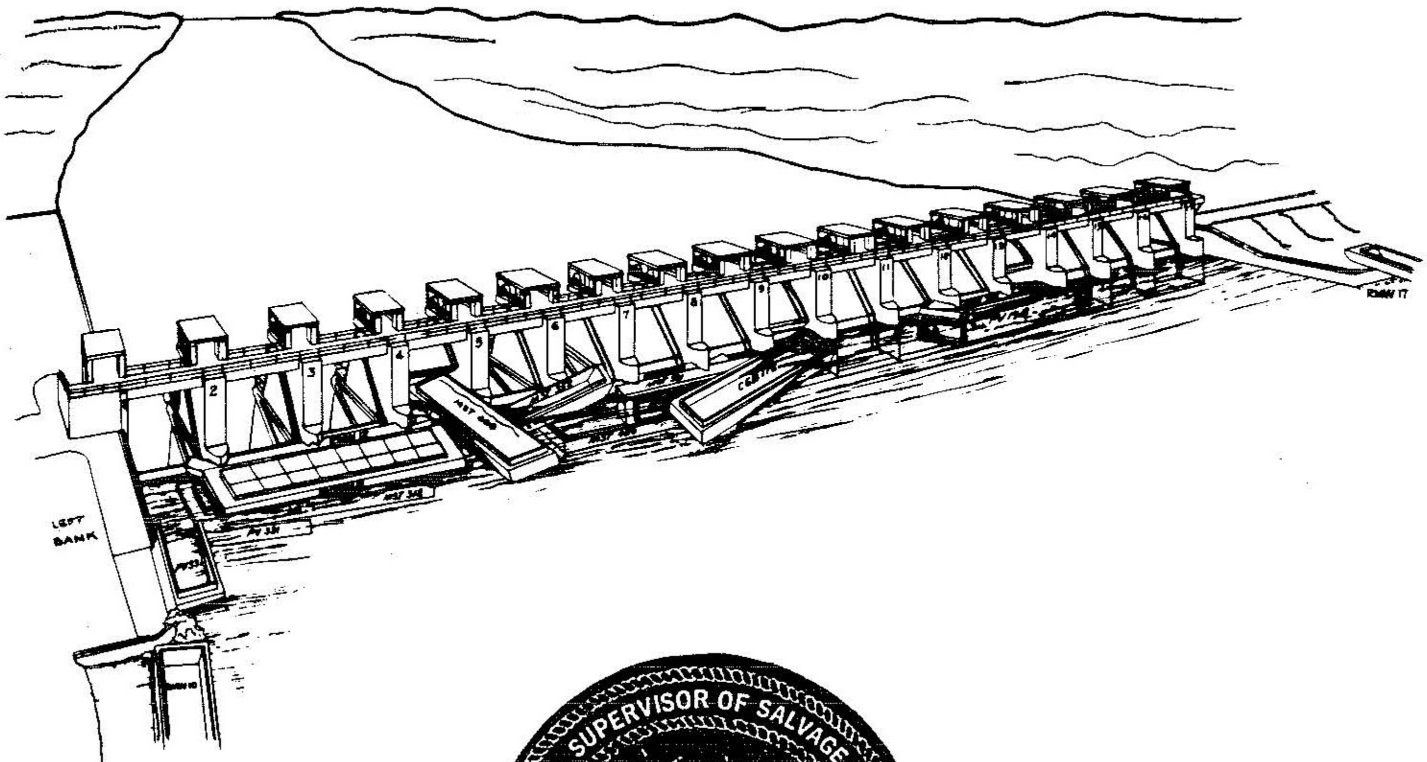
ARKANSAS RIVER
SALVAGE OPERATIONS
AT DAM NO. 2



SUPERVISOR OF SALVAGE
NAVAL SEA SYSTEMS COMMAND
DEPARTMENT OF THE NAVY
WASHINGTON, D.C. 20362
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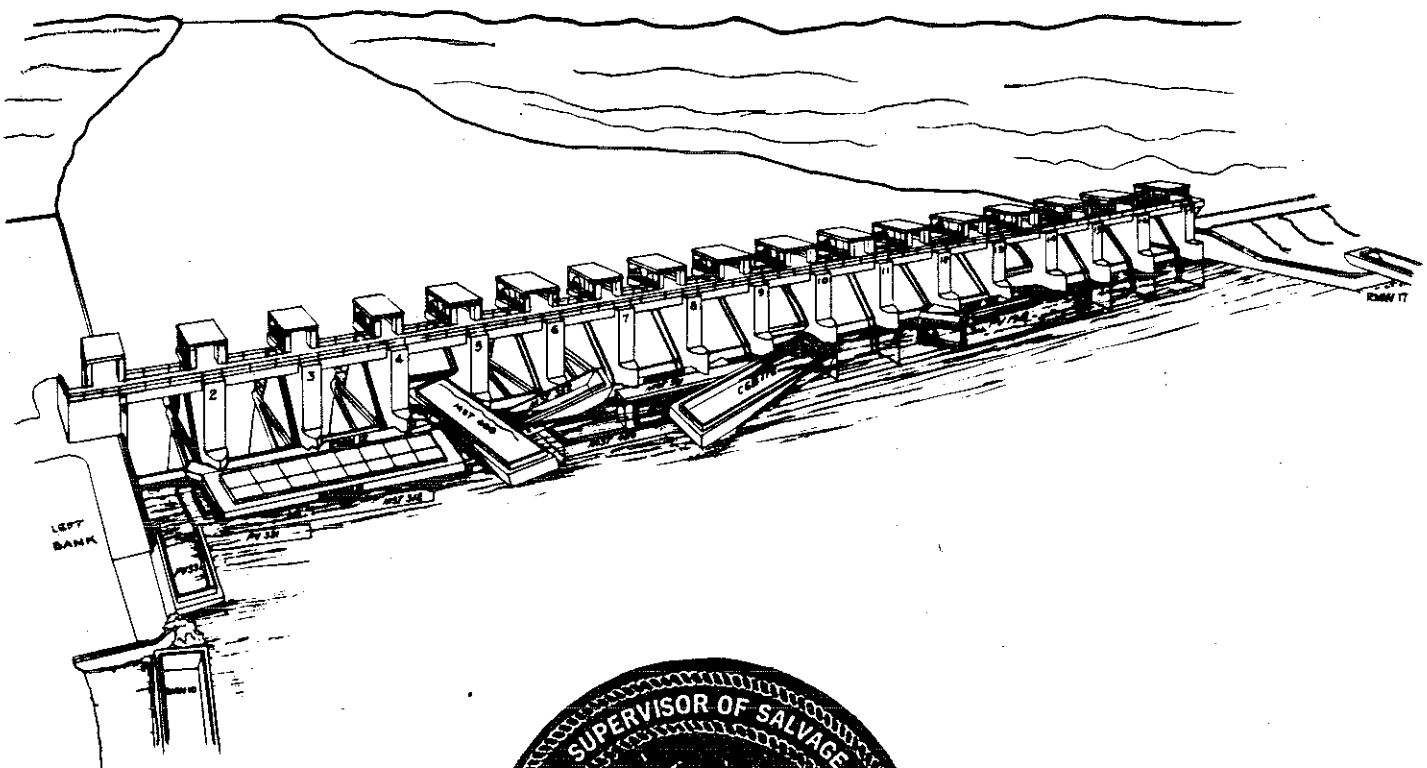

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TABLE OF CONTENTS

APPENDICES

INDEX OF FIGURES

DEPARTMENT OF THE NAVY

NAVAL SEA SYSTEMS COMMAND

WASHINGTON, D.C. 20362

IN REPLY REFER TO

F O R W A R D

The purpose of this report is to set forth a factual reconstruction of the events that took place on the Arkansas River at Dam No. 2 between the period 4 December 1982, when 38 unattended barges broke loose from the fleeting area upstream of the dam, and 8 February 1983, when salvage operations at the dam were completed.

Numerous factors came together at that remote site on the Arkansas River which made this job unique. Time was clearly of the essence. The imminence of the failure of the dam due to intense undermining was certainly of overwhelming priority. That, coupled with the fact that the enormity and complexity of the job was beyond the immediate resources of the U.S. Army Corps of Engineers, who had responsibility for the river, dictated a joint effort between the Corps of Engineers and the U.S. Navy Supervisor of Salvage. This gave rise to a unique adjunct of this effort; the manner in which commercial assistance was brought to bear on potential disaster by the Supervisor of Salvage.

Tracor Marine, Inc., of Port Everglades, Florida, holds the master salvage contract for the Gulf Zone, and hence, the Mississippi River Valley. They were so tasked under this contract by the Supervisor of Salvage and responded immediately. The instant capability that was marshalled by applying assets of the U.S. Army Corps of Engineers, the U.S. Navy Supervisor of Salvage, Tracor Marine and its primary contractor, Bisso Marine, of New Orleans, Louisiana, will be well documented in this report. That the imminent failure of the dam was prevented by the quick and deliberate action of the entire salvage team and that the entire effort was completed without injury to personnel is mute testimony to the effectiveness of the concept employed. That the entire operation was mobilized swiftly and completed ahead of schedule and well below the authorized budget further validates the concept of using a prenegotiated contract by formal tasking for emergency salvage response effort.

It should also be noted that the operation was a complete success due in large part to the close alliance that was quickly formed by the individuals of the Corps, SUPSALV, and the contractors. Unfortunately, no report can adequately chronicle the mutual reliance and cooperation that took place on that river in those sixty days. But, those individuals who were there know of this unspoken bond, the mutual dependence, and the interdependence of assets that came together at Dam No. 2. It was those individuals who worked as one through the long days and the cold nights, through Christmas Day and New Year's Eve, that made it all happen. It is to those salvors that this report is dedicated.

C. S. Maclin, CAPTAIN, USN
U.S. Navy Supervisor of Salvage

SUMMARY

On the evening of 4 December 1982, U.S. Army Corps of Engineers operations personnel were advised that several hopper barges were floating down the Arkansas River, unattended, toward Dam No. 2. These barges were among 38 which had broken loose from the Helena Marine Service fleeting area and the Riceland Dock during a period of high flows in the river.

Throughout the night of 4 December and the following day, the unattended barges made their way downstream. In the final tally, 14 were stopped by the dam. Most of them sank and some were ripped in two by other barges. The remaining 24 barges either went through the dam, ran aground well upstream, sank or were recovered. River flow rates during the time of the accident were calculated by the Corps of Engineers to be 204,000 cubic feet per second. As a reference, normal flow rates for this time of year are less than 50,000 cubic feet per second.

The condition of Dam No. 2 was perilous. Twelve barges had lodged themselves such that the dam could no longer be operated within anti-scouring parameters. Gates 1, 4, 9 and 13 were blocked open with some restricted, but uncontrolled flow through them. Gates 2, 3, 5, 6, 7, 8 and 12 were operable but barges had blocked them to such a degree that there was little flow through them.

With twelve barges owned by four different companies endangering the dam, the Corps of Engineers recognized the need for a unified salvage and wreck removal effort; placing the safety of the dam second only to personnel safety in priority.

On 8 December the U.S. Army Corps of Engineers authorized the U.S. Navy, specifically the Supervisor of Salvage, to perform a survey of the dam site and develop recommendations for a plan of action. On that day SUPSALV gave a task order to Tracor Marine, their Gulf Zone Salvage Contractor, to make a preliminary survey and prepare a proposed plan of action. This plan was presented at a joint meeting of the Corps of Engineers, SUPSALV and Tracor Marine at the Corps of Engineers district headquarters at Pine-Bluff, Arkansas, on 16 December 1982. This plan was subsequently accepted, and Tracor Marine was formally tasked by SUPSALV on 17 December 1982 to perform salvage operations at Dam No. 2.

Full scale mobilization went into immediate effect and salvage operations began on 22 December 1982. Of the fourteen barges comprising the effort, one was towed away reasonably intact, two others were towed away in sections and a fourth, the MST 408, was towed away intact but with no hope of ever being usable. The remaining ten were total losses. Figure 1 is an artist's rendering of the scene at Dam No. 2. As can be noted, many of the wrecks were partially severed, lying on their beams end and impaled on the piers. Others were wedged in the bays and under the gates.

Diving operations were impossible until control of the river flow could be established. Even when divers could be used, their effectiveness should have been severely curtailed due to the lack of visibility and the absolute carnage of much of the wreckage. However, it was the impossible conditions under which these individuals worked which established their true effectiveness. Time after time in the waning days of the project, they performed almost miraculous feats of rigging.

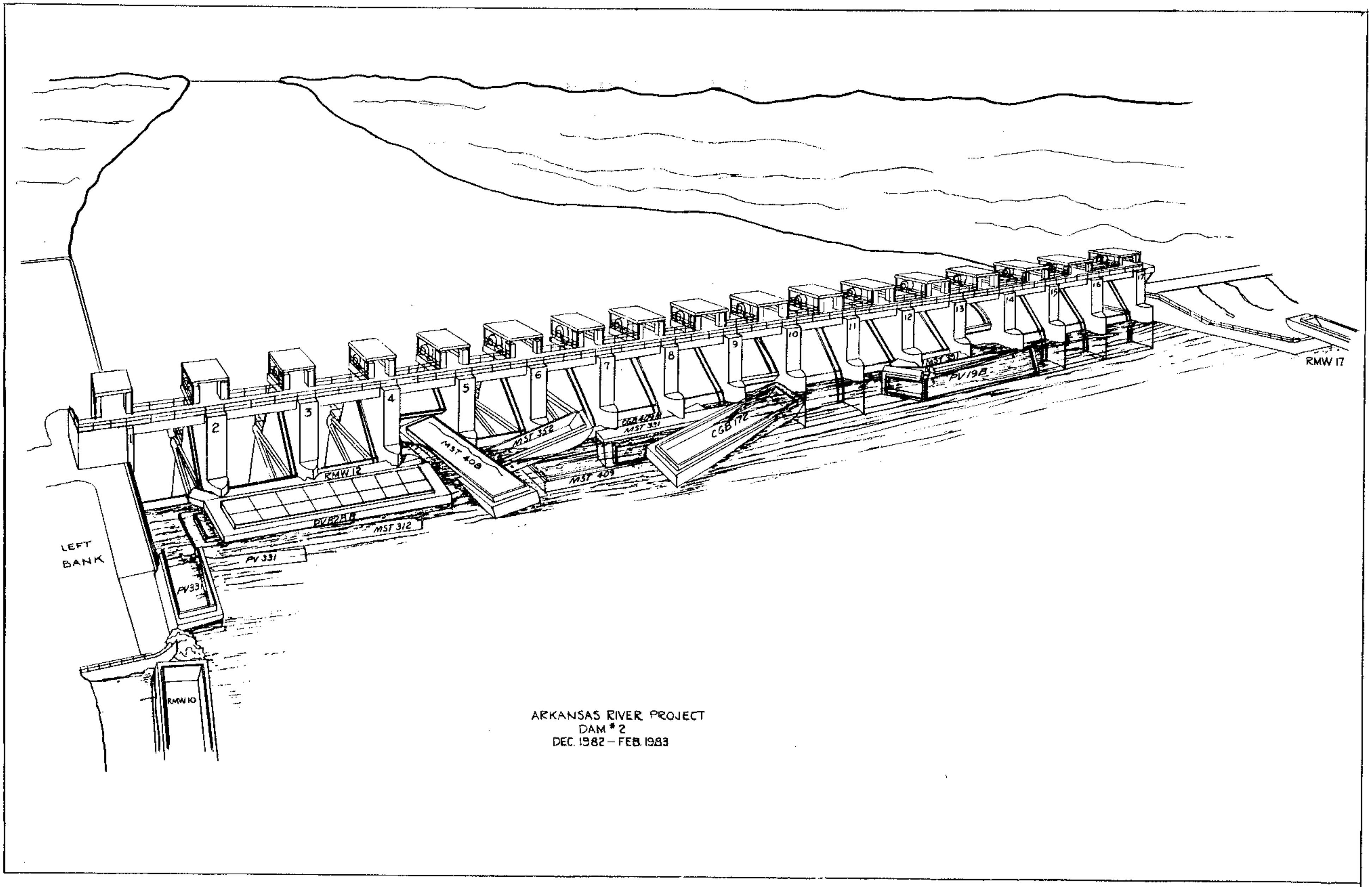

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Figure 1: Artist's rendering of Dam No. 2, Arkansas River on 8 December 1982

The Corps of Engineers was responsible for designating the sequence of wreck removal with initial priority going to those wrecks lodged in bays preventing the closure of the gates. However, as operations progressed, priority was transferred to those sections of the dam experiencing the severe scouring effect that was jeopardizing the foundation of the dam.

Table 1 is a summary of salvage operations and Table 2 provides the schedule of removal by sequence and date. The MST 408 was designated as the most volatile wreck by the Corps of Engineers. This barge, fully loaded with coal, had breached the dam at gate 4 and the forward one-third of the barge was cantilevered through the dam. The MST 408 was resting on top of the MST 352. It was feared by the salvage team that when the MST 408 was retracted from gate 4 that the forces acting on MST 352 would cause it to be forced into the gate vacated by MST 408. Therefore, these two barges had to be treated as one operation. The 1500 tons of coal were removed from MST 408 into a hopper barge and the MST 408 was retracted by the Pull Barge on 28 December. The MST 352 was restrained by SOUTHERN 6 and on 31 December the barge was lifted by SOUTHERN 6 and AJAX and retracted by the Pull Barge, freeing a critical gate.

The only damage to equipment occurred when removing CGB 172. This barge was down by the bow, listing to starboard approximately 45 degrees and had its bow rake wedged into bay 9 between piers 9 and 10. The salvage plan was to employ a double parbuckle lift with SOUTHERN 6 lifting forward, AJAX lifting aft and retraction from the gate by the Pull Barge. Two separate lifts were attempted over a three day period with as much as 750 tons of lift being applied at one point. On 3 January the wreck was rerigged for the third attempt. As approximately 180 tons of

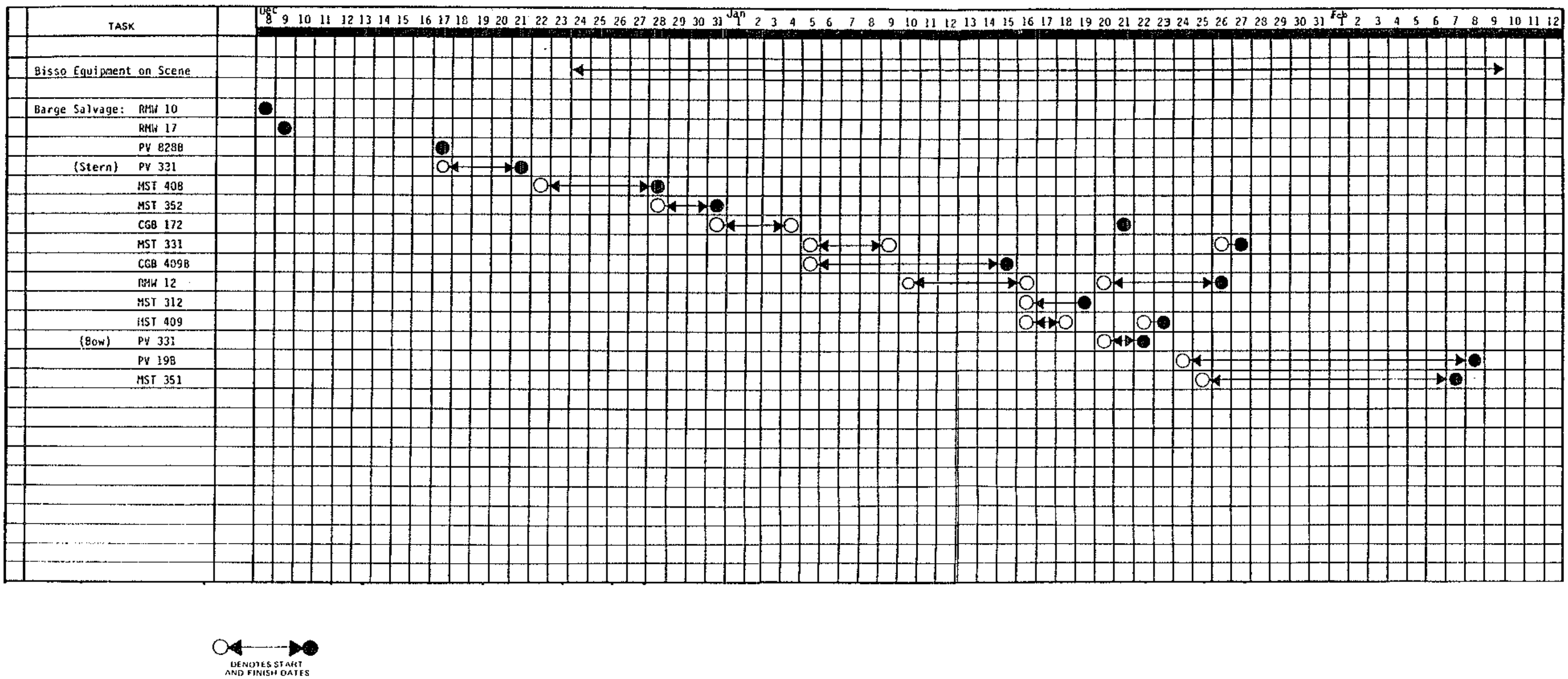
TABLE 1

SUMMARY OF SALVAGE OPERATIONS

Wreck	Started	Completed	Method of Removal
RMW 10	8 Dec	8 Dec	Retrieved by local subcontractor and towed up upriver.
RMW 17	9 Dec	9 Dec	"
PV 828B	17 Dec	17 Dec	Retracted by SHORTY BAIRD and Manitowoc crane barge, pumped and refloated.
PV 331	17 Dec	22 Jan	Torn into two pieces, stern removed by Patton Tully A-frame, bow lifted by SOUTHERN 6 and AJAX
MST 408	22 Dec	28 Dec	Retracted by Pull Barge
MST 352	28 Dec	31 Dec	Lifted by SOUTHERN 6 and AJAX, retracted by Pull Barge
CGB 172	31 Dec	21 Jan	Lifted by SOUTHERN 6 and AJAX, retracted by Pull Barge
MST 331	5 Jan	27 Jan	Cut into two sections, both lifted by SOUTHERN 6 and retracted by Pull Barge
CGB 409B	5 Jan	15 Jan	Retracted by Pull Barge, cut into three sections, each lifted by SOUTHERN 6.
MST 409	16 Jan	23 Jan	Lifted by SOUTHERN 6 and AJAX, torn rake section retrieved by SOUTHERN 6
RMW 12	10 Jan	26 Jan	Cut into two sections, lifted by SOUTHERN 6 and AJAX
MST 312	16 Jan	19 Jan	Lifted by SOUTHERN 6 and AJAX
PV 19B	24 Jan	8 Feb	Cut into three pieces by chisel, retracted by Pull Barge, lifted by SOUTHERN 6 and AJAX
MST 351	25 Jan	8 Feb	Cut into three pieces by chisel, retracted by Pull Barge, lifted by SOUTHERN 6 and Manitowoc crane barge.

TABLE 2

SALVAGE EVENTS SHOWING ACTUAL SEQUENCE OF REMOVAL



lift was applied, the hull failed and the wreck suddenly broke free from the gate, rotated counterclockwise and crashed into the derrick of the AJAX. This partially collapsed the derrick and drove it through the mounting deck plates. Quick reaction by the two liftmasters in dropping their loads prevented more damage. The CGB 172 then settled onto the port bow of AJAX. The bow rake of CGB 172 suddenly broke almost off and stuck through bay 9. With this action, CGB 172 pitched forward with such force that one of the 1-5/8" anchor wires of AJAX broke loose. The other one held. The bow section was burned through with magnesium lances and the 70 ton bow rake slid through the gate and sank downriver. The remainder of the barge was bottomed in the fleeting area and later lifted on a mat barge for disposal.

Considerable damage was done to the AJAX and it was definitely out of commission. The costs of bringing a replacement barge on-site were weighed against retaining AJAX on charter and affecting repairs on site. Repair time was estimated by AJAX owners as being ten days. SUPSALV and the Corps of Engineers concurred that it was far more cost effective to repair AJAX than to replace it and AJAX was authorized to repair on site. AJAX returned to the river one day ahead of schedule, thanks to the concentrated effort of her owners and crew and the efforts of the Corps of Engineers.

While AJAX was out of action, both MST 331 and CGB 409B were cut in sections, rigged and partially removed by SOUTHERN 6. Rigging was done to the MST 312, RMW 12 and PV 331 in preparation for the required two-derrick lifts. AJAX returned to the river on 14 January and three lifts were completed between 16 January and 22 January.

By far the most difficult and dangerous lift involved the MST 351 and PV 19B. These two wrecks were stretched across gates 11, 12, 13 and 14 with gate 12 blocked in the closed position and gate 13 blocked in the open position. This situation is the worst configuration that can confront two adjacent gates on any dam. MST 351 had her bow rake jammed into gate 13 and it was wedged fast by piers 13 and 14. Furthermore, PV 19B was creating a damming effect a few feet upstream of MST 351 in gate 13, causing an intermediate head between the two wrecks. Forces on PV 19B were calculated at 950 tons.

Using a ten ton 40 foot steel chisel, the stern rakes of both barges were cut and hauled free of gate 11. Then both barges were again cut just outside of pier 13. This wreckage was carefully extracted and gate 12 was operable. Some attempt was made to weaken the wreckage of MST 351 which was jammed in gate 13, but before this could be accomplished, the "dam" consisting of PV 19B gave way from the tremendous forces. The remainder of the two wrecks then jammed into gate 13 and all of it was underwater. Attention was focused to gate 14 where a diver could enter the water and rig the bow rake of PV 19B. This was raised on 6 February. What was left in gate 13 could literally take weeks to clear. The salvage crew attempted a long shot. After consultation with the Corps of Engineers representatives, the gate was opened allowing the full force of the river to be brought to bear on the weakened wreckage. The ploy worked and almost 100 tons of steel was forced through the gate and washed downriver. The final gate was cleared. The job was over.

1.0 INTRODUCTION

The Arkansas River begins high in the Rocky Mountains of Colorado. It descends the eastern slopes of the Continental Divide as a clear mountain stream, flowing through breathtaking Royal Gorge on its long journey to the Mississippi. It moves into the wheatlands of Kansas and then meanders through oil-rich northern Oklahoma before it crosses the border into Arkansas, the state which bears her name. In its 1,450-mile journey, it drains an area of 160,000 square miles.

The development of the Arkansas River for navigation, additional flood control, hydroelectric power generation, and other purposes is the largest civil works project ever undertaken by the Corps of Engineers. It was authorized by Congress in the Rivers and Harbors Act of July 24, 1946, and construction began in 1957.

Navigation reached Little Rock in December 1968; Fort Smith in December 1969; and the Port of Catoosa, at the head of navigation, in December 1970. The 445-mile system is now in use. The navigation channel begins at the confluence of the White River and the Mississippi River, proceeds ten miles upstream on the White River to the man-made Arkansas Post Canal, and then nine miles through the canal to the Arkansas River. It crosses the state of Arkansas into Oklahoma on the Arkansas River to the mouth of the Verdigris River at Muskogee and terminates 50 miles upstream on the Verdigris River at Catoosa, Oklahoma, near Tulsa.

Dam No. 2 is located on the Arkansas River two miles south of mile 19 (see Figure 1.1). At mile 19, the navigable portion of the river ends and the navigation channel continues

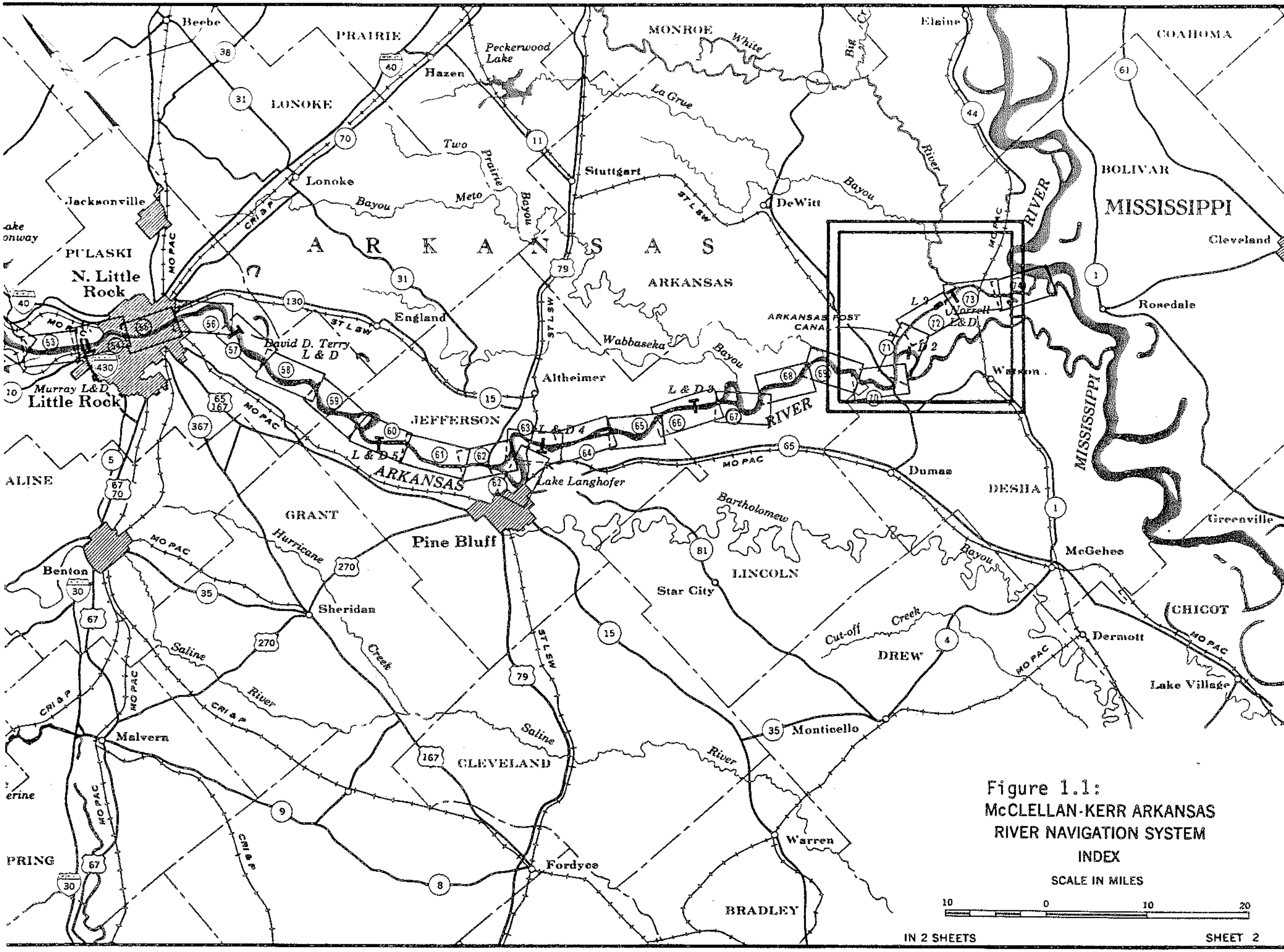


Figure 1.1:
McCLELLAN-KERR ARKANSAS RIVER NAVIGATION SYSTEM
INDEX

SCALE IN MILES

10 0 10 20

IN 2 SHEETS

SHEET 2

through the Arkansas Post Canal into the White River and from there into the Mississippi River (see Figure 1.2). The function of the dam is to maintain the upstream navigation pool at a level of 162 feet (MSL) which insures a navigable depth of nine feet.

The dam is normally unattended, but operators make frequent trips from Lock No. 2 on the Arkansas Post Canal to adjust the gate openings to suit the influx of water discharged from Lock and Dam No. 3 at mile 50.2.

On the evening of 4 December 1982, U.S. Army Corps of Engineers operations personnel were advised that several hopper barges had floated down unattended on Dam No. 2. The barges were among 38 which had broken loose from the Helena Marine Service fleeting area and the Riceland Dock during a period of high flows in the river.

Throughout the night of December 4 and the following day, the unattended barges made their way downstream until, in the final tally, 14 of them came to rest just upstream of Dam No. 2. The remaining 24 barges either went through the dam, ran aground well upstream, sank or were retrieved. River flow rate during the time of the accident was calculated by the Corps of Engineers to be 204,000 cubic feet per second. As a reference, normal flow rates for this time of year are less than 50,000 cubic feet per second.

Dam No. 2 is classified as a Gated Spillway, the intended purpose of which is to maintain the water level in its pool which feeds the Arkansas Post Canal between the Arkansas River and the White River. The White River and the canal are the only navigable waterways connecting the Arkansas River with the

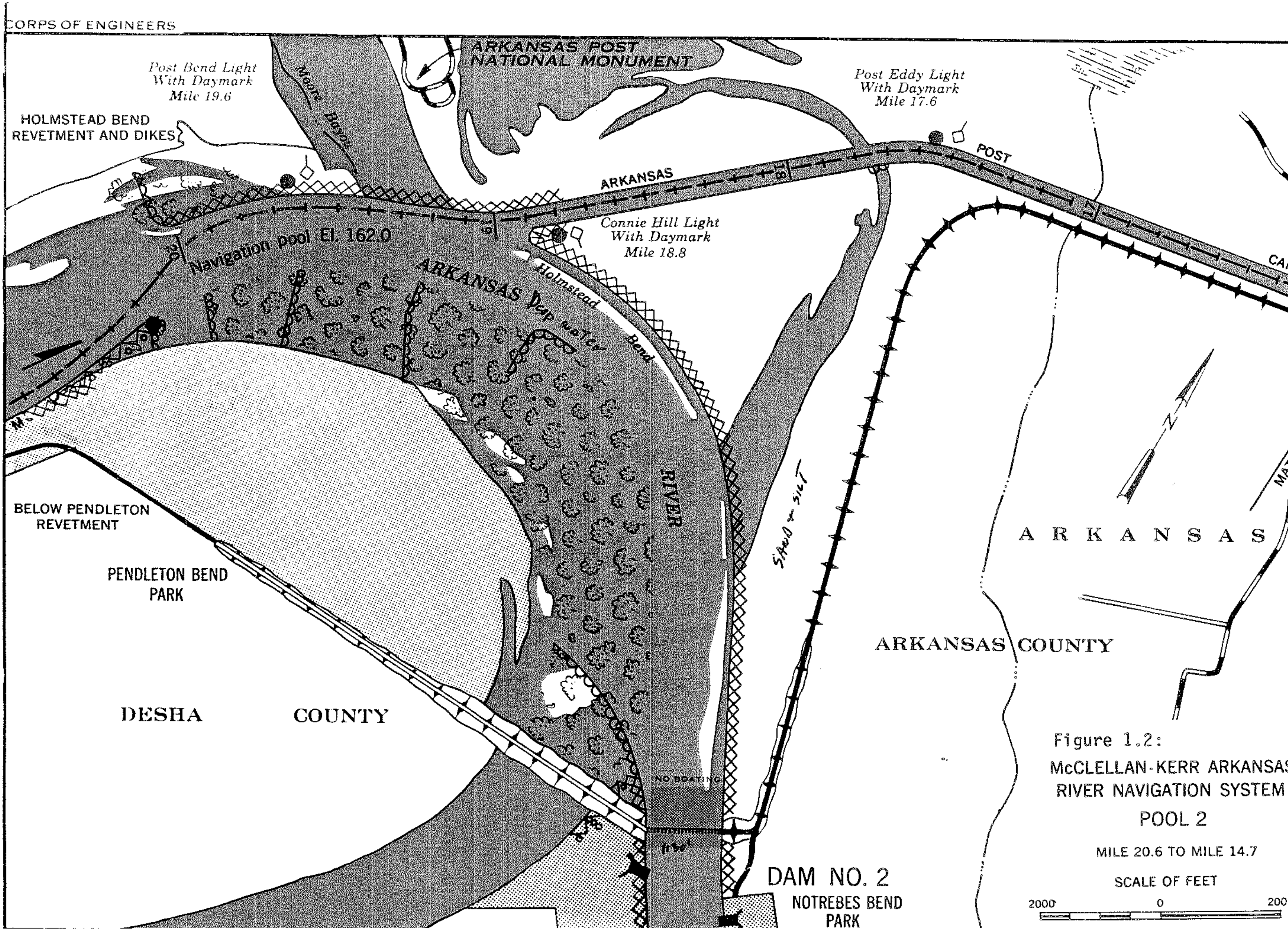


Figure 1.2:
McCLELLAN-KERR ARKANSAS RIVER NAVIGATION SYSTEM
POOL 2
MILE 20.6 TO MILE 14.7

Mississippi River. Thus, Dam No. 2 is critical to commerce in the area, for were it not able to perform its function, the Arkansas River would be cut off from the Mississippi River.

Dam No. 2 has 16 movable floodgates supported by reinforced concrete piers. The entire structure is supported by pilings driven into the earth beneath the dam. Precautions were taken during its construction to prevent waterflow from scouring and undermining the piling foundations. However, the most important factor in preventing undermining is operational rather than design oriented. That factor is to minimize excessively turbulent flows through the dam by limiting differential flow rates between adjacent gates.

Dam operators are directed to maintain gate opening clearances within one foot of those gates adjacent to it. Thus, if gate 3 were open four feet, gates 2 and 4 would be limited to an opening of between three and five feet. The worst possible condition for the dam from a standpoint of risking erosion and undermining is to have one gate fully open with an adjacent gate fully closed. Scouring upstream and downstream of the open gate could continue to the point where the scour holes connect beneath the dam. An irreversible undermining action would then be set up which would eventually destroy a portion of the dam.

The condition of Dam No. 2 on December 8 was perilous. Twelve barges had lodged themselves such that it could no longer be operated within anti-scouring parameters. Gates 1, 4, 9 and 13 were blocked open, with some restricted but uncontrolled flow through them. Gates 2, 3, 5, 6, 7, 8 and 12 were operable, but barges had blocked them to such a degree that there was hardly any flow through them (see Figure 1.3, 1.4, 1.5, 1.6).

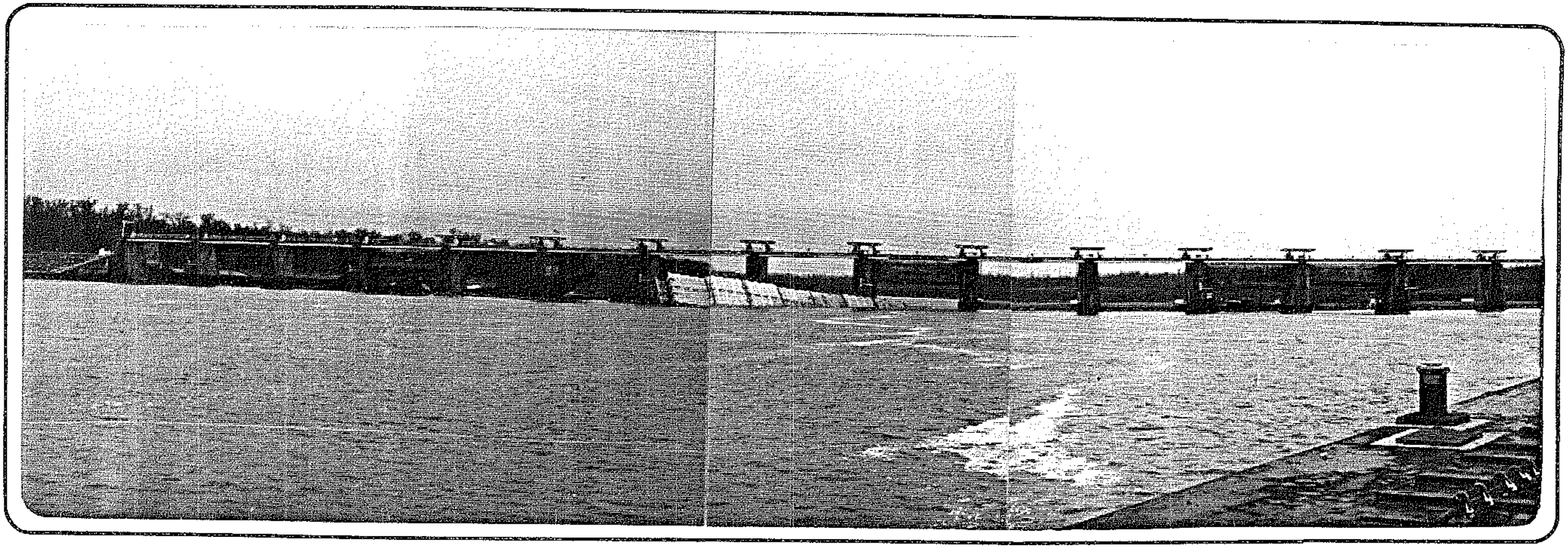


Figure 1.3: Upstream View of Dam No. 2

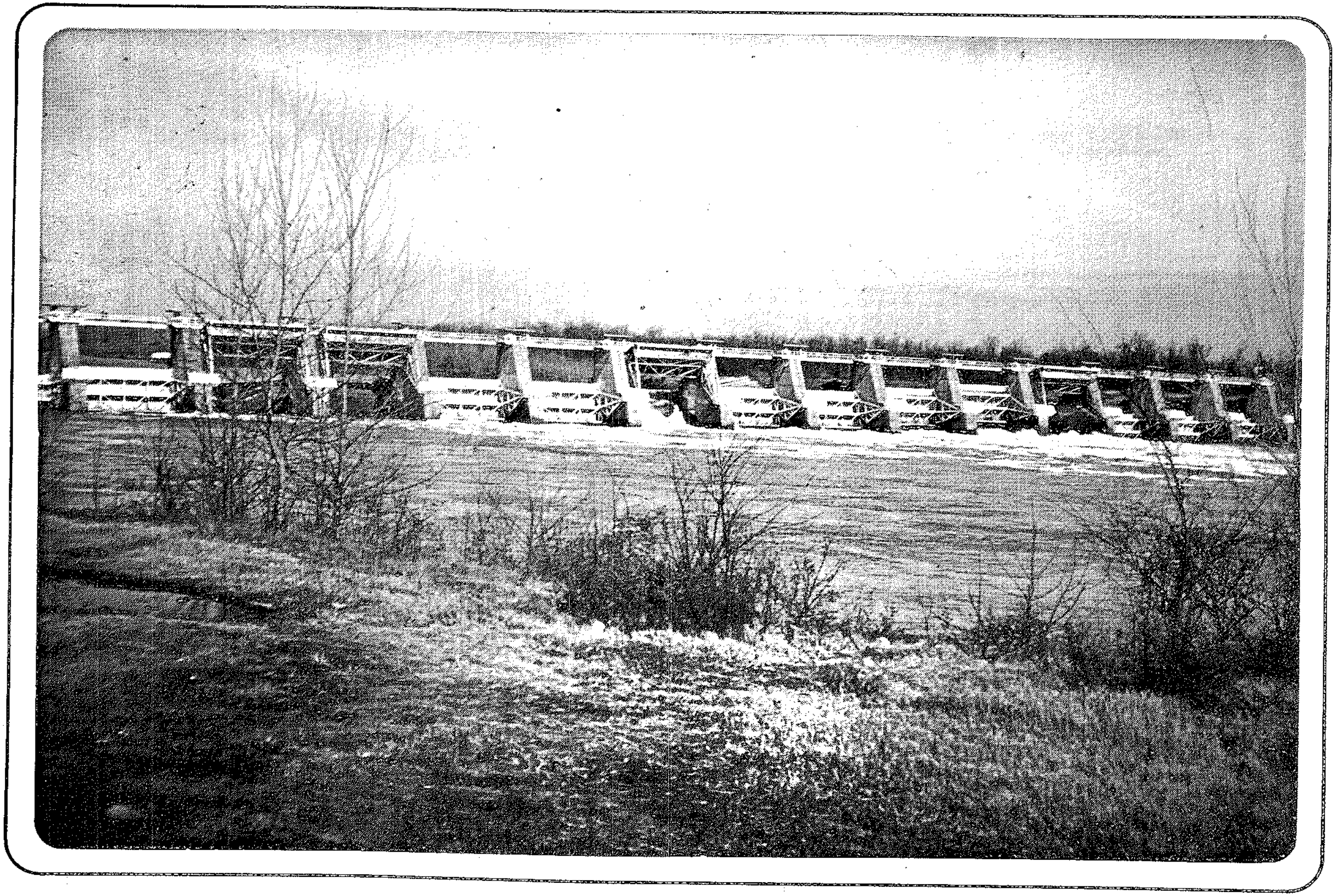


Figure 1.4: Downstream View of Dam No. 2, Note Barges Protruding Through Gates.

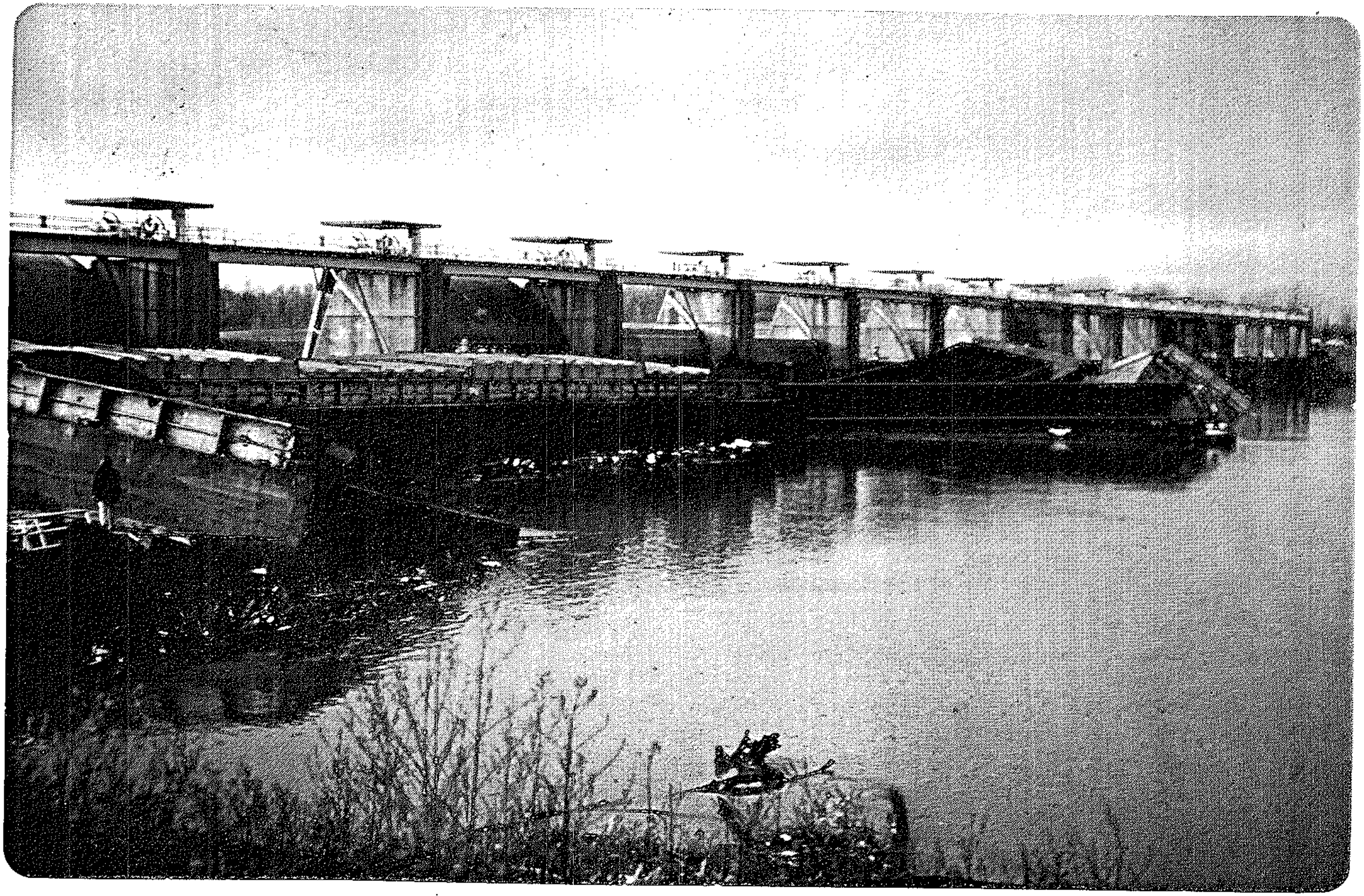


Figure 1.5: Upstream View from the Left Bank, from Left to Right: PV 331, PV 828B, MST 408, MST 352, CGB 172.

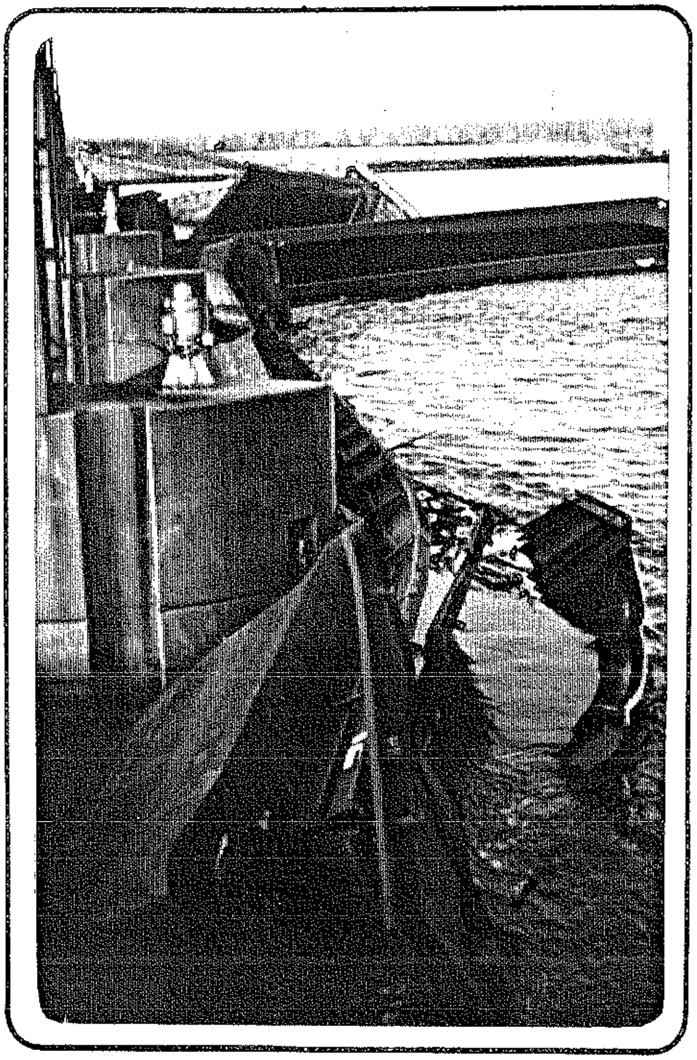


Figure 1.6: Many of the barges were on their beams end and impaled on the piers such as RMW 12 shown here impaled on piers 2, 3 and 4.

With 12 barges owned by four different companies endangering Dam No. 2, the Corps of Engineers recognized the need for a unified salvage and wreck removal effort; placing the safety of the dam second only to personnel safety in priority. On December 8 the Corps of Engineers authorized the U.S. Navy, specifically the Supervisor of Salvage, to perform a survey of the dam site in order to develop recommendations for a plan of action. On that day SUPSALV gave a verbal tasking order to Tracor Marine, their Gulf Zone Salvage Contractor, to provide survey personnel.

On the evening of December 8 Mr. Leon Ryder, Salvage Master, and Mr. Paul Smith, Salvage Engineer, from Tracor's Norfolk Operations, arrived in Little Rock, Arkansas. On the morning of December 9, Commander Harley Oien from SUPSALV arrived in Little Rock and the three traveled to the dam site to perform a preliminary survey. Barge owners were requested by the Corps of Engineers to provide details of their intentions, be they salvage or abandonment, by December 11. All barge owners responded.

During the week that followed, additional Tracor assets were mobilized and preliminary salvage plans and cost estimates were developed. Mr. Jim Jacobs, Tracor Marine Manager of Ocean Construction and Salvage, was designated as Project Manager and more Tracor Marine logistic personnel arrived on site. Tracor Marine presented the plans to SUPSALV and the Corps on December 16. On December 17, the Corps of Engineers authorized SUPSALV to perform the salvage and wreck removal operations above Dam No. 2.

It was during this survey period that critical decisions were made that would later prove to be the key to success of the operation. It was decided by the contractor's salvage team that a lift capacity of at least 700 tons would be required. It was also decided that it would be essential to have the flexibility offered by two heavy lift derricks instead of one. These were located in New Orleans, five days down river. Immediate steps were taken to bring these assets on site. It was also decided that the primary removal technique would be to cut, lift and retract. Accordingly, a pull barge was fashioned from one of the flat barges provided by the Corps of Engineers. This barge was outfitted with two Amcon double drum winches, each with 90 tons of line pull and a double STATO anchoring system.

The river tug, M/V MISSISSIPPI, was relocated from the Corps of Engineers Memphis District and brought on site to serve as an operational headquarters and as a messing and berthing facility for the salvage team. This asset proved its worth time after time by allowing the salvage team to make maximum use of critical daylight hours and by providing hot, nourishing meals throughout long, cold days.

Twenty-four hour operations were requested by the Corps of Engineers because of the critical condition of the dam. This was carefully considered but the project manager's decision was that the conditions were too dangerous and the river, totally out of control, was too treacherous. However, for almost sixty consecutive days, all workers were on the river at first light and never secured before dark. There were occasions when, during a lift, operations extended to 2200 hours.

It was mutually decided that the Corps of Engineers would set the priority of wreck removal based on their knowledge of dam operations and the intense requirement to prevent further scouring from under the dam. These priorities would change from time to time as conditions on the river dictated. For the most part, the original schedule was maintained as to sequence.

What would prove to change with regularity was the individual salvage plans. The fact that most of the wrecks were underwater and in many cases intertwined, and that it was impossible to deploy divers in the early phases, led to daily and sometimes hourly changes in the salvage plans. Much of the rigging was done by "feel" and there were occasions when the true nature of a lift was not determined until it was underway. It was in these instances that the worth of having a two derrick lift capability was to become appreciated.

Although the PV 828B was pulled off the dam and floated upstream and secured on 17 December 1982, actual salvage operations began on 22 December with the coal barge, MST 408, which had breached the dam at gate 9. The heavy lift derricks, SOUTHERN 6 and AJAX, arrived from New Orleans on 23 December along with the dive barge, CAPT. LUKE, and the tug, TYLER.

2.0 INVOLVEMENT OF U.S. NAVY

The operation and maintenance of Dam No. 2, Arkansas River, falls under the jurisdiction of the Little Rock District of the U.S. Army Corps of Engineers. The 14 barges which had been washed downstream onto Dam 2 during a period of extremely high water had both compromised the effectiveness of the dam and jeopardized its structural integrity.

The minor damage resulting from the impact of the barges against the dam was not the chief concern of the Corps. The uncontrolled flow of water through the blocked open gates produced an inordinate amount of turbulence and scouring both upstream and downstream of the dam. To correct this dangerous situation necessitated a quick and unified salvage effort.

The Corps of Engineers had neither the equipment nor the experienced personnel required to undertake the dam clearance. Initially, the Corps intended to undertake the clearance of the dam as a purely commercial venture. However, the urgency of the situation made this impractical; selecting a salvage company capable of the wreckage removal through government channels would be time consuming. More importantly, the negotiations necessary to complete a contractual arrangement would be lengthy, and time was of the absolute essence.

Therefore, the Corps of Engineers consummated an agreement with the U.S. Navy, whereby the Supervisor of Salvage was designated as principal salvage agent and would bring to bear contract vehicles already in place. The Supervisor of Salvage (SUPSALV) is uniquely qualified to undertake salvage operations of this magnitude and had an existing pre-negotiated contract with Tracor Marine, Inc. which, among other appropriate features, allows for immediate contractor response by contracting officer tasking.

SUPSALV then issued a task to Tracor Marine, Inc., its prime contractor under the Gulf Coast Salvage Zone, Contract No. N00024-83-D-4129, to make a preliminary survey and prepare a proposed plan of action, including cost estimates and management plan. The plan was accepted on 17 December 1982 and a second task was issued to provide the salvage expertise for the removal of the barges from the immediate upstream area at Dam No. 2, Arkansas River (see Appendix II and III).

This task included the management and coordination of the overall salvage effort on a 7 day per week basis. The SUPSALV on-site representative was provided at the end of each day with an estimated daily operational cost summary providing a detailed report of the costs incurred to the project including labor and material, subcontracts, rental equipment, transportation, etc. An operations log of the on-site activities was also submitted to SUPSALV for each day. This report recorded the salvage accomplishments for each individual barge, contractor and government equipment utilized, listed all on-site personnel (except the Army Corps of Engineers), weather conditions, dam discharge rates, and any personal or equipment casualties. Video coverage in VHS format of the daily operations was also submitted.

The role of SUPSALV as salvage agent was to administer the contract with Tracor Marine, oversee the salvage operation and interface between the Corps of Engineers and Tracor Marine. This required the on-site presence of Navy personnel throughout the wreckage removal. Additionally, a SUPSALV auditing team was tasked to in the salvage effort, working closely with Tracor Marine in the monitoring of expenses and financial reports.

3.0 ORGANIZATION AND LINES OF COMMUNICATION

The Little Rock District of the Corps of Engineers oversaw all wreck removals at Dam No. 2. The Assistant Resident Engineer, Mr. Chester Shaw, was the on-site project coordinator. The Army Corps of Engineers organizational chart illustrates the personnel responsible for the various functions of the Corps during the salvage operation and is included in Figure 3.1.

The SUPSALV representative was responsible for the administering of the salvage contract with Tracor Marine. The Tracor Marine Project Manager, Mr. James M. Jacobs, directed the operations including waterfront, financial, contractual and administrative matters. The Salvage Master was Mr. Leon Ryder. Figure 3.2 illustrates the personnel lines of communication and function which existed throughout the project.

Personnel from Tracor Marine's Norfolk and Port Everglades operations began arriving on the scene when tasked by the Supervisor of Salvage. The work force fluctuated but averaged about twenty men. Bisso Marine, the primary subcontractor, provided the two heavy lift derrick barges, AJAX and SOUTHERN 6. These vessels were manned by their own five to seven man crews but were assisted by rigging crews of Tracor Marine employees.

Additional subcontractors were local personnel hired to perform casual labor, drafting, messenger, secretarial, and delivery service. A second crew boat with operator and a safety boat with crew positioned downstream of the dam in case of emergency were also contracted locally.

Figure 3.1: U.S. Army Corps of Engineers Organization Chart

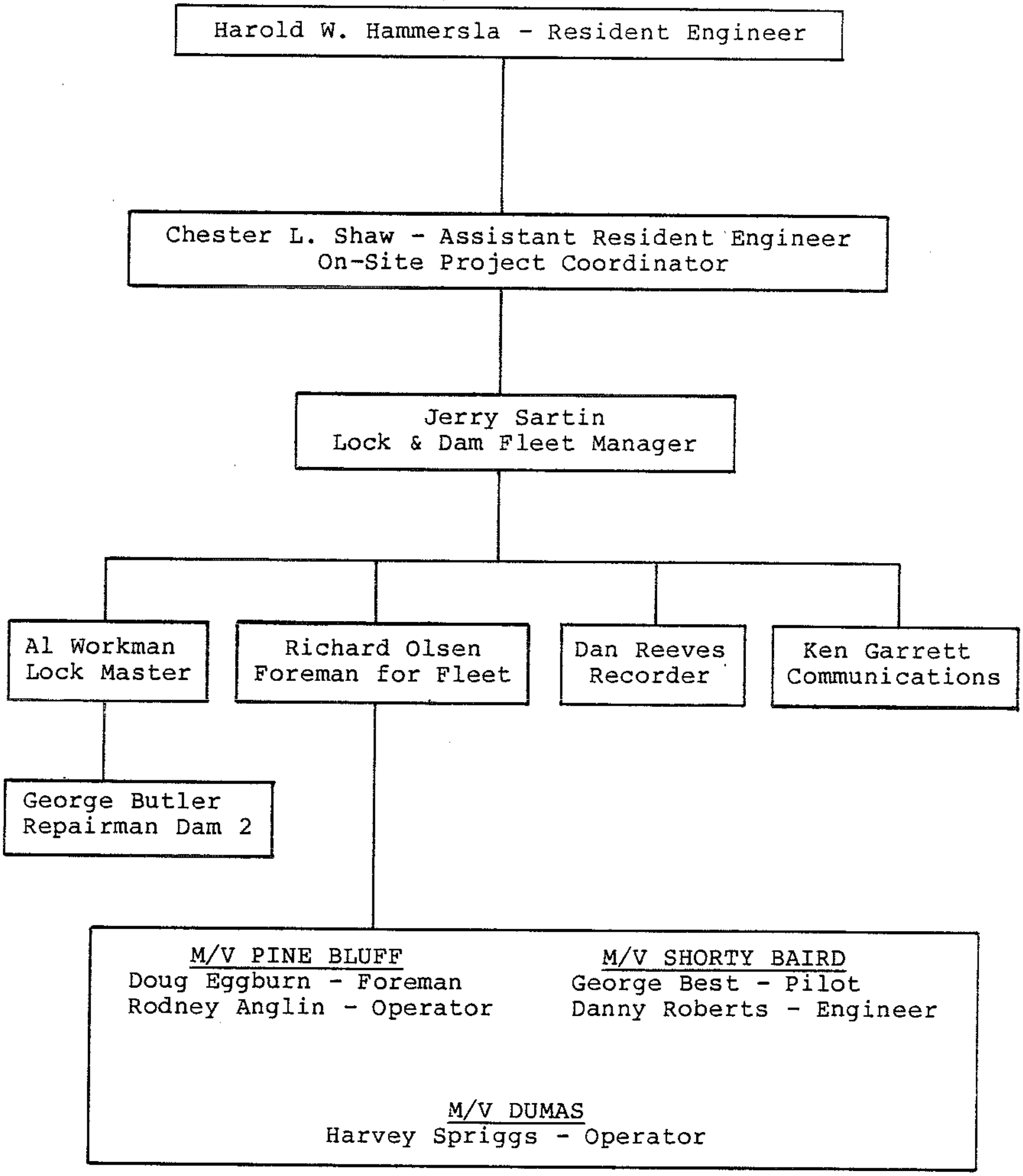
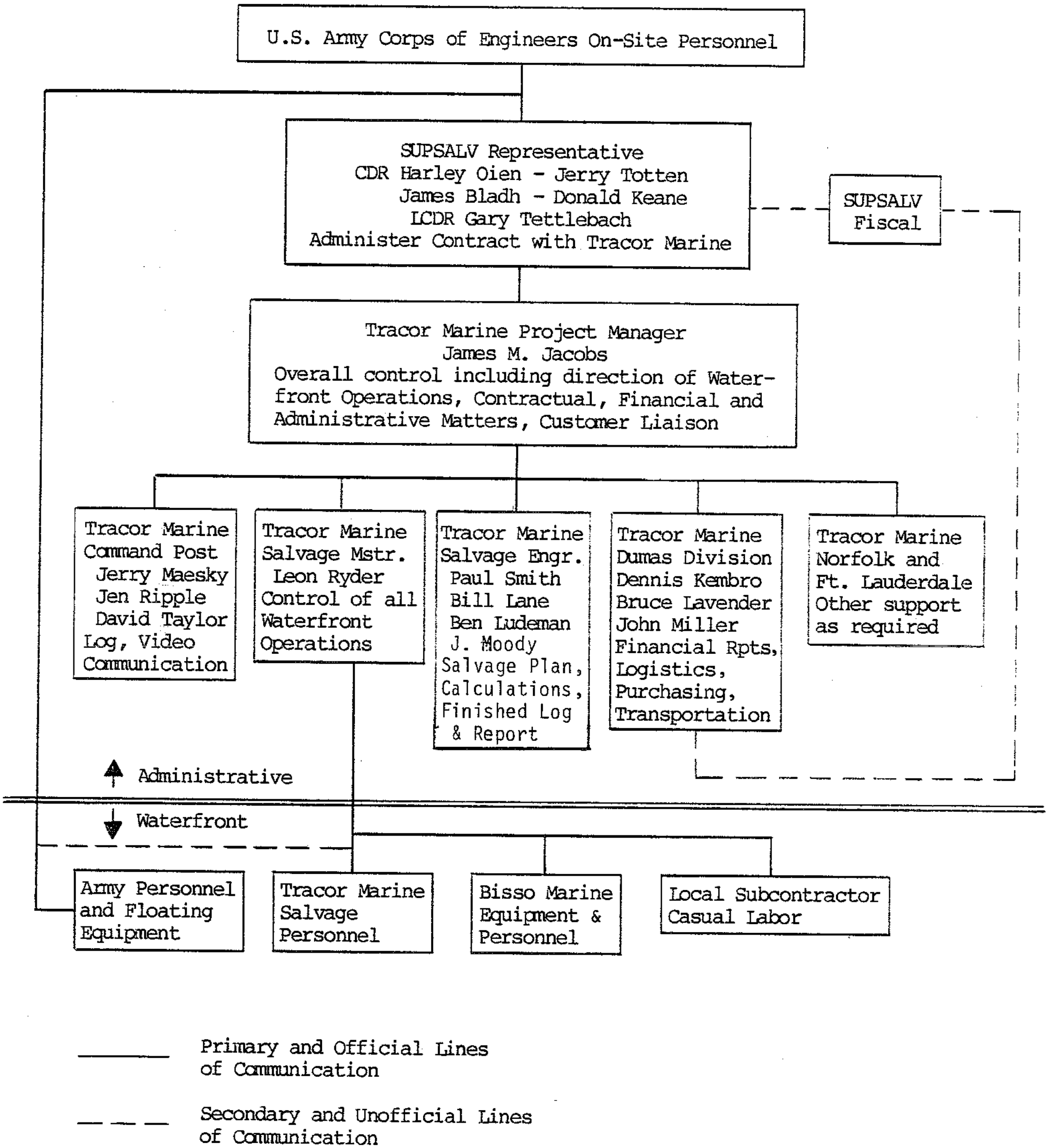


Figure 3.2: Personnel Lines of Communication and Function



4.0 MOBILIZATION AND LOGISTIC SUPPORT

While awaiting formal request by the Supervisor of Salvage to undertake the removal of the barges that were threatening the safety of Dam No. 2, critical decisions were made on the types of equipment required from the results of the salvage survey. These decisions would later prove to be crucial to the success of the salvage operation. It was decided that two heavy lift derricks with a combined lift capacity of 700 tons would be essential.

Tracor Marine located and contacted various marine contractors within a radius of several hundred miles. Subcontractors were required to have floating derrick barges with a minimum lifting capacity of 275 tons, support equipment, such as work barges with cranes and welding equipment and tugs. Any contractor fulfilling these requirements also had to be able to respond within a few days notice, subject to Tracor Marine being tasked by SUPSALV.

One such contractor who met the conditions was Bisso Marine, Co. of New Orleans. When Tracor was given the go ahead, Bisso Marine was ordered to bring the equipment upriver and over into the Arkansas River above Dam No. 2, a five day trip. Bisso brought the AJAX, a heavy lift derrick barge rated at 325 tons; a diving barge, the CAPT. LUKE and the tug, TYLER. In addition, Bisso negotiated with Earl Cunningham of Southern Shipbuilding, Slidell, Louisiana, who brought his crew and the derrick barge, SOUTHERN 6, with a capacity of 400 tons. This equipment arrived on site on 23 December 1982.

Tracor Marine set up an office with two financial logistics assistants (a project coordinator and a purchasing agent) in the town of Dumas, Arkansas, 15 miles by road from the dam site. Lines of credit were established with vendors, banks, etc., and accommodations reserved for personnel at the Delta Lodge in Dumas. A daily report of monies committed to the project, including labor and material, subcontracts, rental equipment, transportation, etc., was established and maintained by the financial logistics assistants.

In the absence of telephone communications, radio links were set up between town and the dam site. In addition, a radio communication network was established between all principals involved in the operation at the dam site.

The U.S. Army Corps of Engineers brought the M/V MISSISSIPPI, the flagship of their riverboats, out of winter quarters at Memphis, Tennessee, and moored it in a small bay on the right descending bank of the river at the wreck site. This vessel was fully manned and was used as the base of operations, berthing and messing facility and first aid station. The boat accommodated 30 people in addition to the regular crew and provided three meals a day to all persons involved in the operations including Corps of Engineers personnel, Navy personnel and contractors. The overflow quartered at the Delta Lodge (see Figures 4.1 and 4.2).

The Corps of Engineers provided a spud barge with a Manitowoc 4100 crane aboard, tended by the M/V SHORTY BAIRD. This barge and tug provided inestimable assistance to the contractor by virtue of the skill of the crane operator and the boat operator.

