MELVIN PRICE LOCKS AND DAM

UPPER MISSISSIPPI RIVER BASIN
MISSISSIPPI RIVER MISSOURI AND ILLINOIS

PROGRESS REPORT 2004 - 2006

DESIGN MEMORANDUM NO. 24
AVOID AND MINIMIZE MEASURES

US Army Corps of Engineers
St. Louis District®

"Good engineering enhances the environment"

JULY 2010

Cover photo

Slim Island Bullnose at RM 267.0R. A bullnose was constructed at the tip of Slim Island in 1996 in order to curb severe erosion that had occurred at the upstream tip of the island after the flood of 1993.
State and Federal natural resource agencies partners in the Avoid and Minimize program have long requested that the Corps of Engineers consider ways to incorporate environmental benefits from the structures we build in our dike and revetment program. Electro-fishing was conducted in 2003 and 2004 to evaluate the structures usefulness as fish habitat. Results show that this structure provides habitat similar to chevrons constructed previously in other parts of the river. Post construction monitoring is a critical tool in assessing the value and impact of these structures as both river training structures and as aquatic habitat.

DESIGN MEMORANDUM NO. 24

AVOID AND MINIMIZE MEASURES

2004 - 2006 PROGRESS REPORT

MELVIN PRICE LOCKS AND DAM
MISSISSIPPI RIVER - MISSOURI AND ILLINOIS

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St. Louis District - Mississippi Valley Division
2004-2006 Progress Report

Executive Summary

The St. Louis District agreed to establish an Avoid and Minimize Program (A&M) in 1992 to reduce possible environmental impacts of increased navigation traffic due to construction of a second lock at Melvin Price Locks and Dam. Full-scale implementation of the program began in 1996. Expenditures in the program total roughly $780,000 a year. Direction of the program is coordinated through the River Resource Action Team, which consists of state, federal and private partners in both natural resources and industry. Each year, a progress report detailing A&M activities during the past year is released.

Several construction efforts were made between 2004 and 2006. In 2005, an additional round point structure was added to the existing 6 point run at river mile 265.7L along with the construction of three more round point structures just behind those (downstream side). Also in 2005, a bullnose was placed at the head of Portage Island at river mile 213.9R and at river mile 257.4L, nine MRS were built with five in the upstream run and four in the downstream run. In 2006, the pile dike at river mile 166.6L was extended past the toe of an unnamed island out toward the thalweg and a notched dike was built at river mile 166.3L. Also in 2006, the river side leg of the downstream chevron at river mile 265.6R was completed; intentionally leaving a 50 foot notch between the existing chevron and the new leg, and a new chevron was constructed at river mile 271.1R.

Biological monitoring continued at several sites and was initiated at others. Monitoring continued at the chevron dikes in pool 25, the chevron dikes in pool 24, and at the multiple roundpoint structure field (MRS) in pool 25. Monitoring commenced at a bullnose in pool 25, the chevron field consisting of four dikes and a short stub dike in pool 26, and sites for a proposed MRS in pool 25. Based on previous years monitoring of the chevrons and MRS, one can conclude that they are providing valuable habitat for a variety of riverine fishes including over-wintering and nursery habitat. This includes the blue sucker, which was found most recently at the MRS at 265.7L in 2005.

Monitoring of fish at the chevron dikes in pool 24 has occurred since 1993. The chevron habitat electrofishing samples are compared to samples taken from nearby backwaters. A total of 59 species have been collected, 53 of them being found at the chevrons. The greatest numbers of fish were sampled inside of the chevrons. It is also apparent, based on the sizes of fish caught, that several species such as the smallmouth buffalo may be using these structures as nursery habitat.

In addition to sampling for fish at the Pool 24 chevron dikes, islands created behind the dikes were surveyed for vegetation and change in physical features. Originally sampled in 1996, the islands showed some slight changes in physical structure with the most dramatic change being the development of a channel between the second island and the riverbank. The density of vegetative cover as well as the diversity of the species present on all three islands has increased

since the original visit in 1996. The most common vegetation presently consists of willows and yellow nutsedge.

A bullnose was constructed at the tip of Slim Island in 1996 in order to curb severe erosion that had occurred at the upstream tip of the island after the flood of 1993. Electro-fishing was conducted in 2003 and 2004 to evaluate the structures usefulness as fish habitat. Results show that this structure provides habitat similar to chevrons constructed previously in other parts of the river. Collections in the two sample years consisted of 166 fish and 22 species.

Sampling with electrofishing occurred at the middle chevron dike at RM 266.0R to complete the evaluation of fish habitat. The site had been previously sampled in 2000, 2001, and 2002. The entire period of sampling has produced a total of ten species. Sampling done previously included electro-fishing, gill netting, and trawling. Hydroacoustic samples from 1999-2002 show that these chevrons are being used as over-wintering habitat.

IDNR has sampled the MRS in pool 25 twenty three times since 1998. A total of 33 species and one hybrid have been collected at these structures. Emerald shiner, flathead catfish, and gizzard shad were the species most often found. The blue sucker, an uncommon species in the Mississippi River, was collected on nine of the sampling trips suggesting that it may be seeking the MRS for favorable habitat conditions.

Monitoring of proposed MRS construction sites in Pool 25 occurred in 2003 and 2004. Sampling before construction using electro-fishing and trawling at the proposed construction sites showed few numbers of fish or fish species. Substrate samples taken throughout the proposed MRS field location were primarily sand, with only one or two samples comprised mostly of silt (at one sight 96 western sand darters were caught). However, at two sites where submerged dikes where present, a more riffle like habitat was present and blue sucker and shorthead redhorse were caught, species that are typically uncommon in the river. The results confirmed the potential for improved fish habitat in the area with the construction of MRS and the need to alter the locations slightly to preserve what quality habitat does exist at this site. Future sampling is planned after project completion.

Post construction biological monitoring of the chevron and kicker dike complex built in 2002 in Pool 26 showed use of the area by UMR fish species similar to that of chevrons sampled in previous years at other locations. The sampling in 2003 and 2004 utilizing electrofishing, trawling, and gill nets produced many young of the year freshwater drum and channel catfish suggesting the areas use as nursery habitat. A large number of macroinvertebrates and mussels were collected at this site as well.

Three hydraulic sediment response (HSR) models were analyzed between 2003 and 2006. The primary objective of these studies was to evaluate new and existing river structures and their influence on river bathymetry. In addition, the studies were conducted to evaluate design alternatives to alleviate repetitive channel maintenance dredging associated with continual sediment deposition in the navigation channel while maintaining or improving existing environmental conditions. Each test was evaluated on the structure's or structures' impact on the overall bed configuration as well as the bathymetry created in the immediate area of the tested structure or structures.

Avoid and Minimize
Environmental Impacts Program
St. Louis District - Mississippi Valley Division
2004-2006 Progress Report

In October 1992, the St. Louis District Corps of Engineers (Corps) issued Design Memorandum No. 24, "Avoid and Minimize Measures, Melvin Price Locks and Dam, Upper Mississippi River - Missouri and Illinois." The document was developed as a commitment made in the 1988 Record of Decision attached to the Melvin Price Locks and Dam Environmental Impact Statement for the Second Lock. St. Louis District set aside funds from 1989 to 1995 to implement eight measures recommended by the study team. Implementation of measures in that part of the program were detailed in the 1995 Progress Report. In fiscal year 1996, O&M funds were received to begin full-scale implementation of recommended measures. The planning and implementation team consists of staff from the Corps, U.S. Fish and Wildlife Service (FWS), Illinois Department of Natural Resources (IDNR), Missouri Department of Conservation (MDOC), River Industry Action Committee (RIAC), and the Long Term Resource Monitoring Field Station (LTRM/MDOC) at Jackson, Missouri. Each group contributes staff time to plan and attend meetings and may collect data as part of an ongoing monitoring program. This team meets at least once a year, recently as members of the River Resources Action Team (RRAT), to discuss ongoing work and planned future work. Outside of these meetings the St. Louis District routinely corresponds with the team to coordinate monitoring and solicit ideas and input.

2004-2006 A&M Program Activities

A&M 1. 2004-2006 Construction.

Several construction efforts were made between 2004 and 2006. In 2005, an additional round point structure was added to the existing 6 point run (built in 1998) at river mile 265.7L along with the construction of three more round point structures just behind those (downstream side). Also in 2005, a bullnose was placed at the head of Portage Island at river mile 213.9R, and at river mile 257.4L, nine MRS were built with five in the upstream run and four in the downstream. In 2006, the pile dike at river mile 166.6L was extended past the toe of an unnamed island out toward the thalweg and a notched dike was built at river mile 166.3L. Also in 2006, the river side leg of the downstream chevron at river mile 265.8R was completed, intentionally leaving a 50 foot notch between the existing chevron and the new leg. Finally, in 2006, a chevron was constructed at river mile 271.1R.

A&M 2. Chevron and Bullnose Monitoring.

A field of three chevron dikes was placed near Cottonwood Island between river miles 289.0 – 290.0L in 1993. They were intended as alternatives to a rock closing structure between the upper ends of Sand Bar Island and North Fritz Island and were designed to increase the proportion of flow through the main channel and thereby reduce dredging. The bullnose at Slim Island was constructed in 1996 at river mile 267.0R and was intended to curb severe erosion that was occurring at the upstream end of the island while providing fish habitat. In 1998 and 1999, three chevron dikes were constructed between river miles 266.1 – 265.8R, in Pool 25. These dikes were placed to focus main channel flow. Four chevrons were constructed between river miles

225.8 – 225.0R in 2002. These dikes were constructed under the Corps dike and revetment program and were designed to correct a chronic dredging problem at that location.

Pool 24, River Mile 289L Biological Monitoring. IDNR has sampled this field of three chevron dikes since their construction in 1993. An analysis of the present data shows that the chevron dikes are providing quality habitat for many fish. This includes probable nursery habitat for fish like the smallmouth buffalo and white bass. Comparisons of fish numbers between chevron habitat and nearby slough habitat are similar. The inside of the chevrons have shown the highest catch of all samples collected in this particular area. The areas outside of the chevrons are providing habitat for a variety of fishes as well. The inside and outside of the chevrons provide different habitats which is evidenced by the different types of species most frequently found there. The inside habitat is more lentic in nature and white bass, smallmouth buffalo, largemouth bass, and bluegill can be found here. The outside habitat is more lotic and caters to species like channel catfish, flathead catfish, common carp, minnows, and shiners. Overall 59 species have been found here since the beginning of sampling.

When these chevrons were built in 1993, dredged material was placed on the channel side and interior of each dike. Over time, water overtopping the dike created scour holes immediately behind the dikes and pushed more sediment up to form larger islands behind the dikes. These dikes were sampled for vegetation and animal and human use in 1996 and 2006. Vegetation density and diversity have both increased on all three islands in the last ten years. The islands have seen an increase in plant diversity from 24 species of vegetation in 1996 to 44 plant species in the most recent survey. Willows and yellow nutsedge appeared to be the predominate vegetation common to all three islands. Numerous birds were seen including Canada geese, killdeer, least sandpipers, and spotted sandpipers. There was also evidence of animal and human use of the islands.

Pool 25, River Mile 267 Biological Monitoring. The bullnose at Slim Island was sampled by St. Louis District staff with electrofishing in both 2003 and 2004. Notches were positioned on the bullnose to allow fish movement in and out of the protected area. The samples from both years shared similar characteristics with species such as shortnose gar, gizzard shad, freshwater drum and bluegill favoring the inside of the bullnose, and species like catfish, largemouth bass, smallmouth bass, and carp being found outside of the bullnose. In all, 21 species were collected over the two years.

Pool 25, River Mile 266R Biological Monitoring. The A&M program has constructed three chevron dikes in Pool 25 of the Mississippi River between river miles 266.1 – 265.8R. One complete and one partial dike were constructed in June 1998. In March 1999 one additional chevron dike was constructed, and the partial dike (left leg of lower chevron 3) was completed in 2006. These chevrons were constructed to concentrate flow more toward the main channel and thereby reduce dredging needs.

This site has been sampled in the past using hydroacoustics, gill nets, deep water electro-fishing, deep water purse seining, and deep water trawling. The results of these sampling efforts showed that the deep scour holes created behind the dikes are used by fish as over-wintering habitat. The

middle chevron of this dike field was sampled both inside and outside in July 2003 with electrofishing. These sampling efforts turned up species and numbers of fish that were to be expected based on previous years samplings of the those dikes and other similarly structured dikes.

Pool 26, Mile 226R Biological Monitoring. Four chevron dikes were constructed at this site in December 2002, under the Corps' dike and revetment program. The dikes at this location were sampled for the first time in July 2003. Sampling continued in 2004 and showed that these dikes provided habitat that has typically been seen in other chevron dike fields. That is, a scour hole below the apex of the upstream end of the dike and a shallower bar that forms between the downstream legs. These two summer samples found young of the year for both freshwater drum and channel catfish. Many freshwater invertebrates and small mussels were collected as well. Mussels have typically not been collected at other chevron sites.

A&M 3. Multiple Roundpoint Structure Monitoring.

In 1998, the A&M Program constructed a multiple round point structure (MRS) in Pool 25 (river mile 265.7L). This innovative training structure consists of 6 separate round rock points, or flat-top cones, on 100 ft centers extending from the bank in a fashion similar to a wing dike. The round point structure was developed to function as a wing dike and appears at the water surface to be a heavily notched wing dike. Each of the six points stands alone and is not connected to the other points.

The multiple round point structure has been monitored since construction for both fish use and bathymetric changes. Electro-fish sampling has been conducted by the Illinois Department of Natural Resources at the site since 1998. The structure was sampled twice in 2004 and three times in 2005. To date, the total number of species collected is 33. Gizzard shad, emerald shiners, and flathead catfish exhibit the highest overall catch rate, followed by common carp, freshwater drum, and channel catfish. Blue sucker have been collected in five of the eight years of sampling. This big river species is of interest because they are uncommonly collected in the Mississippi River and is considered a species of concern by natural resource agencies. The Illinois report concluded that the structure was providing useful and valuable habitat. Bathymetric surveys have shown that the MRS have increased substrate diversity at the site through a series of individual scour holes that have been created directly below and downstream of the MRS. The area was all shallow sand wave habitat prior to construction.

Based on monitoring of the MRS at river mile 265.7L, it was decided to eventually expand the project to include four double rows between river miles 257.4L and 255.7L. This proposed site for the MRS was sampled in 2003 and 2004 using elctrofishing and deep water trawls. A dive survey to look for mussels was conducted as well. The fish samples suggest that the current habitat is similar to what was seen before construction of the MRS at river mile 265.7L with one exception. The presence of two submerged dikes at river miles 256.7L and 255.7L at the proposed sites creates riffle like habitats that are home to species like blue sucker and shorthead redhorse. The presence of these fish influenced a change in location with the MRS to be built

upstream of the submerged dikes instead of on top. The unionid survey found no mussel beds located in the proposed construction area.

A&M 4. ***Hydraulic Sediment Response (HSR) Model Studies- Full reports of the following studies can be found on the St. Louis District's Centers of Expertise web site under Reports: http://www.mvs.usace.army.mil/arec/index.html***

Carroll Island, MRM 273-263 (Jasen Brown et al. 2006)
The St. Louis District's Potamology Section conducted a sedimentation improvement study of the Carroll Island reach between river miles 273.0 and 263.0 near Clarksville, Missouri, from February 2004 to November 2004. The St. Louis District's Avoid and Minimize Environmental Program provided funding. The purpose of this study was to assess the current sediment transport conditions in the Carroll Island reach, evaluate the interaction between the main channel and the side channel complex, and provide a solution or solutions to achieve the project goal of reducing the need for repetitive dredging. The area of repetitive dredging is located in the main channel between Mile 270.5 and Mile 266.0. Preservation of adequate side channel depth is also a goal of this study. Side channel bathymetries should, if possible, remain unchanged while the existing energy in the main channel should be focused in order to provide adequate channel location, width, and depth for navigation.

This reach of the river has been experiencing a dredging problem for some time. Since 1992, there has been roughly 2,825,500 cubic yards of dredging (18 cuts) between miles 272-266. This may be due to a flow split problem. Data collected since 1994 shows that, on average, roughly 1/3 of the total flow is going down the left descending bank side channel – behind Carroll and Coon Islands.

The Corps has been discussing this reach with their partners (FWS, IDNR, MDOC, RIAC, etc.) since 1997. Many alternatives have been discussed that would were thought could help with the problem and in 2002, during the Corps annual coordination boat trip, it was decided to do an HSR study on this reach of river.

Eighteen design alternative plans were model tested to examine methods of modifying the sediment transport response trends that would help alleviate the need for repetitive dredging within the navigation channel. The effectiveness of each design was evaluated by comparing the resultant bed configuration to that of the base condition. Impacts or changes induced by each alternative were evaluated by observing the sediment response of the model.

The recommended plan includes 3 chevrons (RM's 271.2, 270.5, and 269.3 all right descending bank), 3 raised dikes (RM's 269.7, 268.8, and 268.6 all left descending bank), and 1 new dike (RM 266.3 right descending bank). It was recommended that in implementing these structures into the Carroll Island Reach, a phased construction approach should be followed. This is especially true for the new Dike to be constructed at Mile 266.3. Important biological habitat exists in the chevron structures just downstream of this dike, thus a phased construction is recommended. A phased construction will allow for getting the maximum benefit from the

structure without unnecessarily impacting this habitat. In addition, a close monitoring program of navigation channel conditions both before and after construction should be incorporated.

Generic Dike Flume Study, (Jasen Brown et al. 2006)

The St. Louis District's Potamology Section initiated the Generic Dike Flume study conducted between July 2003 and April 2004. The St. Louis District's Avoid and Minimize Environmental Program provided funding. The primary objective of this study was to evaluate new and existing river structures and their influence on the bathymetry of the generic flume. Each test was evaluated on the structure's or structures' impact on the overall bed configuration as well as the bathymetry created in the immediate area of the tested structure or structures. From these evaluations, further insights into the bathymetry forming characteristics of each structure or type of structure can be gained and utilized in future river engineering projects.

Several types of river training structures have already been implemented in the river to maintain the alignment and navigable depths. Some structures, such as straight dikes and trail dikes, have long been used by the Corps to solve navigation problems. Other structures, such as bendway weirs and chevrons, have only recently (within the last 15 years) been developed and put to work. Within the river channel, many opportunities exist to implement new structures and modify existing structures to serve the needs of both the navigation industry while improving environmental conditions. Additional insight into a structure's impact on channel bathymetry is needed for the river engineer to make better, more informed judgments regarding the selection of river training structures.

The following is a summary of observed bathymetric characteristics associated with each test follows the conclusions for each type of structure:

Notched Dikes

The tests showed that deep notches near the bankline or middle of the dike would create the greatest opportunity to create a deep, secondary channel.

Notched L-Dikes

Results were similar to notched dikes except an isolated scour hole could be formed along the inside leg of the dike with a notch near river channel.

