DRIVING FORCES D_h	$-D_r$	SUMMATION OF FORCES RESISTING	DRIVING	FACTOR OF SAFETY
5	1	-10.6	19000	7240	4000	17000	3000	23308	14249	1.62
6	1	-10.6	19111	10800	10914	42000	19000	39884	23084	1.41
6	1	-19.6	17881	8800	13024	51640	24142	37888	28904	1.40
6	1	-19.6	17881	8800	13024	51640	22000	38888	28744	1.37
6	1	-19.6	17881	10450	13024	51640	21848	41355	29397	1.39

SURCHARGE NO.	SOIL TYPE	OVERSTRESS UNIT WT. P.C.F. VERT. 1	VERT. 2	C - UNIT COHESION - P.S.F. CENTER OF SURCHARGE VERT. 1	VERT. 2	BEYOND OF SURCHARGE VERT. 1	VERT. 2	PRESSURE HEAD DEGREES
1	MATERIAL	95.0	95.0	0.0	0.0	0.0	0.0	0.0
2	(SOIL)	120.0	120.0	500.0	500.0	500.0	500.0	0.0
3	(SOIL)	103.0	103.0	500.0	500.0	500.0	500.0	0.0
4	(SOIL)	103.0	103.0	500.0	500.0	500.0	500.0	0.0
5	(SOIL)	103.0	103.0	500.0	500.0	500.0	500.0	0.0
6	(SOIL)	100.0	100.0	500.0	500.0	500.0	500.0	0.0
7	(SOIL)	122.0	122.0	0.0	0.0	0.0	0.0	30.0

GENERAL NOTES:

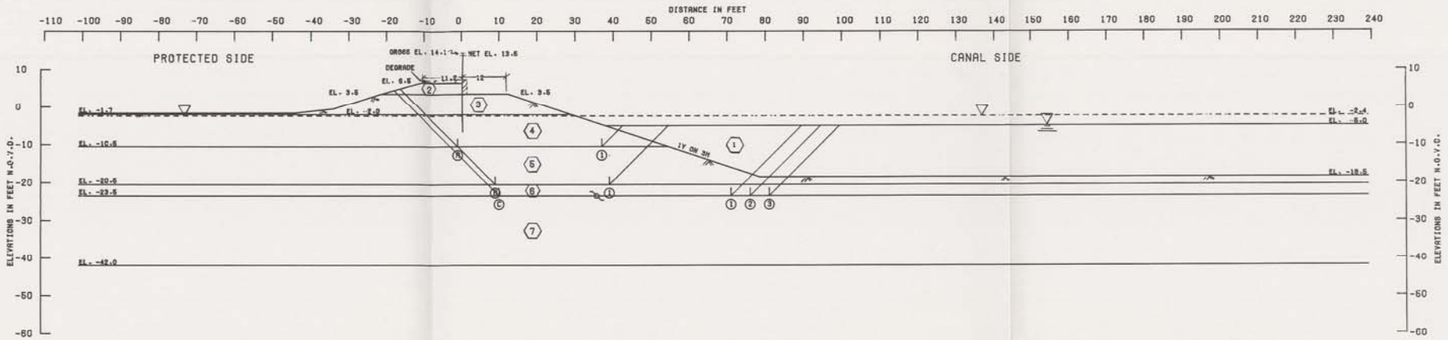
CLASSIFICATION, STRATIFICATION, SHEAR STRENGTH, AND UNIT WEIGHT OF THE SOIL WERE BASED ON THE RESULTS OF UNDISTURBED BORINGS. SEE BORING DATA PLATES.

NOTES:

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

$$\text{FACTOR OF SAFETY} = \frac{R_v + R_h + R_r}{D_h - D_r}$$

LAKE PONTCHARTRAIN, LA. AND VICINITY
HURR LEVEL PLAN
DESIGN MEMORANDUM NO.7D GENERAL DESIGN
ORLEANS PARISH -- JEFFERSON PARISH
17 TH STREET OUTFALL CANAL
(METAIRIE RELIEF)
PROTECTED SIDE LEVEE
STABILITY ANALYSIS
B/L STA 614+00 TO B/L STA 625+00
ORLEANS
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
DATE: MARCH 1965



FAILURE SURFACE NO.	FAILURE SURFACE ELEV.	RESISTING FORCES R_A	R_B	R_P	DRIVING FORCES D_A	$-D_P$	SUMMATION OF FORCES RESISTING	DRIVING	FACTOR OF SAFETY
(B) (1)	-10.5	11874	10840	2449	14979	1472	24763	13507	1.83
(B) (1)	-20.5	18274	11400	7369	34844	11000	37043	23844	1.55
(C) (1)	-23.5	20120	17347	4012	42997	11536	41479	31461	1.32
(C) (2)	-23.5	20120	17631	3600	42997	11230	41351	31767	1.30
(C) (3)	-23.5	20120	17745	3600	42997	11188	41465	31809	1.30

STRATUM NO.	SOIL TYPE	EFFECTIVE UNIT WT. P.C.F. VERT. 1	VERT. 2	C - UNIT COHESION - P.S.F. CENTER OF STRATUM VERT. 1	VERT. 2	BOTTOM OF STRATUM VERT. 1	VERT. 2	FRICTION ANGLE DEGREES
(1)	(WATER)	62.5	62.5	0.0	0.0	0.0	0.0	0.0
(2)	(CH)	120.0	120.0	500.0	500.0	500.0	500.0	0.0
(3)	(CH)	103.0	103.0	500.0	500.0	500.0	500.0	0.0
(4)	(CH)	103.0	103.0	280.0	280.0	280.0	280.0	0.0
(5)	(CH)	103.0	103.0	330.0	330.0	380.0	380.0	0.0
(6)	(CH)	100.0	100.0	380.0	380.0	380.0	380.0	0.0
(7)	(SM)	122.0	122.0	0.0	0.0	0.0	0.0	30.0

GENERAL NOTES:

CLASSIFICATION, STRATIFICATION, SHEAR STRENGTH, AND UNIT WEIGHT OF THE SOIL WERE BASED ON THE RESULTS OF UNDISTURBED BORINGS. SEE BORING DATA PLATES.

NOTES

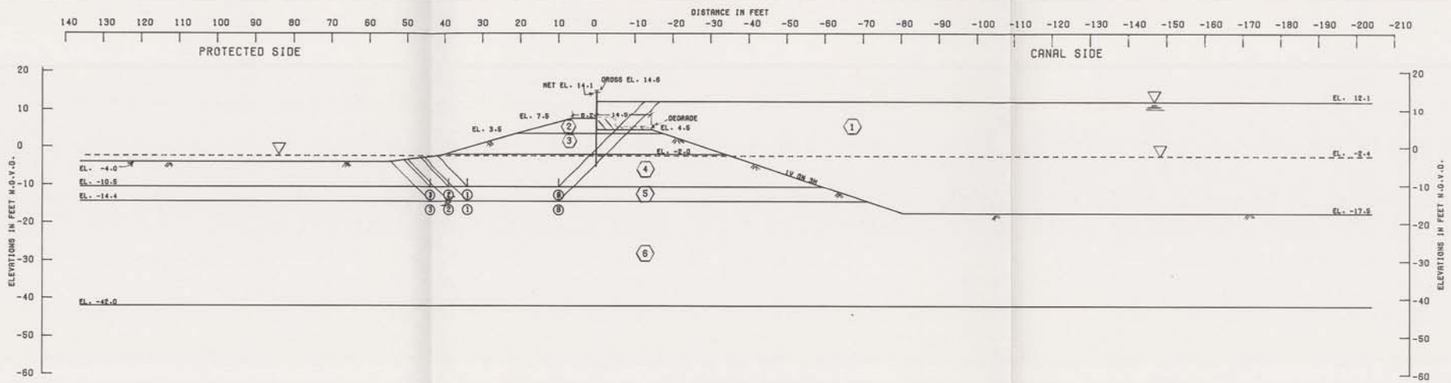
ϕ -- ANGLE OF INTERNAL FRICTION, DEGREES
C -- UNIT COHESION, P.S.F.
∇ -- STATIC WATER SURFACE
D -- HORIZONTAL DRIVING FORCE IN POUNDS
R -- HORIZONTAL RESISTING FORCE IN POUNDS
A -- AS A SUBSCRIPT, REFERS TO ACTIVE WEDGE
B -- AS A SUBSCRIPT, REFERS TO CENTRAL BLOCK
P -- AS A SUBSCRIPT, REFERS TO PASSIVE 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. 30 GENERAL DESIGN
ORLEANS PARISH - JEFFERSON PARISH
17 TH. STREET OUTFALL CANAL
(METAIRIE RELIEF)
FLOOD SIDE LEVEE
STABILITY ANALYSIS
B/L STA.614+25 TO
B/L STA.625+25 ORLEANS
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

DATE: MARCH 1990 FILE NOM-2-30300

PLATE 69



ASSUMED FAILURE SURFACE NO.	ELEV.	RESISTING FORCES R_A	R_B	R_P	DRIVING FORCES D_A	$-D_P$	SUMMATION OF FORCES RESISTING	DRIVING	FACTOR OF SAFETY
(B) (1)	-10.5	11260	6720	4553	19388	4202	22533	15186	1.48
(B) (2)	-10.5	11260	8120	4238	19388	3346	23618	18042	1.47
(B) (3)	-10.5	11260	9520	3923	19388	2848	24703	16540	1.49
(B) (1)	-14.4	13600	7680	6647	28115	8163	27927	19952	1.40
(B) (2)	-14.4	13600	9280	6333	28115	7081	29213	21034	1.39
(B) (3)	-14.4	13600	10729	6018	28115	6367	30347	21758	1.39

STRATUM NO.	SOIL TYPE	EFFECTIVE UNIT WT. P.C.F. VERT. 1	VERT. 2	C - UNIT COHESION - P.S.F. CENTER OF STRATUM VERT. 1	VERT. 2	BOTTOM OF STRATUM VERT. 1	VERT. 2	FRICTION ANGLE DEGREES
(1)	(WATER)	62.5	62.5	0.0	0.0	0.0	0.0	0.0
(2)	(CH)	120.0	120.0	500.0	500.0	500.0	500.0	0.0
(3)	(CH)	103.0	103.0	500.0	500.0	500.0	500.0	0.0
(4)	(CH)	103.0	103.0	280.0	280.0	280.0	280.0	0.0
(5)	(CH)	103.0	103.0	300.0	300.0	320.0	320.0	0.0
(6)	(SM)	122.0	122.0	0.0	0.0	0.0	0.0	30.0

GENERAL NOTES:

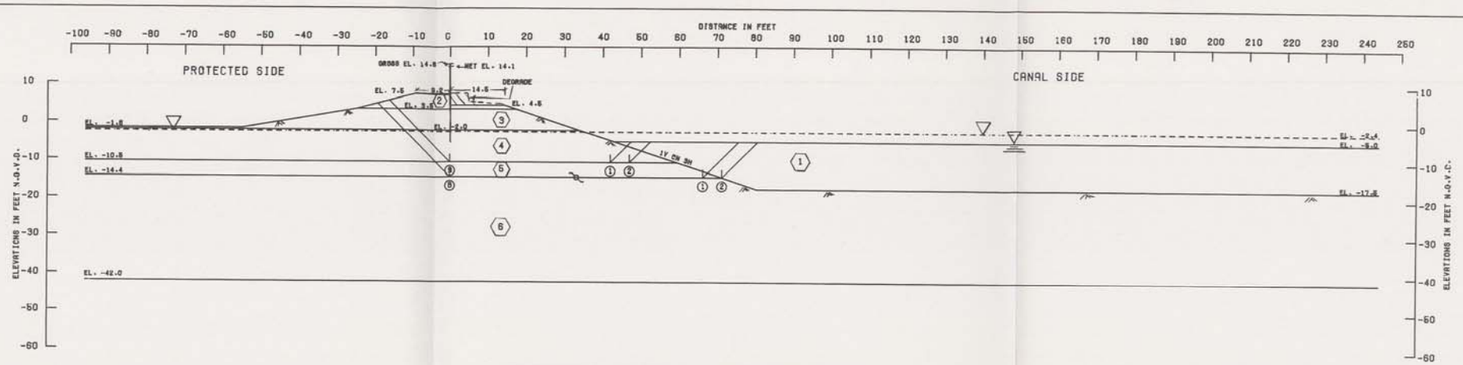
CLASSIFICATION, STRATIFICATION, SHEAR STRENGTH, AND UNIT WEIGHT OF THE SOIL WERE BASED ON THE RESULTS OF UNDISTURBED BORINGS. SEE BORING DATA PLATES.

NOTES

ϕ -- ANGLE OF INTERNAL FRICTION, DEGREES
C -- UNIT COHESION, P.S.F.
Ω -- 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. 53, GENERAL DESIGN
ORLEANS PARISH - JEFFERSON PARISH
17 TH. STREET OUTFALL CANAL
(METAIRIE RELIEF)
PROTECTED SIDE LEVEE
STABILITY ANALYSIS
B/L STA. 625 + 25 TO
B/L STA. 635 + 00 ORLEANS
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
DATE: MARCH 1990 FILE NO. H-2-30300



FAILURE SURFACE NO.	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	-10.5	12485	11760	2449	18677	1472	26694	15205	1.76
Ⓐ ②	-10.5	12485	13160	1749	18677	1209	27394	15468	1.77
Ⓑ ①	-14.4	14030	13833	749	23940	2803	28612	21137	1.35
Ⓑ ②	-14.4	14030	13833	-1	23940	2761	27862	21179	1.32

STRATUM NO.	SOIL TYPE	EFFECTIVE UNIT WT. P.C.F. VERT. 1	EFFECTIVE UNIT WT. P.C.F. VERT. 2	C – UNIT COHESION – P.S.F. CENTER OF STRATUM VERT. 1	C – UNIT COHESION – P.S.F. CENTER OF STRATUM VERT. 2	C – UNIT COHESION – P.S.F. BOTTOM OF STRATUM VERT. 1	C – UNIT COHESION – P.S.F. BOTTOM OF STRATUM VERT. 2	FRICTION ANGLE DEGREES
①	(WATER)	62.5	62.5	0.0	0.0	0.0	0.0	0.0
②	(CH)	120.0	120.0	500.0	500.0	500.0	500.0	0.0
③	(CH)	103.0	103.0	500.0	500.0	500.0	500.0	0.0
④	(CH)	103.0	103.0	280.0	280.0	280.0	280.0	0.0
⑤	(CH)	103.0	103.0	300.0	300.0	320.0	320.0	0.0
⑥	(SM)	122.0	122.0	0.0	0.0	0.0	0.0	30.0

GENERAL NOTES:

CLASSIFICATION, STRATIFICATION, SHEAR STRENGTH, AND UNIT WEIGHT OF THE SOIL WERE BASED ON THE RESULTS OF UNDISTURBED BORINGS. SEE BORING DATA PLATES.

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

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

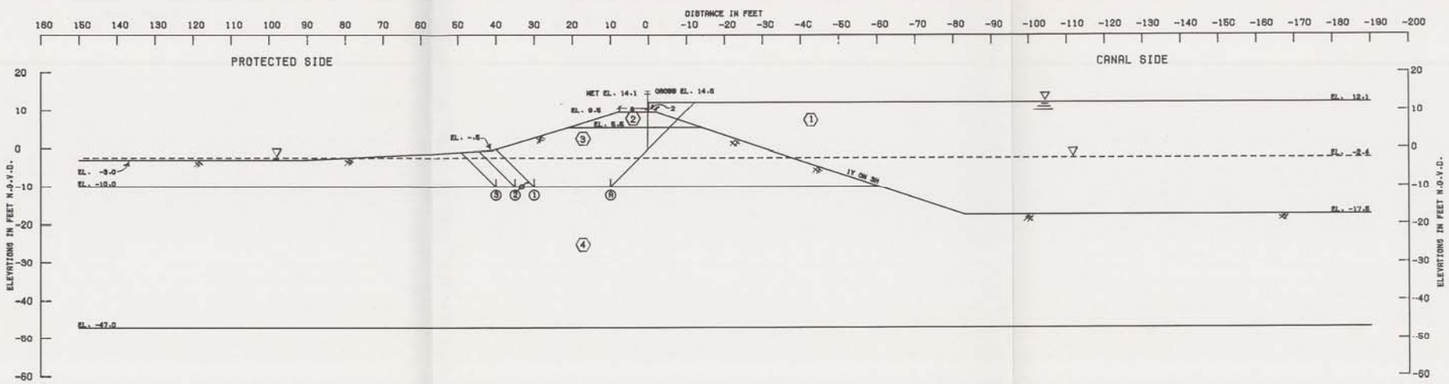
LAKE PONTCHARTRAIN, LA. AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO. 20 GENERAL DESIGN
ORLEANS PARISH – JEFFERSON PARISH
17 TH. STREET OUTFALL CANAL
(METAIRIE RELIEF)

FLOOD SIDE LEVEE
STABILITY ANALYSIS
B/L STA. 625 + 25 TO
B/L STA. 635 + 00 ORLEANS

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

DATE: MARCH 1990 FILE NO. H-2-30300

PLATE 71



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
(5) (1)	-10.0	14238	9100	7424	22346	6741	30762	15605	1.97
(6) (2)	-10.0	14238	11349	7016	22346	5369	32603	16977	1.92
(6) (3)	-10.0	14238	13236	6807	22346	4629	34281	17717	1.93

STRATUM NO.	SOIL TYPE	EFFECTIVE UNIT WT. P.C.F. VERT. 1	EFFECTIVE UNIT WT. P.C.F. VERT. 2	C - UNIT COHESION - P.S.F. CENTER OF STRATUM VERT. 1	C - UNIT COHESION - P.S.F. CENTER OF STRATUM VERT. 2	C - UNIT COHESION - P.S.F. BOTTOM OF STRATUM VERT. 1	C - UNIT COHESION - P.S.F. BOTTOM OF STRATUM VERT. 2	FRICTION ANGLE DEGREES
(1)	(WATER)	62.5	62.5	0.0	0.0	0.0	0.0	0.0
(2)	(CH)	117.0	117.0	600.0	600.0	600.0	600.0	0.0
(3)	(CH)	107.0	107.0	377.0	377.0	455.0	455.0	0.0
(4)	(SM)	122.0	122.0	0.0	0.0	0.0	0.0	30.0

GENERAL NOTES:

CLASSIFICATION, STRATIFICATION, SHEAR STRENGTH, AND UNIT WEIGHT OF THE SOIL WERE BASED ON THE RESULTS OF UNDISTURBED BORINGS. SEE BORING DATA PLATES.

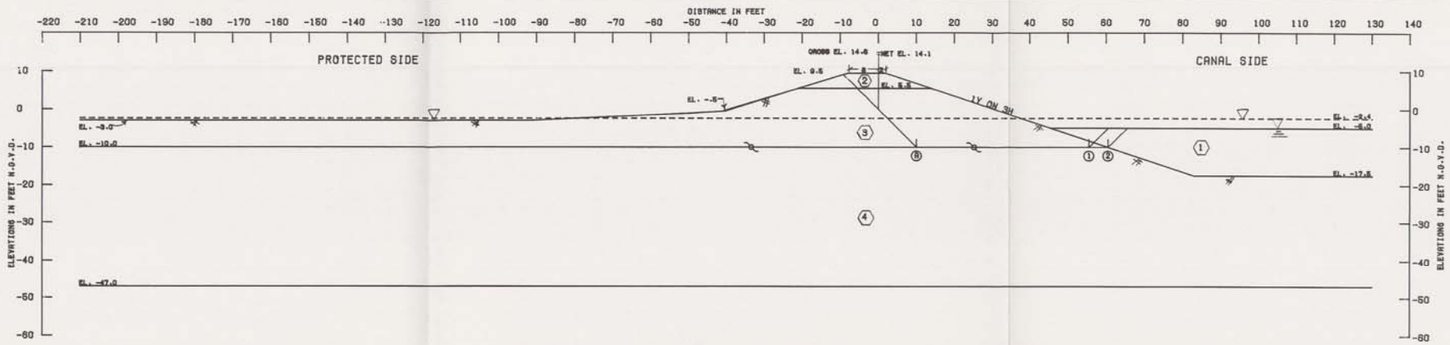
NOTES

ϕ -- ANGLE OF INTERNAL FRICTION, DEGREES
C -- UNIT COHESION, P.S.F.
Σ -- 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
HURRICANE PROTECTION
DESIGN MEMORANDUM NO. 20 GENERAL DESIGN
ORLEANS PARISH – JEFFERSON PARISH
17 TH. STREET OUTFALL CANAL
(METAIRIE RELIEF)
PROTECTED SIDE LEVEE
STABILITY ANALYSIS
B/L STA. 635 + 00 TO
B/L STA. 642 + 00 ORLEANS
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
DATE: MARCH 1990
FILE NO. H-2-30300

PLATE 72



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	
⑥ ①	-10.0	16064	12090	941	19769	827	29095	18932	1.54
⑥ ⑤	-10.0	16064	12119	0	19769	781	28183	18978	1.48

STRATUM NO.	SOIL TYPE	EFFECTIVE UNIT WT. P.C.F.		C - UNIT COHESION - P.S.F.				FRICTION ANGLE
				CENTER OF STRATUM		BOTTOM OF STRATUM		
		VERT. 1	VERT. 2	VERT. 1	VERT. 2	VERT. 1	VERT. 2	DEGREES
①	(WATER)	62.5	62.5	0.0	0.0	0.0	0.0	0.0
②	(CH)	117.0	117.0	600.0	600.0	600.0	600.0	0.0
③	(CH)	107.0	107.0	377.0	377.0	455.0	455.0	0.0
④	(SM)	122.0	122.0	0.0	0.0	0.0	0.0	30.0

GENERAL NOTES:

CLASSIFICATION, STRATIFICATION, SHEAR STRENGTH, AND UNIT WEIGHT OF THE SOIL WERE BASED ON THE RESULTS OF UNDISTURBED BORINGS. SEE BORING DATA PLATES.

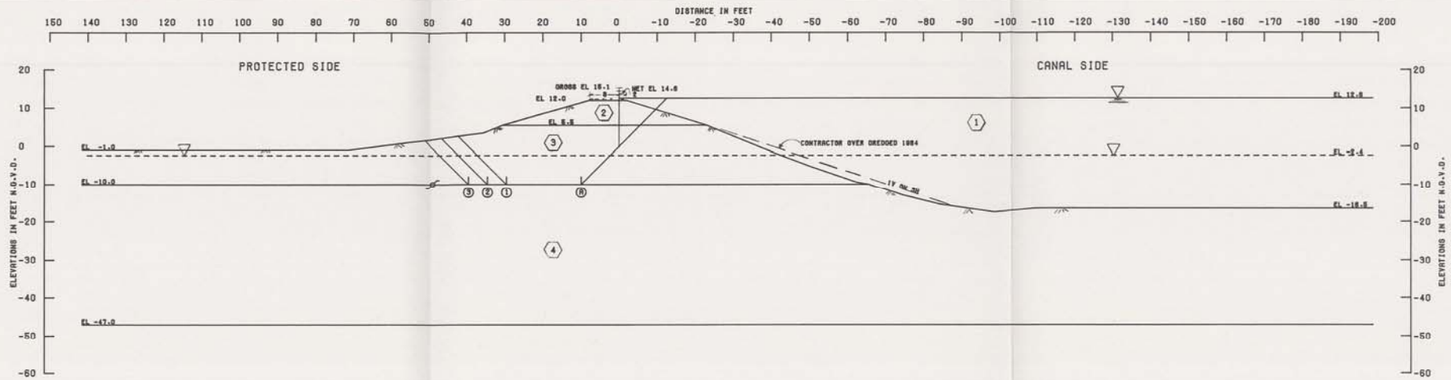
NOTES

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
HURRICANE PROTECTION LEVEE
DESIGN MEMORANDUM NO. 32 GENERAL DESIGN
ORLEANS PARISH – JEFFERSON PARISH
17 TH. STREET OUTFALL CANAL
(METAIRIE RELIEF)
FLOOD SIDE LEVEE
STABILITY ANALYSIS
B/L STA 635+00 TO
B/L STA 642 + 00 ORLEANS
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
DATE: MARCH 1990
FILE NO. H-2-30800

PLATE 73



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
R 1	-10.0	16652	8873	9550	26861	10179	35075	16682	2.10
R 2	-10.0	16652	11148	9131	26861	8841	36931	18020	2.05
R 3	-10.0	16652	13423	8712	26861	8036	38787	18926	2.05

STRATUM NO.	SOIL TYPE	EFFECTIVE UNIT WT. P.C.F. VERT. 1	EFFECTIVE UNIT WT. P.C.F. VERT. 2	C - UNIT COHESION - P.S.F. CENTER OF STRATUM VERT. 1	C - UNIT COHESION - P.S.F. CENTER OF STRATUM VERT. 2	C - UNIT COHESION - P.S.F. BOTTOM OF STRATUM VERT. 1	C - UNIT COHESION - P.S.F. BOTTOM OF STRATUM VERT. 2	FRICTION ANGLE DEGREES
1	(WATER)	62.5	62.5	0.0	0.0	0.0	0.0	0.0
2	(CH)	117.0	117.0	600.0	600.0	600.0	600.0	0.0
3	(CH)	107.0	107.0	377.0	377.0	455.0	455.0	0.0
4	(SM)	122.0	122.0	0.0	0.0	0.0	0.0	30.0

GENERAL NOTES:

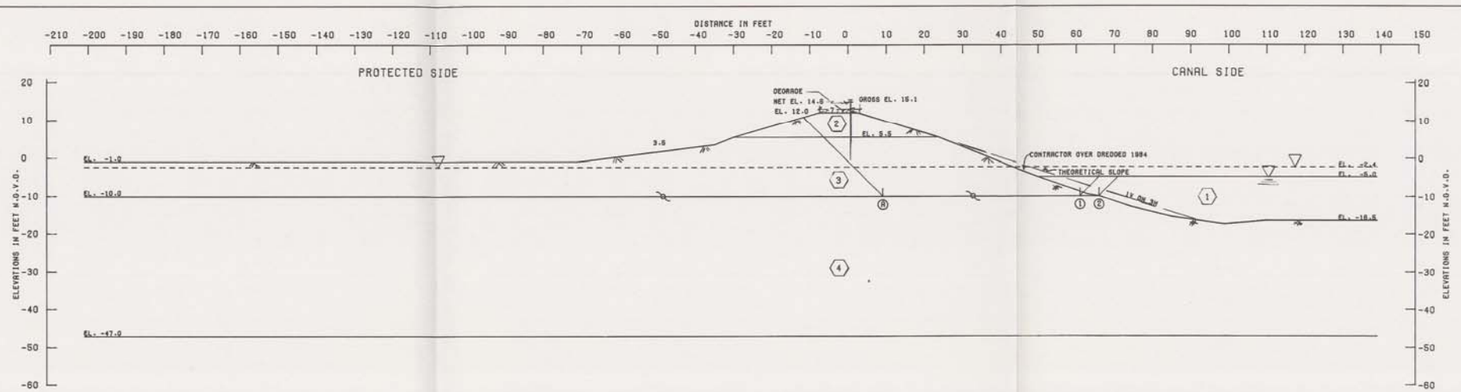
CLASSIFICATION, STRATIFICATION, SHEAR STRENGTH, AND UNIT WEIGHT OF THE SOIL WERE BASED ON THE RESULTS OF UNDISTURBED BORINGS. SEE BORING DATA PLATES.

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.20 GENERAL DESIGN
ORLEANS PARISH -- JEFFERSON PARISH
17 TH. STREET OUTFALL CANAL
(METAIRIE RELIEF)
PROTECTED SIDE LEVEE
STABILITY ANALYSIS
B/L STA 642 + 00 TO
B/L STA 663 + 00 ORLEANS
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
DATE: MARCH 1990 FILE NO. H-2-30800



ASSUMED FAILURE SURFACE NO.	ELEV.	RESISTING FORCES R_A	R_B	R_P	DRIVING FORCES D_A	$-D_P$	SUMMATION OF FORCES RESISTING	DRIVING	FACTOR OF SAFETY
Ⓐ ①	-10.0	18008	15147	667	25948	805	33822	25143	1.35
Ⓐ ②	-10.0	18008	15152		25948	781	33158	25167	1.32

STRATUM NO.	SOIL TYPE	EFFECTIVE UNIT WT. P.C.F. VERT. 1	VERT. 2	C - UNIT COHESION - P.S.F. CENTER OF STRATUM VERT. 1	VERT. 2	BOTTOM OF STRATUM VERT. 1	VERT. 2	FRICTION ANGLE DEGREES
①	(WATER)	62.5	62.5	0.0	0.0	0.0	0.0	0.0
②	(CH)	117.0	117.0	600.0	600.0	600.0	600.0	0.0
③	(CH)	107.0	107.0	377.0	377.0	455.0	455.0	0.0
④	(SM)	122.0	122.0	0.0	0.0	0.0	0.0	30.0

GENERAL NOTES:

CLASSIFICATION, STRATIFICATION, SHEAR STRENGTH, AND UNIT WEIGHT OF THE SOIL WERE BASED ON THE RESULTS OF UNDISTURBED BORINGS. SEE BORING DATA PLATES.

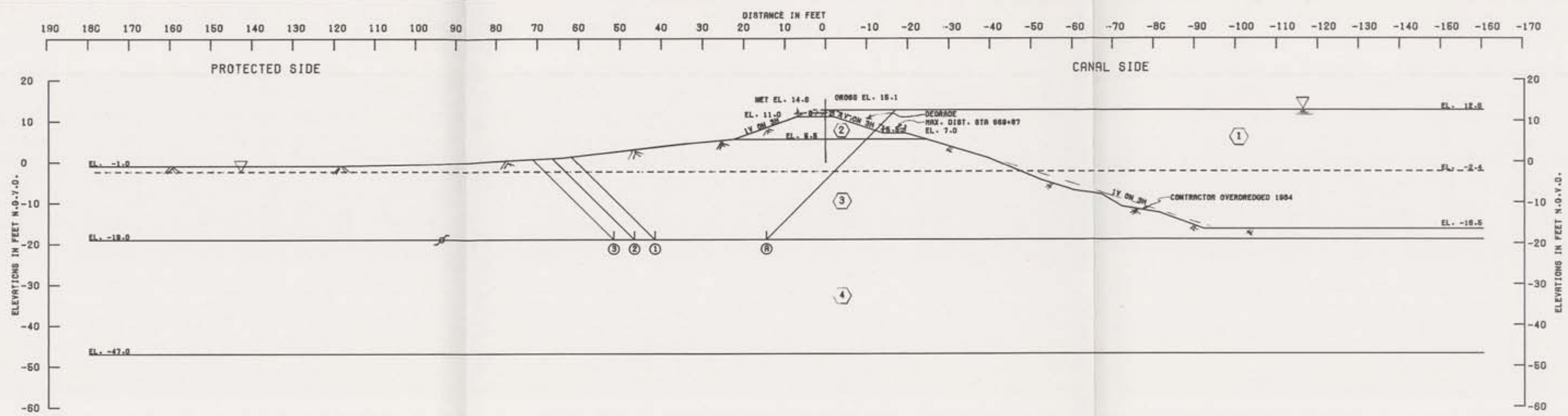
NOTES

- 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. 20 GENERAL DESIGN
ORLEANS PARISH — JEFFERSON PARISH
17 TH. STREET OUTFALL CANAL
(METAIRIE RELIEF)
FLOOD SIDE LEVEE
STABILITY ANALYSIS
B/L STA. 642 + 00 TO
B/L STA. 663 + 00 ORLEANS
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
DATE: MARCH 1990 FILE NO. H-2-39500

PLATE 75



ASSUMED FAILURE SURFACE NO.	ELEV.	RESISTING FORCES R_A	R_B	R_P	DRIVING FORCES D_A	$-D_P$	SUMMATION OF FORCES RESISTING	DRIVING	FACTOR OF SAFETY
Ⓐ ①	-19.0	23231	14715	17102	48868	24528	55048	24340	2.26
Ⓐ ②	-19.0	23231	17440	16779	48868	23297	57450	25571	2.25
Ⓐ ③	-19.0	23231	20165	16578	48868	22232	59974	26636	2.25

STRATUM NO.	SOIL TYPE	EFFECTIVE UNIT WT. P.C.F. VERT. 1	VERT. 2	C - UNIT COHESION - P.S.F. CENTER OF STRATUM VERT. 1	VERT. 2	BOTTOM OF STRATUM VERT. 1	VERT. 2	FRICTION ANGLE DEGREES
①	(WATER)	62.5	62.5	0.0	0.0	0.0	0.0	0.0
②	(CH)	117.0	117.0	600.0	600.0	600.0	600.0	0.0
③	(CH)	107.0	107.0	422.0	422.0	545.0	545.0	0.0
④	(SM)	122.0	122.0	0.0	0.0	0.0	0.0	30.0

GENERAL NOTES:

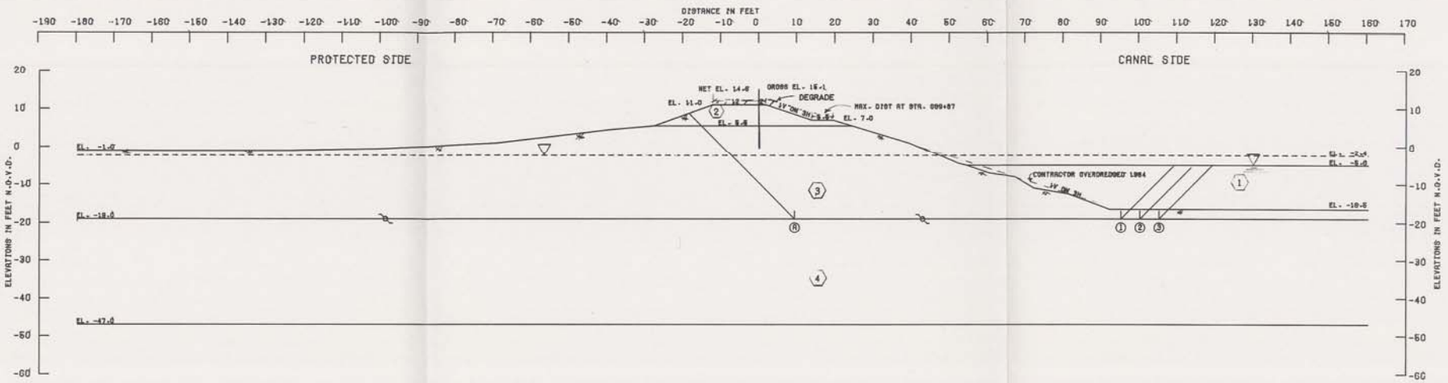
CLASSIFICATION, STRATIFICATION, SHEAR STRENGTH, AND UNIT WEIGHT OF THE SOIL WERE BASED ON THE RESULTS OF UNDISTURBED BORINGS. SEE BORING DATA PLATES.

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 20 GENERAL DESIGN
ORLEANS PARISH — JEFFERSON PARISH
17 TH. STREET OUTFALL CANAL
(METAIRIE RELIEF)
PROTECTED SIDE LEVEE
STABILITY ANALYSIS
B/L STA. 663 + 00 TO
B/L STA. 670 + 63 ORLEANS
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
DATE: MARCH 1990 FILE NO. H-2-30390



ASSUMED FAILURE SURFACE NO.	ELEV.	RESISTING FORCES R_A	R_B	R_P	DRIVING FORCES D_A	$-D_P$	SUMMATION OF FORCES RESISTING	DRIVING	FACTOR OF SAFETY
5 1	-19.0	24596	27863	2110	47436	6204	54369	41171	1.32
5 2	-19.0	24596	27863	2110	47436	6204	54369	41171	1.32
5 3	-19.0	24596	27863	2110	47436	6204	54369	41171	1.32

STRATUM NO.	SOIL TYPE	EFFECTIVE UNIT WT. P.C.F. VERT. 1	VERT. 2	C - UNIT COHESION - P.S.F. CENTER OF STRATUM VERT. 1	VERT. 2	BOTTOM OF STRATUM VERT. 1	VERT. 2	FRICTION ANGLE DEGREES
1	(WATER)	62.6	62.6	0.0	0.0	0.0	0.0	0.0
2	(CH)	117.0	117.0	800.0	800.0	800.0	800.0	0.0
3	(CH)	107.0	107.0	422.0	422.0	646.0	646.0	0.0
4	(SM)	122.0	122.0	0.0	0.0	0.0	0.0	30.0

GENERAL NOTES:

CLASSIFICATION, STRATIFICATION, SHEAR STRENGTH, AND UNIT WEIGHT OF THE SOIL WERE BASED ON THE RESULTS OF UNDISTURBED BORINGS. SEE BORING DATA PLATES.

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

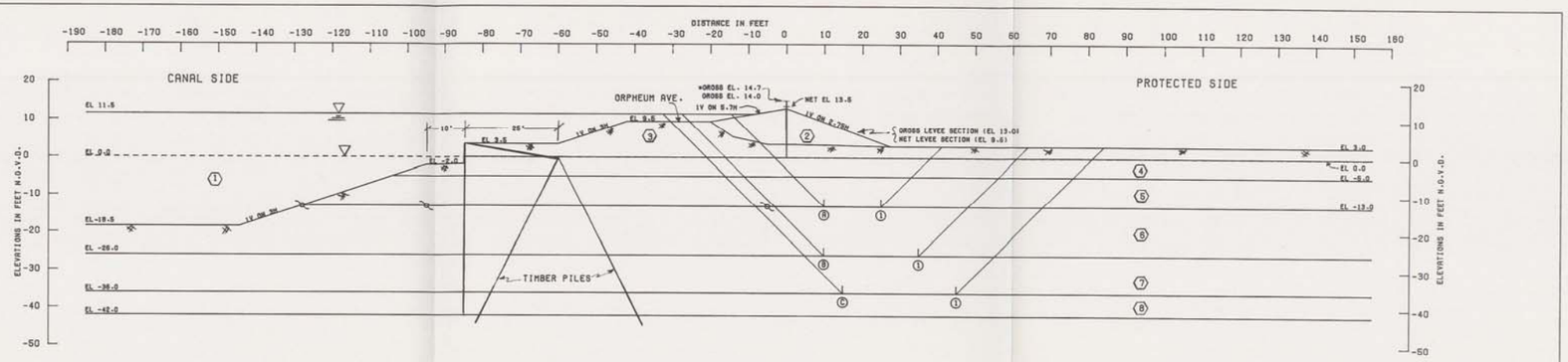
$$\text{FACTOR OF SAFETY} = \frac{R_A + R_B + R_P}{D_A - D_P}$$

LAKE PONTCHARTRAIN, LA. AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO. 20 GENERAL DESIGN

ORLEANS PARISH – JEFFERSON PARISH
17 TH. STREET OUTFALL CANAL
(METAIRIE RELIEF)
FLOOD SIDE LEVEE
STABILITY ANALYSIS
B/L STA. 663 + 00 TO
B/L STA. 670 + 63 ORLEANS

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

DATE: MARCH 1990 FILE NO. H-2-30300



* STA 551+00 TO STA 552+25

STRATUM NO.	SOIL TYPE	EFFECTIVE UNIT WT. P.C.F. VERT. 1	EFFECTIVE UNIT WT. P.C.F. VERT. 2	C - UNIT COHESION - P.S.F. CENTER OF STRATUM VERT. 1	C - UNIT COHESION - P.S.F. CENTER OF STRATUM VERT. 2	C - UNIT COHESION - P.S.F. BOTTOM OF STRATUM VERT. 1	C - UNIT COHESION - P.S.F. BOTTOM OF STRATUM VERT. 2	FRICTION ANGLE DEGREES
1	(WATER)	62.5	62.5	0.0	0.0	0.0	0.0	0.0
2	(CH)	110.0	110.0	400.0	400.0	400.0	400.0	0.0
3	(CH)	110.0	110.0	500.0	500.0	500.0	500.0	0.0
4	(CH)	100.0	100.0	500.0	500.0	500.0	500.0	0.0
5	(CH)	95.0	100.0	280.0	400.0	280.0	400.0	0.0
6	(CH)	100.0	100.0	280.0	500.0	280.0	600.0	0.0
7	(CH)	100.0	100.0	340.0	670.0	400.0	745.0	0.0
8	(SM)	122.0	122.0	0.0	0.0	0.0	0.0	30.0

ASSUMED FAILURE SURFACE NO.	ASSUMED FAILURE SURFACE ELEV.	RESISTING FORCES R_B	RESISTING FORCES R_A	RESISTING FORCES R_P	DRIVING FORCES D_A	DRIVING FORCES $-D_P$	SUMMATION OF FORCES RESISTING	SUMMATION OF FORCES DRIVING	FACTOR OF SAFETY
B 1	-13.0	18760	4200	12480	32231	13200	35440	19031	1.86
B 1	-26.0	26360	7000	19760	72480	42194	53140	30286	1.75
C 1	-36.0	33480	12000	26560	113603	76092	72040	37511	1.92

GENERAL NOTES:

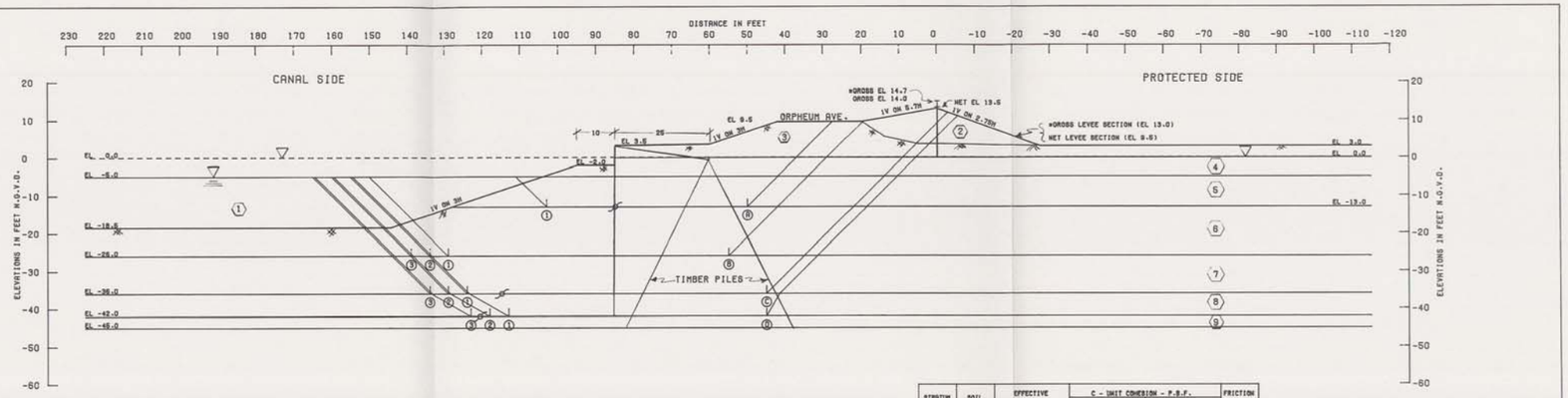
CLASSIFICATION, STRATIFICATION, SHEAR STRENGTH, AND UNIT WEIGHT OF THE SOIL WERE BASED ON THE RESULTS OF UNDISTURBED BORINGS. SEE BORING DATA PLATES.

NOTES

ϕ -- ANGLE OF INTERNAL FRICTION, DEGREES
C -- UNIT COHESION, P.S.F.
Ω -- 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. 20 GENERAL DESIGN
ORLEANS PARISH – JEFFERSON PARISH
17 TH. STREET OUTFALL CANAL
(METAIRIE RELIEF)
PROTECTED SIDE LEVEE
STABILITY ANALYSIS
B/L STA. 549 + 22 TO
B/L STA. 552 + 70 JEFFERSON
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
DATE: MARCH 1980
FILE NO. R-E-30300



* STA 551+00 TO STA 552+25

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
(B) (1)	-13.0	20540	16371	3499	26792	2867	40410	22935	1.76
(B) (1)	-26.0	32534	23720	5320	62705	16035	61574	46669	1.32
(B) (2)	-26.0	32534	25120	4820	62705	15482	62274	47223	1.32
(B) (3)	-26.0	32534	26520	4200	62705	15024	63254	47681	1.33
(C) (1)	-36.0	47655	37065	11420	111668	38342	96160	73326	1.31
(C) (2)	-36.0	47655	38715	11000	111668	37273	97373	74395	1.31
(C) (3)	-36.0	47655	40180	11000	111668	36461	98835	75207	1.31
(D) (1)	-42.0	57391	38760	21519	142368	58109	117670	84259	1.40
(D) (2)	-42.0	57391	41610	20364	142368	56700	119365	85668	1.39
(D) (3)	-42.0	57391	44442	19587	142368	55511	121520	86857	1.40

STRATUM NO.	SOIL TYPE	EFFECTIVE UNIT WT. P.C.F. VERT. 1	EFFECTIVE UNIT WT. P.C.F. VERT. 2	C - UNIT COHESION - P.S.F. CENTER OF STRATUM VERT. 1	C - UNIT COHESION - P.S.F. CENTER OF STRATUM VERT. 2	C - UNIT COHESION - P.S.F. BOTTOM OF STRATUM VERT. 1	C - UNIT COHESION - P.S.F. BOTTOM OF STRATUM VERT. 2	FRICTION ANGLE DEGREES
(1)	(WATER)	62.5	62.5	0.0	0.0	0.0	0.0	0.0
(2)	(CH)	110.0	110.0	400.0	400.0	400.0	400.0	0.0
(3)	(CH)	110.0	110.0	500.0	500.0	500.0	500.0	0.0
(4)	(CH)	100.0	100.0	500.0	500.0	500.0	500.0	0.0
(5)	(CH)	100.0	95.0	400.0	280.0	400.0	280.0	0.0
(6)	(CH)	100.0	100.0	500.0	280.0	600.0	280.0	0.0
(7)	(CH)	100.0	100.0	670.0	340.0	745.0	400.0	0.0
(8)	(SM)	122.0	122.0	0.0	0.0	0.0	0.0	30.0
(9)	(CH)	117.0	117.0	570.0	570.0	570.0	570.0	0.0

GENERAL NOTES:

CLASSIFICATION, STRATIFICATION, SHEAR STRENGTH, AND UNIT WEIGHT OF THE SOIL WERE BASED ON THE RESULTS OF UNDISTURBED BORINGS. SEE BORING DATA PLATES.

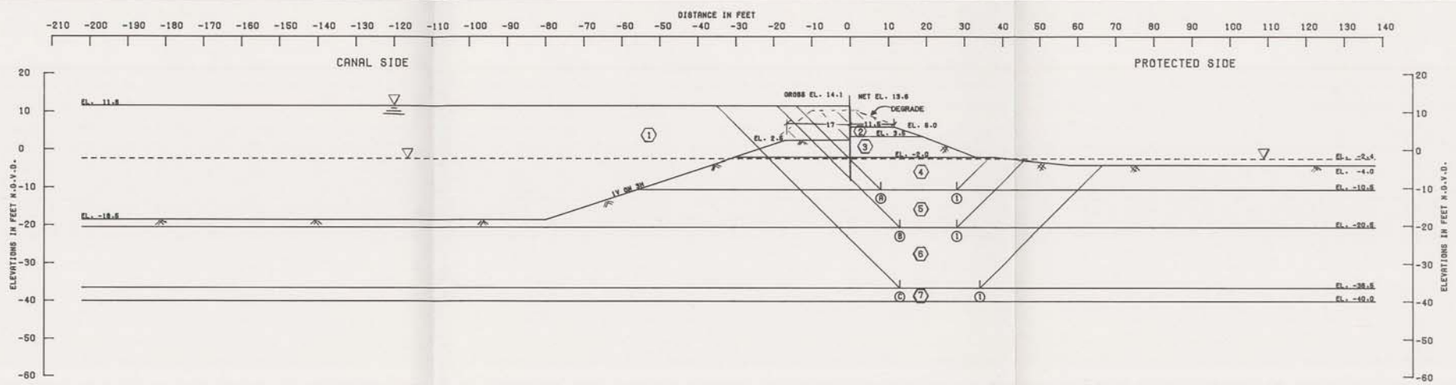
NOTES

Φ -- ANGLE OF INTERNAL FRICTION, DEGREES
C -- UNIT COHESION, P.S.F.
$\underline{W}$ -- 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
HURR LEVEL PLAN
DESIGN MEMORANDUM NO.20 GENERAL DESIGN
ORLEANS PARISH -- JEFFERSON PARISH
17 TH. STREET OUTFALL CANAL
(METAIRIE RELIEF)
FLOOD SIDE LEVEE
STABILITY ANALYSIS
B/L STA. 549 + 22 TO
B/L STA. 552 + 70 JEFFERSON
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
DATE: MARCH 1990 FILE NO. H-2-38300

PLATE 79



ASSUMED FAILURE SURFACE NO.	ELEV.	RESISTING FORCES R_A	R_B	R_F	DRIVING FORCES D_A	$-D_F$	SUMMATION OF FORCES RESISTING	DRIVING	FACTOR OF SAFETY
Ⓑ ①	-10.5	9324	5600	4760	17378	4228	19684	13152	1.50
Ⓑ ①	-20.5	15897	6700	10927	40740	17792	32524	22948	1.42
Ⓒ ①	-36.5	25771	7980	22400	100138	56894	56151	43244	1.30

STRATUM NO.	SOIL TYPE	EFFECTIVE UNIT WT. P.C.F. VERT. 1	VERT. 2	C - UNIT COHESION - P.S.F. CENTER OF STRATUM VERT. 1	VERT. 2	BOTTOM OF STRATUM VERT. 1	VERT. 2	FRICTION ANGLE DEGREES
①	(WATER)	62.5	62.5	0.0	0.0	0.0	0.0	0.0
②	(CH)	120.0	120.0	500.0	500.0	500.0	500.0	0.0
③	(CH)	103.0	103.0	500.0	500.0	500.0	500.0	0.0
④	(CH)	103.0	103.0	280.0	280.0	280.0	280.0	0.0
⑤	(CH)	103.0	103.0	330.0	330.0	380.0	380.0	0.0
⑥	(CH)	100.0	100.0	380.0	380.0	380.0	380.0	0.0
⑦	(SM)	122.0	122.0	0.0	0.0	0.0	0.0	30.0

GENERAL NOTES:

CLASSIFICATION, STRATIFICATION, SHEAR STRENGTH, AND UNIT WEIGHT OF THE SOIL WERE BASED ON THE RESULTS OF UNDISTURBED BORINGS. SEE BORING DATA PLATES.

