BARFIELD BEND POTOMOLOGY STUDY UPDATE
MISSISSIPPI RIVER
Hydraulics and Hydrology Branch

July 1996

I. Purpose. The purpose of this report is to update investigations pertaining to overbank scour at Barfield Bend made as presented in the February 1986 report "Overbank Scour Problem at Barfield Bend Arkansas, Mississippi River Miles 809-807".

This report update will assess the following:

1) potential for additional top bank scour at Barfield Bend,
2) potential for adverse hydraulic impacts of overbank flow on main-line levee,
3) potential formation of a cutoff across Barfield Bend,
4) impacts of the Nebraska Point dike field on overbank flow lines,
5) impacts of stone closure degradation during overbank events, and
6) benefits of recent tree screen improvements (Figure I-1).

II. General.

Conclusions from the 1986 report summarized that there was no threat to the main line Mississippi River levee (at that time), that the top bank control should be maintained throughout the Barfield revetment by maintaining the scour closures, and that a monitoring program be utilized to evaluate the situation with subsequent overbank flow periods. Federal actions recommended in the 1986 report were to monitor the location and to maintain the top bank controls. Local interests actions recommended in the 1986 report included degrading the abandoned private levee and establishment of a tree screen along top bank and around each of the scour holes.

The Memphis District Corps of Engineers has maintained the scour closures and continued a monitoring program as recommended. Local interests have completed a tree screen around the scour holes as the previous report recommended. None of the private levee has been degraded to date.

III. Analysis.

Analysis of potential for additional top bank scour at Barfield Bend consisted of analyzing overbank flow measurements made during several flood events and historical growth rates of the scour holes (Figure III-1) as plano metered from aerial photography. No significant trends could be identified from the data to indicate excessive overbank scour should be expected in the future. Local scour will likely continue where the private levee breaches had originally occurred and where the scour holes were closed by placement of riprap. The closures were constructed to approximately 3 feet above natural ground elevations in the surrounding overbank and about 4 feet below the private levee grade. The closures, therefore, function as weirs during higher

stages and focus flow energy in a relatively small area. With little tailwater on the closures when first overtopped, the scour holes have continued to grow during past flood events. Since historic growth of the scour holes has been limited, however, formation of a cutoff across Barfield Bend appears unlikely in the near future. Degradation of the riprap closures during overbank flow conditions tends to increase the flow energy through and over the closures. The increased energy results in increased scour rates until repair can be completed. Sour holes 1 and 3, where natural depressions occur in the floodplain topography, convey a greater percentage of flow during overbank events, and top bank scour at these locations and along the resulting flow paths has been the greatest. These lower areas exhibited the highest observed velocities for the overbank flow. Negative effects on the main line levee were determined to be minimal when evaluating velocities measured in the overbank near the levee.

Water surface elevations for pre and post Nebraska Dike field were computed for frequency discharges on the Mississippi River using HEC-2. As expected, the dike field in concert with the entire channel improvement program, has improved channel capacity over time and a reduction in Water surface elevations has resulted. Increased channel capacity results in less discharge being conveyed in the overbank areas. Table III-1 indicates computed reductions in water surface elevations with the dike field in place since 1983. A decrease in Water surface elevations is also supported by downward shifts in specific gage records and discharge rating curves downstream of Caruthersville, Missouri in recent years.

Evaluation of buffer strips created by tree screen plantings were qualitative since several years growth will be required to fully establish the stand. However, vegetative cover between the trees in the interim will decrease the potential for soil movement until the trees begin to grow and mature. A mature stand of trees will significantly increase the resistance to flow resulting in decreased soil movement.

IV. Summary.

Following are a list of conclusions from observations and analyses completed.

A. The Mississippi River main line levee is not presently threatened by overbank scour or overbank flows at Barfield Bend.

B. The potential for additional top bank scour at Barfield Bend is primarily a localized problem exaggerated by concentration of flow through the riprap closures constructed at scour holes 1U through 5. Additional scour holes will form should the private levee fail at other locations. Private levee failure at other locations is probable since several locations were observed where overtopping has eroded part of the levee section.

C. Riprap closures constructed approximately 3 feet above the natural ground elevations increase the amount of flow energy to be dissipated and the duration of the higher flow energy (tailwater takes longer to develop) as flow overtops the closures. The higher energy increases the potential for downstream scour and for failure in the riprap closure. Failures in the riprap closures focus even greater flow energy into the overbank areas accelerating the

rate and magnitude of the scour holes.

D. The lower overbank topography downstream of scour holes 1 and 3 (and to a lesser extent 4 and 5) collects overbank flow and acts as primary drainage paths for the majority of overbank discharges. Flow along these paths is affected by the roadway perpendicular to the flow.

E. The risk for formation of a cutoff across Barfield Bend is low given that the top bank control will be maintained by Federal actions.

F. Dike field construction at Nebraska Point, and for the channel improvement project in general, has lowered water surface elevations and reduced overbank discharges.

G. Tree screen improvements will increase resistance to overbank scour in the future, but will have a lesser, although still positive, immediate effect.

V. Recommendations.

Following are recommendations for reducing maintenance of the closures and for reducing top bank scour at Barfield Bend. Figure V-1 provides locations and further description of recommended work.

A. Continue overbank monitoring program to ensure main line levee integrity.

B. Degrade abandoned private levee from scour hole 1U downstream to scour hole 5. Degradation of the levee will permit flow to enter the overbank uniformly and substantially reduce scour potential. As stated in the 1986 report, no major scour problems were identified at Barfield Bend prior to construction of the private levee and its subsequent failure in 1973.

C. Degrade riprap closures to ground elevations consistent with overbank elevations around each scour hole. Flow will then enter the overbank in a more uniform fashion thereby reducing the amount of energy to be dissipated.