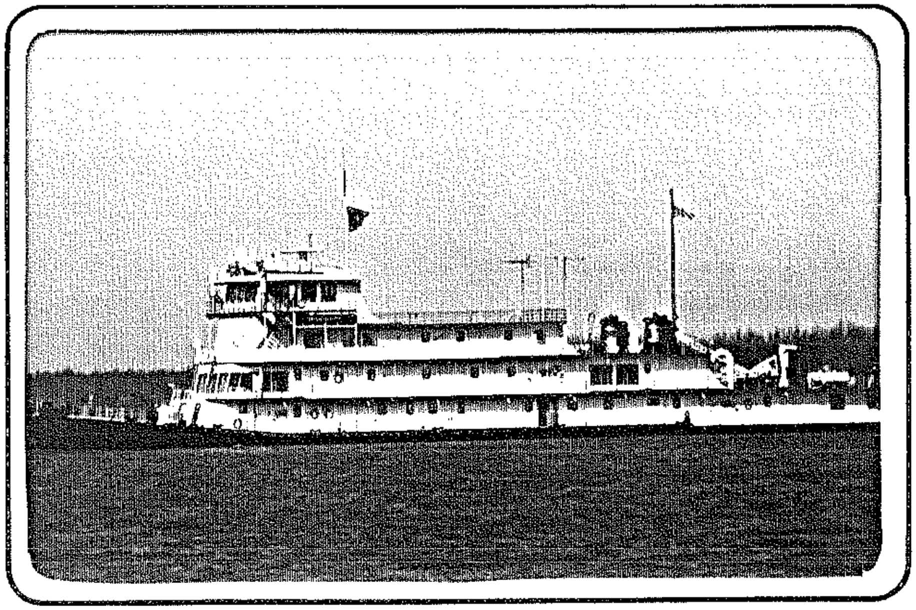


Figure 4.1: M/V MISSISSIPPI - On-site Headquarters

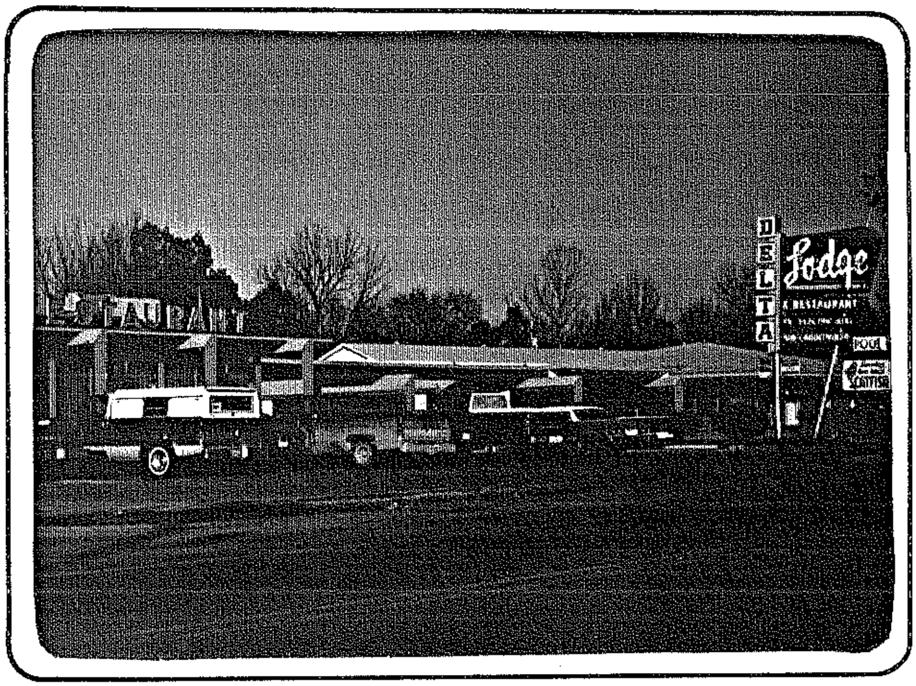


Figure 4.2: Delta Lodge - Dumas Headquarters

In addition, the Corps of Engineers supplied almost a score of barges (170' x 35') with flat decks for loading the recovered wreckage (mat barges). Other Corps equipment was used to drive pilings in the small bay along the right descending bank to secure the mat barges in the fleeting area. On hand also were the tugs OZARK and PINE BLUFF, the crew boat DUMAS and the survey boat BOWFISH. The Corps provided survey teams, both land and waterborne to monitor the dam, the riverbed and the stability of the wreckage. The side scan sonar equipment proved to be invaluable, saving many hours of diver survey time.

Tracor Marine supplied a team of about 20 qualified men, ranging from Program Manager, Salvage Master and Salvage Engineers to the riggers, welders, equipment operators and divers. Tracor reported to the SUPSALV representative on-site, who in turn worked closely with the Corps of Engineers Resident Engineer.

Tracor Marine administers the ESSM contract (Emergency Ship Salvage Material) through the Supervisor of Salvage. However, six 6000 lb. STATO anchor systems and a command van were the only items requisitioned from the Cheatham Annex ESSM pool in Williamsburg, Virginia. Other equipment such as diving compressors, recompression chamber, blocks, pumps, shackles, wire rope, etc., was trucked to the site from the Norfolk office of Tracor Marine.

Two heavy duty, Amcon 450 diesel powered, double-drum winches were leased from Conmaco in New Orleans and trucked to the site, with cooperation from the Arkansas highway authorities who expedited over-the-road permits. The Corps of Engineers provided a mat barge to the contractor for conversion to a pulling barge. The two Amcon winches, a double STATO anchoring system and other equipment were installed on the barge during the mobilization phase (see Appendix VIII for calculations). At the conclusion of the project, the barge was stripped and returned to the Corps.

5.0 EQUIPMENT DESCRIPTION

Listed below are the major capital equipment supplied by the various principals.

U.S. Army Corps of Engineers

1. Crane barge, 170' x 35' with Manitowoc 4100 W Vicon crane, 200 ton capacity when rigged for maximum lift

2. M/V SHORTY BAIRD, twin screw towboat, built 1977 by Superior Boat Works, 86' x 27', Cat. D 398 diesels, 1700 HP

3. M/V MISSISSIPPI, twin screw towboat, inspected, built 1961 by Ingalls Shipbuilding Corp., 217' x 49', Nordberg FS-138-HSC diesels, 3700 HP

4. Mat barges, double rake, 170' x 35'

5. Survey boat DUMAS

Bisso Marine Company

1. Derrick barge AJAX, 121' x 65', 325 ton lift capacity

2. Derrick barge SOUTHERN 6, 124' x 70', 400 ton lift capacity

3. CAPT. LUKE diving barge, 130' x 50'

4. M/V TYLER, twin screw towboat, built 1976 by Larose Shipyard, 60' x 22', GM 12v-71 diesels, 800 HP

Tracor Marine

1. Two Amcon 450 air controlled diesel powered double drum hoists, line pull at stall, 180,000 pounds

2. Recompression chamber

3. Air compressors

4. Diving equipment

5. Salvage pumps and hoses

6. Video camera and recorder
7. Snatch blocks
8. Shackles, straps, rigging gear, etc.
9. Reels of 1-5/8" diameter wire rope

Locally obtained equipment by rental agreement with Tracor Marine

1. Generators
2. Mobile crane
3. Safety boats
4. Crew boat
5. Welding machines
6. Air arc systems
7. Radio communication network

U.S. Navy (Supervisor of Salvage) - ESSM - Cheatham Annex, VA.

1. Control van
2. Six (6) 6000 pound STATO anchor systems

6.0 BARGE DESCRIPTIONS

The 14 barges involved in the salvage task were similar in design and each was owned or operated by one of four companies. In design, each was 195' LOA by 35' beam with a deadweight of 1500 tons at nine feet draft.

Owner/Operator and Barge Number:

Mid-South Towing, Tampa, Florida
MST 312, 331, 351, 352, 408, 409

Consolidated Grain and Barge, Co., St. Louis, Missouri
CGB 172, 409B

Peavey Company, Alton, Illinois
PV 19B, 331, 828B

Helena Marine Services, Little Rock, Arkansas
RMW 10, 12, 17

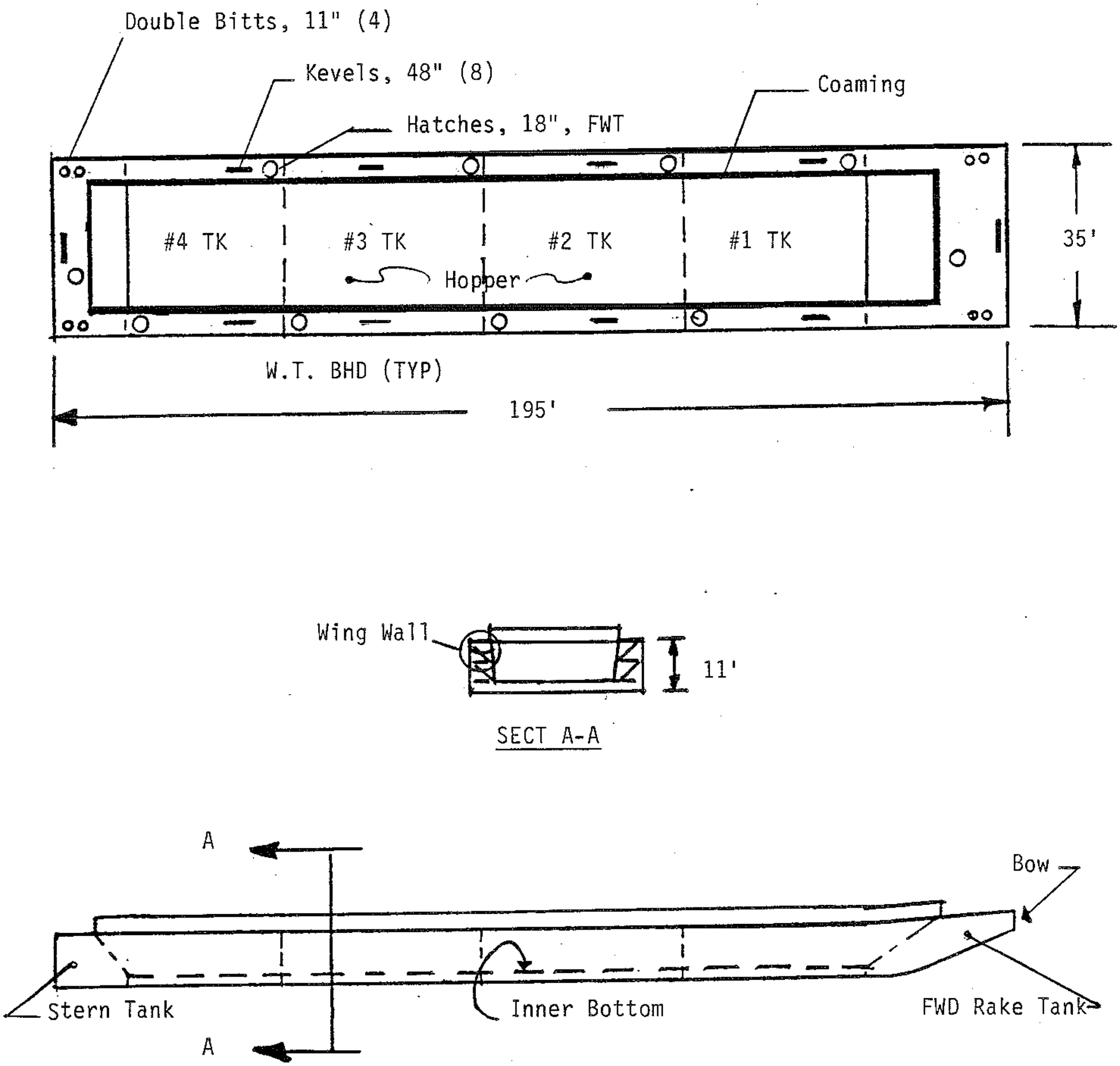
The six Mid-South Towing Co. barges were open hopper barges with a forward rake and a box stern. The tanks consisted of forward rake, stern and four common saddle tanks. There were no longitudinal subdivisions. The bottom plating was 3/8" thick from the headlog to a seam 34 feet aft and from the stern to a seam 15'1-1/2" forward. The midship section bottom plating was 5/16" thick. The barges were constructed by St. Louis Shipbuilding - Federal Barge, Inc.

The two Consolidated Grain and Barge, Co. barges were covered hopper barges, box ended on both ends. The tanks consisted of a forward tank, five common saddle tanks and a stern tank. There were no longitudinal subdivisions.

The three Peavey Company barges were similar or identical to the covered hopper barges described above. The PV-19B and 828B were built by St. Louis Ship and the PV 331 built by Jeffboat.

The three Helena Marine Services barges were open hopper barges similar or identical to those described above belonging to Mid-South Towing.

Figure 6.1: TYPICAL BARGE MST CLASS BUILT BY ST. LOUIS SHIP



7.0 SALVAGE OPERATIONS

On the morning of 9 December 1982, SUPSALV and Tracor Marine personnel arrived at the dam site to begin the survey (see Appendix VII). During the week that followed, additional Tracor assets were mobilized and preliminary salvage plans, equipment requirements, cost estimates and management plans were developed. The proposed salvage plan was prepared by the Tracor Marine Salvage Master, Leon Ryder, and Salvage Engineer, Paul Smith. This plan was submitted to the U.S. Army Corps of Engineers and SUPSALV on 16 December 1982 and is included in Appendix VII.

The salvage plan was based on the use of two heavy lift derrick barges, a pull barge, the crane barge provided by the Corps of Engineers and other work platforms outlined in Section 5.0. Diving operations were considered impossible until a sufficient number of gates were cleared and made operational to control the high velocity currents. Faced with the condition of the barges and the expedient requirement of the operation, it was decided that lift capacity would best be approached by the use of two heavy lift derricks with a total capacity of 700 tons. Two derricks would provide a tremendous amount of flexibility to the operation. Numerous double lifts would be required to lift the partially severed wrecks and simultaneous operations would be possible at different areas of the dam.

SUPSALV was formally authorized by the Army Corps of Engineers on 17 December 1982 and Tracor Marine immediately implemented a full scale mobilization. Salvage gear from ESSM and Norfolk, machinery and personnel from the Norfolk and Port Everglades facilities were mobilized as described in Section 4.0. While awaiting the arrival of the heavy lift derricks, AJAX and

SOUTHERN 6, three and one-half barges were removed using the Army Corps of Engineers floating equipment and a small A-frame and tug owned by a local contractor.

The salvage efforts were first to be directed to removing the wreckage hampering the operation of floodgates 4, 9 and 13. However, when the Corps was able to get survey barges on the scene, scoured areas were located both upstream and downstream of the dam in way of certain gates. Priority was then given to those sections of the dam experiencing the most deterioration.

Of the fourteen barges comprising this effort, four barges were towed away reasonably intact and the remaining ten were total losses. Each barge, or group of barges, was a separate salvage problem, some presenting more problems than anticipated and all requiring the maximum resources of manpower and equipment.

The orderly, planned removal was complicated by the fact that barges were packed together, two and sometimes three deep. Some were deeply impaled on the piers and others twisted and wedged in the bay between the adjacent piers. At least once a day, a conference was held between the SUPSALV representative, the Corps, and Tracor Marine to discuss the progress and the proposed method of removal of the barge currently under consideration and deviations from the original plan that had become necessary.

Many of the barges had been damaged to the extent that sectioning was required, the broken hulls being both unsafe and unsuitable for a single lift. These facts became evident as the barges were uncovered and rigged for lifting. As experience was gained, the recovery and removal effort resolved itself into slinging, lifting, and retraction. Only in the earlier removals where surveys indicated that the barges were salvageable did buoyancy and dewatering play a significant role.

Of considerable importance to the salvage effort was the level of the tailwater, the water downstream of the dam. This level fluctuated according to the gate openings and the downstream water levels. The downstream levels gradually lowered over the course of the salvage operation as the flooding subsided. However, the tailwater level varied in proportion to the number of gates open and the influx of water into the pool from dams upstream. When the tailwater was high, covering the concrete spillway below the gates, the effective head pressure against the wrecks blocking the normal flow was reduced, the velocity of the water through the gates was reduced, and the scouring effect was minimized. The disadvantage was that the condition of the barges resting on the concrete could no longer be observed visually.

The environment encountered by the salvage crew during the winter in Dumas, Arkansas, was varied but could best be described as generally harsh. Conditions ranged from freezing cold winds, rains and sleet storms to unseasonably warm weather. Most days, the crew spent in foul weather gear and heavy winter clothing. Typical temperatures were generally in the low 30's in the morning to the upper 40's in the afternoon. Northern winds frequently produced a wind chill factor which brought the temperature down to as low as 10° F. It was anticipated that some time would be lost to weather-days. However, in spite of sleet storms, heavy rains and high winds, not a single full day was lost to the weather.

Diving conditions were poor with visibility a consistent zero. The water temperature was generally about 45^{o}F. The strong currents produced by the flood water and open gates prevented deployment of divers until a sufficient number of gates were operational and the velocity of the head water reduced. As the flood waters subsided, and control of most of the gates was regained, divers were able to enter the water providing more accurate surveys and greatly accelerating the process of rigging. The difficulties encountered included mangled and torn steel, some pieces adrift, barges deeply embedded in the concrete sill and the danger of air hoses being cut by jagged steel. Frequently, fouled slings were worked under and through barges literally by hand. These factors coupled with numerous holes produced by the scouring action and scattered debris in the form of hatch covers and trees made blind work underwater extremely hazardous.

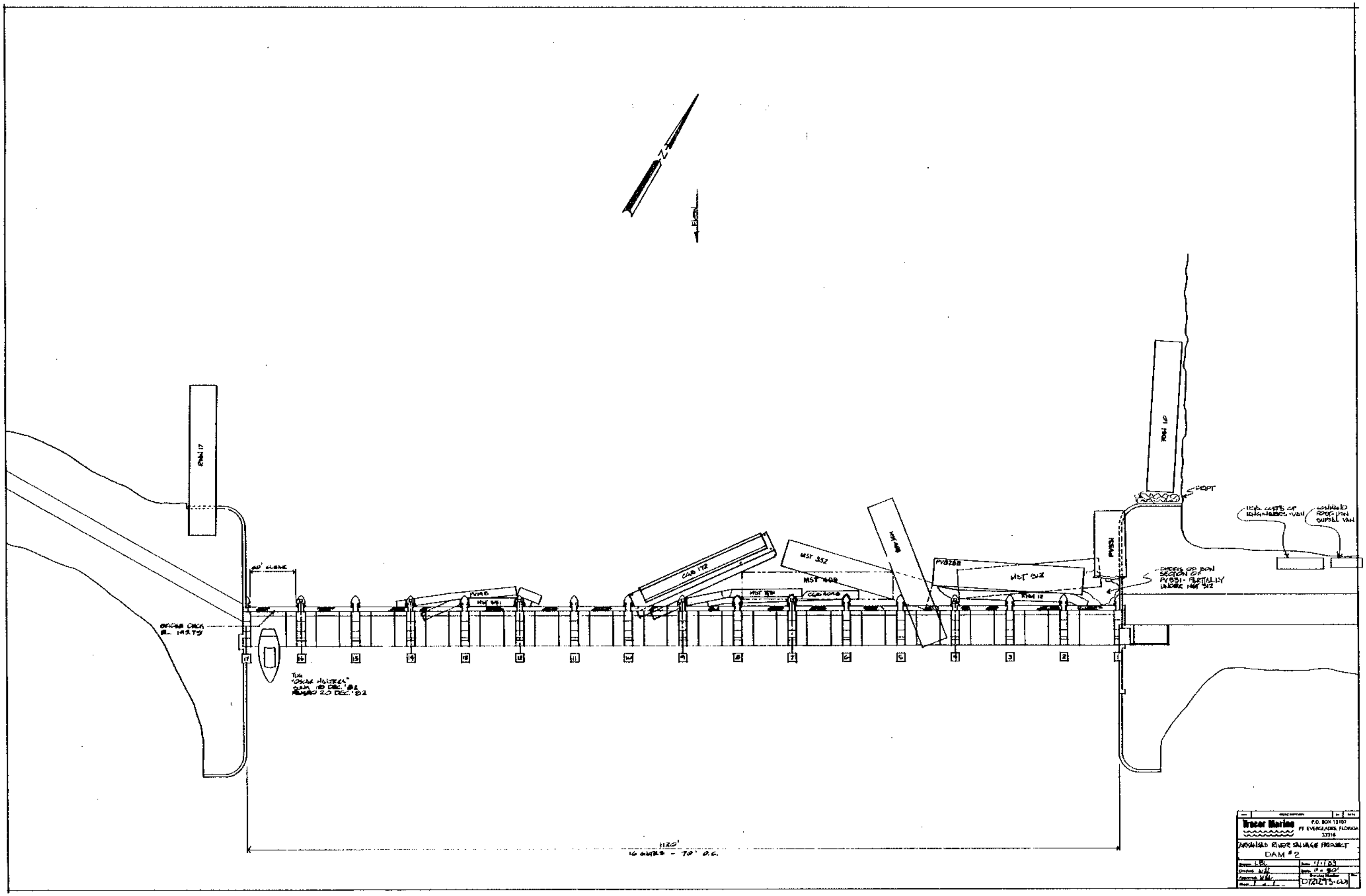


Figure 7.0: Plan view of Dam No. 2

7.1 REMOVAL OF BARGES RMW 10 & RMW 17

DATE: 8-9 December 1983

WRECK SURVEY:

The barge RMW 10 was lying parallel and against the left bank with the bow close to the training wall. The barge was apparently undamaged and intact.

The RMW 17 was lying parallel to the right bank with the forward one-third of the barge aground on the section of training wall that is at right angles to the river bank. The barge had sustained bottom damage in the areas that had crossed the parapet.

SUMMARY OF THE WRECK REMOVAL:

Under a commercial agreement with the barge owners, these barges were pulled off the bank by another contractor's tugs. The RMW 10 was freed and towed from the area on 8 December 1983 and the RMW 17 was pulled free and towed upriver on the following day.

7.2 REMOVAL OF BARGE PV 828B

DATE: 17 December 1982

EQUIPMENT USED:

SHORTY BAIRD
Manitowoc 4100 crane barge

WRECK SURVEY:

The PV 828B was lying parallel to the dam axis with its starboard side pressed against the RMW 12 (see Figure 7.2.1). The RMW 12 was lying on its starboard side against the dam axis and impaled upon piers 2, 3 and 4. The PV 828B was grounded in an even keel position on the sunken barge MST 312. The initial survey had indicated that all tanks except #1 had been breached but that the hopper walls were intact.

SALVAGE PLAN:

The force required to pull the barge free of the MST 312 was calculated to be within the capabilities of the Manitowoc crane barge and tug SHORTY BAIRD. By pivoting the stern of the stranded barge away from the dam, the SHORTY BAIRD would then be able to secure to the stern and retract the barge from the dam. If the ground reaction proved to be too great, the removal would be delayed until the arrival of the heavy lift derricks and the wreck rigged for lifting.

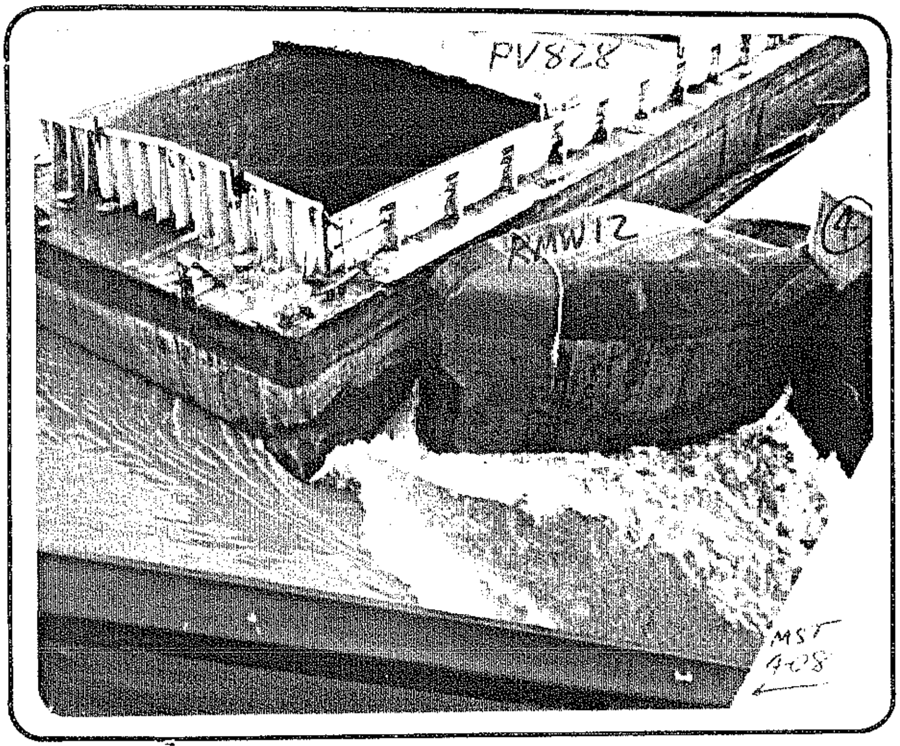


Figure 7.2.1: PV 828B Grounded on the Sunken MST 312
and Parallel to RMW 12.

SUMMARY OF THE WRECK REMOVAL:

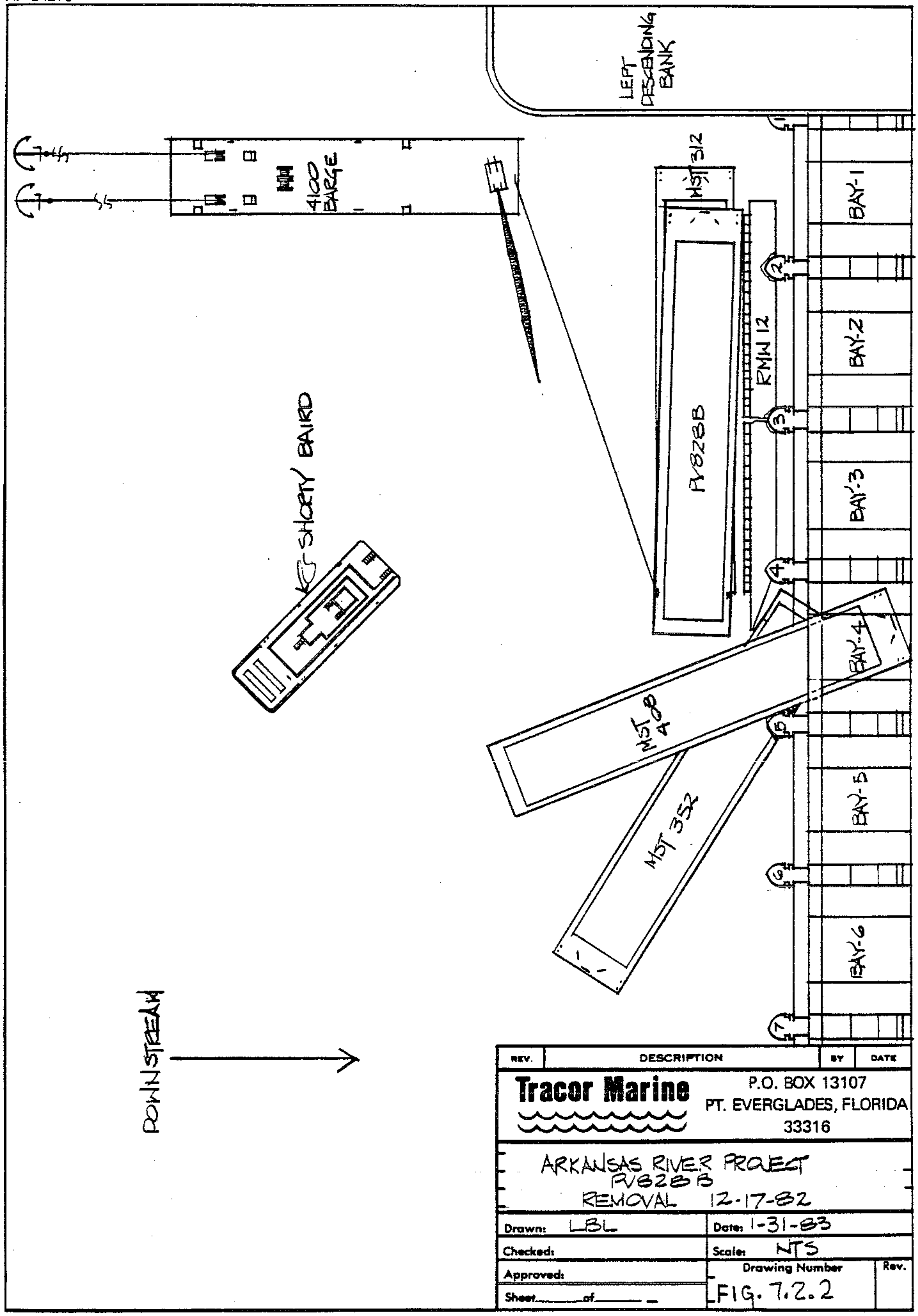
The PV 828B was pulled off the MST 312 by a winch on the Manitowoc crane barge and then transported to the fleeting area by the SHORTY BAIRD.

DETAILS OF THE WRECK REMOVAL:

Friday 17 December

The SHORTY BAIRD brought the Manitowoc 4100 crane barge into position alongside the left bank and upstream of the barge. A wire was run from the winch on the crane barge to a kevel on the aft port quarter of the PV 828B (see Figure 7.2.2 - "Removal"). With the crane barge spuds down, a strain was taken on the wire and the barge pivoted around its forward end until the stern was clear of the MST 408. The SHORTY BAIRD made up to the stern of the PV 828B, backed upstream and worked the barge clear of the MST 312.

The SHORTY BAIRD transferred the damaged barge over to the fleeting area.


LEFT DESCENDING BANK
4100 BARGE
MST 312
PV828B
RMW 12
BAY-1
BAY-2
BAY-3
BAY-4
BAY-5
BAY-6
1
2
3
4
5
6
7
SHORTY BAIRD
MST 408
MST 352
DOWNSTREAM
REV.
DESCRIPTION
BY
DATE
Tracor Marine
P.O. BOX 13107
PT. EVERGLADES, FLORIDA
33316
ARKANSAS RIVER PROJECT
PV828B
REMOVAL 12-17-82
Drawn: LBL
Date: 1-31-83
Checked:
Scale: NTS
Approved:
Drawing Number
Rev.
FIG. 7.2.2
Sheet ___ of ___

7.3 REMOVAL OF BARGE PV 331

DATE: 17, 20-21, 24 December 1982 - Stern Section
20-22 January 1983 - Bow Section

EQUIPMENT USED:

AJAX
SOUTHERN 6
CAPT. LUKE
Manitowoc crane barge
SHORTY BAIRD
TYLER
Patton and Tulley A-frame barge
Two mat barges

WRECK SURVEY:

Barge PV 331, located on the left side of the dam in way of gate 1, was torn in half. The stern section, a piece approximately 80 feet long and weighing about 110 tons, was grounded on the left training wall some 30 feet upstream of gate 1. The forward section of the barge lay at right angles to the training wall under MST 312 and PV 828B. The after tank was dry and the #4 tank pumpable.

SALVAGE PLAN:

The Patton-Tully A-frame would be used to remove the stern section. When the section was rigged for lifting with a pair of slings set athwartships, the barge would then be loaded on a mat barge.

The forward section was completely submerged and inaccessible. It would be necessary to remove the MST 312 and probably the RMW 12 before an underwater inspection would be possible.

SUMMARY OF THE WRECK REMOVAL:

The bow and stern sections of the PV 331 were removed individually. The stern section was lifted out with wire slings and moved to the right bank of the river (see Figure 7.3.1). Later, it was lifted once again and landed on a mat barge which was moved to the fleeting area. The bow portion of the PV 331 had been extensively mangled and was brought up with much difficulty. It was lifted with belly slings using both derricks, landed on a mat barge and transported to the fleeting area (see Figure 7.3.2).

DETAILS OF THE WRECK REMOVAL:

Friday 17 December

The Manitowoc crane barge was positioned to starboard of the PV 331 by SHORTY BAIRD. A portable pump was rigged for pumping #4 tank. Two messengers were run under PV 331

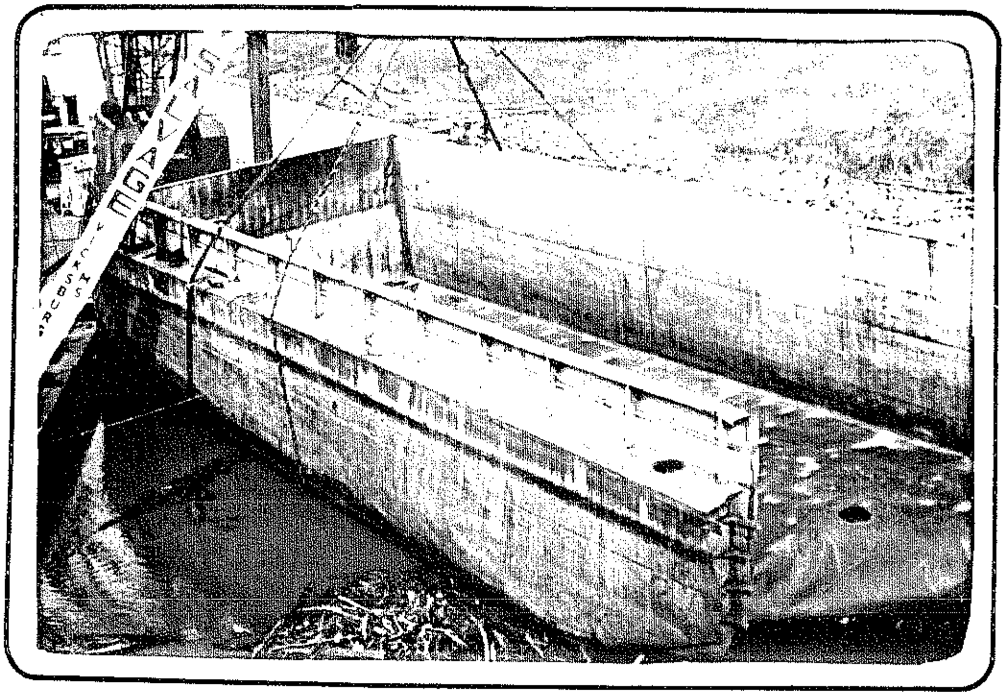


Figure 7.3.1: Severed Stern of PV 331

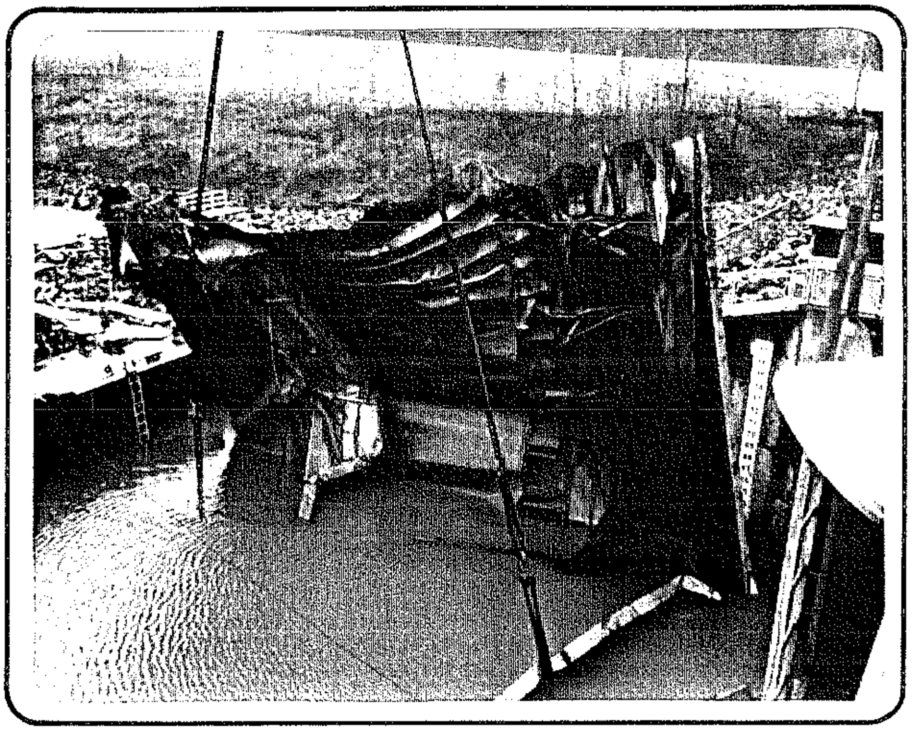


Figure 7.3.2: Mangled Bow Section of PV 331

athwartships. An inspection hole burned through the hopper floor revealed that the PV 331 was hung up on the bow of the MST 312.

Monday 20 December

Patton-Tully A-frame and tug arrived and were positioned for removal of the stern.

Tuesday 21 December

Tracor Marine salvage crew rigged two slings around the stern section of the PV 331. The Patton and Tulley A-frame lifted the section and transported it to a point on the right bank adjacent to the M/V MISSISSIPPI. This one lift was made under subcontract to Tracor Marine and under the direction of the Tracor Marine salvage master.

Friday 24 December

The SOUTHERN 6 transferred the stern section from the right bank to a mat barge and shifted the mat barge to the fleeting area.

Thursday 20 January

The AJAX, SOUTHERN 6, CAPT. LUKE and TYLER moved to the area upstream of gates 1 and 2 and began rigging the submerged section of PV 331. A diver was deployed from the CAPT. LUKE to survey the wreckage and to set messengers. A thorough underwater survey had not previously been possible because the MST 312 was resting over the wreckage of the PV 331. The diver was successful in passing a messenger around the wreckage on the left bank side. However, attempts to pass a messenger around the portion of the PV 331 extending into gate 2 were unsuccessful as the wreck was hard aground on the riprap.

Friday 21 January

The AJAX and CAPT. LUKE continued working in the gate 1 area on the PV 331. A heavy lifting sling was pulled into place using the messenger which had been set the previous day. With considerable help from topside personnel, a diver was able to work the sling toward the right end of the wreck. The difficulty was attributable to the split and contorted condition of the wreckage.

Saturday 22 January

The AJAX and CAPT. LUKE continued working on PV 331 in the gate 1 area. The AJAX elevated the left end of the submerged section with the sling set previously (see Figure 7.3.3 - "Elevating Left End"). This enabled divers from the CAPT. LUKE to set a messenger to the right of the first sling, and then pull a second sling into place.

The CAPT. LUKE then withdrew from gates 1 and 2 as the SOUTHERN 6, the Manitowoc crane barge and the SHORTY BAIRD moved in to assist in the wreck removal. The slings were rigged to the A-frames so that the SOUTHERN 6 and the AJAX were able to perform a joint lift (see Figure 7.3.4 - "Joint Lift-Wreck Removal"). The wreckage was lifted until it surfaced and was then pulled 200 yards upstream of the dam. The PV 331 was then lifted clear of the water and landed on a mat barge brought in by the TYLER. The mat barge was then returned to the fleeting area.

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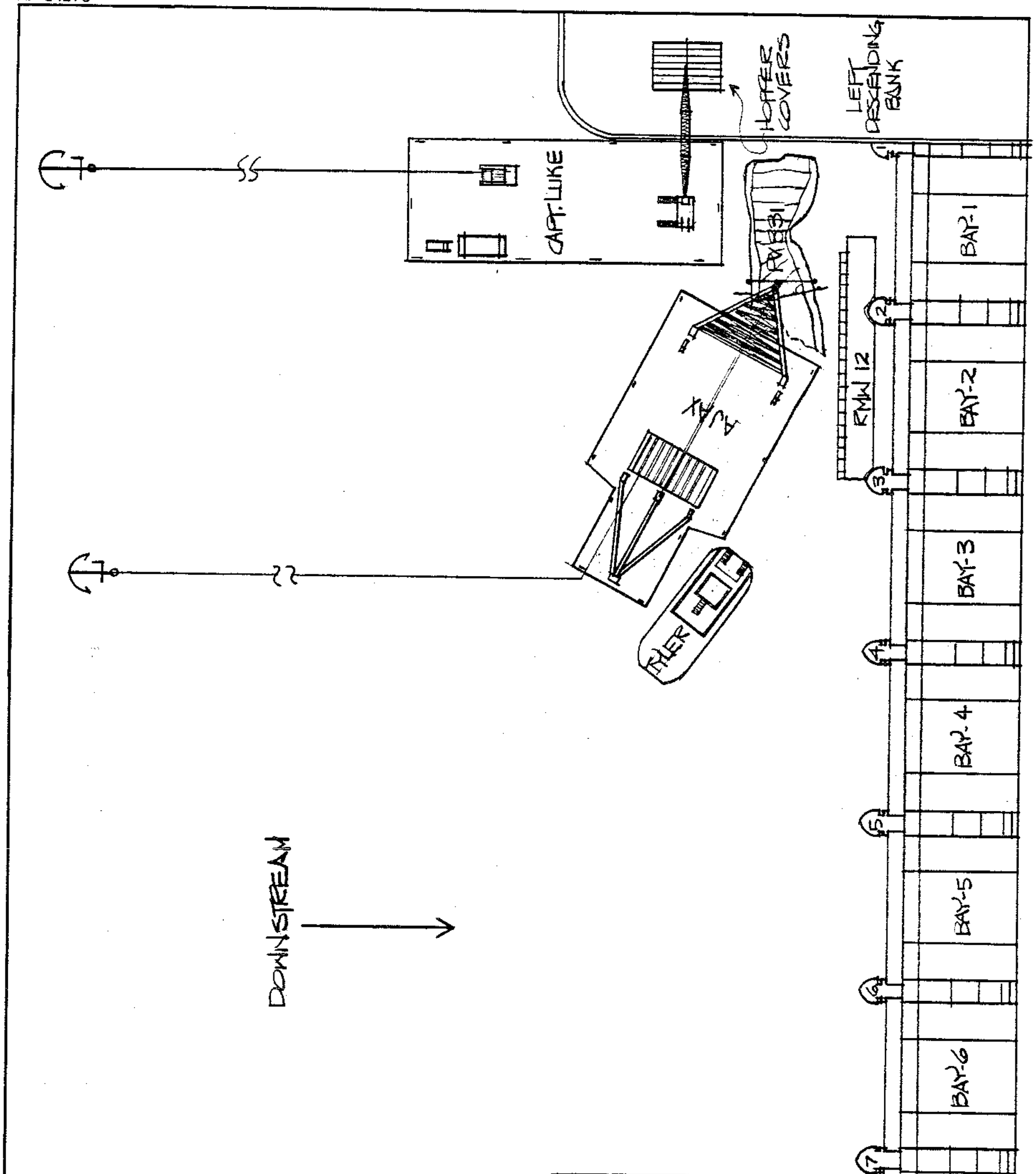

REV.	DESCRIPTION	BY	DATE

Tracor Marine

P.O. BOX 13107
PT. EVERGLADES, FLORIDA
33316

ARKANSAS RIVER PROJECT
FV 331
ELEVATING LEFT END 1-22-83

Drawn: LBL	Date: 1-25-83
Checked:	Scale: NTS
Approved:	Drawing Number: FIG. 7.3.3 — Rev.:
Sheet ___ of ___	

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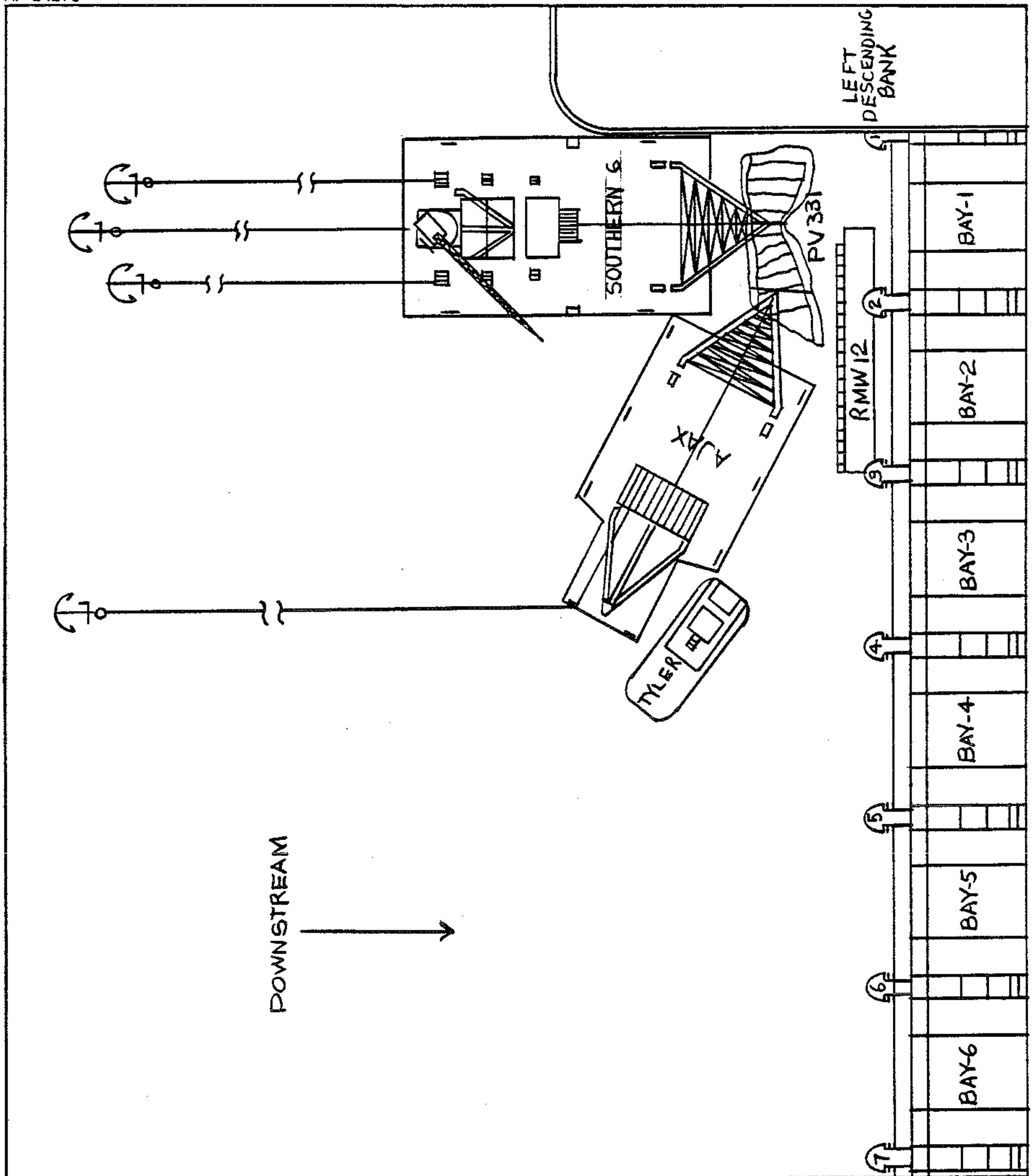

REV.	DESCRIPTION	BY	DATE

Tracor Marine
P.O. BOX 13107
PT. EVERGLADES, FLORIDA
33316

ARKANSAS RIVER PROJECT
PV 331
JOINT LIFT-WRECK REMOVAL

Drawn: GFA	Date: 1·31·83
Checked:	Scale: NTS
Approved: WAJ	Drawing Number: FIG. 7.3.4
Sheet ___ of ___	Rev.

7.4 REMOVAL OF BARGE MST 408

DATE: 22-28 December 1982

EQUIPMENT USED:

Pull Barge
TYLER
SHORTY BAIRD
SOUTHERN 6
Manitowoc 4100 crane barge
Lightering barge

WRECK SURVEY:

The MST 408, containing a full load of coal, had breached the dam at gate 4 and was grounded on the MST 352 with one-third of its length cantilevered past the axis of the dam (see Figure 7.4.1). The original survey indicated that #1 tank was breached on the starboard side at the turn of the bilge, adjacent to the bulkhead between tanks #1 and #2. The hole measured 5" x 8". The bulkhead between tanks #1 and #2 was set up slightly. All other tanks were tight but contained water due to undogged manhole covers.

SALVAGE PLAN:

The plan for the MST 408 consisted of first removing the cargo of coal and then ballasting the stern rake tank to trim the barge to a more nearly horizontal attitude before attempting

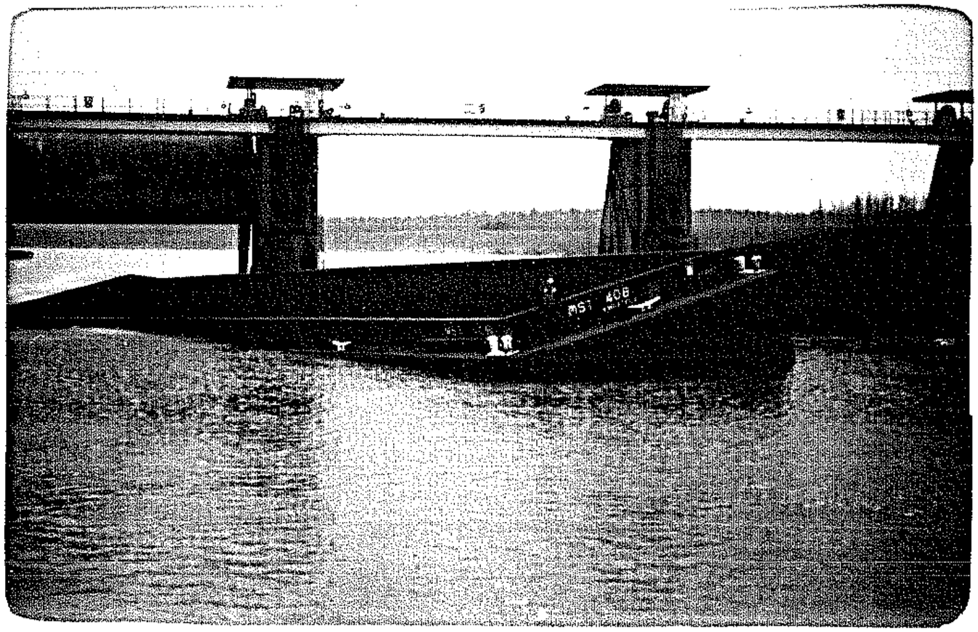

Figure 7.4.1: MST 408 Protruding Through Gate 4

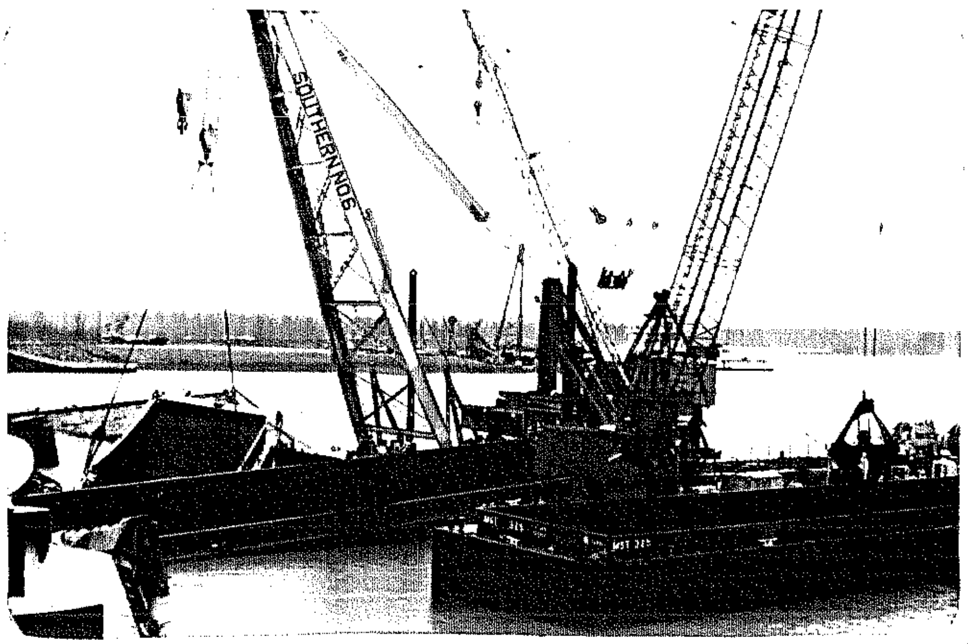

Figure 7.4.2: Unloading Coal Cargo From MST 408

to retract with the Pull Barge. The SOUTHERN 6 would be secured to the MST 352 to prevent the barge from slipping into the gate (see Figure 7.4.2).

SUMMARY OF THE WRECK REMOVAL:

The coal was unloaded into a lighter barge using a clam shell bucket from the Manitowoc crane barge. This relieved the strain caused by both the overhang and the groundout reaction. Two 14' x 14" I-beams were welded to the stern rake of the barge for pulling points. The Pull Barge was used to retract the MST 408 off the MST 352. Careful ballasting and dewatering were required to clear the forward rake from the lip of the gate.

DETAILS OF THE WRECK REMOVAL:

Wednesday 22 December

The Manitowoc crane barge and tug SHORTY BAIRD moved into position upstream of the MST 408 and the crane barge set the two upstream spuds. Two 14' long by 14" wide flange I-beams with reinforced padeyes were welded on both sides of the after deck just outboard of the hopper coaming for use as pull points. These beams were selected and purchased to provide strength when the wires from the Pull Barge were secured to them. This method was considered safer and less prone to failure than using eyes slipped over the kevels. A small hole in tank #2 was repaired.

Thursday 23 December

The Pull Barge was taken by the SHORTY BAIRD 600 feet upstream of the dam and two 6000 lb. Stato anchors were deployed. Each anchor was secured to the cables spooled on the Amcon winches. The barge let down on its anchors toward the dam, paying out cable as it went. A strain was put on the anchors to insure that they were set.

The Pull Barge was then married up to the stern rake of the MST 408. The SHORTY BAIRD returned to the fleeting area, brought out the Manitowoc crane barge and secured it to the port side of the MST 408. A 10" pump and two 3" pumps were put into operation to pump out the wing tanks and remove the coal slurry from the hopper. A lightering barge was brought from the fleeting area and secured on the port side of the crane barge. The Manitowoc crane was rigged with a clam shell and began unloading the coal. Calculations were performed (see Appendix VIII) and an unloading plan was devised for the cargo offload. It was essential that the forward (cantilevered) section of the hopper be offloaded first to prevent upsetting the critical balance of the barge as it was suspended through gate 4. The lightering barge was rigged with one of the 3" pumps to remove the water accumulating in its hopper.

The crane barge and the lightering barge were returned to the fleeting area for the night. The Pull Barge retracted on its anchors approximately 100 yards upstream.

<u>Friday 24 December</u>

The SHORTY BAIRD, Manitowoc crane barge and lightering barge were positioned as on 23 December. Coal removal continued and some change in position of the MST 408 and the MST 352 was noted. Bad weather forced the return of all salvage platforms to the fleeting area with the exception of the Pull Barge; it again retracted on its anchors 100 yards upstream.

Saturday 25 December

The salvage platforms were positioned as on the two previous days. The SOUTHERN 6 moved into a position where it could control the motion of the MST 352. Pumping continued aboard MST 408. Salvage platforms secured as on the two previous nights.

Sunday 26 December

All equipment was positioned as on 25 December and the unloading of coal from the MST 408 continued. A survey team monitored the wrecks during the unloading and advised the salvage master of any motion of either the MST 408 or the MST 352. Coal removal was suspended and an attempt to move the MST 408 towards the left bank was unsuccessful because there was too much ground reaction on the forward section from the MST 352. It would be necessary to flood the after rake tank and the two tanks forward of the after rake tank and continue removing the coal from the hopper of the MST 408.

Monday 27 December

The two 6000 pound STATO anchors upstream of the Pull Barge were reset using the Manitowoc 4100 crane barge and the tug SHORTY BAIRD. Progress was slow due to rain and the suspension of work during tornado alerts. The coal slurry in the forward end of the barge was pumped out.

Tuesday 28 December

The aft tank of the MST 408 was filled to eliminate trim and the rain water that had accumulated in the forward end of the hopper was pumped out. The two 1-5/8" wires from the Amcon winches on the Pull Barge were shackled to eyes on the

I-beams which were welded on the deck of the MST 408 for pull points (see Figure 7.4.3 - "Removal"). A full strain was applied, but the 1-5/8" port anchor wire parted where the wire passed over the stern of the Pull Barge. The Manitowoc crane barge was moved into position along the port side of the Pull Barge and married up. Once secured, the spuds were lowered providing restraint in lieu of the broken anchor wire. Again, a strain was taken and the MST 408 broke free and moved upstream until the vessel's trim prevented the bow from passing under the lip of gate 4. The MST 408 was still grounded on the MST 352.

After deploying its anchors, the SOUTHERN 6 was brought into position and the lifting block secured to a sling that had been rigged around the MST 352. Thus, the SOUTHERN 6 was used as a preventer against the possibility that the MST 352 would slide into gate 4 when the MST 408 was pulled clear of the gate. While the SOUTHERN 6 was positioning, the aft rake tank of the MST 408 was being dewatered in order to trim the barge. When the MST 408 was sufficiently trimmed by the bow, the Pull Barge hauled the MST 408 clear of the gate and off the MST 352. The tug SHORTY BAIRD transported the barge to the fleeting area.

The SOUTHERN 6 remained on station secured to MST 352.

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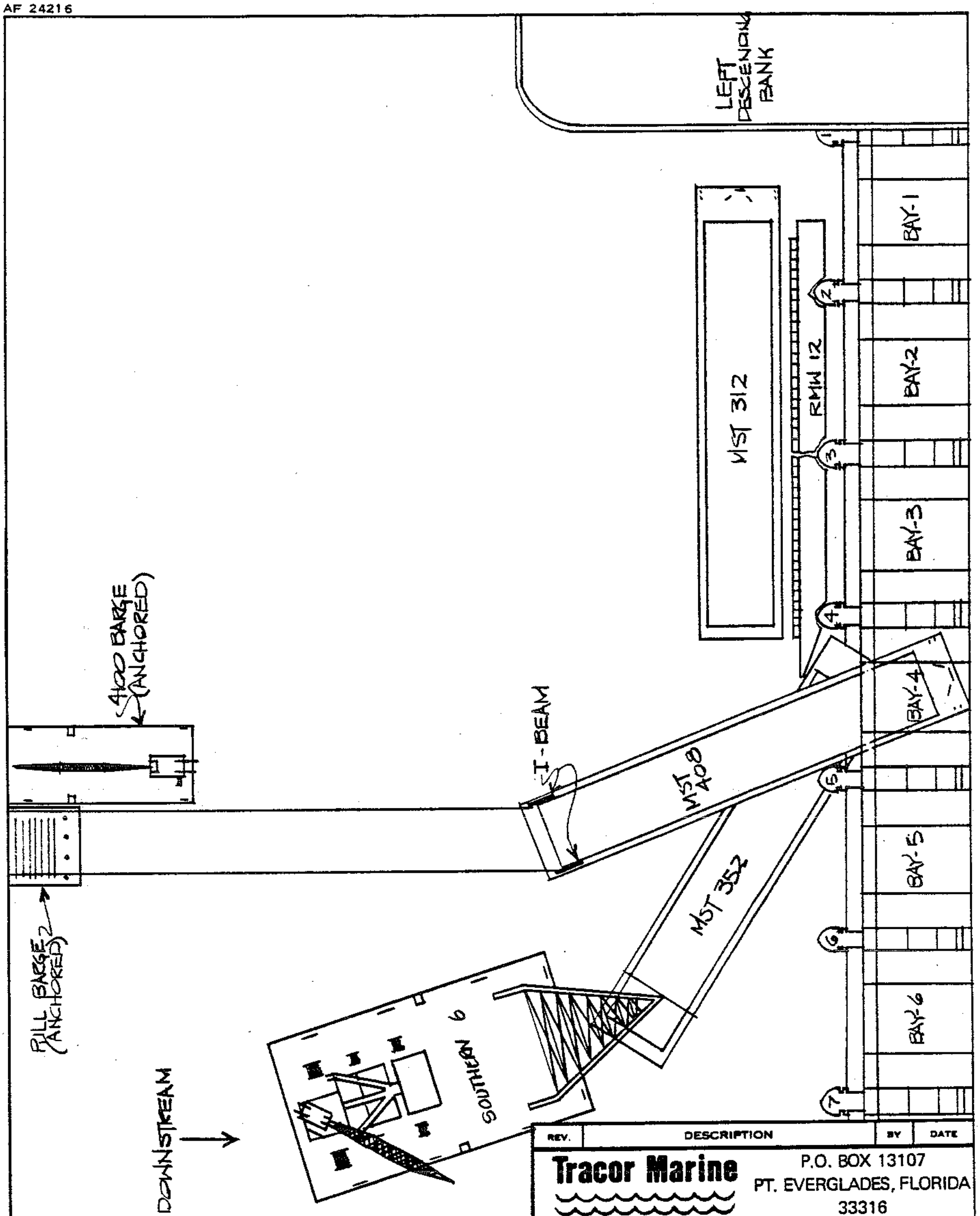

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ARKANSAS RIVER PROJECT
MST 408
REMOVAL 12-28-82

Drawn: LBL	Date: 1-31-83	
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Sheet ____ of ____	FIG. 7.4.3	

7.5 REMOVAL OF BARGE MST 352

DATE: 28-31 December 1982

EQUIPMENT USED:

Pull Barge
SOUTHERN 6
AJAX
SHORTY BAIRD
TYLER
Two mat barges

WRECK SURVEY:

The barge MST 352 was lying at an angle of 20 to 30 degrees to the dam axis with its stern submerged in gate 4 and the port side impaled on pier 5 at a point about 50 feet from the stern. The hull was broken and twisted. It was presumed that all tanks and the hopper were breached. The hull was in a generally upright position. The MST 408 was grounded on the MST 352 which was grounded on what was later identified as the MST 409 (see Figure 7.5.1).

SALVAGE PLAN:

The plan for the MST 352 consisted of rigging two belly slings and using both derricks to lift the wreck. It became necessary to include the Pull Barge to simultaneously retract the barge from pier 5 as it was fouled on wreckage beneath the surface.

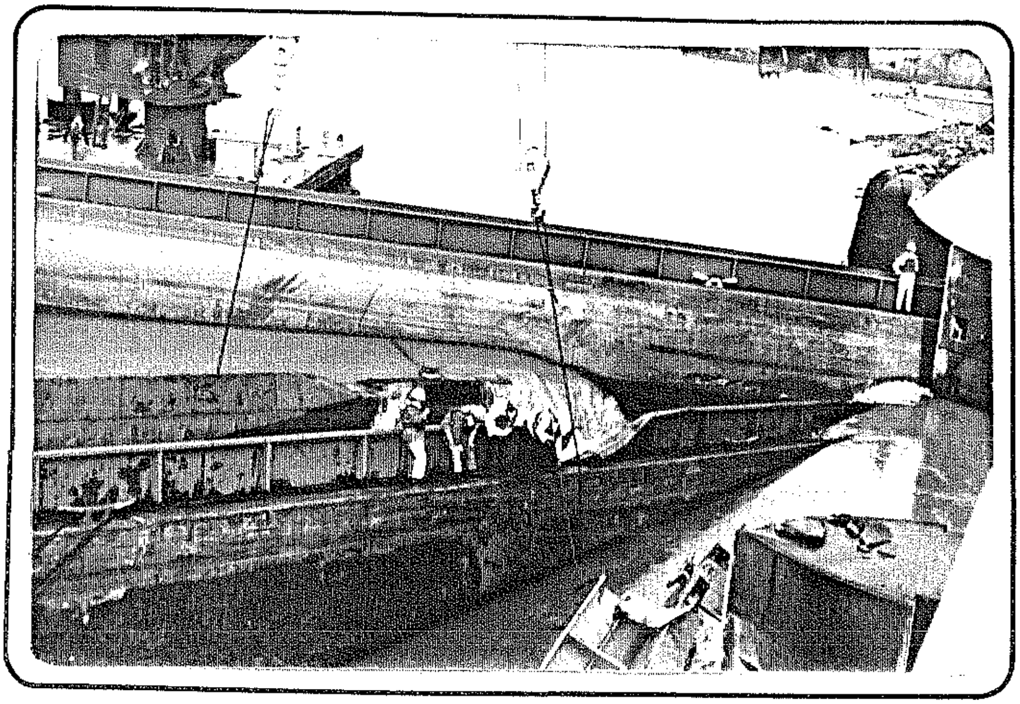

Figure 7.5.1: MST 408 Grounded on MST 352 at Gate 4

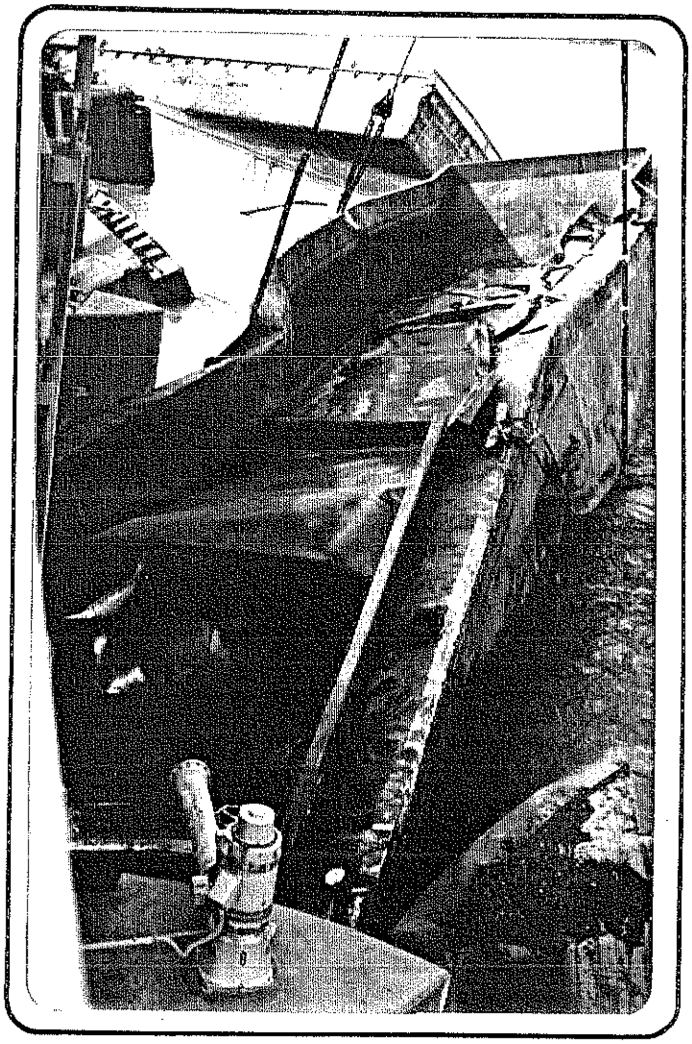

Figure 7.5.2: Lift of MST 352

SUMMARY OF THE WRECK REMOVAL:

The SOUTHERN 6, AJAX and Pulling Barge were all utilized in the removal of the MST 352. The two derricks alternately heaved on the wreck in conjunction with the strain from the Pull Barge to free the MST 352 from its impalement at pier 5 and the grounding on the MST 409 while trying to maintain the wreck in one piece. The wreck was pulled clear of the obstructions and loaded onto two mat barges. Gate 4 was now cleared (see Figure 7.5.2).

DETAILS OF THE WRECK REMOVAL:

Tuesday 28 December

After deploying its anchors, the SOUTHERN 6 was brought into position and the hook secured to a sling that had been placed around MST 352 during the rigging of the MST 408. The SOUTHERN 6 was secured to the MST 352 and acted as a preventer to preclude MST 352 from sliding into gate 4 when the MST 408 was pulled clear of the gate.

Wednesday 29 December

A messenger was passed and a sling was rigged just to the right of the impalement at pier 5. The derrick barge, AJAX, set an anchor and moved into position upstream of pier 5. The broken anchor wire on the port Amcon winch was replaced and four 100 ton capacity padeyes were welded on the Pull Barge, one on each corner of the barge. The forward padeyes were to be used to secure the bitter end of a chain or wire back to the Pull Barge to be used as pulling points. The after padeyes were to be used to secure auxiliary anchor wires if necessary.

Thursday 30 December

After the new wire was spooled onto the port Amcon winch, an anchor was shackled in and set by the SHORTY BAIRD and the Manitowoc crane barge. The Pull Barge was positioned between and upstream of the derrick barges and a wire from the starboard Amcon winch was led between the AJAX and the SOUTHERN 6 and secured to a cleat on the port side of the MST 352.

With the two barges lifting to near capacity and the Pull Barge straining on the cleat, the wreck was eventually broken free of the pier and of an unseen obstruction underneath the wreck believed to be the wreck of the MST 409 (see Fig. 7.5.3 - "Removal"). The two derrick barges lifted both simultaneously and alternately, but always in conjunction with the strain from the Pull Barge. The intention was to cause the barge to work loose without breaking up. When the barge was finally freed, the two derrick barges carefully lifted the wreck clear of the underwater obstruction and worked it upstream away from the gate. The Corps of Engineers then closed the gate to stop the current flow. The wreck was lifted just clear of the water and the derrick barges and tugs moved the wreck over to the right bank, resting it on the beach near the MISSISSIPPI.

