NEW ORLEANS TO VENICE, LOUISIANA

DESIGN MEMORANDUM NO. 1 - GENERAL DESIGN

SUPPLEMENT NO. 5, REVISED

REACH A
CITY PRICE TO TROPICAL BEND

US Army Corps
of Engineers
New Orleans District

65

NOVEMBER 1987

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

REPLY TO
ATTENTION OF:

2 Dec 87

CELMN-ED-SP

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

SUBJECT: New Orleans to Venice, Louisiana, Reach A Revised - City Price to Tropical Bend, La., General Design Memorandum No. 1, Supplement No. 5

1. The subject design memorandum supplement is submitted for review and approval, and has been prepared generally in accordance with the provisions of ER 1110-2-1150, dated 15 November 1984.

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

a. A Section 404 (b)(1) evaluation was signed on 26 April 1983.

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

c. A final Environmental Impact Statement (FEIS) addressing the features of the New Orleans to Venice, Louisiana project was filed with the Council on Environmental Quality (CEQ) in January 1975. This FEIS was not adequate by current environmental standards. Accordingly, a Final Supplemental EIS was filed with EPA on 12 April 85.

An Environmental Assessment (EA) examining the impacts of the proposed alternative borrow pit was distributed on 14 Sept 87, and a Finding of No Significant Impact (FONSI) signed on 2 Nov 87.

d. The New Orleans District is presently developing a management plan/research design for all of Plaquemines Parish. Once complete (in FY 88) all cultural resources and projects will be evaluated and managed in consonance with the plan.

e. There are three proposed primary sources of borrow for constructing the recommended plan. Two sites are located within the protected area of Reach A and the third is located just north of City Price. All sites are in non-wetland areas. At this time we have not received final comments from the U.S. Soil Conservation Service and the State Historic Preservation Office. However, we anticipate that this coordination will be complete shortly. We will at that time prepare an addendum to the EA.

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

4. This report is being submitted to LMVD 3 months beyond the approved submission date of August 1987. There will be no delay in award of the first construction contract for Reach A (scheduled Apr 88) provided that approval of designs contained in this GDM is received NLT December 31, 1987.

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

FOR THE COMMANDER:

Encl (16 cys) fwd sep

FREDERIC M. CHATRY
Chief, Engineering Division

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PROJECT AUTHORIZATION

1. Authority.

a. Public Law 874. Public Law 874, 87th Congress, 2d Session, approved 23 October 1962, authorized the project "Mississippi River Delta at and below New Orleans, Louisiana," (renamed "New Orleans to Venice, Louisiana," after authorization), substantially in accordance with the recommendations of the Chief of Engineers in House Document No. 550, 87th Congress, 2d Session.

b. House Document No. 550. The report of the Chief of Engineers, dated 30 July 1962, submitted for transmittal to Congress the report of the Board of Engineers for Rivers and Harbors, accompanied by the reports of the District and Division Engineers. The Chief of Engineers in his report concurred in the recommendations of the Board of Engineers for Rivers and Harbors. The recommendations of the Board were as follows:

". . . Accordingly, the Board recommends improvements along the Mississippi River below New Orleans, Louisiana, for prevention of hurricane tidal damages by increasing the heights of the existing back levees and modifying the existing drainage facilities where necessary in four separate reaches consisting of:

Reach A on the west bank for about 15 miles between City Price and Empire;

Reach B on the west bank for about 21 miles between Empire and Venice and with such modifications of the main levee as may be required;

Reach C on the east bank for about 16 miles between Phoenix and Bohemia; and

Reach E on the east bank for about 8 miles between Violet and Verret;

generally in accordance with the plans of the District Engineer and with such modifications thereof as in the discretion of the Chief of Engineers may be advisable...."

2. Purpose and Scope. The New Orleans to Venice, Louisiana, Design Memorandum No. 1, General Design Supplement No. 5, Reach A, City Price to Tropical Bend, dated October 1983 presented the essential assumptions, data, criteria and computations which were

used to develop the plans, design and cost for constructing a hydraulic fill sand-core clay covered levee. The plan called for use of marsh borrow areas as a source for the clay materials. This report has been prepared as a revison to the 1983 GDM. The revised GDM presents the essential assumptions, data, criteria and computations that were used to develop the designs, plans and cost estimates for constructing a geotextile reinforced levee. The need to revise the October 1983 GDM was identified through a value engineering study which examined the feasibility of employing the "new generation of high strength fabrics" in the designs and construction of Reach A. The value engineering study recommended that a 400-ft. test section be constructed in Reach A and monitored to establish whether or not the plan was feasible, and if further study was warranted. Test results for the reinforced fabric levee have been extremely successful and this report was prepared as a basis for preparing plans and specifications for construction of the Reach A project feature without need for additional design memorandums. The recommended plan (reinforced fabric levee) presented herein supersedes the plan contained in the 1983 GDM supplement. To aid the reviewer of this document, most of the text from the 1983 GDM which is common to the revised Reach A GDM, has been repeated herein and references to the 1983 report have been held to a minimum.

3. Local Cooperation.

a. Specified by Project Authorization. The conditions of local cooperation pertinent to this supplement, as specified in the report of the Board of Engineers for Rivers and Harbors and as concurred to in the report of the Chief of Engineers, are as follows:

" . . . .that prior to construction local interests give assurances satisfactory to the Secretary of the Army that they will, without cost to the United States:

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

(2) Accomplish all necessary alternatives and relocations to roads, pipelines, cables, wharves, and other facilities required by the construction of the project;

(3) Bear 30 percent of the first cost (for the entire New Orleans to Venice hurricane protection project), a sum presently estimated at $61,365,000, to consist of items listed in subparagraphs (1) and (2) above and a cash contribution, presently estimated at $49,164,000, to be paid in a lump sum prior to initiation of construction or in installments prior to start of pertinent work items, in accordance with construction schedules as required by the Chief of Engineers, or, as a substitute for any

part of the cash contribution, accomplish in accordance with approved construction schedules items of work of equivalent value as determined by the Chief of Engineers, the final apportionment of costs to be made after actual costs and values have been determined;

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

(5) Maintain and operate all works after completion in accordance with regulations prescribed by the Secretary of the Army;

(6) Prevent encroachment on ponding areas unless substitute storage capacity or equivalent pumping is provided promptly; and

(7) At least annually, notify those affected that the project will not provide complete protection from tidal flooding and that further local actions must be taken during hurricane emergencies."

b. Specified by Legislation Subsequent to Project Authorization. In addition to the items of local cooperation specified above, local interests must comply with the following:

(1) Public Law 88-352, Section 601 of Title VI of the Civil Rights Act of 1964, states that no person shall be excluded from participating in, denied the benefits of, or subjected to discrimination in connection with the project on the grounds of race, creed, or national origin.

(2) Public Law 91-611. Since construction of the New Orleans to Venice hurricane protection project commenced prior to 1 January 1972, Section 221 of the Flood Control Act of 1970 (Public Law 91-611) is not applicable.

(3) Public Law 91-646, (the "Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970") authorized an act to provide for uniform and equitable treatment of persons displaced from their homes, businesses, or farms by Federal and federally-assisted programs and to establish uniform and equitable land acquisition policies for Federal and federally-assisted programs. The assurances of local cooperation covering the west bank river levee plan will include this requirement.

(4) Public Law 93-251, Section 9 provides that the requirement that non-Federal interests hold and save the United States free from damages shall not include damages due to the fault or negligence of the United States or its contractors.

4. Other Pertinent Projects.

a. Federal Projects.

(1) Mississippi River Levees. The Mississippi River levees below New Orleans are included in the comprehensive plan for the protection of the alluvial valley of the river between the Head of Passes, Louisiana, and Cape Girardeau, Missouri, as authorized by the Flood Control Act of 15 May 1928 and subsequent acts. The main line Mississippi River levees terminate at Venice (mile 10.8) on the west bank of the river and at Bohemia (mile 44.0) on the east bank.

(2) Mississippi River Delta Region (Salinity Control Structures), Louisiana. Public Law 89-298 of the Flood Control Act of 1965 (H. Doc. 308/88/2) authorized four salinity control structures below New Orleans to divert fresh water from the Mississippi River into certain marshes and bays below New Orleans, Louisiana, to minimize the effects of saltwater intrusion on fish and wildlife resources. Two of the structures are to be located on the east bank of the river and two are to be located on the west bank.

b. Non-Federal Projects.

(1) The Pointe-a-la-Hache Relief Outlet, about 11 miles in length, was constructed in the 1920's by the Orleans Levee District with Federal approval. It is located on the east bank of the Mississippi River below Bohemia and provides for the discharge of floodwaters directly into Breton Sound as a relief outlet for the benefit of the city of New Orleans. The outlet passed some 300,000 ft^3/sec during the 1927 flood but has shoaled in the intervening years to a much lower capacity.

(2) The Louisiana Department of Public Works has constructed a lock through the non-Federal levee at Ostrica. The lock is located on the east bank at about mile 25. The lock is 40 feet wide, 250 feet long, and has a sill elevation of -10.0 feet NGVD (National Geodetic Vertical Datum) [2/]. The lock is extensively used by oilfield and fishing vessels.

(3) In 1955, the Louisiana Department of Public Works constructed a freshwater diversion structure on the east bank of the Mississippi River at Bayou Lamoque in the Pointe-a-la-Hache Relief Outlet. This structure consists of four 10- by 10-foot gated conduits for diverting fresh water from the river through an improved Bayou Lamoque to reduce salinity concentrations on the oyster beds in the bays east of the river. In 1977, the Louisiana Department of Public Works constructed another freshwater

2/ Elevations herein are in feet referred to National Geodetic Vertical Datum (NGVD) unless otherwise noted.

diversion structure on the east bank of the Mississippi River at Bayou Lamoque just downstream of the first structure. This structure, consisting of four 12- by 12-foot gated box culverts, diverts fresh water from the river through an improved Bayou Lamoque for the same purpose as the first structure.

(4) A freshwater diversion structure has been constructed by Plaquemines Parish on the east bank of the Mississippi River at Little Coquille. This structure, used for diverting fresh water to bays east of the river, consists of five 48-inch concrete culverts with provisions to regulate flow.

(5) In 1970, the Louisiana Department of Public Works completed construction of a freshwater diversion structure on the east bank of the Mississippi River at Bohemia. This structure consists of four 60-inch gated conduits and is used for diverting fresh water to bays east of the river.

INVESTIGATIONS

5. Project Document Investigations. Studies and investigations made in connection with the project document (H.D. 550, 87th Congress, 2d Session) consisted of: research of information which was available from previous reports and existing projects in the area, extensive research in history and records of hurricane damages and characteristics of hurricanes, extensive tidal hydraulics investigations, an economic survey, field topographic and hydrographic surveys of reconnaissance scope, and design and cost studies. A public hearing was held in New Orleans, Louisiana, on 13 March 1956 to determine the views of local interests. Federal and state agencies were consulted. The District Engineer made a personal reconnaissance of the area.

6. Investigations Made Subsequent to Project Authorization. Studies and investigations made subsequent to project authorization include:

a. Aerial and field surveys of the project area;

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

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

d. Detailed design studies for construction of levees and structures;

e. Determination of real estate requirements and costs;

f. Determination of operation and maintenance requirements and costs;

g. Cost estimates for levees, structures, relocations, and modifications;

h. Economic evaluations of the recommended protective works; and

i. Environmental studies required by the National Environmental Policy Act of 1969.

7. Planned Future Investigations. Additional soil borings and tests will be made prior to each levee lift subsequent to the first. Design analyses, utilizing information obtained from the additional borings, will be made and preparation of plans and specifications for each lift will be based on these analyses. Also, a bearing pile test will be conducted to determine pile lengths for construction of T-walls at the pumping stations. Additional general type borrow borings will be taken later for development of borrow areas.

LOCAL COOPERATION

8. Status of Local Cooperation.

a. Assurances in connection with the items of local cooperation specified in the project document were requested from the Plaquemines Parish Commission Council on 7 January 1963. The act of assurances and supporting resolution adopted by the Commission Council on 6 March 1964, covering Reaches A, B, and C, were accepted for and on behalf of the United States on 14 April 1965. Supplemental assurances for Reaches A, B, and C covering provisions of the Uniform Relocation Assistance and Real Property Acquisition Act, Public Law 91-646, were accepted on behalf of the United States on 20 June 1973. This district has attempted for a considerable number of years to obtain assurances for the East Bank Barrier Levee from the Plaquemines Parish Commission Council. The local assurer has up to now declined to execute such assurances in the hope of obtaining Congressional approval to fund the East Bank Barrier Levee under the Mississippi River and Tributaries authorization. The local sponsor has indicated its intent to execute assurances for the West Bank Mississippi River Levee plan to accomplish the project purposes envisioned for the East Bank Barrier Levee (see pertinent correspondence in Appendix C. The assurances will be forwarded for signature upon approval of this GDM.

b. The assuring agency and the principal officer of the assuring agency are as follows:

Plaquemines Parish Government
Pointe-a-la-Hache, Louisiana 70082
Luke A. Petrovich, President

9. Views of Local Interests. The Plaquemines Parish Commission Council (recently renamed the "Plaquemines Parish Government") represents local interests. They are in agreement with the plan recommended herein and a letter of support dated July 28, 1987; this letter is contained in Appendix C.

10. Required Non-Federal Cost. The total required non-Federal cost for constructing the Reach A project features, as presented herein, is estimated to be $11,460,000 which includes $1,563,000 for lands and damages, $3,945,000 for relocations, and a cash contribution and/or equivalent work valued at $5,952,000.

LOCATION OF PROJECT AND TRIBUTARY AREA

11. Location of Project. The Reach A project area is located in the Mississippi River delta region of coastal Louisiana along the right descending bank of the Mississipi River from the vicinity of City Price to Tropical Bend, Louisiana. The project area is presently provided a marginal degree of protection from gulf tides by an existing non-Federal back levee. The area remains vulnerable to the ravages of major tropical storms and hurricanes. A general plan, index, and vicinity map are shown on plate 1.

12. Tributary Area. The project area comprises approximately 4,300 acres of land which are essentially bounded by the existing non-Federal back levee and the Mississippi River west bank levee. Interior drainage is provided by an existing system of canals and pumping facilities.

PROJECT PLAN

13. General. The plan of protection presented herein will protect the Reach A project area against tidal flooding resulting from hurricanes. The protected area is along the west bank of the Mississippi River between City Price and Tropical Bend.

14. Plan of Protection. The project plan, shown on plates 2 through 10, provides for construction of protective levees and appurtenant features. The levee system will be about 12.8 miles in length and will have a net elevation ranging from 11.0 feet NGVD at the beginning near City Price to 14.5 feet NGVD at the lower end near Tropical Bend. The upper end of the levee system will tie-in to the main line Mississippi River levee at station 13+29.98. The lower end of the levee system will tie-in to the Reach B-1 levee system. Land access into the project area is

provided by Louisiana Highway 23. Floodwalls will be provided at the City Price drainage structure, Hayes Canal pumping station, Freeport Sulphur unloading dock, and Gainard Woods pumping station. The pumping station discharge pipes will pass through the floodwall, but will be modiifed to prevent potential backflow during high outside stages. The pumping stations will continue to provide for the drainage of the protected area. Relocations and modifications will be made to 10 facilities and 18 pipelines.

15. Departures from Project Document Plan. The project document plan (H.D. 550, 87th Congress, 2d Session) recommended enlargement of the existing back levee system and modification of the existing drainage facilities where necessary. Revisions made to the project document plan which are applicable to Reach A are as follows:

a. Revision of Levee Elevation. The net levee elevations were revised in accordance with the results of tidal hydraulic studies made subsequent to project authorization. These studies utilized the latest hurricane parameters developed by the National Weather Service. Net levee elevations at the upper end of the project area (City Price) decreased while net levee elevations at the lower end of the project area (Tropical Bend) increased.

b. Modification of Reach A Terminus. The project document plan provided that Reach A would terminate (lower end) at the Doullut Canal in Empire, La. However, detailed studies indicated that either enlargement of the existing back levees or construction of floodwalls in the Empire area was impracticable due to the congested nature of the area. A more economical plan was developed which provides for a levee location gulfward of the existing levee at Empire with a floodgate closure in the Empire to Gulf Waterway. This revision was incorporated into Reach B-1, with the result that Reach A was shortened, with its lower terminus shifted from Empire to Tropical Bend.

HYDROLOGY AND HYDRAULICS

16. Hydrology and Hydraulics.

a. General. Detailed results of the hydrology and hydraulic analyses for the plan for Reach A are presented in Appendix A in three sections. Section I presents an introduction and statement of the problem to be addressed. Section II presents the climatology and hydrology of the area. Section III presents detailed descriptions and analyses of the tidal hydraulic procedures used in the tidal hydraulic design. Included in the descriptions and analyses are the essential data, assumptions and criteria used, and the results of studies which provide the bases for determining design wind tide level, wave runup, overtopping, and frequency of hurricanes.

b. Climatology.

(1) The study area has a subtropical marine climate. Located in a subtropical latitude, its climate is related to subtropical latitude and proximity to the Gulf of Mexico. Throughout the year, these water areas modify the relative humidity and temperature conditions, decreasing the range between the extremes. When southern winds prevail, these effects are increased, imparting the characteristics of a marine climate.

(2) The area has mild winters and hot, humid summers. During the summer, prevailing southerly winds produce conditions favorable for afternoon thundershowers. In the colder seasons, the area is subjected to frontal movements which produce squalls and sudden temperature drops. River fogs are prevalent in the winter and spring when the temperature of the Mississippi River is somewhat colder than the air temperature.

(3) Temperature data taken at the New Orleans Audubon Park Station are used to describe the study area. From temperature normals over the period 1951-1980, the mean annual temperature is 69.5°F at this station. Extremes over the period of record are 7°F on 13 February 1899 and 102°F on 30 June 1954 (and other dates). Other records in the area include a maximum of 102°F in Belle Chasse and Port Sulphur on 7 August 1935 and 31 August 1951, respectively, and a minimum of 6°F at Diamond on 12 February 1899. The average temperature in summer is 82.4°F and in winter is 55.3°F. Temperature normals at Audubon are shown in Table B-1 of Appendix B.

(4) There are four major climatological stations located in or near the study area. New Orleans at Algiers has an annual normal rainfall of 61.67 inches based on the 1951-1980 normal period. Annual rainfall at St. Bernard averages 63.0 inches for 19 years of record. The 20 year averages for Boothville and LSU Citrus Research Center (Diamond) are 57.15 inches and 67.86 inches, respectively, for the period 1966-1985. The maximum monthly precipitation for the Algiers normal period was 22.44 inches during April 1980. For St. Bernard, the maximum monthly also occurred during April 1980 and totaled 24.06 inches. LSU Citrus had a maximum of 15.97 inches during August 1984 and Boothville had 14.28 inches for August 1977. A local station, Belle Chasse, recorded a maximum monthly rainfall of 29.0 inches in October 1937. All stations had months with no measurable rainfall. The heavy rainstorms which occurred 12-13 April 1980, dumped 11.86 inches in Algiers and 10.73 inches in St. Bernard. A very localized but extraordinary record of 13.16 inches in 4 hours was reported at Boothville on 7 May 1983. The monthly normals based on averaging records for Burrwood and New Orleans are shown in Section I, page A-2 of Appendix A. Snowfall is rather infrequent and light. However, 8.2 inches fell in New Orleans on 14-15 February 1895 and 4.5 inches fell on 31 December 1963.

c. Hydrology.

(1) Tides. The tide along the coast is diurnal and has a mean range of approximately 1 foot under normal conditions. During periods of low flow on the Mississippi River, tidal effects are observed on the river as far as 200 miles upstream from the Gulf of Mexico. Water surface elevations are observed presently at four locations along the Mississippi River within the project limits. These elevations reflect headwater flow and tidal fluctuation. Recording type gages are located at West Pointe-a-la-Hache, 1926 to date; Empire, 1960 to date; and Venice, 1944 to date. Staff gage records are available at Port Sulphur for the period 1934 to date. In addition, daily river stages were observed at Fort Jackson during the period 1891-1960. Several high water staff gages are also located along the river.

(2) Headwater Flooding. Headwater flooding of the natural banks of the Mississippi River occurs almost annually, but the area flooded is small and confined by the river levees. The coincidence of a hurricane occurring with a major river flood is considered to be possible but very improbable.

(3) Hurricanes of Record. Many severe storms have been experienced in the areas east and west of the lower Mississippi River. Flooding to various depths occurred on one or both sides of the river during the storms of 1856, 1860, 1886, 1887, 1893, 1901, 1906, 1909, 1915, 1916, 1917, 1926, 1940, 1947, 1948, 1956, 1961, 1964, 1965, 1969, and 1985. Hurricane tracks that have been experienced in the project area are shown on plate A-8 in Appendix A. Hurricane Betsy in September 1965 produced what, at that time, was the highest recorded surge elevation in the study area. A hurricane track and isovel pattern of wind speeds at the critical hour during Hurricane Betsy are shown on plate A-4 in Appendix A.

Surges occurring at key locations were 15.7 feet at Bohemia, 15.25 feet at West Pointe-a-la-Hache, 13.6 feet at Ostrica Lock, 10.4 feet at Empire, and 8.8 feet at Venice.

In August 1969, Hurricane Camille caused extensive flooding in Plaquemines Parish, overtopping main line river levees as did Hurricane Betsy. The hurricane track and isovel pattern of windspeeds at the critical hour for Camille are shown on plate A-5 in Appendix A. Surges occurring at the same key locations were 11.5 feet at Bohemia, 11.8 feet at West Pointe-a-la-Hache, 15.9 feet at Ostrica Lock, 10.9 feet at Empire, and 9.1 feet at Venice.

Hurricane Juan in October 1985 was the last storm to strike the study area. Entering from the west, Juan's storm tides overtopped a local levee near Myrtle Grove on the west bank, flooding a 3 mile section of LA State Highway 23 with about 4 feet of water from Lake Judge Perez to Myrtle Grove. Several homes in

Grand Bayou, a small community west of Port Sulphur, were flooded with up to 4 feet of water. No high water was experienced along the study area's river levees; however, Southwest Pass recorded a record high of 5.59 feet.

Hurricanes Betsy and Camille both occurred at a time of relatively low river stage, and caused a large increase in river stages as far as 300 miles upstream. In addition, these hurricanes caused a downward sloping water surface profile to occur some 30 to 75 miles upstream of the peak surge before a normal backwater curve resumed upstream. The peak surge during Hurricane Betsy occurred at mile 50 AHP1/ and the water surface in the river sloped downward upstream to approximately mile 88 AHP. The undisturbed river discharge 12 hours before the peak surge during Betsy was 200,000 cfs (cubic feet per second). The peak surge occurred at mile 25 AHP during Camille and the water surface sloped downward upstream also. The river discharge prior to Camille was 260,000 cfs.

Hurricane surge elevations were obtained from (1) automatic stage recorders located along the Mississippi River; (2) peak recording high-water pipes and staff gages located in the area; (3) still high-water marks in buildings which withstood these hurricanes; and (4) debris lines on obstructions to flow. A greater reliability was placed on still high-water marks in multi-story buildings and automatic stage recorders than on the high-water pipes, debris lines, and water marks on staff gages. Structures on which high reliability was placed were the Plaquemines Parish Court House at Pointe-a-la-Hache, La.; the Sunrise School at Sunrise, La.; the operating houses at Empire and Ostrica Locks; the National Weather Service station at Boothville, La.; and the ramparts at Fort Jackson, La. Two Weather Service employees actually weathered Hurricane Camille at the Boothville station and were able to establish a still high-water mark in the building of 13.8 feet. All of these structures are located in partially protected areas where wave action is minimized. The stage of 14.4 feet experienced at West Pointe-a-la-Hache during Hurricane Betsy was recorded by an automatic stage recorder located in the river at mile 49 AHP. Data such as these were used for verification of surge computations.

(4) Stage-Frequency. Stages critical to the project area are generated by hurricanes that approach from a southerly direction. Records indicate that two-thirds of all hurricanes that strike the Louisiana coast approach from the south while one-third approach from the east. The average azimuth of tracks from the south is 180° while tracks from the east have an average azimuth of 117°. Therefore, in the computation of stage-frequencies, 67 percent or two-thirds of the observed hurricanes were used to reflect stage probabilities for the back protective

1/ Above Head of Passes (AHP)

structures of Reach A. Normally, hurricane stages observed in a study or project area are used in determining stage frequencies. However, due to a scarcity of observed stages along the back protective structures of the project area, the frequency relationships determined for Grand Isle were used to assist in determining the probability of occurrences in the project area.

(5) Design Hurricane. Hurricanes that would produce stages ranging from 8.9 feet at the upper end of the project area to 10.3 feet at the lower end were selected as design hurricanes. Each hurricane has identical parameters, but tracks are transposed in order to obtain critical windspeeds and direction for each of 5 separate reaches along the back protective structures. The reaches are numbered 1 through 5, beginning at the upper end of the project (see Appendix A for location of reaches). Hurricanes of lesser intensity than that of the design hurricane would require lower levee grades and consequently expose protected areas to greater hazards to life and property that would be disastrous in the event of occurrence of hurricanes with the intensity and destructive capability of a design hurricane. A design hurricane for any point location of the project area has a central pressure index of 28.0 inches of mercury and a maximum windspeed of 85 m.p.h. at a radius of 30 nautical miles. The forward speed is 11 knots and is assumed to progress along a track critical to each segment of the project area.

(6) Design Wave Characteristics. The data used to determine wave characteristics for the project area are as follows:

Pertinent Factors	Reach	City 1	Price 2	Reach A to 3	Tropical 4	Bend 5
Length of fetch, mi		5.0	5.0	5.0	5.0	5.0
Windspeed, m.p.h.		85.0	85.0	85.0	85.0	85.0
Stillwater elevation, ft.		8.9	9.2	9.6	10.1	10.3
Average depth of fetch, ft.		6.6	6.9	7.3	7.8	8.0
Depth at toe of structure, ft.		7.9	8.2	8.6	9.1	9.3

The project is designed to prevent overtopping of protective structures by waves of height equal to that of the deepwater significant wave (the highest one-third of the waves in a train) and/or smaller waves which break farther up the levee slope than the significant wave.

(7) Design Elevations. The design wave runup and elevation of protective structures are as follows:

Location	Design Runup feet	Design Elev. of Structures feet
City Price to Tropical Bend:		
Lateral Levee	0.0	11.0
Back Levee	3.6-4.2	12.5-14.5
Floolwalls	5.8-6.4	12.5-16.0-17.0

The design wave runup and elevation of protective structures listed above progress from the upper to lower ends of the project and are dependent on the levee configuration on the flood side of the structures.

(8) Interior Drainage. Local interests have provided drainage in the project area, and construction of the Reach "A" hurricane protection levee in accordance with the plan presented herein will not affect the capability of the existing interior drainage system except for an additional 115 acres near the Freeport Sulphur facility.

These 115 acres consist of two areas: Area 1 (75 acres) and Area 2 (40 acres), both of which are shown on plate A-18 in Appendix A.

(1) Area 1 will be drained through the use of an existing drainage facility (as shown on plate A-18 in Appendix A).

(2) Area 2 will be drained into the Plaquemines Parish Drainage Canal. This would probably be done by constructing an open drainage ditch that would run from the north end of the Grande Ecaille Canal to an existing culvert that is parallel to LA State Highway No. 23 (it would then tie into this culvert). Runoff from Area 2 would then flow from this existing culvert to the Plaquemines Parish Drainage Canal. This is shown on plate A-18 in Appendix A (a culvert with appropriate erosion protection at its inlet and outlet would be required under any local access roads). Local interests, however, will determine exactly how Area 2 is to be drained into the Plaquemines Parish Drainage Canal.

17. Physiography. The project area is located within the Gulf Coastal Plain. More specifically, the area is located on the deltaic plain of the Mississippi River in a region of extremely low relief. The dominant physiographic features are the natural levees of the Mississippi River and its abandoned distributaries, and the marshlands and bodies of water that lie between the natural levees. Elevations range from a maximum of approximately 6 feet along the natural levees to a minimum elevation of 0 feet in the area between the natural levees.

18. General Geology.

a. For this project, only the geologic history since the end of the Pleistocene Epoch is important. At that time, with the sea level about 450 feet below its present level, the Mississippi River began to aggrade the most recent entrenchment which it had cut to the west of the project area during the last glacial period. This initial alluvial sedimentation was confined to the central portion of the alluvial valley. Active downwarping and faulting of the Pleistocene Prairie surface, with accompanying sedimentation, resulted in a gulfward dip of the Prairie surface of about 3 feet per mile, increasing southward towards the coastline. The continued rise in sea level resulted in the reworking and redeposition of minor amounts of fluvial sediments in the project area. The first marine and fluvial marine sediments, of any significance, were carried into the area when the sea level reached a level within tens of feet of its present level.

b. As sea level approached its present level, the Mississippi River began to migrate laterally back and forth across the deltaic plain. Deltaic marine sediments were first carried into the project area when the Mississippi occupied the Teche course near the western margin of the valley. The first major advance of sediments into the project area occurred when the Mississippi River shifted eastward and began to develop the La Loutre-St. Bernard Delta. Later, the Mississippi River shifted westward to the Lafourche course and for a period of several hundred years, the project area was subjected to only minor amounts of sedimentation during which time deltaic deterioration and subsidence became dominant. When the river once again shifted eastward and began to occupy the present Plaquemine course, sedimentation again became the predominant process in the project area. With the construction of levees along the Mississippi River, floodwaters have been eliminated from the area and at present only minor amounts of sediments are being introduced into the project area. Subsidence and erosion have again become the dominant factors, particularly in the marshlands and inland bodies of water and, unless sediment-laden water is introduced into the project area, the land mass along the edges of the project area will continue to decrease.

19. Subsidence and Erosion. Progressive subsidence and downwarping have been occurring in the project area since the end of the Pleistocene Epoch. The surface of the Pleistocene has been downwarped towards the south and west to a maximum of about 500 feet at the edge of the continental shelf, which is about 30-40 miles south of Buras, Louisiana. At present, the rate of subsidence within the project area varies from about 0.5 to 1.0 foot per century at the northern limit to about 5 feet or more per century along the gulfward-facing extremities of the area, gulfward of the project alignment. As a result of subsidence and wave erosion, the gulfward-facing edges of the shoreline, and the shorelines of the ponds, lakes, and bays within the marshlands, are retreating.

20. Investigations Performed. A total of 30 general type borings and 36 undisturbed type borings were made in association with this project, and extend to a maximum depth of 192 feet (elevation -189).

21. Foundation Conditions.

a. The subsurface, as shown on plates 86 through 90 (refer to the Reach A, City Price to Tropical Bend, GDM dated Oct 1983), consists of Holocene deposits of variable thickness underlain by Pleistocene material. Generally, the Holocene deposits consist of a surface layer of natural levee and/or marsh deposits underlain by interdistributary, intradelta, prodelta, and abandoned distributary deposits.

b. The marsh deposits, which vary in thickness from 2 feet to 12 feet, consist of very soft to soft clays with peat and organic matter. Natural levee deposits overlie the marsh deposits between: Sta. 24+90 and Sta. 113+64, Sta. 234+00 and Sta. 329+53, and Sta. 445+00 and Sta. 501+12. These natural levee deposits vary in thickness up to 12 feet and consist of fat and lean clays, silts and silty sands.

c. Abandoned distributary deposits are located in the vicinity of stations 5+00, 70+00, 140+00, 170+00, 290+00, and 385+00. These abandoned distributary deposits consist of very soft to soft clays, silts, silty sands and sands. The depths of the distributary deposits cannot be determined from available boring data; however, depths of from 40 feet to 100 feet are indicated.

d. Underlying the marsh deposits between the abandoned distributaries are interdistributary deposits. These interdistributary deposits vary in thickness from 25 feet to 65 feet and consist predominantly of fat clays. Occasional lean clay, silt, silty sand and sand lenses are found within the interdistributary deposits.

e. Intradelta deposits underlie the interdistributary deposits from Sta. 0+00 to Sta. 665+00 and vary in thickness from 10 feet to 35 feet. Generally, the intradelta deposits consist of silts and silty sands with occasional clay lenses.

f. The interdistributary and intradelta deposits are underlain along the entire reach by prodelta deposits consisting predominantly of medium to stiff fat clay with occasional lean clay and silt lenses.

22. Mineral Resources. Extensive oil and gas production occur in the vicinity of the project area, and it is expected that future exploration will also take place. However, existing and future exploration and production of these natural resources will not be adversely affected by the project, nor will the project be adversely affected by this exploration and production.

23. Conclusion. The various geological environments and the nature of the deposits encountered in the borings are typical of Holocene unconsolidated materials in this region. It is anticipated that the primary problem associated with the project will be settlement primarily beneath the structures. This settlement will be greatest in the very soft and soft clays of the marsh deposits and interdistributary deposits. Conversely, settlement in the silts, silty sands and sands of the abandoned distributary deposits and intradelta deposits will not be as great.

SOILS AND FOUNDATIONS INVESTIGATION DESIGN

24. General. The Reach A levee was divided into five reaches, based on stillwater levels and wave runup. The limits of the five reaches and the design elevations are as follows:

	Reach No. & Levee Stations	Design Levee Crown Elevation, Ft.
*	1 0+00 to 4+00	11.0
**	1 4+50 to 83+30	12.5
	2 83+80 to 314+50	13.0
	3 315+00 to 477+00	13.0
	4 477+50 to 613+00	14.0
	5 613+50 to 681+90.79	14.5

* Pertains to upper return levee
** Pertains to back levee

25. Field Investigations. A total of 30 general type and 36 undisturbed soil borings were made for design in association with the Reach A project. The approximate locations of these borings are shown on plates 2 through 10. The bottom elevations of these borings range from -40 to -189. Plates 42 through 48 show logs of all borings taken along the final project and study alignments. Plates 49 through 85 show the plots of the undisturbed borings with the applicable soils data. The above plate references in this paragraph refer to plates contained in the 1983 GDM. In addition to the above, borings P2-U, PI-G, and I-2-U were taken for the geotextile reinforced levee test section. No changes were made to the geologic profile or the shear strength lines to reflect the information from these borings. These borings are shallow and were taken to determine the local conditions and to find what type of materials the piezometers were going to be installed in. Plate 65 of this report contains the plotted logs of P2-U, PI-G, and I-2-U.

26. Laboratory Tests. Visual classifications were made on all samples obtained from the soil borings, and water content determinations were made on all cohesive samples. Unconfined compression (UC), unconsolidated undrained (Q), consolidated undrained (R), consolidated drained (S), and consolidation (C) tests were performed on selected samples from the undisturbed borings. Unconfined compression tests were made on selected samples from the general type borings. Liquid and plastic limit determinations were made on all samples tested for shear and/or consolidation. Results of laboratory tests are shown on soil boring log plates 49 through 85, and on the detailed laboratory test data sheets (plates B-1 through B-35 in Appendix B) of the 1983 GDM.

27. Existing Levee. Throughout the project area, the existing hurricane levee has a factor of safety slightly above one against a slope failure into the drainage canal which is on the protected side of the levee. Using conventional construction techniques, an enlargement of the existing levee gulfward from its present toe would result in a levee having a factor of safety (F.S.) = 0.80 for a protected side analysis and 0.85 for a flood side analysis. This analysis applies in Reach 5 where the levee crown elevation is 14.5. The critical slip surface for a failure into the canal is much deeper than the slip surface for a gulf side failure; it ranges from elevation -25 to -40.

28. Geotextile Reinforced Levee Option.

a. General. Recent developments in high - molecular - weight polymers and weaving techniques have made it possible to enlarge the present levee in place. Geotextiles are textiles in a traditional sense, but consist of synthetic fibers rather than natural ones like cotton, wool, and silk. Thus, biodegradation is not a problem. The fibers are made into a flexible, porous fabric by standard weaving machinery. Geotextiles are designed to provide a wide range of porosity. The new generation of reinforcing geotextiles are made from polyester, nylon, aramid, or fiberglass fibers. An extremely strong single layer fabric can be manufactured from these fibers with tensile - strain characteristics that are compatible with soft clay soils. Geotextiles made from other fibers generally exhibit excessive creep properties under a lower percentage of their ultimate load strength. Excessive creep can destroy any reinforced soil structure. In order for reinforcement to be effective, it must provide the required tensile force at levels of strain that are compatible with the soils at the site. The soft clay soils throughout this site reach maximum deviator stresses between 3% and 5% strain. A polyester geotextile is recommended, and the maximum recommended strain is 5%. Polyester is presently the most economical geotextile within the high strength group. At present, geotextiles provide the most viable alternative for raising the existing levee in place to design grade.

b. Other Design Considerations for Geotextile Reinforced Levee. The optimum use of geotexile reinforcement in the design of a levee requires the designer to consider a number of possible options. The decision whether or not to use multiple layers of geotextile depends upon whether site conditions require them to provide the tensile strength needed to develop the design factor of safety. In some cases, it may be less expensive to specify several layers of geotextile at lower tensile strengths, than a single layer of fabric which has a very high tensile strength. Anchorage length is also an important factor which influences the number of layers to be used. However, in most cases, a single layer fabric reduces the construction effort and eliminates static equilibrium questions associated with multiple - layer designs; i.e., what percentage of the total load is carried by a given layer, and the proper spacing of fabric layers within the levee.

29. Design Sections and Factors of Safety.

a. Geometry. The design section consists of a IV on 3H slope on the protected side, an 8-ft. crown, and a IV on 3H slope from the crown to the wave berm. Specifics for each reach are presented in the following table:

TABLE 1
REACH GEOMETRY

Reach Number	Levee Stations	Crown Elevation	Top of Berm El.	Berm Slope	Bottom of Berm El.
1*	0+00 to 4+00	11.0	not req'd	not req'd	
1**	4+50 to 83+30	12.5	7.5	IV on 11H	4.5
2	83+80 to 314+50	13.0	7.5	IV on 12H	5.0
3	315+00 to 477+00	13.5	8.0	"	5.0
4	477+50 to 613+00	14.0	8.5	"	5.5
5	613+50 to 681+90.79	14.5	8.5	"	5.5

* Pertains to upper return levee
** Pertains to back levee

The slope from the lower berm elevation to the existing ground is IV on 3H.

b. Factors of Safety. Presented on each plate are geotextile requirements to develop factors of safety of 1.3 or 1.5, as appropriate. A factor of safety of 1.5 is used in the vicinity of pipelines and other structures. Two layers of geotextile will be used in reaches where a safety factor of 1.5 is required.

30. Construction Fill. A sand core is used in the gulf side enlargement of the existing levee. Sand has several advantages in this type of construction, especially in this area.

a. Sand improves the frictional resistance between the geotextile and the fill.

b. Sand provides a more stable foundation to place clay fill on, and also reduces the chances of a failure within the fill.

c. Sand helps relieve the pore pressure at the soil/fabric interface caused by the foundation loading.

Clay will be placed over the sand blanket to provide a seepage barrier, erosion control and a medium in which grass will grow. A minimum of 2 feet of clay will be placed on the sand blanket over the wave berm. A much thicker clay cover will be placed under the centerline of the new levee. An impermeable core is provided by the existing levee, which will effectively prevent flow through the section.

31. Geotextile Design Methodology. Stability analyses were performed using the sliding wedge method and the results were compared to values obtained from circular arc analyses for the

section to el. 14.5 design grade. These stability analyses will be presented in the Reach "A" test section report. A brief description of the test section is given in paragraph 32. For this job, at shallow depths, the wedge method of analysis is more conservative and requires a stronger fabric to achieve the same factor of safety; at greater depths, the geotextile requirements are approximately the same for both methods. The geotextile will provide the required tensile force to reinforce the soil and increase the factor of safety to 1.3 or 1.5 where required against failure.

A reinforced soil structure to develop a stable slope, consists of two primary components:

1) A geotextile that provides the necessary tension for a chosen factor of safety.

2) Sufficient embedment length is available to develop the necessary tensile force.

a. Tensile Requirements. Tensile requirements were computed using the following equation:

$$T = F.S. (D) - R$$
$$D = D_a - D_p$$
$$R = R_a + R_b + R_p$$

F.S. = required factor of safety

Since it is customary to report fabric strength in lbs/in, the T value is divided by 12.

b. Embedment Length. The embedment length required to provide the frictional (cohesive) components to develop T, is calculated by combining the contributions from the top and bottom surfaces of the geotextile strip.

$$L = \frac{T}{[\gamma h \tan\phi + c]^{*} + [\gamma h \tan\phi + c]^{**}}$$

L - ft.
T - lbs/ft.
ϕ - friction angle between soil and geotextile
* - top surface
** - bottom surface

A length equal to or greater than L has to be available from the intersection of the active wedge and geotextile and into the stable portion of the slope.

32. Test Section at Reach "A". A 400-ft. test section was built within the limits of the job. It is being monitored and evaluated. The test section has a crown elevation of 14.5 (the highest within the job limits) and consists of a 1V on 3H side slope on the canal side and 1V on 4H side slope on the gulf side, with a crown width of 8 ft. The section was located so that approximately one half of the gulf side toe was placed in open water, the other half was placed on top of the existing marsh grass. This was done to model the construction effort that will be required, and to determine the best way to build such a section under actual conditions.

Settlement plates, piezometers, inclinometers, and strain gages were installed to measure behavior during and after construction. Two types of strain gages were installed: a foil type and a potentiometer type. The foil gages produced the best results. The test section was brought up to design grade on 26 Nov 86 and is performing very well with no evidence of cracks or other signs of excessive stress.

Maximum strain gage readings (3.5%) are occurring at the row of instruments closest to the gulf side toe of the new levee, this is also the area which is having the greatest settlement and horizontal movement. Horizontal movement is towards the gulf. Although the test section is still under evaluation, the data collected to date indicate that a geotextile reinforced section can be successfully built at the site.

33. Stability Analysis. Presented on each plate is the factor of safety for the enlarged levee without reinforcement, and also, the geotextile tensile force that will be required to increase the factor of safety to 1.3 or 1.5 where required. Two analyses were performed on each reach, one for a protected side failure, the other for a gulf side failure. The job was divided into the following stability reaches:

a. Station 0+00 to Station 6+60. In this reach, a straddle enlargement of the existing levee is planned. Two sections, one to elevation 11 (see plate 27), the other to elevation 12.5 (see plate 28), were designed. The elevation 11 section will apply from station 0+00 to station 4+00 where the levee is perpendicular to the Mississippi River levee and not subject to waves; the elevation 12.5 section will apply from station 5+50 to station 6+60. A transition will be made between stations 4+00 and 5+50. A cost comparison between inverted T-type gates and earthen ramps will be made for the Highway 23 crossing (vicinity stations 1+00).

b. Station 6+60 to Station 9+14. A composite section, consisting of an I-wall embedded in the existing levee, will be used in the vicinity of the City Price drainage structure as shown on plate 29. The sheet pile will extend to station 6+50 then, starting at station 6+60, a IV on 4H transition slope will be applied. An excavation backfilled with compacted clay will be required at the drainage structure to cut off the sand blanket which extends through the levee. The sand blanket is approximately 50 feet wide and extends to about elevation -13. The operating tower will be left in place as well as the pipe floodward of the tower. The pipe landward of the operating tower may be removed during excavation and replaced during backfill operations. The excavation will be backfilled with clay, compacted to the density of adjacent undisturbed material. The 1V on 3.5H berms shown on plate 29 will be applied up to the sides of the catch basins. An earth cofferdam will be used in conjunction with sumps and pumps to dewater the site. The cofferdam design is shown on plate 30. The design consists of a 4 foot wide crown at elevation 2.0 with 1 on 3 slopes to existing terrain with a minimum of 20 feet between the toe of the cofferdam and the excavation provided for service access. Closure sections of the cofferdam design for east side and west side approaches of the existing canal are shown on plates 31 and 32, respectively. These designs have a safety factor of 1.30 and provide for a 30 foot service area. A stability analysis on the existing levee excavation for a safety factor of 1.30 is shown on plate 33. The required slope on the cut parallel to the levee centerline is 1 vertical on 4 horizontal and is symmetrical about the centerline of the excavation.

c. Station 9+14 to Station 29+55 and Station 31+00 to Station 83+80. Within these limits, the levee will be built to the geometric shape for reach number 1 (back levee) in Table 1. The crown elevation is 12.5 feet. This reach contains the Happy Jack Marina which was analyzed separately and is addressed next paragraph. The geotextile design analyses are presented on plates 34 and 35.

d. Station 29+55 to Station 31+00. This reach is for the Happy Jack Marina area. The pump station hole will be filled with shell, rock, and a clay blanket will be placed over these materials. On the gulf side, sand will be placed over the fabric and a clay cover will be placed over the sand core. A road will be placed on the slope of the wave berm (1V on 11H), but it does not create stability problems. Refer to plates 36 and 37 for additional information.

e. Station 83+80 to Station 109+88 and Station 113+30 to Station 245+00. The levee in this reach will be built to the geometric shape for reach number 2 in Table 1. The crown elevation is 13.0 feet. This reach contains the Hayes Canal Pumping Station which is analyzed, separately, and presented in the next segment. A control line for a factor of safety of 1.5 was used to determine the location where the earth section stops and the floodwall begins. I-wall and T-type walls will be used in the vicinity of the pumping station. Plates 38 and 39 present the analyses for these reaches.

f. Station 109+78 to Station 113+97 (Hayes Canal Pumping Station). An I-wall, T-wall combination to avoid relocations or major modification to this facility is planned for this reach. The analyses are shown on plates 40 and 41.

g. Station 245+00 to Station 253+02. Within this reach, an all earth clay levee, with the flood side berm extending into the Port Sulphur bay, is available for use as shown on plate 42. The berm will require wave wash protection.

h. Station 253+02 to Station 281+04 (Freeport Sulphur Reservoir Area). The levee in this reach will be constructed to the geometric shape of segment 2 in Table 1. It is not necessary to degrade the existing levee in this reach, the geotextile will be placed over the existing levee. Plates 43 and 44 show the analyses for this reach.

i. Station 282+50 to Station 284+80 (Freeport Canal Closure). A clay covered shell core closure section was designed for the Port Sulphur canal as shown on plates 45 and 46. The closure section should be completed before any work is started on the adjacent canal banks. Wave wash protection should be used on the flood side slope of the closure section. A drainage structure may be incorporated into the closure to drain runoff from the canal, reservoir, and housing area. Geotextile is not required for a protected side failure, since the sand that will be used to fill in the canal provides a berm and increases the factor of safety to 1.56. Geotextile is required for a gulf side failure which controls the design. Since, the entire section will be constructed in open water, a thick clay blanket will be used over the shell core, and wavewash protection will be used on the gulf side.

j. Station 286+35 to Station 291+40. In this reach, an I-wall driven into the existing levee section has been designed as shown on plate 47. This section requires a shell dike and berm construction in the Port Sulphur loading bay. Wave wash protection will also be required.

k. Station 291+30 to Station 297+50. An all earth clay levee set forward enlargement is designed and shown on plate 48. A 20-foot set forward will be used so that the road on top of the existing levee will not be disturbed.

l. Station 297+50 to Station 304+00. An all earth clay straddle enlargement has been designed for this reach, and is presented on plate 49.

m. Station 304+00 to Station 314+50. The proposed protection consists of filling in the drainage canal with sand and constructing an all earth section as shown on plate 50. This will require a shell closure section to elevation 3 as shown on the top right-hand portion of the plate.

n. Station 314+50 to Station 438+16 and Station 442+38 to Station 476+50. A clay fill embankment with a sand core levee has been designed and is shown on plates 51 and 52. This section is built to the geometric shape for reach number 3 in Table 1.

o. Station 437+69 to Station 443+25 (Gainard Woods Pumping Station). An I-wall, T-wall combination will be used in order to avoid relocations or major modifications to this facility. The section for the existing levee with I-wall is shown on plate 53, and will be used from station 438+00 to station 439+80 and stations 441+00 to 443+00. The inverted T-wall section shown on plate 54 will be used between stations 439+80 and 441+60.

p. Station 476+50 to Station 612+50. The clay fill embankment with a sand core levee is shown on plates 55 and 56. This reach is built to the geometric shape for reach number 4 in Table 1.

q. Station 612+50 to Station 676+88. In this reach, a clay fill embankment with a sand core levee, as shown on plates 57 and 58 will be constructed. The geometric shape for reach number 5 was used.

r. Station 676+88 to Station 681+91. The existing levee in this reach has several sharp alignment breaks. The new alignment, on plates 59 and 60, provides a smooth transition to Reach B-1. This segment will be constructed over virgin ground, and the geotextile will be placed over the existing marsh. The settlement prediction curve for the slope of the test section has been used to predict the crown settlement in this reach.

34. Summary of Geotextile Requirements.

a. Tensile Strength. A geotextile made of polyester fiber will be used and worked at 5% strain. The tensile requirements in the following table are in lbs/in.

TABLE 2
GEOTEXTILE TENSILE STRENGTHS

Stations	Protected Side		Gulf Side	
	T (F.S.=1.3)	T (F.S.=1.5)	T (F.S.=1.3)	T (F.S.=1.5)
9+42 to 29+55 31+15 to 83+30	1,080 2/	1,770 2/	190	460
29+55 to 31+00	1,070	1,730	1,210	1,860
83+80 to 109+78 113+97 to 237+08	1,240	1,890	290	590
253+02 to 282+50	1,270	1,860	140	340
282+50 to 286+15	1/	1/	480	1,250
315+00 to 437+69 443+25 to 477+00	1,300	1,910	430	930
477+50 to 613+00	1,170	1,840	510	860
613+50 to 676+88	1,550	2,290	670	1,070
676+88 to 681+91	1,700	2,420	890	1,330

1/ Geotextile is not required; gulf side analysis governs.
2/ Figure given is lbs/in.

Large geotextile orders will reduce the cost per square yard significantly. Whenever possible, reaches which have similar tensile requirements will be combined, and the higher tensile strength shall be specified for purchase. A geotextile with a grab strength of 250 lbs/in shall be used between the offset location on Table 3 and the toe of the gulf side berm.

b. Embedment Length. Presented in the following table are gulf side offset requirements from the new levee centerline to provide enough embedment length to develop the tensile force in the fabric.

TABLE 3

GULF SIDE OFFSET REQUIREMENTS FROM THE NEW LEVEE CENTERLINE

Stations	Failure Towards	Offset from new Levee Centerline (ft)
9+42 to 29+55 31+15 to 83+30	Canal	35
29+55 to 31+00	Canal	1/
83+80 to 109+78 113+97 to 237+08	Canal	35
253+02 to 282+50	Canal	1/
282+50 to 286+15	Canal	1/
315+00 to 437+69 443+25 to 477+00	Canal	35
477+50 to 613+00	Canal	35
613+50 to 676+88	Canal	40
676+88 to 681+91	Canal	40

1/ - Place geotextile to gulf side toe.

35. Settlement. Settlement data from the test section was used to develop the following logarithmic equations which predict settlement at the crown, and at a location on the gulf side slope approximately 25 feet from the centerline of the new levee.

$$S_2 = 0.588\ LN(X) - 1.404 \quad \text{Crown}$$

$$S_4 = 0.639\ LN(X) - 1.064 \quad \text{Slope}$$

X = number of days since beginning of construction.

Each equation was generated from 38 data points for readings between 22 Oct 86 and 27 Jul 87 at the test section. Settlement plates S1 and S2 monitor the crown settlement at the two instrumented locations next to the levee crown. These plates show almost identical settlement; the other two plates on the gulf side levee slope showed different rates of settlement at each location. The actual settlement at station 660+00 is represented by the closely spaced symbols on plate 62; the symbols which are further apart were generated by the logarithmic equations. It is predicted that the proposed levee will have to be raised in five years by the amounts shown on plate 62. Table 4 contains the predicted settlement.

TABLE 4
PREDICTED SETTLEMENT

Elapsed Time X (yrs)	S2 (ft)	S4 (ft)
0.5	1.66	2.26
1.0	2.07	2.70
2.0	2.47	3.15
3.0	2.71	3.40
4.0	2.88	3.59
5.0	3.00	3.73
10.0	3.41	4.17

36. Methods of Construction. In order to design a levee project economically, the number of fibers in the direction parallel to the levee centerline should be much less than the number of fibers perpendicular to the centerline. Theoretically, once the levee is constructed, the fibers parallel to the levee centerline are no longer needed. Their only function is to facilitate construction. All fill must be placed and pushed parallel to the seams, in a direction perpendicular to the centerline. The seams may separate, if fill is pushed in the direction perpendicular to the seams. Special care must be taken to insure that all folds are removed before fill is placed on the fabric. Any large bushes that may create big voids between the existing ground and geotextile must be removed. The geotextile must be placed over the marsh grass or other vegetation, as long as voids do not become a problem. Disturbance of the marsh grass must be kept to a minimum, since the grass provides a good base to place the geotextile on.

Embedment length will be provided by removing the material of the existing levee which is above elevation +5. The material will be placed on the canal side slope of the existing levee. Fold backs (anchors) are not required on either the canal or gulf side ends of the geotextile. After the fabric is placed, the fill which was removed from the existing levee will be replaced on top of the geotextile to increase the pull-out resistance and to reconstruct the existing levee. A sand core will be constructed on the geotextile, with the elevation of the top of sand next to the reconstructed levee crown 1.5 feet lower than the reconstructed crown. This will reduce the possibility of constructing a seepage path across the crown of the existing levee and will provide a better cutoff. The levee berm must be raised at the same rate as the levee section, to its design grade. The geotextile that is required from Table 2 is to be placed between the protected side limit and the offset location in Table 3. From the offset in Table 3 to the toe of the gulf side berm, a weaker geotextile with a grab strength of 250 lbs/in shall be used. One geotextile must overlap the other by 5 ft. and a thin sand layer shall be placed between the fabrics. The thickness of the sand layer shall be approximately 1 inch, but may vary in thickness (the intent is to have a continuous layer to provide friction between the two pieces of fabric).

Problems occurred in the test section when the clay blanket was placed beyond the geotextile in pond areas where no marsh grass was growing. Extending the geotextile to the berm toe will eliminate such construction problems and reduce the quantity of fill that will be required to construct the clay cover.

37. General.

a. Shear Strength and Wet Densities. The clay shear strength and unit weight trends used in the analyses are shown on plate 157; the alternate shear strength trend for the Freeport Sulphur Dam area is shown on plate 158 (Oct 1983 GDM).

b. Floodwalls. Floodwalls are proposed for use in areas where an earth levee cannot be economically built. A new levee to elevation 10 will be used to make the transition from the sand core levee alignment to the existing back levee (the design is shown on plate 63). This new levee is designed for an initial F.S. of 1.2 and a final F.S. of 1.3 (after settlement to elevation 7). The existing levee I-wall composite section is designed for an F.S. of 1.3 against shear failure. For the high water "Hurricane Loading" case, with water to stillwater level, the I-wall sections are designed for an F.S. of 1.2 against shear failure. In all cases, the penetration of the sheet pile is designed for an F.S. of 1.5. The wave effect was applied as a line force acting at the centroid of the wave pressure diagram. At the site of the two pumping stations, the existing levee across each station will be degraded to elevation 4 and an inverted T-wall construction on top of it. The I-wall will be tied into each end of the T-wall. The design elevations for the floodwalls, which are required only within the first three reaches, are as follows:

Stations	Floodwall design Elevation Ft.
0+00 to 8+80	12.5
8+80 to 83+30	16.0
83+30 to 315+00	16.0
315+00 to 477+00	17.0

These elevations are based on wave runup and a levee crown elevation of 8.5 (for station 0+00 to station 8+80) and 7 (for station 8+80 to station 477+00).

(1) Cantilever I-Wall. The stability and required penetration of the steel sheet piling below the ground surface was determined by the method of planes. The long-term (S) shear strengths (c=0) governed for design. A factor of safety of 1.5 was applied to the friction angle as follows: ϕ_d (developed friction angle) = $\tan^{-1} \frac{(\tan \phi_a)}{F.S.}$. This developed angle was used to determine $K_a = \tan^2 (45° - \frac{\phi_d}{2})$, and $K_p = 1/K_a$. Using the resulting developed shear strengths and net horizontal static water pressure, the earth pressure diagrams were determined for movement toward each side of the sheet pile. Using these pressure diagrams and the wave force, the summation of horizontal forces was equated to zero for various tip penetrations. The tip penetration required for stability was determined as that elevation at which the summation of overturning moments about the bottom of the sheet piling approached zero as shown on plates 29, 64, 114, and 138 of the Oct 1983 Reach A GDM.

(2) Inverted T-Wall.

(a) Steel Sheet Pile Cutoff. A steel sheet pile cutoff will be used beneath the T-wall to provide protection against seepage. The recommended tip elevation of the cutoff below the T-wall and the stability of the T-wall are shown on plates 41 and 54.

(b) Bearing Pile Foundation.

1. The T-wall will be supported by piling, battered as required, to provide stability against the unbalanced lateral waterloads. In compression, a factor of safety of 2.0 was applied to the shear strength and a lateral earth pressure coefficient of K_0 = 1.0 was used for determining the normal pressure on the pile surface. In tension, a factor of safety of 2.0 was applied to the shear strengths and coefficients of K_0 = 0.7 (S-case) and K_0 = 1.0 (Q-case) were used. Design of the T-wall pile foundation was performed for both the (Q) and (S) cases. In these two designs, the (Q) case shear strengths governed. Pile design loads vs. tip elevations, and subgrade moduli vs. tip elevations are shown on plate 159 (Oct 1983 GDM). Settlement of the piles due to consolidation during maximum loading is not expected since the major loads are caused by hurricane-induced stages of insufficient duration for consolidation of the foundation clays to ensue.

2. It is recommended that pile load tests be performed at the Homeplace (Gainard Woods) pumping station prior to preparation of the plans and specifications. A minimum of two piles would be load tested: one at the design tip elevation and another 10 feet below the design tip elevation. The piles would

be tested in both compression and tension, allowing a minimum of 14 days between tests.

38. Erosion Protection. Due to the short duration of hurricane flood stages and the resistant nature of the clayey soils, no erosion protection, other than sodding, is considered necessary on the levee slopes along most of the levee alignment. However, foreshore protection will be constructed on the flood side levee toe in areas where damages could occur from waves generated by other than hurricane winds. This will be any berm or levee slope which is constructed into the open bays and bayous. The foreshore protection will consist of 24 inches of riprap on a 9-inch thick shell bedding. At the pumping stations, protection against erosion will consist of 18 inches of riprap over a 9-inch thick shell bedding.

DESCRIPTION OF PROPOSED STRUCTURES & IMPROVEMENTS

39. Levees. Reach A, Hurricane Levee Project, City Price to Tropical Bend, La., is approximately 12.8 miles in length as shown on plate 1. The detailed alignment and profile of the levee and features contiguous thereto are shown on plates 2 through 10. The typical levee section is a marsh side levee enlargement of the existing local hurricane levee. However, there are two pumping stations (Hayes Canal and Gainard Woods) which require modifications to include I-wall/T-wall construction, modifications to three marinas, an I-wall in the vicinity of the Freeport Sulphur Complex to maintain accessibility to its facilities (i.e., storage, dock, etc.), relocation of Highway 23 and its associated utilities, and several pipeline levee crossings. There are also modifications to be made to the City Price Drainage Structure which is to be a straddle enlargement with a portion of I-wall as well.

The Reach A hurricane levee begins at the Buras Levee District MR&T Mainline Levee near City Price and extends to the Reach B-1 hurricane levee in the vicinity of Tropical Bend, La. The levee height ranges from elevation 11.0 ft. at the junction with the mainline MR&T levee to elevation 14.5 ft. at the junction with Reach B-1.

The typical levee enlargement will consist of a marsh side embankment with a wave berm. The base of the levee will be constructed on geotextile fabric anchored into the existing levee. A sand blanket will be placed on the geotextile fabric, and the sand blanket will be covered by clay. The embankment (including wave berm) will be constructed of uncompacted clay. However, sand may be substituted for the clay core. This option is being maintained to ensure the lowest bid price. Costs are directly related to haul distances and availability of sand pits. Future sand pit operations in the area may make sand more economical than clay fill. A clay cap, a minimum of 2 feet thick, is required over all sand fill. At various locations shown on plates 2 through 10, armor will be used at dead end canals, pipeline canals, marinas, and the closure of the Freeport Canal. Work will proceed from the lower end of the project at Tropical Bend to City Price. The project will be constructed in two enlargements with a 5-year period between the completion of the first enlargement and the start of the second enlargement as indicated by settlement curves (see plate 62). The Freeport Sulphur floodwall is the only portion of the work to be constructed in a single phase. All other structures will be constructed in two phases allowing for settlement prior to capping the I-wall previously placed in the first enlargement. Also, located within the project are numerous pipelines which will be relocated over the enlarged levee. To achieve the required safety factor of 1.5 at these and other structural locations, an additional layer of geotextile material will be used. The project will require approximately 11 years to complete at a cost of approximately $38.2 million.

40. Structures.

a. Floodwalls at Pumping Stations. Hayes Canal and Gainard Woods Pumping Stations are located on the protected side of the existing levee, with discharge pipes passing over the levee and terminating in respective outfall canals. Plan layout of floodwalls at pumping stations are shown on plates 18 and 21. The new levee will not cross the outfall canals but will terminate approximately 150 to 170 feet to each side of discharge pipe crossings. Stability of the existing levee sections at pumping stations requires that the levees be degraded to elevation 7.0 in the vicinity of the I-type floodwalls and to elevation 4.0 in the vicinity of the inverted T-wall. To prevent wave overtopping, the floodwalls will be built into the levees to elevation 16.0 at the Hayes Canal Pumping Station and to elevation 17.0 at the Gainard Woods Pumping Station. The approximate B/L station for the Hayes Canal Pumping Station are 111+51 and for the two Gainard Woods pumping stations are 439+97 and 440+59, respectively. The floodwalls consist of approximately 158 feet of inverted T-wall and 212 feet of I-wall at the Hayes Canal Pumping Station, and approximately 232 feet of inverted T-wall and 224 feet of I-wall at the Gainard Woods Pumping Station. Where the discharge pipes pass through the floodwall, provisions for settlement or deflection of the wall or any small movements of the pipe will be provided by the method shown on plate 23. Details of the floodwalls are shown on plates 22, and 23. Subsequent to publication of Reach A, Design Memorandum No. 1, General Design Supplement No. 5, Oct 1983, Plaquemines Parish expanded pumping capacity at the Gainard Woods site with construction of Pumping Station No. 2.

b. Floodwall at City Price. A combination levee/I-wall system will be used for the flood protection between B/L station

6+50 and station 9+14. This flood protection will transition into adjacent levees, which have fully consolidated. The sections for these adjacent consolidated levees at stations 6+50 and 9+14 are given on plates 11 and 12, respectively. The floodwall alignment is shown on plate 15. The flood protection will be constructed on an existing levee and will have a 20-foot crown at elevation 8.5 (as indicated on plate 16). The length of floodwall is approximately 265 feet in this region, with top of wall elevation 12.5 and a steel sheet pile tip elevation of 0.0. Construction of the floodwall will not begin until after all new and adjacent levee construction has been completed so as to insure that the driving of steel sheet piling and capping can be accomplished in one contract. Typical floodwall details and schedules are shown on plates 22 and 23.

c. Floodwall at Freeport Sulphur. A combination levee/ I-wall will be used to provide flood protection behind the Freeport Sulphur facility between B/L station 286+35 and station 291+40 (as shown on plate 19). The floodwall will be constructed on an existing levee between B/L station 286+81 and B/L station 291+40 (as indicated on plate 19). Between B/L station 286+35 and B/L station 286+81, the floodwall will transition into the Port Sulphur Canal Closure levee. The length of floodwall is approximately 505 feet with a steel sheet pile tip elevation of -15.03 and top of wall elevation of 16.0. Construction of the floodwall will not begin until after all new and adjacent levee construction has been completed so as to insure that the steel sheet piling can be driven and capped in one contract. Typical floodwall details and schedules are shown on plates 22, and 23.

d. Drainage Structure Modification at City Price. A sand blanket extending through the existing levee in the vicinity of the drainage structure will be cut off by excavating the material out and backfilling with clay to the density of the adjacent undisturbed ground. The sand blanket is approximately 50 feet wide and extends down to about elevation -13.0. See plates 14, 15, and 16 for the excavation limits. The two 54-inch diameter pipes landward of the operating tower may be removed to facilitate excavation but must be replaced during backfill operations. The operating tower and the two pipes floodward of the tower, however, shall not be removed. A watertight diaphragm will be placed around the two pipes directly below the floodwall alignment, with ten PZ-27 steel sheet piles being welded to the top of it (as shown by the sections on plate 15). The top of the steel sheet piling will be left uncapped to elevation 9.5, and will be capped during construction of the City Price floodwall described above in paragraph b.

41. General Method and Sequence of Construction.

a. Reach A will generally consist of a marsh side enlargement of the existing locally constructed back levee. The enlargement will be constructed primarily as a hauled sand base placed on a geotextile fabric; uncompacted hauled clay will complete the levee section. The typical section is shown on plate 12 (typical section 5). The only source of sand for the Reach A area exists in the Mississippi River opposite Sixty Mile Point as shown on plates 1 & 26. A stockpile area will be established on the batture as shown on plate 26. The sand will be pumped from the river, stockpiled on the batture, then hauled to the job site. Armor on the flood side wave berm will be required where open canals for pipeline and marinas extend to the levee toe.

The first contract will consist of the first enlargement of the existing levee from approximate levee station 314+00 to station 681+90.79. Construction is scheduled to start in July 1988. At the same time, a separate contract will be awarded for pipeline and facility relocations between levee stations 0+00 and 314+00. Upon completion of the pipeline and facility relocations, a contract will be awarded for the first enlargement of the levee between those levee stations. The contract construction date is scheduled for July 1989. The depleted Freeport borrow area shown on plate 5 will be used as a marina for those marine operations presently located in the existing Freeport Sulphur Canal.

In July 1990, two contracts will be started for the pipeline relocations between levee stations 314+00 and 681+90.79 and the I-wall/T-wall construction at the Gainard Woods Pumping Station shown on plate 7.

Within 300 feet of pipelines and structures, a factor of safety of 1.5 is used. A double layer of geotextile fabric in the levee base is used to increase the safety factor to 1.5.

In July 1991, a contract will be awarded for the relocation of the Freeport marina operations located within the dead end canal and for the Freeport dock extension. Contracts for construction of the new City Price Drainage Structures, the Highway 23 relocations and tie-in to the Mississippi River main line levee, and the Hayes Canal Pumping Station I-wall/T-wall will be awarded.

In January 1992, a contract will be awarded for the closure of the existing Freeport dead end canal. This closure shall consist of a shell core clay capped levee. The contract will also include construction of the I-wall in the Freeport Sulphur Complex, the filling of the dead end canal, and the riprap armorment of the flood side toe of the wave berm. This will complete the first enlargement construction phase of Reach A.

The second enlargement work will start with the capping of the Gainard Woods Pumping Station I-wall in January 1994. The following January contracts will be awarded for the capping of the I-walls at the City Price Drainage Structure and the Hayes Canal Pumping Station facility. The final levee contracts will be the

the first enlargement. In July 1995, the second enlargement of the levee between stations 314+00 and 681+70.97 will start. The following July, the second enlargement of the levee between levee stations 0+00 and 314+00 will start. The final contract to be awarded will be Freeport Canal Closure second enlargement. All construction on Reach A is scheduled to be completed by July 1998, at a cost of $38.2 million.

OTHER PLANS CONSIDERED

42. Recommended Plan of Construction. In general, the recommended plan of construction for Reach A consists of a marsh side embankment with a wave berm. The base of the levee will be constructed on geotextile fabric anchored into the existing levee. A sand blanket will be placed on the geotextile fabric, which in turn, will be covered by clay. The embankment (including wave berm) will be constructed of uncompacted clay. Work will proceed from the lower end of the project at Tropical Bend to City Price. The project will be constructed in two enlargements with a 5-year period between the completion of the first enlargement and the start of the second enlargement as indicated by settlement curves (see plate 62). The Freeport Sulphur floodwall is the only portion of the work constructed in a single phase. All other structures will be constructed in two phases allowing for settlement prior to capping the I-wall previously placed in the first enlargement.

43. Alternative Construction Plan for Levee.

a. General. A number of alternative construction plans were investigated in the preliminary stage of planning. In general, alternative construction methods were examined to satisfy the two basic planning objectives: Environmental Quality (EQ) and National Economic Development (NED). For instance, a plan calling for essentially all I-wall construction, complete with cost estimates, was formulated to satisfy environmental quality objectives. A brief description of each construction alternative follows:

(1) Hydraulic Clay Levee with Sand Core (Plan 2). A sand core hydraulic clay levee would require the excavation of a trench, parallel to the existing back levee, on the flood side. A hydraulic dredge would be used to backfill the trench with approximately 2.4 million cubic yards of sand from a Mississippi River borrow source. The clay cover would be hydraulically pumped from nearby borrow pits in the adjacent marsh areas. Two hydraulic clay lifts would be required along with two shapings to complete the job. One notable exception to this method of construction will be for the reach of levee adjacent to the Freeport Sulphur property where all cast clay construction will be employed. For those areas where it is

cost-effective, short reaches of combination I-wall/levee will be used instead of an all earthen levee. T-wall fronting protection will be employed at existing pumping stations.

(2) Cast Clay (Plan 3). An all cast clay levee was examined; cost estimates were obtained. The cast clay plan would employ a dragline to place material from an adjacent borrow site on the levee. A comparison of first cost for this plan with the other plans is contained in Table 5.

(3) Cast Clay with Sand Core (Plan 4). A sand core cast clay levee would require the excavation of a trench, parallel to the existing back levee, on the floodside; a hydraulic dredge would be used to backfill the trench with approximately 2.4 million cubic yards of sand from a Mississippi River borrow source. The clay cover material would be obtained from borrow areas immediately adjacent to the levee and, using a dragline, would be cast over the sand core and shaped into the proper design section using conventional earth moving equipment. The first cost for this plan is presented in Table 5.

(4) Hauled Clay with Sand Core (Plan 5). This construction method would employ the same sand core construction as in Plan 4. However, instead of using adjacent borrow casting techniques, material would be obtained from borrow pits located within the protected or upland areas of Plaquemines Parish and hauled by truck to the construction site. Shaping to design section would be accomplished by conventional earth moving equipment. Because of an existing parish ordinance which prohibits removal of borrow material from protected or upland areas without replacing the borrowed material with a suitable backfill material, all plans employing this method of construction also include a cost for backfilling the borrow pits although the total cost for pit backfill would be paid for by local interests without benefit of credit to the project. The method of backfill was assumed to be hydraulic sandfill, with the Mississippi River being the source for this fill material. First cost for this plan is shown in Table 5.

(5) I-Wall Construction Plan (Plan 6). This plan would employ construction of a concrete I-wall to provide project protection. The plan would incorporate levee plugs in the I-wall at regular intervals and at appropriate points such as marinas, existing bridges, etc. Use of levee plugs is felt by the local sponsor to be more desirable than placing conventional gates in the system. Because there is an existing borrow/drainage ditch on the protected side which parallels the entire existing levee, access to the unprotected side of the levee is currently limited. However, this problem would be alleviated by incorporating levee plugs at approximately one-mile intervals regardless of whether or not current access is available. Thus, access to the unprotected side of the levee would be gained via road ramps that would be

placed over the levee plugs. Table 5 gives the first cost for the all I-wall plan.

(6) Hydraulic Clay Construction (Plan 7). The use of all hydraulic clay construction was investigated; cost estimates were obtained. This plan would employ a hydraulic dredge to remove material from a nearby borrow source in the marsh. Experience gained during construction of the first levee lift between Tropical Bend and the Empire floodgate showed that excessive settlement of the levee could possibly occur with this method of construction. The cost for this plan is given in Table 5.

(7) Hauled Clay (Plan 8). Cost estimates were obtained for the construction of a levee composed entirely of hauled clay. The plan would require hauling material by truck from an upland borrow source. As with Plan 5, backfill of borrow pits would be required. The first cost for this plan is shown in Table 5.

b. Comparison of Plans. Table 5 gives the first cost of Plans 1 through 8. These plans have been displayed by order of increasing cost. As can be seen, the first cost of Plan 1 was a primary factor in its selection as the tentatively selected plan. Plan 6, the EQ plan, was eliminated because of higher first cost (than Plan 1) and also because of its unreliability. Plan 6, unlike the other plans considered, would have large reaches of I-wall which, during extreme storm conditions, would be exposed and subjected to potential failure due to impacts from barges and other vessels that might break loose from their moorings. Plans 2, 3, 4, 5, 7, and 8 were eliminated primarily because of higher first cost than Plan 1.

Table 5
Cost Estimates of
First Cost for Plans 1 through 8

Plan No.	Description	Estimated First Cost ($)
1	Geotextile levee	55,400,000 1/
2	Hydraulic clay levee with sand core (two hydraulic clay lifts)	87,000,000
3	All cast clay levee	87,934,000
4	Cast clay levee with sand core	92,400,000
5	Hauled clay levee with sand core	92,300,000
6	I-wall with levee plugs	91,600,000
7	All hydraulic clay levee	91,534,000
8	Hauled clay levee	94,800,000

1/ Excludes $17.2 million for upland pit backfill which will be paid for by local interests without benefit of credit to the project.

44. Alternative Plan Studies for Freeport Sulphur Canal.

a. General. Several alternative plans of protection were investigated for the Freeport Sulphur Canal (Grande Ecaille Canal). Plans investigated are briefly described as follows:

(1) Plan A employs lateral protection in the form of an I-wall along the periphery of the canal. This plan would not interrupt navigation access to the canal, but early studies showed that it was cost prohibitive when compared with the other plans under study.

(2) Plan B calls for placing a levee closure at the mouth of the canal, along with providing a 60-inch CMP (for interior drainage) and a positive closure gate to be operated in the event of a hurricane. Because of the pollution load associated with the industrial activity along the canal, it was determined that additional measures would be required to prevent the canal from becoming a health hazard. Accordingly, installation of three floating aerators would be required to

alleviate the problem. The fact that this plan prevents navigation access to the docking facilities which are located along the canal necessitates relocating these facilities to a site on the flood side of the levee system. Plate 5 shows the site for the proposed relocated docking facilities that would be required for Plan B. The docking facilities would utilize the borrow pit that would be created when materials are removed for constructing the levee reach around Freeport Sulphur property. Paragraphs 28.1. and 32.h. of the Soils and Foundations Investigation section give a description of the proposed construction procedures for this levee reach.

(3) Plan C calls for providing a levee closure at the mouth of the canal in conjunction with filling the canal with sand. Plan C, like Plan B, would require relocating the docking facilities which are situated along the canal. These relocated facilities would be the same as those proposed for Plan B (see plate 5).

b. Comparison of Plan B and Plan C. As previously mentioned, it became obvious during the early studies of Plan A that the first cost for the I-wall plan was excessive when compared to Plans B or C. Therefore, Plan A was eliminated from further consideration. Plan B, unlike Plan C, would involve a considerable operation and maintenance cost as well as cost for periodic replacement of equipment and gates over the life of the project. Therefore, in order to equitably compare Plan B and Plan C, it was necessary to annualize their respective costs. This analysis resulted in the selection of Plan C over Plan B, i.e., a levee closure in conjunction with filling the canal with sand.

ACCESS ROADS

45. General. The construction site may be reached via Louisiana Highway 23 and local Plaquemines Parish roads. No additional access roads or improvements to existing roads are anticipated.

STRUCTURAL DESIGN CRITERIA

46. General. Structural design has been made in accordance with standard engineering practice, utilizing criteria set forth in Engineering Manuals for Civil Works construction published by the Office, Chief of Engineers. Wave forces were computed from guidelines outlined in "Shore Protection Manual", Volume II, 1971.

a. Basic Data. Basic data relevant to water surface elevations, structure elevations, and dimensions are shown on plates and summarized below:

Structure Elevations

Location	Top of Wall El.	Design Water Surface El. Ft. NGVD	Wave Loads fm psf	dc ft	psw psf	ds ft
City Price Floodwall	12.5	8.9	128	2.42	155	0.4
	16.0	8.9	220	4.19	268	1.9
Hayes Canal Pumping Station Floodwall	16.0	9.2	224	4.27	273	2.2
Freeport Sulphur Floodwall	16.0	9.2	224	4.27	273	2.2
Gainard Woods Pumping Station Floodwall	17.0	9.6	241	4.59	294	2.6*

* For wave loads, see page D-1 in Appendix D (wave pressure diagram at Gainard Woods Pumping Station).

b. Strength Design Criteria. The concrete structures are designed in accordance with ETL 1110-2-265, "Strength Design Criteria for Reinforced Concrete in Hydraulic Structures" dated 15 Sep 1981, and ACI 318-77, "Building Code Requirements for Reinforced Concrete". Design values used are listed below:

f'_c	3,000 psi
f_y (reinforcement)	40,000 psi
p	.25 p_b
P_{min} (flexure)	$200/f_y$ or 1/3 greater than required by analysis
min temp steel	.0025 bt - (half in each face)
v_c	$2\ (f'_c)^{0.5}$
Sheet Pile	ASTM-36 (18,000 psi allowable)

c. I-Type Floodwalls. I-type floodwalls will be constructed at Hayes Canal and Gainard Woods Pumping Stations, City Price, and at Freeport Sulphur (see plates 15, 18, 19, and 21). The I-wall will consist of steel sheet piling driven into the final levee sections as shown on plate 23. The upper portion of the sheet piling will be capped with concrete. The sheet piling will be driven to the required cutoff depth with 1 foot of sheet piling extending above the levee crown. The concrete portion of the floodwall will extend from 2 feet below the levee crown to the design elevation at the top of the floodwalls. The load case which controls design is water load to the stillwater level (see paragraph 41.a. above) plus the wave loads computed from the information given in paragraph 41.a. above and page D-1 in Appendix D. The design calculations for Gainard Woods Pumping Station I-type wall are shown on pages D-2 through D-14 in Appendix D.

d. T-Type Floodwall. T-type floodwall will be constructed at the Hayes Canal Pumping Station and at the Gainard Woods Pumping Station. See plates 22 and 23 for wall dimensions and elevations. Load cases for the T-wall are as follows:

Load Case		Symbol
I	Dead Load	DL & WL
II	Water Load and Impervious Uplift	UI
III	Pervious Uplift	UP
IV	Wave Load	WL

For pile design, no load factors were used (working stress) and the following load cases were considered:

No.	LD Combination
1	DL + WL + UI
2	DL + WL + UP
3	.75 (DL + WL + UI + WL)
4	.75 (DL + WL + UP + WL)

The design calculations for the T-type wall at Gainard Woods Pumping Station are shown on pages D-15 through D-28 in Appendix D.

SOURCES OF CONSTRUCTION MATERIALS

47. Sources of Construction Materials. Information relative to borrow material for construction of the Reach A levee is contained throughout this report. Sand and gravel are available within 150 miles of the project. Clamshells are available within 80 miles of the project. The nearest sources of rock are in Texas, Alabama, and Arkansas.

a. Rock Material. Rock is available from several locations in Alabama, Texas, Oklahoma, Arkansas, Missouri, and Kentucky. The following is a list of the rock sources suitable for use as riprap:

Source No.		Producer	Lat. (°)	Long. (°)
1.	Arkansas Rock & Gravel Co.	Murfresboro, AR	34	93
2.	Black Rock Sand & Gravel Co.	Black Rock, AR	36	91
3.	Bussen Quarries, Inc.	St. Louis, MO	38	90
4.	Byron Manning, Inc.	DeQueen, AR	34	94
5.	Caddo Quarries	Friendship, AR	34	93
6.	Carter Construction Co.	Benton, AR	34	92
7.	Central Stone Co.	Hannibal, MO	39	91
8.	Central Stone Co.	Huntington, MO	39	92
9.	DeRoche Creek Quarry	Arkadelphia, AR	34	93
10.	Farmers Limestone Co.	Old Appleton, MO	37	89
11.	Gisbar Bros., Inc.	Perryville, MO	38	90
12.	Granite Mountain Quarries	Sweet Home, AR	34	92
13.	Little Rock Quarry Co.	Benton, AR	34	93
14.	Markham & Brown, Inc.	St. Genevieve, MO	38	90
15.	McGeorge Corp.	Pine Bluff, AR	34	92
16.	M & P Power Equipment Co.	Murfreesboro, AR	34	93
17.	Miss. Stone Products	Iuka, MS	34	88
18.	Murray Quarry Co.	Arkadelphia, AR	34	93
19.	Pine Bluff Sand & Gravel	Pine Bluff, AR	34	92
20.	Plattin Quarry	St. Genevieve, MO	37	90
21.	Reed Crushed Stone Co.	Gilbertsville, KY	37	88
22.	Rigsby Barnard Quarry	Cave-in-Rock, IL	37	88
23.	Southern River Rock Co.	Perryville, MO	38	90
24.	Sweet Home Stone Co.	Hollywood, AR	34	93
25.	Sweet Home Stone Co.	Sweet Home, AR	34	92
26.	Three Rivers Rock Co.	Smithland, KY	37	88
27.	Tower Rock Stone Co.	St. Genevieve, MO	38	90
28.	West Lake Quarry	Greys Point, MO	37	89
29.	West Lake Quarry	Neely's Landing, MO	37	89

b. Concrete Aggregate. The following is a list of sources from which concrete aggregate, suitable for construction connected with this project, can be produced. The test data for these sources are included in Volumes III and IV of WES TM, 6-370, "Concrete Aggregates". The locations and index numbers of these sources are as follows:

Producer	Pit Location	Lat. (°)	Long. (°)
A-1 Sand & Gravel	Magnolia, LA	30	90
A.B. Chisum Sand & Gravel Co.	Sicily Island, LA	31	91
American Sand & Gravel Co.	Hattiesburg, MS	31	89
Amyx Sand & Gravel Co.	Jena, LA	31	92

Producer	Pit Location	Lat. (°)	Long. (°)
Arnold Bros. Sand & Gravel Co.	Merryville, LA	30	93
B & B Gravel Co.	Baton Rouge, LA	30	90
Blain Sand & Gravel	Columbia, MS	31	89
Blain Sand & Gravel	Prentiss, MS	31	89
Blain Sand & Gravel	Crystal Springs, MS	31	90
Brasswell Sand & Gravel Co.	Minden, LA	32	93
Delta Industries, Inc.	Crystal Springs, MS	31	90
Dixie Sand & Gravel	Amite, LA	30	90
Feliciana Sand & Gravel	Jackson, LA	30	91
Feliciana Sand & Gravel	St. Francisville, LA	30	91
General Portland	Melder, LA	31	92
Gifford Hill Co., Inc.	Arcola, LA	30	90
Gifford Hill Co., Inc.	Sibley, LA	32	93
Gifford Hill Co., Inc.	Glenmore, LA	31	92
Gifford Hill Co., Inc.	Fluker, LA	30	90
Green Bros., Inc.	Crystal Springs, MS	31	90
Hammett & Green, Inc.	Foxworth, MS	31	89
Lambert Materials	Childersburg, AL	33	86
La. Industries	Hickory, LA	30	89
La. Industries	Alexandria, LA	31	92
La. Industries	Paradise, LA	31	92
La. Industries	Pollock, LA	31	92
La. Industries	Fishville, LA	31	92
La. Industries	Perryville, LA	32	91
La. Industries	Isabelle, LA	30	89
Louisiana Industries	Jena, LA	31	92
Louisiana Industries	DeRidder, LA	30	93
La. Paving Co.	Pearl River, LA	30	89
Louisiana Sand & Gravel	Grangeville, LA	30	90
Lutesville Sand & Gravel	Bentley, LA	31	92
Lutesville Sand & Gravel	Colfax, LA	31	92
Magnolia Gravel Co.	Greenwell Springs, LA	30	90
Mears Sand and Gravel	Denham Springs, LA	30	90
Mid State Material Co.	Woodworth, LA	31	92
Mid State Sand & Gravel	Hotwell, LA	31	92
Monroe Sand & Gravel	Perryville, LA	32	92
Rebel Sand & Gravel	Denham Springs, LA	30	90
Red Stick Sand & Gravel Co.	Baywood, LA	30	90
Reed Crushed Stone Co.	Gilbertsville, KY	37	88
R. L. Hensley & Sons	Washington, MS	31	91
S.A.C.	Jena, LA	31	92
Smith Sand & Gravel	Mt. Herman, LA	30	90
Standard Gravel	Pearl River, LA	30	89
Standard Gravel	Clifton, LA	30	90
St. Catherine S&G	Natchez, MS	31	91
Traxler Bros. Sand & Gravel	Crystal Springs, MS	31	90
Trinity S. Div. Gen. Portland	Longville, LA	30	93
Trinity Sand & Gravel Co.	Kinder, LA	30	92

REAL ESTATE REQUIREMENTS

48. General. All lands, easements, and rights-of-way, including borrow areas and spoil disposal areas necessary for the construction of the project, will be provided by local interests, without cost to the United States.

RELOCATIONS AND MODIFICATIONS

49. General. Project authorization specifies that local interests, prior to construction, "...give assurances satisfactory to the Secretary of the Army that they will, without cost to the United States....accomplish all necessary alterations and relocations to roads, pipelines, cables, wharves, and other facilities required by the construction of the project...". All relocations and modifications for this project, which are the responsibility of local interests, are as follows:

a. Facilities. Construction of the project requires relocations and modifications of the following facilities:

		Plate No.
(1)	City Price Drainage Structure	2, 15
(2)	Pumping Stations Discharge Line Modifications	3, 7
(3)	La. Hwy. 23 Crossing	2, 14
(4)	Ramps - Shell	2, 3, 5
(5)	Ramp - Asphalt	5
(6)	Relocations in vicinity of Port Sulphur Reservoir:	5
	4" Mech Jt CI Discharge Pipe Line	
	8" Water Line	
	2" Water Line	
	6" Water Line (laterals)	
	2300 Volt Power Cable	
	230 Volt House Cables	
	Telephone Cable	
	Pilot Cable	
	2" Gas Line	
	3/4" Gas Line	
	6" Sewer Line	
	2' x 4' Manhole	
	16' x 9' x 4' Sewerage Collection Pit	
(7)	Shell Roadway to Freeport Dock	5, 19
(8)	Freeport Dock Extension (50'±)	5, 19
(9)	Relocations for Port Sulphur Canal Closure:	5
	Pile Clusters for barge mooring	
	2400 Volt Transformer Station	
	2400 Volt Power Line w/poles	
	Marine Warehouse	

(10) Homeplace Marina Area Relocations: 5, 20
2300 Volt Power Line w/T Poles
1" Water Line
2" Water Lines (4 @ 200')

b. Pipelines. Construction of the project requires relocations of the following pipelines:

Size	Type	(B/L station)	Plate No.
2"	Delta Gas Pipe Line	1+50 (parallel	2
6"	Plaquemines Parish Water Line	relocated Highway 23)	
6"	Delta Gas Pipe Line		
20"	Plaquemines Parish Water Line		
-	Underground Cable	Happy Jack	2, 17
4"	Water Line (Steel)	Marina Area	
4"	PVC Force Main Sewer		
2"	Delta Gas Service Line		
36"	Tennessee Gas Line	52+40	2, 12
30"	Tennessee Gas Line	52+80	2, 12
26"	Tennessee Gas Line	54+10	2, 12
6"	United Gas Pipe Line	184+00	4, 12
2 1/2"	Oil Flowlines (2)	212+40	4, 12
10"	Signal Petroleum Pipe Line	281+93	5, 12
18"	Tennessee Gas Pipe Line	604+10	9, 12
20"	Shell Delta Pipe Line	614+90	9, 12
12"	Shell Crude Pipe Line	615+70	9, 12

ENVIRONMENTAL ASSESSMENT

50. Setting.

a. General. The project is within the modern subdelta of the Mississippi Deltaic Plain formed by the recent alluvial deposits of the Mississippi River during the last 12,000 years and is characterized by elevations of less than 5 feet NGVD. Land loss in the area is occurring at about 1 percent per year and is primarily attributed to the leveeing of the Mississippi River, mineral extraction, subsidence, and general sea-level rise. The area's subtropical latitude and proximity to the Gulf of Mexico results in a humid climate, year-long growing season, and abundant rainfall. The natural landforms of the area are the Mississippi River, batture lands, natural alluvial levees, back swamps, marsh, and shallow open water.

b. Biological. The vegetative communities within the natural landforms are batture woodlands, mixed levee forests, swamp, and marsh. Along the frequently flooded batture adjacent to the river, rapidly growing pioneer plant species, such as black willow, are found. As the natural alluvial levees are approached, the vegetation transitions to species such as sycamore, cottonwood, and pecan. Live oak "islands" are also dispersed along the ridge. Within the protected area between the Mississippi River levee and the back protection levee, most of the land has been cleared for agricultural or urban uses, although a few remnant stands of natural mixed levee hardwoods remain. Fish and wildlife use of the batture is low, but use increases as the natural levee areas are approached. The shallow estuarine water bodies associated with the marshes support an extensive commercial and sport fishery for finfish and shellfish.

c. Cultural Resources. In all probability, there was no human occupation of the area prior to about 900 A.D. when the main course of the Mississippi River shifted into the project vicinity. With the exception of Fort Jackson and Fort St. Philip (both National Historic Landmarks), the major Euro-American occupation of the area commenced after 1840. Large-scale farming has never been a successful enterprise, but kitchen gardens have often augmented the fishing and trapping subsistence pattern which characterizes much of the area. With a history of economic activities which favored a highly dispersed settlement pattern and with local production strongly centered around families and affines, few concentrations of populations in large communities occurred in the project area during the historic period. Midden deposits and substructural features associated with many of the 19th century and early 20th century homesteads have undoubtedly been buried through subsidence and alluviation.

d. Water Quality. The Louisiana Department of Environmental Quality (LDEQ) has classified the reach of the Mississippi River within the project area as suitable for primary contact recreation, secondary contact recreation, propagation of fish and wildlife, and a source of raw water for domestic and industrial use. Towns in the project area which draw water from the river for domestic use include Port Sulphur, Pointe-a-la-Hache, and Boothville-Venice. At river discharges of less than 230,000 cfs at Tarbert Landing, the water treatment plants are affected by salt water which intrudes upstream from the Gulf of Mexico. Treated and partially treated sanitary wastewaters from the large communities and industries are discharged into the river. The quantity of the river water is generally acceptable for its designated uses. However, high concentrations of fecal coliform bacteria, trace metals, and man-made organic compounds often result from sanitary, storm, and process wastewater discharges.

e. Recreational Resources. Existing recreational activities in the project area are outdoor oriented and include hunting, fishing, crabbing, birdwatching, and boating. Recreational activities such as picnicking and camping also exist in the project area, but to a lesser degree. Refuges in the area include

Delta-Breton National Wildlife Refuge, Bohemia Wildlife Management Area, and Pass-a-la-Loutre Waterfowl Management Area.

f. Socioeconomics. The New Orleans to Venice, Louisiana, project area is a narrow 16,600-acre strip of land and water located along the west bank of the Mississippi River in Plaquemines Parish. Although this stretch of the river is designated as part of the Port of New Orleans, lower Plaquemines Parish is essentially a wetland peninsula which the Mississippi River passes through before branching off and emptying into the Gulf of Mexico. The area is rich in critical mineral resources, including crude petroleum, natural gas, sulfur, natural gas liquids, and salt. Commercial fishing is also important to the local economy. The limited availability of land protected from the threat of flooding and hurricane damage has discouraged population growth in the parish, even with the rapid expansion of offshore oil activities in the 1950's and early 1960's. Population in Plaquemines Parish increased from 14,239 in 1950 to 22,545 in 1960. Since that time, it has increased only moderately, from 25,225 in 1970 to 26,049 in 1980. The estimated 1980 population for the project area is 12,400.

51. Impacts.

a. General. During project construction, there would be both temporary and long-term impacts. The temporary environmental impacts would be related to the truck hauling of fill material and includes dust and noise. The long-term impacts would be associated with the conversion of various existing habitats to levees or borrow pits. Positive impacts revolve around the social and economic benefits gained by increased hurricane protection.

b. Biological. The impacts to biological systems are predominantly commensurate with the extent of habitat modifications. With the project, about 285 acres would be necessary for levee construction, and about 146 acres required for borrow material. Within the levee rights-of-way, there are about 200 acres of grassed levee and 85 acres of marsh. Within the proposed borrow areas, about 50 acres of secondary, remnant levee forest, 5 acres of marsh, 56 acres of shrub/scrub and 50 acres of abandoned crop land would be lost. Because much of the area impacted for levee or borrow is in the protected area and much of it already disturbed by man, or is batture, the environmental impacts are minimal. About 50 acres of batture land would be temporarily impacted for a stockpile area. An Endangered Species Assessment has been prepared for this area; it has been determined that no threatened or endangered species would be affected. In those areas where there are unavoidable losses, mitigation would be instituted to compensate those impacts.

c. Cultural Resources. There are no known cultural resources in the area affected by the project. The New Orleans District is presently developing a management plan/research design for all of

Plaquemines Parish. Once complete (in FY 87), all cultural resources and projects will be evaluated and managed in consonance with the plan.

d. Water Quality. No short-term or long-term water-quality-related impacts are expected due to project implementation, because bucket dredging will be employed to obtain construction fill from upland borrow pits or batture area of the Mississippi River. Only slightly intensified turbidity, elevated suspended particulate concentrations, and moderately depressed dissolved oxygen concentrations are expected to result in the batture area.

e. Recreational Resources. There are no significant negative impacts on recreational resources associated with development of the borrow pit sites. Due to their location, each being between two parallel roads and adjacent to residential areas, no hunting takes place.

f. Socioeconomics. The improvements authorized for the project area would insure 100-year protection against tidal and fluvial overflows. Although the area is presently depressed as a result of the slump in the oil industry, slow to moderate economic growth is expected to occur as a result of the high degree of flood protection provided by the project.

52. Mitigation.

a. Because the project is constructed on a natural alluvial ridge, and the most economically available borrow material is within the protected area, there are no alternatives but to impact secondary, natural levee forests, batture woodlands, and marsh. To compensate for these project-induced losses, mitigation would be necessary.

b. Specific mitigation recommendations have not been developed at this point in time. The use of a delta-splay technique is currently being evaluated; however, the resource agencies reviewing and evaluating mitigation may not find this method satisfactory because woodland/forest habitat types would be replaced with out-of-kind marsh. If the delta-splay technique was adopted, mitigation would be accomplished by creating openings in the natural levee bank along Main Pass of the Mississippi River to duplicate naturally occurring openings which are known to accrete marsh. It is estimated each opening would yield about 45 acres of marsh. When the accretion slows and the maximum quantity of marsh has accumulated, the remaining opening would be closed and another adjacent bank section breached until the appropriate mitigation requirements have been achieved.

53. Environmental Impact Statement. A final Environmental Impact Statement (EIS), New Orleans to Venice, Louisiana, Hurricane Protection Project, was filed with the Council on Environmental

Quality (CEQ) on 24 January 1975. A final supplemental EIS evaluating the project back levee (Reaches A and B) was filed with the Environmental Protection Agency on 12 April 1985. Because of borrow pit modifications since filing of the original EIS and supplement, an Environmental Assessment (EA) is necessary to address the new borrow areas, and was issued on 14 Aug 1987. The proposed upland borrow sites are tentative, subject to change, and dependent on availability and engineering constraints. In the event alternative sites are selected, an addendum to the EA would be prepared.

54. Conclusion. The New Orleans to Venice Hurricane Protection project, Reach A would provide protection to the developed areas of Plaquemines Parish. Adverse environmental impacts are recognized and discussed in the original EIS, and the subsequent supplement and EA. Because there are no practicable alternatives to locating some project features in batture land, marsh, or woods of the alluvial ridge, mitigation will be necessary.

ESTIMATE OF COST

55. General. The total estimated first cost for constructing Reach A is $38,200,000, of which $26,710,000 is Federal cost and $11,460,000 is non-Federal cost. A summary of first cost for Reach A is shown in Table 6.

TABLE 6
FEDERAL AND NON-FEDERAL
COST BREAKDOWN
(First Cost)

Item	Federal ($)	Non-Federal ($)	Total ($)
Levees, floodwalls, and structures	26,710,000	5,952,000	32,662,000
Lands and damages	30,000	1,563,000	1,593,000
Relocations	-	3,945,000	3,945,000
TOTAL	$26,740,000	$11,460,000	$38,200,000 1/

1/ This figure reflects only that cost in which the Federal Government will participate with local interests. The $17.2 million for upland borrow pit backfill cannot be shared in or credited under the project authorization.

NEW ORLEANS TO VENICE - REACH A (Revised)
(October 1987 Price Levels)

Cost Acct. No.	Item	Estimated Quantity	Unit	Unit Price ($)	Estimated Amount ($)
01	LANDS AND DAMAGES				
	1. Rights-of-way/Easements				
	Levee - Marsh	100	Acre	250	25,000
	Levee - Existing	88	Acre	0	0
	Perpetual Borrow - Agricultural/Potential Residential 1/	41.8	Acre	6,000	250,800
	Perpetual Borrow - Agricultural 2/	48.4	Acre	6,000	290,400
	Perpetual Borrow - Woodland 3/	45.1	Acre	5,000	225,500
	Perpetual Borrow - Marsh	10.3	Acre	1,000	10,300
	Subtotal				$ 802,000 1/
	2. Improvements & Severance Damage				0
	Subtotal: LANDS & DAMAGES				$ 802,000
	Contingencies (25%±)				201,000
	Acquisition				590,000 2/
	TOTAL: LANDS & DAMAGES				$1,593,000

1/ This figure is rounded to the nearest $1,000.

2/ This figure includes $30,000 of Federal acquisition costs.

3/ The estimate assumes 400 tracts.

Cost Acct. No.	Item	Estimated Quantity	Unit	Unit Price ($)	Estimated Amount ($)
02	RELOCATIONS AND MODIFICATIONS				
	1. Facilities				
	a. City Price Drainage Structure	1	Lump Sum	L.S.	175,000
	b. LA Hwy 23 Crossing	1	Lump Sum	L.S.	1,075,000
	c. Happy Jack Marina (remove timber bridge, old pump station foundation & bulkhead & relocate buried cable)	1	Lump Sum	L.S.	15,000
	d. Ramps - Shell (1st & 2nd Enlargements)	3,080	C.Y.	18.00	55,440

NEW ORLEANS TO VENICE - REACH A (Revised)
(October 1987 Price Levels)

Cost Acct. No.		Item	Estimated Quantity	Unit	Unit Price ($)	Estimated Amount ($)
	e.	Ramp - Asphalt (1st & 2nd Enlargements)	1	Lump Sum	L.S.	9,000
	f.	Hayes Canal Pump Station				
		Pump Discharge Pipe Mod. (2-72" dia.)	1	Lump Sum	L.S.	35,000
		72" dia. Butterfly valve w/cylinder actuator	2	Each	50,000	100,000
		12" dia. Steel Pipe Piles - 3/8" thick wall	240	Linear Feet	60.00	14,400
		Misc. Metal	8,000	Lb.	2.00	16,000
	g.	Gainard Woods Pump Station				
		Pump Discharge Pipe Mod. (2-60" dia. & 2-72" dia.)	1	Lump Sum	L.S.	40,000
		60" dia. Butterfly Valve w/cylinder actuator	2	Each	40,000	80,000
		12" dia. Steel Pipe Piles - 3/8" thick wall	240	Linear Feet	60.00	14,400
		Misc. Metal	8,000	Lb.	2.00	16,000
	h.	Freeport Marina Relocation				
		2300 Volt Power Cable	1,100	Feet	6.00	6,600
		230 Volt House Cable	1,200	Feet	2.50	3,000
		Telephone Cable	1,500	Feet	2.00	3,000
		Pilot Cable	900	Feet	1.75	1,575
		2'x4' Manhole	4	Each	1,000	4,000
		16' x 9' x 4' Sewerage Collection Pit	1	Lump Sum	L.S.	500
		Barge Mooring Pile Clusters	12	Each	5,000	60,000
		2400 Volt Transformer Station	1	Lump Sum	L.S.	30,000
		2400 Volt Powerline w/poles	1,100	Feet	7.00	7,700
		Marine Warehouse	1	Lump Sum	L.S.	15,000
		Dock Extension (50'±)	1	Lump Sum	L.S.	50,000

NEW ORLEANS TO VENICE - REACH A (Revised)
(October 1987 Price Levels)

Cost Acct. No.	Item	Estimated Quantity	Unit	Unit Price ($)	Estimated Amount ($)
	i. Homeplace Marina - remove bridge				
	Remove Existing Bridge	1	Lump Sum	L.S.	10,000
	2300 Volt Powerline w/poles	1	Lump Sum	L.S.	5,000
	Subtotal: FACILITIES				$1,841,615
	Contingencies (20%±)				368,385
	Subtotal: FACILITIES				$2,210,000
	E&D (11%±)				245,000
	S&A (11%±)				245,000
	TOTAL: FACILITIES				$2,700,000
2.	Pipelines				
	a. LA Hwy 23 parallel lines				
	2" Delta Gas gas line	1	Lump Sum	L.S.	3,000
	6" Plaquemines Parish water line	1	Lump Sum	L.S.	4,000
	6" Delta Gas gas line	1	Lump Sum	L.S.	5,000
	20" Plaquemines Parish water line	1	Lump Sum	L.S.	13,500
	b. Happy Jack Marina (4" dia. steel water line, 4" PVC force sewer, & 2" dia. gas line)	1	Lump Sum	L.S.	15,000
	c. Freeport Marina Relocation				
	4" Mech. Jt. C.I. discharge pipeline	1,100	Feet	13.00	14,300
	8" PVC water line	1,450	Feet	14.50	21,025
	2" PVC water line	1,050	Feet	4.00	4,200
	6" PVC water line laterals	50	Feet	7.50	375
	2" dia. gas line	1,450	Feet	5.00	7,250
	3/4" dia. gas line	60	Feet	3.50	210
	6" dia. PVC sewer line	1,200	Feet	16.00	19,200
	Freeport Reservoir Overflow Pipe (Sta. 271+29)	1	Lump Sum	L.S.	25,000

NEW ORLEANS TO VENICE - REACH A (Revised)
(October 1987 Price Levels)

Cost Acct. No.	Item	Estimated Quantity	Unit	Unit Price ($)	Estimated Amount ($)
	d. Homeplace Marina				
	1" dia. water line	200	Feet	2.50	500
	2" dia. water line (4 @ 200')	800	Feet	4.00	3,200
	e. Tennessee Gas Pipeline				
	1-36" dia. @ Sta. 52+40	1	Lump Sum	L. S.	94,000
	1-30" dia. @ Sta. 52+80	1	Lump Sum	L. S.	88,000
	1-26" dia. @ Sta. 54+10	1	Lump Sum	L. S.	80,000
	1-18" dia. @ Sta. 604+10	1	Lump Sum	L. S.	65,000
	f. United Gas 1-6" dia. @ Sta. 184+00	1	Lump Sum	L. S.	30,000
	g. Exxon Pipeline 2-2 1/2" dia. @ Sta. 222+51	1	Lump Sum	L. S.	33,000
	h. Signal Petroleum 1-10" dia. @ Sta. 281+93 (Passes across levee & through borrow pit)	1	Lump Sum	L. S.	200,000
	i. Shell Pipeline				
	1-20" dia. @ Sta. 614+90	1	Lump Sum	L. S.	67,000
	1-12" dia. @ Sta. 615+20	1	Lump Sum	L. S.	58,000
	Subtotal: PIPELINES				$ 850,760
	Contingencies (20%±)				169,240
	Subtotal: PIPELINES				$1,020,000
	E&D (11%±)				112,500
	S&A (11%±)				112,500
	TOTAL: PIPELINES				$1,245,000
	TOTAL: RELOCATIONS AND MODIFICATIONS				$3,945,000

NEW ORLEANS TO VENICE - REACH A (Revised)
(October 1987 Price Levels)

Cost Acct. No.	Item	Estimated Quantity	Unit	Unit Price ($)	Estimated Amount ($)
11.1	LEVEES & FLOODWALLS (LEVEE EMBANKMENT)				
	1. First Enlargement (Sta. 0+00 to Sta. 314+50 - Intermittent)				
	Mobilization & Demobilization	1	Lump Sum	L.S.	50,000
	Clearing and Grubbing (Borrow Pit)	45	Acre	1,000	45,000
	Clearing (light debris - Levee)	21	Acre	550	11,550
	Degrading & Backfill for fabric placement	59,500	C.Y.	2.25	133,875
	Fertilizing & Seeding	76	Acre	400	30,400
	Levee Fill -				
	semicompacted clay	20,000	C.Y.	4.50	90,000
	uncompacted clay	476,350	C.Y.	4.05	1,929,220
	sand	38,650	C.Y.	8.00	309,200
	Wave Berm Armor -				
	riprap	11,340	Ton	20.00	226,800
	shell bedding	12,400	C.Y.	18.00	223,200
	Geotextile -				
	Main Levee (1,240 lbs/in woven)	205,700	Sq. Yd.	9.00	1,851,300
	Wave Berm (250 lbs/in woven)	120,450	Sq. Yd.	2.50	301,125
	Homeplace Marina -				
	2-72" CMP culvert @ 600'	1,200	Feet	250	300,000
	2 Manholes	2	Each	1,000	2,000
	1 Drainage Inlet	1	Each	1,000	1,000
	1-36" CMP	80	Feet	75	6,000
	Subtotal				$5,510,670

NEW ORLEANS TO VENICE - REACH A (Revised)
(October 1987 Price Levels)

Cost Acct. No.	Item	Estimated Quantity	Unit	Unit Price ($)	Estimated Amount ($)
11.1	LEVEES & FLOODWALLS - LEVEE EMBANKMENT (Cont'd)				
	2. First Enlargement (Sta. 314+50 to Sta. 681+90.8)				
	Mobilization & Demobilization	1	Lump Sum	L.S.	50,000
	Clearing and Grubbing (Borrow Pit)	50.8	Acre	1,000	50,800
	Clearing (light debris - Levee)	25	Acre	550	13,750
	Degrading & Backfill for fabric placement	77,600	C.Y.	2.75	174,600
	Fertilizing & Seeding	92	Acre	400	36,800
	Levee Fill -				
	uncompacted clay	737,600	C.Y.	5.50	4,056,800
	sand	219,400	C.Y.	6.15	1,349,310
	Wave Berm Armorment -				
	riprap	5,600	Ton	20.00	112,000
	shell bedding	1,230	C.Y.	18.00	22,140
	Geotextile -				
	Main Levee - woven -				
	1700 lbs/in	54,370	Sq. Yd.	10.00	543,700
	1550 lbs/in	96,710	Sq. Yd.	9.50	918,745
	1340 lbs/in	112,500	Sq. Yd.	9.25	1,040,625
	Wave Berm - woven -				
	250 lbs/in	170,165	Sq. Yd.	2.50	425,413
	Subtotal				$8,794,683

NEW ORLEANS TO VENICE - REACH A (Revised)
(October 1987 Price Levels)

Cost Acct. No.	Item	Estimated Quantity	Unit	Unit Price ($)	Estimated Amount ($)
11.1	LEVEES & FLOODWALLS - LEVEE EMBANKMENT (Cont'd)				
	3. Freeport Canal Closure				
	Mobilization & Demobilization	1	Lump Sum	L.S.	50,000
	Fertilizing & Seeding	8.5	Acre	400	3,400
	Sand Fill	175,000	C.Y.	8.00	1,400,000
	Levee Fill - uncompacted clay	2,600	C.Y.	3.60	9,360
	Shell (levee core & wave berm armorment bedding)	8,000	C.Y.	18.00	144,000
	Wave Berm Armorment - riprap	1,000	Ton	20.00	20,000
	Geotextile -				
	Main Levee (1,250 lbs/in woven)	2,325	Sq. Yd.	L.S.	40,000
	Wave Berm (250 lbs/in woven)	543	Sq. Yd.	L.S.	
	Subtotal				$1,666,760

NEW ORLEANS TO VENICE - REACH A (Revised)
(October 1987 Price Levels)

Cost Acct. No.	Item	Estimated Quantity	Unit	Unit Price ($)	Estimated Amount ($)
11.1	LEVEES & FLOODWALLS - LEVEE EMBANKMENT (Cont'd)				
4.	Second Enlargement (Sta. 0+00 to Sta. 314+50 - Intermittent)				
	Mobilization & Demobilization	1	Lump Sum	L.S.	50,000
	Clearing & Grubbing (Borrow Pit)	38	Acre	1,000	38,000
	Clearing (light debris - Levee)	70	Acre	550	38,500
	Fertilizing & Seeding	70	Acre	400	28,000
	Levee Fill - uncompacted clay	317,800	C.Y.	4.30	1,366,540
	Wave Berm Armorment - riprap	1,100	Ton	20.00	22,000
	Subtotal				$1,543,040
5.	Second Enlargement (Sta. 314+50 to Sta. 681+80.9)				
	Mobilization & Demobilization	1	Lump Sum	L.S.	50,000
	Clearing & Grubbing (Borrow Pit)	50	Acre	1,000	50,000
	Clearing (light debris - Levee)	95	Acre	550	5,225
	Fertilizing & Seeding	95	Acre	400	38,000
	Levee Fill - uncompacted clay	585,665	C.Y.	4.30	2,518,360
	Wave Berm Armorment - riprap	500	Ton	20.00	10,000
	Subtotal				$2,671,585

NEW ORLEANS TO VENICE - REACH A (Revised)
(October 1987 Price Levels)

Cost Acct. No.	Item	Estimated Quantity	Unit	Unit Price ($)	Estimated Amount ($)
11.1	LEVEES & FLOODWALLS - LEVEE EMBANKMENT (Cont'd)				
	6. Second Enlargement, Freeport Canal Closure Mobilization & Demobilization	1	Lump Sum	L.S.	40,000
	Clearing & Grubbing (Borrow Pit)	1	Acre	1,000	1,000
	Clearing (light debris - Levee)	2.5	Acre	550	1,375
	Fertilizing & Seeding	2.5	Acre	400	1,000
	Levee Fill - uncompacted clay	37,000	C.Y.	4.10	151,700
	Wave Berm Armorment - riprap	300	Ton	20.00	6,000
	Subtotal				$ 201,075
	Subtotal: LEVEE EMBANKMENT				$20,387,813
	Contingencies (20%±)				4,074,187
	Subtotal: LEVEE EMBANKMENT				$24,462,000
30	E&D (14.7%±)				3,600,000
31	S&A (11.9%±)				2,900,000
	TOTAL: LEVEE EMBANKMENT				$29,862,000

NEW ORLEANS TO VENICE - REACH A (Revised)
(October 1987 Price Levels)

Cost Acct. No.	Item	Estimated Quantity	Unit	Unit Price ($)	Estimated Amount ($)
11.3	LEVEES AND FLOODWALLS (FLOODWALLS)				
	1. Gainard Woods Pump Station Floodwall - Phase I				
	Concrete: T-wall stem	142	C.Y.	350	49,700
	Concrete: T-wall base	172	C.Y.	200	34,400
	Concrete: 4" stability slab	23	C.Y.	70	1,610
	Concrete: Reinforcing Steel	47,000	Lbs.	0.50	23,500
	Prestressed Concrete Pile (12" x 12")	5,160	Feet	20.00	103,200
	Steel Sheet Pile - PMA 22	2,740	Sq. Ft.	11.50	31,510
	Steel Sheet Pile - PZ 32	7,300	Sq. Ft.	12.50	91,250
	Structural Excavation	810	C.Y.	8.00	6,480
	Structural Backfill	340	C.Y.	14.00	4,760
	Riprap	300	Ton	25.00	7,500
	Riprap Bedding - Shell	100	C.Y.	20.00	2,000
	3-Bulb Waterstop	180	Feet	10.00	1,800
	L-Type Waterstop	30	Feet	35.00	1,050
	Expansion Joint Filler	290	Sq. Ft.	2.00	580
	Fertilizing & Seeding	1	Acre	600	600
	Pile Load Test	1	Lump Sum		40,000
	Subtotal				$399,940
	2. Hayes Canal Pump Station Floodwall - Phase I				
	Concrete: T-wall stem	88	C.Y.	350	30,800
	Concrete: T-wall base	117	C.Y.	200	23,400
	Concrete: 4" stability slab	15	C.Y.	70	1,050
	Concrete: Reinforcing Steel	31,000	Lbs.	0.50	15,500
	Prestressed Concrete Pile (12" x 12")	3,480	Feet	20.00	69,600
	Steel Sheet Pile - PMA 22	3,040	Sq. Ft.	11.50	34,960
	Steel Sheet Pile - PZ 32	5,940	Sq. Ft.	12.50	74,250
	Structural Excavation	550	C.Y.	8.00	4,400
	Structural Backfill	230	C.Y.	14.00	3,220
	Riprap	250	Ton	25.00	6,250
	Riprap Bedding - Shell	80	C.Y.	20.00	1,600
	3-Bulb Waterstop	130	Feet	10.00	1,300
	L-Type Waterstop	30	Feet	35.00	1,050
	Expansion Joint Filler	210	Sq. Ft.	2.00	420
	Fertilizing & Seeding	1	Acre	600	600
	Timber Bridge (14' x 36')	1	Lump Sum	L.S.	12,600
	Subtotal				$281,000

NEW ORLEANS TO VENICE - REACH A (Revised)
(October 1987 Price Levels)

Cost Acct. No.	Item	Estimated Quantity	Unit	Unit Price ($)	Estimated Amount ($)
11.3	LEVEES AND FLOODWALLS - FLOODWALLS (Cont'd)				
	3. Freeport Sulphur Floodwall				
	Concrete: I-wall	369	C.Y.	350	129,150
	Concrete: Reinforcing Steel	37,000	Lbs.	0.50	18,500
	Steel Sheet Piling (PZ-27)	11,000	Sq. Ft.	12.50	137,500
	Structural Excavation	224	C.Y.	8.00	1,792
	Structural Backfill	158	C.Y.	14.00	2,212
	3-Bulb Waterstop	170	Feet	10.00	1,700
	Expansion Joint Filler	320	Sq. Ft.	2.00	640
	Fertilizing & Seeding	0.062	Acre	600	37
	Subtotal				$291,531
	4. City Price I-Wall Capping				
	Concrete: I-wall	116	C.Y.	350	40,600
	Concrete: Reinforcing Steel	13,850	Lbs.	0.50	6,925
	Steel Sheet Piling (PZ-27)	2,893	Sq. Ft.	12.50	36,163
	Structural Excavation	120	C.Y.	8.00	960
	Structural Backfill	80	C.Y.	14.00	1,120
	Expansion Joint Filler	118	Sq. Ft.	2.00	236
	3-Bulb Waterstop	68	Feet	10.00	680
	Subtotal				$86,684
	5. Gainard Woods Pump Station I-Wall Capping				
	Concrete: I-wall	180	C.Y.	350	63,000
	Concrete: Reinforcing Steel	15,000	Lbs.	0.50	7,500
	Structural Excavation	130	C.Y.	8.00	1,040
	Structural Backfill	100	C.Y.	14.00	1,400
	3-Bulb Waterstop	90	Feet	10.00	900
	Expansion Joint Filler	170	Sq. Ft.	2.00	340
	Subtotal				$74,180
	6. Hayes Canal Pump Station I-Wall Capping				
	Concrete: I-wall	155	C.Y.	350	54,250
	Concrete: Reinforcing Steel	13,000	Lbs.	0.50	6,500
	Structural Excavation	130	C.Y.	8.00	1,040
	Structural Backfill	100	C.Y.	14.00	1,400
	3-Bulb Waterstop	70	Feet	10.00	700
	Expansion Joint Filler	140	Sq. Ft.	2.00	280
	Subtotal				$64,170

NEW ORLEANS TO VENICE - REACH A (Revised)
(October 1987 Price Levels)

Cost Acct. No.	Item	Estimated Quantity	Unit	Unit Price ($)	Estimated Amount ($)
	Subtotal: FLOODWALLS				$ 1,197,505
	Contingencies (20%+)				192,495
	Subtotal: FLOODWALLS				$ 1,390,000
30	E&D (11%+)				155,000
31	S&A (11%+)				155,000
	TOTAL: FLOODWALLS				$ 1,700,000
	Subtotal: LEVEES AND FLOODWALLS (less contingencies)				$21,585,318
	Contingencies (20%±)				4,266,682
	Subtotal				$25,852,000
30	E&D (14.5%±)				3,755,000
31	S&A (11.8%±)				3,055,000
	TOTAL: LEVEES AND FLOODWALLS				$32,662,000
	TOTAL PROJECT COST				$38,200,000

56. Comparison of Cost Estimates. The current estimate of $38,200,000 for Reach A is a decrease of $59,198,000 from the cost shown in the PB-3 (effective October 1987). Prices in the PB-3 are based on cost estimates detailed in GDM No. 1, Supplement No. 5, Reach A, City Price to Tropical Bend, dated October 1983. These estimates have been escalated to October 1987 price levels and are listed in Table 7. An explanation of the difference in cost estimates by accounts follows:

a. Levees and Floodwalls. The geotextile plan results in a decrease in cost of $48,667,000 for the levees and floodwall account. Most of the cost reduction is due to a substantial reduction in the quantities of materials required for the geofabric levee construction versus those amounts required for hydraulic fill construction. It should also be pointed out that the geofabric plan employes haulfill construction using interior or protected side borrow pits. The reduced quantity of material needed to construct the geofabric plan coupled with the fairly close proximity of the borrow pits to the levee construction generate the substantial savings that would accrue to this account.

b. Engineering and Design. The decrease in E&D cost of $4,757,500 is due to a reanalysis of actual work required rather than applying a percentage to construction cost. The expended E&D to date for the New Orleans to Venice Project has averaged about 11 percent.

c. Supervision and Administration. The decrease in S&A cost of $5,447,500 was determined by applying the same percentage rate (as computed for E&D) to the total estimated construction cost. This might normally result in a conservative estimate (too high) for this project feature. However, due to the need for a high quality control for geofabric placement and field testing, it is believed that this estimate is appropriate.

d. Lands and Damages. The increase of $383,000 in the cost for lands and damages is due primarily to the use of more expensive lands for a borrow source. The cost per acre of interior borrow is 24 times greater than the marsh borrow area previously proposed with the hydraulic fill plan.

e. Relocations. The decrease in relocations cost of $709,000 is due to a smaller levee cross-section which, in turn, reduces the length of pipelines that would need to the relocated. The hydraulic fill plan required very large stability berms.