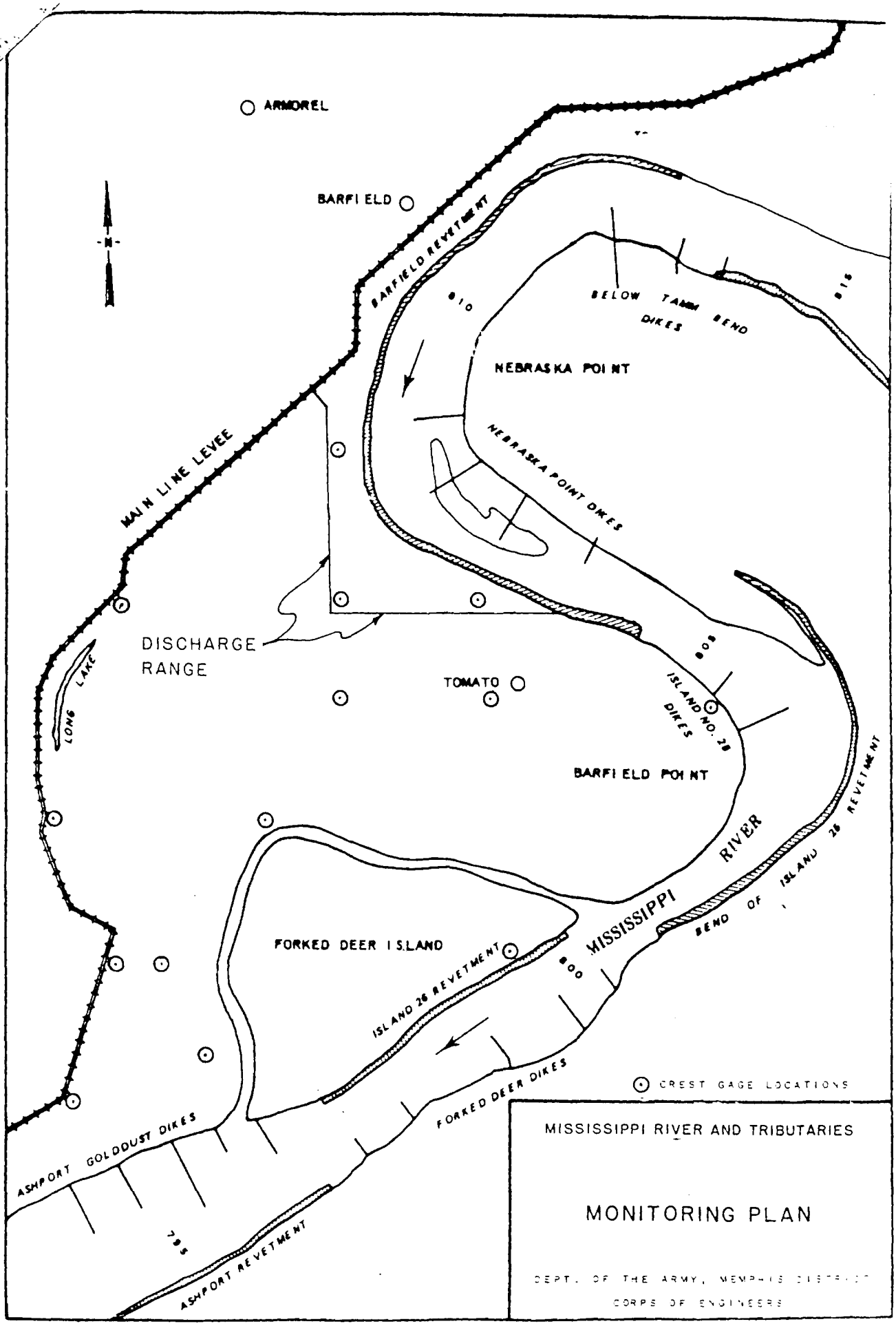
D. Raise the county roadway that runs near top bank at locations (where the highest velocities have been observed) to create a level road profile and uniform flow across the roadway. A 50 foot wide tree screen and grassed area should also be established on the downstream side of the road to further dissipate flow energy as it crosses the road.

