



**US Army Corps  
of Engineers ®**  
Rock Island District

# **OPERATION AND MAINTENANCE MANUAL**

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## **COTTONWOOD ISLAND REHABILITATION AND ENHANCEMENT**

### **UPPER MISSISSIPPI RIVER SYSTEM ENVIRONMENTAL MANAGEMENT PROGRAM**

#### **POOL 21, MISSISSIPPI RIVER MILES 328.5 - 331 LEWIS AND MARION COUNTIES, MISSOURI**

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**MARCH 2001**



REPLY TO  
ATTENTION OF:  
**CEMVR-PM-M**

**DEPARTMENT OF THE ARMY**  
**ROCK ISLAND DISTRICT, CORPS OF ENGINEERS**  
**CLOCK TOWER BUILDING - P.O. BOX 2004**  
**ROCK ISLAND, ILLINOIS 61204-2004**

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- B - Site Manager's Project Inspection and Monitoring Results
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**1. INTRODUCTION.**

**a. Project Responsibility.**

Per the Operation, Maintenance, and Rehabilitation Agreement (see Appendix A), upon completion of construction work, the U.S. Fish and Wildlife Service shall accept the project as part of the Mark Twain National Wildlife Refuge of the Cottonwood Island, Wildlife Management Area, Missouri. The Missouri Department of Conservation shall be responsible for 100 percent of all costs associated with operation, maintenance, and repair of the refuge.

**b. Purpose and Scope.**

(1) This manual serves as a guide for the operation and maintenance of the Cottonwood Island Rehabilitation and Enhancement project. It provides operation and maintenance instructions for the major features of this environmental management project. The instructions are consistent with the general procedures presented in the June 1996 Definite Project Report. This document is written for project and management personnel who are familiar with the project and does not contain detailed information that is common to site personnel or that is presented in other existing manuals or regulations.

(2) The intent of the operating instructions is to provide information that allows orderly and efficient use of the constructed features to meet project goals and objectives. The intent of the maintenance instructions is to present preventative maintenance information consisting of systematic inspections and subsequent corrective actions that should ensure long-term utilization of project features. A timely preventative maintenance program reduces and prevents major damage to constructed features by early corrective action.

(3) This manual provides the general standards of maintenance and establishes an initial frequency of maintenance inspections that should ensure satisfactory project performance.

**c. Use of Manual.**

(1) This manual is divided into the following sections: Section 1 - Introduction; Section 2 - Historical Summary; Section 3 - Description of Project Features; Section 4 - Inspections; Section 5 - Operation and Maintenance of Project Features; and Section 6 - Performance Monitoring and Assessment.

(2) Sections 2 and 3 present historical summaries and descriptions of actual features constructed for this project. Section 4 includes project inspection procedures, and Section 5 presents operation and maintenance instructions for each project feature. Section 6 summarizes

monitoring activities conducted through construction, as well as an overview of continued monitoring actions. Performance monitoring is considered necessary to properly evaluate effects of the constructed project features.

(3) The attached drawings have been included to provide general project “as-built” plans and typical sections.

## **2. HISTORICAL SUMMARY.**

### **a. Authorization and Location.**

(1) This project is authorized by the 1985 Supplemental Appropriations Act (Public Law 99-88) and Section 1103 of the Water Resources Development Act of 1986 (Public Law 99-662). The project was funded and constructed under this authorization by the U.S. Army Corps of Engineers, Rock Island District, in cooperation with the U.S. Fish and Wildlife Service (USFWS) and the Missouri Department of Conservation (MDOC).

(2) The Cottonwood Island complex encompasses approximately 463 acres of aquatic, wetland, and terrestrial habitat. It is located in Pool 21 on the Missouri side of the Upper Mississippi River navigation channel between river miles (RM) 328.5 and 331 in both Lewis and Marion Counties, Missouri, approximately 4 miles upstream of Lock and Dam 21.

### **b. Planning and Construction Activities.**

(1) Summary. Table 2.1 summarizes planning and construction activities.

(2) Goals and Objectives. Goals and objectives were formulated during the design phase. Table 2.2 summarizes project goals and objectives.

(3) Project Design. The Rock Island District of the U.S. Army Corps of Engineers designed the project in cooperation with the USFWS and the MDOC. Design considerations and investigations are presented in the Definite Project Report, dated June 1996.

(4) Construction Contracts. The Stage I construction contract, number DACW25-97-C-0009, was awarded to Massman Construction Company on 28 February 1997 in the amount of \$512,900, which was approximately 91% of the Government Estimate. Stage II, contract number DACW25-99-C-0008, was awarded to Mid River Wetland Restoration on 25 February 1999 for \$51,435.00, which was approximately 28% of the Government Estimate. Stage III, contract number DACW25-00-P-0006, was awarded to Sandy G Construction on 7 March 2000 for \$42,344.98, which was approximately 83% of the Government Estimate. The Rock Island District supervised the construction contracts.

**c. Actual Project Costs.** Table 2.3 presents the actual project costs.

**d. Project References.** Table 2.4 summarizes related project references.

**TABLE 2.1  
SUMMARY OF PLANNING AND CONSTRUCTION ACTIVITIES**

| Project Name      | Purpose  | Responsible Agency | Significant Events   |  | Remarks                    |
|-------------------|--|--------------------|--|--|----------------------------|
|                   |  |                    | Item   | Date   |                            |
| Pre-Project       | Identify and define problems and establish need of project   | Corps/USFWS        | Fact Sheet Submitted to ASA <sup>1/</sup><br>Approved by ASA   | December 1989<br>March 1990  |                            |
| Design            | Quantify project objectives, perform preliminary design, satisfy NEPA and permit requirements, develop performance evaluation plan, obtain project approval for construction | Corps              | Definite Project Report<br>Draft<br>Final<br>Approved  | August 1995<br>June 1996<br>July 1996  |                            |
|                   |  |                    | NEPA Compliance<br>SHPO Concurrence<br>Public Review<br>FONSI for EA   | 13 December 1994<br>January 1996<br>13 June 1996   |                            |
|                   |  |                    | Permits<br>Section 401<br>Section 402<br>Section 404<br>Refuge Compatibility   | 15 April 1996<br>7 June 1996<br>13 June 1996<br>23 January 1996  | Re-issued 23 May 1997      |
| Construction      | Finalize plans and specifications, obtain operation and maintenance agreement, advertise and award construction contracts, construct project                                 | Corps              | Plans and Specifications<br>Final-Stage I<br>Final-Stage II<br>Final-Stage III   | 19 December 1996<br>11 December 1998<br>7 February 2000  |                            |
|                   |  |                    | Real Estate<br>O&M Agreement   | 16 September 1996  | Reference Appendix A       |
|                   |  |                    | Stage I Advertised<br>Awarded<br>Substantially Complete<br><br>Stage II Advertised<br>Awarded<br>Substantially Complete<br><br>Stage III Advertised<br>Awarded<br>Substantially Complete | 13 January 1997<br>28 February 1997<br>21 October 1997<br><br>21 December 1998<br>25 February 1999<br>12 April 2000<br><br>7 February 2000<br>7 March 2000<br>8 May 2000 |                            |
| Post-Construction | Operate and maintain project   | USFWS/MDOC         |  |  | Reference Sections 4 and 5 |
|                   | Perform evaluation monitoring  | Corps              |  |  | Reference Section 6        |

Notes:

<sup>1/</sup> Assistant Secretary of the Army

**TABLE 2.2**  
**PROJECT GOALS, OBJECTIVES, AND ENHANCEMENT POTENTIAL**

| Goal   | Objective  | Enhancement Feature  | Unit                                    | Year 0 Without Alternative | Year 0 With Alternative | Year 50 Target With Alternative |
|--|--|--|---|----------------------------|-------------------------|---------------------------------|
| <b>Restore Aquatic Overwintering Habitat</b> | Improve water quality for fish   | Chute restoration and enhancement  | mg/l D.O.                               | <5                         | >5                      | >5                              |
|  | Provide over-wintering water habitat for fish                              | (Depth $\geq$ 6' < 10')  | acre                                    | 1.9                        | 4.5                     | 4.5                             |
|  |  | Create deep holes (Depth $\geq$ 10')   | acre/hole                               | 0                          | 0.3                     | 0.3                             |
|  |  |  | fish numbers                            | --                         |                         | --                              |
|  |  | Raise causeway road and remove culvert to minimize silting.                              |   |                            |                         |                                 |
| <b>Restore Main Channel Border Habitat</b>   | Provide flowing water habitat for fish                                     | Notch wing dams  | ft/sec                                  |                            |                         |                                 |
|  |  | (100' upstream of wing dam)  |   | 0.3 <sup>1/</sup>          | 0.35 <sup>1/</sup>      | 0.35 <sup>1/</sup>              |
|  |  | (at wing dam)  |   | 1.0 <sup>1/</sup>          | 0.50 <sup>1/</sup>      | 0.50 <sup>1/</sup>              |
|  |  | (100' downstream of wing dam)  |   | 0.3 <sup>1/</sup>          | 0.40 <sup>1/</sup>      | 0.40                            |
|  |  | (areal extent of scour $\geq$ 1')  | ft <sup>2</sup>                         | 0                          | 0                       | <sup>3/</sup>                   |
|  | Provide additional habitat and substrate for benthic and aquatic organisms | Rock placement below wing dams   | number of benthic and aquatic organisms |                            |                         |                                 |
| <b>Restore Wetland Habitat</b>               | Increase food, shelter, and breeding habitat for wildlife                  | Pothole: 1   | ft <sup>2</sup> , <sup>2/</sup>         | 0                          | 783.60                  | <sup>3/</sup>                   |
|  |  | 2  | ft <sup>2</sup> , <sup>2/</sup>         | 0                          | 898.81                  | <sup>3/</sup>                   |
|  |  | 3  | ft <sup>2</sup> , <sup>2/</sup>         | 0                          | 880.56                  | <sup>3/</sup>                   |
|  |  | 4  | ft <sup>2</sup> , <sup>2/</sup>         | 0                          | 847.70                  | <sup>3/</sup>                   |
|  |  | 5  | ft <sup>2</sup> , <sup>2/</sup>         | 0                          | 841.98                  | <sup>3/</sup>                   |
|  | Increase bottomland hardwood diversity and quality                         | Establish hardwood trees in existing forest management, crop, and dredge placement areas | percent survival                        | 0                          | 100%                    | 20%                             |
|  |  |  | acres (mast tree present)               | 0                          | 53.97                   | 30                              |
|  |  |  | percent (mast tree basal area)          | 0                          | 100                     | 10                              |
|  |  |  |   |                            |                         |                                 |
|  |  |  |   |                            |                         |                                 |

<sup>1/</sup> From Hydraulic Study at a discharge of 40,000 ft<sup>3</sup>/s (see DPR Appendix H).

<sup>2/</sup> Cross-sectional area measured on short chord below elevation line of 475'.

<sup>3/</sup> To be determined with future monitoring.

**TABLE 2.3  
ACTUAL PROJECT COSTS**

| <b>CONTRACT NO: DACW25-97-C-0009 (COTTONWOOD ISLAND REHABILITATION AND ENHANCEMENT)</b>                   |  |                 |                        |                       |                          |
|---|--|-----------------|------------------------|-----------------------|--------------------------|
| <b>Item</b>   | <b>Description</b>   | <b>Quantity</b> | <b>Unit of Measure</b> | <b>Unit Cost (\$)</b> | <b>Total Amount (\$)</b> |
| 0001  | Bonds  | 1               | LS                     | 8000.00               | 8000.00                  |
| 0002  | Clearing - Channel Excavation                                      | 1               | LS                     | 500.00                | 500.00                   |
| 0003  | Channel Excavation, 9' Depth                                       | 35655           | CY                     | 4.30                  | 153359.50                |
| 0004  | Channel Excavation, 15' Depth                                      | 29755           | CY                     | 5.50                  | 114152.50                |
| 0005  | Pothole Excavation, ½ Acre   | 2               | EA                     | 15000.00              | 30000.00                 |
| 0006  | Pothole Excavation, 1 Acre   | 3               | EA                     | 31000.00              | 93000.00                 |
| 0007  | Seeding  |                 |                        |                       |                          |
| 0007AA  | Agricultural Field   | 1               | LS                     | 29000.00              | 29000.00                 |
| 0007AB  | All Other Disturbed Areas  | 1               | LS                     | 7500.00               | 7500.00                  |
| 0008  | Notch Wing Dams  | 6               | EA                     | 14250.00              | 85500.00                 |
| 0009  | Additional Clearing/Channel  | 1               | LS                     | 32658.61              | 32658.61                 |
| 0010  | Additional Clearing/Pothole  | 1               | LS                     | 17172.70              | 17172.70                 |
| 0011  | Mob & Demob  | 1               | LS                     | 33233.15              | 33233.15                 |
|   | <b>Total for DACW 25-97-C-0009</b>                                 |                 |                        |                       | <b>604,076.46</b>        |
| <b>CONTRACT NO: DACW25-99-C-0008 (COTTONWOOD ISLAND HABITAT REHABILITATION AND ENHANCEMENT, STAGE II)</b> |  |                 |                        |                       |                          |
| <b>Item</b>   | <b>Description</b>   | <b>Quantity</b> | <b>Unit of Measure</b> | <b>Unit Cost (\$)</b> | <b>Total Amount (\$)</b> |
| 0001  | Bonds  | 1               | LS                     | 500.00                | 500.00                   |
| 0002  | Planting of Container Grown Trees, Except Excavated Materials Berm |                 |                        |                       |                          |
| 0002AA  | Pin Oak (Quercus palustris)  | 500             | EA                     | 13.60                 | 6800.00                  |
| 0002AB  | Sycamore (Platanus occidentalis)                                   | 270             | EA                     | 13.60                 | 3672.00                  |
| 0002AC  | Bur Oak (Quercus macrocarpa)                                       | 500             | EA                     | 13.60                 | 6800.00                  |
| 0002AD  | Northern Pecan (Carya illinoensis)                                 | 500             | EA                     | 13.60                 | 3800.00                  |
| 0002AE  | Swamp White Oak (Quercus bicolor)                                  | 510             | EA                     | 13.60                 | 5936.00                  |
| 0003  | Weed Barrier Mats, Except Excavated Materials Berm                 | 2280            | EA                     | 1.00                  | 2280.00                  |
| 0004  | Seeding, Except Excavated Materials Berm                           | 1               | LS                     | 7800.00               | 7800.00                  |
| 0005  | Herbicide Treatment, Except Excavated Materials Berm (not used)    |                 |                        |                       |                          |
| 0006  | Protection Fencing, Except Excavated Materials Berm                | 75              | EA                     | 19.00                 | 1425.00                  |
| 0007  | Deer Repellent, Except Excavated Materials Berm                    | 75              | EA                     | 2.00                  | 150.00                   |
| 0008  | Planting of Container Grown Trees, Excavated Materials Berm        |                 |                        |                       |                          |
| 0008AA  | Pin Oak (Quercus palustris)  | 70              | EA                     | 13.60                 | 952.00                   |
| 0008AB  | Sycamore (Platanus occidentalis)                                   | 40              | EA                     | 13.60                 | 544.00                   |
| 0008AC  | Bur Oak (Quercus macrocarpa)                                       | 70              | EA                     | 13.60                 | 952.00                   |
| 0008AD  | Northern Pecan (Carya illinoensis)                                 | 70              | EA                     | 13.60                 | 952.00                   |
| 0008AE  | Swamp White Oak (Quercus bicolor)                                  | 70              | EA                     | 13.60                 | 952.00                   |
| 0009  | Weed Barrier Mats, Excavated Materials Berm                        | 320             | EA                     | 1.00                  | 320.00                   |
| 0010  | Seeding, Excavated Materials Berm                                  | 1               | LS                     | 3600.00               | 3600.00                  |
| 0012  | P00002 Seeding Ag-Field  | 1               | LS                     | 16476.60              | 16476.60                 |
|   | <b>Total for DACW25-99-C-0008</b>                                  |                 |                        |                       | <b>67,911.6</b>          |
| <b>CONTRACT NO: DACW25-00-P-0006 (COTTONWOOD ISLAND STAGE III, CAUSEWAY ROAD RAISE)</b>                   |  |                 |                        |                       |                          |
| <b>Item</b>   | <b>Description</b>   | <b>Quantity</b> | <b>Unit of Measure</b> | <b>Unit Cost (\$)</b> | <b>Total Amount (\$)</b> |
| 0001  | Road Stone   |                 |                        |                       |                          |
| 0001AA  | First 100 Tons   | 100             | TN                     | 18.15                 | 1815.00                  |
| 0001AB  | Over 100 Tons  | 109             | TN                     | 18.15                 | 1979.62                  |
| 0002  | Clearing & Grubbing  | 1               | LS                     | 3000.00               | 3000.00                  |
| 0003  | Roadway Embankment   | 1               | LS                     | 8000.00               | 8000.00                  |
| 0004  | Filter Fabric (under stone protection)                             | 975             | SY                     | 2.14                  | 2086.50                  |
| 0005  | Stone Protection, Bedding Stone & Granular Surfacing               |                 |                        |                       |                          |

**TABLE 2.3 (Continued)**

| <b>Item</b> | <b>Description</b>                           | <b>Quantity</b> | <b>Unit of Measure</b> | <b>Unit Cost (\$)</b> | <b>Total Amount (\$)</b> |
|-------------|--|-----------------|------------------------|-----------------------|--------------------------|
| 0005AA      | First 365 Tons                               | 365             | TN                     | 18.50                 | 6752.50                  |
| 0005AB      | Over 365 Tons                                | 63              | TN                     | 18.50                 | 1157.55                  |
| 0006        | Stone Protection, Riprap                     |                 |                        |                       |                          |
| 0006AA      | First 620 Tons                               | 620             | TN                     | 23.10                 | 14322.00                 |
| 0006AB      | Over 620 Tons                                | 197             | TN                     | 23.10                 | 4541.23                  |
| 0007        | Geotextile Fabric (under granular surfacing) | 300             | SY                     | 2.64                  | 792.00                   |
|             | <b>Total for DACW25-00-P-0006</b>            |                 |                        |                       | <b>44,446.40</b>         |
|             |  |                 |                        |                       |                          |
|             |  |                 |                        |                       |                          |
|             | Total Construction                           |                 |                        |                       | 716,434.46               |
|             | Planning, Engineering, and Design (est)      |                 |                        |                       | 601,528.96               |
|             | Construction Management (est)                |                 |                        |                       | 86,986.16                |
|             |  |                 |                        |                       |                          |
|             | <b>Total Project Costs (est)</b>             |                 |                        |                       | <b>\$1,404,949.58</b>    |



**TABLE 2.4  
PROJECT REFERENCES**

| <b>Title</b>   | <b>Date</b>                                | <b>Purpose</b>   |
|--|--|--|
| Upper Mississippi River System Environmental Management Program, Definite Project Report (R16F) with Integrated Environmental Assessment, Cottonwood Island Habitat Rehabilitation and Enhancement, U.S. Army Corps of Engineers, Rock Island District | June 1996                                  | Provides planning, engineering, and sufficient construction details of the selected plan for project approval purposes |
| Construction As-Built: Stage I<br>Stage II<br>Stage III  | March 1998<br>October 2000<br>October 2000 | Provides as-built construction drawings  |
| Contractor Submittals: Stage I<br>Stage II<br>Stage III  | March 1998<br>October 2000<br>October 2000 | Provides detailed construction information   |

### 3. DESCRIPTION OF PROJECT FEATURES.

**a. General Description.** The Cottonwood Island project consists of a mechanically excavated side channel to restore aquatic overwintering habitat, notched wing dams to restore main channel border, and mechanically excavated potholes and planting mast trees to restore wetland habitat.

(1) Side Channel Excavation. The lower 4,550 feet of Cottonwood Chute was mechanically excavated to improve water quality and provide overwintering water habitat for fish. The bottom width of the excavation was 40 feet, with a depth of 9 feet below flat pool (elev. 470 NGVD 1912). The channel includes 4 deep holes, 300 feet long and 15 feet below flat pool. Side slopes are approximately 2H:1V. For side channel cross sections, see plates 11 through 13. For side channel profiles, see plates 14 through 16.

(2) Wing Dam Notching. Six wing dams were notched to provide flowing water habitat for fish and provide additional habitat and substrate for benthic and aquatic organisms. Notches were created by removing existing wing dam material to the original river bottom or a maximum of 10 feet below flat pool. Each notch was 100 feet long. For wing dam notching details, see plate 17. Notches were staggered in anticipation that flow would increase in the vicinity of the notch, creating a scour hole behind the wing dams and stimulating a meander to the next wing dam. Preliminary post-construction monitoring efforts indicate the formation of scour holes behind the wing dams and an increase in velocity at and below the notch.

(3) Potholes. Pothole construction and configuration differed from previous projects featuring blasted or a combination of blasted or mechanically excavated potholes (Big Timber and Potters Marsh HREPs). For the Cottonwood Island HREP, two 1-acre potholes, one  $\frac{3}{4}$ -acre pothole, and two  $\frac{1}{2}$ -acre potholes were mechanically excavated to increase food, shelter, and breeding habitat for wildlife. In general, the potholes are larger and feature a 20-foot bottom width and final elevation approximately 3 feet below flat pool (elev. 470). The sides of the potholes are stepped. Each "step" is approximately 10 feet wide, with a 1-foot transition zone to the next step. The transition slope is 3H:1V. For pothole details and transects, see plates 18 through 23. The potholes have filled with water and were being used by deer, herons, frogs, and tadpoles less than a week after completion of construction. There were fish in the potholes following spring 1998 high water.

(4) Mast Trees. Mast trees were planted in the agricultural field, FMAs 5, 6, and 7, around the perimeter of potholes 1, 3, 4, and 5, and on top of the excavated material berm to increase bottomland hardwood diversity and quality. In the agricultural fields and FMAs, trees were planted on 8- to 10-inch berms with 30 feet between berms. In June 1998, the MDOC constructed the raised planting beds in the agricultural fields and replanted the field with redbud grass. To determine the efficacy of two methods of deer protection, 75 trees in FMAs 5 and 6 received protective fencing, and another 75 trees were sprayed with deer repellent spray as part of the contract. The MDOC will be responsible for maintaining the protective fencing and annual application of deer repellent spray over a 3-year test period. See plates 24 through 29 for the mast tree plantings.

(5) Causeway Road. The causeway road was raised, riprapped, and the existing CMP culvert was removed to improve site access during high water and decrease sedimentation in the slough. See plates 30 through 33 for the road raise construction.

