US Army Corps
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Memphis District

# GRAND PRAIRIE REGION AND BAYOU METO BASIN, ARKANSAS PROJECT

# BAYOU METO BASIN, ARKANSAS

## GENERAL REEVALUATION REPORT

## VOLUME 5

## APPENDIX B

## ENGINEERING INVESTIGATIONS & ANALYSES
## AGRICULTURAL WATER SUPPLY COMPONENT

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**NOVEMBER 2006**

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**NOVEMBER 2006**

# BAYOU METO BASIN, ARKANSAS PROJECT
# GENERAL REEVALUATION REPORT (GRR) INDEX

# SECTION III – CIVIL DESIGN

# EARTHWORK QUANTITIES AND RIGHTS-OF-WAY

## III-1. EARTHWORK QUANTITIES.

Calculations to determine excavation and fill quantities for new canals were made utilizing Intergraph Inroads Design Software using data obtained through aerial photography. Topographical Triangulated Networks (ttn's) and Digital Terrain Models (dtm's) were used and templates "pushed" along horizontal and vertical alignments to obtain volumes of excavation and fill needed to produce the required minimum canal cross section and levee height. In areas where required fill was greater than the quantity of excavation, over-excavation of the canal invert was used to provide additional material in order to minimize haul distances and outside borrow areas. On some canals, levee heights were increased to dispose of excess material in reaches where excavation exceeded fill. A typical cross section of a new canal is shown in Plate III-1.

New canal sections were "cut" for mass haul tables at various intervals. Intervals varied from 100 feet for short canals up to 500 feet for longer canals. The accuracy of the quantities obtained, as compared to a method more accurate than the end area method, varied with the length of the interval with the more accurate information coming from the shorter intervals. The longer section intervals were used to reduce computer processing time and were justified by the accuracy of the design models used to produce the data.

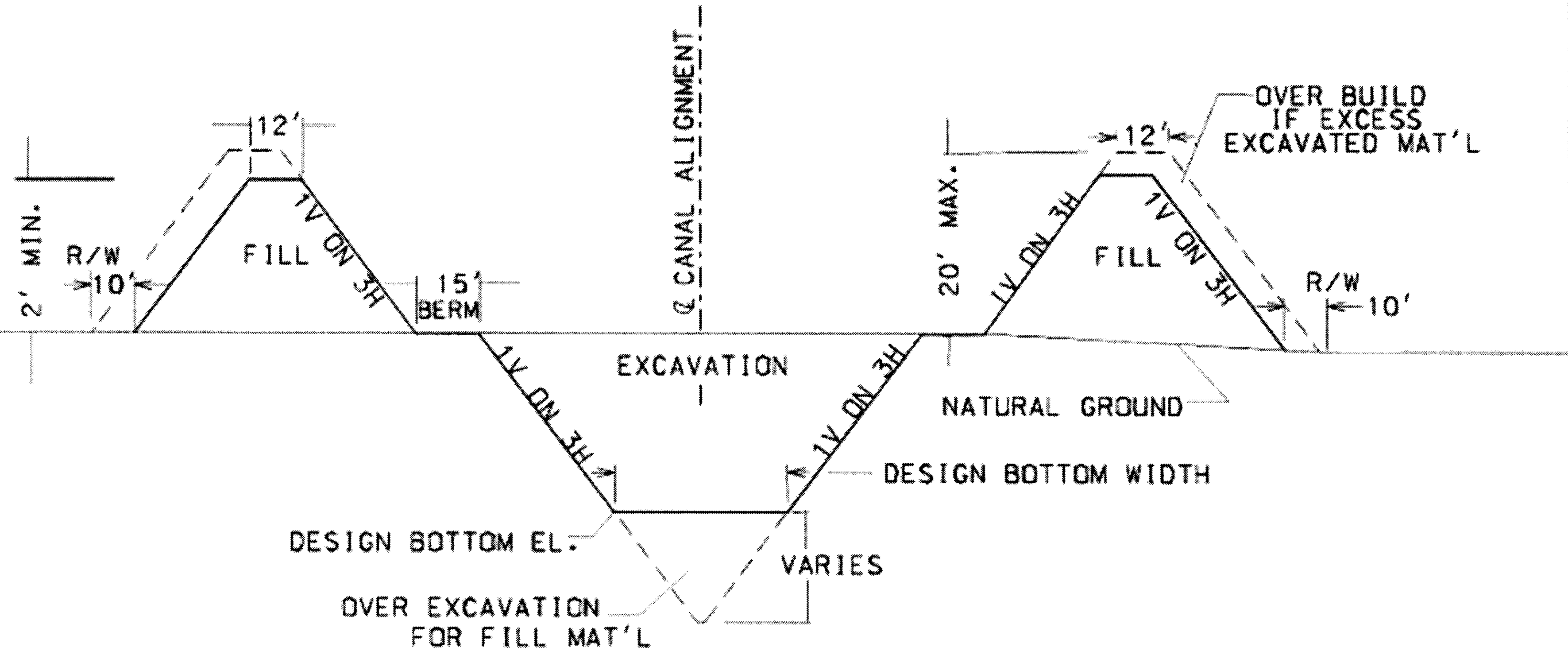
Quantities for existing ditches where channel enlargement is required were computed using the average end area method based on available cross section data and hydraulic design criteria. Excavated material was disposed of along the ditch on the work side. A typical section of an existing ditch is shown in Plate III-2.

Riprap quantities were computed for the inlet canal 500 and 35 bridges on existing ditches and were based on hydraulic design criteria. Riprap and earthwork quantities are presented in Section IX – Cost Engineering.

## III-2. RIGHTS-OF-WAY.

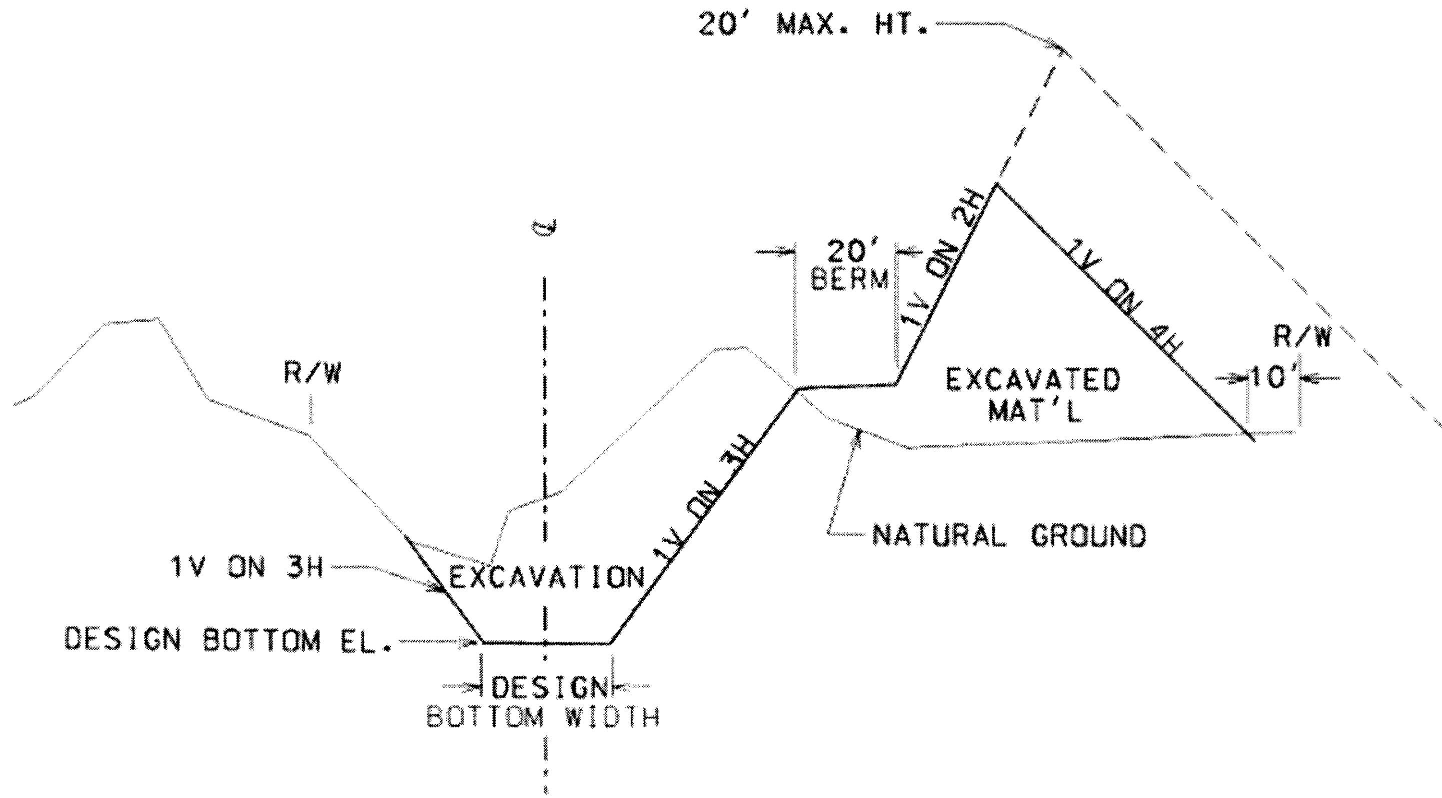
The landside toe of levees was used as a basis to calculate acres of right-of-way for the new canals and levee structure. An additional ten feet of right-of-way was added beyond the levee toe for construction purposes to arrive at the final acreage required. The right-of-way requirements for new canals include any additional lands necessary for the disposal of excess excavated material and for borrow.

On existing ditches where channel cleanout is necessary, the right-of-way extends from the non-work top bank to 10 feet beyond the excavated material disposal pile.




## TYPICAL CROSS SECTION (NEW CANAL)

BAYOU METO AREA DEMONSTRATION PROJECT
TYPICAL CROSS SECTION
NEW CANAL




# TYPICAL SECTION (EXISTING CHANNEL)

BAYOU METO AREA DEMONSTRATION PROJECT
TYPICAL CROSS SECTION
EXISTING CHANNEL

# BAYOU METO BASIN PROJECT,
# ARKANSAS STUDY

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## SECTION IV – STRUCTURAL, ELECTRICAL & MECHANICAL

# BAYOU METO BASIN PROJECT
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## SECTION IV
## STRUCTURAL, ELECTRICAL AND MECHANICAL

# PART A – STRUCTURAL DESIGN DEVELOPMENT

## 4-A-01 SUPPORT STRUCTURES

This section presents the basic criteria for the design of the irrigation structures identified in the Bayou Meto Basin Project feasibility phase. Approval of this GRR will become the basis for initiation of the Design Document Report and plans and specifications for the various structures in this section. Sufficient engineering and design was performed to enable refinement of the project features and prepare the baseline cost estimate. Except for drop structures and weirs, the structural components and configurations of the support structures were adopted from the final design documentation of the Grand Prairie Area Demonstration Project. The structures in this category include:

1) Reservoir control structure
2) Gated check structures
3) Gated well structures
4) Turnouts
5) Inverted pipe siphons
6) Drop structures
7) Weirs
8) Farm Offtakes

## 4-A-02 DESIGN CRITERIA

The Bayou Meto Basin Project falls outside of the traditional Corps civil works flood control project. The major difference between the Bayou Meto project and a typical flood control project is controlled amounts of water are being supplied to the system for irrigation use, where as, in a flood control project life and property is being protected from uncontrolled amounts of water. With this in mind, design criteria was obtained from the United States Bureau of Reclamation (USBR). The USBR's water containing structures are designed essentially the same way as a Corps' structure using the hydraulic factor, specified in EM 1110-2-2104. However, the USBR only designs a structure to this higher standard when leakage from a system is critical. Leakage from a system containing earthen canals is not considered critical. Therefore, a system such as the Bayou Meto Basin project is designed using the lesser water conveying criteria. Applicable USBR criteria can be found in appendices IV-E and IV-F. Quality control and quality assurance correspondence has been included in the "Quality Control Plan and QC/QA Documentation" section. Design Memorandums will be developed as required by ER 1110-2-1150, following approval of this report. The Bayou Meto Basin Project will be designed in accordance with the criteria and guidance furnished in portions of the USBR standards, Corps of Engineers manuals for engineering and design, industry standards, and other technical references as follows:

1) USBR, Design Standard No.3 - Water Conveyance Systems, Chapter 12 - General Structural Considerations, 1994 (Appendix E).

2) USBR, Standard Specification for Reinforced Concrete Pressure Pipe, M0010000.N91, 01 Nov 91
3) US Army Corps of Engineers, Strength Design for Reinforced-Concrete Hydraulic Structures, EM 1110-2-2104.
4) AASHTO, Standard Specifications for Highway Bridges.
5) ACI 318, Building Code Requirements for Reinforced Concrete.
6) AISC, Manual of Steel Construction - Allowable Stress Design.

## 4-A-03 RESERVOIR CONTROL STRUCTURES

Each reservoir has a gated structure to control water passing. Reservoir no. 1 has three 14' taintor gates. Reservoir no. 2 & no.3 each have two 10' taintor gates. The structure consists of base slab with intermediate and end walls that support the gate frames, lifting hoists, and roadway bridge.

## 4-A-04 CHECK STRUCTURES

The main canal has 11 check structures controlling pool elevation and passing water downstream, see appendix IV-B for sketch. Numbers of gates of each structure are tabled on the Table IV-B-1. Off-the-shelf taintor gates will be used. Wing walls at each side of the structures were designed to allow overflow.

## 4-A-05 GATE WELL STRUCTURES AND TURNOUTS

This section covers main canal turnouts, lateral canal turnouts and gate well structures; see appendixes IV-C and IV-D for additional information. Main lateral canals have 183 pump type turnouts that pump water from one canal to another. These structures consist of one 6x6 gate well and pump. There are a total of 14 gate well structures, which are gravity flow structures. These structures serve different hydraulic functions, but, are structurally identical not including size requirements. All these structures have the same components and general configuration as shown in plates IV-C-1 through IV-C-2. Gate well structures consist of precast concrete flared end sections, a length of precast concrete pipe, a cast-in-place concrete gate well and a gate. The gate wells for these structures range in height from 3.5 feet to 13.5 feet. The required length of pipe was calculated by taking the gate well height, multiplying it by twice the slope, and adding a 10-foot crown width minus a gate well and two flared end sections. Class IV pipes, meeting the requirements of ASTM C361, were used for estimating purposes. A gate well inside dimension transverse to the pipe was assumed to be the pipe diameter plus four feet. The inside longitudinal dimension was set to 6 feet. The fourth structure has one gate the same size as the three gated structures. Wall thickness for the gate wells were assumed to be 10 inches for pipe sizes less than 42 inches, 12 inches otherwise. The gate well base was assumed to be 15 inches thick and extend 8 inches beyond the exterior wall face. An 18 inch thick riprap blanket 35 by 20 feet was assumed on the outlet side.

**4-A-06 CROSSINGS**

a. Separation: Structures are needed to separate irrigation water from storm water (natural drainage) and vehicle traffic. Separation of irrigation water and storm water is required in order to control the direction of the irrigation water without impeding natural drainage. Water separation has been accomplished through the use of inverted pipe siphons (sag culverts). Vehicle separation or road crossings have been achieved through the use of inverted pipe siphons and bridges

b. Inverted Pipe Siphons: This section covers inverted pipe siphons at natural drainage and road crossings. Class III pipe, meeting the requirements of ASTM C361, was used for estimating. A typical profile for a pipe siphon is shown in Plate IV-E-1. All pipe was assumed to be placed on six inches of bedding material and backfilled with select material to 37 percent of the pipe diameter. Each run of pipe was assumed to have two flared end sections (one at each end) and four precast concrete pipe elbow sections.

**4-A-07 DROP STRUCTURES**

The drainage chimney drop grade purpose of operation is to stop or reduce the discharge of sediments into the receiving ditches. These structures will be placed at the outlets of the small ditches that empty into the receiving ditches. The drainage chimneys will enable a large flow of water to be discharged while restricting the amount of sediments discharged. See plate IV-F-1 for typical configuration.

**4-A-08 WEIRS**

The Bayou Meto Basin crested weirs are being built to establish pools for pumping irrigation demands. These weirs will allow for control and regulation of flow as it moves downstream. The weirs will regulate the flow by establishing control sections at the weirs that, based on water surface elevations, can be used to compute flow over the weir. The weirs will also act as a sediment trap, which will aid determination of dredging requirements. See plate IV-G-1 for typical configuration.

**4-A-09 FARM OFFTAKES**

The farm offtakes consist of canal offtakes, natural stream offtakes and pipeline offtakes. An intake structure is required for offtakes in canals and natural streams. See plate IV-H-1 for typical sections and structural configurations.

# PART B - ELECTRICAL - POWER, CONTROL SYSTEMS AND OPERATING CONDITIONS

## 4-B-01. Introduction

The Bayou Meto Basin Project includes a land area of approximately 779,109 acres. Within that area a canal network will be constructed which will include gated check structures, main canal turnouts, lateral turnouts and road crossings. Irrigation water will be furnished to the canal system from the Arkansas River via a 1750 CFS (cubic feet per second) pumping station (Pump Station Number 1) operated and controlled by a pumping station operator (Pump Operator), and supplemented in the canal system by three fully automated pump stations. The supplemental pump stations will be designated the Pump Station Number 2 (at Bayou Meto) of 625 CFS, the Pump Station Number 3 (at Bayou Two Prairie) of 260 CFS, and the Pump Station Number 4 (at Caney Creek) of 125 CFS. The main canal turnouts and lateral turnouts, to be furnished as part of this project, will contain individual gates and pumping units for providing water to specific reaches. The entire canal system of gates and pumps (excluding Pump Station Number 1) will be controlled by a Supervisory Control and Data Acquisition (SCADA) system and will be operated by an operator (Watermaster). The SCADA control system may be operated in a fully automatic mode, an operator-assisted (manual) mode, or by using a combination of both automatic and manual modes. The SCADA system is known as a supervisory automatic or supervisory computer directed control system. The central monitoring station for the main canal control system will be located in the control room at a location to be determined and will be separate from the controls for Pump Station Number 1. The control systems for the pumping station and for the canal network will be capable of interfacing with each other for future total automatic control. The Pump Operator, the Watermaster, and all support personnel will possess high levels of technical expertise to insure successful canal operations.

The Bayou Meto Pump Station Number 1 will operate as a supply-type station with upstream control. The pump station will be a supply-oriented system because the amount of available supply water (from the Arkansas River) will determine the operation schedules of the pump station and of the canal flow system. The control structures and turnouts having gravity flow or pumps located in the canal system will be operated as a supply-type system. The system will be controlled by the Watermaster, based on real-time information of water levels upstream and downstream of the structures, and on demands of the water delivery schedule. The control systems for the pump stations and the canal system will be designed with components requiring low maintenance and ease of operation.

## 4-B-02. Canal Flow Requirements

The canal flow requirements (or, water delivery schedule) will be determined by totaling the amount of water required, beginning at the most downstream pool and progressing upstream to the canal headworks (Pump Station Number 1). The farmers will request water amounts at least 24 hours in advance of need. The Watermaster will determine the total amount of water necessary to meet the needs of all customers. The system will then initiate the water transfer procedures by adjusting the water elevation and flows beginning at the canal headworks and progressing downstream to each check structure and turnout. The Pump Operator will provide for continuous readjustments of all equipment as needed to maintain the required water flow. Using a scheduled delivery system will allow the Watermaster the option of requiring water users to reschedule deliveries if the cumulative water orders exceed the daily, monthly or yearly contractual allotments. The canal water flow will be a controlled-volume (dynamic regulation) system capable of responding to a wide range of flow conditions. The controlled-volume operating system, based on real-time dynamic conditions, will require complex and frequent system changes that will affect the entire canal system. A mathematical model of the canal system will be necessary to determine those complex operations. The mathematical model that will be used has been developed and is known as the Sobek model.

## 4-B-03. Water Conveyance System

The water distribution system will consist of the 1750 CFS (cubic feet per second) Pump Station Number 1 delivering water from the Arkansas River through discharge pipes, into a concrete discharge structure, and then to an open channel main canal connector system. The main canal system will discharge to either pump or gravity turnouts that will supply water to local farmers. The canal system will maintain water to levels within specified maximum and minimum limits, thus providing predictable service to canal side turnouts and optimizing pumping unit operation.

The water distribution system will operate on the principle of balanced-pool operation. The amount of water between each check structure will conform to the criteria of QC1 = QTO1 + QC2, or Pool Inflow = Flow from Turnouts + Pool Outflow. The canal flow type (or manner in which the flow depth changes with respect to distance and time) can be classified as an unsteady, gradually varied flow. Any flow change initiated by changing gate positions at a check structure, or by varying the capacity of the pump stations, will create a traveling translatory wave which will travel at a greater velocity than the mean canal water velocity. Because of this positive gravity wave in open channels when a gate is opened even a small increment, water flow will begin to increase at points downstream as soon as the leading edge of the translatory wave front arrives. This translatory wave will arrive sooner than water supplied by the average flow velocity in the canal. At the same time, a negative translatory wave will progress upstream of the gate. Conversely, when a gate closes, an opposite effect will occur. These effects will create complex water conditions that will require multiple control schemes. These will be addressed by the control algorithms and programs associated with the individual site controllers, and the main canal control system controller.

## 4-B-04. Control

Adjustments of the control structure (check structures) and control of the turnout pumps will be based upon information obtained from upstream and downstream water level sensors. The adjustments will occur automatically at the structures, with set points capable of being remotely changed from the central monitoring station. The sensed information will be interpreted by control algorithms designed to calculate the required adjustments of the canal check gates to satisfy the actual water requirements. The algorithms represent a set of well-defined rules and adjustments that will create solutions to water deliveries in a finite number of steps, using mathematical equations and

Boolean logic (a logic system using "and," "or," "if," etc.). Microprocessor equipment will be used to execute the algorithms and perform all necessary logic calculations for automatic control. Each control structure will be equipped with this capability to control gates and/or pumps, automatically.

The control system will operate as a closed loop system; the status of gates and/or pumps will be compared to the desired quantity of water, and any deviation (error) will be fed back into the control system for correction (i.e., feedback control). Should the feedback system not return to equilibrium after a change is initiated, the disturbances will oscillate at constant amplitude or, perhaps, will increase in amplitude. When reviewing the stability of the control system, the characteristics of the Laplace transform for the canal structures and equipment must be analyzed. That analysis, which will be performed in conjunction with the mathematical model of the canal system, will be included in the contract requirements for the control system.

All sensor inputs to the controllers will be conditioned; i.e., wave action (due to wind waves) of canal water surface, and influences from other transient disturbances will not cause continuously changing gate positions. Thus, the number of gate movements will be minimized. Additionally, the control scheme will incorporate dead band and anti-hunt features for improved stability.

The mode of control (i.e., the manner in which the gate system will operate) will be a combination of proportional, integral, and derivative (PID) modes. The proportional control will control the gates using a fixed linear relationship between the desired water elevation and the position of the gates. Proportional control typically has an inherent residual error associated with it, known as "steady state error" or "offset." The steady state error of this system would be a sustained deviation between the water level and the setpoint. To correct this offset (steady state error), an integral control mode will be used that will generate a corrective effort proportional to the sum of all previous errors (rather than addressing only the present error); the combination proportional-integral control functions will return the water level to its desired (setpoint) elevation after a change in flow rates occurs. The third mode of control, derivative or rate-of-change, will allow for an initially large control response when a deviation from the setpoint occurs. Derivative control provides a temporary overcorrection to the system, which is proportional to the rate of deviation per unit time. This control mode is needed because canal systems have an unusually large delay or lag time from when setpoint deviation occurs to when the desired water level is actually restored. After the initial, large control response (derivative) occurs, the other modes of control (proportional-integral) will take effect and "fine-tune" the final gate position.

The Bayou Meto Pump Station Number 1 will be operator-controlled, and will include some automatic systems. In general, the station will be equipped with automatic shutdown provisions for pump motors in the event of a pump or motor failure; other, normal pump station conditions may initiate an automatic shutdown of pump motor(s). The pumps will be started and stopped manually by the pump station operator, based on water supply and customer demand. The station will include provisions for possible future total automatic operation.

Pump Stations Numbers 2, 3, and 4 will operate automatically, based on the upstream water elevation. They will pump only when water is available. Those three stations will also be capable of local manual control, or remote control from the central monitoring station.

## 4-B-05. Gates

The gates used in the check structures, conduit check structures, main canal turnouts, and lateral turnouts will be roller, slide, or taintor gates ranging in size from approximately 1.5 feet to 14 feet, and will be suitable for irrigation use. Each gate will be operated by an electric motor, with provisions for manually raising and lowering the gate in the event of power or equipment failure. Sensors will monitor the position of the gates. The gates will normally operate automatically from a pre-programmed water elevation setpoint. The gate setpoint will be capable of being changed remotely by the operator (Watermaster) from the central monitoring station, or being manually changed at the site if the need should arise. Gates on the check structures will also operate in a submerged condition; i.e., the toe of the downstream hydraulic jump, immediately downstream of the gate lip, will be submerged. Where individual check gates will be operated independently of other check gates in the canal, the gates will be operated selectively. In the event of a power failure, all gates will either automatically close or will remain in their position, depending on the requirements of the entire canal system.

## 4-B-06. Turnouts

The canal system will have a network of main canal turnouts and lateral turnouts. Each turnout will be either a gravity flow type, or will contain a pumping unit. At each turnout, a constant minimum water depth will be maintained, as far as is practicable, to provide a steady flow. Some of the main and/or lateral turnouts will be furnished with electric motor-driven pumping units. The water level will be measured upstream and downstream of the turnouts; the water flow rate(s) will be calculated at the central monitoring station, either manually by the Watermaster or by the main central computer. Also, all monitored features at the site will be transmitted to the central monitoring station. The pumping units will be capable of being operated automatically by remote control, or manually by local control. Normally, the Watermaster, from the central monitoring station, will control each pumping unit.

## 4-B-07. Pumps

The Pump Station Number 1 will comprise a total of four (4) - 1500 horsepower pump units and two (2) - 500 horsepower pump units, and will be capable of delivering 1750 CFS of water from the Arkansas River into the main canal system. The Pump Operator will start and stop the pumps, in any combination, from a master control station. The Watermaster will determine the amount of water available and the amount required by the customers. The pumps will be individually controlled by the Pump Operator to satisfy the water requirements. The combination of different capacity pumping units will allow diversity and operational flexibility in canal water flow.

The Pump Station Number 2 will comprise a total of five (5) - 476 horsepower pump units and will be capable of delivering 625 CFS of water. The pump station will operate automatically, based on the water elevation upstream of the pump station.

The Pump Station Number 3 will comprise a total of three (3) - 316 horsepower pumps and will be capable of delivering 260 CFS of water. The pump station will operate automatically, based on the water elevation upstream of the pump station.

The Pump Station Number 4 will comprise a total of three (3) - 100 horsepower pumps and will be capable of delivering 125 CFS of water. The pump station will operate automatically, based on the water elevation upstream of the pump station.

## 4-B-08. Control System

The Bayou Meto Basin Project will be operated by a supervisory automatic control system with remote set point capability. Each structure having gate(s) and/or pump(s) will have a controller (commonly called a Remote Terminal Unit - RTU) which will measure various parameters, such as upstream and downstream water elevations, position of gate(s), the rate of change of water elevation, pump pressure, and pump status ("on" or "off") at turnouts. The RTU will be a microprocessor-based device that will be capable of performing real-time measurements, signal processing, system control, and communications of remote field conditions. The RTU will operate the structure(s) automatically and/or will transmit data to a central monitoring station for manual operation. Additionally, the RTU will transmit all alarm conditions to the central monitoring station. At the central monitoring station, the operator (Watermaster) will continually monitor the operation and functions at each site. The Watermaster and/or the RTU will compute water flow rates. Also, the Watermaster will be capable of changing the operating parameter(s) remotely from the central station.

The RTU will perform one or more of the following functions:

a. Measure average water elevation (conditioned signal) upstream of the site.
b. Measure average water elevation (conditioned signal) downstream of the site.
c. Measure gate(s) position at gated structures.
d. Measure rate of change of average water elevation (conditioned signal).
e. Automatically raise or lower gate(s) at gated structures.
f. Measure pressure in discharge pipe of pumps at turnouts.
g. Monitor the status of pump(s) at turnouts ("on" or "off").
h. Transmit all measured data to the central monitoring station.
i. Accept remote changes in setpoints from the central monitoring station.
j. Accept remote manual control instructions from the central monitoring station.
k. Transmit alarm signal to the central monitoring station for low or high water elevations, loss of power, intrusion by unauthorized personnel, failure of equipment.
l. Operate on battery with 120 VAC or solar power (if required) recharge.

## 4-B-09. Central Monitoring Station

The Central Monitoring Station (also called Headquarters or Master Station) will be located in a control building that will be identified at a later date. The Master Station will be equipped with an IBM-compatible, Pentium class computer and monitor(s) that will run software programs, enabling the Watermaster to interface with the control system for programming, alarm announcements and acknowledgment, real-time monitoring, supervisory control, and data logging. The main canal control system will be equipped with a color video display and will present canal system information to the Watermaster through a system of display screens. Back-up computer and color display units will be capable of completing all canal control tasks if the primary equipment becomes inoperable or is removed from service for maintenance or upgrading.

The Central Monitoring Station will perform the following functions:

a. Provide a real-time monitor of all network activities.
b. Annunciate alarms and provide acknowledgment capability.
c. Record measurement and status data.
d. Provide an interface for system programming.
e. Support multiple monitoring stations (if required).
f. Provide remote manual control of each monitored site.
g. Use industry standard computer platforms and software.
h. Provide a hardcopy (printer) record of all inputs/outputs.

## 4-B-10. Communications

The monitoring and control system for the canals will be connected from site to site (as required), and from site to the central monitoring station, by radio link and by fiber optic cable. Radio frequency transmission was chosen over other systems (satellite transmission, telephone modem, etc.) because of its simplicity, ease of maintenance, expansion capability, and cost effectiveness. The RF transmissions will be capable of covering a distance of 20 miles (low power, generally 2 watts) with each controller being capable of use as a repeater to extend the range of data transmission from the most distant site to the central monitoring station. Power will be supplied to the transmitters by battery; batteries will be recharged using either 120-volt ac charger(s) or solar cell(s) (at remote sites where the installation of an ac power line would be impractical). The data will be transmitted over dedicated frequencies (mid-400 MHZ range) with each site having a uniquely coded identification address. It is anticipated that the data will be transmitted at least every 15 minutes. Some RTUs may be hard-wired in one location with the final data transmissions sent by buried fiber optic cable to a centrally located RTU, or to the Central Monitoring Station. The entire communications system will be configured as a radial system for rapid communication, direct control, and numerous data points.

## 4-B-11. Lightning and Surge Protection

All canal control equipment will be protected from lightning and transient voltage surges. Protective devices will be installed at the ac power line, the controllers, antennae, and all sensor inputs. The devices will include fuses, MOVs (metal oxide varistors), radio frequency interference filters, and isolation equipment. All equipment and all metallic enclosures will be electrically bonded together and securely grounded. Since the communication devices that will transmit data will operate on battery power (with automatic recharge), the Watermaster will be able to continuously monitor the condition of the canal gates and pumps. All power outages can be reported to the power company immediately for repair.

## 4-B-12. Power Sources

Local electric power supply companies or cooperatives will provide electric power for the Bayou Meto Basin Project (i.e. for the four Bayou Meto pump stations, and all electric-operated gates and small pumps located throughout the project). Entergy Services, Inc., headquartered in Little Rock, Arkansas, will supply power to Pump Station Number 1 and to Pump Station Number 2. First Electric Cooperative, headquartered in Jacksonville, Arkansas will supply power to Pump Station Number 3 and to Pump Station Number 4. Each of two electric substations at the Pump Station Number 1 will be approximately 10 MVA. Additionally, one 315 kVA substation/transformer will be required at Pump Station Number 1 to supply ancillary loads. At each of the Pump Stations Numbers 2, 3, and 4, a single substation will be required. For Pump Stations Numbers 2, 3 and 4, the substations will be approximately 3 MVA, 1 MVA, and 350 kVA, respectively. All the above-mentioned substations will be furnished and installed by the electric service provider.

Entergy Services, Inc. has provided estimates of the costs associated with the construction and/or installation of electrical distribution equipment necessary to provide electric energy to Pump Station Number 1 and to Pump Station Number 2. However, the estimates furnished by Entergy do not include the costs that will result from the construction and installation of transmission line equipment required to connect the pump stations' substations to Entergy's 115-kV distribution system. It is anticipated that those costs will be significant. Further, Entergy has provided estimates of costs for electric energy to be delivered to Pump Station Number 1 and to Pump Station Number 2. The cost estimates are based on the pump station loads shown in the table below. Also, the estimates assumed that Pump Station Number 1 and Pump Station Number 2 would operate at load factors of 0.20 for the month of December and 0.85 for each remaining month.

First Electric Cooperative has provided estimates of the costs associated with the construction and/or installation of electrical distribution equipment necessary to provide electric energy to Pump Station Number 3 and to Pump Station Number 4. Further, First Electric Cooperative has provided estimates of costs for electric energy to be delivered to Pump Station Number 3 and to Pump Station Number 4. The cost estimates are based on the pump station loads shown in the Table 1 below. Also, the estimates assumed that Pump Stations Numbers 3 and 4 would operate 11 months each year, with each December being a "shut-down" month.

**Table 1 – Pump Station Loads**

| Pump Station | Load - Pump Motors | kW Demand |
|---|---:|---:|
| Number 1 | 7000 hp | 6529 |
| Number 2 | 2380 hp | 2331 |
| Number 3 | 948 hp | 710 |
| Number 4 | 300 hp | 310 |
| | | |

The cost estimates furnished by Entergy Services, Inc. and First Electric Cooperative are summarized in the Table 2 below:

**Table 2 – Cost Estimates**

| Plant | Service Provider | Estimated Construction Costs | Estimated Annual Energy Costs |
|---|---|---|---|
| Pump Station Number 1, 4160-V Service | Entergy Services, Inc. | $1,231,069 | $2,227,566 |
| Pump Station Number 1, 480-V Service | Entergy Services, Inc. | $62,000 | Included Above |
| Pump Station Number 2 | Entergy Services, Inc. | $214,000 | $798,138 |
| Pump Station Number 3 | First Electric Cooperative | $213,700 | $159,926 |
| Pump Station Number 4 | First Electric Cooperative | $466,700 | $70,075 |
| | | | |

## 4-B-13. Control System Contract

The contract for the system integrator for the control system is expected to be awarded using a two-step, sealed-bidding procurement process, in accordance with Part 14, Subpart 14.5, "Two-Step Sealed Bidding," of the FAR and the Department of Defense Federal Acquisition Regulation Supplement (DFARS). In the first step, the Government will initiate a purchase procedure by publishing a Request For Technical Proposal (RFTP), which will outline the requirements of the control system. Those requirements will include the controllers, the main master operating station with main computer and display, the type of gate and pump motor control needed, and the use of a mathematical model, including numerical analog studies and analyses, and any other studies necessary such as:

a. Use of "SOBEK" modeling software as a mathematical model.
b. Normal operational studies to determine how the canal system will operate from startup to full capacity.
c. Steady state conditions showing typical water surface fluctuation rates compared to drawdown and freeboard allowance.
d. Abnormal operational studies to determine how flow is affected during minor equipment failure, draining the canal, filling the canal system, and removing parts of the system from service for testing or repair.
e. Emergency operation studies to predict optimum response to the most severe operating conditions, such as excessive water levels or rapid variation in water levels.
f. A computer modeled study to predict radio signal coverage, showing antenna locations

including actual onsite signal-strength tests.

g. The type of gate and pump motor control needed to meet the requirements of the canal system; i.e., single speed motor control or adjustable speed drives.
h. The type of gate needed at each check structure and turnout; i.e., capability of withstanding reverse head, etc.
i. Any recommendations for control of the system that will optimize the operation.

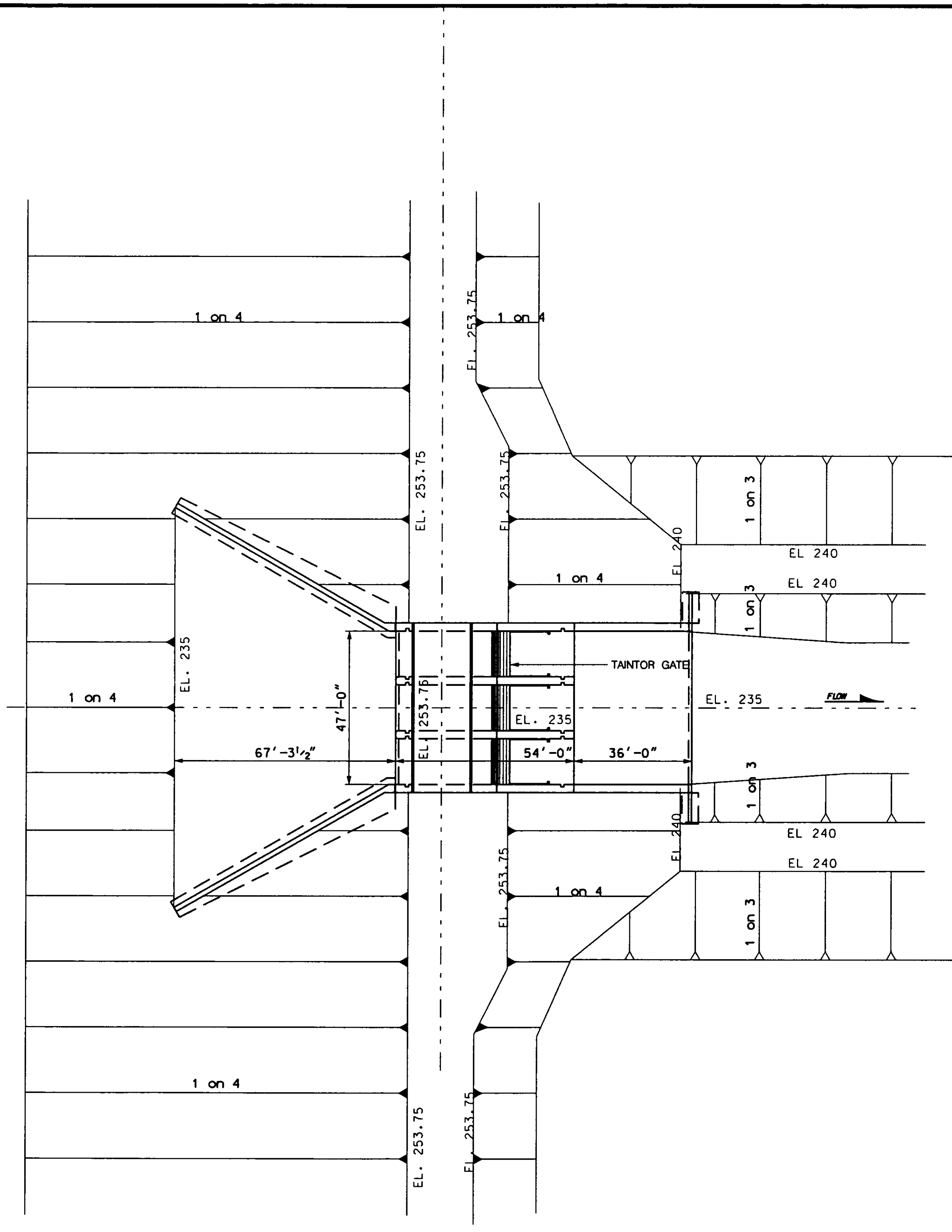
After the Government receives the technical proposals, an evaluation of the proposals will be made. The proposals will be classified as "acceptable," "unacceptable," or "reasonably susceptible to being made acceptable." Only "acceptable" or "reasonably susceptible to being made acceptable" (if necessary to insure adequate price competition) proposals will be allowed to compete in step two. In step two, those proposals deemed "acceptable" will submit sealed bids that will be evaluated, and an award will be made using standard sealed-bid procedures.

# Bayou Meto Basin Project
# Structural, Electrical & Mechanical

# APPENDIX IV-A

# RESERVOIR CONTROL STRUCTURES

U.S. Army Corps of Engineers
Memphis District



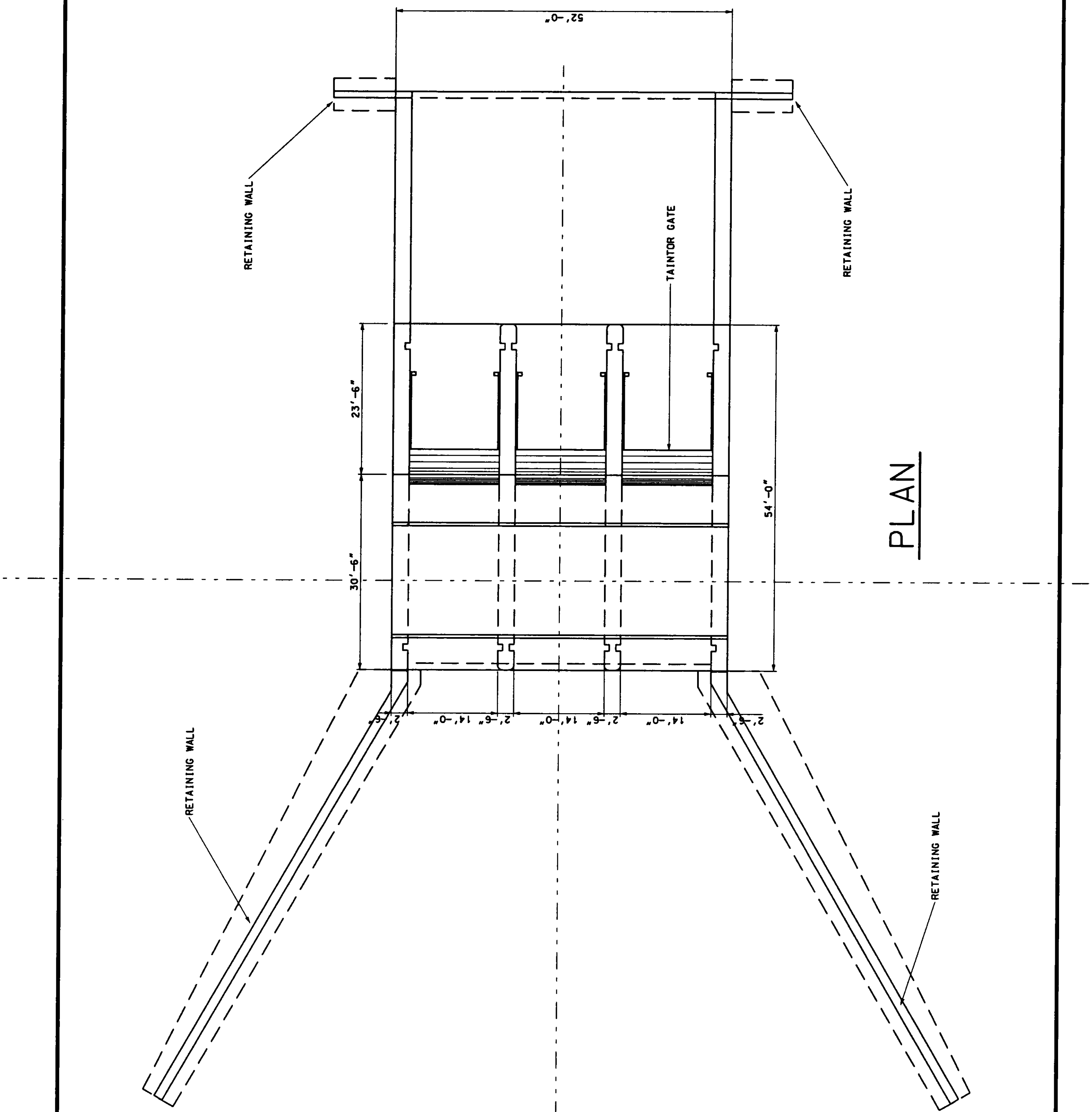

## SITE PLAN

US Army Corps of Engineers

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEER
MEMPHIS, TENNESSEE

BAYOU METO BASIN COMPREHENSIVE STUDY
BAYOU METO BASIN
RESERVOIR NO. 1
CONTROL STRUCTURE - C1000R

PLATE
IV-A-1

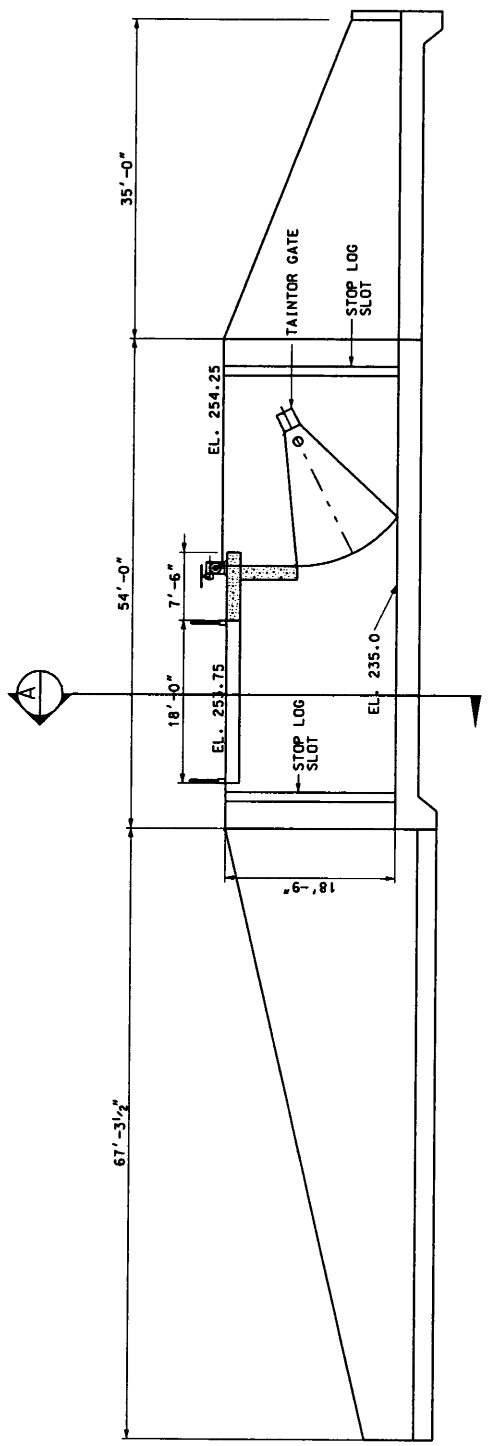



US Army Corps of Engineers

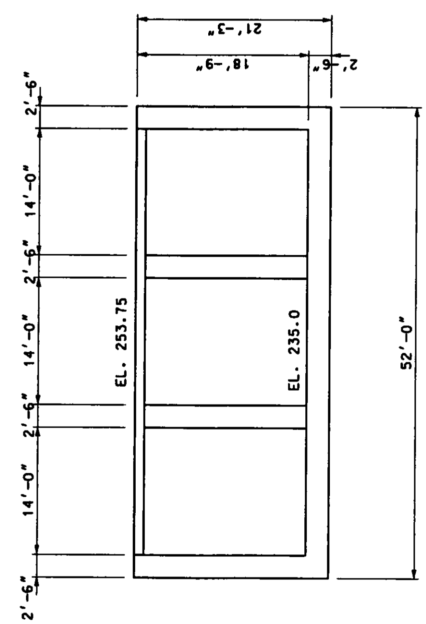
U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEER
MEMPHIS, TENNESSEE

BAYOU METO BASIN COMPREHENSIVE STUDY
BAYOU METO BASIN
RESERVOIR NO.1
CONTOL STRUCTURE C1000R - PLAN

PLATE
IV-A-2




CENTERLINE SECTION




SECTION - A

US Army Corps of Engineers

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEER
MEMPHIS, TENNESSEE

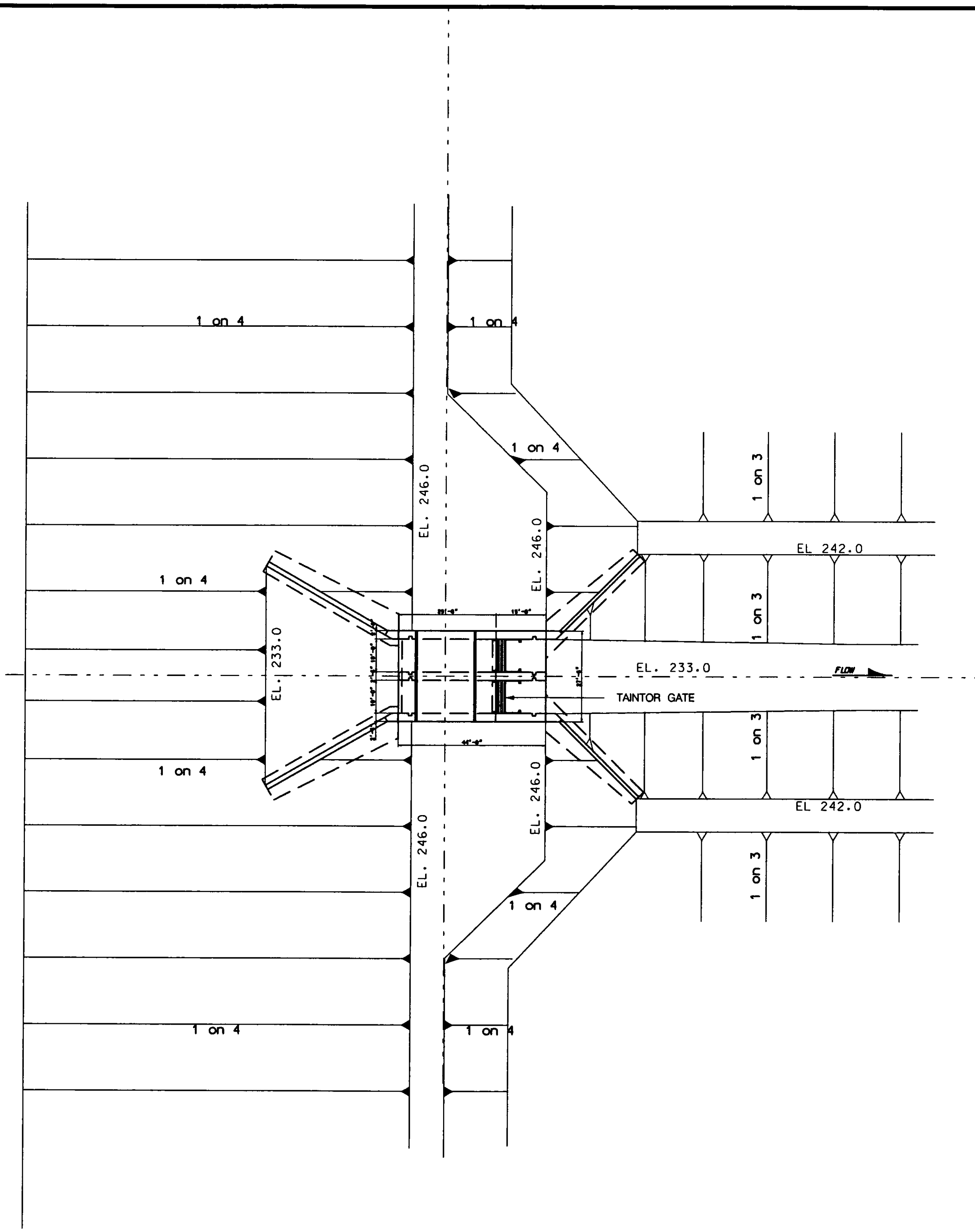
BAYOU METO BASIN COMPREHENSIVE STUDY
BAYOU METO BASIN

RESERVOIR NO.1

CONTROL STRUCTURE C1000R - SECTIONS

PLATE

IV-A-3



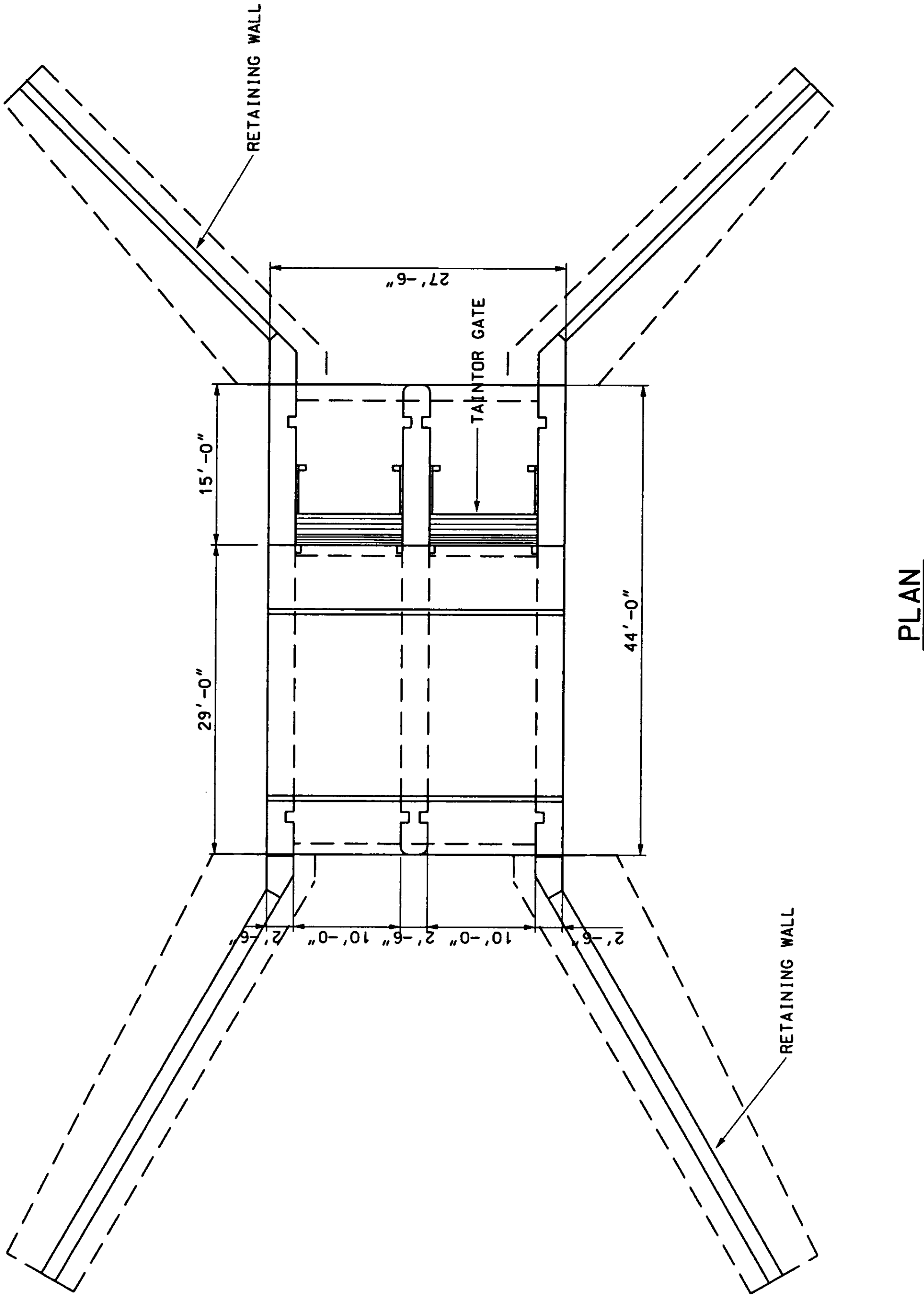

## SITE PLAN

US Army Corps of Engineers

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEER
MEMPHIS, TENNESSEE

BAYOU METO BASIN COMPREHENSIVE STUDY
BAYOU METO BASIN
RESERVOIR NO. 2
CONTROL STRUCTURE C2500R - SITE PLAN

IV-A-4




US Army Corps
of Engineers

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEER
MEMPHIS, TENNESSEE

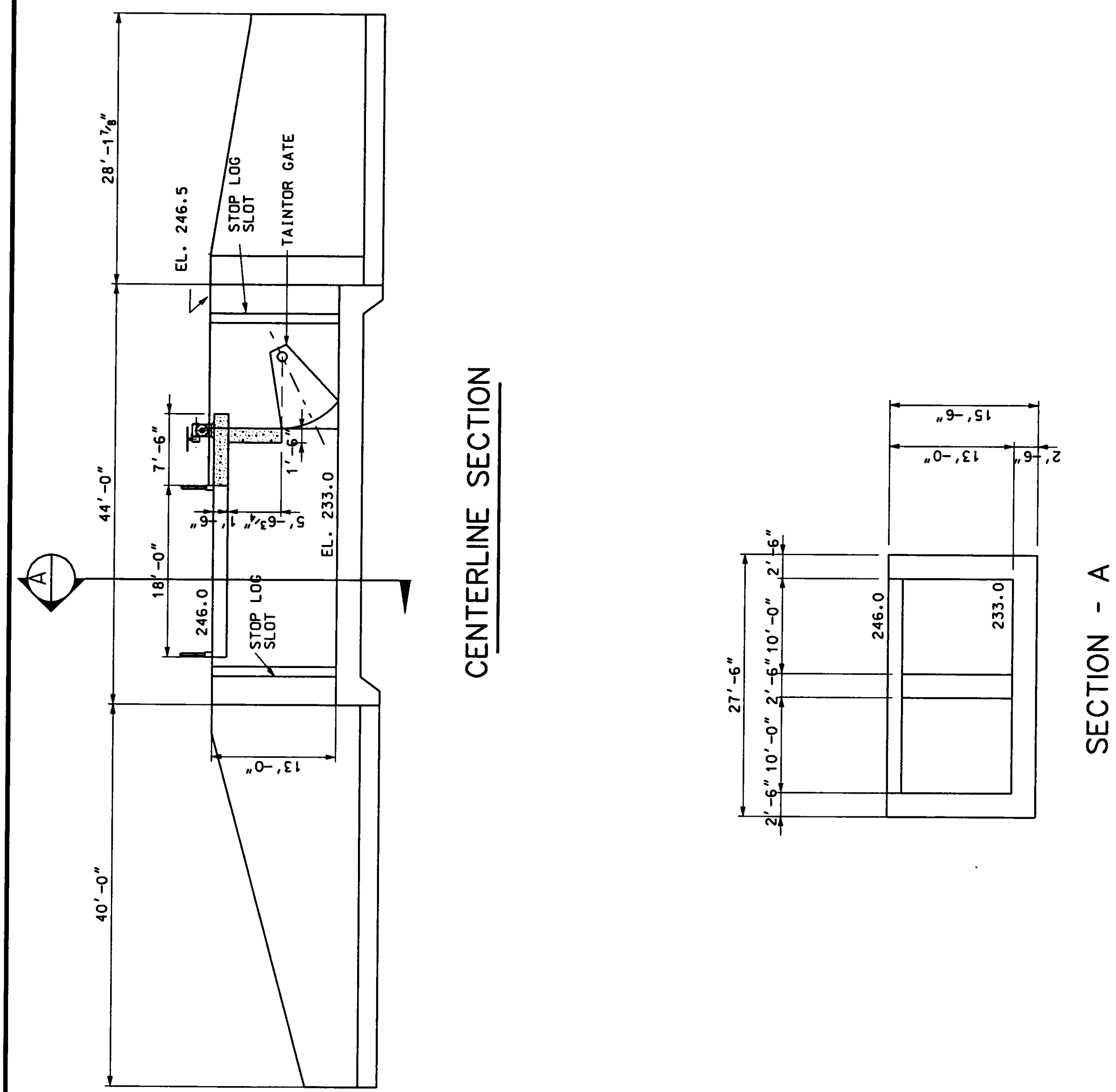
BAYOU METO BASIN COMPREHENSIVE STUDY
BAYOU METO BASIN

RESERVOIR NO. 2

CONTROL STRUCTURE C2500R - PLAN

PLATE

IV-A-5




US Army Corps of Engineers

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEER
MEMPHIS, TENNESSEE

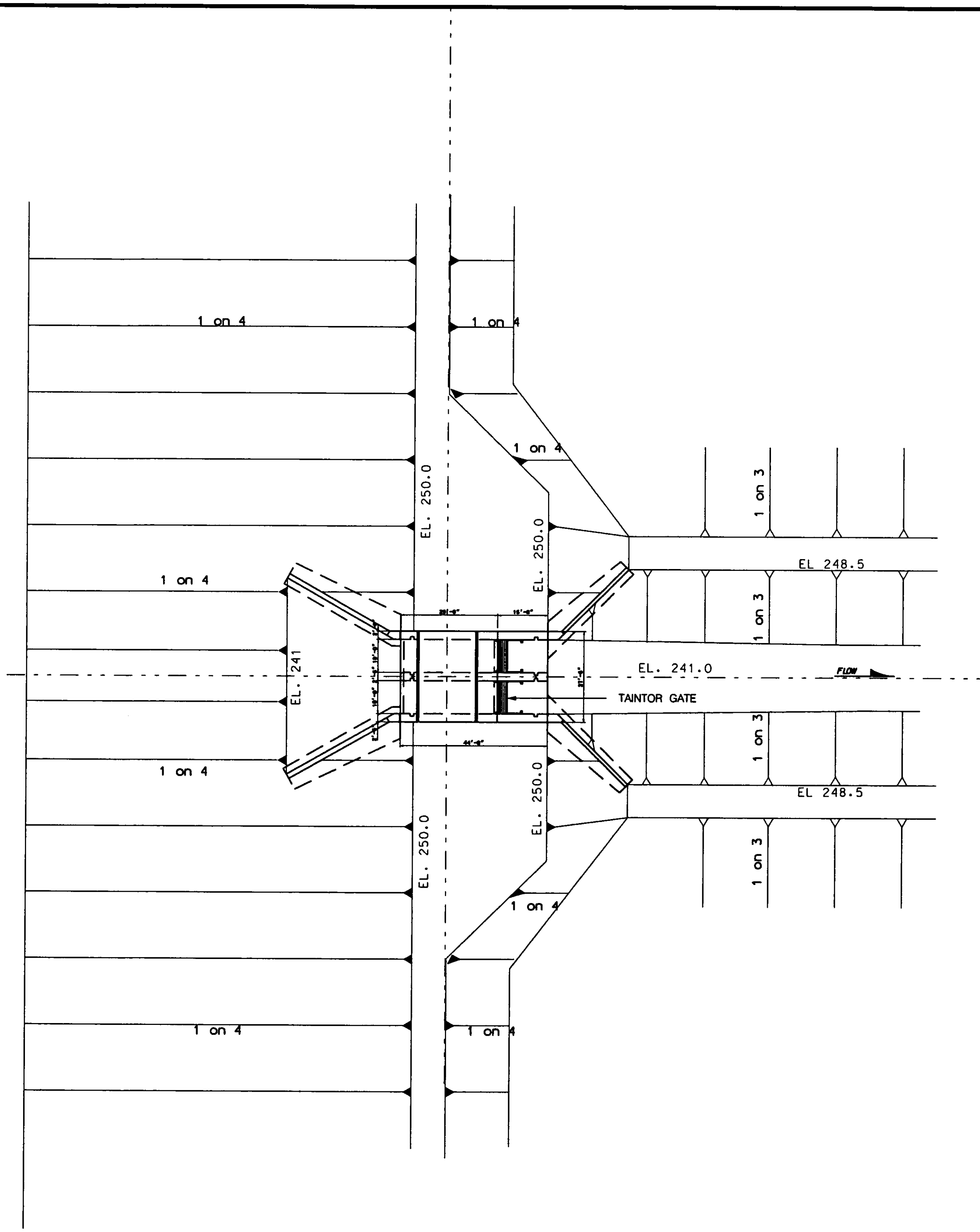
BAYOU METO BASIN COMPREHENSIVE STUDY
BAYOU METO BASIN

RESERVOIR NO. 2

CONTROL STRUCTURE C2500R – SECTIONS

PLATE

IV–A–6



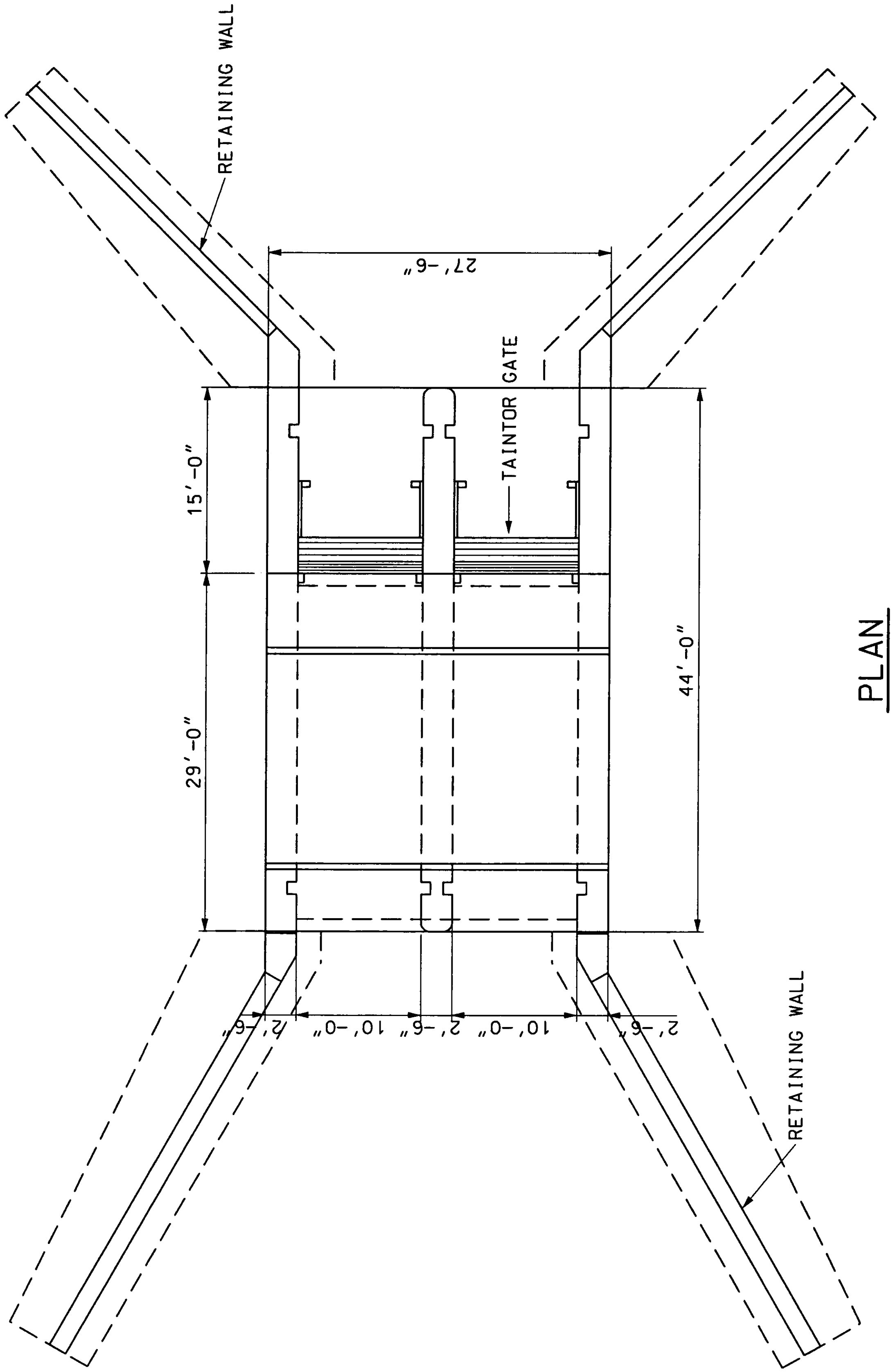

## SITE PLAN

US Army Corps of Engineers

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEER
MEMPHIS, TENNESSEE

BAYOU METO BASIN COMPREHENSIVE STUDY
BAYOU METO BASIN
RESERVOIR NO. 3
CONTROL STRUCTURE C4000R – SITE PLAN

PLATE
IV–A–7




US Army Corps
of Engineers

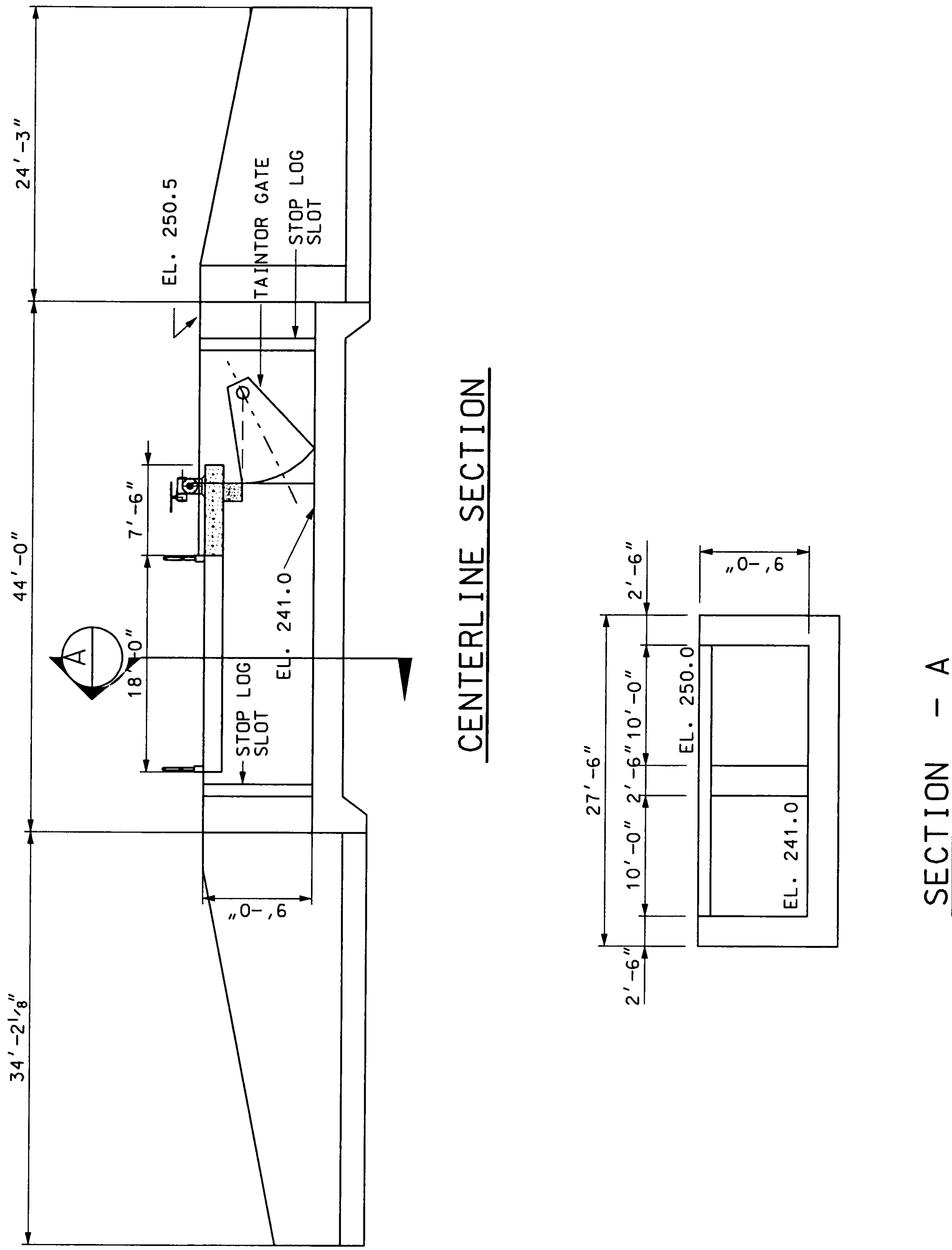
U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEER
MEMPHIS, TENNESSEE

BAYOU METO BASIN COMPREHENSIVE STUDY
BAYOU METO BASIN

RESERVOIR NO. 3

CONTROL STRUCTURE C400R - FLOOR PLAN

PLATE
IV-A-8




US Army Corps of Engineers

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEER
MEMPHIS, TENNESSEE

BAYOU METO BASIN COMPREHENSIVE STUDY
BAYOU METO BASIN

RESERVOIR NO. 3

CONTROL STRUCTURE C4000R - SECTIONS

PLATE

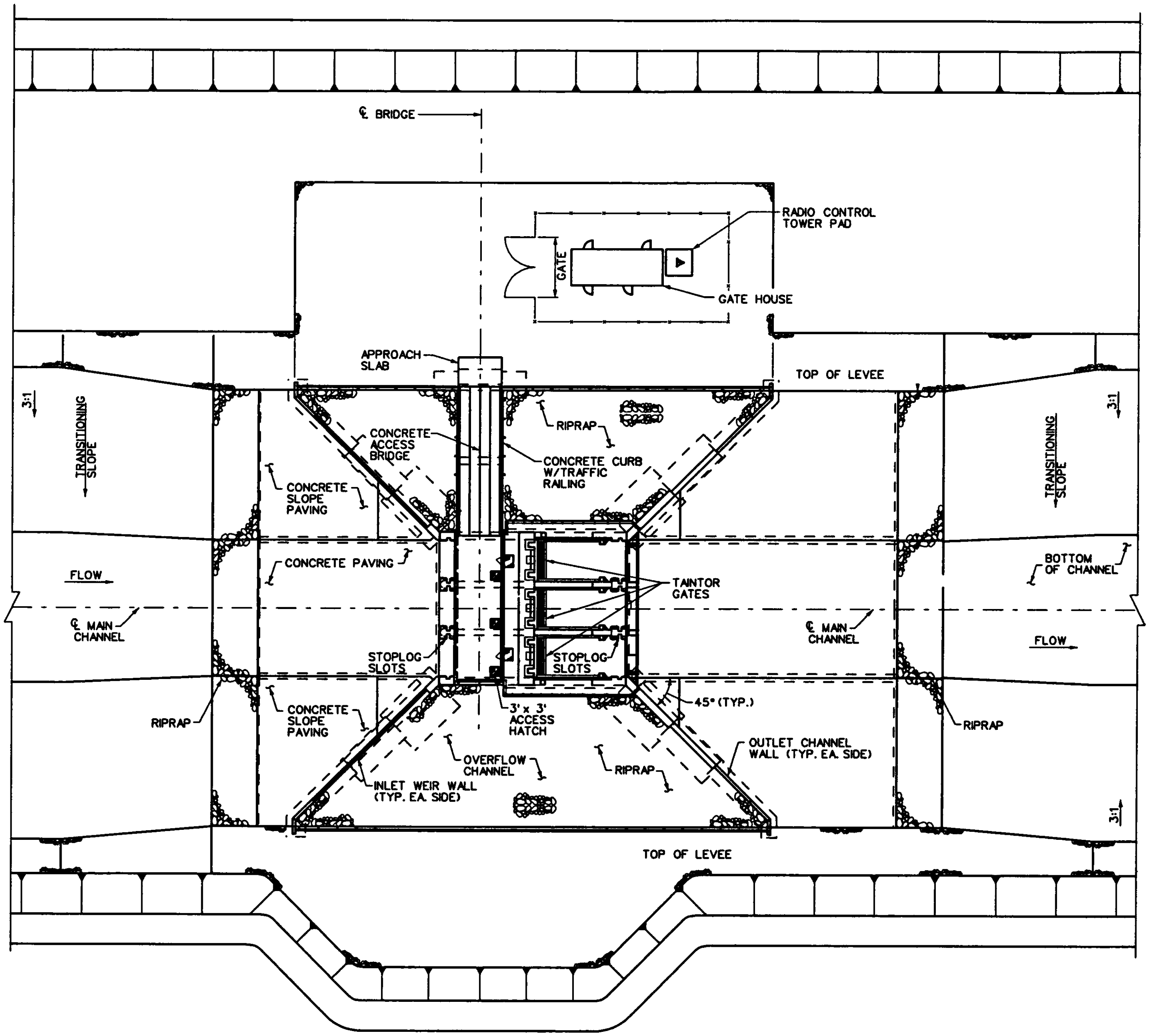
IV-A-9

# Bayou Meto Basin Project
# Structural, Electrical & Mechanical

## APPENDIX IV-B

## CHECK STRUCTURES

U.S. Army Corps of Engineers
Memphis District



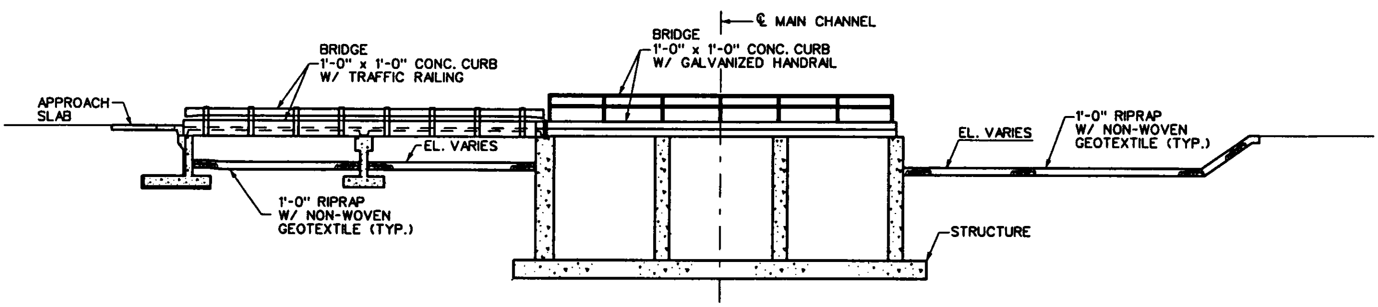

SITE PLAN

US Army Corps of Engineers

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEER
MEMPHIS, TENNESSEE

BAYOU METO BASIN COMPREHENSIVE STUDY
BAYOU METO BASIN
TYPICAL CHECK STRUCTURE
PLAN

PLATE
IV–B–1




TRANSVERSE SECTION

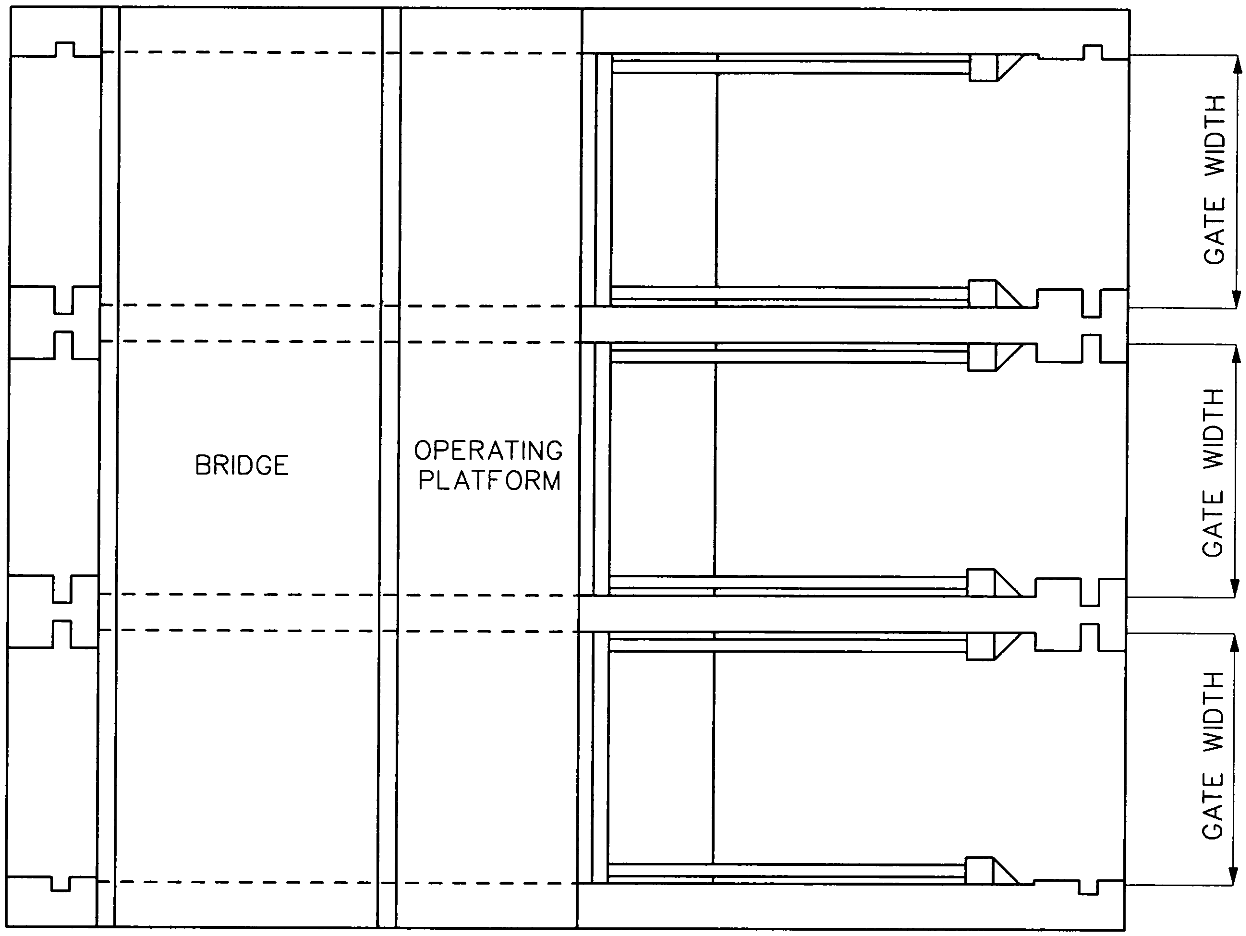
US Army Corps of Engineers

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEER
MEMPHIS, TENNESSEE

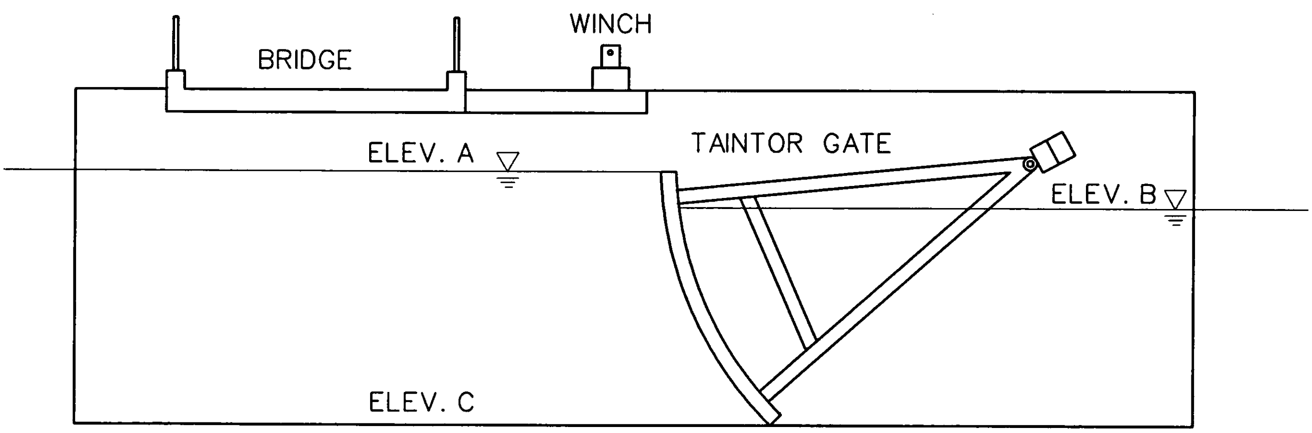
BAYOU METO BASIN COMPREHENSIVE STUDY
BAYOU METO BASIN

CHECK STRUCTURE

PLATE
IV–B–2




PLAN OF THREE GATED CHECK STRUCTURE




LONGITUDINAL SECTION

US Army Corps
of Engineers

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEER
MEMPHIS, TENNESSEE

BAYOU METO BASIN COMPREHENSIVE STUDY
BAYOU METO BASIN

CHECK STRUCTURE

PLATE
IV–B–3

## Table IV-B-1
## Check Structures

| Canal No. | Structure No. | Number of Gates | Gate Width (ft.) | Gate Height (ft.) | *Elev. A | *Elev. B | *Elev. C | Quantities | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | Excavation (cy) | Concrete (cy) | Backfill (cy) | Imp. Backfill (cy) | Perv. Backfill (cy) | Riprap (cy) | Filter Mat (cy) | Bridge (lf) | Fencing (lf) | Misc. Metals (lb) |
| 1000 | C-1000.1 | 3 | 14 | 16 | 243.00 | 240.30 | 229.30 | 4740 | 1824 | 3555 | 610 | 2600 | 945 | 412 | 50 | 327 | 21345 |
| 1000 | C-1000.2 | 3 | 10 | 14 | 238.00 | 234.60 | 225.60 | 3337 | 1571 | 3250 | 516 | 2300 | 840 | 366 | 44 | 315 | 19000 |
| 2000 | C-2000.1 | 2 | 10 | 14 | 232.00 | 227.34 | 219.35 | 2900 | 1400 | 3250 | 516 | 2300 | 790 | 344 | 44 | 300 | 12667 |
| 2100 | C-2000.1 | 2 | 10 | 14 | 232.00 | 226.00 | 219.35 | 2900 | 1400 | 3250 | 516 | 2300 | 790 | 344 | 44 | 300 | 12667 |
| 2110 | C-2110 | 2 | 10 | 10 | 223.00 | 220.87 | 213.87 | 2900 | 1300 | 2666 | 330 | 1790 | 484 | 210 | 38 | 300 | 7600 |
| 2500 | C-2500.R | 2 | 10 | 10 | 242.00 | 239.00 | 233.00 | 2900 | 1300 | 2666 | 330 | 1790 | 484 | 210 | 38 | 300 | 7600 |
| 2500 | C-2500.1 | 2 | 10 | 7.5 | 238.00 | 236.20 | 231.20 | 2900 | 1257 | 2000 | 238 | 1342 | 300 | 130 | 25 | 300 | 5700 |
| 2500 | C-2500.2 | 2 | 10 | 7 | 235.00 | 233.60 | 228.60 | 2900 | 1250 | 1866 | 216 | 1250 | 268 | 117 | 25 | 300 | 5320 |
| 3000 | C-3000 | 2 | 10 | 10 | 236.00 | 232.42 | 226.42 | 2900 | 1300 | 2666 | 330 | 1790 | 484 | 210 | 38 | 300 | 7600 |
| 4000 | C-4000R | 2 | 10 | 7 | 247.00 | 246.00 | 241.00 | 2900 | 1250 | 1866 | 216 | 1250 | 268 | 117 | 25 | 300 | 5320 |
| 4111 | C-4111.1 | 2 | 4 | 5.5 | 232.00 | 231.25 | 227.25 | 1000 | 1540 | 650 | 85 | 490 | 105 | 46 | 10 | 280 | 4180 |

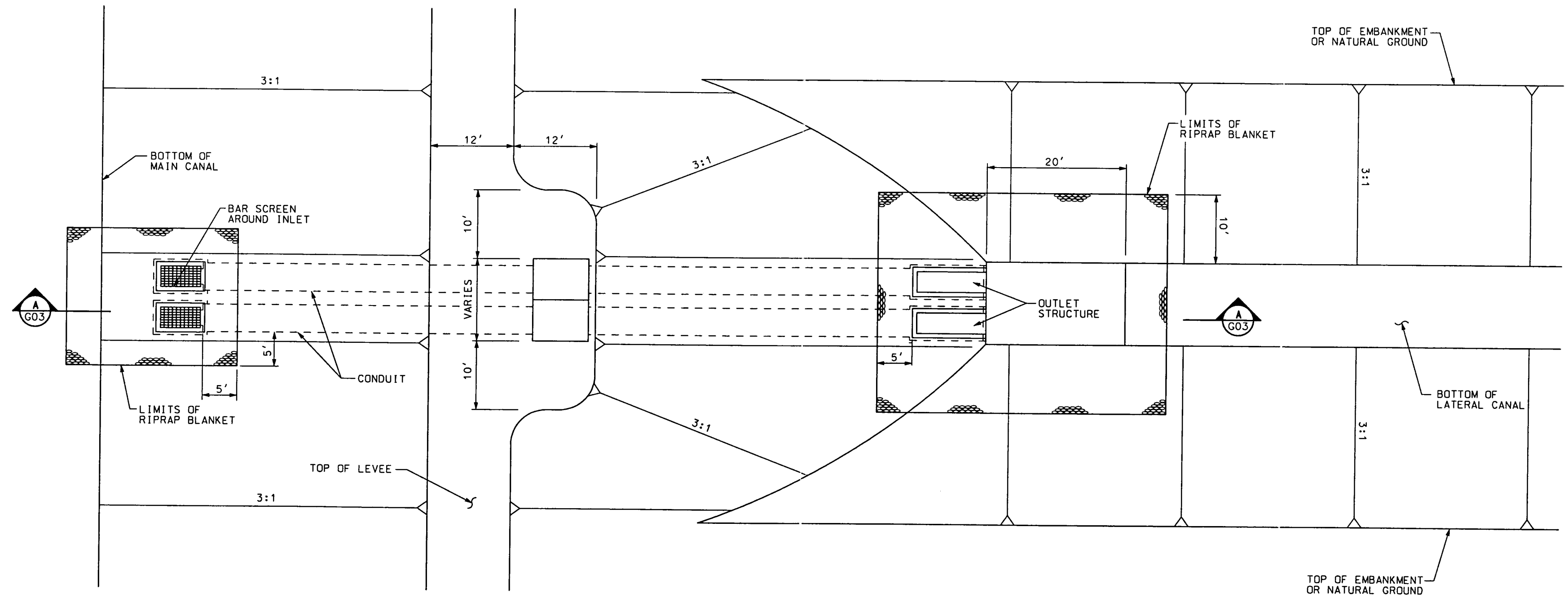
* See Drawing "BMCP.dgn"

# Bayou Meto Basin Project
# Structural, Electrical & Mechanical

# APPENDIX IV-C

# GATEWELL STRUCTURES

**U.S. Army Corps of Engineers**
**Memphis District**




GATE WELL TURNOUT PLAN NOT TO SCALE
(MULTIPLE CELL SHOWN, SINGLE CELL TYPICAL)

NOTE:
GATE WELL TURNOUT SITE PLANS VARY FROM ONE TO THREE CELL STRUCTURES WITH 30" TO 60" DIA. PIPES.