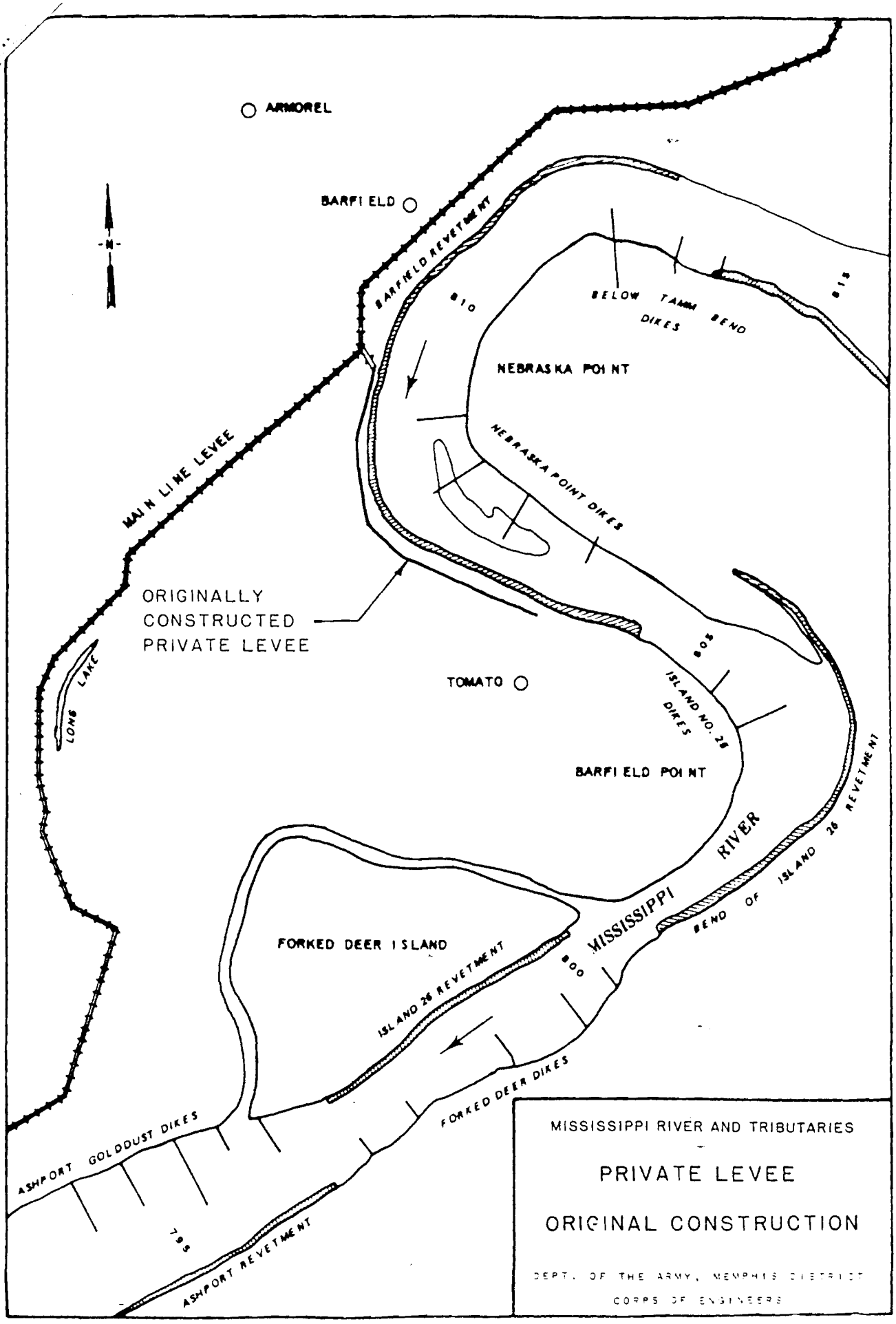
E. Protect the downstream perimeter of the existing scour holes with riprap to minimize their elongation during future overbank flow events.

F. Place riprap at active scour areas around the perimeter of the scour holes.

TABLE III-1 Water Surface Elevation Comparisons from HEC-2 for Pre-Nebraska Point Dike Construction and Post-Nebraska Point Dike Construction Conditions

Mississippi River Barfield Bend Potomology Study Update RM 807-809 July 1996		2 Year Exceedance Frequency Water Surface Elevations (ft.)			5 Year Exceedance Frequency Water Surface Elevations (ft.)			10 Year Exceedance Frequency Water Surface Elevations (ft.)		
		(1)	(2)	(2) - (1)	(3)	(4)	(4) - (3)	(5)	(6)	(6) - (5)
Approximate River Mile AHP	Description	Pre-Nebraska Dikes	Post-Nebraska Dikes	Delta (- is lower) (+ is higher)	Pre-Nebraska Dikes	Post-Nebraska Dikes	Delta (- is lower) (+ is higher)	Pre-Nebraska Dikes	Post-Nebraska Dikes	Delta (- is lower) (+ is higher)
815.1	Surveyed section	254.0	252.2	-1.8	258.0	256.6	-1.4	260.1	259.0	-1.1
814.2	Crossing	253.8	251.8	-1.9	257.7	256.3	-1.5	259.9	258.7	-1.2
813.2	Below Tamm Bend 1 Dike	253.3	251.4	-1.9	257.3	255.9	-1.4	259.5	258.3	-1.2
812.9	Below Tamm Bend 2 Dike	253.0	250.8	-2.2	257.0	255.3	-1.7	259.2	257.8	-1.4
812.4	Surveyed section	252.8	250.6	-2.2	256.8	255.2	-1.7	259.0	257.6	-1.4
811.9	Below Tamm Bend 3 Dike	252.4	250.2	-2.2	256.5	254.8	-1.7	258.7	257.3	-1.4
810.1	Crossing	251.5	249.6	-1.8	255.6	254.2	-1.3	257.8	256.8	-1.1
807.8	Surveyed section	250.9	249.0	-1.9	255.0	253.7	-1.4	257.3	256.2	-1.1
805.2	Crossing	250.1	248.3	-1.8	254.3	253.0	-1.3	256.7	255.7	-1.0
804.5	Island 25 1 Dike	249.6	248.0	-1.6	253.9	252.8	-1.1	256.3	255.4	-0.9
803.8	Surveyed section	249.4	247.9	-1.5	253.7	252.6	-1.0	256.0	255.2	-0.8
803.7	Island 25 2 Dike	249.3	247.8	-1.5	253.6	252.5	-1.0	256.0	255.2	-0.8
801.5	Crossing	247.9	246.8	-1.0	252.2	251.6	-0.6	254.7	254.3	-0.4
800.1	Forked Deer 1 Dike	246.9	246.2	-0.7	251.3	250.9	-0.3	253.8	253.6	-0.2
800.0	Surveyed section	246.8	246.2	-0.6	251.2	250.9	-0.3	253.7	253.6	-0.1


ARMOREL
BARFIELD
BARFIELD REVETMENT
N
MAIN LINE LEVEE
DISCHARGE
RANGE
LONG LAKE
TOMATO
810
BELOW TAMM BEND
DIKES
815
NEBRASKA POINT
NEBRASKA POINT DIKES
805
ISLAND NO. 28
DIKES
BARFIELD POINT
MISSISSIPPI
RIVER
BEND OF ISLAND 28 REVETMENT
FORKED DEER ISLAND
ISLAND 28 REVETMENT
800
FORKED DEER DIKES
CREST GAGE LOCATIONS
ASHPORT GOLDDUST DIKES
795
ASHPORT REVETMENT
MISSISSIPPI RIVER AND TRIBUTARIES
MONITORING PLAN
DEPT. OF THE ARMY, MEMPHIS DISTRICT
CORPS OF ENGINEERS