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
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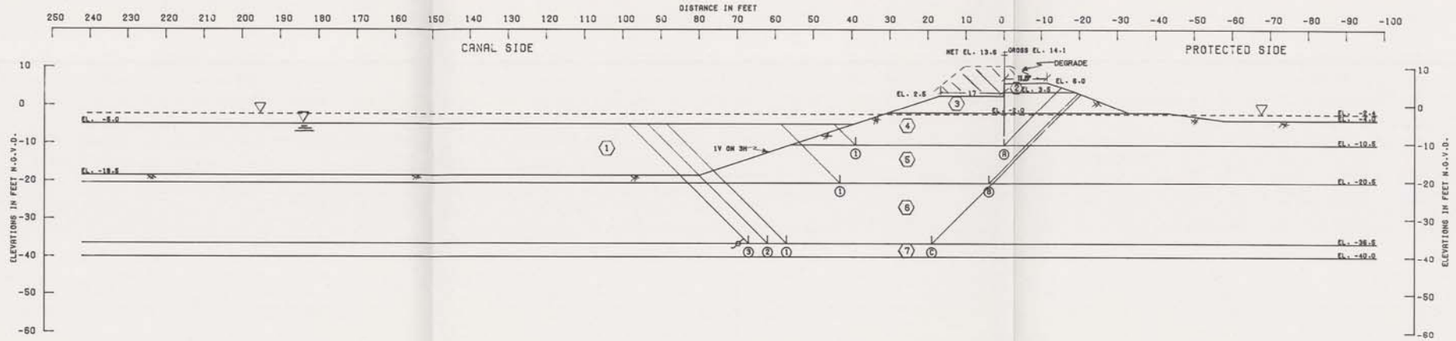
F -- AS A SUBSCRIPT, REFERS TO PASSIVE WEDGE

$$\text{FACTOR OF SAFETY} = \frac{R_A + R_B + R_F}{D_A - D_F}$$

LAKE PONTCHARTRAIN, LA. AND VICINITY
HURR. LEVEL PLAN
DESIGN MEMORANDUM NO.20 GENERAL DESIGN
ORLEANS PARISH – JEFFERSON PARISH
17 TH STREET OUTFALL CANAL
(METAIRIE RELIEF)
PROTECTED SIDE LEVEE
STABILITY ANALYSIS
B/L STA. 554 + 00 TO
B/L STA. 589 + 00 JEFFERSON
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
DATE: MARCH 1990 FILE NO. H-2-30300

PLATE 80



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	
(B) (1)	-10.5	11511	10920	2379	14138	1435	24810	12703	1.95
(B) (1)	-20.5	16580	14820	7019	33685	10626	38419	23059	1.67
(C) (1)	-36.5	28458	14440	14305	84376	40627	57203	43749	1.31
(C) (2)	-36.5	28458	16340	13480	84376	39370	58278	45006	1.30
(C) (3)	-36.5	28458	18240	13480	84376	38324	60178	46052	1.31

STRATUM NO.	SOIL TYPE	EFFECTIVE UNIT WT. P.C.F.		C - UNIT COHESION - P.S.F.				FRICTION ANGLE DEGREES
				CENTER OF STRATUM		BOTTOM OF STRATUM		
		VERT. 1	VERT. 2	VERT. 1	VERT. 2	VERT. 1	VERT. 2	
(1)	(WATER)	62.5	62.5	0.0	0.0	0.0	0.0	0.0
(2)	(CHT	120.0	120.0	500.0	500.0	500.0	500.0	0.0
(3)	(CHT	103.0	103.0	500.0	500.0	500.0	500.0	0.0
(4)	(CHT	103.0	103.0	280.0	280.0	280.0	280.0	0.0
(5)	(CHT	103.0	103.0	330.0	330.0	380.0	380.0	0.0
(6)	(CHT	100.0	100.0	380.0	380.0	380.0	380.0	0.0
(7)	(SRT	122.0	122.0	0.0	0.0	0.0	0.0	30.0

GENERAL NOTES:

CLASSIFICATION, STRATIFICATION, SHEAR STRENGTH, AND UNIT WEIGHT OF THE SOIL WERE BASED ON THE RESULTS OF UNDISTURBED BORINGS. SEE BORING DATA PLATES.

NOTES

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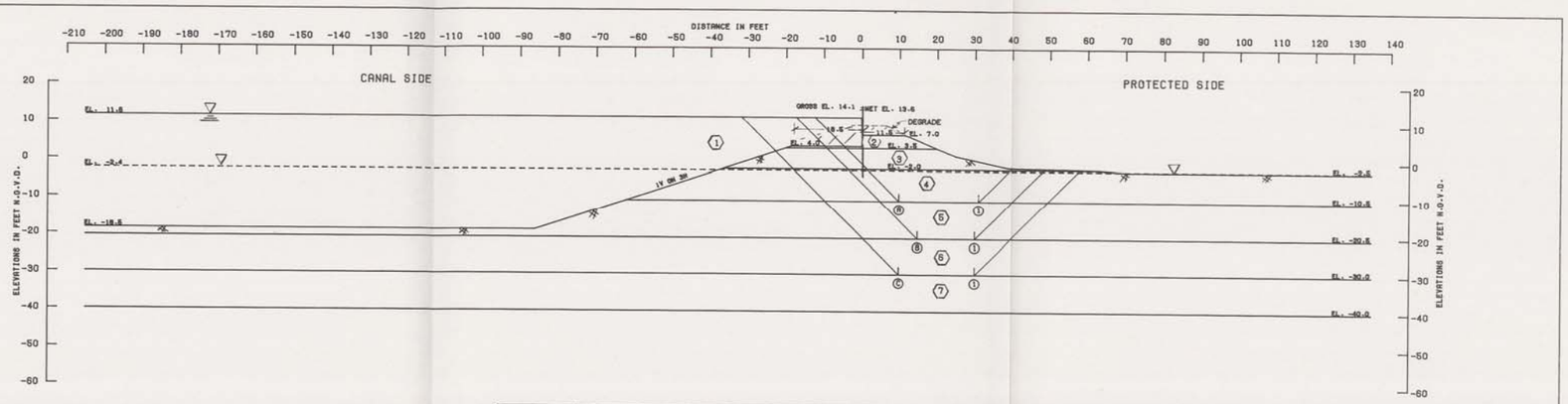
B -- AS A SUBSCRIPT, REFERS TO CENTRAL BLOCK
P -- AS A SUBSCRIPT, REFERS TO PASSIVE WEDGE

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

LAKE PONTCHARTRAIN, LA. AND VICINITY
HURRICANE PROTECTION LEVEE, PLAN
DESIGN MEMORANDUM NO.20 GENERAL DESIGN
ORLEANS PARISH — JEFFERSON PARISH
17 TH. STREET OUTFALL CANAL
(METAIRIE RELIEF)
FLOODSIDE LEVEE
STABILITY ANALYSIS
B/L STA. 554 + 00 TO
B/L STA. 589 + 00 JEFFERSON
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

DATE: MARCH 1990 FILE NO. H-2-30300



ASSUMED FAILURE SURFACE NO.	ELEV.	RESISTING FORCES R_A	R_B	R_P	DRIVING FORCES D_A	$-D_P$	SUMMATION OF FORCES RESISTING	DRIVING	FACTOR OF SAFETY
Ⓑ ①	-10.5	10760	5880	5239	18489	4876	21879	13613	1.61
Ⓑ ①	-20.5	17360	5700	11656	42563	19379	34716	23184	1.50
Ⓒ ①	-30.0	23208	7600	18682	76296	42187	49490	34108	1.45

STRATUM NO.	SOIL TYPE	EFFECTIVE UNIT WT. P.C.F. VERT. 1	VERT. 2	C - UNIT COHESION - P.S.F. CENTER OF STRATUM VERT. 1	VERT. 2	BOTTOM OF STRATUM VERT. 1	VERT. 2	FRICTION ANGLE DEGREES
①	(WATER)	62.5	62.5	0.0	0.0	0.0	0.0	0.0
②	(CH)	120.0	120.0	500.0	500.0	500.0	500.0	0.0
③	(CH)	103.0	103.0	500.0	500.0	500.0	500.0	0.0
④	(CH)	103.0	103.0	280.0	280.0	280.0	280.0	0.0
⑤	(CH)	109.0	109.0	350.0	350.0	350.0	350.0	0.0
⑥	(CH)	100.0	100.0	380.0	380.0	380.0	380.0	0.0
⑦	(SM)	122.0	122.0	0.0	0.0	0.0	0.0	30.0

GENERAL NOTES:

CLASSIFICATION, STRATIFICATION, SHEAR STRENGTH, AND UNIT WEIGHT OF THE SOIL WERE BASED ON THE RESULTS OF UNDISTURBED BORINGS. SEE BORING DATA PLATES.

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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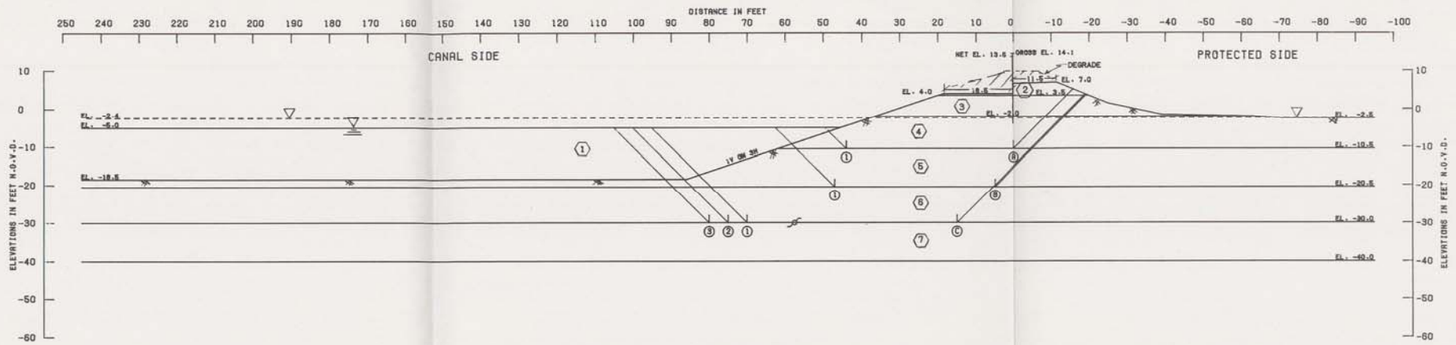
P -- AS A SUBSCRIPT, REFERS TO PASSIVE WEDGE

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

LAKE PONTCHARTRAIN, LA. AND VICINITY
HURRICANE PROTECTION
DESIGN MEMORANDUM NO. 20 - GENERAL DESIGN
ORLEANS PARISH - JEFFERSON PARISH
17 TH. STREET OUTFALL CANAL
(METAIRIE RELIEF)
PROTECTED SIDE LEVEE
STABILITY ANALYSIS
B/L STA. 589 + 00 TO
B/L STA. 614 + 00 JEFFERSON
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
DATE: MARCH 1990
FILE NO. H-2-30300



BOUNDED FAILURE SURFACE NO.	ELEV.	REBISTING FORCES R_A	R_B	R_P	DRIVING FORCES D_B	$-D_P$	SUMMATION OF FORCES REBISTING	DRIVING	FACTOR OF SAFETY
(B) (1)	-10.6	12011	12320	2519	15892	1515	26850	14377	1.87
(B) (1)	-20.5	17154	15960	7299	36391	10923	40413	25468	1.59
(C) (1)	-30.0	24520	20300	9282	54964	23098	54102	41266	1.31
(C) (2)	-30.0	24520	21619	8540	54964	22890	54679	42074	1.30
(C) (3)	-30.0	24520	22743	8540	54964	22316	55803	42648	1.31

STRATUM NO.	SOIL TYPE	EFFECTIVE UNIT WT. P.C.F. VERT. 1	VERT. 2	C - UNIT COHESION - P.S.F. CENTER OF STRATUM VERT. 1	VERT. 2	BOTTOM OF STRATUM VERT. 1	VERT. 2	FRICTION ANGLE DEGREES
(1)	(WATER)	62.5	62.5	0.0	0.0	0.0	0.0	0.0
(2)	(CH)	120.0	120.0	500.0	500.0	500.0	500.0	0.0
(3)	(CH)	103.0	103.0	500.0	500.0	500.0	500.0	0.0
(4)	(CH)	103.0	103.0	280.0	280.0	280.0	280.0	0.0
(5)	(CH)	103.0	103.0	330.0	330.0	380.0	380.0	0.0
(6)	(CH)	100.0	100.0	380.0	380.0	380.0	380.0	0.0
(7)	(SM)	122.0	122.0	0.0	0.0	0.0	0.0	30.0

GENERAL NOTES:

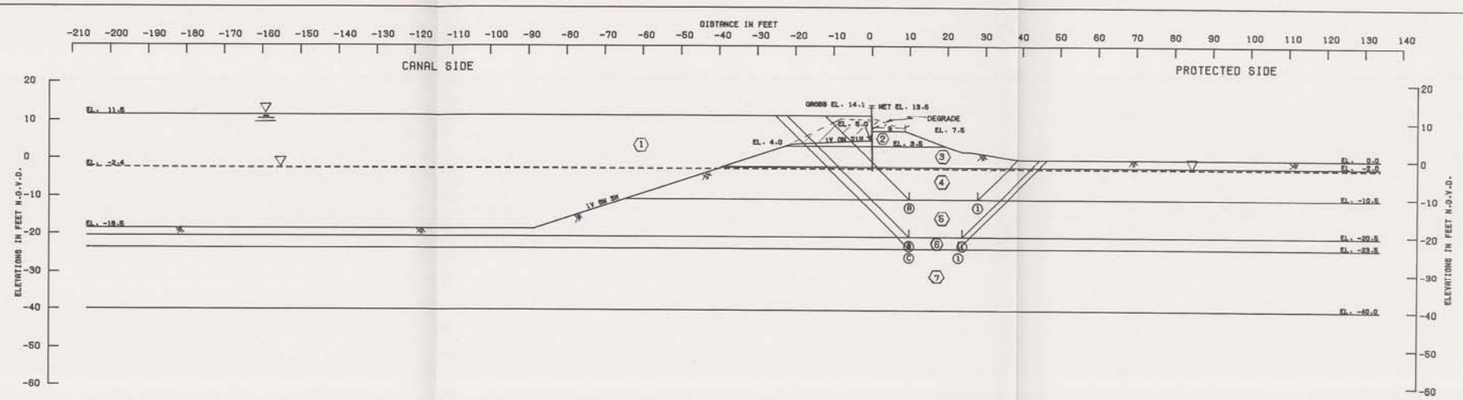
CLASSIFICATION, STRATIFICATION, SHEAR STRENGTH, AND UNIT WEIGHT OF THE SOIL WERE BASED ON THE RESULTS OF UNDISTURBED BORINGS. SEE BORING DATA PLATES.

NOTES

ϕ -- ANGLE OF INTERNAL FRICTION, DEGREES
C -- UNIT COHESION, P.S.F.
Σ -- 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.20 GENERAL DESIGN
ORLEANS PARISH — JEFFERSON PARISH
17 TH. STREET OUTFALL CANAL
(METAIRIE RELIEF)
FLOODSIDE LEVEE
STABILITY ANALYSIS
B/L STA. 589+00 TO
B/L STA. 614 +00 JEFFERSON
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
DATE: MARCH 1990 FILE NO. H-2-30900



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	-10.5	11510	5040	6827	19313	6834	23377	12679	1.84
Ⓑ	①	-20.5	17656	5320	13360	44532	23392	36336	21140	1.72
Ⓒ	①	-23.5	19800	4940	15640	54042	30400	40380	23642	1.71

STRATUM NO.	SOIL TYPE	EFFECTIVE UNIT WT. P.C.F.		C - UNIT COHESION - P.S.F.				FRICTION ANGLE
				CENTER OF STRATUM		BOTTOM OF STRATUM		
		VERT. 1	VERT. 2	VERT. 1	VERT. 2	VERT. 1	VERT. 2	DEGREES
①	(WATER)	62.5	62.5	0.0	0.0	0.0	0.0	0.0
②	(CH)	120.0	120.0	500.0	500.0	500.0	500.0	0.0
③	(CH)	103.0	103.0	500.0	500.0	500.0	500.0	0.0
④	(CH)	103.0	103.0	280.0	280.0	280.0	280.0	0.0
⑤	(CH)	103.0	103.0	330.0	330.0	380.0	380.0	0.0
⑥	(CH)	100.0	100.0	380.0	380.0	380.0	380.0	0.0
⑦	(SM)	122.0	122.0	0.0	0.0	0.0	0.0	30.0

GENERAL NOTES:

CLASSIFICATION, STRATIFICATION, SHEAR STRENGTH, AND UNIT WEIGHT OF THE SOIL WERE BASED ON THE RESULTS OF UNDISTURBED BORINGS. SEE BORING DATA PLATES.

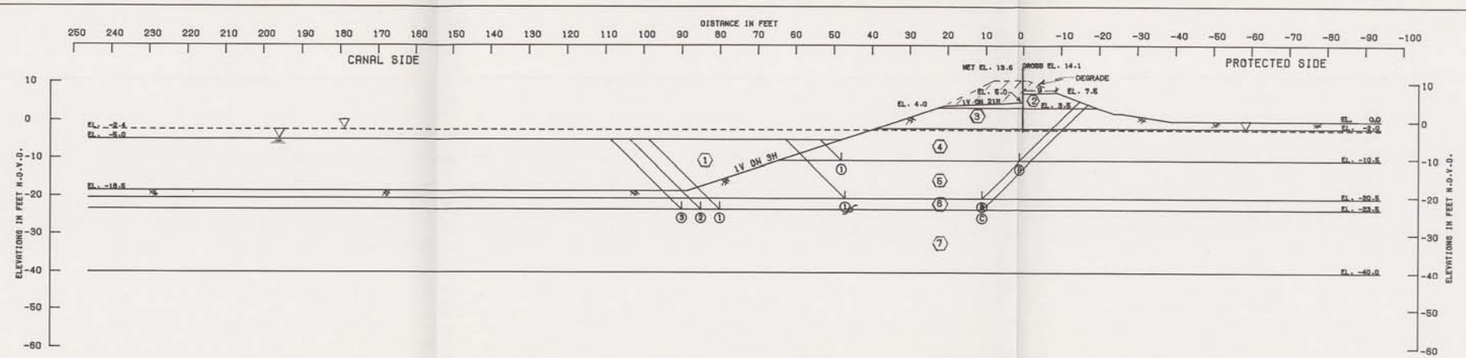
NOTES

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. 20 GENERAL DESIGN
ORLEANS PARISH - JEFFERSON PARISH
17 TH. STREET OUTFALL CANAL
(METAIRIE RELIEF)
PROTECTED SIDE LEVEE
STABILITY ANALYSIS
B/L STA. 614 + 00 TO
B/L STA. 625 + 25 JEFFERSON
U.S. ARMY ENGINEER DISTRICT NEW ORLEANS
CORPS OF ENGINEERS
DATE: MARCH 1990 FILE NO. H-2-30300

PLATE 84



ASSUMED FAILURE SURFACE NO.		ASSUMED FAILURE SURFACE ELEV.	RESISTING FORCES R_A	R_B	R_P	DRIVING FORCES D_B	$-D_P$	SUMMATION OF FORCES RESISTING	DRIVING	FACTOR OF SAFETY
(B)	(1)	-10.5	12055	13160	2309	15304	1404	27524	14900	1.85
(B)	(1)	-20.5	18655	13560	7549	37334	11324	39964	25010	1.54
(C)	(1)	-23.5	20108	20697	4177	45597	11813	44972	34084	1.32
(C)	(2)	-23.5	20108	21010	3600	45597	11270	44718	34427	1.30
(C)	(3)	-23.5	20108	21147	3600	45597	11188	44855	34509	1.30

STRATUM NO.	SOIL TYPE	EFFECTIVE UNIT WT. P.C.F. VERT. 1	VERT. 2	C - UNIT COHESION - P.S.F. CENTER OF STRATUM VERT. 1	VERT. 2	BOTTOM OF STRATUM VERT. 1	VERT. 2	FRICTION ANGLE DEGREES
(1)	(WATER)	62.5	62.5	0.0	0.0	0.0	0.0	0.0
(2)	(CH)	120.0	120.0	500.0	500.0	500.0	500.0	0.0
(3)	(CH)	103.0	103.0	500.0	500.0	500.0	500.0	0.0
(4)	(CH)	103.0	103.0	280.0	280.0	280.0	280.0	0.0
(5)	(CH)	103.0	103.0	330.0	330.0	380.0	380.0	0.0
(6)	(CH)	100.0	100.0	380.0	380.0	380.0	380.0	0.0
(7)	(SM)	122.0	122.0	0.0	0.0	0.0	0.0	30.0

GENERAL NOTES:

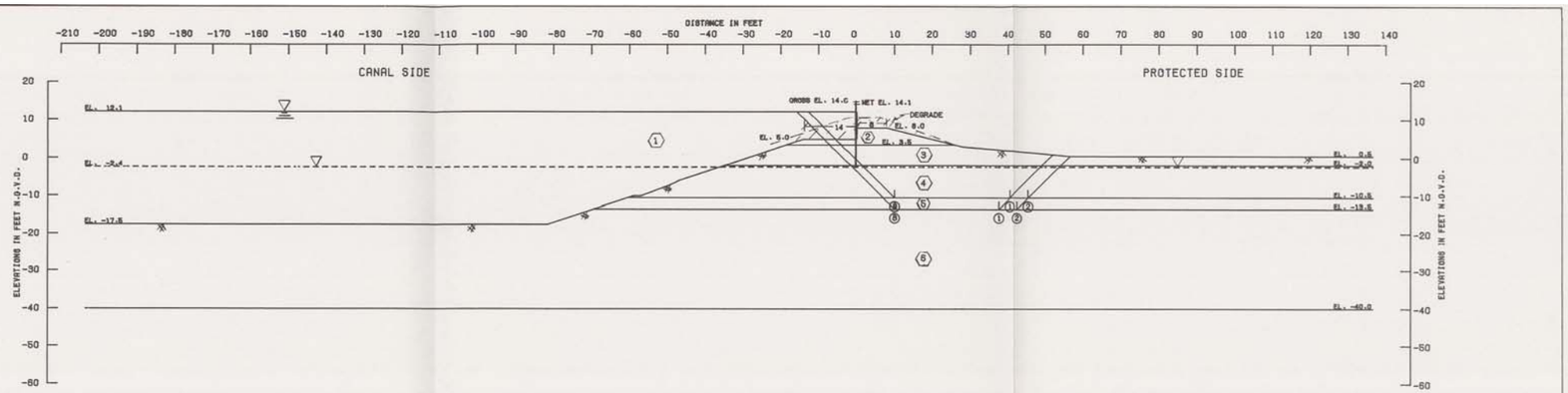
CLASSIFICATION, STRATIFICATION, SHEAR STRENGTH, AND UNIT WEIGHT OF THE SOIL WERE BASED ON THE RESULTS OF UNDISTURBED BORINGS. SEE BORING DATA PLATES.

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

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

LAKE PONTCHARTRAIN, LA. AND VICINITY
HURR LEVEL PLAN
DESIGN MEMORANDUM NO 20 GENERAL DESIGN
ORLEANS PARISH – JEFFERSON PARISH
17 TH. STREET OUTFALL CANAL
(METAIRIE RELIEF)
FLOOD SIDE LEVEE
STABILITY ANALYSIS
B/L STA. 614 + 00 TO
B/L STA. 620 + 25 JEFFERSON
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
DATE: MARCH 1990 FILE NO. H-2-30500



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
8 1	-10.5	11760	8540	7714	20302	7397	28014	12905	2.17
8 2	-10.5	11760	9940	7260	20302	6853	28960	13449	2.15
8 1	-13.5	13530	8525	9484	28962	11758	31539	15206	2.07
8 2	-13.5	13530	10075	9030	28962	11087	32635	15875	2.06

STRATUM NO.	SOIL TYPE	EFFECTIVE UNIT WT. P.C.F. VERT. 1	EFFECTIVE UNIT WT. P.C.F. VERT. 2	C - UNIT COHESION - P.S.F. CENTER OF STRATUM VERT. 1	C - UNIT COHESION - P.S.F. CENTER OF STRATUM VERT. 2	C - UNIT COHESION - P.S.F. BOTTOM OF STRATUM VERT. 1	C - UNIT COHESION - P.S.F. BOTTOM OF STRATUM VERT. 2	FRICTION ANGLE DEGREES
1	(WATER)	62.5	62.5	0.0	0.0	0.0	0.0	0.0
2	(CH)	120.0	120.0	500.0	500.0	500.0	500.0	0.0
3	(CH)	109.0	109.0	500.0	500.0	500.0	500.0	0.0
4	(CH)	103.0	103.0	280.0	280.0	280.0	280.0	0.0
5	(CH)	103.0	103.0	295.0	295.0	310.0	310.0	0.0
6	(SM)	122.0	122.0	0.0	0.0	0.0	0.0	30.0

GENERAL NOTES:

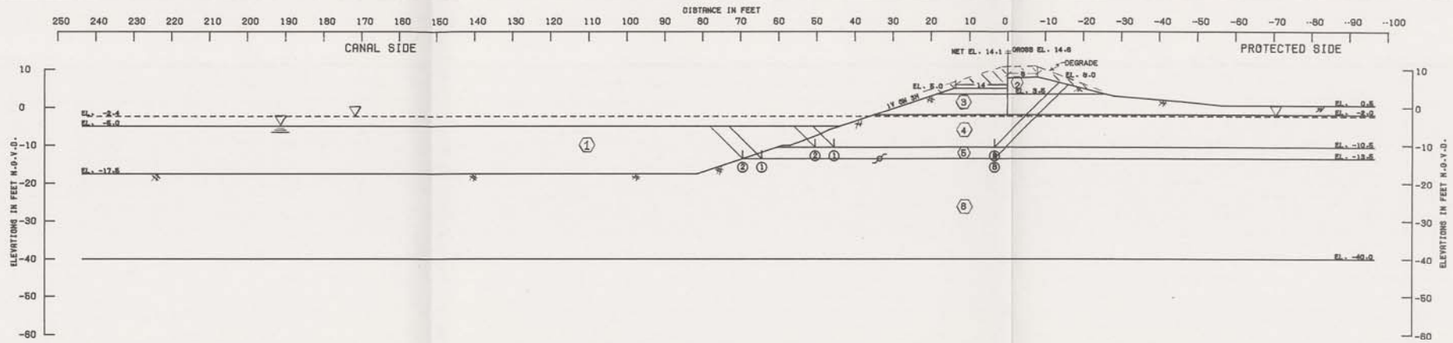
CLASSIFICATION, STRATIFICATION, SHEAR STRENGTH, AND UNIT WEIGHT OF THE SOIL WERE BASED ON THE RESULTS OF UNDISTURBED BORINGS. SEE BORING DATA PLATES.

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. EO GENERAL DESIGN
ORLEANS PARISH -- JEFFERSON PARISH
17 TH. STREET OUTFALL CANAL
(METAIRIE RELIEF)
PROTECTED SIDE LEVEE
STABILITY ANALYSIS
B/L STA. 625 + 25 TO
B/L STA. 635 + 00 JEFFERSON
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
DATE: MARCH 1990 FILE NO. H-2-30300



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
(A) (1)	-10.5	13361	11760	1969	16907	1309	27090	15598	1.74
(A) (2)	-10.5	13361	13160	1196	16907	1072	27716	15835	1.75
(B) (1)	-13.5	14531	12117	736	22704	2300	27384	20404	1.34
(B) (2)	-13.5	14531	12117		22704	2258	26647	20446	1.30

STRATUM NO.	SOIL TYPE	EFFECTIVE UNIT WT. P.C.F. VERT. 1	EFFECTIVE UNIT WT. P.C.F. VERT. 2	C - UNIT COHESION - P.S.F. CENTER OF STRATUM VERT. 1	C - UNIT COHESION - P.S.F. CENTER OF STRATUM VERT. 2	C - UNIT COHESION - P.S.F. BOTTOM OF STRATUM VERT. 1	C - UNIT COHESION - P.S.F. BOTTOM OF STRATUM VERT. 2	FRICTION ANGLE DEGREES
1	(WATER)	62.5	62.5	0.0	0.0	0.0	0.0	0.0
2	(CH)	120.0	120.0	500.0	500.0	500.0	500.0	0.0
3	(CH)	103.0	103.0	500.0	500.0	500.0	500.0	0.0
4	(CH)	103.0	103.0	280.0	280.0	280.0	280.0	0.0
5	(CH)	103.0	103.0	296.0	296.0	310.0	310.0	0.0
6	(SM)	122.0	122.0	0.0	0.0	0.0	0.0	30.0

GENERAL NOTES:

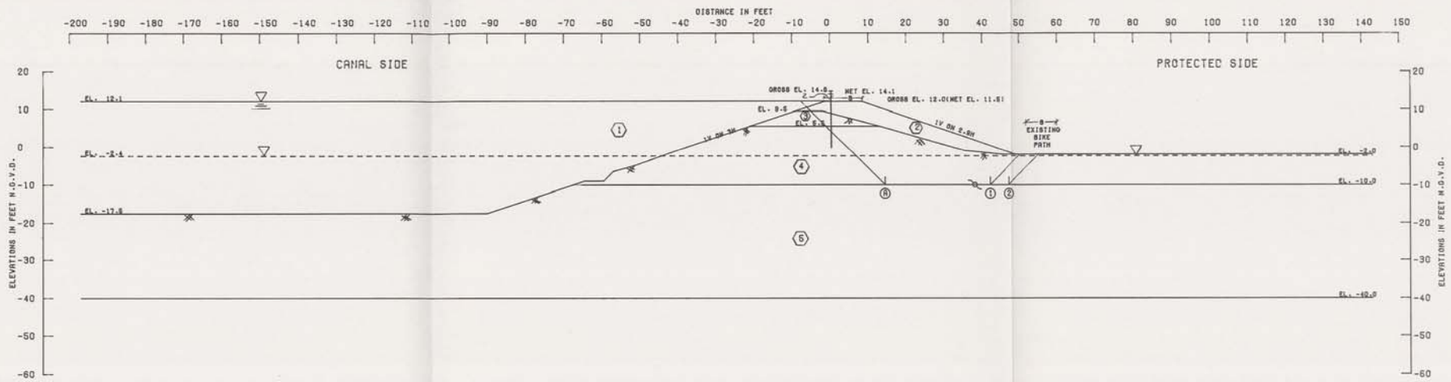
CLASSIFICATION, STRATIFICATION, SHEAR STRENGTH, AND UNIT WEIGHT OF THE SOIL WERE BASED ON THE RESULTS OF UNDISTURBED BORINGS. SEE BORING DATA PLATES.

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.20 GENERAL DESIGN
ORLEANS PARISH – JEFFERSON PARISH
17 TH. STREET OUTFALL CANAL
(METAIRIE RELIEF)
FLOOD SIDE LEVEE
STABILITY ANALYSIS
B/L STA. 635 + 00 JEFFERSON
B/L STA. 625 + 25 TO
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
DATE: MARCH 1990 FILE NO. N-E-30800



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	
8 1	-10.0	17319	11974	6048	25647	4638	35341	21011	1.68
8 2	-10.0	17319	13676	6048	25647	3595	37042	22052	1.68

STRATUM NO.	SOIL TYPE	EFFECTIVE UNIT WT. P.C.F. VERT. 1	EFFECTIVE UNIT WT. P.C.F. VERT. 2	C - UNIT COHESION - P.S.F. CENTER OF STRATUM VERT. 1	C - UNIT COHESION - P.S.F. CENTER OF STRATUM VERT. 2	C - UNIT COHESION - P.S.F. BOTTOM OF STRATUM VERT. 1	C - UNIT COHESION - P.S.F. BOTTOM OF STRATUM VERT. 2	FRICTION ANGLE DEGREES
1	(WATER)	62.5	62.5	0.0	0.0	0.0	0.0	0.0
2	(FILL)	110.0	110.0	400.0	400.0	400.0	400.0	0.0
3	(CH)	117.0	117.0	600.0	600.0	600.0	600.0	0.0
4	(CH)	107.0	107.0	378.0	378.0	455.0	455.0	0.0
5	(SM)	122.0	122.0	0.0	0.0	0.0	0.0	30.0

GENERAL NOTES:

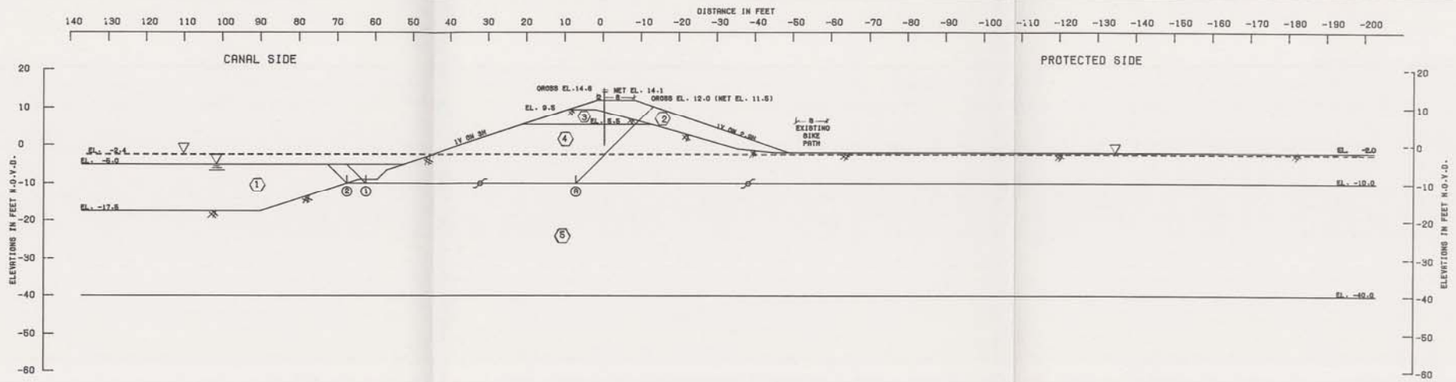
CLASSIFICATION, STRATIFICATION, SHEAR STRENGTH, AND UNIT WEIGHT OF THE SOIL WERE BASED ON THE RESULTS OF UNDISTURBED BORINGS. SEE BORING DATA PLATES.

NOTES

ϕ -- ANGLE OF INTERNAL FRICTION, DEGREES
C -- UNIT COHESION, P.S.F.
Ω -- 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
HPH LEVEL PLAN
DESIGN MEMORANDUM NO. 52 - GENERAL DESIGN
ORLEANS PARISH — JEFFERSON PARISH
17 TH. STREET OUTFALL CANAL
(METAIRIE - RELIEF)
PROTECTED SIDE LEVEE
STABILITY ANALYSIS
B/L STA. 635 + 00 TO
B/L STA. 641 + 50 JEFFERSON
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
DATE: MARCH 1990 FILE NO. H-2-30900



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
B 1	-10.0	15964	15487	754	25440	503	32205	24937	1.35
B 2	-10.0	15964	15487	0	25440	781	32449	24659	1.32

STRATUM NO.	SOIL TYPE	EFFECTIVE UNIT WT. P.C.F. VERT. 1	EFFECTIVE UNIT WT. P.C.F. VERT. 2	C - UNIT COHESION - P.S.F. CENTER OF STRATUM VERT. 1	C - UNIT COHESION - P.S.F. CENTER OF STRATUM VERT. 2	C - UNIT COHESION - P.S.F. BOTTOM OF STRATUM VERT. 1	C - UNIT COHESION - P.S.F. BOTTOM OF STRATUM VERT. 2	FRICTION ANGLE DEGREES
1	(WATER)	62.5	62.5	0.0	0.0	0.0	0.0	0.0
2	(FILL)	110.0	110.0	400.0	400.0	400.0	400.0	0.0
3	(CH)	117.0	117.0	600.0	600.0	600.0	600.0	0.0
4	(CH)	107.0	107.0	375.0	375.0	455.0	455.0	0.0
5	(SM)	122.0	122.0	0.0	0.0	0.0	0.0	30.0

GENERAL NOTES:

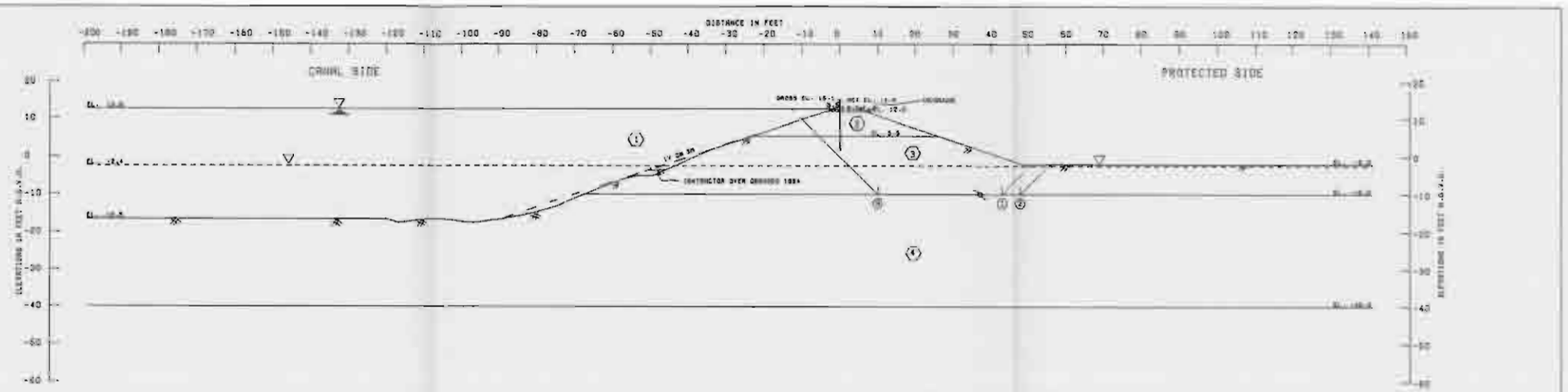
CLASSIFICATION, STRATIFICATION, SHEAR STRENGTH, AND UNIT WEIGHT OF THE SOIL WERE BASED ON THE RESULTS OF UNDISTURBED BORINGS. SEE BORING DATA PLATES.

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 & A AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO.20 GENERAL DESIGN
ORLEANS PARISH — JEFFERSON PARISH
17 TH. STREET OUTFALL CANAL
(METAIRIE RELIEF)
FLOOD SIDE LEVEE
STABILITY ANALYSIS
B/L STA 635 + 00 TO
B/L STA 641 + 50 JEFFERSON
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
DATE: MARCH 1990 FILE NO. H-2-30300



MEASURED			REASISTING FORCES			DRIVING FORCES			SUMMATION OF FORCES		FACTOR OF SAFETY
INCLINE NO.	INCLINE DIRECT.		R_a	R_b	R_c	D_a	$-D_b$		RESISTING	DRIVING	
10	1	-10.0	16660	14660	5649	26835	5053		37010	22873	1.65
10	2	-10.0	16960	16053	5649	26936	3426		38609	23408	1.65

SURFACE NO.	SOIL TYPE	EFFECTIVE UNIT WT. P.C.F.		2 - UNIT COHESION - P.S.F.				FRICTION ANGLE DEGREES
				CENTER OF SURFACE		BOTTOM OF SURFACE		
		VERT. 1	VERT. 2	VERT. 1	VERT. 2	VERT. 1	VERT. 2	
1	[illegible]	52.5	52.5	0.0	0.0	0.0	0.0	0.0
2	[illegible]	117.0	117.0	800.0	800.0	800.0	800.0	0.0
3	[illegible]	107.0	107.0	370.0	370.0	400.0	400.0	0.0
4	[illegible]	122.0	122.0	0.0	0.0	0.0	0.0	30.0

GENERAL NOTES:

CLASSIFICATION, IDENTIFICATION, SHEAR STRENGTH, AND UNIT WEIGHT OF THE SOIL HERE BASED ON THE RESULTS OF UNDISTURBED BORINGS. SEE BORING DATA PLATES.

NOTES

B -- ANGLE OF INTERNAL FRICTION, DEGREES
C -- UNIT COHESION, P.S.F.
W -- STATIC WATER BURDEN
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 = $\frac{R_a + R_b + R_c}{D_a - D_b}$

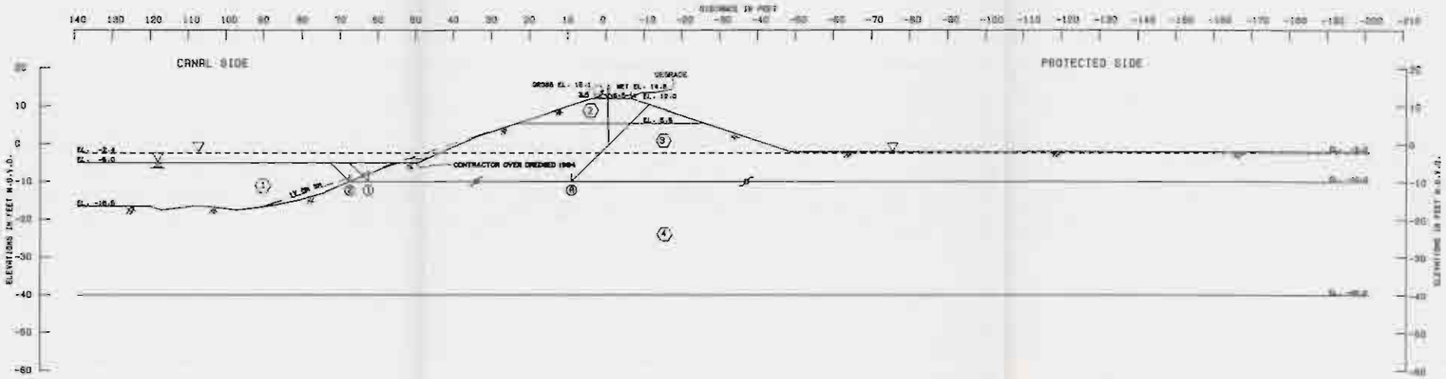
LOUISIANA DEPARTMENT OF HIGHWAYS
DIVISION OF WATERWAYS
DRAINAGE IMPROVEMENT DISTRICT, GENERAL DESIGN
ORLEANS PARISH - JEFFERSON PARISH
17TH STREET OUTFALL CANAL
(METAIRIE RELIEF)

PROTECTED SIDE LEVEE
STABILITY ANALYSIS
B/L STA. 641+50 TO
B/L STA. 663+00 JEFFERSON

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

DATE: MARCH 1965 WORK UNIT NO. [illegible]

PLATE 80



SLIDING FAILURE NO.	SLIDING FAILURE ELEV.	RESISTING FORCES R_x	R_z	R_y	DRIVING FORCES D_x	$-D_y$	SUMMATION OF FORCES RESISTING	DRIVING	FACTOR OF SAFETY
⑧ ①	-10.0	17869	15426	1079	25902	645	34073	25957	1.36
⑥ ⑤	-10.0	17562	15437		25902	781	33004	26121	1.31

STRATUM NO.	SOIL TYPE	EFFECTIVE UNIT WT. PER. 1	PER. 2	S — SHEAR STRENGTH — P.S.F. CENTER OF STRATUM VERT. 1	VERT. 2	BOTTOM OF STRATUM VERT. 1	VERT. 2	FRICTION ANGLE DEGREES
①	WATER	62.5	62.5	0.0	0.0	0.0	0.0	0.0
④	CLAY	117.0	117.0	800.0	800.0	800.0	800.0	0.0
⑤	CLAY	107.0	107.0	375.0	375.0	450.0	450.0	0.0
④	CLAY	122.0	122.0	0.0	0.0	0.0	0.0	30.0

GENERAL NOTES:

CLASSIFICATION, STRATIFICATION, SHEAR STRENGTH, AND UNIT WEIGHT OF THE SOIL WERE BASED ON THE RESULTS OF UNDISTURBED SAMPLING. SEE BORING DATA PLATES.

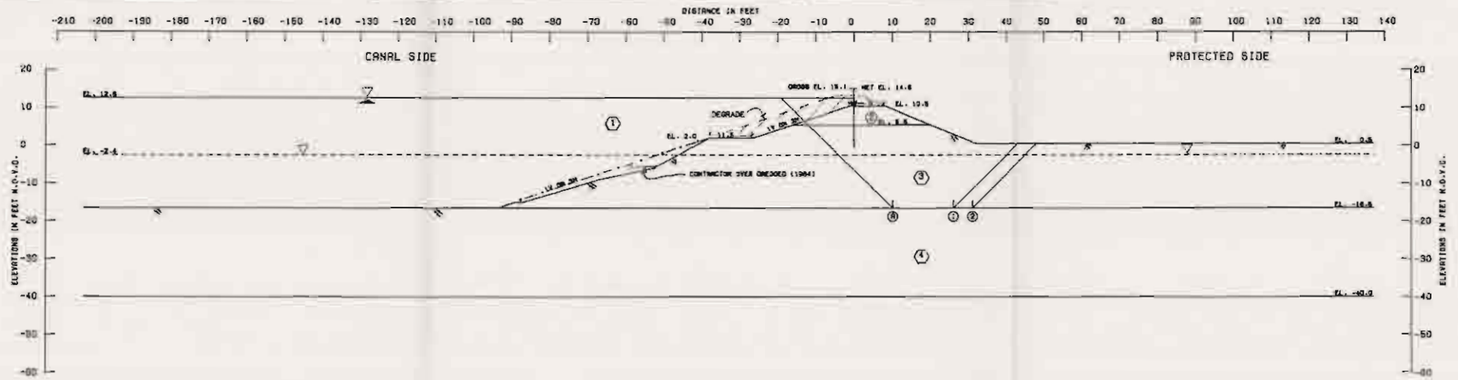
NOTES

B — WIDTH OF STRUCTURE, FRICTION, DEGREES
C — UNIT COHESION, P.S.F.
D — STATIC WATER SURFACE
D_x — HORIZONTAL DRIVING FORCE IN POUNDS
D_y — VERTICAL RESISTING FORCE IN POUNDS
E — ON A BOUNDARY, REFERS TO ACTIVE WEDGE
S — ON A BOUNDARY, REFERS TO CENTRAL BLOCK
P — ON A BOUNDARY, REFERS TO PASSIVE WEDGE

$$\text{FACTOR OF SAFETY} = \frac{R_x + R_z + R_y}{D_x - D_y}$$

LAKE PONTCHARTRAIN, LA. AND VICINITY
HURRICANE PROTECTION
NEW ORLEANS, LA. DISTRICT
HURRICANE-SEVERAGE NO. 1 GENERAL DESIGN
ORLEANS PARISH—JEFFERSON PARISH
17 TH STREET OUTFALL CANAL
(METAIRIE RELIEF)
FLOOD SIDE LEVEE
STABILITY ANALYSIS
B/L STA. 641+50 TO
B/L STA. 663+00 JEFFERSON
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

PLATE 31



MANUAL FAILURE SURFACE NO.	ELEV.	RESISTING FORCES R_A	R_B	R_P	DRIVING FORCES D_A	D_P	SUMMATION OF FORCES RESISTING	DRIVING	FACTOR OF SAFETY
Ⓐ ①	-16.5	19242	8320	13940	40751	16263	41602	24488	1.[illegible]
Ⓑ ②	-18.5	19242	10920	13940	40751	16483	44102	25288	1.75

STRATUM NO.	SOIL TYPE	EFFECTIVE UNIT WT. P.C.F. VERT. 1	VERT. 2	C - UNIT COHESION - P.S.F. CENTER OF STRATUM VERT. 1	VERT. 2	BOTTOM OF STRATUM VERT. 1	VERT. 2	FRICTION ANGLE DEGREES
①	(WATER)	[illegible]	62.5	0.0	0.0	0.0	0.0	0.0
②	[illegible]	117.0	117.0	800.0	[illegible]	[illegible]	[illegible]	0.0
③	(CH)	107.0	107.0	410.0	410.0	[illegible]	[illegible]	0.0
④	[illegible]	122.0	122.0	0.0	0.0	0.0	0.0	30.0

GENERAL NOTES:

CLASSIFICATION, STRATIFICATION, SHEAR STRENGTH, AND UNIT WEIGHT OF THE SOIL WERE BASED ON THE RESULTS OF UNDISTURBED BORINGS. SEE BORING DATA PLATES.