US Army Corps of Engineers

| | | | |
|---|---|---|---|
| Designed by: XXX | Drawn by: XXX | Plotted by: pinkstop | Pen Table: Mphs2.pen |
| Checked by: XXX | Checked by: XXX | Plot date: 09-SEP-2002 | Color table: bw.ctb |
| Submitted by: | | Project ID: XXXX | Raster file name: $RASTERNAME$$$$$$$ / Serial No.: XXXXX |
| Chief, Struct., Elec. and Mech. Section | | Plot scale: 16.167915:1.000000 | |

U. S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
MEMPHIS, TENNESSEE

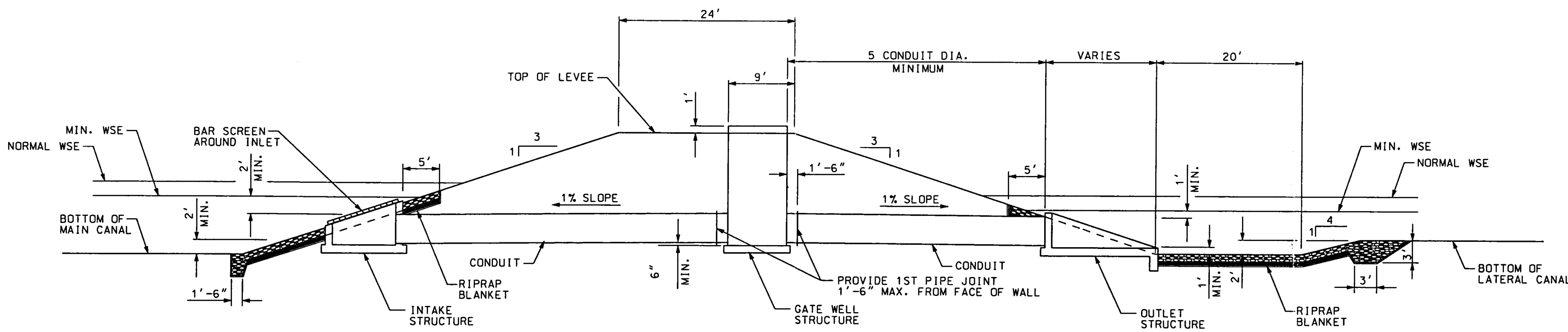
Design file name: gw plan

BAYOU METO COMPREHENSIVE STUDY
BAYOU METO BASIN

# GATEWELL TURNOUT PLAN

PLATE
IV-C-1

HEW/CWT GP57.DGN K:\999\99423 5-31-00




TYPICAL GATE WELL TURNOUT SECTION A-A NOT TO SCALE

US Army Corps of Engineers

| | | | |
|---|---|---|---|
| Designed by: XXX | Drawn by: XXX | Plotted by: pinkstop | Pen Table: Mphs2.pen |
| Checked by: XXX | Checked by: XXX | Plot date: 06-SEP-2002 | Color table: bw.ctb |
| Submitted by: | | Project ID: XXXX | Raster file name: $RASTERNAME$$$$$$$ | Serial No.: XXXXX |
| Chief, Struct., Elec. and Mech. Section | | Plot scale: 16.167915:1.000000 | |

Design file name: gw section

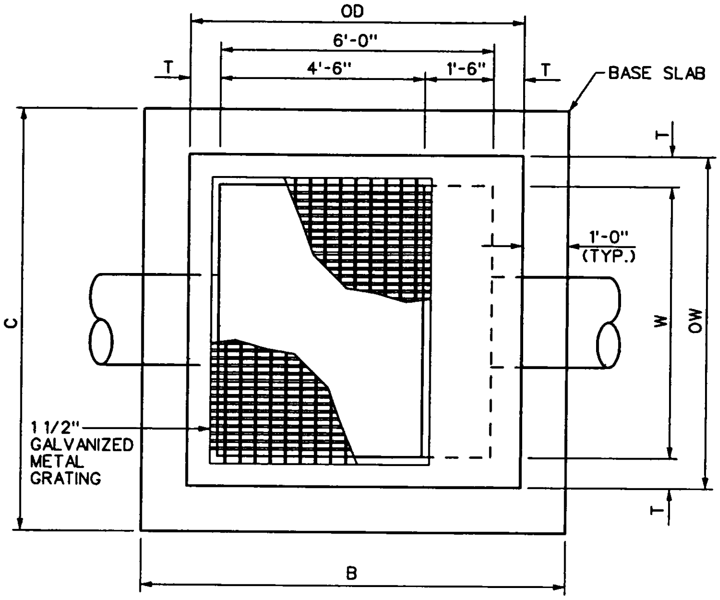
U. S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
MEMPHIS, TENNESSEE

BAYOU METO COMPREHENSIVE STUDY
BAYOU METO BASIN

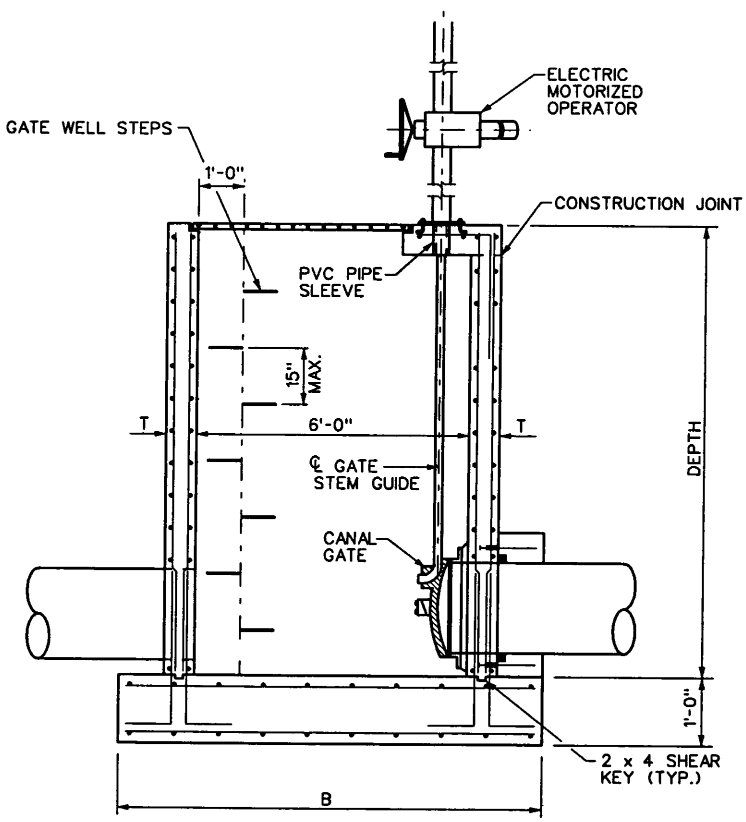
# TYPICAL GATEWELL TURNOUT SECTION

DRAWING
IV-C-2

RM/CWT OPS8.DGN K:\1999\99423 5-30-00




**PLAN VIEW** NOT TO SCALE
SHOWING GRATING & BASE SLAB BELOW




**TYPICAL SECTION** NOT TO SCALE

US Army Corps
of Engineers

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEER
MEMPHIS, TENNESSEE

BAYOU METO BASIN COMPREHENSIVE STUDY
BAYOU METO BASIN

TYPICAL GATEWELL STRUCURE

PLATE
IV-C-3

# Bayou Meto Basin Project
# Structural, Electrical & Mechanical

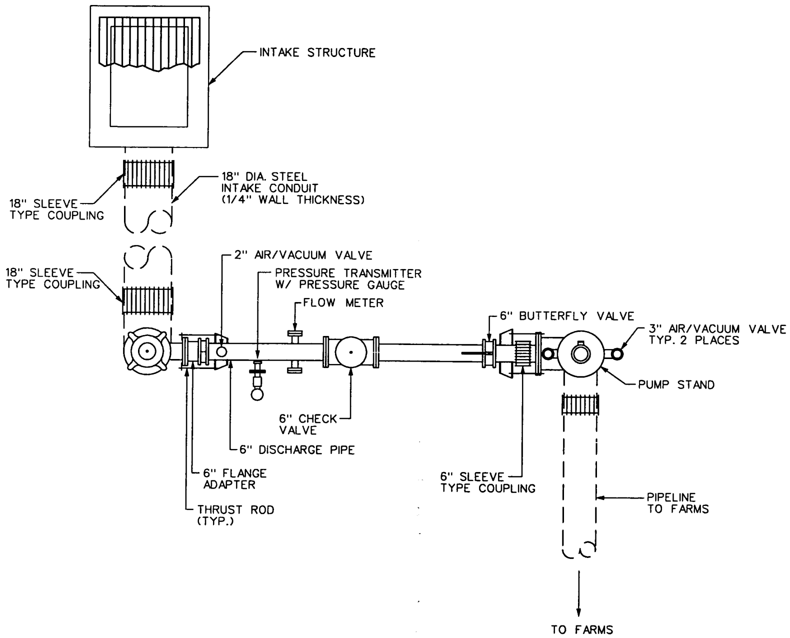
## APPENDIX IV-D

## PUMP TURNOUTS

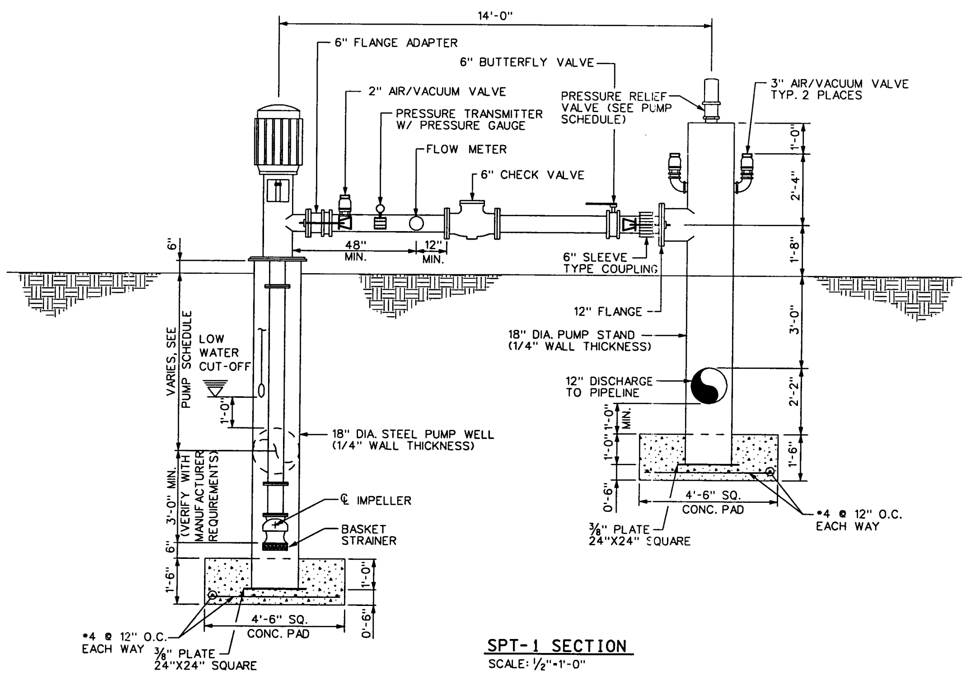
U.S. Army Corps of Engineers
Memphis District

## TABLE 1 - STANDARD PUMP TURNOUT CONFIGURATIONS

| ITEM | FLOW RANGE | PUMP DISCHARGE | INTAKE / PUMP WELL & PUMP STAND DIA. |
|---|---|---|---|
| SPT-1 | < 1.00 cfs | 6" | 18" |
| SPT-2 | 1.01 - 1.75 cfs | 8" | 18" |
| SPT-3 | 1.76 - 3.50 cfs | 12" | 18" |
| SPT-4 | 3.51 - 6.00 cfs | 14" | 24" |
| SPT-5 | 6.01 - 10.00 cfs | 18" | 30" |
| SPT-6 | 10.01 - 16.00 cfs | 24" | 36" |
| SPT-7 | 16.01 - 26.00 cfs | 30" | 48" |




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




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

US Army Corps of Engineers Memphis District

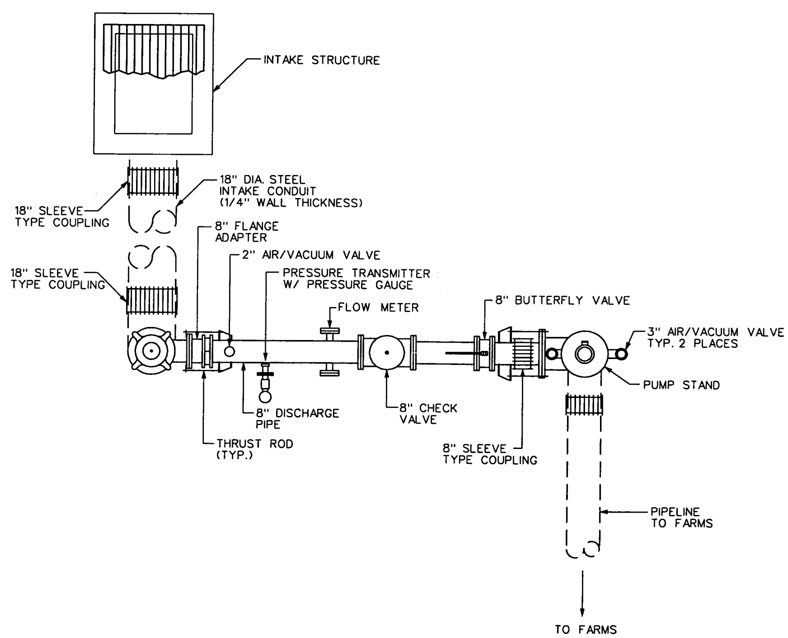
U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
MEMPHIS, TENNESSEE

GARVER / NEEL - SCHAFFER
A JOINT VENTURE
LITTLE ROCK, AR / JACKSON, MS

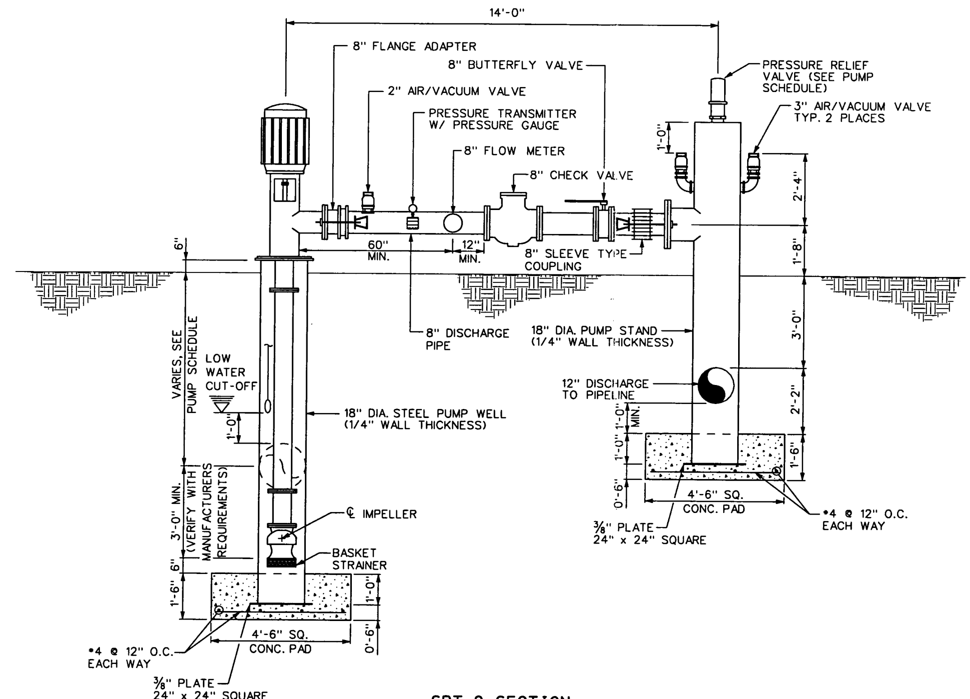
BAYOU METO BASIN — BAYOU METO COMPREHENSIVE STUDY

# STANDARD DRAWING FOR STRUCTURES
## STANDARD PUMP TURNOUT
## SPT - 1 PLAN AND SECTION
## (< 1.00 CFS)

PLATE
IV-D-1




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




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

US Army Corps of Engineers Memphis District

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
MEMPHIS, TENNESSEE

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A JOINT VENTURE
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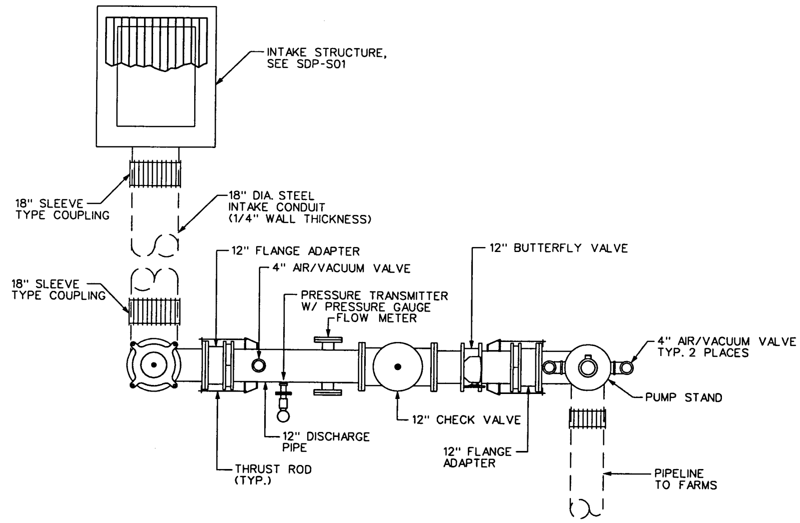
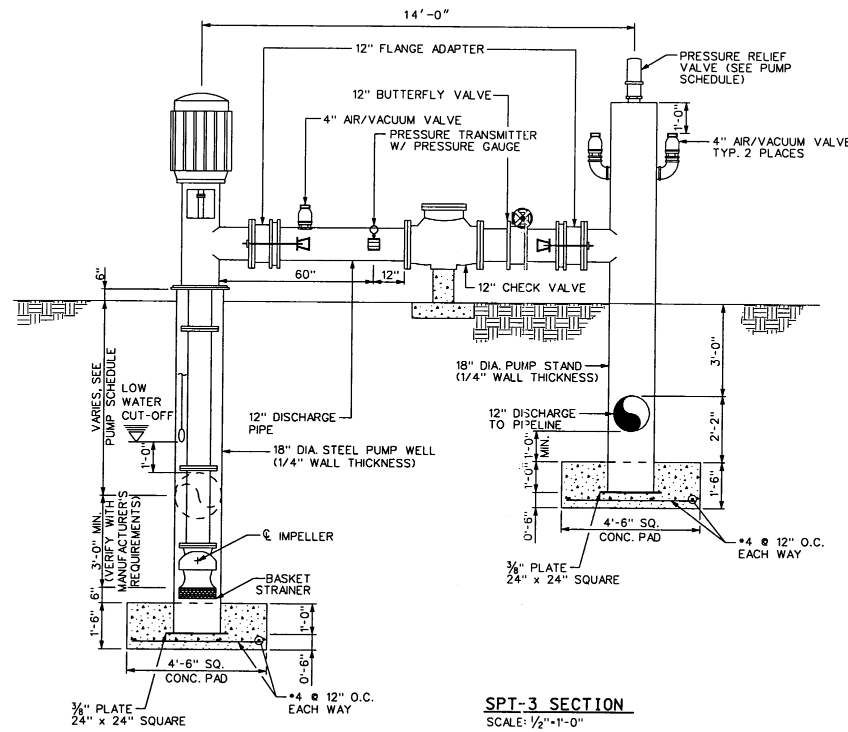
BAYOU METO BASIN
BAYOU METO COMPREHENSIVE STUDY

STANDARD DRAWING FOR STRUCTURES
STANDARD PUMP TURNOUT
SPT - 2 PLAN AND SECTION
(1.01 - 1.75 CFS)

PLATE
IV-D-2




SPT-3 PLAN
SCALE: 1/2"=1'-0"




SPT-3 SECTION
SCALE: 1/2"=1'-0"

US Army Corps of Engineers
Memphis District

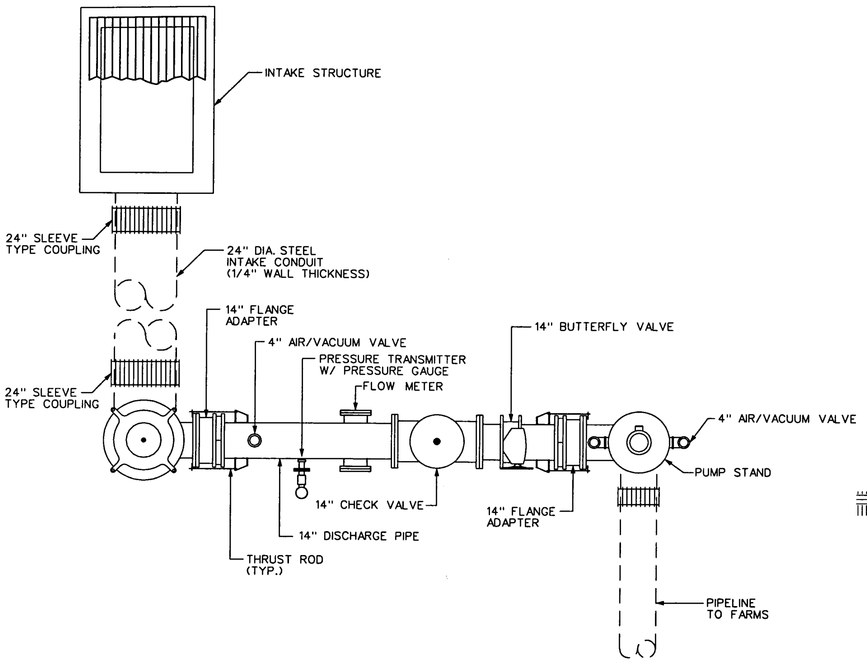
U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
MEMPHIS, TENNESSEE

GARVER / NEEL - SCHAFFER
A JOINT VENTURE
LITTLE ROCK, AR / JACKSON, MS

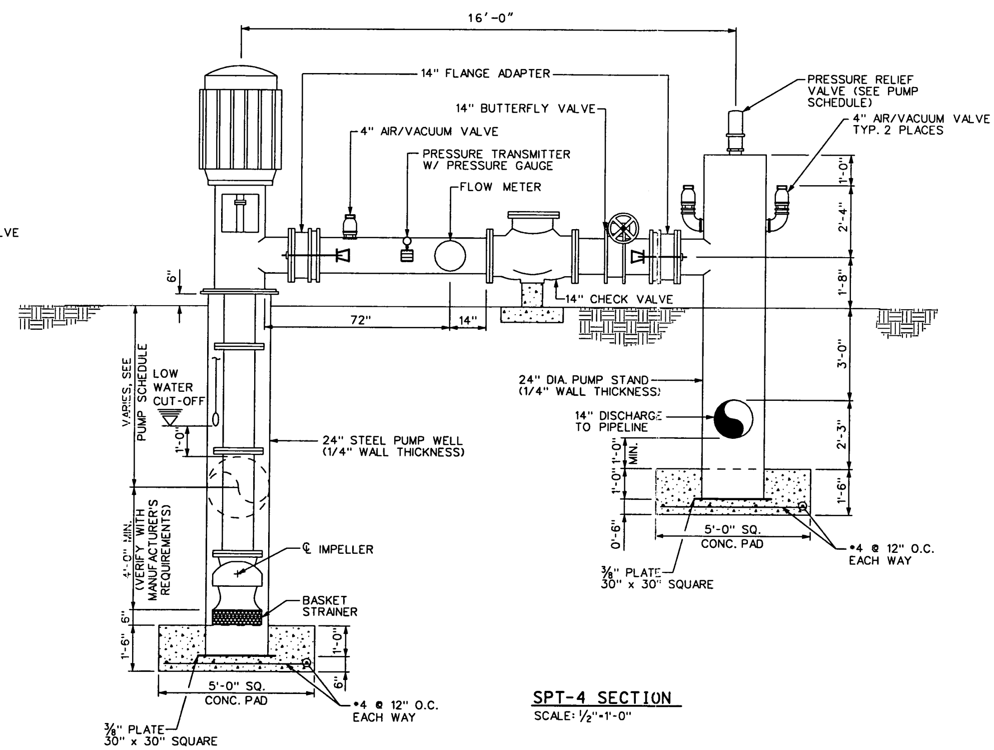
BAYOU METO BASIN — BAYOU METO COMPREHENSIVE STUDY

STANDARD DRAWING FOR STRUCTURES
STANDARD PUMP TURNOUT
SPT-3 PLAN AND SECTION
(1.76 - 3.50 CFS)

PLATE
IV-D-3




SPT-4 PLAN
SCALE: 1/2"=1'-0"




SPT-4 SECTION
SCALE: 1/2"=1'-0"

US Army Corps of Engineers Memphis District

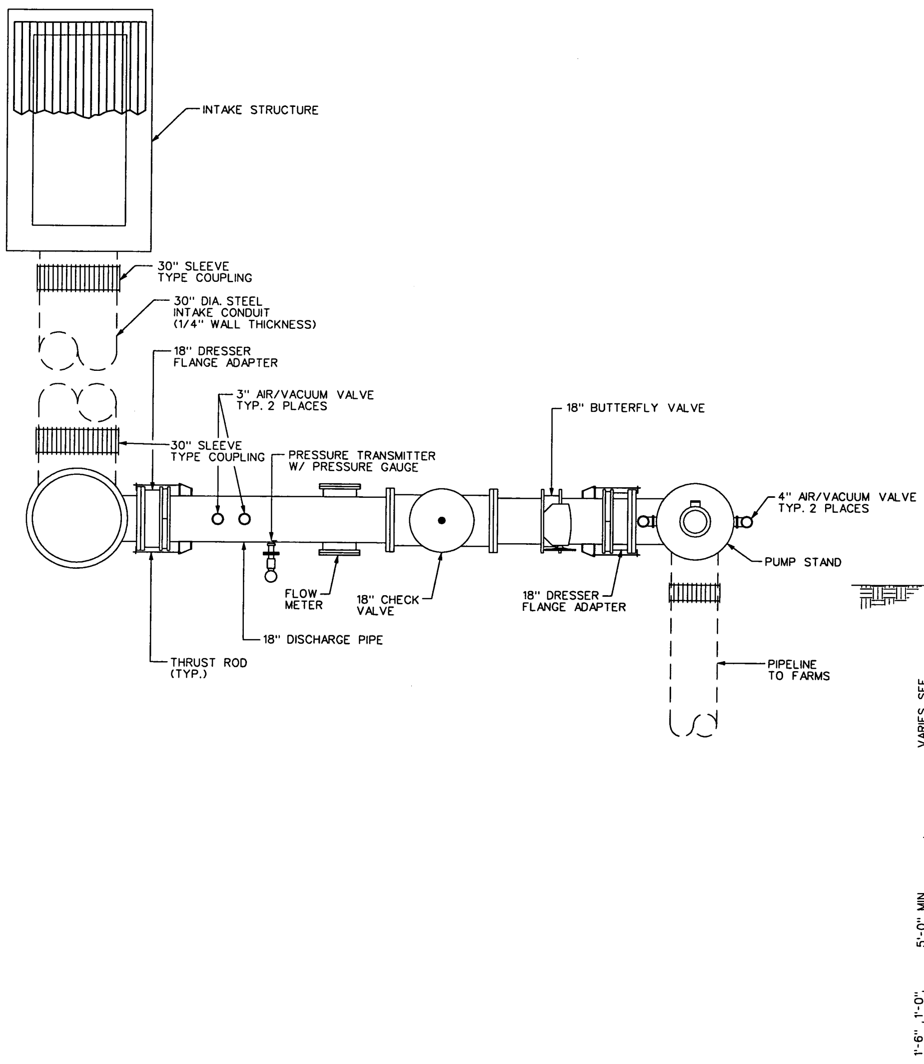
U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
MEMPHIS, TENNESSEE

GARVER / NEEL - SCHAFFER
A JOINT VENTURE
LITTLE ROCK, AR / JACKSON, MS

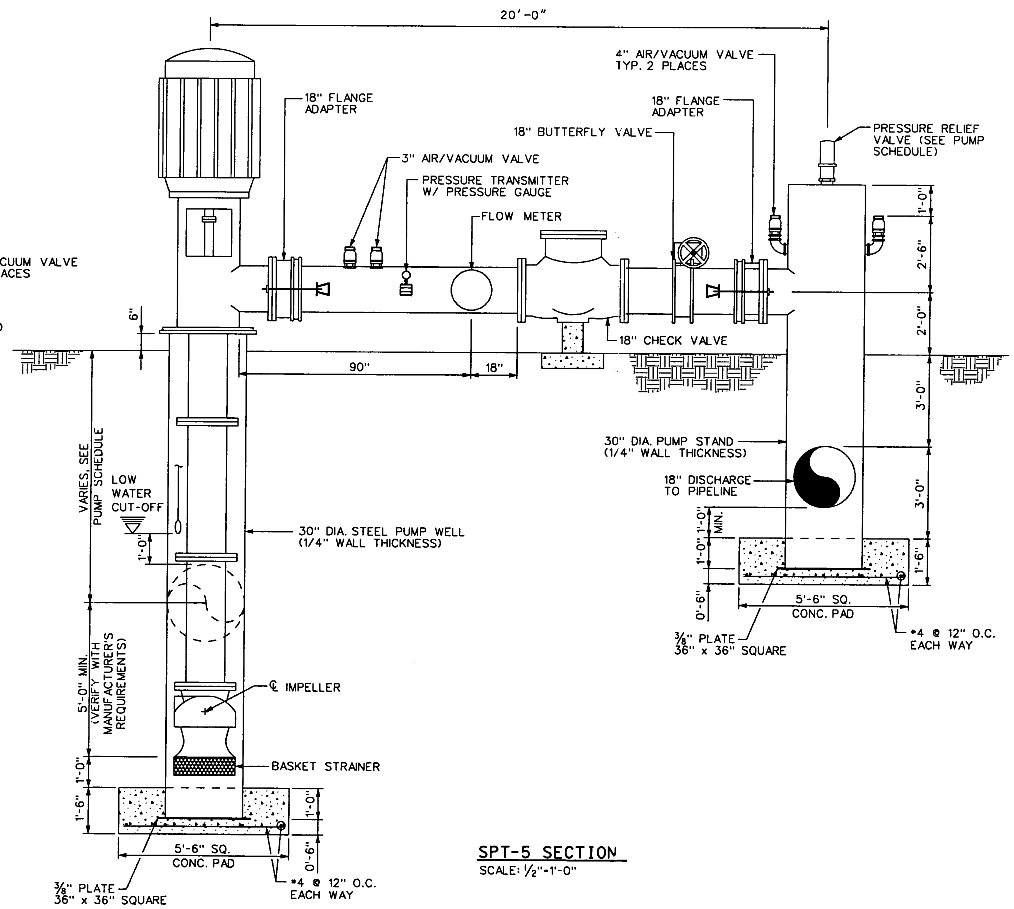
BAYOU METO BASIN — BAYOU METO COMPREHENSIVE STUDY

STANDARD DRAWING FOR STRUCTURES
STANDARD PUMP TURNOUT
SPT-4 PLAN AND SECTION
(3.51 - 6.00 CFS)

PLATE
IV-D-4




SPT-5 PLAN
SCALE: 1/2"=1'-0"




SPT-5 SECTION
SCALE: 1/2"-1'-0"

US Army Corps of Engineers Memphis District

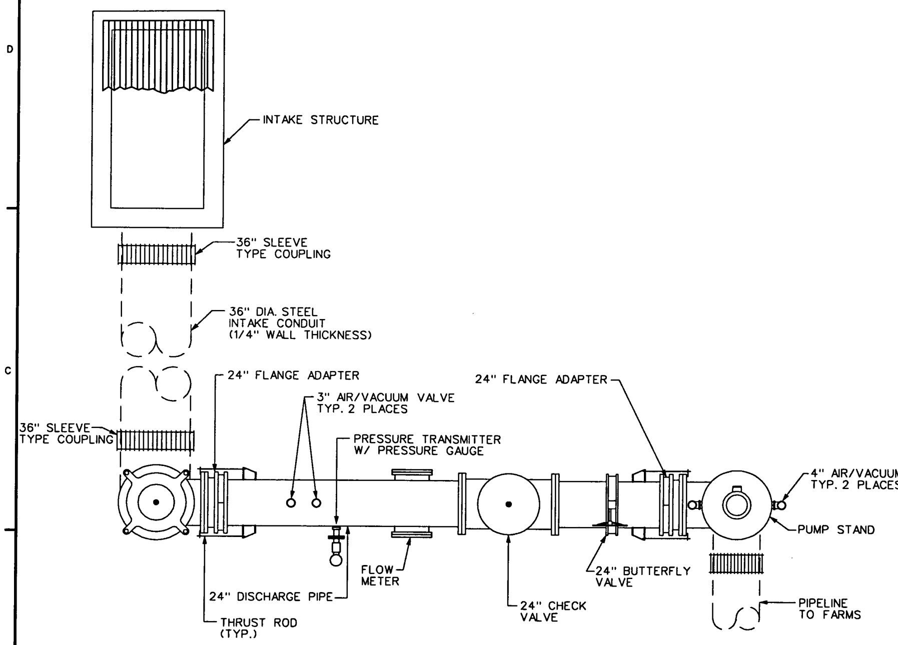
U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
MEMPHIS, TENNESSEE

GARVER/NEEL - SCHAFFER
A JOINT VENTURE
LITTLE ROCK, AR/JACKSON, MS

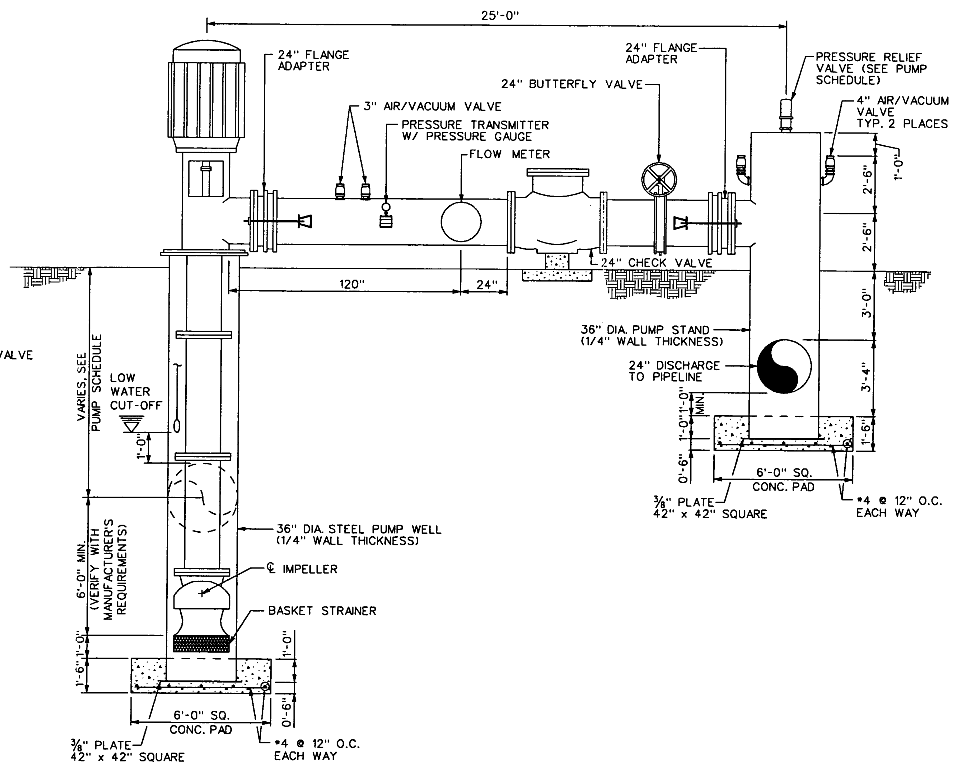
GRAND PRAIRIE AREA DEMONSTRATION PROJECT
EASTERN ARKANSAS REGION COMPREHENSIVE STUDY

STANDARD DRAWING FOR STRUCTURES
STANDARD PUMP TURNOUT
STP-5 PLAN AND SECTION
(6.01 - 10.00 CFS)

DRAWING
IV-D-5




SPT-6 PLAN
SCALE: 3/8"=1'-0"




SPT-6 SECTION
SCALE: 3/8"=1'-0"

US Army Corps of Engineers Memphis District

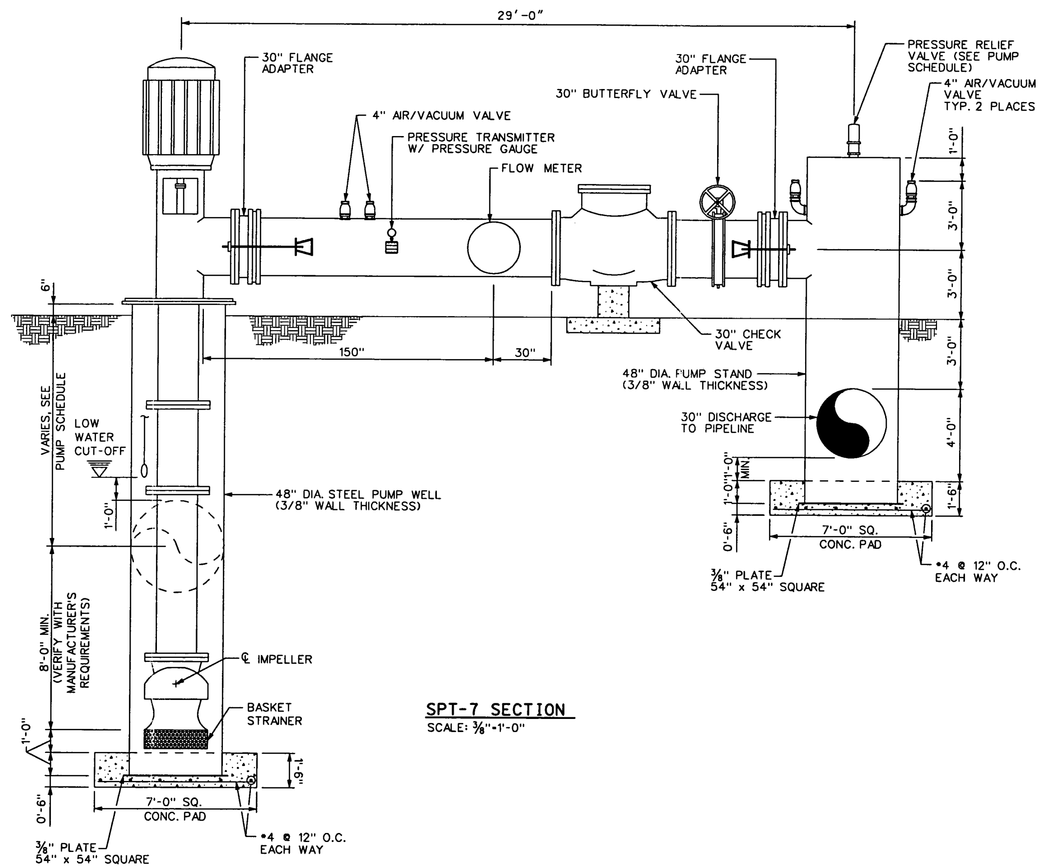
U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
MEMPHIS, TENNESSEE

GARVER / NEEL - SCHAFFER
A JOINT VENTURE
LITTLE ROCK, AR / JACKSON, MS

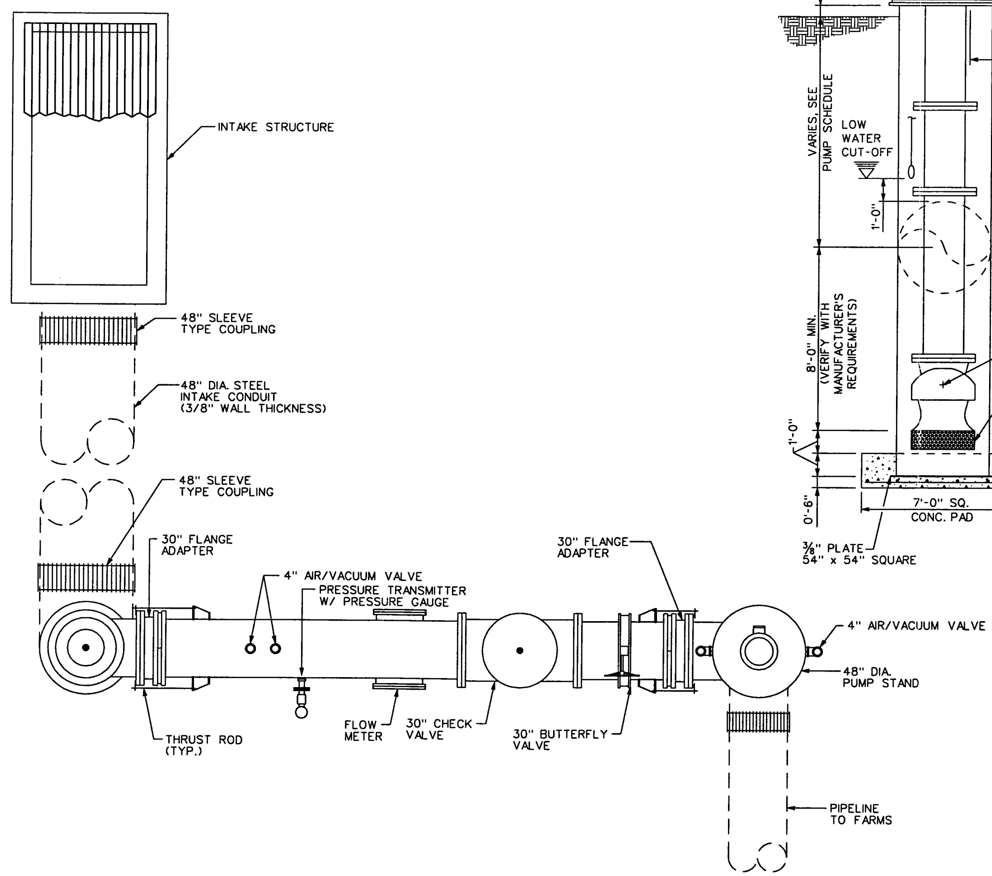
GRAND PRAIRIE AREA DEMONSTRATION PROJECT
EASTERN ARKANSAS REGION COMPREHENSIVE STUDY

**STANDARD DRAWING FOR STRUCTURES**
**STANDARD PUMP TURNOUT**
**SPT-6 PLAN AND SECTION**
**(10.01 - 16.00 CFS)**

PLATE
IV-D-6




SPT-7 SECTION
SCALE: ⅜"=1'-0"




SPT-7 PLAN
SCALE: ⅜"=1'-0"

US Army Corps of Engineers
Memphis District

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
MEMPHIS, TENNESSEE

GARVER / NEEL - SCHAFFER
A JOINT VENTURE
LITTLE ROCK, AR / JACKSON, MS

GRAND PRAIRIE AREA DEMONSTRATION PROJECT
EASTERN ARKANSAS REGION COMPREHENSIVE STUDY

STANDARD DRAWING FOR STRUCTURES

STANDARD PUMP TURNOUT
SPT - 7 PLAN AND SECTION
(16.01 - 26.00 CFS)

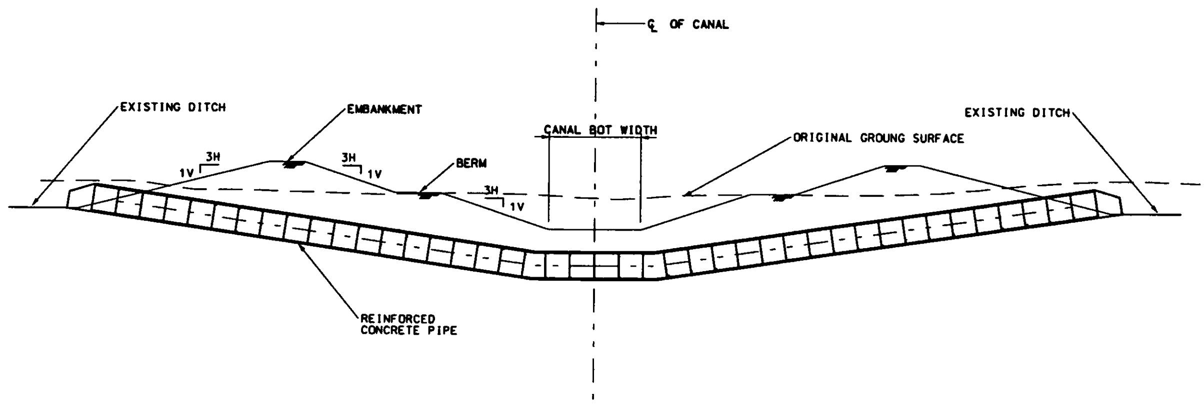
PLATE
IV-D-7

# Bayou Meto Basin Project
# Structural, Electrical & Mechanical

# APPENDIX IV-E

# CROSSINGS

U.S. Army Corps of Engineers
Memphis District




PROFILE
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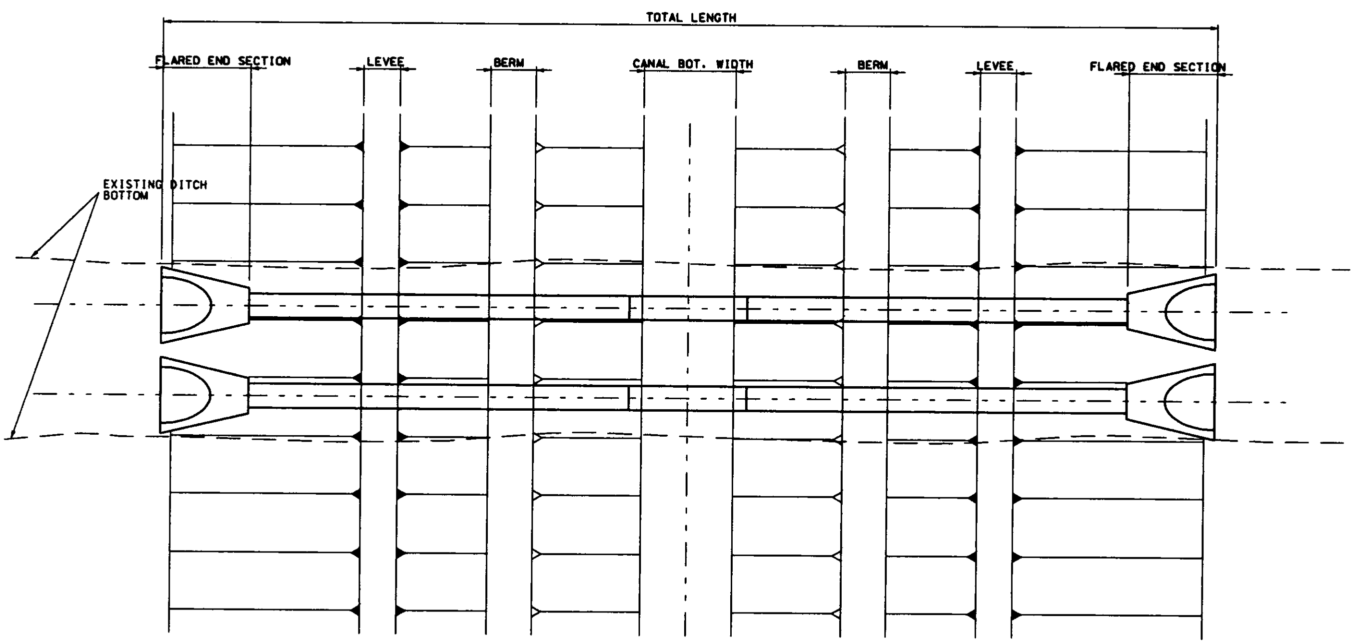



PLAN
NO SCALE

US Army Corps
of Engineers

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEER
MEMPHIS, TENNESSEE

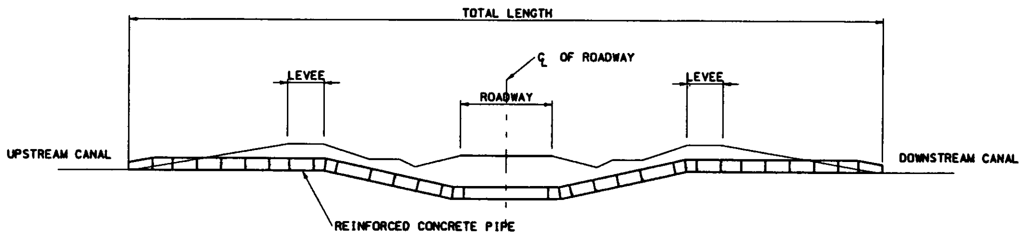
BAYOU METO BASIN COMPREHENSIVE STUDY
BAYOU METO BASIN

INVERTED PIPE SIPHON

NATURAL DRAINAGE CROSSING @ CANAL

PLATE

IV–E–1

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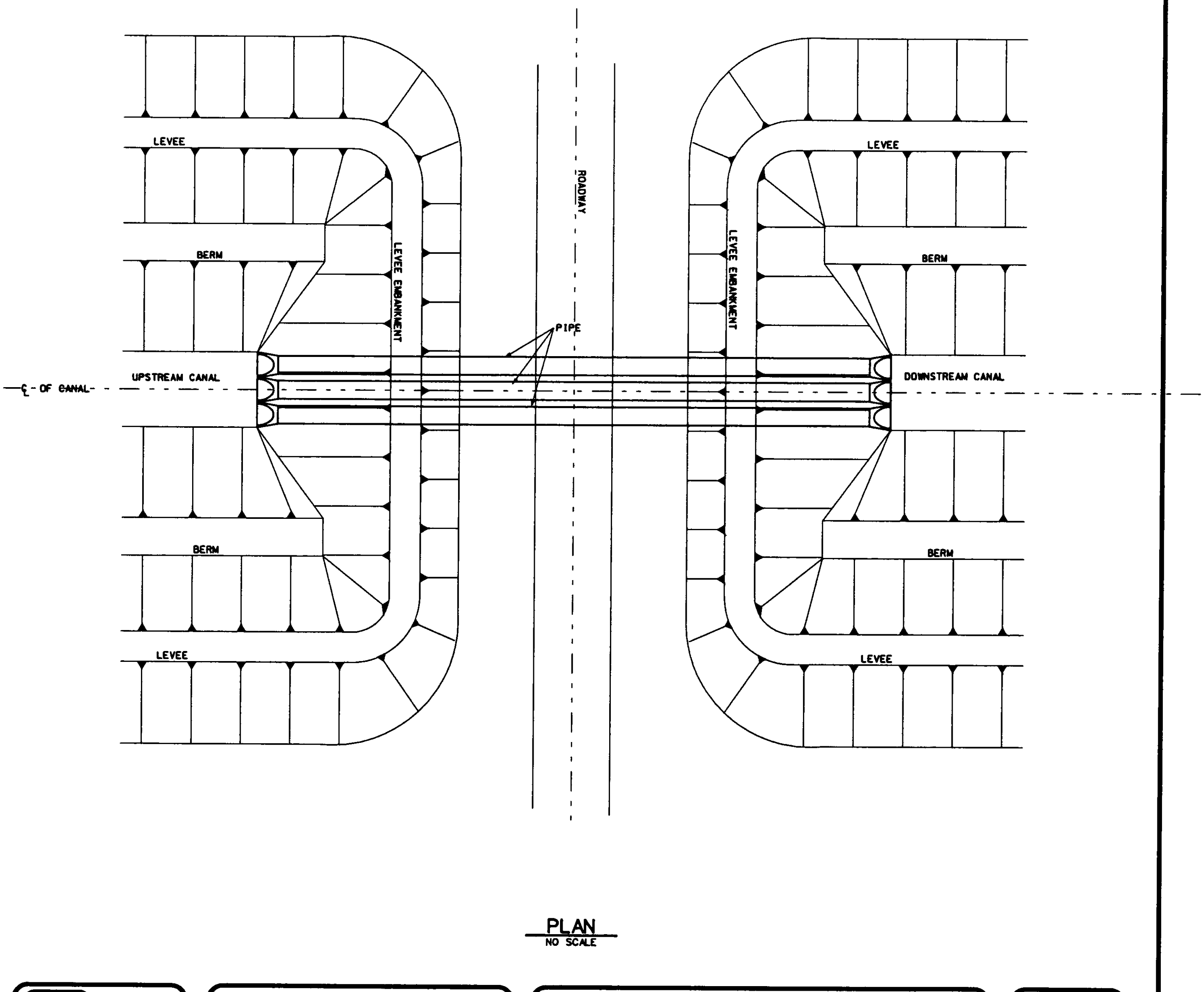



PLAN
NO SCALE

US Army Corps of Engineers

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEER
MEMPHIS, TENNESSEE

BAYOU METO BASIN COMPREHENSIVE STUDY
BAYOU METO BASIN

INVERTED PIPE SIPHON

CANAL CROSSING @ ROADWAY

PLATE

IV–E–2

# Bayou Meto Basin Project
# Structural, Electrical & Mechanical

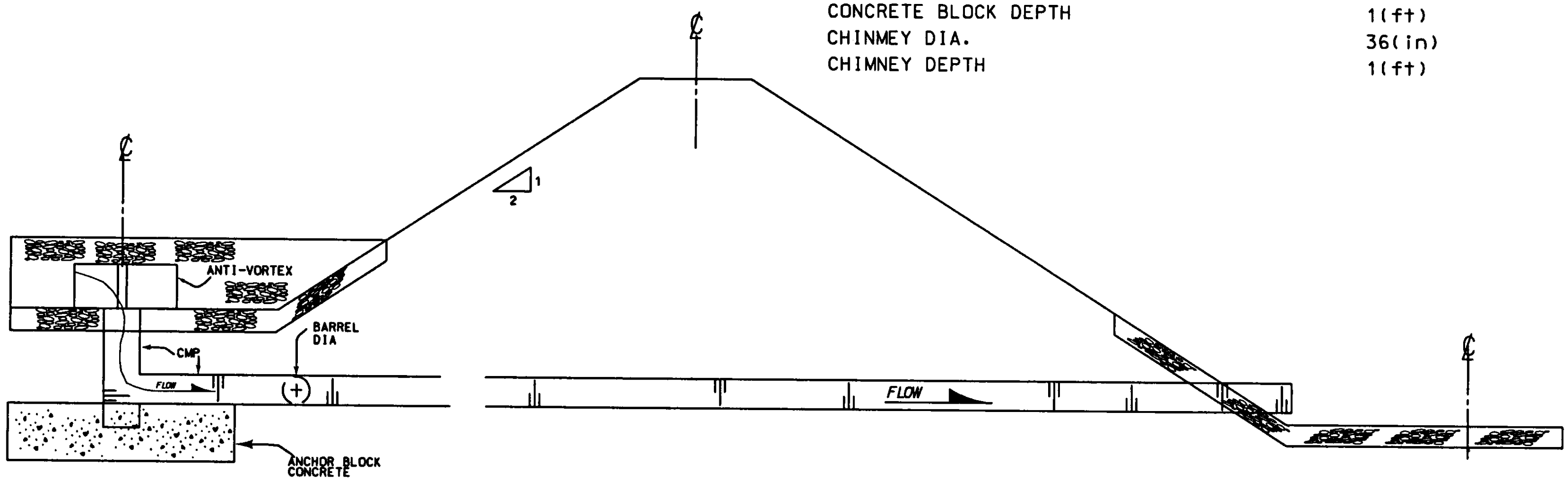
# APPENDIX IV-F

# DROP STRUCTURES

U.S. Army Corps of Engineers
Memphis District

DRAINAGE CHIMNEY DROP DIMENSIONS

| | |
|---|---|
| LEVEE DEPTH | 5(ft) |
| LEVEE WIDTH | 5(ft) |
| SIDE SLOPE(X/Y) | 2 |
| BARREL DIA. | 24(in) |
| RISER DIA. | 30(in) |
| CONCRETE BLOCK | 4(ft) x 4(ft) |
| CONCRETE BLOCK DEPTH | 1(ft) |
| CHINMEY DIA. | 36(in) |
| CHIMNEY DEPTH | 1(ft) |




PIPE DROP STRUCTURE

PROFILE
NOT TO SCALE

US Army Corps of Engineers

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEER
MEMPHIS, TENNESSEE

BAYOU METO BASIN COMPREHENSIVE STUDY
BAYOU METO BASIN

**DROP STRUCTURE**

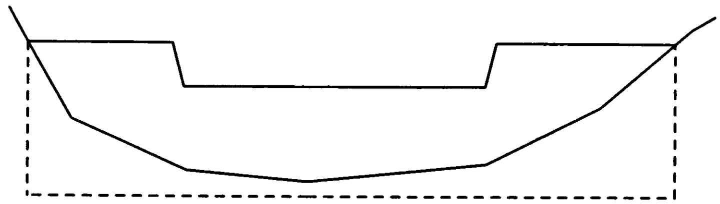
PLATE
**IV-F-1**

# Bayou Meto Basin Project
# Structural, Electrical & Mechanical

## APPENDIX IV-G

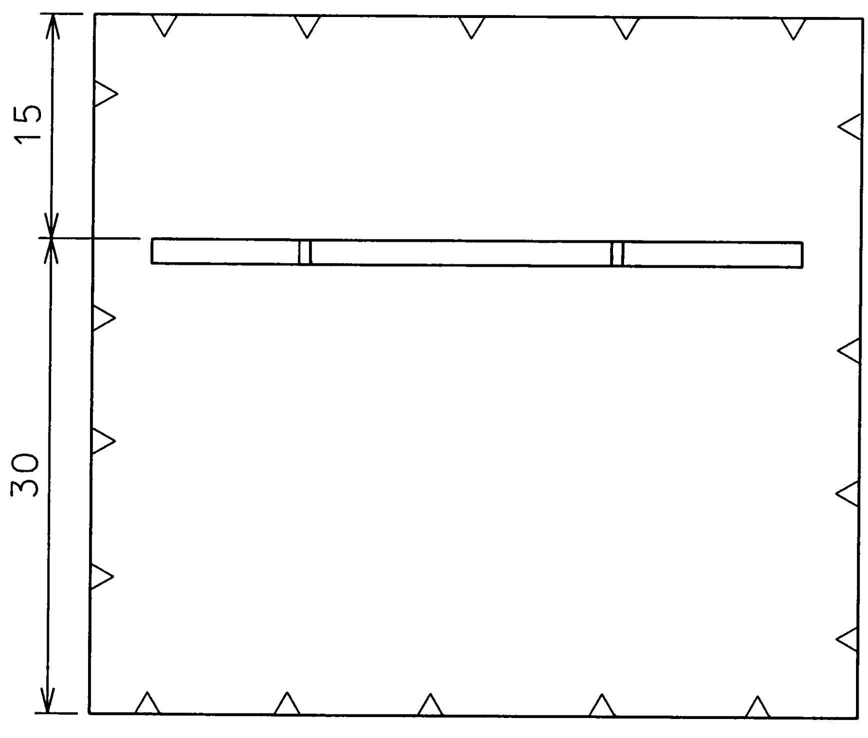
## WEIRS

U.S. Army Corps of Engineers
Memphis District



## TYPICAL WEIR PROFILE

NO SCALE




## TYPICAL WEIR PLAN

NO SCALE

US Army Corps
of Engineers

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEER
MEMPHIS, TENNESSEE

BAYOU METO BASIN COMPREHENSIVE STUDY
BAYOU METO BASIN

TYPICAL WEIR

PLATE

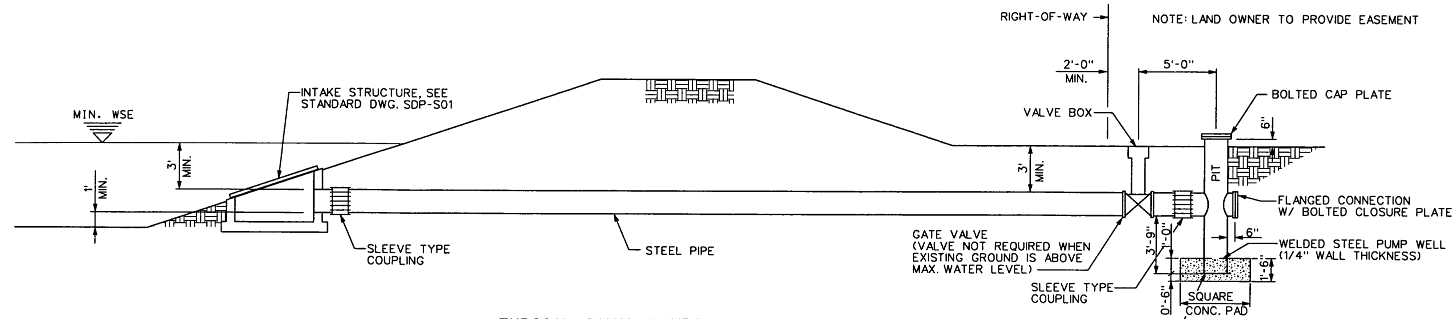
**IV–G–1**

# Bayou Meto Basin Project
# Structural, Electrical & Mechanical

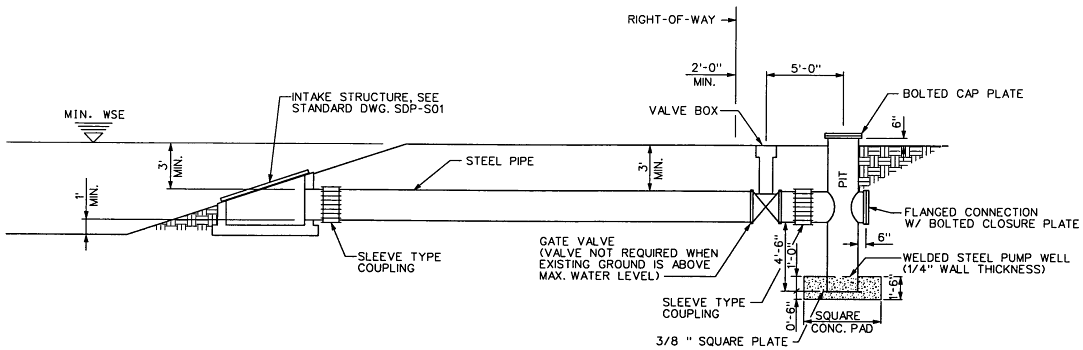
## APPENDIX IV-H

## FARM OFFTAKES

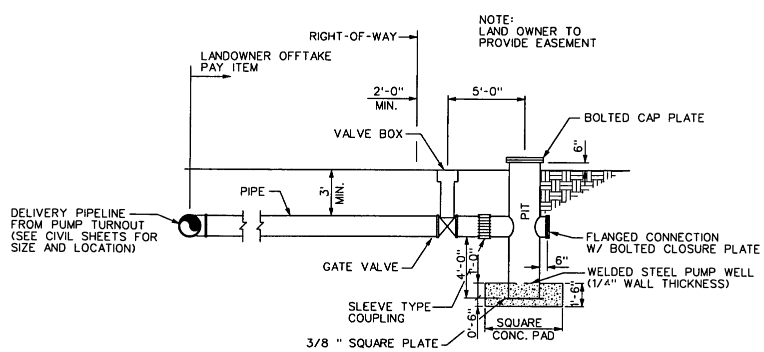
U.S. Army Corps of Engineers
Memphis District




TYPICAL CANAL LANDOWNER OFFTAKE SCALE: 1/4"=1'-0"




TYPICAL NATURAL STREAM LANDOWNER OFFTAKE SCALE: 1/4"=1'-0"




TYPICAL PIPELINE LANDOWNER OFFTAKE SCALE: 1/4"=1'-0"

NOTES:

1. LAND OWNER TO PROVIDE EASEMENT
2. MAIN CANAL GRAVITY LANDOWNER OFFTAKES REQUIRE SOLAR POWERED RTU's. SEE DWG SDP E18.
3. SEE SHEET SDP M18 FOR LANDOWNER OFFTAKE SCHEDULE
4. GRAVITY LANDOWNER OFFTAKES SHALL BE INSTALLED WITH THE TRENCH INSTALLATION DETAIL ON DWG. SDPM15.
5. THE MATERIAL AND INSTALLATION REQUIREMENTS FOR THE PIPELINE LANDOWNER OFFTAKES SHALL BE THE SAME AS THAT UTILIZED FOR THE PRESSURE PIPELINES (SEE CIVIL SHEETS AND TECHNICAL SPECIFICATIONS).

US Army Corps of Engineers
Memphis District

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
MEMPHIS, TENNESSEE

A JOINT VENTURE
LITTLE ROCK, AR / JACKSON, MS

BAYOU METO BASIN

STANDARD DRAWING FOR STRUCTURES

STANDARD FARM OFFTAKES

DRAWING
IV-H-1

# BAYOU METO BASIN PROJECT,
# ARKANSAS STUDY

# BAYOU METO BASIN PROJECT

# GENERAL REEVALUATION REPORT

## VOLUME 5

## APPENDIX B
## ENGINEERING INVESTIGATIONS & ANALYSES

## SECTION V – PUMPING STATIONS

# TABLE OF CONTENTS
# BAYOU METO BASIN PROJECT
# SECTION V
# PUMPING STATIONS

# PART A - GENERAL

**5-A-01. <u>PURPOSE</u>.** The purpose of this engineering support document is to establish essential data, assumptions and criteria for providing a basis for the mechanical, electrical and structural design requirements of the Bayou Meto Pumping Stations. This report, as approved, will form the basis upon which the design documents for final design of the pumping stations will be prepared.

**5-A-02. <u>PROJECT AREA</u>.** The Bayou Meto Basin, Arkansas Region Comprehensive Study includes all or part of 13 counties in eastern Arkansas, a 625 square mile area. The primary emphasis of the study is agricultural water supply and conservation and fish and wildlife restoration/enhancement. Depletion of the groundwater reserves caused by heavy agricultural use is the primary problem. Depletion of the alluvial aquifer is threatening the future of agriculture as it is presently practiced in the region. This valuable resource has been exhausted to only the perennial yields in parts of the area and, if current trends continue, this natural resource could be completely lost, resulting in catastrophic economic losses to the area. This project area covers approximately 107,000 acres, which includes approximately 77,000 acres of cropland. The Bayou Meto Basin Project will provide a supplemental agricultural water supply while preserving the groundwater resource. The project provides significant opportunity for fish and wildlife restoration and environmental enhancement.

**5-A-03. <u>PROJECT DESCRIPTION</u>.** The primary plan of improvement for the Bayou Meto area consists of a major pumping station, three smaller unmanned pumping stations, and a network of new canals, existing channels, pipelines, and associated channel structures to provide interbasin transfer of surface water to the water depleted areas. Included as integral parts of the plan are: conservation measures, groundwater management strategies, retrofit of farms, on-farm storage reservoirs, and fish and wildlife restoration and management features. The main pumping station will be located on the Arkansas River just at the southern edge of Little Rock, Arkansas and will be utilized to deliver excess surface water from the Arkansas River throughout the project area during peak use periods and for filling storage reservoirs during off-season periods.

**5-A-04. <u>FEASIBILITY STUDY</u>.** A feasibility study was first performed in order to determine the merits of this project. The report concluded, based on optimization of on-farm storage, that a pumping station with a capacity of 1750 CFS would meet the demand requirements of the area farmers. The pumping station will be located east of the Arkansas River 5 miles downstream of Little Rock, Arkansas. An inlet channel from the Arkansas River will carry water into the pumping stations.

**5-A-05. <u>CONCLUSIONS</u>.** During the feasibility study phase, in the Bayou Meto Basin Region, it was decided that 1750 cubic feet per second would be a sufficient flow rate for this pumping station. This flow rate was used in the development of the concept design as described in Appendix A. The four large pumps are 375 cfs while the two smaller pumps are 125 cfs.

# PART B - MECHANICAL DESIGN DEVELOPMENT

**5-B-01 – GENERAL.** A 1750 CFS pumping station is needed to feed water from the Arkansas River into the canal network system of the Bayou Meto Basin Project. A conceptual design for this pumping station was developed in order to prepare cost data for the parametric cost estimate. The pumping station will contain 6 pumps driven by electric motors. Each of two middle pumps will deliver water at the rate of 125 CFS and each of the four pumps will deliver water at the rate of 375 CFS. The pumping station substructure will be a rectangular multi-level reinforced concrete structure 126.5 feet long by 42 feet wide. A control room will be located on elevation 254.0. The control room will contain operating consoles for remote operation of all pumps and motors plus remote monitoring of all major irrigation control structures. Each pump will discharge into a steel discharge pipe terminated with a flexible check valve. Principal auxiliary station mechanical equipment will consist of a compressed air system, an overhead traveling crane, a well-water supply system, a plumbing system, a sewage disposal system, a ventilation system, an inlet conduit unwatering system, a station floor drainage system, and an HVAC system. The station will also be equipped with a hydraulic elevator for easy access to lower mechanical and electrical equipment rooms.

<u>Basic Data</u>

| | |
|---|---|
| Sump Floor | 217 feet NGVD |
| Operating Floor | 254 feet NGVD |
| Pump Discharge Centerline | 244 feet NGVD |
| Historical High Water Elevation | 243 feet NGVD |
| Historical Low Water Elevation | 229 feet NGVD |
| Design Main Reservoir Water Elevation | 248 feet NGVD |
| Design Inlet Channel Water Elevation | 229 feet NGVD |
| 100 yr. Flood Elevation | 234 feet NGVD |
| Design Station Flow Rate | 1750 CFS |
| Large Pump Flow Rate (4 pumps) | 375 CFS |
| Small Pump Flow Rate (2 pumps) | 125 CFS |
| Large Motor Horsepower | 1500 HP |
| Small Motor Horespower | 500 HP |
| NGVD - National Geodetic Vertical Datum | |

**5-B-02. MAIN PUMPS.**

a. There will be a total of 6 vertical mixed-flow pumps located in the pumping station. Four of the pumps will be 68" by 78" rated at 375 CFS each. The other two pumps will be 42" by 48" mixed flow rated at 125 CFS each. The operator will have the flexibility of using the two different sizes in combination to best match the required flow demand of the canal network.

b. The pump design was based on a total station capacity of 1750 cubic feet per second, an average low river elevation of 229.0 feet, and a discharge reservoir water surface elevation of 248.0 feet. The pumps will be operating against a static head varying between 19 feet at historic low river and 15 feet at historical high river.

c. The pump column and discharge pipe will be ASTM A-36 steel plate. Pump bowls will be cast from close grain cast iron ASTM A48. Impellers will be single piece 316 stainless steel castings keyed to a stainless steel bowl shaft such that the impeller can be torqued in either direction. Guide bearings shall be sleeve type with bronze linings. Line shafts will have stainless steel bearing journals and stainless steel couplings. Bearings will be grease lubricated with Farval automatic lubricators.

d. Each pump will be fed through a Corps of Engineers high profile type 1 formed suction inlet. The impeller bowl opening size dictates the dimensions of the formed suction inlet. The formed suction inlet will severely reduce problems from vortex formation and subsequent induced cavitation. It will also eliminate the need for a sump model study.

**5-B-03.** **MAIN MOTORS**. The four 375 CFS pumps will be driven by 1500 hp, 4160 volt, three phase induction motors with soft start capability. The two 125 CFS pumps will be driven by 500 horsepower motors. All pump motors will be air-cooled and will have oil lubricated bearings. Motors will be controlled manually from console in control room. Motors will be started and stopped as required to best match the demand of the system.

