US Army Corps
of Engineers
New Orleans District

NEW ORLEANS TO VENICE, LOUISIANA

HURRICANE PROTECTION

REACH B-1 - TROPICAL BEND TO FORT JACKSON

EMPIRE FLOODGATE

PERIODIC INSPECTION REPORT NO. 8

17 JANUARY 1996

CELMV-ET-EG (CELMN-ED-GE/23 Oct 96) (11-2-240a) 3d End
Mr. Bragg/bab/5893
SUBJECT: 1996 Periodic Inspection Report for No. 8 for Empire Floodgate

CDR, Lower Mississippi Valley Division, Vicksburg, MS 39181-0080
6 MAY 97

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

Your actions on subject report are excellent. The professionalism exhibited during discussions concerning this report is appreciated. You are commended for the excellent job you have done. No further correspondence is necessary.

FOR THE COMMANDER:

5 Encls
wd

DOUGLAS J. KAMIEN, P.E.
Chief, Engineering Division

concrete slab for the gate to rest on. The removal of this timber member should not put any undo stress on the gate members or the gate hinges. Mr. Urban stated "after the dredging operation of the gate recess area, the gate is in its fully open position". It was noted that with the gate in its fully open position, the counterweights were still approximately 1' to 1.5' down in the counterweight chambers. It appears that over the years of changing out parts of the counterweight chains, an additional 1' to 1.5' of chain had been added (1 or 2 links). Mr. Urban also stated, they are in the process of making up a hydraulic system to pick-up the counterweights and after the this system is in place, the counterweights will be lifted and the chains will be shorten to the proper length.

8. POC is Mr. Richard Pinner, 504-862-2711.

FOR THE COMMANDER:

for Gerald S. Satterlee
W. EUGENE TICKNER, P.E.
Chief, Engineering Division

5 Encls
2-3, nc
Added 2 encls
4. Report pages V-6 thru V-23,
and VI-4 thru VI-7.
(4 cys of encls 4)
5. as

CF (w/o encls):
C/ Programs & Proj Mgt Br.
C/ Ops Div

gate and settles in front of the gate, a small earthen dam is formed in front of the gate. This small dam, on the protected side of floodgate, is just below the water surface. When the gate is open again, it is assumed this silt flows back on top of the gate.

Safety: Because of silt accumulation in the gate recess area, the gate does not fully open (lowered into the sill seat) after the gate has been closed without significant effort (dredging and cleaning of the gate recess). The gate protrudes above the chamber floor 2 feet to 3 feet on average (El -12 to El -11) in its open position. There is concern that the gate may be sitting up higher than this on some occasions. The top of the gate has been hit on a number of occasions with only minor gate damage occurring to date. It appears only the top member has been damaged. The top member was repaired during the last dewatering in 1991. Since then, its appears the gate has been hit at least four times based on a photo taken 2 Feb 97. Also of safety concern is if one of these deep draft vessels strike the gate while taking harbor from an approaching hurricane and damage the gate such that it can not be closed. This problem should be corrected. Requiring the locals to bring out a dredge to clean the gate recess each time they close the gate is impractical and appears to be more than normal maintenance. Removal of silt from the gate recess by a dredge is an appreciable expense, and results in the structure being closed to navigation an appreciable length of time. A more proficient system needs to be developed to assist the locals in performing readiness checks.

7. Reference telephone conversation on 19 March 1997 between our Mr. Pinner and Mr. Henry Urban, Asst. Superintendent of Plaquemines Parish. The Parish recently completed a maintenance contract to change the counterweight chains and the gate hoisting chains of the subject structure, and the contract required the Contractor to dredge the gate recess area. The Contractor used a 12" dredge and bucket dredge to remove silt, timber, riprap, and other debris from the gate recess area. The removed timber may have been the 24" X 6" treated timber cinch anchored to the

readiness check operation because of the gate seating problem due to silt accumulation in the gate recess area. The gate operation, monthly and quarterly operation requirements, have been revised to be performed annually, see attached letter(encl 5). The annual gate operation combines the monthly and quarterly requirements. The annual requirement is to operate the gate through a complete closing and opening cycle, preferably around April 1st, to assure that the gate and the controls are functioning properly. During the gate operation checks, the machinery should be inspected for loose parts, misalinement, wear and broken parts, and corrective action taken as required. When the gate is fully closed, grease is added to gate hinge through the fittings in the web of the plate girder at the top of the gate. In January 1989, to remove silt in the gate recess area, a Corps designed, built and supplied to the Parish a small jet-suction dredge. Operation of the dredge requires a crane, a high pressure water pump and a hydraulic pump (crane requires a barge and tugboat). This method of silt removal requires significant cost and time and was subsequently abandoned by the Parish. We will continue to monitor the siltation problem in the gate recess area. In particular, we will re-assess subsequent to rehabilitation of the gate recess flushing system.

6. Other Concerns: Based on the following, we will recommend to the project manager that a study be conducted to investigate alternative means of removing the silt from the recess to facilitate fully opening the gate.

Siltation: Site conditions contribute to the siltation problem above and below the gate. The inlet and outlet channels bottom elevation is -12.0 NGVD, whereas the top of gate and sill is at elevation -14.0 (fully open position). In this soft clay/silty bottom water environment, the floodgate sill fills in with silt (2'), on top of the gate, and as the channels silt up additional silt settles on the gate. The silt load on top of the gate is another load the hoisting machine and chains must lift which is designed for a 4' silt load. The silt is a constant problem. When the gate is being closed, the silt slides off the

g. Emergency power generator engine belts, water hoses and fuel lines have been replaced.

h. The hydraulic safety latching system of the gate has been restored. The hydraulic system has been modified to operate manually (hand operating the hydraulic jacking system).

4. On 17 Feb 1997, NOD witnessed motor load tests while raising of the gates with a silt load. Raising of the gate was smooth with the counterweight chains occasionally making a popping noise. The load test electrical readings were forwarded to NOD for our evaluation. A summary of our evaluation will be included in the next periodic inspection report. On 18 Feb 1997, NOD witnessed the operation of the gate through a closed/open cycle after the hoisting and counterweight chains have been changed. Raising the gate, no silt load, was very smooth with only minor noises from the counterweight chains riding in their wildcats. The hoist machinery performed exceptionally well and appeared to be in excellent condition. However, as the gate was being lowered the hoist chain on the west side jumped twice. The first time one link jumped and the second time two links. The east side hoist chain jumped one link, once. The chain jumping did not result in a large impact load because the water displaced by the falling gate slowed the gate movement. The chain jumping was not particularly noticeable. The operator, that has been operating the gate since 1975, the year the project was completed, said that the chains have never jumped while raising the gate. The reason for this is that the weight of the gate on the chains straighten the links as they are fed onto the wildcats. On lowering, the chains are fed to the wildcats from the chain lockers, where the only force available to straighten the links are from the chains weight. NOD will recommend to Parish that the large round pipes immediately below the hoist wildcat be modified so that they straighten the chain links as they are fed onto the wildcats. Hopefully, this will prevent the chains from jumping as the gate is being lowered.

5. NOD revised the O&M manual in March 1988 concerning gate

findings with recommended remedial actions from the last inspection in 1993. Hence, any corrective actions were performed as deemed necessary by the Parish. The O&M manual covers the routine maintenance of the structure which the local officials should be following. Parish representatives will be reminded of their routine maintenance responsibilities.

2. Four copies of the revised pages are submitted for your files (see encl 4).

3. Since the inspections, the following remedial actions have been performed:

a. The gate's two hoisting chains have been replaced.

b. Approximately 50 feet of each counterweight chain has been replaced, from the gate toward the counterweights.

c. Missing boat dock board has been replaced.

d. Electrical load tests have been performed on gate lift motors.

e. The two existing light poles on the east side have been bolted to the structure and at the third light location, a cover box has been placed over the exposed wires. Also, two light poles have been reinstalled on the west side of the structure and at the third light location, a cover box has been placed over the exposed wires. Six (6) outside floodlights were added beneath the control house overhang several years ago on the west side of the control house which also help illuminate the structure.

f. General housekeeping of the generator room has been performed.

because of space constraints), they decided to use the crane on site to raise the counterweight to relieve the weight off the jack, to make using the ratchet devices a lot easier (unloaded). With the counterweights hanging by the jacks, it takes an extraordinary effort to turn these ratchets to raise or lower the counterweights. Again, this may be difficult and require excessive time during an approaching hurricane (rainy and gusty winds).

Therefore, unless a more proficient system is developed to support these counterweights (hydraulic or electric winching device), we would not recommend using the existing counterweight jack\ratchet devices. Also, it appears the counterweight chains have not experienced any problems since 1977.

f. LMVD comment 4. Paragraph 6-02v, page VI-5. We have revised the subject paragraph as follows, "Lighting will be reinstalled to illuminate the structure. The 24' tall original light standards will either be reinstalled or local interests will submit alternative lighting/locations to NOD for review." Also, the following information has been added to paragraph 5-03i(1) "The Parish Officials have stated the original 24' tall light poles were being hit and knocked down by shrimp trawlers and other vessels passing through the structure and the existing lights have been installed several years ago".

g. LMVD comment 5. Concur. Paragraphs 5-03j and 6-03y have been revised to address the decayed timber spacers between the needles and needle girders and the necessity to replace them.

h. LMVD comment 6. Concur. Paragraph 6-03z has been revised to address inspection of the boat deck timbers and remedial action taken as required.

i. LMVD comment 7. Concur. See comment 1a. above.

j. LMVD comment 8. The Corps shares this responsibility with the local officials. The local officials were not given our

except the hoist chains are taut, it was determined that only a boat similar in size to the Corps survey boat traveling through the structure in a downward direction between 12 and 14 mph would cause conditions in which impact loading of the counterweight chain could occur. The larger boats traveled at much slower speeds thus causing very little change from static conditions. The report recommended that the chains always remain in the "slack" condition during the passage of all traffic. We would agree under ideal conditions the counterweights should be dogged off. However, the following reasons make it impractical and a safety concern to dog off the counterweights:

(1) Gate Seating Problems: Because of silt accumulation in the gate recess area, the gate does not fully open without dredging and cleaning of the recess. Therefore, the counterweights do not come up high enough to attach the existing counterweight jack\ratchet devices. The counterweights were approximately 3 feet below the counterweight jacks, in the counter-weight chambers, during the recent motor load tests. Parish representatives have stated that the counterweights are at different elevations each time they close and open the gate because the gate does not seat properly.

(2) Access Difficulty to West Side of Structure: Access to west side of structure is by an earthen levee, a distance of over a mile. This may be very difficult during an approaching hurricane in which the levee would be very muddy. Access to the east side of the structure, control house side, is relatively easy because the Parish has installed a gravel road on the levee protected side berm.

(3) Difficulty Operating Ratchet Devices: During the recent changing of the counterweight chains, the parish personnel welded flat bars together with pin holes to connect the ratchet devices to the counterweights. It required three men to use the two counterweight jack\ratchet devices in an attempt to raise the counterweight high enough to disconnect the chain. After about 5 to 10 minutes of ratcheting (only a 1/6 of a turn on each stoke

d. LMVD comment 3a. Concur. Paragraph 5-03e(7) has been revised to address the corroded condition of the counterweight boxes, and paragraph 6-02q has been revised to state the corroded counterweight boxes will be cleaned and painted during the next dewatering or as soon as practical. It appears two cranes will be required to remove the counterweights. One crane would support the counterweight while the other crane would remove the upper support bracket and wildcat.

e. LMVD comment 3b . Based on correspondence between NOD and LMVD when the structure was first put into service (correspondence dates are between 14 April and 11 August 1977), it was stressed the counterweight jack\ratchet devices supporting the counterweights be used at all times except when the gate is being operated. This was a requirement because both counterweight chains failed in early 1977. It was concluded the counterweight chain failures were caused by impact loading to the chains when the counterweights are not dogged off. It was also concluded the most likely source of the high impact loading was the passage of marine traffic which induced gate movement. Subsequent to these memos, field vibration and strain measurements on the hoisting and counterweight chains were taken by WES on 8 Dec 77. The field test was performed mainly to: measure stains in the gate hoist and counterweight chains under various traffic conditions to determine whether these strains correlated with the recent failure of the counterweight chains; determine any significant movement of the counterweights that may have contributed to the failure of the counterweight chains; and determine the speed of vessels under controlled and uncontrolled conditions passing through the structure and the resulting wave heights. The results of the report showed with the counterweights released from supports, gate in full-open position, 3' of silt and slack in the hoist chains, no impact loads occurred on the chains when the Corps 35' long survey boat, a 55' long shrimp boat, small 40' long towboat passed thru the structure at various speeds. Under similar conditions above,

CELMN-ED-GE(CELMV-ET-EG/16 Jan 97) 2nd End Mr. Pinner/2711
SUBJECT: 1996 Periodic Inspection Report No. 8 for Empire Floodgate

DA, New Orleans District, Corps of Engineers, P.O. Box 60267, New Orleans, Louisiana 70160-0267 7 April 1997

FOR Commander, Lower Mississippi Valley Division,
ATTN: CELMV-ET-EG, Vicksburg, MS 39181-0080

1. We have reviewed your comments and offer the following responses.

a. LMVD comment 2a. NOD shares in the failure to raise the gate during the inspection. Plaquemines Parish Officials were given short notice of the inspection date (approx 2 weeks). NOD did not finalize the inspection date until Jan 2, 1997. In hindsight, the inspection should have been rescheduled to allow the Parish ample time to issue a Navigational Notice for the structure closing. Subsequent to the inspection, Plaquemines Parish Officials informed us that their normal representative for the Empire Floodgate structure was unavailable for the inspection because of illness in his family. Therefore, Mr. Ruben Victory was sent in his place, he was familiar with the operation of the structure and did a very good job during the inspection but maintenance of the structure was not part of his normal duties. For future Periodic Inspections, NOD will ensure the Plaquemines Parish Officials receive adequate advance notice of the inspection with the inspection agenda including required gate closing. Also, NOD will inform the Parish that their representative must be familiar with the structure including their routine maintenance, routine maintenance schedule, and any past maintenance or operation problems since the last inspection.

b. LMVD comment 2b. Concur. Paragraph 6-02ee has been added to the report to require replacement of the safety chains.

c. LMVD comment 2c. Concur. Paragraph 5-03c(4) has been revised to address the condition of the access ladder and paragraph 6-02ff has been added to require repair or replacement of the access ladder.

CELMV-ET-EG 16 JAN 1997
SUBJECT: 1996 Periodic Inspection Report No. 8 for Empire Floodgate

7. Paragraph 6-03, page VI-6. Concur in this recommendation. The interval between inspections should remain at 3 years until all of the observed discrepancies are corrected, and until such time that the local sponsor demonstrates that the facility can be properly maintained. Additionally, the next periodic inspection should include a full gate operation, with adequate time allowed for inspection of the gate once it has been raised. This gate operation will require that the New Orleans District issue navigation bulletins sufficiently in advance of the periodic inspection, to alert towing companies, as well as the general public, that the Empire Waterway will be closed to traffic for several hours on the day of the inspection.

8. The quality of maintenance of the Empire Floodgate structure has steadily declined since the local sponsor assumed operation and maintenance responsibilities in 1976. This inspection report contains more maintenance discrepancies than any inspection report submitted to this office in many years, and almost without exception, the reason for the deterioration of this structure can be attributed to virtually a total lack of routine maintenance.

9. Your response to the comments above should be provided to this office NLT **7 Feb 97**.

FOR THE COMMANDER:

3 EnclS
1. wd 3 copies
2-3. nc

DOUGLAS J. KAMIEN, P.E.
Chief, Engineering Division

3. Paragraph 6-02q, page VI-4.

a. This paragraph should have addressed the corroded condition of the counterweight boxes. The counterweight boxes should be included in the general maintenance work that is scheduled for the structure in the near future.

b. As the first quarter of FY 97 is almost over, the decision concerning whether to hang the counterweights from the chain or the ratchet jacks should have been made by now. You should furnish this information in your response. It should be noted that the intent of the original design was that the counterweights be suspended from the ratchet jacks at all times. It is recognized that releasing the counterweight from the ratchet jack is accomplished with some minor amount of effort, however, this operation is required only when landfall of a hurricane is predicted for that area and the gate is being prepared for operation, or once every 3 years for the periodic inspection of the structure. It should be noted that on at least one previous occasion the counterweight chain broke and one of the counterweights did in fact fall to the bottom of the counterweight well. Proper operation and maintenance of the counterweights should be given high priority.

4. Paragraph 6-02v, page VI-5. This recommendation does not fully address the original observation contained in paragraph 5c of the LMVD Trip Report. If the decision is made to not reinstall the light standards to their original position, and just remove the exposed wires at the original base location as proposed in the referenced paragraph, then it apparently means that the local sponsor intends for the light poles to remain in their "make-shift" location as described in the trip report. This is not acceptable, as the present arrangement is unsightly, as well as unsafe and should be discontinued. Our recommendation is that the light standards be reinstalled as originally designed.

5. Paragraph 6-02y, page VI-5. When the guide wall timbers are replaced, the spacer timbers on the needle girder storage rack should also be replaced. This was not addressed in Section VI.

6. Paragraph 6-02z, page VI-6. The referenced paragraph mentions only one deck board to be replaced on the boat dock. All of the deck boards should be thoroughly inspected and replaced as required, as well as the timber girders below the deck.

S: 7 Feb 97

CELMV-ET-EG (CELMN-ED-GE/23 Oct 96) (11-2-240a) 1st End
Bragg/ghb/5893
SUBJECT: 1996 Periodic Inspection Report No. 8 for Empire Floodgate

CDR, Lower Mississippi Valley Division, Vicksburg, MS 39181-0080
16 JAN 1997
FOR Commander, New Orleans District, ATTN: CELMN-ED-GE

1. The following comments on the subject report are furnished to document additional items that were omitted from Section VI, Conclusions and Proposed Remedial Actions, page VI-1.

2. General.

a. In paragraph 5a(1) of the LMVD trip report located in Appendix A of the subject inspection report, we expressed concern over the apparent lack of direction provided to the Plaquemines Parish field personnel by their superiors as to what the inspection agenda would be, e.g., being prepared to operate the gate as a required part of the inspection, what their responsibilities were as far as performing routine maintenance, etc. There even appeared to be confusion as to what department in their office was in charge of operation and maintenance of the gate. The parish representative at the site on the day of the inspection told us that he normally worked in another department, and really had nothing to do with the floodgate, although he appeared to be reasonably familiar with all of the controls related to the gate's operation. The inspection report does not appear to document any of these problems. It is also not likely that the New Orleans District letter of 30 September 1996 to Plaquemines Parish expressed any of these concerns either. The "bottom line" is that for several years, the floodgate has had "stepchild" status with the local sponsor, as far as maintenance is concerned, and this practice should not be allowed to continue.

b. Reinstallation of the missing hand railing safety chains is not addressed in Section VI. This is a small, but very important item in the area of safety. The New Orleans District should ensure that the chains are replaced.

c. Repair of the access ladder on the pump platform is not addressed in Section VI. The ladder should be repaired as recommended in the LMVD Trip Report.

5 - 6 Jan

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-GE 23 Oct 96

MEMORANDUM FOR Commander, Lower Mississippi Valley Division,
ATTN: CELMV-ET-EG

SUBJECT: 1996 Periodic Inspection Report No. 8 for Empire Floodgate

1. Subject report is submitted for your information and concurrence (Encl 1).

2. The Technical Review was conducted as outlined in Enclosures 2 and 3.

FOR THE COMMANDER:

for Gerard S Satterlee
W. EUGENE TICKNER, P.E.
Chief, Engineering Division

3 Encl
1. Periodic Inspection Report No. 8 (4 cys)
2. Quality Control Plan
3. Design/Review Activities

NEW ORLEANS TO VENICE, LOUISIANA

HURRICANE PROTECTION

REACH B-1 - TROPICAL BEND TO FORT JACKSON

EMPIRE FLOODGATE

PERIODIC INSPECTION REPORT NO. 8

17 JANUARY 1996

PREPARED BY

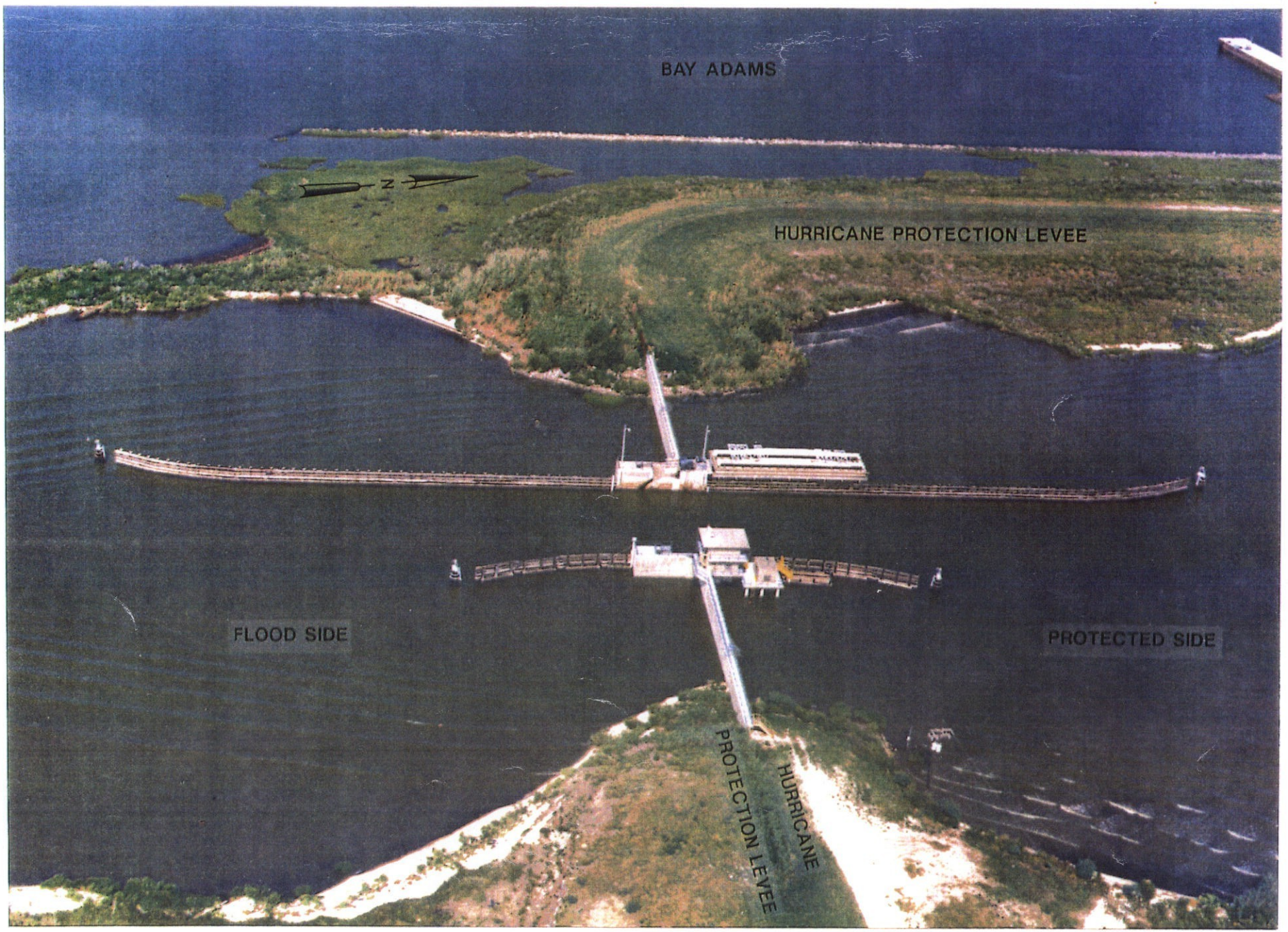
BROWN, CUNNINGHAM & GANNUCH, INC.

