RED ROCK LANDING - DIKE EXTENSIONS

POST-CONSTRUCTION MONITORING COMPLETION REPORT

2012 Survey Results

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US Army Corps of Engineers
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Open River
Mississippi River
River Miles 96 - 97

INTRODUCTION

The U.S. Army Corps of Engineers (USACE), St. Louis District's (District) conducted post-construction biotic (fish) and abiotic (sediment, water quality, bathymetry, and velocity) sampling to compare the fish assemblages and the physical habitats surrounding the rootless dike extensions along the right descending bank of the Mississippi River (Table 1, Exhibit 1). Construction of these structures was funded by the American Recovery and Reinvestment Act (2010). Working with agency partners, river engineers determined that the construction of two rootless dikes and the extension and raising of dike 96.8 would reduce repetitive dredging in this area. These structures are designed to permanently alter the pattern of scour and deposition around them, thus potentially creating more diverse habitat for various aquatic species. This monitoring will serve as the primary source of data concerning the habitat created and fish community utilizing these rootless dike structures at the time of sampling. This information will be used in determining design of future river training structures.

This report provides a summary of fish and water quality data collected during the spring (May and June 2012), and summer (July 2012), as well as bathymetry (March and July 2012), Acoustic Doppler Current Profiler (ADCP) velocity (July 2012), and sediment (August 2012).

Table 1. Existing dikes within the project area. Construction dates were taken from the dike centerline file on the USACE Geographic Information Systems server.

Dike	Length (feet)	Elevation (feet)	Construction Date
97.0R originally pile dike	3,090	347	1979
96.9R	400	350	2010
96.8R (2 notches)	1,040	340 raised to 350	1979 extended & raised 2010
96.6R	400	350	2010
96.5R (1 notch)	1,135	348	1979
96.2R (1 notch)	950	348	1979

METHODS

Study Location

The survey site is located on the right descending bank of the Mississippi River, adjacent to Jones Towhead at River Miles (RM) 96-97 in Perry County, Missouri; 14 miles downstream from Chester, IL.

Sampling Dates

During the first year of post-construction sampling, fish assemblage and water quality sampling occurred during the spring (May 25, June 5, 2012) and summer (July 9-10, 2012).

Fish Sampling & Water Quality

Fish sampling procedures are modified from those used by the Upper Mississippi River Restoration Environmental Management Program (UMRR-EMP) Long Term Resource Monitoring Program (Gutreuter et. al. 1995). A multi-method approach was used to increase the likelihood of sampling the entire fish community in the survey area (Sheehan and Rasmussen 1993). A total of 14 separate electrofishing runs and 5 trawling runs were performed in spring and summer one year post construction (Exhibit 1). No control dikes were chosen because the purpose of this study is to characterize the fish community in this dike field. Sampling was completed when water levels were below +15 ft; the elevation when the dikes are overtopped. All fish were measured and species and length recorded.

Daytime electrofishing (DC pulse rate of 120) was conducted upstream and downstream side of each dike and along the bank (a total of 14 electrofishing runs). If water was flowing through the dike notches, only downstream electrofishing included the notch. The upstream runs did not include the notch because shocked fish went through the notch. When there was no flow, both sides were sampled.

An 8 foot mini-Missouri trawl (Herzog et al. 2009), constructed of 19.05 mm inner mesh unit enclosed by a 4.76 mm outer mesh was attached to the bow of the boat with approximately 75 foot towlines was used. Trawling started just upstream of the rootless dike tips. Run length was established to sample the habitat influenced by the flow created by the dike extensions. Trawling was run in reverse and proceeded with the flow.

Water quality data was collected within each chevron field, on the day of but prior to, fish sampling in that area. A HydroLab unit was used to collect pH, conductivity (µS/cm) water temperature (°C), and dissolved oxygen (mg/L) at the surface of the water column (approximately 1-2 feet). Water velocity was also recorded near the bank and navigation tips of each dike and averaged and at the midpoint of the electrofishing bank runs and trawling runs. Turbidity was recorded using a secchi disk.