TABLE 7

COMPARISON OF ESTIMATES
(Incremental)

Feature	PB-3 Eff Oct 87	GDM No. 1 Supp. No. 5 (Revised)	Difference
11 Levees and Floodwalls	$74,519,000	$25,852,000	-$48,667,000
30 Engineering and Design	8,870,000	4,112,500	- 4,757,500
31 Supervision and Admin.	8,860,000	3,412,500	- 5,447,500
Subtotal	$92,249,000	$33,377,000	-$58,872,000
01 Lands and Damages	1,210,000	1,593,000	+ 383,000
02 Relocations	3,939,000	3,230,000	- 709,000
Subtotal	$ 5,149,000	$ 4,823,000	-$ 326,000
TOTAL	$97,398,000	$38,200,000	-$59,198,000

57. Schedule for Design, Construction, Relocations, and Land Acquisition. The sequence of contracts and the schedules for design, construction, relocations, and land acquisition are shown in Table 8.

TABLE 8

SCHEDULES FOR DESIGN, CONSTRUCTION, RELOCATIONS, AND LAND ACQUISITION

Contracts	Design 1/		Construction			Estimated Construction 2/ Cost ($)
	Start	Complete	Advertise	Award	Complete	
1. R/W Land Acquisition Sta. 314+00 to Sta. 682+00	Nov 1987	Dec 1987	N/A	Jan 1988	Jul 1988	1,593,000
2. First Enlargement Sta. 314+00 to Sta. 682+00	Nov 1987	Apr 1988	May 1988	Jul 1988	Jul 1990	11,700,000

TABLE 8 (Cont'd)

SCHEDULES FOR DESIGN, CONSTRUCTION, RELOCATIONS, AND LAND ACQUISITION

Contracts	Design [1]		Construction			Estimated Construction Cost [2]
	Start	Complete	Advertise	Award	Complete	($)
3. Pipeline & Facility Relocations Sta. 0+00 to Sta. 314+00	Nov 1987	May 1988	N/A	Jul 1988	Jul 1989	880,000
4. First Enlargement Sta. 0+00 to Sta. 314+00	Nov 1987	Apr 1989	May 1989	Jul 1989	Jul 1991	7,400,000
5. Freeport Sulphur Relocation Dock Extension	Jan 1991	Apr 1991	May 1991	Jul 1991	Dec 1991	245,000
6. City Price Drainage Structure	Jul 1990	Apr 1991	May 1991	Jul 1991	Dec 1991	235,000
7. Hwy 23 Relocations	Jul 1990	Apr 1991	May 1991	Jul 1991	Dec 1991	1,461,000
8. Gainard Woods Pumping Station T-Wall & Sheetpile	Jul 1989	Apr 1990	May 1990	Jul 1990	Dec 1990	675,000
9. Hayes Canal Pumping Station T-Wall & Sheetpile	Jul 1990	Apr 1991	May 1991	Jul 1991	Dec 1992	600,000
10. Pipeline Relocation Sta. 314+00 to Sta. 682+00	Jul 1989	Apr 1990	N/A	Jul 1990	Dec 1990	255,000
11. Freeport Canal Closure & I-Wall	Jan 1990	Oct 1991	Nov 1991	Jan 1992	Jul 1992	2,620,000
12. City Price I-Wall Capping	Jan 1994	Oct 1994	Nov 1994	Jan 1995	Jul 1995	120,000
13. Gainard Woods I-Wall Capping	Jan 1993	Oct 1993	Nov 1993	Jan 1994	Jul 1994	110,000

TABLE 8 (Cont'd)

SCHEDULES FOR DESIGN, CONSTRUCTION, RELOCATIONS, AND LAND ACQUISITION

Contracts	Design 1/		Construction			Estimated Construction Cost 2/
	Start	Complete	Advertise	Award	Complete	($)
14. Hayes Canal I-Wall Capping	Jan 1994	Oct 1994	Nov 1994	Jan 1995	Jul 1995	90,000
15. Second Enlargement Sta. 314+00 to Sta. 682+00	Jul 1993	Apr 1995	May 1995	Jul 1995	Jul 1997	3,550,000
16. Second Enlargement Sta. 0+00 to Sta. 314+00	Jul 1994	Apr 1996	May 1996	Jul 1996	Jul 1998	2,080,000
17. Second Enlargement Freeport Canal Closure	Jul 1995	Apr 1997	May 1997	Jul 1997	Jan 1998	270,000

1/ Design completion dates reflect resolution of all comments.

2/ This cost includes Contingencies, Federal and non-Federal Supervision and Inspection (S & I) Costs and Federal & Non-Federal Construction Costs.

58. Funds Required by Fiscal Year. In order to maintain the schedules for design, construction, relocations, and land acquisition, as shown in Table 8, funds will be required by fiscal years as shown below:

Fiscal Year	Federal ($)	Non-Federal ($)	Total ($)
Total Estimated Cost Through FY 1986	2,537,900	0	2,537,900
1987	230,000	0	230,000
1988	2,288,200	2,166,900	4,455,100
1989	5,562,500	2,384,000	7,946,500
1990	5,486,300	2,351,000	7,837,300
1991	3,349,100	1,436,000	4,785,100
1992	2,041,600	875,000	2,916,600
1993	546,700	234,000	780,700
1994	231,000	99,000	330,000
1995	665,700	285,300	951,000
1996	1,675,600	718,000	2,393,600
1997	1,500,800	643,000	2,143,800
1998	624,600	267,800	892,400
	$26,740,000	$11,460,000	38,200,000

OPERATION AND MAINTENANCE

59. Federal. Federal operation and maintenance costs are not involved in this project.

60. Non-Federal. As specified in the authorizing act, local interests are to operate and maintain the completed works in accordance with regulations prescribed by the Secretary of the Army and good maintenance practices. The estimated total annual cost for operation, maintenance, and replacement for Reach A is broken down as follows:

a. Operation and Maintenance.

Annual cost for operation and maintenance of all levees	$ 17,000/yr

b. Replacement.

Replacement of City Price drainage structure in year 50	$570,000
Present worth (factor .2226)	$127,000
Amort. @ 2 7/8%, 100 years	$ 3,900/yr
Total Annual O&M Cost (including replacement) for Reach A	$ 20,900/yr

61. General.

a. The New Orleans to Venice, Louisiana (Hurricane Protection) project, as authorized by the Congress in 1962, generally comprises a system of levees, floodwalls, and floodgates to protect developed areas on the east and west banks of the Mississippi River from flooding by hurricane-generated tidal surges. With all of the features of the project working in combination, the project will provide protection from a hurricane having a return frequency of once in 100 years.

b. The project consists of four features, each of which is at a different stage of construction or planning. Construction of Reach A has not been started while Reaches B-1 and B-2 are each approximately 80 percent complete. Reach C, although previously considered complete, has since required additional work due to settling. Base completion years by reach are: A, B-1 and B-2, 1993; and C, 1998.

c. The benefit analyses for Reaches A, B-1, and B-2 are based on the West Bank Mississippi River Levee, City Price to Venice improvement which consists of enlargement of the back levees from the west. This improvement provides essentially complete protection from storms having a return frequency of once in 100 years.

62. Population. The population of Plaquemines Parish increased from 1950 to 1960 at an annual rate of 4.7 percent and from 1960 to 1970 at an annual rate of 1.1 percent. For the last decade, the annual growth rate slowed to 0.3 percent. Whereas the area appears to be primarily rural in nature, due to the strip-type development along the alluvial ridge, population densities are such that a large portion could be characterized as urban. Pointe-a-la-Hache, the parish seat, is the primary center of activity on the east bank of the Mississippi River. Within the more populous west bank reaches are the communities of Port Sulphur, Empire, Buras, Boothville, Triumph, and Venice. Most of the population growth in Plaquemines Parish from 1950 to 1980 has occurred on the west bank of the river, largely as a result of nearby offshore petroleum exploration and production activities. A sizeable portion of this growth took place in the lower reaches until 1965 when Hurricane Betsy effectively destroyed most of the improvements located therein; another major disaster struck the lower reaches in 1969 (Hurricane Camille), again demolishing nearly all of the rebuilt structures. Due to the enormous damages which were caused by these storms, many inhabitants were forced to temporarily relocate north of the project area on the west bank near the town of Belle Chasse where flood hazards are considerably reduced. During the 1970's, a large segment of the original inhabitants of the lower reaches reestablished residency in

Reaches B-1 and B-2 using mobile homes. Employment associated with offshore petroleum activities in large measure provided the incentive for their return. A new four-lane highway has been constructed which extends over much of the length of the west bank to Venice, facilitating the movement of traffic to the New Orleans metropolitan area. Because of the continuing serious flood threats to the lower reaches, overall population growth for the parish has been projected to maintain only a 0.3 percent annual rate until 1993 (base year for the west bank reaches). At that time, the West Bank Mississippi River Levee, although not complete, will offer a high degree of flood protection, and the overall project will be highly effective. Subsequent to 1993, the projections were based on growth rates established in the 1980 OBERS BEA Regional Projections for the non-SMSA portion of Economic Area 113 (New Orleans).

63. Land Use.

a. The project area consists of relatively low-lying lands with ground elevations varying from a maximum of 5 feet in Reach A to a minimum of about -3 feet in Reach B-2 (where consolidation has occurred as a result of pumped drainage).

b. Land use under conditions of development existing as of October 1978 were analyzed and projections for the future were made in the following categories: residential, commercial, public and semipublic, light and heavy industry, transportation, communications, utilities, and agriculture. Growth rates for the residential, commercial, and public and semipublic categories were directly related to those that were anticipated for future population changes. Increases for light and heavy industry were based on the 1980 OBERS BEA Regional Projections for construction and manufacturing employment, as provided, for the non-SMSA portion of Economic Area 113. Projections for transportation and public utilities, in the same document, were utilized in estimating growth for the transportation, communications, and utilities categories. Agricultural conditions were assumed to remain relatively unchanged.

64. Flood Damage Relationships.

a. General. During 1979-1980, the NOD entered into a contract (DACW38-79-C-0023) to obtain data for the Lake Pontchartrain, Louisiana and Vicinity Hurricane Protection Project. Some of the data furnished under the contract requirements included the determination of replacement values for residential and non-residential structures, determination of contents value expressed as a percent of structural value, and determination of saltwater and freshwater damages for residential and non-residential structures and contents by one-half foot increments. The data developed in these studies have been used extensively in the analysis presented herein.

b. Field Surveys. Field data collected after Hurricanes Betsy and Camille occurred were used in the current analysis. In addition, the area was reinventoried in 1978 in order to ascertain the level of reoccupation and development which had occurred since these two devastating storms.

c. Depth-Damage Relationships. The relationships indicating the percent damage to structures and/or contents as related to the depth of flooding over the floor for residential structures and for various classes of non-residential structures were derived from data furnished by the contractor's indepth field investigations. Table 9 defines the depth-damage relationship for single-story residential structures from saltwater flooding. Similar relationships were used for other categories of residential and non-residential structures.

d. Stage-Frequency Data. Stage-frequency relationships were developed for each of the hydrologically-independent areas for "existing" (1982) adjusted to "1987 conditions" and "with-project" conditions (i.e., existing back levees and Mississippi River main line levees to authorized grade in place, and the above plus authorized improvements, respectively). Stage-frequency curves used in this analysis are shown on plates 81 through 85. Hydraulic analyses indicated that when the project levees are completed to grade, only minor flooding from ponded rainwater and wave splash would occur from all but the most devastating hurricanes. Estimates of residual damages were found to be negligible in all reaches.

e. Remaining Benefits. As previously stated, this analysis will determine the remaining benefits and costs. As the benefits will not be accrued until the project levees are substantially completed to grade, this analysis considers all benefits for Reaches A, B-1, B-2, and C to be remaining. For presentation purposes, and for clarity, all benefits are labeled "remaining".

Table 9
Saltwater Depth-Damage Relationship*
Single-Story Residential Structures

Depth of Flooding (Ft.)	Percent Damage to Buildings (%)	Percent Damage to Contents (%)
-1.0	0.0	0.0
-0.5	0.5	0.0
0.0	14.5	0.0
0.5	22.9	11.5
1.0	29.3	21.5
1.5	34.0	31.0
2.0	38.0	39.7
2.5	41.3	46.8

Table 9 (Cont'd)
Saltwater Depth-Damage Relationship*
Single-Story Residential Structures

Depth of Flooding (Ft.)	Percent Damage to Buildings (%)	Percent Damage to Contents (%)
3.0	44.3	52.5
3.5	47.0	57.5
4.0	49.0	61.7
4.5	51.4	64.8
5.0	52.9	67.3
5.5	54.4	69.3
6.0	55.7	70.7
6.5	57.0	71.7
7.0	57.9	72.6
7.5	58.7	73.6
8.0	59.5	74.1
8.5	60.0	74.8
9.0	60.8	75.7
9.5	61.3	76.1
10.0	61.5	76.6
10.5	62.0	77.1
11.0	62.1	77.5
11.5	62.3	77.8
12.0	62.4	78.0
12.5	62.5	78.1
13.0	62.5	78.2
13.5	62.5	78.4
14.0	62.5	78.6
14.5	62.5	78.8
15.0	62.5	79.0

*Source: Contract DACW38-79-C-0023 for Lake Pontchartrain, La. and Vicinity Hurricane Protection Project.

65. Benefits.

a. General. For the purposes of this analysis, remaining costs and benefits have been evaluated at October 1987 price levels (assuming a 100-year project life). In addition, the present worth of project costs and benefits was computed to their base years at the authorized Federal interest rate of 2-7/8 percent and the current Federal interest rate of 8-5/8 percent. Benefits were evaluated for the period 1993-2093 and 1968-2068; however, no growth projections were made beyond project year 50 due to current Corps policy. Benefits defined as existing refer to those benefits which remain to be achieved at the time of this analysis. Benefits are discussed in the following paragraphs and are categorized by type: inundation reduction and intensification.

b. Inundation Reduction Benefits. Flood damages which will be prevented with the project in place, or savings in costs which will result from reduced flood stages, include: damages prevented to residences, commercial establishments, and public and semipublic facilities; damages prevented to industry, agriculture, and transportation, communications, and utilities; and savings in clean-up and emergency costs.

(1) Damages Prevented to Residential Structures.

(a) During field surveys conducted in 1978, the numbers of structures, by type, were inventoried and the first floor elevations were established for all residential structures within the project area. Structural values were determined by information obtained from interviews with local real estate firms and general knowledge acquired as to on-going property values. Depth-damage relationship data used were those developed from empirical data collected for the Corps of Engineers in the Lake Pontchartrain, Louisiana and Vicinity Hurricane Protection project reanalysis under contract DACW38-79-C-0023 in 1979. Contents were valued at an estimated 60 percent of residential structural value.

(b) In order to express the residential development in terms of its base year condition, the number of structures were projected from 1978 to 1993 conditions using actual and anticipated growth rates. The value of structures and contents, depth-damage relationship data, and the stage-frequency relationships were then integrated in order to derive the remaining average annual damages that would be prevented over the 100-year project life (as shown in Table 10).

Table 10
Remaining Average Annual Damages Prevented to Residential Structures
Existing Conditions as of the Base Year
(October 1987 Price Levels)

Reach	Flood Damages Prevented ($)
A	1,622,000
B-1	1,450,000
B-2	1,280,000
C	204,000
TOTAL	$ 4,556,000

(c) Provisions of the Federal Flood Insurance Act specify that residential structures cannot be constructed within the flood plain unless the first floor elevations are at or above the 100-year flow line. In addition, current Water Resources Council guidelines require that, where floodproofing is expected without a plan, the future benefit is the cost of floodproofing plus residual damages (assuming floodproofing in place). As there will be little or no residual damages on future developments (assuming floodproofing in place), the future inundation reduction benefits for residential structures equal the annual costs of floodproofing saved (as shown in Table 11). When a residential structure is built elevated on pilings, the cost is increased by an average of 20 percent over that of an identically sized house built with conventional foundations. Costs of floodproofing residential structures were derived by applying the 20 percent factor to projected future residential growth (1993-2043) and (1968-2018), discounting the values obtained to present worth values in the base year, and then amortizing those values over the 100-year project life.

Table 11
Annual Savings in Residential Floodproofing Costs

Reach	Cost of Floodproofing Saved	
	2 7/8%	8 5/8%
	($)	($)
A	99,000	92,000
B-1	110,000	102,000
B-2	45,000	42,000
C	21,000	20,000
TOTAL	$ 275,000	$ 256,000

(d) The remaining residential inundation reduction benefits (including the average annual flood damages prevented plus the annual costs of floodproofing saved) are shown in Table 12.

Table 12
Remaining Inundation Reduction Benefits
-Residential Structures-

Reach	Existing: Flood Damages Prevented (as of base year)	Future: Costs of Floodproofing Saved		Total	
		2 7/8%	8 5/8%	2 7/8%	8 5/8%
	($)	($)	($)	($)	($)
A	1,622,000	99,000	92,000	1,721,000	1,714,000
B-1	1,450,000	110,000	102,000	1,560,000	1,552,000
B-2	1,280,000	45,000	42,000	1,325,000	1,322,000
C	204,000	21,000	20,000	225,000	224,000
TOTAL	$4,556,000	$275,000	$256,000	$4,831,000	$4,812,000

(2) Damages Prevented to Commercial Establishments.

(a) Damages sustained by businesses were based on the damages to structures and the loss of furnishings and inventory. Prevention of the net loss of normal business profits and return to capital, labor, and management were not considered since such losses are partially or wholly compensated for by postponement of purchasing by flood-affected residents or through transfer of purchasing activities to business establishments not affected. In addition, the losses associated with the resulting marketing inefficiencies are difficult to determine.

(b) Commercial damages were based on extensive field surveys which were undertaken following Hurricanes Betsy and Camille. The data obtained during these field surveys were updated in 1978 by a resurvey of the area to bring the data to current conditions. The data obtained were then adjusted to reflect conditions as of the base year. Therefore, remaining average annual damages were computed in the same manner as for residential structures except that, under FIA regulations, commercial establishments do not have to be built to the 100-year flood elevation. It was assumed, however, that future commercial structures would be built of more flood-resistant building materials. Remaining inundation reduction benefits accruing to commercial establishments under existing and future conditions are shown in Table 13.

Table 13
Remaining Inundation Reduction Benefits
-Commercial Establishments-

Reach	Base Year Conditions	Future		Total	
		2 7/8%	8 5/8%	2 7/8%	8 5/8%
	($)	($)	($)	($)	($)
A	176,000	28,000	15,000	204,000	191,000
B-1	737,000	115,000	56,000	852,000	793,000
B-2	507,000	79,000	38,000	586,000	545,000
C	100,000	18,000	8,000	118,000	108,000
TOTAL	$1,520,000	$240,000	$117,000	$1,760,000	$1,637,000

(3) Damages Prevented to Public and Semipublic Facilities, Industry, Transportation, Communications, Utilities, and Agriculture. In determining damages prevented in this category, the empirical damage data gathered in the wake of Hurricane Camille was brought to current price levels and adjusted for current conditions. Stage-damage relationships were then formulated for each reach and integrated with appropriate stage-frequency relationships to derive the annual damages under with- and without-project conditions. The present worth of the damages prevented was then computed to the base year (1993). Table 14 displays the remaining benefits to be derived from inundation reduction for the combined categories of public and semipublic facilities, industry, transportation, communications, utilities, and agriculture.

Table 14
Remaining Inundation Reduction Benefits
-Public and Semipublic Facilities, Industry,
Transportation, Communications, Utilities, and Agriculture-

Reach	Base Year Conditions	Future		Total	
		2 7/8%	8 5/8%	2 7/8%	8 5/8%
	($)	($)	($)	($)	($)
A	292,000	45,000	22,000	337,000	314,000
B-1	1,466,000	229,000	111,000	1,695,000	1,577,000
B-2	648,000	101,000	49,000	749,000	697,000
C	143,000	46,000	22,000	189,000	165,000
TOTAL	$2,549,000	$421,000	$204,000	$2,970,000	$2,753,000

(4) Savings in Cleanup Costs Prevented. The cleanup costs incurred for residential and non-residential structures were based on actual expenditures after the passage of Hurricane Camille in 1969. Cleanup costs represent the labor and transportation charges resulting from the cleanup and removal of flood related debris throughout the overflow area. These costs do not include the purchases of new furnishings or the costs of repairing damaged items. Cleanup costs are a function of the number of residential and commercial structures in an area as well as the intensity and the maximum flood stage of a hurricane. Using the actual costs experienced after Hurricane Camille, adjusting for development as of the base year and current price levels, and employing the relationship described above, the cleanup costs for all flood stages were integrated with the stage-frequency data to determine the remaining average annual benefits in cleanup costs to be prevented by the project (as shown in Table 15).

Table 15
Remaining Inundation Reduction Benefits
-Cleanup Costs Prevented-

Reach	Base Year Conditions	Future		Total	
		2 7/8%	8 5/8%	2 7/8%	8 5/8%
	($)	($)	($)	($)	($)
A	16,000	3,000	1,000	19,000	17,000
B-1	19,000	3,000	1,000	22,000	20,000
B-2	15,000	3,000	1,000	18,000	16,000
C	5,000	2,000	1,000	7,000	6,000
TOTAL	$ 55,000	$11,000	$ 4,000	$ 66,000	$ 59,000

(5) Savings in Emergency Costs. These costs are associated with the occurrence of major hurricanes for both evacuation and subsistence. All residents are required to leave for higher ground when a storm is approaching and it is assumed that they will continue to do so even with the project in place. Under current conditions, some 4,400 people evacuate from Reach A when a storm is threatening, about 5,400 from Reach B-1, 2,600 leave Reach B-2, and another 1,300 leave Reach C. As the projected population is the same under with- and without-project conditions, future residents also will be forced to seek shelter during times of pending danger. However, the costs of evacuation will be lessened with the project in place as the danger of serious flooding will be materially reduced and residents will be able to return home sooner. It is reasonable to expect that six major hurricanes will strike the project area in the next 100 years and that the average stay, without-project, in an evacuation shelter will be some 21 days per person. Under with-project conditions, the average stay will be reduced to 2 days. In addition, it is anticipated that less severe storms will force the evacuation of the area every three years for an average evacuation period of 2 days without the project. With the project in place, it is estimated that only 50 percent of the residents will evacuate for an average evacuation period of one day. The daily evacuation cost per person ($16.72) multiplied by the existing population was integrated with length of evacuation (in days)-storm frequency data to determine emergency costs for the with- and without-project conditions. The existing saving in emergency costs is the difference between these two conditions.

Future emergency costs saved were determined by projecting the current amounts saved, when considering anticipated population growth, discounting the values obtained to present worth values in the base year, and then amortizing the values over the 100-year project life (as shown in Table 16).

Table 16
Remaining Inundation Reduction Benefits
-Annual Savings in Emergency Costs-

Reach	Base Year Conditions	Future		Total	
		2 7/8%	8 5/8%	2 7/8%	8 5/8%
	($)	($)	($)	($)	($)
A	286,000	45,000	23,000	331,000	309,000
B-1	352,000	55,000	27,000	407,000	379,000
B-2	168,000	26,000	13,000	194,000	181,000
C	87,000	13,000	6,000	100,000	93,000
TOTAL	$893,000	$139,000	$69,000	$1,032,000	$962,000

(6) Inundation Reduction Benefits Summation. A summary of all remaining inundation reduction benefits for the project area is contained in Table 17 with a tabulation by project reaches following in Table 18.

Table 17
Summation of Remaining Inundation Reduction Benefits -
By Damage Categories

Category	Base Year Conditions ($)	Future 2 7/8% ($)	Future 8 5/8% ($)	Total 2 7/8% ($)	Total 8 5/8% ($)
Flood damages prevented:					
Residential	4,556,000	275,000	256,000	4,831,000	4,812,000
Commercial	1,520,000	240,000	117,000	1,760,000	1,637,000
Other*	2,549,000	421,000	204,000	2,970,000	2,753,000
Subtotal	$8,625,000	$936,000	$577,000	$9,561,000	$9,202,000
Savings in costs prevented:					
Cleanup costs	55,000	11,000	4,000	66,000	59,000
Emergency costs	893,000	139,000	69,000	1,032,000	972,000
Subtotal	$948,000	$150,000	$73,000	$1,098,000	$1,021,000
Total Inundation Reduction Benefit	$9,573,000	$1,086,000	$650,000	$10,659,000	$10,223,000

*Public and semipublic, Industrial, Transportation, Communications, Utilities, and Agricultural.

Table 18
Summation of Remaining Inundation Reduction Benefits - By Reaches

Category	Base Year Conditions ($)	Future		Total	
Reach A		2 7/8% ($)	8 5/8% ($)	2 7/8% ($)	8 5/8% ($)
Flood Damages Prevented	2,090,000	172,000	129,000	2,262,000	2,219,000
Savings in Costs Prevented	302,000	48,000	24,000	350,000	326,000
Total, Reach A	$2,392,000	$220,000	$153,000	$2,612,000	$2,545,000
Reach B-1		2 7/8%	8 5/8%	2 7/8%	8 5/8%
Flood Damages Prevented	3,653,000	454,000	269,000	4,107,000	3,922,000
Savings in Costs Prevented	371,000	58,000	28,000	429,000	399,000
Total, Reach B-1	$4,024,000	$512,000	$297,000	$4,536,000	$4,321,000
Reach B-2		2 7/8%	8 5/8%	2 7/8%	8 5/8%
Flood Damages Prevented	2,435,000	225,000	129,000	2,660,000	2,564,000
Savings in Costs Prevented	183,000	29,000	14,000	212,000	197,000
Total, Reach B-2	$2,618,000	$254,000	$143,000	$2,872,000	$2,761,000
Reach C		2 7/8%	8 5/8%	2 7/8%	8 5/8%
Flood Damages Prevented	447,000	85,000	50,000	532,000	497,000
Savings in Costs Prevented	92,000	15,000	7,000	107,000	99,000
Total, Reach C	$539,000	$100,000	$57,000	$639,000	$596,000
		2 7/8%	8 5/8%	2 7/8%	8 5/8%
TOTAL PROJECT	$9,573,000	$1,086,000	$650,000	$10,659,000	$10,223,000

c. Intensification.

(1) Additional growth is anticipated under "existing" and "without" project conditions due to the area's favorable geographic location with respect to Louisiana's fishing and citrus industries, and the freshwater and deep draft channel provided by the Mississippi River.

(2) The project area cannot be developed without protection from both fluvial and tidal flooding and suitable nearby floodfree lands are non-existent. Thus, alternative sites are not available for accommodating the existing and projected urban-type developments ascribed to the study area. The validity of the benefits claimed as increases in land values which will eventuate as a result of project construction rests on the determination that the area to be protected is required for future development.

(3) The protected areas of the project vary from sparse to dense developments. With the project in place, residential and commercial construction will be of a higher order than the construction which would occur without the project because completion of the levees essentially removes the threat of massive flooding such as that which occurred during Hurricanes Betsy and Camille.

(4) Pre- and post-project land values were based on analyses of comparable lands in Plaquemines Parish and the surrounding parishes of Orleans, St. Bernard, and Jefferson. Care was taken to identify, isolate, and exclude from the computed increases in land value any increments which would result from subsequent construction of drainage facilities, roadways, utilities, and other improvements requisite to full utilization of the project area. The computed increase, therefore, represents the increment directly attributable to construction of the project improvements. In this determination, land values were based on October 1987 price levels.

(5) The current value of land within the project area is approximately $130,725,000. By providing protection from hurricane-induced tidal overflows, the value will increase to an estimated $170,548,000. The intensification benefit was based on an increase in the appraised market value of land afforded additional flood protection by the project. The increase in value, about $766,000, was taken to represent the present value to private investors of increased earning power discounted at 8%; their assumed minimally acceptable rate of return needed to cover inflation and return to capital. The constant dollar annual increase in output which equates to the above increase in net present value was calculated to be $45,000 per year, exclusive of inflation and return to capital. Since this is a constant annuity, the annual value is unaffected by changes in the discount rate. Upon completion of the west bank levees, the total intensification benefit of $45,000 would be realized (see Table 19).

TABLE 19
INTENSIFICATION BENEFITS
(October 1987 Prices)

Reach	Total Acres	Acres To Be Developed	Existing Value Per Acre ($)	Post-Project Value Per Acre ($)	Total Increase In Land Value ($)	Increase in Net Present Value ($)
A	4,300	140	7,875	10,274	336,000	13,000
B-1	3,800	95	7,875	10,274	228,000	9,000
B-2	2,300	84	7,875	10,274	202,000	7,000
C	6,200	186	7,875	10,274	446,000	16,000
TOTAL	16,600	505	-	-	$1,212,000	$45,000

d. Summary. A summary of remaining benefits is shown in Table 20.

Table 20
Summation of Remaining Benefits - By Reaches

Reach	Inundation Reduction		Intensification	Total	
	2 7/8% ($)	8 5/8% ($)	($)	2 7/8% ($)	8 5/8% ($)
A	2,612,000	2,545,000	13,000	2,625,000	2,558,000
B-1	4,536,000	4,321,000	9,000	4,545,000	4,330,000
B-2	2,872,000	2,761,000	7,000	2,879,000	2,768,000
C	639,000	596,000	16,000	655,000	612,000
TOTAL	$10,659,000	$10,223,000	$45,000	$10,704,000	$10,268,000

66. Costs. The present worth of the remaining project costs was computed to the base year at the project interest rate (2 7/8 percent) and the current interest rate (8 5/8 percent) in order to express the costs and benefits on the same basis in deriving the benefit-to-cost ratio. Tables 21 and 22 delineate the time-stream of all project costs. Table 23 identifies the remaining construction costs and average annual charges, the remaining average annual benefits, and the benefit-to-cost ratio for the remaining portion of the project to be constructed.

Table 21
Remaining Project Costs
(October 1987 Prices, 2 7/8%, 8 5/8%, Base Year 1993)
Reach A, Reach B-1, Reach B-2, WBMRL

Fiscal Year	Remaining Cost ($)	Present Value (2 7/8%) ($)	Present Value (8 5/8%) ($)
1988	5,084,000	5,776,000	7,378,000
1989	14,133,000	15,607,000	18,879,000
1990	14,796,000	15,882,000	18,196,000
1991	13,086,000	13,654,000	14,815,000
1992	5,255,000	5,330,000	5,477,000
1993	9,373,000	9,241,000	8,993,000
1994	1,885,000	1,807,000	1,665,000
1995	5,670,000	5,282,000	4,611,000
1996	6,977,000	6,318,000	5,223,000
1997	5,601,000	4,930,000	3,860,000
1998	4,620,000	3,953,000	2,931,000
1999	2,804,000	2,333,000	1,638,000
2000	3,223,000	2,606,000	1,733,000
2001	3,681,000	2,893,000	1,822,000
2002	4,536,000	3,465,000	2,067,000
2003	4,473,000	3,322,000	1,877,000
2004	4,603,000	3,323,000	1,778,000
2005	4,147,000	2,910,000	1,474,000
2006	4,820,000	3,287,000	1,577,000
2007	4,431,000	2,938,000	1,335,000
2008	4,179,000	2,693,000	1,159,000
2009	4,466,000	2,798,000	1,140,000
2010	4,770,000	2,905,000	1,121,000
2011	4,470,000	2,646,000	967,000
2012	4,822,000	2,774,000	961,000
2013	4,652,000	2,602,000	853,000
Subtotal	$150,557,000	$131,275,000	$113,530,000

Table 22
Remaining Project Costs
(October 1987 Prices, 2 7/8%, 8 5/8%, Base Year 1968)
Reach C

Fiscal Year	Remaining Cost ($)	Present Value (2 7/8%) ($)	Present Value (8 5/8%) ($)
1988	2,000,000	1,119,000	367,000
1989			
1990			
1991	1,300,000	668,000	186,000
1992	1,300,000	649,000	172,000
1993			
1994	1,300,000	614,000	145,000
1995	1,310,000	601,000	135,000
Subtotal	$7,210,000	$3,651,000	$1,005,000
TOTAL	$157,767,000	$134,926,000	$114,535,000

Table 23
First Costs-Annual Charges-Annual Benefits
(October 1987 Prices, 2 7/8%)

	Total ($)
1. First costs	
a. Total construction cost	230,802,000 1/ 2/
b. Remaining construction cost	157,767,000 3/
c. Present worth, remaining cost	134,926,000
d. Mitigation construction cost	522,000
e. Present worth, mitigation cost	521,000
2. Average annual charges	
a. Interest (2 7/8%)	3,879,000
b. Amortization (100 yrs)	242,000
c. Operation and Maintenance	300,000
d. Replacements	131,000
e. Mitigation Losses	18,000
f. Mitigation costs	
(1) Interest (2 7/8%)	15,000
(2) Amortization (100 yrs)	1,000
g. Total	$ 4,586,000
3. Average annual benefits	
a. Inundation Reduction	10,659,000
b. Intensification	45,000
c. Mitigation	13,000
d. Total	$ 10,717,000
4. Benefit-to-cost ratio	2.3 to 1

1/ Includes costs of $38,200,000 for Reach A, $42,201,000 for Reach B-1, $35,980,000 for Reach B-2, $26,562,000 for Reach C, and $87,859,000 for the West Bank Mississippi River Levee.

2/ Includes $644,000 mitigation cost.

3/ Excludes mitigation cost.

67. Benefit-to-Cost Ratio. Based on the remaining construction cost of $157,767,000, with a present value of $134,926,000, remaining average annual charges of $4,586,000, and remaining average annual benefits of $10,717,000, the benefit-to-cost ratio for that portion of the New Orleans to Venice, La. (Hurricane Protection) project remaining to be constructed is 2.3 to 1.

68. <u>Summary of Benefits and Costs at Current Discount Rate</u>. Table 24 displays the remaining costs and benefits at the current Federal discount rate of 8 5/8%. The present worth of all costs and benefits has been computed to the project base year and amortized over the project life.

Table 24
Remaining Costs and Benefits
at Current Discount Rate of 8 5/8 Percent
(October 1987 Price Levels)

	Total ($)
1. First costs	
a. Total construction cost	230,802,000 1/ 2/
b. Remaining construction cost	157,767,000 3/
c. Present worth, remaining cost	114,535,000
d. Mitigation construction cost	522,000
e. Present worth, mitigation cost	523,000
2. Average annual charges	
a. Interest (8 5/8%)	9,879,000
b. Amortization (100 yrs)	2,000
c. Operation and Maintenance	300,000
d. Replacements	113,000
e. Mitigation Losses	17,000
f. Mitigation costs	
(1) Interest (8 5/8%)	45,000
(2) Amortization (100 yrs)	0 4/
g. Total	$ 10,356,000

Table 24 (Cont'd)
Remaining Costs and Benefits
at Current Discount Rate of 8 5/8 Percent
(October 1987 Price Levels)

	Existing ($)	Future ($)	Total ($)
3. Average annual benefits			
a. Inundation Reduction			
(1) Residential	4,556,000	256,000	4,812,000
(2) Commercial	1,520,000	117,000	1,637,000
(3) Other 5/	2,549,000	204,000	2,753,000
(4) Cleanup costs	55,000	4,000	59,000
(5) Emergency costs	893,000	69,000	962,000
(6) Subtotal	$9,573,000	$650,000	$10,223,000
b. Intensification			45,000
c. Mitigation			12,000
d. Total			$10,280,000
4. Benefit-to-cost ratio			0.99 to 1

1/ Includes costs of $38,200,000 for Reach A, $42,201,000 for Reach B-1, $35,980,000 for Reach B-2, $26,562,000 for Reach C, and $87,859,000 for the West Bank Mississippi River Levee.

2/ Includes $644,000 mitigation cost.

3/ Excludes mitigation cost.

4/ Less than $500.

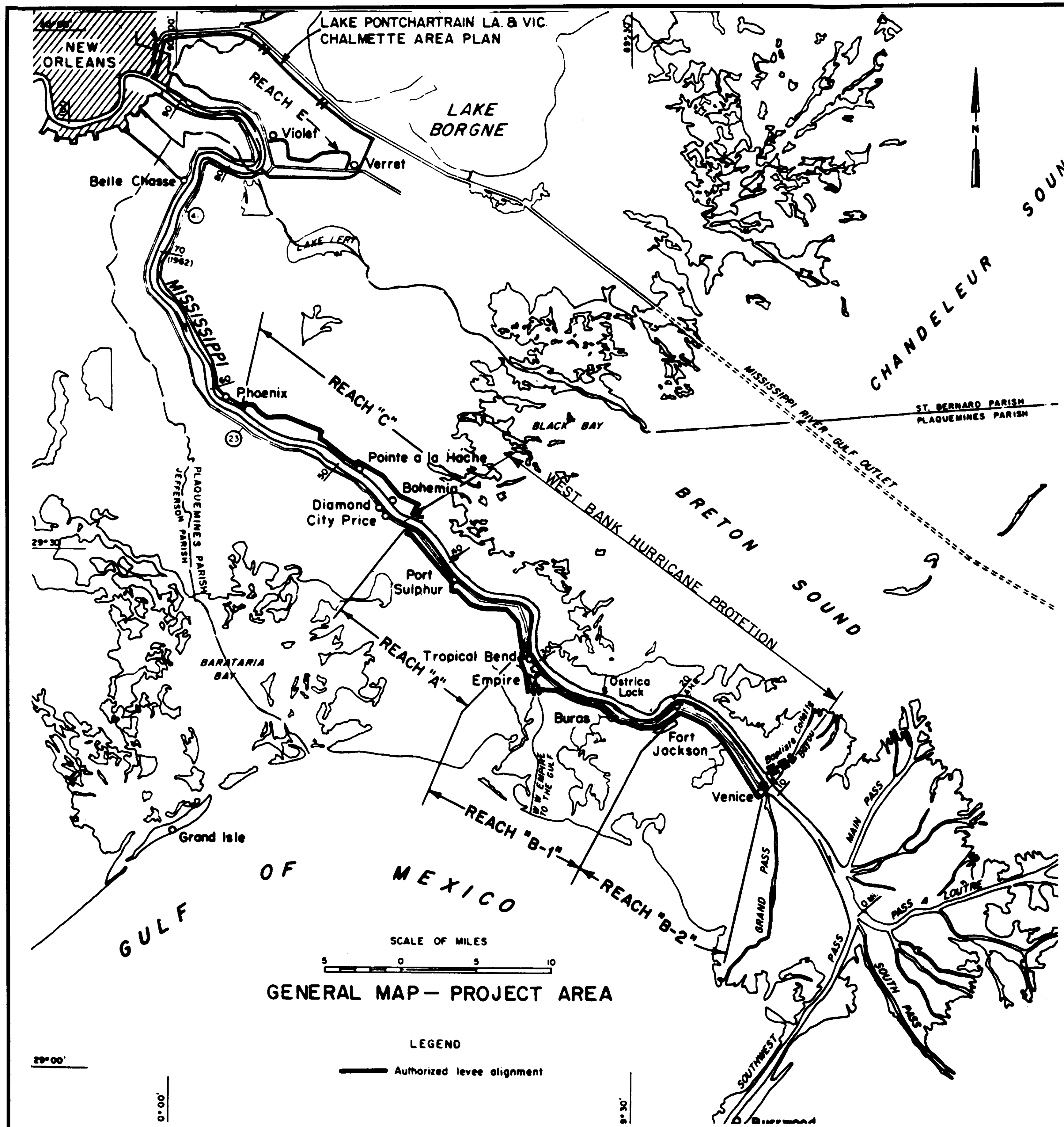
5/ Includes Public and Semipublic, Industrial, Transportation, Communications, Utilities, and Agricultural.

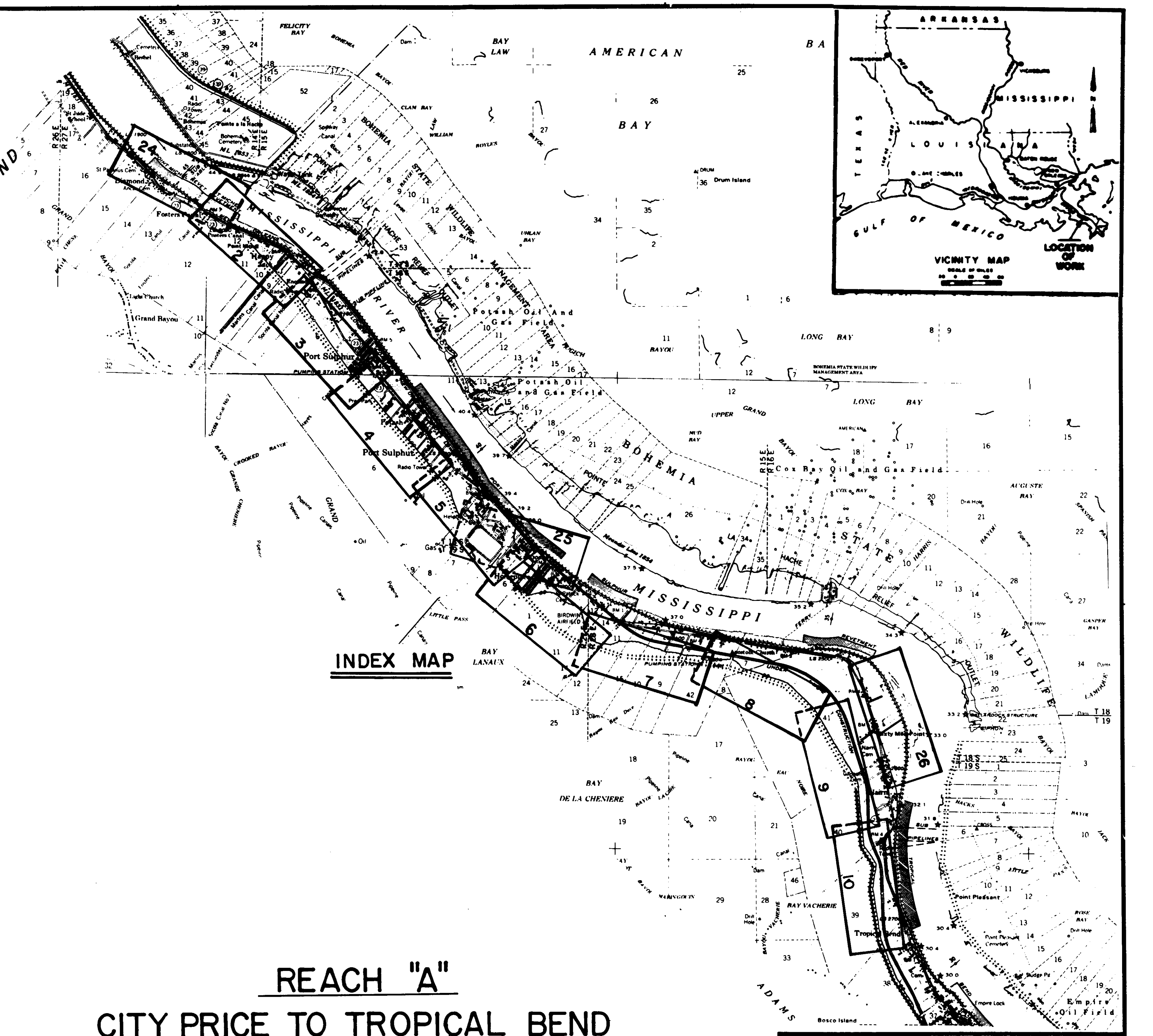
WATER CONSERVATION MEASURES

69. General. The use of water conservation measures for Reach A was investigated during the preparation of this report. The investigation showed that there were no opportunities to implement water conservation measures (due to the nature of the project features). The investigation also showed that population growth and land-use for Plaquemines Parish are expected to increase with- or without-project construction. However, some additional intensification is expected as a result of project construction; therefore, it is anticipated that there will be a slight increase in the consumptive use of potable water.

RECOMMENDATIONS

70. Recommendations. It is recommended that this General Design Memorandum be approved as a basis to prepare plans and specifications for the Project Plan as described in paragraphs 13, 14, and 15. This is contingent on local interests satisfying all of the requirements of local cooperation described in paragraphs 8, 9, and 10.



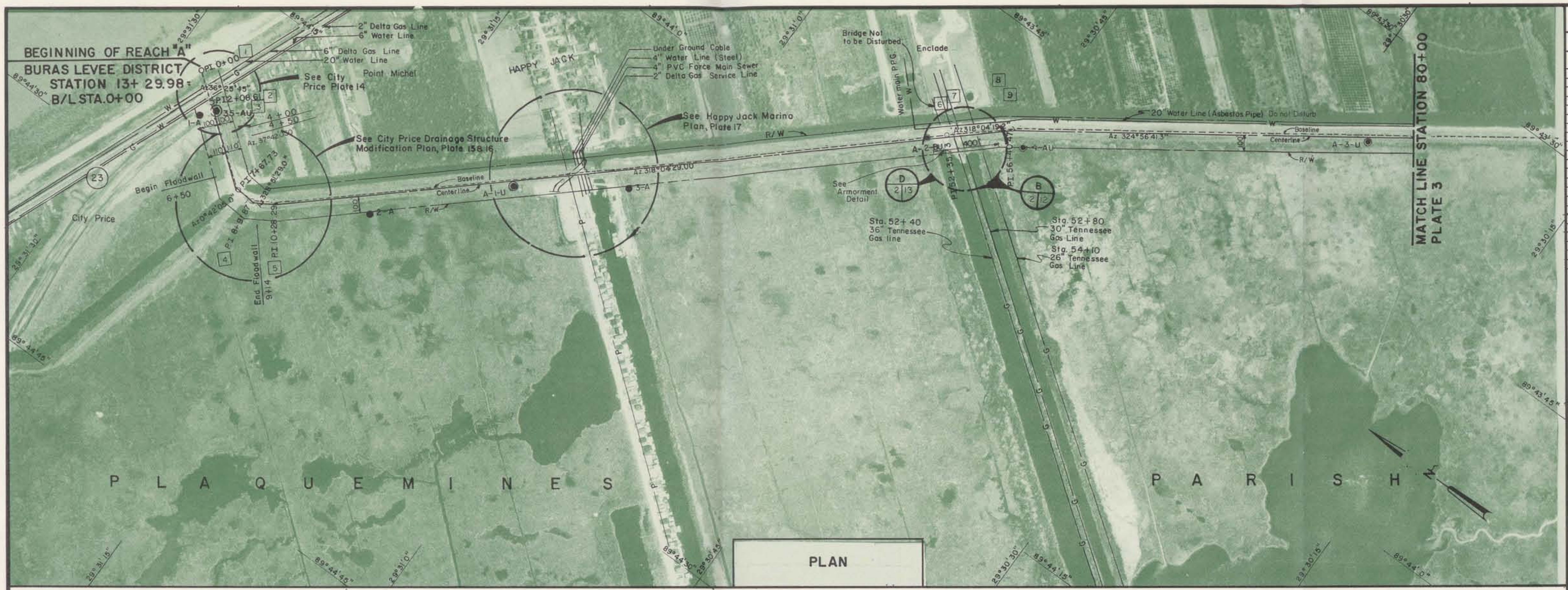


REACH "A"
CITY PRICE TO TROPICAL BEND
PLAQUEMINES PARISH, LA.

NEW ORLEANS TO VENICE, LA.
DESIGN MEMORANDUM NO. 1 - GENERAL DESIGN
SUPPLEMENT NO. 5
REACH A—CITY PRICE TO TROPICAL BEND
GENERAL PLAN, INDEX AND VICINITY MAP

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

AUGUST 1967 FILE NO. H-2-30260



	CENTERLINE	
	OFFSET FROM BASELINE	
	STATIONS	DISTANCE
1	0+00	0.00'
2	2+08.61	0.00'
3	2+67.73	0.00'
4	8+91.87	12.00'
5	10+28.29	12.02'
6	52+30	12.00'
7	52+97.79	11.54'
8	55+97.78	9.42'
9	56+50	8.00'

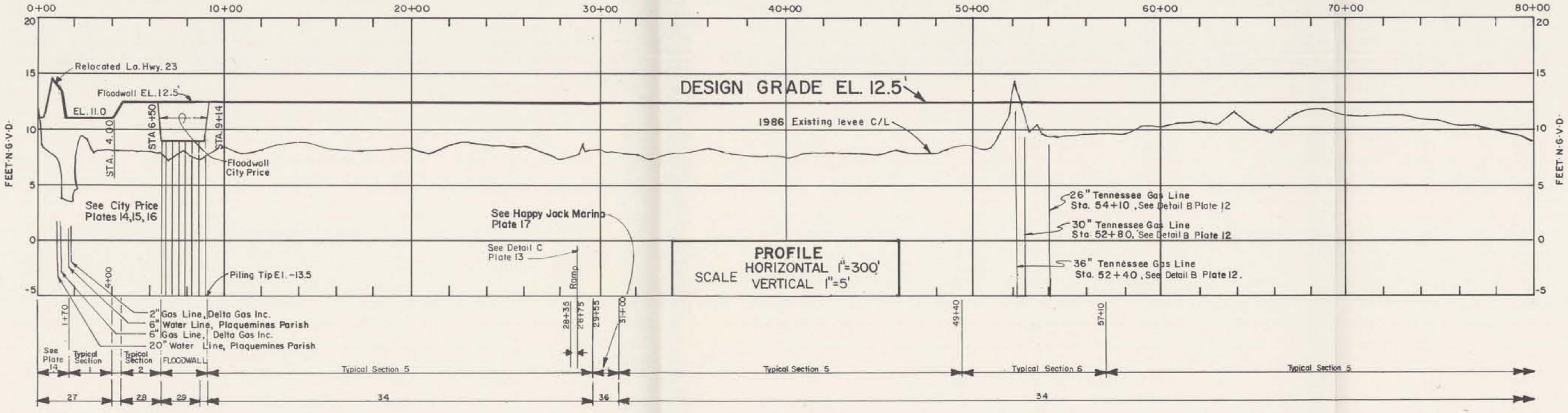
LEGEND: [1] Denotes ℄ offset point ⊥ to Baseline Azimuth shown.
- Denotes general type soil boring.
- Denotes Undisturbed soil boring.

SCALE IN FEET

300 0 300 600 900

NOTES:

INSIDE THE PLAN AREA, POLYCONIC PROJECTION-1927 NORTH AMERICAN DATUM IS SHOWN BY SOLID TICKS. PREPARED FROM AERIAL PHOTOS FLOWN FEBRUARY 1978.



REVISION	DATE	DESCRIPTION	BY

NEW ORLEANS TO VENICE, LA.

DESIGN MEMORANDUM NO. 1 - GENERAL DESIGN SUPPLEMENT NO. 5

REACH A - CITY PRICE TO TROPICAL BEND

PLAN AND PROFILE

STA. 0+00 TO STA. 80+00

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

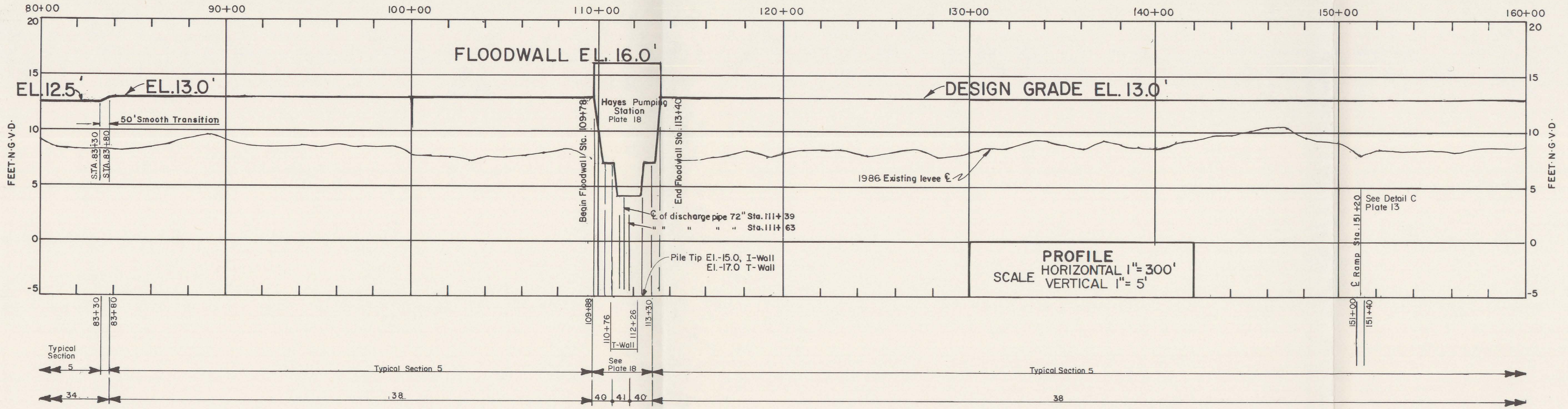
DATE AUGUST 1987 FILE NO. H-2-30260

CENTERLINE		
OFFSET FROM BASELINE		
	STATIONS	DISTANCE
10	108+60	15.00'
11	108+99.29	14.87'
12	109+99.29	14.32'
13	110+60	15.00'

LEGEND
- [1] Denotes ℄ offset point ⊥ to Baseline Azimuth shown.
- ● Denotes general type soil boring.
- ◉ Denotes Undisturbed soil boring.

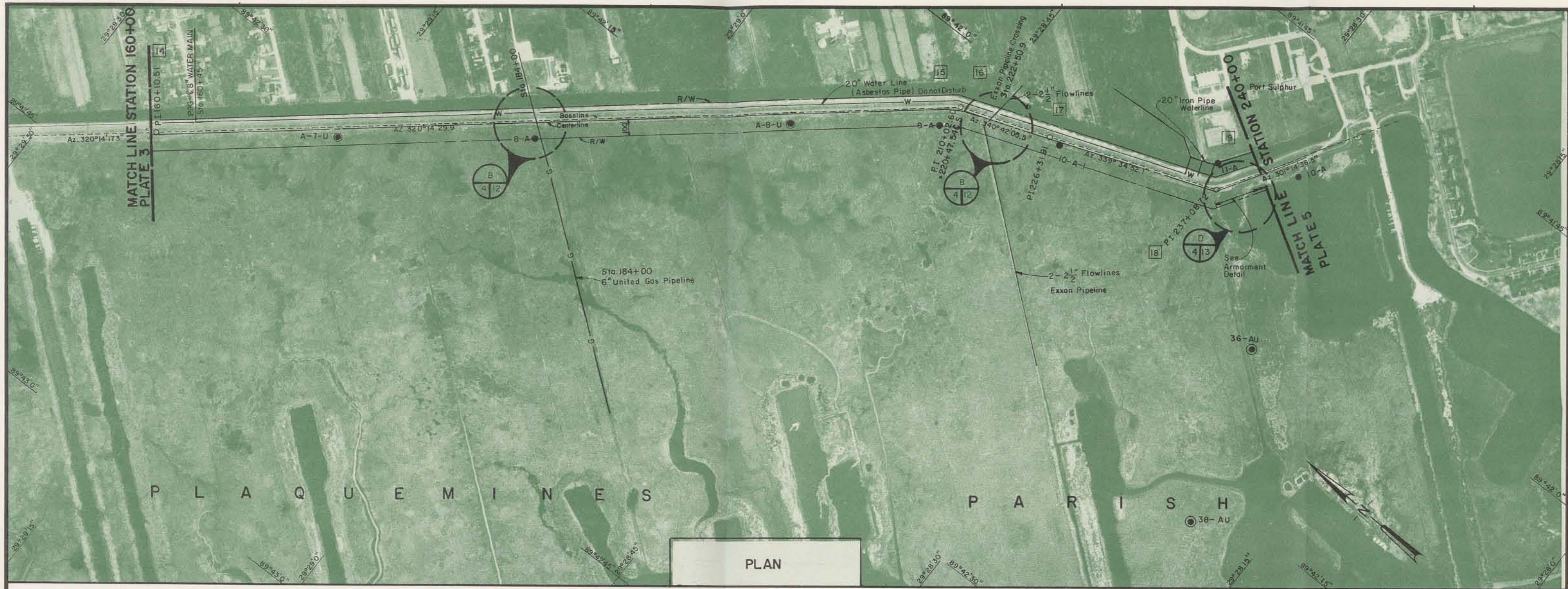
SCALE IN FEET
300 0 300 600 900

NOTES:
INSIDE THE PLAN AREA, POLYCONIC PROJECTION - 1927 NORTH AMERICAN DATUM IS SHOWN BY SOLID TICKS. PREPARED FROM AERIAL PHOTOS FLOWN FEBRUARY, 1978.

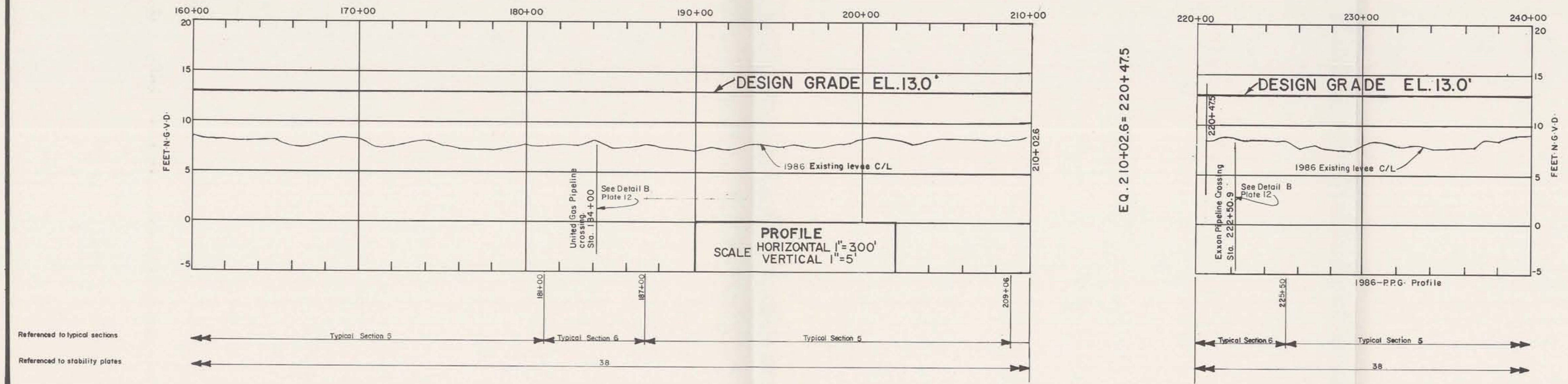


REVISION	DATE	DESCRIPTION	BY

NEW ORLEANS TO VENICE, LA.
DESIGN MEMORANDUM NO. 1 - GENERAL DESIGN SUPPLEMENT NO. 5
REACH A - CITY PRICE TO TROPICAL BEND
PLAN AND PROFILE
STA. 80+00 TO STA. 160+00
U. S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
DATE AUGUST 1987 FILE NO. H-2-30260



PLAN



PROFILE

SCALE HORIZONTAL 1"=300'
VERTICAL 1"=5'

CENTERLINE

OFFSET FROM BASELINE

	STATIONS	DISTANCE
14	160+10.51	13.00'
15	209+00	8.00'
16	221+00	12.00'
17	226+31.91	12.00'
18	237+08.72	12.00'
19	238+40.54	19.30'

LEGEND
- [1] Denotes ℄ offset point ⊥ to Baseline Azimuth shown.
- ● Denotes general type soil boring.
- ◉ Denotes Undisturbed soil boring.

SCALE IN FEET
300 0 300 600 900

NOTES:
INSIDE THE PLAN AREA, POLYCONIC PROJECTION-1927 NORTH AMERICAN DATUM IS SHOWN BY SOLID TICKS. PREPARED FROM AERIAL PHOTOS FLOWN FEBRUARY 1978.

REVISION	DATE	DESCRIPTION	BY

NEW ORLEANS TO VENICE, LA.
DESIGN MEMORANDUM NO. 1-GENERAL DESIGN
SUPPLEMENT NO. 5

REACH A – CITY PRICE TO TROPICAL BEND

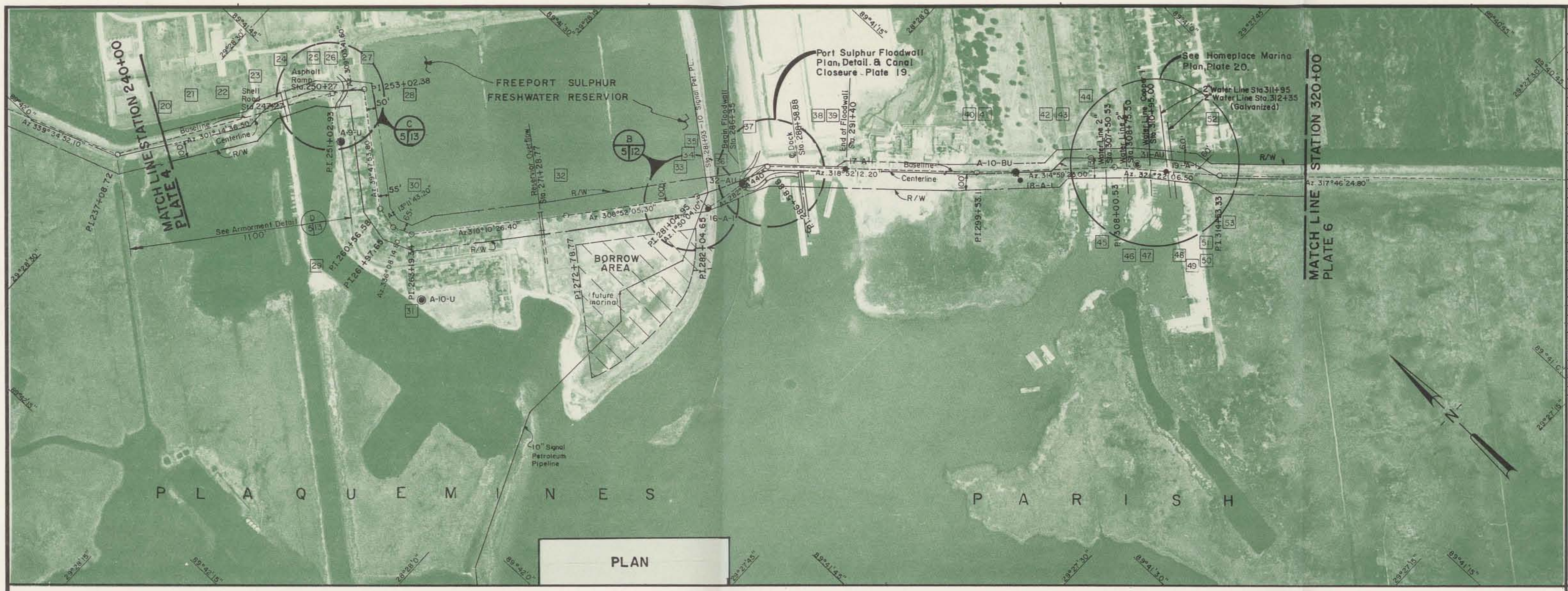
PLAN AND PROFILE

STA. 160+00 TO STA. 240+00

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

DATE AUGUST 1967 FILE NO. H-2-30260

PLATE 4



	STATIONS	DISTANCE
20	240+40.23	30.46'
21	242+39.92	41.61'
22	244+39.60	42.77'
23	246+29.00	-5.00' 1/
24	248+02.00	-40.00' 1/
25	250+11.73	-41.38' 1/
26	251+02.93	-9.07' 1/
27	253+02.27	-9.02' 1/
28	253+10	0.01'
29	260+56.57	0.01'
30	261+11.40	0.01'
31	263+19.33	0.01'
32	272+78.76	0.01'
33	281+04.94	0.01'
34	281+07.74	5.84'
35	281+51.06	95.97'
36	284+82.08	20.58'
37	286+57.00	25.00'
38	291+15.00	25.00'
39	291+18.00	12.00'
40	299+50.00	12.00'
41	299+60.00	12.00'
42	304+04.00	12.00'
43	305+07.00	-67.00' 1/
44	306+28.61	-62.43' 1/
45	307+28.54	-58.68' 1/
46	308+22.17	-58.01' 1/
47	310+22.00	-75.00' 1/
48	311+21.42	-72.58' 1/
49	312+68.00	-69.00' 1/
50	313+16.57	-46.85' 1/
51	314+07.55	-5.36' 1/
52	314+50.00	14.00'
53	314+70.00	14.00'

CENTERLINE OFFSET FROM BASELINE

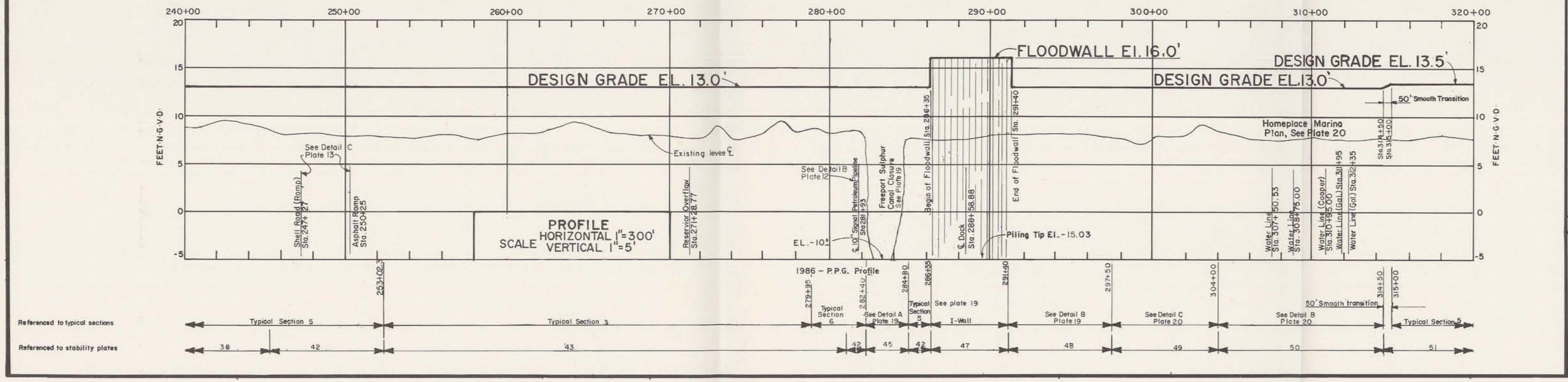
1/ Minus sign indicates offset to the protected side of the Baseline

LEGEND: [1] Denotes ℄ offset point ⊥ to Baseline Azimuth shown.
● Denotes general type soil boring.
◉ Denotes Undisturbed soil boring.

SCALE IN FEET
300 0 300 600 900

NOTES:

INSIDE THE PLAN AREA POLYCONIC PROJECTION-1927 NORTH AMERICAN DATUM IS SHOWN BY SOLID TICKS, PREPARED FROM AERIAL PHOTOS FLOWN FEBRUARY 1978.



REVISION	DATE	DESCRIPTION	BY

NEW ORLEANS TO VENICE, LA.

DESIGN MEMORANDUM NO. 1 - GENERAL DESIGN
SUPPLEMENT NO. 5

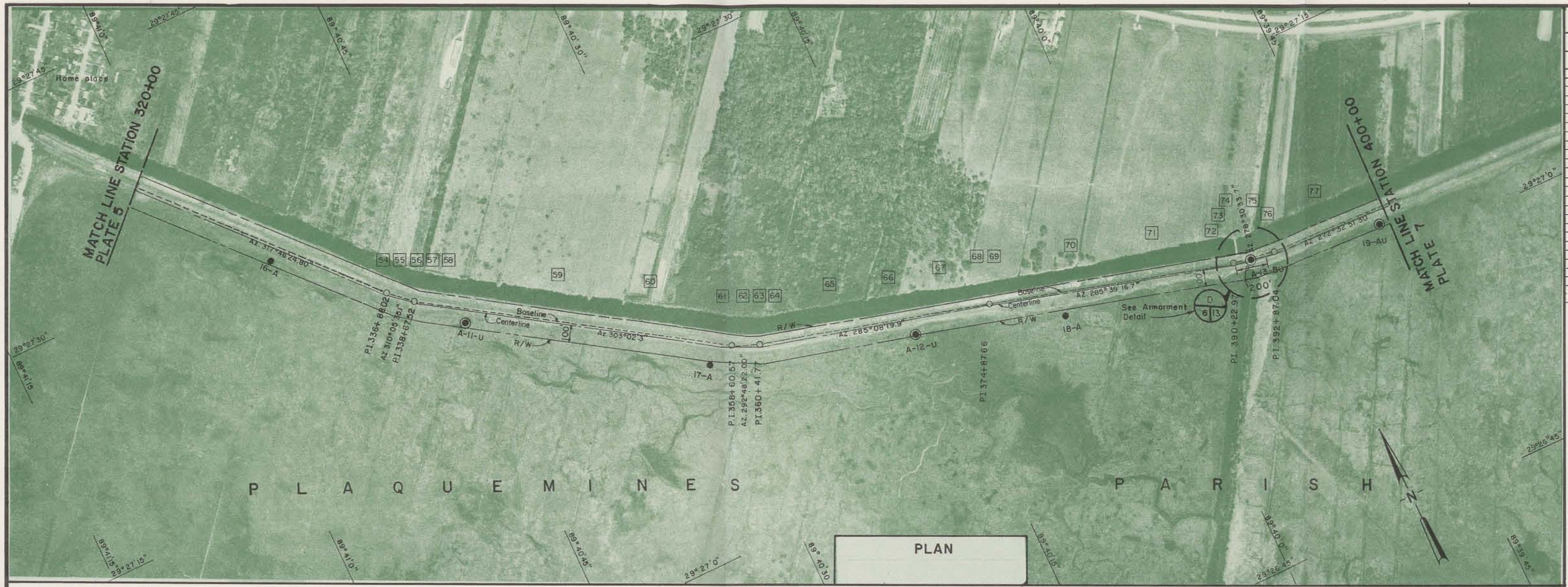
REACH A - CITY PRICE TO TROPICAL BEND

PLAN AND PROFILE

STA. 240+00 TO STA. 320+00

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

DATE AUGUST 1987 FILE NO. H-2-30260

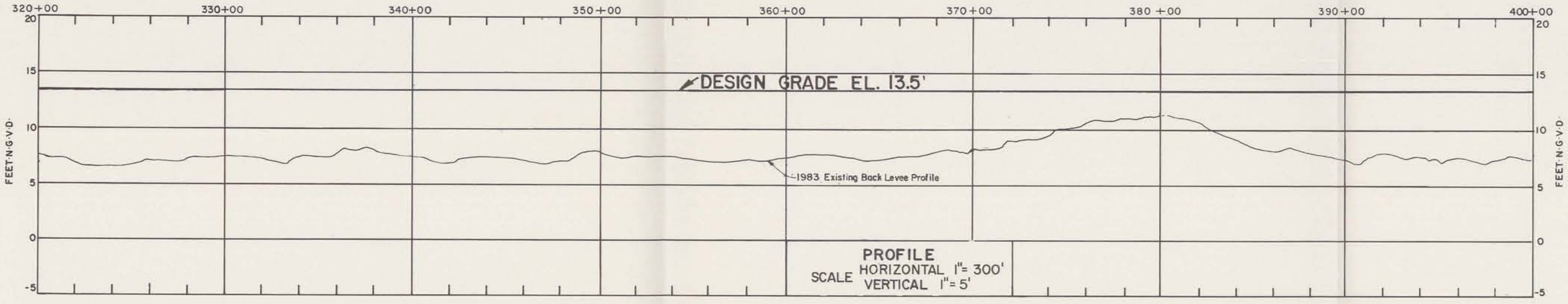


CENTERLINE		
OFFSET FROM BASELINE		
	STATIONS	DISTANCE
54	336+50.00	14.00'
55	337+00.94	9.23'
56	338+00.93	10.06'
57	338+99.34	14.91'
58	339+00	15.00'
59	345+99.33	16.47'
60	351+99.33	17.74'
61	357+99.33	19.00'
62	358+96.84	11.75'
63	359+96.77	15.59'
64	360+50.00	19.00'
65	364+9425	15.19'
66	368+94.24	11.76'
67	371+9422	9.19'
68	374+50.00	7.00'
69	375+00.00	7.00'
70	380+94.27	9.38'
71	385+94.27	11.38'
72	390+00.00	13.00'
73	390+92.82	11.45'
74	391+92.81	12.94'
75	392+91.27	14.96'
76	393+00.00	16.00'
77	396+91.21	15.76'

LEGEND
- [1] Denotes ℄ offset point ⊥ to Baseline Azimuth shown.
- ● Denotes general type soil boring.
- ◉ Denotes Undisturbed soil boring.

SCALE IN FEET
300 0 300 600 900

NOTES:
INSIDE THE PLAN AREA, POLYCONIC PROJECTION-1927 NORTH AMERICAN DATUM IS SHOWN BY SOLID TICKS. PREPARED FROM AERIAL PHOTOS FLOWN FEBRUARY 1978.



PROFILE
SCALE HORIZONTAL 1"= 300'
VERTICAL 1"= 5'

Referenced to typical sections — Typical Section 5

Referenced to stability plates — 51

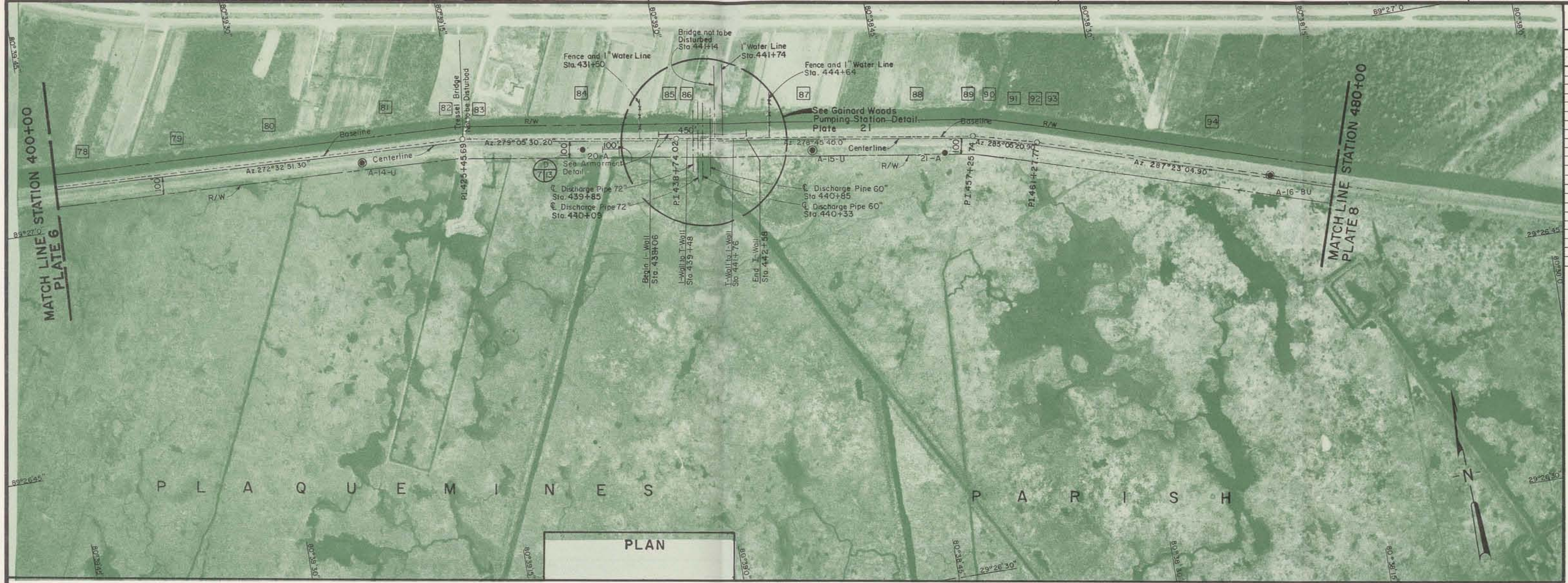
REVISION	DATE	DESCRIPTION	BY

NEW ORLEANS TO VENICE, LA.
DESIGN MEMORANDUM NO. 1 - GENERAL DESIGN
SUPPLEMENT NO. 5

REACH A - CITY PRICE TO TROPICAL BEND
PLAN AND PROFILE
STA.320+00 TO STA.400+00

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

DATE AUGUST 1987 FILE NO. H-2-30260

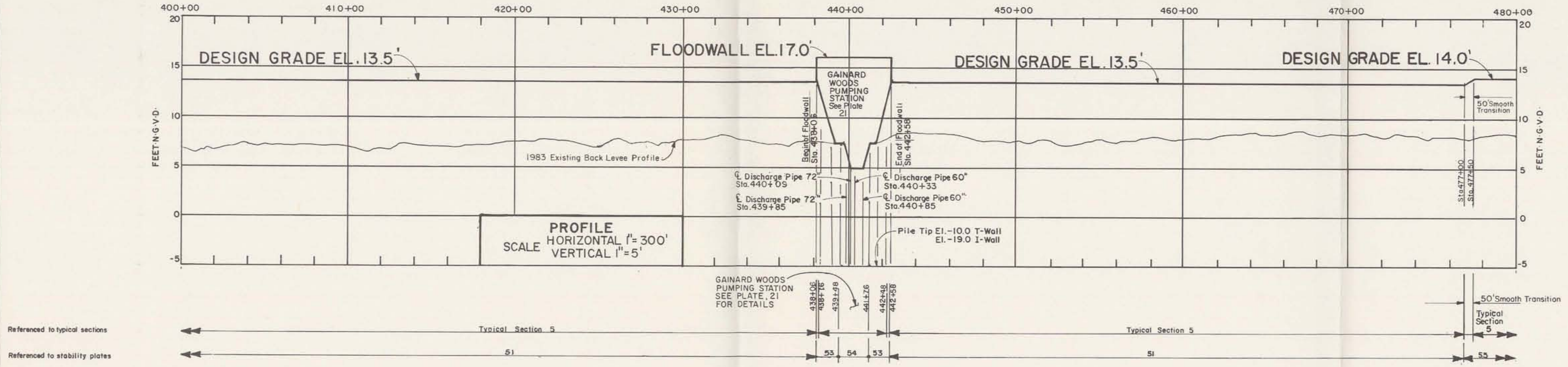


CENTERLINE		
OFFSET FROM BASELINE		
	STATIONS	DISTANCE
78	401+91.21	15.44'
79	407+91.21	15.07'
80	413+91.21	14.69'
81	420+91.21	14.26'
82	425+00	14.00'
83	426+00	14.00'
84	432+92.96	12.89'
85	438+50	12.00'
86	439+00	12.00'
87	446+92.89	13.32'
88	453+92.89	14.49'
89	457+00	15.00'
90	458+00	15.00'
91	460+00	15.00'
92	460+94.65	16.19'
93	461+50.00	16.00'
94	471+95.31	15.08'

LEGEND: [1] Denotes ℄ offset point ⊥ to Baseline Azimuth shown.
- ● Denotes general type soil boring.
- ◉ Denotes Undisturbed soil boring.

SCALE IN FEET

300 0 300 600 900



NOTES:

INSIDE THE PLAN AREA POLYCONIC PROJECTION-1927 NORTH AMERICAN DATUM IS SHOWN BY SOLID TICKS. PREPARED FROM AERIAL PHOTOS FLOWN FEBRUARY, 1978.

REVISION	DATE	DESCRIPTION	BY

NEW ORLEANS TO VENICE, LA.

DESIGN MEMORANDUM NO. 1 - GENERAL DESIGN SUPPLEMENT NO. 5

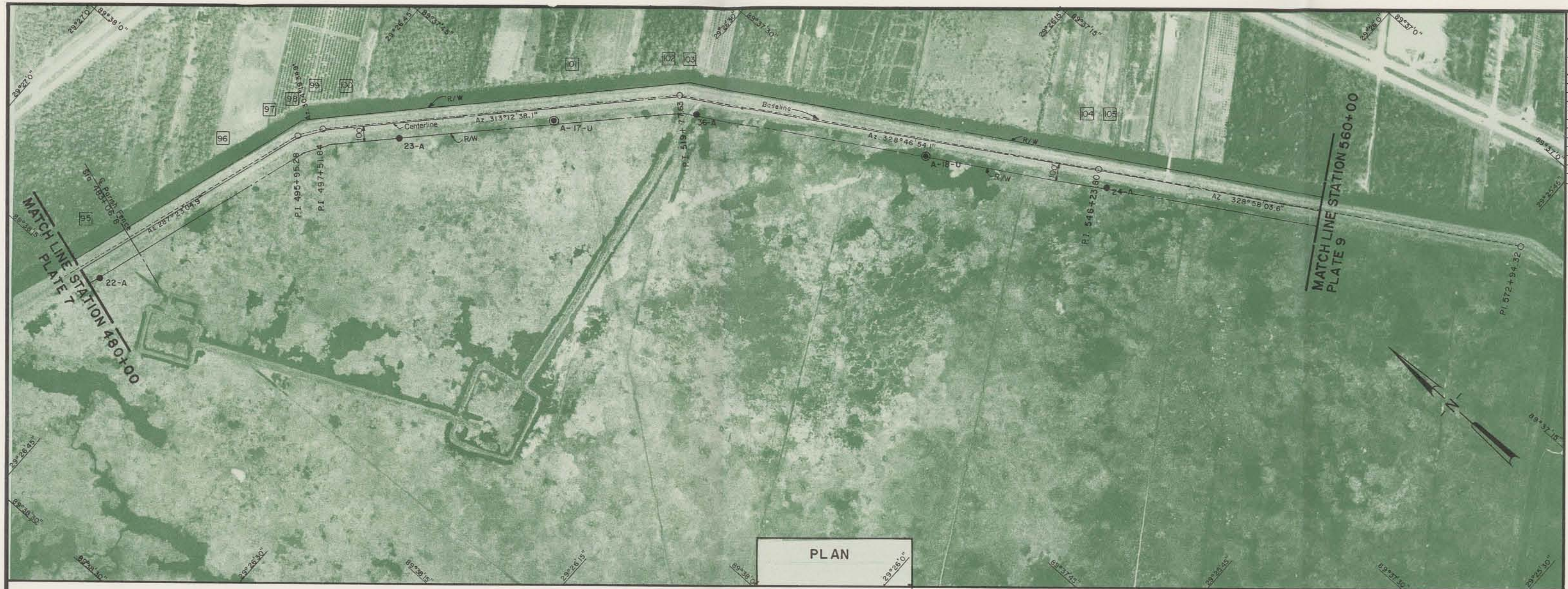
REACH A - CITY PRICE TO TROPICAL BEND

PLAN AND PROFILE

STA. 400+00 TO STA. 480+00

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

DATE AUGUST 1987 FILE NO. H-2-30260



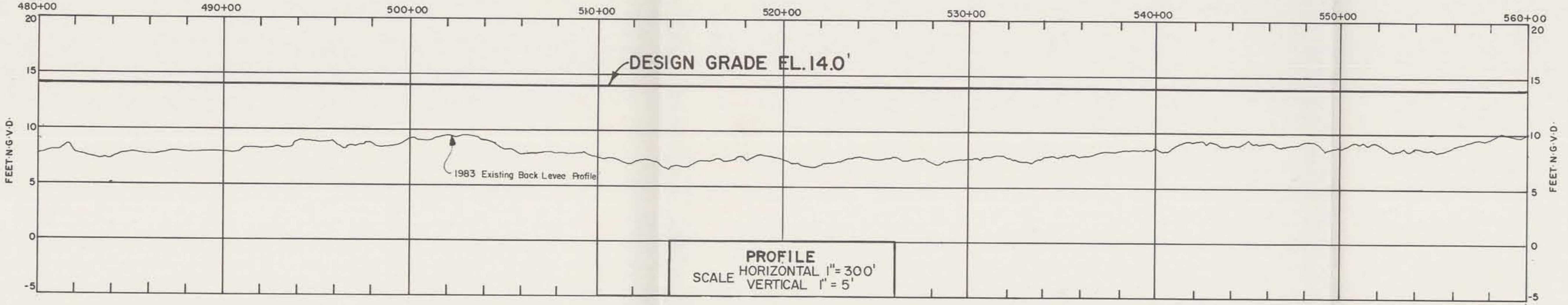
CENTERLINE		
OFFSET FROM BASELINE		
STATIONS		DISTANCE
95	481+95.31	14.20'
96	491+95.31	13.31'
97	495+50	13.00'
98	496+00.93	22.18'
99	497+00.64	14.57'
100	499+01.95	9.00'
101	511+01.96	9.00'
102	519+70.00	9.00'
103	520+00.00	10.00'
104	546+00.00	10.00'
105	546+50.00	8.00'

LEGEND
- [1] Denotes ℄ offset point ⊥ to Baseline Azimuth shown.
- ● Denotes general type soil boring.
- ◉ Denotes Undisturbed soil boring.

SCALE IN FEET
300 0 300 600 900

NOTES:

INSIDE THE PLAN AREA POLYCONIC PROJECTION-1927 NORTH AMERICAN DATUM IS SHOWN BY SOLID TICKS. PREPARED FROM AERIAL PHOTOS FLOWN FEBRUARY, 1978.



Referenced to typical sections — Typical Section 5

Referenced to stability plates — 55

REVISION	DATE	DESCRIPTION	BY

NEW ORLEANS TO VENICE, LA.

DESIGN MEMORANDUM NO. 1-GENERAL DESIGN
SUPPLEMENT NO. 5

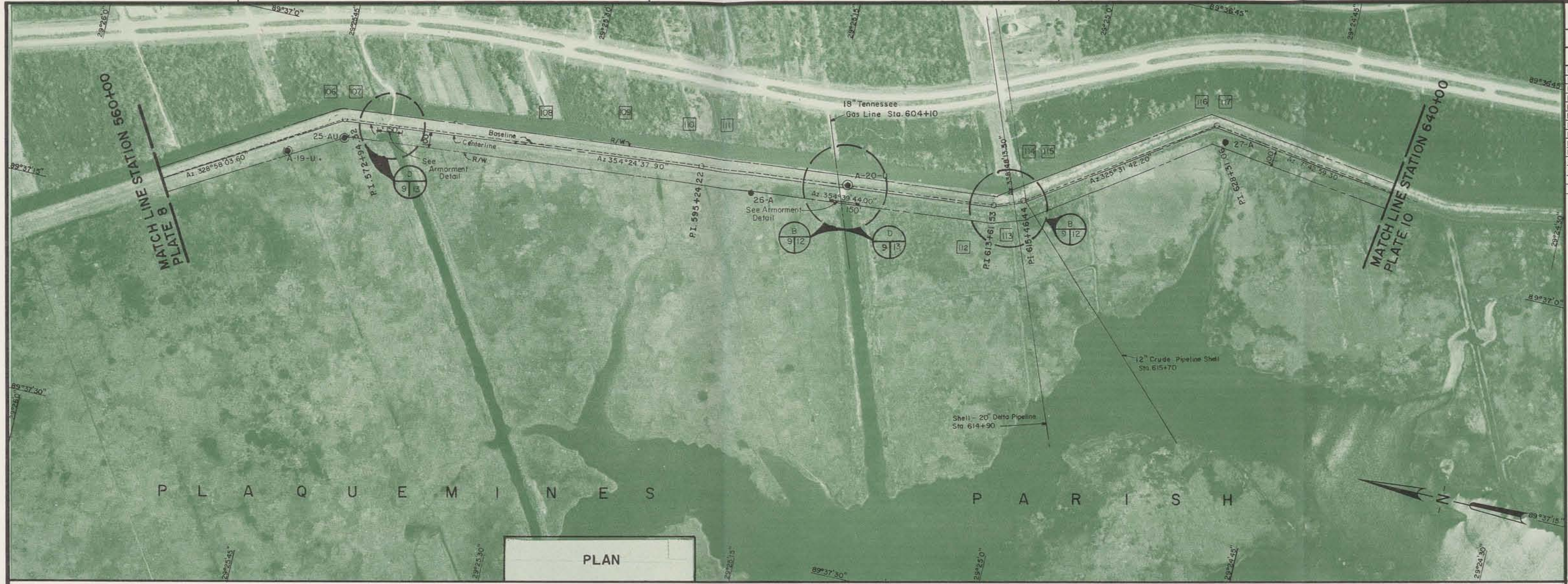
REACH A – CITY PRICE TO TROPICAL BEND

PLAN AND PROFILE

STA.480+00 TO STA.560+00

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

DATE AUGUST 1987 FILE NO. H-2-30260



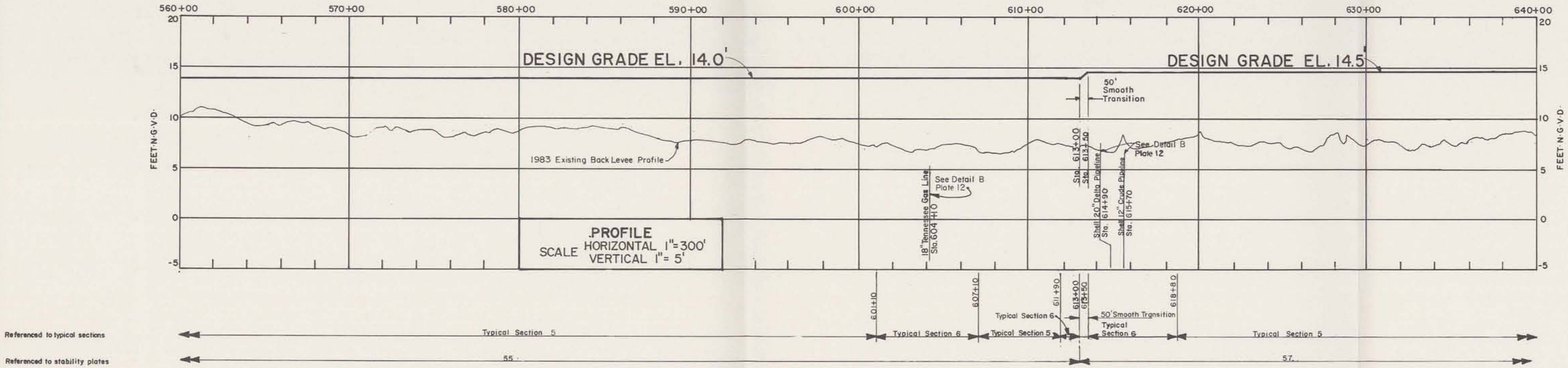
CENTERLINE		
OFFSET FROM BASELINE		
	STATIONS	DISTANCE
106	572+90.00	8.00'
107	573+00.00	10.00'
108	585+08.42	11.73'
109	590+08.42	12.44'
110	595+08.41	14.11'
111	596+50.00	15.00'
112	613+50.00	15.00'
113	614+04.81	11.16'
114	615+04.81	10.96'
115	615+50	12.00'
116	628+00	12.00'
117	628+50	14.00'

LEGEND
- [1] Denotes ℄ offset point ⊥ to Baseline Azimuth shown.
- ● Denotes general type soil boring.
- ◉ Denotes Undisturbed soil boring.

SCALE IN FEET
300 0 300 600 900

NOTES:

INSIDE THE PLAN AREA POLYCONIC PROJECTION-1927 NORTH AMERICAN DATUM IS SHOWN BY SOLID TICKS, PREPARED FROM AERIAL PHOTOS FLOWN FEBRUARY 1978.



REVISION	DATE	DESCRIPTION	BY

NEW ORLEANS TO VENICE, LA.

DESIGN MEMORANDUM NO. 1 - GENERAL DESIGN SUPPLEMENT NO. 5

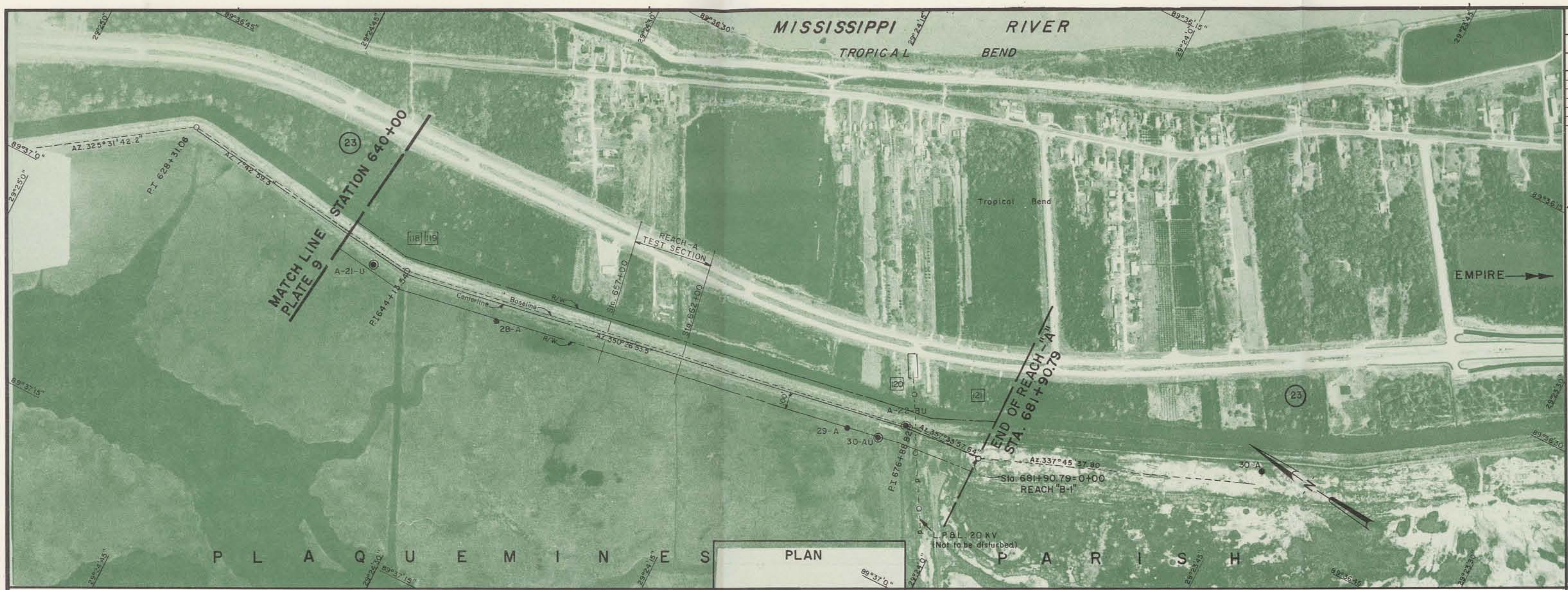
REACH A - CITY PRICE TO TROPICAL BEND

PLAN AND PROFILE

STA. 560+00 TO STA. 640+00

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

DATE AUGUST 1987 FILE NO. H-2-30260

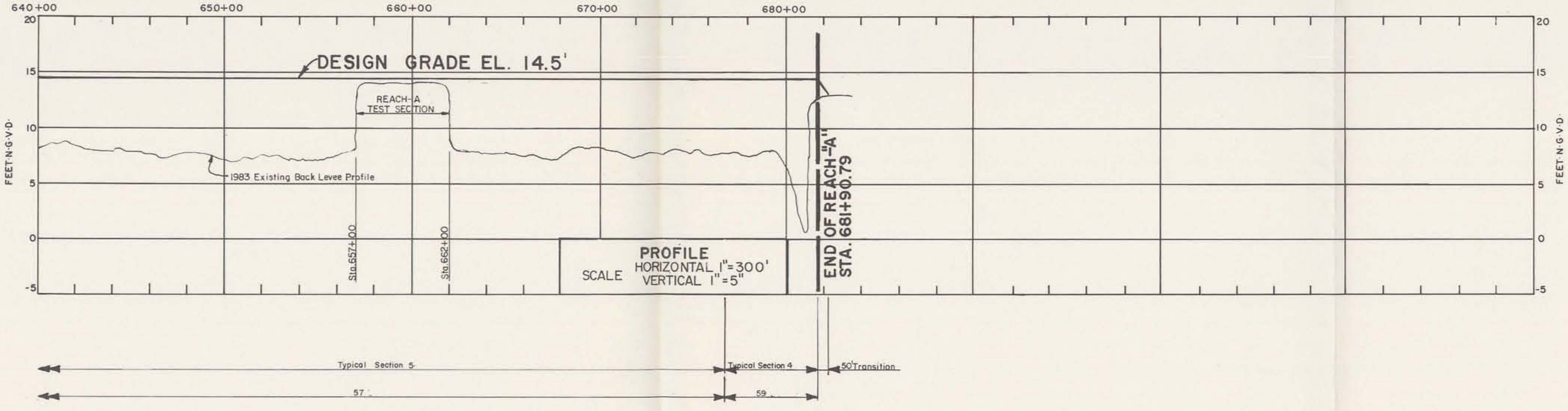


	CENTERLINE OFFSET FROM BASELINE	
	STATIONS	DISTANCE
118	644+00	14.00'
119	645+00	20.00'
120	676+80	20.00'
121	681+90.8	0.0

LEGEND: [1] Denotes ℄ offset point ⊥ to Baseline Azimuth shown.
- ● Denotes general type soil boring.
- ◉ Denotes Undisturbed soil boring.

SCALE IN FEET

300 0 300 600 900



NOTES:

INSIDE THE PLAN AREA POLYCONIC PROJECTION-1927 NORTH AMERICAN DATUM IS SHOWN BY SOLID TICKS. PREPARED FROM AERIAL PHOTOS FLOWN FEBRUARY, 1978.

REVISION	DATE	DESCRIPTION	BY

NEW ORLEANS TO VENICE, LA.