FOR

U.S. ARMY ENGINEER DISTRICT

CORPS OF ENGINEERS

NEW ORLEANS, LA



EMPIRE FLOODGATE

PHOTO TAKEN 22 JULY 86

SUMMARY

The Empire Floodgate was inspected on 17 January 1996 by the Brown, Cunningham & Gannuch, Inc. inspection team and representatives of the Lower Mississippi Valley Division (LMVD) and the New Orleans District (NOD). Since the gate was not closed (raised) for this inspection, a supplemental inspection of the gate in the closed position was conducted on 13 February 1996 by a Brown, Cunningham & Gannuch, Inc. inspection team and representatives of the New Orleans District. The gate bay is structurally adequate. The concrete "T" wall floodwalls, however, required additional analysis to verify their structural stability. In addition, modifications to the sheet pile floodwalls are needed to re-establish their design grade. The project is adequate from an operations standpoint. The portion of the gate exposed when it was closed was in overall good condition, but the damage at the top of the gate noted in the previous inspection has not been repaired. Deficiencies were identified during the inspection and concerns were expressed over the adequacy of the gate hoisting system. By letter dated September 30, 1996, NOD notified Plaquemines Parish of the deficiencies and recommended that remedial action be taken prior to the next inspection. The deficiencies will be corrected as discussed in Section VI.

EMPIRE FLOODGATE

PREVIOUS PERIODIC INSPECTION REPORTS

REPORT NO.	DATED	APPROVED
1	4 September 1975	7 April 1976
2	4 October 1978	13 August 1979
3	29 July 1981	20 October 1982
4	31 January 1984	4 January 1985
5	29 January 1987	21 September 1987
6	30 January 1990	Not Available
7	~~Not Available~~ 28 January 1993	Not Available

EMPIRE FLOODGATE

PERIODIC INSPECTION REPORT NO. 8

TABLE OF CONTENTS

SECTION I - INTRODUCTION

1-01 Authority. Authority is provided by ER 1110-2-100, "Periodic Inspection and Continuing Evaluation of Completed Civil Works Structures", dated 15 February 1995.

1-02 Purpose and Scope. The results and conclusions of the inspection and evaluation for assuring the structural integrity and operational adequacy of the structure are presented herein.

1-03 Datum. All elevations, unless otherwise specified, are in feet and refer to the National Geodetic Vertical Datum of 1929 (NGVD), formerly mean sea level (msl).

SECTION II - PROJECT DESCRIPTION AND BACKGROUND

2-01 Project Authorization. The Empire Floodgate is a feature of the hurricane protection project, "New Orleans to Venice, La", authorized by Public Law 874, 87th Congress, approved 23 October 1962, to provide hurricane protection in accordance with the recommendations of the Chief of Engineers in his report entitled "Mississippi River Delta at and below New Orleans, La", and contained in House Document No. 550, 87th Congress, 2nd Session. Improvement for prevention of hurricane tidal damages along the Mississippi River below New Orleans, Louisiana, in Reach B-1 between Tropical Bend and Fort Jackson are to be provided by raising the heights of the existing back levees and modifying the existing drainage facilities where necessary.

2-02 Purpose of Structure. Upon completion of the raising of the levees in Reach B-1, Tropical Bend to Fort Jackson, in the project "New Orleans to Venice, LA", the Empire Floodgate will serve to protect the general area from hurricane tidal overflows and will allow water traffic to proceed normally along the waterway from Empire to the Gulf of Mexico. The Empire Floodgate provides drainage for an area of about 365 acres enclosed by the hurricane protection levee, the levee along the Mississippi River, and the levees approximately parallel to the Mississippi River levee which were constructed to approximately elevation 8.0 by local interest.

2-03 Location. The floodgate structure is part of the Hurricane Protection levee system and is located at the hurricane protection levee base line station 101+80.89 in Plaquemines Parish, Louisiana, near Empire at the river end of the Empire to Gulf Waterway. The site is accessible by a temporary road from Louisiana Highway No. 23.

2-04 Local Interest. The Empire Floodgate Structure was turned over to the Plaquemines Parish Commission Council, Pointe-a-la-Hache, Louisiana on 11 May 1976, for maintenance and operation in accordance with the conditions of local cooperation, as specified by the authorizing law. In this connection, maintenance has been construed as keeping all the structure components in first-class condition to serve the purpose for which they were designed.

2-05 Description.

a. General. The Empire Floodgate structure consists of a reinforced concrete gate bay, supported on prestressed concrete piles, timber guide walls, pile supported inverted "T" reinforced concrete floodwalls and uncapped steel sheet piling connecting the "T" floodwalls to the earthen levee on each side. The gate bay is 109 feet in total width and has a channel width of 84 feet. The elevation of the tops of the gatebay and floodwalls is 15.0 feet, and top of sill is at -14.0 feet. The gate is a bottom hinged single-leaf flap gate which, in the open position, is stored in a recess in the base slab of the structure.

b. Foundation. The gate bay and "T"-type floodwalls are supported on 12-inch square prestressed concrete piling with lengths of 78 feet. The gate bay monolith has two rows of vertical piles and two batter pile groups, 2.5V to 1H and 2V to 1H. The "T"-type floodwalls have three batter pile groups, 2.5V to 1H, 2V to 1H, and 3V to 1H. Steel sheet (PMA-22) pile cutoff walls are beneath the gate bay and "T"-type floodwalls to provide protection against seepage. Tip elevations of the steel sheet pile cutoffs beneath the gate bay and "T"-type floodwall monolith T-1 is -40.0 feet. "T"-type floodwall monoliths T-2, T-3,and T-4 steel sheet pile cutoff tip elevations are -30.00, -23.00 and -23.00 feet, respectively. The design of the prestressed piling was based upon actual pile load tests.

c. Gate Bay. The gate bay was designed as a reinforced concrete "U" frame, 50 feet in length with a channel clearance of 84 feet. The top of the gate in its raised position, the gate bay walls and the inverted "T" floodwalls, are at elevation 15.0 feet and the top of the sill is at elevation -14.0 feet.

d. Gate. The gate is fabricated structural steel, mounted on horizontal hinges at the bottom and operated by lifting chains connected to each end of a horizontal girder at the top. This horizontal girder spans the full width of the gate and supports vertical beams at the top. Each vertical beam is supported by a hinge at the

bottom and horizontal ribs span between the veritcal beams to support the skin plate.

e. Gate Operating Machinery. The operating machinery for the floodgate consists of two identical, opposite hand, sets of machinery located on the tops of the gate bay walls. Each set of machinery is comprised of a motor-powered chain hoist and a freewheeling counterweight system. Each chain hoist consists of an electrical motor with rear mounted electric brakes, a right angle speed reducer, a mechanical load brake, a parallel shaft speed reducer, a limit switch, and a synchro transmitter. A wildcat sheave is keyed to the extended output shaft of the parallel shaft speed reducer and engages the die lock chain attached to the gate. The synchro transmitter monitors the position of the wildcats. Each counterweight system consists of an approximately 40,000 lb. weight attached to the gate by the die lock chain passing over freewheeing wildcat sheaves. Other items of mechanical equipment are gate locking devices, gate shock adsorbers, a diesel engine driven vertical water pump, which relieves the suction under the gate, and ratchet jacks used to dog-off the counterweights and relieve the tension of the chain when the gate is in the open position.

f. Electrical Power. Commercial electrical power is furnished for gate operation and interior lighting. An

auxiliary diesel engine- generator, rated at 30 kw, 0.8 PF, 480 volts, 3 phase, 60Hz, is available for emergencies.

g. Floodwalls. There are two types of floodwalls constructed between the gate bay and the adjacent levees. The inverted "T" type floodwall commences at the gate bay wall and extends approximately 150 feet toward the levee on each side of the structure. The inverted "T"-type floodwall consists of a pile-supported concrete base slab and stem, with a sheet-pile cutoff wall. The "T"-type floodwall is supported against settlement and overturning by battered, prestressed concrete piles. The other type of floodwall is the "I"-type and it is still incomplete. The floodwall extending from the edge of the "T"-type floodwall to the levee on each side of the structure consists of uncapped PZ-32 steel sheet piling. After major settlement of the levee embankment is deemed complete, the sheet piling will be cut off below final grade and a new "I" type reinforced concrete floodwall will be constructed over the cut sheet piling.

h. Timber Guide Walls and Fenders. A 300-foot long timber guide wall and 100-foot long timber fender are located on each side of the gate structure. The guide wall is on the west side of the channel and the fender is on the east side. The tops of the guide walls and fenders are at elevation 9.5. The guidewalls and fenders consist of treated timber piles, vertical and batter. A 7-pile timber dolphin is located at the end of each guide wall and fender.

i. Breakwater. A breakwater with top elevation of +3.0 is located to the southwest of the structure. The breakwater will cause the larger hurricane waves in the wave spectrum approaching the structure from Adams Bay to break on the breakwater during the closing operation, thus limiting the incident wave heights to those equal in height to the smaller waves which approach directly along the channel alignment. The breakwater will provide a quieted area and a substantial reduction in wave loads on the gate machinery during closing operations.

j. Access Road. The floodgate structure is presently accessible by a shell surface construction road located along the levee centerline on the east side of the structure. Other access routes will be along the hurricane protection levee, when completed, and across the bridge at the Sunrise Pump Station.

k. Control House. A two-story control house constructed of reinforced concrete is located at the east end of the gate bay and above the east "T" floodwall. The second floor is at elevation 24.00 to enable the operator to view the operation of the gate over the main switch board and motor control center for the operation of the gate. The first floor is used for storage and to house the engine-generator.

l. Approach Channels. The approach channels were dredged to project depth by hydraulic dredge and the side slopes were shaped by dragline.

m. Pump. A two-story pump platform constructed of reinforced concrete is located on the north side of the control house. The first floor has reinforced concrete pipe supports, which are used to support the pump intake suction pipe. The pump and pump motor are located on the second floor. The pump is vertical, 12,000 gallons per minute, TDH of 19.5 feet, and a shut off head of approximately 50 feet. The pump engine is a Detroit Diesel Model No. 1064-7000 with a minimum rating of 238 bhp at 2100 rpm, and with all standard equipment. The pump is used in connection with the raising of the flap gate to a closed position. Water is pumped under the open flap gate in order to break the pressure seal and allow the flap gate to be raised.

n. Boat Dock. The boat dock is constructed of treated timbers on treated timber piles and is located on the north side of the pump platform.

o. Cathodic Protection. Cathodic protection is provided for the gate and is designed to protect both sides. The sacrificial metal type cathodic protection system is used because the structure is unmanned and commercial power was not originally available at the structure site.

2-06 Gate Operating Criteria. The floodgate will be closed when rising tides, in advance of an approaching hurricane, exceed elevation 5.0 on the landside of the structure. The floodgate will be kept closed until such time that the hurricane tides have receded and the stage on

the landside is equal to or higher than the stage on the gulfside.

2-07 Subsurface Conditions. The subsurface at the project site is generally similar to that shown on the profile in the GDM. The foundation soils as indicated by borings 1-SEU and 2-SE through 5-SE, consist predominantly of Recent backswamp clays having soft to medium consistencies, and extending to depths of approximately 90 feet below the natural ground surface. The Recent clays contain 3-feet to 5-feet thick layers of sands at approximate elevations -20, -30, and -50. The 5 to 10 foot thick clay layer, extending from the ground surface, contains organic matter with some peat.

2-08 Instrumentation. Settlement. Permanent settlement reference marks have been installed on the tops of the gate bay structure and the floodwalls as shown on Plate No. 1. The initial elevation of each reference mark was determined when the structure was completed. Observations are made prior to periodic inspections.

2-09 Dewatering Procedure. Dewatering of the gate bay is to be accomplished only at low water periods with the gate in the closed position and by using concrete needle beams. The concrete needles are supported and secured at the top by a steel girder. At the bottom, the concrete needles fit into recesses in the base slab. Before placing the needles, it is necessary to secure the services of a diver to clean out the needle dam recesses. At that time,

it is necessary to close the gate. After the needles are set in place, the gate bay can be dewatered by lowering the water level at a rate not to exceed one half foot per hour. Prior to dewatering, four temporary monitoring points are to be installed on the gate bay walls (two on each side). Elevations and measurements of the distance across the gate bay are to be taken every four hours during the dewatering and refilling periods.

SECTION III - OPERATION AND MAINTENANCE DATA

3-01 Operation and Maintenance Problems. No significant problems have been reported since the previous inspection.

3-02 Actions on Deficiencies From Last Inspection. Periodic Inspection No. 7 of Empire Floodgate was conducted by NOD personnel in January 1993. The report for that inspection was not finalized. Deficiencies and recommendations, along with corresponding proposed remedial actions, were not received by Plaquemines Parish. Hence, any corrective actions as well as routine maintenance were performed as deemed necessary by the Parish. The remedial actions proposed for deficiencies found during this inspection (No. 8), as described in Section VI of this report, will also correct deficiencies found during Inspection No. 7. Observations made by inspection team members during Periodic Inspection No. 7 are included in Appendix B of this report.

SECTION IV - REVIEW OF DESIGN AND ANALYSIS OF INSTRUMENTATION

4-01 Review of Design. A detailed comparison of the original design criteria to current design criteria was performed. The design of the concrete and structural steel portions of the structure was based on EM 1110-2-2101, dated November 1963, "Working Stresses for Structural Design" which is still current, with minor revisions, for structural steel elements. The design criteria for concrete elements has been revised and is now governed by EM 1110-2-2104, dated June 1992, "Strength Design for Reinforced Concrete Hydraulic Structures". A review of the original design utilizing this new criteria, but with the original design hydraulic loadings, indicates the following:

1) The design of the floodgate structure meets or exceeds the current criteria.

2) The design of the tie-in floodwalls appears to not meet the current criteria based on a detailed review of the floodwall monolith adjacent to the floodgate (Monolith Nos. T-1R or T-1L). Potential design deficiencies noted were:

a) The base slab, using the design pile loads, appeared to be overstressed in shear and does not quite meet the criteria for flexure and axial load. It is recommended that the pile reactions be reevaluated since a cursory review appeared to indicate that some of the loads may be in error.

b) The wall stem appeared to be slightly overstressed in compression when considering the original design wave loading which may be high using current hydraulic criteria. The structure has likely experienced stages close to those anticipated during the design. The design wave loading however, probably has not occurred since no major hurricanes have struck the area since 1975.

Since the floodwall appeared to not meet the current criteria and because of uncertainties in both the hydraulic loading and the design pile reactions, it was recommended that the floodwall monolith design be reviewed in detail.

Subsequent to the inspection, NOD Engineering Division personnel conducted a detailed structural design analysis of Monolith T-1R using current hydraulic criteria, and it was concluded that the design of T-1R meets the most current strength and load criteria established for design of hydraulic structures. This is discussed further in paragragh 6-01.

4-02 Analysis of Instrumentation Data.

a. General. The engineering measurements at Empire Floodgate consist of cross sections and profiles of the approach channels and elevations taken on the settlement reference marks on the floodgate structure, the east and west concrete "T" walls, the east and west sheet pile walls, and concrete hubs in the earth fill adjacent to the north face of the sheet pile walls. Joint opening measurements are taken between the reference marks adjacent to joints in

the "T" walls. Analyses of the engineering measurements are presented in the following paragraphs.

b. Settlement Reference Marks.

(1) General. The locations of the reference marks are shown on Plate No. 1 and tabulations of the survey data are presented on Plate No. 2. Plots of the settlement data versus time are presented on Plate Nos. 3 through 6. The data presented include the initial survey in 1975 and five sets of data from 1984 to 1993. The February 1992 data generally show rebound and have apparently been confirmed to be in error (suspected error of 0.07 feet). The east sheet pile wall was raised by pulling in 1992. The 1992 and 1993 data were obtained after the raising and are therefore not related to prior readings. The design grade for the top of the floodgate structure and the walls is elevation 15.0 (NGVD), and the design grade for the levee adjacent to the sheet pile wall is elevation 8.0 feet (NGVD).

(2) Floodgate Structure and T-Walls. The survey data indicate the floodgate structure was 0.24 to 0.32 feet below the design grade of 15.0 feet (NGVD) at the time of the initial set of readings in December 1975, the west T-wall was 0.21 to 0.41 feet below grade, and the east T-wall was 0.33 to 0.43 feet below design grade. Total settlements since the initial survey (through January 1993) have been from 0.38 to 0.47 feet for the floodgate structure, 0.37 to 0.51 feet for the west T-wall, and 0.47 to 0.90 feet for the east T-wall. The greater settlements

have been at the ends of the T-walls where the T-walls abut the "I"-type sheet pile walls. This is illustrated graphically by the plots on Plate No. 6. The greater settlements at the ends of the T-walls are caused by the stresses induced into the foundation soils by the presence of the levee. Differential movements from one end to the other of the easternmost and westernmost T-walls monoliths have been 0.27 and 0.11 feet, respectively. These differential movements have caused the end monoliths to rotate down on the ends. This rotation has caused significant joint openings between the end monoliths and the adjacent monoliths. The joint openings are discussed further in paragraph 4-02.c. The rate of settlement appears to be decreasing with time as would normally be expected. The settlement readings have been made over a time span of 18 years. The percent of the total measured settlement that had occurred at the end of the first nine years (1975 to 1984) was 87 to 97 for the floodgate structure, 80 to 95 for the west T-wall, and 71 to 87 for the east T-wall. The percent of the total measured settlement that has occurred over the last five years (1988 to 1993) has been from 5 to 10 for the floodgate structure, 8 to 13 for the west T-wall and 10 to 14 for the east T-wall. Differential vertical movements between monoliths have been moderately small. Total differential vertical movements between the floodgate structure and the adjacent T-wall have been about 0.02 feet

and less. Total differential vertical movements between adjacent T-wall monoliths have been about 0.01 feet and less.

(3) Sheet Pile Walls and Levees. As mentioned previously, the east sheet pile wall was raised in 1992 and subsequent readings are therefore not related to the prior readings. Also, the 1992 data are apparently erroneous. Therefore, the 1988 data are used as the most recent data in evaluating settlement of the top of the east sheet pile wall. Other data are also in error or missing as indicated by the notes on Plate No. 2. The survey data indicate the east sheet pile wall was 0.87 to 1.24 feet below the design grade of elevation 15.0 (NGVD) at the time of the initial set of readings, and the west sheet pile wall was 1.13 to 2.35 feet below design grade. Total settlements have ranged from 0.59 to 1.07 feet for the west sheet pile wall and from 1.58 to 1.86 feet for the west levee. The greater settlements have occurred on the ends where the sheet pile walls transition into the full levee section. This is illustrated graphically by the plots on Plate No. 6. Similar to the floodgate structure and T-wall, the rate of settlement for the sheet pile walls and levee is decreasing with time. The percent of the total measured settlement (through 1993 or either 1988 as applicable) that has occurred at the end of the first nine years (1975 through 1984) ranged from 70 to 88 percent. These comparisons are distorted, somewhat by the limited data since 1988; however, they do indicate that the settlement rates are decreasing

with time. Settlement of the levee embankment relative to the sheet pile walls has ranged for 0.42 to 1.03 feet on the east side. Similar data is available at only one location on the west side and indicates a settlement of 0.79 feet.

c. Joint Openings. Joint openings on the west T-wall vary from a maximum of 0.65 inches to a minimum of 0.01 inches from the westernmost joint to the easternmost joint. Joint openings on the east T-wall vary from 0.24 inches to 0.77 inches from the westernmost joint to the easternmost joint. The fact that the greater joint openings have occurred between the end and adjacent monoliths is consistent with the differential movements in the end monoliths that were discussed previously. An average of 65 percent of the total joint opening movement had occurred by 1984, and an average of only 14 percent of the total joint opening movement occurred during the time period 1988 to 1993. Therefore the joint openings are consistent with the indicated settlements with respect to both magnitude and rate of settlement.

d. Conclusions. Appreciable settlements and joint openings have occurred since the structure was constructed. However, the rate of the movements has significantly decreased with time. Also, the magnitude of the movements is fairly consistent with the subsurface soil conditions. With the settlements measured to date, the floodgate structure is now approximately 0.6 to 0.7 feet

below its design grade, the west T-wall is about 0.7 to 0.9 feet below grade, and the east T-wall is about 0.7 to 1.3 feet below the design grade. The east sheet pile wall was raised and is now 0.27 feet to 0.32 feet above design grade, and the west sheet pile wall is approximately 1.7 feet to 3.0 feet below grade. Because of the significant settlements and joint openings, all joints were closely observed durng this inspection (No. 8) to determine the condition of the waterstops and joint filler materials.

e. Scour Surveys. The scour surveys consist of cross sections along 20 ranges in the structure area and the north and south approach channels. The locations of the 20 ranges are shown on Plate Nos. 7 and 13. The centerline profile for the structure and north approach channel is presented on Plate No. 8, and comparative cross-sections are presented on Plate Nos. 9 through 12. The plots on these plates dated 6 April 1993 should be corrected to 28 February 1992. The centerline profile for the structure and south approach channel is presented on Plate No. 14 and comparative cross-sections are presented on Plate Nos. 15 through 18. The plots on these plates dated 6 April 1993 should be corrected to 28 February 1992. The earliest survey plotted on the profile and cross-sections is dated 21 May 1976. Subsequent surveys plotted were made in June 1982, January 1983, February 1992 and January 1993. Comparison of the 1976 survey and the more recent surveys indicates primarily deposition in the channel and some

erosion at about the water line. The deposition appears to vary from survey to survey. The deposition is typically 2 to 3 feet thick in the center of the channel and 5 to 7 feet thick along the edges. The erosion at the waterline is variable. In some reaches where the natural ground surface is only 1 or 2 feet higher than normal stage, the erosion has caused the bank line to recede as much as 20 feet or more. During this inspection, the receding bank lines were closely observed to determine their present condition and potential influence on the levee. Loss of stone from the breakwater due to erosion was noted in a previous inspection. Therefore, the breakwater was also closely observed during this inspection.

SECTION V - INSPECTION

5-01 Inspection Team. Periodic Inspection No. 8 of the Empire Floodgate was conducted on 17 January 1996 by the following personnel:

LOWER MISSISSIPPI VALLEY DIVISION

Mr. Malcolm Dove	Engineering & Tech Services Directorate
Mr. Frank Johnson	Engineering & Tech Services Directorate

NEW ORLEANS DISTRICT

Mr. Johnny Drummond	Gen. & Env. Des. Sec. (COR)
Ms. Colette Bozant	Operations Division
Mr. Brian Keller	Operations Division
Ms. Amy Elsensohn	Operations Division

BROWN, CUNNINGHAM & GANNUCH, INC.