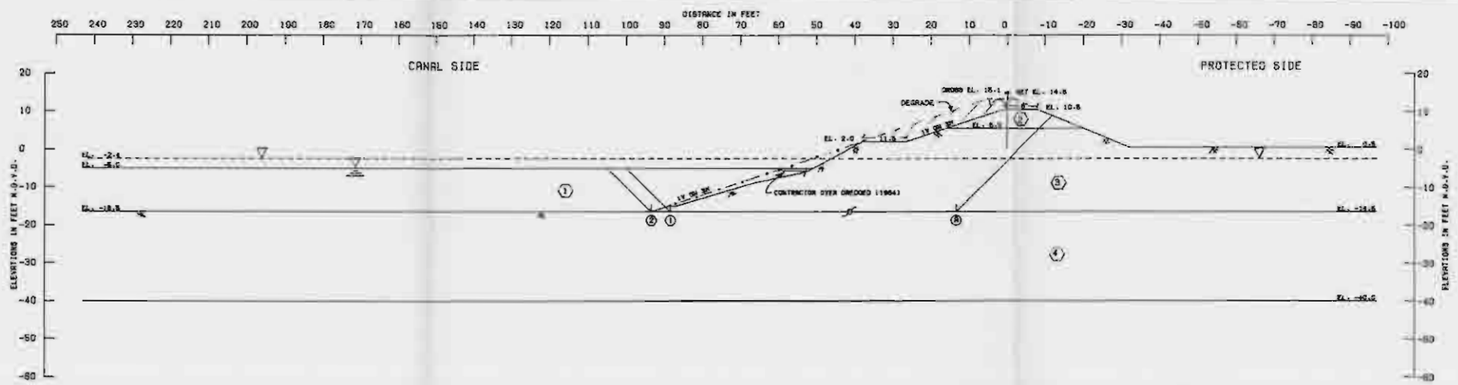
NOTES

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
DESIGN MEMORANDUM NO. 20 SEWERAGE DESIGN
ORLEANS PARISH - JEFFERSON PARISH
17 TH. STREET OUTFALL CANAL
(METAIRIE RELIEF)
PROTECTED SIDE LEVEE
STABILITY ANALYSIS
B/L STA. 663+00 TO
B/L STA. 670+00 JEFFERSON
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
DATE: MARCH [illegible] FILE NO. H-2-30300

PLATE 92



MARKED FAILURE SURFACE NO.	ELEV.	RESISTING FORCES R_B	R_S	R_P	DRIVING FORCES D_A	$-D_P$	SUMMATION OF FORCES RESISTING	DRIVING	FACTOR OF SAFETY
Ⓐ ①	-16.5	22100	20987	1024	36653	4177	44111	32476	1.36
Ⓑ ②	-16.5	22100	20987	C	36653	4133	43087	32520	1.32

STRATUM NO.	SOIL TYPE	EFFECTIVE UNIT WT. P.C.F. VERT. 1	VERT. 2	C - UNIT COHESION - P.S.F. CENTER OF STRATUM VERT. 1	VERT. 2	BOTTOM OF STRATUM VERT. 1	VERT. 2	FRICTION ANGLE DEGREES
①	(WATER)	[illegible]	62.5	0.0	0.0	0.0	0.0	0.0
②	(CH)	117.0	117.0	600.0	600.0	600.0	600.0	0.0
③	(CH)	107.0	107.0	410.0	410.0	[illegible]	520.0	0.0
④	[illegible]	122.0	122.0	0.0	0.0	0.0	0.0	[illegible]

GENERAL NOTES:

CLASSIFICATION, STRATIFICATION, SHEAR STRENGTH, AND UNIT WEIGHT OF THE SOIL WERE BASED ON THE RESULTS OF UNDISTURBED BORINGS. SEE BORING DATA PLATES.

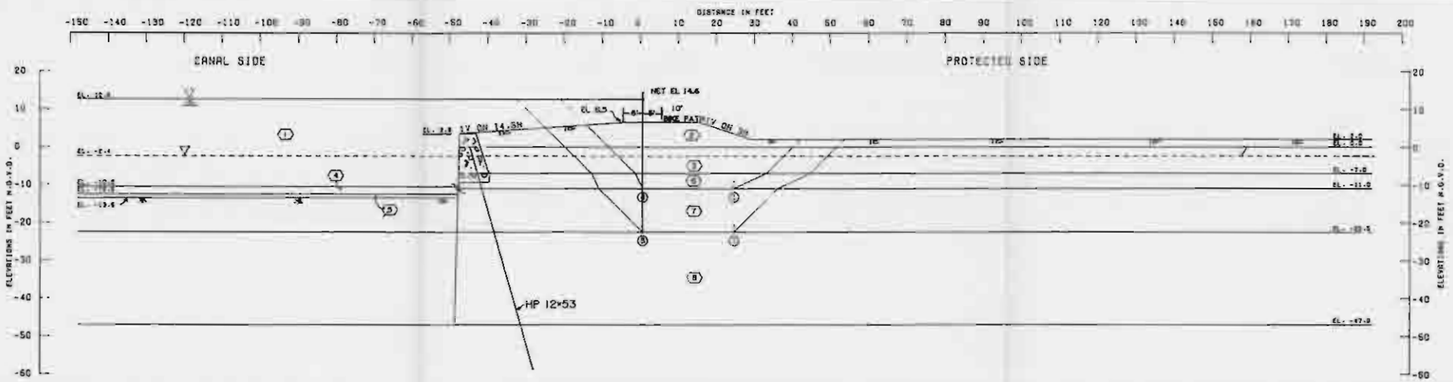
NOTES

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 = $\frac{R_B + R_S + R_P}{D_A - D_P}$

LAKE PONTCHARTRAIN, LA. AND VICINITY
HURRICANE PROTECTION PLAN
DESIGN MEMORANDUM NO. 20 GENERAL DESIGN
ORLEANS PARISH – JEFFERSON PARISH
17 TH. STREET OUTFALL CANAL
(METAIRIE RELIEF)
FLOOD SIDE LEVEE
STABILITY ANALYSIS
B/L STA. 663 + 00 TO
B/L STA. 670 + 00 JEFFERSON
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
MARCH 1990

PLATE 93



STRATUM NO.	SOIL TYPE	EFFECTIVE UNIT WT. P.C.F.		C - UNIT COHESION - P.S.F.				FRICTION ANGLE DEGREES
				CENTER OF STRATUM		BOTTOM OF STRATUM		
		VERT. 1	VERT. 2	VERT. 1	VERT. 2	VERT. 1	VERT. 2	
1	(WATER)	62.5	62.5	0.0	0.0	0.0	0.0	0.0
2	(CH)	113.0	113.0	700.0	700.0	700.0	700.0	0.0
3	(CH)	113.0	113.0	550.0	550.0	550.0	550.0	0.0
4	(SIPRAP)	132.0	132.0	0.0	0.0	0.0	0.0	40.0
5	(SHELL)	80.0	80.0	0.0	0.0	0.0	0.0	40.0
6	(CH)	115.0	115.0	720.0	720.0	720.0	720.0	0.0
7	(CH)	107.0	107.0	480.0	480.0	480.0	480.0	0.0
8	(CH)	122.0	122.0	0.0	0.0	0.0	0.0	20.0

BASIMED FACTORS NO.	SURFACE ELEV.	RESISTING FORCES R_a	R_b	R_c	DRIVING FORCES D_a	D_b	CORRECTION OF FORCES RESISTING	DRIVING	FACTOR OF SAFETY
6 1	-11.0	100000	11620	31934	84503	9480	54010	15000	3.50
5 1	-22.0	100000	11620	32340	100000	32680	74416	24410	3.05

GENERAL NOTES:

CLASSIFICATION, STRATIFICATION, SHEAR STRENGTH, AND UNIT WEIGHT OF THE SOIL WERE BASED ON THE RESULTS OF UNDISTURBED BORINGS. SEE BORING DATA PLATES.

NOTES

- ⊕ -- 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 = $\frac{R_a + R_b + R_c}{D_a - D_b}$

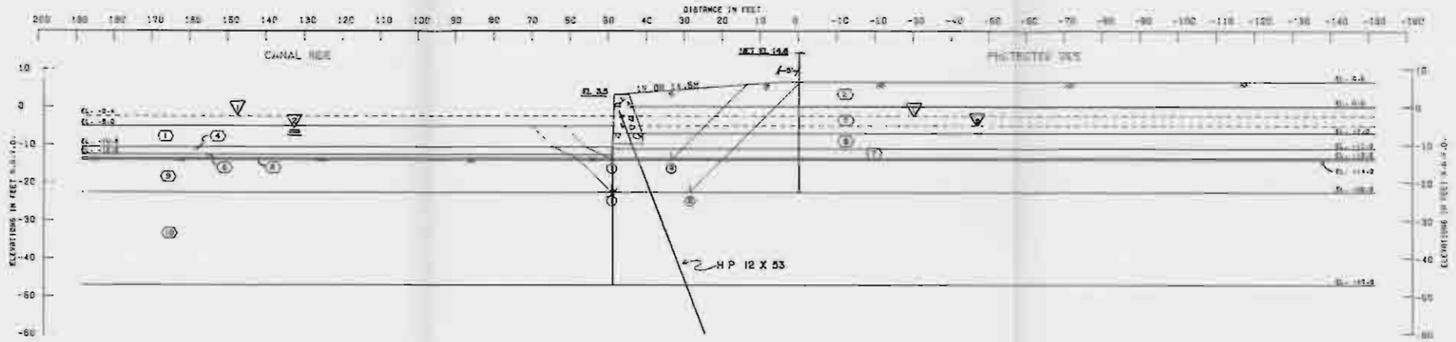
LAKE PONTCHARTRAIN, LA. AND VICINITY
HURRICANE PROTECTION
ORLEANS PARISH - JEFFERSON PARISH
17 TH. STREET OUTFALL CANAL
(METAIRIE RELIEF)

PROTECTED SIDE LEVEE
STABILITY ANALYSIS
W/L STA. 0 + 00 TO
W/L STA. 4 + 15 JEFFERSON

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

DATE: MARCH 1980 FILE NO. H-2-30500

PLATE 94



1 1 PH LINE IN STRATUM 10

2 2 PH LINE IN STRATA 4 AND 6

STATION NO.	SOIL TYPE	EFFECTIVE UNIT WT. P.C.F. VERT. 1	EFFECTIVE UNIT WT. P.C.F. VERT. 2	X - UNIT COHESION - P.S.F. LOCATION OF STATION VERT. 1	X - UNIT COHESION - P.S.F. LOCATION OF STATION VERT. 2	X - UNIT COHESION - P.S.F. BOTTOM OF STATION VERT. 1	X - UNIT COHESION - P.S.F. BOTTOM OF STATION VERT. 2	FRICTION ANGLE DEGREES
1	(WATER)	62.5	62.5	0.0	0.0	0.0	0.0	0.0
2	(CH)	112.0	112.0	700.0	700.0	700.0	700.0	0.0
3	(CH)	112.0	112.0	500.0	500.0	500.0	500.0	0.0
4	(SEPARATOR)	120.0	120.0	0.0	0.0	0.0	0.0	40.0
5	(CH)	118.0	118.0	700.0	700.0	700.0	700.0	0.0
6	(SHELL)	92.0	92.0	0.0	0.0	0.0	0.0	40.0
7	(CH)	107.0	107.0	480.0	480.0	480.0	480.0	0.0
8	(CH)	107.0	107.0	480.0	480.0	480.0	480.0	0.0
9	(CH)	107.0	107.0	480.0	480.0	480.0	480.0	0.0
10	(SAND)	122.0	122.0	0.0	0.0	0.0	0.0	30.0

WEDGE NUMBER (FIGURE)	WEDGE NUMBER (FIGURE)	ELEV.	RESISTING FORCES R_x	R_y	R_z	DRIVING FORCES D_x	$-D_y$	SUMMATION OF FORCES (RESISTING)	(DRIVING)	FACTOR OF SAFETY
8	1	-14.0	34000	7530	1533	20999	2014	33104	17485	1.89
8	2	-22.0	33160	3864	5693	44697	13195	52697	31390	1.68

GENERAL NOTES:

CLASSIFICATION, STRATIFICATION, SHEAR STRENGTH, AND UNIT WEIGHT OF THE SOIL WERE BASED ON THE RESULTS OF UNDISTURBED BORINGS. SEE BORING DATA PLATES.

NOTES

ϕ -- ANGLE OF INTERNAL FRICTION, DEGREES

c -- UNIT COHESION, P.S.F.

γ -- BASIC WATER SURFACE

P -- HORIZONTAL DRIVING FORCE IN POUNDS

R -- HORIZONTAL RESISTING FORCE IN POUNDS

a -- NO A SUBSCRIPT, REFERS TO ACTIVE WEDGE

b -- NO B SUBSCRIPT, REFERS TO CENTRAL BLOCK

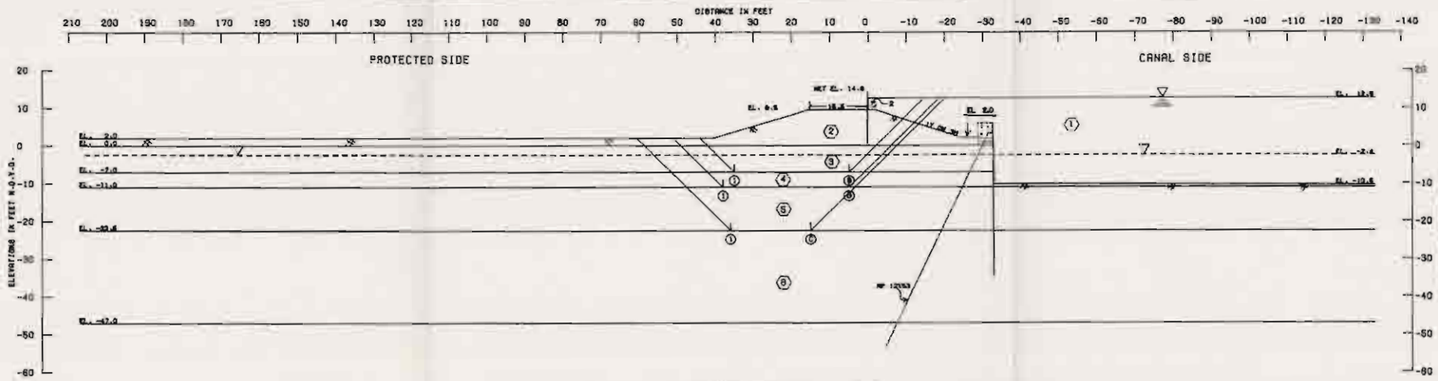
p -- NO P SUBSCRIPT, REFERS TO PASSIVE WEDGE

FACTOR OF SAFETY = $\frac{R_x + R_y + R_z}{D_x - D_y}$

LAKE PONTCHARTRAIN, LA. AND VICINITY
HURRICANE SPILLWAY, GENERAL DESIGN
ORLEANS PARISH - JEFFERSON PARISH
17TH STREET OUTFALL CANAL
(METAIRIE RELIEF)
FLOOD SIDE LEVEE
STABILITY ANALYSIS
W/L STA. 0 + 00 TO
W/L STA. 4 + 15 JEFFERSON
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

DATE: MARCH 1962 FILE NO. H-2-35000

PLATE 95



AS BUILT 1988-1989

WEDGES FAILURE NO.	WEDGES FAILURE SURFACE ELEV.	REASISTING FORCES R_A	R_B	R_P	DRIVING FORCES D_A	$-D_P$	SUMMATION OF FORCES RESISTING	DRIVING	FACTOR OF SAFETY
⑥ ①	-7.0	17266	15600	10080	17223	6044	42936	12179	3.52
⑥ ②	-11.0	21517	15640	15640	26740	9593	53297	18147	2.93
⑥ ③	-22.6	32132	10080	25900	53302	33786	68092	25697	2.70

STRATUM NO.	SOIL TYPE	EFFECTIVE UNIT WT. P.C.F. VERT. 1	VERT. 2	C - UNIT COHESION - P.S.F. CENTER OF STRATUM VERT. 1	VERT. 2	BOTTOM OF STRATUM VERT. 1	VERT. 2	FRICTION ANGLE DEGREES
①	SAND(SP)	62.6	62.6	0.0	0.0	0.0	0.0	0.0
②	(CH)	112.0	112.0	700.0	700.0	700.0	700.0	0.0
③	(CH)	112.0	112.0	520.0	520.0	520.0	520.0	0.0
④	(CH)	115.0	115.0	720.0	720.0	720.0	720.0	0.0
⑤	(CH)	107.0	107.0	480.0	480.0	480.0	480.0	0.0
⑥	(SM)	122.0	122.0	0.0	0.0	0.0	0.0	30.0

GENERAL NOTES:

CLASSIFICATION, STRATIFICATION, SHEAR STRENGTH, AND UNIT WEIGHT OF THE SOIL WERE BASED ON THE RESULTS OF UNDISTURBED BORINGS. SEE BORING DATA PLATES.

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

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

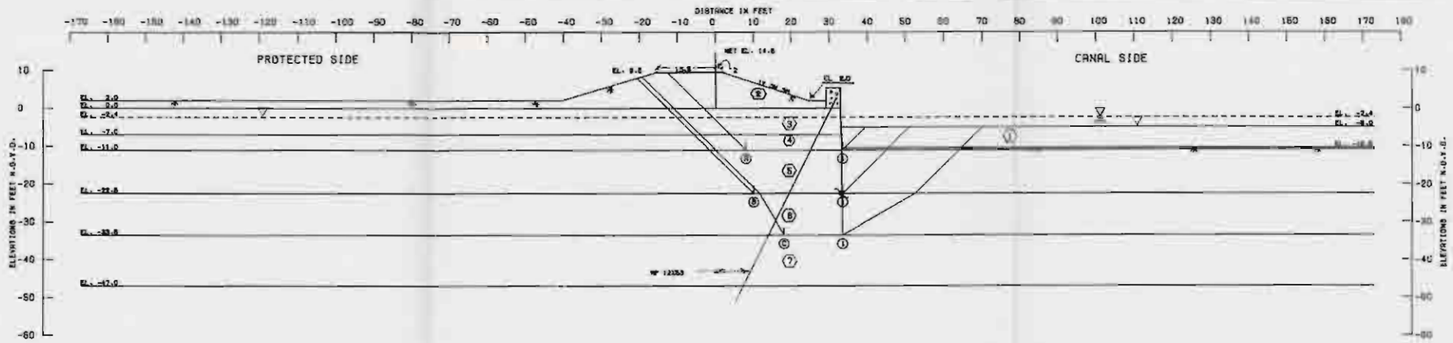
LAKE PONTCHARTRAIN, LA AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO 20 GENERAL DESIGN
ORLEANS PARISH – JEFFERSON PARISH
17TH STREET OUTFALL CANAL
(METAIRIE RELIEF)

PROTECTED SIDE LEVEE
STABILITY ANALYSIS
ORLEANS SIDE OF PUMP STA
TO SOUTH OF SOUTHERN RR

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

DATE MARCH 1990 FILE NO. [illegible]

PLATE 96



AS BUILT 1988-1989

SURCHARGE FRICTION NO.	SURCHARGE ELEV.	REGISTING FORCES R_a	R_b	R_p	DRIVING FORCES D_a	$-D_p$	SUMMATION OF FORCES REGISTING	DRIVING	FACTOR OF SAFETY
⑤ ①	-11.0	28339	12240	720	22881	1132	39299	21749	1.81
⑤ ①	-22.0	36282	11217	11760	56429	12921	58259	43508	1.37
⑥ ①	-33.0	61437	16563	27219	96152	33151	97619	59011	1.65

STRATUM NO.	SOIL TYPE	EFFECTIVE UNIT WT. P.C.F. VERT. 1	VERT. 2	C - UNIT COHESION - P.S.F. CENTER OF STRATUM VERT. 1	VERT. 2	MARGIN OF STRATUM VERT. 1	VERT. 2	FRICTION ANGLE DEGREES
①	(WATER)	62.5	62.5	0.0	0.0	0.0	0.0	0.0
②	(CH)	112.0	112.0	700.0	700.0	700.0	700.0	0.0
③	(CH)	112.0	112.0	520.0	520.0	520.0	520.0	0.0
④	(CH)	115.0	115.0	720.0	720.0	720.0	720.0	0.0
⑤	(CH)	107.0	107.0	460.0	460.0	460.0	460.0	0.0
⑥	(SM)	122.0	122.0	0.0	0.0	0.0	0.0	30.0
⑦	(SM)	122.0	122.0	0.0	0.0	0.0	0.0	30.0

GENERAL NOTES:

CLASSIFICATION, STRATIFICATION, SHEAR STRENGTH, AND UNIT WEIGHT OF THE SOIL WERE BASED ON THE RESULTS OF UNDISTURBED BORINGS. SEE BORING DATA PLATES.

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

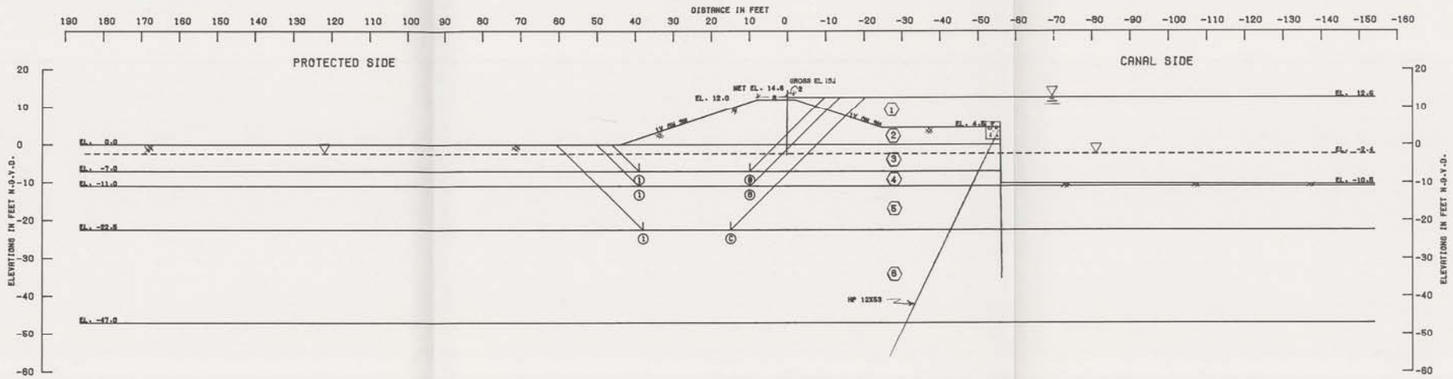
$$\text{FACTOR OF SAFETY} = \frac{R_a + R_b + R_p}{D_a - D_p}$$

LAKE PONTCHARTRAIN, LA. AND VICINITY
HURRICANE PROTECTION
DERBIGNY MEMORANDUM NO. 1 - GENERAL DESIGN
ORLEANS PARISH - JEFFERSON PARISH
17 TH. STREET OUTFALL CANAL
(METAIRIE RELIEF)

FLOOD SIDE LEVEE
STABILITY ANALYSIS
ORLEANS SIDE OF PUMP STA.
TO SOUTH OF SOUTHERN R.R.

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

DATE: MARCH 1990 FILE NO. A-87-52500



AS BUILT 1988-1989

ASSUMED FAILURE SURFACE NO.	ASSUMED FAILURE SURFACE ELEV.	REBISTING FORCES R_A	REBISTING FORCES R_B	REBISTING FORCES R_P	DRIVING FORCES D_B	DRIVING FORCES $-D_P$	SUMMATION OF FORCES REBISTING	SUMMATION OF FORCES DRIVING	FACTOR OF SAFETY
Ⓑ ①	-7.0	21632	15080	7280	20186	3210	43992	16976	2.59
Ⓑ ①	-11.0	26902	13920	13040	29322	7266	52962	22056	2.40
Ⓒ ①	-22.5	34769	11040	24080	54416	28863	69879	36552	1.96

STRATUM NO.	SOIL TYPE	EFFECTIVE UNIT WT. P.C.F. VERT. 1	EFFECTIVE UNIT WT. P.C.F. VERT. 2	C - UNIT COHESION - P.S.F. CENTER OF STRATUM VERT. 1	C - UNIT COHESION - P.S.F. CENTER OF STRATUM VERT. 2	C - UNIT COHESION - P.S.F. BOTTOM OF STRATUM VERT. 1	C - UNIT COHESION - P.S.F. BOTTOM OF STRATUM VERT. 2	FRICTION ANGLE DEGREES
①	(WATER)	62.5	62.5	0.0	0.0	0.0	0.0	0.0
②	(CH)	112.0	112.0	700.0	700.0	700.0	700.0	0.0
③	(CH)	112.0	112.0	520.0	520.0	520.0	520.0	0.0
④	(CH)	115.0	115.0	720.0	720.0	720.0	720.0	0.0
⑤	(CH)	107.0	107.0	480.0	480.0	480.0	480.0	0.0
⑥	(SM)	122.0	122.0	0.0	0.0	0.0	0.0	30.0

GENERAL NOTES:

CLASSIFICATION, STRATIFICATION, SHEAR STRENGTH, AND UNIT WEIGHT OF THE SOIL WERE BASED ON THE RESULTS OF UNDISTURBED BORINGS. SEE BORING DATA PLATES.

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

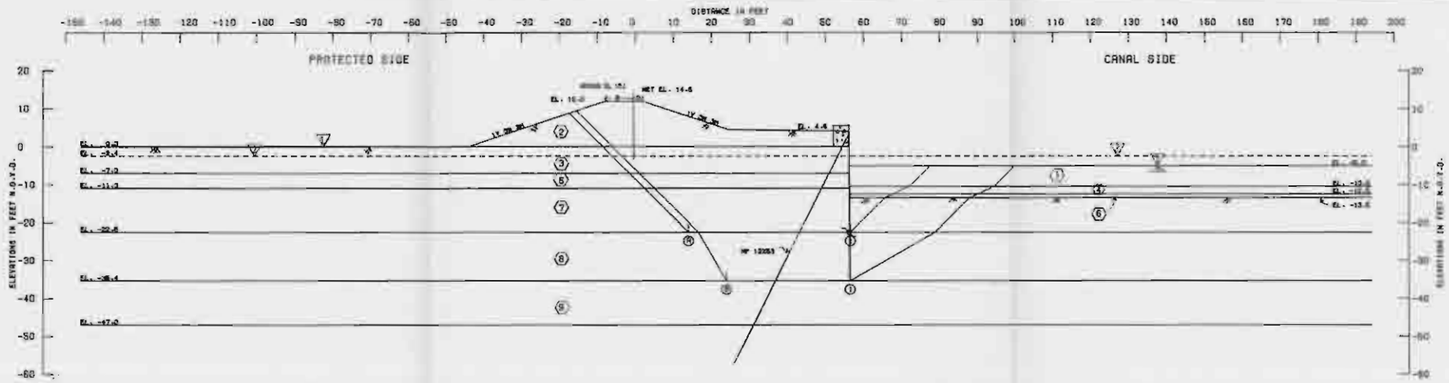
$$\text{FACTOR OF SAFETY} = \frac{R_A + R_B + R_P}{D_B - D_P}$$

LAKE PONTCHARTRAIN, LA. AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO.20 GENERAL DESIGN
ORLEANS PARISH- JEFFERSON PARISH
17 TH. STREET OUTFALL CANAL
(METAIRIE RELIEF)

PROTECTED SIDE LEVEE
STABILITY ANALYSIS
SOUTH OF SOUTHERN R.R. TO
B/L STA. 670+63 ORLEANS

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

DATE: MARCH 1990 FILE NO. H-2-30300



1/1 PH LINE STRATA 4 AND 6
2/2 PH LINE STRATA 8 AND 9
AS BUILT 1988-1989

FAILURE NO.	SURFACE ELEV.	RESISTING FORCES R_a	R_s	R_p	DRIVING FORCES D_a	$-D_p$	SUMMATION OF FORCES RESISTING	DRIVING	FACTOR OF SAFETY
⑥ ①	-22.5	36505	20340	9693	61806	13161	66539	48424	1.37
⑧ ①	-38.4	66868	48031	30081	111747	44781	132978	66966	1.99

STRATUM NO.	SOIL TYPE	EFFECTIVE UNIT WT. P.C.F.		C - UNIT COHESION - P.S.F. CENTER OF STRATUM		BOTTOM OF STRATUM		FRICTION ANGLE
		VERT. 1	VERT. 2	VERT. 1	VERT. 2	VERT. 1	VERT. 2	DEGREES
①	(WATER)	62.0	62.0	0.0	0.0	0.0	0.0	0.0
②	(CH)	112.0	112.0	700.0	700.0	700.0	700.0	0.0
③	(CH)	112.0	112.0	520.0	520.0	520.0	520.0	0.0
④	(STRAW)	132.0	132.0	0.0	0.0	0.0	0.0	40.0
⑤	(CH)	116.0	116.0	720.0	720.0	720.0	720.0	0.0
⑥	(SC)	92.0	92.0	0.0	0.0	0.0	0.0	40.0
⑦	(CH)	107.0	107.0	480.0	480.0	480.0	480.0	0.0
⑧	(SM)	122.0	122.0	0.0	0.0	0.0	0.0	30.0
⑨	(SM)	122.0	122.0	0.0	0.0	0.0	0.0	30.0

GENERAL NOTES:

CLASSIFICATION, STRATIFICATION, SHEAR STRENGTH, AND UNIT WEIGHT OF THE SOIL WERE BASED ON THE RESULTS OF UNDISTURBED BORINGS. SEE BORING DATA PLATES.

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
R — AS A SUBSCRIPT, REFERS TO ACTIVE WEDGE
S — AS A SUBSCRIPT, REFERS TO CENTRAL BLOCK
P — AS A SUBSCRIPT, REFERS TO PASSIVE WEDGE

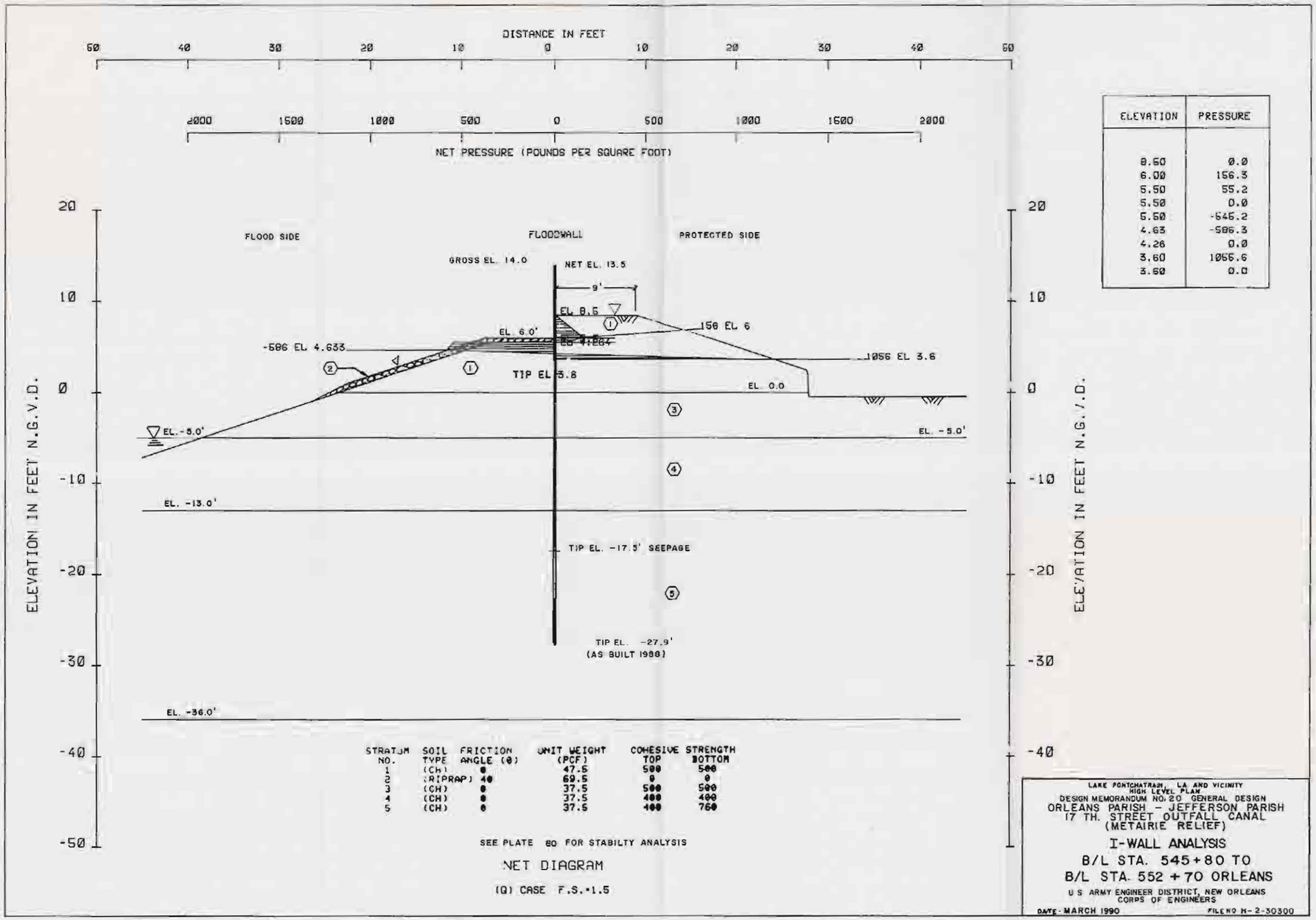
FACTOR OF SAFETY = $\frac{R_a + R_s + R_p}{D_a - D_p}$

LAKE PONTCHARTRAIN, LA. AND VICINITY
HURRICANE PROTECTION
DESIGN MEMORANDUM NO. 56 GENERAL DESIGN
ORLEANS PARISH - JEFFERSON PARISH
17TH STREET OUTFALL CANAL
(METAIRIE RELIEF)

FLOOD SIDE LEVEE
STABILITY ANALYSIS
SOUTH OF SOUTHERN R.R. TO
B/L STA 870+63 ORLEANS

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

SAN MARCO 1960 PLATE 99



ELEVATION	PRESSURE
8.50	0.0
6.00	156.3
5.50	55.2
5.50	0.0
5.50	-645.2
4.63	-506.3
4.26	0.0
3.60	1055.6
3.60	0.0

STRATUM NO.	SOIL TYPE	FRICTION ANGLE (Ø)	UNIT WEIGHT (PCF)	COHESIVE STRENGTH TOP	COHESIVE STRENGTH BOTTOM
1	(CH)	0	47.5	500	500
2	(RIPRAP)	40	69.5	0	0
3	(CH)	0	37.5	500	500
4	(CH)	0	37.5	400	400
5	(CH)	0	37.5	400	760

SEE PLATE 80 FOR STABILTY ANALYSIS

NET DIAGRAM

(Q) CASE F.S.=1.5

LAKE PONTCHARTRAIN, LA AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO. 20 GENERAL DESIGN
ORLEANS PARISH – JEFFERSON PARISH
17 TH. STREET OUTFALL CANAL
(METAIRIE RELIEF)

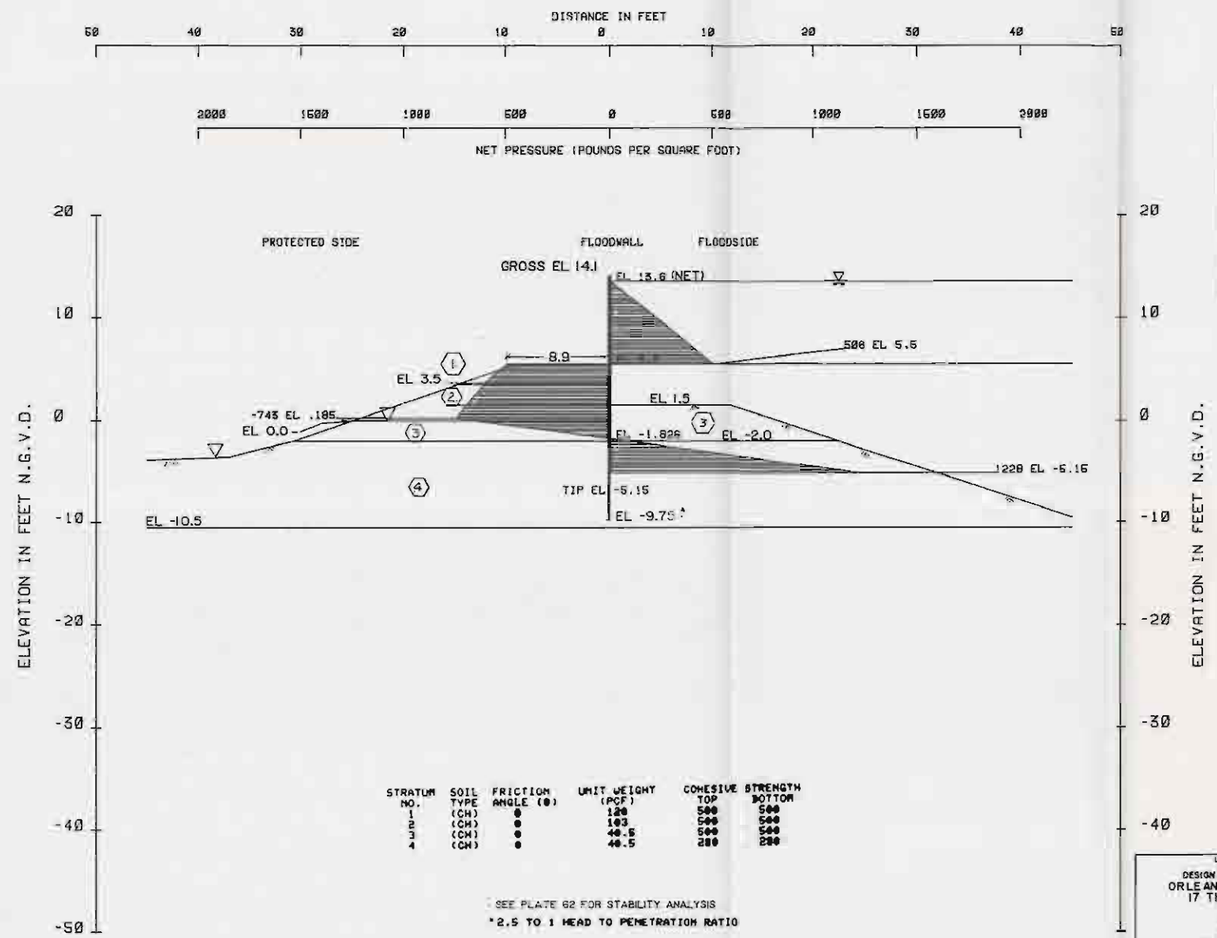
I-WALL ANALYSIS

B/L STA. 545+80 TO
B/L STA. 552 + 70 ORLEANS

U S ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

DATE- MARCH 1990 FILE NO H-2-30300

PLATE 100



ELEVATION	PRESSURE
13.60	0.0
6.50	506.3
5.50	0.0
5.50	-493.0
3.60	-600.7
0.19	-743.0
-1.83	0.0
-6.15	1227.7
-5.15	0.0

STRATUM NO.	SOIL TYPE	FRICTION ANGLE (Ø)	UNIT WEIGHT (PCF)	COHESIVE STRENGTH TOP	COHESIVE STRENGTH BOTTOM
1	(CH)	0	120	500	500
2	(CH)	0	103	500	500
3	(CH)	0	40.5	500	500
4	(CH)	0	40.5	280	280

SEE PLATE 62 FOR STABILITY ANALYSIS

*2.5 TO 1 HEAD TO PENETRATION RATIO

NET DIAGRAM

(Q) CASE F.S.=1.

LAKE PONTCHARTRAIN, LA. AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO. 20 GENERAL DESIGN
ORLEANS PARISH - JEFFERSON PARISH
17 TH. STREET OUTFALL CANAL
(METAIRIE RELIEF)

I-WALL ANALYSIS

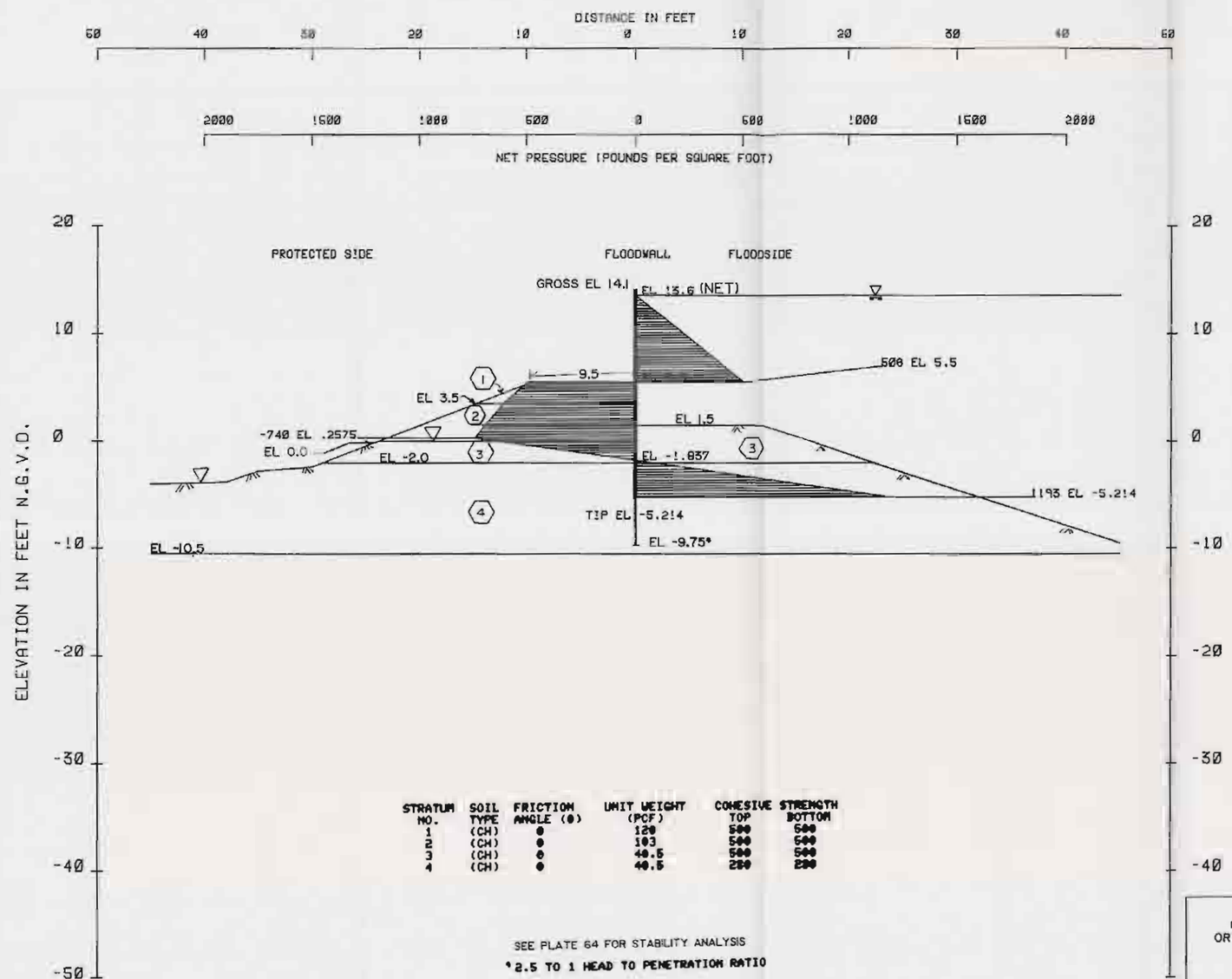
B/L STA. 554+00 TO

B/L STA. 568+00 ORLEANS

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

DATE: MARCH 1990 FILE NO. H-2-30300

PLATE 101



ELEVATION	PRESSURE
13.60	0.0
6.50	506.3
6.50	0.0
5.50	-493.8
3.50	-609.7
0.26	-740.1
-1.84	0.0
-6.21	1192.9
-5.21	0.0

STRATUM NO.	SOIL TYPE	FRICTION ANGLE (Φ)	UNIT WEIGHT (PCF)	COHESIVE STRENGTH TOP	COHESIVE STRENGTH BOTTOM
1	(CH)	0	120	500	500
2	(CH)	0	103	500	500
3	(CH)	0	40.5	500	500
4	(CH)	0	40.5	250	250

SEE PLATE 64 FOR STABILITY ANALYSIS

*2.5 TO 1 HEAD TO PENETRATION RATIO

NET DIAGRAM

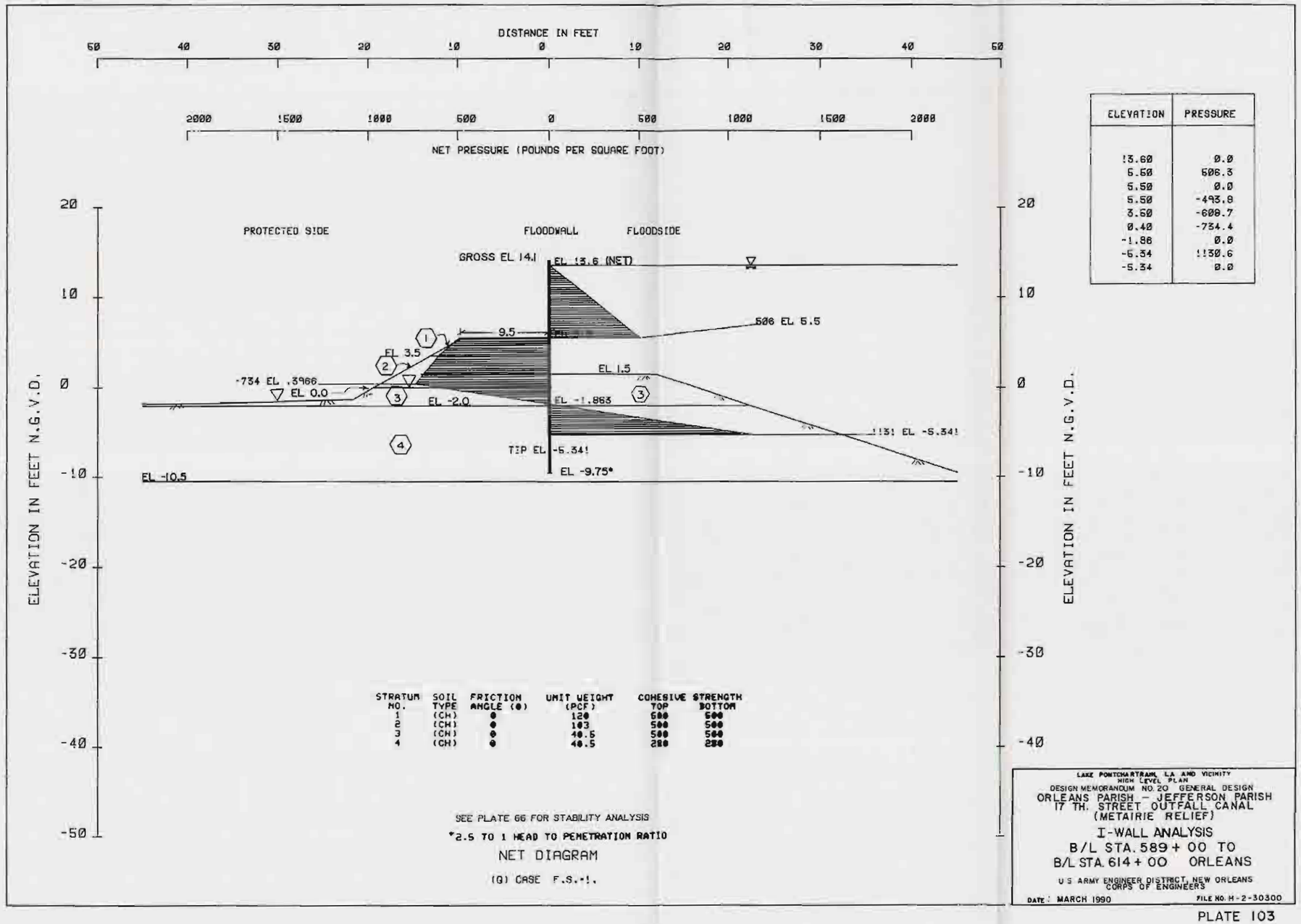
(Q) CASE F.S.=1.

