MELVIN PRICE LOCKS & DAM

UPPER MISSISSIPPI RIVER BASIN
MISSISSIPPI RIVER MISSOURI AND ILLINOIS

PROGRESS REPORT 1996

DESIGN MEMORANDUM NO. 24
AVOID AND MINIMIZE MEASURES

US Army Corps
of Engineers
St. Louis District

"Good engineering enhances the environment"

December 1996

Lesly Conaway (MDOC/LTRM Station, Cape Girardeau, Missouri) and Chuck Theiling (Ecological Specialist, Inc.) prepare to remove a macroinvertebrate sample from one of the retrieved buoy rock samplers into a Surber sampler. The buoy anchor was set in a bendway weir field at R.M. 164. The one foot square sample area was sprayed with 10% nitric acid solution to dislodge macroinvertebrates and their cases prior to brushing and rinsing into to the sampler net.

AVOID AND MINIMIZE MEASURES

DESIGN MEMORANDUM #24

PROGRESS REPORT--1996

MELVIN PRICE LOCKS AND DAM
MISSISSIPPI RIVER - MISSOURI AND ILLINOIS

Prepared By:

U.S. Army Engineering District

1222 Spruce Street

St. Louis, Mo. 63103-2833

December 1996

AVOID AND MINIMIZE PROGRAM
ST. LOUIS DISTRICT
PROGRESS REPORT - 1996

In October 1992, the St. Louis District issued Design Memorandum No. 24, "Avoid and Minimize Measures". The document was developed as a commitment made in the Record of Decision (1988) attached to the Melvin Price Locks and Dam EIS for the Second Lock. St. Louis District set-aside O&M funds from 1989 to 1995 to implement some elements recommended by the study team (Table I). Implementation of measures in this part of the program was released in the 1995 Progress Report. In fiscal year 1996, the Avoid and Minimize Program (A&M) was fully funded and the planned major implementation began. The planning and implementation team, consisted of staff from the St. Louis District, U.S. Fish and Wildlife Service (FWS) - Rock Island, Illinois Department of Natural Resources (IDNR), River Industry Action Committee (RIAC), Missouri Department of Conservation (MDOC) and the Long Term Resource Monitoring Station (LTRM/MDOC) at Cape Girardeau, Missouri. Each group contributed staff time to plan and attend meetings, collect data as part of a monitoring program, and spent considerable time in the micro-model lab at District facilities.

A&M 1) **Bullnose Dikes were constructed at the heads of Blackbird Island (Pool 24 - Mile 292.1), Slim Island (Pool 25 - Mile 267.0) and Peruque Island (Pool 26 - Mile 234.8).**

During the fall 1995 river trip with natural resource agency personnel, it was decided that bullnose rock dikes were needed to protect the heads of selected islands that had been severely eroded during high water in 1993, 1994 and 1995. All of the dikes are tied into the islands on both ends, except the bullnose structure at Blackbird Island. The dikes have 50 foot wide notches and are expected to perform biologically similar to offshore revetment, which had the highest projected natural resource benefit of the eight A&M measures.

A&M 2) **Rock revetment was placed onshore as bank protection at towboat anchor points along Clarksville Refuge, Pool 24 (Mile 275.0) in the summer of 1996.**

In cooperation with MDOC, which manages the Clarksville Refuge, onshore anchors were placed above Lock and Dam #24 as mooring anchor points in 1989. The refuge shoreline is a traditional mooring site for tows approaching Lock and Dam 24, which is downstream at mile 273.4. In cooperation with the towing industry, the anchors were located at three points along the shoreline. Traditional mooring cables were cut from trees and signs were erected, by MDOC, to identify the buried anchors and connecting chains. Because of the concentration of tows mooring at the three anchors, the associated prop-wash, and high water erosion, it was decided that rock revetment bank protection was needed.

TABLE I

DESIGN MEMORANDUM NO. 24

AVOID AND MINIMIZE MEASURES RECOMMENDED FOR IMPLEMENTATION

NUMBER	MEASURE
A-3	Designate locks approach waiting areas--provide on-bank anchor points or mooring buoys.
A-10	Reduce open water dredge material disposal--create recreation beaches.
A-11	Reduce open water dredge material disposal--create wetlands.
A-13	Place dredge material in the thalweg.
A-16	Continue dike configuration studies (i.e.., notched dikes, chevron dikes and bullnose dikes.
A-17	Place off-bank revetment on islands.
A-19	Monitor bendway weirs.
B-8	Study reduction of tow waiting times.

A&M 3) **The experimental round point dike approved by the A&M team, was designed and was to be constructed in the spring of 1996. The structure will be located in shallow water and the rock contractor could not enter the area due to inadequate depth. The dike will be constructed during high water in spring, 1997.**

The dike is to be located in Pool 25 (mile 265.7) and consists of six piles of rock and rock bank protection. Thus configured, the river training structure will have six notches (including the space between the last rock round point and the bank protection) and is expected to perform similar to a notched dike. District staff conducted pre-construction bottom and fisheries monitoring in the summer of 1996. Because rock was not placed during the fiscal year, the macroinvertebrate sampling contract will be advanced to fiscal year 1997. Thus, the A&M team will have before/after biological and physical conditions to compare.

A&M 4) **Five experimental small chevron dikes were approved by the team and designed and were to be constructed in Pool 25 (Mile 250.2). The rock contractor was only able to build one chevron due to low water. The other four chevrons will be built in fiscal year 1997.**

District staff conducted pre-construction biological and physical monitoring in the summer of 1996. Pre-construction macroinvertebrate sampling will be completed in 1997.

A&M 5) **Biological monitoring of bendway weirs continued during 1996. Efforts were concentrated on gathering data on macroinvertebrates. Conducting sampling around weir fields is very difficult due to the depth, swiftness and swirling action of the current. As a result, the St. Louis District Motor Vessel Pathfinder and a large work barge with crane and clamshell bucket were utilized as a sampling platform. Concrete buoy anchors were placed in a new weir field and retrieved 30 days later. Rock from weirs, placed in 1991, were retrieved and macroinvertebrate samples were gathered. Bottom samples from the thalweg (in areas without weirs) were also obtained. Further hydro-acoustic fishery monitoring was conducted by St. Louis Corps staff utilizing new District equipment. Contract reports of the lab work will be available in 1997 (see Appendix A).**

The river training structure, the bendway weir, is an river engineering innovation from the combined efforts of St. Louis District staff and engineers from the Corps Waterways Experiment Station at Vicksburg, Mississippi. The underwater structure, in contrast to the standard rock dike, does not decrease the water surface area of the river and has widened deepwater bends in the river which has reduced groundings of tows. In Design Memorandum #24, the A&M planning document, staff from MDOC wrote in 1992 "It is our professional opinion as biologists that bendway weirs significantly improve aquatic habitat". All information collected to date appears to support this statement.

A&M 6) **The St. Louis District Potomology Section has developed a physical hydraulic Micro-Model as a planning and river engineering design tool. The A&M team made a decision in 1996 to conduct work in the open river reach area in side channels. Models of Schenimann (mile 57.1 - 62.2 R) and Santa Fe Chutes (mile 35.0 - 39.5 L) were constructed, calibrated and operated under various flow and structure modification situations. The team met on several occasions to discuss structural placement and configuration. Based on the recommendation of the team, stub dikes and rock revetment will be placed in Santa Fe Chute during high water 1997, and the Schenimann structures will be constructed in 1998. (see Appendix B).**

It has been known for several years that the side channels in the Middle River are filling with silt causing these unique aquatic habitats to become shallow and less diverse. From a planning perspective, the micro-model is an excellent means of testing various river engineering designs and their effects on the navigation channel and side channels. Prior to construction, biologists can now "see" how a rock structure will create the desired aquatic habitat diversity. The District has conducted baseline surveys of bottom conditions in both chutes, while our partners and the District have conducted biological aquatic surveys. The Micro-Model has been used to predict the geomorphological changes that will occur after construction of the training structures. The team will know if the experimental work was successful in 1997, if the river cooperates with high flow conditions.

A&M 7) **Thalweg placement of dredge material has been conducted successfully in the Rock Island District. In 1975, a contractor for the COE Waterways Experiment Station calculated a mathematical model for the St. Louis District and concluded that the methodology could be successfully conducted in the St. Louis District's reach of the river. Thalweg disposal was conducted at Bolter's Bar, river mile 225.0, Pool 26, in Oct. 1996. The District's Dredge Potter was utilized.**

Prior to the experimental dredging, channel sweep river surveys were conducted one mile downstream from the dredge site to identify a 20 to 30 foot deep hole that could be utilized for dredge material placement. Additional surveys were conducted prior to disposal, immediately after placement, thirty days after placement and will be surveyed again after the next high hydrograph. The latter two surveys will determine if the material moves out of the thalweg hole where disposal occurred, during normal seasonal flows and/or moves only with high water. The area of disposal was also checked by District biological staff, who hired a commercial musseler to brail in and around the disposal site. The area brailed did not produce mussels. District staff also checked for fish with hydro-acoustic equipment and few fish were located (see Appendix C).

A&M 8) **Monitoring of the endangered species, the Pallid Sturgeon, continued during 1996.**

Study methods were developed and habitat use data collection was initiated in year one of the monitoring study. All sturgeon (11) given sonic transmitters showed physical identification characteristics within the range reported for pallid sturgeon. Some specimens, however, may have been genetically affected by hybridization with Shovelnose Sturgeon, but techniques are not available at this time to determine this with certainty.

The telemetry system performed well, except during periods of high river discharge. The sturgeon were found (n=84) in the main channel (MCL) 46% of the time. They were in the MCL 48% (n=23) of the time at water temperatures less than 4° C, suggesting Pallid Sturgeon winter habitat requirements are not restricted. Sturgeon not in the MCL were usually near or between wing dams. Sturgeon were found in locations with depths of 6 to 12 m 72% of the time. Individual sturgeon ranged from 1.9 (10 contacts) to 60.3 (6 contacts) river miles. Mean range was 22.2 miles.

A&M 9) **Progress continued in the placement of mooring buoys and bank anchors in 1996. Additional chain and anchors were purchased and connectors were improved after the buoy below L&D 25 broke loose while three tows were moored waiting to proceed upstream through the lock. Additional input was obtained from industry and the lock masters concerning mooring site location and buoy tie-off improvement. Industry will provide to the District a prototype mooring buoy. A Mooring Plan is presently being developed. Real Estate Division worked on obtaining easements for the on-bank anchors.**

Towing industry representatives and captains have voiced dissatification with the configuration of the mooring buoys. The round flat buoys, presently being utilized, are considered unstable and difficult to attach a line from an unloaded barge (the buoy is 11 - 12 feet below the empty barge). The captains desire to remain in the channel by tieing off to a buoy and cutting back on the engines. The lock masters and the captains agree that utilizing buoys, placed immediately below the dam, is more efficient, thus, resulting in less lockage time. As a result of this dissatisfaction, the River Industry Action Committee (RIAC) will design and build a prototype mooring buoy and present it to the District. St. Louis District will provide chain and anchor and will set the buoy. The buoy will be designed by river boat captains and the A&M team is excited about this cooperation and input from those people who use the buoys. The on-shore anchor points continue to be heavily utilized and industry is requesting more anchor locations. District staff are working with our partners to locate the anchors and buoys.

A&M 10) **The Tow Waiting Time Study was initiated by District staff in 1996. The study identifies and evaluates non-structural alternatives, i.e. small scale improvement measures for reducing tow waiting times at lock facilities.**

The study, which complements and incorporates the ongoing navigation work for the Upper Mississippi River and Illinois Waterway (UMR-IWW) System Navigation Study, is being coordinated with our partners and will be completed in fiscal year 1997. Tow waiting time at locks, also known as delay time, results in higher transportation costs and can cause environmental degradation above and below the locks. A more efficient system will result in less waiting time for a given tow movement and therefore, less possibility for environmental damage. The small scale measures are evaluated under the following criteria: Environmental Impacts, Cost, Time Savings, Implementation, Safety and Technical Feasibility. Tables summarizing the application of this criteria to the small scale measures will be presented to District staff, lockmasters and tow industry personnel for their valued input.

District staff and lockmasters representing area locks have discussed the authority of lockmasters regarding lock operation decisions overseeing UMR traffic conditions, lock approach waiting areas and the implementation of special mooring sites, namely the construction and placement of buoys and anchors. Effective placement of mooring buoys and anchors will contribute to faster lockages by allowing tows to wait closer to the lock, minimizing lock idle time. Floating mooring buoys will also help reduce environmental damage by allowing tows to wait near the channel, thus reducing propeller wash against river banks and resuspension of sediments into the water column. Bank anchors and chains will also reduce the tieing-off of waiting tows to frail trees. A lockmaster survey will facilitate the construction of navigation charts detailing lock approach waiting areas as well as existing and desired locations of mooring sites. This survey will be incorporated into a master plan for the A&M program.

A publication essential to minimizing environmental impacts, Resource Alert!, alerts tow captains and crew to environmentally sensitive fish and wildlife areas on the Upper Mississippi River within the St. Louis District. A revised publication is near completion.

A&M 1997 Planned Activities. As previously stated in this report, the team was unable to monitor some structures because they were not constructed. Thus, this 1996 work will continue in 1997. Large numbers of macroinvertebrate samples were collected during the 1996 field season and will be analysed in 1997. Monitoring of bendway weirs, both macroinvertebrates and fisheries will continue in 1997. The A&M team agreed to move the construction of structures to the open river (mouth of the Ohio to the mouth of the Missouri--or the Middle River). By working with the Micro-Model, a plan for the placement of rock training structures in Santa Fe Chute was developed and the short dikes will be constructed in spring, 1997. Interest in providing nesting sites for the endangered

Least Tern was also high, thus, the team decided to isolate two existing sandbars by placing rock hardpoints in side channels to isolate the bar at mile 33.0 to 34.0, at Billings Island and mile 84.0 to 85.9, at Owl Creek. A Micro-model is being constructed for Marquette Chute (mile 48.0 - 51.0), across from Cape Girardeau, Missouri. The team will decide what modifications can be made during the spring of 1997 for 1998 construction. A Micro-model will also be built to model the troublesome dredging reach at Bolter's Bar in Pool 26. Thalweg disposal was performed at this site in 1996. Decisions will be made by the team as to what is the least environmentally damaging and lowest cost method to address the shoaling problem at this site. The buoy and anchor program will proceed as previously described. Schenimann Chute, mile 57.0 - 63.0, has been modeled and the team has conducted pre-construction physical and biological monitoring. The rock hard points have been designed and located. The District has decided to seek Section 1135 funds to modify the side channel.

A&M physical and biological monitoring. The Avoid and Minimize program is conducting experimental operation and maintenance activities. Thus, it is most important to know if the activities have a positive or negative effect on the aquatic environment, are cost effective and do not adversely affect the navigation mission of the Corps. If the reader desires to obtain copies of the complete biological report, other than that provided in the appendices, please contact Mr. T. Miller or Ron Yarbrough of the District A&M team.

OPEN PLAN (R)

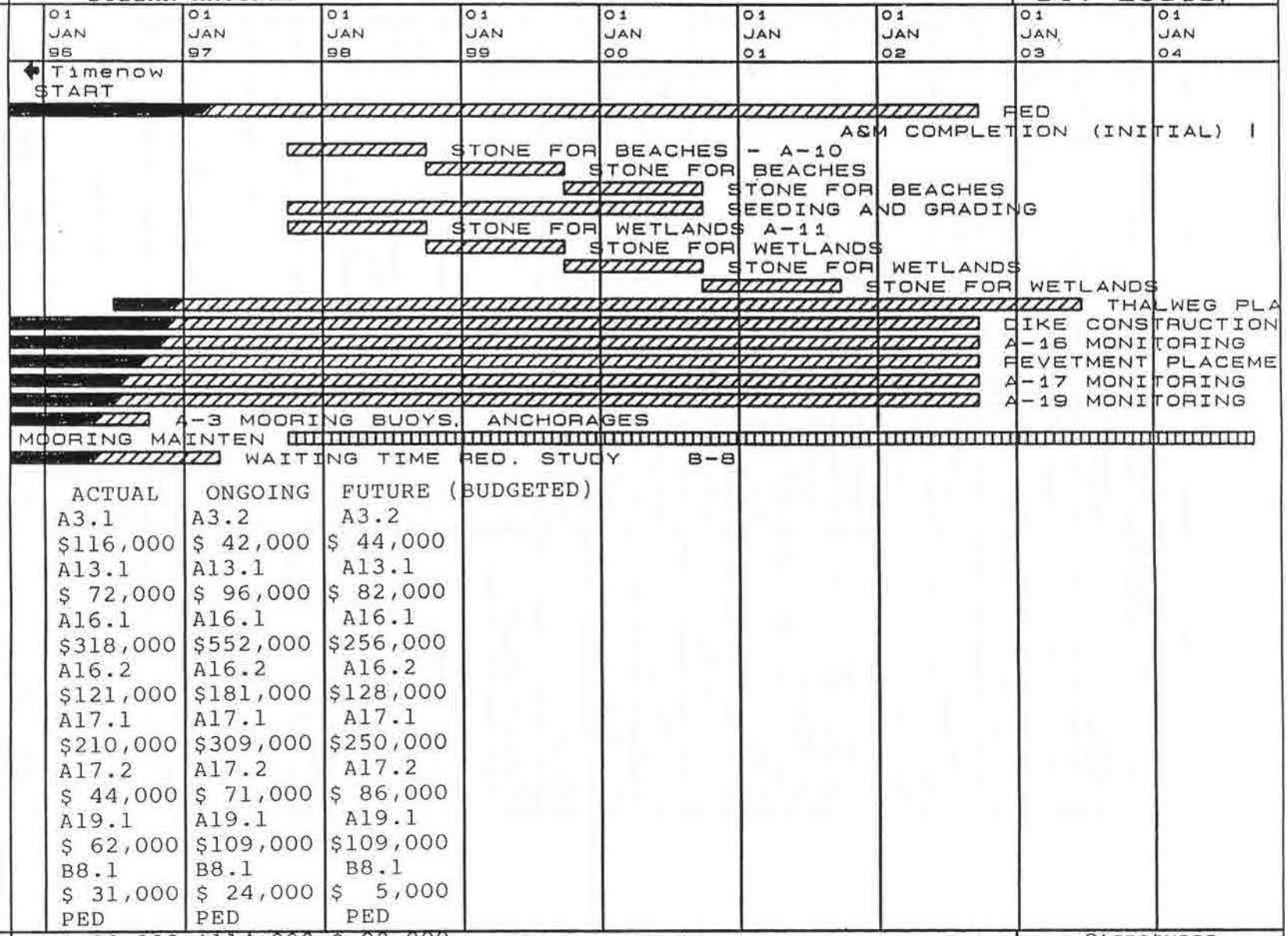
Report: GRAFBAR
Project: DM24
Time Now: 01OCT95
Date: 14DEC95
Time: 13:32:50
Page: 1

A&M MEASURES

FY 96 FY 97 FY 98

DOLLAR AMOUNTS

Army Corps of Engineers, St. Louis,



ACTUAL	ONGOING	FUTURE (BUDGETED)
A3.1	A3.2	A3.2
$116,000	$ 42,000	$ 44,000
A13.1	A13.1	A13.1
$ 72,000	$ 96,000	$ 82,000
A16.1	A16.1	A16.1
$318,000	$552,000	$256,000
A16.2	A16.2	A16.2
$121,000	$181,000	$128,000
A17.1	A17.1	A17.1
$210,000	$309,000	$250,000
A17.2	A17.2	A17.2
$ 44,000	$ 71,000	$ 86,000
A19.1	A19.1	A19.1
$ 62,000	$109,000	$109,000
B8.1	B8.1	B8.1
$ 31,000	$ 24,000	$ 5,000
PED	PED	PED
$ 80,000	$114,000	$ 82,000

Legend
-In progress
-Planned
-Critical

TOTAL: $1.054 M $1.498 M $1.042 M

Bar Chart Key: Early Dates

Signatures

Prep: _____

Appv: _____

AVOID AND MINIMIZE TEAM	
Name	**Organization**
Ron Yarbrough	Corps of Engineers
Phil Eydmann	Corps of Engineers
Norm Stucky	Missouri Department of Conservation
Steve Dierker	Corps of Engineers
Tommy Seals	Brown Water Towing (RIAC)
Dan Erickson	Corps of Engineers
T. Miller	Corps of Engineers
Bob Clevenstine	Fish and Wildlife Service
Jenny Frazier	Missouri Department of Conservation/LTRM
Bob Hrabek	Missouri Department of Conservation/LTRM
Joyce Collins	Fish and Wildlife Service
Claude N. Strauser	Corps of Engineers
Gordon Farabee	Missouri Department of Conservation
Rob Davinroy	Corps of Engineers
Gene Buglewicz	Corps of Engineers/LMVD
Roger Myhre	Corps of Engineers
Buddy Compton	Orgulf Transport (RIAC)
Tracy Butler	Corps of Engineers
Steve Redington	Corps of Engineers
Mike Kruckeberg	Corps of Engineers
Ron Messerli	Corps of Engineers
Butch Atwood	Illinois Department of Natural Resources
Ken Dalrymple	Missouri Department of Conservation
Ted Postol	Corps of Engineers
Ken Brummett	Missouri Department of Conservation
Brian Johnson	Corps of Engineers
Bob Sheehan	SIU-Carbondale
Dave Kelly	Corps of Engineers

APPENDIX A

ROCK STRUCTURE
BIOLOGICAL SAMPLING

1). Bendway Weir Macroinvertebrate Sampling Field Reports--17 July 1996, 18 Sept. 96, 22 Oct 96

2). Bendway Weir Macroinvertebrate Monitoring Interim Report, Nov. 1996

3). Pre-construction Monitoring--Round Points and Chevron Dikes

4). Fishery Monitoring of Off-Bankline Revetment and Chevron Dikes--by Elmer (Butch) Atwood, Illinois Department of Natural Resources

CELMS-PD-A **July 17 1996**

MEMORANDUM FOR CELMS-PD-A (Yarbrough)

SUBJECT: Bendway weir macroinvertebrate sampler placement trip - Trip Report.