**5-B-04.** **STATION OVERHEAD CRANE**. A 25-ton, double girder bridge type crane, with top running trolley will be provided in the station. The crane bridge will have a span of 37 feet and shall be provided with a walkway. The hoist shall have a total lift of 58 feet. The bridge, trolley, and hoist will be motorized and will have infrared remote controls for easy operation. The main hoist shall be equipped with multi-speed type controls with speeds such that " inching " is possible to permit close positioning of the loads. The bridge will have a variable speed drive capable of traveling a maximum of 160 feet per minute. The trolley will also have a variable speed drive with a maximum travel speed of 80 feet per minute. The hoist will have a variable speed of between 21 feet per minute and a creep speed of 1.6 feet per minute. An auxiliary 10 ton monorail hoist will be mounted on the trolley for light lifting operations.

**5-B-05.** **SUMP UNWATERING SYSTEM**. The sump unwatering system for this pumping station will consist of mud valves, concrete embedded gravity drain pipes, and a submersible pump located in a drain pit beside the station. Mud valves will be of the rising stem type and will be controlled by hand-wheel operated floor stands located at elevation 242.0. Each floor stand shall have an indicator to show the relative position of each mud valve. The stem shall be stainless steel and of the manufacture's recommended diameter for the application. Stem guides will be placed at intervals along the stem to keep the L/R ratio below 200. Each sump bay will be equipped with one 6" mud valve. Mud valves will be connected to a 12" cast iron header which will carry sump water to the pump pit. The pump pit will contain a removable submersible pump. A 4 HP, 1730 RPM, single-stage, vertical, submersible, non-clog, 4 inch pump with check valve will be installed in the chamber and will discharge the effluent into the inlet channel through the pumping station wing walls. Access to the pumping pit will be through a hinged hatch at the top of the pit. The pump will be capable of delivering 315 GPM against a 28 foot head, thus giving a sump unwatering time of approximately 60 minutes. See **Appendix B** for calculations. The discharge pipe will exit the pit, travel through the ground, and discharge into the inlet channel. The end of the discharge pipe will have a flap valve, as an added measure, to prevent backflow of river water into the station when the unwatering pump is not being used. The pump will operate automatically via float control switches and will be capable of removal by sliding up guide rails and without using tools to disconnect the pump from the discharge piping. The pump will also have manual override controls to allow the pump to be started and stopped at any time as station personnel see fit.

**5-B-06. FLOOR DRAINAGE SYSTEM**. The pumping station will have floor drains or trench trains located on each level, as required, to capture water leaking from the pumps, leaching through the walls, or resulting from washdown operations. Water will be carried by cast iron drainage pipes to the dewatering sump where it will be pumped back into the river by the submersible dewatering pump. Floats in the dewatering pit will automatically control pump.

**5-B-07. VENTILATION SYSTEM**. The pump room will be ventilated via 6 belt-driven roof mounted ventilators. Motorized air intake louvers will be provided along the north, south and east walls of the station. The ventilators will have a 1 HP NEMA standard motor, which will be permanently sealed and prelubricated with ball bearings and of the open drip-proof type, and a 48 inch fan with a capacity of 10,485 CFM each at 1/4 inch static pressure. See **Appendix C** for calculations. The ventilator hoods shall be aluminum with a wire mesh bird screen to prevent entrance of foreign matter and the fan assembly shall be all steel.. There will be six operable louvers, 96 inches by 72 inches, and eight stationary louvers of the same size mounted in series. The damper blades of the operable louvers shall have a width of at least 4 inches and provide at least 50 percent free area when in the open operating position. The dampers shall be made of 16 gauge galvanized steel with stainless steel adjusting linkages and ball bearings. The blades shall be at four to six inch centers. The inside of the dampers will have an insect screen. The stationary louvers shall be constructed of 16 gauge galvanized steel. The louvers will be constructed with at least 50 percent free area and of the drainable type. Velocity through the intake louver/dampers will not exceed 1200 feet per minute. The toilet area will be ventilated using a small single speed direct drive centrifugal ventilator. The fan shall be capable of exhausting at least 300 cubic feet per minute at a 1/4 inch static pressure.

**5-B-08. OFFICE HEATING AND AIR CONDITIONING**. The office shall have a nominal 2 ton heat pump with auxiliary strip heating. See **Appendix D** for calculations. The heat pump will be a commercial rooftop mounted unit. The heat pump shall have an outside air intake for bringing in fresh air. The condenser section shall have direct drive propeller type fans with permanently lubed bearings and resiliently mounted to reduce vibration; a hermetically sealed reciprocating compressor with low and high pressure protection, charged with R-22 refrigerant; and copper refrigerant coils with mechanically bonded smooth plate fins. The evaporator section shall have horizontal discharge provided by permanently lubricated forward curved fan(s), copper refrigerant coils with mechanically bonded smooth plate fins, a thermal expansion valve, and condensate drain with pan. A remote mounted thermostat located in the office space will control the heat pump. The thermostat shall have controls for on/off, temperature, airflow, and heating/cooling mode. The unit shall operate on 480 volts, 3 phase, 60 hertz. During the winter months should additional heat be needed on the operating floor and/or lower levels while doing maintenance, plug-in infrared heaters will be used. The water pipe located throughout the station will use pipe heated cable and the pipe will also be insulated to prevent freezing. The pipe heating cable will be sized to pass no more than 6 watts/ft. at 40 degrees F for the pipe size pipe being heated.

**5-B-9.** **<u>WELL WATER SYSTEM</u>**. A well will be drilled near the pumping station to provide water for all pumping station needs. The well will be located approximately 250 feet north of the pumping station. The piping will run to the station underground. The pump will be made for well water pump applications and constructed of corrosion resistant metals to ensure a long life. A submersible pump will be provided to deliver water at a rate of not less than 15 gallons per minute against a pressure of 50 PSI. The pumping level will depend upon how deep the well must be drilled. Since there is a great variance in the potable drinking water level throughout the area, the depth of the well will not be known for certain until the well is actually drilled. The well will be drilled deep enough so that all water needs are be supplied by one well. The water will be filtered and/or cleaned as necessary before being used. The water will be stored in a 150 gallon diaphragm type hydro-pneumatic storage tank located in the mechanical room at elevation 174.0.

**5-B-10.** **<u>PLUMBING</u>**. The plumbing system will consist of a water supply system, bathroom fittings, and a sewage disposal system.

a. The water supply system shall consist of supply piping, a 150 gallon hydro-pneumatic storage tank, chlorinator and a water heater. The storage tank shall be of the diaphragm type operating between 30 and 50 PSI. The water heater shall be a 40 gallon, 9000 watt, 240 volt tank with an adjustable thermostat.

b. The bathroom fittings in the men's latrine shall consist of one water closet with flush valve, one urinal with flush valve, and two lavatories with hot and cold water available. The bathroom fittings in the women's latrine shall consist of two water closets with flush valves and two lavatories. The sewage discharge from the latrines will be piped into a small Coast Guard approved sewage treatment plant. The sewage treatment plant will have a treatment capacity of 240 gallons of wastewater per day. The system shall be self contained and the effluent, after treatment, shall be free from all bacteria, colorless, and odorless and will be discharged into the inlet.

c. The sewage treatment plant will be a Coast Guard certified Type II Marine Sanitation Device consisting of two treatment tanks and a chlorine contact chamber. The first treatment tank will be an aeration tank where sewage mixes with aerated liquid. The second tank will be a biological filter tank where sludge in the liquid settles out in the bottom of the tank and the remaining liquid passes through the biological filter to the top. After passing through the biological filter, the liquid will pass into a chlorine contact chamber where disease-carrying bacteria area killed. The effluent will be discharged into the pump station sump.

**5-B-11.** **<u>FIRE EXTINGUISHERS</u>**. One portable fire extinguisher will be located in the office area and three portable fire extinguishers will be installed on each of the lower levels, and eight portable fire extinguishers will be installed on the operating floor. All fire extinguishers will be Underwriter's laboratory tested. The fire extinguishers shall be all-purpose A-B-C dry chemical type. They shall have a pressure gauge showing proper operating pressures, a discharge nozzle, use either air or nitrogen as an expeller, and use non-toxic dry chemical. The fire extinguisher shall have a capacity of 20 lbs. and UL. Rating of 10A: 40B: C.

**5-B-12. COMPRESSED AIR SYSTEM**. Air compressors will be located in the mechanical room on the operating floor. Air will be needed for operating tools, for cleaning equipment, and for operating the pneumatic pump control valves. The compressed air system will consist of two 5 horsepower, 208 volt, 3 phase, 60 Hz, 1096 RPM motorized compressors and enough storage tanks to operate all pump control valves in a power loss situation. The system will operate between 110 PSI and 140 PSI. Dryers will be used to reduce the moisture content of the air stored in the air tanks.

**5-B-13. HYDRAULIC ELEVATOR**. One hydraulic elevator will be located in an elevator shaft on the west side of the station. The elevator will have inside dimensions of 80 inches wide and 65 inches in depth. The elevator will have a 3'-6" by 7 foot door. The hydraulic equipment will be housed in a machine room located on the operating floor. The hydraulic pump will be driven by a 30 hp motor operating on 480 volts, 3 phase.

**5-B-14. PUMPING STATION # 2**. A lift station pumping 625 cfs will be required to lift water to higher elevation for continuous gravity flow through the system. This lift station will contain five 56-inch drop-in submersible pumps, each having a 476 horsepower, 510-rpm submersible motor. Pumps will have a maximum total dynamic head of 22.85 feet. See appendix E.

**Basic Data**

| | |
|---|---|
| Sump Floor Elevation | 213.00 NGVD |
| Operating Floor Elevation | 240.00 NGVD |
| Inlet Channel Invert Elevation | 217.15 NGVD |
| Design Inlet Channel Water Elevation | 225.15 NGVD |
| Design Reservoir Water Elevation | 242.00 NGVD |
| Station Design Flow | 625 CFS |
| Head | 22.85 TDH |
| Number of Pumps | 5 @ 125 CFS |
| Motor Horsepower | 476 HP |

**5-B-15. PUMPING STATION # 3.** A relatively small lift station pumping 260 cfs will be required to lift water to higher elevation for continuous gravity flow through the system. This pumping station will contain three 48-inch drop-in submersible pumps, each having a 316 horsepower, 505-rpm submersible motor. Pumps will have a maximum total dynamic head of 21.56 feet. See appendix F.

**Basic Data**

| | |
|---|---|
| Sump Floor Elevation | 220.00 NGVD |
| Operating Floor Elevation | 250.50 NGVD |
| Inlet Channel Invert Elevation | 224.35 NGVD |
| Design Inlet Channel Water Elevation | 230.35 NGVD |
| Design Reservoir Water Elevation | 247.00 NGVD |
| Station Design Flow | 260 CFS |
| Head | 21.56 TDH |
| Number of Pumps | 3 @ 87 CFS |
| Motor Horsepower | 316 HP |

**5-B-16. PUMPING STATION # 4**. A relatively small lift station pumping 125 cfs will be required to lift water to higher elevation for continuous gravity flow through the system. This pumping station will contain three 40-inch drop-in submersible pumps, each having a 100 horsepower, 580-rpm submersible motor. Pumps will have a maximum total dynamic head of 11.88 feet. See appendix G.

**Basic Data**

| | |
|---|---|
| Sump Floor Elevation | 184.50 NGVD |
| Operating Floor Elevation | 203.50 NGVD |
| Inlet Channel Invert Elevation | 188.00 NGVD |
| Design Inlet Channel Water Elevation | 192.00 NGVD |
| Design Discharge Channel Elevation | 200.00 NGVD |
| Station Design Flow | 125 CFS |
| Head | 11.88 TDH |
| Number of Pumps | 3 @ 42 CFS |
| Motor Horsepower | 100 HP |

# PART C - ELECTRICAL DESIGN DEVELOPMENT

## 5-C-01. Project Description

a. General. The Bayou Meto Area Basin Project will include the construction of four pumping stations for supplying irrigation water.

(1.) Pump Station Number 1. Pump Station Number 1, capable of delivering 1750 CFS of water, will consist of four (4) - 1500 horsepower pump units and two (2) - 500 horsepower pump units. Each of the pumps will be an electric motor-driven unit. The pump motors and all ancillary electrical systems in the pump station will receive power from an electric substation located adjacent to the pump station. The substation will be owned, operated, and maintained by the local power company. The pump station will have a monitoring and control system. The pump station operator (Pump Operator) will operate the station from the pump station control room. The operation of the pump station will be determined by supply conditions in the Arkansas River, and by demands of the project's canal system. The normal pump station parameters (pump low water cutoff, pump and motor bearing temperatures, lubricating system operation, loss of electrical power, position of gates, etc.) will be monitored and/or alarmed as required.

(2.) Pump Station Number 2. Pump Station Number 2, capable of delivering water at 625 CFS, will consist of five (5) - 476 horsepower pump units. The pump station will operate automatically, based on the water elevation upstream of the pump station. The station will be located at the end of Canal 2000. The pump station will be fully automatic, controlled by upstream water level sensors. It will be possible to operate the station using local manual control, or by remotely adjusting the setpoint at the central monitoring station. The pump station will contain sensors and/or alarms for pump(s) status ("on" or "off"), high or low water in the pump bay(s), and for other normal pump station parameters. The alarms will register at a central monitoring station and will include motor and pump bearing temperatures, lubrication failures, loss of power, etc.

(3.) Pump Station Number 3. Pump Station Number 3, capable of delivering water at 260 CFS, will consist of three (3) - 316 horsepower pumps units. The pump station will operate automatically, based on the water elevation upstream of the pump station. The station will be located at the end of Canal 3000. The pump station will be fully automatic, controlled by upstream water level sensors. It will be possible to operate the station using local manual control, or by remotely adjusting the setpoint at the central monitoring station. The pump station will contain sensors and/or alarms for pump(s) status ("on" or "off"), high or low water in the pump bay(s), and for other normal pump station parameters. The alarms will register at a central monitoring station and will include motor and pump bearing temperatures, lubrication failures, loss of power, etc.

(4.) Pump Station Number 4. Pump Station Number 4, capable of delivering water at 125 CFS, will consist of three (3) - 100 horsepower pumps. The pump station will operate automatically, based on the water elevation upstream of the pump station. The station will be located on Caney Creek at Canal 2140. The pump station will be fully automatic, controlled by upstream water level sensors. It will be possible to operate the station using local manual control, or by remotely adjusting the setpoint at the central monitoring station. The pump station will contain sensors and/or alarms for pump(s) status ("on" or "off"), high or low water in the pump bay(s), and for other normal pump station parameters. The alarms will register at a central monitoring station and will include motor and pump bearing temperatures, lubrication failures, loss of power, etc.

b. Electrical Design. The design of the electrical systems for servicing the pumping plants will include provisions for power, control, lighting, ventilation, lightning protection, and grounding. The design of the various subsystems will be based on the use of equipment and materials that are available as standard products of the electrical industry. In the selection of material and equipment, special consideration will be given to ease of operation, reliability, and ease of maintenance. The Standards of the National Electrical Manufacturers Association (NEMA), the Institute of Electrical and Electronics Engineers (IEEE) and the American National Standards Institute (ANSI) will be used as guides in the selection of motors, switchboards and other electrical equipment. The design of circuits, conduit systems and the grounding system will conform to the National Electrical Code, the National Electrical Safety Code, and the Unified Facilities Guide Specifications. The electrical design of the pump station will be in general accordance with EM 1110-2-3105 (Changes 1 and 2) dated 30 November 1999, "Engineering and Design - Mechanical and Electrical Design of Pumping Stations." That document contains criteria pertinent to the design and selection of mechanical and electrical systems for flood control structures; however, it does not specifically address the design of facilities for irrigation water supply.

## 5-C-02. Power Sources

a. Commercial. The four pumping plants will be supplied with commercial electrical power. Entergy Services, Inc., whose headquarters are in Little Rock, Arkansas, will supply Pump Station Number 1 and Pump Station Number 2. First Electric Cooperative, whose headquarters are in Jacksonville, Arkansas, will supply electrical power to Pump Station Number 3 and Pump Station Number 4. The 4160-volt, three-phase power needed at Pump Station Number 1 for the pump motors (having a total of 7,000 HP), and the 480-volt, three-phase power needed for ancillary systems will be furnished from a transformer station that will be located adjacent to the pump station and will be fed from a transmission line. Pump Station Number 2 will require 4160-volt, three-phase service. Pump Stations Numbers 3 and 4 will require 480-volt, three-phase service. The pump stations will be located in remote areas where no electric utility lines currently exist. Therefore, the utility companies will construct new transmission lines specifically for the pump stations, and the ultimate end user must pay all construction costs for the electrical service. Entergy Services, Inc. will supply the 4.16-kV electrical power for Pump Station Number 1 and Pump Station Number 2 through either a primary selective system or a secondary selective system, thereby providing increased reliability. Entergy Services, Inc. has requested that no pump motor be started at full voltage (across-the-line) and that not more than one pump motor be started at one time. Therefore, a type of reduced-voltage starter, such as the autotransformer type, will be used to start each pump motor.

b. Energy Costs. Entergy Services, Inc. has furnished estimates for a significant portion of the costs associated with the construction and/or installation of distribution lines, transformer substations, equipment, and etc. necessary to supply electrical energy to Pump Stations Numbers 1 and 2. The Government will be responsible for those construction costs. The construction of transmission lines and associated equipment for supplying the substations from Entergy's 115-kV distribution system will necessitate additional costs (for which estimates have not been furnished to the Government). Further, Entergy Services, Inc. furnished cost estimates for supplying electrical energy to operate the pumping units and auxiliary equipment at Pump Station Number 1 and at Pump Station Number 2. The estimates were based on equipment requirements described below (section "5-C-03. Power Distribution"). Also, the estimates assumed load factors of 0.20 for the month of December and 0.85 for each remaining month. Accordingly, the estimated costs are as follows:

| | |
|---|---|
| **Construction Costs** | |
| Pump Station Number 1, 4160-V Service | $1,231,069 |
| Pump Station Number 1, 480-V Service | $62,000 |
| Pump Station Number 2, 4160-V Service | $214,000 |
| | |
| **Energy Costs** | |
| Pump Station Number 1, Estimated Annual | $2,227,566 |
| Pump Station Number 2, Estimated Annual | $798,138 |
| | |
| | |

First Electric Cooperative has furnished estimates of the costs associated with the construction and/or installation of distribution lines, transformer substations, equipment, and etc. necessary to supply electrical energy to Pump Stations Numbers 3 and 4. The Government will be responsible for those construction costs. Further, First Electric Cooperative has furnished cost estimates for supplying electrical energy to operate the pumping units and auxiliary equipment at Pump Station Number 3 and at Pump Station Number 4. The estimates were based on equipment requirements described below (section "5-C-03. Power Distribution"). Also, the estimates assumed that Pump Stations Numbers 3 and 4 would operate 11 months each year, with each December being a "shut-down" month. Accordingly, the estimated costs are as follows:

| Construction Costs | |
|---|---|
| Pump Station Number 3,   480-V Service | $213,700 |
| Pump Station Number 4,   480-V Service | $466,700 |
| | |
| | |
| **Energy Costs** | |
| Pump Station Number 3, Estimated Annual | $159,926 |
| Pump Station Number 4, Estimated Annual | $70,075 |
| | |
| | |

## 5-C-0.3. Power Distribution

a. General. Each of the four pump stations will utilize electric motors as prime movers to drive irrigation water pumps. The pump motors for Pump Station Number 1 and for Pump Station Number 2 will operate from medium-voltage (4.16-kV), three-phase power. Ancillary loads at those stations will operate from low-voltage (480Y/277-volt, 208Y/120-volt, and 240/120-volt) power. Pump Stations Numbers 2 and 3 will require low-voltage (480-volt, three-phase) power for pump motors and low-voltage (240/120-volt, single-phase) power for ancillary loads. At Pump Station Number 1 and at Pump Station Number 2, 4.16-kV electric power will be distributed to the pumping units through a line-up of metal-enclosed medium-voltage motor controllers; auxiliary loads of 480-volts (or lower) will be distributed through a motor control center and/or power panels. At each of the Pump Stations Numbers 3 and 4, 480-volt electric power will be distributed to the pumping units through a motor control center. At those stations, auxiliary loads of 480-volts (or lower) will be distributed through a strategically located power panel(s), which may be included in the motor control center. Where the supplying power company imposes restrictions on motor starting, appropriate provisions will be included to assure that motors are not started at full-voltage (across-the-line) and/or that not more than one motor is started at one time.

b. Loads. Utilization equipment to be controlled from metal-enclosed medium-voltage motor controllers, motor control centers, and power panels will be as follows:

PUMP STATION NUMBER 1

4160-volt, three-phase equipment:
4 - 1500 HP horizontal-shaft pump motors
2 - 500 HP horizontal-shaft pump motors

480-volt, three-phase equipment:
Bridge crane
Well pump
Dewatering pumps

Air compressor
Elevator
Effluent pump
Portable water pump
Welder receptacles
Exhaust fans
Water heater
Air Conditioning/Electric heat unit

<u>277-volt, single-phase equipment:</u>
Interior and exterior lighting

<u>208-volt, single-phase equipment</u>:
Motor heaters
Bus duct heaters

<u>120-volt, single-phase equipment</u>:
Motor starter control power
Well motor heater
Receptacles (general use)
Emergency lights
Sanitation device
Annunciator
Switchgear heaters
Louvers
Vacuum relief heat trace
Pump lubricators
Sump pumps
Vibration monitor system
PLC control panel
Fire alarm panel
Oil-Water separator
Water fountain

<u>PUMP STATION NUMBER 2</u>

<u>4160-volt, three-phase equipment</u>:
5-476 HP horizontal-shaft pump motors

<u>120-volt, single-phase equipment</u>:
Heaters - motors and motor control center
Receptacles

Lighting

PUMP STATION NUMBER 3

480-volt, three-phase equipment:
3-316 HP horizontal-shaft pump motors

120-volt, single-phase equipment:
Heaters - motors and motor control center
Receptacles
Lighting

PUMP STATION NUMBER 4

480-volt, three-phase equipment:
3-100 HP horizontal-shaft pump motors

120-volt, single-phase equipment:
Heaters - motors and motor control center
Receptacles
Lighting

## 5-C-04. Pump Motor Control System

a. General. Each of the four pump stations will be equipped with power distribution equipment in conformance with the requirements of EM 1110-2-3105. Each pump station will have a main disconnecting device as required by NFPA-70, "National Electrical Code." Each station's main disconnecting device will be a fusible interrupter switch (which requires no maintenance). In Pump Station Number 1, the main disconnecting switch will be a medium-voltage, metal enclosed load interrupter switch, which will be installed as a part of the motor controller line-up. In each of Pump Stations Numbers 2, 3, and 4, the main disconnecting switch will be a quick-make, quick-break fusible interrupter switch, which will be installed as a part of the motor control center. At each pump station, the service equipment will be provided with protection against single-phasing.

b. Motor Control. At each pump station, control of pump motors will be provided through equipment that will reduce and limit the effects of motor starting on the power system. At Pump Station Number 1, the medium-voltage motors will be controlled by means of reduced voltage, non-reversing, autotransformer type starters. At Pump Station Number 2, the medium-voltage motors will be controlled by means of solid-state, reduced voltage starters. At Pump Stations Numbers 3 and 4, the low-voltage motors will be controlled by means of solid-state, reduced voltage starters.

c. Motor Protection. At each pump station, protection of pump motors will be provided through a microprocessor-based protective system, which will combine control, monitoring, and protection functions in one assembly. The protective system will monitor the motor's three phase AC current, the temperature of the motor windings, and the temperatures of the motor and/or pump bearings. Protective features of the system will include motor overload, instantaneous overcurrent, ground fault, phase loss and phase unbalance, jam trip, number of motor starts per time period, motor bearing temperature, and incomplete sequence.

## 5-C-05. Low Voltage Distribution System

Each pump station will have a low-voltage power distribution system. The low-voltage distribution system will provide power to all low-voltage utilization equipment, including auxiliary pumps (where used), the lighting system, gate operators (where used), overhead crane (where used), air conditioning system (where used), air compressors (where used), control equipment, and all small motors. The low-voltage distribution system will include 480Y/277-volt, 208Y/120-volt, and/or 120/240-volt systems.

## 5-C-06. Pump Low Water Cutoff Control

Each pump station will have a pump low water cutoff control system. The pump low water cutoff control will consist of a strain gage or vibrating wire technology sensor in each pump bay (one for each pump motor). The sensors will be sealed and be made of an abrasion and corrosion resistant material. The sensor will be supported by a corrosion and abrasion resistant jacketed cable, which will be capable of holding the switch in a vertical position, resisting any drift during pump operation. The sensors will be installed in a PVC-type pipe for physical protection.

## 5-C-07. Conduit and Boxes

a. General. All wiring will be installed in rigid metal conduit except that motors and other electrical equipment subject to vibration will be connected with liquid-tight flexible metal conduit. All conduits will be embedded unless otherwise specified. All conduit runs will avoid pockets or traps, which retain moisture, and the specifications will emphasize provisions necessary to drain all conduits.

b. Pull and Junction Boxes. All embedded pull boxes and junction boxes will be of cast metal of sufficient thickness, or provided with bosses, to accommodate the required threads for conduit connections of the sizes specified. Drainpipe and screen will be provided in the bottom of the boxes.

c. Outlet Boxes. All outlet boxes for receptacles, switches, and lighting fixtures will be of cast metal with bosses drilled and tapped, or with threaded hubs of the specified size. The edges will be designed to take a heavy cover gasket with four or more screws for attaching covers or fixtures.

## 5-C-08. Motors

a. Main-Pump Motors. The main-pump motors for Pump Station Number 1 will consist of four 1500-hp, 4.16 kV, three-phase, 60 Hz., 1.1 service factor, horizontal shaft, 1200-rpm motors, and two 500-hp, 4.16 kV, three-phase, 60 Hz, 1.1 service factor, horizontal shaft, 1200-rpm motors. Pump motors will be furnished with power factor correction capacitors to correct the power factor to 92 to 95 percent at full load.

The pump motors for the Pump Station Number 2 will be five 476-hp, 4160-volt, three-phase, 60 Hz, 1.1 service factor, vertical motors. Each pump motor will be integral with its driven pump.

The pump motors for the Pump Station Number 3 will be three 316-hp, 480-volt, three-phase, 60 Hz, 1.1 service factor, vertical motors. Each pump motor will be integral with its driven pump.

The pump motors for the Pump Station Number 4 will be three 100-hp, 480-volt, three-phase, 60 Hz, 1.1 service factor, vertical motors. Each pump motor will be integral with its driven pump.

b. Ancillary Motors. Motors used for operating the pump station auxiliaries and station service equipment will be single-speed, 480-volt, three-phase, 60 Hz motors. The horsepower ratings for all 480-volt motors will be determined by the machinery requirements and duty cycle. Motors one horsepower and larger will be provided with space heaters to prevent condensation while idle.

## 5-C-09. Lighting and Receptacles

a. Lighting.

(1.) Interior Lighting. Energy efficient lighting techniques will be used for the interior lighting of Main Pump Station. Appropriate luminaires will be selected for use with high intensity discharge (HID) lamps. Lighting levels will be based on recommendations of the Illuminating Engineering Society of North America (IESNA) and EM 1110-2-3105. The number of luminaires required for each area will be determined using the Zonal Cavity Method lighting calculation procedure. The computed loads for sizing feeders and branch circuits serving interior lighting loads will conform to the requirements of Article 220 of the National Electrical Code.

(2.) Exterior Lighting. Energy efficient lighting techniques will be used for the exterior lighting at each pump station. Appropriate luminaires will be selected for use with high intensity discharge (HID) lamps. Lighting levels will be based on recommendations of the Illuminating Engineering Society of North America (IESNA) and EM 1110-2-3105. The number of luminaires and the size of lamps required for each area to be illuminated will be determined using the Beam-Lumen Method lighting calculation procedure. The computed loads for sizing feeders and branch circuits serving interior lighting loads will conform to the requirements of Article 220 of the National Electrical Code.

(3.) Emergency Lighting. Each pump station will be provided with emergency lighting in accordance with NFPA 101, Life Safety Code. Installation of emergency systems will conform to

Article 700 of the National Electrical Code.

b. Receptacles. At Pump Station Number 1, three-pole duplex receptacles will be provided at appropriate points in the walls of the operating floor, office, and equipment room. No exterior convenience receptacle outlets will be provided since experience indicates that such exterior devices are targets of vandalism. At Pump Stations Numbers 2, 3, and 4, receptacles will be strategically located to provide power for servicing equipment. Receptacles will be 120-volt AC, 20-ampere, two-wire with grounding pole. All receptacle outlets will be provided with ground fault circuit interrupter (GFCI) protection.

## 5-C-10. Ventilation

All pump sump areas and all operating areas of Pump Station Number 1 will be furnished with equipment for ventilation in accordance with the recommendations of EM 1110-2-3105. Also, all toilet rooms will be equipped with a vent fan.

## 5-C-11. Communications

A strategically located outlet box for future telephone connections will be provided at each pump station. A conduit from the outlet box will be stubbed outside of Pump Station Number 1 and capped. Appropriate equipment will be installed at each station to allow for communication cables and equipment associated with an automated control system for the entire canal network.

## 5-C-12. Annunciator

At each of the four pump stations, each irrigation-water pump motor circuit will be equipped with a microprocessor-based, multiple-function motor protective device. In addition to providing the motor and pump with numerous protection features, the protective device will provide a panel display for indicating operating and/or alarm conditions of the pump/motor. Further, the protective devices will have provisions for initializing an audible alarm in the event that a pump/motor alarm or pre-alarm condition occurs. Each protective device will be mounted so that its display panel is visible from the front of the motor controller line-up (medium-voltage motors) or the motor control center (low-voltage motors).

## 5-C-13. Grounding System

Each pump station will have provisions for system and equipment grounding that meet the requirements of the National Electrical Code (Article 250) and the recommendations of EM 1110-2-3105. The grounding electrode system will include one or more of the following, bonded together: a ground ring (ground bus) encircling the building or structure, concrete-encased electrode (sump floor reinforcing bars), 20-foot ground rods driven at the corners of the structure. At Pump Station Number 1, a ground loop to which systems, equipment, enclosures, and non-current carrying metal will be connected, will be embedded in the operating floor and connected to the grounding electrode system through exothermically welded conductors.

## 5-C-14. Lightning Protection System

A lightning protection system will be provided for each pump station. Each system will be the standard product of a manufacturer regularly engaged in the production of lightning protection systems, and will conform to NFPA Nos. 70 and 78, UL 96 and UL 96A. In general, the systems will consist of air terminals, roof conductors, down conductors, and ground connections, electrically interconnected to form the shortest possible distance to ground without passing through nonconducting parts of the structure. All conductors on the structures will be exposed except where conductors are in protective sleeves exposed on outside walls. Secondary conductors will interconnect with grounded metallic parts within the building. The lightning protection systems will be designed in accordance with procedures outlined in TM 5-811-3, "Electrical Design: Lightning and Static Electricity Protection."

## 5-C-15. Short-Circuit Analysis

Short-circuit (fault current) calculations for the 4160-volt and 480-volt, three-phase systems in the pump stations will be performed using a short-circuit analysis computer program. A complete single-line diagram of each power system will be prepared for the analysis. Each power source, conductor, circuit component, motor, and generator will be programmed into the software. The short-circuit program will perform computations to indicate the potential fault current at each point on the single-line diagram. The calculated values of available fault current will be used to assure that properly sized protective devices are installed throughout each system to prevent possible equipment damage or personal injury.

# PART - D STRUCTURAL DESIGN DEVELOPMENT

## 5-D-01 GENERAL

This section presents the basic criteria, assumptions, and methods of analysis for the design of the pumping station. Allowable stresses and design procedures follow accepted engineering practice and applicable parts of the Engineering Manual. Approval of this GRR will become the basis for initiation of the Design Document Report and plans and specifications for the various pumping stations in this section.

## 5-D-02 BASIC CRITERIA

a. Unit weights The following units weights and lateral coefficients were used.

| Material | Wt.(lb. per cu. Ft) |
|---|---|
| Concrete | 150 |
| Earth | |
| moist | 125 |
| saturated | 125 |
| submerged | 62.5 |
| Water | 62.5 |

b. Lateral earth pressure

| | |
|---|---|
| active | 0.33 |
| at-rest | 0.5 |

c. Concrete strength and serviceability requirements. Pertinent values for concrete design are in accordance with EM 1110-2-2104 Strength design for reinforced-concrete hydraulic structures and ACI 318-95.

Reinforced concrete compressive strength @ 28 days, f'c=3000 psi
Steel reinforcement ASTM grade 60, fy=60 ksi

## 5-D-03 PUMPING STATION NO. 1

a. Description: The pumping station is reinforced concrete construction consisting of six pump bays and one service bay. The substructure consists of an operating floor, sump floors, intake and trash racks. The superstructure will be constructed of reinforced concrete rigid frames with longitudinal beams framing into it. The building walls will be concrete masonry and brick.

b. Substructure Load Case foundation pressures were computed for the loading conditions as described below:

CASE IA Construction condition; structure complete to elevation 254; backfill in place exerting at rest soil pressure; site dewatered; no uplift

CASE IB Construction condition; structure complete with equipment in place; moisted backfill;no uplift

CASE IIA Operating condition; pump flow; maximum water in sump; maximum uplift

CASE IIB Operating condition; pump flow; minimum water in sump; minimum uplift

CASE IIC Operating condition; pump flow; normal water in sump; normal uplift

CASE III Maintenance condition: CASE IIC with one exterior pump bay dewatered

CASE IV Earthquake condition; CASE IIC combined with earthquake forces; earthquake acceleration considered both perpendicular and parallel to flow

The loading conditions and results of the stability analysis are shown on plate .

c. Superstructure loading – the design of superstructure will be based on the following loads:

| | |
|---|---|
| Roof Live Load | 50 psf |
| Floor Live Load | 100 psf |
| Crane Capacity | 25 ton |

CASE I Dead Load + Live Load + Crane Load

CASE II Dead Load + Live Load + Crane Load + Wind Load

CASE III Dead Load + ½ Live Load + Earthquake Load

## 5-D-04 UNMANNED STATIONS

a. **<u>PUMPING STATION # 2</u>**. A lift station pumping 625 cfs will be required to lift water to higher elevation for continuous gravity flow through the system. This lift station will contain five 56-inch drop-in submersible pumps, each having a 476 horsepower, 510-rpm submersible motor. Pumps will have a maximum static head of 17.85 feet. See appendix E.

b. **<u>PUMPING STATION # 3</u>**. A relatively small lift station pumping 260 cfs will be required to lift water to higher elevation for continuous gravity flow through the system. This pumping station will contain three 48-inch drop-in submersible pumps, each having a 316 horsepower, 505-rpm submersible motor. Pumps will have a maximum static head of 17.65 feet. See appendix F.

c. **<u>PUMPING STATION # 4</u>**. A relatively small lift station pumping 125 cfs will be required to lift water to higher elevation for continuous gravity flow through the system. This pumping station will contain three 40-inch drop-in submersible pumps, each having a 100 horsepower, 580-rpm submersible motor. Pumps will have a maximum static head of 9.00 feet. See appendix G.

# Bayou Meto Basin Project
## Conceptual Design of Bayou Meto Basin Pumping Station

# APPENDIX A

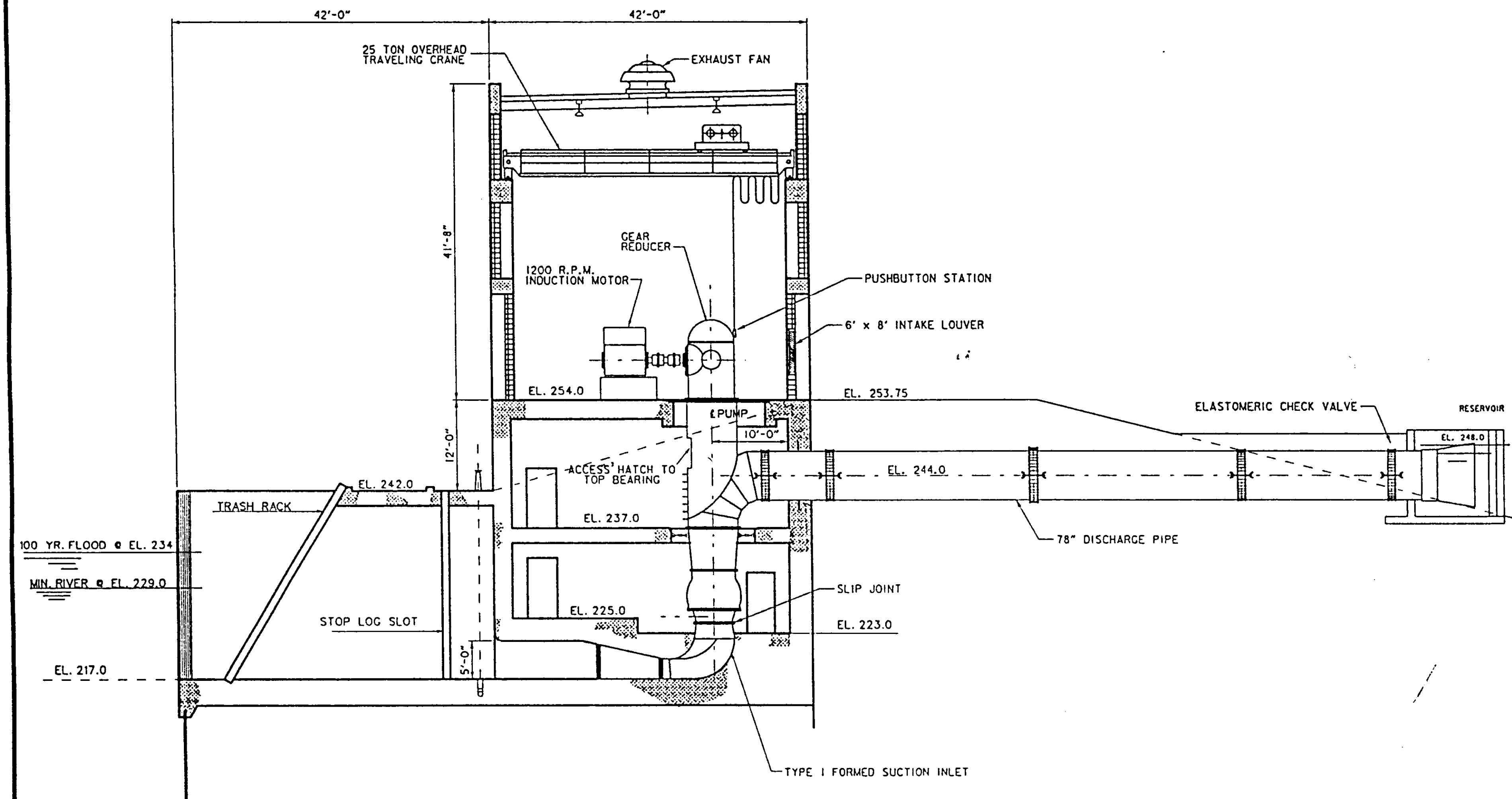
# BAYOU METO BASIN PUMPING STATIONS

# MECHANICAL DESIGN DEVELOPMENT

# STATION LAYOUT AND PUMP CURVES

# FOR PUMPING STATION # 1

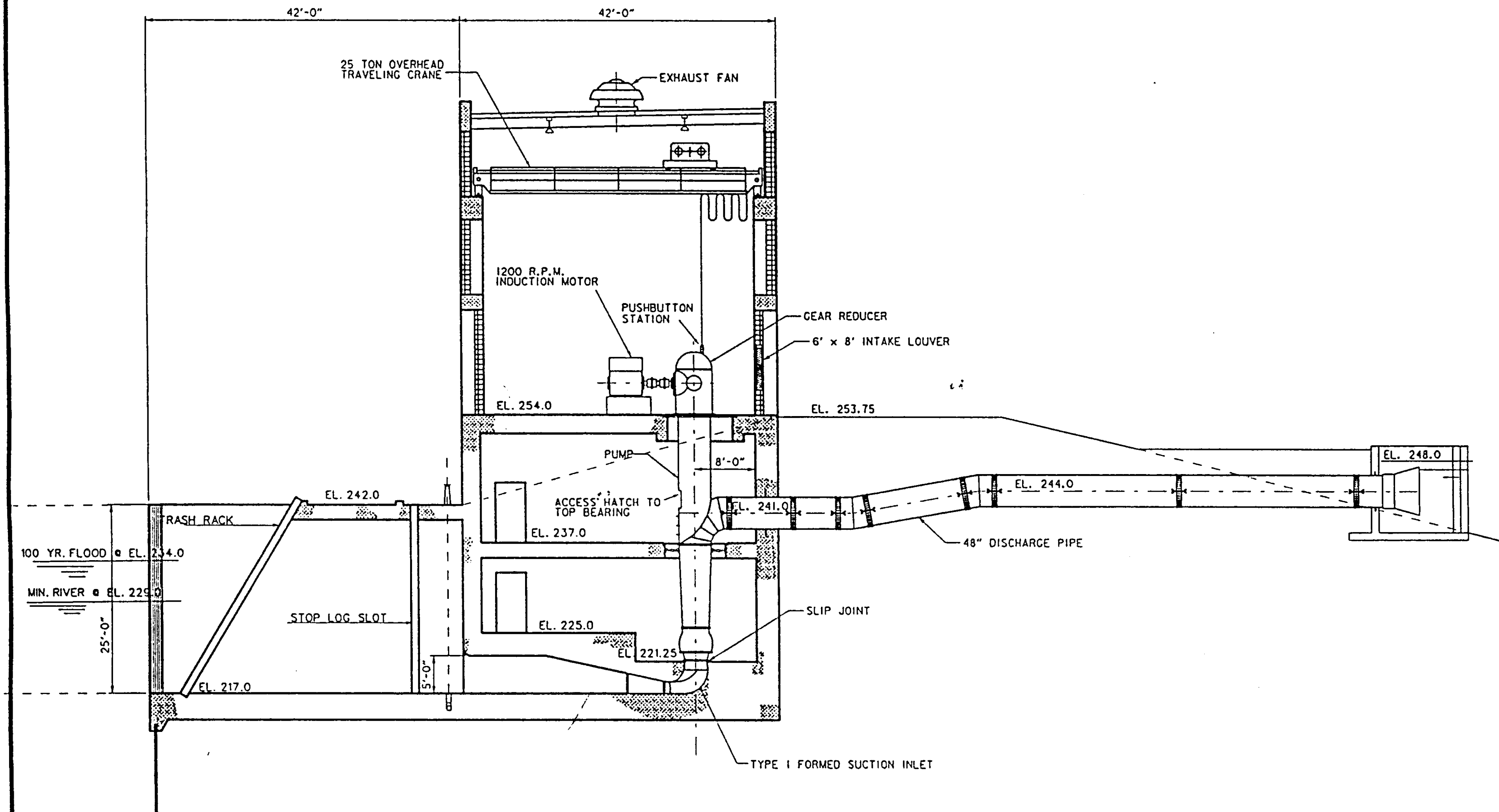
U.S. Army Corps of Engineers
Memphis District



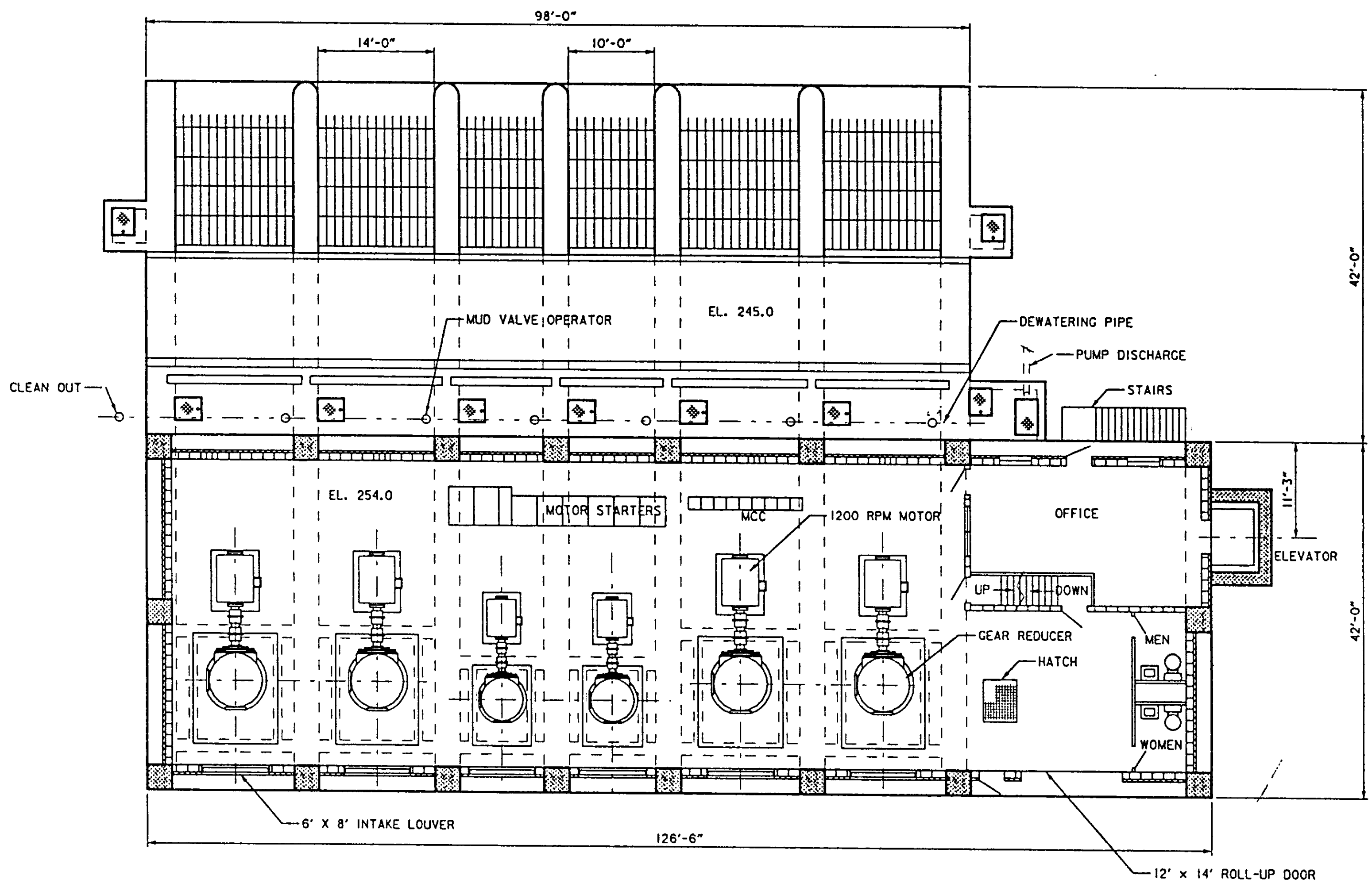

PUMP - 375 CFS

TRANSVERSE ELEVATION

SCALE: 1" = 20'-0"

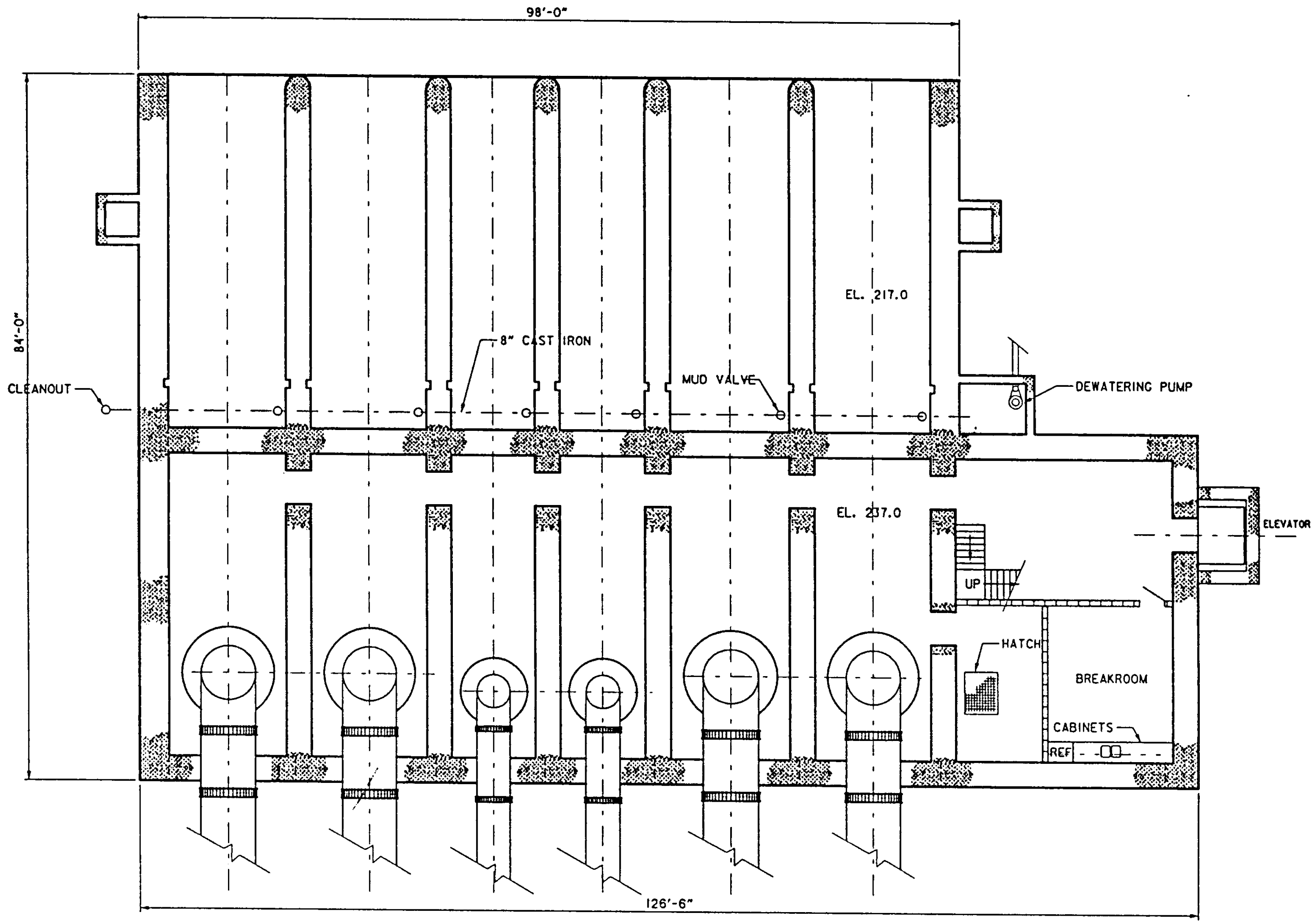



PUMP - 125 CFS
TRANSVERSE ELEVATION
SCALE: 1" = 20'-0"



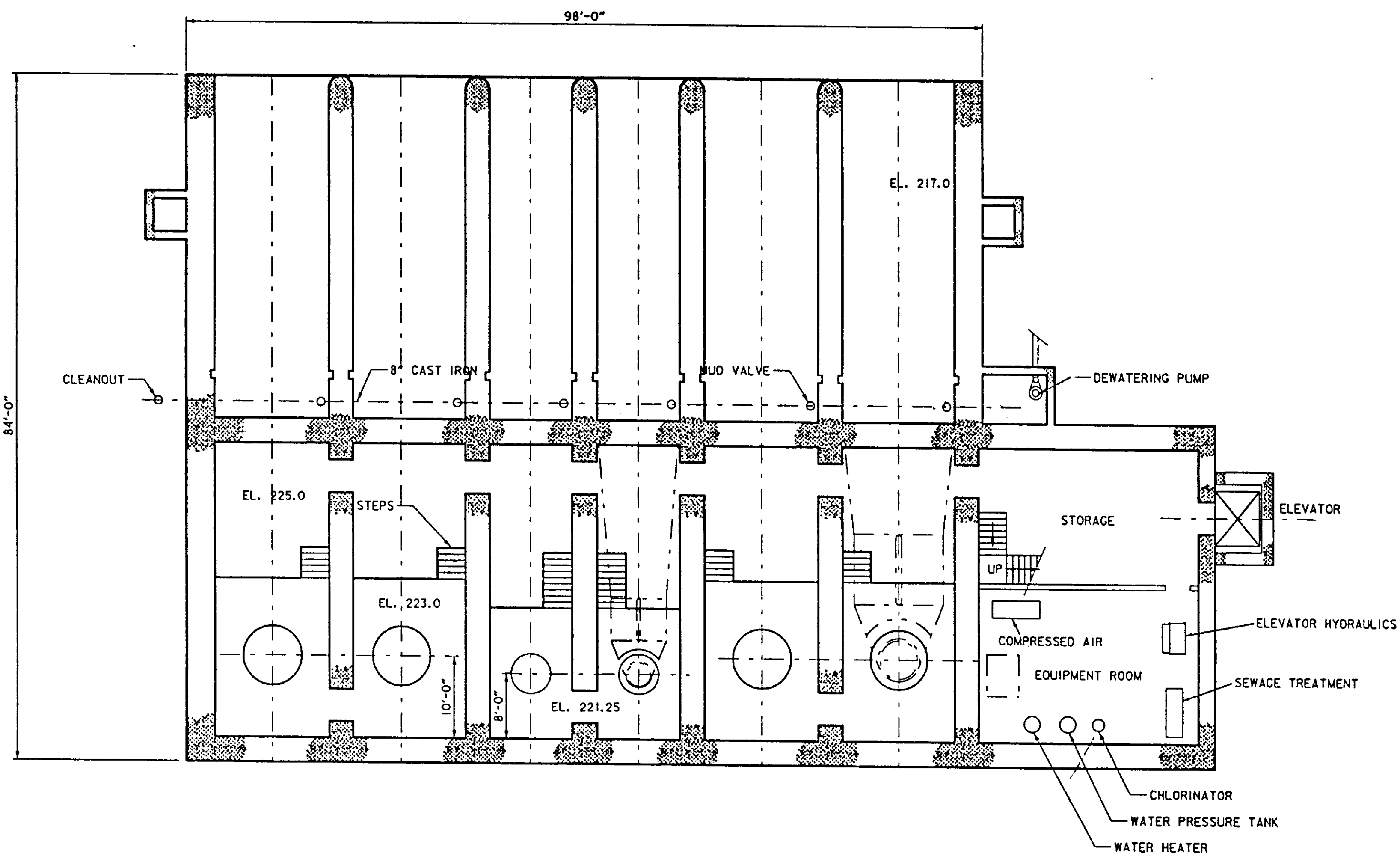

FLOOR PLAN - EL. 254.0/245.0

SCALE: 1" = 20'-0"




FLOOR PLAN - EL. 237.0

SCALE: 1" = 20'-0"




FLOOR PLAN - EL. 225.0/223.0/221.25

SCALE: 1" = 20'-0"

CALCULATIONS FOR BAYOU METO PUMPING STATION
1750 CFS PUMPING STATION
68" x 78" VERTICAL MIXED FLOW PUMPS - 375 CFS EACH

1. DISCHARGE PIPE DIAMETER

FLOW RATE THRU PIPE = 375 CFS
DESIRED VELOCITY THRU PIPE = 10 FT/SEC
NOMINAL DIAMETER OF PIPE = (4*375/(10*3.14))**1/2 = 6.912 FT. DIAMETER
USE 78" DIAMETER DISCHARGE PIPE W/ DESIGN VELOCITY OF 11.33 FT/SEC

2. DESIGN CRITERIA

| | |
|---|---|
| A. HISTORICAL HIGH WATER | 243.0 NGVD |
| B. 100 YEAR FLOOD | 234.0 NGVD |
| B. HISTORICAL LOW RIVER | 229.0 NGVD |
| C. RESERVOIR ELEVATION | 248.0 NGVD |
| E. STATION DESIGN FLOW | 1750 CFS |
| F. LARGE PUMP DESIGN FLOW RATE | 375 CFS |
| G. SMALL PUMP DESIGN FLOW RATE | 125 CFS |

3. CONDITION POINTS

A. MAXIMUM HEAD (DESIGN)

| | |
|---|---|
| RESERVOIR ELEVATION | = 248.0 NGVD |
| MINIMUM RIVER | = 229.0 NGVD |
| Hst (Static Head) | = 19.0 NGVD |

NPSHA = Hp + Hse - Hf - Hvpa
Hp = Atmospheric Pressure
Hse = Height of Water Above Pump Impeller Datum (EL. 225.0')
Hf = Friction Loss in Formed Suction Inlet and Trash Rack
Hvpa = Vapor Pressure of Water
NPSHA = 33.9' + 4.0' – 1.49' - 1.38'
NPSHA = 35.03'
NPSHR = 24.00'

B. 100 YEAR FLOOD

| | | |
|---|---|---|
| RESERVOIR ELEVATION | = 248.0 NGVD |
| 100 YEAR RIVER | = 234.0 NGVD |
| Hst (Static Head) | = 14.0 NGVD |

NPSHA = 33.9' + 14.0' – 1.82' - 1.38'
NPSHA = 44.7'
NPSHR = 26.0'

C. MINIMUM HEAD (PERIOD OF RECORD)

| | |
|---|---|
| RESERVOIR ELEVATION | = 248.0 NGVD |
| PERIOD OF RECORD | = 243.0 NGVD |
| Hst (Static Head) | = 5.0 NGVD |

NPSHA = 33.9' + 18.0' – 1.99' - 1.38'
NPSHA = 48.53'
NPSHR = 27.5'

3. CONCLUSIONS

A. MAXIMUM PUMP HORSEPOWER = 1248 HP
B. BRAKE HORSEPOWER AT GEAR INPUT= 1248/.94 = 1328 HP
E. MAXIMUM MOTOR HORSEPOWER REQ'D = 1328 x 110% = 1460 HP
F. MOTOR SIZE REQUIRED = 1500 HP

LOSSES FOR 78" PUMP (375 CFS)
MAX STATIC HEAD= 19

RATED GPM= 168,303
PIPE AREA (SQ.FT.)= 33.16625
RATED VELOCITY (FT/SEC)= 11.30662432
EQUIV. LENGTH OF PIPE (FT)= 87

| PUMP FLOW GPM | CFS | VELOCITY | TRASH RACK | FSI | 78" PIPE | TIDEFLEX | VEL. LOSS | TOTAL DYNAMIC |
|---|---|---|---|---|---|---|---|---|
| 10,000 | 22.28 | 0.67 | 0.03 | 0.00 | 0.0048 | 0.3172 | 0.01 | 19.36 |
| 20,000 | 44.56 | 1.34 | 0.06 | 0.01 | 0.0096 | 0.3844 | 0.03 | 19.50 |
| 30,000 | 66.84 | 2.02 | 0.09 | 0.03 | 0.0143 | 0.4515 | 0.06 | 19.65 |
| 40,000 | 89.12 | 2.69 | 0.12 | 0.06 | 0.0191 | 0.5187 | 0.11 | 19.82 |
| 50,000 | 111.40 | 3.36 | 0.15 | 0.09 | 0.0239 | 0.5859 | 0.18 | 20.02 |
| 60,000 | 133.68 | 4.03 | 0.18 | 0.13 | 0.0287 | 0.6531 | 0.25 | 20.24 |
| 70,000 | 155.96 | 4.70 | 0.21 | 0.17 | 0.0335 | 0.7202 | 0.34 | 20.48 |
| 80,000 | 178.24 | 5.37 | 0.24 | 0.22 | 0.0382 | 0.7874 | 0.45 | 20.74 |
| 90,000 | 200.52 | 6.05 | 0.27 | 0.28 | 0.0430 | 0.8546 | 0.57 | 21.02 |
| 100,000 | 222.80 | 6.72 | 0.30 | 0.35 | 0.0478 | 0.9218 | 0.70 | 21.32 |
| 110,000 | 245.08 | 7.39 | 0.33 | 0.42 | 0.0526 | 0.9889 | 0.85 | 21.64 |
| 120,000 | 267.36 | 8.06 | 0.36 | 0.50 | 0.0574 | 1.0561 | 1.01 | 21.98 |
| 130,000 | 289.64 | 8.73 | 0.39 | 0.59 | 0.0621 | 1.1233 | 1.18 | 22.35 |
| 140,000 | 311.92 | 9.40 | 0.42 | 0.69 | 0.0669 | 1.1905 | 1.37 | 22.73 |
| 150,000 | 334.20 | 10.08 | 0.45 | 0.79 | 0.0717 | 1.2577 | 1.58 | 23.14 |
| 160,000 | 356.48 | 10.75 | 0.48 | 0.90 | 0.0765 | 1.3248 | 1.79 | 23.57 |
| 168,303 | 374.98 | 11.31 | 0.50 | 0.99 | 0.0804 | 1.3806 | 1.98 | 23.94 |
| 170,000 | 378.76 | 11.42 | 0.51 | 1.01 | 0.0813 | 1.3920 | 2.03 | 24.02 |
| 180,000 | 401.04 | 12.09 | 0.53 | 1.14 | 0.0860 | 1.4592 | 2.27 | 24.49 |
| 190,000 | 423.32 | 12.76 | 0.56 | 1.26 | 0.0908 | 1.5264 | 2.53 | 24.98 |
| 200,000 | 445.60 | 13.44 | 0.59 | 1.40 | 0.0956 | 1.5935 | 2.80 | 25.49 |
| 210,000 | 467.88 | 14.11 | 0.62 | 1.55 | 0.1004 | 1.6607 | 3.09 | 26.02 |
| 220,000 | 490.16 | 14.78 | 0.65 | 1.70 | 0.1052 | 1.7279 | 3.39 | 26.57 |
| 230,000 | 512.44 | 15.45 | 0.68 | 1.85 | 0.1099 | 1.7951 | 3.71 | 27.15 |
| 240,000 | 534.72 | 16.12 | 0.71 | 2.02 | 0.1147 | 1.8623 | 4.04 | 27.74 |
| 250,000 | 557.00 | 16.79 | 0.74 | 2.19 | 0.1195 | 1.9294 | 4.38 | 28.36 |
| 260,000 | 579.28 | 17.47 | 0.77 | 2.37 | 0.1243 | 1.9966 | 4.74 | 29.00 |
| 270,000 | 601.56 | 18.14 | 0.80 | 2.55 | 0.1290 | 2.0638 | 5.11 | 29.66 |
| 280,000 | 623.84 | 18.81 | 0.83 | 2.75 | 0.1338 | 2.1310 | 5.49 | 30.34 |
| 290,000 | 646.12 | 19.48 | 0.86 | 2.95 | 0.1386 | 2.1981 | 5.89 | 31.04 |
| 300,000 | 668.40 | 20.15 | 0.89 | 3.15 | 0.1434 | 2.2653 | 6.31 | 31.76 |

DESIGN CONDITIONS= 168,303 GPM @ 23.9384 TDH

PUMP HORSEPOWER= 1,248.34 HP

MOTOR HORSEPOSER= 1,460.83 HP USE 1500 HP MOTOR

LOSSES FOR 78" PUMP (375 CFS)
STATIC HEAD = 14

RATED GPM= 168,303
PIPE AREA (SQ.FT.)= 33.16625
RATED VELOCITY (FT/SEC)= 11.30662432
EQUIV. LENGTH OF PIPE (FT)= 87

| PUMP FLOW GPM | CFS | VELOCITY | TRASH RACK | FSI | 78" PIPE | TIDEFLEX | VEL. LOSS | TOTAL DYNAMIC |
|---|---|---|---|---|---|---|---|---|
| 10,000 | 22.28 | 0.67 | 0.03 | 0.00 | 0.0048 | 0.3172 | 0.01 | 14.36 |
| 20,000 | 44.56 | 1.34 | 0.06 | 0.01 | 0.0096 | 0.3844 | 0.03 | 14.50 |
| 30,000 | 66.84 | 2.02 | 0.09 | 0.03 | 0.0143 | 0.4515 | 0.06 | 14.65 |
| 40,000 | 89.12 | 2.69 | 0.12 | 0.06 | 0.0191 | 0.5187 | 0.11 | 14.82 |
| 50,000 | 111.40 | 3.36 | 0.15 | 0.09 | 0.0239 | 0.5859 | 0.18 | 15.02 |
| 60,000 | 133.68 | 4.03 | 0.18 | 0.13 | 0.0287 | 0.6531 | 0.25 | 15.24 |
| 70,000 | 155.96 | 4.70 | 0.21 | 0.17 | 0.0335 | 0.7202 | 0.34 | 15.48 |
| 80,000 | 178.24 | 5.37 | 0.24 | 0.22 | 0.0382 | 0.7874 | 0.45 | 15.74 |
| 90,000 | 200.52 | 6.05 | 0.27 | 0.28 | 0.0430 | 0.8546 | 0.57 | 16.02 |
| 100,000 | 222.80 | 6.72 | 0.30 | 0.35 | 0.0478 | 0.9218 | 0.70 | 16.32 |
| 110,000 | 245.08 | 7.39 | 0.33 | 0.42 | 0.0526 | 0.9889 | 0.85 | 16.64 |
| 120,000 | 267.36 | 8.06 | 0.36 | 0.50 | 0.0574 | 1.0561 | 1.01 | 16.98 |
| 130,000 | 289.64 | 8.73 | 0.39 | 0.59 | 0.0621 | 1.1233 | 1.18 | 17.35 |
| 140,000 | 311.92 | 9.40 | 0.42 | 0.69 | 0.0669 | 1.1905 | 1.37 | 17.73 |
| 150,000 | 334.20 | 10.08 | 0.45 | 0.79 | 0.0717 | 1.2577 | 1.58 | 18.14 |
| 160,000 | 356.48 | 10.75 | 0.48 | 0.90 | 0.0765 | 1.3248 | 1.79 | 18.57 |
| 168,303 | 374.98 | 11.31 | 0.50 | 0.99 | 0.0804 | 1.3806 | 1.98 | 18.94 |
| 170,000 | 378.76 | 11.42 | 0.51 | 1.01 | 0.0813 | 1.3920 | 2.03 | 19.02 |
| 180,000 | 401.04 | 12.09 | 0.53 | 1.14 | 0.0860 | 1.4592 | 2.27 | 19.49 |
| 190,000 | 423.32 | 12.76 | 0.56 | 1.26 | 0.0908 | 1.5264 | 2.53 | 19.98 |
| 200,000 | 445.60 | 13.44 | 0.59 | 1.40 | 0.0956 | 1.5935 | 2.80 | 20.49 |
| 210,000 | 467.88 | 14.11 | 0.62 | 1.55 | 0.1004 | 1.6607 | 3.09 | 21.02 |
| 220,000 | 490.16 | 14.78 | 0.65 | 1.70 | 0.1052 | 1.7279 | 3.39 | 21.57 |
| 230,000 | 512.44 | 15.45 | 0.68 | 1.85 | 0.1099 | 1.7951 | 3.71 | 22.15 |
| 240,000 | 534.72 | 16.12 | 0.71 | 2.02 | 0.1147 | 1.8623 | 4.04 | 22.74 |
| 250,000 | 557.00 | 16.79 | 0.74 | 2.19 | 0.1195 | 1.9294 | 4.38 | 23.36 |
| 260,000 | 579.28 | 17.47 | 0.77 | 2.37 | 0.1243 | 1.9966 | 4.74 | 24.00 |
| 270,000 | 601.56 | 18.14 | 0.80 | 2.55 | 0.1290 | 2.0638 | 5.11 | 24.66 |
| 280,000 | 623.84 | 18.81 | 0.83 | 2.75 | 0.1338 | 2.1310 | 5.49 | 25.34 |
| 290,000 | 646.12 | 19.48 | 0.86 | 2.95 | 0.1386 | 2.1981 | 5.89 | 26.04 |
| 300,000 | 668.40 | 20.15 | 0.89 | 3.15 | 0.1434 | 2.2653 | 6.31 | 26.76 |

PUMP HORSEPOWER= 1,135.78 HP

MOTOR HORSEPOSER= 1,329.11 HP

LOSSES FOR 78" PUMP (375 CFS)

MIN STATIC HEAD = 5

RATED GPM= 168,303

PIPE AREA (SQ.FT.)= 33.16625

RATED VELOCITY (FT/SEC)= 11.30662432

EQUIV. LENGTH OF PIPE (FT)= 87

| PUMP FLOW GPM | CFS | VELOCITY | TRASH RACK | FSI | 78" PIPE | TIDEFLEX | VEL. LOSS | TOTAL DYNAMIC |
|---|---|---|---|---|---|---|---|---|
| 10,000 | 22.28 | 0.67 | 0.03 | 0.00 | 0.0048 | 0.3172 | 0.01 | 5.36 |
| 20,000 | 44.56 | 1.34 | 0.06 | 0.01 | 0.0096 | 0.3844 | 0.03 | 5.50 |
| 30,000 | 66.84 | 2.02 | 0.09 | 0.03 | 0.0143 | 0.4515 | 0.06 | 5.65 |
| 40,000 | 89.12 | 2.69 | 0.12 | 0.06 | 0.0191 | 0.5187 | 0.11 | 5.82 |
| 50,000 | 111.40 | 3.36 | 0.15 | 0.09 | 0.0239 | 0.5859 | 0.18 | 6.02 |
| 60,000 | 133.68 | 4.03 | 0.18 | 0.13 | 0.0287 | 0.6531 | 0.25 | 6.24 |
| 70,000 | 155.96 | 4.70 | 0.21 | 0.17 | 0.0335 | 0.7202 | 0.34 | 6.48 |
| 80,000 | 178.24 | 5.37 | 0.24 | 0.22 | 0.0382 | 0.7874 | 0.45 | 6.74 |
| 90,000 | 200.52 | 6.05 | 0.27 | 0.28 | 0.0430 | 0.8546 | 0.57 | 7.02 |
| 100,000 | 222.80 | 6.72 | 0.30 | 0.35 | 0.0478 | 0.9218 | 0.70 | 7.32 |
| 110,000 | 245.08 | 7.39 | 0.33 | 0.42 | 0.0526 | 0.9889 | 0.85 | 7.64 |
| 120,000 | 267.36 | 8.06 | 0.36 | 0.50 | 0.0574 | 1.0561 | 1.01 | 7.98 |
| 130,000 | 289.64 | 8.73 | 0.39 | 0.59 | 0.0621 | 1.1233 | 1.18 | 8.35 |
| 140,000 | 311.92 | 9.40 | 0.42 | 0.69 | 0.0669 | 1.1905 | 1.37 | 8.73 |
| 150,000 | 334.20 | 10.08 | 0.45 | 0.79 | 0.0717 | 1.2577 | 1.58 | 9.14 |
| 160,000 | 356.48 | 10.75 | 0.48 | 0.90 | 0.0765 | 1.3248 | 1.79 | 9.57 |
| 168,303 | 374.98 | 11.31 | 0.50 | 0.99 | 0.0804 | 1.3806 | 1.98 | 9.94 |
| 170,000 | 378.76 | 11.42 | 0.51 | 1.01 | 0.0813 | 1.3920 | 2.03 | 10.02 |
| 180,000 | 401.04 | 12.09 | 0.53 | 1.14 | 0.0860 | 1.4592 | 2.27 | 10.49 |
| 190,000 | 423.32 | 12.76 | 0.56 | 1.26 | 0.0908 | 1.5264 | 2.53 | 10.98 |
| 200,000 | 445.60 | 13.44 | 0.59 | 1.40 | 0.0956 | 1.5935 | 2.80 | 11.49 |
| 210,000 | 467.88 | 14.11 | 0.62 | 1.55 | 0.1004 | 1.6607 | 3.09 | 12.02 |
| 220,000 | 490.16 | 14.78 | 0.65 | 1.70 | 0.1052 | 1.7279 | 3.39 | 12.57 |
| 230,000 | 512.44 | 15.45 | 0.68 | 1.85 | 0.1099 | 1.7951 | 3.71 | 13.15 |
| 240,000 | 534.72 | 16.12 | 0.71 | 2.02 | 0.1147 | 1.8623 | 4.04 | 13.74 |
| 250,000 | 557.00 | 16.79 | 0.74 | 2.19 | 0.1195 | 1.9294 | 4.38 | 14.36 |
| 260,000 | 579.28 | 17.47 | 0.77 | 2.37 | 0.1243 | 1.9966 | 4.74 | 15.00 |
| 270,000 | 601.56 | 18.14 | 0.80 | 2.55 | 0.1290 | 2.0638 | 5.11 | 15.66 |
| 280,000 | 623.84 | 18.81 | 0.83 | 2.75 | 0.1338 | 2.1310 | 5.49 | 16.34 |
| 290,000 | 646.12 | 19.48 | 0.86 | 2.95 | 0.1386 | 2.1981 | 5.89 | 17.04 |
| 300,000 | 668.40 | 20.15 | 0.89 | 3.15 | 0.1434 | 2.2653 | 6.31 | 17.76 |

PUMP HORSEPOWER= 805.98 HP

MOTOR HORSEPOSER= 943.16 HP

PATTERSON PUMP COMPANY
A subsidiary of The Gorman-Rupp Co.