Bathymetry, Velocity, and Sediment Surveys

To characterize the river bottom, bathymetric data were gathered using both channel cross-section (single-beam) and multiple transducer sweep (multi-beam) surveys. The single beam survey followed pre-existing survey transects that incorporate overlapping transects to validate data by comparing adjacent soundings from different transects. Utilizing pre-existing transects also allows for comparison between surveys collected on different dates. These surveys used a boat mounted acoustic echo sounder to measure depth, a differential GPS to provide accurate position, and a computer to time-tag and record the depth and position data. All components were configured prior to the survey to reflect the survey vessel, sensor type, and survey area. The Acoustic Doppler Current Profiler (ADCP) was mounted to the same survey vessel and collected with the multi-beam data.

Sediment samples were collected by ponar dredge in transects around the two dike extensions. Sediments were classified into fines, sand, gravel or cobble assigned a size class of fine/small, medium, or coarse/large.

RESULTS

Bathymetry, Velocity, and Sediment Surveys (Exhibits 2 - 4)

The single beam bathymetry data was collected pre-construction (April 2010; Exhibit 2a). Post-construction single beam bathymetry collected on March 13-14, 2012 (Chester gage approximately 9.5 ft.) captured depth information around extension 96.9, below dike 96.8 and above dike 96.6 (Exhibit 2b). Areas of deep water, > -20 ft. LWRP, have formed off the tips of dikes 96.8 and 96.6. Bathymetry and sampling data also found deep water along the bank of 96.8, 96.5 and 96.2 and on the navigation side of the downward arm of 96.8. In other areas, there is a mosaic of shallow and very shallow water. Dikes 96.8 and 96.5 have been notched and islands are forming downstream. Dike 97.0 has accumulations of sand against the dike but a channel remains open to Jones Chute.

Multi-beam bathymetry and ADCP data were gathered on July 26, 2012 (Chester gage approximately 3.47 ft.; Exhibit 2c). Due to the lower water, the survey covered only the main channel and contains little information about the dike field habitat. However, the survey does show a deep area has formed off the tip of extension 96.9. The ADCP indicates swift main channel currents run along the edge of the upper part of the dike field (3.2 – 5.0 ft/sec). The current begins to redirect toward the left descending bank below the second dike extension (Exhibit 3). Velocities recorded during fish sampling were highest on the navigation side trawl runs (Table 2). Velocities were slowest downstream of the original dikes and slightly higher along the bank. During both samples, water was flowing through the notches in the dikes creating flow along the bank.

Sediment surveys were conducted around each dike extension (Exhibit 4). Sediment was almost exclusively fine and medium sand. Of the 234 samples, four samples contained gravel. This is supported by sediment contained within the trawling runs. There was gravel in the bank side most upstream trawl. All other runs were over sand/mud.

Table 2. Average water velocities (mph) recorded for each electrofishing and trawling run each season. Runs were conducted along the bank, along the rock of the original dikes, along the rock of the dike extensions, and perpendicular to the navigation and bank side tips of the extensions.

Location	Sample ID	Water Velocity (mph)	
		Spring	Summer
Bank	RE5B	1.2	0.5
	RE7B	0.3	0
Original	RE1D	0.7	0.8
	RE3D	0.5	0
	RE6D	0.3	0
	RE8D	0.3	0.5
Extension	RE2D	1.1	1.3
	RE4D	0.7	1
Original	RE1U	1.6	2
	RE3U	1.1	2.5
	RE6U	1.8	1.5
	RE8U	0.5	0
Extension	RE2U	1.5	2.3
	RE4U	2.5	3
Bankside	RT1	3.5	4
	RT3	1.5	0.5
	RT5	0.5	1.5
Navigation	RT2	4	4
	RT4	1	4.5