ARMOREL
BARFIELD
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810
BELOW TAMM BEND DIKES
813
NEBRASKA POINT
NEBRASKA POINT DIKES
MAIN LINE LEVEE
ORIGINALLY CONSTRUCTED PRIVATE LEVEE
LONG LAKE
TOMATO
805
ISLAND NO. 28 DIKES
BARFIELD POINT
MISSISSIPPI RIVER
BEND OF ISLAND 28 REVETMENT
FORKED DEER ISLAND
ISLAND 28 REVETMENT
800
FORKED DEER DIKES
ASHPORT GOLDDUST DIKES
795
ASHPORT REVETMENT
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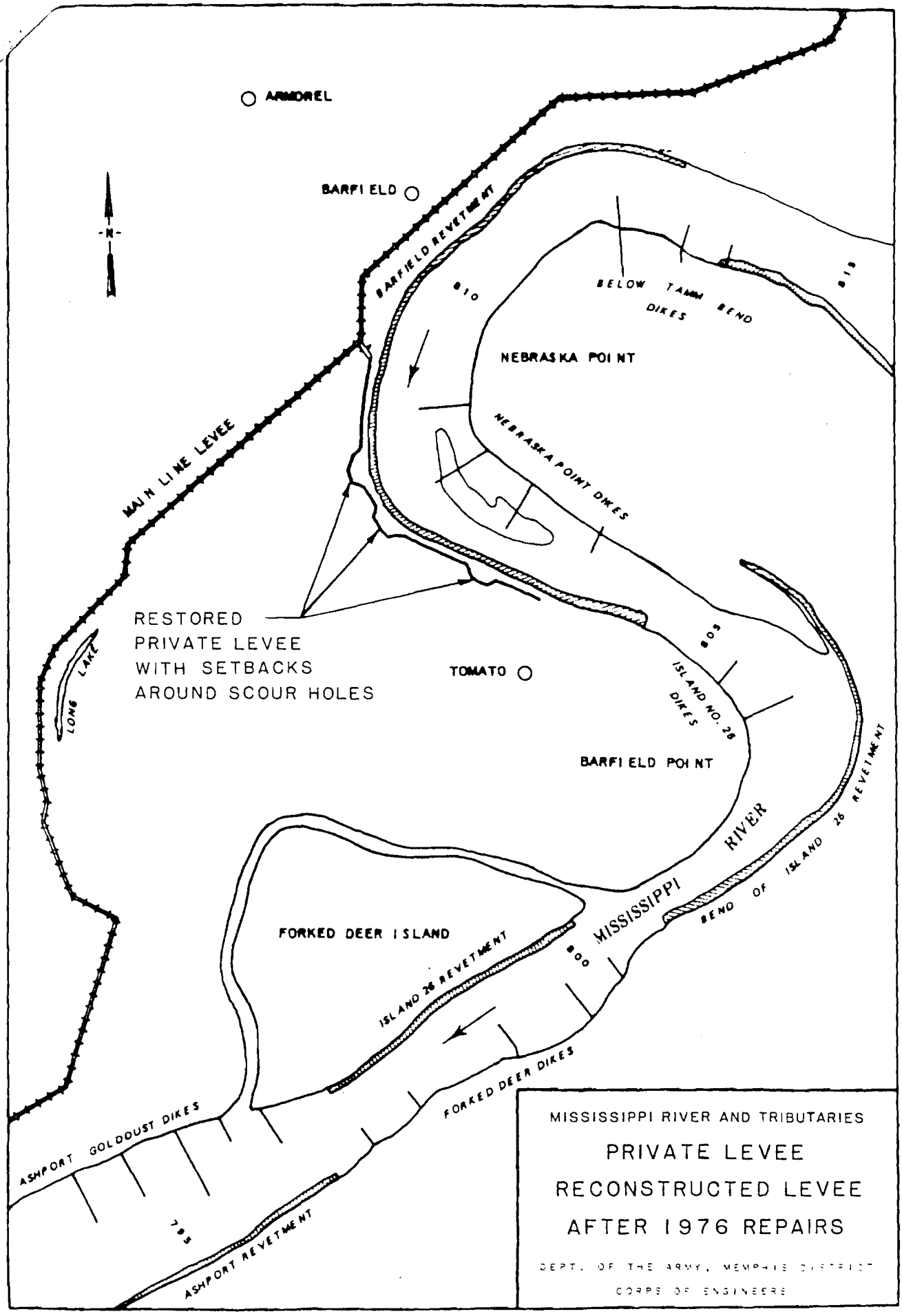
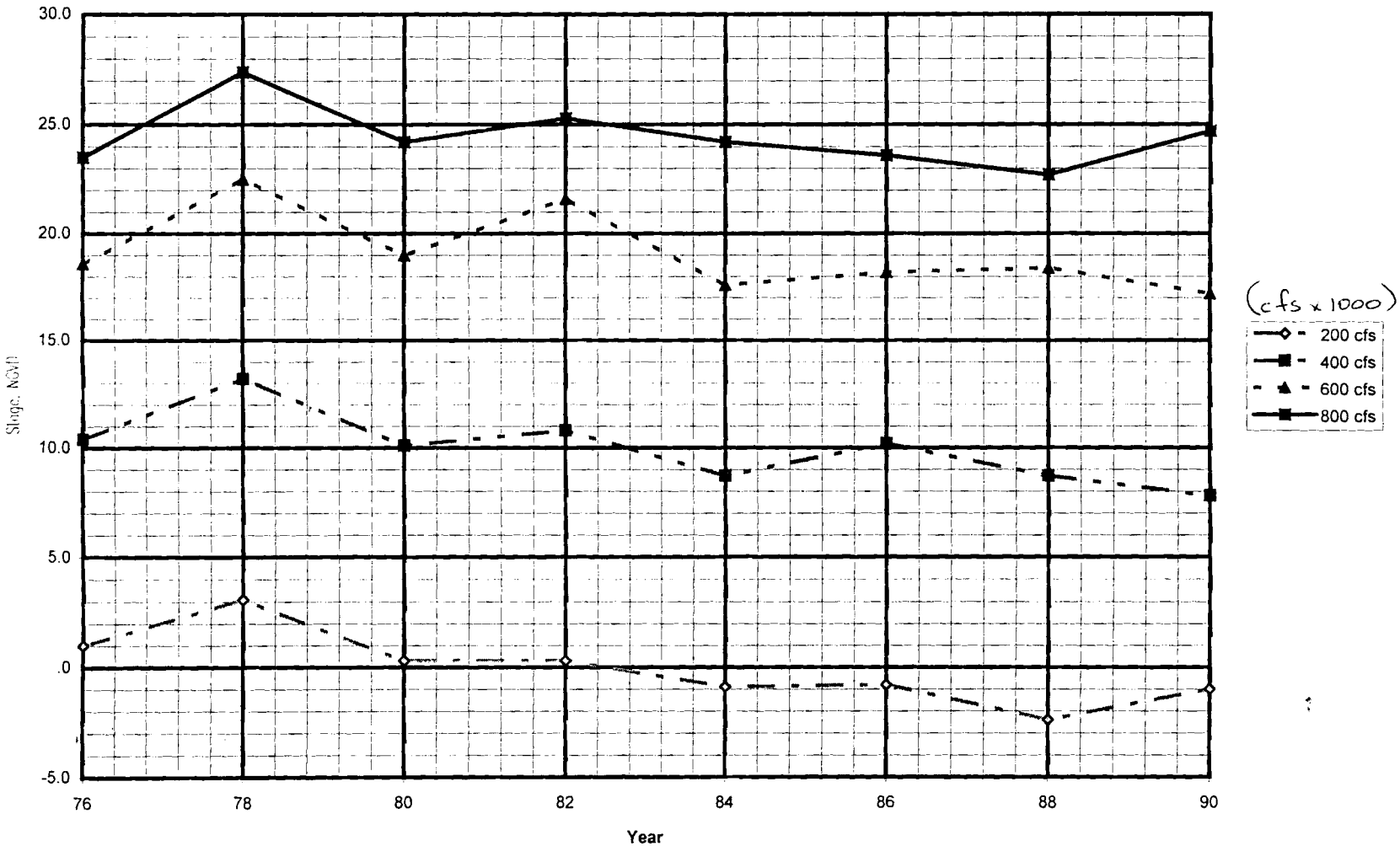
PRIVATE LEVEE
ORIGINAL CONSTRUCTION
DEPT. OF THE ARMY, MEMPHIS DISTRICT
CORPS OF ENGINEERS