1. In response to your asking that trip reports be completed for all A&M field work, I have completed and attached a trip report for the bendway weir macroinvertebrate sampler placement trip on 16 July 1996.

2. A collection trip has not been scheduled. Sometime in the last two weeks of August is our target timeframe. Two days for collection are expected.

.

Brian Johnson

BRIAN JOHNSON
Fishery Biologist,
Environmental Planning Branch

CF:
PD-A Ragland, Miller, Keevin
C0-D Dierker
PM-M Eydmann
ED-HQ Myhre
ED-HP Strauser
Chuck Theiling

A&M Trip Report

Date: 16 July 1996

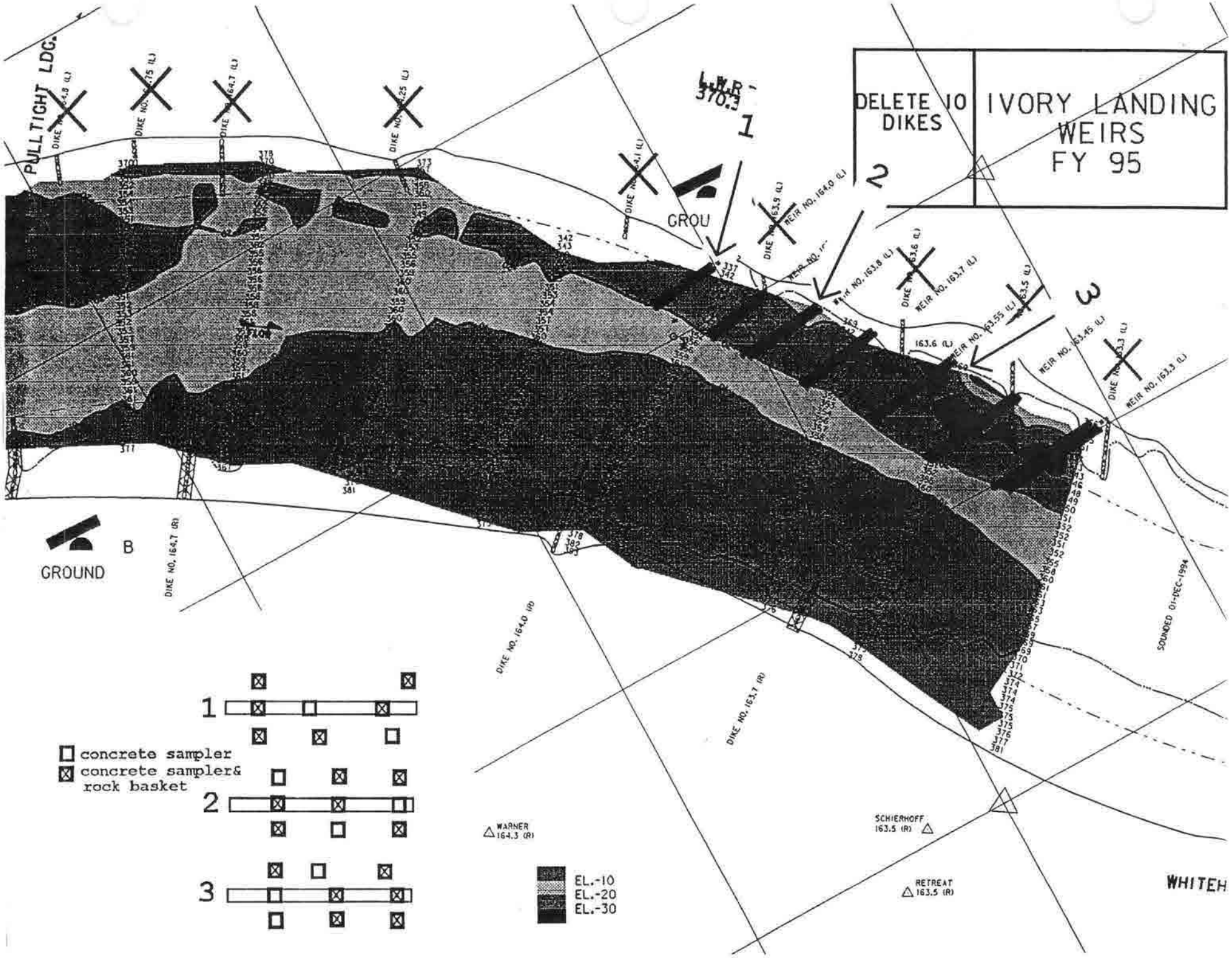
Purpose: Macroinvertebrate sampler placement on bendway weirs (R.M. 164.0-163.55)

Participants: Ron Yarbrough, Brian Johnson, T. Miller, Steve Dierker, Chuck Theiling, the crew of the Pathfinder

Summary: On 16 July 1996, we placed 26 concrete macroinvertebrate samplers (36"x36"x15", 1500 lbs) and 18 rock basket samplers on three bendway weirs located at Carl Baer bend (Mississippi R.M. 164.0-163.55). ~~Four~~ 2-5 weirs are present at the site. Nine concrete samplers were placed on, in front of, and behind weirs at R.M. 164.0, R.M. 163.8, and R.M. 163.55. No samplers were placed on a weir located at 163.45. In each case, three samplers were placed in front of the weir, three were placed on the weir, and three were placed behind the weir. The only exception was in front of the first weir, where only two concrete samplers were placed. Three samplers were cabled together in a line using wire rope, about 100-150 ft. apart, and were attached to an anchor rock on the shore. In addition, on two of the three concrete samplers in each line, rock baskets were attached with about six foot of cable. The attached table gives sampler depths, distances from shore, and indicates which samplers also had rock baskets attached. Samplers were set between 1100 and 1530 hours. Rivers stages were taken at St. Louis (14.1 ft.) and at the J.B. Bridge (10.4 ft.). Samplers will be deployed between 30-45 days. Tentatively the last two weeks of August were discussed as potential removal dates. It is expected that two days will be required for removal and sample collection. The concrete samplers will be reset in the river after samples are collected in anticipation on a second round of data during FY 1997. Ron Yarbrough took pictures and will have slides developed. A map of the collection site is attached.

BRIAN JOHNSON
Fishery Biologist,
Environmental Planning Branch

	Bendway weir macroinvertebrate sampling			
Placement date:	16 July 1996			
Weir 1 (R.M. 164.0)	sample 1 dist.	sample 2 dist.	sample 3. dist.	sample depth (ft)
	from shore (ft)	from shore (ft)	from shore (ft)	
above	450*	150*		40-45
on	450*	350	250*	29
below	400*	300*	200	40
Weir 2 (R.M. 163.8)				
above	400	300*	200*	40
on	400*	300*	200	28.5
below	400*	300	200*	36
Weir 3 (R.M. 163.55)				
above	450*	350	250*	36
on	450	300*	150*	31
below	450	300*	150*	38-46
* indicates rock basket was placed in addition to concrete sampler.				


DELETE 10 DIKES
IVORY LANDING WEIRS FY 95
PULLTIGHT LDG.
GROUND
B
GROU
1
2
3
DIKE NO. 164.7 (R)
DIKE NO. 164.0 (R)
DIKE NO. 163.7 (R)
WEIR NO. 164.0 (L)
WEIR NO. 163.8 (L)
WEIR NO. 163.7 (L)
WEIR NO. 163.55 (L)
WEIR NO. 163.45 (L)
WEIR NO. 163.3 (L)
163.6 (L)
SOUNDED 01-DEC-1994
concrete sampler
concrete sampler& rock basket
EL.-10
EL.-20
EL.-30
WARNER 164.3 (R)
SCHIERHOFF 163.5 (R)
RETREAT 163.5 (R)
WHITEH

CELMS-PD-A **September 18 1996**

MEMORANDUM FOR CELMS-PD-A (Yarbrough)

SUBJECT: Bendway macroinvertebrate sampling trip - Trip Report.

1. In response to your asking that trip reports be completed for all A&M field work, I have completed and attached a trip report for the bendway macroinvertebrate sampling trip on 27 August 1996.

2. Samples were collected from a bendway with weirs, Price's Bend (R.M. 30), and a bendway without weirs, Thompson's Bend (R.M. 20). An analysis and report on the samples will be prepared under contract during fiscal year 1997.

Brian Johnson

BRIAN JOHNSON
Fishery Biologist,
Environmental Planning Branch

CF:
PD-A Ragland, Miller
C0-D Dierker
PM-M Eydmann
ED-HQ Postal, Myhre
ED-HP Strauser
(MDC) Frazier, Conaway
(USFWS) Clevinstine

A&M Trip Report

Date: 27 August 1996

Purpose: Macroinvertebrate sampling of bendways with and without weirs (R.M. 30-20)

Participants: Present from the Corps were Brian Johnson, T. Miller, Ron Yarbrough, Roger Myhre, and the crew of the m.v. Pathfinder. Present from other agencies were Bob Clevinstine (U.S. Fish and Wildlife Service), and Lesly Conaway and Jennifer Frazier (Mo. Dept. of Conservation, Long Term Resource Monitoring).

Summary: On 27 August 1996 we conducted macroinvertebrate sampling on nine bendway weirs between R.M. 30.55 and 29.6 (Price's Bend). Samples were collected by grabbing rocks off the weirs using a clamshell dredge. Though the clamshell dredge often picked up more than one rock in a sample, only one rock was selected for subsampling per sample. The rock with the greatest surface area covered with macroinvertebrates was selected. Three separate samples were collected on each weir (see attached tables for exceptions). On each rock, a 6 inch diameter circle was sprayed with nitric acid and the macroinvertebrates were removed and placed in sample jars. Twenty-six total samples were collected. An analysis and report on the samples will be prepared under contract during fiscal year 1997. Each sample was approximately 90-100 ft. off the anchoring bank and in 30-35 ft. of water. Initial observations showed that many of the rocks were covered with macroinvertbrates and/or zebra mussels. River mile and state plane x and y coordinates were taken for sample sites on each weir. Pictures of the sampling methodology were taken by Ron Yarbrough. Data collected at each weir is on the accompanying sheet.

In addition to the twenty-six samples collected on the outside of the bend, we also attempted preliminary collection of weir rocks on the inside of the bend with the clamshell dredge. The higher velocities, and depths (45 ft.) associated with this area made collection difficult. Thirteen attempts were made to collect rocks. Rocks were collected on the last two attempts. These rocks appeared "sandblasted" and exhibited rounded corners on most surfaces. However, macroinvertebrates were collected on what appeared to be the "protected" (jagged, pointy side of rock) side of one rock. What this suggests is the macroinvertebrates were living on the side of the rock subject to lower velocities. Macroinvertebrate densities appeared lower than those on the rocks collected off the anchoring bank. No zebra mussels were observed on these rocks. A more complete collection of rocks on this portion of the weir need to be conducted.

On 27 August 1996 we also collected macroinvertebrate samples on a bendway without weirs between R.M. 20.8 and 19.8 (Thompson's Bend). Bottom substrate samples were collected by grabbing 3/4 of a cubic yard of the river bed using a clamshell dredge. This sample was subsampled by placing a petite ponar dredge on the top of the collected sample, pressing the ponar into the sample, and collecting a smaller sample. Three transects were taken (R.M. 20.8, 20.2, 19.8) with samples taken at 300 ft. intervals across the channel. Eleven total samples were collected. River mile and state plane x and y coordinates were taken for each sample in the

transect. Pictures of the sampling methodology were taken by Ron Yarbrough. Data collected along each transect is on the accompanying sheet. An analysis and report will be prepared under contract during fiscal year 1997.

Brian Johnson

BRIAN JOHNSON
Fishery Biologist
Environmental Planning Branch

MACROINVERTBRATE SAMPLING, PRICES BEND, M.R.M. 29.6-30.55, 8-27-1996

Bendway number	1
samples collected	1
river mile	30.55
distance from shore (ft)	90
water depth (ft)	not taken
x coordinate	824329.09
y coordinate	445293.69

notes:
zebra mussels and macroinverts. present

Bendway number	2
samples collected	3
river mile	30.5
distance from shore (ft)	90
water depth (ft)	31
x coordinate	824427.09
y coordinate	444888.69

notes:
many zebra mussels and macroinverts. on rocks

Bendway number	3
samples collected	4
river mile	30.3
distance from shore (ft)	90
water depth (ft)	31
x coordinate	824526.00
y coordinate	444220.10

notes:
zebra mussels and macroinverts. present

Bendway number	4
samples collected	3
river mile	30.2
distance from shore (ft)	90
water depth (ft)	32
x coordinate	824601.56
y coordinate	443747.93

notes:
zebra mussels and macroinverts. present

Bendway number	5
samples collected	3
river mile	30.1
distance from shore (ft)	90
water depth (ft)	32
x coordinate	824831.56
y coordinate	443162.93

notes:
zebra mussels and macroinverts. present

Bendway number	6
samples collected	3
river mile	30
distance from shore (ft)	90
water depth (ft)	35
x coordinate	825299.00
y coordinate	442522.96

notes:
sample BW 6-3 covered with zebra mussels

Bendway number	7
samples collected	3
river mile	29.9
distance from shore (ft)	90
water depth (ft)	31
x coordinate	825790.67
y coordinate	441999.51

notes:
zebra mussels and macroinverts. present

Bendway number	8
samples collected	3
river mile	29.8
distance from shore (ft)	90
water depth (ft)	32
x coordinate	826421.56
y coordinate	441415.21

notes:
zebra mussels and macroinverts. present

Bendway number	9
samples collected	3
river mile	29.6
distance from shore (ft)	90
water depth (ft)	32
x coordinate	827646.72
y coordinate	440382.33

notes:
rocks seemed to be have more macroinverts. than other weirs

Bendway number	8
samples collected	1
river mile	29.8
distance from shore (ft)	end of weir
water depth (ft)	45
x coordinate	not taken
y coordinate	not taken

notes: difficult to sample, collected rocks on the 12th sample, rocks collected were rounded (sand blasted). 13th sample, 2 rocks collected, macroinverts. collected on jagged side (suggests protected side of rocks w/ lower velocity), other sides sand rounded, no zebra mussels collected

GENERAL NOTES

Cape Giradeau gauge (8/27/96) - 18.0 ft
Bendway gauge (8/27/96) - 10.1 ft
trip report prepared
most rocks had macroinverts. and/or zebra mussels

MACROINVERTEBRATE SAMPLING, THOMPSONS BEND, M.R.M. 19.8-20.8, 8-27-1996

TRANSECT 1

sample number	1
distance from shore (ft) -right descending bank	300
river mile	20.8
water depth (ft)	32
x coordinate	862261.21
y coordinate	436289.57
notes: just below Thompson Field light outside of bend, coarse sand	

sample number	2
distance from shore (ft) -right descending bank	600
river mile	20.8
water depth (ft)	34
x coordinate	862373.21
y coordinate	435904.57
notes: just below Thompson Field light middle of bend	

sample number	3
distance from shore (ft) -right descending bank	900
river mile	20.8
water depth (ft)	28
x coordinate	862150.01
y coordinate	435788.57
notes: just below Thompson Field light middle of bend	

sample number	4
distance from shore (ft) -right descending bank	1200
river mile	20.8
water depth (ft)	22
x coordinate	860970.91
y coordinate	435592.84
notes: just below Thompson Field light inside of bend, finer grained sand	

TRANSECT 2

sample number	5
distance from shore (ft) -right descending bank	300
river mile	20.2
water depth (ft)	47
x coordinate	861201.43
y coordinate	437528.20
notes: at the water gauge outside of bend, coarse sand	

sample number	6
distance from shore (ft) -right descending bank	600
river mile	20.2
water depth (ft)	30
x coordinate	861015.83
y coordinate	437351.40
notes: at the water gauge middle of bend	

sample number	7
distance from shore (ft) -right descending bank	900
river mile	20.2
water depth (ft)	22
x coordinate	860820.63
y coordinate	437215.40
notes: at the water gauge middle of bend	

sample number	8
distance from shore (ft) -right descending bank	1200
river mile	20.2
water depth (ft)	13
x coordinate	860688.58
y coordinate	436784.64
notes: at the water gauge inside of bend, finer grained sand	

TRANSECT 3

sample number	9
distance from shore (ft) -right descending bank	300
river mile	19.8
water depth (ft)	55
x coordinate	859554.49
y coordinate	438548.82
notes: at the Thompson daymark outside of bend, coarse sand	

sample number	10
distance from shore (ft) -right descending bank	600
river mile	19.8
water depth (ft)	35
x coordinate	859346.49
y coordinate	438238.42
notes: at the Thompson daymark middle of bend	

sample number	11
distance from shore (ft) -right descending bank	900
river mile	19.8
water depth (ft)	14
x coordinate	859278.49
y coordinate	437975.22
notes: at the Thompson daymark inside of bend, finer grained sand	

ONLY 3 SAMPLES BECAUSE
RIVER WAS <1200 ft

GENERAL NOTES

Cape Giradeau gauge (8/27/96) - 18.0 ft
Thompsons Bend gauge (8/27/96) 304.3
trip report prepared
sampled collected with clamshell bucket (3/4 cubic yard) with a petite ponar subsample of top sand

CELMS-PD-A **22 October 1996**

MEMORANDUM FOR CELMS-PD-A (Yarbrough)

SUBJECT: Bendway weir macroinvertebrate sampler placement trip - Trip Report.

1. In response to your asking that trip reports be completed for all A&M field work, I have completed and attached a trip report for the bendway weir macroinvertebrate sample collection trip at Carl Baer bend (M.R.M. 164.5-163.55) on 17 September 1996.

2. During the trip, ten samplers placed above the bendway weirs on 21 August 1996 were retrieved and fifteen additional samples on the bendway weirs were collected. An analysis and report on the samples will be prepared under contract during fiscal year 1997.

Brian Johnson

BRIAN JOHNSON
Fishery Biologist,
Environmental Planning Branch

CF:
PD-A Ragland, Miller,
C0-D Dierker
PM-M Eydmann
ED-HQ Postal, Myhre
ED-HP Strauser
(MDC) Frazier, Conaway
Ecological Specialists - Heidi Dunn

A&M Trip Report

Date: 17 September 1996

Purpose: Macroinvertebrate sampling of bendways with and without weirs (R.M. 164.5-163.55)

Participants: Present from the Corps were Brian Johnson, T. Miller, Terrie Hatfield, and the crew of the m.v. Pathfinder. Present from the Missouri Department of Conservation (Long Term Resource Monitoring) were Lesly Conaway and Jennifer Frazier.

Summary: On 17 September 1996 we conducted macroinvertebrate sampling on four bendway weirs between R.M. 163.55 and 164.0 (Carl Baer bend). Samples were collected by grabbing rocks off the weirs using a clamshell dredge. Though the clamshell dredge often picked up more than one rock in a sample, only one rock was selected for subsampling per sample. The rock with the greatest surface area covered with macroinvertebrates was selected. The number of samples collected differed on each weir (see attached tables). On each rock, a 6 inch diameter circle was sprayed with nitric acid and the macroinvertebrates were removed and placed in sample jars. Fifteen total samples were collected. An analysis and report on the samples will be prepared under contract during fiscal year 1997. Sample were collected from 50-400 ft. off the anchoring bank and in 20-22 ft. of water. Initial observations showed that many of the rocks were covered with macroinvertbrates and/or zebra mussels. River mile and state plane x and y coordinates were taken for sample sites on each weir. Data collected at each weir is on the accompanying sheet.