LAKE PONTCHARTRAIN, LA. AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO. 20 GENERAL DESIGN
ORLEANS PARISH - JEFFERSON PARISH
17 TH. STREET OUTFALL CANAL
(METAIRIE RELIEF)

I-WALL ANALYSIS
B/L STA. 568 + 00 TO
B/L STA. 589 + 00 ORLEANS

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
DATE : MARCH 1990 FILE NO. H-2-30300

PLATE 102



ELEVATION	PRESSURE
13.60	0.0
5.50	506.3
5.50	0.0
5.50	-493.8
3.50	-608.7
0.40	-734.4
-1.86	0.0
-5.34	1130.6
-5.34	0.0

STRATUM NO.	SOIL TYPE	FRICTION ANGLE (Φ)	UNIT WEIGHT (PCF)	COHESIVE STRENGTH TOP	COHESIVE STRENGTH BOTTOM
1	(CH)	0	120	500	500
2	(CH)	0	103	500	500
3	(CH)	0	40.5	500	500
4	(CH)	0	40.5	250	250

SEE PLATE 66 FOR STABILITY ANALYSIS

*2.5 TO 1 HEAD TO PENETRATION RATIO

NET DIAGRAM

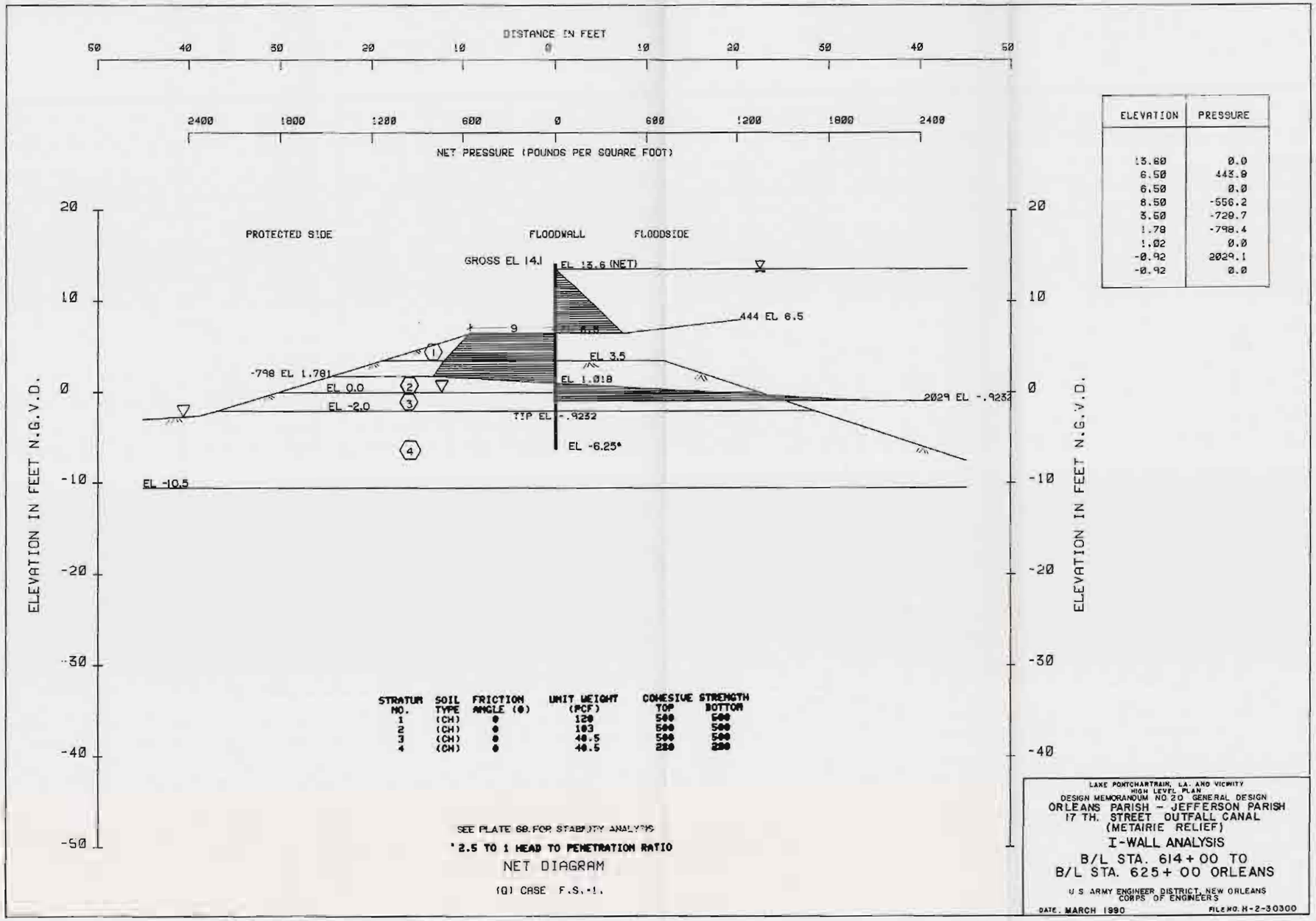
(G) CASE F.S.=1.

LAKE PONTCHARTRAIN, LA AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO. 20 GENERAL DESIGN
ORLEANS PARISH - JEFFERSON PARISH
17 TH. STREET OUTFALL CANAL
(METAIRIE RELIEF)

I-WALL ANALYSIS
B/L STA. 589 + 00 TO
B/L STA. 614 + 00 ORLEANS

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

DATE: MARCH 1990 FILE NO. H-2-30300



ELEVATION	PRESSURE
13.60	0.0
6.50	443.9
6.50	0.0
8.50	-556.2
3.50	-729.7
1.78	-798.4
1.02	0.0
-0.92	2029.1
-0.92	0.0

STRATUM NO.	SOIL TYPE	FRICTION ANGLE (Φ)	UNIT WEIGHT (PCF)	COHESIVE STRENGTH TOP	COHESIVE STRENGTH BOTTOM
1	(CH)	0	120	500	500
2	(CH)	0	103	500	500
3	(CH)	0	40.5	500	500
4	(CH)	0	40.5	220	220

SEE PLATE 68 FOR STABILITY ANALYSIS

* 2.5 TO 1 HEAD TO PENETRATION RATIO

NET DIAGRAM

(Q) CASE F.S.=1.

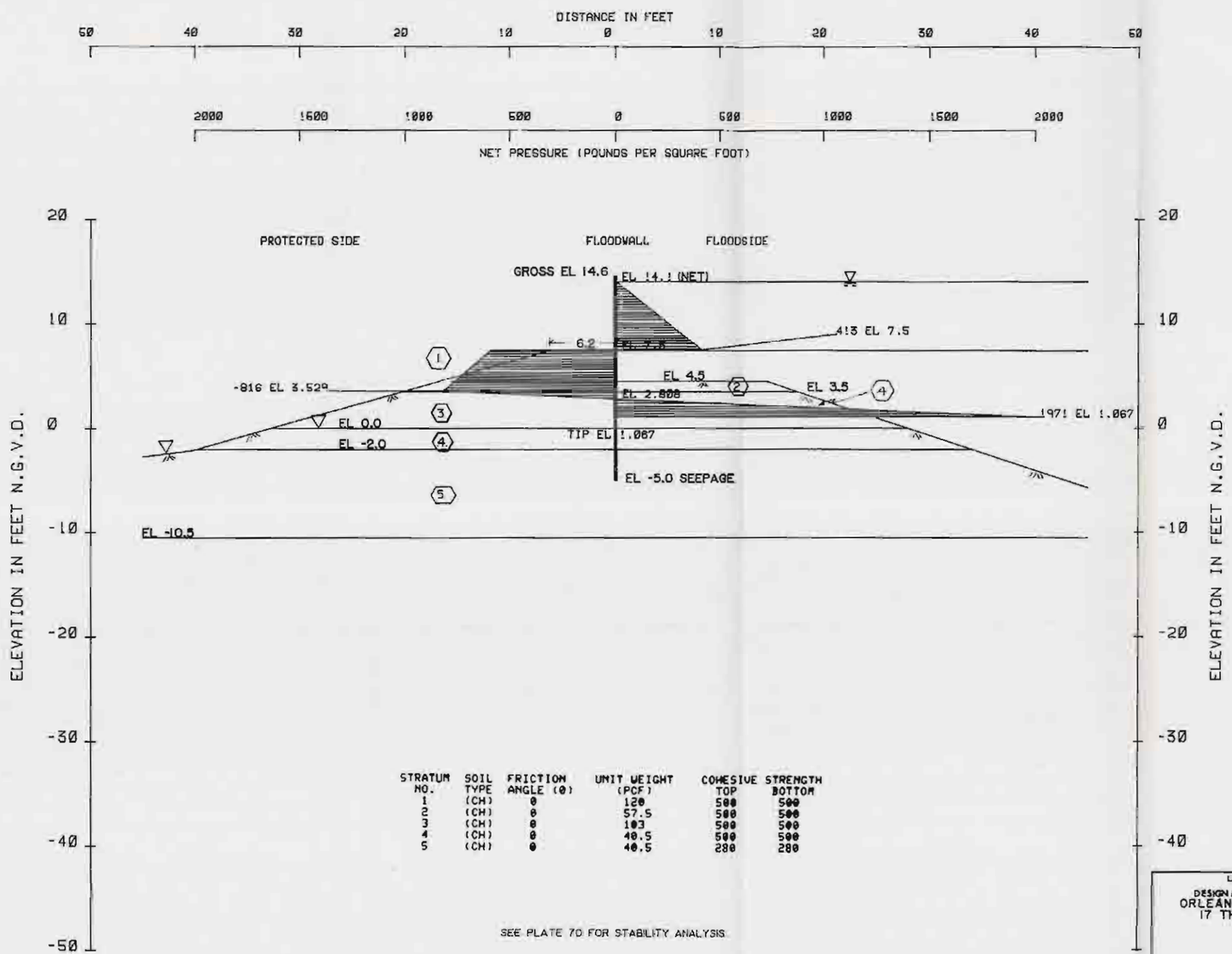
LAKE PONTCHARTRAIN, LA. AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO. 20 GENERAL DESIGN
ORLEANS PARISH - JEFFERSON PARISH
17 TH. STREET OUTFALL CANAL
(METAIRIE RELIEF)

I-WALL ANALYSIS

B/L STA. 614+00 TO
B/L STA. 625+00 ORLEANS

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

DATE: MARCH 1990 FILE NO. H-2-30300



ELEVATION	PRESSURE
14.10	0.0
7.50	412.5
7.50	0.0
7.50	-507.5
3.53	-915.9
2.81	0.0
1.07	1970.6
1.07	0.0

STRATUM NO.	SOIL TYPE	FRICTION ANGLE (Ø)	UNIT WEIGHT (PCF)	COHESIVE STRENGTH TOP	COHESIVE STRENGTH BOTTOM
1	(CH)	0	120	500	500
2	(CH)	0	57.5	500	500
3	(CH)	0	103	500	500
4	(CH)	0	40.5	500	500
5	(CH)	0	40.5	280	280

SEE PLATE 70 FOR STABILITY ANALYSIS

NET DIAGRAM

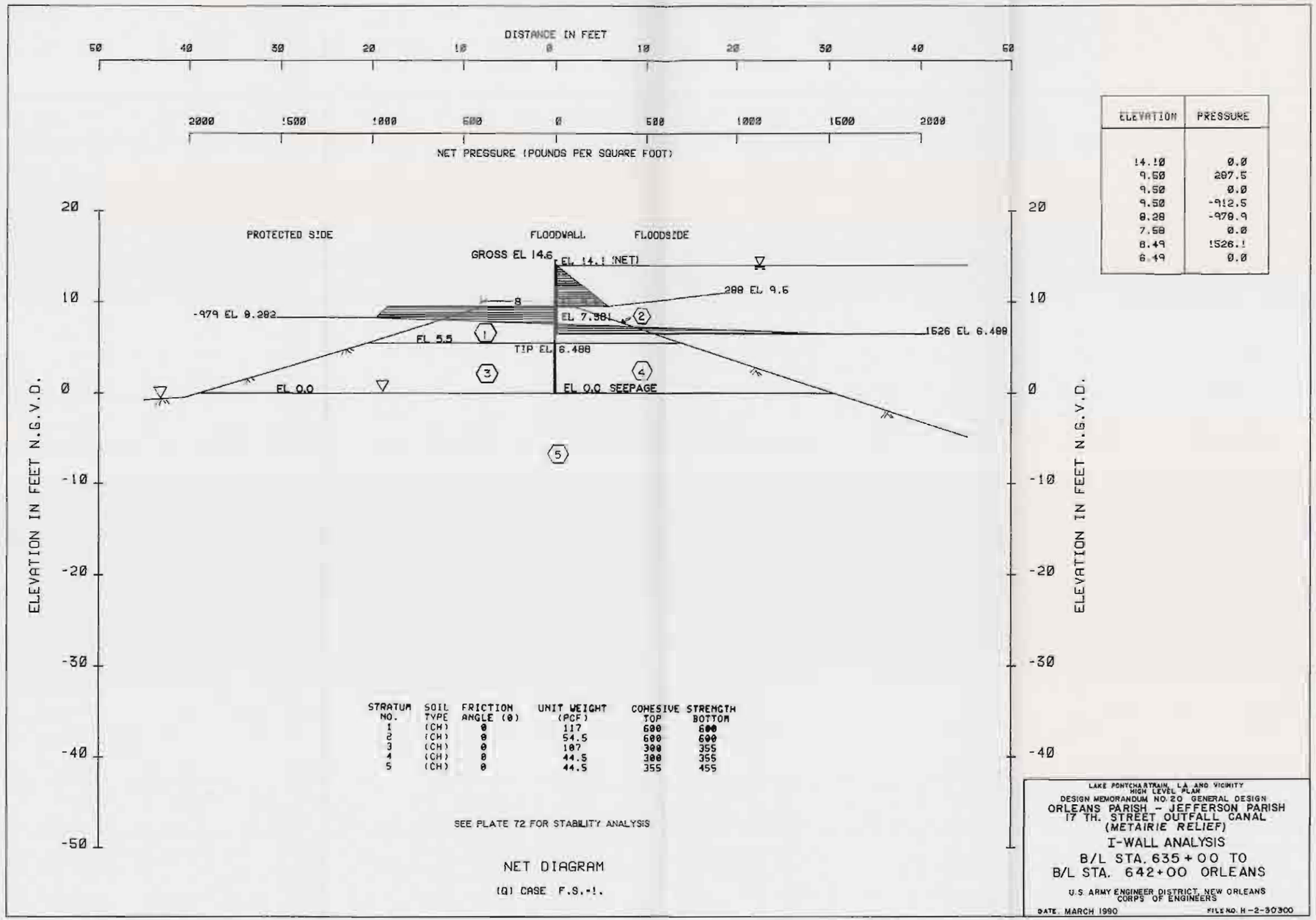
(Q) CASE F.S.=1.

LAKE PONTCHARTRAIN, LA. AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO. 20 GENERAL DESIGN
ORLEANS PARISH – JEFFERSON PARISH
17 TH. STREET OUTFALL CANAL
(METAIRIE RELIEF)

I-WALL ANALYSIS
B/L STA. 625+00 TO
B/L STA. 635+00 ORLEANS

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

DATE: MARCH 1980 FILE NO H-2-30300



ELEVATION	PRESSURE
14.10	0.0
9.50	287.5
9.50	0.0
9.50	-912.5
8.28	-979.9
7.58	0.0
6.49	1526.1
6.49	0.0

STRATUM NO.	SOIL TYPE	FRICTION ANGLE (0)	UNIT WEIGHT (PCF)	COHESIVE STRENGTH TOP	COHESIVE STRENGTH BOTTOM
1	(CH)	0	117	600	600
2	(CH)	0	54.5	600	600
3	(CH)	0	107	300	355
4	(CH)	0	44.5	300	355
5	(CH)	0	44.5	355	455

SEE PLATE 72 FOR STABILITY ANALYSIS

NET DIAGRAM

(Q) CASE F.S.=1.

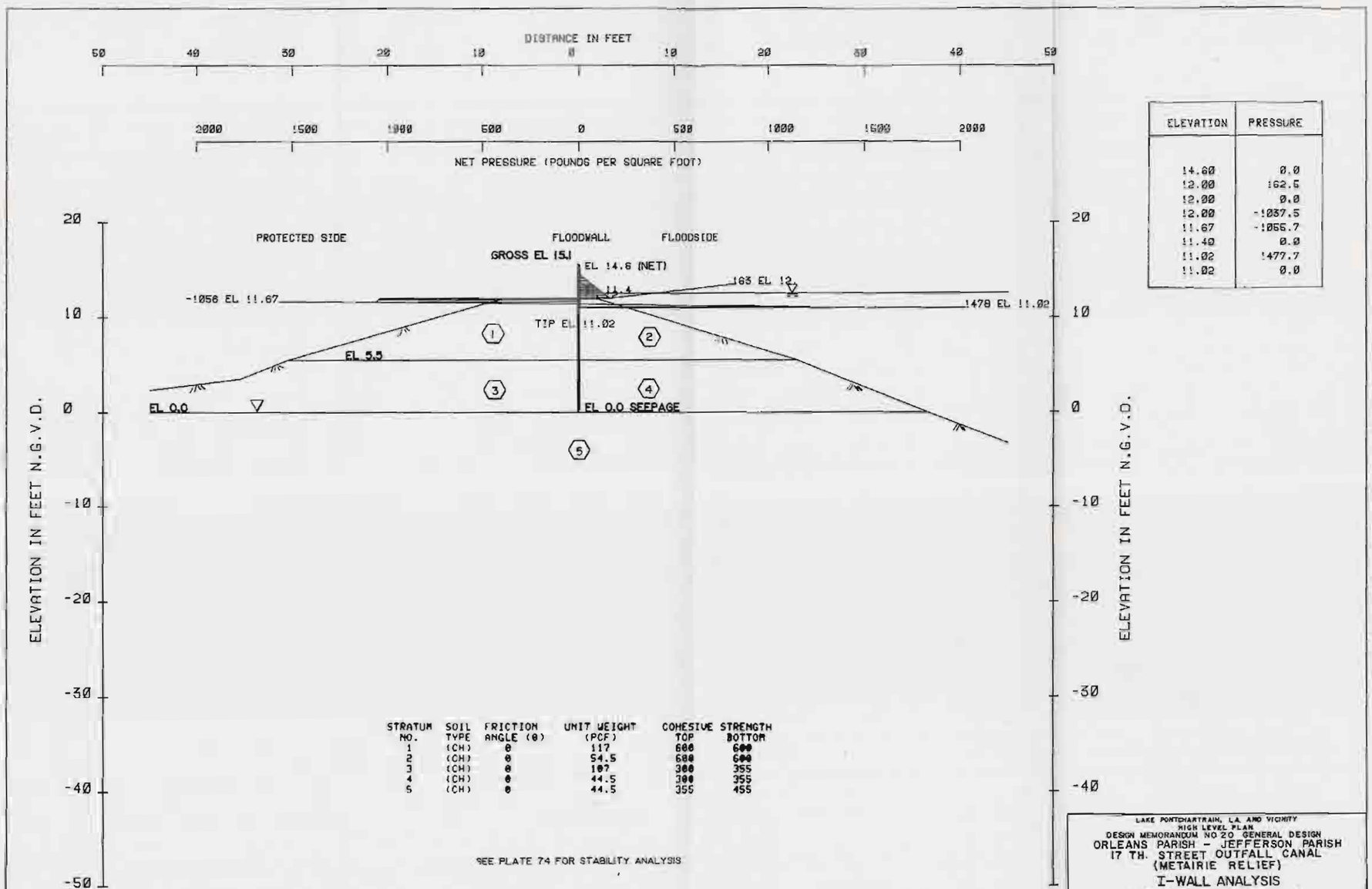
LAKE PONTCHARTRAIN, LA. AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO. 20 GENERAL DESIGN
ORLEANS PARISH - JEFFERSON PARISH
17 TH. STREET OUTFALL CANAL
(*METAIRIE RELIEF*)

I-WALL ANALYSIS

B/L STA. 635+00 TO
B/L STA. 642+00 ORLEANS

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

DATE: MARCH 1990 FILE NO. H-2-30300



ELEVATION	PRESSURE
14.60	0.0
12.00	162.5
12.00	0.0
12.00	-1037.5
11.67	-1055.7
11.40	0.0
11.02	1477.7
11.02	0.0

STRATUM NO.	SOIL TYPE	FRICTION ANGLE (Ø)	UNIT WEIGHT (PCF)	COHESIVE STRENGTH TOP	COHESIVE STRENGTH BOTTOM
1	(CH)	0	117	600	600
2	(CH)	0	54.5	600	600
3	(CH)	0	107	300	355
4	(CH)	0	44.5	300	355
5	(CH)	0	44.5	355	455

SEE PLATE 74 FOR STABILITY ANALYSIS

NET DIAGRAM

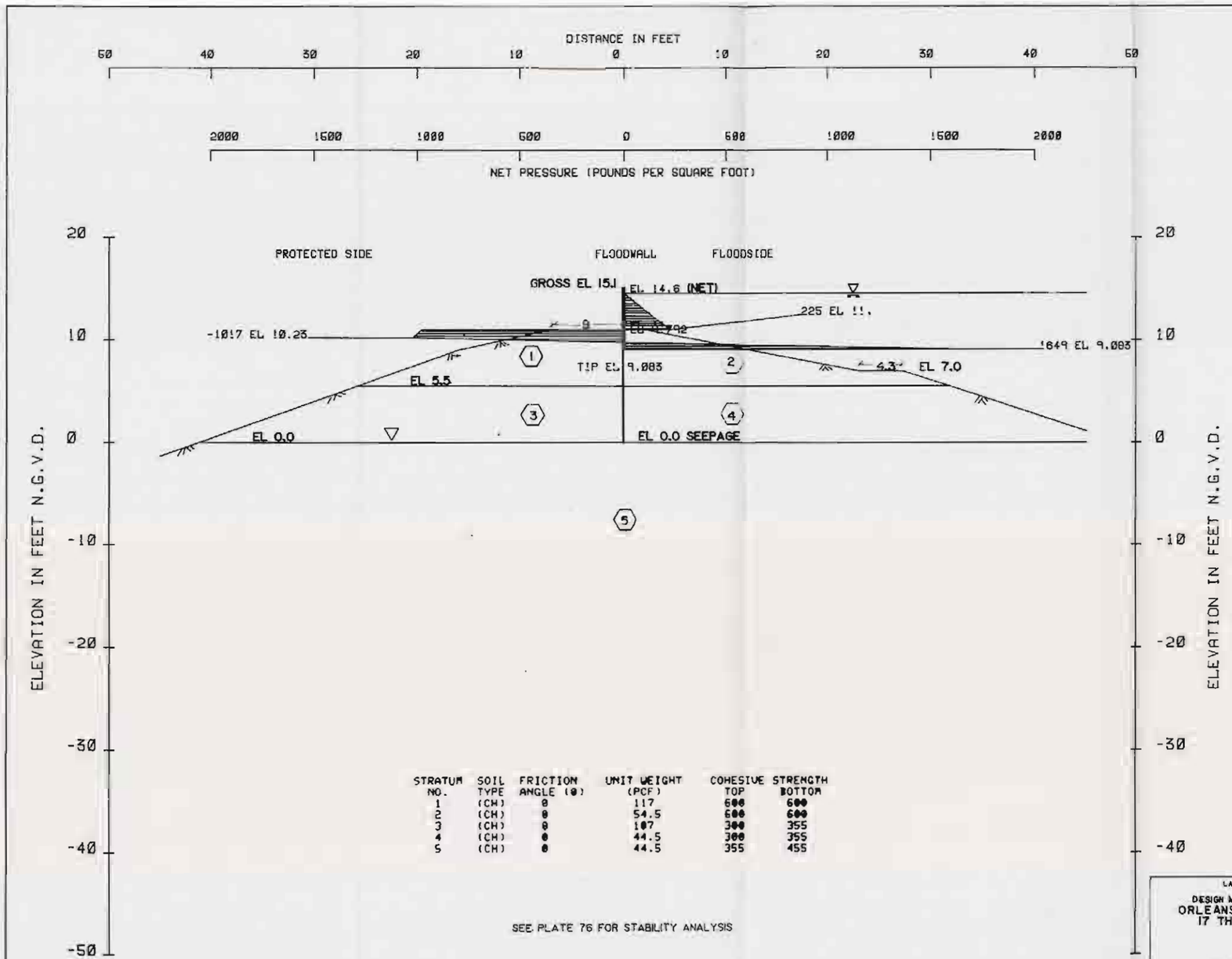
(Q) CASE F.S.=1.

LAKE PONTCHARTRAIN, LA. AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO 20 GENERAL DESIGN
ORLEANS PARISH - JEFFERSON PARISH
17 TH. STREET OUTFALL CANAL
(METAIRIE RELIEF)

I-WALL ANALYSIS
B/L STA. 642+00 TO
B/L STA. 663+00 ORLEANS

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

DATE: MARCH 1990 FILE NO. H-2-30300



ELEVATION	PRESSURE
14.60	0.0
11.00	225.0
11.00	0.0
11.00	-975.0
10.25	-1017.0
9.79	0.0
9.08	1649.3
9.08	0.0

STRATUM NO.	SOIL TYPE	FRICTION ANGLE (Ø)	UNIT WEIGHT (PCF)	COHESIVE STRENGTH TOP	COHESIVE STRENGTH BOTTOM
1	(CH)	0	117	600	600
2	(CH)	0	54.5	600	600
3	(CH)	0	107	300	355
4	(CH)	0	44.5	300	355
5	(CH)	0	44.5	355	455

SEE PLATE 76 FOR STABILITY ANALYSIS

NET DIAGRAM

(Q) CASE F.S.=1.

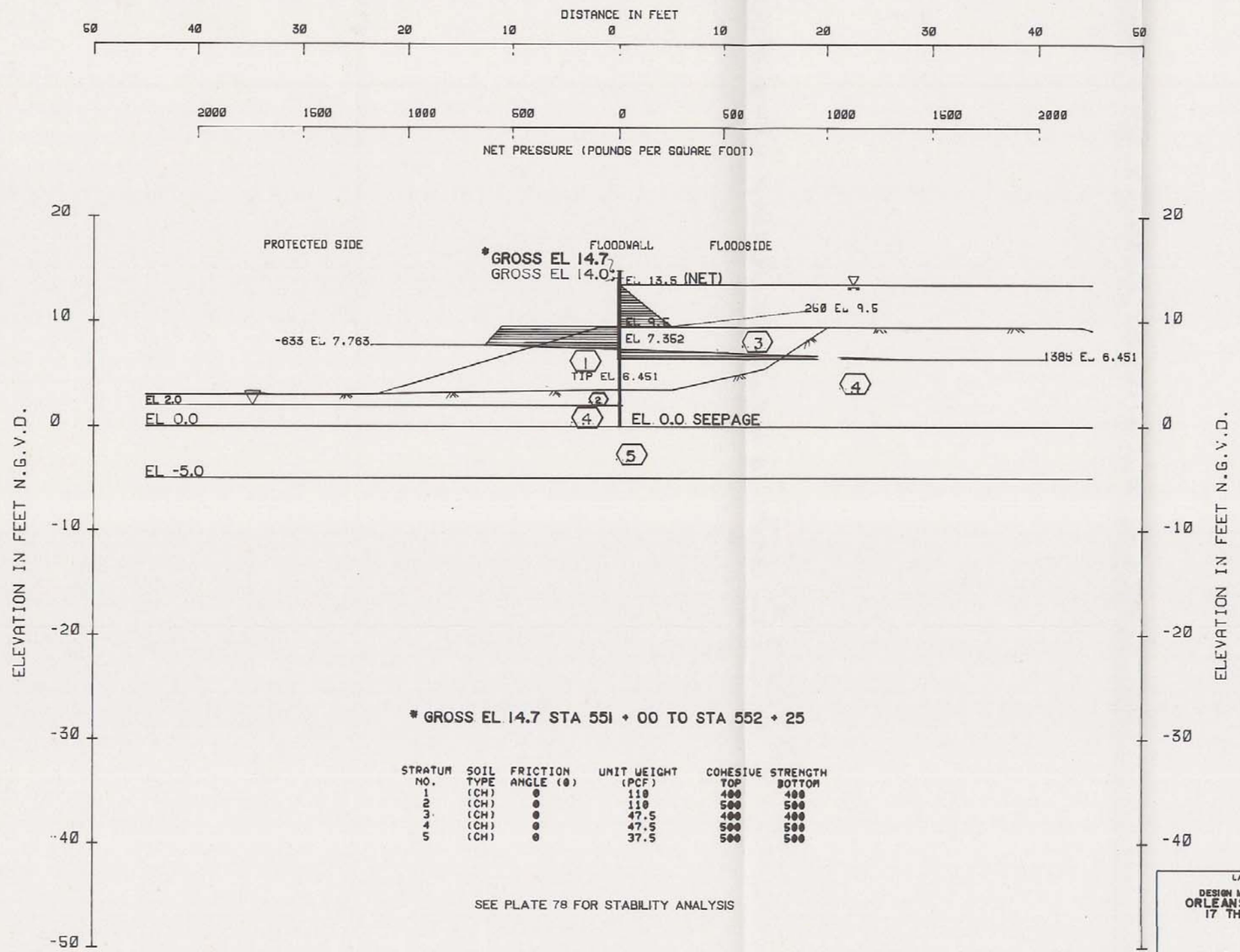
LAKE PONTCHARTRAIN, LA. AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO.20 GENERAL DESIGN
ORLEANS PARISH – JEFFERSON PARISH
17 TH. STREET OUTFALL CANAL
(METAIRIE RELIEF)

I-WALL ANALYSIS

B/L STA. 663+00 TO
B/L STA. 670+63 ORLEANS

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

DATE: MARCH 1990 FILE NO. H-2-30300



ELEVATION	PRESSURE
13.50	0.0
9.50	250.0
9.50	0.0
9.50	-550.0
7.76	-632.5
7.35	0.0
6.45	1385.4
6.45	0.0

* GROSS EL 14.7 STA 551 + 00 TO STA 552 + 25

STRATUM NO.	SOIL TYPE	FRICTION ANGLE (Ø)	UNIT WEIGHT (PCF)	COHESIVE STRENGTH TOP	COHESIVE STRENGTH BOTTOM
1	(CH)	0	110	400	400
2	(CH)	0	110	500	500
3	(CH)	0	47.5	400	400
4	(CH)	0	47.5	500	500
5	(CH)	0	37.5	500	500

SEE PLATE 78 FOR STABILITY ANALYSIS

NET DIAGRAM

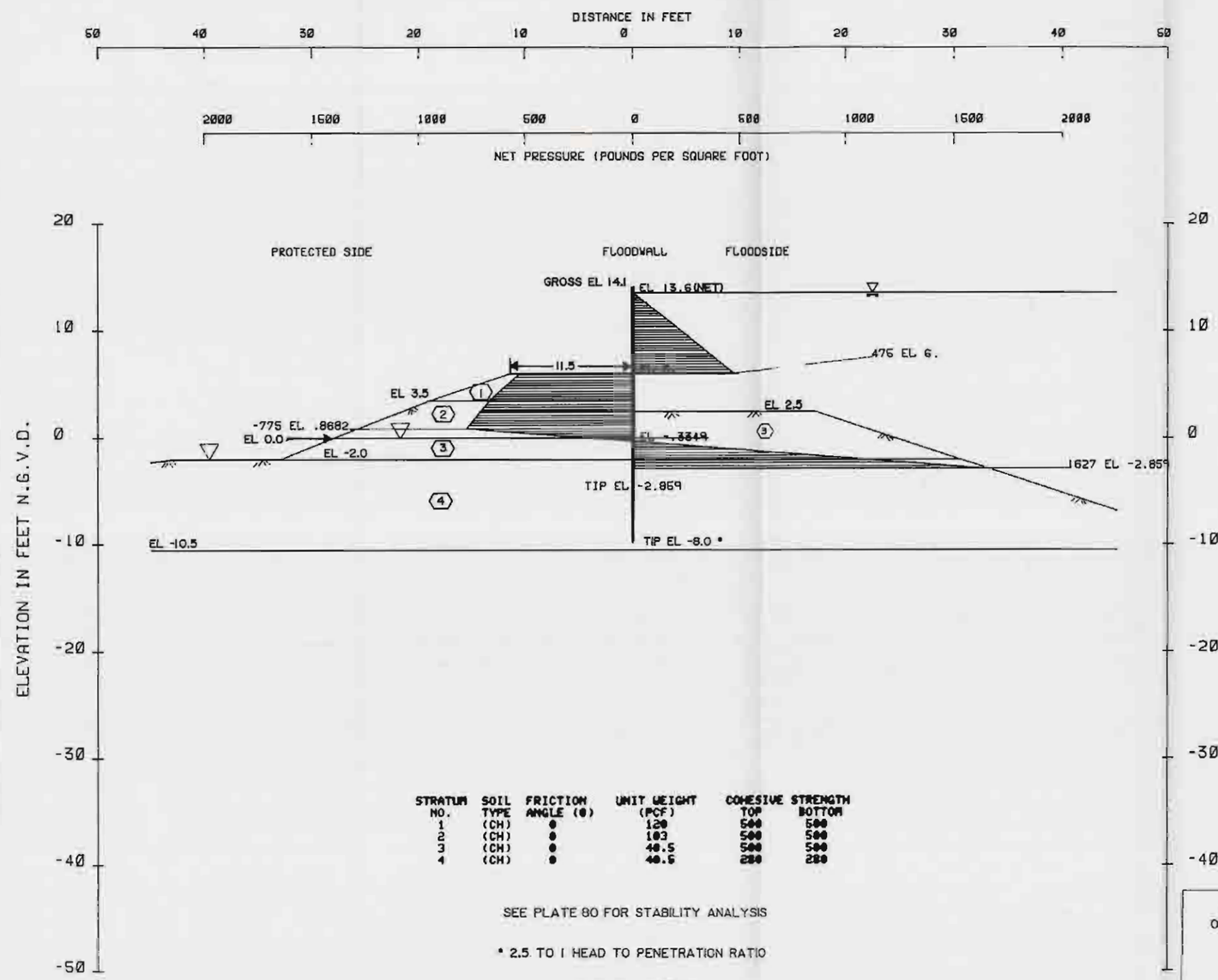
(Q) CASE F.S.=1.

LAKE PONTCHARTRAIN, LA. AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO. 20 GENERAL DESIGN
ORLEANS PARISH - JEFFERSON PARISH
17 TH. STREET OUTFALL CANAL
(METAIRIE RELIEF)

I-WALL ANALYSIS
B/L STA. 549+22 TO
B/L STA. 552+70 JEFFERSON

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

DATE: MARCH 1990 FILE NO. H-2-30300



ELEVATION	PRESSURE
13.60	0.0
6.00	476.0
6.00	0.0
6.00	-525.0
3.50	-669.7
0.87	-775.3
-0.33	0.0
-2.86	1627.1
-2.86	0.0

STRATUM NO.	SOIL TYPE	FRICTION ANGLE (Φ)	UNIT WEIGHT (PCF)	COHESIVE STRENGTH TOP	COHESIVE STRENGTH BOTTOM
1	(CH)	0	120	500	500
2	(CH)	0	103	500	500
3	(CH)	0	40.5	500	500
4	(CH)	0	40.5	280	280

SEE PLATE 80 FOR STABILITY ANALYSIS

* 2.5 TO 1 HEAD TO PENETRATION RATIO

NET DIAGRAM

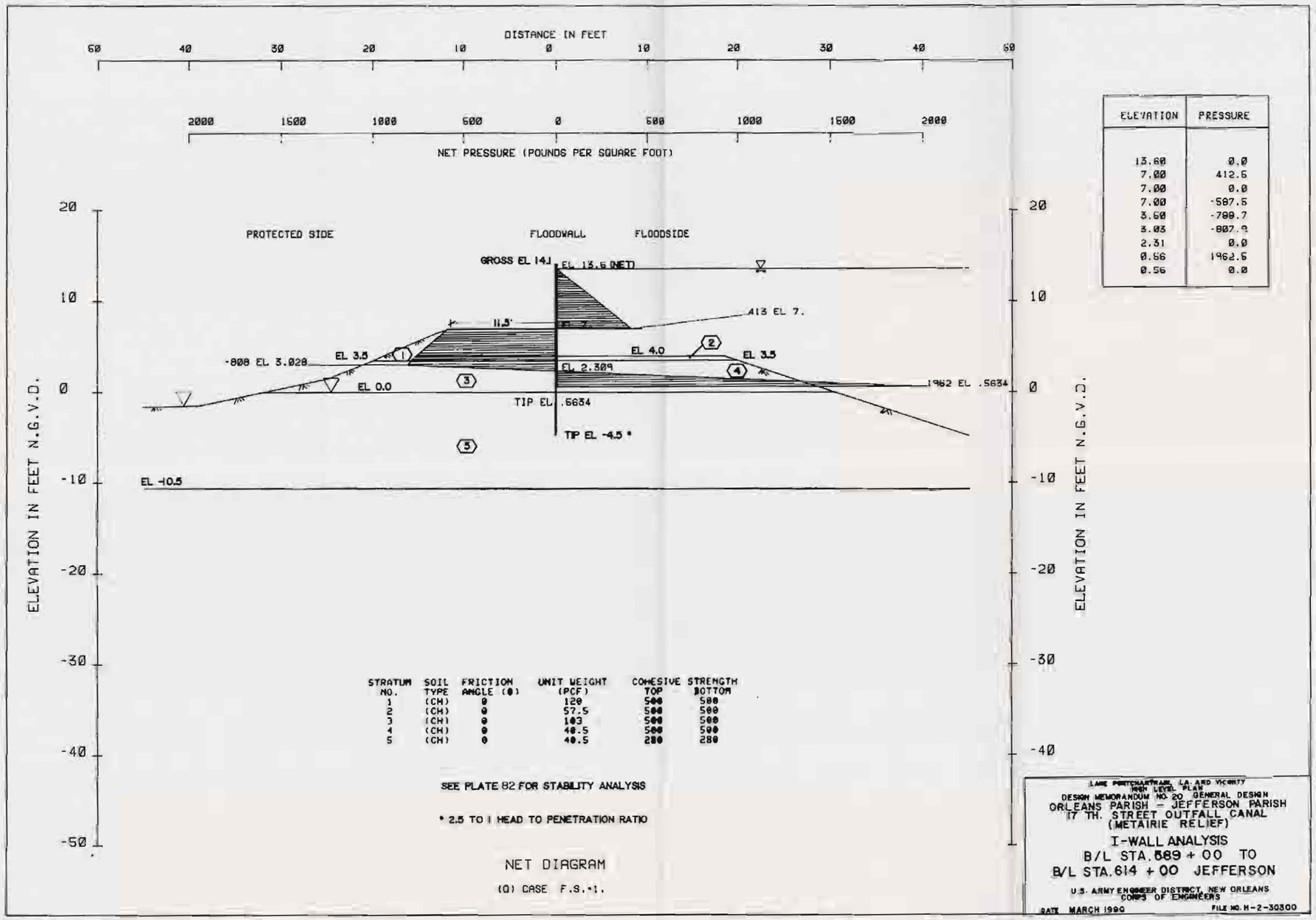
(Q) CASE F.S.=1.

LAKE PONTCHARTRAIN, LA. AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO. 20 GENERAL DESIGN
ORLEANS PARISH – JEFFERSON PARISH
17 TH. STREET OUTFALL CANAL
(METAIRIE RELIEF)

I-WALL ANALYSIS
B/L STA. 554+00 TO
B/L STA. 589+00 JEFFERSON

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

DATE: MARCH 1990 FILE NO H-2-30300



ELEVATION	PRESSURE
13.60	0.0
7.00	412.5
7.00	0.0
7.00	-587.5
3.60	-799.7
3.03	-807.9
2.31	0.0
0.56	1962.5
0.56	0.0

STRATUM NO.	SOIL TYPE	FRICTION ANGLE (Φ)	UNIT WEIGHT (PCF)	COHESIVE STRENGTH TOP	COHESIVE STRENGTH BOTTOM
1	(CH)	0	120	500	500
2	(CH)	0	57.5	500	500
3	(CH)	0	103	500	500
4	(CH)	0	40.5	500	500
5	(CH)	0	40.5	280	280

SEE PLATE 82 FOR STABILITY ANALYSIS

* 2.5 TO 1 HEAD TO PENETRATION RATIO

NET DIAGRAM

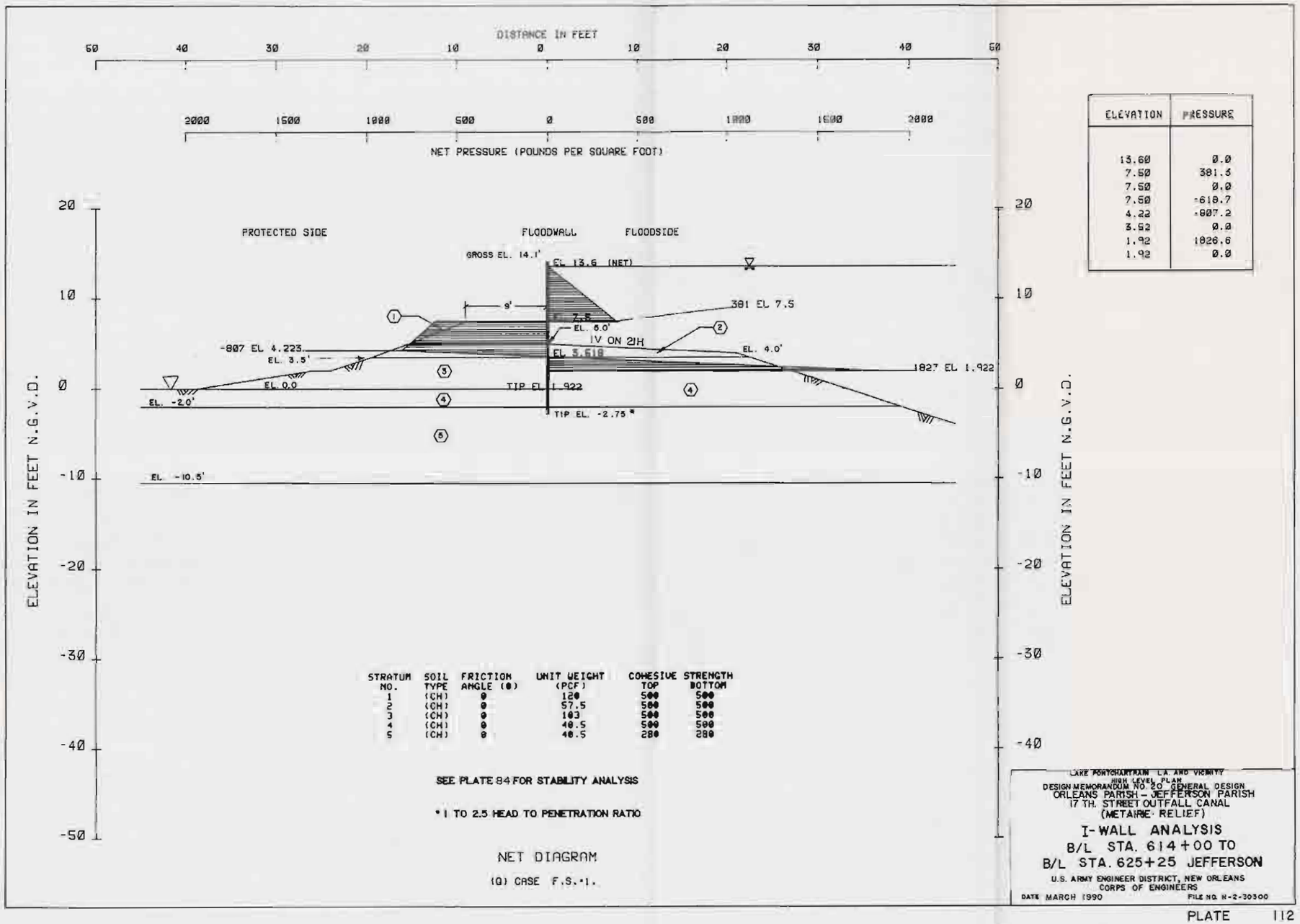
(Q) CASE F.S.=1.

LAKE PONTCHARTRAIN, LA. AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO. 20 GENERAL DESIGN
ORLEANS PARISH - JEFFERSON PARISH
17 TH. STREET OUTFALL CANAL
(METAIRIE RELIEF)

I-WALL ANALYSIS
B/L STA. 589 + 00 TO
B/L STA. 614 + 00 JEFFERSON

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

DATE MARCH 1990 FILE NO. H-2-30300



ELEVATION	PRESSURE
13.60	0.0
7.50	381.3
7.50	0.0
7.50	-618.7
4.22	-807.2
3.52	0.0
1.92	1826.6
1.92	0.0

STRATUM NO.	SOIL TYPE	FRICTION ANGLE (Ø)	UNIT WEIGHT (PCF)	COHESIVE STRENGTH TOP	COHESIVE STRENGTH BOTTOM
1	(CH)	0	120	500	500
2	(CH)	0	57.5	500	500
3	(CH)	0	103	500	500
4	(CH)	0	40.5	500	500
5	(CH)	0	40.5	280	280

SEE PLATE 84 FOR STABILITY ANALYSIS

* 1 TO 2.5 HEAD TO PENETRATION RATIO

NET DIAGRAM

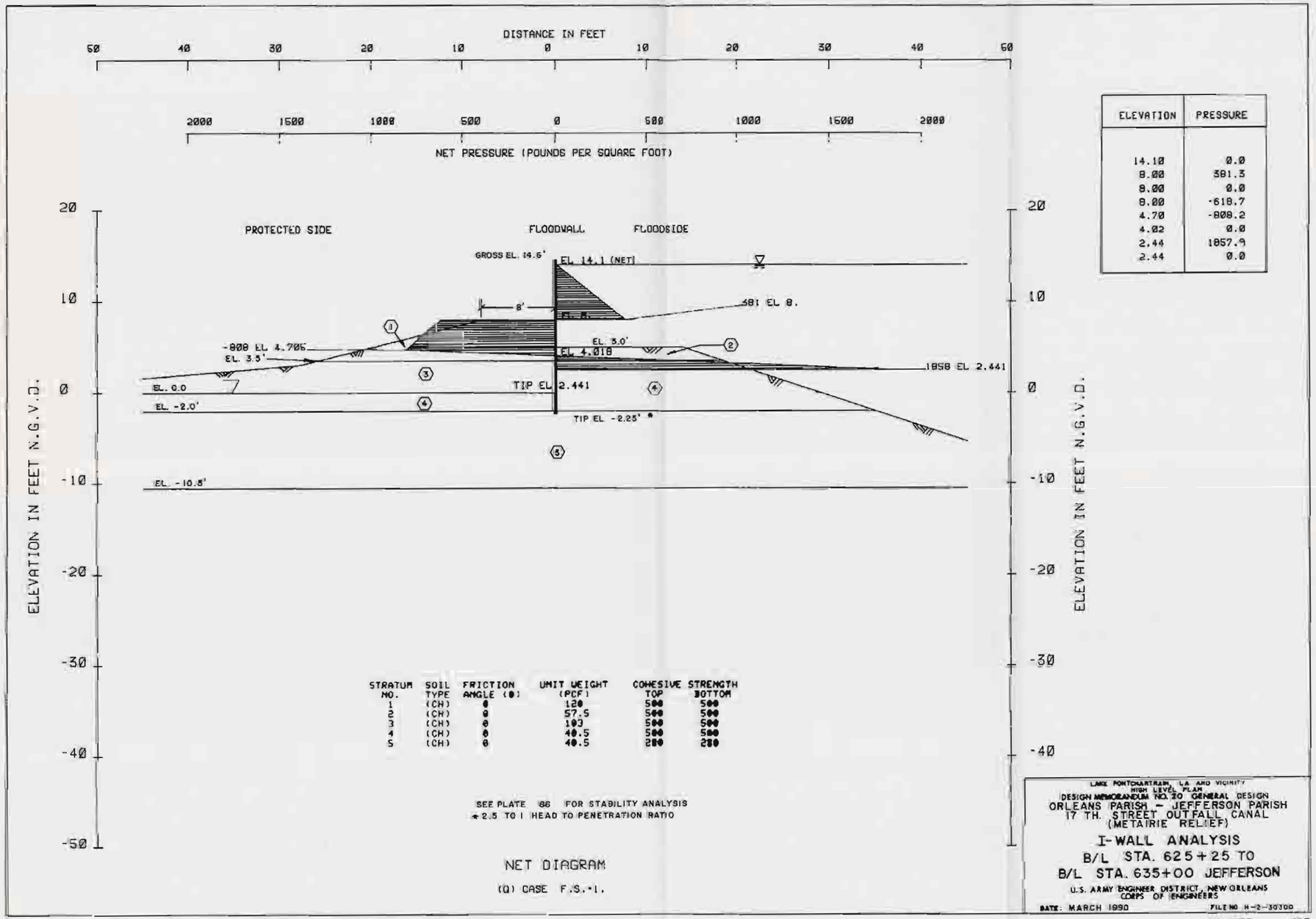
(Q) CASE F.S.=1.