**b. Project Data.** Table 3.1 summarizes project data.

**TABLE 3.1  
PROJECT DATA SUMMARY**

| <b>Feature</b>  | <b>Measurement</b> | <b>Unit of Measure</b> |
|---|--------------------|------------------------|
| <b><i>Side Channel Dredging</i></b>                                     |                    |                        |
| Length  | 4,550              | Feet                   |
| Depth below flat pool   | 9                  | Feet                   |
| Bottom width  | 40                 | Feet                   |
| Side slopes   | 2:1                | Horizontal:vertical    |
| <b><i>Deep Holes (included in total length of channel dredging)</i></b> |                    |                        |
| Number of holes   | 4                  | Holes                  |
| Length  | 300                | Feet                   |
| Depth below flat pool   | 15                 | Feet                   |
| Bottom width  | 40                 | Feet                   |
| Side slopes   | 2:1                | Horizontal:vertical    |
| <b>Total Side Channel/Deep Hole Excavation/Dredging:</b>                | <b>65,410</b>      | <b>Cubic yards</b>     |
| <b><i>Dredged Material Placement</i></b>                                |                    |                        |
| Length  | 4,550              | Feet                   |
| Width   | 80                 | Feet                   |
| Height of dredged material berm   | 6-8                | Feet                   |
| Grading & shaping (60-foot width)                                       | TBD if necessary   | Square yards           |
| Clearing (through timber sale)  | 9                  | Acres                  |
| <b><i>Potholes</i></b>  |                    |                        |
| Number of potholes  | 5                  | Each                   |
| Total area (3 @ 1 acre, 2 @ ½ acre)                                     | 4                  | Acres                  |
| Depth below flat pool   | 3                  | Feet                   |
| Bottom width  | 20                 | Feet                   |
| Bench width   | 10                 | Feet                   |
| Side slopes   | 3:1                | Horizontal:vertical    |
| Clearing/grubbing   | 15.5               | Acres                  |
| <b>Total Pothole Excavation:</b>  | <b>32,700</b>      | <b>Cubic yards</b>     |
| <b><i>Mast Trees</i></b>  |                    |                        |
| Pin oak   | 581                | Trees                  |
| Sycamore  | 316                | Trees                  |
| Bur oak   | 581                | Trees                  |
| Northern pecan  | 581                | Trees                  |
| Swamp white oak   | 591                | Trees                  |
| <b><i>Wing Dam Notching</i></b>   |                    |                        |
| Number  | 6                  | Notches                |
| Length  | 100                | Feet                   |
| Depth below flat pool   | Varies             | Feet                   |
| Bottom width  | Varies             | Feet                   |
| Side slopes   | 1:2                | Horizontal:vertical    |
| <b><i>Causeway Road Raise</i></b>                                       |                    |                        |
| Length  | 276                | Feet                   |
| Crown width   | 12                 | Feet                   |
| Side slopes   | 4:1                | Horizontal:vertical    |
| Filter fabric   | 975                | Square yards           |
| Geotextile fabric   | 300                | Square yards           |
| Riprap  | 817                | Tons                   |
| Road stone  | 428                | Tons                   |

**c. Construction Highlights, Details, and Problems.**

(1) Timber Sale. The majority of the clearing for this project was accomplished through a pre-construction timber sale. Stumps approximately 2 feet  $\pm$  were left in place, with the intent that the Contractor would place excavated channel material directly on top of the stumps. A row of trees was left along the left bank of Cottonwood Chute, adjacent to where the excavated material was to be placed. These trees were left in place to provide shade for fish. Trees were also cleared at potholes 1, 2, and 3.

(2) Additional Clearing. The advertised drawings did not accurately describe the extent or amount of trees remaining along the shoreline. Consequently, additional clearing was negotiated for the areas surrounding potholes 1 and 2 and along the left bank of Cottonwood Chute. The awarded cost of this modification was \$49,831.31. Additional clearing also was required for pothole 3.

The additional clearing surrounding the potholes was for placement of the material excavated from the potholes. The additional clearing along the left bank of Cottonwood Chute was to facilitate movement of the barge-mounted crane during placement of the excavated channel material. The buffer zone at the downstream end of Cottonwood Chute was increased from 150 feet to 350 feet to match the clearing limits of the timber sale. Deep holes were relocated to take advantage of gaps or breaks in the timber along the shoreline. The Contractor indicated that he would be able to work around small groups of trees along the bank. The MDOC subsequently flagged groups of trees to remain in place. Although several small clumps of trees remain along the bank following construction, many trees were ultimately sacrificed or damaged during construction. This was particularly evident as the Contractor progressed upstream and excavation requirements increased.

In an effort to retain existing timber that may be damaged by construction, future contracts should consider an incentive/penalty clause. This clause should take into account the number of existing trees and allow for clearing a certain percentage of these trees. The remaining trees would be subject to the incentive/penalty clause. Such a clause may be an incentive of \$100 for trees not damaged by construction activity and a penalty of \$300 for trees damaged by construction activity.

(3) Indiana Bat. During summer months, federally endangered Indiana bats forage over streams and raise their young in riparian forests such as Cottonwood Island. During the design phase, it was anticipated that construction would take place outside of the summer rearing period (May 1- through August 31) to avoid potential impacts to the bats. However, because of high water conditions, the Contractor was unable to initiate clearing operations before the restricted season. To determine if Indiana bats would be impacted by tree removal during the summer months, a determination was needed as to whether the trees to be removed were suitable habitat for the bats and, if so, whether the bats were using the area. A site visit was conducted and it was determined that suitable habitat was present in the areas surrounding potholes 1 and 2, and along the left bank of Cottonwood Chute. No suitable habitat was found in the vicinity of pothole 3. An Indiana bat mist survey was then initiated to determine whether Indiana bats were using the areas surrounding potholes 1 and 2, and along the left bank of Cottonwood Chute. A male Indiana bat was captured the first night of the survey along the left bank of Cottonwood Chute. To avoid impacts to the bats, clearing in the areas surrounding potholes 1 and 2, and along the left bank of Cottonwood Chute was consequently suspended until September 1. Because the Contractor had already mobilized his equipment at the project site, the contract was subsequently modified to provide labor, material, and equipment necessary to demobilize from the project site and remobilize back to the project site after 1 September 1997. The total cost of this modification was \$33,233.15.

(4) Potholes. During the restricted season, pothole construction commenced on potholes 3, 4, and 5. Potholes 4 and 5 were located in the agricultural field, in areas with moderate to high buried archaeological potential. Archaeological monitoring was required for these potholes. No items of archaeological, historical, or architectural interest were uncovered.

The approximate elevation in the plans for pothole 1 was 474 NGVD 1912. The actual elevation was 477. The finished size of this pothole was decreased from 1 acre to a little more than  $\frac{3}{4}$  acre in order to maintain essentially the same quantity of excavated material.

(5) Wing Dam Notching. The project plans included bathymetric data of the area surrounding the wing dams. In general, water levels were sufficiently high that the Contractor experienced little difficulty during notching of the wing dams. However, future projects including wing dam notching should note that the Contractor may need to excavate in order to reach the area due to changing river conditions and conditions adjacent to the wing dam.

(6) Channel Excavation. The estimated quantities for channel excavation were modified for final adjustment. The quantity of Channel Excavation, 9' Depth, was changed from 33,000 CY to 35,665 CY for a cost of \$11,459. The quantity of Channel Excavation, 15' Depth, was changed from 20,000 CY to 20,755 CY for a cost of \$4,152. The awarded cost of this modification was \$15,612.

(7) Seeding. The excavated channel material had not stabilized by the time seeding was accomplished in the agricultural field and around the potholes. Consequently, the All Other Disturbed Areas seeding portion of the contract was modified from \$15,000 to \$7,500.

The specified seeding mix was a combination of winter wheat and redtop. During fall plantings such as at Cottonwood, the winter wheat can dominate the redtop. Fall seedings should consist of redtop only. Spring seedings should be a combination of winter wheat and redtop.

(8) Mast Tree Planting. The original contracted amount of trees remained the same. At the request of the MDOC, the number of trees planted in the agricultural field, and on the excavated material berm, was increased. The trees planted around pothole 1 were decreased and pothole 2 received none but was originally contracted to receive plantings.

(9) Causeway Road Raise. As a result of the road raise and the removal of the existing culvert, the MDOC raised concerns about the possibility of the dissolved oxygen (DO) content of the area below the causeway dropping and adversely affecting fish. It was agreed upon that the DO levels would continue to be monitored, along with the MDOC checking for any fish kills, and that if problems occurred, action would be taken to correct any such problems.

#### 4. INSPECTIONS.

a. **Purpose.** An active preventative maintenance program reduces damage to constructed features by taking early corrective action. High costs associated with repair and rehabilitation also are avoided. An effective preventative maintenance program requires regular, thorough inspections. Inspections will aid the Site Manager in discovering deficiencies in the project. They also will provide the Corps and Site Manager with baseline condition data. These data are necessary for considering repair options as a result of major damage caused by a storm or a flood.

b. **Types of Inspections.** Two types of inspections will be used for this project: (1) Project Inspections, which are conducted by the Site Manager alone; and (2) Joint Inspections, which are conducted by the Site Manager and the Corps of Engineers.

(1) **Project Inspections.**

(a) **Annual.** Annual Project Inspections should be performed by the Site Manager or an appropriate representative. This inspection should be performed at periods not exceeding 12 months and should follow inspection guidance presented in Section 5 of this manual. It is suggested that the inspections be conducted every May or June, which is representative of conditions after spring floods.

(b) **Other Inspections.** Other project inspections can and should occur as necessary after other high water events or as scheduled by the Site Manager.

(2) **Joint Inspections.**

(a) **Routine.** A Joint Inspection by the Site Manager and the Corps of Engineers shall be made in accordance with ER 1130-2-339. The purpose of this inspection is to assure that adequate maintenance is being performed as presented in the Definite Project Report (DPR) and this manual. For this purpose, the District Engineer or Authorized Representative should have access to all portions of the constructed project upon coordination with the Site Manager.

(b) **Catastrophic.** A Joint Inspection should be formally requested by the Site Manager immediately following a specific storm or flood event that causes damage in excess of annual operation and maintenance costs specified in this manual and the DPR. A comparison of pre-and post-event Project Inspections and the Joint Inspections will be the basis for determining maintenance responsibility and potential rehabilitation by the Corps of Engineers.

(3) **Checklist.** Appendix B presents a project inspection checklist. The Site Manager should furnish a copy of the completed checklist to the U.S. Army Corps of Engineers, Rock Island District, immediately following each project inspection. Besides completion of the inspection checklist, each individual report should briefly summarize the condition of the entire system, including any maintenance work done during the past 1-year period. The address is U.S. Army Corps of Engineers, Rock Island District, ATTN: CEMVR-EM, Clock Tower Building, P.O. Box 2004, Rock Island, Illinois 61204-2004.

## 5. OPERATION AND MAINTENANCE OF PROJECT FEATURES.

### a. General.

(1) This section presents operation and maintenance instructions for the major project features. These features were designed and constructed to minimize operation and maintenance requirements. The estimated annual maintenance costs are presented in Table 5.1. Regarding O&M of the Mast Trees, the animal protection measures experiment described in the DPR has been scaled back to the numbers represented in the table below.

**TABLE 5.1**  
**ESTIMATED ANNUAL OPERATION AND MAINTENANCE COSTS**  
(June 1995 Price Level)

|   | <u>Quantity</u> | <u>Unit</u> | <u>Unit Price (\$)</u> | <u>Total Cost (\$)</u> |
|---|-----------------|-------------|------------------------|------------------------|
| <b>Operation</b>  |                 |             |                        | <sup>1/</sup>          |
| <b>Maintenance</b>  |                 |             |                        |                        |
| Inspection  | 32              | Hours       | 25.00                  | 800                    |
| Debris Removal (side channel and wing dam notches)                        | 40              | Hours       | 50.00                  | 2,000                  |
| Apply Herbicide (if necessary - first two years)                          | 2650            | Tree        | 3.09                   | 8,189                  |
| Animal Protection Measures Experiment                                     |                 |             |                        |                        |
| Remove Deer Protection Fencing (one time cost after third growing season) | 75              | Tree        | 7.50                   | 563                    |
| Spray Deer Repellent (years one and two)                                  | 75              | Tree        | 3.00                   | 225                    |
| Subtotal Maintenance: Years one and two                                   |                 |             |                        | 11,214                 |
| Year three  |                 |             |                        | 3,363                  |
| After year three  |                 |             |                        | 2,800                  |
| <b>Rehabilitation <sup>2/</sup></b>                                       |                 |             |                        |                        |
| Contingencies (20%): Years one and two                                    |                 |             |                        | 2,243                  |
| Year three  |                 |             |                        | 673                    |
| After year three  |                 |             |                        | 560                    |
| <b>TOTAL: Years one and two</b>   |                 |             |                        | <b>13,457</b>          |
| <b>Year three</b>   |                 |             |                        | <b>4,036</b>           |
| <b>After year three</b>   |                 |             |                        | <b>3,360</b>           |

<sup>1/</sup> No operation costs are identified.

<sup>2/</sup> Rehabilitation work cannot be accurately estimated. Rehabilitation is reconstructive work that significantly exceeds the annual operation and maintenance requirements identified above and that is needed as the result of major storm events.

(2) The Site Manager shall take action to correct conditions disclosed by Project Inspections or Joint Inspections. To ensure feature serviceability, the Site Manager shall schedule regular maintenance repair measures for accomplishment during the appropriate season. Appropriate advance measures shall be taken to ensure the availability of adequate labor and materials to meet contingencies.

(3) Project features should be continuously operated and maintained to obtain maximum benefits. No encroachments or trespasses that adversely affect the efficient operation or maintenance of the project shall be permitted. No improvement shall be passed over, under, or through constructed features. Excavation or construction within these features is subject to prior approval by the Corps of Engineers, Rock Island District. Such improvements or alterations that are desirable and permissible shall be constructed in accordance with standard engineering practice. Advice regarding the effect of proposed improvements or alterations on the functioning of the project and information concerning methods of construction acceptable under standard engineering practice shall be obtained from the District Engineer or, if otherwise obtained, shall be submitted for approval. Drawings or prints showing improvements or alterations as finally constructed shall be furnished to the District Engineer after completion of such work.

**b. Side Channel Excavation.**

(1) Operation. Specific operation requirements will be performed as determined by the Site Manager.

(2) Maintenance. Project inspections of the side channel excavation will be made by the Site Manager to record the presence of undesirable debris, waste materials, or unauthorized structures.

**c. Wing Dam Notching.**

(1) Operation. Specific operation requirements will be performed as determined by the Site Manager.

(2) Maintenance. Project inspections of the wing dam notching will be made by the Site Manager to record the presence of undesirable debris, waste materials, or unauthorized structures.

**d. Potholes.**

(1) Operation. Specific operation requirements will be performed as determined by the Site Manager. The potholes should be inspected following high water events.

(2) Maintenance. Project inspections of the potholes will be made by the Site Manager to record the presence of undesirable debris, waste materials, or unauthorized structures.

**e. Mast Trees.**

(1) Operation. Specific operation requirements will be performed as determined by the Site Manager. Survival and growth of mast trees will be monitored by the Rock Island District of the U.S. Army Corps of Engineers through annual inspections of the planting sites. Remedial action shall be taken by the Site Manager as necessary to ensure survival. The Site Manager shall



keep records of any herbicide and deer repellent application, in addition to records of inspections and any corrective actions taken to ensure survival.

(2) Maintenance. Vegetation between mast trees shall be controlled for a minimum of two growing seasons by either mowing or herbicide application. Vegetation between the planted rows shall not be allowed to exceed a height of 1 foot during this maintenance period.

(3) Animal Protection Measures Experiment. Maintenance associated with the Animal Protection Measures Experiment shall apply to the first three growing seasons. Deer repellent spray shall be applied in accordance with manufacturer's directions to coincide with the second and third growing seasons. Maintenance measures associated with the protective fencing shall be performed for the first two growing seasons. The protective fencing shall be removed at the end of the third growing season.

## 6. PERFORMANCE MONITORING AND ASSESSMENT.

a. **General.** The purpose of this section is to summarize monitoring and data collection aspects of the project. Table 6.1 presents the principal types, purposes, and responsibility of monitoring and data collection. Table 6.2 summarizes actual monitoring and data parameters grouped by project phase, responsible agency, and data collection intervals. Changes to the monitoring plan should be coordinated with the USFWS, the MDOC, and the U.S. Army Corps of Engineers.

### b. Post-Construction.

(1) **General.** Table 6.4 presents the annual post-construction field observations to be performed by the Site Manager. These observations are summarized in checklist form in Appendix B. Table 6.5 presents the post-construction quantitative measurements to be performed by the Corps of Engineers. The monitoring parameters were developed to measure the effectiveness of the stated goals. The annual field observations and the quantitative monitoring parameters will form the basis of project evaluation. The proposed monitoring focuses primarily on the physical response to the project (e.g., acres of side channel and deep water, cross-sectional area of the potholes, and velocities upstream, at, and below the wing dam notches). The following potential biological performance monitoring of the Cottonwood Island project is also proposed:

(2) **Side Channel Excavation.** The dredged channels have already begun to attract overwintering fish. Overwintering and summer fish use of the deep holes and side channels will be monitored by the MDOC through electrofishing and netting. Sedimentation transects will be monitored by the Corps of Engineers through means of hydrographic soundings (see Table 6.2).

(3) **Wing Dam Notches.** Notches were staggered in anticipation that flow would increase in the vicinity of the notch, creating a scour hole behind the wing dams and stimulating a meander to the next wing dam. Preliminary post-construction monitoring efforts indicate the formation of scour holes behind the wing dams and an increase in velocity at and below the notch. The MDOC recommended limiting quantitative monitoring of this feature to the physical monitoring of the wing dam notches and scour areas. Fish and invertebrate use of rock structures, fish use of scour holes associated with such structures, and habitat benefits of wing dam notching have been well documented. The Corps will monitor flow by the notched wing dam. See Table 6.2 and plate 34 for information.

(4) **Pothole Monitoring.** Cottonwood Island presents a unique opportunity to study the effectiveness of larger, stepped potholes in a big river floodplain. Monitoring may be used in tandem with similar data gathered at the Potters Marsh HREP to evaluate which design is more effective at attracting wildlife and providing life requisites for those species.

The targeted species used in the pothole justification for Cottonwood Island were migratory birds and non-game species. Migratory waterfowl depend upon high protein foods such as invertebrates during brood and migration periods. Invertebrates inhabit submergent and emergent plants and thrive in the small, quiet pools. Invertebrates also provide food for animals such as insects, frogs, wood ducks, and a host of other species. Measuring the invertebrate populations of the potholes is critical in determining their impacts to the waterfowl and other species that may feed upon them. This monitoring will be completed in association with waterfowl/wading bird surveys.

The pothole side slopes were benched to promote littoral zone emergent growth and enhance growth of moist soil plants. In addition to providing invertebrate habitat, the vegetation may also

be used as cover for broods (family groups) of ducks, songbirds, neotropical migrants, and other nongame wildlife species. Species of plants and amount of cover are important aspects that should be studied.

Observational data of adult and juvenile ducks during critical periods of the year (brood and migration) are needed to determine use and production of the potholes. The invertebrate and vegetation monitoring will be conducted in association with waterfowl/wading bird surveys. Volunteer organizations should be encouraged to install artificial nest platforms/wood duck boxes on some of the potholes. The MDOC will coordinate the volunteer effort. Use of these structures may be monitored as well. The potholes have filled with water and were being used by deer, herons, frogs, and tadpoles less than a week after completion of construction. Following high water in the spring of 1998, fish were found in the majority of the potholes. During the Site Manager's annual inspection (see Section 4 and Appendix B), the Site Manager will make and note observations of vegetation and wildlife.

(5) Mast Trees. Test efficacy of tree protection measures in terms of tree growth and survival. During the annual site inspection, the Site Manager shall be observing mast tree growth (see Table 6.4).

**TABLE 6.1  
MONITORING AND PERFORMANCE EVALUATION MATRIX**

| <b>Project Phase</b>     | <b>Type of Activity</b>                      | <b>Purpose</b>  | <b>Responsible Agency</b>                            | <b>Implementing Agency</b>  | <b>Funding Source</b> | <b>Implementation Instructions</b>   |
|--------------------------|--|---|--|---|-----------------------|--|
| <b>Pre-Project</b>       | Sedimentation Problem Analysis               | System-wide problem definition. Evaluates planning assumptions.   | USGS   | USGS (EMTC)   | LTRMP <sup>1/</sup>   | --   |
|                          | Pre-Project Monitoring                       | Identify and define problems at HREP site. Establish need of proposed project features.   | MDOC   | MDOC  | MDOC                  | --   |
|                          | Baseline Monitoring                          | Establish baselines for performance evaluation.   | Corps  | Field Station or Sponsor through Cooperative Agreements or Corps                      | HREP/<br>Sponsor      | See Table 6.2.   |
| <b>Design</b>            | Data Collection for Design                   | Include quantification of project objectives, design of project, and development of performance evaluation plan.  | Corps  | Corps   | HREP <sup>2/</sup>    | See Table 6.2.   |
| <b>Construction</b>      | Construction Monitoring                      | Assess construction impacts; assures permit conditions are met.   | Corps  | Corps   | HREP                  | See State Section 401 Stipulations.  |
| <b>Post-Construction</b> | Performance Evaluation Monitoring            | Determine success of project as related to objectives.  | Corps (quantitative)<br>Sponsor (field observations) | Field Station or Sponsor through Cooperative Agreement, Sponsor through O&M, or Corps | HREP/-Sponsor         | See Tables 6.4 and 6.5.  |
|                          | Analysis of Biological Responses to Projects | Evaluate predictions and assumptions of habitat unit analysis. Studies beyond scope of performance evaluation, or if projects do not have desired biological results. | Corps  | Corps   | HREP                  | This is an overall EMP program element, carried out at select project sites. Cottonwood is not included among these sites. |

<sup>1/</sup> Long-Term Resource Monitoring Program is a component of the UMRS-EMP.