ARMOREL
BARFIELD
N
BARFIELD REVETMENT
810
BELOW TAMM BEND DIKES
815
NEBRASKA POINT
NEBRASKA POINT DIKES
MAIN LINE LEVEE
RESTORED PRIVATE LEVEE WITH SETBACKS AROUND SCOUR HOLES
LONG LAKE
TOMATO
805
ISLAND NO. 26 DIKES
BARFIELD POINT
MISSISSIPPI RIVER
BEND OF ISLAND 26 REVETMENT
FORKED DEER ISLAND
ISLAND 26 REVETMENT
800
FORKED DEER DIKES
ASHPORT GOLDDUST DIKES
795
ASHPORT REVETMENT
MISSISSIPPI RIVER AND TRIBUTARIES
PRIVATE LEVEE
RECONSTRUCTED LEVEE
AFTER 1976 REPAIRS
DEPT. OF THE ARMY, MEMPHIS DISTRICT
CORPS OF ENGINEERS

HW 152 Gage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25.0
20.0
15.0
10.0
5.0
.0
-5.0
Stage, NGVD
76
78
80
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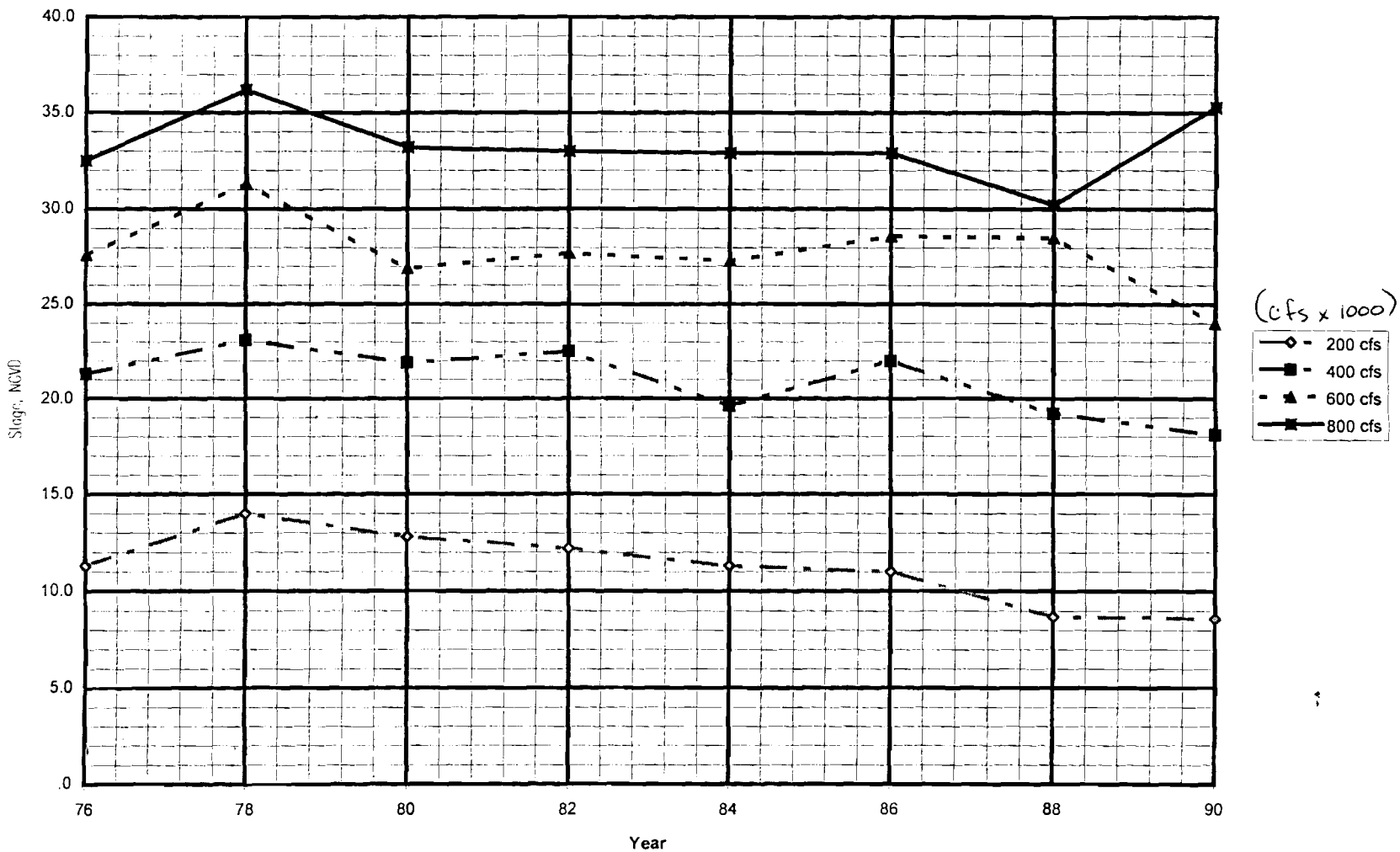
86
88
90
Year
(cfs x 1000)
200 cfs
400 cfs
600 cfs
800 cfs