Friday 31 December

Two mat barges were brought from the fleeting area and positioned so as to receive the wreckage of the MST 352. It was necessary to handle the wreck with extreme care to preclude it from breaking in half. The impalement at pier 5 had partially severed the barge, such that when the AJAX took a strain on the forward sling, the bow section of the MST 352 canted downward from her own weight at an angle of 30 degrees. The two derrick

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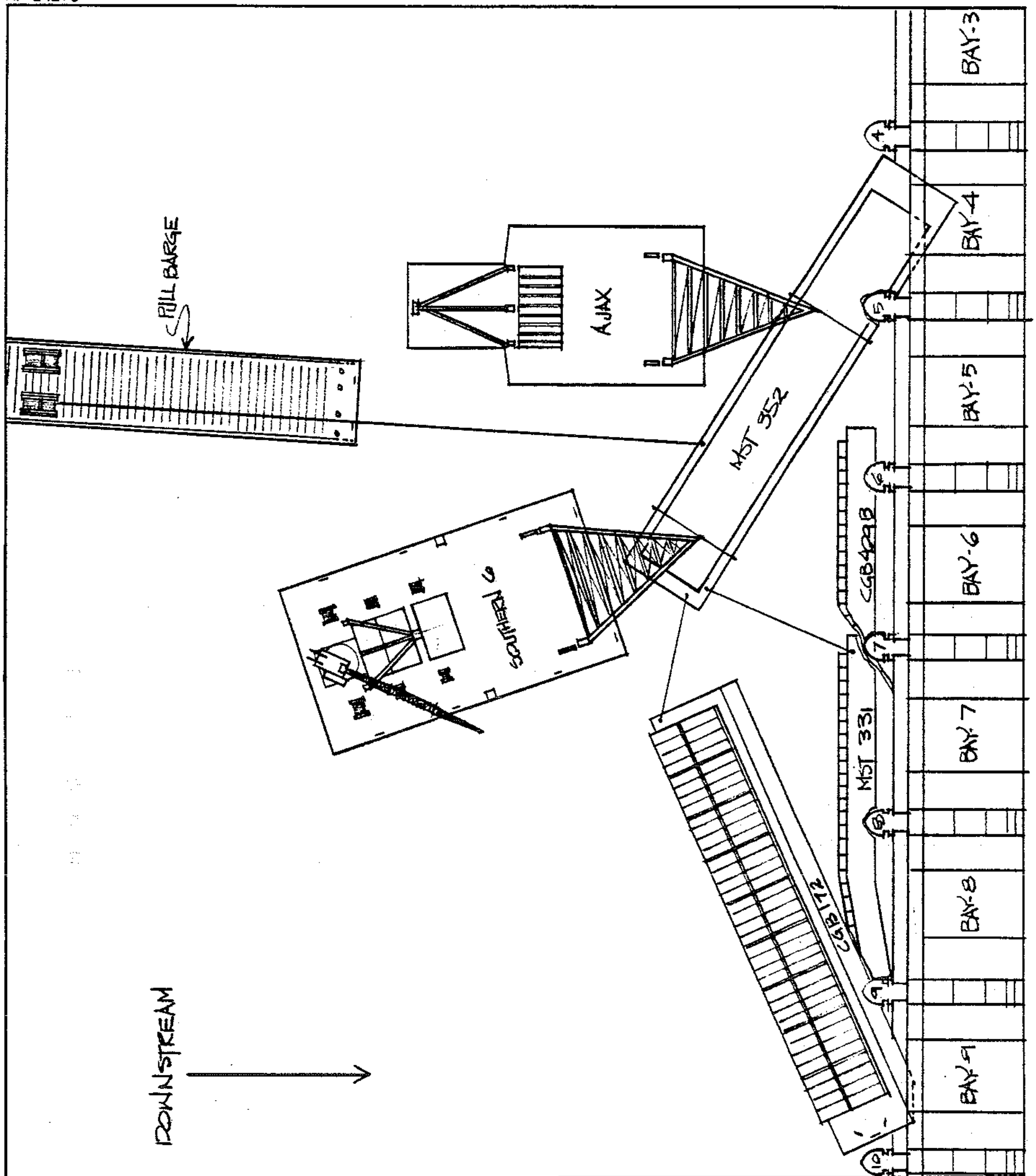

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ARKANSAS RIVER PROJECT
MST 352
REMOVAL 12-30-82

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Sheet ____ of ____	

barges lifted the wreck high enough to permit the mat barges to be moved underneath it and then lowered the wreckage onto the mat barges.

7.6 REMOVAL OF BARGE CGB 172

DATE: 31 December 1982 - 4, 21 January 1983

EQUIPMENT USED:

Pull Barge
SOUTHERN 6
AJAX
SHORTY BAIRD
TYLER
Manitowoc 4100 crane barge
Two mat barges

WRECK SURVEY:

The CGB 172 lay at approximately a 30 degree angle to the axis of the dam with the forward rake wedged in bay 9, blocking the gate. The barge lay with about a 45 degree starboard list and was 15 to 20 degrees down by the bow (see Figure 7.6.1). The port wing wall in way of #2 tank was impaled on pier 9 at a point approximately 50 feet from the bow with penetration extending into the hopper. The forward rake tank appeared to be ruptured. The other tanks contained water. It was reported the barge had a cargo of soybean meal. All the hatch covers were in place.

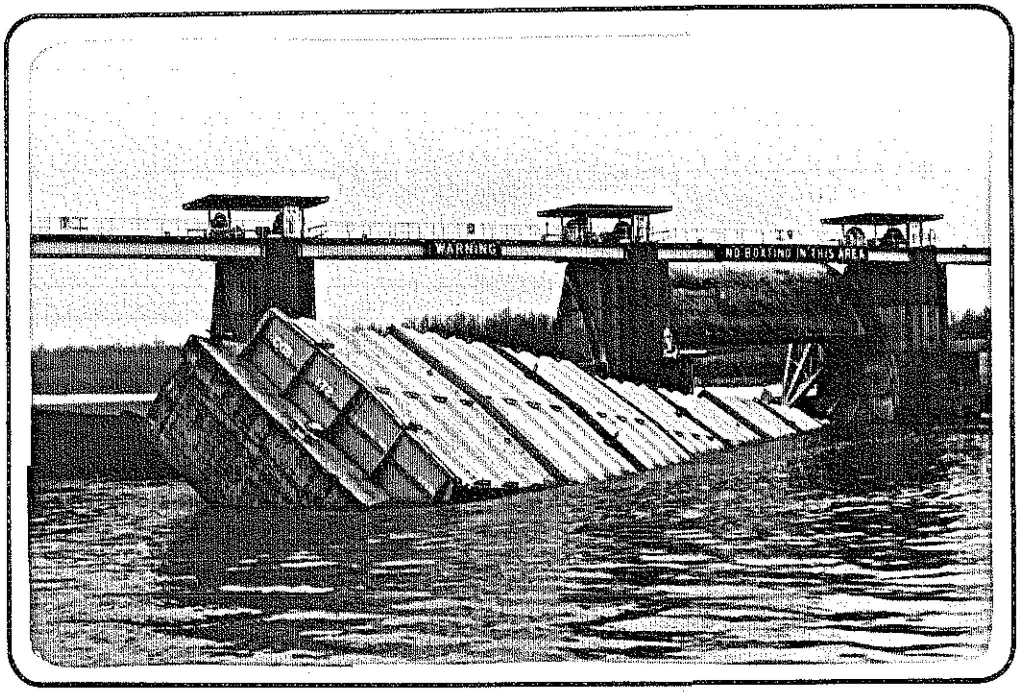

Figure 7.6.1: CGB 172 Sunk at Gate 9

SALVAGE PLAN:

The plan for dislodging the CGB 172 was to use the Pull Barge, the SOUTHERN 6 and the AJAX rigged such that the wreck would be simultaneously subjected to a pulling, lifting and parbuckling action. First, it would be necessary to remove the hatch covers and pump and flush what remained of the grain into the river. The positioning of the heavy lift and retraction system for CGB 172 would be dependent on passing the forward lifting wire under the barge adjacent to the ice breaker penetration. Messenger wires would be placed under the after end of the barge using the crane on the CAPT. LUKE and slid forward as far as possible. Slings would then be drawn around the hull and secured with preventer wires. With both heavy lift derricks rigged, the tanks would be pumped. The barge would then be lifted and parbuckled simultaneously to free it from the ice breaker. The barges would retract on their anchors in conjunction with the Pull Barge and move the wreck upstream.

SUMMARY OF THE WRECK REMOVAL:

The removal of the CGB 172 represented a formidable task in that the vessel was impaled on pier 9 and wedged against the inboard side of pier 10, firmly wedged in bay 9. The gate was totally blocked and would not close. Two unsuccessful lifts were attempted with up to 750 tons of lift applied. The wreck was rerigged for a third lift attempt with lift points moved forward (see Figure 7.6.2). When a strain was applied with the two derricks and the Pull Barge, the barge hull failed near the point of impalement with the result that the mid-body rotated counterclockwise with the stern striking the lower truss section

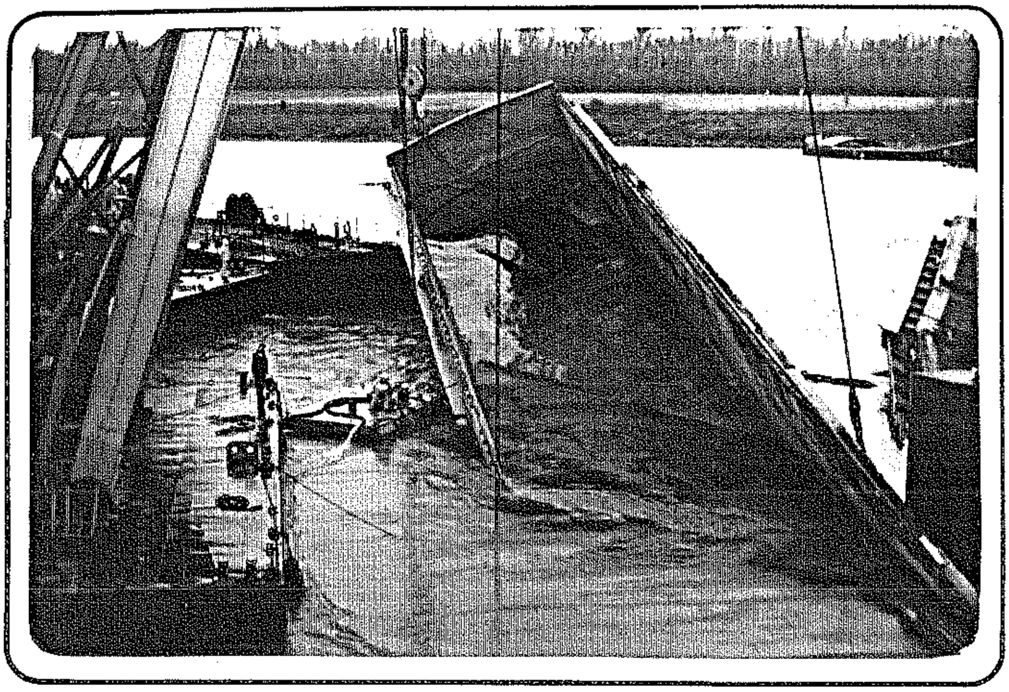

Figure 7.6.2: Pumping Starboard Tank of CGB 172

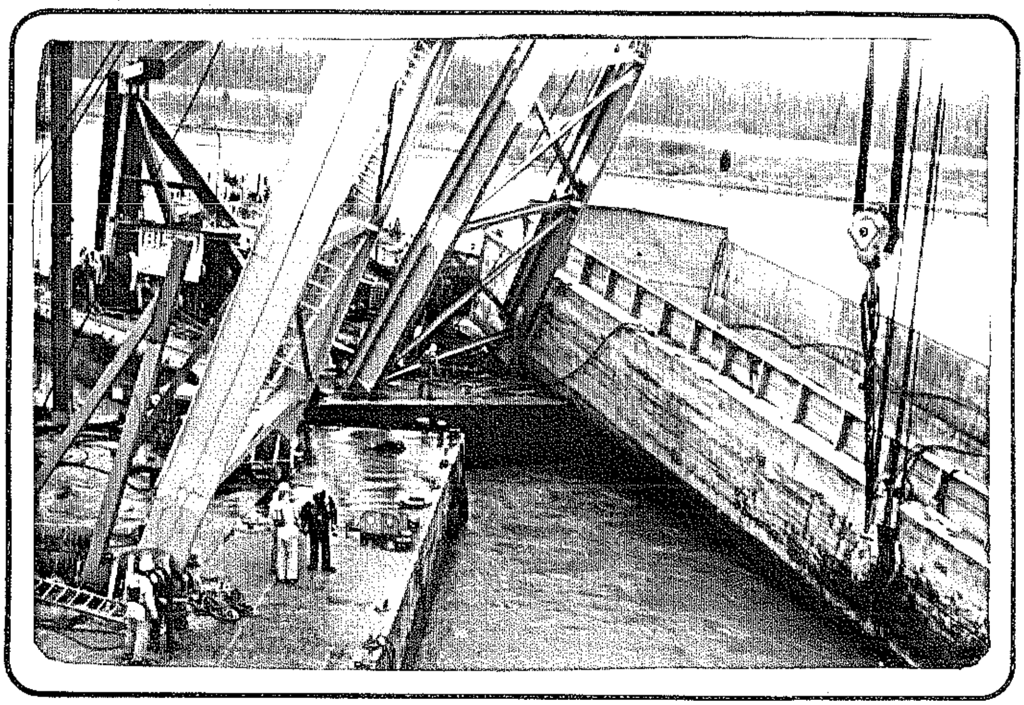

Figure 7.6.3: CGB 172 After Striking AJAX

of the port derrick leg of the AJAX, causing considerable damage (see Figure 7.6.3). The bow section was still connected to the midsection at the port wing wall and was under the gate. Subsequently, the bow section was cut free using magnesium burning lances and it was swept downstream.

The wreck was eased upstream by SOUTHERN 6, AJAX and the Pull Barge. The Pull Barge was released, and the two derricks proceeded with the CGB 172 to shallow water where the wreck was lowered to the bottom for later retrieval.

DETAILS OF THE WRECK REMOVAL:

Friday 31 December

The Pull Barge eased downstream and secured the two pulling wires to the stern cleats on the CGB 172. The SHORTY BAIRD brought the Manitowoc crane barge to the scene and secured it to the starboard side of the Pull Barge. A mat barge was then brought from the fleeting area and secured to the port side of the Pull Barge. Slings were rigged to the eyes on the removable hatch covers and the Manitowoc crane transferred them across the Pull Barge and onto the mat barge (see Figure 7.6.4 - "Removal of Hatch Covers").

During the removal, it was discovered that the hatch covers were linked together and that upon lifting a cover, the neighboring covers would tend to lift with it. This resulted in the loss of two hatch covers; one passed through the dam and the other hung up on the submerged bow of the CGB 172.

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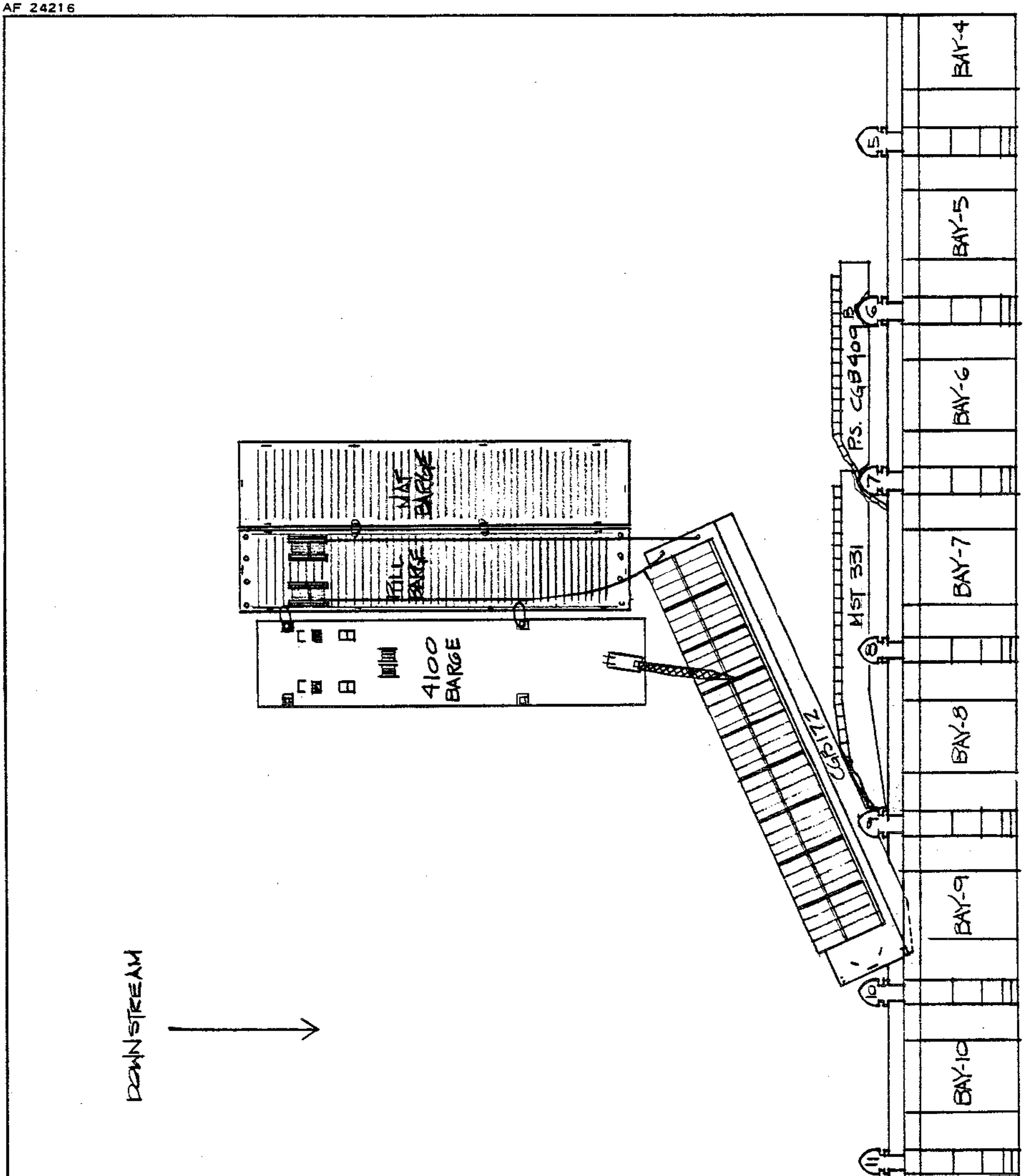

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ARKANSAS RIVER PROJECT
CGB 172
REMOVAL OF HATCH COVERS 12-31-82

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Sheet____ of ____	

The Manitowoc crane barge was then returned to the berthing area and the mat barge was transported to the fleeting area with its load of hatch covers.

Saturday 1 January

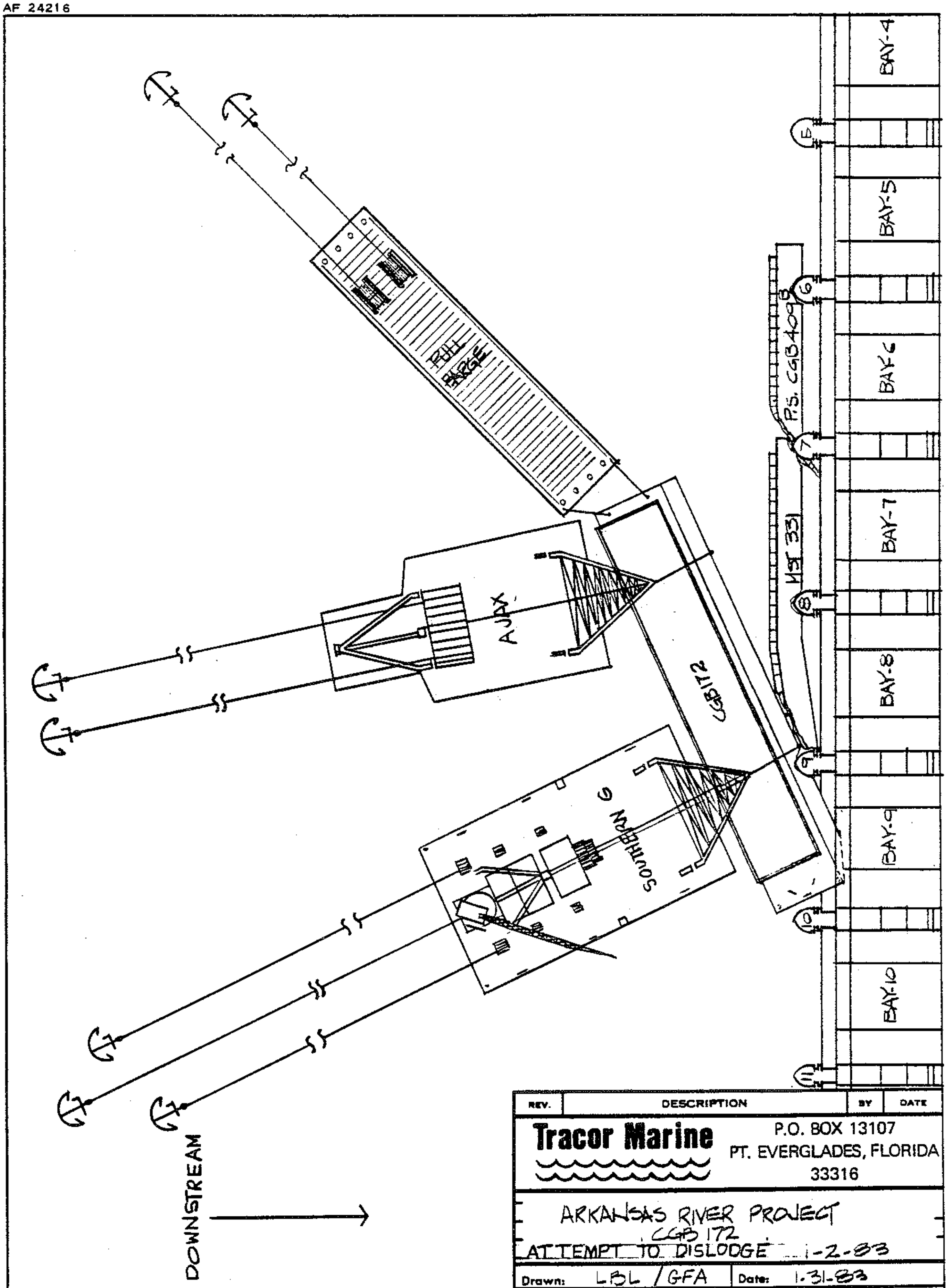
The SOUTHERN 6 positioned herself at right angles to the starboard side of the CGB 172 near the dam face. The SOUTHERN 6 then worked a steel strap (3/4" plate, 36" wide) around the wreck with one end of the strap on each hook. A lift was then attempted and the SOUTHERN 6 succeeded in raising the stern about 15 feet above the water. However, the CGB 172 remained wedged. The salvage crew then pumped approximately 50 tons of water into the aft tank of the wreck.

The AJAX moved into position alongside the SOUTHERN 6 and passed a messenger wire around the hull.

Sunday 2 January

The messenger wire passed by the AJAX was used to lead a wire sling around the hull of the CGB 172. One end of the sling was secured on the port side of the CGB 172 to the cleat located 40 feet forward of the stern. The other end of the sling was secured to the hook on the AJAX, completing the rigging necessary for parbuckling.

The SOUTHERN 6 and the AJAX then lifted the stern until the starboard manhole opening into tank #2 was exposed. Tank #2 was then pumped dry, the hatch coaming was burned off, and a plate was welded over the opening. The hatch and coaming were turned over to the Corps of Engineers to show the typical state of disrepair of most hatches on each of the wrecks (see Fig. 7.6.5 - "Attempt to Dislodge").



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ARKANSAS RIVER PROJECT
CGB 172
ATTEMPT TO DISLODGE 1-2-83

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Sheet ___ of ___	Rev.

Meanwhile, the steel lifting strap on the SOUTHERN 6 had been slipping towards the stern of the CGB 172. Keeper plates were welded onto the hull to restrain the strap. The AJAX moved its parbuckling sling to a cleat 40 feet forward of its previous location.

Monday 3 January

An attempt to lift, pull and parbuckle the CGB 172 using both derrick barges and the Pull Barge resulted in the failure of the CGB 172. The barge failed in way of tank #1, close to the point of its impalement on pier 9. The starboard side parted completely with the forward 35 feet of the barge, remaining attached by a portion of the port side of the barge. The aft end of CGB 172 had been lifted clear of the water and as a result of the strong current, the bow section rotated about pier 9, ending up perpendicular to gate 9 and in bay 9 (see Figure 7.6.6 - "Loss of Bow Section").

The Pull Barge had been in control of the CGB 172 until the bow section tore and rotated. That action caused the stern of the CGB 172 to swing, striking the lower truss section of the port derrick leg of the AJAX. The impact caused the legs of the A-frame to twist, crumple and then penetrate the main deck of the AJAX. The structure was prevented from collapsing by the topping lift.

Immediately after striking the A-frame, the barge hull slid forward some six to eight feet toward the gate until it came to rest on the AJAX with its stern on top of distorted members of the A-frame, including the port trunnion bearing. This downstream movement moved the break in the hull to the right of

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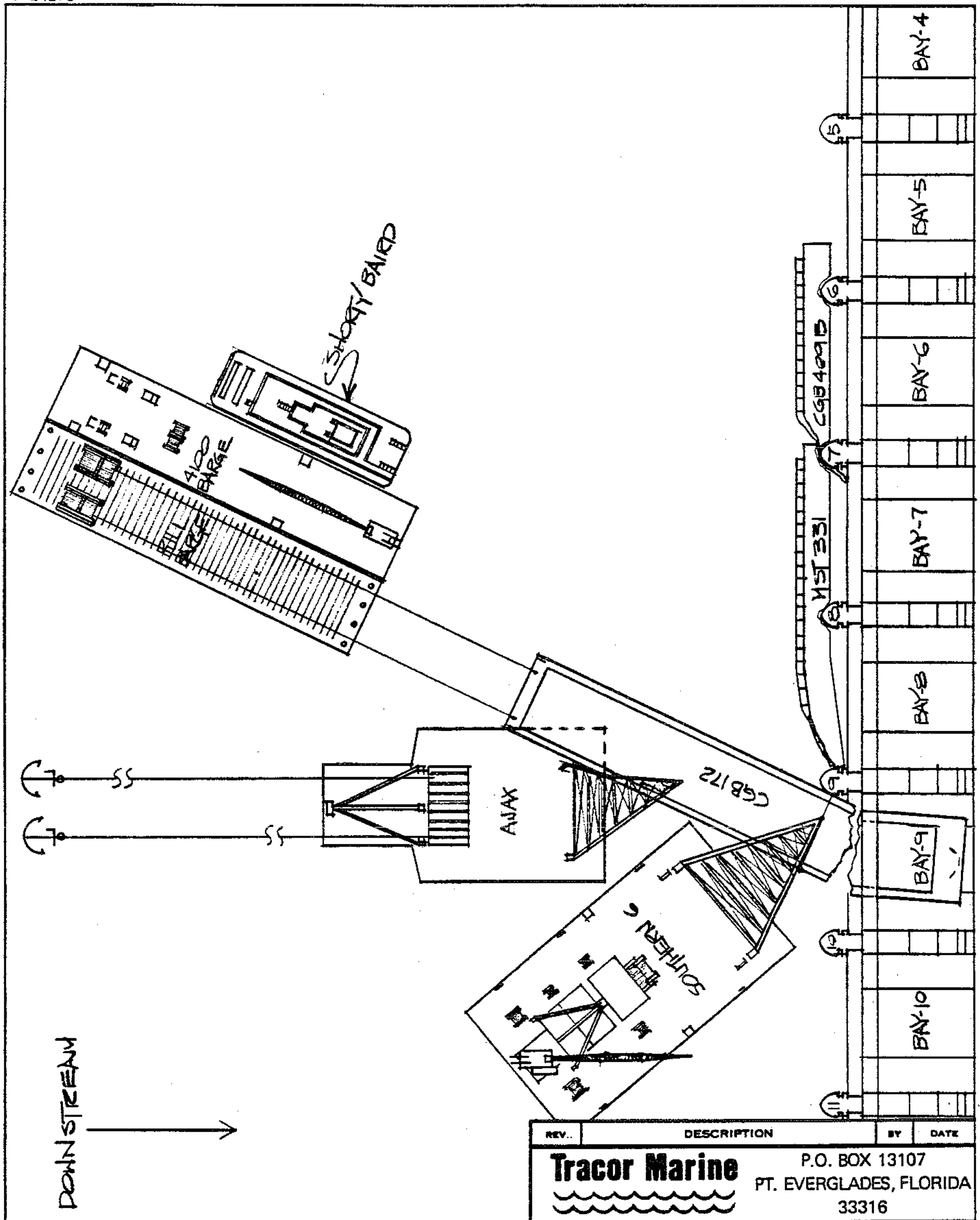

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ARKANSAS RIVER PROJECT
CGB 172
LOSS OF BOW SECTION 1-3-83

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Sheet ____ of ____	

pier 9 and to a position inside bay 9. The 3/4" plate strap that was secured to the SOUTHERN 6 had moved with the hull from the left side to the right side of pier 9, retaining some control at the broken port wing wall. After equilibrium had been restored and the damage assessed, the barge appeared to be under the control of the Pull Barge and in no imminent danger of being swept through the gate.

The parbuckling wire on the port cleat of the CGB 172 was burned off. The still operational traveling block of the AJAX hauled the wire under the barge and clear of the CGB 172, removing the load from the AJAX. The steel lifting strap secured to SOUTHERN 6 was pulled clear of the wreckage and a wire rope sling was passed around the hull of the CGB 172 just upstream of where the hull pressed against pier 9.

The 35 foot forward section of the CGB 172 was cut free using magnesium burning rods furnished by the Corps of Engineers. The current swept the severed section through the gate and it sank downstream. The edge of the port wing wall where the cut had been made extended under gate 9 and prevented it from closing. The magnesium burning rods were then used to trim the ragged edge. The gate was lowered onto the protruding section, bending it down and causing the barge to shift towards the center of the gate.

The SOUTHERN 6 retracted on her anchors pulling the wreckage clear of the gate. An operator then lowered the gate. Once the gate was closed, the current became negligible and it was possible for the salvage platforms to retract upstream and secure for the night.

Tuesday 4 January

The wire restraints connecting the Pull Barge to the wreckage were released. The AJAX and the SOUTHERN 6 were then transported as a unit to the fleeting area where the water was about 12 feet deep. The SOUTHERN 6 then eased out on the sling that it had hooked around the CGB 172. It continued to slacken the sling until the forward end of the CGB 172 had grounded with the aft end still balanced on the AJAX.

The SOUTHERN 6 released the sling and then moved so that it was alongside the port side of the AJAX. A new sling was worked around the aft end of the wreckage, the SOUTHERN 6 hooked on to it and lifted the barge clear of the AJAX. The AJAX backed away and the SOUTHERN 6 lowered the wreckage until it settled on the bottom.

Friday 21 January

The SHORTY BAIRD, the Manitowoc crane barge and the SOUTHERN 6 moved to the fleeting area to retrieve the CGB 172 section that had been deposited on the bottom on 4 January. Two slings were pulled into place using messengers that had been intentionally left on the wreckage. The wreckage was lifted by the heavy lifting block on SOUTHERN 6 and loaded onto two mat barges. The SHORTY BAIRD pushed the loaded barges back to the fleeting area.

7.7 REMOVAL OF BARGE MST 331

DATE: 5-9, 21, 26-27 January 1983

EQUIPMENT USED:

SOUTHERN 6
Manitowoc 4100 crane barge
SHORTY BAIRD
TYLER
Three mat barges
Pull Barge
CAPT. LUKE

WRECK SURVEY:

The MST 331 was lying on its starboard beams end with its bottom badly impaled on piers 7, 8 and 9 and with its stern towards the left descending bank. The starboard side lay submerged and aground on the concrete sill with the port side several feet above the surface. The hull was torn and had suffered a considerable reduction in the longitudinal strength in the gate 8 area. There was a considerable flow of water around the stern and through gate 7 as the gate was jammed open about one foot by wreckage from the CGB 409B.

SALVAGE PLAN:

The initial salvage plan called for rigging two lifting slings and using the two derrick barges to lift and retract the

MST 331 from the dam. However, with the barge deeply impaled on the pier, the plan was revised and a decision was made to weld a large padeye through the shell to an intact bulkhead for a single point lift. A cutting wire could then be worked under the hull to the right of pier 8 and the barge cut into two pieces.

SUMMARY OF THE WRECK REMOVAL:

With only one heavy lift derrick, the MST 331 wreckage could not be lifted in one piece. This was due to its large and unwieldy nature, and also because it had suffered substantial structural damage at its midsection. Divers could not be deployed to pass messengers and sling the aft section of the wreckage because of the flow through gate 7. A lifting eye was installed in the section of the wreckage blocking gate 7 (see Figure 7.7.1). The MST 331 was cut to the right of pier 8 with a cutting wire worked into position by rotating the stern section clear of the pier. It was then lifted and loaded on a mat barge (see Figure 7.7.2). The forward section of the wreckage was set in a sling, pulled clear of the dam, lifted and loaded on a mat barge. The rake section had been torn off. It was later located, rigged with a chain and removed.

DETAILS OF THE WRECK REMOVAL:

Wednesday 5 January

A Salvage Engineer inspected the MST 331 and marked locations for placement of lifting eyes onboard the barge. A 150 ton lifting eye was fabricated from 2" plate on board the Pull Barge (see Appendix VIII for design). At the end of the day, the

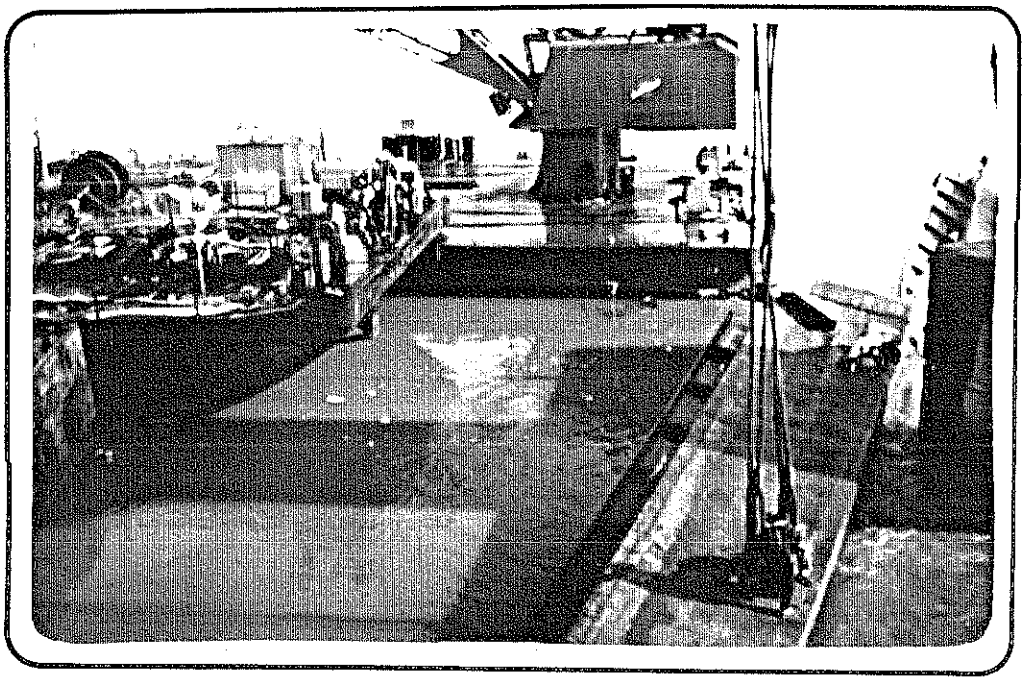

Figure 7.7.1: Rigging SOUTHERN 6 to Padeye on MST 331

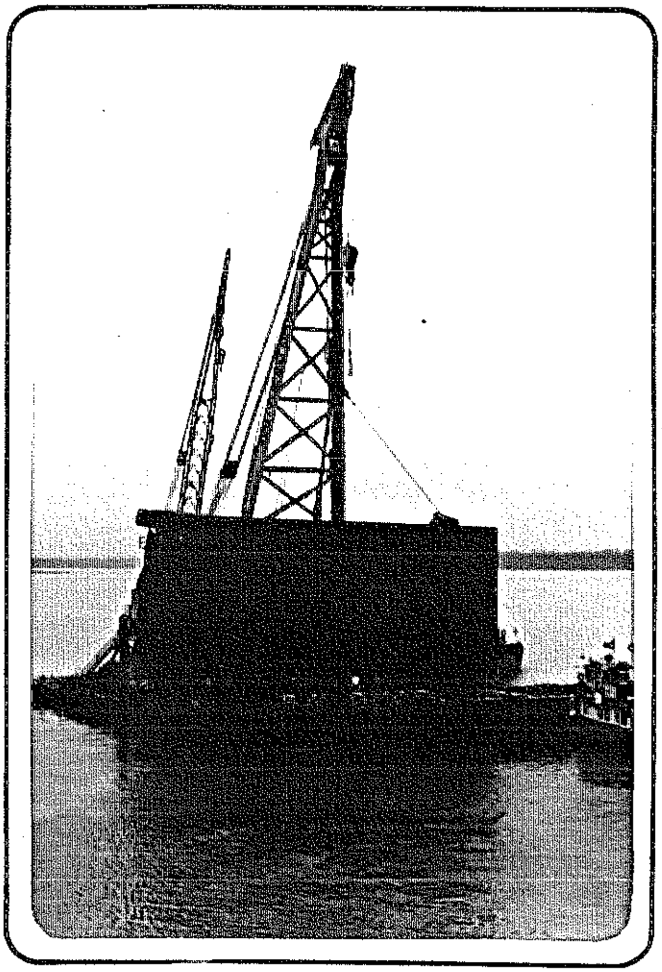

Figure 7.7.2: Lift of MST 331 Stern Section

Pull Barge was positioned with its bow approximately 15 feet upstream of the MST 331 in preparation of the next day's work.

Thursday 6 January

Early in the morning, the Manitowoc crane barge was positioned to the left of the Pull Barge and "spudded in". In order to install the previously fabricated 150 ton lifting eye, burners commenced burning through the shell adjacent to the water-tight wing bulkhead at frame 67. Also during the day, a 10' x 12" I-beam was placed on the port side shell of the MST 331 in way of the after hopper bulkhead (between frames 81 and 85) of the MST 331. This beam was welded to the side shell at a 45° angle to the sloped hopper bulkhead. A reinforced hole in the web allowed the beam to be used as a padeye (see Figure 7.7.3 - "Padeye Installation").

The SOUTHERN 6 was positioned to starboard of the Pull Barge in preparation for the lift. Approximately two hours of welding remained when the salvage crew secured because of darkness and inclement weather.

Friday 7 January

Padeye weldments were completed by 0900, and the Manitowoc crane barge pulled her spuds and shifted position to the starboard side of SOUTHERN 6. The starboard winch on the Pull Barge was rigged to the reinforced beam on the after port shell of the wreck and the SOUTHERN 6 rigged to the lifting eye at frame 67 on MST 331. The SOUTHERN 6 raised the after end of the barge and the port winch on the Pull Barge was rigged to the aft starboard kevel on the wreck. The barge was lifted further, a single cable sling was worked around the wreck about 10 feet forward of the bulkhead at frame 44, and a 3" cutting wire was

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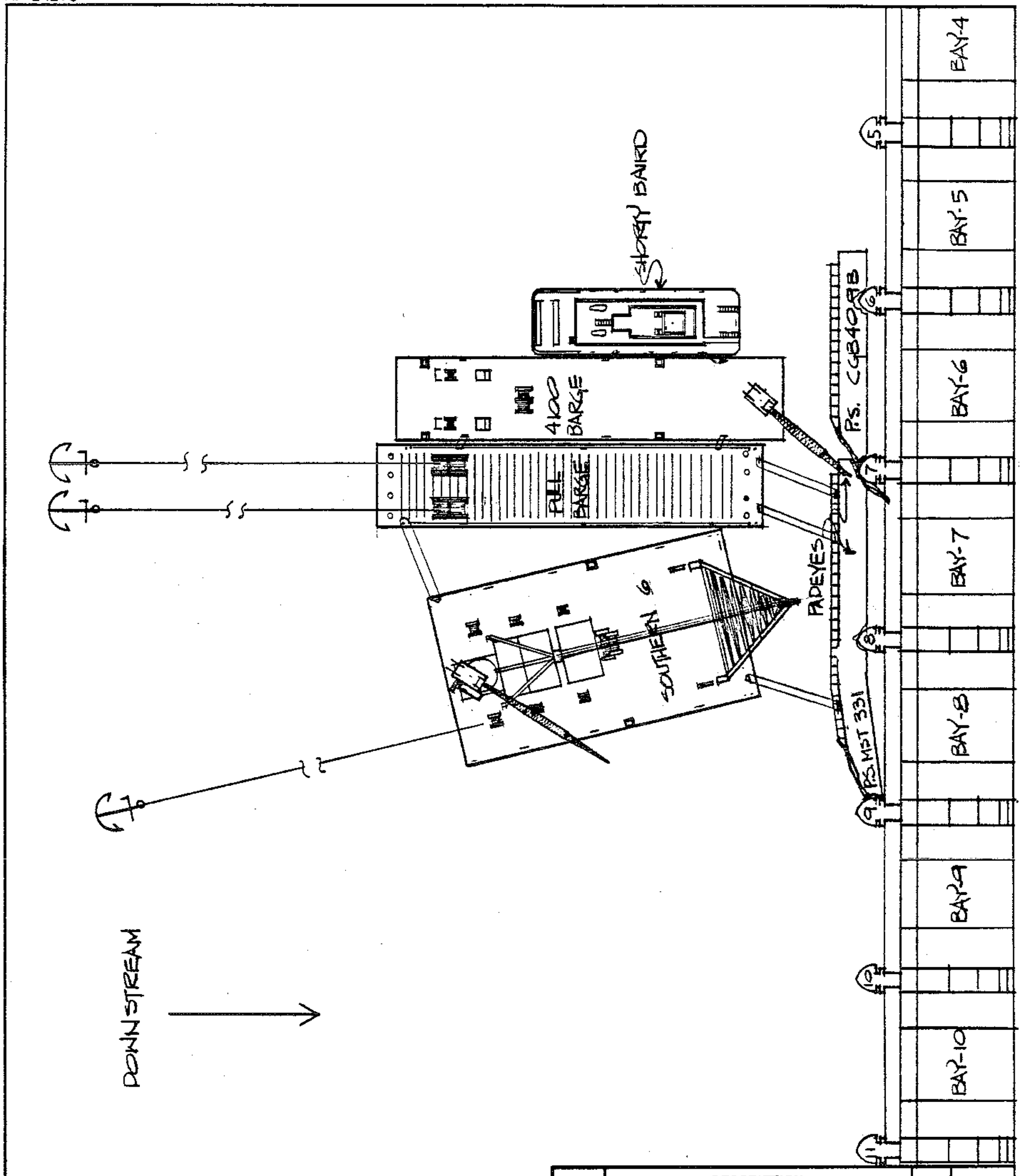

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ARKANSAS RIVER PROJECT
MST 331
PADEYE INSTALLATION 1-6-83

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Approved:	Drawing Number FIG. 7.7.3 — Rev.
Sheet___ of ___	

rigged from the SOUTHERN 6 in preparation for severing the wreck at frame 44.

The ends of the sling forward of frame 44 were secured to the Manitowoc crane barge. The SOUTHERN 6 lowered the wreck, released the lifting eye and repositioned so as to exert a pull on the cutting wire. A 200 ton strain was put on the cutting wire and the barge was severed. The SOUTHERN 6 then repositioned and rerigged to the lifting eye at frame 67. The SOUTHERN 6 lifted the aft wreck section and retracted on her anchor cable upstream until she was some 300 feet from the dam (see Figure 7.7.4 - "Removal of Aft Section"). The TYLER brought out a mat barge and secured it to the fleet. The aft section of MST 331 was left on the SOUTHERN 6 hook for the night. The forward section, which was still impaled on the piers of the dam, remained secured to the crane barge for the night.

<u>Saturday 8 January</u>

In the morning, the aft section of the MST 331 was lifted clear of the water with the SOUTHERN 6 still rigged to the lifting eye at frame 67 and with the Pull Barge controlling the swing of the section. The TYLER was used to position a mat barge upon which the MST 331 aft section was landed port side down. Welded clips were used to secure the deck edge, the turn of the bilge, and the hopper coaming of the wreck to the mat barge deck. Four one inch cables were secured to the wreck on its centerline from the mat barge's snubbing winches. The TYLER then moved the loaded barge to the fleeting area.

Due to expediency, it was decided to leave the wreck in an upright position. Engineering calculations were performed on the loaded mat barge to insure adequate stability in high winds

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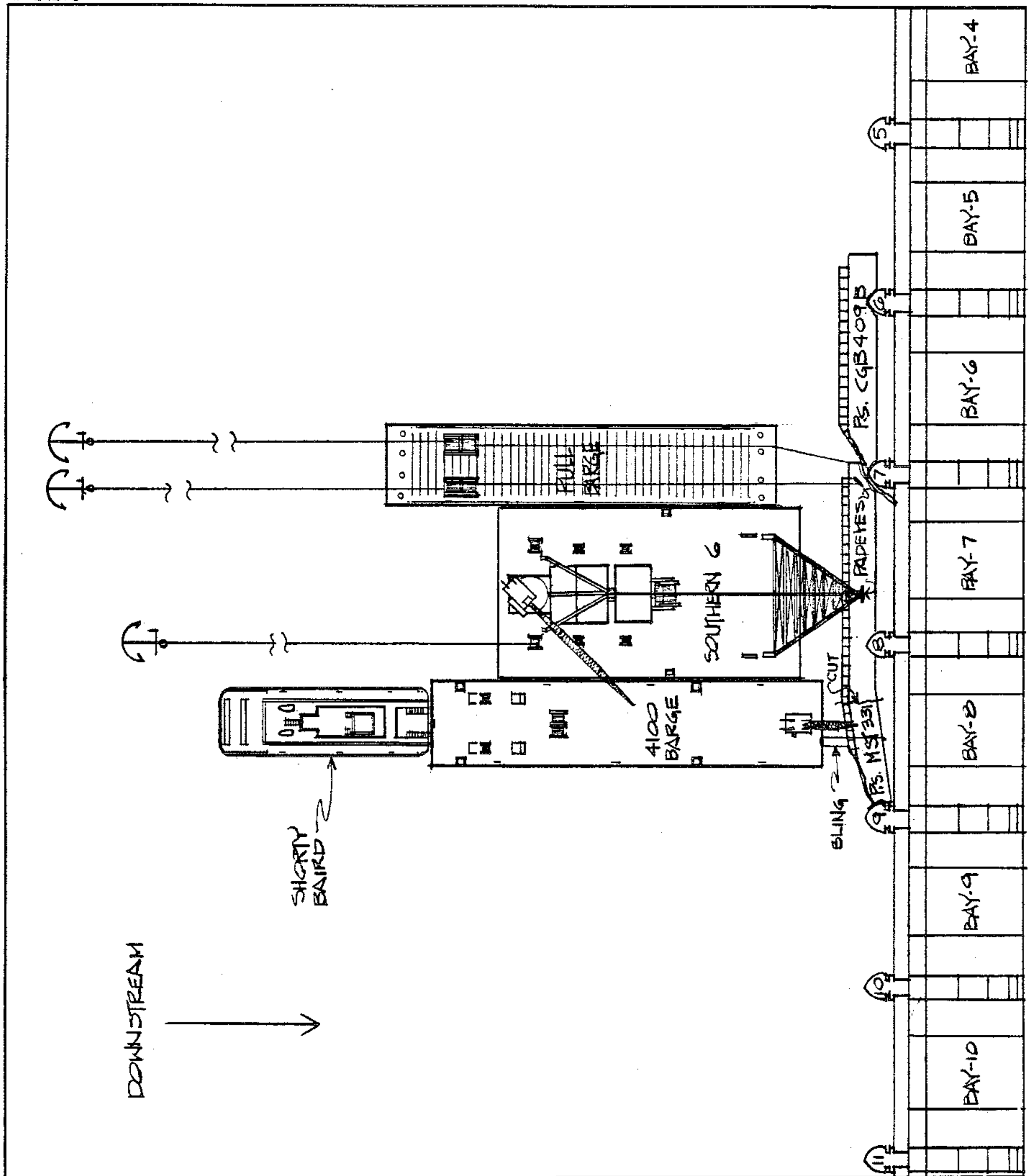

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ARKANSAS RIVER PROJECT
MST 331
REMOVAL OF AFT SECTION 1-7-83

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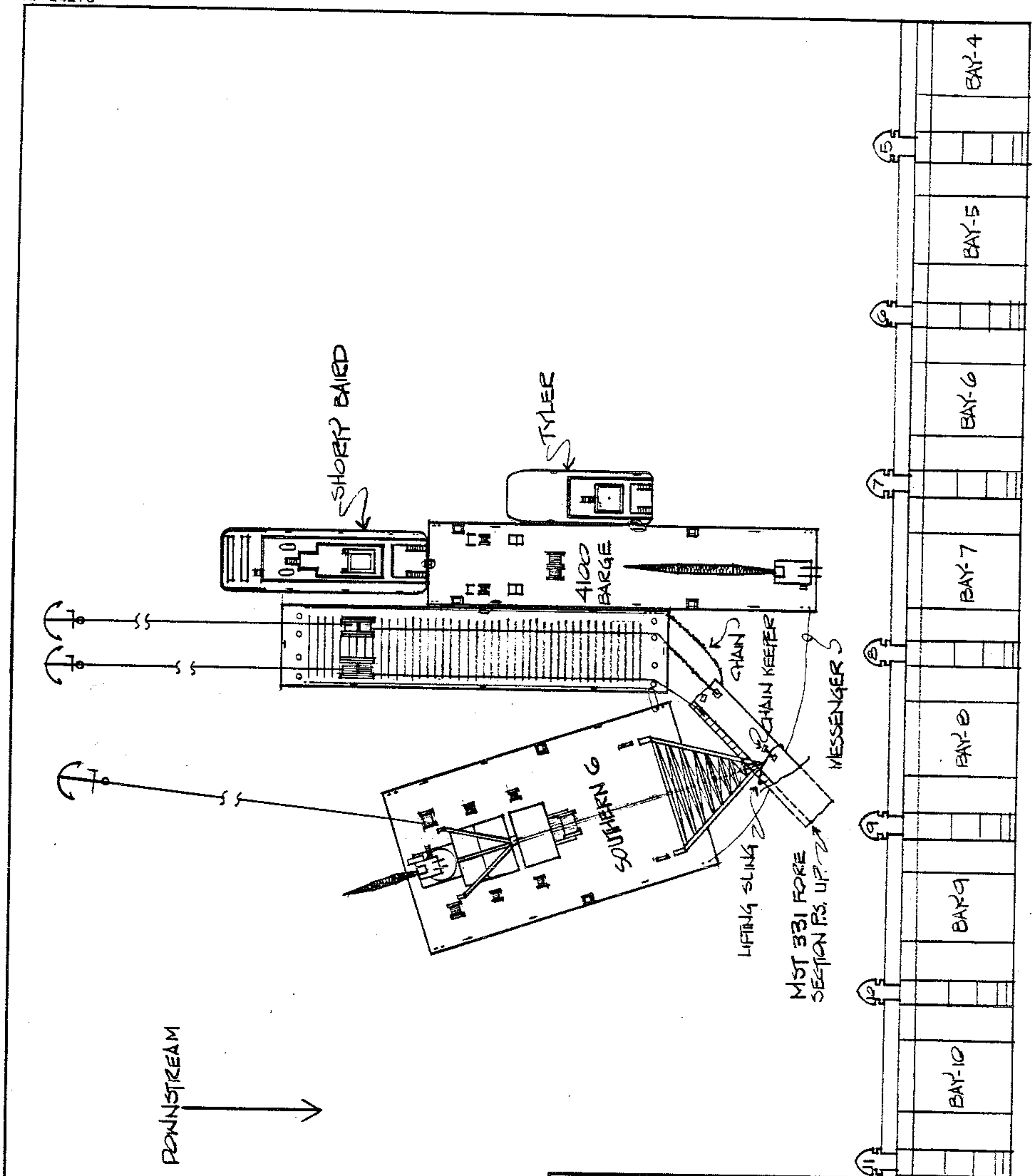

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ARKANSAS RIVER PROJECT
MST 331
REMOVAL OF FWD SECTION 1-4-83

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Approved:	Drawing Number: FIG. 7.7.5 Rev.
Sheet ___ of ___	

and load security (see Appendix VIII). The wreck was later positioned on her bottom to better facilitate a long river tow.

The SOUTHERN 6 and the Pull Barge repositioned close to the dam to begin clearing the forward section of the MST 331. The Pull Barge rigged onto a midship kevel and retracted upstream while the SOUTHERN 6 lifted against the single sling which had been set previously. The forward section pulled clear of pier 9 and the Manitowoc crane then passed a messenger around the wreck so that an additional sling could be positioned on the following day.

Sunday 9 January

An attempt to pull a sling with the messenger previously set was unsuccessful because the sling repeatedly fouled on the side of the barge that was aground on the sill. Therefore, holes were burned through the side shell and hopper wall on both sides of the frame 44 bulkhead. The Manitowoc crane was then used to reeve a chain through these holes and around the sling which had been previously positioned in the same area. The chain was stoppered to prevent the sling from slipping, thus allowing a single point lift.

The forward section was lifted and the Pull Barge and the SOUTHERN 6 retracted upstream with the wreck in tow (see Figure 7.7.5 - "Removal of Forward Section"). The MST 331 forward section was turned in the single sling until the bottom was down. The section was then lifted clear of the water and lowered onto a mat barge positioned by the TYLER. The load was then moved to the fleeting area.

Saturday 21 January

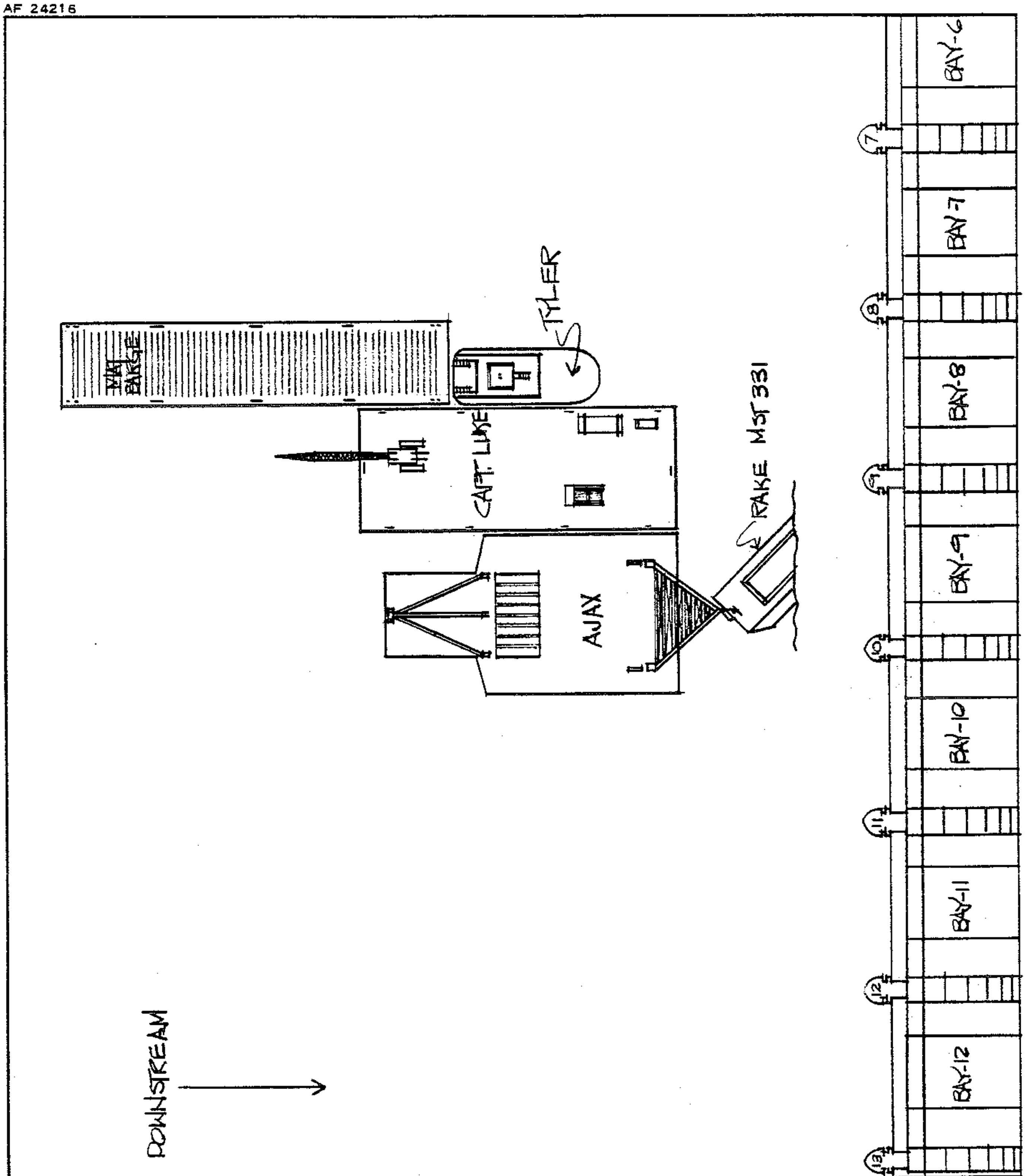
The SOUTHERN 6, the Manitowoc crane barge, and the SHORTY BAIRD worked in the fleeting area burning the aft section of the MST 331 free from the mat barge deck and rolling the section bottom side up. This section had been previously loaded port side down and had been welded to the deck.

Wednesday 26 January

A side scan sonar survey of the area upstream of gate 9 discovered the missing rake section. Divers rigged a lifting chain through the rake tank scuttle and through a hole that had been burned in the bottom plating. The AJAX was moved into position over the wreck and hooked into the sling.

Thursday 27 January

The AJAX lifted the rake and loaded it aboard a mat barge. It was noted that the lifting chain had started to cut through the bottom and deck plating. However, the cutting action of the chain did not endanger the lift, for the chain ceased cutting long before it pulled through. The mat barge was then returned to the fleeting area (see Figure 7.7.6 - "Removal of Forward Rake").



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ARKANSAS RIVER PROJECT
MST 331
REMOVAL OF FWD RAKE 1-27-83

Drawn: LBL	Date: 2-7-83
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Approved:	Drawing Number: FIG. 7.7.6 — Rev.
Sheet____ of ____	

7.8 REMOVAL OF BARGE CGB 409B

DATE: 5-15 January 1983

EQUIPMENT USED:

Manitowoc 4100 crane barge
Pull Barge
SHORTY BAIRD
TYLER
CAPT. LUKE
SOUTHERN 6
Three mat barges

WRECK SURVEY:

The CGB 409B had box ends with no designated bow or stern. In order to avoid confusion in describing the wreckage removal, the bow was considered to be the end facing the right descending bank as the barge lay impaled on the dam.

The CGB 409B was lying on its beam ends with its bottom so badly impaled on piers 6, 7 and 8 that the wreck had almost been severed at piers 7 and 8. Also, the wreck had cracked along the hopper bulkhead where it was pressed against pier 6. The starboard side was lying on the concrete sill with the port side several feet above the surface. The forward section of the wreckage had wrapped around pier 7 with part of the hull extending under gate 7, preventing its complete closure.

SALVAGE PLAN:

The initial salvage plan called for rigging two lifting slings and using the two derrick barges to lift and retract from the dam. However, with the loss of the AJAX, the plan was revised and preparations would be made to remove the wreck in sections with one derrick barge and the Pull Barge.

SUMMARY OF THE WRECK REMOVAL:

The CGB 409B was removed in three sections. The wreckage was initially pulled clear of the dam as one unit by the Pull Barge, allowing gate 7 to be fully closed. The aft end of the CGB 409B was then lifted by the SOUTHERN 6 and a through cut made 80 feet forward of the stern log. The aft section was then loaded on a mat barge. The remainder of the wreckage was raised and a through cut made 80 feet forward of the previous cut. The 80 foot long midsection and 40 foot long forward section were then each loaded on mat barges and were transferred to the fleeting area (see Figure 7.8.1 and 7.8.2).

DETAIL OF THE WRECK REMOVAL:

Wednesday 5 January

Engineers sounded by hand around pier 7 to locate wreckage from the CGB 409B that had jammed gate 7 open one foot.

Thursday 6 January

Prior to the removal of the MST 331, an attempt was made to clear gate 7 of debris from the CGB 409B in order to

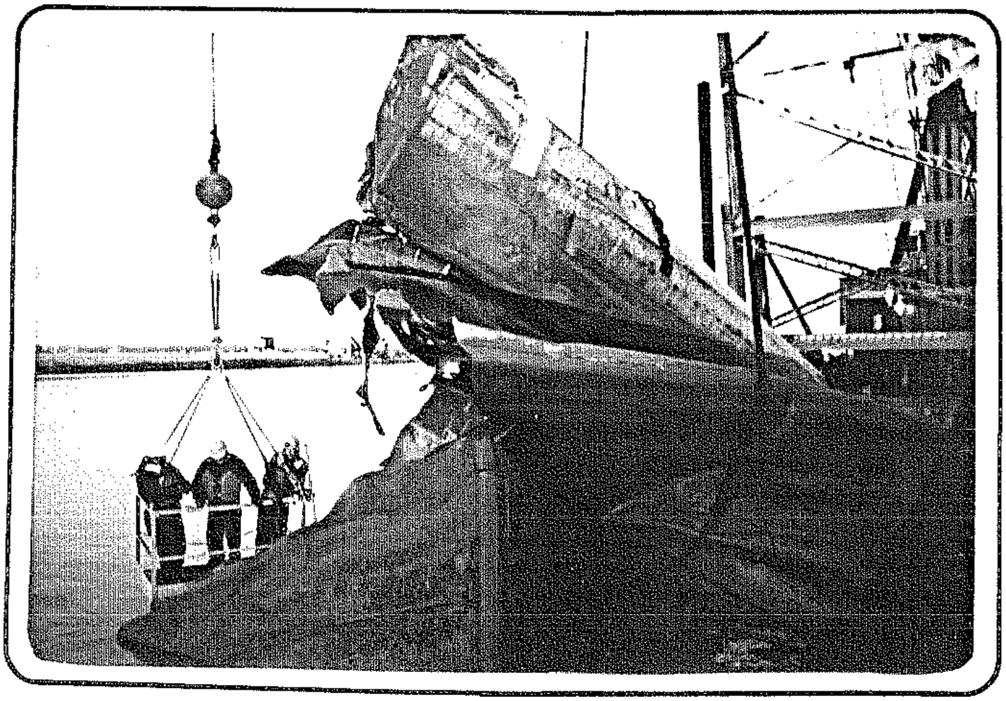

Figure 7.8.1: Fouling of the Forward Section of CGB 409B Required Cutting the Wreck into Three Pieces

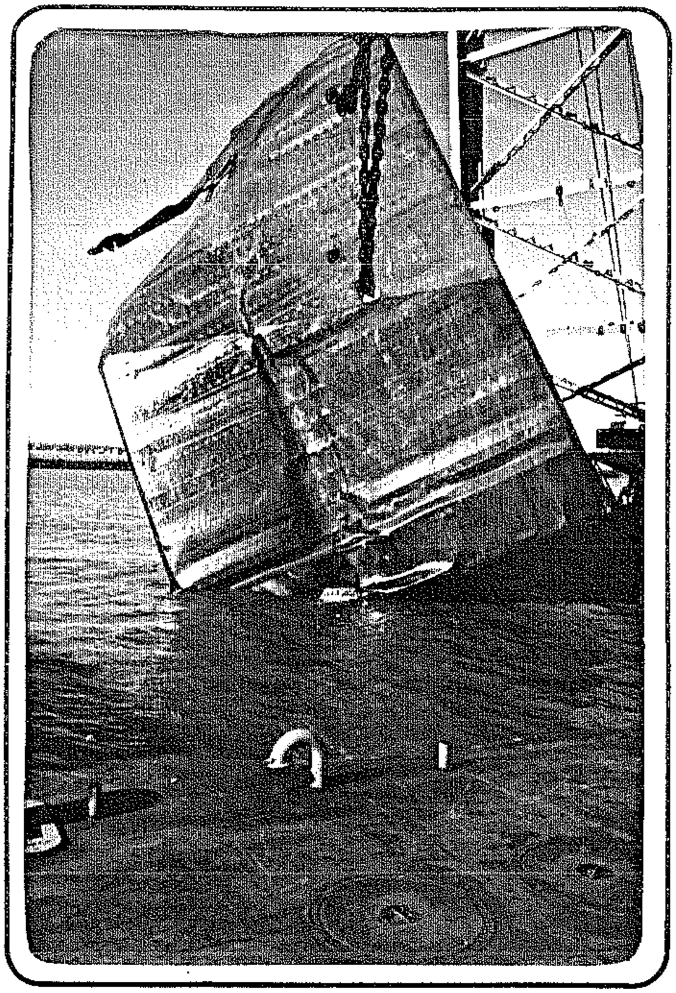

Figure 7.8.2: SOUTHERN 6 Lifting Forward Section of CGB 409B

reduce the water flowing over the MST 331. The gate was opened until the level of the pool of water dammed downstream of the MST 331 had fallen an amount sufficient to expose some of the wreckage from the CGB 409B. A man basket was lowered from the Manitowoc crane, a hole burned through the 5/16" shell plate, and a 50 ton shackle attached. The Manitowoc lifted the wreckage approximately one and one half feet before the shackle pulled through the plate. The gate was then lowered to within six inches of closing, a gain of six inches. The gate was raised again and another hole was burned in the plate much lower than the first allowing a bigger "bite" and, therefore, a harder pull. However, nightfall prevented another lifting attempt.

<u>Friday 7 January</u>

It was decided to continue the removal of the MST 331, rather than rig to clear gate 7, as the flow had been reduced enough that it did not encumber operations. The 8th and 9th of January were spent working on the MST 331.

<u>Monday 10 January</u>

The Pull Barge was positioned head on to pier 6. The Pull Barge secured its port wire to the aft kevel (port side) of the CGB 409B and rigged a line to a shackle through the port coaming of the wreck.

The Manitowoc crane barge was positioned to the left of the Pull Barge to assist in burning holes through the port side shell and the stern log. A two inch chain was reeved through these holes and secured to the port and starboard padeyes on the bow of the Pull Barge. A diver was deployed to secure the starboard wire of the Pull Barge to a submerged amidships kevel on the port side of the wreck. The Pull Barge retracted on its anchors, dragging the wreck clear of the dam. As the wreck moved upstream, it rotated such that the port side turn of the bilge was uppermost and was suspended from the Pull Barge approximately ten feet below the surface (see Fig. 7.8.3 - "Retraction from Dam").

Once the wreck was pulled clear of the dam, gate 7 was closed making it possible for the Corps of Engineers to perform a probe survey of the area. The Corps found significant scour damage with a 30 foot deep hole and a caved-in scour slab.

Meanwhile, the CAPT. LUKE was used to support a diver who surveyed the wreckage and set two messengers. The messengers were set 40 feet and 90 feet forward of the stern log. The Manitowoc crane barge was secured to the forward messenger while the CAPT. LUKE pulled a sling with the aft messenger. When an attempt was made to pull the forward sling, the messenger fouled. A diver was deployed to free the messenger, but was unsuccessful as the messenger had fouled in the wreckage and in the granite riprap.

<u>Tuesday 11 January</u>

The day began by moving the SOUTHERN 6 from the fleeting area to a position upstream of the CGB 409B. The main lifting block was secured to the aft sling which had been positioned the previous day.