Chevrons

Test results showed that deeper and / or longer scour patterns were created by notching the apex or legs of the chevrons. Unique depositional patterns were formed with the notches and / or stub dikes along the legs of the chevron.

Sloped Dikes

A dike sloping upward from the bankline toward the river channel created a small side channel that was less pronounced than those formed with deep notches.

Double-Dike
The double-dike formation appeared to allow less scour downstream of the structure.

Wedge Dikes
The wedge dike structure also appeared to allow less scour downstream of the structure.

MRS Structures
The plunge pool area that formed downstream of the single row MRS was shallower than the plunge pool from a standard dike. However, the area of scour extended further downstream of the structure. The scour was somewhat reduced by using 2 rows and staggering the MRS points upstream to downstream. The MRS chevron produced significant differences from the standard chevron including less upstream deposition and additional scouring in the immediate vicinity of the structure.

Angled Dikes
The most significant difference between the upstream and downstream angled dikes was their effect on the river channel. The upstream angled structure formed a much deeper, wider channel downstream while the downstream angled dike had bathymetric patterns similar to the base test. This was due to the downstream angled dike forcing flow into the bankline while the upstream dike forced it towards the river channel. Consistent with actual river structures, the downstream angled structure created a large scour hole along the bankline.

W-Dikes
The resultant bathymetry of each test suggested that when laying out a W-dike, the most environmentally beneficial layout would be to have the upstream points somewhat lower in elevation than the downstream points. However, to protect the bankline, the first leg should be angled in the upstream direction and sloped down from towards the first upstream point.

Iowa/Squaw Island Reach, MRM 230-219 (R) (Mike Rodgers et al. 2006)
The St. Louis District's Potamology Section initiated a sedimentation improvement study of the Iowa-Squaw Island reach between river miles 230.0 and 219.0 near Grafton, Illinois, from March 2005 to February 2006. The St. Louis District's Avoid and Minimize Environmental Program provided funding.

The purpose of the study was to evaluate design alternatives to alleviate repetitive channel maintenance dredging associated with continual sediment deposition in the navigation channel adjacent to Iowa Island, Enterprise Island, and Island 521, while maintaining or improving existing environmental conditions. In addition, a primary goal of this study was to evaluate design alternatives that would not negatively affecting the side channel complex for environmental and recreational purposes. Design alternatives included examining methods of increasing velocities in the main channel and improving the navigation channel alignment without closing off the chutes. The use of dikes, chevrons, and other structures in the main channel were considered. Assessments of these alternatives included the examination of the

ultimate effects to sedimentation patterns within the main channel, at the entrances to the side channels, and within each side channel. Placing dredge material in areas that will not affect recreation, landowners, or the environment proves difficult. In this reach, areas to place material are very limited; therefore, an innovative solution must be found to utilize the dredge material in a beneficial manner. This work has been coordinated with the FWS, IDNR, MDOC, and RIAC.

Ten design alternatives were tested in the HSR model using a variety of structures. Normal dikes, longitudinal dikes, and chevrons were used in the model testing. The effectiveness of each design was evaluated by comparing the resultant bed configuration to that of the base condition. Impacts or changes induced by each alternative were evaluated by observing the sediment response of the model. Currently, the Potamology Section has agreed upon a solution that includes the addition of 5 dikes, removal of 4 dikes, raising one dike and adding a trail to it, raising 3 existing dikes and modifying 1 dike by raising the first 2/3rds from the bank and lowering the remaining portion. It is recommended that in implementing these structures into the Iowa/Squaw Island Reach, a phased construction approach should be followed. Caution should be taken when working on Dike 222.5 in the side channel. This structure has been identified as creating excellent aquatic habitat. In addition, a close monitoring program of navigation channel conditions both before and after construction should be incorporated.

St. Louis District Avoid and Minimize Program
Dollars Expended, 1996 - 2006

Fiscal Year	Total Expended
FY 1996	1,054,000
FY 1997	1,489,000
FY 1998	1,060,000
FY 1999	1,040,000
FY 2000	421,000
FY 2001	684,400
FY 2002	148,200
FY 2003	684,800
FY 2004	568,700
FY 2005	939,600
FY 2006	526,700
	8,616,400

TOTAL A&M PROGRAM
DOLLARS THROUGH FY 2006

Appendix A

Cottonwood Island Chevron Dike
Fisheries Evaluation Update

Cottonwood Island Chevron Dike
Fisheries Evaluation Update

Prepared for:
U.S. Army Corps of Engineers
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Introduction

The Illinois Department of Natural Resources, with assistance from the St. Louis District, Corps of Engineers, has conducted fish sampling with A.C. boat electrofishing (EF) at the Cottonwood Island chevron dikes since October 1993. Three stone filled chevrons were constructed by the St. Louis District in the October 1993. The chevrons were constructed as an alternative to a rock closing structure between the upper ends of Sand Bar Island and North Fritz Island, between river miles 290 and 289L. Construction of two more chevrons at this location is planned. The chevrons were constructed to increase the proportion of the flow in the main channel with the goal of reducing the amount of maintenance dredging in this river reach. Habitat along the outside of the chevrons is main channel border and side channel border with constantly flowing water, while that inside the chevrons is quiet backwater habitat, until the structures are overtopped.

Methods

The upstream and downstream-most chevrons have been sampled, along with a small backwater slough at Drift Island as a control station. In 1998 two additional control stations (Head of Bay Island and main channel border along Cottonwood Island, adjacent to the upper chevron) were sampled to evaluate them for possible inclusion in the study. Head of Bay Island was added as a control station. The main channel border station was sampled only one time. The dates of sampling for these sites, as well as EF sampling time for each site are presented in Table 1.

The electrofishing unit used in this study consists of a 230 volt, 4000 watt, 3 phase A.C. generator which energizes 3 steel cable electrodes (5/8") suspended from 3 booms projecting off the bow of the boat (18' welded aluminum boat). The electrodes are approximately 5' apart, project about 6' off the bow and extend into the water about 4' in depth, thus creating an electric field with an approximate diameter of 10' and reaching a depth of about 6'. Typically 6 - 10 amperes of current are generated within this field. The sampling is conducted by a two person crew, one stationed in the bow of the boat to dip stunned fish with a long handled dip net from the water and into an oxygenated live well, and one operating the motor. Typically, two EF runs are conducted at each chevron, one along the outside of the chevron and one within the inside of the chevron.

After each EF run the fish are identified to species, weighed and measured, checked for abnormalities and disease, and returned live to the river. Fishes too small to identify in the field are preserved and returned to the lab for processing. Data are tabulated on standard field sheets and later entered into the Department's fisheries database (Fisheries Analysis System). Voucher specimens were sent to the Department of Zoology at Southern Illinois University, Carbondale for preservation and storage.

Results and Discussion

A total of 14,144 (Table 1-3) fishes representing 59 species have been collected during 2011 minutes of electrofishing (105.50 fish/15 ef min). When these data are summarized by habitat type (inside the chevron, outside the chevron, Drift Island Slough and Head of Bay Island) over all sampling periods (Table 2), the highest catch rate was observed inside the chevrons (138.21 fish/15 min EF), followed by Drift Island Slough (109.85 fish/15 min EF), outside the chevrons (93.42 fish/15 min EF) and Head of Bay Island (58.62 fish/15 min EF). The number of species collected was also highest inside the chevrons (46 species), followed by Drift Island Slough (44 species), outside the chevrons (36 species) and Head of Bay Island (32 species) [Table 2]. Fifty three of the 59 species collected have been collected at the chevrons (inside and outside combined).

When the total number of species collected at each individual station over all years are compared (Table 3), the highest species richness was observed inside the upper chevron and at Drift Island Slough (44 species), followed by upper chevron outside (35 species), Head of Bay Island (32 species), lower chevron inside (28 species), and lower chevron outside (19 species). When total catch rates for each site (over all sampling periods) are compared, the catch rate at the upper inside chevron is higher than all other sites with 136.69 fish/15 min EF, followed by lower chevron inside (130.94 fish/15 min) and Drift Island Slough (109.85 fish/15 min) [Table 3]. Although some of the difference in catch rates and species richness can be explained by variable sampling efforts among stations, and differences in electrofishing efficiency among stations, these data suggest the habitat created inside the chevron dikes are holding more individual fishes and more fish species than either the habitat immediately outside of the chevrons or nearby side channel or backwater habitats.

The total catch rate for longnose gar, bowfin, bigmouth buffalo, smallmouth buffalo, black buffalo, spotted sucker, black crappie, white crappie, largemouth bass, warmouth, bluegill and orangespotted sunfish was highest in Drift Island Slough. The total catch rates for American eel, mooneye, silver chub, silvery minnow, spotfin shiner, emerald shiner, bigmouth shiner, sand shiner, channel shiner, channel catfish, flathead catfish, freckled madtom, yellow bass, smallmouth bass, slenderhead darter and logperch were highest on the outside of the chevrons (Table 3). The total catch rates for gizzard shad, threadfin shad, suckermouth minnow, bluntnose minnow, bullhead minnow, silverband minnow, river shiner, spottail shiner, quillback, river carpsucker, brook silversides, white bass, green sunfish, sauger and freshwater drum were higher inside chevrons than elsewhere (Table 3). The fish communities described by the composition of fishes collected in this study suggest that the habitat inside the chevrons is ecologically intermediate between main channel border and side channel border and backwater habitats. This is logical, as the backwater type habitat inside the chevrons is nested within main channel border habitat.

Looking at the annual catch rates of selected numerically dominant fishes that prefer either flowing water or quiet water help illustrate the point. Plots of the annual catch rates for the current loving emerald shiner and spotfin shiner for the four habitat types indicate that densities of these fishes inside the chevrons and at the head of Bay Island are

generally lower than rates outside and are generally higher than those at Drift Slough (Figures 1 & 2). Conversely, the catch rates for smallmouth buffalo and bluegill, fishes which generally prefer quiet water habitats, indicate the opposite trend, the estimated density of these fishes inside the chevrons is lower than at Drifts Island Slough and higher than outside the chevrons (Figures 3 & 4).

An examination of the length frequencies of selected fishes collected from the vicinity of the chevrons and Drift Island Slough helps illustrate the similarities and differences in the fish populations inhabiting these habitat types. For instance, although smallmouth buffalo densities associated with the chevrons appear to be considerably less than those in Drift Island Slough, the size range observed for this species is slightly greater in the vicinity of the chevrons than in the slough. This may indicate the nursery habitat provided by the chevron and slough habitats are similar in quality for this species (Atwood, 2001).

The channel catfish catch rate was almost three times higher along the outside of the chevrons than inside, suggesting higher densities outside. The channel catfish catch rate at Drift Island Slough is similar to that observed inside. The size structure of channel catfish collected at Drift Island Slough, inside and outside the chevrons indicates similar sized fishes are utilizing these areas. The catch rate data coupled with the length frequency data suggests that adult fish are residing most often outside the chevrons and occasionally move to the inside. The purpose of such movement is unknown, but at least two possibilities exist. Channel catfish may use the inside as a temporary resting place from higher current velocities experienced on outside, and may be utilizing the higher density of forage fishes and a different macroinvertebrate assemblage (Ecological Specialists, Inc 1997) found inside the chevrons.

Unlike the channel catfish, the catch rate for white bass on the inside was almost 2 times that on the outside and the observed size distribution of these fishes between these habitats is markedly different. The majority of white bass found inside were young of the year fishes, while most of those fish collected on the outside of the chevrons were one year or older, suggesting the interior habitat is providing nursery habitat for young white bass (Atwood, 2001).

Conclusion

The data collected thus far in this evaluation suggest that chevron dikes are providing useful and valuable habitat for a variety of riverine fishes. The outside of chevrons have been shown to provide excellent habitat for quality sized channel catfish, flathead catfish, common carp and a variety of minnows and shiners. Smallmouth bass, uncommon within this river reach, have also been collected along the outside of chevrons. From the species composition and the number of young of the year fishes present, the inside of chevrons appear to be providing backwater type habitat (at appropriate water levels) in a reach of river where such habitat is limited.

Literature Cited

Atwood, E.R. 2001. Cottonwood Island Chevron Dike Fisheries Evaluation Update. Design Memorandum No. 24 Avoid and Minimize Measures 2000 Progress Report. U.S. Army Engineering District - St. Louis, June 2001.

Ecological Specialists, Inc. 1997. Macroinvertebrates Associated with Habitats of Chevron Dikes in Pool 24 of the Mississippi River. Design Memorandum No. 24 Avoid and Minimize Measures 2000 Progress Report. U.S. Army Engineering District - St. Louis, December 1997.

Table 1-1. Sampling dates and electrofishing efforts for Cottonwood Island chevrons, 1993-2005

Sampling date	Station name	effort(min)
12-Jun-98	Cottonwood MCB	20
21-Jul-95	Drift Island Slough	60
12-Aug-96	Drift Island Slough	60
9-Sep-96	Drift Island Slough	15
8-Oct-96	Drift Island Slough	15
4-Aug-97	Drift Island Slough	60
6-Aug-98	Drift Island Slough	60
25-Aug-99	Drift Island Slough	60
29-Aug-00	Drift Island Slough	60
21-Aug-01	Drift Island Slough	60
13-Aug-02	Drift Island Slough	60
11-Aug-03	Drift Island Slough	60
9-Aug-04	Drift Island Slough	60
21-Jul-05	Drift Island Slough	60
14-Oct-98	Head of Bay Island	20
26-Aug-99	Head of Bay Island	15
23-Sep-99	Head of Bay Island	20
22-May-00	Head of Bay Island	20
29-Sep-00	Head of Bay Island	15
18-Oct-00	Head of Bay Island	15
21-Aug-01	Head of Bay Island	20
20-Sep-01	Head of Bay Island	15
17-Oct-01	Head of Bay Island	15
19-Sep-02	Head of Bay Island	15
27-Jun-03	Head of Bay Island	18
24-Jul-03	Head of Bay Island	17
22-Jul-04	Head of Bay Island	20
15-Sep-05	Head of Bay Island	15
14-Oct-93	Lower Chevron Inside	9
12-Sep-95	Lower Chevron Inside	16
14-Aug-96	Lower Chevron Inside	15
16-Jul-97	Lower Chevron Inside	15
12-Jun-98	Lower Chevron Inside	15
17-Aug-98	Lower Chevron Inside	15
14-Oct-93	Upper Chevron Inside	9
2-Aug-95	Upper Chevron Inside	14
12-Sep-95	Upper Chevron Inside	16
11-Oct-95	Upper Chevron Inside	14
14-Aug-96	Upper Chevron Inside	15
9-Sep-96	Upper Chevron Inside	15
8-Oct-96	Upper Chevron Inside	15
16-Jul-97	Upper Chevron Inside	10
26-Sep-97	Upper Chevron Inside	15
12-Jun-98	Upper Chevron Inside	15
17-Aug-98	Upper Chevron Inside	15
14-Oct-98	Upper Chevron Inside	15
26-Aug-99	Upper Chevron Inside	15
23-Sep-99	Upper Chevron Inside	12
22-May-00	Upper Chevron Inside	12
29-Aug-00	Upper Chevron Inside	15
29-Sep-00	Upper Chevron Inside	15
18-Oct-00	Upper Chevron Inside	15
27-Jul-01	Upper Chevron Inside	15
21-Aug-01	Upper Chevron Inside	17
20-Sep-01	Upper Chevron Inside	15
17-Oct-01	Upper Chevron Inside	15
13-Aug-02	Upper Chevron Inside	15
19-Sep-02	Upper Chevron Inside	15
17-Oct-02	Upper Chevron Inside	15
27-Jun-03	Upper Chevron Inside	15
24-Jul-03	Upper Chevron Inside	15
22-Jul-04	Upper Chevron Inside	15
9-Jun-05	Upper Chevron Inside	15
14-Oct-93	Lower Chevron Outside	9
12-Sep-95	Lower Chevron Outside	16
14-Aug-96	Lower Chevron Outside	15
9-Sep-96	Lower Chevron Outside	15
8-Oct-96	Lower Chevron Outside	15
16-Jul-97	Lower Chevron Outside	15
17-Aug-98	Lower Chevron Outside	15
14-Oct-93	Upper Chevron Outside	9
2-Aug-95	Upper Chevron Outside	14
12-Sep-95	Upper Chevron Outside	16
11-Oct-95	Upper Chevron Outside	14
14-Aug-96	Upper Chevron Outside	15
9-Sep-96	Upper Chevron Outside	15
8-Oct-96	Upper Chevron Outside	15
16-Jul-97	Upper Chevron Outside	10
26-Sep-97	Upper Chevron Outside	15
12-Jun-98	Upper Chevron Outside	20
17-Aug-98	Upper Chevron Outside	15
14-Oct-98	Upper Chevron Outside	15
26-Aug-99	Upper Chevron Outside	15
23-Sep-99	Upper Chevron Outside	12
22-May-00	Upper Chevron Outside	12
29-Aug-00	Upper Chevron Outside	15
29-Sep-00	Upper Chevron Outside	15
18-Oct-00	Upper Chevron Outside	15
27-Jul-01	Upper Chevron Outside	15
21-Aug-01	Upper Chevron Outside	18
20-Sep-01	Upper Chevron Outside	15
17-Oct-01	Upper Chevron Outside	15
13-Aug-02	Upper Chevron Outside	20
19-Sep-02	Upper Chevron Outside	15
17-Oct-02	Upper Chevron Outside	15
27-Jun-03	Upper Chevron Outside	15
24-Jul-03	Upper Chevron Outside	19
22-Jul-04	Upper Chevron Outside	20
9-Jun-05	Upper Chevron Outside	16
15-Sep-04	Upper Chevron Outside	17
	Total effort to date	2011

Table 1-2. Composition of fishes collected with boat electrofishing at Cottonwood Island Chevron Dikes study area, 1993-2005.