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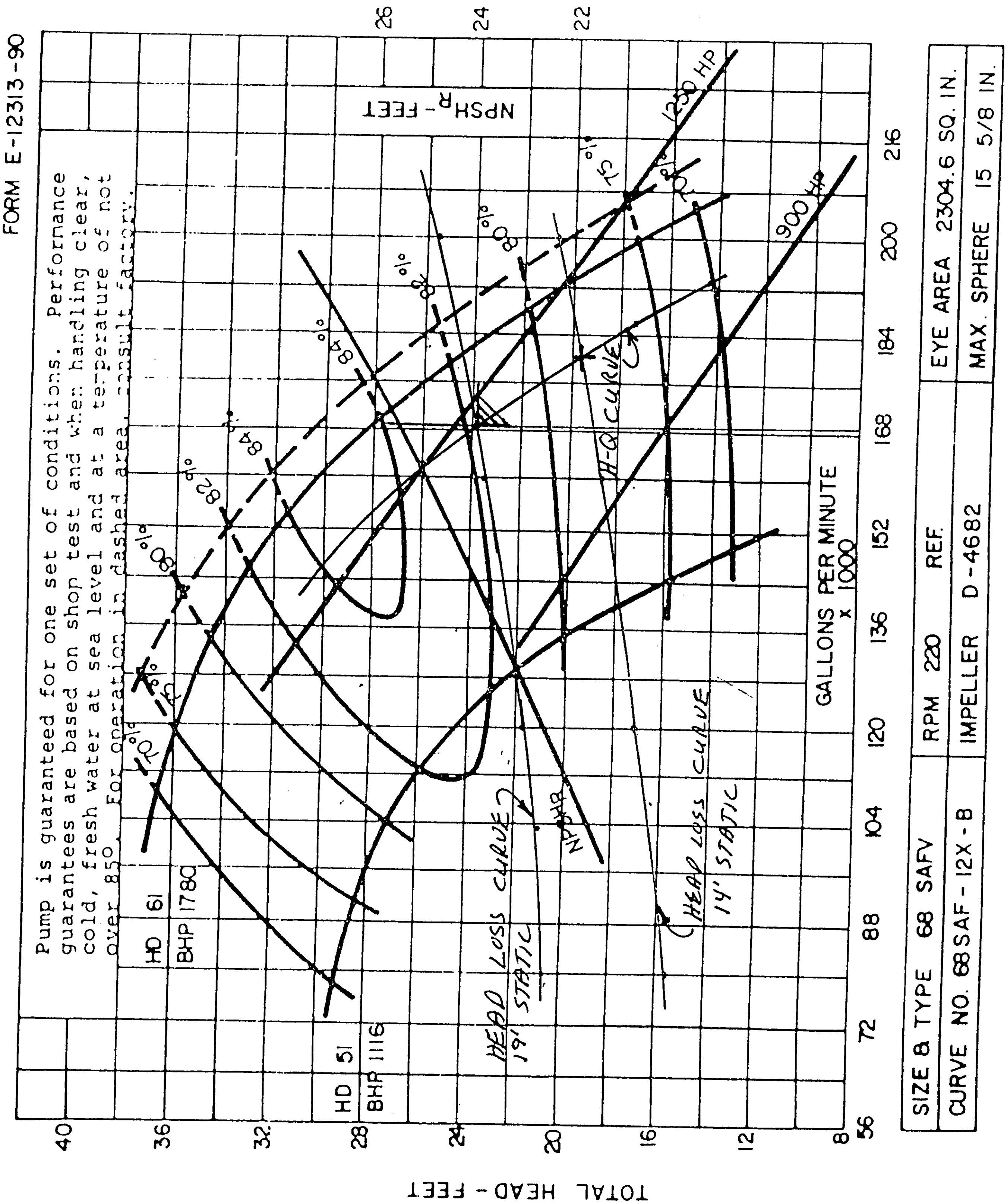
Post Office Box 790
Toccoa, Georgia 30577


# G
Section



CALCULATIONS FOR BAYOU METO PUMPING STATION
1750 CFS PUMPING STATION
42" x 48" VERTICAL MIXED FLOW PUMPS - 125 CFS EACH

1. DISCHARGE PIPE DIAMETER

FLOW RATE THRU PIPE = 125 CFS
DESIRED VELOCITY THRU PIPE = 10 FT/SEC
NOMINAL DIAMETER OF PIPE = (4*125/(10*3.14))**1/2 = 3.99 FT. DIAMETER
USE 48" DIAMETER DISCHARGE PIPE W/ DESIGN VELOCITY OF 9.95 FT/SEC

2. DESIGN CRITERIA

| | |
|---|---|
| A. HISTORICAL HIGH WATER | 243.0 NGVD |
| B. 100 YEAR FLOOD | 234.0 NGVD |
| B. HISTORICAL LOW RIVER | 229.0 NGVD |
| C. RESERVOIR ELEVATION | 248.0 NGVD |
| E. STATION DESIGN FLOW | 1750 CFS |
| F. LARGE PUMP DESIGN FLOW RATE | 375 CFS |
| G. SMALL PUMP DESIGN FLOW RATE | 125 CFS |

3. CONDITION POINTS

A. MAXIMUM HEAD (DESIGN)

| | |
|---|---|
| RESERVOIR ELEVATION | = 248.0 NGVD |
| MINIMUM RIVER | = 229.0 NGVD |
| Hst (Static Head) | = 19.0 NGVD |

NPSHA = Hp + Hse - Hf - Hvpa
Hp = Atmospheric Pressure
Hse = Height of Water Above Pump Impeller Datum (EL. 225.0')
Hf = Friction Loss in Formed Suction Inlet and Trash Rack
Hvpa = Vapor Pressure of Water
NPSHA = 33.9' + 4.0' – 1.49' - 1.38'
NPSHA = 35.03'
NPSHR = 25.0'

B. 100 YEAR FLOOD

| | |
|---|---|
| RESERVOIR ELEVATION | = 248.0 NGVD |
| 100 YEAR RIVER | = 234.0 NGVD |
| Hst (Static Head) | = 14.0 NGVD |

NPSHA = 33.9' + 14.0' – 1.82' - 1.38'
NPSHA = 44.7'
NPSHR = 27.0'

C. MINIMUM HEAD (PERIOD OF RECORD)

| | |
|---|---|
| RESERVOIR ELEVATION | = 248.0 NGVD |
| PERIOD OF RECORD | = 243.0 NGVD |
| Hst (Static Head) | = 5.0 NGVD |

NPSHA = 33.9' + 18.0' – 1.99' - 1.38'
NPSHA = 48.53'
NPSHR = 30.0'

3. CONCLUSIONS

| | |
|---|---|
| A. MAXIMUM PUMP HORSEPOWER= | 400 HP |
| B. BRAKE HORSEPOWER AT GEAR INPUT= 400/.94 = | 425 HP |
| E. MAXIMUM MOTOR HORSEPOWER REQ'D = 425 x 110% = | 467 HP |
| F. MOTOR SIZE REQUIRED = | 500 HP |

| LOSSES FOR 48" PUMP (125 CFS) | | RATED GPM= | 56101 |
|---|---|---|---|
| MAX STATIC HEAD= | 19 | PIPE AREA (SQ. FT.)= | 12.56 |
| | | RATED VELOCITY (FT/SEC)= | 9.95218495 |
| | | EQUIV. LENGTH OF PIPE (FT)= | 110 |

| PUMP FLOW GPM | CFS | VELOCITY | TRASH RACK | FSI | 48" PIPE | TIDEFLEX | VEL. LOSS | TOTAL |
|---|---|---|---|---|---|---|---|---|
| 10,000 | 22.28 | 1.77 | 0.09 | 0.02 | 0.0559 | 0.4274 | 0.05 | 19.65 |
| 20,000 | 44.56 | 3.55 | 0.18 | 0.10 | 0.1117 | 0.6048 | 0.20 | 20.19 |
| 30,000 | 66.84 | 5.32 | 0.27 | 0.22 | 0.1676 | 0.7822 | 0.44 | 20.88 |
| 40,000 | 89.12 | 7.10 | 0.36 | 0.39 | 0.2234 | 0.9596 | 0.78 | 21.71 |
| 50,000 | 111.40 | 8.87 | 0.45 | 0.61 | 0.2793 | 1.1369 | 1.22 | 22.69 |
| 56,101 | 124.99 | 9.95 | 0.50 | 0.77 | 0.3133 | 1.2452 | 1.54 | 23.37 |
| 60,000 | 133.68 | 10.64 | 0.53 | 0.88 | 0.3351 | 1.3143 | 1.76 | 23.82 |
| 70,000 | 155.96 | 12.42 | 0.62 | 1.20 | 0.3910 | 1.4917 | 2.39 | 25.10 |
| 80,000 | 178.24 | 14.19 | 0.71 | 1.56 | 0.4468 | 1.6691 | 3.13 | 26.52 |
| 90,000 | 200.52 | 15.97 | 0.80 | 1.98 | 0.5027 | 1.8465 | 3.96 | 28.09 |
| 100,000 | 222.80 | 17.74 | 0.89 | 2.44 | 0.5585 | 2.0239 | 4.89 | 29.80 |
| 110,000 | 245.08 | 19.51 | 0.98 | 2.96 | 0.6144 | 2.2013 | 5.91 | 31.66 |
| 120,000 | 267.36 | 21.29 | 1.07 | 3.52 | 0.6702 | 2.3787 | 7.04 | 33.67 |
| 130,000 | 289.64 | 23.06 | 1.16 | 4.13 | 0.7261 | 2.5561 | 8.26 | 35.83 |
| 140,000 | 311.92 | 24.83 | 1.25 | 4.79 | 0.7819 | 2.7335 | 9.58 | 38.13 |
| 150,000 | 334.20 | 26.61 | 1.34 | 5.50 | 0.8378 | 2.9108 | 10.99 | 40.58 |
| 160,000 | 356.48 | 28.38 | 1.43 | 6.25 | 0.8936 | 3.0882 | 12.51 | 43.17 |
| 170,000 | 378.76 | 30.16 | 1.52 | 7.06 | 0.9495 | 3.2656 | 14.12 | 45.91 |
| 180,000 | 401.04 | 31.93 | 1.60 | 7.92 | 1.0053 | 3.4430 | 15.83 | 48.80 |
| 190,000 | 423.32 | 33.70 | 1.69 | 8.82 | 1.0612 | 3.6204 | 17.64 | 51.83 |
| 200,000 | 445.60 | 35.48 | 1.78 | 9.77 | 1.1170 | 3.7978 | 19.54 | 55.01 |

DESIGN CONDITIONS= 56,101 GPM @ 23.3653 TDH

PUMP HORSEPOWER= 406.15 HP

MOTOR HORSEPOSER= 475.28 HP **USE 500 HP MOTORS**

LOSSES FOR 48" PUMP (125 CFS)

STATIC HEAD= 14

RATED GPM= 56101

PIPE AREA (SQ. FT.)= 12.56

RATED VELOCITY (FT/SEC)= 9.95218495

EQUIV. LENGTH OF PIPE (FT)= 110

| PUMP FLOW GPM | CFS | VELOCITY | TRASH RACK | FSI | 48" PIPE | TIDEFLEX | VEL. LOSS | TOTAL |
|---|---|---|---|---|---|---|---|---|
| 10,000 | 22.28 | 1.77 | 0.09 | 0.02 | 0.0559 | 0.4274 | 0.05 | 14.65 |
| 20,000 | 44.56 | 3.55 | 0.18 | 0.10 | 0.1117 | 0.6048 | 0.20 | 15.19 |
| 30,000 | 66.84 | 5.32 | 0.27 | 0.22 | 0.1676 | 0.7822 | 0.44 | 15.88 |
| 40,000 | 89.12 | 7.10 | 0.36 | 0.39 | 0.2234 | 0.9596 | 0.78 | 16.71 |
| 50,000 | 111.40 | 8.87 | 0.45 | 0.61 | 0.2793 | 1.1369 | 1.22 | 17.69 |
| 56,101 | 124.99 | 9.95 | 0.50 | 0.77 | 0.3133 | 1.2452 | 1.54 | 18.37 |
| 60,000 | 133.68 | 10.64 | 0.53 | 0.88 | 0.3351 | 1.3143 | 1.76 | 18.82 |
| 70,000 | 155.96 | 12.42 | 0.62 | 1.20 | 0.3910 | 1.4917 | 2.39 | 20.10 |
| 80,000 | 178.24 | 14.19 | 0.71 | 1.56 | 0.4468 | 1.6691 | 3.13 | 21.52 |
| 90,000 | 200.52 | 15.97 | 0.80 | 1.98 | 0.5027 | 1.8465 | 3.96 | 23.09 |
| 100,000 | 222.80 | 17.74 | 0.89 | 2.44 | 0.5585 | 2.0239 | 4.89 | 24.80 |
| 110,000 | 245.08 | 19.51 | 0.98 | 2.96 | 0.6144 | 2.2013 | 5.91 | 26.66 |
| 120,000 | 267.36 | 21.29 | 1.07 | 3.52 | 0.6702 | 2.3787 | 7.04 | 28.67 |
| 130,000 | 289.64 | 23.06 | 1.16 | 4.13 | 0.7261 | 2.5561 | 8.26 | 30.83 |
| 140,000 | 311.92 | 24.83 | 1.25 | 4.79 | 0.7819 | 2.7335 | 9.58 | 33.13 |
| 150,000 | 334.20 | 26.61 | 1.34 | 5.50 | 0.8378 | 2.9108 | 10.99 | 35.58 |
| 160,000 | 356.48 | 28.38 | 1.43 | 6.25 | 0.8936 | 3.0882 | 12.51 | 38.17 |
| 170,000 | 378.76 | 30.16 | 1.52 | 7.06 | 0.9495 | 3.2656 | 14.12 | 40.91 |
| 180,000 | 401.04 | 31.93 | 1.60 | 7.92 | 1.0053 | 3.4430 | 15.83 | 43.80 |
| 190,000 | 423.32 | 33.70 | 1.69 | 8.82 | 1.0612 | 3.6204 | 17.64 | 46.83 |
| 200,000 | 445.60 | 35.48 | 1.78 | 9.77 | 1.1170 | 3.7978 | 19.54 | 50.01 |

PUMP HORSEPOWER= 365.51 HP

MOTOR HORSEPOSER= 427.72 HP

LOSSES FOR 48" PUMP (125 CFS)

MIN STATIC HEAD= 5

RATED GPM= 56101

PIPE AREA (SQ. FT.)= 12.56

RATED VELOCITY (FT/SEC)= 9.95218495

EQUIV. LENGTH OF PIPE (FT)= 110

| PUMP FLOW GPM | CFS | VELOCITY | TRASH RACK | FSI | 48" PIPE | TIDEFLEX | VEL. LOSS | TOTAL |
|---|---|---|---|---|---|---|---|---|
| 10,000 | 22.28 | 1.77 | 0.09 | 0.02 | 0.0559 | 0.4274 | 0.05 | 5.65 |
| 20,000 | 44.56 | 3.55 | 0.18 | 0.10 | 0.1117 | 0.6048 | 0.20 | 6.19 |
| 30,000 | 66.84 | 5.32 | 0.27 | 0.22 | 0.1676 | 0.7822 | 0.44 | 6.88 |
| 40,000 | 89.12 | 7.10 | 0.36 | 0.39 | 0.2234 | 0.9596 | 0.78 | 7.71 |
| 50,000 | 111.40 | 8.87 | 0.45 | 0.61 | 0.2793 | 1.1369 | 1.22 | 8.69 |
| 56,101 | 124.99 | 9.95 | 0.50 | 0.77 | 0.3133 | 1.2452 | 1.54 | 9.37 |
| 60,000 | 133.68 | 10.64 | 0.53 | 0.88 | 0.3351 | 1.3143 | 1.76 | 9.82 |
| 70,000 | 155.96 | 12.42 | 0.62 | 1.20 | 0.3910 | 1.4917 | 2.39 | 11.10 |
| 80,000 | 178.24 | 14.19 | 0.71 | 1.56 | 0.4468 | 1.6691 | 3.13 | 12.52 |
| 90,000 | 200.52 | 15.97 | 0.80 | 1.98 | 0.5027 | 1.8465 | 3.96 | 14.09 |
| 100,000 | 222.80 | 17.74 | 0.89 | 2.44 | 0.5585 | 2.0239 | 4.89 | 15.80 |
| 110,000 | 245.08 | 19.51 | 0.98 | 2.96 | 0.6144 | 2.2013 | 5.91 | 17.66 |
| 120,000 | 267.36 | 21.29 | 1.07 | 3.52 | 0.6702 | 2.3787 | 7.04 | 19.67 |
| 130,000 | 289.64 | 23.06 | 1.16 | 4.13 | 0.7261 | 2.5561 | 8.26 | 21.83 |
| 140,000 | 311.92 | 24.83 | 1.25 | 4.79 | 0.7819 | 2.7335 | 9.58 | 24.13 |
| 150,000 | 334.20 | 26.61 | 1.34 | 5.50 | 0.8378 | 2.9108 | 10.99 | 26.58 |
| 160,000 | 356.48 | 28.38 | 1.43 | 6.25 | 0.8936 | 3.0882 | 12.51 | 29.17 |
| 170,000 | 378.76 | 30.16 | 1.52 | 7.06 | 0.9495 | 3.2656 | 14.12 | 31.91 |
| 180,000 | 401.04 | 31.93 | 1.60 | 7.92 | 1.0053 | 3.4430 | 15.83 | 34.80 |
| 190,000 | 423.32 | 33.70 | 1.69 | 8.82 | 1.0612 | 3.6204 | 17.64 | 37.83 |
| 200,000 | 445.60 | 35.48 | 1.78 | 9.77 | 1.1170 | 3.7978 | 19.54 | 41.01 |

PUMP HORSEPOWER= 192.25 HP

MOTOR HORSEPOSER= 224.97 HP

PATTERSON PUMP COMPANY
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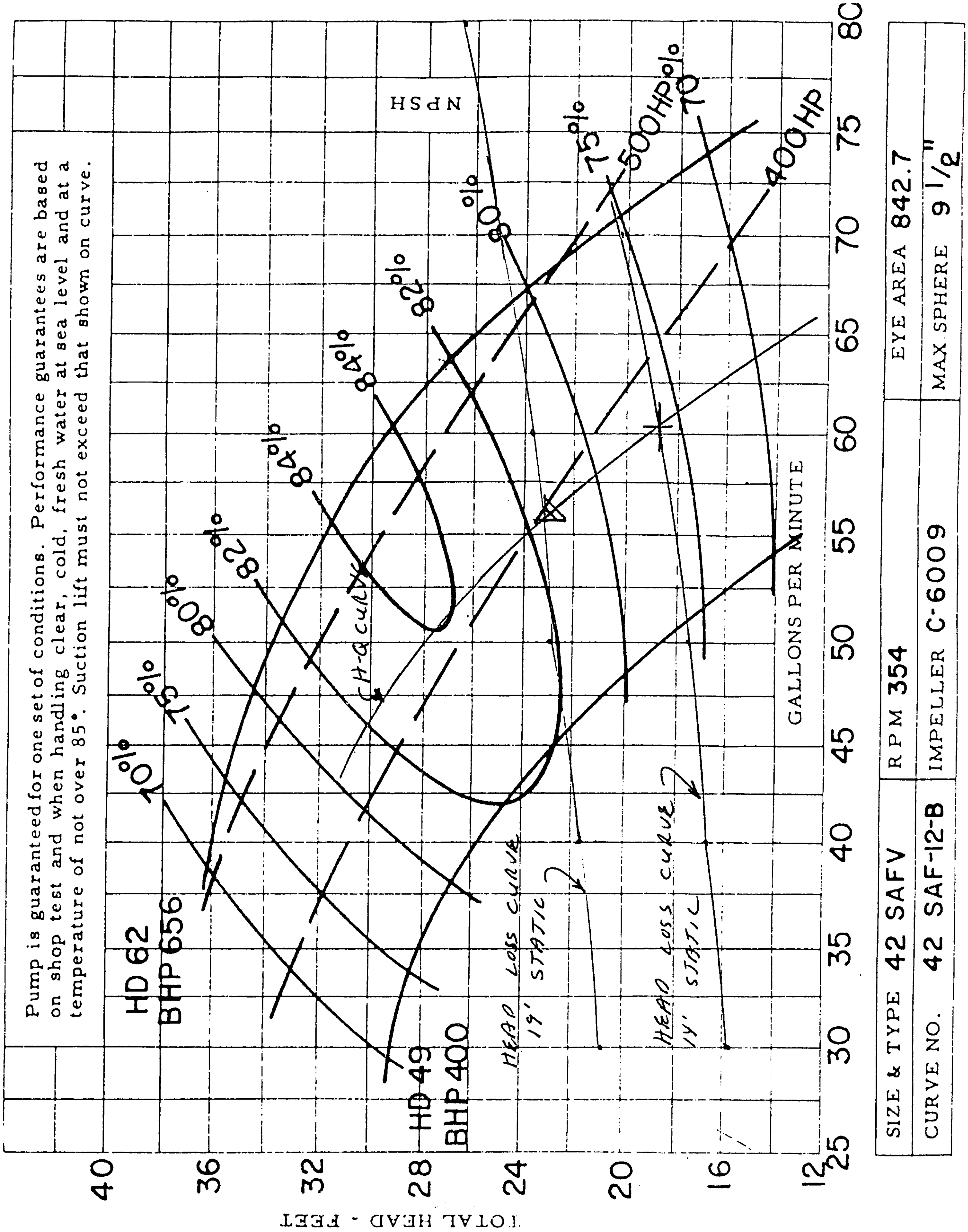


# Bayou Meto Basin Project
Conceptual Design of Bayou Meto Basin Pumping Stations

## APPENDIX B

## BAYOU METO BASIN PUMPING STATIONS

## MECHANICAL DESIGN DEVELOPMENT

## SUMP UNWATERING SYSTEM FOR

## PUMPING STATION # 1

U.S. Army Corps of Engineers
Memphis District

<u>**Sump Dewatering System**</u>

Calculate Of formed suction inlet (FSI).

From the FSI shown in Figure A:

$V_{1(triangle)} = ½(b)(w)(h)$
$= ½(1.82')(8.637')(10.403')$
$= 81.76\ ft^3$

$V_{2(Rectangle)} = b(h)(w)$
$= 8.637'(2.613')(11.2' - .75')$
$= 235.86\ ft^3$

$V_3 = V_{Cylinder} + V_{Triangle}$
$= \pi(r^2)h + ½(b)(h)(w)$
$= 58.08\ ft^3 + 146.61\ ft^3$
$= 204.69\ ft^3$

$V_{4(Triangle)} = 1/3(A_1 + A_2 + \sqrt{}A_1 + A_2)\ H$
$A_1 = \pi(2.638')^2 = 21.86\ ft^2$
$A_2 = \pi(2.333')^2 = 17.104\ ft^2$
$V_{4(triangle)} = 58.3\ ft^3$

**Figure A**
FSI Type 1 Design
56" Eye Diameter (NTS)

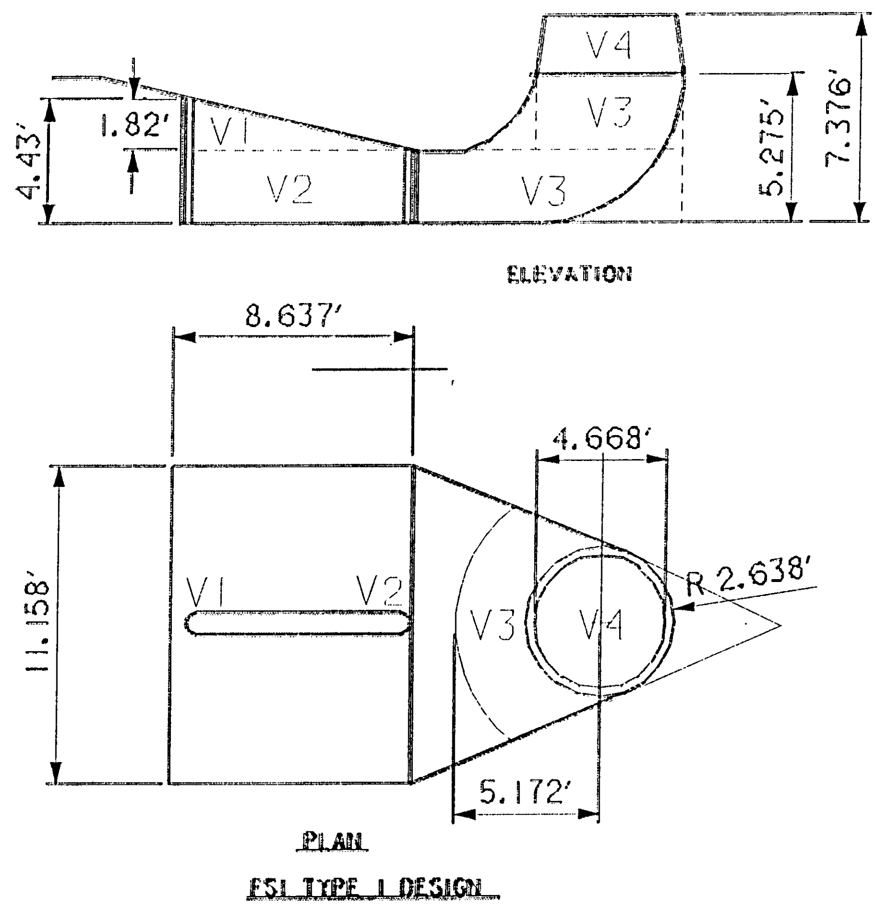
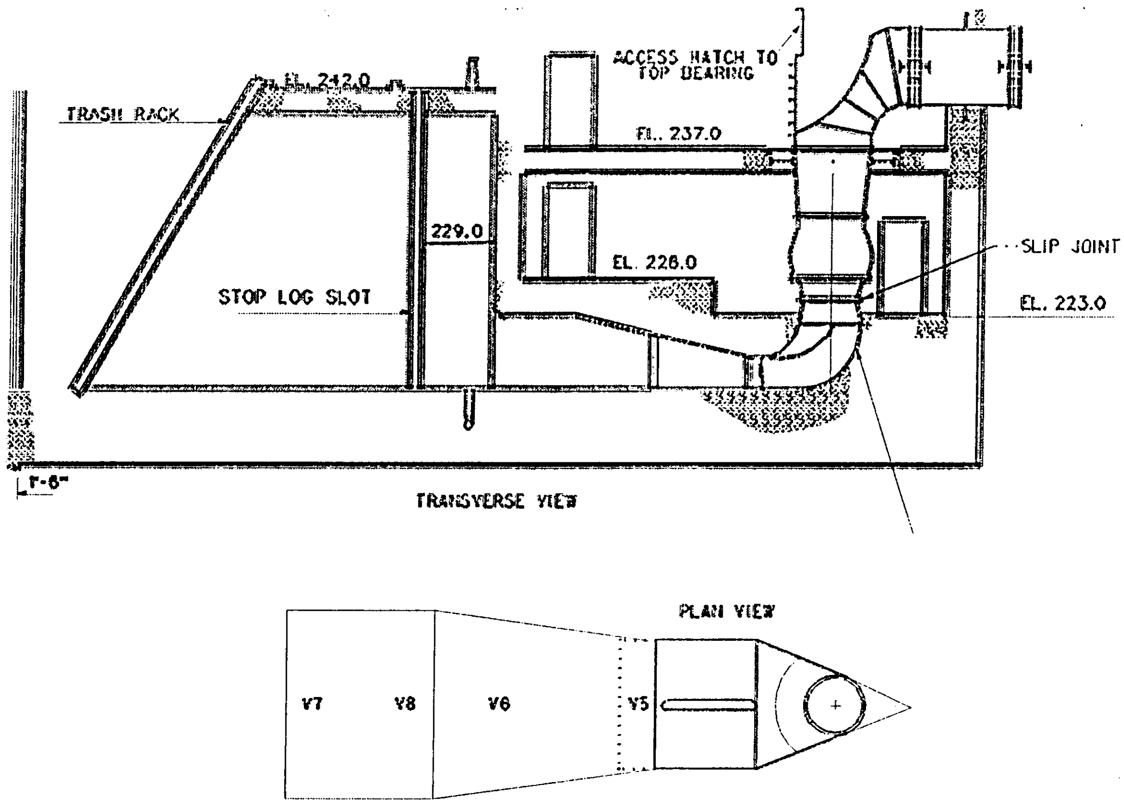


FIGURE B
PLAN AND TRANSVERSE VIEW OF THE
360 CFS PUMP SUMP BAY (NTS)




Calculate volume of sump bay. From the 360 cfs sump bay shown in figure B:

$$V_5 = A_{5\,(\text{rectangle})} + A_{6\,(\text{trapezoid})} + A_{7\,(\text{square})} + A_{8\,(\text{rectangle})} * (16)$$
$$= b(w)\ \ [(a + b)/2]h + b(w) + b(w)(16)$$
$$= (36.70735 + 72.2905 + 6.7482 + 5.8994)16$$
$$= 1946.01\ \text{ft}^3$$

$$V_{Total} = V_1 + V_2 + V_3 + V_4 + V_5$$
$$= 81.764 + 235.86 + 204.69 + 58.3 + 1946.01$$
$$= 2526.62\ \text{ft}^3$$

$1\ \text{ft}^3 = 7.4805$ gallons

**$V_{total}$ = 18900.4 gallons**

Time for Dewatering one sump = $V_{total}$ / Pump Capacity

Pump Capacity = 18900.4 gallons / 60 mins.

Pump Capacity = 315.006 gpm

Consider a 4" diameter drain pipe

Area = .08840 $ft^2$

Determine drainage rate of sump.

$Q = V * A$

$V = 315.006(1/7.4803)(1/.08840)$

V = 476.373 fpm

$H = f(L/D)(V^2/2g)$

$H = .02(50/.335)[(476.373)^2/231,840]$

H = 2.92188 ft.

$H_{Total} = H_{static} + H_L$

$H_{Total} = 26 + 2.92188$

$H_{Total} = 28.9219$

Conclusion:

A 315 GPM pump will satisfactorily dewater a single pump bay in approximately 60 minutes. There will be an ample flow rate from the sump bay with a head of approximate head of 2.9 ft. to supply the pump. The pump selected is a Flygt Submersible Pump, model # C-3102.

# Bayou Meto Basin Project
## Conceptual Design of Bayou Meto Basin Pumping Stations

# APPENDIX C

# BAYOU METO BASIN PUMPING STATIONS

# MECHANICAL DESIGN DEVELOPMENT,

# VENTILATION SYSTEM FOR

# PUMPING STATION # 1

U.S. Army Corps of Engineers
Memphis District

| ROOOF VENTILATORS WITH MOTORIIZED BACKDRAFT DAMPER AND 0.25" STATIC PRESSURE | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| SELECTION MADE FROM THE GREENHECK FAN CORPORATION CATALOG | | | | | | | | | | | | | | |
| FAN TYPE | PUMP MOTOR (HP) | (BTU/HR) | GRADIENT DEGREE | FLOW (CFM) | MOTOR (HP) | VENT (CFM) | NO. OF FANS | LENGTH (FT.) | WIDTH (FT.) | HEIGHT (FT.) | FAN RPM | MAX BHP | SONE | TIP SPEED (T.S.) |
| RBE - 2H48 - 10 | 7580 | 1,929,110 | 30 | 59266.1 | 1 | 10485 | 6 | 135 | 42 | 40 | 399 | 1 | 10 | 50143.07 |

# Flow (CFM)

Q = CFM(delta t)(1.085 $^{\text{Btu/min}}/\text{ft}^3$ hrs.)

CFM = Q / delta t (1.085 $^{\text{Btu/min}}/\text{ft}^3$ hrs.)

CFM = (165,425 Btu/hr + 27,486/.10) / (30 °F) (1.085 $^{\text{Btu/min}}/\text{ft}^3$ hrs.)

CFM = 59,266.1 / 6 ventilators

CFM = 9,877.68

# Tip Speed

T.S. = RPM * 12.566

T.S. = 399 * 12.566

T.S. = 50,143.07

# Bayou Meto Basin Project

## Conceptual Design of Bayou Meto Basin Pumping Stations

# APPENDIX D

# BAYOU METO BASIN PUMPING STATIONS

# MECHANICAL DESIGN DEVELOPMENT,

# OFFICE HEATING AND AIR CONDITIONING FOR

# PUMPING STATION # 1

U.S. Army Corps of Engineers
Memphis District

| Resistances Values For Office | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Materials | | | | | | | | | | | |
| Room parts | 1" insulation polyscirene | 8" Concrete Block | 4" Face Brick | Ceiling Airspace | Coefficent inside | Coefficent outside | .5" gypsium | 8" concrete | 2.5" Concrete Slab | Accoustic Tile | 1" Air Space in | Resistance Total |
| Roof | 4.4 | 0 | 0 | 1 | 0.003089 | 0.003089 | 0 | 1.42 | 0 | 1.79 | 0 | 8.616178 |
| West Wall | 4.4 | 1.11 | 0.43 | 0 | 0.003258 | 0.000896 | 0.45 | 0 | 0 | 0 | 0.91 | 7.304154 |
| South Wall | 4.4 | 1.11 | 0.43 | 0 | 0.04591 | 0.001263 | 0.45 | 0 | 0 | 0 | 0.91 | 7.347173 |
| East Wall | 4.4 | 1.11 | 0 | 0 | 0.005079 | 0.005079 | 0.45 | 0 | 0 | 0 | 0 | 5.970158 |
| North Wall | 4.4 | 1.11 | 0 | 0 | 0.003281 | 0.003281 | 0.45 | 0 | 0 | 0 | 0 | 5.966562 |
| Floor | 0 | 0 | 0 | 0 | 0.003089 | 0.003089 | 0 | 0 | 1.3 | 0 | 0 | 1.306178 |
| Int. Window | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1.852 |

| | Cooling Load Calculations For Office | | | | | |
|---|---|---|---|---|---|---|
| Room parts | U Factor (1/Rtotal) | Area (a=lw) | Delta t | CLTD | Cooling Load (q=u(a)(deltat)) | Cooling Load [q=u(a)CLTD] |
| Roof | 0.116060741 | 392.346 | 53 | 0 | 2413.406269 | 0 |
| West Wall | 0.136908395 | 186 | 53 | 0 | 1349.642957 | 0 |
| South Wall | 0.136106772 | 132 | 53 | 0 | 952.2029766 | 0 |
| East Wall | 0.167499755 | 217.33 | 0 | 22 | 0 | 800.8598767 |
| North Wall | 0.167600705 | 119.334 | 0 | 20 | 0 | 400.0092516 |
| Floor | 0.765592438 | 392.346 | 13 | 0 | 3904.902701 | 0 |
| Int. Window | 0.539956803 | 18 | 53 | 0 | 515.1187905 | 0 |

| | Cooling Load Calculations For Office | | | | | |
|---|---|---|---|---|---|---|
| Room parts | Resistance Factor | Area (sp.ft.) | SHGF | CLF | SC | Cooling Load [q=a(SHGF)(CLF)(SC)] |
| Ext. Window | 1.85185 | 40 | 213 | 0.61 | 0.58 | 3014.376 |
| | | | | | | |
| Total Sensible | 13350.51882 | | | | | |

| Resistances Values For Break Room | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Materials | | | | | | | | | | |
| Room parts | 2.5" slab | 8" Concrete Block | .5" gypsium | 1" polystyrin | Ceiling Air space | Coefficent inside | Coefficent | Ceiling Tile | blank | blank | Resistance Total |
| Roof | 1.3 | 0 | 0 | 4.4 | 1 | 0.002145 | 0.00215 | 1.79 | 0 | 0 | 8.494294 |
| West Wall | 0 | 1.11 | 0.45 | 4.4 | 0 | 0.002786 | 0.00279 | 0 | 0 | 0 | 5.965572 |
| South Wall | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| East Wall | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| North Wall | 0 | 1.11 | 0.45 | 4.4 | 0 | 0.002219 | 0.00222 | 0 | 0 | 0 | 5.964438 |
| Floor | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Int. Window | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

| | Cooling Load Calculations For Break Room | | | | |
|---|---|---|---|---|---|
| Room parts | U Factor (1/Rtotal) | Area (a=lw) | Delta t | CLTD | Cooling Load (q=u(a)(deltat)) |
| Roof | 0.117726088 | 282.5 | 53 | 0 | 1762.653847 |
| West Wall | 0.167628519 | 217.5 | 13 | 0 | 473.9696378 |
| South Wall | 0 | 0 | 0 | 0 | 0 |
| East Wall | 0 | 0 | 0 | 0 | 0 |
| North Wall | 0.16766039 | 273.1 | 13 | 0 | 595.2446819 |
| Floor | 0 | 0 | 0 | 0 | 0 |
| Int. Window | 0 | 0 | 0 | 0 | 0 |
| Total Sensible Load | | | | = | 2831.868167 |

## Cooling Load For Office

### Load Estimate Sheet

| Item # | Exterior Item # | Area SQ.FT. | CLTD | "U" Factor | BTU/HR |
|---|---|---|---|---|---|
| **Transmission And Solar Sensible Heat Gain** | | | | | |
| 1 | North Wall | 119.334 | 20 | 0.1676 | 400.007568 |
| 2 | South Wall | 0 | 0 | 0 | 0 |
| 3 | East Wall | 217.33 | 22 | 0.1674 | 800.382924 |
| 4 | West Wall | 0 | 0 | 0 | 0 |
| Item # | Exterior Item # | Area SQ.FT. | SHGF | CLF * SC | BTU/HR |
| 5 | Window | 40 | 213 | 0.3538 | 3014.376 |
| Item # | Internal Partition Item | Area SQ.FT. | Temp. Diff. | "U" Factor | BTU/HR |
| 6 | North Wall | 0 | 0 | 0 | 0 |
| 7 | South Wall | 132 | 53 | 0.136107 | 952.2029766 |
| 8 | East Wall | 0 | 0 | 0 | 0 |
| 9 | West Wall | 186 | 53 | 0.136908 | 1349.642957 |
| 10 | Windows | 18 | 53 | 0.54 | 515.16 |
| **Transmission Sensible Heat** | | | | | |
| Item # | Internal Partition Item | Area SQ.FT. | Temp. Diff. | "U" Factor | BTU/HR |
| 11 | Floor | 392.346 | 13 | 0.7657 | 3905.451319 |
| 12 | Ceiling | 392.346 | 53 | 0.1161 | 2414.222642 |
| **Body Heat Gains** | | | | | |
| Item # | Type | No. People | BTU/HR | | |
| 13 | Sensible | 4 | 250 | = | 1000 |
| 14 | Latent | 4 | 200 | = | 800 |
| **Equuipment Heat Gains** | | | | | |
| 15 | Lights | 1431.89 | 3.4 | = | 4868.426 |
| **Design Data** | | | | | |
| Item # | Summer | Outside | Inside | Total | |
| 16 | Dry Bulb | 95 | 72 | 23 | |
| 17 | Total Enthalpy Btu Per Lb.of dry air | 39.57 | 28.3 | 11.27 | |
| **Summary Of Heat Gains** | | | | | |
| 18 | Total Sensible | | = | | 19219.87239 |
| 19 | Total Latent | | = | | 800 |
| 20 | Total Heat Gains | | = | | 20019.87239 |
| 21 | Total | | = | | 0.960039705 |
| **Total Air supply** | | | | | |
| 22 | CFM= Q/DELTA T(1.08) | | = | | 773.7468754 |
| 23 | 10% Air Supply | | = | | 77.37468754 |
| 24 | Exhaust Air | | = | | |
| 25 | Total Min.Outside Air | | = | | 77.37468754 |
| **Outside Air Load** | | | | | |
| 26 | Sesible = Air flow(1.08)(Delta t) | | = | | 1921.987239 |
| 27 | Total = Air Flow(4.45)(Enthalpy | | = | | 3880.456642 |
| 28 | Grand Total Sensible | | = | | 21141.85962 |
| 29 | Grand Total load | | = | | 23900.32903 |
| **Total Sensible Ratio** | | | | | |
| 30 | Total | | = | | 0.884584459 |
| 31 | Tons Of Refrigerant | | = | | 1.991694086 |

## Heating Load For Office

### Load Estimate Sheet

| Item # | Exterior Item # | Area SQ.FT. | Temp. Diff. | "U" Factor | BTU/HR |
|---|---|---|---|---|---|
| **Transmission And Solar Sensible Heat Gain** | | | | | |
| 1 | North Wall | 119.334 | 62 | 0.1676 | 1240.023 |
| 2 | South Wall | 0 | 0 | 0 | 0 |
| 3 | East Wall | 217.33 | 62 | 0.1674 | 2255.625 |
| 4 | West Wall | 0 | 0 | 0 | 0 |
| 5 | Windows | 40 | 62 | 0.54 | 1339.2 |
| Item # | Internal Partition Item | Area SQ.FT. | Temp. Diff. | "U" Factor | BTU/HR |
| 6 | North Wall | 0 | 0 | 0 | 0 |
| 7 | South Wall | 132 | 53 | 0.1553 | 1086.479 |
| 8 | East Wall | 0 | 0 | 0 | 0 |
| 9 | West Wall | 186 | 53 | 0.1564 | 1541.791 |
| 10 | Windows | 18 | 53 | 0.54 | 515.16 |
| Item # | Internal Partition Item | Area SQ.FT. | Temp. Diff. | "U" Factor | BTU/HR |
| 11 | Floor | 392.346 | 13 | 0.7656 | 3904.941 |
| 12 | Ceiling | 392.346 | 53 | 0.116 | 2412.143 |
| **Summary Of Heat Gains** | | | | | |
| Item # | Type | No. People | BTU/HR | = | |
| 13 | Sensible | 0 | 0 | = | 0 |
| 14 | Latent | 0 | 0 | = | 0 |
| **Equuipment Heat Gains** | | | | | |
| 15 | Lights | | 0 | = | 0 |
| **Design Data** | | | | | |
| Item # | Summer | Outside | Inside | Total | |
| 16 | Dry Bulb | 10 | 72 | 62 | |
| 17 | Total Enthalpy Btu Per Lb.of dry air | 39.57 | 28.3 | 11.27 | |
| **Summary Of Heat Gains** | | | | | |
| 18 | Total Sensible | | = | | 14295.36 |
| 19 | Total Latent | | = | | 0 |
| 20 | Total Heat Gains | | = | | 14295.36 |
| **Space Sensible Heat ratio** | | | | | |
| 21 | Total | | = | | 1 |
| **Total Air Load** | | | | | |
| 22 | CFM= (Q)DELTA T(1.08) | | = | | 5156.885 |
| 23 | Grand Total load | | = | | 19452.25 |

## Cooling Load For Break Room

### Load Estimate Sheet

| | | | | | |
|---|---|---|---|---|---|
| **Transmission And Solar Sensible Heat Gain** | | | | | |
| Item # | Exterior Item # | Area SQ.FT. | CLTD | "U" Factor | BTU/HR |
| 1 | North Wall | 0 | 0 | 0 | 0 |
| 2 | South Wall | 0 | 0 | 0 | 0 |
| 3 | East Wall | 0 | 0 | 0 | 0 |
| 4 | West Wall | 0 | 0 | 0 | 0 |
| 5 | Windows | 0 | 0 | 0 | 0 |
| Item # | Internal Partition Item | Area SQ.FT. | Temp. Diff. | "U" Factor | BTU/HR |
| 6 | North Wall | 273.1 | 13 | 0.1677 | 595.3853 |
| 7 | South Wall | 0 | 0 | 0 | 0 |
| 8 | East Wall | 0 | 0 | 0 | 0 |
| 9 | West Wall | 217.5 | 13 | 0.1676 | 473.889 |
| 10 | Windows | 0 | 0 | 0 | 0 |
| **Transmission Sensible Heat** | | | | | |
| Item # | Internal Partition Item | Area SQ.FT. | Temp. Diff. | "U" Factor | BTU/HR |
| 11 | Floor | 0 | 0 | 0 | 0 |
| 12 | Ceiling | 282.5 | 53 | 0.1177 | 1762.263 |
| **Body Heat Gains** | | | | | |
| Item # | Type | No. People | BTU/HR | | |
| 13 | Sensible | 5 | 250 | = | 1250 |
| 14 | Latent | 5 | 200 | = | 1000 |
| **Equuipment Heat Gains** | | | | | |
| 15 | Lights | 1431.89 | 3.4 | = | 4868.426 |
| **Design Data** | | | | | |
| Item # | Summer | Outside | Inside | Total | |
| 16 | Dry Bulb | 85 | 72 | 13 | |
| 17 | Total Enthalpy Btu Per Lb.of dry air | 39.57 | 28.3 | 11.27 | |
| **Summary Of Heat Gains** | | | | | |
| 18 | Total Sensible | | = | | 8949.964 |
| 19 | Total Latent | | = | | 1000 |
| 20 | Total Heat Gains | | = | | 9949.964 |
| **Space Sensible Heat ratio** | | | | | |
| 21 | Total | | = | | 0.899497 |
| **Total Air supply** | | | | | |
| 22 | CFM= Q/DELTA T(1.08) | | = | | 637.4618 |
| **Min. Outside Air** | | | | | |
| 23 | 10% Air Supply | | = | | 63.74618 |
| 24 | Exhaust Air | | = | | |
| 25 | Total Min.Outside Air | | = | | 63.74618 |
| **Outside Air Load** | | | | | |
| 26 | Sesible = Air flow(1.08)(Delta t) | | = | | 894.9964 |
| 30 | Total = Air Flow(4.45)(Enthalpy | | = | | 3196.967 |
| 31 | Grand Total Sensible | | = | | 9844.96 |
| 32 | Grand Total load | | = | | 13146.93 |
| **Total Sensible Ratio** | | | | | |
| 33 | Total | | = | | 0.748841 |
| **Tonnage Equivalent of Cooling Load** | | | | | |
| 34 | Tons Of Refrigerant | | = | | 1.095578 |

## Heating Load for Break Room

### Load Estimate Sheet

| | | | | | |
|---|---|---|---|---|---|
| **Transmission And Solar Sensible Heat Gain** | | | | | |
| Item # | Exterior Item # | Area SQ.FT. | Temp. Diff. | "U" Factor | BTU/HR |
| 1 | North Wall | 0 | 0 | 0 | 0 |
| 2 | South Wall | 0 | 0 | 0 | 0 |
| 3 | East Wall | 0 | 0 | 0 | 0 |
| 4 | West Wall | 0 | 0 | 0 | 0 |
| 5 | Windows | 0 | 0 | 0 | 0 |
| Item # | Internal Partition Item | Area SQ.FT. | Temp. Diff. | "U" Factor | BTU/HR |
| 6 | North Wall | 273.1 | 13 | 0.1677 | 595.3853 |
| 7 | South Wall | 0 | 0 | 0 | 0 |
| 8 | East Wall | 0 | 0 | 0 | 0 |
| 9 | West Wall | 217.5 | 13 | 0.1676 | 473.889 |
| 10 | Windows | 0 | 0 | 0 | 0 |
| **Transmission Sensible Heat** | | | | | |
| Item # | Internal Partition Item | Area SQ.FT. | Temp. Diff. | "U" Factor | BTU/HR |
| 11 | Floor | 0 | 0 | 0 | 0 |
| 12 | Ceiling | 282.5 | 53 | 0.1177 | 1762.263 |
| **Body Heat Gains** | | | | | |
| Item # | Type | No. People | BTU/HR | Total | |
| 13 | Sensible | 0 | 0 | | 0 |
| 14 | Latent | 0 | 0 | | 0 |
| **Equuipment Heat Gains** | | | | | |
| 15 | Lights | | 0 | | 0 |
| **Design Data** | | | | | |
| Item # | Winter | Outside | Inside | Total | |
| 16 | Dry Bulb | 85 | 72 | 13 | |
| 17 | Total Enthalpy Btu Per Lb.of dry air | 39.57 | 28.3 | 11.27 | |
| **Summary Of Heat Gains** | | | | | |
| 18 | Total Sensible | | = | | 2831.538 |
| 19 | Total Latent | | = | | 0 |
| 20 | Total Heat Gains | | = | | 2831.538 |
| **Space Sensible Heat ratio** | | | | | |
| 21 | Total | | = | | 1 |
| **Total Air Load** | | | | | |
| 22 | CFM= (Q)DELTA T(1.08) | | = | | 894.9964 |
| 23 | Grand Total load | | = | | 3726.534 |

# Bayou Meto Basin Project
## Conceptual Design of Bayou Meto Basin Pumping Stations

# APPENDIX E

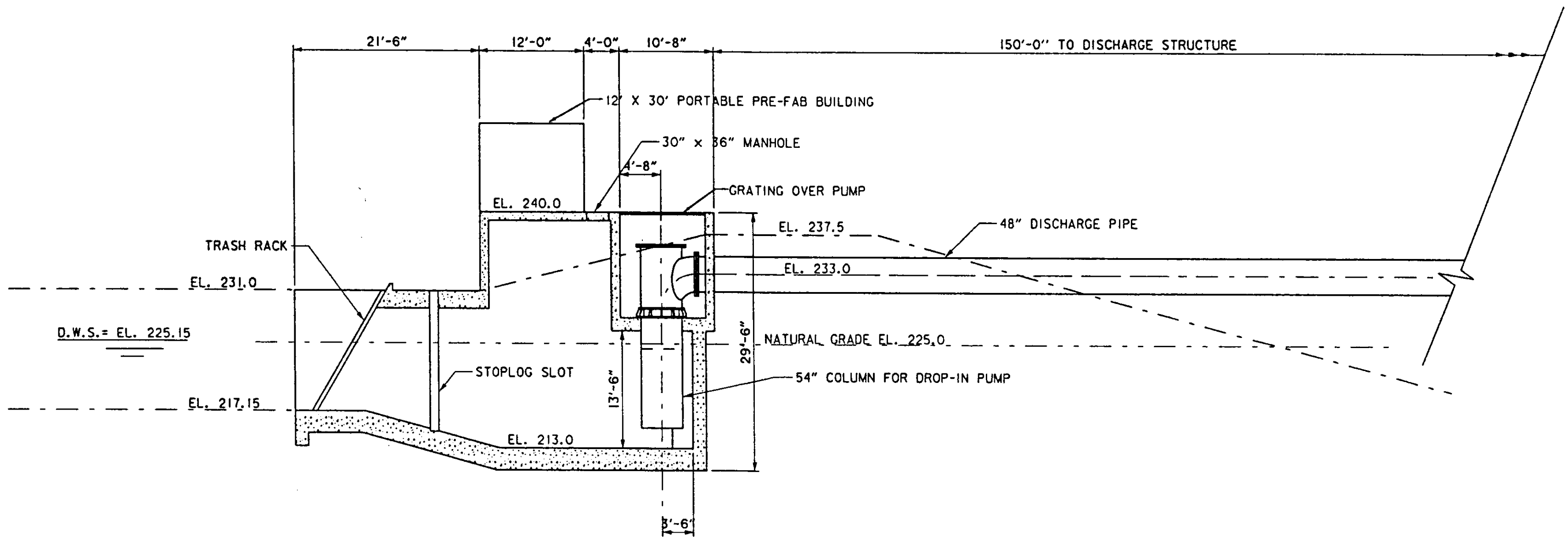
# BAYOU METO BASIN PUMPING STATIONS

# MECHANICAL DESIGN DEVELOPMENT

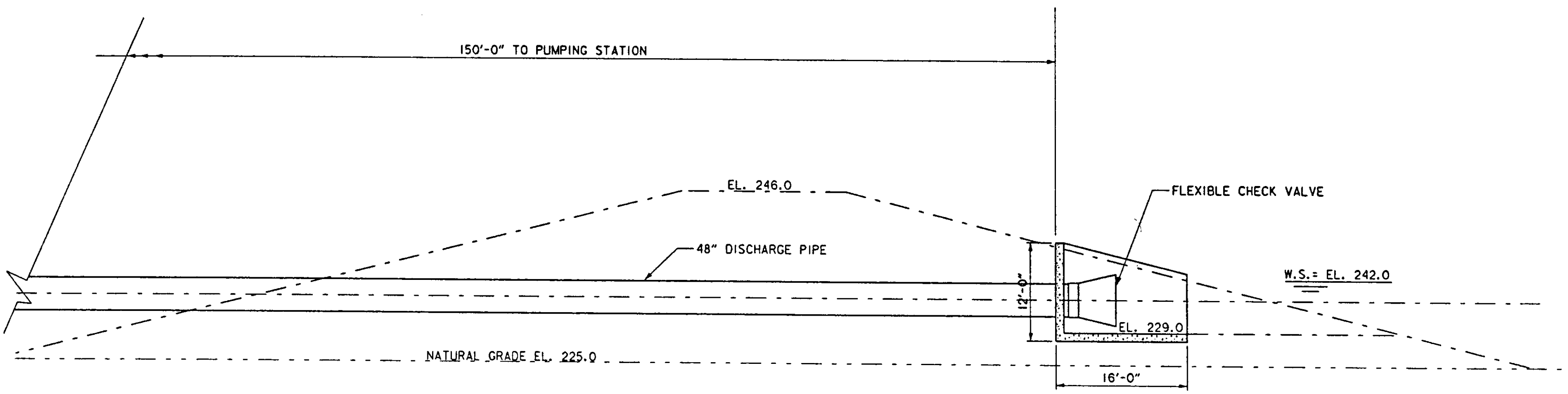
# STATION LAYOUT AND PUMP CURVES FOR

# PUMPING STATION # 2

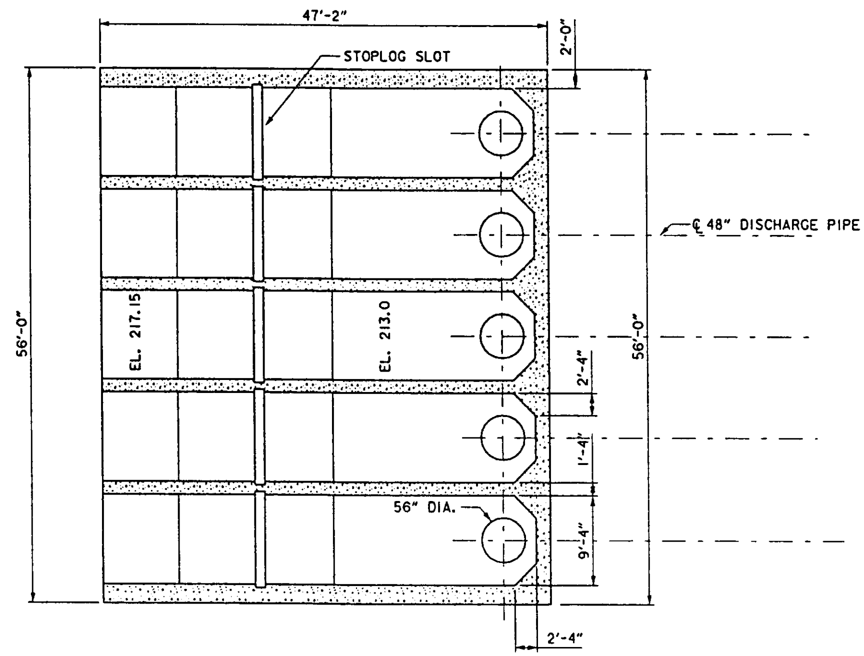
U.S. Army Corps of Engineers
Memphis District




# PUMPING STATION NUMBER 2
## ELEVATION
SCALE: 1" = 20'-0"




PUMPING STATION NUMBER 2
ELEVATION - OUTLET STRUCTURE
SCALE: 1" = 20'-0"




PUMPING STATION NUMBER 2
PLAN VIEW - ELEVATION 217.15
SCALE: 1" = 20'-0"

## PUMPING STATION #2 (STATION CAPACITY = 625 CFS)

| | | |
|---|---|---|
| LOSSES FOR ONE OF FIVE PUMPS (125 CFS) | | |
| MAX STATIC HEAD = | 243.0'-225.15' = | 17.85 |

| | |
|---|---|
| RATED GPM = | 56,101 |
| PIPE AREA (SQ.FT.) = | 12.568 |
| PIPE DIAMETER (FT) = | 4 |
| RATED VELOCITY (FT/SEC) = | 9.946 |
| EQUIV. LENGTH OF PIPE (FT) = | 150 |
| PUMP INLET DIA. (FT) = | 4.5 |
| PUMP AREA (SQ. FT.) = | 15.896 |

| FLOW GPM | CFS | PIPE VEL. | TRASH RACK | ELBOW | PIPE LOSSES | TIDEFLEX | VELOCITY LOSS | TOTAL LOSS | TDH |
|---|---|---|---|---|---|---|---|---|---|
| 1,000 | 2.23 | 0.18 | 0.00 | 0.021 | 0.000 | 0.2648 | 0.00 | 0.29 | 18.14 |
| 2,000 | 4.46 | 0.35 | 0.02 | 0.041 | 0.002 | 0.2795 | 0.00 | 0.34 | 18.19 |
| 3,000 | 6.68 | 0.53 | 0.03 | 0.062 | 0.003 | 0.2943 | 0.00 | 0.39 | 18.24 |
| 4,000 | 8.91 | 0.71 | 0.04 | 0.083 | 0.006 | 0.3091 | 0.01 | 0.44 | 18.29 |
| 5,000 | 11.14 | 0.89 | 0.04 | 0.103 | 0.009 | 0.3238 | 0.01 | 0.49 | 18.34 |
| 6,000 | 13.37 | 1.06 | 0.05 | 0.124 | 0.012 | 0.3386 | 0.02 | 0.55 | 18.40 |
| 7,000 | 15.60 | 1.24 | 0.06 | 0.145 | 0.016 | 0.3534 | 0.02 | 0.60 | 18.45 |
| 8,000 | 17.82 | 1.42 | 0.07 | 0.166 | 0.021 | 0.3681 | 0.03 | 0.66 | 18.51 |
| 9,000 | 20.05 | 1.60 | 0.08 | 0.186 | 0.025 | 0.3829 | 0.04 | 0.71 | 18.56 |
| 10,000 | 22.28 | 1.77 | 0.09 | 0.207 | 0.031 | 0.3977 | 0.05 | 0.77 | 18.62 |
| 11,000 | 24.51 | 1.95 | 0.10 | 0.228 | 0.037 | 0.4124 | 0.06 | 0.83 | 18.68 |
| 12,000 | 26.74 | 2.13 | 0.11 | 0.248 | 0.043 | 0.4272 | 0.07 | 0.90 | 18.75 |
| 13,000 | 28.96 | 2.30 | 0.12 | 0.269 | 0.050 | 0.4420 | 0.08 | 0.96 | 18.81 |
| 14,000 | 31.19 | 2.48 | 0.12 | 0.290 | 0.057 | 0.4567 | 0.10 | 1.02 | 18.87 |
| 15,000 | 33.42 | 2.66 | 0.13 | 0.310 | 0.065 | 0.4715 | 0.11 | 1.09 | 18.94 |
| 16,000 | 35.65 | 2.84 | 0.14 | 0.331 | 0.073 | 0.4863 | 0.12 | 1.16 | 19.01 |
| 17,000 | 37.88 | 3.01 | 0.15 | 0.352 | 0.082 | 0.5010 | 0.14 | 1.23 | 19.08 |
| 18,000 | 40.10 | 3.19 | 0.16 | 0.372 | 0.091 | 0.5158 | 0.16 | 1.30 | 19.15 |
| 19,000 | 42.33 | 3.37 | 0.17 | 0.393 | 0.100 | 0.5306 | 0.18 | 1.37 | 19.22 |
| 20,000 | 44.56 | 3.55 | 0.18 | 0.414 | 0.110 | 0.5453 | 0.20 | 1.44 | 19.29 |
| 21,000 | 46.79 | 3.72 | 0.19 | 0.434 | 0.120 | 0.5601 | 0.22 | 1.52 | 19.37 |
| 22,000 | 49.02 | 3.90 | 0.20 | 0.455 | 0.131 | 0.5749 | 0.24 | 1.59 | 19.44 |
| 23,000 | 51.24 | 4.08 | 0.20 | 0.476 | 0.142 | 0.5896 | 0.26 | 1.67 | 19.52 |
| 24,000 | 53.47 | 4.25 | 0.21 | 0.497 | 0.153 | 0.6044 | 0.28 | 1.75 | 19.60 |
| 25,000 | 55.70 | 4.43 | 0.22 | 0.517 | 0.165 | 0.6192 | 0.30 | 1.83 | 19.68 |
| 26,000 | 57.93 | 4.61 | 0.23 | 0.538 | 0.178 | 0.6339 | 0.33 | 1.91 | 19.76 |
| 27,000 | 60.16 | 4.79 | 0.24 | 0.559 | 0.190 | 0.6487 | 0.36 | 1.99 | 19.84 |
| 28,000 | 62.38 | 4.96 | 0.25 | 0.579 | 0.203 | 0.6635 | 0.38 | 2.08 | 19.93 |
| 29,000 | 64.61 | 5.14 | 0.26 | 0.600 | 0.217 | 0.6782 | 0.41 | 2.16 | 20.01 |
| 30,000 | 66.84 | 5.32 | 0.27 | 0.621 | 0.231 | 0.6930 | 0.44 | 2.25 | 20.10 |
| 31,000 | 69.07 | 5.50 | 0.28 | 0.641 | 0.245 | 0.7078 | 0.47 | 2.34 | 20.19 |
| 32,000 | 71.30 | 5.67 | 0.29 | 0.662 | 0.260 | 0.7225 | 0.50 | 2.43 | 20.28 |
| 33,000 | 73.52 | 5.85 | 0.29 | 0.683 | 0.275 | 0.7373 | 0.53 | 2.52 | 20.37 |
| 34,000 | 75.75 | 6.03 | 0.30 | 0.703 | 0.290 | 0.7521 | 0.56 | 2.61 | 20.46 |
| 35,000 | 77.98 | 6.20 | 0.31 | 0.724 | 0.306 | 0.7669 | 0.60 | 2.71 | 20.56 |
| 36,000 | 80.21 | 6.38 | 0.32 | 0.745 | 0.322 | 0.7816 | 0.63 | 2.80 | 20.65 |
| 37,000 | 82.44 | 6.56 | 0.33 | 0.766 | 0.339 | 0.7964 | 0.67 | 2.90 | 20.75 |
| 38,000 | 84.66 | 6.74 | 0.34 | 0.786 | 0.356 | 0.8112 | 0.70 | 3.00 | 20.85 |
| 39,000 | 86.89 | 6.91 | 0.35 | 0.807 | 0.373 | 0.8259 | 0.74 | 3.10 | 20.95 |
| 40,000 | 89.12 | 7.09 | 0.36 | 0.828 | 0.391 | 0.8407 | 0.78 | 3.20 | 21.05 |
| 41,000 | 91.35 | 7.27 | 0.37 | 0.848 | 0.409 | 0.8555 | 0.82 | 3.30 | 21.15 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 42,000 | 93.58 | 7.45 | 0.37 | 0.869 | 0.427 | 0.8702 | 0.86 | 3.40 | 21.25 | |
| 43,000 | 95.80 | 7.62 | 0.38 | 0.890 | 0.446 | 0.8850 | 0.90 | 3.51 | 21.36 | |
| 44,000 | 98.03 | 7.80 | 0.39 | 0.910 | 0.465 | 0.8998 | 0.94 | 3.61 | 21.46 | |
| 45,000 | 100.26 | 7.98 | 0.40 | 0.931 | 0.485 | 0.9145 | 0.99 | 3.72 | 21.57 | |
| 46,000 | 102.49 | 8.15 | 0.41 | 0.952 | 0.505 | 0.9293 | 1.03 | 3.83 | 21.68 | |
| 47,000 | 104.72 | 8.33 | 0.42 | 0.972 | 0.525 | 0.9441 | 1.08 | 3.94 | 21.79 | |
| 48,000 | 106.94 | 8.51 | 0.43 | 0.993 | 0.546 | 0.9588 | 1.12 | 4.05 | 21.90 | |
| 49,000 | 109.17 | 8.69 | 0.44 | 1.014 | 0.567 | 0.9736 | 1.17 | 4.16 | 22.01 | |
| 50,000 | 111.40 | 8.86 | 0.45 | 1.034 | 0.588 | 0.9884 | 1.22 | 4.28 | 22.13 | |
| 51,000 | 113.63 | 9.04 | 0.45 | 1.055 | 0.610 | 1.0031 | 1.27 | 4.39 | 22.24 | |
| 52,000 | 115.86 | 9.22 | 0.46 | 1.076 | 0.632 | 1.0179 | 1.32 | 4.51 | 22.36 | |
| 53,000 | 118.08 | 9.40 | 0.47 | 1.097 | 0.654 | 1.0327 | 1.37 | 4.63 | 22.48 | |
| 54,000 | 120.31 | 9.57 | 0.48 | 1.117 | 0.677 | 1.0474 | 1.42 | 4.75 | 22.60 | |
| 55,000 | 122.54 | 9.75 | 0.49 | 1.138 | 0.700 | 1.0622 | 1.48 | 4.87 | 22.72 | |
| 56,000 | 124.77 | 9.93 | 0.50 | 1.159 | 0.723 | 1.0770 | 1.53 | 4.99 | 22.84 | |
| 56,101 | 124.99 | 9.95 | 0.50 | 1.161 | 0.726 | 1.0785 | 1.54 | 5.00 | 22.85 | *** |
| 57,000 | 127.00 | 10.10 | 0.51 | 1.179 | 0.747 | 1.0917 | 1.59 | 5.11 | 22.96 | |
| 58,000 | 129.22 | 10.28 | 0.52 | 1.200 | 0.771 | 1.1065 | 1.64 | 5.24 | 23.09 | |
| 59,000 | 131.45 | 10.46 | 0.53 | 1.221 | 0.796 | 1.1213 | 1.70 | 5.36 | 23.21 | |
| 60,000 | 133.68 | 10.64 | 0.53 | 1.241 | 0.821 | 1.1360 | 1.76 | 5.49 | 23.34 | |

| | | | | |
|---|---|---|---|---|
| DESIGN CONDITIONS = | 56,101 GPM @ | | 22.85 | TDH |
| PUMP HORSEPOWER = | 405 | HP | 301.76 | KW |
| MOTOR HORSEPOWER = | 468.55 | HP | 349.40 | KW |

USE 355 KW MOTOR

NPSHA= h(atm) - h(vap) + h(static)- h(losses before pump)

NPSHA= 34' - .837' + 9.82' - 1.005'

NPSHA= 41.97" FROM CHART: NPSHR =10.0 meters = 32.808'

SUBMERGENCE REQUIRED TO PREVENT VORTEXING (SEE CHART)= 8.694'

ACTUAL SUBMERGENCE = 9.82' - 1.005' = 8.815'

FORMULAS USED TO CALCULATE LOSSES

TRASH RACK LOSSES: ASSUME .5 FOOT LOSS AT DESIGN FLOW OF 125 CFS.
ASSUME LOSS PROPORTIONAL TO SQUARE OF VELOCITY.
LOSS = ( ACTUAL VELOCITY^2/ RATED VELOCITY^2 )* .5 FOOT

PUMP ELBOW LOSS: FROM FLYGT DESIGN MANUAL ASSUMING LINEAR EQUATION AND CONVERTING TO ENGLISH UNITS
LOSS= CFS*9.286/1000

PIPE LOSS: USING WILLIAMS AND HAZEN FORMULA FOR CONCRETE PIPELINES
LOSS =(.00036*PIPE LENGTH*VELOCITY^1.83)/(PIPE DIAMETER^1.17)

TIDEFLES VALVE LOSS: FROM TIDEFLES CATALOG, ASSUMING LINEAR CONVERSION OF CURVE
LOSS= (.0833*PIPE VELOCITY)+.25

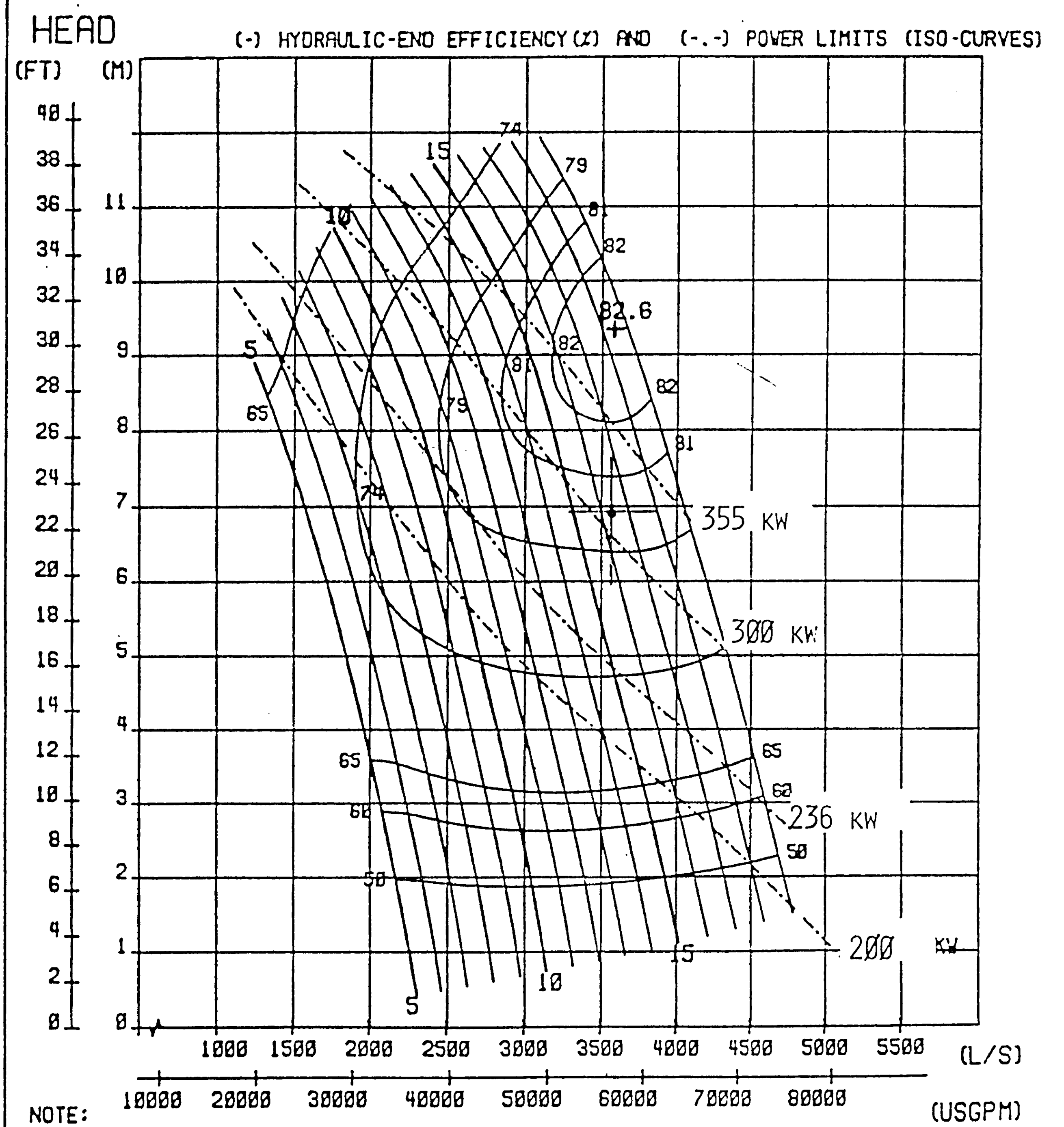
VELOCITY LOSS: LOSS = (VELOCITY^2)/2g

| FLYGT | PERFORMANCE CURVE | PROD. 7120 |
|---|---|---|

| DATE | ISSUE | FREQ | NOMINAL HYDRAULIC-END SPEED | CURVE NO |
|---|---|---|---|---|
| 1984-06-06 | 3 | 60 HZ | 510 RPM | 63-510B4 |

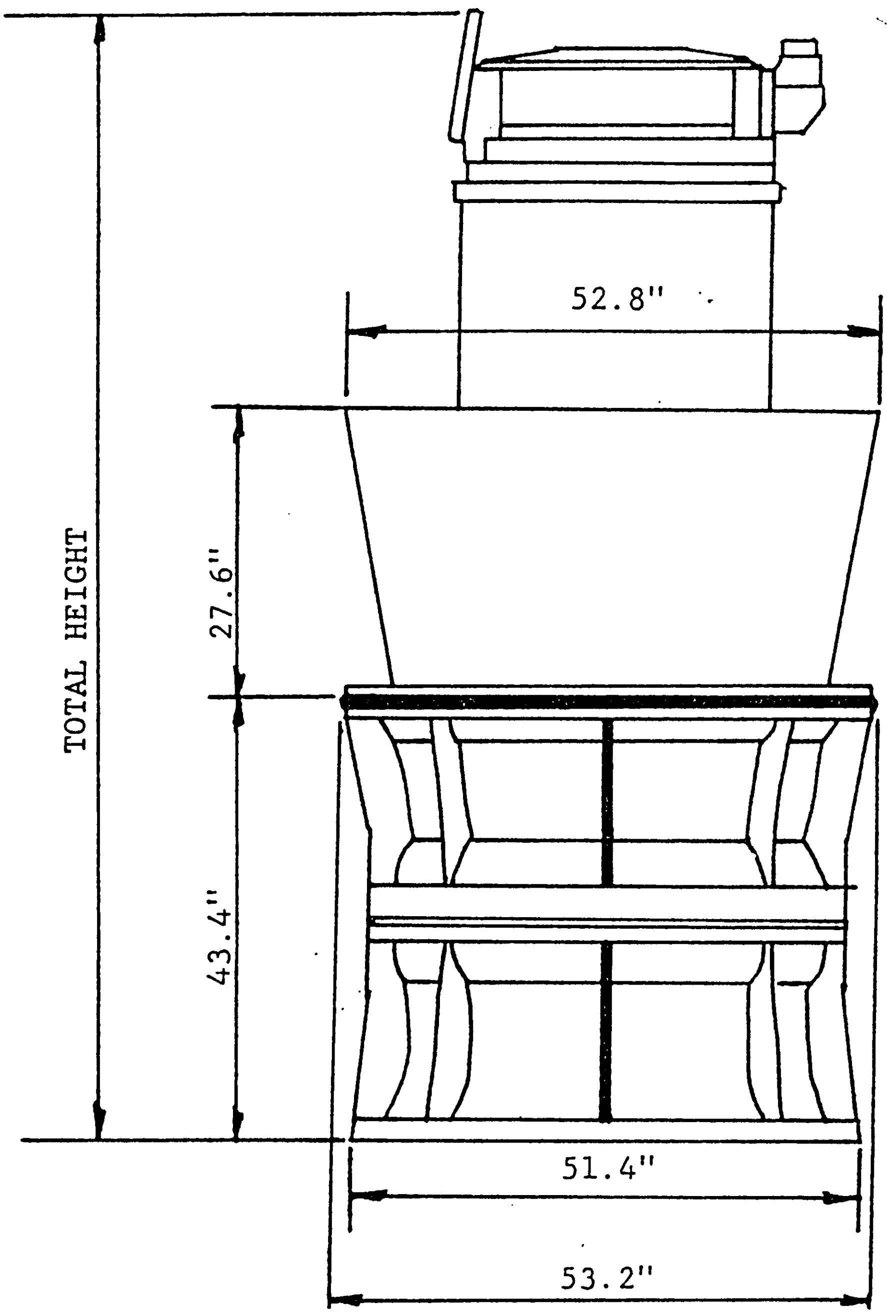
| IMPELLER/HUB DIAMETER | TYPE OF BLADES | NO. OF BLADES | AVAILABLE BLADE ANGLES |
|---|---|---|---|
| 1000/550 MM | B | 4 | EVERY DEG. FROM 5 TO 19 DEG |

| MOTOR | POLES | SHAFT POWER | GEARTYPE | GEAR RATIO | GEAR EFFICIENCY (1/1-3/4 LOAD) | RATED SPEED |
|---|---|---|---|---|---|---|
| 40-57-4 | 4 | 200 KW | 350-13 | 1:3.500 | 96.6 % - 95.9 % | 507 RPM |
| 51-43-4 | 4 | 236 | 350-13 | 1:3.500 | 96.9 % - 96.3 % | 510 |
| 51-56-4 | 4 | 300 | 360-13 | 1:3.500 | 97.3 % - 96.8 % | 510 |
| 65-56-6 | 6 | 355 | 350-13 | 1:2.333 | 97.5 % - 97.1 % | 510 |
| 65-76-6 | 6 | 500 | 360-13 | 1:2.321 | 97.9 % - 97.6 % | 513 |
| | | | | | | |




NOTE:
CURVES ARE BASED ON NOMINAL CONSTANT HYDRAULIC-END SPEED
AND SHOW PERFORMANCE WITH CLEAR WATER.
ALL HYDRAULIC LOSSES UP TO 520 MM. ABOVE THE PUMP/MOTOR TOP ARE INCLUDED

# PL-7120

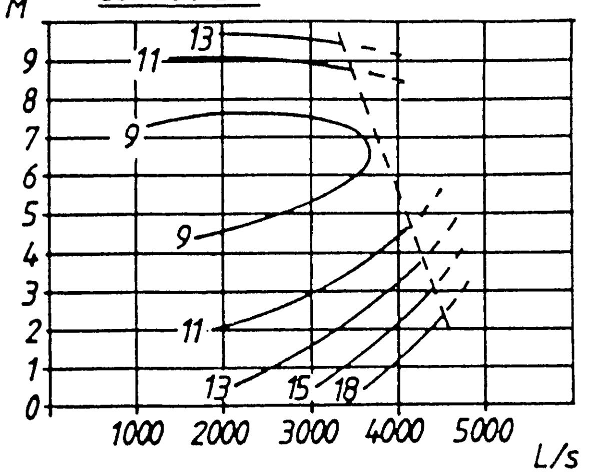



| MOTOR NO. | KW | DRIVE UNIT | TOTAL HEIGHT | WEIGHT |
|---|---|---|---|---|
| 40-30-4 | 110 | 760 | 133.2" | 6160# |
| 40-44-4 | 160 | 770 | 143.8" | 6565# |
| 40-57-4 | 200 | 770 | 143.8" | 7275# |
| 51-43-4 | 236 | 820 | 133.2" | 8160# |
| 51-56-4 | 300 | 860 | 136.5" | 10405# |
| 65-56-6BB(LV) | 375 | 900 | 132.5" | 11300# |
| 65-56-6 (HV) | 355 | 930 | 145.5" | 12410# |
| 65-76-6 | 500 | 930 | 145.5" | 13110# |

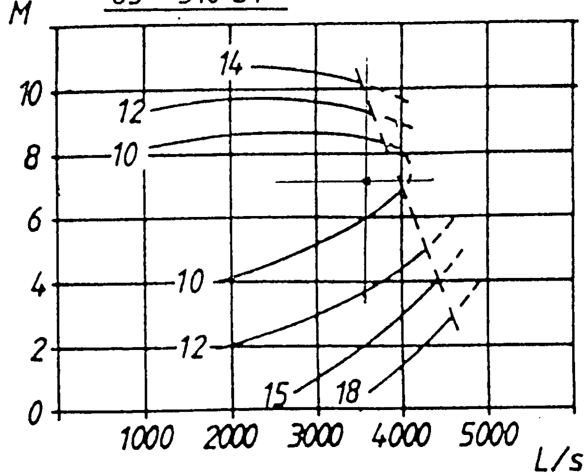
| FLYGT | DATE 831206<br>ISSUE 2 | NPSH CURVES | 7120 |
|---|---|---|---|

## $NPSH_{RE}$ VALUES IN M $H_2O$

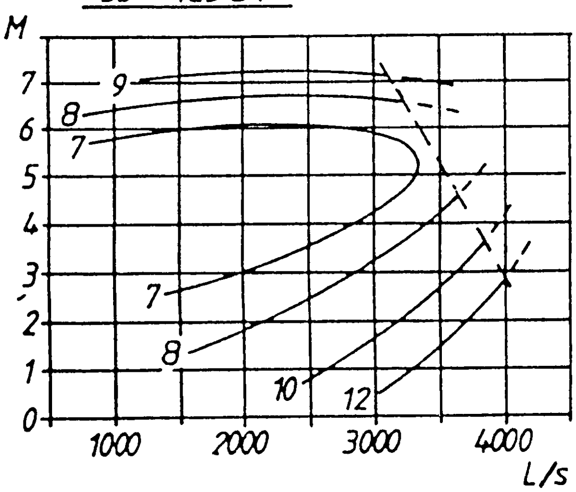
53-490 B4



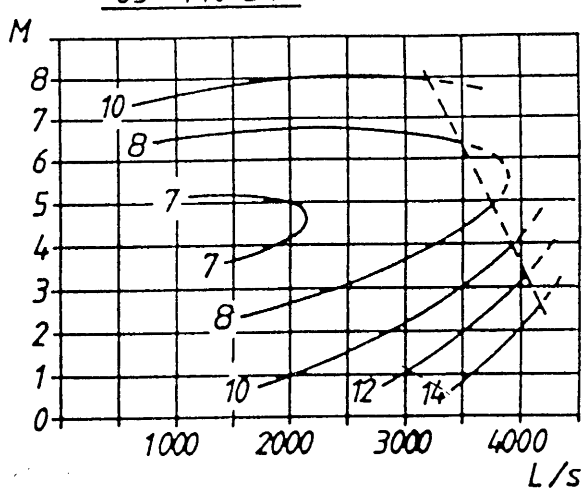

63-510 B4



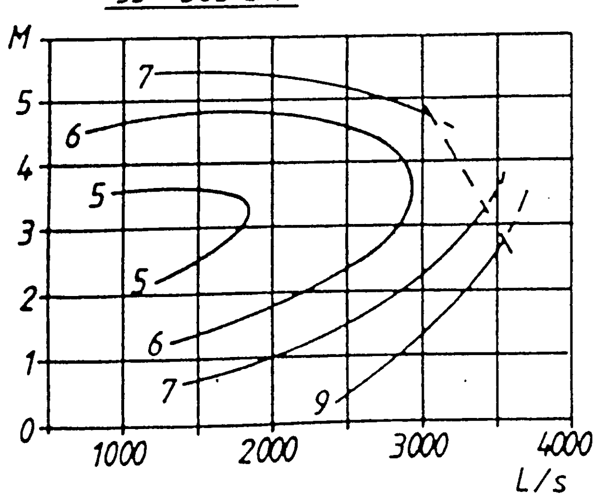

53-425 B4



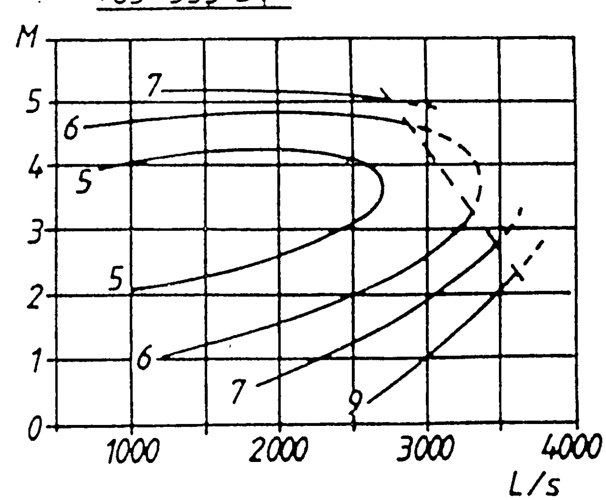

63-440 B4




53-365 B4




63-355 B4




THE NPSH VALUES ARE RELATED TO THE INLET FLANGE.
ALL NPSH LIMIT CURVES ARE VALID FOR OPERATION WITHOUT LOSS IN PERFORMANCE AND NO REDUCTION ON LIFE TIME.

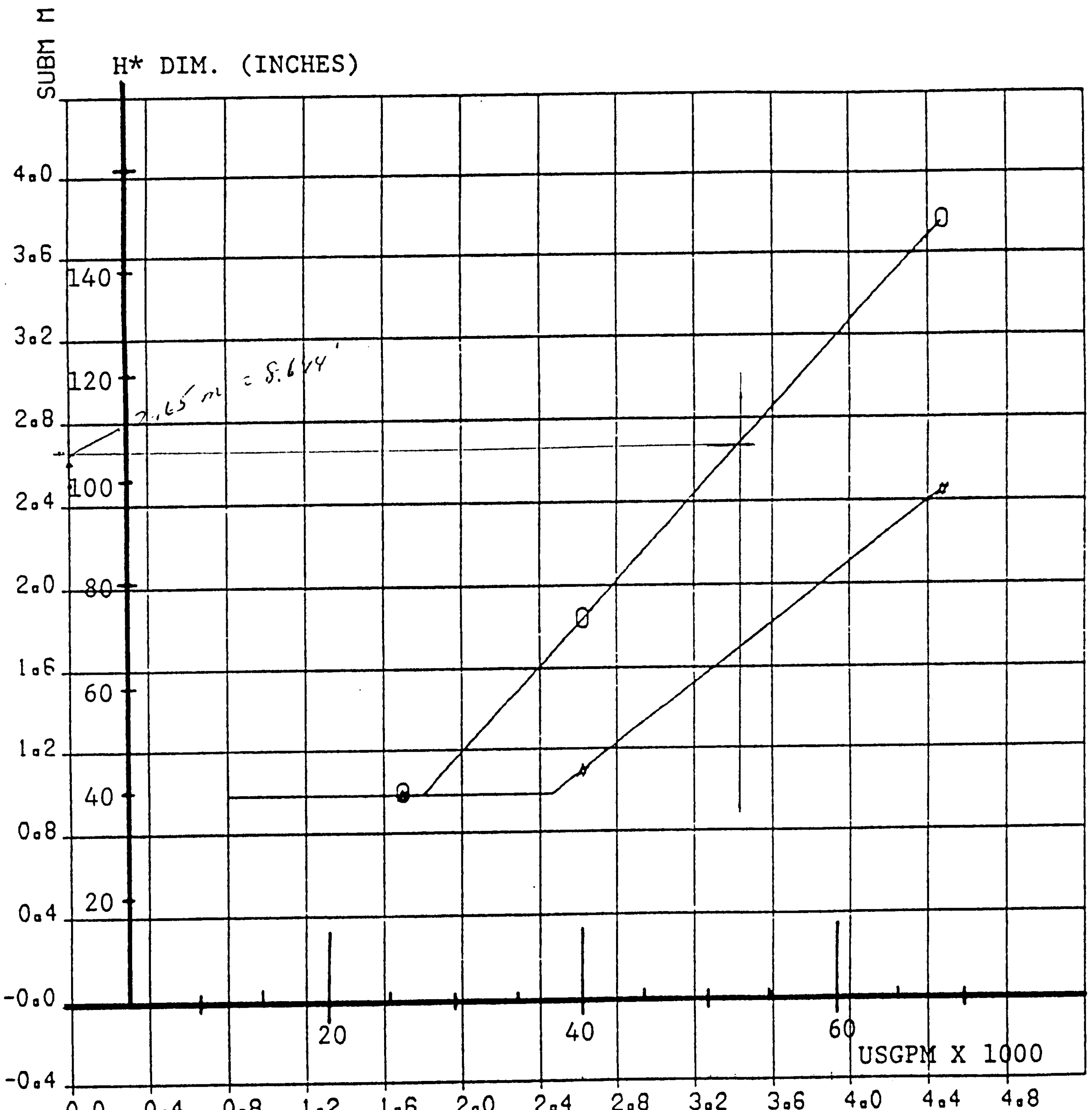
FLYGT

# SYSTEM AND APPLICATION ENGINEERING

DIAGRAM: SUBMERGENCE REQUIREMENTS FOR PL 7120 | ISSUE: 2 | DATE: 84-05-23

REQUIRED SUBMERGENCE FOR SUMP DESIGN ACCORDING TO FLYGT TYPE "A","B".

REQUIRED SUBMERGENCE TO PREVENT VORTEXING WHICH WOULD AFFECT THE PERFORMANCE OF THE PUMP. IN SOME INSTANCES ADDITIONAL SUBMERGENCE MAY BE REQUIRED BECAUSE OF NPSH REQUIREMENTS.