When the SOUTHERN 6 took a strain on the aft sling set around the CGB 409B, the stern of the wreck broke the surface. The Pull Barge retracted against the chain that was set previously. This caused the wreck to slide in the single sling

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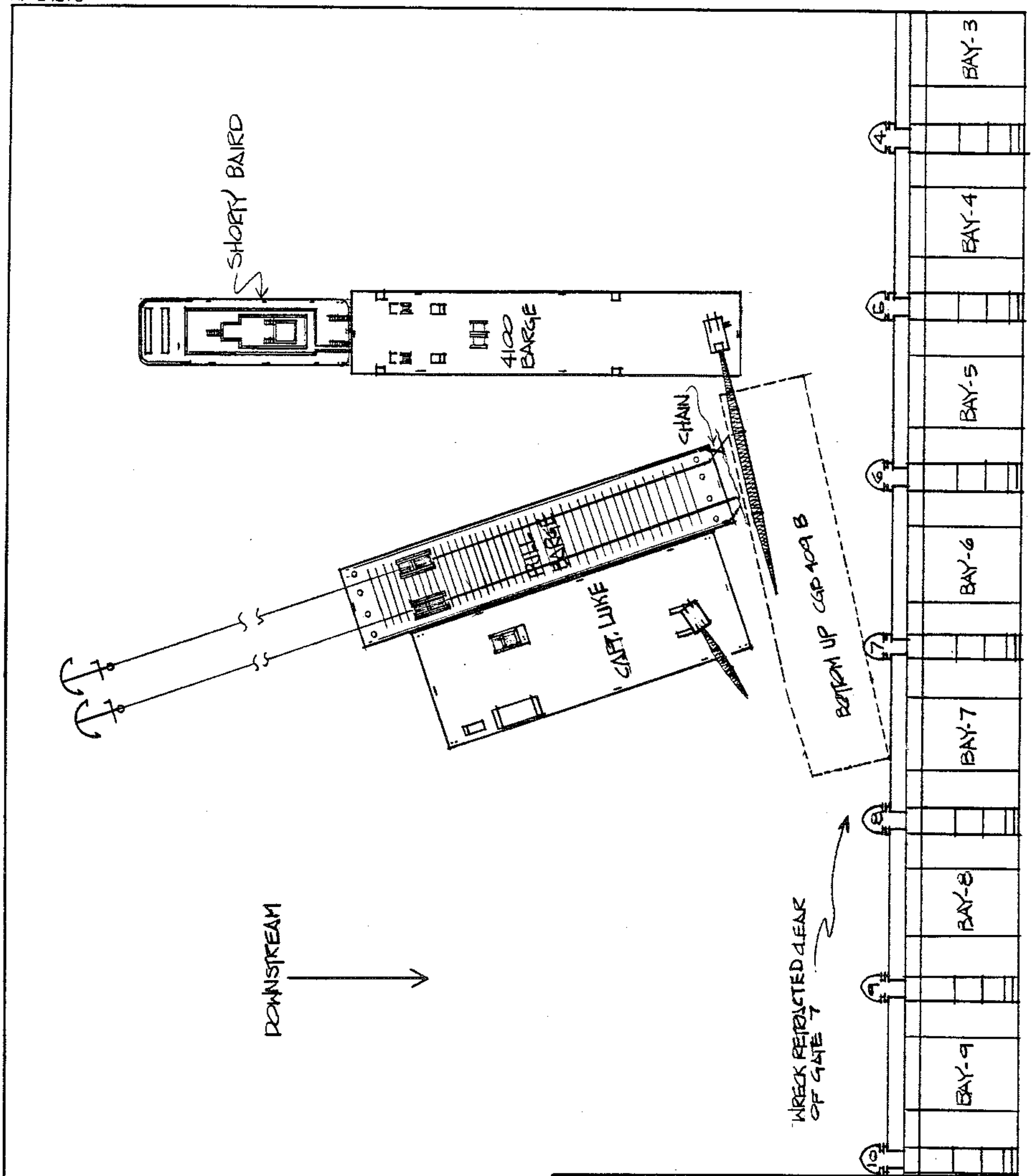

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ARKANSAS RIVER PROJECT
CGB 409 B
RETRACTION FROM DAM 1-10-83

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Approved:	Drawing Number: FIG. 7.8.3 — Rev.
Sheet ___ of ___	

until it was upside down (see Figure 7.8.4 - "Lifting the Stern"). The combined action of these motions freed the fouled forward messenger, allowing the SOUTHERN 6 to pass a second sling 90 feet forward of the stern log.

The SOUTHERN 6 took a strain on the forward sling. Reluctantly, the wreck moved slightly. The SOUTHERN 6 began a cycle of straining against the forward sling, waiting until the wreck creeped up a bit and then straining again. By day's end, the wreck was lying bottom up with about 100 feet of the bottom out of the water and the stern log about 30 feet in the air. The forward section was apparently fouled in wreckage lying beneath the CGB 409B.

Wednesday 12 January

The SOUTHERN 6 lifted with a force in excess of 200 tons while the Pull Barge retracted against the chain which passed through the stern log and side shell of the CGB 409B. This combined action dislodged the wreck such that it pulled free and leveled off with the single sling attached to the SOUTHERN 6 providing its support (see Figure 7.8.5 - "Freeing the Aft Section").

A messenger wire was reeved about the forward section of the wreckage and used to pull another sling (see Figure 7.8.6 - "Setting Sling on the Aft Section"). A burner was outfitted with magnesium burning rods and deployed in a man basket from the Manitowoc crane to begin cutting the stern section away from the foresection. The burner was unable to cut through the hopper decks as they were submerged. The wreckage was lowered into the water for the evening.

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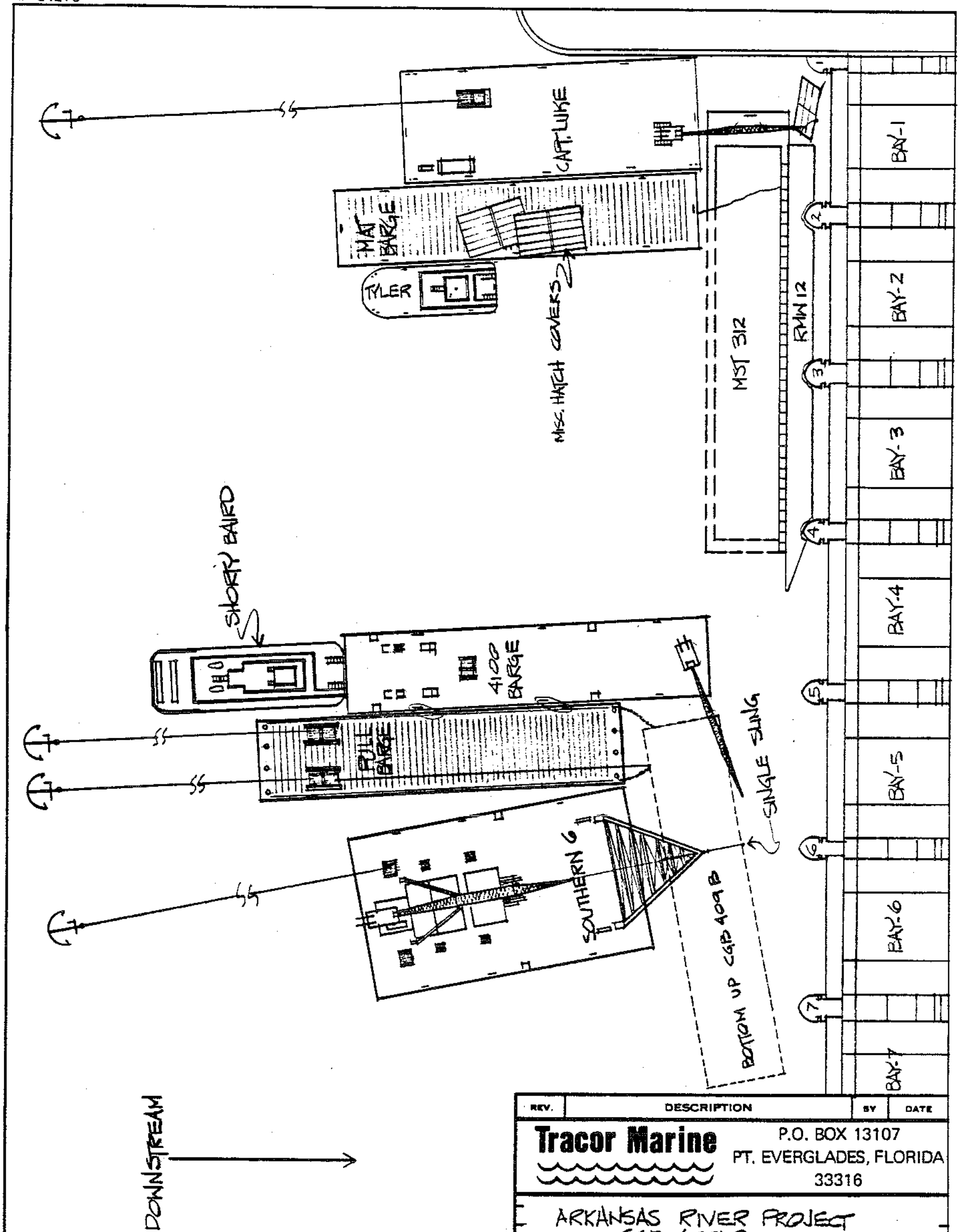

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ARKANSAS RIVER PROJECT
CGB 409 B
LIFTING THE STERN 1-11-83

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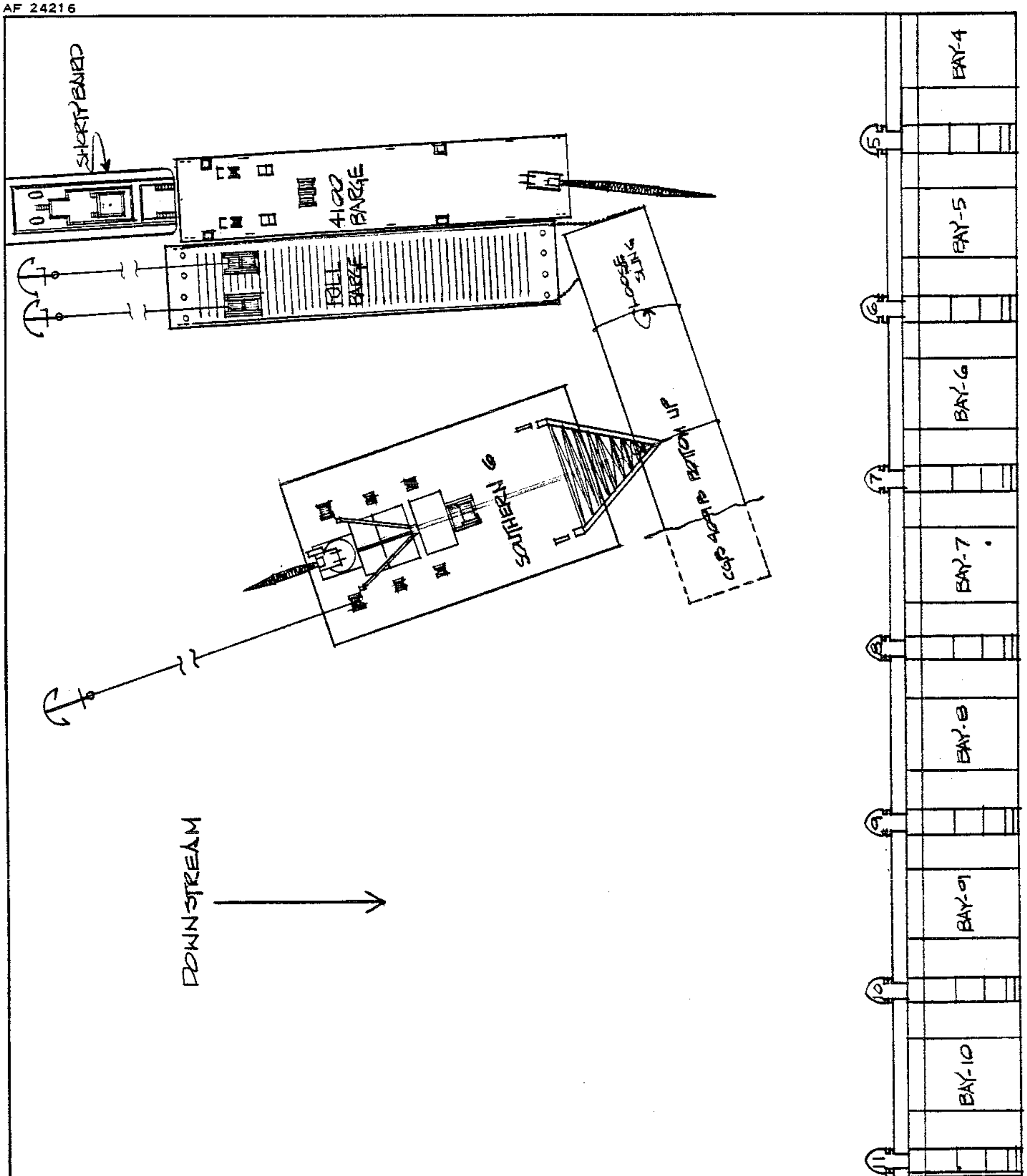
Sheet ___ of ___	Rev.



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ARKANSAS RIVER PROJECT
CGB 409 B
FREEING THE AFT SECTION 1-12-83

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Sheet ___ of ___		FIG. 7.8.5	

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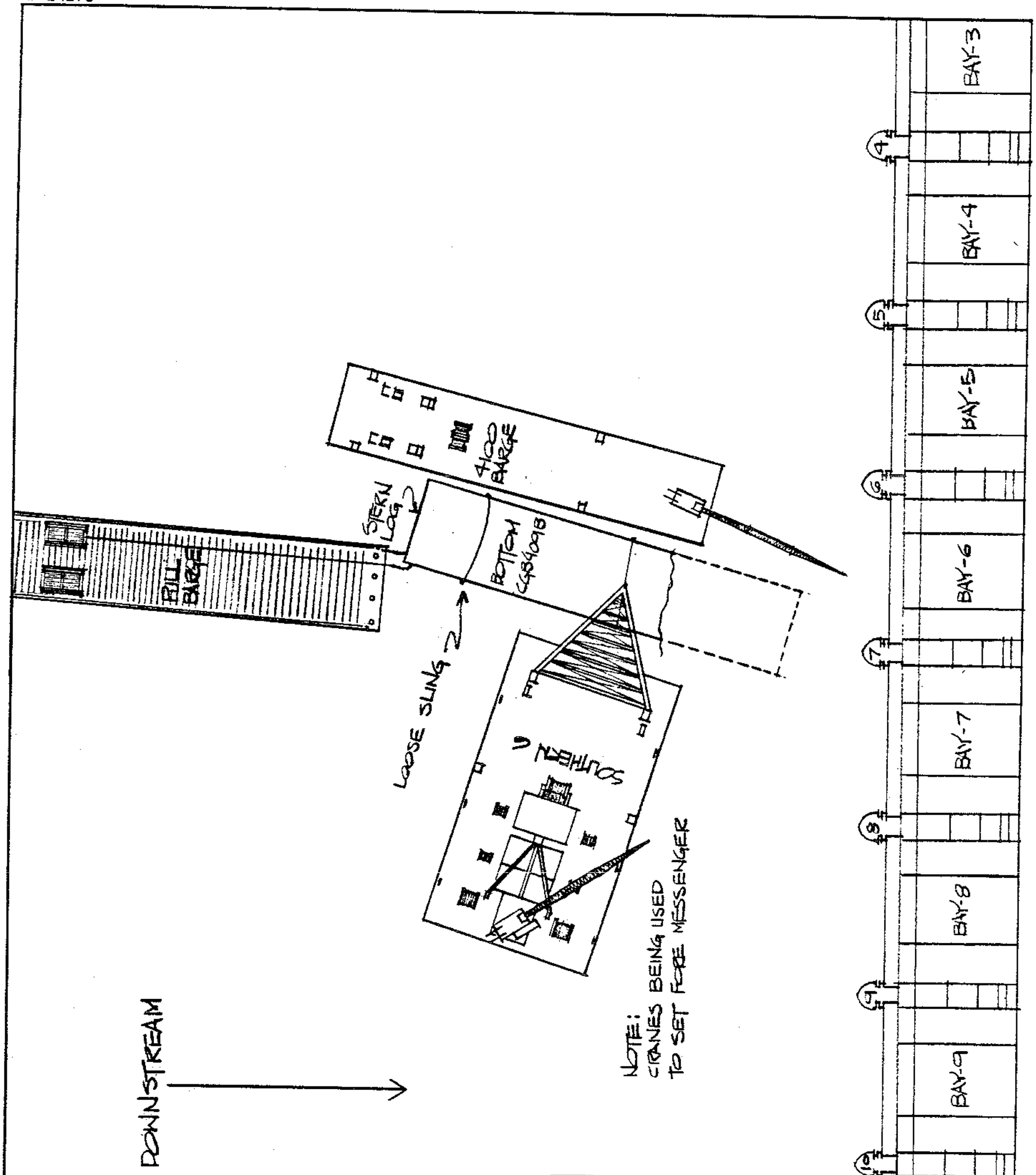

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ARKANSAS RIVER PROJECT
CGB4098
SETTING SLING ON AFT SECTION 1-12-83

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Sheet____of____	FIG. 7.8.6	

Thursday 13 January

The SOUTHERN 6 raised the aft section of the CGB 409B to the surface with two slings. The wreckage emerged bottom side up with the forward cut toward pier 8 and the stern log toward the Manitowoc crane barge. The lance cut of the previous day had left the starboard hopper deck intact such that some of the wreckage forward of the cut was still attached.

While the TYLER brought out a mat barge to receive the wreckage, the Manitowoc crane barge and the SHORTY BAIRD moved to the left of the wreckage. A lance operator was deployed in a man basket from the Manitowoc crane and cut away the remaining deck plate. The SOUTHERN 6 then pulled the entire aft section clear of the water except for the starboard coaming that was still attached to the submerged forward section. The approximately 80 foot long aft section was then lowered onto a mat barge and the coaming was cut.

While the aft section was being loaded, a sling previously positioned around the forward section of the CGB 409B was secured to the SOUTHERN 6's small work barge (see Figure 7.8.7 - "Removal of Aft Section"). The TYLER then pushed the loaded mat barge to the fleeting area.

The SOUTHERN 6 relocated over the wreckage of the forward section of the CGB 409B, recovered the sling secured to the work barge, hooked onto the sling and lifted. The port side of the recently cut end of the wreckage emerged from the water, but the forward section remained submerged and fouled in underlying wreckage later identified as the MST 409. The CGB 409B wreckage was suspended with its bottom up and the port wing

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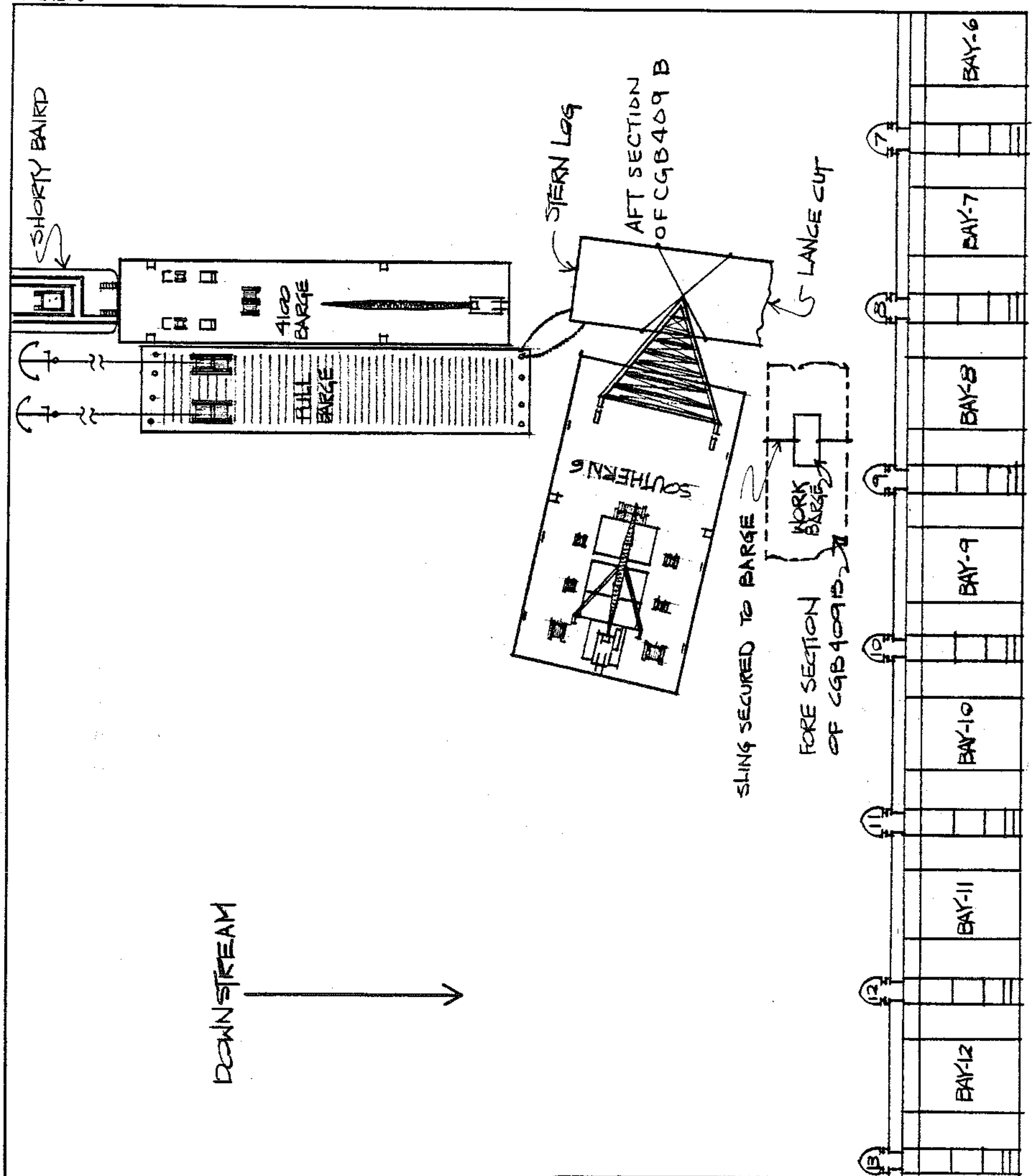

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ARKANSAS RIVER PROJECT
CGB 409 B
REMOVAL OF AFT SECTION 1-13-83

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Sheet ____ of ____	FIG, 7.8.7	

wall bent 180° around the bottom (see Figure 7.8.8 - "Removal of the Midsection").

Burners were deployed to cut a hole through the port side shell from a man basket on the hook of the Manitowoc crane. A chain was rigged through the hole and was then secured around the sling hooked by the SOUTHERN 6, facilitating a single point lift. The SOUTHERN 6 lifted again and additional wreckage emerged. It was observed that most of the structure forward of the forwardmost wing bulkhead was gone. The SOUTHERN 6 crane and the capstan on the Manitowoc crane barge were used to pass a messenger under the wreckage. The above- water section of the wreckage was then lowered for the evening.

<u>Friday 14 January</u>

The SOUTHERN 6 lifted and the remaining piece of the CGB 409B emerged on the sling that had been secured the previous day. Burners were again deployed in the man basket to cut holes in the starboard wing. Chain was then passed through these holes and about the sling to prevent slipping.

The forward 40 feet of the CGB 409B had almost broken free from the midsection, but was still attached to the midsection by the starboard wing wall. Holes were burned through the deck, hopper wall, side shell, bottom and inner bottom of the dangling forward section. A chain was reeved through the holes and secured to the light lift hook of the SOUTHERN 6. Burners were deployed from the small work boat and cut through the starboard hopper wall of the wreckage in a line parallel and adjacent to the forwardmost wing bulkhead. A lance operator in the man basket then burned through the starboard side shell adjacent to the same bulkhead. The two sections separated,

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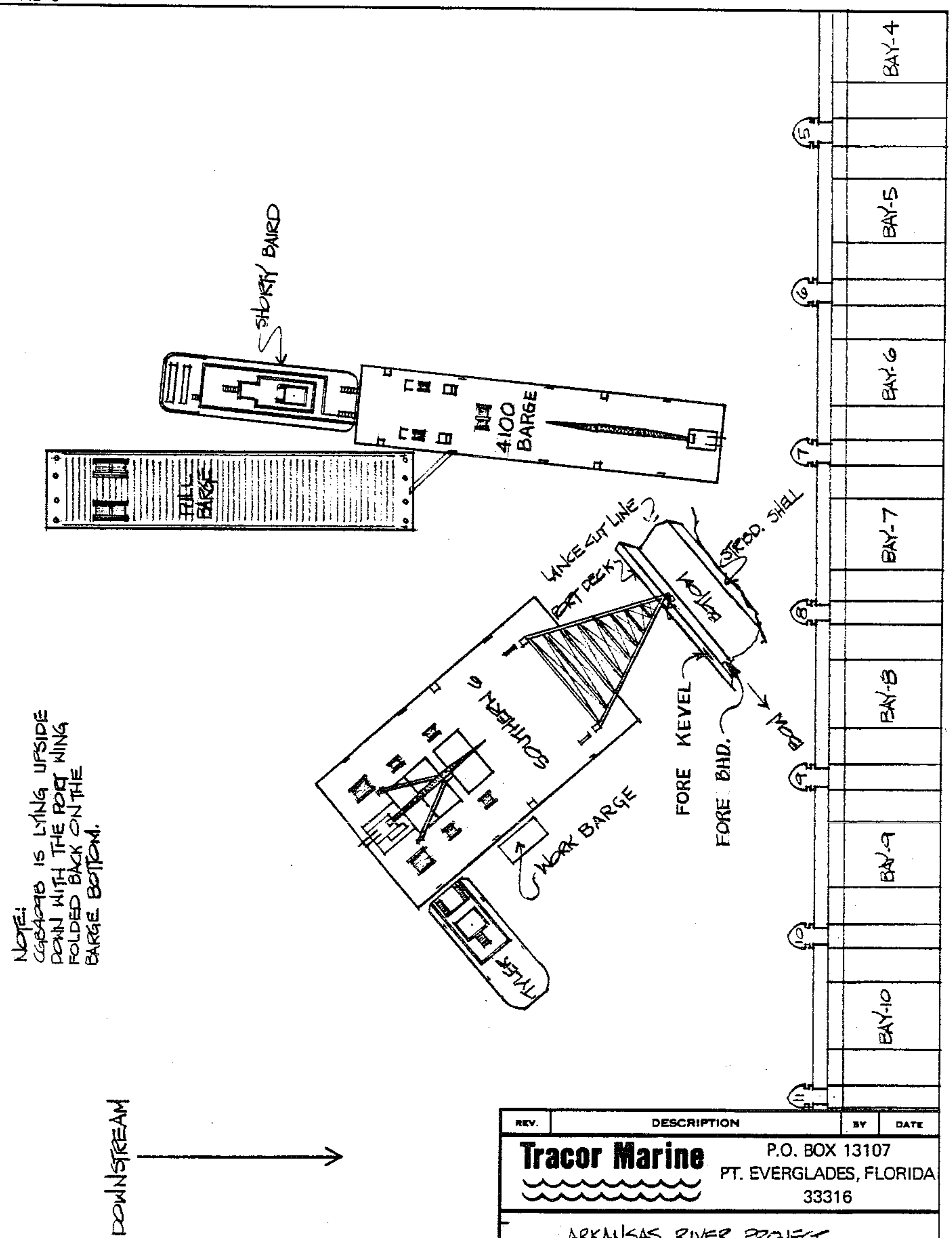

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ARKANSAS RIVER PROJECT
CGB 409 B
REMOVAL OF MID SECTION 1-13-83

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Sheet ____ of ____	Rev.

leaving an 80 foot long midsection on the heavy lift hook and a 40 foot long forward section on the light lift hook.

The midsection was then lowered into the water and a second sling worked around the wreckage. The chain secured to the forward section was passed from the light lift hook of the SOUTHERN 6 to the Manitowoc crane barge and secured. The TYLER returned to the fleeting area to get two mat barges which would receive the wide entanglement of midsection wreckage. The SOUTHERN 6 retracted some 600 feet upstream of the dam where the midsection was lifted by both slings. Following the removal of dangling pieces, the wreckage was lowered onto the mat barges (see Figure 7.8.9 - "Landing Midsection on Mat Barges"). The TYLER then returned the loaded barges to the fleeting area.

Saturday 15 January

The TYLER moved the SOUTHERN 6 back to the dam area to remove the forward section which had been secured to the Manitowoc crane barge. The SOUTHERN 6 rigged its heavy lift hook to the chain which passed through the wreck and took a strain. The chain pulled through the deck plate, but held when it beared against the wing bulkhead. Burners were deployed in a small workboat to cut holes through the bottom and inner bottom. The Manitowoc crane was used to rig a second chain through the holes and onto the light lift hook of the SOUTHERN 6 (see Figure 7.8.10 - "Removal of the Forward Section").

The forward section of the CGB 409B was then lifted by both blocks and the SOUTHERN 6 retracted on her anchor some 600 feet upstream of the dam. With the assistance of the SHORTY BAIRD, the SOUTHERN 6 retrieved her anchor, moved toward the right bank and then lowered her load onto a sling set on the

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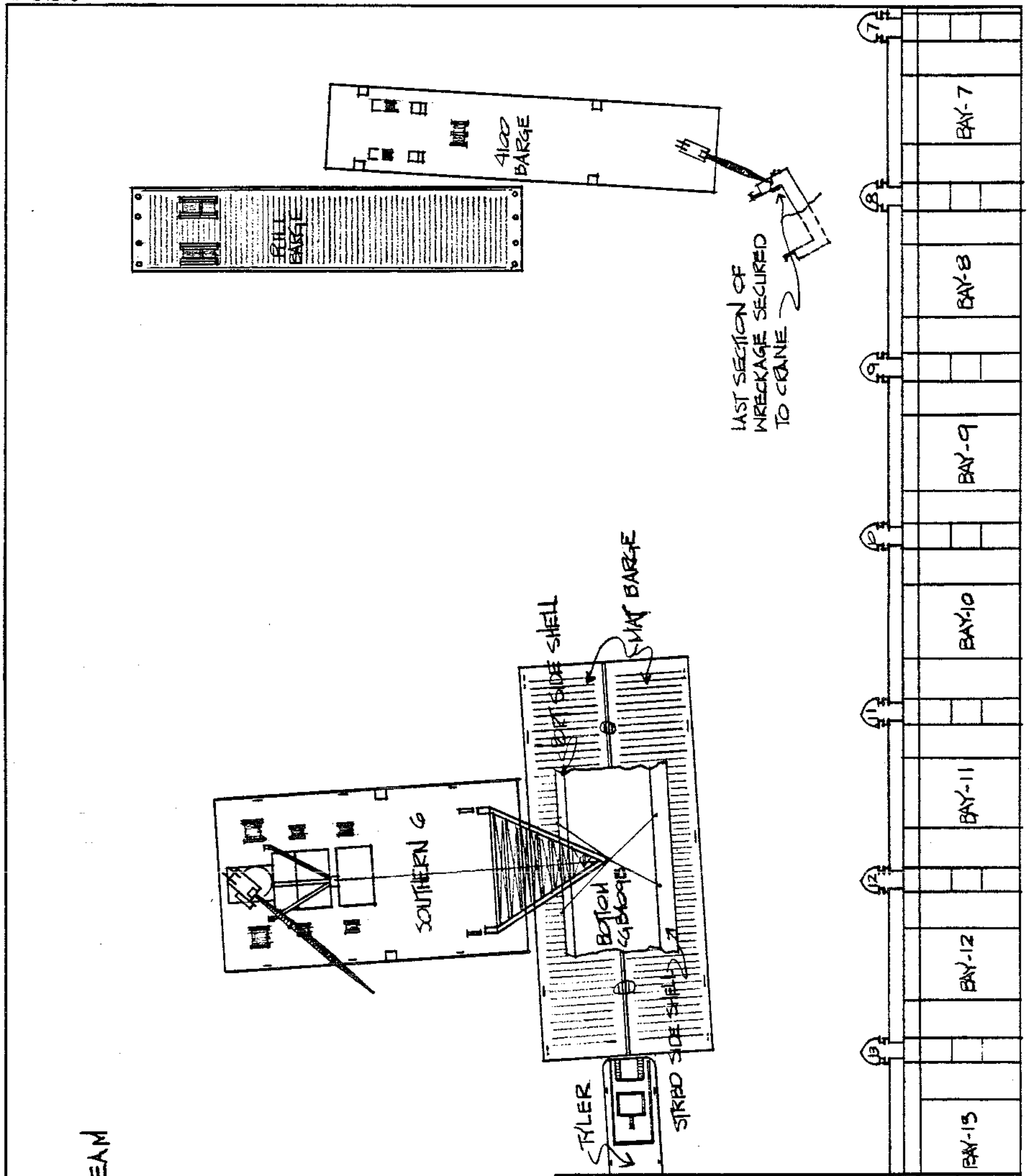

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ARKANSAS RIVER PROJECT
CGB 409 B
LANDING MIDSECTION ON MAT BARGES 1-14-83

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Sheet ___ of ___	FIG. 7.8.9		

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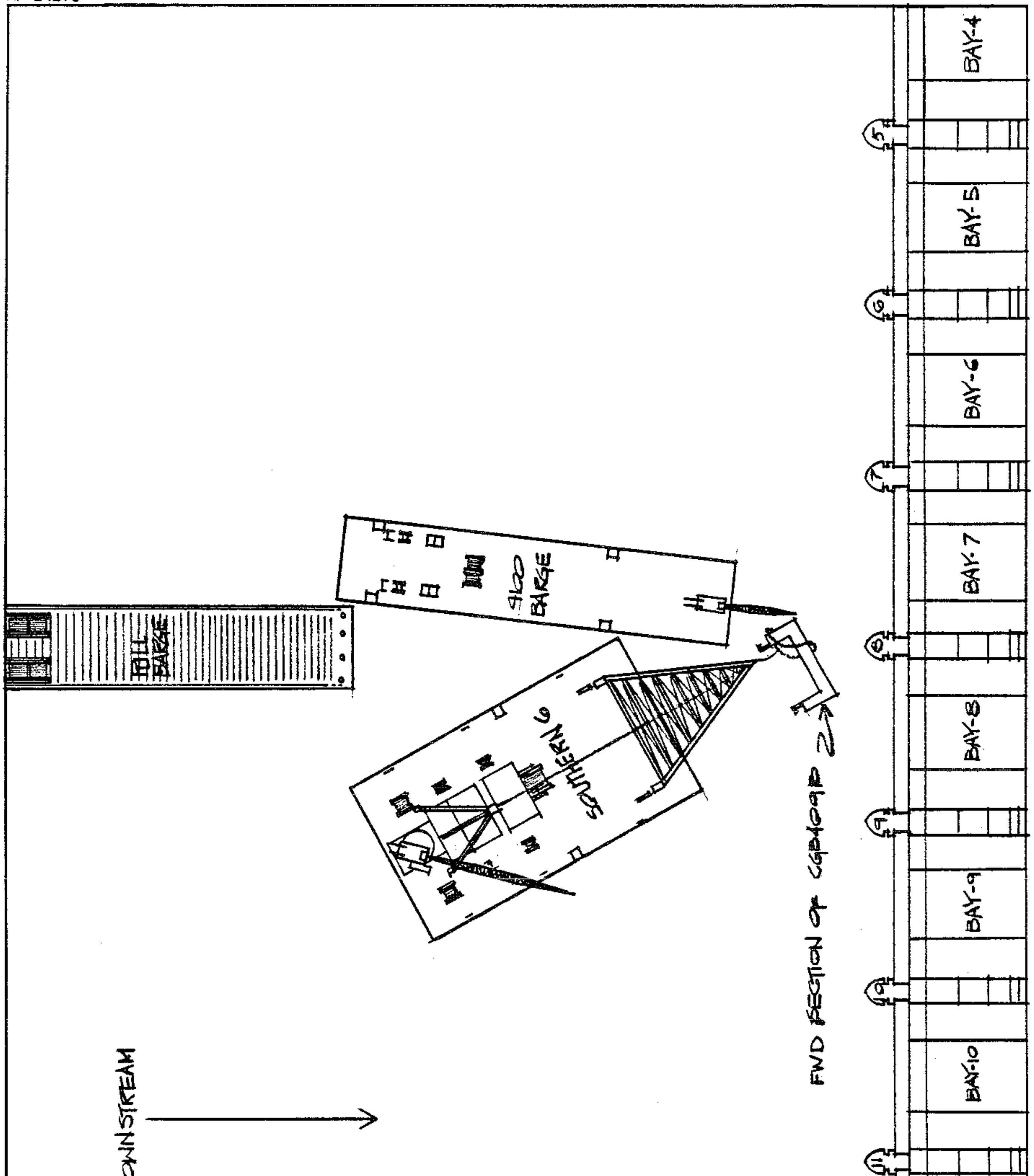

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ARKANSAS RIVER PROJECT
CGB 409 B
REMOVAL OF FWD SECTION 1-15-83

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Approved:	Drawing Number: FIG. 7.8.10 — Rev.
Sheet ___ of ___	

right bank. The wreckage was rotated and relifted bottom side down. The SHORTY BAIRD moved the SOUTHERN 6 to the fleeting area and the SOUTHERN 6 landed the wreckage on the two mat barges previously loaded with the midsection of the CGB 409B.

7.9 REMOVAL OF BARGE MST 409

DATE: 16-18, 22-23 January 1983

EQUIPMENT USED:

SOUTHERN 6
AJAX
CAPT. LUKE
Manitowoc 4100 crane barge
SHORTY BAIRD
TYLER
Three mat barges

WRECK SURVEY:

A side scan sonar survey indicated an unidentified wreck laying parallel to the dam at gates 5 through 8. This submerged wreckage was responsible for the fouling problems encountered in the removal of the CGB 409B and MST 352. It was assumed that this was the missing barge MST 409.

Enough gates in the vicinity of the wreckage were operational to allow an underwater survey. The wreckage of the MST 409 was lying bottom side down with the bow toward the right descending bank at a 60^{o} angle. The barge lay in a deep scour hole which ran down the axis of the dam and extended to a depth of 70 feet of water. The foredeck was split across from the port side to approximately 8 feet from the starboard side. The barge was almost cut in half amidships. The barge was deeply embedded in the concrete sill which was collapsed and fractured.

SALVAGE PLAN:

From the results of the diver survey, it was decided to attempt to remove the barge in one piece using both derricks. Lifting slings would be rigged around the forebody and secured to the hook of the SOUTHERN 6. When the wreckage was lifted clear of the bottom, more slings could be rigged for a more advantageous purchase and the AJAX could be brought in to assist.

SUMMARY OF THE WRECK REMOVAL:

Divers passed messengers wires which were used to pull two slings around the midbody of the MST 409. The wreckage was partially lifted by the SOUTHERN 6 and then retracted from the dam by the Pull Barge. The AJAX was called in to assist and hook up to a third sling set on the stern. Using both derricks, the wreckage was lifted clear of the water and loaded on two mat barges (see Figure 7.9.1). However, the damaged rake section tore off and sank during the lift. Divers located the wreckage and passed messengers. Slings were pulled into place, the wreckage was lifted, loaded on another mat barge and moved to the fleeting area.

DETAILS OF THE WRECK REMOVAL:

Sunday 16 January

The SOUTHERN 6 spent the day with its head to gate 5 rigging the fully submerged MST 409. The wreck had been located

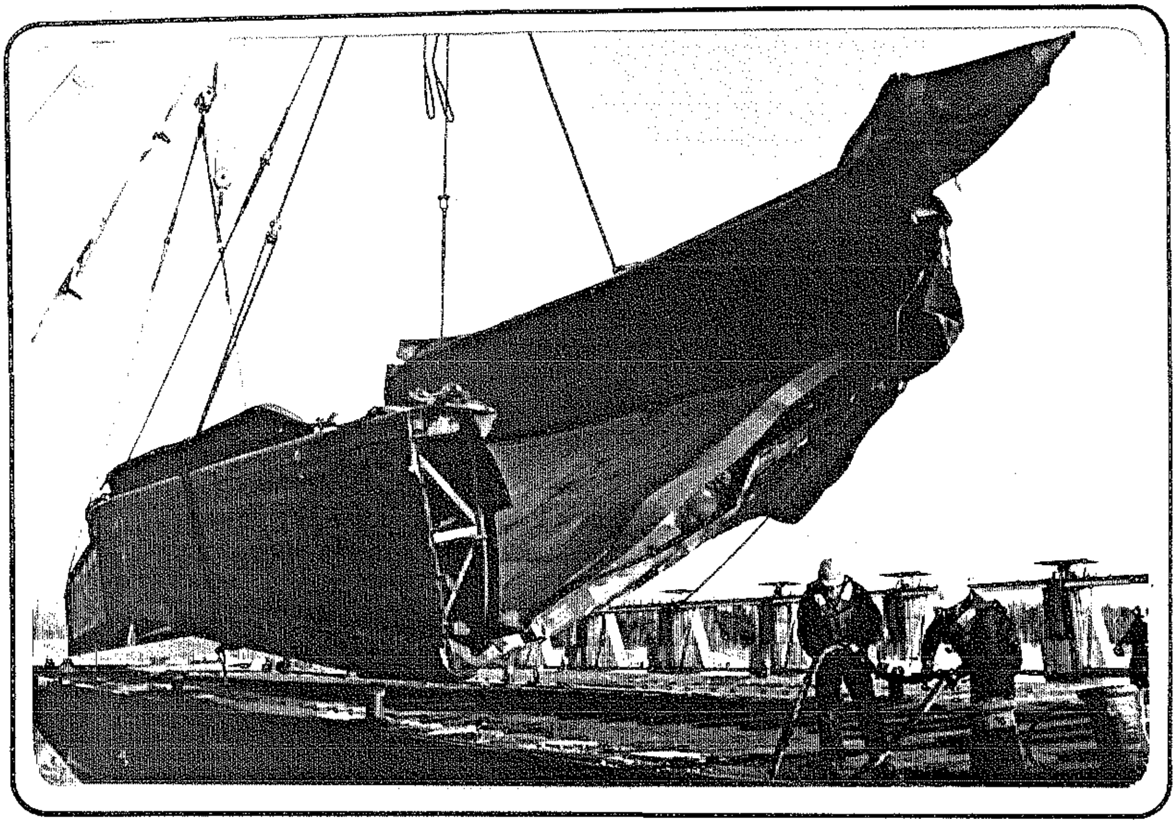

Figure 7.9.1: Missing Barge MST 409 Lifted by SOUTHERN 6 and AJAX

by soundings and by a side scan sonar survey. The wreckage was lying parallel to the dam in a deep scour hole (70 feet at the deepest point) along piers 5, 6 and 7. The CAPT. LUKE was used to support divers who were surveying the wreckage and attempting to pass messengers. Considerable difficulty was experienced as the messengers fouled on the riprap and broken concrete. By nightfall, the SOUTHERN 6 was successful in pulling one sling into place around the midbody of the MST 409.

Monday 17 January

The SOUTHERN 6 rigged to the sling previously set around the MST 409 and lifted the forward end of the wreck off the bottom, but did not bring the wreckage to the surface (see Figure 7.9.2 - "First Lift"). A diver then passed a second messenger which was used to pull another sling into place. Both slings were then secured to the main hook of the SOUTHERN 6. However, when a lift was attempted, the slings began to slide together. A diver from the CAPT. LUKE was deployed to survey the problem but was unsuccessful in preventing the slings from sliding.

Eventually, one of the slings was released from the hook of the SOUTHERN 6 and a lift was made with a single sling which was located about 50 feet aft of the forward rake bulkhead. The bow end of the wreckage broke the surface while the stern was still bearing against the bottom. It was then possible to observe that the forward rake section had nearly torn free from the rest of the wreckage. With the bow of the MST 409 elevated, the Manitowoc crane barge was used to work a messenger around the submerged wreckage just aft of the lifting sling. The wreck was lowered for the night.

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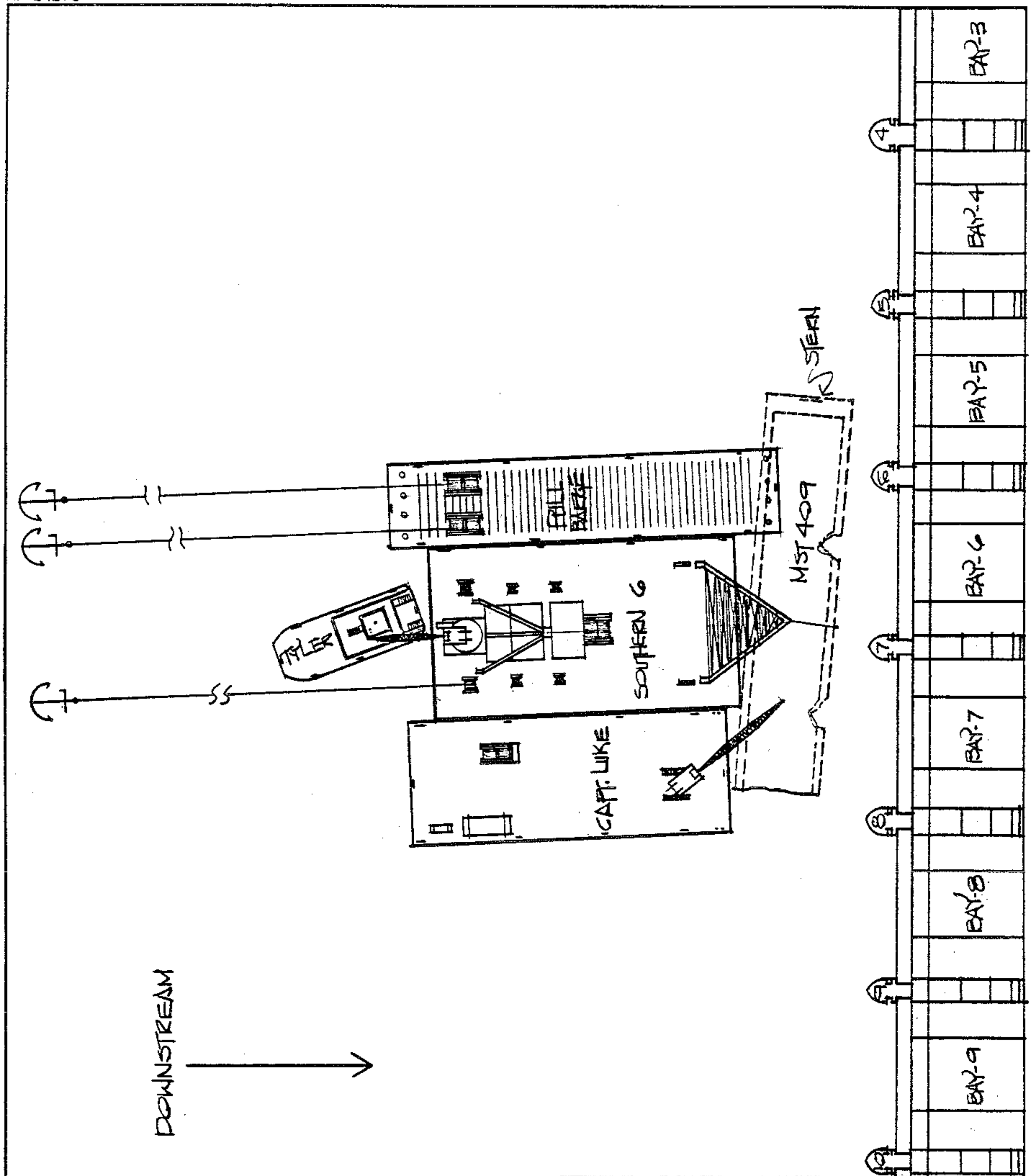

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ARKANSAS RIVER PROJECT
MST 409
FIRST LIFT 1-17-83

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Sheet ____ of ____	Rev.

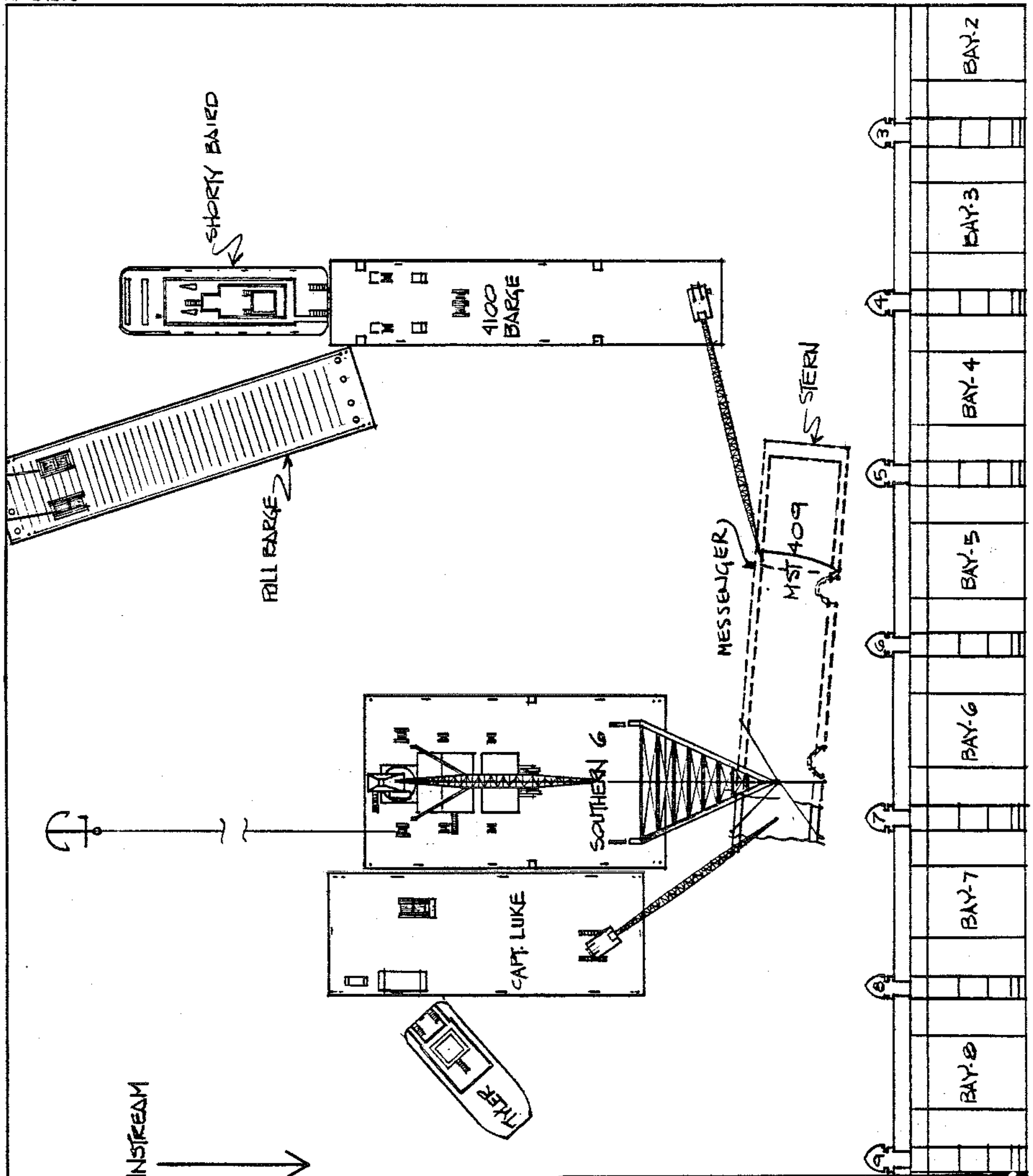
Tuesday 18 January

A sling was pulled into place using the messenger set the previous day. The two slings which had been around the midbody of the wreckage were then secured to the main hook of the SOUTHERN 6. The SOUTHERN 6 lifted the wreckage until the port side hopper coaming surfaced with the bottom side down and the stern still bearing against the sill. Cranes from the CAPT. LUKE and the Manitowoc crane barge were used to pull a messenger into position 35 feet forward of the aft hopper bulkhead (see Figure 7.9.3 - "Lifting to Pass Messenger").

Repairs were completed on AJAX and she returned to the river ahead of schedule. The AJAX was deployed on the port side of the SOUTHERN 6. A third sling was pulled into place with the previously set messenger and was secured to the main lifting hook on the AJAX. The AJAX lifted the aft end of the MST 409 off the bottom. The SOUTHERN 6 and the AJAX then retracted on their anchors, pulling the wreckage clear of the dam and out of the deep scour hole in which the MST 409 had previously rested. The rake section tore off and sank as the wreck was raised (see Figure 7.9.4 - "Removal of the Main Section").

With the wreckage suspended from the AJAX and SOUTHERN 6, the flotilla was swung toward the right shore by the TYLER. Meanwhile, the SHORTY BAIRD had made a trip to the fleeting area and had returned with two mat barges rafted together prepared to receive the wreckage.

The SOUTHERN 6 elevated the forward section of the wreckage so that water trapped in the hopper ran out of the aft end. As the hopper emptied, the wreckage was lifted higher until



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ARKANSAS RIVER PROJECT
MST 409
LIFTING TO PASS A MESSENGER 1-18-83

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Sheet ___ of ___	

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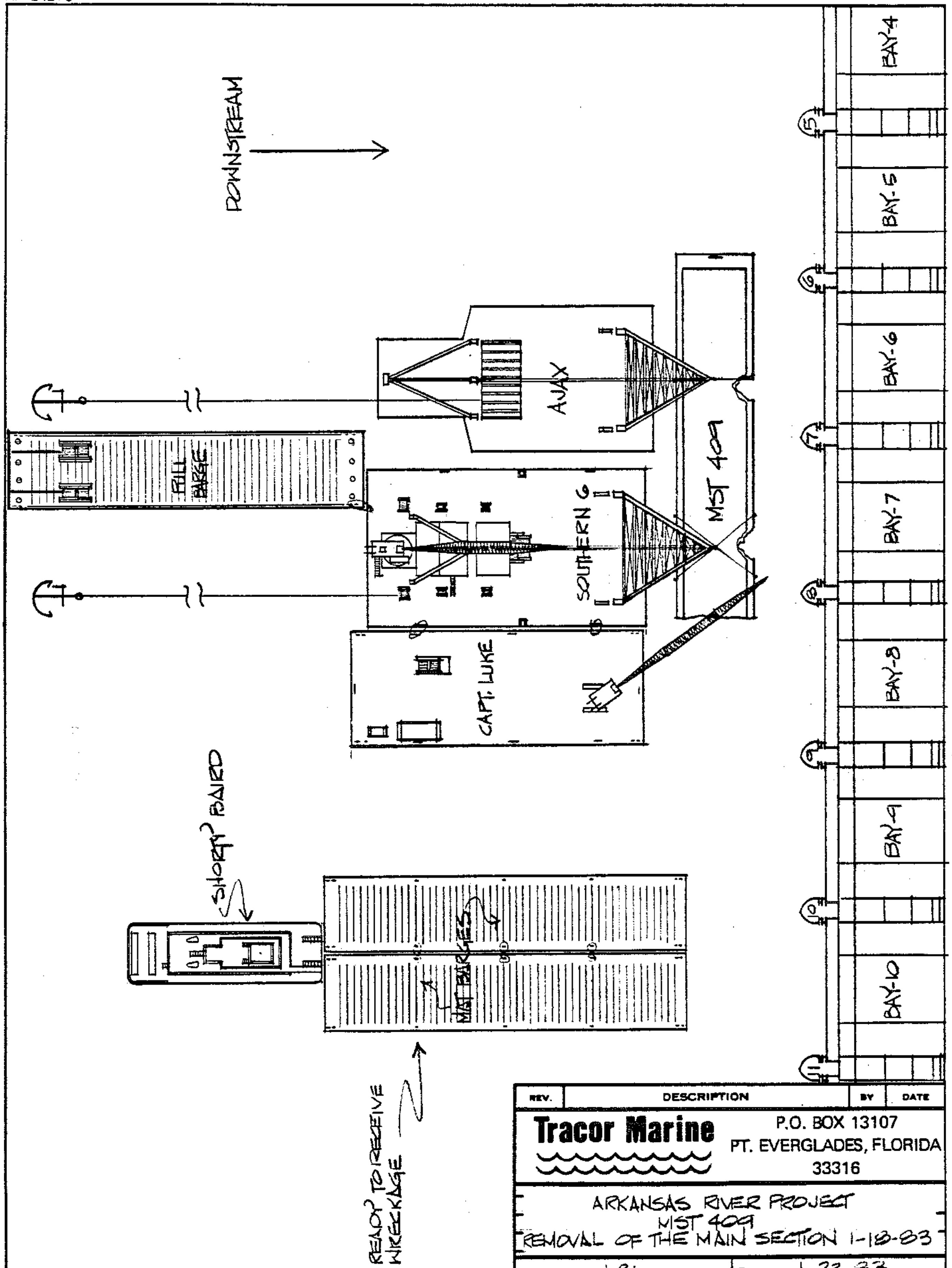

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ARKANSAS RIVER PROJECT
MST 409
REMOVAL OF THE MAIN SECTION 1-18-83

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Sheet ___ of ___	

it was possible to load it onto the mat barges. The AJAX had rigged pumps to aid in the dewatering of the hopper. Workmen positioned lengths of wood cribbing on the mat barge decks to protect the deck plate from the MST 409 wreckage. The wreckage was then lifted clear of the water while the SHORTY BAIRD maneuvered the mat barges under the wreckage. The wreckage was landed on the mat barges and returned to the fleeting area. This was the heaviest dead lift made during the entire operation.

After the removal of the wreck, the Corps of Engineers conducted a side scan sonar survey of the scour area. The chart record indicated an unidentified piece of wreckage upstream of pier 7 which was suspected to be the rake section of MST 409.

<u>Saturday 22 January</u>

The CAPT. LUKE was positioned in the gate 7 area to support divers searching for the rake section of the MST 409. The divers located and buoyed the wreckage.

<u>Sunday 23 January</u>

Divers working from the CAPT. LUKE passed a messenger under the rake section. The SOUTHERN 6 pulled a sling into place, lifted the section to the surface and retracted upstream. Burners cut holes into the wreckage and two chains were reeved through the holes. The chains were then secured to the main lifting hook of the SOUTHERN 6 which lifted and loaded the rake onto a mat barge. The TYLER returned the mat barge to the fleeting area.

7.10 REMOVAL OF BARGE RMW 12

DATE: 11-16, 20-26 January 1983

EQUIPMENT USED:

- AJAX
- SOUTHERN 6
- Manitowoc 4100 crane barge
- SHORTY BAIRD
- TYLER
- Three mat barges
- CAPT. LUKE

WRECK SURVEY:

The RMW 12 was lying on its starboard beams end, parallel to the dam axis, with the bow pointing toward the right bank. The RMW 12 spanned bays 2 and 3 and extended into bays 1 and 4. The vessel was impaled by piers 2, 3 and 4 with the rupture at pier 3 very nearly severing the barge. The portion of RMW 12 in bay 3 was grounded on barge MST 312, preventing the salvage of the MST 312. The forward section of PV 331 was sunk below the MST 312. The aft section of the RMW 12 was pinned against pier 2 by MST 312 (see Figure 7.10.1).

SALVAGE PLAN:

The initial plan to remove the RMW 12 was to use both derricks lifting on belly slings. However, diver survey

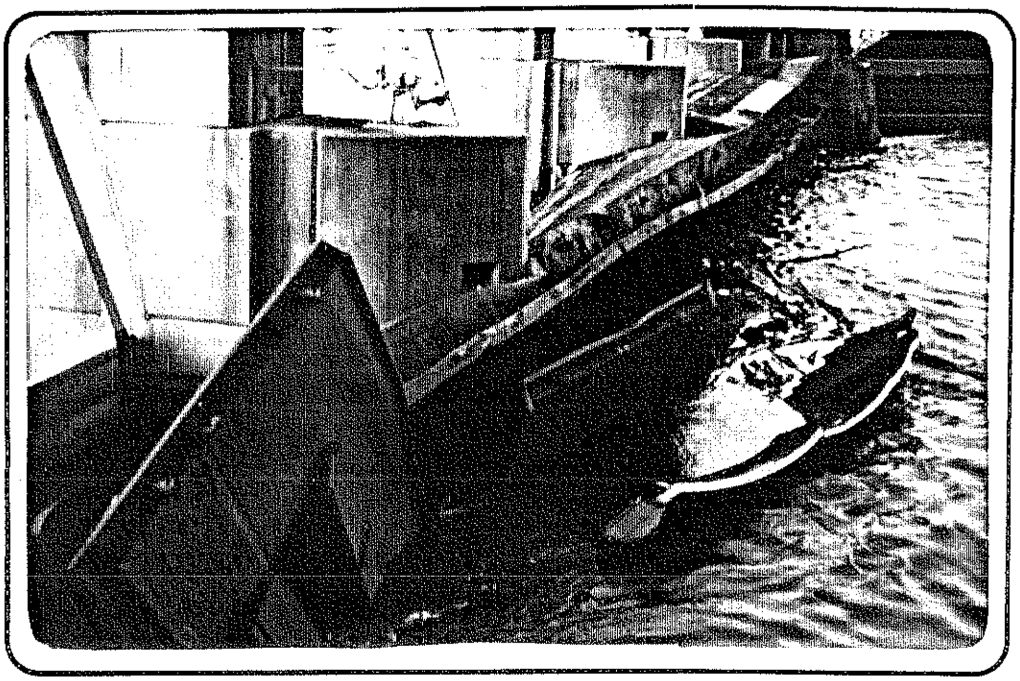


Figure 7.10.1: RMW 12 impaled on Piers 2, 3 and 4 with PV 331 Bow Underneath

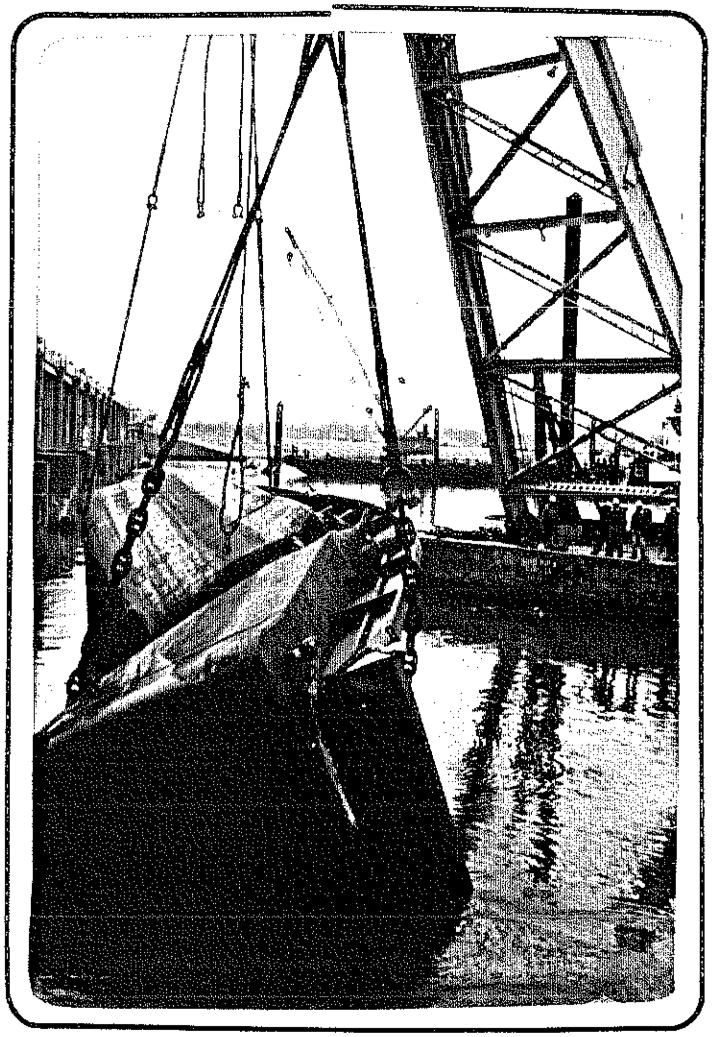


Figure 7.10.2: AJAX and SOUTHERN 6 Remove RMW 12 Stern Section

indicated that the forward section of the barge was grounded on the MST 312 and that the stern section was firmly pinned against pier 2 by the starboard side of the MST 312. It was now apparent that the RMW 12 would have to be removed in sections, and the most logical place to separate the sections was at pier 3. Once the forward section of the RMW 12 was removed, the MST 312 would have to be removed before considering the aft section of the RMW.12.

SUMMARY OF THE WRECK REMOVAL:

The RMW 12 was removed in two sections. The forward one-third was severed at pier 3. The section was lifted by the AJAX, landed on the river bank, and later loaded on a mat barge. The stern section was not removed until after the removal of both the MST 312 and the submerged portion of PV 331. At that time, the SOUTHERN 6 and the AJAX lifted the stern section and landed it on mat barges which were taken to the fleeting area (see Figure 7.10.2).

DETAILS OF THE WRECK REMOVAL:

Monday 10 January

The CAPT. LUKE was positioned head to gate 1. Divers were deployed to survey RMW 12, MST 312 and PV 331 in the vicinity of gates 1, 2 and 3.

Tuesday 11 January

Survey continued on the wrecks at gates 1 through 4. Hatch covers were removed from the wrecks. Weight centers and bulkheads were marked on the RMW 12.

Wednesday 12 January

Surveying continued and messengers were set on wreckage at gates 1 through 4.

Thursday 13 January

Engineering analysis and diver survey indicated that lifting barge RMW 12 was not advisable since the MST 312 was pinning the stern section at pier 2. It was decided to cut the barge in half where it had been partially severed by pier 3 and remove the 90 foot forward section. A diver deployed with an underwater cutting torch began cutting inside of the wing wall from the hopper coaming and across the deck, a distance of approximately sixteen feet. Attempts to pass a second messenger about RMW 12 just to the left of pier 4 were unsuccessful due to fouling on the wreckage below.

Friday 14 January

Underwater burning of the RMW 12 was completed. A topside burner completed the cuts in the remaining structure in the port wing wall and deck. This caused the wreck to move apart slighty with the two sections held together by a portion of the starboard side shell and stringers.

Saturday 15 January

In the morning the AJAX moved from the fleeting area and set her anchor with the help of the TYLER. The AJAX let down on her anchor to gate 3 and began rigging the forward section of RMW 12. A sling was pulled into place using the previously placed messenger. The sling was positioned at the first bulkhead forward of the pier 3 impalement. The AJAX then lifted the wreckage a small distance and a diver working from the CAPT. LUKE worked another messenger around the forward section. During this operation, the CAPT. LUKE positioned herself with her head to gate 2. The Manitowoc crane barge then pulled a second sling into place using the messenger set by the diver.

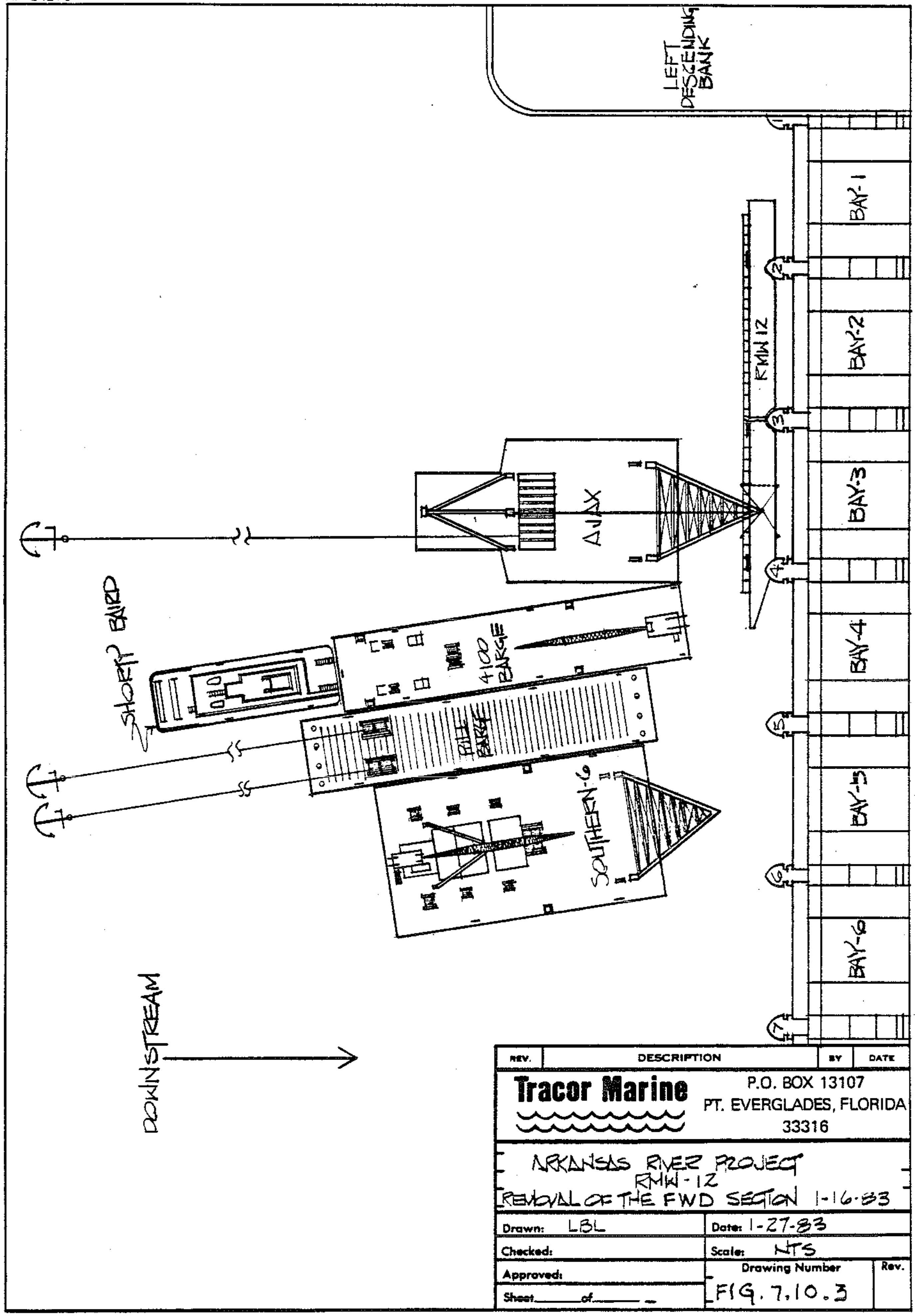
Sunday 16 January

The AJAX began the day working on the forward section of the RMW 12. One sling was secured while the second was tugged forward on the wreckage by the capstan on the Manitowoc crane barge. The CAPT. LUKE retracted on her anchor to a point clear of the dam area. With the help of the TYLER, the CAPT. LUKE reset her anchor and then repositioned to starboard of the SOUTHERN 6 with her head to gate 7.

The AJAX then rigged to the two slings and lifted the 92 foot long forward section of RMW 12 (see Figure 7.10.3 - "Removal of the Forward Section"). With the wreck on the hook, the AJAX retracted on her anchor clear of the dam area and with assistance from the SHORTY BAIRD moved to the right bank 1000 feet upstream of the dam. The wreck was landed ashore starboard side down.