	Chevron Inside		Chevron Outside		Chevron total		Head of Bay Is.		Drift Is. Slough		All Stations	
sampling effort (min)	504		557		1061		240		690		2011	
Species	N	N/15min	N	N/15min	N	N/15min	N	N/15min	N	N/15min	N	N/15min
Paddlefish									1	0.022	1	0.008
Shortnose gar	6	0.179			6	0.085	5	0.313	7	0.152	18	0.136
Longnose gar									7	0.152	7	0.053
Bowfin									37	0.804	37	0.279
American eel			3	0.081	3	0.042					3	0.023
Skipjack herring	1	0.030			1	0.014	1	0.063	1	0.022	3	0.023
Gizzard shad	1277	38.006	275	7.406	1552	21.942	33	2.063	548	11.913	2133	16.070
Threadfin shad	2	0.060			2	0.028					2	0.015
Mooneye	1	0.030	4	0.108	5	0.071					5	0.038
Bighead carp	3	0.089			3	0.042			1	0.022	4	0.030
Silver carp									2	0.043	2	0.015
Goldfish	4	0.119			4	0.057			3	0.065	7	0.053
Carp	63	1.875	144	3.878	207	2.926	79	4.938	184	4.000	470	3.541
Carp x Goldfish hybrid									1	0.022	1	0.008
Central stoneroller			2	0.054	2	0.028	1	0.063			3	0.023
Suckermouth minnow	5	0.149			5	0.071					5	0.038
Silver chub	7	0.208	12	0.323	19	0.269			15	0.326	34	0.256
Silvery minnow	6	0.179	35	0.943	41	0.580	6	0.375			47	0.354
Spotfin shiner	153	4.554	410	11.041	563	7.959	107	6.688	5	0.109	675	5.085
Red shiner	14	0.417	48	1.293	62	0.877	34	2.125			96	0.723
Bluntnose minnow	11	0.327	7	0.189	18	0.254			1	0.022	19	0.143
Bullhead minnow	569	16.935	80	2.154	649	9.175	26	1.625	81	1.761	756	5.696
Emerald shiner	726	21.607	1319	35.521	2045	28.911	252	15.750	4	0.087	2301	17.336
Silverband shiner	1	0.030			1	0.014					1	0.008
River shiner	74	2.202	47	1.266	121	1.711	1	0.063			122	0.919
Bigmouth shiner			1	0.027	1	0.014					1	0.008
Sand shiner	9	0.268	19	0.512	28	0.396					28	0.211
Channel shiner	195	5.804	318	8.564	513	7.253	15	0.938	2	0.043	530	3.993
Spottail shiner	4	0.119			4	0.057					4	0.030
Shiner spp.	13	0.387			13	0.184					13	0.098
Bigmouth buffalo	20	0.595	1	0.027	21	0.297	21	1.313	154	3.348	196	1.477
Smallmouth buffalo	71	2.113	30	0.808	101	1.428	13	0.813	350	7.609	464	3.496
Black buffalo	1	0.030			1	0.014	4	0.250	19	0.413	24	0.181
Carpsucker spp.	14	0.417			14	0.198					14	0.105
Quillback	15	0.446	2	0.054	17	0.240			2	0.043	19	0.143
River carpsucker	119	3.542	3	0.081	122	1.725	3	0.188	52	1.130	177	1.334
Highfin carpsucker	1	0.030			1	0.014					1	0.008
Spotted sucker			1	0.027	1	0.014			8	0.174	9	0.068
Shorthead redhorse	4	0.119	14	0.377	18	0.254	5	0.313	11	0.239	34	0.256
Golden redhorse	3	0.089			3	0.042	2	0.125	1	0.022	6	0.045
Channel catfish	50	1.488	147	3.959	197	2.785	26	1.625	75	1.630	298	2.245
Flathead catfish	20	0.595	163	4.390	183	2.587	22	1.375	58	1.261	263	1.981
Freckled madtom			2	0.054	2	0.028	1	0.063	1	0.022	4	0.030
Mosquitofish	23	0.685	1	0.027	24	0.339	1	0.063	57	1.239	82	0.618
Brook silverside	3	0.089			3	0.042			3	0.065	6	0.045
White bass	37	1.101	22	0.592	59	0.834	9	0.563	8	0.174	76	0.573
Yellow bass	4	0.119	1	0.027	5	0.071					5	0.038
Black crappie	12	0.357			12	0.170	25	1.563	236	5.130	273	2.057
White crappie	2	0.060			2	0.028	1	0.063	77	1.674	80	0.603
Largemouth bass	146	4.345	80	2.154	226	3.195	27	1.688	237	5.152	490	3.692
Smallmouth bass			12	0.323	12	0.170	1	0.063			13	0.098
Warmouth	8	0.238			8	0.113			17	0.370	25	0.188
Green sunfish	158	4.702	45	1.212	203	2.870	5	0.313	17	0.370	225	1.695
Bluegill x Green sunfish	1	0.030			1	0.014			1	0.022	2	0.015
Bluegill	451	13.423	115	3.097	566	8.002	166	10.375	2057	44.717	2789	21.012
Redear sunfish	1	0.030			1	0.014			2	0.043	3	0.023
Orangespotted sunfish	141	4.196	3	0.081	144	2.036	6	0.375	519	11.283	669	5.040
Walleye									1	0.022	1	0.008
Sauger	4	0.119			4	0.057			2	0.043	6	0.045
Slenderhead darter			4	0.108	4	0.057	1	0.063	2	0.043	7	0.053
Logperch	1	0.030	2	0.054	3	0.042			2	0.043	5	0.038
Mud darter									4	0.087	4	0.030
Freshwater drum	190	5.655	97	2.612	287	4.057	39	2.438	180	3.913	506	3.812
Total of fish collected	4644	138.214	3469	93.420	8113	114.698	938	58.625	5053	109.848	14104	106.258
Number of species collected	46		36		53		32		44		59	

Table 1-3. Summary of fishes collected with A.C. electrofishing at Cottonwood Island Chevron Dikes study area, 1993-2005.

	Chevrons				Control sites			
	Lower Inside	Upper inside	Lower outside	Upper outside	Head of Bay Is.	MCB	Drift Is. Slough	All Stations
sampling effort (min)	85	419	100	457	240	20	690	2011
Species								
Paddlefish							1	1
Shortnose gar		6			5		7	18
Longnose gar							7	7
Bowfin							37	37
American eel				3				3
Skipjack herring		1			1		1	3
Gizzard shad	215	1062	41	234	33	5	548	2138
Threadfin shad	1	1						2
Mooneye		1		4				5
Silver carp							2	2
Bighead carp	1	2					1	4
Goldfish		4					3	7
Carp	7	56	27	117	79	4	184	474
Carp x Goldfish hybrid							1	1
Central stoneroller				2	1			3
Suckermouth minnow	3	2						5
Silver chub		7	2	10			15	34
Silvery minnow		6		35	6			47
Spotfin shiner	52	101	57	353	107	3	5	678
Red shiner	1	13	5	43	34			96
Bluntnose minnow	1	10		7			1	19
Bullhead minnow	114	455	7	73	26	1	81	757
Emerald shiner	119	607	194	1125	252	3	4	2304
Silverband shiner	1							1
River shiner	20	54	13	34	1	2		124
Bigmouth shiner				1				1
Sand shiner		9	1	18				28
Channel shiner	5	190	8	310	15	2	2	532
Spottail shiner		4						4
Shiner spp.		13						26
Bigmouth buffalo	10	10		1	21		154	196
Smallmouth buffalo	27	44	8	22	13	2	350	466
Black buffalo	1				4		19	24
Carpsucker spp.		14						28
Quillback	5	10		2		1	2	20
River carpsucker	30	89		3	3	3	52	180
Highfin carpsucker		1						1
Spotted sucker				1			8	9
Shorthead redhorse		4	4	10	5	5	11	39
Golden redhorse	1	2			2	1	1	7
Channel catfish	8	42	56	91	26	2	75	300
Flathead catfish	3	17	27	136	22		58	263
Freckled madtom				2	1		1	4
Mosquitofish		23		1	1		57	82
Brook silverside		3					3	6
White bass	14	23	5	17	9	1	8	77
Yellow bass		4	1					5
Black crappie	3	9			25		236	273
White crappie		2			1		77	80
Largemouth bass	11	135		80	27		237	490
Smallmouth bass			1	11	1			13
Warmouth		8					17	25
Green sunfish	4	154		45	5		17	225
Bluegill x Green sunfish		1					1	2
Bluegill	23	428	4	111	166	1	2057	2790
Redear sunfish		1					2	3
Orangespotted sunfish	23	118		3	6		519	669
Walleye							1	1
Sauger		4					2	6
Slenderhead darter				4	1		2	7
Logperch		1		2			2	5
Mud darter							4	4
Freshwater drum	39	151	18	79	39	4	180	510
Total number of fish collected	742	3902	479	2990	938	40	5053	14144
Total number of fish collected/15min electrofising	130.94	139.69	71.85	98.14	58.63	30.00	109.85	105.50
Number of fish species collected	28	44	19	35	32	16	44	59

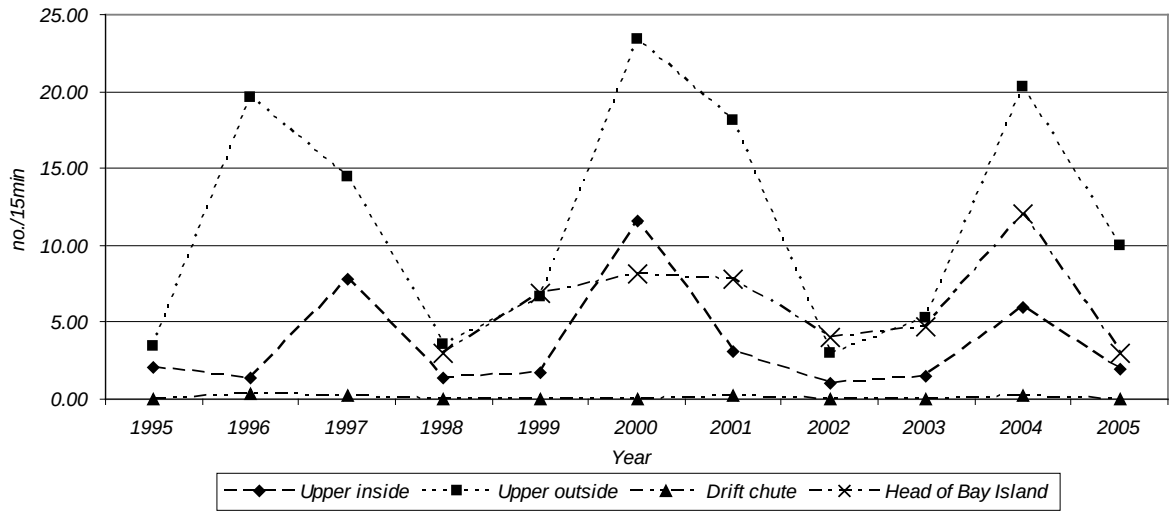

Figure 1. Annual catch rates of spotfin shiner at four chevron dike study sites.

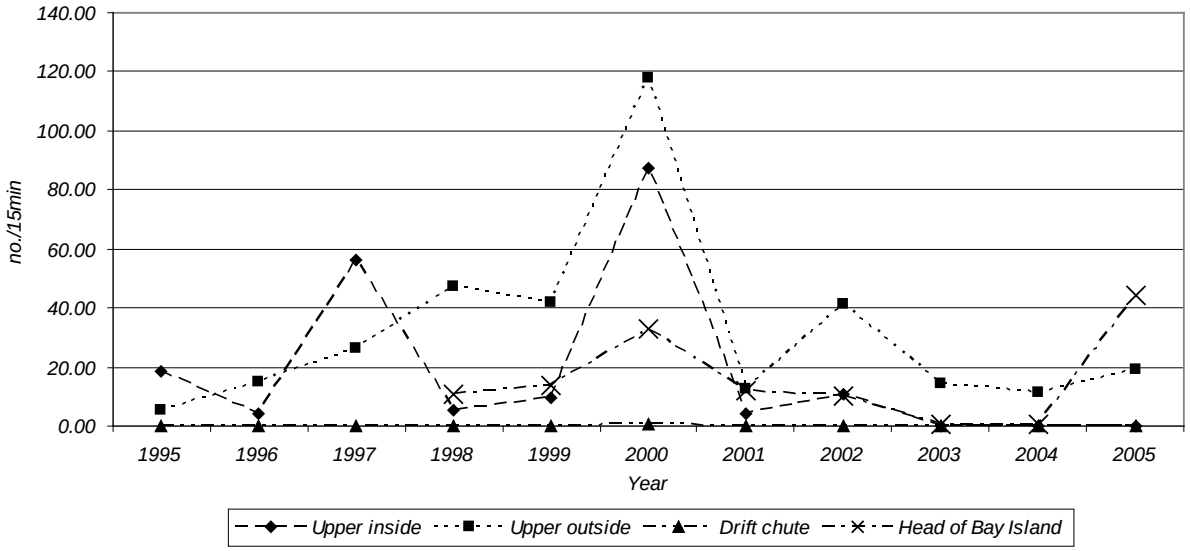

Figure 2. Annual catch rates of emerald shiner at four chevron dike study sites.

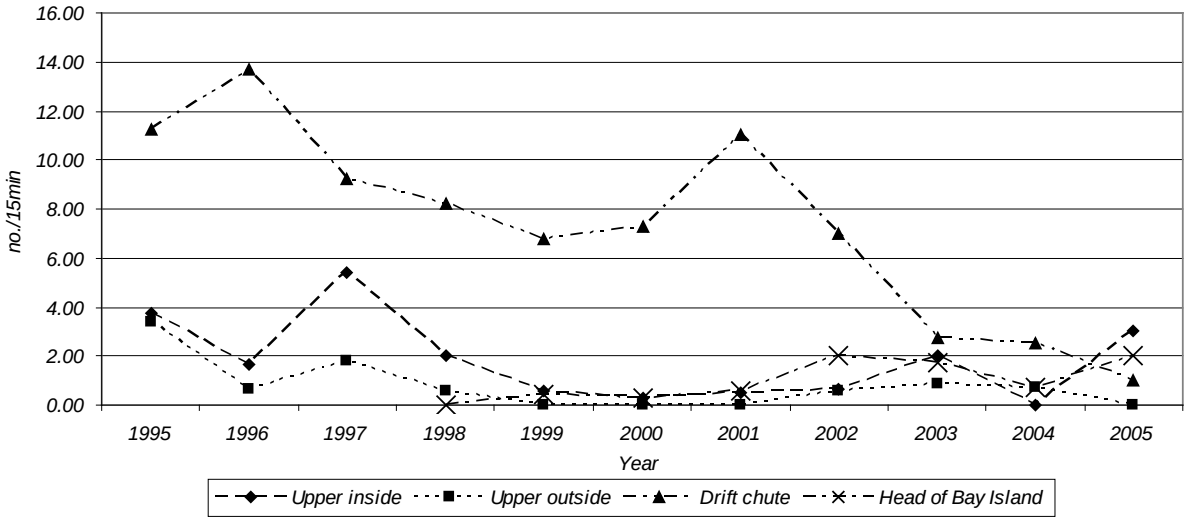

Figure 3. Annual catch rates of smallmouth buffalo at four chevron dike study sites.

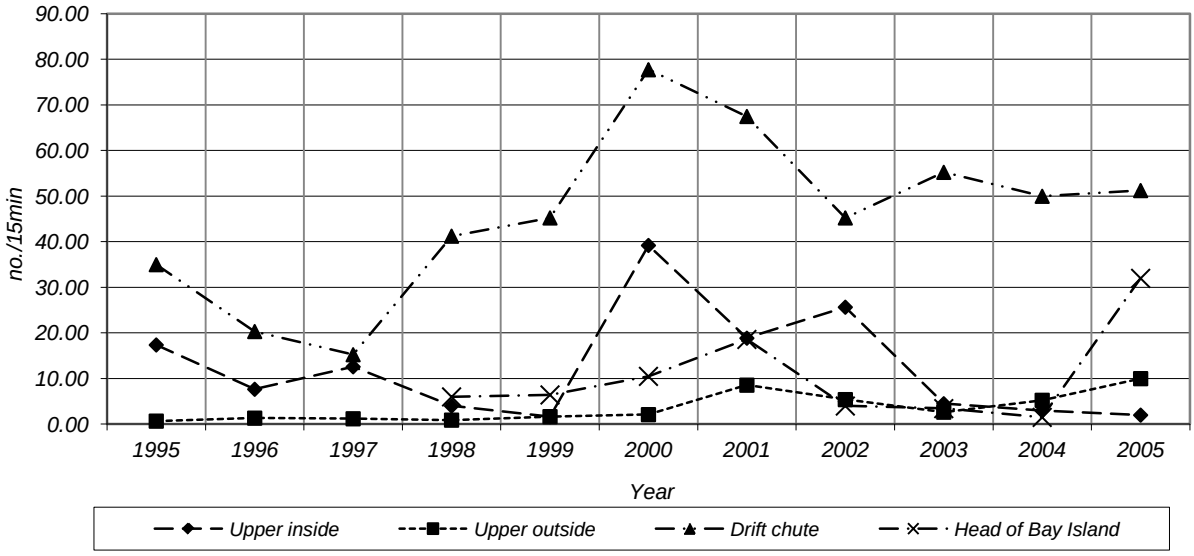

Figure 4. Annual catch rates of bluegill at four chevron dike study sites.

Appendix B

A & M TRIP REPORT

A & M TRIP REPORT

Date: 31 July 2006
Purpose: Vegetation Survey of Chevron Islands (R.M. 289.3 - 289.7)
Participants: Present from PM-E were T. Miller, Jason Farmer, and Amanda Oliver

Summary:
The construction of three prototype chevron dikes in Pool 24 at river mile 289.5 was first suggested during a 1991 meeting between the St. Louis District and the River Regulatory Team. These dikes were proposed as an alternative to the installation of a rock closing structure. The proposed dikes' purposes were to help divert water into the thalweg, provide a location to dump dredged material, and produce new habitat for aquatic and terrestrial organisms. In October, 1993 three chevron dikes were constructed near river mile 289.5. Dredged material was placed on the channel side and interior of each chevron in November, 1993. Illinois Department of Natural Resources (IDNR) began fish sampling in 1993 to determine fish use of the chevron dike habitat. Fish diversity and numbers were so high that IDNR requested no additional dredged material be placed behind chevrons 1 and 3. Additional material was placed behind the second chevron in August, 1999. The habitat created by the chevron dikes and associated islands has been monitored for mussels, invertebrates (1994 – 96), fish (1993 – 2006), and vegetation (1996 and 2006) since their installation (USACE 2004). This report details the 2006 vegetation survey of the chevron dikes and associated islands and their use by terrestrial animals. This data will be compared to similar data gathered during a 1996 terrestrial survey (USACE 2004). All plant species present and any visible animal and human use on the three islands was recorded and photographed to make a permanent record of vegetation establishment (available on request).

Blackbird Island:
Observations were made of the bullnose at the head of Blackbird Island (river mile 292R) during the trip to the chevrons. The bullnose remains open at both ends with a permanent barrier around the upper end of the island. A small sandbar has formed at the tip of Blackbird Island and is covered in dense grass, sedge, and ammania. The bullnose is also heavily vegetated with cocklebur, dogbane, and cottonwood saplings.