On 17 September 1996 we also retrieved ten macroinvertebrate samples on a bendway without weirs between R.M. 164.5 and 163.7 (directly upstream from the weir samples). These samples were collected on ten concrete macroinvertebrate samplers (36"x 36"x 15", 1500 lbs). These samplers were placed parallel to and, approximately 200 ft off, the left descending bank on 21 August 1996. Each sampler was attached with wire rope to a red nun buoy. The attached table gives sample depths, distances from shore, and Global Positioning System (GPS) coordinates. Rivers stages were taken at St. Louis (4.7 ft.) and at the J.B. Bridge (0.5 ft.) on 17 September 1996. A map of the collection site is attached. An analysis and report will be prepared under contract during fiscal year 1997.

BRIAN JOHNSON
Fishery Biologist
Environmental Planning Branch

MACROINVERTEBRATE SAMPLING, CARLS BAER BEND, M.R.M. 163.7-164.5, 9-17-1996

BUOY SAMPLERS WERE PLACED ON 8/21/96

Buoy number	1
river mile	
distance from shore (ft)	200
water depth (ft)	38
GPS coordinates	N 38 25 59.52 W 90 17 39.78
notes: inverts. present	

Buoy number	2
river mile	
distance from shore (ft)	200
water depth (ft)	40
GPS coordinates	N 38 25 56.22 W 90 17 44.35
notes: Buoy behind a dike, may have moved, inverts. present	new position 9/17/96 x 560039.12 y 943952.90

Buoy number	3
river mile	
distance from shore (ft)	200
water depth (ft)	36
GPS coordinates	N 38 25 52.61 W 90 17 47.33
notes: pulled rock away from dike, may have dislodged some inverts.	

Buoy number	4
river mile	
distance from shore (ft)	200
water depth (ft)	37
GPS coordinates	N 38 25 47.72 W 90 17 49.80
notes: inverts. present	

Buoy number	5
river mile	
distance from shore (ft)	200
water depth (ft)	37
GPS coordinates	N 38 25 44.23 W 90 17 54.15
notes: inverts. present	

Buoy number	6
river mile	
distance from shore (ft)	200
water depth (ft)	37
GPS coordinates	N 38 25 41.73 W 90 17 57.37
notes: inverts. present	

Buoy number	7
river mile	
distance from shore (ft)	200
water depth (ft)	37
GPS coordinates	N 38 25 39.78 W 90 17 60.87
notes: no inverts., iron had turned black, probably sanded in	

Buoy number	8
river mile	
distance from shore (ft)	200
water depth (ft)	39
GPS coordinates	N 38 25 34.84 W 90 17 64.47
notes: inverts. present	

Buoy number	9
river mile	
distance from shore (ft)	200
water depth (ft)	43
GPS coordinates	N 38 25 34.84 W 90 17 68.48
notes: fewer inverts., inverts. on cable	

Buoy number	10
river mile	
distance from shore (ft)	200
water depth (ft)	38
GPS coordinates	N 38 25 31.52 W 90 17 72.60
notes: inverts. present	

GENERAL NOTES: J.B. Bridge gauge = 0.5 ft, St. Louis gauge = 4.7 ft, trip report prepared, all substrate samplers had inverts except # 7, 1500 lbs buoy anchors were used as samplers

MACROINVERTEBRATE SAMPLING, CARL BAER BEND, M.R.M. 164.0-163.55, 9-17-1996

Bendway number	1
samples collected	5
river mile	164
distance from shore (ft)	50
water depth (ft)	21.5
x coordinate	558140.71
y coordinate	942150.73

notes: samples labeled 1-1, 1-2, 1-3, 1-4, 1-5,
sample 1-1, rock sand rounded, some inverts.,
sample 1-2, sand rounded, inverts. on jagged side of rock
sample 1-3, inverts. present
sample 1-4 sand rounded, zebra mussels present on jagged side, inverts. on both jagged and round sides
sample 1-5 inverts. present

Bendway number	2
samples collected	4
river mile	163.8
distance from shore (ft)	100
water depth (ft)	20
x coordinate	557334.59
y coordinate	941311.29

notes: sample labeled 2-2, 2-3, 2-4, 2-5
no rounded rocks, zebra mussels and inverts. present

Bendway number	3
samples collected	1
river mile	163.55
distance from shore (ft)	400
water depth (ft)	22
x coordinate	556695.10
y coordinate	9410181.59

notes: sample labeled 2-1
difficult sampling

Bendway number	1.5
samples collected	5
river mile	163.9
distance from shore (ft)	
water depth (ft)	20
x coordinate	557802.59
y coordinate	941611.29

notes: weir located between #1 and #2, samples labeled 3-1, 3-2, 3-3, 3-4, 3-5

GENERAL NOTES

St. Louis gauge (9/17/96) - 4.7 ft
JB Bridge gauge (9/17/96) - 0.5 ft
trip report prepared

CELMS-PD-A **22 October 1996**

MEMORANDUM FOR CELMS-PD-A (Yarbrough)

SUBJECT: Bendway weir macroinvertebrate sampler collection trip - Trip Report.

1. In response to your asking that trip reports be completed for all A&M field work, I have completed and attached a trip report for the bendway weir macroinvertebrate sampler collection trip at Carl Baer bend (M.R.M. 164.5-163.55) on 20 August 1996.

2. During the trip, we retrieved seventeen of the twenty-six concrete samplers which were deployed on 16 July 1996. We also recovered four of the 18 rock baskets deployed on July 16, 1996. These samples will be analyzed, under contract, along with samples collected on 17 September 1996, and a report will be prepared during fiscal year 1997.

Brian Johnson

BRIAN JOHNSON
Fishery Biologist,
Environmental Planning Branch

CF:
PD-A Ragland, Miller,
C0-D Dierker
PM-M Eydmann
ED-HQ Postal, Myhre
ED-HP Strauser
(MDC) Frazier, Conaway
Ecological Specialists - Heidi Dunn

A&M Trip Report

Date: 20 August 1996

Purpose: Macroinvertebrate sampler retrieval from bendway weirs (R.M. 164.0-163.55)

Participants: Present from the Corps were Brian Johnson, T. Miller, and the crew of the m.v. Pathfinder. Present from the Missouri Department of Conservation (Long Term Resource Monitoring) were Lesly Conaway and Jennifer Frazier. Present from Ecological Specialists were Chuck Theiling and Melissa Moore.

Summary: On 16 July 1996, we placed 26 concrete macroinvertebrate samplers (36"x 36"x 15", 1500 lbs) and 18 rock basket samplers on three bendway weirs located at Carl Baer bend (Mississippi R.M. 164.0-163.55). Nine concrete samplers were placed on, in front of, and behind weirs at R.M. 164.0, R.M. 163.8, and R.M. 163.55. In each case, three samplers were placed in front of the weir, three were placed on the weir, and three were placed behind the weir. The only exception was in front of the first weir, where only two concrete samplers were placed. Three samplers were cabled together in a line using wire rope, about 100-150 ft. apart, and were attached to an anchor rock on the shore. In addition, on two of the three concrete samplers in each line, rock baskets were attached with about six foot of cable. Samplers were set between 1100 and 1530 hours. Rivers stages were taken on 16 July 1996 at the St. Louis (14.1 ft.) and the J.B. Bridge (10.4 ft.) gauges.

On 20 August 1996, 35 days after deployment, we returned to Carl Baer bend to retrieve the samplers and rock baskets. Seventeen on the 26 concrete samplers originally deployed were recovered. Of these seventeen, six were colonized by macroinvertebrates. Most of the eleven samplers which did not have macroinvertebrates had the appearance of being "sanded in" (showed evidence of iron oxide, which is formed under anaerobic conditions). Only four of the 18 rock baskets deployed were recovered intact. Two of the rock baskets had been smashed, likely during deployment. The remaining 12 rock baskets were either lost during retrieval or during the 35 day deployment period. It appeared that most of the rock baskets broke at the connection between the rock basket and the wire rope. The rock baskets were constructed of materials which were insufficent for deployment under these conditions.

Safety of the crew was the major reason for the low recovery rate (65%) of the concrete samplers. During recovery of the first two row of samplers, as we moved out away from the bank, the wire rope exhibited dangerously high tension levels (one broke). Rather than risk injury we decided to cut the wire rope and abandon the samples. Only three of nine concrete samplers deployed at the end of the row (the farthest out, 400-450 ft. from the bank) were recovered. All nine on the closest concrete samplers (150-250 ft. from the bank) were recovered. Five out of eight of the concrete samplers in the middle (300-350 ft. from the bank) were recovered. This information is presented in the attached table. We surmised that the high tensions associated with the wire ropes were due to a combination of the wires "sanding in", becoming entangled in the rocks on the weir, drag from the m.v. Pathfinder, pulling on the wire rope by the crane used to remove the samplers, and the high water velocities associated with river bends.

Overall, neither sampling methodology worked well. Modifications in deployment of the concrete samplers by either attaching only one sampler to a bank line or attaching the samplers to

navigation buoys, to keep the wire rope off the bottom, would work better. The use of standard rock baskets does not seem to work in bendway weir field environment. Since this effort, use of a clamshell dredge to pick rocks up off the weir, as used on 27 August 1996 (Prices Bend M.R.M. 19.6-30.55), works much better. However, abandoning this methodology meant that only qualitative comparisons, and not quantitative comparisons, could be made between collected samples.

The river stage at the St. Louis gauge was 11.9 ft. on 20 August 1996. The river stage at the J.B. Bridge gauge was 7.9 ft. on 21 August 1996. Pictures of the sampling methodology were taken by T. Miller and Brian Johnson. An analysis and report will be prepared under contract during fiscal year 1997.

Brian Johnson

BRIAN JOHNSON
Fishery Biologist,
Environmental Planning Branch

MACROINVERTEBRATE SAMPLING, CARL BAER BEND, M.R.M. 164.0-163.55, 8-20-1996

Placement date: 16 July 1996
Retrieval date: 20 August 1996

Weir 1 (R.M. 164.0)	sample 1 dist. from shore (ft)	sampler retrieved	inverts. present	rock basket retrieved	sample 2 dist. from shore (ft)	sampler retrieved	inverts. present	rock basket retrieved	sample 3. dist. from shore (ft)	sampler retrieved	inverts. present	rock basket retrieved	sample depth (ft)
above	450*	N		N	150*	Y	Y	N					40-45
on	450*	N		N	350	N			250*	Y	Y	N	29
below	400*	Y	N	N	300*	Y	N	N	200	Y	N		40
Weir 2 (R.M. 163.8)													
above	400	N			300*	Y	N	N	200*	Y	N	N	40
on	400*	N		N	300*	Y	Y	Y	200	Y	N		28.5
below	400*	Y	N	N	300	Y	N		200*	Y	Y	Y	36
Weir 3 (R.M. 163.55)													
above	450*	N		N	350	N			250*	Y	Y	Y	36
on	450	Y	N		300*	Y	N	N	150*	Y	N	N	31
below	450	N			300*	N		N	150*	Y	Y	Y	38-46

* indicates rock basket was placed in addition to concrete sampler.

Water level
St. Louis gauge 11.9 ft, 8/20/96
J.B. Bridge gauge 7.9 ft, 8/21/96

Draft Report: Macroinvertebrates Associated with Carl Baer Bendway Weirs in the Mississippi River

Prepared for:

Harland, Bartholomew and Associates, Inc.
Chesterfield, Missouri

Under contract to:

U.S. Army Corps of Engineers
St. Louis District

Prepared by:

Ecological Specialists, Inc.
St. Peters, Missouri

January 1997

(ESI Project #96-022)

2.0 Methods

2.1 Field Effort

Macroinvertebrate samples were collected near Carl Baer Bendway Weirs in the summer of 1996 to determine species composition, density, and diversity of epilithic communities colonizing the weirs. Sampling was attempted on the upstream and downstream sides of three weirs, and on top of four of the five weirs in the weir field (Figure 2-1). Samples were collected from buoy anchors, rock baskets, and weir rocks. Reference samples were collected from buoy anchors placed in a bendway without weirs, upstream of the weir field; MRM 164.5 (see Figure 1-1). A total of 69 samples were attempted using the three methods, however only 34 samples were collected and 33 analyzed.

2.1.1 Buoy Anchor Samplers

The weirs are composed of 0.4kg (1lb) to 2,268kg (5,000lb) limestone rocks, with the largest rocks being approximately 1m in diameter. Buoy anchors, which are approximately 680kg (1,500lb), 0.9m x 0.9m x 0.3m concrete blocks with reinforced rebar eyes on the top and one side for lifting (Figure 2-2), were considered an appropriate artificial substrate for weir rock sampling because of their size and similarity to weir rocks. However, buoy anchors have a rigid square shape with smooth sides, rather than having a rounded irregular shape like weir rocks. Using the crane on the USCOE M.V. Pathfinder, 26 buoy anchors were placed on and adjacent to three of the five Carl Baer Bendway Weirs on 16 July 1996; bendway weir (BW) 1, BW 2, and BW 5 (see Figure 2-1). Groups of buoy anchors (three buoy anchors [two upstream of BW 1] tethered together and to the bank with steel cable [see Figure 2-2]) were placed in rows running parallel to weirs directly upstream, downstream, and on the weir structure.

Sample retrieval was attempted after 35 days of colonization (20 August 1996), however retrieval success was low. Cables for each set of samplers were retrieved at the bank and followed out to samplers. Several buoy anchors became entangled with the cable lines from other samplers and in bottom debris; causing extreme tension in the cable lines and forcing abandonment of ten buoy anchors. Recovery of buoy anchors was highest closer to the bank (75%), while only 33% of the buoy anchors placed furthest from the bank were retrieved. Overall, 17 of the 26 deployed buoy anchors were retrieved, but 11 of those were apparently sand blasted or had been buried, and only six yielded macroinvertebrate scrape samples. Samples were scraped from the area within a 0.0929m^2 (1ft^2) Surber sampler on the rock surface with the highest colonization. To ensure minimal damage to the animals, a 10% nitric acid solution spray was used to dislodge macroinvertebrates and their cases from the rocks. The animals were lightly brushed and rinsed into the sampler, transferred to 1L plastic jars, preserved with 10% formalin, and returned to the laboratory for processing.

2.1.2 Rock Basket Samplers

Although buoy anchors are similar to weir rocks, their value as an artificial substrate invertebrate sampler was untested. Rock baskets have been previously used for monitoring invertebrates on other channel maintenance structures (ESI, 1996). Therefore, rock baskets were deployed along with buoy anchors (see Figure 2-1) to assess their efficacy in the harsh weir environment.

Baskets were constructed from one-half of a standard minnow trap. Each basket was filled with 35 rocks of approximately the same size. Rock surface area was crudely estimated by calculating the surface area of shapes similar to the rocks (cones and cylinders in most cases). Rock surface area in each basket averaged 0.3m^2. Baskets were covered with 6mm hardware cloth secured with plastic ties.

Baskets were deployed at 18 locations in the weir field along with buoy anchor samplers on 16 July 1996 (see Figure 2-1). Rock baskets were connected to two of the three buoy anchors in each buoy anchor set with approximately 2m of 6mm steel cable (see Figure 2-2), resulting in two baskets directly upstream, downstream, and on top of each of the three sampled weirs; BW 1, BW 2, and BW5 (see Figure 2-1).

Rock basket recovery was also attempted after 35 days of colonization (20 August 1996). However, as with buoy anchor retrieval success, only a few rock baskets (4 of 18) were retrieved. Three were heavily colonized, but one was apparently buried in the sediment, as colonization was minimal and the basket was full of sand. This sample was therefore excluded from analyses. Buoy anchor loss accounted for some of the low return of rock baskets, but most were lost due to basket structure failure. Buoy anchors were retrieved with torn pieces of a rock basket attached, and in all cases, the cables and clips securing the basket to the buoy anchor were still intact, indicating that baskets were torn from cables either during the colonization period or retrieval. Retrieved rock baskets were placed in 13.3L (3.5gal) buckets, preserved with 10% formalin, and returned to the laboratory for processing.

2.1.3 Weir Rock Scrapes

Since previous sampling methods proved less than successful, 14 scrape samples were collected from the weir rocks on 17 September 1996. Weir rocks were collected with the USCOE M.V. Pathfinder's clam shell dredge. Sample collection was attempted on the three previously sampled weirs, however swift current on BW 5 proved dangerous and only one sample was obtained. Therefore, five, five, four, and one samples were collected from BW 1, BW 2, BW 4, and BW 5, respectively (see Figure 2-1). A scrape sample was collected from rock surfaces with the greatest macroinvertebrate colonization using a 0.15m (6in) diameter (0.018m^2) sampling frame, 10% nitric acid spray to

dislodge the animals from the surface, and a pan to catch the falling debris. Samples were washed into plastic 1L jars, preserved with 10% formalin, and returned to the laboratory for processing.

2.1.4 Upstream Reference Samples

In addition to weir sampling, ten concrete buoy anchors (without rock baskets attached) were placed near MRM 164.5, in a bendway without weirs, upstream of the Carl Baer Bendway on 21 August 1996 (see Figure 1-1). Our objective was to obtain comparable samples within and upstream of the weir field to assess the weir field's influence on species composition and colonization rate. Buoy anchors were attached with cable to red nun buoys, and deployed parallel to and approximately 61m (200ft) from the left descending bank. All ten buoy anchors from the upstream bendway were retrieved after 30 days (17 September 1996). Scrape samples were collected as previously described for weir rock scrapes. A sample was not collected from one of the ten buoy anchors due to lack of macroinvertebrate colonization.

2.2 Laboratory Procedures

2.2.1 Sample Tracking

Upon arrival at ESI's laboratory, all samples were logged on a project-specific tracking form. Each sample was assigned and labeled (internally and externally) with a unique code that followed the sample through sorting and identification. Pertinent sample information, including collection date (set and retrieval), collection location, and collection personnel were recorded in the log book. Personnel and date were recorded following each sample processing task.

2.2.2 Sorting

Each sample was rinsed through a #30 sieve to remove preservative and a portion was placed in a white pan. Samples with many animals were subsampled according to procedures outlined below. Animals were sorted from debris with the aid of a magnifying lamp or dissection microscope, and placed in scintillation vials containing 75% alcohol. Abundant groups (chironomids, oligochaetes, tricopterans, ephemeropterans) were sorted into separate vials. Vials were labeled internally and externally with the sample's code. The resultant number of vials was recorded on the tracking form.

Sample debris was searched until all animals were retrieved. The remaining debris was rinsed into the original sample container, preserved in 75% alcohol, and marked with the sorters initials and sorting date. The sorters initials and sorting date were also recorded on the sample tracking form.

2.2.3 Subsampling

A Folsom sample splitter was used for all subsampling. Very large samples (>500 animals) were split before sorting. However, only samples relatively free of entangling debris (biasing the

Table 3-2. Macroinvertebrate community characteristics in Mississippi River bendway weirs (MRM 163.5) and an upstream bendway (MRM 164.5).