Fish Sampling

A total of 1077 individuals representing 11 families and 30 species were collected over all seasons and gears (Tables 3 & 4). The most common (>10% of total catch) families collected in the spring included Catostomidae 20%, Clupeidae 30%, Cyprinidae 13%, Ictaluridae 21%, and Lepisosteidae 11%. The pre-dominant species was Gizzard Shad (30% of total catch). In the spring, species collected that are of special interest included shovelnose sturgeon (n=5), blue sucker (n=1), and paddlefish (n=1). The most common families in the summer included Catostomidae 16%, Clupeidae 17%, Cyprinidae 23%, Ictaluridae 11%, and Sciaenidae 20%. The pre-dominant species were emerald shiner (10%), freshwater drum (20%), and gizzard shad (17%). In the summer, species collected that are of special interest included the Sicklefin chub (n=1). The spring sample was predominantly composed of adult individuals with some juvenile blue catfish, young of the year (YOY) sturgeon and a YOY paddlefish. The summer sample had an abundance of juveniles in many different species which may indicate good spawning and rearing habitat in the sample area.

CONCLUSIONS

The most noteworthy results of this sampling were the presence of five YOY sturgeon and one YOY paddlefish in the spring navigation and bank side trawls. Young individuals of these species are of special concern to state and federal agencies. Further sampling is needed to determine if these species found the habitat suitable or were merely deposited by the currents in the area. There is the potential that the dike extensions create a unique combination of current, substrate, and forage for these species.

Overall, the dike extensions supported a greater number of individuals and species compared to bank line. Species found near the dikes prefer rock crevices, or feed in fast currents (Pflieger 1997). Of note was the blue sucker captured upstream of the dike extension in the spring. This species prefers swift currents associated with natural or artificial obstructions (Pflieger 1997), which suggests that the dike extensions are creating the swift current habitat associated with structure that this species prefers.

The original dikes and bank line support a diversity of fish species. The backwater habitat created along the bank supports some species uncommon to this section of the Mississippi River (longear sunfish, spotted gar and black crappie) (Steuck et al. 2010). These species are more typical of backwater and lake habitats. It appears that the project area is providing a unique habitat not common in the open river section of the Mississippi River.

Conditions during fisheries samples, bathymetric data, and ADCP suggest that the dike extensions create different habitat from traditional dikes. Because of their short length and position near the thalweg, current remains relatively strong below the dikes and any depositional zones remain submerged. Additional physical and biological monitoring of these structures would provide further information needed to more fully assess how fish are using these river training structures.

Table 3. Total fish count by species collected by gear in the spring grouped by adult (A) and juvenile (J). Electrofishing runs were along the bank between dikes and along the rock downstream (D) and upstream (U).

Fish Species	**Electrofishing**				**Trawl**			**Total Over All Gears Spring**		
	Bank	**D**	**U**	**Total**	**A**	**J**	**Total**	**A**	**J**	**Total**
	A	**A**	**A**	**A**						
bigmouth buffalo	3	11	1	15				15		15
black buffalo	8	20	4	32				32		32
blue catfish		13	1	14	1	21	22	15	21	36
blue sucker			1	1				1		1
channel catfish		15	20	35				35		35
common carp	6	17	9	32				32		32
flathead catfish	1	8	9	18				18		18
freshwater drum		6	5	11		1	1	11	1	12
gizzard shad	60	59	7	126				126		126
longnose gar	1	4		5				5		5
paddlefish						1	1		1	1
red shiner	1	6	2	9				9		9
river carpsucker		1	2	3				3		3
shoal chub					1		1	1		1
shortnose gar	17	22		39				39		39
shovelnose sturgeon						5	5		5	5
silver carp	4	8		12				12		12
smallmouth buffalo	11	14	10	35				35		35
spotfin shiner		3		3				3		3
spotted gar		1		1				1		1
white bass		3	1	4				4		4
Grand Total	**112**	**211**	**72**	**395**	**2**	**28**	**30**	**402**	**28**	**425**

Table 4. Total fish count by species collected by gear in the spring grouped by adult (A) and juvenile (J). Electrofishing runs were along the bank between dikes and along the rock downstream (D) and upstream (U).