Chevron Islands:
All three islands had a maximum height of approximately 6ft (1.8m) above water level. The highest portion of the islands was located in the top (closest to the chevron dike) third of the island. Substrate on the high portion of the island was typically pea gravel size. Substrate on the head two-thirds of the island consisted of a sand silt mixture while the tail (furthest from the chevron) third was predominantly sand. The island head tapered down to a scour pool between the island and the chevron. All islands tapered more steeply toward the scour pool and more gradually downriver. The islands had a diverse vegetative assembly (Table 1). The tail half of each island formed a large grass covered sandflat interspersed with forb species with vegetation density decreasing toward the tail. Woody invasion was occurring in the high areas of the islands and on the chevron dikes. The head of the islands were covered by mesic species: nutsedge,

ammania, and pimpernel. Arrowheads were growing in the shallow water along the upper part of the right descending island bank. Species along the dikes were a subset of the island species with cocklebur, dogbane, and cottonwood saplings predominating. Numerous shorebird tracks were evident along the shore of all islands. Birds observed included: killdeer, spotted sandpipers, least sandpipers, turkey vultures, Canada geese, and red-winged blackbirds. Large and small wading bird tracks were also present. All islands had considerable evidence of human use including fire sites on each island.

Table 1. The location (Loc.) and names of plant species found on the three chevron islands and dikes during the 2006 survey. Plants with grey highlights were also found in 1996.

2006 Vegetation Survey: RM 289 Chevron Islands

Loc.	Common Name	Scientific Name	Loc.	Common Name	Scientific Name
	Trees:			**Forbs:**	
A	Silver maple	*Acer saccharinum*	A	Pigweed	*Amaranthus sp.*
2, 3	Green ash	*Fraxinus pennsylvanica*	A	Red ammannia	*Ammannia coccinea*
A	Mulberry	*Morus alba*	A	Dogbane	*Apocynum cannabinum*
A	Sycamore	*Platanus occidentalis*	A	Sweet wormwood	*Artemesia annua*
A	Cottonwood	*Populus deltoides*	A	Swamp milkweed	*Asclepias incarnata*
1, 3	Black locust	*Robinia pseudoacacia*	3	Trumpetvine	*Campsis radicans*
3	Carolina willow	*Salix caroliniana*	A	Spreading sandmat	*Chamaesyce humistrata*
A	Sandbar willow	*Salix exigua*	A	Horseweed	*Conyza canadensis*
A	Black willow	*Salix nigra*	3	Dodder vine	*Cuscuta sp.*
			A	Yellow nut sedge	*Cyperus esculentus*
	Grasses:		A	Late boneset	*Eupatorium serotinum*
1, 2	Crab grass	*Digitaria* sp.	A	Small white morning glory	*Ipomea lacunosa*
A	Barnyard grass	*Echinochloa crus-galli*	A	Water willow	*Justicia americana*
A	Love grass	*Eragrosits hypnoides*	A	False pimpernel	*Lindernia anagallidea*
2, 3	Rice cut grass	*Leersia oryzoides*	1, 3	Climbing hemp vine	*Mikania scandens*
A	Sprangletop	*Leptochloa panicea*	2, 3	Monkeyflower	*Mimulus sp.*
A	Switch grass	*Panicum sp.*	1	Primrose	*Oenothera sp.*
A	Green Foxtail	*Setaria sp.*	A	Frog fruit	*Phyla nodoflora*
			A	Smartweed	*Polygonum lapathifolium*
	Shrubs:		1, 3	Curly dock	*Rumex crispus*
A	Button bush	*Cephalanthus occidentalis*	A	Arrowhead	*Sagittaria* sp.
A	Marsh mallow	*Hibiscus moscheutos*	1, 3	Purple verbena	*Verbena hastata*
			A	Wild grape	*Vitis sp.*
			A	Cockleburr	*Xanthium strumarium*
			2	Unknown mint 1	
			2	Unknown mint 2	

1 – Occurs at chevron island 1
2 – Occurs at chevron island 2
3 – Occurs at chevron island 3
A – Occurs at all three chevron islands

Chevron # 1:

This chevron is located on the upstream end of the series at RM 289.7L. The island and associated scour pool covered 2.5 acres and 1.9 acres respectively (Table 2). The island tip was connected to the left descending portion of the chevron dike. The depth of the pool varied from 5' (1.5 m) at the center to > 12' (> 3.7 m) at the tip. The pool could be accessed by boat on the right descending side. Vegetation on the island transitioned from dense mesic forbs at the top to a mix of forbs and tree species to less dense xeric grass

and forbs interspersed with bare sand (Table 1). Some cottonwood trees on the island surpassed 6 ft and were two years or older.

Indications of animal use included numerous turtle nests, raccoon scat, and goose droppings and tracks. There were numerous small fish in the shallow water by the island and one dead shovelnose sturgeon on the island. Additionally, mussel shells from one of each of the following were found on the shore: three ridge, fragile paper shell, and warty back. Signs of human use included one trail running along each bank of the island.

Table 2. Approximate size of the three chevron dike islands and associated scour pools calculated from a February, 2006 aerial photograph[1].

	English			Metric		
Island	**Lgth (yrds)**	**Wdth (yrds)**	**Area (acres)**	**Lgth (m)**	**Wdth (m)**	**Area (m^2)**
1	348.6	51.8	2.466	318.8	47.3	9981.55
2	973.7	146.7	17.86	890.3	134.1	72291.13
3	289.1	77.5	2.44	264.4	70.9	9876.66
Pool	**Lgth $(yrds)^2$**	**Wdth (yrds)**	**Area (acres)**	**Lgth $(m)^2$**	**Wdth (m)**	**Area (m^2)**
1		204.7	1.93		62.4	7832.36
2		253.8	1.96		77.4	7940.87
3		279.1	1.64		85.1	6621.33

[1] Length of pool could not be accurately measured because of variability in the island shore.
[2] February 2006 river stage – 11.96; 31 July 2006 river stage Louisiana, MO– 12.05 (USACE 2006)

Chevron # 2:
This chevron island was the largest of the three covering 17.9 acres (Table 2). The scour pool encompassed 2.0 acres and was completely isolated form the river (Table 2). A shallow channel < 2' deep and 48' wide (0.6 m by 14.6 m) began at the top of the island and deepened as it progressed towards the downriver tip separating the island from the riverbank. There were several bighead carp in this channel. On the left descending bank, an inlet had formed approximately one-third of the way from the top and scouring was evident on the inside bank. Sand waves were present below this inlet providing excellent shallow water habitat and an undulating shoreline. Several sandpipers, numerous killdeer, and large and small wading bird tracks were present in this area. Vegetation was dense with no visible bare ground on the upper half of the island. Yellow nutsedge was the predominate species. Sandbar and black willow formed a dense stand in the middle one-third of the island with trees up to 20' (6 m) tall. The lower third of the island was more xeric with bare ground and grass predominating. There were several sycamore trees along the dike with a dbh of 6" (15.2 cm).

Indications of animal use included numerous turtle nests and tracks, and a beaver slide on the left descending bank. There were numerous small fish in the shallow water by the island and one dead: shovelnose sturgeon, shortnose gar, and channel catfish on the island. Signs of human use included two duck blinds.

Chevron # 3:
The island behind this chevron was larger than island one but smaller than island two and covered 2.4 acres (Table 2). The scour pool encompassed 1.6 acres, was connected to the river on both sides, and was accessible by boat (Table 2). This island was the most heavily vegetated with excellent migratory bird forage. The top of the island was covered in dense yellow nutsedge and red ammania. Some willows on the island and sycamores on the dike appeared to be two to three years old.

There were 36 geese at the top and bottom of the island. Other animals observed include: bass, great blue heron, gar, red-winged blackbird, and a finch. There were also turtle eggs and signs of beaver on the island.

Comparison of 1996 and 2006:
The islands have all increased in size since the 1996 survey. Some physical features of the islands still resemble those found in 1996. Island #1 remains connected to the dike on the left descending bank. The sand waves and closed pool found on island #2 during the 1996 survey are still present. However, movement of the island substrates has also occurred. A channel has formed between island #2 and the riverbank. An inlet has also formed on the left descending bank of island #2. Island #3 is no longer connected to the dike on the right descending bank.

Table 3. The location (Loc.) and names of plant species found on the three chevron islands and dikes during the 1996 terrestrial survey (USACE 1996).

1996 Terrestrial Survey Chevron Islands

Loc	Com. Name	Scientific Name	Loc	Com. Name	Scientific Name
	Trees:			**Forbs:**	
2	Silver maple	*Acer saccharinum*	A	Pigweed 1	*Amaranthus sp.*
2	Sycamore	*Platanus occidentalis*	A	Pigweed 2	*Amaranthus sp.*
A	Cottonwood	*Populus deltoides*	2	Red ammannia	*Ammannia coccinea*
2	Sandbar willow	*Salix exigua*	A	Beggarticks	*Bidens sp.*
			A	Nut sedge 1	*Cyperus sp.*
	Grasses:		A	Nut sedge 2	*Cyperus sp.*
A	Barnyard grass	*Echinochloa crus-galli*	2	Flat sedge	*Cyperus sp.*
A	Love grass	*Eragrosits sp.*	A	Morning glory	*Ipomea sp.*
A	Wild millet		A	Carpetweed	*Mollugo verticillata*
A	Green Foxtail	*Setaria sp.*	A	Smartweed	*Polygonum sp.*
			A	Smartweed	*Polygonum lapathifolium*
			A	Curly dock	*Rumex crispus*
			A	Arrowhead	*Sagittaria* sp.
			A	Cockleburr	*Xanthium strumarium*
			A	Unknown mint	
			2	Sessil-flowered cress	

A – plant present on all islands
2 – plant present on chevron dike island 2

The density and diversity of the vegetation has changed considerably on the islands. In 1996 the vegetation was described as sparse and pictures indicate that the islands and

dikes had more bare ground than vegetated ground. The vegetation during the 2006 survey was dense with little bare ground on the top half of the islands transitioning to a mixture of sand and grass on the bottom third of the islands. There was new plant colonization and species turnover on the islands. The number of plant species identified on the islands has increased from 24 species in 1996 to 44 species in 2006 (Table 1, 3). Nine species identified on the island in 1996 were not found in 2006. Additional trees species have colonized the islands and existing trees have increased in size (Table 1, 3). On each island, the area colonized by trees has also increased. Finally, there continues to be considerable animal and human use of the islands.

There are two main factors that could explain the vegetation differences observed in 2006 compared to 1996. The high water stages in May through July of 1996 resulted in submergence of large portions of the three chevron islands. At the time of the survey, the majority of the islands had been above water for less than 50 days (Fig. 1). This submergence would prevent extensive vegetation growth like that observed in 2006. Conversely, the stage level had been low for the majority of 2006 allowing for extensive vegetation (Fig. 1). The second contributing factor is island age. The islands had been established for only three years during the 1996 survey. The substrate was predominantly loose sand which is not conducive to vegetation. The dense vegetation observed in the upper two thirds of the islands during the 2006 survey required time and sufficient suitable substrate, and the vegetations' presence may be a sign of continued succession and silt build up.

Monitoring Plan:
We plan to continue monitoring the three chevron dike islands every five years to document changes in island shape and vegetation. Monitoring will be conducted in the fall when the water stage is similar to previous years. Knowledge gained from this monitoring will aide the corps in understanding what type of habitat the islands provide and how that habitat changes with time.

We will continue to identify all plant species present on the island and dike to monitor species turnover. We will estimate island and pool size and record pool depth in the center of the pool. Any large trees and animal presence will also be noted. Finally, we will continue to take photographs at previous locations to maintain a photographic record of island change.

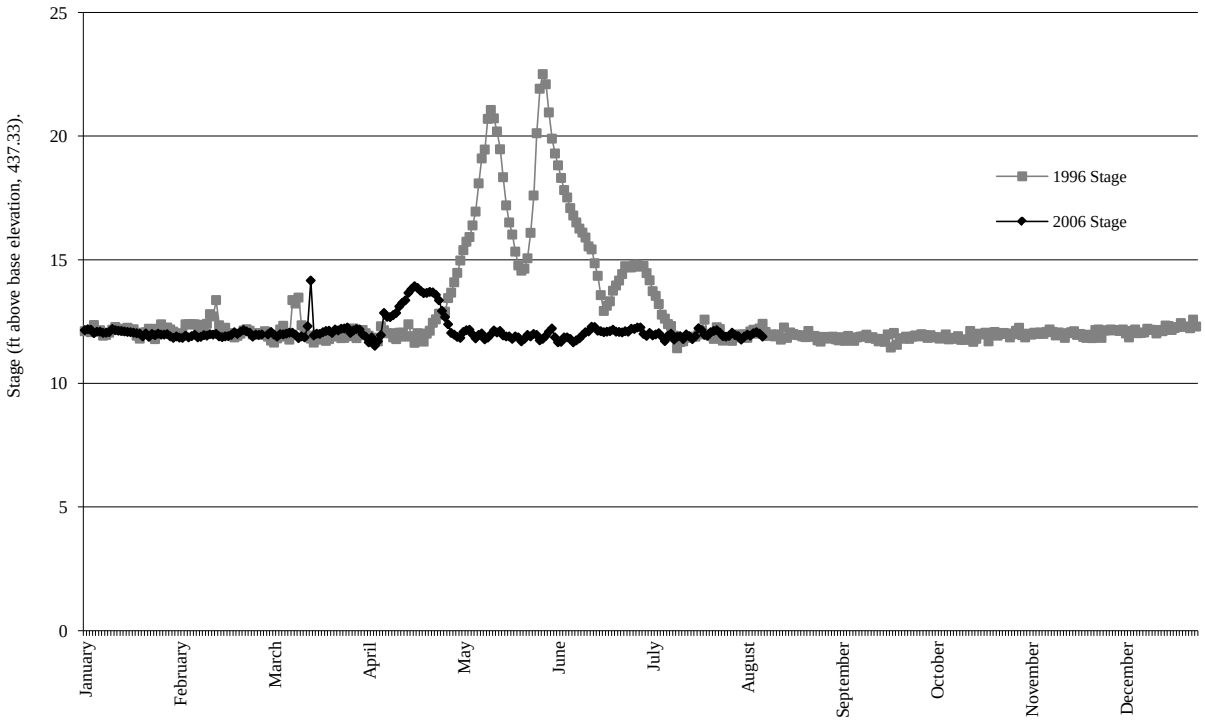

Figure 1. The 1996 and 2006 river stages* at river mile 282.9 near Louisiana, Missouri.
*Data from USACE 2006. At the time of this report, preliminary data for 2006 were only available to 10 August 2006.

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Submitted: 14 September 2006

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Appendix C

Slim Island Bullnose
Preliminary Fisheries Evaluation

Slim Island Bullnose
Preliminary Fisheries Evaluation

Prepared for:
U.S. Army Corps of Engineers
St. Louis District

Prepared by:
U.S. Army Corp of Engineers
St. Louis District

August 2006

SLIM ISLAND BULLNOSE – RM 267R
Fish Collection Summary
31 July 2003 & 9 September 2004

The interior and exterior of the bullnose at the head end of Slim Island were sampled by electrofishing on July 31, 2003 and September 9, 2004. This bullnose, a form of chevron/off-bankline revetment was constructed in 1996 as a result of an agreement reached with partners on the 1995 River Resources Action Team Annual Coordination Boat Trip. The upstream end of the island was severely eroded by high water during the flood of 1993 which resulted in the loss of many large trees and all other vegetation. A large (50' high, 250' long) cutbank on the off-channel side of the island tip also developed. There was agreement among the team that such a bullnose would help limit excessive erosion of the island tip while providing habitat for a variety of fish species and allow sediment accretion on the interior of the structure close to the island, at the toe of the cutbank. The structure is constructed of graded "A" stone (Not more than 5% finer than ½ inch), with a crown elevation of 439 and notch elevation of 429. The bullnose is in the shape of a chevron, with the apex upstream into the current and the legs on the downstream end tied into the island, providing current protection along both sides as off-bank revetment. There is a notch in each leg, just above the island tie-in to allow ingress and egress by fish and other aquatic organisms as well as fishermen.

There was ample evidence of physical changes within the bullnose on the dates of the surveys. A 15' deep plunge pool has developed immediately below the upstream apex of the structure that decreases in depth along the legs of the chevron toward the island. Sediment has been forced out of the deep hole to form an area of accretion and associated shallow water across the base of the structure. The notch on the off-channel side was impassable by boat or by fish in July of 2003 and nearly impassable (2' to 3'deep) in September of 2004. The channel side notch was passable for both surveys, but barely so in 2003. A large amount of debris - logs, limbs and trees - has accumulated in the shallower water area forming excellent fish and turtle habitat. This area also provides excellent habitat for wading birds, such as the great blue heron. Small trees, such as cottonwood and sycamore have begun to invade the base of the cutbank on substrate deposited since the 1993 flood, and vines, such as Virginia creeper are invading the cutbank at the top. Thus, it appears that the bullnose has reduced the excessive erosion that occurs during high water events and all river stages down to flat pool. Small trees, again mostly cottonwood and willow, are also becoming established along the rock structure where enough sediment is present for rooting to occur. There was evidence of use by beavers and muskrats in and around the structure. A fisherman was present along the outside of the bullnose on the channel side of the island during the July, 2003 survey, and there were remnants of trotlines and bank poles along the outside of the off-channel side, extending downstream along the side of the island.

The attached fish electrofishing collection summaries (Tables 3-1 thru 3-5) includes the two survey dates and two habitat types present, lentic habitat (quiet water, inside the bullnose) and lotic habitat (outside the bullnose and affected by the flow of the river).

Fish species favoring the lentic habitat included shortnose gar, gizzard shad, freshwater drum and bluegill and other sunfishes. Those species favoring the flowing habitat included catfishes, large and smallmouth bass, carp (so many that most were not collected) and smallmouth buffalo. Electrofishing is generally more effective in lentic habitats because the fish are less likely to escape the electric field and are easier to net. Lotic samples are frequently much smaller in number, although substantially more fish may be present. The affects of the electric field are shorter lived due to the increased speed of the electrofishing boat, or the current pushing the electrodes under the bow of the boat, and the fish are more likely to escape capture. Fish species found in these respective habitats are similar to those reported by Atwood (ILDNR) for the same habitats in the Cottonwood Island chevrons and reported in Avoid and Minimize Progress Reports beginning in 1995.

Water quality parameters on both survey dates were within acceptable ranges, although dissolved oxygen on the inside of the bullnose in 2003 may have been limiting the presence of some species. The greatest number of fish and the greatest variety of fish were collected at the interface with the river on the channel side of the structure. Once away from the interface, shortnose gar, a species know to be tolerant to low oxygen levels, was the predominant species collected. The notches were deepened in 2005 in order to improve fish access and help improve dissolved oxygen levels during the summer months.

Table 3-1. Summary of all fish caught electrofishing at the bullnose at river mile 267 on 7-31-03 and 9-9-04.