O:CONTINOUS OPERATION

ø:MAX 500 OPERATING HOURS/YEAR

# Bayou Meto Basin Project
## Conceptual Design of Bayou Meto Basin Pumping Stations

# APPENDIX F

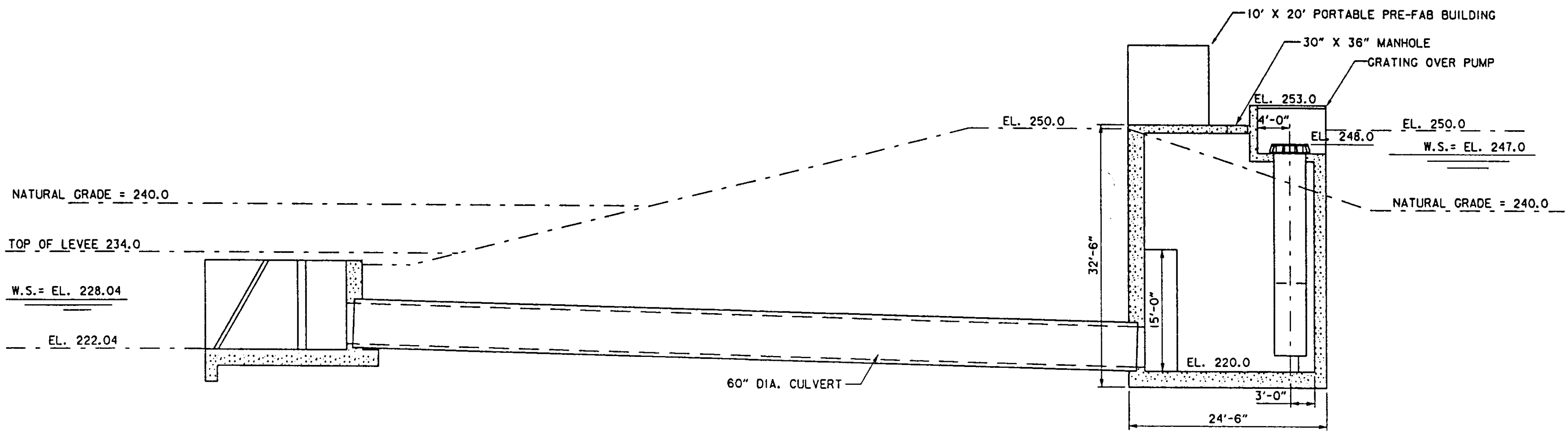
# BAYOU METO BASIN PUMPING STATIONS

# MECHANICAL DESIGN DEVELOPMENT

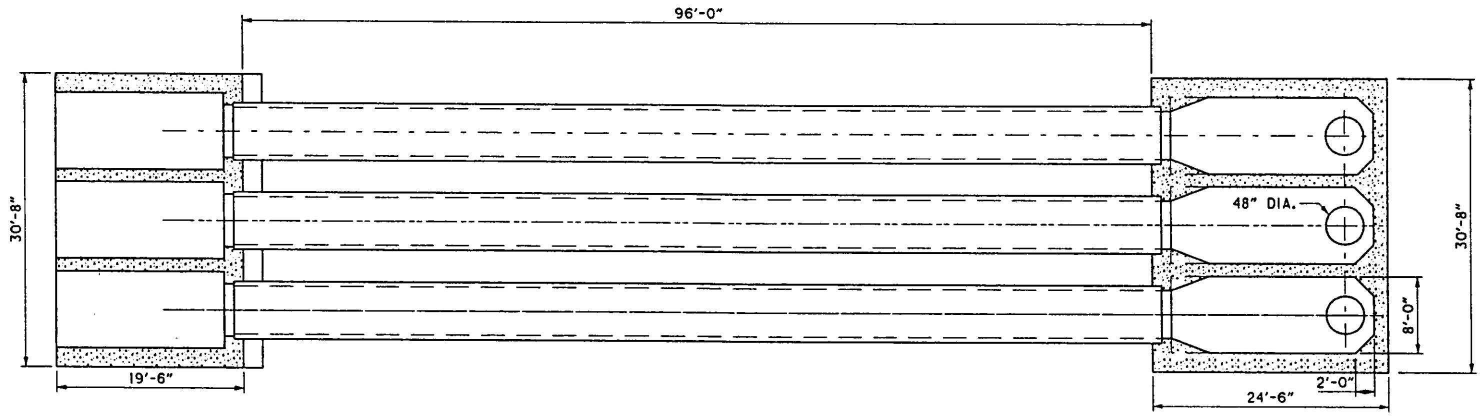
# STATION LAYOUT AND PUMP CURVES FOR

# PUMPING STATION # 3

U.S. Army Corps of Engineers
Memphis District




# PUMPING STATION NUMBER 3
## ELEVATION
SCALE: 1" = 20'-0"




PUMPING STATION NUMBER 3
PLAN VIEW
SCALE: 1" = 20'-0"

## PUMPING STATION #3 (STATION CAPACITY = 260 CFS)

| LOSSES FOR ONE OF THREE PUMPS (87 CFS) | | |
|---|---|---|
| MAX STATIC HEAD = | 248'-230.35' = | 17.65 |

| | |
|---|---|
| RATED GPM = | 39,048 |
| PIPE AREA (SQ.FT.) = | 19.64 |
| PIPE DIAMETER (FT) = | 5 |
| RATED VELOCITY (FT/SEC) = | 4.430 |
| EQUIV. LENGTH OF PIPE (FT) = | 90.7 |
| PUMP INLET DIA. (FT) = | 4 |
| PUMP AREA (SQ. FT.) = | 12.566 |

| FLOW GPM | CFS | PIPE VEL. | TRASH RACK | INLET LOSS | PIPE LOSSES | PIPE EXIT | OUTLET LOSSES | TOTAL LOSS | TDH | |
|---|---|---|---|---|---|---|---|---|---|---|
| 1,000 | 2.23 | 0.11 | 0.13 | 0.00 | 0.000 | 0.0002 | 0.43 | 0.55 | 18.20 | |
| 2,000 | 4.46 | 0.23 | 0.03 | 0.00 | 0.000 | 0.0007 | 0.49 | 0.52 | 18.17 | |
| 3,000 | 6.68 | 0.34 | 0.04 | 0.00 | 0.001 | 0.0017 | 0.55 | 0.60 | 18.25 | |
| 4,000 | 8.91 | 0.45 | 0.05 | 0.00 | 0.001 | 0.0030 | 0.62 | 0.68 | 18.33 | |
| 5,000 | 11.14 | 0.57 | 0.06 | 0.00 | 0.002 | 0.0046 | 0.68 | 0.76 | 18.41 | |
| 6,000 | 13.37 | 0.68 | 0.08 | 0.00 | 0.003 | 0.0066 | 0.75 | 0.84 | 18.49 | |
| 7,000 | 15.60 | 0.79 | 0.09 | 0.00 | 0.004 | 0.0090 | 0.81 | 0.92 | 18.57 | |
| 8,000 | 17.82 | 0.91 | 0.10 | 0.01 | 0.005 | 0.0118 | 0.88 | 1.00 | 18.65 | |
| 9,000 | 20.05 | 1.02 | 0.12 | 0.01 | 0.006 | 0.0149 | 0.94 | 1.09 | 18.74 | |
| 10,000 | 22.28 | 1.13 | 0.13 | 0.01 | 0.007 | 0.0185 | 1.01 | 1.17 | 18.82 | |
| 11,000 | 24.51 | 1.25 | 0.14 | 0.01 | 0.009 | 0.0223 | 1.07 | 1.26 | 18.91 | |
| 12,000 | 26.74 | 1.36 | 0.15 | 0.01 | 0.010 | 0.0266 | 1.14 | 1.34 | 18.99 | |
| 13,000 | 28.96 | 1.47 | 0.17 | 0.02 | 0.012 | 0.0312 | 1.20 | 1.43 | 19.08 | |
| 14,000 | 31.19 | 1.59 | 0.18 | 0.02 | 0.014 | 0.0362 | 1.27 | 1.51 | 19.16 | |
| 15,000 | 33.42 | 1.70 | 0.19 | 0.02 | 0.016 | 0.0415 | 1.33 | 1.60 | 19.25 | |
| 16,000 | 35.65 | 1.82 | 0.20 | 0.03 | 0.018 | 0.0472 | 1.39 | 1.69 | 19.34 | |
| 17,000 | 37.88 | 1.93 | 0.22 | 0.03 | 0.020 | 0.0533 | 1.46 | 1.78 | 19.43 | |
| 18,000 | 40.10 | 2.04 | 0.23 | 0.03 | 0.022 | 0.0598 | 1.52 | 1.87 | 19.52 | |
| 19,000 | 42.33 | 2.16 | 0.24 | 0.04 | 0.024 | 0.0666 | 1.59 | 1.96 | 19.61 | |
| 20,000 | 44.56 | 2.27 | 0.26 | 0.04 | 0.027 | 0.0738 | 1.65 | 2.05 | 19.70 | |
| 21,000 | 46.79 | 2.38 | 0.27 | 0.04 | 0.029 | 0.0814 | 1.72 | 2.14 | 19.79 | |
| 22,000 | 49.02 | 2.50 | 0.28 | 0.05 | 0.032 | 0.0893 | 1.78 | 2.23 | 19.88 | |
| 23,000 | 51.24 | 2.61 | 0.29 | 0.05 | 0.035 | 0.0976 | 1.85 | 2.33 | 19.98 | |
| 24,000 | 53.47 | 2.72 | 0.31 | 0.06 | 0.038 | 0.1063 | 1.91 | 2.42 | 20.07 | |
| 25,000 | 55.70 | 2.84 | 0.32 | 0.06 | 0.041 | 0.1153 | 1.98 | 2.51 | 20.16 | |
| 26,000 | 57.93 | 2.95 | 0.33 | 0.07 | 0.044 | 0.1247 | 2.04 | 2.61 | 20.26 | |
| 27,000 | 60.16 | 3.06 | 0.35 | 0.07 | 0.047 | 0.1345 | 2.11 | 2.71 | 20.36 | |
| 28,000 | 62.38 | 3.18 | 0.36 | 0.08 | 0.050 | 0.1447 | 2.17 | 2.80 | 20.45 | |
| 29,000 | 64.61 | 3.29 | 0.37 | 0.08 | 0.054 | 0.1552 | 2.23 | 2.90 | 20.55 | |
| 30,000 | 66.84 | 3.40 | 0.38 | 0.09 | 0.057 | 0.1661 | 2.30 | 3.00 | 20.65 | |
| 31,000 | 69.07 | 3.52 | 0.40 | 0.10 | 0.061 | 0.1773 | 2.36 | 3.09 | 20.74 | |
| 32,000 | 71.30 | 3.63 | 0.41 | 0.10 | 0.064 | 0.1889 | 2.43 | 3.19 | 20.84 | |
| 33,000 | 73.52 | 3.74 | 0.42 | 0.11 | 0.068 | 0.2009 | 2.49 | 3.29 | 20.94 | |
| 34,000 | 75.75 | 3.86 | 0.44 | 0.12 | 0.072 | 0.2133 | 2.56 | 3.39 | 21.04 | |
| 35,000 | 77.98 | 3.97 | 0.45 | 0.12 | 0.076 | 0.2260 | 2.62 | 3.49 | 21.14 | |
| 36,000 | 80.21 | 4.08 | 0.46 | 0.13 | 0.080 | 0.2391 | 2.69 | 3.60 | 21.25 | |
| 37,000 | 82.44 | 4.20 | 0.47 | 0.14 | 0.084 | 0.2526 | 2.75 | 3.70 | 21.35 | |
| 38,000 | 84.66 | 4.31 | 0.49 | 0.14 | 0.088 | 0.2664 | 2.82 | 3.80 | 21.45 | |
| 39,000 | 86.89 | 4.42 | 0.50 | 0.15 | 0.093 | 0.2806 | 2.88 | 3.91 | 21.56 | |
| 39,048 | 87.00 | 4.43 | 0.50 | 0.15 | 0.093 | 0.2813 | 2.88 | 3.91 | 21.56 | **** |
| 40,000 | 89.12 | 4.54 | 0.51 | 0.16 | 0.097 | 0.2952 | 2.95 | 4.01 | 21.66 | |
| 41,000 | 91.35 | 4.65 | 0.52 | 0.17 | 0.102 | 0.3102 | 3.01 | 4.12 | 21.77 | |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 42,000 | 93.58 | 4.77 | 0.54 | 0.18 | 0.106 | 0.3255 | 3.07 | 4.22 | 21.87 |
| 43,000 | 95.80 | 4.88 | 0.55 | 0.18 | 0.111 | 0.3412 | 3.14 | 4.33 | 21.98 |
| 44,000 | 98.03 | 4.99 | 0.56 | 0.19 | 0.116 | 0.3572 | 3.20 | 4.43 | 22.08 |
| 45,000 | 100.26 | 5.11 | 0.58 | 0.20 | 0.121 | 0.3736 | 3.27 | 4.54 | 22.19 |
| 46,000 | 102.49 | 5.22 | 0.59 | 0.21 | 0.126 | 0.3904 | 3.33 | 4.65 | 22.30 |
| 47,000 | 104.72 | 5.33 | 0.60 | 0.22 | 0.131 | 0.4076 | 3.40 | 4.76 | 22.41 |
| 48,000 | 106.94 | 5.45 | 0.61 | 0.23 | 0.136 | 0.4251 | 3.46 | 4.87 | 22.52 |
| 49,000 | 109.17 | 5.56 | 0.63 | 0.24 | 0.142 | 0.4430 | 3.53 | 4.98 | 22.63 |
| 50,000 | 111.40 | 5.67 | 0.64 | 0.25 | 0.147 | 0.4613 | 3.59 | 5.09 | 22.74 |
| 51,000 | 113.63 | 5.79 | 0.65 | 0.26 | 0.152 | 0.4799 | 3.66 | 5.20 | 22.85 |
| 52,000 | 115.86 | 5.90 | 0.67 | 0.27 | 0.158 | 0.4989 | 3.72 | 5.31 | 22.96 |
| 53,000 | 118.08 | 6.01 | 0.68 | 0.28 | 0.164 | 0.5183 | 3.79 | 5.43 | 23.08 |
| 54,000 | 120.31 | 6.13 | 0.69 | 0.29 | 0.169 | 0.5380 | 3.85 | 5.54 | 23.19 |
| 55,000 | 122.54 | 6.24 | 0.70 | 0.30 | 0.175 | 0.5581 | 3.91 | 5.65 | 23.30 |
| 56,000 | 124.77 | 6.35 | 0.72 | 0.31 | 0.181 | 0.5786 | 3.98 | 5.77 | 23.42 |
| 57,000 | 127.00 | 6.47 | 0.73 | 0.32 | 0.187 | 0.5995 | 4.04 | 5.89 | 23.54 |
| 58,000 | 129.22 | 6.58 | 0.74 | 0.34 | 0.193 | 0.6207 | 4.11 | 6.00 | 23.65 |
| 59,000 | 131.45 | 6.69 | 0.76 | 0.35 | 0.200 | 0.6423 | 4.17 | 6.12 | 23.77 |
| 60,000 | 133.68 | 6.81 | 0.77 | 0.36 | 0.206 | 0.6642 | 4.24 | 6.24 | 23.89 |

| | | | | | |
|---|---|---|---|---|---|
| DESIGN CONDITIONS = | 39,048 GPM @ | | | 21.56 | TDH |
| PUMP HORSEPOWER = | 269 | HP | | 200.68 | KW |
| MOTOR HORSEPOWER = | 311.61 | HP | | 232.37 | KW |

USE 236 KW MOTOR

NPSHA= h(atm) - h(vap) + h(static)

NPSHA= 34' - .837' + 8.35' - 1.024'

NPSHA= 40.489' FROM CHART: NPSHR = 7.95 meters = 26.08'

SUBMERGENCE REQUIRED TO PREVENT VORTEXING (SEE CHART) = 7.54'

ACTUAL SUBMERGENCE AVAILABLE = 8.35'-1.024' = 7.326'

FORMULAS USED TO CALCULATE LOSSES

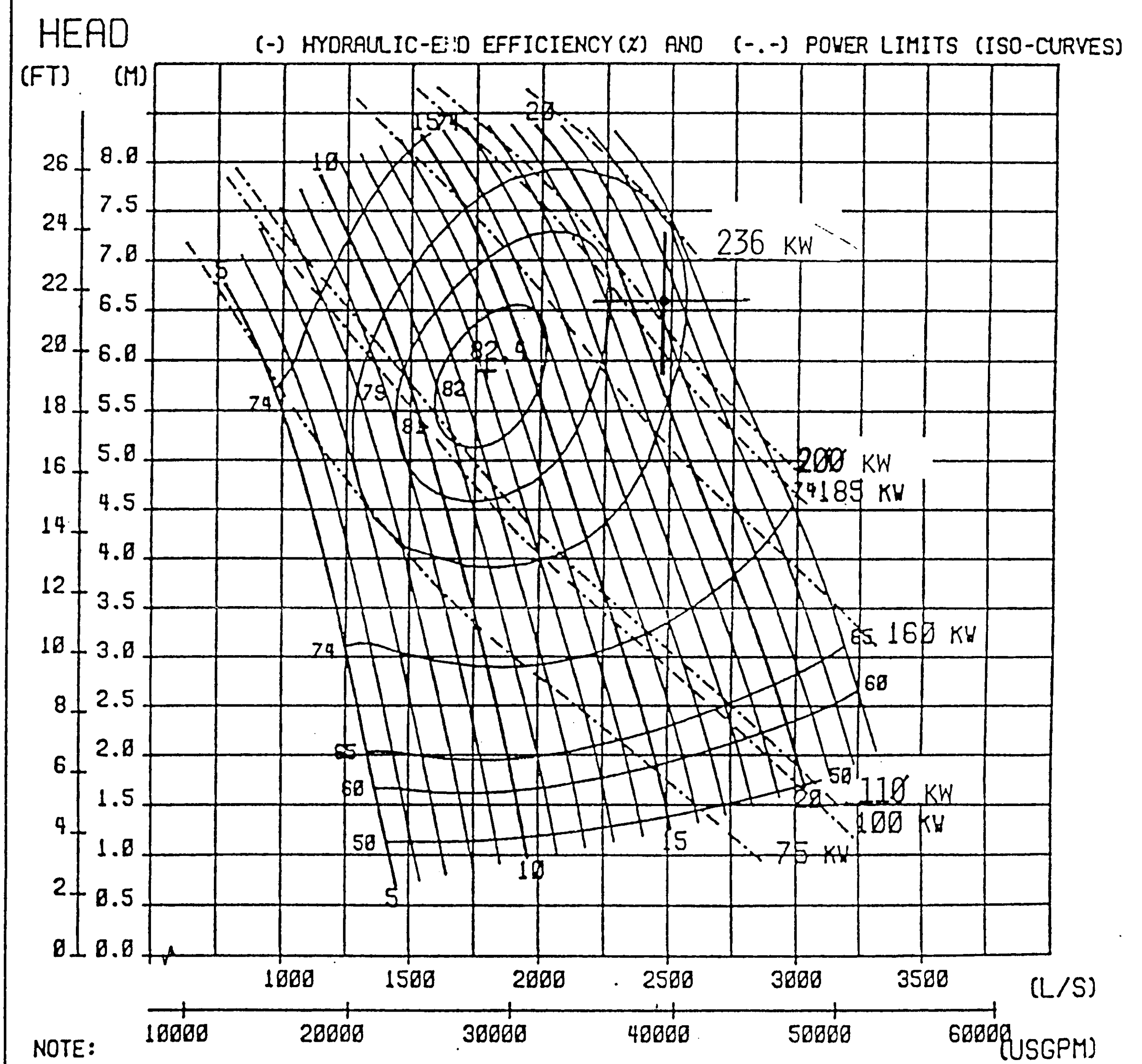
| | |
|---|---|
| TRASH RACK LOSSES: | ASSUME .5 FOOT LOSS AT DESIGN FLOW OF 87 CFS.<br>ASSUME LOSS PROPORTIONAL TO SQUARE OF VELOCITY.<br>LOSS = ( ACTUAL VELOCITY^2/ RATED VELOCITY^2 )* .5 FOOT |
| INLET LOSS: | LOSS = (.5* V^2)/2*g |
| PIPE LOSSES: | USING WILLIAMS AND HAZEN FORMULA FOR CONCRETE PIPELINES<br>LOSS = (.0004258*PIPE LENGTH*VELOCITY^1.852)/(PIPE DIAMETER^1.167) |
| PIPE EXIT LOSSES: | LOSS = (PIPE VELOCITY^2 - OUTLET VELOCITY^2)/2*g |
| PUMP OUTLET LOSS: | FROM ATTACHED CHART<br>LOSS = .029*CFS + .361 |

| FLYGT | PERFORMANCE CURVE | PROD. 7100 |
|---|---|---|

| DATE | ISSUE | FREQ | NOMINAL HYDRAULIC-END SPEED | CURVE NO |
|---|---|---|---|---|
| 1984-06-06 | 3 | 60 HZ | 505 RPM | 63-505B4 |

| IMPELLER/HUB DIAMETER | TYPE OF BLADES | NO. OF BLADES | AVAILABLE BLADE ANGLES |
|---|---|---|---|
| 850/480 MM | B | 4 | EVERY DEG. FROM 5 TO 23 DEG |

| MOTOR | POLES | SHAFT POWER | GEARTYPE | GEAR RATIO | GEAR EFFICIENCY (1/1-3/4 LOAD) | RATED SPEED |
|---|---|---|---|---|---|---|
| 51-43-5 | 14 | 75 KW | | | | 500 RPM |
| 51-56-5 | 14 | 100 | | | | 505 |
| 65-51-5BB | 14 | 185 | | | | 510 |
| 65-71-5BB | 14 | 250 | | | | 505 |
| 40-30-4 | 4 | 110 | 350-13 | 1:3.500 | 94.9 % - 93.8 % | 507 |
| 40-44-4 | 4 | 160 | 350-13 | 1:3.500 | 96.2 % - 95.4 % | 506 |
| 40-57-4 | 4 | 200 | 350-13 | 1:3.500 | 96.6 % - 95.9 % | 507 |
| 51-43-4 | 4 | 236 | 350-13 | 1:3.500 | 96.9 % - 96.3 % | 510 |
| 51-56-4 | 4 | 300 | 350-13 | 1:3.500 | 97.3 % - 96.8 % | 510 |

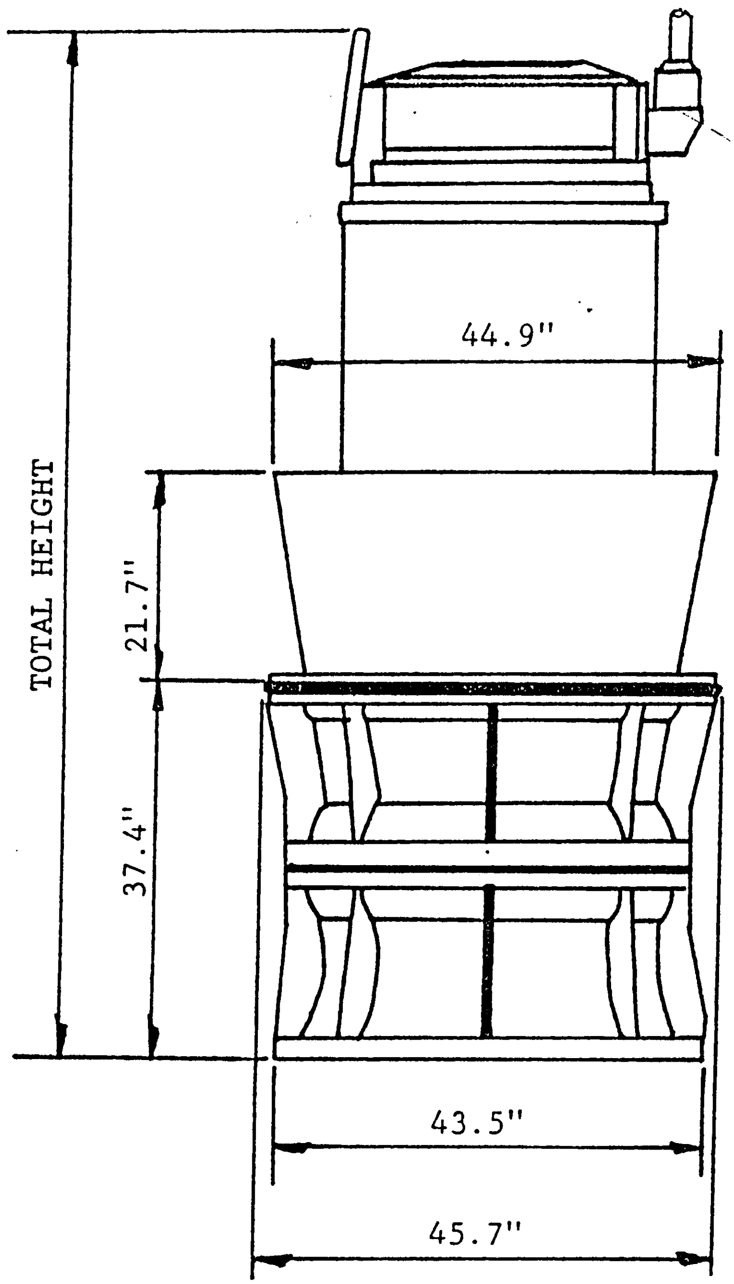



NOTE:

CURVES ARE BASED ON NOMINAL CONSTANT HYDRAULIC-END SPEED AND SHOW PERFORMANCE WITH CLEAR WATER.

ALL HYDRAULIC LOSSES UP TO 500 MM. ABOVE THE PUMP/MOTOR TOP ARE INCLUDED

# PL-7100



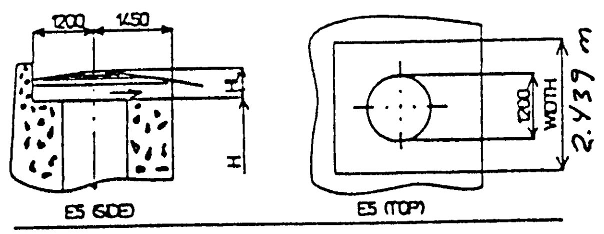

| MOTOR NO. | KW | DRIVE UNIT | TOTAL HEIGHT | WEIGHT |
|---|---|---|---|---|
| 51-43-5 | 75 | 820 | 95.7" | 6290# |
| 51-56-5 | 100 | 860 | 100.8" | 6560# |
| 65-51-5 | 185 | 900 | 94.5" | 10030# |
| 65-51-3 | 220 | 900 | 94.5" | 10030# |
| 65-56-6BB(LV) | 375 | 900 | 126.5" | 11150# |
| 65-71-3 | 280 | 930 | 102.4" | 11135# |
| 65-56-6(HV) | 355 | 930 | 131.9" | 12235# |
| 40-30-4 | 110 | 760 | 127.4" | 5400# |
| 40-44-4 | 160 | 770 | 137.8" | 5845# |
| 40-57-4 | 200 | 770 | 137.8" | 6615# |
| 51-43-4 | 236 | 820 | 127.2" | 7585# |
| 51-56-4 | 300 | 860 | 132.3" | 8490# |

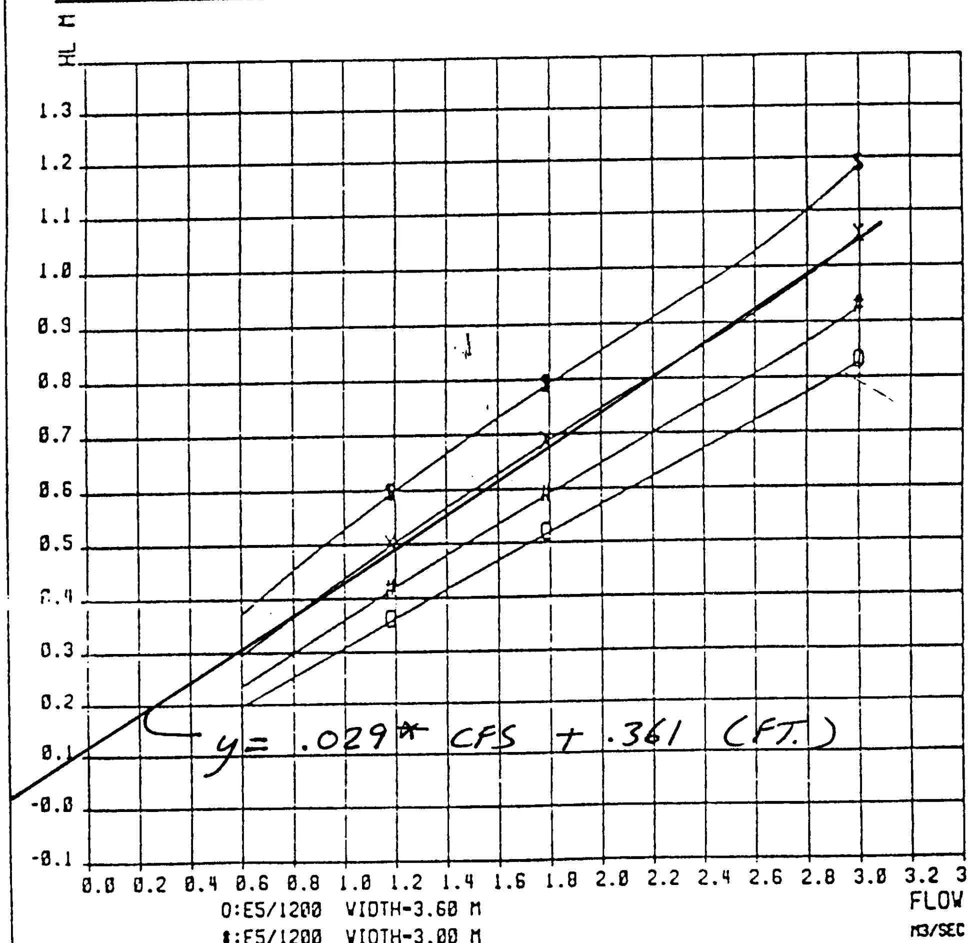
Conversions: (GPM)(0.06308)=L/S
(L/S)(0.001)=M3/S
(FT)(0.3048)=M

FLYGT SYSTEM AND APPLICATION ENGINEERING

DIAGRAM: HEAD LOSS E5/1200 (PL7100) | ISSUE: 1 | DATE: 82-06-14

INLET DIAMETER 1.2 M. HL-HEAD LOSS
NOTE THAT THE OUTLET LOSS IS INCLUDED IN TYPE E5



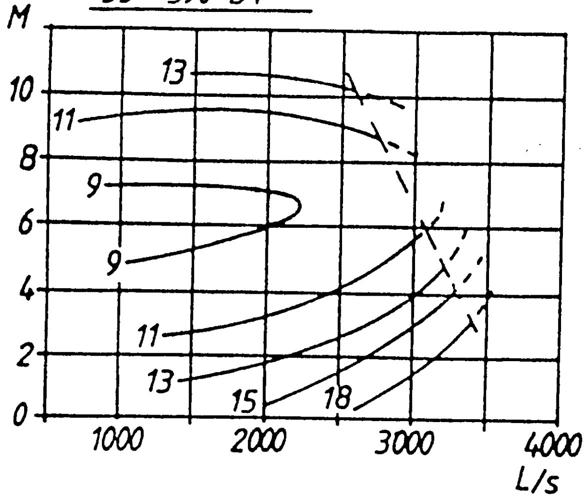




O:E5/1200 WIDTH-3.60 M
#:E5/1200 WIDTH-3.00 M
X:E5/1200 WIDTH-2.40 M ←
$:E5/1200 WIDTH-1.80 M

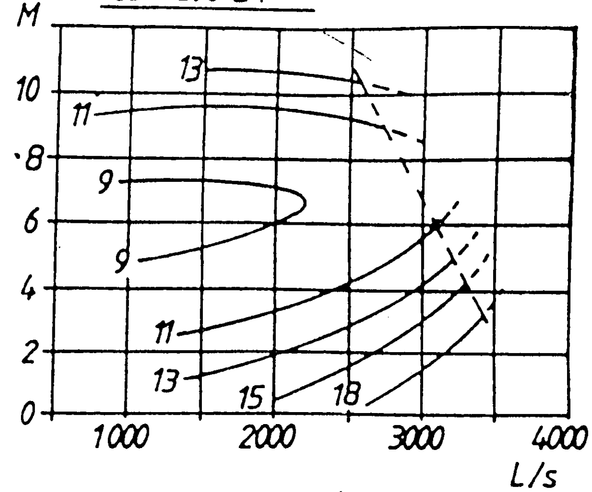
| FLYGT | DATE 831205 / ISSUE 2 | NPSH CURVES | 7100 |
|---|---|---|---|

## $NPSH_{RE}$ VALUES IN M $H_2O$

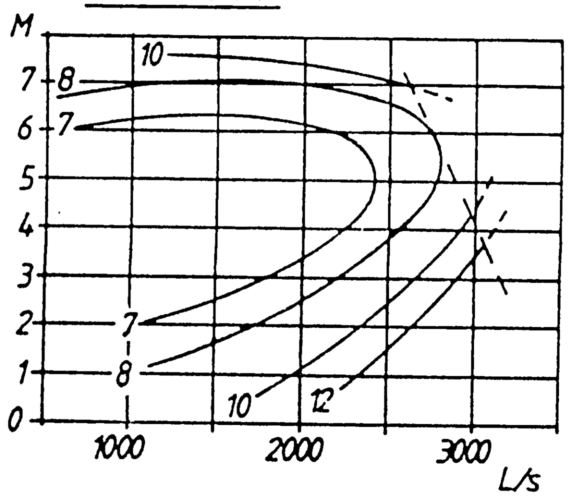
53 - 590 B4



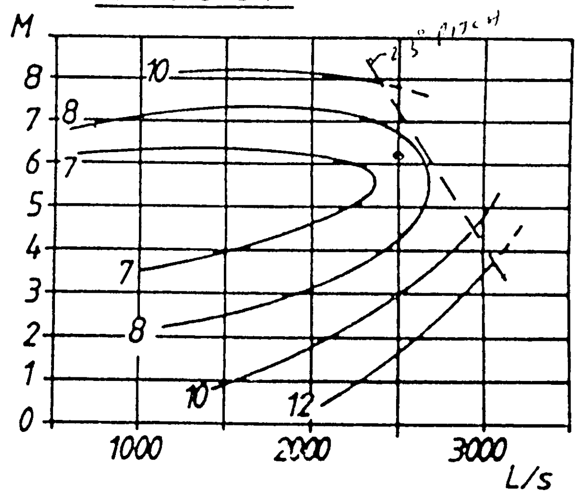

63 - 590 B4



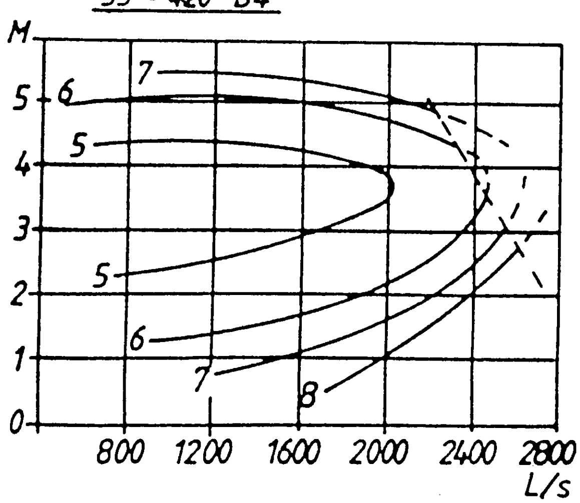

53 - 490 B4



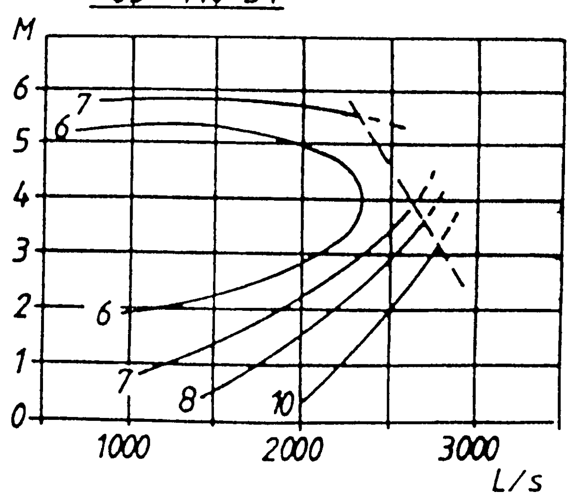

63 - 505 B4




53 - 420 B4




63 - 440 B4




THE NPSH VALUES ARE RELATED TO THE INLET FLANGE.
ALL NPSH LIMIT CURVES ARE VALID FOR OPERATION WITHOUT
LOSS IN PERFORMANCE AND NO REDUCTION ON LIFE·TIME.

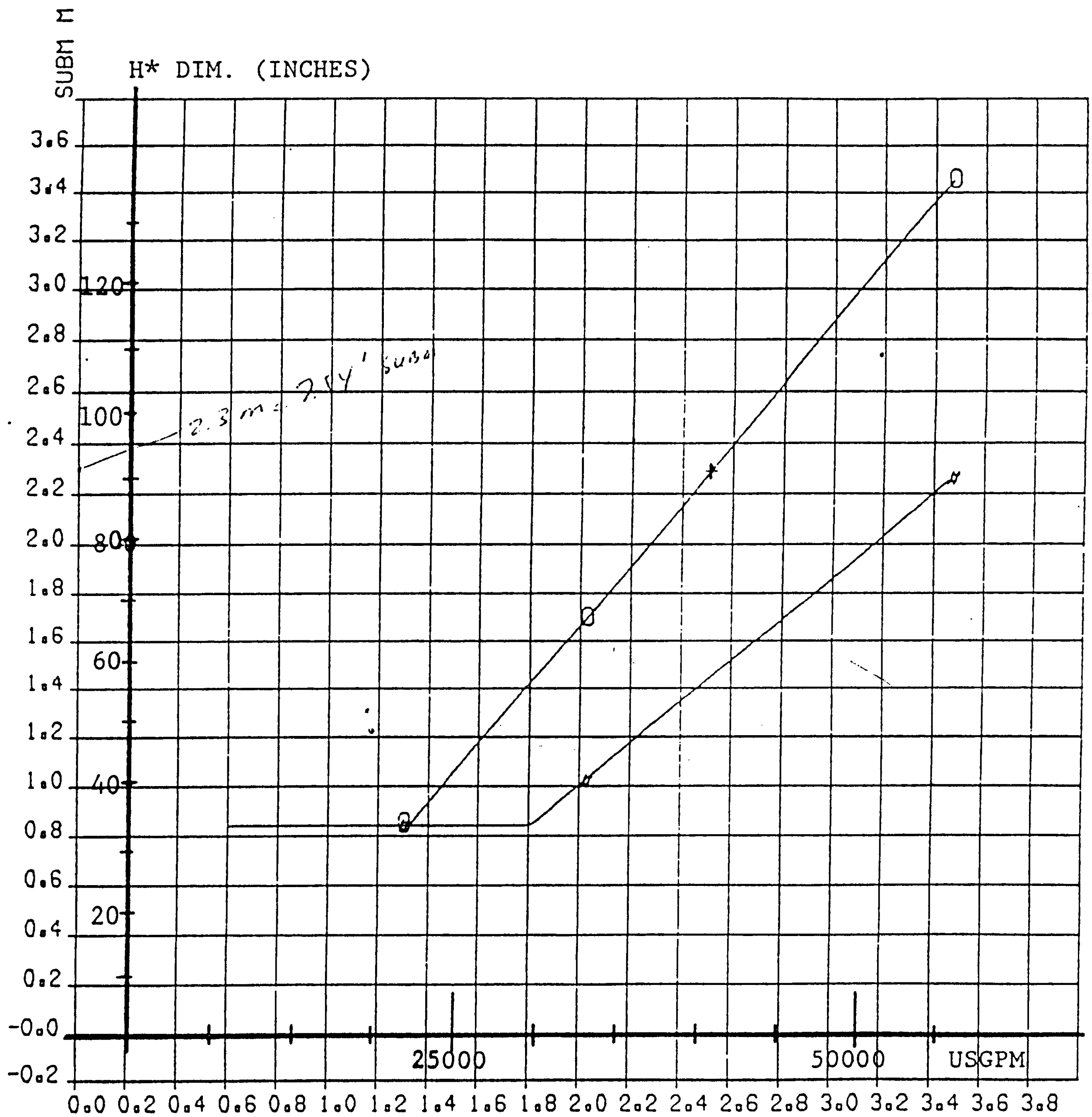
FLYGT

# SYSTEM AND APPLICATION ENGINEERING

| DIAGRAM: SUBMERGENCE REQUIREMENTS FOR PL 7100 | ISSUE: 2 | DATE: 84-05-23 |
|---|---|---|

REQUIRED SUBMERGENCE FOR SUMP DESIGN ACCORDING TO FLYGT TYPE "A","B".

REQUIRED SUBMERGENCE TO PREVENT VORTEXING WHICH WOULD AFFECT THE PERFORMANCE OF THE PUMP. IN SOME INSTANCES ADDITIONAL SUBMERGENCE MAY BE REQUIRED BECAUSE OF NPSH REQUIREMENTS.




O:CONTINOUS OPERATION

#:MAX 500 OPERATING HOURS/YEAR

# Bayou Meto Basin Project

**Conceptual Design of Bayou Meto Basin Pumping Stations**

# APPENDIX G

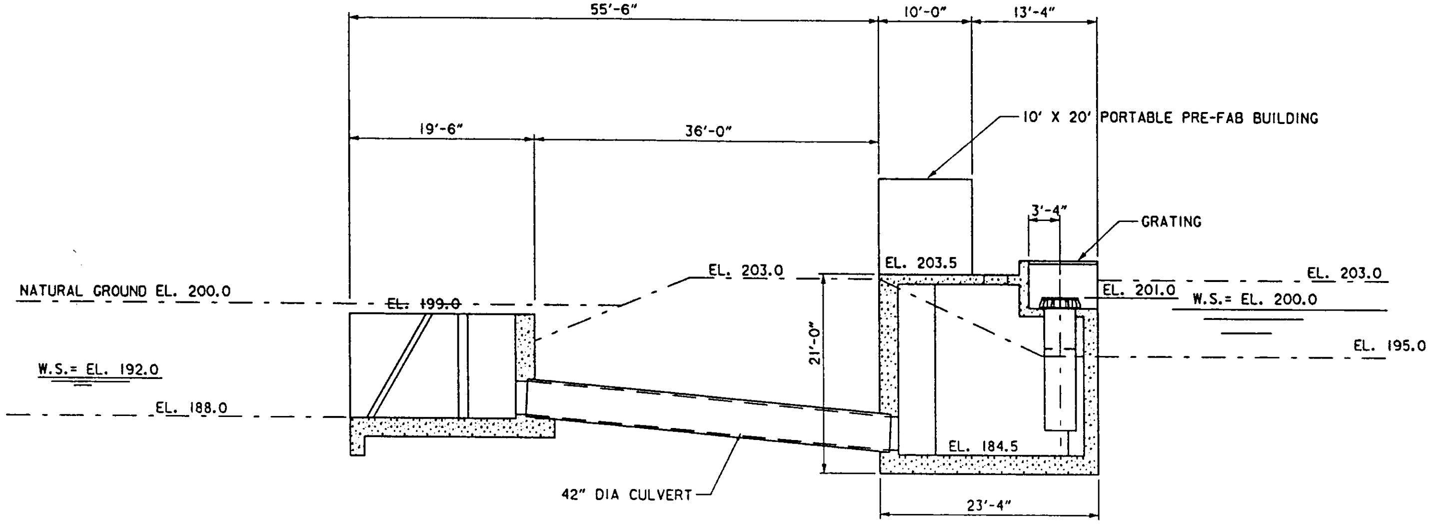
# BAYOU METO BASIN PUMPING STATIONS

# MECHANICAL DESIGN DEVELOPMENT

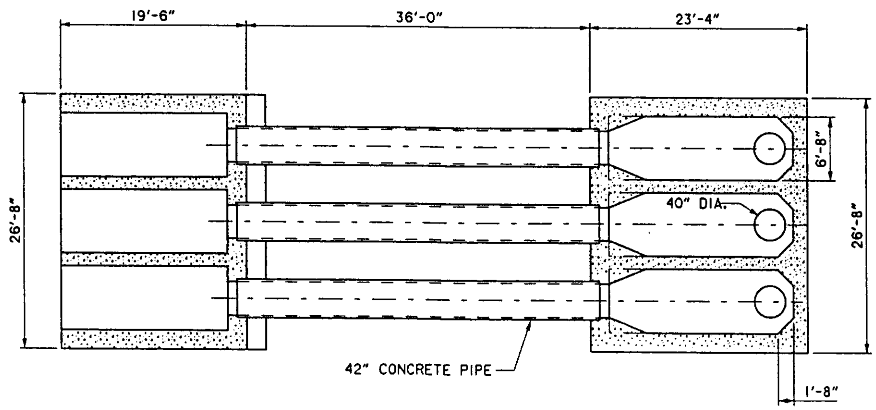
# STATION LAYOUT AND PUMP CURVES FOR

# PUMPING STATION # 4

U.S. Army Corps of Engineers
Memphis District




PUMPING STATION NUMBER 4
ELEVATION
SCALE: 1" = 20'-0"




PUMPING STATION NUMBER 4
PLAN VIEW
SCALE: 1" = 20'-0"

# PUMPING STATION #4 (STATION CAPACITY = 125 CFS)

| | |
|---|---|
| LOSSES FOR ONE OF THREE PUMPS (41.67 CFS) | |
| MAX STATIC HEAD = 201'-192.0' = | 9 |

| | |
|---|---|
| RATED GPM = | 18,703 |
| PIPE AREA (SQ.FT.) = | 9.622 |
| PIPE DIAMETER (FT) = | 3.5 |
| RATED VELOCITY (FT/SEC) = | 4.331 |
| EQUIV. LENGTH OF PIPE (FT) = | 40 |
| PUMP INLET DIA. (FT) = | 3.333 |
| PUMP AREA (SQ. FT.) = | 8.723 |

| FLOW GPM | CFS | PIPE VEL. | TRASH RACK | INLET LOSS | PIPE LOSSES | PIPE EXIT | OUTLET LOSSES | TOTAL LOSS | TDH | |
|---|---|---|---|---|---|---|---|---|---|---|
| 1,000 | 2.23 | 0.23 | 0.00 | 0.00 | 0.000 | 0.0008 | 0.35 | 0.35 | 9.35 | |
| 2,000 | 4.46 | 0.46 | 0.01 | 0.00 | 0.001 | 0.0033 | 0.44 | 0.46 | 9.46 | |
| 3,000 | 6.68 | 0.69 | 0.01 | 0.00 | 0.002 | 0.0074 | 0.52 | 0.55 | 9.55 | |
| 4,000 | 8.91 | 0.93 | 0.02 | 0.01 | 0.003 | 0.0131 | 0.61 | 0.66 | 9.66 | |
| 5,000 | 11.14 | 1.16 | 0.04 | 0.01 | 0.005 | 0.0204 | 0.70 | 0.77 | 9.77 | |
| 6,000 | 13.37 | 1.39 | 0.05 | 0.01 | 0.007 | 0.0294 | 0.78 | 0.89 | 9.89 | |
| 7,000 | 15.60 | 1.62 | 0.07 | 0.02 | 0.010 | 0.0400 | 0.87 | 1.01 | 10.01 | |
| 8,000 | 17.82 | 1.85 | 0.09 | 0.03 | 0.012 | 0.0523 | 0.96 | 1.14 | 10.14 | |
| 9,000 | 20.05 | 2.08 | 0.12 | 0.03 | 0.015 | 0.0662 | 1.04 | 1.28 | 10.28 | |
| 10,000 | 22.28 | 2.32 | 0.14 | 0.04 | 0.019 | 0.0817 | 1.13 | 1.42 | 10.42 | |
| 11,000 | 24.51 | 2.55 | 0.17 | 0.05 | 0.022 | 0.0989 | 1.22 | 1.56 | 10.56 | |
| 12,000 | 26.74 | 2.78 | 0.21 | 0.06 | 0.026 | 0.1177 | 1.30 | 1.71 | 10.71 | |
| 13,000 | 28.96 | 3.01 | 0.24 | 0.07 | 0.030 | 0.1381 | 1.39 | 1.87 | 10.87 | |
| 14,000 | 31.19 | 3.24 | 0.28 | 0.08 | 0.035 | 0.1602 | 1.48 | 2.04 | 11.04 | |
| 15,000 | 33.42 | 3.47 | 0.32 | 0.09 | 0.040 | 0.1839 | 1.57 | 2.20 | 11.20 | |
| 16,000 | 35.65 | 3.70 | 0.37 | 0.11 | 0.045 | 0.2092 | 1.65 | 2.38 | 11.38 | |
| 17,000 | 37.88 | 3.94 | 0.41 | 0.12 | 0.050 | 0.2361 | 1.74 | 2.56 | 11.56 | |
| 18,000 | 40.10 | 4.17 | 0.46 | 0.13 | 0.056 | 0.2647 | 1.83 | 2.74 | 11.74 | |
| 18,703 | 41.67 | 4.33 | 0.50 | 0.15 | 0.060 | 0.2858 | 1.89 | 2.88 | 11.88 | **** |
| 19,000 | 42.33 | 4.40 | 0.52 | 0.15 | 0.061 | 0.2950 | 1.91 | 2.94 | 11.94 | |
| 20,000 | 44.56 | 4.63 | 0.57 | 0.17 | 0.067 | 0.3269 | 2.00 | 3.13 | 12.13 | |
| 21,000 | 46.79 | 4.86 | 0.63 | 0.18 | 0.074 | 0.3604 | 2.09 | 3.33 | 12.33 | |
| 22,000 | 49.02 | 5.09 | 0.69 | 0.20 | 0.081 | 0.3955 | 2.17 | 3.54 | 12.54 | |
| 23,000 | 51.24 | 5.33 | 0.76 | 0.22 | 0.087 | 0.4323 | 2.26 | 3.76 | 12.76 | |
| 24,000 | 53.47 | 5.56 | 0.82 | 0.24 | 0.095 | 0.4707 | 2.35 | 3.98 | 12.98 | |
| 25,000 | 55.70 | 5.79 | 0.89 | 0.26 | 0.102 | 0.5107 | 2.43 | 4.20 | 13.20 | |
| 26,000 | 57.93 | 6.02 | 0.97 | 0.28 | 0.110 | 0.5524 | 2.52 | 4.43 | 13.43 | |
| 27,000 | 60.16 | 6.25 | 1.04 | 0.30 | 0.118 | 0.5957 | 2.61 | 4.67 | 13.67 | |
| 28,000 | 62.38 | 6.48 | 1.12 | 0.33 | 0.126 | 0.6406 | 2.69 | 4.91 | 13.91 | |
| 29,000 | 64.61 | 6.71 | 1.20 | 0.35 | 0.134 | 0.6872 | 2.78 | 5.16 | 14.16 | |
| 30,000 | 66.84 | 6.95 | 1.29 | 0.37 | 0.143 | 0.7354 | 2.87 | 5.41 | 14.41 | |
| 31,000 | 69.07 | 7.18 | 1.37 | 0.40 | 0.152 | 0.7853 | 2.96 | 5.67 | 14.67 | |
| 32,000 | 71.30 | 7.41 | 1.46 | 0.43 | 0.161 | 0.8367 | 3.04 | 5.93 | 14.93 | |
| 33,000 | 73.52 | 7.64 | 1.56 | 0.45 | 0.171 | 0.8898 | 3.13 | 6.20 | 15.20 | |
| 34,000 | 75.75 | 7.87 | 1.65 | 0.48 | 0.180 | 0.9446 | 3.22 | 6.47 | 15.47 | |
| 35,000 | 77.98 | 8.10 | 1.75 | 0.51 | 0.190 | 1.0010 | 3.30 | 6.76 | 15.76 | |
| 36,000 | 80.21 | 8.34 | 1.85 | 0.54 | 0.200 | 1.0590 | 3.39 | 7.04 | 16.04 | |
| 37,000 | 82.44 | 8.57 | 1.96 | 0.57 | 0.211 | 1.1186 | 3.48 | 7.33 | 16.33 | |
| 38,000 | 84.66 | 8.80 | 2.06 | 0.60 | 0.222 | 1.1799 | 3.56 | 7.63 | 16.63 | |
| 39,000 | 86.89 | 9.03 | 2.17 | 0.63 | 0.232 | 1.2428 | 3.65 | 7.93 | 16.93 | |
| 40,000 | 89.12 | 9.26 | 2.29 | 0.67 | 0.244 | 1.3074 | 3.74 | 8.24 | 17.24 | |
| 41,000 | 91.35 | 9.49 | 2.40 | 0.70 | 0.255 | 1.3736 | 3.82 | 8.56 | 17.56 | |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 42,000 | 93.58 | 9.72 | 2.52 | 0.73 | 0.267 | 1.4414 | 3.91 | 8.88 | 17.88 |
| 43,000 | 95.80 | 9.96 | 2.64 | 0.77 | 0.279 | 1.5109 | 4.00 | 9.20 | 18.20 |
| 44,000 | 98.03 | 10.19 | 2.77 | 0.81 | 0.291 | 1.5820 | 4.09 | 9.53 | 18.53 |
| 45,000 | 100.26 | 10.42 | 2.89 | 0.84 | 0.303 | 1.6547 | 4.17 | 9.87 | 18.87 |
| 46,000 | 102.49 | 10.65 | 3.02 | 0.88 | 0.316 | 1.7290 | 4.26 | 10.21 | 19.21 |
| 47,000 | 104.72 | 10.88 | 3.16 | 0.92 | 0.328 | 1.8050 | 4.35 | 10.56 | 19.56 |
| 48,000 | 106.94 | 11.11 | 3.29 | 0.96 | 0.341 | 1.8827 | 4.43 | 10.91 | 19.91 |
| 49,000 | 109.17 | 11.35 | 3.43 | 1.00 | 0.355 | 1.9619 | 4.52 | 11.27 | 20.27 |
| 50,000 | 111.40 | 11.58 | 3.57 | 1.04 | 0.368 | 2.0428 | 4.61 | 11.63 | 20.63 |
| 51,000 | 113.63 | 11.81 | 3.72 | 1.08 | 0.382 | 2.1253 | 4.69 | 12.00 | 21.00 |
| 52,000 | 115.86 | 12.04 | 3.87 | 1.13 | 0.396 | 2.2095 | 4.78 | 12.38 | 21.38 |
| 53,000 | 118.08 | 12.27 | 4.02 | 1.17 | 0.410 | 2.2953 | 4.87 | 12.76 | 21.76 |
| 54,000 | 120.31 | 12.50 | 4.17 | 1.21 | 0.425 | 2.3827 | 4.95 | 13.14 | 22.14 |
| 55,000 | 122.54 | 12.73 | 4.32 | 1.26 | 0.439 | 2.4718 | 5.04 | 13.54 | 22.54 |
| 56,000 | 124.77 | 12.97 | 4.48 | 1.31 | 0.454 | 2.5625 | 5.13 | 13.93 | 22.93 |
| 57,000 | 127.00 | 13.20 | 4.64 | 1.35 | 0.469 | 2.6548 | 5.21 | 14.34 | 23.34 |
| 58,000 | 129.22 | 13.43 | 4.81 | 1.40 | 0.485 | 2.7488 | 5.30 | 14.74 | 23.74 |
| 59,000 | 131.45 | 13.66 | 4.98 | 1.45 | 0.500 | 2.8444 | 5.39 | 15.16 | 24.16 |
| 60,000 | 133.68 | 13.89 | 5.15 | 1.50 | 0.516 | 2.9417 | 5.48 | 15.58 | 24.58 |

DESIGN CONDITIONS = 18703 GPM @ 11.88 TDH

PUMP HORSEPOWER = 71.01 HP 52.96 KW

MOTOR HORSEPOWER = 82.23 HP 61.32 KW

USE 75 KW MOTOR

NPSHA= h(atm) - h(vap) + h(static) - h(losses before pump)

NPSHA= 34' - .837' + 5.33' - 1.08'

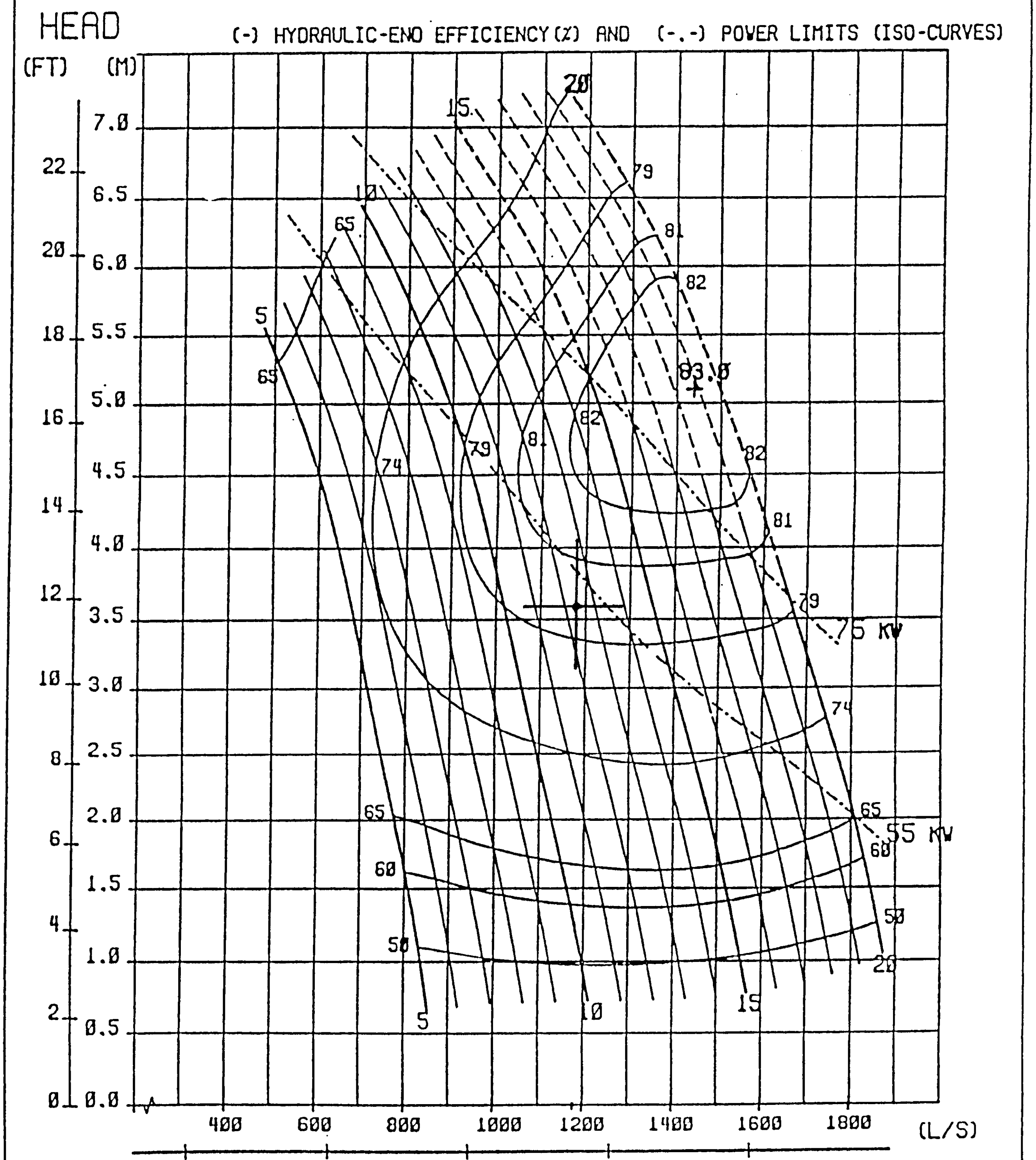
NPSHA= 37.41' FROM CHART: NPSHR = 6.5 meters = 21.32'

SUBMERGENCE REQUIRED TO PREVENT VORTEXING (SEE CHART) = 3.74'

ACTUAL SUBMERGENCE AVAILABLE =4.83' -1.08' = 3.75'

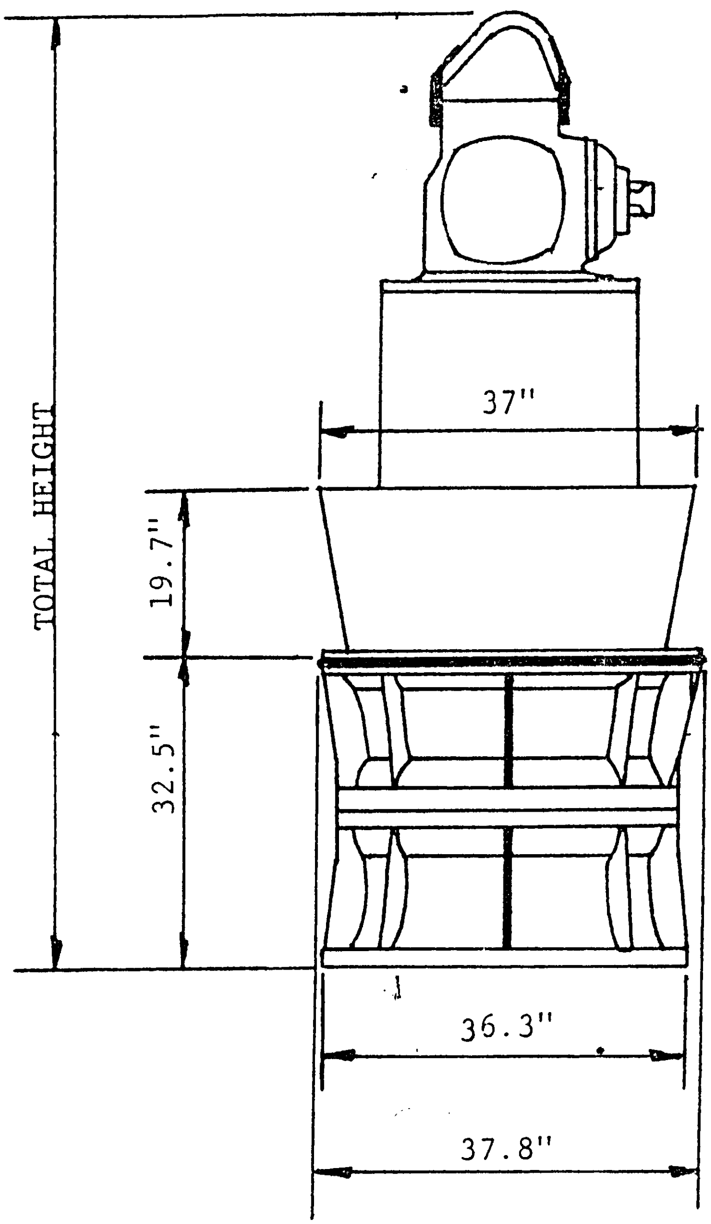
| FORMULAS USED TO CALCULATE LOSSES | |
|---|---|
| TRASH RACK LOSSES: | ASSUME .5 FOOT LOSS AT DESIGN FLOW OF 41.67 CFS.<br>ASSUME LOSS PROPORTIONAL TO SQUARE OF VELOCITY<br>LOSS = ( ACTUAL VELOCITY^2/ RATED VELOCITY^2 )* .5 FOOT |
| INLET LOSS: | LOSS = (.5* V^2)/2*g |
| PIPE LOSSES: | USING WILLIAMS AND HAZEN FORMULA FOR CONCRETE PIPELINES<br>LOSS = (.0004258*PIPE LENGTH*VELOCITY^1.852)/(PIPE DIAMETER^1.167) |
| PIPE EXIT LOSSES: | LOSS = (PIPE VELOCITY^2 - OUTLET VELOCITY^2)/2*g |
| PUMP OUTLET LOSS: | FROM ATTACHED CHART<br>LOSS = .039*CFS + .262 |

| FLYGT | PERFORMANCE CURVE | | | | | PROD. 7080 |
|---|---|---|---|---|---|---|
| DATE 1984-06-12 | ISSUE 3 | FREQ 60 HZ | NOMINAL HYDRAULIC-END SPEED 580 RPM | | | CURVE NO 63-580B4 |
| IMPELLER/HUB DIAMETER 700/400 MM | TYPE OF BLADES B | | | NO. OF BLADES 4 | | AVAILABLE BLADE ANGLES EVERY DEG. FROM 5 TO 20 DEG |
| MOTOR | POLES | SHAFT POWER | GEARTYPE | GEAR RATIO | GEAR EFFICIENCY (1/1-3/4 LOAD) | RATED SPEED |
| 40-44-3 | 12 | 55 KW | | | | 580 RPM |
| 40-57-3 | 12 | 75 | | | | 580 |
| | | | | | | |




NOTE:
CURVES ARE BASED ON NOMINAL CONSTANT HYDRAULIC-END SPEED
AND SHOW PERFORMANCE WITH CLEAR WATER.
ALL HYDRAULIC LOSSES UP TO 500 MM. ABOVE THE PUMP/MOTOR TOP ARE INCLUDED

# PL-7080




| MOTOR NO. | KW | DRIVE UNIT | TOTAL HEIGHT | WEIGHT |
|---|---|---|---|---|
| 40-44-4 | 55 | 770 | 103.5" | 3640# |
| 40-57-3 | 75 | 770 | 103.5" | 3970# |
| 51-43-5 | 75 | 820 | 93" | 4960# |
| 51-43-3 | 90 | 820 | 93" | 4960# |
| 51-43-1 | 126 | 820 | 93" | 4960# |
| 51-43-8 | 200 | 820 | 93" | 4960# |
| 51-56-5 | 100 | 860 | 98" | 5240# |
| 51-56-3 | 115 | 860 | 98" | 5240# |
| 51-56-1 | 160 | 860 | 98" | 5240# |
| 65-51-3 | 220 | 900 | 93" | 8620# |
| 65-51-1 | 236 | 900 | 93" | 8620# |

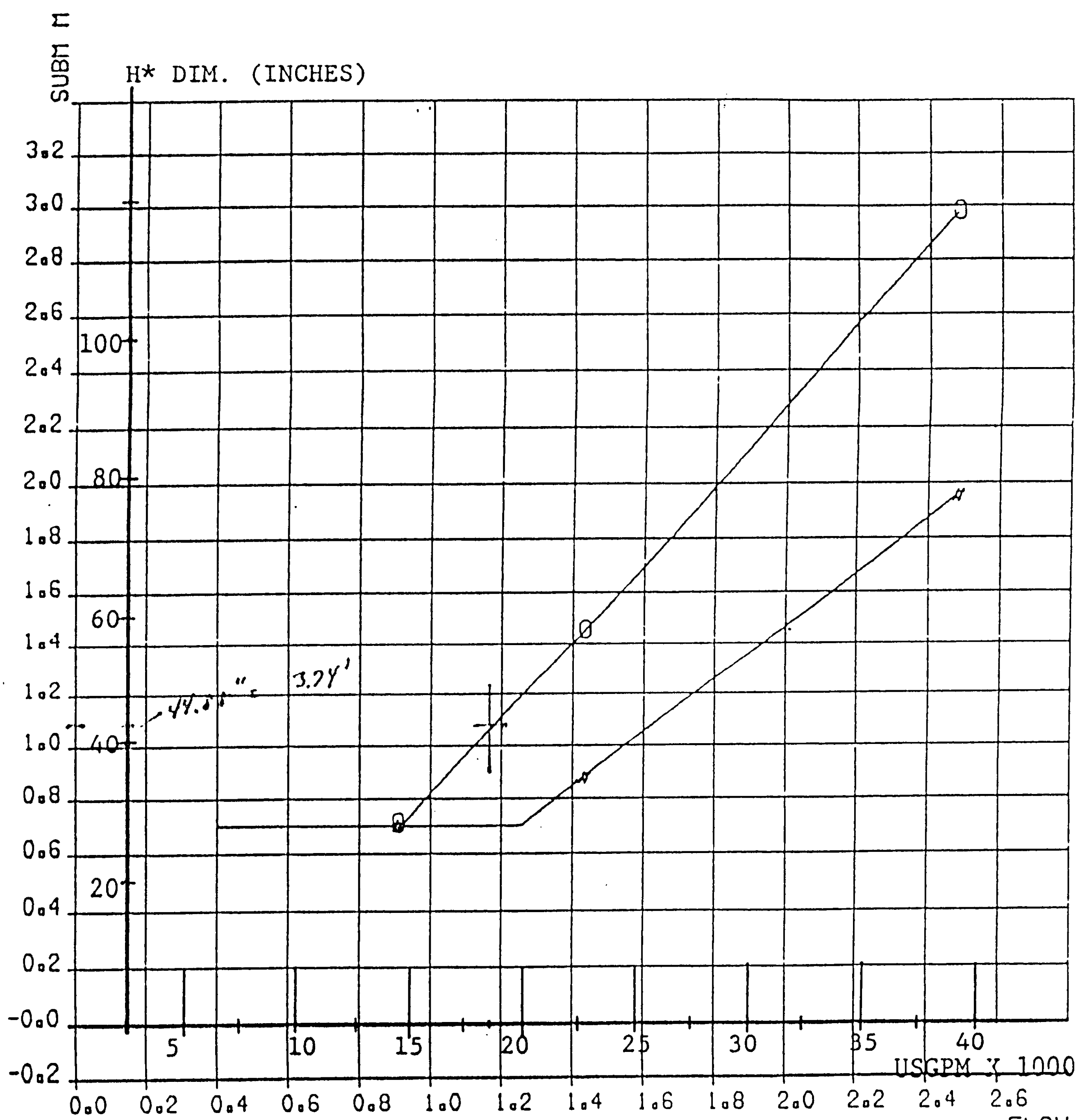
FLYGT

# SYSTEM AND APPLICATION ENGINEERING

DIAGRAM: SUBMERGENCE REQUIREMENTS FOR PL 7075/80 | ISSUE: 2 | DATE: 84-05-23

REQUIRED SUBMERGENCE FOR SUMP DESIGN ACCORDING TO FLYGT TYPE "A", "B".

REQUIRED SUBMERGENCE TO PREVENT VORTEXING WHICH WOULD AFFECT THE PERFORMANCE OF THE PUMP. IN SOME INSTANCES ADDITIONAL SUBMERGENCE MAY BE REQUIRED BECAUSE OF NPSH REQUIREMENTS.




O:CONTINOUS OPERATION

#:MAX 500 OPERATING HOURS/YEAR

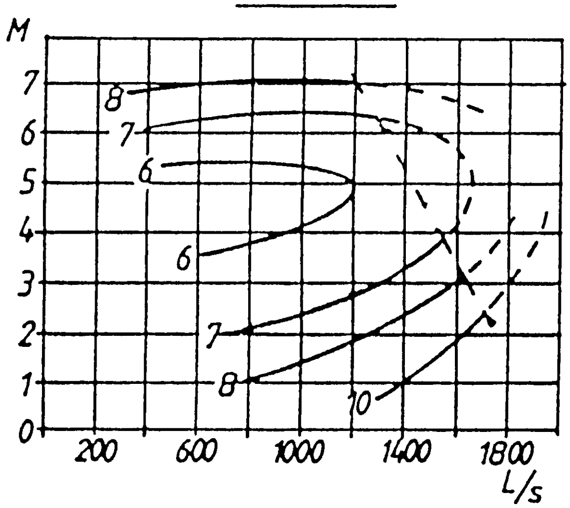
| FLYGT | DATE 831010<br>ISSUE 2 | NPSH CURVES | 7080(Small) |
|---|---|---|---|

NPSH$_{RE}$ VALUES IN M $H_2O$

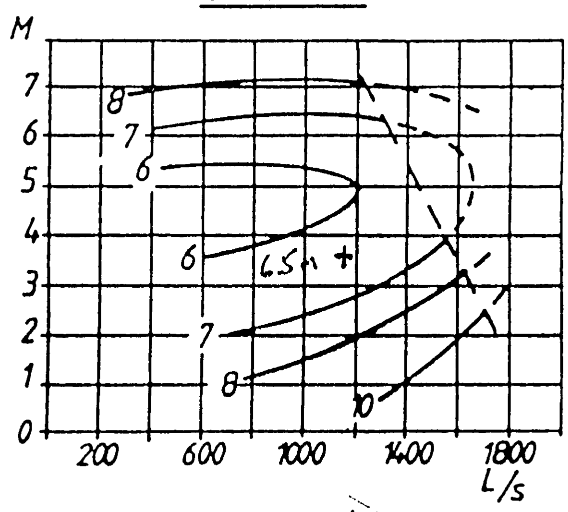
1180 L/s

3.65 m

53-575 B4

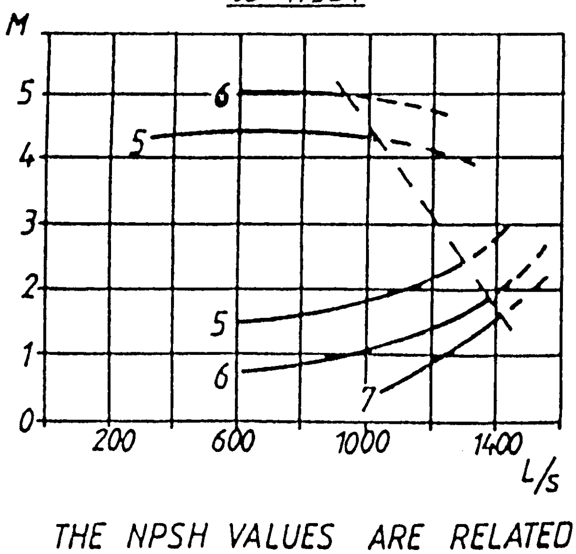



63-580 B4




21.32

53-475B4



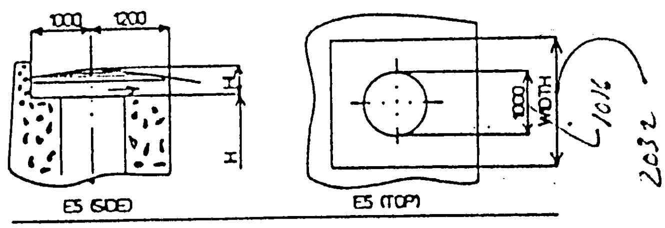

THE NPSH VALUES ARE RELATED TO THE INLET FLANGE.
ALL NPSH LIMIT CURVES ARE VALID FOR OPERATION WITHOUT LOSS IN PERFORMANCE AND NO REDUCTION ON LIFE TIME.

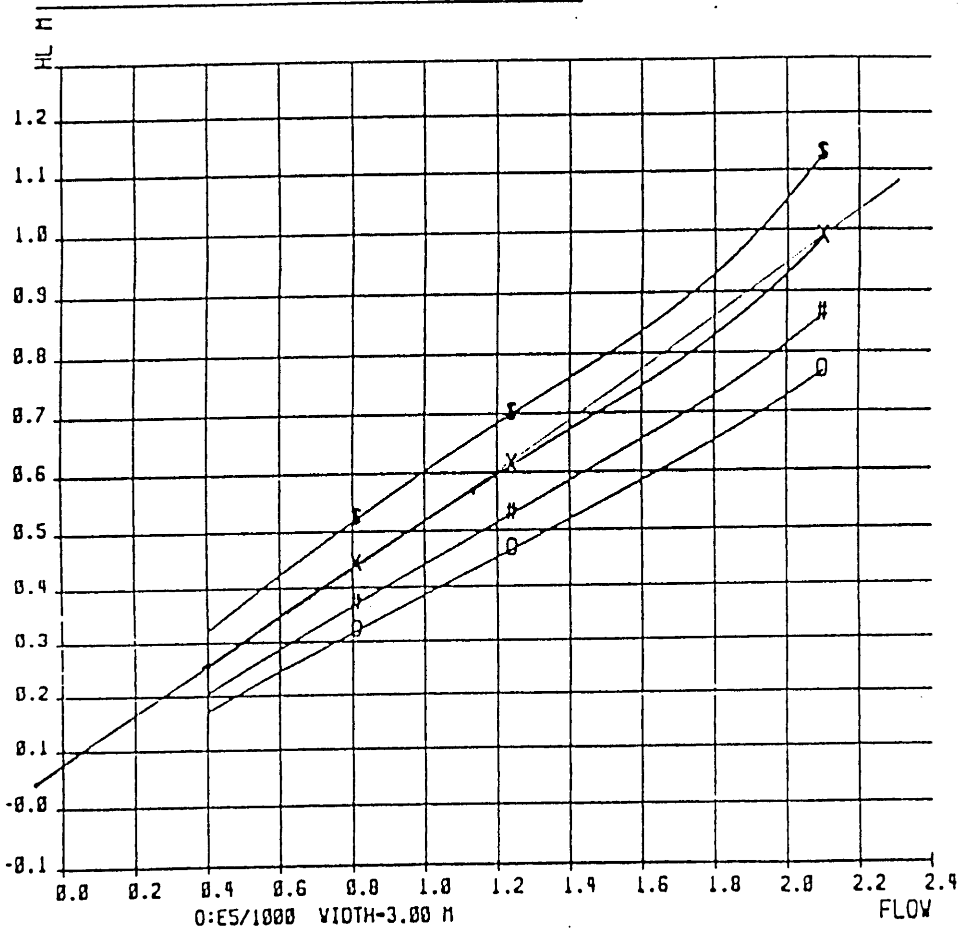
Conversions: (GPM)(0.06308)=L/S
(L/S)(0.001)=$M^3/S$
(FT)(0.3048)=M

FLYGT SYSTEM AND APPLICATION ENGINEERING

DIAGRAM: HEAD LOSS E5/1000 (PL7080) | ISSUE: 1 | DATE: 82-06-14

INLET DIAMETER 1.0 M. HL=HEAD LOSS
NOTE THAT THE OUTLET LOSS IS INCLUDED IN TYPE E5




0:E5/1000 WIDTH-3.00 M
#:E5/1000 WIDTH-2.50 M
X:E5/1000 WIDTH-2.00 M ←
$:E5/1000 WIDTH-1.50 M

y = .039 CFS + .267

# Bayou Meto Basin Project
## Conceptual Design of Bayou Meto Basin Pumping Stations

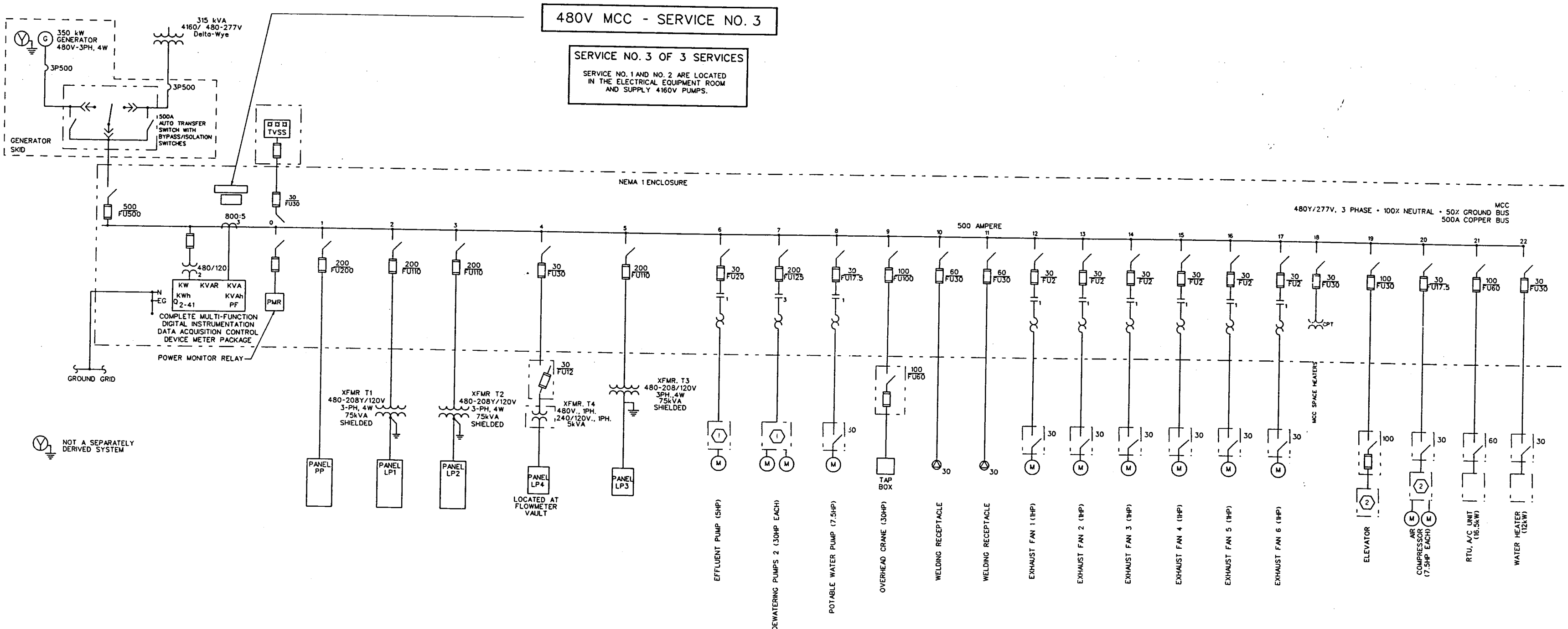
# APPENDIX H

# BAYOU METO BASIN PUMPING STATIONS 1 -4

# ELECTRICAL DESIGN DEVELOPMENT,

# SINGLE LINE DIAGRAMS

U.S. Army Corps of Engineers
Memphis District




KEYED NOTES:

(1) VENDOR FURNISHED COMBINATION STARTER CONTROL PANEL.

(2) VENDOR FURNISHED CONTROL PANEL.