DESIGN MEMORANDUM NO. 1 - GENERAL DESIGN SUPPLEMENT NO. 5

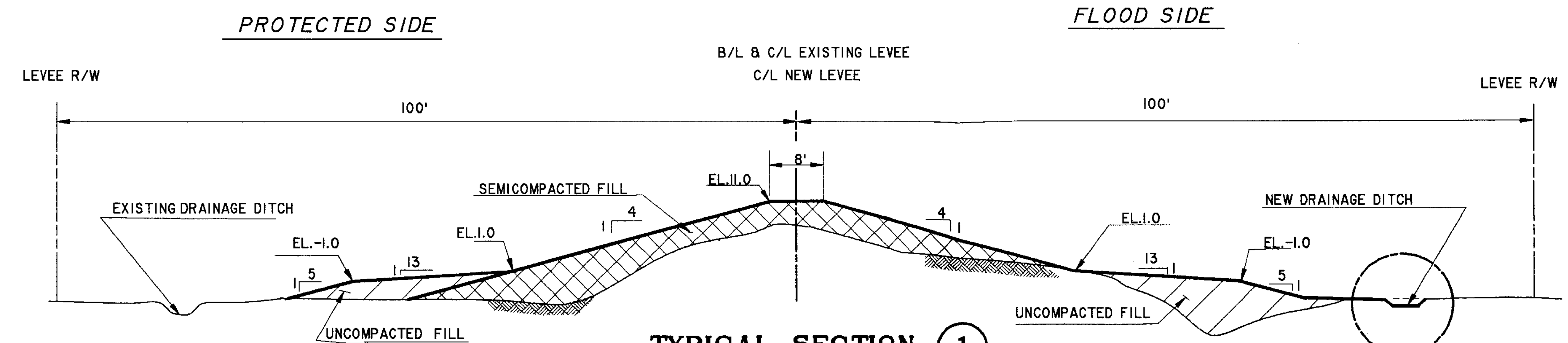
REACH A – CITY PRICE TO TROPICAL BEND

PLAN AND PROFILE

STA. 640+00 TO STA. 681+90.79

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

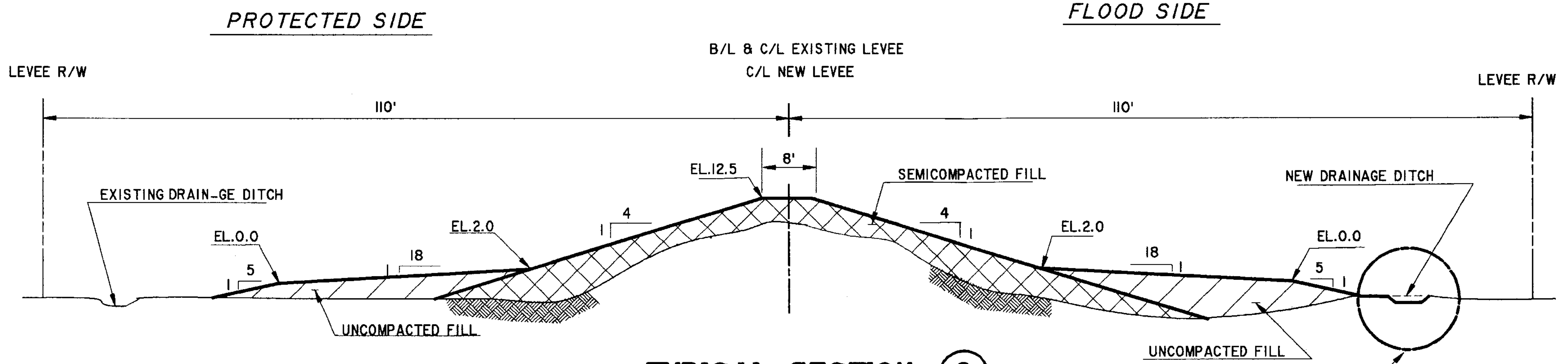
DATE AUGUST 1987 FILE NO. H-2-30260



TYPICAL SECTION 1

N.T.S.

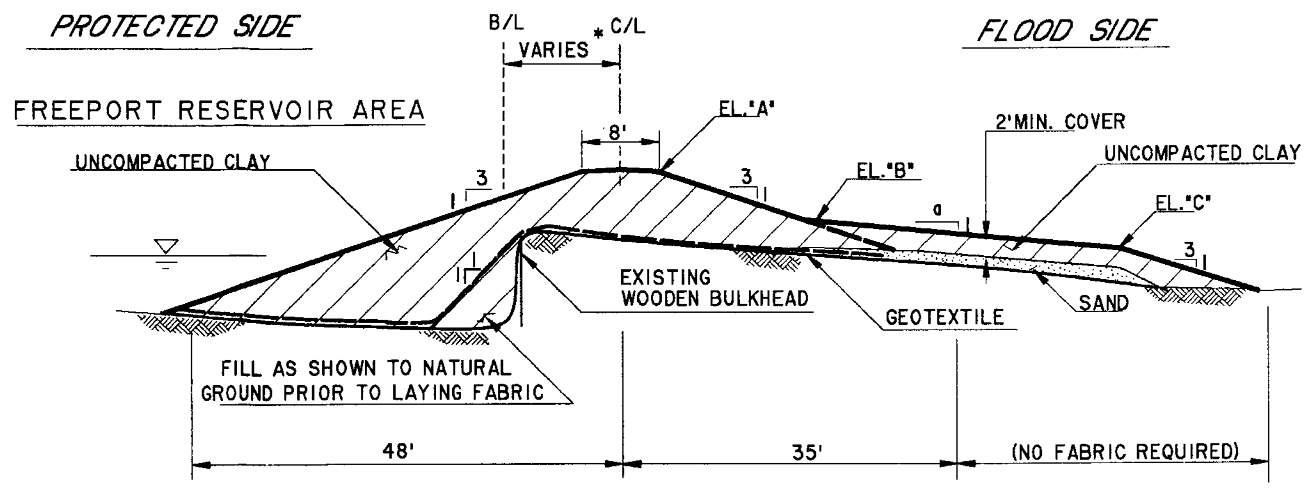
STA.1+70 TO STA.4+00



TYPICAL SECTION 2

N.T.S.

STA.4+50 TO STA.6+60



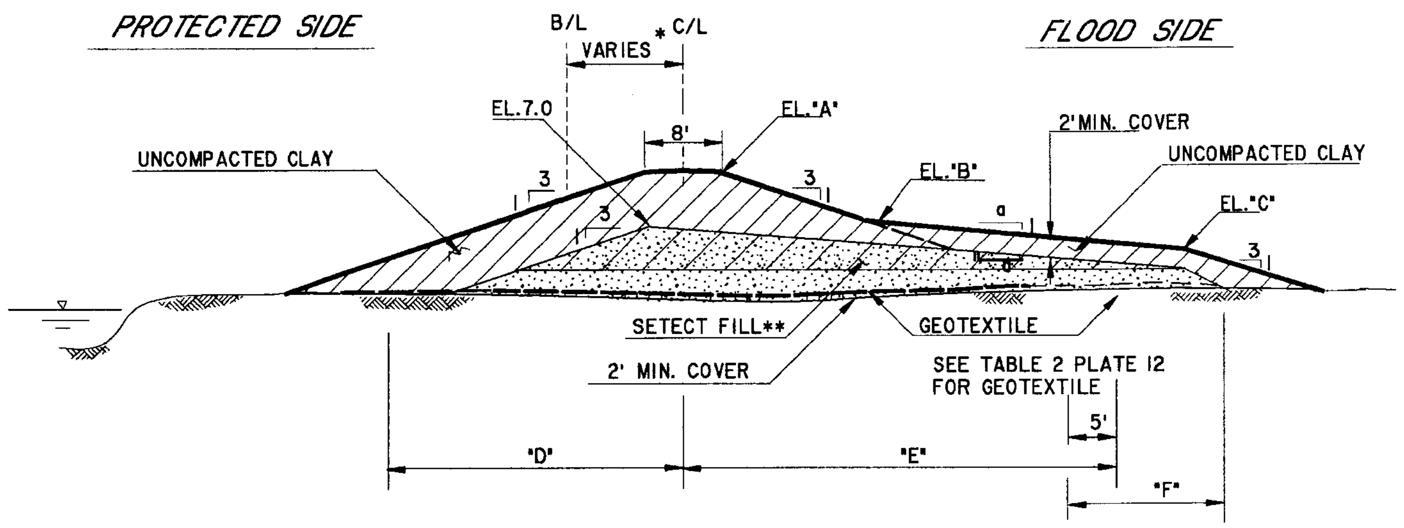
TYPICAL SECTION 3

N.T.S.

STA. 253+02 TO STA.282+65

SEE TABLE 1 PLATE 12 FOR ELEVATIONS

*SEE PLAN AND PROFILE FOR OFFSET DISTANCE



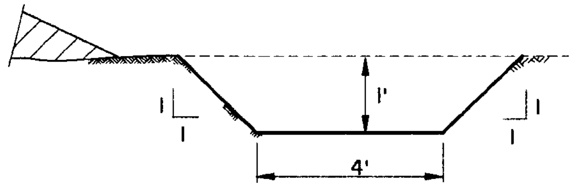
TYPICAL SECTION 4

N.T.S.

STA. 676+88 TO STA.681+90.79

SEE TABLE 1 PLATE 12 FOR ELEVATIONS

*SEE PLAN AND PROFILE FOR OFFSET DISTANCE
** SAND AND/OR CLAY



DETAIL A

N.T.S.

INTERNAL DRAINAGE DITCH

NEW ORLEANS TO VENICE, LA.

DESIGN MEMORANDUM NO.1-GENERAL DESIGN
SUPPLEMENT NO.5

REACH A-CITY PRICE TO TROPICAL BEND

TYPICAL SECTIONS

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

AUGUST 1987 H-2-30260

TABLE-1 ELEVATIONS

STATION	TYP CAL SECTION	"A"	"B"	"C"	"a"	REMARKS
0+00 TO 1+70	—	—	—	—	—	SEE PLATE 14 FOR LEVEE TIE AND RELOCATED HWY. 23
1+70 TO 4+00	1	—	—	—	—	SEE PLATE 14,15 & 16
4+50 TO 6+60	2	—	—	—	—	SEE PLATE 14,15 & 16
6+50 1/ TO 9+14 1/	—	—	—	—	—	SEE PLATE 15,16, CITY PRICE DRAINAGE STRUCTURE
9+04 TO 28+35	5	12.5	7.5	4.5	11.0	
28+35 TO 28+75	5	12.5	7.5	4.5	11.0	RAMP SEE DETAIL C PLATE 13
28+75 TO 29+55	5	12.5	7.5	4.5	11.0	
29+55 TO 31+00		12.5	7.5	4.5	11.0	SEE PLATE 17,HAPPY JACK MARINA
31+00 TO 49+40	5	12.5	7.5	4.5	11.0	
49+40 TO 57+10	6	12.5	7.5	4.5	11.0	SEE PLATE 12, PIPELINE RELOCATION
57+10 TO 83+30	5	12.5	7.5	4.5	11.0	
83+80 TO 109+88	5	13.0	7.5	5.0	12.0	
109+78 1/ TO 113+30 1/		—	—	—	—	SEE PLATES 18 & 21 HAYES CANAL PUMPING STATION
113+20 TO 151+00	5	13.0	7.5	5.0	12.0	
151+00 TO 151+40		13.0	7.5	5.0	12.0	RAMP SEE DETAIL C PLATE 13
151+40 TO 181+00	5	13.0	7.5	5.0	12.0	
181+00 TO 187+00	6	13.0	7.5	5.0	12.0	SEE PLATE 12, PIPELINE RELOCATION
187+00 TO 219+50	5	13.0	7.5	5.0	12.0	
219+50 TO 225+50	6	13.0	7.5	5.0	12.0	SEE PLATE 12, PIPELINE RELOCATION
225+50 TO 247+07	5	13.0	7.5	5.0	12.0	
247+07 TO 247+47	5	13.0	7.5	5.0	12.0	RAMP SEE DETAIL C PLATE 13
247+47 TO 250+05	5	13.0	7.5	5.0	12.0	
250+05 TO 250+45	5	13.0	7.5	5.0	12.0	RAMP SEE DETAIL C PLATE 13
250+45 TO 253+02	5	13.0	7.5	5.0	12.0	
253+02 TO 282+65	3	13.0	7.5	5.0	12.0	FREEPORT RESERVOIR AREA PLATE 11
282+65 TO 284+20		13.0	7.5	5.0	12.0	SEE PLATE 19 FREEPORT CANAL CLOSURE
284+20 TO 286+45	5	13.0	7.5	5.0	12.0	
286+35 1/ TO 291+40 1/		—	—	—	—	SEE PLATES 19 FREEPORT SULPHUR FLOODWALL
291+30 TO 297+50	5	13.0	7.5	5.0	12.0	SEE PLATES 19 FREEPORT SULPHUR FLOODWALL
297+50 TO 304+00	5	13.0	7.5	5.0	12.0	SEE PLATE 20 HOMEPLACE MARINA
304+00 TO 314+00	—	—	—	—	—	SEE PLATE 20 HOMEPLACE MARINA
314+00 TO 314+50	5	13.0	7.5	5.0	12.0	
315+00 TO 438+26	5	13.5	8.0	5.0	12.0	
438+16 1/ TO 442+48 1/		—	—	—	—	SEE PLATES 21 GAINARD WOODS PUMPING STATION
442+38 TO 477+00	5	13.5	8.0	5.0	12.0	
477+50 TO 601+10	5	14.0	8.5	5.5	12.0	
601+10 TO 607+10	6	14.0	8.5	5.5	12.0	SEE PLATE 12, PIPELINE RELOCATION
607+10 TO 611+90	5	14.0	8.5	5.5	12.0	
611+90 TO 613+00	6	14.0	8.5	5.5	12.0	
613+50 TO 618+70	6	14.5	8.5	5.5	12.0	
618+70 TO 676+90	5	14.5	8.5	5.5	12.0	
676+90 TO 681+90.76	4	14.5	8.5	5.5	12.0	TIE IN REACH B-1

1/ SHEETPILE OVERLAP INTO LEVEE SECTION

TABLE-2 GEOTEXTILE FABRIC WIDTHS AND STRENGTHS

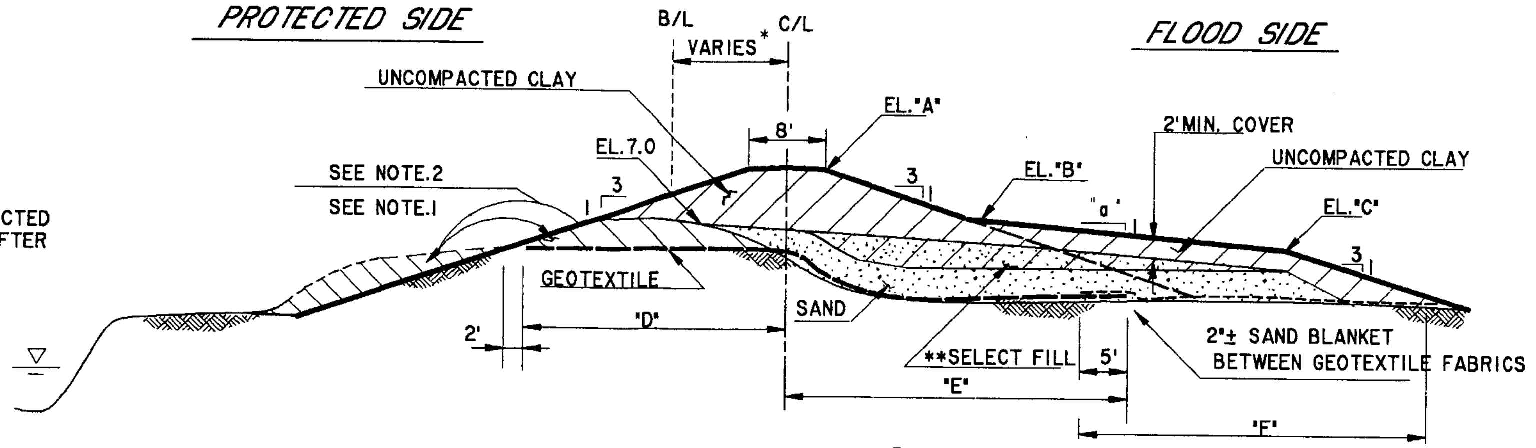
STABILITY PLATE NO	DESIGN GRADE OF LEVEE	MAIN LEVEE "D"&"E" WIDTH	PROTECTED SIDE C/L "D" WIDTH	FLOODSIDE C/L "E" WIDTH	WAVE BERM "F" WIDTH	WOVEN FABRIC STRENGTH * "(E&D)" MAIN LEVEE F.S. 1.3	"(E&D)" MAIN LEVEE △F.S. 1.5	"(F)"BERM F.S. 1.3	"(F)"BERM △F.S. 1.5	REMARKS
34	12.5	59.5	24.5	35.0	31.5	1080	1770	250	250	
36	12.5	59.5	24.5	35.0	31.5	1210	1860	250	250	HAPPY JACK MARINA
38	13.0	61.0	26.0	35.0	31.5	1240	1890	250	250	
43	13.0	62.5	26.0	35.0	31.5	1270	1860	250	250	
45	13.0	135.0	55.0	80.0	31.5	—	1250	250	250	FREEPORT CANAL CLOSURE
51	13.5	62.5	27.5	35.0	37.5	1300	1910	250	250	
55	14.0	64.0	29.0	35.0	33.0	1170	1840	250	250	
57	14.5	70.5	30.5	40.0	33.0	1550	2290	250	250	
59	14.5	70.5	30.5	40.0	33.0	1700	2420	250	250	ALIGNMENT AT LOWER END OF JOB

* NOTE: TEST PROCEDURE FOR LISTED STRENGTHS ASTMD 1682 GRAB TEST METHOD
△ TO ACHIEVE A FACTOR OF SAFTY (F.S.) OF 1.5 A DOUBLE LAYER OF FABRIC MAY BE USED

NOTES:
1. ALL CLAY SECTION IS TO BE CONSTRUCTED BETWEEN B/L STA. 244+60 & B/L STA.253+02 WITHOUT GEOTEXTILE BASE. NO DEGRADING IS REQUIRED.
2. DEGRADE EXISTING LEVEE TO ELEVATION 5.0 AND STOCKPILE THE MATERIAL ON THE PROTECTED SIDE SLOPE. RESTORE THE EXISTING LEVEE AFTER PLACING THE GEOTEXTILE FABRIC WITH THE STOCKPILED MATERIAL.
3. USE DOUBLE LAYER OF GEOTEXTILE TO MAINTAIN A 1.5 FACTOR OF SAFETY WITHIN 300' OF ALL HIGH PRESSURE PIPELINES AND STRUCTURES

* SEE PLAN & PROFILE PLATES FOR OFFSET DISTANCE

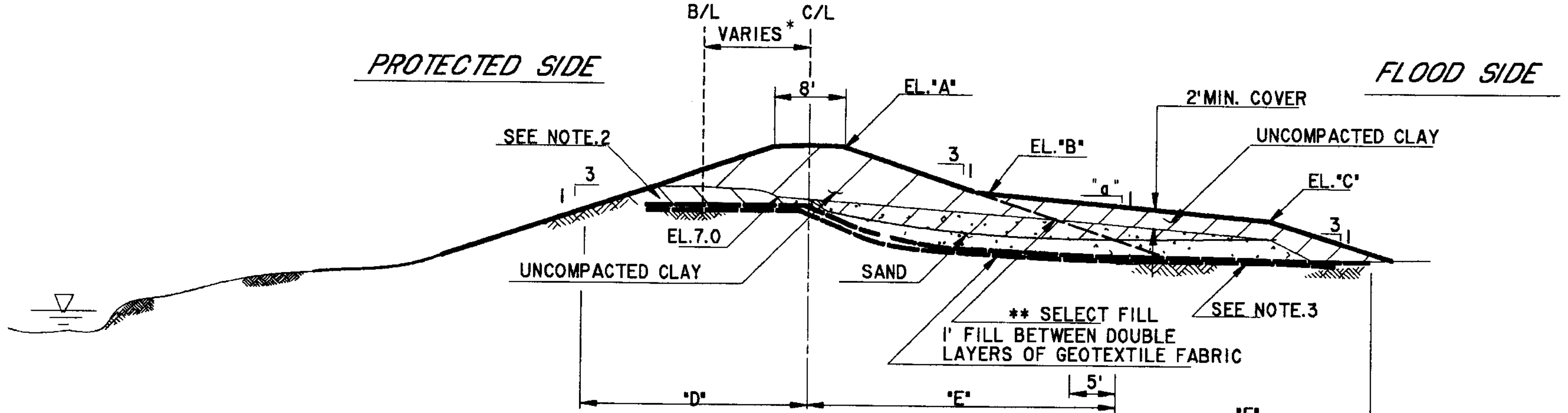
**SAND AND/OR CLAY



TYPICAL SECTION (5)

N.T.S.

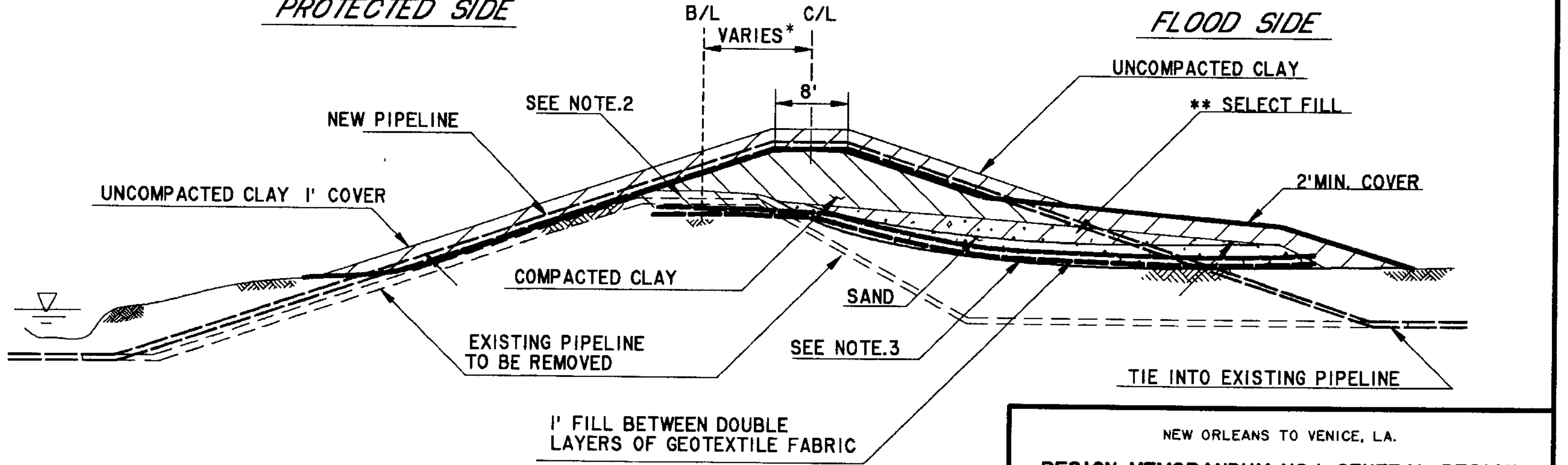
SEE TABLE 2 FOR GEOTEXTILE EMBEDMENT
SEE TABLE 1 FOR ELEVATIONS



TYPICAL SECTION (6)

N.T.S.

SEE TABLE 1 FOR ELEVATIONS



DETAIL (B)

N.T.S.

TYPICAL PIPELINE RELOCATION

NEW ORLEANS TO VENICE, LA.

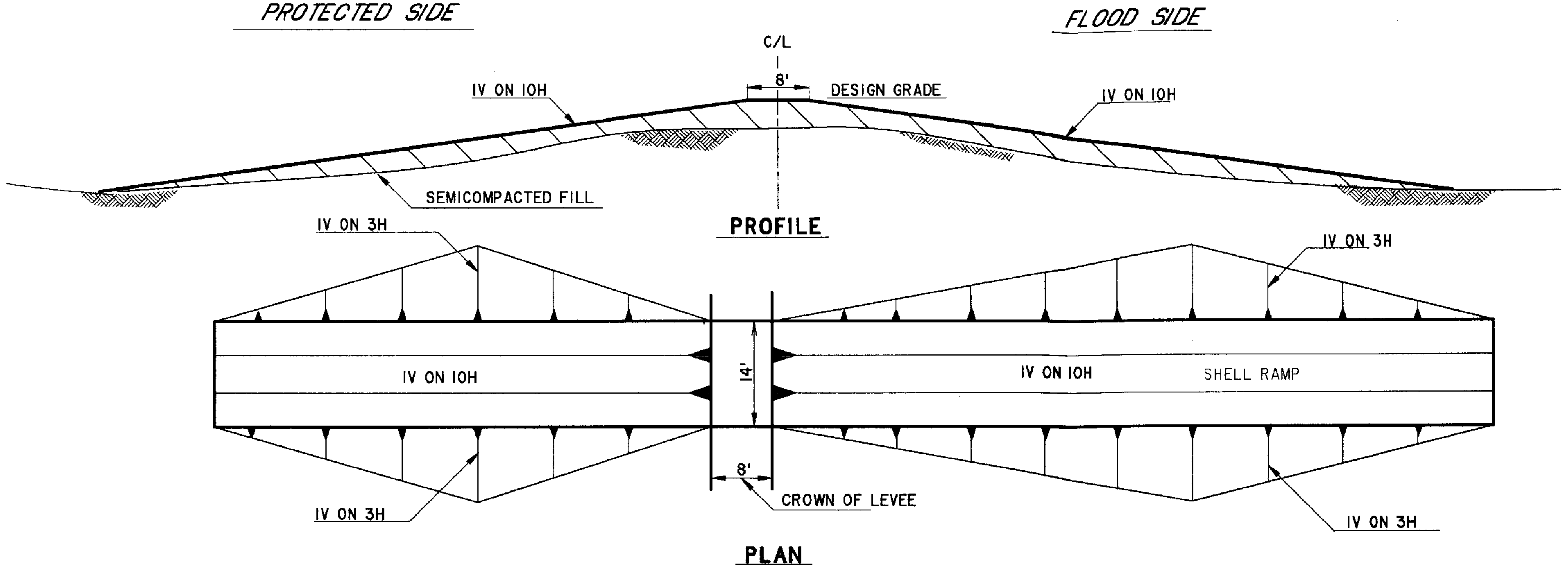
DESIGN MEMORANDUM NO.1-GENERAL DESIGN
SUPPLEMENT NO.5

REACH A-CITY PRICE TO TROPICAL BEND

TYPICAL SECTIONS AND TABLES

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

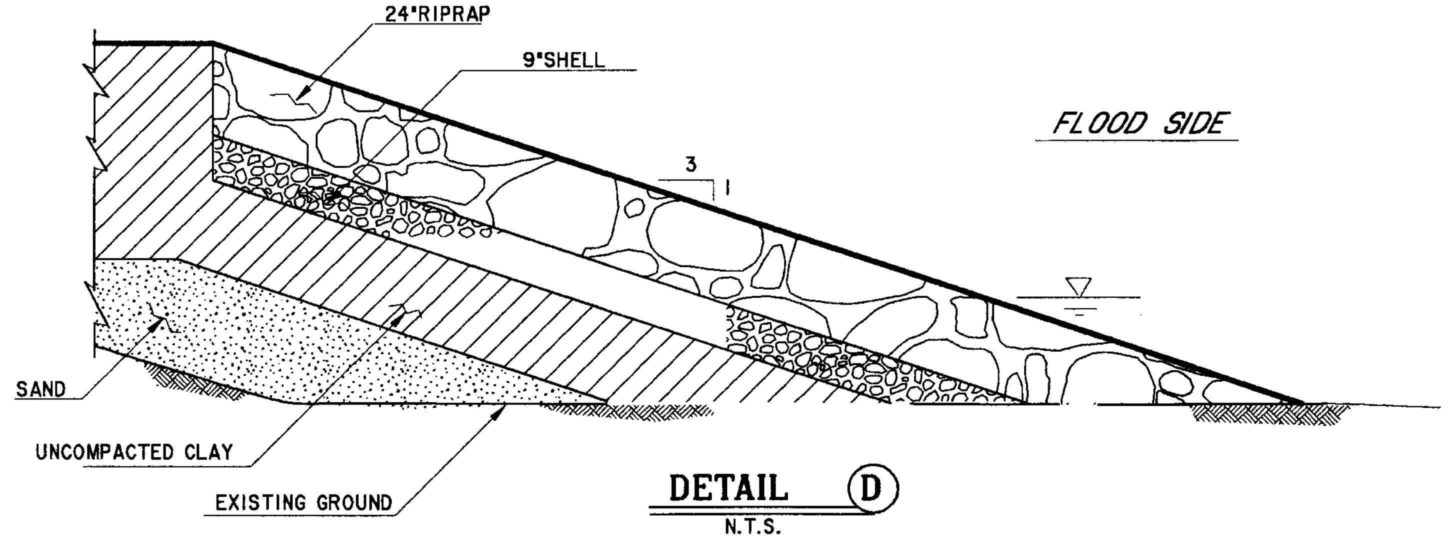
AUGUST 1987 H-2-30260



DETAIL (C)

N.T.S.

TYPICAL RAMP



DETAIL (D)

N.T.S.

TYPICAL ARMOR

SEE PLAN/PROFILE SHEETS FOR
EXACT LOCATION AND ARMORMENT LENGTHS PLATES 2,4-7 & 9.

NEW ORLEANS TO VENICE, LA.

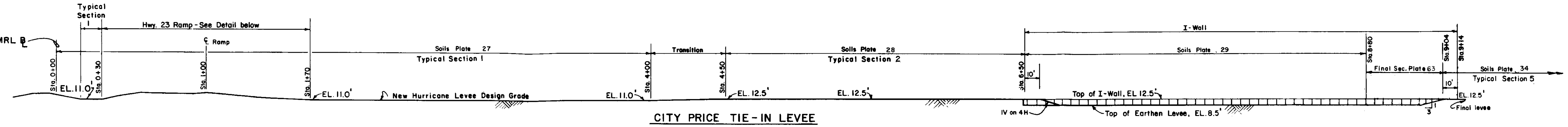
DESIGN MEMORANDUM NO.1-GENERAL DESIGN
SUPPLEMENT NO.5

REACH A-CITY PRICE TO TROPICAL BEND

DETAILS

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

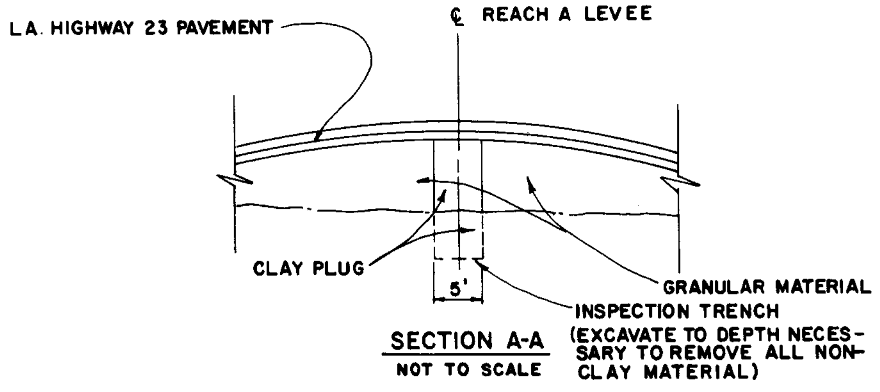
AUGUST 1987 H-2-30260



CITY PRICE TIE-IN LEVEE

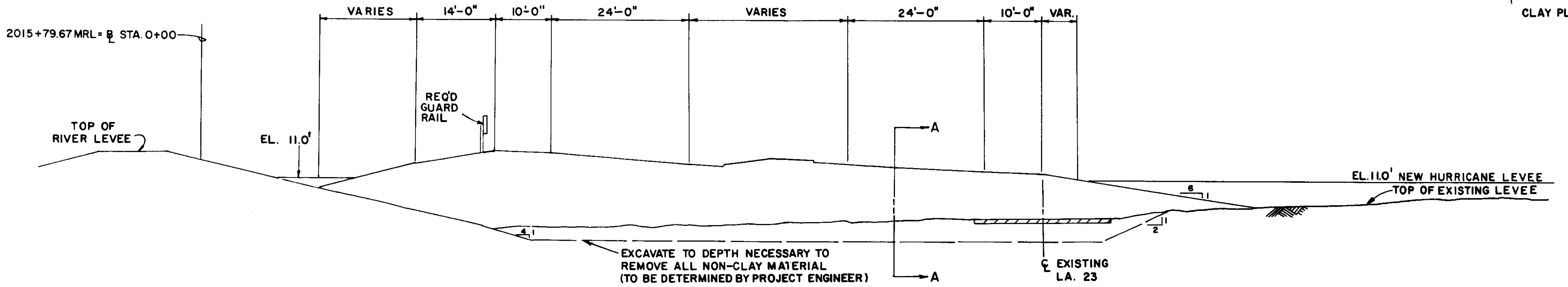
MAINLINE MISSISSIPPI RIVER LEVEE TO HURRICANE PROTECTION LEVEE

NOT TO SCALE



SECTION A-A

NOT TO SCALE



RELOCATED HWY. 23
TYPICAL FINISHED GRADE LINES

CITY PRICE

APPROX. STA. 1+00

NOT TO SCALE

NEW ORLEANS TO VENICE, LA.

DESIGN MEMORANDUM NO. 1-GENERAL DESIGN SUPPLEMENT NO.5

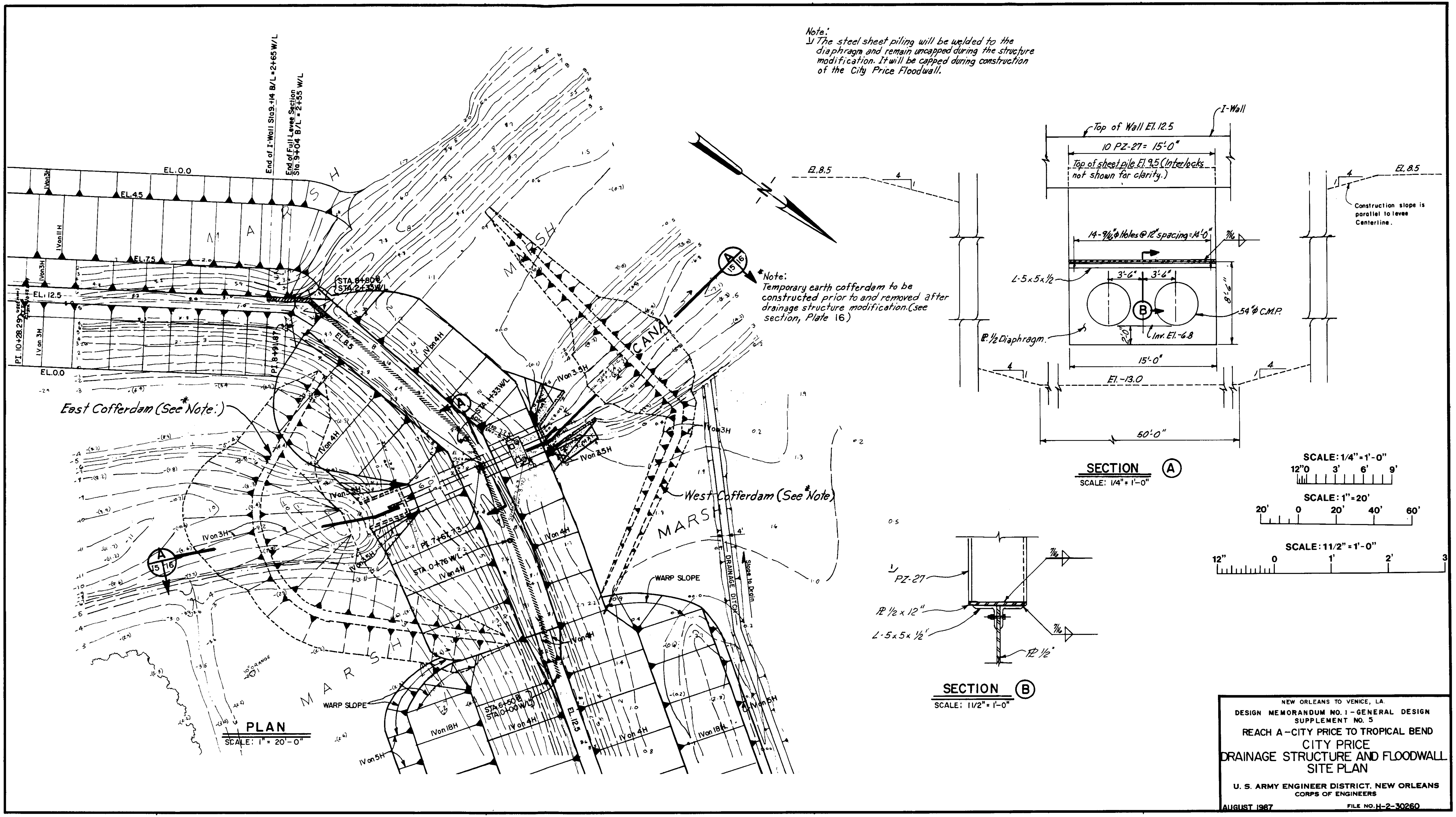
REACH A - CITY PRICE TO TROPICAL BEND

CITY PRICE DETAIL

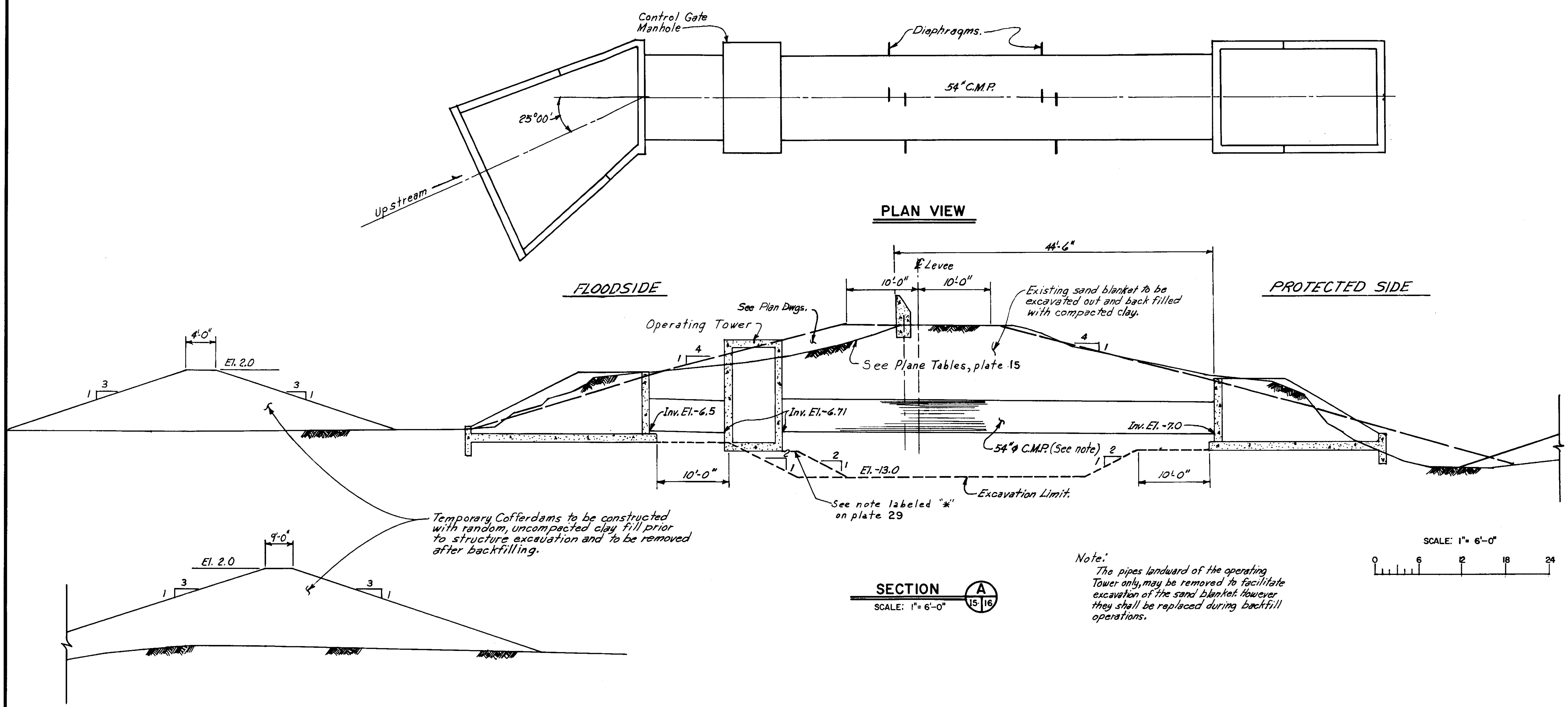
STA. 0+00 TO STA. 9+14

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

AUGUST 1987 FILE NO. H-2-30260



NEW ORLEANS TO VENICE, LA.
DESIGN MEMORANDUM NO. 1 - GENERAL DESIGN
SUPPLEMENT NO. 5
REACH A - CITY PRICE TO TROPICAL BEND
CITY PRICE
DRAINAGE STRUCTURE AND FLOODWALL
SITE PLAN
U. S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
AUGUST 1987 FILE NO. H-2-30260



NEW ORLEANS TO VENICE, LA

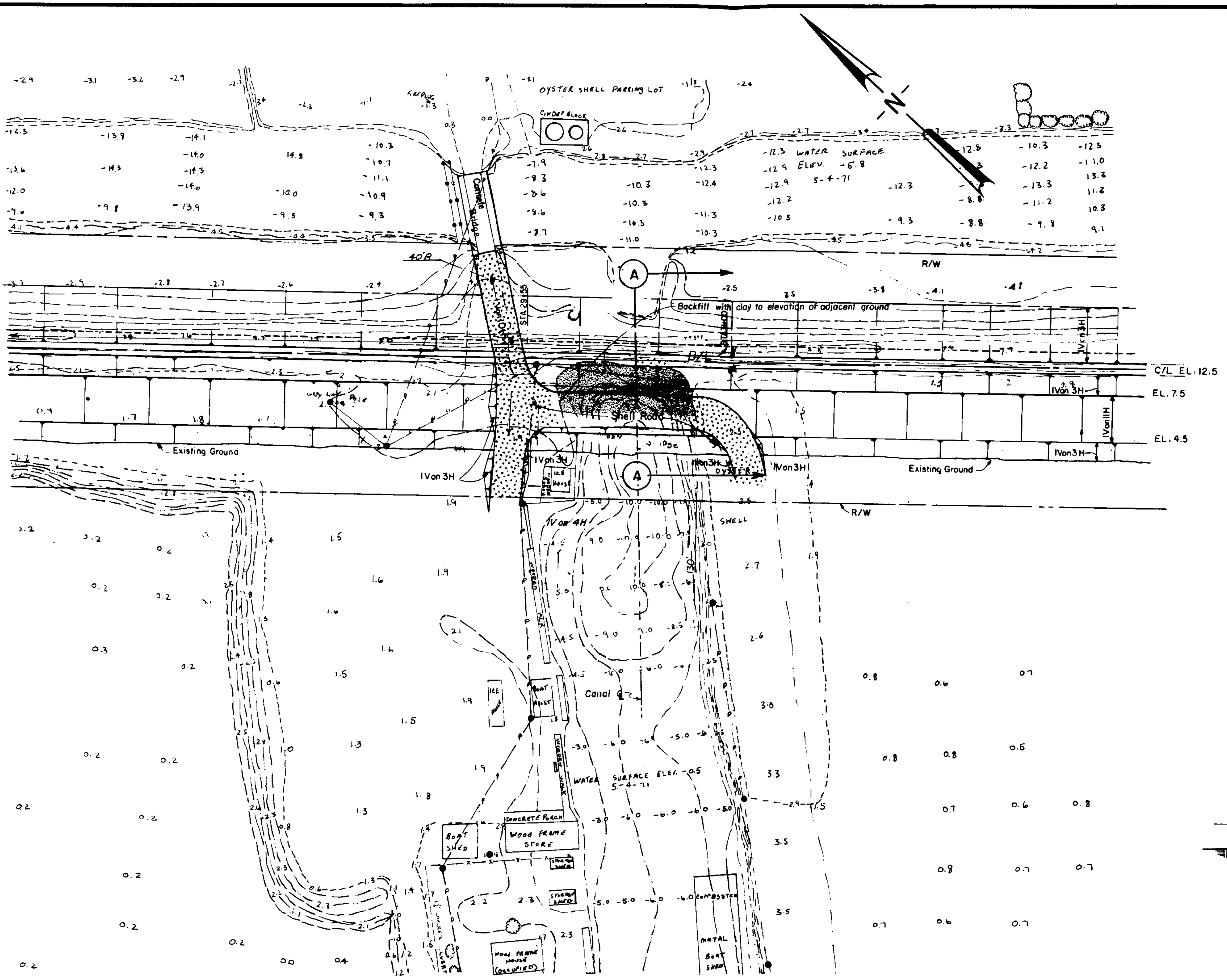
DESIGN MEMORANDUM NO. 1 - GENERAL DESIGN
SUPPLEMENT NO. 5

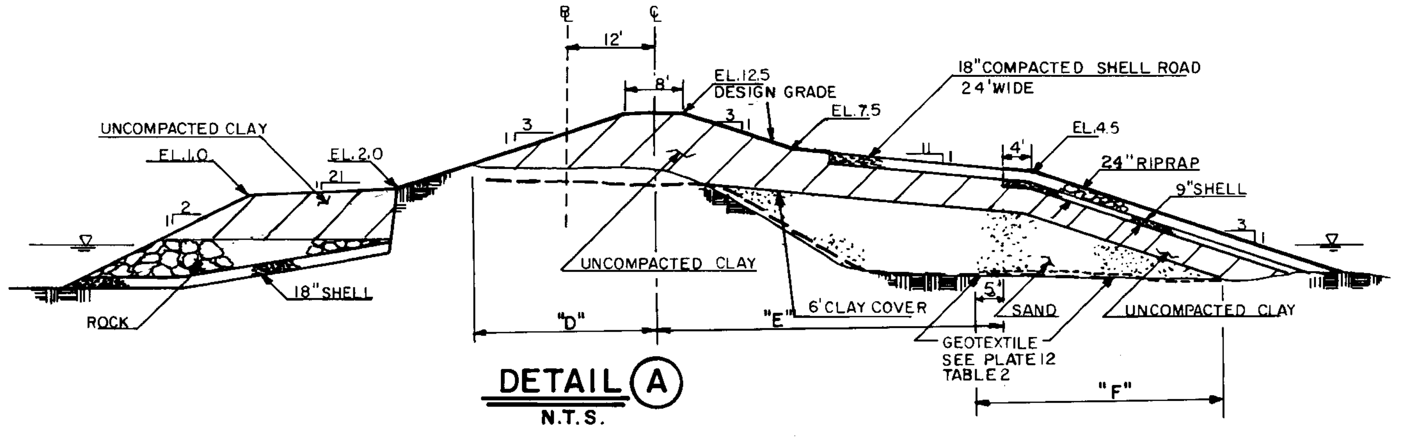
REACH A - CITY PRICE TO TROPICAL BEND

**CITY PRICE DRAINAGE STRUCTURE
PLAN AND SECTION**

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

AUGUST 1987 FILE NO. H-2-30260





DETAIL (A)
N.T.S.

NOTE: REMOVAL OF ABANDONED PUMP HOUSE & INTAKE AREA FILL

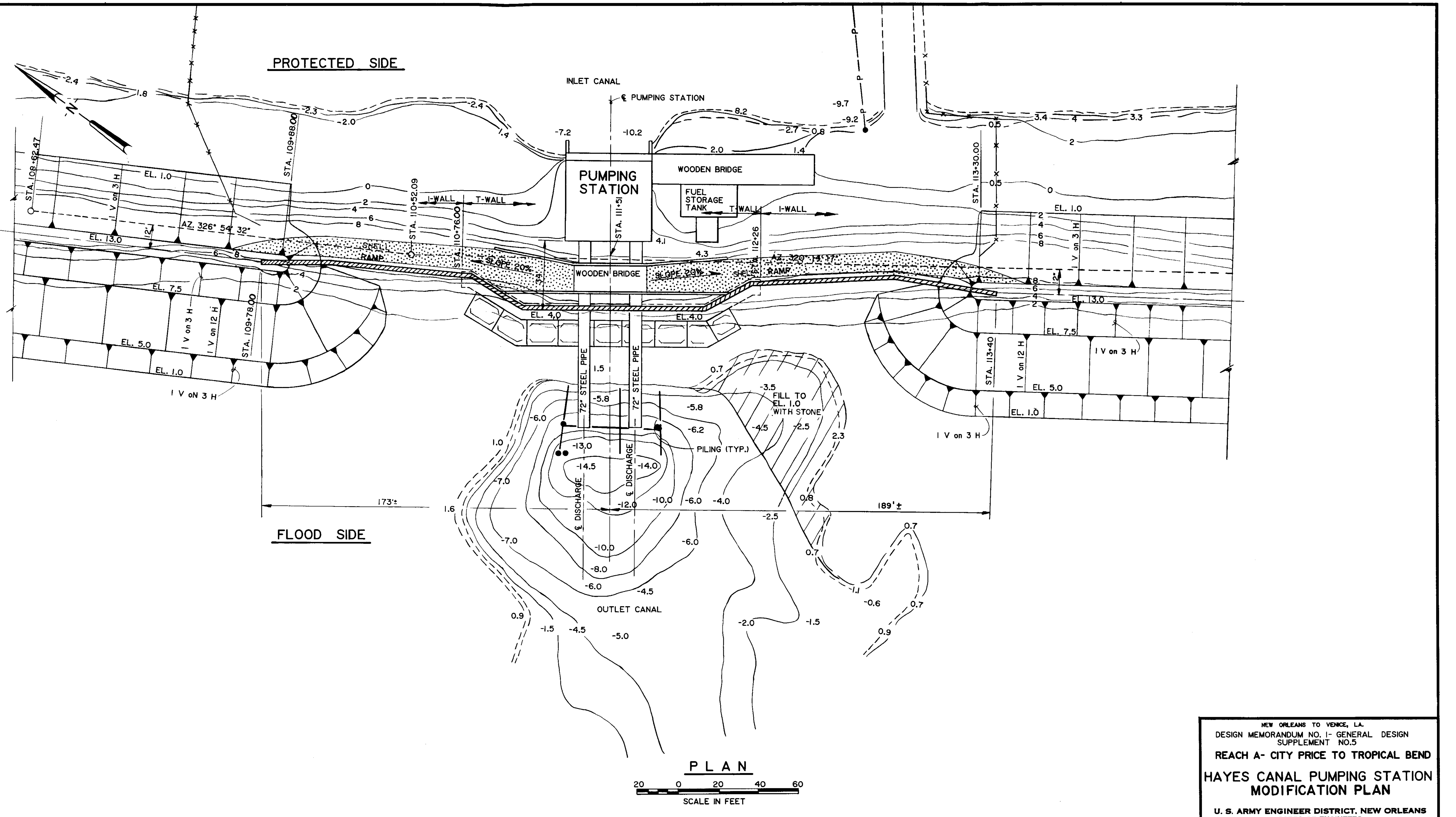
NEW ORLEANS TO VENICE, LA.
DESIGN MEMORANDUM NO. 1 – GENERAL DESIGN
SUPPLEMENT NO. 5
REACH A–CITY PRICE TO TROPICAL BEND

HAPPY JACK MARINA

PLAN DETAIL

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

AUGUST 1987 FILE NO. H-2-30260



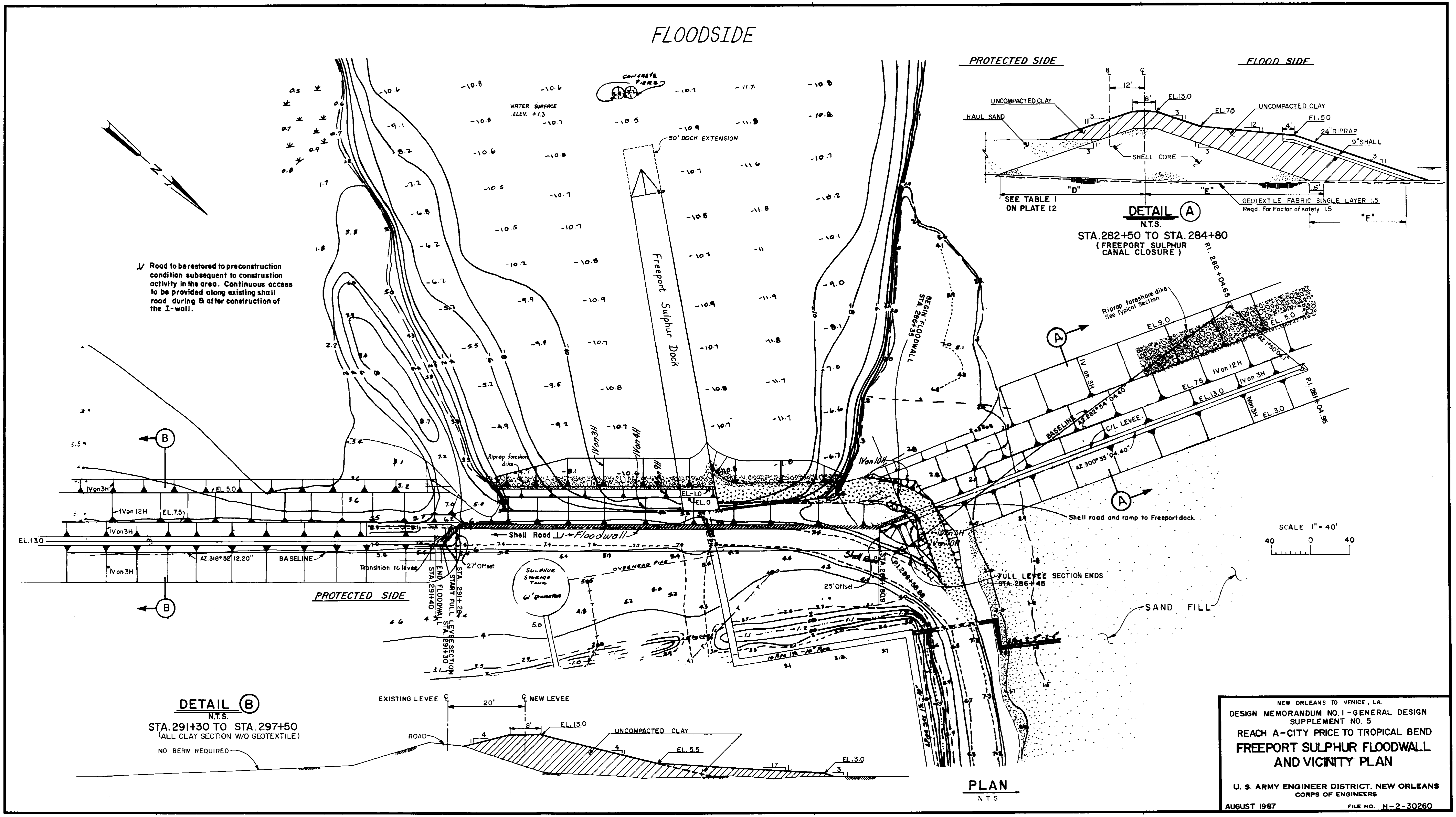
NEW ORLEANS TO VENICE, LA.
DESIGN MEMORANDUM NO. 1- GENERAL DESIGN
SUPPLEMENT NO.5

REACH A- CITY PRICE TO TROPICAL BEND

HAYES CANAL PUMPING STATION
MODIFICATION PLAN

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

DATE AUGUST 1987 FILE NO. H-2-30260



NEW ORLEANS TO VENICE, LA.

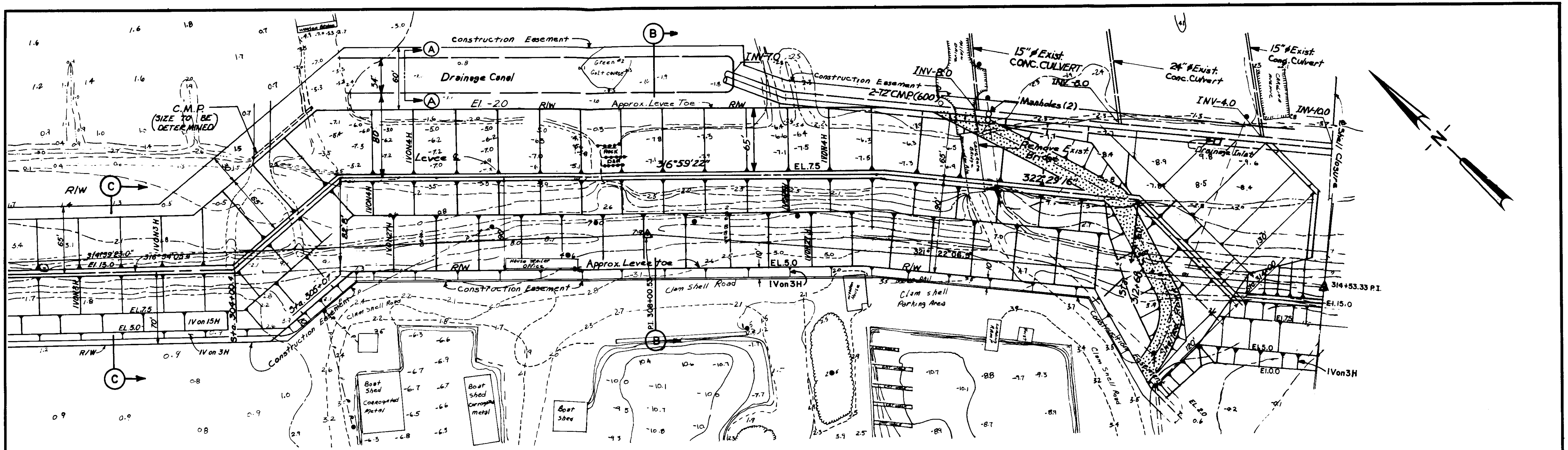
DESIGN MEMORANDUM NO. 1 - GENERAL DESIGN SUPPLEMENT NO. 5

REACH A-CITY PRICE TO TROPICAL BEND

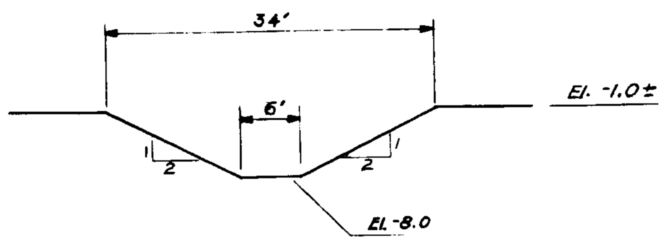
FREEPORT SULPHUR FLOODWALL AND VICINITY PLAN

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

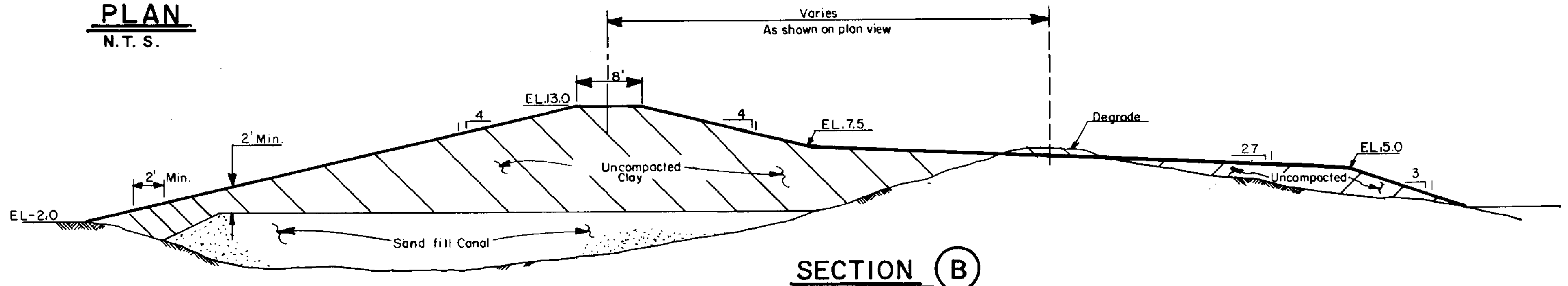
AUGUST 1987 FILE NO. H-2-30260



PLAN
N. T. S.



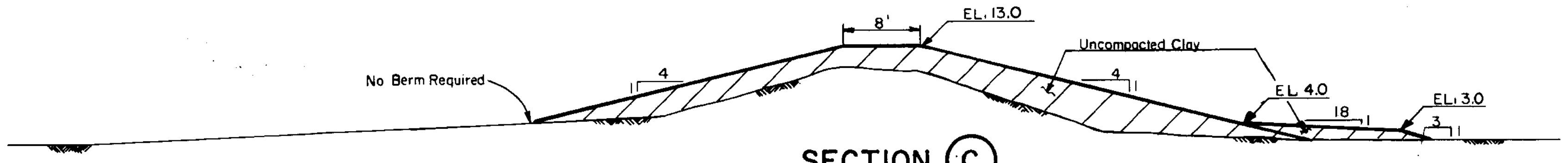
Section (A-A)
Scale 1" = 10'



SECTION (B)
N.T.S.

STA. 304+00 TO STA. 314+00
(CLAY SECTION ON SAND FILL CANAL W/O GEOTEXTILE)

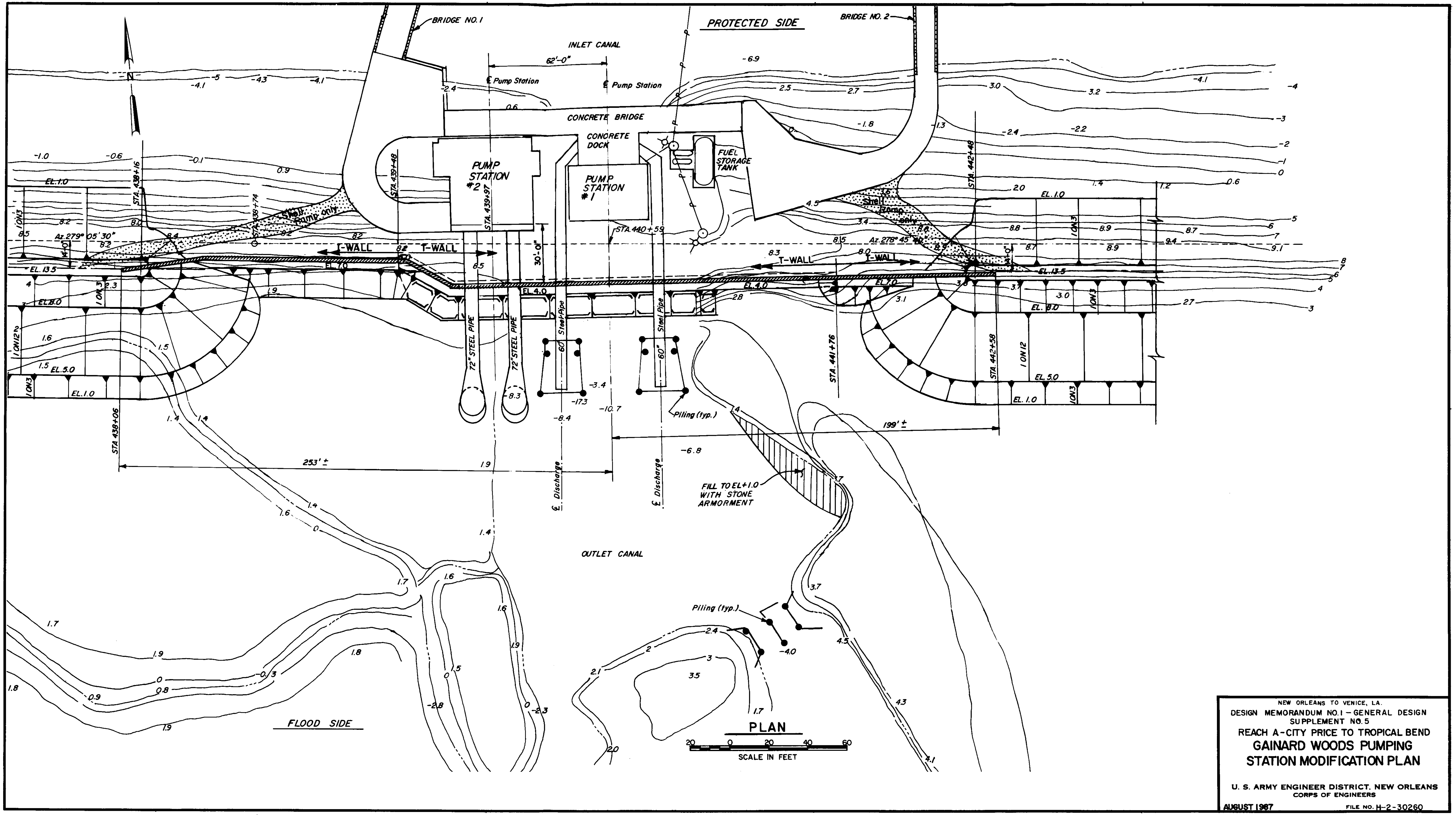
Notes!
Those portions of the shell road and parking area that are within the levee berm will be raised to the required height by adding earthen fill and then resurfaced with shell.



SECTION (C)
N.T.S.

STA. 297+50 TO STA. 304+00
(ALL CLAY SECTION W/O GEOTEXTILE)

NEW ORLEANS TO VENICE, LA.
DESIGN MEMORANDUM NO. 1 – GENERAL DESIGN
SUPPLEMENT NO. 5
REACH A – CITY PRICE TO TROPICAL BEND
HOMEPLACE MARINA
PLAN DETAIL
U. S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
AUGUST 1987 FILE NO. H-2-30260

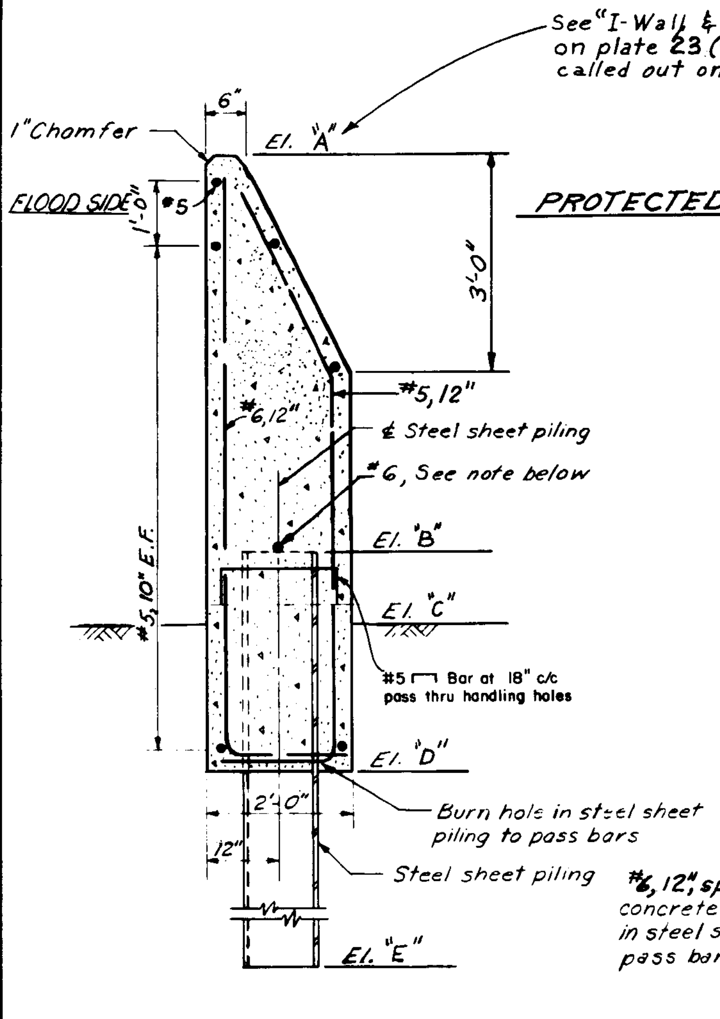


NEW ORLEANS TO VENICE, LA.
DESIGN MEMORANDUM NO. 1 – GENERAL DESIGN
SUPPLEMENT NO. 5
REACH A-CITY PRICE TO TROPICAL BEND

GAINARD WOODS PUMPING STATION MODIFICATION PLAN

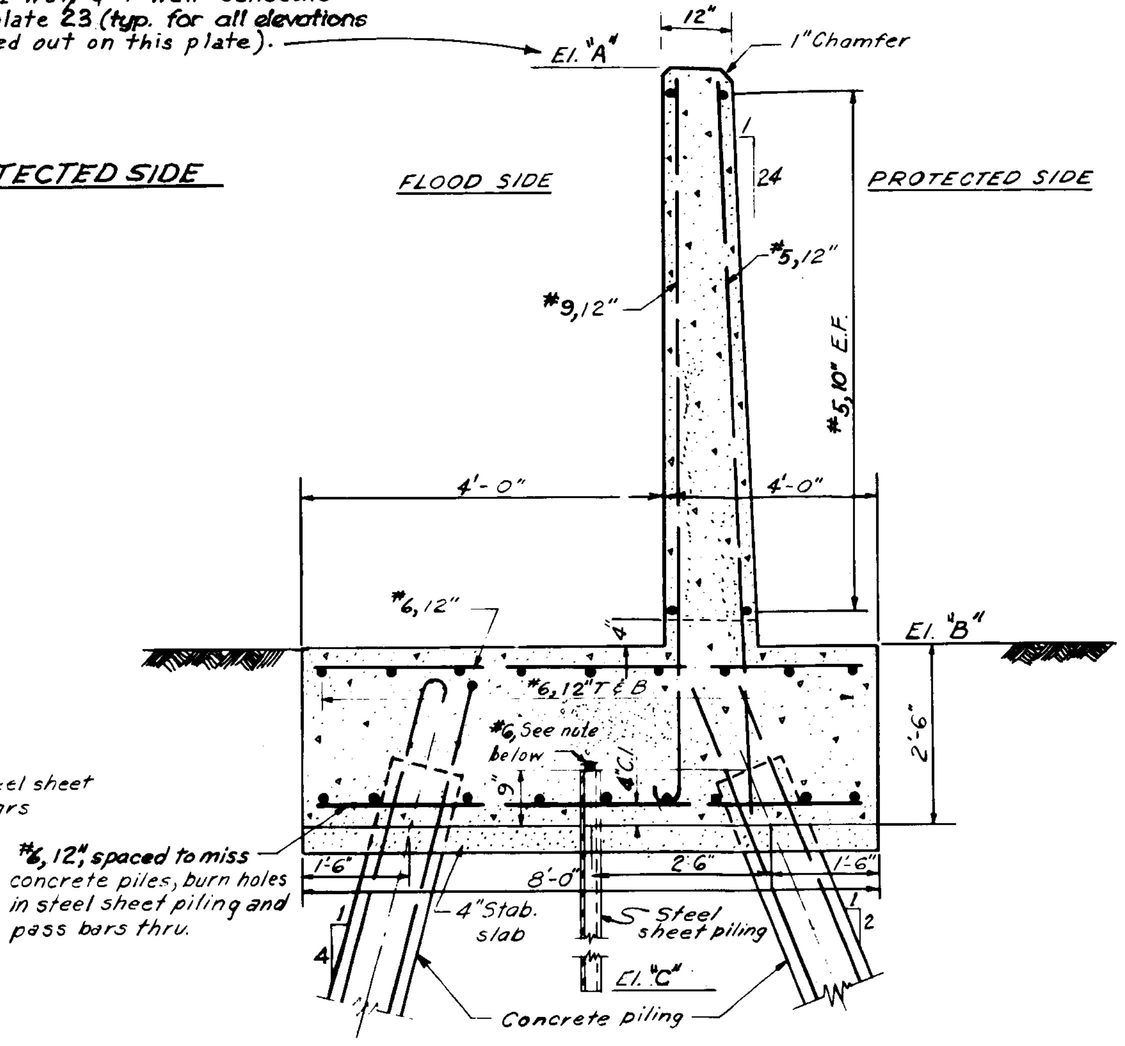
U. S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

AUGUST 1967 FILE NO. H-2-30260



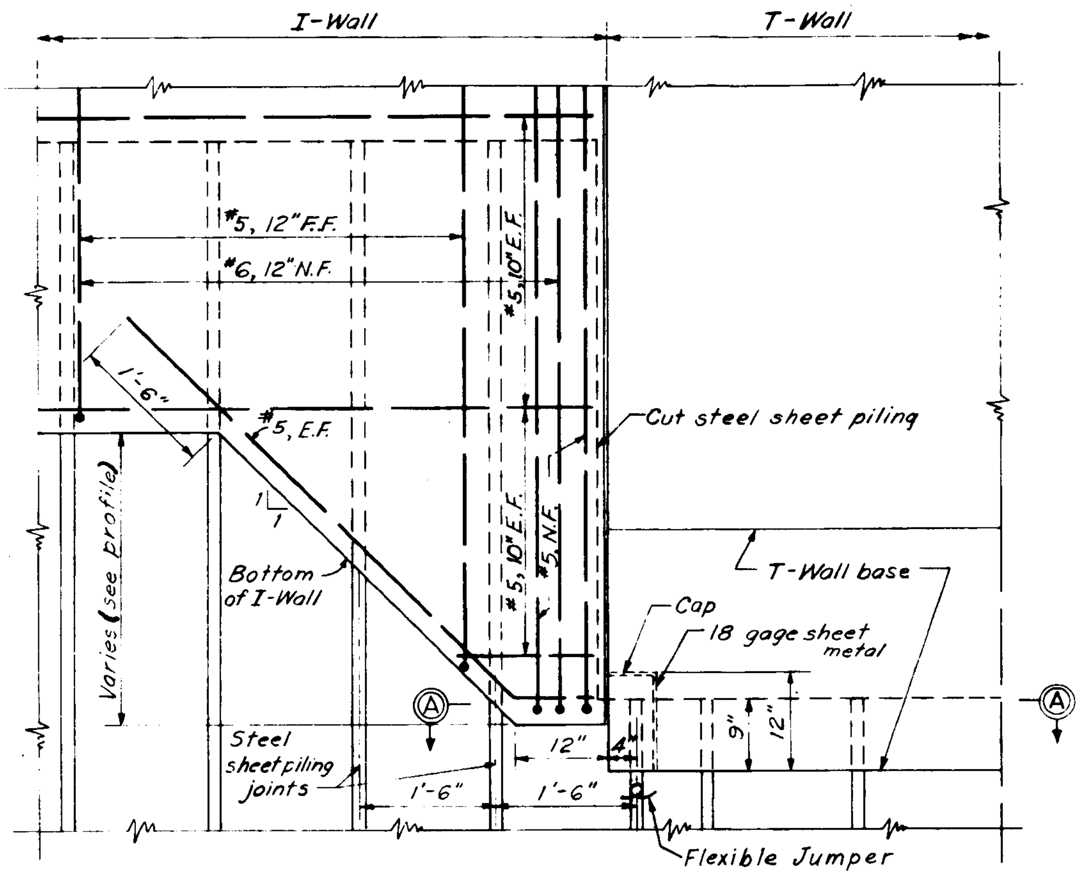
TYPICAL I-WALL SECTION

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



TYPICAL T-WALL SECTION

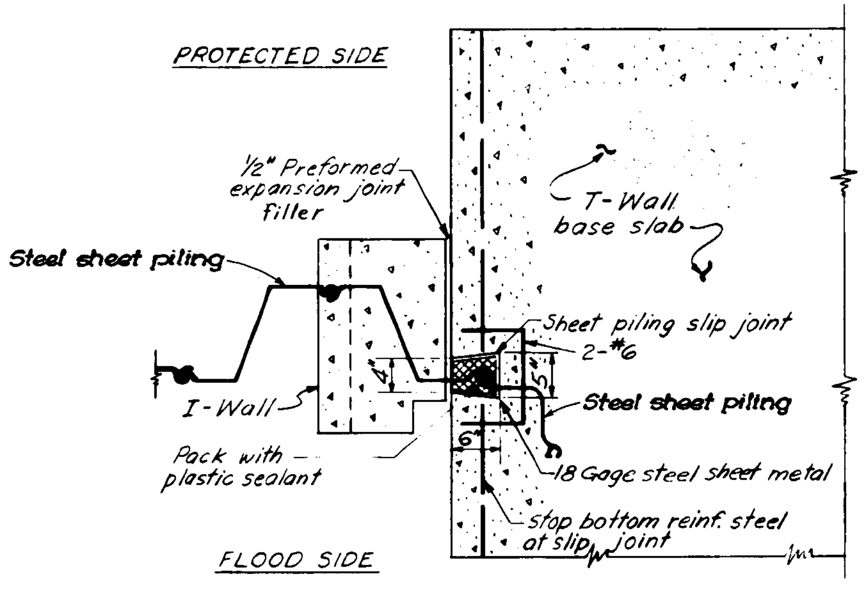
Scale: 3/4" = 1'-0"



FLOODSIDE ELEVATION

TYPICAL DETAIL FOR I-WALL TO T-WALL AT BASE

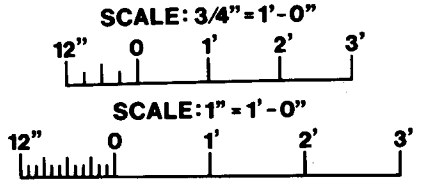
Scale 1" = 1'-0"



SECTION (A)

Scale: 1" = 1'-0"

Note:
Weld a No. 6 reinf. rod to top of each steel sheet pile. Install flexible jumper at all monolith joints. Jumpers shall be insulated No. 1/0 AWG copper, insulated with cross linked polyethylene in an 8" dia. loop. Jumper shall be welded to adjacent steel sheet piles 3 inches below bottom of concrete cap. Welded connections shall be coated with splicing epoxy to obtain a moisture proof connection.

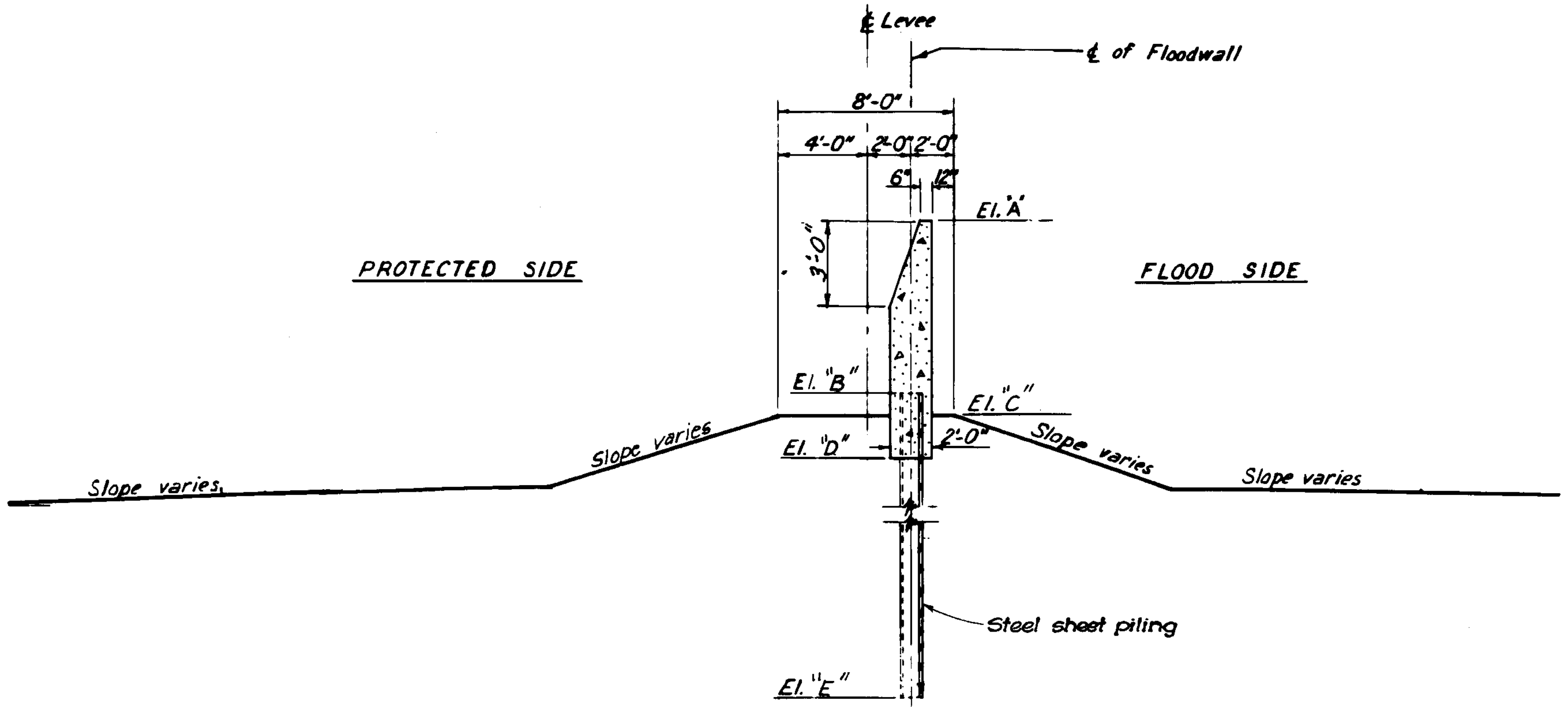


NEW ORLEANS TO VENICE, LA.
DESIGN MEMORANDUM NO. 1 - GENERAL DESIGN
SUPPLEMENT NO. 5
REACH A - CITY PRICE TO TROPICAL BEND

TYPICAL WALL SECTIONS

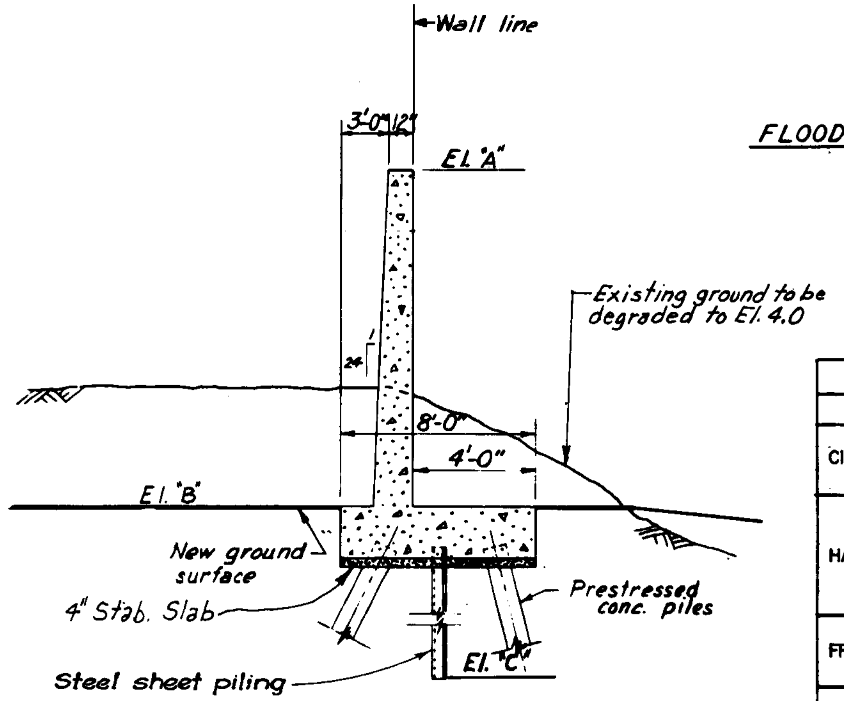
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

AUGUST 1987 FILE NO. H-2-30260



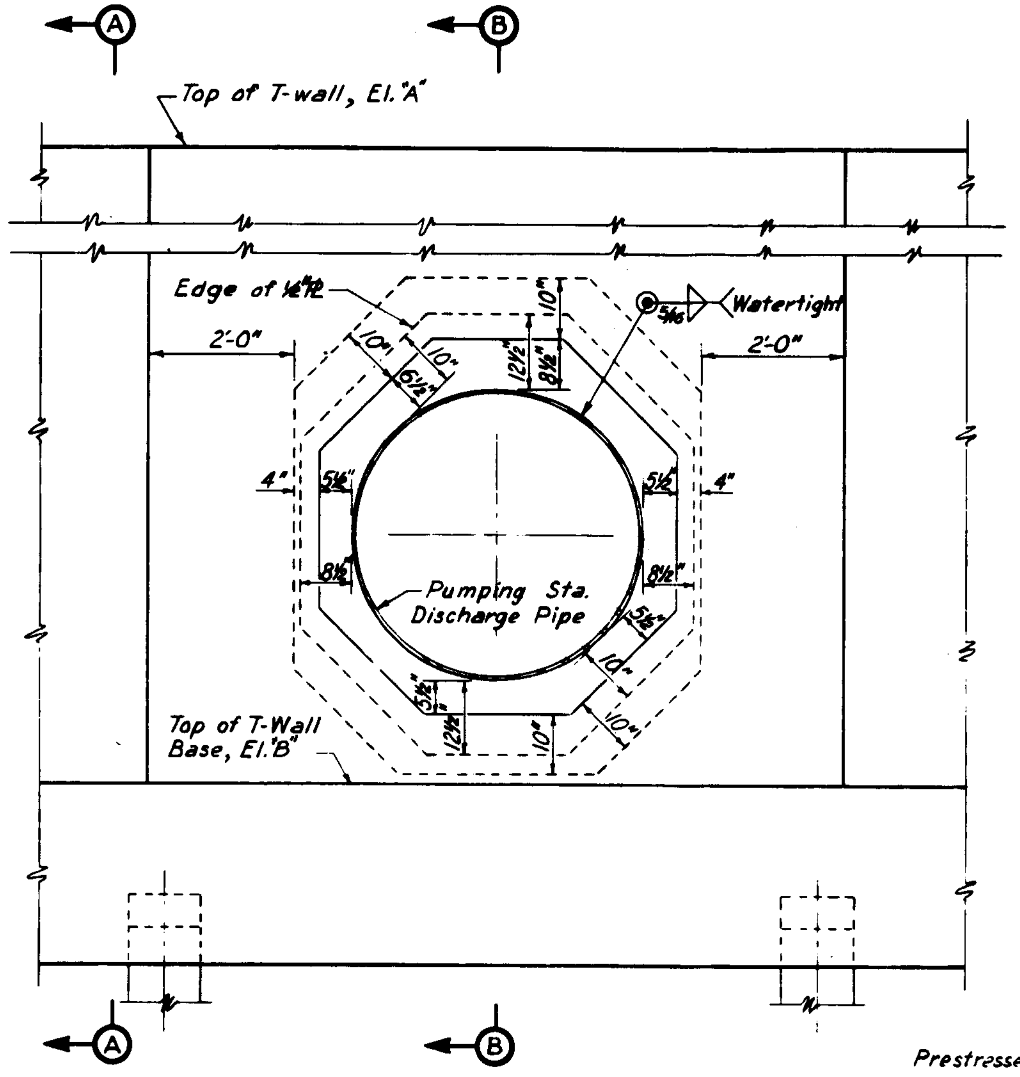
TYPICAL I-WALL SECTION

Scale 12" 0 5'



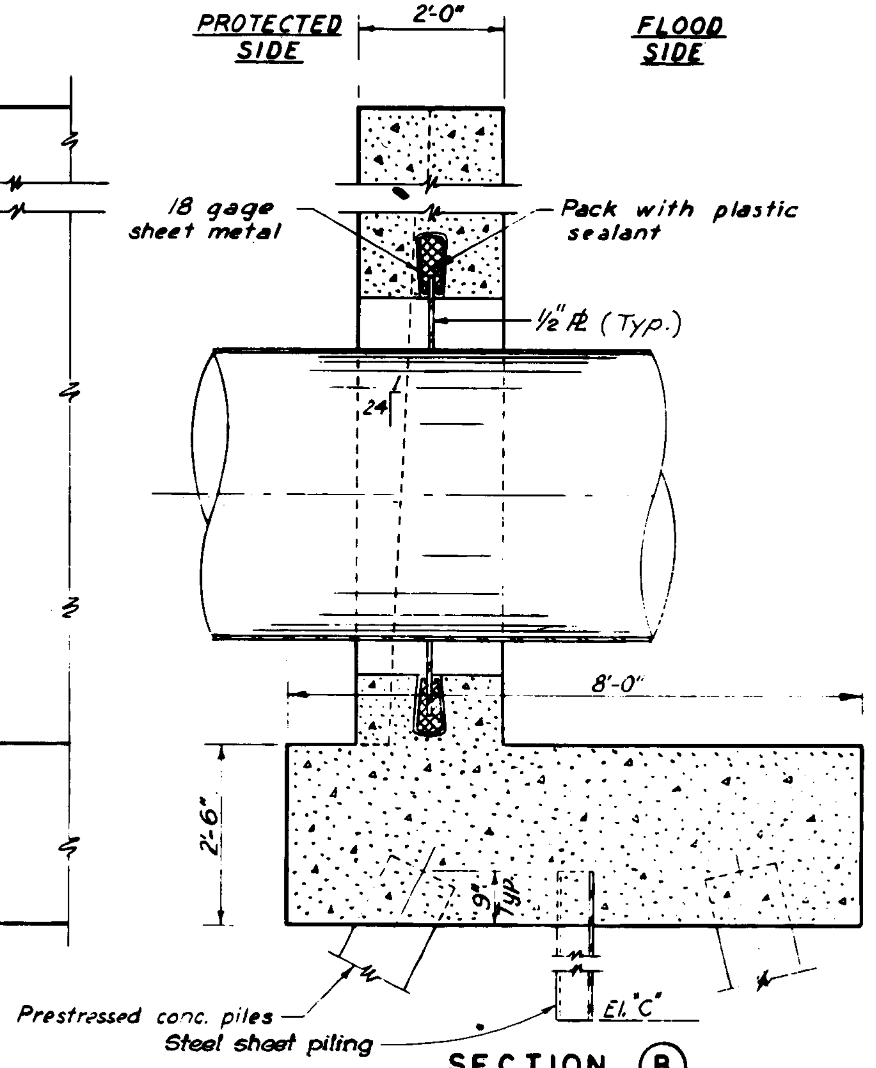
TYPICAL T-WALL SECTION

Scale 12" 0 5'



PROTECTED SIDE ELEVATION

Scale 12" 6" 0 1' 2'



SECTION (B)

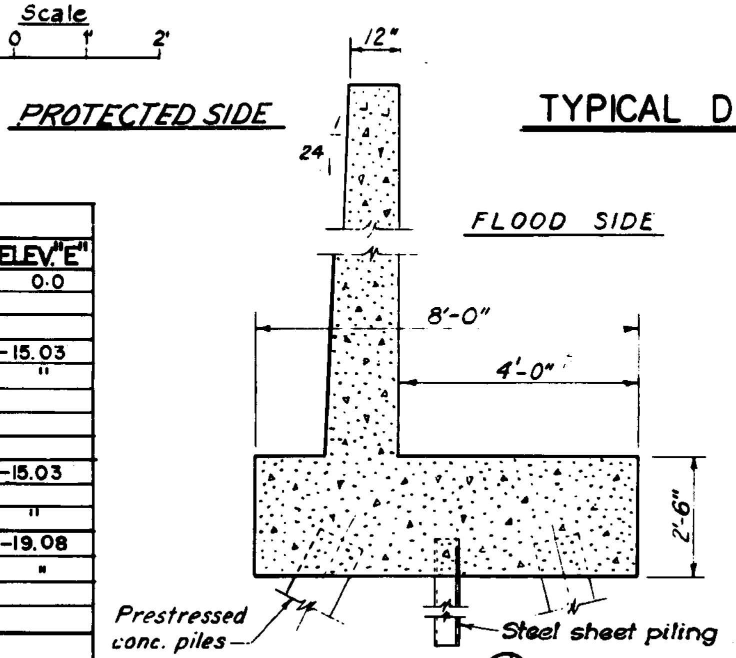
Scale 12" 6" 0 1' 2'

TYPICAL DISCHARGE PIPE MODIFICATION

*A description of the levee on which the floodwall is ~~being constructed~~ is given in the parenthesis.

I-WALL SCHEDULE						
LOCATION	*APPROX STA. LIMITS ℄	ELEV. "A"	ELEV. "B"	ELEV. "C"	ELEV. "D"	ELEV. "E"
CITY PRICE	6+50-9+14 (EXIST. LEV.)	12.5	9.5	8.5	6.5	0.0
HAYES CANAL	109+78 -110+76 (Exist. LEV.)	16.0	8.0	7.0	5.0	-15.03
	112+26-113+40 (Exist. LEV.	"	"	"	"	"
FREEPORT SULPHUR	286+35-286+81 (NEW LEV.)	16.0	8.0	7.0	5.0	-15.03
	286+81-291+40 (Exist. LEV.	"	"	"	"	"
GAINARD WOODS	438+06-439+48 (Exist. LEV.	17.0	8.0	7.0	5.0	-19.08
	441+76-442+48 (Exist. LEV.	"	"	"	"	"

T-WALL SCHEDULE						
LOCATION	APPROX STA. LIMITS ℄	ELEV. "A"	ELEV. "B"	ELEV. "C"		
HAYES CANAL	110+76 — 112+26	16.0	4.0	-17.0		
GAINARD WOODS.	439+48 — 441+76	17.0	4.0	-10.0		



SECTION (A)

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

NEW ORLEANS TO VENICE, LA.
DESIGN MEMORANDUM NO:1 - GENERAL DESIGN
SUPPLEMENT NO. 5
REACH A - CITY PRICE TO TROPICAL BEND

PUMPING STATIONS FLOODWALL DETAILS

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

AUGUST 1987 FILE NO. H-2-30260

SCALE IN FEET

1000 0 1000 2000

Note
Uncontrolled mosaic prepared from aerial photos flown January 1986

NEW ORLEANS TO VENICE, LA.

DESIGN MEMORANDUM NO.1-GENERAL DESIGN
SUPPLEMENT NO.5

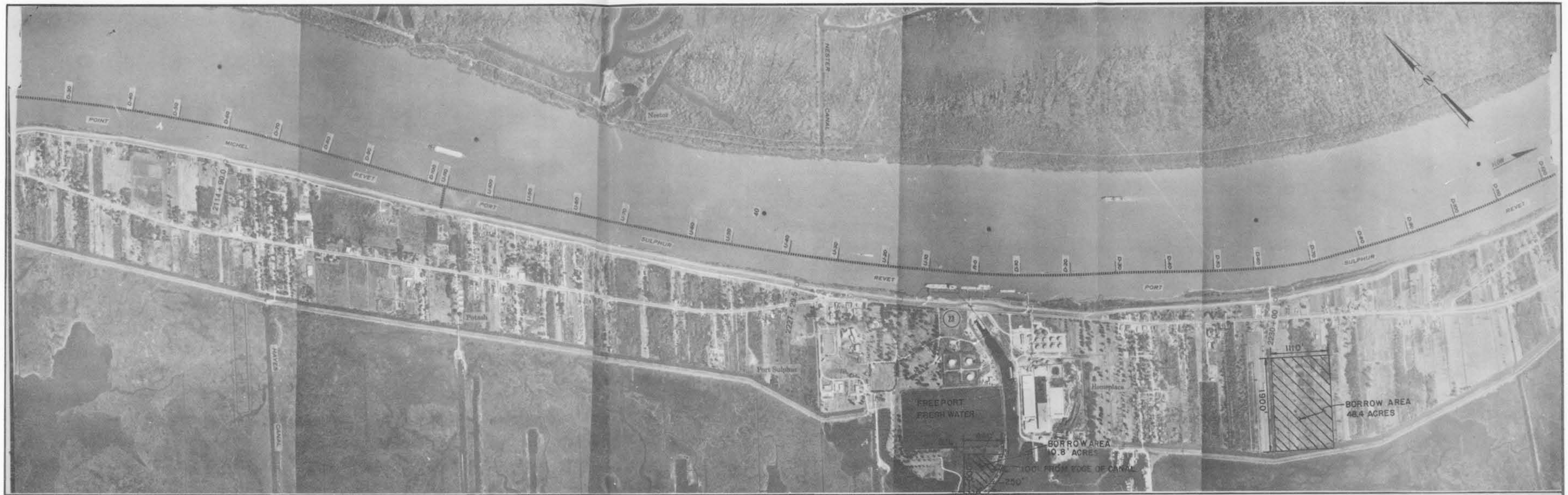
REACH A-CITY PRICE TO TROPICAL BEND

BORROW AREA

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

DATE AUGUST 1987 FILE NO. H-2-30260

PLATE 24



SCALE IN FEET

1000 0 1000 2000

Note:

Uncontrolled mosaic prepared from aerial photos flown January 1986

NEW ORLEANS TO VENICE, LA

DESIGN MEMORANDUM NO. 1 - GENERAL DESIGN
SUPPLEMENT NO. 5

REACH A-CITY PRICE TO TROPICAL BEND

BORROW AREA

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

DATE AUGUST 1987 FILE NO. H-2-30260

SCALE IN FEET
1000 0 1000 2000

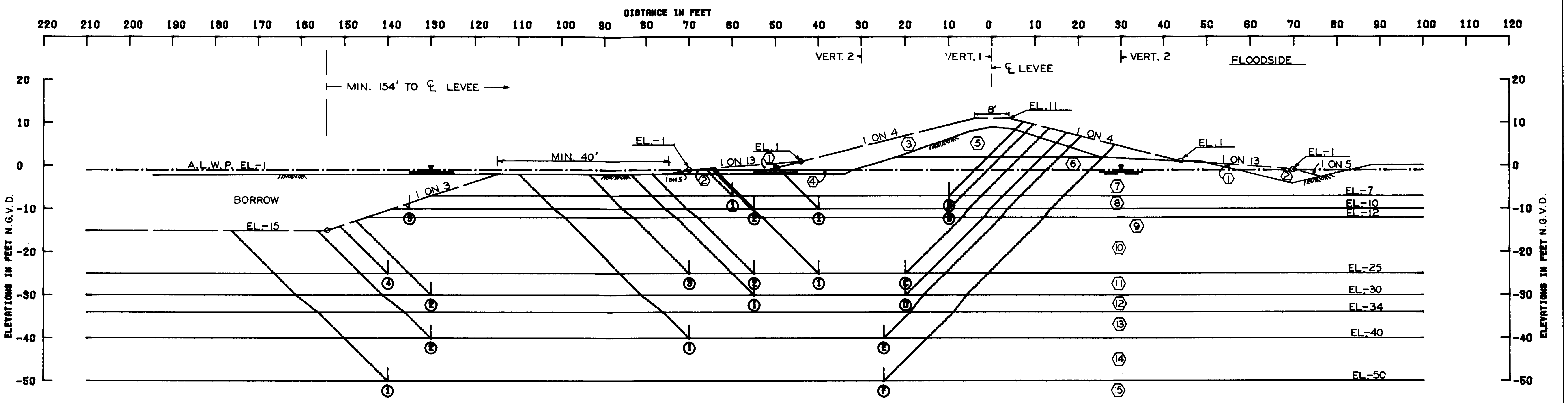
Note:
Uncontrolled mosaic prepared from aerial photos flown January 1986

NEW ORLEANS TO VENICE, LA.
DESIGN MEMORANDUM NO. 1 - GENERAL DESIGN
SUPPLEMENT NO. 5
REACH A - CITY PRICE TO TROPICAL BEND

BORROW AREA

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

DATE. AUGUST 1987 FILE NO. H-2-30260



GENERAL NOTES

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

SHEAR STRENGTHS BETWEEN VERTICALS 1 AND 2 WERE ASSUMED TO VARY LINEARLY BETWEEN THE VALUES INDICATED FOR THESE LOCATIONS.

VERT. 1 = BOR. A-2-BU.
VERT. 2 = BORS. 35-AU, A-1-U, 4-AU & A-3-U.

A TRANSITION SHOULD BE MADE BETWEEN STATIONS 4+00 AND 5+50 (SEE PLATE 94)

STRATUM NO.	SOIL TYPE	EFFECTIVE UNIT WT. P.C.F.		C - UNIT COHESION - P.S.F.				FRICTION ANGLE DEGREES
				CENTER OF STRATUM		BOTTOM OF STRATUM		
		VERT. 1	VERT. 2	VERT. 1	VERT. 2	VERT. 1	VERT. 2	
1	CH	100.0	100.0	200.0	200.0	200.0	200.0	0.0
2	CH	38.0	38.0	200.0	200.0	200.0	200.0	0.0
3	CH	110.0	110.0	400.0	400.0	400.0	400.0	0.0
4	CH	48.0	48.0	400.0	400.0	400.0	400.0	0.0
5	CH	106.0	106.0	400.0	400.0	400.0	400.0	0.0
6	CH	86.0	86.0	300.0	150.0	300.0	150.0	0.0
7	CH	24.0	24.0	300.0	150.0	300.0	150.0	0.0
8	CH	34.0	34.0	300.0	150.0	300.0	150.0	0.0
9	ML	55.0	55.0	200.0	200.0	200.0	200.0	15.0
10	CH	38.0	38.0	300.0	235.0	300.0	300.0	0.0
11	CH	38.0	38.0	325.0	325.0	350.0	350.0	0.0
12	ML	55.0	55.0	200.0	200.0	200.0	200.0	15.0
13	CH	38.0	38.0	420.0	420.0	450.0	450.0	0.0
14	CH	40.0	40.0	500.0	500.0	550.0	550.0	0.0
15	CH	44.0	44.0	600.0	600.0	650.0	650.0	0.0

ASSUMED FAILURE SURFACE			RESISTING FORCES			DRIVING FORCES		SUMMATION OF FORCES		FACTOR OF SAFETY
NO.		ELEV.	R_A	R_B	R_P	D_A	$-D_P$	RESISTING	DRIVING	
A	1	-7.00	11465	8500	2014	14919	836	21979	14083	1.561
B	1	-10.00	12770	5500	4040	18849	3414	22310	15435	1.445
B	2	-10.00	12770	7750	2971	18849	1872	23491	16977	1.384
B	3	-10.00	12770	19750	300	18849	22	32820	18827	1.743
C	1	-25.00	21120	6000	10721	41933	13522	37841	28411	1.332
C	2	-25.00	21120	10500	10000	41933	10395	41620	31538	1.320
C	3	-25.00	21120	15000	9939	41933	8986	46059	32947	1.398
C	4	-25.00	21120	36000	5170	41933	3134	62290	38799	1.605
D	1	-30.00	23538	12250	13197	51343	15022	48986	36321	1.349
D	2	-30.00	23538	38500	9007	51343	7888	71046	43455	1.635
E	1	-40.00	32228	20250	23460	72124	26192	75938	45931	1.653
E	2	-40.00	32228	47250	17803	72124	16142	97080	55981	1.734
F	1	-50.00	39622	63250	26974	95970	25906	129846	70066	1.853

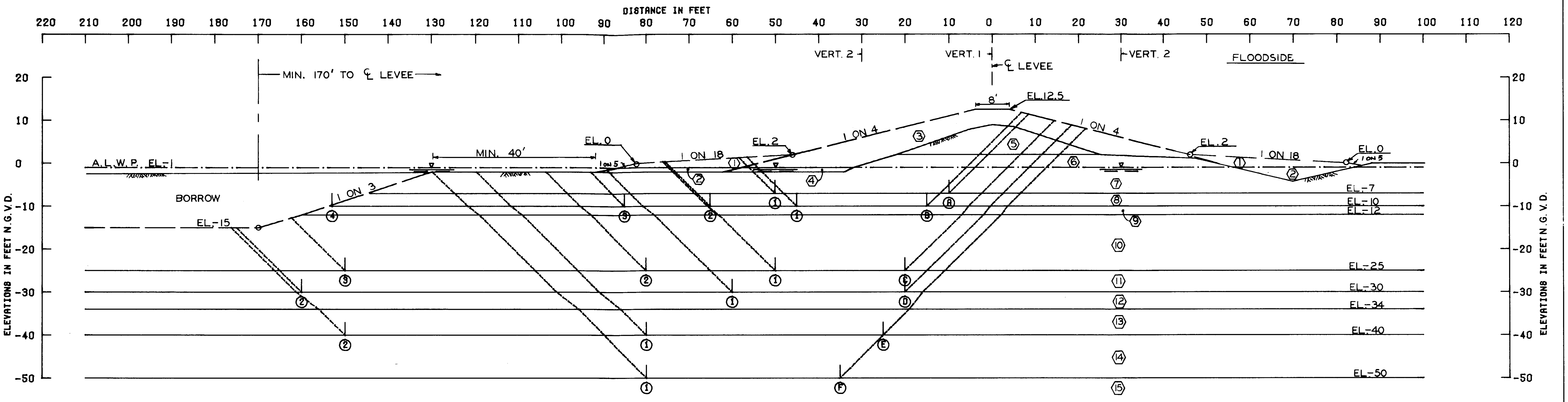
NOTES

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

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

NEW ORLEANS TO VENICE, LA
DESIGN MEMORANDUM NO. 1 - GENERAL DESIGN
SUPPLEMENT NO. 5
REACH A - CITY PRICE TO TROPICAL BEND
STA. 0+00 TO 4+00
FINAL SECTION - ALL CLAY

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
AUGUST 1987 FILE NO. H-2-30260



GENERAL NOTES

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

SHEAR STRENGTHS BETWEEN VERTICALS 1 AND 2 WERE ASSUMED TO VARY LINEARLY BETWEEN THE VALUES INDICATED FOR THESE LOCATIONS.

VERT. 1 = BOR. A-2-BU.

VERT. 2 = BORS. 35-AU, A-1-U, 4-AU & A-3-U.