Mr. Luther Newton	Project Engineer
Mr. Doan Modianos	Mechanical Engineer
Mr. Robert Yokum	Structural Engineer
Mr. Larry Cooley	Geotechnical Engineer
Mr. Kenneth McLaughlin	Electrical Engineer

PLAQUEMINES PARISH GOVERNMENT

Mr. Ruben Victory	Floodgate Operator, Drainage Division

Inspection team members from left to right: Mr. Dove, Ms. Bozant, Mr. Victory, Ms. Elsensohn, Mr. Drummond, Mr. Johnson, Mr. McLaughlin, Mr. Modianos, Mr. Cooley, Mr. Yokum, Mr. Newton and Mr. Keller.

b. A supplemental inspection of the gate and gate operating components with the gate in the closed (raised) position was conducted on 13 February 1996. Inspection team members were: Messrs. Brian Keller and Bruce Bivona and Ms. Colette Bozant, NOD, Messrs. Doan Modianos and Robert Yokum, BCG, and Messrs. Ruben Victory and Henry Urban, Plaquemines Parish Government.

5-02 Orientation. A condensed project description was presented by Mr. Luther Newton, Project Engineer, Brown, Cunningham & Gannuch, Inc. Mr. Victory, Floodgate Operator,

Plaquemines Parish Drainage Department, stated he knew of no new operational problems since the previous inspection. Each Brown, Cunningham & Gannuch, Inc. team member then presented the project features they would be inspecting and what they would be looking for. The plan for accomplishing the inspection was then discussed and agreed upon.

5-03 Observations.

a. General. At the periodic inspection on 17 January 1996, the floodgate was not unwatered and the gate was fully open (in the recess in the sill). Mr. Victory, Plaquemines Parish, Floodgate Operator, stated that he had not received word that the gate was to be closed (raised) and that no public notice had been issued to warn navigation interests that the floodgate would be closed to marine traffic while the gate was closed for inspection. The gate was consequently operated (raised) only enough to determine that the gate operating machinery was functional, but not enough to inhibit navigation through the floodgate. At the time of the inspection the stage was 0.5 feet NGVD. A detailed visual inspection was made of all features of the structure above the water level. The gate was subsequently closed (raised) on 13 February 1996 for the supplemental inspection of the gate and its operating components. At this time the stage was 0.2 feet NGVD. The overall condition of the structure is fair. See Photo No. 1.

b. Concrete.

(1) In general the integrity of the gate structure and the floodwalls is good except for conditions

noted in the following sub-paragraphs. Some minor cracking, spalls, and small popouts were noted, but these have no bearing on the function of the structure. The spalls should be reparied with epoxy as previously recommended.

(2) The floodwall concrete was found to be in overall good condition. No significant cracking or spalling of the concrete was noted. The "L" type waterstop at the juncture of monolith T-4R and the sheet pile floodwall on the east side was in proper contact to seal the joint. On the west side of the structure, a gap of approximately 1 to 1 1/2 inches exists between the "L" type waterstop and its sealing contact area on monolith T-4L. See Photo No. 2. At the joint between Floodwall monoliths T-3L and T-4L (west side) and T-3R and T-4R (east side) the waterstops were torn to a point in excess of four feet down from the top of the monoliths. See Photo No. 3. The waterstops were torn as a result of differential settlements between the east and west ends of monoliths T-4L and T-4R. None of the floodwall monolith joints are sealed with joint sealer, and the joint filler material has deteriorated to such extent that much of it is completely gone. The "L" type waterstop at the juncture of floodwall monolith T-4L and the sheet pile floodwall on the west side of the structure should be remounted on the sheet pile such that it effectively seals the presently open joint. The joints between the concrete floodwall monoliths should be sealed with an approved (approved by New Orleans District Materials Engineer)

joint sealer, with particular emphasis on joints where the waterstops are torn.

(3) The gatebay concrete was in good condition. No new cracks or spalls were observed. The spalls noted in previous inspections have not been repaired and appeared to be in the same condition previously noted.

c. Embedded Metals and Miscellaneous Metals

(1) Corrosion of the embedded metals continues to worsen. As a minimum, it is recommended that the corroded areas of embedded metals above water be cleaned and painted. Any embedded metals below water level that are accessible during dewatering should be evaluated for the effects of corrosion and cleaned and painted accordingly during the unwatering.

(2) Corrosion and deterioration of the paint systems was noted on all the exterior miscellaneous metals (handrails, stairs, ladders, safety chains, etc.) See Photo Nos. 4, 5 & 6. The exterior miscellaneous metals should be cleaned and painted.

(3) The handrails on the boat dock have deteriorated to such extent that they no longer provide the safety features they were designed for. See Photo No. 6. The handrails on the boat dock should be repaired or replaced as applicable (depending on their condition) and properly reinstalled.

(4) The bottom tread and bottom attachment plate on the boat dock stairway are severly corroded and should be replaced, and the entire stairway then cleaned and painted. *The access ladder on the east side of the pump platform is badly corroded in the splash zone. The ladder should be repaired or replaced and painted as required.* (See Photo No. 5.)

d. Gate. As stated in subparagraph 5-03a the gate was opened (raised) only slightly, approximately 2 feet vertically, during the periodic inspection of 17 January 1996. Therefore no portion of the gate could be visually inspected at that time. The gate was subsequently closed (raised) fully on 13 February 1996 and those portions of the gate above the water surface were inspected. The overall condition of the gate that was exposed to view was very good. The coating system and cathodic protection system have been very effective against corrosion. See Photo Nos. 7, 8 and 9. As the gate was being closed (raised) a silt accumulation was noted on the top (skin plate) surface of the gate. This accumulation appeared to be at least 18-inches thick at the outer perimeter of the gate and at least 12-inches thick near the center of the gate. The silt accumulations subsequently "slid off" the smooth skin plate surface as the gate continued to raise. This silt accumulation is a significant load to overcome by the hoist chain and operating machinery when the gate is being closed,

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but does not exceed the design load of four (4) feet of silt on the gate at initiation of closing. There is a noticable "silt marking" on the vertical members on the "underside" of the gate. See Photo Nos. 7 and 8. This evidence, along with the obvious siltation on the chamber floor, leads to the conclusion that silt and other debris intrude into the gate recess in the chamber floor. This precludes the gate fully recessing, causing its surface to protrude above the level of the chamber floor. As a result, the top of the gate has apparently been damaged by heavy laden vessels passing through the floodgate structure. See Photo No. 9. This damage was observed at both the 1990 and 1993 periodic inspection. Major silt removal from in and around the gate recess is accomplished by either a bucket or jet dredge. At the request of Plaquemines Parish, NOD in 1973 designed and built, and turned over to Plaquemines Parish, a small jet dredge which could be used to clean the silt from small recesses in the concrete and around the gate hinges not easily cleaned by conventional dredge methods. Removal of silt from the gate recess is obviously an appreciable expense, and results in the structure being closed to navigation an appreciable length of time. Ideally, the gate recess would be cleaned out each time the gate is closed, just prior to reopening the gate.

e. Gate Operating Machinery.

(1) The gate operating equipment package for each side of the structure consists of an "outdoor" type

package consisting of a 7.5 horsepower electrical motor driving the main hoisting chain sprocket (called a "wildcat" sprocket) through a drive system consisting of several gear reducers, shaft couplings, etc., with auxiliary components such as brakes and synchronizing elements connected thereto. See Photo Nos. 10 and 11. Each package is mounted on a steel base unit partially embedded in the concrete gate bay structure. Weather protection for certain components is provided by a metal cover system bolted to the steel base unit. The inspection team noted that access to the west side of the structure is along the top of the protection levee, a distance of over a mile, utilizing a light duty vehicle, and only during good weather, to the juncture of the levee and the sheet pile floodwall. From that point tools, equipment, lubricants, etc., necessary for normal maintenance must be handcarried down the levee, across a sodded berm area, up a fixed ladder to the walkway on top of the concrete floodwall, and thence along the walkway to the proximity of the gate operating machinery. Access to the east side of the structure is relatively easy, but still requires handcarrying of equipment, tools and/or supplies up a stairway to the walkway on top of the concrete floodwall, and thence along the walkway to the proximity of the control house and gate operating machinery. The negative features of the access difficulties impact and probably contribute to deficiencies in maintenance.

(2) All operating components of the drive trains were in operating condition. All the anchor bolts were tight and no movement symptoms which could lead to misalignments were observed.

(3) The paint systems on the exterior surfaces of the gate operating machinery exposed to the weather has deteriorated badly and corrosion was noted in many areas. The exposed surfaces of the gate operating machinery should be cleaned and painted.

(4) The lubrication of the various gear drives with self contained oil reservoirs was satisfactory and oil leakage at shaft seals was not observed, hence the condition of the seals was judged satisfactory. In general the harshness of the environment demands more frequent lubrication of greasing points, particularly the large pillow block bearings of the chain sprockets. It is recommended that a frequency of lubrication for greasing points be established, and the local interest be requested to comply with the schedule.

(5) The hoisting chain sprockets (wildcat sprockets) are mounted on the output shaft of the last stage of gear reduction. The hoist chains are an 8.5-inch pitch anchor type chain with each link reinforced by a cross bar. See Photo No. 12. The chain had been coated with a paint system (appeared to be Coal Tar Epoxy), but this coating has been severly damaged and chipped as a result of its engagement with the sprocket, and wear at the points of

tensile contact between the links. Maintaining a protective paint coating on a chain operating in a manner such as the hoist chains do is impossible.

(6) The BCG inspection team was concerned that siltation on the skin plate side of the gate, added to the ineffeciency of the gate recess flushing system, has increased the hoist and hoist chain loadings such that it appeared to be higher than the original design loads assumed. The full load torque of the 7.5 horsepower, 1750 RPM, electric motors when their speed is reduced to 0.3 rated RPM, can exert a chain pull of about 130,000 pounds. However, a standard induction motor, such as those here, can easily exert a torque of 2.5 times the full torque for very short time periods. Unless the overload lasts long enough to activate the motor overload devices, the hoist chains can momentarily be subjected to loads approaching 250,000 pounds each. However subsequent investigation by NOD determined that the chain specified in the original contract documents had a design breaking strength of 548,000 pounds, providing a safety factor of 3.4 for the maximum design hoisting load (161,000 pounds). The chain is not of the type that would be considered a traditional power transmission chain, and doesn't have rollers or any other such features to reduce the friction between the links when engaging with the sprocket. The sprocket is a steel casting of ordinary consistency, not hard surfaced or case hardended to resist wear. The sprocket is about the smallest pitch diameter that

is allowable for this size chain, hence the angular articulation of an individual link compared to its sister links is of the greatest magnitude. The inspection team noted that both the drive sprocket and hoist chain was devoid of any chain lubricant. The point of tensile contact of the chain links in the sprocket is showing wear and corrosion as these wear points are highly susceptible to stress corrosion effects. The sprockets are also showing wear effects at the points of chain link contact that transmit the tensile loads. The combined net effect of these conditions is to produce a noisy drive, characterized by occasional sharp ringing noises as the chains engage and disengage with their sprocket. These snaps of the chain are clearly accompanied by substantial dynamic effects as the chains can be observed to vibrate in phase with the noises. The operation of the hoisting chain, was disconcerting. It was also noted that a link in the hoist chain on the west side had failed during an attempted gate raising in September 1995. The failed link was replaced with a "connecting" link. See Photo No. 12. The drive train clearly did not receive any damage as a result of the chain link failure. The failure of the link makes the ability of the hoist chains to withstand the imposed loads suspect. The following conclusions are made:

(a) Copious and frequent application of an environmentally compatible chain lubricant should be applied to the hoist chains and the sprockets. As a minimum this

should be accomplished prior to (those portions accessible) and during gate operations. This will provide immediate beneficial results. Prior to application of the lubricant the chain and the sprocket to be lubricated should be cleaned (as a minimum washed and allowed to dry) prior to application.

(b) The chains were thoroughly visually inspected at the supplmental gate inspection on 13 February 1996. The segments of chains in the zone of normal tidal fluctuation and several links below the zone, are severly corroded and encrusted with oyster shells and other barnacle type growths. As these segments of chain engage with the hoist sprockets, the encrustations fracture and crumble and contribute to abrasion of the chains and sprockets. The portions of the chains that are normally submerged are less corroded than those normally in the zone of normal tidal fluctuation, but more corroded than those that are normally dry. The observed corrosion of the chains has obviously weakened the strength of the chains as verified by the previously noted failure of one of the links in the hoist chain on the west side.

(c) Necessary electrical test instruments should be used to precisely determine the hoist motor loads, thence the determination of torques applied, and subsequently the resultant chain loads applied. This information will assist in making decisions on replacement of the hoist chains, along with the degree of urgency to do so as well as provide

material for future evaluations of the hoisting equipment.

(d) The BCG inspection team considers it desirable to accomplish remedial repairs to the sprockets to aleviate binding of the hoist chains in the sprockets. This can be accomplished by careful weld surfacing of the sprockets followed by grinding to the proper countours. NOD Engineering Division design personnel stated they do not consider the above suggested repairs to be necessary as they do not agree that the hoisting chains are binding in the sprockets. They further stated that noisy operation is typical for the type of hoisting systems utilized at Empire Floodgate, and in this case, is not indicative of improper chain/sprocket contact. In view of the BCG inspection team's concern for the condition of the wildcat sprockets, it is suggested that appropriate NOD personnel visit the site and observe the operation of a closing/opening cycle of the gate and then make a determination as to whether any repairs to the wildcat sprockets are needed.

(e) There is no alternative method of raising the gate in the event of failure of any component of the gate operating machinery, including the hoist chains and counterweight chains. The Corps Operations and Maintenance Manual for Empire Floodgate specifies that the gate should be test operated monthly and operated through a complete closing and opening cycle quarterly. This is not being done. However, operational cycles performed to verify readiness of the systems may subtract from the total of

operating cycles available for the necessary closing of the gate. The determination of whether or not to perform readiness check operations should be made by the NOD in conjunction with Plaquemines Parish Officials.

(7) The counterweight is a smaller chain version of the main hoist system, but with a counterweight providing the motive force on the chain. The counterweight chain on each side connects to the gate and then passes over two "wildcat" sheaves to a counterweight which is suspended by the chain in a pit chamber, allowing vertical movement of the counterweight. The same deficiencies found on the hoist chains were noted on the counterweight chains, but with corrosion effects having a greater impact on the stress and load capability because of the hoist chains smaller sizes. Because of the high design factor of safety of the counterweight chains (approximately 5) NOD Engineering Division design personnel do not believe that the current corrosion effects noted on these chains are severe enough to impact their performance. *The steel counterweight cages are badly corroded and should be cleaned and painted.* Ratchet type load binders were provided to allow removal of the counterweight load from the counterweight chains and thus from the gate, when the gate was open. The load binders on the counteweights were not in place. See Photo No. 13. Clearly the intent was to disconnect the binders immediately prior to a gate closing, (raising). The

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consequences of the counterweight chain breaking would be most inconvenient and costly to repair if the counterweight dropped to the bottom of it's pit. This was surmised to be the purpose of attaching the binders to suspend the counterweights. On the other hand, the operational hassle and personnel safety hazards making or disconnecting the connections of the load binders, and the difficult accessibility of the west side of the structure, all militate against continuance of suspending the counterweights. Recommended remedial measures for the hoist chains and sprockets, except replacemnt of the chains, are applicable to the counterweight chains and the sprockets. The suspension of the counterweights using the load binders should be evaluated by the NOD in conjunction with Plaquemines Parish officials and then either utilized or discontinued.

f. Gate Recess Flushing System. A system consisting of pipe with jet nozzle holes in the gate recess, and the necessary pipe and pump to supply water thereto, is provided to break the vacuum when the gate initially rises out of its open position (in its recess). This assists in closing (raising) the gate by lessening the loads required to lift the gate at the start of the closing operation. The pump is a vertical shaft, mixed flow, top suspended type, driven by a diesel engine through a right angle gear drive. The intermediate shaft between the engine clutch and right angle gear drive is provided with universal joint type

couplings at each end. The engine clutch is the twin disc type. The engine is housed inside a small building, with the right angle gear drive and pump located adjacent to and outside the building. The pump is provided with a basket type suction strainer at its suction bell. The drive gear, pump and engine are difficult to access, and the pump could not be observed or listened to during operation. However, certain conclusions were made by the inspection team during the operation of the system. Mr. Frank Johnson, LMVD, had observed the system in operation shortly after construction. He stated that evidence of distribution of the action of the water could be faintly observed completely across the underwater upper edge of the opened (lowered) gate, as indicated by slight turbulence patterns at the surface. At both the periodic inspection on 17 January 1996, and the supplemental gate inspection on 13 February 1996, the system flow initially showed indications of turbulence only at the chain slot on the east side. See Photo No. 14. This condition did not change until the gate was lifted slightly, at which time a slight turbulence was noted at the west side chain slot. During the supplemental gate inspection, when the gate had been raised about 20 degrees above horizontal, the flow effect at the west side chain slot became more pronounced along with a decrease in the observed flow effect at the east side chain slot. When the gate had reached the full open position, there was no indication of water movement at the east side chain slot. Flow effect at the

west side chain slot was pronounced. Only slight turbulence was noted along the gate. See Photo No. 15. This effect clearly indicates that the flow distribution in the discharge manifold is at present very poor, and that changes in the pump capacity and/or piping frictions destroyed whatever flow balance that initially existed. Clearly the characteristics of this system have changed adversely with the passage of time. Many factors could contribute to this change such as:

(1) Increased friction in the system piping caused by corrosion and growth of marine organisms on the inner surfaces of the pipe, and

(2) Chocking of openings in the inlet strainer by marine organisms, and

(3) Increased clearances between the surfaces of the stationary impeller casing and tips of the pump impeller caused by corrosion and erosion effects, and

(4) Corrosion of the diffuser bowl vanes. A pump of this type, with cast iron bowl and bronze impeller, will suffer from internal electrolysis effects of disimilar metals, more so in a salt water environment, and especially when the pump is idle and submerged, as is the case at Empire Floodgate. It is estimated that the cumulative impact of the preceeding effects could easily reduce the pump capacity by 30 percent, without any corresponding reduction of engine load. The pump does not appear to run particularly rough, but conversely is not as smooth as a

pump in "mint" condition. The engine is normal for a machine of its age, a bit ragged in engine response, but without indications of requiring overhaul. The engine muffler however needs replacing. Lubrication of the engine was satisfactory. It is recommended that the pump be removed and renovated with new or reconditioned parts. It is also recommended that consideration be given to replacing the pump suction bowl with a larger one. This remedial work is not thought to be as urgent as the recommended remedial work for the gate hoisting system.

g. Hydraulic Systems. Hydraulic systems were provided for safety latching of the gate in the closed position, and for shock absorption when the gate approaches the fully closed (raised) position. These systems were not operable during this inspection, and certain of the motive components, the electric motor/hydraulic pump combination which generates the hydraulic pressure, were not in place. It is recommended that the hydraulic systems be restored to the original design operational capability.

h. Emergency Power Generator. Reportedly the unit had recently experienced problems operating. Cleaning of the fuel tank and filters apparently corrected the problem since the unit performed adequately while supplying power to raise the gate slightly (5 to 10 min.). The unit did stall once after it was started. The reason was not apparent, and the unit restarted with no problem. Response to load application was adequate, considering the age of the

unit and its outdated voltage regulator and governing system. When the load was removed the unit exhibited some noise of a hunting nature. General maintenance on the unit is needed. Fan belts are old and loose and should be replaced and adjusted. Cooling water hoses are old and showing sign of fatique. Fuel or lube oil has been leaking on the floor for sometime. The leak should be isolated and repaired, and the floor area cleaned. General housekeeping of the generator room should be performed. See Photo No. 16.

i. Electrical.

(1) Two of the existing pole type area lights on the east side of the structure need diffuser lenses. One of the area light poles has been removed and the wires to it are exposed. The diffuser lenses should be replaced. The exposed wires to the removed pole should be removed unless the pole is replaced. *The Parish Officials have stated the original 24' tall light poles were being hit and knocked down by shrimp trawlers and other vessels passing through the structure and the existing lights were installed several years ago.*

(2) All three of the area light poles on the west side of the structure have been removed. Two of the poles are stacked on the access walkway on top of the west floodwall and the third pole is lying on the west gatebay wall. See Photo No. 17. The poles should be reinstalled or the exposed wires to their bases removed.

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(3) At the gate latching device on the east side, the motor and hydraulic unit are in place, but the junction boxes are open with wiring hanging out. The wiring should be properly reconnected after the gate latching device is restored to operable condition (See subparagraph 5-03g).

(4) Switchgear and controls appeared to be operating properly.

(5) The navigation lights on the dolphins were not tested but appear to be in good condition based on visual inspection. The units are solar powered and appear to have been recently installed. See Photo No. 18.

j. Needles and Needle Girders. The concrete needles and steel needle girders are properly stored and in good condition. See photo No. 19. Non-destructive testing of fracture critical welds on the steel needle girders has not been performed. Since Empire Floodgate is a "local interest" structure, the responsible "local interest" (Plaquemines Parish) is responsible for performing the necessary non-destructive weld testing. *The 12-inch treated timber used as spaces between the needles and needle girders are badly decayed.*

k. Timber Guidewalls. The overall condition of the timber guidewalls, fenders and dolphins was very good. Caps were in place on the timber piles. See Photo No. 20. On the northwest guidewall one timber may need replacement in the very near future and on the northeast guidewall two

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timbers will need replacement in the near future. See Photo No. 21.

(1) Boat Dock. One of the deck boards is missing and the handrails are in very bad condition. See Photo No. 6. The missing board creates a safety hazard and should be replaced as soon as possible. The poor condition of the handrails also creates a safety hazard and they also should be replaced. Replacement of the handrails has previously been addressed in subparagraph 5-03c.(3).

m. Channels.

(1) The stone breakwater at the southwest end of the channel appears to have lost some stone on the lakeside end over a distance of some 50 to 75 feet. See Photo No. 22. A loss of stone in this area was previously noted at the 1990 inspection. The design grade for the breakwater was elevation 3.0. Based on the water surface elevation at the time of this inspection, the existing grade of the stone in this area appears to be about elevation 1.0. The breakwater original section appears to be intact between the apparent low area and the levee tie-in with no signs of erosion. One of the Plaquemines Parish employees at the inspection reported that erosion of the lake bottom is apparently occurring beyond the end of the breakwater. Originally the lake bottom in that area was so shallow that small boats had to go around the area. Currently small boats cross the area with no apparent difficulty. A detailed survey of the breakwater should be made to

determine the actual grade and section of the breakwater and also to determine the extent of any erosion of the lake bottom beyond the breakwater area. An evaluation should then be performed to determine if existing conditions are adequate to provide the required reduction of wave forces on the floodgate. If not, the breakwater should be restored to its original design grade and section. Erosion of the lake bed should also be evaluated to determine if any remedial measures are required, and if so remedial measures accomplished.

(2) As discussed in subparagraph 4-02e the bank lines in the unprotected areas are receeding due to wave wash. The greatest amount of erosion has occurred in areas where the natural ground surface is only 1 to 2 feet higher than the normal stage. See Photo Nos. 23 and 24. This erosion is variable and has apparently been occurring for several years. Encroachment into the levees does not appear imminent at any location. However, continued erosion will eventually encroach into the levees. The receeding bank lines along the approach channels should continue to be monitored for encroachment that would endanger the stability of the levees.

n. Sheet Pile Floodwalls.

(1) The sheet pile floodwalls top of pile design elevation was 15.0. Based on the latest reliable instrumentation data [see subparagraph 4-02b.(3) and Plate No. 2] the east side sheet pile floodwall, after being

raised in 1992, is now slightly above design grade, while the east end of the west floodwall is 1.7 feet below design grade and the west end is 3.4 feet below design grade. See Photo Nos. 25 and 26. Since settlement of the sheetpile floodwalls is essentially complete, the west sheetpile floodwall should be restored to design grade.