US Army Corps of Engineers Memphis District

U.S. ARMY ENGINEER DISTRICT
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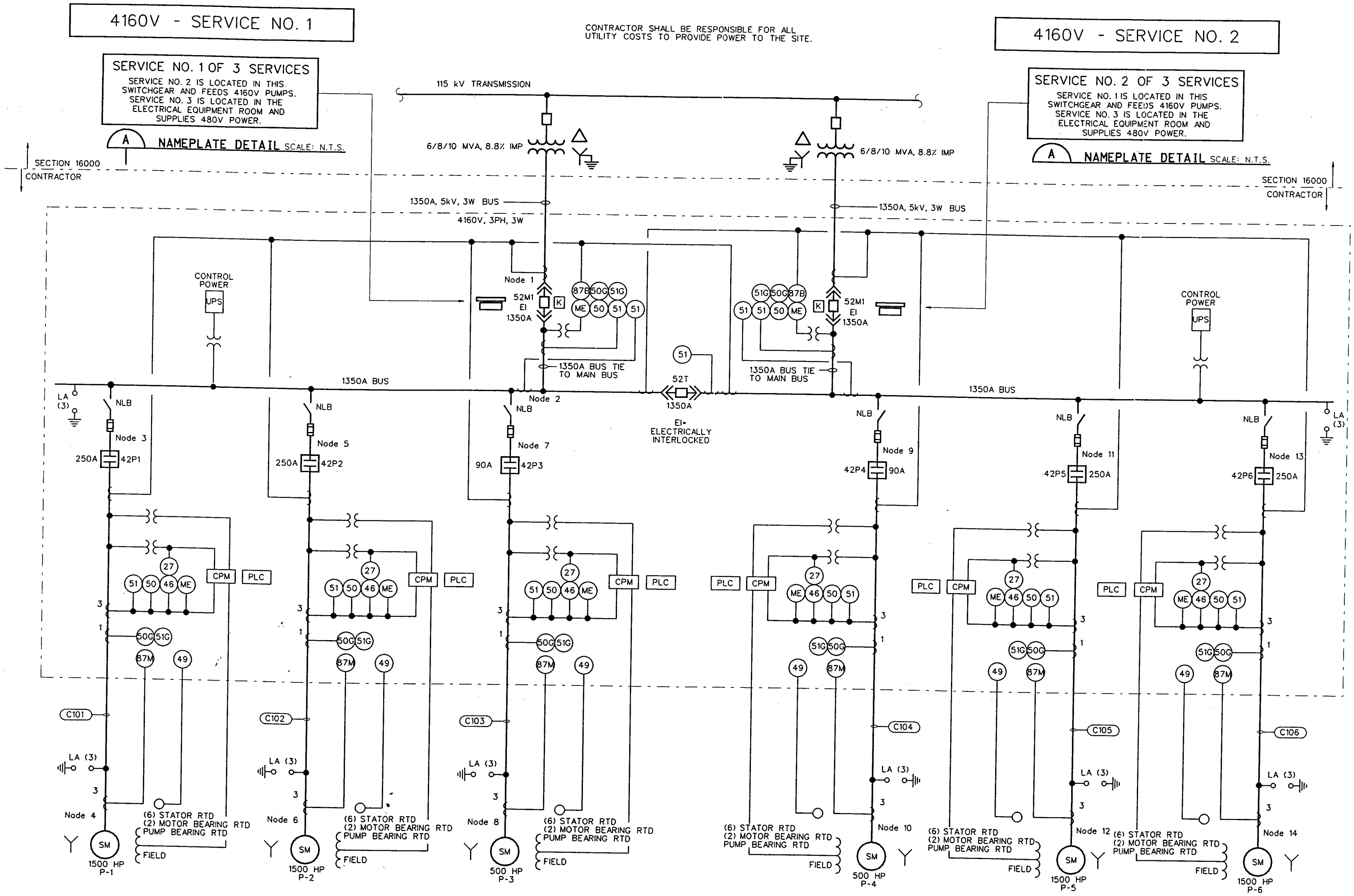
MEMPHIS, TENNESSEE

EASTERN REGION ARKANSAS COMPREHENSIVE STUDY

# BAYOU METO PUMP STATION NO. 1 480V DEVICES

ONE-LINE ELECTRICAL DIAGRAM

DRAWING
1 OF 1




ONE-LINE DIAGRAM SCALE: N.T.S.

US Army Corps of Engineers
Memphis District

| Symbol | Description | Date | Appr |
|---|---|---|---|

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
MEMPHIS, TENNESSEE

Supervised by: DAPHLYN L. KOESTER
Chief, Struct., Elec. and Mech. Engineering Branch

Designed by: SWR | Checked by:

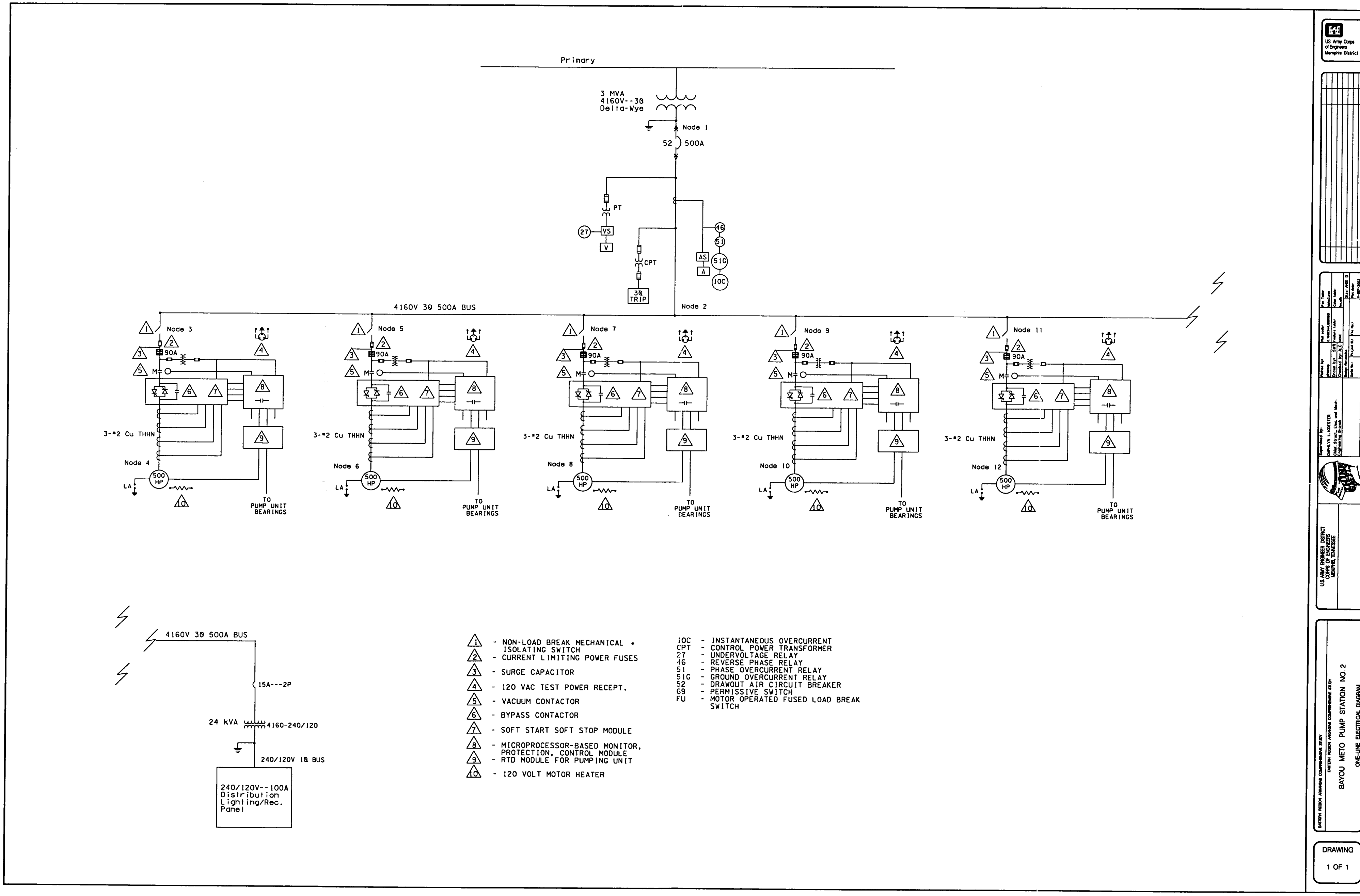
| | | | |
|---|---|---|---|
| Plotted by: reede | Plot scale: 0.166667:1.000000 | Pen Table: Mpha2.pen | |
| Drawn by: SWR | Feature table: | Color table: be.ctb | |
| Checked by: ALC | NONE | | |
| Design file: oneline | | | Size: ANSI D |
| Serial No.: | Project ID.: | File No.: | Plot date: 27-NOV-2001 |
| Inv. No.: | | | Inv. Date: AUG 2001 |

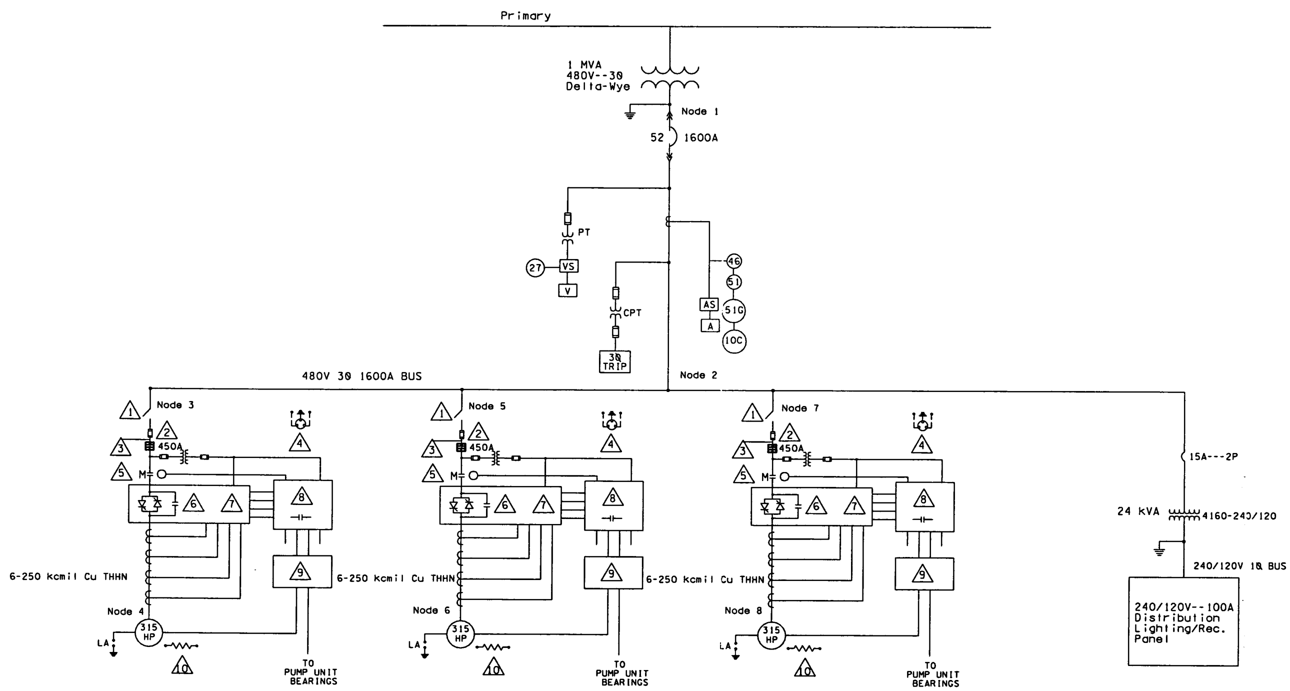
EASTERN REGION ARKANSAS COMPREHENSIVE STUDY

BAYOU METO PUMP STATION NO.1

ONE-LINE ELECTRICAL DIAGRAM

DRAWING
1 OF 1


Primary
3 MVA
4160V--3Ø
Delta-Wye
Node 1
52
500A
PT
27
VS
V
CPT
3Ø TRIP
46
51
AS
51G
A
IOC
Node 2
4160V 3Ø 500A BUS
Node 3
Node 5
Node 7
Node 9
Node 11
90A
M
3-#2 Cu THHN
Node 4
Node 6
Node 8
Node 10
Node 12
500 HP
LA
TO PUMP UNIT BEARINGS
4160V 3Ø 500A BUS
15A---2P
24 KVA
4160-240/120
240/120V 1Ø BUS
240/120V--100A Distribution Lighting/Rec. Panel
1 - NON-LOAD BREAK MECHANICAL • ISOLATING SWITCH
2 - CURRENT LIMITING POWER FUSES
3 - SURGE CAPACITOR
4 - 120 VAC TEST POWER RECEPT.
5 - VACUUM CONTACTOR
6 - BYPASS CONTACTOR
7 - SOFT START SOFT STOP MODULE
8 - MICROPROCESSOR-BASED MONITOR, PROTECTION, CONTROL MODULE
9 - RTD MODULE FOR PUMPING UNIT
10 - 120 VOLT MOTOR HEATER
IOC - INSTANTANEOUS OVERCURRENT
CPT - CONTROL POWER TRANSFORMER
27 - UNDERVOLTAGE RELAY
46 - REVERSE PHASE RELAY
51 - PHASE OVERCURRENT RELAY
51G - GROUND OVERCURRENT RELAY
52 - DRAWOUT AIR CIRCUIT BREAKER
69 - PERMISSIVE SWITCH
FU - MOTOR OPERATED FUSED LOAD BREAK SWITCH
US Army Corps of Engineers Memphis District
U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
MEMPHIS, TENNESSEE
EASTERN REGION ARKANSAS COMPREHENSIVE STUDY
BAYOU METO PUMP STATION NO. 2
ONE-LINE ELECTRICAL DIAGRAM
DRAWING
1 OF 1




1 - NON-LOAD BREAK MECHANICAL ISOLATING SWITCH
2 - CURRENT LIMITING POWER FUSES
3 - SURGE CAPACITOR
4 - 120 VAC TEST POWER RECEPT.
5 - VACUUM CONTACTOR
6 - BYPASS CONTACTOR
7 - SOFT START SOFT STOP MODULE
8 - MICROPROCESSOR-BASED MONITOR, PROTECTION, CONTROL MODULE
9 - RTD MODULE FOR PUMPING UNIT
10 - 120 VOLT MOTOR HEATER

10C - INSTANTANEOUS OVERCURRENT
CPT - CONTROL POWER TRANSFORMER
27 - UNDERVOLTAGE RELAY
46 - REVERSE PHASE RELAY
51 - PHASE OVERCURRENT RELAY
51G - GROUND OVERCURRENT RELAY
52 - DRAWOUT AIR CIRCUIT BREAKER
69 - PERMISSIVE SWITCH
FU - MOTOR OPERATED FUSED LOAD BREAK SWITCH

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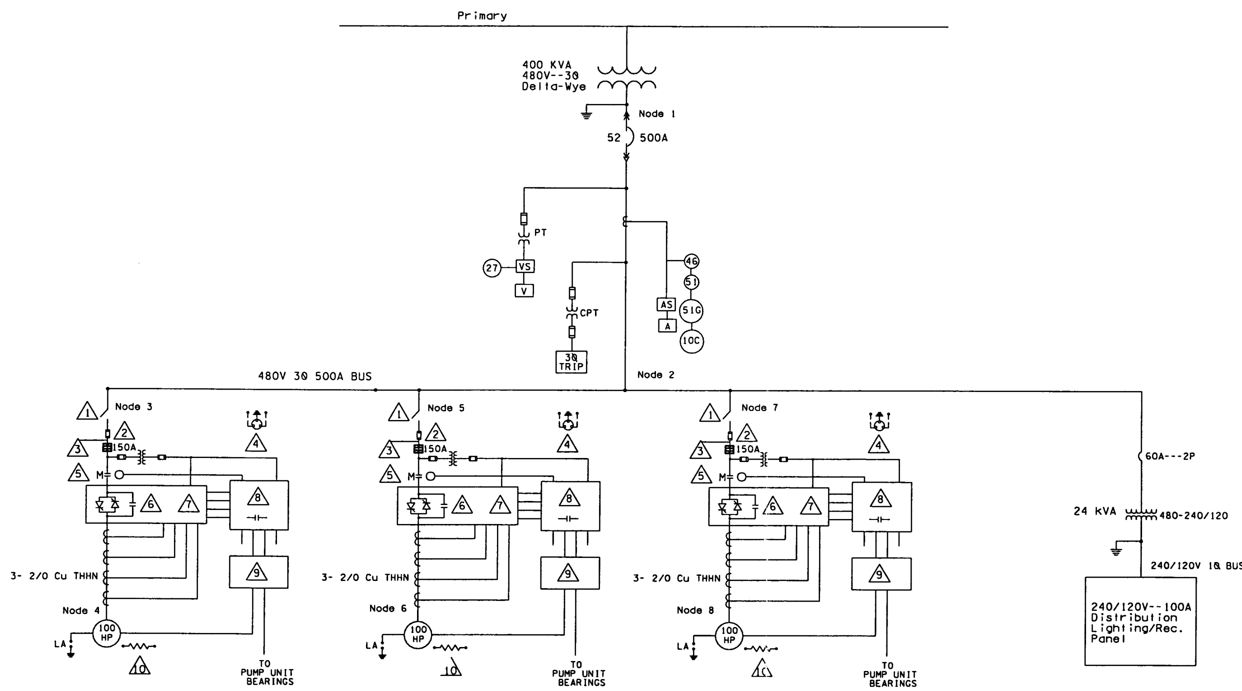
EASTERN REGION ARKANSAS COMPREHENSIVE STUDY

BAYOU METO PUMP STATION NO.3

ONE-LINE ELECTRICAL DIAGRAM

DRAWING
1 OF 1




1 - NON-LOAD BREAK MECHANICAL ISOLATING SWITCH
2 - CURRENT LIMITING POWER FUSES
3 - SURGE CAPACITOR
4 - 120 VAC TEST POWER RECEPT.
5 - VACUUM CONTACTOR
6 - BYPASS CONTACTOR
7 - SOFT START SOFT STOP MODULE
8 - MICROPROCESSOR-BASED MONITOR, PROTECTION, CONTROL MODULE
9 - RTD MODULE FOR PUMPING UNIT
10 - 120 VOLT MOTOR HEATER

| | | |
|---|---|---|
| IOC | - | INSTANTANEOUS OVERCURRENT |
| CPT | - | CONTROL POWER TRANSFORMER |
| 27 | - | UNDERVOLTAGE RELAY |
| 46 | - | REVERSE PHASE RELAY |
| 51 | - | PHASE OVERCURRENT RELAY |
| 51G | - | GROUND OVERCURRENT RELAY |
| 52 | - | DRAWOUT AIR CIRCUIT BREAKER |
| 69 | - | PERMISSIVE SWITCH |
| FU | - | MOTOR OPERATED FUSED LOAD BREAK SWITCH |

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CORPS OF ENGINEERS
MEMPHIS, TENNESSEE

EASTERN REGION ARKANSAS COMPREHENSIVE STUDY

BAYOU METO PUMP STATION NO. 4

ONE-LINE ELECTRICAL DIAGRAM

DRAWING
1 OF 1

# Bayou Meto Basin Project

## Conceptual Design of Bayou Meto Basin Pumping Stations

# APPENDIX I

# ELECTRICAL CALCULATIONS

# FOR PUMPING STATIONS 1-4

U.S. Army Corps of Engineers
Memphis District

# ELECTRICAL CALCULATIONS

## BAYOU METO PUMP STATION NO. 1
## LOAD STUDY AND SHORT-CIRCUIT ANALYSIS

# <u>Load Study Bayou Meto Pump Station #1</u>

**Connected Load: 480V Load**

| Panel | VA |
|---|---|
| PP (480/277V) | 25582 |
| LP1 (208/120V) | 29400 |
| LP2 (208/120V) | 34000 |
| LP3 (208/120V) | 18250 |
| LP4 (240/120V) | 3600 |
| **Total** | **110832** |

**Assume .8 PF for all motors**

| Connected 480V Devices | Watts | VA |
|---|---|---|
| Effluent Pump (5HP) | 3728.5 | 4660.625 |
| 2-Dewater Pumps (20HP) | 29828 | 37285 |
| Portable Water Pump (7.5HP) | 5592.75 | 6990.9375 |
| Overhead Crane (30HP) | 22371 | 27963.75 |
| 2-Welding Rec (52A each single phase) | 49920 | 62400 |
| 6-Exhaust Fans (1HP each) | 4474.2 | 5592.75 |
| Elevator (10HP) | 7457 | 9321.25 |
| MCC Space Heaters | 10000 | 10000 |
| Air Compressor (7.5HP) | 5592.75 | 6990.9375 |
| A/C (16.5kW) | 16500 | 20625 |
| Water Heater (12kW) | 12000 | 12000 |
| | **Total** | **203830.25** |

| | |
|---|---|
| **Total Connected 480V Load for Pump Station #1:** | **314.662 kVA** |
| **Total Connected 480V Load for Pump Station #1 as seen by the 4160V primary side: (Amps)** | **43.67199991** |
| **Total Connected 4160V Load for Pump Station #1: (Amps)**<br>4-1500HP and 2-500HP Motors | **1006.61** |
| **Total Connected Load For Pump Station #1: (Amps)** | **1050.282** |
| **Capacity should be 125% of Full Load: (Amps)** | **1312.8525** |
| **Total KVA for Pump Station #1:** | **9.46 MVA** |

Motor Load Calculations for Bayou Meto Pump Station #1:

| Motor # | Voltage (L-L) | HP output | Power Factor (as a fraction) | Efficiency (as a fraction) |
|---|---|---|---|---|
| 1 | 4160 | 1500 | 0.8 | 0.9 |
| 2 | 4160 | 1500 | 0.8 | 0.9 |
| 3 | 4160 | 500 | 0.8 | 0.9 |
| 4 | 4160 | 500 | 0.8 | 0.9 |
| 5 | 4160 | 1500 | 0.8 | 0.9 |
| 6 | 4160 | 1500 | 0.8 | 0.9 |

## Calculation:

| Motor # | Full Load Current (Amps) | HP Input |
|---|---|---|
| 1 | 215.7030926 | 1666.666667 |
| 2 | 215.7030926 | 1666.666667 |
| 3 | 71.90103087 | 555.5555556 |
| 4 | 71.90103087 | 555.5555556 |
| 5 | 215.7030926 | 1666.666667 |
| 6 | 215.7030926 | 1666.666667 |

**Total Motor Load: (Amps)** **1006.614432**

**Point-to-Point Short Circuit Ananlysis for 3-Phase System Bayou Meto Pump Station #1**

This method for short circuit ananysis starts at the transformer and extends throughout the circuit. It includes the available short-circuit current both with and without motor contribution.

## At Transformer (Secondary):

| Voltage(L-L) | KVA Rating | %Z (as a fraction) |
|---|---|---|
| 4160 | 10000 | 0.088 |

## At Next point of system: (Node 1)

| Conductor Length (Feet) | "C" Value | I (s.c) previous | Conductors per phase | Wire Size (Copper) |
|---|---|---|---|---|
| 100 | 90100 | 15771.61291 | 1 | 1350A Bus Feeder |

## At Next point of system: (Node 2)

| Conductor Length (Feet) | "C" Value | I (s.c) previous | Conductors per phase | Wire Size (Copper) |
|---|---|---|---|---|
| 50 | 119000 | 15657.5017 | 1 | 1350A Bus Plug-In |

## At Next point of system: (Node 3)

| Conductor Length (Feet) | "C" Value | I (s.c) previous | Conductors per phase | Wire Size (Copper) |
|---|---|---|---|---|
| 50 | 16292 | 15614.73215 | 1 | 300 kcmil Cu THHN |

## At Next point of system: (Node 4)

| Conductor Length (Feet) | "C" Value | I (s.c) previous | Conductors per phase | Wire Size (Copper) |
|---|---|---|---|---|
| 100 | 16292 | 15309.28257 | 1 | 300 kcmil Cu THHN |

## At Next point of system: (Node 5)

| Conductor Length (Feet) | "C" Value | I (s.c) previous | Conductors per phase | Wire Size (Copper) |
|---|---|---|---|---|
| 50 | 16292 | 15614.73215 | 1 | 300 kcmil Cu THHN |

## At Next point of system: (Node 6)

| Conductor Length (Feet) | "C" Value | I (s.c) previous | Conductors per phase | Wire Size (Copper) |
|---|---|---|---|---|
| 100 | 16292 | 15309.28257 | 1 | 300 kcmil Cu THHN |

## At Next point of system: (Node 7)

| Conductor Length (Feet) | "C" Value | I (s.c) previous | Conductors per phase | Wire Size (Copper) |
|---|---|---|---|---|
| 50 | 5736 | 15614.73215 | 1 | #2 Cu THHN |

## At Next point of system: (Node 8)

| Conductor Length (Feet) | "C" Value | I (s.c) previous | Conductors per phase | Wire Size (Copper) |
|---|---|---|---|---|
| 100 | 5736 | 14777.30836 | 1 | #2 Cu THHN |

## At Next point of system: (Node 9)

| Conductor Length (Feet) | "C" Value | I (s.c) previous | Conductors per phase | Wire Size (Copper) |
|---|---|---|---|---|
| 50 | 5736 | 14732.88417 | 1 | #2 Cu THHN |

## At Next point of system: (Node 10)

| Conductor Length (Feet) | "C" Value | I (s.c) previous | Conductors per phase | Wire Size (Copper) |
|---|---|---|---|---|
| 100 | 5736 | 14777.30836 | 1 | #2 Cu THHN |

## At Next point of system: (Node 11)

| Conductor Length (Feet) | "C" Value | I (s.c) previous | Conductors per phase | Wire Size (Copper) |
|---|---|---|---|---|
| 50 | 16292 | 15614.73215 | 1 | 300 kcmil Cu THHN |

## At Next point of system: (Node 12)

| Conductor Length (Feet) | "C" Value | I (s.c) previous | Conductors per phase | Wire Size (Copper) |
|---|---|---|---|---|
| 100 | 16292 | 15309.28257 | 1 | 300 kcmil Cu THHN |

## At Next point of system: (Node 13)

| Conductor Length (Feet) | "C" Value | I (s.c) previous | Conductors per phase | Wire Size (Copper) |
|---|---|---|---|---|
| 50 | 16292 | 15614.73215 | 1 | 300 kcmil Cu THHN |

## At Next point of system: (Node 14)

| Conductor Length (Feet) | "C" Value | I (s.c) previous | Conductors per phase | Wire Size (Copper) |
|---|---|---|---|---|
| 100 | 16292 | 15309.28257 | 1 | 300 kcmil Cu THHN |

**Transformer Short Circuit Calculation:**

**Full Load Current:**
I (f.l.) 1387.901936

**M Value:** 11.36363636

**Short Circuit Current:**
I (s.c.) 15771.61291

**Node 1 Short Circuit Current:**

**F Value:** 0.007287958

**New M Value:** 0.992764772

**Short Circuit Current at this point:**
I (s.c.) 15657.5017

**Node 2 Short Circuit Current:**

**F Value:** 0.002739051

**New M Value:** 0.997268431

**Short Circuit Current at this point:**
I (s.c.) 15614.73215

**Node 3 Short Circuit Current:**

**F Value:** 0.01995192

**New M Value:** 0.980438372

**Short Circuit Current at this point:**
I (s.c.) 15309.28257

**Node 4 Short Circuit Current:**

| | |
|---|---|
| **F Value:** | 0.039123256 |
| **New M Value:** | 0.962349744 |
| **Short Circuit Current at this point:** I (s.c.) | 14732.88417 |

**<u>Node 5 Short Circuit Current:</u>**

| | |
|---|---|
| **F Value:** | 0.01995192 |
| **New M Value:** | 0.980438372 |
| **Short Circuit Current at this point:** I (s.c.) | 15309.28257 |

**<u>Node 6 Short Circuit Current:</u>**

| | |
|---|---|
| **F Value:** | 0.039123256 |
| **New M Value:** | 0.962349744 |
| **Short Circuit Current at this point:** I (s.c.) | 14732.88417 |

**<u>Node 7 Short Circuit Current:</u>**

| | |
|---|---|
| **F Value:** | 0.056669575 |
| **New M Value:** | 0.946369635 |
| **Short Circuit Current at this point:** I (s.c.) | 14777.30836 |

**<u>Node 8 Short Circuit Current:</u>**

| | |
|---|---|
| **F Value:** | 0.10726073 |
| **New M Value:** | 0.903129654 |

**Short Circuit Current at this point:**

| | |
|---|---|
| I (s.c.) | 13345.82538 |

**Node 9 Short Circuit Current:**

| | |
|---|---|
| **F Value:** | 0.056669575 |
| **New M Value:** | 0.946369635 |
| **Short Circuit Current at this point:** <br> I (s.c.) | 14777.30836 |

**Node 10 Short Circuit Current:**

| | |
|---|---|
| **F Value:** | 0.10726073 |
| **New M Value:** | 0.903129654 |
| **Short Circuit Current at this point:** <br> I (s.c.) | 13345.82538 |

**Node 11 Short Circuit Current:**

| | |
|---|---|
| F Value: | 0.01995192 |
| New M Value: | 0.980438372 |
| Short Circuit Current at this point: <br> I (s.c.) | 15309.28257 |

**Node 12 Short Circuit Current:**

| | |
|---|---|
| F Value: | 0.039123256 |
| New M Value: | 0.962349744 |
| Short Circuit Current at this point: <br> I (s.c.) | 14732.88417 |

**Node 13 Short Circuit Current:**

| | |
|---|---|
| F Value: | 0.01995192 |
| New M Value: | 0.980438372 |
| Short Circuit Current at this point: I (s.c.) | 15309.28257 |

**Node 14 Short Circuit Current:**

| | |
|---|---|
| F Value: | 0.039123256 |
| New M Value: | 0.962349744 |
| Short Circuit Current at this point: I (s.c.) | 14732.88417 |

## Any Motor Contribution:

### Motor 1:

| HP rating | Power Factor | Voltage(L-L) |
|---|---|---|
| 1500 | 0.8 | 4160 |

**Motor Short Circuit Current:**

KVA rating 1118550

**Short Circuit Current at this point:**

I (m.s.c.) 1344.411

### Motor 2:

| HP rating | Power Factor | Voltage(L-L) |
|---|---|---|
| 500 | 0.8 | 4160 |

KVA rating 372849.9

**Short Circuit Current at this point:**
I (m.s.c.) 448.1369

**Total Motor Contribution:**

**4-1500HP and 2-500HP Induction Motors**

| | | |
|---|---|---|
| **Motor Size** | 1500 HP | 500 HP |
| **S.C. motor contribution** | 1344.410826 | 448.1369421 |
| **Quantity of motors** | 4 | 2 |
| **Total SC Contribution** | 5377.643305 | 896.2738841 |

**Total Motor SC Contribution:** **6273.917189**

Final Short-Circuit Analysis for Bayou Meto Pump Station #1

| Node # | S.C. No Motor Contribution (AIC) | S.C. With Motor Contribution (AIC) |
|---|---|---|
| At Transformer Secondary | 15771.61291 | 22045.5301 |
| 1 | 15657.5017 | 21931.41888 |
| 2 | 15614.73215 | 21888.64934 |
| 3 | 15309.28257 | 21583.19976 |
| 4 | 14732.88417 | 21006.80135 |
| 5 | 15309.28257 | 21583.19976 |
| 6 | 14732.88417 | 21006.80135 |
| 7 | 14777.30836 | 21051.22555 |
| 8 | 13345.82538 | 19619.74257 |
| 9 | 14777.30836 | 21051.22555 |
| 10 | 13345.82538 | 19619.74257 |
| 11 | 15309.28257 | 21583.19976 |
| 12 | 14732.88417 | 21006.80135 |
| 13 | 15309.28257 | 21583.19976 |
| 14 | 14732.88417 | 21006.80135 |

# ELECTRICAL CALCULATIONS

## BAYOU METO PUMP STATION NO. 2
## LOAD STUDY AND SHORT-CIRCUIT ANALYSIS

## Load Study Bayou Meto Pump Station #2

**Connected Load: 240/120V Load**

| Panel | VA |
|---|---|
| Distribution Panel (Lighting and General use recepticles) | 24000 |
| **Total** | **24000** |

| | |
|---|---|
| **Total Connected 240/120V Load for Pump Station #2:** | **24 KVA** |
| **Total Connected 240/120V Load for Pump Station #2 as seen by the 4160V primary side: (Amps)** | **5.769230769** |
| **Total Connected 4160V Load for Pump Station #2: (Amps)** | **359.5** |
| 5 - 500HP Motors | |
| **Total Connected Load For Pump Station #2: (Amps)** | **365.2692308** |
| **Capacity should be 125% of Full Load: (Amps)** | **456.5865385** |
| **Total KVA for Pump Station #2:** | **2.63 MVA** |

Motor Load Calculations for Bayou Meto Pump Station #2:

| Motor # | Voltage (L-L) | HP output | Power Factor (as a fraction) | Efficiency (as a fraction) |
|---|---|---|---|---|
| 1 | 4160 | 500 | 0.8 | 0.9 |
| 2 | 4160 | 500 | 0.8 | 0.9 |
| 3 | 4160 | 500 | 0.8 | 0.9 |
| 4 | 4160 | 500 | 0.8 | 0.9 |
| 5 | 4160 | 500 | 0.8 | 0.9 |

## Calculation:

| Motor # | Full Load Current (Amps) | HP Input |
|---|---|---|
| 1 | 71.90103087 | 555.5555556 |
| 2 | 71.90103087 | 555.5555556 |
| 3 | 71.90103087 | 555.5555556 |
| 4 | 71.90103087 | 555.5555556 |
| 5 | 71.90103087 | 555.5555556 |

**Total Motor Load: (Amps)** **359.5051544**

Point-to-Point Short Circuit Ananlysis for 3-Phase System Bayou Meto Pump Station #2

This method for short circuit ananysis starts at the transformer and extends throughout the circuit. It includes the available short-circuit current both with and without motor contribution.

## At Transformer (Secondary):

| Voltage(L-L) | KVA Rating | %Z (as a fraction) |
|---|---|---|
| 4160 | 3000 | 0.088 |

## At Next point of system: (Node 1)

| Conductor Length (Feet) | "C" Value | I (s.c) previous | Conductors per phase | Wire Size (Copper) |
|---|---|---|---|---|
| 100 | 14924 | 4731.483874 | 2 | 250 kcmil Cu THHN |

## At Next point of system: (Node 2)

| Conductor Length (Feet) | "C" Value | I (s.c) previous | Conductors per phase | Wire Size (Copper) |
|---|---|---|---|---|
| 50 | 14924 | 4700.461347 | 2 | 250 kcmil Cu THHN |

## At Next point of system: (Node 3)

| Conductor Length (Feet) | "C" Value | I (s.c) previous | Conductors per phase | Wire Size (Copper) |
|---|---|---|---|---|
| 50 | 5736 | 4685.102137 | 1 | #2 Cu THHN |

## At Next point of system: (Node 4)

| Conductor Length (Feet) | "C" Value | I (s.c) previous | Conductors per phase | Wire Size (Copper) |
|---|---|---|---|---|
| 100 | 5736 | 4606.77159 | 1 | #2 Cu THHN |

**At Next point of system: (Node 5)**

| Conductor Length (Feet) | "C" Value | I (s.c) previous | Conductors per phase | Wire Size (Copper) |
|---|---|---|---|---|
| 50 | 5736 | 4685.102137 | 1 | #2 Cu THHN |

**At Next point of system: (Node 6)**

| Conductor Length (Feet) | "C" Value | I (s.c) previous | Conductors per phase | Wire Size (Copper) |
|---|---|---|---|---|
| 100 | 5736 | 4606.77159 | 1 | #2 Cu THHN |

**At Next point of system: (Node 7)**

| Conductor Length (Feet) | "C" Value | I (s.c) previous | Conductors per phase | Wire Size (Copper) |
|---|---|---|---|---|
| 50 | 5736 | 4685.102137 | 1 | #2 Cu THHN |

**At Next point of system: (Node 8)**

| Conductor Length (Feet) | "C" Value | I (s.c) previous | Conductors per phase | Wire Size (Copper) |
|---|---|---|---|---|
| 100 | 5736 | 4606.77159 | 1 | #2 Cu THHN |

**At Next point of system: (Node 9)**

| Conductor Length (Feet) | "C" Value | I (s.c) previous | Conductors per phase | Wire Size (Copper) |
|---|---|---|---|---|
| 50 | 5736 | 4685.102137 | 1 | #2 Cu THHN |

## At Next point of system: (Node 10)

| Conductor Length (Feet) | "C" Value | I (s.c) previous | Conductors per phase | Wire Size (Copper) |
|---|---|---|---|---|
| 100 | 5736 | 4606.77159 | 1 | #2 Cu THHN |

## At Next point of system: (Node 11)

| Conductor Length (Feet) | "C" Value | I (s.c) previous | Conductors per phase | Wire Size (Copper) |
|---|---|---|---|---|
| 50 | 5736 | 4685.102137 | 1 | #2 Cu THHN |

## At Next point of system: (Node 12)

| Conductor Length (Feet) | "C" Value | I (s.c) previous | Conductors per phase | Wire Size (Copper) |
|---|---|---|---|---|
| 100 | 5736 | 4606.77159 | 1 | #2 Cu THHN |

**Transformer Short Circuit Calculation:**

| | |
|---|---|
| **Full Load Current:** I (f.l.) | 416.3705809 |
| **M Value:** | 11.36363636 |
| **Short Circuit Current:** I (s.c.) | 4731.483874 |

**Node 1 Short Circuit Current:**

| | |
|---|---|
| **F Value:** | 0.00659989 |
| **New M Value:** | 0.993443383 |
| **Short Circuit Current at this point:** I (s.c.) | 4700.461347 |

**Node 2 Short Circuit Current:**

| | |
|---|---|
| **F Value:** | 0.003278308 |
| **New M Value:** | 0.996732404 |
| **Short Circuit Current at this point:** I (s.c.) | 4685.102137 |

**Node 3 Short Circuit Current:**

| | |
|---|---|
| **F Value:** | 0.01700335 |
| **New M Value:** | 0.983280931 |
| **Short Circuit Current at this point:** I (s.c.) | 4606.77159 |

**Node 4 Short Circuit Current:**

| | |
|---|---|
| **F Value:** | 0.033438139 |
| **New M Value:** | 0.967643793 |
| **Short Circuit Current at this point:** I (s.c.) | 4457.713933 |

**Node 5 Short Circuit Current:**

| | |
|---|---|
| **F Value:** | 0.01700335 |
| **New M Value:** | 0.983280931 |
| **Short Circuit Current at this point:** **I (s.c.)** | 4606.77159 |

**Node 6 Short Circuit Current:**

| | |
|---|---|
| **F Value:** | 0.033438139 |
| **New M Value:** | 0.967643793 |
| **Short Circuit Current at this point:** **I (s.c.)** | 4457.713933 |

**Node 7 Short Circuit Current:**

| | |
|---|---|
| **F Value:** | 0.01700335 |
| **New M Value:** | 0.983280931 |
| **Short Circuit Current at this point:** **I (s.c.)** | 4606.77159 |

**Node 8 Short Circuit Current:**

| | |
|---|---|
| **F Value:** | 0.033438139 |
| **New M Value:** | 0.967643793 |
| **Short Circuit Current at this point:** **I (s.c.)** | 4457.713933 |

**Node 9 Short Circuit Current:**

| | |
|---|---|
| **F Value:** | 0.01700335 |
| **New M Value:** | 0.983280931 |
| **Short Circuit Current at this point:** **I (s.c.)** | 4606.77159 |

**<u>Node 10 Short Circuit Current:</u>**

| | |
|---|---|
| **F Value:** | 0.033438139 |
| **New M Value:** | 0.967643793 |
| **Short Circuit Current at this point: I (s.c.)** | 4457.713933 |

**<u>Node 11 Short Circuit Current:</u>**

| | |
|---|---|
| F Value: | 0.01700335 |
| New M Value: | 0.983280931 |
| Short Circuit Current at this point: I (s.c.) | 4606.77159 |

**<u>Node 12 Short Circuit Current:</u>**

| | |
|---|---|
| F Value: | 0.033438139 |
| New M Value: | 0.967643793 |
| Short Circuit Current at this point: I (s.c.) | 4457.713933 |

## Any Motor Contribution:

### Motor 1:

| HP rating | Power Factor | Voltage(L-L) |
|---|---|---|
| 500 | 0.8 | 4160 |

**Motor Short Circuit Current:**

| | |
|---|---|
| KVA rating | 372849.94 |

**Short Circuit Current at this point:**

| | |
|---|---|
| I (m.s.c.) | 448.13694 |

**Total Motor Contribution:**

**5- 500HP Induction Motors**

| | |
|---|---|
| **Motor Size** | 500 HP |
| **S.C. motor contribution** | 448.1369421 |
| **Quantity of motors** | 5 |
| **Total SC Contribution** | 2240.68471 |

**Total Motor SC Contribution:** 2240.68471

Final Short-Circuit Analysis for Bayou Meto Pump Station #2

| Node # | S.C. No Motor Contribution (AIC) | S.C. With Motor Contribution (AIC) |
|---|---|---|
| At Transformer Secondary | 4731.483874 | 6972.168584 |
| 1 | 4700.461347 | 6941.146057 |
| 2 | 4685.102137 | 6925.786848 |
| 3 | 4606.77159 | 6847.4563 |
| 4 | 4457.713933 | 6698.398644 |
| 5 | 4606.77159 | 6847.4563 |
| 6 | 4457.713933 | 6698.398644 |
| 7 | 4606.77159 | 6847.4563 |
| 8 | 4457.713933 | 6698.398644 |
| 9 | 4606.77159 | 6847.4563 |
| 10 | 4457.713933 | 6698.398644 |
| 11 | 4606.77159 | 6847.4563 |
| 12 | 4457.713933 | 6698.398644 |

# ELECTRICAL CALCULATIONS

## BAYOU METO PUMP STATION NO. 3
## LOAD STUDY AND SHORT-CIRCUIT ANALYSIS

## Load Study Bayou Meto Pump Station #3

**Connected Load: 240/120V Load**

| Panel | VA |
|---|---|
| Distribution Panel (Lighting and General use recepticles) | 24000 |
| **Total** | **24000** |

| | |
|---|---|
| **Total Connected 240/120V Load for Pump Station #3:** | **24 KVA** |
| **Total Connected 240/120V Load for Pump Station #3 as seen by the 480V primary side: (Amps)** | **50** |
| **Total Connected 480V Load for Pump Station #3: (Amps)**<br>3 - 315HP | **1177.8** |
| **Total Connected Load For Pump Station #3: (Amps)** | **1227.8** |
| **Capacity should be 125% of Full Load: (Amps)** | **1534.75** |
| **Total KVA for Pump Station #3:** | **1.02 MVA** |

**Motor Load Calculations for Bayou Meto Pump Station #3:**

| Motor # | Voltage (L-L) | HP output | Power Factor (as a fraction) | Efficiency (as a fraction) |
|---|---|---|---|---|
| 1 | 480 | 315 | 0.8 | 0.9 |
| 2 | 480 | 315 | 0.8 | 0.9 |
| 3 | 480 | 315 | 0.8 | 0.9 |

## Calculation:

| Motor # | Full Load Current (Amps) | HP Input |
|---|---|---|
| 1 | 392.5796286 | 350 |
| 2 | 392.5796286 | 350 |
| 3 | 392.5796286 | 350 |

**Total Motor Load: (Amps)** **1177.738886**

**Point-to-Point Short Circuit Ananlysis for 3-Phase System Bayou Meto Pump Station #3**

This method for short circuit ananysis starts at the transformer and extends throughout the circuit. It includes the available short-circuit current both with and without motor contribution.

## At Transformer (Secondary):

| Voltage(L-L) | KVA Rating | %Z (as a fraction) |
|---|---|---|
| 480 | 1000 | 0.088 |

## At Next point of system: (Node 1)

| Conductor Length (Feet) | "C" Value | I (s.c) previous | Conductors per phase | Wire Size (Copper) |
|---|---|---|---|---|
| 100 | 101000 | 13668.73119 | 1 | 1600A Bus Feeder |

## At Next point of system: (Node 2)

| Conductor Length (Feet) | "C" Value | I (s.c) previous | Conductors per phase | Wire Size (Copper) |
|---|---|---|---|---|
| 50 | 129900 | 13032.32362 | 1 | 1600A Bus Plug-In |

## At Next point of system: (Node 3)

| Conductor Length (Feet) | "C" Value | I (s.c) previous | Conductors per phase | Wire Size (Copper) |
|---|---|---|---|---|
| 50 | 16483 | 12800.62653 | 2 | 250 kcmil Cu THHN |

## At Next point of system: (Node 4)

| Conductor Length (Feet) | "C" Value | I (s.c) previous | Conductors per phase | Wire Size (Copper) |
|---|---|---|---|---|
| 100 | 16483 | 11962.58298 | 2 | 250 kcmil Cu THHN |

## At Next point of system: (Node 5)

| Conductor Length (Feet) | "C" Value | I (s.c) previous | Conductors per phase | Wire Size (Copper) |
|---|---|---|---|---|
| 50 | 16483 | 12915.43603 | 2 | 250 kcmil Cu THHN |

## At Next point of system: (Node 6)

| Conductor Length (Feet) | "C" Value | I (s.c) previous | Conductors per phase | Wire Size (Copper) |
|---|---|---|---|---|
| 100 | 16483 | 12062.79281 | 2 | 250 kcmil Cu THHN |

## At Next point of system: (Node 7)

| Conductor Length (Feet) | "C" Value | I (s.c) previous | Conductors per phase | Wire Size (Copper) |
|---|---|---|---|---|
| 50 | 16483 | 12915.43603 | 2 | 250 kcmil Cu THHN |

## At Next point of system: (Node 8)

| Conductor Length (Feet) | "C" Value | I (s.c) previous | Conductors per phase | Wire Size (Copper) |
|---|---|---|---|---|
| 100 | 16483 | 12062.79281 | 2 | 250 kcmil Cu THHN |

**Transformer Short Circuit Calculation:**

| | |
|---|---|
| **Full Load Current:** I (f.l.) | 1202.848345 |
| **M Value:** | 11.36363636 |
| **Short Circuit Current:** I (s.c.) | 13668.73119 |

**Node 1 Short Circuit Current:**

| | |
|---|---|
| **F Value:** | 0.048833008 |
| **New M Value:** | 0.953440626 |
| **Short Circuit Current at this point:** I (s.c.) | 13032.32362 |

**Node 2 Short Circuit Current:**

| | |
|---|---|
| **F Value:** | 0.018100449 |
| **New M Value:** | 0.982221352 |
| **Short Circuit Current at this point:** I (s.c.) | 12800.62653 |

**Node 3 Short Circuit Current:**

| | |
|---|---|
| **F Value:** | 0.070055402 |
| **New M Value:** | 0.934531052 |
| **Short Circuit Current at this point:** I (s.c.) | 11962.58298 |

**Node 4 Short Circuit Current:**

| | |
|---|---|
| **F Value:** | 0.130937896 |

| | |
|---|---|
| **New M Value:** | 0.884221851 |
| **Short Circuit Current at this point:**<br>I (s.c.) | 10577.57726 |

**Node 5 Short Circuit Current:**

| | |
|---|---|
| **F Value:** | 0.070683732 |
| **New M Value:** | 0.933982622 |
| **Short Circuit Current at this point:**<br>I (s.c.) | 12062.79281 |

**Node 6 Short Circuit Current:**

| | |
|---|---|
| **F Value:** | 0.132034755 |
| **New M Value:** | 0.883365105 |
| **Short Circuit Current at this point:**<br>I (s.c.) | 10655.85023 |

**Node 7 Short Circuit Current:**

| | |
|---|---|
| **F Value:** | 0.070683732 |
| **New M Value:** | 0.933982622 |
| **Short Circuit Current at this point:**<br>I (s.c.) | 12062.79281 |

**Node 8 Short Circuit Current:**

| | |
|---|---|
| **F Value:** | 0.132034755 |
| **New M Value:** | 0.883365105 |
| **Short Circuit Current at this point:**<br>I (s.c.) | 10655.85023 |

## Any Motor Contribution:

### Motor 1:

| HP rating | Power Factor | Voltage(L-L) |
|---|---|---|
| 315 | 0.8 | 480 |

**Motor Short Circuit Current:**

| | |
|---|---|
| KVA rating | 234895 |

**Short Circuit Current at this point:**

| | |
|---|---|
| I (m.s.c.) | 2446.83 |

**Total Motor Contribution:**

**3 - 315HP Induction Motors**

| | |
|---|---|
| **Motor Size** | 315 HP |
| **S.C. motor contribution** | 2446.827704 |
| **Quantity of motors** | 3 |
| **Total SC Contribution** | 7340.483111 |

**Total Motor SC Contribution:** **7340.483111**

Final Short-Circuit Analysis for Bayou Meto Pump Station #3

| Node # | S.C. No Motor Contribution (AIC) | S.C. With Motor Contribution (AIC) |
|---|---|---|
| At Transformer Secondary | 13668.73119 | 21009.2143 |
| 1 | 13032.32362 | 20372.80673 |
| 2 | 12800.62653 | 20141.10964 |
| 3 | 11962.58298 | 19303.06609 |
| 4 | 10577.57726 | 17918.06037 |
| 5 | 12062.79281 | 19403.27592 |
| 6 | 10655.85023 | 17996.33334 |
| 7 | 12062.79281 | 19403.27592 |
| 8 | 10655.85023 | 17996.33334 |

# ELECTRICAL CALCULATIONS

## BAYOU METO PUMP STATION NO. 4
## LOAD STUDY AND SHORT-CIRCUIT ANALYSIS

## Load Study Bayou Meto Pump Station #4

**Connected Load: 240/120V Load**

| Panel | VA |
|---|---|
| Distribution Panel (Lighting and General use recepticles) | 24000 |
| **Total** | **24000** |

**Total Connected 240/120V Load for Pump Station #4:** **24 KVA**

**Total Connected 240/120V Load for Pump Station #4 as seen by the 480V primary side: (Amps)** **50**
**Total Connected 480V Load for Pump Station #4: (Amps)** **373.9**
3 - 100HP

**Total Connected Load For Pump Station #4: (Amps)** **423.9**

**Capacity should be 125% of Full Load: (Amps)** **529.875**

**Total KVA for Pump Station #4:** **352 KVA**

**Motor Load Calculations for Bayou Meto Pump Station #4:**

| Motor # | Voltage (L-L) | HP output | Power Factor (as a fraction) | Efficiency (as a fraction) |
|---|---|---|---|---|
| 1 | 480 | 100 | 0.8 | 0.9 |
| 2 | 480 | 100 | 0.8 | 0.9 |
| 3 | 480 | 100 | 0.8 | 0.9 |

## Calculation:

| Motor # | Full Load Current (Amps) | HP Input |
|---|---|---|
| 1 | 124.6284535 | 111.1111111 |
| 2 | 124.6284535 | 111.1111111 |
| 3 | 124.6284535 | 111.1111111 |

**Total Motor Load: (Amps)** **373.8853605**

**Point-to-Point Short Circuit Ananlysis for 3-Phase System Bayou Meto Pump Station #4**

This method for short circuit ananysis starts at the transformer and extends throughout the circuit. It includes the available short-circuit current both with and without motor contribution.

## At Transformer (Secondary):

| Voltage(L-L) | KVA Rating | %Z (as a fraction) |
|---|---|---|
| 480 | 400 | 0.088 |

## At Next point of system: (Node 1)

| Conductor Length (Feet) | "C" Value | I (s.c) previous | Conduc | Wire Size (Copper) |
|---|---|---|---|---|
| 100 | 16483 | 5467.492477 | 2 | 250 kcmil Cu THHN |

## At Next point of system: (Node 2)

| Conductor Length (Feet) | "C" Value | I (s.c) previous | Conduc | Wire Size (Copper) |
|---|---|---|---|---|
| 50 | 16483 | 5158.765636 | 2 | 250 kcmil Cu THHN |

## At Next point of system: (Node 3)

| Conductor Length (Feet) | "C" Value | I (s.c) previous | Conduc | Wire Size (Copper) |
|---|---|---|---|---|
| 50 | 10755 | 5017.117625 | 1 | 2/0 Cu THHN |

## At Next point of system: (Node 4)

| Conductor Length (Feet) | "C" Value | I (s.c) previous | Conduc | Wire Size (Copper) |
|---|---|---|---|---|
| 100 | 10755 | 4627.642005 | 1 | 2/0 Cu THHN |

## At Next point of system: (Node 5)

| Conductor Length (Feet) | "C" Value | I (s.c) previous | Conduc | Wire Size (Copper) |
|---|---|---|---|---|
| 50 | 10755 | 5017.117625 | 1 | 2/0 Cu THHN |

## At Next point of system: (Node 6)

| Conductor Length (Feet) | "C" Value | I (s.c) previous | Conduc | Wire Size (Copper) |
|---|---|---|---|---|
| 100 | 10755 | 4627.642005 | 1 | 2/0 Cu THHN |

## At Next point of system: (Node 7)

| Conductor Length (Feet) | "C" Value | I (s.c) previous | Conduc | Wire Size (Copper) |
|---|---|---|---|---|
| 50 | 10755 | 5017.117625 | 1 | 2/0 Cu THHN |

## At Next point of system: (Node 8)

| Conductor Length (Feet) | "C" Value | I (s.c) previous | Conduc | Wire Size (Copper) |
|---|---|---|---|---|
| 100 | 10755 | 4627.642005 | 1 | 2/0 Cu THHN |

**Transformer Short Circuit Calculation:**

| | |
|---|---|
| **Full Load Current:** | |
| I (f.l.) | 481.139338 |
| **M Value:** | 11.36363636 |
| **Short Circuit Current:** | |
| I (s.c.) | 5467.492477 |

**Node 1 Short Circuit Current:**

| | |
|---|---|
| **F Value:** | 0.059845099 |
| **New M Value:** | 0.943534108 |
| **Short Circuit Current at this point:** | |
| I (s.c.) | 5158.765636 |

**Node 2 Short Circuit Current:**

| | |
|---|---|
| **F Value:** | 0.028232946 |
| **New M Value:** | 0.972542267 |
| **Short Circuit Current at this point:** | |
| I (s.c.) | 5017.117625 |

**Node 3 Short Circuit Current:**

| | |
|---|---|
| **F Value:** | 0.084162867 |
| **New M Value:** | 0.922370642 |
| **Short Circuit Current at this point:** | |
| I (s.c.) | 4627.642005 |

**Node 4 Short Circuit Current:**

| | |
|---|---|
| **F Value:** | 0.155258716 |

| | |
|---|---|
| **New M Value:** | 0.865606973 |
| **Short Circuit Current at this point:** I (s.c.) | 4005.719187 |

**<u>Node 5 Short Circuit Current:</u>**

| | |
|---|---|
| **F Value:** | 0.084162867 |
| **New M Value:** | 0.922370642 |
| **Short Circuit Current at this point:** I (s.c.) | 4627.642005 |

**<u>Node 6 Short Circuit Current:</u>**

| | |
|---|---|
| **F Value:** | 0.155258716 |
| **New M Value:** | 0.865606973 |
| **Short Circuit Current at this point:** I (s.c.) | 4005.719187 |

**<u>Node 7 Short Circuit Current:</u>**

| | |
|---|---|
| **F Value:** | 0.084162867 |
| **New M Value:** | 0.922370642 |
| **Short Circuit Current at this point:** I (s.c.) | 4627.642005 |

**<u>Node 8 Short Circuit Current:</u>**

| | |
|---|---|
| **F Value:** | 0.155258716 |
| **New M Value:** | 0.865606973 |
| **Short Circuit Current at this point:** I (s.c.) | 4005.719187 |

## Any Motor Contribution:

### Motor 1:

| HP rating | Power Factor | Voltage(L-L) |
|---|---|---|
| 100 | 0.8 | 480 |

**Motor Short Circuit Current:**

| | |
|---|---|
| KVA rating | 74569.99 |

**Short Circuit Current at this point:**

| | |
|---|---|
| I (m.s.c.) | 776.7707 |

**Total Motor Contribution:**

**3 - 315HP Induction Motors**

| | |
|---|---|
| **Motor Size** | 100 HP |
| **S.C. motor contribution** | 776.7706996 |
| **Quantity of motors** | 3 |
| **Total SC Contribution** | 2330.312099 |

**Total Motor SC Contribution:** **2330.312099**

Final Short-Circuit Analysis for Bayou Meto Pump Station #4

| Node # | S.C. No Motor Contribution (AIC) | S.C. With Motor Contribution (AIC) |
|---|---|---|
| At Transformer Secondary | 5467.492477 | 7797.804575 |
| 1 | 5158.765636 | 7489.077735 |
| 2 | 5017.117625 | 7347.429724 |
| 3 | 4627.642005 | 6957.954103 |
| 4 | 4005.719187 | 6336.031286 |
| 5 | 4627.642005 | 6957.954103 |
| 6 | 4005.719187 | 6336.031286 |
| 7 | 4627.642005 | 6957.954103 |
| 8 | 4005.719187 | 6336.031286 |

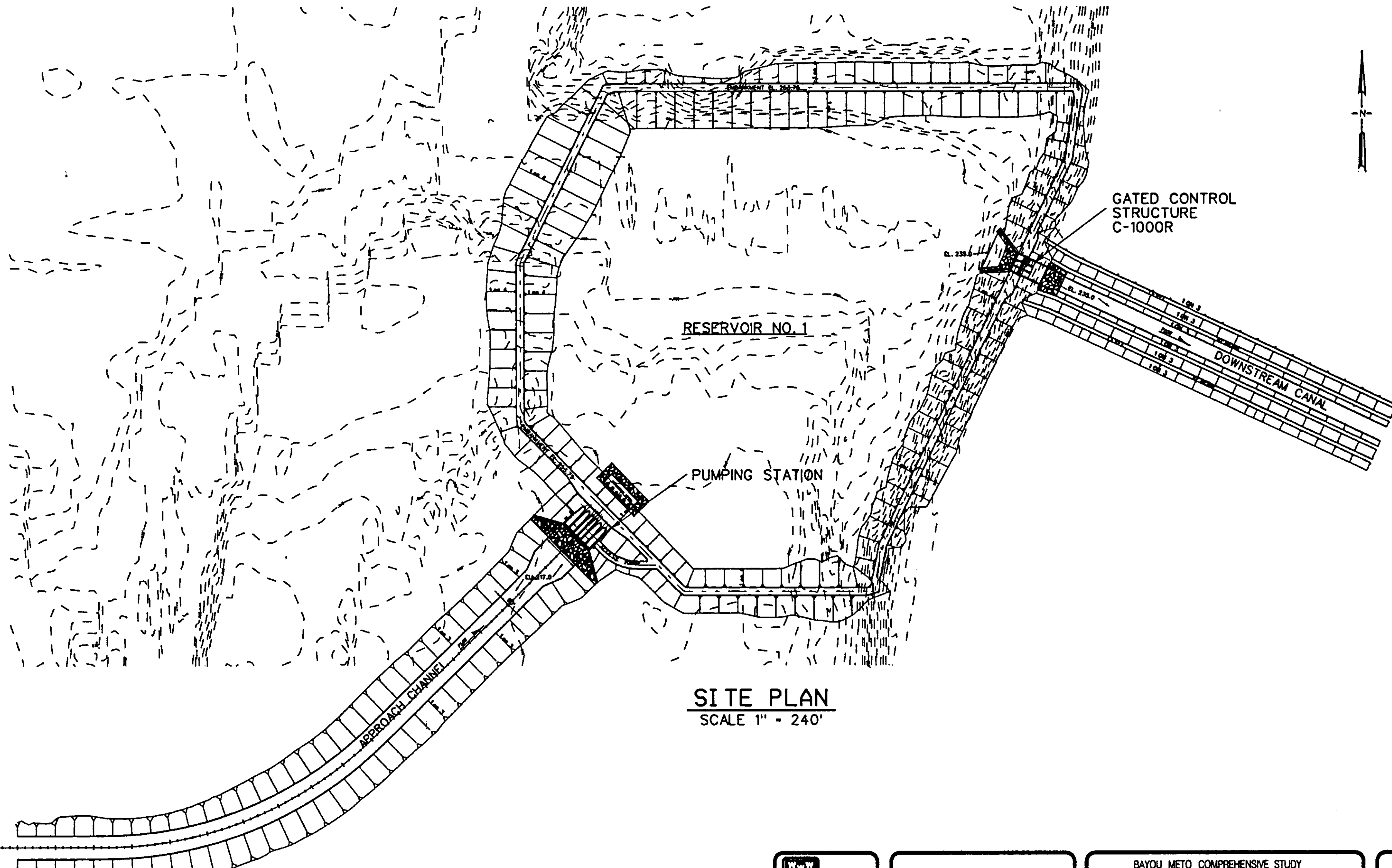
# Bayou Meto Basin Project
**Conceptual Design of Bayou Meto Basin Pumping Stations**

# APPENDIX J

# BAYOU METO PUMPING STATION NO. 1

# STRUCTURAL DESIGN DEVELOPMENT

U.S. Army Corps of Engineers
Memphis District



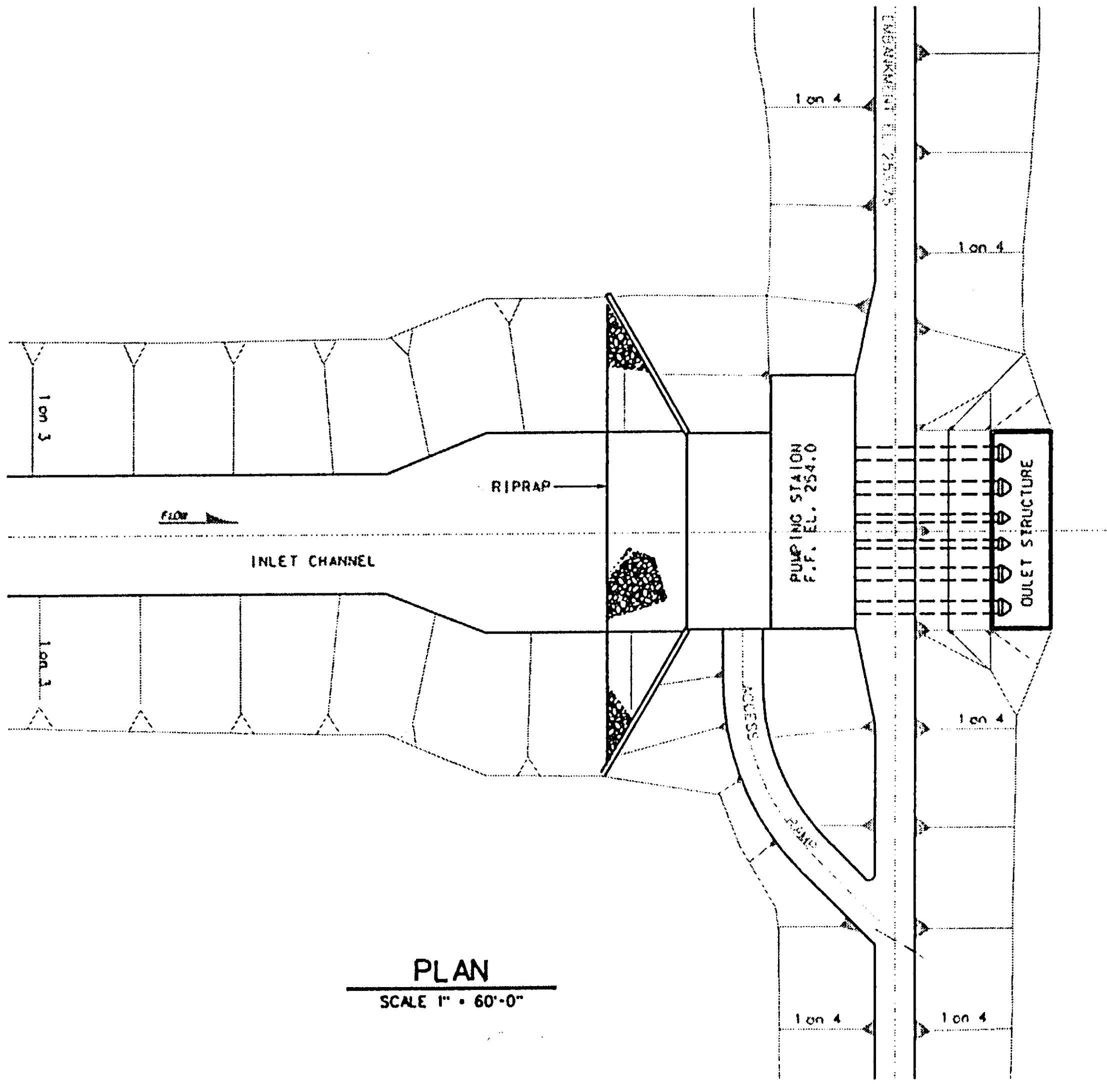

## SITE PLAN
SCALE 1" = 240'

US Army Corps of Engineers

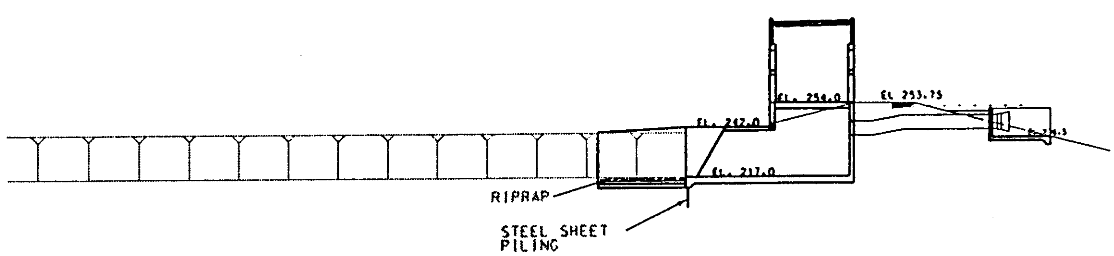
U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEER
MEMPHIS, TENNESSEE

BAYOU METO COMPREHENSIVE STUDY
BAYOU METO BASIN
PUMPING STATION NO. 1
SITE PLAN

PLATE
V-J-1




## PLAN
SCALE 1" = 60'-0"



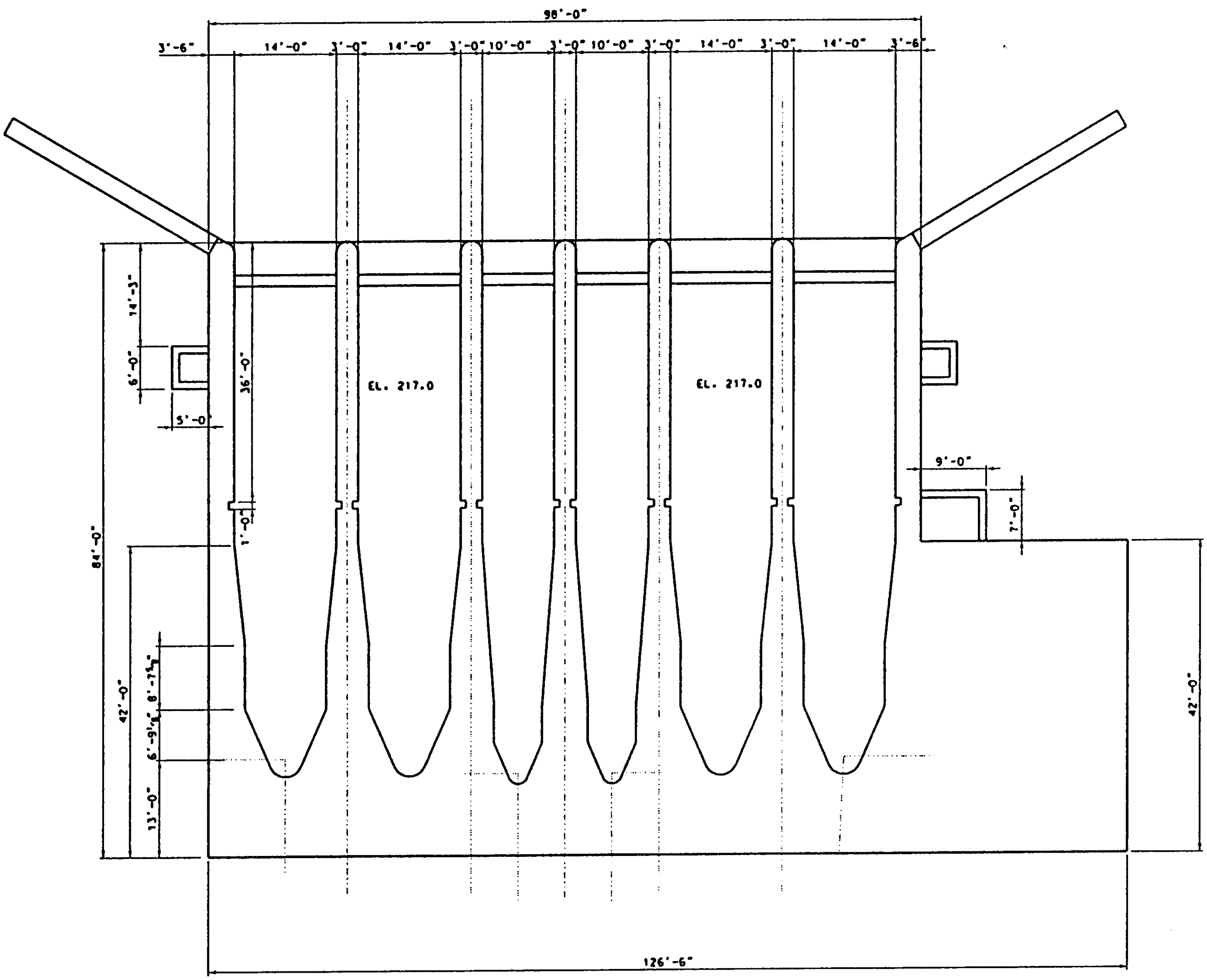

## PROFILE
SCALE 1" = 60'-0"

US Army Corps of Engineers

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEER
MEMPHIS, TENNESSEE

BAYOU METO BASIN COMPREHENSIVE STUDY
BAYOU METO BASIN
PUMPING STATION NO. 1
PLAN & PROFILE

PLATE
V-J-2




**PLAN @ EL. 217.0**

SCALE " = 1'-0"

US Army Corps of Engineers

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEER
MEMPHIS, TENNESSEE

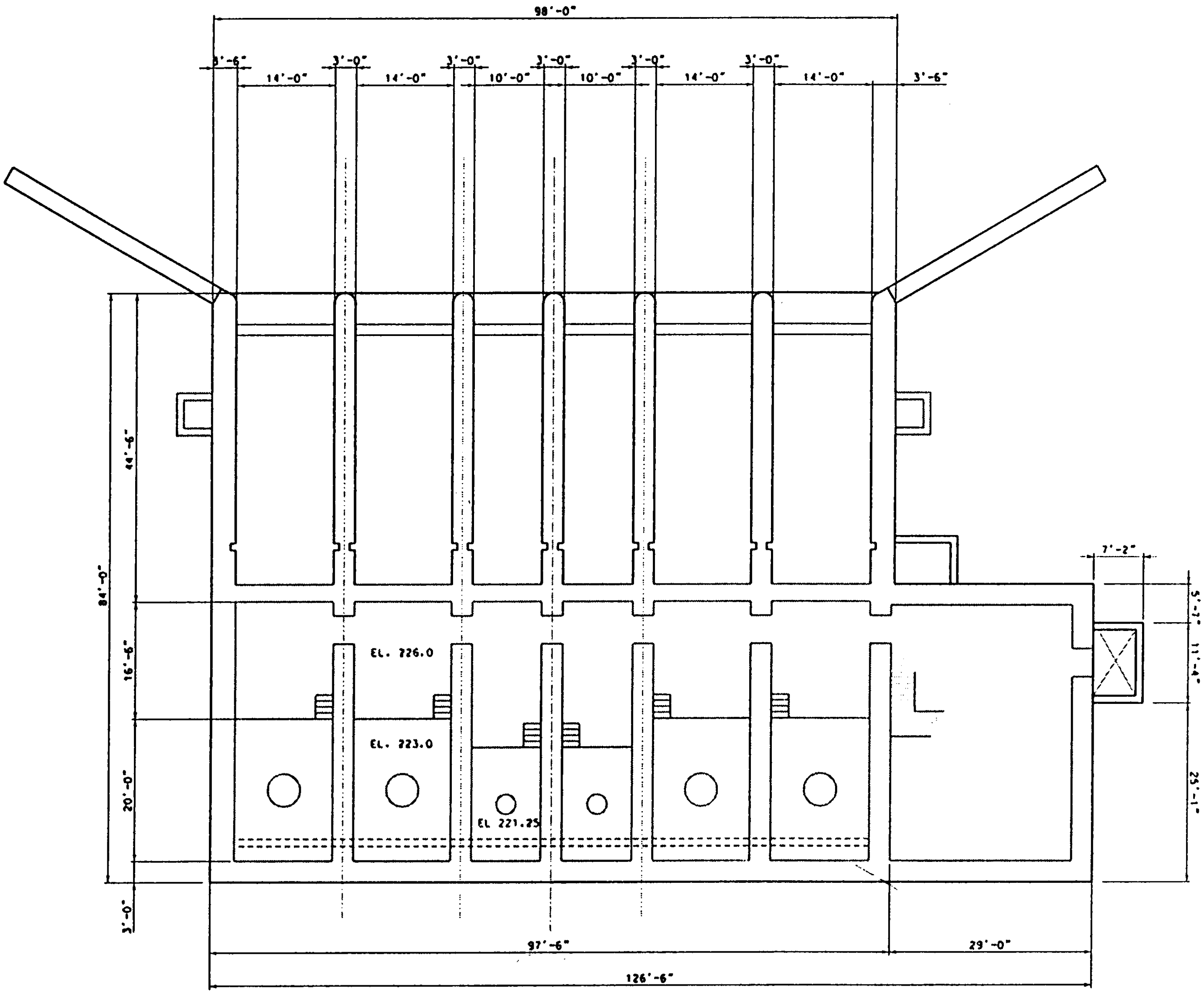
EASTERN ARKANSAS REGION COMPREHENSIVE STUDY
BAYOU METO BASIN

PUMPING STATION NO. 1

FLOOR PLAN - EL. 217.0

PLATE

V-J-3




EL. 226.0 PLAN

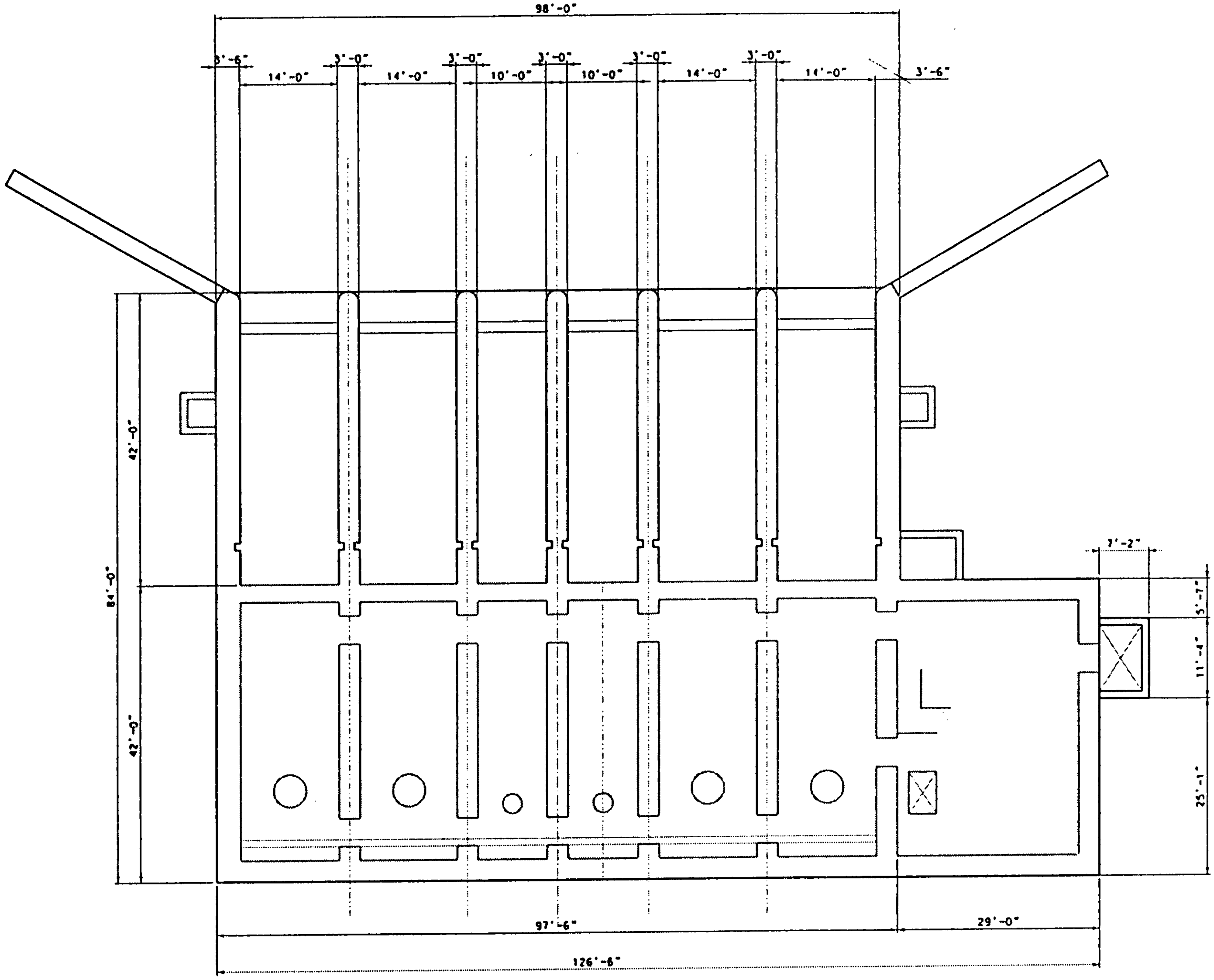
SCALE 1/8" = 1'-0"

US Army Corps of Engineers

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEER
MEMPHIS, TENNESSEE

BAYOU METO BASIN COMPREHENSIVE STUDY
BAYOU METO BASIN
PUMPING STATION NO. 1
FLOOR PLAN – EL. 226.0

PLATE
V–J–4




EL. 237.0 PLAN

SCALE 1/8" = 1'-0"

US Army Corps of Engineers

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEER
MEMPHIS, TENNESSEE

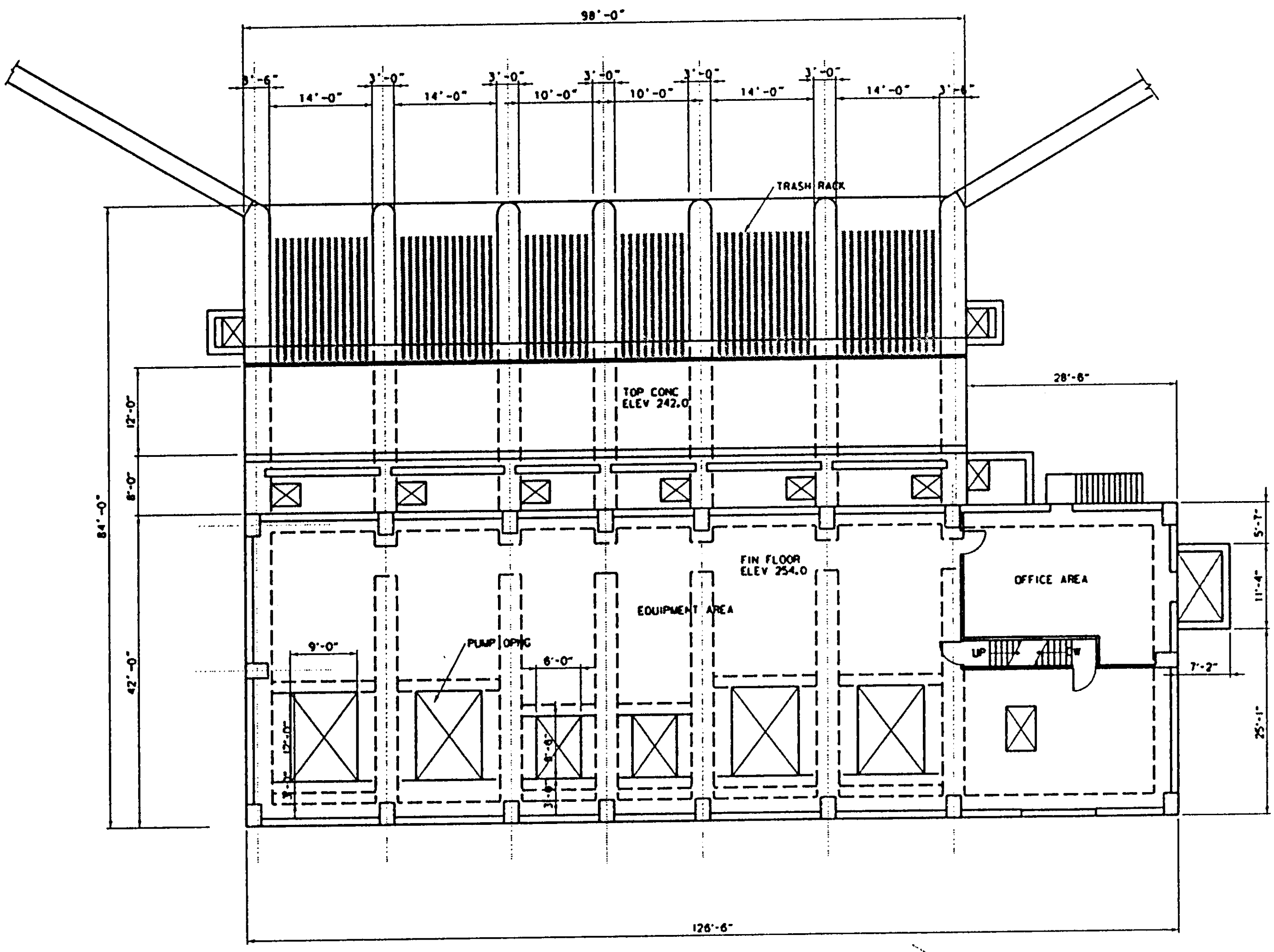
BAYOU METO BASIN COMPREHENSIVE STUDY
BAYOU METO BASIN

PUMPING STATION NO. 1

FLOOR PLAN – EL. 237.0

PLATE

V–J–5




PLAN @ EL. 254/242

SCALE 1/8" = 1'-0"

US Army Corps of Engineers

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEER
MEMPHIS, TENNESSEE

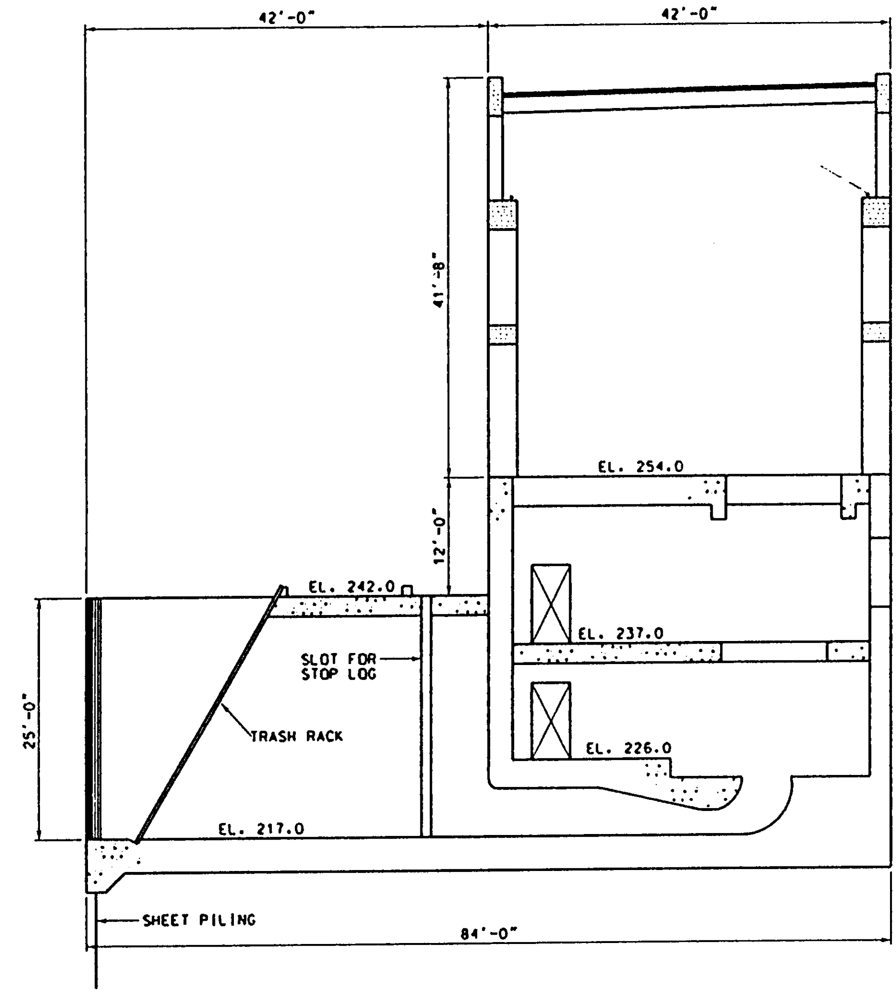
BAYOU METO BASIN COMPREHENSIVE STUDY
BAYOU METO BASIN

PUMPING STATION NO. 1

FLOOR PLAN - EL. 254.0

PLATE

V-J-6




SECTION

SCALE 1/8" = 1'-0"

US Army Corps of Engineers

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEER
MEMPHIS, TENNESSEE

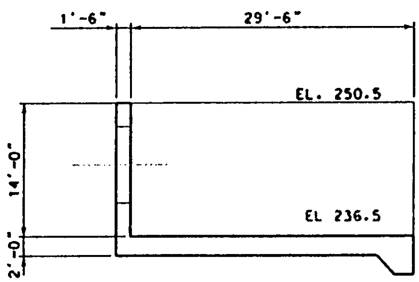
BAYOU METO BASIN COMPREHENSIVE STUDY
BAYOU METO BASIN

PUMPING STATION NO. 1

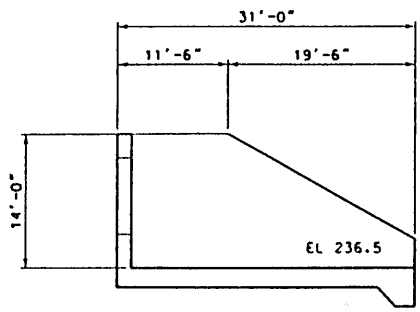
SECTION

PLATE

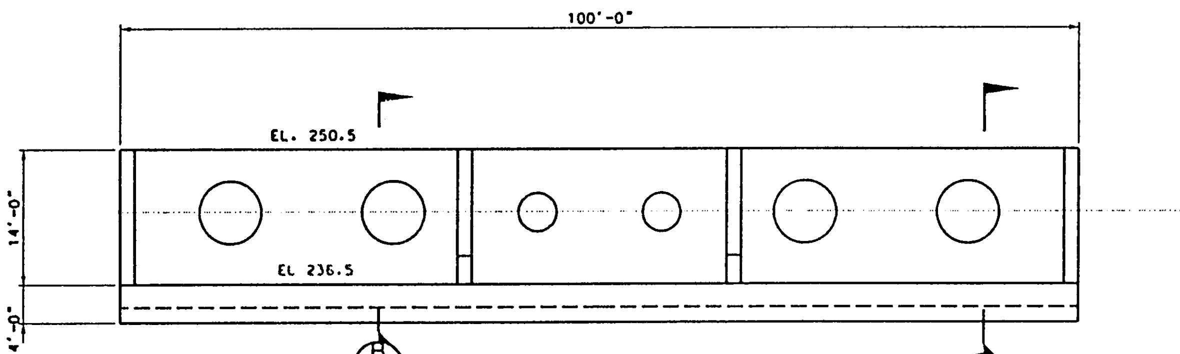
V-J-7



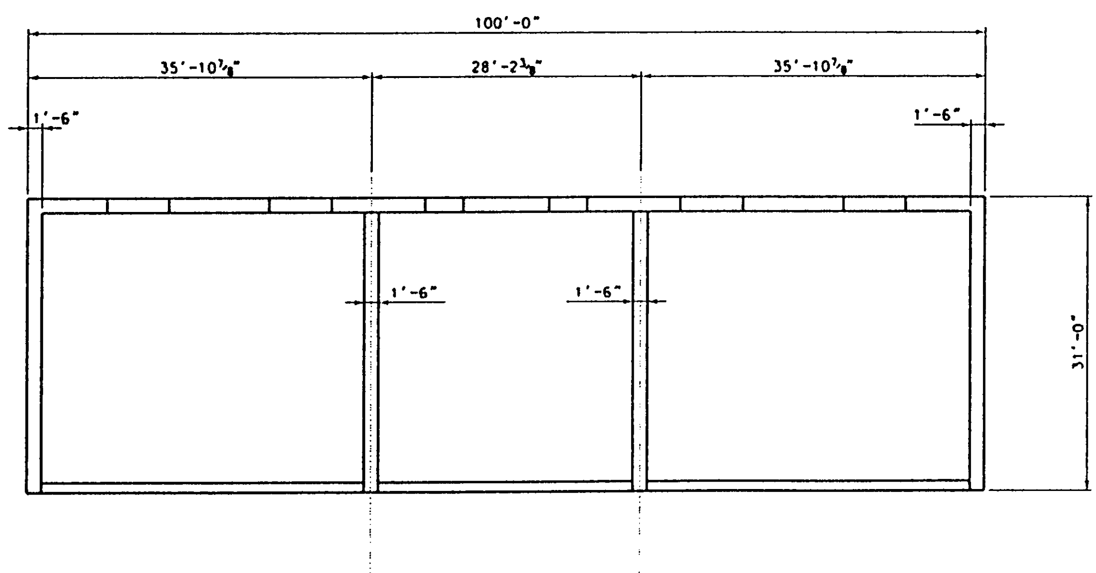

SECTION - A




SECTION - B




ELEVATION




PLAN

US Army Corps of Engineers

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEER
MEMPHIS, TENNESSEE

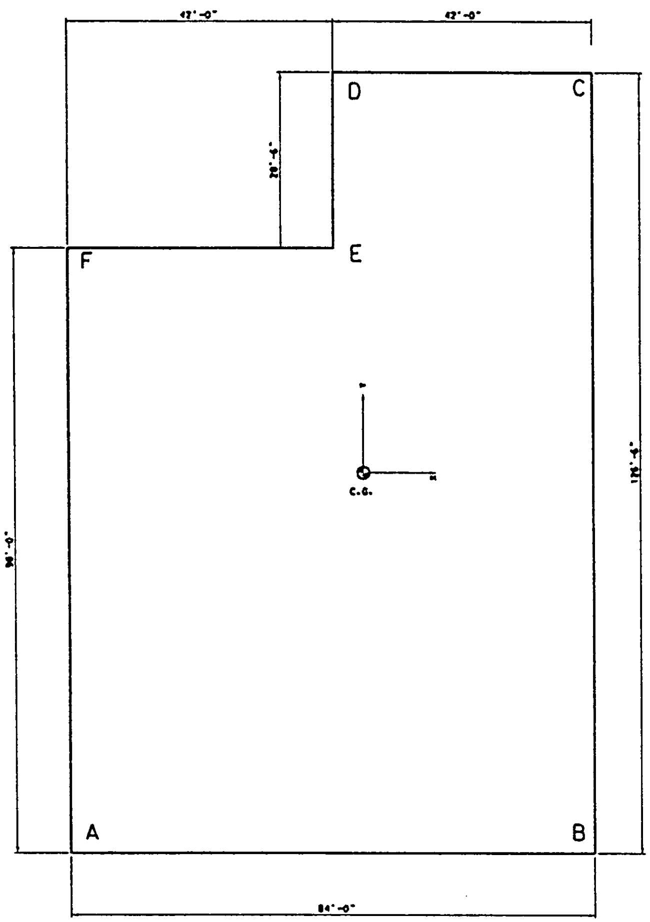
BAYOU METO BASIN COMPREHENSIVE STUDY
BAYOU METO BASIN

PUMPING STATION NO. 1

OUTLET STRUCTURE

PLATE

V–J–8




LOADING CONDITION

CASE I-A CONSTRUCTION CONDITION:STRUCTURE COMPLETE TO ELEV. 254.0. BACKFILL IN PLACE EXERTING AT REST SOIL PRESSURE. SITE DEWATERED. NO UPLIFT.