*A TRANSITION SHOULD BE MADE BETWEEN STATIONS 4+00 AND 5+50(SEE PLATE 93 OF OCT 83 GMD)

STRATUM NO.	SOIL TYPE	EFFECTIVE UNIT WT. P.C.F.		C - UNIT COHESION - P.S.F.				FRICTION ANGLE
				CENTER OF STRATUM		BOTTOM OF STRATUM		
		VERT. 1	VERT. 2	VERT. 1	VERT. 2	VERT. 1	VERT. 2	DEGREES
1	CH	100.0	100.0	200.0	200.0	200.0	200.0	0.0
2	CH	38.0	38.0	200.0	200.0	200.0	200.0	0.0
3	CH	110.0	110.0	400.0	400.0	400.0	400.0	0.0
4	CH	48.0	48.0	400.0	400.0	400.0	400.0	0.0
5	CH	108.0	108.0	400.0	400.0	400.0	400.0	0.0
6	CHO	86.0	86.0	300.0	150.0	300.0	150.0	0.0
7	CHO	24.0	24.0	300.0	150.0	300.0	150.0	0.0
8	CH	34.0	34.0	300.0	150.0	300.0	150.0	0.0
9	ML	55.0	55.0	200.0	200.0	200.0	200.0	15.0
10	CH	38.0	38.0	300.0	235.0	300.0	300.0	0.0
11	CH	38.0	38.0	325.0	325.0	350.0	350.0	0.0
12	ML	55.0	55.0	200.0	200.0	200.0	200.0	15.0
13	CH	38.0	38.0	420.0	420.0	450.0	450.0	0.0
14	CH	40.0	40.0	500.0	500.0	550.0	550.0	0.0
15	CH	44.0	44.0	600.0	600.0	650.0	650.0	0.0

ASSUMED FAILURE SURFACE		RESISTING FORCES			DRIVING FORCES		SUMMATION OF FORCES		FACTOR OF SAFETY
NO.	ELEV.	R_A	R_B	R_P	D_A	$-D_P$	RESISTING	DRIVING	
A 1	-7.00	12425	7000	3386	17857	2488	22811	15369	1.484
B 1	-10.00	13960	5063	4488	21702	4258	23511	17445	1.348
B 2	-10.00	13960	8063	3347	21702	2758	25370	18944	1.339
B 3	-10.00	13960	11063	2400	21702	1023	27423	20680	1.326
B 4	-10.00	13960	21263	75	21702	1	35298	21701	1.627
C 1	-25.00	22216	9000	11204	47592	15089	42420	32503	1.305
C 2	-25.00	22216	18000	9939	47592	9712	50155	37880	1.324
C 3	-25.00	22216	39000	5785	47592	4029	67001	43563	1.538
D 1	-30.00	24634	14000	13629	57663	18285	52263	39377	1.327
D 2	-30.00	24634	49000	7950	57663	4842	81584	52820	1.545
E 1	-40.00	33594	24750	23535	79959	26886	81878	53073	1.543
E 2	-40.00	33594	56250	17367	79959	14814	107210	65145	1.646
F 1	-50.00	43594	24750	33459	104411	43557	101803	60854	1.673

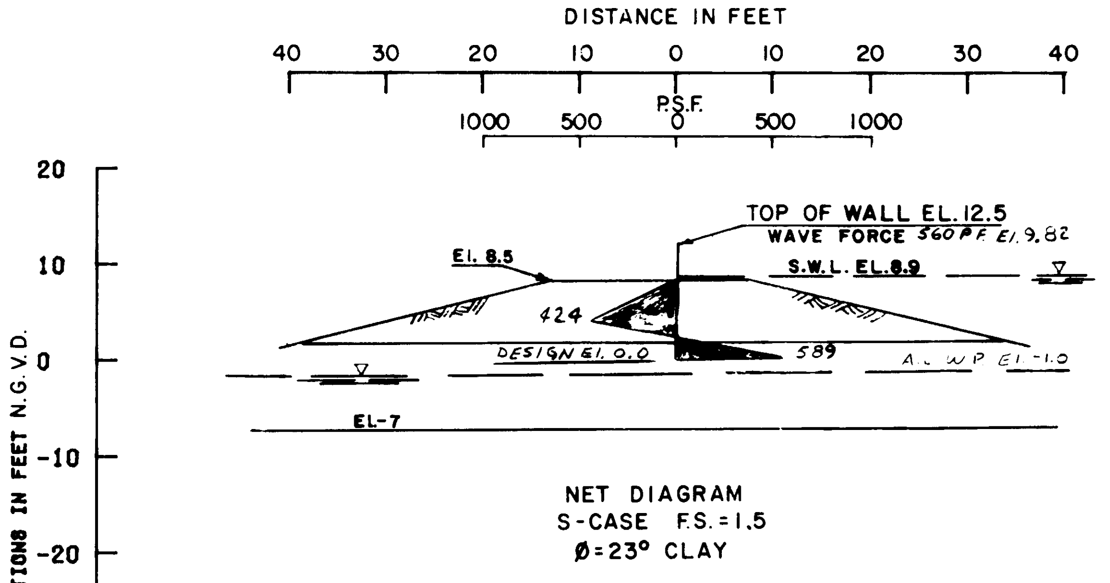
NOTES

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

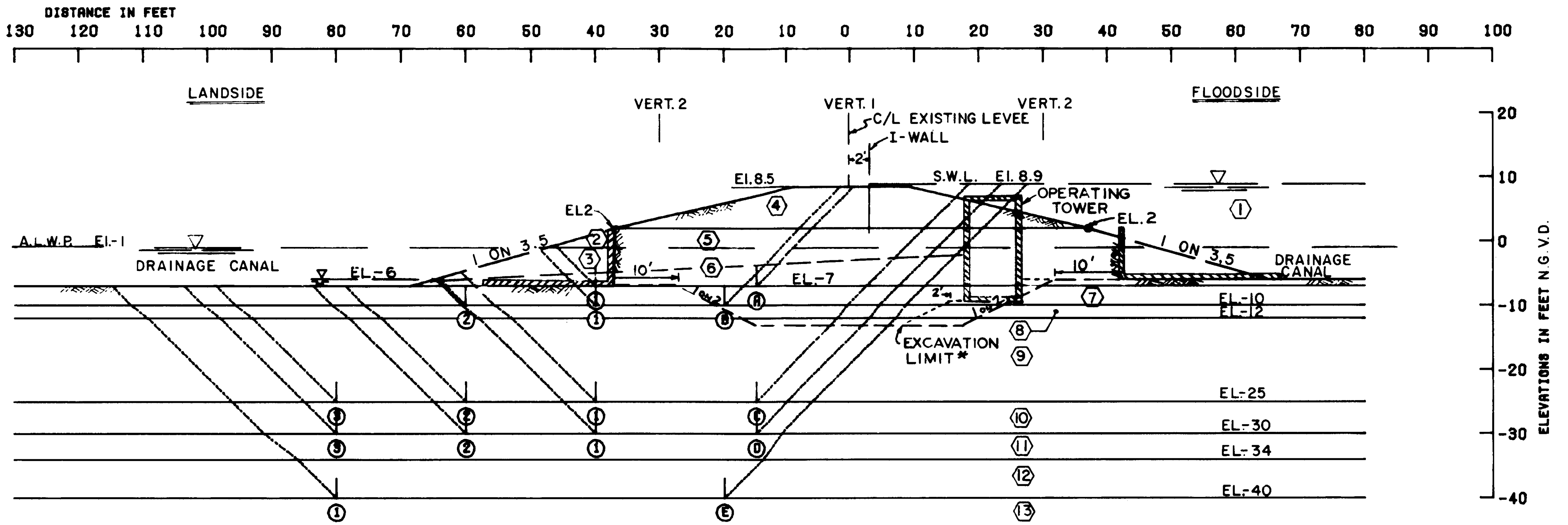
$$\text{FACTOR OF SAFETY} = \frac{R_A + R_B + R_P}{D_A - D_P}$$

NEW ORLEANS TO VENICE, LA
DESIGN MEMORANDUM NO 1-GENERAL DESIGN
SUPPLEMENT NO. 5
REACH A-CITY PRICE TO TROPICAL BEND
STA. 4+50 TO 6+60*
FINAL SECTION - ALL CLAY

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
AUGUST 1987 FILE NO. H-2-30260



NET DIAGRAM
S-CASE F.S.=1.5
ϕ=23° CLAY



GENERAL NOTES

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

SHEAR STRENGTHS BETWEEN VERTICALS 1 AND 2 WERE ASSUMED TO VARY LINEARLY BETWEEN THE VALUES INDICATED FOR THESE LOCATIONS.

THIS DESIGN SECTION SHOULD BE APPLIED TO THE AREA WHERE THE LEVEE CROSSES THE DRAINAGE CANAL, VIC. STA. 6+60 TO 8+80. THIS ALSO INCLUDES THE CITY PRICE DRAINAGE STRUCTURE (THE 1V ON 3.5H BERMS SHOULD BE APPLIED UP TO THE SIDES OF THE CATCH BASINS.)

VERT. 1 = BOR. A-2-BU
VERT. 2 = BORS. 35-AU, A-1-U, 4-AU & A-3-U.

STRATUM NO.	SOIL TYPE	EFFECTIVE UNIT WT. P.C.F.		C - UNIT COHESION - P.S.F.				FRICTION ANGLE DEGREES
				CENTER OF STRATUM		BOTTOM OF STRATUM		
		VERT. 1	VERT. 2	VERT. 1	VERT. 2	VERT. 1	VERT. 2	
(1)	WA	62.5	62.5	0.0	0.0	0.0	0.0	0.0
(2)	CHO	86.0	86.0	150.0	150.0	150.0	150.0	0.0
(3)	CHO	24.0	24.0	150.0	150.0	150.0	150.0	0.0
(4)	CH	108.0	108.0	400.0	400.0	400.0	400.0	0.0
(5)	CHO	86.0	86.0	300.0	150.0	300.0	150.0	0.0
(6)	CHO	24.0	24.0	300.0	150.0	300.0	150.0	0.0
(7)	CH	34.0	34.0	300.0	150.0	300.0	150.0	0.0
(8)	ML	55.0	55.0	200.0	200.0	200.0	200.0	15.0
(9)	CH	38.0	38.0	300.0	235.0	300.0	300.0	0.0
(10)	CH	38.0	38.0	325.0	325.0	350.0	350.0	0.0
(11)	ML	55.0	55.0	200.0	200.0	200.0	200.0	15.0
(12)	CH	38.0	38.0	420.0	420.0	450.0	450.0	0.0
(13)	CH	38.0	38.0	420.0	420.0	450.0	450.0	0.0

ASSUMED FAILURE SURFACE NO.		ASSUMED FAILURE SURFACE ELEV.	RESISTING FORCES R_A	R_B	R_P	DRIVING FORCES D_A	$-D_P$	SUMMATION OF FORCES RESISTING	DRIVING	FACTOR OF SAFETY
(A)	(1)	-7.00	9655	4313	1900	10520	1100	15868	9419	1.685
(B)	(1)	-10.00	10720	3542	2600	12919	1700	16862	11219	1.503
(B)	(2)	-10.00	10720	6542	1267	12919	319	18529	12600	1.471
(C)	(1)	-25.00	19346	7500	9067	36861	9393	35914	27468	1.307
(C)	(2)	-25.00	19346	13500	8272	36861	6679	41118	30183	1.362
(C)	(3)	-25.00	19346	19500	8272	36861	6431	47118	30430	1.548
(D)	(1)	-30.00	21545	8750	11936	46029	13615	42231	32414	1.303
(D)	(2)	-30.00	21545	15750	11522	46029	10683	48817	35347	1.381
(D)	(3)	-30.00	21545	22750	11522	46029	10435	55817	35594	1.568
(E)	(1)	-40.00	30204	27000	21457	66870	21838	78661	45032	1.747
WITH WATER AT EL-6 IN THE LANDSIDE DRAINAGE CANAL, EL-1 FLOODSIDE.										
(C)	(1)	-25.00	19439	7500	9285	39681	13224	36224	26457	1.369
(C)	(2)	-25.00	19439	13500	8272	39681	6835	41211	32846	1.255
(D)	(1)	-30.00	21622	8750	12049	49182	17602	42421	31580	1.343
(D)	(2)	-30.00	21622	15750	11522	49182	10839	48894	38343	1.275
WITHOUT WATER SURCHARGE (S.W.L.) FLOODSIDE.										
(C)	(2)	-25.00	19439	13500	8272	38931	6835	41211	32096	1.284
(D)	(2)	-30.00	21622	15750	11522	47651	10839	48894	36812	1.328

NOTES

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

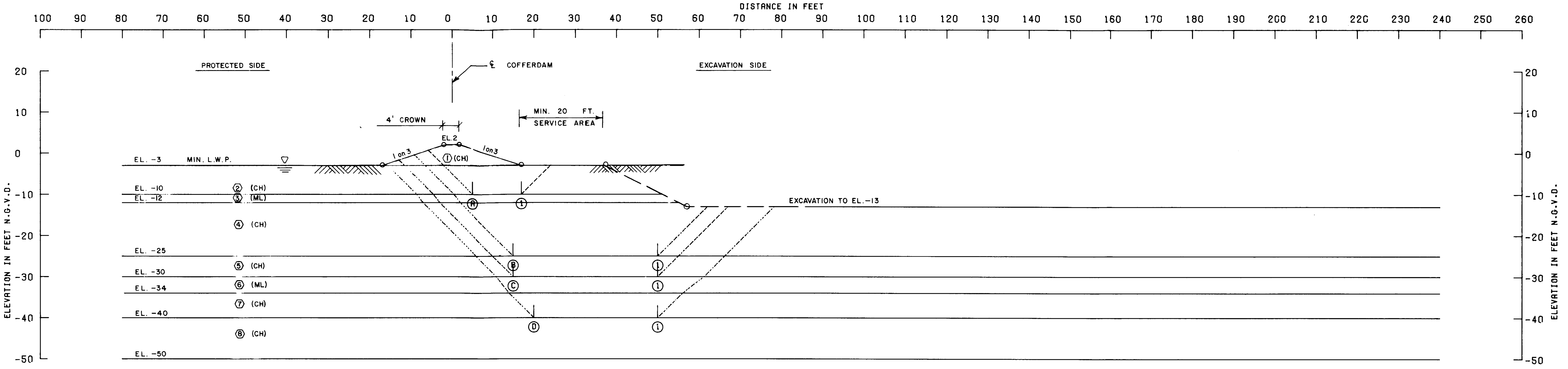
$$\text{FACTOR OF SAFETY} = \frac{R_A + R_B + R_P}{D_A - D_P}$$

THE ANALYSIS PRESENTED IS FOR THE MOST CRITICAL FOUNDATION WITHIN THE APPLICABLE STATION LIMITS.

* AN EXCAVATION WILL BE REQUIRED AT THE DRAINAGE STRUCTURE TO CUTOFF THE SAND BLANKET WHICH EXTENDS THROUGH THE LEVEE. THE SAND BLANKET IS APPROXIMATELY 50 FT. WIDE AND EXTENDS TO ABOUT EL-13. THE OPERATING TOWER SHOULD BE LEFT IN PLACE AS WELL AS THE PIPE FLOODWARD OF THE TOWER. THE PIPE LANDWARD OF THE OPERATING TOWER MAY BE REMOVED DURING EXCAVATION AND REPLACED DURING BACKFILL OPERATIONS. THE EXCAVATION SHOULD BE BACKFILLED WITH CLAY, COMPACTED TO THE DENSITY OF ADJACENT UNDISTURBED MATERIAL. AN EARTH COFFERDAM SHOULD BE USED IN CONJUNCTION WITH SUMPS & PUMPS TO DEWATER THE SITE.

NEW ORLEANS TO VENICE, LA
DESIGN MEMORANDUM NO 1-GENERAL DESIGN
SUPPLEMENT NO. 5
REACH A-CITY PRICE TO TROPICAL BEND
CITY PRICE DRAINAGE STRUCTURE
I-WALL—EXISTING LEVEE: FINAL SECTION
STA. 6+60 TO 8+80

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
AUGUST. 1987 FILE NO. H-2-30260



GENERAL NOTES

CLASSIFICATION STRATIFICATION SHEAR STRENGTHS AND UNIT WEIGHTS OF THE SOIL WERE BASED ON THE RESULTS OF THE UNDISTURBED BORINGS A-1-U, A-3-U, 4-AU, 35-AU

(SEE THE APPROPRIATE BORING DATA PLATES).

STRATUM NO.	SOIL TYPE	EFFECTIVE UNIT WT. P.C.F.		C - UNIT COHESION - P.S.F.				FRICTION ANGLE DEGREES
				CENTER OF STRATUM		BOTTOM OF STRATUM		
		VERT. 1	VERT. 2	VERT. 1	VERT. 2	VERT. 1	VERT. 2	
1	CH	100.0	100.0	200.0	200.0	200.0	200.0	0.0
2	CH	34.0	34.0	150.0	150.0	150.0	150.0	0.0
3	ML	55.0	55.0	200.0	200.0	200.0	200.0	15.0
4	CH	38.0	38.0	235.0	235.0	300.0	300.0	0.0
5	CH	38.0	38.0	325.0	325.0	350.0	350.0	0.0
6	ML	55.0	55.0	200.0	200.0	200.0	200.0	15.0
7	CH	38.0	38.0	420.0	420.0	450.0	450.0	0.0
8	CH	38.0	38.0	420.0	420.0	450.0	450.0	0.0

ASSUMED FAILURE SURFACE			RESISTING FORCES			DRIVING FORCES		SUMMATION OF FORCES		FACTOR OF SAFETY
NO.		ELEV.	R_A	R_B	R_P	D_A	$-D_P$	RESISTING	DRIVING	
Ⓐ	①	-10.00	3600	1800	2100	5123	832	7500	4291	1.748
Ⓑ	①	-25.00	10523	10500	5640	17455	3300	26663	14155	1.884
Ⓒ	①	-30.00	13225	12250	8890	23109	6054	34365	17055	2.015
Ⓓ	①	-40.00	21101	13500	18132	36369	14954	52733	21414	2.462

NOTES

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

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

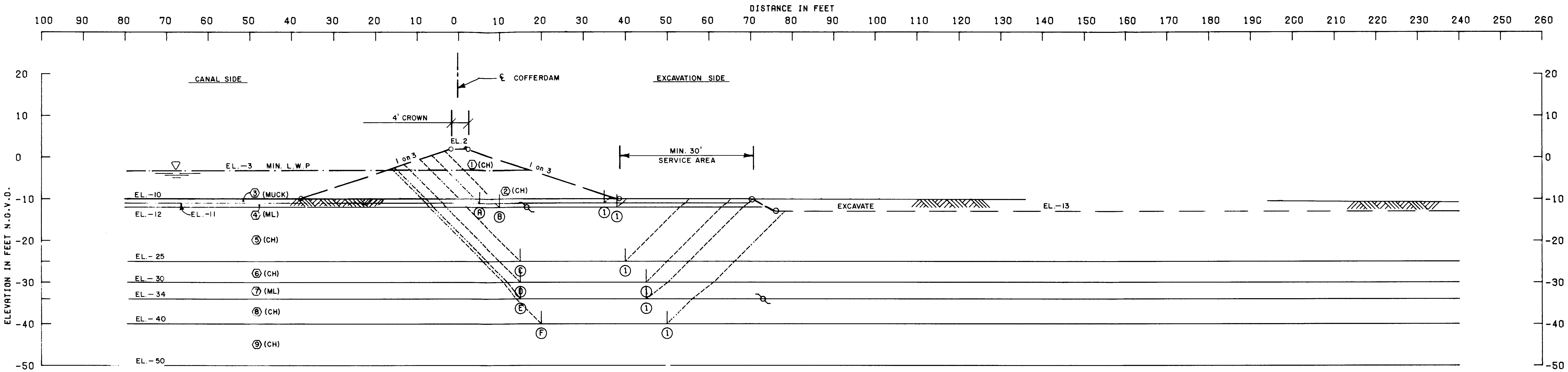
NEW ORLEANS TO VENICE, LA
DESIGN MEMORANDUM NO 1-GENERAL DESIGN
SUPPLEMENT NO. 5
REACH A-CITY PRICE TO TROPICAL BEND
CITY PRICE DRAINAGE STRUCTURE

STABILITY ANALYSIS

LANDSIDE COFFERDAM

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

AUGUST 1987 FILE NO. H-2-30260



GENERAL NOTES

CLASSIFICATION STRATIFICATION SHEAR STRENGTHS AND UNIT WEIGHTS OF THE SOIL WERE BASED ON THE RESULTS OF THE UNDISTURBED BORINGS. SEE BCR DATA PLATES FOR BORS. A-1-U, A-3-U 4-AU, 35-AU

STRATUM NO.	SOIL TYPE	EFFECTIVE UNIT WT. P.C.F.		C - UNIT COHESION - P.S.F.				FRICTION ANGLE DEGREES
				CENTER OF STRATUM		BOTTOM OF STRATUM		
		VERT. 1	VERT. 2	VERT. 1	VERT. 2	VERT. 1	VERT. 2	
1	CH	100.0	100.0	200.0	200.0	200.0	200.0	0.0
2	CH	38.0	38.0	200.0	200.0	200.0	200.0	0.0
3	MUCK	38.0	38.0	100.0	100.0	100.0	100.0	0.0
4	ML	55.0	55.0	200.0	200.0	200.0	200.0	15.0
5	CH	38.0	38.0	235.0	235.0	300.0	300.0	0.0
6	CH	38.0	38.0	325.0	325.0	350.0	350.0	0.0
7	ML	55.0	55.0	200.0	200.0	200.0	200.0	15.0
8	CH	38.0	38.0	420.0	420.0	450.0	450.0	0.0
9	CH	38.0	38.0	420.0	420.0	450.0	450.0	0.0

ASSUMED FAILURE SURFACE			RESISTING FORCES			DRIVING FORCES		SUMMATION OF FORCES		FACTOR OF SAFETY
NO.		ELEV.	R_A	R_B	R_P	D_A	$-D_P$	RESISTING	DRIVING	
A	1	-11.00	4400	3000	400	5869	57	7800	5813	1.342
B	1	-12.00	5368	7571	767	6135	84	13706	6051	2.265
C	1	-25.00	10782	7500	6877	17671	4502	25159	13169	1.911
D	1	-30.00	13513	10500	10127	23367	7911	34140	15456	2.209
E	1	-34.00	16483	13500	14655	28350	11457	44638	16893	2.642
F	1	-40.00	21464	13500	18493	36687	17244	53456	19443	2.749

NOTES

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

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

NEW ORLEANS TO VENICE LA
DESIGN MEMORANDUM NO 1-GENERAL DESIGN
SUPPLEMENT NO 5

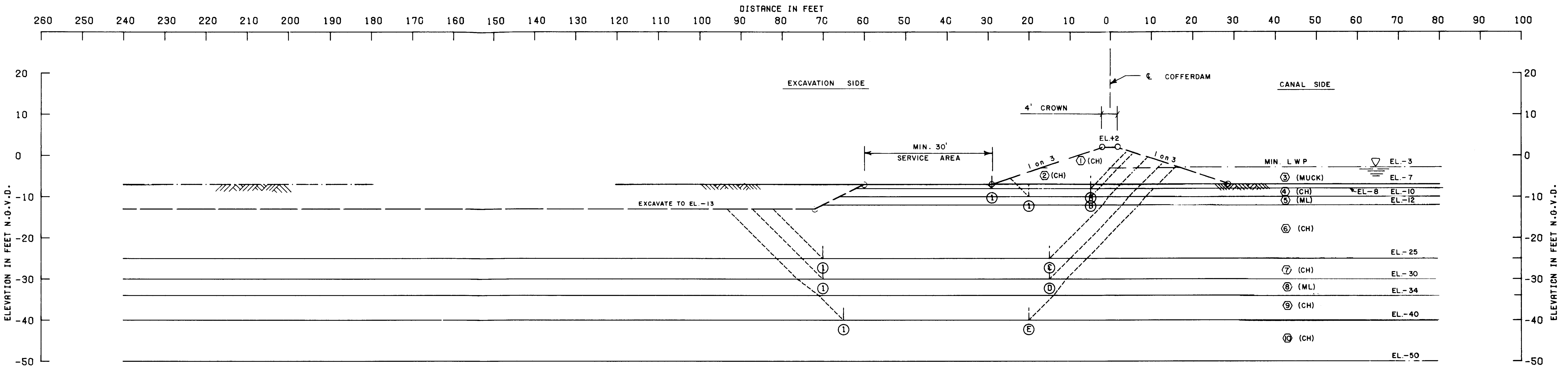
REACH A - CITY PRICE TO TROPICAL BEND
CITY PRICE DRAINAGE STRUCTURE

STABILITY ANALYSIS

COFFERDAM AT EAST CANAL

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

AUGUST 1987 FILE NO. H-2-30260



GENERAL NOTES

CLASSIFICATION STRATIFICATION SHEAR STRENGTHS AND UNIT WEIGHTS OF THE SOIL WERE BASED ON THE RESULTS OF THE UNDISTURBED BORINGS. SEE BOR DATA PLATES FOR

BORS A-1-U, A-3-U
4-AU, 35-AU

STRATUM NO.	SOIL TYPE	EFFECTIVE UNIT WT. P.C.F.		C - UNIT COHESION - P.S.F.				FRICTION ANGLE DEGREES
				CENTER OF STRATUM		BOTTOM OF STRATUM		
		VERT. 1	VERT. 2	VERT. 1	VERT. 2	VERT. 1	VERT. 2	
1	CH	100.0	100.0	200.0	200.0	200.0	200.0	0.0
2	CH	38.0	38.0	200.0	200.0	200.0	200.0	0.0
3	MUCK	38.0	38.0	100.0	100.0	100.0	100.0	0.0
4	CH	34.0	34.0	150.0	150.0	150.0	150.0	0.0
5	ML	55.0	55.0	200.0	200.0	200.0	200.0	15.0
6	CH	38.0	38.0	235.0	235.0	300.0	300.0	0.0
7	CH	38.0	38.0	325.0	325.0	350.0	350.0	0.0
8	ML	55.0	55.0	200.0	200.0	200.0	200.0	15.0
9	CH	38.0	38.0	420.0	420.0	450.0	450.0	0.0
10	CH	38.0	38.0	420.0	420.0	450.0	450.0	0.0

ASSUMED FAILURE SURFACE			RESISTING FORCES			DRIVING FORCES		SUMMATION OF FORCES		FACTOR OF SAFETY
NO.		ELEV.	R_A	R_B	R_P	D_A	$-D_P$	RESISTING	DRIVING	
A	1	-8.00	3500	2400	200	3965	19	6100	3946	1.546
B	1	-10.00	3900	2250	1400	5213	504	7550	4709	1.603
C	1	-25.00	10839	16500	5640	17845	2772	32979	15073	2.188
D	1	-30.00	13541	19250	8890	23600	5526	41681	18073	2.306
E	1	-40.00	21450	20250	18132	37001	14954	59832	22047	2.714

NOTES

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

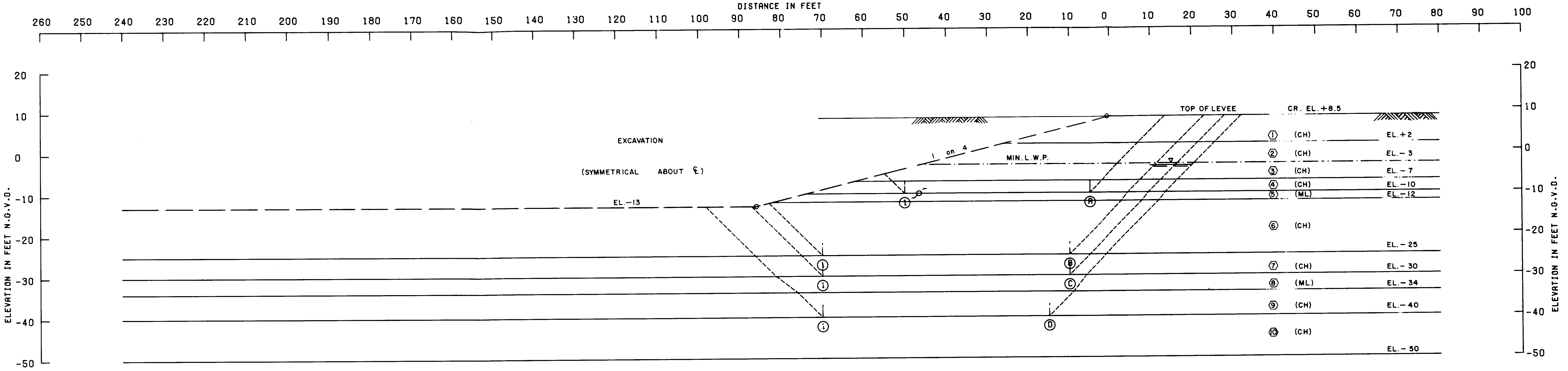
$$\text{FACTOR OF SAFETY} = \frac{R_A + R_B + R_P}{D_A - D_P}$$

NEW ORLEANS TO VENICE, LA
DESIGN MEMORANDUM NO 1-GENERAL DESIGN
SUPPLEMENT NO 5
REACH A-CITY PRICE TO TROPICAL BEND
CITY PRICE DRAINAGE STRUCTURE

STABILITY ANALYSIS

COFFERDAM AT WEST CANAL

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
AUGUST 1987 FILE NO. H-2-30260



GENERAL NOTES

CLASSIFICATION STRATIFICATION SHEAR STRENGTHS AND UNIT WEIGHTS OF THE SOIL WERE BASED ON THE RESULTS OF THE [illegible] [illegible]. PLATE FOR BOR. A-2-BU

STRATUM NO.	SOIL TYPE	EFFECTIVE UNIT WT. P.C.F.		C - UNIT COHESION - P.S.F.				FRICTION ANGLE DEGREES
				CENTER OF STRATUM		BOTTOM OF STRATUM		
		VERT. 1	VERT. 2	VERT. 1	VERT. 2	VERT. 1	VERT. 2	
1	CH	108.0	108.0	400.0	400.0	400.0	400.0	0.0
2	CH	86.0	86.0	300.0	300.0	300.0	300.0	0.0
3	CH	24.0	24.0	300.0	300.0	300.0	300.0	0.0
4	CH	34.0	34.0	300.0	300.0	300.0	300.0	0.0
5	ML	55.0	55.0	200.0	200.0	200.0	200.0	15.0
6	CH	38.0	38.0	300.0	300.0	300.0	300.0	0.0
7	CH	38.0	38.0	325.0	325.0	350.0	350.0	0.0
8	ML	55.0	55.0	200.0	200.0	200.0	200.0	15.0
9	CH	38.0	38.0	420.0	420.0	450.0	450.0	0.0
10	CH	38.0	38.0	420.0	420.0	450.0	450.0	0.0

ASSUMED FAILURE SURFACE			RESISTING FORCES			DRIVING FORCES		SUMMATION OF FORCES		FACTOR OF SAFETY
NO.		ELEV.	R_A	R_B	R_P	D_A	$-D_P$	RESISTING	DRIVING	
Ⓐ	ⓘ	-10.00	12400	13471	2880	15142	867	28751	14274	2.014
Ⓑ	ⓘ	-25.00	21953	18000	7680	38982	4152	47633	34830	1.368
Ⓒ	ⓘ	-30.00	25203	21000	10450	49128	6967	56653	42161	1.344
Ⓓ	ⓘ	-40.00	34863	24750	19923	71217	15767	79536	55450	1.434

NOTES

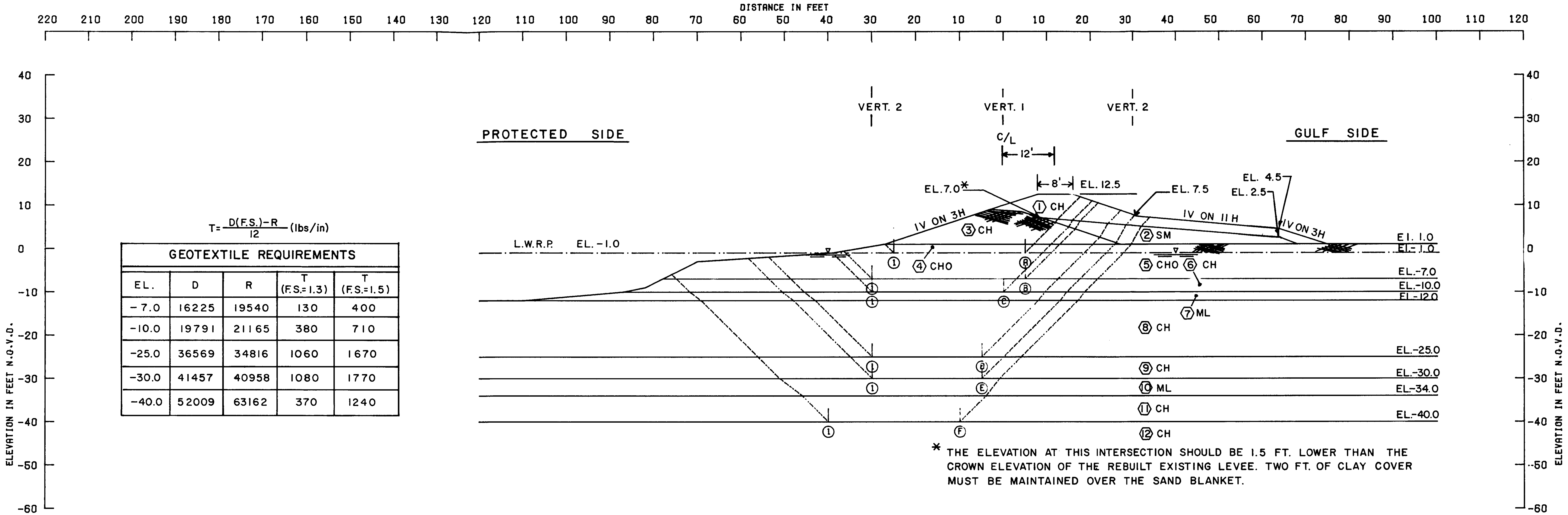
- ◇ -- STRATUM NUMBER
- ○ -- WEDGE NUMBER
- -- CROSSOVER POINT
- Φ -- ANGLE OF INTERNAL FRICTION, DEGREES
- C -- UNIT COHESION, P.S.F.
- ∇ -- STATIC WATER SURFACE
- D -- HORIZONTAL DRIVING FORCE IN POUNDS
- R -- HORIZONTAL RESISTING FORCE IN POUNDS
- A -- AS A SUBSCRIPT, REFERS TO ACTIVE WEDGE
- B --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

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

NEW ORLEANS TO VENICE, LA
DESIGN MEMORANDUM NO 1-GENERAL DESIGN
SUPPLEMENT NO. 5
REACH A-CITY PRICE TO TROPICAL BEND
CITY PRICE DRAINAGE STRUCTURE

STABILITY ANALYSIS

EXISTING LEVEE EXCAVATION
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
AUGUST 1987 FILE NO. H-2-30260



$T = \frac{D(F.S.) - R}{12}$ (lbs/in)

GEOTEXTILE REQUIREMENTS				
EL.	D	R	T (F.S.=1.3)	T (F.S.=1.5)
-7.0	16225	19540	130	400
-10.0	19791	21165	380	710
-25.0	36569	34816	1060	1670
-30.0	41457	40958	1080	1770
-40.0	52009	63162	370	1240

* THE ELEVATION AT THIS INTERSECTION SHOULD BE 1.5 FT. LOWER THAN THE CROWN ELEVATION OF THE REBUILT EXISTING LEVEE. TWO FT. OF CLAY COVER MUST BE MAINTAINED OVER THE SAND BLANKET.

GENERAL NOTES

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

SHEAR STRENGTHS BETWEEN VERTICALS 1 AND 2 WERE ASSUMED TO VARY LINEARLY BETWEEN THE VALUES INDICATED FOR THESE LOCATIONS.

STRATUM NO.	SOIL TYPE	EFFECTIVE UNIT WT. P.C.F.		C - UNIT COHESION - P.S.F.				FRICTION ANGLE
				CENTER OF STRATUM		BOTTOM OF STRATUM		
		VERT. 1	VERT. 2	VERT. 1	VERT. 2	VERT. 1	VERT. 2	DEGREES
1	CH	100.0	100.0	200.0	200.0	200.0	200.0	0.0
2	SM	122.0	122.0	0.0	0.0	0.0	0.0	30.0
3	CH	108.0	108.0	400.0	400.0	400.0	400.0	0.0
4	CHO	86.0	86.0	300.0	150.0	300.0	150.0	0.0
5	CHO	24.0	24.0	300.0	150.0	300.0	150.0	0.0
6	CH	34.0	34.0	300.0	150.0	300.0	150.0	0.0
7	ML	55.0	55.0	200.0	200.0	200.0	200.0	15.0
8	CH	38.0	38.0	300.0	230.0	300.0	230.0	0.0
9	CH	38.0	38.0	325.0	325.0	325.0	325.0	0.0
10	ML	55.0	55.0	200.0	200.0	200.0	200.0	15.0
11	CH	38.0	38.0	420.0	420.0	420.0	420.0	0.0
12	CH	38.0	38.0	420.0	420.0	420.0	420.0	0.0

ASSUMED FAILURE SURFACE		RESISTING FORCES			DRIVING FORCES		SUMMATION OF FORCES		FACTOR OF SAFETY
NO.	ELEV.	R_A	R_B	R_P	D_A	$-D_P$	RESISTING	DRIVING	
A 1	-1.00	7472	7375	680	9164	243	15527	8921	1.740
B 1	-7.00	9424	8188	1929	17181	956	19540	16225	1.204
C 1	-10.00	11698	6767	2700	21387	1596	21165	19791	1.069
D 1	-25.00	18490	6479	9848	46432	9862	34816	36569	0.952
E 1	-30.00	19837	8125	12996	55917	14459	40958	41457	0.988
F 1	-40.00	28433	12600	22129	77556	25547	63162	52009	1.214

NOTES

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

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

$D = D_A - D_P$ = DRIVING FORCE

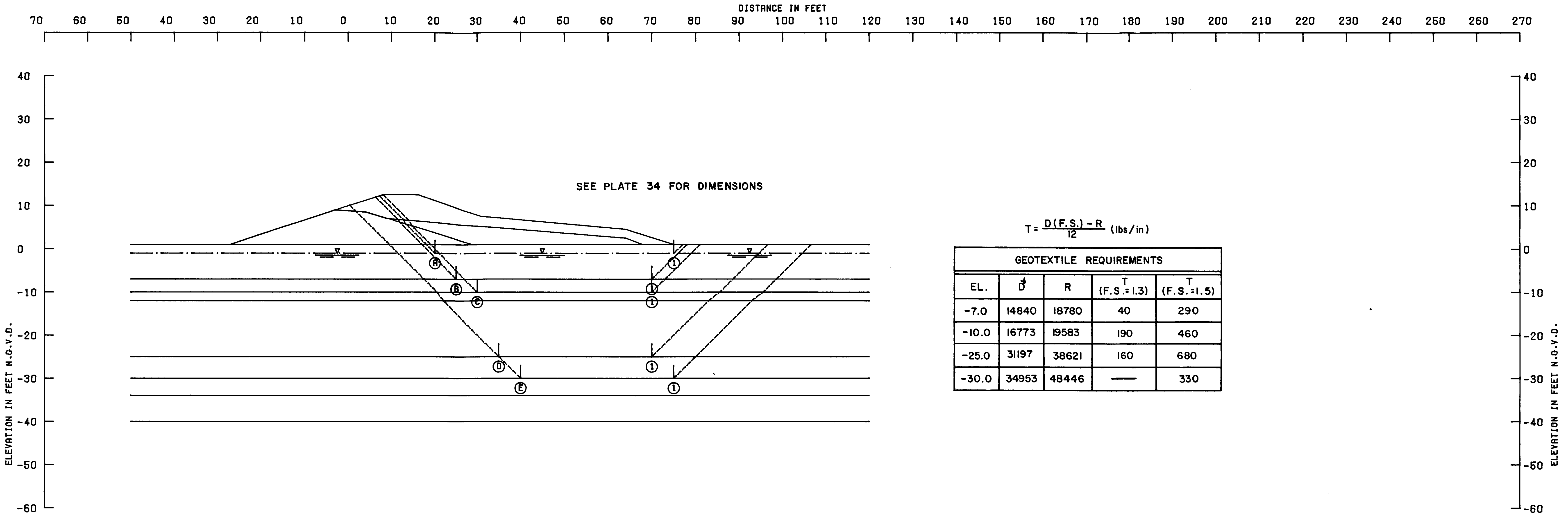
$R = R_A + R_B + R_P$ = RESISTING FORCE

T = FABRIC TENSILE STRENGTH (lbs/in)

NEW ORLEANS TO VENICE, LA.
DESIGN MEMORANDUM NO. 1-GENERAL, DESIGN SUPPLEMENT NO. 5
REACH A-CITY PRICE TO TROPICAL BEND
STA. 9+04 TO 29+55 & 31+00 TO 83+80
PROTECTED SIDE ANALYSIS
GEOTEXTILE REINFORCED LEVEE

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

AUGUST 1987 FILE NO. H-2-30260



$$T = \frac{D(F.S.) - R}{12} \text{ (lbs/in)}$$

GEOTEXTILE REQUIREMENTS				
EL.	D	R	T (F.S.=1.3)	T (F.S.=1.5)
-7.0	14840	18780	40	290
-10.0	16773	19583	190	460
-25.0	31197	38621	160	680
-30.0	34953	48446	——	330

GENERAL NOTES

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

SHEAR STRENGTHS BETWEEN VERTICALS 1 AND 2 WERE ASSUMED TO VARY LINEARLY BETWEEN THE VALUES INDICATED FOR THESE LOCATIONS.

STRATUM NO.	SOIL TYPE	EFFECTIVE UNIT WT. P.C.F.		C - UNIT COHESION - P.S.F.				FRICTION ANGLE DEGREES
				CENTER OF STRATUM		BOTTOM OF STRATUM		
		VERT. 1	VERT. 2	VERT. 1	VERT. 2	VERT. 1	VERT. 2	
1	CH	100.0	100.0	200.0	200.0	200.0	200.0	0.0
2	SM	122.0	122.0	0.0	0.0	0.0	0.0	30.0
3	CH	108.0	108.0	400.0	400.0	400.0	400.0	0.0
4	CHO	86.0	86.0	300.0	150.0	300.0	150.0	0.0
5	CHO	24.0	24.0	300.0	150.0	300.0	150.0	0.0
6	CH	34.0	34.0	300.0	150.0	300.0	150.0	0.0
7	ML	55.0	55.0	200.0	200.0	200.0	200.0	15.0
8	CH	38.0	38.0	300.0	230.0	300.0	230.0	0.0
9	CH	38.0	38.0	325.0	325.0	325.0	325.0	0.0
10	ML	55.0	55.0	200.0	200.0	200.0	200.0	15.0
11	CH	38.0	38.0	420.0	420.0	420.0	420.0	0.0
12	CH	38.0	38.0	420.0	420.0	420.0	420.0	0.0

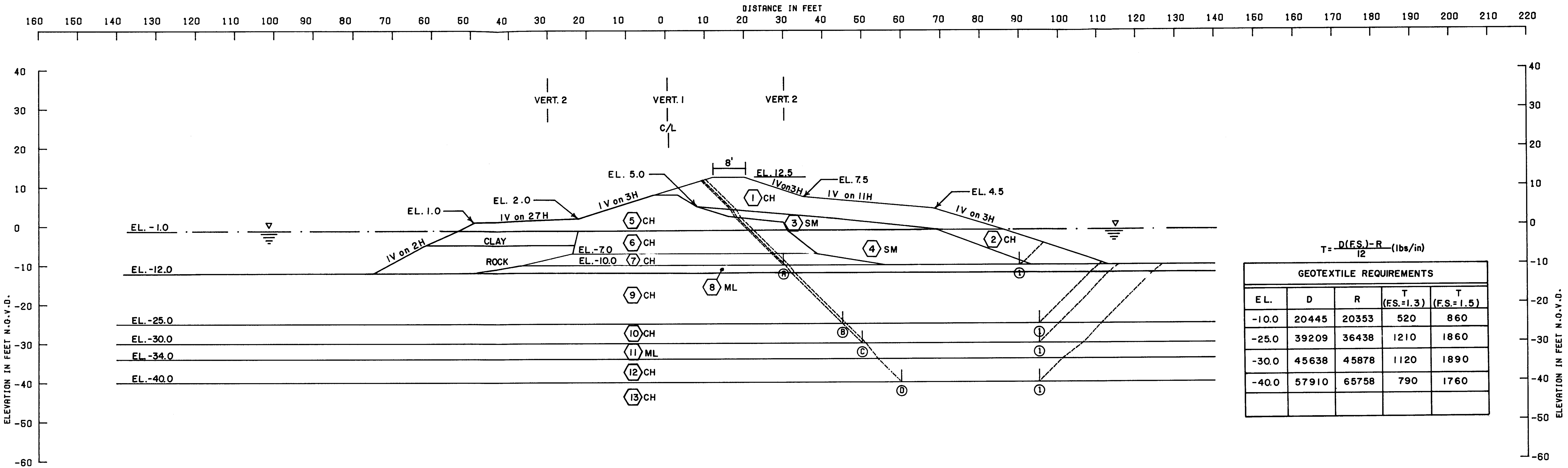
ASSUMED FAILURE SURFACE			RESISTING FORCES			DRIVING FORCES		SUMMATION OF FORCES		FACTOR OF SAFETY
NO.		ELEV.	R_A	R_B	R_P	D_A	$-D_P$	RESISTING	DRIVING	
A	1	-1.00	7228	8500	600	9176	171	16328	9005	1.813
B	1	-7.00	9567	6813	2400	16872	2032	18780	14840	1.265
C	1	-10.00	10281	6002	3300	19905	3132	19583	16773	1.168
D	1	-25.00	19588	8050	10983	45347	14151	38621	31197	1.238
E	1	-30.00	22838	11375	14233	54291	19338	48446	34953	1.386

NOTES

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

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

NEW ORLEANS TO VENICE, LA.
DESIGN MEMORANDUM NO.1-GENERAL, DESIGN SUPPLEMENT NO.5
REACH A-CITY PRICE TO TROPICAL BEND
STA. 9+04 TO 29+55 AND 31+00 TO 83+80
GEOTEXTILE REINFORCED LEVEE
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
AUGUST 1987 FILE NO. H-2-30260



$$T = \frac{D(F.S.) - R}{12} \text{ (lbs/in)}$$

GEOTEXTILE REQUIREMENTS				
EL.	D	R	T (F.S.=1.3)	T (F.S.=1.5)
-10.0	20445	20353	520	860
-25.0	39209	36438	1210	1860
-30.0	45638	45878	1120	1890
-40.0	57910	65758	790	1760

GENERAL NOTES

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

SHEAR STRENGTHS BETWEEN VERTICALS 1 AND 2 WERE ASSUMED TO VARY LINEARLY BETWEEN THE VALUES INDICATED FOR THESE LOCATIONS.

STRATUM NO.	SOIL TYPE	EFFECTIVE UNIT WT. P.C.F.		C - UNIT COHESION - P.S.F.				FRICTION ANGLE DEGREES
				CENTER OF STRATUM		BOTTOM OF STRATUM		
		VERT. 1	VERT. 2	VERT. 1	VERT. 2	VERT. 1	VERT. 2	
1	CH	100.0	100.0	200.0	200.0	200.0	200.0	0.0
2	CH	38.0	38.0	100.0	100.0	100.0	100.0	0.0
3	SM	122.0	122.0	0.0	0.0	0.0	0.0	30.0
4	SM	60.0	60.0	0.0	0.0	0.0	0.0	30.0
5	CH	108.0	108.0	400.0	400.0	400.0	400.0	0.0
6	CH	24.0	24.0	300.0	150.0	300.0	150.0	0.0
7	CH	34.0	34.0	300.0	150.0	300.0	150.0	0.0
8	ML	55.0	55.0	200.0	200.0	200.0	200.0	15.0
9	CH	38.0	38.0	300.0	230.0	300.0	230.0	0.0
10	CH	38.0	38.0	325.0	325.0	325.0	325.0	0.0
11	ML	55.0	55.0	200.0	200.0	200.0	200.0	15.0
12	CH	38.0	38.0	420.0	420.0	420.0	420.0	0.0
13	CH	38.0	38.0	420.0	420.0	420.0	420.0	0.0

ASSUMED FAILURE SURFACE		RESISTING FORCES			DRIVING FORCES		SUMMATION OF FORCES		FACTOR OF SAFETY
NO.	ELEV.	R_A	R_B	R_P	D_A	$-D_P$	RESISTING	DRIVING	
A 1	-10.00	9936	9042	1375	21256	811	20353	20445	0.995
B 1	-25.00	17654	11500	7284	45953	6744	36438	39209	0.929
C 1	-30.00	20904	14625	10349	55932	10294	45878	45638	1.005
D 1	-40.00	30727	14700	20331	78442	20532	65758	57910	1.136

NOTES

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

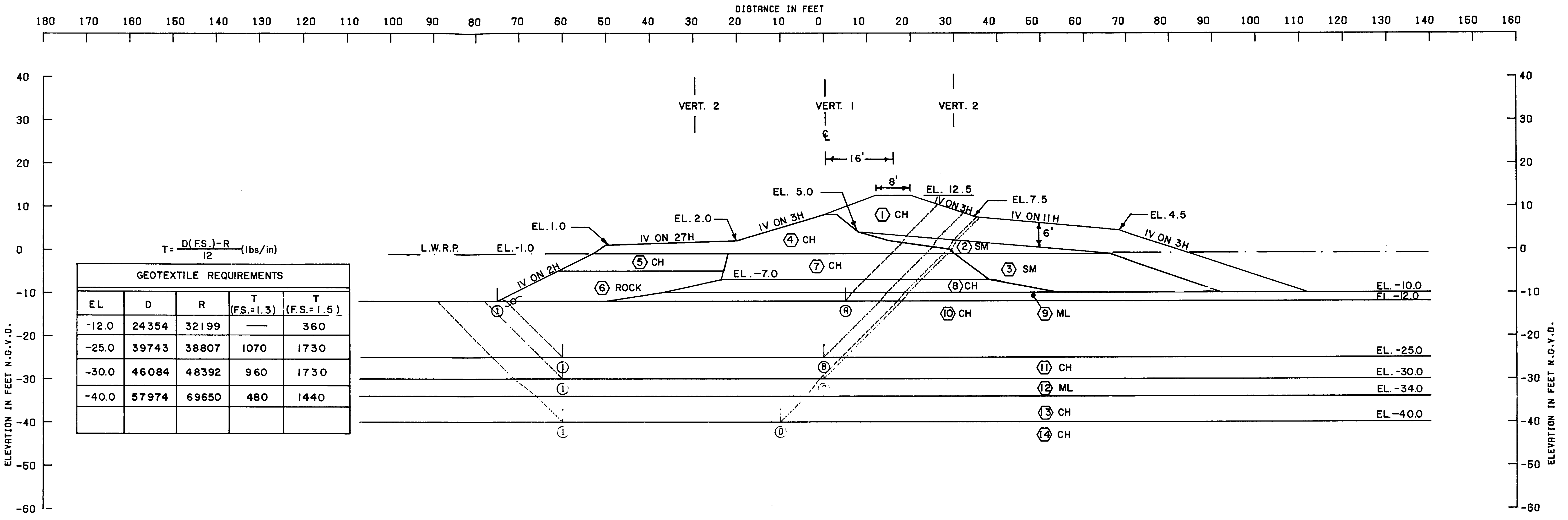
FACTOR OF SAFETY = $\frac{R_A + R_B + R_P}{D_A - D_P}$

$D = D_A - D_P$ = DRIVING FORCE

$R = R_A + R_B + R_P$ = RESISTING FORCE

T=FABRIC TENSILE STRENGTH (LBS/IN)

NEW ORLEANS TO VENICE, LA.
DESIGN MEMORANDUM NO. 1-GENERAL, DESIGN SUPPLEMENT NO. 5
REACH A-CITY PRICE TO TROPICAL BEND
STA. 29+55 TO STA. 31+00
HAPPY JACK MARINA
GULF SIDE ANALYSIS
GEOTEXTILE REINFORCED LEVEE
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
AUGUST 1987 FILE NO. H-2-30260



$T = \frac{D(F.S.)-R}{12}$ (lbs/in)

GEOTEXTILE REQUIREMENTS				
EL	D	R	T (F.S.=1.3)	T (F.S.=1.5)
-12.0	24354	32199	—	360
-25.0	39743	38807	1070	1730
-30.0	46084	48392	960	1730
-40.0	57974	69650	480	1440

GENERAL NOTES

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

SHEAR STRENGTHS BETWEEN VERTICALS 1 AND 2 WERE ASSUMED TO VARY LINEARLY BETWEEN THE VALUES INDICATED FOR THESE LOCATIONS.

STRATUM NO.	SOIL TYPE	EFFECTIVE UNIT WT. P.C.F.		C - UNIT COHESION - P.S.F.				FRICTION ANGLE DEGREES
				CENTER OF STRATUM		BOTTOM OF STRATUM		
		VERT. 1	VERT. 2	VERT. 1	VERT. 2	VERT. 1	VERT. 2	
1	CH	100.0	100.0	200.0	200.0	200.0	200.0	0.0
2	SM	122.0	122.0	0.0	0.0	0.0	0.0	30.0
3	SM	60.0	60.0	0.0	0.0	0.0	0.0	30.0
4	CH	108.0	108.0	400.0	400.0	400.0	400.0	0.0
5	CH	38.0	38.0	100.0	100.0	100.0	100.0	0.0
6	ROC	60.0	60.0	0.0	0.0	0.0	0.0	40.0
7	CH	24.0	24.0	300.0	150.0	300.0	150.0	0.0
8	CH	34.0	34.0	300.0	150.0	300.0	150.0	0.0
9	ML	55.0	55.0	200.0	200.0	200.0	200.0	15.0
10	CH	38.0	38.0	300.0	230.0	300.0	230.0	0.0
11	CH	38.0	38.0	325.0	325.0	325.0	325.0	0.0
12	ML	55.0	55.0	200.0	200.0	200.0	200.0	15.0
13	CH	38.0	38.0	420.0	420.0	420.0	420.0	0.0
14	CH	38.0	38.0	420.0	420.0	420.0	420.0	0.0

ASSUMED FAILURE SURFACE		RESISTING FORCES			DRIVING FORCES		SUMMATION OF FORCES		FACTOR OF SAFETY
NO.	ELEV.	R_A	R_B	R_P	D_A	$-D_P$	RESISTING	DRIVING	
A 1	-12.00	12251	19948	0	24354	0	32199	24354	1.322
B 1	-25.00	17926	14850	6032	46274	6531	38807	39743	0.976
C 1	-30.00	19602	19500	9230	55604	9521	48392	46084	1.050
D 1	-40.00	29542	21000	19108	76545	18570	69650	57974	1.201

NOTES

◇ -- STRATUM NUMBER
○ -- WEDGE NUMBER
∫ -- CROSSOVER POINT
Φ -- ANGLE OF INTERNAL FRICTION, DEGREES
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▽ -- STATIC WATER SURFACE
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B -- AS A SUBSCRIPT REFERS TO CENTRAL BLOCK
P -- AS A SUBSCRIPT REFERS TO PASSIVE WEDGE

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

$D = D_A - D_P$ = DRIVING FORCE

$R = R_A + R_B + R_P$ = RESISTING FORCE

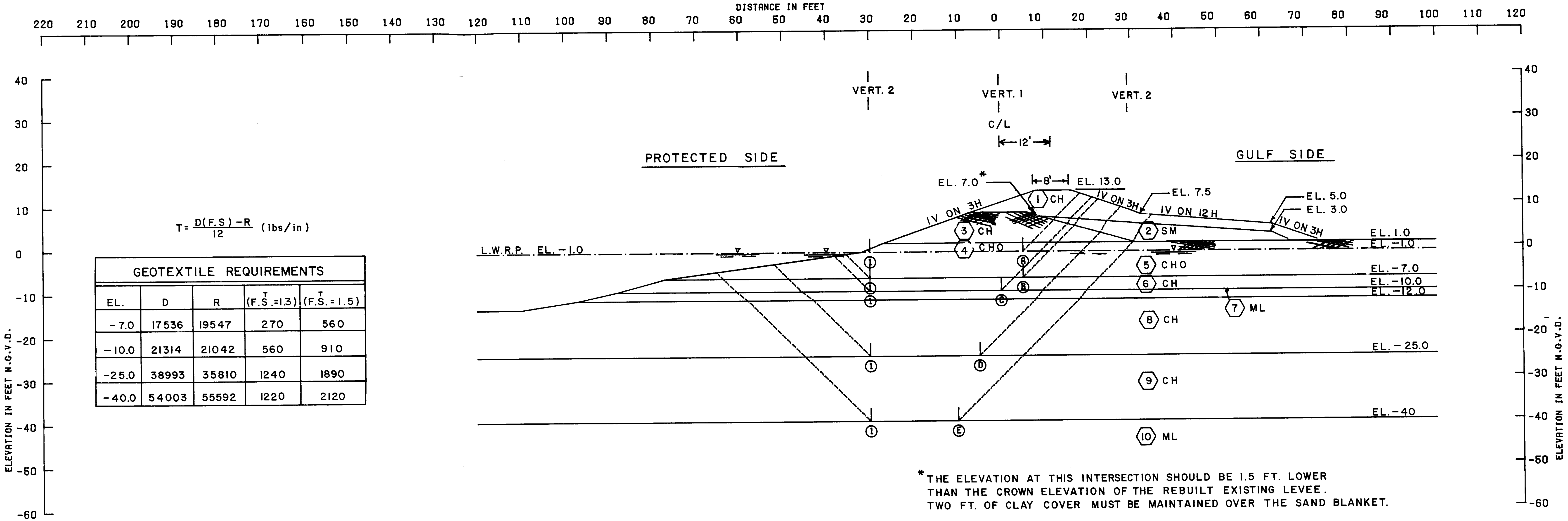
T = FABRIC TENSILE STRENGTH (LBS/IN)

NEW ORLEANS TO VENICE, LA.
DESIGN MEMORANDUM NO. 1-GENERAL, DESIGN SUPPLEMENT NO. 5

REACH A-CITY PRICE TO TROPICAL BEND
STA. 29 + 55 TO STA. 31 + 00
HAPPY JACK MARINA
PROTECTED SIDE ANALYSIS
GEOTEXTILE REINFORCED LEVEE

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

AUGUST 1987 FILE NO. H-2-30280



$T = \frac{D(F.S) - R}{12}$ (lbs/in)

GEOTEXTILE REQUIREMENTS				
EL.	D	R	T (F.S.=1.3)	T (F.S.=1.5)
-7.0	17536	19547	270	560
-10.0	21314	21042	560	910
-25.0	38993	35810	1240	1890
-40.0	54003	55592	1220	2120

*THE ELEVATION AT THIS INTERSECTION SHOULD BE 1.5 FT. LOWER THAN THE CROWN ELEVATION OF THE REBUILT EXISTING LEVEE. TWO FT. OF CLAY COVER MUST BE MAINTAINED OVER THE SAND BLANKET.

GENERAL NOTES

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

SHEAR STRENGTHS BETWEEN VERTICALS 1 AND 2 WERE ASSUMED TO VARY LINEARLY BETWEEN THE VALUES INDICATED FOR THESE LOCATIONS.

STRATUM NO.	SOIL TYPE	EFFECTIVE UNIT WT. P.C.F.		C - UNIT COHESION - P.S.F.				FRICTION ANGLE
		VERT. 1	VERT. 2	CENTER OF STRATUM VERT. 1	CENTER OF STRATUM VERT. 2	BOTTOM OF STRATUM VERT. 1	BOTTOM OF STRATUM VERT. 2	DEGREES
1	CH	100.0	100.0	200.0	200.0	200.0	200.0	0.0
2	SM	122.0	122.0	0.0	0.0	0.0	0.0	30.0
3	CH	108.0	108.0	400.0	400.0	400.0	400.0	0.0
4	CHO	86.0	86.0	300.0	150.0	300.0	150.0	0.0
5	CHO	24.0	24.0	300.0	150.0	300.0	150.0	0.0
6	CH	34.0	34.0	300.0	150.0	300.0	150.0	0.0
7	ML	55.0	55.0	200.0	200.0	200.0	200.0	15.0
8	CH	38.0	38.0	300.0	235.0	300.0	300.0	0.0
9	CH	38.0	38.0	375.0	375.0	450.0	450.0	0.0
10	ML	55.0	55.0	200.0	200.0	200.0	200.0	15.0

ASSUMED FAILURE SURFACE NO.	ELEV.	RESISTING FORCES R_A	R_B	R_P	DRIVING FORCES D_A	$-D_P$	SUMMATION OF FORCES RESISTING	DRIVING	FACTOR OF SAFETY
A 1	-1.00	7688	8188	171	9806	19	16047	9786	1.640
B 1	-7.00	9700	8188	1659	18013	477	19547	17536	1.115
C 1	-10.00	11960	6628	2453	22329	1015	21042	21314	0.987
D 1	-25.00	18890	7500	9420	47819	8825	35810	38993	0.918
E 1	-40.00	26519	9000	20073	78605	24602	55592	54003	1.029

NOTES

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

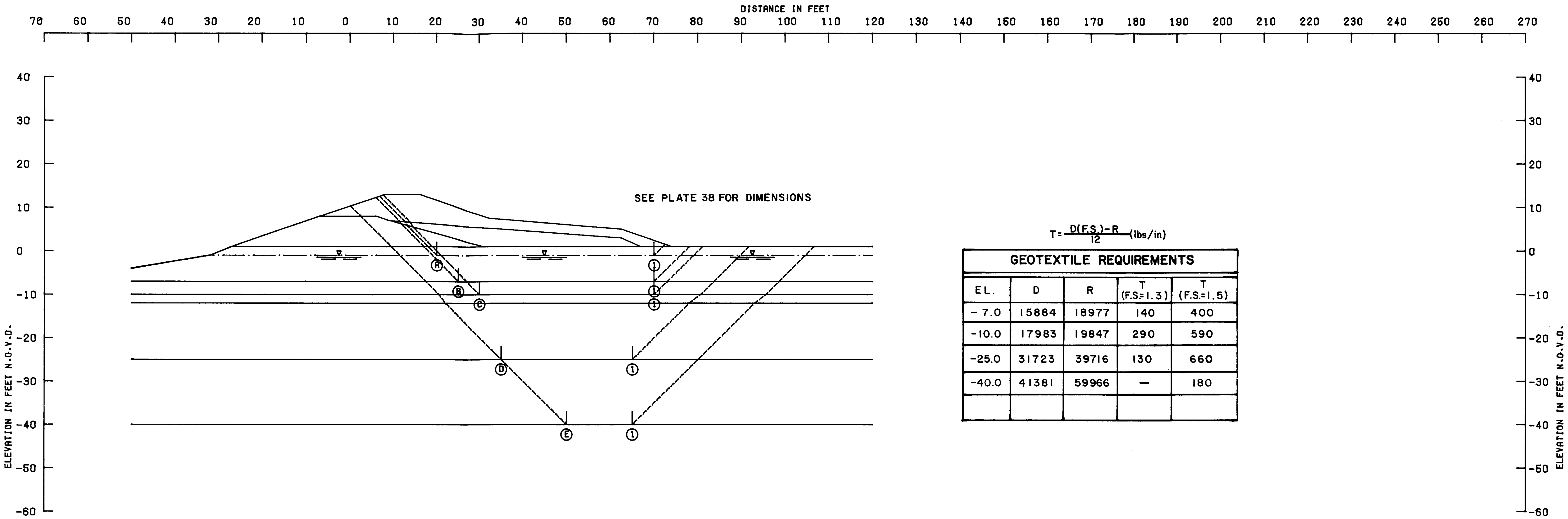
FACTOR OF SAFETY = $\frac{R_A + R_B + R_P}{D_A - D_P}$

$D = D_A - D_P$ = DRIVING FORCE

$R = R_A + B_B + R_P$ = RESISTING FORCE

T = FABRIC TENSILE STRENGTH (lbs/in)

NEW ORLEANS TO VENICE, LA.
DESIGN MEMORANDUM NO. 1-GENERAL, DESIGN SUPPLEMENT NO. 5
REACH A-CITY PRICE TO TROPICAL BEND
STA. 83+80 TO 109+88 & 113+30 TO 245+00
281+04 - 282+50 284+80 - 286+38
PROTECTED SIDE ANALYSIS
GEOTEXTILE REINFORCED LEVEE
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
AUGUST 1987 FILE NO. H-2-30260



$$T = \frac{D(F.S.) - R}{12} \text{ (lbs/in)}$$

GEOTEXTILE REQUIREMENTS				
EL.	D	R	T (F.S.=1.3)	T (F.S.=1.5)
-7.0	15884	18977	140	400
-10.0	17983	19847	290	590
-25.0	31723	39716	130	660
-40.0	41381	59966	—	180

GENERAL NOTES

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

SHEAR STRENGTHS BETWEEN VERTICALS 1 AND 2 WERE ASSUMED TO VARY LINEARLY BETWEEN THE VALUES INDICATED FOR THESE LOCATIONS.

STRATUM NO.	SOIL TYPE	EFFECTIVE UNIT WT. P.C.F.		C - UNIT COHESION - P.S.F.				FRICTION ANGLE DEGREES
				CENTER OF STRATUM		BOTTOM OF STRATUM		
		VERT. 1	VERT. 2	VERT. 1	VERT. 2	VERT. 1	VERT. 2	
1	CH	100.0	100.0	200.0	200.0	200.0	200.0	0.0
2	SM	122.0	122.0	0.0	0.0	0.0	0.0	30.0
3	CH	108.0	108.0	400.0	400.0	400.0	400.0	0.0
4	CHO	86.0	86.0	300.0	150.0	300.0	150.0	0.0
5	CHO	24.0	24.0	300.0	150.0	300.0	150.0	0.0
6	CH	34.0	34.0	300.0	150.0	300.0	150.0	0.0
7	ML	55.0	55.0	200.0	200.0	200.0	200.0	15.0
8	CH	38.0	38.0	300.0	235.0	300.0	300.0	0.0
9	CH	38.0	38.0	375.0	375.0	450.0	450.0	0.0
10	ML	55.0	55.0	200.0	200.0	200.0	200.0	15.0

ASSUMED FAILURE SURFACE			RESISTING FORCES			DRIVING FORCES		SUMMATION OF FORCES		FACTOR OF SAFETY
NO.		ELEV.	R_A	R_B	R_P	D_A	$-D_P$	RESISTING	DRIVING	
A	1	-1.00	7451	7750	806	9834	397	16008	9436	1.696
B	1	-7.00	9764	6813	2400	17796	1912	18977	15884	1.195
C	1	-10.00	10534	6013	3300	20996	3013	19847	17983	1.104
D	1	-25.00	19603	9000	11113	46904	15180	39716	31723	1.252
E	1	-40.00	30853	6750	22363	76164	34783	59966	41381	1.449

NOTES

⬡ -- STRATUM NUMBER
○ -- WEDGE NUMBER
-- CROSSOVER POINT
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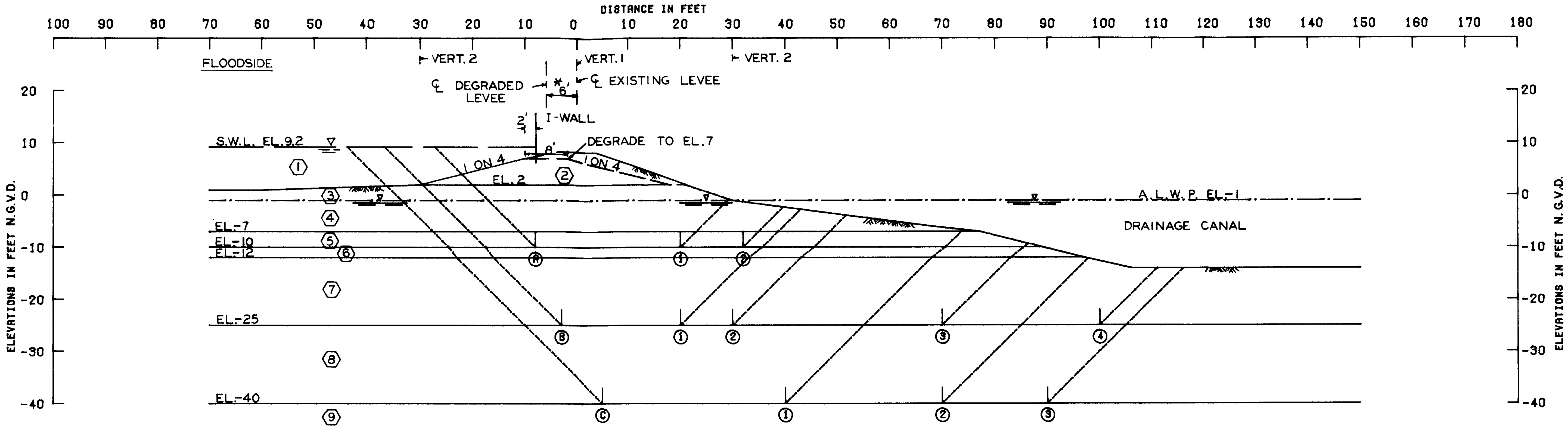
$$\text{FACTOR OF SAFETY} = \frac{R_A + R_B + R_P}{D_A - D_P}$$

NEW ORLEANS TO VENICE, LA.
DESIGN MEMORANDUM NO. I-GENERAL, DESIGN SUPPLEMENT NO. 5

REACH A—CITY PRICE TO TROPICAL BEND
STA. 83+80 TO 109+88 & 113+30 TO 245-00
281+04 - 282+50 284+80 - 286+38
GULF SIDE ANALYSIS
GEOTEXTILE REINFORCED LEVEE

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
AUGUST 1987 FILE NO. H-2-30260



GENERAL NOTES

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

SHEAR STRENGTHS BETWEEN VERTICALS 1 AND 2 WERE ASSUMED TO VARY LINEARLY BETWEEN THE VALUES INDICATED FOR THESE LOCATIONS.

THIS DESIGN SECTION MAY BE USED IN AREAS WHERE THERE IS AN EXISTING LEVEE.

* THE MAXIMUM DISTANCE POSSIBLE SHOULD BE MAINTAINED TO THE FLOODSIDE OF EXISTING ℄.

THE NET DIAGRAM FOR THE NEW LEVEE I-WALL (SHOWN ON PLATE 114 OF OCT 83 GDM) ALSO APPLIES TO THIS EXISISTING LEVEE I-WALL

VERT. 1 = BORS. 34-AUC & A-10-BU
VERT. 2 = BORS. A-4-U, A-5-U, 34-AU, A-6-U, A-7-U, A-8-U, 33-AU, 32-AU, A-9-U, A-10-U, 36-AU, 37-AU & 38-AU.

STRATUM NO.	SOIL TYPE	EFFECTIVE UNIT WT. P.C.F.		C - UNIT COHESION - P.S.F.				FRICTION ANGLE DEGREES
				CENTER OF STRATUM		BOTTOM OF STRATUM		
		VERT. 1	VERT. 2	VERT. 1	VERT. 2	VERT. 1	VERT. 2	
1	WATER	62.5	62.5	0.0	0.0	0.0	0.0	0.0
2	CH	108.0	108.0	400.0	400.0	400.0	400.0	0.0
3	CHO	86.0	86.0	300.0	150.0	300.0	150.0	0.0
4	CHO	24.0	24.0	300.0	150.0	300.0	150.0	0.0
5	CH	34.0	34.0	300.0	150.0	300.0	150.0	0.0
6	ML	55.0	55.0	200.0	200.0	200.0	200.0	15.0
7	CH	38.0	38.0	300.0	235.0	300.0	300.0	0.0
8	CH	38.0	38.0	375.0	375.0	450.0	450.0	0.0
9	ML	55.0	55.0	200.0	200.0	200.0	200.0	15.0

ASSUMED FAILURE SURFACE NO.	ELEV.	RESISTING FORCES R_A	R_B	R_P	DRIVING FORCES D_A	$-D_P$	SUMMATION OF FORCES RESISTING	DRIVING	FACTOR OF SAFETY
A 1	-10.00	7120	7060	3272	13026	2423	17452	10603	1.648
A 2	-10.00	7120	9110	2316	13026	853	18546	12173	1.524
B 1	-25.00	13283	6900	9941	33071	10583	30124	22488	1.340
B 2	-25.00	13283	9900	9351	33071	8637	32534	24434	1.332
B 3	-25.00	13283	21900	7488	33071	6076	42671	26995	1.581
B 4	-25.00	13283	30900	5170	33071	2449	49353	30622	1.612
C 1	-40.00	23109	15750	19652	60724	23285	58511	37439	1.563
C 2	-40.00	23109	29250	17275	60724	18808	69634	41915	1.661
C 3	-40.00	23109	38250	16420	60724	14050	77779	46674	1.666
WITH WATER AT EL.-6 IN THE DRAINAGE CANAL, EL.-1 FLOODSIDE.									
B 2	-25.00	13337	9900	9526	34794	11622	32763	23172	1.414
B 4	-25.00	13337	30900	5170	34794	2448	49407	32346	1.527

NOTES

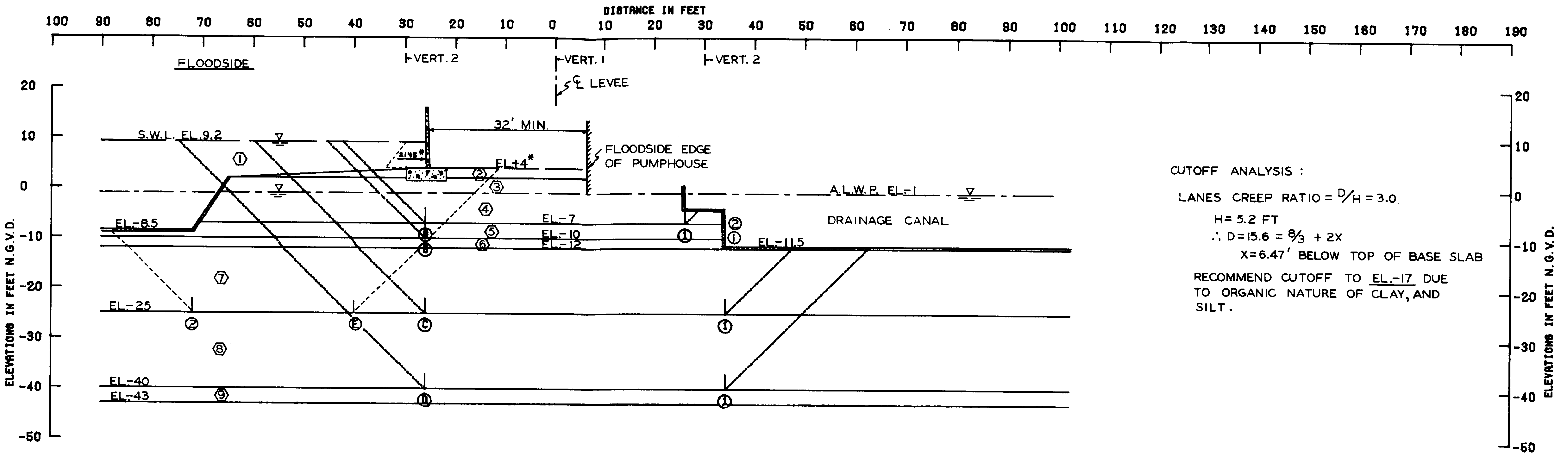
ϕ -- ANGLE OF INTERNAL FRICTION, DEGREES
C -- UNIT COHESION, P.S.F.
▽ -- STATIC WATER SURFACE
D -- HORIZONTAL DRIVING FORCE IN POUNDS
R -- HORIZONTAL RESISTING FORCE IN POUNDS
A -- AS A SUBSCRIPT, REFERS TO ACTIVE WEDGE
B -- AS A SUBSCRIPT REFERS TO CENTRAL BLOCK
P -- AS A SUBSCRIPT REFERS TO PASSIVE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

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

** 109+78 TO 110+76, 112+20 TO 112+40

NEW ORLEANS TO VENICE, LA.
DESIGN MEMORANDUM NO. 1 - GENERAL DESIGN
SUPPLEMENT NO. 5
REACH A-CITY PRICE TO TROPICAL BEND
STABILITY ANALYSIS
I-WALL, EXISTING LEVEE : FINAL SECTION
STATIONS**

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
AUGUST 1987 FILE NO. H-2-30260



GENERAL NOTES

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

SHEAR STRENGTHS BETWEEN VERTICALS 1 AND 2 WERE ASSUMED TO VARY LINEARLY BETWEEN THE VALUES INDICATED FOR THESE LOCATIONS.

VERT. 1 = BORS. 34-AUC & A-10-BU.
VERT. 2 = BORS. A-4-U, A-5-U, 34-AU, A-6-U, A-7-U, A-8-U, 33-AU, 32-AU, A-9-U, A-10-U, 36-AU, 37-AU & 38-AU

*THE EXISTING LEVEE SHOULD BE DEGRADED TO EL.+4 TO ALLOW FOR PASSAGE OF THE PIPES THROUGH THE T-WALL.

A WATER LOAD OF 2145 P.S.F. WILL BE TAKEN BY THE PILES. THIS LOAD IS NOT REFLECTED IN "D_A" FOR THIS ANALYSIS.

STRATUM NO.	SOIL TYPE	EFFECTIVE UNIT WT. P.C.F.		C - UNIT COHESION - P.S.F.				FRICTION ANGLE DEGREES
				CENTER OF STRATUM		BOTTOM OF STRATUM		
		VERT. 1	VERT. 2	VERT. 1	VERT. 2	VERT. 1	VERT. 2	
1	WATER	62.5	62.5	0.0	0.0	0.0	0.0	0.0
2	CH	108.0	108.0	400.0	400.0	400.0	400.0	0.0
3	CHO	88.0	88.0	300.0	150.0	300.0	150.0	0.0
4	CHO	24.0	24.0	300.0	150.0	300.0	150.0	0.0
5	CH	34.0	34.0	300.0	150.0	300.0	150.0	0.0
6	ML	55.0	55.0	200.0	200.0	200.0	200.0	15.0
7	CH	38.0	38.0	300.0	235.0	300.0	300.0	0.0
8	CH	38.0	38.0	375.0	375.0	450.0	450.0	0.0
9	ML	55.0	55.0	200.0	200.0	200.0	200.0	15.0

ASSUMED FAILURE SURFACE			RESISTING FORCES			DRIVING FORCES		SUMMATION OF FORCES		FACTOR OF SAFETY
NO.		ELEV.	R_A	R_B	R_P	D_A	$-D_P$	RESISTING	DRIVING	
A	1	-7.00	3823	12254	969	6670	108	17046	6562	2.597
A	2	-7.00	3823	13475	0	6670	0	17298	6670	2.593
B	1	-10.00	4411	13490	0	9569	0	17901	9569	1.871
C	1	-25.00	9563	18090	6375	29295	3573	34028	25722	1.323
D	1	-40.00	17757	27135	17625	57053	15668	62517	41385	1.511
E	2	-25.00	13825	9600	7750	21780	5552	31175	16228	1.921
WITH WATER AT EL.-6 IN THE DRAINAGE CANAL, EL.-1 FLOODSIDE.										
C	1	-25.00	9563	18090	6375	29729	3573	34028	26156	1.301

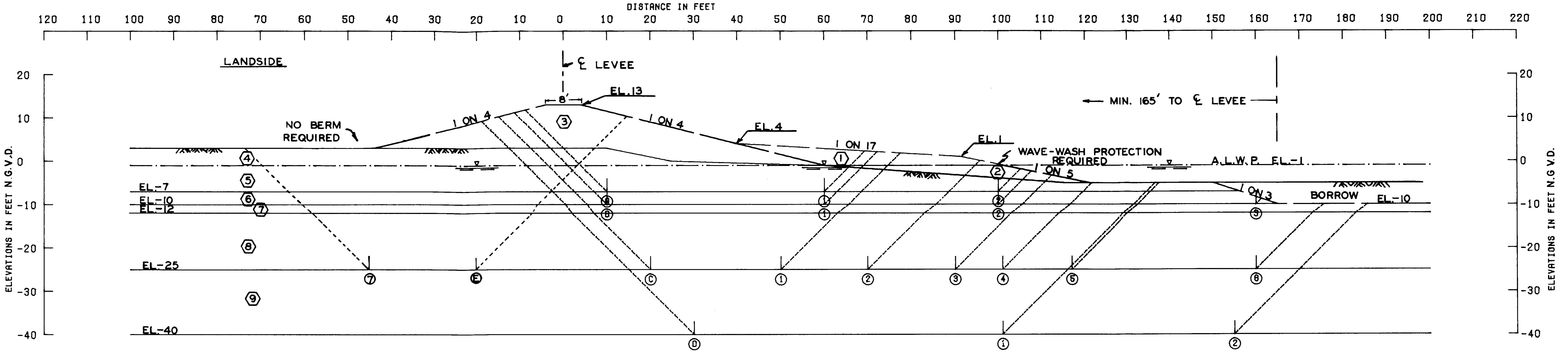
NOTES

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

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

NEW ORLEANS TO VENICE, LA.
DESIGN MEMORANDUM NO 1 - GENERAL DESIGN
SUPPLEMENT NO. 5
REACH A-CITY PRICE TO TROPICAL BEND
STABILITY ANALYSIS
HAYES CANAL PUMP STATION
STA. 110+76 TO 112+26

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
AUGUST 1987 FILE NO. H-2-30260



GENERAL NOTES

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

SHEAR STRENGTHS BETWEEN VERTICALS 1 AND 2 WERE ASSUMED TO VARY LINEARLY BETWEEN THE VALUES INDICATED FOR THESE LOCATIONS.

VERT. 1 = VERT. 2 = BORS.: A-9-U, A-10-U, 33-AU, 32-AU, & A-10-BU.

STRATUM NO.	SOIL TYPE	EFFECTIVE UNIT WT. P.C.F.		C - UNIT COHESION - P.S.F.				FRICTION ANGLE DEGREES
				CENTER OF STRATUM		BOTTOM OF STRATUM		
		VERT. 1	VERT. 2	VERT. 1	VERT. 2	VERT. 1	VERT. 2	
1	CH	100.0	100.0	200.0	200.0	200.0	200.0	0.0
2	CH	38.0	38.0	200.0	200.0	200.0	200.0	0.0
3	CH	110.0	110.0	400.0	400.0	400.0	400.0	0.0
4	CHO	86.0	86.0	200.0	200.0	200.0	200.0	0.0
5	CHO	24.0	24.0	200.0	200.0	200.0	200.0	0.0
6	CH	34.0	34.0	200.0	200.0	200.0	200.0	0.0
7	ML	55.0	55.0	200.0	200.0	200.0	200.0	15.0
8	CH	38.0	38.0	235.0	235.0	300.0	300.0	0.0
9	CH	38.0	38.0	375.0	375.0	450.0	450.0	0.0
10	ML	55.0	55.0	200.0	200.0	200.0	200.0	15.0

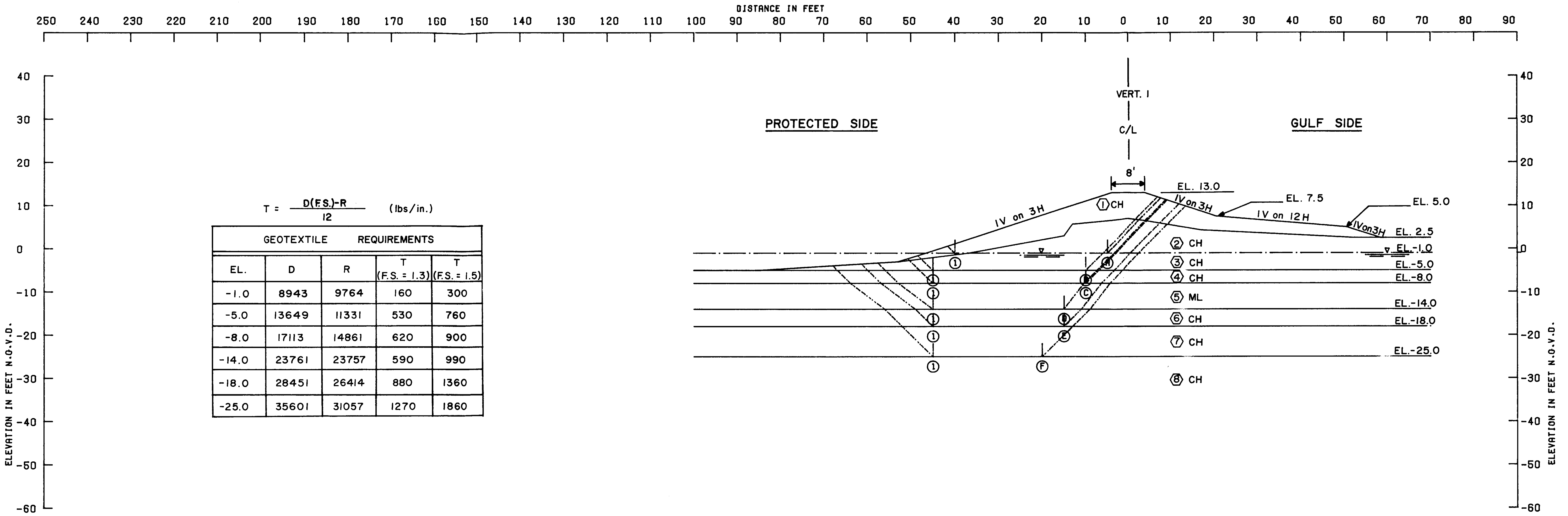
ASSUMED FAILURE NO.	SURFACE ELEV.	RESISTING FORCES R_A	R_B	R_P	DRIVING FORCES D_A	$-D_P$	SUMMATION OF FORCES RESISTING	DRIVING	FACTOR OF SAFETY
A 1	-7.00	11040	10000	3711	18800	3204	24751	15595	1.587
A 2	-7.00	11040	18000	2067	18800	552	31107	18248	1.705
B 1	-10.00	11760	10000	4844	23222	4768	26604	18454	1.442
B 2	-10.00	11760	18000	3067	23222	1148	32827	22074	1.487
B 3	-10.00	11760	30000	500	23222	35	42260	23187	1.823
C 1	-25.00	19143	9000	12797	49387	18915	40941	30472	1.344
C 2	-25.00	19143	15000	11968	49387	15967	46111	33421	1.380
C 3	-25.00	19143	21000	10294	49387	11015	50437	38372	1.314
C 4	-25.00	19143	24300	9499	49387	8736	52942	40651	1.302
C 5	-25.00	19143	29100	9439	49387	7404	57682	41984	1.374
C 6	-25.00	19143	42000	7229	49387	4890	68372	44497	1.537
D 1	-40.00	29644	31950	20689	81232	24345	82282	56887	1.446
D 2	-40.00	29644	56250	18479	81232	18646	104373	62586	1.668
E 7	-25.00	19143	7500	13654	49147	18400	40297	30747	1.311

NOTES

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

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

NEW ORLEANS TO VENICE, LA
DESIGN MEMORANDUM NO 1-GENERAL DESIGN
SUPPLEMENT NO. 5
REACH A-CITY PRICE TO TROPICAL BEND
STA. 245+00 TO 253+02
FINAL SECTION - ALL CLAY
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
AUGUST 1987 FILE NO. H-2-30260



$$T = \frac{D(F.S.) - R}{12} \quad \text{(lbs/in.)}$$

GEOTEXTILE REQUIREMENTS				
EL.	D	R	T (F.S. = 1.3)	T (F.S. = 1.5)
-1.0	8943	9764	160	300
-5.0	13649	11331	530	760
-8.0	17113	14861	620	900
-14.0	23761	23757	590	990
-18.0	28451	26414	880	1360
-25.0	35601	31057	1270	1860

GENERAL NOTES

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

SHEAR STRENGTHS BETWEEN VERTICALS 1 AND 2 WERE ASSUMED TO VARY LINEARLY BETWEEN THE VALUES INDICATED FOR THESE LOCATIONS.

STRATUM NO.	SOIL TYPE	EFFECTIVE UNIT WT. P.C.F.		C - UNIT COHESION - P.S.F.				FRICTION ANGLE DEGREES
				CENTER OF STRATUM		BOTTOM OF STRATUM		
		VERT. 1	VERT. 2	VERT. 1	VERT. 2	VERT. 1	VERT. 2	
1	CH	100.0	100.0	200.0	200.0	200.0	200.0	0.0
2	CH	88.0	88.0	140.0	140.0	140.0	140.0	0.0
3	CH	26.0	26.0	140.0	140.0	140.0	140.0	0.0
4	CH	33.0	33.0	190.0	190.0	190.0	190.0	0.0
5	ML	55.0	55.0	200.0	200.0	200.0	200.0	15.0
6	CH	40.0	40.0	190.0	190.0	190.0	190.0	0.0
7	CH	40.0	40.0	200.0	200.0	200.0	200.0	0.0
8	CH	40.0	40.0	250.0	250.0	250.0	250.0	0.0

ASSUMED FAILURE SURFACE			RESISTING FORCES			DRIVING FORCES		SUMMATION OF FORCES		FACTOR OF SAFETY
NO.		ELEV.	R_A	R_B	R_P	D_A	$-D_P$	RESISTING	DRIVING	
A	1	-1.00	4180	4900	684	9114	171	9764	8943	1.092
B	1	-5.00	5387	4900	1045	14115	467	11331	13649	0.830
C	1	-8.00	6269	6650	1942	18090	977	14861	17113	0.868
D	1	-14.00	11616	5700	6441	26523	2763	23757	23761	1.000
E	1	-18.00	13102	5700	7612	33538	5088	26414	28451	0.928
F	1	-25.00	15893	5000	10163	46080	10479	31057	35601	0.872

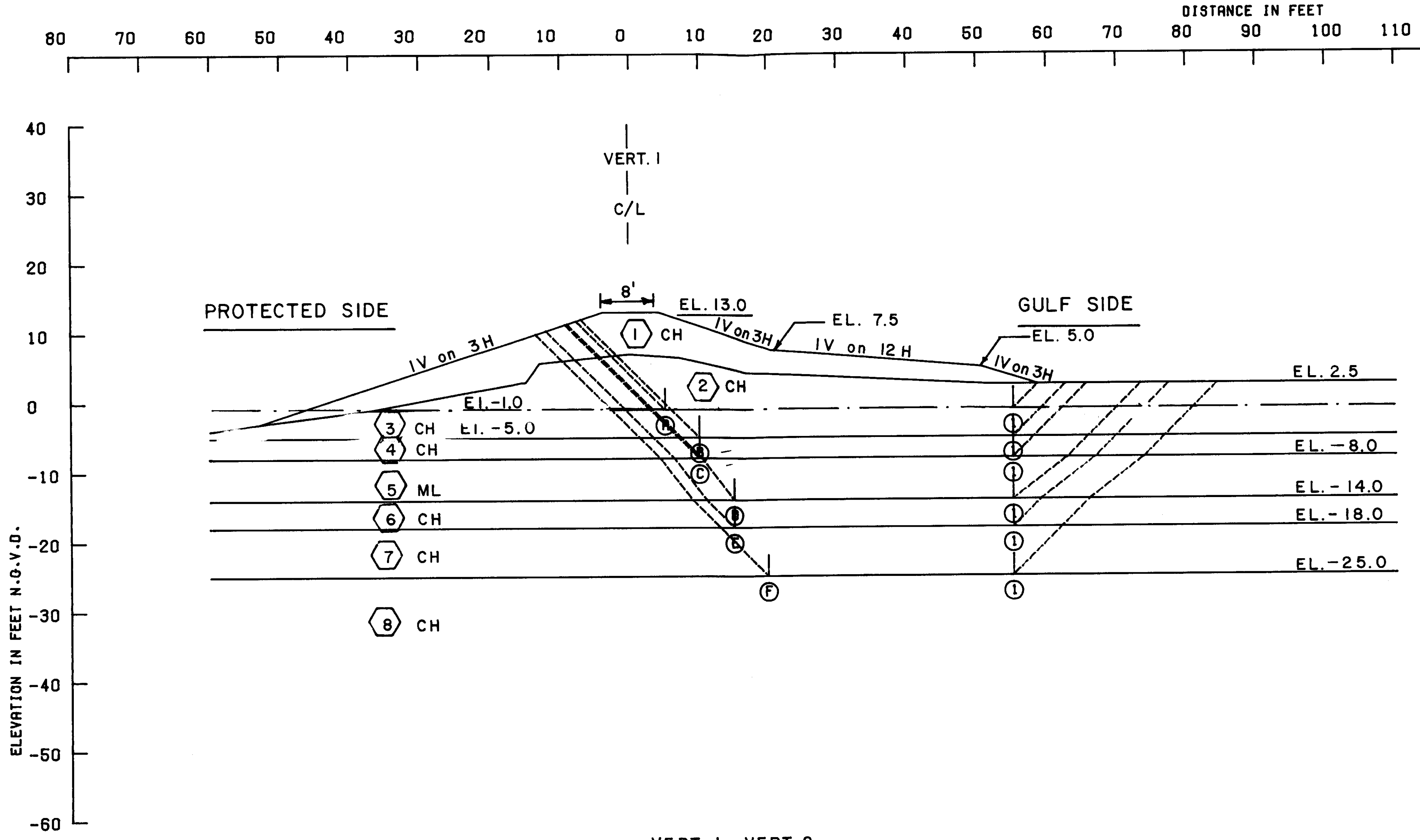
NOTES

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

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

$D = D_A - D_P$ = DRIVING FORCE
$R = R_A + R_B + R_P$ = RESISTING FORCE
T = FABRIC TENSILE STRENGTH (lbs/in)

NEW ORLEANS TO VENICE, LA
DESIGN MEMORANDUM NO.1-GENERAL, DESIGN
SUPPLEMENT NO.5
REACH A-CITY PRICE TO TROPICAL BEND
253+02 - 281+04
PROTECTED SIDE ANALYSIS
GEOTEXTILE REINFORCED LEVEE
FREEPORT SULPHUR LAKE AREA
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
AUGUST 1987 FILE NO. H-2-30260



$$T = \frac{D(F.S.) - R}{12} \text{ (lbs/in)}$$

GEOTEXTILE REQUIREMENTS				
EL.	D	R	T (F·S·=1.3)	T (F·S·=1.5)
-5.0	11925	13770	140	340
-8.0	14500	18023	70	310
-18.0	22155	31348	—	160
-25.0	26549	36318	—	290

GENERAL NOTES

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

SHEAR STRENGTHS BETWEEN VERTICALS 1 AND 2 WERE ASSUMED TO VARY LINEARLY BETWEEN THE VALUES INDICATED FOR THESE LOCATIONS.

VERT. 1 = VERT. 2

STRATUM NO.	SOIL TYPE	EFFECTIVE UNIT WT. P.C.F.		C - UNIT COHESION - P.S.F.				FRICTION ANGLE DEGREES
				CENTER OF STRATUM		BOTTOM OF STRATUM		
		VERT. 1	VERT. 2	VERT. 1	VERT. 2	VERT. 1	VERT. 2	
1	CH	100.0	100.0	200.0	200.0	200.0	200.0	0.0
2	CH	88.0	88.0	140.0	140.0	140.0	140.0	0.0
3	CH	26.0	26.0	140.0	140.0	140.0	140.0	0.0
4	CH	33.0	33.0	190.0	190.0	190.0	190.0	0.0
5	ML	55.0	55.0	200.0	200.0	200.0	200.0	15.0
6	CH	40.0	40.0	190.0	190.0	190.0	190.0	0.0
7	CH	40.0	40.0	200.0	200.0	200.0	200.0	0.0
8	CH	40.0	40.0	250.0	250.0	250.0	250.0	0.0

ASSUMED FAILURE SURFACE			RESISTING FORCES			DRIVING FORCES		SUMMATION OF FORCES		FACTOR OF SAFETY
NO.		ELEV.	R_A	R_B	R_P	D_A	$-D_P$	RESISTING	DRIVING	
A	1	-1.00	4180	7000	980	9113	729	12160	8385	1.450
B	1	-5.00	5388	6300	2100	14102	2168	13788	11934	1.155
C	1	-8.00	6265	8550	3240	18080	3552	18055	14528	1.243
D	1	-14.00	11604	7600	9302	26488	7563	28506	18925	1.506
E	1	-18.00	13077	7600	10720	33510	11290	31396	22219	1.413
F	1	-25.00	15856	7000	13520	45916	19276	36376	26640	1.365

NOTES

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

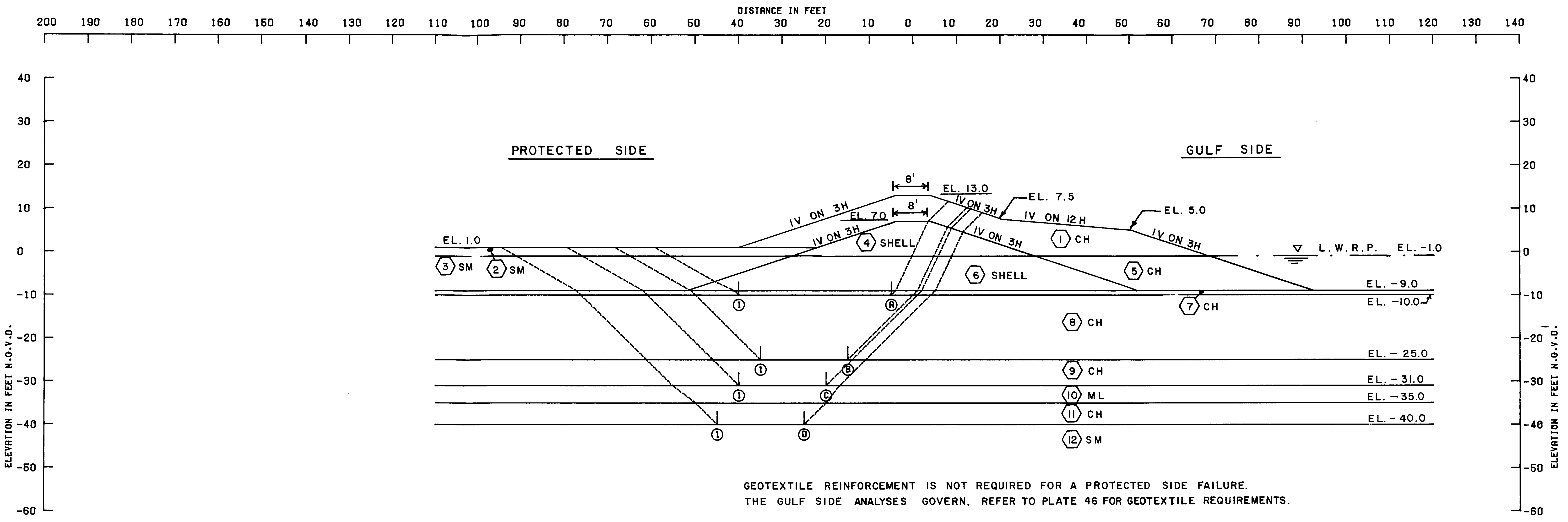
$$\text{FACTOR OF SAFETY} = \frac{R_A + R_B + R_P}{D_A - D_P}$$

$D = D_A - D_P$ = DRIVING FORCE

$R = R_A + R_B + R_P$ = RESISTING FORCE

T = FABRIC TENSILE STRENGTH (lbs/in)

NEW ORLEANS TO VENICE, LA.
DESIGN MEMORANDUM NO. I-GENERAL, DESIGN SUPPLEMENT NO. 5
REACH A-CITY PRICE TO TROPICAL BEND
253+02-281+04
GULF SIDE ANALYSIS
GEOTEXTILE REINFORCED LEVEE
FREEPORT SULPHUR LAKE AREA
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
AUGUST 1987 FILE NO. H-2-30260



GEOTEXTILE REINFORCEMENT IS NOT REQUIRED FOR A PROTECTED SIDE FAILURE.
THE GULF SIDE ANALYSES GOVERN. REFER TO PLATE 46 FOR GEOTEXTILE REQUIREMENTS.

GENERAL NOTES

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

SHEAR STRENGTHS BETWEEN VERTICALS 1 AND 2 WERE ASSUMED TO VARY LINEARLY BETWEEN THE VALUES INDICATED FOR THESE LOCATIONS.

VERT. 1 = VERT. 2

STRATUM NO.	SOIL TYPE	EFFECTIVE UNIT WT. P.C.F.		C - UNIT COHESION - P.S.F.				FRICTION ANGLE DEGREES
				CENTER OF STRATUM		BOTTOM OF STRATUM		
		VERT. 1	VERT. 2	VERT. 1	VERT. 2	VERT. 1	VERT. 2	
1	CH	100.0	100.0	100.0	100.0	100.0	100.0	0.0
2	SM	122.0	122.0	0.0	0.0	0.0	0.0	30.0
3	SM	60.0	60.0	0.0	0.0	0.0	0.0	30.0
4	SHL	92.0	92.0	0.0	0.0	0.0	0.0	40.0
5	CH	38.0	38.0	100.0	100.0	100.0	100.0	0.0
6	SHL	30.0	30.0	0.0	0.0	0.0	0.0	40.0
7	CH	34.0	34.0	150.0	150.0	150.0	150.0	0.0
8	CH	38.0	38.0	225.0	225.0	300.0	300.0	0.0
9	CH	38.0	38.0	330.0	330.0	360.0	360.0	0.0
10	ML	55.0	55.0	200.0	200.0	200.0	200.0	15.0
11	CH	38.0	38.0	425.0	425.0	450.0	450.0	0.0
12	SM	60.0	60.0	0.0	0.0	0.0	0.0	30.0

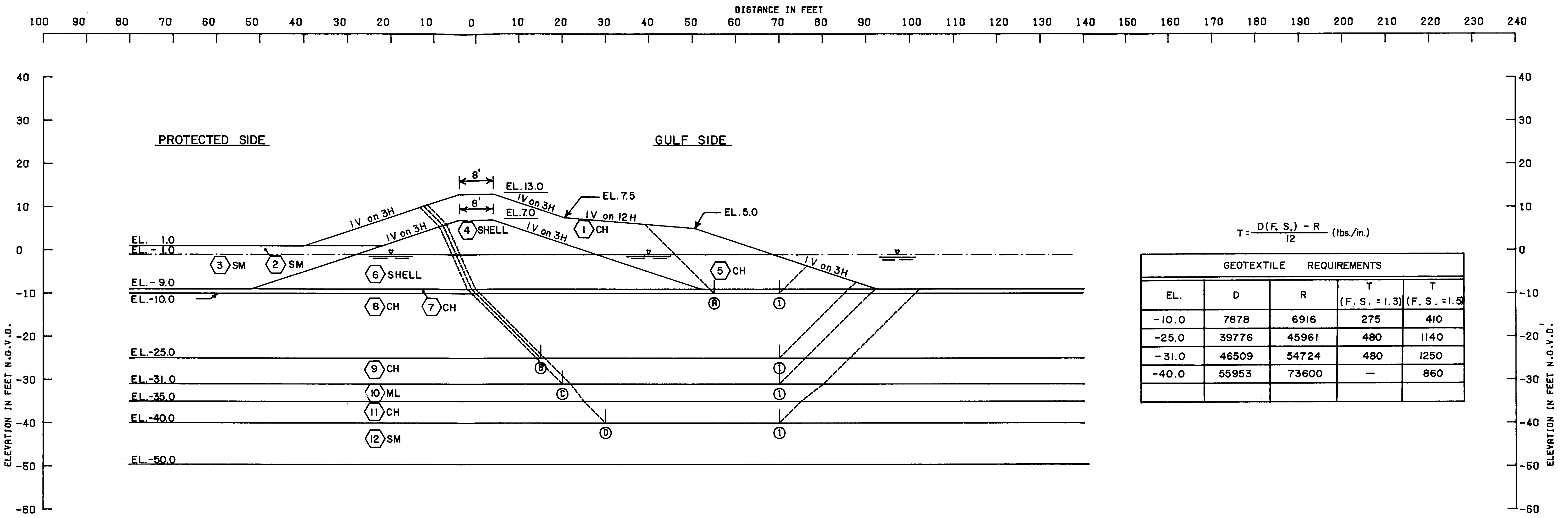
ASSUMED FAILURE SURFACE			RESISTING FORCES			DRIVING FORCES		SUMMATION OF FORCES		FACTOR OF SAFETY
NO.		ELEV.	R_A	R_B	R_P	D_A	$-D_P$	RESISTING	DRIVING	
A	1	-10.00	16410	5250	10362	22408	4623	32022	17786	1.800
B	1	-25.00	22086	6000	15498	47432	19443	43584	27989	1.557
C	1	-31.00	25689	7200	19238	58506	28429	52128	30076	1.733
D	1	-40.00	33178	9000	30216	77007	44926	72395	32081	2.257

NOTES

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

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

NEW ORLEANS TO VENICE, LA.
DESIGN MEMORANDUM NO. 1-GENERAL, DESIGN SUPPLEMENT NO. 5
REACH A-CITY PRICE TO TROPICAL BEND
STA. 282+50 TO 284+80
PORT SULPHUR CANAL
PROTECTED SIDE ANALYSIS
GEOTEXTILE REINFORCED LEVEE
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
AUGUST 1987 FILE NO. H-2-30260



$T = \frac{D(F.S.) - R}{12}$ (lbs./in.)

GEOTEXTILE REQUIREMENTS				
EL.	D	R	T (F. S. = 1.3)	T (F. S. = 1.5)
-10.0	7878	6916	275	410
-25.0	39776	45961	480	1140
-31.0	46509	54724	480	1250
-40.0	55953	73600	—	860

GENERAL NOTES

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

SHEAR STRENGTHS BETWEEN VERTICALS 1 AND 2 WERE ASSUMED TO VARY LINEARLY BETWEEN THE VALUES INDICATED FOR THESE LOCATIONS.

STRATUM NO.	SOIL TYPE	EFFECTIVE UNIT WT. P.C.F.		C - UNIT COHESION - P.S.F.				FRICTION ANGLE DEGREES
				CENTER OF STRATUM		BOTTOM OF STRATUM		
		VERT. 1	VERT. 2	VERT. 1	VERT. 2	VERT. 1	VERT. 2	
1	CH	100.0	100.0	100.0	100.0	100.0	100.0	0.0
2	SM	122.0	122.0	0.0	0.0	0.0	0.0	30.0
3	SM	60.0	60.0	0.0	0.0	0.0	0.0	30.0
4	SHL	92.0	92.0	0.0	0.0	0.0	0.0	40.0
5	CH	38.0	38.0	100.0	100.0	100.0	100.0	0.0
6	SHL	30.0	30.0	0.0	0.0	0.0	0.0	40.0
7	CH	34.0	34.0	150.0	150.0	150.0	150.0	0.0
8	CH	38.0	38.0	225.0	225.0	300.0	300.0	0.0
9	CH	38.0	38.0	330.0	330.0	360.0	360.0	0.0
10	ML	55.0	55.0	200.0	200.0	200.0	200.0	15.0
11	CH	38.0	38.0	425.0	425.0	450.0	450.0	0.0
12	SM	60.0	60.0	0.0	0.0	0.0	0.0	30.0

ASSUMED FAILURE SURFACE		RESISTING FORCES			DRIVING FORCES		SUMMATION OF FORCES		FACTOR OF SAFETY
NO.	ELEV.	R_A	R_B	R_P	D_A	$-D_P$	RESISTING	DRIVING	
A 1	-10.00	3291	2250	1375	8904	1026	6916	7878	0.878
B 1	-25.00	22086	16500	7375	47580	7804	45961	39776	1.155
C 1	-31.00	25689	18000	11035	58819	12310	54724	46509	1.177
D 1	-40.00	35097	18000	20503	77538	21584	73600	55953	1.315

NOTES

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

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

$D = D_A - D_P$ = DRIVING FORCE

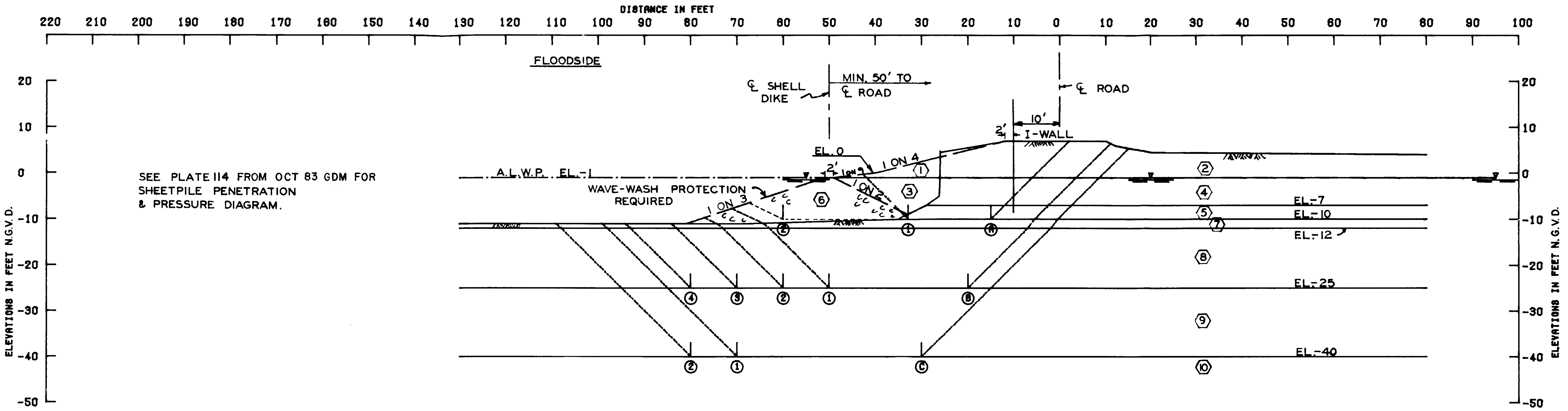
$R = R_A + R_B + R_P$ = RESISTING FORCE

T = FABRIC TENSILE STRENGTH (lbs/in)

NEW ORLEANS TO VENICE, LA.
DESIGN MEMORANDUM NO. 1 - GENERAL DESIGN
SUPPLEMENT NO. 5

REACH A-CITY PRICE TO TROPICAL BEND
STA. 282 + 50 TO STA. 284 + 80
PORT SULPHUR CANAL
GULF SIDE ANALYSIS
GEOTEXTILE REINFORCED LEVEE

U. S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
AUGUST 1987 FILE NO. H-2-30260



GENERAL NOTES

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

SHEAR STRENGTHS BETWEEN VERTICALS 1 AND 2 WERE ASSUMED TO VARY LINEARLY BETWEEN THE VALUES INDICATED FOR THESE LOCATIONS.