(2) The coal tar epoxy protective coating originally applied to the areas of sheet piling near the ground line has completely deteriorated. See Photo No. 27. It is recommended that the sheet piles be cleaned and painted with coal tar epoxy from slightly below ground line up to the tops.

PHOTO NO. 1 - VIEW LOOKING NORTH ALONG THE CENTERLINE OF EMPIRE FLOODGATE.

PHOTO NO. 2 - JOINT BETWEEN FLOODWALL MONOLITH T-4L AND THE WEST SIDE SHEET PILE FLOODWALL SHOWING THE GAP BETWEEN THE L TYPE SEAL AND MONOLITH T-4L.

PHOTO NO. 3 - JOINT BETWEEN FLOODWALL MONOLITHS T-3L AND T-4L. NOTE TORN WATERSTOP.

PHOTO NO. 4 - VIEW SHOWING DETERIORATED PAINT ON HANDRAIL AND MISSING EYE FOR CONNECTING THE SAFETY CHAIN.

PHOTO NO. 5 - BADLY CORRODED BOTTOM TREAD AND ATTACHMENT PLATE ON STAIRWAY TO BOAT DOCK. NOTE MISSING DECK BOARD.

PHOTO NO. 6 - BADLY DETERIORATED HANDRAILS ON THE BOAT DOCK.

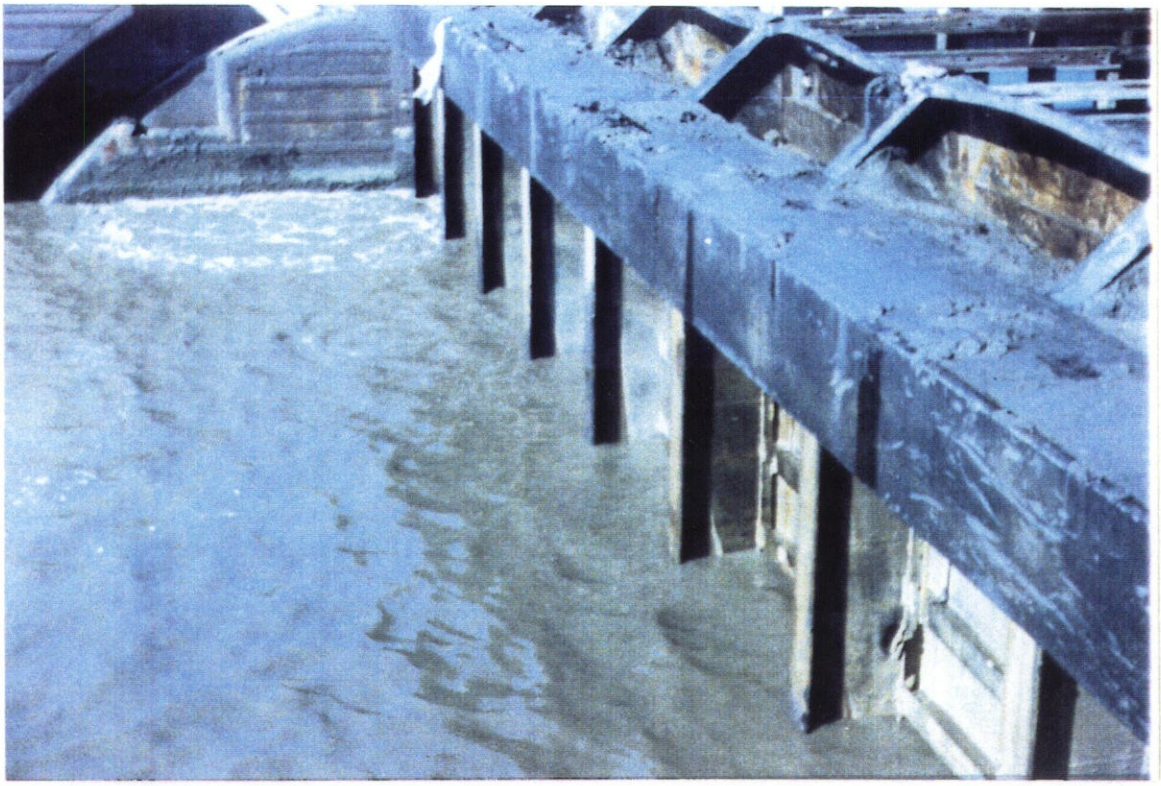

PHOTO NO. 7 - VIEW LOOKING WEST AT UNDERSIDE OF THE GATE. GATE IS IN THE FULLY CLOSED POSITION. NOTE LINES ON VERTICAL MEMBERS MADE BY SILT LINE WHEN THE GATE WAS OPEN (LOWERED INTO ITS RECESS).

PHOTO NO. 8 - VIEW LOOKING EAST AT THE UNDERSIDE OF THE GATE. GATE IS IN THE FULLY CLOSED POSITION. NOTE LINES ON VERTICAL MEMBERS MADE BY SILT LINE WHEN THE GATE WAS OPEN (LOWERED INTO ITS RECESS).

PHOTO NO. 9 - VIEW LOOKING WEST SHOWING DAMAGE TO THE TOP OF THE GATE. NOTE SILT ON TOP OF GATE.

PHOTO NO. 10 - GATE OPERATING MACHINERY ON THE EAST SIDE.

PHOTO NO. 11 - GATE OPERATING MACHINERY ON THE WEST SIDE.

PHOTO NO. 12 - WEST SIDE HOIST CHAIN. NOTE CORROSION AND CONNECTING LINK INSTALLED TO REPLACE A FAILED LINK.

PHOTO NO. 13 - TOP OF WEST SIDE COUNTERWEIGHT. NOTE DISCONNECT LOAD BINDER RATCHET LYING ON TOP OF THE COUNTERWEIGHT.

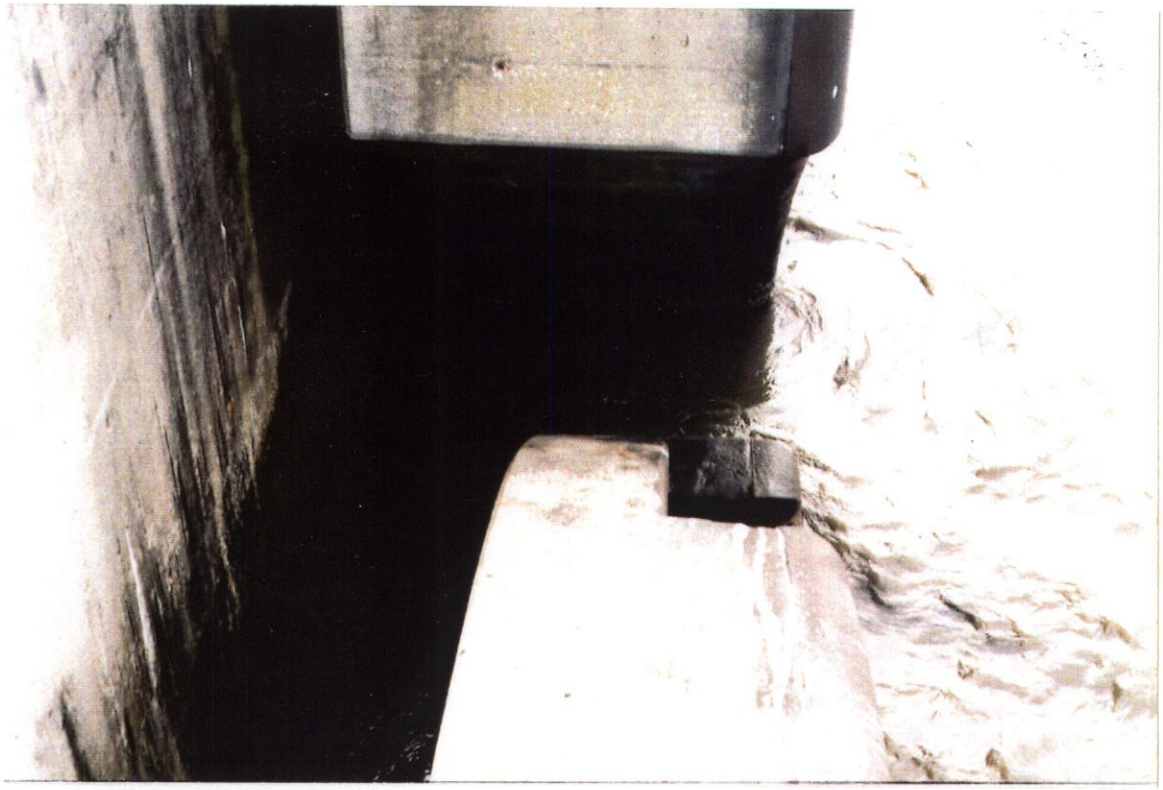

PHOTO NO. 14 - TURBULENCE AT EAST SIDE GATE SLOT DURING PERIODIC INSPECTION ON 17 JANUARY 1996. TURBULENCE IS A RESULT OF OPERATION OF THE GATE RECESS FLUSHING SYSTEM. GATE IS RAISED FROM FULLY OPEN ABOUT 2-FEET.

PHOTO NO. 15 - VIEW SHOWING SLIGHT AMOUNT OF TURBULENCE FROM GATE RECESS FLUSHING SYSTEM WITH GATE FULLY CLOSED (RAISED) DURING THE SUPPLEMENTAL GATE INSPECTION ON 13 FEBRUARY 1996.

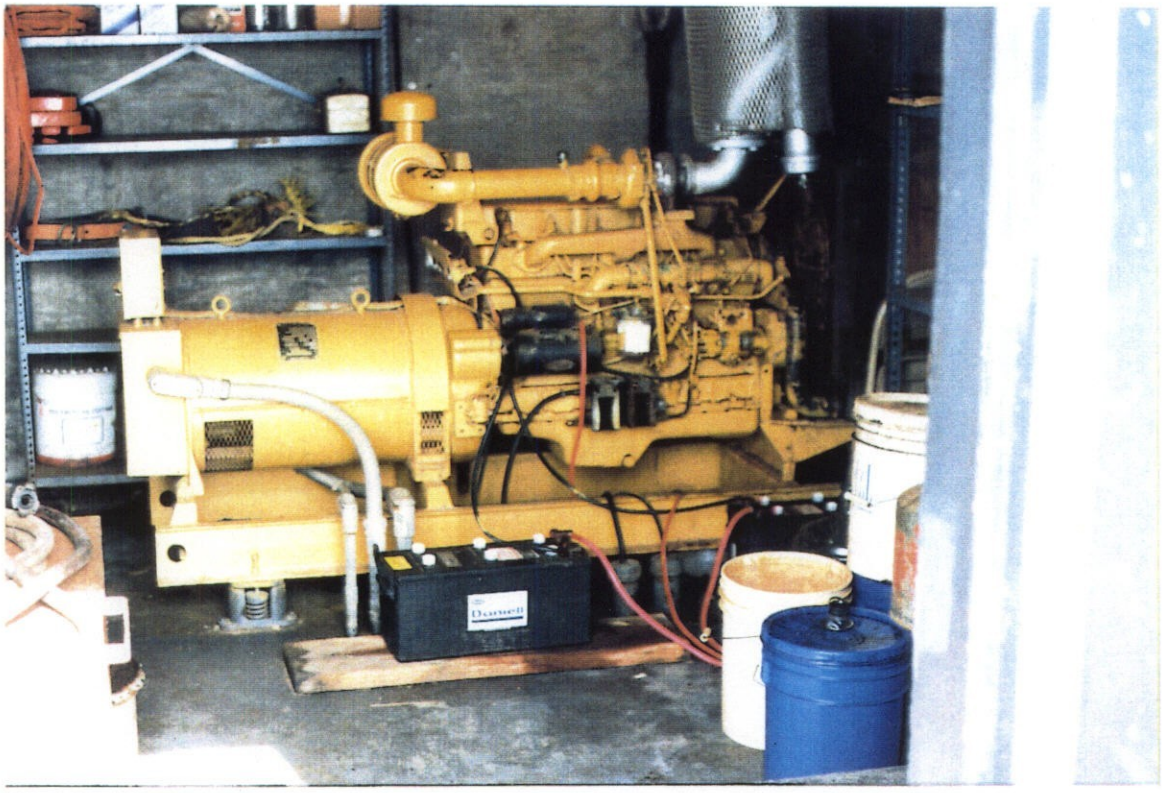

PHOTO NO. 16 - EMERGENCY POWER GENERATOR. NOTE FUEL OR LUBE OIL HAS LEAKED ON THE FLOOR.

PHOTO NO. 17 - LIGHT POLES REMOVED AND STACKED ON THE ACCESS WALKWAY ON TOP OF THE WEST FLOODWALL.

PHOTO NO. 18 - NORTHEAST GUIDEWALL. NOTE NEW APPEARANCE OF NAVIGATION LIGHT UNIT.

PHOTO NO. 19 - VIEW OF STORED NEEDLES, NEEDLE GIRDERS, AND SUPPORTS. NOTE GOOD CONDITION OF PROTECTIVE COATING SYSTEMS.

PHOTO NO. 20 - VIEW OF NORTHWEST TIMBER GUIDEWALL.

PHOTO NO. 21 - NORTHWEST GUIDEWALL. NOTE DETERIORATED TIMBERS.

PHOTO NO. 22 - STONE BREAKWATER AT THE SOUTHWEST END OF THE CHANNEL. NOTE LOSS OF STONE FROM THE END OF THE BREAKWATER.

PHOTO NO. 23 - RECEEDING EAST SIDE BANK CAUSED BY EROSION.

PHOTO NO. 24 - RECEEDING WEST SIDE CHANNEL BANK CAUSED BY EROSION.

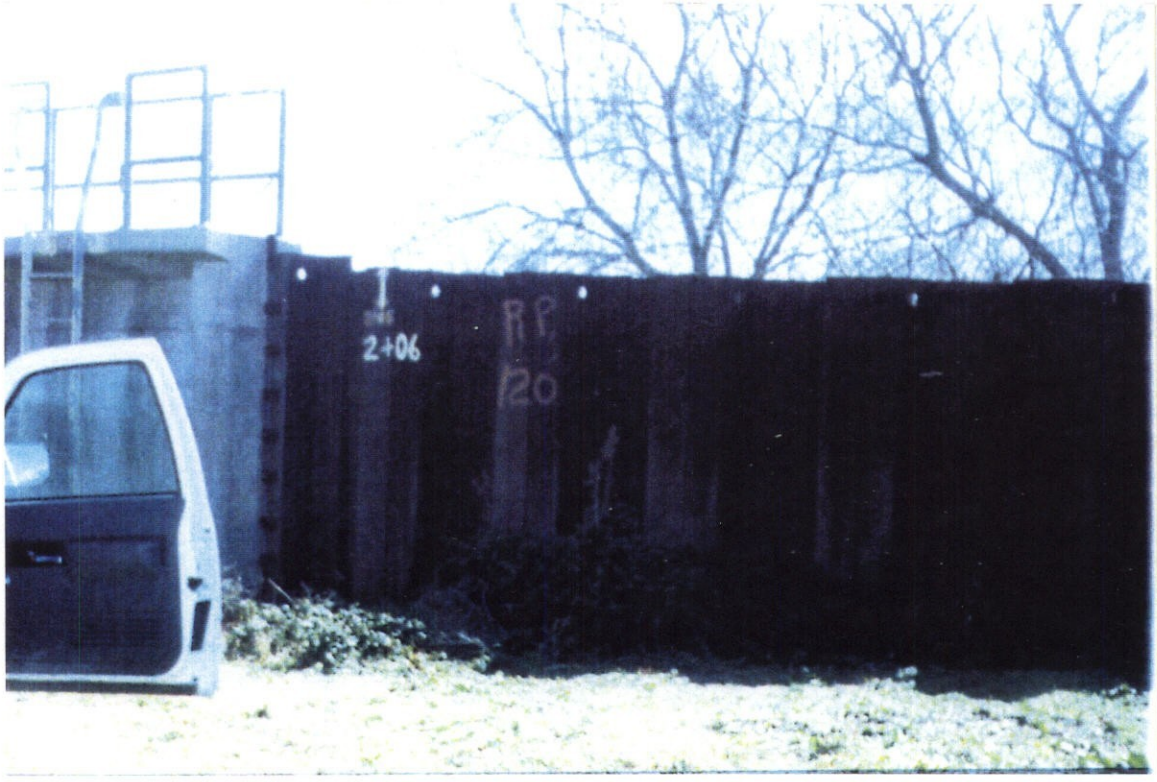

PHOTO NO. 25 - EAST END OF WEST SHEET PILE FLOODWALL. NOTE SETTLEMENT.

PHOTO NO. 26 - WEST END OF WEST SHEET PILE FLOODWALL.
NOTE SETTLEMENT.

PHOTO NO. 27 - VIEW OF SHEET PILE FLOODWALL SHOWING
COMPLETELY DETERIORATED COAL TAR EPOXY.

SECTION VI- CONCLUSIONS AND PROPOSED REMEDIAL ACTIONS

6.01 Conclusions. It is concluded from Periodic Inspection No. 8 and the supplemental gate inspection that the Empire Floodgate gate bay is strucurally adequate. As recommended in paragraph 4-01, NOD Engineering Division personnel conducted a structural design analysis of Monolith T-1R (floodwall monolith) using current wave load data and EM 1110-2-2104, "Strength Design for Reinforced Concrete, Hydraulic Structures", dated 30 June 92. Design pile loadings and reactions were also reviewed. It was concluded that the design of Monolith T-1R meets the most current strength and load criteria established for design of hydraulic structures. The project is adequate from an operations standpoint. In addition, modifications to the west sheet pile floodwall are needed to reestablish its design grade. Routine maintenance by the operating personnel was minimally adequate.

6-02 Proposed Remedial Action. To assure the continued structural integrity and operational adequacy of Empire Floodgate the following remedial measures will be performed by local interests prior to the next inspection, unless otherwise noted.

a. Spalls in the concrete surfaces will be repaired with epoxy.

b. Subsequent to the inspection, the "L" shaped seal at the juncture of monlith T-4L and the west sheetpile wall was remounted on the sheetpile wall to provide for more adjustment and then adjusted to properly seal. This was accomplished by NOD Hired Labor Forces during raising of the west sheet pile floodwall (see para. 6-02 cc).

c. Joints in the concrete floodwalls will be properly sealed. Priority should be given to joints between monoliths T-3L and T-4L (west side) and T-3R and T-4R (east side).

d. Corroded areas of the embedded metals above the waterline will be cleaned and painted. Embedded metals below water level that are accessible during dewatering will be cleaned and painted as necessary during the next dewatering.

e. Exterior miscellaneous metals will be cleaned and painted.

f. Handrails on the boat dock will be repaired or replaced as applicable.

g. The bottom tread and bottom attachment plates on the boat dock stairway will be replaced and the stairway then cleaned and painted.

h. The damage on the top of the gate will be repaired when the gate bay is dewatered.

i. Exposed surfaces of the gate operating machinery will be cleaned and painted.

j. The frequency of lubrication for greasing currently presented in the Empire Floodgate O&M manual will be reviewed by NOD personnel to determine its effectivenss. If necessary, a new frequency of lubrications schedule for greasing points will be established by NOD by the end of the first quarter of FY 97. Local interests will then be requested to comply with the schedule.

k. Copius and frequent application of chain lubricant will be applied to the hoist chains and sprockets prior to and during gate operations.

l. The hoist chains will be replaced.

m. Electrical test instruments will be used to precisely determine the hoist motor loads and then determine the actual chain loads applied. Local interest will be requested to do this with NOD guidance and assistance.

n. NOD will schedule an operation of the gate through a closed/open cycle. Appropriate NOD personnel will

observe this operation. Based on these observations, NOD will make a determination as to whether repairs to the wildcat sprockets are needed.

o. NOD personnel will re-evaluate information in the O&M manual concerning readiness check operations. A determination of whether or not to perform periodic readiness check operations of the gate will be made by the end of the first quarter of FY 97.

p. Remedial actions for the hoist chains noted in subparagraph 6-02 k and for the hoist chain "wildcat" sprockets in subparagraph 6-02n are also applicable to the counterweight system.

q. A determination as to whether or not to suspend the counterweight from the ratchet load binders will be made by the end of the first quarter of FY 97. *The corroded counterweight cages will be cleaned and painted during the next dewatering or as soon as practical.*

r. The gate recess flushing system pump will be removed and rehabilitated. At that time replacement of the intake strainer with a larger intake strainer will be considered.

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s. The inoperative hydraulic systems will be restored to operative condition.

t. The emergency power generator engine belts, water hoses, and fuel lines will be replaced. The fuel oil or lube oil leak will be located and repaired, and the floor area cleaned. General housekeeping of the generator room will be performed.

u. Missing diffuser lenses on the east side area lights will be replaced. The missing area light on the east side will be replaced, or the exposed wires to its base removed.

v. Lighting will be installed to illuminate the structure. THe 24 ft tall original light standards will either be reinstalled or local interests will submit alternative lighting/location to NOD for review.

w. The open junction boxes with wires hanging out at the gate latching device on the east side will be corrected when the hydraulic systems are restored per subparagraph 6-02 s.

x. NOD Engineering Divison will be available to furnish Technial assistance to Plaquemines Parish in performing non-destructive weld testing of fracture critical welds on the steel needle girders.

y. The guidewall timbers needing replacement will be replaced. *Also, the timber spaces on the needle girder storage rack will be replaced during the next dewatering.*

z. The missing deck board on the boat dock will be replaced, *and all the desk boards and timber girders beneath the desk will be thouroughly inspected and replaced as necessary.*

aa. Detailed surveys of the stone breakwater and adjacent area of lakebed erosion will be included in the NOD instrumenation surveys, NOD will evaluate them and formulate any indicated necessary actions.

bb. Receeding bank lines along the approach channels will continue to be monitored for encroachment that could endanger the stability of the levees.

cc. Subsequent to the inspection, NOD Hired Labor Forces raised the west sheet pile floodwall to El. 15.5. The deficient top elevations of the floodgate structure and adjacent T-wall were reported to the NOD project manager for future investigation.

dd. Capping of the sheet piles is not expected in the near future, probably not prior to the next inspection. Therefore, to preserve the integrity of the sheet pile

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walls, the sheet piles will be cleaned and painted with coal tar epoxy from slightly below the ground line up to the tops.

ee. Missing handrail closure chains and attachment eyes will be replaced.

ff. The access ladder on the east side of the pump platform will be repaired or replaced.

6-03 Next Inspection. Due to the significant deficiencies noted at this inspection, it is recommended that the interval between inspections be reduced from five (5) to three (3) years. Accordingly, the next periodic inspection of Empire Floodgate is scheduled for March 1999.

VICINITY MAP

APPENDIX A

LMVD TRIP REPORT

CELMV-ET-ES 6 March 1996

MEMORANDUM FOR RECORD

SUBJECT: Trip Report, Periodic Inspection No. 8, Empire Floodgate, New Orleans District

1. On 17 Jan 1996, the undersigned participated in the eighth periodic inspection of the Empire Floodgate with representatives of the New Orleans District, the Plaquemines Parish Commission Council (local sponsor), and the Architect-Engineer firm of Brown Cunningham & Gannuch which was contracted to perform this inspection. Personnel participating in the inspection are listed in enclosure 1.