Fish Species	**Electrofishing**							**Trawling**			**Total Over All Gears Summer**		
	Bank		**D**		**U**		**Total**	**A**	**J**	**Total**	**A**	**J**	**Total**
	A	**J**	**A**	**J**	**A**	**J**	**A**						
bigmouth buffalo	2		14		4		20				20		20
black buffalo	3		14		1		18				18		18
black crappie	1						1				1		1
blue catfish			2		1		3		2	2	3	2	5
bluegill			1		1		2				2		2
channel catfish	1		11	1	18		31		12	12	30	13	43
common carp	2		18		14		34				34		34
emerald shiner	6	5	25	16	8	4	64		1	1	39	26	65
flathead catfish	2		6		14		22				22		22
freshwater drum	1	3	3	26	17	4	54		77	77	21	110	131
gizzard shad	23	1	53	20	12	2	111			0	88	23	111
goldeye		1		38		4	43		12	12		55	55
longear sunfish			1				1				1		1
longnose gar			1	2			3				1	2	3
orangespotted sunfish			1				1				1		1
red shiner			3				3				3		3
river carpsucker	2	14	2	3	2	8	31		3	3	6	28	34
shorthead redhorse					1		1				1		1
shortnose gar	5		10		1		16				16		16
sicklefin chub								1		1	1		1
silver carp			5		2		7				7		7
silver chub									42	42		42	42
smallmouth buffalo	3		19		11		33				33		33
white bass			2		1		3				3		3
Grand Total	**51**	**24**	**191**	**106**	**108**	**22**	**502**	**1**	**149**	**150**	**351**	**301**	**652**

Table 5. Comparison of electrofishing (bank, downstream, and upstream) and trawling percent of total catch by family over all seasons. Dominant families (>10% of total catch) are bolded and shaded in gray.

Family	Electrofishing						Trawling	
	Bank		Upstream		Downstream			
	Total Count	% of Total Catch	Total Count	% of Total Catch	Total Count	% of Total Catch	Total Count	% of Total Catch
Acipenseridae	0	0.00	0	0.00	0	0.00	5	2.78
Catostomidae	**46**	**24.60**	**45**	**22.28**	**98**	**19.29**	3	1.67
Centrarchidae	1	0.53	1	0.50	3	0.59	0	0.00
Clupeidae	**84**	**44.92**	**21**	**10.40**	**132**	**25.98**	0	0.00
Cyprinidae	**24**	**12.83**	**39**	**19.31**	**101**	**19.88**	**45**	**25.00**
Hiodontidae	1	0.53	4	1.98	38	7.48	12	6.67
Ictaluridae	4	2.14	**63**	**31.19**	**56**	**11.02**	**36**	**20.00**
Lepisosteidae	**23**	**12.30**	1	0.50	40	7.87	0	0.00
Moronidae	0	0.00	2	0.99	5	0.98	0	0.00
Polyodontidae	0	0.00	0	0.00	0	0.00	1	0.56
Sciaenidae	4	2.14	**26**	**12.87**	35	6.89	**78**	**43.33**
TOTAL	**187**	**100.00**	**202**	**100.00**	**508**	**100.00**	**180**	**100.00**