Thursday 20 January

The SOUTHERN 6, SHORTY BAIRD and Manitowoc crane barge assembled along the right bank where the forward section of RMW 12 had previously been deposited. The SOUTHERN 6 rigged one eye of each of the two slings already in place to the heavy lift block and the other two eyes to the light lift hook. The RMW 12 forward section was then lifted and rotated until the bottom side was down. The Corps of Engineers requested the section be left on the shore rather than loaded onto a mat barge so that it could be used as a test platform for the newly fabricated chisel.


LEFT DESCENDING BANK
BAY-1
BAY-2
BAY-3
BAY-4
BAY-5
BAY-6
1
2
3
4
5
6
7
RMW 12
AJAX
4100 BARGE
SHORTY BAIRD
BILL BARGE
SOUTHERN-6
DOWNSTREAM
REV.
DESCRIPTION
BY
DATE
Tracor Marine
P.O. BOX 13107
PT. EVERGLADES, FLORIDA
33316
ARKANSAS RIVER PROJECT
RMW-12
REMOVAL OF THE FWD SECTION 1-16-83
Drawn: LBL
Date: 1-27-83
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Drawing Number
Rev.
Sheet ___ of ___
FIG. 7.10.3

During the lift, the rigging to the light lift block of the SOUTHERN 6 fouled due to a buildup of ice on the rollers.

<u>Friday 21 January</u>

The SOUTHERN 6 crew completed rigging repairs and pulled the slings from under the RMW 12.

<u>Sunday 23 January</u>

With the TYLER's assistance, the AJAX moved to the vicinity of gate 1 to begin work on the remaining section of the RMW 12. The CAPT. LUKE joined the AJAX by positioning to starboard in the gate 2 area. A diver was deployed from the CAPT. LUKE and was successful in passing a single messenger about the wreckage.

<u>Monday 24 January</u>

The AJAX pulled a sling into place about RMW 12 between piers 2 and 3. With the assistance of divers, a series of holes were burned in the submerged aft end of the RMW 12. A chain was then set through and rigged to a sling. The SOUTHERN 6 positioned to starboard of the AJAX while CAPT. LUKE retracted out of the way. The AJAX rigged to the aft chain sling while the SOUTHERN 6 rigged to the sling set between piers 2 and 3. The A-frames lifted the wreckage and retracted upstream of the dam (see Figure 7.10.4 - "Removing Aft Section"). The TYLER brought out two mat barges which received the wreckage of the aft section and were then returned to the fleeting area.

<u>Wednesday 26 January</u>

The SOUTHERN 6 came alongside the port side of the M/V MISSISSIPPI with her bow toward the bank and rigged a sling under the rake of the RMW 12 forward section. During the testing

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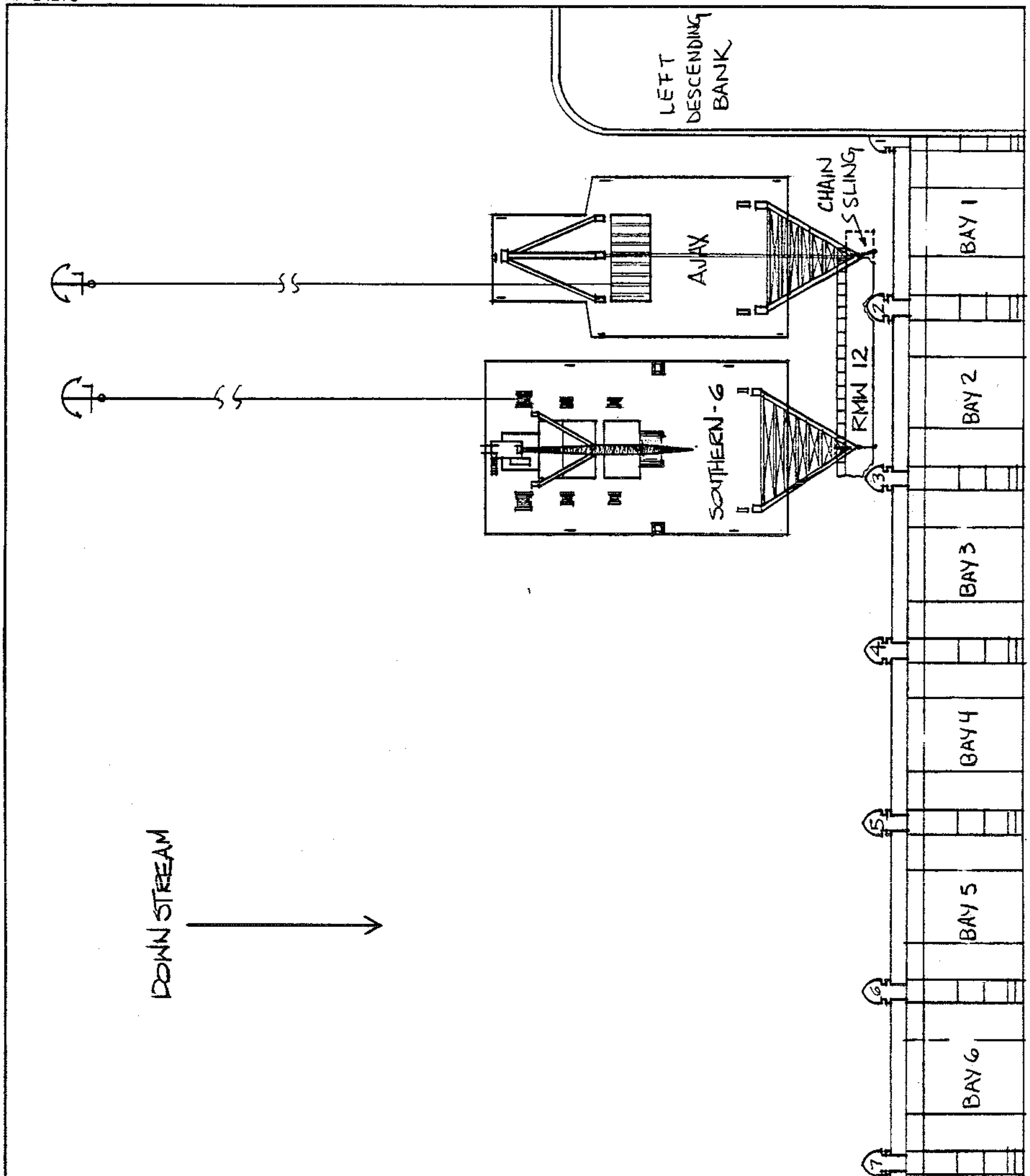

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PT. EVERGLADES, FLORIDA
33316

ARKANSAS RIVER PROJECT
RMW 12
REMOVING AFT SECTION 1-24-83

Drawn: LBL	Date: 1-27-83
Checked:	Scale: NTS
Approved:	Drawing Number: FIG. 7.10.4 Rev.
Sheet ___ of ___	

of the chisel, the forward section had been partially severed. Burners completed cutting the forward section into two pieces. The rake section was lifted by the SOUTHERN 6 and transported by the TYLER and the SOUTHERN 6 to a mat barge in the fleeting area.

The SOUTHERN 6 returned to the point and rigged two slings around the remaining piece of the RMW 12 and lifted. The TYLER moved the SOUTHERN 6 to the fleeting area to load the wreckage onto a mat barge.

7.11 REMOVAL OF BARGE MST 312

DATE: 16-19 January 1983

EQUIPMENT USED:

AJAX
SOUTHERN 6
SHORTY BAIRD
TYLER
CAPT. LUKE
Two mat barges

WRECK SURVEY:

The MST 312 had sunk in an upright attitude and bridged bays 1, 2 and 3. The wreck lay parallel to the axis of the dam with the bow toward the left descending bank. The forward end of the RMW 12 was resting on top of the MST 312 throughout the bay 3 area and partially into bay 2. The MST 312 was resting on top of the wreckage of the PV 331 in bays 1 and 2. Timber heads and kevels from the PV 331 had perforated the bottom shell of the MST 312 in numerous locations. The starboard side was pinning the RMW 12 against pier 2. The hull of the MST 312 was hogged and the starboard side shell was buckled.

SALVAGE PLAN:

The initial plan was to remove the MST 312 by rigging belly slings and lifting with the two derrick barges. However, the diver survey indicated that part of the RMW 12 would have to be removed in order to free the MST 312. It was also considered that the MST 312 could be salvaged and floated by pumping and patching. It was decided that this would be attempted after the removal of the RMW 12 forward section.

SUMMARY OF THE WRECK REMOVAL:

The forward section of the RMW 12 was removed first to allow access to the MST 312. An attempt was made to refloat the barge and put it back into service (see Appendix VIII for calculations). However, it became apparent that the MST 312 had been damaged beyond economical repair. Consequently, the barge was lifted in one piece by both derricks and loaded on two mat barges (see Figure 7.11.1).

DETAILS OF THE WRECK REMOVAL:

Sunday 16 January

With assistance from the TYLER, the AJAX moved to the left side of the river and secured to her anchor. The AJAX was then moved to the area upstream of gate 1 to begin refloating operations on the MST 312. A diver working from the CAPT. LUKE set a messenger which was used to pull a sling around the forward hopper bulkhead of MST 312. The sling was secured to the main lifting hook of the AJAX for the night.

Monday 17 January

The AJAX spent the day working to refloat the MST 312. The A-frame rigged to the sling positioned at the forward hopper

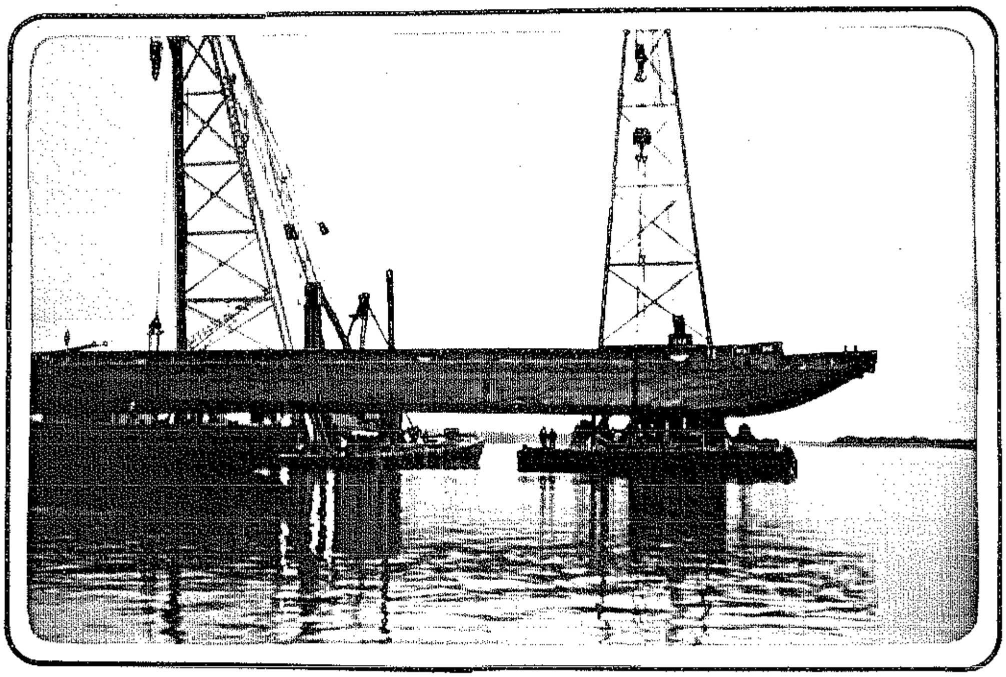

Figure 7.11.1: AJAX and SOUTHERN 6 Lift MST 312

bulkhead and lifted the bow clear of the water while the stern remained grounded on the concrete sill. Pumps were deployed from the SOUTHERN 6 small work barge and set up to pump out the rake tank (see Figure 7.11.2 - "Pumping the Rake Tank"). However, it was discovered that a timber head on the underlying PV 331 wreckage had holed the MST 312 on the starboard side at the turn of the bilge.

The bow of the MST 312 was raised higher until the hole was exposed. A welder entered the rake tank and installed a patch. Holes were found and repaired in the #1 tank, also. The wreckage was lowered into the water for the night to determine if the patches were watertight.

<u>Tuesday 18 January</u>

While positioned head to gate 1, the AJAX deployed welders onto MST 312. The welders repaired holes in the fore deck and sealed the manhole into the rake tank. The pumping and sealing of the rake tank generated sufficient buoyancy so that when the MST 312 was lowered into the water, the stern remained grounded on the concrete sill while the bow floated freely with the rake exposed.

The sling was removed from the AJAX hook and tied off to the small SOUTHERN 6 work barge which had been positioned over the submerged hopper of the wreck. The AJAX was then moved and assisted the SOUTHERN 6 in the removal of the MST 409.

<u>Wednesday 19 January</u>

The SOUTHERN 6 and the AJAX were moved back to the dam site upstream of gates 1 and 2 to continue the salvage of the MST 312. It was observed that the MST 312 was floating very low

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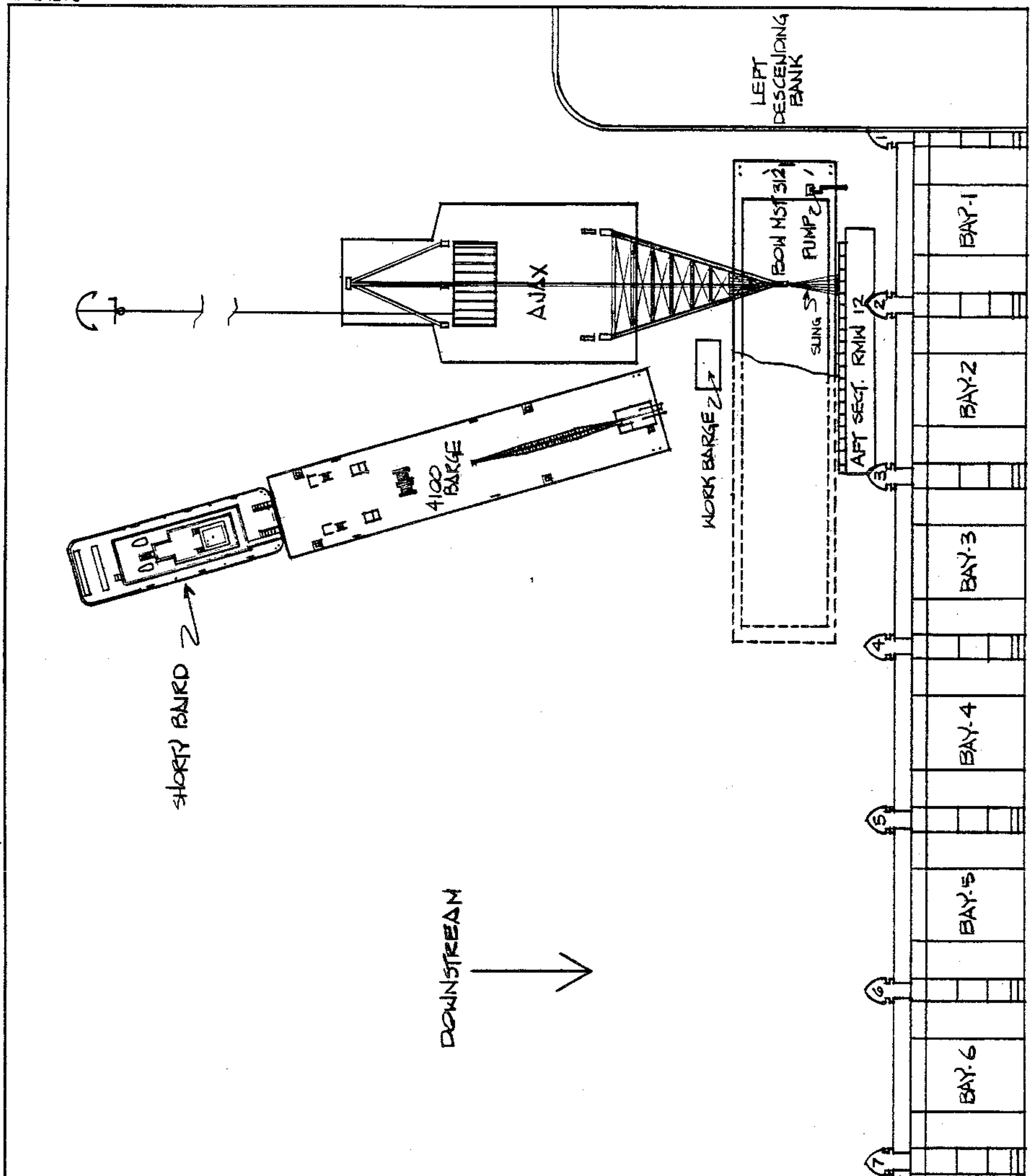

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Tracor Marine
P.O. BOX 13107
PT. EVERGLADES, FLORIDA
33316

ARKANSAS RIVER PROJECT
MST 312
PUMPING RAKE TANK 1-17-83

Drawn: LBL	Date: 1-21-83
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Approved:	Drawing Number: FIG. 7.11.2
Sheet ____ of ____	Rev.

indicating that some leakage into the rake tank that had been sealed on Tuesday had occurred.

A second sling was pulled into place about the aft end of MST 312 and rigged to the main lifting hook of the SOUTHERN 6. The AJAX rigged to the sling that had been secured to the small SOUTHERN 6 work barge (see Fig. 7.11.3 - "Removal From Dam").

The wreckage was lifted off the bottom and retracted upstream until it was clear of the RMW 12 aft section that had been impaled on piers 2 and 3. The MST 312 was lifted until the hopper coaming broke the surface.

Efforts on the previous Sunday and Monday had demonstrated that refloating the barge by pumping its tanks was impractical due to the numerous shell perforations. However, in order to lift the wreck onto mat barges, it was necessary to rig pumps and remove the 1500 tons of water trapped in the hopper.

The SOUTHERN 6 and the AJAX raised the MST 312 and landed the wreckage on two mat barges that the SHORTY BAIRD had brought from the fleeting area. The SHORTY BAIRD returned the loaded mat barges to the fleeting area.

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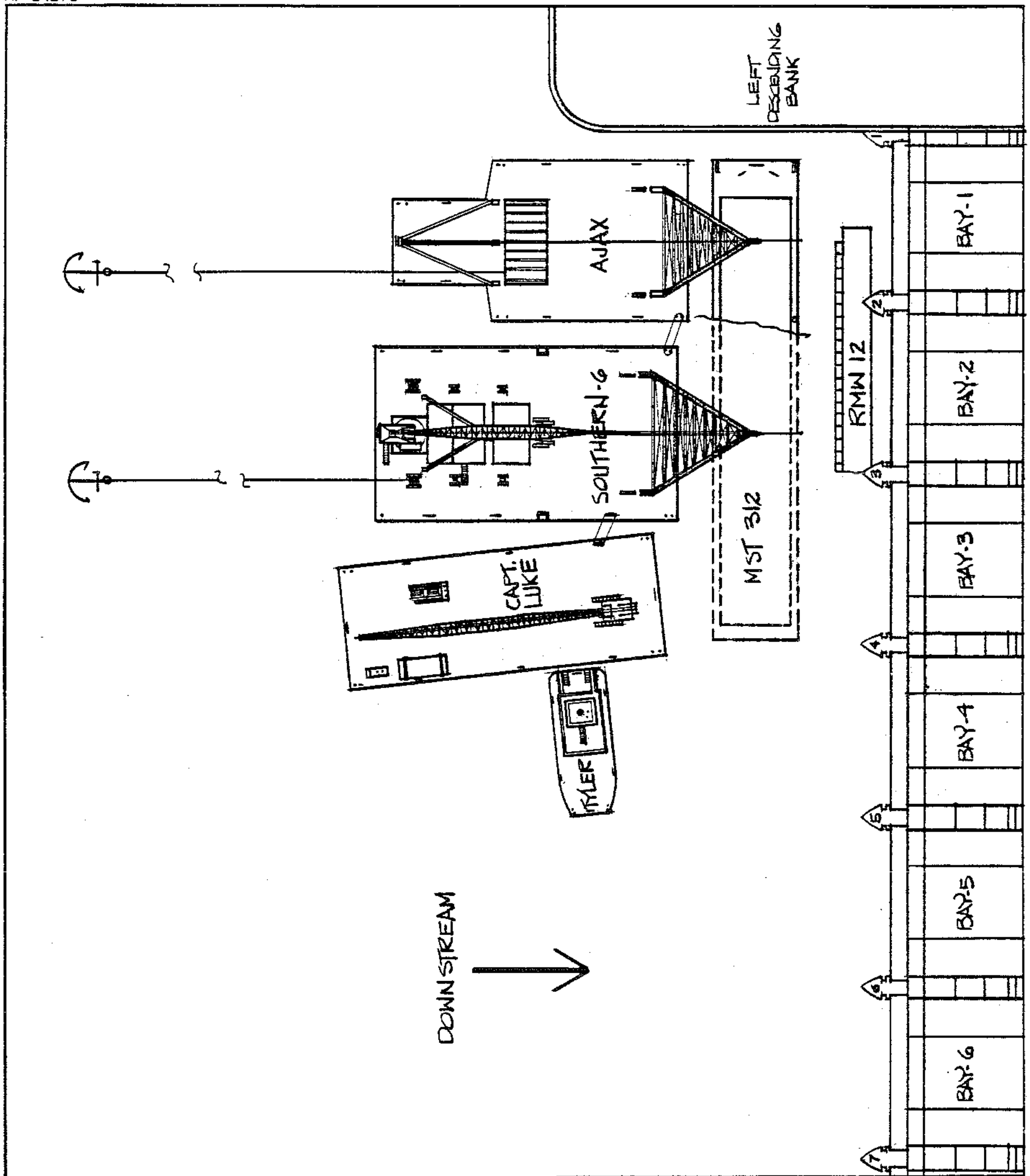

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PT. EVERGLADES, FLORIDA
33316

ARKANSAS RIVER PROJECT
MST 312
REMOVAL FROM DAM 1-19-83

Drawn: LBL	Date: 1-21-83
Checked: BML	Scale: NTS
Approved:	Drawing Number: FIG. 7.11.3 — Rev.:
Sheet ___ of ___	

7.12 **REMOVAL OF BARGE PV 19B**

DATE: 24 January - 8 February 1983

EQUIPMENT USED:

SOUTHERN 6
AJAX
Manitowoc 4100 crane barge
CAPT. LUKE
Pull Barge
SHORTY BAIRD
TYLER
Two 40 foot I-beam cutting chisels
Five mat barges

WRECK SURVEY:

The PV 19B had box ends with no designated bow or stern. In order to avoid confusion in describing the wreckage removal, the bow was considered to be the end pointed towards the right descending bank as the barge lay impaled on the dam.

The PV 19B was lying parallel to the axis of the dam with its bow toward the right bank. It was listing at an angle of approximately 60 degrees with its starboard side resting on the concrete sill. The wreck was down by the head with the forward 35 feet of the wreck submerged. The wreck spanned bays 12 and 13 and extended 30 feet into bay 11 and 25 feet into bay 14. The PV 19B was crushed against the MST 351 which had been badly impaled on piers 12 and 13.

Just to the right of pier 12, the stern section of the PV 19B was partially separated from the rest of the hull such that the section was angling into bay 11. The midbody of the wreckage was slightly impaled on pier 13 and the forward end was deeply impaled on pier 14. The icebreaker had cut through the port wing wall and a portion of the bottom (see Figures 7.12.1 and 7.12.2).

The damming effect of the PV 19B and the MST 351 restricted the flow of water through bay 12 even though gate 12 remained operational. Gate 13 was jammed open by the MST 351 but the water flow was effectively blocked by the PV 19B with only a small volume of water cascading over the deck of the wreck. However, numerous cracks were visible in the shell plate of the PV 19B with the worst occurring 25 feet to the right of pier 13. This damming effect also caused almost 30 feet of head pressure between the headwater and the water level over the sill of gate 13 where the bow section of MST 351 was wedged.

SALVAGE PLAN:

The initial plan was to coordinate the salvage operations of both PV 19B and MST 351 as a unit by rotating the bow section of the MST 351 until it was hard aginst the PV 19B. With gate 13 closed, both barges would be retracted upstream and then rigged for removal.

PV 19B would be rigged with belly slings and lifted on beam ends using both derricks. The Pull Barge would then be rigged to restrain the afterbody, should it part company with the

Figure 7.12.1: PV 19B and MST 351 Spanning Gates 11, 12 and 13

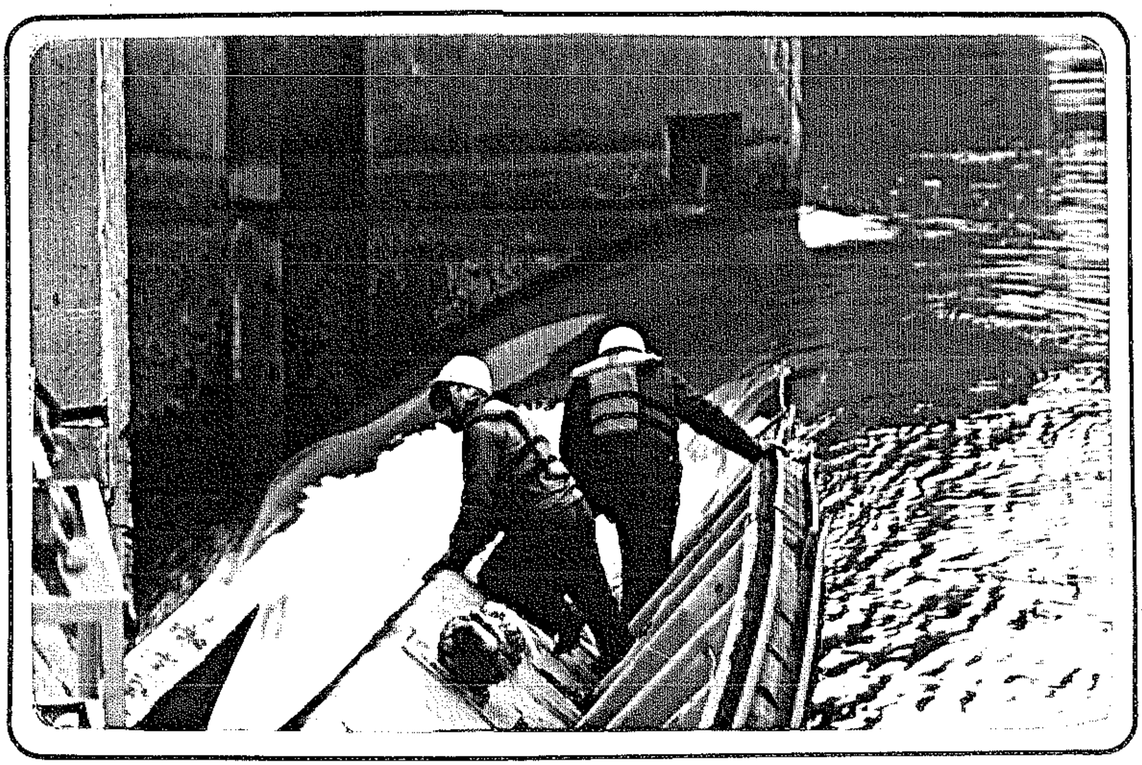

Figure 7.12.2: PV 19B Had Formed a Cofferdam at Gate 13

remainder of the barge during the lift. It would be relatively easy to retrieve the 50 ton afterbody at a later date. The forebody of the MST 351 would be slung and cut away from the remainder using oxy-arc cutting or the 3", 6 x 19 cutting wire provided by Bisso.

During the course of the salvage operations, the experience gained emphasized problems and conditions that had been unforeseen when the original plans were prepared. For example, the excessive structural damage done when a barge was impaled frequently weakened it to the point of failure when extreme forces were applied to free the barge. The experience gained in cutting, slinging and sectioning made this form of recovery a more viable option than attempting a heavy lift of the broken hull as a unit.

It was feared that the crack in the hull of the PV 19B in way of bay 13 would propagate and cause the hull to split with the result that the wreckage would shift, jam the gate open and allow an uncontrolled flow of water. If the gates on either side were operational, the detrimental effect on the dam due to the turbulence and scouring would be reduced.

It was decided that the barges would be cut and removed in sections, clearing gates 11 and 12 before proceeding to gate 13. If the PV 19B should fail, not only would the neighboring gates be operational, but it was more likely that the shorter sections of the MST 351 and PV 19B would wash through the gate rather than lodge within the bay. The use of a heavy cutting chisel would be effective in sectioning the wreck.

SUMMARY OF THE WRECK REMOVAL:

The stern section of the PV 19B which angled into bay 11 was cut with the 40 foot steel I-beam chisel to the right of pier 12. The Pull Barge retracted upstream, but the cut was not complete and the stern was strung out on the bottom. Gate 11 was now cleared and the stern was buoyed off for later removal (see Figure 7.12.3).

The chisel was then used to cut the section of PV 19B lying in bay 12. This section of the midbody was then lifted with two chain slings on the hook of the SOUTHERN 6 and landed on two mat barges (see Figure 7.12.4). Following this removal and similar operations on the MST 351, the PV 19B failed upstream of gate 13.

Attempts were made to recover as much of the wreckage as possible. A section of wing wall and some small pieces of wreckage were recovered and loaded onto a mat barge. The bow section extending into bay 14 was rigged and pulled upstream where it was loaded onto a mat barge.

Gate 13 was opened and all remaining pieces of wreckage were washed downstream.

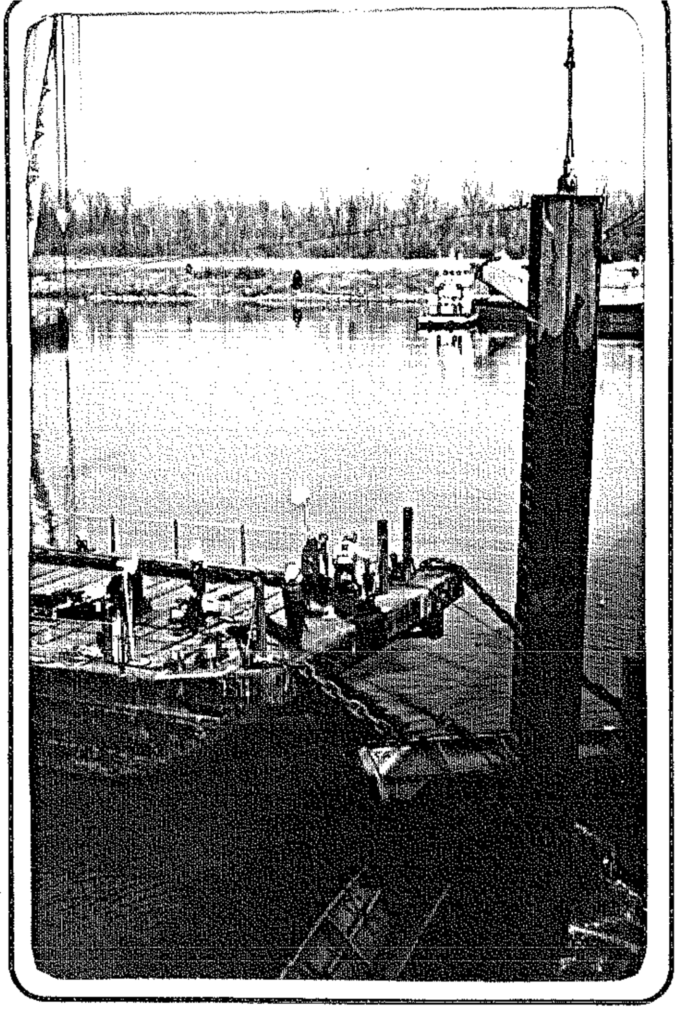

Figure 7.12.3: Chiseling PV 19B and MST 351 at Gate 11

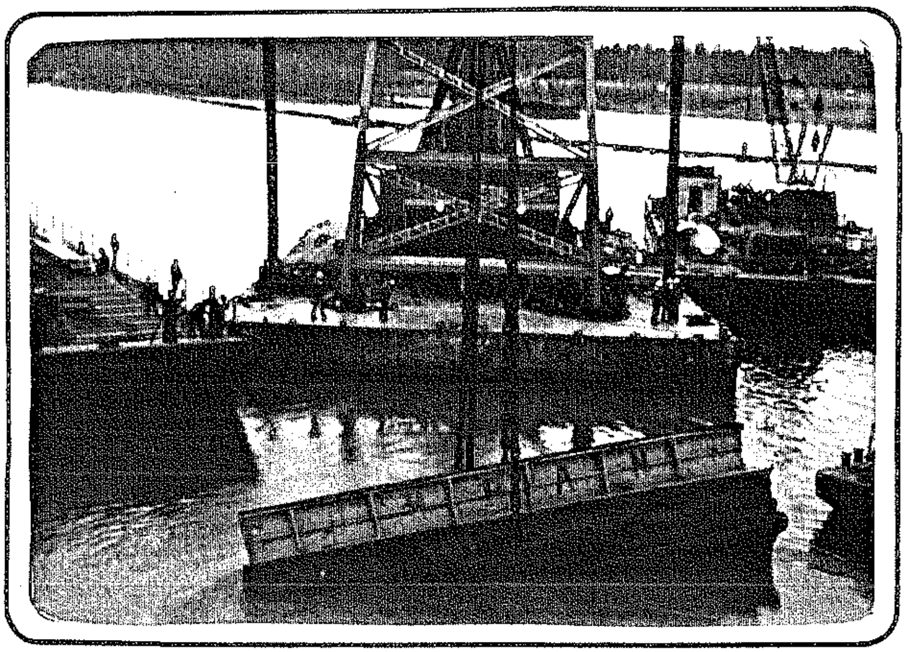

Figure 7.12.4: Removing Mid Section of PV 19B from Gate 12

DETAILS OF THE WRECK REMOVAL:

Monday 24 January

The SHORTY BAIRD, the Manitowoc crane barge and the Pull Barge were positioned upstream of pier 12. The Pull Barge had set four anchors upstream - two were secured to the anchor wires from the Amcon winches and two were secured to the padeyes on the stern of the Pull Barge. The two pulling wires from the Amcon winches were secured to kevels on the stern section of the PV 19B and were armed with incendiary cutters so that they could be released instantly should the chiseling upset the delicate balance of the PV 19B and cause it to move into or through the gate. Additionally, a chain was passed through holes that had been cut in the stern section and was then secured to the padeyes on the bow of the Pull Barge.

The cutting chisel was rigged to the light load hook of the Manitowoc crane and used to cut the partially separated stern section which extended into bay 11. The cut was made along the first bulkhead forward of the aft hopper bulkhead (see Figure 7.12.5 - "Chiseling Stern Section"). The chisel was not entirely successful in severing the stern section from the rest of the PV-19B. The pulling wire from the port winch was removed from the kevel and rigged to the chain end which had just been unshackled from the port padeye.

The Pull Barge retracted on its anchors, putting a strain on the port winch wire. This pulled the stern section upstream of the wreckage. It did not separate cleanly from the hull, but seemed to unwrap with members stringing out along the bottom before parting. The load was suspended from the bow of the Pull Barge and operations were secured for the day.

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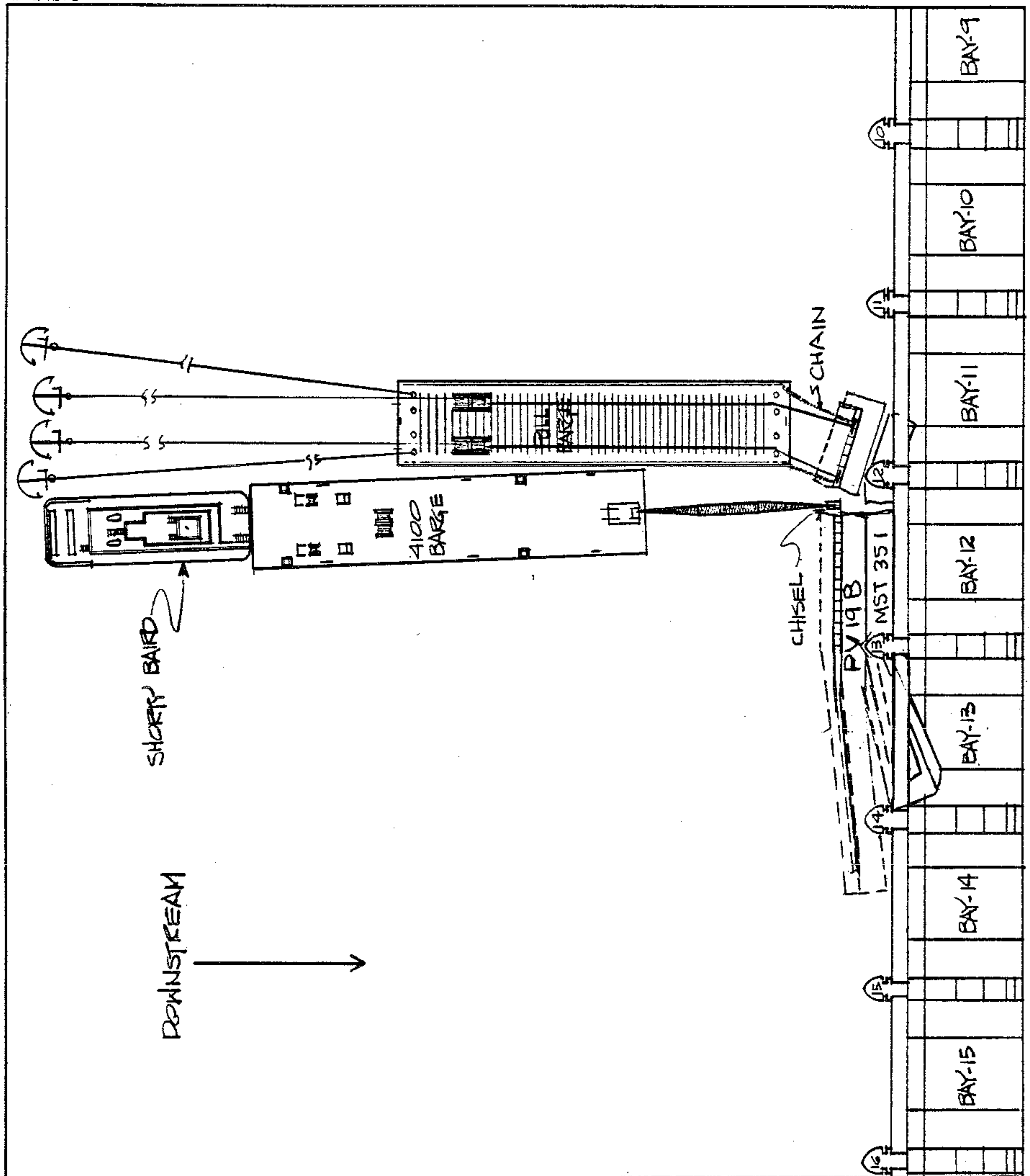

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33316

ARKANSAS RIVER PROJECT
PV 19B
CHISELING STERN SECTION 1-24-83

Drawn: LBL	Date: 1-28-83
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Sheet___of___	Rev.

Tuesday 25 January:

The SOUTHERN 6 derrick barge shifted to a position alongside the Pull Barge and the heavy hook was rigged onto the chain passed through the stern section of the PV 19B. An attempt was then made to lift the wreckage. However, the section had been so badly damaged that a portion of the port wing wall and some adjacent metal tore free from the rest of the wreckage. The debris was landed on a pair of partially loaded mat barges which were returned to the fleeting area. A buoy was attached to the portion of the stern section which had remained on the bottom to facilitate its location and removal at a later date.

Thursday 27 January

The Manitowoc crane barge moved into position alongside piers 10, 11 and 12 where the Manitowoc crane attempted to sweep chain under the midbody of both the MST 351 and the PV 19B. The sweeping effort was suspended at dark with the chain not yet swept under the barges to the satisfaction of the Salvage Master.

Saturday 29 January

Holes were burned through both wing walls of the PV 19B to allow the passing of chain slings. The exposed port side shell was cut just below the sheer strake and adjacent to the first kevel forward of the stern. A diver then cut holes along the hopper bottom in the port and starboard wing walls and a matching cut was made in the starboard side shell. A wire messenger was then passed through the port wing wall, a chain slung around the wing wall and the ends secured to a kevel on the PV 19B.

Sunday 30 January

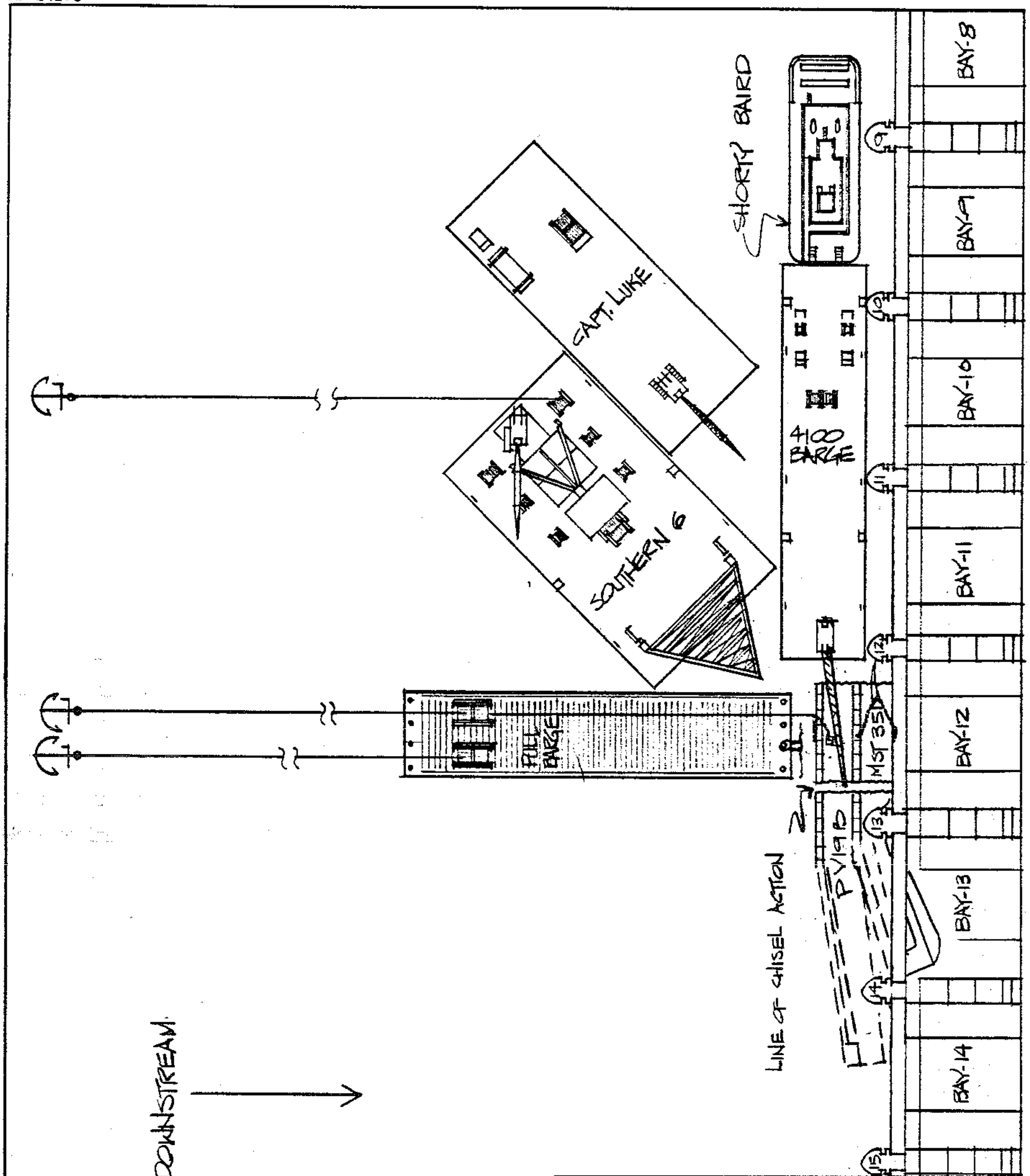
A diver passed a messenger line through holes cut in the starboard wing wall, a wire sling was run through the holes and a length of chain slung around the starboard wing wall. The two ends of the chain were temporarily shackled to the bow of the Pull Barge. A cut line was painted approximately eight feet to the left of pier 13.

Monday 31 January

Burners, using magnesium lances and torches, cut a 36 inch wide portion out of the exposed part of the port wing wall in way of the painted cut line. Following this, the chisel was employed and sliced through the barge progressing from the port wing wall toward the starboard side (see Figure 7.12.6 - "Chiseling Midbody"). After the chisel had cut as much as possible, its use was discontinued and the SOUTHERN 6 was brought into position to make a lift. The SOUTHERN 6 rigged onto both chain slings, took a strain and pulled until the midbody section pulled clear (see Figure 7.12.7 - "Removal of Midbody"). The Pull Barge, SOUTHERN 6 and CAPT. LUKE retracted about 300 feet upstream. The TYLER brought out two mat barges which received the wreckage and were then returned to the fleeting area.

Friday 4 February

At 0615, the Salvage Master was standing downstream of the dam on the right bank observing the downstream side of Gate 13 when he witnessed a sudden "wall of water" surging through gate 13. Upon inspection, it appeared that the side shell of the PV 19B had cracked, opened up and then disappeared from view. The SOUTHERN 6 positioned upstream of gate 13 and secured a wire pendant to a kevel. The kevel was visible on the remnant of the PV 19B wing wall which clung to the right side of pier 13 and was



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33316

ARKANSAS RIVER PROJECT
PV 193
CHISELING MIDBODY 1-31-83

Drawn: LBL	Date: 2-8-83
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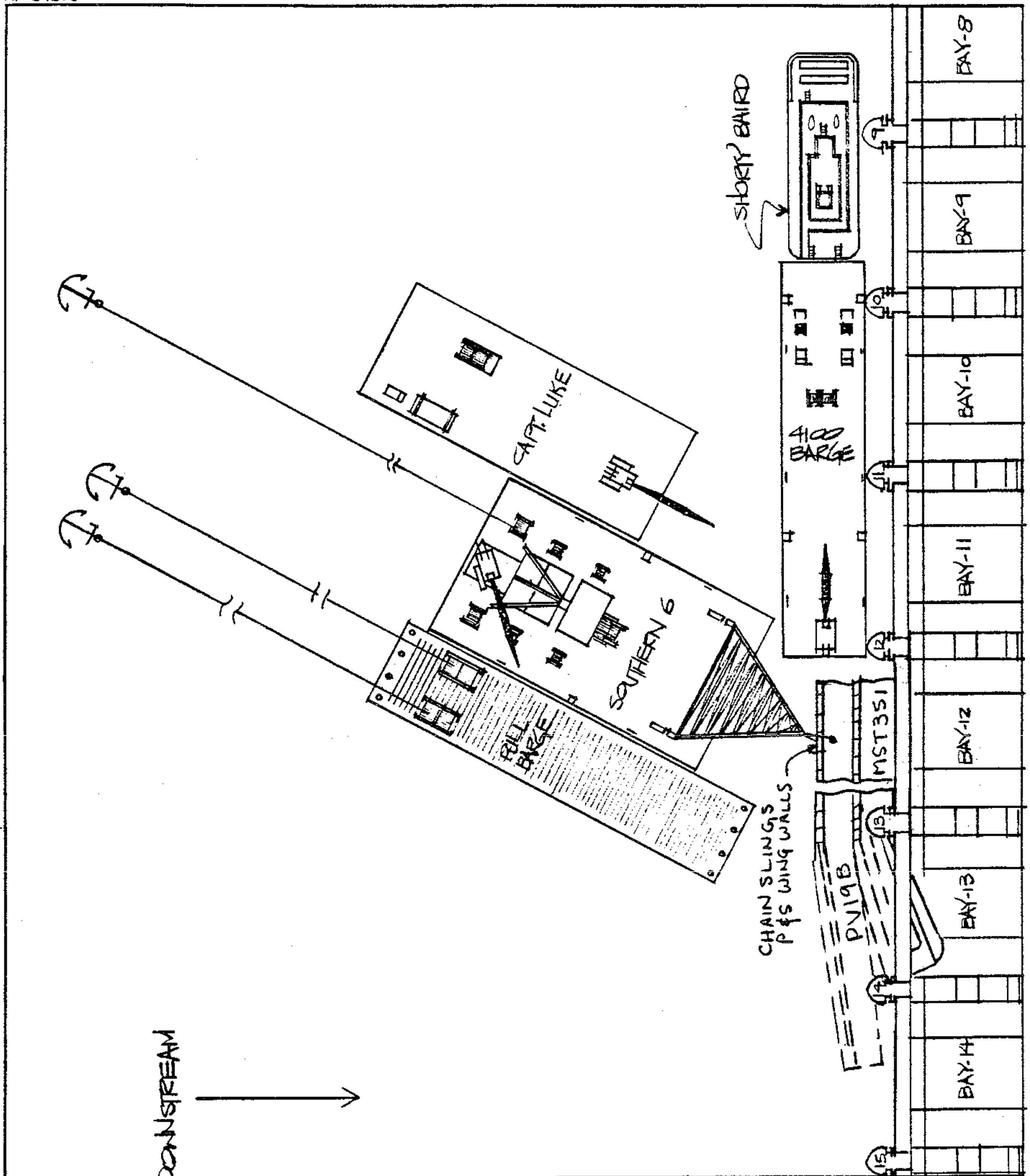
Approved:	Drawing Number:
Sheet ___ of ___	FIG. 7.12.6



REV.	DESCRIPTION	BY	DATE

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ARKANSAS RIVER PROJECT
PV 19B
REMOVAL OF MIDBODY 1-31-83

Drawn: LBL	Date: 2-3-83
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Approved:	Drawing Number: FIG. 7.12.7 / Rev.
Sheet ____ of ____	

trapped beneath gate 13. A small amount of wreckage was lifted clear of the water by the SOUTHERN 6 and loaded onto a mat barge which the TYLER transported back to the fleeting area.

The Manitowoc crane barge, SOUTHERN 6 and starboard Amcon winch on the Pull Barge were rigged to provide, respectively, a crown line, lifting line and pulling line for a drag anchor. The anchor was lowered into the water by pier 13, snagged the wreckage and lifted, bringing about 30 feet of starboard wing wall and its associated hopper bottom to the surface.

A kevel exposed during the lift was then used to further secure the wreckage by running a wire strap around it and up to the heavy lifting block of the SOUTHERN 6.

<u>Saturday 5 February</u>:

The LWT anchor used to snag the wreckage on the previous day was released, shifting the entire load to the SOUTHERN 6. Holes were burned in the starboard side shell and hopper wall just aft of the kevel. A chain sling was then passed through and attached to the light lift hook on the SOUTHERN 6. A lift of about 5 feet was then made. A second set of holes was burned in the starboard wing wall. This set was as far forward and as close to the waterline as possible.

The pendant and strap securing the heavy lift block to the kevel was slacked off and removed. It was then hooked to a chain sling which the CAPT. LUKE had previously rigged through the second set of holes in the starboard wing wall of PV 19B. The kevel on the wing wall was then secured to a padeye on the deck of the SOUTHERN 6 via a fixed pendant.

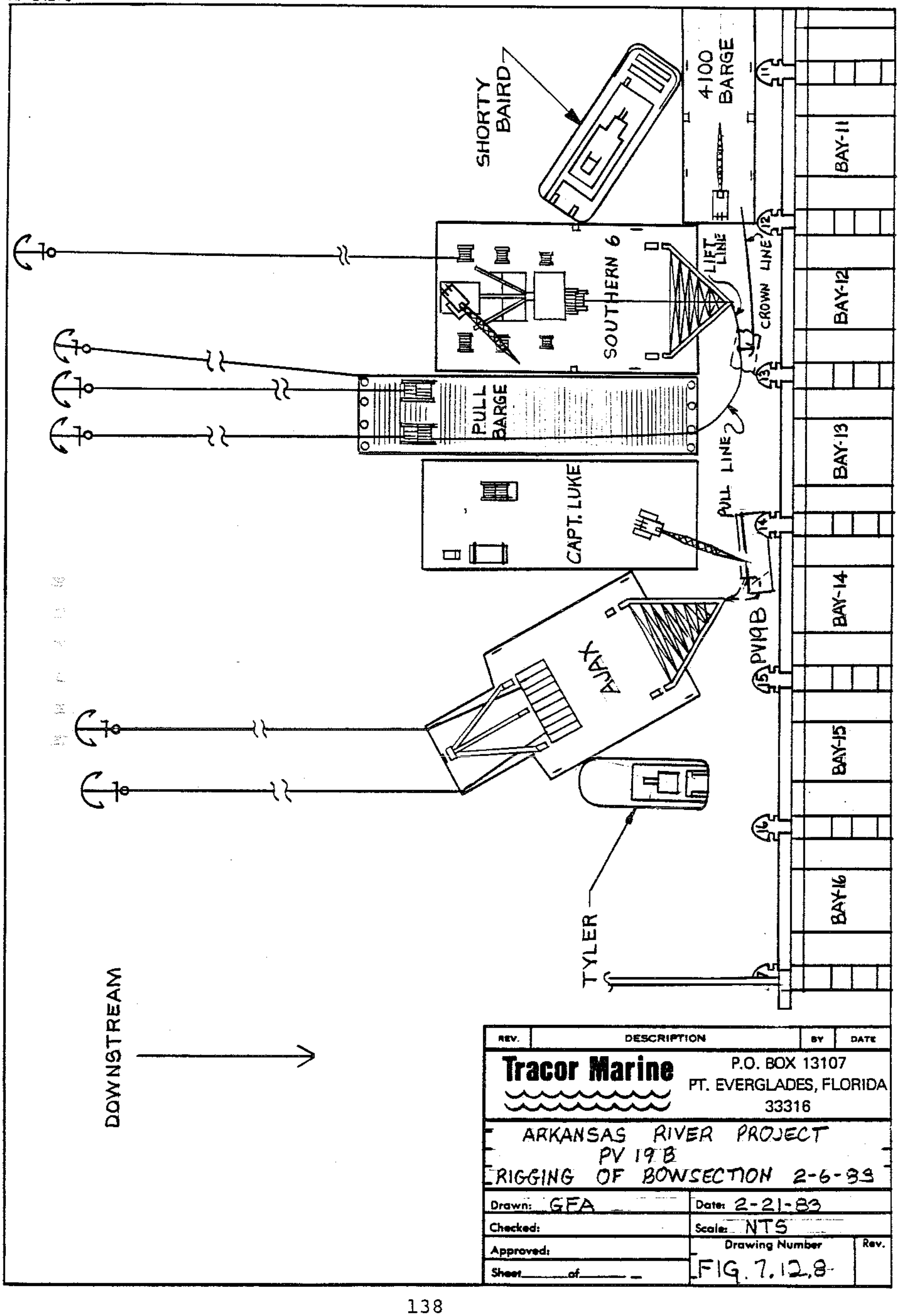
In an attempt to break the trapped section free, the SOUTHERN 6 simultaneously lifted and retracted. Forty feet of the starboard wing wall and its adjacent hopper bottom came to the surface. However, before the wreckage was freed, the wing wall and a small amount of hopper bottom tore loose. The tug TYLER brought out a mat barge upon which the wreckage of the PV 19B was landed. The mat barge was then shifted back to the fleeting area.

Sunday 6 February

The CAPT. LUKE moved into position upstream of pier 14. A diver was deployed and burned holes in the forward box end of PV 19B. The holes pierced both the hopper wall and the bow plating and were offset by one longitudinal truss. It was necessary for the diver to position himself inside the bow wall to complete the cuts. The diver then rigged a messenger and a chain sling was passed through the holes using the crane aboard the CAPT. LUKE.

The TYLER shifted the AJAX to starboard of the CAPT. LUKE where the chain slings were shackled to the lift blocks of the AJAX (see Figure 7.12.8 - "Rigging of Bow Section").

The AJAX lifted the bow section of the PV 19B until the wreck was a few feet above the water line. The section rotated to an even keel position. The result of the lift was that the bow section had pulled away from pier 14 and the starboard wing wall was exposed for about 40 feet. The forward 25 feet of the port wing wall was exposed with an additional ten feet of the wing wall visible within the hopper.


SHORTY BAIRD
4-100 BARGE
BAY-11
BAY-12
BAY-13
BAY-14
BAY-15
BAY-16
LIFT LINE
CROWN LINE
SOUTHERN 6
PULL BARGE
PULL LINE
CAPT. LUKE
PV19B
AJAX
TYLER
DOWNSTREAM
REV.
DESCRIPTION
BY
DATE
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ARKANSAS RIVER PROJECT
PV 19 B
RIGGING OF BOWSECTION 2-6-83
Drawn: GFA
Date: 2-21-83
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Scale: NTS
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Drawing Number
Rev.
Sheet ___ of ___
FIG. 7.12.8

Monday 7 February

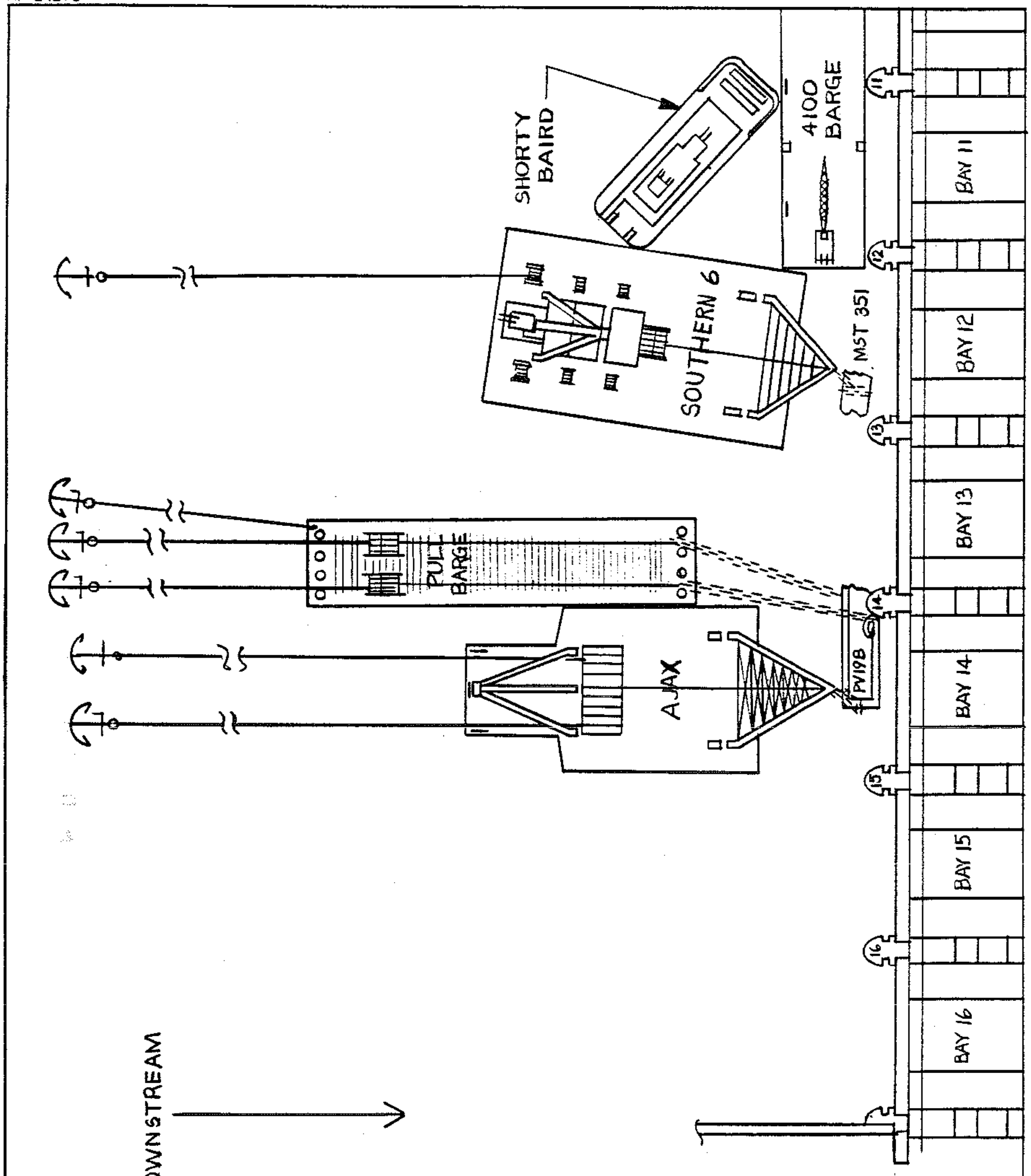
All salvage platforms positioned as on the previous day. The crane on the CAPT. LUKE passed a messenger wire and worked a chain sling around the bow section of the PV 19B. The sling was rigged around the bow section just to the right of pier 14 and the ends were shackled on to the hauling wires from the Amcon winches.

The TYLER then backed the CAPT. LUKE upstream clear of the flotilla and returned her to her berth. The AJAX and the Pull Barge shifted position so as to have a perpendicular pull on the wreckage (see Figure 7.12.9 - "Removal of Bow Section").

The chain sling settled into the notch in the wreckage at pier 14. The Pull Barge retracted about 20 feet, pulling the bow section of the PV 19B with it. The section had rotated and been pulled upstream but no movement was noticed in the portion of the barge trapped under gate 13. After the SOUTHERN 6 rigged the wreckage from the MST 351, the Pull Barge and the AJAX retracted 200 feet upstream with the bow section partially submerged.

The TYLER brought the CAPT. LUKE alongside the AJAX. The CAPT. LUKE rigged a man basket from which a burner cut an additional set of holes through the wing wall of the bow section. A chain sling was led through the holes and secured to the block of the SOUTHERN 6.

The TYLER took the CAPT. LUKE back to the berthing area and brought a mat barge out in preparation for the loading of the bow section.



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ARKANSAS RIVER PROJECT
PV 19 B
REMOVAL OF BOW SECTION 2-7-83

Drawn: GFA	Date: 2/22/83
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Approved:	Drawing Number: FIG. 7.12.9 — Rev.
Sheet ___ of ___	

With some difficulty, the chain from the port Amcon winch on the Pull Barge was freed from the starboard wing wall. The bow section was then landed on the foredeck of the mat barge. However, 30 feet of the starboard wing wall hung off the barge and remained submerged. The wing wall was then hooked by the SOUTHERN 6 and burned free of the wreckage.

The TYLER returned the mat barge to the fleeting area. The AJAX, SOUTHERN 6 and Pull Barge remained upstream for the night with the wing wall suspended from the hook of the SOUTHERN-6.

When all equipment was secured, arrangements were made with the Corps of Engineers to open gate 13 in an attempt to flush the remaining wreckage. Gates 12 and 14 were opened 5 feet and gate 13 was raised from the 9 foot mark to the 17 foot mark. As the gate opened, the flow increased and wreckage began to tumble through the gate. Two large pieces were spotted as they briefly surfaced on the downstream side of the dam, but were not identifiable. After several minutes at the 17 foot mark, no further movement of wreckage was seen or heard and the gate was closed.

<u>Tuesday 8 February</u>

The TYLER brought out a mat barge and the SOUTHERN 6 landed the suspended portion of the starboard wing wall. After returning the mat barge to the fleeting area, the TYLER shifted the CAPT. LUKE from the mooring area to a position alongside the SOUTHERN 6.

A diver was deployed and located the stern section of the PV 19B which had been pulled free of gate 11 on 25 January. The SOUTHERN 6 was successful in encircling the wreckage with a wire rope and brought it to the surface.

The current upstream of the dam was too strong for the wreckage to be landed in the SOUTHERN 6's mid-channel position. Therefore, the SOUTHERN 6 recovered its anchors and with assistance from the TYLER moved toward the fleeting area with the hooked wreckage only partly above water. After moving into calm water, the section of the PV 19B was landed on a mat barge.

A side scan survey was performed and no wreckage was found upstream of the dam.

7.13 REMOVAL OF BARGE MST 351

DATE: 25 January - 8 February 1983

EQUIPMENT USED:

SOUTHERN 6
Pull Barge
Manitowoc 4100 crane barge
SHORTY BAIRD
TYLER
Two 40 foot I-Beam Cutting Chisels
Two mat barges

WRECK SURVEY:

The MST 351 was lying on its starboard beams end, parallel to the axis of the dam, with the bow toward the right bank. The MST 351 spanned gate 12 with an 80 foot section extending into gate 13 and a 20 foot section protruding into gate 11. A portion of the stern rake was missing. The stern and the midbody had been badly impaled on piers 12 and 13, respectively. The barge had been damaged by the static head and dynamic forces which were transmitted through the PV 19B which lay parallel to and upstream of the MST 351.

The bow section of the MST 351 had lodged in bay 13 at approximately a 30 degree angle to the dam axis and prevented the closure of gate 13. Additionally, the rake section had rotated in bay 13 until it was nearly in a horizontal position, with the bottom resting on the concrete sill.

Gate 12 was operable, but the wreckage upstream of it restricted the water flow through bay 12. Gate 13 was prevented from closing by the MST 351 and the PV 19B effectively blocked the flow of water.

SALVAGE PLAN:

The initial salvage plan and subsequent revision for the removal of MST 351 and PV 19B are addressed as one unit in Section 7.12.

SUMMARY OF THE WRECK REMOVAL:

The 40 foot I-beam chisel was employed to the right of pier 12 to cut the stern section free and clear gate 11. After the cutting was completed, the Pull Barge retracted, unwrapping the stern section which still clung to the main body of the wreckage. Later, small pieces of this peeled section were recovered.

After cutting through the hull to the left of pier 13 with the chisel, the midbody of the MST 351 was lifted by the SOUTHERN 6 with two chain slings. The section was removed to the fleeting area on a mat barge (see Figure 7.13.1).

The chisel was used on the forward section to cut a line between piers 13 and 14 just clear of the upstream side of the bridge deck. It was also used on the downstream side of the bridge deck to weaken the forward rake. The burning bar lance

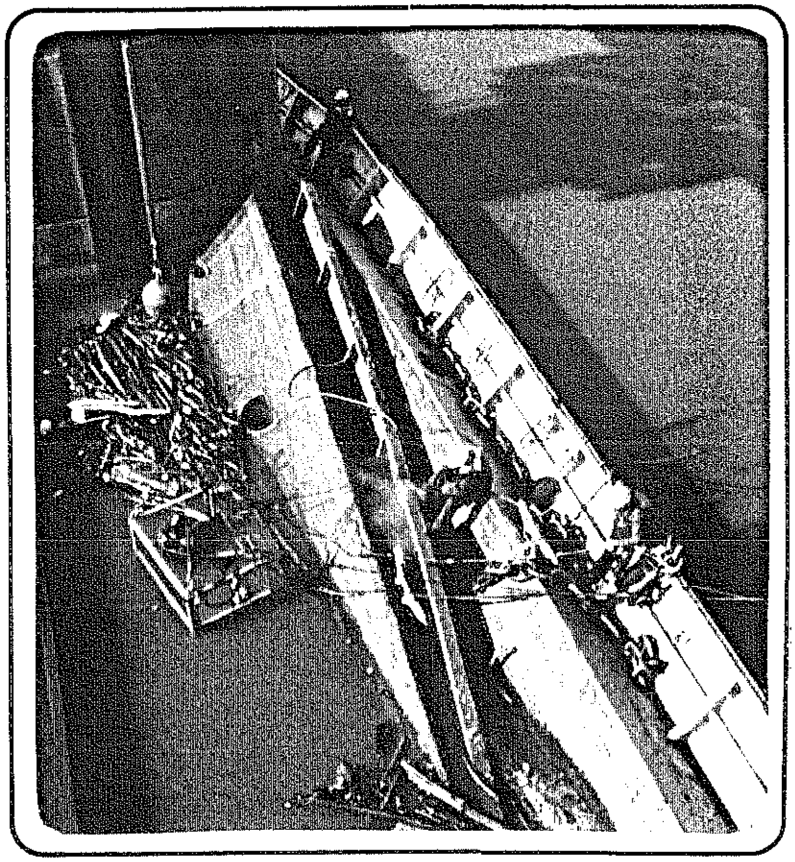


Figure 7.13.1: Diver Deployed in Man Basket to Burn Chain Holes in MST 351

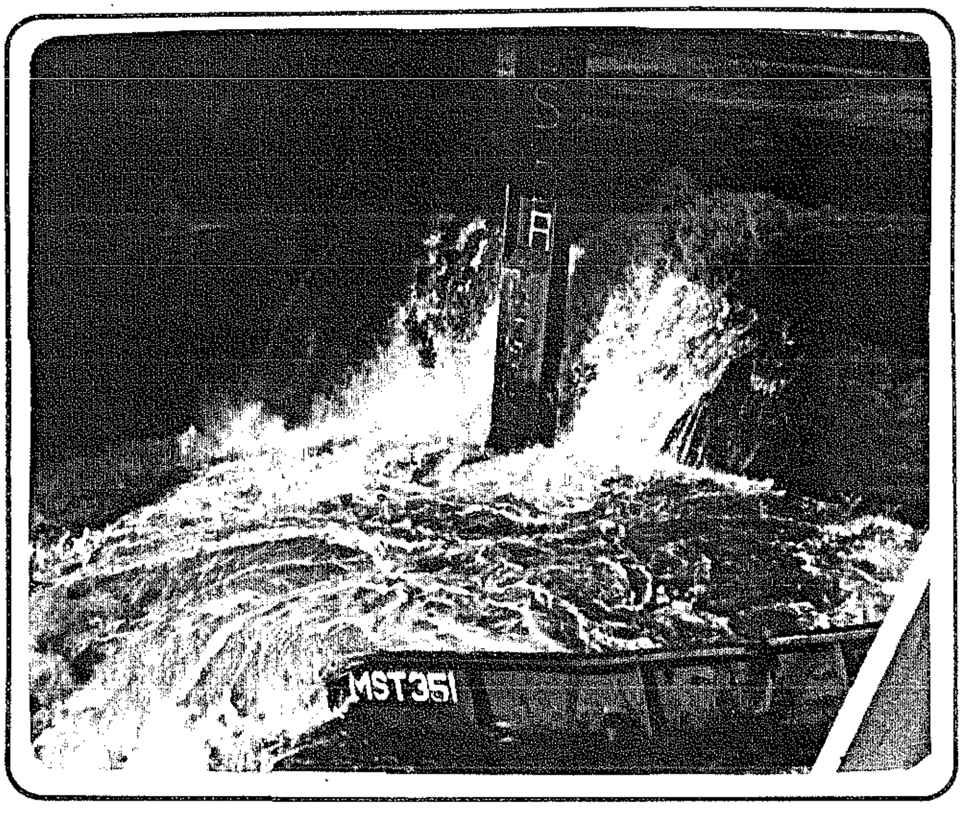


Figure 7.13.2: Chiseling Across Gate 13 to Free Bow of MST 351

was also used on the downstream side to weaken the port wing wall (see Figures 7.13.2, 7.13.3 and 7.13.4). Before the section could be isolated and recovered or washed downstream, the failure of the hull of PV 19B caused much of the port side of the PV 19B to lay over on the MST 351.