VERT. 1 = VERT. 2

STRATUM NO.	SOIL TYPE	EFFECTIVE UNIT WT. P.C.F.		C - UNIT COHESION - P.S.F.				FRICTION ANGLE DEGREES
				CENTER OF STRATUM		BOTTOM OF STRATUM		
		VERT. 1	VERT. 2	VERT. 1	VERT. 2	VERT. 1	VERT. 2	
1	CH	100.0	100.0	100.0	100.0	100.0	100.0	0.0
2	CH	86.0	86.0	200.0	200.0	200.0	200.0	0.0
3	CH	38.0	38.0	100.0	100.0	100.0	100.0	0.0
4	CHO	24.0	24.0	200.0	200.0	200.0	200.0	0.0
5	CH	34.0	34.0	200.0	200.0	200.0	200.0	0.0
6	SI	30.0	30.0	0.0	0.0	0.0	0.0	40.0
7	ML	55.0	55.0	200.0	200.0	200.0	200.0	15.0
8	CH	38.0	38.0	235.0	235.0	300.0	300.0	0.0
9	CH	38.0	38.0	375.0	375.0	450.0	450.0	0.0
10	ML	55.0	55.0	200.0	200.0	200.0	200.0	15.0

ASSUMED FAILURE SURFACE		RESISTING FORCES			DRIVING FORCES		SUMMATION OF FORCES		FACTOR OF SAFETY
NO.	ELEV.	R_A	R_B	R_P	D_A	$-D_P$	RESISTING	DRIVING	
A 1	-10.00	6800	3580	2322	9868	3071	12702	6798	1.869
A 2	-10.00	6800	11166	1132	9868	314	19098	9554	1.999
B 1	-25.00	14133	9000	7762	28007	7687	30895	20320	1.520
B 2	-25.00	14133	12000	6858	28007	5975	32991	22031	1.497
B 3	-25.00	14133	15000	6650	28007	4556	35783	23451	1.526
B 4	-25.00	14133	18000	6650	28007	3956	38783	24051	1.613
C 1	-40.00	24984	18000	17900	52579	17063	60885	35516	1.714
C 2	-40.00	24984	22500	17900	52579	16464	65385	36116	1.810

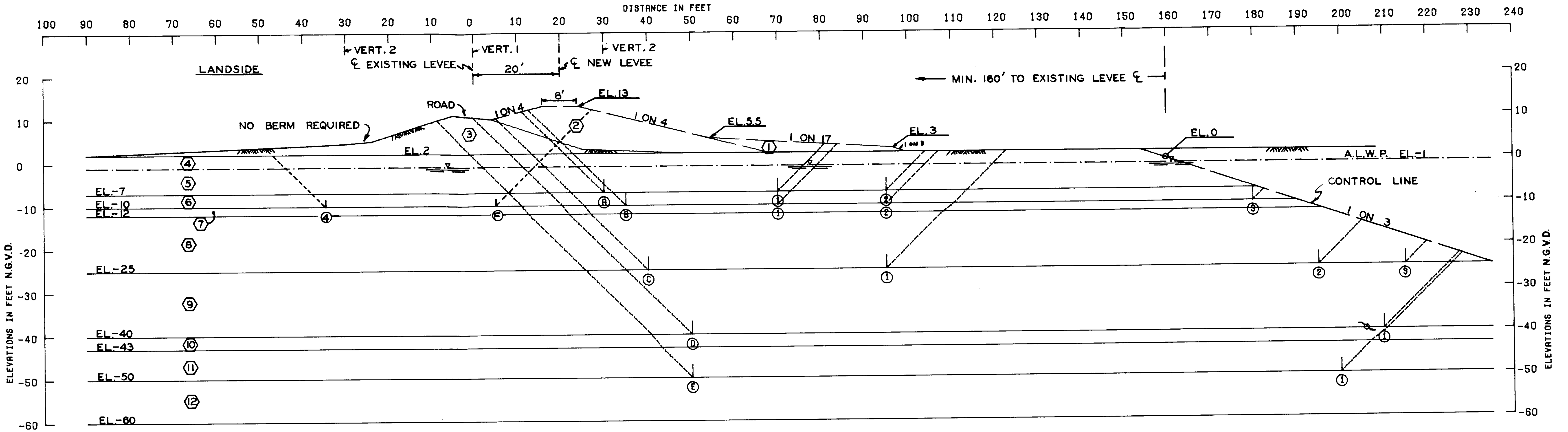
NOTES

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

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

EXISTING BULKHEAD TO BE REMOVED AFTER BERM IS IN PLACE.

NEW ORLEANS TO VENICE, LA
DESIGN MEMORANDUM NO 1-GENERAL DESIGN
SUPPLEMENT NO. 5
REACH A-CITY PRICE TO TROPICAL BEND
STABILITY ANALYSIS
I-WALL : FINAL SECTION
STATIONS 286+35 TO 291+40
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
AUGUST 1987 FILE NO. H-2-30260



GENERAL NOTES

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

SHEAR STRENGTHS BETWEEN VERTICALS 1 AND 2 WERE ASSUMED TO VARY LINEARLY BETWEEN THE VALUES INDICATED FOR THESE LOCATIONS.

VERT. 1 = BORS. 34-AUC & A-10-BU.

VERT. 2 = BORS. A-4-U, A-5-U, 34-AU, A-6-U, A-7-U, A-8-U, 33-AU, 32-AU, A-9-U, A-10-U, 36-AU, 37-AU & 38-AU.

STRATUM NO.	SOIL TYPE	EFFECTIVE UNIT WT. P.C.F.		C - UNIT COHESION - P.S.F.				FRICTION ANGLE DEGREES
				CENTER OF STRATUM		BOTTOM OF STRATUM		
		VERT. 1	VERT. 2	VERT. 1	VERT. 2	VERT. 1	VERT. 2	
1	CH	100.0	100.0	200.0	200.0	200.0	200.0	0.0
2	CH	110.0	110.0	400.0	400.0	400.0	400.0	0.0
3	CH	108.0	108.0	400.0	400.0	400.0	400.0	0.0
4	CHO	86.0	86.0	300.0	150.0	300.0	150.0	0.0
5	CHO	24.0	24.0	300.0	150.0	300.0	150.0	0.0
6	CH	34.0	34.0	300.0	150.0	300.0	150.0	0.0
7	ML	55.0	55.0	200.0	200.0	200.0	200.0	15.0
8	CH	38.0	38.0	300.0	235.0	300.0	300.0	0.0
9	CH	38.0	38.0	375.0	375.0	450.0	450.0	0.0
10	ML	55.0	55.0	200.0	200.0	200.0	200.0	15.0
11	CH	40.0	40.0	515.0	515.0	550.0	550.0	0.0
12	CH	44.0	44.0	600.0	600.0	650.0	650.0	0.0

ASSUMED FAILURE SURFACE		RESISTING FORCES			DRIVING FORCES		SUMMATION OF FORCES		FACTOR OF SAFETY
NO.	ELEV.	R_A	R_B	R_P	D_A	$-D_P$	RESISTING	DRIVING	
A 1	-7.00	10945	6000	3467	18997	4624	20412	14374	1.420
A 2	-7.00	10945	9750	2700	18997	2672	23395	16326	1.433
B 1	-10.00	11985	5250	4300	23043	6532	21535	16511	1.304
B 2	-10.00	11985	9000	3600	23043	4030	24585	19012	1.293
B 3	-10.00	11985	21750	750	23043	140	34485	22903	1.506
C 1	-25.00	19626	16500	11533	49683	16339	47659	33345	1.429
C 2	-25.00	19626	46500	4700	49683	2534	70826	47149	1.502
C 3	-25.00	19626	52500	2350	49683	632	74476	49051	1.518
D 1	-40.00	31777	71977	12425	81371	7755	116179	73616	1.578
E 1	-50.00	43978	82500	23150	109601	19417	149628	90183	1.659
F 4	-10.00	12920	8937	5040	22938	6493	26897	16445	1.636

NOTES

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

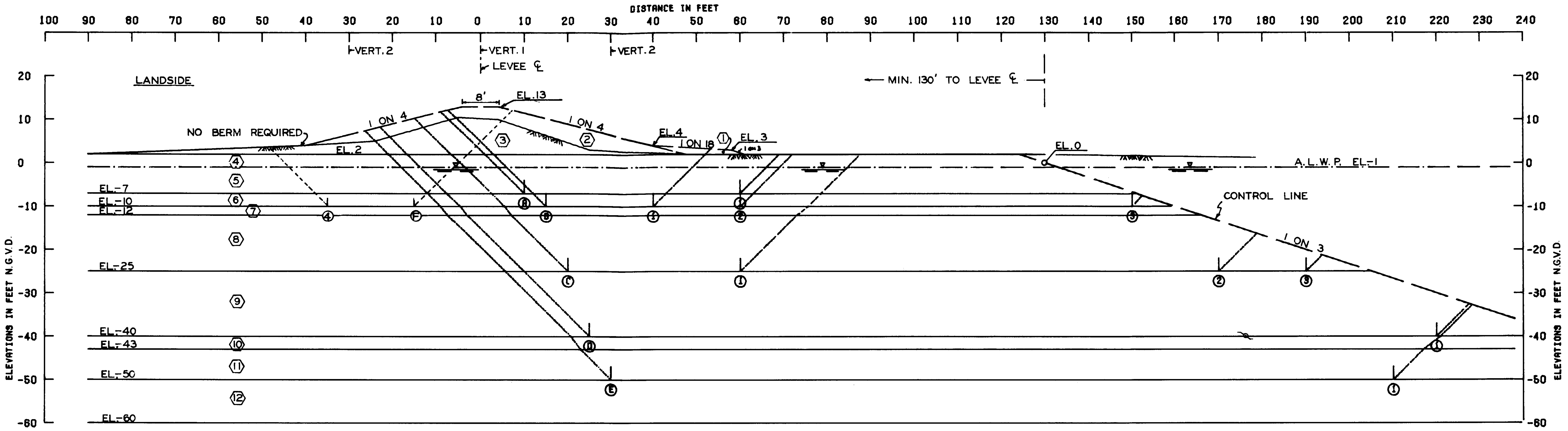
$$\text{FACTOR OF SAFETY} = \frac{R_A + R_B + R_P}{D_A - D_P}$$

NEW ORLEANS TO VENICE, LA
DESIGN MEMORANDUM NO. 1-GENERAL DESIGN
SUPPLEMENT NO. 5

REACH A-CITY PRICE TO TROPICAL BEND

STA. 291+30 TO 297+50
FINAL SECTION - ALL CLAY
LEVEE SFT - FORWARD

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
AUGUST 1987 FILE NO. H-2-30260



GENERAL NOTES

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

SHEAR STRENGTHS BETWEEN VERTICALS 1 AND 2 WERE ASSUMED TO VARY LINEARLY BETWEEN THE VALUES INDICATED FOR THESE LOCATIONS.

VERT. 1 = BORS. 34-AUC & A-10-BU.

VERT. 2 = BORS. A-4-U, A-5-U, 34-AU, A-6-U, A-7-U, A-8-U, 33-AU, 32-AU, A-9-U, A-10-U, 36-AU, 37-AU & 38-AU.

STRATUM NO.	SOIL TYPE	EFFECTIVE UNIT WT. P.C.F.		C - UNIT COHESION - P.S.F.				FRICTION ANGLE DEGREES
				CENTER OF STRATUM		BOTTOM OF STRATUM		
		VERT. 1	VERT. 2	VERT. 1	VERT. 2	VERT. 1	VERT. 2	
1	CH	100.0	100.0	200.0	200.0	200.0	200.0	0.0
2	CH	110.0	110.0	400.0	400.0	400.0	400.0	0.0
3	CH	108.0	108.0	400.0	400.0	400.0	400.0	0.0
4	CHO	86.0	86.0	300.0	150.0	300.0	150.0	0.0
5	CHO	24.0	24.0	300.0	150.0	300.0	150.0	0.0
6	CH	34.0	34.0	300.0	150.0	300.0	150.0	0.0
7	ML	55.0	55.0	200.0	200.0	200.0	200.0	15.0
8	CH	38.0	38.0	300.0	235.0	300.0	300.0	0.0
9	CH	38.0	38.0	375.0	375.0	450.0	450.0	0.0
10	ML	55.0	55.0	200.0	200.0	200.0	200.0	15.0
11	CH	40.0	40.0	515.0	515.0	550.0	550.0	0.0
12	CH	44.0	44.0	800.0	800.0	850.0	850.0	0.0

ASSUMED FAILURE NO.	SURFACE ELEV.	RESISTING FORCES			DRIVING FORCES		SUMMATION OF FORCES		FACTOR OF SAFETY
		R_A	R_B	R_P	D_A	$-D_P$	RESISTING	DRIVING	
A 1	-7.00	12745	8500	2700	18826	2382	23945	16444	1.456
B 1	-10.00	14280	4313	4105	22847	5884	22698	16963	1.338
B 2	-10.00	14280	7313	3600	22847	3740	25193	19107	1.318
B 3	-10.00	14280	20813	750	22847	140	35843	22708	1.578
C 1	-25.00	22578	12000	11533	49405	16049	46112	33356	1.382
C 2	-25.00	22578	45000	4112	49405	1938	71691	47468	1.510
C 3	-25.00	22578	51000	1762	49405	356	75341	49050	1.536
D 1	-40.00	31878	84515	5625	81737	1423	122017	80313	1.519
E 1	-50.00	41920	9900C	15224	108904	8135	156145	98769	1.581
F 4	-10.00	14280	3562	5040	22847	6768	22882	16079	1.423

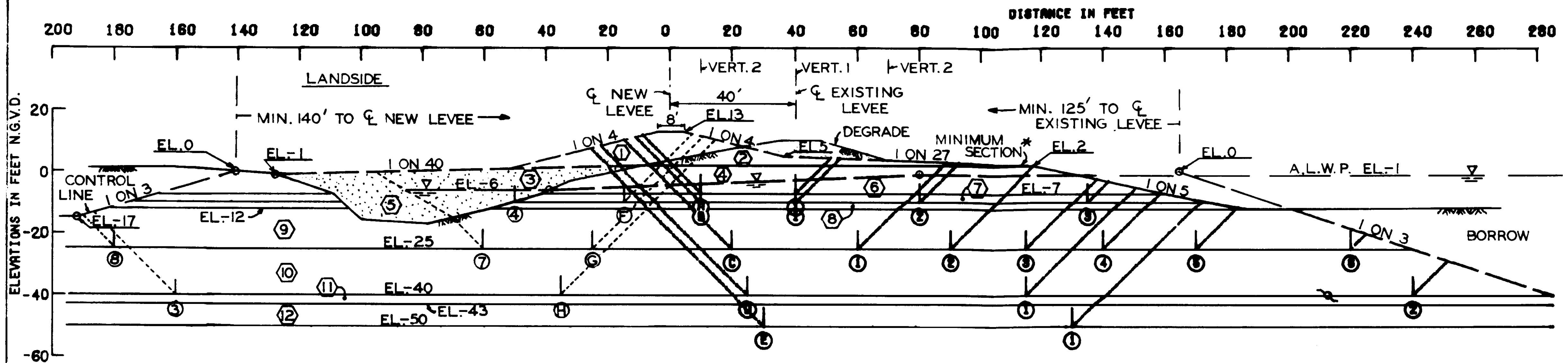
NOTES

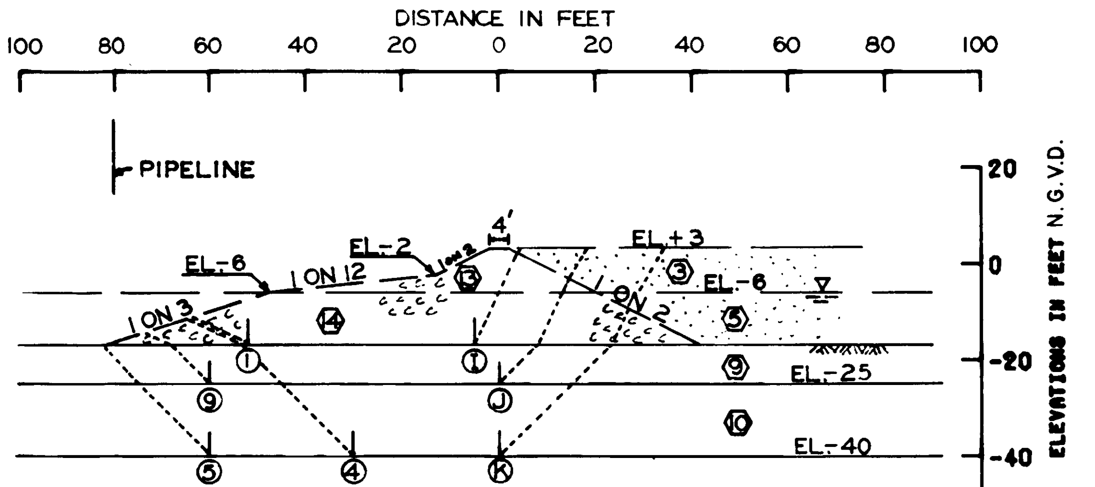
Φ -- ANGLE OF INTERNAL FRICTION, DEGREES
C -- UNIT COHESION, P.S.F.
∇ -- STATIC WATER SURFACE
D -- HORIZONTAL DRIVING FORCE IN POUNDS
R -- HORIZONTAL RESISTING FORCE IN POUNDS
A -- AS A SUBSCRIPT, REFERS TO ACTIVE WEDGE
B -- AS A SUBSCRIPT REFERS TO CENTRAL BLOCK
P -- AS A SUBSCRIPT REFERS TO PASSIVE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

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

NEW ORLEANS TO VENICE, LA
DESIGN MEMORANDUM NO 1-GENERAL DESIGN
SUPPLEMENT NO. 5
REACH A-CITY PRICE TO TROPICAL BEND
FINAL SECTION-ALL CLAY
STRADDLE ENLARGEMENT
STA. 297+50 TO 304+00

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
AUGUST 1987 FILE NO. H-2-30260





DRAINAGE CANAL-CLOSURE SECTION.
THIS SECTION IS DESIGNED FOR A F.S.=1.5 DUE TO PROXIMITY OF PIPELINE.

GENERAL NOTES

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

SHEAR STRENGTHS BETWEEN VERTICALS 1 AND 2 WERE ASSUMED TO VARY LINEARLY BETWEEN THE VALUES INDICATED FOR THESE LOCATIONS.

VERT. 1 = BORS. 34-AUC & A-10-BU.
VERT. 2 = BORS. A-4-U, A-5-U, 34-AU, A-6-U, A-7-U, A-8-U, 33-AU, 32-AU, A-9-U, A-10-U, 36-AU, 37-AU & 38-AU.

THE CONTROL LINE SHOULD BE USED TO LOCATE THE TERMINUS OF THIS SECTION.

THE EXISTING DRAINAGE CANAL SHOULD BE FILLED WITH SAND AS SHOWN.

STRATUM NO.	SOIL TYPE	EFFECTIVE UNIT WT. P.C.F.		C - UNIT COHESION - P.S.F.				FRICTION ANGLE DEGREES
				CENTER OF STRATUM		BOTTOM OF STRATUM		
		VERT. 1	VERT. 2	VERT. 1	VERT. 2	VERT. 1	VERT. 2	
1	CH	100.0	100.0	200.0	200.0	200.0	200.0	0.0
2	CH	108.0	108.0	400.0	400.0	400.0	400.0	0.0
3	SP	122.0	122.0	0.0	0.0	0.0	0.0	30.0
4	CHO	88.0	88.0	300.0	150.0	300.0	150.0	0.0
5	SP	60.0	60.0	0.0	0.0	0.0	0.0	30.0
6	CHO	24.0	24.0	300.0	150.0	300.0	150.0	0.0
7	CH	34.0	34.0	300.0	150.0	300.0	150.0	0.0
8	ML	55.0	55.0	200.0	200.0	200.0	200.0	15.0
9	CH	38.0	38.0	300.0	235.0	300.0	300.0	0.0
10	CH	38.0	38.0	375.0	375.0	450.0	450.0	0.0
11	ML	55.0	55.0	200.0	200.0	200.0	200.0	15.0
12	CH	40.0	40.0	515.0	515.0	550.0	550.0	0.0
13	SI	92.0	92.0	0.0	0.0	0.0	0.0	40.0
14	SI	30.0	30.0	0.0	0.0	0.0	0.0	40.0

*THE MINIMUM SECTION SHOWN MAY REQUIRE CONSTRUCTION OF BERMS AT A FEW LOCATIONS.

ASSUMED FAILURE SURFACE		RESISTING FORCES			DRIVING FORCES		SUMMATION OF FORCES		FACTOR OF SAFETY
NO.	ELEV.	R_A	R_B	R_P	D_A	$-D_P$	RESISTING	DRIVING	
(A) (1)	-7.00	6783	6750	6937	18544	5814	20470	12730	1.608
(B) (1)	-10.00	6938	6750	8338	23363	8207	22026	15156	1.453
(B) (2)	-10.00	6939	15000	4314	23363	5255	26253	18108	1.450
(B) (3)	-10.00	6939	23250	2065	23363	734	32254	22629	1.425
(C) (1)	-25.00	14161	12000	12829	51458	21269	38990	30189	1.292
(C) (2)	-25.00	14161	21000	11574	51458	17456	46735	34003	1.374
(C) (3)	-25.00	14161	28500	9935	51458	11761	52596	39697	1.325
(C) (4)	-25.00	14161	36000	8386	51458	7437	58547	44021	1.330
(C) (5)	-25.00	14161	45000	6402	51458	4440	65563	47018	1.394
(C) (6)	-25.00	14161	60000	2350	51458	832	76511	50626	1.506
(D) (1)	-40.00	23667	40500	20238	86369	27891	84405	58478	1.443
(D) (2)	-40.00	23667	95356	8438	86369	3204	127461	83165	1.533
(E) (1)	-50.00	34305	55000	30546	113396	38119	119851	75277	1.592
THE FOLLOWING LANDSIDE WEDGES WERE RUN WITH THE WATER TABLE AT EL.-1									
(F) (4)	-10.00	8141	5250	8987	21507	4649	22378	16858	1.327
(G) (7)	-25.00	16303	12000	20500	47450	20018	48803	27432	1.779
(G) (8)	-25.00	16303	48000	3798	47450	2353	68101	45097	1.510
(H) (3)	-40.00	27668	58500	15280	79390	19152	101448	60238	1.684
(I) (1)	-17.00	11170	10340	2940	14282	817	24450	13465	1.816
(J) (9)	-25.00	17300	18000	4750	27891	2739	40050	25152	1.592
(K) (4)	-40.00	29685	13500	18150	59553	19980	61335	39573	1.550
(K) (5)	-40.00	29685	27000	15410	59553	12068	72095	47485	1.518

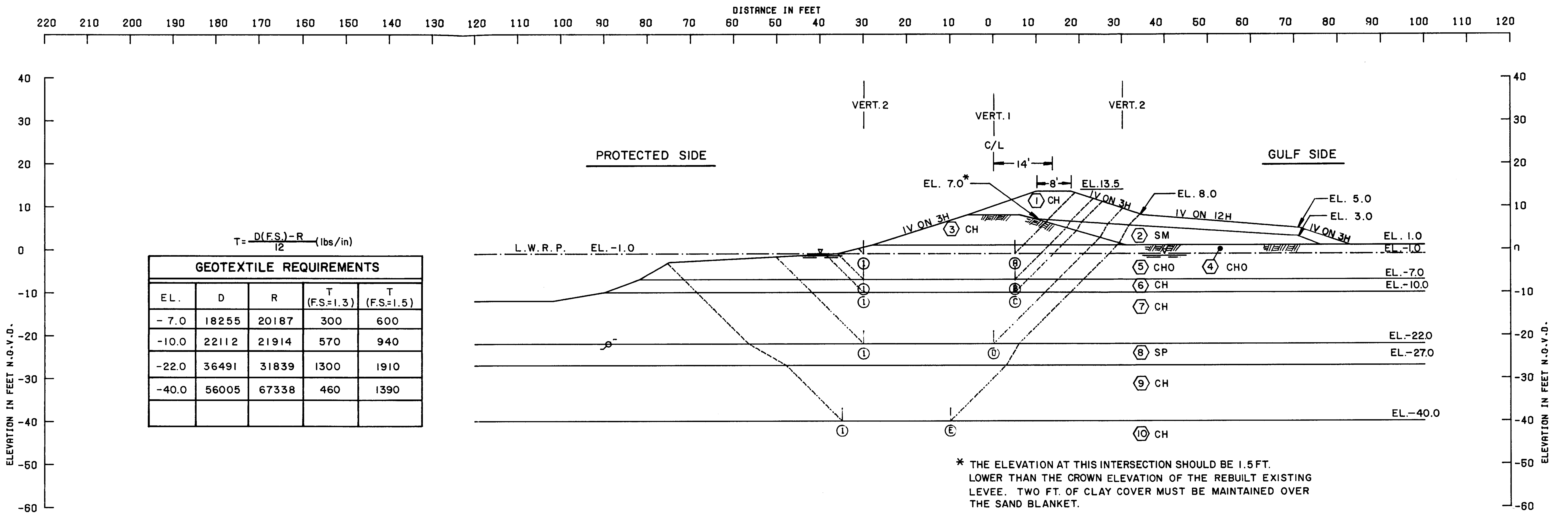
NOTES

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

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

NEW ORLEANS TO VENICE, LA.
DESIGN MEMORANDUM NO 1 - GENERAL DESIGN
SUPPLEMENT NO. 5
REACH A-CITY PRICE TO TROPICAL BEND
FINAL DESIGN SECTION
STA. 304+00 TO 314+50

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
AUGUST 1987 FILE NO. H-2-30260



$T = \frac{D(F.S.) - R}{12}$ (lbs/in)

GEOTEXTILE REQUIREMENTS

EL.	D	R	T (F.S.=1.3)	T (F.S.=1.5)
-7.0	18255	20187	300	600
-10.0	22112	21914	570	940
-22.0	36491	31839	1300	1910
-40.0	56005	67338	460	1390

* THE ELEVATION AT THIS INTERSECTION SHOULD BE 1.5 FT. LOWER THAN THE CROWN ELEVATION OF THE REBUILT EXISTING LEVEE. TWO FT. OF CLAY COVER MUST BE MAINTAINED OVER THE SAND BLANKET.

GENERAL NOTES

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

SHEAR STRENGTHS BETWEEN VERTICALS 1 AND 2 WERE ASSUMED TO VARY LINEARLY BETWEEN THE VALUES INDICATED FOR THESE LOCATIONS.

STRATUM NO.	SOIL TYPE	EFFECTIVE UNIT WT. P.C.F. VERT. 1	VERT. 2	C - UNIT COHESION - P.S.F. CENTER OF STRATUM VERT. 1	VERT. 2	BOTTOM OF STRATUM VERT. 1	VERT. 2	FRICTION ANGLE DEGREES
1	CH	100.0	100.0	200.0	200.0	200.0	200.0	0.0
2	SM	122.0	122.0	0.0	0.0	0.0	0.0	30.0
3	CH	108.0	108.0	400.0	400.0	400.0	400.0	0.0
4	CHO	86.0	86.0	300.0	150.0	300.0	150.0	0.0
5	CHO	24.0	24.0	300.0	150.0	300.0	150.0	0.0
6	CH	34.0	34.0	300.0	150.0	300.0	150.0	0.0
7	CH	38.0	38.0	300.0	210.0	300.0	270.0	0.0
8	SP	60.0	60.0	0.0	0.0	0.0	0.0	30.0
9	CH	38.0	38.0	385.0	385.0	450.0	450.0	0.0
10	CH	40.0	40.0	475.0	475.0	500.0	500.0	0.0

ASSUMED FAILURE SURFACE NO.		ELEV.	RESISTING FORCES R_A	R_B	R_P	DRIVING FORCES D_A	$-D_P$	SUMMATION OF FORCES RESISTING	DRIVING	FACTOR OF SAFETY
A	1	-1.00	8120	8188	360	10313	77	16667	10236	1.628
B	1	-7.00	10200	8188	1800	19073	818	20187	18255	1.106
C	1	-10.00	11071	8188	2656	23509	1397	21914	22112	0.991
D	1	-22.00	15790	8529	7520	43448	6957	31839	36491	0.873
E	1	-40.00	30693	11250	26395	82268	26263	67338	56005	1.202

NOTES

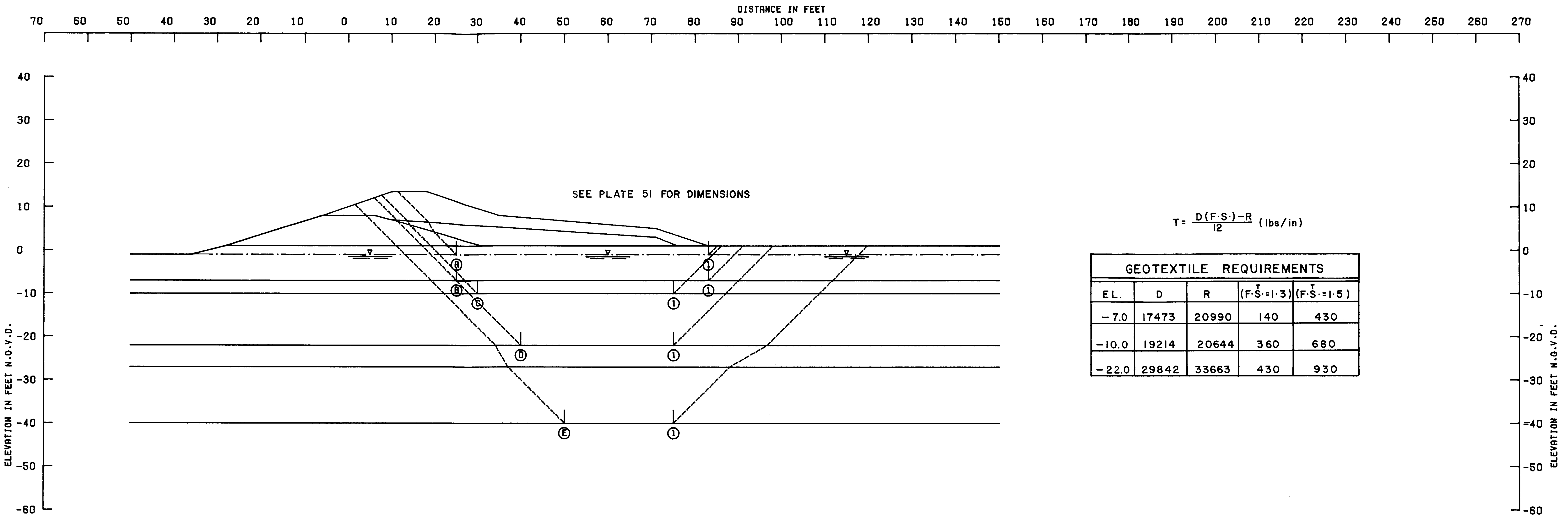
- ◇ -- STRATUM NUMBER
- ○ -- WEDGE NUMBER
- -- CROSSOVER POINT
- Φ -- ANGLE OF INTERNAL FRICTION, DEGREES
- C -- UNIT COHESION, P.S.F.
- ∇ -- STATIC WATER SURFACE
- D -- HORIZONTAL DRIVING FORCE IN POUNDS
- R -- HORIZONTAL RESISTING FORCE IN POUNDS
- A -- AS A SUBSCRIPT, REFERS TO ACTIVE WEDGE
- B --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

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

$D = D_A - D_P$ = DRIVING FORCE
$R = R_A + R_B + R_P$ = RESISTING FORCE
T = FABRIC TENSILE STRENGTH (lbs/in)

NEW ORLEANS TO VENICE, LA.
DESIGN MEMORANDUM NO. 1-GENERAL, DESIGN SUPPLEMENT NO. 5
REACH A - CITY PRICE TO TROPICAL BEND
STA. 314+50 TO 438+16 & 442+38 TO 476+50
PROTECTED SIDE ANALYSIS
GEOTEXTILE REINFORCED LEVEE

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
AUGUST 1987 FILE NO. H-2-30260



$T = \frac{D(F \cdot S \cdot) - R}{12}$ (lbs/in)

GEOTEXTILE REQUIREMENTS				
EL.	D	R	T (F·S·=1·3)	T (F·S·=1·5)
-7.0	17473	20990	140	430
-10.0	19214	20644	360	680
-22.0	29842	33663	430	930

GENERAL NOTES

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

SHEAR STRENGTHS BETWEEN VERTICALS 1 AND 2 WERE ASSUMED TO VARY LINEARLY BETWEEN THE VALUES INDICATED FOR THESE LOCATIONS.

STRATUM NO.	SOIL TYPE	EFFECTIVE UNIT WT. P.C.F.		C — UNIT COHESION - P.S.F.				FRICTION ANGLE DEGREES
				CENTER-OF-STRATUM		BOTTOM-OF STRATUM		
		VERT. 1	VERT. 2	VERT. 1	VERT. 2	VERT. 1	VERT. 2	
1	CH	100.0	100.0	200.0	200.0	200.0	200.0	0.0
2	SM	122.0	122.0	0.0	0.0	0.0	0.0	30.0
3	CH	108.0	108.0	400.0	400.0	400.0	400.0	0.0
4	CHO	86.0	86.0	300.0	150.0	300.0	150.0	0.0
5	CHO	24.0	24.0	300.0	150.0	300.0	150.0	0.0
6	CH	34.0	34.0	300.0	150.0	300.0	150.0	0.0
7	CH	38.0	38.0	300.0	210.0	300.0	270.0	0.0
8	SP	60.0	60.0	0.0	0.0	0.0	0.0	30.0
9	CH	38.0	38.0	385.0	385.0	450.0	450.0	0.0
10	CH	40.0	40.0	475.0	475.0	500.0	500.0	0.0

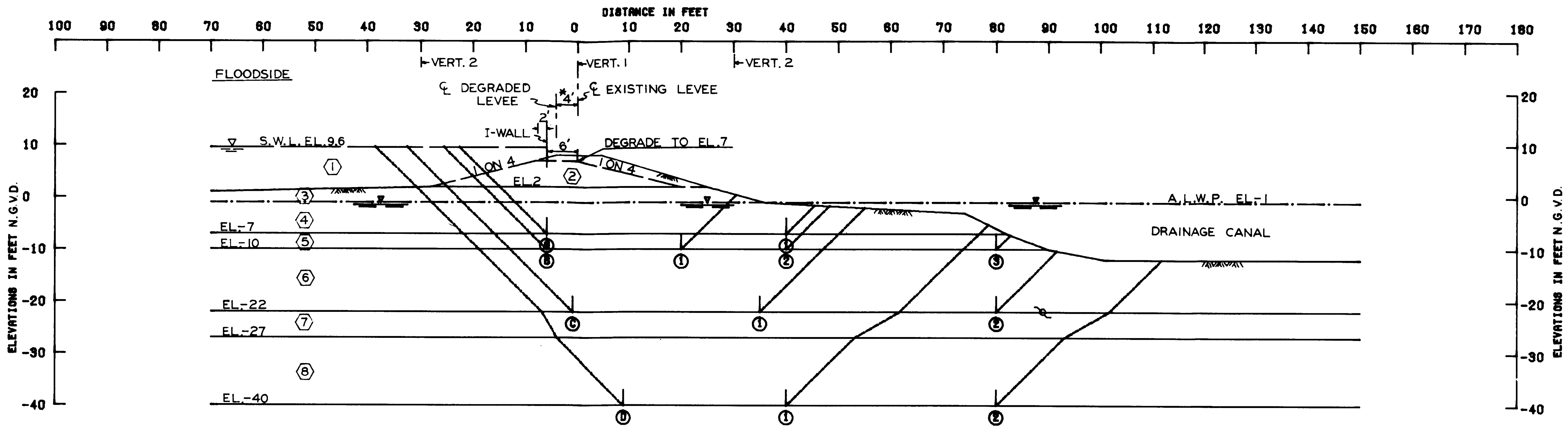
ASSUMED FAILURE SURFACE			RESISTING FORCES		DRIVING FORCES		SUMMATION OF FORCES		FACTOR OF SAFETY
NO.	ELEV.	R_A	R_B	R_P	D_A	$-D_P$	RESISTING	DRIVING	
A 1	-1.00	7307	8763	600	10090	171	16669	9919	1.681
B 1	-7.00	9828	8763	2400	19108	1635	20990	17473	1.201
C 1	-10.00	10594	6750	3300	23019	3805	20644	19214	1.074
D 1	-22.00	15873	9450	8340	41397	11555	33663	29842	1.128
E 1	-40.00	32654	11250	28589	80033	35145	72492	44887	1.615

NOTES

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

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

NEW ORLEANS TO VENICE, LA.
DESIGN MEMORANDUM NO.1-GENERAL, DESIGN SUPPLEMENT NO.5
REACH A—CITY PRICE TO TROPICAL BEND
STA. 314+50 TO 438+16 & 442+38 TO 476+50
GULF SIDE ANALYSIS
GEOTEXTILE REINFORCED LEVEE
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
AUGUST 1987 FILE NO. H-2-30260



GENERAL NOTES

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

SHEAR STRENGTHS BETWEEN VERTICALS 1 AND 2 WERE ASSUMED TO VARY LINEARLY BETWEEN THE VALUES INDICATED FOR THESE LOCATIONS.

THIS DESIGN SECTION MAY BE USED IN AREAS WHERE THERE IS AN EXISTING LEVEE.

*THE MAXIMUM DISTANCE POSSIBLE SHOULD BE MAINTAINED TO THE FLOODSIDE OF EXISTING ℄.

THE NET DIAGRAM FOR THE NEW LEVEE I-WALL (SHOWN ON PLATE 138 OF OCT 83 GMD) ALSO APPLIES TO THIS EXISTING LEVEE I-WALL

VERT. 1 = BOR. A-13-BU.
VERT. 2 = BORS. 31-AU, A-11-U, A-12-U, A-14-U, A-15-U, & A-16-U.

STRATUM NO.	SOIL TYPE	EFFECTIVE UNIT WT. P.C.F.		C - UNIT COHESION - P.S.F.				FRICTION ANGLE DEGREES
				CENTER OF STRATUM		BOTTOM OF STRATUM		
		VERT. 1	VERT. 2	VERT. 1	VERT. 2	VERT. 1	VERT. 2	
1	WATER	62.5	62.5	0.0	0.0	0.0	0.0	0.0
2	CH	108.0	108.0	400.0	400.0	400.0	400.0	0.0
3	CHO	86.0	86.0	300.0	150.0	300.0	150.0	0.0
4	CHO	24.0	24.0	300.0	150.0	300.0	150.0	0.0
5	CH	34.0	34.0	300.0	150.0	300.0	150.0	0.0
6	CH	38.0	38.0	300.0	210.0	300.0	270.0	0.0
7	SP	60.0	60.0	0.0	0.0	0.0	0.0	30.0
8	CH	38.0	38.0	385.0	385.0	450.0	450.0	0.0

ASSUMED FAILURE SURFACE NO.	ELEV.	RESISTING FORCES R_A	R_B	R_P	DRIVING FORCES D_A	$-D_P$	SUMMATION OF FORCES RESISTING	DRIVING	FACTOR OF SAFETY
A 1	-7.00	6535	9960	1650	10413	381	18145	10032	1.809
B 1	-10.00	7360	6710	3649	13512	3272	17719	10239	1.730
B 2	-10.00	7360	9960	2505	13512	925	19825	12587	1.575
B 3	-10.00	7360	15960	818	13512	172	24138	13340	1.809
C 1	-22.00	12096	10214	7440	28744	6474	29750	22270	1.336
C 2	-22.00	12096	22365	4911	28744	3358	39371	25386	1.551
D 1	-40.00	26153	13950	24733	62282	25848	64836	36434	1.780
D 2	-40.00	26153	31950	19764	62282	18316	77866	43966	1.771
WITH WATER AT EL.-6 IN THE DRAINAGE CANAL, EL.-1 FLOODSIDE.									
C 1	-22.00	12096	10214	7440	30272	10015	29750	20257	1.468
C 2	-22.00	12096	22364	4910	30272	3357	39370	26915	1.462

NOTES

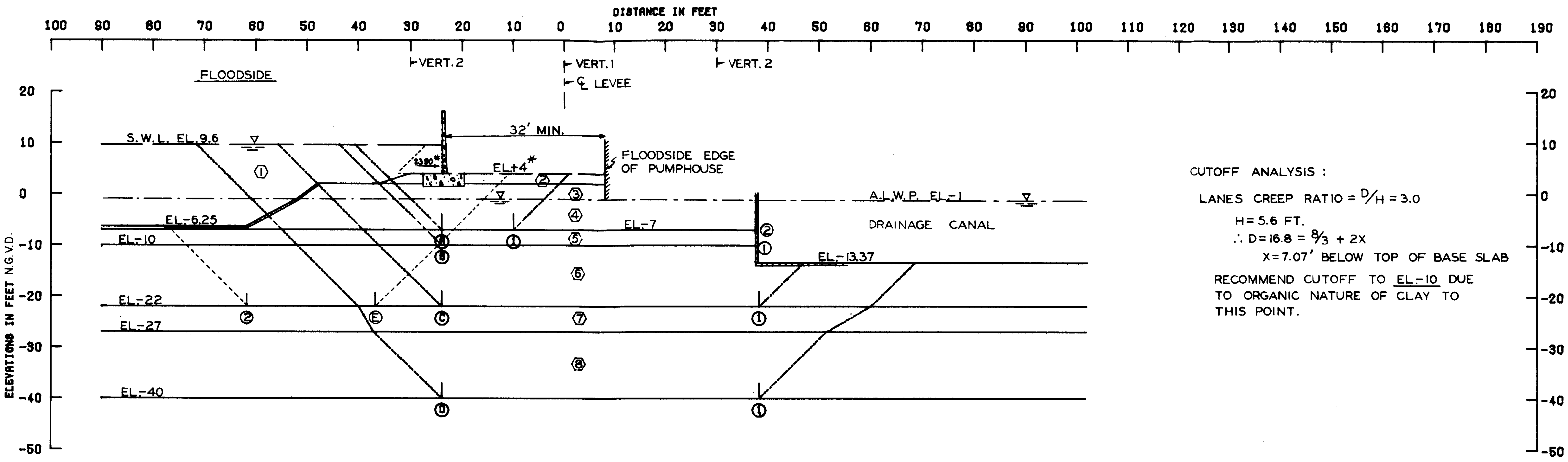
φ — ANGLE OF INTERNAL FRICTION, DEGREES
C — UNIT COHESION, P.S.F.
▽ — STATIC WATER SURFACE
D — HORIZONTAL DRIVING FORCE IN POUNDS
R — HORIZONTAL RESISTING FORCE IN POUNDS
A — AS A SUBSCRIPT, REFERS TO ACTIVE WEDGE
B — AS A SUBSCRIPT REFERS TO CENTRAL BLOCK
P — AS A SUBSCRIPT REFERS TO PASSIVE WEDGE

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

** 438+06 - 439+48
441+76 - 442+58

NEW ORLEANS TO VENICE, LA
DESIGN MEMORANDUM NO 1-GENERAL DESIGN
SUPPLEMENT NO 5
REACH A-CITY PRICE TO TROPICAL BEND
STABILITY ANALYSIS
I-WALL, EXISTING LEVEE : FINAL SECTION
STATIONS **

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
AUGUST 1987 FILE NO. H-2-30260



CUTOFF ANALYSIS :

LANES CREEP RATIO = D/H = 3.0

H = 5.6 FT.

∴ D = 16.8 = 8/3 + 2X

X = 7.07' BELOW TOP OF BASE SLAB

RECOMMEND CUTOFF TO EL-10 DUE TO ORGANIC NATURE OF CLAY TO THIS POINT.

GENERAL NOTES

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

SHEAR STRENGTHS BETWEEN VERTICALS 1 AND 2 WERE ASSUMED TO VARY LINEARLY BETWEEN THE VALUES INDICATED FOR THESE LOCATIONS.

VERT. 1 = BORS. 31-AU, A-13-BU.
VERT. 2 = BORS. A-11-U, A-12-U, A-14-U, A-15-U & A-16-U.

*THE EXISTING LEVEE SHOULD BE DEGRADED TO EL.+4 TO ALLOW FOR PASSAGE OF THE PIPES THROUGH THE T-WALL.

A WATER LOAD OF 2380 P.S.F. WILL BE TAKEN BY THE PILES. THIS LOAD IS NOT REFLECTED IN "D_A" FOR THIS ANALYSIS.

STRATUM NO.	SOIL TYPE	EFFECTIVE UNIT WT. P.C.F.		C - UNIT COHESION - P.S.F.				FRICTION ANGLE DEGREES
				CENTER OF STRATUM		BOTTOM OF STRATUM		
		VERT. 1	VERT. 2	VERT. 1	VERT. 2	VERT. 1	VERT. 2	
1	WATER	62.5	62.5	0.0	0.0	0.0	0.0	0.0
2	CH	108.0	108.0	400.0	400.0	400.0	400.0	0.0
3	CHO	86.0	86.0	300.0	150.0	300.0	150.0	0.0
4	CHO	24.0	24.0	300.0	150.0	300.0	150.0	0.0
5	CH	34.0	34.0	300.0	150.0	300.0	150.0	0.0
6	CH	38.0	38.0	300.0	210.0	300.0	270.0	0.0
7	SP	60.0	60.0	0.0	0.0	0.0	0.0	30.0
8	CH	36.0	38.0	385.0	385.0	450.0	450.0	0.0

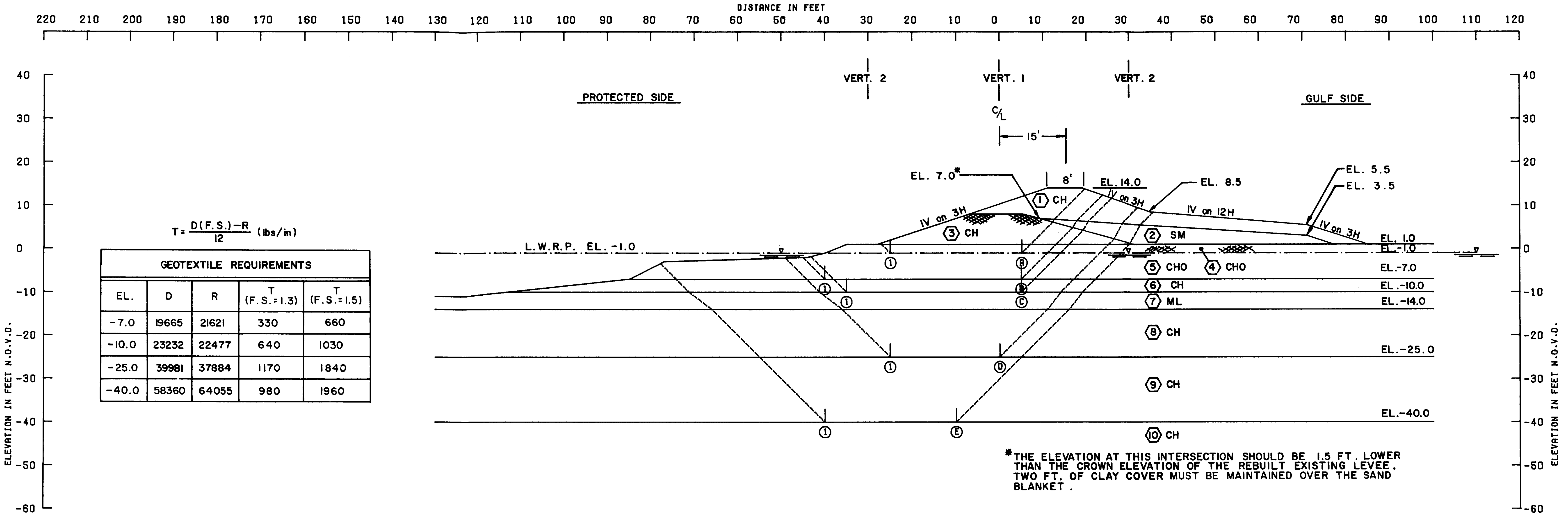
ASSUMED FAILURE SURFACE		RESISTING FORCES			DRIVING FORCES		SUMMATION OF FORCES		FACTOR OF SAFETY
NO.	ELEV.	R_A	R_B	R_P	D_A	$-D_P$	RESISTING	DRIVING	
(A) (1)	-7.00	3435	3010	6505	6839	4524	12950	2315	5.594
(A) (2)	-7.00	3435	13725	0	6839	0	17160	6839	2.509
(B) (1)	-10.00	3600	13740	0	9675	0	17340	9675	1.792
(C) (1)	-22.00	8640	17699	3625	24161	1413	29964	22748	1.317
(D) (1)	-40.00	19497	28035	18413	57507	15174	65944	42333	1.558
(E) (2)	-22.00	11560	6750	6165	17629	4388	24475	13241	1.848
WITH WATER AT EL.-6 IN THE DRAINAGE CANAL, EL.-1 FLOODSIDE.									
(C) (1)	-22.00	8640	17699	3625	24657	1413	29964	23244	1.289

NOTES

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

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

NEW ORLEANS TO VENICE, LA
DESIGN MEMORANDUM NO 1-GENERAL DESIGN
SUPPLEMENT NO. 5
REACH A-CITY PRICE TO TROPICAL BEND
STABILITY ANALYSIS
GAINARD WOODS PUMP STATION
STATION 439+48-441+76
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
AUGUST 1987 FILE NO. H-2-30260



$T = \frac{D(F.S.) - R}{12}$ (lbs/in)

GEOTEXTILE REQUIREMENTS

EL.	D	R	T (F.S.=1.3)	T (F.S.=1.5)
-7.0	19665	21621	330	660
-10.0	23232	22477	640	1030
-25.0	39981	37884	1170	1840
-40.0	58360	64055	980	1960

*THE ELEVATION AT THIS INTERSECTION SHOULD BE 1.5 FT. LOWER THAN THE CROWN ELEVATION OF THE REBUILT EXISTING LEVEE. TWO FT. OF CLAY COVER MUST BE MAINTAINED OVER THE SAND BLANKET.

GENERAL NOTES

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

SHEAR STRENGTHS BETWEEN VERTICALS 1 AND 2 WERE ASSUMED TO VARY LINEARLY BETWEEN THE VALUES INDICATED FOR THESE LOCATIONS.

STRATUM NO.	SOIL TYPE	EFFECTIVE UNIT WT. P.C.F.		C - UNIT COHESION - P.S.F. CENTER OF STRATUM		C - UNIT COHESION - P.S.F. BOTTOM OF STRATUM		FRICTION ANGLE DEGREES
		VERT. 1	VERT. 2	VERT. 1	VERT. 2	VERT. 1	VERT. 2	
1	CH	100.0	100.0	200.0	200.0	200.0	200.0	0.0
2	SM	122.0	122.0	0.0	0.0	0.0	0.0	30.0
3	CH	108.0	108.0	400.0	400.0	400.0	400.0	0.0
4	CHO	86.0	86.0	300.0	150.0	300.0	150.0	0.0
5	CHO	24.0	24.0	300.0	150.0	300.0	150.0	0.0
6	CH	34.0	34.0	300.0	150.0	300.0	150.0	0.0
7	ML	55.0	55.0	200.0	200.0	200.0	200.0	15.0
8	CH	38.0	38.0	300.0	245.0	300.0	300.0	0.0
9	CH	38.0	38.0	375.0	375.0	450.0	450.0	0.0
10	CH	38.0	38.0	450.0	450.0	450.0	450.0	0.0

ASSUMED FAILURE SURFACE NO.		ASSUMED FAILURE SURFACE ELEV.	RESISTING FORCES R_A	R_B	R_P	DRIVING FORCES D_A	$-D_P$	SUMMATION OF FORCES RESISTING	DRIVING	FACTOR OF SAFETY
A	1	-1.00	8330	7375	880	10895	319	16585	10576	1.568
B	1	-7.00	10442	9688	1491	20012	347	21621	19665	1.099
C	1	-10.00	11369	8647	2460	24638	1407	22477	23232	0.968
D	1	-25.00	19416	7500	10968	51897	11916	37884	39981	0.948
E	1	-40.00	28975	13500	21581	84458	26098	64055	58360	1.098

NOTES

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

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

$D = D_A - D_P$ = DRIVING FORCE

$R = R_A + R_B + R_P$ = RESISTING FORCE

T = FABRIC TENSILE STRENGTH (lbs/in)

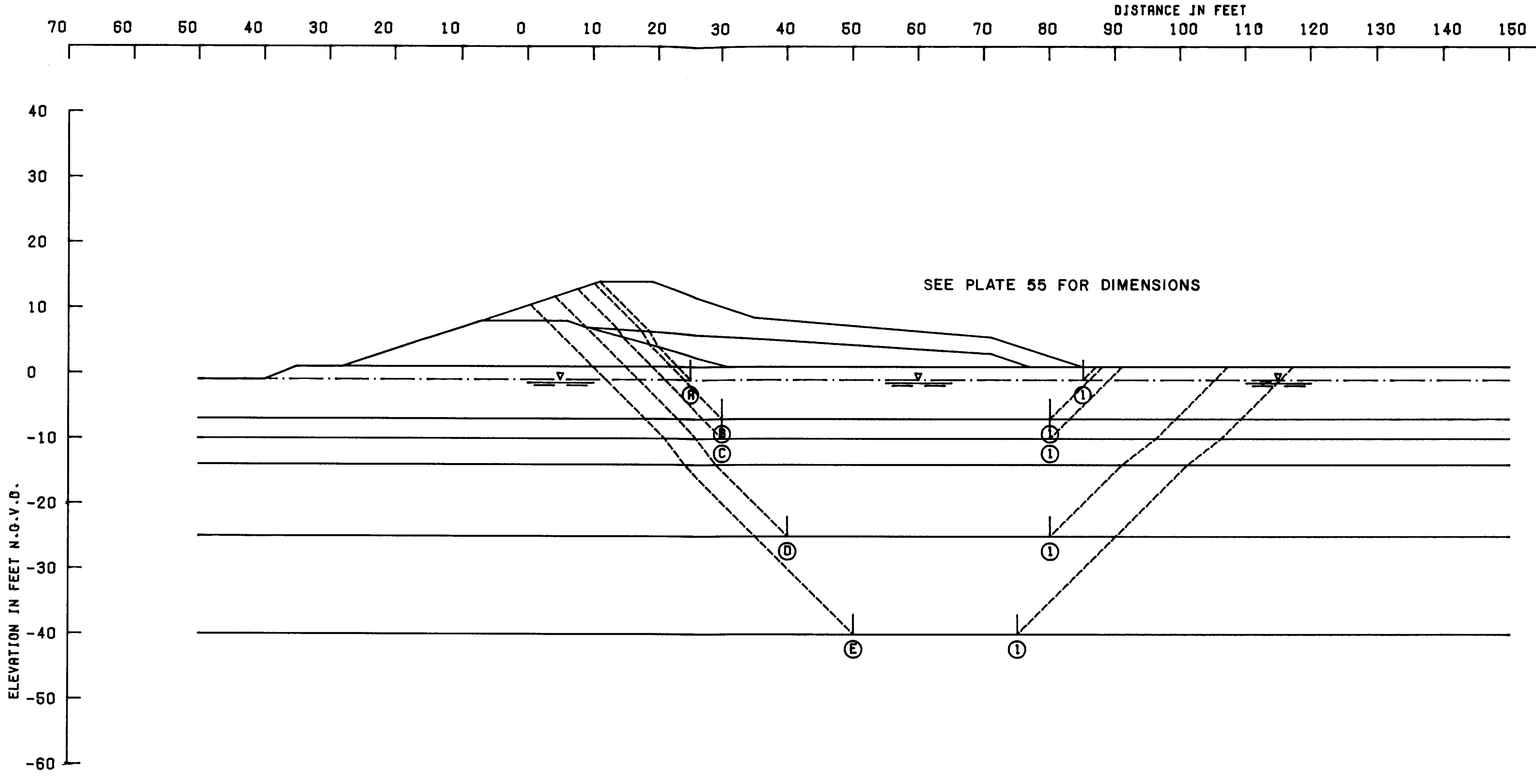
NEW ORLEANS TO VENICE, LA.
DESIGN MEMORANDUM NO. 1-GENERAL, DESIGN SUPPLEMENT NO. 5

REACH A - CITY PRICE TO TROPICAL BEND

STA. 476+50 TO 612+50
PROTECTED SIDE ANALYSIS
GEOTEXTILE REINFORCED LEVEE

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

AUGUST 1987 FILE NO. H-2-30260



$T = \frac{D(F.S.)-R}{12}$ (lbs/in)

GEOTEXTILE REQUIREMENTS				
EL.	D	R	T (F.S.=1.3)	T (F.S.=1.5)
- 7.0	17326	19449	260	550
-10.0	21196	21460	510	860
-25.0	35740	44607	150	750
-40.0	47476	67077	—	340

GENERAL NOTES

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

SHEAR STRENGTHS BETWEEN VERTICALS 1 AND 2 WERE ASSUMED TO VARY LINEARLY BETWEEN THE VALUES INDICATED FOR THESE LOCATIONS.

STRATUM NO.	SOIL TYPE	EFFECTIVE UNIT WT. P.C.F.		C - UNIT COHESION - P.S.F.				FRICTION ANGLE DEGREES
				CENTER OF STRATUM		BOTTOM OF STRATUM		
		VERT. 1	VERT. 2	VERT. 1	VERT. 2	VERT. 1	VERT. 2	
1	CH	100.0	100.0	200.0	200.0	200.0	200.0	0.0
2	SM	122.0	122.0	0.0	0.0	0.0	0.0	30.0
3	CH	108.0	108.0	400.0	400.0	400.0	400.0	0.0
4	CHO	86.0	86.0	300.0	150.0	300.0	150.0	0.0
5	CHO	24.0	24.0	300.0	150.0	300.0	150.0	0.0
6	CH	34.0	34.0	300.0	150.0	300.0	150.0	0.0
7	ML	55.0	55.0	200.0	200.0	200.0	200.0	15.0
8	CH	38.0	38.0	300.0	245.0	300.0	300.0	0.0
9	CH	38.0	38.0	375.0	375.0	450.0	450.0	0.0
10	CH	38.0	38.0	450.0	450.0	450.0	450.0	0.0

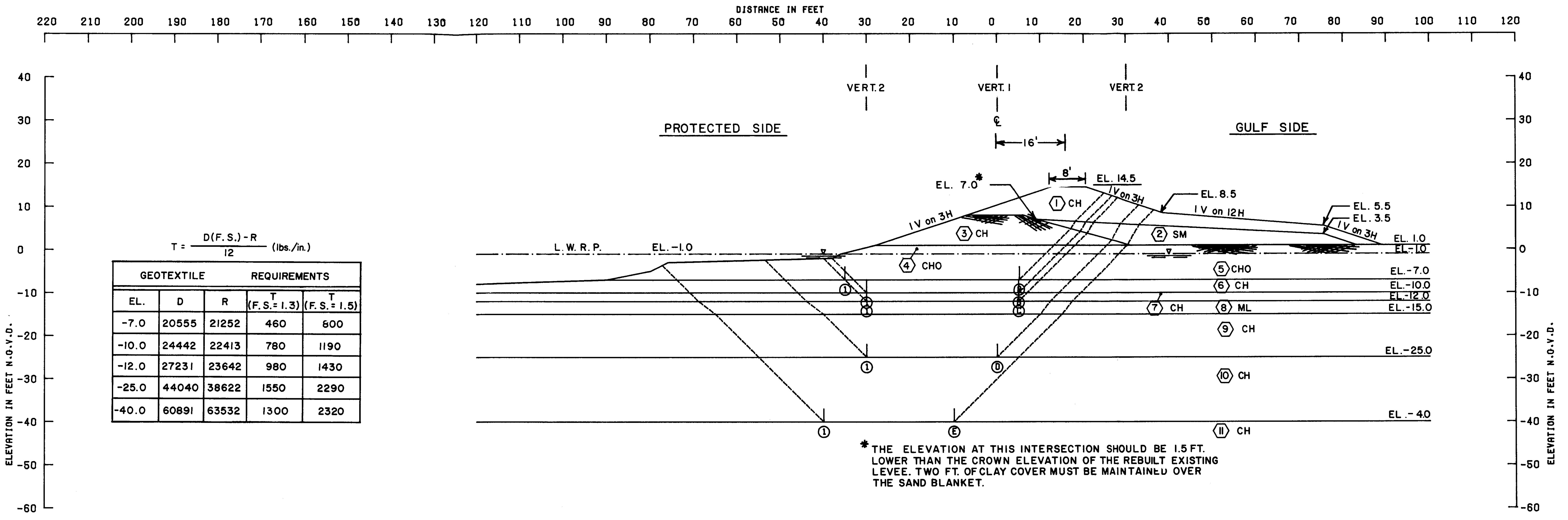
ASSUMED FAILURE SURFACE			RESISTING FORCES			DRIVING FORCES		SUMMATION OF FORCES		FACTOR OF SAFETY
NO.		ELEV.	R_A	R_B	R_P	D_A	$-D_P$	RESISTING	DRIVING	
A	1	-1.00	7587	9063	600	11024	171	17250	10852	1.589
B	1	-7.00	9549	7500	2400	19362	2036	19449	17326	1.122
C	1	-10.00	10617	7543	3300	24332	3136	21460	21196	1.012
D	1	-25.00	20358	12000	12250	50303	14563	44607	35740	1.248
E	1	-40.00	32327	11250	23500	83371	35895	67077	47476	1.413

NOTES

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

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

NEW ORLEANS TO VENICE, LA.
DESIGN MEMORANDUM NO. I-GENERAL, DESIGN
SUPPLEMENT NO. 5
REACH A-CITY PRICE TO TROPICAL BEND
STA. 476+50 TO 612+50
GULF SIDE ANALYSIS
GEOTEXTILE REINFORCED LEVEE
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
AUGUST 1987 FILE NO. H-2-30260



$$T = \frac{D(F.S.) - R}{12} \text{ (lbs./in.)}$$

GEOTEXTILE		REQUIREMENTS		
EL.	D	R	T (F.S.= 1.3)	T (F.S.= 1.5)
-7.0	20555	21252	460	600
-10.0	24442	22413	780	1190
-12.0	27231	23642	980	1430
-25.0	44040	38622	1550	2290
-40.0	60891	63532	1300	2320

*THE ELEVATION AT THIS INTERSECTION SHOULD BE 1.5 FT. LOWER THAN THE CROWN ELEVATION OF THE REBUILT EXISTING LEVEE. TWO FT. OF CLAY COVER MUST BE MAINTAINED OVER THE SAND BLANKET.

GENERAL NOTES

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

SHEAR STRENGTHS BETWEEN VERTICALS 1 AND 2 WERE ASSUMED TO VARY LINEARLY BETWEEN THE VALUES INDICATED FOR THESE LOCATIONS.

STRATUM NO.	SOIL TYPE	EFFECTIVE UNIT WT. P.C.F.		C - UNIT COHESION - P.S.F.				FRICTION ANGLE DEGREES
				CENTER OF STRATUM		BOTTOM OF STRATUM		
		VERT. 1	VERT. 2	VERT. 1	VERT. 2	VERT. 1	VERT. 2	
1	CH	100.0	100.0	200.0	200.0	200.0	200.0	0.0
2	SM	122.0	122.0	0.0	0.0	0.0	0.0	30.0
3	CH	108.0	108.0	400.0	400.0	400.0	400.0	0.0
4	CHO	86.0	86.0	300.0	150.0	300.0	150.0	0.0
5	CHO	24.0	24.0	300.0	150.0	300.0	150.0	0.0
6	CH	34.0	34.0	300.0	150.0	300.0	150.0	0.0
7	CH	38.0	38.0	300.0	160.0	300.0	170.0	0.0
8	ML	55.0	55.0	200.0	200.0	200.0	200.0	15.0
9	CH	38.0	38.0	300.0	250.0	300.0	300.0	0.0
10	CH	38.0	38.0	375.0	375.0	450.0	450.0	0.0
11	CH	38.0	38.0	450.0	450.0	450.0	450.0	0.0

ASSUMED FAILURE SURFACE		RESISTING FORCES			DRIVING FORCES		SUMMATION OF FORCES		FACTOR OF SAFETY
NO.	ELEV.	R_A	R_B	R_P	D_A	$-D_P$	RESISTING	DRIVING	
A 1	-7.00	10830	8938	1486	20912	357	21252	20555	1.034
B 1	-10.00	11825	8188	2400	25808	1366	22413	24442	0.917
C 1	-12.00	12407	8211	3025	29116	1885	23642	27231	0.868
D 1	-25.00	19349	9000	10273	53520	9480	38622	44040	0.877
E 1	-40.00	28910	13500	21121	86299	25408	63532	60891	1.043

NOTES

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

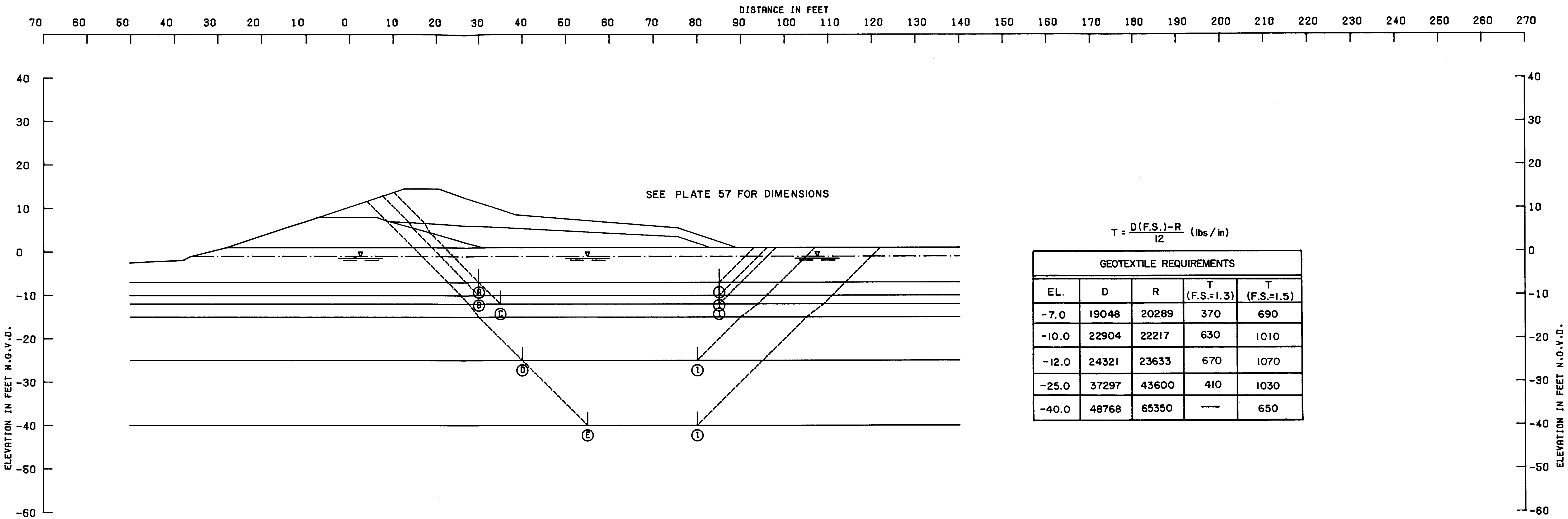
$$\text{FACTOR OF SAFETY} = \frac{R_A + R_B + R_P}{D_A - D_P}$$

$D = D_A - D_P$ =DRIVING FORCE

$R = R_A + R_B + R_P$ =RESISTING FORCE

T=FABRIC TENSILE STRENGTH(lbs/in)

NEW ORLEANS TO VENICE, LA.
DESIGN MEMORANDUM NO.1-GENERAL,DESIGN SUPPLEMENT NO.5
REACH A-CITY PRICE TO TROPICAL BEND
STA. 612 + 50 TO STA.676 + 88
PROTECTED SIDE ANALYSIS
GEOTEXTILE REINFORCED LEVEE
U.S. ARMY ENGINEER DISTRICT,NEW ORLEANS
CORPS OF ENGINEERS
AUGUST 1987 FILE NO. H-2-30260



$$T = \frac{D(F.S.)-R}{12} \text{ (lbs / in)}$$

GEOTEXTILE REQUIREMENTS				
EL.	D	R	T (F.S.=1.3)	T (F.S.=1.5)
-7.0	19048	20289	370	690
-10.0	22904	22217	630	1010
-12.0	24321	23633	670	1070
-25.0	37297	43600	410	1030
-40.0	48768	65350	—	650

GENERAL NOTES

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

SHEAR STRENGTHS BETWEEN VERTICALS 1 AND 2 WERE ASSUMED TO VARY LINEARLY BETWEEN THE VALUES INDICATED FOR THESE LOCATIONS.

STRATUM NO.	SOIL TYPE	EFFECTIVE UNIT WT. P.C.F.		C - UNIT COHESION - P.S.F.				FRICTION ANGLE DEGREES
				CENTER OF STRATUM		BOTTOM OF STRATUM		
		VERT. 1	VERT. 2	VERT. 1	VERT. 2	VERT. 1	VERT. 2	
1	CH	100.0	100.0	200.0	200.0	200.0	200.0	0.0
2	SM	122.0	122.0	0.0	0.0	0.0	0.0	30.0
3	CH	108.0	108.0	400.0	400.0	400.0	400.0	0.0
4	CHO	86.0	86.0	300.0	150.0	300.0	150.0	0.0
5	CHO	24.0	24.0	300.0	150.0	300.0	150.0	0.0
6	CH	34.0	34.0	300.0	150.0	300.0	150.0	0.0
7	CH	38.0	38.0	300.0	160.0	300.0	170.0	0.0
8	ML	55.0	55.0	200.0	200.0	200.0	200.0	15.0
9	CH	38.0	38.0	300.0	250.0	300.0	300.0	0.0
10	CH	38.0	38.0	375.0	375.0	450.0	450.0	0.0
11	CH	38.0	38.0	450.0	450.0	450.0	450.0	0.0

ASSUMED FAILURE SURFACE			RESISTING FORCES			DRIVING FORCES		SUMMATION OF FORCES		FACTOR OF SAFETY
NO.		ELEV.	R_A	R_B	R_P	D_A	$-D_P$	RESISTING	DRIVING	
A	1	-7.00	9639	8250	2400	20948	1901	20289	19048	1.065
B	1	-10.00	10667	8250	3300	25905	3001	22217	22904	0.970
C	1	-12.00	11179	8514	3940	28233	3913	23633	24321	0.972
D	1	-25.00	19889	12000	11711	52542	15246	43600	37297	1.169
E	1	-40.00	31139	11250	22961	83871	35104	65350	48768	1.340

NOTES

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○ -- WEDGE NUMBER
-- CROSSOVER POINT
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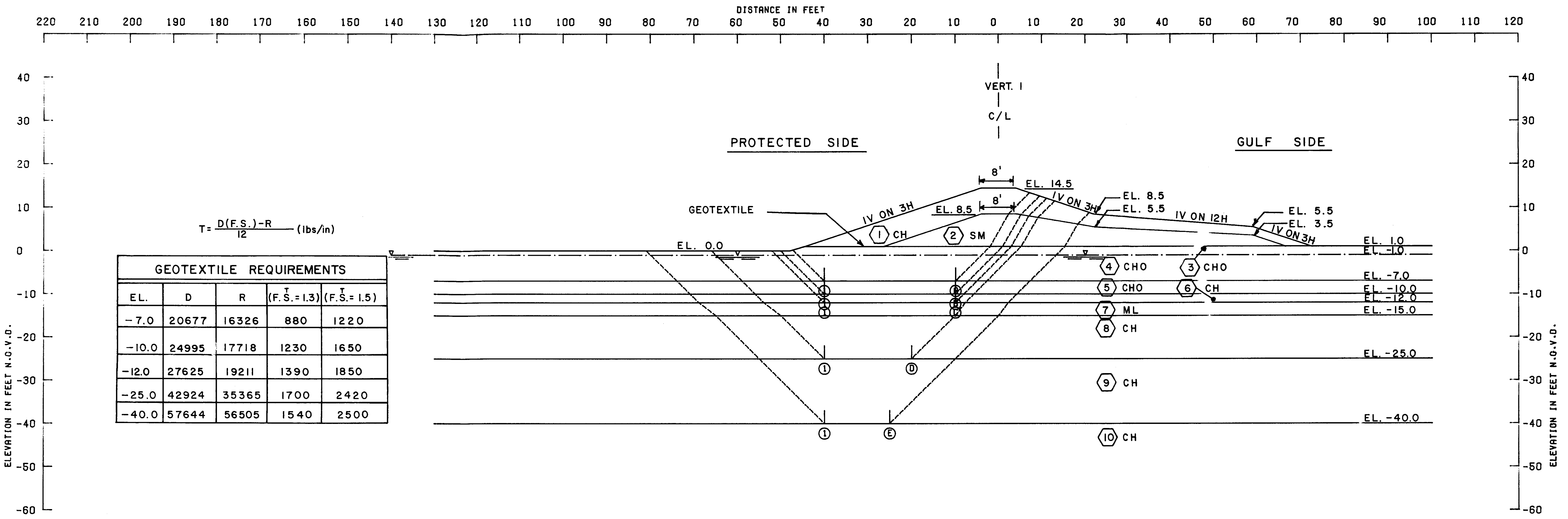
∇ -- STATIC WATER SURFACE
D -- HORIZONTAL DRIVING FORCE IN POUNDS
R -- HORIZONTAL RESISTING FORCE IN POUNDS
A -- AS A SUBSCRIPT, REFERS TO ACTIVE WEDGE
B -- AS A SUBSCRIPT REFERS TO CENTRAL BLOCK
P -- AS A SUBSCRIPT REFERS TO PASSIVE WEDGE

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

NEW ORLEANS TO VENICE, LA
DESIGN MEMORANDUM NO. I-GENERAL, DESIGN SUPPLEMENT NO. 5
REACH A – CITY PRICE TO TROPICAL BEND
STA. 612 + 50 TO STA. 676 + 88
GULF SIDE ANALYSIS
GEOTEXTILE REINFORCED LEVEE
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
AUGUST 1987 FILE NO. H-2-30260



GEOTEXTILE REQUIREMENTS

EL.	D	R	T (F.S.= 1.3)	T (F.S.= 1.5)
-7.0	20677	16326	880	1220
-10.0	24995	17718	1230	1650
-12.0	27625	19211	1390	1850
-25.0	42924	35365	1700	2420
-40.0	57644	56505	1540	2500

GENERAL NOTES

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

SHEAR STRENGTHS BETWEEN VERTICALS 1 AND 2 WERE ASSUMED TO VARY LINEARLY BETWEEN THE VALUES INDICATED FOR THESE LOCATIONS.

VERT. 1 = VERT. 2

STRATUM NO.	SOIL TYPE	EFFECTIVE UNIT WT. P.C.F.		C - UNIT COHESION - P.S.F. CENTER OF STRATUM		C - UNIT COHESION - P.S.F. BOTTOM OF STRATUM		FRICTION ANGLE DEGREES
		VERT. 1	VERT. 2	VERT. 1	VERT. 2	VERT. 1	VERT. 2	
1	CH	100.0	100.0	200.0	200.0	200.0	200.0	0.0
2	SM	122.0	122.0	0.0	0.0	0.0	0.0	30.0
3	CHO	86.0	86.0	150.0	150.0	150.0	150.0	0.0
4	CHO	24.0	24.0	150.0	150.0	150.0	150.0	0.0
5	CH	34.0	34.0	150.0	150.0	150.0	150.0	0.0
6	CH	38.0	38.0	160.0	160.0	170.0	170.0	0.0
7	ML	55.0	55.0	200.0	200.0	200.0	200.0	15.0
8	CH	38.0	38.0	250.0	250.0	300.0	300.0	0.0
9	CH	38.0	38.0	375.0	375.0	450.0	450.0	0.0
10	CH	38.0	38.0	450.0	450.0	450.0	450.0	0.0

ASSUMED FAILURE SURFACE NO.		ASSUMED FAILURE SURFACE ELEV.	RESISTING FORCES R_A	R_B	R_P	DRIVING FORCES D_A	$-D_P$	SUMMATION OF FORCES RESISTING	DRIVING	FACTOR OF SAFETY
A	1	-7.00	9659	4500	2167	22531	1854	16326	20677	0.790
B	1	-10.00	10218	4500	3000	27702	2706	17718	24995	0.709
C	1	-12.00	10471	5100	3640	31071	3446	19211	27625	0.695
D	1	-25.00	18134	6000	11231	55470	12546	35365	42924	0.824
E	1	-40.00	27274	6750	22481	88757	31113	56505	57644	0.980

NOTES

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

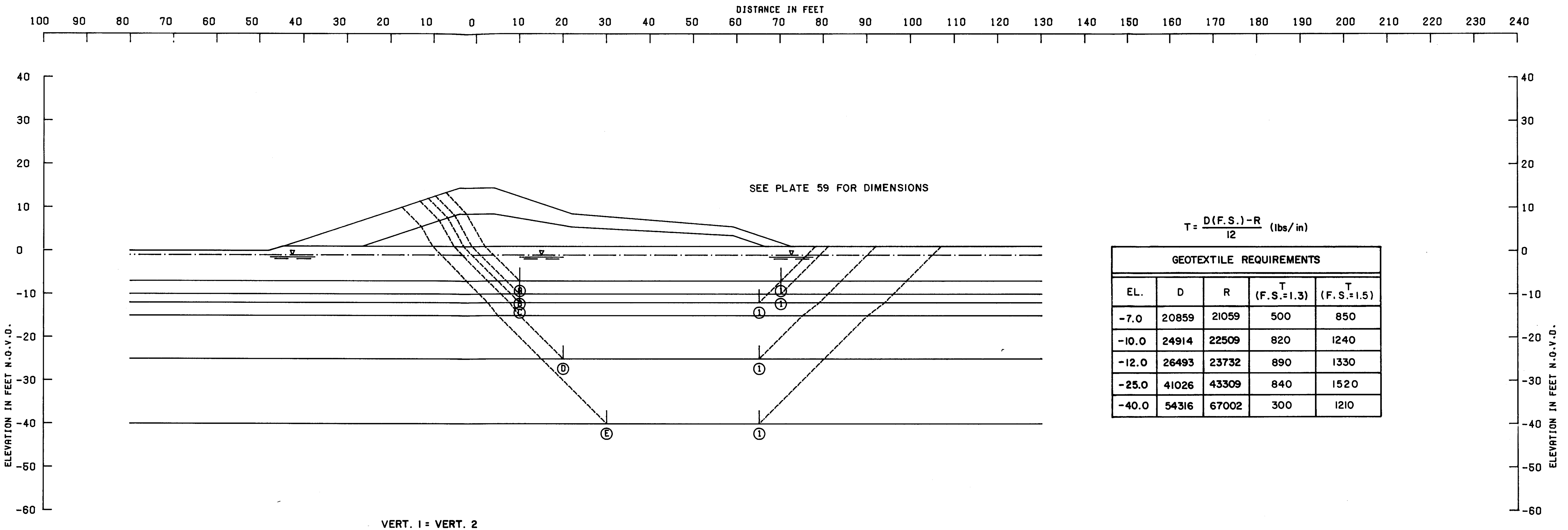
FACTOR OF SAFETY = $\frac{R_A + R_B + R_P}{D_A - D_P}$

$D = D_A - D_P$ = DRIVING FORCE

$R = R_A + R_B + R_P$ = RESISTING FORCE

T = FABRIC TENSILE STRENGTH (lbs/in)

NEW ORLEANS TO VENICE, LA.
DESIGN MEMORANDUM NO. 1-GENERAL, DESIGN
SUPPLEMENT NO. 5
REACH A - CITY PRICE TO TROPICAL BEND
STA. 676+88 TO 681+91
PROTECTED SIDE ANALYSIS
GEOTEXTILE REINFORCED LEVEE
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
AUGUST 1987 FILE NO. H-2-30260



$T = \frac{D(F.S.)-R}{12}$ (lbs/in)

GEOTEXTILE REQUIREMENTS				
EL.	D	R	T (F.S.=1.3)	T (F.S.=1.5)
-7.0	20859	21059	500	850
-10.0	24914	22509	820	1240
-12.0	26493	23732	890	1330
-25.0	41026	43309	840	1520
-40.0	54316	67002	300	1210

GENERAL NOTES

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

SHEAR STRENGTHS BETWEEN VERTICALS 1 AND 2 WERE ASSUMED TO VARY LINEARLY BETWEEN THE VALUES INDICATED FOR THESE LOCATIONS.

VERT. 1 = VERT. 2

STRATUM NO.	SOIL TYPE	EFFECTIVE UNIT WT. P.C.F.		C - UNIT COHESION - P.S.F.				FRICTION ANGLE DEGREES
				CENTER OF STRATUM		BOTTOM OF STRATUM		
		VERT. 1	VERT. 2	VERT. 1	VERT. 2	VERT. 1	VERT. 2	
1	CH	100.0	100.0	200.0	200.0	200.0	200.0	0.0
2	SM	122.0	122.0	0.0	0.0	0.0	0.0	30.0
3	CHO	86.0	86.0	150.0	150.0	150.0	150.0	0.0
4	CHO	24.0	24.0	150.0	150.0	150.0	150.0	0.0
5	CH	34.0	34.0	150.0	150.0	150.0	150.0	0.0
6	CH	38.0	38.0	160.0	160.0	170.0	170.0	0.0
7	ML	55.0	55.0	200.0	200.0	200.0	200.0	15.0
8	CH	38.0	38.0	250.0	250.0	300.0	300.0	0.0
9	CH	38.0	38.0	375.0	375.0	450.0	450.0	0.0
10	CH	38.0	38.0	450.0	450.0	450.0	450.0	0.0

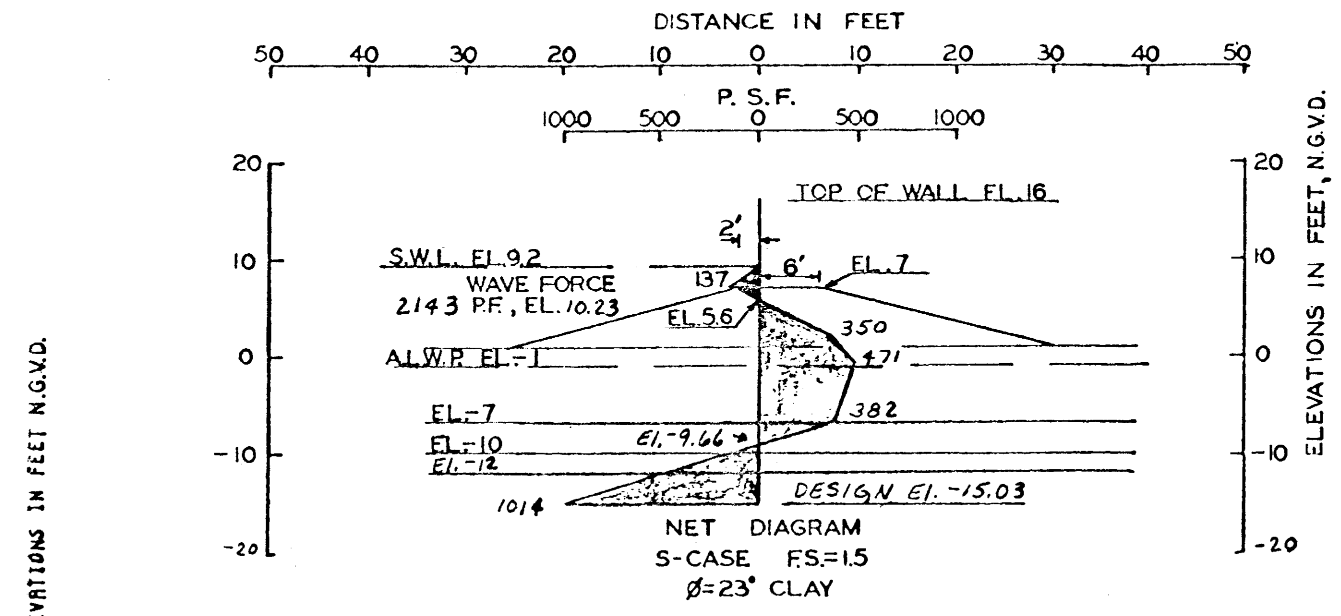
ASSUMED FAILURE SURFACE			RESISTING FORCES			DRIVING FORCES		SUMMATION OF FORCES		FACTOR OF SAFETY
NO.		ELEV.	R_A	R_B	R_P	D_A	$-D_P$	RESISTING	DRIVING	
Ⓐ	①	-7.00	9659	9000	2400	22597	1738	21059	20859	1.010
Ⓑ	①	-10.00	10209	9000	3300	27753	2839	22509	24914	0.903
Ⓒ	①	-12.00	10442	9350	3940	31086	4591	23732	26493	0.896
Ⓓ	①	-25.00	18097	13500	11711	55834	14809	43309	41026	1.056
Ⓔ	①	-40.00	28290	15750	22961	88982	34667	67002	54316	1.234

NOTES

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

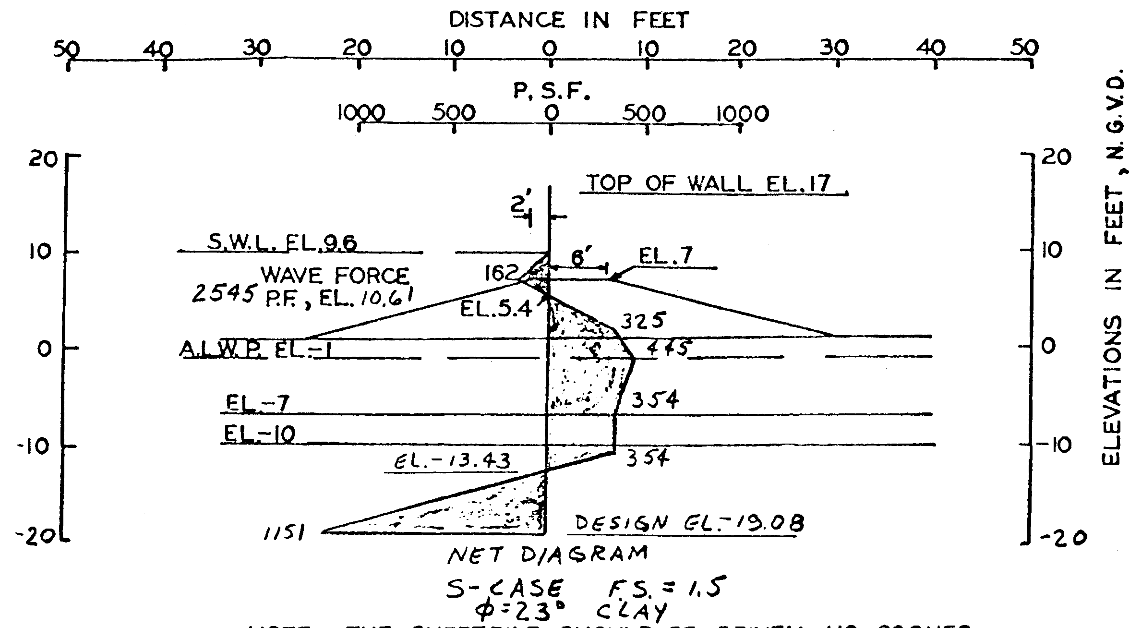
FACTOR OF SAFETY = $\frac{R_A + R_B + R_P}{D_A - D_P}$

NEW ORLEANS TO VENICE, LA.
DESIGN MEMORANDUM NO. I-GENERAL, DESIGN SUPPLEMENT NO. 5
REACH A-CITY PRICE TO TROPICAL BEND
STA. 676 + 88 TO STA. 681 + 91
GULF SIDE ANALYSIS
GEOTEXTILE REINFORCED LEVEE
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
AUGUST 1987 FILE NO. H-2-30260



NOTE : THE SHEETPILE SHOULD BE DRIVEN NO SOONER THAN THREE YEARS FROM COMPLETION OF THE SECOND LIFT.

Figure 1



NOTE : THE SHEETPILE SHOULD BE DRIVEN NO SOONER THAN THREE YEARS FROM COMPLETION OF THE SECOND LIFT.

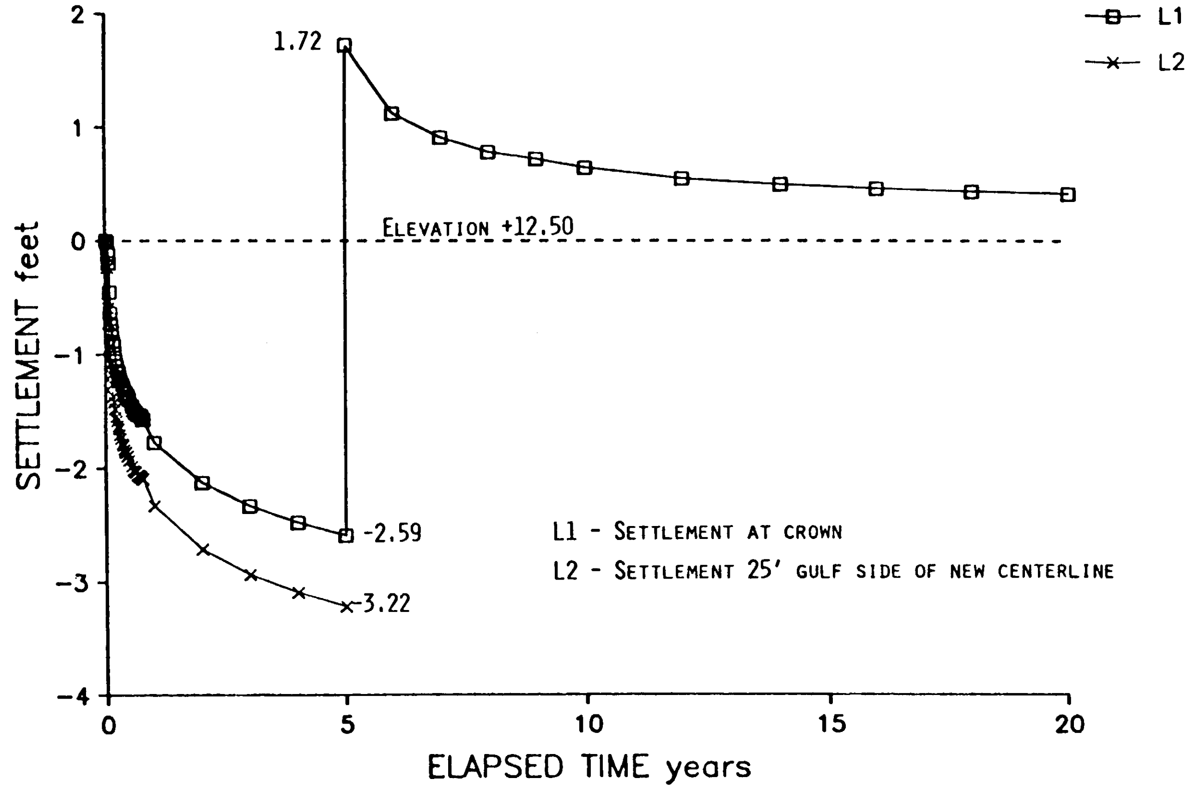
Figure 2

NEW ORLEANS TO VENICE, LA
DESIGN MEMORANDUM NO. I-GENERAL DESIGN
SUPPLEMENT NO. 5

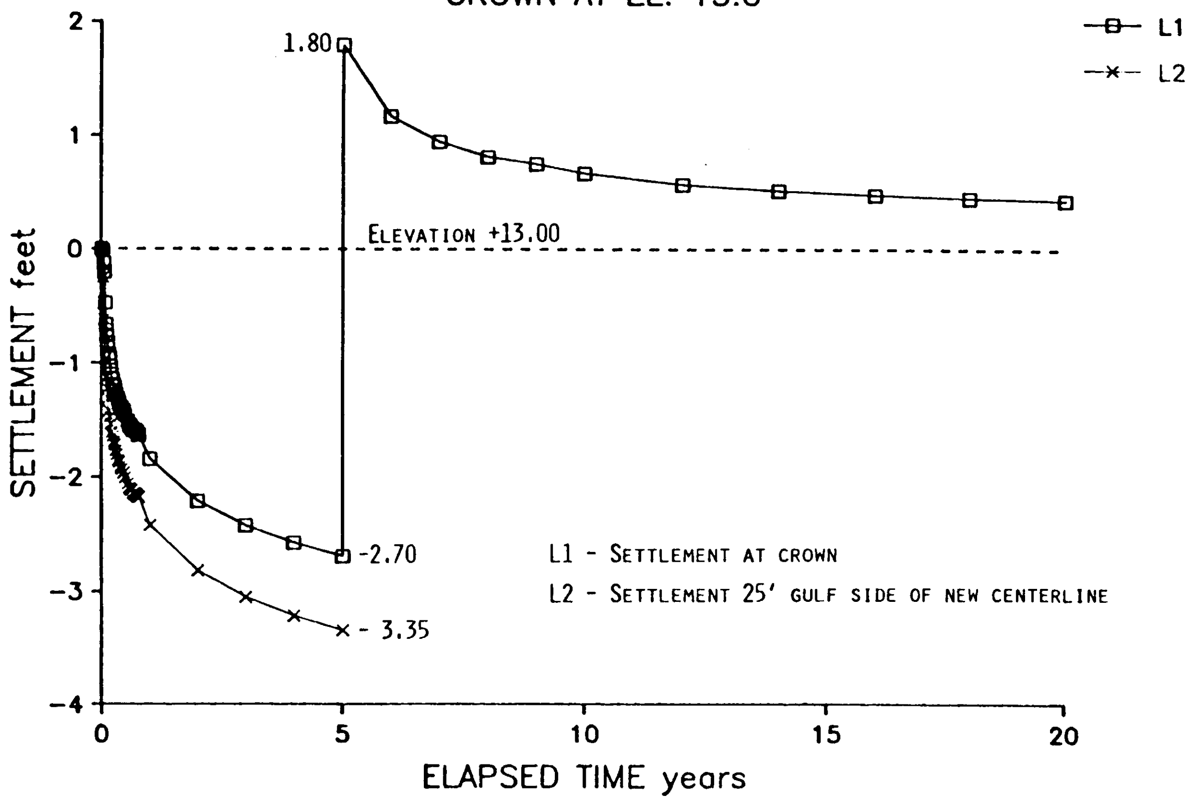
REACH A-CITY PRICE TO TROPICAL BEND
SHEET-PILE ANALYSIS

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
AUGUST 1987 FILE NO. H-2-30260

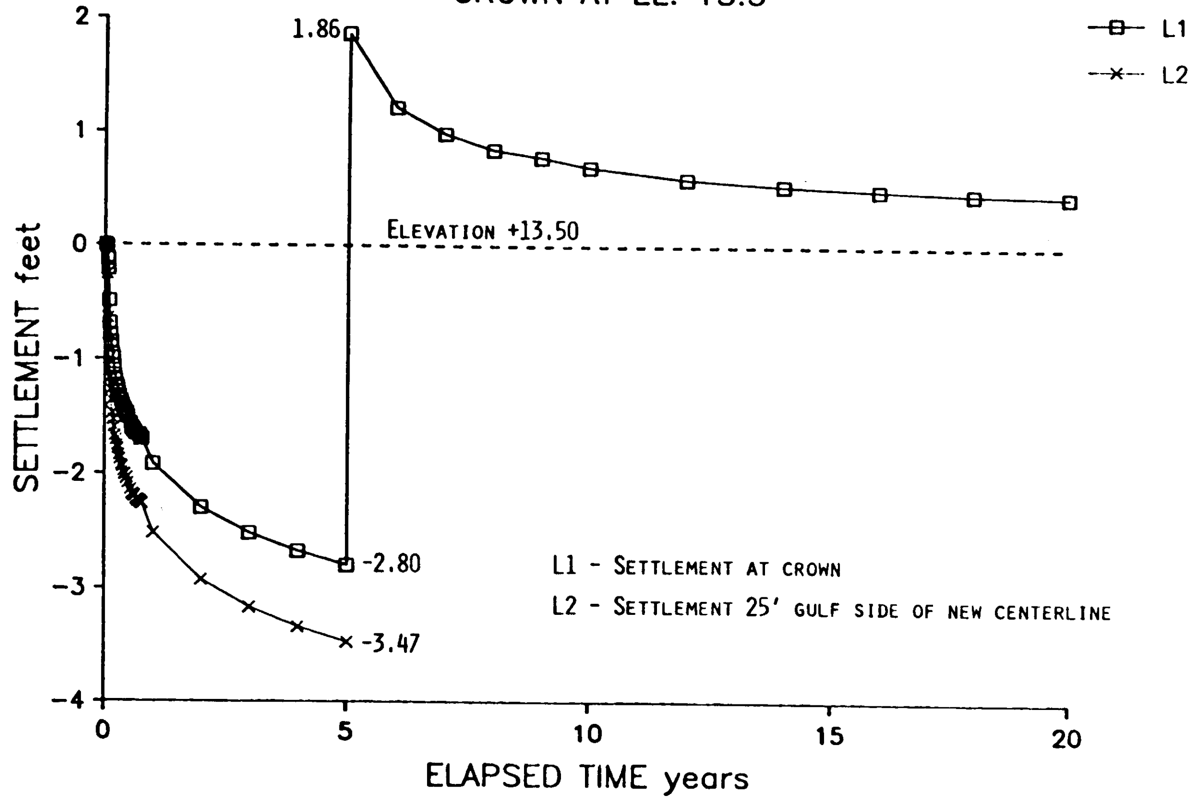
SETTLEMENT PREDICTION
CROWN AT EL. 12.5



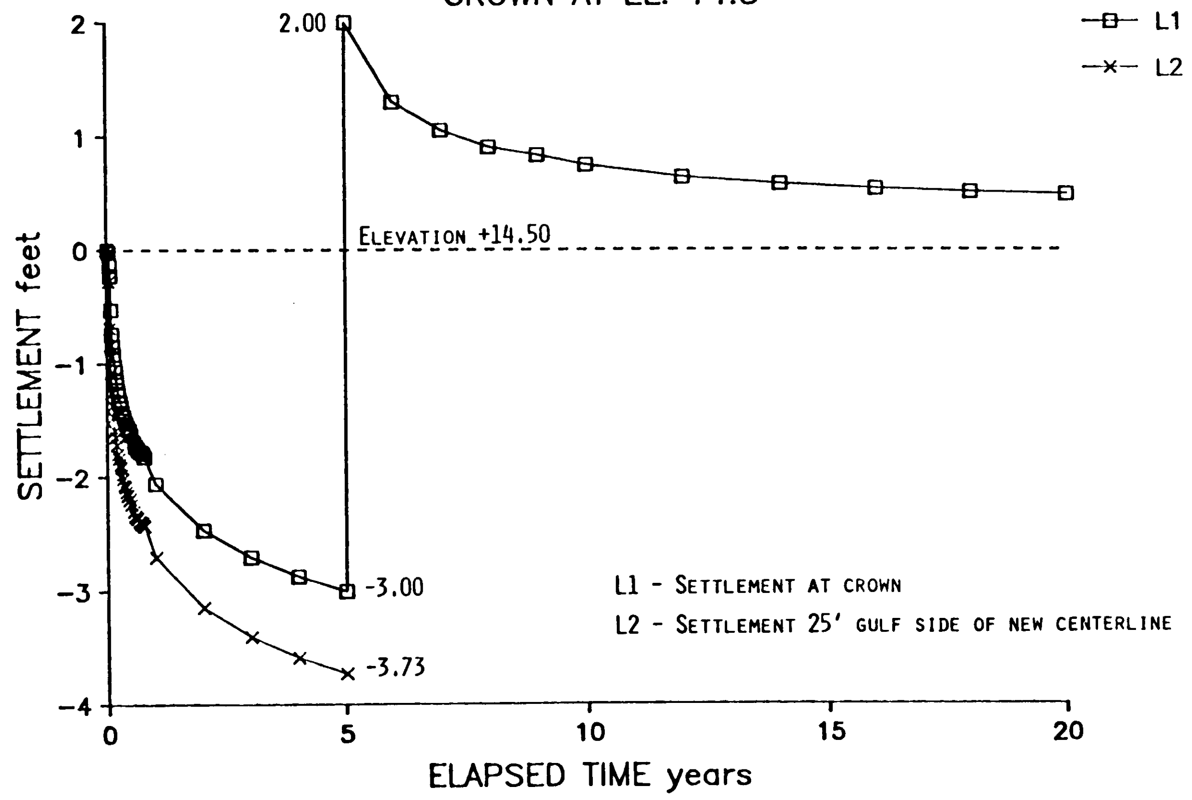
SETTLEMENT PREDICTION
CROWN AT EL. 13.0



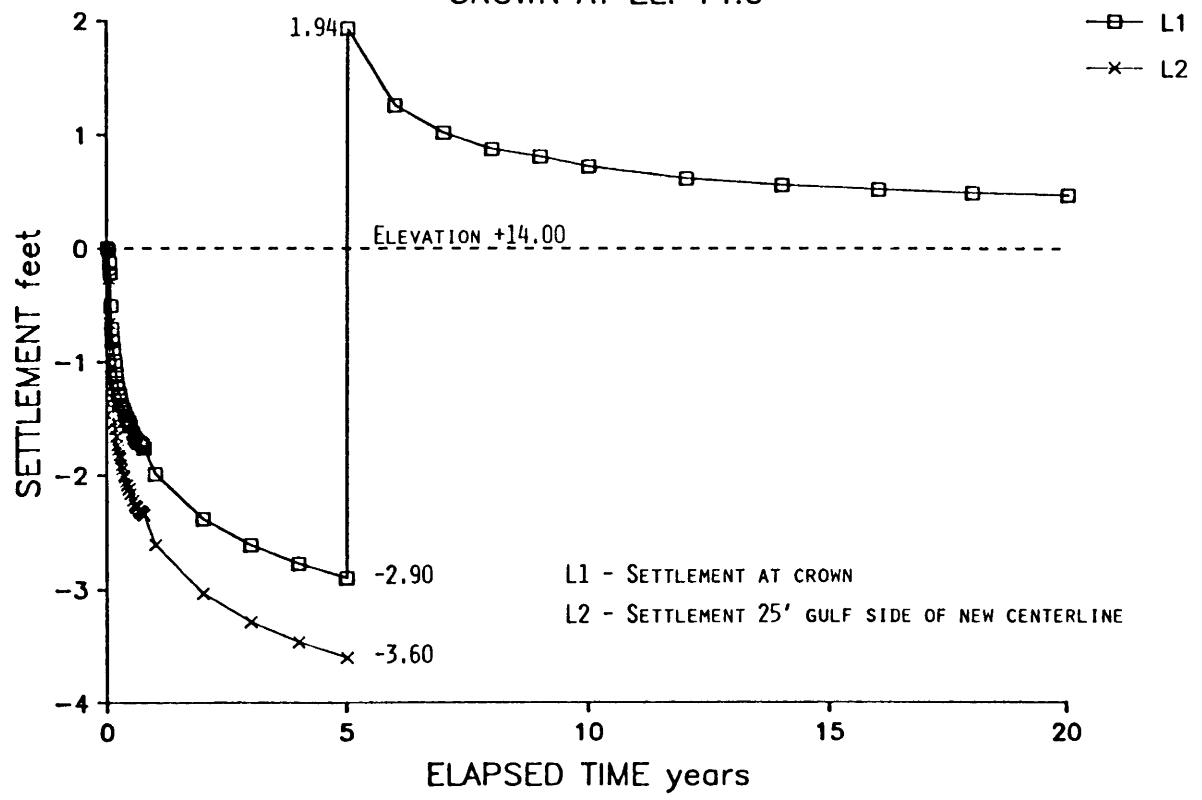
SETTLEMENT PREDICTION
CROWN AT EL. 13.5



SETTLEMENT PREDICTION
CROWN AT EL. 14.5



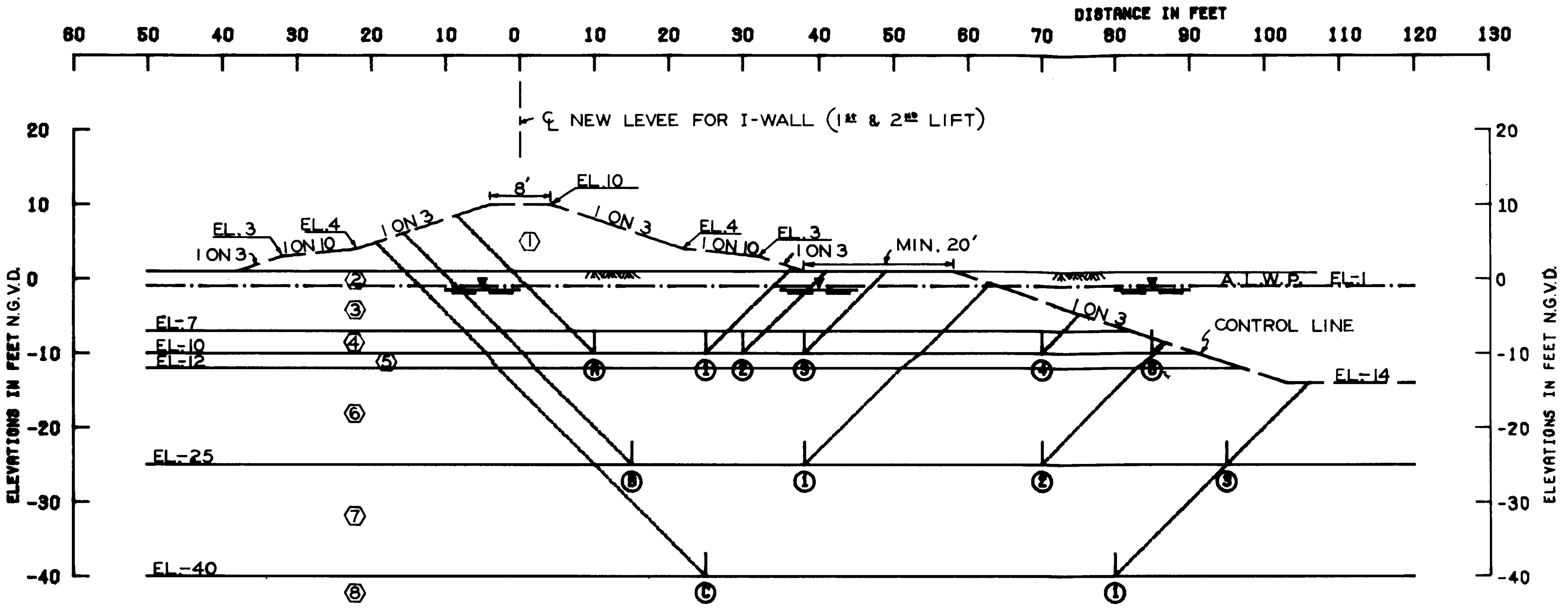
SETTLEMENT PREDICTION
CROWN AT EL. 14.0

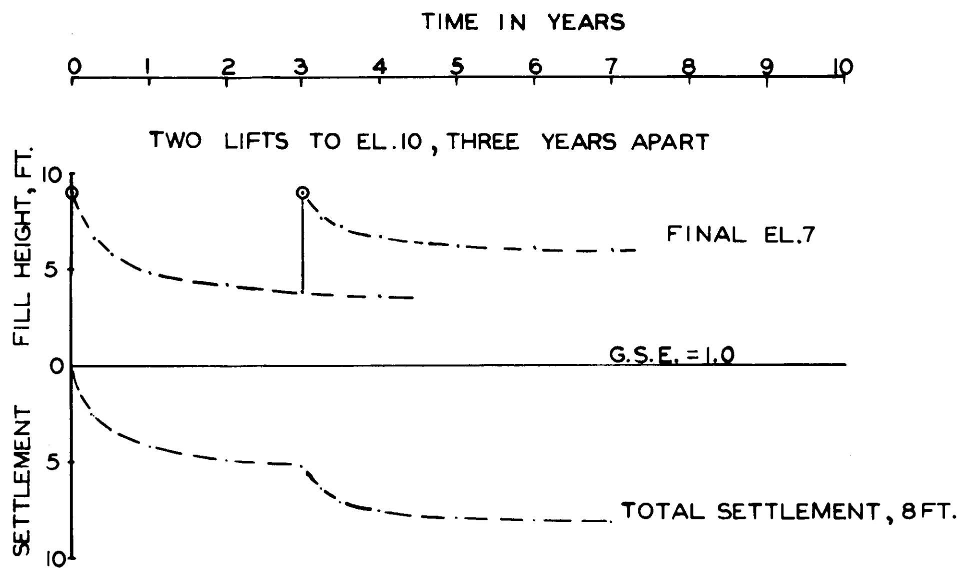


NEW ORLEANS TO VENICE, LA
DESIGN MEMORANDUM NO. I-GENERAL DESIGN
SUPPLEMENT NO. 5
REACH A-CITY PRICE TO TROPICAL BEND

SETTLEMENT ANALYSIS

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
AUGUST 1987 FILE NO. H-2-30260





GENERAL NOTES

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

SHEAR STRENGTHS BETWEEN VERTICALS 1 AND 2 WERE ASSUMED TO VARY LINEARLY BETWEEN THE VALUES INDICATED FOR THESE LOCATIONS.