LITERATURE CITED

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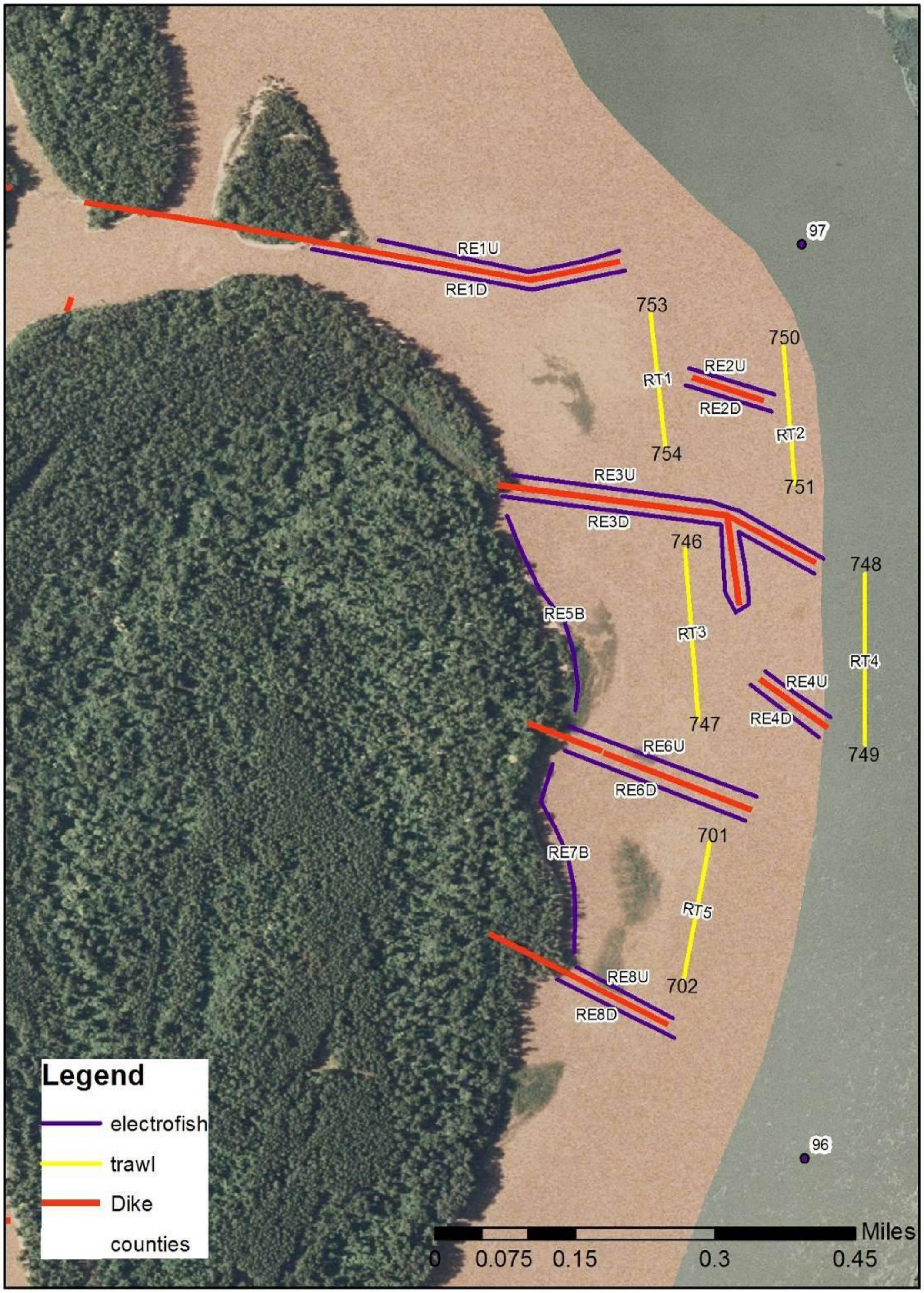

Exhibit 1. The existing dikes and offset rootless dike extensions, and transects for the fish survey along the right descending bank of the Mississippi River MRM 96.0 - 97.0.