<sup>2/</sup> Habitat Rehabilitation and Enhancement Projects

**TABLE 6.2**  
**RESOURCE MONITORING AND DATA COLLECTION SUMMARY <sup>1/</sup>**

| Type Measurement                       | Water Quality Data |         |              |         |                   |         | Engineering Data  |              |                   | Natural Resource Data |              |                   | Sampling Agency | Remarks     |
|--|--------------------|---------|--------------|---------|-------------------|---------|-------------------|--------------|-------------------|-----------------------|--------------|-------------------|-----------------|-------------|
|  | Pre-Project Phase  |         | Design Phase |         | Post-Const. Phase |         | Pre-Project Phase | Design Phase | Post-Const. Phase | Pre-Project Phase     | Design Phase | Post-Const. Phase |                 |             |
|  | Apr-Sep            | Oct-Mar | Apr-Sep      | Oct-Mar | Apr-Sep           | Oct-Mar |                   |              |                   |                       |              |                   |                 |             |
| POINT MEASUREMENTS                     |                    |         |              |         |                   |         |                   |              |                   |                       |              |                   |                 |             |
| Water Quality Stations <sup>2/</sup>   |                    |         |              |         |                   |         |                   |              |                   |                       |              |                   | Corps           |             |
| Turbidity                              |                    |         | 2W           | M       | 2W                | M       |                   |              |                   |                       |              |                   |                 |             |
| Secchi Disk Transparency               | 2W                 |         | 2W           | M       | 2W                | M       |                   |              |                   |                       |              |                   |                 |             |
| Suspended Solids                       | 2W                 |         | 2W           | M       | 2W                | M       |                   |              |                   |                       |              |                   |                 |             |
| Dissolved Oxygen                       | 2W                 |         | 2W           | M       | 2W                | M       |                   |              |                   |                       |              |                   |                 |             |
| Specific Conductance                   | 2W                 |         | 2W           | M       | 2W                | M       |                   |              |                   |                       |              |                   |                 |             |
| Water Temperature                      | 2W                 |         | 2W           | M       | 2W                | M       |                   |              |                   |                       |              |                   |                 |             |
| pH                                     | 2W                 |         | 2W           | M       | 2W                | M       |                   |              |                   |                       |              |                   |                 |             |
| Total Alkalinity                       | --                 |         | 2W           | M       | 2W                | M       |                   |              |                   |                       |              |                   |                 |             |
| Chlorophyll                            | 2W                 |         | 2W           | M       | 2W                | M       |                   |              |                   |                       |              |                   |                 |             |
| Velocity                               | --                 |         | 2W           | M       | 2W                | M       |                   |              |                   |                       |              |                   |                 |             |
| Water Depth                            | 2W                 |         | 2W           | M       | 2W                | M       |                   |              |                   |                       |              |                   |                 |             |
| Water Elevation                        | 2W                 |         | 2W           | M       | 2W                | M       |                   |              |                   |                       |              |                   |                 |             |
| Percent Ice Cover                      |                    |         |              | M       |                   | M       |                   |              |                   |                       |              |                   |                 |             |
| Ice Depth                              |                    |         |              | M       |                   | M       |                   |              |                   |                       |              |                   |                 |             |
| Percent Snow Cover                     |                    |         |              | M       |                   | M       |                   |              |                   |                       |              |                   |                 |             |
| Snow Depth                             |                    |         |              | M       |                   | M       |                   |              |                   |                       |              |                   |                 |             |
| Wind Direction                         |                    |         | 2W           | M       | 2W                | M       |                   |              |                   |                       |              |                   |                 |             |
| Wind Velocity                          |                    |         | 2W           | M       | 2W                | M       |                   |              |                   |                       |              |                   |                 |             |
| Wave Height                            |                    |         | 2W           | M       | 2W                | M       |                   |              |                   |                       |              |                   |                 |             |
| Air Temperature                        |                    |         | 2W           | M       | 2W                | M       |                   |              |                   |                       |              |                   |                 |             |
| Percent Cloud Cover                    |                    |         | 2W           | M       | 2W                | M       |                   |              |                   |                       |              |                   |                 |             |
| Bulk Sediment Sampling <sup>3/</sup>   |                    |         | 1            |         |                   |         |                   |              |                   |                       |              |                   |                 |             |
| Column Settling Stations <sup>4/</sup> |                    |         |              |         |                   |         |                   |              |                   |                       |              |                   |                 |             |
| Column Settling Analysis               |                    |         |              |         |                   |         |                   | 1            |                   |                       |              |                   | Corps           |             |
| Boring Stations <sup>5/</sup>          |                    |         |              |         |                   |         |                   |              |                   |                       |              |                   |                 |             |
| Geotechnical Borings                   |                    |         |              |         |                   |         |                   | 1            |                   |                       |              |                   | Corps           |             |
| Fish Stations <sup>6/</sup>            |                    |         |              |         |                   |         |                   |              |                   |                       |              |                   |                 |             |
| Electrofishing                         |                    |         |              |         |                   |         |                   |              |                   |                       |              | 2Y                | MDOC            | For 5 years |
| Pothole Monitoring <sup>7/</sup>       |                    |         |              |         |                   |         |                   |              |                   |                       |              |                   |                 |             |
| Waterfowl/Wading Bird Use              |                    |         |              |         |                   |         |                   |              |                   |                       |              |                   |                 |             |

**TABLE 6.2 (Continued)**  
**RESOURCE MONITORING AND DATA COLLECTION SUMMARY <sup>1/</sup>**

| Type Measurement                             | Water Quality Data |         |              |         |                   |         | Engineering Data  |              |                   | Natural Resource Data |              |                   | Sampling Agency | Remarks |
|--|--------------------|---------|--------------|---------|-------------------|---------|-------------------|--------------|-------------------|-----------------------|--------------|-------------------|-----------------|---------|
|  | Pre-Project Phase  |         | Design Phase |         | Post-Const. Phase |         | Pre-Project Phase | Design Phase | Post-Const. Phase | Pre-Project Phase     | Design Phase | Post-Const. Phase |                 |         |
|  | Apr-Sep            | Oct-Mar | Apr-Sep      | Oct-Mar | Apr-Sep           | Oct-Mar |                   |              |                   |                       |              |                   |                 |         |
| TRANSECT MEASUREMENTS                        |                    |         |              |         |                   |         |                   |              |                   |                       |              |                   |                 |         |
| <u>Sedimentation Transects</u> <sup>8/</sup> |                    |         |              |         |                   |         | 1                 |              | 5Y                |                       |              |                   | Corps           |         |
| Hydrographic Soundings                       |                    |         |              |         |                   |         |                   |              | 5Y                |                       |              |                   | Corps           |         |
| Potholes                                     |                    |         |              |         |                   |         |                   |              |                   |                       |              |                   |                 |         |
| AREA MEASUREMENTS                            |                    |         |              |         |                   |         |                   |              |                   |                       |              |                   |                 |         |
| <u>Mast Tree Survey</u> <sup>9/</sup>        |                    |         |              |         |                   |         |                   |              |                   |                       |              | Y                 | Corps           |         |
| <u>Mapping</u> <sup>10/</sup>                |                    |         |              |         |                   |         |                   |              |                   |                       |              |                   |                 |         |
| Aerial Photography/<br>Remote Sensing        |                    |         |              |         |                   |         |                   |              |                   | 1                     |              | 5Y                | Corps           |         |

**LEGEND**

W = Weekly

M = Monthly

Y = Yearly

nW = n-Week interval

nY = n-Yearly interval

1,2,3, --- = number of times data is collected within designated project phase

**TABLE 6.2 (Continued)**

<sup>1/</sup> See plate 34 for active monitoring sites.

<sup>2/</sup> Water Quality Stations

W1  
W2

Wing Dam Stations

WD-6U  
WD-6A  
WD-6D  
WD-15U  
WD-15A  
WD-15D

<sup>3/</sup> Bulk Sediment Sampling Stations (Design Phase)

E-M330.1A  
E-M328.7B  
E-M329.6A

<sup>4/</sup> Column Settling Analysis (Design Phase)

| <u>Station Code</u> | <u>Geotechnical Boring</u> |
|---------------------|----------------------------|
| C-M330.4A           | C-94-2, EMP #1             |
| C-M329.2A           | C-94-2, EMP #2             |

<sup>5/</sup> COE Geotechnical Borings (Design Phase)

| <b>Station Code</b> | <b>Geotechnical Boring</b> | <b>Date</b> |
|---------------------|----------------------------|-------------|
| C-M330.4A           | C-94-1                     | 02-08-94    |
| C-M329.2A           | C-94-2                     | 02-08-94    |
| B-M330.8D           | C-94-3                     | 11-29-94    |
| B-M330.7C           | C-94-4                     | 11-30-94    |
| B-M329.7A           | C-94-5                     | 11-30-94    |
| B-M330.0H           | C-94-6                     | 11-30-94    |
| B-M330.2H           | C-94-7                     | 11-30-94    |
| B-M330.5H           | C-94-8                     | 12-01-94    |
| B-M330.5B           | C-94-9                     | 12-01-94    |
| B-M330.3D           | C-94-10                    | 12-01-94    |
| B-M330.5M           | C-94-11                    | 12-01-94    |
| B-M330.8H           | C-94-12                    | 12-01-94    |
| B-M 328.7B          | C-95-1                     | 12-05-95    |
| B-M 328.9B          | C-95-2                     | 12-05-95    |
| B-M 329.2B          | C-95-3                     | 12-05-95    |

<sup>6/</sup> Fish Stations. Monitor overwintering and mid-summer use of side channel and deep holes.

<sup>7/</sup> Potholes. Monitoring waterfowl/wading bird use.

<sup>8/</sup> Sedimentation Transects

Design Phase

|                        |                        |
|------------------------|------------------------|
| S-M328.7A to S-M328.7C | S-M330.2H to S-M330.2I |
| S-M329.2A to S-M329.2B | S-M330.6D to S-M330.6D |
| S-M329.5A to S-M329.5C | S-M330.7B to S-M330.7D |
| S-M330.0G to S-M330.0I | S-M330.9D to S-M330.9E |
| S-M330.2A to S-M330.2B |                        |

Post-Construction Phase - See Table 6.3

<sup>9/</sup> Mast Tree Survey (Post-Construction Phase. Test of treatment effects for alternative deer exclusion methods will be evaluated by an analysis of variance for tree growth.)

<sup>10/</sup> Mapping (Post-Construction Phase)

| TABLE 6.3<br>COTTONWOOD ISLAND REHABILITATION AND ENHANCEMENT PROJECT<br>SEDIMENTATION TRANSECT PROJECT OBJECTIVES EVALUATION |                                    |  |  |   |
|---|------------------------------------|--|--|---|
|   | Project Objectives to Be Evaluated |  |  |   |
| Transect  | Improve Water<br>Quality for Fish  | Provide<br>Overwintering Water<br>Habitat for Fish | Provide Flowing<br>Water Habitat<br>for Fish | Increase Food, Shelter,<br>and Breeding Habitat<br>for Wildlife |
| Cottonwood Chute  |                                    |  |  |   |
| A   |                                    |  |  |   |
| B   | X                                  |  |  |   |
| C   | X                                  | X  |  |   |
| D   | X                                  | X  |  |   |
| E   | X                                  | X  |  |   |
| F   | X                                  | X  |  |   |
| G   | X                                  |  |  |   |
| H   | X                                  |  |  |   |
| I   | X                                  |  |  |   |
| J   | X                                  |  |  |   |
| Wing Dam Notches <sup>1/</sup>  |                                    |  | X  |   |
| Potholes  |                                    |  |  |   |
| 1a  |                                    |  |  | X   |
| 1b  |                                    |  |  | X   |
| 2a  |                                    |  |  | X   |
| 2b  |                                    |  |  | X   |
| 3a  |                                    |  |  | X   |
| 3b  |                                    |  |  | X   |
| 4a  |                                    |  |  | X   |
| 4b  |                                    |  |  | X   |
| 5a  |                                    |  |  | X   |
| 5b  |                                    |  |  | X   |

<sup>1/</sup> Bathymetric mapping of the dike field as water levels permit.



**TABLE 6.4  
SITE MANAGER  
ANNUAL POST-CONSTRUCTION FIELD OBSERVATIONS**

| Enhancement Potential                        |   |  |   |  |
|--|---|--|---|--|
| Goal   | Objective   | Enhancement Feature  | Unit                                    | Annual Field Observations by Site Manager  |
| <b>Restore Aquatic Overwintering Habitat</b> | Improve water quality for fish  | Chute restoration and enhancement (side channel creation) (Depth $\geq 6'$ < 10')        | mg/l D.O.                               | Describe presence of fish stress or kills  |
|  |   |  | acre                                    | Describe presence or absence of debris snags, channel sedimentation or vegetation  |
|  | Provide over-wintering water habitat for fish                         | Create deep holes (Depth $\geq 10'$ )  | acre/hole                               | Describe presence or absence of debris snags, channel sedimentation, or vegetation |
|  |   |  | fish numbers                            | Qualitative observations   |
| <b>Restore Main Channel Border Habitat</b>   | Provide flowing water habitat for fish                                | Notch wing dams (100' upstream of wing dam) (at wing dam) (100' downstream of wing dam)  | ft/sec                                  | Describe presence or absence of debris snags, channel sedimentation, or vegetation |
|  |   |  |   | Qualitative observations   |
|  |   | (areal extent of scour $\geq 1'$ )   | ft <sup>2</sup>                         |  |
|  | Provide add'l habitat and substrate for benthic and aquatic organisms | Rock placement below wing dams   | number of benthic and aquatic organisms |  |
| <b>Restore Wetland Habitat</b>               | Increase food, shelter, and breeding habitat for wildlife             | Potholes   | water surface area ft <sup>2</sup>      | Areal survey of wildlife use, vegetation types and density, invertebrate studies   |
|  | Increase bottomland hardwood diversity and quality                    | Establish hardwood trees in existing forest management, crop, and dredge placement areas | percent survival                        | Estimate effective acreage and wildlife use  |
|  |   |  | acres (mast trees present)              | Presence or absence of mast  |

**TABLE 6.5**  
**CORPS OF ENGINEERS POST-CONSTRUCTION QUANTITATIVE MEASUREMENTS**

| Enhancement Potential                         |   |  |   |                            |                         |                                       |                                 |  |
|---|---|--|---|----------------------------|-------------------------|---------------------------------------|---------------------------------|--|
| Goal  | Objective   | Enhancement Feature  | Unit                                    | Year 0 Without Alternative | Year 0 With Alternative | Year X With Alternative <sup>1/</sup> | Year 50 Target With Alternative | Feature Measurement Reference Table 6-2                          |
| <b>Restore Aquatic Over-Wintering Habitat</b> | Improve water quality for fish  | Chute restoration and enhancement  | mg/l D.O.                               | <5                         | >5                      |                                       | >5                              | Perform water quality tests at W-1 and W-2                       |
|   |   | (Depth ≥ 6' < 10')   | acre                                    |                            | 4.5                     |                                       | 4.5                             | Sediment transects   |
|   | Provide overwintering water habitat for fish                          | Create deep holes (Depth ≥ 10')  | acre/hole                               | 0                          | 0.3                     |                                       | 0.3                             | Sediment transects   |
|   |   |  | fish numbers                            | --                         |                         |                                       | --                              | Electrofishing, netting  |
| <b>Restore Main Channel Border Habitat</b>    | Provide flowing water habitat for fish                                | Notch wing dams  | ft/sec                                  |                            |                         |                                       |                                 | Flow/velocity measurements                                       |
|   |   | (100' upstream of wing dam)  |   | 0.3 <sup>2/</sup>          | 0.35 <sup>2/</sup>      |                                       | 0.35 <sup>2/</sup>              |  |
|   |   | (at wing dam)  |   | 1.0 <sup>2/</sup>          | 0.50 <sup>2/</sup>      |                                       | 0.50 <sup>2/</sup>              |  |
|   |   | (100' downstream of wing dam)  |   | 0.3 <sup>2/</sup>          | 0.40 <sup>2/</sup>      |                                       | 0.40 <sup>2/</sup>              |  |
|   | Provide add'l habitat and substrate for benthic and aquatic organisms | (areal extent of scour ≥ 1')   | ft <sup>2</sup>                         | 0                          | 0                       |                                       | <sup>4/</sup>                   | Sediment transects   |
|   |   | Rock placement below wing dams   | number of benthic and aquatic organisms | --                         |                         |                                       |                                 | Benthic surveys<br>Fishery surveys                               |
| <b>Restore Wetland Habitat</b>                | Increase food, shelter, and breeding habitat for wildlife             | Pothole: 1   | ft <sup>2</sup> <sup>3/</sup>           | 0                          | 783.60                  |                                       | <sup>4/</sup>                   | Pothole sedimentation transects                                  |
|   |   | 2  | ft <sup>2</sup> <sup>3/</sup>           | 0                          | 898.81                  |                                       | <sup>4/</sup>                   |  |
|   |   | 3  | ft <sup>2</sup> <sup>3/</sup>           | 0                          | 880.56                  |                                       | <sup>4/</sup>                   |  |
|   |   | 4  | ft <sup>2</sup> <sup>3/</sup>           | 0                          | 847.70                  |                                       | <sup>4/</sup>                   |  |
|   |   | 5  | ft <sup>2</sup> <sup>3/</sup>           | 0                          | 841.98                  |                                       | <sup>4/</sup>                   |  |
|   | Increase bottomland hardwood diversity and quality                    | Establish hardwood trees in existing forest management, crop, and dredge placement areas | percent survival                        | 0                          | 100%                    |                                       | 10%                             | Tree count/random sample (deer exclusion study)<br>Random sample |
|   |   |  | acres (mast trees present)              | 0                          | 53.97                   |                                       | 30                              |  |

<sup>1/</sup> This column is completed for the year the enhancement feature is monitored.

<sup>2/</sup> From Hydraulic Study at a discharge of 40,000 ft<sup>3</sup>/s (see DPR Appendix H).

<sup>3/</sup> Cross-sectional area measured on short chord below elevation line of 475'.

<sup>4/</sup> To be determined with monitoring.

**APPENDIX A**

**OPERATION, MAINTENANCE, AND REHABILITATION AGREEMENT**

**MEMORANDUM OF AGREEMENT  
BETWEEN  
THE UNITED STATES FISH AND WILDLIFE SERVICE  
AND  
THE DEPARTMENT OF THE ARMY  
FOR  
ENHANCING FISH AND WILDLIFE RESOURCES  
OF THE  
UPPER MISSISSIPPI RIVER SYSTEM  
AT  
COTTONWOOD ISLAND WILDLIFE MANAGEMENT AREA, MISSOURI**

**I. PURPOSE**

The purpose of this memorandum of agreement (MOA) is to establish the relationships, arrangements, and general procedures under which the U.S. Fish and Wildlife Service (USFWS) and the Department of the Army (DOA) will operate in constructing, operating, maintaining, repairing, and rehabilitating the Cottonwood Island Wildlife Management Area (CIWMA), Missouri, separable element of the Upper Mississippi River System - Environmental Management Program (UMRS-EMP).

**II. BACKGROUND**

a. The Federally owned project lands of the Cottonwood Island Wildlife Management Area are managed under a cooperative agreement between the Department of the Interior, USFWS, and the U.S. Army Corps of Engineers, dated 14 February 1963. Management of these project lands has been assumed by the Missouri Department of Conservation under a cooperative agreement between the USFWS and the Missouri Department of Conservation dated 5 May 1954.

b. Section 1103 of the Water Resources Development Act of 1986, Public Law 99-662, authorizes construction of measures for the purpose of enhancing fish and wildlife resources in the Upper Mississippi River System. Under conditions of Section 906(e) of the Water Resources Development Act of 1986, Public Law 99-662, all construction costs of those fish and wildlife features for the Cottonwood Island Wildlife Management Area, Missouri are 100 percent Federal and pursuant to Section 107(b) of the Water Resources Development Act of 1992, Public Law 102-580, all costs of operation and maintenance for the Cottonwood Island Wildlife Management Area, Missouri are 100 percent non-Federal.

**III. GENERAL SCOPE**

The project to be accomplished pursuant to this MOA shall consist of, dredging the lower 4,800 feet of Cottonwood Chute, stagger notching of existing wing dams, excavating potholes, and

the planting of mast-producing hardwood trees on dredge disposal material and in existing open areas on the island.

#### IV. RESPONSIBILITIES

##### A. DOA is responsible for:

1. Construction. Dredging Cottonwood Chute, notching of existing wing dams, excavating potholes, and planting of mast producing hardwood trees.

2. Major Rehabilitation. The Federal share of any mutually agreed upon rehabilitation of the project that exceeds the annual operation and maintenance requirements identified in the definite project report and that is needed as a result of specific storm or flood events.

3. Construction Management. Subject to and using funds appropriated by the Congress of the United States, and in accordance with Section 906(e) of the Water Resources Development Act of 1986, Public Law 99-662, DOA will construct the Fish and Wildlife Enhancement Project of the Cottonwood Island Wildlife Management Area, Missouri as described in the Upper Mississippi River System Environmental Management Program Definite Project Report (R-16D) with Integrated Environmental Assessment Cottonwood Island Wildlife Management Area dated August 1995, applying those procedures usually followed or applied in Federal projects, pursuant to Federal laws, regulations, and policies. The USFWS will be afforded the opportunity to review and comment on all modifications and change order prior to the issuance to the contractor of a Notice to Proceed. If DOA encounters potential delays related to construction of the project, DOA will promptly notify USFWS of such delays.

4. Maintenance of Records. The DOA will keep books, records, documents, and other evidence pertaining to costs and expenses incurred in connection with construction of the project to the extent and in such detail as will properly reflect total costs. The DOA shall maintain such books, records, documents, and other evidence for a minimum of three years after completion of construction of the project and resolution of all relevant claims arising therefrom, and shall make available at its offices, at reasonable times, such books, records, documents, and other evidence for inspection and audit by authorized representatives of the USFWS.

b. USFWS Responsibilities. Upon completion of construction as determined by the District Engineer, Rock Island, the USFWS shall accept the Project as part of the Mark Twain National Wildlife Refuge of the Cottonwood Island, Wildlife Management Area, Missouri.

c. Non-Federal Responsibilities. In accordance with Section 107(b) of the Water Resources Development Act of 1992, Public Law 102-580, 100 percent of all costs associated with the operation, maintenance, and repair of the Cottonwood Island Wildlife Management Area, Missouri will be borne by the Missouri Department of Conservation.

## V. MODIFICATION AND TERMINATION

This MOA may be modified or terminated at any time by mutual agreement of the parties. Any such modification or termination must be in writing. Unless otherwise modified or terminated, this MOA shall remain in effect for a period of no more than 50 years after initiation of construction of the project.

## VI. REPRESENTATIVES

The following individuals or their designated representatives shall have authority to act under this MOA for their respective parties.

FWS: Regional Director  
U.S. Fish and Wildlife Service  
Federal Building, Fort Snelling  
Twin Cities, Minnesota 55111


DOA: District Engineer  
U.S. Army Engineer District, Rock Island  
Clock Tower Building, P.O. Box 2004  
Rock Island, Illinois 61204-2004

## VII. EFFECTIVE DATE OF MOA

This MOA shall become effective when signed by the appropriate representatives of both parties.

THE DEPARTMENT OF THE ARMY

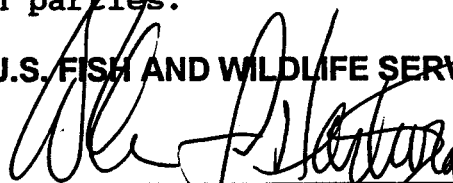
BY:



CHARLES S. COX  
Colonel, U.S. Army  
District Engineer

THE U.S. FISH AND WILDLIFE SERVICE

BY:



WILLIAM F. HARTWIG  
Regional Director  
U.S. Fish and Wildlife Service

DATE:

16 Sep 96

DATE:

9/9/96

**APPENDIX B**

**SITE MANAGER'S  
PROJECT INSPECTION AND MONITORING RESULTS**

**OPERATION AND MAINTENANCE MANUAL  
COTTONWOOD ISLAND REHABILITATION AND ENHANCEMENT**

**UPPER MISSISSIPPI RIVER SYSTEM  
ENVIRONMENTAL MANAGEMENT PROGRAM**

**POOL 21, MISSISSIPPI RIVER MILES 328.5 - 331  
LEWIS AND MARION COUNTIES, MISSOURI**

**SITE MANAGER'S PROJECT INSPECTION AND MONITORING RESULTS**

Inspected by \_\_\_\_\_ Date \_\_\_\_\_

Type of Inspection (Annual) (Emergency) (Other)

1. PROJECT INSPECTION (DEFICIENCIES REQUIRE CORRECTION).

Item

Comment

a. Side Channel Excavation

- ( ) Describe presence or absence of debris snags,  
channel sedimentation or vegetation
- ( ) Describe any maintenance performed
- ( ) Describe presence of fish stress or kills
- ( ) Qualitative observations

b. Wing Dam Notching

- ( ) Describe presence or absence of debris snags,  
channel sedimentation or vegetation
- ( ) Describe any maintenance performed
- ( ) Qualitative observations



Item

Comment

c. Potholes

- ☐ Describe presence or absence of debris, sedimentation, or vegetation
- ☐ Areal survey of wildlife use, vegetation types, and density, invertebrate studies
- ☐ Qualitative observations

d. Mast Trees

- ☐ Seeding condition
- ☐ Herbicide Treatment
- ☐ Deer protection fencing (remove after 3<sup>rd</sup> growing season)
- ☐ Deer repellent (apply at year 1 and year 2)
- ☐ Estimate effective acreage and wildlife use
- ☐ Presence of absence of mast
- ☐ Qualitative observations

---

Site Manager

**APPENDIX C**  
**DISTRIBUTION LIST**

**DISTRIBUTION:**

Ms. Karen Westphall  
EMP Coordinator  
U.S. Fish and Wildlife Service  
Mark Twain National Wildlife Refuge  
1704 North 24<sup>th</sup> Street  
Quincy, Illinois 62301

Mr. Rick Nelson  
Field Supervisor  
U.S. Fish and Wildlife Service  
4469 48th Avenue Court  
Rock Island, Illinois 61201

Mr. Gordon Farabee  
Missouri Department of Conservation  
2901 West Truman Blvd., P.O. Box 180  
Jefferson City, Missouri 65102-0180 (3 copies)

Mr. Ken Brummett  
Missouri Department of Conservation  
P.O. Box 428  
653 Clinic Road  
Hannibal, Missouri 63401

Mr. Edward L. Tamerius  
District Forester  
Missouri Department of Conservation  
P.O. Box 428  
653 Clinic Road  
Hannibal, Missouri 63401

Mr. Keith Jackson  
Missouri Department of Conservation  
P.O. Box 428  
653 Clinic Road  
Hannibal, Missouri 63401