LAKE PONTCHARTRAIN LA. AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO. 20 GENERAL DESIGN
ORLEANS PARISH - JEFFERSON PARISH
17 TH. STREET OUTFALL CANAL
(METAIRIE RELIEF)

I-WALL ANALYSIS
B/L STA. 614+00 TO
B/L STA. 625+25 JEFFERSON

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

DATE MARCH 1990 FILE NO. H-2-30300



NET DIAGRAM

(Q) CASE F.S.=1.

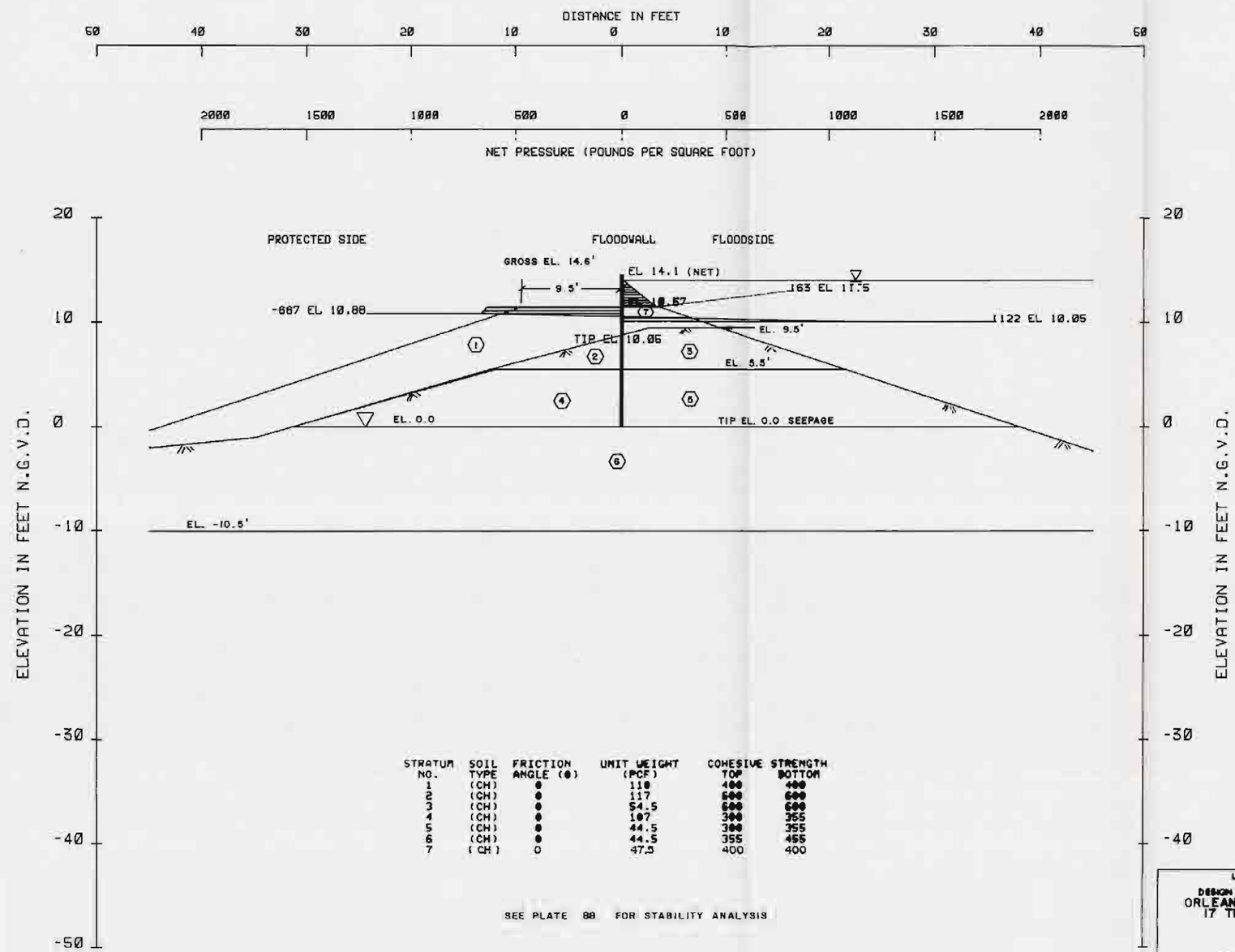
ELEVATION	PRESSURE
14.10	0.0
8.00	581.3
8.00	0.0
8.00	-618.7
4.70	-808.2
4.02	0.0
2.44	1857.9
2.44	0.0

LAKE PONTCHARTRAIN, LA. AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO. 20 GENERAL DESIGN
ORLEANS PARISH – JEFFERSON PARISH
17 TH. STREET OUTFALL CANAL
(METAIRIE RELIEF)

I-WALL ANALYSIS
B/L STA. 625+25 TO
B/L STA. 635+00 JEFFERSON

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

DATE: MARCH 1990 FILE NO. H-2-30300



STRATUM NO.	SOIL TYPE	FRICTION ANGLE (Φ)	UNIT WEIGHT (PCF)	COHESIVE STRENGTH TOP	COHESIVE STRENGTH BOTTOM
1	(CH)	0	110	400	400
2	(CH)	0	117	600	600
3	(CH)	0	54.5	600	600
4	(CH)	0	107	300	355
5	(CH)	0	44.5	300	355
6	(CH)	0	44.5	355	455
7	(CH)	0	47.5	400	400

SEE PLATE 88 FOR STABILITY ANALYSIS

NET DIAGRAM

(Q) CASE F.S.-1.

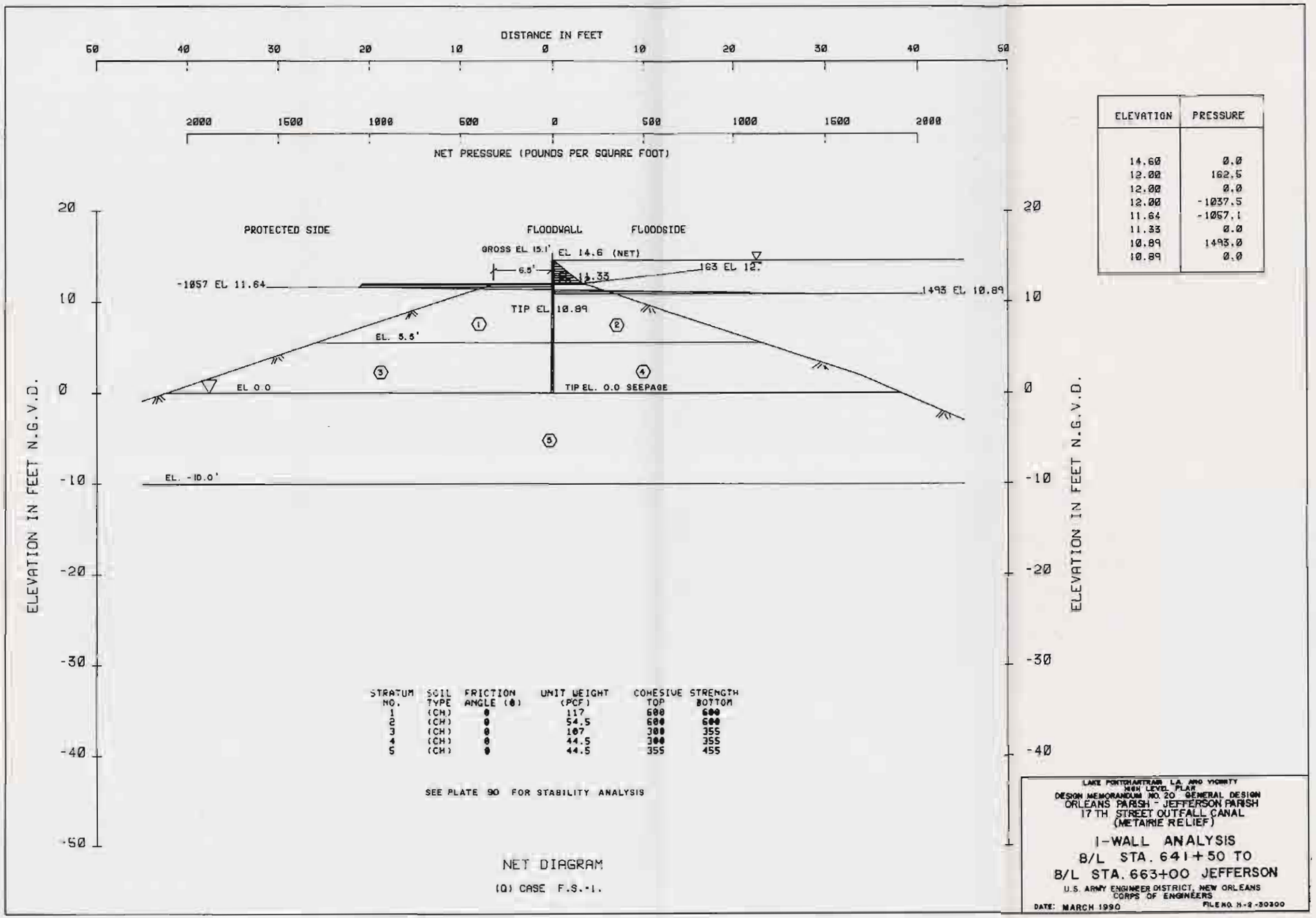
ELEVATION	PRESSURE
14.10	0.0
11.60	162.5
11.50	0.0
11.50	-637.5
10.88	-666.7
10.57	0.0
10.05	1122.0
10.06	0.0

LAKE PONTCHARTRAIN, L.A. AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO. 20 GENERAL DESIGN
ORLEANS PARISH – JEFFERSON PARISH
17 TH. STREET OUTFALL CANAL
(METAIRIE RELIEF)

I WALL ANALYSIS
B/L STA. 635+00 TO
B/L STA. 641+50 JEFFERSON

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

DATE: MARCH 1990 FILE NO. H-2-30300



ELEVATION	PRESSURE
14.60	0.0
12.00	162.5
12.00	0.0
12.00	-1037.5
11.64	-1057.1
11.33	0.0
10.89	1493.0
10.89	0.0

STRATUM NO.	SOIL TYPE	FRICTION ANGLE (Ø)	UNIT WEIGHT (PCF)	COHESIVE STRENGTH TOP	COHESIVE STRENGTH BOTTOM
1	(CH)	0	117	600	600
2	(CH)	0	54.5	600	600
3	(CH)	0	107	300	355
4	(CH)	0	44.5	300	355
5	(CH)	0	44.5	355	455

SEE PLATE 90 FOR STABILITY ANALYSIS

NET DIAGRAM

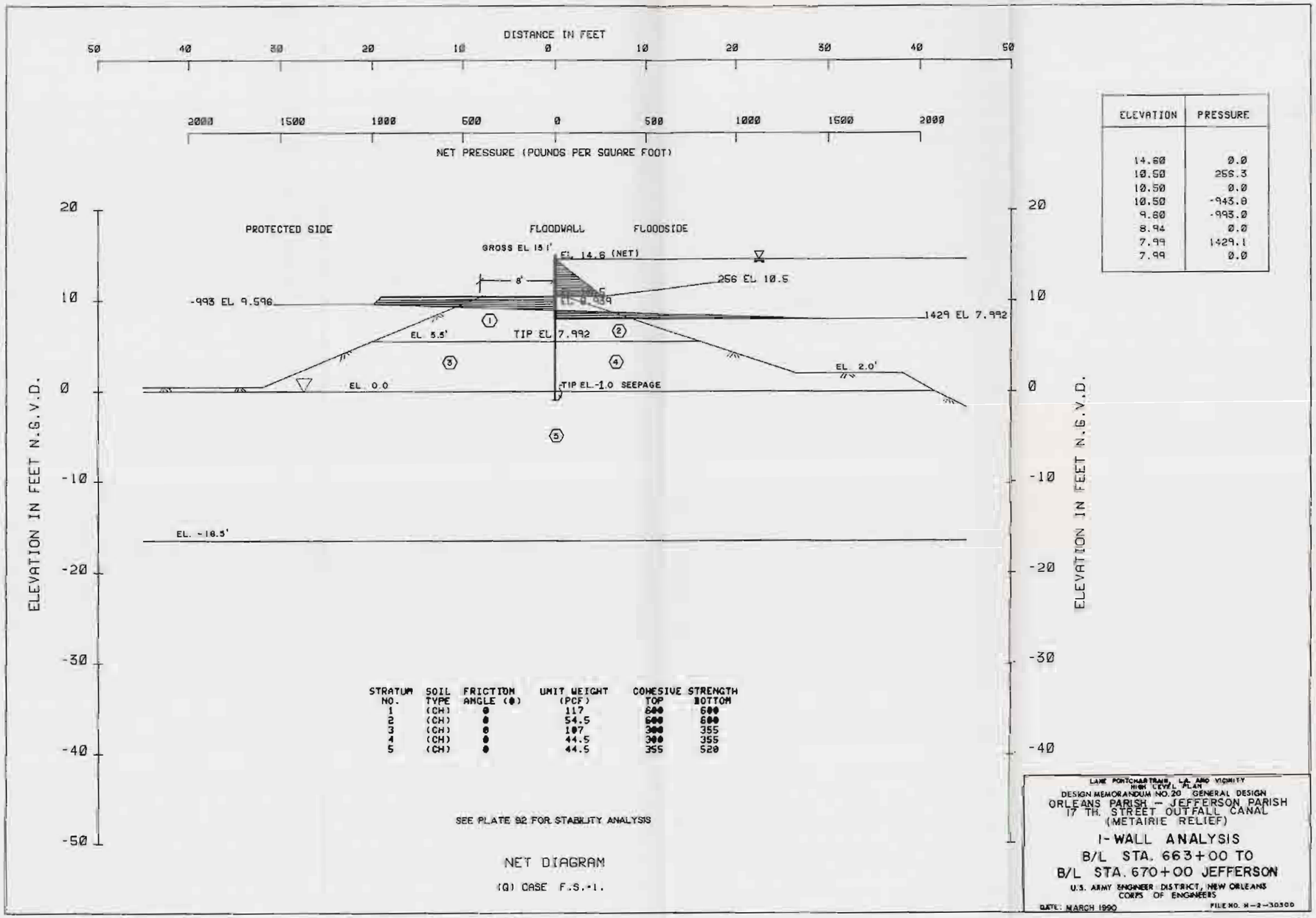
(Q) CASE F.S.-1.

LAKE PONTCHARTRAIN, LA. AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO. 20 GENERAL DESIGN
ORLEANS PARISH - JEFFERSON PARISH
17 TH STREET OUTFALL CANAL
(METAIRIE RELIEF)

I-WALL ANALYSIS
B/L STA. 641+50 TO
B/L STA. 663+00 JEFFERSON

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

DATE: MARCH 1990 FILE NO. H-2-30300



STRATUM NO.	SOIL TYPE	FRICTION ANGLE (φ)	UNIT WEIGHT (PCF)	COHESIVE STRENGTH TOP	COHESIVE STRENGTH BOTTOM
1	(CH)	0	117	600	600
2	(CH)	0	54.5	600	600
3	(CH)	0	107	300	355
4	(CH)	0	44.5	300	355
5	(CH)	0	44.5	355	520

ELEVATION	PRESSURE
14.60	0.0
10.50	255.3
10.50	0.0
10.50	-943.0
9.80	-993.0
8.94	0.0
7.99	1429.1
7.99	0.0

SEE PLATE 92 FOR STABILITY ANALYSIS

NET DIAGRAM

(Q) CASE F.S.-1.

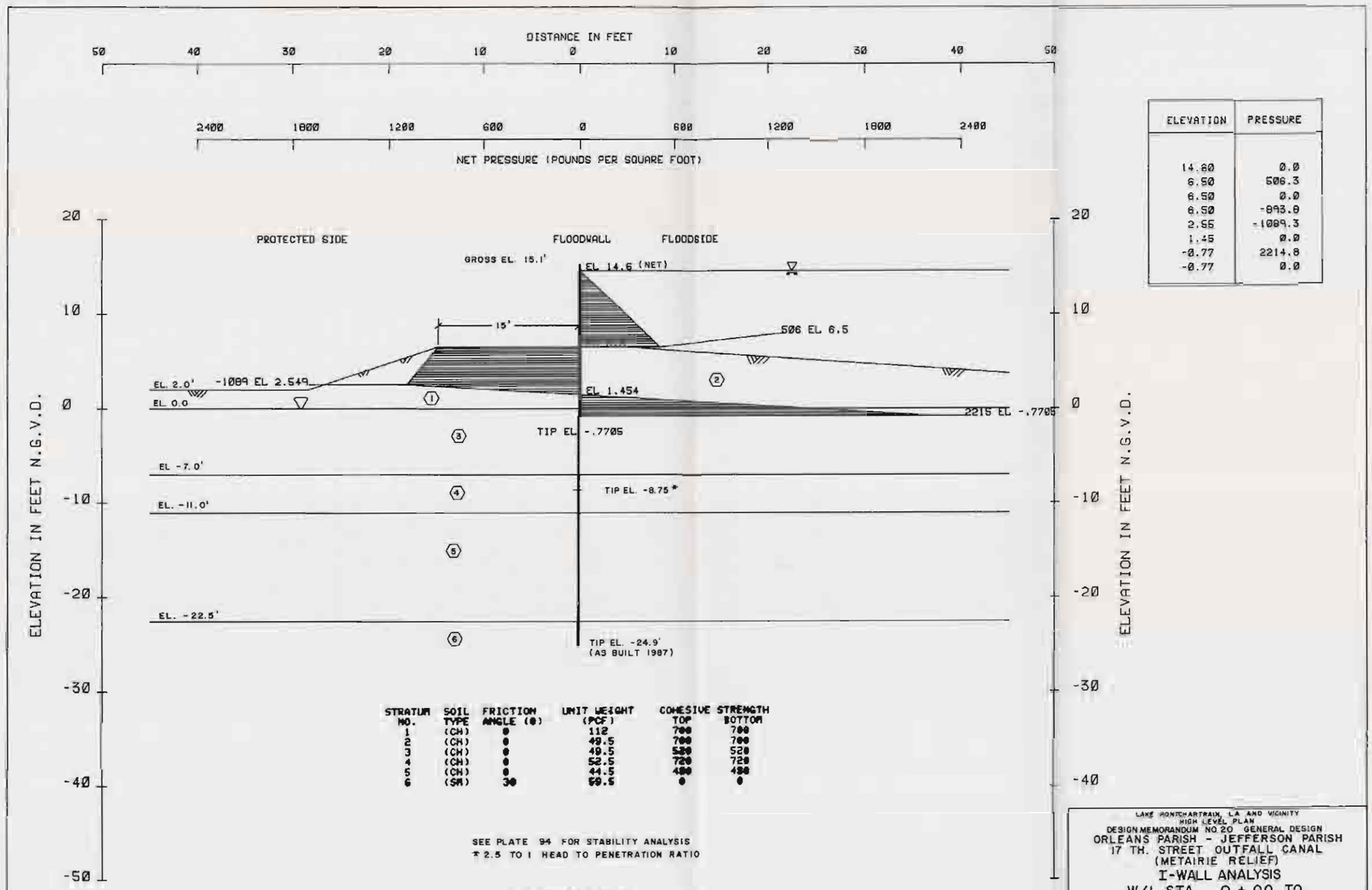
LAKE PONTCHARTRAIN, LA. AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO.20 GENERAL DESIGN
ORLEANS PARISH – JEFFERSON PARISH
17 TH. STREET OUTFALL CANAL
(METAIRIE RELIEF)

I-WALL ANALYSIS

B/L STA. 663+00 TO
B/L STA. 670+00 JEFFERSON

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

DATE: MARCH 1990 FILE NO. H-2-30300



ELEVATION	PRESSURE
14.60	0.0
6.50	506.3
6.50	0.0
6.50	-893.0
2.55	-1089.3
1.45	0.0
-0.77	2214.8
-0.77	0.0

STRATUM NO.	SOIL TYPE	FRICTION ANGLE (Φ)	UNIT WEIGHT (PCF)	COHESIVE STRENGTH TOP	COHESIVE STRENGTH BOTTOM
1	(CH)	0	112	700	700
2	(CH)	0	49.5	700	700
3	(CH)	0	49.5	520	520
4	(CH)	0	52.5	720	720
5	(CH)	0	44.5	480	480
6	(SM)	30	69.5	0	0

SEE PLATE 94 FOR STABILITY ANALYSIS
* 2.5 TO 1 HEAD TO PENETRATION RATIO

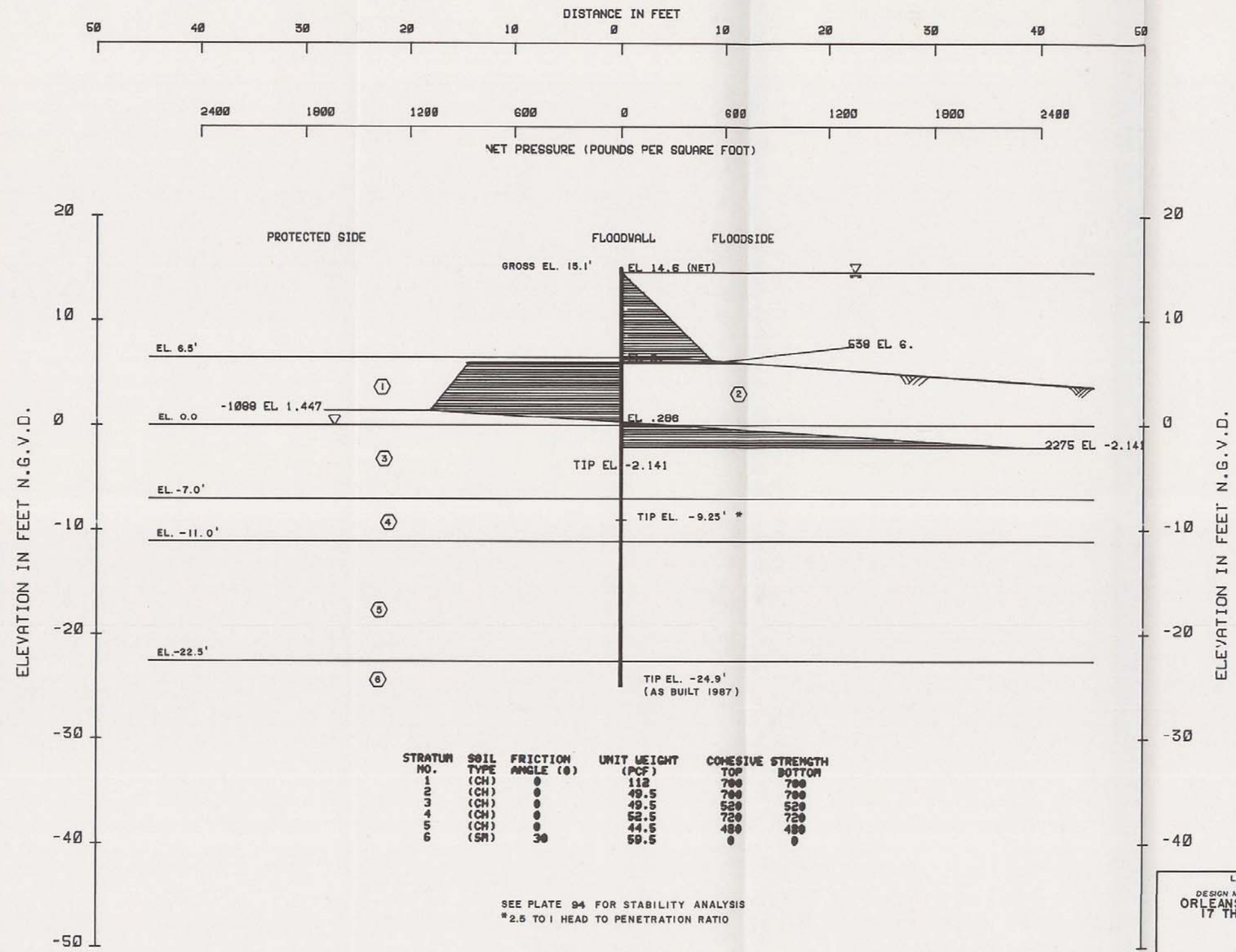
NET DIAGRAM

(G) CASE F.S.-1.

LAKE PONTCHARTRAIN, LA AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO. 20 GENERAL DESIGN
ORLEANS PARISH - JEFFERSON PARISH
17 TH. STREET OUTFALL CANAL
(METAIRIE RELIEF)
I-WALL ANALYSIS
W/L STA. 0 + 00 TO
W/L STA. 2+ 75 JEFFERSON

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

DATE: MARCH 1990 FILE NO. H-2-30300



ELEVATION	PRESSURE
14.60	0.0
6.00	537.5
6.00	0.0
6.00	-862.5
1.45	-1087.9
0.29	0.0
-2.14	2274.9
-2.14	0.0

STRATUM NO.	SOIL TYPE	FRICTION ANGLE (Ø)	UNIT WEIGHT (PCF)	COHESIVE STRENGTH TOP	COHESIVE STRENGTH BOTTOM
1	(CH)	0	112	700	700
2	(CH)	0	49.5	700	700
3	(CH)	0	49.5	520	520
4	(CH)	0	52.5	720	720
5	(CH)	0	44.5	480	480
6	(SM)	30	59.5	0	0

SEE PLATE 94 FOR STABILITY ANALYSIS
*2.5 TO 1 HEAD TO PENETRATION RATIO

NET DIAGRAM

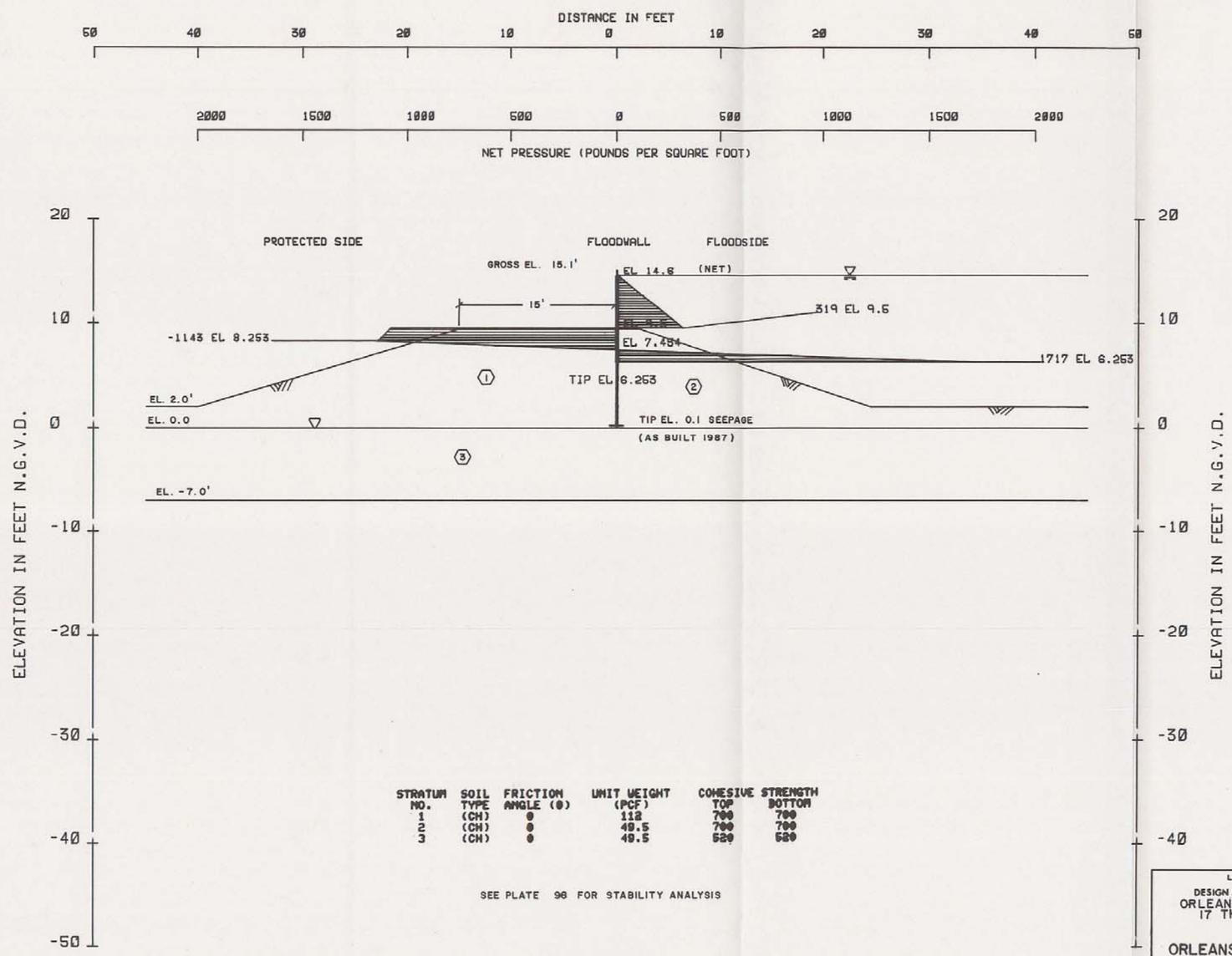
(Q) CASE F.S.=1.

LAKE PONTCHARTRAIN LA. AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO. 20 GENERAL DESIGN
ORLEANS PARISH - JEFFERSON PARISH
17 TH. STREET OUTFALL CANAL
(METAIRIE RELIEF)

I-WALL ANALYSIS
W/L STA. 3 + 05 TO
W/L STA. 4 + 15 JEFFERSON

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

DATE: MARCH 1990 FILE NO. H-2-30300



ELEVATION	PRESSURE
14.60	0.0
9.60	319.9
9.50	0.0
9.50	-1001.3
8.26	-1143.0
7.45	0.0
6.25	1716.9
6.26	0.0

STRATUM NO.	SOIL TYPE	FRICTION ANGLE (Ø)	UNIT WEIGHT (PCF)	COHESIVE STRENGTH TOP	COHESIVE STRENGTH BOTTOM
1	(CH)	0	112	700	700
2	(CH)	0	49.5	700	700
3	(CH)	0	49.5	520	520

SEE PLATE 96 FOR STABILITY ANALYSIS

NET DIAGRAM

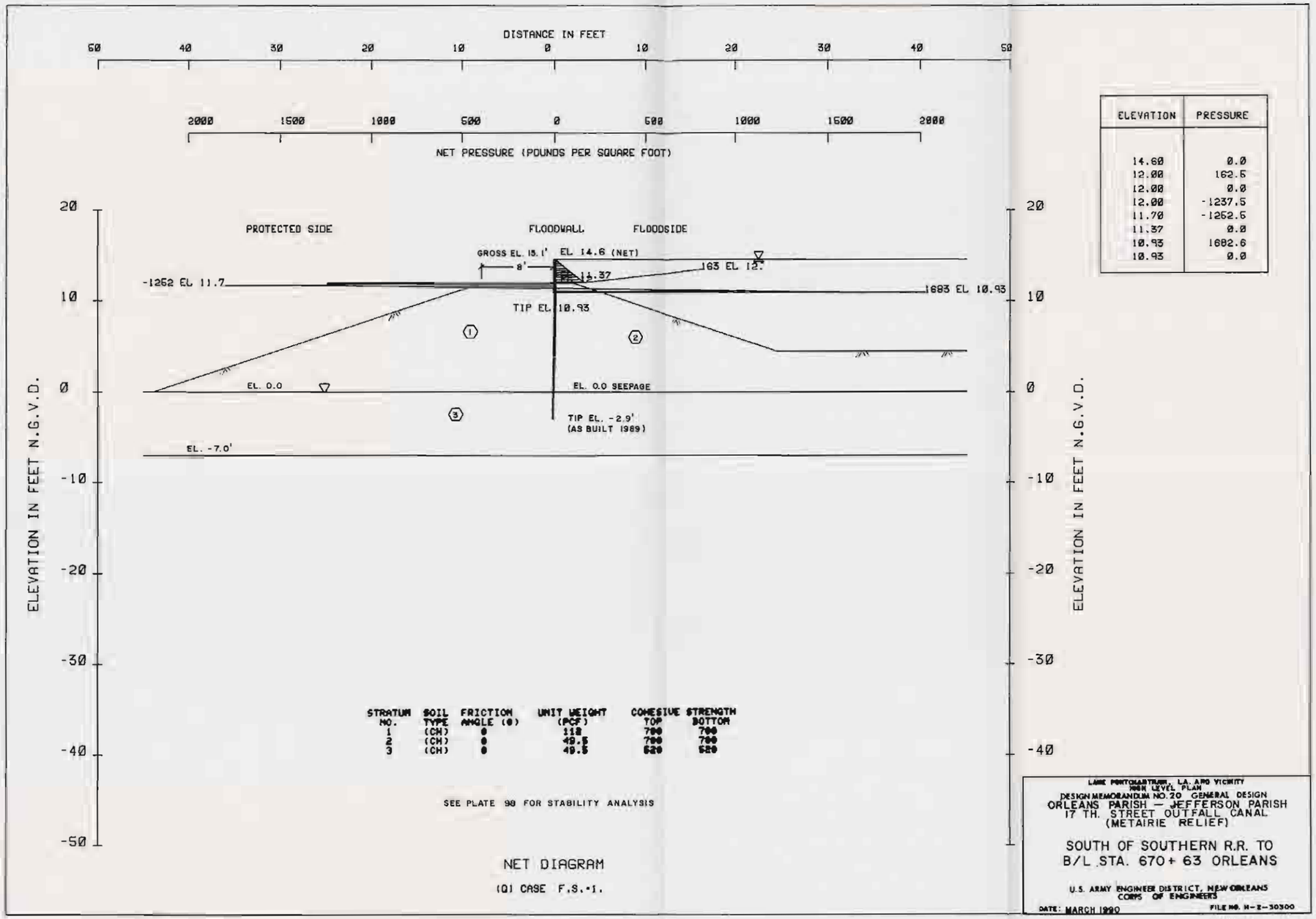
(Q) CASE F.S.=1.

LAKE PONTCHARTRAIN, LA. AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO 20 GENERAL DESIGN
ORLEANS PARISH – JEFFERSON PARISH
17 TH. STREET OUTFALL CANAL
(METAIRIE RELIEF)

ORLEANS SIDE OF PUMPING STATION
TO SOUTH OF SOUTHERN R.R.

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

DATE: MARCH 1990 FILE NO H-2-30900



STRATUM NO.	SOIL TYPE	FRICTION ANGLE (Φ)	UNIT WEIGHT (PCF)	COHESIVE STRENGTH TOP	COHESIVE STRENGTH BOTTOM
1	(CH)	0	112	700	700
2	(CH)	0	49.5	700	700
3	(CH)	0	49.5	520	520

ELEVATION	PRESSURE
14.60	0.0
12.00	162.5
12.00	0.0
12.00	-1237.5
11.70	-1252.5
11.37	0.0
10.93	1682.6
10.93	0.0

SEE PLATE 98 FOR STABILITY ANALYSIS

NET DIAGRAM

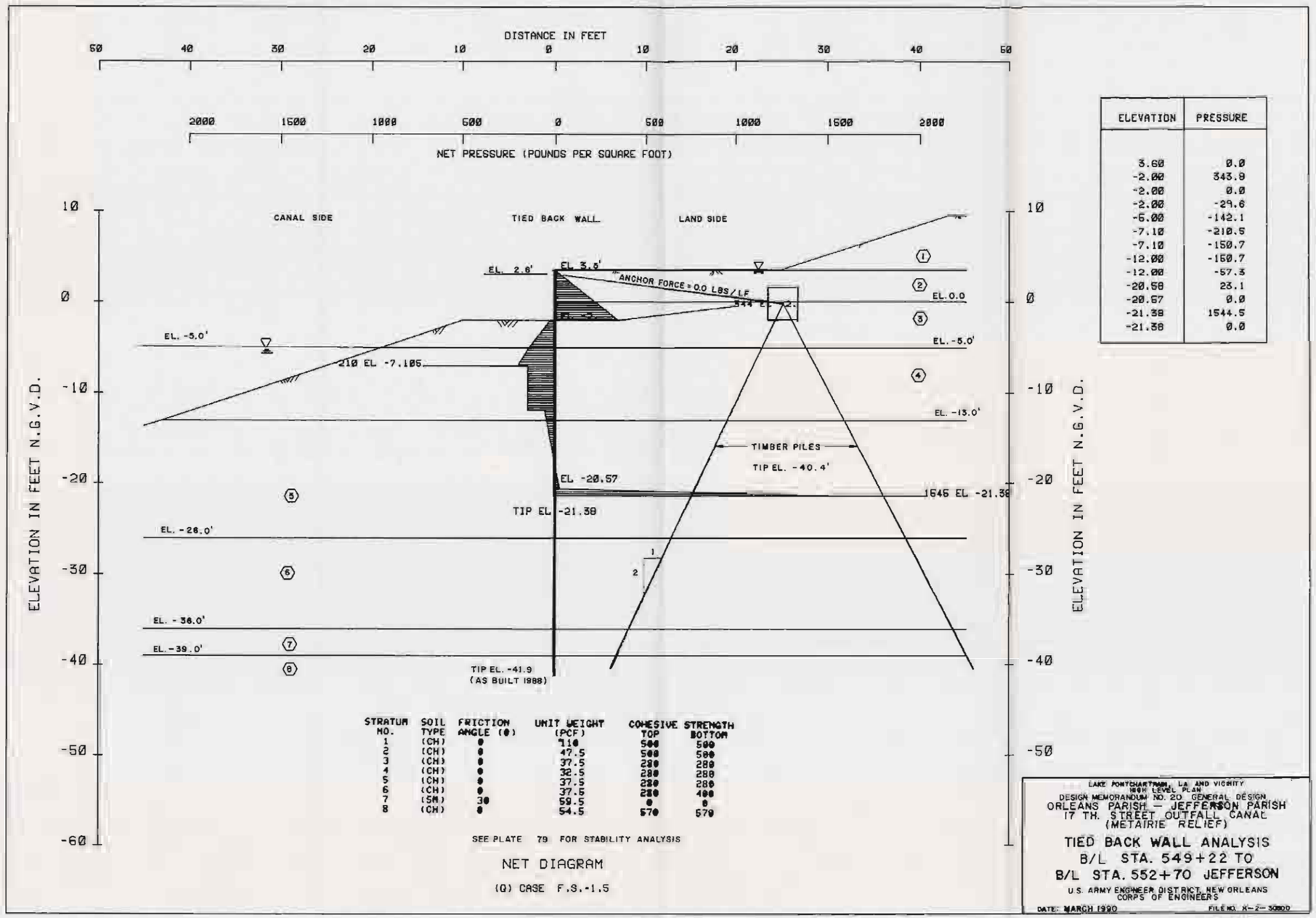
(Q) CASE F.S.=1.

LAKE PONTCHARTRAIN, LA. AND VICINITY
MAIN LEVEL PLAN
DESIGN MEMORANDUM NO. 20 GENERAL DESIGN
ORLEANS PARISH — JEFFERSON PARISH
17 TH. STREET OUTFALL CANAL
(METAIRIE RELIEF)

SOUTH OF SOUTHERN R.R. TO
B/L STA. 670+ 63 ORLEANS

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

DATE: MARCH 1990 FILE NO. H-2-30300



ELEVATION	PRESSURE
3.60	0.0
-2.00	343.9
-2.00	0.0
-2.00	-29.6
-5.00	-142.1
-7.10	-210.5
-7.10	-150.7
-12.00	-150.7
-12.00	-57.3
-20.58	23.1
-20.57	0.0
-21.38	1544.5
-21.38	0.0

STRATUM NO.	SOIL TYPE	FRICTION ANGLE (Ø)	UNIT WEIGHT (PCF)	COHESIVE STRENGTH TOP	COHESIVE STRENGTH BOTTOM
1	(CH)	0	110	500	500
2	(CH)	0	47.5	500	500
3	(CH)	0	37.5	280	280
4	(CH)	0	32.5	280	280
5	(CH)	0	37.5	280	280
6	(CH)	0	37.5	280	400
7	(SM)	30	59.5	0	0
8	(CH)	0	54.5	570	570

SEE PLATE 79 FOR STABILITY ANALYSIS

NET DIAGRAM

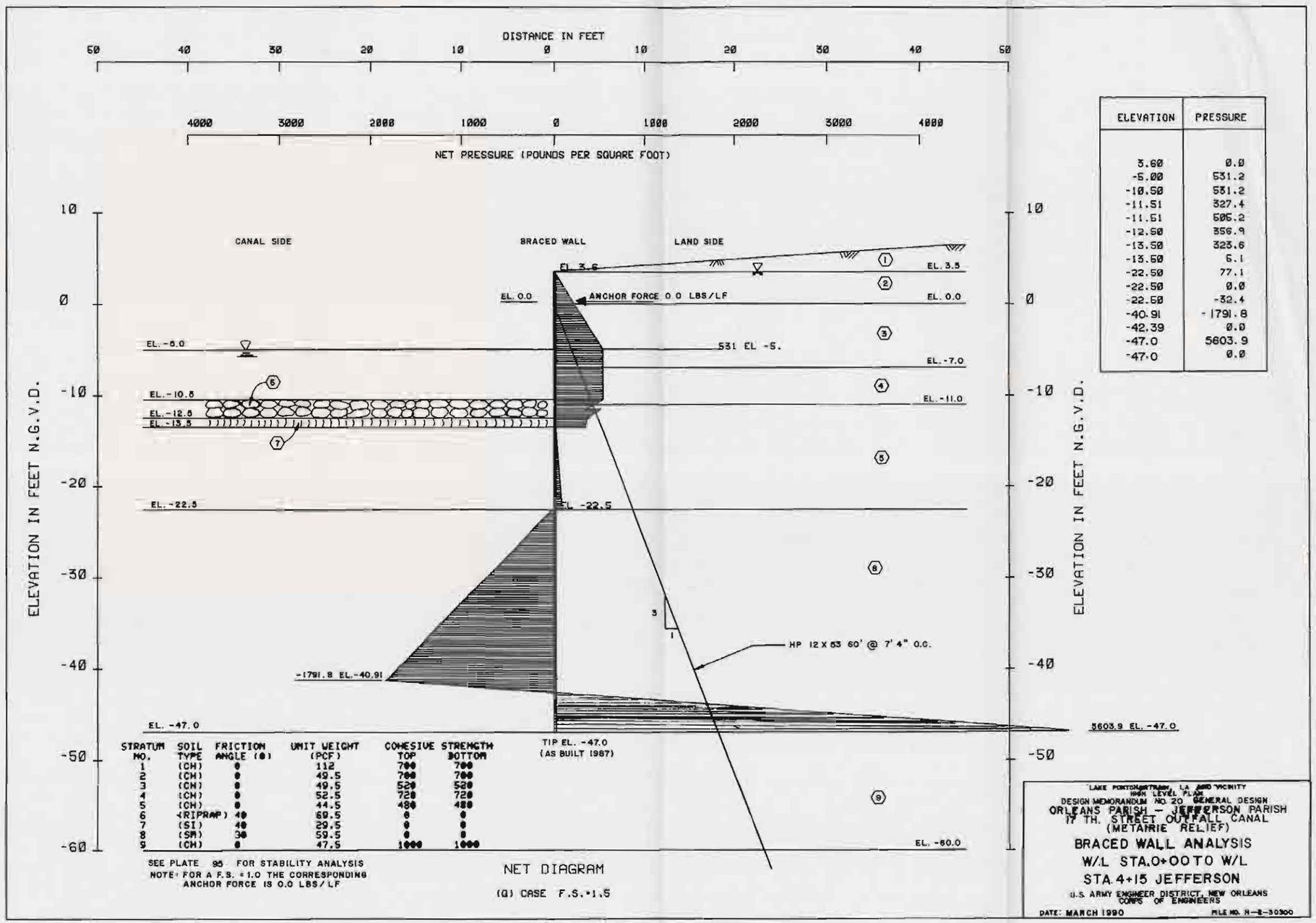
(Q) CASE F.S.-1.5

LAKE PONTCHARTRAIN, LA AND VICINITY
100YR LEVEL PLAN
DESIGN MEMORANDUM NO. 20 GENERAL DESIGN
ORLEANS PARISH — JEFFERSON PARISH
17 TH. STREET OUTFALL CANAL
(METAIRIE RELIEF)

TIED BACK WALL ANALYSIS
B/L STA. 549+22 TO
B/L STA. 552+70 JEFFERSON

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

DATE: MARCH 1990 FILE NO. X-2-30800



ELEVATION	PRESSURE
3.60	0.0
-5.00	531.2
-10.50	531.2
-11.51	327.4
-11.51	505.2
-12.50	356.9
-13.50	323.6
-13.50	5.1
-22.50	77.1
-22.50	0.0
-22.50	-32.4
-40.91	-1791.8
-42.39	0.0
-47.0	5603.9
-47.0	0.0

STRATUM NO.	SOIL TYPE	FRICTION ANGLE (Φ)	UNIT WEIGHT (PCF)	COHESIVE STRENGTH TOP	COHESIVE STRENGTH BOTTOM
1	(CH)	0	112	700	700
2	(CH)	0	49.5	700	700
3	(CH)	0	49.5	520	520
4	(CH)	0	52.5	720	720
5	(CH)	0	44.5	480	480
6	(RIPRAP)	40	69.5	0	0
7	(SI)	40	29.5	0	0
8	(SM)	30	59.5	0	0
9	(CH)	0	47.5	1000	1000

SEE PLATE 95 FOR STABILITY ANALYSIS

NOTE: FOR A F.S. = 1.0 THE CORRESPONDING ANCHOR FORCE IS 0.0 LBS/LF

NET DIAGRAM

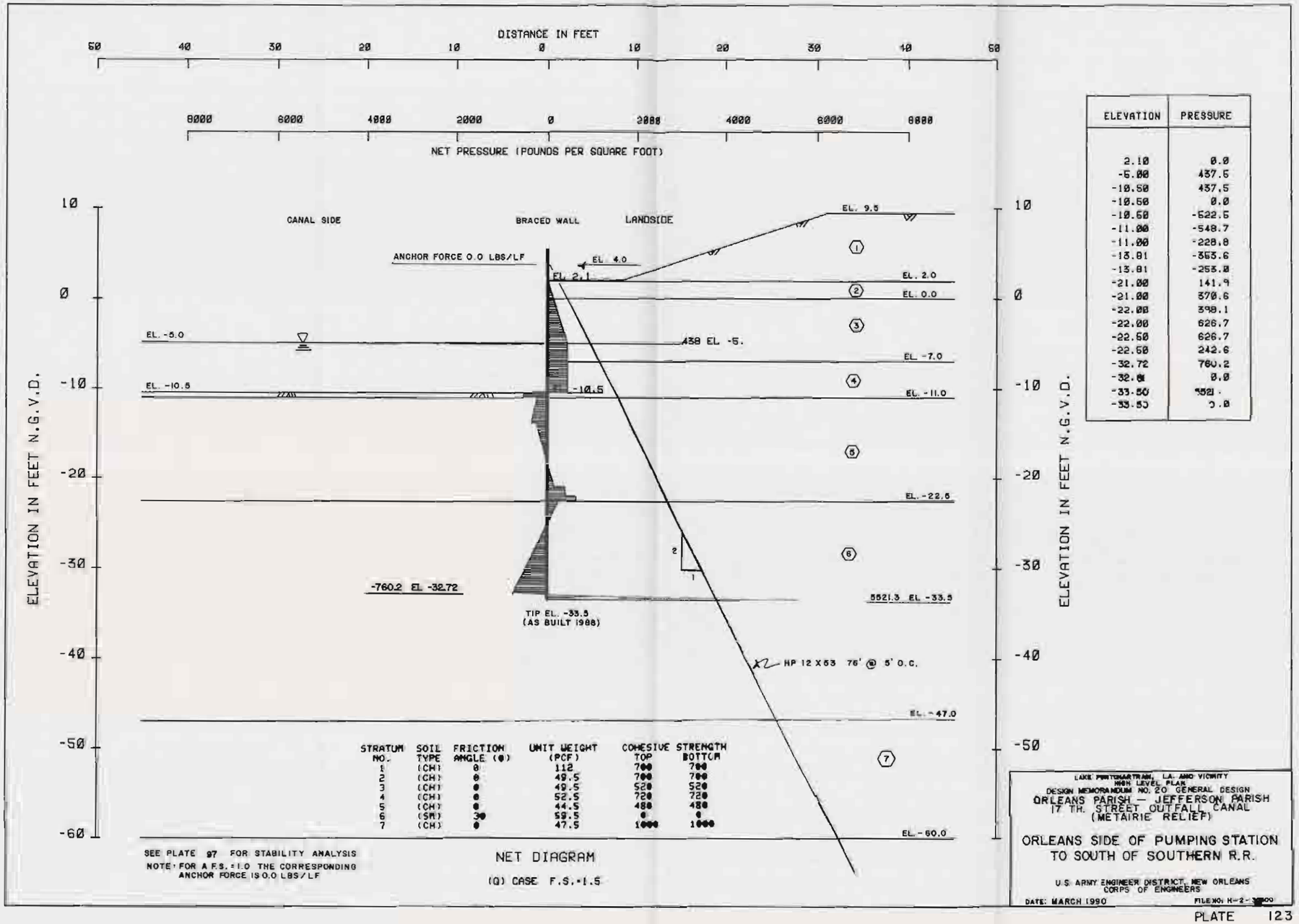
(G) CASE F.S.=1.5

LAKE PONTCHARTRAIN, LA. AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO. 20 GENERAL DESIGN
ORLEANS PARISH – JEFFERSON PARISH
17 TH. STREET OUTFALL CANAL
(METAIRIE RELIEF)

BRACED WALL ANALYSIS
W/L STA.0+00 TO W/L
STA. 4+15 JEFFERSON

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

DATE: MARCH 1990 FILE NO. H-2-30300



STRATUM NO.	SOIL TYPE	FRICTION ANGLE (φ)	UNIT WEIGHT (PCF)	COHESIVE STRENGTH TOP	COHESIVE STRENGTH BOTTOM
1	(CH)	0	112	700	700
2	(CH)	0	49.5	700	700
3	(CH)	0	49.5	520	520
4	(CH)	0	52.5	720	720
5	(CH)	0	44.5	480	480
6	(SM)	30	59.5	0	0
7	(CH)	0	47.5	1000	1000

ELEVATION	PRESSURE
2.10	0.0
-5.00	437.5
-10.50	437.5
-10.50	0.0
-10.50	-522.5
-11.00	-548.7
-11.00	-228.8
-13.81	-353.6
-13.81	-253.0
-21.00	141.9
-21.00	370.6
-22.00	398.1
-22.00	626.7
-22.50	626.7
-22.50	242.6
-32.72	760.2
-32.[illegible]	0.0
-33.50	552[illegible]
-33.55	[illegible].0

SEE PLATE 97 FOR STABILITY ANALYSIS

NOTE: FOR A F.S. = 1.0 THE CORRESPONDING ANCHOR FORCE IS 0.0 LBS/LF

NET DIAGRAM

(Q) CASE F.S. = 1.5

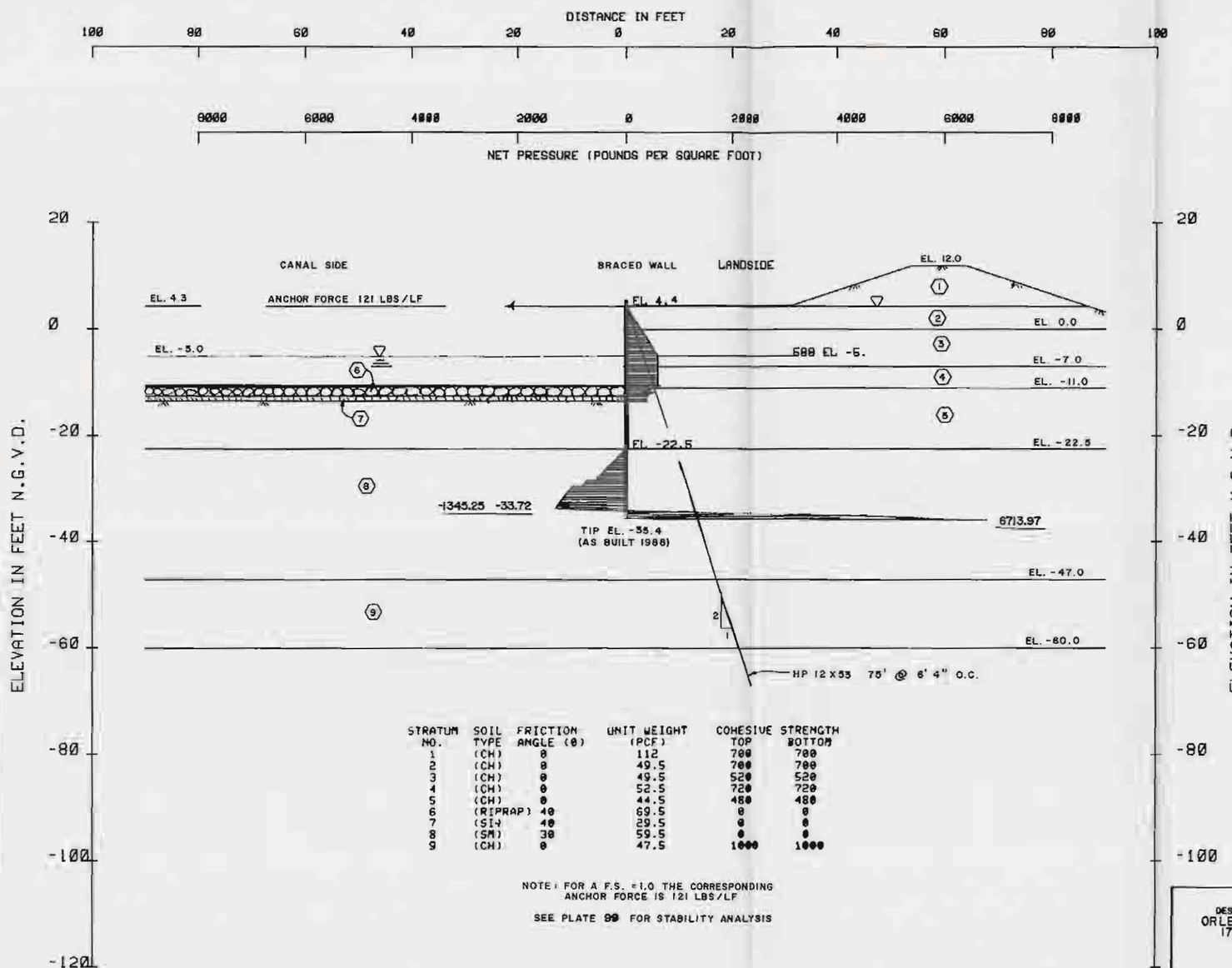
LAKE PONTCHARTRAIN, LA. AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO. 20 GENERAL DESIGN
ORLEANS PARISH — JEFFERSON PARISH
17 TH. STREET OUTFALL CANAL
(METAIRIE RELIEF)

ORLEANS SIDE OF PUMPING STATION
TO SOUTH OF SOUTHERN R.R.