CASE I-B CONSTRUCTION CONDITION:STRUCTURE COMPLETE WITH EQUIPMENT IN PLACE. MOIST BACKFILL EXERTING AT REST SOIL PRESSURE. SITE DEWATERED. NO UPLIFT.

CASE II-A OPERATING CONDITION:PUMP FLOW: MAXIMUM SUMP(EL. 241.5); MAXIMUM LAKE POOL(EL. 248.0): AT REST SOIL PRESSURE:UPLIFT ACTING.

CASE II-B OPERATING CONDITION:PUMP FLOW: MINIIMUM SUMP(EL. 227.0); MINIMUM LAKE POOL(EL. 241.3): AT REST SOIL PRESSURE:UPLIFT ACTING.

CASE II-C OPERATING CONDITION:PUMP FLOW: NORMAL SUMP(EL. 231.0); NORMAL LAKE POOL(EL. 244.0): AT REST SOIL PRESSURE:UPLIFT ACTING.

CASE III EXTREME MAINTENANCE CONDITION:CASE II-C WITH ONE EXTERIOR PUMP BAY DEWATERED: AT REST SOIL PRESSURE:UPLIFT ACTING.

CASE IV A-B EARTHQUAKE CONDITION:CASE II-C COMBINED WITH EARTHQUAKE FORCES EARTHQUAKE ACCELERATION CONSIDERED BOTH PERPENDICULAR AND PARALLEL TO FLOW.

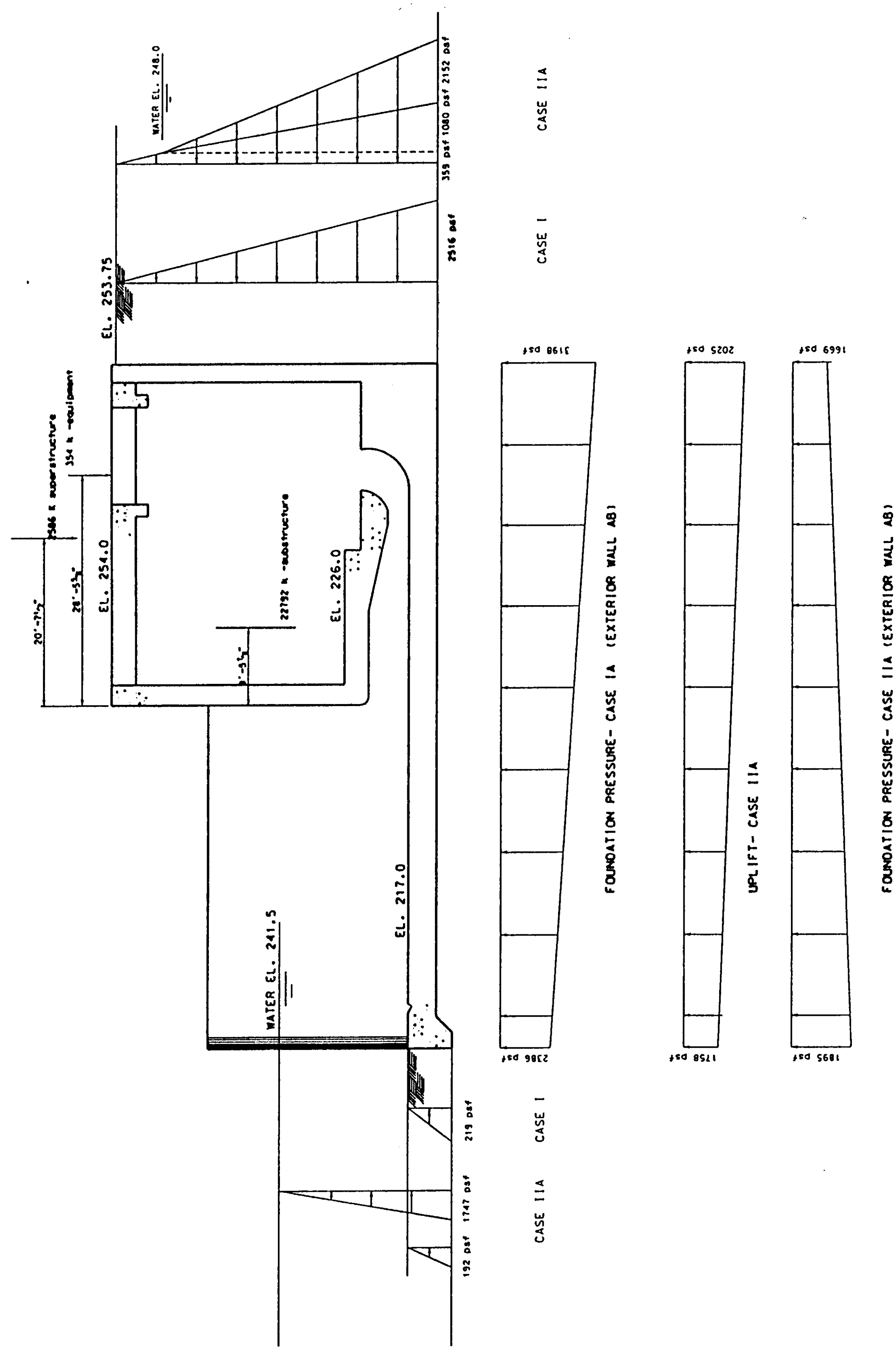
| CASE | LOAD IN KIPS | | | ECCENTRICITY | | NET FOUNDATION PRESSURE (K.S.F.) | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Pv | Phx | Phy | ex | ey | A | B | C | D | E | F |
| I-A | 22792 | 4923 | | +1.91 | -2.66 | 2.39 | 3.20 | 2.34 | 1.93 | 2.12 | 1.72 |
| I-B | 25732 | 4923 | | +3.33 | -2.37 | 2.39 | 3.87 | 2.88 | 2.14 | 2.36 | 1.62 |
| II-A | 14277 | 5290 | | -1.44 | -3.41 | 1.90 | 1.67 | 1.15 | 1.26 | 1.38 | 1.49 |
| II-B | 17928 | 6587 | | +0.75 | -2.52 | 2.02 | 2.32 | 1.74 | 1.58 | 1.72 | 1.56 |
| II-C | 16666 | 6385 | | +0.03 | -2.70 | 1.98 | 2.08 | 1.53 | 1.48 | 1.61 | 1.56 |
| III | 16152 | 6518 | | +0.80 | -2.69 | 1.80 | 2.08 | 1.58 | 1.44 | 1.55 | 1.41 |
| IV-A | 16666 | 7862 | | -2.99 | -2.70 | 2.35 | 1.65 | 1.26 | 1.61 | 1.69 | 2.04 |
| IV-B | 16666 | 6385 | +3798 | -0.69 | +1.58 | 1.73 | 1.49 | 1.84 | 1.96 | 1.88 | 2.00 |
| IV-C | 16666 | 6385 | -3798 | -0.69 | -6.97 | 2.40 | 2.46 | 1.09 | 1.06 | 1.37 | 1.34 |

US Army Corps of Engineers

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEER
MEMPHIS, TENNESSEE

EASTERN ARKANSAS REGION COMPREHENSIVE STUDY
BAYOU METO BASIN
PUMPING STATION NO. 1
STABILITY ANALYSIS - FOUNDATION PRESSURES

PLATE
V-J-9




US Army Corps of Engineers

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEER
MEMPHIS, TENNESSEE

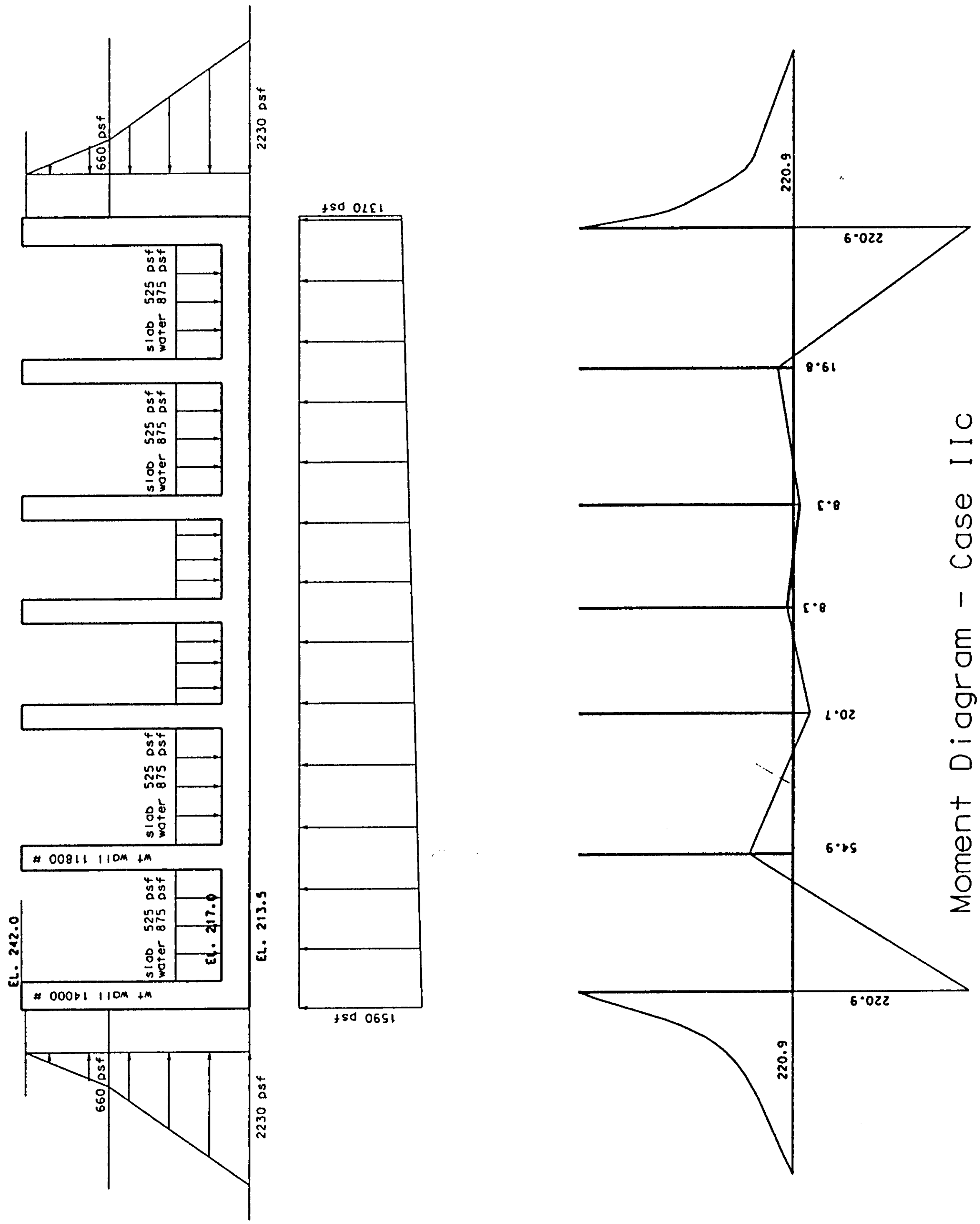
BAYOU METO BASIN COMPREHENSIVE STUDY
BAYOU METO BASIN

PUMPING STATION NO. 1

STABILITY ANALYSIS–LOADING DIAGRAMS

PLATE

V–J–10




US Army Corps of Engineers

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEER
MEMPHIS, TENNESSEE

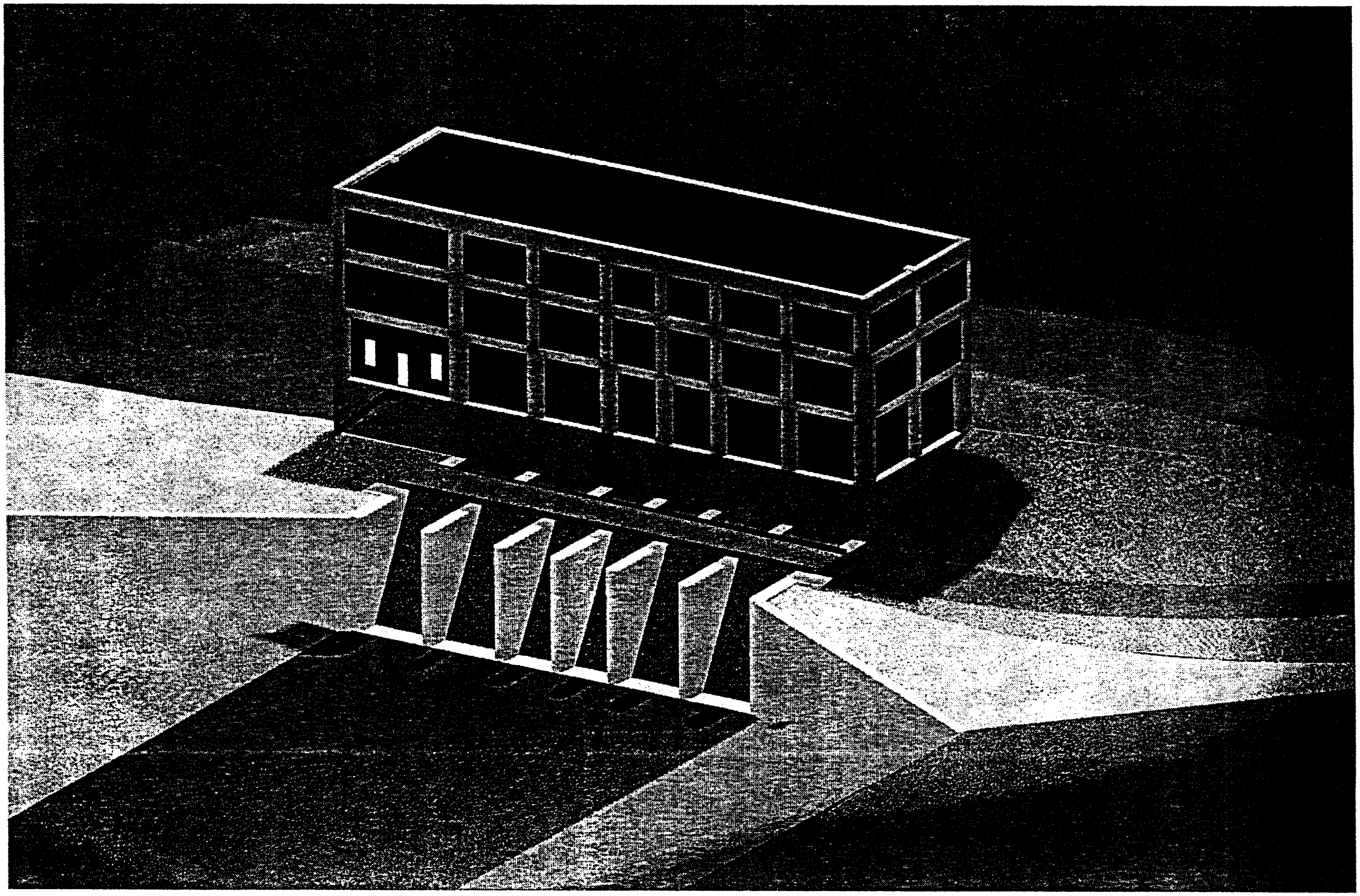
BAYOU METO BASIN COMPREHENSIVE STUDY
BAYOU METO BASIN

PUMPING STATION NO. 1

MOMENT DIAGRAM

PLATE

V–J–11



US Army Corps of Engineers

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEER
MEMPHIS, TENNESSEE

BAYOU METO BASIN COMPREHENSIVE STUDY
BAYOU METO BASIN

PUMPING STATION NO. 1

PERSPECTIVE

PLATE

V-J-12

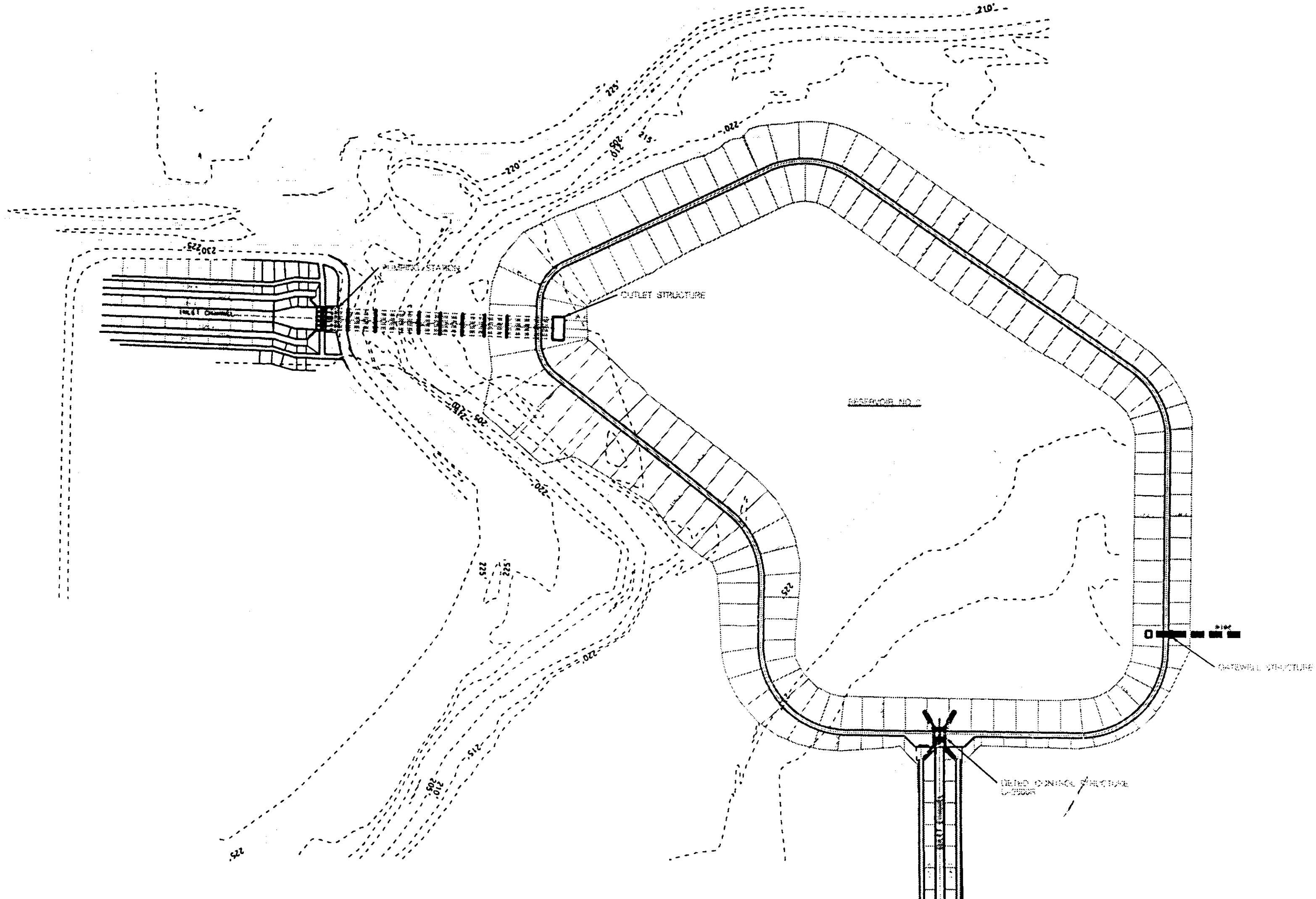
# Bayou Meto Basin Project
**Conceptual Design of Bayou Meto Basin Pumping Stations**

# APPENDIX K

# BAYOU METO PUMPING STATION NO. 2

# STRUCTURAL DESIGN DEVELOPMENT

**U.S. Army Corps of Engineers**
**Memphis District**




SITE PLAN

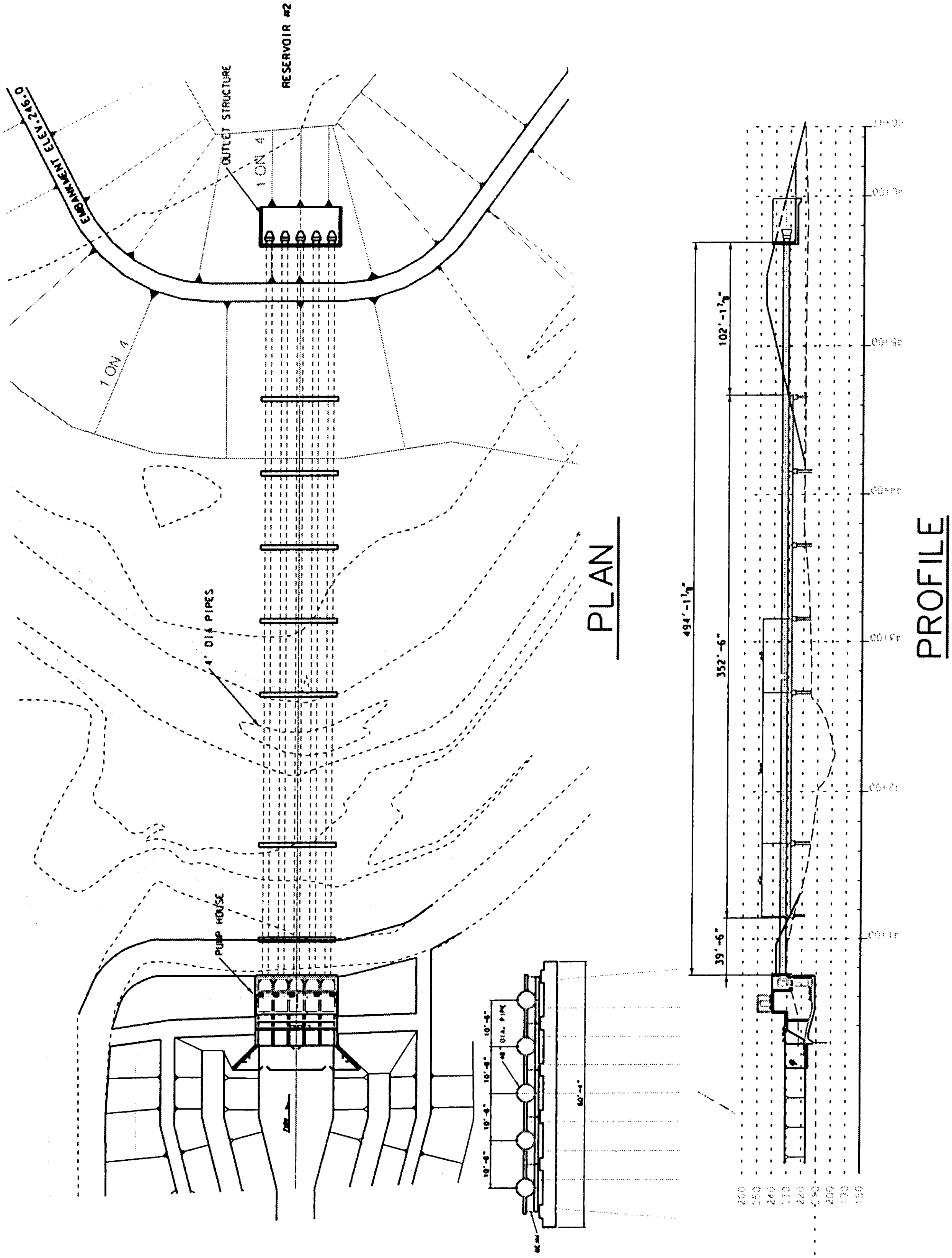
SCALE 1" = 240'

US Army Corps of Engineers

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEER
MEMPHIS, TENNESSEE

BAYOU METO COMPREHENSIVE STUDY
BAYOU METO BASIN
PUMPING STATION NO. 2
SITE PLAN

PLATE
V-K-1




US Army Corps of Engineers

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEER
MEMPHIS, TENNESSEE

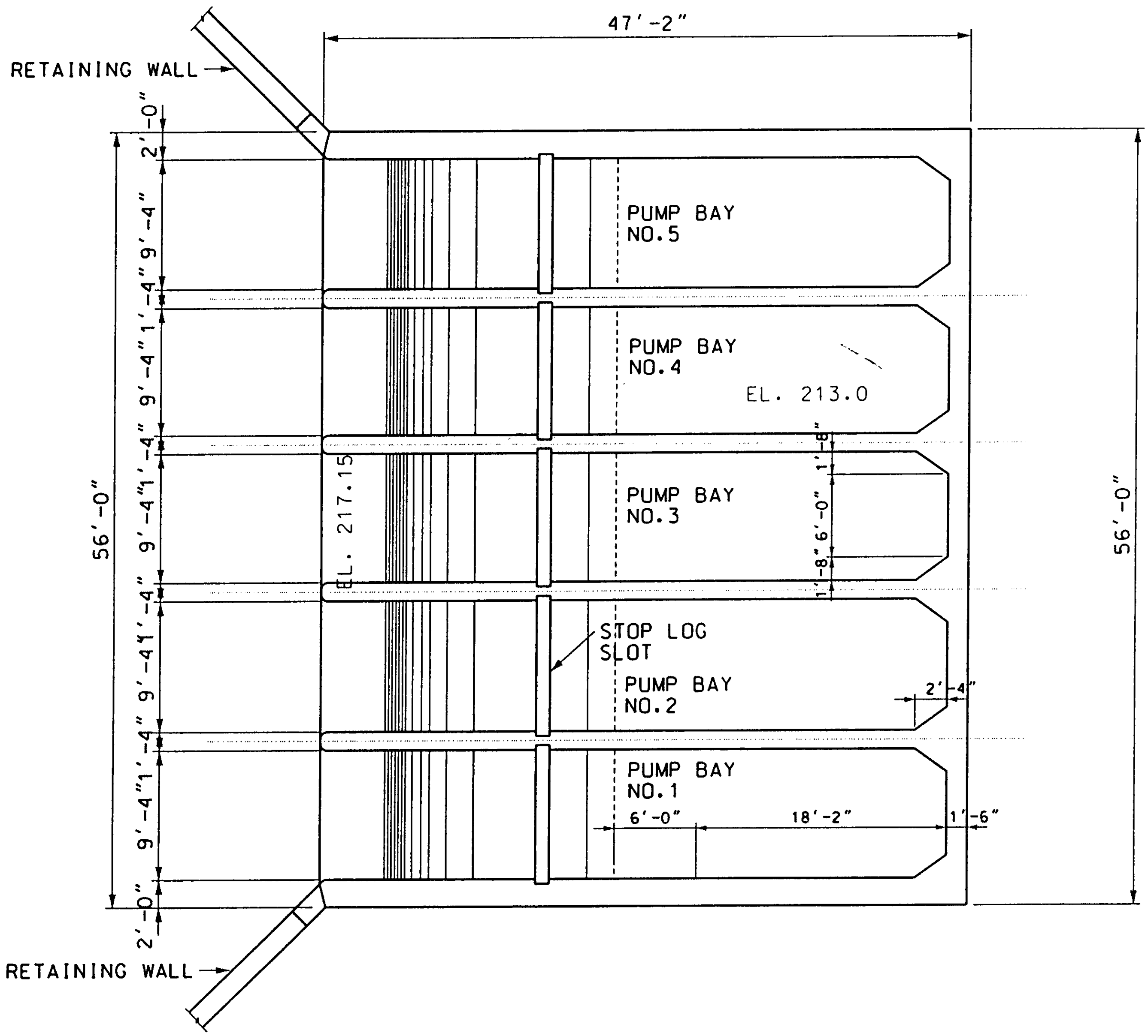
BAYOU METO BASIN COMPREHENSIVE STUDY
BAYOU METO BASIN

PUMPING STATION NO. 2

PLAN AND PROFILE

PLATE

V–K–2




PLAN @ EL. 217.15/213.0.0

US Army Corps of Engineers

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEER
MEMPHIS, TENNESSEE

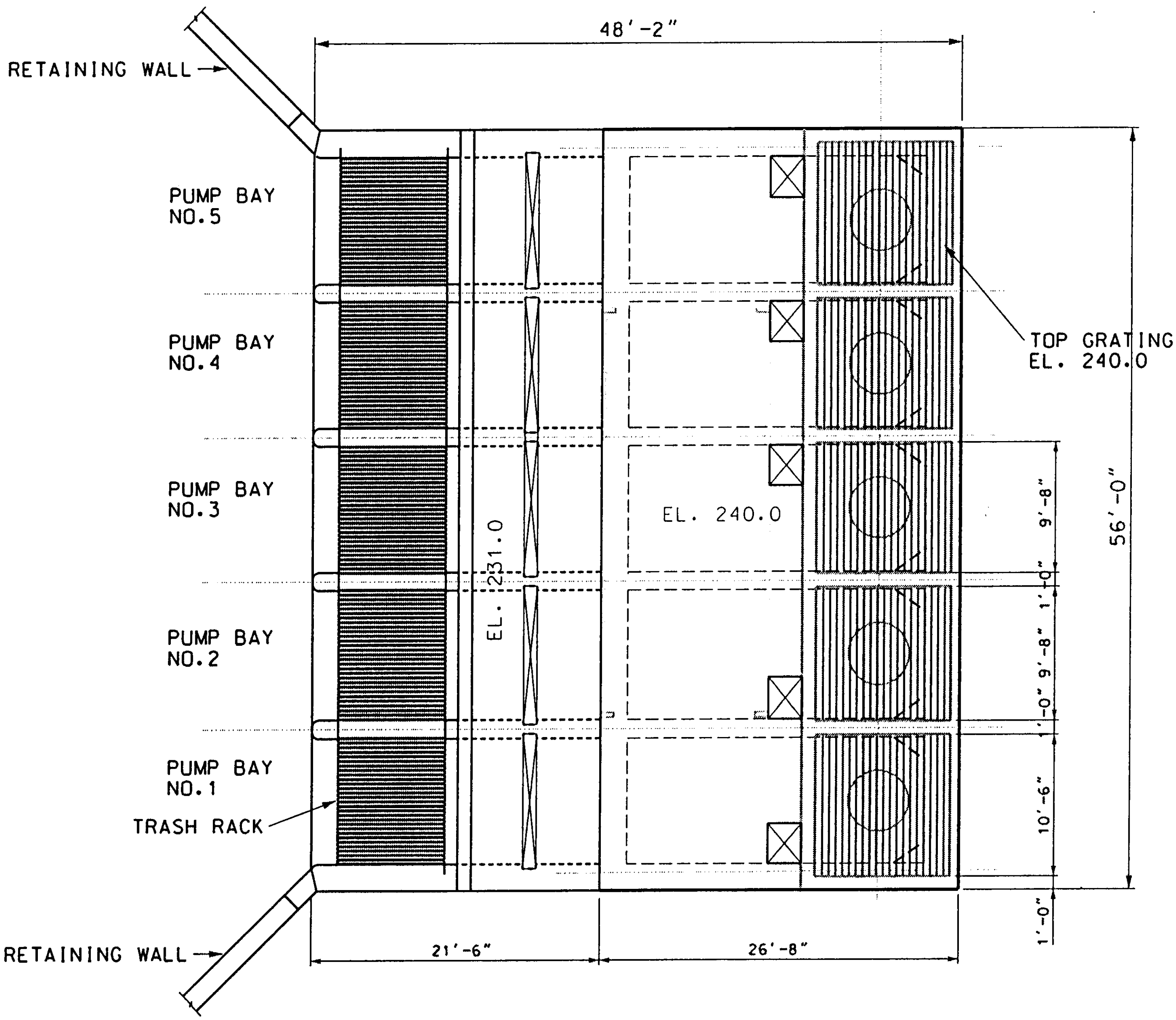
BAYOU METO BASIN COMPREHENSIVE STUDY
BAYOU METO BASIN

PUMPING STATION NO. 2

PUMPHOUSE PLAN

PLATE

V-K-3



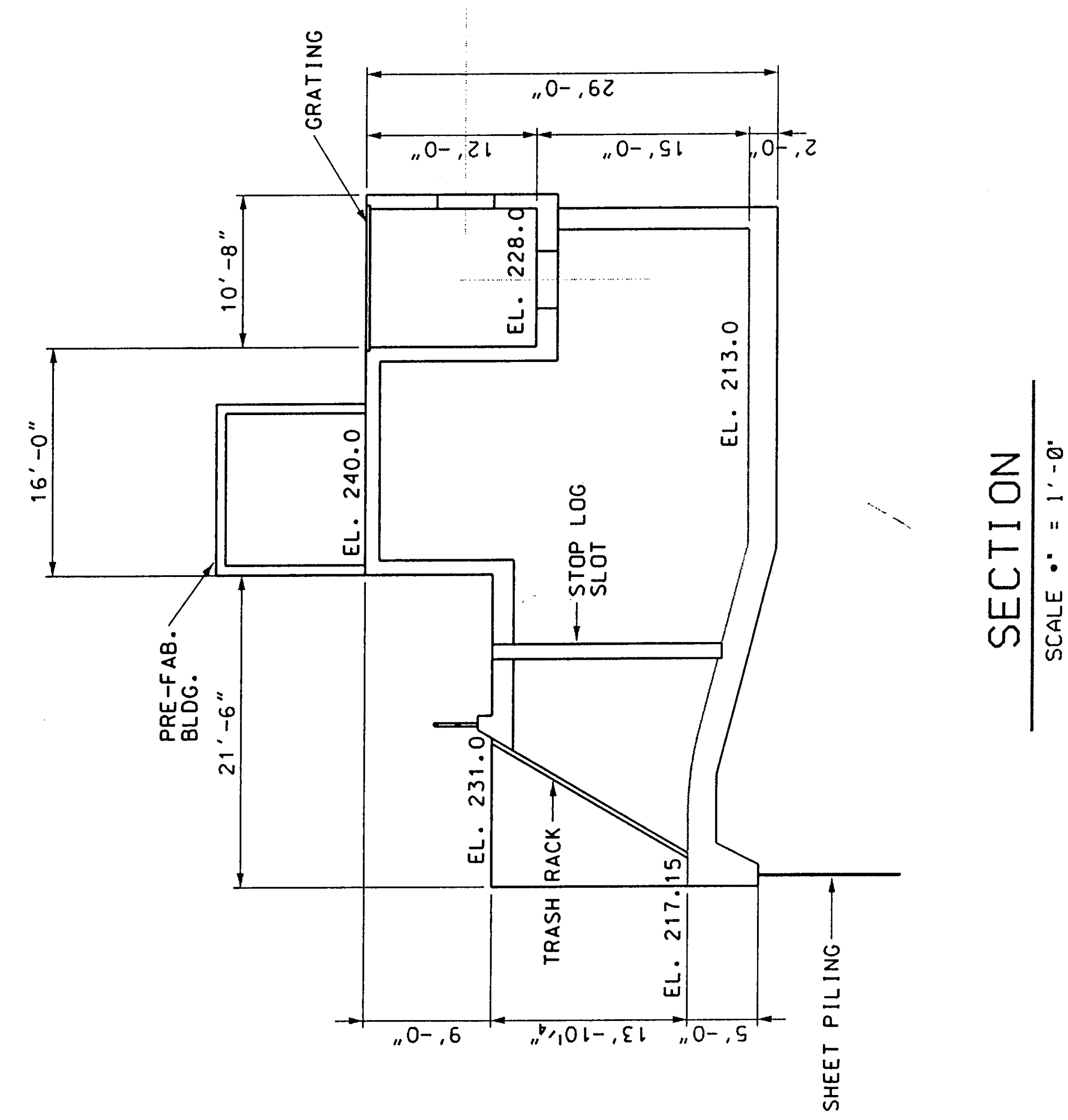

PLAN @ EL. 240/231

US Army Corps of Engineers

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEER
MEMPHIS, TENNESSEE

BAYOU METO BASIN COMPREHENSIVE STUDY
BAYOU METO BASIN
PUMPING STATION NO. 2
PUMPHOUSE PLAN

PLATE
V–K–4




US Army Corps of Engineers

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEER
MEMPHIS, TENNESSEE

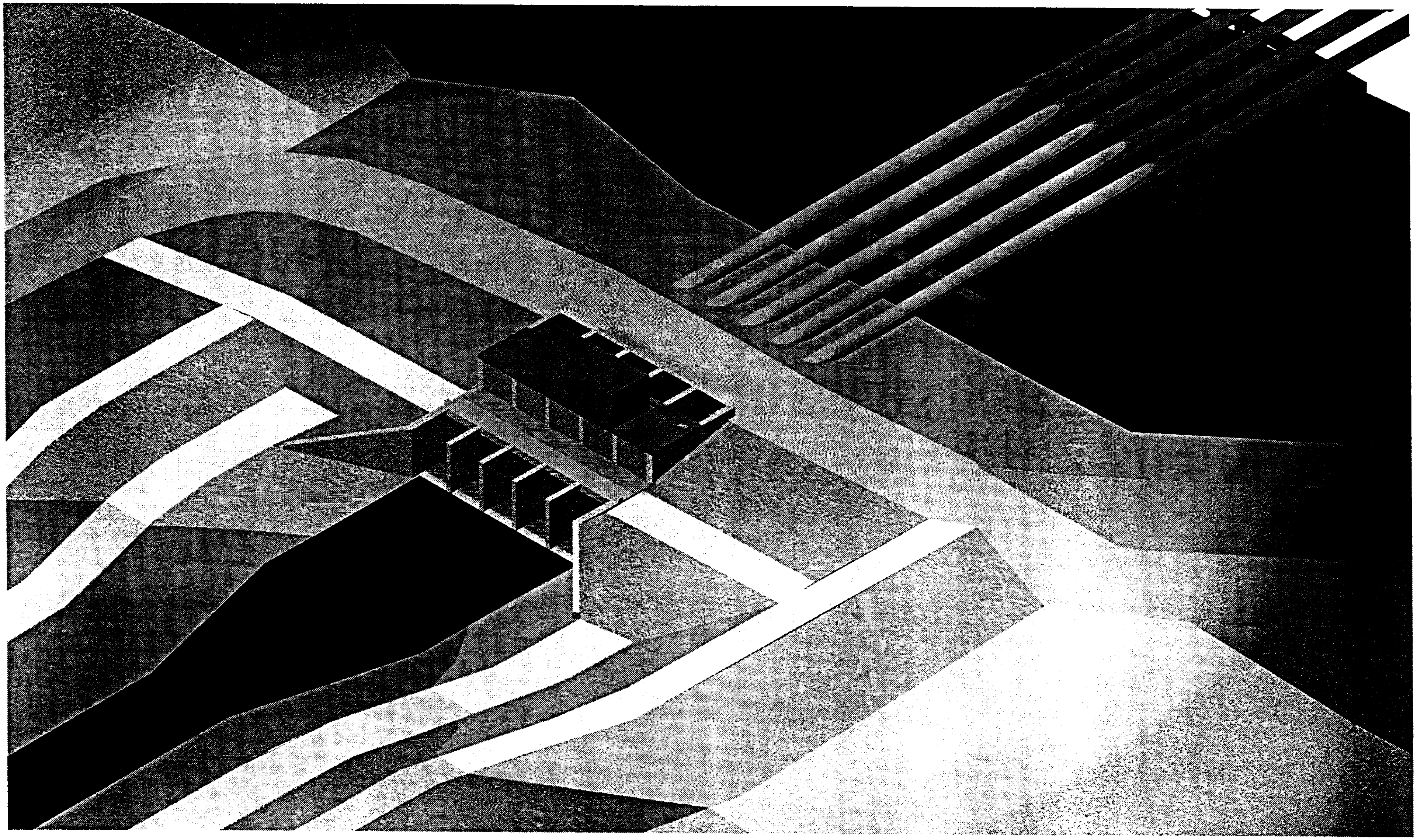
BAYOU METO BASIN COMPREHENSIVE STUDY
BAYOU METO BASIN

PUMPING STATION NO. 2

PUMPHOUSE SECTION

PLATE

V–K–5



US Army Corps of Engineers

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEER
MEMPHIS, TENNESSEE

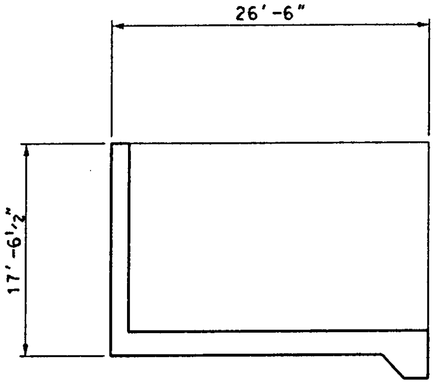
BAUOU METO COMPREHENSIVE STUDY
BAYOU METO BASIN

PUMPING STATION NO. 2

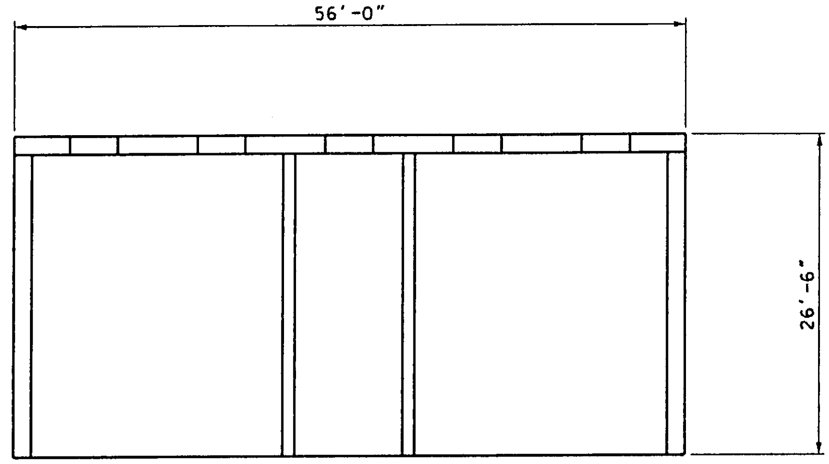
PERSPECTIVE

PLATE

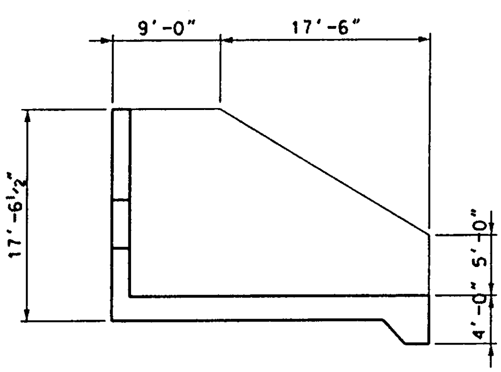
V-K-6



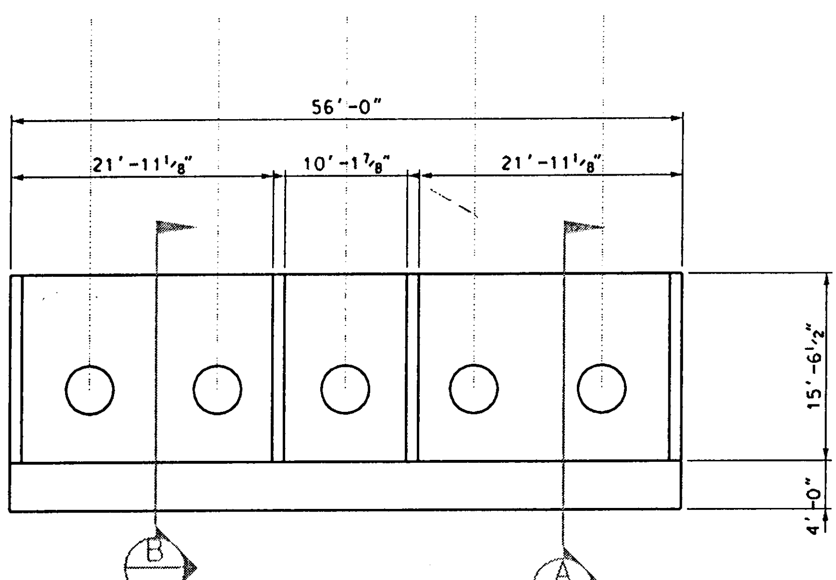

SECTION A




PLAN




SECTION B



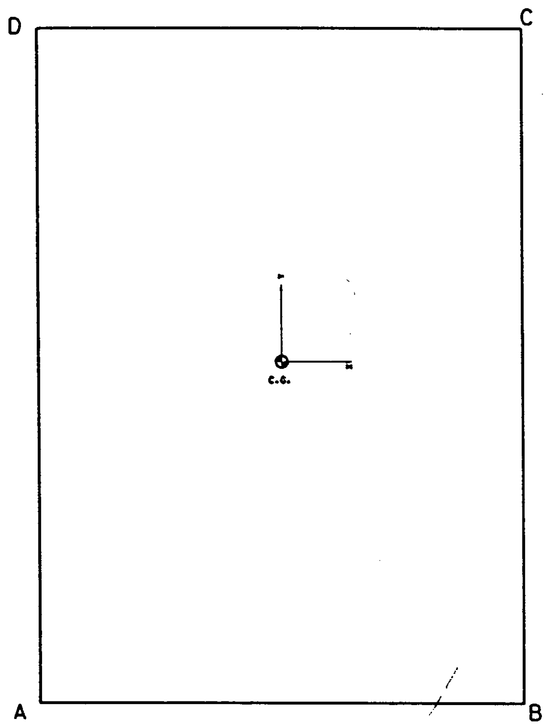

ELEVATION

US Army Corps
of Engineers

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEER
MEMPHIS, TENNESSEE

BAYOU METO BASIN COMPREHENSIVE STUDY
BAYOU METO BASIN
PUMPING STATION NO. 2
OUTLET STRUCTURE

PLATE
V–K–7




LOADING CONDITION

CASE I — CONSTRUCTION CONDITION:STRUCTURE COMPLETE WITH EQUIPMENT IN PLACE. MOIST BACKFILL EXERTING AT REST SOIL PRESSURE. SITE DEWATERED. NO UPLIFT.

CASE II-A — OPERATING CONDITION:PUMP FLOW: MAXIMUM SUMP(EL. 225.15): AT REST SOIL PRESSURE:UPLIFT ACTING.

CASE II-B — OPERATING CONDITION:PUMP FLOW: MINIIMUM SUMP(EL. 220.15): AT REST SOIL PRESSURE:UPLIFT ACTING.

CASE III — EXTREME MAINTENANCE CONDITION:CASE II-B WITH ONE EXTERIOR PUMP BAY DEWATERED: AT REST SOIL PRESSURE:UPLIFT ACTING.

CASE IV — EARTHQUAKE CONDITION:CASE II-B COMBINED WITH EARTHQUAKE FORCES EARTHQUAKE ACCELERATION CONSIDERED BOTH PERPENDICULAR AND PARALLEL TO FLOW.

| CASE | LOAD IN KIPS | | ECCENTRICITY | | NET FOUNDATION PRESSURE (KSF) | | | |
|---|---|---|---|---|---|---|---|---|
| | Pv | Ph | ex | ey | A | B | C | D |
| I | 2961 | 1163 | +0.38 | 0 | 1.05 | 1.15 | 1.15 | 1.05 |
| II-A | 2249 | 1021 | -0.19 | 0 | 0.85 | 0.81 | 0.81 | 0.85 |
| II-B | 2014 | 1224 | +0.77 | 0 | 0.67 | 0.82 | 0.82 | 0.67 |
| III | 1862 | 1224 | +1.02 | +1.75 | 0.65 | 0.47 | 0.73 | 0.91 |
| IV | 2014 | 1135 | -1.18 | 0 | 0.86 | 0.64 | 0.64 | 0.86 |

US Army Corps of Engineers

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEER
MEMPHIS, TENNESSEE

BAYOU METO COMPREHENSIVE STUDY
BAYOU METO BASIN
PUMPING STATION NO. 2
FOUNDATION PRESSURE

PLATE
V-K-8

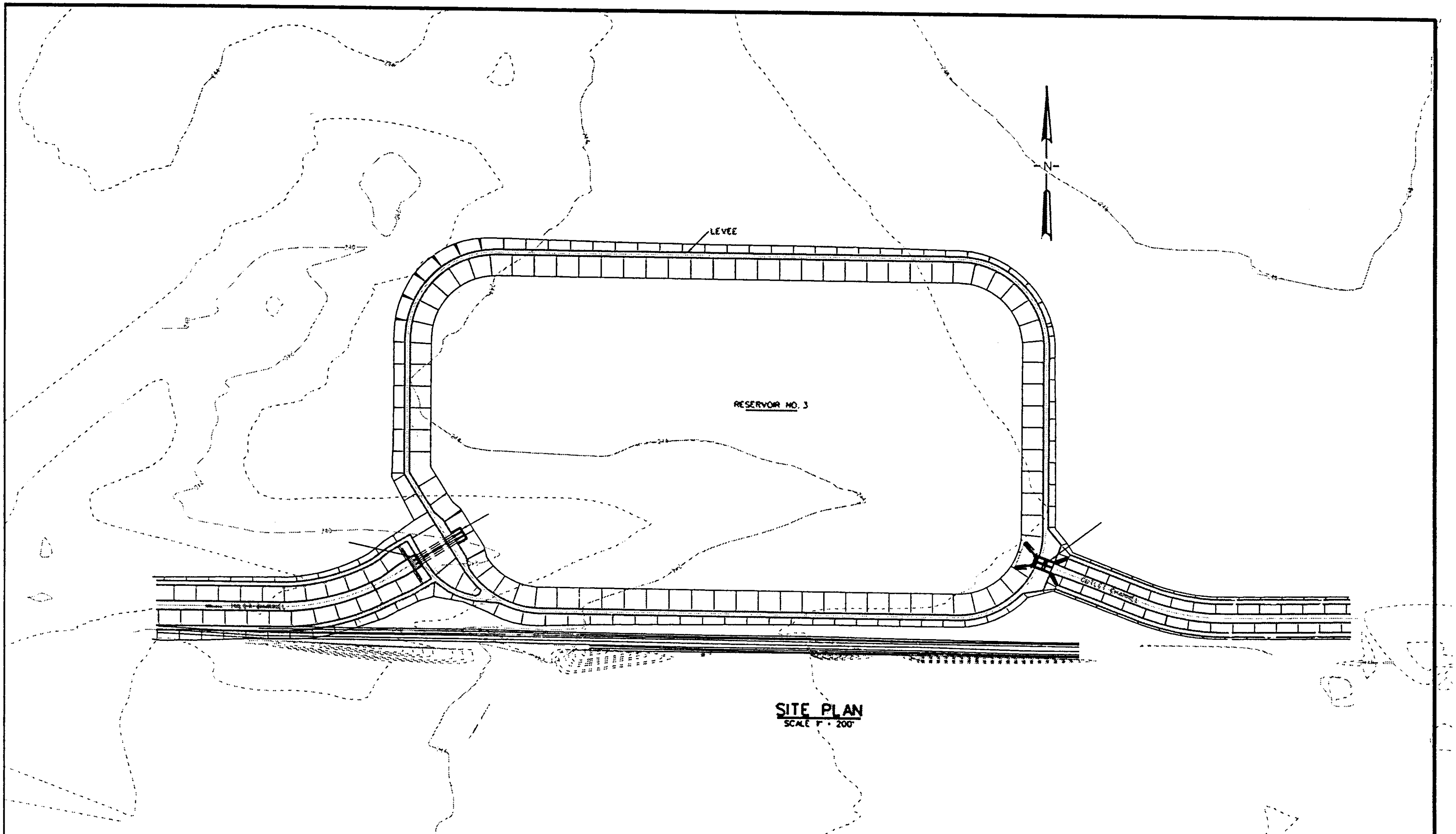
# Bayou Meto Basin Project
## Conceptual Design of Bayou Meto Basin Pumping Stations

# APPENDIX L

# BAYOU METO PUMPING STATION NO. 3

# STRUCTURAL DESIGN DEVELOPMENT

U.S. Army Corps of Engineers
Memphis District



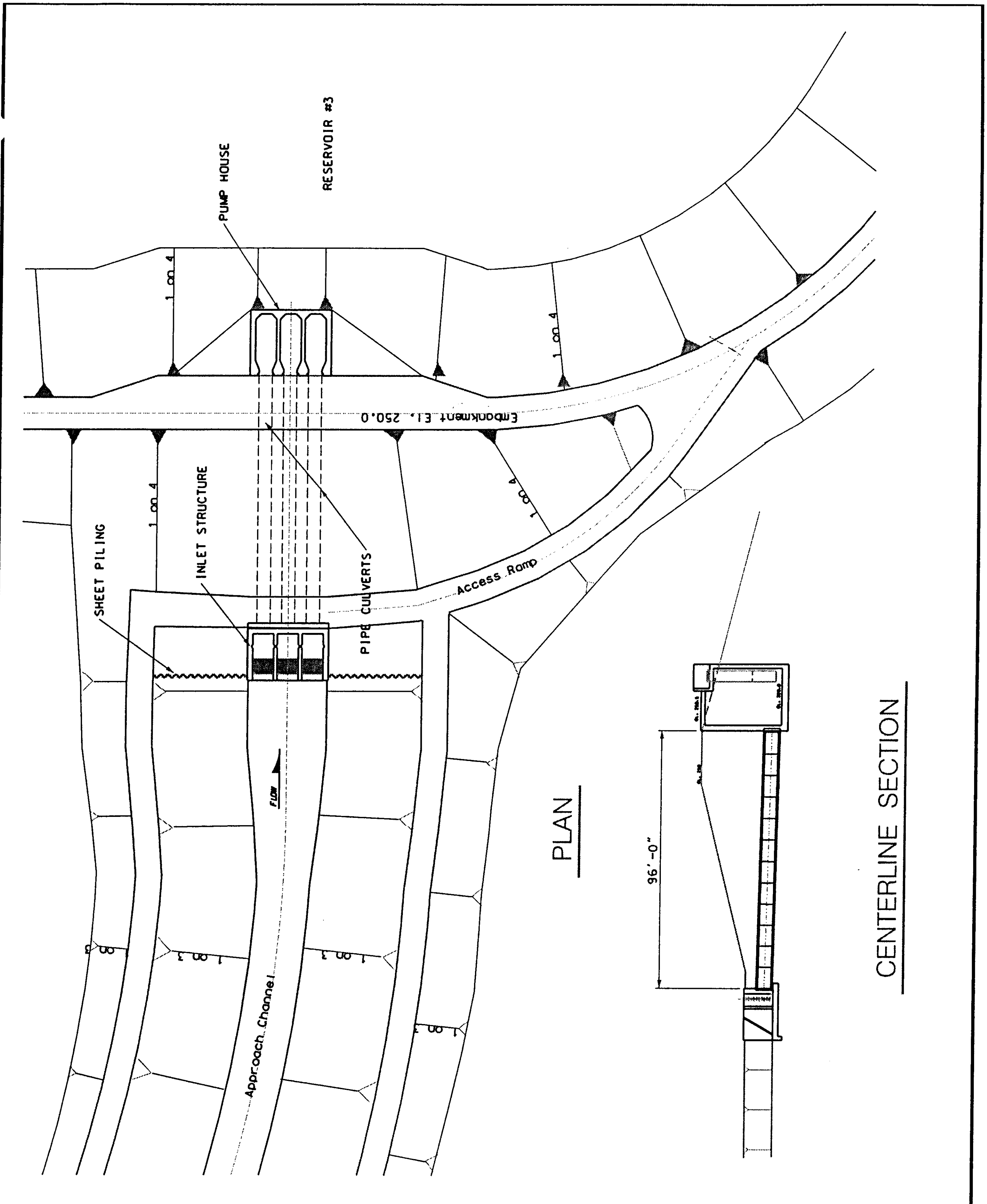

## SITE PLAN
SCALE 1" = 200'

US Army Corps of Engineers

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEER
MEMPHIS, TENNESSEE

BAYOU METO COMPREHENSIVE STUDY
BAYOU METO BASIN
PUMPING STATION NO. 3
SITE PLAN

PLATE
V-L-1

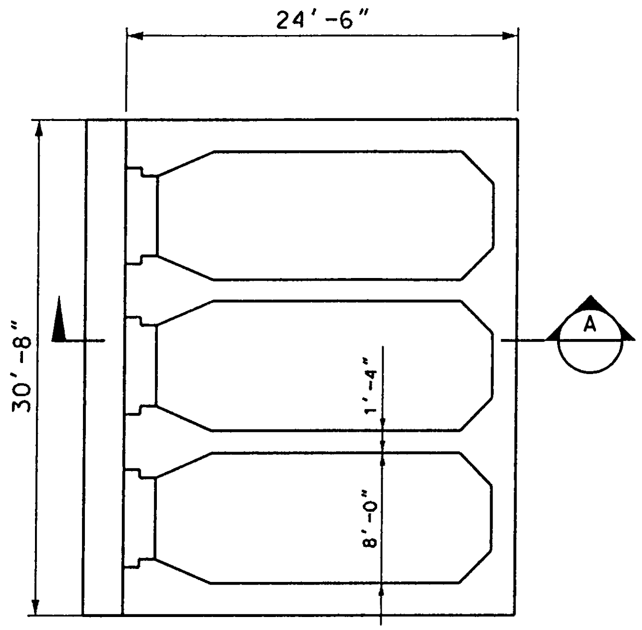



US Army Corps of Engineers

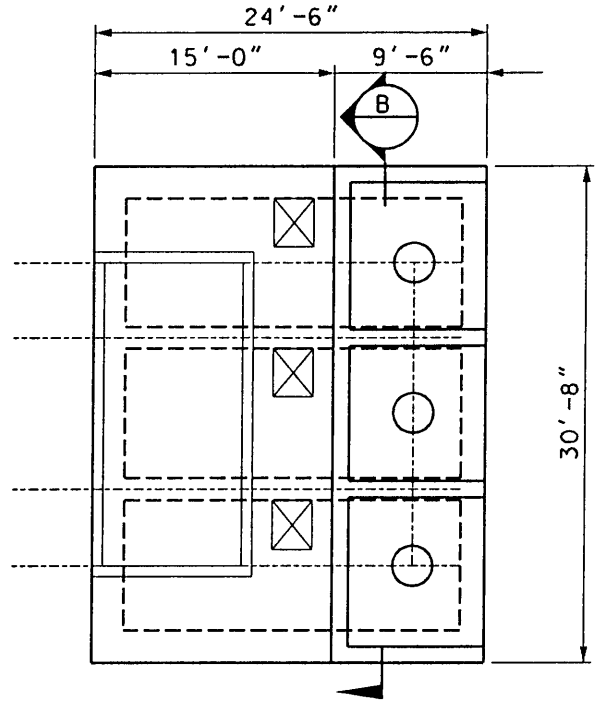
U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEER
MEMPHIS, TENNESSEE

BAYOU METO BASIN COMPREHENSIVE STUDY
BAYOU METO BASIN
PUMPING STATION NO. 3
PLAN AND PROFILE

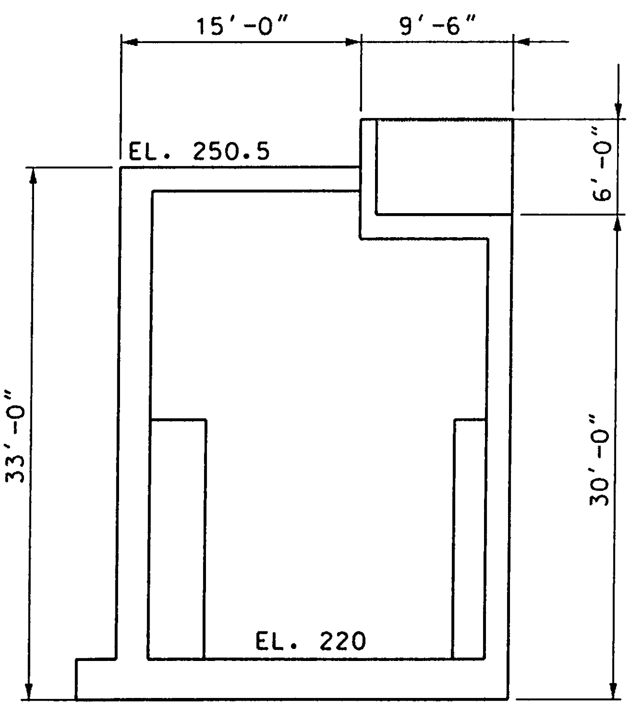
PLATE
V–L–2



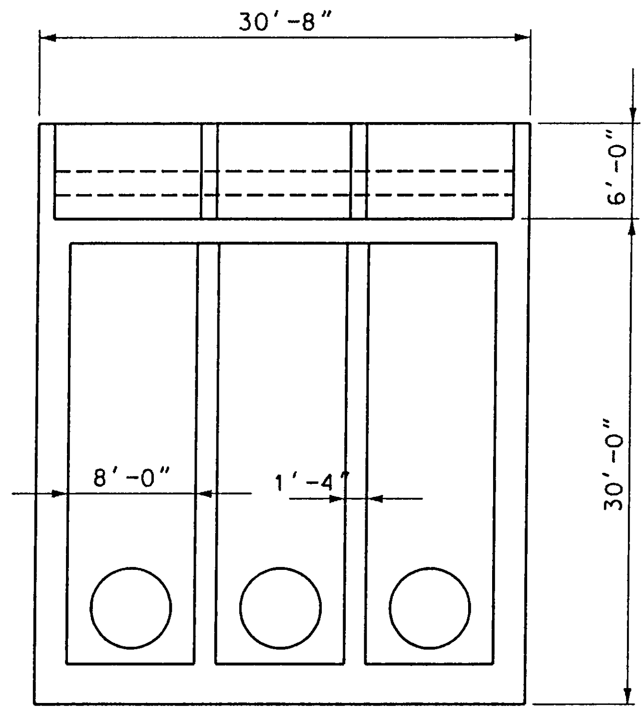

PLAN - EL. 220.0




PLAN - EL. 250.5




SECTION - A



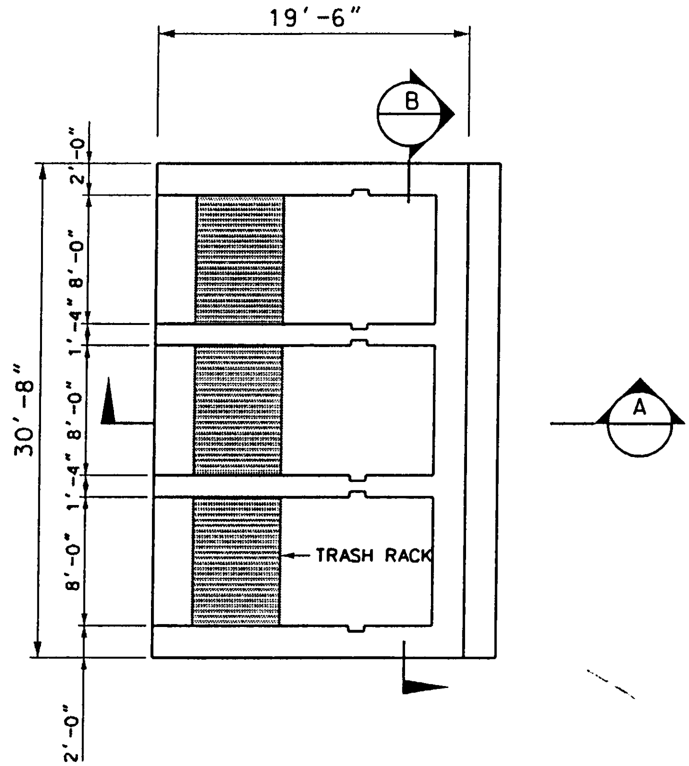

SECTION - B

US Army Corps of Engineers

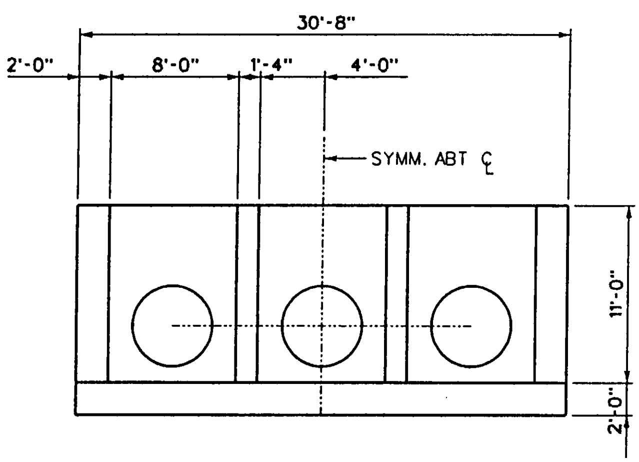
U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEER
MEMPHIS, TENNESSEE

BAYOU METO BASIN COMPREHENSIVE STUDY
BAYOU METO BASIN
PUMPING STATION NO. 3
PUMPHOUSE - PLANS AND SECTIONS

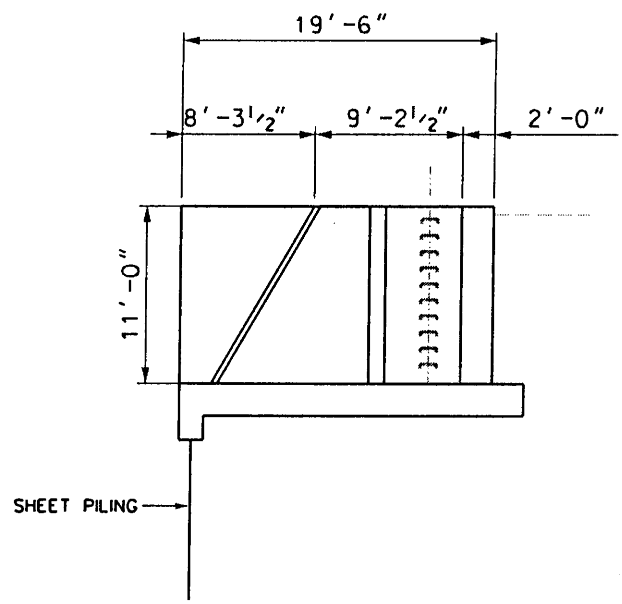
PLATE
V-L-3




PLAN




SECTION - B



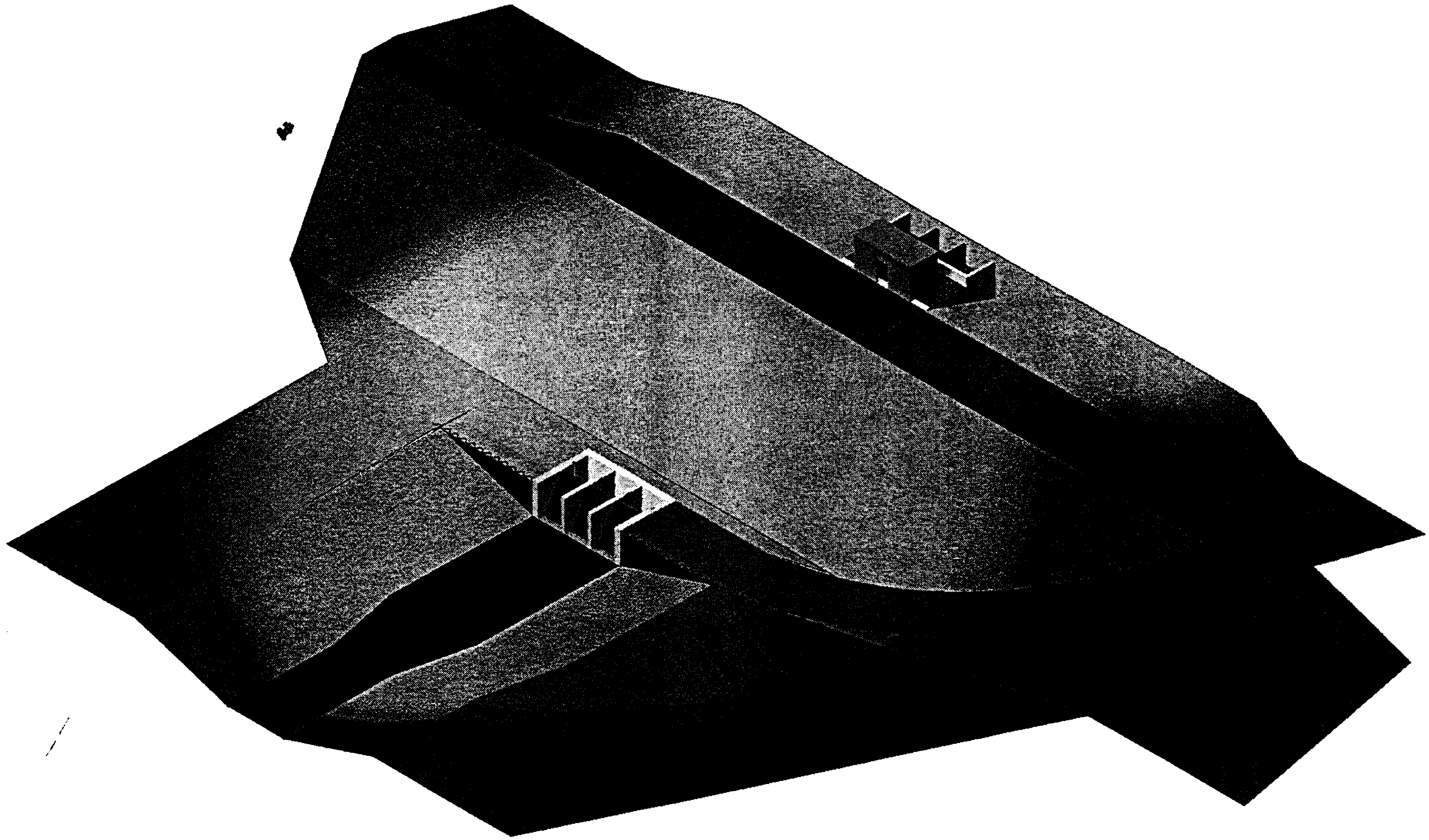

SECTION - A

US Army Corps of Engineers

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEER
MEMPHIS, TENNESSEE

BAYOU METO BASIN COMPREHENSIVE STUDY
BAYOU METO BASIN
PUMPING STATION NO. 3
INLET STRUCTURE - PLAN AND SECTIONS

PLATE
V-L-4

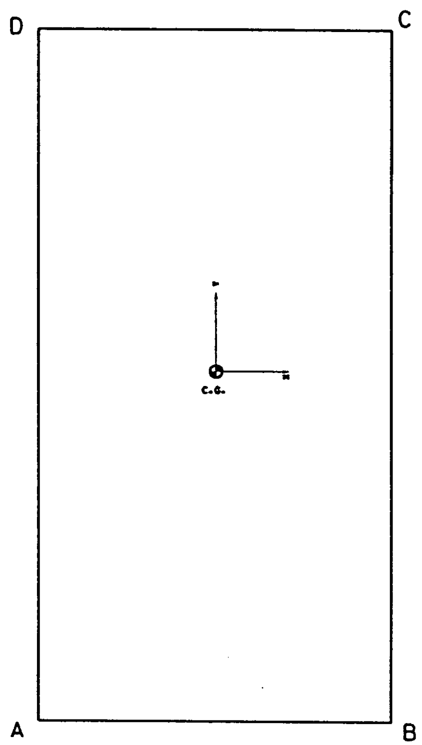


US Army Corps
of Engineers

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEER
MEMPHIS, TENNESSEE

EASTERN ARKANSAS REGION COMPREHENSIVE STUDY
BAYOU METO BASIN
PUMPING STATION NO. 3
PERSPECTIVE

PLATE
V-L-5




LOADING CONDITION

CASE I — CONSTRUCTION CONDITION:STRUCTURE COMPLETE WITH EQUIPMENT IN PLACE. MOIST BACKFILL EXERTING AT REST SOIL PRESSURE. SITE DEWATERED. NO UPLIFT.