THIS DESIGN SECTION MAY BE USED AS A TRANSITION FROM THE NEW LEVEE TO THE EXISTING LEVEE.

THE CONTROL LINE SHOULD BE USED TO LOCATE THE ALINEMENT OF THIS SECTION.

VERT. I = VERT. 2

STRATUM NO.	SOIL TYPE	EFFECTIVE UNIT WT. P.C.F.		C - UNIT COHESION - P.S.F.				FRICTION ANGLE DEGREES
				CENTER OF STRATUM		BOTTOM OF STRATUM		
		VERT. 1	VERT. 2	VERT. 1	VERT. 2	VERT. 1	VERT. 2	
1	CH	108.0	108.0	400.0	400.0	400.0	400.0	0.0
2	CHO	88.0	88.0	150.0	150.0	150.0	150.0	0.0
3	CHO	24.0	24.0	150.0	150.0	150.0	150.0	0.0
4	CH	34.0	34.0	150.0	150.0	150.0	150.0	0.0
5	ML	55.0	55.0	200.0	200.0	200.0	200.0	15.0
6	CH	38.0	38.0	235.0	235.0	300.0	300.0	0.0
7	CH	38.0	38.0	375.0	375.0	450.0	450.0	0.0
8	ML	55.0	55.0	200.0	200.0	200.0	200.0	15.0

ASSUMED FAILURE SURFACE NO.		ELEV.	RESISTING FORCES R_A	R_B	R_P	DRIVING FORCES D_A	$-D_P$	SUMMATION OF FORCES RESISTING	DRIVING	FACTOR OF SAFETY
A	1	-10.00	9300	2250	3700	16674	5105	15250	11570	1.318
A	2	-10.00	9300	3000	3300	16674	3835	15600	12839	1.215
A	3	-10.00	9300	4200	3300	16674	2735	16800	13939	1.205
A	4	-10.00	9300	9000	1575	16674	485	19875	16189	1.228
A	5	-10.00	9300	11250	450	16674	51	21000	16624	1.263
B	1	-25.00	15306	6900	10616	37976	13285	32823	24691	1.329
B	2	-25.00	15306	16500	7740	37976	6837	39545	31139	1.270
B	3	-25.00	15306	24000	5170	37976	2713	44476	35262	1.261
C	1	-40.00	25553	24750	16420	64079	16578	66723	47502	1.405

NOTES

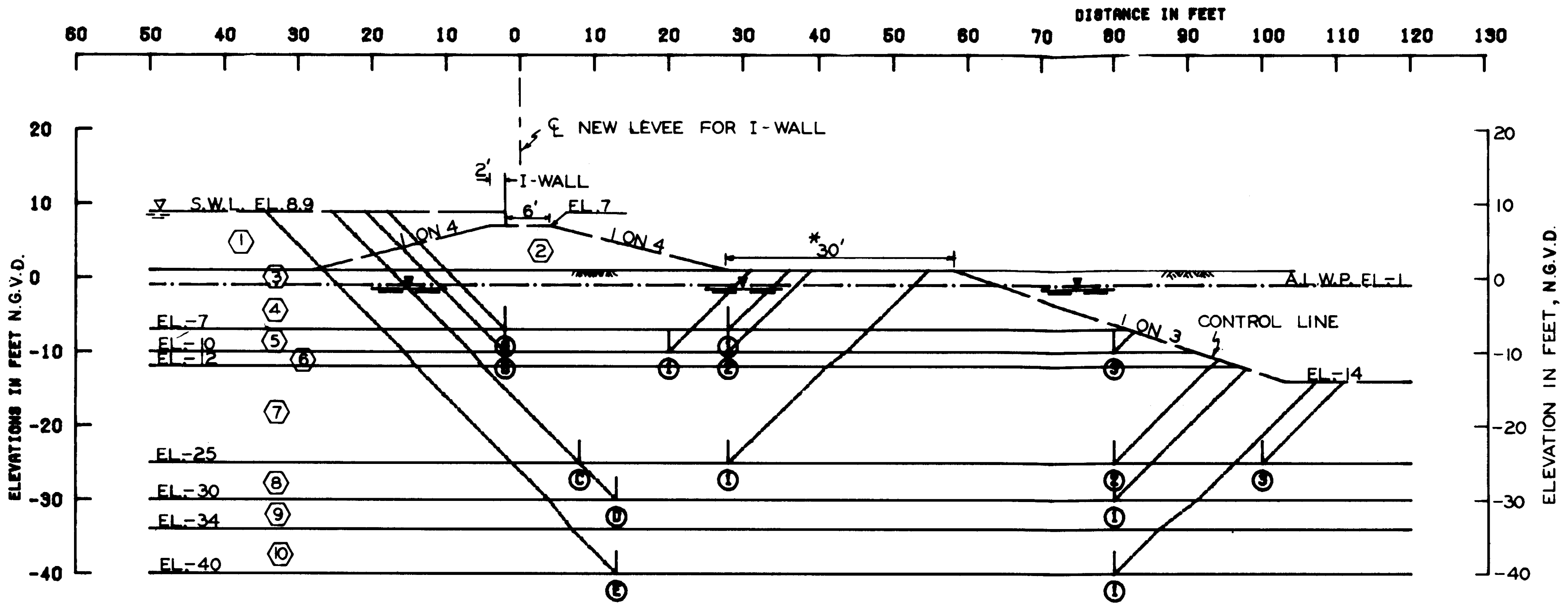
Φ — ANGLE OF INTERNAL FRICTION, DEGREES
C — UNIT COHESION, P.S.F.
▽ — STATIC WATER SURFACE
D — HORIZONTAL DRIVING FORCE IN POUNDS
R — HORIZONTAL RESISTING FORCE IN POUNDS
A — AS A SUBSCRIPT, REFERS TO ACTIVE WEDGE
B — AS A SUBSCRIPT REFERS TO CENTRAL BLOCK
P — AS A SUBSCRIPT REFERS TO PASSIVE WEDGE

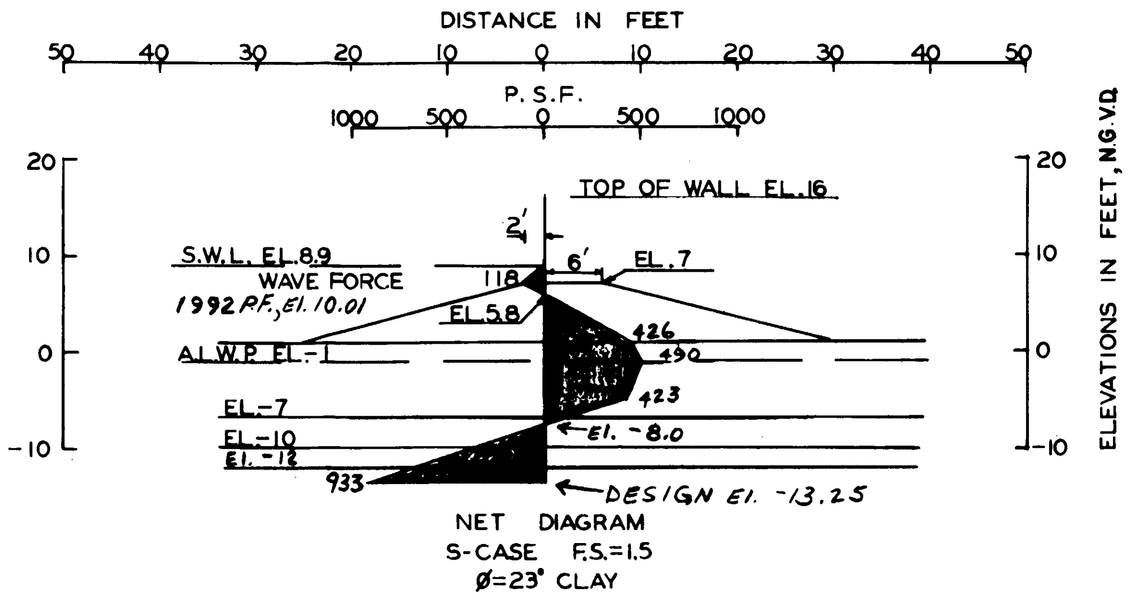
$$\text{FACTOR OF SAFETY} = \frac{R_A + R_B + R_P}{D_A - D_P}$$

** 8+80 TO 9+20, 27+85 TO 29+40, 32+10 TO 33+15, 109+25 TO 110+52, 112+52 TO 113+95, 248+30 TO 253+70, 285+40 TO 291+40, 438+40 TO 439+60, AND 441+60 TO 443+20

NEW ORLEANS TO VENICE, LA
DESIGN MEMORANDUM NO. 1 - GENERAL DESIGN
SUPPLEMENT NO. 5
REACH A - CITY PRICE TO TROPICAL BEND
STABILITY ANALYSIS & SETTLEMENT PLOT
I-WALL, NEW LEVEE: 1st & 2nd LIFT
STATIONS**

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
AUGUST 1987 FILE NO. H-2-30260





NOTE : THE SHEETPILE SHOULD BE DRIVEN NO SOONER THAN THREE YEARS FROM COMPLETION OF THE SECOND LIFT.

GENERAL NOTES

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

SHEAR STRENGTHS BETWEEN VERTICALS 1 AND 2 WERE ASSUMED TO VARY LINEARLY BETWEEN THE VALUES INDICATED FOR THESE LOCATIONS.

THIS DESIGN SECTION MAY BE USED IN AREAS WHERE THERE IS NOT AN EXISTING LEVEE.

*THE CONTROL LINE IS LOCATED THE SAME DISTANCE FROM THE LEVEE ℄ AS IS INDICATED FROM THE FIRST LIFT.

VERT. 1 = VERT. 2

STRATUM NO.	SOIL TYPE	EFFECTIVE UNIT WT. P.C.F.		C - UNIT COHESION - P.S.F.				FRICTION ANGLE DEGREES
				CENTER OF STRATUM		BOTTOM OF STRATUM		
		VERT. 1	VERT. 2	VERT. 1	VERT. 2	VERT. 1	VERT. 2	
1	WATER	62.5	62.5	0.0	0.0	0.0	0.0	0.0
2	CH	108.0	108.0	400.0	400.0	400.0	400.0	0.0
3	CHO	86.0	86.0	150.0	150.0	150.0	150.0	0.0
4	CHO	24.0	24.0	150.0	150.0	150.0	150.0	0.0
5	CH	34.0	34.0	150.0	150.0	150.0	150.0	0.0
6	ML	55.0	55.0	200.0	200.0	200.0	200.0	15.0
7	CH	38.0	38.0	235.0	235.0	300.0	300.0	0.0
8	CH	38.0	38.0	325.0	325.0	350.0	350.0	0.0
9	ML	55.0	55.0	200.0	200.0	200.0	200.0	15.0
10	CH	38.0	38.0	420.0	420.0	450.0	450.0	0.0

ASSUMED FAILURE SURFACE			RESISTING FORCES			DRIVING FORCES		SUMMATION OF FORCES		FACTOR OF SAFETY
NO.		ELEV.	R_A	R_B	R_P	D_A	$-D_P$	RESISTING	DRIVING	
A	1	-7.00	5280	4500	2400	9669	1835	12180	8254	1.476
B	1	-10.00	5700	3300	3300	12922	3598	12300	9324	1.319
B	2	-10.00	5700	4500	3300	12922	2735	13500	10187	1.325
B	3	-10.00	5700	12300	825	12922	164	18825	12758	1.476
C	1	-25.00	12702	6000	11113	33327	13754	29815	19573	1.523
C	2	-25.00	12702	21600	6618	33327	5314	40920	28013	1.461
C	3	-25.00	12702	27600	5170	33327	2354	45472	30973	1.468
D	1	-30.00	15952	23450	9243	41275	8366	48644	32909	1.478
E	1	-40.00	23859	30150	18146	61327	16863	72155	44464	1.623

NOTES

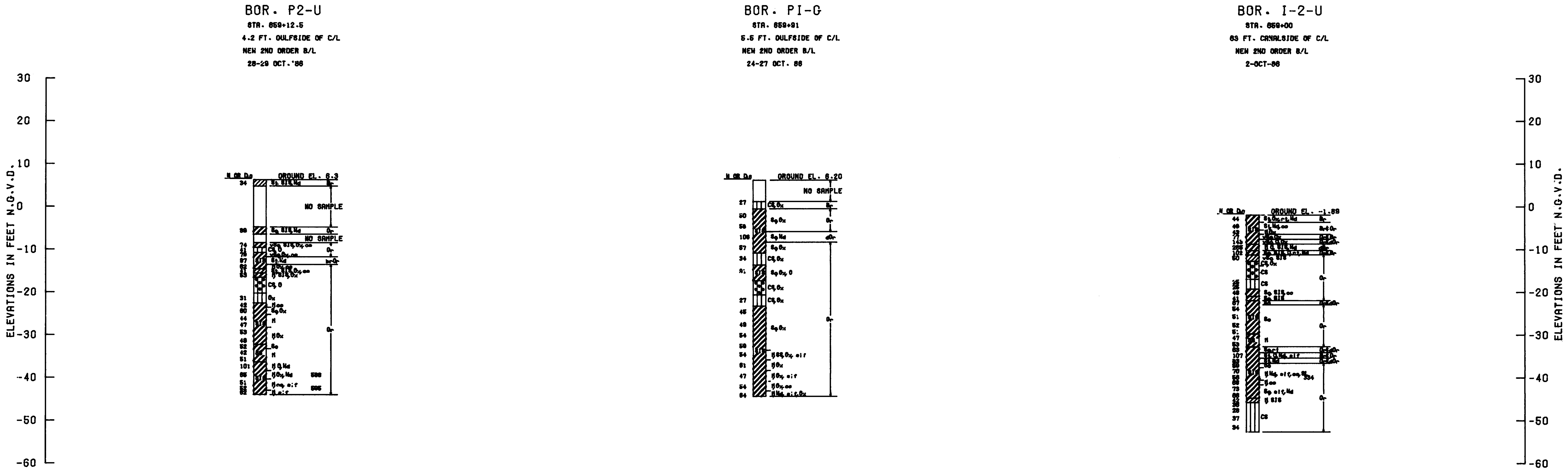
Φ -- ANGLE OF INTERNAL FRICTION.DEGREES
C -- UNIT COHESION. P.S.F.
∇ -- STATIC WATER SURFACE
D -- HORIZONTAL DRIVING FORCE IN POUNDS
R -- HORIZONTAL RESISTING FORCE IN POUNDS
A -- AS A SUBSCRIPT.REFERS TO ACTIVE WEDGE
B -- AS A SUBSCRIPT REFERS TO CENTRAL BLOCK
P -- AS A SUBSCRIPT REFERS TO PASSIVE WEDGE

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

** 8+80 TO 9+20 , 27+85 TO 29+40 , AND 32+10 TO 33+15.

NEW ORLEANS TO VENICE, LA.
DESIGN MEMORANDUM NO. I-GENERAL DESIGN
SUPPLEMENT NO. 5
REACH A-CITY PRICE TO TROPICAL BEND
STABILITY ANALYSIS & PRESSURE DIAGRAM
I-WALL, NEW LEVEE : FINAL SECTION
STATIONS **

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
AUGUST 1987 FILE NO. H-2-30260



NEW ORLEANS TO VENICE, LA
DESIGN MEMORANDUM NO. I-GENERAL DESIGN
SUPPLEMENT NO. 5
REACH A-CITY PRICE TO TROPICAL BEND
REACH A TEST SECTION
GEOTEXTILE REINFORCED LEVEE
SOIL BORINGS
BORINGS P2-U, I2-U, PI-G

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

AUGUST 1987 FILE NO. H-2-30260

UNIFIED SOIL CLASSIFICATION

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

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

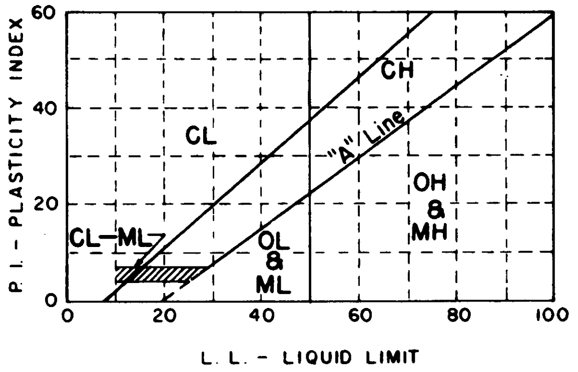
DESCRIPTIVE SYMBOLS

COLOR

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

CONSISTENCY FOR COHESIVE SOILS

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



PLASTICITY CHART
For classification of fine-grained soils

MODIFICATIONS

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

NOTES:

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

Are natural water contents in percent dry weight

When underlined denotes D_{10} size in mm*

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

Are liquid and plastic limits, respectively

SYMBOLS TO LEFT OF BORING

▽ Ground-water surface and date observed

Ⓒ Denotes location of consolidation test**

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

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

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

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

FW Denotes free water encountered in boring or sample

FIGURES TO RIGHT OF BORING

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

In parenthesis are driving resistances in blows per foot determined with a standard split spoon sampler (1⅜" I. D., 2" O. D.) and a 140 lb. driving hammer with a 30" drop

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

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

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

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

TYPICAL NOTES

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

Ground-water elevations shown on the boring logs represents ground-water surfaces encountered in such borings on the dates shown. Absence of water surface data on certain borings indicates that no ground-water data are available from the boring but does not necessarily mean that ground-water will not be encountered at the locations or within the vertical reaches of such borings.

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

SOIL BORING LEGEND

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

1 JUNE 1987 FILE NO. H-2-21800

NEW ORLEANS TO VENICE, LOUISIANA
DESIGN MEMORANDUM NO. 1, GENERAL DESIGN
SUPPLEMENT NO. 5, REVISED
REACH - A CITY PRICE TO TROPICAL BEND
NOVEMBER 1987

APPENDIX A
HYDROLOGY AND HYDRAULIC ANALYSIS

NOTE: Pages A-12, A-13 and Plate A-13 revised to support Hydraulic Design of a high strength geofabric levee.

NEW ORLEANS TO VENICE, LOUISIANA
DESIGN MEMORANDUM NO. 1, GENERAL DESIGN
SUPPLEMENT NO. 5
REACH A - CITY PRICE TO TROPICAL BEND

APPENDIX A
HYDROLOGY AND HYDRAULIC ANALYSIS

TABLE OF CONTENTS

Table of Contents (cont'd)

TABLES

PLATES

PLATES (cont'd)

GLOSSARY

ASTRONOMICAL TIDE - See PREDICTED NORMAL TIDE

ATMOSPHERIC PRESSURE ANOMALY - The difference between atmospheric pressure at any point within the hurricane and normal pressure at the periphery of the hurricane.

BUILDUP - The increase, in feet, over that from other causes, of water surface elevation in a body of water resulting from:

a. Convergence
b. Construction of a barrier
c. Ponding

CENTRAL PRESSURE INDEX - A parameter of hurricane intensity which reflects the minimum atmospheric pressure within the eye of a particular hurricane.

FETCH - The continuous area of water over which the wind blows in essentially a constant direction. Often used with FETCH LENGTH.

FETCH LENGTH - The horizontal distance over which the wind from a fixed direction may have unobstructed contact with the water surface.

HURRICANE - A cyclonic storm, usually of tropical origin, containing winds of 75 miles per hour or more.

a. DESIGN HURRICANE - That hurricane selected by the reporting office as a basis for design of the proposed plan of improvement.

b. STANDARD PROJECT HURRICANE - A hypothetical hurricane intended to represent the most severe combination of meteorological conditions that are reasonably characteristic of the region involved, excluding extremely rare combinations.

c. PROBABLE MAXIMUM HURRICANE - A hypothetical hurricane that might result from the most severe combination of meteorological conditions that are considered reasonably possible in the region involved. This hurricane is substantially more severe than the standard project hurricane and is seldom, if ever, used as the controlling consideration in design.

d. MODERATE HURRICANE - A hurricane that may be expected from a combination of meteorological conditions that are frequently experienced in the region.

e. TRANSPOSED HURRICANE - A storm transferred from actually observed location to another location for the purpose of study, with appropriate changes in storm characteristics.

HURRICANE TRACK - The line connecting successive locations of central pressure of the hurricane.

HURRICANE SPEED - The rate of forward movement of the hurricane eye in knots or miles per hour.

HURRICANE SURGE - The mass of water causing an increase in elevation of the water surface above normal tide at the time of a hurricane.

HURRICANE SURGE HEIGHT - The elevation of the stillwater level at a given point resulting from predicted normal tide and from hurricane surge action. It may be the result of one or more of the following components:

a. Predicted normal tide
b. Pressure setup
c. Setup due to winds over the continental shelf
d. Buildup

In inland lakes, hurricane surge height is the average lake level and does not include local wind setup.

HURRICANE TIDE - The elevation of the stillwater level at a given point during a hurricane. In inland lakes it is the sum of a hurricane surge height and additional local wind setup.

ISOVEL - Line connecting points of simultaneous equal wind velocities and in this appendix represents a 5-minute average, 30 feet above ground level.

KNOT - A velocity equal to one nautical mile (6,080 feet) per hour, or about 1.15 statute miles per hour.

LANDFALL - The arrival of a hurricane center at the coastline.

OVERTOPPING - The amount of water passing over the top of a structure as a result of wave runup or surge action.

PONDING - The storage behind a water-retaining structure of water from interior runoff or from overtopping of a structure.

PREDICTED NORMAL TIDE - The periodic rising and falling of the water that results from gravitational attraction of the moon and sun acting upon the rotating earth.

PRESSURE SETUP - A rise in the surface of a large body of water caused by a measurable reduction in local atmospheric pressure at sea level.

RANGE - An imaginary line representing the centerline of a narrow fetch over which the hurricane surge height is computed.

RUNUP - The vertical elevation above stillwater level to which water rises on the face of a structure as a result of wave action.

SETUP - The vertical rise in the stillwater level, above that which would occur without wind action, caused by wind stresses on the surface of the water.

GLOSSARY (cont'd)

SIGNIFICANT WAVE - A statistical term denoting waves having the average height and period of the highest one-third waves of a given wave train.

STILLWATER LEVEL - The elevation of the water surface if all wave action were to cease.

STORM SURGE - Same as HURRICANE SURGE, except that it may be caused by storms not of hurricane characteristics as well as by hurricanes.

SURGE REFERENCE LINE - The locus of points where the maximum surge height would be observed along fetches normal to the general coast.

WAVE HEIGHT - The vertical distance between the crest and the preceding trough (referenced to significant waves in this report).

WAVE SETUP - The superelevation of the water surface above the hurricane surge height due to wave action alone.

WAVE TRAIN - A series of waves from the same direction.

WIND SETUP - Same as SETUP.

WIND TIDE LEVEL - Same as STILLWATER LEVEL.

NEW ORLEANS TO VENICE, LOUISIANA
DESIGN MEMORANDUM NO. 1, GENERAL DESIGN
SUPPLEMENT NO. 5
REACH A - CITY PRICE TO TROPICAL BEND

APPENDIX A
HYDROLOGY AND HYDRAULIC ANALYSIS

SECTION I - CLIMATOLOGY AND HYDROLOGY

1. Climatology.

a. Climate. The climate of the project area is related to subtropical latitude and proximity to the Gulf of Mexico. It may be characterized as a marine climate, especially in summer when southerly winds prevail, producing conditions favorable for the generation of convective thundershowers. In the colder seasons the area is subjected to frontal movements which produce squalls and sudden temperature drops. Fogs on the Mississippi River are prevalent during the winter and spring when the temperature of the river is generally somewhat colder than the air temperature. Normally, the flood season of the river occurs from December to early June, and the hurricane season is from June to October. Climatological data for this area are contained in monthly and annual publications by the U. S. Department of Commerce, Weather Bureau, titled "Climatological Data for Louisiana", and "Local Climatological Data, New Orleans, Louisiana". The temperature and precipitation data are available for several U. S. Weather Bureau Stations. U. S. Weather Bureau precipitation and temperature normals (1931-1960) for Burrwood, Louisiana and New Orleans, Louisiana were averaged to get normals representative of the study area.

b. Temperature. The annual normal temperature is 70° Fahrenheit, with monthly means ranging from 57°F in January to 83°F in July and August. The maximum temperature of 102°F was recorded at Belle Chasse on 7 August 1935, at New Orleans on 30 June 1954 and earlier dates, and at Port Sulphur on 31 August 1951. Minimum temperatures of 6°F were recorded at Diamond on 12 February 1899 and 7°F at New Orleans on 13 February 1899. Normal temperatures (°F) for each month, which are determined by averaging Weather Bureau normals for Burrwood and New Orleans, are as follows:

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
56.8	58.2	62.2	68.8	76.0	81.7	83.1	83.2	80.4	73.5	63.6	58.4

c. Rainfall. Precipitation generally is heavy in two fairly definite periods. Summer showers occur from about mid-June to mid-September and winter rains from mid-December to mid-March. Precipitation is greatest in the warm months due to summer thundershowers, and February has a greater average than other winter months. The annual normal rainfall is 60.8 inches. At New Orleans a maximum annual rainfall accumulation of 85.73 inches was recorded in 1875 and a minimum of 31.04 inches fell in 1899. Normal monthly rainfall ranges from 7.3 inches in July to 3.3 inches in October. Monthly normals based on averaging records for Burrwood and New Orleans are as follows:

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
4.25	4.50	5.22	4.71	4.60	4.87	7.31	6.93	6.83	3.31	3.94	4.34

The maximum monthly rainfall was 29.0 inches, recorded at Belle Chasse in October 1937. Several stations have experienced periods in which no rainfall was recorded in a calendar month. Snow occurs infrequently in the area. New Orleans had an 8.2-inch snowfall on 14-15 February 1895. The last appreciable snowfall in the project area occurred on 12 February 1958 when stations reported from 1.3 inches to 4.0 inches.

2. Hydrology.

a. Tides. The tide along the coast is diurnal and has a mean range of approximately 1-foot under normal conditions. During periods of low flow on the Mississippi River, tidal effects are observed on the river as far as 200 miles upstream from the Gulf of Mexico. Water surface elevations are presently observed regularly at four locations along the Mississippi River within the project limits. These elevations reflect headwater flow and tidal fluctuation. Recording type gages are located at West Pointe-a-la-Hache, 1926 to date; Empire, 1960 to date; and Venice, 1944 to date. Staff gage records are available at Port Sulphur for the period 1934 to date. In addition, daily river stages were obtained at Fort Jackson during the period 1891-1960. Crest stage indicators are maintained at two points landside of the east and landside of the west Mississippi River levees to record the maximum tide reached during tropical storms. Water surface elevations for the river gages are available in "Stages and Discharges of the Mississippi River and its Outlets and Tributaries", published annually by the Mississippi River Commission; and in "Stages and Discharges of the Mississippi River and Tributaries and Other Streams and Waterways in the New Orleans District", published biennially by the U. S. Army Engineer District, New Orleans.

b. River floods of record. Headwater flooding of the natural banks of the river occurs almost annually, but the area flooded is small and confined by the river levees. The higher stages usually occur during the period February to May. The 1950 high water which produced stages of 10.7 and 7.5 feet at Pointe-a-la-Hache and Fort Jackson, respectively, is the maximum of record in the project area. The coincidence of a hurricane occurring with a major river flood is considered to be possible but very improbable.

c. Storm tides. Many severe storms have been experienced in the area east and west of the Mississippi River. Flooding to various depths occurred on one or both sides of the river during the storms of 1856, 1860, 1886, 1887, 1893, 1901, 1906, 1909, 1915, 1916, 1917, 1926, 1940, 1947, 1948, 1956, 1961, 1964, 1965 and 1969. Hurricane "Betsy", in September 1965, produced what at that time was the highest recorded tides in the project area. Experienced tides at key locations were 14.8 feet at Bohemia; 14.4 feet at West Pointe-a-la-Hache; 12.6 feet at Ostrica Lock; 9.7 feet at Empire; 8.8 feet at Grand Isle; and 7.9 feet at Venice. Hurricane "Camille", occurring in August 1969, passed south and east of the project area and inundated the protected area on the west side of the Mississippi River from Port Sulphur to Venice and caused almost total destruction to facilities located south of the latitude of Port Sulphur. The portion of the project area from City Price to Port Sulphur was fortunate in escaping severe flood damage because the hurricane passed a safe distance east of the Mississippi River Passes. Some of the flood stages caused by Hurricane "Camille" at and near the project area were: Ostrica Lock, 15.1 feet; Mississippi River, mile 48.7 AHP, 10.9 feet; Mississippi River, mile 35.5 AHP, 10.6 feet; Bohemia back levee 10.1 feet; and Pointe-a-la-Hache back levee, 6.0 feet. Had the path of Hurricane "Camille" passed closer to the project area, damage would have equalled that which was experienced by the areas located below Port Sulphur.

SECTION II - TIDAL HYDRAULIC DESIGN

3. Description and verification of procedures.

a. Hurricane memorandums. The Hydrometeorological Branch (HMB), U.S. Weather Bureau (now the National Weather Service), cooperated in the development of hurricane criteria for experienced and potential hurricanes in the project area. Memorandums prepared by the HMB provided isovel patterns, hurricane tracks, pressure profiles, rainfall estimates, frequency data, and various other parameters required for the hydraulic computations. A reevaluation of historical meteorologic and hydrologic data was the basis for memorandums relative to experienced hurricanes. Those relative to potential hurricanes were developed through the use of generalized estimates of hurricane parameters based on the latest research and theory. Memorandums applicable to the project area are listed in Section IV, Bibliography.

b. <u>Historical storms used for verification</u>. Three observed storms, with known parameters and effects, were used to establish and verify procedures and relationships for determining hurricane surge heights. These three storms occurred in September of 1915, 1947, and 1956. Isovel patterns for the hurricanes of September 1915 (1)*, September 1947 (2), and September 1956 (3) are shown on plates A-1, A-2, and A-3, respectively. Isovel patterns are also shown for the two recent devastating hurricanes, "Betsy" (4) and "Camille" (5), on plates A-4 and A-5, respectively.

(1) The hurricane of 29 September 1915 had a central pressure index (CPI) of 27.87 inches, an average forward speed of 10 knots, and a maximum windspeed of 99 m.p.h. at a radius of 27 nautical miles. This hurricane approached the mainland from the south. A surge height of 12 feet was experienced at Pointe-a-la-Hache and surge heights for the Reach A-City Price to Tropical Bend area ranged from 7 feet to 9 feet. Empire, which is just below the lower end of Reach A had a stage of 9.3 feet, while Grand Isle, located south and west of the project area, experienced a stage of 9 feet.

(2) The 19 September 1947 hurricane had a CPI of 28.57 inches, an average forward speed of 16 knots, and a maximum windspeed of 100 m.p.h. at a radius of 33 nautical miles. The direction of approach of this hurricane was approximately from the southeast. Some of the surge heights experienced during this hurricane were 8.2 feet at Bohemia, and 11.5 feet at Ostrica.

(3) Hurricane "Flossy", 23 September 1956, had a CPI of 28.76 inches, an average forward speed of 10 knots, and a maximum windspeed of 80 m.p.h. at a radius of 30 nautical miles. "Flossy" approached the mainland from the southwest. A hurricane tide of 12.1 feet occurred at Ostrica and 8 feet at Grand Isle.

(4) The hurricane of 9 September 1965, "Betsy", had a CPI of 27.79 inches, an average forward speed of about 17 knots, and a maximum windspeed of 122 m.p.h. The storm approached land from a southeasterly direction. Some of the maximum surge heights which occurred in and near the project area are described in paragraph 2.c.

* Numbers in parentheses indicate reference in Section IV of this appendix

(5) Hurricane "Camille" of 17 August 1969 had a 26.61 CPI, an average forward speed of about 13 knots, and a maximum windspeed of 146 m.p.h. See paragraph 2.c. for a description of maximum surge heights for the area.

c. Synthetic storms. Computed hurricane surge heights, resulting from synthetic storms are necessary for frequency and design computations. Parameters for certain synthetic storms and methods for derivation of others were furnished by the U.S. Weather Bureau. The Standard Project Hurricane (SPH) for the Louisiana coast was used as the base hurricane since other hurricanes could be derived from it. The Probable Maximum Hurricane (PMH) and Moderate Hurricane (Mod H) were derived from the SPH and differ from it only in wind velocity and CPI.

(1) The SPH used in the "Interim Survey Report, Mississippi River Delta at and below New Orleans, Louisiana", was derived by the U.S. Weather Bureau from a study of 42 hurricanes that occurred in the region over a period of 57 years. Based on subsequent studies of recent hurricanes, the U.S. Weather Bureau revised the original SPH wind field patterns [6][7]. A typical track and isovels for the 100-year hurricane that would be critical to the center of the City Price-Tropical Bend area (Homeplace) are shown on plate A-6. The wind pattern and speed can be transposed to reflect critical conditions for any specific location in the project area.

(a) The SPH has a frequency of once in 100 years for the Louisiana coastal region. The CPI that corresponds to this frequency is 27.5 inches. CPI probabilities are based on the following relationship [8][12]:

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

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

(b) Radius of maximum winds is an index of hurricane size. The average radius of 12 hurricanes occurring in the vicinity of the project area is 36 nautical miles. From relationships of CPI and radius of maximum winds of gulf coast hurricanes [8], a radius of 30 nautical miles is considered representative for an SPH having a CPI of 27.5 inches.

(c) An average forward speed of 11 knots was used for hurricanes critical to the project area. The forward speeds of experienced hurricanes in the Gulf of Mexico have ranged from 5 to 30 miles per hour and the forward speed of a real hurricane varies during its life.

(d) Maximum theoretical gradient wind [8] is expressed as follows:

$$V_{gx} = 73 \sqrt{P_n - P_o} - R\,(0.575\ f)$$

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

The estimated windspeed (V_x)[9] in the region of the highest speeds is obtained as follows:

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

where T = forward speed of translation in miles per hour. From these relationships, a windspeed of approximately 100 m.p.h.* was obtained for the SPH.

(2) Synthetic storms with various frequencies and corresponding CPI's are derived from the SPH. The CPI for any frequency except the PMH is obtained on plate A-7. For the PMH, the U.S. Weather Bureau recommends a CPI of 26.9 inches [10][11][12]. V_{gx} for all synthetic storms and experienced storms is computed just as for the SPH; however, for the PMH, P_n is increased to 31.22 inches [12]. Similarly, V_x for any storm is computed as for the SPH. Various isovels are adjusted from the SPH pattern using the ratio V_x of any hurricane to V_x of the SPH. Characteristics of hurricanes for Zone B, a 400-mile zone along the central gulf coast from Cameron, Louisiana to Pensacola, Florida, are tabulated in Table A-1. This table includes, in addition to five experienced storms, some large radius synthetic storms which have moderate speeds of translation. The track for a hurricane most critical to the project area (Track B) and the paths of some large experienced storms are shown on plate A-8.

* Windspeeds represent a 5-minute average, 30 feet above ground level.

TABLE A-1
HURRICANE CHARACTERISTICS

Hurricane*	CPI inches	Radius of max. winds nautical miles	Forward speed knots	V_x m.p.h.
Sep 1915	27.87	29	10	99
Sep 1947	28.57	33	16	100
Sep 1956	28.76	30	10	80
Sep 1965	27.79	32	17	122
Aug 1969	26.61	15	13	146 (@ 25° Latitude)
PMH	26.90	30	11	143 (@ 30° Latitude)
SPH	27.40	30	11	100
Mod H	28.30	30	11	83

*Tracks are shown on plate A-8.

d. Surges.

(1) Maximum hurricane surge heights along the gulf shore were determined from computations made for ranges extending from the shore out to the continental shelf by use of a general wind tide formula that is based on the steady state conception of water superelevation (13)(14)(15). In order to reach agreement between computed maximum surge heights and observed high water marks, it was necessary to introduce a calibration coefficient or surge adjustment factor (Z) into the general equation which, in its modified form is:

$$S = 1.165 \times \frac{10^{-3}V^2 F}{D} NZ \cos \theta$$

where S = wind setup in feet
V = windspeed in statute miles per hour
F = fetch length in statute miles
D = average depth of fetch in feet
N = planform factor, generally equal to unity
Z = surge adjustment factor
θ = angle between direction of wind and the fetch

(2) Water surface elevations along a range were determined by incremental summation of wind setup above the water elevation at the gulf end of the range. Initial elevation at the beginning of each range was determined from the predicted normal tide and the setup due to atmospheric pressure anomaly. Typical tidal cycles for the project area are shown on plate A-9. An adjustment was made at the shoreward end of the range to

compensate for the difference in pressure setup between the ends of the range. This procedure for the determination of surge heights at the coastline was developed for an area along the Mississippi gulf coast where reliable data were available at several locations for more than one severe hurricane. The procedure was then used for the entire Louisiana coastal region. Due to dissimilar shoreline configurations, different surge adjustment factors were required at each location, but identical factors were used at a particular location for all storms. The value of the factor is apparently a function of the distance between the shoreline and deep water and varies inversely with this distance. Comparative computed maximum elevations and observed high water elevations for the 1915 and 1947 hurricanes at the locations that were used in the development of the procedure are shown in table A-2.

TABLE A-2
HURRICANE SURGE HEIGHTS

Location	Surge Adjustment factor (Z)	1915 Observed (feet)	1915 Computed (feet)	1947 Observed (feet)	1947 Computed (feet)
Bay St. Louis, Miss.	0.46	11.8	11.8	15.2	15.1
Gulfport, Miss.	0.60	10.2[1]	9.9	14.1	14.3
Biloxi, Miss.	0.65	10.1[1]	9.8	12.2[1]	12.6

[1] Average of several high water marks.

(3) The incremental step computation was used to check experienced maximum hurricane surge heights at several locations within the project area. Verification of these surge heights and the surge adjustment factors used in the computations are shown in table A-3.

TABLE A-3
VERIFICATION OF HURRICANE SURGE HEIGHTS

Location	Surge Adjustment factor (Z)	Sep 1915 Observed (feet)	Sep 1915 Computed (feet)	Sep 1956 Observed (feet)	Sep 1956 Computed (feet)
Belair	0.52	-	-	5.3	6.2
Phoenix	0.52	-	-	8.5	7.8
Pointe a la Hache	0.52	12.0	12.4	10.3	10.2
Ostrica	0.64	-	-	12.1	12.2
Grand Isle	0.80	9.0	8.8	3.9	4.1

(4) The storms under consideration are accompanied by strong winds. For each surge computation, the average windspeed was determined from isovel charts supplied by the U.S. Weather Bureau [6] and average depth values were derived from standard hydrographic charts prepared by the U.S. Coast and Geodetic Survey.

(5) Marshlands fringe the coastline and are inundated for considerable distances inland by hurricane surges that approach the shores. The limit of overland surge penetration is dependent upon the height of the surge and the duration of high stages at the coast. The surge height at the coastline depends primarily on the direction and intensity of winds and the hurricane velocity of translation. Bays are prevalent in the project area and influence surge heights at inland locations. The routing of these surges overland by conventional methods was complicated by the undefinable effect of high windspeeds on flow, such that the procedures yielded questionable results when applied to different experienced hurricanes in a given location. Attempts to correlate hurricane translation speeds, surge hydrographs at the coastline, and surge heights at inland locations also yielded inconsistent and therefore unusable relationships. A study of available observed high water marks at the coastline and inland indicates a consistent simple relation between the maximum surge height and the distance inland from the coast, as shown on plate A-10. This relationship exists independently of the speed of hurricane translation, windspeed, or direction. The data indicate that the weighted mean decrease in surge heights inland is at the rate of 1.0-foot per 2.75 miles. This relationship remains true even in the western portion of Louisiana where relatively high chenieres, or wooded ridges, parallel the coast. Efforts to establish time lags between the crest surge heights at the coast and at inland locations were unsuccessful because of inadequate basic data.

(6) For the purpose of surge routing procedures, the coastline is defined as the locus of points where the maximum surge heights would be observed along fetches normal to the general coast. This synthetic coastline has been designated the surge reference line (SRL) and is shown on plate A-11. In order to determine maximum surge heights at inland locations, it was necessary to compute maximum surge heights at the SRL, and then reduce these computed elevations at the rate of 1.0-foot per 2.75 miles to the location of interest. The procedure has given satisfactory results in the project area, and has verified the observed data in other areas of study. The location of interest for this study, the back protective levee is located an average

distance of 6.3 miles from the SRL at the upper end of the project area (City Price) to 2.5 miles from the SRL at the lower end (Tropical Bend). Consequently, the reduction in stages from the SRL to the protective structure site range from 2.3 feet to 0.9-feet. Surge heights and frequencies in this study reflect elevations at the protective structure. For convenience, the study area has been divided into 5 segments numbered 1 through 5. Table A-4 reflects pertinent data related to surge heights at the SRL and reductions in stages to the protective structures by segments for the design hurricane. The segments are identified by project levee stationing and can be found on plate A-12 of Appendix A.

TABLE A-4
SRL PERTINENT DATA
DESIGN HURRICANE

Seg. No. and Levee Stationing	Av. Distance from SRL miles	W. S. Elev. at SRL feet	Dropoff 1 ft/2.75 mi feet
1 (0+00 - 83+30)	6.3	11.2	2.3
2 (83+30 - 315+00)	3.3	10.4	1.2
3 (315+00 - 477+00)	3.3	10.8	1.2
4 (477+00 - 613+00)	2.5	11.0	0.9
5 (613+00 - 681+67.45)	2.5	11.2	0.9

NOTE: Levee stationing referred to is project levee stationing.

e. Wave runup.

(1) Wave runup on a protective structure depends on the characteristics of the structure (i.e., shape and roughness), the wave characteristics, and the depth of water at the structure. The vertical height to which water from a breaking wave will run up on a given protective structure determines the top elevation to which the structure must be built to prevent serious wave overtopping.

(2) Computations were made to determine wave runup for the protective system along the authorized alinement. Levees are a very predominant feature of the protective structures, but a combination levee-vertical floodwall has been recommended for areas where pumping stations and other installations exist. The configurations of the flood sides of the levees and the levee-floodwalls are shown on plates A-13 and A-14, respectively. Any major change in the flood side levee slopes would require further study and a probable revision to the levee height.

(3) In order to compute wave runup on a protective structure, the significant wave height (H_s) and wave period (T) in the vicinity of the structure must be known. They were determined according to Bretschneider[15] and as described in paragraph 1.25 of reference [13]. The windspeed and depth used in determining H_s and T were average values over a 5-mile fetch. Data used to determine wave characteristics in the vicinity of the protective structure are shown in table A-5.

TABLE A-5
DATA USED TO DETERMINE WAVE CHARACTERISTICS
DESIGN HURRICANE

Pertinent Factors	Reach A City Price to Tropical Bend				
	Seg. 1	Seg. 2	Seg. 3	Seg. 4	Seg. 5
F - Length of fetch, miles	5.0	5.0	5.0	5.0	5.0
U - Windspeed, m/h	85.0	85.0	85.0	85.0	85.0
s.w.l. - Stillwater elevation, feet	8.9	9.2	9.6	10.1	10.3
d - Average depth of fetch, feet	6.6	6.9	7.3	7.8	8.0
d - Depth at toe of structure, feet	7.9	8.2	8.6	9.1	9.3

(4) Wave runup was calculated by use of model study data developed by Saville [17][18][19][20] which relate relative runup (R/H'_o), wave steepness (H'_o/T^2), and relative depth (d/H'_o). The average depth (d) of the 5-mile fetch is shown in table A-5 and the significant wave height (H_s) and wave period (T) can be determined from the data in table A-5. The equivalent deep water wave height (H'_o) can be determined from table D-1 of reference [13] which relates d/L_o to H/H'_o. The deep water wave length (L_o) is determined from the equation:

$$L_o = 5.12\ T^2$$

When determining runup from the significant wave, H in the term H/H'_o is equal to H_s. Wave characteristics used in computing runup from the significant wave are shown in table A-6.

TABLE A-6
WAVE CHARACTERISTICS
DESIGN HURRICANE

Pertinent Factors	Reach A City Price to Tropical Bend Seg. 1	Seg. 2	Seg. 3	Seg. 4	Seg. 5
H - Significant wave height, feet	3.20	3.26	3.49	3.65	3.71
T - Wave period, seconds	4.35	4.40	4.50	4.65	4.70
L_o - Deepwater wave length, feet	96.87	99.12	103.68	110.69	113.10
d/L_o - Relative depth	0.06813	0.06911	0.07041	0.07047	0.07073
H_s/H'_o-Shoaling coefficient	0.9749	0.9730	0.9704	0.9703	0.9699
H'_o- Deepwater wave height, feet	3.28	3.35	3.60	3.76	3.82
H'_o/T^2-Wave steepness	0.173	0.173	0.178	0.174	0.173

*Station 9+32 - 83+30 (back levee).

(5) With the terms d/H'_o and H'_o/T^2 known, runup on a protective structure can be computed if the slope of the structure is known. The levee configurations used in these computations had stabilizing berms on the water side. These berms broke the continuity of the levee slope and Saville's [20] method of determining wave runup on composite slopes was used (plate A-15). In using this method, the actual composite slope is replaced by a single constant hypothetical slope. This hypothetical slope (see Fig. A-15) is computed by estimating a value of wave runup and then determining the slope of a line from the point where the wave breaks to the estimated point of runup. The breaking depth is then determined using the curves presented in the 1984 edition of the Shore Protection Manual (SPM). Using the hypothetical slope, a runup value is computed from the empirical runup curves in the

1984 SPM and corrected for scale effects as shown on figure 7-13 as modified by the Non 1986 errata for the SPM. If the computed wave runup differs from the estimated runup, the process is then repeated using the new value of runup to obtain a new hypothetical slope, which, in turn, determines a new value of runup. This process is repeated until the estimated value of runup is within 1/2-foot of the computed value of runup.

(6) Protective structures exposed to wave runup will be constructed to an elevation that is sufficient to prevent all overflow from the significant wave and waves smaller than the significant wave accompanying the design hurricane. Waves larger than the significant wave may overtop the protective structures but such overtopping will not endanger the security of the structures or cause excessive interior flooding. During the time of maximum hurricane surge height, the berms on the water side of the levees become submerged and waves of lesser height than the significant wave, but of the same period, break farther up the levee slope. Runup from these smaller waves sometimes reach an elevation higher than that from the significant wave; therefore, runup resulting from these smaller waves must also be computed. The equivalent deep water wave height for the smaller waves breaking on the berms can be computed using charts and formulas presented in the 1984 SPM. Runup was computed for the significant wave and for smaller waves breaking on each berm, and the required levee height was determined by adding the highest computed runup value to the maximum stillwater elevation. Design runup values and proposed elevations of protective structures are shown in table A-7, while a graphical illustration of water surface and levee profiles is presented on plate A-12.

TABLE A-7
DESIGN WAVE RUNUP AND DESIGN ELEVATIONS
FOR
PROTECTIVE STRUCTURES
DESIGN HURRICANE

(LEVEES)

Location segment	Av. Depth feet	Surge Height feet	*Design Runup feet	*Design Elevation Protective Structure feet
1 (Lateral Levee)	6.6	8.9	0.0	11.0
1 (Back Levee)	6.6	8.9	3.5	12.5
2	6.9	9.2	3.8	13.0
3	7.3	9.6	3.7	13.5
4	7.8	10.1	3.8	14.0
5	8.0	10.3	4.0	14.5

f. Residual flooding. Protective structures were designed to prevent wave overtopping from the significant wave, or any lower wave, that would be experienced during an occurrence of the design hurricane. However, 14 percent of the waves in a spectrum are higher than the significant wave and the maximum wave height to be expected is about 1.87 times the significant wave height. Thus the protective structures herein may be overtopped by those waves of the spectrum which exceed the significant wave. Studies indicate that flooding will not result from such overtopping.

4. Frequency estimates.

a. Procedure.

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

(2) Lack of historical data relative to elevation of hurricane surges prohibits the establishment of dependable observed stage-frequency relationships for Reach A-City Price to Tropical Bend. Therefore, a procedure was developed to establish synthetic stage frequency relationships. Grand Isle, located southwest of Reach A is the only location on the west side of the Mississippi River where a sufficient number of observed hurricane stages are available to compute a dependable observed hurricane stage frequency curve for comparison with the results of the synthetic method of computing frequencies. Probabilities for historical data on the curve shown on plate A-16 were calculated by means of the formula:

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

(3) The first requirement in the development of synthetic frequency relationships for localities within the project area was to select representative critical hurricane tracks for the particular locale in question. Tracks B and D were selected as critical tracks for Reach A and Grand Isle, respectively. These tracks are shown on plate A-8. In the process of formulating synthetic frequency relationships, it was necessary to correlate the following hurricane parameters: central pressure indices, tracks of approach, wind velocities, radii to maximum winds, and forward speeds of translation.

(4) Surge heights were then developed for at least three storms of different CPI values for each track. Each hurricane selected for the representative tracks was assumed to have the same radius of maximum winds, the same forward speed of translation, and the same adjustment for any land effects. Conversion of wind fields of hurricanes of different CPI's requisite to computing surge heights is covered in paragraph 3.c. Surge heights for storms with other CPI values were obtained graphically by plotting the above data and reading from the resulting curves.

(5) Hurricane characteristics of area-representative storms were developed in cooperation with the U.S. Weather Bureau. This agency has made a generalized study of hurricane frequencies for a 400 mile zone along the central gulf coast, Zone B, from Cameron, La. to Pensacola, Fla., and has presented the results in two memorandums [6][12]. Frequencies for hurricane central pressure indices that were presented in the report, as shown on plate A-7, reflect the probability of hurricane recurrence from any direction in the midgulf coastal area. In order to establish frequencies for the localities under study, it was assumed that a hurricane whose track is perpendicular to the coast will ordinarily cause high tides and inundation for a distance of about 50 miles along the coast. Thus, the number of occurrences in the 400-mile zone was determined, provided that all hurricanes traveled in a direction normal to the coast. However, the usual track is oblique to the shoreline as shown in table 2 of the HMS memorandum [6]. The average projection along the coast of this 50-mile swath for the azimuths of 48 Zone B hurricanes is 80 miles. Since this is 1.6 times the width of the normal 50-mile strip affected by a hurricane, the probability of occurrence of any hurricane in the 50-mile subzone would be 1.6 times the 12.5 percent, or 20 percent of the probability for the entire midgulf Zone B. Thus, 20 percent of the Zone B frequencies shown on plate A-7 were used to represent the CPI frequencies in the 50-mile subzone that is critical for each study locality.

(6) The azimuth (0^0 North) of tracks observed in the vicinity of landfall were divided into quadrants corresponding to the four cardinal points. In Zone B, 29 tracks were from the south, 15 from the east, 3 from the west, and 1 from the north. This indicates that approximately two-thirds of all experienced hurricanes have come from a southerly direction whereas about one-third have come from the east. The average azimuth of tracks from the south is 180° and tracks from the east had an average azimuth of 117°.

(7) In order to insure the maximum accuracy in the computation of hurricane stage-frequencies, levees of the Mississippi River and azimuths of the critical hurricane tracks are considered the principal determinants for this analysis. Stage-frequencies for Grand Isle and the City Price to Tropical Bend areas were computed for presentation in the appendix and are used to reflect probabilities for Reach A.

(8) The location and physical features of Grand Isle are conducive to critical stages for a hurricane approaching from any direction. Therefore, the full 20 percent of the probabilities for midgulf Zone B, column (3) of table A-8, was used for computing synthetic frequencies for Grand Isle. Column (4) of table A-8 illustrates the result of this computation.

TABLE A-8
STAGE-FREQUENCY
GRAND ISLE

		Synthetic Frequency[1]		Indicated Frequency
CPI	Surge height	Zone B (400 miles)	Grand Isle (50-mile subzone)	Grand Isle (50-mile subzone)
in.	ft.	occ/100 years	occ/100 years	occ/100 years
(1)	(2)	(3)	(4)	(5)
27.5	9.9	1	0.2	0.54
27.7	9.5	2	0.4	0.85
28.3	7.9	10	2.0	2.80
29.1	5.1	40	8.0	9.50

[1] Frequency = $\frac{100}{\text{Return period in years}}$

Column (4) = 20 percent of column (3)

Column (5) is indicated stage frequencies obtained from Grand Isle shifted frequency curve.

(9) The synthetic frequency curve for Grand Isle was shifted to the experienced frequency plot, maintaining as nearly as possible its general shape. Plate A-16 is a graphical presentation of the shift. The indicated frequencies shown in column (5) for the corresponding surge heights shown in column (2) of table A-8 were taken from the shifted curve. This curve was adopted as the stage-frequency relationship for Grand Isle.

(10) Despite the proximity of Reach A and Grand Isle, computations of stage-frequencies for those locations differ slightly. Whereas hurricanes approaching from any direction generate critical stages for Grand Isle, only hurricanes approaching from between an azimuth of 160° and due west would generate critical stages for the back levee along Reach A. Consequently, 27 of the 48 Zone B tracks or 56 percent were used in computations for developing synthetic frequency curves for Reach A. This means that the most critical surge height along Reach A for a Zone B hurricane of given frequency occurs only 56 percent as often as the most critical surge height at Grand Isle for the same hurricane. Therefore, final stage-frequency curves for all segments of City Price to Tropical Bend were developed by plotting the computed stages for several different Zone B hurricanes at 56 percent of the corresponding probabilities indicated by the shifted Grand Isle curve. Computations used to develop the frequency curve for segment 2 of Reach A are shown in table A-9.

TABLE A-9
SYNTHETIC STAGE-FREQUENCY
REACH A-CITY PRICE TO TROPICAL BEND
SEGMENT 2

CPI	Surge height	Zone B (400 miles)	Reach A-Seg 2 50-mile subzone	Adopted Freq (Grand Isle)	Adopted Freq Reach A-Seg 2
in.	ft.	occ/100 years	occ/100 years	occ/100 years	occ/100 yrs
(1)	(2)	(3)	(4)	(5)	(6)
27.5	10.85	1	0.2	0.54	0.30
27.7	10.23	2	0.4	0.85	0.48
28.3	8.37	10	2.0	2.80	1.57
29.1	5.31	40	8.0	9.50	5.32

Column (4) = 20 percent of column (3)
Column (5) = Probabilities for identical CPI's adjusted to indicate probabilities of Grand Isle experienced frequency curve, plate A-16
Column (6) = 56 percent of column (5)

b. Relationships. Based on the procedures described above, stage-frequency relationships were established for segments 1 through 5 for Reach A-City Price to Tropical Bend area. The stage-frequency curve for segment 2 and plotted points depicting the design elevations and frequency for each of the other segments are presented on plate A-17.

5. Design Hurricane.

a. Selection of the design hurricane. Since the project area is sparsely populated, the hurricanes that would produce the stages shown in table A-7 were selected as the design hurricanes (Des H). Design hurricanes of lesser intensity which would indicate a lower levee grade and an increased frequency would expose the protected areas to hazards to life and property that would be disastrous in the event a hurricane with the intensity and destructive capability of the Des H or the SPH occurred.

b. Characteristics. The Des H for Reach A-City Price to Tropical Bend has a CPI of 28.0 inches and a maximum windspeed of 85 m.p.h. at a radius of 30 nautical miles. The forward speed of the hurricane is 11 knots.

c. Normal predicted tide. The range of normal predicted tides in the project area is 1-foot and the mean tide varies from 0.4 to 1.0-foot. The difference in height of hurricane surge heights for an occurrence of the Des H at high or low tides is only a few tenths of a foot. In determining the elevation of design surge heights, it was assumed that mean normal predicted tide occurs at the initial period of surges.

d. Design tide. The hurricane surge height is the maximum stillwater surface elevation experienced at a given location during the passage of a hurricane. It reflects the combined effects of the hurricane surge, and where applicable the overland flow of the surge. Design hurricane surge heights were computed for conditions reflecting authorized and revised protective works or improvements.

SECTION III - HYDRAULIC DESIGN INTERIOR DRAINAGE

6. Interior drainage. Local interests have provided drainage in the project area, and construction of the Reach "A" hurricane protection levee in accordance with the plan presented herein will not affect the capability of the existing interior drainage system except for an additional 115 acres near the Freeport Sulphur facility.

These 115 acres consist of two areas: Area 1 (75 acres) and Area 2 (40 acres), both of which are shown on plate A-18.

a. Area 1 will be drained through the use of an existing drainage facility (as shown on plate A-18).

b. Area 2 will be drained into the Plaquemines Parish Drainage Canal. This would probably be done by constructing an open drainage ditch that would run from the north end of the Grande Ecaille Canal to an existing culvert that is parallel to LA State Highway No. 23 (it would then tie into this culvert). Runoff from Area 2 would then flow from this existing culvert to the Plaquemines Parish Drainage Canal. This is shown on plate A-18 (a culvert with appropriate erosion protection at its inlet and outlet would be required under any local access roads). Local interests, however, will determine exactly how Area 2 is to be drained into the Plaquemines Parish Drainage Canal.

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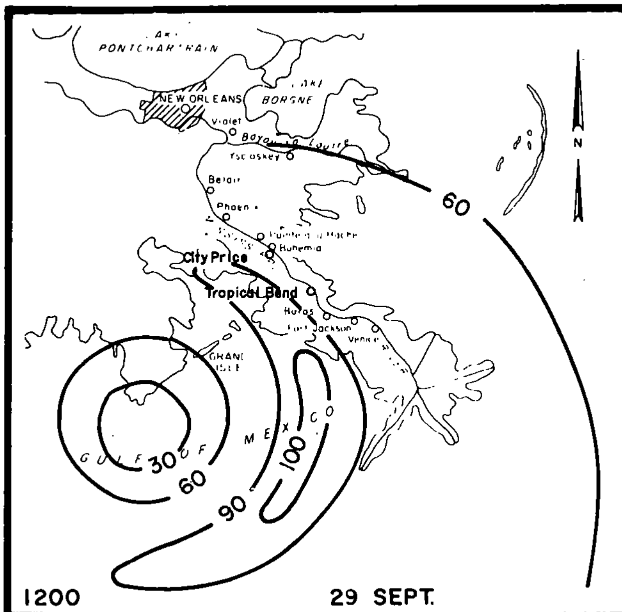
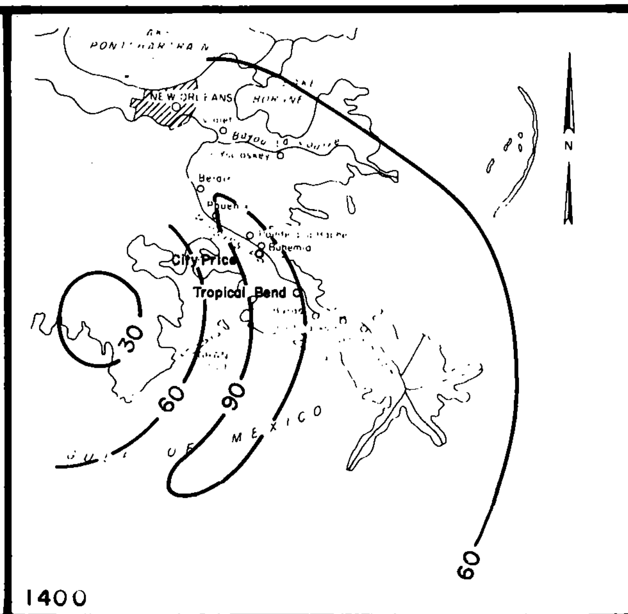
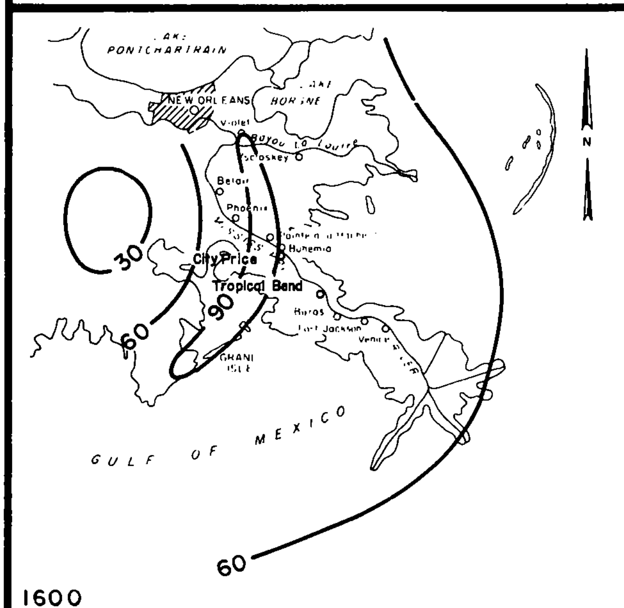
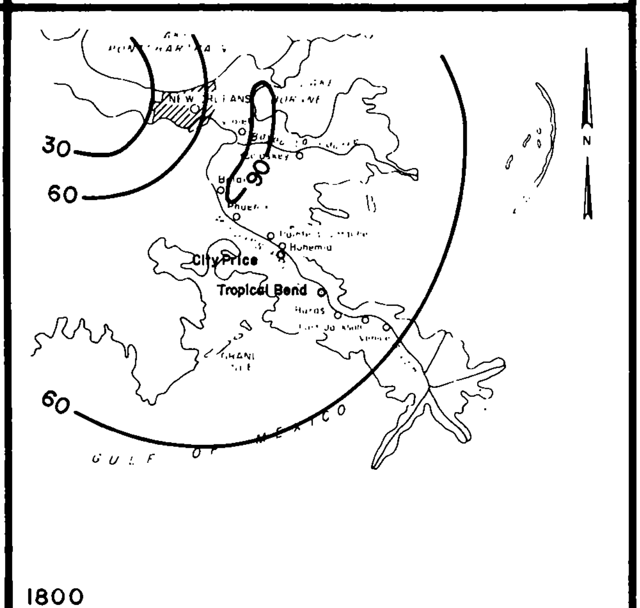
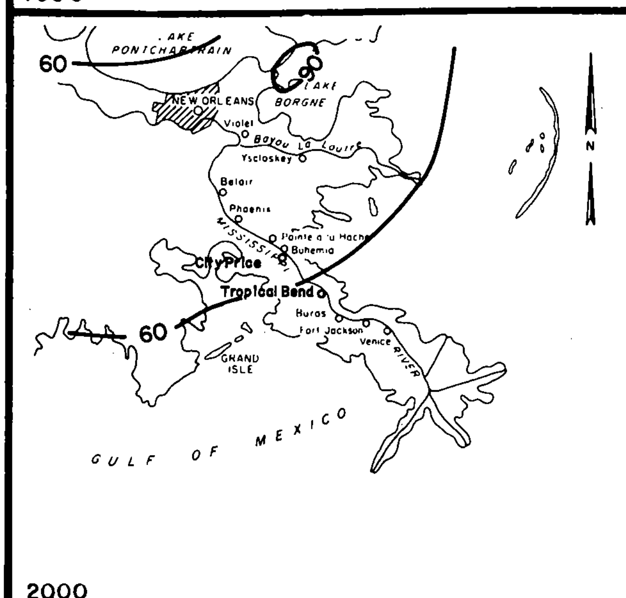










LEGEND

70 — Average Wind Velocity in M.P.H.

SCALE IN MILES

25 0 25 50

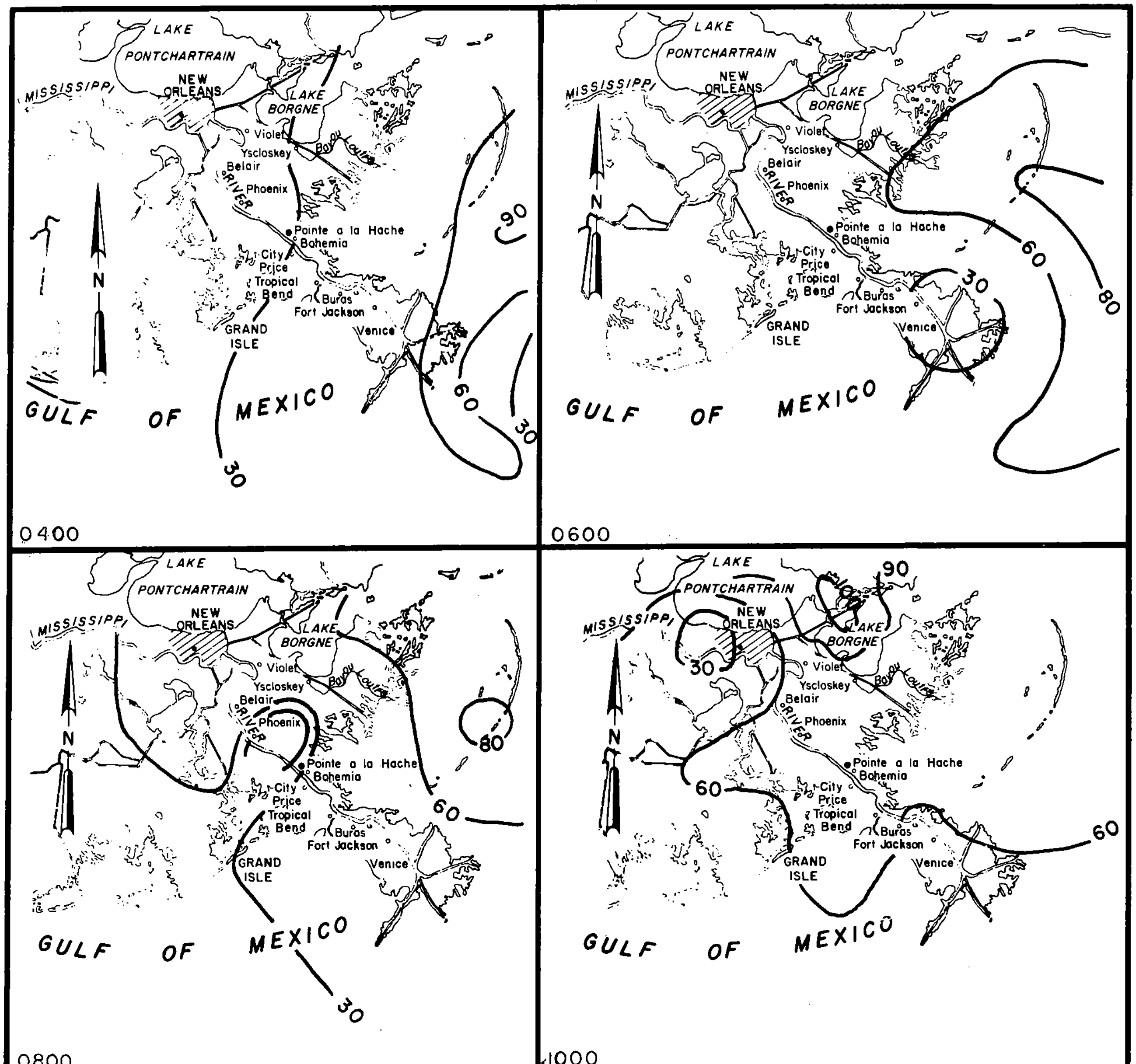
NEW ORLEANS TO VENICE, LOUISIANA
DESIGN MEMORANDUM NO. 1-GENERAL DESIGN
SUPPLEMENT NO. 5
REACH A-CITY PRICE TO TROPICAL BEND

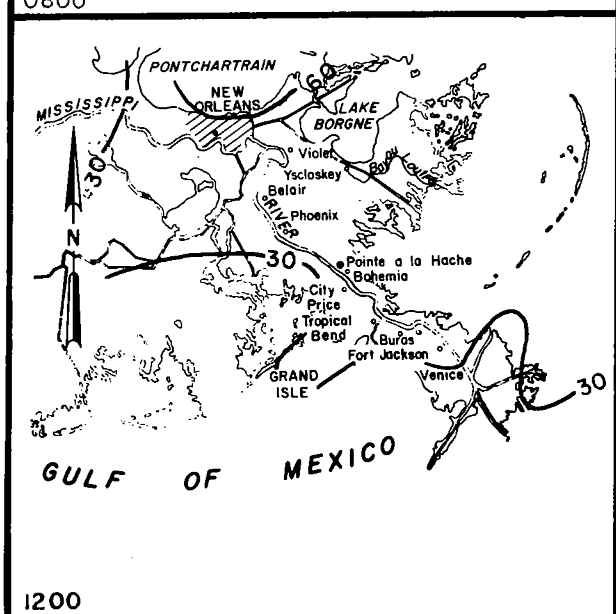
ISOVEL PATTERNS
HURRICANE OF 28 SEPT.-1 OCT. 1915

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

AUGUST 1983 FILE NO. H-2-28611

PLATE A-1





LEGEND

70 — Average Wind Velocity in M. P. H.

SCALE IN MILES

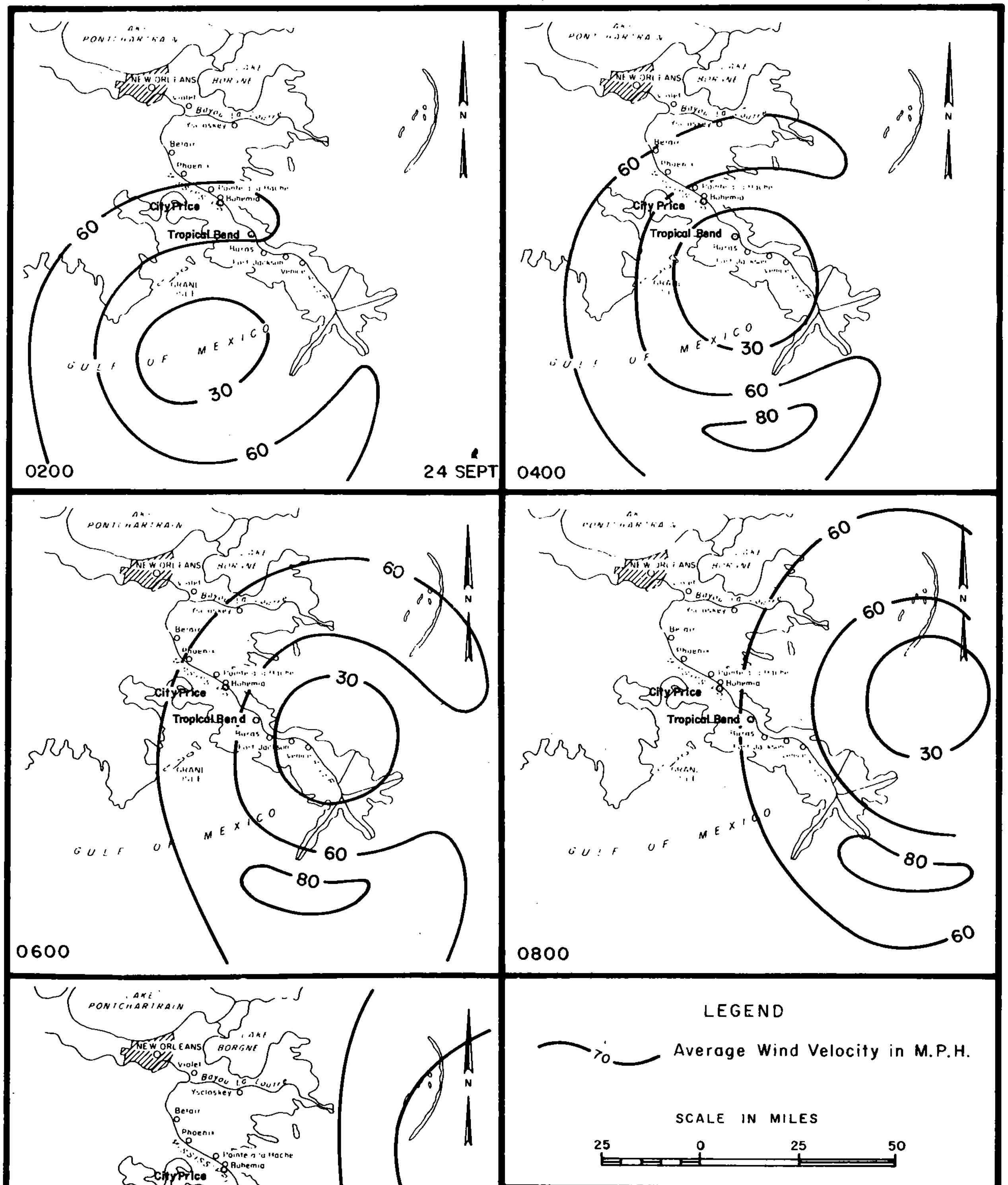
25 0 25 50

NEW ORLEANS TO VENICE, LOUISIANA
DESIGN MEMORANDUM NO. 1-GENERAL DESIGN
SUPPLEMENT NO. 5
REACH A-CITY PRICE TO TROPICAL BEND

ISOVEL PATTERNS
HURRICANE OF 19 SEPT. 1947

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

AUGUST 1983 FILE NO H-2-28611

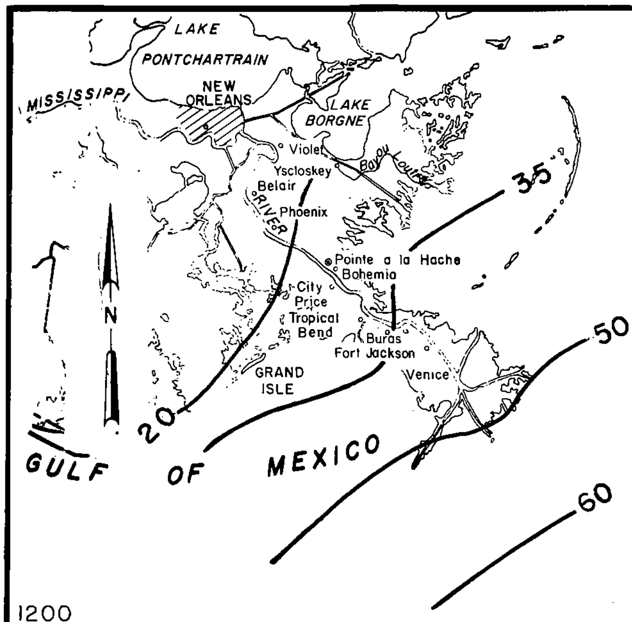


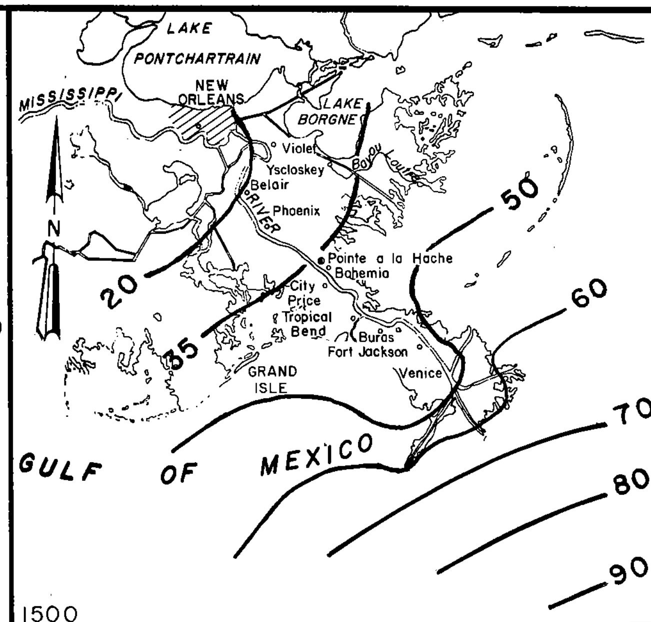
NEW ORLEANS TO VENICE, LOUISIANA
DESIGN MEMORANDUM NO. I-GENERAL DESIGN
SUPPLEMENT NO. 5
REACH A-CITY PRICE TO TROPICAL BEND

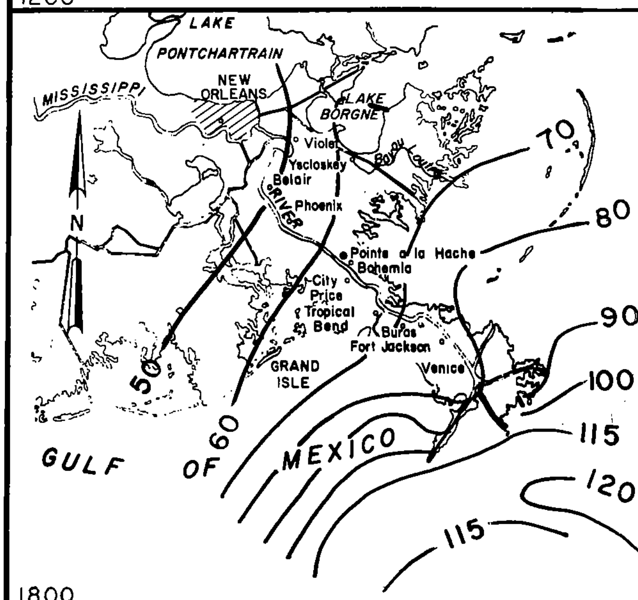
ISOVEL PATTERNS
HURRICANE FLOSSY
23-24 SEPT. 1956

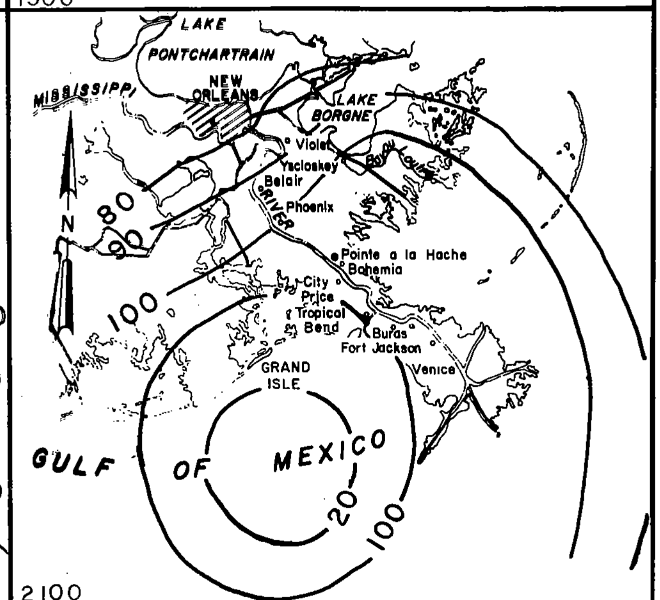
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

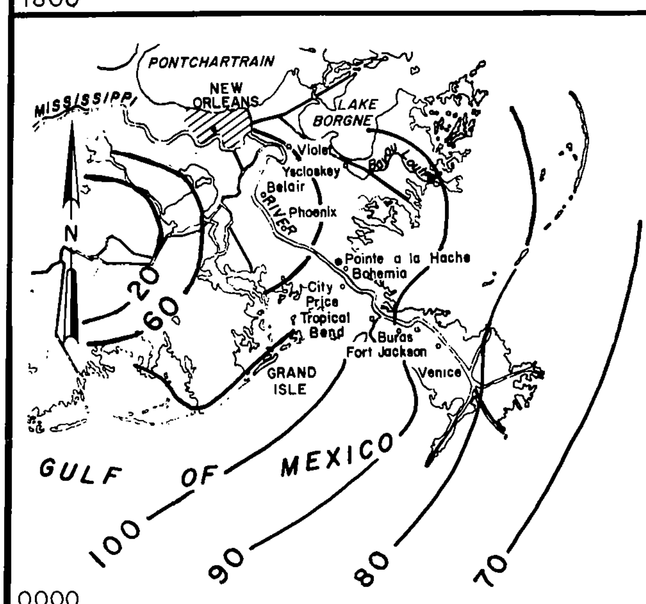
AUGUST 1983 FILE NO. H-2-28611











LEGEND

70 — Average Wind Velocity in M. P. H.

SCALE IN MILES

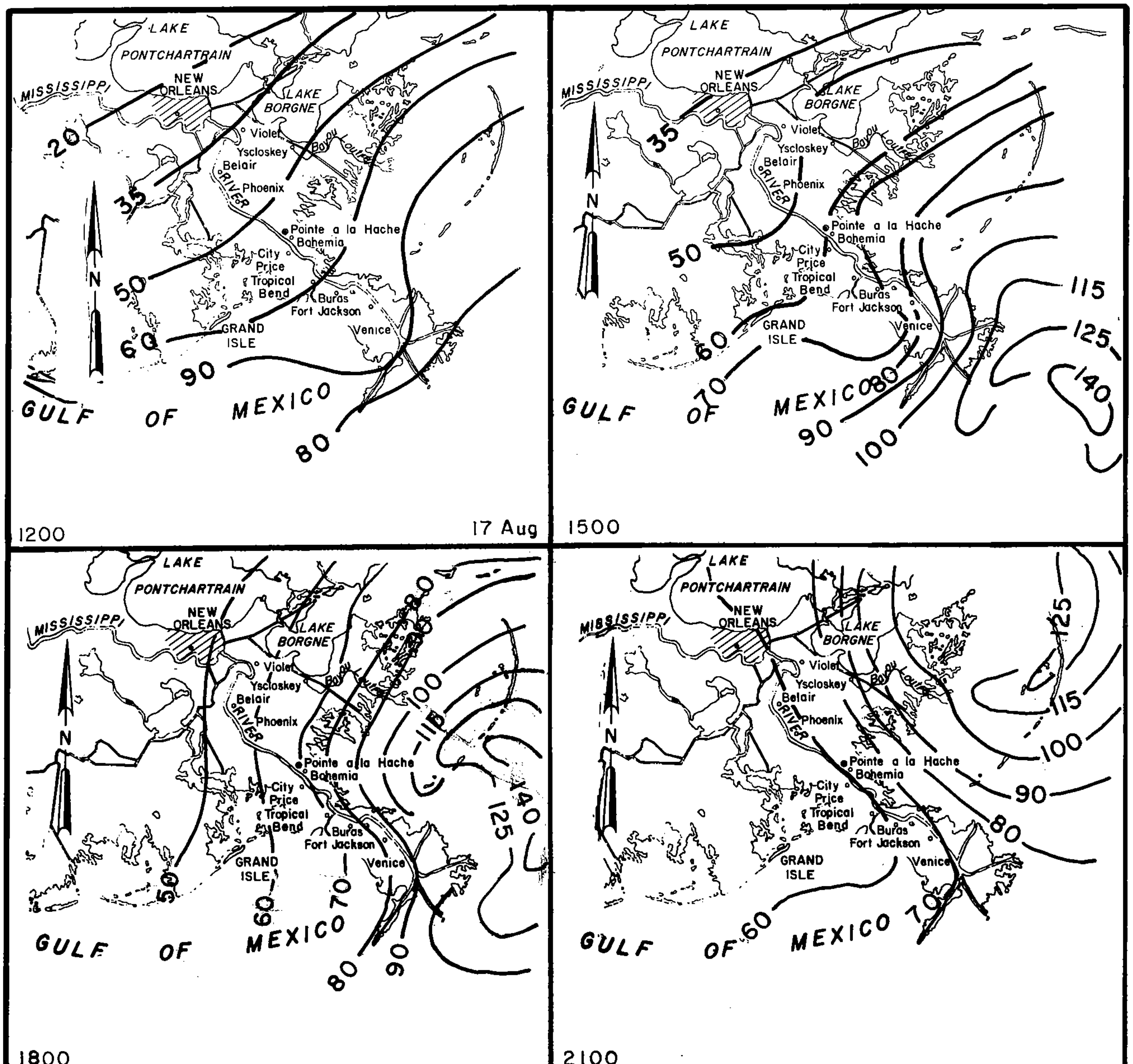
25 0 25 50

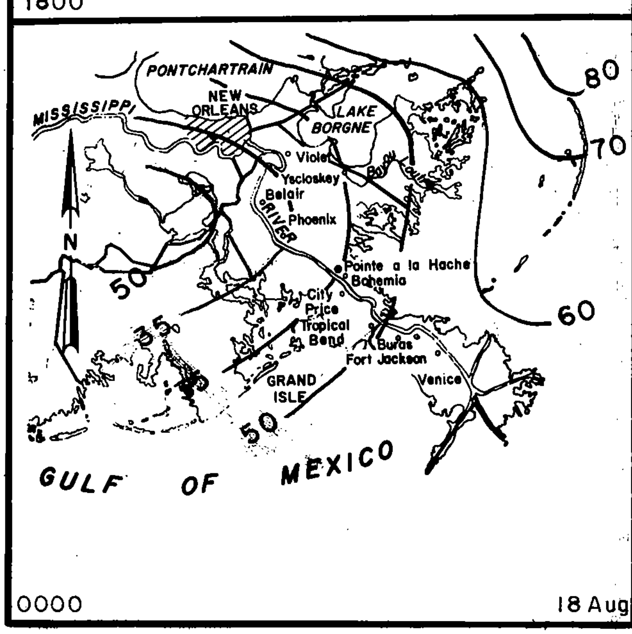
NEW ORLEANS TO VENICE, LOUISIANA
DESIGN MEMORANDUM NO. 1-GENERAL DESIGN
SUPPLEMENT NO. 5
REACH A-CITY PRICE TO TROPICAL BEND

ISOVEL PATTERNS
HURRICANE BETSY
9-10 SEPT. 1965

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

AUGUST 1983 FILE NO. H-2-28611





LEGEND

70 Average Wind Velocity in M. P. H.

SCALE IN MILES

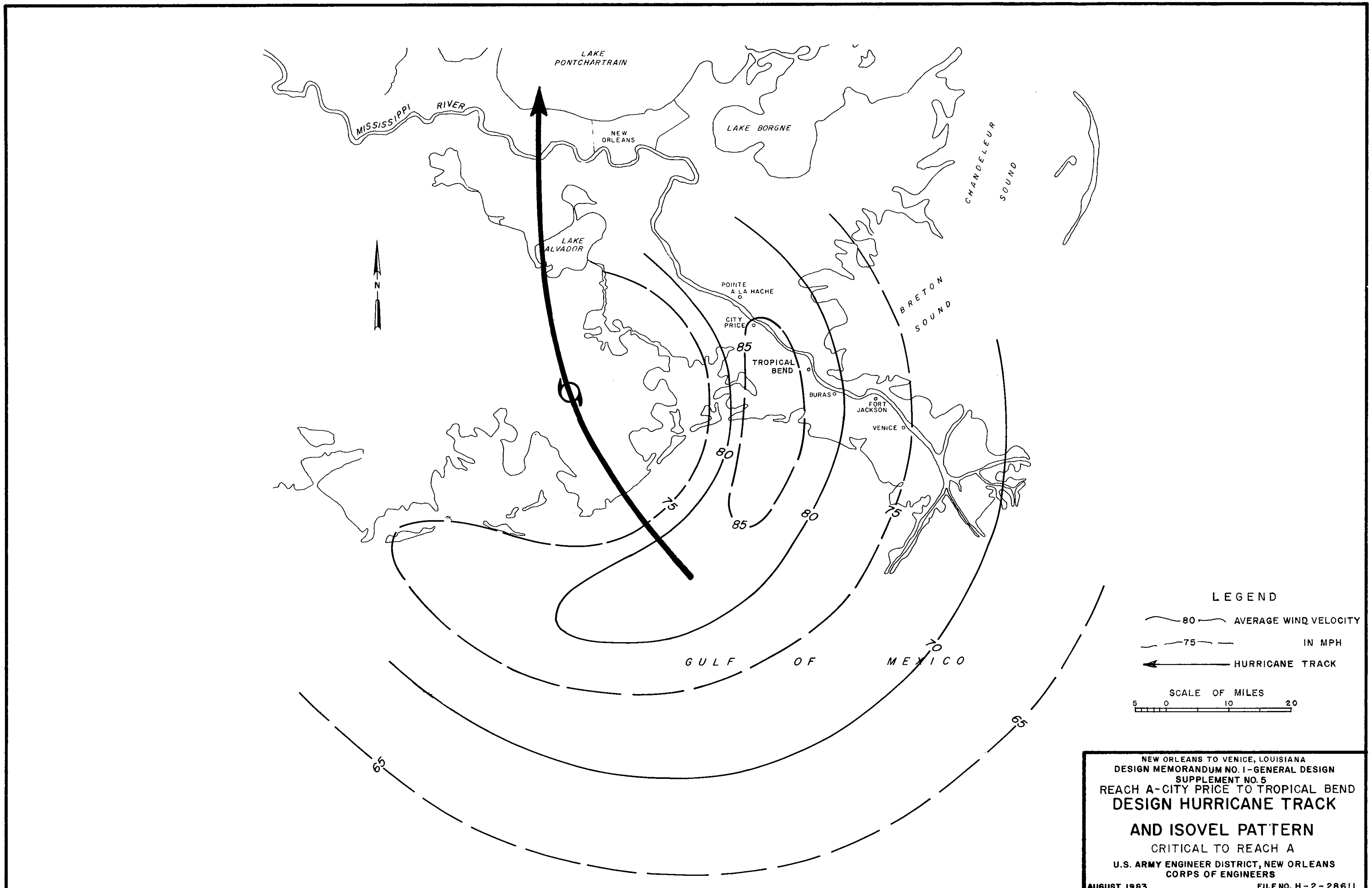
25 0 25 50

NEW ORLEANS TO VENICE, LOUISIANA
DESIGN MEMORANDUM NO. 1-GENERAL DESIGN
SUPPLEMENT NO. 5
REACH A-CITY PRICE TO TROPICAL BEND

ISOVEL PATTERNS
HURRICANE CAMILLE
17-18 AUG. 1969

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

AUGUST 1983 FILE NO. H-2-28611



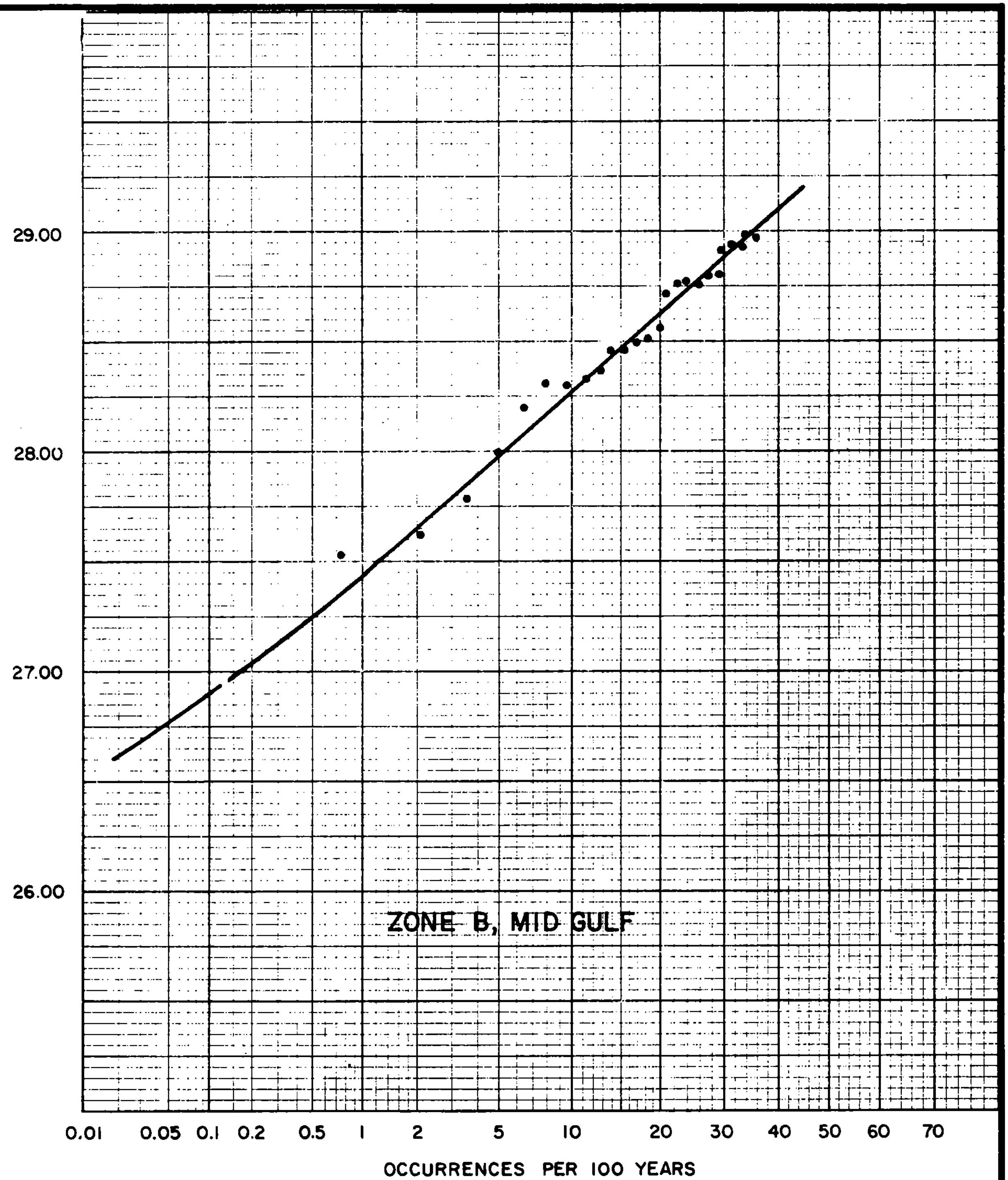
NEW ORLEANS TO VENICE, LOUISIANA
DESIGN MEMORANDUM NO. 1-GENERAL DESIGN
SUPPLEMENT NO. 5
REACH A-CITY PRICE TO TROPICAL BEND

DESIGN HURRICANE TRACK AND ISOVEL PATTERN

CRITICAL TO REACH A

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

AUGUST 1983 FILE NO. H-2-28611

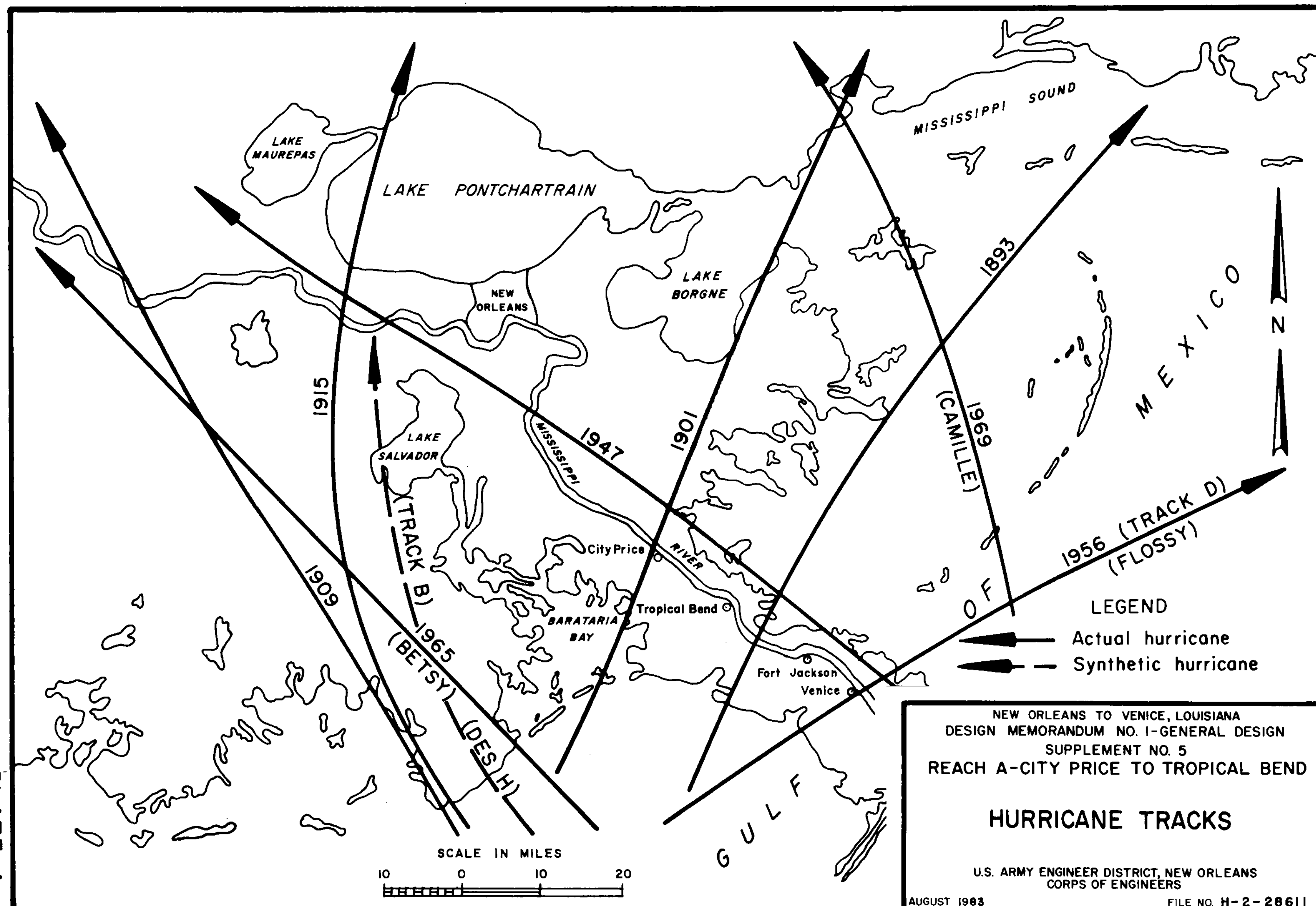


NEW ORLEANS TO VENICE, LOUISIANA
DESIGN MEMORANDUM NO. I-GENERAL DESIGN
SUPPLEMENT NO. 5
REACH A-CITY PRICE TO TROPICAL BEND

FREQUENCY OF HURRICANE CENTRAL PRESSURES ZONE B, MIDGULF

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

AUGUST 1983 FILE NO. H-2-28611



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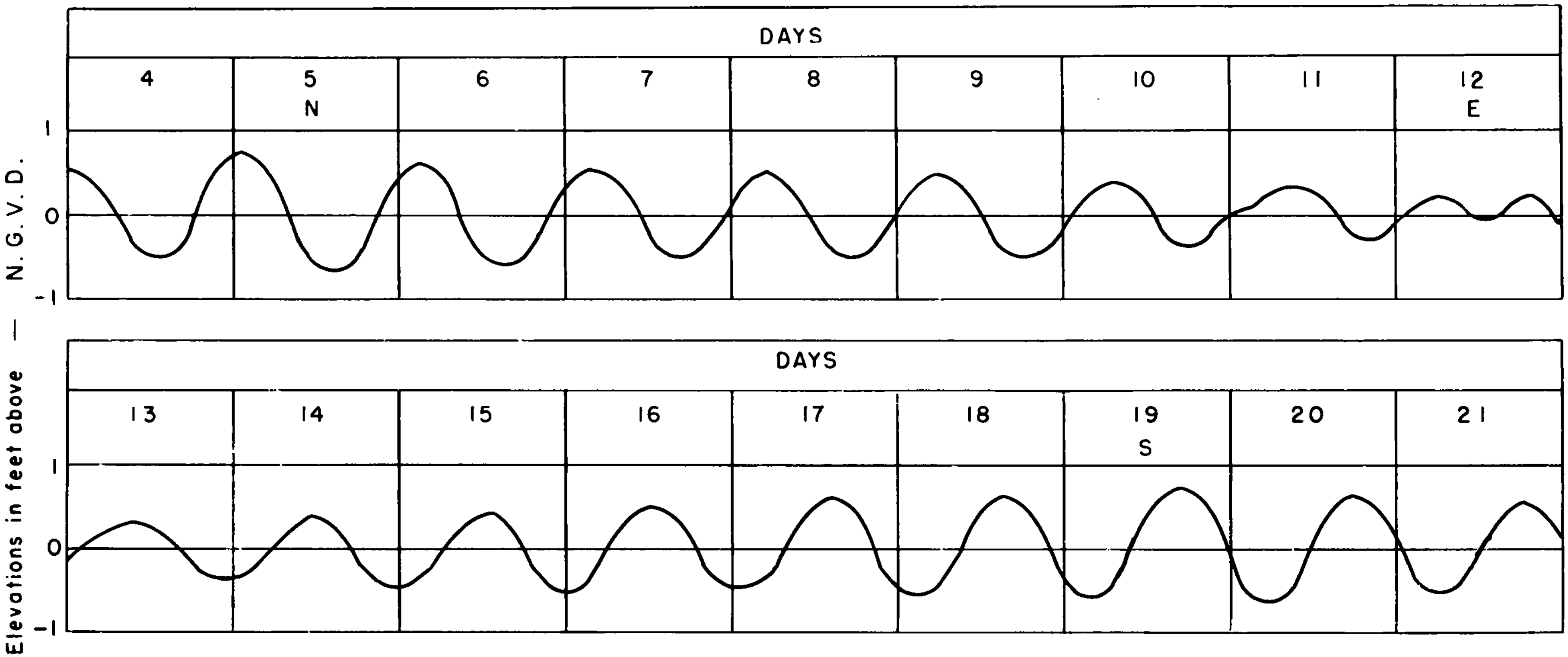
DESIGN MEMORANDUM NO. 1-GENERAL DESIGN
SUPPLEMENT NO. 5
REACH A-CITY PRICE TO TROPICAL BEND

HURRICANE TRACKS

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

AUGUST 1983 FILE NO. H-2-28611

PLATE A-8



LEGEND

E, moon on the equator
N, S, moon farthest north
or south of the equator

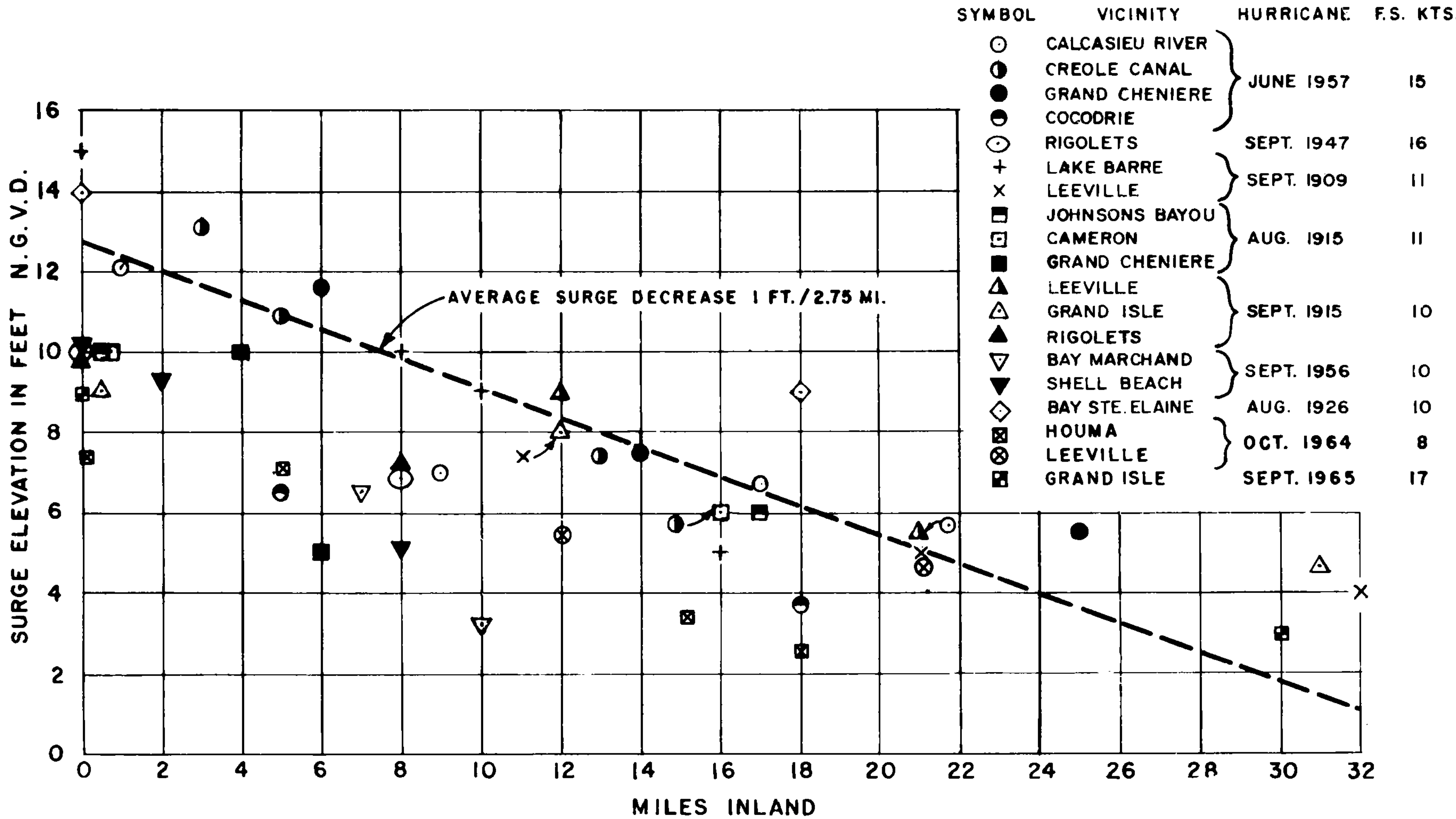
NEW ORLEANS TO VENICE, LOUISIANA
DESIGN MEMORANDUM NO. 1-GENERAL DESIGN
SUPPLEMENT NO. 5
REACH A-CITY PRICE TO TROPICAL BEND

TYPICAL TIDAL CYCLES

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

AUGUST 1983 FILE NO. H-2-28611

PLATE A-9



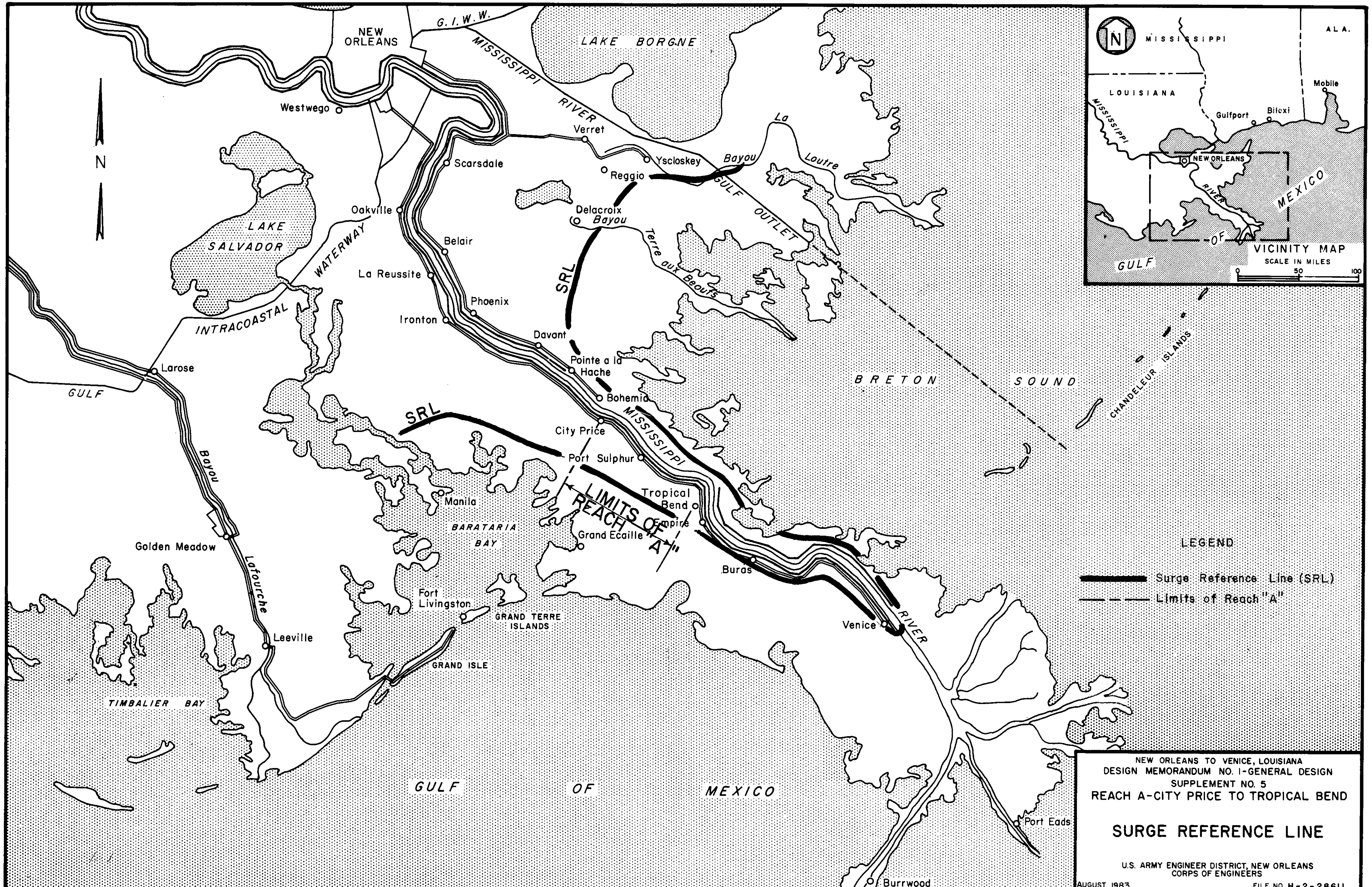
NEW ORLEANS TO VENICE, LOUISIANA
DESIGN MEMORANDUM NO. 1-GENERAL DESIGN
SUPPLEMENT NO. 5
REACH A-CITY PRICE TO TROPICAL BEND

OVERLAND SURGE ELEVATIONS COASTAL LOUISIANA

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

AUGUST 1983 FILE NO. H-2-28611

PLATE A-10



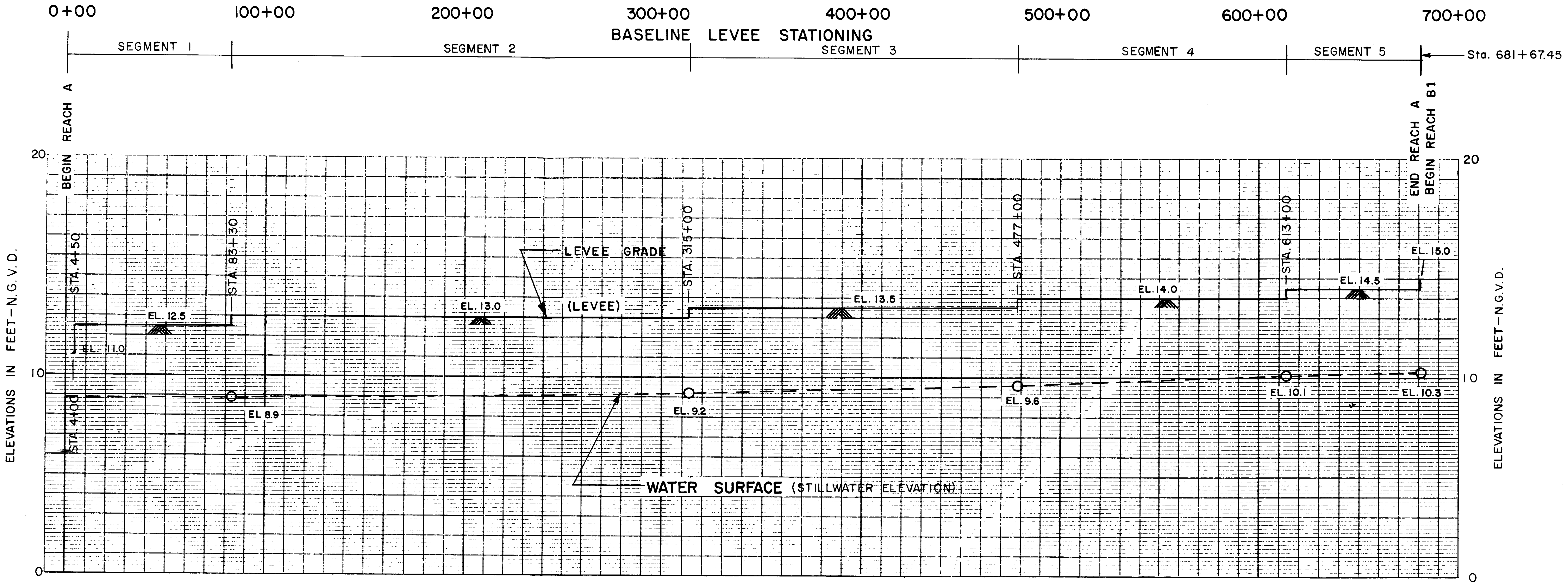
NEW ORLEANS TO VENICE, LOUISIANA
DESIGN MEMORANDUM NO. 1-GENERAL DESIGN
SUPPLEMENT NO. 5
REACH A-CITY PRICE TO TROPICAL BEND

SURGE REFERENCE LINE

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

AUGUST 1983 FILE NO. H-2-28611

PLATE A-11



NOTE:
LEVEE GRADE TRANSITIONS TO BE MADE IN ACCORDANCE WITH SOUND ENGINEERING PRACTICE.