River Mile 267 - Slim Island Bullnose - Fish Collection Summary - 7-31-03 & 9-9-04		
Species	**Number**	**Size Range - mm**
Longnose Gar	1	633
Shortnose Gar	21	380-640
Gizzard Shad	43	81-359
Bigmouth Buffalo	7	400-556
Blue Sucker	1	Observed
River Carpsucker	7	290-443
Smallmouth Buffalo	5	275-610
Common Carp	23	425-662
Channel Catfish	8	341-511
Flathead Catfish	17	140-391
Black Striped Topminnow	1	Not Taken
Mosquito Fish	1	Not Taken
White Bass	6	65-379
Bluegill	3	72-100
Green Sunfish	1	51-82
Smallmouth Bass	5	100-191
Largemouth Bass	1	317
Orange-spotted Sunfish	4	44-68
Freshwater Drum	14	32-500
Exotics		
Bighead Carp	1	649
Grass Carp	1	677
Silver Carp	1	351
Number Species	**21**	
Number Fish	**172**	

Table 3-2. Electrofishing sample of inside of bullnose at river mile 267 on 7-31-03 by Kevin Slattery, T. Miller, and Brian Johnson.

TIME OF DAY	0845	**CONDUCTIVITY**	435
SAMPLE EFFORT (secs)	547	**WATER TEMPERATURE (^{o}C)**	26.8
VOLTS	120	**DISSOLVED OXYGEN**	6
AMPS	14	**GAGE LOCATION**	Mosier
PULSE	120	**STAGE HEIGHT (ft)**	434.5
%	30		

Species	Length (mm)	Species	Length (mm)
Shortnose gar	380	Bighead carp	649
Shortnose gar	416	Common carp	425
Shortnose gar	430	Common carp	456
Shortnose gar	440	Common carp	459
Shortnose gar	450	Common carp	465
Shortnose gar	475	Common carp	513
Shortnose gar	540	Common carp	595
Shortnose gar	555	Bigmouth buffalo	445
Shortnose gar	560	Bigmouth buffalo	495
Shortnose gar	570	River carpsucker	290
Gizzard shad	81	River carpsucker	420
Gizzard shad	82	Smallmouth buffalo	275
Gizzard shad	86	Flathead catfish	155
Gizzard shad	133	Flathead catfish	175
Gizzard shad	225	Flathead catfish	270
Gizzard shad	225	Flathead catfish	345
Gizzard shad	241	White bass	216
Gizzard shad	250	White bass	230
Gizzard shad	252	White bass	280
Gizzard shad	260	Bluegill	100
Gizzard shad	265	Freshwater drum	58
Gizzard shad	270	Freshwater drum	71
Gizzard shad	270	Freshwater drum	235
Gizzard shad	291	Freshwater drum	246
Gizzard shad	303	Freshwater drum	275
Gizzard shad	331	Freshwater drum	449

Total Number of Fish **52**
Total Number of Species **11**

Table 3-3. Electrofishing sample of outside of bullnose at river mile 267 on 7-31-03 by Kevin Slattery, T. Miller, and Brian Johnson.

TIME OF DAY	0900	**CONDUCTIVITY**	435
SAMPLE EFFORT (secs)	684	**WATER TEMPERATURE (^{o}C)**	26.8
VOLTS	120	**DISSOLVED OXYGEN**	Not Taken
AMPS	14	**GAGE LOCATION**	Mosier
PULSE	120	**STAGE HEIGHT (ft)**	434.5
%	30		

Species	Length (mm)	Species	Length (mm)
Shortnose gar	544	Common carp	510
Shortnose gar	640	Common carp	515
Gizzard shad	156	Common carp	538
Gizzard shad	156	Smallmouth buffalo	610
Gizzard shad	175	Channel catfish	348
Gizzard shad	190	Channel catfish	378
Gizzard shad	200	Channel catfish	395
Gizzard shad	205	Channel catfish	420
Gizzard shad	215	Channel catfish	511
Gizzard shad	215	Flathead catfish	140
Gizzard shad	225	Flathead catfish	170
Gizzard shad	230	Flathead catfish	245
Common carp	370	Flathead catfish	250
Common carp	400	Flathead catfish	300
Common carp	445	Flathead catfish	391
Common carp	450	White Bass	65
Common carp	453	Bluegill	95
Common carp	470	Largemouth bass	317
Common carp	470	Smallmouth bass	170
Common carp	480	Freshwater drum	355
Common carp	508	Freshwater drum	498
Common carp	510		

Total Number of Fish **43**
Total Number of Species **11**

Table 3-4. Electrofishing sample of inside of bullnose at river mile 267 on 9-9-04 by Brian Johnson, Kip Runyon, and Dave Gates.

TIME OF DAY	1130	**CONDUCTIVITY**	356
SAMPLE EFFORT (secs)	1154	**WATER TEMPERATURE (^{o}C)**	21.7
VOLTS	120	**DISSOLVED OXYGEN**	6.8
AMPS	14	**GAGE LOCACTION**	mosier
PULSE	120	**STAGE HEIGHT (ft)**	435
%	40		

Species	Length (mm)	Species	Length (mm)
Shortnose gar	479	Bigmouth buffalo	462
Shortnose gar	490	Bigmouth buffalo	472
Shortnose gar	523	Bigmouth buffalo	536
Shortnose gar	540	Bigmouth buffalo	556
Shortnose gar	543	River carpsucker	365
Shortnose gar	574	River carpsucker	384
Shortnose gar	599	River carpsucker	384
Gizzard shad	85	River carpsucker	443
Gizzard shad	96	Smallmouth buffalo	418
Gizzard shad	112	Channel catfish	341
Gizzard shad	125	Flathead catfish	260
Gizzard shad	132	Flathead catfish	272
Gizzard shad	262	Flathead catfish	325
Gizzard shad	307	Mosquitofish	32
Gizzard shad	323	Bluegill	72
Gizzard shad	326	Green sunfish	82
Gizzard shad	341	Orangespotted sunfish	44
Gizzard shad	346	Orangespotted sunfish	45
Gizzard shad	352	Orangespotted sunfish	61
Gizzard shad	356	Orangespotted sunfish	68
Gizzard shad	379	Smallmouth bass	191
Gizzard shad	382	Freshwater drum	32
Gizzard shad	389	Freshwater drum	109
Common carp	483	Freshwater drum	275
Common carp	485	Freshwater drum	347
Common carp	640	Freshwater drum	425
Silver carp	351	Minnows	Not Taken
Bigmouth buffalo	400		

Total Number of Fish **54 (not including minnows)**
Total Number of Species **15**

Table 3-5. Electrofishing sample of outside of bullnose at river mile 267 on 9-9-04 by Brian Johnson, Kip Runyon, and Dave Gates.

TIME OF DAY	1230	**CONDUCTIVITY**	378
SAMPLE EFFORT (secs)	1126	**WATER TEMPERATURE (^{o}C)**	24.3
VOLTS	120	**DISSOLVED OXYGEN**	8.8
AMPS	13	**GAGE LOCATION**	mosier
PULSE	120	**STAGE HEIGHT (ft)**	435
%	40		

Species	Length (mm)
Longnose gar	633
Shortnose gar	542
Shortnose gar	565
Gizzard shad	344
Common carp	662
Grass carp	677
Green sunfish	51
River carpsucker	235
Smallmouth buffalo	120
Smallmouth buffalo	229
Channel catfish	388
Channel catfish	432
Flathead catfish	169
Flathead catfish	177
Flathead catfish	255
Flathead catfish	257
Blackstriped topminnow	100
White bass	348
White bass	500
Smallmouth bass	105
Smallmouth bass	119
Smallmouth bass	379
Freshwater drum	Not Taken

Total Number of Fish **23 (Not including minnows)**
Total Number of Species **14**

Appendix D

River Mile 266 Chevrons
Preliminary Fisheries Evaluation

River Mile 266 Chevrons
Preliminary Fisheries Evaluation

Prepared for:
U.S. Army Corps of Engineers
St. Louis District

Prepared by:
U.S. Army Corp of Engineers
St. Louis District

August 2006

RIVER MILE 266 (R) CHEVRONS
Fish Collection Summary
31 July 2003

The interior and exterior of the middle chevron at RM 266R was sampled by electrofishing on 31 July 2003. The chevron dike field (3 adjacent chevrons) was constructed in 1998 and 1999 in a downstream line to deflect flows to the main channel. The left leg of the downstream chevron (chevron 3) was not completed, leaving the interior unprotected from main channel currents [Editors note: this chevron was completed in 2006 but with a 50 foot notch at the middle of the leg]. These chevrons have been sampled multiple times for fisheries and physical data (See 2000, 2001 and 2002/2003 Avoid and Minimize Progress Reports). The final fisheries sample was collected in 2003. Sampling indicates that fish are using these chevrons during all seasons of the year. It appears that fish are actively seeking the interior habitat created by the chevrons as over-wintering habitat. In fact, fish densities, estimated by hydroacoustic samples, were six times higher in winter samples than in summer samples. Sampling of the interior of the upper two chevrons with electrofishing, purse seining and trawling have collected up to 10 species of fish and nearly a thousand individuals. Predominant species in the samples were freshwater drum and channel catfish estimated to be mostly of age classes I – III.

The electrofishing sample collected in July of 2003 was comprised entirely of fish already known to inhabit the interior and exterior of the chevrons. All species collected at this series of chevron dikes are similar to samples collected at other chevrons and the bullnose on Slim Island as seen in Appendices A, B, and C. However, the number of fish using these chevrons in winter far exceeds numbers collected at any other location. This may be an indication that over-wintering habitat is limiting in this stretch of river, or may be a reflection of multiple samples with a variety of gear types. This series of chevrons is providing excellent fish habitat and has likely improved since construction of the downstream, channel side leg of chevron 3 was completed. The attached fish collection summaries are a composite of two samples, one each on the inside and outside of the chevron (Tables 4-1 thru 4-3).

The objectives for the location and construction of this series of chevrons were two-fold: 1) to concentrate flows more toward the main part of the channel, and thus reduce a chronic dredging problem, and 2) to improve aquatic habitat diversity by utilizing chevron dikes rather than stone dikes placed perpendicular to the shoreline. Both objectives have been met, the amount of dredging at the site has decreased from an average of 1,125.6 cubic yards per year to 556.6 cubic yards per year, and fish use of the chevrons in summer and winter appears much greater than would have been expected from fish use at standard stone dikes. At this time, there are no further plans to continue fish monitoring at the site, except for a spot check to determine fish use of chevron 3 since construction.

Table 4-1. Summary of all fish caught electrofishing the middle chevron at river mile 266.

Species	Number	Size Range (mm)
Shortnose Gar	3	417-640
Bigmouth Buffalo	3	420-580
Smallmouth Buffalo	2	285-550
River Carpsucker	3	259-300
Common Carp	8	415-520
Emerald Shiner	1	N/a
Channel Catfish	2	336-460
Flathead Catfish	4	158-510
White Bass	1	70
Freshwater Drum	4	184-512

Total Number of Fish 31
Total Number of Species 10

Table 4-2 Electrofishing sample of outside of middle chevron at river mile 266R on 7-31-03 by Kevin Slattery, T. Miller, and Brian Johnson with gage at Mosier reading 434.5 ft.

Time of Day	1030
Sample Effort (secs)	405
Volts	120
Amps	13
Pulse	120
%	30
Conductivity	435
Water Temperature (^{o}C)	27
Dissolved Oxygen	7.3

Species	Length
Shortnose gar	640
Common carp	415
Common carp	480
Common carp	497
Common carp	520
Emerald shiner	Not Taken
Smallmouth buffalo	285
Channel catfish	336
Channel catfish	460
Flathead catfish	158
Flathead catfish	300
Flathead catfish	305
Flathead catfish	510
Freshwater drum	184
Freshwater drum	435
Freshwater drum	440
Freshwater drum	512

Total Number of Fish 17
Total Number of Species 7

Table 4-3 Electrofishing sample of inside of middle chevron at river mile 266R on 7-31-03 by Kevin Slattery, T. Miller, and Brian Johnson with gage at Mosier reading 434.5 ft.

Time of Day	1000
Sample Effort (secs)	544
Volts	120
Amps	13
Pulse	120
%	30
Conductivity	435
Water Temperature (^{o}C)	27
Dissolved Oxygen	7.3

Species	Length
Shortnose gar	417
Shortnose gar	471
Common carp	501
Common carp	504
Common carp	505
Common carp	506
Bigmouth buffalo	420
Bigmouth buffalo	470
Bigmouth buffalo	580
River carpsucker	259
River carpsucker	295
River carpsucker	300
Smallmouth buffalo	550
White Bass	70

Total Number of Fish 14
Total Number of Species 6

Appendix E

Multiple Roundpoint Structures
Preliminary Fisheries Evaluation

Multiple Roundpoint Structures
Preliminary Fisheries Evaluation

Prepared for:
U.S. Army Corps of Engineers
St. Louis District

Prepared by:
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Boundary Rivers Program

August 2006

Introduction

Since August 1998, the Illinois Department of Natural Resources has collected 23 fish samples with A.C. boat electrofishing (EF) at the Multiple Roundpoint Structures constructed by the St. Louis District, Corps of Engineers at Mississippi River mile 265.7L. The sampling was conducted in order to obtain information on the composition of the fish community utilizing the habitat created by these structures.

Methods

The electrofishing unit and the sampling methodology used in this effort is the same as that used in the chevron dike study. Each sampling run involved electrofishing around each of the six roundpoints, collecting fishes stunned within the range of the dip net, then circling around below and between structures to capture stunned fishes initially out of range.

Results and Discussion

A total of 1533 fish (52.74 fish/15min EF), representing 33 species and 1 hybrid have been collected on the 23 sampling runs (436 minutes total) [Table 1 and Table 2]. Emerald shiner, flathead catfish, and gizzard shad exhibited the highest overall catch rates, followed by freshwater drum, common carp and channel catfish. Emerald shiner were collected on 22 of 23 sampling trips; flathead catfish were collected on 21 trips and channel catfish and freshwater drum were collected on 19 trips (Table 3).

Blue sucker have been collected in 5 of the 8 years of sampling (’98, ’99, ’02, ’03, ‘05). This big river species is uncommonly collected in the Mississippi River and is considered a species of concern by state and federal natural resources agencies. The collection of blue sucker on 9 of 23 sampling runs may indicate that these fish are seeking the habitat conditions provided by these structures. These fish have ranged in total length from 45mm to 664mm (2900g). Length data from flathead and channel catfishes collected so far indicate that both juveniles and adults are utilizing habitat provided by these structures.

Conclusion

The data collected so far in this evaluation suggest that multiple roundpoint structures are providing valuable habitat for a variety of riverine fishes. Collection of such species as blue sucker, stonecat, river darter and slenderhead darter may indicate these structures are providing riffle-like habitat, a habitat not commonly seen in the river today.

Table 5-1. Sampling dates and electrofishing period for Pool 25, MRS, RM 265.7L 1998-2005.

Sampling date	Electrofishing period
18-Aug-98	22
15-Oct-98	15
07-Sep-99	20
22-Sep-99	30
23-May-00	15
28-Aug-00	20
26-Sep-00	20
17-Oct-00	22
24-Jul-01	25
20-Aug-01	21
17-Sep-01	20
16-Oct-01	15
12-Aug-02	22
16-Sep-02	15
16-Oct-02	15
24-Jun-03	17
21-Jul-03	13
15-Sep-03	20
19-Jul-04	15
13-Sep-04	30
06-Jun-05	11
18-Jul-05	13
12-Sep-05	20
Total	436

Table 5-2. Composition of fishes collected with A.C. electrofishing at Pool 25, MRS, RM 265.7L, 1998-2005.

Species	Number	No./15min ef
Skipjack herring	1	0.03
Gizzard shad	109	3.75
Goldeye	1	0.03
Mooneye	2	0.07
Carp	70	2.41
Central stoneroller	1	0.03
Silvery minnow	4	0.14
Spotfin shiner	57	1.96
Red shiner	15	0.52
Bullhead minnow	4	0.14
Emerald shiner	805	27.69
Silverband shiner	1	0.03
River shiner	12	0.41
Sand shiner	3	0.10
Mimic shiner	30	1.03
Bigmouth buffalo	3	0.10
Smallmouth buffalo	13	0.45
River carpsucker	1	0.03
Blue sucker	16	0.55
Shorthead redhorse	38	1.31
Channel catfish	69	2.37
Flathead catfish	134	4.61
Stonecat	2	0.07
Brook silverside	2	0.07
White bass	9	0.31
Striped bass x White bass hybrid	1	0.03
Smallmouth bass	2	0.07
Green sunfish	14	0.48
Bluegill	16	0.55
Orangespotted sunfish	1	0.03
Walleye	1	0.03
River darter	2	0.07
Slenderhead darter	3	0.10
Freshwater drum	91	3.13
Total number	1533	52.74
Total number species	33	

Table 5-3. Composition of fishes collected with A.C. electrofishing at Pool 25, MRS, RM 265.7L, 1998-2005

Species	8/18/98	10/15/98	9/07/99	9/22/99	5/23/2000	8/28/2000	9/26/2000	10/17/2000	7/24/2001	8/20/2001	9/17/2001	10/16/2001
sampling effort (min)	22	15	20	30	15	20	20	22	25	21	20	15
Skipjack herring												
Gizzard shad	22	30	1	5	17			13	3			
Goldeye												
Mooneye						1						
Carp	3		5	12	3	6	1	2	5	5	6	11
Central stoneroller												
Silvery minnow										4		
Spotfin shiner					1	5	3		10	8	4	2
Red shiner			1			1		1	4	3	3	
Bullhead minnow							1	1	1	1		
Emerald shiner	41	8	31	1	1	87	55	164	24	51	52	31
Silverband shiner												1
River shiner								2	1	2		
Sand shiner						1		1				
Channel shiner				4	1	1	2	5	2	4	4	
Bigmouth buffalo												
Smallmouth buffalo	2	2	2						1	1	1	
River carpsucker												
Blue sucker	2	1	6	1								
Shorthead redhorse	2	3	2	3		3	1	1	1	2	6	
Channel catfish	5	3	3	3	4	3	1	1	6	1	1	
Flathead catfish	14	5	13	5	2	11	4	3	1	10	3	
Stonecat			1			1						
Brook silverside												
White bass				1						2		
Striped bass x white bass hybrid												
Smallmouth bass												
Green sunfish			2			3		2		2	1	2
Bluegill			1							1		
Orangespotted sunfish												
Walleye												
River darter									2			
Slenderhead darter			1									
Freshwater drum	2	3	4	1	1	3	12	2	2	5	9	1
Totals	93	55	73	36	30	126	80	198	63	102	90	48
Number of species	9	8	14	10	8	13	9	13	14	16	11	6

Table 5-3 (cont.). Composition of fishes collected with A.C. electrofishing at Pool 25, MRS 1998-2005