					MRM 163.5												MRM 164.5		
					Rock baskets			Weir rocks			Buoy anchors			Total			Buoy anchors		
Phylum	Class	Order	Family	Species	Mean[1]	2SE	%[2]	Mean	2SE	%	Mean	2SE	%	Mean	2SE	%	Mean	2SE	%
Platyhelminthes	Turbellaria										7	14	0.09	2	4	0.01			
Platyhelminthes	Turbellaria	Tricladida	Planariidae	*Dugesia tigrina*	1	2	T[3]	680	989	4.59				425	625	2.90	6	12	0.04
Nematoda					366	636	1.35	73	68	0.49	41	61	0.50	102	90	0.69	30	61	0.20
Nematomorpha											1	1	T			T	6	12	0.04
Mollusca	Bivalvia	Veneroida	Dreissenidae	*Dreissena polymorpha*				88	75	0.59				55	49	0.37	128	142	0.83
Annelida	Oligochaeta	Haplotaxida	Enchytraeidae	*Barbidrulus paucisetus*	9	19	0.03							1	2	T			
			Naididae	*Dero digitata*	2	5	T								1	T			
				Nais behningi	9	19	0.03	62	62	0.42	3	5	0.03	41	40	0.28			
				Nais variabilis	9	19	0.03							1	2	T	6	12	0.04
				Slavina appendiculata	1	2	T									T			
Arthropoda	Arachnida	Acarina	Oribatei	*Oribatei sp.*	2	5	T								1	T			
Arthropoda	Insecta	Ephemeroptera	Baetidae	*Baetis sp.*	131	154	0.48	4	7	0.02	357	658	4.38	108	166	0.74	55	71	0.36
			Caenidae	*Caenis sp.*	126	183	0.47	26	37	0.17	26	47	0.32	38	35	0.26			
			Heptageniidae	(early instars)	16	32	0.06	7	15	0.05	5	8	0.06	8	10	0.05			
				Heptagenia sp.													6	12	0.04
				Stenacron sp.	2	5	T								1	T			
				Stenonema sp.	10	17	0.04	7	15	0.05	6	9	0.07	7	9	0.05	55	110	0.36
			Siphlonuridae	*Ameletus sp.*													6	12	0.04
Arthropoda	Insecta	Plecoptera		(damaged)							1	1	T	<1		T			
Arthropoda	Insecta	Coleoptera	Elmidae	*Stenelmis sp.* (larva)	2	5	T	4	7	0.02				3	5	0.02			
			Tenebrionidae	*Tenebrionidae sp.* (larva)	3	4	0.01								1	T			
Arthropoda	Insecta	Diptera		(pupa)	2	5	T	11	12	0.07	3	4	0.04	8	7	0.05	67	63	0.44
			Chironomidae					11	16	0.07	14	29	0.18	10	12	0.07	6	12	0.04
				Dicrotendipes nervosus Type I							4	7	0.04	1	2	T			
				Eukiefferiella claripennis group							2	4	0.02		1	T			
				Thienemannimyia group	13	15	0.05	22	14	0.15	9	14	0.11	18	10	0.12	30	37	0.20
				Nanocladius bicolor group				4	7	0.02				2	5	0.02	61	85	0.40
				Orthocladiinae sp.							16	28	0.20	4	7	0.03			
				Polypedilum convictum	1,567	2,630	5.80	866	854	5.85	1,188	2,095	14.58	1,034	775	7.05	1,078	1,138	7.03
				Polypedilum illinoense	2	5	T	73	108	0.49				46	68	0.31			
				Rheosmittia sp.	12	17	0.04	4	7	0.02	29	57	0.35	11	15	0.07			
				Rheotanytarsus exiguus group	179	301	0.66	1,023	418	6.91	579	478	7.12	807	310	5.50	3,941	2,896	25.68
				Robackia clavinger							7	14	0.09	2	4	0.01			
			Empididae	*Hemerodromia sp.*				11	12	0.07	5	7	0.07	8	8	0.06	12	24	0.08
Arthropoda	Insecta	Trichoptera		(pupa)	289	544	1.07	804	611	5.43	47	90	0.57	550	407	3.75	201	375	1.31
			Hydropsychidae	*Hydropsyche orris*	7,250	13,423	26.85	7,357	5,114	49.70	3,058	4,707	37.56	6,269	3,703	42.76	3,777	4,712	24.61
				Hydropsyche simulans	9	19	0.03	18	23	0.12				13	15	0.09	12	24	0.08
				Potamyia flava	16,981	20,468	62.90	3,648	3,186	24.64	2,737	2,871	33.61	5,087	3,522	34.69	5,848	5,676	38.11
			Polycentropodidae	*Neureclipsis sp.*													6	12	0.04
Arthropoda	Crustacea	Isopoda	Asellidae	*Lirceus fontinalis*													6	12	0.04
				Total density	26,998	37,885		14,803	8,742		8,144	10,977		14,662	7,509		15,345	14,279	
				Minimum density	4,090			164			182			164			1,151		
				Maximum density	64,583			68,037			35,377			68,037			70,998		
				Sample size (n)	3			15			6			24			9		
				No. taxa	25			22			22			29			22		
				Diversity (SW index)	1.49			2.18			2.17			2.16			2.15		

[1] Mean = Mean (no/m²)
[2] % = Relative Abundance
[3] T = relative abundance is less than 0.01%

5.0 Summary

1. Five bendway weirs were constructed at the Carl Baer Bendway near Mississippi River Mile 163.5 in April 1996. Their purpose was to widen the effective width of the navigation channel by scouring the outer edge and reducing point bar development on the inner side of the bend, and at the same time provide habitat for a diverse invertebrate community by adding rock to an otherwise homogenous sand substrate.

2. Macroinvertebrates were sampled upstream, downstream, and directly on weirs, to determine invertebrate community characteristics and distribution within the weir field. Similar samplers were placed in a upstream bendway without weirs to determine the influence of the weir field on rock colonization.

3. The samples were dominated mostly by hydropsychid caddis flies, *H. orris* and *P. flava*. Chironomids, such as *R. exiguus* group and *P. convictum*, were also fairly abundant. These species typically cling to rock substrate, and are not typically found in the homogenous sand substrate that was present prior to weir construction.

4. Density, diversity and species composition did not differ among sampling methods. Rock basket density was somewhat higher than scrape sample density, although the difference was not significant ($P>0.05$). However, only three rock baskets were collected and this trend might prove to be significant with a larger sample size.

5. Density, diversity and species composition did not differ with position of collection in the weir field, however the position of sample collection on a rock may influence results.

6. Invertebrate communities were similar within and upstream of the weir field. Dominant species were the same, as well as species richness and diversity. This similarity in invertebrate communities suggests that at present the rock substrate and not the weir field is influencing the invertebrate community. However, if habitat complexity within the weir field increases with time, these invertebrate communities may diverge.

7. PCA was used to analyze similarities among samples and species. Although measured environmental variables did not correlate with PCA axes, PCA axes appeared to be related to substrate (sand vs. rock substrate) and macroinvertebrate feeding habits (filterers and shredders vs. scrapers). This suggests that the species collected were associated with exposed rock surfaces, protected crevices, and sand/rock interface. Since dominant taxa were associated with

rock substrates and were all shredders or filterers, exposed rock surfaces appear to be the most abundant habitat at this time.

8. Sampling difficulties yielded insights for future sampling of weir structures. Overall, weir rock scrape sampling seemed to yield the best results, although sampling near the end of the weirs in the swifter current proved dangerous. Rock baskets were the least useful, due to basket structure weakness. Buoy anchor sampling upstream of the bendway yielded comparable results to weir rocks within the weir field. However, buoy anchors were difficult to retrieve in the weir field. We recommend using scrape samples from weir rocks in the weir field and buoy anchors upstream of the bendway.

6.0 Conclusion

Although bendway weirs are still experimental at this time, the benefits are already apparent, not only in the function of navigation channel maintenance, but in the improved habitat conditions for epilithic invertebrate communities within the rock structure. Where conditions are right, high densities of invertebrates can colonize and survive in the bendway weir environment, although colonization of rocks is extremely variable. At this point the bendway weir field does not appear to add habitat complexity, but the rock structure of the weir provides valuable habitat. As the weir field stabilizes and debris accumulates, however, the effects of the weir field may be apparent.

CELMS-PD-A **9 April 1996**

MEMORANDUM FOR CELMS-PD-A (Yarbrough)

SUBJECT: Macroinvertebrate collecting trips - Trip Report.

1. In response to your asking that trip reports be completed for all A&M field work, I have completed and attached trip reports for the chevron dike and round point structure macroinvertebrate sampling trips on 2-3 April 1996. All preconstruction samples have now been collected.

2. Per your request, I have also forwarded copies to Myhre (ED-HQ), Postal (ED-HQ), Miller (PD-A), Ragland (PD-A), and Eydmann (PM-M).

Brian

BRIAN JOHNSON
Fishery Biologist,
Environmental Planning Branch

A&M Trip Report

Date: 3 April 1996

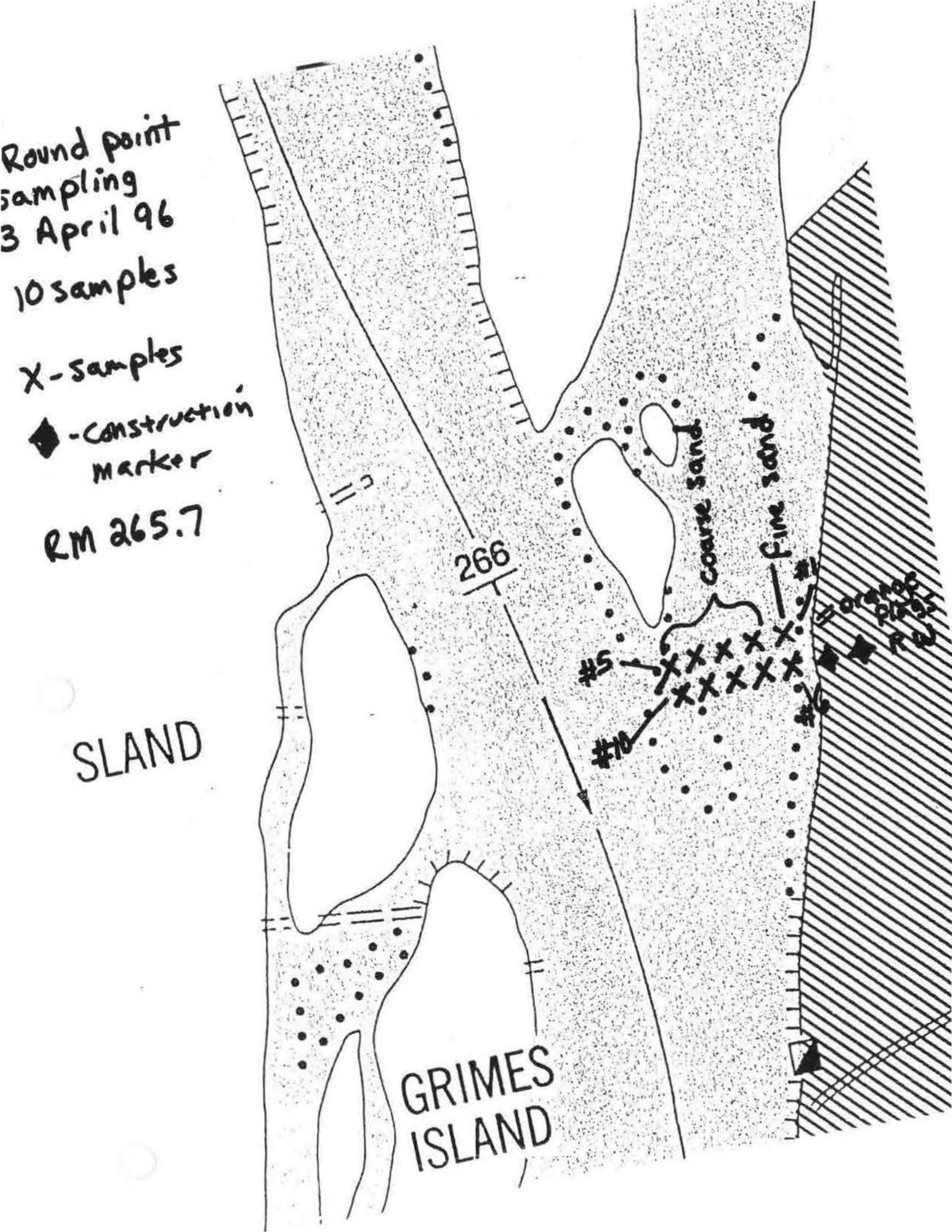
Purpose: Macroinvertebrate sampling for round point structures (R.M. 265.7)

Participants: Roger Myhre, Brian Johnson, Chuck Theiling

Summary: On 3 April 1996 a.m., we collected ten bottom samples from RM 265.7, the site of the new round point structures. Samples were collected with a 9 inch Ponar sampler, filtered through a standard 30 mesh screen, bottled, and fixed in a 10% formaldehyde solution. Substrate and depth were as follows:

Sites	Substrate	Depth
1,6	fine sand	9-10 ft.
2,3,4,7,8,9	coarse sand	10 ft.
5, 10	coarse sand	15 ft.

Heavy winds made sampling difficult. A map of the collection site is attached. This work completes our pre-construction sampling needs.


Round point
sampling
3 April 96
10 samples
X-samples
◆-construction
marker
RM 265.7
SLAND
266
coarse sand
fine sand
#1
#5
#10
GRIMES
ISLAND

A&M Trip Report

Date: 2 April 1996

Purpose: Macroinvertebrate sampling for chevron dikes (R.M. 250.2)

Participants: Roger Myhre, Brian Johnson, Chuck Theiling

Summary: On 2 April 1996 p.m., we collected ten bottom samples from RM 250.2, the site of the new chevron dikes. Samples were collected with a 9 inch Ponar sampler, filtered through a standard 30 mesh screen, bottled, and fixed in a 10% formaldehyde solution. Substrate and depth were as follows:

Sites	Substrate	Depth
1,2,3	silt/sand	8-9 ft.
4,5,6	hard pan sand/gravel/clay	5-6 ft.
7,8,9,10	sand	2-3 ft.

There were some hexagenia (sp) mayfly larvae collected. Heavy winds made sampling difficult. A map of the collection site is attached. This work completes our pre-construction sampling needs.

BJ

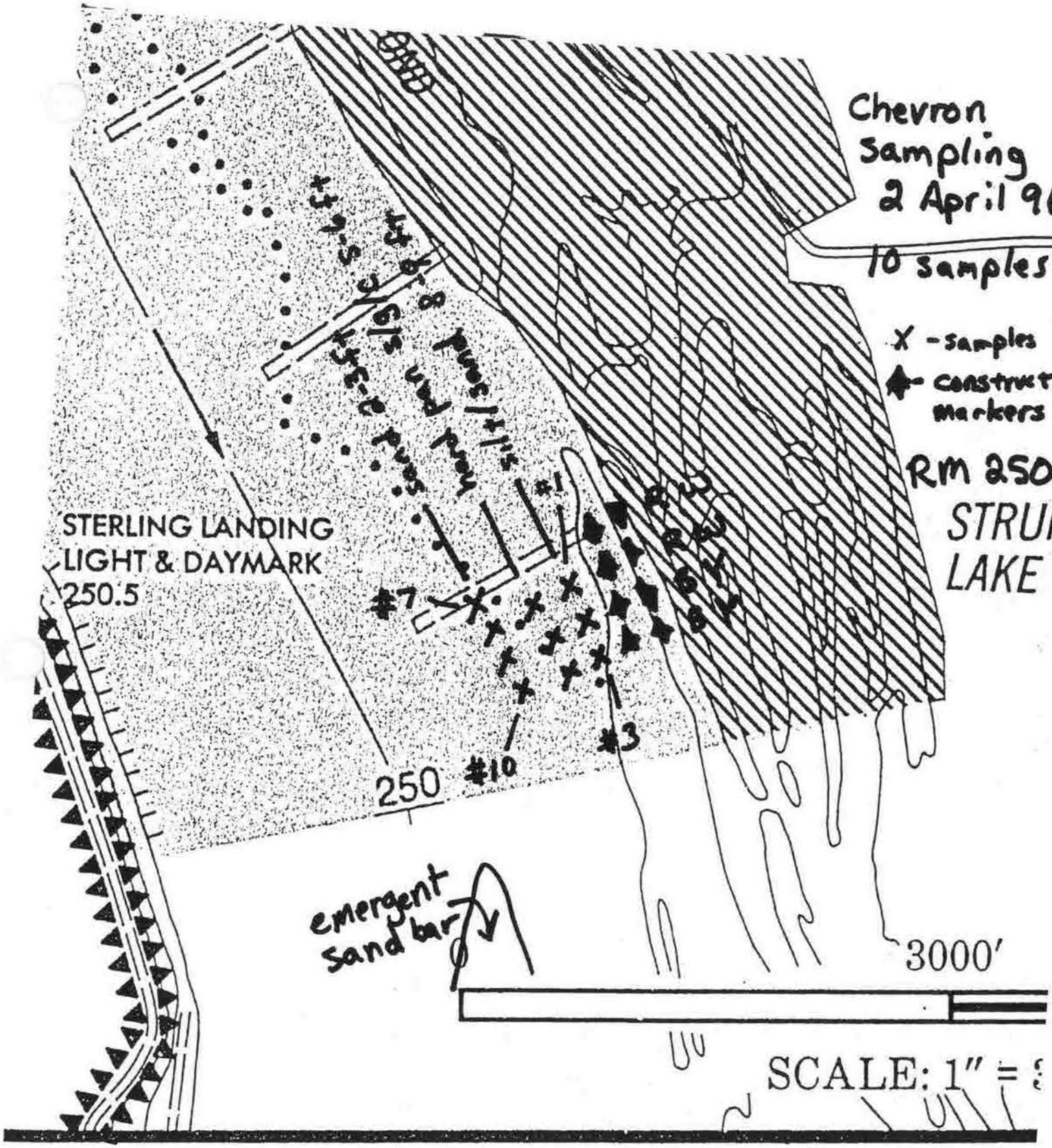
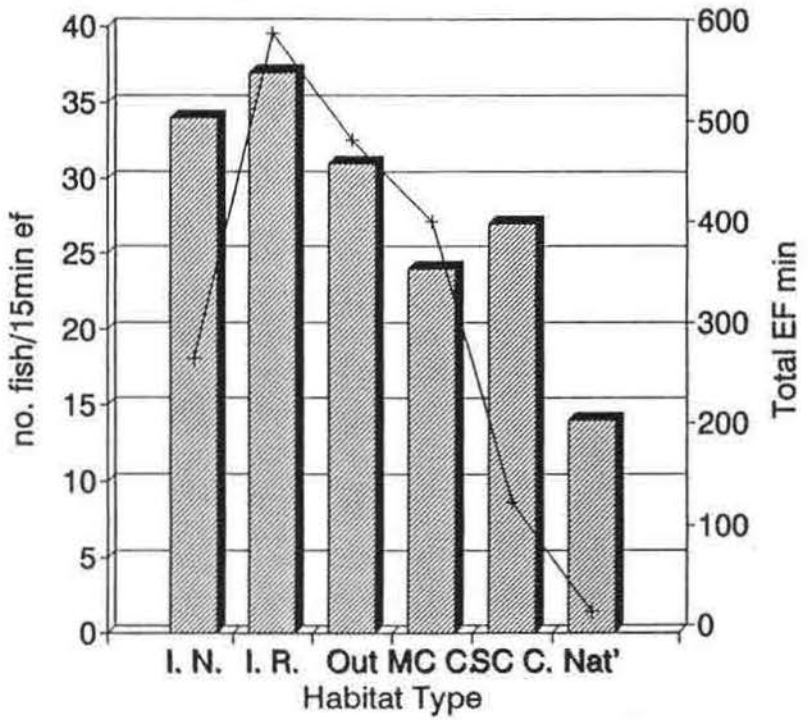

Chevron
Sampling
2 April 96
10 samples
X - samples
construction markers
Rm 250.2
STRUM
LAKE
STERLING LANDING
LIGHT & DAYMARK
250.5
#1
#7
#10
#3
250
emergent
sand bar
3000'
SCALE: 1" =