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

DATE: MARCH 1990

FILE NO: H-2-[illegible]



ELEVATION	PRESSURE
4.50	0.0
4.40	0.0
-5.00	587.5
-10.50	587.5
-11.70	329.0
-11.70	589.2
-12.50	595.6
-13.50	364.3
-13.50	35.8
-22.50	35.8
-22.50	0.0
-22.50	-7.9
-28.50	-596.8
-28.50	-759.7
-29.50	-929.8
-29.50	-1007.3
-33.72	-1345.25
-34.00	0.0
-35.40	6713.97
-35.40	0.0

STRATUM NO.	SOIL TYPE	FRICTION ANGLE (Ø)	UNIT WEIGHT (PCF)	COHESIVE STRENGTH TOP	COHESIVE STRENGTH BOTTOM
1	(CH)	0	112	700	700
2	(CH)	0	49.5	700	700
3	(CH)	0	49.5	520	520
4	(CH)	0	52.5	720	720
5	(CH)	0	44.5	480	480
6	(RIPRAP)	40	69.5	0	0
7	(SP)	40	29.5	0	0
8	(SM)	30	59.5	0	0
9	(CH)	0	47.5	1000	1000

NOTE: FOR A F.S. = 1.0 THE CORRESPONDING ANCHOR FORCE IS 121 LBS/LF

SEE PLATE 80 FOR STABILITY ANALYSIS

NET DIAGRAM

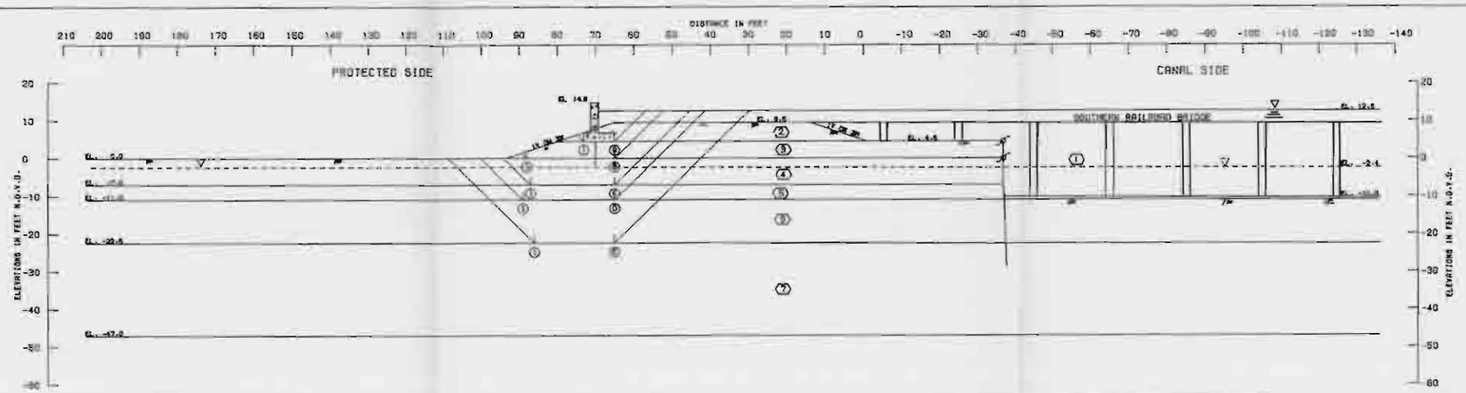
(Q) CASE F.S.=1.5

LAKE PONTCHARTRAIN, LA. AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO. 20 GENERAL DESIGN
ORLEANS PARISH – JEFFERSON PARISH
17 TH. STREET OUTFALL CANAL
(METAIRIE RELIEF)

SOUTH OF SOUTHERN R.R.
TO B/L STA. 673+63 ORLEANS

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

DATE MARCH 1980 FILE NO. H-2-32300



AS BUILT 1988
NOTE: ANALYSIS WAS PERFORMED WITH A FACTOR OF SAFETY OF 1.3
INCORPORATED INTO THE SOIL PARAMETERS.
SKEWED SECTION

WEDGE NO.	ELEV.	U_A, U_C, U_P D_A	D_C	D_P	U_A, R_C, R_P, D_P R_A	R_C	R_P	D_P	U_C	U_P	$U_A - U_P$
1	4.5	2684	5386	8870	0	0	0	0	-2135	8870	-10788
2	0.0	7187	10222	9248	1447	135	-3835	10038	-13865		
3	-7.0	13733	15822	8795	5688	5555	2911	17838	-15819		
4	-11.0	17818	20254	8749	10802	7252	7564	26884	-19448		
5	-22.5	23988	28741	7824	18518	25116	34919	55139	-29629		

STRATUM NO.	SOIL TYPE	EFFECTIVE UNIT WT. P.C.F. WEST. 1	WEST. 2	C - UNIT COHESION - P.S.F. CROWN OF STRATUM WEST. 1	WEST. 2	BOTTOM OF STRATUM WEST. 1	WEST. 2	FRICTION ANGLE CROWN
1	(MATERIAL)	62.5	62.5	0.0	0.0	0.0	0.0	0.0
2	(CH)	112.0	112.0	500.0	500.0	500.0	500.0	0.0
3	(CH)	112.0	112.0	500.0	500.0	500.0	500.0	0.0
4	(CH)	112.0	112.0	400.0	400.0	400.0	400.0	0.0
5	(CH)	112.0	112.0	554.0	554.0	554.0	554.0	0.0
6	(CH)	107.0	107.0	369.0	369.0	369.0	369.0	0.0
7	(SM)	120.0	120.0	0.0	0.0	0.0	0.0	30.0

GENERAL NOTES:
CLASSIFICATION, STRATIFICATION, SHEAR STRENGTH AND UNIT WEIGHT OF THE SOIL WERE BASED ON THE RESULTS OF UNDISTURBED BORINGS. SEE BORING DATA PLATES.

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
C -- AS A SUBSCRIPT, REFERS TO CENTRAL BLOCK
P -- AS A SUBSCRIPT, REFERS TO PASSIVE WEDGE

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

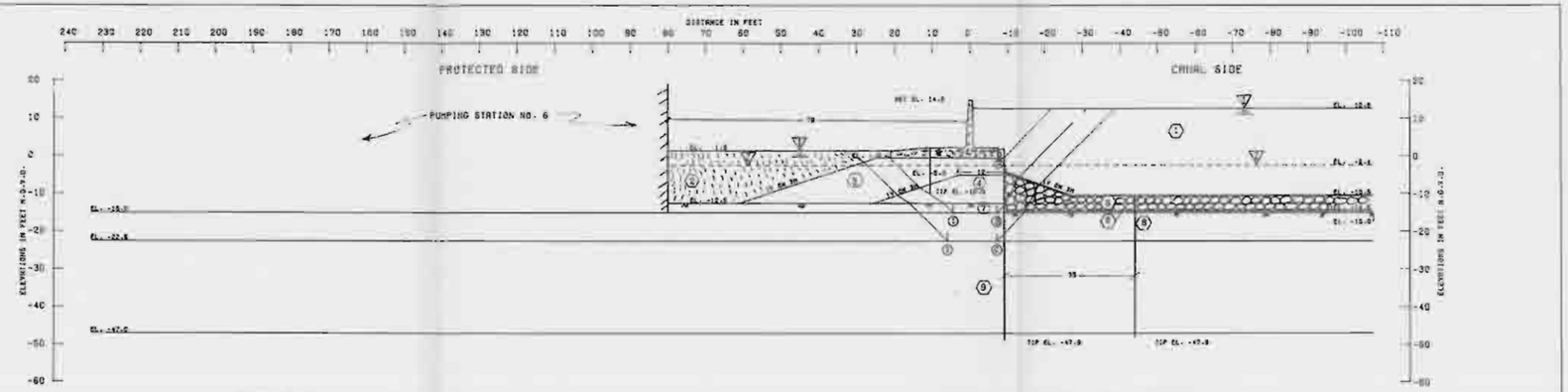
LAKE PONTCHARTRAIN, LA. AND VICINITY
NEW ORLEANS, LA.
DESIGN MEMORANDUM NO. 10 GENERAL DESIGN
ORLEANS PARISH - JEFFERSON PARISH
17 TH. STREET OUTFALL CANAL
(METAIRIE RELIEF)

DEEP SEATED ANALYSIS
SOUTHERN RAILROAD FLOODGATE

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

DATE: MARCH 1990 FILE NO. H-2-30300

PLATE 125



AS BUILT 1985

PH LINE IN STRATA 2,4,5 AND 6

PH LINE IN STRATUM 8

NOTE: ANALYSIS WAS PERFORMED WITH A FACTOR OF SAFETY OF 1.3 INCORPORATED INTO THE SOIL PARAMETERS.

NO	ELEV.	U_{PS} D_A - R_P U_A	R_P	U_{PT} R_B - R_P - D_P D_B	D_P	D_P	U_C	D_P	U_A - D_P
BASE	-8.5	5363	0	0	0	0	5363	0	5363
1	-15.0	27698	3387	4243	18179	19809	24583	28491	-4908
2	-22.5	47577	7316	4797	14934	31514	48091	51245	-18084

STRATUM NO.	SOIL TYPE	EFFECTIVE UNIT WT. P.C.F. VERT. 1	VERT. 2	C - UNIT COHESION - P.S.F. CENTER OF STRATUM VERT. 1	VERT. 2	BOTTOM OF STRATUM VERT. 1	VERT. 2	FRICTION ANGLE DEGREES
1	LINERS	62.5	62.5	0.0	0.0	0.0	0.0	0.0
2	CLAY	92.0	92.0	0.0	0.0	0.0	0.0	32.0
3	CLAY	110.0	110.0	300.0	300.0	300.0	300.0	0.0
4	CLAY	122.0	122.0	0.0	0.0	0.0	0.0	23.0
5	SANDY CLAY	132.0	132.0	0.0	0.0	0.0	0.0	32.0
6	CLAY	92.0	92.0	0.0	0.0	0.0	0.0	32.0
7	CLAY	127.0	127.0	300.0	300.0	300.0	300.0	0.0
8	CLAY	127.0	127.0	300.0	300.0	300.0	300.0	0.0
9	CLAY	122.0	122.0	0.0	0.0	0.0	0.0	23.0

GENERAL NOTES:

CLASSIFICATION, STRATIFICATION, SHEAR STRENGTH, AND UNIT WEIGHT OF THE SOIL WERE BASED ON THE RESULTS OF UNDISTURBED BORINGS. SEE BORING DATA PLATES.

NOTES

ϕ -- ANGLE OF INTERNAL FRICTION, DEGREES
C -- UNIT COHESION, P.S.F.
Ω -- STATIC WATER SURFACE
S -- 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

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

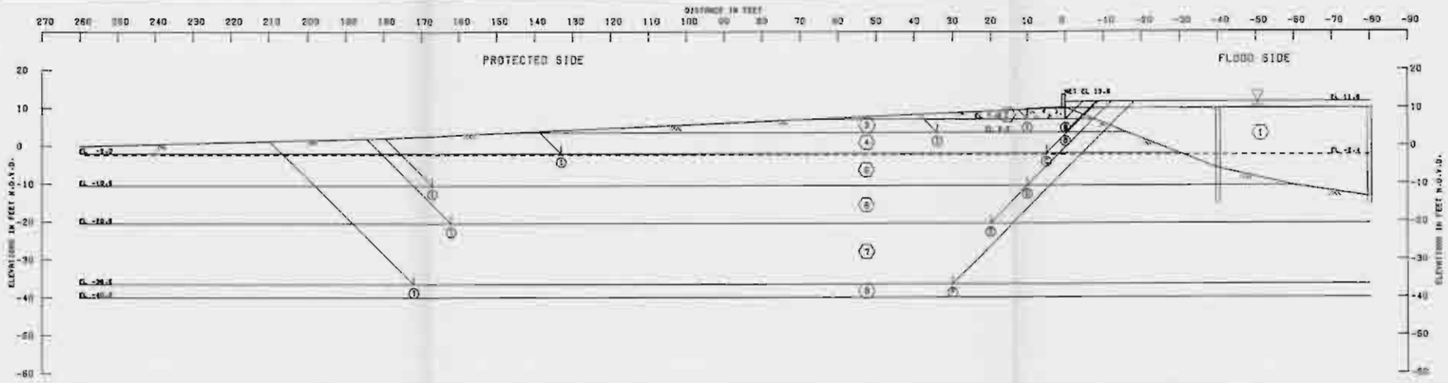
LOUISIANA DISTRICT, CORPS OF ENGINEERS
NEW ORLEANS, LOUISIANA
DESIGN MEMORANDUM NO. 1B - GENERAL DESIGN

ORLEANS PARISH - JEFFERSON PARISH
17TH STREET OUTFALL CANAL
(METAIRIE RELIEF)

DEEP SEATED ANALYSIS
T-WALL FRONTING PUMPING STA. NO. 6

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

DATE: MARCH 1980 FILE NO. H-2-35000



NOTE: ANALYSIS WAS PERFORMED WITH A FACTOR OF SAFETY OF 1.3 INCORPORATED INTO THE SOIL PARAMETERS.

NO.	ELEV.	UA = DA - RA		UP = RB + RP			UW	UP	UA - UP
		DA	RA	RB	RP	SP			
BASE	7	813	1635	3850	1888	376	-822	6112	-5300
1	3.5	2877	3888	12090	2479	1430	-602	18138	-15999
2	-2.0	8659	7890	27520	4481	1898	964	33867	-25208
3	-10.5	23474	13667	33750	8751	8476	12867	48826	-36849
4	-20.8	50046	18887	41484	11729	26780	34379	79893	-45561
5	-30.8	113056	23084	41484	20699	76125	89400	137147	-47746

STATION NO.	SOIL TYPE	EFFECTIVE UNIT WT. P.C.F.		C = UNIT COHESION - P.S.F.				FRICTION ANGLE DEGREES
				COHESION ON STATION		FRICTION ON STATION		
		VERT. γ	VERT. γ	VERT. γ		VERT. γ	VERT. γ	
1	CONTROL	62.8	62.8	0.0	0.0	0.0	0.0	0.0
2	CGM1	105.0	105.0	885.0	885.0	885.0	885.0	0.0
3	CGM1	105.0	105.0	885.0	885.0	885.0	885.0	0.0
4	CGM1	105.0	105.0	885.0	885.0	885.0	885.0	0.0
5	CGM1	105.0	105.0	815.0	815.0	815.0	815.0	0.0
6	CGM1	105.0	105.0	884.0	884.0	892.0	892.0	0.0
7	CGM1	105.0	105.0	892.0	892.0	892.0	892.0	0.0
8	CGM1	105.0	105.0	0.0	0.0	0.0	0.0	24.0

GENERAL NOTES:

CLASSIFICATION, STRATIFICATION, SHEAR STRENGTH, AND UNIT WEIGHT OF THE SOIL WERE BASED ON THE RESULTS OF UNDISTURBED BORINGS. SEE BORING DATA PLATES.

NOTES

φ -- ANGLE OF INTERNAL FRICTION, DEGREES
C -- UNIT COHESION, P.S.F.
W -- 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

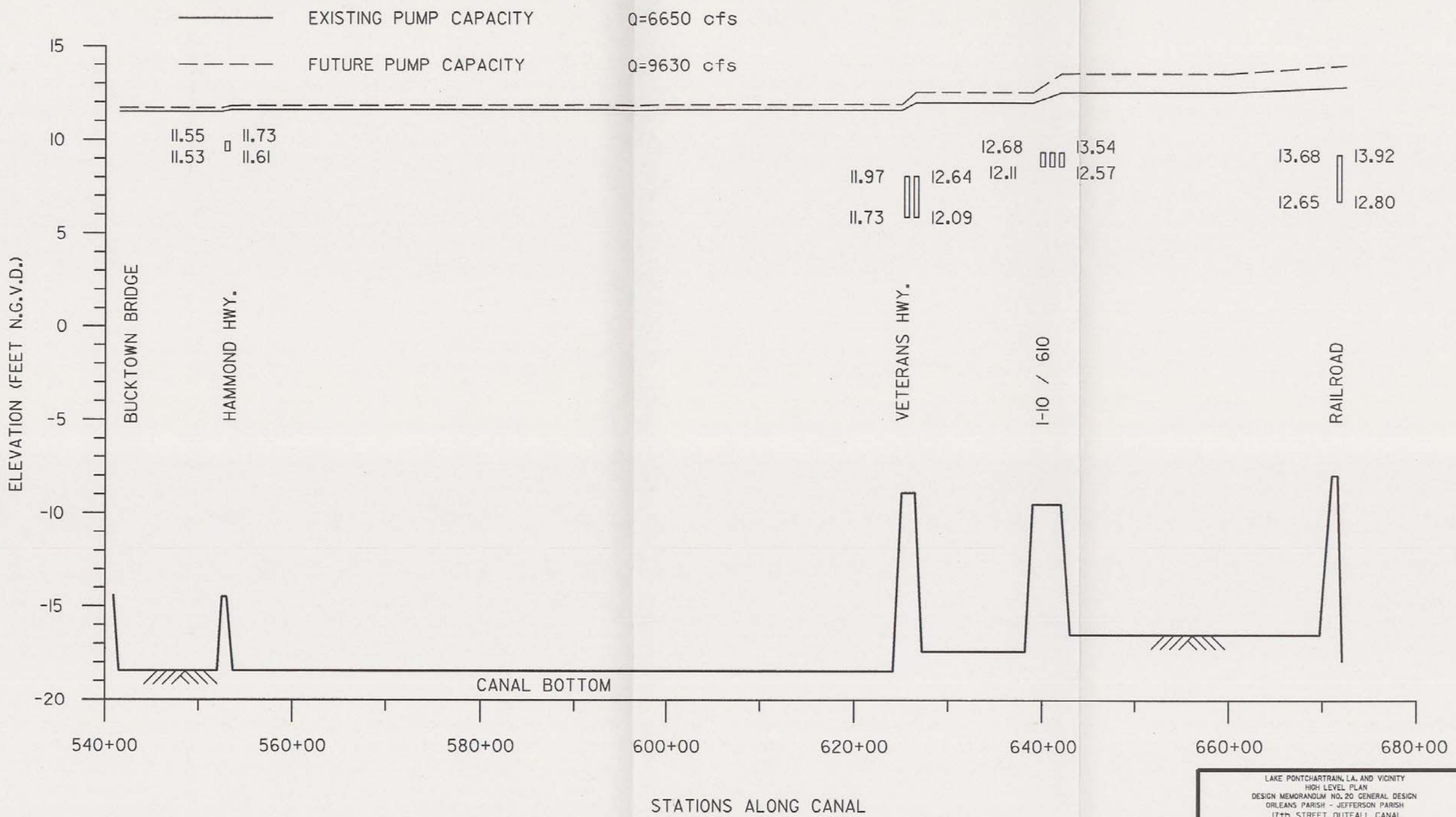
FACTOR OF SAFETY = $\frac{R_A + R_B + R_P}{D_A - D_P}$

LAKE PONTCHARTRAIN, LA. AND VICINITY
HURRICANE PROTECTION
DESIGN MEMORANDUM NO. 30 GENERAL DESIGN
ORLEANS PARISH - JEFFERSON PARISH
17TH STREET OUTFALL CANAL
(METAIRIE RELIEF)

HAMMOND HIGHWAY FLOODGATE
DEEP SEATED ANALYSIS

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
DATE: MARCH 1965 FILE NO. H-3-87030

PLATE 127

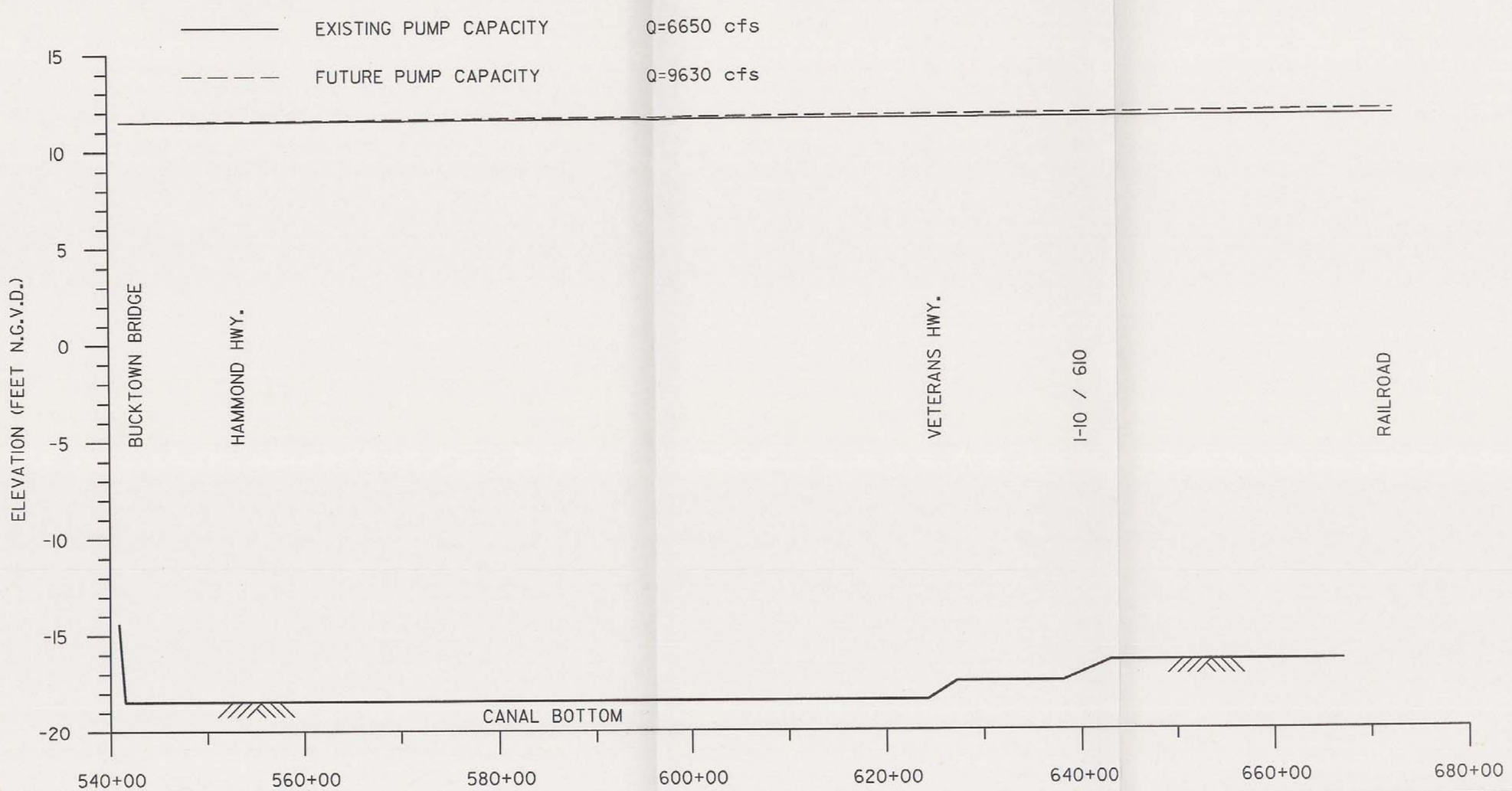


LAKE PONTCHARTRAIN, LA. AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO. 20 GENERAL DESIGN
ORLEANS PARISH - JEFFERSON PARISH
17th STREET OUTFALL CANAL
(METAIRIE RELIEF)

EXISTING BRIDGE CONFIGURATION
DREDGED CHANNEL
EXCEPT UNDER BRIDGES

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

DATE: MARCH 1990 FILE NO. H-2-30300



LAKE PONTCHARTRAIN, LA. AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO. 20 GENERAL DESIGN
ORLEANS PARISH - JEFFERSON PARISH
17th STREET OUTFALL CANAL
(METAIRIE RELIEF)

DREDGED CHANNEL
ALL BRIDGES RAISED

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
DATE: MARCH 1990 FILE NO. H-2-30300

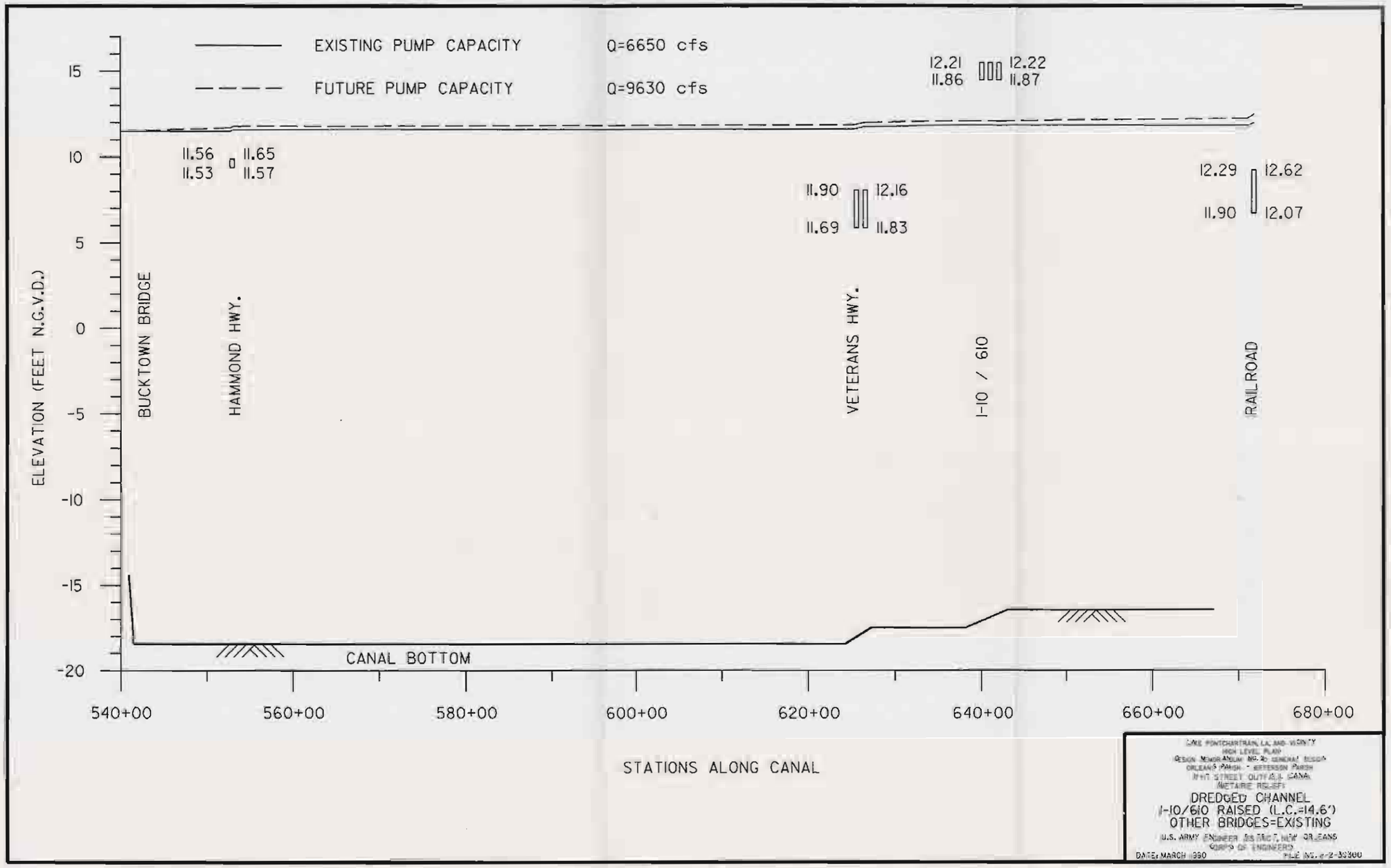

EXISTING PUMP CAPACITY Q=6650 cfs
FUTURE PUMP CAPACITY Q=9630 cfs
ELEVATION (FEET N.G.V.D.)
15
10
5
0
-5
-10
-15
-20
11.56
11.53
11.65
11.57
11.90
11.69
12.16
11.83
12.21
11.86
12.22
11.87
12.29
11.90
12.62
12.07
BUCKTOWN BRIDGE
HAMMOND HWY.
VETERANS HWY.
I-10 / 610
RAILROAD
CANAL BOTTOM
540+00
560+00
580+00
600+00
620+00
640+00
660+00
680+00
STATIONS ALONG CANAL
LAKE PONTCHARTRAIN, LA. AND VICINITY
HIGH LEVEL PLAN
DREDGED CHANNEL
I-10/610 RAISED (L.C.=14.6')
OTHER BRIDGES=EXISTING
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
DATE: MARCH 1990

PLATE 130

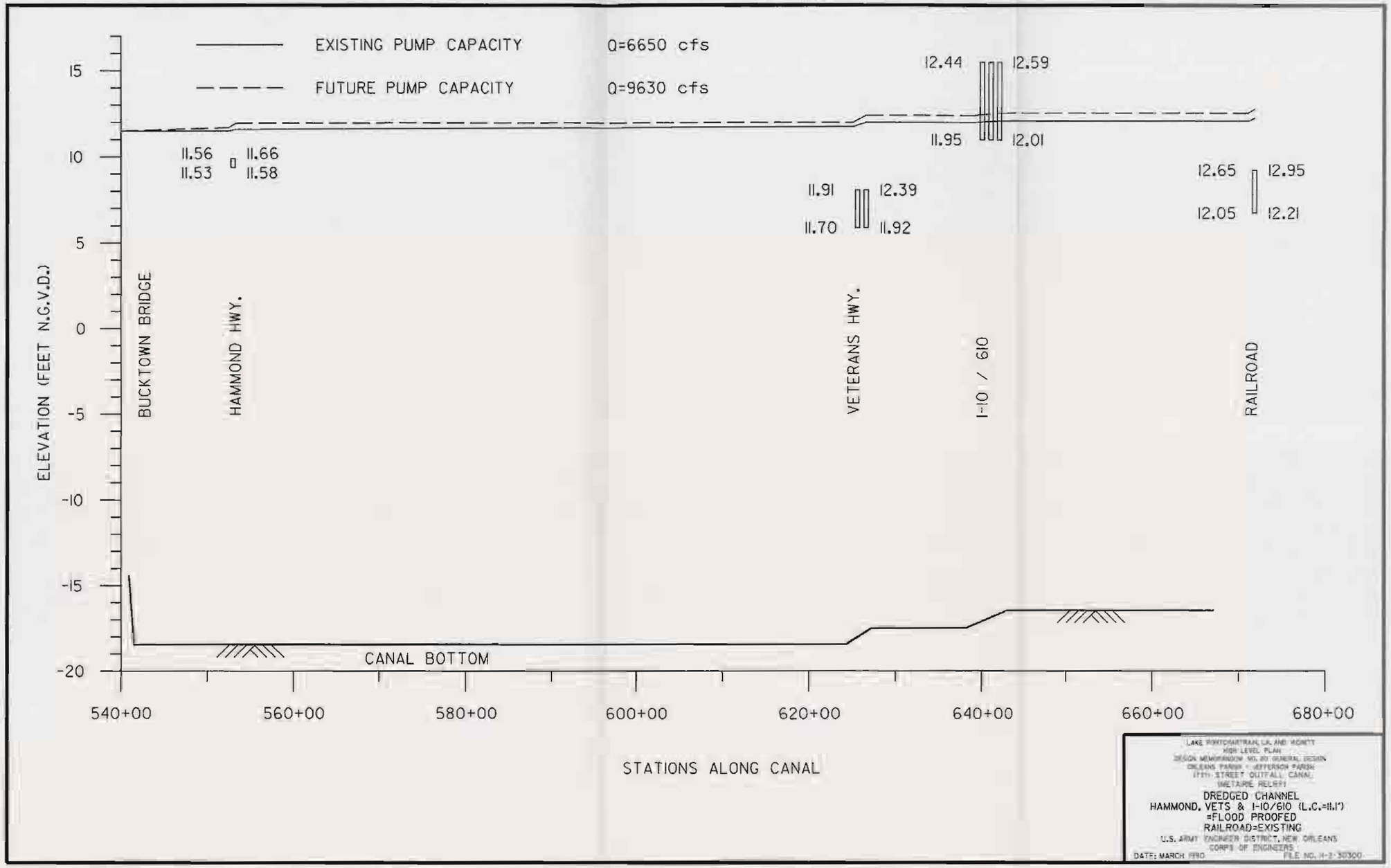
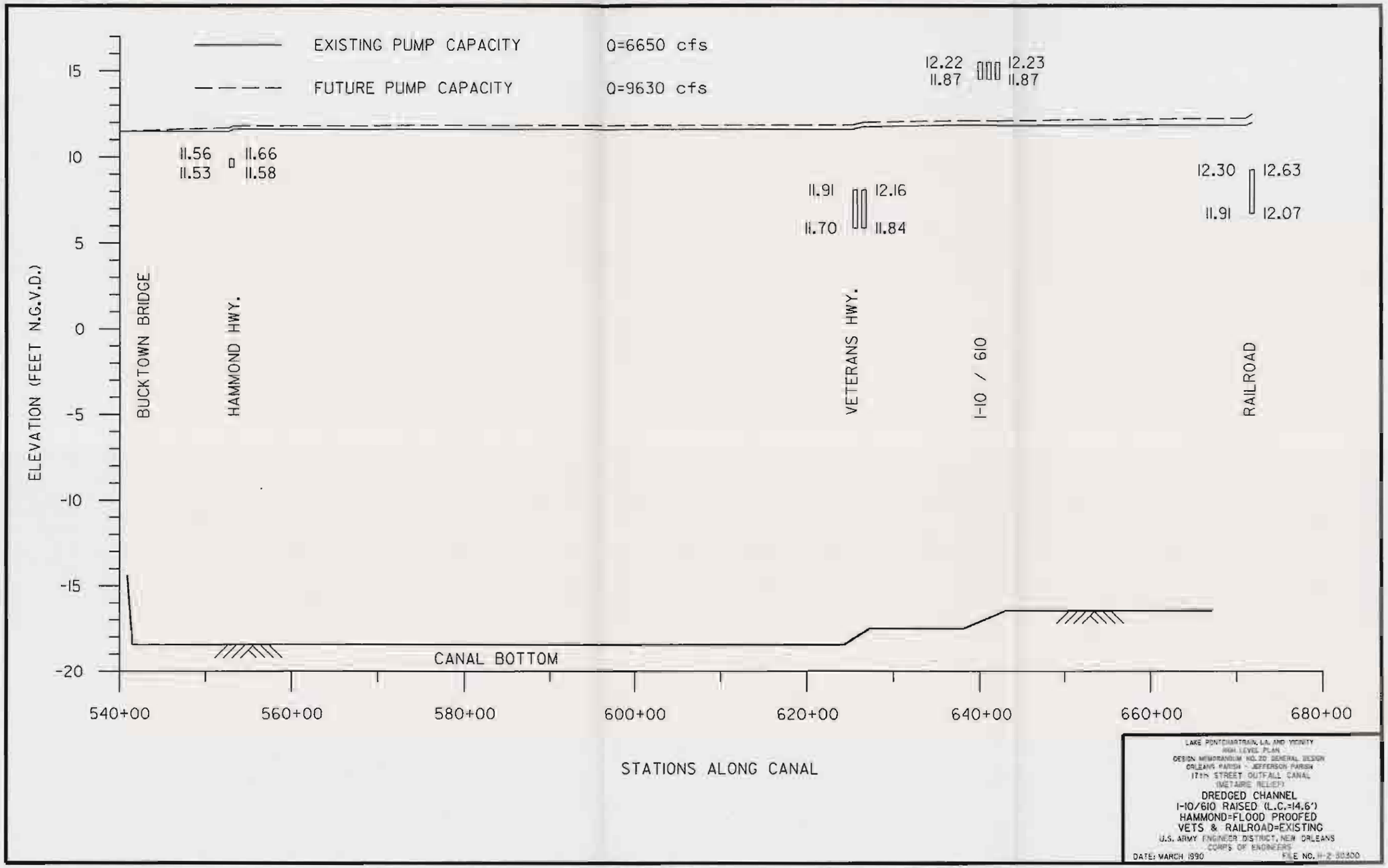
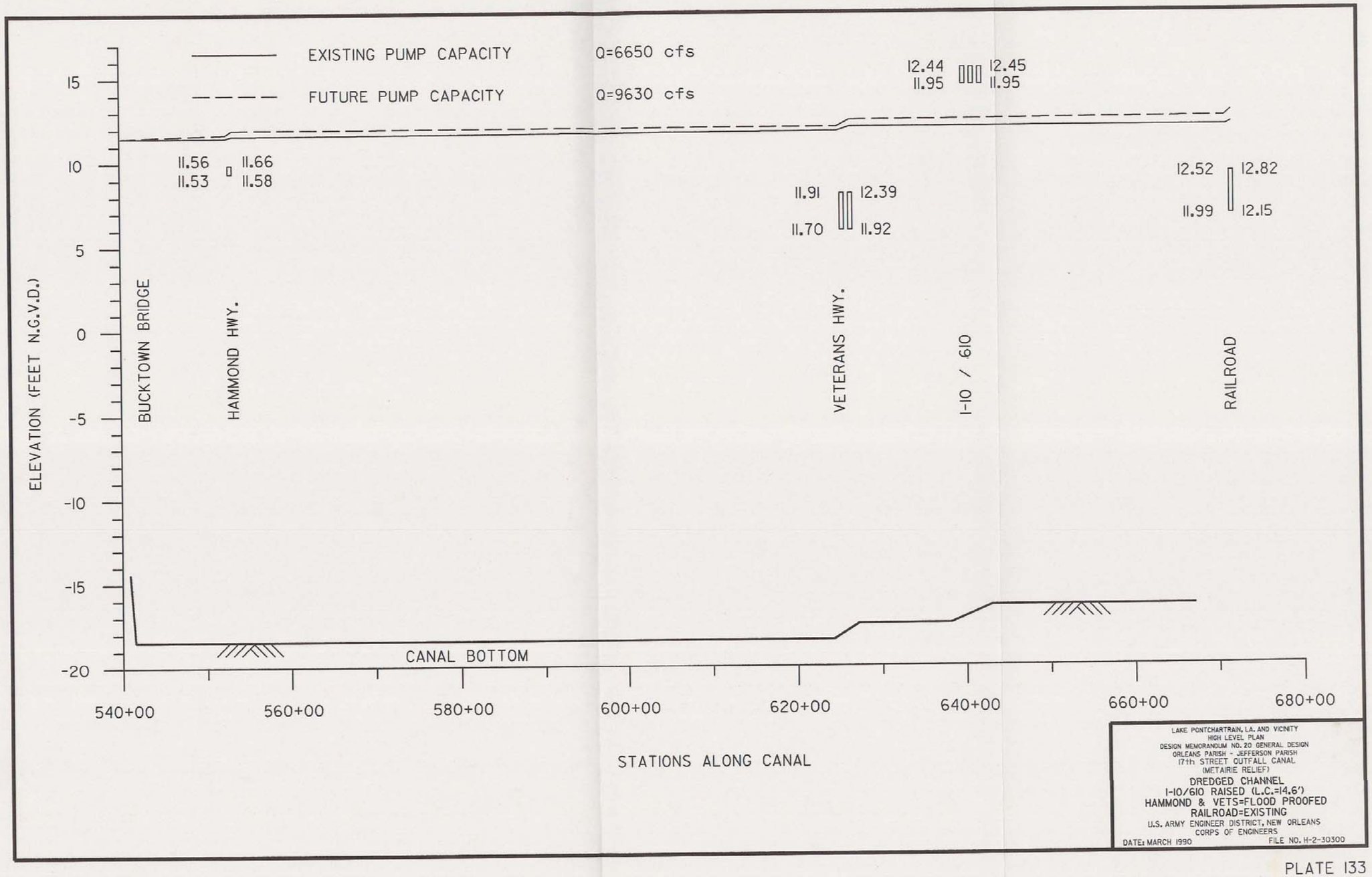

EXISTING PUMP CAPACITY Q=6650 cfs
FUTURE PUMP CAPACITY Q=9630 cfs
ELEVATION (FEET N.G.V.D.)
15
10
5
0
-5
-10
-15
-20
11.56
11.53
11.66
11.58
11.91
11.70
12.39
11.92
12.44
11.95
12.59
12.01
12.65
12.05
12.95
12.21
BUCKTOWN BRIDGE
HAMMOND HWY.
VETERANS HWY.
I-10 / 610
RAILROAD
CANAL BOTTOM
540+00
560+00
580+00
600+00
620+00
640+00
660+00
680+00
STATIONS ALONG CANAL
LAKE PONTCHARTRAIN, LA. AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO. 20 GENERAL DESIGN
ORLEANS PARISH - JEFFERSON PARISH
17th STREET OUTFALL CANAL
(METAIRIE RELIEF)
DREDGED CHANNEL
HAMMOND, VETS & I-10/610 (L.C.=11.1')
=FLOOD PROOFED
RAILROAD=EXISTING
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
DATE: MARCH 1980
FILE NO. H-2-30300

PLATE 131


EXISTING PUMP CAPACITY
Q=6650 cfs
FUTURE PUMP CAPACITY
Q=9630 cfs
ELEVATION (FEET N.G.V.D.)
15
10
5
0
-5
-10
-15
-20
11.56
11.53
11.66
11.58
11.91
11.70
12.16
11.84
12.22
11.87
12.23
11.87
12.30
11.91
12.63
12.07
BUCKTOWN BRIDGE
HAMMOND HWY.
VETERANS HWY.
I-10 / 610
RAILROAD
CANAL BOTTOM
540+00
560+00
580+00
600+00
620+00
640+00
660+00
680+00
STATIONS ALONG CANAL
LAKE PONTCHARTRAIN, LA. AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO. 20 GENERAL DESIGN
ORLEANS PARISH - JEFFERSON PARISH
17th STREET OUTFALL CANAL
(METAIRIE RELIEF)
DREDGED CHANNEL
I-10/610 RAISED (L.C.=14.6')
HAMMOND=FLOOD PROOFED
VETS & RAILROAD=EXISTING
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
DATE: MARCH 1990
FILE NO. H-2-30300


EXISTING PUMP CAPACITY
Q=6650 cfs
FUTURE PUMP CAPACITY
Q=9630 cfs
ELEVATION (FEET N.G.V.D.)
15
10
5
0
-5
-10
-15
-20
BUCKTOWN BRIDGE
HAMMOND HWY.
VETERANS HWY.
I-10 / 610
RAILROAD
11.56
11.53
11.66
11.58
11.91
11.70
12.39
11.92
12.44
11.95
12.45
11.95
12.52
11.99
12.82
12.15
CANAL BOTTOM
540+00
560+00
580+00
600+00
620+00
640+00
660+00
680+00
STATIONS ALONG CANAL
LAKE PONTCHARTRAIN, LA. AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO. 20 GENERAL DESIGN
ORLEANS PARISH - JEFFERSON PARISH
17th STREET OUTFALL CANAL
(METAIRIE RELIEF)
DREDGED CHANNEL
I-10/610 RAISED (L.C.=14.6')
HAMMOND & VETS=FLOOD PROOFED
RAILROAD=EXISTING
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
DATE: MARCH 1990
FILE NO. H-2-30300

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

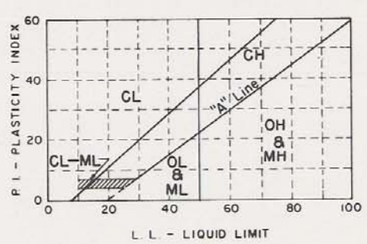
DESCRIPTIVE SYMBOLS

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



PLASTICITY CHART
For classification of fine-grained soils

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

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

Ⓒ Denotes location of consolidation test**

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

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

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

Ⓣ 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 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 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

TYPICAL 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 the contract clause entitled "Differing Site Conditions".