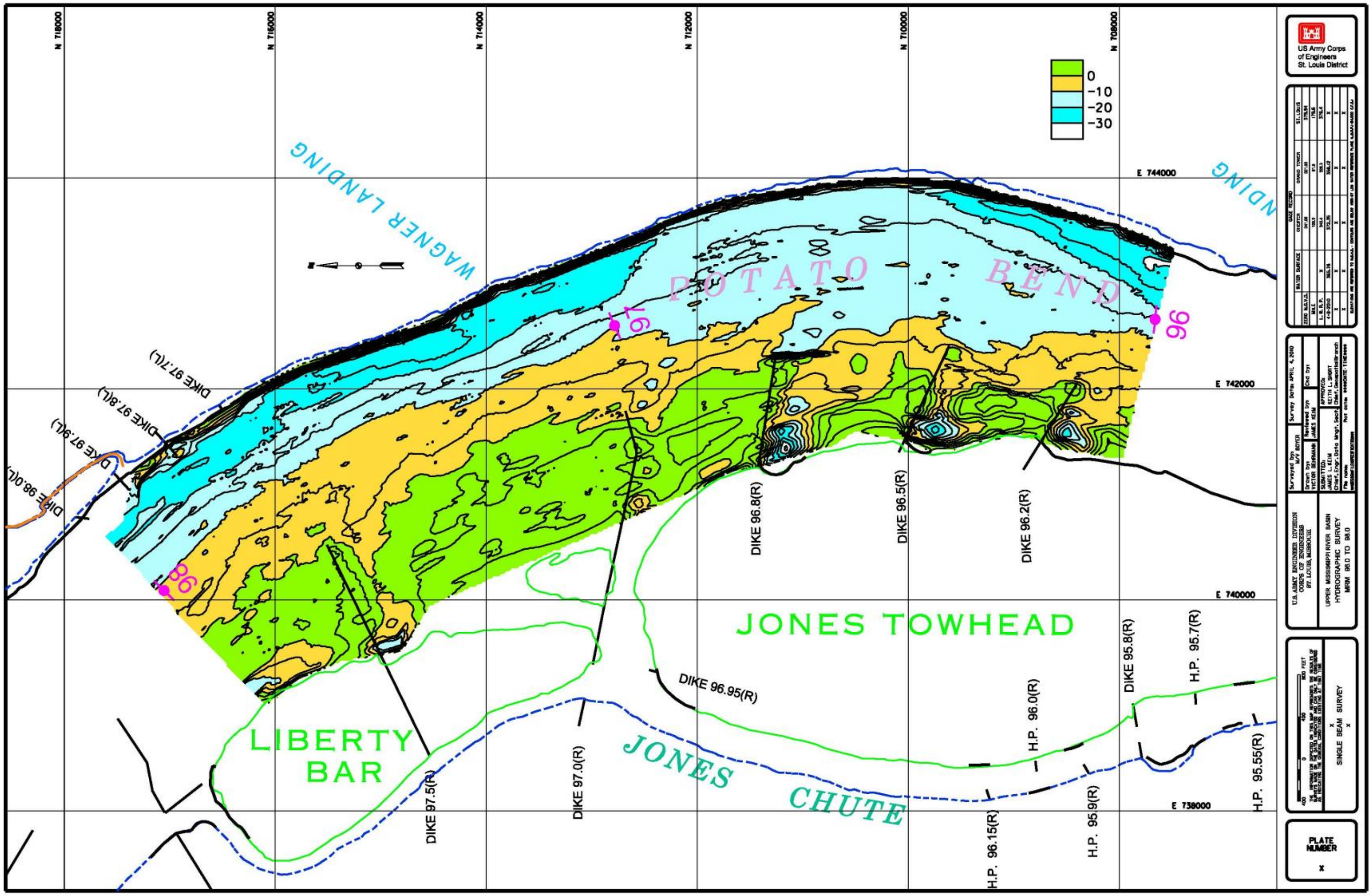

Exhibit 2a. Pre-construction single beam bathymetric data collected on April 8, 2010. Elevations are in feet low water reference plane (LWRP).