Mr. Norm Stucky  
Missouri Department of Conservation  
2901 W. Truman Blvd., P.O. Box 180  
Jefferson City, Missouri 65102-0180

Ms. Holly Stoerker  
Upper Mississippi River Basin Association  
415 Hamm Building  
408 St. Peter Street  
St. Paul, Minnesota 55102

Dr. Leslie Holland-Bartels  
Upper Midwest Environmental Sciences Center  
575 Lester Avenue  
Lake Onalaska, Wisconsin 54650-8552

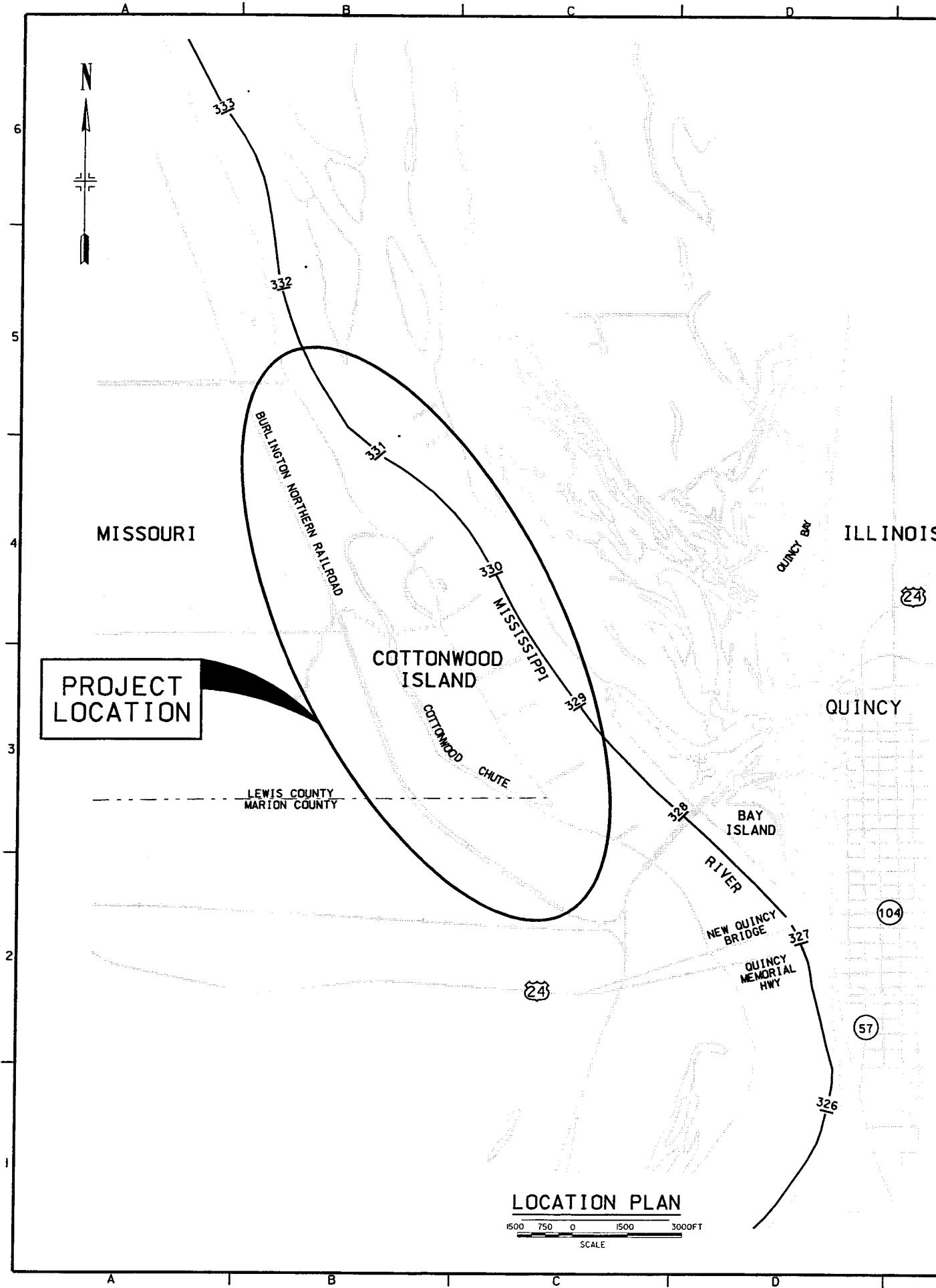
Mr. Michael Steuck  
LTRM-Bellevue Field Station  
206 Rose Street  
Bellevue, Iowa 52031

Division Engineer  
U.S. Army Engineer Division, Mississippi Valley  
ATTN: Greg Ruff (CEMVD-PM-E)  
P.O. Box 80  
Vicksburg, Mississippi 39180

COMMANDER, U.S. ARMY ENGINEER DISTRICT, ROCK ISLAND  
CLOCK TOWER BUILDING - P.O. BOX 2004  
ROCK ISLAND, ILLINOIS 61204-2004

|                 |                     |
|-----------------|---------------------|
| ATTN: CEMVR-ED  | CEMVR-PM-M (Niles)  |
| CEMVR-ED-D      | CEMVR-PM-M (2)      |
| CEMVR-ED-DN (3) | CEMVR-OD-M          |
| CEMVR-ED-H      | CEMVR-OD-MN (Adcox) |
| CEMVR-ED-G      | CEMVR-OD-MN         |
| CEMVR-CD        | CEMVR-EM            |
| CEMVR-PM-AR     |                     |

**PLATES**

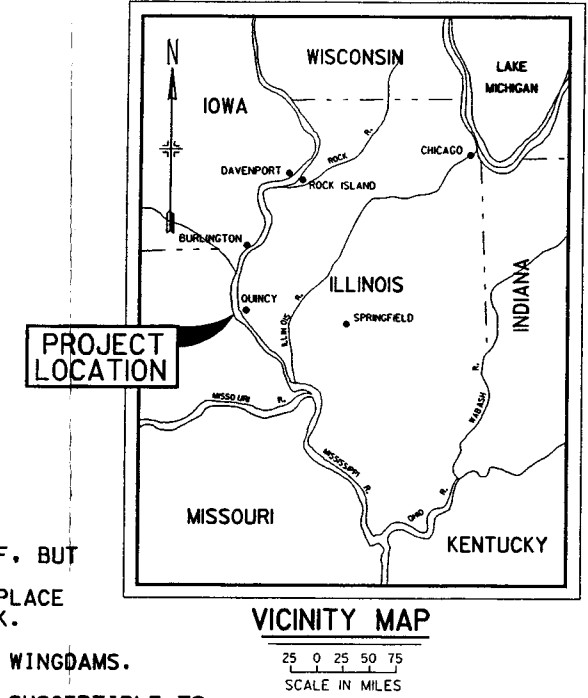


PROJECT LOCATION

LOCATION PLAN  
SCALE  
1500 750 0 1500 3000FT

GENERAL NOTES:

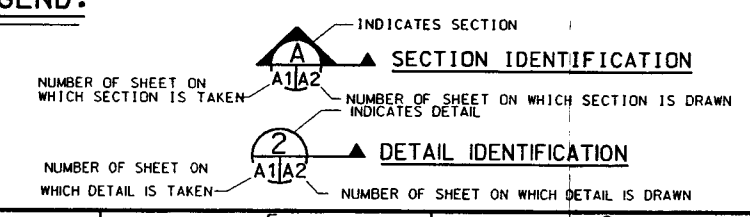
1. THE SCOPE OF WORK GENERALLY CONSISTS OF, BUT IS NOT LIMITED TO:  
A. MECHANICALLY EXCAVATE CHANNEL AND PLACE EXCAVATED MATERIAL ON ADJACENT BANK.  
B. MECHANICALLY EXCAVATE POTHOLES.  
C. REMOVE ROCK MATERIAL FROM EXISTING WINGDAMS.
2. THE ENTIRE CONSTRUCTION SITE IS HIGHLY SUSCEPTIBLE TO FLOODING. SEE HYDRAULIC DATA IN SPECIFICATIONS.
3. CONTOURS SHOWN ARE FROM PRE-1993 SURVEYS. ACTUAL ELEVATIONS SHALL BE VERIFIED BY THE CONTRACTOR. ALL ELEVATIONS REFERENCED TO 1912 NGVD.
4. THE LAYOUT OF PROJECT FEATURES AS SHOWN SHALL BE FIELD STAKED BY THE CONTRACTOR AND APPROVED BY THE CONTRACTING OFFICER'S REPRESENTATIVE PRIOR TO CONSTRUCTION.



VICINITY MAP  
SCALE IN MILES  
25 0 25 50 75

| INDEX     |                |  |
|-----------|----------------|--|
| SHEET NO. | SHEET REF. NO. | TITLE OF DRAWING                             |
| 1         | X1             | COVER SHEET                                  |
| 2         | X2             | LOCATION PLAN, INDEX, & VICINITY MAP         |
| 3         | C1             | SITE PLAN                                    |
| 4         | C2             | BORING LOCATIONS                             |
| 5         | C3             | BORING LOGS I                                |
| 6         | C4             | BORING LOGS II                               |
| 7         | C5             | SURVEY DATA                                  |
| 8         | C6             | SURVEY CONTROL I                             |
| 9         | C7             | SURVEY CONTROL II                            |
| 10        | C8             | SURVEY CONTROL III                           |
| 11        | C9             | CHANNEL AND DEEPHOLE EXCAVATION PLAN         |
| 12        | C10            | CHANNEL AND DEEPHOLE EXCAVATION SECTIONS I   |
| 13        | C11            | CHANNEL AND DEEPHOLE EXCAVATION SECTIONS II  |
| 14        | C12            | CHANNEL AND DEEPHOLE EXCAVATION SECTIONS III |
| △ 15      | C12A           | COTTONWOOD CHUTE PROFILES RIGHT BANK         |
| △ 16      | C12B           | COTTONWOOD CHUTE PROFILES CENTER LINE        |
| △ 17      | C12C           | COTTONWOOD CHUTE PROFILES LEFT BANK          |
| △ 18      | C13            | WING DAM NOTCHING                            |
| △ 19      | C14            | POTHOLE DETAILS                              |
| △ 20      | C15            | POTHOLE 1 TRANSECTS                          |
| △ 21      | C16            | POTHOLE 2 TRANSECTS                          |
| △ 22      | C17            | POTHOLE 3 TRANSECTS                          |
| △ 23      | C18            | POTHOLE 4 TRANSECTS                          |
| △ 24      | C19            | POTHOLE 5 TRANSECTS                          |

LEGEND:



US Army Corps of Engineers  
Rock Island District

|        |                        |                     |          |          |
|--------|------------------------|---------------------|----------|----------|
| Symbol | Revised As Constructed | Added Sheets To Set | Date     | Approved |
| △      | 1                      | 1                   | 9 JAN 98 | CK/BLK   |

U.S. ARMY ENGINEER DISTRICT  
CORPS OF ENGINEERS  
ROCK ISLAND, ILLINOIS

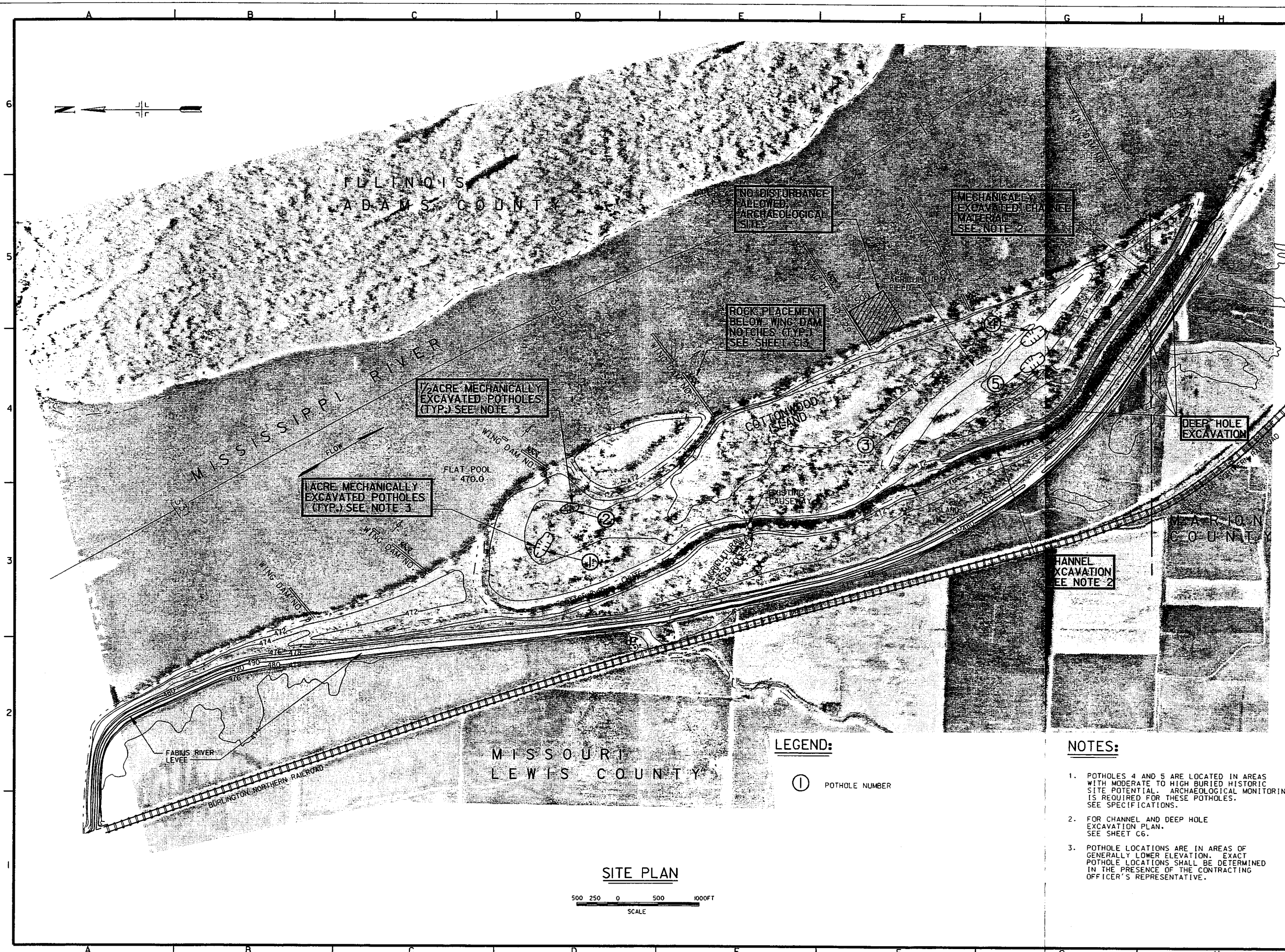
Designated By: CK  
Drawn By: SDH/BLK/HLW  
Checked By: BLK  
Reviewed By: BLK

Date: 3 JAN, '97  
Scale: AS SHOWN  
Drawing Code: M-L21-141  
Solicitation Number: DACW53-97-B-0011

UPPER MISSISSIPPI RIVER  
ENVIRONMENTAL MANAGEMENT PROGRAM  
POOL 21 THROUGH PILE 328.5  
COTTONWOOD ISLAND REHABILITATION  
AND ENHANCEMENT

STAGE I  
LOCATION PLAN,  
INDEX, & VICINITY MAP

PLATE 1



US Army Corps  
of Engineers  
Rock Island  
District

| Symbol | Description            | Revisions |
|--------|------------------------|-----------|
| 1      | REVISED AS CONSTRUCTED |           |
| 2      |                        |           |
| 3      |                        |           |
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|--|-----------------------|--------------------------------------|
| U.S. ARMY ENGINEER DISTRICT<br>ROCK ISLAND, ILLINOIS | DESIGNED BY: CCK      | DATE: 3 JAN. '97                     |
|  | DRAWN BY: SDH/BLK/HLW | SCALE: AS SHOWN                      |
|  | CHECKED BY: BLK       | DRAWING CODE: M-21-141               |
|  | REVIEWED BY: BLK      | SOLICITATION NUMBER: DAC25-97-B-0011 |

UPPER MISSISSIPPI RIVER  
ENVIRONMENTAL IMPACT  
STATEMENT  
COTTONWOOD ISLAND  
REHABILITATION  
AND  
ENHANCEMENT  
PROJECT  
PLATE 2

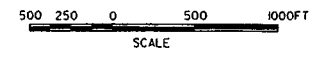
LEGEND:

① POTHOLE NUMBER

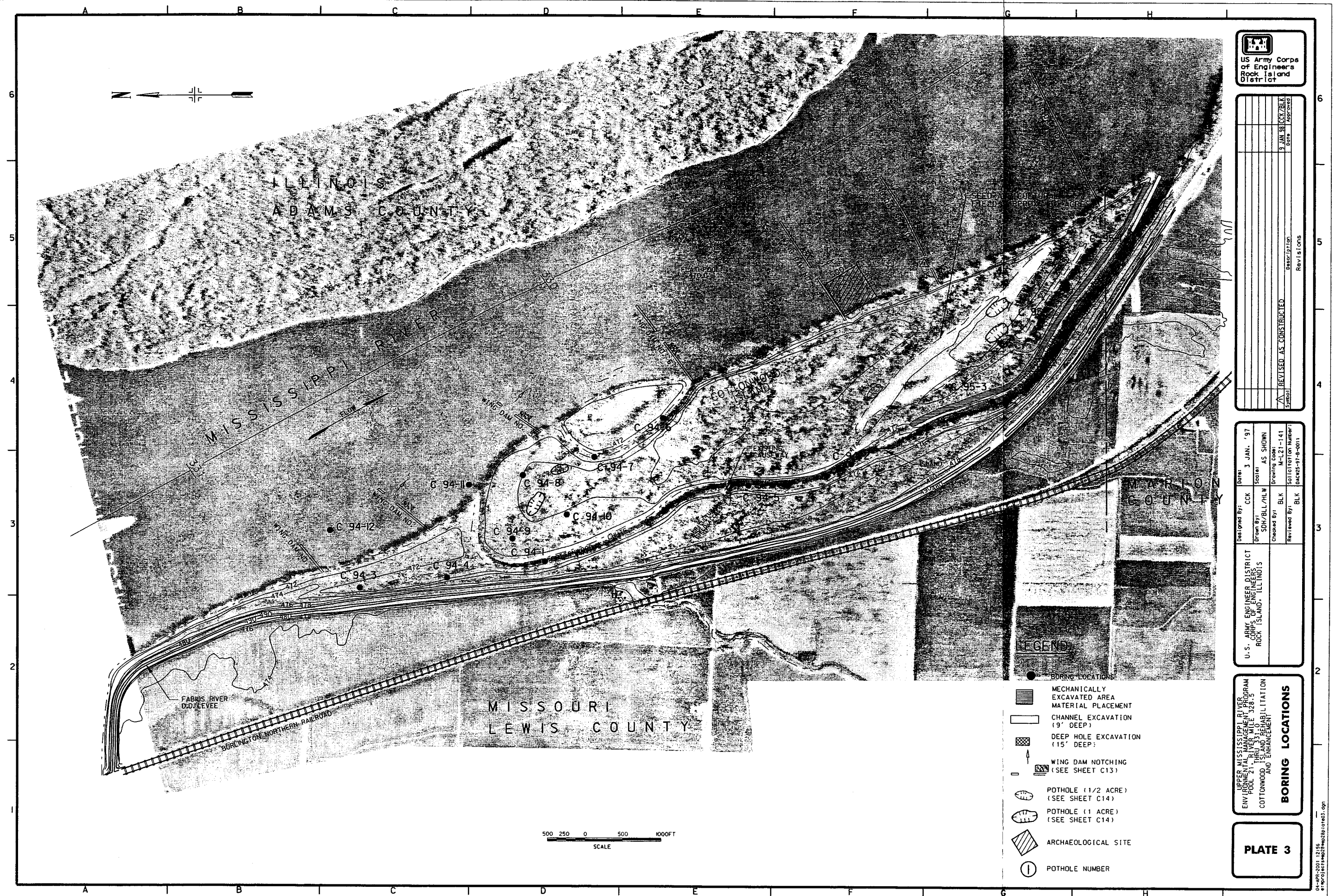
NOTES:

1. POTHOLES 4 AND 5 ARE LOCATED IN AREAS WITH MODERATE TO HIGH BURIED HISTORIC SITE POTENTIAL. ARCHAEOLOGICAL MONITORING IS REQUIRED FOR THESE POTHOLES. SEE SPECIFICATIONS.
2. FOR CHANNEL AND DEEP HOLE EXCAVATION PLAN. SEE SHEET C6.
3. POTHOLE LOCATIONS ARE IN AREAS OF GENERALLY LOWER ELEVATION. EXACT POTHOLE LOCATIONS SHALL BE DETERMINED IN THE PRESENCE OF THE CONTRACTING OFFICER'S REPRESENTATIVE.