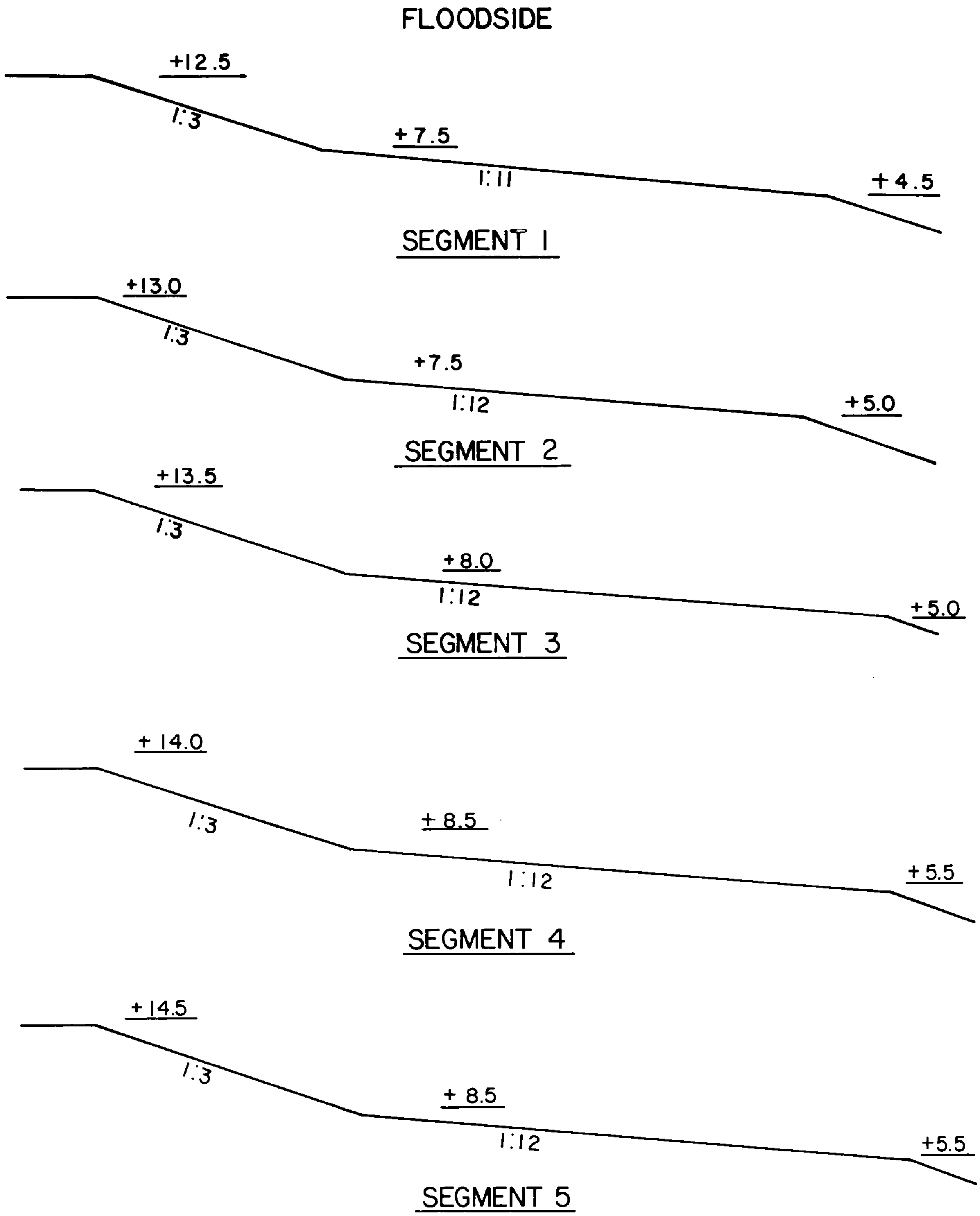
NEW ORLEANS TO VENICE, LOUISIANA
DESIGN MEMORANDUM NO. 1-GENERAL DESIGN
SUPPLEMENT NO. 5
REACH A-CITY PRICE TO TROPICAL BEND

WATER SURFACE AND LEVEE PROFILES

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

AUGUST 1983 FILE NO H-2-28611

PLATE A-12

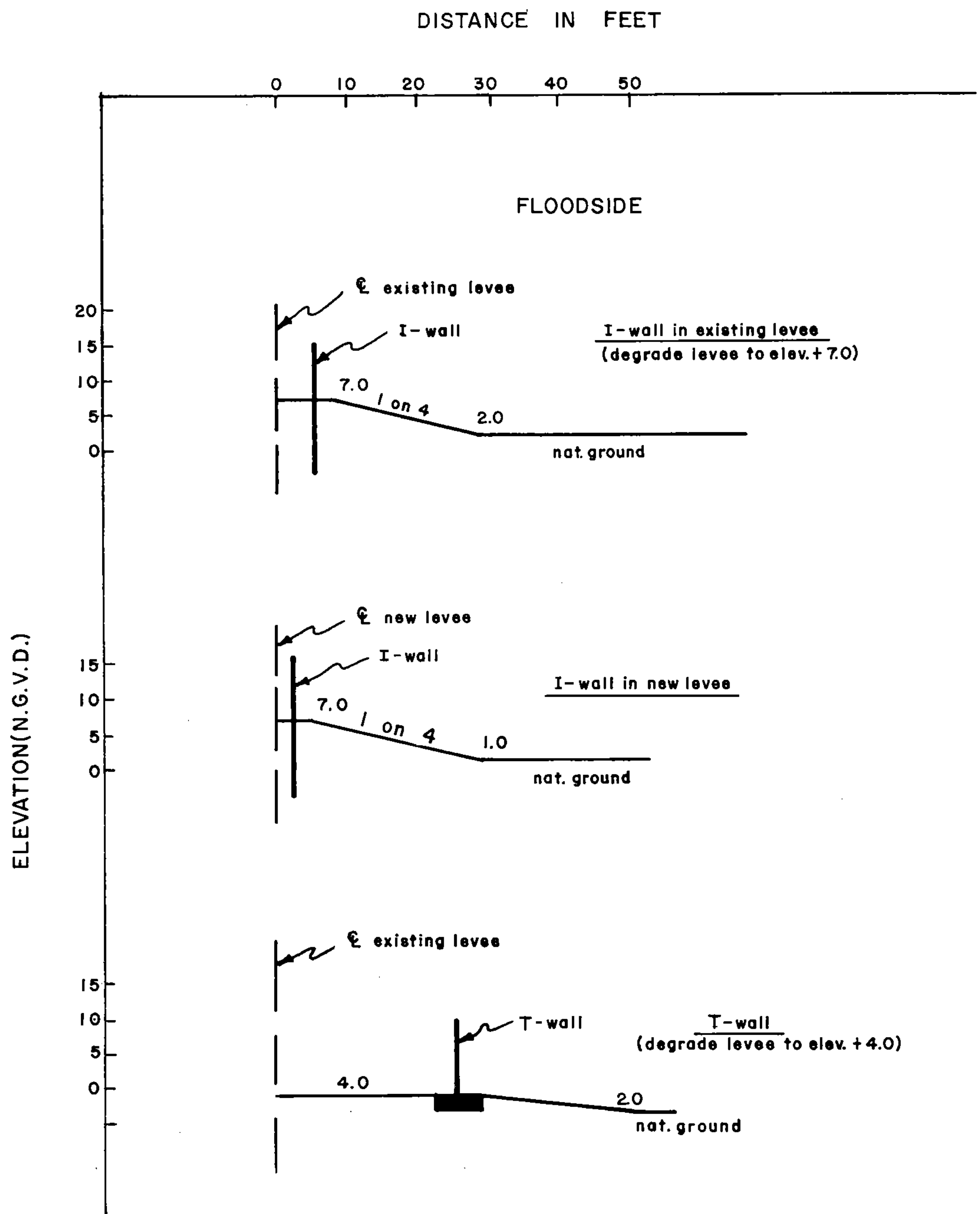


NEW ORLEANS TO VENICE, LOUISIANA
DESIGN MEMORANDUM NO. 1-GENERAL DESIGN
SUPPLEMENT NO. 5
REACH A-CITY PRICE TO TROPICAL BEND

TYPICAL SECTIONS

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

SEPTEMBER 1987 FILE NO. H-2-28611



Floodwall design elevations

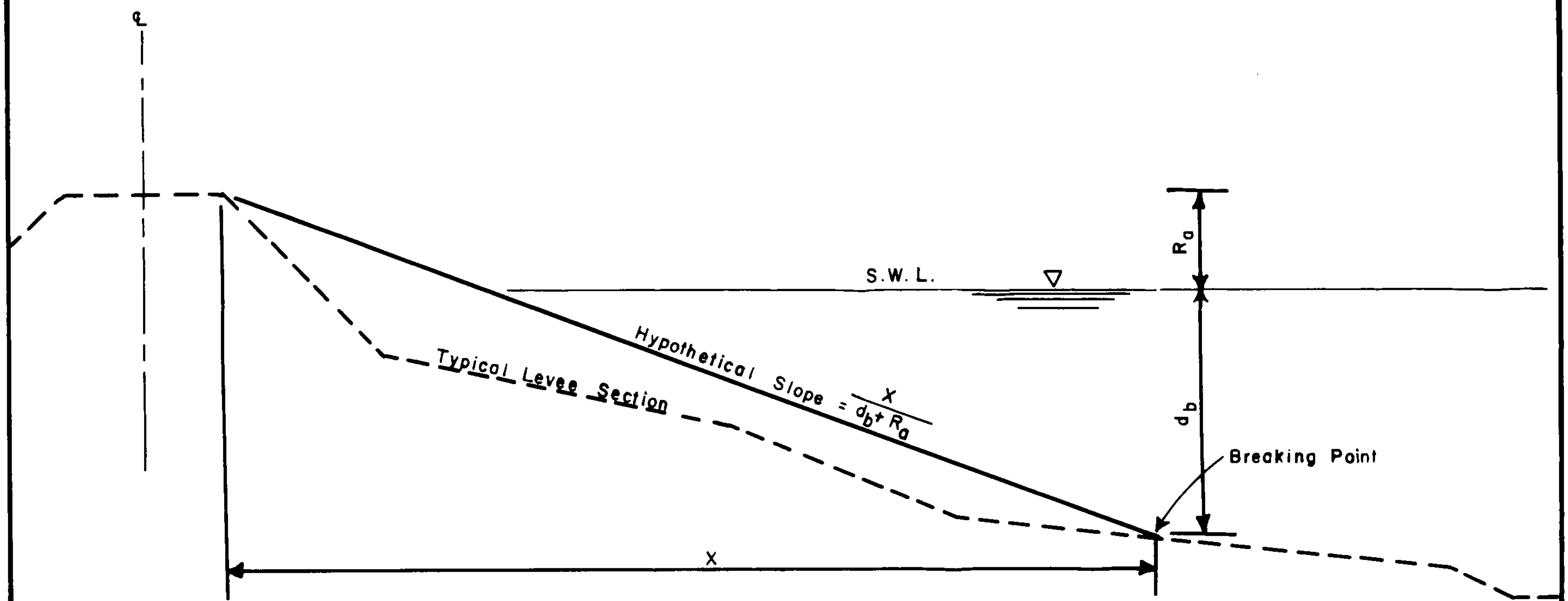
Segments	1-2	16.0 ft.
Segments	3-5	17.0 ft.

NEW ORLEANS TO VENICE, LOUISIANA
DESIGN MEMORANDUM NO. 1-GENERAL DESIGN
SUPPLEMENT NO. 5
REACH A-CITY PRICE TO TROPICAL BEND

TYPICAL LEVEE-FLOODWALL CROSS SECTIONS

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

AUGUST 1983 FILE NO. H-2-28611



LEGEND

R_a = assumed runup
d_b = breaking depth of wave
X = horizontal distance from breaking point to elevation of runup
S.W.L. = stillwater level

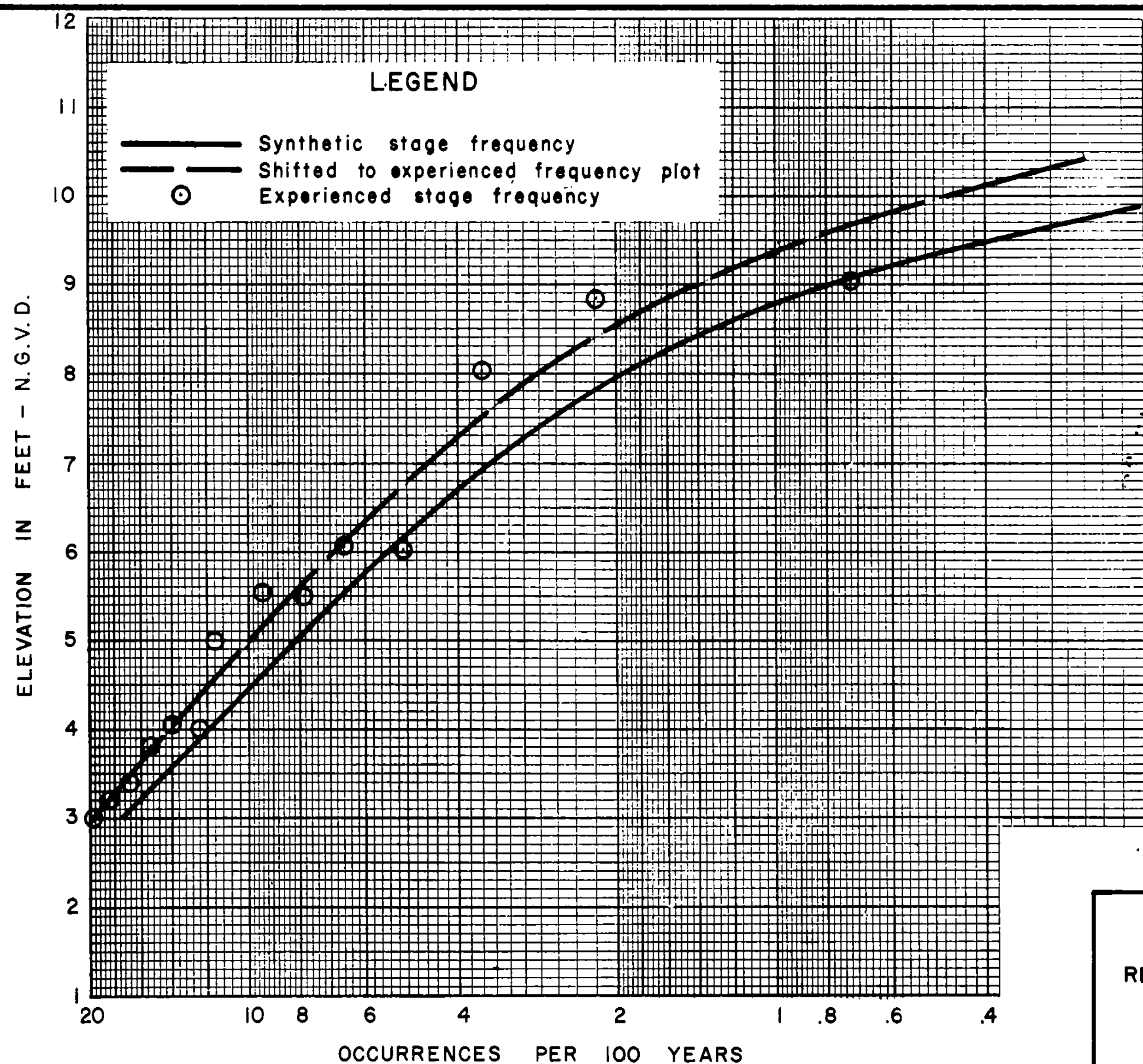
NEW ORLEANS TO VENICE, LOUISIANA
DESIGN MEMORANDUM NO. 1-GENERAL DESIGN
SUPPLEMENT NO. 5
REACH A-CITY PRICE TO TROPICAL BEND

DETERMINATION OF HYPOTHETICAL SLOPE

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

AUGUST 1983 FILE NO. H-2-28611

PLATE A-15



FREQUENCY ANALYSIS

M	YEARS	WIND TIDE LEVEL (FT.)	P
1	*1915	9.0	0.72
2	1965	8.8	2.17
3	1956	8.0	3.62
4	1919	6.0	5.08
5	**1915	6.0	6.54
6	1964	5.5	7.94
7	1909	5.5	9.43
8	1901	5.0	10.90
9	1947	4.0	12.4
10	1926	4.0	13.7
11	1940	3.8	15.2
12	1941	3.4	16.7
13	1954	3.2	18.2
14	1969	3.0	19.5

* September 1915
** August 1915

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

P = Probability
M = Number of the event (rank)
Y = Number of years of record (69)

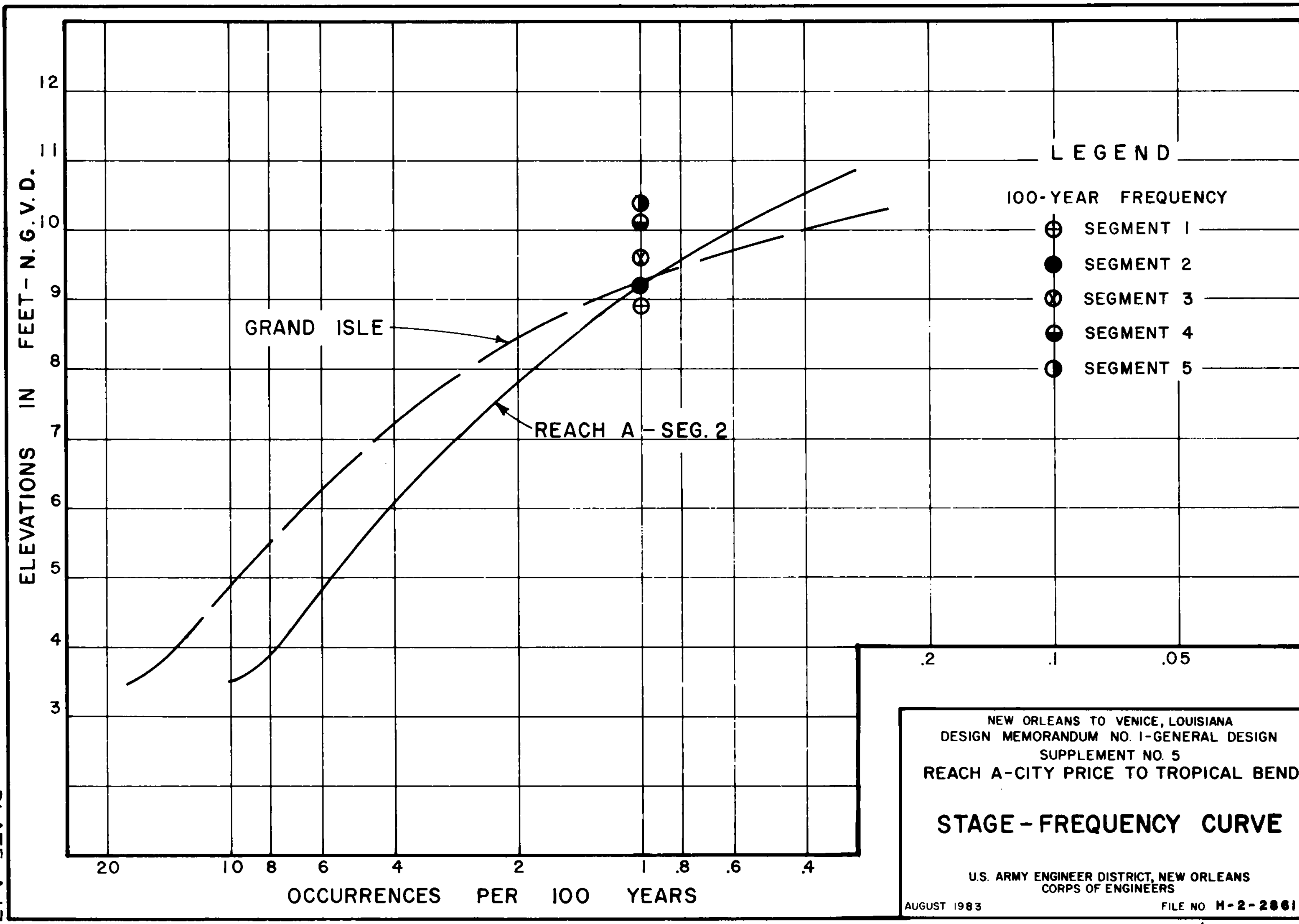
NEW ORLEANS TO VENICE, LOUISIANA
DESIGN MEMORANDUM NO. 1-GENERAL DESIGN
SUPPLEMENT NO. 5
REACH A-CITY PRICE TO TROPICAL BEND

STAGE-FREQUENCY GRAND ISLE, LA.

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

AUGUST 1983 FILE NO. H-2-28611

PLATE A-16



NEW ORLEANS TO VENICE, LOUISIANA
DESIGN MEMORANDUM NO. 1-GENERAL DESIGN
SUPPLEMENT NO. 5
REACH A-CITY PRICE TO TROPICAL BEND

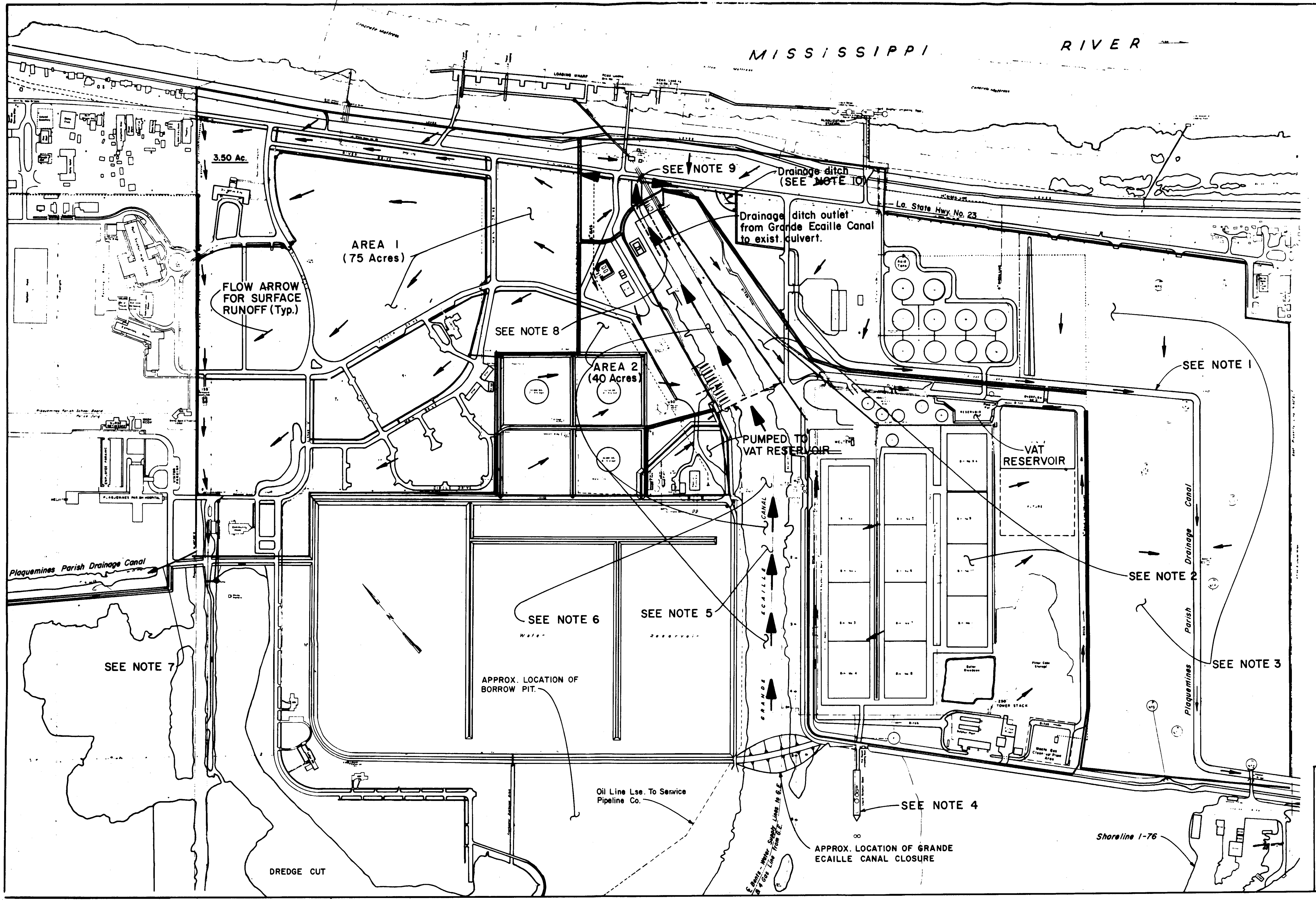
STAGE - FREQUENCY CURVE

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

AUGUST 1983

FILE NO. H-2-28611

PLATE A-17



GENERAL NOTES

1. PLAQUEMINES PARISH DRAINAGE CANAL MAY NEED MINOR IMPROVEMENTS AT UPPER END.
2. THIS AREA DRAINS INTO VAT RESERVOIR WHERE THE WATER IS THEN TREATED AND PUMPED INTO THE MISSISSIPPI RIVER.
3. THIS AREA GRAVITY DRAINS INTO PLAQUEMINES PARISH DRAINAGE CANAL.
4. THIS DOCK WILL BE EXTENDED APPROX. 50 FT.
5. THIS PORTION OF GRANDE ECAILLE CANAL WILL BE HYDRAULICALLY FILLED WITH SAND (TO AN APPROX. ELEV. OF +3.0 FT. N.G.V.D.). SAND WILL THEN BE SHAPED SO THAT THIS AREA CAN DRAIN INTO AN OUTLET.
6. ALL DOCKING FACILITIES IN THIS AREA WILL BE RELOCATED TO BORROW PIT APPROX. LOCATED S.W. OF WATER RESERVOIR.
7. AREA 1 GRAVITY DRAINS THROUGH EXISTING DRAINAGE FACILITY INTO PLAQUEMINES PARISH DRAINAGE CANAL.
8. AREA 2 DRAINS INTO DRAINAGE DITCH OUTLET.
9. DRAINAGE DITCH OUTLET SHOULD TIE INTO THE SIDE OF THE EXISTING CULVERT (EROSION PROTECTION REQ'D). HOWEVER, DIRECTION OF DRAINAGE IS SUBJECT TO CHANGE DUE TO MODIFICATIONS REQUIRED AS A RESULT OF IMPROVEMENTS TO LA. STATE HWY. NO. 23.
10. THIS DRAINAGE DITCH SHOULD BE CONSTRUCTED ONLY IF EXIT. CULVERT DOES NOT TIE-IN WITH THE PLAQUEMINES PARISH DRAINAGE CANAL.

SCALE: 1 in.= Approx. 400 ft.

NEW ORLEANS TO VENICE, LOUISIANA
DESIGN MEMORANDUM NO. 1 GENERAL DESIGN
SUPPLEMENT NO. 5
REACH A - CITY PRICE TO TROPICAL BEND

INTERIOR DRAINAGE
FREEPORT SULPHUR FACILITY

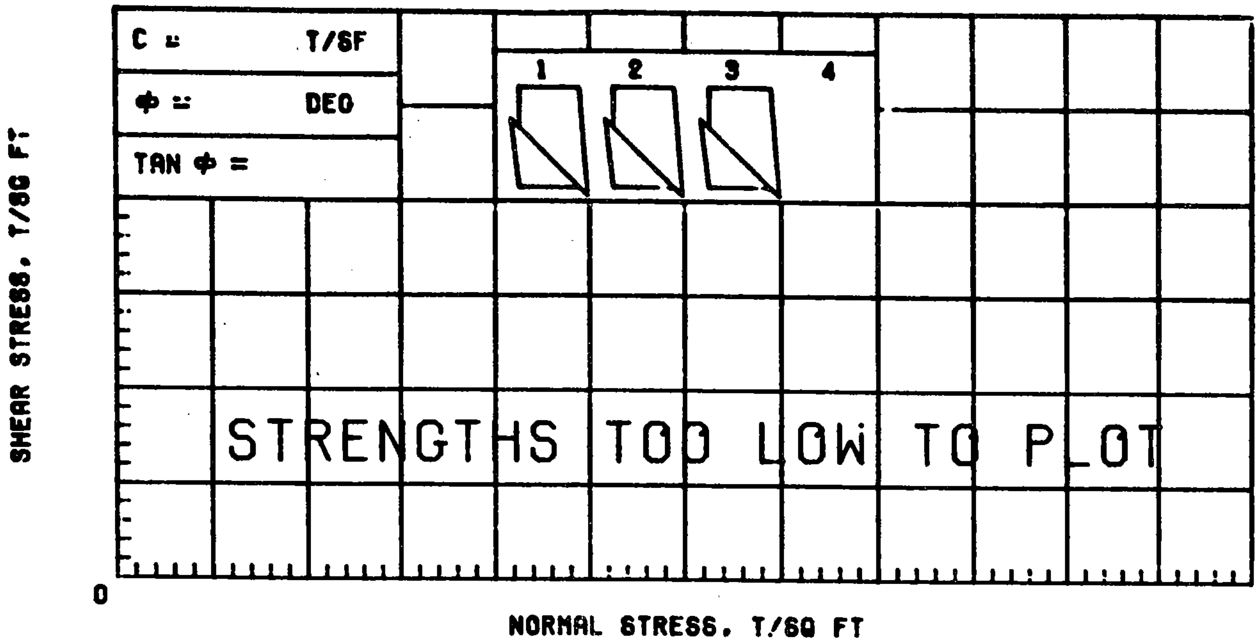
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

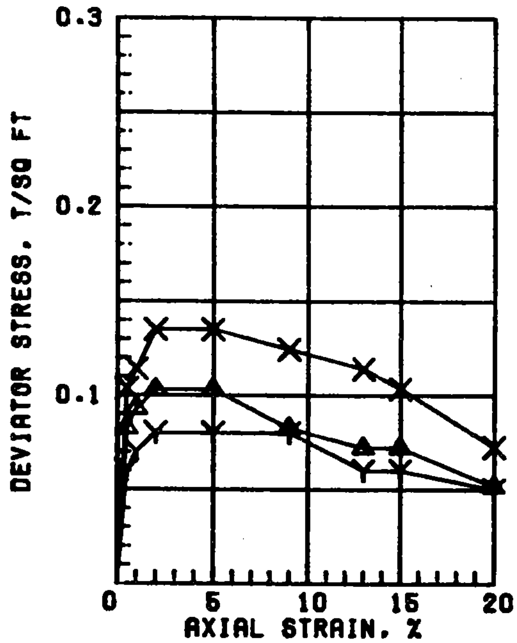
AUGUST 1983 FILE NO. H-2-28611

PLATE A-18

NEW ORLEANS TO VENICE, LOUISIANA
DESIGN MEMORANDUM NO. 1, GENERAL DESIGN
SUPPLEMENT NO. 5, REVISED
REACH A - CITY PRICE TO TROPICAL BEND
NOVEMBER 1987

APPENDIX B
SOIL TEST DATA SHEETS





		▲1	Y2	X3	4
SPECIMEN NO.		▲1	Y2	X3	4
INITIAL	WATER CONTENT, %	93.4	97.6	89.1	
	DRY DENSITY, PCF	47.4	44.5	48.9	
	SATURATION, %	98.6	94.7	98.5	
	VOID RATIO	2.556	2.784	2.444	
BEFORE SHEAR	WATER CONTENT, %				
	DRY DENSITY, PCF				
	SATURATION, %				
	VOID RATIO				
	BACK PRESS., TSF				
MIN PRIN. STRESS, TSF		0.5	1.5	3.0	
MAX. DEV. STRESS, TSF		0.10	0.08	0.13	
TIME TO FAILURE, MIN.		4	12	9	
RATE OF STRAIN INCR.%			9	13	
INITIAL DIAMETER, IN.		1.38	1.40	1.37	
INITIAL HEIGHT, IN.		3.00	3.00	3.00	

CONTROLLED-STRAIN TEST

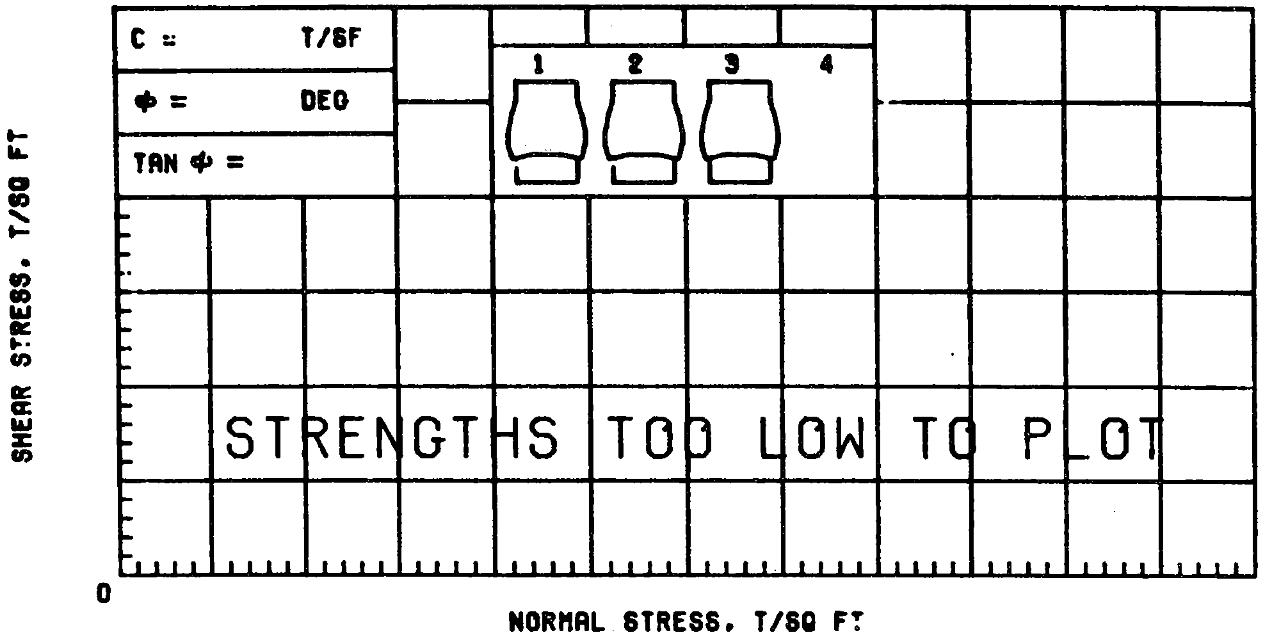
DESCRIPTION OF SPECIMENS: CLAY (CH), DARK GRAY; ORGANIC MATERIAL

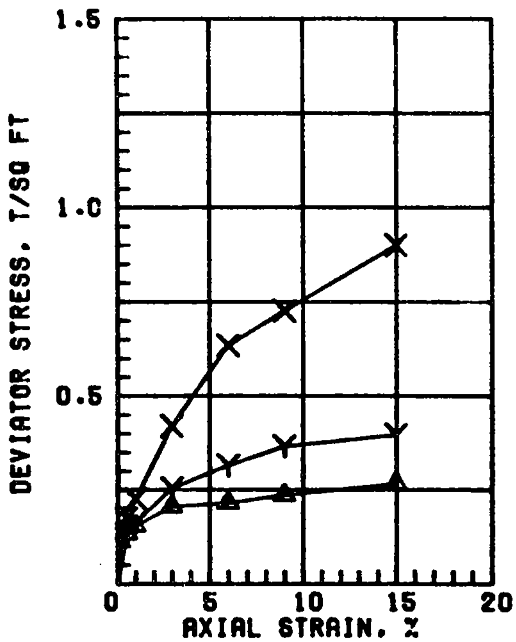
LL 113	PL 25	PI 88	GS 2.70 (ESTIMATED)	UNDISTURBED SPECIMEN	Q TEST

REMARKS:

PROJECT REACH "A" GEOTEXTILE TEST SECTION	
BORING NO. P2-U	SAMPLE NO. 3-B
DEPTH/ELEV - 12.3 / -6.0	TECH. BD
LABORATORY USAE WES	DATE 20 JAN 87

TRIAXIAL COMPRESSION TEST REPORT





SPECIMEN NO.		Δ1	Y2	X3	4
INITIAL	WATER CONTENT, %	47.4	37.9	46.6	
	DRY DENSITY, PCF	72.6	81.5	73.2	
	SATURATION, %	96.8	95.9	96.4	
	VOID RATIO	1.322	1.068	1.303	
BEFORE SHEAR	WATER CONTENT, %				
	DRY DENSITY, PCF				
	SATURATION, %				
	VOID RATIO				
	BACK PRESS., TSF				
MIN PRIN. STRESS, TSF		0.5	1.5	3.0	
MAX. DEV. STRESS, TSF		0.27	0.40	0.90	
TIME TO FAILURE, MIN.		30	28	31	
RATE OF STRAIN INCR.%					
INITIAL DIAMETER, IN.		1.39	1.39	1.39	
INITIAL HEIGHT, IN.		3.00	3.00	3.00	

CONTROLLED-STRAIN TEST

DESCRIPTION OF SPECIMENS: CLAY (CL), GRAY; ORGANIC MATERIAL; FINE SAND POCKETS

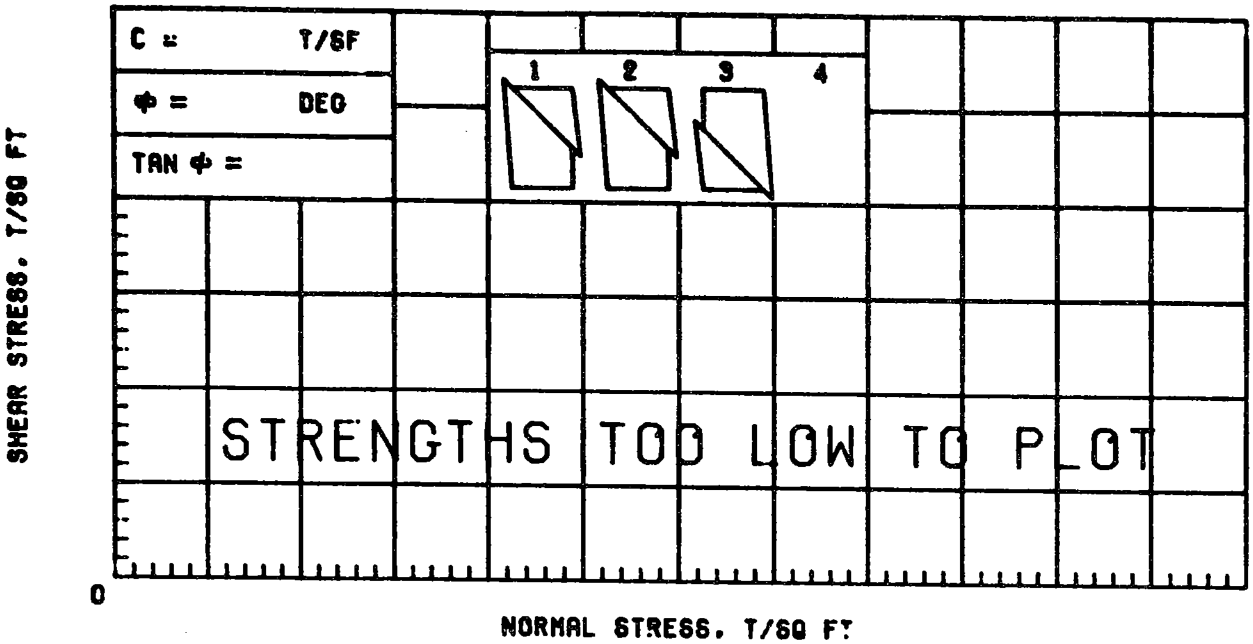
LL 43	PL 22	PI 21	GS 2.70 (ESTIMATED)	UNDISTURBED SPECIMEN	Q TEST

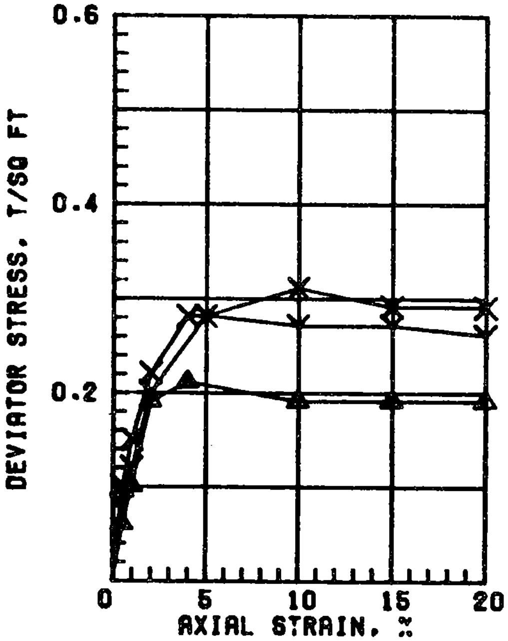
REMARKS:

PROJECT REACH "A" GEOTEXTILE TEST SECTION

BORING NO. P2-U	SAMPLE NO. 5-D
DEPTH/ELEV - 21.9/-15.6	TECH. BD
LABORATORY USAE WES	DATE 02 FEB 87

TRIAXIAL COMPRESSION TEST REPORT





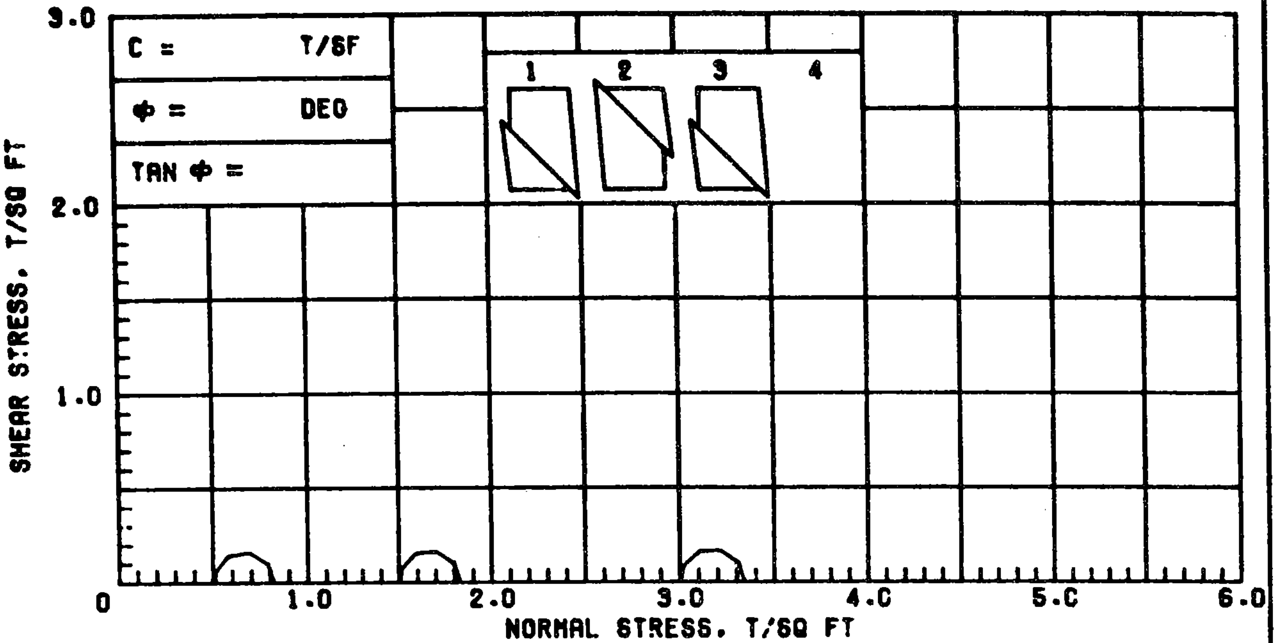
	SPECIMEN NO.	▲1	Y2	X3	4
INITIAL	WATER CONTENT, %	59.9	61.2	53.7	
	DRY DENSITY, PCF	63.9	62.5	68.3	
	SATURATION, %	98.7	97.5	98.8	
	VOID RATIO	1.639	1.695	1.468	
BEFORE SHEAR	WATER CONTENT, %				
	DRY DENSITY, PCF				
	SATURATION, %				
	VOID RATIO				
	BACK PRESS., TSF				
	MIN PRIN. STRESS, TSF	0.5	1.5	3.0	
	MAX. DEV. STRESS, TSF	0.21	0.28	0.28	
	TIME TO FAILURE, MIN.	8	30	24	
	RATE OF STRAIN INCR.,%		6	6	
	INITIAL DIAMETER, IN.	1.40	1.40	1.40	
	INITIAL HEIGHT, IN.	3.0C	3.0C	3.00	

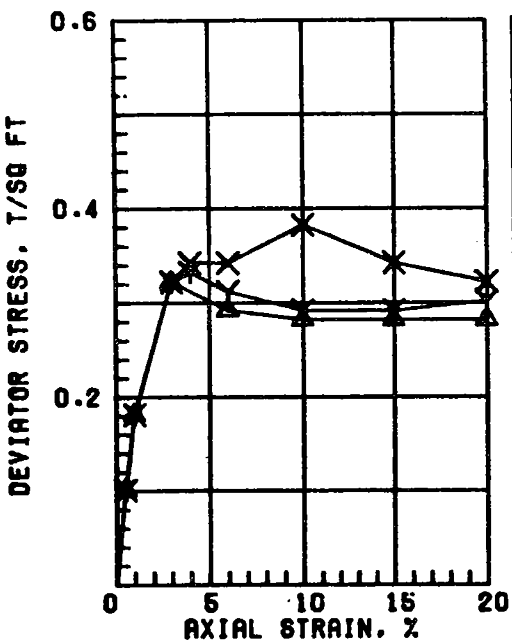
CONTROLLED-STRAIN TEST

DESCRIPTION OF SPECIMENS: CLAY (CH), GRAY; 1/4" SILT LAYERS

LL 62	PL 21	PI 41	GS 2.70 (ESTIMATED)	UNDISTURBED SPECIMEN	Q TEST

REMARKS:	PROJECT REACH "A" GEOTEXTILE TEST SECTION
	BORING NO. P2-U — SAMPLE NO. 8-C
	DEPTH/ELEV -32.9 / -26.6 — TECH. KOC
	LABORATORY USAE WES — DATE 30 JAN 87
	TRIAXIAL COMPRESSION TEST REPORT





SPECIMEN NO.		▲1	Y2	X3	4
INITIAL	WATER CONTENT, %	47.0	51.4	52.5	
	DRY DENSITY, PCF	73.0	69.6	69.2	
	SATURATION, %	96.9	97.7	98.8	
	VOID RATIO	1.309	1.420	1.434	
BEFORE SHEAR	WATER CONTENT, %				
	DRY DENSITY, PCF				
	SATURATION, %				
	VOID RATIO				
	BACK PRESS., TSF				
MIN PRIN. STRESS, TSF		0.5	1.5	3.0	
MAX. DEV. STRESS, TSF		0.32	0.33	0.34	
TIME TO FAILURE, MIN.		6	24	24	
RATE OF STRAIN INCR.%			6	6	
INITIAL DIAMETER, IN.		1.40	1.40	1.40	
INITIAL HEIGHT, IN.		3.00	3.00	3.00	

CONTROLLED-STRAIN TEST

DESCRIPTION OF SPECIMENS: CLAY (CH), GRAY; SILT SEAMS

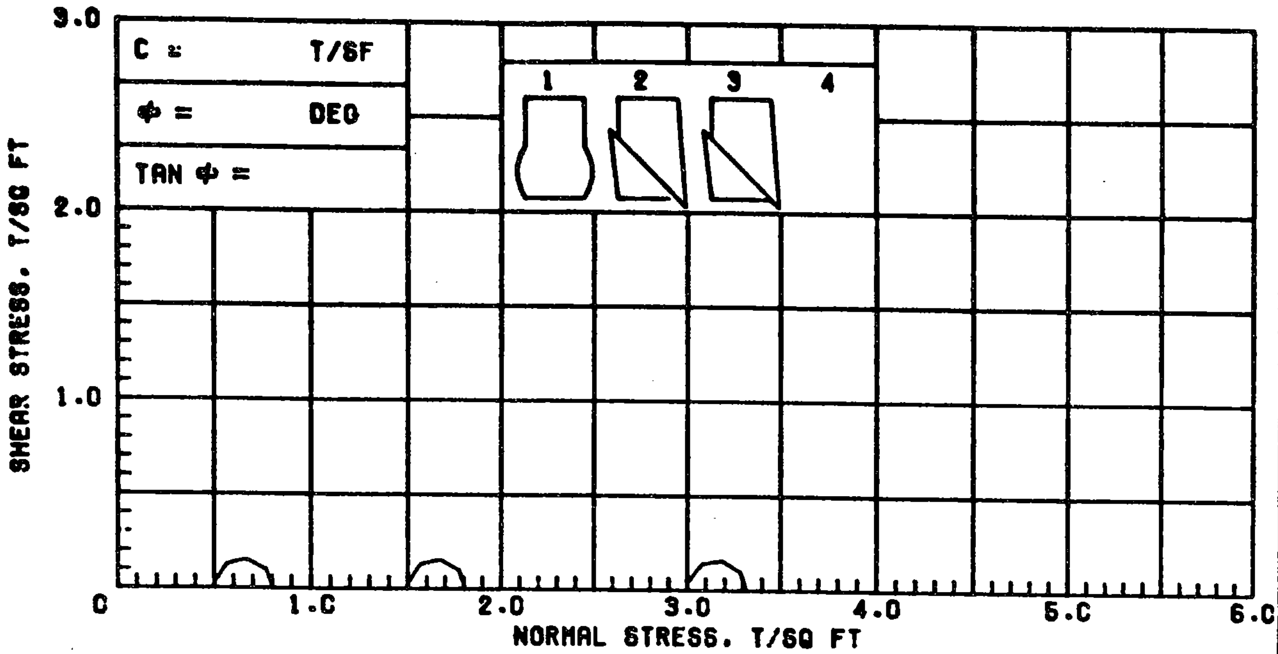
LL 61	PL 21	PI 40	GS 2.70 (ESTIMATED)	UNDISTURBED SPECIMEN	Q TEST

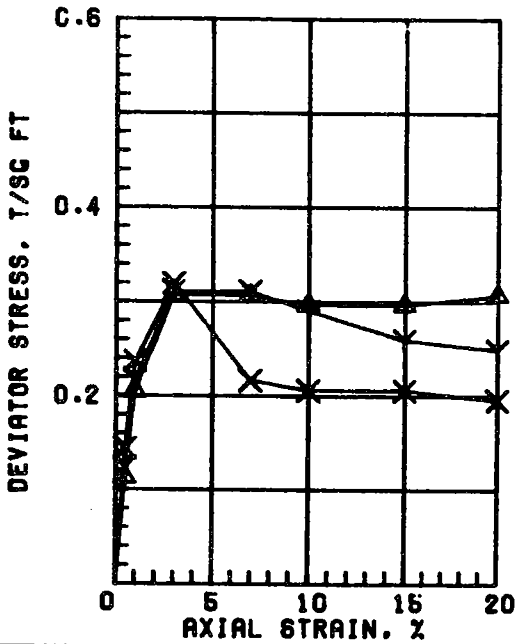
REMARKS:

PROJECT REACH "A" GEOTEXTILE TEST SECTION

BORING NO. P2-U	SAMPLE NO. 9-D
DEPTH/ELEV - 38.0/-31.7	TECH. KOC
LABORATORY USAE WES	DATE 30 JAN 87

TRIAXIAL COMPRESSION TEST REPORT





SPECIMEN NO.		△1	Y2	X3	4
INITIAL	WATER CONTENT, %	57.5	58.2	59.9	
	DRY DENSITY, PCF	64.7	64.2	63.7	
	SATURATION, %	96.7	96.5	98.2	
	VOID RATIO	1.605	1.627	1.646	
BEFORE SHEAR	WATER CONTENT, %				
	DRY DENSITY, PCF				
	SATURATION, %				
	VOID RATIO				
	BACK PRESS., TSF				
MIN PRIN. STRESS, TSF		0.5	1.5	3.0	
MAX. DEV. STRESS, TSF		0.31	0.31	0.32	
TIME TO FAILURE, MIN.		6	12	12	
RATE OF STRAIN INCR.%			12	12	
INITIAL DIAMETER, IN.		1.39	1.37	1.38	
INITIAL HEIGHT, IN.		3.00	3.00	3.00	

CONTROLLED-STRAIN TEST

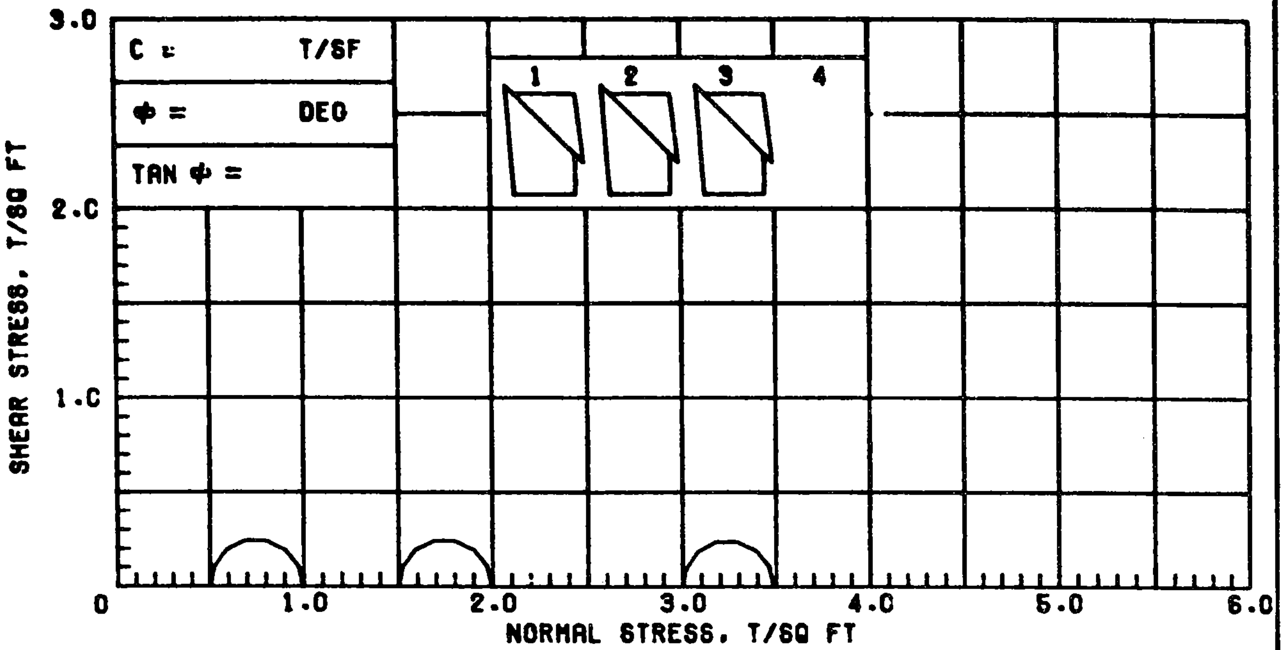
DESCRIPTION OF SPECIMENS: CLAY (CH), DARK GRAY; SILT POCKETS; ORGANIC MATERIAL

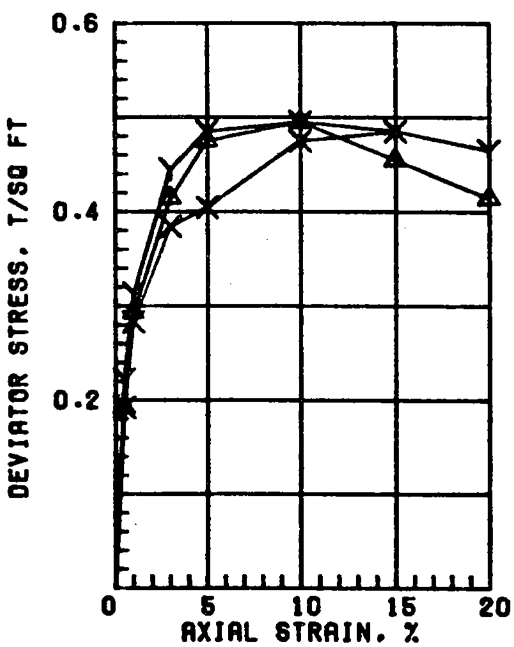
LL 75	PL 21	PI 54	GS 2.70 (ESTIMATED)	UNDISTURBED SPECIMEN	Q TEST

REMARKS:

PROJECT REACH "A" GEOTEXTILE TEST SECTION	
BORING NO. P2-U	SAMPLE NO. 12-D
DEPTH/ELEV -49.7/-43.4	TECH. RD
LABORATORY USAE WES	DATE 02 FEB 87

TRIAXIAL COMPRESSION TEST REPORT





	SPECIMEN NO.	△1	Y2	X3	4
INITIAL	WATER CONTENT, %	45.6	45.7	46.1	
	DRY DENSITY, PCF	75.2	75.5	75.4	
	SATURATION, %	99.3	100+	100+	
	VOID RATIO	1.240	1.233	1.235	
BEFORE SHEAR	WATER CONTENT, %				
	DRY DENSITY, PCF				
	SATURATION, %				
	VOID RATIO				
	BACK PRESS., TSF				
	MIN PRIN. STRESS, TSF	0.5	1.5	3.0	
	MAX. DEV. STRESS, TSF	0.49	0.49	0.48	
	TIME TO FAILURE, MIN.	20	20	30	
	RATE OF STRAIN INCR.%				
	INITIAL DIAMETER, IN.	1.39	1.39	1.39	
	INITIAL HEIGHT, IN.	3.00	3.00	3.00	

CONTROLLED-STRAIN TEST

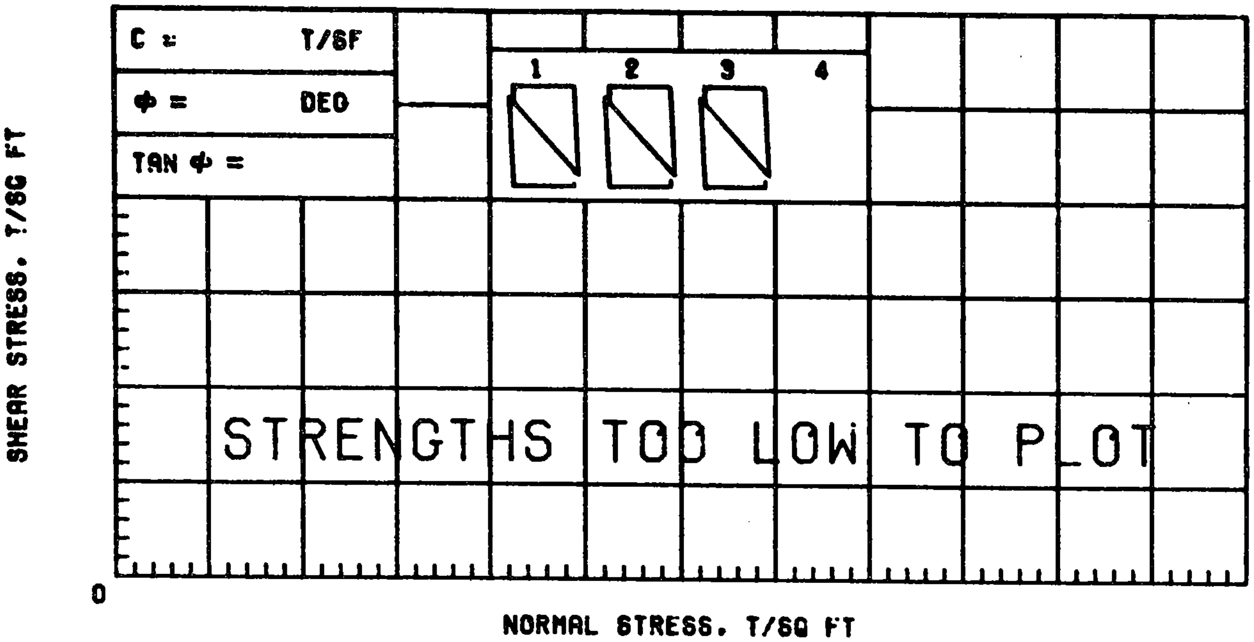
DESCRIPTION OF SPECIMENS: CLAY (CH), GRAY

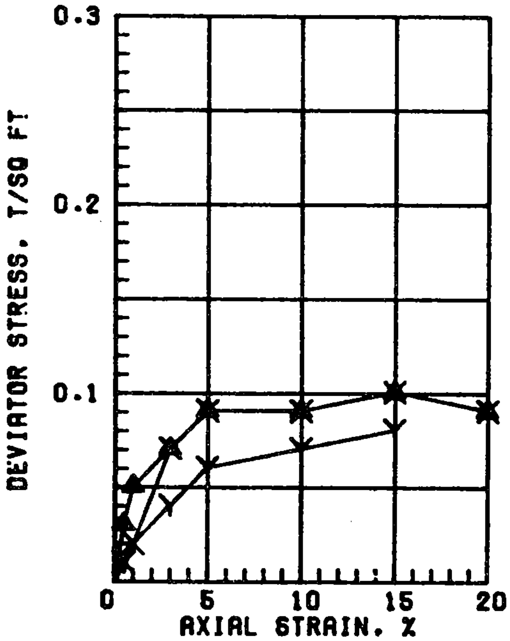
LL 72	PL 19	PI 53	GS 2.70 (ESTIMATED)	UNDISTURBED SPECIMEN	Q TEST

REMARKS:

PROJECT REACH "A" GEOTEXTILE TEST SECTION	
BORING NO. I-2-U	SAMPLE NO. 1-C2
DEPTH/ELEV - 2.2/-4.1	TECH. KOC
LABORATORY USAE WES	DATE 02 FEB 87

TRIAXIAL COMPRESSION TEST REPORT





SPECIMEN NO.		▲1	Y2	X3	4
INITIAL	WATER CONTENT, %	134.9	127.2	136.2	
	DRY DENSITY, PCF	35.9	37.9	35.8	
	SATURATION, %	98.6	99.6	99.1	
	VOID RATIO	3.692	3.447	3.711	
BEFORE SHEAR	WATER CONTENT, %				
	DRY DENSITY, PCF				
	SATURATION, %				
	VOID RATIO				
	BACK PRESS., TSF				
MIN PRIN. STRESS, TSF		0.5	1.5	3.0	
MAX. DEV. STRESS, TSF		0.09	0.08	0.09	
TIME TO FAILURE, MIN.		10	30	10	
RATE OF STRAIN INCR,%					
INITIAL DIAMETER, IN.		1.39	1.39	1.39	
INITIAL HEIGHT, IN.		3.00	3.00	3.00	

CONTROLLED-STRAIN TEST

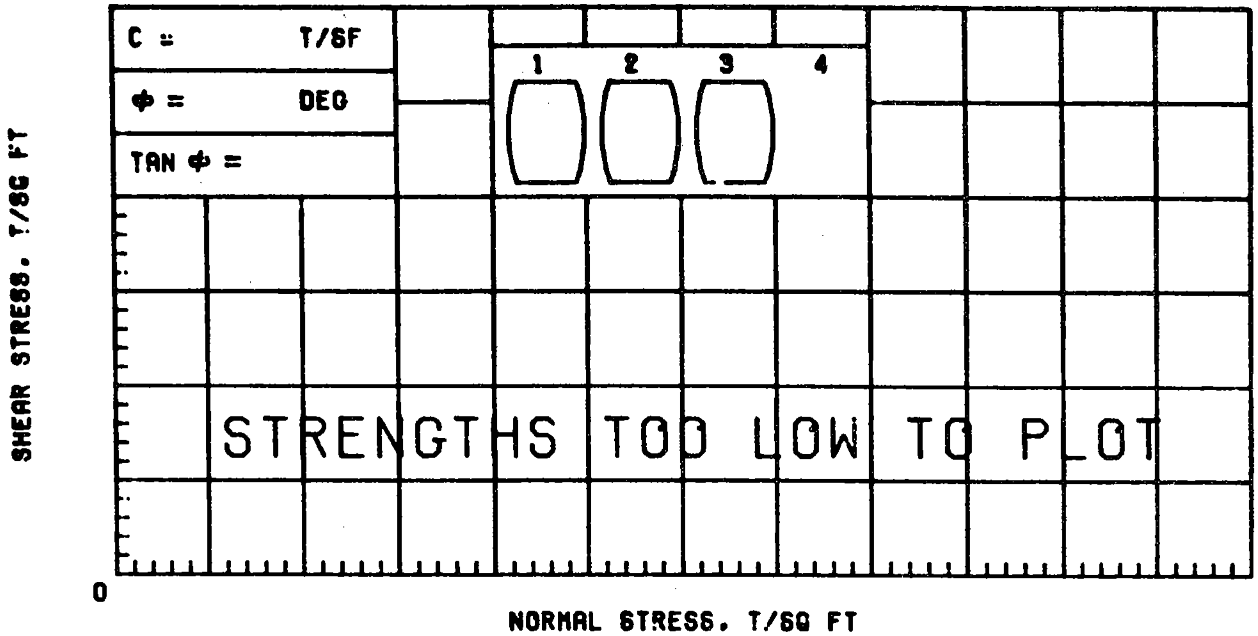
DESCRIPTION OF SPECIMENS: CLAY (CH), GRAY; ORGANIC MATERIAL

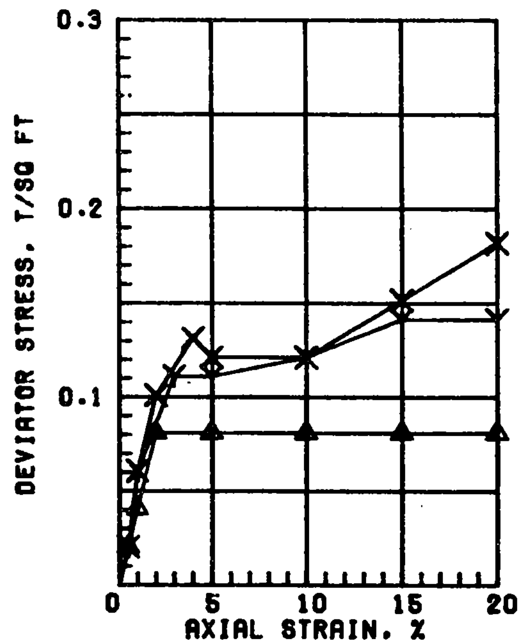
LL 156	PL 32	PI 124	GS 2.70 (ESTIMATED)	UNDISTURBED SPECIMEN	Q TEST

REMARKS:

PROJECT REACH "A" GEOTEXTILE TEST SECTION	
BORING NO. I-2-U	SAMPLE NO. 2-D
DEPTH/ELEV 6.2/-8.1	TECH. KOC
LABORATORY USAE WES	DATE 02 FEB 87

TRIAXIAL COMPRESSION TEST REPORT





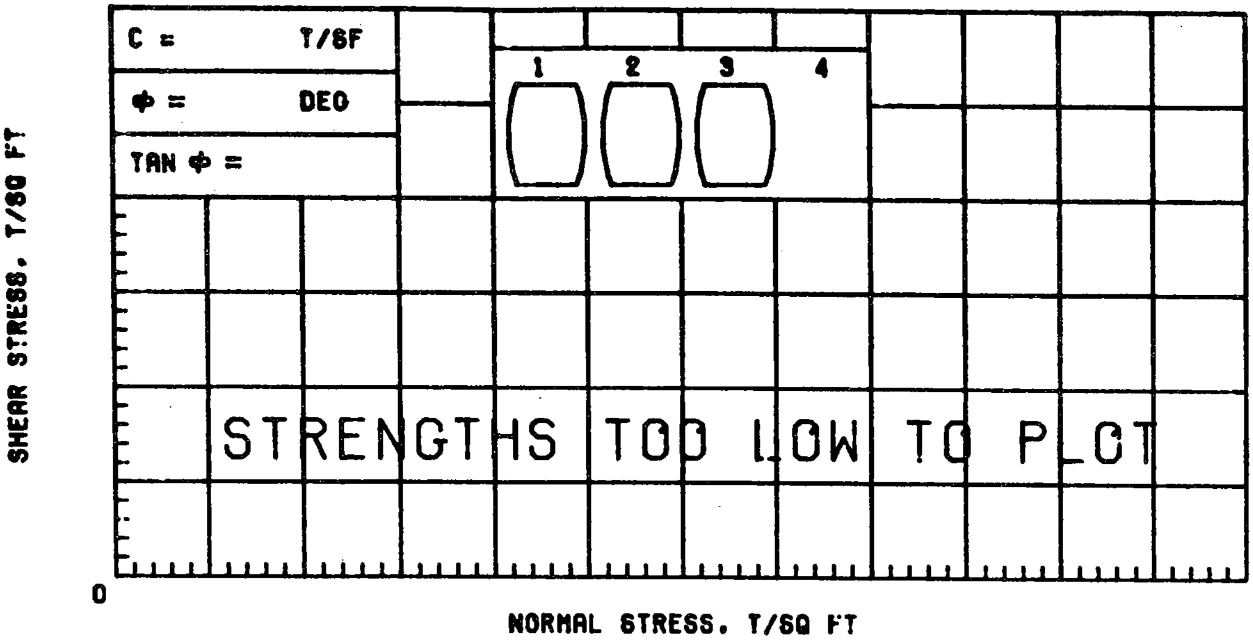
SPECIMEN NO.		Δ1	Y2	X3	4
INITIAL	WATER CONTENT, %	55.4	56.7	54.8	
	DRY DENSITY, PCF	67.9	66.0	68.5	
	SATURATION, %	100+	98.6	100+	
	VOID RATIO	1.484	1.552	1.461	
BEFORE SHEAR	WATER CONTENT, %				
	DRY DENSITY, PCF				
	SATURATION, %				
	VOID RATIO				
	BACK PRESS., TSF				
MIN PRIN. STRESS, TSF		0.5	1.5	3.0	
MAX. DEV. STRESS, TSF		0.08	0.11	0.13	
TIME TO FAILURE, MIN.		4	18	24	
RATE OF STRAIN INCR.,%			6	6	
INITIAL DIAMETER, IN.		1.39	1.39	1.39	
INITIAL HEIGHT, IN.		3.00	3.00	3.00	

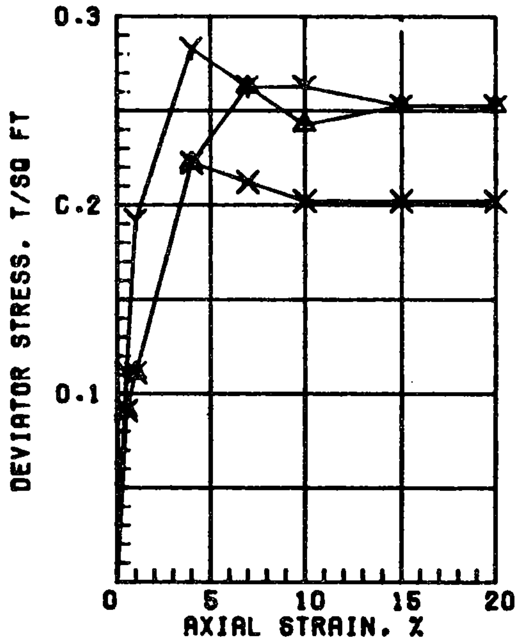
CONTROLLED-STRAIN TEST

DESCRIPTION OF SPECIMENS: CLAY (CH), GRAY; SILT SEAMS

LL 53	PL 19	PI 34	GS 2.70 (ESTIMATED)	UNDISTURBED SPECIMEN	Q TEST

REMARKS:	PROJECT REACH "A" GEOTEXTILE TEST SECTION	
	BORING NO. I-2-U	SAMPLE NO. 5-D
	DEPTH/ELEV -17.7/-19.6	TECH. KOC
	LABORATORY USAE WES	DATE 03 FEB 87
	TRIAXIAL COMPRESSION TEST REPORT	





SPECIMEN NO.		▲1	Y2	X3	4
INITIAL	WATER CONTENT, %	41.8	50.2	53.3	
	DRY DENSITY, PCF	76.7	70.0	69.3	
	SATURATION, %	94.2	96.2	100+	
	VOID RATIO	1.197	1.409	1.432	
BEFORE SHEAR	WATER CONTENT, %				
	DRY DENSITY, PCF				
	SATURATION, %				
	VOID RATIO				
	BACK PRESS., TSF				
MIN PRIN. STRESS, TSF		0.5	1.5	3.0	
MAX. DEV. STRESS, TSF		0.26	0.28	0.22	
TIME TO FAILURE, MIN.		14	8	8	
RATE OF STRAIN INCR.%					
INITIAL DIAMETER, IN.		1.39	1.39	1.39	
INITIAL HEIGHT, IN.		3.00	3.00	3.00	

CONTROLLED-STRAIN TEST

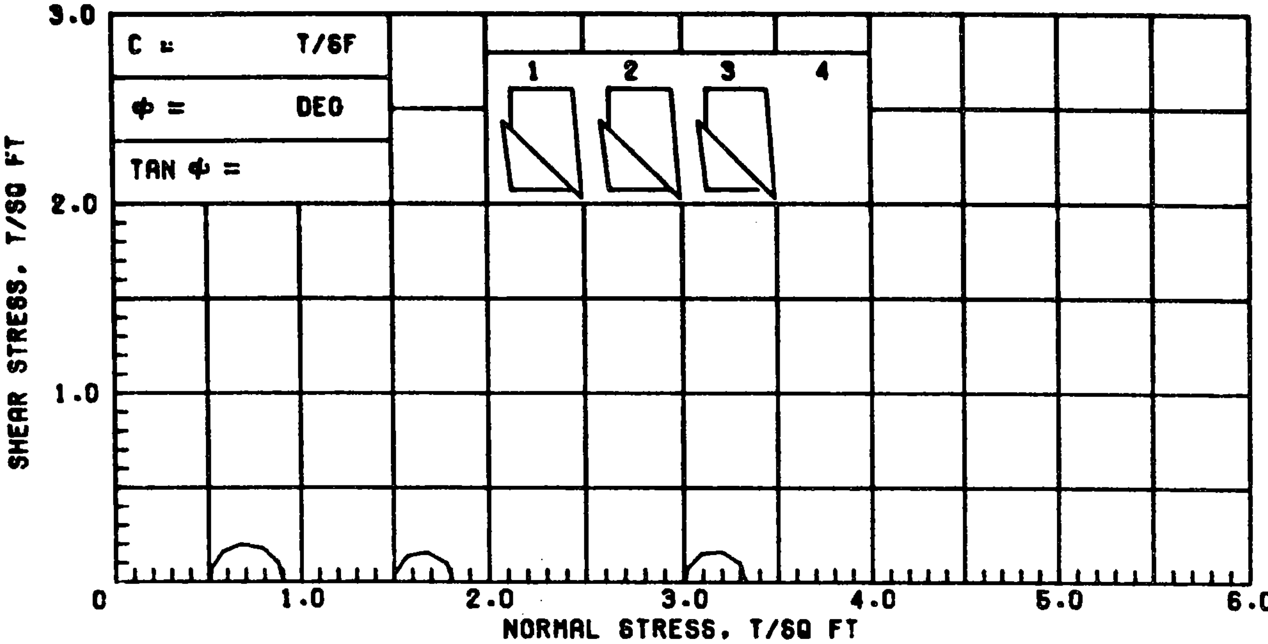
DESCRIPTION OF SPECIMENS: CLAY (CH), GRAY; SILT SEAMS

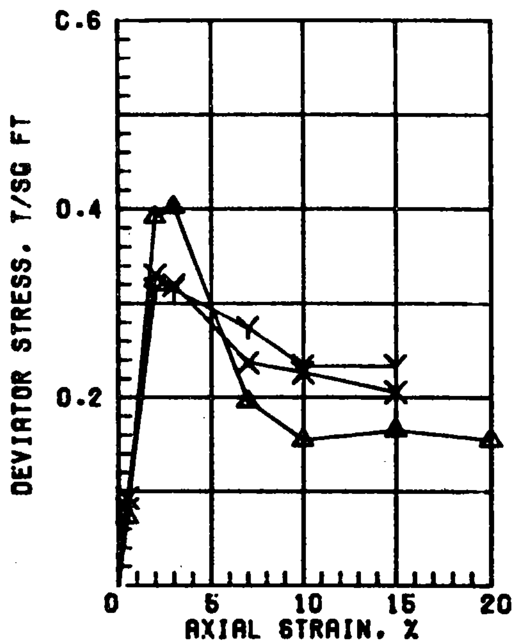
LL 52	PL 19	PI 33	GS 2.70 (ESTIMATED)	UNDISTURBED SPECIMEN	Q TEST

REMARKS:

PROJECT REACH "A" GEOTEXTILE TEST SECTION	
BORING NO. I-2-U	SAMPLE NO. 8-C
DEPTH/ELEV -29.1/-31.0	TECH. KOC
LABORATORY USAE WES	DATE 03 FEB 87

TRIAXIAL COMPRESSION TEST REPORT





SPECIMEN NO.		Δ1	Y2	X3	4
INITIAL	WATER CONTENT, %	75.9	76.2	76.5	
	DRY DENSITY, PCF	54.4	52.7	53.3	
	SATURATION, %	97.8	93.7	95.4	
	VOID RATIO	2.097	2.198	2.165	
BEFORE SHEAR	WATER CONTENT, %				
	DRY DENSITY, PCF				
	SATURATION, %				
	VOID RATIO				
	BACK PRESS., TSF				
MIN PRIN. STRESS, TSF		0.5	1.5	3.0	
MAX. DEV. STRESS, TSF		0.40	0.31	0.33	
TIME TO FAILURE, MIN.		6	10	10	
RATE OF STRAIN INCR.%			11	15	
INITIAL DIAMETER, IN.		1.38	1.39	1.38	
INITIAL HEIGHT, IN.		3.00	3.00	3.00	

CONTROLLED-STRAIN TEST

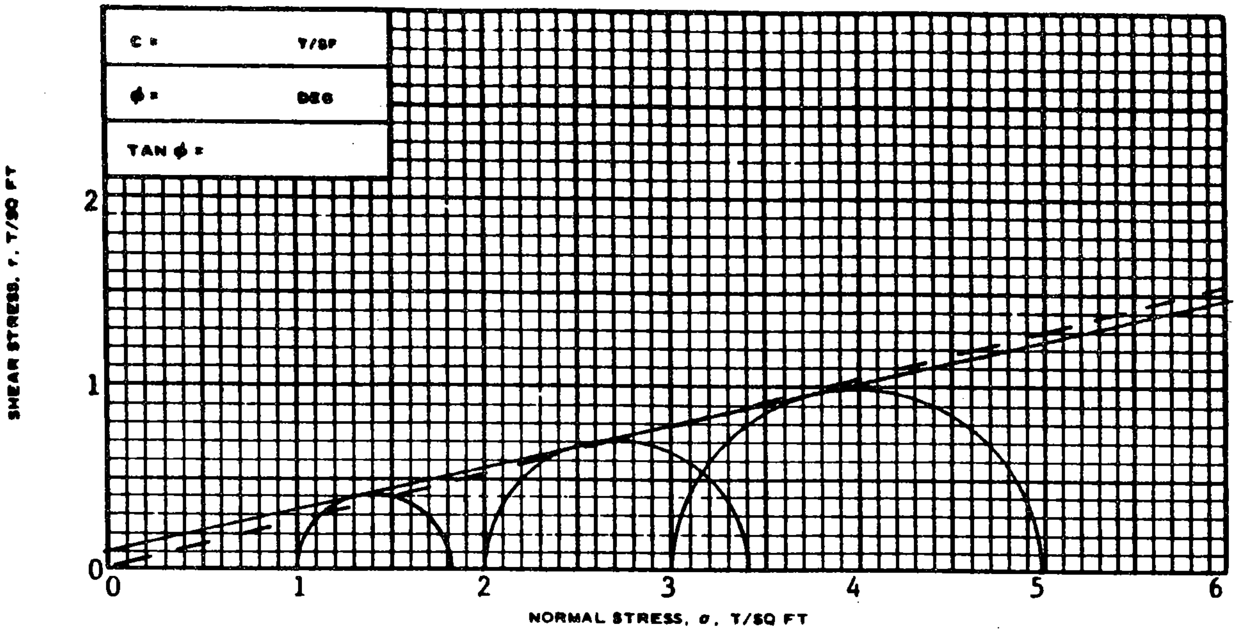
DESCRIPTION OF SPECIMENS: CLAY (CH), GRAY; SILT LENSES; SHELL PARTICLES

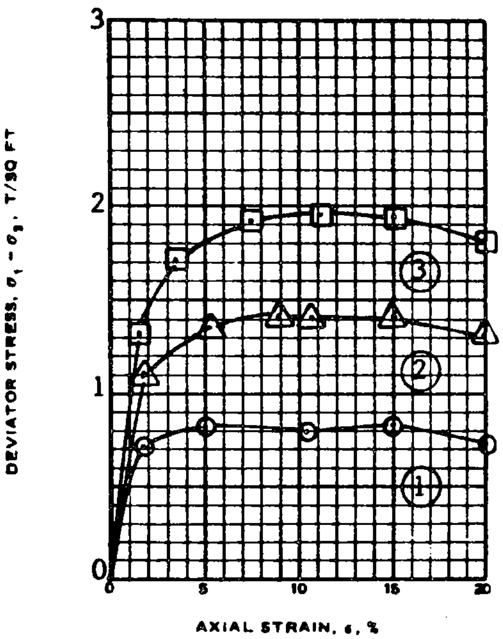
LL 98	PL 28	PI 70	GS 2.70 (ESTIMATED)	UNDISTURBED SPECIMEN	Q TEST

REMARKS:

PROJECT	REACH "A" GEOTEXTILE TEST SECTION
BORING NO. I-2-U	SAMPLE NO. 10-C
DEPTH/ELEV -36.8/-38.7	TECH. BD
LABORATORY USAE WES	DATE 03 FEB 87

TRIAXIAL COMPRESSION TEST REPORT





SPECIMEN NO.			1	2	3	
INITIAL	WATER CONTENT, %	w_o	54.6	53.4	55.7	
INITIAL	DRY DENSITY LB/CU FT	γ_{d_o}	67.6	69.3	67.6	
INITIAL	SATURATION, %	S_o	98.2	100+	100+	
INITIAL	VOID RATIO	e_o	1.512	1.450	1.513	
BEFORE SHEAR	WATER CONTENT, %	w_c	50.2	43.4	39.6	
BEFORE SHEAR	DRY DENSITY LB/CU FT	γ_{d_c}	73.9	80.4	84.3	
BEFORE SHEAR	SATURATION, %	S_c	100+	100+	100+	
BEFORE SHEAR	VOID RATIO	e_c	1.299	1.111	1.014	
BEFORE SHEAR	FINAL BACK PRESSURE, T/SQ FT	u_o	4.32	4.32	4.32	
MINOR PRINCIPAL STRESS, T/SQ FT		σ_3	1.0	2.0	3.0	
MAXIMUM DEVIATOR STRESS, T/SQ FT		$(\sigma_1 - \sigma_3)_{MAX}$	0.82	1.41	1.96	
TIME TO $(\sigma_1 - \sigma_3)_{MAX}$, MIN		t_f	333	593	556	
ULTIMATE DEVIATOR STRESS, T/SQ FT		$(\sigma_1 - \sigma_3)_{ULT}$				
INITIAL DIAMETER, IN.		D_o	1.39	1.39	1.39	
INITIAL HEIGHT, IN.		H_o	3.00	3.00	3.00	

CONTROLLED- STRAIN TEST

DESCRIPTION OF SPECIMENS CLAY (CH), GRAY; SILT SEAMS

LL 69 | PL 23 | PI 46 | Gs 2.72 (EST)

TYPE OF SPECIMEN UNDISTURBED | TYPE OF TEST $\overline{R}$

REMARKS:

PROJECT REACH "A" GEOTEXTILE TEST SECTION

BORING NO. P2-U | SAMPLE NO. 5-C

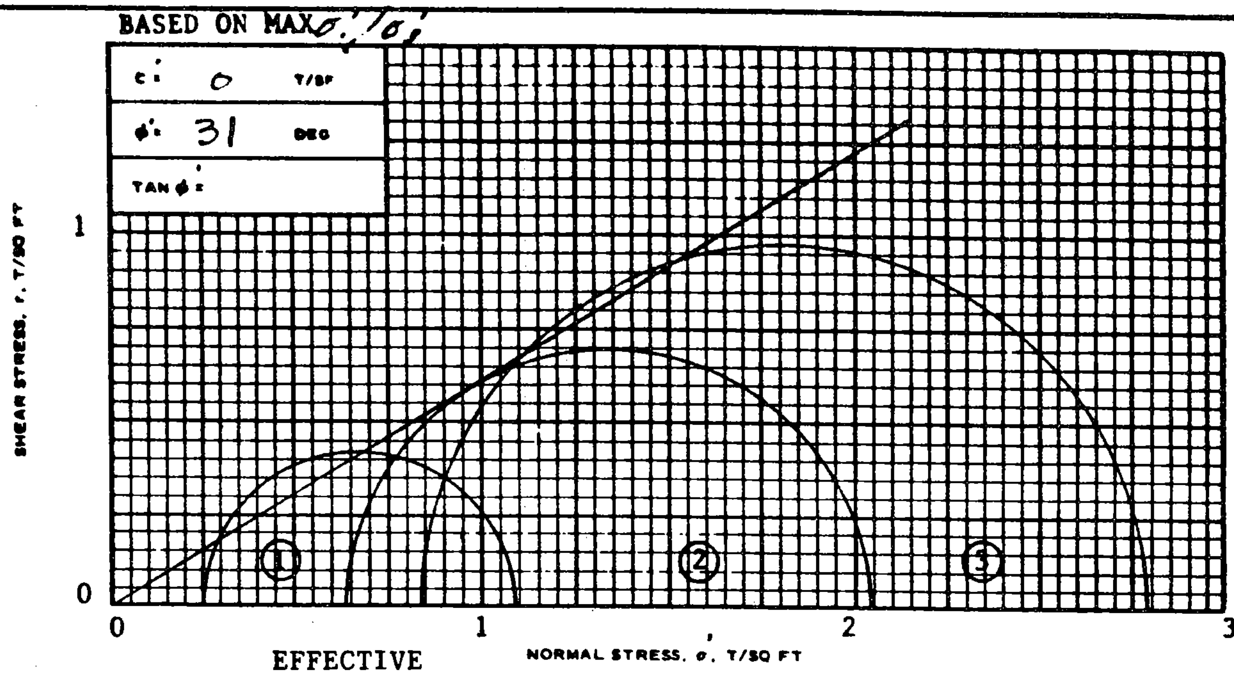
DEPTH/ELEV 21.1 / -14.8

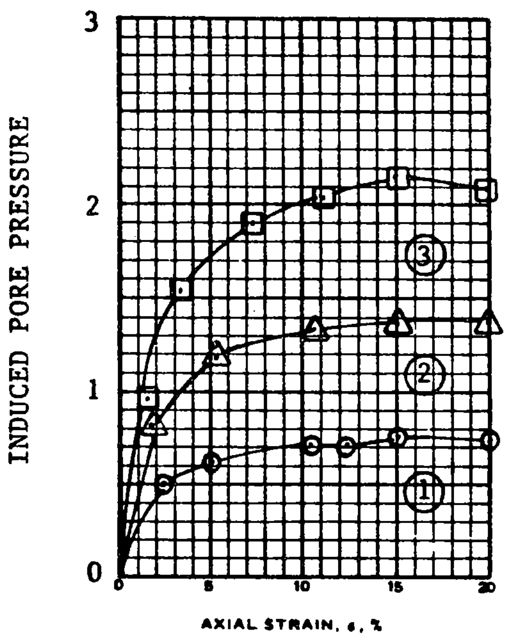
LABORATORY USAEWES | DATE 20 MAR 87

SHEET 1 OF 2

JMS TRIAXIAL COMPRESSION TEST REPORT

ENG FORM NO. 2089 REV JUNE 1970 PREVIOUS EDITION IS OBSOLETE TRANSLUCENT *(EM 1110–2–1906)*





SPECIMEN NO.			1	2	3	
INITIAL	WATER CONTENT, %	w_o				
	DRY DENSITY LB/CU FT	γd_o				
	SATURATION, %	S_o				
	VOID RATIO	e_o				
BEFORE SHEAR	WATER CONTENT, %	w_c				
	DRY DENSITY LB/CU FT	γd_c				
	SATURATION, %	S_c				
	VOID RATIO	e_c				
	FINAL BACK PRESSURE, T/SQ FT	u_o				
MINOR PRINCIPAL STRESS, T/SQ FT		σ_3	0.25	0.64	0.84	
MAXIMUM DEVIATOR STRESS, T/SQ FT		$(\sigma_1 - \sigma_3)_{MAX}$	0.83	1.41	1.94	
TIME TO $(\sigma_1 - \sigma_3)_{MAX}$, MIN		t_f				
ULTIMATE DEVIATOR STRESS, T/SQ FT		$(\sigma_1 - \sigma_3)_{ULT}$				
INITIAL DIAMETER, IN.		D_o				
INITIAL HEIGHT, IN.		H_o				

CONTROLLED- TEST

DESCRIPTION OF SPECIMENS

LL	PL	PI	Gs	TYPE OF SPECIMEN	TYPE OF TEST

REMARKS:

PROJECT REACH "A" GEOTEXTILE TEST SECTION

BORING NO. P2-U SAMPLE NO. 5-C

DEPTH/ELEV 21.1 / -14.8

LABORATORY USAEWES DATE 20 MAR 87

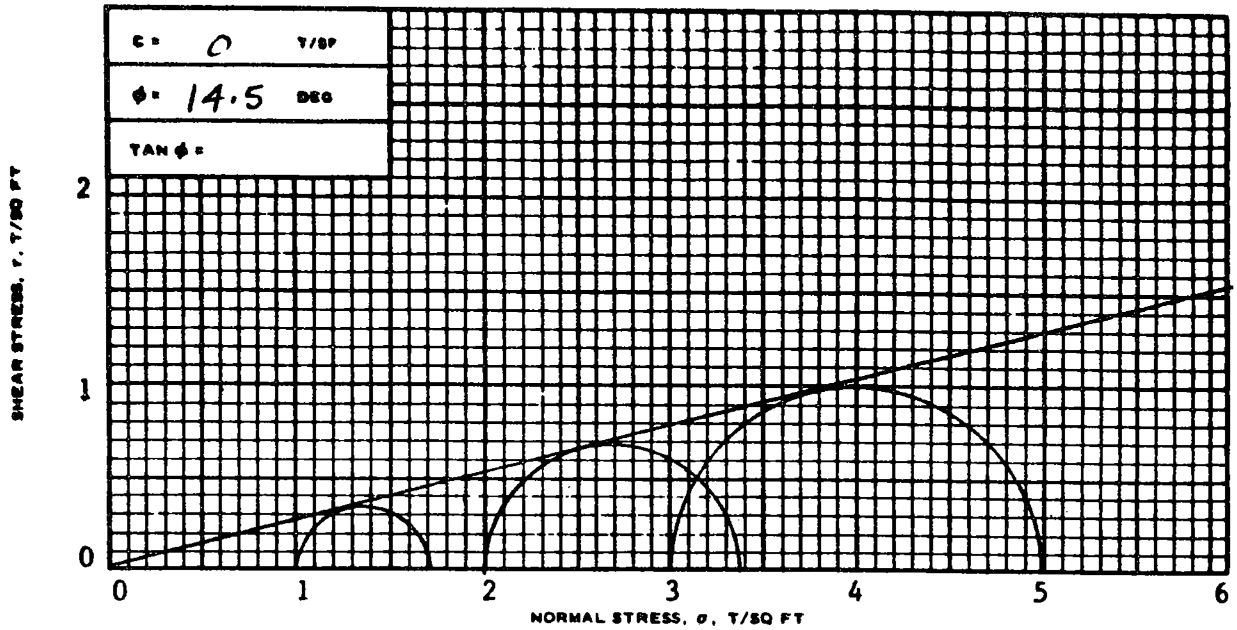
SHEET 2 OF 2

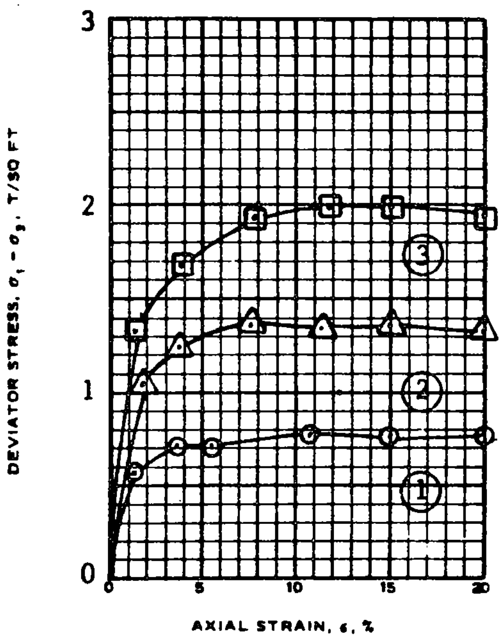
TRIAXIAL COMPRESSION TEST REPORT

ENG FORM NO. 2089 REV JUNE 1970 PREVIOUS EDITION IS OBSOLETE TRANSLUCENT (EM 1110-2-1906) c = 0 T/SF

φ = 14.5 DEG

TAN φ =





SPECIMEN NO.			1	2	3
INITIAL	WATER CONTENT, %	w_o	93.2	92.4	95.8
	DRY DENSITY LB/CU FT	γ_{d_o}	48.4	48.4	47.6
	SATURATION, %	S_o	100+	100+	100+
	VOID RATIO	e_o	2.511	2.512	2.569
BEFORE SHEAR	WATER CONTENT, %	w_c	70.1	57.2	53.4
	DRY DENSITY LB/CU FT	γ_{d_c}	60.8	67.5	70.1
	SATURATION, %	S_c	100+	100+	100+
	VOID RATIO	e_c	1.793	1.516	1.424
	FINAL BACK PRESSURE, T/SQ FT	u_o	5.04	5.04	5.04
MINOR PRINCIPAL STRESS, T/SQ FT		σ_3	1.0	2.0	3.0
MAXIMUM DEVIATOR STRESS, T/SQ FT		$(\sigma_1 - \sigma_3)_{MAX}$	0.71	1.37	1.99
TIME TO $(\sigma_1 - \sigma_3)_{MAX}$, MIN		t_f	240	475	694
ULTIMATE DEVIATOR STRESS, T/SQ FT		$(\sigma_1 - \sigma_3)_{ULT}$			
INITIAL DIAMETER, IN.		D_o	1.38	1.38	1.38
INITIAL HEIGHT, IN.		H_o	3.00	3.00	3.00

CONTROLLED- STRAIN TEST

DESCRIPTION OF SPECIMENS CLAY (CH), GRAY; DECAYED WOOD

LL 96	PL 19	PI 77	Gs 2.72	TYPE OF SPECIMEN UNDISTURBED	TYPE OF TEST $\overline{R}$

REMARKS: (EST)

PROJECT REACH "A" GEOTEXTILE TEST SECTION

BORING NO. I-2-U SAMPLE NO. 3-C

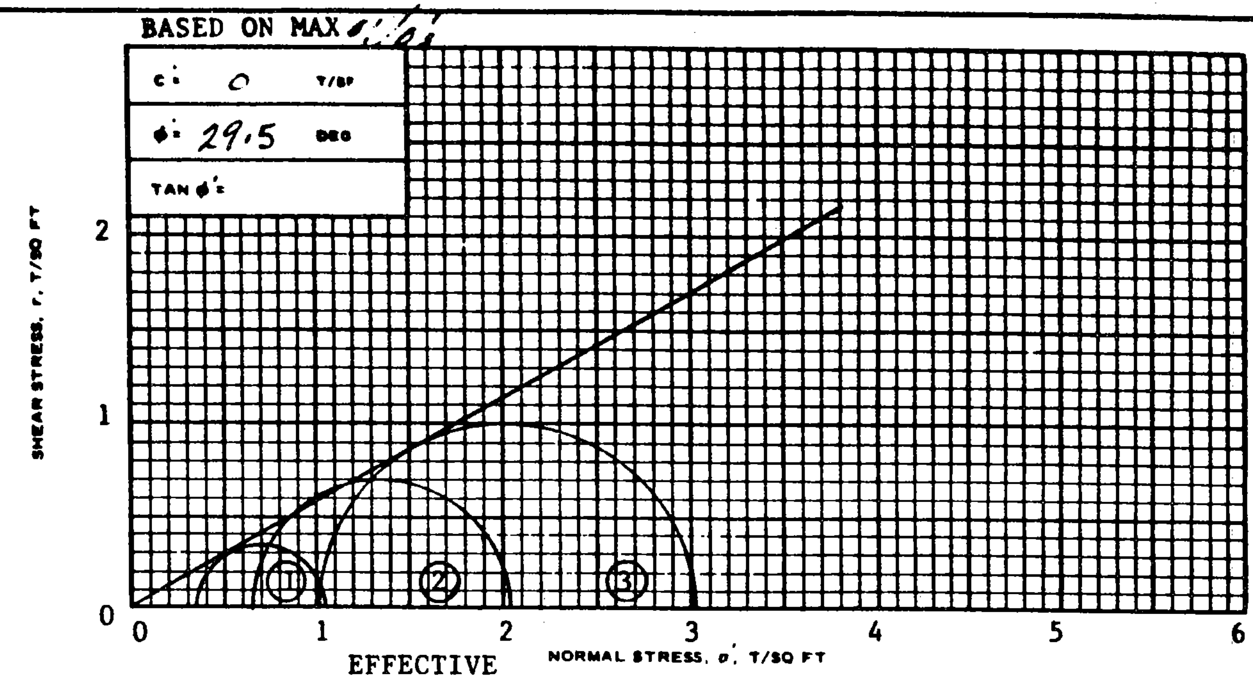
DEPTH/ELEV 8.7 / -10.6

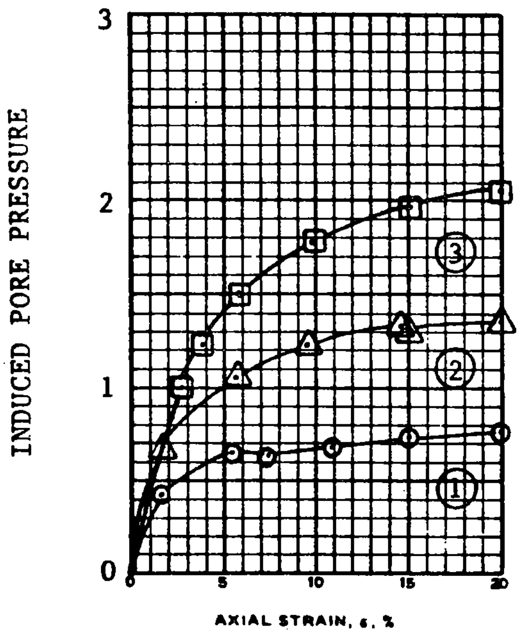
LABORATORY USAEWES DATE 27 MAR 87

SHEET 1 OF 2

JMS **TRIAXIAL COMPRESSION TEST REPORT**

ENG FORM NO. 2089 REV JUNE 1970 PREVIOUS EDITION IS OBSOLETE TRANSLUCENT (EM 1110-2-1906)





SPECIMEN NO.			1	2	3	
INITIAL	WATER CONTENT, %	w_o				
	DRY DENSITY LB/CU FT	γd_o				
	SATURATION, %	S_o				
	VOID RATIO	e_o				
BEFORE SHEAR	WATER CONTENT, %	w_c				
	DRY DENSITY LB/CU FT	γd_c				
	SATURATION, %	S_c				
	VOID RATIO	e_c				
	FINAL BACK PRESSURE, T/SQ FT	u_o				
MINOR PRINCIPAL STRESS, T/SQ FT		σ_3	0.35	0.66	1.03	
MAXIMUM DEVIATOR STRESS, T/SQ FT		$(\sigma_1 - \sigma_3)_{MAX}$	0.71	1.37	1.99	
TIME TO $(\sigma_1 - \sigma_3)_{MAX}$, MIN		t_f				
ULTIMATE DEVIATOR STRESS, T/SQ FT		$(\sigma_1 - \sigma_3)_{ULT}$				
INITIAL DIAMETER, IN.		D_o				
INITIAL HEIGHT, IN.		H_o				

CONTROLLED- TEST

DESCRIPTION OF SPECIMENS

LL	PL	PI	Gs	TYPE OF SPECIMEN	TYPE OF TEST

REMARKS:

PROJECT REACH "A" GEOTEXTILE TEST SECTION

BORING NO. I-2-U SAMPLE NO. 3-C

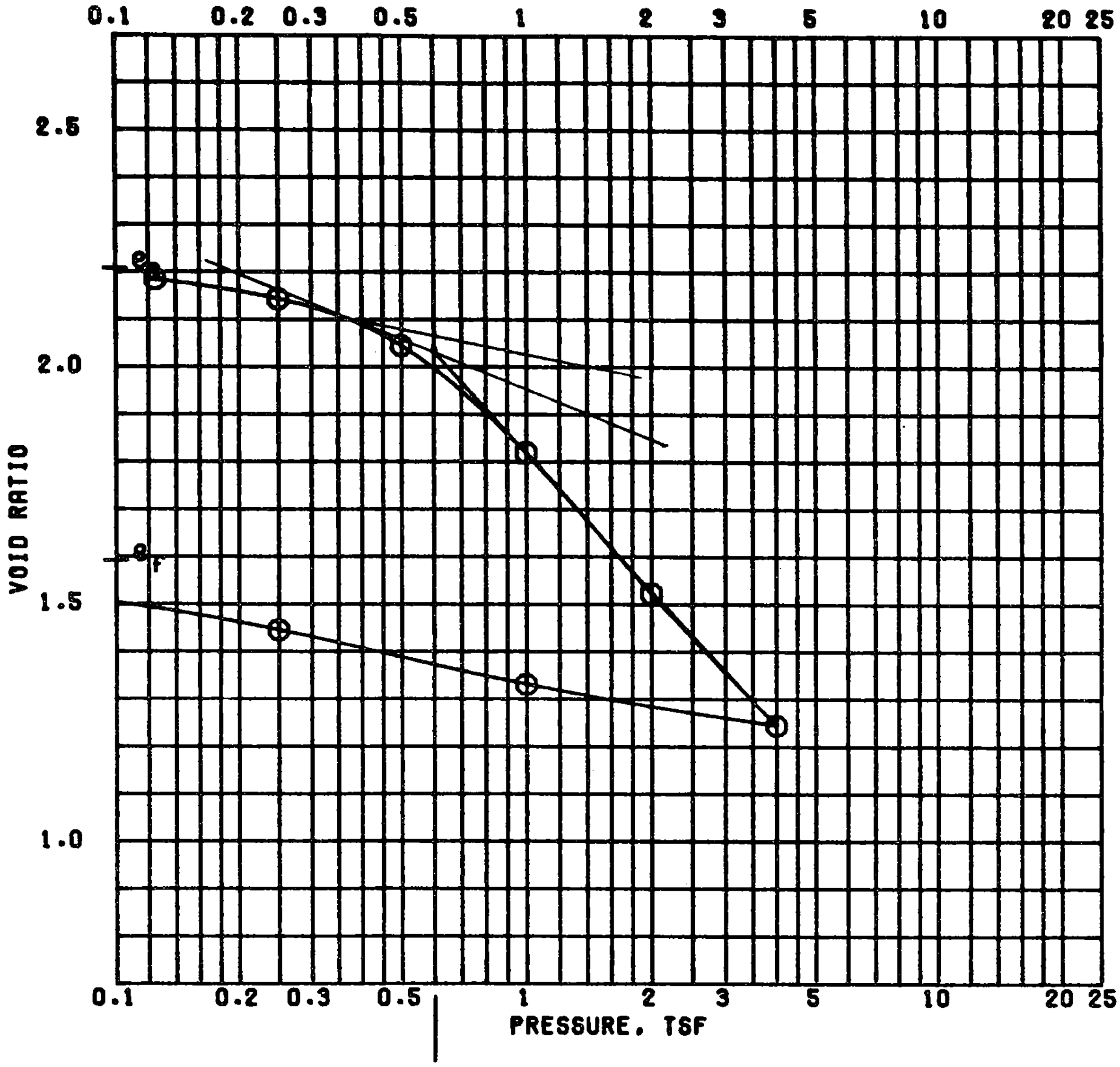
DEPTH/ELEV 8.7/-10.6

LABORATORY USAEWES DATE 27 MAR 87

SHEET 2 OF 2

JMS **TRIAXIAL COMPRESSION TEST REPORT**

ENG FORM NO. 2089 REV JUNE 1970 PREVIOUS EDITION IS OBSOLETE TRANSLUCENT *(EM 1110-2-1906)*

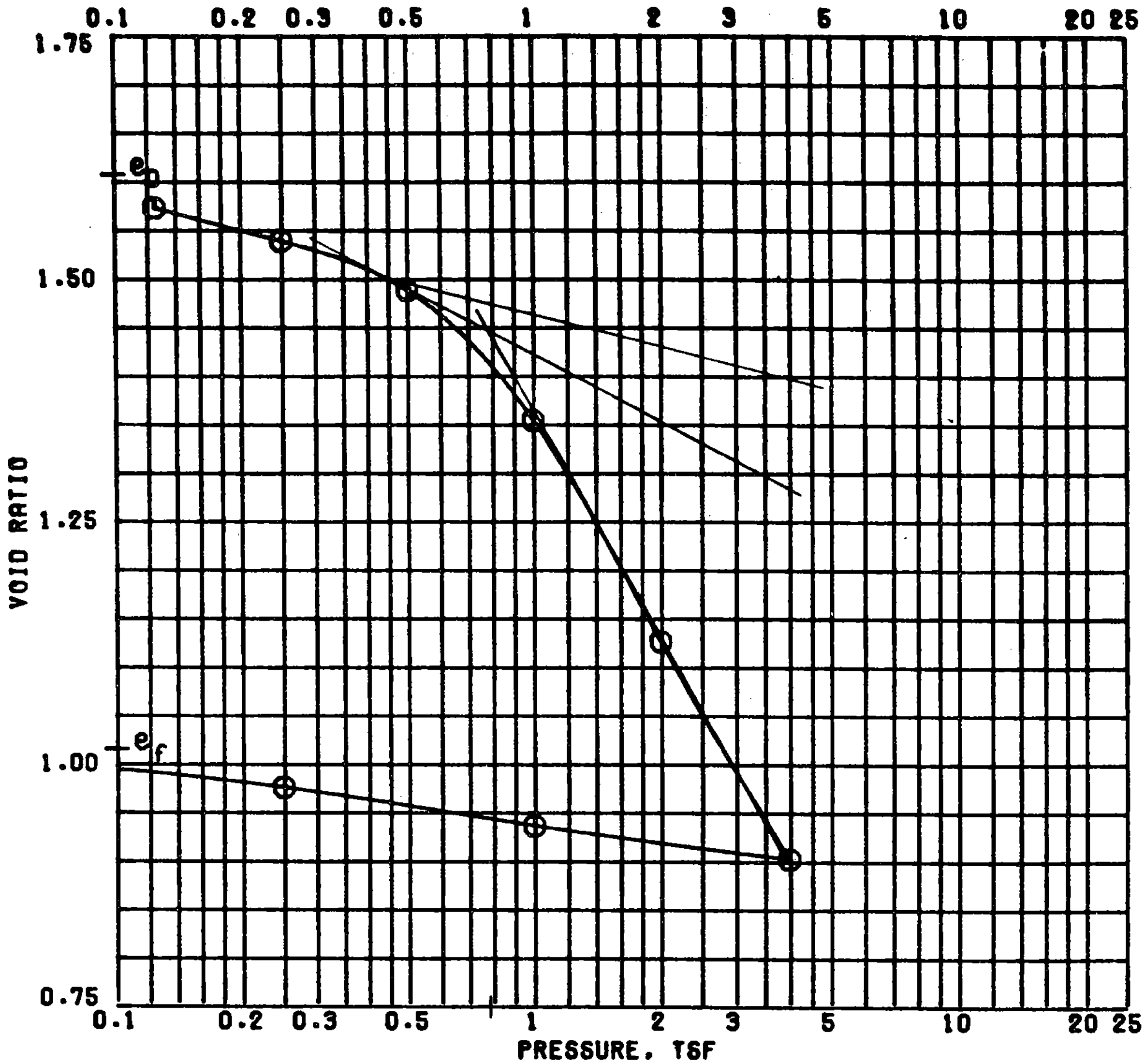


			BEFORE TEST	AFTER TEST
OVERBURDEN PRESSURE, TSF		WATER CONTENT, %	81.1	59.7
PRECONSOL. PRESSURE, TSF		DRY DENSITY, PCF	52.6	65.1
COMPRESSION INDEX		SATURATION, %	99.4	100 +
TYPE SPECIMEN	UNDISTURBED	VOID RATIO	2.203	1.587
DIA. IN 4.44	HT. IN 1.107	BACK PRESSURE, TSF		

CLASSIFICATION CLAY (CH), GRAY			
LL 113	PL 25	PI 88	PROJECT REACH "A" GEOTEXTILE TEST SECTION
GS 2.70 (EST)	D_{10}		
REMARKS		BORING NO. P2-U	SAMPLE NO. 3-B
		DEPTH/ELEV -12.3/-6.0	DATE 18 FEB 87

CONSOLIDATION TEST REPORT

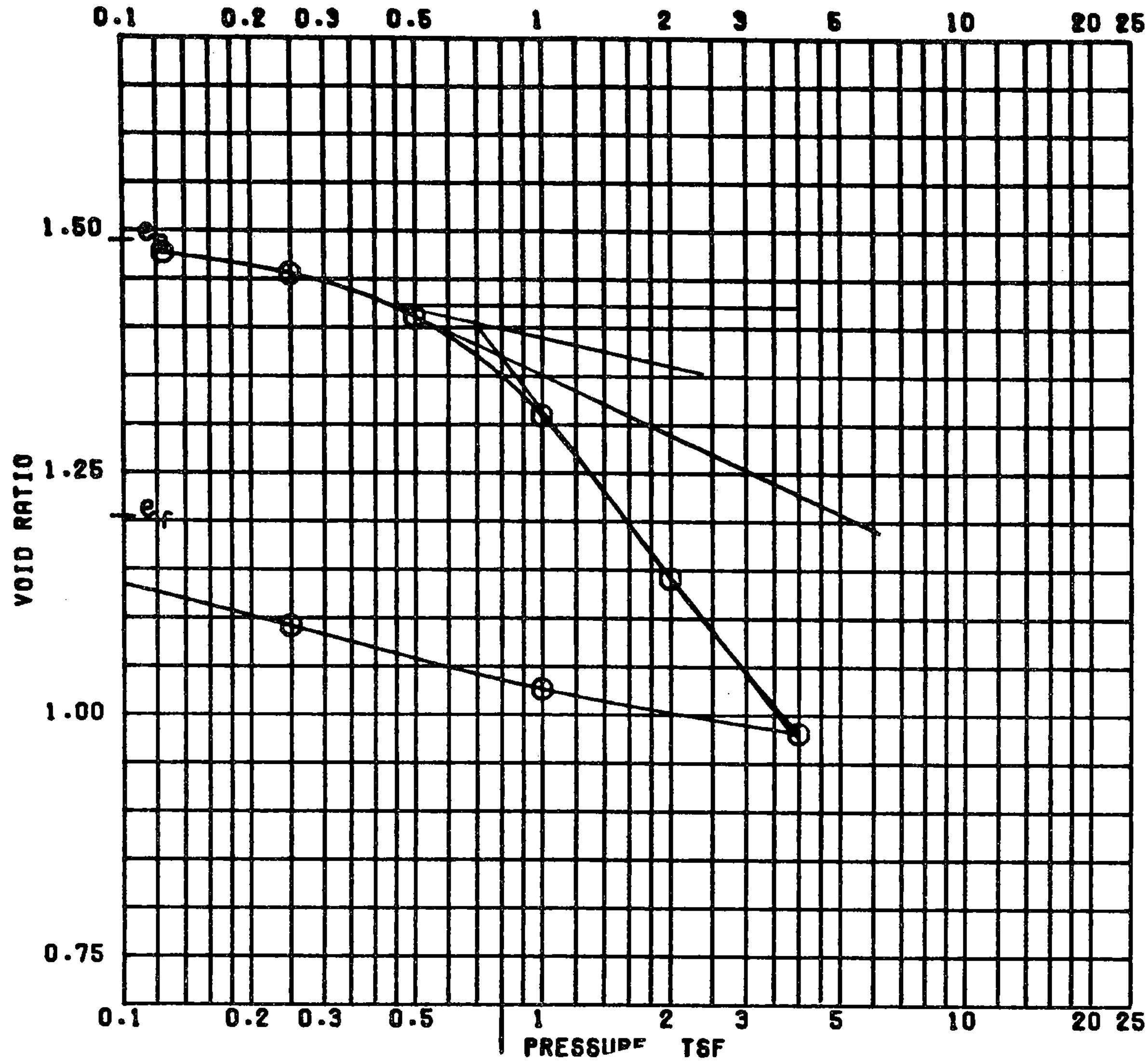
SHEET 1 OF 11



			BEFORE TEST	AFTER TEST
OVERBURDEN PRESSURE, TSF		WATER CONTENT, %	59.3	42.4
PRECONSOL. PRESSURE, TSF		DRY DENSITY, PCF	64.7	83.7
COMPRESSION INDEX		SATURATION, %	99.6	100 +
TYPE SPECIMEN	UNDISTURBED	VOID RATIO	1.607	1.014
DIA. IN 4.25	HT. IN 1.162	BACK PRESSURE, TSF		
CLASSIFICATION	CLAY (CH), GRAY			
LL 71 / PL 22 / PI 49		PROJECT	REACH "A" GEOTEXTILE TEST SECTION	
GS 2.70 (EST)	D_{10}			
REMARKS		BORING NO. P2-U	SAMPLE NO. 5-B	
		DEPTH/ELEV -20.2 / -13.9	DATE 20 FEB 87	

CONSOLIDATION TEST REPORT

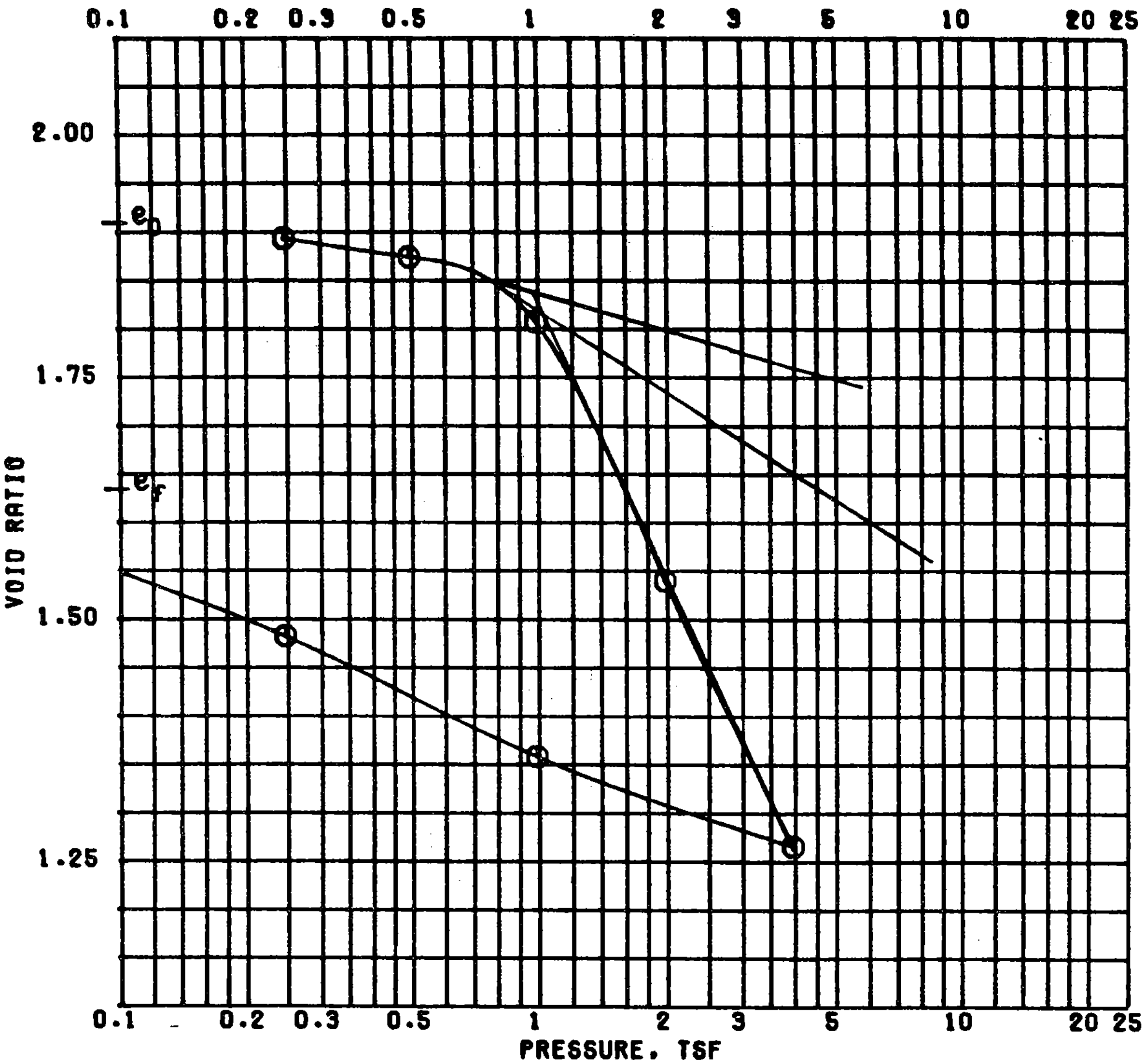
SHEET 1 OF 11



			BEFORE TEST	AFTER TEST
OVERBURDEN PRESSURE, TSF		WATER CONTENT, %	59.4	45.4
PRECONSOL. PRESSURE, TSF		DRY DENSITY, PCF	67.8	76.6
COMPRESSION INDEX		SATURATION, %	100 +	100 +
TYPE SPECIMEN	UNDISTURBED	VOID RATIO	1.487	1.202
DIA. IN 4.25	HT. IN 1.156	BACK PRESSURE, TSF		
CLASSIFICATION CLAY (CH), GRAY				
LL 50 / PL 18 / PI 32		PROJECT REACH "A" GEOTEXTILE TEST SECTION		
GS 2.70 (EST)	D_{10}			
REMARKS		BORING NO. P2-U	SAMPLE NO. 8-B	
		DEPTH/ELEV -32.0/-25.7	DATE 20 FEB 87	

CONSOLIDATION TEST REPORT

SHEET 1 OF 11



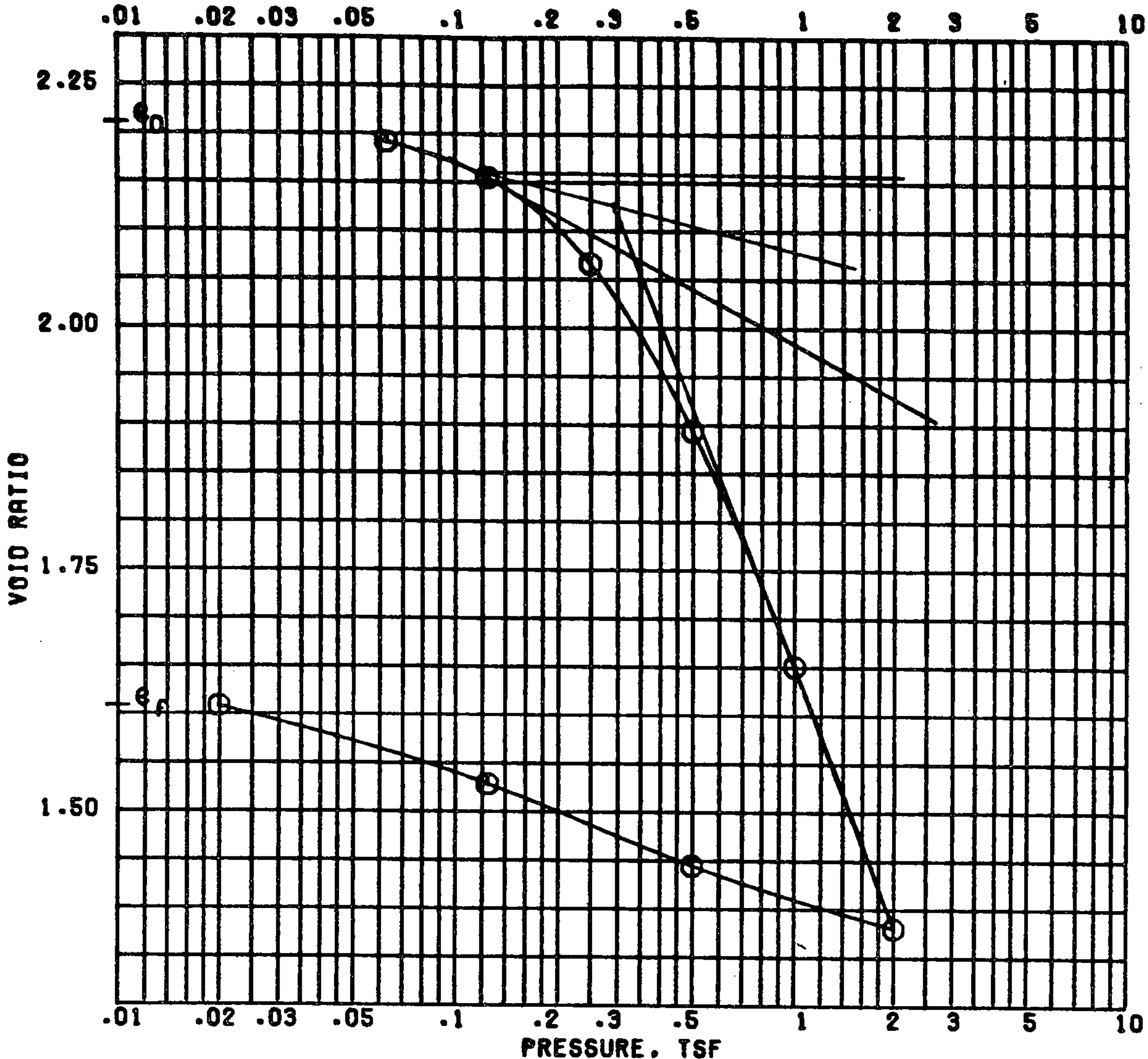
			BEFORE TEST	AFTER TEST
OVERBURDEN PRESSURE, TSF		WATER CONTENT, %	69.3	60.6
PRECONSOL. PRESSURE, TSF		DRY DENSITY, PCF	58.0	64.1
COMPRESSION INDEX		SATURATION, %	98.2	100 +
TYPE SPECIMEN	UNDISTURBED	VOID RATIO	1.907	1.631
DIA. IN 4.44	HT. IN 1.124	BACK PRESSURE, TSF		

CLASSIFICATION CLAY (CH), GRAY

LL 97	PL 27	PI 70	PROJECT REACH "A" GEOTEXTILE TEST SECTION	
GS 2.70 (EST)	D_{10}			
REMARKS			BORING NO. P2-U	SAMPLE NO. 11-C
			DEPTH/ELEV -45.1/-38.8	DATE 21 FEB 87

CONSOLIDATION TEST REPORT

SHEET 1 OF 10

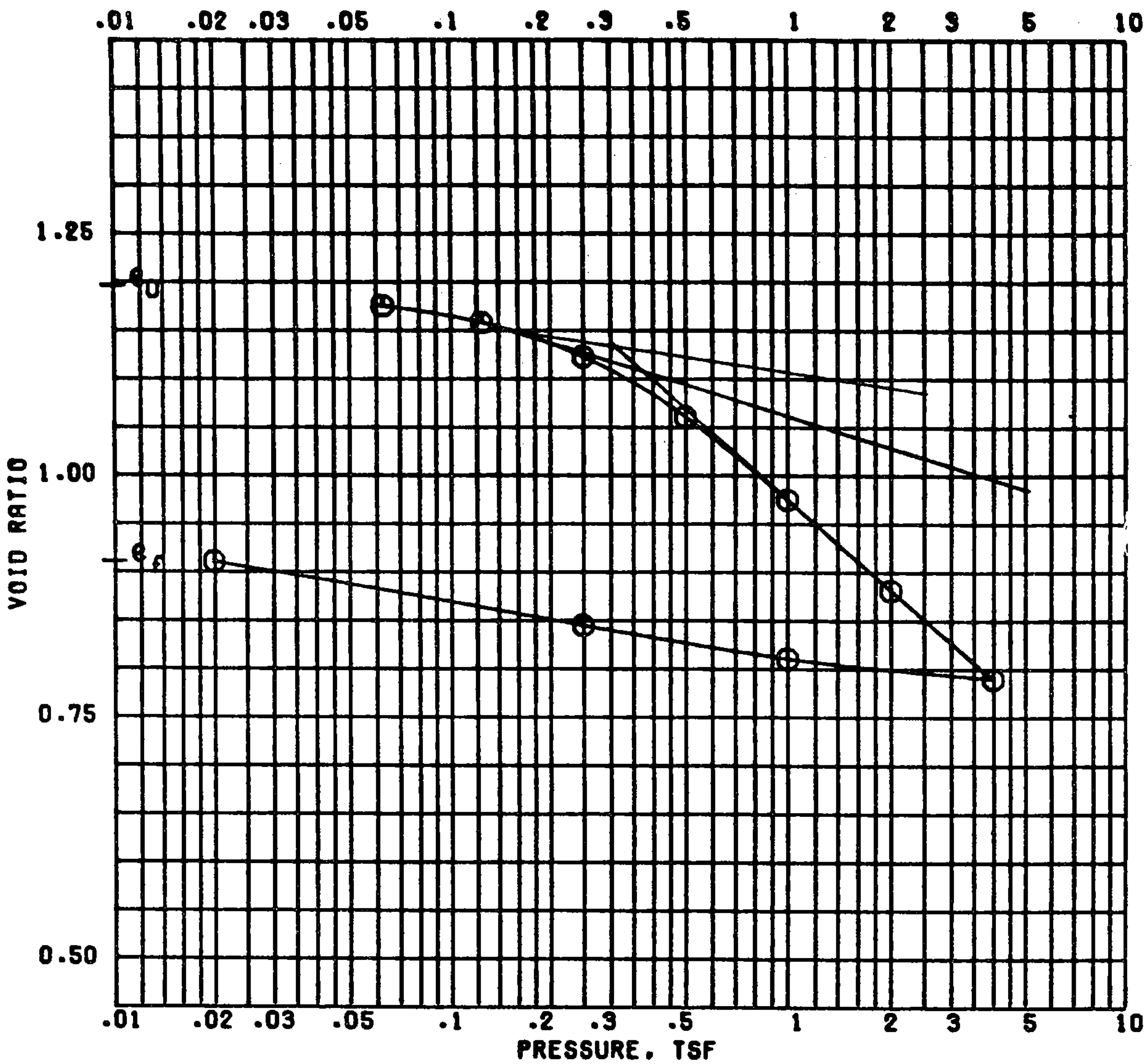


			BEFORE TEST	AFTER TEST
OVERBURDEN PRESSURE, TSF		WATER CONTENT, %	81.2	58.9
PRECONSOL. PRESSURE, TSF		DRY DENSITY, PCF	52.5	64.7
COMPRESSION INDEX		SATURATION, %	99.3	98.9
TYPE SPECIMEN	UNDISTURBED	VOID RATIO	2.209	1.607
DIA. IN 4.44	HT. IN 1.135	BACK PRESSURE, TSF		

CLASSIFICATION CLAY (CH), REDDISH GRAY

LL 75	PL 24	PI 51	PROJECT REACH "A" GEOTEXTILE TEST SECTION
GS 2.70 (EST)	D_{10}		
REMARKS		BORING NO. I-2-U	SAMPLE NO. 2C2
		DEPTH/ELEV -5.3/-7.2	DATE 23 FEB 87

CONSOLIDATION TEST REPORT



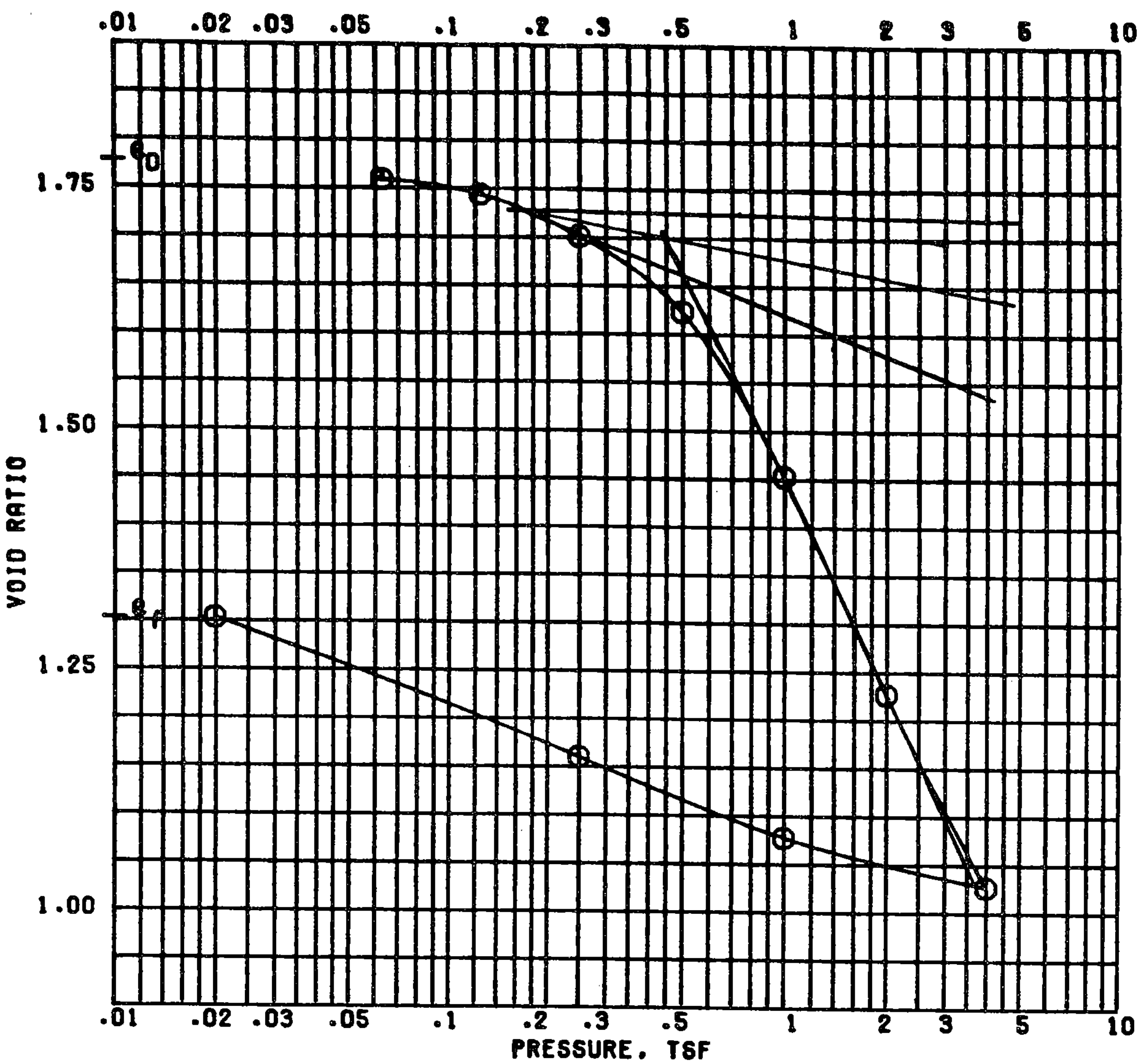
			BEFORE TEST	AFTER TEST
OVERBURDEN PRESSURE, TSF		WATER CONTENT, %	46.0	34.9
PRECONSOL. PRESSURE, TSF		DRY DENSITY, PCF	76.8	88.3
COMPRESSION INDEX		SATURATION, %	100 +	100 +
TYPE SPECIMEN	UNDISTURBED	VOID RATIO	1.195	0.909
DIA. IN 4.24	HT. IN 1.143	BACK PRESSURE, TSF		

CLASSIFICATION CLAY (CH), GRAY

LL 53	PL 19	PI 34	PROJECT REACH "A" GEOTEXTILE TEST SECTION
GS 2.70 (EST)	D_{10}		
REMARKS		BORING NO. I-2-U	SAMPLE NO. 5-D
		DEPTH/ELEV -17.7/-19.6	DATE 21 FEB 87

CONSOLIDATION TEST REPORT

SHEET 1 OF 11



				BEFORE TEST	AFTER TEST
OVERBURDEN PRESSURE, TSF			WATER CONTENT, %	66.8	50.7
PRECONSOL. PRESSURE, TSF			DRY DENSITY, PCF	60.7	73.2
COMPRESSION INDEX			SATURATION, %	100 +	100 +
TYPE SPECIMEN	UNDISTURBED		VOID RATIO	1.776	1.301
DIA. IN 4.25	HT. IN 1.158		BACK PRESSURE, TSF		
CLASSIFICATION CLAY (CH), GRAY					
LL 52	PL 19	PI 33	PROJECT REACH "A" GEOTEXTILE TEST SECTION		
GS 2.70 (EST)	D_{10}				
REMARKS			BORING NO. I-2-U	SAMPLE NO. 8-C	
			DEPTH/ELEV -29.1/-31.0	DATE 21 FEB 87	
			CONSOLIDATION TEST REPORT		

SHEET 1 OF 11

NEW ORLEANS TO VENICE, LOUISIANA
DESIGN MEMORANDUM NO. 1, GENERAL DESIGN
SUPPLEMENT NO. 5, REVISED
REACH - A CITY PRICE TO TROPICAL BEND
NOVEMBER 1987

APPENDIX C
PLAQUEMINES PARISH GOVERNMENT

Plaquemines Parish Government

P.O. BOX 61
POINTE-A-LA-HACHE, LA 70082
504-392-6690 • 504-682-0081 • 504-564-2761

Parish President
LUKE A. PETROVICH

July 28, 1987

Re: New Orleans to Venice
Hurricane Protection Project
Reach A - Geotextile Fabric Construction

United States Army
Corps of Engineers
Office of the District Engineer
New Orleans District
P. O. Box 60267
New Orleans, Louisiana 70160

Gentlemen:

In accordance with Resolution No. 87-272 adopted by the Plaquemines Parish Council on July 16, 1987, two copies attached and on behalf of the Plaquemines Parish Government, I am issuing this formal letter of support to the United States Army Corps of Engineers for the construction of that portion of the New Orleans to Venice Hurricane Protection Project, Plaquemines Parish, Louisiana, designated as "Reach A" with Geotextile Fabric. The Plaquemines Parish Government wholeheartedly supports the U. S. Army Corps of Engineers in the use of the geotextile fabric to bring the New Orleans to Venice Hurricane Protection Levee up to grade and feels that the cost and time saved to complete this portion of the project was excellent.

The Plaquemines Parish Government wishes to assure the Corps that it is completely satisfied with that portion of the levee constructed with geotextile fabric and is eager and willing to assist the United States Army Corps of Engineers with the completion of the entire "Reach A" project, and prays that funding for completion of the "Reach A" project will be made availabe in the United States Army Corps of Engineers 1989 Budget. If we can be of any further assistance in helping to secure funds, please let us know.

Sincerely,

Luke A. Petrovich, Parish President
Plaquemines Parish Government

LAP:sb
encls.
cc's: Mr. Arthur L. Lafrance
Mr. Carroll Martin
Mr. Jack Griffin
Mr. Wallace J. Buras, Jr.

RESOLUTION NO. 87-272

On motion of Council Member Treadway, seconded by Council Member Vullo, and on roll call all members present and voting "Yes", the following resolution was unanimously adopted:

> A Resolution authorizing Luke A. Petrovich, Parish President, to issue a formal letter of support to the United States Army Corps of Engineers for the Geotextile construction of that portion of the New Orleans to Venice Hurricane Protection Project, Plaquemines Parish, Louisiana, designated Reach A.

WHEREAS, the United States Army Corps of Engineers in October, 1986 constructed the Geotextile Fabric Test Section between Station 657+00 and Station 662+00 within the Reach A portion of the New Orleans to Venice Hurricane Protection Project, Plaquemines Parish, Louisiana; and

WHEREAS, the results from said test section were deemed to be excellent and the United States Army Corps of Engineers now desires to continue with the construction of the entire Reach A Project; and

WHEREAS, the possibility exists that funds for construction may become available during the United States Army Corps of Engineers fiscal year 1989 budget; and

WHEREAS, a formal letter of support has been requested by the United States Army Corps of Engineers from the Plaquemines Parish Government supporting this project;

NOW, THEREFORE:

BE IT RESOLVED by the Plaquemines Parish Council that it hereby authorizes Luke A. Petrovich, Parish President, to issue a formal letter of support to the United States Army Corps of Engineers supporting the Geotextile Fabric construction of the Reach A portion of the New Orleans to Venice Hurricane Protection Project, Plaquemines Parish, Louisiana, at the earliest date; and

BE IT FURTHER RESOLVED that said letter contain the support and willingness of the Plaquemines Parish Government to assist the United States Army Corps of Engineers in the completion of this project; and

BE IT FURTHER RESOLVED by the Plaquemines Parish Council that the Secretary of this Council is hereby authorized and directed to immediately certify and release this resolution and that Parish employees and officials are authorized to carry out the purposes of this resolution, both without further reading and approval by the Plaquemines Parish Council.

I hereby certify the above and foregoing to be a true and correct copy of a resolution adopted by the Plaquemines Parish Council at its regular meeting held at its office in the Courthouse, Pointe ala Hache, Louisiana, on July 16, 1987.

Merl D. Ansardi
Secretary

NEW ORLEANS TO VENICE, LOUISIANA
DESIGN MEMORANDUM NO. 1, GENERAL DESIGN
SUPPLEMENT NO. 5, REVISED
REACH A - CITY PRICE TO TROPICAL BEND
NOVEMBER 1987

APPENDIX D
STRUCTURAL DESIGN CALCULATIONS

NEW ORLEANS TO VENICE, LOUISIANA
DESIGN MEMORANDUM NO. 1 - GENERAL DESIGN
SUPPLEMENT NO. 5
REACH A - CITY PRICE TO TROPICAL BEND

APPENDIX D

STRUCTURAL DESIGN CALCULATIONS

TABLE OF CONTENTS

CALCULATIONS

COMPUTATION SHEET

PROJECT: REACH A	PAGE 1 OF 1	COMPUTED BY: Hote	DATE: 19 Aug 82
SUBJECT: WAVE LOADS		CHECKED BY: DRV	DATE: MAY 84

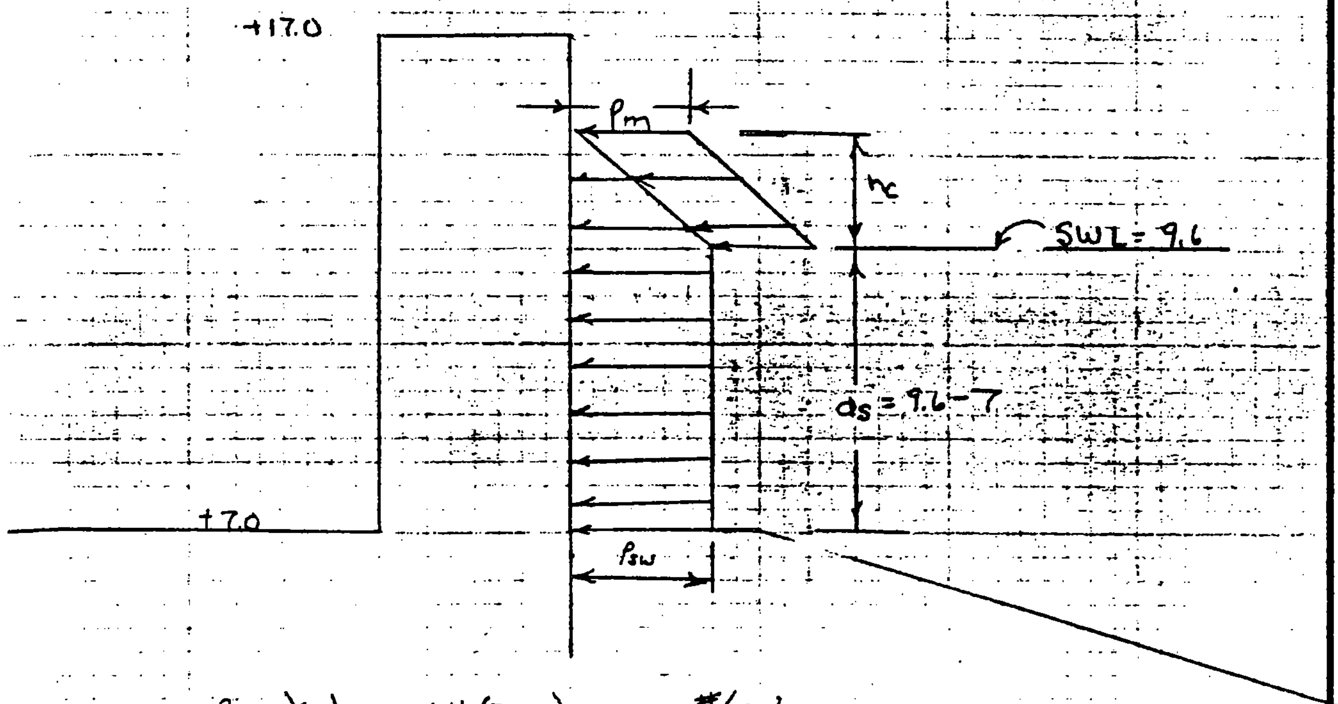
Data from Hyd & Hydro Branch

Reach 3 — STA 309+55 to 477+00

1% Wave $H_1 = 5.89$

BREAKING DEPTH $d_B = 7.54$

BREAKING ELEV $d_{BEL} = 2.1$



$p_m = \frac{\gamma d_B}{2} = \frac{64(7.54)}{2} = 241\ \#/ft^2$

$h_c = .78 H_1 = .78(5.89) = 4.59\ ft$

$R_m = p_m h_c = 241(4.59) = 1107\ \#/ft$

$p_{sw} = \gamma h_c = 64(4.59) = 294\ \#/ft^2$

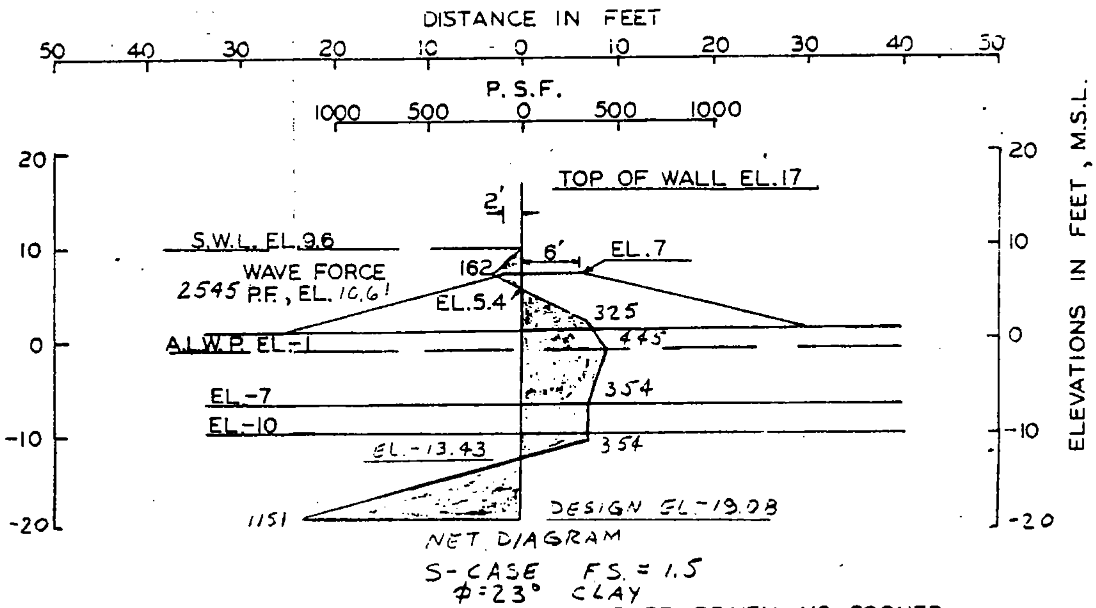
$R_{sw} = p_{sw}\left(d_s + \frac{h_c}{2}\right) = 294\left(2.6 + 4.59/2\right) = 1438\ \#/ft$

$R_{tw} = R_{sw} + R_m = 1438 + 1107 = 2545$

R_{tw} ELEVATION = 10.61 ft. NGVD

ref: DF 19 Aug 81 from C/Hyd & Hydro Br

LMV FORM 1 DEC 79 107a-R PREVIOUS EDITIONS MAY BE USED



NOTE : THE SHEETPILE SHOULD BE DRIVEN NO SOONER THAN THREE YEARS FROM COMPLETION OF THE SECOND LIFT.

(I)G FORCES		DRIVING FORCES		SUMMATION OF FORCES		FACTOR OF SAFETY
R_B	R_P	D_A	$-D_P$	RESISTING	DRIVING	
0	2400	10600	1635	12180	8966	1.359
0	3300	13765	3598	12300	10166	1.210
0	3300	13765	2735	13500	11029	1.224
00	825	13765	184	18825	13600	1.384
0	8340	29119	10485	24180	18634	1.297
40	4935	29119	3408	34795	25712	1.353
80	3360	29119	1271	38280	27848	1.374
50	18628	63180	17544	73214	45618	1.605
50	3300	10733	3598	12350	7135	1.731

NOTES

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

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

** 438+40 TO 439+60 & 441+60 TO 443+10

REACH 3

NEW ORLEANS TO VENICE, LA.
DESIGN MEMORANDUM NO. 1 - GENERAL DESIGN
REACH A - CITY PRICE TO TROPICAL BEND
STABILITY ANALYSIS & PRESSURE DIAGRAM
I-WALL, NEW LEVEE : FINAL SECTION
STATIONS **
U.S. ARMY CORPS OF ENGINEERS NEW ORLEANS, LA.
MARCH, 1979 FILE NO.

```
*LIST SM3

010 1 1 0 0 1
020 'BIVONA REACH A-3'
030 'I-WALL  BB0826'
040 9.6 -1 -8 -18 9.6 1.5 6 -22
050 2545 10.61
060 0 0 0 0 0 0 0 0 9.6
070 23 46 0 0 23 108 0 0 7
080 23 24 0 0 23 86 0 0 1
090 23 24 0 0 23 24 0 0 -1
100 23 34 0 0 23 34 0 0 -7
110 23 38 0 0 23 38 0 0 -10
120 0 9.6 100 9.6 200 9.6 9999.9 0
130 0 1 74 1 98 7 100 7 106 7 130 1
140 200 1 9999.9 0
150 0 1 74 1 100 1 130 1 200 1 9999.9 0
160 0 -1 100 -1 200 -1 9999.9 0
170 0 -7 100 -7 200 -7 9999.9 0
180 0 -10 100 -10 200 -10 9999.9 0
190 0 -22 100 -22 200 -22 9999.9 0

*FRN WESLIB/CORPS/I0007,R
```

```
*LIST SM3OUT

                    *CANTILEVER RETAINING WALL STABILITY*

BIVONA REACH A-3'
I-WALL  BB0826'

HEAD WATER ** TAIL WATER ** U RNG ** L RNG ** HEAD WATER ** FS ** NUMBER
ELEV (FT)  ** ELEV (FT)  ** (FT)  ** (FT)  ** GR EL (FT) **    ** STRATA

   9.60          -1.00       -8.00   -18.00       9.60      1.50      6


                           FLOODWALL ANALYSIS

       DYNAMIC WAVE
  LOAD (LBS)   ELEV (FT)
   2545.00       10.61


AREA     SUM FORCE   MOM ARM      MOMENT
           (LBS)      (FT)       (LBS-FT)

X(1)       343.27     26.40      9063.59
X(2)      6137.32     14.78     90696.89
X(3)      3249.05      1.88      6114.96
*         2545.00     29.69     75558.21  WAVE FORCE AT ELEV    10.61

 TRIAL ELEV=  -8.00  SUM OF FORCES=      0.    SUM OF MOM=  27794.48

 TRIAL ELEV= -18.00  SUM OF FORCES=    -0.00   SUM OF MOM=   4381.07

 TRIAL ELEV= -19.87  SUM OF FORCES=      0.    SUM OF MOM=  -3479.39

 TRIAL ELEV= -18.87  SUM OF FORCES=    -0.00   SUM OF MOM=    912.14

DESIGN ELEV= -19.08  SUM OF FORCES=    -0.00   SUM OF MOM=     39.87


                   NET PRESSURES        FORCE OF
ELEVATION         FLOOD PROTECTED         WATER
  (FT)             (LBS/SQ FT)         (LBS/SQ FT)
    9.60          0.           0.          0.
    8.60         62.50        62.50       62.50
    7.60        125.00       125.00      125.00
    7.00        162.50       168.50      162.50
```

7.00	162.50	162.50	162.50
6.00	243.65	62.49	225.00
5.00	315.06	-37.52	287.50
4.00	376.24	-139.02	350.00
3.00	437.41	-243.22	412.50
2.00	498.58	-325.72	475.00
1.00	559.75	-383.01	537.50
1.00	559.75	-383.01	537.50
0.	595.04	-414.41	600.00
-1.00	630.98	-445.82	662.50
-1.00	630.98	-445.82	662.50
-2.00	649.06	-431.32	662.50
-3.00	667.13	-416.83	662.50
-4.00	685.21	-402.34	662.50
-5.00	703.28	-387.84	662.50
-6.00	721.36	-373.35	662.50
-7.00	739.43	-358.85	662.50
-7.00	739.43	-358.85	662.50
-8.00	769.27	-356.12	662.50
-9.00	799.11	-353.39	662.50
-10.00	828.95	-350.66	662.50
-10.00	828.95	-350.66	662.50
-11.00	863.49	-352.64	662.50
-12.00	898.04	-354.61	662.50
-13.00	932.58	-356.59	662.50
-14.00	967.13	-358.57	662.50
-15.00	1001.67	-360.54	662.50
-16.00	1036.22	-362.52	662.50
-17.00	1070.76	-364.49	662.50
-18.00	1105.31	-366.47	662.50
-19.00	1146.57	-368.44	662.50
-20.00	1201.10	-370.42	662.50
-21.00	1255.62	-372.39	662.50
-22.00	1310.15	-388.98	662.50

*** STEP 1 DIAGRAM ***

ELEVATION (FT)	NET DIAGRAM (LBS/SQ FT)
9.60	0.
8.60	62.50
7.60	125.00
7.00	162.50
7.00	162.50
6.00	62.49
5.38	0.
5.00	-37.52
4.00	-139.02
3.00	-243.22
2.00	-325.72
1.00	-383.01
1.00	-383.01
0.	-414.41
-1.00	-445.82
-1.00	-445.82
-2.00	-431.32
-3.00	-416.83
-4.00	-402.34
-5.00	-387.84
-6.00	-373.35
-7.00	-358.85
-7.00	-358.85
-8.00	-356.12
-9.00	-353.39
-10.00	-350.66
-10.00	-350.66
-11.00	-352.64
-11.70	-354.01
-13.43	0.
-19.08	1150.88
-19.08	0.

** RUN COMPLETED **

*LIST SM3OUT1

ELEV ARE IN FEET, GROSS PRESSURES (FAF, FAP, FPF, AND FPP)
AND DEVELOPED COHESIONS (CAF, CAP, CPF, AND CPP) ARE IN LBS/SQ FT.

ELEV	FAF	FAP	FPF	FPP	CAF	CAP	CPF	CPP
9.60	0.	0.	0.	0.	0.	0.	0.	0.
8.60	0.	0.	0.	0.	0.	0.	0.	0.
7.60	0.	0.	0.	0.	0.	0.	0.	0.
7.00	0.	0.	0.	0.	0.	0.	0.	0.
7.00	0.	0.	0.	0.	0.	0.	0.	0.
6.00	26.3	61.8	80.4	188.8	0.	0.	0.	0.
5.00	52.6	123.5	151.1	377.6	0.	0.	0.	0.
4.00	77.4	185.3	211.6	566.5	0.	0.	0.	0.
3.00	99.6	247.1	272.0	755.3	0.	0.	0.	0.
2.00	121.7	308.9	332.4	922.4	0.	0.	0.	0.
1.00	143.8	370.6	392.9	1064.3	0.	0.	0.	0.
1.00	143.8	370.6	392.9	1064.3	0.	0.	0.	0.
0.	153.4	419.8	414.9	1167.8	0.	0.	0.	0.
-1.00	162.9	468.4	436.8	1271.2	0.	0.	0.	0.
-1.00	162.9	468.4	436.8	1271.2	0.	0.	0.	0.
-2.00	172.5	472.3	458.8	1266.3	0.	0.	0.	0.
-3.00	182.0	476.2	480.8	1261.3	0.	0.	0.	0.
-4.00	191.5	480.1	502.8	1256.4	0.	0.	0.	0.
-5.00	201.1	484.0	524.8	1251.4	0.	0.	0.	0.
-6.00	210.6	487.9	546.7	1246.5	0.	0.	0.	0.
-7.00	220.2	491.8	568.7	1241.5	0.	0.	0.	0.
-7.00	220.2	491.8	568.7	1241.5	0.	0.	0.	0.
-8.00	235.4	501.4	608.2	1254.1	0.	0.	0.	0.
-9.00	250.7	511.0	647.7	1266.6	0.	0.	0.	0.
-10.00	266.0	520.7	687.1	1279.1	0.	0.	0.	0.
-10.00	266.0	520.7	687.1	1279.1	0.	0.	0.	0.
-11.00	283.5	532.6	733.6	1298.7	0.	0.	0.	0.
-12.00	301.1	544.5	780.0	1318.2	0.	0.	0.	0.
-13.00	318.6	556.4	826.5	1337.7	0.	0.	0.	0.
-14.00	336.2	568.3	872.9	1357.2	0.	0.	0.	0.
-15.00	353.7	580.2	919.4	1376.8	0.	0.	0.	0.
-16.00	371.3	592.1	965.9	1396.3	0.	0.	0.	0.
-17.00	388.8	604.1	1012.3	1415.8	0.	0.	0.	0.
-18.00	406.4	616.0	1058.8	1435.3	0.	0.	0.	0.
-19.00	423.9	627.9	1112.0	1454.9	0.	0.	0.	0.
-20.00	441.5	639.8	1178.4	1474.4	0.	0.	0.	0.
-21.00	459.0	651.7	1244.8	1493.9	0.	0.	0.	0.
-22.00	476.6	663.6	1311.3	1528.1	0.	0.	0.	0.

*

```
*LIST SM3OUT2
*
10001 'BIVONA REACH A-3'
10002 'I-WALL  BB0826'
10003                  1  0.10610000E 02  0.25450000E 04
10004                  3  0.96000000E 01  0.
10005                  3  0.86000000E 01  0.62500000E 02
10006                  3  0.76000000E 01  0.12500000E 03
10007                  3  0.70000000E 01  0.16250000E 03
10008                  3  0.70000000E 01  0.16250000E 03
10009                  3  0.60000000E 01  0.62488707E 02
10010                  3  0.53751835E 01  0.
10011                  3  0.50000000E 01 -0.37522591E 02
10012                  3  0.40000000E 01 -0.13902113E 03
10013                  3  0.30000000E 01 -0.24321600E 03
10014                  3  0.20000000E 01 -0.32572474E 03
10015                  3  0.10000000E 01 -0.38300897E 03
10016                  3  0.10000000E 01 -0.38300897E 03
10017                  3  0.             -0.41441285E 03
10018                  3 -0.10000000E 01 -0.44581670E 03
10019                  3 -0.10000000E 01 -0.44581670E 03
10020                  3 -0.20000000E 01 -0.43132286E 03
10021                  3 -0.30000000E 01 -0.41682906E 03
10022                  3 -0.40000000E 01 -0.40233513E 03
10023                  3 -0.50000000E 01 -0.38784126E 03
10024                  3 -0.60000000E 01 -0.37334745E 03
10025                  3 -0.70000000E 01 -0.35885369E 03
10026                  3 -0.70000000E 01 -0.35885369E 03
10027                  3 -0.80000000E 01 -0.35612365E 03
10028                  3 -0.90000000E 01 -0.35339360E 03
10029                  3 -0.10000000E 02 -0.35066354E 03
10030                  3 -0.10000000E 02 -0.35066354E 03
10031                  3 -0.11000000E 02 -0.35263909E 03
10032                  3 -0.11695855E 02 -0.35401374E 03
10033                  3 -0.13432656E 02  0.
10034                  3 -0.19078885E 02  0.11508757E 04
10035                  4 -0.19078885E 02  0.
10036                  0 -0.19078885E 02  0.
10037   -0.19078885E 02 -0.61035156E-04  0.39868164E 02

*
```

```
*LIST SJMIN

1010 1 17.0 -19.08 -1 -19.08 0 -1 4.0
1020 PZ-32
1030 29000000 9.43 220.2

*LIST SMA3

10001 'BIVONA REACH A-3
10002 'I-WALL  BB0826
10003                1  0.10610000E 02  0.25450000E 04
10004                3  0.96000000E 01  0.
10005                3  0.86000000E 01  0.62500000E 02
10006                3  0.76000000E 01  0.12500000E 03
10007                3  0.70000000E 01  0.16250000E 03
10008                3  0.70000000E 01  0.16250000E 03
10009                3  0.60000000E 01  0.62488707E 02
10010                3  0.53751835E 01  0.
10011                3  0.50000000E 01 -0.37522591E 02
10012                3  0.40000000E 01 -0.13902113E 03
10013                3  0.30000000E 01 -0.24321600E 03
10014                3  0.20000000E 01 -0.32572474E 03
10015                3  0.10000000E 01 -0.38300897E 03
10016                3  0.10000000E 01 -0.38300897E 03
10017                3  0.              -0.41441285E 03
10018                3 -0.10000000E 01 -0.44581670E 03
10019                3 -0.10000000E 01 -0.44581670E 03
10020                3 -0.20000000E 01 -0.43132286E 03
10021                3 -0.30000000E 01 -0.41682906E 03
10022                3 -0.40000000E 01 -0.40233513E 03
10023                3 -0.50000000E 01 -0.38784126E 03
10024                3 -0.60000000E 01 -0.37334745E 03
10025                3 -0.70000000E 01 -0.35885369E 03
10026                3 -0.70000000E 01 -0.35885369E 03
10027                3 -0.80000000E 01 -0.35612365E 03
10028                3 -0.90000000E 01 -0.35339360E 03
10029                3 -0.10000000E 02 -0.35066354E 03
10030                3 -0.10000000E 02 -0.35066354E 03
10031                3 -0.11000000E 02 -0.35263909E 03
10032                3 -0.11695855E 02 -0.35401374E 03
10033                3 -0.13432656E 02  0.
10034                3 -0.19078885E 02  0.11508757E 04
10035                4 -0.19078885E 02  0.
10036                0 -0.19078885E 02  0.
10037  -0.19078885E 02 -0.61035156E-04  0.39868164E 02

*FRN WESLIB/CORPS/X0015,R
```

*LIST SJMOUT

BEAMS (SHEAR, MOMENT, DEFLECTION)

BIVONA REACH A-3
I-WALL BB0826

THE REFERENCE SYSTEM SELECTED DEFINES POSITIVE FORCES AS TO THE RIGHT INCREASING MEMBER COORDINATES AS UPWARD, AND POSITIVE MOMENTS AS CLOCKWISE.

THE MAXIMUM DEFLECTION IS -2.71 INCHES AND OCCURS AT MEMBER COORDINATE 17.00 FT.

PZ-32 HAS BEEN GIVEN TO SUPPORT THE LOAD SYSTEM.

THE WEIGHT OF THIS VERTICAL MEMBER HAS BEEN NEGLECTED.

CALCULATED EXTERNAL LOADS

DISTANCE FROM REFERENCE(FT)	TYPE OF LOAD	MAGNITUDE OF LOAD
-19.08	POINT LD	-0.00 LBF
-19.08	COUPLE	-39.88 LBF-FT

INPUTTED LOADS

DISTANCE FROM REFERENCE(FT)	TYPE OF LOAD	MAGNITUDE OF LOAD
10.61	POINT LD	2545.00 LBF
9.60	CONTN LD	0. LBF/SQ FT
8.60	CONTN LD	62.50 LBF/SQ FT
7.60	CONTN LD	125.00 LBF/SQ FT
7.00	CONTN LD	162.50 LBF/SQ FT
7.00	CONTN LD	162.50 LBF/SQ FT
6.00	CONTN LD	62.49 LBF/SQ FT
5.38	CONTN LD	0. LBF/SQ FT
5.00	CONTN LD	-37.52 LBF/SQ FT
4.00	CONTN LD	-139.02 LBF/SQ FT
3.00	CONTN LD	-243.22 LBF/SQ FT
2.00	CONTN LD	-325.72 LBF/SQ FT
1.00	CONTN LD	-383.01 LBF/SQ FT
1.00	CONTN LD	-383.01 LBF/SQ FT
0.	CONTN LD	-414.41 LBF/SQ FT
-1.00	CONTN LD	-445.82 LBF/SQ FT
-1.00	CONTN LD	-445.82 LBF/SQ FT
-2.00	CONTN LD	-431.32 LBF/SQ FT
-3.00	CONTN LD	-416.83 LBF/SQ FT
-4.00	CONTN LD	-402.34 LBF/SQ FT
-5.00	CONTN LD	-387.84 LBF/SQ FT
-6.00	CONTN LD	-373.35 LBF/SQ FT
-7.00	CONTN LD	-358.85 LBF/SQ FT

-7.00	CONTN LD	-358.85	LBF/SQ FT
-8.00	CONTN LD	-356.12	LBF/SQ FT
-9.00	CONTN LD	-353.39	LBF/SQ FT
-10.00	CONTN LD	-350.66	LBF/SQ FT
-10.00	CONTN LD	-350.66	LBF/SQ FT
-11.00	CONTN LD	-352.64	LBF/SQ FT
-11.70	CONTN LD	-354.01	LBF/SQ FT
-13.43	CONTN LD	0.	LBF/SQ FT
-19.08	CONTN LD	1150.88	LBF/SQ FT
-19.08	CONTN LD	0.	LBF/SQ FT

PZ-32 . PROPERTIES ARE AS FOLLOWS.

MOMENT OF INERTIA= 220.20 IN. TO THE 4TH PER FOOT OF WALL
CROSS SECTIONAL AREA= 9.43 SQ IN.
ELASTIC MODULUS= 29000000. LBF/SQ IN.
DEFLECTION REFERENCE IS AT -19.080

THE MAXIMUM BENDING MOMENT IS 29841.01 LBF-FT AND OCCURS AT -3.66
WHICH HAS THE SHEAR FORCE OF -1.62 LBF.

$$f_b = \frac{M}{S_x} = \frac{29841.01\text{#-}'(12)}{38.3 \text{ in}^3} = 9349.7 \text{ psi}$$

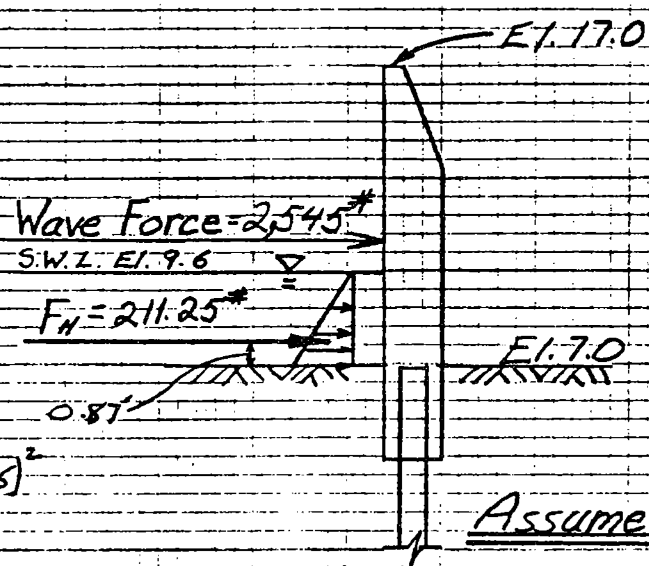
DISTANCE (FEET)	SHEAR FOR (LBF)	SHEAR STR (LBF/SQIN)	BENDING MOM (LBF-FT)	DEFLECTION FROM TANG. THRU DEFLE REFERENCE (INCHES)
17.000	0.	0.	0.	-2.7122
16.999	0.	0.	0.	-2.7121
16.000	0.	0.	0.	-2.5888
15.000	0.	0.	0.	-2.4653
14.000	0.	0.	0.	-2.3419
13.000	0.	0.	0.	-2.2184
12.000	0.	0.	0.	-2.0950
11.000	0.	0.	0.	-1.9716
10.611	0.	0.	0.	-1.9235
10.609	2545.0	269.9	2.5	-1.9233
10.000	2545.0	269.9	1552.5	-1.8481
9.601	2545.0	269.9	2567.9	-1.7989
9.599	2545.0	269.9	2573.0	-1.7986
9.000	2556.3	271.1	4099.7	-1.7247
8.000	2625.0	278.4	6685.1	-1.6012
7.000	2756.3	292.3	9370.5	-1.4778
6.000	2868.7	304.2	12191.4	-1.3543
5.376	2888.3	306.3	13989.0	-1.2773
5.374	2888.3	306.3	13994.8	-1.2771
5.000	2881.2	305.5	15074.7	-1.2309
4.000	2793.0	296.2	17920.2	-1.1075
3.000	2601.8	275.9	20626.3	-0.9866
2.000	2317.4	245.7	23092.8	-0.8713
1.000	1963.0	208.2	25237.7	-0.7622
0.	1564.3	165.9	27004.0	-0.6599
-1.000	1134.2	120.3	28355.9	-0.5649
-2.000	695.6	73.8	29269.5	-0.4776
-3.000	271.5	28.8	29751.9	-0.3982
-3.663	-1.6	-0.2	29841.0	-0.3499
-4.000	-138.1	-14.6	29817.4	-0.3268
-5.000	-533.1	-56.5	29480.6	-0.2634

-6.000	-913.7	-96.9	28756.0	-0.2080
-7.000	-1279.8	-135.7	27658.0	-0.1604
-8.000	-1637.3	-173.6	26199.2	-0.1203
-9.000	-1992.1	-211.2	24384.2	-0.0872
-10.000	-2344.1	-248.6	22215.9	-0.0607
-11.000	-2695.8	-285.9	19696.1	-0.0402
-12.000	-3039.9	-322.4	16824.7	-0.0250
-13.000	-3230.0	-342.5	13672.8	-0.0144
-13.432	-3249.1	-344.5	12273.1	-0.0110
-13.434	-3249.1	-344.5	12266.6	-0.0110
-14.000	-3216.2	-341.1	10432.7	-0.0074
-15.000	-2998.7	-318.0	7308.2	-0.0033
-16.000	-2577.3	-273.3	4503.2	-0.0012
-17.000	-1952.1	-207.0	2221.6	-0.0003
-18.000	-1123.0	-119.1	667.0	-0.0000
-19.000	-90.2	-9.6	43.4	-0.0000
-19.078	-1.2	-0.1	39.9	0.
-19.079	0.0	0.0	0.0	0.
-19.080	0.0	0.0	0.0	0.

RUN COMPLETED

COMPUTATION SHEET

PROJECT N.O. - Venice GDM - Reach A	PAGE 1 OF	COMPUTED BY RLT	DATE 7/6/83
SUBJECT Typical I-Wall Design		CHECKED BY DRV	DATE MAY 84



$F_H = \frac{1}{2}(62.5)(2.6)^2$
$= 211.25\#$

Assume: $f'_c = 3{,}000$ psi
$f_y = 40{,}000$ psi
$b = 12''$
$2\frac{1}{2}''$ cover
No axial load
$h = 24''$

$M_W = (211.25)(0.87) + (2545)(3.6)$
$= 9{,}345.8\ \#\text{-}'$
$= 9.346^{k\text{-}'}(12) = \underline{112.15^{k\text{-}in}}$

$M_N = \frac{(1.9)(112.15)}{0.9} = \underline{236.76^{k\text{-}in}}$

$\rho_{max} = 0.25\rho_b = 0.0093$ (From ETL 1110-2-265)

$m = \frac{f_y}{.85 f'_c} = \frac{40}{.85(3)} = 15.69$

$R_u = \rho f_y(1 - \frac{1}{2}\rho m) = (.0093)(40)(1 - \frac{1}{2}(.0093)(15.69))$
$= 0.345$ ksi

$bd^2 = \frac{M_N}{R_u} = \frac{236.76^{k\text{-}in}}{0.345\ ksi} = 686.26\ in^3$

$\therefore$ req'd $d = \sqrt{\frac{686.26}{12}} = \underline{7.56''}$

req'd. $A_s = \rho bd = (0.0093)(12)(7.56)$
$= \underline{0.844\ in^2}$ $\therefore$ #9, 12''

actual $d = 24'' - 2\frac{1}{2} - \frac{1.128}{2}$
$= 20.94''$

LMV FORM 1 FEB 79 107e

COMPUTATION SHEET

PROJECT N.O. - Venice GDM - Reach A	PAGE 2 OF	COMPUTED BY RLT	DATE 7/6/83
SUBJECT I-Wall Design		CHECKED BY DRV	DATE May 84

REVISED AUG 87 DB

Revised $R_u = \frac{M_N}{bd^2} = \frac{236.76^{k\text{-}in}}{(12)(20.94)} = \underline{\underline{0.044996 \text{ ksi}}}$

Revised $\rho = \frac{1}{m}\left(1 - \sqrt{1 - \frac{2mR_u}{f_y}}\right)$

$= \frac{1}{15.69}\left(1 - \sqrt{1 - \frac{(2)(15.69)(.044996)}{40}}\right)$

$= \underline{\underline{0.001135}}$

Revised $A_s = \rho bd = (0.001135)(12)(20.94)$

$= \underline{\underline{0.285 \text{ in}^2}}$

Minimum Steel

Tensile

$A_{min} = \frac{200}{f_y} bd = \frac{200}{40000}(12)(20.94)$ (ACI 10.5.1)

$= \underline{\underline{1.256 \text{ in}^2}}$

or $A_{min} = (4/3)(\text{Req'd. } A_s) = (4/3)(0.285)$ (ACI 10.5.2)

$= \underline{\underline{0.380 \text{ in}^2}}$

∴ **Use #6, 12"**

Temp.

$A_s = 0.0025\, bh$ (Half in each face)

$= 0.0025\,(12)(24)$

$= 0.72 \text{ in}^2$

∴ $A_s = 0.72/2$

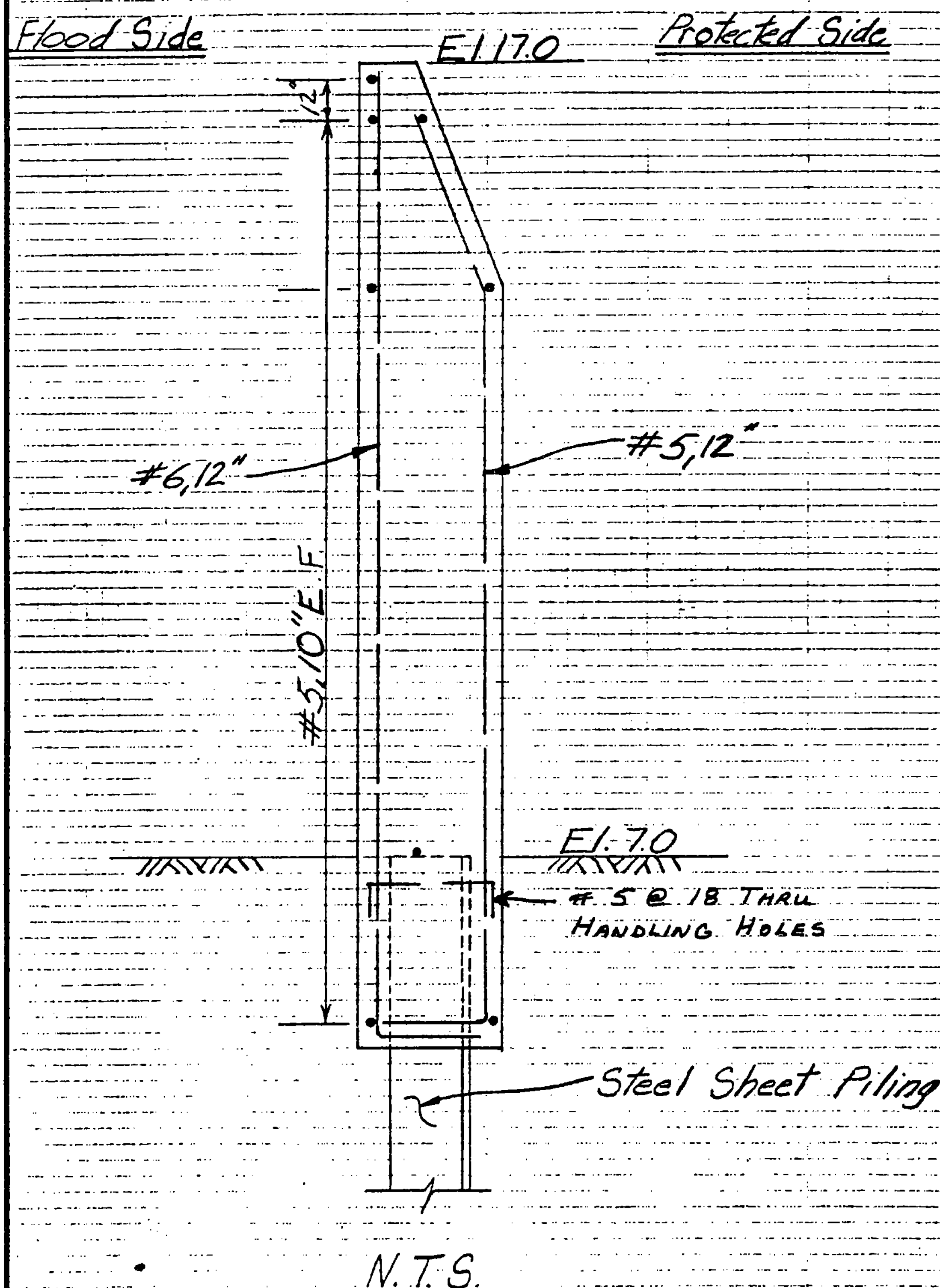
$= \underline{\underline{0.36 \text{ in}^2}}$ (Each face)

∴ **Use #5, 10"**

LMV FORM 1 FEB 79 107e

COMPUTATION SHEET

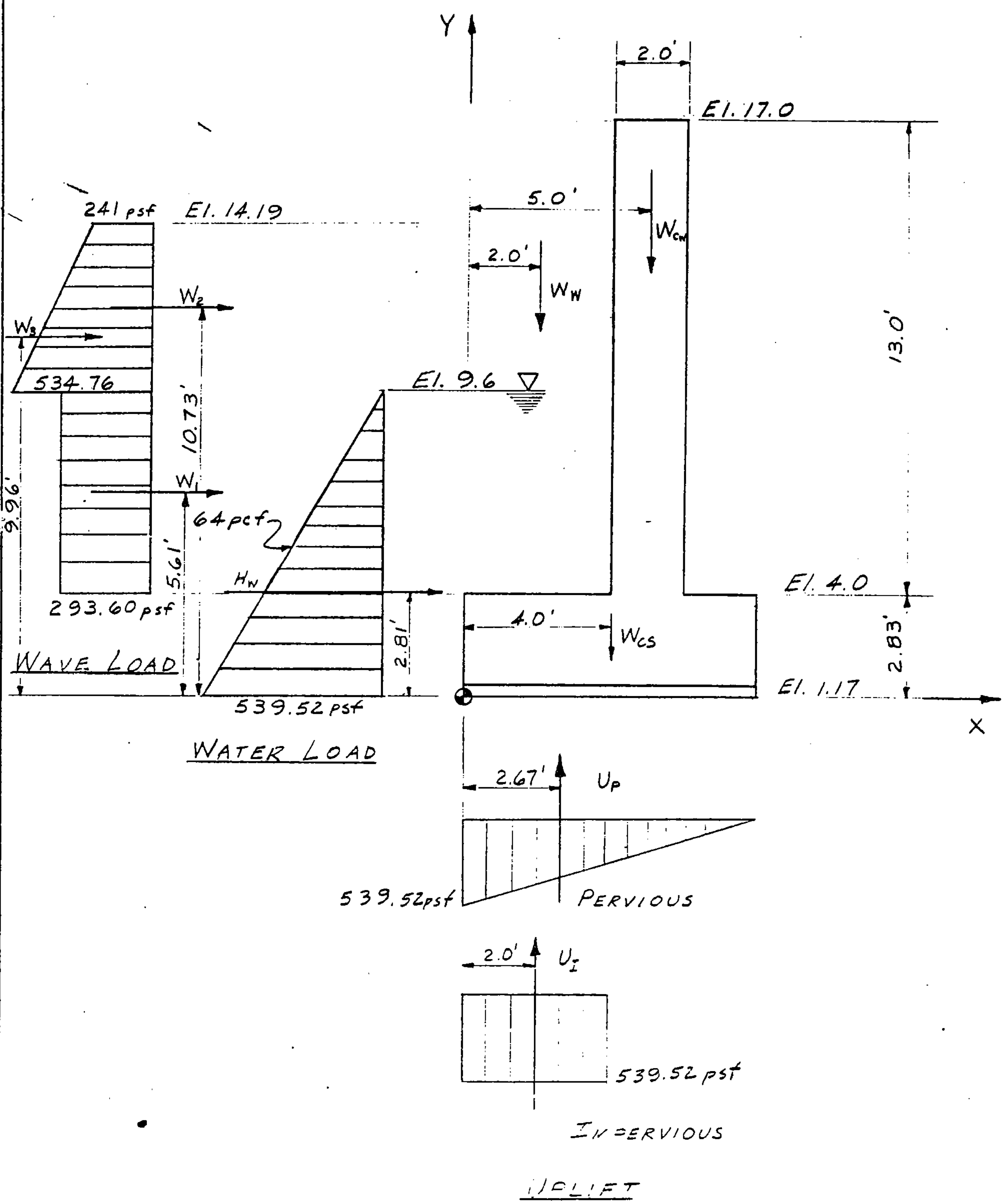
PROJECT N.O.-Venice GDM-Reach A	PAGE 3 OF	COMPUTED BY KJ	DATE 7/6/83
SUBJECT I-Wall Design (Section)		CHECKED BY DRV	DATE MAY 84



LMV FORM 107e 1 FEB 79

PROJECT		COMPUTED BY	DATE
NEW ORLEANS TO VENICE, LA.	Page 5 of —	DRV	AUG 78
SUBJECT		CHECKED BY	DATE
REACH A: GAINARD WOODS PUMP STATION		RLT	MAY 84

T-WALL DESIGN STA 440+59



PROJECT New Orleans to Venice, La.	Page 6 of —	COMPUTED BY DRV	DATE Aug '78
SUBJECT Reach A: Gainard Woods Pump Station		CHECKED BY RLT	DATE May 84

T-Wall Design STA 440+59

Dead Load + Water Load

Item	Computation	Fx (k)	Fy (k)	Arm (ft)	Moment (1-k)
W_{cw}	$2.0' \times 13.0' \times 1.0^{LF} \times 0.150^{k/ft^3}$		3.90	5.0	19.50
W_{cs}	$2.5' \times 8.0' \times 1.0^{LF} \times 0.150^{k/ft^3}$		3.00	4.0	12.00
H_W	$0.5 \times 0.540^{ksf} \times 8.43' \times 1.0^{LF}$	2.276		2.81	6.40
W_W	$4.0' \times 5.6' \times 1.0^{LF} \times 0.064^{k/ft^3}$		1.434	2.0	2.87
	Subtotal A	2.276	8.33		40.77

Impervious Uplift

U_I	$0.540^{ksf} \times 4.0' \times 1.0^{LF}$		-2.16	2.0	-4.32
	Subtotal B		-2.16		-4.32

Pervious Uplift

U_P	$0.5 \times 0.540^{ksf} \times 8.0' \times 1.0^{LF}$		-2.16	2.67	-5.77
	Subtotal C		-2.16		-5.77

Wave Load

W_1	$0.294^{ksf} \times 5.6 \times 1.0^{LF}$	1.65		5.61	9.26
W_2	$0.241^{ksf} \times 4.59' \times 1.0^{LF}$	1.11		10.73	11.91
W_3	$0.5 \times 0.294^{ksf} \times 4.59 \times 1.0^{LF}$	0.674		9.96	6.71
	Subtotal D	3.43			27.88

PROJECT		COMPUTED BY	DATE
NEW ORLEANS TO VENICE, LA.	Page 1 of —	DRV	AUG '78
SUBJECT		CHECKED BY	DATE
REACH A: GAINARD WOODS PUMP STATION		RLT	MAY 84

T-WALL DESIGN STA 440+59

CASE NO.	LOAD COMBINATION	F_x (K)	F_y (K)	MOMENT (1-K)
II-1	A+B	2.27	6.17	36.45
II-2	A+C	2.27	6.17	35.00
III-1	0.75(A+B+D)	4.27	4.62	48.24
III-2	0.75(A+C+D)	4.27	4.62	47.16

PROJECT NEW ORLEANS TO VENICE, LA.	Page 8 of —	COMPUTED BY DRV	DATE AUG '78
SUBJECT REACH A: GAINARD WOODS PUMP STATION		CHECKED BY RLT	DATE MAY 84

T-WALL DESIGN STA 440+59

PILE ANALYSIS DATA:

10 NEW ORLEANS TO VENICE, REACH A: STA 440+59

T-WALL

20 4 15.83 1

30 1 2

40 2 0 2

50 1 100

60 12 60 40 40

70 1 -2

80 1.5 1

90 1 2

100 6.5 1

110 0 0

120 36.45 6.17 2.27

130 35.00 6.17 2.27

140 48.24 4.62 4.27

150 47.16 4.62 4.27

160 $ $ $

LMV FORM 107a
1 AUG 68

COMPUTATION SHEET

```
*LIST

10 NEW ORLEANS TO VENICE LA.,REACH A: STA 444+59 PUMP STATION T-WALL
20 4 15.83 1
30 1 2
40 2 0 2
50 1 100
60 12 60 40 40
70 1 -2
80 1.5 1
90 1 2
100 6.5 1
110 0 0
120 36.45 6.17 2.27
130 35.00 6.17 2.27
140 48.24 4.62 4.27
150 47.16 4.62 4.27
160 $$$

READY

*REMOVE D29004
*RUN RK29004

        09/12/78     13.617



   PROG. NO. 713-F3-A2-150, MOD 10 - AUG'76; FOR DESCRIPTION,
 LIST SOURCE FILE --- A2B00/ADP/HRENN/K29003M

 SELECT INPUT METHOD:
   1 = ALL DATA FROM USER'S DATA FILE (D29004);
   2 = BINARY DATA FILE FROM K29002 PLUS USER'S DATA FILE (D29004);
   3 = BINARY DATA FILE FROM K29002 PLUS KEYBOARD INPUT;
   4 = ALL DATA FROM KEYBOARD INPUT.
=1
```

PROG. NO. 713-F3A2-150 MOD 10   08/76   13:37:43   09/12/78   PAGE 1

NEW ORLEANS TO VENICE LA.,REACH A: STA 444+59 PUMP STATION T-WALL

RUN NO. 1 - CASE 1.00

FILE ARRANGEMENT

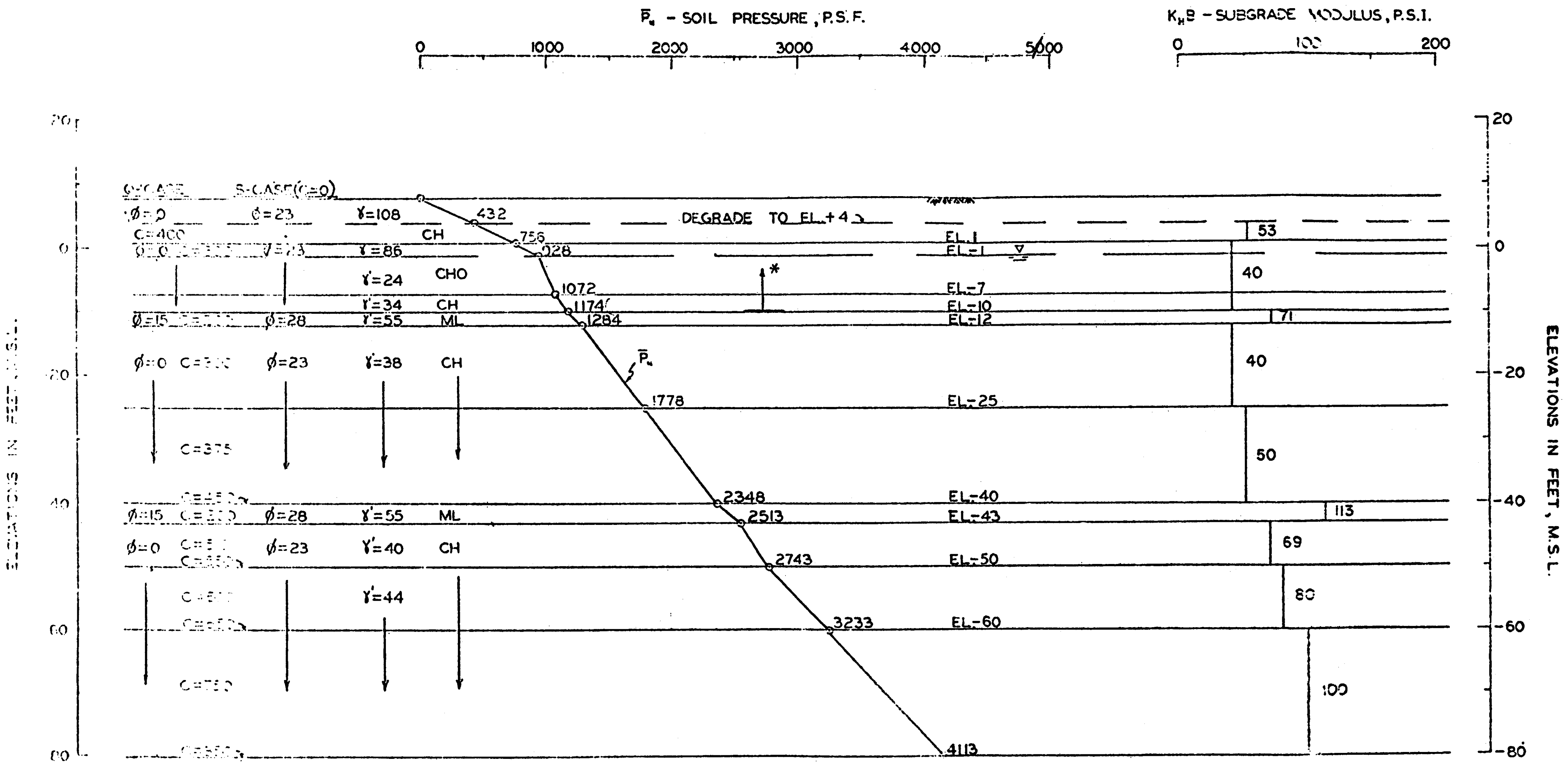
PILE GROUP	NO. ROWS	CENTROID DISTANCE	BATTER RATIO	NUMBER PILES
A	1	1.50	-2.00	1.00
B	1	6.50	2.00	1.00

TOTAL NO. OF PILES = 2.

MAXIMUM PILE SPACINGS

ROW NO.	DIST. FT.		COMP. LOADS KIPS	ALLOW. LOADS KIPS	MAX PILE SPACING FT.	CASE NO.	COMP. DEFL. IN.
				GROUP A			
1	1.50	P =	-3.70	40.00	10.816	30001.00	0.2445
		Q =	0.747	3.491	4.671	30001.00	0.2445
				GROUP B			
1	6.50	P =	8.86	40.00	4.515	30001.00	0.2445
		Q =	0.757	2.932	3.872	30001.00	0.2445

MAX. DEFL. FOR AT REST SOIL PRESS. = 0.0950



SKIN FRICTION FROM THE TOP 2/3 OF MATERIAL ABOVE THIS LINE WAS NEGLECTED IN THE S-CASE ANALYSIS AND THE LEVEE IS TO BE DEGRADED TO EL.+4 TO ACCOUNT FOR NEGATIVE SKIN FRICTION.

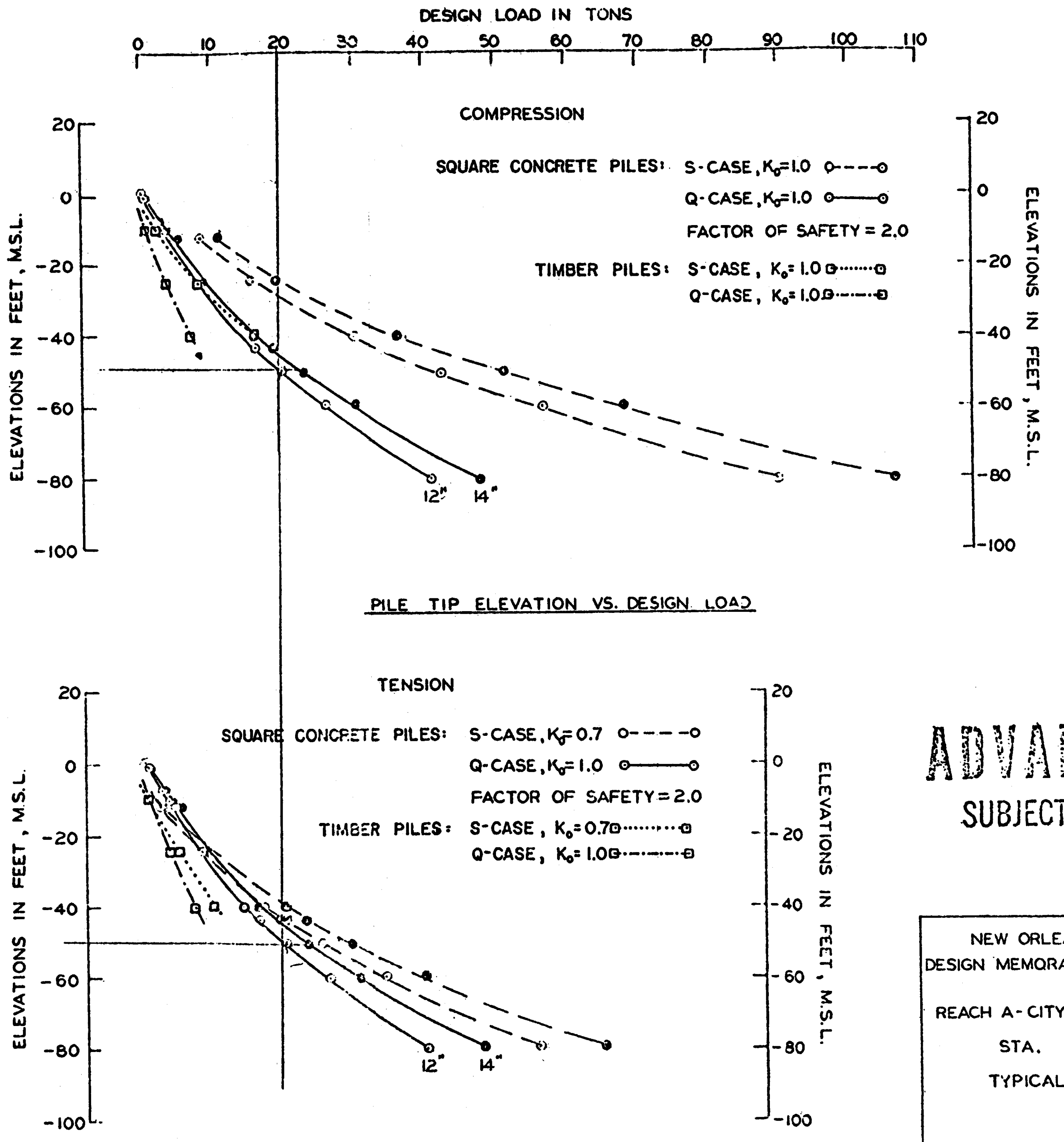
NOTES: $K_H B = 0.2222\ Q_u (0.3)$

WHERE

0.3 = REDUCTION FACTOR FOR CYCLIC LOADING

B = PROJECTED DIAMETER OF PILE, IN.

$Q_u = 2C$ = UNCONFINED COMPRESSIVE STRENGTH, P.S.F.



ADVANCE COPY

SUBJECT TO CORRECTION

D-21

NEW ORLEANS TO VENICE, LA.
DESIGN MEMORANDUM NO. 1 - GENERAL DESIGN

REACH A - CITY PRICE TO TROPICAL BEND

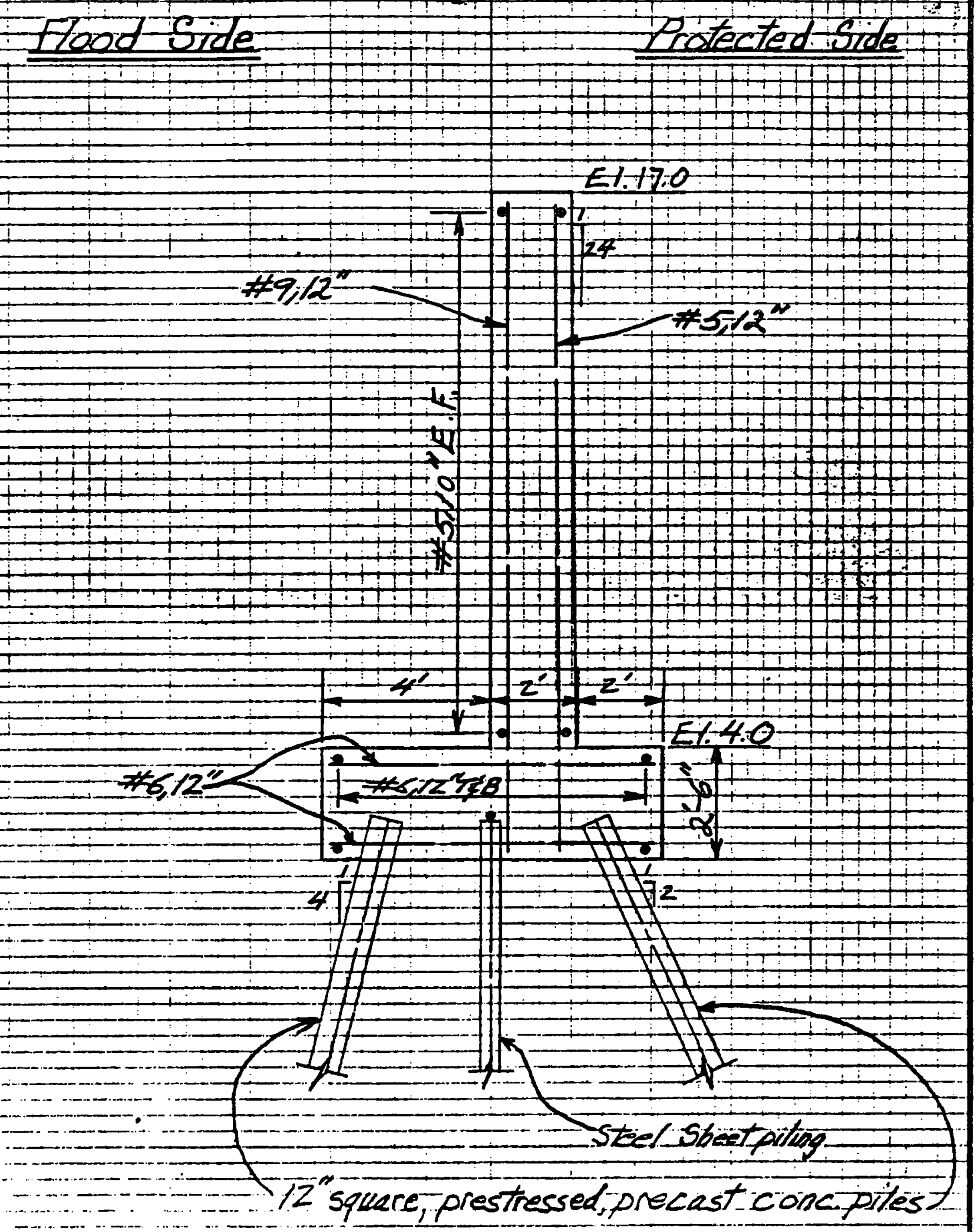
STA. 0+00 TO 675+00

TYPICAL PILE ANALYSIS

LMNED-FD Plate 83 JAN., 1978

COMPUTATION SHEET

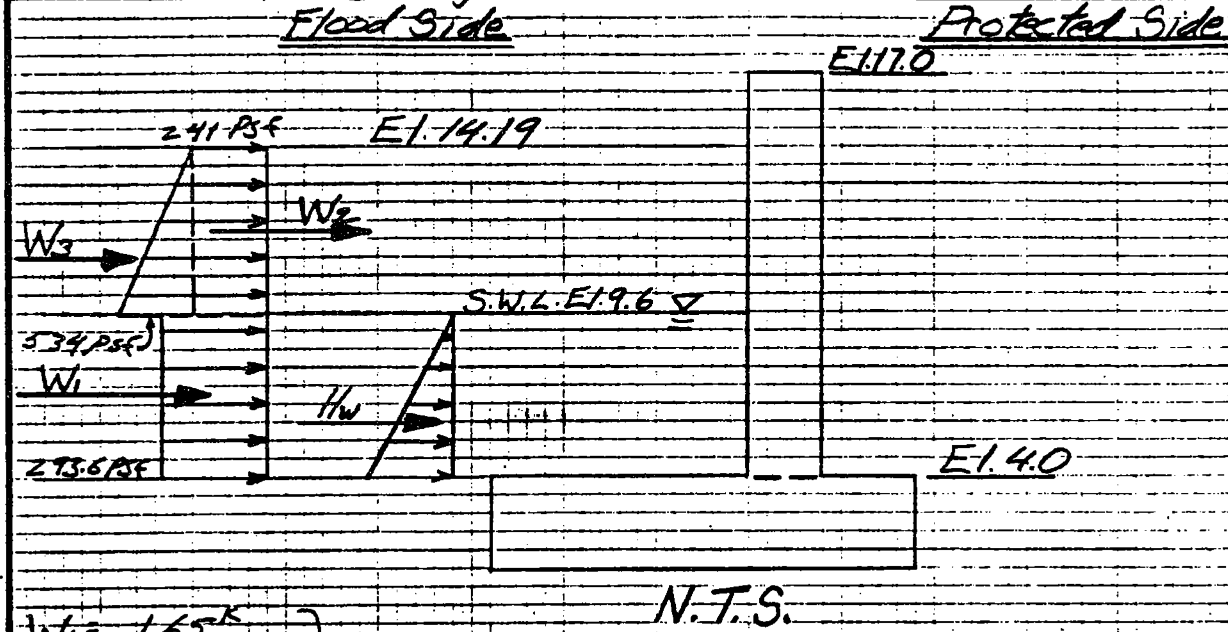
PROJECT N.O.-Venice GDM-Reach A	PAGE 1 OF	COMPUTED BY RLT	DATE 7/6/83
SUBJECT T-Wall Design (Section)		CHECKED BY	DATE MAY 84



LMV FORM 1 FEB 79 107e

COMPUTATION SHEET

PROJECT N.O. - Venice GDM-Reach A	PAGE 1 OF	COMPUTED BY RLT	DATE 7/6/83
SUBJECT T-Wall Design (Stem)		CHECKED BY DRV	DATE MAY 84



$W_1 = 1.65^k$
$W_2 = 1.11^k$ (From Wave Load Computations)
$W_3 = 0.674^k$

Note: Moments taken at elevation 4.0.

$H_w = (\frac{1}{2})(.064)(5.6)^2 = 1.04^k$

$M_W = M_{W1} + M_{W2} + M_{W3} + M_{HW}$

$= (1.65)(2.80) + (1.11)(7.90) + (0.674)(7.13) + (1.04)(1.87)$

$= \underline{20.08^{k\text{-}'}}$

$M_u = 1.9(M_W) = (1.9)(20.08)(12) = 457.8^{k\text{-}in}$

$M_N = \frac{M_u}{0.9} = \frac{457.8}{0.9}$

$= \underline{508.6^{k\text{-}in}}$

LMV FORM 107e 1 FEB 79

COMPUTATION SHEET

PROJECT N. O. - Venice GDM - Reach A	PAGE 2 OF	COMPUTED BY RLT	DATE 7/6/83
SUBJECT T-Wall Design (Stem)		CHECKED BY DRV	DATE MAY 84

Assume: $f'_c = 3{,}000$ psi   3" cover

$f_y = 40{,}000$ psi $h = 24"$

$b = 12"$ No axial load

$\rho_{max.} = 0.25\,\rho_b = 0.0093$ (From ETL 1110-2-265)

$m = \frac{f_y}{.85 f'_c} = \frac{40}{.85(3)} = 15.69$

$R_u = \rho f_y(1 - \frac{1}{2}\rho m) = (0.0093)(40)(1 - (\frac{1}{2})(.0093)(15.69))$

$= 0.345$ ksi

$bd^2 = \frac{M_N}{R_u} = \frac{508.6}{0.345} = 1{,}461.44\, in^3$

$\therefore$ req'd. $d = \sqrt{\frac{1{,}461.44}{12}} = \underline{\underline{11.04"}}$

req'd. $A_s = \rho bd = (0.0093)(12)(11.04)$

$= \underline{\underline{1.23\, in^2}}$

Actual $d = 24 - 3 - \frac{1.00}{2} = \underline{\underline{20.5"}}$ (Assuming #9 bar)

Revised $R_u = \frac{M_N}{bd^2} = \frac{508.6^{k\text{-}in}}{(12)(20.5)^2} = \underline{\underline{0.101\text{ ksi}}}$

Revised $\rho = \frac{1}{m}\left(1 - \sqrt{1 - \frac{2mR_u}{f_y}}\right)$

$= \frac{1}{15.69}\left(1 - \sqrt{1 - \frac{(2)(15.69)(.101)}{40}}\right)$

$= \underline{\underline{0.0026}}$

Revised $A_s = \rho bd = (0.0026)(12)(20.5)$

$= \underline{\underline{0.634\, in^2}}$

LMV FORM 107e 1 FEB 79

COMPUTATION SHEET

PROJECT N. O. - Venice GDM-Reach A	PAGE 3 OF	COMPUTED BY RJ	DATE 7/6/83
SUBJECT T-Wall Design (Stem)		CHECKED BY DRV	DATE MAY 84

REVISED AUG 87 DB

Minimum Steel

Tensile

$A_{min} = \frac{200}{f_y} bd = \frac{200}{49000}(12)(20.5)$ (ACI 10.5.1)

$= 1.23 \ in^2$

or $A_{min} = (4/3)(Req'd \ A_s) = (4/3)(0.634)$ (ACI 10.5.2)

$= 0.845 \ in^2$

$\therefore$ **Use #9, 12"**

Temp.

$A_s = 0.0025 \ bh$ (Half in each face)

$= 0.0025 \ (12)(24)$

$= 0.72 \ in^2$

$\therefore A_s = 0.72/2$

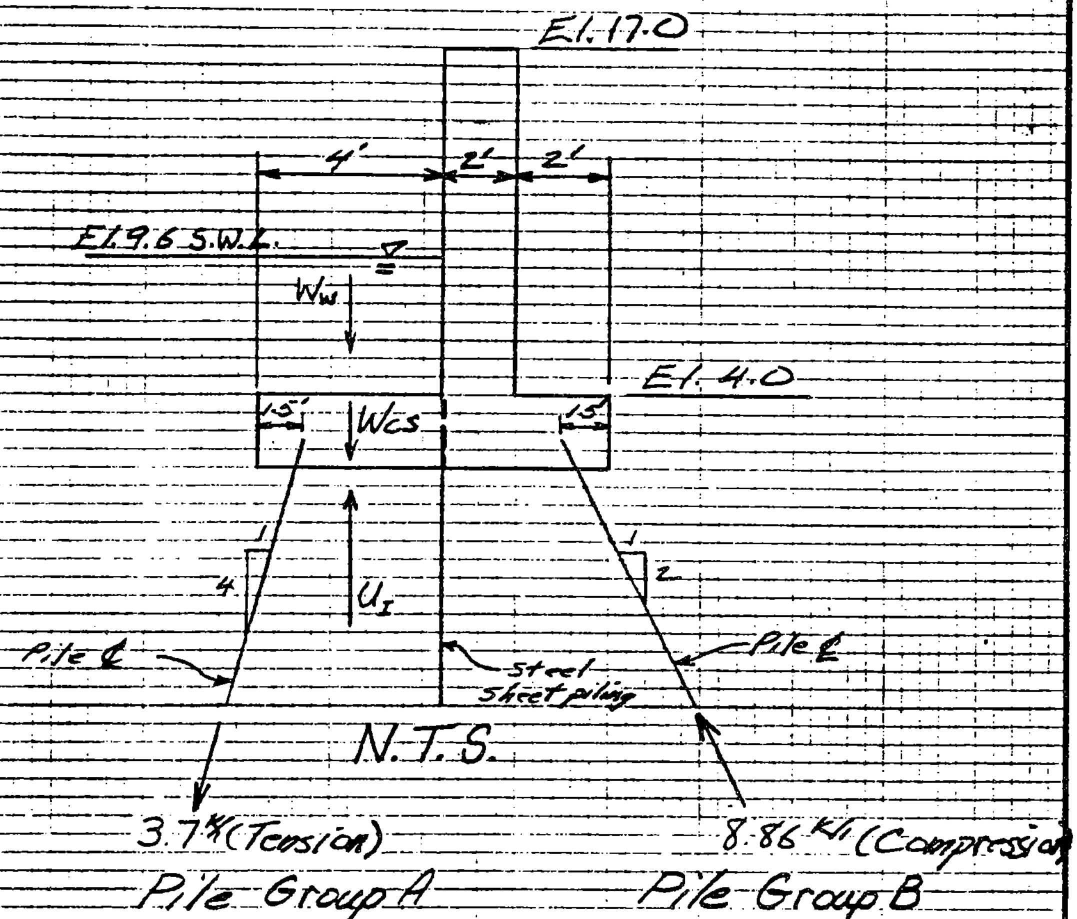
$= 0.36 \ in^2$ (Each face)

$\therefore$ **Use #5, 10"**

LMV FORM 1 FEB 79 107e

COMPUTATION SHEET

PROJECT N.O.-Venice GDM-Reach A	PAGE / OF	COMPUTED BY RCT	DATE 7/6/83
SUBJECT T-Wall Design (Base Slab)		CHECKED BY DRV	DATE MAY 84



Vert. Component $= \frac{4}{\sqrt{17}}(3.7) = \underline{3.59^k\ T}$ Vert. Component $= \frac{2}{\sqrt{5}}(8.86) = \underline{7.92^k\ C}$

$W_W = (0.064)[(1)(4)(5.6)] = 1.43^k$

$W_{CS} = (0.150)[(1)(4)(2.5)] = 1.50^k$

$U_I = 2.16^k$ (Impervious)

$M_W = [(1.43 + 1.50 - 2.16)(2) + (3.59)(2.5)]$

$= 10.515^{k\text{-}1}(12)$

$= \underline{126.18^{k\text{-}in}}$

$M_u = (1.9)(126.18)$

$= \underline{239.74^{k\text{-}in}}$

$M_N = \frac{M_u}{0.9} = \frac{239.74}{0.9}$

$= \underline{266.38^{k\text{-}in}}$

LMV FORM 1 FEB 79 107e

COMPUTATION SHEET

PROJECT N.O. - Venice GDM - Reach A	PAGE 2 OF	COMPUTED BY KLT	DATE
SUBJECT T-Wall Design (Base Slab)		CHECKED BY	DATE

Assumptions: $f'_c = 3{,}000 psi$ 3" Cover

$f_y = 40{,}000 psi$ $h = 30"$

$b = 12"$

$\rho_{max} = 0.25 \rho_b = 0.0093$ (From ETL 1110-2-265)

$m = \frac{f_y}{.85 f_c} = \frac{40}{.85(3)} = 15.69$

$R_u = 0.345 ksi$ (From previous comps.)

$bd^2 = \frac{M_N}{R_u} = \frac{266.38}{0.345} = 772.12 in^3$

$\therefore$ req'd. $d = \sqrt{\frac{772.12}{12}} = \underline{8.02"}$

req'd $A_s = \rho bd = (0.0093)(12)(8.02)$

$= \underline{0.895 in^2}$

Actual $d = 30 - 3 - \frac{1.128}{2}$ (Assuming #9 bar)

$= \underline{26.436"}$

Revised $R_u = \frac{M_N}{bd^2} = \frac{266.38}{(12)(26.436)^2} = \underline{0.032 ksi}$

Revised $\rho = \frac{1}{m}\left(1 - \sqrt{1 - \frac{2mR_u}{f_y}}\right)$

$= \frac{1}{15.69}\left(1 - \sqrt{1 - \frac{(2)(15.69)(.032)}{40}}\right)$

$= \underline{0.0008}$

Revised $A_s = \rho bd = (.0008)(12)(26.436)$

$= \underline{0.253 in^2}$

LMV FORM 107e 1 FEB 79

COMPUTATION SHEET

PROJECT N.O.-Venice GDM-Reach A	PAGE 3 OF	COMPUTED BY RET	DATE
SUBJECT T-Wall Design (Base Slab)		CHECKED BY	DATE

Minimum Steel

Tensile

$A_{min} = \frac{200}{f_y} bd = \frac{200}{40{,}000}(12)(26.436)$ (ACI 10.5.1)

$= \underline{\underline{1.59 in^2}}$

or $A_{min} = (4/3)(Req'd\ A_s) = (4/3)(0.253)$ (ACI 10.5.2)

$= \underline{\underline{0.337 in^2}}$

∴ **Use #6, 12"**

Temp.

$A_s = 0.002bh$ (Half in each face)

$= (0.002)(12)(30)$

$= 0.72 in^2$

∴ $A_s = 0.72/2$

$= \underline{\underline{0.36 in^2}}$ (Each face)

∴ **Use #6, 12"**

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