Subsequent operations were then directed to recover as much of PV 19B as practical , including dragging an anchor to hook submerged pieces. When it was deemed impractical to spend time recovering pieces of wreckage, all submerged, the decision was made to open gate 13 and flush the remaining wreckage through the gate. This was done successfully with confirmation from the side scan sonar survey that no further wreckage was present upstream of the dam.

DETAILS OF THE WRECK REMOVAL:

Tuesday 25 January

The Pull Barge was positioned with its bow to pier 12 and the SHORTY BAIRD brought the Manitowoc crane barge along the port side of the Pull Barge. With the light hook, the crane maneuvered a length of chain around the stern section extending to the left of pier 12. One end of the chain was secured by a plate shackle to the end of a hauling wire from the port Amcon winch. The other end was similarly secured to the hauling wire from the starboard Amcon winch (see Figure 7.13.5 - "Rigging Stern Section with Chain").

The crane took charge of the 40 foot I-beam cutting chisel and started to cut the hull of the MST 351 at a point about 10 feet to the right of pier 12. The cut was started at

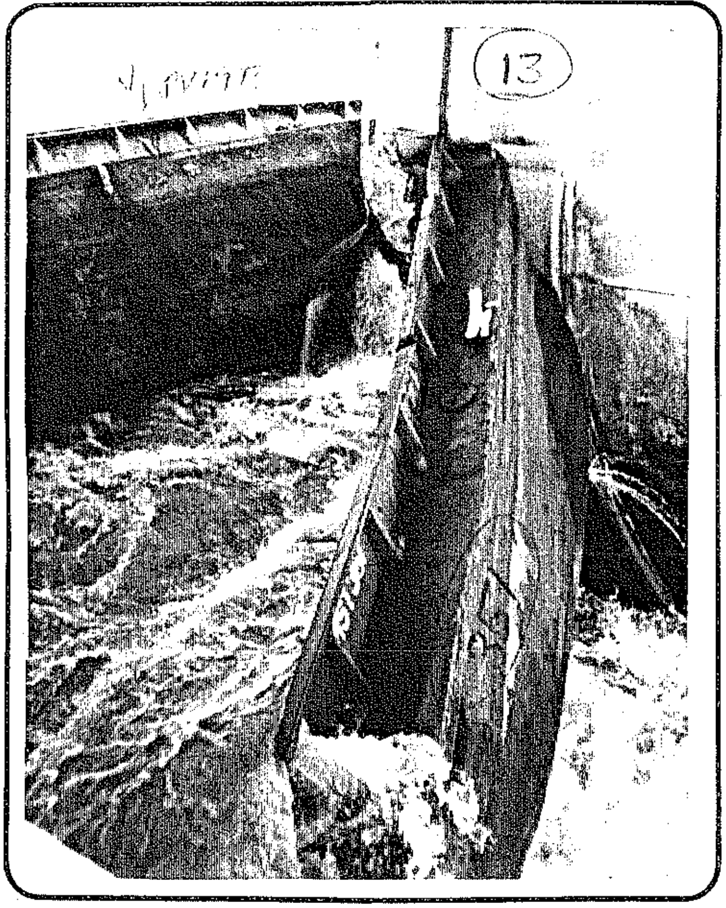


Figure 7.13.3: Barges PV 19B and MST 351 Wedged in Bay 13

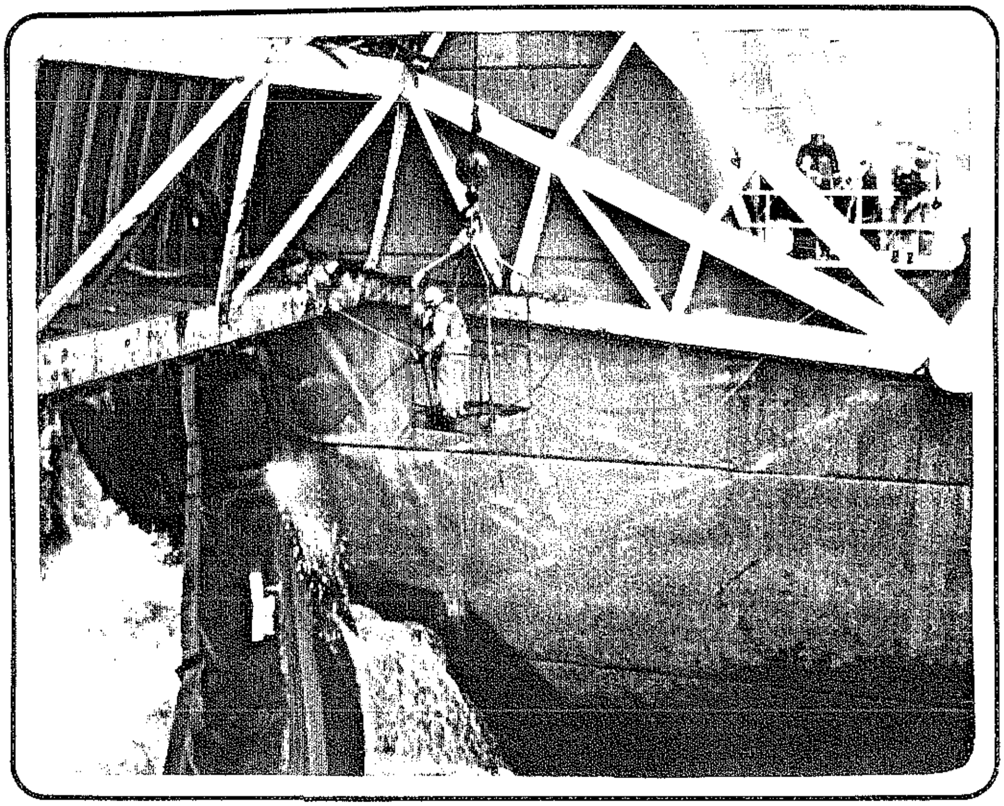
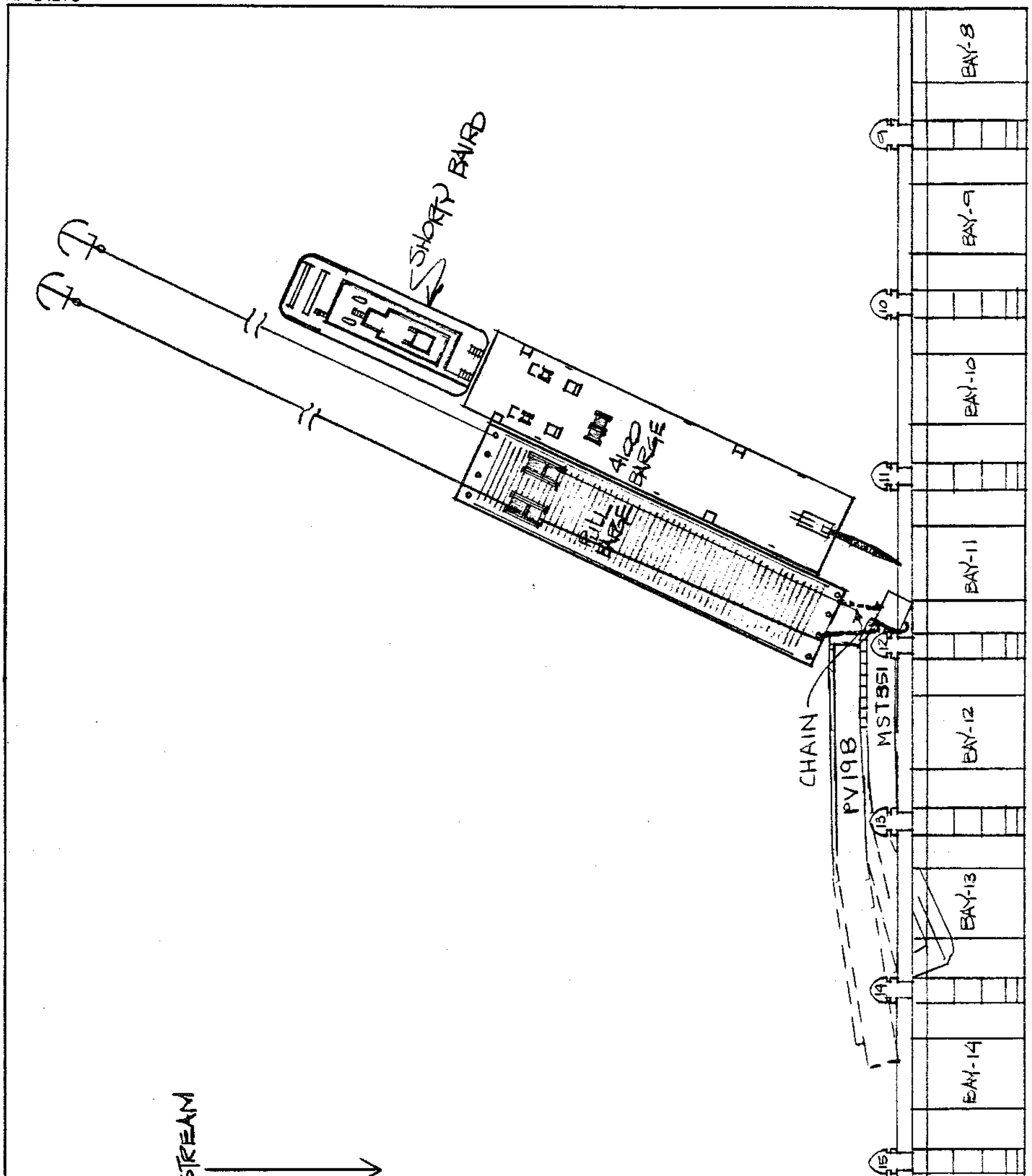


Figure 7.13.4: Cutting MST 351 Using Magnesium Burning Lance



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ARKANSAS RIVER PROJECT
MST 351
RIGGING STERN SECTION w/CHAIN 1-25

Drawn: LBL	Date: 2-7-83
Checked:	Scale: NTS
Approved:	Drawing Number: FIG. 7.13.5 — Rev.
Sheet____ of ____	

the juncture of the side shell and deck plating by allowing the chisel to free fall from a height of a few feet. This work continued for about three hours until operations were secured at dusk. A significant cut had been made through the hull with progress only slightly impeded by the chisel lodging in the wreckage.

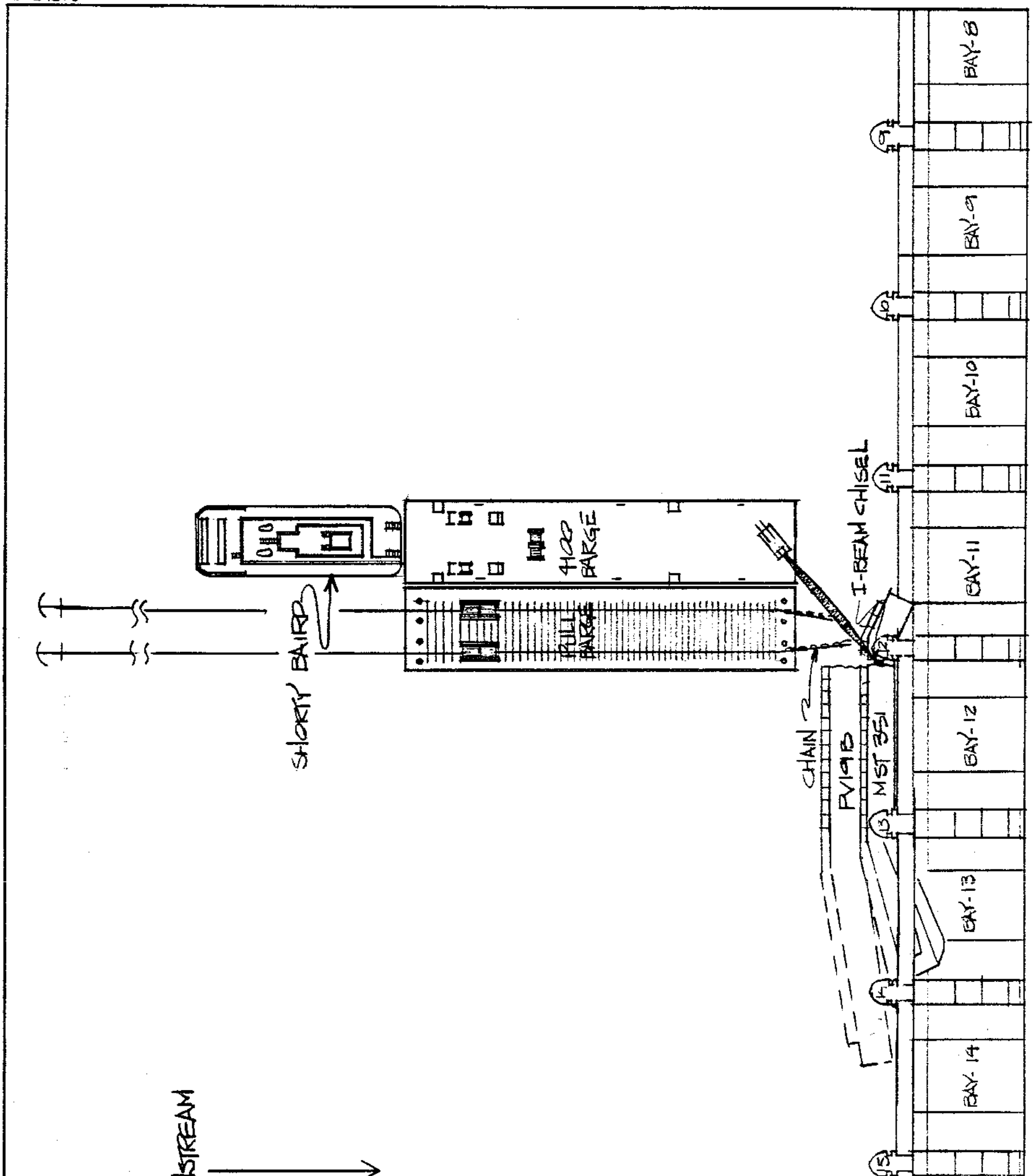
Wednesday 26 January

The cutting chisel used the previous day was removed to the deck of the Pull Barge for welding repairs. A second cutting chisel fabricated from a 40 foot length of WF 36 x 300 steel was secured to the whip on the Manitowoc crane and cutting continued on the MST 351 (see Figure 7.13.6 - "Cutting Stern Rake"). The Pull Barge took a light strain on the chain around the wreckage of the MST 351 to the left of pier 12. Some movement of PV 19B was observed, indicating that the aft section of the MST 351 had not been entirely cut free.

The Pull Barge took another strain on the chain slung around the section of MST 351 and the chain tore loose. An effort was made to wrap the chain around the wreckage still attached in the vicinity of pier 12. Several attempts to encircle the torn section of MST 351 at the chisel cut were unsuccessful (see Figure 7.13.7 - "Sweeping Chain").

Thursday 27 January

The inability to encircle the midbody and begin its removal resulted in the redirecting of the salvage efforts back to the stern section of MST 351, still within bay 11. A chain was led around the torn and chiseled stern section of the MST 351 with one end secured to the port padeye on the Pull Barge and the other end shackled to the starboard pulling wire. The section



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ARKANSAS RIVER PROJECT
MST 351
CUTTING STERN RAKE 1-25,26-83

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Sheet ___ of ___	Rev.

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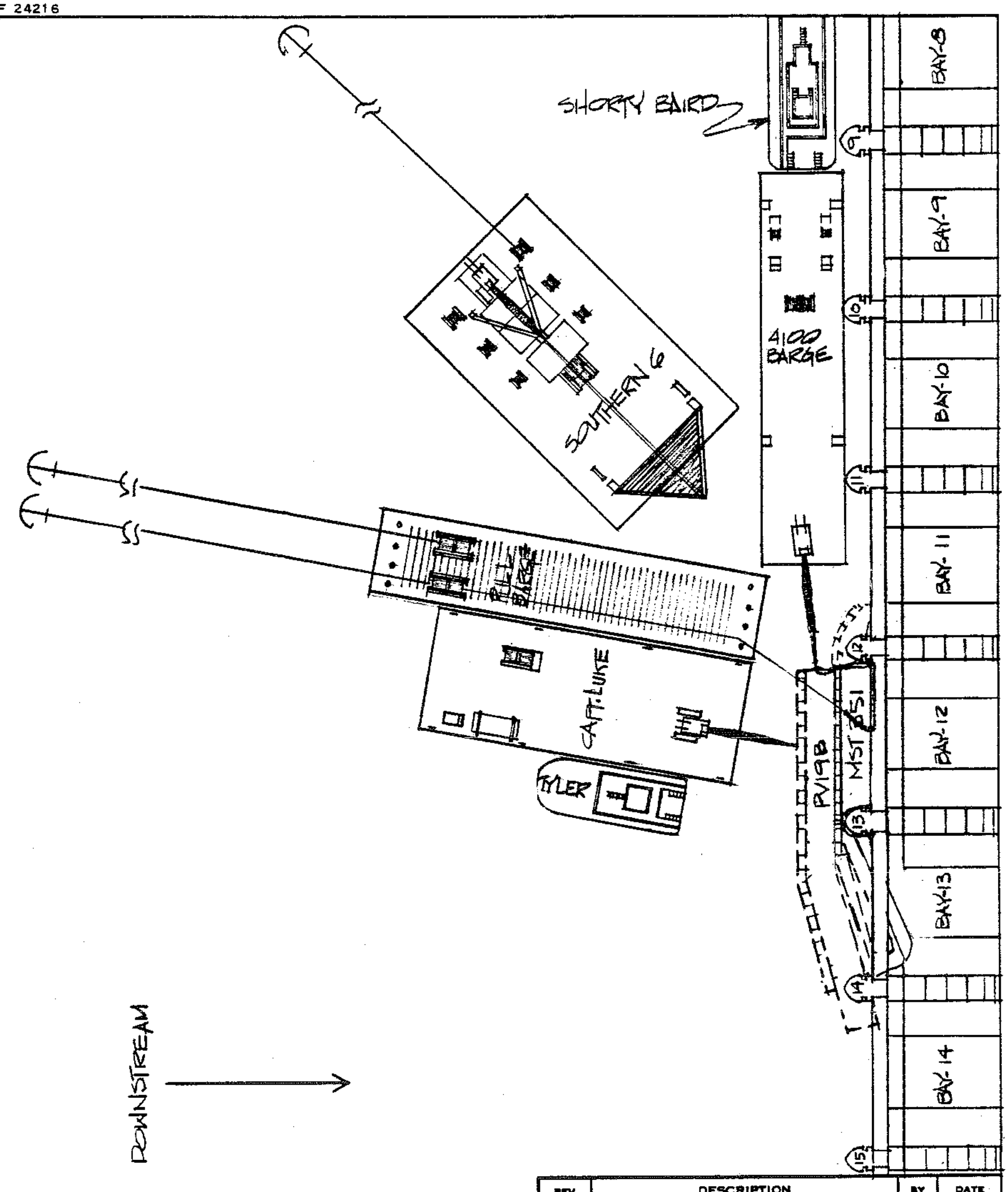

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Tracor Marine P.O. BOX 13107 PT. EVERGLADES, FLORIDA 33316

ARKANSAS RIVER PROJECT
MST 351
SWEEPING CHAIN 1-26-83

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Approved:	Drawing Number: FIG 7.13.7 Rev.
Sheet ___ of ___	

was pulled upstream by the Pull Barge. However, rather than tearing free, it seemed to unwrap with members remaining attached to the main portion of the barge. No wreckage was recovered at this time.

The Manitowoc crane barge moved into position alongside piers 10, 11 and 12. Using the chain end previously shackled to the padeye on the Pull Barge, the Manitowoc, once again, attempted to sweep the chain under the midbodies of both the MST 351 and the PV 19B. The chain was manipulated by heaving in on the starboard Amcon winch. The chain was prevented from slipping to the left by shackling a tail block to a kevel on MST 351 near pier 13. The sweeping effort was suspended at dark with the chain still not in proper position under the MST 351 and PV 19B.

Friday 28 January

Divers inspected the wreckage at the left end of MST 351 and cut free entangling members. A sling was rigged on a 10' x 20' piece of wreckage upstream of the MST 351. The Manitowoc crane brought it to the surface and landed the wreckage on a mat barge brought to the scene by the TYLER. Divers then secured a lifting strap around a second piece of wreckage. The Manitowoc brought the section to the surface where it was identified as a portion of the aft rake of the MST 351. Its mangled condition necessitated returning it to the bottom for rerigging as it was in danger of tearing free of the lifting strap.

Saturday 29 January

The wreckage brought to the surface the previous day was raised by the Manitowoc, rerigged and landed on a mat barge.

Sunday 30 January

A diver was lowered in a man basket to burn a hole in the port side shell in bay 12. Two additional holes were burned above the water line, one in the deck plating outboard of the coaming and the other in the side shell below the sheer strake. A messenger line was passed and a chain slung around the port wing wall through the hole in the deck and the hole underwater. The ends of the chain were stopped off and temporarily secured to a kevel on the MST 351. A cut line was painted approximately 8 feet to the left of pier 13.

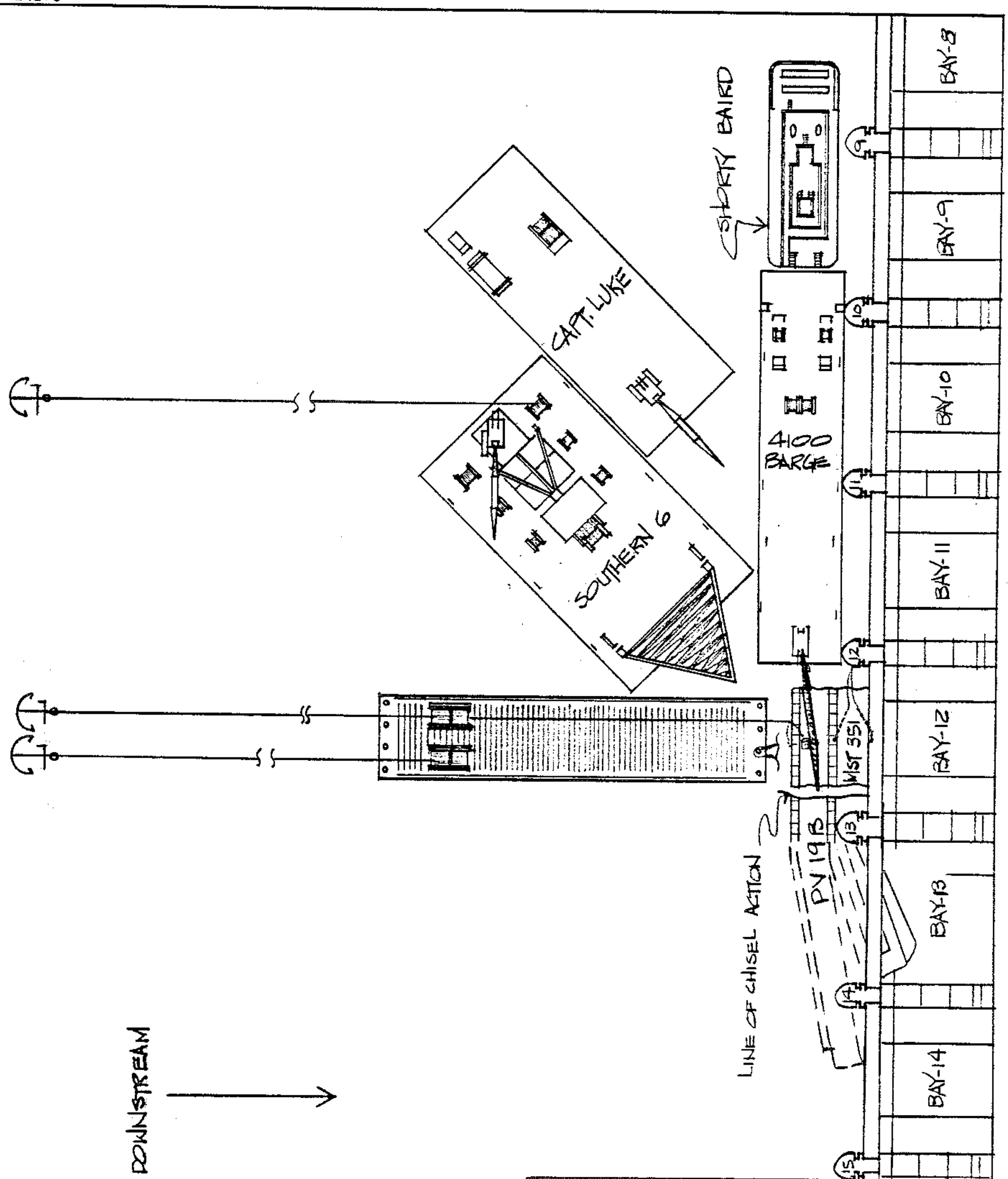
Monday 31 January

A burning lance and torch cut a 36 inch wide slice from the exposed portion of the port wing wall. The chisel was rigged onto the Manitowoc light hook and cutting operations commenced, progressing from the port wing wall toward the starboard side (see Figure 7.13.8 - "Chiseling Midbody").

Tuesday 1 February

The Pull Barge and SOUTHERN 6 took up station head on to pier 12. The heavy lifting block of the SOUTHERN 6 was rigged to the chain sling that had been passed through the port wing wall of the MST 351. The SOUTHERN 6 then hoisted the midbody far enough out of the water to allow burners, suspended in a man basket from the Manitowoc, to cut an additional set of holes in the port wing wall. A chain sling was rigged and attached to the light lift block of the SOUTHERN 6. The wreckage was lifted so that half of it remained submerged (see Figure 7.13.9 - "Removal of Midbody").

The Pull Barge and the SOUTHERN 6 retracted on their anchors 300 feet upstream. The SOUTHERN 6 landed the wreckage on two partially loaded mat barges brought alongside by the TYLER.



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ARKANSAS RIVER PROJECT
MST351
CHISELING MIDBODY 1-31-93

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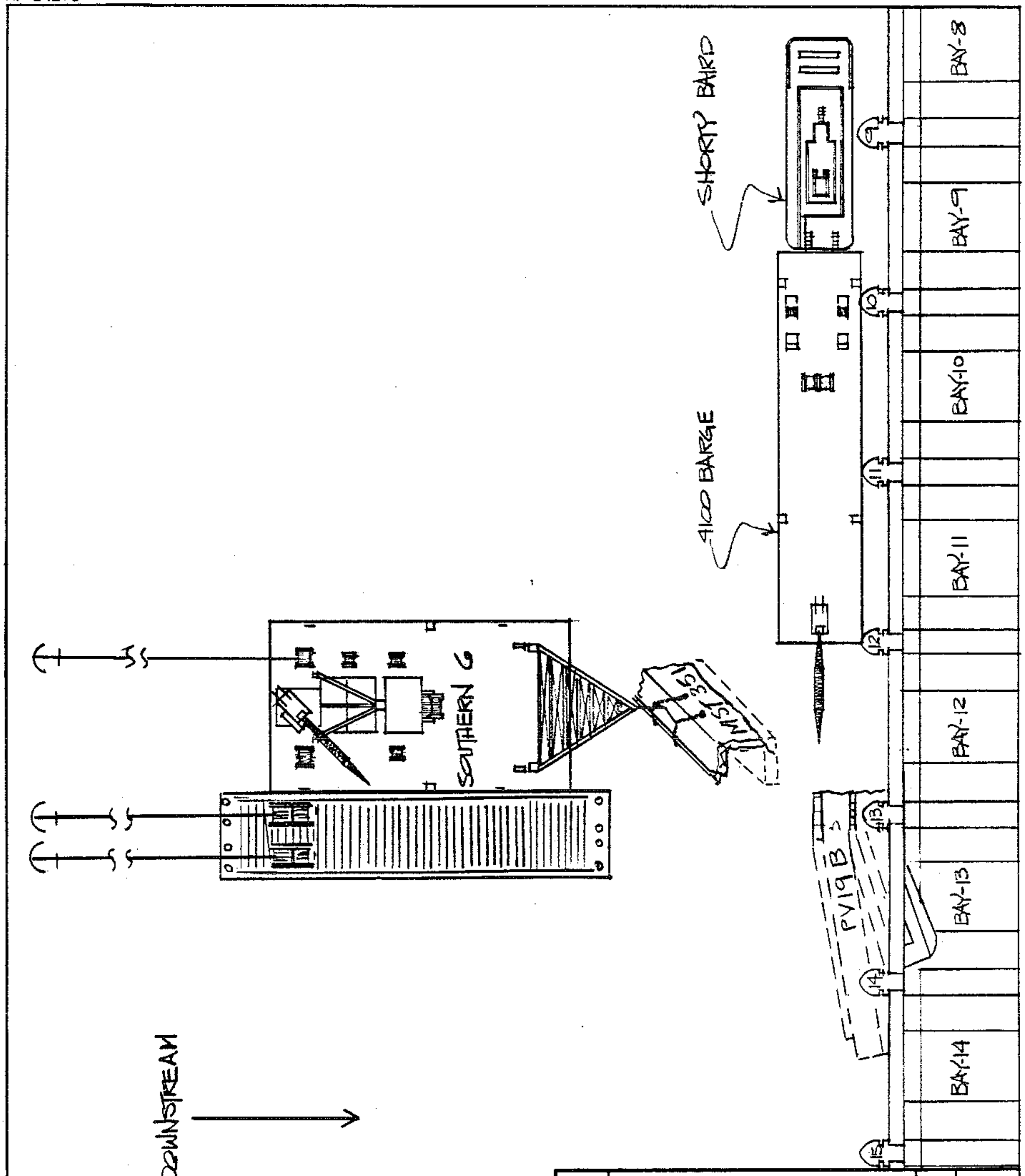

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ARKANSAS RIVER PROJECT
MST 351
REMOVAL OF MIDBODY 2-1-83

Drawn: LBL	Date: 2-7-83
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Approved:	Drawing Number: FIG. 7.13.9 — Rev.:
Sheet___ of ___	

The salvage team recognized that the removal of MST 351 from bay 13 would be extremely hazardous due to the sheer forces imposed by a thirty foot head differential between the headwater and the tailwater on the wreckage spanning the gate. A token attempt was made to dislodge MST 351 by lowering gate 13 on the coaming of the wreck. No discernable movement was detected.

The next step in the deliberately conceived plan was to attempt to weaken the longitudinal axis of the MST 351 by burning through the portion of the coaming, main deck and port wing wall that were visible just downstream of the bay 13 sill. Burners were lowered over the dam in a man basket and burning commenced with magnesium rods. This operation was considered extremely hazardous, but absolutely necessary if there was to be any chance of dislodging the wreckage.

While in position, the salvors in the man basket rigged a 3/4" pendant over a kevel that was visible and accessible on the port bow rake of the wreck. The other end of the pendant was stopped off with small stuff to pier 13.

<u>Wednesday 2 February</u>

Burners continued cutting the MST 351 throughout the day. A section about one foot wide was cut out of the wing wall about eight feet from pier 13. The wreckage hung up on pier 13 shifted slightly, but the rake of the MST 351 remained stationary. Once again, the gate was lowered on the wreckage, but still with no effect.

Thursday 3 February

All salvage platforms positioned as they were the day before. The Manitowoc crane barge was rigged with the chisel and began cutting upstream of gate 13. The cut was made from pier 13 to pier 14 along the stop log slot. The chisel was then moved to the downstream side of gate 13 where a portion of the port wing wall was cut (see Figure 7.13.10 - "Chiseling Bow Section").

Friday 4 February

At 0615, the Salvage Master was standing downstream of the dam on the right bank observing the downstream side of gate 13 when he witnessed a sudden "wall of water" surging through gate 13. Upon inspection, it appeared that the side shell of the PV 19B had cracked, opened up and then disappeared from view. This resulted in some change in the position of the MST 351, but it was impossible to determine exactly where the remnants lay. A small section of the port wing wall was visible on the downstream side of gate 13 alongside pier 13. Another small section was visible in gate 12 along the left side of pier 13.

The chisel was rigged and cut on the section of MST 351 which protruded into gate 12 until it disappeared from view. Gate 12 was opened but no wreckage slipped through. The SOUTHERN 6 and Pull Barge moved into position just upstream of gate 13. The SOUTHERN 6 boomed over the dam and lowered its hook downstream of gate 13 and attempted to lift the wreckage of the MST 351 with the 3/4" pendant previously attached. However, upon taking a strain, the pendant parted without causing any movement of the wreckage.

Sunday 6 February

The Manitowoc crane, SOUTHERN 6 and starboard Amcon winch were rigged to provide, respectively, a crown line, lifting

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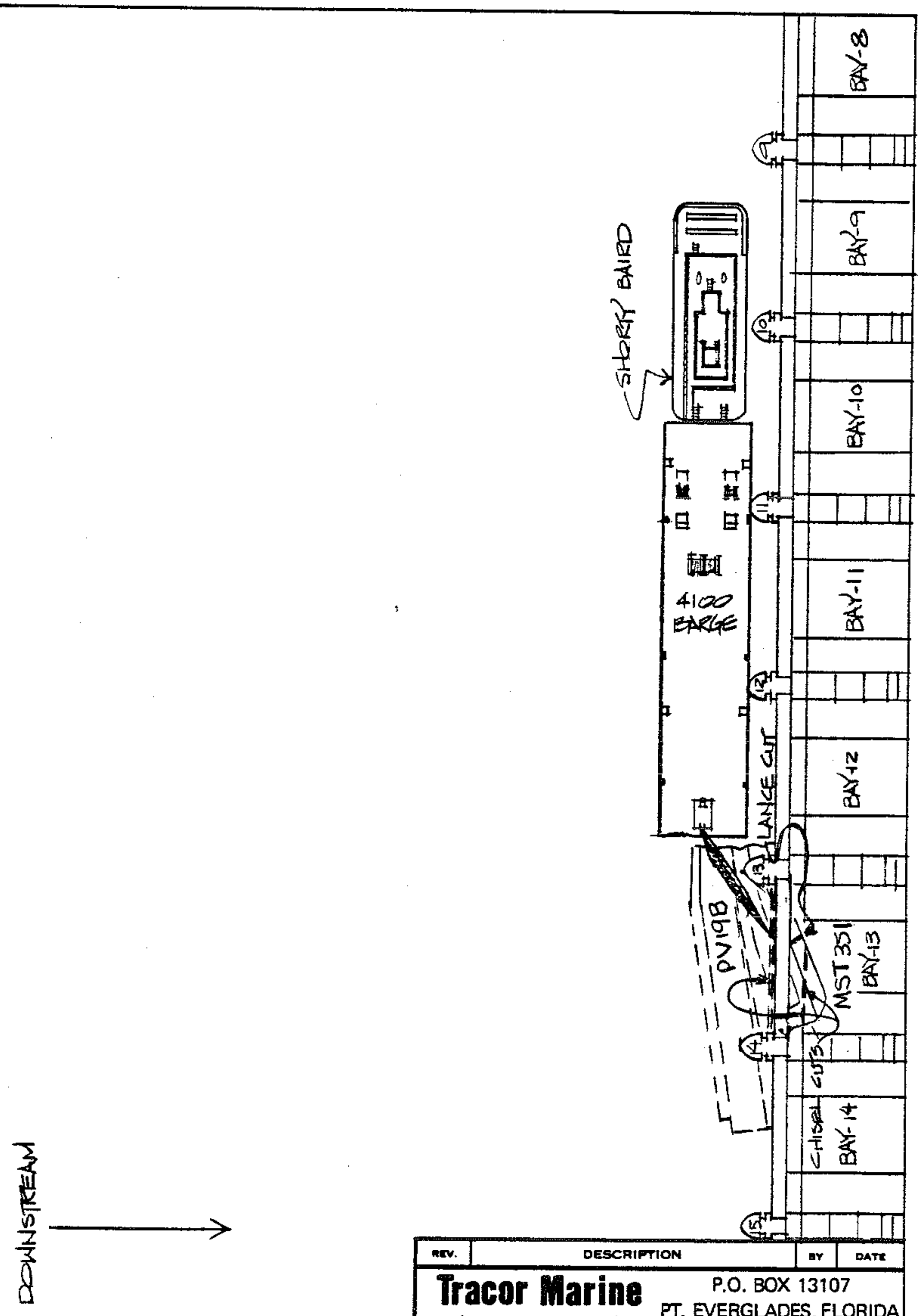

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ARKANSAS RIVER PROJECT
MST 351
CHISELING BOW SECTION 2-3-83

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Sheet ____ of ____	

line and pulling line for a 6000 pound LWT anchor. The anchor was deployed to the left of pier 13, where after being dragged a few feet, it snagged the wreckage of the midbody of the MST 351. Attempts were made to recover this piece by burning holes and then rigging slings to the exposed plating. At day's end, one small piece had been recovered and the remainder was secured to a sling from the Manitowoc.

> Note: It must be remembered by the reader that removal of the PV 19B and MST 351 were conducted as one salvage operation while they are addressed separately in the text of this report. Therefore, it should be noted that a considerable amount of wreckage from PV 19B was being removed concurrently during the 6th and 7th of February. All of this led to the decision to open gate 13 the evening of 7 February.

By 2000 in the evening, it was considered that the only wreckage remaining in the area of gate 13 was two sections of the port wing wall of PV 19B, part of the hopper bottom from PV 19B and the bow rake of the MST 351, which was in the gate. With the exception of a piece of the MST 351, none of this wreckage was visible. It was further believed that the advantages to be gained by the possibility of flushing all the remaining wreckage through and clear of the gate justified the risk that some or all of the wreckage would further block the gate.

<u>Monday 7 February</u>

Late in the evening, arrangements were made with the Corps of Engineers to open gate 13 in an attempt to flush the remaining wreckage. All equipment was secured upstream and gates 12 and 14 were opened 5 feet. Gate 13 was raised from the 9 foot mark to the 17 foot mark. As the gate opened, the flow increased and wreckage began to tumble through the gate. With the flow and turbulence of the cascading water, it was impossible to identify specific pieces of wreckage, even when standing on the bridgeway immediately above the spillway, however, two large pieces were spotted as they briefly surfaced on the downstream side of the dam. After several minutes at the 17 foot mark, no further movement of wreckage was seen or heard and the gate was closed. The closure of the gate signified that the decision to open the gate fully had been a good one.

Tuesday 8 February

Results of the side scan sonar survey indicated that no further wreckage was present on the upstream side of the dam.

8.0 OBSERVATIONS

8.1 Overview

The Arkansas River project was unique in many respects. SUPSALV has always maintained a contractual relationship with one or more salvors in the private sector, but these contracts have varied in form. It is also interesting to note, that in this case of instant effort, the customer was the U.S. Army Corps of Engineers using public funds. With such funding, the Corps of Engineers was prohibited from transferring money to the U.S. Navy but rather was required to reimburse the contractor directly, even though the contract was a U.S. Navy contract.

This entire method of doing business, coupled with the "heat of battle" atmosphere prevalent in any salvage effort, could have spawned many problems. However, it was the decision of SUPSALV at the onset that the Corps of Engineers would be a party to all decisions that would be made in the course of the salvage effort and that the Corps of Engineers on-site representative would be given a daily accounting of all funds committed for that particular day, along with a cumulative accounting of some fourteen catagories.

It is felt that this method of operation that was established in the very beginning was the cornerstone of an effective alliance between the Army, Navy, and Contractor and had a salient effect on the success of the program.

Also worthy of note in the context of an overview is the unique situation of having fourteen salvage opportunities at one site; fourteen salvage opportunities all of which were different.

Any salvor present for the sixty day operational period who did not come away with a headfull of lessons learned simply was not paying attention. However, there are almost as many ways to raise a wreck as there are salvors to raise them. Any attempt to document lessons learned in rigging and lifting by those who were there would be pared off as already known by those who weren't.

That the project was completed within 60% of budget, ahead of schedule, and without any injury to personnel should stand as testimony as to the professionalism of the salvage team and to the engineering that was employed.

8.2. Lessons Learned

Notwithstanding the above, there were lessons learned that should be documented here and which should secure future salvage operations.

8.2.1 Project Management

The concept of on-site management of a salvage effort has pretty much covered the spectrum. There has been Navy management, contractor management, and even management by the Salvage Master. It is noted that there is no Project Manager category in the scheduled labor provisions of the contract. In the Arkansas River Project, project management was provided by the contractor as unscheduled labor and management of the project was essentially exerted with full operational scope of responsibility including logistics, personnel selection, subcontracts, management, liaison with customer, material procurement, fiscal and accounting systems management, etc.

The Project Manager had overall responsibility for all aspects of the project. However, all decisions pertaining directly to the salvage effort were essentially committee decisions. If the Salvage Master and the Salvage Engineer concurred on a technical approach, the Project Manager was so informed and no action on his part was required. Only if there was a disagreement between the Salvage Master and the Engineering staff would the Project Manager become involved in the salvage process. This management approach worked well.

8.2.2 Lift Approach

Due to the lead time required to get heavy lift craft on site and the brittle situation that existed at Dam No. 2 relative to the integrity of the dam, critical decisions as to lift capacity had to be made without benefit of fine grain survey or detailed engineering analysis. The decision to employ the assets from Bisso Marine was based upon a realistic worst case of a 700 ton lift requirement with a real world safety factor of 20%. It was also recognized that this capacity should be divided between two lift craft because of the flexibility offered. It was correctly assumed that the inability to put divers in the water in the early stages of the project would severely restrict rigging options and viable rigging configurations from the surface would be an absolute necessity.

In the final analysis, the full 700 ton capacity of the two lift craft was used on several occasions and numerous double lifts were required. At no time was there a concensus that there was an excessive amount of lift capacity on site. The use of two cranes of 700 ton capacity vice one 700 ton capacity crane proved absolutely essential to efficient salvage operations and was a key management/engineering decision.

8.2.3 Safety

There is absolutely no way that a salvage operation can be guaranteed to be safe. However, the fact that over 2000 man days were expended on this effort under the most hazardous conditions without personnel injury is testimony to the attention that went into the safety aspects of the project.

In a wartime environment, should a capital asset stand in harms way, it is certain that sailors/salvors might become expendable. One must resist that tendency, even in the heat of a salvage job when perspective becomes overwhelmed with getting the job done. In addition to the admitted amount of luck involved with keeping this project injury free, certain deliberate steps were taken that included:

> A safety boat was stationed downstream from the dam and was manned and in constant radio communication with the Salvage Master and other project personnel. A crew member of a tug not associated with the salvage effort was swept overboard on the first day that the safety boat was in position. The man was picked out of the icy water by the safety boat crew, averting what would have been a more serious injury if not a fatality.

In the early stage of the project with the integrity of the dam a distinct question, pressure was exerted to require the salvage team to initiate a two shift operation. This pressure was resisted in the belief that the ambient conditions were entirely too hostile to risk night operations. It would be presumptious to proclaim that this decision precluded a mishap, but the lesson is that night operations should be undertaken only under the most urgent of situations; situations which of themselves, if uncorrected, might cause loss of life.

8.2.4 Logistics/Procurement

One salient factor in the completion of this project ahead of schedule and under budget was the favorable impact of the logistics and procurement practices that were immediately established and maintained throughout the project. The contractor provided, as a full time member of the salvage team, an experienced purchasing agent who set up shop in the Delta Lodge in Dumas, Arkansas. This agent immediately established a line of credit with a local bank and opened a score of accounts with local (statewide) vendors. He was instrumental in the mobilization phase of the project in getting the required heavy equipment headed toward Arkansas and he stayed with the job down to pursuing special permits for extra-wide loads required for shipping the equipment. The contractor was spending a total of $50,000 a day and the certainty exists that having an experienced purchasing agent doing all the buying, no doubt, paid for his time many times over.

8.2.5 Berthing on Site

The Corps of Engineers made an extremely cost effective decison when they elected to marshall the M/V MISSISSIPPI from the Memphis District for use as an on-site hotel facility. The MISSISSIPPI proved to be a dominant factor in the efficiency of the salvage crew. A comfortable messing and berthing facility for the salvage crew at the site insured maximum utilization of all twelve of the daylight hours that were available in December and January. The effect on morale of having three nutritious meals served in pleasant surroundings also cannot be overlooked. These excellent living conditions were a significant factor in permitting continuous twelve hour days, seven days per week operation without crew burnout.

8.2.6 Communication

Essentially three radio nets were established and maintained during the operation. Two of these nets were operational, linking the salvage master, salvage bos'n, tug captains, heavy lift operators, and other key personnel as required. The third net was a control net with wide area VHF radio (hand-held) linking the project manager with the logistic/ procurement personnel in Dumas, the engineering personnel deployed on the M/V MISSISSIPPI and the SUPSALV representative on the dam or in the SUPSALV control van. The combination of the three nets essentially placed every member of the salvage team in contact with all other members. There was almost no time lost awaiting information.

8.2.7 Video Documentation

Certainly many major salvage operations have generated video documentation or perhaps even a documentary. The requirement was recognized early that due to the inordinate number of activities involved that there would be an unsatiable demand for video documentation. The contractor provided a portable video capability and assigned the task of acquiring footage to the individual responsible for the logs and records. The pace of certain phases of the operation soon overtaxed this individual and approximately half way through the project, a dedicated video technician was designated and made responsible for all video documentation and for tape dubbing and dissemination to all parties. The need for good documentation to preserve factual information for future reference and possible litigation at some distant future date cannot be overemphasized.

8.2.8 Side Scan Sonar

The zero underwater visability and the treacherous river currents made it almost impossible to survey the site with any means except side scan sonar. The particular side scan available had been newly acquired by the Corps of Engineers and their personnel had had little experience in its use. Nevertheless, the surveys made with the side scan were invaluable during certain phases of the operation. Many days would have been added to the project had not this equipment been made available.

8.2.9 Guillotine

Certainly the use of a guillotine or steel chisel is nothing new to ocean salvage. However, the manner in which the chisel that was employed in this project came into being and was used, is worthy of note. The contractor had initially intended to make liberal use of the guillotine technique in this project. However, during early meetings with the Corps of Engineers, the use of such a device was prohibited because of the unacceptable chance of imparting further damage to the dam.

Nevertheless, as it became more and more apparent that every conceivable technique might need to be employed to clear the wrecks at gates 12 and 13. The Corps set about fabricating two forty foot, ten ton steel chisels. Once completed, several hours of practice were undertaken by the Corps' Manitowoc 4100 crane operator, on a beached hull. With no more practice than just described, the crane operator was able to do a remarkable precision cutting job on both the PV 19B and the MST 351. In the final analysis, every trick in the book was used in clearing these two gates, not the least of which was demonstrated by the Corps' "Doug's Dagger" chisel.

8.2.10 Financial Accounting

Last but certainly not least in the string of successes associated with this project were the procedures developed on-site for the precise financial accounting required by both the Corps of Engineers and SUPSALV. A longstanding agreement of the Supervisor of Salvage on all salvage efforts, as well as an existing contractual requirement,is that of daily reporting of all funds committed.

Fourteen categories were included and daily costs committed against each were listed, cumulated and presented to the on-site SUPSALV representative daily. These reports were also passed on to the Corps of Engineers on-site representative by the SUPSALV rep on a daily basis. The categories maintained and reported included:

- Scheduled Labor
- Scheduled Equipment
- Non-Scheduled Labor
- Non-Scheduled Equipment
- Subcontracted Services
- Personnel Transportation
- Equipment Transportation
- Per diem
- Purchased Material/Miscellaneous Costs
- Material Handling
- General and Administrative (G&A) Exercise
- Award Fee (Projected)
- Contractual Rental Equipment
- Other

With expenditures reaching a daily peak of $50,000, maintaining the running daily summary proved to be a full time job for one individual. The benefits derived from having this realtime record available for instant timely approval by the "buyers" cannot be overemphasized. It is anticipated that the procedures that were developed during this project will be used as a basis for a SUPSALV instruction on all subsequent salvage and oil spill exercises. It is further anticipated that these procedures will also be incorporated into a computer based system using a portable personal computer for field operations.

APPENDIX I

NOMENCLATURE

NOMENCLATURE

Amcon winch, the trade name of a winch manufactured by CONMACO, Inc. In this case, a double drum winch of 180,000 pounds line pull.

Bank, left descending, the term applied to the bank or shoreline on the left hand as a person or boat heads downstream.

Bank, right descending, the term applied to the bank or shoreline on the right hand as a person or boat heads downstream.

Bay, used in this context, the area between two adjacent piers of the dam.

Cutting chisel, a built up beam about 40' x 3' with a tapered end; used in conjunction with a crane for dropping or free falling on a hull, wherein its weight tends to cut or shear the plating.

Dam axis, used to describe the centerline of the dam from one bank to the other, the longest dimension, generally perpendicular to the river.

Fleeting area, an area of shallow water near the bank with pilings or dolphins, used to moor barges while waiting to make up a tow.

Gate, one of sixteen movable structures used to regulate or stop the flow of water between two adjacent piers. Each gate is 60 feet in width with the lower edge capable of traveling along an arc 45 feet in length (full open to full closed).

Headache ball, a spherical steel ball of significant weight secured to the end of the hauling wire or whip on a crane. The hook is part of the ball. The weight facilitates the free running of the wire under no load, overcoming friction and brake drag.

Hopper barge, a barge used in river transport, usually 170' x 35', for bulk cargo, about 1500 tons deadweight capacity; can be open or fitted for removable covers.

Kevel, a river term used to describe a cleat, usually of cast steel, with two horns or projecting arms upon which to belay lines.

Lightering barge, in this context, an open hopper barge used to transport cargo unloaded from a wrecked barge.

Manitowoc 4100 W Crane, the model number of a pedestal mounted crane with a lattice boom, manufactured by Manitowoc. This crane was mounted on a U.S. Army Corps of Engineers barge, 170' x 35'.

Mat barge, a flat decked barge, 170' x 35', raked at both ends; used by the USACE to transport material for stabilizing the river banks.

Messenger, a line or wire, easily handled, passed through or around the wreckage in order to pull increasingly heavier wire or chain to rig slings.

Padeye, usually a plate with a reinforced eye for the purpose of receiving a shackle pin. This plate is welded wherever needed and rated for the load to be applied.

Parbuckling, a term used in salvage or rigging to describe a method of rotating a hull by passing a wire under and around a hull and stopping it off or securing it to the sheer strake at the gunwale. The hauling part of the wire, attached to beach gear or the block on a derrick barge, tends to rotate the hull to a desired attitude.

Pier, a concrete structure, integral with the foundation, used to support the dam; the supporting structure for the trunnions of the gate.

Rake Tank, forward or aftmost tank with bottom shell and hopper rake as boundaries.

Reeve, the act of passing the end of a rope, wire or chain through an opening, as passing a rope through a block.

Stato anchor, a U.S. Navy anchor of special design, very efficient with high holding power in soft bottoms.

Training wall, the term applied to the concrete walls at each end of the dam that protects the bank from erosion.

Wing wall, longitudinal bulkhead which forms the outboard boundary of the hopper.

Whip, a term frequently used in reference to a single wire running over a sheave on the boom of a crane.

APPENDIX II

DELIVERY ORDER 003

CONTRACT N00024-83-D-4129

Issued to Tracor Marine to perform initial survey effort.

CHECKED BOX APPLIES

☐ ORDER FOR SUPPLIES OR SERVICES

☐ REQUEST FOR QUOTATIONS NO.
RETURN COPIES OF THIS QUOTE BY
(THIS IS NOT AN ORDER. See DD Form 1155c)

PAGE 1 OF 3

1. CONTRACT/PURCH ORDER NO.	2. DELIVERY ORDER NO.	3. DATE OF ORDER	4. REQUISITION/PURCH REQUEST NO.	5. CERTIFIED FOR NATIONAL DEFENSE UNDER DMS REG 1
N00024-83-D-4129	0003	82DEC09		DO

6. ISSUED BY: CODE N00024
NAVAL SEA SYSTEMS COMMAND
DEPARTMENT OF THE NAVY
WASHINGTON, D.C. 20362
BUYER/SYMBOL: MS.E.L.BRILHART
PHONE: Area Code 202-692-7711

7. ADMINISTERED BY: (If other than 6) CODE S1002A
DCASMA, Orlando
3555 Maguire Blvd.
Orlando, Florida 32803

8. DELIVERY FOB ☐ DESTINATION ☐ OTHER (See Schedule if other)

9. CONTRACTOR/QUOTER CODE 4D747 FACILITY CODE

NAME AND ADDRESS
Tracor Marine, Inc.
Port Everglades
Fort Lauderdale, FL 33316
(Mailing Address: P.O. Box 13107
Port Everglades, FL 33316

10. DELIVER TO FOB POINT BY:

11. CHECK IF SMALL BUSINESS ☐

12. DISCOUNT TERMS

13. MAIL INVOICES TO: Blk 15 Via DCAA, Atlanta w/copy to SEA 00C-12

14. SHIP TO: CODE

15. PAYMENT WILL BE MADE BY: CODE
Disbursing Officer
Tulsa District, Corps of Engineers
P. O. Box 61
Tulsa, Oklahoma 74121

MARK ALL PACKAGES AND PAPERS WITH CONTRACT OR ORDER NUMBER

16. TYPE OF ORDER

DELIVERY ☐ This delivery order is subject to instructions contained on this side of form only and is issued on another Government agency or in accordance with and subject to terms and conditions of above numbered contract.

PURCHASE ☐ Reference your , furnish the following on terms specified herein, including: for U. S. purchases, General Provisions of Purchase Order on DD Form 1155r (Except CLAUSE NO. 13 APPLIES ONLY IF THIS BOX ☐ IS CHECKED, and NO. 15 IF THIS BOX ☐ IS CHECKED); special provisions ; and delivery as indicated. This purchase is negotiated under authority of 10 USC 2304(a)(3) or as specified in the schedule if within the U. S., its possessions or Puerto Rico; if otherwise, under 2304(a)(6).

☐ If checked, Additional General Provisions apply; Supplier shall sign "Acceptance" on DD Form 1155r and return copies.

17. ACCOUNTING AND APPROPRIATION DATA – ACCOUNTING CLASSIFICATION (REV. 7-65)

ITEM NO.	APPROPRIATION SYMBOL AND SUBHEAD	OBJECT CLASS	BUREAU CONT. NO.	SUB-ALLOT.	AUTH'N ACCTG ACTY	TRANS. TYPE	PROPERTY ACCTG ACTY	COUNTRY	COST CODE	AMOUNT
	See	ATTACHMENT "A"			*N00024-83-PR-00079 3 00C1 00079					

18. ITEM NO.	19. SCHEDULE OF SUPPLIES/SERVICES	20. QUANTITY ORDERED/ACCEPTED*	21. UNIT	22. UNIT PRICE	23. AMOUNT
	In accordance with the terms and conditions of the above contract, incorporated herein by reference, the Government hereby orders and you are hereby required to furnish the supplies and services described herein.				
	DUPLICATE ORIGINAL	(MAXIMUM LIABILITY)			

* If quantity accepted by the Government is same as quantity ordered, indicate by ✓ mark. If different, enter actual quantity accepted below quantity ordered and encircle.

24. UNITED STATES OF AMERICA
BY Date: 83JAN12
BERNARD KORACH
CONTRACTING/ORDERING OFFICER

25. TOTAL $200,000.00
29. DIFFERENCES

26. QUANTITY IN COLUMN 20 HAS BEEN: ☐ RECEIVED ☐ INSPECTED ☐ ACCEPTED, AND CONFORMS TO THE CONTRACT EXCEPT AS NOTED

Date (Signature of authorized Government representative)

27. SHIP. NO. ☐ FINAL PARTIAL

28. D.O. VOUCHER NO.

30. INITIALS

31. PAYMENT ☐ COMPLETE ☐ PARTIAL ☐ FINAL

32. PAID BY

33. AMOUNT VERIFIED CORRECT FOR

34. CHECK NUMBER

35. BILL OF LADING NO.

36. I CERTIFY this account is correct and proper for payment.

(Signature and title of Certifying Officer)

37. RECEIVED AT	38. RECEIVED BY	39. DATE RECEIVED	40. TOTAL CONTAINERS	41. S/R ACCOUNT NUMBER	42. S/R VOUCHER NO.

DD FORM 1 AUG 66 1155 (NAVY)

Form Approved by Comptroller General, U. S., 17 May 66
Exception to SF 18 under 12,500 Approved by Budget Bureau Oct 66

DEPARTMENT OF THE NAVY
NAVAL SEA SYSTEMS COMMAND
WASHINGTON, D. C. 20362

DELIVERY ORDER

1. Contract Number	2. Delivery Order No.	3. Effective Date	Page	of
N00024-83-D-4129	0003	09 December 1982	2	3

4. Contractor	5. Requisition Number
Tracor Marine, Inc. P. O. Box 13107 Port Everglades, Florida 33316	N00024-83-PR-00079
	6. Completion Date 30 June 1983

7. Maximum Liability of the Government/ Basis of Compensation	8. Security Classification
$200,000.00/Cost Plus Award Fee	UNCLASSIFIED

9. STATEMENT OF WORK

Under Line Item 0005: Contractor shall provide a salvage master, salvage engineer, financial manager, other necessary personnel, and equipment needed to conduct a salvage survey at Dam Number 2 on the Arkansas River, approximately 20 miles upstream from its confluence with the Mississippi River. This survey is in preparation for a follow-on salvage effort to clear the dam once the extent of the task is known.

Additional survey effort may be required during the course of salvage operations to determine changed conditions resulting from partial wreckage removal, variations in the river water level and shifting of barges and/or cargo.

A U. S. Navy Supervisor of Salvage Command Van shall be picked up at the ESSM Base, Cheatham Annex, Williamsburg, Virginia, and transported to the left bank of Dam Number 2 for the Supervisor of Salvage on-scene representative utilization during the survey and subsequent salvage operations. The Contractor shall provide telephone, water, gas, fuel, daily maintenance and material support for operation of the Command Van during the course of this operation. The Contractor shall return the Command Van to the ESSM Base, Cheatham Annex and clean, repair or replace any damage or loss to the van or its systems.

A salvage survey shall be developed on-site prior to 16 December 1982 for presentation to the Supervisor of Salvage on-scene representative, together with a detailed salvage plan revised on a daily basis. These survey documents and salvage plans shall be in a form suitable for incorporation in the final report.

An estimated operational cost summary shall be provided daily to the Supervisor of Salvage on-scene representative. Each operational cost summary shall recapitulate the numbers and categories of personnel and equipment used and shall list all estimated pertinent materials and miscellaneous costs incurred. The Supervisor of Salvage on-scene representative shall review each operational cost summary submitted for completeness and accuracy and shall certify, by signature, for acceptance.

Upon completion of this task, the Contractor shall provide five (5) copies of a final report to the Supervisor of Salvage.

Tracor Marine, Inc.
P. O. Box 13107
Port Everglades, Florida 33316

The Contractor shall provide a copy of each invoice document submitted for payment under this task to the Supervisor of Salvage. A copy of the final invoice, with copies of certified operational cost summaries, shall be forwarded to the Supervisor of Salvage, Naval Sea Systems Command, Code 00C-12E, Washington, D.C. 20362.

Immediately upon completion and prior to final invoicing, the Contractor shall notify by letter the congnizant Administrative Contracting Officer, with a copy to the Supervisor of Salvage, the date of the physical completion of the task order.

PLACE OF PERFORMANCE

These services shall be performed in the vicinity of Washington, D.C.; Fort Lauderdale, Florida; Norfolk, Virginia; and Little Rock, Arkansas.

GOVERNMENT FURNISHED PROPERTY/EQUIPMENT

Command Van
Six Hand-held Radios

GENERAL PROVISIONS

General Provisions for this Delivery Order are those called out as applicable to Per Diem/Cost Plus Award Fee Tasks in Section I of the Contract. Further, the Contractor's attention is directed to the applicable "Limitation of Cost" Clause, (i) requiring notification, in writing, to the Contracting Officer whenever the Contractor believes the maximum liability of the Government may be exceeded, and (ii) to the expressed limitation of the Government's liability in such situations.

NEGOTIATION AUTHORITY

This is to certify that the circumstances under which this order is being placed are covered by NAVSEA D&F No. 82-4442(C) approved 8 April 1982 issued under the authority of 10 U. S. Code, Section 2304(a)(10), and that it is impracticable to obtain competition for the supplies or services procured hereunder by either formal advertisement or negotiation.

PAYMENT

The Contractor shall forward all invoices for payment to:

Disbursing Officer
Tulsa District, Corps of Engineers
P. O. Box 61
Tulsa, Oklahoma 74121

This confirms verbal direction given to the Contractor on 09 December 1982.

APPENDIX III

DELIVERY ORDER 004

CONTRACT N00024-83-D-4129

Issued to Tracor Marine to provide the salvage effort at Dam No. 2.

CHECKED BOX APPLIES	ORDER FOR SUPPLIES OR SERVICES	REQUEST FOR QUOTATIONS NO. RETURN COPIES OF THIS QUOTE BY (THIS IS NOT AN ORDER. See DD Form 1155r)	PAGE 1 OF 4

1. CONTRACT/PURCH ORDER NO.	2. DELIVERY ORDER NO.	3. DATE OF ORDER	4. REQUISITION/PURCH REQUEST NO.	5. CERTIFIED FOR NATIONAL DEFENSE UNDER DMS REG 1
N00024-83-D-4129	0004	82DEC17		DO

6. ISSUED BY: CODE N00024
NAVAL SEA SYSTEMS COMMAND
DEPARTMENT OF THE NAVY
WASHINGTON, D.C. 20362
BUYER/SYMBOL: MS.E.L.BRILHART
PHONE: Area Code 202-692-7711

7. ADMINISTERED BY: (If other than 6) CODE S1002A
DCASMA, Orlando
3555 Maguire Blvd.
Orlando, Florida 32803

8. DELIVERY FOB ☐ DESTINATION ☐ OTHER (See Schedule if other)

9. CONTRACTOR/QUOTER CODE 4D747 FACILITY CODE

NAME AND ADDRESS
Tracor Marine, Inc.
Port Everglades
Fort Lauderdale, FL 33316
(Mailing Address: P.O. Box 13107
Port Everglades, FL 33316

10. DELIVER TO FOB POINT BY:

11. CHECK IF SMALL BUSINESS ☐

12. DISCOUNT TERMS

13. MAIL INVOICES TO: Blk 15 Via DCAA, Atlanta w/copy to SEA 00C-12

14. SHIP TO: CODE

15. PAYMENT WILL BE MADE BY: CODE
Disbursing Officer
Tulsa District, Corps of Engineer
P. O. Box 51
Tulsa, Oklahoma 74121

MARK ALL PACKAGES AND PAPERS WITH CONTRACT OR ORDER NUMBER

16. TYPE OF ORDER

DELIVERY ☐ This delivery order is subject to instructions contained on this side of form only and is issued on another Government agency or in accordance with and subject to terms and conditions of above numbered contract.

PURCHASE ☐ Reference your , furnish the following on terms specified herein, including; for U. S. purchases, General Provisions of Purchase Order on DD Form 1155r (Except CLAUSE NO. 11 APPLIES ONLY IF THIS BOX ☐ IS CHECKED, and NO. 15 IF THIS BOX ☐ IS CHECKED); special provisions ; and delivery as indicated. This purchase is negotiated under authority of 10 USC 2304(a)(3) or as specified in the schedule if within the U. S., its possessions or Puerto Rico; if otherwise, under 2304(a)(6).

☐ If checked, Additional General Provisions apply; Supplier shall sign "Acceptance" on DD Form 1155r and return copies.

17. ACCOUNTING AND APPROPRIATION DATA - ACCOUNTING CLASSIFICATION (REV. 7-65)

ITEM NO.	APPROPRIATION SYMBOL AND SUBHEAD	OBJECT CLASS	BUREAU CONT. NO.	SUB-ALLOT.	AUTH'N ACCTG ACTY	TRANS. TYPE	PROPERTY ACCTG ACTY	COUNTRY	COST CODE	AMOUNT
	See ATTACHMENT "A"				*N00024-83-PR-00093 3 OOC1 00093					

18. ITEM NO.	19. SCHEDULE OF SUPPLIES/SERVICES	20. QUANTITY ORDERED/ACCEPTED*	21. UNIT	22. UNIT PRICE	23. AMOUNT
	In accordance with the terms and conditions of the above contract, incorporated herein by reference, the Government hereby orders and you are hereby required to furnish the supplies and services described herein.				
		(MAXIMUM LIABILITY)			

DUPLICATE ORIGINAL

* If quantity accepted by the Government is same as quantity ordered, indicate by √ mark. If different, enter actual quantity accepted below quantity ordered and encircle.

24. UNITED STATES OF AMERICA
Date: 83JAN12
BY: BERNARD KORACH
CONTRACTING/ORDERING OFFICER

25. TOTAL $2,850,000.

29. DIFFERENCES

26. QUANTITY IN COLUMN 20 HAS BEEN: ☐ RECEIVED ☐ INSPECTED ☐ ACCEPTED, AND CONFORMS TO THE CONTRACT EXCEPT AS NOTED	27. SHIP NO. ☐ FINAL / PARTIAL	28. D.O. VOUCHER NO.	30. INITIALS
Date / (Signature of authorized Government representative)	31. PAYMENT ☐ COMPLETE ☐ PARTIAL ☐ FINAL	32. PAID BY	33. AMOUNT VERIFIED CORRECT FOR
36. I CERTIFY that this account is correct and proper for payment. (Signature and title of Certifying Officer)			34. CHECK NUMBER
			35. BILL OF LADING NO.

37. RECEIVED AT	38. RECEIVED BY	39. DATE RECEIVED	40. TOTAL CONTAINERS	41. S/R ACCOUNT NUMBER	42. S/R VOUCHER NO.

DD FORM 1 AUG 65 1155 (NAVY)

Form Approved by Comptroller General, U. S., 27 May 66
Exception to SF 10 under $2,500 Approved by Budget Bureau Oct 66

DEPARTMENT OF THE NAVY
NAVAL SEA SYSTEMS COMMAND
WASHINGTON, D.C. 20362

IN REPLY REFER TO

DELIVERY ORDER

1. Contract Number N00024-83-D-4129	2. Delivery Order No. 0004	3. Effective Date 17 December 82	Page 2	of 4
4. Contractor Tracor Marine, Inc. P. O. Box 13107 Port Everglades, Florida 33316		5. Requisition Number N00024-83-PR-00093 6. Completion Date 30 June 1983		
7. Maximum Liability/Basis of Compensation $2,850,000.00/Cost Plus Award Fee		8. Security Clasification UNCLASSIFIED		

9. STATEMENT OF WORK

Under Line Item 0002:

The Contractor shall provide salvage effort in the removal of eleven or more barges and/or craft from the immediate vicinity of Dam Number 2 on the Arkansas River near Dumas, Arkansas. Salvage effort shall include management and coordination of the overall salvage operation on a 24-hour per day basis utilizing enhanced portable lighting systems and adequate numbers of salvage personnel and support equipment to sustain operations on a seven-day per week basis.

An estimated operational cost summary shall be provided on a daily basis to the Supervisor of Salvage on-scene representative listed by separate tasks. Each operational cost summary shall recapitulate the numbers and categories of personnel and equipment used and shall list all estimated pertinent materials and miscellaneous costs incurred.

A regular daily log of salvage activities shall be maintained in sufficient detail to enable a reconstruction of salvage efforts. The log shall specifically list on a per-day basis:

(a) all contract equipment utilized;
(b) all Government equipment utilized;
(c) all contractor personnel on site, by name;
(d) all subcontractor personnel on-site, by name;
(e) newly initiated orders during that day for additional personnel and salvage equipment;
(f) personnel injuries and equipment casualties for the day;
(g) the identity of the on-site Supervisor of Salvage representative for that day;
(h) weather conditions including temperature, rain fall, snow, etc;
(i) the Dam discharge rate and pool level for that day, (Information to be gotten from the U. S. Army Corps of Engineers' local representative.) and;

(j) each barge worked on that day together with a scope of effort associated with that barge, i.e., crane, anchor systems, fuels, divers, materials and manpower. This shall include U. S. Army Corps of Engineers assets.