SITE PLAN







US Army Corps  
of Engineers  
Rock Island  
District

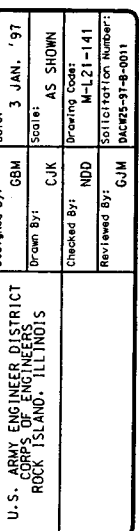
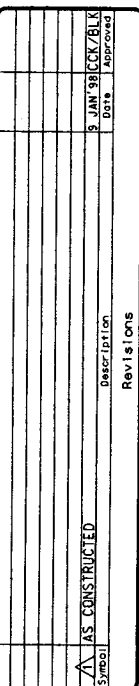
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| U.S. ARMY ENGINEER DISTRICT<br>CORPS OF ENGINEERS<br>FORT TSNAND, ILL INDS | CCK<br>3 JAN. '97<br>Scale:<br>AS SHOWN<br>Drawn By:<br>SDH/BLK/HLM<br>Checked By:<br>BLK<br>Reviewed By:<br>BLK | Drawing Code:<br>M-L21-141<br>Solicitation Number:<br>DAC25-97-a-0015 |
|--|--|---|

**BORING LOCATIONS**

**PLATE 3**

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**PLATE 4**





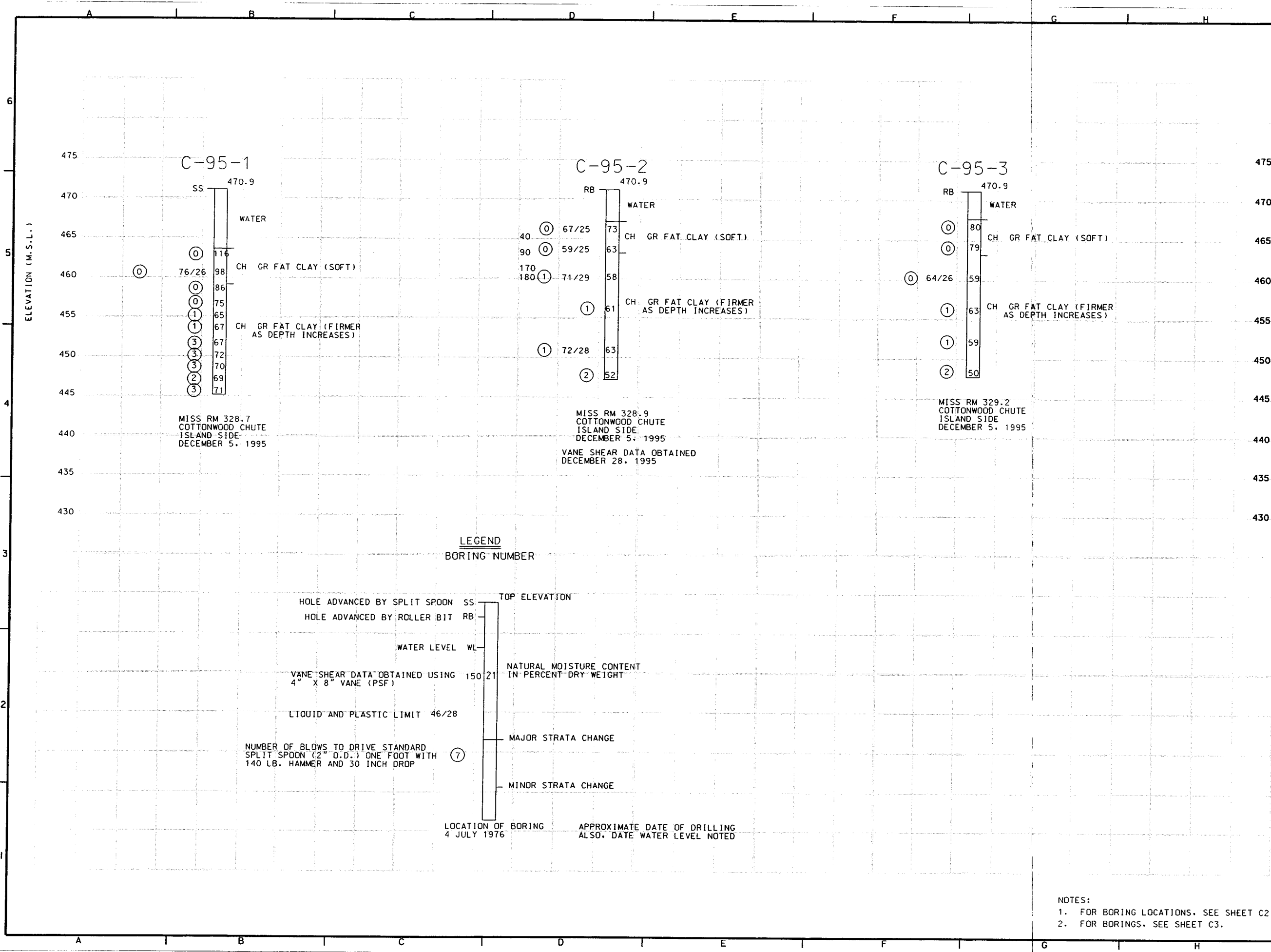
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|----------------|-------------|-----------|
| AS CONSTRUCTED |             |           |
| DATE           | DATE        | APPROVES  |
| DATE           | DATE        | APPROVES  |

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| U.S. ARMY ENGINEER DISTRICT<br>CORPS OF ENGINEERS<br>ROCK ISLAND, ILLINOIS | Designed By: GBM<br>Drawn By: CJK<br>Checked By: NDD<br>Reviewed By: GJM | Date: 3 JAN. '97<br>Scale: AS SHOWN<br>Drawing Code: M-L-21-141<br>Solicitation Number: DACK25-97-4-0011 |
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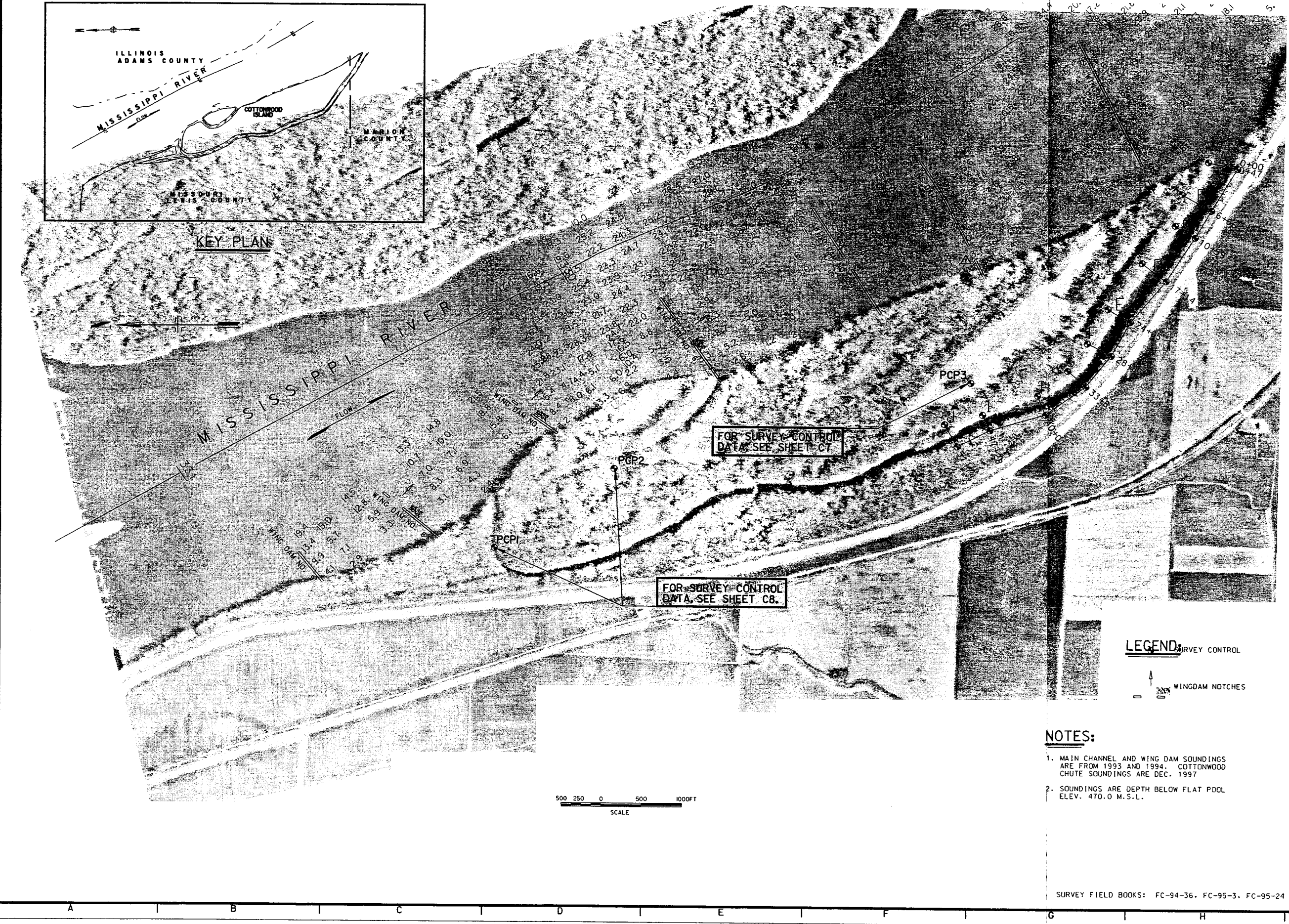
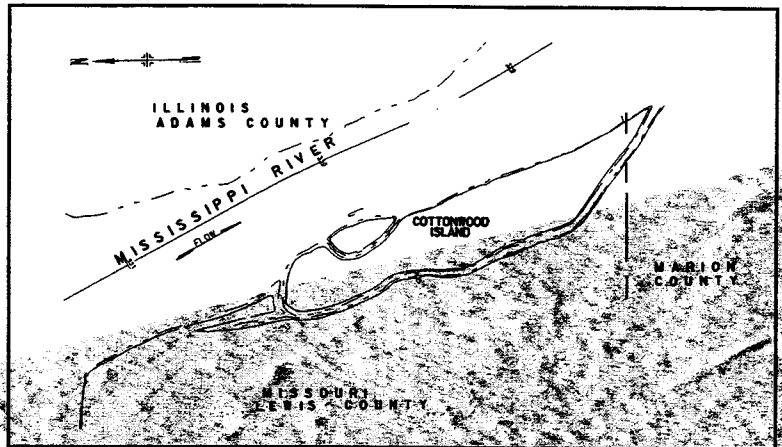
UPPER MISSISSIPPI RIVER  
ENVIRONMENTAL MANAGEMENT PROGRAM  
POOL 21 THROUGH HOLE 328.5  
COTTONWOOD ISLAND REHABILITATION  
AND ENHANCEMENT

**BORING LOGS II**

**PLATE 5**



NOTES:  
1. FOR BORING LOCATIONS, SEE SHEET C2.  
2. FOR BORINGS, SEE SHEET C3.



FOR SURVEY CONTROL  
DATA SEE SHEET C7

FOR SURVEY CONTROL  
DATA SEE SHEET C8

**LEGEND:**  
 SURVEY CONTROL  
 WINGDAM NOTCHES

**NOTES:**

1. MAIN CHANNEL AND WING DAM SOUNDINGS ARE FROM 1993 AND 1994. COTTONWOOD CHUTE SOUNDINGS ARE DEC. 1997
2. SOUNDINGS ARE DEPTH BELOW FLAT POOL ELEV. 470.0 M.S.L.

US Army Corps  
of Engineers  
Rock Island  
District

| Symbol | Description            | Revisions    |
|--------|------------------------|--------------|
| Δ      | REVISED AS CONSTRUCTED |              |
|        | Symbol                 | Date         |
|        |                        | 3 JAN 98/BLK |
|        |                        | Approved     |

|              |             |                       |                |
|--------------|-------------|-----------------------|----------------|
| Designed By: | CCK         | Date:                 | 3 JAN '97      |
| Drawn By:    | SDH/BLK/H/W | Scale:                | AS SHOWN       |
| Checked By:  | BLK         | Drawing Code:         | M-L21-141      |
| Reviewed By: | BLK         | Specification Number: | DA625-97-R-001 |

UPPER MISSISSIPPI RIVER  
ENVIRONMENTAL MANAGEMENT PROGRAM  
POOL 21, RIVER MILE 328.5  
COTTONWOOD CHUTE  
REPAIR AND ENHANCEMENT  
**BATYMETRIC DATA**

**PLATE 6**

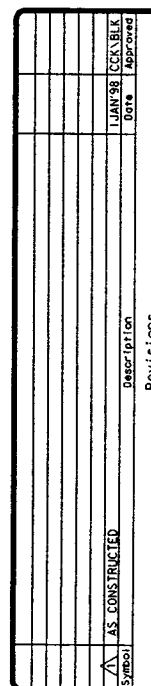
SURVEY FIELD BOOKS: FC-94-36, FC-95-3, FC-95-24

15 JAN 1998 15:25  
E:\PROJECTS\BATHY\BATHY289.DWG









U.S. ARMY ENGINEER DISTRICT  
CORPS OF ENGINEERS  
ROCK ISLAND, ILLINOIS

**PLATE 8**



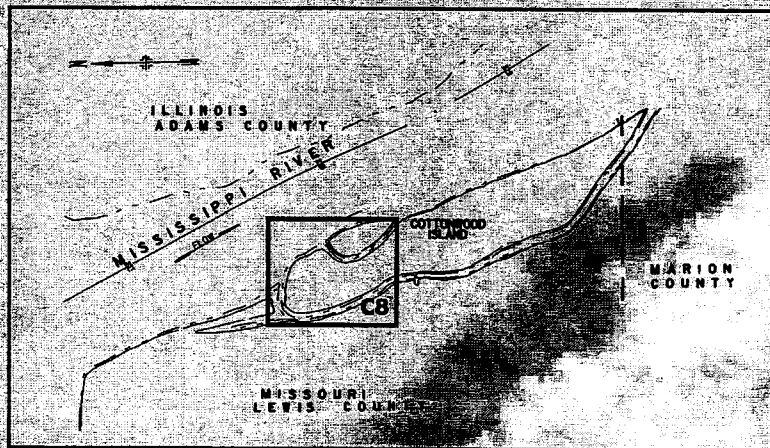
| POTHOLE CONTROL<br>POINT COORDINATES |            |           |
|--------------------------------------|------------|-----------|
| PCP                                  | NORTHINGS  | EASTINGS  |
| 3                                    | 1199169.55 | 139446.79 |

| SECTION COORDINATES |            |           |            |           |
|---------------------|------------|-----------|------------|-----------|
| RANGE               | BEGINNING  |           | ENDING     |           |
|                     | NORTHINGS  | EASTINGS  | NORTHINGS  | EASTINGS  |
| J                   | 1199327.56 | 138860.78 | 1199483.65 | 138935.10 |
| I                   | 1198929.00 | 138860.69 | 1199016.82 | 139054.74 |
| H                   | 1198231.14 | 139064.44 | 1198333.80 | 139304.13 |
| G                   | 1197724.08 | 139215.89 | 1197951.97 | 139613.43 |
| F                   | 1197409.22 | 139805.50 | 1197709.58 | 139956.27 |
| E                   | 1197174.94 | 140222.16 | 1197459.86 | 140377.55 |

**NOTE:**

1. SURVEY CONTROL ON COTTONWOOD ISLAND MAY HAVE BEEN DISTURBED DURING 1996 TIMBER SALE CONTRACT





NEW PLAN

COTTONWOOD ISLAND

20' COTTONWOOD  
16' MAPLE  
12' NAIL  
ELEV 477.5'  
PCP2

24' MAPLE  
12' NAIL  
ELEV 478.7'  
PCP1  
18' MAPLE  
12' NAIL  
ELEV 478.7'

| POT HOLE CONTROL<br>POINT COORDINATES |            |           |
|---------------------------------------|------------|-----------|
| PCP                                   | NORTHINGS  | EASTINGS  |
| 1                                     | 1205330.64 | 137350.13 |
| 2                                     | 1205336.74 | 138348.99 |

NOTE:  
1. SURVEY CONTROL ON COTTONWOOD ISLAND  
MAY HAVE BEEN DISTURBED DURING 1996  
TIMBER SALE CONTRACT.



| Symbol | Description    | Date     | Revisions |
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| AS     | AS CONSTRUCTED | 9 JAN 98 | CCX/2BLK  |

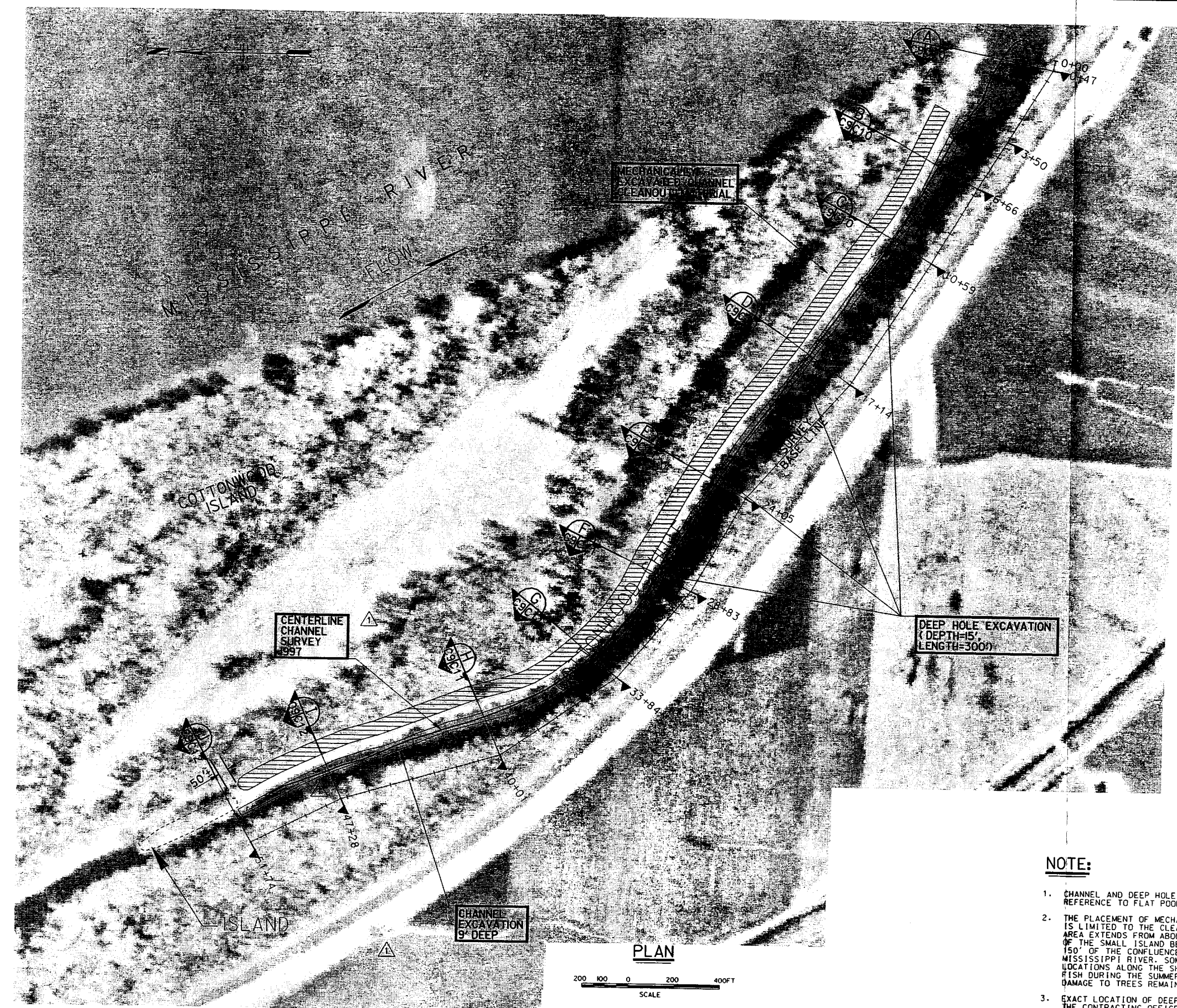
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| Drawn By:    | RHD | Scale:               | NO SCALE        |
| Checked By:  | BLK | Drawing Code:        | M-L-21-141      |
| Reviewed By: | BLK | SOI (COTTON) Number: | 04225-91-8-0011 |

UPPER MISSISSIPPI RIVER  
ENVIRONMENTAL MANAGEMENT PROGRAM  
FOUL 21, 1993  
COTTONWOOD ISLAND REHABILITATION  
AND ENHANCEMENT  
SURVEY CONTROL III

PLATE 9

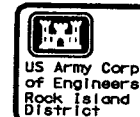
04-MRP-2001 13:13  
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NOTE:

1. CHANNEL AND DEEP HOLE EXCAVATION DEPTHS ARE IN REFERENCE TO FLAT POOL (ELEV. 470).
2. THE PLACEMENT OF MECHANICALLY EXCAVATED MATERIAL IS LIMITED TO THE CLEARED AREA. THE CLEARED AREA EXTENDS FROM ABOUT 50' DOWNSTREAM OF THE SMALL ISLAND BELOW THE CAUSEWAY TO WITHIN 150' OF THE CONFLUENCE OF COTTONWOOD CHUTE AND THE MISSISSIPPI RIVER. SOME TREES REMAIN AT STAGGERED LOCATIONS ALONG THE SHORELINE TO PROVIDE SHADE FOR FISH DURING THE SUMMER. CONTRACTOR SHALL MINIMIZE DAMAGE TO TREES REMAINING ALONG SHORELINE.
3. EXACT LOCATION OF DEEP HOLES TO BE DETERMINED BY THE CONTRACTING OFFICER'S REPRESENTATIVE.

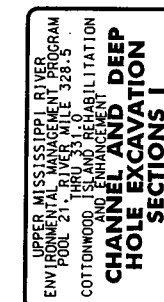
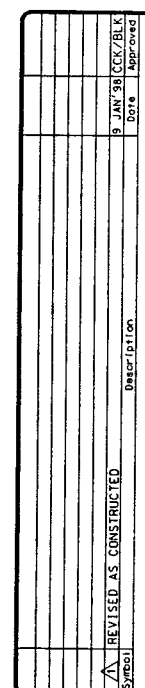
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| U.S. ARMY ENGINEER DISTRICT<br>CORPS OF ENGINEERS<br>ROCK ISLAND, ILL 61201 | Designed By: CCK     | Date: 3 JAN. '97                    |
|   | Drawn By: SDH/BL/HLW | Scale: AS SHOWN                     |
|   | Checked By: BLK      | Drawing Code: M-L21-141             |
|   | Reviewed By: BLK     | SATIGATION NUMBER: DACK25-97-a-0011 |

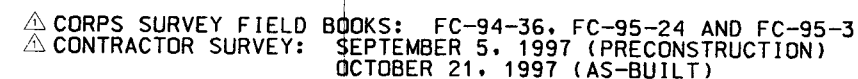
UPPER MISSISSIPPI RIVER  
ENVIRONMENTAL MANAGEMENT PROGRAM  
POOL 21, RIVER MILE 328.5  
THRU 331.0  
TITTONWOOD ISLAND REHABILITATION  
AND ENHANCEMENT

**CHANNEL AND  
DEEP HOLE  
EXCAVATION PLAN**

## PLATE 10



4-APR-2001 11:00 —

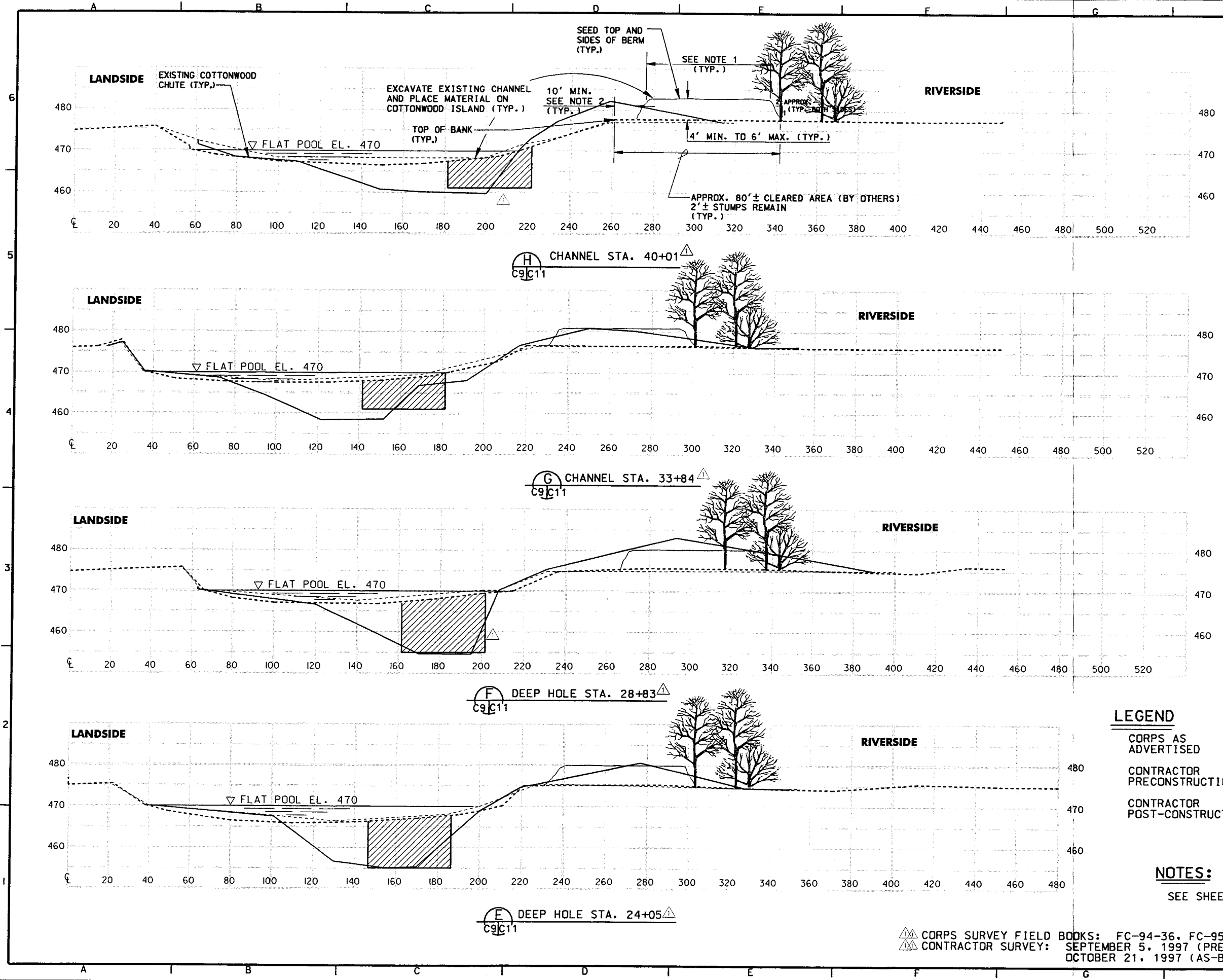


| Symbol | Description            | Revisions |
|--------|------------------------|-----------|
| △      | REVISED AS CONSTRUCTED |           |