HW 158 Gage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.0
Stage, NGVD
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88
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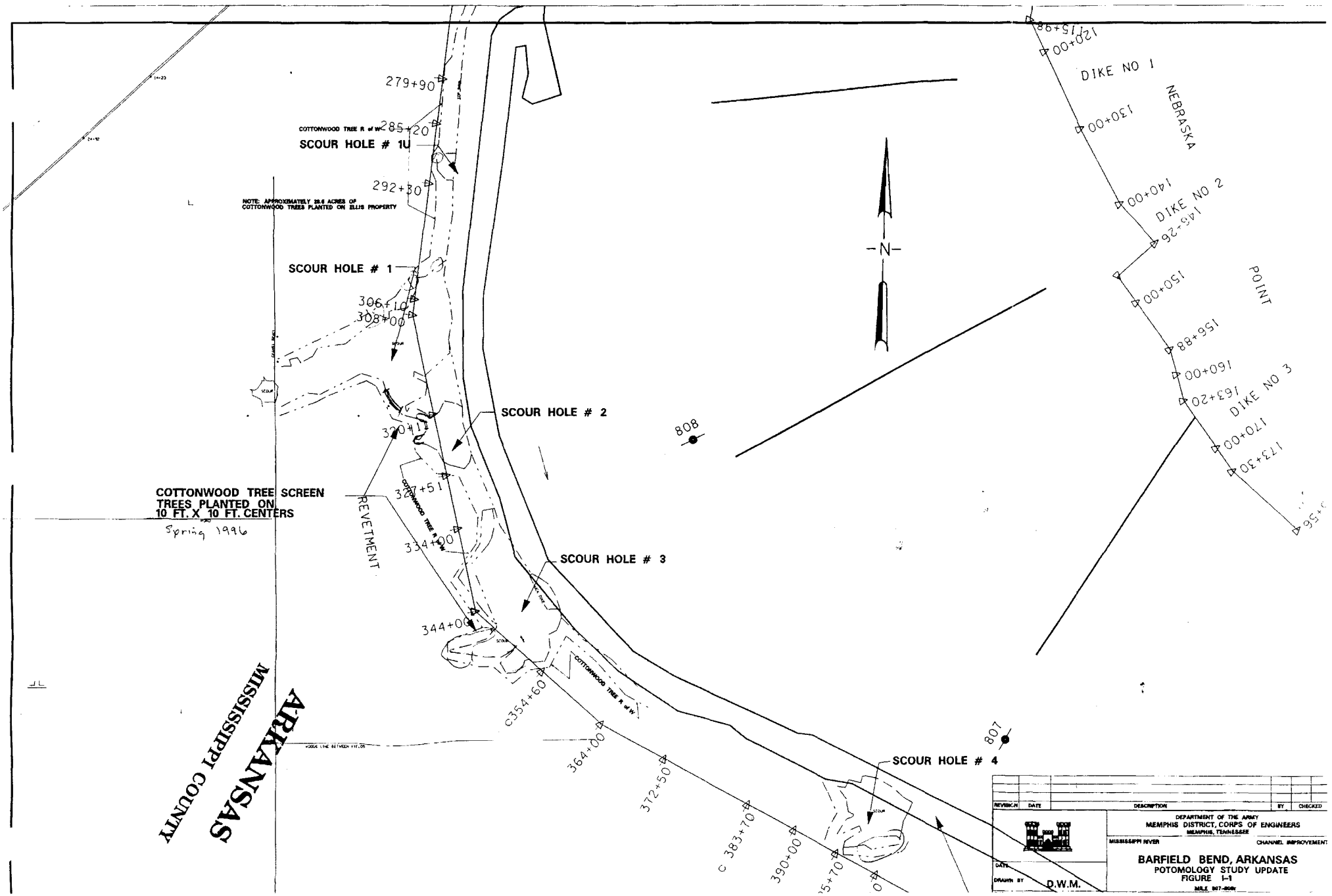
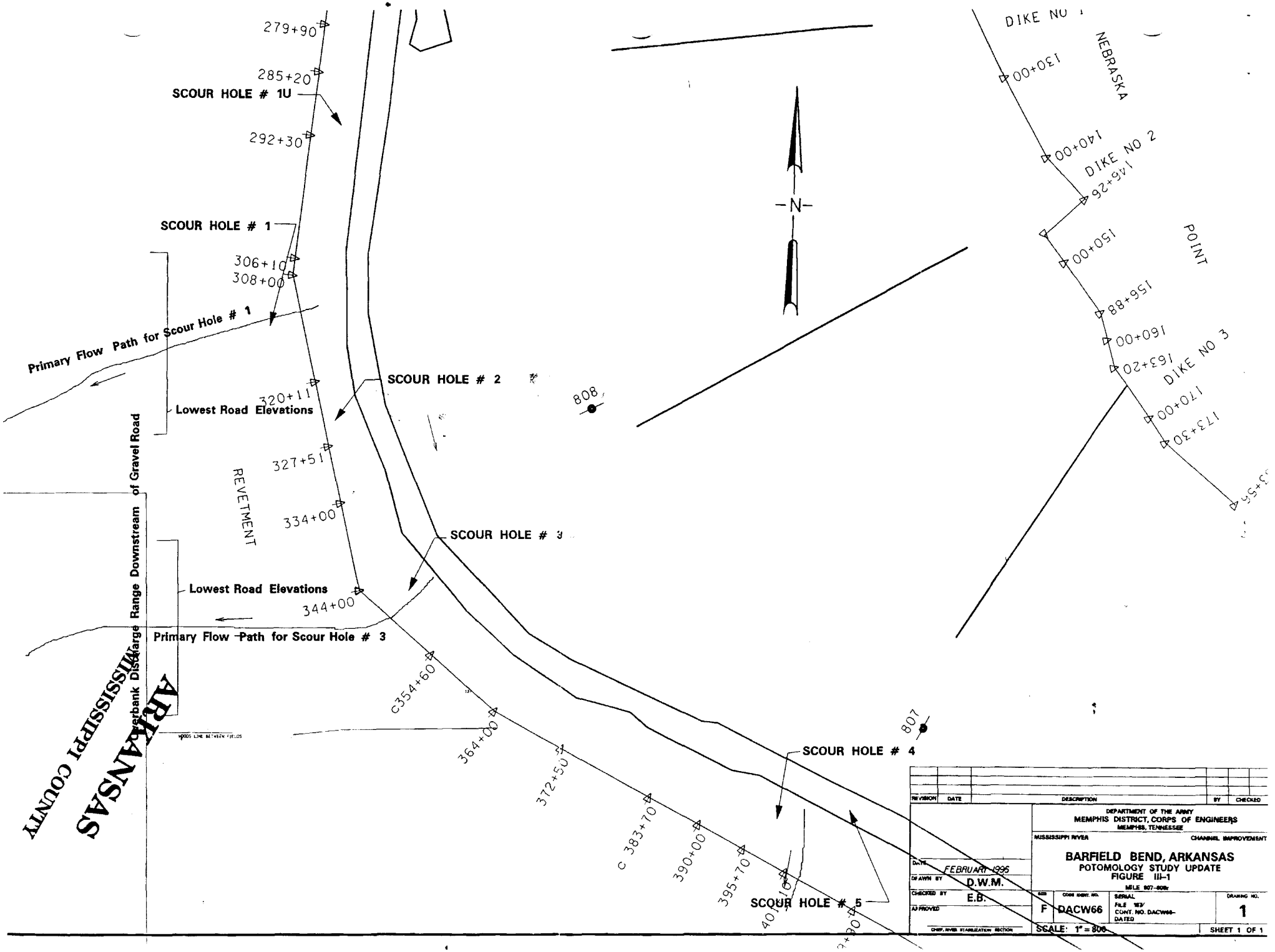
Year
(cfs x 1000)
200 cfs
400 cfs
600 cfs
800 cfs


279+90
285+20
COTTONWOOD TREE R of W
SCOUR HOLE # 1U
292+30
NOTE: APPROXIMATELY 28.6 ACRES OF COTTONWOOD TREES PLANTED ON ELLIS PROPERTY
SCOUR HOLE # 1
306+10
308+00
SCOUR HOLE # 2
320+11
327+51
COTTONWOOD TREE R of W
334+00
SCOUR HOLE # 3
344+00
COTTONWOOD TREE R of W
354+60
364+00
372+50
383+70
390+00
SCOUR HOLE # 4
COTTONWOOD TREE SCREEN
TREES PLANTED ON
10 FT. X 10 FT. CENTERS
Spring 1996
REVETMENT
808
807
-N-
120+00
DIKE NO 1
130+00
NEBRASKA
140+00
DIKE NO 2
145+26
150+00
POINT
156+88
160+00
163+20
DIKE NO 3
170+00
173+30
MISSISSIPPI COUNTY
ARKANSAS
REVISION
DATE
DESCRIPTION
BY
CHECKED
DEPARTMENT OF THE ARMY
MEMPHIS DISTRICT, CORPS OF ENGINEERS
MEMPHIS, TENNESSEE
MISSISSIPPI RIVER
CHANNEL IMPROVEMENT
DATE
DRAWN BY
D.W.M.
BARFIELD BEND, ARKANSAS
POTOMOLOGY STUDY UPDATE
FIGURE 1-1