Ground-water elevations shown on the boring logs represents ground-water surfaces encountered in such borings on the dates shown. Absence of water surface data on certain borings indicates that no ground-water data are available from the boring but does not necessarily mean that ground-water will not be encountered at the locations or within the vertical reaches of such 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.

SOIL BORING LEGEND

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

1 JUNE 1987 FILE NO. H-2-21800

LAKE PONTCHARTRAIN, LOUISIANA AND VICINITY
HIGH LEVEL PLAN

DESIGN MEMORANDUM NO. 20, GENERAL DESIGN
17TH STREET OUTFALL CANAL

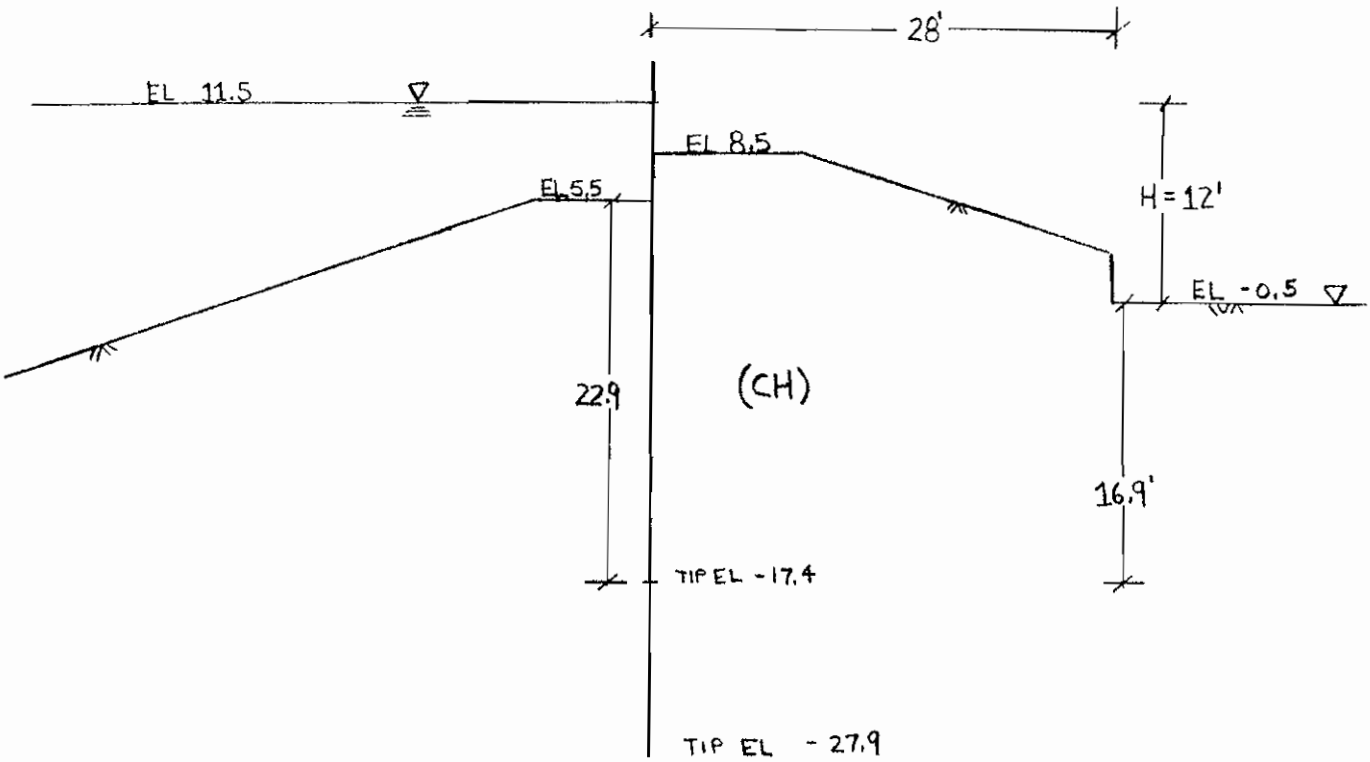
APPENDIX A

SEEPAGE CALCULATIONS

APPENDIX A
VOLUME I

17th St Outfall Canal

STA 545+80 TO STA 552+70 ORLEANS



CHECK EL -17.4

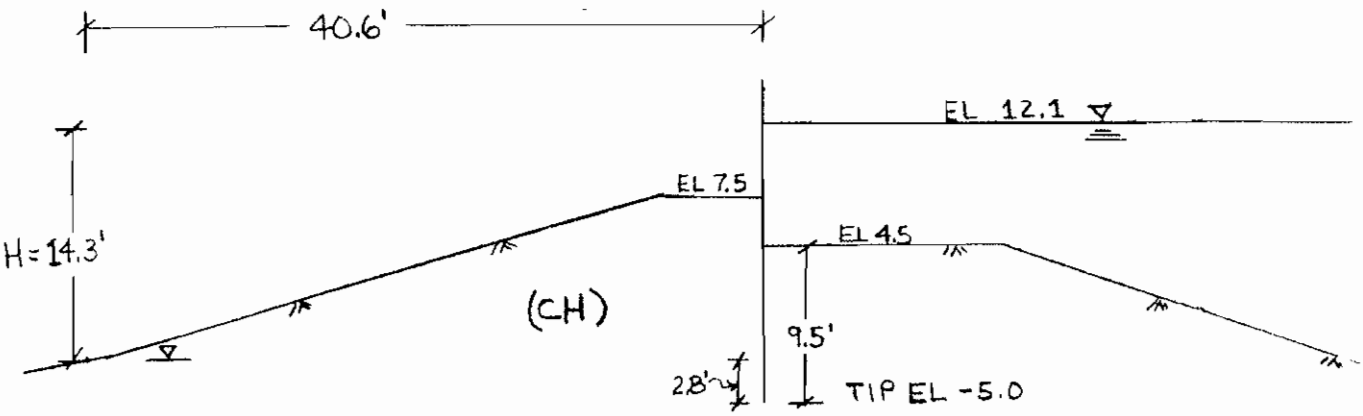
$$\text{CREEP RATIO} = \frac{22.9' + 28'/3 + 16.9'}{12} = 4.1 > 4.0^{*} \text{ (OK) (GRANULAR MATERIALS)}^{*}$$

EM 1110-2-2501 pg 14

* SEE WRITE UP

17th St Outfall Canal

STA 625+25 TO STA 635+00 ORLEANS

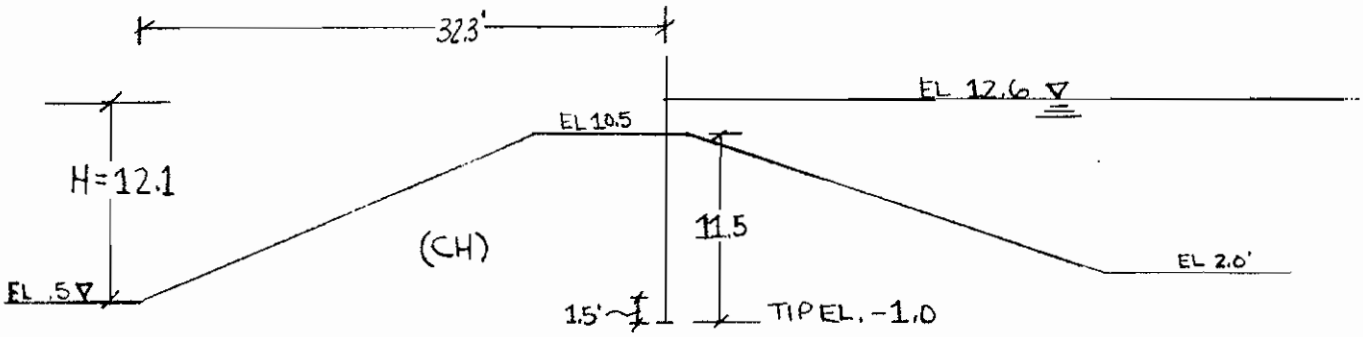


$$\text{CREEP RATIO} = \frac{9.5' + 2.8' + 40.6'/3}{14.3'} = 1.81 > 1.8 \quad \text{(OK) (silt clays)}$$

EM 1110-2-2501 pg 14

17th St Outfall Canal

STA 663+00 TO STA 670+00 JEFFERSON

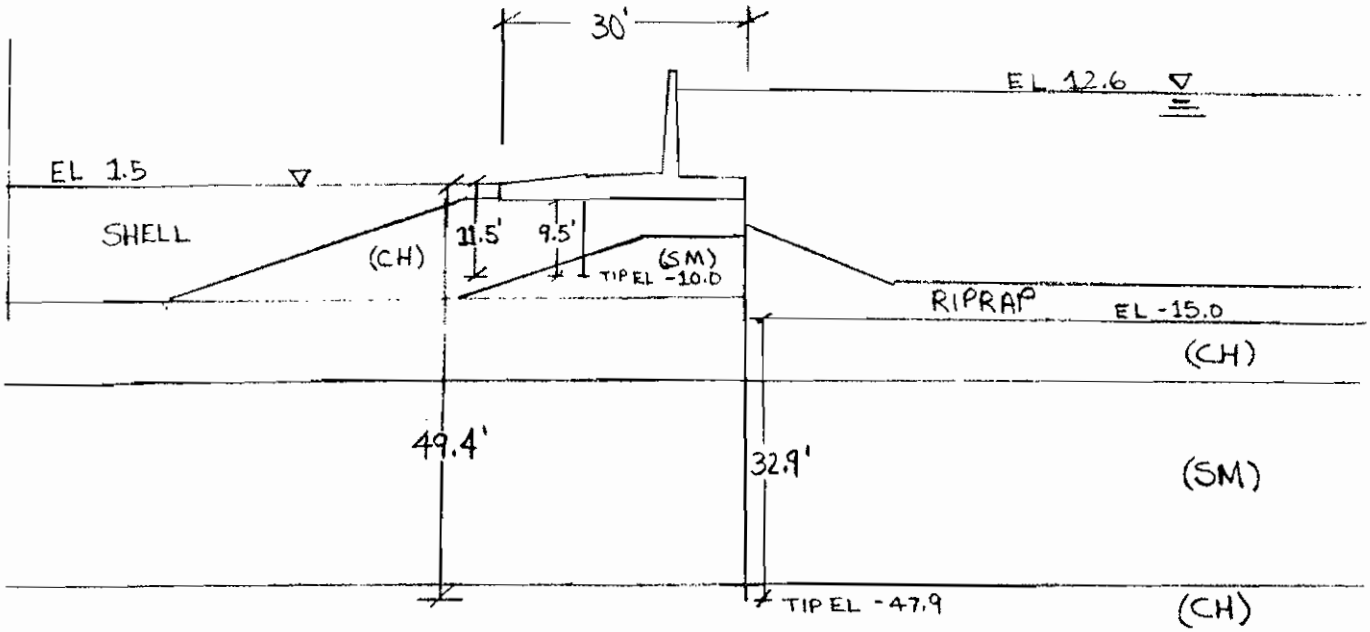


$$\text{CREEP RATIO} = \frac{11.5 + 1.5' + 32.3'/3}{12.1'} = 1.96 > 1.8 \text{ (OK) (silt clays)}$$

EM 1110-2-2501 pg 14

17th St Outfall Canal

T-WALL FRONTING PUMPING STATION NO. 6



Upper Sheetpile

$$\text{CREEP RATIO} = \frac{9.5' + 11.5' + 30'/3}{11.1'} = 2.8 > 2.0 \text{ (Well graded sandy silts) (OK}$$

Lower Sheetpile

$$\text{CREEP RATIO} = \frac{32.9' + 49.4' + 30'/3}{11.1'} = 8.3 > 4.0 \text{ (Granular materials)(OK}$$

EM 1110-2-2501 pg 14

LAKE PONTCHARTRAIN, LOUISIANA AND VICINITY
HIGH LEVEL PLAN

DESIGN MEMORANDUM NO. 20, GENERAL DESIGN
17TH STREET OUTFALL CANAL

APPENDIX B

ALTERNATIVE PLAN FOUNDATION ANALYSIS

APPENDIX B
VOLUME I

ASSUMPTIONS: LINE SOURCE, ARTESIAN FLOW, FULLY PENETRATING INFINITE LINE OF WELLS

AQUIFER 1 (SM) EL. -31.0 TO EL. -43.0
AQUIFER 2 (SM) EL. -60.0 TO EL. -78.0

TRANSFORMATION:

$K_h / K_v = 4$

$\bar{d}_1 = 12' \sqrt{\frac{K_{h1}}{K_{v1}}} = 24'$; $\bar{d}_2 = 18' \sqrt{\frac{K_{h2}}{K_{v2}}} = 36'$ (E - 1)

$K_1 = K_2 = \sqrt{K_h K_v} = \sqrt{(.109 \times 10^{-4})(.27 \times 10^{-4})} = 0.00543$ cm/sec = 0.01069 fpm

WELL POINTS DRAWDOWN TO EL. -24.5 ; HIGHWATER STAGE EL. +5.0
ASSUME EL. +5.0 AQUIFER 1
EL. +1.0 AQUIFER 2

ASSUMING AN EQUIVALENT CONTINUOUS SLOT
AQUIFER 1 H = 48' he = h_0 = 18.5' V = 15' rw = .479' D = 24' H - hw = 47'
R = C (H - hw) $\sqrt{K}$ = 3 (47')($\sqrt{54.3}$) = 1039' FIG. 4 - 23 EQ 1

ASSUMING 15' SPACING BETWEEN WELLPOINTS

$Q_w = \frac{KDa}{L}(H - he) = \frac{(.01069)(24')(15')(48-18.5')}{1039'} = .11$ cfm FIG. 4-1 EQ 1

$\Delta hw = \left(\frac{Q_w}{2\pi KD}\right) \ln\left(\frac{a}{2\pi r_w}\right) = \left(\frac{.11}{2\pi(.01069)(24')}\right) \ln\left(\frac{15'}{2\pi(.479')}\right) = .11'$ FIG. 4-20 EQ 1

AQUIFER 2 H = 79' he = h_0 = 54.5' V = 15' rw = .479' D = 36' H - hw ≈ 78'
R = C(H-hw)$\sqrt{K}$ = 3(78')($\sqrt{54.3}$) = 1724' FIG. 4-23 EQ 1
K = 0.01069 fpm a = 15'

ASSUMING 15' SPACING BETWEEN WELLPOINTS

$Q_w = \frac{KDa}{L}(H - he) = \frac{(.01069)(36')(15')(79'-54.5')}{1724} = .082$ cfm

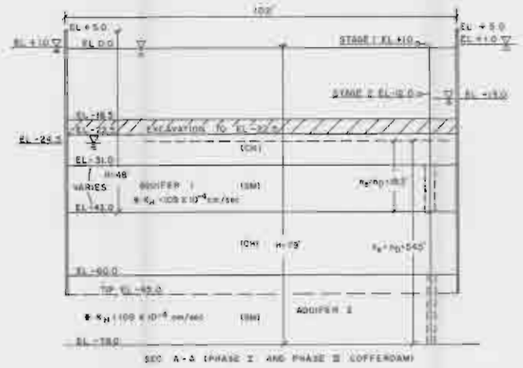
$\Delta hw = \left(\frac{Q_w}{2\pi KD}\right) \ln\left(\frac{a}{2\pi r_w}\right) = \left(\frac{.082}{2\pi(36')(.01069)}\right) \ln\left(\frac{15}{2\pi(.479')}\right) = .054'$

Δhw TOTAL = 0.054' + 0.11' = 0.164'
HEAD LOSS IN WELLPOINTS
Hw = He + Hs + Hf + Hv FIG. 4 - 25
ASSUMING 3 FT. SCREEN
Hw ≈ 0 DUE TO LOW FLOW
M = V + he - Δhw - Hw
M = 15' + 18.5' - 0.164' - 0 = 33.34' SET HEADER NO HIGHER THAN EL. -9.66'
M = 15' + 53.5' - 0.164' - 0 = 68.34' " " " " " EL. -9.66'
SET 1st STAGE WELLPOINTS @ EL. +1.0
DRAWDOWN WATER IN AQUIFERS TO EL. -13.0
SUMP PUMP WATER OUT OF EXCAVATION TO EL. -13.0

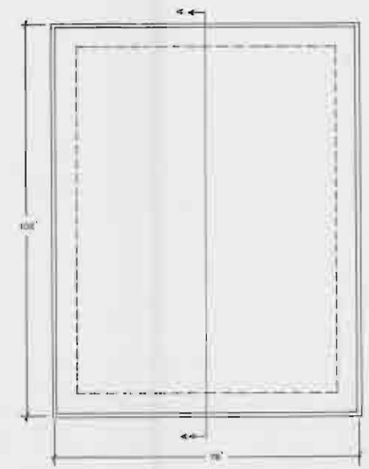
CHECK AQUIFER 1

NET UPLIFT: $\frac{12.5' \times 37.5^{pcf}}{5.5' \times 62.5^{pcf}} = 1.36 > 1.25$ (OK)

GROSS UPLIFT: $\frac{12.5' \times 100^{pcf} + 5.5' \times 62.5^{pcf}}{18' \times 62.5^{pcf}} = 1.42 > 1.25$ (OK)



SEC A-A (PHASE I AND PHASE II COFFERDAM)



CHECK AQUIFER 2

NET UPLIFT $\frac{(12.5')(37.5^{pcf}) + (59.5^{pcf})(6') + (39.5^{pcf})(23')}{(62.5^{pcf})(5.5')} = 5 > 1.25$ (OK)

GROSS UPLIFT $\frac{(12.5')(100^{pcf}) + (122^{pcf})(6') + (102^{pcf})(23') + (5.5')(62.5^{pcf})}{(62.5^{pcf})(47')} = 1.59 > 1.25$ (OK)

SUMMARY

USE F.S. = 1.25 THEN $\frac{15'}{1.25} = 12'$, USE 12' SPACING BETWEEN WELLPOINTS

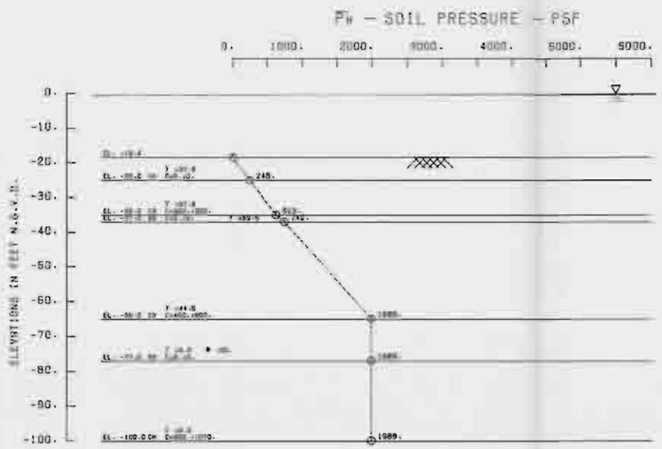
HEADERS ELEVATION : +1.0 1ST STAGE
: -12.0 2ND STAGE

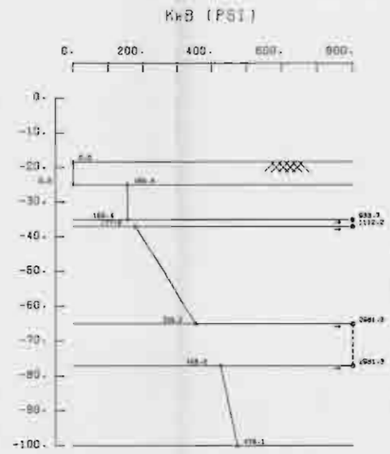
TIP ELEVATION EL. -78.0
3 FT SCREEN WITH 5" FILTER FROM EL. -31.0 TO EL. -43.0
AND FROM EL. -60.0 TO EL. -78.0
1.5" WELLPOINT
REFERENCE TM5-818-5 NOV. 1983

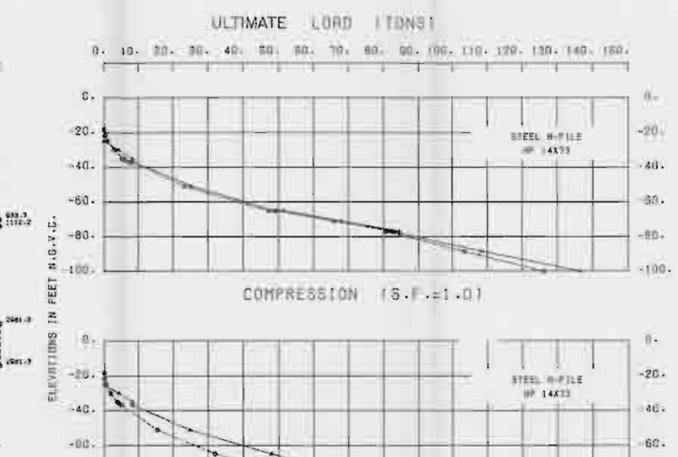
* FIELD PUMPING TEST DDM NO.8 RIGOLETS LOCK 1969

ORLEANS PARISH - JEFFERSON PARISH
TK STREET OUTFALL CANAL
(METAIRIE RELIEF)

DEWATERING SYSTEM
VALVE STRUCTURE







S-CASE
CH.CL- ϕ=23°
ML- ϕ=30°
SM.SP- ϕ=30°,33°

TYPICAL SOIL PROFILE

SOIL STRATIFICATION IS BASED ON GEOLOGIC PROFILE
SHEAR STRENGTH AND WET DENSITIES SEE PLATE 57

D	FILE SPACING IN DIRECTION OF LOADING
1.00	88
0.85	78
0.70	68
0.55	58
0.40	48
0.25	38

C	LOADING CONDITION
1.00	INITIAL LOADING
0.30	CYCLIC LOADING

NOTES: Kw = ϕ(D/B)(0.2222 ω_1/B)(C)(D) COHESIVE
ω = 0.4 = factor of safety of properties of soil and pile
ω_1 = Modulus of subgrade reaction for test plate (psi)
B1 = Width or diameter of test plate (in)
ω_1 = K1 B1 = 80 qu (psf) = 0.5555 qu (psf)
qu = 2-c = Unconfined compressive strength (psf)
C = Reduction for cyclic loading-not applicable
D = Group effect reduction factor
B = Width of pile measured at right angles to the direction of displacement (in)
ϕ = tan(2/3(31)(D)) DIMENSIONLESS
m = Coefficient of horizontal subgrade reaction (psi)
Z = Depth below equivalent ground surface (in)

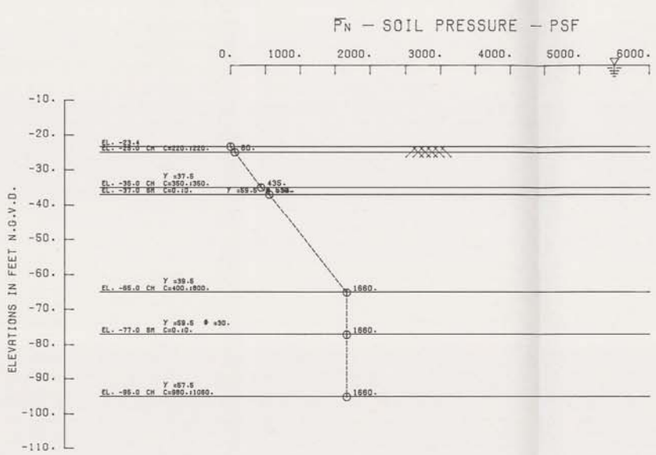
THE FACTOR KHBW, MODULUS OF HORIZONTAL SUBGRADE Kw, TIMES THE PILE WIDTH IN INCHES (B), MEASURED AT RIGHT ANGLES TO THE DIRECTION OF DISPLACEMENT, MUST BE MODIFIED BY A REDUCTION FACTOR FOR THE EFFECT OF GROUP ACTION (D) AND A REDUCTION FACTOR FOR CYCLIC LOADING (C). EX: Kw = KHBW x D x C

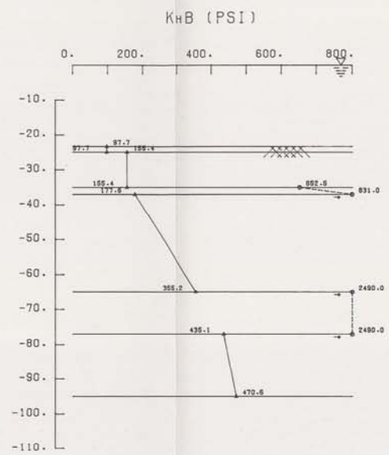
----- S-CASE
——— Q-CASE

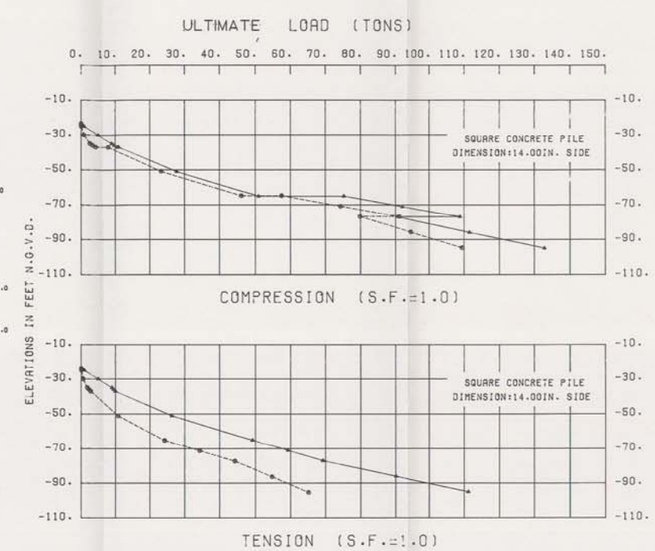
NOTE: ALLOWABLE CAPACITIES SHOULD BE DETERMINED INCORPORATING FS=1.50 WITH FILE TEST OR FS=3.0 WITHOUT FILE TEST

[illegible]
NEW ORLEANS, LOUISIANA
[illegible] STREET OUTFALL CANAL
(METAIRIE RELIEF)
VALVE STRUCTURE EXCAVATION
14 X 73 STEEL H-PILES
PILE CAPACITY CURVES
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
DATE: MARCH 1983 FILE NO. [illegible]

APPENDIX B 2







S-CASE

CH,CL- Φ=23°

ML- Φ=30°

SM,SP- Φ=30°, 33°

TYPICAL SOIL PROFILE

SOIL STRATIFICATION IS BASED ON GEOLOGIC PROFILE

SHEAR STRENGTH AND WET DENSITIES SEE PLATE 57

D	PILE SPACING IN DIRECTION OF LOADING
1.00	8B
0.85	7B
0.70	6B
0.55	5B
0.40	4B
0.25	3B

C	LOADING CONDITION
1.00	INITIAL LOADING
0.30	CYCLIC LOADING

NOTES: $K_H = *K_1/B = (0.2222\,qu/B)(C)(D)$ COHESIVE

$*$ = 0.4 = Factor of material properties of soil and pile

k_1 = Modulus of subgrade reaction for test plate (pci)

B_1 = Width or diameter of test plate (in)

$K_1 = k_1 B_1 = 80\,qu$ (psf) $= 0.5556\,qu$ (psi)

$qu = 2 \cdot c$ = Unconfined compressive strength (psf)

C = Reduction for cyclic loading-not applicable

D = Group effect reduction factor

B = Width of pile measured at right angles to the direction of displacement (in)

$K_H = (nh)(Z/B)(C)(D)$ COHESIONLESS

nh = Coefficient of horizontal subgrade reaction (pci)

Z = Depth below equivalent ground surface (in)

THE FACTOR SHOWN, (MODULUS OF HORIZONTAL SUBGRADE K_H, TIMES THE PILE WIDTH IN INCHES (B), MEASURED AT RIGHT ANGLES TO THE DIRECTION OF DISPLACEMENT) MUST BE MODIFIED BY A REDUCTION FACTOR FOR THE EFFECT OF GROUP ACTION (D) AND A REDUCTION FACTOR FOR CYCLIC LOADING (C) EX: $K_H = \frac{0.2222\,qu\,(C)(D)}{(B)}$

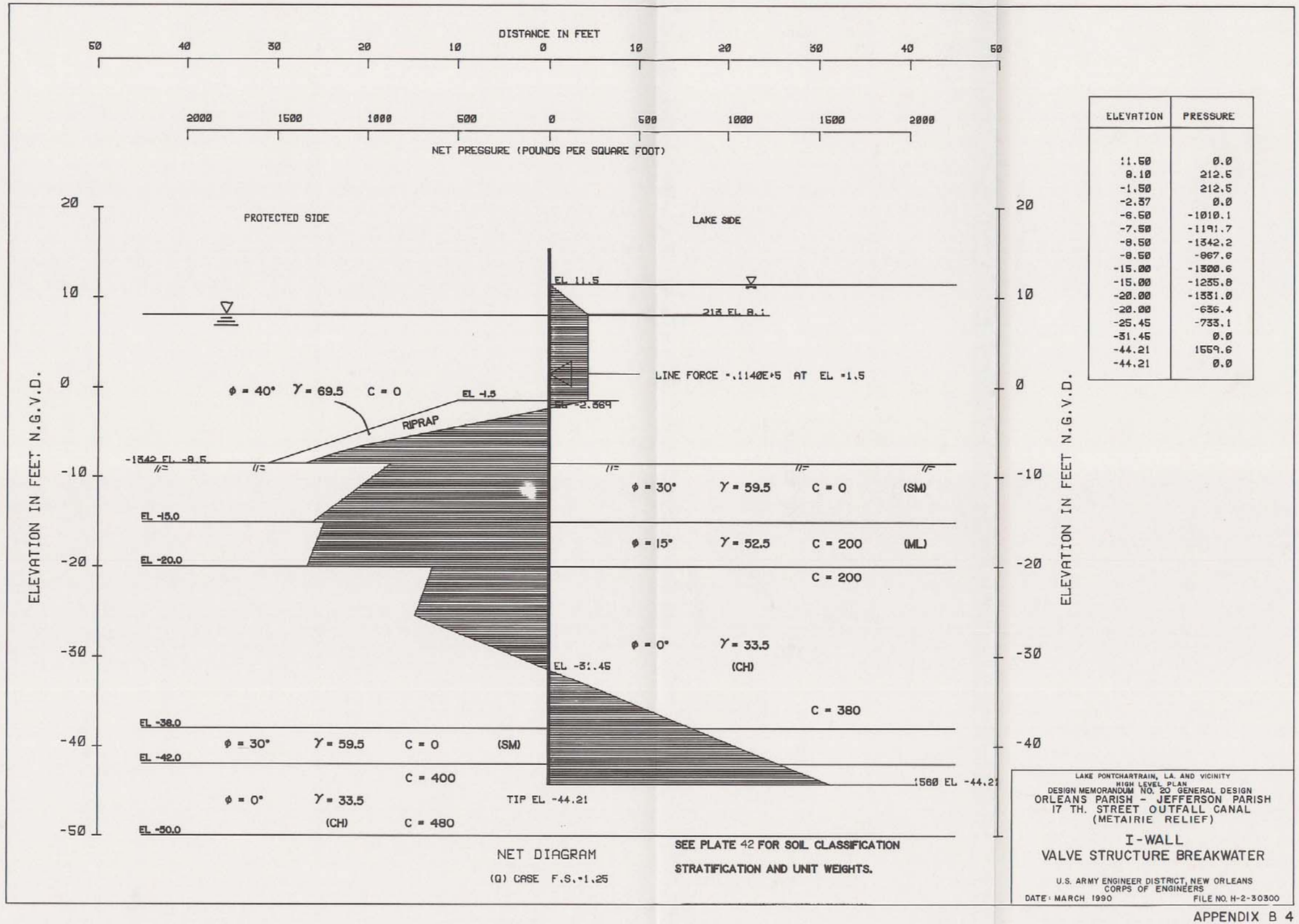
------ S-CASE

——— Q-CASE

NOTE: ALLOWABLE CAPACITIES SHOULD BE DETERMINED INCORPORATING F.S. = 2.0 WITH PILE TEST OR $F.S._H$ = 3.0 WITHOUT PILE TEST.

LAKE PONTCHARTRAIN, LA AND VICINITY
HURRICANE PROTECTION
DESIGN MEMORANDUM NO. 20, GENERAL DESIGN
ORLEANS PARISH AND JEFFERSON PARISH
17 TH. STREET OUTFALL CANAL
(METAIRIE RELIEF)
VALVE STRUCTURE
14" SQ. PRESTRESSED CONCRETE PILES
PILE CAPACITY CURVES
U.S. ARMY ENGINEER DISTRCT, NEW ORLEANS
CORPS OF ENGINEERS
DATE - MARCH 1990 FILE NO. H-2-30300

APPENDIX B 3



ELEVATION	PRESSURE
11.50	0.0
9.10	212.5
-1.50	212.5
-2.37	0.0
-6.50	-1010.1
-7.50	-1191.7
-8.50	-1342.2
-8.50	-867.6
-15.00	-1300.6
-15.00	-1235.8
-20.00	-1331.0
-20.00	-636.4
-25.45	-733.1
-31.45	0.0
-44.21	1559.6
-44.21	0.0

LAKE PONTCHARTRAIN, LA. AND VICINITY
HIGH LEVEL PLAN
DESIGN MEMORANDUM NO. 20 GENERAL DESIGN
ORLEANS PARISH - JEFFERSON PARISH
17 TH. STREET OUTFALL CANAL
(METAIRIE RELIEF)

I-WALL
VALVE STRUCTURE BREAKWATER

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
DATE: MARCH 1990 FILE NO. H-2-30300

LAKE PONTCHARTRAIN, LOUISIANA AND VICINITY
HIGH LEVEL PLAN

DESIGN MEMORANDUM NO. 20, GENERAL DESIGN
17TH STREET OUTFALL CANAL

APPENDIX C

PERTINENT CORRESPONDENCE

APPENDIX C
VOLUME I

LOUISIANA DEPARTMENT OF TRANSPORTATION AND DEVELOPMENT
P.O. Box 94245, Baton Rouge, Louisiana 70804-9245

NEIL L. WAGONER, P.E.
SECRETARY

June 27, 1989
(504)379-1200

BUDDY ROEMER
GOVERNOR

STATE PROJECT NO. 700-19-06
F.A.P. NO. IR-10-5(260)231
I-10/I-610 WIDENING
(17TH STREET CANAL BRIDGES)
ROUTE I-10
ORLEANS PARISH

MR. FREDRIC CHATRY
CHIEF, ENGINEERING DIVISION
DEPARTMENT OF THE ARMY
NEW ORLEANS DISTRICT, CORPS OF ENGINEERS
P.O. BOX 60267
NEW ORLEANS, LA 70160-0267

Dear Sir:

As you are aware, the Department has been planning the replacement of the three I-10 and I-610 bridges over the 17th Street Canal in conjunction with the I-10 widening project which will eventually extend from Williams Boulevard to Metairie Road. Contrary to our previous plans to rebuild these bridges at a higher elevation, this was too costly and was rejected by the Federal Highway Administration. Therefore, the only viable option that would satisfy the proposed High Level Flood Protection Plan and provide uninterupted traffic flow for a hurricane event would be the sealing option. For this option, the abutments will be designed in a manner that will facilitate future connection to the proposed levee floodwalls. The bridge will consist of three 70' continuous spans with joints only at the abutments. These joints will be sealed to prevent water intrusion in the event of a flood.

The low concrete elevation will be 7.57 on the west end and 9.5 on the east end of the bridge, which will satisfy the New Orleans Sewerage and Water Board criteria. The sealed joints will be tested periodically to insure their adequacy for a hurricane event. The top of bridge rail elevation will be 14.5 to coincide with top of floodwall elevation.

Transmitted, herewith, for your review and comment are two blueline drawings showing a general plan of the bridge and cross sections of the abutment and sealing system. Also included is a brief writeup including a design summary.

Your expeditious review and favorable consideration of this concept would be greatly appreciated, as this is a much needed project due to the tremendous traffic problems on I-10 and poor condition of the lightweight bridge deck. It is requested that your conceptual approval or comments be received by July 21, 1989.

Sincerely,

NEIL L. WAGONER
DOTD SECRETARY

NLW:rdc
Attachment
cc: Mr. Dempsey White
Mr. Charles Higgins
Mr. Al Dunn
Mr. John Evanco
Mr. Kent Israel

State Project No. 700-19-06
F.A.P. No. IR-10-5(260)231
I-10/I-610 Widening
(17th Street Canal Bridges)
Route I-10
Orleans Parish

SEALING OF I-10 BRIDGES OVER THE 17TH. ST. CANAL

The I-10 bridges over the 17th St. Canal will be replaced with new bridges which will have the same profile as the existing bridges. The I-10 EB. and I-610 EB. will be combined over the canal and will be separated after crossing the canal. The existing I-10 EB. will be demolished after new bridges are built and open for traffic.

The new bridges over the canal will be built with three continuous spans of 3' thick voided slab and 4'-3" high concrete railing. It is recommended to provide 3' thick voided slab instead of precast concrete girders or cast-in-place rectangular concrete girders in order to have sufficient weight to overcome the uplift force from the canal water. The top of concrete railing will be at same elevation as the floodwall elevation which is 14.50. The high water elevation is at 12.50 which is 2'-0" above the bridge deck at west abutment. In order to keep water from coming in on the bridge deck, joint at both ends of 210' span over the canal must be sealed.

Several possible seal configurations that would be suitable for the I-10 bridges over the canal were studied. Following is the summary of the design features suggested for sealing the 17th St. Canal bridges.

DESIGN SUMMARY ;

1. Sufficient bridge weight to completely overcome buoyant force to assure no net uplift, and eliminate need for hold down devices at expansion end of spans. In computing the buoyant force, it is assumed that the water level is at the elevation of 12.50, which is Corps of Engineers proposed highwater elevation for a 300 year storm. The top of floodwall is at elevation 14.50 due to 2 feet for waves and freeboard. It is felt that it is not necessary to take this additional 2 feet in computing uplift forces which are balanced by the weight of the structure. Additional anchorage of superstructure at the bents will be provided to take care of this 2 feet of additional uplift forces (see item 2).

2. The voided slab will be rigidly connected to the bents, and the piles will be solidly anchored into the caps, as the secondary measure to prevent uplift, which is caused by the high water elevation between 12.50 and 14.50.

3. At the west abutment of the bridge, a seal system with multiple backups, including a reservoir, will be employed beneath the bridge to prevent water intrusion from the canal. The reservoir will provide a holding area to test for leaks in the seals. It would only be necessary to pump water into the reservoir, and monitor the water level over a period of time. Portable pumps will be required for this procedure. A periodic testing and maintenance program by LDOTD will be required to assure proper working of seals.

4. The east abutment of the bridge is approximately 2' higher than the west abutment. The minimum deck slab elevation at the east abutment is approximately 12.50 which is same as high water elevation. Therefore, we have not recommended an extensive seal system in the reservoir at the east abutment. Instead, a continuous J type waterstop at top anb bottom of reservoir and a strip seal at joint opening are recommended as means of sealing system.

5. The existing floodwalls will be raised (by others) to an elevation 14.50 and an expansion joint with a waterstop will be provided between raised floodwall and new abutment wall. Therefore, the abutment wall will be constructed with a 9" three-bulb waterstop for a future connection of raised floodwalls.

Attached are two drawings:

Drawing No. 1: General Plan and Elevation of I-10 bridges over the 17th St. Canal, typical section of voided slab, and a typical anchorage details of voided slab and a bent cap.

Drawing No. 2: An enlarged partial plan view of west abutment, an elevation section of the end of the span, also showing a cross section view, which shows the configuration the reservoir holding area, and the location of the seals. A section view of the seal configuration , showing primary seal, expandable rubber backup seal, and narrow opening which would limit water intrusion , in the event of the seal failure.

An enlarged partial plan view of east abutment, an elevation section of the end of the span, also showing a cross section view, which shows the location of the strip seal and a J type continuous waterstop at top and bottom of the reservoir.

July 25, 1989

Design Services Branch
Projects Engineering Section

Mr. Neil L. Wagoner, Secretary
Department of Transportation and Development
Post Office Box 94245
Baton Rouge, Louisiana 70804-9245

Dear Mr. Wagoner:

Reference your June 27, 1989 letter concerning State Project NO. 700-19-06, F.A.P. No. IR-10-5(260)231, I-10/I-610 Widening, (17th Street Canal Bridges), Route I-10, Orleans Parish.

We have reviewed the preliminary plans furnished in your June 27, 1989 letter. The concept of the joint sealing for flood-proofing the bridge decks is acceptable from a preliminary design standpoint. When more details are available, it is requested that you furnish, for our review, a final submittal that includes joint details showing critical dimensions affecting the joint sealing material. In order to determine if the replacement bridges satisfy the hurricane protection design criteria, we request that your office provide design computations showing the stability of the bridges under normal loads as well as under the design hurricane condition. The design hurricane produces a lake stage of 11.5 ft. N.G.V.D. This stage should be used in conjunction with the total "nominal" pumping capacity of Pumping Station Number 6. The total nominal capacity that this office has used in our back water analysis for the 17th Street Canal is 9630 C.F.S.

I am pleased to see that progress on the I-10/610 replacement bridges is being made. We look forward to working with you and your staff in connection with this vitally needed project.

Sincerely,

Frederic M. Chatry
Chief, Engineering Division

Copies Furnished:

Mr. Om P. Dixit, P.E.
Burk and Associates, Inc.
4176 Canal Street
New Orleans, Louisiana 70119

Mr. C. E. Bailey, Chief Engineer
Board of Levee Commissioners
Orleans Levee District
Suite 202, Administration Building
New Orleans Lakefront Airport
New Orleans, Louisiana 70126

Mr. C. J. Nettles
Board of Commissioners
East Jefferson Levee District
203 Plauche Court
Harahan, Louisiana 70123

STUTTS
CELMN-ED-SP

BARTON
CELMN-ED-SP

HARRINGTON
CELMN-ED-S

MARSALONE
CELMN-ED-D

PICCIOLA
CELMN-ED-F

CHATRY
CELMN-ED

DEPARTMENT OF THE ARMY
NEW ORLEANS DISTRICT, CORPS OF ENGINEERS
P.O. BOX 60267
NEW ORLEANS, LOUISIANA 70160-0267

REPLY TO
ATTENTION OF:

Planning Division
Environmental Analysis Branch

FINDING OF NO SIGNIFICANT IMPACT

Lake Pontchartrain, Louisiana, and Vicinity
Hurricane Protection Project

Seventeenth Street Outfall Canal - Flood Protection

Description of Action. The U.S. Army Corps of Engineers, New Orleans District, has studied alternative methods of providing high-level flood protection for the 17th Street Outfall Canal. The Corps recommends a plan of parallel protection that would raise existing levees along both sides of the canal.

Factors Considered in Determination. The following factors were considered in determining that the proposed action would cause no significant impact: fisheries, wildlife, cultural resources, endangered species, noise, community cohesion, esthetics, and recreation.

Public Involvement. The project EA was circulated to interested parties in March 1990.

Conclusion. This office has assessed the environmental impact of both proposed actions and has determined that neither would have significant impact upon the human environment. Therefore, no Environmental Impact Statement Supplement will be prepared. The Corps recommends the construction of the parallel plan of protection since costs are approximately the same as the fronting protection solution, and the plan of parallel protection more completely fulfills the sponsors' needs.

3-12-90
Date

Richard V. Gorski
Colonel, U.S. Army
District Engineer

Environmental Assessment

Lake Pontchartrain, Louisiana, and Vicinity
Hurricane Protection Project,
17th Street Outfall Canal
Flood Protection

INTRODUCTION

The Lake Pontchartrain, Louisiana, and Vicinity Hurricane Protection project was initially authorized by Public Law 89-298, 27 October 1965 as a "barrier" plan of hurricane protection. An Environmental Impact Statement (EIS) was prepared on the original project and filed with the Council on Environmental Quality in January 1975. Subsequently, a court-ordered reevaluation was undertaken. The resultant reevaluation recommending a high level plan of hurricane protection was addressed in Supplement I to the Final Environmental Impact Statement (FEIS), filed with the Environmental Protection Agency in December 1984. The approval of the high level plan was granted in 1985 with the signing of the Record of Decision.

However, at the time the FEIS was prepared, the designs for providing hurricane protection for the lakefront outfall canals were unresolved. The design for the protection along the 17th Street Outfall Canal is now completed.

This Environmental Assessment (EA) evaluates the impacts of constructing a system of floodwalls and floodgates along the canal as a method of providing hurricane protection to the residences along the 17th Street Outfall Canal. The U.S. Army Corps of Engineers (Corps), New Orleans District, is recommending a system of parallel protection by raising the existing levees adjacent to the canal.

NEED

The 17th Street Canal provides interior drainage for the City of New Orleans and portions of Jefferson Parish by moving water to Lake Pontchartrain. Protection from hurricane-induced tidal inundation via the lake/canal connection is presently achieved by locally constructed parallel protection levees adjacent to the canal. The existing levees along the canal do not meet the design height or sectional stability required for the Lake Pontchartrain project under either the previously authorized barrier

or the more recently authorized high level plan. Since the portion of New Orleans adjacent to the canal is well below sea level, protection from a hurricane surge overtopping the levee is necessary to eliminate the risk of interior flooding.

The project area is located in southeastern Louisiana on the south side of Lake Pontchartrain in Orleans and Jefferson Parishes (Plate 1). The 17th Street Canal is a man-made channel approximately 200 feet wide situated at the boundary line between Jefferson and Orleans Parishes.

ALTERNATIVES CONSIDERED

Two alternatives, in addition to the future-without-project condition, were considered. The first plan was fronting protection at or near the lakefront end of the canal. A butterfly valve type structure consisting of four 28 x 16-foot gated bays that automatically open or close as the flow changes would be built. As long as the direction of flow is toward the lake, the gate would remain open. During a hurricane event, when the lake elevation rises enough to reverse the direction of flow, the gates would automatically close. This structure and appurtenant floodwall would be connected to the existing lakefront levee so that once closed, a continuous line of protection could be achieved.

A second plan is upgrading the existing lateral protection provided by levees paralleling the 2.4-mile canal on either side. The existing levees would be degraded, reshaped, and the deteriorated sheet pile would be replaced. Any borrow material required for use in the construction would be taken from the Corps-approved borrow site in the Bonnet Carre' Spillway. Sheet pile walls with concrete caps (I-wall design) would be placed along both sides of the canal. In addition, some lowering of existing levees behind the proposed sheet pile walls would be required to meet stability requirements. Roller-mounted floodgates would be constructed to provide closure of Old Hammond Highway while hurricane conditions exist. This plan would require bridges at Veterans Highway and

Old Hammond Highway to be modified or floodproofed since their respective deck elevations are below grades required to achieve project protection.

The parallel protection plan is recommended by the Corps because costs of the two plans are approximately equal, and the parallel protection more completely fulfills the sponsors' needs.

SIGNIFICANT RESOURCES

The resources described below are considered significant because of their ecological, esthetic, or cultural attributes and their institutional, technical, or public recognition (see Table 1).