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|---|---|--|
| U.S. ARMY ENGINEER DISTRICT<br>ROCK ISLAND DISTRICT | Designed By: CCK<br>Drawn By: SDH/BL/HLW<br>Checked By: BLK<br>Reviewed By: BLK | Date: 3 JAN, '97<br>Scale: AS SHOWN<br>Drawing Code: M-L-21-141<br>Specification Number: DACR-97-B-001 |
|---|---|--|

UPPER MISSISSIPPI RIVER  
ENVIRONMENTAL RESTORATION  
PROGRAM  
POOL 21, RIVER MILE 328.5  
COTTONWOOD AND CHUTE REVEAL  
AND CHANNEL AND DEEP  
HOLE EXCAVATION  
SECTION II

PLATE 12





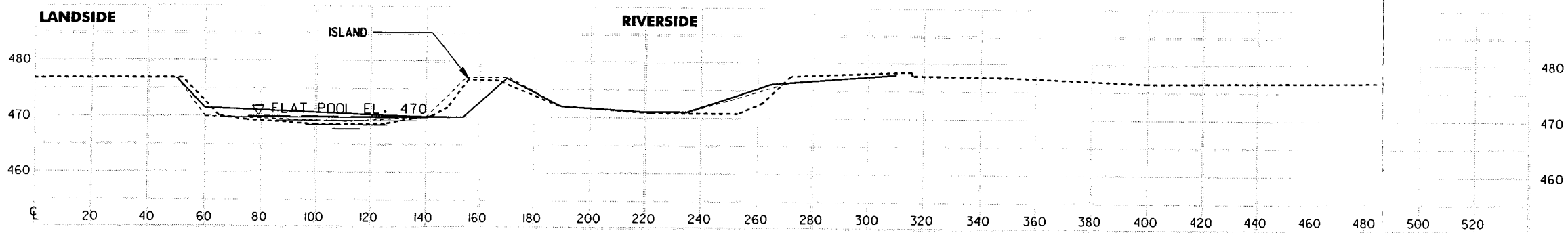


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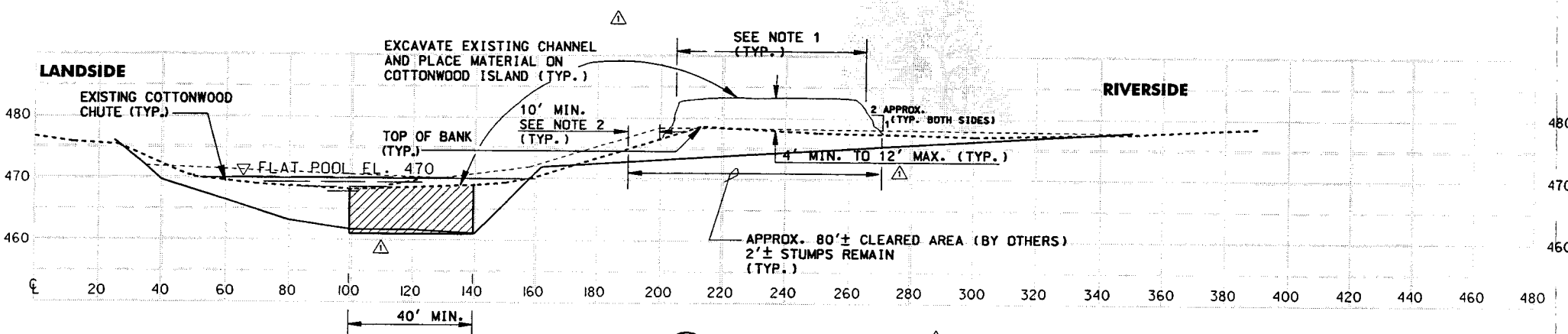
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| U.S. ARMY ENGINEER DISTRICT<br>CORPS OF ENGINEERS<br>ROCK ISLAND, ILLINOIS | Designed By: CCK<br>Drawn By: SDH/BL/HLW<br>Checked By: BLK<br>Reviewed By: BLK | Date: 3 JAN. '97<br>Scale: AS SHOWN<br>Drawing Code: M-21-141<br>Solicitation Number: DACRS-97-B-001 |
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UPPER MISSISSIPPI RIVER  
ENVIRONMENTAL MANAGEMENT PROGRAM  
POOL 21, RIVER MILE 328.5  
COTTONWOOD ISLAND REHABILITATION  
AND ENHANCEMENT  
**CHANNEL AND DEEP  
HOLE EXCAVATION  
SECTIONS III**

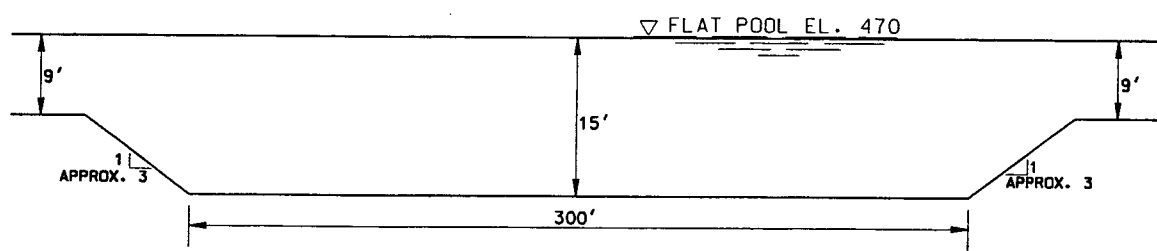
**PLATE 13**



NO WORK STA. 51+74  
C9/C12



CHANNEL STA. 47+28  
C9/C12



TRANSITION FROM 9' CHANNEL TO DEEP HOLE (TYP.)  
NO SCALE

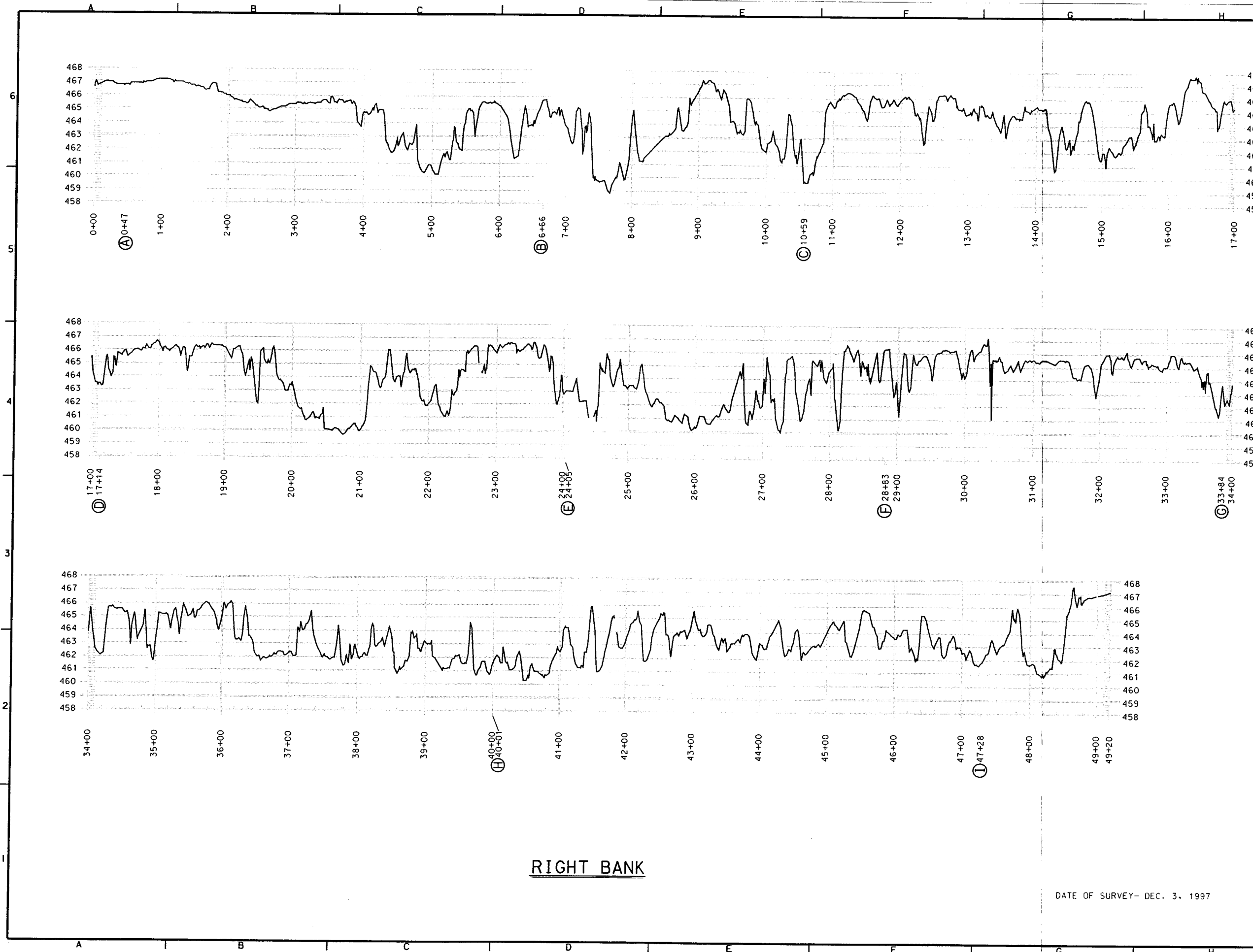
**LEGEND**

- △ CORPS AS ADVERTISED
- △ CONTRACTOR PRECONSTRUCTION
- CONTRACTOR POST-CONSTRUCTION

**NOTES:**

SEE SHEET C10.

△ CORPS SURVEY FIELD BOOKS: FC-94-36, FC-95-24 AND FC-95-3  
△ CONTRACTOR SURVEY: SEPTEMBER 5, 1997 (PRECONSTRUCTION)  
OCTOBER 21, 1997 (AS-BUILT)



| Revisions                                 | Date      | By      | Appr'd |
|---|-----------|---------|--------|
| 1   | 9 JAN '98 | CKK/BLK |        |
| REVISED AS CONSTRUCTED-SHEET ADDED TO SET |           |         |        |

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| U.S. ARMY ENGINEER DISTRICT<br>CORPS OF ENGINEERS<br>ROCK ISLAND, ILLINOIS | Desig'd By: CKK<br>Drawn By: SDH/BLK/HLW<br>Checked By: BLK<br>Reviewed By: BLK | Date: 3 JAN. '97<br>Scale: AS SHOWN<br>Drawing Code: M-21-141<br>Sollitt Plot on Number: 04242-31-8-0011 |
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UPPER MISSISSIPPI RIVER  
ENVIRONMENTAL IMPROVEMENT PROGRAM  
POOL 27, MILE 26.5  
COTTONWOOD, ILLINOIS  
ISLAND REHABILITATION  
AND ENHANCEMENT  
**COTTONWOOD CHUTE  
PROFILES RIGHT BANK**

**PLATE 14**

DATE OF SURVEY- DEC. 3, 1997

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ELEVATION

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① 0+47

1+00

2+00

3+00

4+00

5+00

6+00

② 6+66

7+00

8+00

9+00

10+00

③ 10+59

11+00

12+00

13+00

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⑥ 24+00

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ELEVATION

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CENTERLINE

DATE OF SURVEY- DEC. 3, 1997



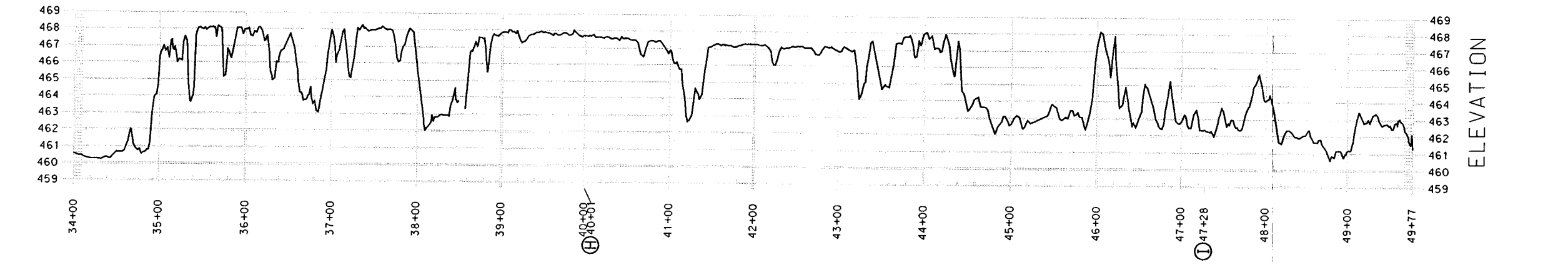
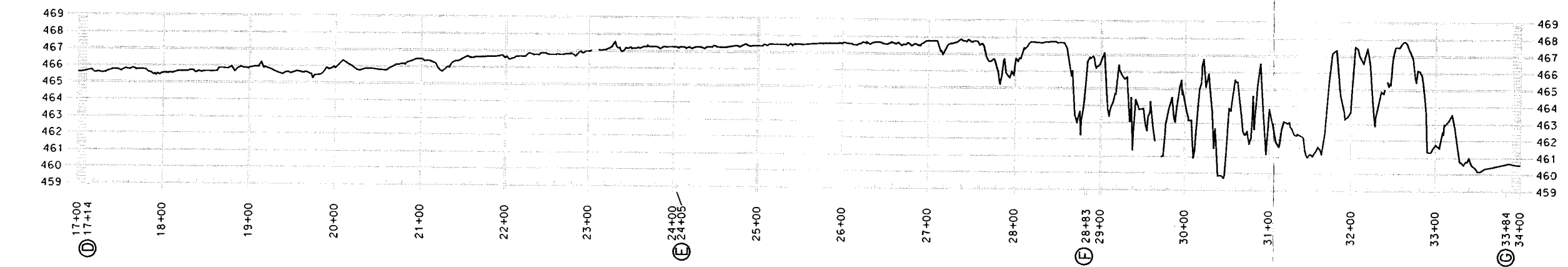
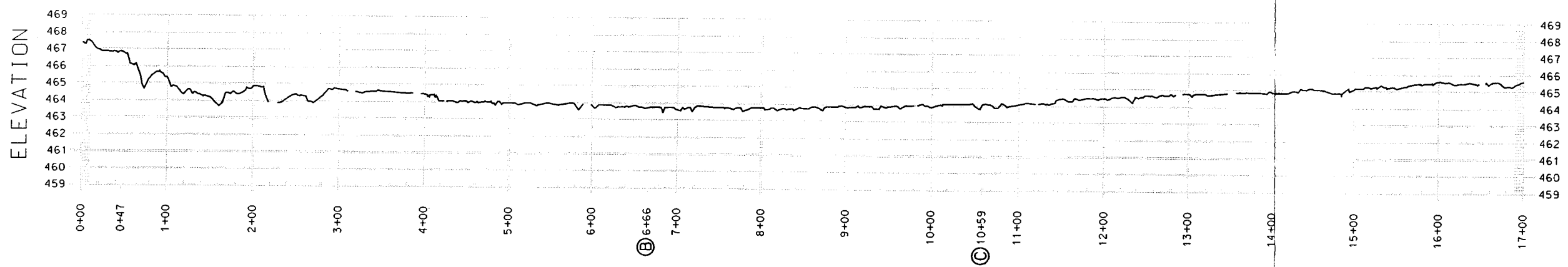
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| U.S. ARMY ENGINEER DISTRICT<br>CORPS OF ENGINEERS<br>ROCK ISLAND, ILLINOIS | Designed By: CCK<br>Drawn By: SDH/BLK/H/W<br>Checked By: BLK<br>Reviewed By: BLK | Date: 3 JAN. '97<br>Scale: AS SHOWN<br>Drawing Code: H-121-141<br>Solicitation Number: DEC93-91-B-0011 |
|--|--|--|

UPPER MISSISSIPPI RIVER  
ENVIRONMENTAL MANAGEMENT PROGRAM  
POOL 21, RIVER MILE 328.5  
COTTONWOOD ISLAND REHABILITATION  
AND ENHANCEMENT  
**COTTONWOOD CHUTE  
PROFILES CENTER LINE**

**PLATE 15**

04-APR-2001 11:04  
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**PLATE 16**

UPPER MISSISSIPPI RIVER  
ENVIRONMENTAL MANAGEMENT PROGRAM  
POOL 21, RIVER MILE 328.5  
COTTONWOOD ISLAND REHABILITATION  
AND ENHANCEMENT

**COTTONWOOD CHUTE  
PROFILES LEFT BANK**

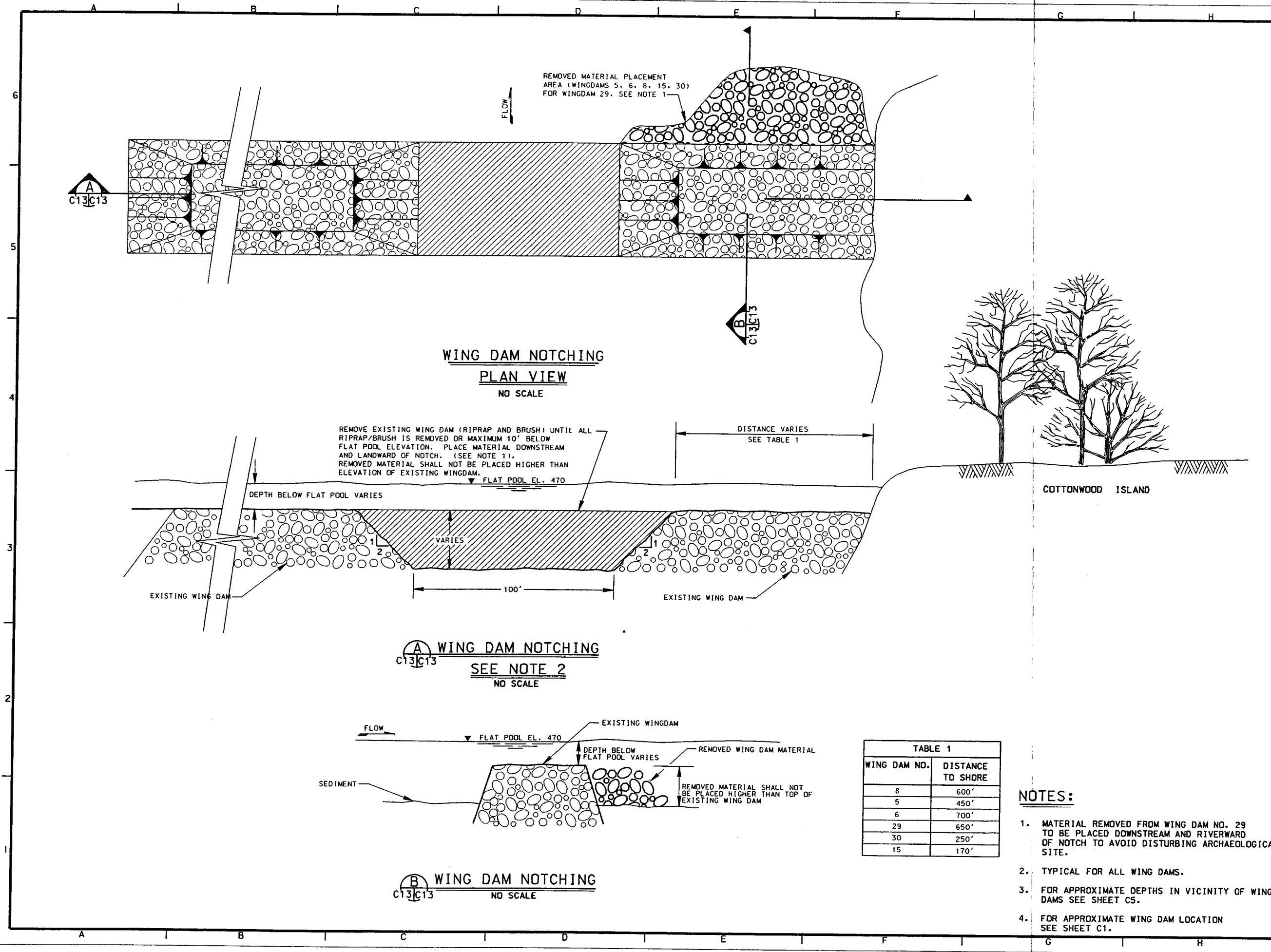
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|----------------|-----------|-----------|
| AS CONSTRUCTED | 3 JAN '97 |           |

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|--------------|------------|-----------------------|----------------|
| Designed By: | CCK        | Date:                 | 3 JAN '97      |
| Drawn By:    | SDH/BL/HLW | Scale:                | AS SHOWN       |
| Checked By:  | BLK        | Drawing Code:         | M-L21-141      |
| Reviewed By: | BLK        | Soil Citation Number: | DAKES-97-9-001 |

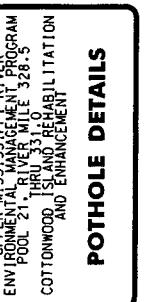
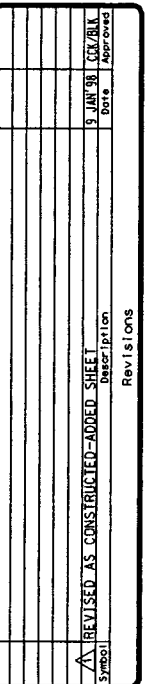
UPPER MISSISSIPPI RIVER  
ENVIRONMENTAL MANAGEMENT PROGRAM  
POOL 21, TRIBUTARY MILE 328.5  
COTTONWOOD ISLAND REHABILITATION  
AND ENHANCEMENT

**WING DAM NOTCHING**

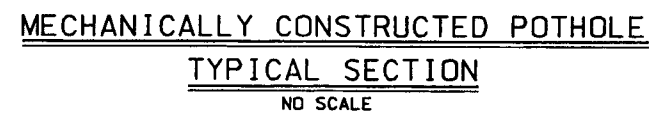
**PLATE 17**



- NOTES:**
- MATERIAL REMOVED FROM WING DAM NO. 29 TO BE PLACED DOWNSTREAM AND RIVERWARD OF NOTCH TO AVOID DISTURBING ARCHAEOLOGICAL SITE.
  - TYPICAL FOR ALL WING DAMS.
  - FOR APPROXIMATE DEPTHS IN VICINITY OF WING DAMS SEE SHEET C5.
  - FOR APPROXIMATE WING DAM LOCATION SEE SHEET C1.