Video coverage of salvage operation shall be conducted by the Contractor utilizing cassettes which shall be made available to the U. S. Army Corps of Engineers for review daily together with the operations log for that day. A final tape of the operation shall be edited and developed and delivered, upon completion of the operation, together with the smooth log of daily operations.

PLACE OF PERFORMANCE

These services shall be performed in the vicinity of Dumas, Arkansas; Little Rock, Arkansas; Norfolk, Virginia; and Fort Lauderdale, Florida.

GOVERNMENT FURNISHED PROPERTY/EQUIPMENT

8 Stato Anchors
8 Crown buoys
2 Can buoys

Other equipment requested from the Emergency Ship Salvage Material (ESSM) System per approval of the Supervisor of Salvage on-scene representative.

DELIVERABLES

The following items shall be delivered, upon completion of the operation, to the Office of the Supervisor of Salvage, Naval Sea Systems Command, Code 00C21, Washington, D. C. 20362:

(1) Operations logs and cassettes, three (3) copies.
(2) Final edited cassette.
(3) Salvage Report, five (5) copies.

PAYMENT

The Contractor shall forward all invoices for payment to:

Disbursing Officer
Tulsa District, Corps of Engineers
P. O. Box 61
Tulsa, Oklahoma 74121

Tracor Marine, Inc. Delivery Order 0004 N00024-83-PR-00093
P. O. Box 13107
Port Everglades, Florida 33316

GENERAL PROVISIONS

General Provisions for this Delivery Order are those called out as applicable to Per Diem/Cost Plus Award Fee Tasks in Section I of the Contract. Further, the Contractor's attention is directed to the applicable "Limitation of Cost" Clause, (i) requiring notification, in writing, to the Contracting Officer whenever the Contractor believes the maximum liability of the Government may be exceeded, and to the expressed limitation of the Government's liability in such situations.

NEGOTIATION AUTHORITY

This is to certify that the circustances under which this order is being placed are covered by NAVSEA D&F No. 82-4442(C) approved 08 April 1982 issued under the authority of U. S. Code, Section 2304(a)(10), and that it is impracticable to secure competition for the suplies or services procured hereunder by either formal advertising or negotiation.

THIS CONFIRMS VERBAL DIRECTION GIVEN THE CONTRACTOR ON 17 DECEMBER 1982.

APPENDIX IV

CHRONOLOGY OF SALVAGE EVENTS

APPENDIX IV

CHRONOLOGY OF EVENTS

8 Dec — Tracor Marine tasked by U.S. Navy (SUPSALV) to survey Dam No. 2 and prepare preliminary salvage plan, including a management plan and cost proposal. SUPSALV and Tracor Marine personnel arrived on the scene.

17 Dec — Tracor Marine officially tasked under salvage contract. M/V MISSISSIPPI arrived with mat barges. PV 828B retracted from the dam by Manitowoc crane barge and SHORTY BAIRD. Completed running 2 messengers on PV 331.

18 Dec — Safety boat arrived on station. Tug OSCARS WALTERS sank at gate 16 below dam. Safety boat rescued one person, no injuries. Began rigging and pumping of OSCAR WALTERS.

19 Dec — Navy, ESSM, Army Corps of Engineers, Tracor, and subcontractors trucks arrived with salvage gear, materials and machinery. Mat barge #7512 designated as Pull Barge to receive Amcon winches. Continued rigging OSCAR WALTERS.

20 Dec — Completed refloating OSCAR WALTERS and towed downstream. Patton-Tully A-frame arrived to remove PV 331 stern. Piles driven in fleeting area for mooring mat barges.

21 Dec — Completed rigging PV 331, removed from dam and placed on the point.

22 Dec Terminated contract with Patton-Tully. Manitowoc crane barge positioned at MST 408 and completed welding I-beams. Two lightering barges arrived from removal of cargo of coal from hopper of MST 408. Completed outfitting Pull Barge.

23 Dec Positioned Pull Barge at MST 408 and commenced pumping and unloading coal into lightering barge. Subcontractor, Bisso Marine, arrived with two heavy lift derricks, SOUTHERN 6 and AJAX, CAPT LUKE crane barge, Tug TYLER, and 16 men.

24 Dec SOUTHERN 6 lifted PV stern of PV 331 and loaded on a mat barge. Continued unloading coal cargo from MST 408.

25 Dec Continued removing coal amd pumping MST 408. SOUTHERN 6 positioned to secure MST 352, MST 331 and CGB 172 when MST 408 retracted.

26 Dec Completed unloading coal from MST 408 and flooded rake tank of MST 352 for stability. Raised upstream pool level. Attempts to retract MST 408 using Pull Barge unsuccessful.

27 Dec Continued rigging MST 352, MST 331 and CGB 172. PULL BARGE reset anchors. Severe weather precluded attempt on MST 408.

28 Dec Pumped out forward end of MST 408 and ballasted stern rake tank. Retracted MST 408 from under gate 4.

29 Dec Continued rigging MST 352 for lift. AJAX positioned for two derrick lift.

30 Dec Received reels of 1-5/8" wire. AJAX and SOUTHERN 6 lift and retract MST 352 from pier 5. Wreck removed to the point.

31 Dec Loaded MST 352 onto two mat barges. Pull Barge and Manitowoc crane barge positioned at gate 9 to commence rigging CGB 172 and remove hatch covers.

1 Jan SOUTHERN 6 positioned and rigged steel strap around the hull of CGB 172 and lifted. Ballasted after peak with 70 tons of water. Positioned AJAX at gate 9. Completed rigging second messenger.

2 Jan AJAX and SOUTHERN 6 rigged for parbuckling/lifting combination of CGB 172. Pumped #2 tank starboard. Several attempts to remove wreck unsuccessful as wreck is firmly wedged between piers 9 and 10.

3 Jan AJAX and SOUTHERN 6, with aid of Pull Barge, lifted CGB 172 free of gate 9. Once clear of piers, momentum caused stern to swing and strike A-frame of AJAX. Load restrained by SOUTHERN 6 and Pull Barge. Bow section partially severed from midbody and lying under gate, bow section cut off and allowed to wash downstream, clearing gate 9.

4 Jan AJAX and SOUTHERN 6 maneuvered over to fleeting area and deposited CGB 172 in a shallow area. SOUTHERN 6 took the load and AJAX moved to the staging area for repairs.

5 Jan With assistance from SOUTHERN 6, boom of AJAX lowered to a barge for repair. MST 331 surveyed for placement of lifting padeyes. Pull Barge positioned at gate 6.

6 Jan Commenced installation of padeye at frame 67 of MST 331. Installed a flange beam between frames 81 and 85 to be used as a second padeye. Rigged exposed portion of CGB 409B. SOUTHERN 6 positioned at gate 7.

7 Jan Completed padeye weldments on MST 331. SOUTHERN 6 and Pull Barge lifted and retracted. Severed the wreck at frame 44 with a 3" cutting wire. Manitowoc crane barge held the forward section.

8 Jan Aft section of MST 331 loaded on a mat barge and removed to fleeting area. SOUTHERN 6 and Pull Barge lifted and retracted on the forward section of MST 331 clearing gates 8 and 9.

9 Jan Burned holes and rigged chain to stopper off the sling on the forward section of MST 331. SOUTHERN 6 lifted, retracted, lowered wreckage on mat barge and removed it to fleeting area.

10 Jan Pull Barge positioned at gate 6. Burned holes and rigged chains to stern of CGB 409B. Pull Barge retracted wreck from the dam to clear gate 7. Divers rerigged for lifting. CAPT. LUKE positioned at gate 1. Conducted underwater survey and began rigging MST 312 and RMW 12.

11 Jan SOUTHERN 6 positioned at gate 6. Completed rigging two slings to CGB 409B. Lifting/retracting unsuccessful as

forward section remains fouled beneath the surface. Continued survey of wrecks at gates 1 through 4.

12 Jan Corps performed dye injection test at gate 7 to determine if scour action had occured beneath the foundation of the dam, results negative. Commenced cutting away forward section of CGB 409B with burning bar lance and completed rigging stern section and secured forward section. Ran messengers on RMW 12 and MST 312.

13 Jan Loaded stern section of CGB 409B on mat barge to complete cutting operation and removed to fleeting area. Retrieved sling set on forward section of CGB 409B and set lifting chains. Wreckage is still fouled on the bottom. Commenced underwater burning to sever 90' forward section of RMW 12 at pier 3.

14 Jan Severed middle section of CGB 409B from forward section, rigged another sling and removed to the fleeting area. Completed separation of RMW 12. AJAX load tested and returned to service.

15 Jan SOUTHERN 6 rigged a second chain and removed CGB 409B bow section to point and rerigged. Righted section and loaded on mat barge in the fleeting area. AJAX put into service at gate 3 to rig bow section of RMW 12. Side scan sonar survey indicates sunken barge at gates 5 through 8, as deep as 70 feet.

16 Jan SOUTHERN 6, Pull Barge, Manitowoc crane barge and CAPT LUKE positioned at gate 7 to survey submerged wreck (MST 409). Difficulties encountered in passing

messengers under wreck as it is firmly embedded in the concrete. RMW 12 bow section removed by AJAX to point for rerigging. AJAX returned to gate 2 to continue rigging MST 312.

17 Jan Rigged slings and preventor wire on MST 312. Commenced pumping and patching. Many holes found in rake tank and wing walls. Set two slings on MST 409 but rerigging required due to slippage.

18 Jan Completed rerigging second sling on MST 409 and lifted. Due to heavy damage amidships, AJAX secured operations on MST 312 and moved to the stern section to make a two derrick lift rather than cut the MST 409. Wreck lifted, pumped, loaded on mat barges and returned to the fleeting area.

19 Jan AJAX and SOUTHERN 6 positioned at gates 1 through 3 for removal of MST 312. Completed rigging for two derrick lift. Attempts to refloat MST 312 unsuccessful due to numerous holes. MST 312 placed on two mat barges and returned to fleeting area. Pull Barge renewing wire on Amcons in fleeting area.

20 Jan AJAX, SOUTHERN 6 and CAPT LUKE positioned at gates 1 through 3 for removal of RMW 12 stern and PV 331 bow. Due to difficulties in rigging mesengers, SOUTHERN 6 and Manitowoc crane barge shifted to point to right bow section of RMW 12 for testing chisel.

21 Jan SOUTHERN 6 and Manitowoc crane barge completed righting bow of RMW 12, retrieved CGB 172 submerged in fleeting area and placed on a mat barge. AJAX and CAPT LUKE continued rigging PV 331.

22 Jan SOUTHERN 6 righted forward section of MST 331 on mat barge. SOUTHERN 6 repositioned along AJAX to make two derrick lift on stern of PV 331. Wreckage was loaded on a mat barge and returned to the fleeting area. Chisel completed and tested on bow section of RMW 12 on the point. CAPT LUKE positioned upstream of gate 7 for diver survey of bow section of MST 409.

23 Jan SOUTHERN 6 positioned at bow section of MST 409. Diver burned holes to pass chain. Section lifted and removed on mat barge. AJAX and CAPT. LUKE repositioned at gate 1 to survey RMW 12 stern and remove hatch covers. Pull Barge completed wire renewal and positioned at gate 13 to begin rigging PV 19B and MST 351.

24 Jan Burned chain holes through the hopper bottom of RMW 12. Repositioned SOUTHERN 6 at gate 1 for a two derrick lift on RMW 12. Stern loaded on mat barges and returned to fleeting area. Gates 1-4 now cleared. Manitowoc crane barge positioned at gate 11 to commence chiseling operation on stern of PV 19B. Mangled section strung out when retracted from the dam.

25 Jan SOUTHERN 6 recovered a portion of the wreckage of the stern of PV 19B retracted yesterday. Pull Barge and Manitowoc crane barge began rigging and chiseling stern of MST 351. CAPT LUKE shifted to gate 9 to survey and rig bow section of MST 331.

26 Jan SOUTHERN 6 moved to the fleeting area and removed bow section of RMW 12 and consolidated wreckage to fewer mat barges for transport upriver. Continued chiseling

and rigging on MST 351 stern. Current prohibits diving operations until gate 11 is cleared. AJAX completed rigging bow of MST 331.

27 Jan Lifted bow of MST 331 and removed to fleeting area on mat barge. Commenced underwater survey to locate objects from side scan sonar. SOUTHERN 6 positioned at gate 11, CAPT LUKE positioned at gate 13. Continued chiseling and rigging on MST 351 and PV 19B.

28 Jan Diver deployed to survey and rig sections of PV 19B and MST 351 retracted from the dam on 24 Jan. Manitowoc crane barge recovered a portion of the aft rake of MST 351. Due to the lack of structural integrity, piece must be rerigged. Gate 11 now cleared.

29 Jan Attempts to pass chain underneath MST 351 at gate 12 aborted since wreck is hard aground. Plan changed in favor of burning holes through the wing walls to pass chains as diver access was possible on certain portions of PV 19B and MST 351 with gate 11 closed.

30 Jan Completed passing a chain thorugh starboard wing wall of PV 19B and a chain through port wing wall of MST 351.

31 Jan Completed chiseling 50' midsection of PV 19B and MST 351 at gate 12. SOUTHERN 6 lifted PV 19B, loaded on mat barge and removed to fleeting area. Completed rigging MST 351.

1 Feb SOUTHERN 6 repositioned at gate 12. A second set of chains was rigged to MST 351. Section lifted and removed to fleeting area on mat barges. Commenced

burning port wing wall on the bow of MST 351 wedged in gate 13.

2 Feb Continued burning operations on MST 351. Attempts to compress and flush it thorugh the gate were unsuccessful.

3 Feb Commenced chiseling on MST 351 under gate 13. Chiseled upstream and shifted chisel over the dam, cutting into wing wall hopper and forward deck. Upper pool level lowered.

4 Feb At 0615, port bulkhead of PV 19B collapsed into gate 13. leaving little visible wreckage. SOUTHERN 6 attempted to lift MST 351 over the dam by an exposed cleat on port wing wall, but was unsuccessful. Repositioned to chisel and rig a section of PV 19B exposed at pier 13. Ripped a 3-1/2 ton piece off. Rigged a 600 lb LWT anchor and snagged a portion of the hopper bottom and starboard wing wall of PV 19B.

5 Feb Burned holes and passed two chains through bow section of PV 19B at gate 14. Opened gate slightly while AJAX retracted and tore a 40 ton piece from the starboard wing wall. Removed to fleeting area on a mat barge.

6 Feb AJAX, Pull Barge and CAPT. LUKE positioned at gates 13, 14 and 15. Diver surveyed and cut chain holes through forward hopper wall of bow of PV 19B in gate 14. AJAX raised section to the surface to rig chain to Pull Barge. SOUTHERN 6 continued grapnelling with LWT anchor at pier 13. Minimal structural integrity to obtain substantial grip.

7 Feb Pull Barge rigged chain and retracted with AJAX. SOUTHERN 6 lifted a piece and loaded it, and took over chain from Pull Barge. Burned holes and rigged another chain for SOUTHERN 6. Lifted the bow section, placed on a mat barge, rerigged and cut away the forward 40' section. Gate 14 now cleared. Raised gate 13 and remaining wreckage was flushed through the gate.

8 Feb SOUTHERN 6 removed section of PV 19B to fleeting area. Side scan sonar survey confirmed that no further wreckage waas present on the upstream side of the dam. Salvage operations completed.

9 Feb Heavy lift derricks depart for New Orleans.

12 Feb Demobilization completed.

APPENDIX V

U.S. GOVERNMENT AND CONTRACTOR PERSONNEL

U.S. GOVERNMENT AND CONTRACTOR PERSONNEL

U.S. Navy, Supervisor of Salvage

CDR Charles Maclin	Supervisor of Salvage
CDR Harley Oien	Deputy Supervisor of Salvage
LCDR Gary Tettlebach	On-site SUPSALV Rep.
James Bladh	On-site SUPSALV Rep.
Jerry Totten	On-site SUPSALV Rep.
Donald Keane	On-site SUPSALV Rep.
LCDR Scott Johnson	Auditor
Soroya Correa	Auditor
Cathy Mercilliott	Auditor

U.S. Army Corps of Engineers

Little Rock Engineering District

LTCOL Larry Bonine	District Engineer
MAJ Raymon Massey	Deputy District Engineer
O.T. Dixon	Auditor
Dave McNully	Public Affairs Officer
R.E. Rogers, Jr.	District Counsel Attorney
Ted Cook	Chief, Contruction Ops.
Jim Marlow	Asst. Chief, Construc. Ops
Ken Akers	Chief, Engineering
Jim Tollett	Chief, Navigation and Maintenance Branch
Paul Revis	Chief, Navigation Section
Cerry Strickland	Chief, Maintenance Section
Dan Reeves	Mechanical Engineer

Pine Bluff Resident Office

Harold Hammersla	Resident Engineer
Chester Shaw	Asst. Resident Engineer
Jerry Sartin	Facilities Manager
Richard Olsen	OR&H, C&M Foreman
Doug Eggburn	OR&H, C&M Foreman
Bill Aldridge	Crane Operator
Don Featherston	Crane Operator
Rodney Anglin	Tender Operator
Felton Croswell	Electrician
Mike Hutchison	Electrician
Brian Rhodes	Engr. Equipment Mechanic
Roger Hobson	Heavy Mobile Equip. Mech.
Charlie Barber	Boat Operator
Harvey Spriggs	Boat Operator

Jimmy Bailey	Welder
Troy James	Maintenance Mechanic
Dale Green	Maintenance Mechanic
Billy Calloway	Welding Worker
Robert Aud	Rigger
Gary Martin	Maintenance Worker
Don Culpepper	Maintenance Worker
Dewayne Combs	Supv. Civil Engr. Tech.
Jerry Hughes	Civil Engr. Tech.
Charlie Nichols	Supv. Survey Tech.
R.F. Harrison	Survey Tech.
Bill Rhodes	Survey Tech.
Adrian Russel	Survey Tech.
T.D. Greenfield	Park Ranger
Al Workman	Lock Master
George Butler	Lock and Dam Equip. Mech.
George Best	Captain, SHORTY BAIRD
Danny Roberts	Engineer, SHORTY BAIRD
Floyd Worley	Crane Operator
Shorty Stewart	Deck Equipment Operator
Doc Sanderson	Deck Hand

<u>Tracor Marine</u>

Jim Jacobs	Program Manager
Roy Sea	Program Manager
Leon Ryder	Salvage Master
Ralph Jones	Asst. Salvage Master
Richard Counter	Salvage Foreman
Robert Pich	Salvage Foreman
Paul Smith	Salvage Engineer
William Lane	Salvage Engineer
Ben Ludeman	Salvage Engineer
James Moody	Salvage Engineer
Dennis Kembro	Financial Logistics Asst.
Bruce Lavender	Financial Logistics Asst.
John Miller	Financial Logistics Asst.
Lee Johnson	Equipment Operator
Steve Hagland	Equipment Operator
Jerry Kidd	Equipment Operator
Clyde Jacobs	Rigger/Welder
Mick Robor	Rigger/Welder
Richard Hoffman	Boat Operator
Chris Cameron	Rigger/Welder
Charles Slocum	Boat Operator
Terry Flynn	Rigger/Welder
Kevin Cherington	Boat Operator
Paul Douglas	Rigger/Welder

William Burton	Rigger/Welder
Robert DeVere	Rigger/Welder
Buddy Best	Rigger/Welder
Ray Parrish	Diver
C. Boman	Rigger/Welder
Bill Hayes	Rigger/Welder
Jerry Maesky	Video, Communications, Log
Jennifer Ripple	Video, Communications, Log
David Taylor	Video, Documentary
Darrill LaCotts	Safety Boat Operator
James Boney	Crew boat Operator
Linda Robinson	Secretary
Linda Lee	Drafter
James Benton	Driver

Bisso Marine

W.A. Bisso, Jr.	President
W.A. Bisso, III	Vice President
Berry Patterson	Marine Superintendent
Sonny Dempster	Marine Superintendent
Lewis Barrio	Marine Superintendent
Charles Labiche	Port Engineer
John Campbell	Mechanic/Operator
Robert Rome	Captain, TYLER
Willie Lepine	Mate/TYLER
Lee Roy Marroy	Deck Hand/TYLER
Clifford Curtis	Operator

Southern Shipbuilding

Earl Cunningham	Vice President
Earl Dyson	Operator
Lawrence Hale	Operator
Phillip Cousin	Rigger
Jerry Hemphill	Rigger
Bill Broom	Rigger

APPENDIX VI

CHARACTERISTICS OF HEAVY LIFT CRAFT

AJAX AND SOUTHERN 6

APPENDIX VI

CHARACTERISTICS OF HEAVY LIFT CRAFT AJAX AND SOUTHERN 6

General

The heavy lift derrick barges AJAX and SOUTHERN 6 are designed for salvage lift by the bow. The derrick barge must be placed in a secure moor before commencing any lift operation. Each barge is equipped with three stern anchors that can be deployed in an arrangement to suit the condition of the wreck being lifted. The barge is generally positioned with its longitudinal axis normal to the longitudinal axis of the wreck.

The lift uses the permanently rigged tackle on the A-frame with the multi-part traveling blocks. The angle of the movable A-frame is controlled by a winch hauling on the topping lift tackle. The basic principle is that wires or chains are passed under the wreck and made up to the hooks of the traveling blocks below the peak of the A-frame. The barge is usually ballasted to provide significant trim by the stern before making the lift. When a heavy lift is made, the high freeboard at the forward end compensates for the rotation about the transverse pivot axis.

The derrick barges are equipped with auxiliary winches for accurate positioning relative to other fixed objects by means of wire ropes fairled through lead blocks on the barge and stopped off on bitts or cleats on other moored or fixed objects.

Characteristics of SOUTHERN 6

1. Principal Dimensions
   - o Length: 124 feet
   - o Beam: 70 feet
   - o Depth: 11 feet
   - o Draft, light: 3.5 feet

2. Lifting Features
   - o Load, main hook:
     - one hook, 300 tons, from A-frame jack

   - o Clearance, main hook*:
     - Maximum load of 300 tons can be lifted 100 feet above water with 50 foot horizontal clearance between hook and front plate of pontoon

   - o Load, auxiliary hook:
     - one hook, 200 tons

   - o Clearance, auxiliary hook:
     - Maximum load of 200 tons can be lifted 112 feet above water with 70 foot horizontal clearance between hook and front plate of pontoon

A 300 ton lift can be made by the main block and a 200 ton lift by the auxiliary bock when used separately. When used together during a lift, the capacity of the tackle is 400 tons.

The SOUTHERN 6 is equipped with a pedestal mounted, 360° rotation crane mounted aft with a rated capacity of 35 tons.

* Heights measured block to block.
Tonnage rated in short tons.

Characteristics of AJAX

1. Principal Dimensions
   - o Length: 121 feet
   - o Beam: 65 feet
   - o Depth: 11 feet
   - o Draft, light: 4.5 feet

2. Lifting Features
   - o Load, main hook:
     - one hook, 260 tons, from A-frame jack
   - o Clearance, main hook*:
     - Maximum load of 260 tons can be lifted 98 feet above water with 40 feet of horizontal clearance between hook and front plate of pontoon
     - Maximum horizontal clearance is 60 feet, with 85 foot height above water, and a maximum load of 150 tons
     - Maximum height above water of 109 feet can be reached with a horizontal clearance of 10 feet and a maximum load of 260 tons
   - o Load, auxiliary hook:
     - one hook, 50 tons
   - o Clearance, auxiliary hook:
     - Maximum load of 50 tons can be lifted 103 feet above water 40 foot horizontal clearance between hook and front plate of pontoon
     - Maximum horizontal clearance is 60 feet, with 90 foot height above water, and a maximum load of 50 tons
     - Maximum height above water of 113 feet can be reached with a horizontal clearance of 10 feet and a maximum load of 50 tons

A 260 ton lift can be made by the main block and a 50 ton lift by the auxiliary block when used separately. When used together during a lift, the capacity of the tackle is 325 tons.

* Heights measured block to block.
Tonnage rated in short tons.

APPENDIX VII

PRELIMINARY SURVEY AND SALVAGE PLAN

MEMO TO FILES: 9 December 1982

SUBJECT: Status Report, Loose Barges in Pool No. 2

1. Flows have decreased to approximately 124,000 c.f.s. at Dam No. 2 with a headwater elevation of 162.1 (Navigation Pool is El. 162.0). U.S. Coast Guard reopened Pool 2 for navigation with safety advisories yesterday afternoon following side-scan sonar and hydrographic surveys by Little Rock District personnel.

2. Movement of loose barges has been established and individual barge owners started securing barges yesterday. Patton-Tully Company A-frame and other salvage equipment was on-site and had removed one partially floating barge (RMW-10) from the dam. Current estimates are that 36 barges lost moorings (33 from Helena Marine Service, Inc., fleet at N.M. 25 and 3 knocked loose at Riceland Dock at N.M. 22 by uncontrolled barges from upstream). (See Enclosure 1.)

3. Navy salvage personnel arrived today and have been taken to Dam No. 2 to survey the situation.

4. Contracted with Pine Bluff Sand & Gravel Co. to deliver 15,000 tons of stone downstream of Dam No. 2. Arrangements have been made with MO-PAC Railraod for raising Yancopin Bridge on the Arkansas River. Contractor estimates that first stone should arrive at Dam No. 2 on 13 December 1982 from Smithland, Kentucky.

5. Bids received today for anticipated channel dredging.

6. Inspection of fleeting area conducted yesterday by Little Rock District and U.S. Coast Guard personnel. USCG (Captain of the Port, Memphis) is conducting the investigation of the loose barges.

PAUL N. REVIS, P.E.
Chief, Navigation Section
U.S. Army Corps of Engineers
9 December 1982

Enclosure 1

BARGE LOCATIONS

Locations of 32 of the 36 barges have been reported by barge number. The locations of the other 4 are believed to be: (1) One sunk at the third pier from the left bank of Pendleton Bridge, (2) One sunk below rubble at Dam 2, and (3) Two sunk below Dam 2.

Disposition by company is as follows:

Mid-South Towing Co., Tampa, Florida

21 lost from Helena Marine Service Fleet at N.M. 25
6 secured
7 partially sunk or aground upstream of Dam No. 2
4 sunk or in Dam No. 2
4 unidentified (MST-409, 412, 369, and 312)

Consolidated Grain and Barge Co., St. Louis, Missouri

2 lost from Helena Marine Service Fleet at N.M. 25
2 sunk at Dam No. 2

Marine Equipment Management Co., St. Louis, Missouri

1 lost from Helena Marine Service Fleet at N.M. 25
1 secured

Helena Marine Service, Inc., Little Rock, Arkansas

9 lost from Helena Marine Service Fleet at N.M. 25
5 secured
2 partially sunk or aground upstream of Dam No. 2
1 floating at Dam No. 2
1 sunk at Dam No. 2

Peavey Company, Alton, Illinois

3 lost from Riceland Dock
1 floating at Dam No. 2
2 sunk at Dam No. 2

No other loose barges from any source have been reported. Disposition of individual barges on 8 December 1982 are shown on attached listings as updated on 9 December 1982.

<u>DISPOSITION OF BARGES ON 8 DECEMBER 1982</u>

Mid-South Towing, P.O. Box 18443, Tampa, Florida

MST-322	downstream in tow of M/V Ruth Brent
MST-317	Do.
MST-333	Do.
MST-403	Do.
MST-413	Do.
MST-328	partially sunk at end of right bank revetment
MST-408	through gate No. 4 at Dam 2
MST-347	grounded on left bank across from fleeting area
MST-320	held by M/V J E Gegenheimer across from Riceland
MST-406	partially sunk between canal and Dam 2
MST-417	Do.
MST-351	sunk at Dam 2
MST-331	sunk at Dam 2
MST-330	partially sunk on dike at N.M. 19.6
MST-348	Do.
MST-352	sunk at Dam 2
MST-13	aground behind island between canal and Dam 2
MST-412	unaccounted for
MST-409	unaccounted for
MST-369	unaccounted for
MST-312	unaccounted for
MST-335	N.M. 24?

Consolidated Grain & Barge Co., 5100 Oakland Avenue, St. Louis, MO 63110.

CGB-172	sunk at Dam 2
CGB-409B	sunk at Dam 2

Marine Equipment Management Co., P.O. Box 9937, St. Louis, MO 63122

SHE-8117	at Riceland dock

Helena Marine Service, Inc. 2224 Cottondale Lane, Little Rock, AR 72202

RMW-10	was floating at Dam 2, is now at mouth of the canal with M/V Senator Stennis	
RMW-11	1 1/2 miles downstream of Dam 2	
RMW-12	sunk at Dam 2	
RMW-13	left bank in trees	
RMW-14	In NM 25 Fleeting Area	Info. received by
RMW-15	In NM 25 Fleeting Area	Revis from Roberson
RMW-16	In NM 25 Fleeting Area	at 3:30 on 9 Dec. 82
RMW-18	In NM 25 Fleeting Area	
RMW-17	floating at Dam 2	

SUBJECT: Disposition of Barges on 8 December 1982

2 barges went through Dam 2 and are unaccounted for (unidentified)

1 barge sunk at Dam 2 (unidentified)

1 barge sank upstream of the 3rd pier of the Pendleton Bridge (unidentified)

TBL-106 is in the canal

PV-19B is sunk at Dam 2

PV-828B is floating against Dam 2

PV 331 is sunk at Dam 2, broken in two.

The following barges are at the Riceland dock:

PV-1B
OKG-17
WTT-838
PV-311LB
TBL-106

The following barges are in the fleeting area:

MST-290
MST-336
SHE-8044F
TGP-701
RMW-19
OT-341
OT-403

The following barges were previously listed as staying secure in fleeting area and may be in a tow:

MST-314
MST-361
MEM-120
HLEM-502
K-401
OT-403 Ref: Telecom Revis & Blake Roberson on 9 Dec. 82
VLX-7745
VLX-7691

Probe Survey

On this date, a probe survey was performed in the area of Dam No. 2 in search of submerged barges. The 45 foot probe was suspended from the whip line of the Little Rock District Crane Barge, tended by the M/V SHORTY BAIRD. The attached sketch shows soundings recorded at the various probe locations.

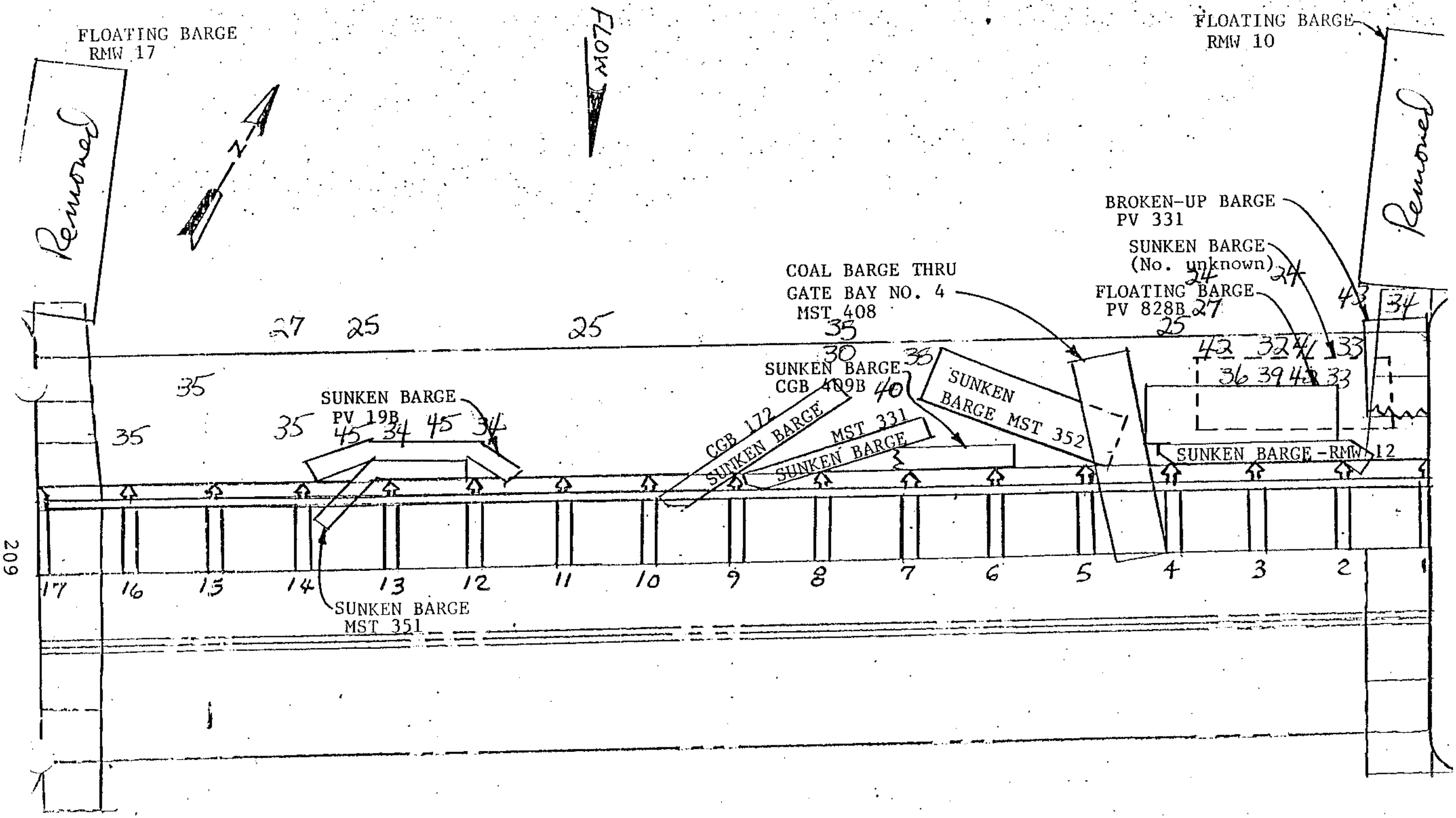
Findings:

1. No submerged barges were located in the areas upstream of the known wrecks. The areas between the dam and known wrecks could not be probed.

2. There is evidence of scouring upstream of the wrecks in several locations. In particular, excess of 40 feet of water was found in way of Gates 1, 2, 3, 7, 12, and 13.

3. There is evidence of buildup from gate 4 to the left bank approximately 200 feet upstream of the dam axis. Water depths were less than 25 feet.

Attendees: Ryder, Tettelbach, and Smith



DAM NO. 2
ARKANSAS RIVER, ARKANSAS
8 DECEMBER 1982

ON - BOARD SURVEY

On this date an onboard survey of barges PV 331, PV 828 B, and MST 408 was performed in the vicinity of Dam No. 2, Arkansas River. Wrecks boarded from Survey Boat DUMAS.

Findings:

PV 331-

* After rake tidal
* #4 tank appears tight
* #3 tank tidal
* Barge severed 2 feet forward of bulkhead 2/3 forward section

PV 828B-

* Forward rake tidal
* #1 tank tight, some water
* #2, 3, 4, 5 Tidal
* After rake dry but breached on starboard quarter above waterline. Port side breached in 2 locations. Fracture in deck plating running athwartships from starboard after hopper corner to gunwale.

Note: Sunken barge beneath PV 828B identified as JEFFBOAT Hull NO. 2483, built 1971, marked "312".

Note: All manhole covers found in place but not dogged.

ONBOARD SURVEY - 12/15/82 (cont.)

MST 408-

* After rake dry
* #4 tank dry
* #2, 3 tanks apparently tight. Approximately 2 feet of water on port (low) side.
* #1 tank- breached starboard side at turn of bilge, adjacent to bulkhead 1/2. Hole measures 5" x 8". Bottom set up 2 - 3" for a length of 10 - 12 feet on starboard side beginning just forward of bulkhead 1/2. Bulkhead 1/2 breached slightly.
* Forward rake shows signs of being breached. Holes not found. Rake now dry.

Note: All manhole covers found in place but not dogged. Survey team dogged all covers. Loose covers on port side suspected source of water in tanks 2 and 3.

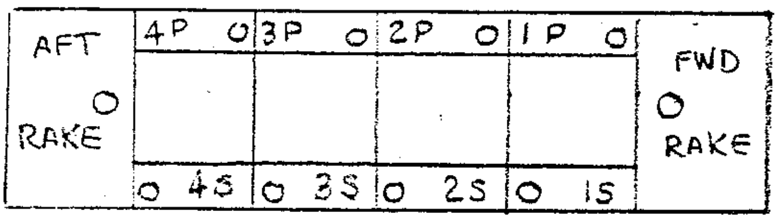
Attendees: Ryder, Tettelbach, and Smith.

FROM: William Lane - Salvage Engineer

TO: Commander Harley Oien - USN SUPSALV Representative

SUBJECT: Post salvage survey of MST Barge #408, Dumas, Arkansas

1. Each tank of subject barge was inspected on 12/29/82 by the undersigned. Tank numbers are as follows: Note: #1, #2, #3, #4 are saddle tanks extending width of beam.



Results of the survey are as follows:

TANK	WATER LEVEL	DAMAGE
FWD rake	2" silt portside	None visible
1 P	9" FWD 12" aft	" "
1 S	Dry FWD 2" aft	Transverse bulkhead set up at junction of tank 2, seam and shell is leaking
2 P	10" FWD 12" aft	None visible
2 S	1/4" water	" "
3 P	4" FWD 5-1/4" aft	" "
3 S	Dry	" "
4 P	2" FWD 4" aft	" "
4 S	Dry	" "
AFT rake	54" center line	" "

(Tank was not fully dewatered after counter flooding during salvage effort).

2. Draft marks on the barge were as follows:

Port	Stbd
FWD 2'9"	1'8"
AFT 3'6"	2'6"

3. By comparing draft marks and tank water levels, it is determined that there is no significant leakage in barge #408 except in tank #1, stbd side as noted.

William Lane
Salvage Engineer
Tracor Marine

Consider barge safe for river transits without adding cargo.

H.M. Oien
CDR, USN

PRELIMINARY SALVAGE PLAN

The following report was prepared by th Tracor Marine Salvage Master and Salvage Engineer after completion of the survey at Dam No. 2. This plan was submitted to the U.S. Army Corps of Engineers and SUPSALV on 16 December 1982.

Preliminary Plan of Action

The proposed order of removal of the eleven known wrecks adjacent to Dam No. 2 is shown in the attached schedule of operations. The philosophy behind the schedule is to first remove wreckage now hampering the operation of floodgates 4, 9 and 13. By restoring the dam to a more or less operational condition, the risks of further erosion around the dam are minimized.

In view of the inherent hazards working upstream of the dam, the schedule of operations was developed assuming that most work would be performed during daylight hours. Second shift operations would be restricted to equipment maintenance, shoreside fabrication or when necessary, the completion of a critical evolution such as a heavy lift started earlier in the day.

The major pieces of equipment will include two heavy-lift derricks, a pulling barge and the Corps of Engineers towboat, SHORTY BAIRD and crane barge. We also intend to use the Corps of Engineers survey boat, DUMAS, as well as two other contractor furnished tow boats.

We propose that the area on the right bank, upstream of Dam No. 2, behind the Warning To Boaters sign be designated as the disposal site for all scrap metal. Wreckage delivered there can be pulled ashore, cut up and trucked away. The calm water, gentle bottom slope and access to Route 212 make it a suitable site. The time and cost (or revenue) from the scrapping operation has not been considered in this proposal.

Preparations

Critical to the success of this operation is the provision of adequate moorings upstream of Dam No. 2. Because of the amount of time required to drive pilings for deadmen, we intend to set large anchors (in excess of 10,000 pounds each) well upstream of the dam, riprap and clay bottom barriers. These will provide positive positioning control of work barges and pulling points for operations requiring them. They will also be used to stabilize pieces of wreckage during their removal. The anchors will be provided from the U.S. Navy's Emergency Ship Salvage Materials (ESSM) assets at Williamsburg, Virginia, and Stockton, California.

Methods of Removal

PV 331: While PV 331 is not presently blocking any gate, it is in danger of breaking loose and partially blocking gate 1. Therefore, it will be removed first. It displaces an estimated 110 tons. It will be rigged with two belly lift slings made up of 2-1/2" die-lock chain (breaking strength: 170 tons). One derrick will be used to make the lift.

MST 408: Prior to any lightering or refloating attempts, MST 408 will be secured by wires to the anchors upstream. Once secure, the Corps crane barge will be used to remove the coal cargo. In order to prevent the barge from tipping, the after rake will be ballasted down. Once lightered, the Pull Barge will be used to retract and refloat MST 408. Prior to refloat, the hole in tank #1 on the starboard side will be patched from the inside using wooden wedges and epoxy.

CGB 172: CGB 172 will be rigged for lift in a manner similar to PV 331. The slings will be rigged by sweeping under the hull to a location in way of a transverse bulkhead to take advantage of its inherent strength. Two derricks will be used to lift the barge clear of the bottom. The Pull Barge will be used to retract it and the derricks upstream.

PV 19B & MST 351: PV 19B and MST 351 will be secured upstream and lifted on beam ends. We may ask that floodgates and pool level be manipulated to relieve the water pressure against the barges. Two derricks will be used.

PV 828B: Though it has substantial damage, the PV 828B may be refloated on its hopper. To preclude any further damage in refloating, it will be lifted off the barge beneath, using two derricks. It will be floated in a backwater and may be salvaged.

MST 312: The heretofore unidentified barge beneath the PV 828B was identified as Jeffboat Hull No. 2483, built 1971, and is marked "312". It will be lifted using belly lift slings and two derricks.

RMW 12, MST 331 & CGB 409B: RMW 12 will be lifted on beam ends using two derricks as will MST 331 and CGB 409B, similar to PV-19B.

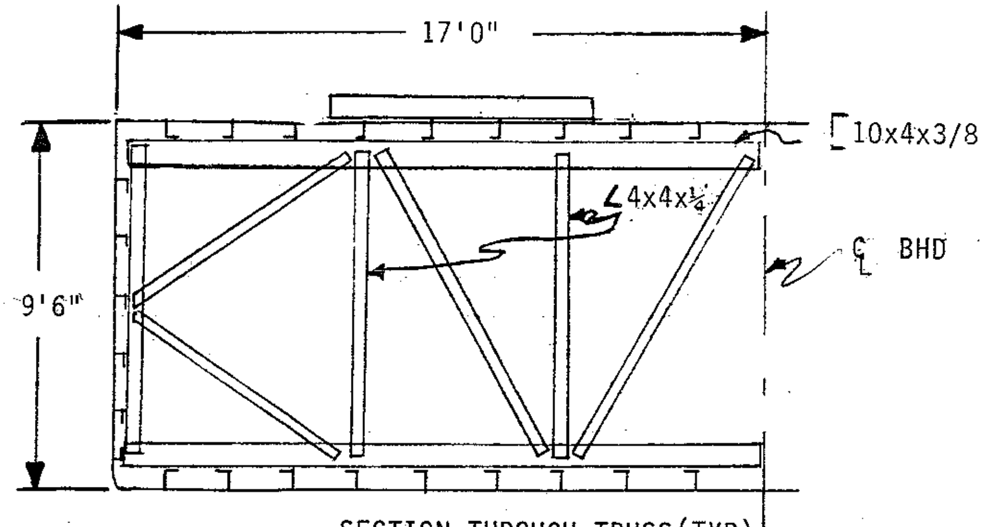
MST 352: MST 352 will be rigged with belly slings and lifted using two derricks.

Wreckage downstream of CGB 409B: This unidentified wreckage between CGB 409B and gate 6 will be slung and removed while the derricks are working on CGB 409B.

APPENDIX VIII

CALCULATIONS

ADEQUACY OF CORPS MAT BARGE FOR WINCH BARGE

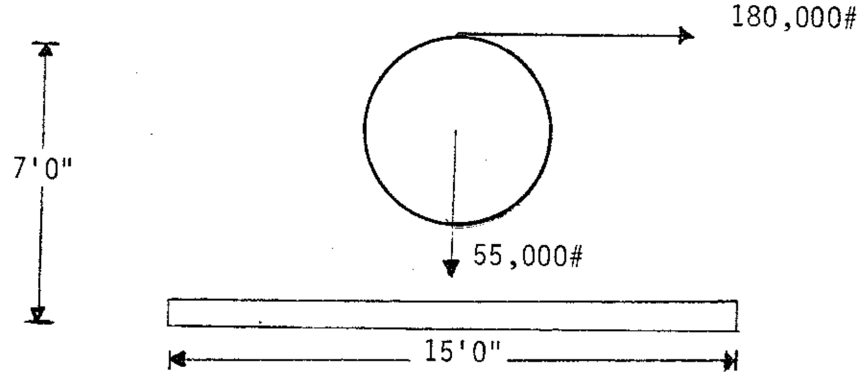


Longitudinals: L 5x3x¼

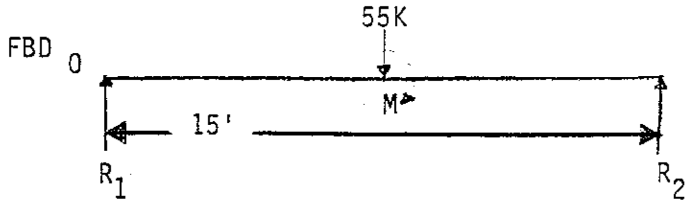
SECTION THROUGH TRUSS(TYP)

Each winch weighs 55,000 pounds including wire. It has a pulling capacity of 180,000 pounds on each drum.

Each winch will be rigged such that the drums are pulling in opposite directions. However, assume a single line pull of 180,000 pounds.



Assume winch bed is perfectly stiff such that all forces are transmitted to reactions at the ends of the winch bed.



$M = (7)(180K) = 1260$ FT.K

$\Sigma F = 0 \Rightarrow R_1 + R_2 = 55K$

$\Sigma M_o = 0 \Rightarrow (55)(7.5) + 1260 = 15R_2$

$$R_2 = 111.5K$$
$$R_1 = -56.5K$$

Assume R_2 lies on a web frame. Assume further that the load is shared equally by the two columns in the truss.

$\therefore$ Each column will be subjected to a load of $\frac{111.5}{2}$ or 55.75K.

Check column integrity

Columns are L 4 x 4 x ¼

Characteristics of L 4 x 4 x ¼

$A = 1.94$ in^2 $\qquad$ $L_e = 7'0''$ (assumed)

$r = 0.795$ in $\qquad$ $\sigma_{all} = 22$ ksi

$E = 29 \times 10^6$ psi

$\sigma_y = 36$ ksi

From Material Strength:

$$P_{all} = A\sigma_{all} = (1.94)(22ksi)$$
$$= 42.7K$$

From Column Buckling:

$$P_{cr} = \frac{\pi^2 EA}{(L_e/r)^2}$$

$$= \frac{(\pi^2)(29 \times 10^6)(1.94)}{\left(\frac{(7)(12)}{0.795}\right)^2}$$

$$= 49.7K$$

In spite of the fact that the estimated column loading of 55.75K exceeds the column strength, no modification to the barge structure is recommended due to the excessively conservative analysis of the structure.

(a) End constraints for column buckling were assumed pinned.

(b) No benefit was derived from truss diagonals or neighboring trusses.

(c) No benefit was derived from the $\mathrm{C_L}$ bulkhead or side shell.

(d) A unidirectional 90 ton line pull is not likely in this application.

$\therefore$ The barge structure is suitable, as is, for mounting the two Amcon winches.

Check Welding Requirements

Welds will have to withstand 180K horizontal and 56.5K vertical loading.

Assume 3/8" weld size.

Vertical Loading

Allowable load/In. weld $= \underbrace{(0.375)(0.707)}_{\text{(shear area)}}\underbrace{(14.5\text{KSI})}_{\text{(allow shear)}}$

$= 3.8\text{K/in}$

Minimum weld length (at ends of winch bed)

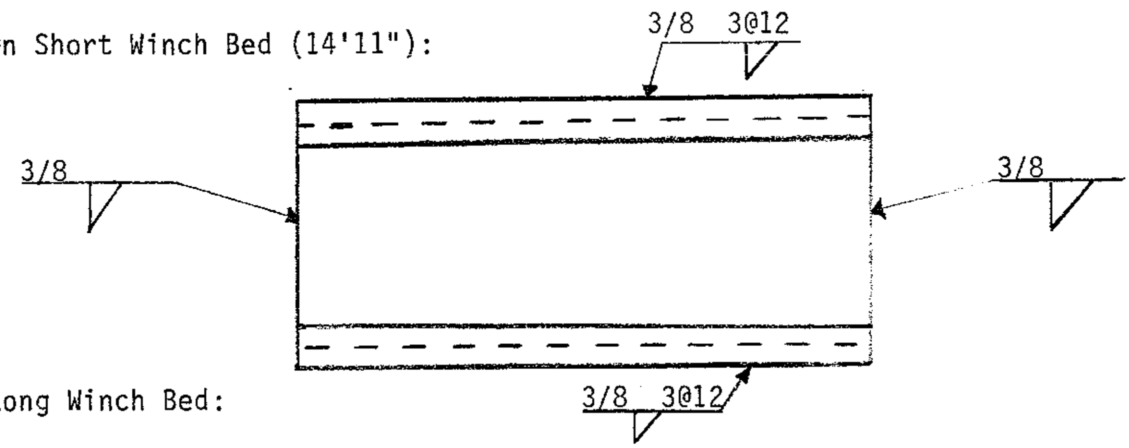
$$= \frac{56.5\text{K}}{3.8\text{K/in}} = 14.7 \text{ in}$$

Horizontal Loading

Minimum weld length $= \dfrac{180\text{K}}{3.8\text{K/in}} = 47.4 \text{ in}$

Recommended Welding Plan

On Short Winch Bed (14'11"):



Long Winch Bed:

Similar to above, but continuous welds will be layed on bed beams fore and aft of winch foundation (there is no lateral member as on short winch bed).

18 December 1982

GROUND TACKLE

Available Anchors: 6,000 lb LWT

6,000 lb STATO

Holding Power: Bottom is assumed to be mud.

LWT

Holding Power = Weight x Efficiency

= (6.0 K)(3.2)

= 19.2 K/anchor

STATO

Holding Power = (6.0)(17.6)

= 105.6 K/anchor

Anchor Wire: 1-5/8" Ø

Minimum Breaking Strength: 192 K

With surge loads at a minimum in the river, 1-5/8" wire should be acceptable.

CURRENT DRAG ON WRECKS

$D = C_D \frac{1}{2} \rho S V^2$

For a bluff body (circular disk oriented normal to flow)

$C_D = 1.1$

$\rho_{FW} = \dfrac{62.4 \text{ lb/ft}^3}{32.2 \text{ ft/sec}^2}$

$V = 1.689 V_k$ ft/sec

$\therefore D = (1.1)(0.5) \dfrac{62.4}{32.2} S(1.689 V_k)^2$

$D = 3.04 \, S \, V_k^{\,2}$

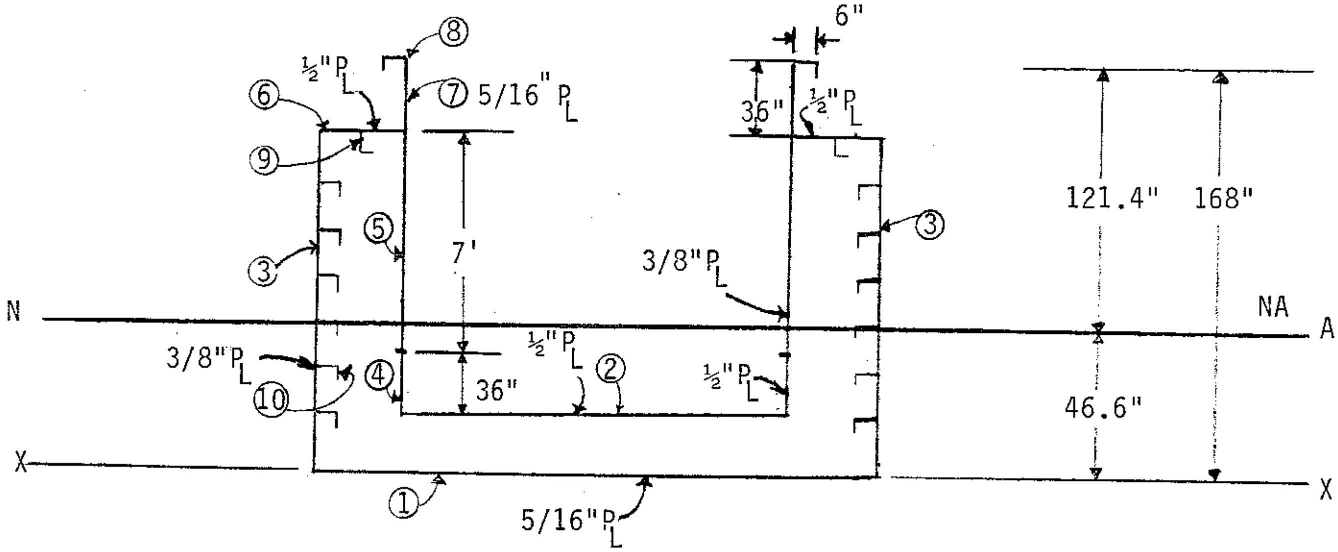
Where S = Projected area in ft^2

V_k = Current Velocity in Knots

(Skin friction is considered negligible)

MST 408 - SALVAGE CALCULATIONS

MST 408 - Moment of Inertia of the Hull



ITEM	b	h	A	y	Ay	Ay^2	I_{cg}
①	420	.313	131.5	.15	19.7	3.0	----
②	329	.5	164.5	12.00	1,974	23,688	----
③ (2)	.38	132	100.3	66	6,620	436,906	143,748
④ (2)	.5	36	36.0	30	1,080	32,400	3,888
⑤ (2)	.38	84	63.8	90	5,742	516,780	37,044
⑥ (2)	45.6	.5	45.6	132	6,019	794,534	----
⑦ (2)	.31	36	22.3	150	3,345	501,750	2,430
⑧ (2)	6	.38	4.6	168	773	129,830	----
⑨ (2)	---	---	4.8	129	619	79,877	12.52
⑩ (12)	---	---	28.8	66	1,901	125,453	21
			602.2	46.6	28,092.7	2,641,221	187,143.5

MST 408 - Moment Of Inertia of the Hull (cont)

$$\overline{y} = \frac{Ay}{A}$$

$$= \frac{28092.7}{602.2}$$

$$= 46.6 \text{ in}$$

$$I_{XX} = Ay^2 + I_{CG}$$

$$= 2{,}641{,}221 + 187{,}143.5$$

$$= 2{,}828{,}364.5 \text{ in}^4$$

$$I_{NA} = I_{XX} - Ay(\overline{y})$$

$$= 2{,}828{,}364.5 - (28{,}092.7)(46.6)$$

$$= 2{,}828{,}364.5 - 1{,}309{,}119.8$$

$$= 1{,}519{,}244.7 \text{ in}^4$$

$$\text{LEAST SM} = \frac{I}{C} = \frac{1{,}519{,}244.7}{121.4}$$

$$= 12{,}514 \text{ in}^3$$

MST 408 - Analysis of Ballasting Stern Tanks

Problem: The coal aboard the MST 408 has been unloaded. The barge remains grounded at a steep downward angle. In order for the Pull Barge to get a better purchase and pull more effectively, it is decided to pump ballast water into the after tanks.

It is necessary to calculate the effect that this will have on the ground reaction and bending moment experienced by the barge.

Solution:

	Before Ballasting	After Ballasting
$T_{Groundout}$	= .67 ft	.67 ft
T_{Stern}	= .67 ft	6.3 ft
Displacement	= 198 tons	506 tons
Ground Reaction	= 116 tons	80 tons
Max Hull Stress	= 5750 psi	5750 psi

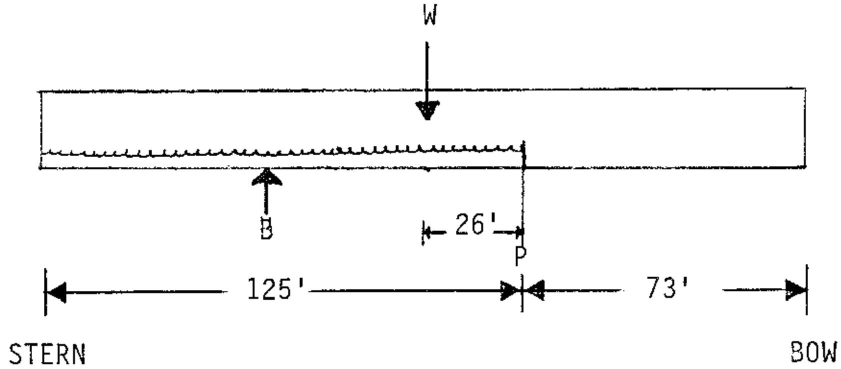
OK to Ballast ✓

Ground Reaction Reduced, Hull Stress Not Increased

MST 408 - Analysis of Ballasting Stern Tanks (cont)

MST 408 - Present Condition

No Ballast, No Coal



Vessel Characteristics

LOA = 198 ft

Breadth = 35 ft

Weight = 1 ton/ft = 198 tons

Groundout reaction occurs 73 feet aft of the bow. The forward portion of the vessel is overhanging the dam, the stern portion is floating with no trim.

Calculation of Ground Reaction

$$\circlearrowleft + \Sigma M_B = W(36.5) - P(62.5) = 0$$

$$P = \frac{198(36.5)}{62.5} = \underline{\underline{116 \text{ tons}}}$$

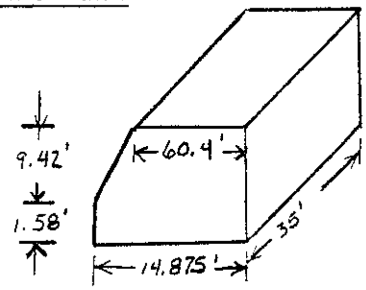
$$B = 198 - 16 = \underline{\underline{82 \text{ tons}}}$$

$$\text{Draft} = \frac{(\text{Buoyancy})(35.9\text{ft}^3/\text{ton})}{(\text{LWL})(\text{Beam})} \quad \frac{(82)(35.9)}{(125)(35)} = \underline{\underline{.67 \text{ ft}}}$$

MST 408 - Analysis of Ballasting Stern Tanks

Estimate of Tank Capacities

Stern Rake Tank

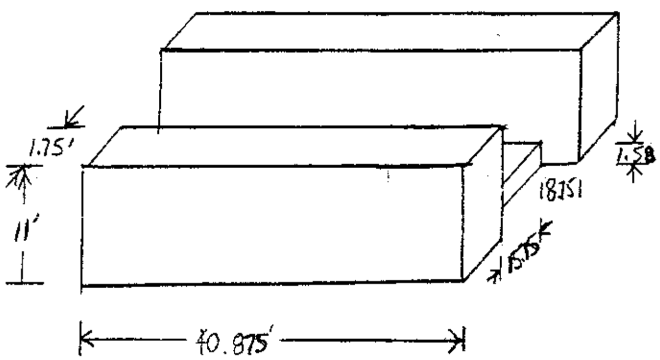


$$CAP = \frac{(35)((\tfrac{1}{2})(6.04 + 14.875)(9.42) + 14.875(1.58))}{35.9ft^3/ton} = \underline{\underline{119 \text{ tons}}}$$

$$LCG = \frac{3.02(6.04)(11) + \left(\frac{6.04 + 8.84(2(1.58) + 11)}{3(1.58 + 11)}\right)\tfrac{1}{2}(8.84(11+1.58))}{119(35.9)/35}$$

$$= \underline{\underline{5.9 \text{ ft FWD Stern}}}$$

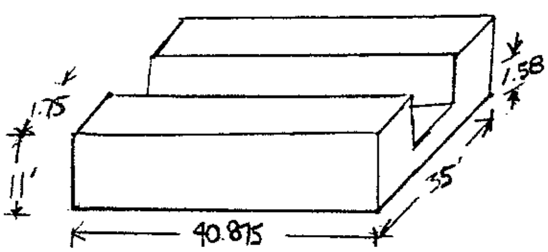
Aft Tank



$$CAP = \frac{2(40.875(1.75)(11) + 15.75(1.58)(40.875 - 8.75))}{35.9 \text{ tons/ft}^3} = \underline{\underline{88 \text{ tons}}}$$

$$LCG = \frac{40.875}{2} + 6.125 = \underline{\underline{26.5 \text{ ft FWD Stern}}}$$

Next Tank



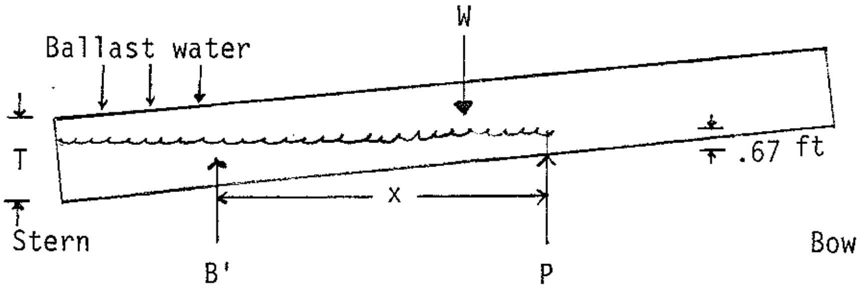
$$CAP = 2((40.875)(11)(1.75) + (15.75)(1.58)(40.875))/35.9 = \underline{\underline{101 \text{ tons}}}$$

$$LCG = 40.875/2 + 40.875 + 6.125 = \underline{\underline{67.4 \text{ ft Fwd Stern}}}$$

MST 408 - Analysis of Ballasting Stern Tanks (cont)

MST 408 - Effect of Adding Ballast

Sketch



Adding ballast water to the three sternmost tanks causes MST 408 to trim about the ground out point. This results in an increase in the buoyant reaction and a shift in its location until equilibrium is reached. The draft at the stern will increase while the draft at the ground out reaction will remain constant.

Calculation of Ground Out Reaction, Vessel Draft

From Statics:

$$\circlearrowleft + \Sigma M_p = B'(x) - 198(26) - 119(125-5.9) - 88(125-26.5) - 101(125-67.4) = 0$$

$$\uparrow + \Sigma F = 0 = B' + P - 119 - 88 - 101 - 198 = 0$$

(EQN.1) $B'(x) = 33{,}807$ ft-tons

(EQN.2) $B' + P = 506$ tons

From Geometry of Immersed Wedge:

(EQN.3) $B' = \frac{1}{2}(T + .67)(125)(35)/35.9$ tons

(EQN.4) $x = (125)\dfrac{(2T+.67)}{3(T+.67)}$ ft

Substituting EQN.3 and EQN.4 into EQN 1:

$$\frac{1(T+.67)(125)(35)}{2(35.9)}\frac{(125)(2T+.67)}{3(T+.67)} = 33{,}807$$

$$2T + .67 = 13.32$$

$$T_{Stern} = \underline{\underline{6.3 \text{ ft}}}$$

MST 408 - Analysis of Ballasting Stern Tanks (cont)

Effect of Adding Ballast (cont.)