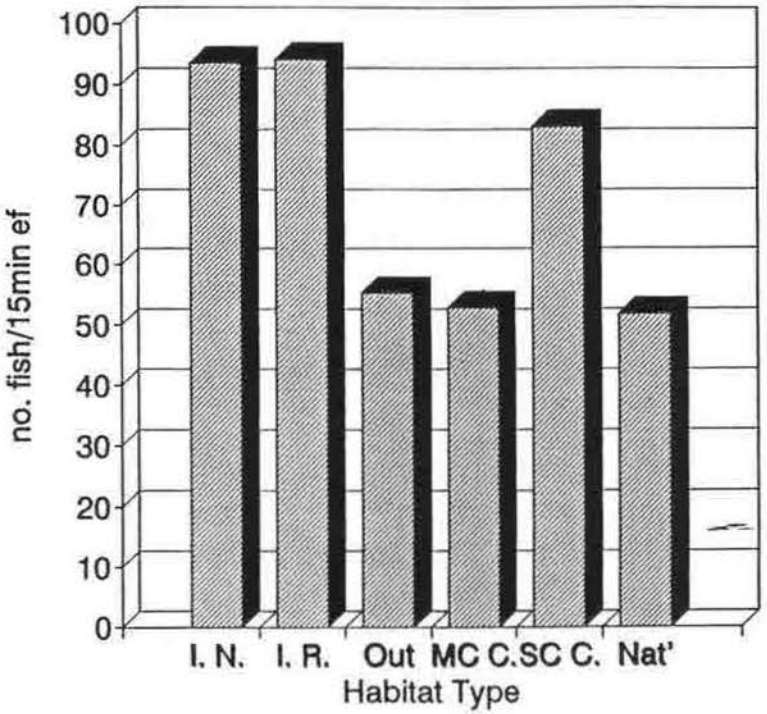
Table 1. Summary of composition of fishes collected for Gosline Off-bankline Revetment study. (1991-95)

common name	Inside Natural 270.25min no./15min	Inside Rock 593min no./15min	Outside 488min no./15min	MC Control 408min no./15min	SC Control 130min no.15min	Natural Control 20min no./15min
Shortnose gar	0.167	0.076				
Gar spp.	0.056					
Bowfin	0.056					
American eel			0.051	0.037		
Gizzard shad	22.202	34.275	19.705	14.816	7.269	2.250
Goldeye		0.051				
Mooneye		0.076		0.294		
Northern Pike	0.056					
Goldfish	0.111	0.126			0.115	
Carp	6.660	5.059	3.263	3.051	7.962	4.500
Carp x Goldfish				0.037		
Silver chub	0.056	0.051	0.177	0.331		
Golden shiner	0.056	0.051				
Emerald shiner	7.604	5.464	7.538	6.140	9.692	4.500
River shiner	0.278	0.126			0.115	0.750
Red shiner	0.167	0.152	0.126		0.115	
Silverband shiner		0.025				
Spotfin shiner	2.553	1.088	0.531	0.588	2.192	2.250
Sand shiner		0.076				
Mimic shiner	0.111		0.051		0.115	
Bullhead minnow	3.219	1.568	0.658	0.294	0.692	4.500
minnow spp		0.025				
shiner spp		0.025				
River carpsucker	0.333	1.467	0.228	0.110	2.538	
Quillback	0.056	0.076			0.115	
Smallmouth buffalo	3.219	2.605	0.582	1.140	2.885	2.250
Bigmouth buffalo	0.666	0.177	0.051	0.110	0.231	
Black buffalo	0.389	0.177	0.025		0.231	
Golden redhorse			0.025			
Shorthead redhorse		0.177	0.076			
Channel catfish	0.944	4.300	3.794	2.647	4.500	4.500
Flathead catfish	0.056	0.278	2.201	0.662	2.308	
Blackstripe topminnow	0.167	0.076				
Mosquitofish	0.333	0.177				
Brook silversides	0.056	0.076	0.051	0.037		
White bass	0.500	0.582	0.354	1.140	1.731	
Yellow bass		0.101	0.025	0.037		
Green sunfish	0.666	2.757	0.379	0.441	4.615	3.000
Warmouth					0.115	
Orangespotted sunfish	1.055	0.177				
Bluegill	18.316	14.115	4.730	3.787	9.692	0.750
Bluegill x Green sunfish		0.025	0.025		0.231	
Smallmouth bass		0.101	0.228	0.110	0.115	
Largemouth bass	4.052	4.376	2.378	1.471	6.346	0.750
White crappie	4.052	0.354	0.025	0.037	0.115	
Black crappie	6.438	1.417	0.076	0.221	0.923	1.500
Fantail Darter			0.025			
Logperch			0.025			
Slenderhead darter			0.025		0.231	
Sauger	0.278	0.177			0.231	
Walleye	0.278		0.025	0.037		0.750
Freshwater drum	8.270	11.990	7.917	15.184	17.769	19.500
Total fish, No./min ef	93.469	94.073	55.371	52.757	83.192	51.750
Total No. species	34 ~~35~~	37 ~~40~~	31 ~~32~~	24 ~~25~~	27 ~~28~~	14

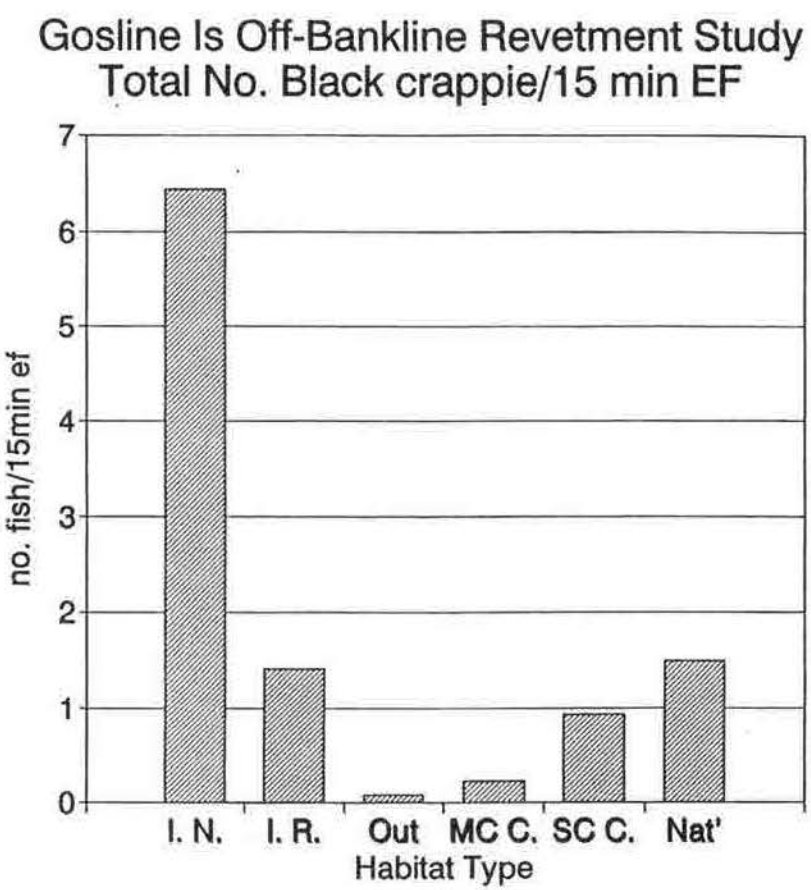
Gosline Is Off-Bankline Revetment Study
Total No. Fish Species Collected/Site

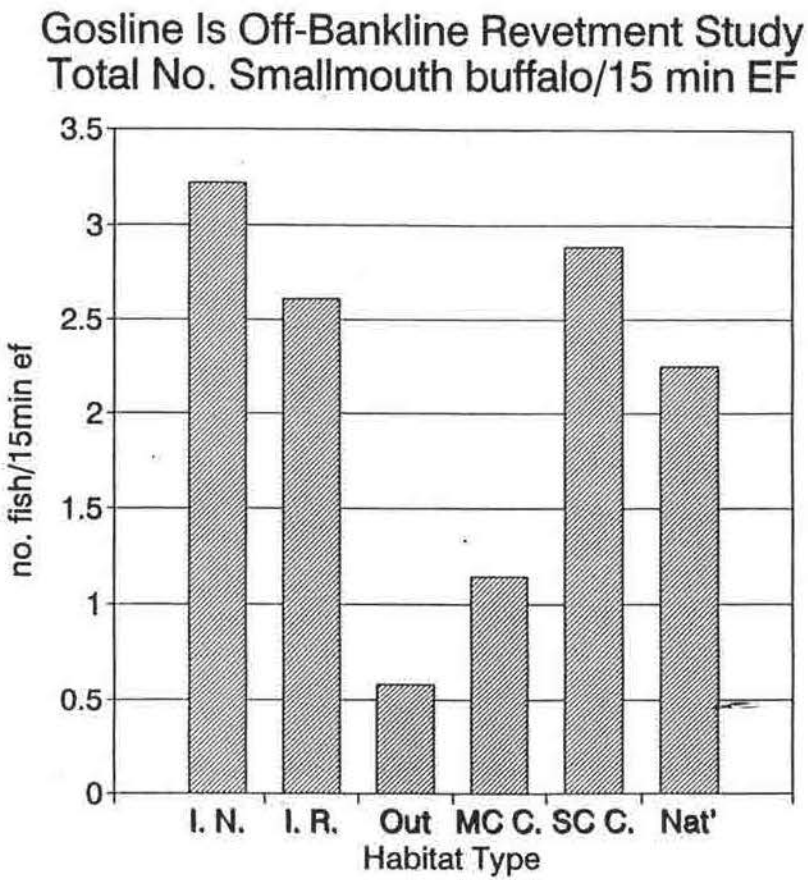


Gosline Is Off-Bankline Revetment Study
Total No. Fish collected/15 min EF



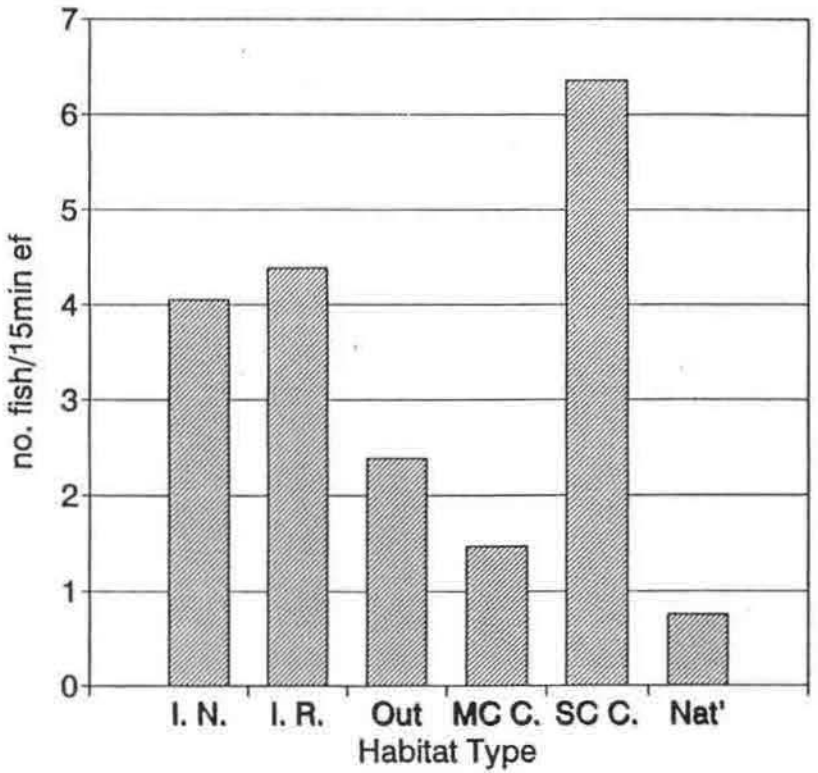
I.N. = Inside Natural
I.R. = Inside Rock
Out = Outside
MC C. = Main Channel Control
SC C. = Side Channel Control
Nat' = Natural Control



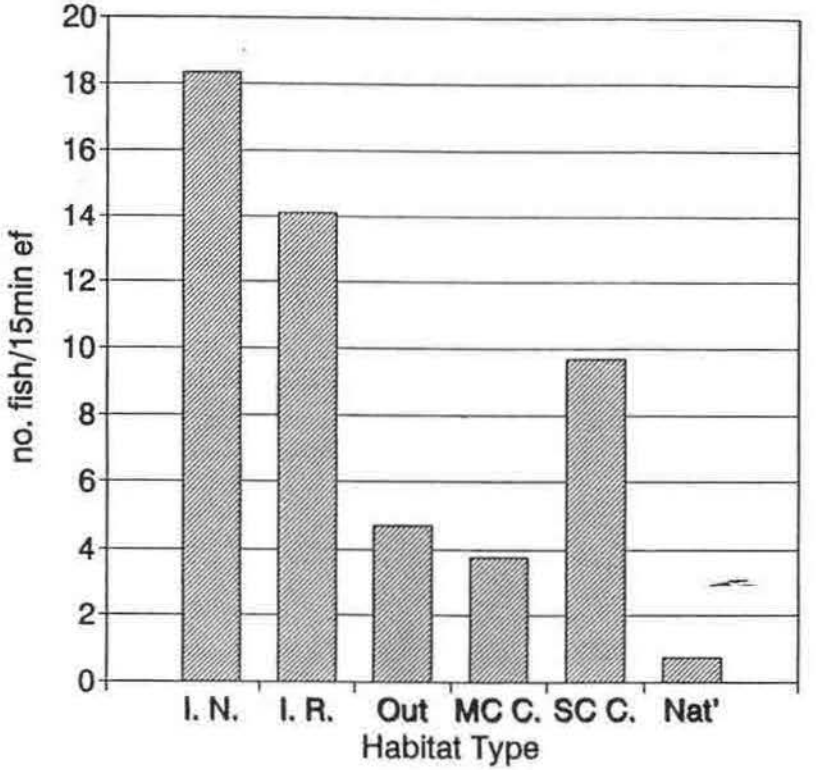


I.N. = Inside Natural
I.R. = Inside Rock
Out = Outside
MC C. = Main Channel Control
SC C. = Side Channel Control
Nat' = Natural Control

Gosline Is Off-Bankline Revetment Study
Total No. Largemouth bass/15 min EF

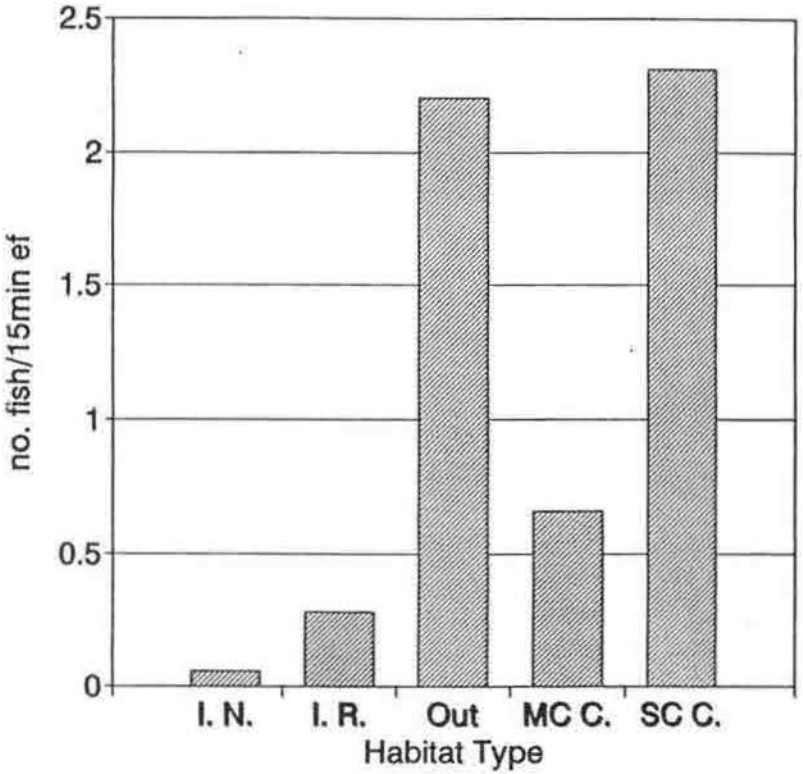


Gosline Is Off-Bankline Revetment Study
Total No. Bluegill/15 min EF

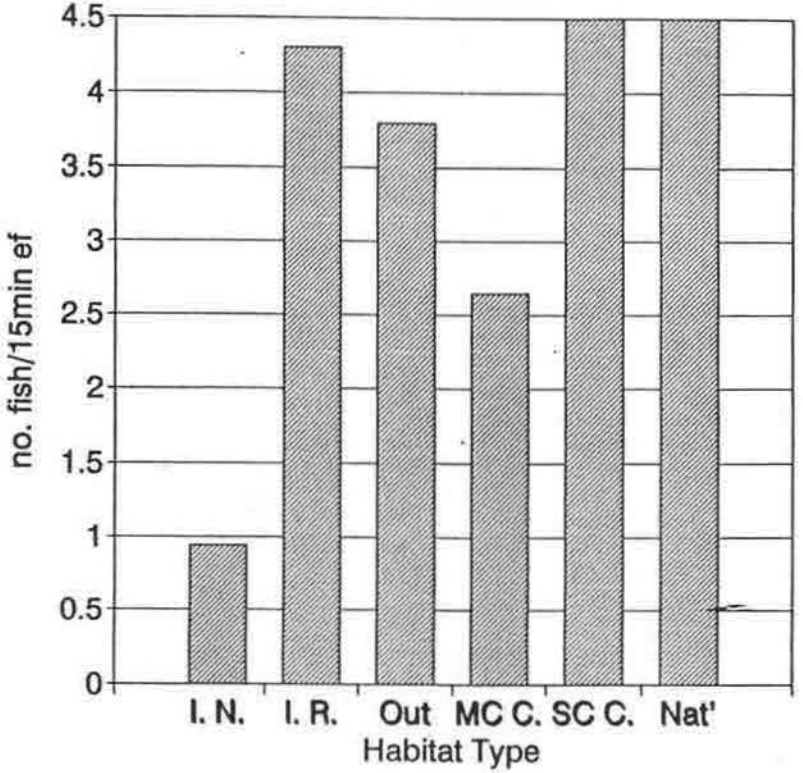


I.N. = Inside Natural
I.R. = Inside Rock
Out = Outside
MC C. = Main Channel Control
SC C. = Side Channel Control
Nat' = Natural Control

Gosline Is Off-Bankline Revetment Study
Total No. Flathead catfish/15 min EF



Gosline Is Off-Bankline Revetment Study
Total No. Channel catfish/15 min EF

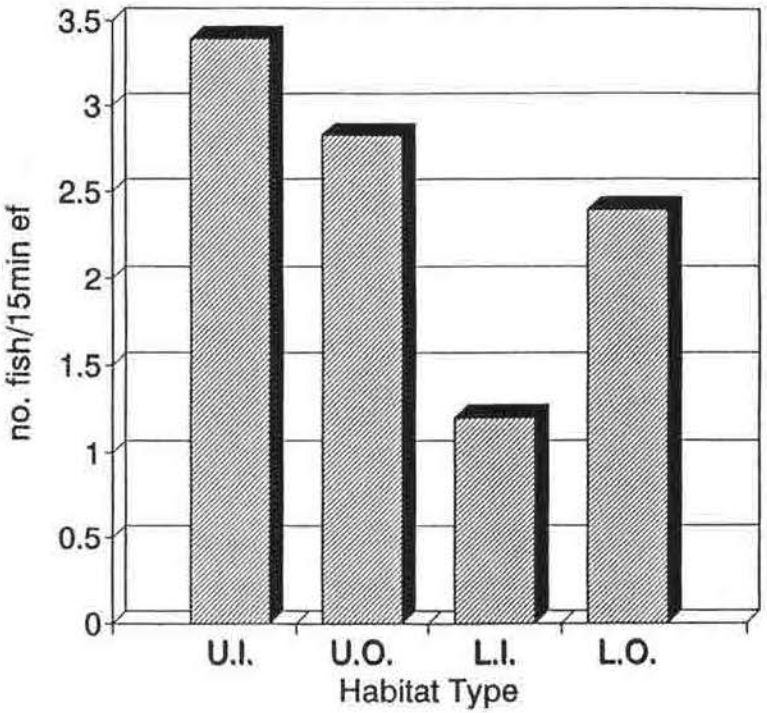


I.N. = Inside Natural
I.R. = Inside Rock
Out = Outside
MC C. = Main Channel Control
SC C. = Side Channel Control
Nat' = Natural Control

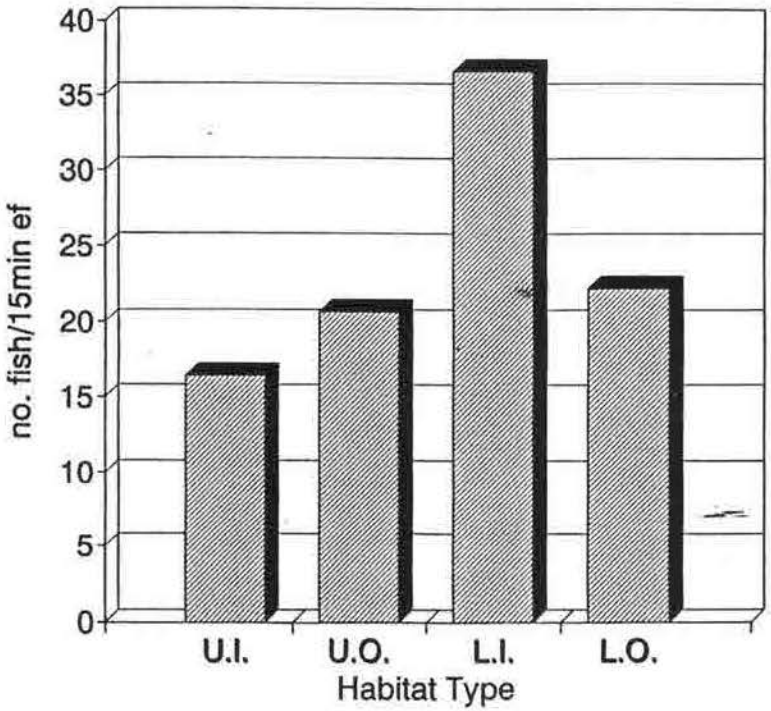
Table 2. Summary of composition of fishes collected for Cottonwood Island Chevron study (1995-96)