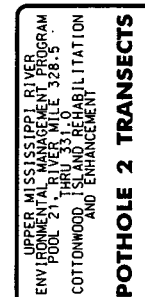
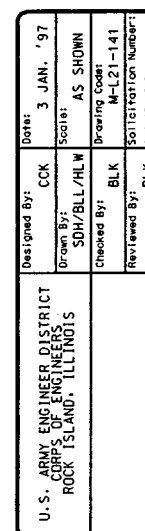
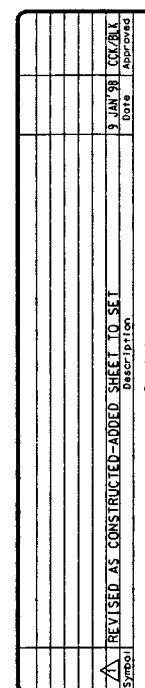
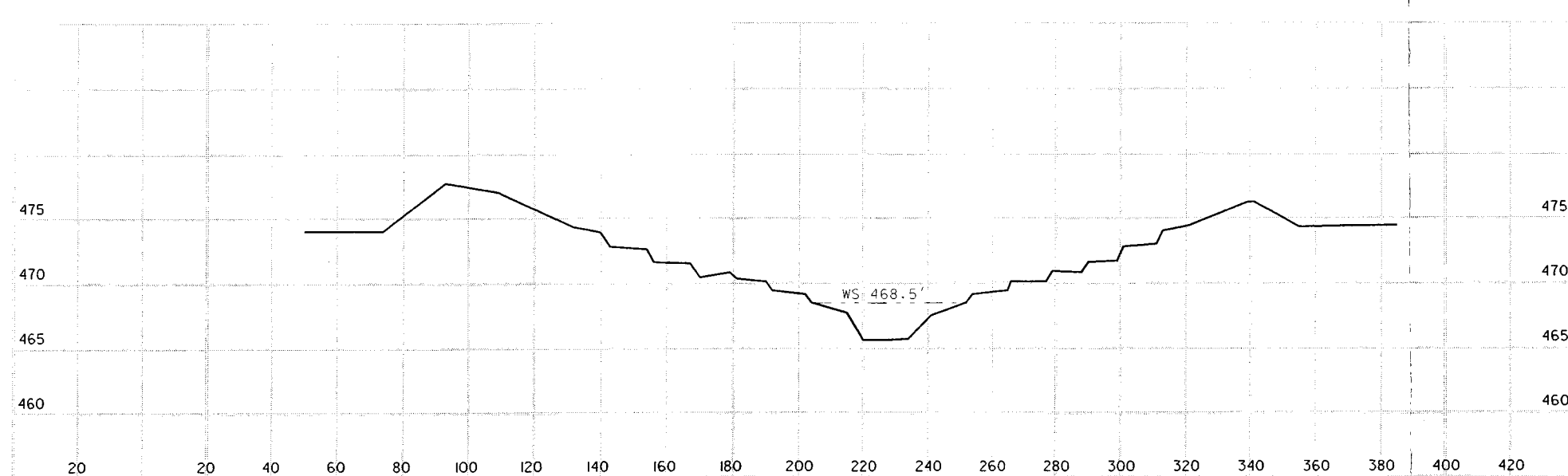
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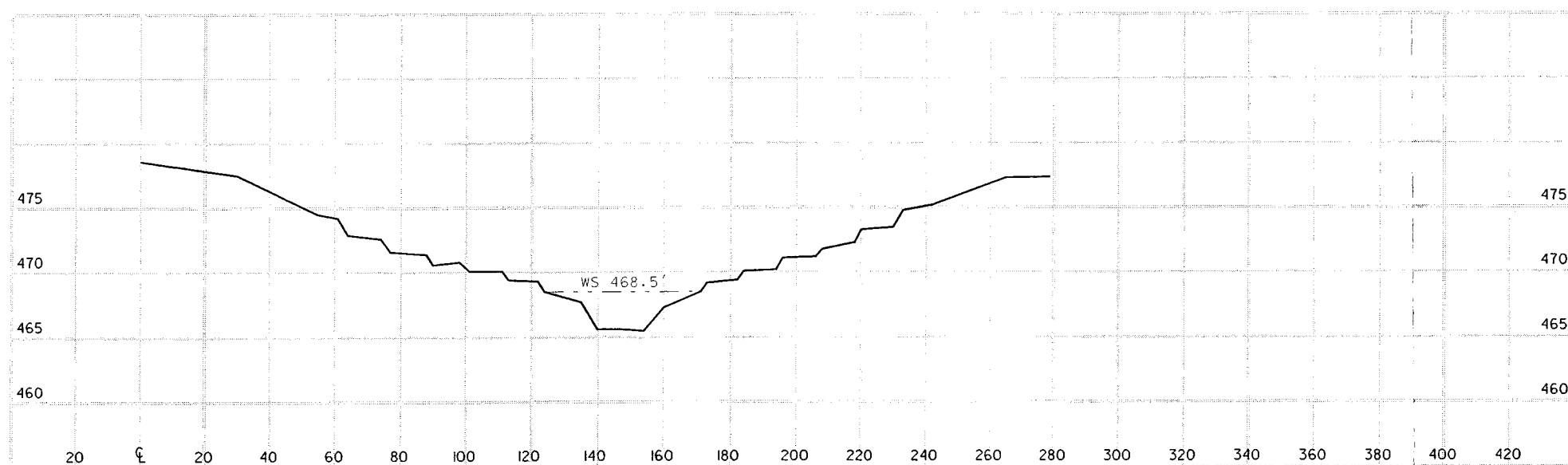
| POTHOLE<br>NUMBER | AREA<br>(ACRES) | APPROXIMATE EXISTING<br>GROUND ELEVATION | APPROXIMATE<br>WIDTH, FT. | APPROX.<br>LENGTH, FT. | APPROX. CLEARED<br>AREA, ACRES |
|-------------------|-----------------|--|---------------------------|------------------------|--------------------------------|
| 1                 | 1               | 474                                      | 180                       | 200                    | 3.5                            |
| 2                 | 1/2             | 474                                      | 180                       | 180                    | 2                              |
| 3                 | 1/2             | 474                                      | 180                       | 185                    | 2                              |
| 4                 | 1               | 475                                      | 208                       | 267                    | 4                              |
| 5                 | 1               | 475                                      | 208                       | 267                    | 4                              |

1. FOR APPROXIMATE POTHOLE LOCATIONS SEE SHEET C1.
2. POTHOLE 4 AND 5 ARE LOCATED IN AREAS WITH MODERATE TO HIGH BURIED HISTORIC SITE POTENTIAL. ARCHAEOLOGICAL MONITORING IS REQUIRED FOR THESE POTHOLE. SEE SPECS.
3. ALL MECHANICALLY CONSTRUCTED POTHOLE TO BE STAKED BY THE CONTRACTOR AND APPROVED BY THE C.D.R. PRIOR TO CONSTRUCTION.
4. FOR POTHOLE 1, 2, & 3 STUMPS SHALL BE BURIED DOWNSTREAM AND BEYOND LIMITS OF BERM.
5. LENGTH & WIDTH OF POTHOLE VARY. SEE TABLE 1.



**PLATE 20**

POTHOLE #2 - SHORT CHORD

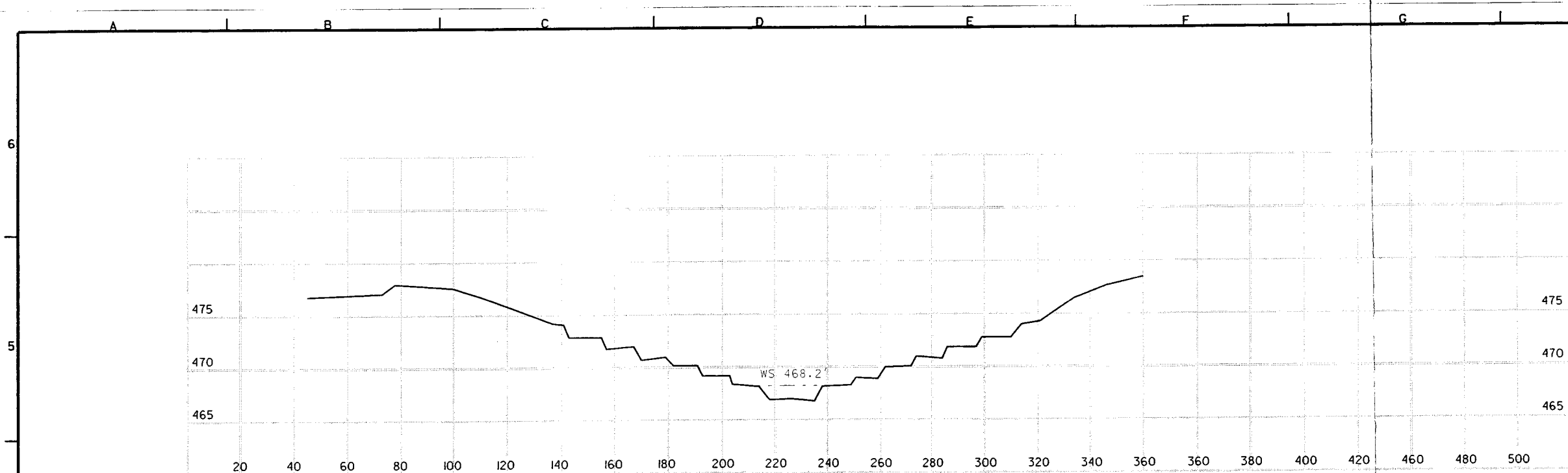


POTHOLE #2 - LONG CHORD

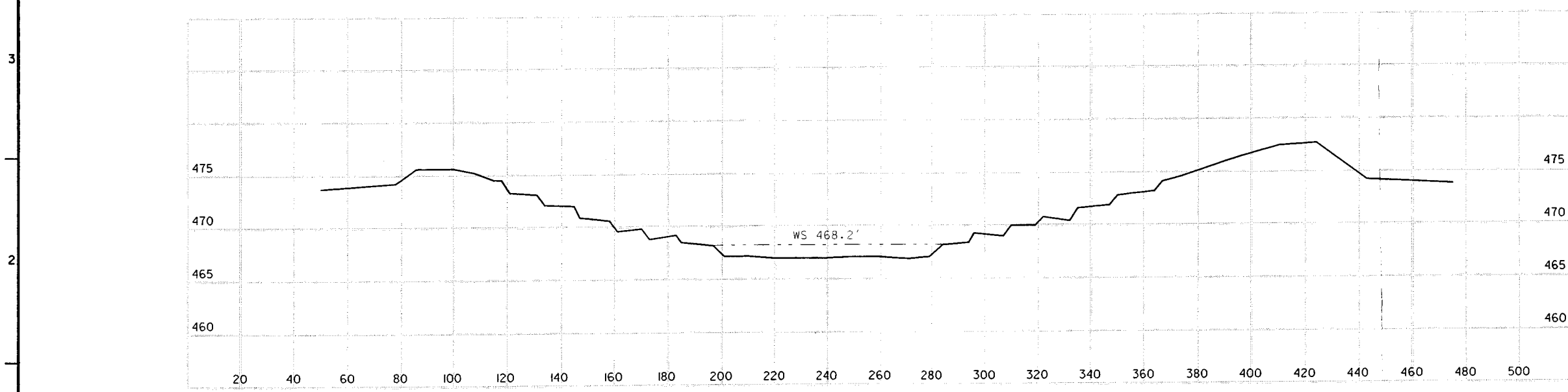
SURVEY FIELD BOOKS: FC-97-4  
DATE OF SURVEY 10/21/97-10/23/97







POTHOLE #4 - SHORT CHORD



POTHOLE #4 - LONG CHORD

SURVEY FIELD BOOKS: FC-97-4  
DATE OF SURVEY 10/21/97-10/23/97



| Symbol | Description                               | Date     | Approved |
|--------|---|----------|----------|
| Δ      | REVISED AS CONSTRUCTED-ADDED SHEET TO SET | 9 JAN 98 | COX/BLK  |

|              |             |                       |                  |
|--------------|-------------|-----------------------|------------------|
| Designed By: | CKK         | Date:                 | 3 JAN. '97       |
| Drawn By:    | SDH/BLK/H/W | Scale:                | AS SHOWN         |
| Checked By:  | BLK         | Drawing Code:         | M-121-141        |
| Reviewed By: | BLK         | Soil Citation Number: | DAK423-97-4-0011 |

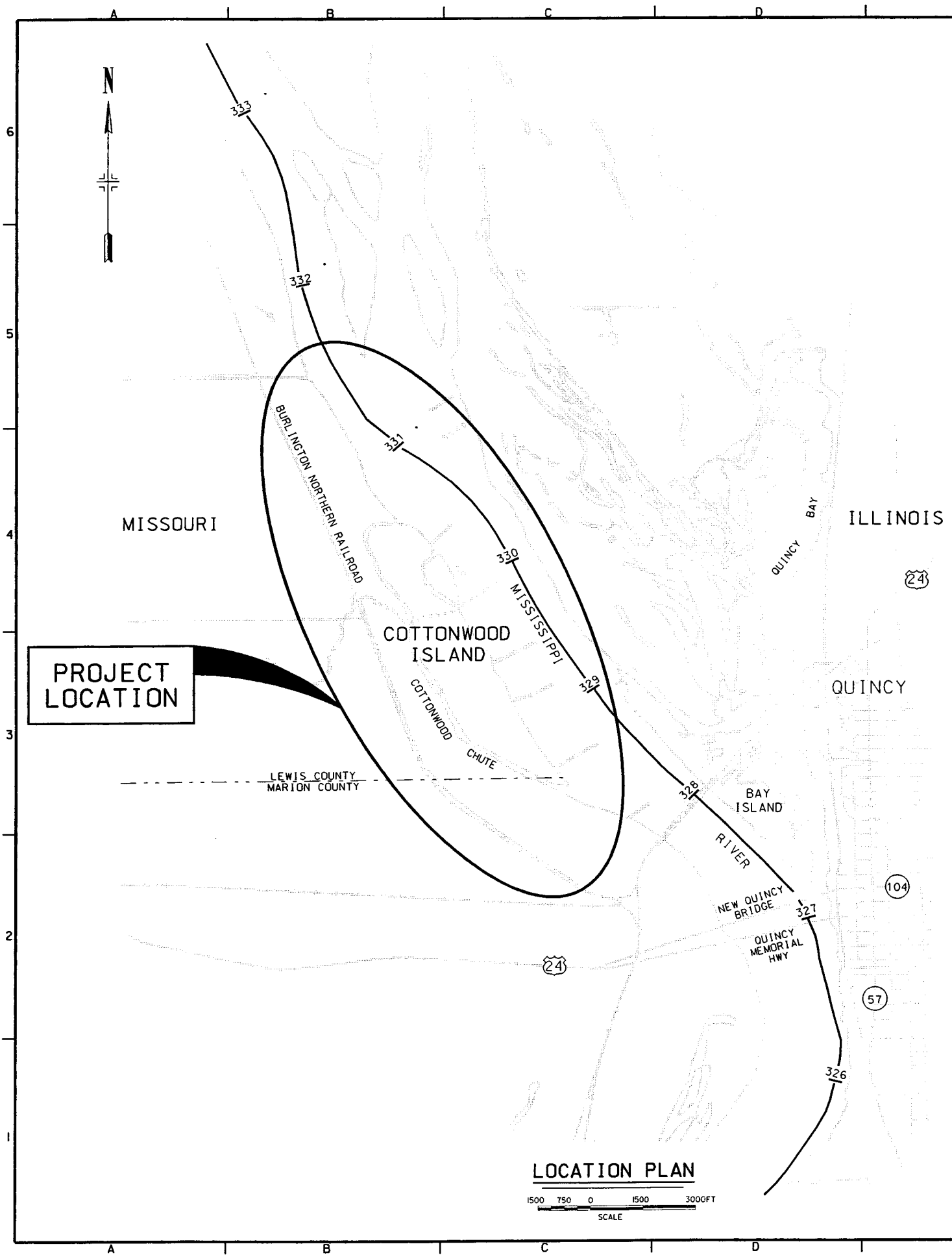
UPPER MISSISSIPPI RIVER  
ENVIRONMENTAL MANAGEMENT PROGRAM  
POOL 21, RIVER MILE 328.5  
COTTONWOOD ISLAND REHABILITATION  
AND ENHANCEMENT

**POT HOLE 4 TRANSECTS**

**PLATE 22**

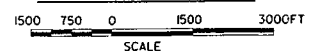
04-jpr-0011 11/97  
04-jpr-0011 11/97





PROJECT LOCATION

LOCATION PLAN

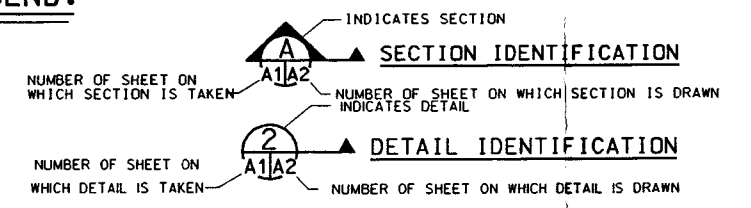


GENERAL NOTES:

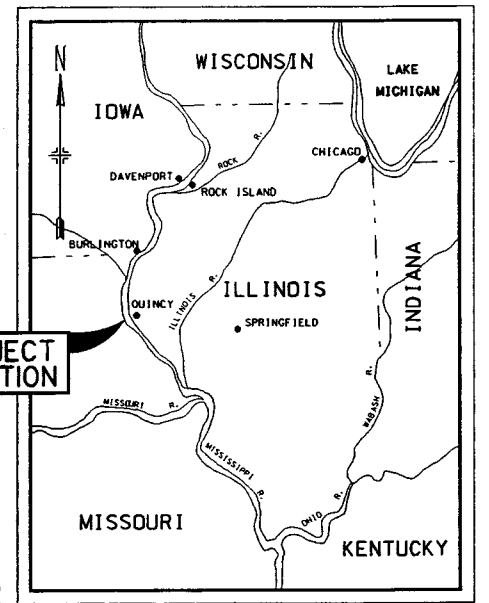
1. THE SCOPE OF WORK GENERALLY CONSISTS OF, BUT IS NOT LIMITED TO:  
A. CLEARING & GRUBBING FOREST MANAGEMENT AREAS (FMA) 5, 6, & 7. CLEAR ACCESS TO FMA 6 & 7.  
B. SEED FMAS, DISTURBED AREAS IN AGRICULTURAL FIELD, AND EXCAVATED MATERIAL BERM.  
C. PLANT TREES AND SEED FMAS, POTHOLE PERIMETERS, AGRICULTURAL FIELD, & EXCAVATED MATERIAL BERM.  
D. INSTALL DEER PROTECTION (FENCING) AROUND 35 TREES IN FMA 5 AND 40 TREES IN FMA 6.  
E. SPRAY DEER REPELLENT AROUND 35 TREES IN FMA 5 AND 40 TREES IN FMA 6. FENCED TREES SHALL NOT BE SPRAYED.
2. THE ENTIRE CONSTRUCTION SITE IS HIGHLY SUSCEPTIBLE TO FLOODING. SEE HYDRAULIC DATA IN SPECIFICATIONS.
3. CONTOURS SHOWN ON SHEET C1 ARE FROM PRE-1993 SURVEYS. ACTUAL ELEVATIONS SHALL BE VERIFIED BY THE CONTRACTOR. ALL ELEVATIONS REFERENCED TO 1912 NGVD.
4. THE LAYOUT OF PROJECT FEATURES AS SHOWN SHALL BE FIELD STAKED BY THE CONTRACTOR IN COORDINATION WITH THE CONTRACTING OFFICER PRIOR TO CONSTRUCTION.

| INDEX     |                |   |
|-----------|----------------|---|
| SHEET NO. | SHEET REF. NO. | TITLE OF DRAWING  |
| 1         | X1             | COVER SHEET   |
| 2         | X2             | LOCATION PLAN, INDEX, & VICINITY MAP                            |
| 3         | C1             | MAST TREE PLANTING SITE PLAN                                    |
| 4         | C2             | BATHYMETRIC DATA  |
| 5         | C3             | POTHoles AND FOREST MANAGEMENT AREA PLANTING DETAILS            |
| 6         | C4             | AGRICULTURAL FIELD AND EXCAVATED MATERIAL BERM PLANTING DETAILS |
| 7         | C5             | TREE PLANTING SCHEDULE AND DETAILS                              |

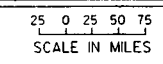
LEGEND:



PROJECT LOCATION



VICINITY MAP



| Symbol | Description    | Revisions |
|--------|----------------|-----------|
| AS     | AS CONSTRUCTED |           |

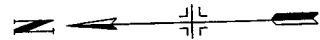
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| U.S. ARMY ENGINEER DISTRICT<br>CORPS OF ENGINEERS<br>ROCK ISLAND, ILLINOIS | Designed By: CCK<br>Drawn By: SDB/BL<br>Checked By: MUT<br>Reviewed By: BLK | Date: 12 DEC. 1998<br>Scale: AS SHOWN<br>Drawing Code: M-121-142<br>Schematic Number: D4425-95-9-005 |
|--|---|--|

UPPER MISSISSIPPI RIVER  
ENVIRONMENTAL MANAGEMENT PROGRAM  
POOL 21. RIVER MILE 328.5 THRU 331.0  
COTTONWOOD ISLAND REHABILITATION  
AND ENHANCEMENT STAGE 11  
**STAGE II  
LOCATION PLAN,  
INDEX, & VICINITY MAP**

PLATE 24







US Army Corps  
of Engineers  
Rock Island  
District

| Symbol | Description    | Date | Approved |
|--------|----------------|------|----------|
| AS     | AS CONSTRUCTED |      |          |

|              |         |                      |                 |
|--------------|---------|----------------------|-----------------|
| Designed By: | CKK     | Date:                | 12 DEC. 1998    |
| Drawn By:    | SDB/BLK | Scale:               | AS SHOWN        |
| Checked By:  | MIT     | Drawing Code:        | M-L21-142       |
| Reviewed By: | BLK     | Salicitation Number: | PACKS-98-9-0005 |

UPPER MISSISSIPPI RIVER  
ENVIRONMENTAL MANAGEMENT PROGRAM  
POOL 2, RIVER MILE 328.5 THRU 331.0  
COTTONWOOD ISLAND REHABILITATION  
AND ENHANCEMENT STAGE II

PLATE 26

### NOTES:

1. MAIN CHANNEL AND WING DAM SOUNDINGS ARE FROM 1993 AND 1994. COTTONWOOD CHUTE SOUNDINGS ARE DEC. 1997
2. SOUNDINGS ARE DEPTH BELOW FLAT POOL ELEV. 470.0 M.S.L.