Species	8/12/2002	9/16/2002	10/16/2002	6/24/2003	7/21/2003	9/15/2003	7/19/2004	9/13/2004	6/6/2005	7/18/2005	9/12/2005	Total Number	Frequency of occurrence
sampling effort (min)	22	15	15	17	13	20	15	30	11	13	20	436	23
Skipjack herring						1						1	1
Gizzard shad			3					1		9	5	109	11
Goldeye					1							1	1
Mooneye										1		2	2
Carp	1	1				1	1	3	1		3	70	18
Central stoneroller				1								1	1
Silvery minnow												4	1
Spotfin shiner		1		2	1	5	2	7	3	2	1	57	16
Red shiner						2						15	7
Bullhead minnow												4	4
Emerald shiner	63	56	3	4	7	24		7	16	23	56	805	22
Silverband shiner												1	1
River shiner	1					2				4		12	6
Sand shiner										1		3	3
Channel shiner				1	1	2	2	1				30	13
Bigmouth buffalo								1			2	3	2
Smallmouth buffalo	1	1					1				1	13	10
River carpsucker					1							1	1
Blue sucker	1	2		1	1					1		16	9
Shorthead redhorse	3	1	1	2			2	2	2	1		38	18
Channel catfish	2	5		2	1	2		11		2	13	69	19
Flathead catfish	8	6		7	5	9	7	5	2	5	9	134	21
Stonecat												2	2
Brook silverside						1		1				2	2
White bass			1					2			3	9	5
Striped bass x white bass hybrid										1		1	1
Smallmouth bass											2	2	1
Green sunfish	2											14	7
Bluegill	2			1		6		2			3	16	7
Orangespotted sunfish						1						1	1
Walleye											1	1	1
River darter												2	1
Slenderhead darter		1								1		3	3
Freshwater drum	2	1				29	1	3		2	8	91	19
Totals	86	75	8	21	18	85	16	46	24	53	107	1533	
Number of species	11	10	4	9	8	13	7	13	5	12	13	33	

Appendix F

River Mile 257 Multiple Roundpoint Structures
Preliminary Fisheries Evaluation

Kelly Island, RM 257.4 – 255.7L
Multiple Roundpoint Structures
Pre-construction Monitoring Narrative 2003 – 2004

Prepared for:
U.S. Army Corps of Engineers
St. Louis District

Prepared by:
U.S. Army Corp of Engineers
St. Louis District

August 2006

Kelly Island, RM 257.4 – 255.7L
Multiple Roundpoint Structures
Pre-construction Monitoring Narrative 2003 – 2004

St. Louis District, Corps of Engineers, under the Avoid and Minimize Program, has been designing, locating and constructing innovative river training structures in the Mississippi River in an effort to develop new structures that minimize harm to, or enhance, the environment, while maintaining or improving the navigation channel. One structure type consists of a field of multiple roundpoint structures (MRS). Currently a single row of MRS exists at RM 265.7L. These structures provide scouring velocities and previous sampling data from thus type of structure suggests that they provide valuable habitat for a variety of riverine fishes (see ILDNR this report Appendix E). The ILDNR collected species such as blue sucker, stonecat, river darter and slenderhead darter which may indicate that MRS provide riffle-like habitat, once more common in the river than it is currently. Expansion of this project into a field of 4 double rows of MRS is planned to start in 2006. Placement of the structures at RM 257L has previously been coordinated with state and federal natural resource agencies.

The pre-construction monitoring of these anticipated MRS locations at RM 257L was conducted in 2003 and 2004. Substrate sampling was conducted using petit ponar and pole/can grab samplers. Fish monitoring was conducted using the Missouri trawl and electrofishing. A dive survey to detect the presence/absence of freshwater mussels was also conducted through a contract with Ecological Specialists, Inc. Summaries of the fish collections, substrate samples and mussel survey are attached (see tables 6-1 thru 6-16).

Substrate samples taken throughout the proposed MRS field location were primarily sand, with only one or two samples comprised mostly of silt. Generally, sand substrate without much diversity of depth or structure provides little habitat for riverine fishes. Sampling with the Missouri trawl and electrofishing indicates low fish diversity in most of the area where the MRS field will be located. There were two notable exceptions, submerged dikes at RM 256.8L and RM 255.7L are apparently providing riffle-type habitat, based on the fish species collected from these two areas. A blue sucker was collected at RM 256.8L along with several shorthead redhorse and a variety of sizes of channel catfish. The sample at RM 255.7L also included shorthead redhorse and channel catfish. These species are lotic oriented and tend to inhabit riffles and riffle-like habitat. Based on the fish samples from these submerged dike areas, the MRS construction will occur on the upstream side of these dikes rather than on top as originally planned.

The mussel survey conducted in the area resulted in one three-ridge being collected, a species that is very common in Pool 25. Stray individuals of this species are found throughout the pool. The sand substrate in the area is believed to be unstable and thus, poor habitat for unionid mussels. The continual erosion and deposition that occurs on such substrates under normal or high-magnitude fluvial events, bury and displace the mussels and are generally unsuitable habitat conditions. Construction of the MRS field is scheduled for 2006 and beyond depending upon funding and water levels in the river.

Table 6-1. Kelly Island Pre-construction Fish Summary - All Gears and Dates

Species	Number	Size Range (mm)
Shortnose Gar	1	530
Gizzard Shad	3	275 - 483
Emerald Shiner	1	n/a
Blue Sucker	1	495
Shorthead Redhorse	14	275 - 495
Smallmouth Buffalo	4	300 - 540
Common Carp	1	570
Channel Catfish	46	20 - 560
Flathead Catfish	1	190
Walleye	1	110
Freshwater Drum	14	30 - 240
Miscellaneous Minnows	73	5 Preserved for ID

Total Number of Fish **180**

Total Number of Species (Minnows not Included) **11**

Note: for the following tables: Planned construction location number and river mile for the following tables. MRS #1 – RM 257.4L, MRS #2 – RM 257.2L, MRS #3 – RM 256.7L, MRS #4 – RM 255.7L.

Table 6-2. Electrofishing sample in location 4 of the proposed multiple roundpoint structures at river mile 257 on 7-31-03 by Kevin Slattery, T. Miller, and Brian Johnson with gage at Mosier reading 435.2 ft.

TIME OF DAY	1500
SAMPLE EFFORT (secs)	1000
VOLTS	120
AMPS	13
PULSE	120
%	30
WATER TEMPERATURE (^{o}C)	26.4
DISSOLVED OXYGEN	6.4
CONDUCTIVITY	Not Taken

Species	Length
Gizzard shad	275
Gizzard shad	300
Gizzard shad	483
Common carp	570
Emerald shiner	60
Shorthead redhorse	350
Shorthead redhorse	455
Shorthead redhorse	460
Shorthead redhorse	480
Shorthead redhorse	495
Smallmouth buffalo	300
Smallmouth buffalo	470
Smallmouth buffalo	540
Channel catfish	435
Channel catfish	560
Flathead catfish	190
Freshwater drum	170
Freshwater drum	185

Total Number of Fish 18
Total Number of Species 8

Table 6-3. Electrofishing sample in location 3 of the proposed multiple roundpoint structures at river mile 257 on 7-31-03 by Kevin Slattery, T. Miller, and Brian Johnson with gage at Mosier reading 435.2 ft.

TIME OF DAY	1500
SAMPLE EFFORT(secs)	1000
VOLTS	120
AMPS	13
PULSE	120
%	30
WATER TEMPERATURE(^{o}C)	26.4
DISSOLVED OXYGEN	6.4
CONDUCTIVITY	Not Taken

Species	Length
Blue sucker	495
Shorthead redhorse	275
Shorthead redhorse	275
Shorthead redhorse	293
Shorthead redhorse	340
Shorthead redhorse	345
Shorthead redhorse	410
Shorthead redhorse	425
Shorthead redhorse	425
Shorthead redhorse	425
Shorthead redhorse	465
Shorthead redhorse	485
Smallmouth buffalo	375
Channel catfish	420
Channel catfish	505
Freshwater drum	188
Freshwater drum	190
Freshwater drum	195
Freshwater drum	240

Total Number of Fish 19
Total Number of Species 5

Table 6-4. Trawling sample 1 in location 2 of the proposed multiple roundpoint structures at river mile 257 on 7-31-03 by Kevin Slattery, T. Miller, and Brian Johnson with gage at Mosier reading 435.2 ft.

Time of Day	0932
Sampling Effort (seconds)	219
Water Temperature (^{o}C)	26.4
Dissolved Oxygen	6.4
Conductivity	Not Taken
Water Depth (feet)	6

Species	Length	Number
Channel catfish	25	1
Channel catfish	25	1
Channel catfish	25	1
Channel catfish	25	1
Channel catfish	30	1
Channel catfish	35	1
Channel catfish	35	1
Walleye	110	1
Minnows	Not Taken	50

Total Number of Fish 58
Total Number of Species 4

Table 6-5. Trawling sample 2 in location 2 of the proposed multiple roundpoint structures at river mile 257 on 7-31-03 by Kevin Slattery, T. Miller, and Brian Johnson with gage at Mosier reading 435.2 ft.

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Time of Day	0945
Sampling Effort (seconds)	310
Water Temperature (^{o}C)	26.4
Dissolved Oxygen	6.4
Conductivity	Not Taken
Water Depth (feet)	8.5

Species	Length	Number
Shortnose gar	530	1
Channel catfish	20-30	21
Channel catfish	35	1
Channel catfish	40	1
Minnows	Not Taken	6

Total Number of Fish 24
Total Number of Species 3

Table 6-6. Trawling sample 1 in location 1 of the proposed multiple roundpoint structures at river mile 257 on 7-31-03 by LH, Kevin Slattery, T. Miller, and Brian Johnson with gage at Mosier reading 435.2 ft.

Time of Day	0840
Sampling Effort (seconds)	165
Water Temperature (°C)	26.4
Dissolved Oxygen	6.4
Conductivity	Not Taken
Water Depth (feet)	6

Species	Length	Number
Freshwater drum	30	1
Freshwater drum	30	1
Freshwater drum	30	1
Freshwater drum	35	1
Freshwater drum	40	1
Freshwater drum	45	1
Freshwater drum	55	1
Minnows	Not Taken	9

Total Number of Fish 16
Total Number of Species 2

Table 6-7. Trawling sample 2 in location 1 of the proposed multiple roundpoint structures at river mile 257 on 7-31-03 by LH, Kevin Slattery, T. Miller, and Brian Johnson with gage at Mosier reading 435.2 ft.

Time of Day	0850
Sampling Effort (seconds)	160
Water Temperature (°C)	26.4
Dissolved Oxygen	6.4
Conductivity	Not Taken
Water Depth (feet)	Not Taken

Species	Length	Number
Channel catfish	20	1
Channel catfish	25	1
Channel catfish	25	1
Channel catfish	25	1
Channel catfish	30	1
Channel catfish	30	1
Channel catfish	30	1
Channel catfish	35	1
Channel catfish	40	1
Channel catfish	50	1
Channel catfish	50	1
Channel catfish	90	1
Freshwater drum	20	1
Minnows	NT	8

Total Number of Fish 21
Total Number of Species 3

Table 6-8. Electrofishing sample in location 4 of the proposed multiple roundpoint structures at river mile 257 on 9-9-04 by Brian Johnson, Kip Runyon, and Dave Gates with gage at Mosier reading 435 ft.

Time of Day	1015
Sample Effort (secs)	900
Volts	120
Amps	13
Pulse	120
%	40
Water Temperature(^{o}C)	23.5
Dissolved Oxygen	9.5
Conductivity	362

Species	Length
Longnose gar	LOST IT
Longnose gar	LOST IT
Gizzard shad	117
Gizzard shad	125
Gizzard shad	207
Gizzard shad	210
Gizzard shad	223
Gizzard shad	223
Gizzard shad	228
Gizzard shad	230
Gizzard shad	239
Gizzard shad	242
Gizzard shad	255
Gizzard shad	265
Gizzard shad	280
Gizzard shad	317
Gizzard shad	318
Gizzard shad	320
Gizzard shad	322
Gizzard shad	330
Gizzard shad	337
Gizzard shad	340
Gizzard shad	340
Gizzard shad	345
Gizzard shad	363
Shorthead redhorse	404
Shorthead redhorse	415
Shorthead redhorse	528
Smallmouth buffalo	540
Channel catfish	447
Channel catfish	532
Flathead catfish	434
Smallmouth bass	208

Total Number of Fish 33
Total Number of Species 7

Table 6-9. Electrofishing sample in location 3 of the proposed multiple roundpoint structures at river mile 257 on 9-9-04 by Brian Johnson, Kip Runyon, and Dave Gates with gage at Mosier reading 435 ft.

Time of Day	915
Sample Effort (secs)	1000
Volts	120
Amps	14
Pulse	120
%	40
Water Temperature(^{o}C)	23.7
Dissolved Oxygen	8.5
Conductivity	377

Species	Length
Longnose gar	LOST IT
Gizzard shad	115
Gizzard shad	242
Gizzard shad	245
Gizzard shad	280
Gizzard shad	283
Gizzard shad	294
Common carp	346
Common carp	495
Common carp	531
Common carp	537
Common carp	591
River carpsucker	380
Shorthead redhorse	425
Shorthead redhorse	435
Shorthead redhorse	463
Shorthead redhorse	463
Smallmouth buffalo	710
Channel catfish	352
Channel catfish	383
Channel catfish	391
Channel catfish	399
Channel catfish	446
Channel catfish	534
Channel catfish	596
Freshwater drum	247
Freshwater drum	378

Total Number of Fish 27
Total Number of Species 8

Table 6-10. Trawling sample 1 in location 2 of the proposed multiple roundpoint structures at river mile 257 on 9-9-04 by Brian Johnson, Kip Runyon, and Dave Gates with gage at Mosier reading 434.6.

Sampling Effort (seconds)	130
Water Temperature (°C)	24.2
Dissolved Oxygen	9.4
Conductivity	Not Taken
Water Depth (feet)	Not Taken

Species	Length	Number
Western sand darter	48	1
Freshwater drum	15	1
Channel catfish	58	1
Minnows	Not Taken	Many

Total Number of Fish **Many**
Total Number of Species **4**

Table 6-11. Trawling sample 2 in location 2 of the proposed multiple roundpoint structures at river mile 257 on 9-9-04 by Brian Johnson, Kip Runyon, and Dave Gates with gage at Mosier reading 434.6.

Sampling Effort (seconds)	555
Water Temperature (°C)	24.2
Dissolved Oxygen	9.4
Conductivity	Not Taken
Water Depth (feet)	6-9

Species	Length	Number
Channel catfish	25	1
Channel catfish	25	1
Channel catfish	39	1
Channel catfish	48	1
Channel catfish	135	1
Channel catfish	145	1
Western sand darter	Not Taken	66
Western sand darter	47	1
Western sand darter	48	1
Western sand darter	50	1
Western sand darter	54	1
Western sand darter	54	1
Western sand darter	55	1
Western sand darter	63	1
Western sand darter	65	1
Freshwater drum	30	1
Minnows	Not Taken	100

Total Number of Fish **181**
Total Number of Species **4**

Table 6-12. Trawling sample 3 in location 2 of the proposed multiple roundpoint structures at river mile 257 on 9-9-04 by Brian Johnson, Kip Runyon, and Dave Gates with gage at Mosier reading 434.6 ft.

Sampling Effort (seconds)	150
Water Temperature (^{o}C)	24.2
Dissolved Oxygen	9.4
Conductivity	Not Taken
Water Depth (feet)	8-9

Species	Length	Number
Channel catfish	24	1
Channel catfish	25	1
Channel catfish	34	1
Channel catfish	37	1
Channel catfish	47	1
Channel catfish	54	1
Channel catfish	55	1
Channel catfish	62	1
Channel catfish	63	1
Channel catfish	63	1
Western sand darter	Not Taken	18
Western sand darter	45	1
Western sand darter	49	1
Western sand darter	49	1
Western sand darter	51	1
Freshwater drum	32	1
Freshwater drum	32	1
Freshwater drum	38	1
Freshwater drum	42	1
Freshwater drum	42	1
Freshwater drum	43	1
Freshwater drum	52	1
Minnows	Not Taken	28

Total Number of Fish 67
Total Number of Species 4

Table 6-13. Trawling sample 1 in location 1 of the proposed multiple roundpoint structures at river mile 257 on 9-9-04 by Brian Johnson, Kip Runyon, and Dave Gates with gage at Mosier reading 434.6 ft.

Sampling Effort (seconds)	163
Water Temperature (^{o}C)	24.3
Dissolved Oxygen	9.5
Conductivity	378
Water Depth (feet)	5-7

Species	Length	Number
Channel catfish	59	1
Freshwater drum	10	1
Freshwater drum	12	1
Freshwater drum	18	1
Freshwater drum	22	1
Freshwater drum	23	1
Freshwater drum	23	1
Freshwater drum	27	1
Freshwater drum	29	1
Freshwater drum	29	1
Freshwater drum	30	1
Freshwater drum	30	1
Freshwater drum	31	1
Freshwater drum	32	1
Freshwater drum	36	1
Freshwater drum	37	1
Freshwater drum	37	1
Freshwater drum	38	1
Freshwater drum	38	1
Freshwater drum	40	1
Freshwater drum	42	1
Freshwater drum	42	1
Freshwater drum	43	1
Freshwater drum	45	1
Freshwater drum	48	1
Freshwater drum	49	1
Freshwater drum	52	1
Minnows	Not Taken	Many

Total Number of Fish Many
Total Number of Species 2

Table 6-14. Trawling sample 2 in location 1 of the proposed multiple roundpoint structures at river mile 257 on 9-9-04 by Brian Johnson, Kip Runyon, and Dave Gates with gage at Mosier reading 434.6 ft.

Time of Day	1330
Sampling Effort (seconds)	137
Conductivity	378
Water Temperature (^{o}C)	24.3
Dissolved Oxygen	9.5
Water Depth (feet)	6-8

Species	Length	Number
Channel catfish	48	1
Channel catfish	60	1
Channel catfish	63	1
Freshwater drum	10	1
Freshwater drum	33	1
Freshwater drum	36	1
Freshwater drum	37	1
Freshwater drum	41	1
Freshwater drum	42	1
Freshwater drum	43	1
Freshwater drum	44	1
Freshwater drum	46	1

Total Number of Fish 12
Total Number of Species 2

Table 6-15. Subtrate data at mutltiple roundpoint structures at river mile 257 on 7-30-03 with gage At Mosier reading 435.2. MRS #1 – RM 257.4L, MRS #2 – RM 257.2L, MRS #3 – RM 256.7L, MRS #4 – RM 255.7L.