	All Stations		Upper inside		Upper outside		Lower inside		Lower outside	
ef.min.	156		53		53		25		25	
fish species	N	no./15min	N	no./15min	N	no./15min	N	no./15min	N	no./15min
Gizzard shad	345	33.173	247	69.906	16	4.528	60	36.000	22	13.200
Emerald shiner	229	22.019	58	16.415	73	20.660	61	36.600	37	22.200
Bluegill	71	6.827	51	14.434	2	0.566	17	10.200	1	0.600
Channel catfish	52	5.000	7	1.981	25	7.075	2	1.200	18	10.800
Carp	52	5.000	9	2.547	31	8.774	3	1.800	9	5.400
Freshwater drum	50	4.808	15	4.245	16	4.528	10	6.000	9	5.400
Bullhead minnow	40	3.846	26	7.358	1	0.283	13	7.800		
Flathead catfish	29	2.788			29	8.208				
Smallmouth Buffalo	28	2.692	12	3.396	10	2.830	2	1.200	4	2.400
River shiner	22	2.115	14	3.962			1	0.600	2	1.200
River carpsucker	22	2.115	18	5.094	5	1.415	4	2.400		
Largemouth bass	22	2.115	17	4.811	1	0.283	4	2.400		
White bass	21	2.019	12	3.396	3	0.849	4	2.400	2	1.200
Silver chub	17	1.635	6	1.698	9	2.547			2	1.200
Spotfin shiner	15	1.442	2	0.566	10	2.830			3	1.800
Carpsucker spp.	14	1.346	14	3.962						
Shorthead redhorse	7	0.673	1	0.283	2	0.566			4	2.400
Quillback	7	0.673	6	1.698			1	0.600		
Green sunfish	7	0.673	4	1.132	1	0.283	2	1.200		
Spottail shiner	4	0.385	4	1.132						
Mooneye	3	0.288			3	0.849				
Mimic shiner	3	0.288	1	0.283	2	0.566				
Golden redhorse	2	0.192	2	0.566						
Yellow bass	1	0.096							1	0.600
Threadfin shad	1	0.096					1	0.600		
Goldfish	1	0.096	1	0.283						
Bigmouth buffalo	1	0.096					1	0.600		
Shortnose gar	1	0.096	1	0.283						
Logperch	1	0.096	1	0.283						
Total fish,no./15min	1068	102.692	529	149.717	239	67.642	186	111.600	114	68.400
Total no. spp.	28		23		18		16		13	

Cottonwood Island Chevron Study
Total No. Smallmouth buffalo/15 min EF

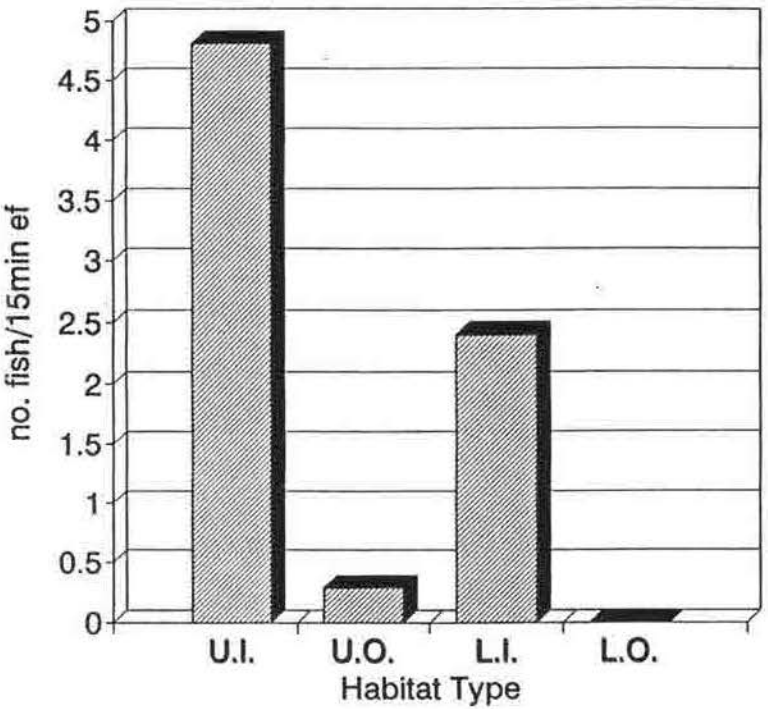


Cottonwood Island Chevron Study
Total No. Emerald shiner/15 min EF

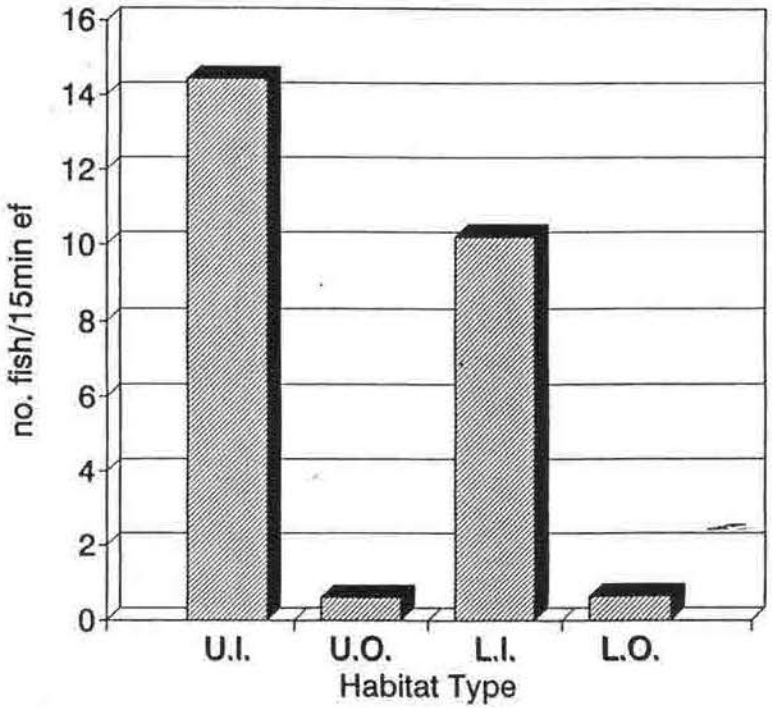


U.I. = Upper Chevron, Inside
U.O = Upper Chevron, Outside
L.I. = Lower Chevron, Inside
L.O. = Lower Chevron, Outside
EF = Electrofishing

Cottonwood Island Chevron Study
Total No. Largemouth bass/15 min EF

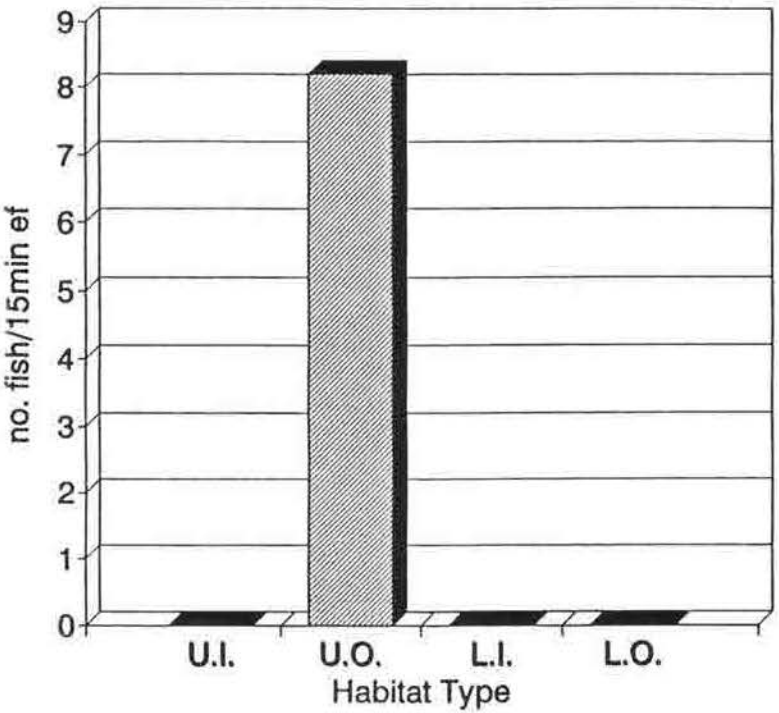


Cottonwood Island Chevron Study
Total No. Bluegill/15 min EF

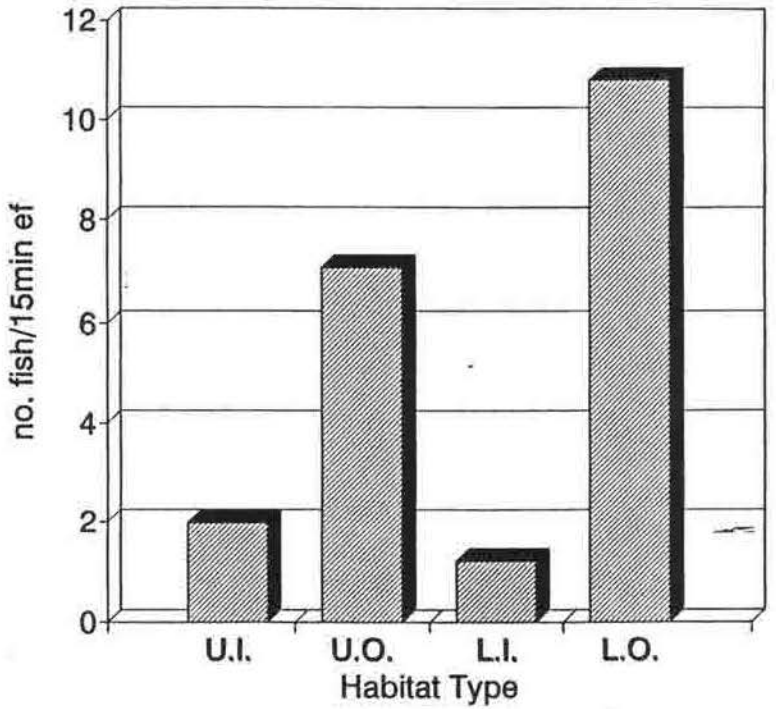


U.I. = Upper Chevron, Inside
U.O = Upper Chevron, Outside
L.I. = Lower Chevron, Inside
L.O. = Lower Chevron, Outside
EF = Electrofishing

Cottonwood Island Chevron Study
Total No. Flathead catfish/15 min EF



Cottonwood Island Chevron Study
Total No. Channel catfish/15 min EF



U.I. = Upper Chevron, Inside
U.O = Upper Chevron, Outside
L.I. = Lower Chevron, Inside
L.O. = Lower Chevron, Outside
EF = Electrofishing

APPENDIX B

MICRO-MODELING
OF
SANTA FE CHUTE

1). Santa Fe Chute Project Report--November 1996

AVOID AND MINIMIZE PROGRAM
PROJECT REPORT
Sante Fe Chute Side Channel Restoration Initiative
Summary of Micro Model Study and Development of Construction Plans

November 1996

Prepared By Robert Davinroy
Applied River Engineering Center
Engineering Division

1. Introduction. An engineering effort to address possible restoration measures in a side channel of the Mississippi River (Sante Fe Chute, River Mile 39.5 to Mile 35) was initiated in January of 1996 by the St. Louis District through the Avoid and Minimize Program. This was a cooperative effort between the District and several state and federal agencies, including the Missouri Department of Conservation, the Illinois Department of Conservation, and the U.S. Fish and Wildlife Agency. The effort hinged upon a scaled micro model of the Mississippi River, whereby various design alternatives or construction measures were tested in the model to address both short term and long term improvements to side channel sedimentation in Sante Fe Chute.

2. Micro Model Study. Biologist and engineers from the previously mentioned agencies met at the St. Louis District Applied River Engineering Center (see attached photo) to brainstorm and experiment with the micro model. Various alternatives were tried in the model, and those that showed promise were studied later in more detail.

It should be noted that the micro model meeting proved quite valuable because it enabled biologist and engineers to thread common perceptions and goals and visualize alternatives in the model. The otherwise complex process of side channel and main channel sedimentation were clearly defined by the micro model at the meeting.

3. Design Alternatives. Various design alternatives were tested in detail in the micro model, including chevrons, alternating hardpoints, closure structure modification, and dredging. The results of these tests were documented in the model study report.

4. Chosen Alternative. Engineers and biologist agreed upon and chose a design alternative consisting of alternating dikes within Sante Fe Chute. The plan consisted of 9 dikes strategically placed off the left and right descending banks within the upper one half of the side channel. This plan developed favorable sediment and flow conditions. Potential biological diversity was

created in the form of numerous scour holes and the development of an alternating or sinuous flow pattern through the chute.

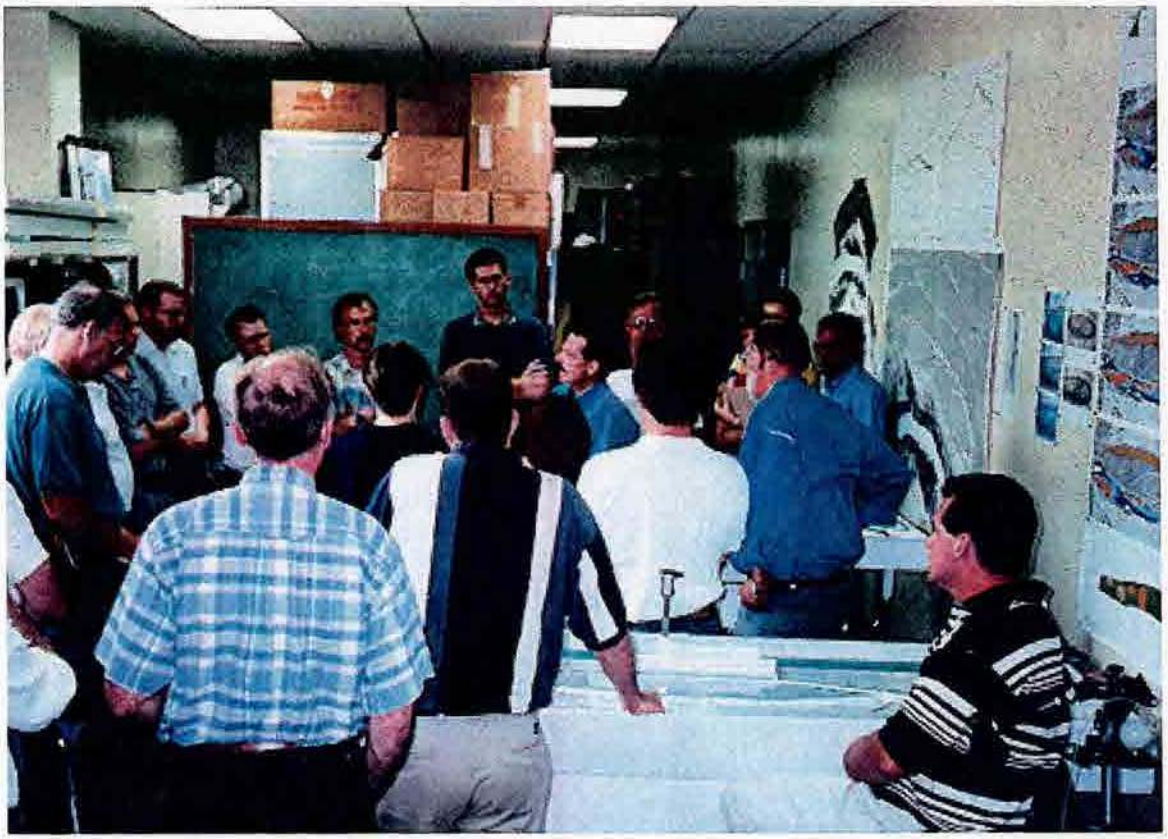
5. Construction Plans and Specs. The model study plan was slightly modified and adopted into a construction plan (see attachment). Bankline revetment works were also developed to prevent future lateral erosion. Specifications for the dike plan included:

Effective Dike Lengths- 300 feet
Dike Elevation,- Sloping Dike, From Top of Bank +30 LWRP to +21 LWRP, with minimum 5 feet section.
Crown Width- 6 feet
Sideslopes- 1 on 1.5

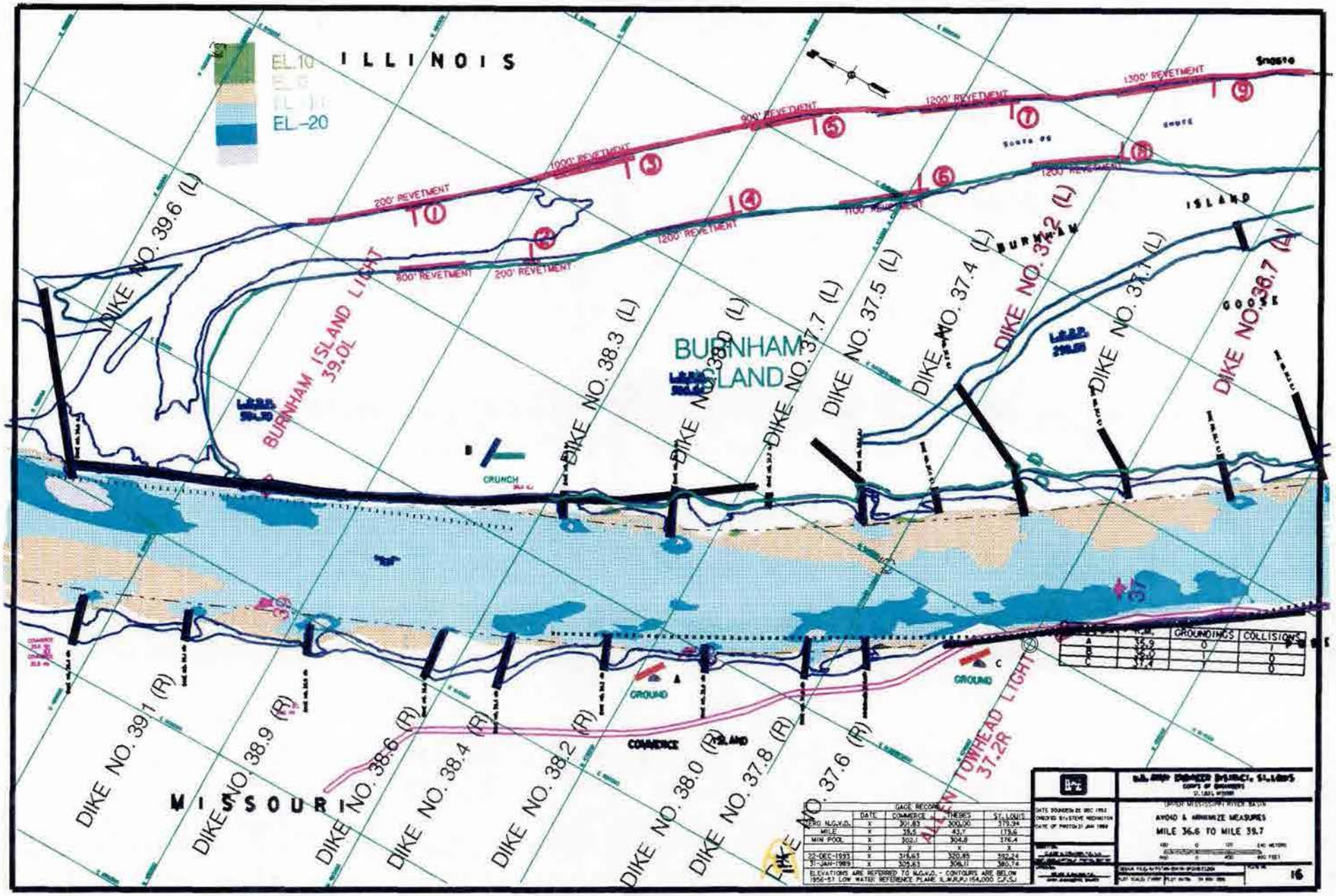
Construction material consist of Graded A Stone.