2. Purpose. This inspection was made in accordance with the provisions of ER 1110-2-100, Periodic Inspection and Continuing Evaluation of Completed Civil Works Structures, 15 February 1995. The structure was not dewatered for the inspection.

3. Description of Project. The Empire Floodgate is part of the New Orleans to Venice, LA, Hurricane Protection levee system. It serves to provide drainage for an area of about 365 acres inclosed by hurricane protection levees and Mississippi River Levees and allows water traffic to proceed normally along the waterway from Empire, LA, to the Gulf of Mexico.

4. Description of Structure. The Empire Floodgate structure consists of a reinforced concrete gate bay, supported on prestressed concrete piles, timber guide walls, pile supported inverted "T" type reinforced concrete flood walls, and uncapped steel sheet piling connecting the "T" type floodwalls to the earthen levee on each side. The gate bay is 109 ft in length and has a channel width of 84 ft. The floodgate is a bottom hinged single-leaf flap gate, which in the open position, rests in a recess in the base slab of the structure. For a more detailed description of the various components of the project, you are referred to the preinspection brochure.

5. Observations and Recommendations.

a. General.

(1) Plaquemine Parish is responsible for the daily upkeep of the structure, and in general, the structure is in satisfactory condition. However, there appeared to be a general lack of day to day "house keeping" which is necessary for the overall upkeep of the structure. Many of the items that would normally require greasing, obviously had not been greased in months, or even years. Also virtually all of the steel components have accumulated a fair amount of rust, simply due to lack of periodic maintenance. There seemed to be some confusion among the parish representatives as to who was supposed to do

what. For example, no one seemed to know why the structure was in such a run down condition, and was the gate going to be raised as part of the inspection, or when was the gate last operated, and have repairs been made that were recommended at the last inspection, etc. It should be emphasized that the two Parish representatives in the field were very cooperative, and fully capable of performing the tasks requested of them to complete the inspection, however, it appears that someone farther up the chain of command needs to provide more direction for the people in the field.

(1) Based on the information in paragraph 4-02 (2), page IV-3, of the preinspection brochure, and subsequent hydraulic data from CELMN-ED-H regarding the height of the levees and floodwalls on both the east and west end of the structure, it appears the sheetpile floodwall on the west side of the structure could be as much as 3 feet below the design grade of 15 feet NGVD. It is recommended that New Orleans District evaluate the settlement of the sheetpile floodwall on the west side of the structure and take appropriate action to ensure the integrity of the floodwall and the possibility of overtopping from the design hurricane surge. Also, it appears that the breakwater structure has deteriorated over time. The District should ensure the breakwater structure is up to grade (+3.0 feet NGVD), since the design of the floodgate and sheetpile walls are dependant on the full length and height of the breakwater structure being in place.

b. Bottom Hinged Flap Gate.

(1) Hoist and Counterweight Chains. The flood gate was not operated throughout it's full closing and opening cycle, i.e., the gate never broke the surface of the water, therefore we could not inspect it. It was reported that during the 1995 hurricane season, a broken link was discovered in the west hoist chain. A replacement link was installed, and the gate was lifted shortly thereafter with no problems. It was also reported that when lifting the gate, both hoist chains will sometime slip, two or three links at a time, on the hoist wildcat. We did not observe any links slipping during this inspection. However, both the hoist chain links, and the counterweight links made very loud popping sounds during the short lifting operation. It was concluded that this was a result of the total absence of lubrication on the chains. It is very likely that the broken link in the west hoist chain, and the slipping of the links is also a result of these items not being properly lubricated. As the gate is lifted, a properly lubricated chain will slip smoothly into the grooves in the hoist wildcat (or the counterweight idler), with no popping or misalignment of the links due to friction of the links against one another. Misalignment of the links as they ride over the grooves, can cause a link to be subjected to excessive flexural stresses, and consequent failure. The hoist chain and wildcat, and the counterweight chain and idler should be lubricated on a regular basis to prevent future problems during their operation, and the gate should be operated throughout it's full cycle at the next periodic inspection.

(2) Counterweights. Each of the counterweights is composed of melted lead ingots poured into welded structural steel boxes, suspended by a chain. The steel boxes are now quiet rusty, from long years of exposure to the elements and not from not having been painted since completion of construction in the early 1970's. It was also noted that both counterweights are hanging free in their respective counterweight wells. This is contrary to operating procedure established in the late 1970's, when it was decided that the counterweights should always be supported by the ratchet jacks when the gate was in the "down," (open) position for long periods of time. This procedure was established as a result of a problem with the counterweight chains periodically breaking, when the counterweights were free hanging on the chain. The current procedure of letting the counterweight chains hang free from the chain should be evaluated by CELMN-ED/OD as to it's acceptability, and appropriate action taken as required.

(3) Hydraulic Gate Stops. The hydraulic gate stop on the east side of the structure is inoperable due to lack of maintenance, and the hydraulic gate stop (ram and electric motor) on the west side of the structure is missing. The function of the two gate stops is to provide a positive means of holding the gate in the closed position while the structure is un-manned during passage of a hurricane. Also, a reverse head can develope on the landside, resulting from the receding surge tide after the storm passes. In the design of the operating equipment, it was assumed that the gate operator may not be able to return to the structure immediately after the passage of the storm, in order to lower the gate, as the floodside stage receded and the static head equalized. Without the hydraulic rams, the reverse head force on the gate would have to be taken by the two hoist chains, which would subject the hoist machinery to forces for which it is not designed. The gate stop machinery should be rehabilitated or replaced as necessary, in order to reinstate this operational function to the floodgate.

c. Structure Lighting. The original floodside light poles on the east and west side are missing. The two "add-on" light poles on each side of the structure in the vicinity of the hoist machinery area, appear to be somewhat unstable. The base plate of one of the poles is not connected to the concrete, and both poles are secured to the hand railing on the second floor of each control house with a short length of rope. This "make-shift" lighting arrangement is unsightly, and subject to damage by storms. It should be removed and the original structure lighting fixtures replaced.

d. Embedded Metals. Wall armor and corner protection plates in the splash zone are

severely corroded. These items will be sandblasted and painted when the structure is dewatered.

e. Needle Girder Storage Rack.

(1) The concrete storage rack for the needle girders, concrete needles, and related hardware is in satisfactory condition, however, the 12" x 12" treated timbers used as spacers between the stacked items on the rack are badly decayed. All of the timbers should be replaced when the structure is dewatered.

(2) The paint job on the steel needle girders and steel needle girder supports is satisfactory at this time, however, an accumulation of soil and other debris has collected on the top surface of the steel members. This material should be removed as part of general maintenance and also to prevent moisture retained by the soil from corroding the steel.

f. Riprap. In general the riprap protection appeared satisfactory, however, as mentioned above, one area that appeared deficient is the southeast leg of the breakwater dike, on the floodside of the structure. The design elevation of the top of the dike is 3.0 ft. NGVD Repair of this item can be performed at any time and does not have to wait for the dewatering of the structure.

g. Landside Boat Dock.

(1) Several of the deck timbers of the wooden boat dock are missing, and should be replaced.

(2) The west handrail is deteriorated beyond repair, and should be replaced if it is decided that it is necessary for the operation of the dock. As the dock is located immediately behind the landside guide wall, the west handrail is positioned such that it almost touches the guide wall timbers, i.e., the absence of the handrail would not appear to present a hazard to personnel using the dock. The CELMN safety office should evaluate this deficiency, and make a determination if the handrail should be replaced.

(3) The last three stair treads at the bottom of the stairway from the pump platform to the boat dock are badly corroded and in some cases have rusted through. These treads should be repaired or replaced as required.

h. Miscellaneous.

(1) The access ladder on the east side of the pump platform is badly corroded

in the splash zone. The ladder should be removed and repaired as required.

(2) Several of the hand railing safety chains are not installed, i.e., not properly hooked across the hand railing opening. This is probably due to corrosion of the latching device, making the chain difficult or impossible to hook and unhook. The chains should be rehabilitated or replaced as required, and periodically lubricated to ensure their operability.

6. Action. No action required by the Division Commander at this time. Those deficiencies requiring action should be corrected as described above. CELMN will document the findings of this inspection in a report for submission to this office for approval. A copy of the report will be furnished to Plaquemine Parish and the State of Louisiana, with a letter recommending action be taken to correct deficiencies on those items for which they are responsible.

7. Next Inspection. The next periodic inspection of this structure will be in January of 1999.

FRANK N. JOHNSON
Structural Engineer

MALCOLM L. DOVE
Hydraulics Engineer

ROUTING:

~~CELMV-ET-ES~~
~~CELMV-ET-ET (Mr. Rush)~~
~~CELMV-ET-EG~~
~~CELMV-ET-EW~~
~~CELMV-ET-C~~
~~CELMV-SO (Mr. Cordes)~~
~~CELMV-ET-E~~
CELMV-ET-E/Files, Mrs Robertson

CF w/encl
CELMN-ED-GE (Mr. Drummond)

List of Attendees

Empire Floodgate
Periodic Inspection No. 8

17 January 1996

Lower Mississippi Valley Division

Frank N. Johnson	Structures, Engineering Division
Malcolm Dove	Water Control, Engineering Division

New Orleans District

Johnny Drummond	Gen. and Environmental Design Section (coordinator)
Brian Keller	Operations and Readiness Division
Colette Bozant	Operations and Readiness Division
Amy Elsensohn	Operations and Readiness Division (student aid)

Brown Cunningham & Gannuch, Inc.

Luther Newton	Project Engineer
Doan Modianos	Mechanical Engineer
Robert Yokum	Structural Engineer
Larry Cooley	Geotechnical Engineer
Kenneth McLaughlin	Electrical Engineer

Plaquemines Parish

Ruben Victory	Floodgate Operator
Henry Urban	Field Foreman

Encl 1

APPENDIX B

OBSERVATIONS BY TEAM MEMBERS DURING PERIODIC INSPECTION NO. 7

CELMN-ED-DD (ED-DG/6 Jan 93) 1st End Mr. Tan/dg/2650
SUBJECT: Periodic Inspection No. 7, Empire Floodgate

CELMN-ED-DD 9 Feb 93

FOR CELMN-ED-DG

1. Enclosed for your use in preparing the final report for the subject inspection, is the structural input.

2. Point of contact is Mr. Tan, extension 2650.

Carl R. Guggenheimer

Encl

CARL R. GUGGENHEIMER
Chief, Structural Design Section

STRUCTURAL INPUT FOR PERIODIC
INSPECTION NO. 7, EMPIRE FLOODGATE

OBSERVATIONS

Observations. The structure was not dewatered at the time of the inspection. Therefore, the following observations were limited to those portions of the structure above the water surface.

1. Floodwall. Overall, the floodwall was in very good condition, some concrete popouts were found on the surface of concrete walkway on top of inverted T-wall and gatebay. (See Photo #1). A gap of approximately two half to three inches was observed between the L-type waterstop that is attached to sheetpiling and the adjacent T-wall monolith on the west side of the structure. The L-type waterstop was not secured to the sheet pile on the floodside.

2. Steel Sheet Pile. Generally, the steel sheet pile was in good condition. Except, the protective coating along the bottom portion of the sheet pile above the ground were corroded and crumbled. (See Photo #2).

3. Gatebay monolith. The gatebay concrete was in good condition. No concrete spalled, cracked or reinforcing steel exposed was found, except those where indicated in the previous periodic inspection report. (See Photo #1).

4. Flap Gate. The operation of the gate was satisfactory during the testing of the gate in open and close positions. The paint on both sides of the gates appeared to be in fairly good condition. The sacrificial anodes of the cathodic protection system seemed to be in good working condition. The top of the channel beam was hit again by the passing vessel after it had just been replaced the damaged skin plate and channel beam during the last dewatering. The damage was due to the gate inability to seat properly when in the fully opened position. It is caused by the silt buildup on the gate sill. (See Photo #3).

5. Handrail. Overall, the handrails were in good condition. On the east half of the structure, the south handrail still has the dent which was noted in the previous inspection report. The dent was caused by the hit from the vessels. Although the concrete around the anchor bolts on top of the south face of the structure were spalled, no exposed reinforced bars could be seen in the spall areas. (See Photo #4).

6. Approach Channels. The general condition of the timber guide walls, fenders and dolphins was excellent.

7. Needles and Storage Rack. The timber storage rack and the concrete needle girders appeared to be in good condition.

8. Miscellaneous. The stair between the pump platform and the boat dock, the strings and rungs at the bottom of the stair have rusted. (See Photo #5).

CONCLUSIONS AND PROPOSED REMEDIAL ACTIONS

CONCLUSIONS. It is concluded that the Empire Floodgate structure is structurally stable, safe and in satisfactory operating condition.

Proposed Remedial Actions. To insure continuation of the safety, stability and operational capability of the flapgate structure, the following remedial actions are proposed:

a. The damage to the flapgate beam flange as stated above should be repaired as soon as practicable. The L-type waterstop on the floodside of the structure should be properly secured to the sheetpile. The gap should be re-adjusted such that the gap between the sheetpile and the T-wall monolith is sealed.

b. The two foot section of handrail on the west half of the structure adjacent to and on the north side the channel ladder should be secured by replacing the missing anchor bolts.

c. The slightly bent section of the handrail on the south side of the east half of the structure with spalls around the anchor bolt base plates is still secure but should be monitored periodically for signs of loosening.

d. The corrosion to the ladders on each of the channel walls needs to be sanded, cleaned and painted.

e. The corroded protective coating on the bottom surface of the sheetpile, should be scraped off and sand busted and put on a new protective coating.

RECOMMENDATIONS

The Empire Floodgate structure should be inspected whenever possible in the dewatered state to ascertain whether or not damages have been sustained below the water surface. The possible damages to the gate usually either due to impact from passing vessels, or from the racking of the gate that may have occurred due to the uneven seating while attempting to bring the gate into the fully open position. In the past, due to funding problems on the parish and state levels, it has been unable to schedule for dewatering as often as it should. However, the parish should make an effort to arrange the necessary funding as soon as possible so that a detailed dewatered inspection can be made.

CELMN-ED-HC February 11, 1993

MEMORANDUM FOR C/ DESIGN BRANCH

SUBJECT: Periodic Inspection No. 7, Empire Floodgate

1. Reference is made to your CELMN-ED-DG multiple memorandum dated 6 Jan 1993, subject as above. Comments concerning the 27 Jan 93 inspection are given below.

2. We noticed that the stone revetment between the structure and the east and west levee was barely visible above the waterline. As per conversation with Ms. Connie Standige of the Louisiana Department of Transportation and Development, remedial actions, including the placement of riprap along the banks of the north and south approach channels, were taken during February 1991. The staff gages read 0.6 feet NGVD. The settlement of the riprap may indicate a different problem occurring at the floodgate. The most recent scour surveys, taken in 1983 and 1992, indicated insignificant changes near the banklines. Close monitoring of these areas is advised in order to determine impacts on the levee system.

3. The east bank of the north and south approach channels continues to recede. Continue to monitor the area for possible impacts on the levee and the parking area.

4. The loss of stone from the breakwater appears to have stopped. There are tall bushes growing where the stone once was. Restoration of the breakwater to its design elevation of 3.0 ft NGVD is important in the reduction of wave forces on the floodgate.

5. Point of contact is Deborah Garrett extension 2488.

Soileau

1 Encl
wd

CECIL W. SOILEAU
Chief Hydraulics and Hydrology Branch

CELMN-ED-DG 6 January 1993

MEMORANDUM FOR C/F&M Br
C/H&H Br ✓

SUBJECT: Periodic Inspection No. 7, Empire Floodgate

1. Enclosed is the preinspection brochure for subject inspection. The inspection is scheduled for 28 Jan 93.

2. The preinspection briefing will be held in the Engineering Division Conference Room, Room 304, on Thursday, morning, 21 Jan 93 at 1000 hours. Final preparations for the inspection will be made at this briefing.

3. Input for preparation of the final report is required from each team member by 11 Feb 93.

4. Charge inspection cost to account no. CB149 10 11 11 SPCA.

5. POC is Mr. Drummond, ext. 2711.

Encl

for DANIEL A. MARSALONE
Chief, Design Branch

CELMN-ED-FM, FS 9 Feb 93

MEMORANDUM FOR C/Des Br, Attn: Mr. Drummond

SUBJECT: Empire Floodgate, 1993 Periodic Inspection No. 7.

1. Empire Floodgate: We offer the following as a result of the inspection that was conducted on 28 Jan 93.

a. There are spalls at the edge of gatebays where the hand rails are located on the east and west side. (See photos 11, 12 and 16).

b. There are a few minor popouts on the slab on top of the floodwall on the east and west side. (See photos 1 and 15).

c. The sheetpile coating is peeling off in flakes on the east side. (See photo 13).

d. There are several thin cracks on the structure. (See photo 2, 3, 9, and 14).

e. The breakwater dike is now completely underwater.

f. The area from the levee nose slope to the structure was originally designed with 24" of riprap. The existing riprap, which was recently supplemented, is insufficient. There is no riprap apparent on the levee nose. Site personnel report that the rock disappears into the mud. No filter layer was placed below the rock. (See photo No. 4).

g. Where the west T-wall meets the I-wall there is a small gap between the waterstop and the T-wall. The gap rises about 1 foot from the soil.

h. The joint at RM-2 and RM-3 has a split waterstop from El 6 to the top of wall. Other waterstops are deteriorated to a lesser degree.

i. Where the east T-wall meets the I-wall there is a large gap of 1.5 to 3 inches between the waterstop and the T-wall. The gap is the full height of the wall.

j. There are 2 large rodent holes in the soil along the west I-wall on the protected side which need filling.

2. The following comments refer to the instrumentation survey.

a. All structure and T-wall reference mark elevations as stated by this survey are 0.07' lower than should be expected by past surveys. This may be a problem with the survey since

the elevations from Dec 1988 to Feb 1992 settled at a rate 3 times faster than Nov 1984 to July 1986. The wall and structure appeared to be stable as observed on the inspection.

b. Distances between reference marks appear to have been stable over the last 3 years.

c. The steel sheet piling and levees appear to continue to settle. Most of the marks are missing or are in error.

d. The scour survey indicates no areas of scour occurring.

3. Points of contact are Ms. Holley (1007) and Mr. Dressler (2985).

RPB

1 Encl
as

RODNEY P. PICCIOLA
Chief, Foundations & Materials Branch

Empire Floodgate
Periodic Inspection No. 7
Photo Captions
28 Jan 1993 inspection

Photo No.	Remarks

(Empire Floodgate East Bank):

1. Small popout on floodwall slab at RM 20.
2. Typical hairline cracks on floodwall slab at RM 19.
3. Typical hairline cracks on floodwall slab at RM 15.
4. Lack of riprap on the east bank.
5. Riprap falling in the channel.
6. Timber guide wall in good condition.
7. Efflorescence on the gatebay.
8. Rusted ladder.
9. Crack on top of the step.
10. Exposed aggregate on top of the gatebay.

11 & 12. Spall at the edge of the gatebay and the hand rail.

13. Large flakes of sheetpile coating peeling off.

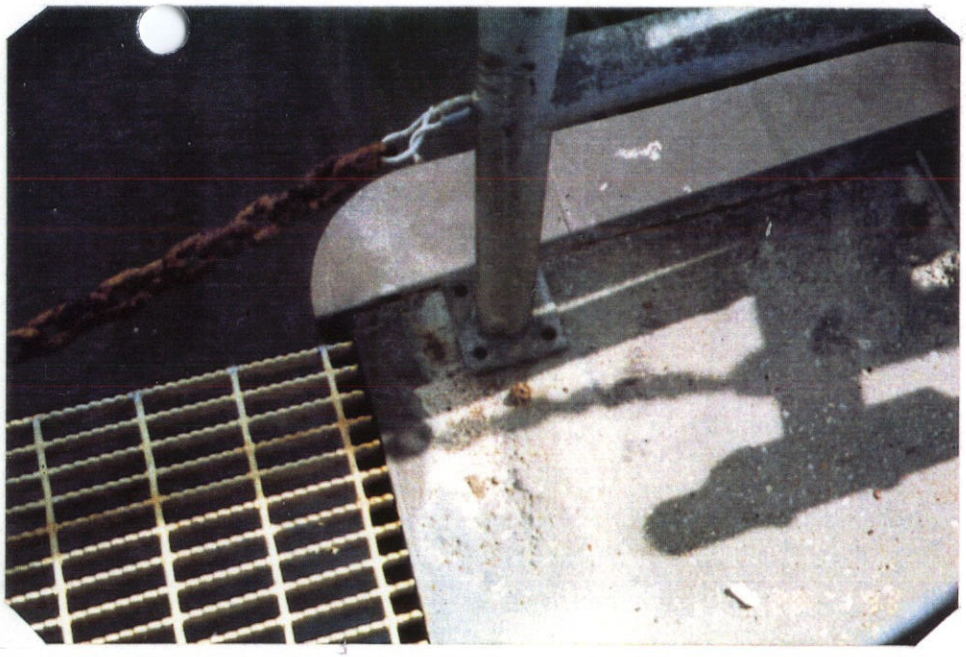
(Empire Floodgate West Bank):

14. Typical hairline cracks on the T-wall slab.
15. Large popout on the gatebay slab.
16. Spall at the edge of gatebay and hand rail.
17. Efflorescence on the gatebay wall.

Photo #1 Concrete popout on concrete walkway and Gatebay.

Photo #2 Protecting coating corroded and crumbled.

Photo #3 Top of channel beam flange was buckled by vessel.