279+90
285+20
SCOUR HOLE # 1U
292+30
SCOUR HOLE # 1
306+10
308+00
Primary Flow Path for Scour Hole # 1
Lowest Road Elevations
320+11
SCOUR HOLE # 2
808
327+51
REVETMENT
334+00
SCOUR HOLE # 3
Lowest Road Elevations
344+00
Primary Flow Path for Scour Hole # 3
Riverbank Disposal Range Downstream of Gravel Road
ARKANSAS
MISSISSIPPI COUNTY
WOODS LINE BETWEEN FIELDS
354+60
364+00
372+50
383+70
390+00
395+70
401+10
SCOUR HOLE # 4
807
SCOUR HOLE # 5
DIKE NO 1
130+00
NEBRASKA
140+00
DIKE NO 2
146+26
150+00
POINT
156+88
160+00
163+20
DIKE NO 3
170+00
173+30
N
REVISION
DATE
DESCRIPTION
BY
CHECKED
DEPARTMENT OF THE ARMY
MEMPHIS DISTRICT, CORPS OF ENGINEERS
MEMPHIS, TENNESSEE
MISSISSIPPI RIVER
CHANNEL IMPROVEMENT
BARFIELD BEND, ARKANSAS
POTOMOLOGY STUDY UPDATE
FIGURE III-1
MILE 807-808
DATE
FEBRUARY 1996
DRAWN BY
D.W.M.
CHECKED BY
E.B.
APPROVED
SIZE
F
CODE IDENT. NO.
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FILE W37
CONT. NO. DACW66-
DATED
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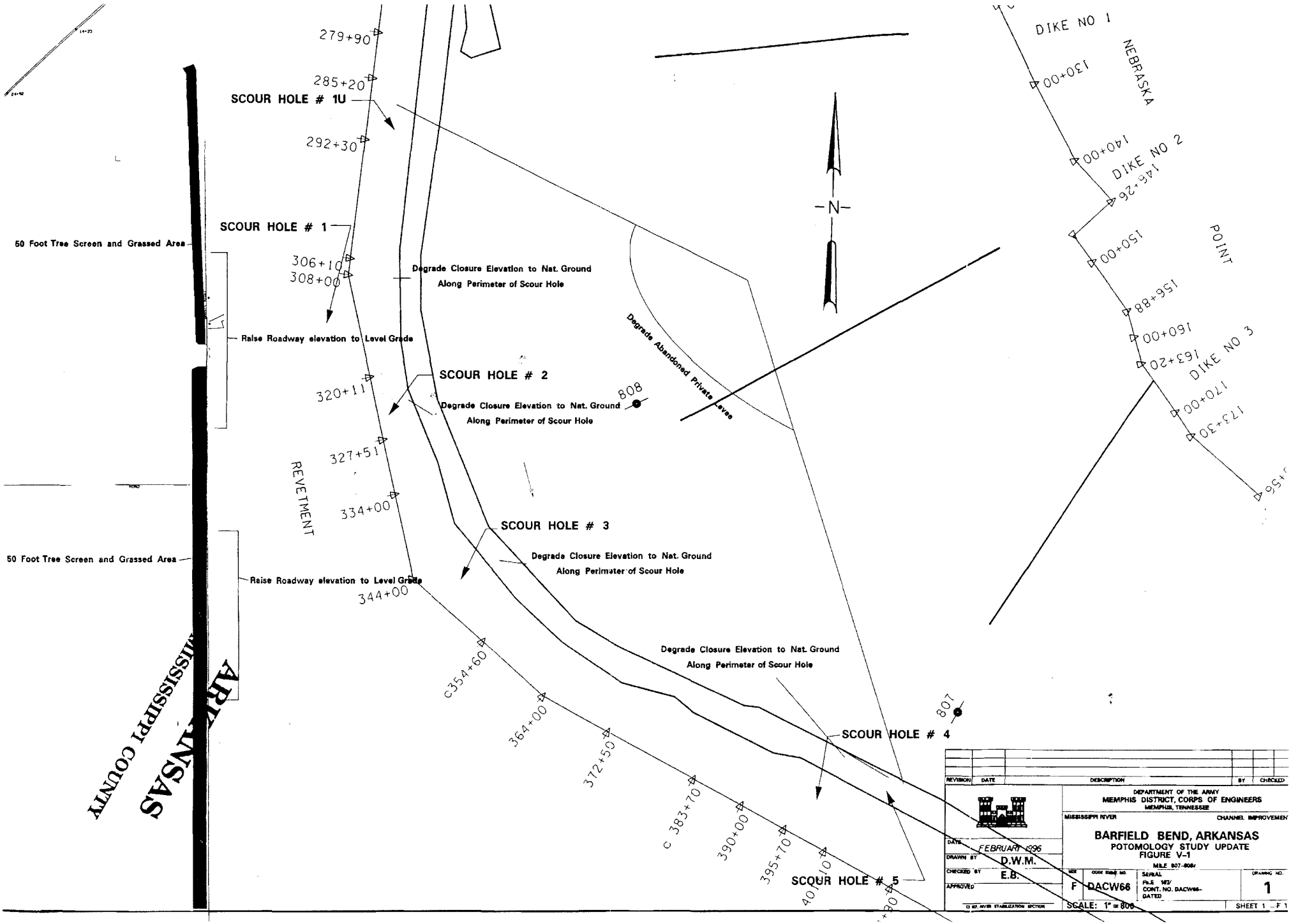
SHEET 1 OF 1



REVISION	DATE	DESCRIPTION	BY	CHECKED

DEPARTMENT OF THE ARMY
MEMPHIS DISTRICT, CORPS OF ENGINEERS
MEMPHIS, TENNESSEE

MISSISSIPPI RIVER — CHANNEL IMPROVEMENT

BARFIELD BEND, ARKANSAS
POTOMOLOGY STUDY UPDATE
FIGURE V-1

MILE 807-808

DATE	FEBRUARY 1996
DRAWN BY	D.W.M.
CHECKED BY	E.B.
APPROVED	

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CO-MO. RIVER STABILIZATION SECTION

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