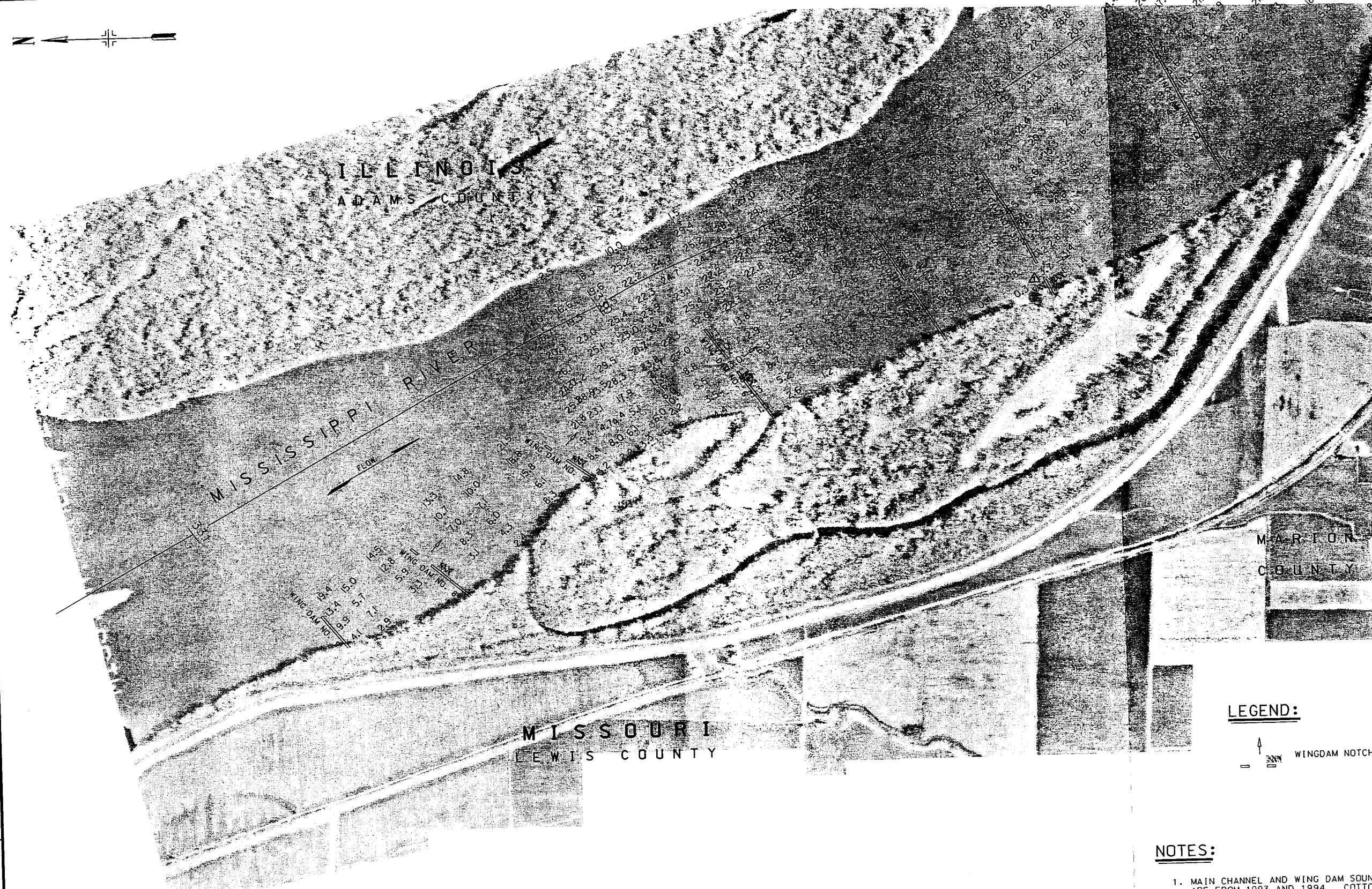
SURVEY FIELD BOOKS: FC-94-36, FC-95-3, FC-95-24  
PHOTO TAKEN NOVEMBER 1995

### SITE PLAN

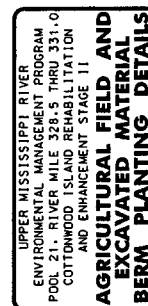
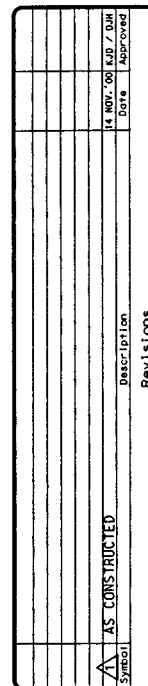
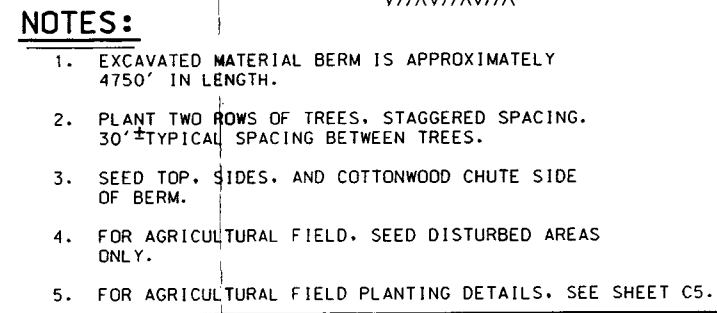
500 250 0 500 1000  
SCALE IN FEET

### LEGEND:

WINGDAM NOTCHES



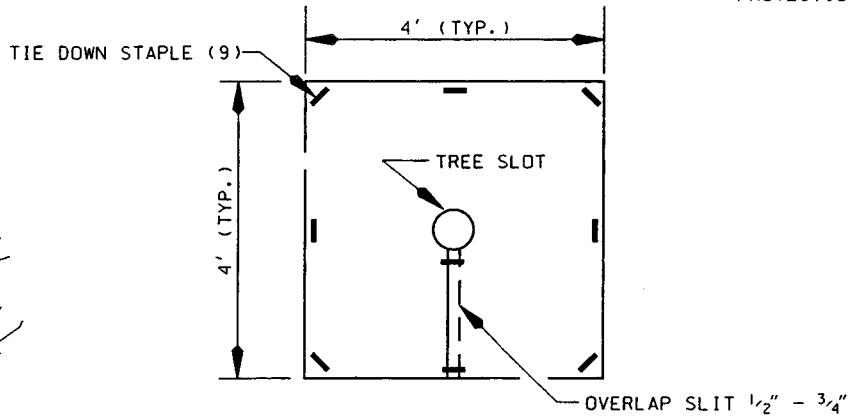
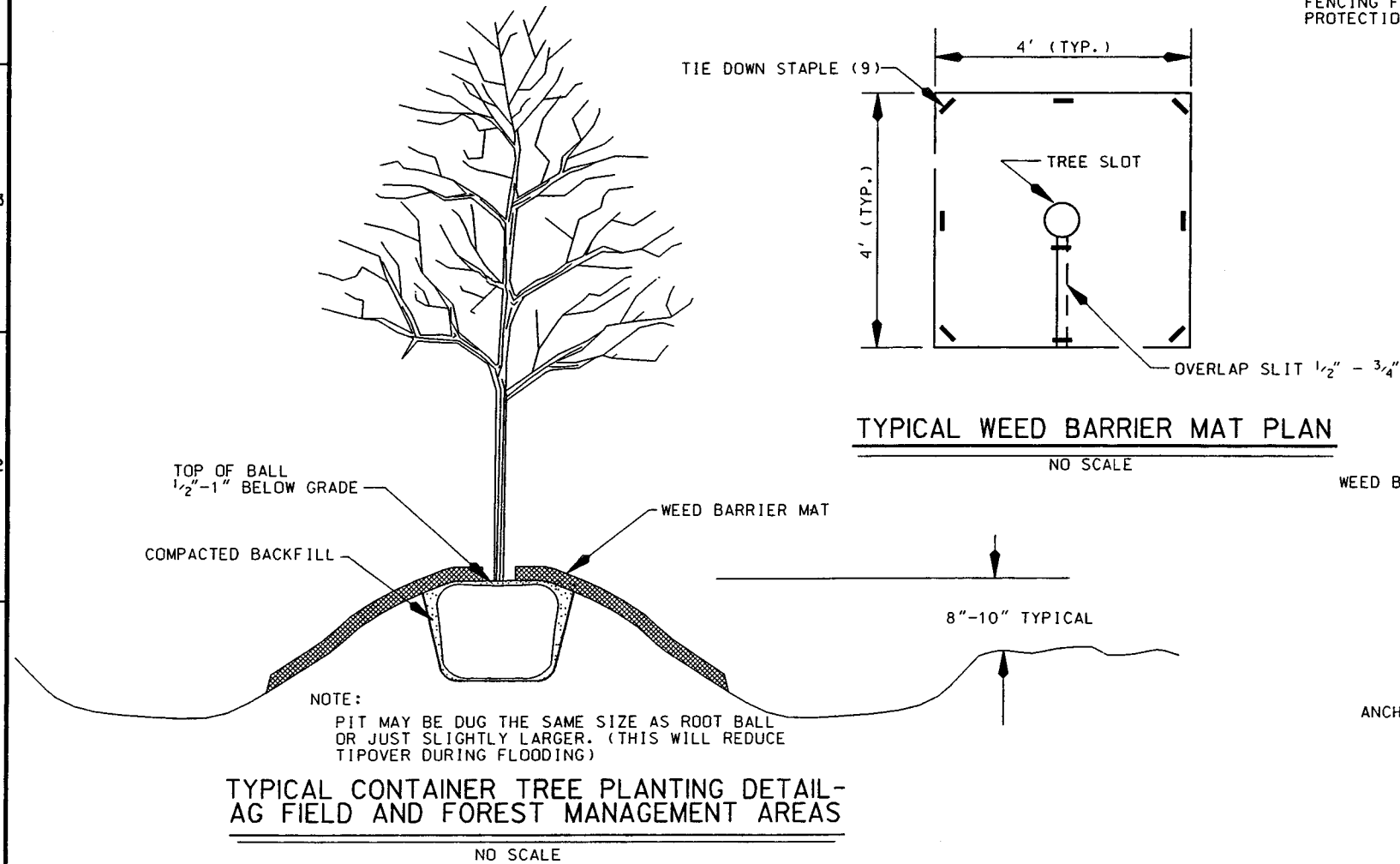


**PLATE 28**

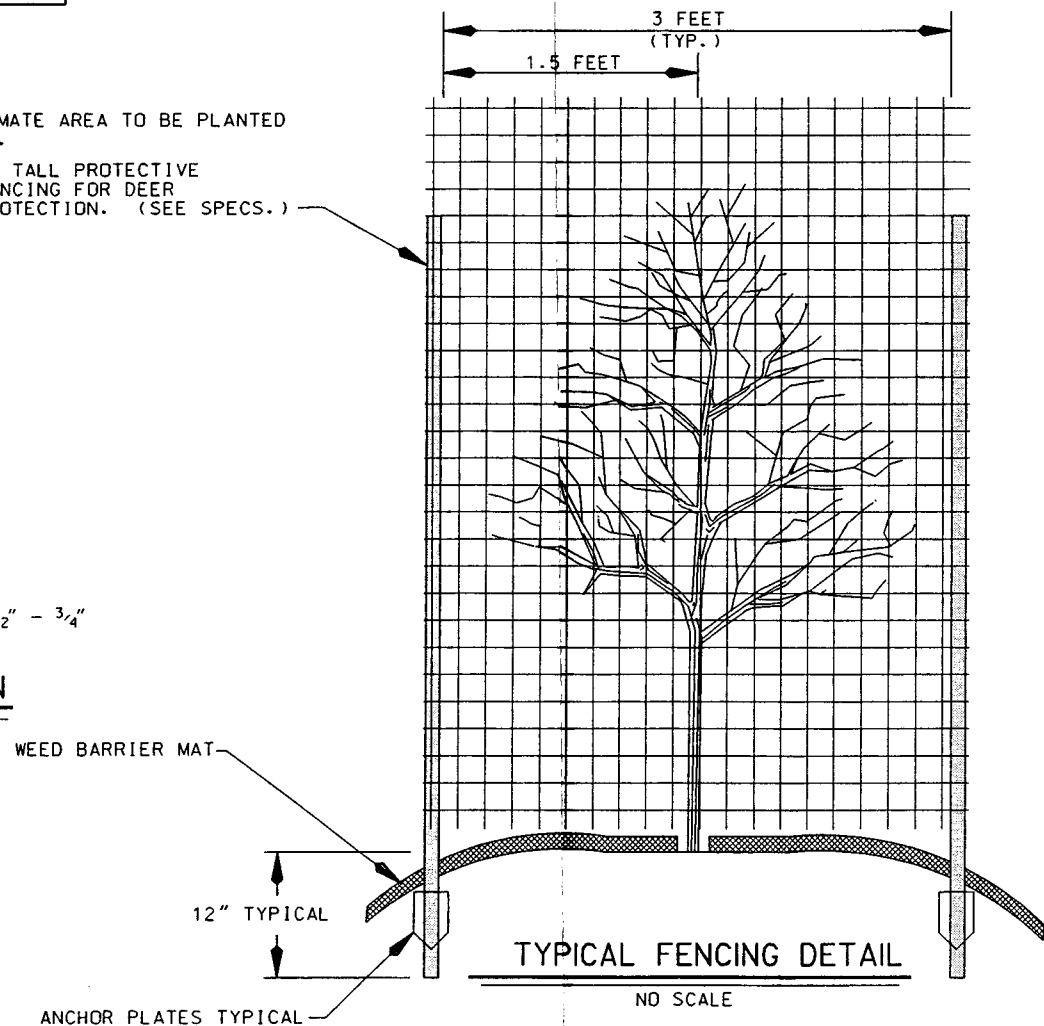


| PLANTING AREAS                                 |                            |           |  |  |   | TREES                             |  |                                    |   |  | TOTALS   |   |   |
|--|----------------------------|-----------|--|--|---|-----------------------------------|--|------------------------------------|---|--|--|---|---|
| LOCATION                                       | APPROXIMATE<br>AREA, ACRES |           | APPROXIMATE<br>AREA TO BE<br>SEEDED, ACRES | APPROXIMATE<br>PLANTING<br>BORDER, ACRES | APPROXIMATE<br>PLANTING<br>ACRES #3                   | PIN OAK<br>(QUERCUS<br>PALUSTRIS) | SYCAMORE<br>(PLATANUS<br>OCCIDENTALIS) | BUR OAK<br>(QUERCUS<br>MACROCARPA) | NORTHERN<br>PECAN<br>(CARYA<br>ILLINOENSIS) | SWAMP<br>WHITE OAK<br>(QUERCUS<br>BICOLOR) | NO. OF TREES,<br>(APPROX.<br>30' x 30'<br>SPACING) | NO. OF TREES<br>TO RECEIVE<br>PROTECTION<br>FENCING | NO. OF TREES<br>TO RECEIVE<br>DEER<br>REPELLENT |
| APPROXIMATE<br>PLANTING<br>RATE/ACRE           |                            |           |  |  |   | 11                                | 6                                      | 11                                 | 11  | 11   | 50   |   |   |
| 1. FOREST<br>MANAGEMENT<br>SEGMENT 5           | 8.0                        |           | 8.0  | 1.5                                      | 6.5   | 75                                | 45                                     | 75                                 | 75  | 70   | 340  | 25  | 25  |
| 2. FOREST<br>MANAGEMENT<br>SEGMENT 6           | 9.8                        |           | 9.8  | 2.1                                      | 7.8   | 85                                | 45                                     | 85                                 | 85  | 85   | 385  | 25  | 25  |
| 3. FOREST<br>MANAGEMENT<br>SEGMENT 7           | 5.8                        |           | 5.8  | 1.4                                      | 4.4   | 50                                | 25                                     | 50                                 | 50  | 50   | 225  |   |   |
| 4. AGRICULTURAL<br>FIELD #1                    | 33.0                       |           | 33   | 7.6                                      | 23.4  | 260                               | 140                                    | 260                                | 260   | 260  | 1180   | 25  | 25  |
| 5. POTHOLES #2                                 | LENGTH, FT                 | WIDTH, FT |  |  | LENGTH TO BE<br>PLANTED/ROW<br>FT (PLANT TWO<br>ROWS) |                                   |  |                                    |   |  |  |   |   |
| * 1  | 200                        | 180       | NA   |  | 760   | 12                                | 6                                      | 12                                 | 12  | 18   | 60   |   |   |
| * 2  | 180                        | 180       | NA   |  | 720   | 6                                 | 3                                      | 6                                  | 6   | 9  | 30   |   |   |
| * 3  | 185                        | 180       | NA   |  | 730   | 6                                 | 3                                      | 6                                  | 6   | 9  | 30   |   |   |
| * 4  |                            |           | NA   |  |   | 6                                 | 3                                      | 6                                  | 6   | 9  | 30   |   |   |
| * 5  |                            |           | NA   |  |   | 6                                 | 3                                      | 6                                  | 6   | 9  | 30   |   |   |
|  |                            |           |  |  |   | TOTAL TREES BY SPECIES, ITEMS 1-5 |  |                                    |   |  | TOTAL<br>TREES,<br>ITEMS 1-5                       | TOTAL<br>PROTECTION<br>FENCING                      | TOTAL<br>DEER<br>REPELLENT                      |
|  |                            |           |  |  |   | 511                               | 276                                    | 511                                | 511   | 521  | 2330   | 75  | 75  |
| 6. EXCAVATED<br>CHANNEL<br>MATERIAL<br>BERM #2 | 4750                       | NA        | 11   |  | 4750  | 70                                | 40                                     | 70                                 | 70  | 70   | 320  |   |   |

- \*1 APPROXIMATE AREA INCLUDES POTHOLE 4 AND 5. POTHOLE (APPROXIMATELY 1 ACRE EACH) HAVE BEEN SUBTRACTED FROM APPROXIMATE AREA TO BE PLANTED  
 \*2 PLANT TWO ROWS. LENGTHS GIVEN ARE APPROXIMATE (PERIMETER FOR POTHOLE, LENGTH FOR EXCAVATED CHANNEL MATERIAL BERM).  
 \*3 APPROXIMATE AREA TO BE PLANTED EQUALS APPROXIMATE AREA MINUS PLANTING BORDER.



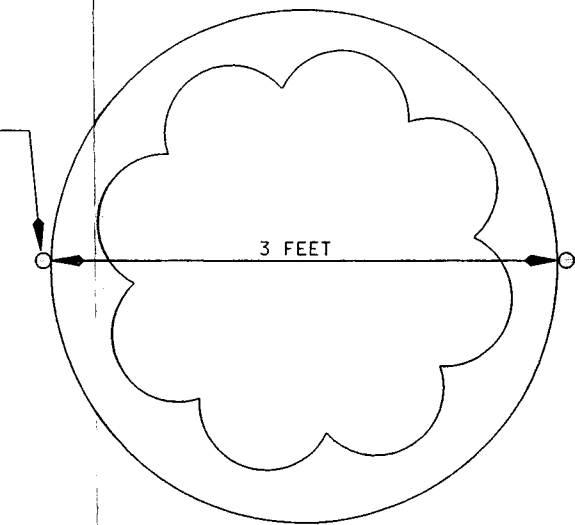
6' TALL PROTECTIVE FENCING FOR DEER PROTECTION. (SEE SPECS.)



#### GENERAL NOTES:

- FOR SITE PLAN OF THIS AREA, SEE C1.
- SPACE TREES APPROX. 30' x 30'.

2 POSTS FOR EACH ENCLOSURE



| NO. | DATE         | DESCRIPTION            | REVISIONS |
|-----|--------------|------------------------|-----------|
| 1   | 12 DEC. 1998 | REVISED AS CONSTRUCTED |           |

|                  |                                   |
|------------------|-----------------------------------|
| DESIGNED BY: CCK | DATE: 12 DEC. 1998                |
| DRAWN BY: SDB/BL | SCALE: AS SHOWN                   |
| CHECKED BY: MUT  | DRAWING CODE: M-L21-142           |
| REVIEWED BY: BLK | SOLICITATION NUMBER: DWR95-99-005 |

UPPER MISSISSIPPI RIVER  
 ENVIRONMENTAL MANAGEMENT PROGRAM  
 POOL 21, RIVER MILE 328.5 THRU 331.0  
 COTTONWOOD ISLAND REHABILITATION  
 AND ENHANCEMENT STAGE 11

U.S. ARMY ENGINEER DISTRICT  
 CORPS OF ENGINEERS  
 ROCK ISLAND, ILLINOIS

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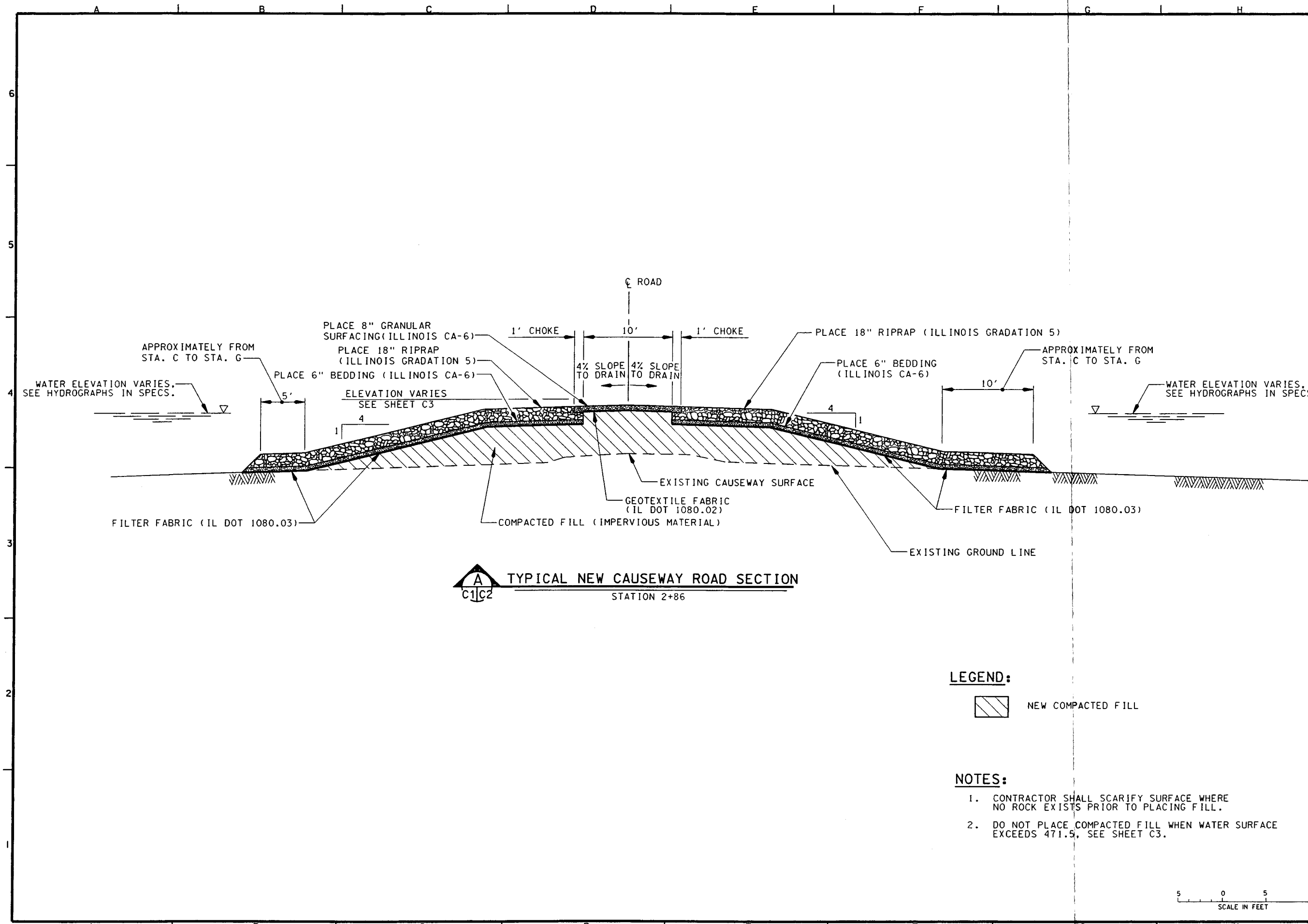


| Symbol      | Description    | Revisions |
|-------------|----------------|-----------|
| AS          | AS CONSTRUCTED |           |
| 27 OCT 2000 | DATE           |           |

|  |  |   |
|--|--|---|
| U.S. ARMY ENGINEER DISTRICT<br>CORPS OF ENGINEERS<br>ROCK ISLAND, ILLINOIS | DESIGNED BY: KJD<br>DRAWN BY: TPD<br>CHECKED BY: MJT<br>REVIEWED BY: DJJ | DATE: 2 JAN. 2000<br>SCALE: AS SHOWN<br>PROJECT CODE: EP56.08/PLATES<br>SOLICITATION NUMBER: DACPES-00-1-0006 |
|--|--|---|

UPPER MISSISSIPPI RIVER SYSTEM  
PROGRAM PLAN NO. 11-1  
CAUSEWAY ROAD RAISE  
TYPICAL CAUSEWAY  
SECTION

PLATE 32



**LEGEND:**

NEW COMPACTED FILL

**NOTES:**

1. CONTRACTOR SHALL SCARIFY SURFACE WHERE NO ROCK EXISTS PRIOR TO PLACING FILL.
2. DO NOT PLACE COMPACTED FILL WHEN WATER SURFACE EXCEEDS 471.5, SEE SHEET C3.

5 0 5 10  
SCALE IN FEET