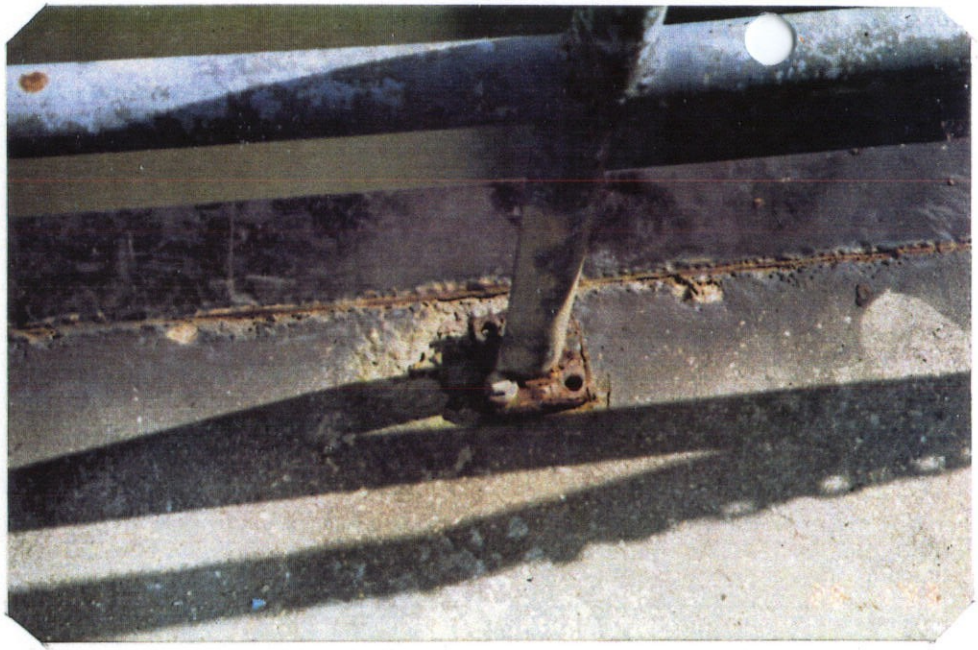
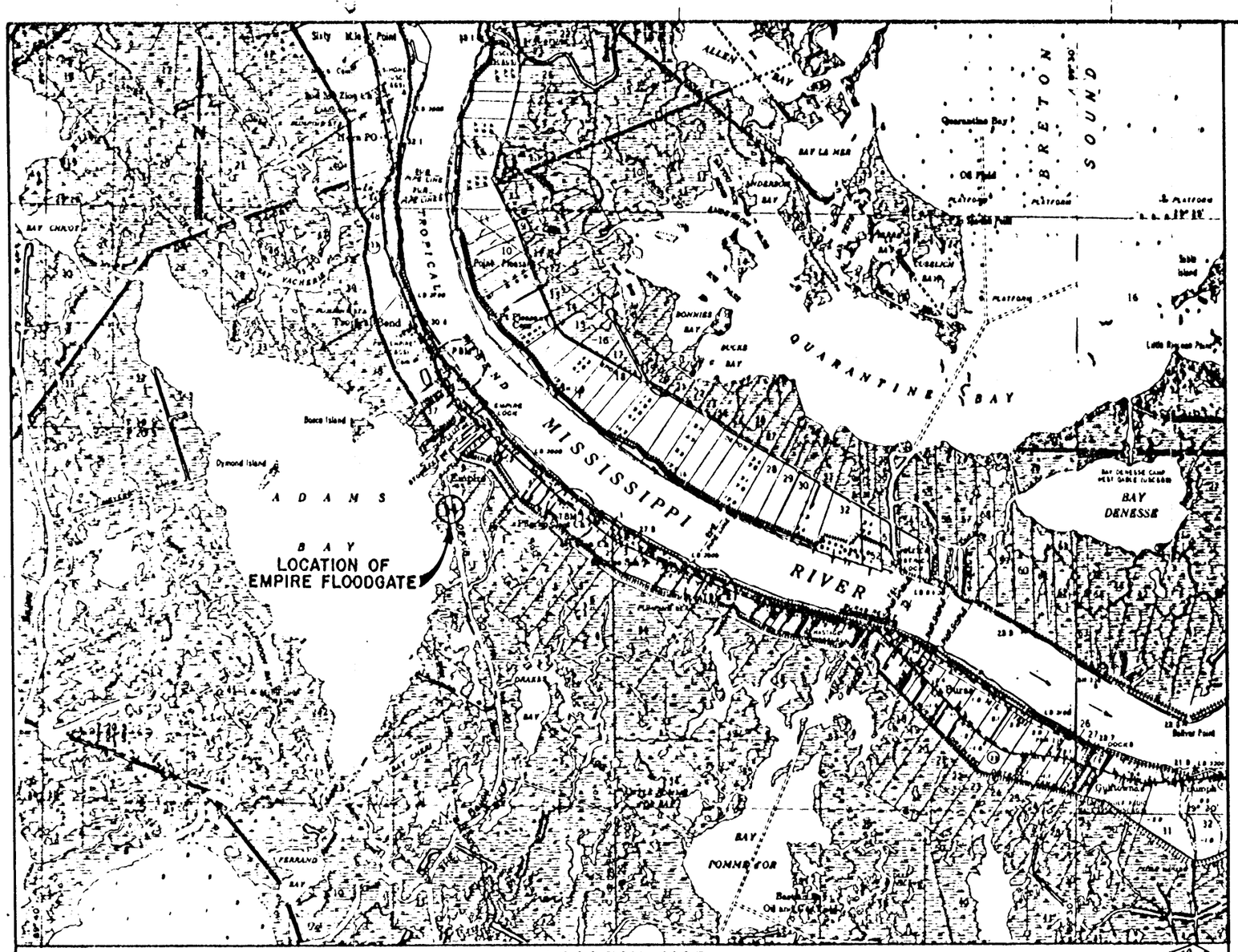


Photo #4 Missing anchor bolts and concrete spalled around bases of handrails.

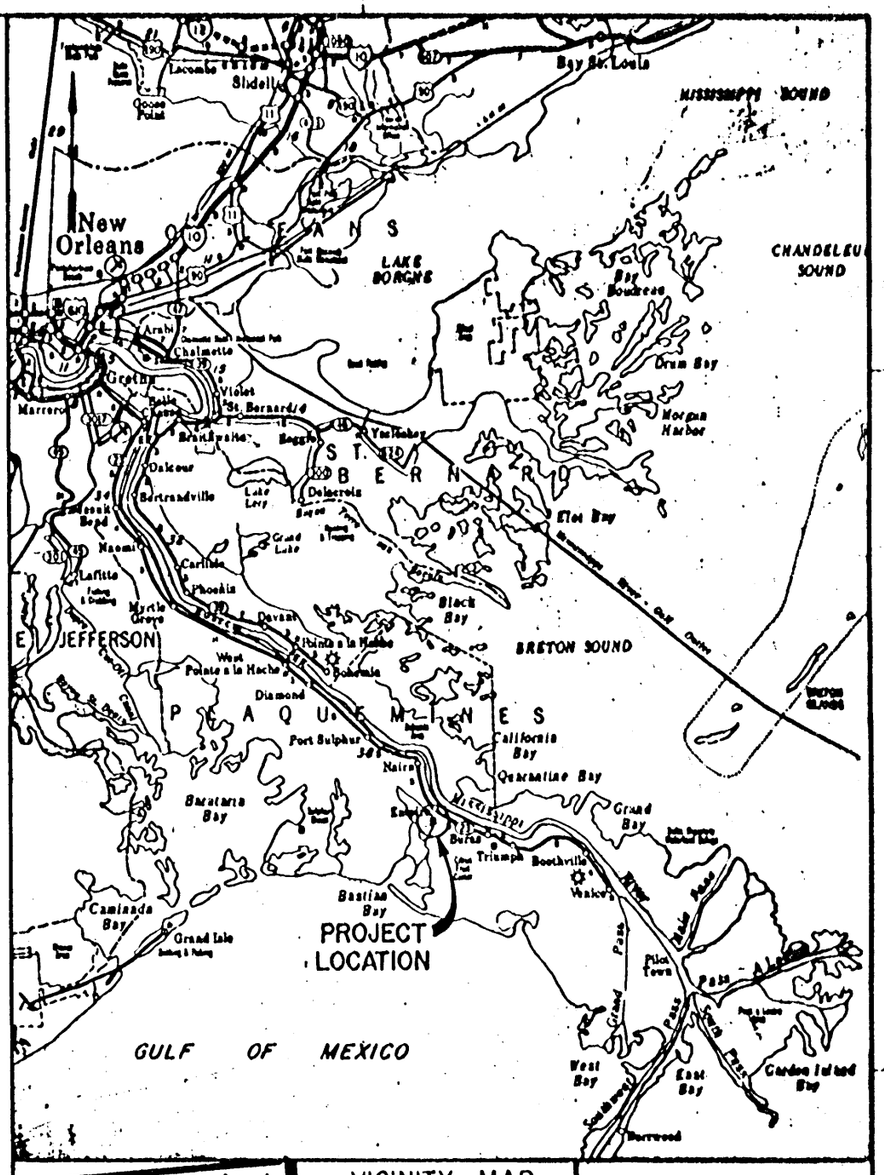
Photo #5 Strings and rungs of stair were rusted.



LOCATION MAP

SCALE 1 : 31,680

MILES



VICINITY MAP

SCALE IN MILES

Safety is a Part of Your Contract

INDEX TO DRAWINGS

DWG.	TITLE
	GENERAL DRAWINGS
1	LOCATION MAP, VICINITY MAP, AND INDEX
2	SITE PLAN
3	SOIL BORINGS
4	SOIL BORING LEGEND
5	COMPLETED PLAN
6	COMPLETED SECTION
7	TYPICAL SECTIONS
8	INITIAL EXCAVATION
9	INITIAL EXCAVATION
10	STRUCTURE EXCAVATION AND SECURITY FENCE
	FLOODGATE STRUCTURE
11	GATE BAY AND FLOODWALL PILING LAYOUT
12	PLAN OF GATE BAY MONOLITH
13	SECTIONAL ELEVATION OF GATE BAY MONOLITH
14	TRANSVERSE SECTION OF GATE BAY MONOLITH
15	GATE BAY WALL REINFORCEMENT PLAN AT EL. 18.0
16	GATE BAY WALL REINFORCEMENT PLAN AND SECTIONS
16A	GATE BAY WALL REINFORCEMENT PLAN AND SECTIONS
17	GATE BAY WALL REINFORCEMENT SECTIONS
18	GATE BAY WALL REINFORCEMENT SECTIONS
19	GATE BAY SLAB REINFORCEMENT
20	GATE BAY SLAB REINFORCEMENT
20-A	GATE BAY SLAB REINFORCEMENT
21	FLOODWALL MASONRY AND REINFORCEMENT
22	FLOODWALL TRANSITION SECTIONS
23	EXPANSION JOINT DETAILS
24	CONTROL HOUSE PLAN AND ELEVATIONS
25	CONTROL HOUSE ELEVATIONS AND DETAILS
26	CONTROL HOUSE REINFORCEMENT
27	CONTROL HOUSE REINFORCEMENT
28	PUMP PLATFORM
29	PUMP PLATFORM
29A	PUMP PLATFORM - MISCELLANEOUS DETAILS
30	NEEDLES AND STORAGE RACK
31	MISCELLANEOUS EMBEDDED METALS
32	MISCELLANEOUS EMBEDDED METALS
33	EMBEDDED METAL - CORNER PROTECTION
34	LADDER AND STAFF GAGE DETAILS
35	HANDRAILING LAYOUT - SECTIONS AND DETAILS

DWG.	TITLE
	FLAP GATE
36	FLAP GATE - PLAN AND SECTIONS
37	FLAP GATE SECTION AND HINGE DETAILS
38	GATE SEAL DETAILS
39	HINGE LUBRICATION DETAILS
40	TRASH PLATE - PLAN AND SECTIONS
41	NEEDLE GIRDER - PLAN AND DETAILS
42	COUNTERWEIGHT CAGE SECTIONS AND DETAILS
37A	WALKWAY GRATING FOR FLAPGATE
	GUIDE WALL
43	TIMBER GUIDE WALL - PLAN AND SECTIONS
44	TIMBER DOCK AND DOLPHINS
	OPERATING MACHINERY
45	PLAN - MACHINERY ARRANGEMENT
46	ELEVATION - MACHINERY ARRANGEMENT
47	MACHINERY BASE
48	MACHINERY HOUSING
49	MISCELLANEOUS DETAILS
50	CHAIN AND SHAFT DETAILS
51	LOCKING DEVICE AND SHOCK ABSORBER DETAILS
52	ENGINE GENERATOR LAYOUT
53	PUMPING UNIT LAYOUT
54	PUMPING UNIT DETAILS
49A	MISSCELLANEOUS DETAILS
	ELECTRICAL
55	SCHEMATIC WIRING DIAGRAMS
56	CONTROL WIRING DIAGRAMS
57	SWITCHBOARD, CONTROL CENTER, AND DESK
58	CONDUIT LAYOUT
59	CONDUIT LAYOUT
60	LIGHTING AND DETAILS
61	CATHODIC PROTECTION

Note:
See dwg. 2 for tabulation of bench marks.

AS CONSTRUCTED

NO.	DATE	DESCRIPTION
2	8-4-76	ADDED NEW DRAWING 49B MOD # 12
1	8-20-76	ADDED NEW DRAWING 37A MOD # 11

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

NEW ORLEANS TO VENICE, LOUISIANA
HURRICANE PROTECTION, REACH B-1
EMPIRE FLOODGATE
PLAQUEMINES PARISH, LA.
LOCATION MAP VICINITY MAP AND INDEX

DRAWN: R.A.M. CHECKED: R.B.B. TRACED: E.M.A. DATE: FEB 1973

H-4-26081

SHEET 1 OF 64 SHEETS

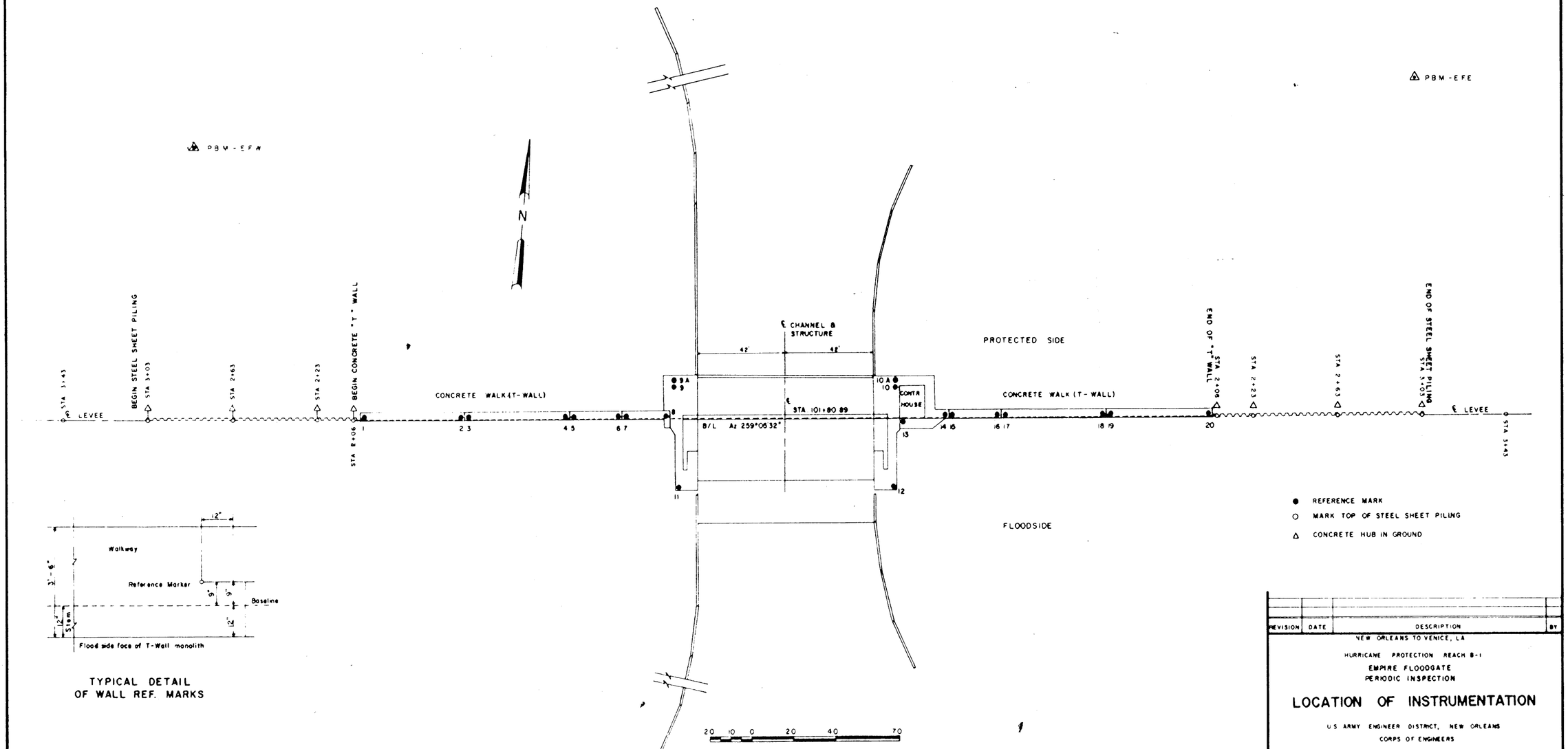
PLATE - 1

INSTRUMENTATION PLATES

INSTRUMENTATION PLATES

Plate No.	Title
1	Location of Instrumentation
2	Settlement Reference Marks - Tabulations
3	Settlement and Reference Marks Differential Movement
4	Settlement and Reference Marks Differential Movement
5	Settlement and Reference Marks Differential Movement
6	Reference Marks-Differential Chart
7	Baseline and Range Layout
8	Profile Survey (FY-93) - Empire Floodgate and North Approach Channel
9	Scour Survey (FY-93)
10	Scour Survey (FY-93)
11	Scour Survey (FY-93)

12	Scour Survey (FY-93)
13	Baseline and Range layout
14	Profile Survey (FY-93) - Empire Floodgate and South Approach Channel
15	Scour Survey (FY-93)
16	Scour Survey (FY-93)
17	Scour Survey (FY-93)
18	Scour Survey (FY-93)



TYPICAL DETAIL
OF WALL REF. MARKS

REVISION	DATE	DESCRIPTION	BY

NEW ORLEANS TO VENICE, LA

HURRICANE PROTECTION REACH B-1

EMPIRE FLOODGATE
PERIODIC INSPECTION

LOCATION OF INSTRUMENTATION

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

SHEET OF SHEET FILE NO H-4-27323

PLATE 1

SETTLEMENT REFERENCE MARK - STRUCTURE AND T-WALL

PBM

NO. OF REFERENCE MARK		RM 1	RM 2	RM 3	RM 4	RM 5	RM 6	RM 7	RM 8	RM 9	RM 9A	RM 10	RM 10A	RM 11	RM 12	RM 13	RM 14	RM 15	RM 16	RM 17	RM 18	RM 19	RM 20	TEM	GAGE1	GAGE2	REMARK	E.F.E.	E.F.W.
INITIAL DATE		12-2-75	12-2-75	12-2-75	12-2-75	12-2-75	12-2-75	12-2-75	12-2-75	12-2-75	12-2-75	12-2-75	12-2-75	12-2-75	12-2-75	12-2-75	12-2-75	12-2-75	12-2-75	12-2-75	12-2-75	12-2-75	12-2-75	49°	0.32			12-2-75	
ORIGINAL READINGS (FT)		14.59	14.72	14.73	14.78	14.76	14.77	14.79	14.74	14.76	14.77	14.71	14.70	14.74	14.73	14.75	14.68	14.67	14.67	14.66	14.61	14.61	14.57					3.122	
DATE OF OBSERVATION	9 NOV. 1984	14.58	14.38	14.39	14.44	14.42	14.42	14.42	14.36	14.39	14.38	14.30	14.30	14.37	14.33	14.34	14.27	14.26	14.25	14.24	14.14	14.13	13.93	70°	0.90	0.90		2.971	-
	24 JUL. 1986	14.16	14.38	14.38	14.45	14.43	14.43	14.43	14.37	14.40	14.40	14.30	14.29	14.39	14.32	14.34	14.26	14.25	14.24	14.24	14.11	14.11	13.86	83°	1.20	1.20		2.971	4.200
	8 DEC. 1988	14.14	14.37	14.37	14.44	14.42	14.44	14.43	14.36	14.40	14.39	14.29	14.28	14.38	14.33	14.33	14.25	14.24	14.22	14.23	14.07	14.07	13.79	60°	0.00	0.00		2.971	4.217
	25 FEB. 1992	14.07	14.30	14.30①	14.37	14.35	14.35	14.36	14.30	14.33	14.33	14.23	14.22	④	14.27	14.27	14.18	14.17	14.15	14.14	13.97	13.97	13.67	72°	1.20	1.20		2.970	-
	22 JAN. 1993	14.08	14.32	14.33	14.40	14.39	14.39	14.40	14.34	14.38	14.37	14.26	14.25	14.36	14.30	14.30	14.21	14.20	14.17	14.15	13.98	13.98	13.67	72°	0.9	0.4			

DISTANCES TO REFERENCE MARKS

NO. OF REFERENCE MARKS		RM2-RM3	RM4-RM5	RM6-RM7	RM9A-RM10A	RM11-RM12	RM14-RM15	RM16-RM17	RM18-RM19	TEMP	REMARKS
INITIAL DATE		12-2-75	12-2-75	12-2-75	12-2-75	12-2-75	12-2-75	12-2-75	12-2-75		
ORIGINAL READINGS (2D)		24.313	24.500	23.750	105.83 ①	103.96 ①	24.000	24.094	24.313		
DATE OF OBSERVATION	9 NOV. 1984	24.750	24.750	23.813	-	-	24.000	24.375	24.813	70°	
	24 JUL. 1986	24.843	24.750	23.718	-	-	24.000	24.406	25.000	83°	
	8 DEC. 1988	24.875	24.906	23.781	-	-	24.156	24.530	25.219	70°	
	25 FEB. 1992	24.875	24.906	23.750	-	-	24.063	24.469	25.156	72°	
	22 JAN. 1993	24.96	24.96	23.76	-	-	24.24	24.48	25.08	72°	

NOTE:
THE DIFFERENTIAL GRAPHS (1975-DATE) ARE PLOTTED USING THE EQUATION (R-R1-.05F = DIFF. THE .05FT'S CAUSED BY THE FOLLOWING BENCH MARK (N.G.V.D.) CORRECTIONS; PBM E.F.E. (1975-76) ELEV. 3.122'-(1979) ELEV. 2.97F = .05F.