CASE II-A — OPERATING CONDITION:PUMP FLOW: MAXIMUM SUMP(EL. 235.0): MAXIMUM LAKE POOL(EL. 247.0): AT REST SOIL PRESSURE:UPLIFT ACTING.

CASE II-B — OPERATING CONDITION:PUMP FLOW: MINIIMUM SUMP(EL. 229.35): MINIMUM LAKE POOL(EL. 245.0): AT REST SOIL PRESSURE:UPLIFT ACTING.

CASE III — EXTREME MAINTENANCE CONDITION:CASE II-B WITH ONE EXTERIOR PUMP BAY DEWATERED: AT REST SOIL PRESSURE:UPLIFT ACTING.

CASE IV A-B EARTHQUAKE CONDITION:CASE II-B COMBINED WITH EARTHQUAKE FORCES EARTHQUAKE ACCELERATION CONSIDERED BOTH PERPENDICULAR AND PARALLEL TO FLOW.

| CASE | LOAD IN KIPS | | ECCENTRICITY | | NET FOUNDATION PRESSURE (KSF) | | | |
|---|---|---|---|---|---|---|---|---|
| | Pv | Ph | ex | ey | A | B | C | D |
| I | 1658 | 457 | +3.70 | 0 | 0.21 | 4.20 | 4.20 | 0.21 |
| II-A | 1130 | 107 | +0.68 | 0 | 1.25 | 1.76 | 1.76 | 1.25 |
| II-B | 1102 | 138 | +1.20 | 0 | 1.04 | 1.90 | 1.90 | 1.04 |
| III | 988 | 138 | +1.31 | +1.08 | 0.32 | 1.30 | 2.30 | 1.34 |
| IV | 1102 | 177 | +1.83 | 0 | 0.81 | 2.12 | 2.12 | 0.81 |

US Army Corps of Engineers

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEER
MEMPHIS, TENNESSEE

BAYOU METO COMPREHENSIVE STUDY
BAYOU METO BASIN
PUMPING STATION NO. 3
FOUNDATION PRESSURE

PLATE
V-L-6

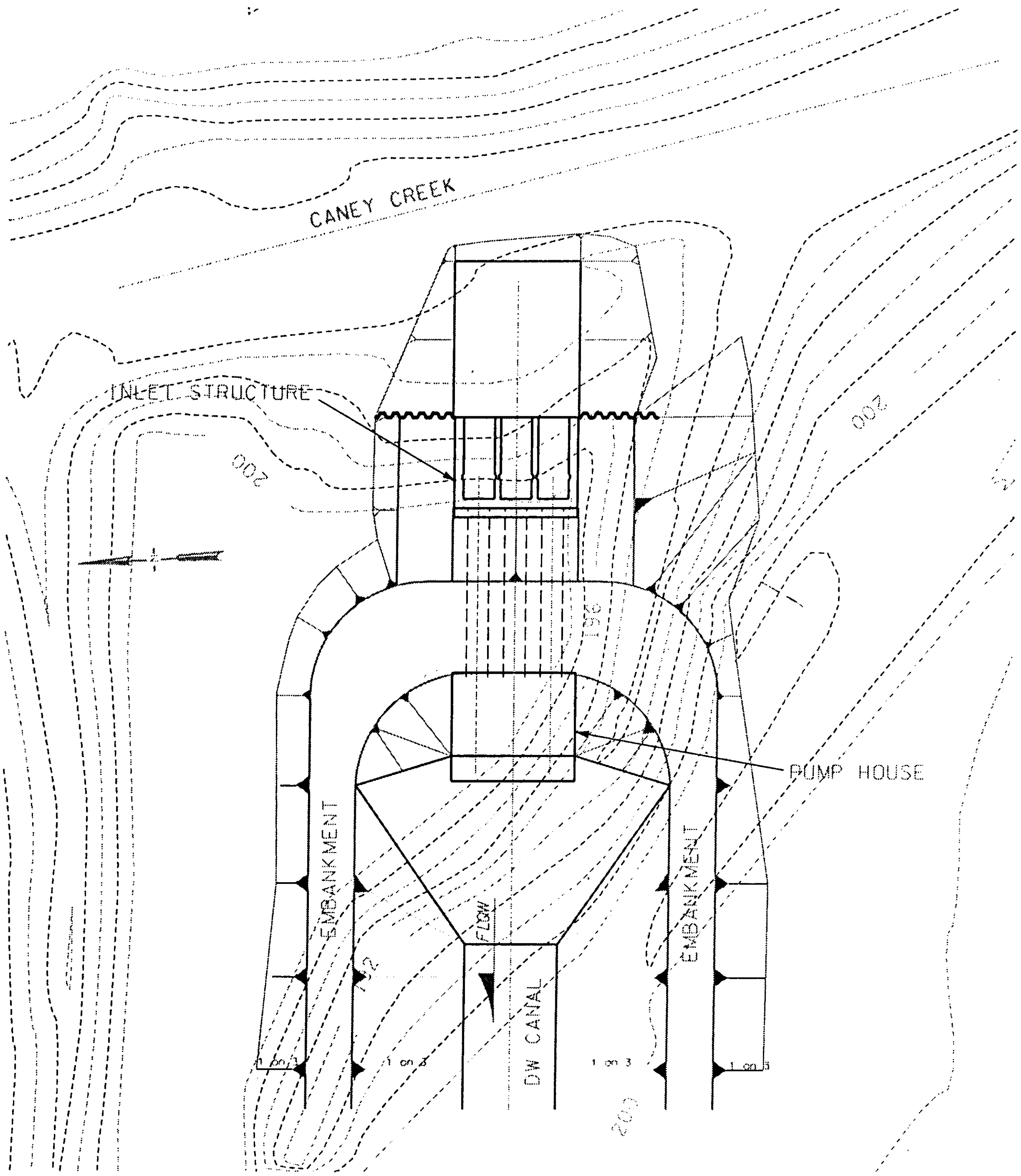
# Bayou Meto Basin Project
## Conceptual Design of Bayou Meto Basin Pumping Stations

# APPENDIX M

# BAYOU METO PUMPING STATION NO. 4

# STRUCTURAL DESIGN DEVELOPMENT

U.S. Army Corps of Engineers
Memphis District



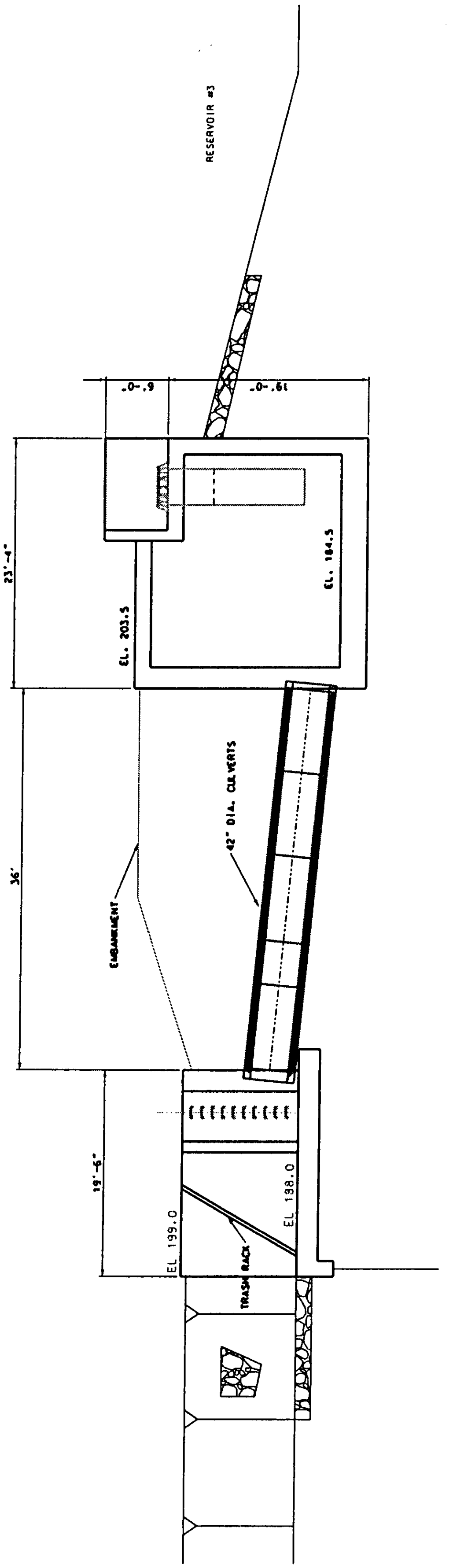

# SITE PLAN

US Army Corps of Engineers

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEER
MEMPHIS, TENNESSEE

BAYOU METO BASIN COMPREHENSIVE STUDY
BAYOU METO BASIN
PUMPING STATION NO. 4
SITE PLAN

PLATE
V–M–I




CENTERLINE SECTION

US Army Corps of Engineers

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEER
MEMPHIS, TENNESSEE

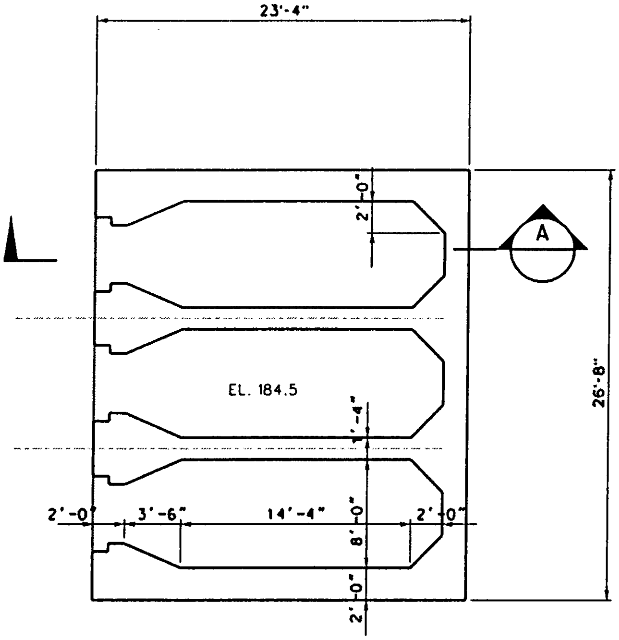
BAYOU METO BASIN COMPREHENSIVE STUDY
BAYOU METO BASIN

PUMPING STATION NO. 4

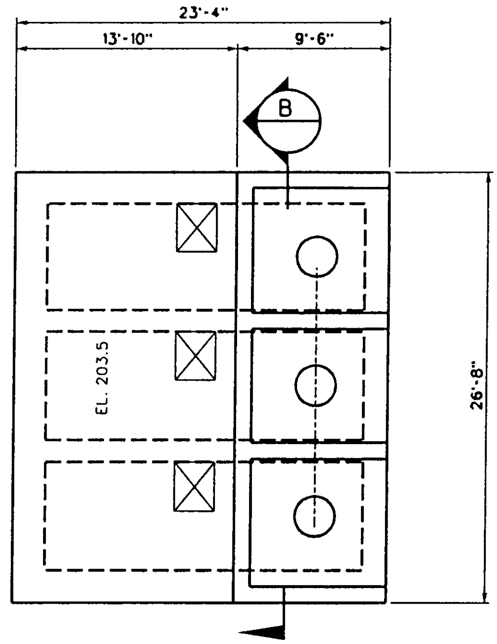
CENTERLINE SECTION

PLATE

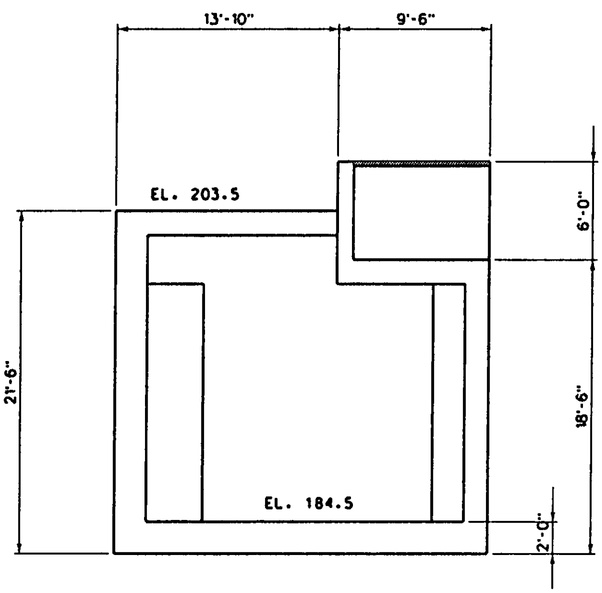
V–M–2



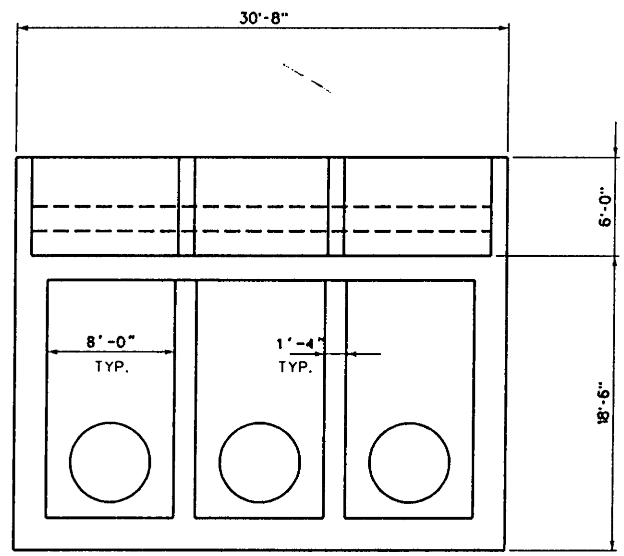

PLAN - EL. 184.5




PLAN - EL. 203.5




SECTION - A



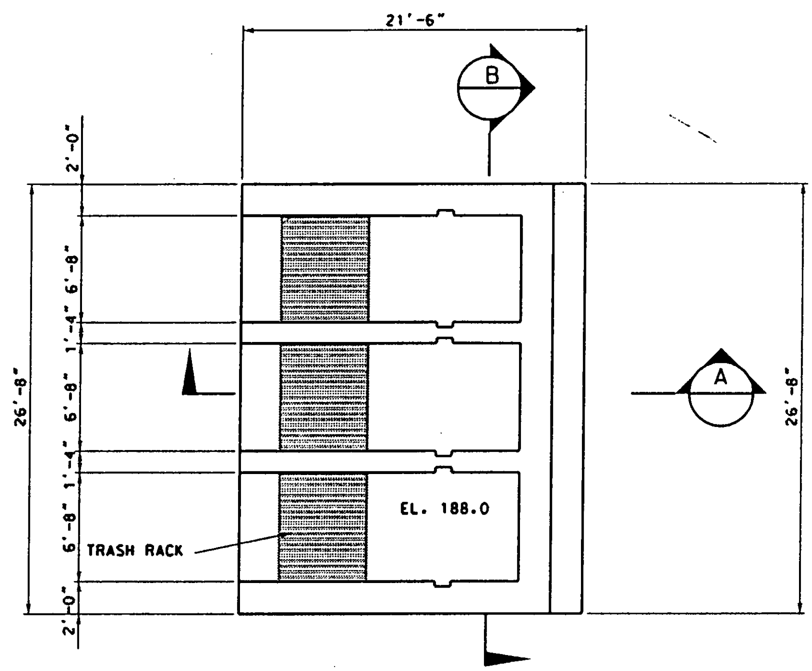

SECTION - B

US Army Corps of Engineers

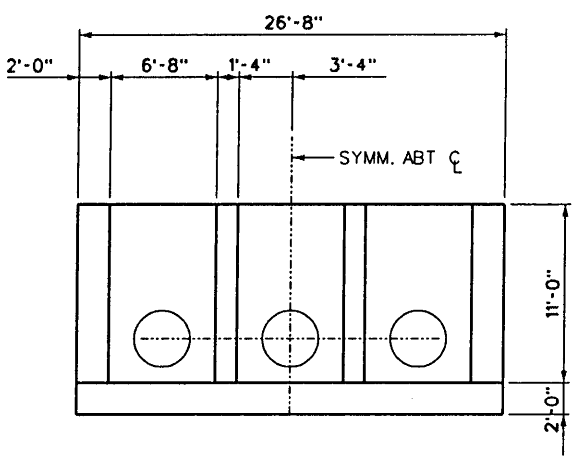
U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEER
MEMPHIS, TENNESSEE

BAYOU METO BASIN COMPREHENSIVE STUDY
BAYOU METO BASIN
PUMPING STATION NO. 4
PUMPHOUSE - PLANS AND SECTIONS

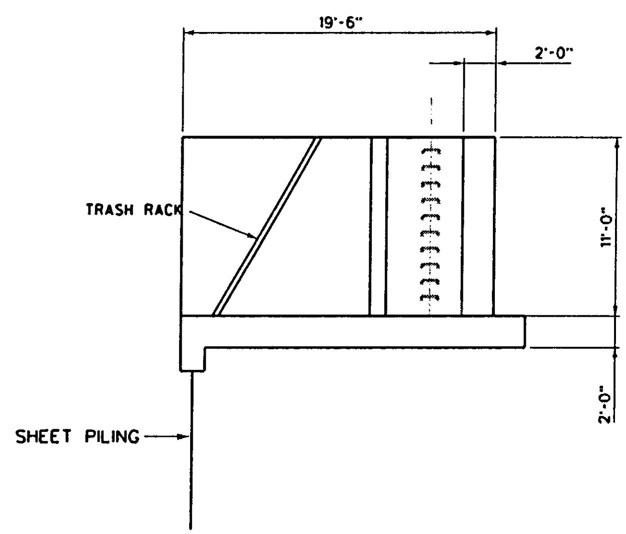
PLATE
V-M-3




PLAN




SECTION - B



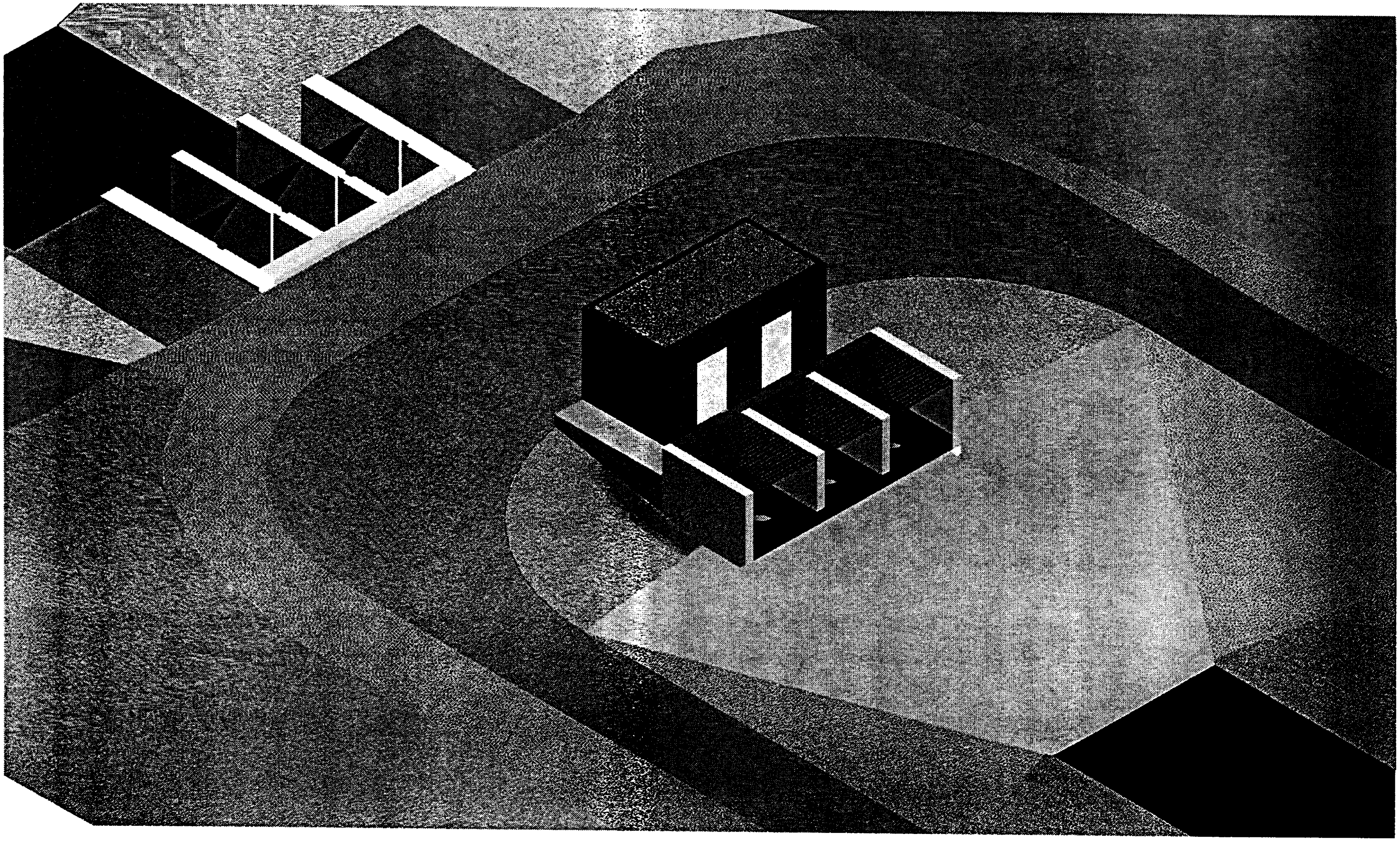

SECTION - A

US Army Corps of Engineers

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEER
MEMPHIS, TENNESSEE

BAYOU METO BASIN COMPREHENSIVE STUDY
BAYOU METO BASIN
PUMPING STATION NO. 4
INLET STRUCTURE - PLAN AND SECTIONS

PLATE
V-M-4

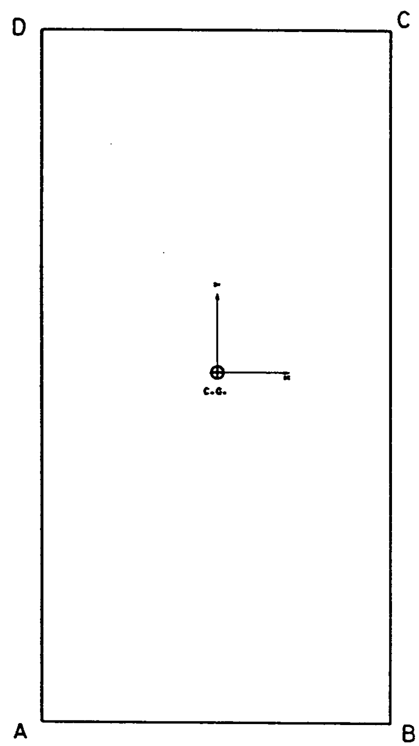


US Army Corps of Engineers

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEER
MEMPHIS, TENNESSEE

BAUOU METO COMPREHENSIVE STUDY
BAYOU METO BASIN
PUMPING STATION NO. 4
PERSPECTIVE

PLATE
V–M–5




LOADING CONDITION

CASE I CONSTRUCTION CONDITION:STRUCTURE COMPLETE WITH EQUIPMENT IN PLACE. MOIST BACKFILL EXERTING AT REST SOIL PRESSURE. SITE DEWATERED. NO UPLIFT.

CASE II-A OPERATING CONDITION:PUMP FLOW: MAXIMUM SUMP(EL. 235.0): MAXIMUM LAKE POOL(EL. 247.0): AT REST SOIL PRESSURE:UPLIFT ACTING.

CASE II-B OPERATING CONDITION:PUMP FLOW: MINIIMUM SUMP(EL. 229.35): MINIMUM LAKE POOL(EL. 245.0): AT REST SOIL PRESSURE:UPLIFT ACTING.

CASE III EXTREME MAINTENANCE CONDITION:CASE II-B WITH ONE EXTERIOR PUMP BAY DEWATERED: AT REST SOIL PRESSURE:UPLIFT ACTING.

CASE IV A-B EARTHQUAKE CONDITION:CASE II-B COMBINED WITH EARTHQUAKE FORCES EARTHQUAKE ACCELERATION CONSIDERED BOTH PERPENDICULAR AND PARALLEL TO FLOW.

| CASE | LOAD IN KIPS | | ECCENTRICITY | | NET FOUNDATION PRESSURE (KSF) | | | |
|---|---|---|---|---|---|---|---|---|
| | Pv | Ph | ex | ey | A | B | C | D |
| I | 1658 | 457 | +3.70 | 0 | 0.21 | 4.20 | 4.20 | 0.21 |
| II-A | 588 | 83 | +0.64 | 0 | 0.66 | 0.91 | 0.91 | 0.66 |
| II-B | 764 | 113 | +1.28 | 0 | 0.70 | 1.34 | 1.34 | 0.70 |
| III | 762 | 113 | +1.28 | +0.02 | 0.64 | 1.37 | 1.39 | 0.66 |
| IV | 764 | 177 | +2.53 | 0 | 0.39 | 1.65 | 1.65 | 0.39 |

US Army Corps of Engineers

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEER
MEMPHIS, TENNESSEE

BAYOU METO COMPREHENSIVE STUDY
BAYOU METO BASIN
PUMPING STATION NO. 4
FOUNDATION PRESSURE

PLATE
V-M-6

# Bayou Meto Basin Project
## Conceptual Design of Bayou Meto Basin Pumping Stations

# APPENDIX N

# BAYOU METO BASIN PUMPING STATIONS

# DESIGN DEVELOPMENT, CONSTRUCTION COST ESTIMATE

U.S. Army Corps of Engineers
Memphis District

BAYOU METO PUMPING STATION #1 - 1750 CFS

| | | | | |
|---|---|---|---|---|
| Discount Rate = 7.75 | | | | |
| **BAYOU METO PUMPING STATION #1 - 1750 CFS** | | | | |
| I. FIRST COST OF PUMPING STATION | | | | |
| | | | | |
| DESCRIPTION | PRICE | QUANTITY | UNIT | TOTAL |
| CIVIL | | | | |
| MOBILIZATION & DEMOBILIZATION | 50,000.00 | 1 | LS | 50,000.00 |
| CLEARING & GRUBBING | 25,000.00 | 1 | LS | 25,000.00 |
| ASPHALT ROAD | 45,000.00 | 1 | LS | 45,000.00 |
| DEWATERING | 500,000.00 | 1 | LS | 500,000.00 |
| COFFERDAM | 174,000.00 | 1 | LS | 174,000.00 |
| STRUCTURAL EXCAVATION | 2.50 | 21,000 | CY | 52,500.00 |
| RANDOM BACKFILL | 3.00 | 6,800 | CY | 20,400.00 |
| GRANULAR BACKFILL | 10.00 | 15,000 | CY | 150,000.00 |
| | | | | |
| **TOTAL FIRST COST CIVIL** | | | | 1,016,900.00 |
| | | | | |
| STRUCTURAL - SUBSTRUCTURE | | | | |
| REINFORCED CONCRETE | | | | |
| SLAB ON GRADE | 350.00 | 1,220 | CY | 427,000.00 |
| ELEVATED SLABS | 350.00 | 1,500 | CY | 525,000.00 |
| VERTICAL WALLS | 350.00 | 2,880 | CY | 1,008,000.00 |
| | | | | |
| STRUCTURAL - SUPERSTRUCTURE | | | | |
| REINFORCED CONCRETE | 350.00 | 550 | CY | 192,500.00 |
| DECORATIVE CONCRETE BLOCK WALL | 6.30 | 7,000 | SF | 44,100.00 |
| METAL DOORS | 550.00 | 8 | EA | 4,400.00 |
| WINDOWS | 300.00 | 4 | EA | 1,200.00 |
| 12 x 14 ROLL UP DOOR | 2,625.00 | 1 | EA | 2,625.00 |
| SUSPENDED CEILING | 1.20 | 1,000 | SF | 1,200.00 |
| 10 FOOT HIGH STUD WALL | 25.60 | 100 | LF | 2,560.00 |
| SHEET ROCK WALL | 0.80 | 1,250 | SF | 1,000.00 |
| BUILT-UP ROOFING | 3.00 | 4,600 | SF | 13,800.00 |
| STRUCTURAL STEEL (CRANE RAIL) | 600.00 | 20 | TON | 12,000.00 |
| GRATING (2 - 6 X 16 - SUPPORT TRUCKS) | 25.00 | 40 | SF | 1,000.00 |
| MISCELLANEOUS METALS | 5,000.00 | 1 | LS | 5,000.00 |
| | | | | |
| **TOTAL FIRST COST STRUCTURAL** | | | | 2,241,385.00 |

BAYOU METO PUMPING STATION #1 - 1750 CFS

| DESCRIPTION | PRICE | QUANTITY | UNIT | TOTAL |
|---|---|---|---|---|
| MECHANICAL | | | | |
| 68x72 VERTICAL PUMP (1) | 287,500.00 | 4 | EA | 1,150,000.00 |
| 1500 HP RIGHT ANGLE GEAR REDUCER (1) | 112,000.00 | 4 | EA | 448,000.00 |
| 1500 HP INDUCTION MOTOR (1) | 138,000.00 | 4 | EA | 552,000.00 |
| 42x48 VERTICAL PUMP (1) | 175,000.00 | 2 | EA | 350,000.00 |
| 500 HP RIGHT ANGLE GEAR RECUCER (1) | 22,000.00 | 2 | EA | 44,000.00 |
| 500 HP INDUCTION MOTOR | 30,500.00 | 2 | EA | 61,000.00 |
| DISCHARGE PIPE -48" diameter | 340.00 | 180 | LF | 61,200.00 |
| DISCHARGE PIPE - 78" diameter | 490.00 | 350 | LF | 171,500.00 |
| DRESSER COUPLING - 78" diameter | 3,500.00 | 20 | EA | 70,000.00 |
| DRESSER COUPLING - 48" diameter | 820.00 | 16 | EA | 13,120.00 |
| FLEXIBLE CHECK VALVE - 48" | 17,500.00 | 1 | EA | 17,500.00 |
| FLEXIBLE CHECK VALVE - 78" | 57,200.00 | 1 | EA | 57,200.00 |
| PLUMBING | 52,000.00 | 1 | JOB | 52,000.00 |
| TRASH RACKS | 71,000.00 | 6 | EA | 426,000.00 |
| OVERHEAD TRAVELING CRANE | 200,000.00 | 1 | JOB | 200,000.00 |
| SUMP DEWATERING SYSTEM | 50,000.00 | 1 | JOB | 50,000.00 |
| FLOOR DRAINAGE SYSTEM | 65,000.00 | 1 | JOB | 65,000.00 |
| COMPRESSED AIR SYSTEM (PUMPS/TANK) | 75,000.00 | 1 | JOB | 75,000.00 |
| POTABLE WATER WELL - FULLY DEVELOPED | 50,000.00 | 1 | JOB | 50,000.00 |
| HEAT/AIR CONDITIONING | 9,500.00 | 1 | JOB | 9,500.00 |
| MOBILE CRANE | 250,000.00 | 1 | EA | 250,000.00 |
| SEWAGE DISPOSAL | 7,500.00 | 1 | JOB | 7,500.00 |
| REFRIGERATOR | 1,516.00 | 1 | JOB | 1,516.00 |
| ELECTRIC RANGE & VENTILATOR HOOD | 1,060.00 | 1 | JOB | 1,060.00 |
| ELEVATOR/HYDRAULIC EQUIPMENT (2) | 40,000.00 | 1 | JOB | 40,000.00 |
| MOTORIZED ROOF VENTILATORS (3) | 3,167.25 | 6 | EA | 19,003.50 |
| COMBINATION LOUVERS W/ MOTORS (4) | 700.00 | 6 | EA | 4,200.00 |
| | | | | |
| TOTAL FIRST COST MECHANICAL | | | | 4,246,299.50 |
| | | | | |
| ELECTRICAL | | | | |
| LIGHTING | 36,192.00 | 1 | JOB | 36,192.00 |
| GROUNDING SYSTEM | 936.00 | 1 | JOB | 936.00 |
| WIRE AND CABLE | 180,765.00 | 1 | JOB | 180,765.00 |
| ALARM SYSTEM | 19,600.00 | 1 | JOB | 19,600.00 |
| TRANSFORMERS | 6,000.00 | 1 | JOB | 6,000.00 |
| 4160 VOLT MOTOR CONTROL CENTER | 90,487.00 | 1 | JOB | 90,487.00 |
| 480 VOLT MOTOR CONTROL CENTER | 73,900.00 | 1 | JOB | 73,900.00 |
| SAFETY SWITCHES | 13,400.00 | 1 | JOB | 13,400.00 |
| WATER LEVEL SENSORS | 10,500.00 | 1 | JOB | 10,500.00 |
| COMMUNICATIONS | 3,500.00 | 1 | JOB | 3,500.00 |
| CONTROL ROOM | 18,600.00 | 1 | JOB | 18,600.00 |
| SWITCHGEAR (MAIN) AND BUSWORK | 104,700.00 | 1 | JOB | 104,700.00 |
| SUBSTATION | 1,200,000.00 | 1 | JOB | 1,200,000.00 |
| TRANSMISSION LINE | 800,000.00 | 1 | JOB | 800,000.00 |
| MISCELLANEOUS | 140,000.00 | 1 | JOB | 140,000.00 |
| | | | | |
| TOTAL FIRST COST ELECTRICAL | | | | 2,698,580.00 |
| | | | | |
| TOTAL FIRST COST | | | | 10,203,164.50 |

# BAYOU METO PUMPING STATION #1 - 1750 CFS

| | PLANT COST | LIFE | L.C.C. | ANNUAL COST |
|---|---|---|---|---|
| II.REPLACEMENT COST | | | | |
| PUMP IMPELLERS (20%) | 230,000.00 | 40 | 12,202 | 946.20 |
| ELECTRIC MOTOR STATOR (40%) | 220,800.00 | 35 | 17,383 | 1,347.99 |
| MOTOR CONTROL CENTERS | 164,387.00 | 35 | 12,942 | 1,003.59 |
| ROOF (46 SQUARES) | 13,800.00 | 20 | 3,990 | 309.40 |
| | | | | |
| IV.OPERATING COST | | | | |
| LABOR | | | 2,966,041 | 230,000.00 |
| ENERGY CHARGES (5) | | | 28,726,313 | 2,227,566.00 |
| | | | | |
| V.SUMMARY | | | | |
| TOTAL FIRST COST MECHANICAL | | | 4,246,300 | 329,276.94 |
| TOTAL FIRST COST ELECTRICAL | | | 2,698,580 | 209,259.89 |
| TOTAL FIRST COST CIVIL | | | 1,016,900 | 78,854.95 |
| TOTAL FIRST COST STRUCTURAL | | | 2,241,385 | 173,806.96 |
| REPLACEMENT COST | | | 46,518 | 3,607.18 |
| OPERATING COST | | | 31,692,354 | 2,457,566.00 |
| | | | | |
| **TOTAL** | | | 41,942,036 | 3,252,371.90 |

(1) Cost quoted from the Patterson Pump Co.

(2) Cost quoted from Dover Elevators, Memphis,TN.

(3) Cost quoted from Gorham - Schaffler, Inc., Memphis, TN., a Greenheck Representative

(4) Cost quoted from Mills - Wilson - George, Memphis, TN., an Industrial Louver representative.

(5) Based on quote from Entergy Arkansas, Inc.

BAYOU METO PUMPING STATION #2 - 625 CFS

| | | | | |
|---|---|---|---|---|
| Discount Rate = 7.75 | | | | |
| **BAYOU METO PUMPING STATION #2 - 625 CFS** | | | | |
| I. FIRST COST OF PUMPING STATION | | | | |
| | | | | |
| DESCRIPTION | PRICE | QUANTITY | UNIT | TOTAL |
| CIVIL | | | | |
| MOBILIZATION & DEMOBILIZATION | 25,000.00 | 1 | LS | 25,000.00 |
| CLEARING & GRUBBING | 15,000.00 | 1 | LS | 15,000.00 |
| ASPHALT ROAD | 40,000.00 | 1 | LS | 40,000.00 |
| DEWATERING | 250,000.00 | 1 | LS | 250,000.00 |
| COFFERDAM | 100,000.00 | 1 | LS | 100,000.00 |
| STRUCTURAL EXCAVATION | 2.50 | 2,830 | CY | 7,075.00 |
| RANDOM BACKFILL | 3.00 | 1,880 | CY | 5,640.00 |
| GRANULAR BACKFILL | 10.00 | 3,000 | CY | 30,000.00 |
| | | | | |
| **TOTAL FIRST COST CIVIL** | | | | 472,715.00 |
| | | | | |
| STRUCTURAL - SUPERSTRUCTURE | | | | |
| PRE-FABRICATED CONCRETE BUILDING | 50,000.00 | 1 | LS | 50,000.00 |
| | | | | |
| STRUCTURAL - SUBSTRUCTURE | | | | |
| REINFORCED CONCRETE | 350.00 | 752 | CY | 263,200.00 |
| MISCELLANEOUS METALS | 5,000.00 | 1 | LS | 5,000.00 |
| | | | | |
| **TOTAL FIRST COST STRUCTURAL** | | | | 318,200.00 |
| | | | | |
| DESCRIPTION | PRICE | QUANTITY | UNIT | TOTAL |
| MECHANICAL | | | | |
| 54" DROP-IN SUBMERSIBLE PUMP (1) | 186,000.00 | 5 | EA | 930,000.00 |
| DISCHARGE PIPE -48" diameter | 340.00 | 180 | LF | 61,200.00 |
| DRESSER COUPLING - 48" diameter | 820.00 | 25 | EA | 20,500.00 |
| FLEXIBLE CHECK VALVE - 48" | 17,500.00 | 5 | EA | 87,500.00 |
| TRASH RACKS | 30,000.00 | 5 | EA | 150,000.00 |
| PORTABLE DEWATERING PUMP | 5,000.00 | 1 | JOB | 5,000.00 |
| HEAT/AIR CONDITIONING | 3,000.00 | 1 | JOB | 3,000.00 |
| | | | | |
| **TOTAL FIRST COST MECHANICAL** | | | | 1,257,200.00 |

## BAYOU METO PUMPING STATION #2 - 625 CFS

| DESCRIPTION | PRICE | QUANTITY | UNIT | TOTAL |
|---|---|---|---|---|
| ELECTRICAL | | | | |
| LIGHTING | 13,300.00 | 1 | JOB | 13,300.00 |
| GROUNDING SYSTEM | 8,900.00 | 1 | JOB | 8,900.00 |
| WIRE AND CABLE | 18,320.00 | 1 | JOB | 18,320.00 |
| ELECTRICAL TUBING AND FITTINGS | 25,830.00 | 1 | JOB | 25,830.00 |
| TRANSFORMERS | 16,300.00 | 1 | JOB | 16,300.00 |
| 4160 VOLT MOTOR CONTROL CENTER | 264,500.00 | 1 | JOB | 264,500.00 |
| DISTRIBUTION PANELBOARD AND BREAKERS | 9,050.00 | 1 | JOB | 9,050.00 |
| SAFETY SWITCHES | 13,500.00 | 1 | JOB | 13,500.00 |
| WATER LEVEL SENSORS | 8,000.00 | 1 | JOB | 8,000.00 |
| COMMUNICATIONS | 2,200.00 | 1 | JOB | 2,200.00 |
| AUTOMATIC CONTROLS | 28,500.00 | 1 | JOB | 28,500.00 |
| LIGHTNING PROTECTION | 13,000.00 | 1 | JOB | 13,000.00 |
| SUBSTATION & TRANSMISSION LINE | 214,000.00 | 1 | JOB | 214,000.00 |
| MISCELLANEOUS | 158,850.00 | 1 | JOB | 158,850.00 |
| | | | | |
| **TOTAL FIRST COST ELECTRICAL** | | | | 794,250.00 |
| **TOTAL FIRST COST** | | | | 2,842,365.00 |
| | | | | |
| | PLANT COST | LIFE | L.C.C. | ANNUAL COST |
| II.REPLACEMENT COST | | | | |
| PUMP IMPELLERS (20%) | 93,000.00 | 40 | 4,934 | 382.60 |
| ELECTRIC MOTOR STATOR (40%) | 186,000.00 | 35 | 14,644 | 1,135.53 |
| MOTOR CONTROL CENTERS | 273,550.00 | 35 | 21,536 | 1,670.03 |
| | | | | |
| IV.OPERATING COST | | | | |
| LABOR | | | 644,792 | 50,000.00 |
| ENERGY CHARGES (2) | | | 10,292,652 | 798,138.00 |
| | | | | |
| V.SUMMARY | | | | |
| TOTAL FIRST COST MECHANICAL | | | 1,257,200 | 97,488.88 |
| TOTAL FIRST COST ELECTRICAL | | | 794,250 | 61,589.68 |
| TOTAL FIRST COST CIVIL | | | 472,715 | 36,656.42 |
| TOTAL FIRST COST STRUCTURAL | | | 318,200 | 24,674.64 |
| REPLACEMENT COST | | | 41,114 | 3,188.16 |
| OPERATING COST | | | 10,937,444 | 848,138.00 |
| | | | | |
| **TOTAL** | | | 13,820,923 | 1,071,735.77 |

(1) Cost quoted from Jack Tyler Engineering, Memphis, Tn, a Flygt Pump Representative

(2) Based on quote from Entergy Arkansas, Inc.

BAYOU METO PUMPING STATION #3 - 260 CFS

| | | | | |
|---|---|---|---|---|
| Discount Rate = 7.75 | | | | |
| **BAYOU METO PUMPING STATION #3 - 260 CFS** | | | | |
| I. FIRST COST OF PUMPING STATION | | | | |
| | | | | |
| DESCRIPTION | PRICE | QUANTITY | UNIT | TOTAL |
| CIVIL | | | | |
| MOBILIZATION & DEMOBILIZATION | 25,000.00 | 1 | LS | 25,000.00 |
| CLEARING & GRUBBING | 15,000.00 | 1 | LS | 15,000.00 |
| ASPHALT ROAD | 40,000.00 | 1 | LS | 40,000.00 |
| DEWATERING | 250,000.00 | 1 | LS | 250,000.00 |
| COFFERDAM | 100,000.00 | 1 | LS | 100,000.00 |
| STRUCTURAL EXCAVATION | 2.50 | 2,400 | CY | 6,000.00 |
| RANDOM BACKFILL | 3.00 | 1,780 | CY | 5,340.00 |
| GRANULAR BACKFILL | 10.00 | 500 | CY | 5,000.00 |
| | | | | |
| **TOTAL FIRST COST CIVIL** | | | | 446,340.00 |
| | | | | |
| STRUCTURAL - SUPERSTRUCTURE | | | | |
| PRE-FABRICATED CONCRETE BUILDING | 50,000.00 | 1 | LS | 50,000.00 |
| | | | | |
| STRUCTURAL - SUBSTRUCTURE | | | | |
| REINFORCED CONCRETE | 350.00 | 370 | CY | 129,500.00 |
| MISCELLANEOUS METALS | 5,000.00 | 1 | LS | 5,000.00 |
| | | | | |
| **TOTAL FIRST COST STRUCTURAL** | | | | 184,500.00 |
| | | | | |
| DESCRIPTION | PRICE | QUANTITY | UNIT | TOTAL |
| MECHANICAL | | | | |
| 48" DROP-IN SUBMERSIBLE PUMP (1) | 101,000.00 | 3 | EA | 303,000.00 |
| 60" DIAMETER CONCRETE CULVERT | 120.00 | 270 | LF | 32,400.00 |
| TRASH RACKS | 30,000.00 | 3 | EA | 90,000.00 |
| PORTABLE DEWATERING PUMP | 5,000.00 | 1 | JOB | 5,000.00 |
| HEAT/AIR CONDITIONING | 3,000.00 | 1 | JOB | 3,000.00 |
| | | | | |
| **TOTAL FIRST COST MECHANICAL** | | | | 433,400.00 |

## BAYOU METO PUMPING STATION #3 - 260 CFS

| DESCRIPTION | PRICE | QUANTITY | UNIT | TOTAL |
|---|---|---|---|---|
| ELECTRICAL | | | | |
| LIGHTING | 9,600.00 | 1 | JOB | 9,600.00 |
| GROUNDING SYSTEM | 5,200.00 | 1 | JOB | 5,200.00 |
| WIRE AND CABLE | 19,200.00 | 1 | JOB | 19,200.00 |
| TRANSFORMERS | 12,600.00 | 1 | JOB | 12,600.00 |
| ELECTRICAL TUBING AND FITTINGS | 22,130.00 | 1 | JOB | 22,130.00 |
| 480 VOLT MOTOR CONTROL CENTER | 63,000.00 | 1 | JOB | 63,000.00 |
| DISTRIBUTION PANELBOARD AND BREAKERS | 5,350.00 | 1 | JOB | 5,350.00 |
| SAFETY SWITCHES | 9,800.00 | 1 | JOB | 9,800.00 |
| WATER LEVEL SENSORS | 8,000.00 | 1 | JOB | 8,000.00 |
| COMMUNICATIONS | 2,200.00 | 1 | JOB | 2,200.00 |
| AUTOMATIC CONTROLS | 19,800.00 | 1 | JOB | 19,800.00 |
| LIGHTNING PROTECTION | 9,300.00 | 1 | JOB | 9,300.00 |
| SUBSTATION | 213,700.00 | 1 | JOB | 213,700.00 |
| MISCELLANEOUS | 99,970.00 | 1 | JOB | 99,970.00 |
| | | | | |
| **TOTAL FIRST COST ELECTRICAL** | | | | 499,850.00 |
| **TOTAL FIRST COST** | | | | 1,564,090.00 |
| | | | | |
| | | | | |
| | | | | |
| | PLANT COST | LIFE | L.C.C. | ANNUAL COST |
| II.REPLACEMENT COST | | | | |
| PUMP IMPELLERS (20%) | 30,300.00 | 40 | 1,607 | 124.65 |
| ELECTRIC MOTOR STATOR (40%) | 60,600.00 | 35 | 4,771 | 369.96 |
| MOTOR CONTROL CENTERS | 68,350.00 | 35 | 5,381 | 417.28 |
| | | | | |
| IV.OPERATING COST | | | | |
| LABOR | | | 644,792 | 50,000.00 |
| ENERGY CHARGES (2) | | | 2,062,391 | 159,927.00 |
| | | | | |
| V.SUMMARY | | | | |
| TOTAL FIRST COST MECHANICAL | | | 433,400 | 33,607.76 |
| TOTAL FIRST COST ELECTRICAL | | | 499,850 | 38,760.59 |
| TOTAL FIRST COST CIVIL | | | 446,340 | 34,611.19 |
| TOTAL FIRST COST STRUCTURAL | | | 184,500 | 14,306.95 |
| REPLACEMENT COST | | | 11,760 | 911.89 |
| OPERATING COST | | | 2,707,183 | 209,927.00 |
| | | | | |
| **TOTAL** | | | 4,283,033 | 332,125.39 |

(1) Cost quoted from Jack Tyler Engineering, a Representative of Flygt Pump

(2) Based on quote from First Electric Cooperative

BAYOU METO PUMPING STATION #4 - 125 CFS

| | | | | |
|---|---|---|---|---|
| Discount Rate = 7.75 | | | | |
| **BAYOU METO PUMPING STATION #4 - 125 CFS** | | | | |
| I. FIRST COST OF PUMPING STATION | | | | |
| | | | | |
| DESCRIPTION | PRICE | QUANTITY | UNIT | TOTAL |
| CIVIL | | | | |
| MOBILIZATION & DEMOBILIZATION | 25,000.00 | 1 | LS | 25,000.00 |
| CLEARING & GRUBBING | 15,000.00 | 1 | LS | 15,000.00 |
| ASPHALT ROAD | 40,000.00 | 1 | LS | 40,000.00 |
| DEWATERING | 250,000.00 | 1 | LS | 250,000.00 |
| COFFERDAM | 100,000.00 | 1 | LS | 100,000.00 |
| STRUCTURAL EXCAVATION | 2.50 | 1,400 | CY | 3,500.00 |
| RANDOM BACKFILL | 3.00 | 1,010 | CY | 3,030.00 |
| GRANULAR BACKFILL | 10.00 | 500 | CY | 5,000.00 |
| | | | | |
| **TOTAL FIRST COST CIVIL** | | | | 441,530.00 |
| | | | | |
| STRUCTURAL - SUPERSTRUCTURE | | | | |
| PRE-FABRICATED CONCRETE BUILDING | 30,000.00 | 1 | LS | 30,000.00 |
| | | | | |
| STRUCTURAL - SUBSTRUCTURE | | | | |
| REINFORCED CONCRETE | 350.00 | 240 | CY | 84,000.00 |
| MISCELLANEOUS METALS | 5,000.00 | 1 | LS | 5,000.00 |
| | | | | |
| **TOTAL FIRST COST STRUCTURAL** | | | | 119,000.00 |
| | | | | |
| DESCRIPTION | PRICE | QUANTITY | UNIT | TOTAL |
| MECHANICAL | | | | |
| 40" DROP-IN SUBMERSIBLE PUMP (1) | 60,000.00 | 3 | EA | 180,000.00 |
| 42" DIAMETER CONCRETE CULVERT | 96.00 | 120 | LF | 11,520.00 |
| TRASH RACKS | 30,000.00 | 3 | EA | 90,000.00 |
| PORTABLE DEWATERING PUMP | 5,000.00 | 1 | JOB | 5,000.00 |
| HEAT/AIR CONDITIONING | 3,000.00 | 1 | JOB | 3,000.00 |
| | | | | |
| **TOTAL FIRST COST MECHANICAL** | | | | 289,520.00 |

# BAYOU METO PUMPING STATION #4 - 125 CFS

| DESCRIPTION | PRICE | QUANTITY | UNIT | TOTAL |
|---|---|---|---|---|
| ELECTRICAL | | | | |
| LIGHTING | 9,600.00 | 1 | JOB | 9,600.00 |
| GROUNDING SYSTEM | 5,200.00 | 1 | JOB | 5,200.00 |
| WIRE AND CABLE | 10,700.00 | 1 | JOB | 10,700.00 |
| ELECTTRICAL TUBING AND FITTINGS | 22,130.00 | 1 | JOB | 22,130.00 |
| TRANSFORMERS | 12,600.00 | 1 | JOB | 12,600.00 |
| 480 VOLT MOTOR CONTROL CENTER | 37,100.00 | 1 | JOB | 37,100.00 |
| DISTRIBUTION PANELBOARD AND BREAKERS | 5,350.00 | 1 | JOB | 5,350.00 |
| SAFETY SWITCHES | 9,800.00 | 1 | JOB | 9,800.00 |
| WATER LEVEL SENSORS | 8,000.00 | 1 | JOB | 8,000.00 |
| COMMUNICATIONS | 2,200.00 | 1 | JOB | 2,200.00 |
| AUTOMATIC CONTROLS | 19,800.00 | 1 | JOB | 19,800.00 |
| LIGHTNING PROTECTION | 9,300.00 | 1 | JOB | 9,300.00 |
| SUBSTATION | 466,700.00 | 1 | JOB | 466,700.00 |
| MISCELLANEOUS | 154,620.00 | 1 | JOB | 154,620.00 |
| **TOTAL FIRST COST ELECTRICAL** | | | | 773,100.00 |
| **TOTAL FIRST COST** | | | | 1,623,150.00 |
| | | | | |
| | PLANT COST | LIFE | L.C.C. | ANNUAL COST |
| II.REPLACEMENT COST | | | | |
| PUMP IMPELLERS (20%) | 18,000.00 | 40 | 955 | 74.05 |
| ELECTRIC MOTOR STATOR (40%) | 36,000.00 | 35 | 2,834 | 219.78 |
| MOTOR CONTROL CENTERS | 42,450.00 | 35 | 3,342 | 259.16 |
| IV.OPERATING COST | | | | |
| LABOR | | | 644,792 | 50,000.00 |
| ENERGY CHARGES (5) | | | 903,675 | 70,075.00 |
| V.SUMMARY | | | | |
| TOTAL FIRST COST MECHANICAL | | | 289,520 | 22,450.67 |
| TOTAL FIRST COST ELECTRICAL | | | 773,100 | 59,949.61 |
| TOTAL FIRST COST CIVIL | | | 441,530 | 34,238.20 |
| TOTAL FIRST COST STRUCTURAL | | | 119,000 | 9,227.79 |
| REPLACEMENT COST | | | 7,131 | 552.99 |
| OPERATING COST | | | 1,548,467 | 120,075.00 |
| **TOTAL** | | | 3,178,748 | 246,494.26 |
| (1) Cost quoted from Jack Tyler Engineering, Memphis, Tn, a representative of Flygt Pump | | | | |
| (2) Based on quote from First Electric Cooperative | | | | |

# SECTION VI – RELOCATIONS

## VI-1. GENERAL.

a. Purpose, Extent and Scope. The purpose of the relocations studies included in this report is to identify the roads, bridges and utilities (used by and serving the public) which will be impacted by this project, and to estimate the cost of providing for the continuing function of the facilities that will be required to be altered during the construction of this project.

The extent of the relocations required was determined after considering existing conditions; present and contemplated uses by the owners; criteria for relocations; and general project economics evaluated from field investigations, engineering analysis and cost studies.

The scope of work on which the estimated cost of relocations is based was determined from field investigations of all facility sites that will be impacted by the construction of this project and discussions with utility owners. The work, if implemented, will consist primarily of building bridges across new canals, replacing bridges across existing channels and altering utilities associated with the building of the bridges.

b. Estimates. The estimates for the relocations of all affected facilities were developed by the Vicksburg District based on the information from field investigations of each affected site and on the best available unit prices, estimates from utility owners and on cost records for similar relocations in the past.

## VI-2. ROADS AND BRIDGES.

New bridges at the sites where new canals cross existing roads and replacement of bridges across existing channels will be required at 66 sites to adequately pass the design flows. The bridge designs are based on Arkansas State Highway Department of Transportation standards and current County bridge standards. A tabulation of the bridges is shown on Table VI-1. The cost of the bridges is included in the cost data presented in Appendix B, Section IX – Cost Engineering Report.

## VI-3. RAILROADS.

There are no railroads that will require altering to allow for construction of this project.

## VI-4. UTILITIES.

a. General. The proposed project will affect utilities at 159 locations within the project area. The utilities are primarily overhead electric lines, telephone cables, waterlines, gas service lines, fiber optic cables, ammonia pipelines and television cables.

b. <u>Utility Provisions.</u> The extent of utility alterations necessary to accommodate the project is predicated on providing horizontal and vertical clearance for project construction, operation and maintenance and to maintain utility service to the public. A list of the utilities to be altered is shown on Table VI-1. The cost of the utility alterations is included in the cost data presented in Appendix B, Section IX – Cost Engineering Report.

# TABLE VI-1
# RELOCATION REQUIREMENTS

## NEW CHANNELS

| REACH | CHANNEL NO./NAME | STATE HWY BRIDGES | COUNTY BRIDGES | POWER LINES | TELEPHONE CABLES | GAS PIPELINES | WATER LINES | AMMONIA PIPELINES | TV CABLES |
|---|---|---|---|---|---|---|---|---|---|
| 2 | 1000 | 3 | 3 | 4 | 6 | 2 | 3 | 1 | 1 |
| 4 | 1400 | 1 | 1 | 2 | 3 | 1 | | 1 | |
| 4 | 1410 | 1 | | 2 | 2 | | | 1 | |
| 2 | 2000 | | 3 | 3 | 2 | | 1 | | |
| 5 | 2100 | 1 | 3 | 2 | 3 | 3 | 1 | | |
| 5 | 2140 | | 3 | 2 | 2 | 2 | | | |
| 7B | 2260 | | 1 | 1 | 1 | 1 | 1 | | |
| 7B | 2280 | 1 | 3 | 3 | 3 | 1 | 2 | | |
| 9 | 2500 | 1 | 4 | 4 | 3 | 1 | 2 | | |
| 9 | 2510 | | 2 | 2 | 2 | 1 | 1 | | |
| 6 | 2520 | | 2 | 3 | 1 | | | | |
| 6 | 2531 | | 2 | 1 | 1 | 1 | | | |
| 10 | 3000 | 4 | 6 | 7 | 5 | 3 | 2 | | |
| 15 | 4000 | 1 | 1 | 2 | 2 | 1 | 1 | | |
| 15 | 4100 | | 1 | | 1 | | 1 | | |
| 17 | 4111 | 1 | 6 | 7 | 6 | 4 | 3 | | |
| 17 | 4112 | 1 | 4 | 6 | 4 | 4 | 2 | | |

## EXISTING CHANNELS

| REACH | CHANNEL NO./NAME | STATE HWY BRIDGES | COUNTY BRIDGES | POWER LINES | TELEPHONE CABLES | GAS PIPELINES | WATER LINES | AMMONIA PIPELINES | TV CABLES |
|---|---|---|---|---|---|---|---|---|---|
| 6 | 2530 | | | | | | | | |
| | Skinner | | 2 | 2 | 1 | | | | |
| 17 | 4110 | | | | | | | | |
| | Rickey | | 4 | 4 | 3 | 1 | 1 | | |

# Reference Maps

The purpose of this appendix is to present graphically the project area along with the features of the selected plan. Due to the magnitude and complexity of this project, all of the features could not be conveyed on a single set of maps. The coverage of the individual base maps coincides with the coverage presented on the standard 7-1/2 minute USGS quadrangles; however, the scale is set to 1:62,500, the same as the scale for a standard 15 minute USGS quadrangle. The USGS naming convention has been retained for the base maps. An index map showing spatial relationships of the individual maps is provided for easy reference. A composite map of the project area and a vicinity map of the eastern Arkansas regions are also included. For clarity, several series of these base maps have been generated with each series depicting a specific type or types of project features. The components comprising the various series of maps are discussed below. Detailed information regarding the specifics of the project features depicted can be obtained by referencing the text of the report.

**PROJECT MAP**
The project map is in essence the same as the base map. It includes a USGS quadrangle background, as well as major project features such as pipelines, canals, and ditches. It also includes the construction reach boundaries and the project boundary.

**CULVERTS AND BRIDGES**
Physical location and naming/numbering convention (when available) of culverts and bridges necessary to pass the water across existing roads and railroads is presented on this series of maps.

**HYDRAULIC STRUCTURES**
This series depicts the approximate physical location of hydraulic structures along the distribution system. These structures include weirs, siphons, drop structures, culverts, turnout structures, pump structures, and check structures.

**LANDUSE/LANDCOVER AND WETLANDS**
Wetland areas were developed by Vicksburg District and represent those areas within the project that are considered wetlands. Landuse/landcover data were also developed by Vicksburg District. The two layers were intersected to determine areas of impact to Forested and Cleared wetlands.

**PROPERTY OWNERSHIP**
Property ownership data was obtained from Marceline Mapping Services, Inc., for the project area in DXF format. This data was layered with other project area data to obtain property ownership information for areas where right-of-way would need to be obtained.

# PROJECT PLANNING AND DEVELOPMENT

## INVENTORY AND FORECAST RESOURCES

The collection, assimilation, management and utilization of data for a project of the magnitude and complexity of the Bayou Meto Basin, Arkansas, could not be efficiently accomplished without a data management system. This was even more important since the data would be collected, developed, analyzed, utilized, and shared by two Corps districts and numerous other parties outside the Corps. Easy transfer of data to and from a central data bank was essential to efficient execution of studies. In order to be compatible with existing in-house survey and mapping, computer-aided drafting and design (CADD), and database software, a Geographic Information System (GIS) was developed using Intergraph Microstation MGE software and ESRI Arcview.

### BASE MAPPING

Existing mapping of the Bayou Meto area consisted of U. S. Geological Survey quadrangle maps and associated Digital Line Graphics (DLG). The 1:24,000 scale maps were used for planning, engineering and design studies.

#### AERIAL PHOTOGRAPHY / SATELLITE IMAGERY

Project boundaries were established and aerial photography and satellite imagery for the project area was obtained. Based on the data needs and analyses required for the study and an evaluation of the cost associated with mapping of the area at various altitudes, it was determined that 30 meter satellite data would provide the level of detailed needed for the land cover and wetlands. It was also determined that 1 meter satellite imagery would provide the level of detailed needed to assist in planning and design. Imagery at this altitude provided current mapping at accuracy within acceptable design limits.

#### TOPOGRAPHIC INFORMATION

Channel cross sections along existing streams were obtained for hydraulic modeling and engineering design. Detailed surveys of the pumping stations and diversion sites along the existing streams and rivers were conducted. Other topographic information was obtained to meet the planning, engineering and design needs for the general reevaluation. All survey data was input into the model for improved accuracy.

### DATA COLLECTION AND ASSIMILATION

#### DATABASE & GEOGRAPHIC INFORMATION SYSTEM (GIS)

The topographical model was the base of the GIS system. Other information was input on levels that could be active or inactive depending on data needs. The structure and various layers of data contained within the GIS are shown in Table 3. Briefly, the GIS consist of base map data, hydrography, natural resources, and hydraulic features. Each of the data layers is described in the following sections. The true utility of the GIS lies in its ability to link tabular and graphical data. Along with all of the graphical features contained within the GIS, there exists a corresponding tabular entry containing descriptive information about each unique feature. Table 4 describes the tabular data for each of the data layers within the GIS.

**Table _.**
**BAYOU METO BASIN, ARKANSAS PROJECT**
**Summary of GIS Database**

| THEME/ CATEGORY | DESCRIPTION | SOURCE | FORMAT |
|---|---|---|---|
| Base Map | Physical Features (Roads, Railroads, Cities, Airports, | USGS 1:24,000 DLG | Intergraph MGE, Arcview |

| Table _.<br>BAYOU METO BASIN, ARKANSAS PROJECT<br>Summary of GIS Database | | | |
|---|---|---|---|
| **THEME/ CATEGORY** | **DESCRIPTION** | **SOURCE** | **FORMAT** |
| | etc.)<br>Jurisdictional (City Limits, County Lines, WRRIWDD Boundaries, etc.)<br>Property Lines & Ownership<br>Land Use/Land /Cover<br>Construction Items | <br>USGS 1:24,000 DLG<br><br><br>Farm Service Agency<br>Software<br>Project Design | <br>Intergraph MGE, Arcview<br><br><br>Intergraph MGE, Arcview<br>Intergraph MGE, Arcview<br>Intergraph MGE, Arcview |
| Hydrography | Rivers & Streams<br>Wetlands | USGS 1:24,000 DLG<br>USFWS - National Wetlands Inventory, 30m Satellite Imagery | Intergraph MGE, Arcview |
| Natural Resources | Forested Areas<br>Natural Areas<br>Soils | 30m Satellite Imagery<br>30 m Satellite Imagery<br>USDA | Intergraph MGE, Arcview<br>Intergraph MGE, Arcview<br>Arcview |
| Project Features | Canals and Pipelines<br>Structures<br>Ditches<br>Relocations<br><br>Canal & Pipeline Rights-Of-Way | Project Design<br>Project Design<br>Project Design<br>Hardcopy, Field Investigations<br>Project Design | Intergraph MGE, Arcview<br>Intergraph MGE, Arcview<br>Intergraph MGE, Arcview<br>Intergraph MGE, Arcview<br><br>Intergraph MGE, Arcview |

| Table _.<br>BAYOU METO BASIN, ARKANSAS PROJECT<br>Tabular Data Associated with Each<br>GIS Data Layer | | |
|---|---|---|
| **THEME/ CATEGORY** | **DESCRIPTION** | **TABULAR DATA** |
| Base Map | Roads<br><br>Property Lines & Ownership<br><br><br>Land Use/Land Cover<br>Construction Items | USGS Road Classification (Interstate, US Highway, State Highway, or County Road<br>FSA Identification Number; Township, Range, and Section Numbers; Owner and Operator Name and Address<br>Land Use/Land Cover Classification<br>Identification Number (Item Number) |
| Hydrography | Rivers & Streams<br>Wetlands | Stationing & Cross Section Data<br>NWI Wetlands Classification, COE Habitat Classification, Acreage |
| Natural Resources | Forested Areas<br>Natural Areas<br>Soils | COE Habitat Classification, Acreage<br>Land Class type<br>Soil Type |
| Project Features | Canals and Pipelines<br>Structures<br>Ditches<br>Canal and Pipeline Rights-Of-Way<br>Relocations | Identification Number<br>Identification Number<br>Identification Number<br>Identification Number<br>Type of Facility and Number of Each Location |

The REEGIS schema was modified to accommodate the structure needs of the database to meet the data needs of the study. GIS features and attributes were developed both in Intergraph MGE and ESRI Arcview environments and combined to an Arcview environment for analysis.

## LANDUSE

The base unit to which all landuse data is tied is the tract. A tract is a unit of land, identified by legal description and coordinate system, and having a unique Farm Service Agency (FSA) identification number. Section G of the NRCS Documentation Report, Volume 2, Appendix A, Section II provides detailed information on the FSA tract identification system. A farm may consist of a single tract or a group of tracts. Each individual farm also has an identification number. FSA maintains comprehensive records containing land use and cropping history for each farm tract participating in USDA farm programs. The FSA tract number was used as the record identifier for tract data.

Landuse was obtained from 30 meter satellite imagery and field inspection. Location, perimeter and area were calculated utilizing the GIS functionality. Base acreages are computed on a land cover type basis. Individual tracts were computed by overlaying the land use layer on the tract layer, clipping the land use to the tract boundaries. Acres were re-calculated. Other bodies of water (fish & wildlife lakes, treatment lagoons, irrigation reservoirs, etc.) and landuse (woodlands, pasture, prairie, etc.) were identified from the satellite imagery and as. location, type, perimeter and area were determined from the GIS software.

**Bayou Meto Study Team**
**25 June 2002**
**Summary Report for 1998 Surveys**

Geospatial Branch was tasked to procure surveys for thirty (30) streams/ditches. The 30 stream/ditches were subdivided into four (4) tasks. Task 1 consisted of Delivery Orders 24 & 25 and covered Little Bayou Meto (LBM), Crooked Creek (CC), Fishtrap Slough (FTS), Blue Point Ditch (BPD) and Big Bayou Meto (BBM). Task 2 consisted of Delivery Orders 26, 27 & 28 and covered Brooks Branch (BB), Skinners Branch (SKB), Shumaker Branch (SHB), White Oak Branch (WOB), Rickey Branch (RB), Cross Bayou (CBB), Flat Bayou (FB), Wabbeseka Bayou (WAB), Crooked Creek (CC), Main Ditch (MD) and Salt Bayou Ditch (SBD). Task 3 was completed by the Vicksburg District. Task 4 consisted of Delivery Order 29 and covered Crooked Creek Ditch (CCD), Crooked Creek (CC), Two Prairie Bayou (TPB) and Tributary to Two Prairie Bayou (TPT). And, Task 5 consisted of Delivery Order 30 and covered Indian Bayou (IB), Caney Creek Ditch (CACD), Old Caney Creek East (OCCE), Old Caney Creek West (OCCW), Caney Creek (CAC), Faras Run (FR) and Buck Creek (BC). The A-E services were provided by EMC, Inc. of Greenwood under contract DACW66-98-D-0007 and the above listed delivery orders.

**Delivery Order 24** consisted of 89 channel sections and 1 bridge section on Big Bayou Meto (BBM). All bridge sections are indicated with a "B" following the numeric identified, ex. BBM 1B. The cross section survey was performed by 4-man survey crews between the dates of 1 September and 17 September 1998. Topographic field data was collected utilizing a Topcon GTS-3B Total Station with data collector. The lateral limits for each section extended to 100 ft back of each top bank or to the toe of the levee where a levee was present. Hydrographic control was developed by the use of the Radiobeacon DGPS. The amount for delivery order 24 was **$126,567.35**.

**Delivery Order 25** consisted of 7 channel sections and 1 bridge section on Little Bayou Meto (LBM), 12 channel sections and 1 bridge section on Crooked Creek, 10 channel sections and 2 bridge sections on Fishtrap Slough (FTS) and 10 channel sections and 6 bridge sections on Blue Point Ditch (BPD). All bridge sections are indicated with a "B" following the numeric identified, ex. BBM 1B. The amount for delivery order 25 was **$54,007.46**.

**Delivery Order 26** consisted of 8 channel sections and 7 bridge sections on Brooks Branch (BB), 10 channel sections and 3 bridge sections on Skinners Branch (SKB), 9 channel sections and 6 bridge sections on Shumaker Branch (SHB), 9 channel sections and 5 bridge sections on White Oak Branch (WOB), and 14 channel sections and 11 bridge sections on Rickey Branch (RB). All bridge sections are indicated with a "B" following the numeric identified, ex. BBM 1B. The cross section survey was performed by 4-man survey crews between the dates of 16 September and 1 October 1998. Topographic field data was collected utilizing a Topcon GTS-3B Total Station with data collector. The lateral limits for each section extended to 100 ft back of each top bank or to the toe of the levee where a levee was present. Hydrographic control was developed by the use of the Radiobeacon DGPS. The amount for delivery order 26 was **$28,121.59.**

**Delivery Order 27** consisted of 8 channel sections and 7 bridge sections on Brooks Branch (BB), 10 channel sections and 3 bridge sections on Skinners Branch (SKB), 9 channel sections and 6 bridge sections on Shumaker Branch (SHB), 9 channel sections and 5 bridge sections on White Oak Branch (WOB), 14 channel sections and 11 bridge sections on Rickey Branch (RB). All bridge sections are indicated with a "B" following the numeric identified, ex. BBM 1B. The amount for delivery order 27 was **$54,721.08.**

**Delivery Order 28** consisted of 9 channel sections and 1 bridge section on Cross Bayou (CBB), 26 channel sections and 9 bridge sections on Flat Bayou (FB), 18 channel sections and 2 bridge sections on Wabbeseka Bayou (WAB), 20 channel sections and 9 bridge sections on Crooked Creek (CC), 18 channel sections on Crooked Creek Ditch (CCD), 6 channel sections and 2 bridge sections on Main Ditch (MD), and 10 channel sections and 1 bridge section on Salt Bayou Ditch (SBD). All bridge sections are indicated with a "B" following the numeric identified, ex. BBM 1B. The amount for delivery order 28 was **$147,404.76.**

**Delivery Order 29** consisted of 29 channel sections on Big Bayou Meto (BBM), 15 channel sections and 1 bridge section on Crooked Creek Ditch (CCD), 20 channel sections and 13 bridge sections on Crooked Creek (CC), 37 channel sections and 6 bridge sections on Two Prairie Bayou (TPB), and 8 channel sections and 3 bridge sections on the Tributary to Two Prairie Bayou (TPT). All bridge sections are indicated with a "B" following the numeric identified, ex. BBM 1B. The cross section survey was performed by 4-man survey crews in November 1998. Topographic field data was collected utilizing a Topcon GTS-3B Total Station with data collector. The lateral limits for each section extend to 100 ft back of each top bank or to the toe of the levee where a levee was present. The amount for delivery order 29 was **$116,304.36.**

**Delivery Order 30** consisted of 34 channel sections and 4 bridge sections on Indian Bayou Meto (IB), 10 channel sections on Caney Creek Ditch (CACD), 5 channel sections and 3 bridge sections on Old Caney Creek East (OCCE), 6 channel sections and 4 bridge sections on Old Caney Creek West (OCCW), 4 channel sections and 2 bridge sections on Caney Creek (CAC), 19 channel sections and 8 bridge sections on Faras Run (FR), and 10 channel sections and 5 bridge sections on Buck Creek (BC). All bridge sections are indicated with a "B" following the numeric identified, ex. BBM 1B. The cross section survey was performed by 4-man survey crews between the dates of December 1998 and January 1999. Topographic field data was collected utilizing a Topcon GTS-3B Total Station with data collector. The lateral limits for each section extend to 100 ft back of each top bank or to the toe of the levee where a levee was present. The amount for delivery order 30 was **$103,969.98.**

**Delivery Order 45** consisted of obtaining 500 ft intervals along the existing channel from the Arkansas River to the existing levee, a distance of approximately two miles. A longitudinal section was also requested along the crest of an existing rock dike located on the east side of the Arkansas River just upstream of the existing lock and dam. This section included the existing notch in the rock dike which allowed water to flow into the existing channel from the Arkansas River. Three cross sections were requested across the Arkansas River. These sections were located at the centerline of the existing notch in the rock dike and 500 ft upstream and downstream of the centerline of the notch. One cross section was also requested at the existing levee at the proposed location of the new canal. Channel sections were taken normal to the channel and extended at least 200 feet beyond top of bank along with 35 mm photographs made of the upstream channel. HEC-2 files were requested for all section data for sections ARS-1 to ARS-23. Sections were entered in order from downstream to upstream such that the downstream-most section (ARS-23) was at the top of the file. The amount for delivery order 45 was **$14,311.69**.

The total amount expended for 1998 was **$645,408.27**.

**Bayou Meto Study Team**
**27 September 2001**
**Summary Report**

Geospatial Branch (Survey Engineering) was tasked to procure surveys for Pumping Station #1 at the Arkansas River (Task Order # 47 and 57), Pumping Station #2 at Bayou Meto (Task Order # 48), Bayou Meto Interstate 40 Crossing (Baker's Bayou, Task Order # 49)), Pumping Station #3 at Bayou Two Prairie/North Side of Canal 1000 (Task Order #50 and 64) and Pumping Station #4 at Caney Creek (Task Order # 65).

**Pumping Station #1 at the Arkansas River** consisted of developing cross sectional data and a one ft DTM of the topographic area for proposed Pumping Station #1 at the Arkansas River. The survey also required establishing a new baseline along the inlet channel alignment. The survey was performed by 4-men and 2-men survey crews between the dates of November 20, 2000 and February 11, 2001. Control data was obtained by static GPS, conventional traversing and differential leveling methods using dual-frequency GPS receivers, total stations and automatic self-compensating levels. Topographic data was obtained by station-offset methods utilizing a Topcon self-compensating automatic level. Hydrographic data was collected by DGPS methods incorporating corrections provided by a Coast Guard beacon signal and a Trimble GPS receiver. The data was then processed in the office to develop the IGDS formatted file. The initial survey amount for Pumping Station # 1 was $59,933.80. Additional cross sectional and hydrographic data was also requested for Pumping Station #1. The survey was performed by 4-men and 2-men survey crews between the dates of April 4, 2001 and April 6, 2001. . Topographic data was obtained by station-offset methods utilizing a Topcon self-compensating automatic level. Hydrographic data was collected by DGPS methods incorporating corrections provided by a Coast Guard beacon signal and a Trimble GPS receiver. The data was then processed in the office to develop the IGDS formatted file. The additional survey amount was $7,608.84. The total amount for Pumping Station #1 at the Arkansas River was **$67,542.64**.

**Pumping Station #2 at Bayou Meto** consisted of developing cross sectional data up to the stream; a one ft DTM of the topographic area for proposed Pumping Station #2 at Bayou Meto; and install a third order baseline that ties into the levee. The survey was performed by a 4-men survey crew between the dates of November 21, 2000 and January 30, 2001. Control data was obtained by static GPS, conventional traversing and differential leveling methods using dual-frequency GPS receivers, total stations and automatic self-compensating levels. Topographic data was obtained by station-offset methods utilizing a Topcon self-compensating automatic level. Planimetric data was collected by total station data collection methods using TDS software loaded on Hewlett Packard Palmtop computers. The data was then processed in the office to develop the IGDS formatted file.
The amount for Pumping Station #2 was **$42,408.88**.

**Pumping Station #3 at Bayou Two Prairie/North Side of Canal 1000** consisted of developing cross sectional data and a one foot DTM of the topographic area for the proposed Pumping Station #3 at Bayou Two Prairie. The survey was performed by a 4-men survey crew between the dates of January 24, 2001 and March 19, 2001. Control data was obtained by static GPS, conventional traversing and differential leveling methods using dual-frequency GPS receivers, total stations and automatic self-compensating levels. Topographic data was obtained by station-offset methods utilizing a Topcon self-compensating automatic level and handheld data collector methods utilizing Topcon total stations. The data was then processed in the office to develop the IGDS formatted file. The amount for Pumping Station #3 at Bayou Two Prairie/North Side of Canal 1000 was **$86,911.92**.

**Pumping Station #3 at Bayou Two Prairie** consisted of developing cross sectional data and a DTM of the topographic area for proposed Pumping Station #3 at Bayou Two Prairie near Lonoke, AR. The survey required establishing eight (8) type "F" monuments for a baseline near the center of the project site. The survey was performed by a 4-men survey crew between the dates of June 12, 2001 and July 12, 2001. Control data was obtained by conventional traversing and differential leveling methods utilizing total stations and automatic self-compensating levels. Topographic data was obtained by station-offset methods utilizing a Topcon self-compensating automatic level and handheld data collector methods utilizing Topcon total stations. This data was then processed in the office to develop the IGDS formatted file. The amount for Pumping Station #3 at Bayou Two Prairie was **$31,721.12.**

**Pumping Station #4 at Caney Creek** consisted of developing cross sectional data and a DTM of the topographic area for proposed Pumping Station #4 at Caney Creek near Coy, AR. The survey required establishing two type "F" monuments and a temporary baseline along the west side of the project site. The survey was performed by a 4-men survey crew between the dates of May 31, 2001 and July 12, 2001. Control data was obtained by static GPS, conventional traversing and differential leveling methods using dual-frequency GPS receivers, total stations and automatic self-compensating levels. Topographic data was obtained by station-offset methods utilizing a Topcon self-compensating automatic level and handheld data collector methods utilizing Topcon total stations. This was then processed in the office to develop the IGDS formatted file. The amount for Pumping Station #4 at Caney Creek was **$17,089.36**.

**Interstate 40 Crossing (Baker's Bayou)** consisted of developing cross sectional data at 1000 ft intervals along the Bakers Bayou channel and 500 ft either side of the channel centerline. Any manmade structures, drainage and utilities within 200 ft of the channel were located. A hub or nail was established at each cross section along the left descending side of the channel. Three new Type "F" monuments were established during this survey. The survey was performed by a 4-men survey crew between the dates of March 7,2001 and April 18, 2001. Control data was obtained by DGPS, conventional traversing and differential leveling methods using dual-frequency GPS receivers, total stations and automatic self-compensating levels. Topographic data was obtained by station-offset methods utilizing a Topcon self-compensating automatic level. Planimentric data was collected by total station data collection methods using TDS software loaded on Hewlett-Packard Palmtop computers. This data was then processed in the office to develop the IGDS formatted file. The amount for Interstate 40 Crossing was **$53,971.40**.

The total bill for A-E services for Bayou Meto for FY01 was **$299,645.32**.