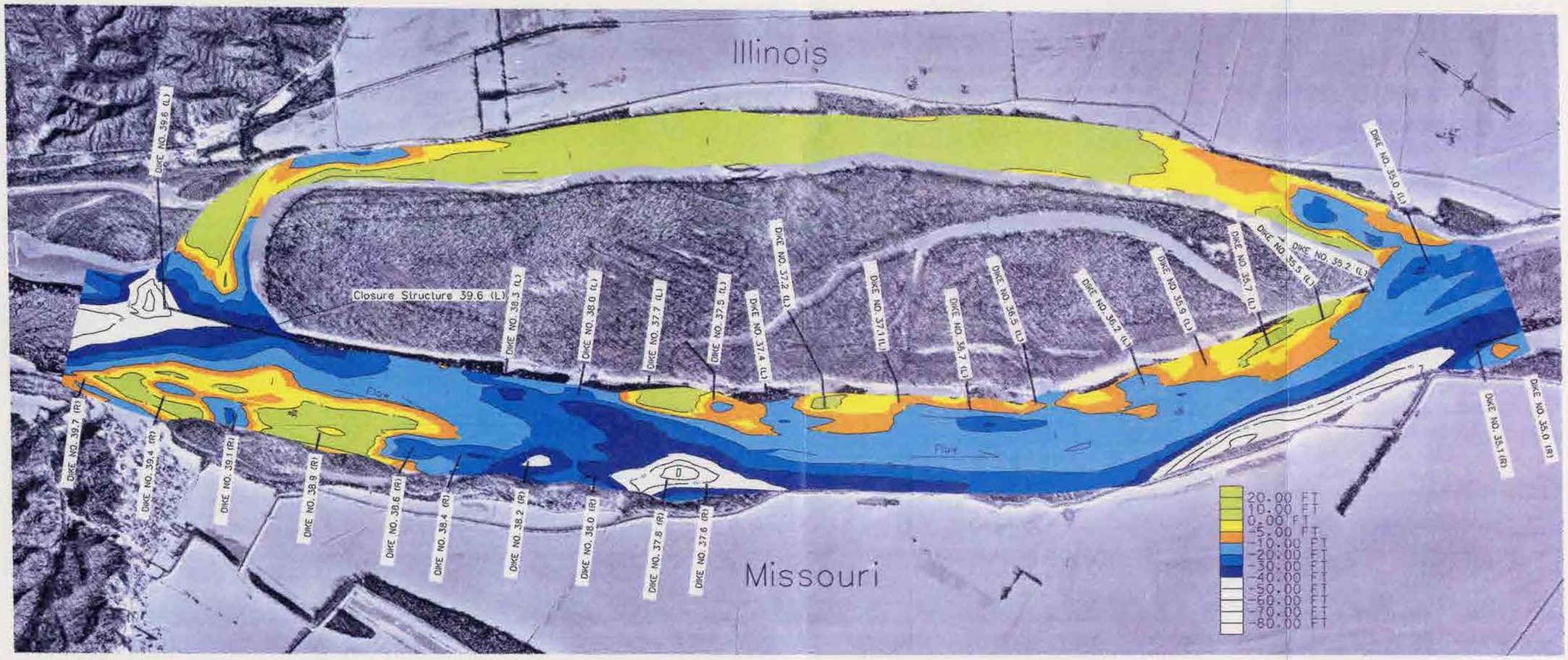
6. Construction Implementation. The construction of the adopted plan is pending until sufficient high water is achieved on the Mississippi River, since the side channel is at a relatively high elevation as compared with the main channel.

7. Monitoring. Detailed hydrographic surveys will be conducted after construction to monitor the development of the bed within the side channel.



	U.S. ARMY ENGINEER DISTRICT, ST. LOUIS **CORPS OF ENGINEERS**
PREPARED BY R. Helnick CHECKED BY R. Dawiroy	Sante Fe/Doolan Chute Micro Model Study Mississippi River Miles 40 - 35 *Biologists and Engineers Testing Design Alternatives at the Applied River Engineering Center*
	PLATE NO

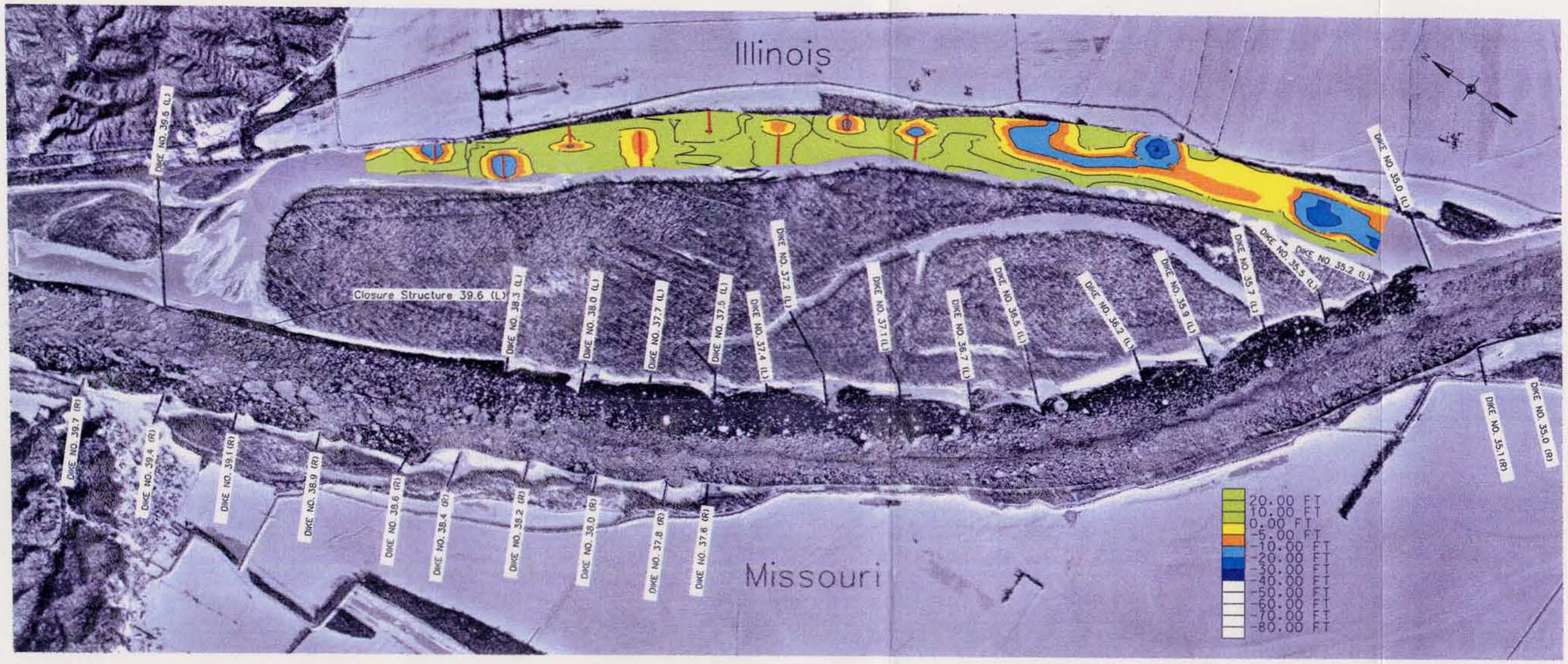

ILLINOIS
EL.10
EL.0
EL.-11
EL.-20
1300' REVETMENT
1200' REVETMENT
900' REVETMENT
1000' REVETMENT
200' REVETMENT
800' REVETMENT
1100' REVETMENT
DIKE NO. 39.6 (L)
BURNHAM ISLAND LIGHT 39.0L
DIKE NO. 38.3 (L)
DIKE NO. 38.0 (L)
DIKE NO. 37.7 (L)
DIKE NO. 37.5 (L)
DIKE NO. 37.4 (L)
DIKE NO. 37.2 (L)
DIKE NO. 37.1 (L)
DIKE NO. 36.7 (L)
BURNHAM ISLAND
ISLAND
CRUNCH
DIKE NO. 39.1 (R)
DIKE NO. 38.9 (R)
DIKE NO. 38.6 (R)
DIKE NO. 38.4 (R)
DIKE NO. 38.2 (R)
DIKE NO. 38.0 (R)
DIKE NO. 37.8 (R)
DIKE NO. 37.6 (R)
MISSOURI
GROUND
COMMERCE
ISLAND
ALTON TOWHEAD LIGHT 37.2R
GROUNDINGS
COLLISIONS
AVOID & MINIMIZE MEASURES
MILE 36.6 TO MILE 39.7
16



U.S. ARMY ENGINEER DISTRICT, ST. LOUIS
CORPS OF ENGINEERS
ST. LOUIS, MISSOURI

Sante Fe/Doolan Chute Micro Model Study
Mississippi River Miles 40 - 35

BASE TEST



U.S. ARMY ENGINEER DISTRICT, ST. LOUIS
CORPS OF ENGINEERS
ST. LOUIS, MISSOURI

PREPARED BY: R. Herrick
DRAWN BY: R. Herrick
CHECKED BY: R. Demonbrun
DATE: 24 July 1996

Sante Fe/Doolan Chute Micro Model Study
Mississippi River Miles 40 - 35
ALTERNATIVE E
ALTERNATIVE LEVEL CRESTED HARDPOINTS AT +30 LWRP WITH LENGTH MODIFICATION AND DOWNSTREAM DREDGING

PLATE NO. 23

APPENDIX C

THALWEG PLACEMENT
OF
DREDGE MATERIAL

1). Thalweg Bottom Sampling--Mile 121, Field Report, 22 July 1996

2) Thalweg Bottom Sampling--Mile 225, Field Report, 22 August 1996

3). Hydroacoustic Fish Survey--Mile 225, Field Report, 3 Sept. 1996

4). Contract Report (Selected Pages) Thalweg Disposal--Mile 225, 21 November 1996

CELMS-PD-A 22 July 1996

MEMORANDUM FOR PD-A (Yarbrough)

SUBJECT: Avoid and Minimize Invertebrate Substrate Sampling in the Thalweg at River Mile 121.

1. On 11 June 1996, the Pathfinder and crew took four substrate samples at River Mile 121 (near Ste. Genevieve, Missouri) using the Crops specially designed and operated collection box. The substrate collector consists of an open ended, heavy metal, rectangular box which when operated with a series of cables can drag along the river bottom and collect substrate samples with very little disturbance from wash.

2. Two samples were taken in the middle of the channel (course sand substrate), one on the Missouri bank (no substrate collected, revetment material), and one on the Illinois bank (course sand substrate). No velocity measurements were taken. Water depth ranged from 40-52 feet.

3. The samples and collection box were initially looked through for large invertebrates with none found. Portions of the samples were then collected and fixed in formalin for laboratory analysis. Roger Myhre (CELMS-ED-HQ) will provide the results of the laboratory analysis.

4. My first impression of the samples was that the material is highly disturbed by currents, especially the mid-channel samples, and probably not very good habitat for aquatic invertebrates.

5. Work done for the Corps in 1974 showed similar results. Solomon, Johnson, Bingham, and Colbert found that: a)The primary sediment in the channel is fine- to medium-sized sand, which appears to provide a poor substrate establishment of benthic communities. The sediment in the disposal and river border areas ranges from silt and/or clay to fine- and medium-sized sand. These finer grained substrate materials provide a more favorable habitat for benthic organisms.; b)A limited degree of benthic recolonization can be expected to occur both at dredge and disposal sites within a period of one year. However, recolonization appears to occur faster in an area with a more suitable habitat (i.e., silt and clay substrates).; c)Among the sampling areas investigated, the mean number of benthic organisms and associated number of taxa were lowest at dredged areas, higher at disposal areas, and highest at river border areas.; and d)Based on the distribution of benthic organisms, disposal of dredged material has the greatest impact in river border areas with no previous dredging history; disposal in areas with a previous disposal record has less sever impact; and disposal in the channel has the least impact.

6. Reference of the above information: Solomon, Raymond C. Physical, biological, and chemical inventory and analysis of selected dredged and disposal sites, Middle Mississippi River, by Raymond C. Solomon, Jeffrey H. Johnson, C. Rex Bingham, and Billy K. Colbert. Vicksburg, U.S. Army Engineer Waterways Experiment Station, 1974. 1v. (various pagings) ills. 27 cm. (U.S. Waterways Experiment Station. Miscellaneous paper Y-74-6). Prepared for the U.S. Army Engineer District, St. Louis, Missouri.

CELMS-PD-A
SUBJECT: Avoid and Minimize Invertebrate Substrate Sampling in the Thalweg at River Mile 121.

7. Please contact me at 331-8148 if you have any questions.

Sherrie Zenk-Reed

SHERRIE ZENK-REED
Wildlife Biologist

CF:
PD-A/Ragland
ED-HQ/Postol
ED-HQ/Myhre

CELMS-PD-A **August 22, 1996**

MEMORANDUM FOR CELMS-PD-A (Yarbrough)

SUBJECT: Thalweg Disposal Mussel Sampling - Trip Report.

1. In response to your asking that trip reports be completed for all A&M field work, I have completed and attached a trip report for the thalweg mussel sampling trip on 13 August 1996.

2. No mussels were collected in either of the thalweg sites proposed for disposal.

Brian Johnson

BRIAN JOHNSON
Fishery Biologist,
Environmental Planning Branch

CF:
PD-A Ragland, Miller
C0-D Dierker
PM-M Eydmann
ED-HQ Postal, Myhre

A&M Trip Report

Date: 13 August 1996

Purpose: Thalweg disposal mussel sampling (R.M. 225-224)

Participants: Present from the Corps were Brian Johnson, Roger Myhre, Ted Postol, John Stewart, and Red Mezo. Others present were L.V. Gibbons (Applied Research & Development Laboratory, ARDL), Dale Hayes (ARDL), Todd Gentles (ARDL), and Chris Haslem (commercial musseler).

Summary: On 13 August 1996 we conducted mussel brailing between R.M. 224.9 and 224.7 (Site 1) and R.M. 224.2 and 224.0 (Site 2). Each site consisted of a deep (20-40 ft) thalweg scour hole in which dredge spoil placement is proposed. Six transects were run parallel to the bank at each site, each approximately 50 ft apart. Global Positioning System (GPS) coordinates were taken at the start and end of each transect. Depths were taken at each site. Each transect involved orienting the boat with the current and deploying two 16 ft. brails (24 ft of bottom coverage), each with 55 lines of hooks (10 4-pronged hooks to a line), and dragging the brails downstream through the transect area. Areas were sampled both inside and outside the thalweg at each site. No mussels were collected in either site. Both Roger Myhre and I took pictures. Data collected at each site is on the accompanying sheets.

Following completion of the thalweg sampling we sampled two areas which we felt might contain mussels. During these runs we collected several zebra mussels and one three-horned warty-back (Obliquaria reflexa). Data for these sites are also on the accompanying sheets.

This work was done under Engineering Division-Water Quality Branch's contract with ARDL. A commercial musseler was hired to conduct the sampling.

BRIAN JOHNSON
Fishery Biologist
Environmental Planning Branch

Site 1 RM 224.9-224.7 Top edge of Iowa Island to power lines

Transect	1
Start	N 38 54 03.42 W 90 31 04.70
End	N 38 54 06.60 W 90 31 03.40
Distance (ft) from bank	50
Depth (ft) start	28-37 ft
Depth (ft) middle	
Depth (ft) end	
# brails	1

no mussels were collected
16 ft of coverage

Transect	2
Start	N 38 54 03.20 W 90 31 05.50
End	N 38 54 08.70 W 90 31 03.41
Distance (ft) from bank	100
Depth (ft) start	18
Depth (ft) middle	
Depth (ft) end	22
# brails	2

no mussels were collected
24 ft of coverage

Transect	3
Start	N 38 54 12.09 W 90 31 01.22
End	N 38 54 10.75 W 90 31 02.45
Distance (ft) from ban	140
Depth (ft) start	20
Depth (ft) middle	34
Depth (ft) end	22
# brails	2

no live mussels were collected
1 half shell was impaled one hooks
24 ft of coverage

Transect	4
Start	N 38 54 10.79 W 90 31 02.62
End	N 38 54 10.52 W 90 31 03.24
Distance (ft) from bank	200
Depth (ft) start	22
Depth (ft) middle	28
Depth (ft) end	22
# brails	2

no mussels were collected
24 ft of coverage

Transect	5
Start	N 38 54 05.53 W 90 31 10.86
End	N 38 54 09.89 W 90 31 08.01
Distance (ft) from bank	250
Depth (ft) start	18
Depth (ft) middle	24
Depth (ft) end	20
# brails	2

no mussels were collected
24 ft of coverage

Transect	6
Start	N 38 54 11.26 W 90 31 07.47
End	N 38 54 11.21 W 90 31 07.95
Distance (ft) from ban	325
Depth (ft) start	17
Depth (ft) middle	14
Depth (ft) end	12
# brails	2

no mussels were collected
24 ft of coverage
transect outside the channel bouy

Site 2 RM 224.2-224.0 Calhoun point night marker to marked tree downtream (approx. 150 yds)

Transect	1	Transect	2	Transect	3
Start	N 38 54 15.16 W 90 31 06.98	Start	N 38 54 22.55 W 90 31 02.93	Start	N 38 54 37.88 W 90 30 53.04
End	N 38 54 21.84 W 90 31 03.33	End	N 38 54 24.48 W 90 31 01.77	End	N 38 54 40.27 W 90 30 51.15
Distance (ft) from bank	50	Distance (ft) from bank	100	Distance (ft) from ban	150
Depth (ft) start	34	Depth (ft) start	35	Depth (ft) start	32
Depth (ft) middle	20	Depth (ft) middle		Depth (ft) middle	
Depth (ft) end	19	Depth (ft) end	20	Depth (ft) end	23
# brails	1	# brails	2	# brails	2
no mussels were collected 16 ft of coverage		no mussels were collected 24 ft of coverage		no mussels were collected 24 ft of coverage	

Transect	4	Transect	5	Transect	6
Start	N 38 54 40.59 W 90 30 50.50	Start	N 38 54 39.79 W 90 30 49.40	Start	N 38 54 39.71 W 90 30 49.35
End	N 38 54 39.50 W 90 30 49.80	End	N 38 54 39.65 W 90 30 49.62	End	N 38 54 39.30 W 90 30 48.64
Distance (ft) from bank	300	Distance (ft) from bank	200	Distance (ft) from ban	350
Depth (ft) start	14	Depth (ft) start	26	Depth (ft) start	12
Depth (ft) middle		Depth (ft) middle		Depth (ft) middle	
Depth (ft) end	20	Depth (ft) end	22	Depth (ft) end	9
# brails	2	# brails	2	# brails	2
no mussels were collected 24 ft of coverage transect outside channel bouy		no mussels were collected 24 ft of coverage		no mussels were collected 24 ft of coverage transect outside channel bouy	

Site 3&4 RM 226-227 Missouri bank (1&2), Illinois bank (3&4)

Transect	1
Start	N 38 52 34.22 W 90 32 22.37
End	N 38 52 33.50 W 90 32 22.22
Distance (ft) from bank	50
Depth (ft) start	
Depth (ft) middle	30-34
Depth (ft) end	
# brails	1

two zebra mussels were collected
16 ft of coverage

Transect	2
Start	N 38 52 34.70 W 90 32 22.57
End	N 38 52 39.22 W 90 32 29.41
Distance (ft) from bank	50
Depth (ft) start	10
Depth (ft) middle	12
Depth (ft) end	9
# brails	1

caught a dead washboard shell
16 ft of coverage

Transect	3
Start	N 38 52 41.66 W 90 32 30.89
End	N 38 52 41.63 W 90 32 34.28
Distance (ft) from ban	50
Depth (ft) start	13
Depth (ft) middle	9
Depth (ft) end	11
# brails	2

32 ft of coverage
caught a lid with zebra mussels
a washboard shell (dead) with zebra

Transect	4
Start	N 38 52 42.38 W 90 32 34.47
End	N 38 52 44.76 W 90 32 32.60
Distance (ft) from bank	50
Depth (ft) start	9
Depth (ft) middle	
Depth (ft) end	4
# brails	2

32 ft of coverage
** caught a live 3-horn mussel**

September 3, 1996

TO: Dr. Ronald Yarbrough

FROM: Thomas Keevin

SUBJECT: Hydroacoustic Fish Survey of Boulters Bar Reach.

1. The Boulters Bar Reach, Mississippi River, is in need of dredging. Since state agencies are concerned with on-land dredged material disposal in this reach, alternative dredge disposal methods are being evaluated. One such method is thalweg disposal in a deep hole at Boulters Bar.

2. On 7 August 1996 I observed a Contractor conduct a hydroacoustic fish survey of the Boulters Bar Reach while the crew of the M.V. Blankenship conducted a bottom profile survey of the same reach covered during the fish survey. The thalweg hole was quickly found and was determined to be approximately 30-35 feet deep (Boulters Bar Reach was at normal pool level).