① APPEARS TO BE SURVEY ERROR.
② CAP DESTROYED; SHOT NATURAL GROUND.
③ NO PILE WALL (REMOVED)
④ NO READING

SETTLEMENT REFERENCE MARK - SHEET PILING and LEVEE

REFERENCE MARK EAST or WEST		2+06E	2+06E	2+23E	2+23E	2+63E	2+63E	3+03E	3+03E	3+43E	E-W	2+06W	2+06W	2+23W	2+23W	2+63W	2+63W	3+03W	3+03W	3+43W
INITIAL DATE		12-2-75	12-2-75	12-2-75	12-2-75	12-2-75	12-2-75	12-2-75	12-2-75	12-2-75		12-2-75	12-2-75	12-2-75	12-2-75	12-2-75	12-2-75	12-2-75	12-2-75	12-2-75
ORIGINAL READINGS (FT)		14.13	7.65	13.89	8.13	13.78	7.96	13.76	14.45	14.11		13.87	7.11	13.38	7.56	13.03	7.80	12.65	13.91	11.69
DATE OF OBSERVATION	9 NOV. 1984	13.21	6.29	12.75	②	12.32	6.22	12.07	11.88	12.03		13.37	②	12.78	②	12.26	②	11.71	12.42	10.11
	24 JUL. 1986	13.11	6.17	12.62	②	12.16	5.95	11.92	11.61	11.86		13.35	②	12.75	②	12.22	②	11.64	12.15	②
	8 DEC. 1988	13.00	6.02	12.49	②	12.01	5.77	11.74	11.40	45.74		13.33	②	12.72	②	12.18	②	11.58	12.05	②
	25 FEB. 1992	15.30①	5.74	15.23①	②	15.28①	②	15.32①	②	④		13.25	②	12.62	②	12.01	②	③	②	②
	22 JAN. 1993	15.31	5.73	15.23	②	15.27	2	15.32	②	④		13.28	②	12.65	②	12.03	②	③	②	④

NOTE: FIRST STATIONINGS LISTED ARE ON STEEL SHEET PILINGS. ELEVATIONS FOR 3 + 43 E & W ARE ON CONCRETE MONUMENTS

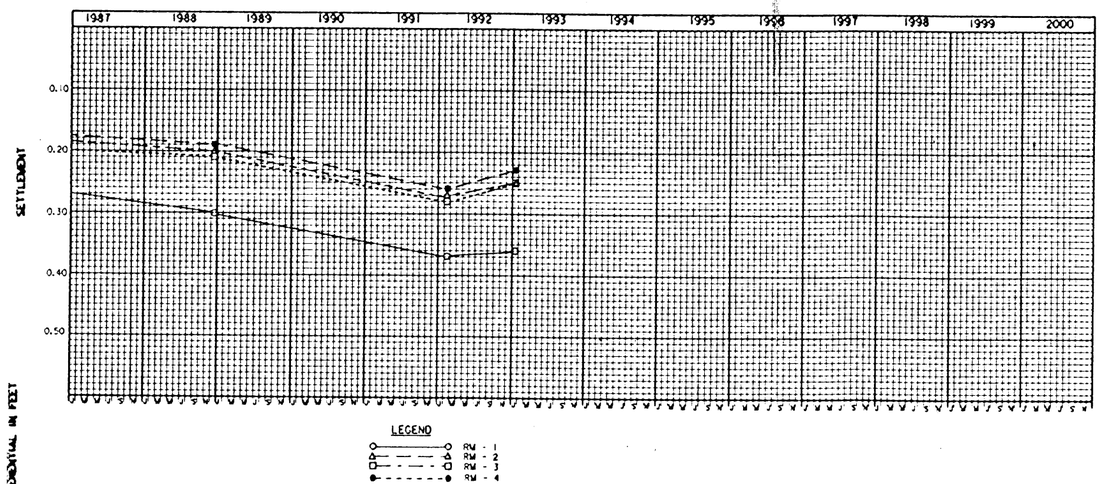
COMPUTER AIDED DESIGN DRAFTING

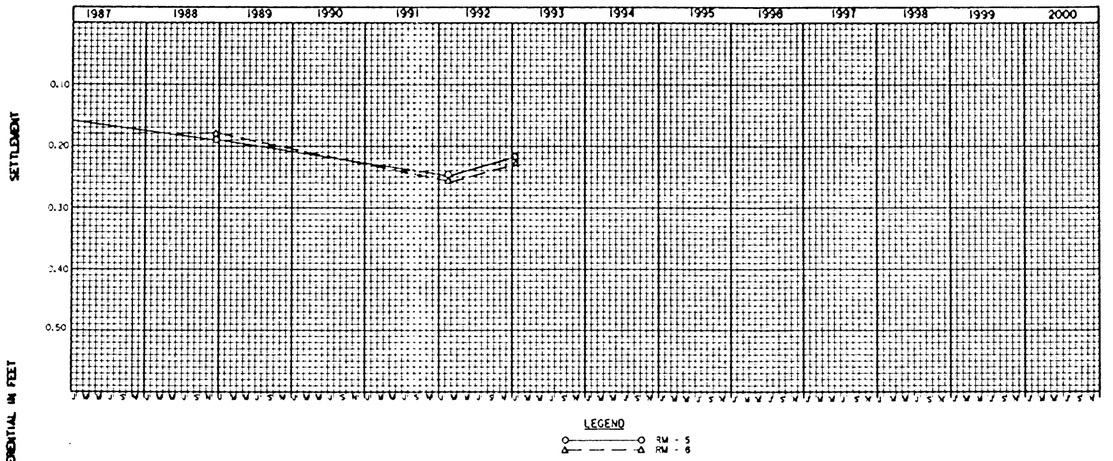
NEW ORLEANS TO VENICE, LA.
HURRICANE PROTECTION REACH B-1
PERIODIC INSPECTION
EMPIRE FLOODGATE

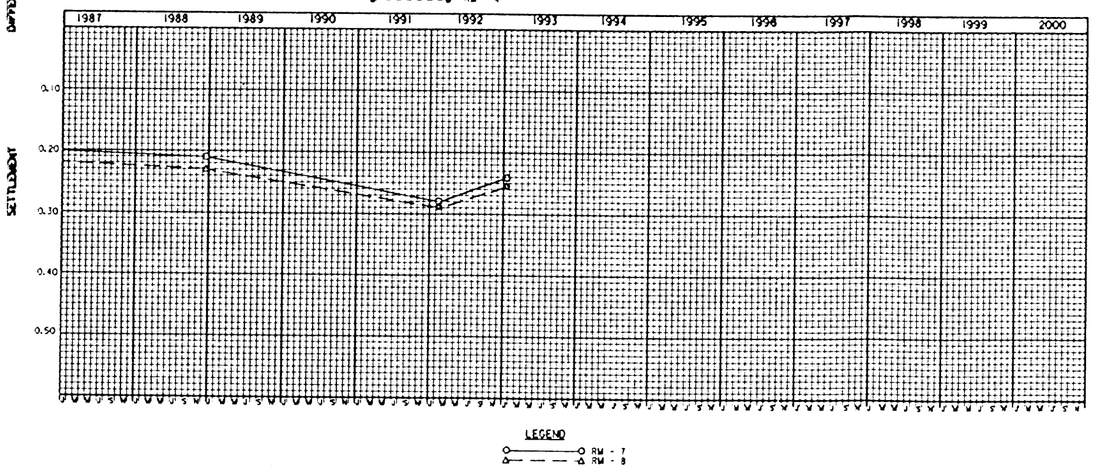
SETTLEMENT REFERENCE MARKS TABULATIONS

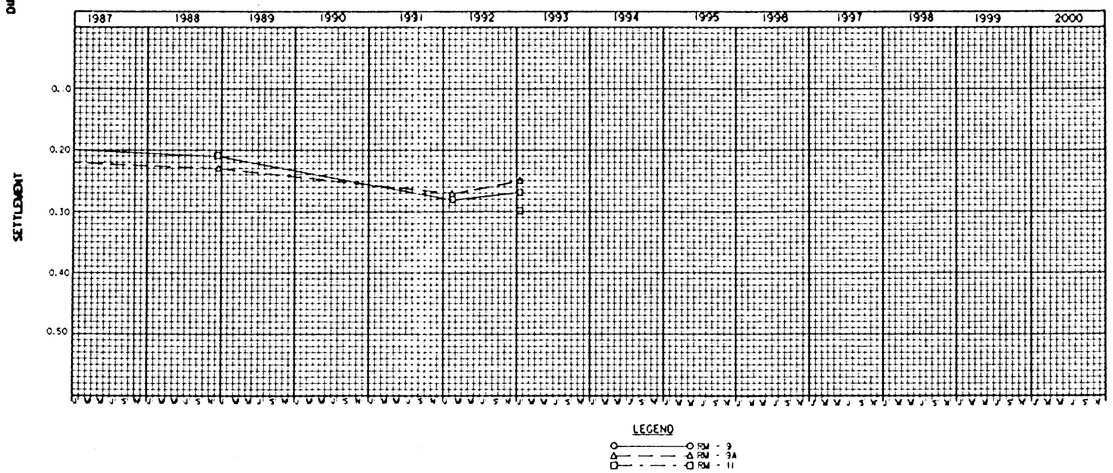
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

PLATE 2









NOTE: ALL POINTS PLOTTED AFTER 1979 ARE USING THE EQUATION (R-R) +.151 = DIFF. SEE TABULATION CHART FOR FURTHER INFORMATION

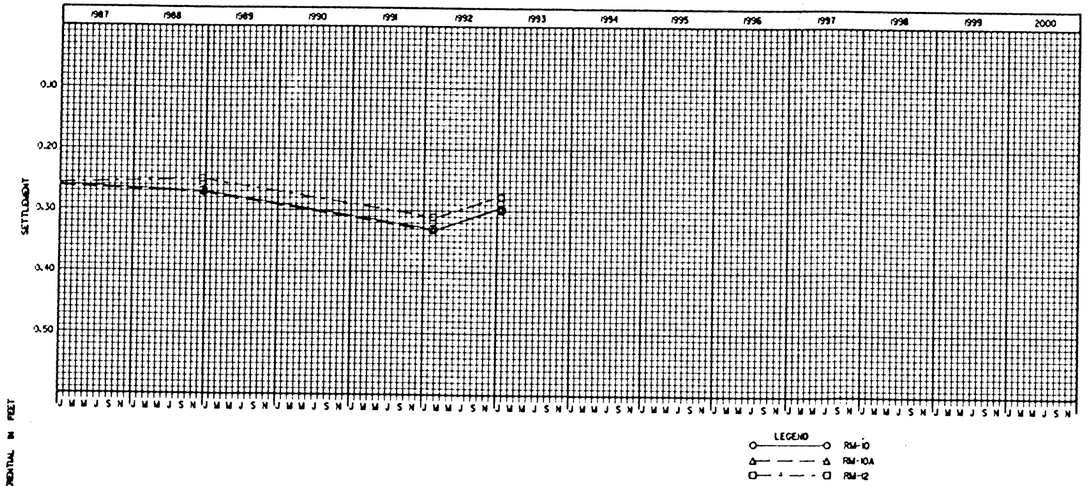
COMPUTER AIDED DESIGN DRAFTING

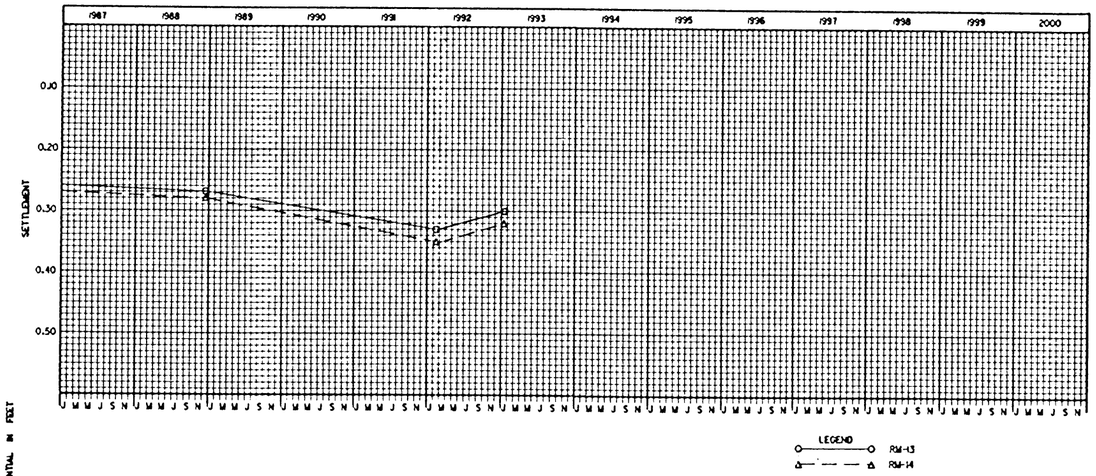
NEW ORLEANS TO VENICE, LA
HURRICANE PROTECTION REACH B-1
PERIODIC INSPECTION
EMPIRE FLOODGATE

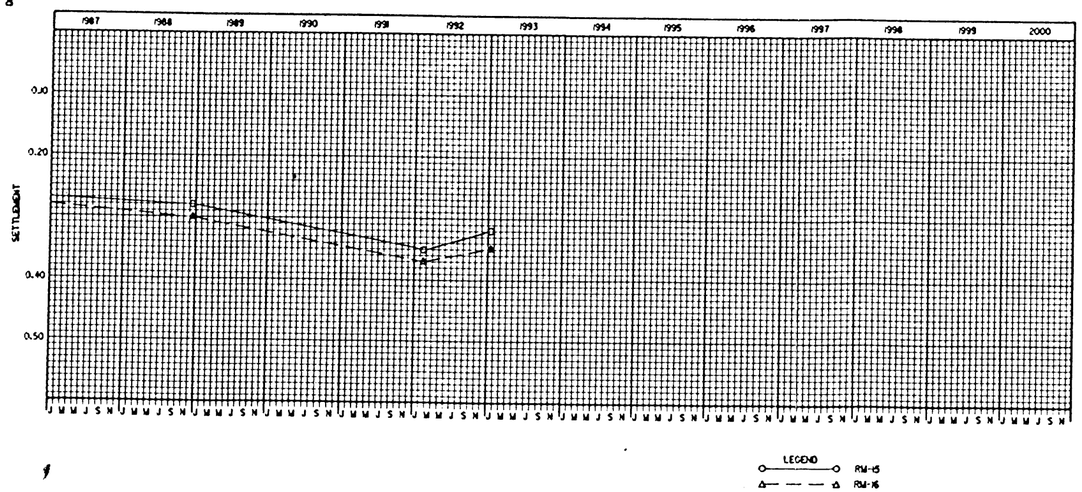
SETTLEMENT AND REFERENCE MARKS DIFFERENTIAL'S MOVEMENT

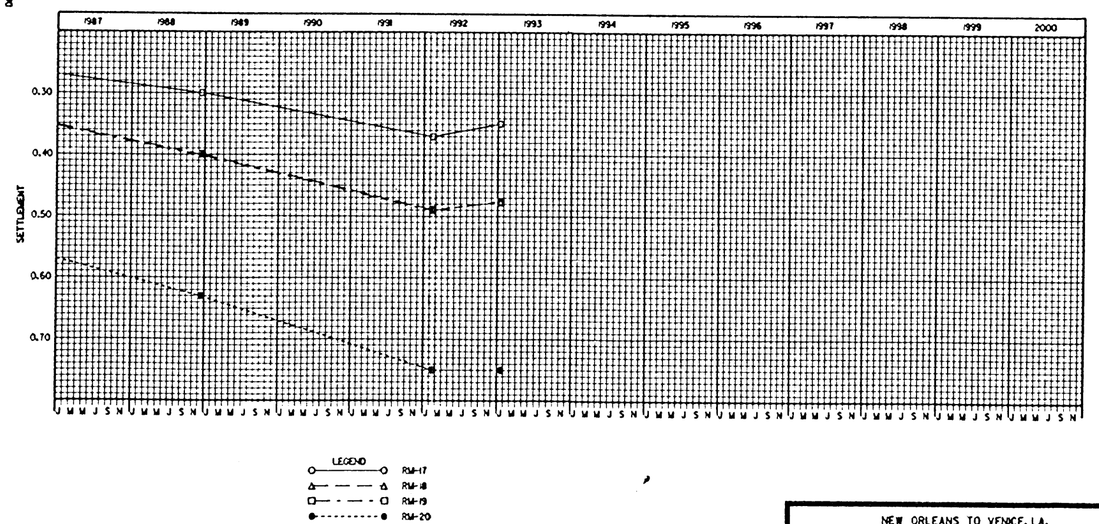
U. S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

PLATE 3









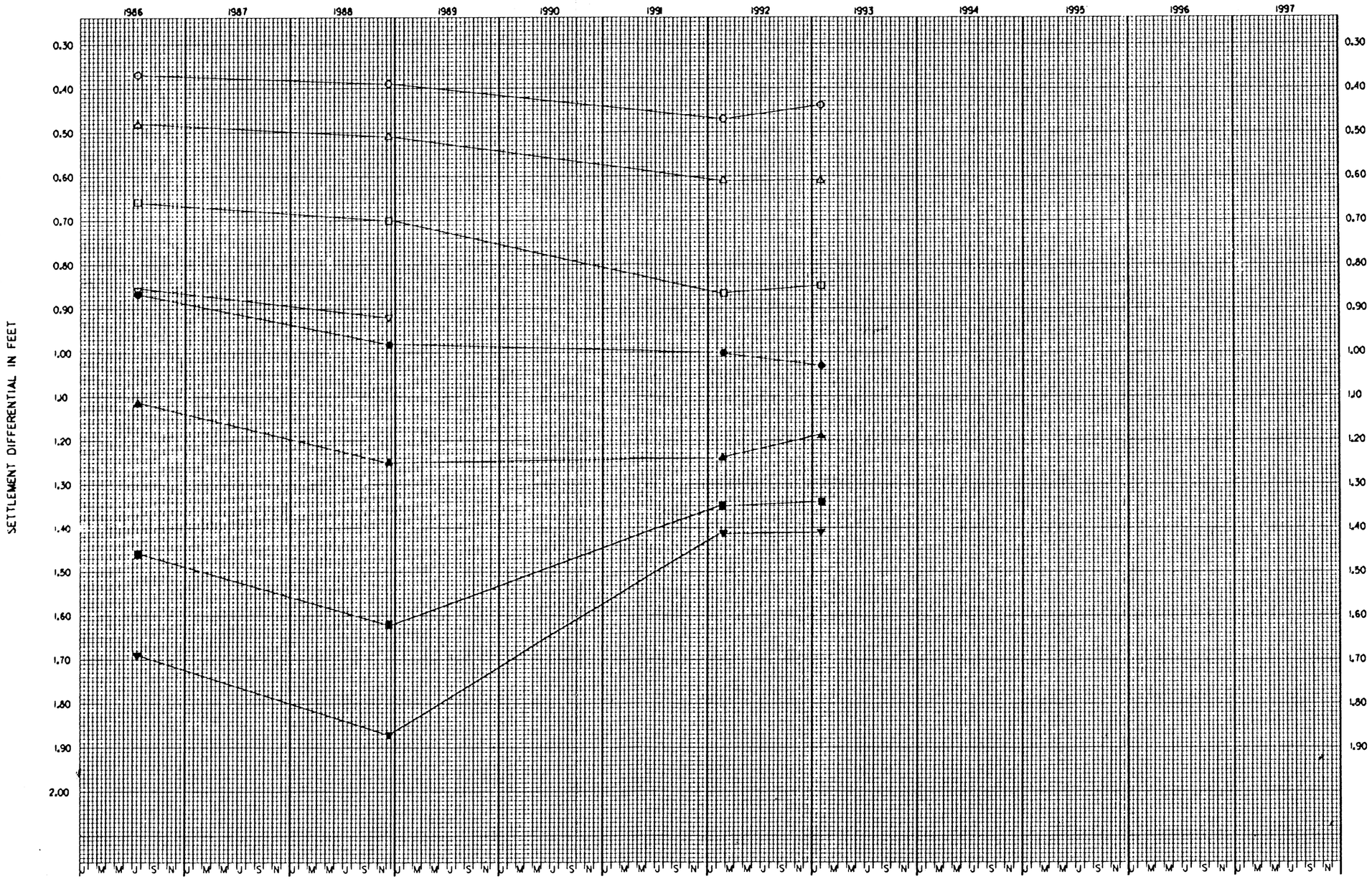
NOTE: ALL POINTS PLOTTED AFTER 1979 ARE USING THE EQUATION (R-R0-HS) = DIFF.; SEE TABULATION CHART FOR FURTHER INFORMATION.

COMPUTER AIDED DESIGN DRAFTING

NEW ORLEANS TO VENICE, LA.
HURRICANE PROTECTION REACH B-1
PERIODIC INSPECTION
EMPIRE FLOODGATE

SETTLEMENT AND REFERENCE MARKS DIFFERENTIAL'S MOVEMENT

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



LEGEND

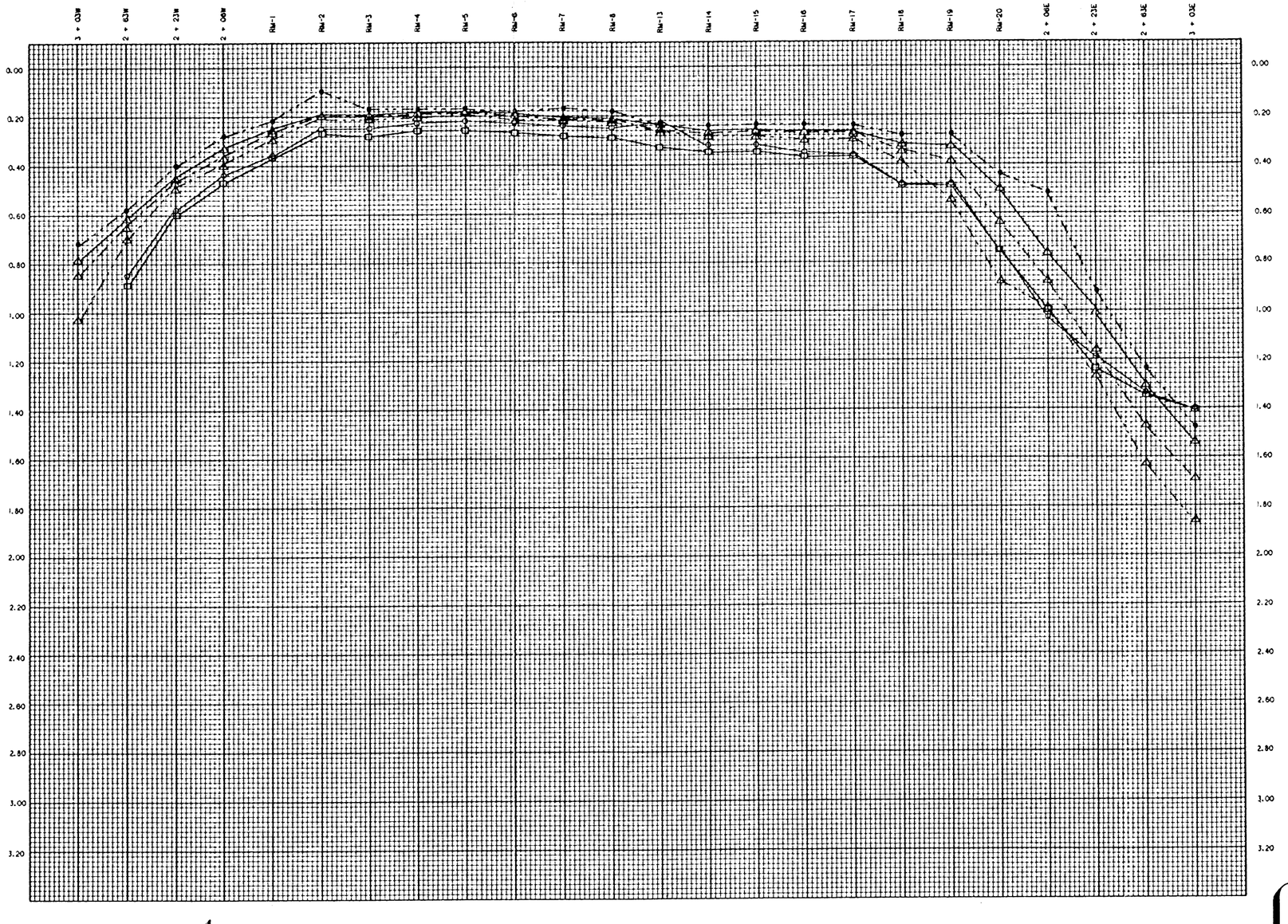
- 2+06 W
- 2+23 W
- 2+63 W
- 3+03 W
- 2+06 E
- 2+23 E
- 2+63 E
- 3+03 E

NOTE:
ALL POINTS PLOTTED AFTER 1979 ARE USING THE EQUATION (R-A)-151 = DIFF.; SEE TABULATION CHART FOR FURTHER INFORMATION.