Way-point	% cobble	% gravel	% sand	C/N/F sand	% silt	% clay	other	dominate substrate	MRS #	collection method		
58	0	0	100	N	0	0	0	SAND	4	pole/ponar	39.19171367	-90.71361681
59	0	0	100	N	0	0	0	SAND	4	pole/ponar	39.19139233	-90.71364385
60	0	0	5	F	95	0	0	SILT	4	pole/ponar	39.19127357	-90.71185019
61	0	0	70	N	30	0	0	SAND	4	pole/ponar	39.1914552	-90.71210256
62	0	0	100	N	0	0	0	SAND	4	pole/ponar	39.19070773	-90.71230086
63	0	0	100	N	0	0	0	SAND	4	pole/ponar	39.19040734	-90.71311206
65	0	5	95	C	0	0	0	SAND	3	pole/ponar	39.2062424	-90.71485164
66	0	0	100	C	0	0	0	SAND	3	pole/ponar	39.20634018	-90.71424775
67	0	0	199	N	0	0	0	SAND	3	pole/ponar	39.20634018	-90.71367089
68	0	20	80	C 50N	0	0	0	SAND	3	pole/ponar	39.20537635	-90.71409452
69	0	0	100	50F	0	0	0	SAND	3	pole/ponar	39.20524365	-90.71474348
70	0	50	50	C	0	0	0	SAND	3	pole/ponar	39.20499221	-90.71554567
71	0	5	95	C	0	0	0	SAND	2	pole/ponar	39.20948302	-90.71410353
72	0	0	100	N	0	0	0	SAND	2	pole/ponar	39.20965063	-90.71331035
73	0	0	100	N	0	0	0	SAND	2	pole/ponar	39.21030013	-90.7126704
74	0	0	100	N 50N	0	0	0	SAND	2	pole/ponar	39.21191338	-90.71166992
75	0	0	100	50F 50N	0	0	0	SAND	2	pole/ponar	39.21203908	-90.71216566
76	0	0	100	50F 60N 40	0	0	0	SAND	2	pole/ponar	39.21195528	-90.71313009
77	0	0	100	F	0	0	0	SAND	1	pole/ponar	39.21284918	-90.71386918
78	0	0	100	F	0	0	0	SAND	1	pole/ponar	39.21299584	-90.71295883
79	0	0	100	F	0	0	0	SAND	1	pole/ponar	39.21337993	-90.7124
80	0	0	0	N/A	100	0	0	SILT	1	pole/ponar	39.21446936	-90.71303094
81	0	0	100	N 50C	0	0	0	SAND	1	pole/ponar	39.21437159	-90.71386017
82	0	0	100	50N	0	0	0	SAND	1	pole/ponar	39.21417605	-90.71418465

Table 6-16. Subtrate data at mutltiple roundpoint structures at river mile 257 on 9-9-04 with gage At Mosier reading 435. MRS #1 – RM 257.4L, MRS #2 – RM 257.2L, MRS #3 – RM 256.7L, MRS #4 – RM 255.7L.

Way-point	% cobble	% gravel	% sand	C/N/F sand	% silt	% clay	other	dominate substrate	MRS #	collection method		
58	0	0	100	80N 20F	0	0	0	SAND	4	pole/ponar	39.19171	-90.71362
59	0	0	90	20N 70F	10	0	0	SAND	4	pole/ponar	39.19139	-90.71364
60	0	0	10	10F	60	30	0	SILT	4	pole/ponar	39.19127	-90.71185
61	0	0	10	10F	60	30	0	SILT	4	pole/ponar	39.19146	-90.7121
62	0	0	100	50N 50F	0	0	0	SAND	4	pole/ponar	39.19071	-90.7123
63	0	0	100	50N 50F	0	0	0	SAND	4	pole/ponar	39.19041	-90.71311
65	0	0	100	80N 20F	0	0	0	SAND	3	pole/ponar	39.20624	-90.71485
66	0	0	100	70N 30F	0	0	0	SAND	3	pole/ponar	39.20634	-90.71425
67	0	0	100	80N 20F	0	0	0	SAND	3	pole/ponar	39.20634	-90.71367
68	0	0	100	90N 10F	0	0	0	SAND	3	pole/ponar	39.20538	-90.71409
69	0	0	100	80N 20F	0	0	0	SAND	3	pole/ponar	39.20524	-90.71474
70	0	0	100	80N 20F	0	0	0	SAND	3	pole/ponar	39.20499	-90.71555
71	0	0	100	90N 10F	0	0	0	SAND	2	pole/ponar	39.20948	-90.7141
72	0	0	100	70N 30F	0	0	0	SAND	2	pole/ponar	39.20965	-90.71331
73	0	0	100	80N 20F	0	0	0	SAND	2	pole/ponar	39.2103	-90.71267
74	0	0	80	80F	20	0	0	SAND	2	pole/ponar	39.21191	-90.71167
75	0	0	100	25N 75F	0	0	0	SAND	2	pole/ponar	39.21204	-90.71217
76	0	0	95	95F	5	0	0	SAND	2	pole/ponar	39.21196	-90.71313
77	0	0	100	50N 50F	0	0	0	SAND	1	pole/ponar	39.21285	-90.71387
78	0	0	90	30N 60F	10	0	0	SAND	1	pole/ponar	39.213	-90.71296
79	0	0	80	80F	20	0	0	SAND	1	pole/ponar	39.21338	-90.7124
80	0	0	10	10F	60	30	0	SILT	1	pole/ponar	39.21447	-90.71303
81	0	0	100	50N 50F	0	0	0	SAND	1	pole/ponar	39.21437	-90.71386
82	0	0	100	80N 20F	0	0	0	SAND	1	pole/ponar	39.21418	-90.71418
158	0	10	90	80C 10F	0	0	0	SAND		pole/ponar	Not Taken	Not Taken

Appendix G

River Mile 226-225R Chevrons and Kicker Dike
Preliminary Fisheries Evaluation

River Mile 226-225R Chevrons and Kicker Dike
Preliminary Fisheries Evaluation

Prepared for:
U.S. Army Corps of Engineers
St. Louis District

Prepared by:
U.S. Army Corp of Engineers
St. Louis District

August 2006

RM 226 - 225R CHEVRONS AND KICKER DIKE
BOLTERS BAR/IOWA ISLAND
MONITORING SUMMARY NARRATIVE
2003 – 2004

Four chevron dikes and a kicker dike were constructed at this site in December 2002 in an attempt to concentrate flows and improve scour in a chronic dredging site. The results have been outstanding from a river engineering standpoint. Cost of construction was approximately $1.5 million and that amount has been saved in reduced dredging costs in the first three years since the 2002 construction. The navigation channel has also moved slightly to the Illinois bankline, improving the channel alignment and allowing tows to traverse the area with less difficulty than prior to construction.

Results of the monitoring conducted in 2003 and 2004 show that this project was also a success from an aquatic life standpoint. The chevrons formed the typical plunge pool just below the upstream apex of each dike and the shallow bar that usually forms between the downstream legs of the structure. Aquatic life was sampled using electrofishing, gill nets and trawling, and substrate was sampled with petit ponar and pole/can equipment. The results are similar to those found for other chevron and bullnose type structures. Lentic habitats on the inside of the chevrons are important as nursery areas for several species, while lotic habitats on the outside attract fish species that are more oriented to the current. An excellent sample of young of the year channel catfish and freshwater drum, including sac fry of both species, was collected in 2003. Young of the year freshwater drum, including sac fry, were again collected in 2004, although that sample was less successful for channel catfish. A number of macroinvertebrates and juvenile mussels were also collected during the inside trawling. Although these chevrons were not sampled during the winter, it is likely they are important wintering habitat similar to what has been found for other chevrons. The exterior of the chevrons continue to be important to lotic species such as flathead catfish and white bass. Anecdotal fishing information indicates that the outside of the chevrons provides good to excellent fishing for channel catfish as well.

Substrate samples within the dike field were similar to samples collected in conjunction with other chevrons, primarily sand in scoured areas (generally outside the chevrons) and a mixture of silt and sand, predominantly silt on the protected inside. Other physical data collected was within normal ranges. Data for all sample areas are attached (see Tables 7-1 thru 7-23).

Table 7-1. Bolter's Bar fish and substrate data summary for all gears, dates and structures, RM 226-225R.

Species	Number	Size Range - mm
Shortnose Gar	13	455 - 645
American Eel	1	705
Gizzard Shad	143	25 - 325
Skipjack Herring	6	95 - 120
Goldeye	3	275 - 305
Mooneye	1	63
Common Carp	66	320 - 630
Emerald Shiner	22	n/a
Silver Chub	2	n/a
Spotfin Shiner	6	n/a
River Carpsucker	2	375 - 378
Shorthead Redhorse	1	420
Smallmouth Buffalo	7	295 - 473
Channel Catfish	42	12 - 490
Flathead Catfish	17	120 - 465
White Bass	10	70 - 337
Black Crappie	2	145 - 155
Bluegill	7	85 - 158
Green Sunfish	1	133
Largemouth Bass	4	85 - 170
Sauger	1	360
Freshwater Drum	231	12 - 530
Total Species	**22**	
Total Fish	**587**	
Total Substrate Samples	**36**	

Table 7-2. Electrofishing sample inside chevron 3 at river mile 225.3R on 7-28-03 by Teri Allen, T. Miller, and Brian Johnson with Grafton gage reading 15.3 ft and L&D 25 gage reading 16.7 ft.

Time of Day	1354
Sample Effort (secs)	339
Volts	120
Amps	14
Pulse	120
%	30
Conductivity	443
Water Temperature (˚C)	27.3
Dissolved Oxygen	7.7

Species	Length
Shortnose gar	480
Shortnose gar	620
Gizzard shad	70
Gizzard shad	75
Gizzard shad	80
Gizzard shad	80
Gizzard shad	85
Gizzard shad	85
Gizzard shad	85
Gizzard shad	85
Gizzard shad	85
Gizzard shad	90
Gizzard shad	110
Gizzard shad	145
Gizzard shad	145
Gizzard shad	145
Gizzard shad	153
Gizzard shad	170
Gizzard shad	180
Gizzard shad	195
Gizzard shad	195
Gizzard shad	195
Gizzard shad	210
Gizzard shad	215
Gizzard shad	220
Gizzard shad	220
Gizzard shad	230
Gizzard shad	235
Common carp	415
Smallmouth buffalo	320
Channel catfish	210
Channel catfish	395
Sauger	360
Freshwater drum	415

Total Number of Fish	**36**
Total Number of Species	**7**

Table 7-3. Electrofishing sample outside chevron 3 at river mile 225.3R on 7-28-03 by Teri Allen, T. Miller, and Brian Johnson with Grafton gage reading 15.3 ft and L&D 25 gage reading 16.7 ft.

Time of Day	1400
Sample Effort (secs)	510
Volts	120
Amps	13
Pulse	120
%	30
Conductivity	443
Water Temperature (˚C)	27.3
Dissolved Oxygen	7.7

Species	Length
Gizzard shad	200
Common carp	445
Common carp	456
Common carp	465
Common carp	475
Common carp	489
Flathead catfish	135
Flathead catfish	140
Flathead catfish	248
Flathead catfish	300
White bass	70
White bass	290
White bass	310
White bass	337
Emerald shiner	Not Taken
Emerald shiner	58
Emerald shiner	61
Emerald shiner	63
Emerald shiner	63
Emerald shiner	65
Emerald shiner	70
Emerald shiner	70
Freshwater drum	78
Freshwater drum	131
Freshwater drum	162
Freshwater drum	168
Freshwater drum	175
Freshwater drum	178
Freshwater drum	228
Freshwater drum	263
Freshwater drum	307
Freshwater drum	310

Total Number of Fish	**32**
Total Number of Species	**6**

Table 7-4. Electrofishing sample inside chevron 2 at river mile 225.5R on 7-28-03 by Teri Allen, T. Miller, and Brian Johnson with Grafton gage reading 15.3 ft and L&D 25 gage reading 16.7 ft.

Time of Day	1440
Sample Effort (secs)	470
Volts	120
Amps	13
Pulse	120
%	30
Conductivity	443
Water Temperature (˚C)	27.3
Dissolved Oxygen	7.7

Species	Length
Shortnose gar	483
Shortnose gar	645
American eel	705
Gizzard shad	100
Gizzard shad	185
Gizzard shad	205
Gizzard shad	245
Common carp	410
Common carp	470
Common carp	480
Common carp	505
Emerald shiner	68
Smallmouth buffalo	295
Smallmouth buffalo	300
Channel catfish	186
Channel catfish	490
Flathead catfish	183
Freshwater drum	470
Freshwater drum	475

Total Number of Fish	**19**
Total Number of Species	**9**

Table 7-5. Electrofishing sample outside chevron 2 at river mile 225.5R on 7-28-03 by Teri Allen, T. Miller, and Brian Johnson with Grafton gage reading 15.3 ft and L&D 25 gage reading 16.7 ft.

Time of Day	1500
Sample Effort (secs)	618
Volts	120
Amps	14
Pulse	120
%	30
Conductivity	443
Water Temperature (oC)	27.3
Dissolved Oxygen	7.7

Species	Length
Common carp	395
Common carp	440
Common carp	450
Common carp	455
Common carp	462
Common carp	465
Common carp	478
Common carp	485
Common carp	515
Common carp	535
Common carp	562
Flathead catfish	120
Flathead catfish	170
Flathead catfish	180
Flathead catfish	213
Flathead catfish	465
Freshwater drum	190
Freshwater drum	280
Freshwater drum	355
Freshwater drum	400

Total Number of Fish	**20**
Total Number of Species	**9**

Table 7-6. Trawling sample 1 at chevron 1 at river mile 225.8R on 7-29-03 by Teri Allen, T. Miller, and Brian Johnson with Grafton gage reading 15.4 ft and L&D 25 gage reading 17.2 ft.

Time of Day	0945
Sampling Effort (seconds)	210
Conductivity	Not Taken
Water Temperature (°C)	26.8
Dissolved Oxygen	7.8
Water Depth (feet))	12

Species	Length	Number
Gizzard shad	25	1
Emerald shiner	42	1
Channel catfish	20-30	8
Channel catfish	22	1
Channel catfish	22	1
Channel catfish	27	1
Freshwater drum	15	1
Freshwater drum	15	1
Freshwater drum	15	1
Freshwater drum	20	1
Freshwater drum	25	1
Freshwater drum	25	1
Freshwater drum	28	1
Freshwater drum	30	1
Freshwater drum	32	1
Freshwater drum	32	1
Freshwater drum	32	1
Freshwater drum	32	1
Freshwater drum	32	1
Freshwater drum	36	1
Freshwater drum	37	1
Freshwater drum	38	1
Freshwater drum	38	1
Freshwater drum	42	1
Freshwater drum	42	1
Freshwater drum	45	1
Freshwater drum	50	1
Freshwater drum	53	1
Freshwater drum	55	1
Freshwater drum	57	1
Freshwater drum	57	1

Total Number of Fish	**38**
Total Number of Species	**4**

Table 7-7. Trawling sample 2 at chevron 1 at river mile 225.5R on 7-29-03 by Teri Allen, T. Miller, and Brian Johnson with Grafton gage reading 15.4 ft and L&D 25 gage reading 17.2 ft.

Time of Day	1020
Sampling Effort (seconds)	210
Conductivity	Not Taken
Water Temperature (^{o}C)	26.8
Dissolved Oxygen	7.8
Water Depth (feet))	12

Species	Length	Number	Species	Length	Number
Gizzard shad	25	1	Freshwater drum	32	1
Gizzard shad	62	1	Freshwater drum	32	1
Emerald shiner	47	1	Freshwater drum	32	1
Channel catfish	12	1	Freshwater drum	32	1
Channel catfish	12	1	Freshwater drum	32	1
Channel catfish	17	1	Freshwater drum	32	1
Channel catfish	27	1	Freshwater drum	33	1
Channel catfish	28	1	Freshwater drum	34	1
Channel catfish	42	1	Freshwater drum	34	1
Channel catfish	52	1	Freshwater drum	35	1
Freshwater drum	12	1	Freshwater drum	35	1
Freshwater drum	15	1	Freshwater drum	35	1
Freshwater drum	15	1	Freshwater drum	35	1
Freshwater drum	21	1	Freshwater drum	37	1
Freshwater drum	22	1	Freshwater drum	38	1
Freshwater drum	22	1	Freshwater drum	38	1
Freshwater drum	25	1	Freshwater drum	40	1
Freshwater drum	27	1	Freshwater drum	41	1
Freshwater drum	27	1	Freshwater drum	41	1
Freshwater drum	27	1	Freshwater drum	42	1
Freshwater drum	28	1	Freshwater drum	42	1
Freshwater drum	28	1	Freshwater drum	42	1
Freshwater drum	28	1	Freshwater drum	43	1
Freshwater drum	28	1	Freshwater drum	47	1
Freshwater drum	30	1	Freshwater drum	48	1
Freshwater drum	30	1	Freshwater drum	50	1
Freshwater drum	30	1	Freshwater drum	52	1
Freshwater drum	30	1	Freshwater drum	53	1
Freshwater drum	31	1	Freshwater drum	55	1
Freshwater drum	31	1	Freshwater drum	55	1
Freshwater drum	31	1	Freshwater drum	60	1
Freshwater drum	32	1	Freshwater drum	65	1
Freshwater drum	32	1	Freshwater drum	67	1

Total Number of Fish 66
Total Number of Species 4

Table 7-8. Trawling sample 1 at chevron 2 at river mile 225.5R on 7-29-03 by Teri Allen, T. Miller, and Brian Johnson. with Grafton gage reading 15.4 ft and L&D 25 gage reading 17.1 ft.

Time of Day	0845
Sampling Effort (seconds)	210
Conductivity	Not Taken
Water Temperature (°C)	26.8
Dissolved Oxygen	7
Water Depth (feet))	Not Taken

Species	Length	Number
Channel catfish	30	1
Channel catfish	45	1
Channel catfish	45	1
Freshwater drum	27	1
Freshwater drum	28	1
Freshwater drum	30	1
Freshwater drum	32	1
Freshwater drum	32	1
Freshwater drum	33	1
Freshwater drum	35	1
Freshwater drum	35	1
Freshwater drum	35	1
Freshwater drum	38	1
Freshwater drum	38	1
Freshwater drum	43	1
Freshwater drum	45	1
Freshwater drum	60	1
Minnows	Not Taken	2

Total Number of Fish 19
Total Number of Species 2

Table 7-9. Water quality at trawling sample 2 at chevron 2 at river mile 225.5R on 7-29-03 by Teri Allen, T. Miller, and Brian Johnson with Grafton gage reading 15.4 ft and L&D 25 gage reading 17.1 ft.

Time of Day	0930
Sampling Effort (seconds)	210
Conductivity	Not Taken
Water Temperature (°C)	26.8
Dissolved Oxygen	7
Water Depth (feet))	7

Species	Length	Number
Gizzard shad	29	1
Channel catfish	42	1
Channel catfish	53	1
Freshwater drum	29	1
Freshwater drum	30	1
Freshwater drum	31	1
Freshwater drum	33	1
Freshwater drum	38	1
Freshwater drum	45	1

Total Number of Fish 9
Total Number of Species 3

Table 7-10. Gill net sample 1 inside chevron 3 at river mile 225.3R on 7-29-03 by Teri Allen, T. Miller, and Brian Johnson with Grafton gage reading 15.4 ft and L&D 25 gage reading 17.1 ft.