3. The hydroacoustic fish survey equipment allowed us to view a 1 meter section of the river bottom. Three series of transects were taken during the survey: 1. across the river channel (across the deep hole); 2. up and down river (through the deep hole); and 3. across the river channel down stream of the deep hole (an area where dredged material could potentially migrate).

4. The hydroacoustic fish survey equipment was set to "record" fish $\geq$ 6 inches. All data were stored on computer for later analysis. Fish were observed predominantly in revetment in main channel border habitat. Few fish were observed in the deep hole or in the area down stream from the hole.

5. Bottom profiles from the hydroacoustic equipment showed an bottom surface wave pattern, indicating that the bottom consisted of sand waves moving down river. Fish that were observed were on the downstream face of the sand wave, presumably out of the strong water currents in the area. Moving sand habitat is not "ideal" fish habitat, which explains the low numbers of fish observed during the hydroacoustic survey.

6. It is my understanding that the Contractor will analyze the hydroacoustic computer record and provide number and size for each fish observed along a transect. The crew of the M.V. Blankenship will provide location and depth information for each transect. These two pieces of information will be combined to determine the number of fish per area of the large thalweg hole at Boulters Bar and the reach monitored below the thalweg hole.

Thomas Keevin, Ph.D.
Research Fisheries Biologist
CELMS-PD-A

FINAL REPORT

THALWEG DISPOSAL
MISSISSIPPI RIVER MILE 224 TO 224.9
AVOID AND MINIMIZE PROJECT

Prepared for:
U.S. Army Engineer District, St. Louis
Corps of Engineers
1222 Spruce Street
St. Louis, MO 63103-2033

Prepared by:
ARDL, Inc.
P.O. Box 1566
Mt. Vernon, IL 62864

Contract No. DACW-43-96-D-0519
Delivery Order No. 0005

Prepared by:

Todd Gentles
Field Services Manager
ARDL, Inc.

Approved by:

L. V. Gibbons, Ph.D.
President and Laboratory Director
ARDL, Inc.

Date Prepared: 4 November 1996

Approved by:

Date of Approval: 3 Dec 96

Theodore S. Postol, P.E.
Chief, Environmental Quality Section
U.S. Army Corps of Engineers
St. Louis District (CELMS-ED-HQ)

Revision 1.0 - 21 November 1996

TABLE OF CONTENTS

LIST OF TABLES

1.0 EXECUTIVE SUMMARY

The U.S. Army Corps of Engineers St. Louis District, with assistance of ARDL, Inc., performed a general assessment of the habitat at Mississippi River Mile 224 to 224.9 on the upper river. The Thalweg Disposal site is located at Mile 224.8.

Surveys conducted as a part of this investigation were as follows:

1. Hydroacoustic Fish Survey
2. Mussel Abundance Survey
3. Benthic Invertebrate Survey
4. Grain Size Survey
5. Multi-Beam Hydrographic Survey

This evaluation was performed to assess the habitat of the scour holes prior to the placement of dredged material.

The hydroacoustic fish survey results revealed a total of thirty-eight fish targets within the upper and lower holes. Twenty (20) fish were in the lower hole and eighteen (18) were in the upper hole.

Mussels were not found within or surrounding the scour holes from River Mile 224 to 224.9.

Benthic invertebrate surveys revealed twenty-five species, a total of 328 organisms and a mean value of organisms per sample of 36.4 within the upper hole. Seventeen (17) species, one hundred forty organisms and a mean value of organisms per sample of 70.0 was determined for the channel locations between the upper and lower holes. The lower hole had thirty-three (33) species, a total of 1537 organisms and a mean value of organisms per sample of 170.8.

Analytical results revealed that the sediments were primarily sands. Content of sands ranged from 95.6% to 99.9%. The material description on all samples was a poorly graded sand.

2.0 GENERAL BACKGROUND

The U.S. Army Corps of Engineers has an interest in minimizing if not eliminating any adverse impact from its mission of maintaining a navigation channel..

This evaluation is focused on the environmental status of the deep holes within the main river channel, known as a Thalweg. This investigation specifically deals with the Thalweg sites located at Mississippi River Miles 224 to 224.9. Two (2) distinct scour holes exist within this section of the river. The first scour hole referred to as the Lower Hole runs from approximately River Mile 224 to 224.2. The second hole referred to as the Upper Hole runs from approximately River Mile 224.7 to 224.9. Dredged material is proposed to be placed in the Upper Hole. Continued evaluation after placement of dredged material will be performed to document changes in the upper hole using the lower hole as control site.

3.0 SCOPE

The scope of the Avoid and Minimize - Thalweg Disposal Project was to collect and evaluate data on the environmental condition of the Thalweg sites (River Mile 224 to 224.9) prior to placement of dredged material into the area. The Thalweg sites were investigated by conducting the following surveys:

1. Hydroacoustic Fish Survey
2. Mussel Abundance Survey
3. Benthic Invertebrate Population Survey
4. Grain Size Survey
5. Multi-Beam Hydrographic Survey

4.0 PURPOSE

The overall purpose of the investigation was to determine the environmental condition of a Thalweg Disposal Area prior to placement of dredged material in an effort to determine any impact that Thalweg Disposal may have on the area. The investigation is used as a means to safeguard against adversely impacting the overall environmental conditions of the river system. By studying the conditions which exist prior to implementing a mechanical change in the river system and extrapolating the environmental changes which will occur, conclusions and recommendations can be drawn from the knowledge obtained to assist in safeguarding good balance between environmental and river engineering management.

5.0 SITE INVESTIGATION

5.1 Fish Survey

The St. Louis District Corps of Engineers performed a survey of fish abundance within the Upper and Lower Holes using digital hydroacoustic equipment. The survey was conducted on 6 and 7 August 1996. The pool elevation at Grafton, Illinois was 420.6 and 420.8 feet NGVD (National Geodetic Vertical Datum) respectively.

Mississippi River Mile 224.0 to 224.9 was surveyed with a Biosonics Model DT 4000 hydroacoustic single beam (10 degree) transducer interfaced with a portable computer for data storage, data reduction and interpretation. The hydroacoustic system was calibrated to U.S. Navy Standards at the Biosonics, Inc. laboratory, located in Seattle, Washington.

Surveying was conducted by traversing the target area of the river from shoreline to shoreline, then from upstream to downstream through the target area. The survey was conducted at a speed of three (3) miles per hours. The transducer was mounted in a tow fin suspended from a davit mounted on the bow of the boat. The face of the transducer was maintained at a depth of eighteen (18) inches. Processing parameters are summarized in Table 5.1. A DGPS receiver collected survey location data and survey transect length. Table 5.2 provides a summary of the DGPS transect data. A total of thirty transects were performed through the target area. Each transect was identified as an individual range. Figure 5.1 through 5.30 provide the plotted range results.

TABLE 5.1
Hydroacoustic System Parameters

Unit Serial Number	49632
Frequency	200 KHz
Beam Width	10°, nominal
SL (Source Level)	216.27 dB/uPa
RS (Received Sensitivity)	-61.41 dsC/uPa
Ping Rate	5 pps
Pulse Width	0.2 ms
Data Threshold	-60 dB
Water Temperature	25°C
Sound Velocity	1496.22 m/s

Processing:

Minimum Range from Transducer	30 cm (12 inches)
Distance from Bottom	20 cm (8 inches)
Beam Width for TS of -44.7 db	13.6°, measured

5.5 Photographic Documentation

Photographs were obtained by the field team and document the field activities conducted. The complete photograph file is retained on-file with the USACE-St. Louis District Office. The photo records are presented in Appendix 1 as an excerpt of the major field tasks conducted as well as further documentation of field observations.

5.6 Field Observations

Field notes compiled by the field team members during the conductance of the various field surveys and sampling events are presented in Appendix 2.

6.0 SURVEY AND ANALYTICAL RESULTS

6.1 Fish Survey Results

A total of thirty-eight (38) fish were identified within the two (2) scour holes. The majority of the fish count were in water depths of twenty (20) feet or less.

The lower hole had eighteen (18) fish in water depth ranging from 7.6 feet to 15.8 feet. Two (2) fish were targeted at 31.6 and 30.2 within the lower hole. The maximum depth of the lower hole was approximately forty-two (42) feet on 7 August 1996.

A total of twenty (20) fish were targeted in the upper hole. Five (5) fish were targeted in water depth greater than twenty (20) feet within the upper hole. The upper hole fish targets were in water depth ranging from 8.3 to 24.0 feet. The maximum depth of the upper hole was approximately thirty-nine (39) feet on 7 August 1996.

The river elevation at Grafton, Illinois on 7 August 1996 was 420.8 feet (NGVD).

The mean fish size was 6.6 inches. The minimum size was 1.2 inches and the maximum was 9.1 inches. All the targeted fish were identified near the shore slope. Fish were not present within the middle of the scour holes. Table 6.1 provides a summary of the fish targets identified with each transect made over the scour holes. Included in the summary is the depth of the fish targets and total depth of water at the point of fish target contact.

6.2 Mussel Abundance Survey

The mussel abundance survey conducted with commercial mussel fishing brail boards within the Upper and Lower holes of the Mississippi River Mile 224.0 to 224.9 resulted in no live mussels being found. Six (6) passes were made through each of the two (2) holes. Two (2) 16 foot brail boards were deployed to perform the survey.

Four (4) passes were conducted upriver (approximate River Mile 226 to 227) from the target scour hole area in an attempt to find a habitat more conducive to mussels. One (1) Threehorn wartyback (Obliquaria reflexa) mussel approximately 1.25 to 1.5 inches in diameter was obtained in 4 to 9 feet of water along the shoreline. Several zebra mussels (Dreissena polymorpha) were also obtained in the same vicinity.

2. which way.

TABLE 6.1
Summary of Fish Target Survey by River Transect

Transect	Number of Fish Targets	Fish Depth (ft.)	Water Depth (ft.)
Lower Hole			
1	—	---	---
2	—	---	---
3	—	---	---
4	4	7.6	18.1
4a	—	---	---
5	1	10.2	19.7
5a	1	15.8	19.4
5a	3	13.2	19.4
5a	1	8.3	19.4
5a	5	14.5	16.8
5a	1	8.3	17.1
5a	2	13.8	17.1
6			
bed plot	1	31.6	33.2
bed plot	1	30.2	31.6
Upper Hole			
7			
8	1	11.2	17.4
9			
10	2	23.7	27.3
11	1	19.1	23.0
11	1	8.9	16.1
12	—	---	---
13	---	---	---
14	—	---	---
15	---	---	---
16	---	---	---
17	—	---	---
18	---	---	---
19	—	---	---
20	2	10.2	13.2
20	1	8.3	10.9
20	1	9.6	11.2
20	1	18.4	23.4
21	---	---	---
22	2	21.7	26.6
23	---	---	---
24	1	21.7	28.9
24	2	24.0	27.0
24	1	23.4	25.3
25	—	---	---
26	2	19.1	21.7
27	—	---	---

6.3 Benthic Invertebrate Population Survey

Benthic macroinvertebrate community structure data as determined from natural substrate for all locations in the Thalweg Disposal area are presented in Table 6.2. Summaries of benthic community measures are presented in Table 6.3 and shown graphically in Figures 6.1 and 6.2. A statistical comparison of the stations based on density is found in Table 6.4 while the same type of comparison, based on number of species, is found in Table 6.5.

Benthic macroinvertebrate populations in the four areas of the Thalweg Disposal are represented by 10 orders, 15 families and a minimum of 36 species. Dominant groups within the benthic community were the micro turbellarians (Neorhabdocoela), non-biting midges (Chironomidae), and nematodes (Nematoda).

Station T consisted of two (2) sediments from River Mile 123 which were placed in with River Mile 224 Thalweg sediments as a control/check measure. At Station T, nine (9) species of benthic macroinvertebrates were taken from the location (Table 6.2). The area was dominated by microturbellarians (Neorhabdocoela) which made up 95% of the individuals collected followed by the midge Rheotanytarsus sp. Two (2) individuals of mayflies (Ephemeroptera, a group considered sensitive) representing two (2) species were taken at Station T. Diversity and evenness values were low at this location because of the abundance of the micro-turbellarians (Table 6.3).

At Station UH (Upper Hole), 25 species were collected (Table 6.2). Chironomids were abundant with a minimum of 12 species represented. Groups considered sensitive found at location UH include the mayfly Pentagenia sp. and the caddisflies (Trichoptera) Hydropsyche sp. and Potamyia flava. Diversity and evenness values were high because of the high number of species and low dominance of any one species (Table 6.3).

At Station Chan (between upper and lower hole), 17 species were collected (Table 6.2) with midges (Chironomidae) and segmented worms (Annelida) the dominant groups. Sensitive species at location CHAN included the mayflies Hexagenia sp. and Pentagenia sp. and the caddisfly Potamyia flava. Diversity and evenness values were high at the channel location due to the lack of dominance of a few species (Table 6.3).

Samples taken from Station LH (Lower Hole) yielded 33 species (Table 6.2) with Nematoda, Chironomids and Neorhabdocoela the dominant groups. Sensitive groups were represented by three (3) species of Mayflies (Ephemeroptera) and three (3) species of caddis flies (Trichoptera). Diversity and evenness values were high representing a high number of species with a low dominance of individuals (Table 6.3).

Cluster analyses for the four (4) locations using 1-Jaccard's Coefficient (species shared) places Stations UH and LH most similar forming the first cluster followed by a second cluster with the channel location (CHAN) (Figure 6.1). Station T is the least similar in terms of species shared and cluster last. When a density component is included using

Percent Dissimilarity Stations UH and CHAN cluster first followed by Station LH and T (Figure 6.2). According to data presented in Table two, location LH and UH are more similar (73.4%) followed by Station UH and CHAN (51.9%) while Station T is the least similar.

The ANOVA statistical tests and the Duncan's Multiple Range means Separation tests were used to compare the sites in terms of numbers of individuals (density) and number of taxa per sample. In terms of density, Station T had significantly more individuals than the UH site. In terms of species at each location, there were no significant differences between the four (4) locations. Appendix 3 provides the complete benthic analytical methods and results for the project.

6.4 Grain Size Survey

Grain size analysis was performed by the St. Louis District Laboratory on twenty (20) sediment samples collected from the Upper and Lower scour holes located between River Miles 224.0 to 224.9. Analytical results as provided by the Laboratory are enclosed as Appendix 4. Analytical results revealed that the sediments were primarily sands. Content of sands ranged from 95.6% to 99.9%. The material description on all samples was a poorly graded sand.

6.5 Multi-Beam Hydrographic Survey

The survey conducted on 15 August 1996 was used to calculate the disposal volume available in the Thalweg holes at River Mile 224 to 224.9. The upper hole had a calculated volume of 9270 cubic yards. The lower hole had a calculated volume of 19018 cubic yards. An additional survey conducted on 10 September confirmed the first survey results. Maximum depths within the upper and lower holes were greater than 32 feet.

The survey conducted on 10-12 October 1996 checked the conditions of the Thalweg sites just prior to dredging upriver with disposal in the upper hole of the Thalweg. Conditions were very similar to those found in the previous surveys.

Surveying was conducted during the dredging and disposal operation on 12 October 1996. The survey revealed the changes in total depth within the upper hole which was used for disposal of the dredged material.

The survey conducted on 15 October 1996 was conducted after disposal was completed. The survey revealed that disposal was successful in the primary (deepest) section of the Upper Thalweg hole.

Copies of the plotted surveys are enclosed as Appendix 5. Subsequent surveys to monitor the condition of the Thalweg disposal will be conducted by the Corps in November 1996

and after the first major flood event of the season. Results of the surveys will be available from the St. Louis District Corps upon completion.

7.0 CONCLUSION

The investigation surveys conducted on the Thalweg Site, Mississippi River Mile 224 to 224.9 revealed that the area was low in fish population at the time of the survey.

Benthic invertebrate population was similar between the two (2) scour holes and the channel locations. Sensitive groups found in the upper hole and lower hole were the mayfly and caddis flies.

Mussel surveys revealed no mussels within either the upper or lower hole. The control site upriver did find a live Threehorn wartyback (Obliquaria reflexa) mussel and several zebra (Dreissena polymorpha) mussels along the Illinois river bank at River Mile 226 to 227.

Channel sweep surveys revealed the total available volume for disposal within the upper hole. Subsequent surveys revealed the areas being filled during disposal of dredged material and the final disposition of the upper hole upon completion of disposal.

8.0 RECOMMENDATIONS

It is recommended that the environmental status of the upper and lower holes be reviewed over the course of the next year. Comparisons of the follow-up surveys with the original surveys can be made to assess the environmental impact that the Thalweg Disposal has had within the upper hole. The results of the comparisons can be used to improve the procedures used in Thalweg Disposals so that environmental conditions within the river system are enhanced.

APPENDIX D

1). PALLID STURGEON STUDY

Middle Mississippi River Pallid Sturgeon Habitat Use Project

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EXECUTIVE SUMMARY

Study methods were developed and habitat use data collection was initiated in Year 1. All sturgeon (11) but one given sonic transmitters showed meristic characteristics within the range reported for pallid sturgeon; the other was most probably a hybrid. Some specimens, however, may have been genetically introgressed, but molecular genetic techniques are not available at this time to determine this with certainty.

The telemetry system performed well, except during periods of high discharge. Detection ranges were up to 0.5 mi. The sturgeon were found (n=84) in the main channel (MCL) 46% of the time. They were in the MCL 48% (n=23) of the time at water temperatures less than 4 C, suggesting winter habitat requirements may not be too restrictive for pallid sturgeon of the size we studied. Sturgeon not in the MCL were usually near or between wing dams. Sturgeon were found in locations with depths of 6 to 12 m 72% of the time. Individual sturgeon ranged along 1.9 (10 contacts) to 60.3 (6 contacts) river miles. Mean range was 22.2 miles.

Several key questions were answered in this, the first year of a three-year study: 1) it was possible to obtain a reasonably sufficient number of large pallid sturgeon from the middle Mississippi River (MMR) to conduct the study; 2) a sonic telemetry system was developed which functioned well most of the

time at boat tracking velocities of 11 to 13 km/h in the acoustically noisy MMR; 3) the sturgeon did not move distances so great that they could not be tracked by boat; 4) a Character Index was developed to enable rapid identification of specimens in the field to determine whether they were suitable for the study; and 5) sonic tracking was not feasible during periods of high water (>7.6 m at the Chester, Illinois, gage).

INTRODUCTION

Overview

The pallid sturgeon *Scaphirhynchus albus* was listed by the U.S. Fish and Wildlife Service as endangered in 1990. The biology of this species is poorly understood, as is the case for many species existing in low numbers. Consequently, the Pallid Sturgeon Recovery Plan (Dryer and Sandvol 1993) identified the need to gain better understanding of the basic biological characteristics of the species.

The present study, funded by the U.S. Fish and Wildlife Service (USFWS) and U.S. Army Corps of Engineers (USACE) and recommended with high priority by the Central States Pallid Sturgeon Work Group, was principally designed to address the Recovery Plan's Primary Task 3.2.1, "Conduct field investigations to describe the micro- and macro-habitat components of spawning, feeding, staging, and rearing areas." The study was conceived

to utilize sonic telemetry to determine the movements, locations, and habitat use of pallid sturgeon. Because of its approach, the study also addresses several Recovery Plan Secondary Tasks: 1) 1.1, "Reduce or eliminate potential and documented threats from past, present and proposed developments initially within recovery priority areas;" 2) 3.1, "Obtain information on life history of the pallid sturgeon; 3) 3.3, "Obtain information on genetic makeup of hatchery-reared and wild *Scaphirhynchus* stocks;" and 4) 3.4, "Obtain information on population status and trends." The specific project objectives are to identify and obtain information on habitats used by wintering and spawning pallid sturgeon in the middle Mississippi River (MMR); i.e., the River between the mouths of the Missouri and Ohio Rivers.

The first year of the study was designed to determine the feasibility of using sonic telemetry for the above purposes. Questions such as: 1) Could a telemetry system suitable for pallid sturgeon in the acoustically noisy MMR be developed? 2) Would it be possible to obtain a sufficient number of large sturgeon from the MMR into which transmitters could be implanted? and 3) Would study sturgeon move distances so great that they could not reasonably be tracked from a boat?

In the course of pursuing answers to these questions, another problem arose during the first year of the study. A perceived threat to the pallid sturgeon is interspecific

End of Document

The full Middle Mississippi River Pallid Sturgeon Habitat Use Project report was not included in the 1996 A & M Report.