NEW ORLEANS TO VENICE, LA.
HURRICANE PROTECTION REACH B-1
PERIODIC INSPECTION
EMPIRE FLOODGATE
SETTLEMENT AND REFERENCE MARKS
DIFFERENTIAL'S MOVEMENT

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

PLATE 5



LEGEND

MAR 1984
NOV 1984
JUL 1986
DEC 1988
FEB 1992
JAN 1993

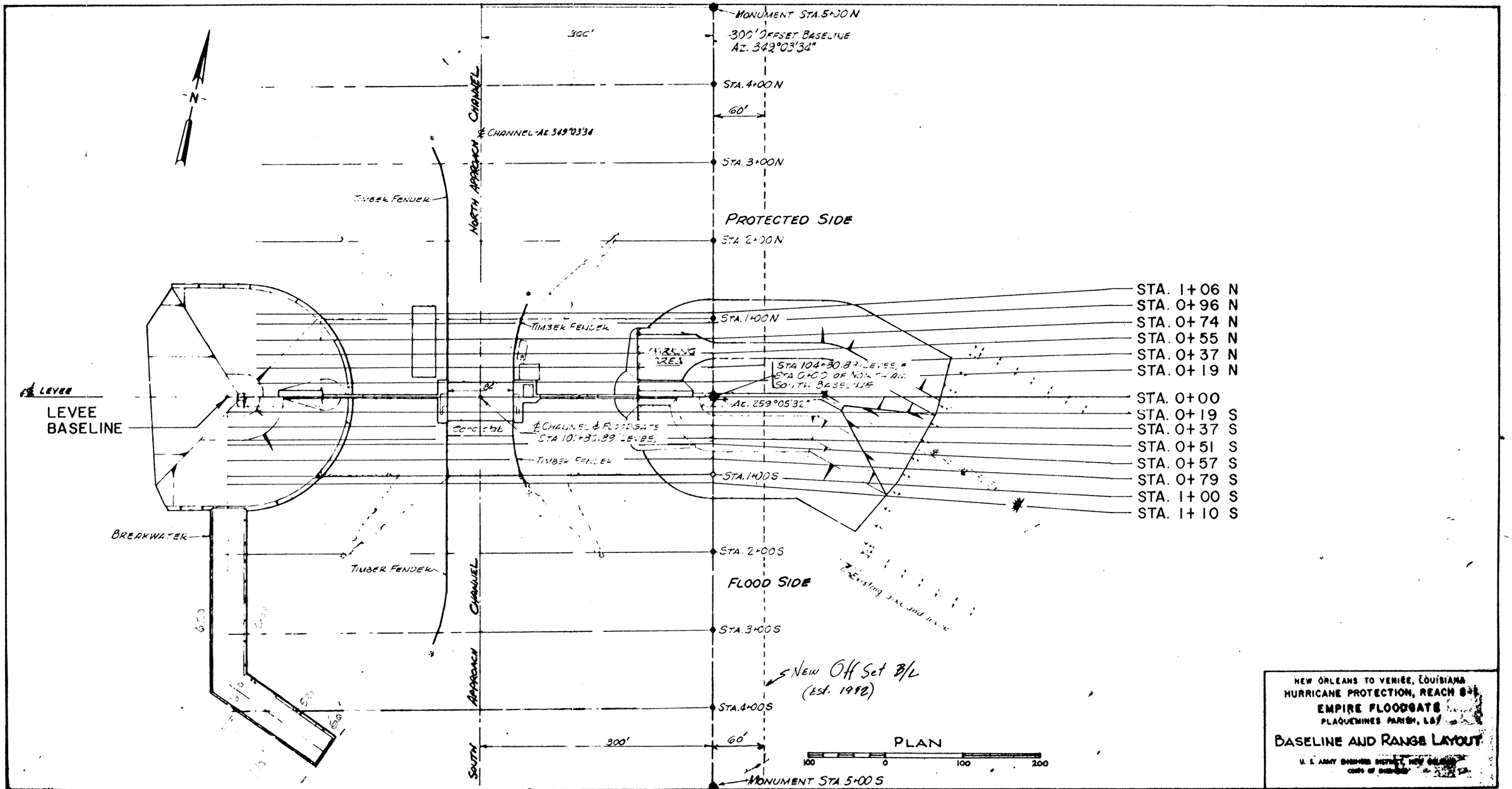
COMPUTER AIDED DESIGN DRAFTING

NEW ORLEANS TO VENICE, LA
HURRICANE PROTECTION REACH B-1
PERIODIC INSPECTION
EMPIRE FLOODGATE

REFERENCE MARKS DIFFERENTIAL CHART

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

PLATE 6

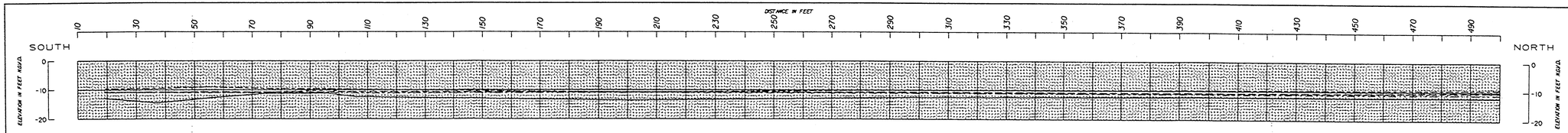


NEW ORLEANS TO VENICE, LOUISIANA
HURRICANE PROTECTION, REACH 8-1
EMPIRE FLOODGATE
PLAQUEMINES PARISH, LA.

BASELINE AND RANGE LAYOUT

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

PLATE EMP - 7



LEGEND:

- 21-MAY-1976
- 29-JAN-1982
- 06-JAN-1983
- 09-APR-1993
- 26-JAN-1993

NOTE:
SECTIONS PLOTTED LOOKING NORTH
PROFILE OFFSET 300'

NEW ORLEANS TO VENICE, LA.
HURRICANE PROTECTION REACH B-1
EMPIRE FLOODGATE & NORTH APPROACH CHANNEL
PROFILE SURVEY (FY 93)
U.S. ARMY ENGINEERS, NEW ORLEANS CORPS OF ENGINEERS

LEGEND:

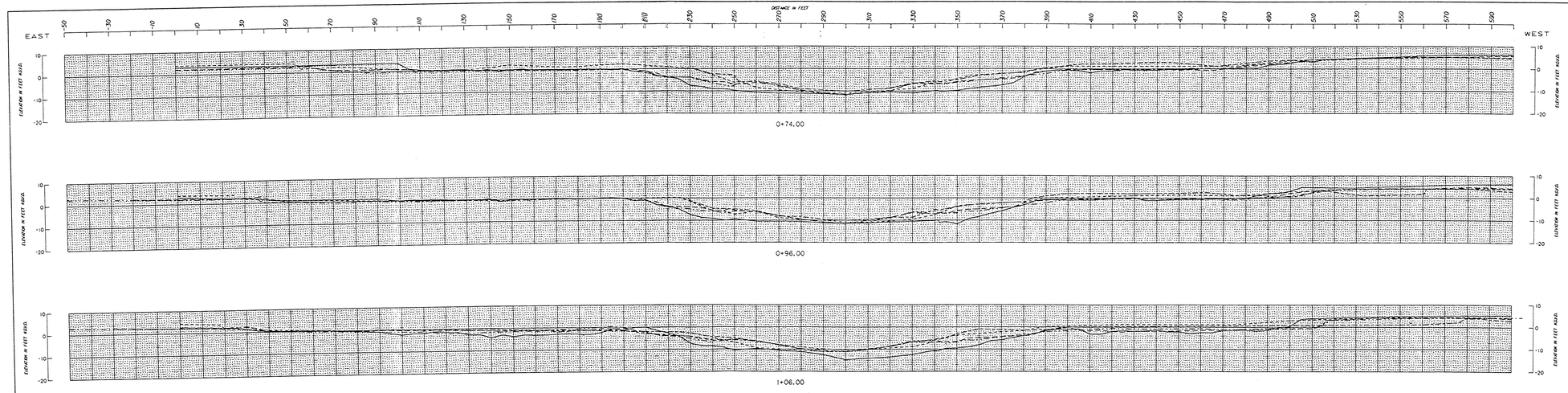
21-MAY-1976
29-JUN-1982
06-JAN-1983
06-APR-1993
26-JAN-1993

NOTES:

STATION:

0+19.00
0+37.00
0+55.00

NEW ORLEANS TO VENICE, LA.
HURRICANE PROTECTION REACH B-1
EMPIRE FLOODGATE & NORTH APPROACH CHANNEL
SCOUR SURVEY (FY 93)
U.S. ARMY ENGINEERS, NEW ORLEANS CORPS OF ENGINEERS



NOTES:

STATION:

0+74.00
0+96.00
1+06.00

NEW ORLEANS TO VENICE, LA.
HURRICANE PROTECTION, REACH B-II
EMPIRE FLOODGATE & NORTH APPROACH CHANNEL
SCOUR SURVEY (FY 93)
U.S. ARMY ENGINEERS, NEW ORLEANS CORPS OF ENGINEERS

PLATE 10

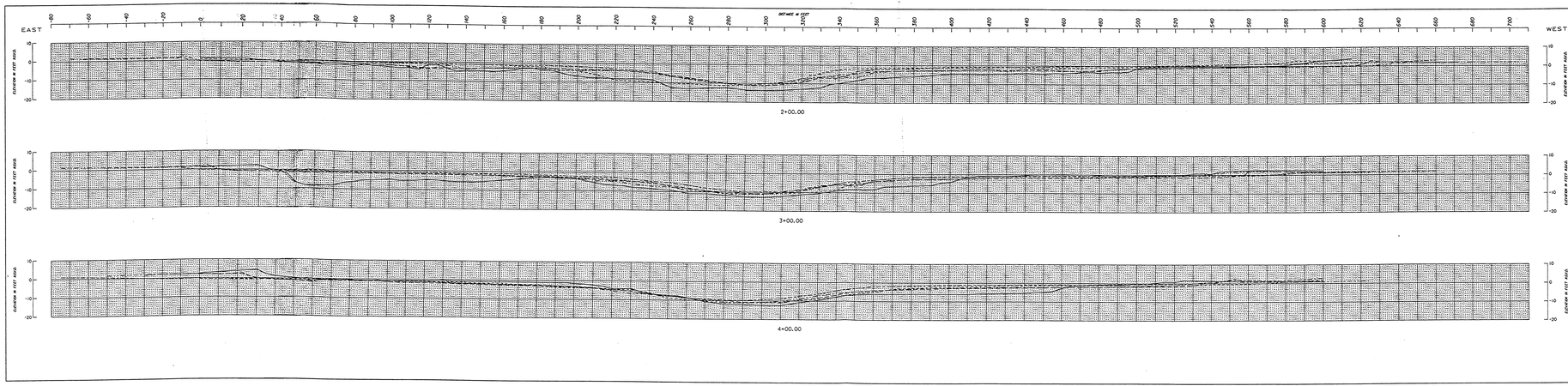
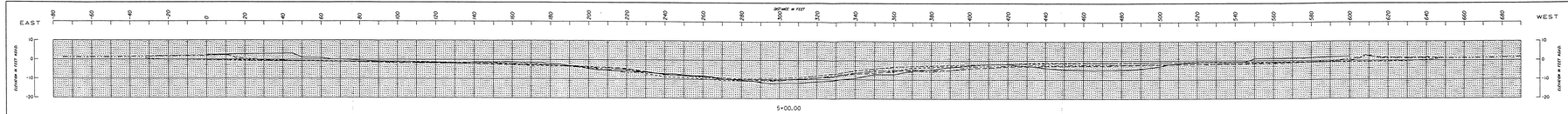
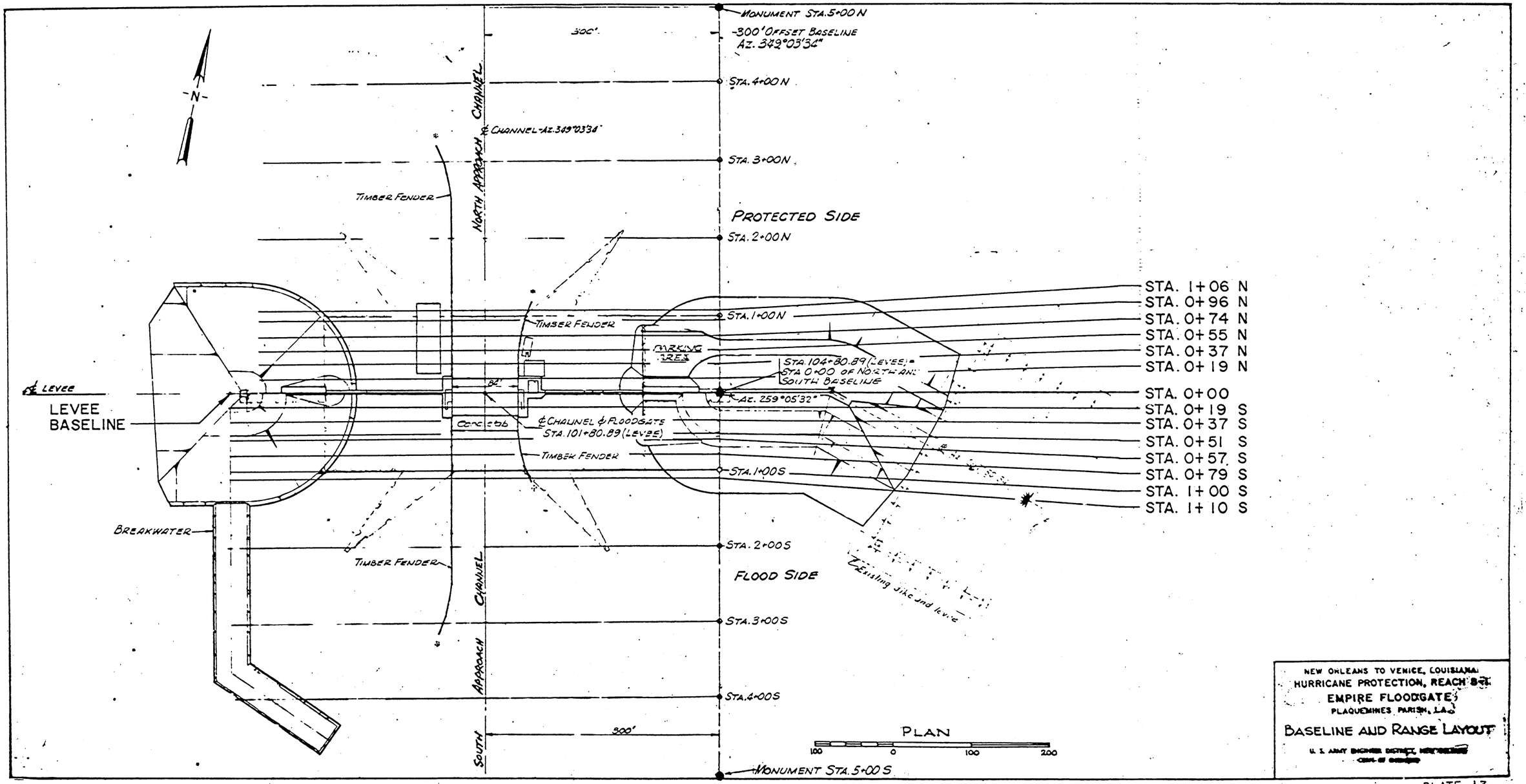

EAST
WEST
DISTANCE IN FEET
ELEVATION IN FEET NGVD
2+00.00
3+00.00
4+00.00
LEGEND:
NOTES:
STATION:
2+00.00
3+00.00
4+00.00
NEW ORLEANS TO VENICE, LA.
HURRICANE PROTECTION REACH B-1
EMPIRE FLOODGATE & NORTH APPROACH CHANNEL
SCOUR SURVEY (FY 93)
U.S. ARMY ENGINEERS, NEW ORLEANS DISTRICT OF LOUISIANA

PLATE 11



NEW ORLEANS TO VENICE, LA.
HURRICANE PROTECTION REACH B-
EMPIRE FLOODGATE & NORTH APPROACH CHANNEL
SCOUR SURVEY (CY 93)
U.S. ARMY ENGINEERS, NEW ORLEANS CORPS OF ENGINEERS

PLATE 12



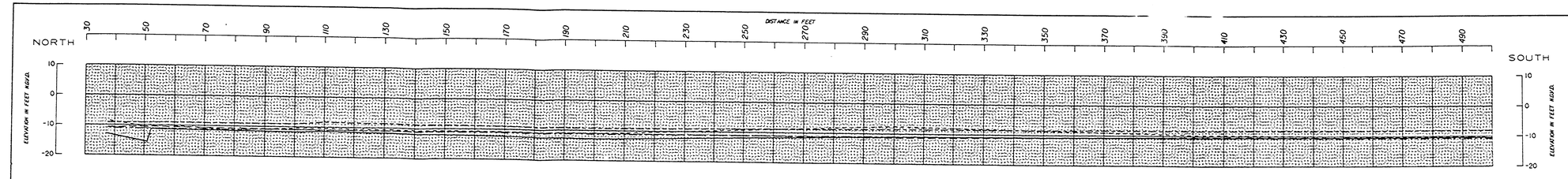
NEW ORLEANS TO VENICE, LOUISIANA
HURRICANE PROTECTION, REACH 8-1
EMPIRE FLOODGATE
PLAQUEMINES PARISH, LA.

BASELINE AND RANGE LAYOUT

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

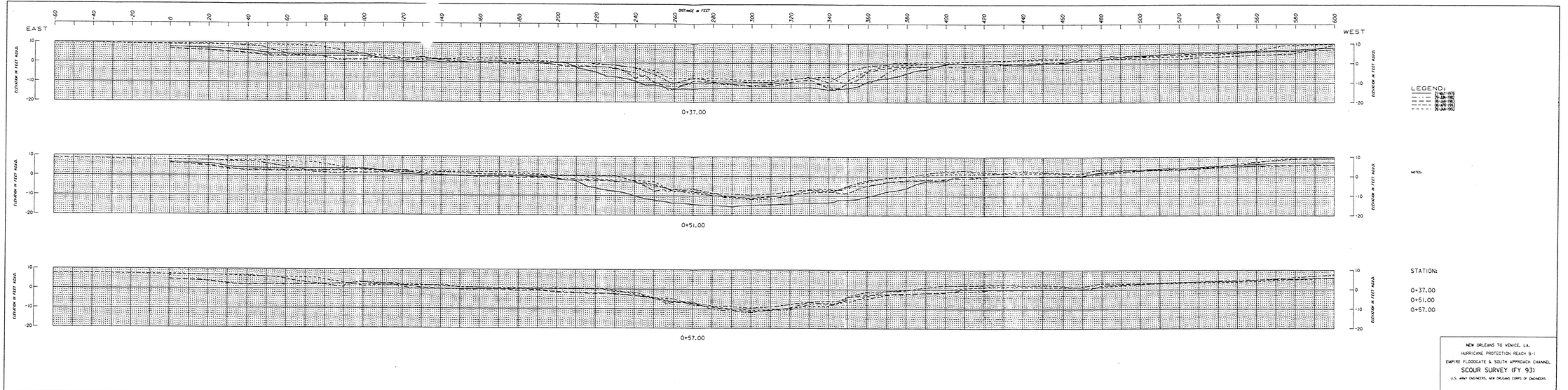
(See Plate 7)

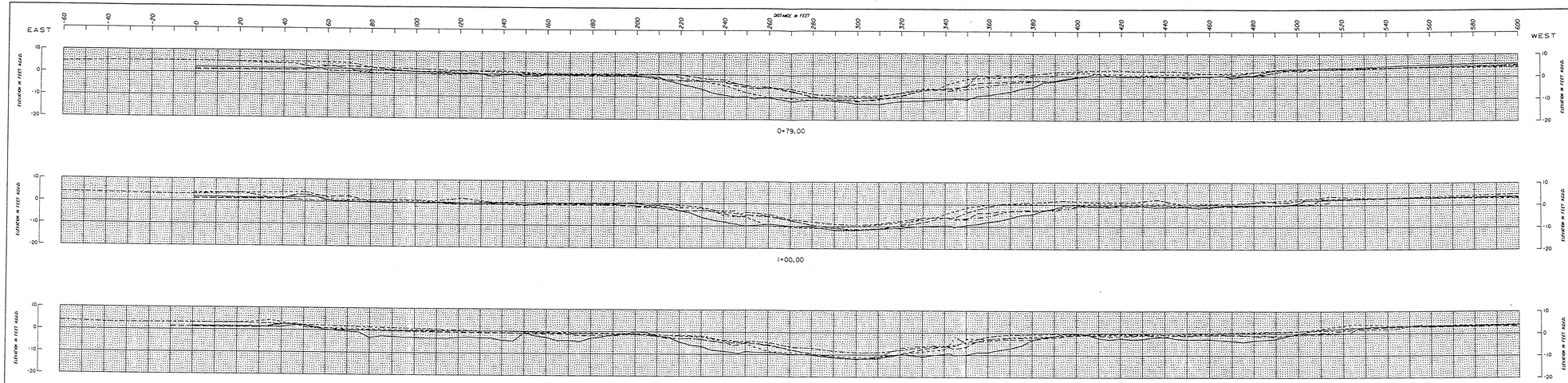
PLATE 13



NOTE:
SECTIONS PLOTTED LOOKING SOUTH
PROFILE OFFSET 300'

NEW ORLEANS TO VENICE, LA.
HURRICANE PROTECTION REACH B-1
EMPIRE FLOODGATE & SOUTH APPROACH CHANNEL
PROFILE SURVEY (FY 93)
U.S. ARMY ENGINEERS, NEW ORLEANS CORPS OF ENGINEERS


EAST
WEST
DISTANCE IN FEET
-60 -40 -20 0 20 40 60 80 100 120 140 160 180 200 220 240 260 280 300 320 340 360 380 400 420 440 460 480 500 520 540 560 580 600
ELEVATION IN FEET NGVD
10 0 -10 -20
0+37.00
0+51.00
0+57.00
LEGEND:
11-MAY-1926
26-JAN-1983
06-APR-1983
01-APR-1993
26-JAN-1993
NOTES:
STATION:
0+37.00
0+51.00
0+57.00
NEW ORLEANS TO VENICE, LA.
HURRICANE PROTECTION REACH B-1
EMPIRE FLOODGATE & SOUTH APPROACH CHANNEL
SCOUR SURVEY (FY 93)
U.S. ARMY ENGINEERS, NEW ORLEANS CORPS OF ENGINEERS



NEW ORLEANS TO VENICE, LA.
HURRICANE PROTECTION REACH B-1
EMPIRE FLOODGATE & SOUTH APPROACH CHANNEL
SCOUR SURVEY (FY 93)
U.S. ARMY ENGINEERS, NEW ORLEANS CORPS OF ENGINEERS

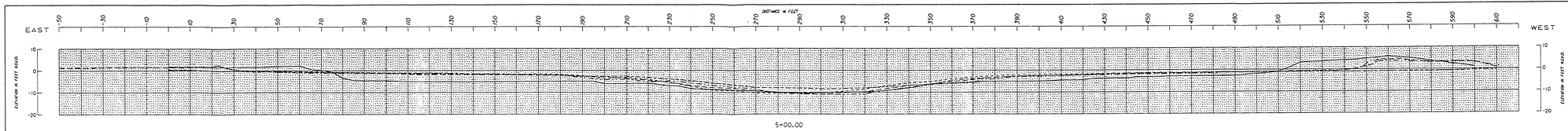
LEGEND:
21-MAY-1976
29-JUN-1982
06-JAN-1983
06-APR-1993
26-JAN-1993

NOTES:

STATION:

2+00.00
3+00.00
4+00.00

NEW ORLEANS TO VENICE, LA.
HURRICANE PROTECTION REACH B-1
EMPIRE FLOODGATE & SOUTH APPROACH CHANNEL
SCOUR SURVEY (FY 93)
U.S. ARMY ENGINEERS, NEW ORLEANS CORPS OF ENGINEERS



LEGEND:

	7-SEP-1976
	29-JUN-1985
	16-JAN-1987
	05-APR-1993
	24-JAN-1993

NOTES:

STATION:

5+00.00

NEW ORLEANS TO VENICE, LA.
HURRICANE PROTECTION REACH B-1
EMPIRE FLOODGATE & SOUTH APPROACH CHANNEL
SCOUR SURVEY (FY 93)
U.S. ARMY ENGINEERS, NEW ORLEANS CORPS OF ENGINEERS