$\therefore$ B' = ½(6.3 + .67)(125)(35)/35.9 = 426 tons

$$x = \frac{125((2)(6.3)+.67)}{3(6.3+.67)} = \underline{79.3 \text{ ft}} \text{ aft ground out point}$$

P = 506 - 425 = 80 tons

Determination of Loading, Shear and Moment Diagrams

Weight Curve

1. Barge weight = 198 tons = 1 ton/ft
2. Stern Tank = 119 tons W/LCG = 5.9 ft FWD Stern $\Rightarrow$ Model as trapezoid

   $$5.9 = \frac{14.875(B+2b)}{3(B+b)} \qquad \tfrac{1}{2}(B+b)(14.875)$$

   Solving by Substitution

   b = 3.04 tons/ft

   B = 12.96 tons/ft

3. Aft Tank

   88 tons W/LCG = 26.5 ft FWD Stern = Model as a trapezoid

   $$11.63 = \frac{32.125(B+2b)}{3(B+b)} \qquad \tfrac{1}{2}(B+b)(32.125) = 88$$

   b = .47 tons/ft

   B = 5.02 tons/ft

4. Next Tank = 101 tons W/LCG 67.4 ft FWD Stern

   b = B = 101/40.875 = 2.47 tons/ft

Buoyancy Curve

Curve has trapezoidal shape with buoyancy and LCB known

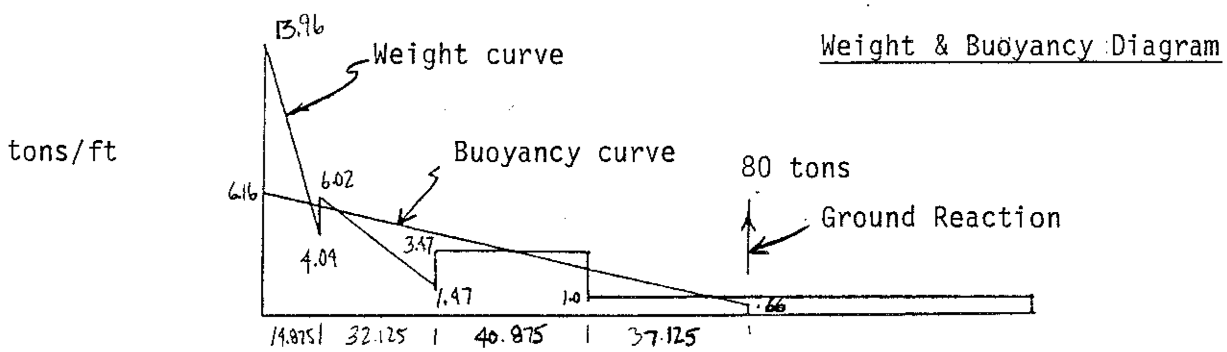
$$45.7 = \frac{125(B+2b)}{3(B+b)} \qquad \tfrac{1}{2}(B+b)(125) = 426$$

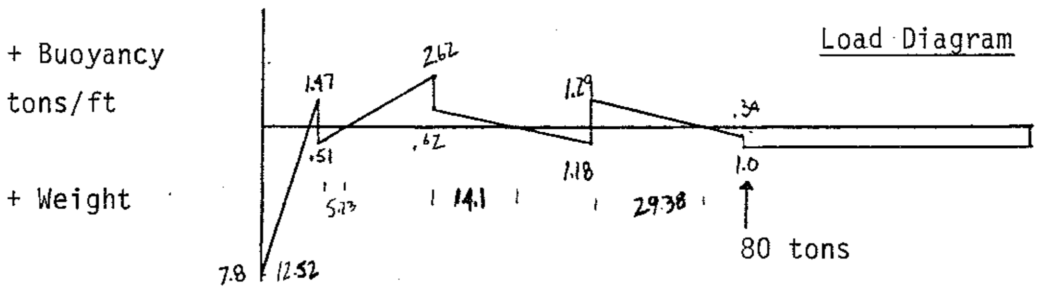
b = .66 tons/ft

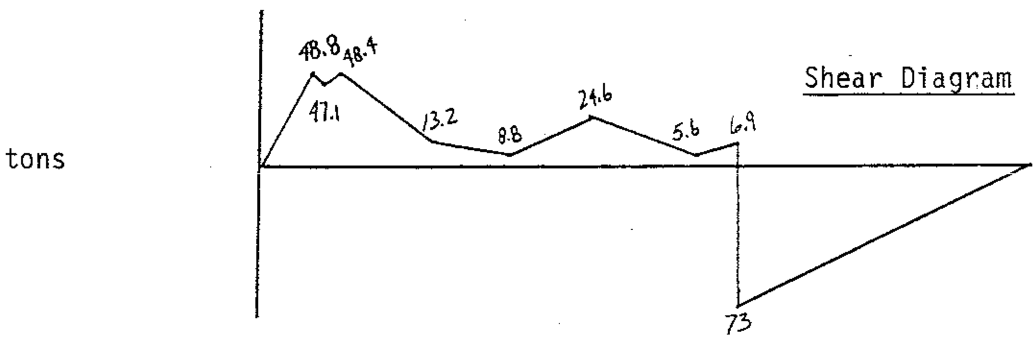
B = 6.16 tons/ft

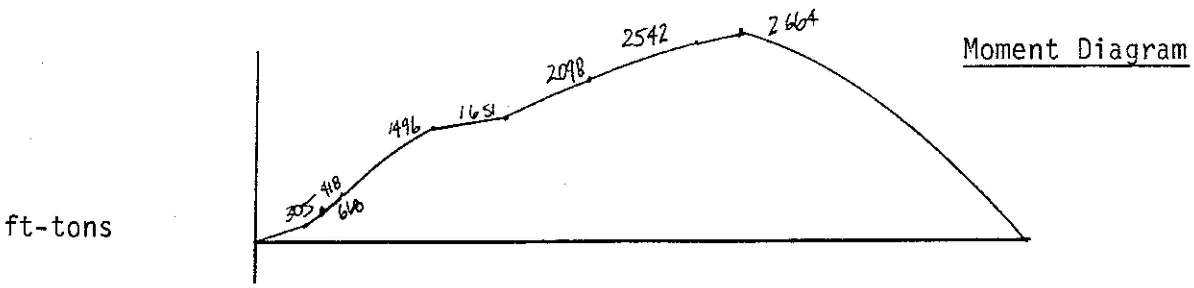
SLOPE: B = 6.16 - .044d

MST 408 - Diagrams









MST 408 - Analysis of Ballasting Stern Tanks

MST 408 - Stress Calculation

Max Bending Moment = 2664 ft-ton

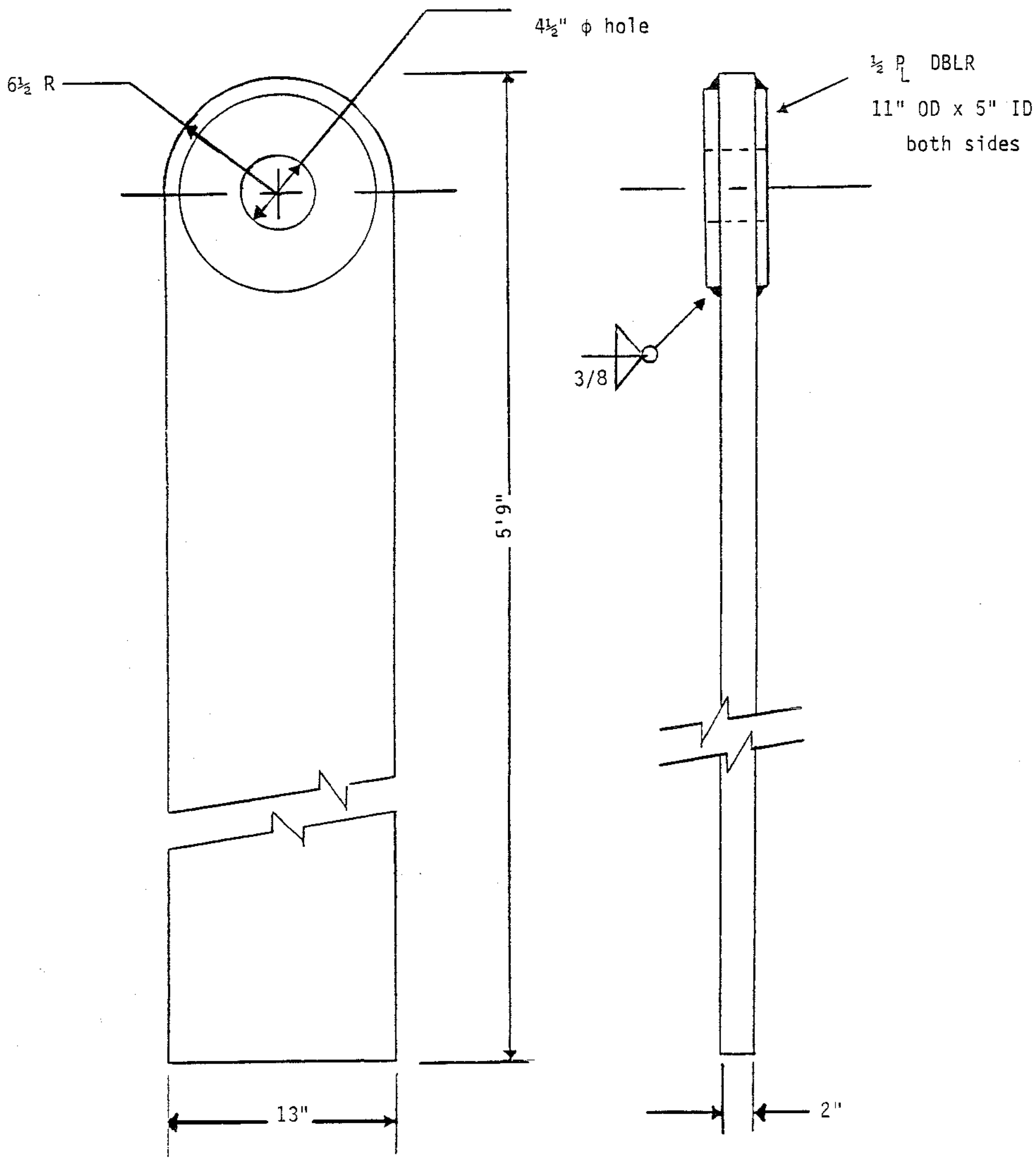
SM = $1.25 \times 10^4 in^3$

$$\sigma = \frac{BM}{SM} = \frac{2664 \text{ ft-ton}}{1.25 \times 10^4 \text{ in}^3} \cdot \frac{12 \text{ in}}{\text{ft}} \cdot \frac{2240 \text{ lb}}{} = \underline{\underline{5750 \text{ psi}}}$$

MST 331 - SALVAGE CALCULATIONS

Design and Installation on Bulkhead of 150 Ton Lifting Padeye

Use standard 4" shackle with 4¼" pin diameter



Scale: 1½" = 1'0"

MST 331 - Design and Installation of 150 Ton Lifting Padeye (cont)

1. Calculate Stress in Eye for 150 Ton Force

   a. Area, Bearing = dt = 4.25 x 3 = 12.75 in^2

   $$Stress_B = \frac{P}{A_B} = \frac{300K}{12.75} = 23{,}529 \text{ psi}$$

   b. Area, Tension = (13 - 4.75) x 3 = 24.75 in^2

   $$Stress_T = \frac{P}{A_T} = \frac{300K}{24.75} = 12121 \text{ psi}$$

   c. Area, Shear = 6.5 x 2 x 3 = 39 in^2

   $$Stress_S = \frac{P}{A_S} = \frac{300K}{39} = 7696 \text{ psi}$$

2. Find Required Area of 5/16" P_L Bulkhead to Resist Pull

   Design Stress = 22,000 psi

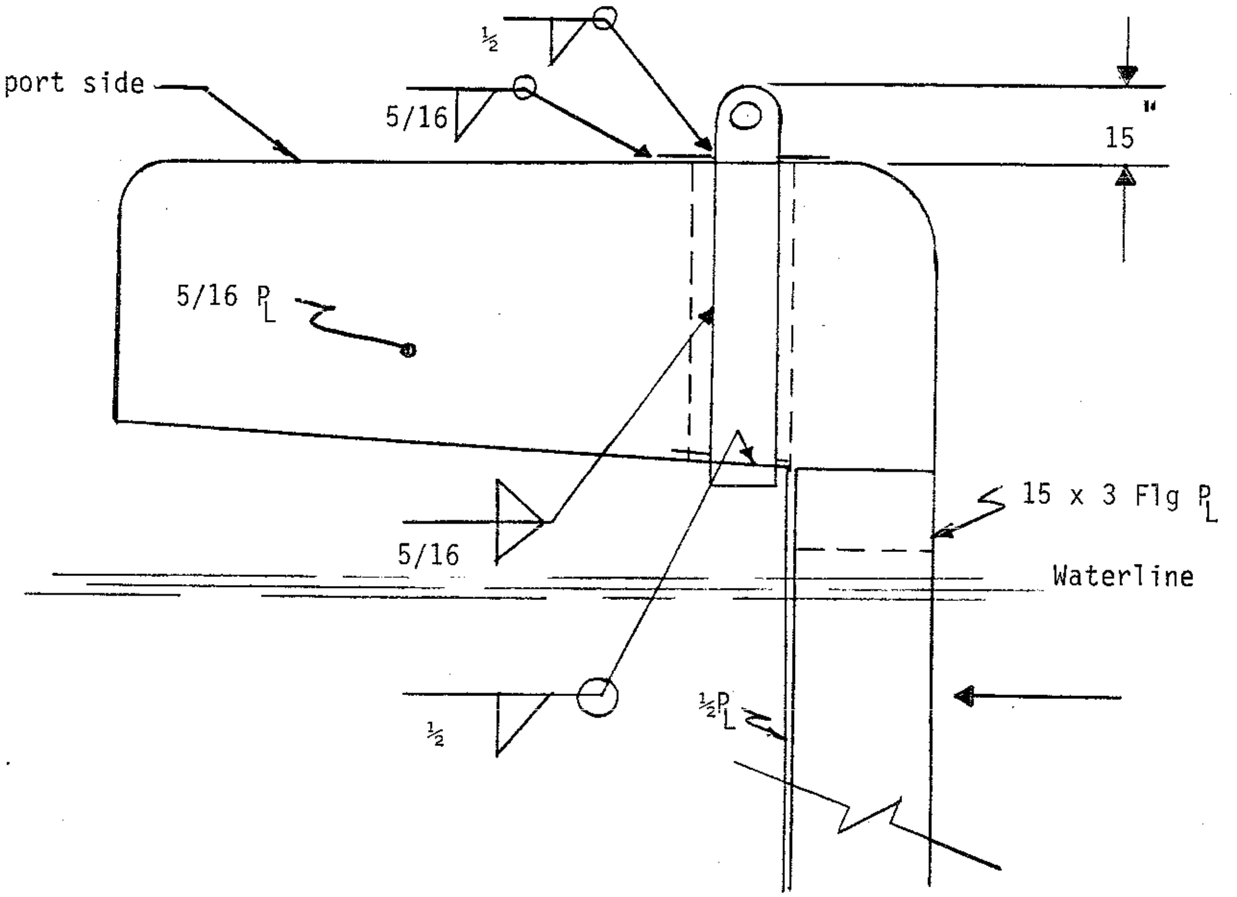
   $$A = \frac{P}{S} = \frac{300K}{22K} = 13.67 \text{ in}^2$$

   $$\text{Linear inches} = \frac{13.07}{.313} = 43.5 \text{ or 22" down each side}$$

   Depth of bulkhead (width of wing wall) is about 3'10" (46") for an eye running full width. There is twice as many linear inches as required. The force will be distributed into the shell and the hopper wall, as well as into the 15 x 3 FLG P_L transverse beam.

MST 331 - Design and Installation of 150 Ton Lifting Padeye(cont)

Installation of 150 Ton Padeye on Barge MST 331



1. Cut 2½" x 14" slot in outer shell and in hopper side alongside a bulkhead.

Scale: 3/8" = 1'

2. Weld ½" closure plates to padeye and to shell plating.

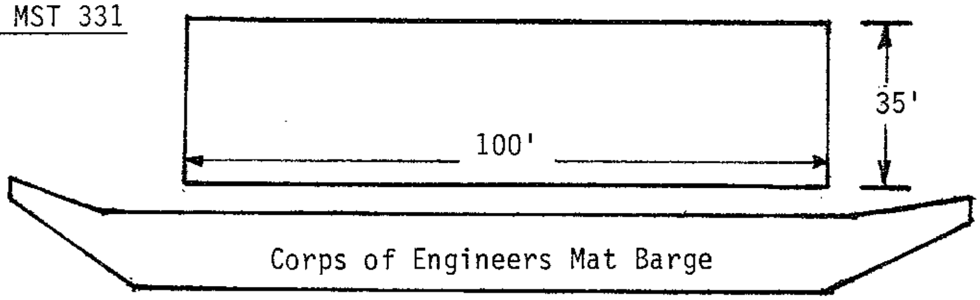
NOTE: Padeye width was increased to 34" to allow two eyes to be installed facilitating rigging to SOUTHERN 6. Also, the padeye was butted to hopper side rather than penetrating. (BML 1-6-83)

8 January 1983

MST 331 - SALVAGE CALCULATIONS

Stability of Mat Barge Based on Wind Loading of Stern Section

Windage on MST 331



Assume beam wind of 60 knots.

From Salvor's Handbook

$F = 0.004\ V^2\ A$

where F = Wind Force (lbs)

V = Wind Velocity (knots)

A = Projected Area (ft^2)

$F = 0.004(60)^2(3500)$

$= 50,400$ lbs

$= 25.2$ short tons

For 100 knot wind

$F = 0.004(100)^2(3500)$

$= 140,000$ lbs

$= 70$ short tons

MST 331 - Stability of Mat Barge . . . (cont)

Heeling Moment Induced

Heeling Arm $\cong \overline{BW}$ (Centroid of wind force)

$$VCB = 1.5$$

$$VCW = 9.5 + \frac{35}{2} = 27.0'$$

$$HA = 27 - 1.5 = 25.5'$$

Heeling MOM = (25.5)(25.2) = 642.6 ft $

= 573.75 ft L

At 60 knots:

$$\sin \theta = \frac{(\text{Heel MOM})}{\Delta\ GM}$$

$$= \frac{573.75}{(280)(34)}$$

$$= 0.06$$

$$\theta = 3.5^{0}$$

At 100 knots:

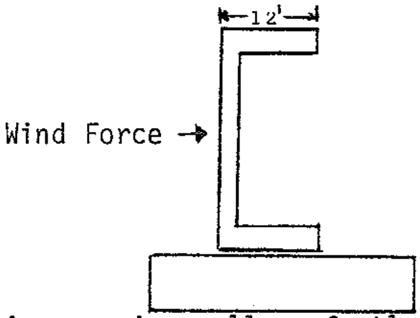
$$\sin \theta = \frac{(70)(25.5)}{(280)(34)(1.12)}$$

$$= 0.17$$

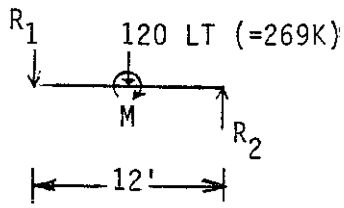
$$\theta = 9.6^{0}$$

MST 331 - Stability of Mat Barge . . . (cont)

The heeling moment will be resisted by the weld in the deck. Critical loading will be tension in the deck welds.



Assume wing wall perfectly stiff:



M (100 kts) = (70)(25.5)(2.24) = 4,000 ftK

$\Sigma F = 0 \Rightarrow 269K = R_2 - R_1$

$\Sigma M = 0 \Rightarrow (6)(269) + 4{,}000 = 12R_2$

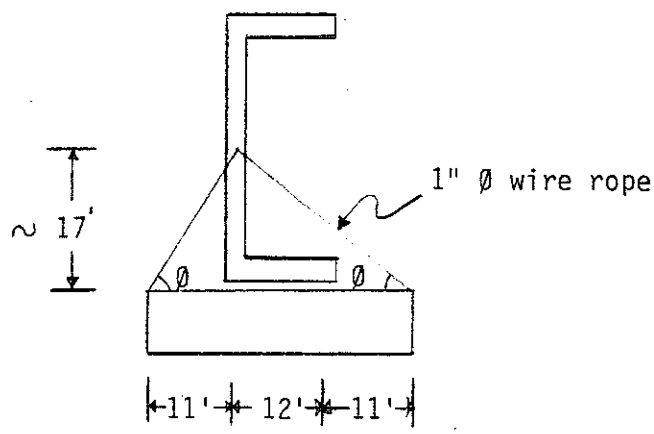
$R_2 = 468K$

$R_1 = 199K$

Assume ¼" fillet welds.

Allow load = 2K/in => 100 in weld required.

Add wire rope tie-downs at four locations.



MST 331 - Stability of Mat Barge . . . (cont)

1" Ø wire has B.S. of 70,000 #

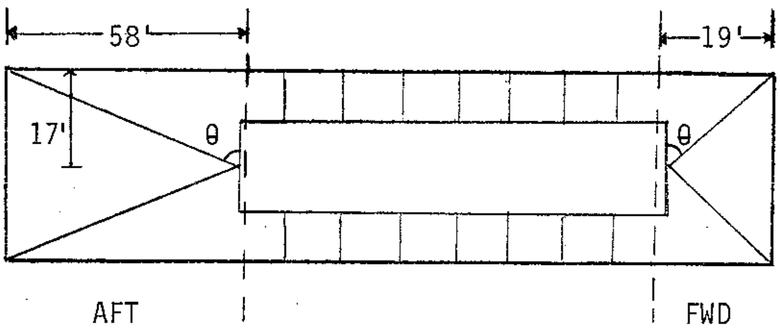
Assume an acceptable working load of 25K.

In transverse plane, bottom side of guy wire can provide a stablizing force of:

$$F = (25K)(\cos\theta)$$

$$= (25K)\left(\frac{11}{\sqrt{(17)^2 + (11)^2}}\right)$$

$$= 13.6K$$



$$F = (13.6)(\cos\theta)$$

On aft end wire supplies:

$$F = (13.6)\left(\frac{17}{\sqrt{(58)^2 + (17)^2}}\right)$$

$$= 3.8K$$

On forward end:

$$F = (13.6)\left(\frac{17}{\sqrt{(19)^2 + (17)^2}}\right)$$

$$= 9.1K$$

MST 331 - Stability of Mat Barge . . . (cont)

Total Lateral Moment to resist tipping:

$M_R = (3.8 + 9.1)(17) = 219$ ft.K

Unsatisfactory: Need additional guy wires.

How many 1" guys would be required?

Total Moment required: 4000 ft.K

MOM supplied by weld (& weight of barge)

$$(4000)\left(\frac{48}{100}\right) = 1920 \text{ ft.K}$$

Where 48 is inches available and 100 is inches required.

Required by additional wires:

$$4000 - 1920 - 219 = 1861$$

MOM provided by one 1" guy to side:

$$(13.6K)(17ft) = 231.2 \text{ ft.K}$$

Additional wires required:

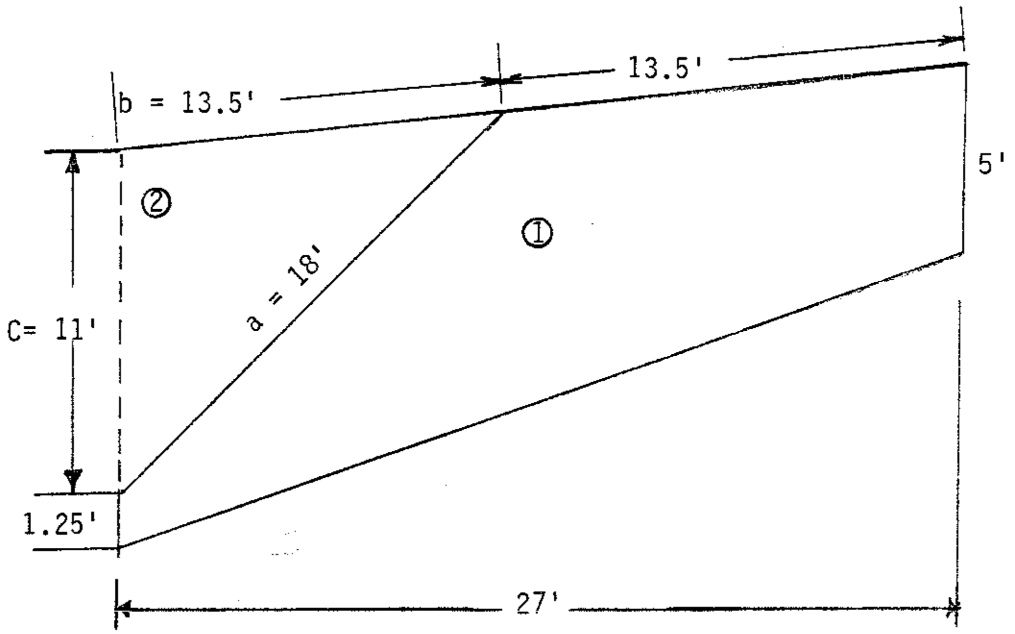
$$\frac{1861}{231.2} = 8 \text{ wires}$$

CGB 172 - Buoyancy of Intact Tanks

Calculate volume of each compartment in barge CGB 172 to determine buoyancy.

Size: 195' LOA x 35' x 12'

A. Assume forward rake to approximate a trapezoidal shape.



$$A_T = \frac{11 + 1.25 + 5}{2} \times 27$$

$$= 8.625 \times 27$$

$$= 232.88 \text{ ft}^2$$

Subtract area of the triangle 2

$$S = \frac{a + b + c}{2} = \frac{18 + 13.5 + 11}{2} = 21.25$$

$$a = \sqrt{S(S - a)(S - b)(S - c)}$$

$$a = 4.61 \sqrt{3.25 \times 7.75 \times 10.25}$$

$$a = 4.61 \times 16 = 74.1 \text{ ft}^2$$

$$\text{Net } A = 232.88 - 74.1 = 158.8 \text{ ft}^2$$

$$V = A \times \text{beam}$$

$$= 158.8 \times 35 = 5557.3 \text{ ft}^3$$

$$\text{Buoyancy} = \frac{5557.3}{36} = 154.37 \text{ tons}$$

CGB 172- Buoyancy of Intact Tanks (cont)

Cross sectional area of tanks:

A = (12 x 35) - (10.75 x 28.5)

A = 420 - 306.38

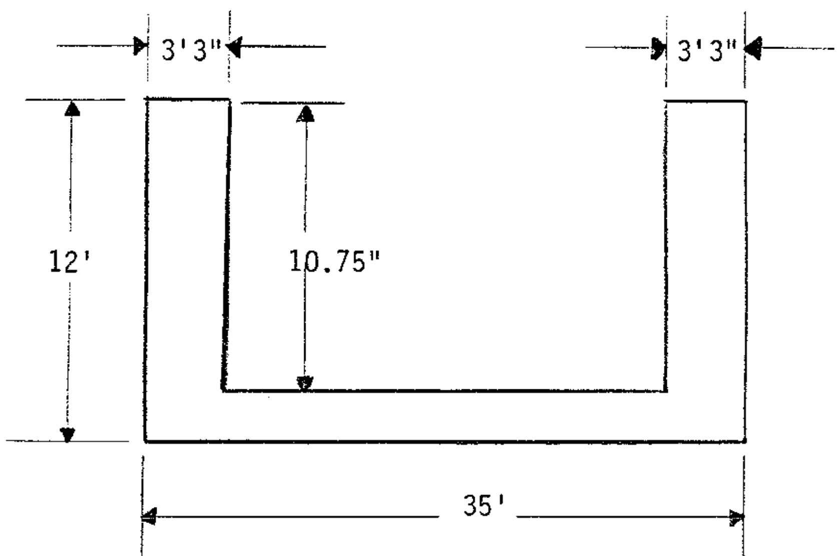
A = 113.6 ft^2

Volume of tank = 113.6 x 40.5 = 4601.6 ft^3

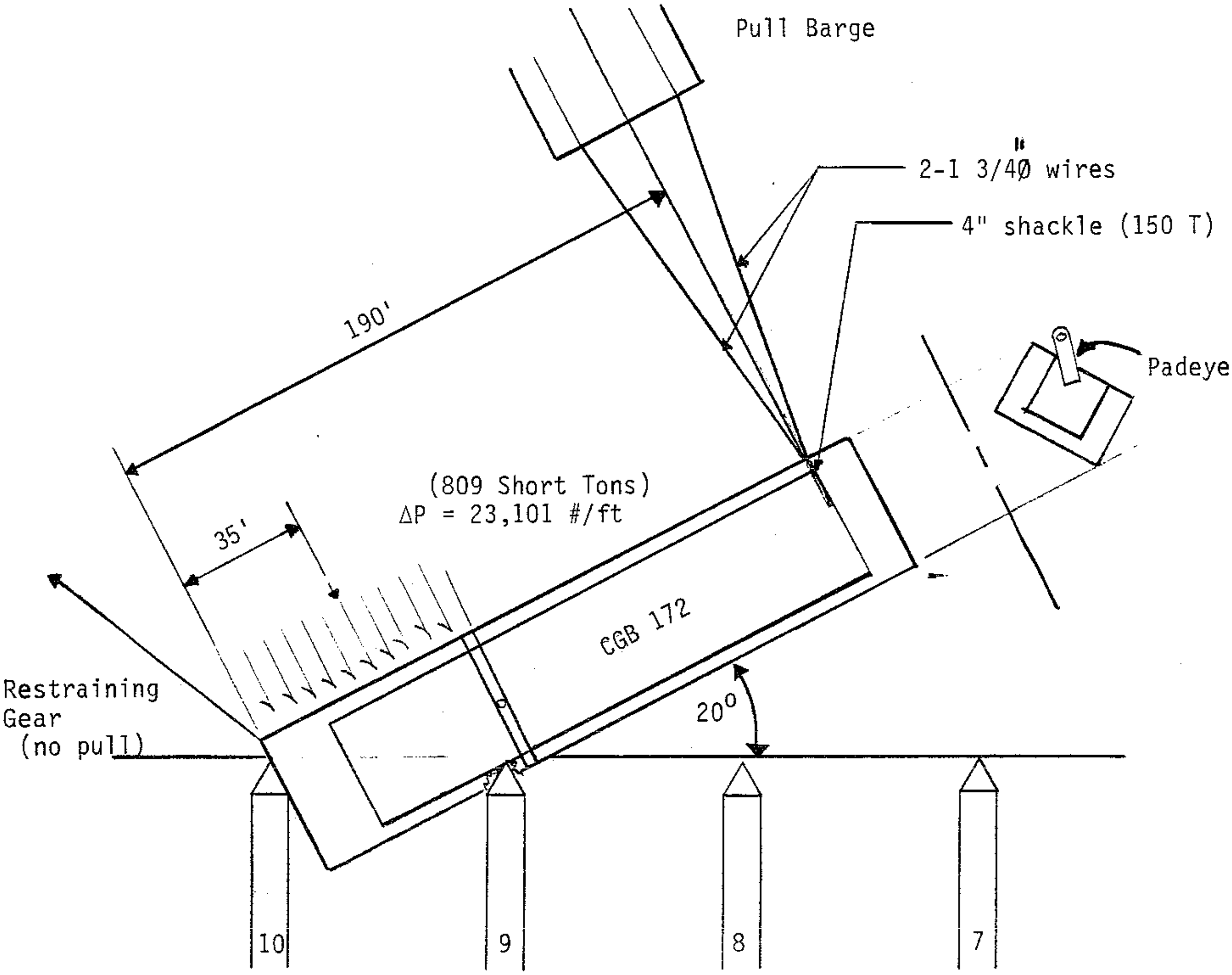
Buoyant Force = 127.8 tons per tank

Forward rake - Δ = 154 L.T.

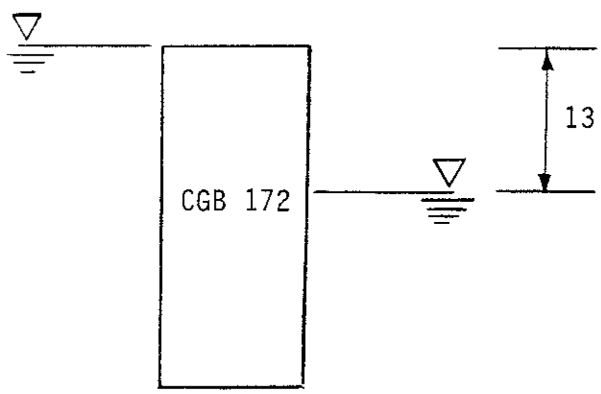
#1	= 127
#2	= 127
#3	= 127
#4	= 127
Aft tank	= 70 $\frac{(6 \times 35 \times 12)}{36}$
TOTAL	= 732 L.T.



Estimated Line Pull Required to Move CGB-172 Using the Pull Barge

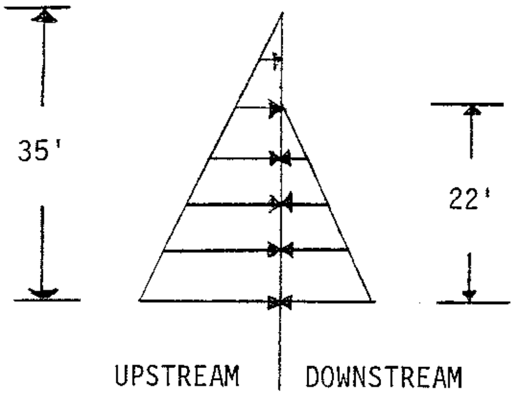


Assume section of CGB 172 bridging bay 9 is acting as a stoplog causing a 13 foot water level drop.



Estimated Line Pull Required to Move CGB 172 Using the Pull Barge (cont.)

The static pressure profile would look like:



(Assumes full breadth of barge being acted on)

$$F_{up} = \tfrac{1}{2}(35ft^2)(0.433psi/ft)(144in^2/ft^2)$$
$$= 38{,}190 \text{ lb/ft (length)}$$
$$F_{down} = \tfrac{1}{2}(22)^2(0.433)(144)$$
$$= 15{,}089 \text{ lb/ft}$$

$$\Delta P = F_{up} - F_{down} = 38{,}190 - 15{,}089$$
$$= 23{,}101 \text{ lb/ft}$$

Projected barge length: 70 feet

Total Force = 1,617,000 #
= 809 short tons

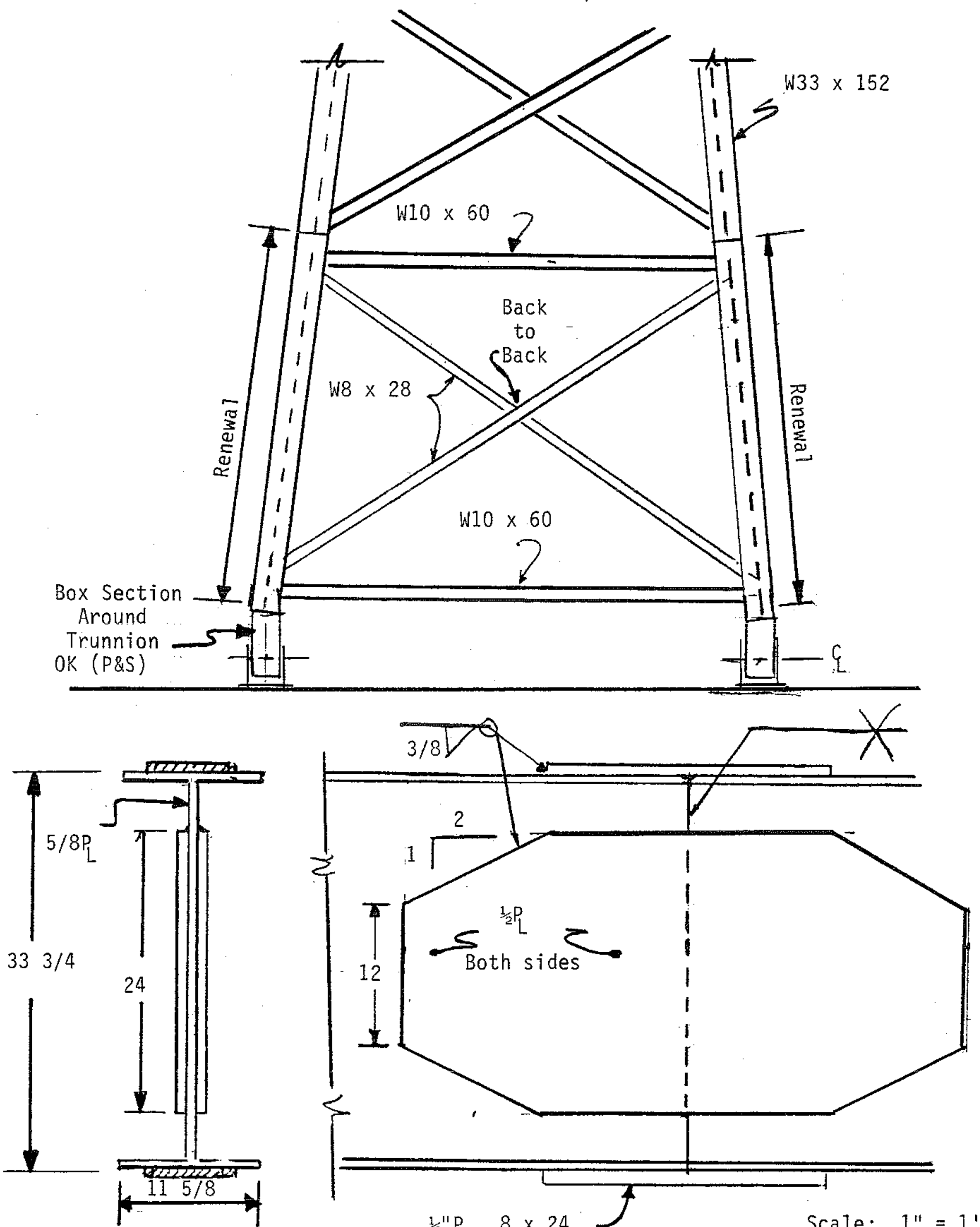
Force required by Pull Barge

$$\Sigma M_0 = 0 \Rightarrow (809)(35) = (F_{pull})(190)$$
$$F_{pull} = 149 \text{ tons}$$

Within Capability of AMCON Pull Barge.

4 January 1983

Damage Summary - AJAX - Repairs to Derrick



Scale: 1" = 1'0"

Damage Summary - AJAX - Repairs to Derrick (cont.)

Structure	Quantity	Size	Length
- 30' section of main leg	2	W33x152	30'
- 35' lower transverse I-beam	1	W10x60	35'
- 35' #2 transverse I-beam	1	W10x60	35'
- Diagonal braces between first and second transverse beams	2	W8x28	50'
- Ladder		FB 2½x3/8	60'
- Port backstop, forward leg	1	W12x72	30'
- Port backstop, wing brace	1	W12x72	15'

Miscellaneous

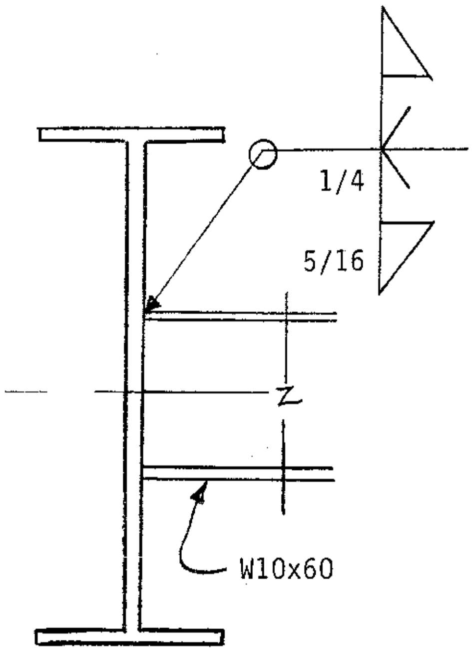
1 - Dodge, 3" bearing (4 bolt flange type for fairlead)

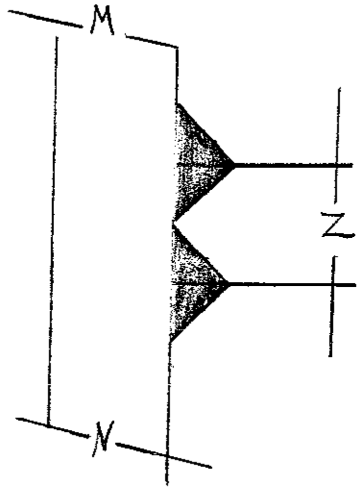
P_L

- Fairlead - 6' x 4' x 5/8"
- Port Backstop - 4' x 5' x ½", 4' x 4' x ½"
- Port Mainleg - ½" P_L (size unknown)
- Starboard Main Leg - 5' x 15' x ½"
- Lifting padeye-1½"P_L 36" x 14"

Damage Summary - AJAX - Repairs to Derrick (cont.)

Typical Intersection of Transverse I-Beam and Main Leg





14 January 1983

MST 312 - SALVAGE CALCULATIONS

Problem Statement

The barge is sunk as indicated on Sketch 1 and appears to be repairable. The plan is to attempt to refloat the barge by either slinging it to the surface or by pumping it out.

The purpose of these calculations is to develop a pumping plan and a procedure to sling the vessel. In either case, barge stress is to be checked to insure no additional vessel damage results.

Slinging will require both the SOUTHERN 6 and the AJAX due to the unwieldy nature of the load. Pumping may be accomplished from the CAPT. LUKE with an assist from either the AJAX or SOUTHERN 6.

The plan followed will largely depend on the extent of barge damage and on the availability of the AJAX and SOUTHERN 6.

Results of Diver Survey

A diver deployed on the wreck reported the vessel to be sunk as depicted in Sketch 1. He also reported finding coal extending 29 feet across the fore end of the hopper and three feet deep. The stack extended 20 feet fore and aft in a wedge shape. The volume of coal was estimated to be:

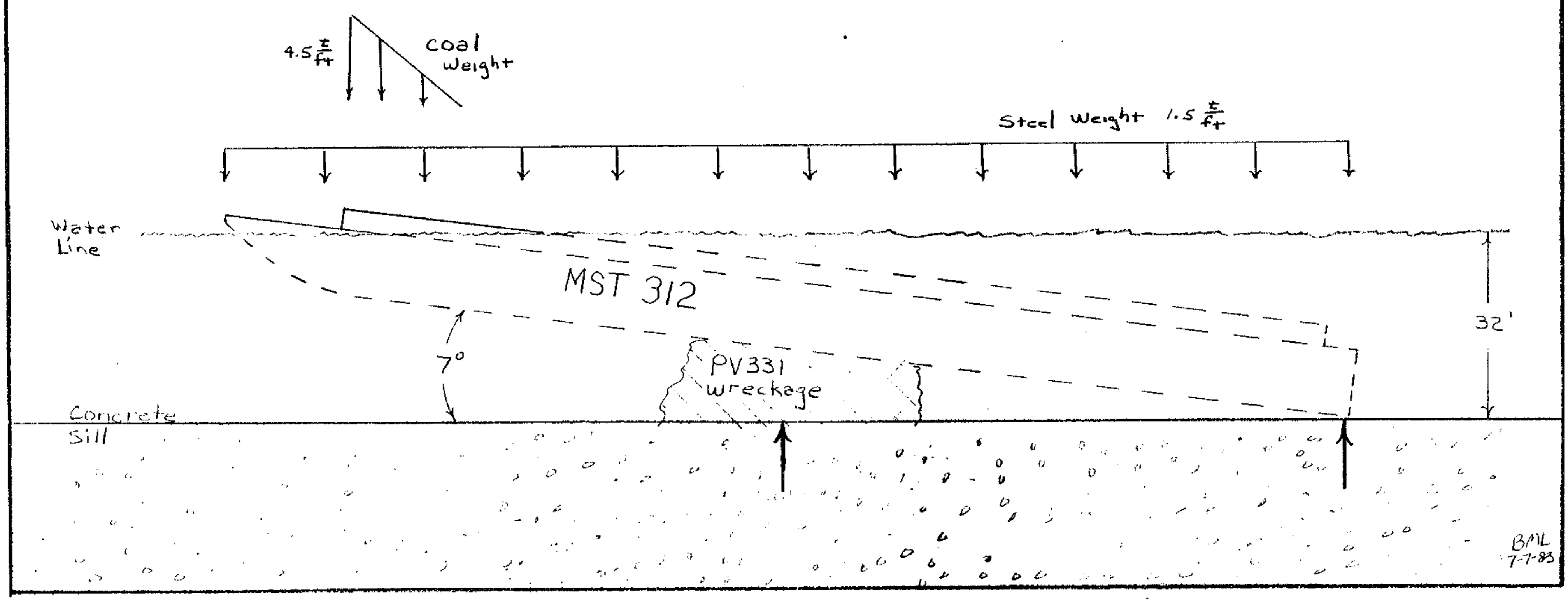
$$\begin{aligned}\text{Volume} &= \text{length} \times \text{breadth} \times \text{depth} \times \text{shape factor}\\ &= 20 \text{ ft} \times 29 \text{ ft} \times 3 \text{ ft} \times .5\\ &= 870 \text{ ft}^3\end{aligned}$$

The coal weight was estimated at:

$$\begin{aligned}\text{Weight} &= (\text{volume})(\text{specific weight})\\ &= (870 \text{ ft}^3)(901 \text{ lb/ft}^3)(\text{LT}/2240 \text{ lb})\\ &= 35 \text{ L.T.}\end{aligned}$$

The presence of a large volume of coal was considered questionable due to the slope of the hopper bottom. Nonetheless, the coal weight was considered in the pumping and slinging calculations as its effects were significant. However, the coal weight was not considered in the bending moment calculations as its effects were minimal.

WRECK OF MST 312



Sketch 1

Solution I - Procedure to Refloat by Pumping

Step 1 - Sandbag or cofferdam around the manhole into the fore peak tank.

Step 2 - Pump out the fore peak tank.

Step 3 - Pull a sling under the fore rake bulkhead and lift with 83 LT. This will expose the manholes into the #1 tanks.

Step 4 - Pump out the #1 tanks. The barge will rotate to a larger trim angle while still grounded at the stern.

Step 5 - Continue working the sling and pumping the tanks and hopper until the vessel is floating at moderate trim. Approximately 100 LT of crane capacity will be required.

NOTE: After a tank is pumped down, a damage survey and necessary repairs should follow to maintain water tight integrity.

Solution II - Procedure to Refloat by Slinging

Step 1 - Set slings around the barge in the way of the end most bulkheads. These bulkheads are located 30 feet in from the bow and 16 feet in from the stern. Rolled steel plates should be put between the barge shell and the slings to prevent localized barge damage.

Step 2 - Lift the barge until the hopper coaming clears the surface. Sling reactions are estimated at 193 LT (bow) and 134 LT (stern).

Step 3 - Pump out hopper to float the barge on its inner bottom.

Step 4 - Pump out all the tanks so that the barge floats at its light draft.

Note: Maximum primary bending stress in the hull resulting from slinging is estimated at only 9280 psi.

Results of Calculations

Tank Capacities

FP	151 LTFW
#1	151 LTFW
#2	107 LTFW
#3	107 LTFW
#4	83 LTFW
AP	140 LTFW
Hopper	1624 LTFW

Barge Structure

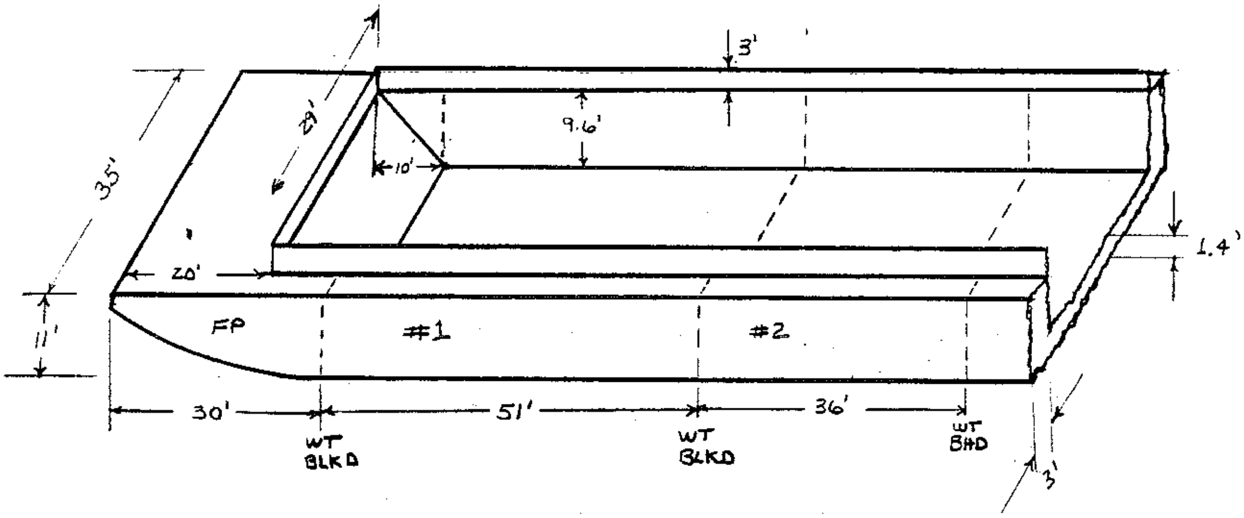
1.30×10^6 in^4 = Moment of inertia of the midship section about the neutral axis

1.47×10^4 in^3 = Section modulus to the top of the hopper coaming

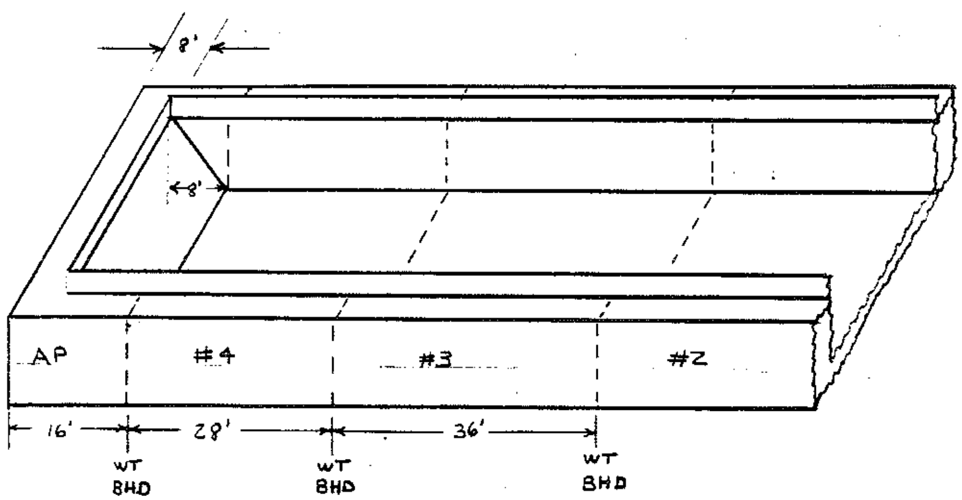
Barge Weight

Light ship displacement: 292.5 L.T.

SKETCHES FOR VOLUME CALCS



BOW OF MST 312



STERN OF MST 312

Sketch 2

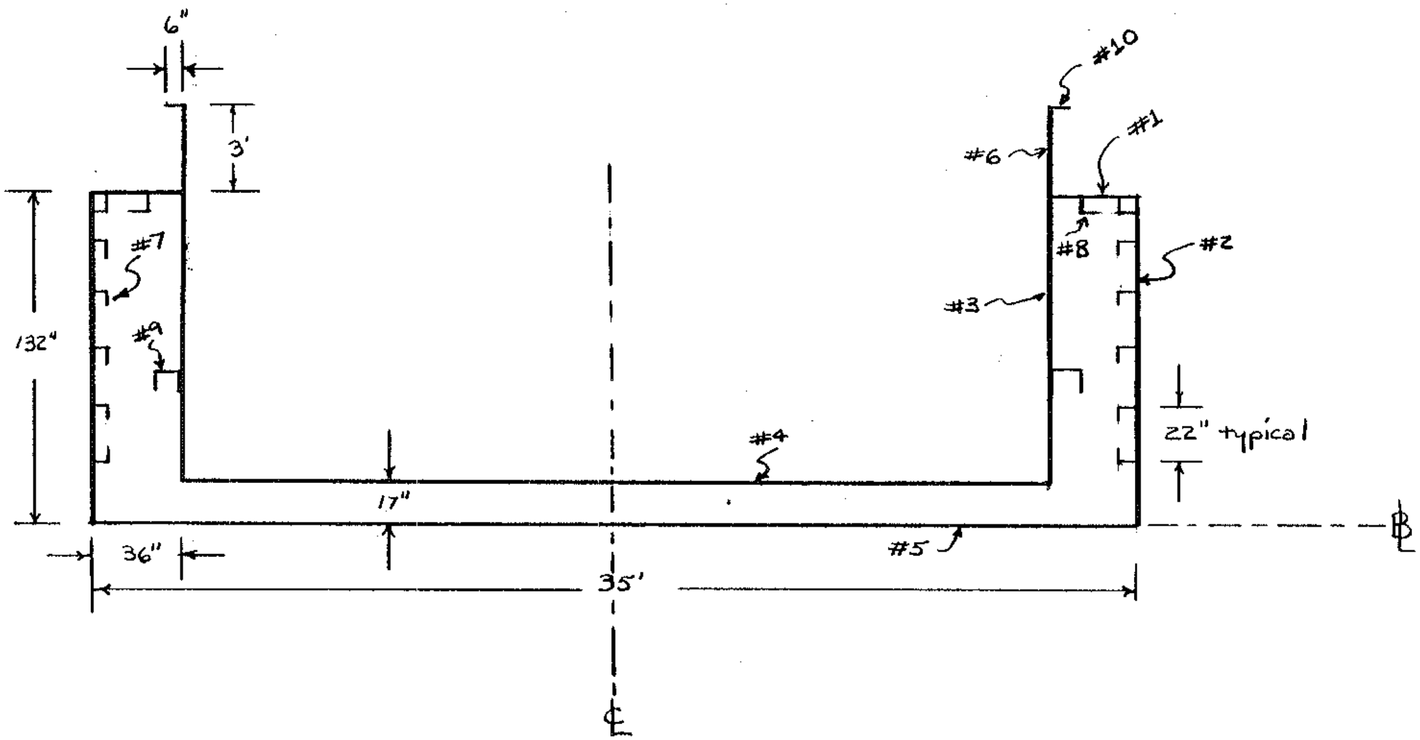
BML
7-8-83

CALCULATIONS - TANK CAPACITIES

(see Sketch 2)

TANK	PORTION	LENGTH (ft)	BEAM (ft)	DEPTH (ft)	SHAPE FACTOR	VOLUME (ft^3)	CAPACITY (LTFW)
Hopper	fore	10	29	12.6	.5	1827	
"	middle	151	29	12.6	1	55175	
"	aft	8	29	12.6	.5	1461	
TOTAL						58463	1624
Tank #1	port	51	3	11.0	1	1683	
"	stbd	51	3	11.0	1	1683	
"	DB	51	29	1.4	1	2071	
TOTAL						5437	151
Tank #2	port	36	3	11.0	1	1188	
"	stbd	36	3	11.0	1	1188	
"	DB	36	29	1.4	1	1462	
TOTAL						3838	107
Tank #3	port	36	3	11.0	1	1188	
"	stbd	36	3	11.0	1	1188	
"	DB	36	29	1.4	1	1462	
TOTAL						3838	107
Tank #4	port	28	3	11.0	1	924	
"	stbd	28	3	11.0	1	924	
"	DB	28	29	1.4	1	1137	
TOTAL						2985	83
Aft	full	16	35	11.0	1	6160	
"	-hopper	8	29	-9.6	.5	-1114	
TOTAL						5046	140
Fore	log	30	35	1.0	1	1050	
"	bow	30	35	10.0	.55	5755	
"	hopper	10	29	-9.6	.5	-1392	
TOTAL						5433	151

MIDSHIP SECTION
MST 312



Sketch 3

BML
7-11-83

CALCULATIONS - MIDSHIP SECTION PROPERTIES
(See Sketch 3)

Piece #	Type	Quantity	area	Distance to B_L	1st Moment about B_L	Distance to NA	Ad^2	I_{CG}
--	--	--	in^2	in	in^3	in	in^4	in^4
1	1/2"P_L	2	28	132	3696	87	211,932	----
2	3/8"P_L	2	99	66	6534	21	43,659	143,748
3	5/16"P_L	2	72	74.5	5364	29.5	62,658	79,212
4	1/2"P_L	1	174	17	2958	28	136,416	----
5	5/16"P_L	1	131	.25	33	44.75	262,336	----
6	5/16"P_L	2	22.5	150	3375	105	248,063	2,430
7	5x3x3/16"	12	17	66	1122	21	7,497	46
8	5x3x3/16"	4	9.6	132	1267	87	72,662	25
9	9"x13.4#	2	3.9	68	265	23	2,063	10
10	5/16"P_L	2	3.75	168	630	123	56,733	
TOTALS			560.75	———	25,244	———	1,104,024	224,471

Neutral Axis = N.A. = 1st moment/area = 25,244 in^3/ 560.75 in^2 = 45.0 in. above B_L

Moment of Inertia = $Ad^2 + I_{CG}$ = (1,104,029 + 224,471)in^4 = 1.33×10^6 in^4

Section Modulus to Coaming = $\frac{\text{Moment of Inertia}}{\text{Distance: coaming to N.A.}} = \frac{1.33 \times 10^6 \ in^4}{(132 + 36 - 45)in} = 1.08 \times 10^4 in^3$

MST 312 CALCULATIONS - WEIGHT ESTIMATE

ITEM	AREA	LENGTH	QUANTITY	VOLUME	WEIGHT
	in^2	in	--	in^3	LT
Sides	49.5	2340	2	231,660	28.7
Bottom	131.25	1788	1	234,675	28.7
Hopper bottom	174.0	1788	1	311,112	38.6
Hopper sides	36.0	2004	2	144,288	17.9
Coaming	13.13	4704	1	61,764	7.7
Side deck	18.0	2340	2	84,240	10.5
Fore deck	9.2	240	1	2,206	.3
Aft deck	9.2	96	1	883	.1
Hopper BHD	174	175	2	60,900	7.6
Fore rake bottom	157.5	420	1	66,150	8.2
Aft bottom piece	157.5	96	1	15,120	1.9
Wing BHD	8294	.375	5	15,552	1.9
Stern log	55,440	1.5	1	83,160	10.3
Head log	12,600	.75	1	9,450	1.2
NWT flrs	7.5	420	71	223,650	27.7
WT flrs	7.5	420	5	15,750	1.9
Buck frm	5.0	725	71	257,375	31.9
Side frm	2.5	2340	10	58,500	7.3
Side deck frm	2.5	2340	4	23,400	2.9
Hopper stringer	4.02	1788	2	14,376	1.8
Fore deck frm	2.5	240	13	7,800	1.0
Aft deck frm	2.5	96	13	3,120	.4
Rake truss	2.5	1200	5	15,000	1.9
Box truss	2.5	700	13	22,750	2.8
Coaming flng	3.125	36	68	7,650	1.0
Kevels	--	--	8	--	1.3
Misc. members	--	--	--	--	30.0
Paint	--	--	--	--	6.0
Steel margin	--	--	--	--	11.0
				Total Estimated "Light Ship" Weight	292.5 LT

MST 312 - Calculations for Pumping Plan

Problem

To pump out the MST 312, it is necessary to cause the barge to increase its trim angle so that the manholes into the #1 tank (located 36 feet aft of the head log) are above the water surface. Then the #1 tank can be pumped. The plan is to pump out the FP tank and then to lift with a sling until the manhole into the #1 tank surfaces. The question is,

"How much sling force is required?"

Data

Pumping out the FP tank will result in 151 LT of buoyancy, 175 feet forward of the stern. The unknown sling force will be applied 165 feet forward of the stern. The steel weight is 292.5 LT centered 97.5 feet forward. The coal weight is 35 LT centered 158 feet forward.

Sum Moments About the Stern

(151LT)(175ft) + (Sling Force)(165ft) = (292.5LT)(97.5ft) + (35LT)(158ft)

Sling Force = 46 LT

Note: This is the sling force required to cause the barge to begin to lift off the wreckage of the PV 331. This sling force is in addition to the pumping of the FP tank.

MST 312 - Calculations for Pumping Plan (cont)

Correct for Lost Buoyancy

As the bow of the barge rises above the water surface, the reduction in displacement results in a loss of buoyancy force from FP tank void. This force must be replaced by an increment in the sling force. The estimated loss in buoyancy is:

$$\begin{aligned}\text{Buoyancy Loss} &= \text{Length} \times \text{Beam} \times \text{Depth} \times \text{Shape Factor} \times \text{Specific Weight}\\ &= 36\text{ ft} \times 35\text{ ft} \times 5\text{ ft} \times .20 \times \text{LT}/36\text{ ft}^3\\ &= 35\text{ LT}\end{aligned}$$

This will result in a rise in sling force of:

$$\begin{aligned}\text{Sling Force Increment} &= (\text{lost buoyancy})\frac{\text{distance to FP tank}}{\text{distance to sling}}\\ &= (35\text{ LT})\,\frac{175\text{ ft}}{165\text{ ft}}\\ &= 37\text{ LT}\end{aligned}$$

The total sling force will then be:

$$\begin{aligned}\text{Sling Force Total} &= 46\text{ LT} + 37\text{ LT}\\ &= 83\text{ LT}\end{aligned}$$

Continue the Lift and Pump Process

The process of lifting one end of the barge and pumping accessible water tight spaces should be continued until the barge is floating on either the inner or outer bottom. Crane capacity equal to approximately 100 LT will be required to complete the process.

MST 312 - Calculations for Slinging Plan

Problem

Estimate the sling force required to lift the barge to the surface so that it may be pumped out.

Data

That weights to be lifted are the barge weight of 292.5 LT centered 97.5 feet forward of the stern log and 35 LT of coal at 158 feet forward. The slings will be landed 16 feet and 165 feet forward of the stern log.

Sum Forces

aft sling force + fore sling force = barge weight + coal weight

aft sling force = 292.5 LT + 35 LT - fore sling force

aft sling force = 327.5 - fore sling force

Sum Moments about Stern Log

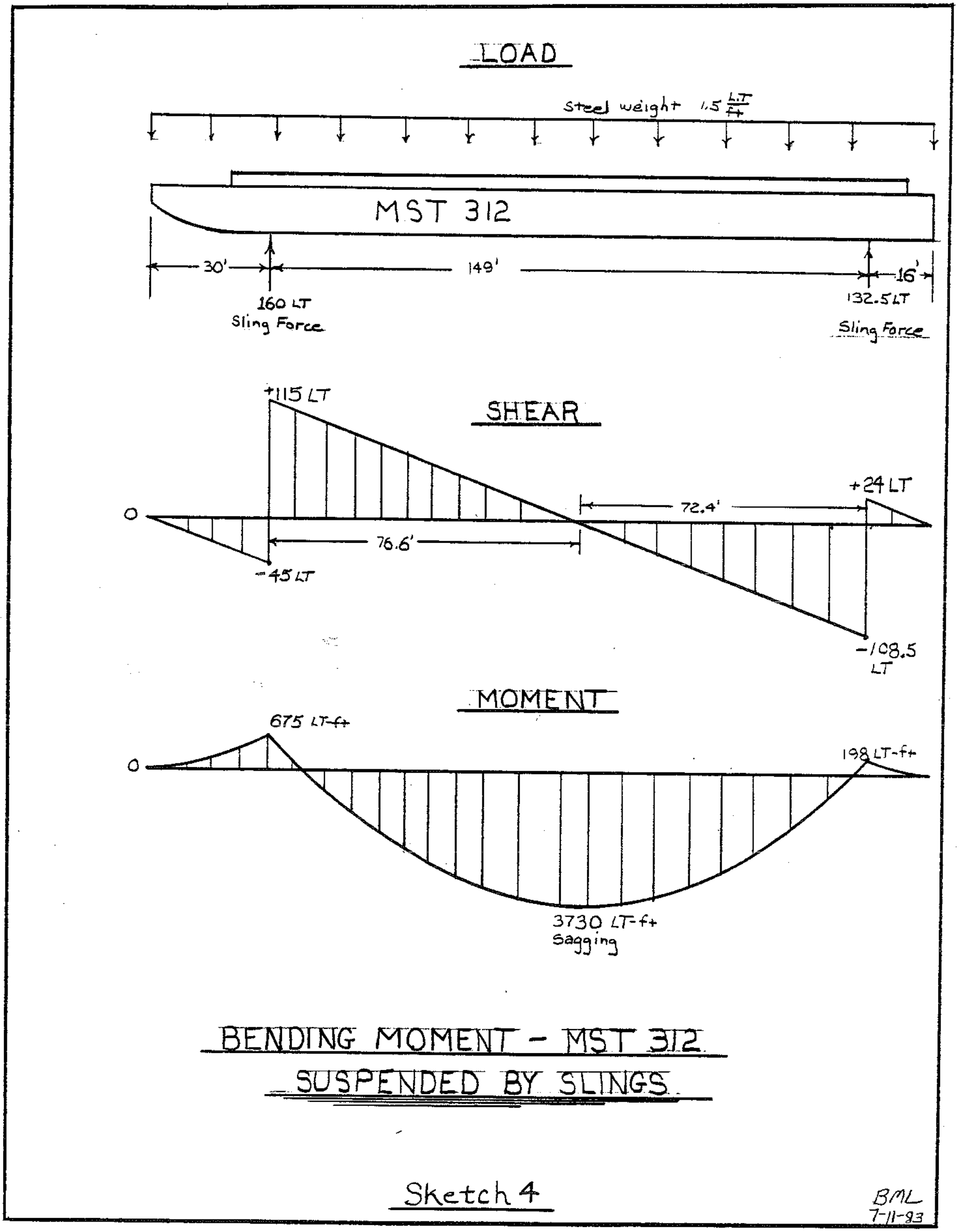
(aft sling force)(16ft) + (fore sling force)(165 ft)
= (barge weight)(97.5ft) + (coal weight)(158ft)

(327.5 - fore sling force)(16ft) + (fore sling force)(165 ft)
= (292.5 LT)(97.5ft) + (35 LT)(158ft)

fore sling force = 193.3 LT

Solve for Aft Sling Force

aft sling force = 327.5 LT - fore sling force
= (327.5 - 193.3) LT
= 134.2 LT


LOAD
Steel weight 1.5 LT/ft
MST 312
30'
149'
16'
160 LT
Sling Force
132.5 LT
Sling Force
SHEAR
+115 LT
+24 LT
0
72.4'
76.6'
-45 LT
-108.5 LT
MOMENT
675 LT-ft
198 LT-ft
0
3730 LT-ft
Sagging
BENDING MOMENT - MST 312
SUSPENDED BY SLINGS
Sketch 4
BML
7-11-93

MST 312 - Calculations for Primary Bending Stress

Problem

Both pumping out the fore end of the barge while the stern is grounded and slinging the barge from its ends will create sagging bending stress in the midships area of the hull. The latter is assumed to be the worst case and therefore, it will be used for calculation purposes.

Data

Maximum primary hull moment was calculated to be 3730 LT-ft sagging (see Sketch 4).

Section Modulus to the hopper coaming was calculated to be 1.08×10^4 in^3

Yield stress of the material is assumed to be 35 ksi.

Find Stress:

$$\text{Bending Stress} = \frac{\text{Max Moment}}{\text{Section Modulus}}$$

$$= \frac{(3730 \text{ LT-ft})}{(1.08 \times 10^4 \text{ in}^3)} \frac{(2240 \text{ lb})}{(\text{LT})} \frac{(12 \text{ in})}{(\text{ft})}$$

$$= 9280 \text{ psi compression at the top of the coaming}$$

Conclusion

The calculated bending stress is only 27% of the material yield stress. This is well within design limits for primary stress. Therefore, slinging the barge will not damage the longitudinal structure.

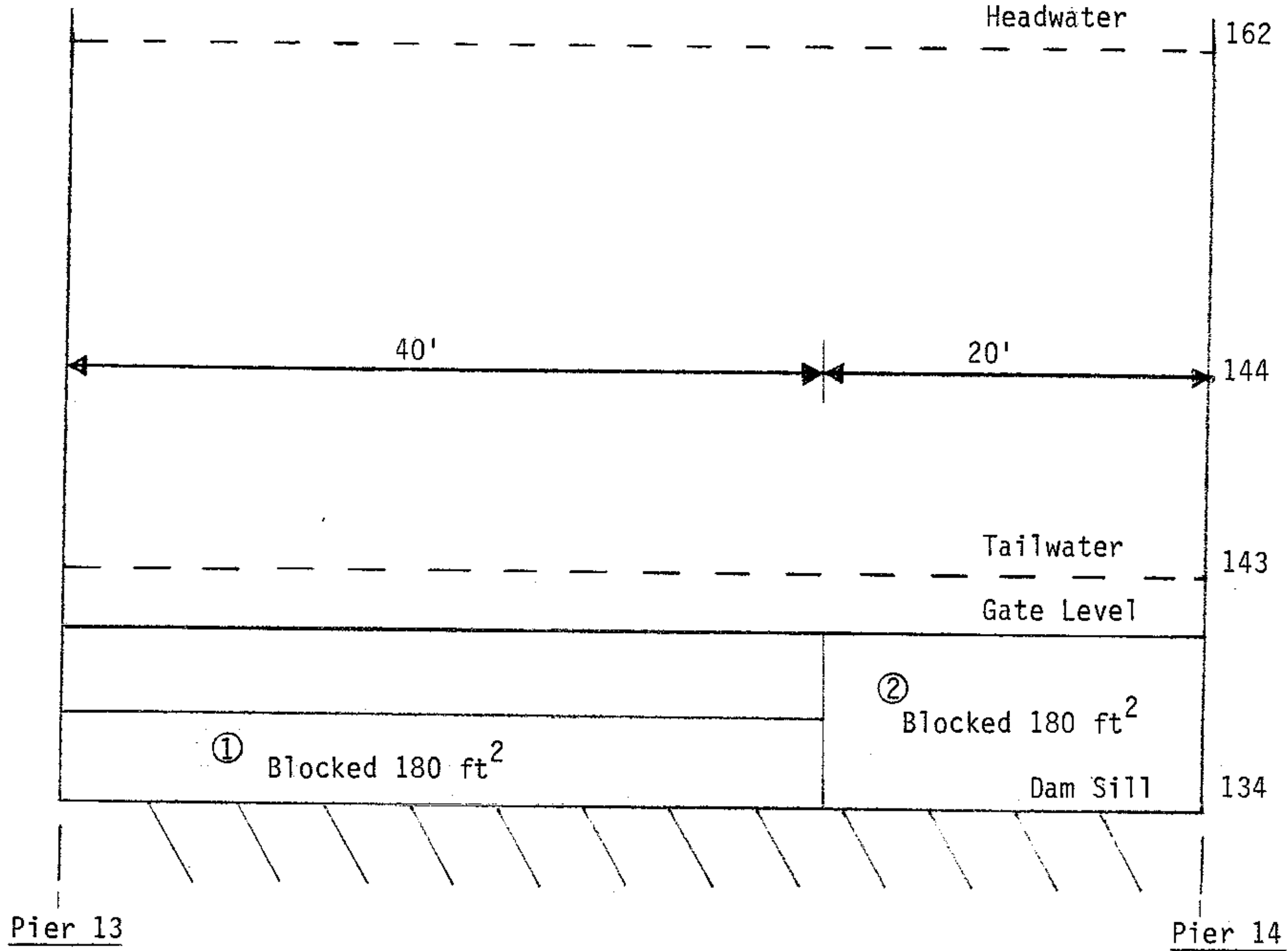
6 February 1983

PV 19B AND MST 351 - SALVAGE CALCULATIONS

Static and Dynamic Pressure on PV 19B and MST 351 In Way of Gate 13

MODEL

ELEVATION AT GATE 13 LOOKING DOWNSTREAM



Scale 1' = 10'

Headwater = 162 ft
Tailwater = 144 ft
Gate 13 is 9 feet open
Head = 162 - 144 = 18 feet

Assumptions:

Opening is totally blocked from twenty feet to the left of pier 14 to pier 14. Remainder of gate opening is fifty percent blocked (USACE).

Procedure:

Solve for dynamic and static pressure against wreckage for gate opening of one inch and one foot.

Static and Dynamic Pressure on PV 19B and MST 351 In Way of Gate 13 (cont.)

Condition 1. If gate is open one inch:

Velocity Potential = $\sqrt{2gh}$

h = Head = 18 ft (As long as gate level remains beneath tailwater)

$$V = \sqrt{2 \times 32.2\text{ft/sec}^2 \times 18\text{ft}} = \frac{34\text{ ft}}{\text{sec}} \Bigg| \frac{\text{sec-kts}}{1.69\text{ ft}} = 20\text{ knots}$$

$$D = C_D \tfrac{1}{2}\rho AV^2 \qquad P_{FW} = \frac{62.4\text{ lb}}{\text{ft}^3} \Bigg| \frac{\text{sec}^2}{32.2\text{ ft}}$$

C_D = 2.0 (Square cylinder, B/H = high)

A = (40ft)(4.5ft) - 180ft^2 (block 1)

V = 20 knots

A. Dynamic Pressure (drag) =

$$\frac{2.0}{} \Bigg| \frac{1}{2} \Bigg| \frac{62.4\text{lb}\ \ \text{sec}^2}{\text{ft}^3\ \ 32.2\text{ft}} \Bigg| \frac{180\text{ft}^2}{} \Bigg| \frac{34^2\text{ft}^2}{\text{sec}^2} \Bigg| \frac{\text{short ton}}{2000\text{ lb}} = 201.6\text{ short tons}$$

B. Static Pressure =

$P_{Depth} \times A$

h = 18 ft

h_{avg} = 9 ft

P_{Depth} = .433 psi/ft x 9 ft = 3.9 psi

A = (40)(4.5) + (20)(0) = 360 ft^2

$$= \frac{3.9\text{ lb}}{\text{in}^2} \Bigg| \frac{360\text{ft}^2}{} \Bigg| \frac{144\text{in}^2}{\text{ft}^2} \Bigg| \frac{\text{ton}}{2000\text{lb}} = 101\text{ short tons}$$

Static and Dynamic Pressure on PV 19B and MST 351 In Way of Gate 13 (cont.)

Condition 2: If gate is open one foot:

Head does not change until water "slopes" due to greater flow and velocity, therefore, static pressure does not change against blocked sections 1 and 2. However, as gate opens, Block #2 is affected, permitting greater dynamic pressure. Ultimately, the flowlines will approach the ideal condition and exert a maximum force of 2 x 201.6 = 403 tons

Conclusions:

1. Wreckage experiences 101 tons of static pressure due to an 18 foot head.
2. With gate raised just enough to eliminate contact with wreckage, the wreckage will experience something less than 202 tons of pressure. As the gate opens further, the dynamic drag will increase as the flow becomes more nearly ideal.
3. If the gate is raised significantly, not only will the drag become more ideal, but the area affected will double with a corresponding increase in drag.

Recommendations:

1. When pulling upstream, do not raise gate more than necessary to clear wreckage as it is pulled free.
2. When chain slings are rigged to port and starboard wing walls of the section of PV 19B extending into gate 14, the SOUTHERN 6 will have the load. The Pull Barge and SOUTHERN 6 should retract together, maintaining a horizontal pull instead of a vertical lift.