Time of Day	0830
Sampling Effort (hours)	4
Conductivity	Not Taken
Water Temperature (^{o}C)	27.3
Dissolved Oxygen	Not Taken

Species	Length
Shortnose gar	610
Gizzard shad	305
Goldeye	275
Goldeye	295
Goldeye	305
Common carp	420

Total Number of Fish 6
Total Number of Species 4

Table 7-11. Water quality at gill net 2 inside chevron 3 at river mile 225.3R on 7-29-03 by Teri Allen, T. Miller, and Brian Johnson with Grafton gage reading 15.4 ft and L&D 25 gage reading 17.1 ft.

Time of Day	0830
Sampling Effort (hours)	4
Conductivity	Not Taken
Water Temperature (^{o}C)	27.3
Dissolved Oxygen	Not Taken

Species	Length
Common carp	530
Common carp	560
Common carp	630
Shorthead redhorse	460

Total Number of Fish 4
Total Number of Species 2

Table 7-12. Electrofishing sample inside chevron 3 at river mile 225.3R on 8-3-04 by Dave Gates, T. Miller, and Brian Johnson with Grafton gage reading 15.6 ft and L&D 25 gage reading 15.6 ft.

Time of Day	1100
Sample Effort (secs)	312
Volts	120
Amps	14
Pulse	120
%	30
Conductivity	482
Water Temperature (^{o}C)	26.6
Dissolved Oxygen	7.5

Species	**Length**
Shortnose gar	500
Shortnose gar	530
Shortnose gar	645
Gizzard shad	100
Gizzard shad	110
Gizzard shad	115
Gizzard shad	120
Gizzard shad	120
Gizzard shad	145
Gizzard shad	147
Gizzard shad	160
Gizzard shad	165
Gizzard shad	165
Gizzard shad	170
Gizzard shad	178
Gizzard shad	184
Gizzard shad	195
Gizzard shad	203
Gizzard shad	203
Gizzard shad	208
Gizzard shad	210
Gizzard shad	217
Gizzard shad	223
Gizzard shad	247
Gizzard shad	265
Gizzard shad	268
Gizzard shad	270
Skipjack herring	95
Common carp	504
Emerald shiner	80
Emerald shiner	80
Emerald shiner	80
Emerald shiner	160
River carpsucker	375
Smallmouth buffalo	370
Green sunfish	133
Total Number of Fish	**36**
Total Number of Species	**8**

Table 7-13. Electrofishing sample outside chevron 3 at river mile 225.3R on 8-3-04 by Dave Gates, T. Miller, and Brian Johnson with Grafton gage reading 15.6 ft and L&D 25 gage reading 15.6 ft.

Time of Day	1200
Sample Effort (secs)	522
Volts	120
Amps	14
Pulse	120
%	30
Conductivity	483
Water Temperature (^{o}C)	26.5
Dissolved Oxygen	7.2

Species	**Length**	**Species**	**Length**
Gizzard shad	110	Emerald shiner	80
Skipjack herring	112	Smallmouth buffalo	350
Skipjack herring	120	Channel catfish	472
Common carp	427	Flathead catfish	120
Common carp	445	Flathead catfish	175
Common carp	455	Flathead catfish	183
Common carp	480	Flathead catfish	195
Common carp	480	Flathead catfish	295
Common carp	485	White bass	95
Common carp	490	White bass	115
Common carp	490	White bass	122
Common carp	495	Bluegill	85
Common carp	505	Bluegill	110
Common carp	520	Bluegill	112
Common carp	522	Bluegill	157
Common carp	540	Bluegill	158
Common carp	570	Freshwater drum	110
Emerald shiner	72	Freshwater drum	112

Total Number of Fish	**36**
Total Number of Species	**10**

Table 7-14. Electrofishing sample outside chevron 2 at river mile 225.5R on 8-3-04 by Dave Gates, T. Miller, and Brian Johnson with Grafton gage reading 15.6 ft and L&D 25 gage reading 15.6 ft.

Time of Day	1030
Sample Effort (secs)	398
Volts	120
Amps	14
Pulse	120
%	30
Conductivity	483
Water Temperature (˚C)	26.5
Dissolved Oxygen	7.2

Species	Length
Common carp	430
Common carp	433
Common carp	460
Common carp	465
Common carp	472
Common carp	485
Common carp	490
Common carp	560
Common carp	565
Common carp	580
Emerald shiner	65
Emerald shiner	85
River carpsucker	398
Smallmouth buffalo	378
Smallmouth buffalo	473
Flathead catfish	183
White bass	92
White bass	118
Freshwater drum	140
Freshwater drum	255
Freshwater drum	320
Freshwater drum	405
Freshwater drum	445

Total Number of Fish	**23**
Total Number of Species	**7**

Table 7-15. Electrofishing sample inside chevron 2 at river mile 225.5R on 8-3-04 by Dave Gates, T. Miller, and Brian Johnson with Grafton gage reading 15.6 ft and L&D 25 gage reading 15.6 ft.

Time of Day	1000
Sample Effort (secs)	227
Volts	120
Amps	13
Pulse	120
%	30
Conductivity	496
Water Temperature(˚C)	26.6
Dissolved Oxygen	6.8

Species	Length
Shortnose gar	510
Shortnose gar	515
Shortnose gar	630
Gizzard shad	85
Gizzard shad	100
Gizzard shad	104
Gizzard shad	104
Gizzard shad	120
Gizzard shad	160
Gizzard shad	165
Gizzard shad	173
Gizzard shad	173
Gizzard shad	180
Gizzard shad	208
Gizzard shad	210
Gizzard shad	210
Gizzard shad	210
Gizzard shad	236
Gizzard shad	248
Gizzard shad	265
Gizzard shad	293
Skipjack herring	112
Common carp	453

Total Number of Fish	**23**
Total Number of Species	**4**

Table 7-16. Electrofishing sample inside kicker dike at river mile 226.0R on 8-3-04 by Dave Gates, T. Miller, and Brian Johnson with Grafton gage reading 15.6 ft and L&D 25 gage reading 15.6 ft.

Time of Day	1230
Sample Effort (secs)	429
Volts	120
Amps	13
Pulse	120
%	30
Conductivity	480
Water Temperature (°C)	26.7
Dissolved Oxygen	7.4

Species	Length	Species	Length
Shortnose gar	455	Gizzard shad	248
Gizzard shad	125	Gizzard shad	250
Gizzard shad	125	Gizzard shad	252
Gizzard shad	157	Gizzard shad	255
Gizzard shad	163	Gizzard shad	258
Gizzard shad	165	Gizzard shad	270
Gizzard shad	168	Gizzard shad	275
Gizzard shad	170	Gizzard shad	276
Gizzard shad	170	Gizzard shad	280
Gizzard shad	173	Gizzard shad	300
Gizzard shad	175	Gizzard shad	300
Gizzard shad	175	Gizzard shad	310
Gizzard shad	178	Gizzard shad	316
Gizzard shad	180	Gizzard shad	316
Gizzard shad	180	Gizzard shad	325
Gizzard shad	182	Common carp	425
Gizzard shad	183	Common carp	460
Gizzard shad	188	Common carp	460
Gizzard shad	190	Common carp	480
Gizzard shad	200	Common carp	480
Gizzard shad	204	Common carp	510
Gizzard shad	205	Common carp	510
Gizzard shad	207	Emerald shiner	68
Gizzard shad	214	Flathead catfish	155
Gizzard shad	215	Largemouth bass	95
Gizzard shad	235	Largemouth bass	105
Gizzard shad	245		

Total Number of Fish	**54**
Total Number of Species	**6**

Table 7-17. Electrofishing sample outside kicker dike at river mile 226.0R on 8-3-04 by Dave Gates, T. Miller, and Brian Johnson with Grafton gage reading 15.6 ft and L&D 25 gage reading 15.6 ft.

Time of Day	1300
Sample Effort (secs)	522
Volts	120
Amps	13
Pulse	120
%	30
Conductivity	480
Water Temperature (^{o}C)	26.7
Dissolved Oxygen	7.4

Species	Length
Gizzard shad	105
Gizzard shad	115
Gizzard shad	120
Gizzard shad	173
Common carp	320
Common carp	445
Common carp	470
Common carp	485
Common carp	525
Emerald shiner	63
Emerald shiner	70
Emerald shiner	75
Spotfin shiner	65
Spotfin shiner	65
Spotfin shiner	70
Spotfin shiner	70
Spotfin shiner	70
White bass	100
Skipjack herring	120
Bluegill	95
Largemouth bass	85
Largemouth bass	170
Freshwater drum	162
Freshwater drum	235
Freshwater drum	478
Freshwater drum	530

Total Number of Fish 27
Total Number of Species 9

Table 7-18. Trawling sample 1 at chevron 1 at river mile 225.8R on 7-21-04 by Kevin Slattery, T. Miller, and Brian Johnson with Grafton gage reading 15.7 ft and L&D 25 gage reading 20.1 ft

Time of Day	1130
Sampling Effort (seconds)	258
Conductivity	Not Taken
Water Temperature (^{o}C)	28
Dissolved Oxygen	Equipment Failure
Water Depth (feet))	Not Taken

Species	Length	Number
Blue catfish	151	1
Channel catfish	98	1
Channel catfish	101	1
Channel catfish	110	1
Channel catfish	111	1
Channel catfish	135	1
Freshwater drum	19	1
Freshwater drum	44	1
Freshwater drum	51	1
Freshwater drum	94	1
Freshwater drum	129	1
Freshwater drum	153	1

Total Number of Fish 24
Total Number of Species 3

Table 7-19. Trawling sample 2 at chevron 1 at river mile 225.8R on 7-21-04 by Kevin Slattery, T. Miller, and Brian Johnson with Grafton gage reading 15.7 ft and L&D 25 gage reading 20.1 ft

Time of Day	1200
Sampling Effort (seconds)	212
Conductivity	Not Taken
Water Temperature (°C)	28
Dissolved Oxygen	Equipment Failure
Water Depth (feet))	Not Taken

Species	Length	Number
Blue catfish	145	1
Channel catfish	95	1
Channel catfish	100	1
Channel catfish	123	1
Channel catfish	125	1
Channel catfish	125	1
Channel catfish	127	1
Channel catfish	132	1
Freshwater drum	11	1
Freshwater drum	14	1
Freshwater drum	15	1
Freshwater drum	15	1
Freshwater drum	18	1
Freshwater drum	20	1
Freshwater drum	22	1
Freshwater drum	25	1
Freshwater drum	25	1
Freshwater drum	50	1
Freshwater drum	52	1
Freshwater drum	120	1
Freshwater drum	120	1
Freshwater drum	135	1
Freshwater drum	140	1
Freshwater drum	162	1

Total Number of Fish 12
Total Number of Species 3

Table 7-20. Trawling sample 1 at chevron 2 at river mile 225.5R on 7-21-04 by Kevin Slattery, T. Miller, and Brian Johnson with Grafton gage reading 15.7 ft and L&D 25 gage reading 20.1 ft

Time of Day	1315
Sampling Effort (seconds)	219
Conductivity	Not Taken
Water Temperature (°C)	28
Dissolved Oxygen	Equipment Failure
Water Depth (feet))	Not Taken

Species	Length	Number	Species	Length	Number
Channel catfish	268	1	Freshwater drum	24	1
Freshwater drum	13	1	Freshwater drum	24	1
Freshwater drum	13	1	Freshwater drum	25	1
Freshwater drum	13	1	Freshwater drum	25	1
Freshwater drum	15	1	Freshwater drum	26	1
Freshwater drum	15	1	Freshwater drum	26	1
Freshwater drum	15	1	Freshwater drum	27	1
Freshwater drum	15	1	Freshwater drum	27	1
Freshwater drum	15	1	Freshwater drum	28	1
Freshwater drum	15	1	Freshwater drum	28	1
Freshwater drum	19	1	Freshwater drum	29	1
Freshwater drum	19	1	Freshwater drum	30	1
Freshwater drum	20	1	Freshwater drum	30	1
Freshwater drum	20	1	Freshwater drum	30	1
Freshwater drum	20	1	Freshwater drum	35	1
Freshwater drum	20	1	Freshwater drum	40	1
Freshwater drum	21	1	Freshwater drum	42	1
Freshwater drum	21	1	Freshwater drum	128	1
Freshwater drum	21	1	Freshwater drum	158	1
Freshwater drum	22	1	Freshwater drum	222	1
Freshwater drum	22	1	Freshwater drum	227	1
Freshwater drum	22	1	Freshwater drum	294	1
Freshwater drum	23	1	Freshwater drum	365	1
Freshwater drum	24	1			

Total Number of Fish 47
Total Number of Species 2

Table 7-21. Trawling sample 2 at chevron 2 at river mile 225.5R on 7-21-04 by Kevin Slattery, T. Miller, and Brian Johnson with Grafton gage reading 15.7 ft and L&D 25 gage reading 20.1 ft.

Time of Day	1400
Sampling Effort (seconds)	229
Conductivity	Not Taken
Water Temperature (°C)	28
Dissolved Oxygen	Equipment Failure
Water Depth (feet))	Not Taken

Species	Length	Number	Species	Length	Number
Mooneye	63	1	Freshwater drum	15	1
Silver chub	31	1	Freshwater drum	20	1
Silver chub	32	1	Freshwater drum	20	1
Freshwater drum	15	1	Freshwater drum	21	1
Freshwater drum	15	1	Freshwater drum	21	1
Freshwater drum	15	1	Freshwater drum	21	1
Freshwater drum	15	1	Freshwater drum	21	1
Freshwater drum	15	1	Freshwater drum	21	1
Freshwater drum	15	1	Freshwater drum	22	1
Freshwater drum	15	1	Freshwater drum	22	1
Freshwater drum	15	1	Freshwater drum	28	1
Freshwater drum	15	1	Freshwater drum	31	1
Freshwater drum	15	1	Freshwater drum	35	1
Freshwater drum	15	1	Freshwater drum	36	1
Freshwater drum	15	1	Freshwater drum	37	1
Freshwater drum	15	1	Freshwater drum	40	1
Freshwater drum	15	1	Freshwater drum	45	1
Freshwater drum	15	1	Freshwater drum	50	1
Freshwater drum	15	1			

Total Number of Fish 12
Total Number of Species 3

Table 7-22. Bolter's Bar substrate data collected on 7-29-03 with water stage at Grafton at 15.4 feet and Lock & Dam 25 at 17.1 feet. Chevron #1 – RM 225.8R, Chevron #2 – 225.5R, Chevron #3 – 225.3R, Chevron #4 – 225.1R.

Way-point	% cobble	% gravel	% sand	C/N/F sand	% silt	% clay	other	dominate substrate	Chevron #	Inside /outside	collection method		
15	0	0	0	N/A	100	0	0	SILT	1	I	pole/ponar	38.88997898	-90.52398445
16	0	0	0	N/A	100	0	0	SILT	1	I	pole/ponar	38.89039992	-90.52420077
17	0	0	0	N/A	100	0	0	SILT	1	I mouth	pole/ponar	38.89057531	-90.52372306
18	0	0	50	F	50	0	0	SILT/SAND	between 1&2	between	pole/ponar	38.89139612	-90.5230741
19	0	0	100	N	0	0	0	SAND	2	O RDB	pole/ponar	38.89192929	-90.52267751
20	0	0	100	N	0	0	0	SAND	2	O RDB	pole/ponar	38.89210467	-90.5224702
22	0	10	90	C	0	0	0	SAND	2	O RDB	pole/ponar	38.89233618	-90.52160492
23	0	0	0	N/A	100	0	0	SILT	2	I	pole/ponar	38.89275009	-90.52168604
24	0	0	0	N/A	100	0	0	SILT	2	I	pole/ponar	38.89258873	-90.52201052
25	0	0	0	N/A	100	0	0	SILT	2	I	pole/ponar	38.89278516	-90.52211868
26	0	0	50	F	50	0	0	SILT/SAND	2	O below mouth	pole/ponar	38.89340251	-90.52148774
27	0	0	100	N	0	0	0	SAND	between 2&3	between	pole/ponar	38.89409701	-90.52101905
28	0	0	100	C	0	0	0	SAND	3	O RDB	pole/ponar	38.89504406	-90.51964902
29	0	0	100	N	0	0	0	SAND	between 3&4	between	pole/ponar	38.8966996	-90.51912624
30	0	0	0	N/A	100	0	0	SILT	4	I	pole/ponar	38.89867076	-90.51840517
31	0	0	0	N/A	80	20	0	SILT	4	I	pole/ponar	38.89844629	-90.51820688
32	0	0	70	F	30	0	0	SAND	4	O RDB	pole/ponar	38.89850942	-90.5175489
39	0	5	95	C	0	0	0	SAND	4	O river side?	pole/ponar	38.89594198	-90.52040614

Table 7-23. Bolter's Bar substrate data collected on 7-21-04 with water stage at Grafton at 15.7 feet and Lock & Dam 25 at 20.1 feet. Chevron #1 – RM 225.8R, Chevron #2 – 225.5R, Chevron #3 – 225.3R, Chevron #4 – 225.1R. (NT = Not Taken)

Way-point	% cobble	% gravel	% sand	C/N/F sand	% silt	% clay	other	dominate substrate	Chevron #	Inside/outside	Collection method		
15	0	0	10	F	90	0	0	SILT	1	I	ponar	38.88997898	-90.52398445
16	0	0	20	F	80	0	0	SILT	1	I	ponar	38.89039992	-90.52420077
17	0	0	0	N/A	90	10	0	SILT	1	I mouth	ponar	38.89057531	-90.52372306
18	0	0	50	N	50	0	0	SILT/SAND	between 1&2	between	ponar	38.89139612	-90.5230741
19	0	0	100	N	0	0	0	SAND	2	O RDB	ponar	38.89192929	-90.52267751
20	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	38.89210467	-90.5224702
22	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	38.89233618	-90.52160492
23	0	0	0	N/A	80	20	0	SILT	2	I	ponar	38.89275009	-90.52168604
24	0	0	0	N/A	30	70	0	CLAY	2	I	ponar	38.89258873	-90.52201052
25	0	0	10	F	30	60	0	CLAY	2	I	ponar	38.89278516	-90.52211868
26	0	0	100	N	0	0	0	SAND	2	O below mouth	ponar	38.89340251	-90.52148774
27	0	0	100	N	0	0	0	SAND	between 2&3	between	ponar	38.89409701	-90.52101905
28	0	0	100	50 F 50 C	0	0	0	SAND	3	O RDB	ponar	38.89504406	-90.51964902
29	0	0	100	F	0	0	0	SAND	between 3&4	between	ponar	38.8966996	-90.51912624
30	0	0	0	N/A	##	0	0	SILT	4	I	ponar	38.89867076	-90.51840517
31	0	0	0	N/A	##	0	0	SILT	4	I	ponar	38.89844629	-90.51820688
32	0	0	70	F	30	0	0	SAND	4	O RDB	ponar	38.89850942	-90.5175489
39	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	38.89594198	-90.52040614