ENVIRONMENTAL SETTING

FISH AND WILDLIFE RESOURCES

Existing Conditions

The 17th Street Outfall Canal is a man-made canal approximately 2.4 miles in length, and approximately 200 feet wide, paralleled by levees with floodwalls on both sides. The canal is oriented in a north/south direction between Lake Pontchartrain and Interstate 10 (see Plate 1). South of Old Hammond Highway, the canal has a sodded bank with brush and small trees along the water's edge. The existing levee is frequently mowed. Due to extreme water level fluctuations coupled with the depth and turbidity of the canal, it is doubtful that submerged aquatic vegetation could establish in the canal. The canal slopes support some aquatic vegetation such as water hyacinth, grasses, and other opportunistic weedy plants. Predominant vegetation on the levee and adjacent rights-of-way includes perennial grasses, herbs, ornamental shrubs, and various trees, including pine, hackberry, and oak. Due to human disturbance and vegetative structure, the levee and surrounding rights-of-way do not provide high-quality wildlife habitat. Mammals other than small rodents,

TABLE 1

SIGNIFICANT RESOURCES IN AREA

RESOURCE	RESOURCE	ECOLOGICAL ATTRIBUTES	CULTURAL ATTRIBUTES	ESTHETIC ATTRIBUTES
THREATENED AND ENDANGERED SPECIES.	THREATENED AND ENDANGERED SPECIES.	These species are of increased value due to their rarity.	These species are a valuable part of a cultural heritage.	Seeing a rare animal or plant in its natural habitat is often esthetically pleasing.
CULTURAL RESOURCES	CULTURAL RESOURCES	None	Indicators of previous residents.	Some cultural resources have esthetic appeal.
RECREATION RESOURCES	RECREATION RESOURCES	Potential for interacting with nature and limited fishing in study area.	Recreation is an integral part of urban culture.	Nature study and levee walking are esthetically pleasing.
FISH AND WILDLIFE RESOURCES	FISH AND WILDLIFE RESOURCES	Some fish, birds, and invertebrates use the area. Mouth of canal provides nursury habitat for some fish and shellfish.	Urban culture still appreciates the nature study and limited fishing.	Birds and fish associated with canal and levee provide scenic appeal.
SECTION 122 ITEMS (Noise, community cohesion, esthetic resources)	SECTION 122 ITEMS (Noise, community cohesion, esthetic resources)	N/A	N/A	N/A

RESOURCE	INSTITUTIONAL RECOGNITION	TECHNICAL RECOGNITION	PUBLIC RECOGNITION
THREATENED AND ENDANGERED SPECIES.	Endangered Species Act, Bald Eagle Act.	USFWS, NMFS, LDWF,& COE recognize importance of endangered species.	Environmental groups and general public desire the preservation of these rare species.
CULTURAL RESOURCES	E.O. 11953, National Environmental Policy Act, National Historic Preservation Act, Nat. Historic Preserv. Act.	An archeological site has been documented in the study area.	Public recognizes importance of preservation of cultural sites.
RECREATION RESOURCES	Land and Water Conservation Fund Act of 1965. La. Scenic Streams Act.	A few man-days of fishing and nature study occur.	Public desires expansion of recreation base.
FISH AND WILDLIFE RESOURCES	Clean Water Act of 1977, La. Water Control Act, Fish and Wildlife Coordination Act. Coastal Zone Mgmt. Act of 1972. Estuary Protection Act, La. State and Local Coastal Resources Mgmt. Act of 1978.	USFWS, NMFS, LDWF, & COE recognize value of fisheries and good water quality.	Environmental groups and general public desire the preservation of fisheries and water quality.
SECTION 122 ITEMS (Noise, community cohesion, esthetic resources)	River and Harbor Flood Control Act.	N/A	Public recognition of these items is strong.

rabbits, and opossums are not likely to frequent the area. Only limited amounts of habitat are available for the more opportunistic species. The canal is lined in some areas with marsh grasses, which provide limited cover, feeding, and resting habitat for various songbirds, seabirds, and some ducks. Common birds in the area are redwinged blackbirds, sparrows, bluejays, mockingbirds, grackles, morning doves, pigeons, various species of waterfowl and a large group of laughing gulls that utilize the resting sites along the mouth of the canal. Various reptiles and amphibians are common in the project area; these include green anoles, tree frogs, various snakes, and turtles. Least terns and seagulls are commonly seen feeding on the canal.

The water quality in the 17th Street Outfall Canal is generally poor; therefore, the canal has minimal value as habitat for fishery resources although some fishery exists at the canal mouth. The canal itself receives pumped storm water runoff from Metropolitan New Orleans. Typical contaminants present in the canal include oils, petroleum hydrocarbons, pesticides, fertilizers, heavy metals, salts, combustion hydrocarbons and acids, plasticizers, oxygen-demanding waste, sediment, and raw domestic sewage (Schurtz and St. Pe', 1984). Organic chemicals and heavy metals are the toxicants of most concern that affect aquatic life in the canal and nearshore vicinity.

The canal is classified as "water quality limited." This classification is given a stream segment where it is known that water quality does not meet all applicable water quality standards and/or is not expected to meet all applicable standards, even after application of the effluent limitations required by the Federal Water Pollution Control Act.

The marsh grasses that fringe portions of the canal provide nursery habitat for various fish. Due to the poor water quality, the benthos of the canal is limited to worms, blue crabs, clams, and gastropods. The benthic community is more diverse near the lake. Most benthic species in the area are tolerant of prolonged periods of low dissolved oxygen and are

not the benthics primarily utilized as fish food organisms by commercially important fish species.

Future Without Project

Fish and Wildlife resources would remain as they are at present.

Future With Parallel Protection

Approximately 37 acres of low-value wildlife habitat would be impacted by degrading, earth moving, and shaping operations. Approximately two mature trees are located in the right-of-way and could possibly be destroyed. Sixteen trees may incur minimal impact as a result of trimming required to provide levee access for construction equipment. Ten young oaks would be planted for every mature tree taken. The new levee would provide habitat similar to the existing levee.

Minimal temporary displacement of habitat for songbirds and tree-dwelling animals would occur in association with tree removal. While these trees would be replaced, habitat in the immature trees would be of only moderate value for some species. This impact would only be short term. In the long term, habitat for tree dwellers would be increased.

Runoff during construction would slightly increase turbidity in the canal and would also increase the amount of airborne dust in the project area. Once the levee becomes vegetated, this impact would be eliminated.

ENDANGERED SPECIES

Existing Conditions

No threatened or endangered species or their critical habitat are found in the project area.

Future Without and Both Alternatives

No impact on endangered species.

RECREATION

Existing Conditions

There is some levee walking; however, this is limited due to few access points available to the public and its semi-private status as a continuation of backyard private property.

Future Without Project

Recreational resources would remain as they are at present.

Future With Parallel Protection

South of Hammond Highway, the existing concrete floodwall would be raised. Installation of these taller walls would further inhibit recreational access toward the water's edge. Due to the higher floodwalls, a visual as well as a physical barrier would be created. Recreational use, such as walking, would continue along the protected side of the new wall.

ESTHETICS

Existing Conditions

Two parallel levees line the 17th Street Canal its entire length. On the Jefferson Parish side between Orpheum Avenue and the levee crown, no trees exist. This reach consists of a grass levee, some floodwall, and limited shade. However, on the opposite side (Orleans), a completely different esthetic environment exists. Backyards border the right-of-way and, in places, heavy tree cover exists within this corridor.

Future Without Project

Esthetics would remain as they are at present.

Future With Parallel Protection

Increasing the height of 2.4 miles of earthen levee by the addition of a floodwall on the levee crown would cause impacts to the esthetic environment. The finished height of the floodwall would be 2 to 7 feet higher than the existing levee and floodwall. Approximately two mature trees would be removed. In places where floodwalls replace an earthen levee, a visual barrier would be created. This would impact an area that has traditionally been a linear open green space. Esthetic surface treatment is proposed along the protected side of each wall. Surface wall texture treatment would increase esthetic appeal. Light and shadow patterns would add interest to an otherwise plain white, painted, concrete wall.

CULTURAL

Existing Conditions

The project area includes an existing levee corridor and the artificial channel of the 17th Street Outfall Canal. Only one cultural resource is recorded in the vicinity of the work. Archeological site 16JE4 is located west of, and outside, the project area along the Jefferson Parish lakefront. No cultural resources are known to exist in the project impact areas, and none are expected due to prior ground disturbance along this corridor.

Future Without Project

Same as existing conditions.

Future With Parallel Protection

No impacts to significant cultural resources are anticipated and no cultural resource surveys are warranted.

NOISE

Existing Conditions

The background noise levels for the project area are estimated to range from 70 dBA in the project reaches located in residential areas, intermixed with light commercial on the west side of the canal, to 50 dBA in the quieter park-like residential areas on the east side of the canal.

Future Without Project

There would be no noise above existing levels without construction.

Future With Parallel Protection

This method of construction results in increases in noise levels produced from degrading and upgrading existing levees and floodwalls. The noise levels expected would range from 95-105 dBA when measured 50 feet from the center of the noise source. Approximately 109 residences would be exposed to noise levels ranging from 77-95 dBA. Approximately 423 residences would be exposed to 77-83 dBA. Ambient noise level for the area is 50-70 dBA. Table 2 shows the number of days a particular residence would be exposed to a specific noise level.

Construction workers would have protective hearing devices. Since construction would take place during daylight hours, sleep interference should occur only for napping children and day sleepers. Noise mainly affects bodily functions (hearing rate, respiratory volume, digestive secretions, hormonal secretions, etc.). If prolonged, the construction

noise levels could produce significant physiological damage; however, the relatively short duration of the noise should prevent such problems from occurring. The noise could be annoying to inhabitants of the 562 residences within the 400 feet of the actual work site. During the time the noise was higher than 85 dBA, it could be difficult to hold a conversation within the impacted houses and recreational areas.

TABLE 2
NOISE EXPOSURE FOR FLOODWALLS
(DAYS)

Distance (feet)	Buildings (number)	Decibels			
		95-105	89-95	83-89	77-83
0-50	30 residences, 1 green space	7	7	14	27
50-100	109 residences	-	10	16	28
100-200	207 residences	-	-	21	32
200-400	216 residences	-	-	-	42

Therefore, during construction the noise levels would increase a maximum of 35-45 dBA above ambient. This level of increase is not expected to interfere with residential activity since most of the work would be done during daylight hours, and exposure levels inside the homes would be further reduced.

COMMUNITY COHESION

Existing Conditions

The residents of Orleans and Jefferson Parishes are in favor of protection provided by the hurricane protection project and have voted for a bond issue that assists in funding the work.

Future Without the Project

The area adjacent to the canal would be subject to flooding from the canal during hurricanes.

Future With Parallel Protection

This alternative would provide the necessary flood protection. Some temporary disruption in traffic patterns would result from the project due to the hauling required to dispose of the degraded levee material. Potential points of access used to accomplish hauling and other construction access would be as follows:

East - Canal Boulevard	West - Hammond Highway
East - Bellaire Drive	West - Lake Avenue
East - Harrison Avenue	West - West Esplanade
East - West End	West - Bonnabel Boulevard
East - West Kenilworth	West - Orpheum Avenue
East - Academy Drive	West - Veterans Boulevard
	West - North Frontage Road

The truck hauling of degraded material is not expected to be more than 10 trucks per day in any given work area. The work hours would be in accordance with existing parish ordinance. Increased levels of noise would be expected during the entire two-year construction period somewhere along the canal from the lakefront to Interstate 10. This method of construction is not localized to a specific area, for the impacts are mobilized down the canal as each work segment is completed.

MITIGATION

Because of the low habitat quality of the construction site and the minimal habitat affected, no wildlife mitigation is proposed. To minimize potential impacts, turbidity screens would be used during construction

activities. To minimize noise-associated problems, pile driving would be limited to daylight hours.

COMPLIANCE WITH ENVIRONMENTAL LAWS

Compliance with the Endangered Species Act has been achieved. Cultural compliance has been achieved. The parallel protection alternative would not affect wetlands or coastal waters; therefore, Section 404(b)(1) Evaluation or Coastal Zone Management Consistency Determination would not be necessary.

COORDINATION

Copies of this EA will be distributed to the parties shown in Table 3.

LITERATURE CITED

Schurtz, M.H. and K.M. St. Pe'. 1984. Report on Interim Findings: water quality Investigation of environmental conditions in Lake Pontchartrain. Louisiana Department of Environmental Quality. Water Pollution Control Division, Baton Rouge, Louisiana.

CONCLUSION

The U.S. Army Corps of Engineers, New Orleans District, proposes to provide flood protection to areas adjacent to the 17th Street Outfall Canal by construction of parallel protection, utilizing levees with floodwalls on each side of the canal. Impacts to fish and wildlife resources, recreation, endangered species, cultural resources, esthetics, noise, and community cohesion would be minimal with this plan. The Orleans and Jefferson Levee Boards prefer the parallel protection, which would be accomplished by raising levees and floodwall along the entire 2.4-mile canal. Most impacts would be of a temporary nature, with noise and traffic disruption being the most significant.

Prepared by: Larry Hartzog

Reviewed by: R. W. Schroeder Jr.

2-23-90

Date:

TABLE 3

LAKE PONTCHARTRAIN, LOUISIANA, AND VICINITY EA MAILING LIST

CONGRESSIONAL

Honorable J. Bennett Johnston
Honorable John B. Breaux
Honorable Lindy Boggs
Honorable Billy Tauzin
Honorable Robert L. Livingston

FEDERAL

U.S. Department of Commerce
Washington, D.C.

National Marine Fisheries Service
St. Petersburg, FL
Baton Rouge, LA

U.S. Environmental Protection Agency
Dallas, TX

Gulf of Mexico Fisheries Mgmt. Coun.
Tampa, FL

U.S. Dept. of Housing and Urban Devel.
Ft. Worth, TX

U.S. Dept. of the Interior
Washington, D.C.

U.S. Fish and Wildlife Service
Lafayette, LA

Federal Highway Administration
Baton Rouge, LA

U.S. Coast Guard
New Orleans

Advisory Council on Historic Preserv.
Golden, CO
Washington, D.C.

STATE

State Historic Preservation Officer

Department of Environmental Quality
Water Pollution Control Division

STATE (Cont'd)

Department of Natural Resources
Office of Environmental Affairs
Coastal Resources Program

Department of Transportation
Office of Public Program

Department of Wildlife
and Fisheries
Secretary
Ecological Studies Section
Natural Heritage Program

LOCAL

Orleans Levee Board

East Jefferson Levee Board

Pontchartrain Levee Board

Lake Borgne Levee Board

City of New Orleans
City Planning Commission
City Council
Mayor

Regional Planning Commission

St. Charles Parish Council

St. Bernard Parish Police Jury

Plaquemines Parish Commission
Council

St. Tammany Parish Police Jury

City of Mandeville

ENVIRONMENTAL

Orleans Audubon Society

Environmental Defense Fund

ENVIRONMENTAL (Cont'd)

League of Women Voters of Louisiana

Louisiana Wildlife Federation

Delta Chapter, Sierra Club

Bonnet Carre' Rod and Gun Club

Tulane Law School

St. Charles Environmental Council

OTHERS

Hayne Elementary School

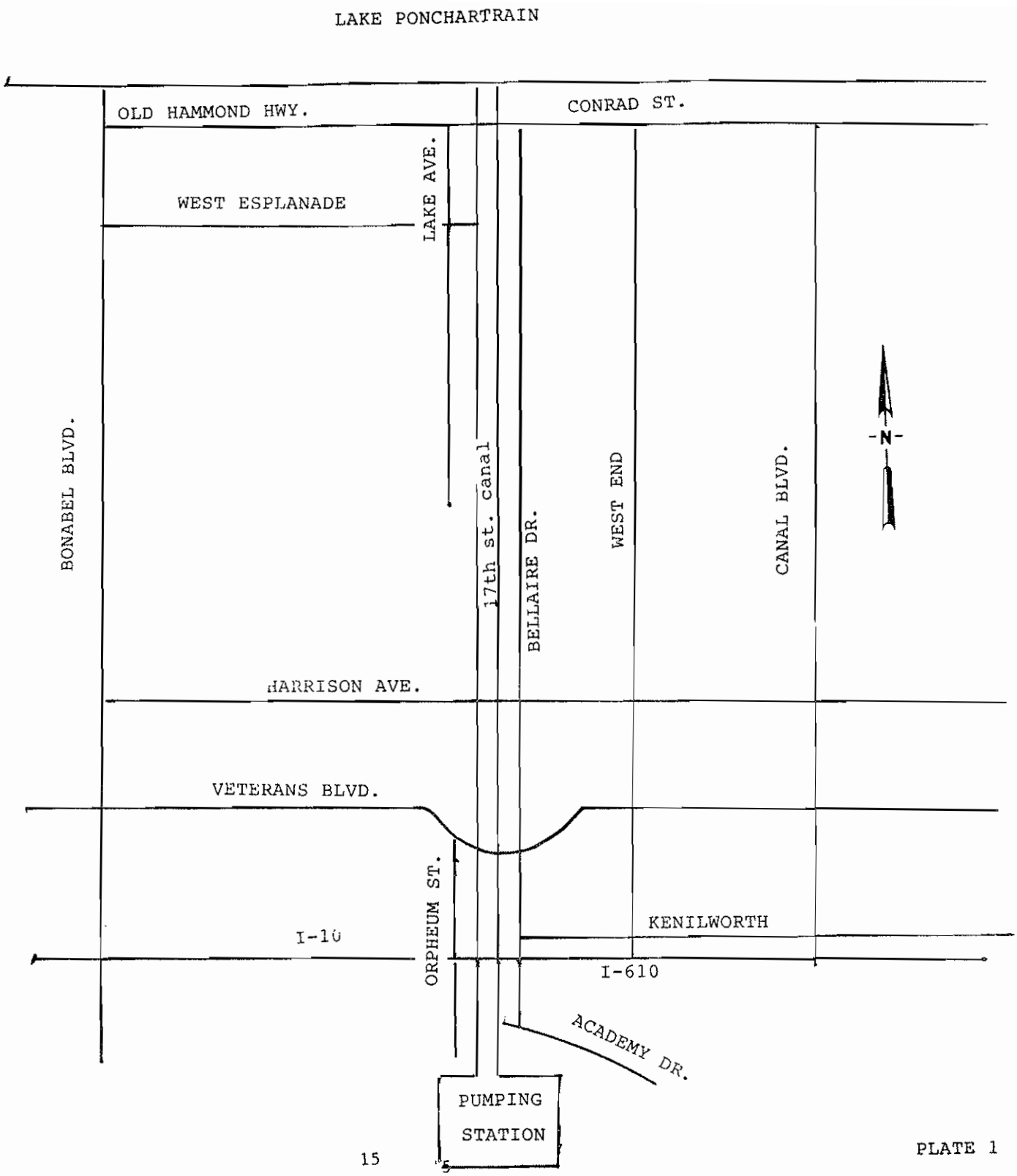

LAKE PONCHARTRAIN
OLD HAMMOND HWY.
CONRAD ST.
WEST ESPLANADE
LAKE AVE.
BONABEL BLVD.
17th st. canal
BELLAIRE DR.
WEST END
CANAL BLVD.
N
HARRISON AVE.
VETERANS BLVD.
ORPHEUM ST.
KENILWORTH
I-10
I-610
ACADEMY DR.
PUMPING
STATION

PLATE 1

United States Department of the Interior
FISH AND WILDLIFE SERVICE

POST OFFICE BOX 4305
103 EAST CYPRESS STREET
LAFAYETTE, LOUISIANA 70502

DEC 11 1987

December 3, 1987

Colonel Lloyd K. Brown
District Engineer
U.S. Army Corps of Engineers
Post Office Box 60267
New Orleans, Louisiana 70160

Dear Colonel Brown:

Reference is made to the General Design Memorandum for the 17th Street Outfall Canal feature of the Lake Pontchartrain, Louisiana, and Vicinity Hurricane Protection Project. The intent of this report is to provide your agency with essential data, assumptions, and information to be used in developing the above-referenced General Design Memorandum. This report is provided as a supplement to the Fish and Wildlife Coordination Act Report which was submitted in July 1984 and attached to the Corps of Engineers (Corps) Main Report and Supplement I to the Environmental Impact Statement for this project. This supplemental report constitutes the report of the Secretary of the Interior as required by Section 2(b) of the Fish and Wildlife Coordination Act (48 Stat. 401, as amended; 16 U.S.C. 661 et seq.) and was prepared in consultation with the Louisiana Department of Wildlife and Fisheries and the National Marine Fisheries Service.

The recommended plan presented in the Corps' July 1984 Main Report and Environmental Impact Statement proposes to rectify deficiencies in the main outfall canals entering Lake Pontchartrain, to provide hurricane protection for Metropolitan New Orleans. The proposed project includes modification of the 17th Street Outfall Canal, located on the boundary line separating Jefferson and Orleans Parishes, which provides interior drainage for a portion of the metropolitan New Orleans area.

Presently, two alternatives are under consideration. The first alternative consists of placement of a water control structure, recessed within the 17th Street Outfall Canal, inland from the outfall at the south shore of Lake Pontchartrain. The water control structure would require partial closure of the canal and installation of a vertical-pivoting butterfly valve gate. The gate would allow canal waters to flow into Lake Pontchartrain whenever the water level in the canal exceeds that of the lake. Conversely, when lake water levels exceed that of the canal, the gate would automatically close. This alternative would require an undetermined amount of dredging of the canal during construction of the water control structure, levees, and approach channels.

The second alternative is identified in the Corps' Main Report and Supplement I to the Environmental Impact Statement for the Hurricane Protection Project. This alternative consists of raising the height of the return levees paralleling the 17th Street Outfall Canal and providing floodgates or road ramps at all existing bridges crossing the canal. The levees would either be widened landward from the canal, or floodwalls would be installed atop the existing levee to achieve the required height for hurricane protection. The amount of dredging associated with this second alternative is also undetermined at this time.

The existing levee to be affected by the proposed improvements is frequently mowed. Predominant vegetation on the levee includes perennial grasses and herbs. Due to human disturbance and vegetative structure, the levee is thought to provide habitat of negligible value to wildlife. In addition, the waters of the 17th Street Canal receive stormwater runoff pumped from the Metropolitan New Orleans area and are of generally poor water quality and of negligible value as habitat for fishery resources. Accordingly, the habitat of the levees and adjacent canal to be directly affected by the two alternatives under consideration have been designated as having medium to low value to fish and wildlife resources. However, the Service believes that planning goals to minimize further loss of habitat value or project impacts to adjacent areas should be considered.

Indirect impacts of the proposed project may include adverse effects to the nearshore areas of Lake Pontchartrain. Wildlife use of these nearshore areas include limited feeding and resting by various seabirds and migratory waterfowl, principally lesser scaup. Lesser scaup feed on benthic fauna of the project area during the winter months. Accordingly, the estuarine subtidal open water habitat found in the vicinity of proposed project feature is considered to have medium wildlife resource value. The nearshore areas adjacent to the proposed project area also provide moderate to high value nursery and feeding habitat for estuarine-dependent commercial and sport finfishes and shellfishes. Economically important sport and commercial species common to the nearshore areas of Lake Pontchartrain include brown shrimp, white shrimp, blue crab, Atlantic croaker, gulf menhaden, spot, striped mullet, red drum, southern flounder, spotted seatrout, sand seatrout, black drum, and sheepshead.

Such estuarine areas are relatively abundant on a national basis and within the Louisiana coastal zone. However, the fish and wildlife habitat quality of such areas has been and continues to be degraded by a variety of human activities and natural phenomena. This degradation is particularly acute in the southern portion of Lake Pontchartrain. This area receives chronic inputs of a broad spectrum of contaminants from urban, domestic, and commercial sources. The most significantly impacted habitats are nearshore areas that receive discharges from the major drainage canals (including the 17th Street Outfall Canal). These canals are the primary receiving basins for stormwater runoff and incidental sewerage effluent from the metropolitan area adjacent to the lake (Schurtz and St. Pé 1984). The 17th Street Outfall Canal drains the largest and oldest developed area of metropolitan New

Orleans, and is subject to a larger proportion of inputs from industrial, commercial, and transportation-related activities within the drainage area than the other major outfall canals. Storm water runoff pumped into the 17th Street Outfall Canal and ultimately discharged into Lake Pontchartrain has been characterized as heavily polluted. This is confirmed by the high levels of total hydrocarbons, polychlorinated biphenyls, polycyclic aromatic hydrocarbons, chlordane, DDT metabolites, heavy metals, and other contaminants found in the nearshore sediments adjacent to the mouth of the 17th Street Outfall Canal (Schurtz and St. Pé 1984). Sediment concentrations of polychlorinated biphenyls reach 120 parts per billion near the canal outfall. This concentration is 6 times greater than the U.S. Geological Survey alert levels for aquatic sediments, and over 120 times the mean sediment concentration for Lake Pontchartrain as a whole (Schurtz and St. Pé 1984). In addition, high levels of other contaminants typically present in the discharge from the 17th Street Outfall Canal include pesticides, fertilizers, heavy metals, salts, combustion hydrocarbons and acids, detergents, organic plasticizers, oxygen demanding wastes, sediment, and raw domestic sewage (Schurtz and St. Pé 1984).

Nearshore waters affected by the canal effluent do not meet water quality standards applicable to the effluent limitations required by the Clean Water Act. Because of this, the Louisiana Department of Environmental Quality (1985) has classified the receiving waters of Lake Pontchartrain in the vicinity of the 17th Street Outfall Canal as Water Quality Limited. Waters of the outfall canals and the adjacent nearshore areas are designated by the Louisiana Department of Environmental Quality (1984) for primary and secondary contact recreation and for propagation of fish and wildlife. However, in practice the waters usually do not satisfy the primary contact designation because of excessive fecal coliform bacteria levels.

There are two basic types of contaminants in the stormwater effluent entering the 17th Street Outfall Canal which affect aquatic life in the canal and nearshore vicinity of the proposed project area. One type biodegrades very slowly, e.g., organic chemicals and heavy metals. These contaminants tend to accumulate in the sediments and may demonstrate varying degrees of toxicity, bioaccumulation, and/or sublethal effects to aquatic organisms. Other compounds biodegrade much more readily. Their decomposition causes periodic and severe oxygen depletions in the canal and nearshore areas (especially during the warmer months), and also result in eutrophication (i.e., excessive enrichment) in the lake overall (Schurtz and St. Pé 1984).

Englande et al. (1979) stated that the mouths of the canals west of the Inner Harbor Navigation Canal (including the 17th Street Outfall Canal) chronically exceed standards for fecal coliform, ammonia, and a variety of heavy metals. Furthermore, they indicate that Environmental Protection Agency criteria for propagation of fish and wildlife were consistently exceeded for dissolved oxygen, copper, iron, barium, zinc, cadmium, and phenol. In addition, they identified nickel, mercury, cynanide, arsenic, lead, pH, suspended solids, and

oil and grease concentrations as frequently exceeding recommended levels.

Runoff entering the outfall canals undergoes quality changes prior to discharge from the drainage canal system. Dissolved oxygen levels decrease and coliform concentrations increase dramatically during canal storage (Englande et al. 1979). Although the effect of contaminated runoff is a year-round problem in the project area, it is most critical during intense rainfall events. Oxygen depletions caused by the "first-flush" of stormwater are particularly detrimental. Results are similar in content to domestic sewage due to comingling of effluent from stormwater and leaking sanitary sewers (Englande et al. 1979).

Populations of benthic organisms are severely affected, both in total numbers and in species diversity, by oxygen depletions and chronic exposure to pollutants because they cannot readily move to cleaner areas. Severe dissolved oxygen depletions cause mass mortalities of aerobic benthic organisms. If such conditions persist they result in mortality of even highly tolerant, facultatively anaerobic organisms as well (Schurtz and St. Pé 1984). The effects of oxygen depletions and chronic exposure to contaminants on demersal and pelagic fishes and crustaceans is more difficult to assess because they can avoid the affected area.

There are several anticipated impacts on fish and wildlife resources which may result from the dredging and construction activities associated with the proposed project. Installation of the butterfly-valve water control structure may resuspend contaminated sediment into the water column, resulting in a temporary increase of turbidity in the project area. Reductions in benthic and plankton populations in the canal and nearshore areas due to increased turbidity may also be anticipated. Consequently, local populations of fishes and shellfishes which are dependent upon these food sources may be displaced. Resuspension of polluted sediments are likely to cause an oxygen depletion and release toxic materials into the canal and adjacent nearshore areas, potentially resulting in a fish kill. Similar impacts would be associated with dredging of borrow material from the 17th Street Outfall Canal if such action was needed to upgrade existing pump stations and to enlarge the parallel levees along that canal.

To minimize the potential impacts to fish and wildlife resources associated with either proposed alternative, the Service recommends that the following modifications be incorporated in the General Design Memorandum for the 17th Street Outfall Canal feature:

1. To minimize potential discharges of contaminated suspended sediment into Lake Pontchartrain, a turbidity screen should be used in the outfall canal during all dredging and construction activities which are likely to resuspend sediment.

2. All dredged material should be removed by bucket dredge and transported to a state-approved, upland site for disposal.

Please advise us of any significant changes in the proposed project alternatives as the General Design Memorandum proceeds through the Corps' review and approval process so that we may provide you with appropriate findings and recommendations relative to those changes.

Sincerely yours,

David M. Smith
Acting Field Supervisor

cc: EPA, Dallas, TX
LA Dept. of Wildlife and Fisheries, Baton Rouge, LA
LA Dept. of Natural Resources (CMD), Baton Rouge, LA
LA Dept. of Environmental Quality (Attn: Mike Schurtz)
NMFS, Baton Rouge, LA
FWS, Atlanta, GA (AWE)
FWS, Jackson, MS
FWS, Washington, DC (ES/FP)

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Englande, A.J., Jr., Suter, K.P., and N.K. Williams, 1979. Water quality in Orleans Parish: problems, trends, and recommendations. Pages 37-63 In: J.W. Day, Jr., D.D. Culley, Jr., R.E. Turner and A.J. Mumphrey, Jr., eds. Proceedings Third Coastal Marsh and Estuary Management Symposium. Louisiana State University Division of Continuing Education, Baton Rouge, Louisiana.

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LAKE PONTCHARTRAIN, LOUISIANA AND VICINITY
HIGH LEVEL PLAN

DESIGN MEMORANDUM NO. 20, GENERAL DESIGN
17TH STREET OUTFALL CANAL

APPENDIX D

ALTERNATIVE PLAN DETAIL
COST ESTIMATE

APPENDIX D
VOLUME I

SUMMARY OF GDM SCOPE COST ESTIMATE FOR BUTTERFLY VALVE STRUCTURE (ALTERNATIVE PLAN)

Code	Item	Const. Time	Unit		Amount	Contingencies	Project Cost
15.-.-.-	BUTTERFLY VALVE STRUCTURE	2 & 1/2	yrs		$5,495,000	$1,440,000	$6,935,000
11.-.-.-	LEVEES AND FLOODWALLS (EAST SIDE)	10	mths		$585,000	$88,000	$673,000
11.-.-.-	LEVEES AND FLOODWALLS (WEST SIDE)	10	mths		$519,000	$81,000	$600,000
10.-.-.-	BREAKWATERS AND SEAWALLS	1	yr		$5,374,000	$1,607,000	$6,981,000
02.-.-.-	RELOCATIONS (WEST SIDE)	*			$102,000	$20,000	$122,000
	* Relocations for the West Side Floodwall to be performed concurrently with floodwall construction.						
	TOTALS FOR BUTTERFLY STRUCTURE, BREAKWATER, LEVEES & FLOODWALLS				$12,075,000	$3,236,000	$15,311,000
30.-.-.-	ENGINEERING AND DESIGN						$1,531,000
30.-.-.-	ENGINEERING MODEL STUDY						$600,000
30.-.-.-	SUNK COST GDM PREPARATION						$631,000
31.-.-.-	CONSTRUCTION MANAGEMENT (S&I)						$2,380,000
	PROJECT CONTINGENCIES:			27%			
TOTAL PROJECT COST, BUTTERFLY STRUCTURE, BREAKWATER, LEVEES & FLOODWALLS:							$20,500,000

GDM SCOPE COST ESTIMATE FOR BUTTERFLY VALVE STRUCTURE (ALTERNATIVE PLAN)

Code	Item	Quantity	Unit	Unit Price	Amount	Contingencies	Project Cost
15.-.-.-	BUTTERFLY VALVE STRUCTURE						
15.0.A.-	MOB & DEMOB	LUMP SUM	LS	$200,000.00	$200,000	$40,000	$240,000
15.0.C.-	PERMANENT ACCESS ROADS AND PARKING:						
15.0.C.B	SITE WORK						
15.0.C.B	ASPHALT ROAD & PARKING LOT	LUMP SUM	LS	$25,000.00	$25,000	$5,000	$30,000
15.0.C.B	ACCESS BRIDGE	LUMP SUM	LS	$85,000.00	$85,000	$21,250	$106,250
15.0.B.-	CARE & DIVERSION OF WATER						
15.0.B.B	SITE WORK						
15.0.B.B	COFFERDAM (PHASE I)						
15.0.B.B	STEEL SHEET PILING TYPE PZ-35	18,060	SF	$20.00	$361,200	$126,420	$487,620
15.0.B.B	WALERS, BRACES, & MISL. METALS	420,000	LBS	$.75	$315,000	$110,250	$425,250
15.0.B.B	HP 14 X 73	420	LF	$25.00	$10,500	$3,675	$14,175
15.0.B.B	UNWATERING COFFERDAM						
15.0.B.B	DEWATERING	LUMP SUM	LS	$200,000.00	$200,000	$70,000	$270,000
15.0.B.B	REMOVAL OF COFFERDAM	LUMP SUM	LS	$100,000.00	$100,000	$35,000	$135,000
15.0.B.B	COFFERDAM (PHASE II) (USE MATERIALS OF PHASE I)						
15.0.B.B	STEEL SHEET PILING TYPE PZ-35	18,060	SF	$3.00	$54,180	$18,963	$73,143
15.0.B.B	WALERS, BRACES, & MISL. METALS	420,000	LBS	$.40	$168,000	$58,800	$226,800
15 0.B.B	HP 14 X 73	420	LF	$5.00	$2,100	$735	$2,835
15.0.B.B	UNWATERING COFFERDAM						
15.0.B.B	DEWATERING	LUMP SUM	LS	$200,000.00	$200,000	$70,000	$270,000
15.0.B.B	REMOVAL OF COFFERDAM	LUMP SUM	LS	$100,000.00	$100,000	$35,000	$135,000
15.0.B.B	COFFERDAM (PHASE III) (USE MATERIALS OF PHASE II)						
15.0.B.B	STEEL SHEET PILING TYPE PZ-35	8,260	SF	$3.00	$24,780	$8,673	$33,453
15.0.B.B	WALERS, BRACES, & MISL. METALS	200,000	LBS	$.40	$80,000	$28,000	$108,000
15.0.B.B	UNWATERING COFFERDAM						
15.0.B.B	DEWATERING	LUMP SUM	LS	$100,000.00	$100,000	$35,000	$135,000
15.0.B.B	REMOVAL OF COFFERDAM	LUMP SUM	LS	$50,000.00	$50,000	$17,500	$67,500
15.0.D.-	EARTHWORK FOR STRUCTURES:						
15.0.D.B	SITE WORK						
15.0.D.B	STRUCTURE EXCAVATION	13,400	CY	$3.00	$40,200	$10,050	$50,250
15.0.D.B	STRUCTURE BACKFILL	2,000	CY	$8.00	$16,000	$4,000	$20,000
15.0.D.B	18" FILTER "B" STONE	720	TONS	$22.00	$15,840	$3,960	$19,800
15.0.D.B	6" SAND SUBBASE	220	CY	$8.00	$1,760	$440	$2,200
	SUBTOTAL, BUTTERFLY STRUCTURE				$2,149,560	$702,716	$2,852,276

GDM SCOPE COST ESTIMATE FOR BUTTERFLY VALVE STRUCTURE (ALTERNATIVE PLAN)

Code	Item	Quantity	Unit	Unit Price	Amount	Contingencies	Project Cost
15.0.E.-	FOUNDATION WORK:						
15.0.E.B	SITE WORK						
15.0.E.B	FOUNDATION PREPARATION						
15.0.E.B	PILING, TEST						
15.0.E.B	COMPRESSION TEST	1	EA	$18,000.00	$18,000	$4,500	$22,500
15.0.E.B	TENSION TEST	1	EA	$19,000.00	$19,000	$4,750	$23,750
15.0.E.B	ADDT'L COMP. TEST	1	EA	$14,000.00	$14,000	$3,500	$17,500
15.0.E.B	ADDT'L TENSION TEST	1	EA	$14,000.00	$14,000	$3,500	$17,500
15.0.E.B	PILING, 14" PRESTRD. CONC.	19,500	LF	$20.00	$390,000	$97,500	$487,500
15.0.E.B	PILING, STEEL SHEET, PZ-22	6,270	SF	$12.00	$75,240	$18,810	$94,050
15.0.E.C	CONCRETE						
15.0.E.C	CONC. IN STAB. SLABS	220	CY	$70.00	$15,400	$3,850	$19,250
15.0.1.-	APPROACH CHANNELS:						
15.0.1.B	SITE WORK						
15.0.1.B	EXCAVATION, COMMON	6,700	CY	$1.50	$10,050	$2,513	$12,563
15.0.1.B	SHELL BEDDING	460	CY	$20.00	$9,200	$2,300	$11,500
15.0.1.B	RIPRAP	5,000	TONS	$22.00	$110,000	$27,500	$137,500
15.0.4.-	BUTTERFLY VALVE STRUCTURE:						
15.0.4.C	CONCRETE						
15.0.4.C	CONCRETE, IN PLACE						
15.0.4.C	BASE SLABS	2,290	CY	$200.00	$458,000	$91,600	$549,600
15.0.4.C	WALLS	1,490	CY	$350.00	$521,500	$104,300	$625,800
15.0.4.C	MACHINERY HOUSE	415	CY	$350.00	$145,250	$29,050	$174,300
15.0.4.C	DEWATERING SHEETPILE STORAGE RACK	LUMP SUM	LS	$35,000.00	$35,000	$7,000	$42,000
15.0.4.E	METALS						
15.0.4.E	DEWATERING BULKHEADS						
15.0.4.E	STEEL SHEET PILING, PZ-35	1,540	SF	$20.00	$30,800	$6,160	$36,960
15.0.4.E	NEEDLE GIRDERS, W30 X 211	62	LF	$160.00	$9,920	$1,984	$11,904
15.0.5.-	BUTTTERFLY VALVE GATES AND OPERATING MACHINERY						
15.0.5.E	METALS						
15.0.5.E	BUTTERFLY GATES	340,200	lbs	$2.00	$680,400	$170,100	$850,500
15.0.5.Q	MECHANICAL						
15.0.5.Q	GATE OPERATING MACHINERY	LUMP SUM	LS	$330,000.00	$330,000	$66,000	$396,000
15.0.8.-	POWER AND LIGHTING SYSTEMS:						
15.0.8.R	ELECTRICAL						
15.0.8.R	ELECTRIC SERVICE-EMERGENCY, INCLUDING STANDBY GENERATOR AND DIESEL ENGINE	LUMP SUM	LS	$60,000.00	$60,000	$12,000	$72,000
15.0.8.R	ELECTRIC WORK	LUMP SUM	LS	$400,000.00	$400,000	$80,000	$480,000
	SUBTOTAL, CONSTRUCTION COSTS				$5,495,000		
15.0.Z.-	CONTINGENCIES:					$1,440,000	
15.-.-.-	BUTTERFLY VALVE STRUCTURE TOTAL:						$6,935,000

GDM SCOPE COST ESTIMATE FOR BUTTERFLY VALVE STRUCTURE (ALTERNATIVE PLAN)

Code	Item	Quantity	Unit	Unit Price	Amount	Contingencies	Project Cost
10.-.-.-	BREAKWATERS AND SEAWALLS						
10.0.A.-	MOB & DEMOB	LUMP SUM	LS	$100,000.00	$100,000	$25,000	$125,000
10.0.1.-	BREAKWATERS:						
10.0.1.B	SITE WORK						
10.0.1.B	RIPRAP	18,900	TONS	$22.00	$415,800	$124,740	$540,540
10.0.1.B	PILING						
10.0.1.B	PILING, STEEL SHEET,PZ-35	132,090	SF	$20.00	$2,641,800	$792,540	$3,434,340
10.0.1.B	PILING, STEEL W36 X 135	25,230	LF	$50.00	$1,261,500	$378,450	$1,639,950
10.0.1.B	COAL TAR EPOXY	LUMP SUM	LS	$140,000.00	$140,000	$42,000	$182,000
10.0.1.C	CONCRETE						
10.0.1.C	CONCRETE PILE CAP	2,470	CY	$330.00	$815,100	$244,530	$1,059,630
	SUBTOTAL, CONSTRUCTION COSTS:				$5,374,000		
10.0.Z.-	CONTINGENCIES					$1,607,000	
10.-.-.-	TOTAL: BREAKWATERS & SEAWALLS						$6,981,000

GDM SCOPE COST ESTIMATE FOR BUTTERFLY VALVE STRUCTURE (ALTERNATIVE PLAN)

Code	Item	Quantity	Unit	Unit Price	Amount	Contingencies	Project Cost
11.-.-.-	LEVEES AND FLOODWALLS (EAST SIDE)						
11.0.A.-	MOB. & DEMOB.	LUMP SUM	LS	$40,000.00	$40,000	$6,000	$46,000
11.0.1.-	LEVEES:						
11.0.1.B	SITE WORK						
11.0.1.B	CLEARING	1	ACRE	$1,000.00	$1,000	$150	$1,150
11.0.1.B	EXCAVATION AND EMBANKMENT:						
11.0.1.B	DEGRADE EXISTING LEVEE & HAUL TO STOCKPILE AREA	3,200	CY	$3.00	$9,600	$1,920	$11,520
11.0.1.B	RIPRAP SLOPE PROT.	1,000	TONS	$22.00	$22,000	$4,400	$26,400
11.0.1.B	SHELL BEDDING	340	CY	$20.00	$6,800	$1,360	$8,160
11.0.1.B	SLOPE TREATMENT:						
11.0.1.B	SEEDING, FERTILIZING AND MULCHING	1	ACRE	$500.00	$500	$75	$575
11.0.2.-	FLOODWALLS						
11.0.2.B	SITE WORK						
11.0.2.B	FOUNDATION WORK:						
11.0.2.B	STRUCTURAL EXCAVATION	330	CY	$4.00	$1,320	$264	$1,584
11.0.2.B	STRUCTURAL BACKFILL	170	CY	$10.00	$1,700	$340	$2,040
11.0.2.B	STEEL SHEET PILE, PZ-22	1,450	SF	$12.00	$17,400	$2,610	$20,010
11.0.2.B	STEEL SHEET PILE, PZ-27	4,820	SF	$13.00	$62,660	$12,532	$75,192
11.0.2.B	STEEL SHEET PILE, PZ-40	5,150	SF	$21.50	$110,725	$22,145	$132,870
11.0.2.B	STEEL HP 14 X 73	1,500	LF	$25.00	$37,500	$7,500	$45,000
11.0.2.B	PRSTD. CONC. PILES, 12" X 12"	1,340	LF	$18.00	$24,120	$3,618	$27,738
11.0.2.B	12" TREATED TIMBER PILES.	1,000	LF	$10.00	$10,000	$1,500	$11,500
11.0.2.C	CONCRETE						
	CONCRETE, IN PLACE INCLUDING CEMENT						
11.0.2.C	I-WALL STEM	460	CY	$330.00	$151,800	$15,180	$166,980
11.0.2.C	GATE STAB. SLABS	14	CY	$70.00	$980	$98	$1,078
11.0.2.C	GATE WALLS	3	CY	$330.00	$990	$99	$1,089
11.0.2.C	GATE BASE SLAB	104	CY	$200.00	$20,800	$2,080	$22,880
11.0.2.C	WATERPROOF FINISH	17,000	SF	$1.00	$17,000	$1,700	$18,700
11.0.2.E	METALS						
11.0.2.E	ROLLER GATE NO. 3 (SIZE 38' X 4')	LUMP SUM	LS	$48,000.00	$48,000	$4,800	$52,800
	SUBTOTAL, CONSTRUCTION COSTS:				$585,000		
11.0.Z.-	CONTINGENCIES					$88,000	
11.-.-.-	TOTAL: LEVEES & FLOODWALLS (EAST SIDE)						$673,000

GDM SCOPE COST ESTIMATE FOR BUTTERFLY VALVE STRUCTURE (ALTERNATIVE PLAN)

Code	Item	Quantity	Unit	Unit Price	Amount	Contingencies	Project Cost
11.-.-.-	LEVEES AND FLOODWALLS (WEST SIDE)						
11.0.A.-	MOB. & DEMOB.	LUMP SUM	LS	$40,000.00	$40,000	$6,000	$46,000
11.0.1.-	LEVEES:						
11.0.1.B	SITE WORK						
11.0.1.B	CLEARING	1	ACRE	$1,000.00	$1,000	$150	$1,150
11.0.1.B	EXCAVATION AND EMBANKMENT:						
11.0.1.B	DEGRADE EXISTING LEVEE & HAUL TO STOCKPILE AREA	3,800	CY	$3.00	$11,400	$2,280	$13,680
11.0.1.B	SEMICOMPACTED FILL (ADJACENT BORROW)	LUMP SUM	LS	$5,000.00	$5,000	$1,000	$6,000
11.0.1.B	SLOPE TREATMENT:						
11.0.1.B	SEEDING, FERTILIZING AND MULCHING	1	ACRE	$500.00	$500	$75	$575
11.0.2.-	FLOODWALLS						
11.0.2.B	SITE WORK						
11.0.2.B	FOUNDATION WORK:						
11.0.2.B	STRUCTURAL EXCAVATION	200	CY	$4.00	$800	$160	$960
11.0.2.B	STRUCTURAL BACKFILL	100	CY	$10.00	$1,000	$200	$1,200
11.0.2.B	STEEL SHEET PILE, PZ-22	3,990	SF	$12.00	$47,880	$7,182	$55,062
11.0.2.B	STEEL SHEET PILE, PZ-27	2,530	SF	$13.00	$32,890	$6,578	$39,468
11.0.2.B	STEEL SHEET PILE, PZ-40	6,020	SF	$21.50	$129,430	$25,886	$155,316
11.0.2.B	STEEL HP 14 X 73	1,500	LF	$25.00	$37,500	$7,500	$45,000
11.0.2.B	PRSTD. CONC. PILES, 12" X 12"	2,040	LF	$18.00	$36,720	$5,508	$42,228
11.0.2.B	12" TREATED TIMBER PILES	1,000	LF	$10.00	$10,000	$1,500	$11,500
11.0.2.C	CONCRETE						
	CONCRETE, IN PLACE INCLUDING CEMENT						
	I-WALL STEM	200	CY	$330.00	$66,000	$6,600	$72,600
11.0.2.C	GATE STAB. SLABS	20	CY	$70.00	$1,400	$140	$1,540
11.0.2.C	GATE WALLS	9	CY	$330.00	$2,970	$297	$3,267
11.0.2.C	GATE BASE SLAB	130	CY	$200.00	$26,000	$2,600	$28,600
11.0.2.C	WATERPROOF FINISH	9,000	SF	$1.00	$9,000	$900	$9,900
11.0.2.E	METALS						
11.0.2.E	SWING GATE NO. 1 (SIZE 24' X 4')	LUMP SUM	LS	$12,000.00	$12,000	$1,200	$13,200
11.0.2.E	ROLLER GATE NO. 2 (SIZE 38' X 4')	LUMP SUM	LS	$48,000.00	$48,000	$4,800	$52,800
	SUBTOTAL, CONSTRUCTION COSTS:				$519,000		
11.0.Z.-	CONTINGENCIES					$81,000	
11.-.-.-	TOTAL: LEVEES & FLOODWALLS (WEST SIDE)						$600,000

GDM SCOPE COST ESTIMATE FOR BUTTERFLY VALVE STRUCTURE (ALTERNATIVE PLAN)

Code	Item	Quantity	Unit	Unit Price	Amount	Contingencies	Project Cost
02.-.-.-	RELOCATIONS (WEST SIDE)						
02.-.-.-	MOB & DEMOB	LUMP SUM	LS	$40,000.00	$40,000	$8,000	$48,000
02.1.-.-	ROADS, CONSTRUCTION ACTIVITIES						
02.1.3.-	ROAD SURFACING						
02.1.3.B	SITE WORK						
02.1.3.B	REMOVAL & REPLACEMENT OF ASPHALT ROAD AT ORPHEUM AVE. (3-1/2" ASPHALT OVER 8-1/2" SAND/SHELL/CEMENT)	900	SY	$30.00	$27,000	$5,400	$32,400
02.3.-.-	CEMENTERIES, UTILITIES, AND STRUCTURES, CONSTRUCTION ACTIVITIES						
02.3.2.-	UTILITIES						
02.3.2.-	12" DIA. CAST IRON WATER LINE (RELOCATE OVER LEVEE, 50')	LUMP SUM	LS	$15,000.00	$15,000	$3,000	$18,000
02.3.2.-	2" DIA H.P. GAS LINE THRU "I"-WALL WITH SLEEVE	LUMP SUM	LS	$20,000.00	$20,000	$4,000	$24,000
	SUBTOTAL, CONSTRUCTION COSTS:				$102,000		
02.0.Z.-	CONTINGENCIES					$20,000	
02.-.-.-	TOTAL: RELOCATIONS						$122,000