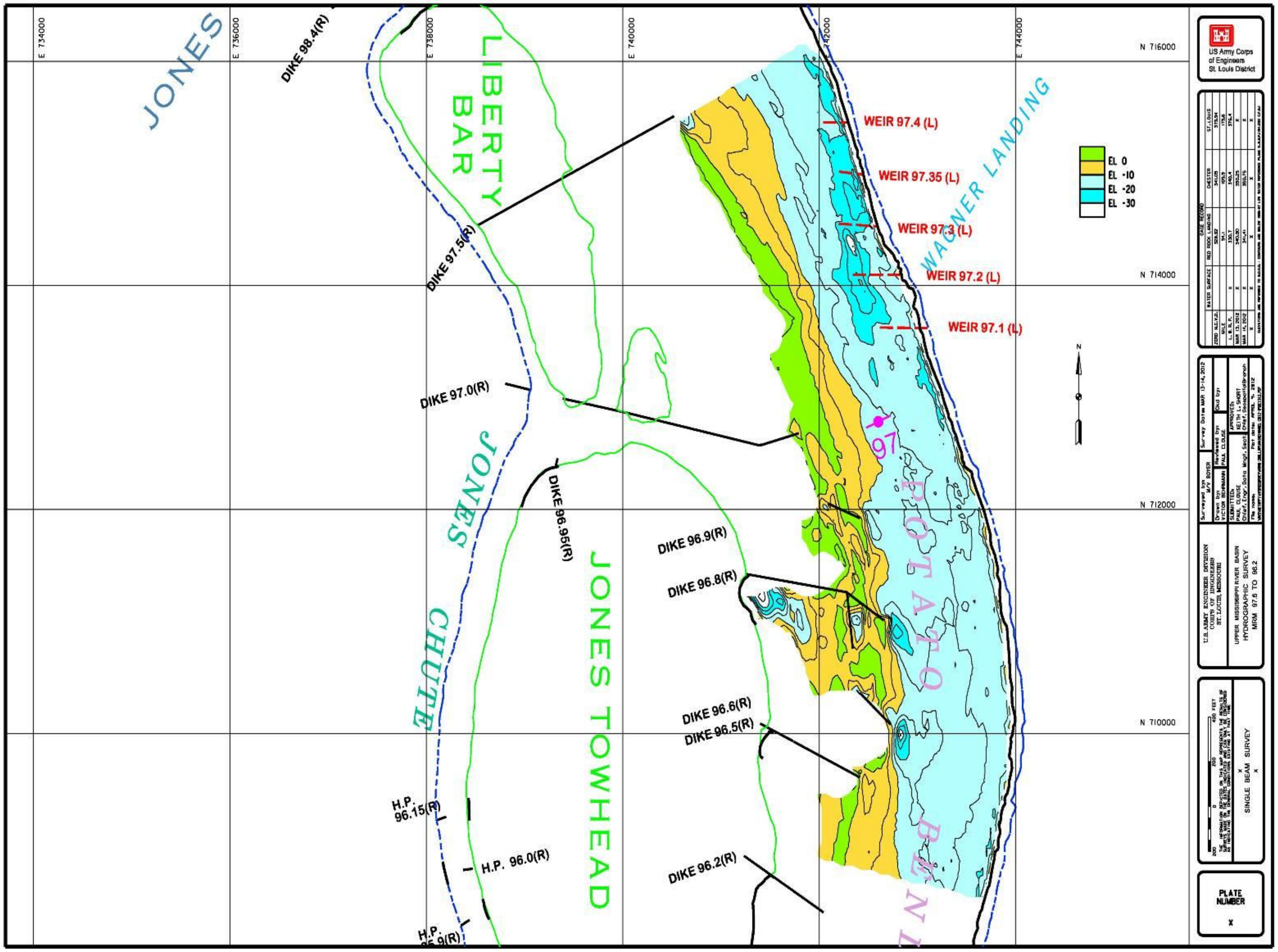

Exhibit 2b. Single beam bathymetric data collected on March 13 & 14, 2012 in the vicinity of the Devil's Island dike field. Water surface elevation limited the area of data acquisition. Elevations are in feet low water reference plane (LWRP).

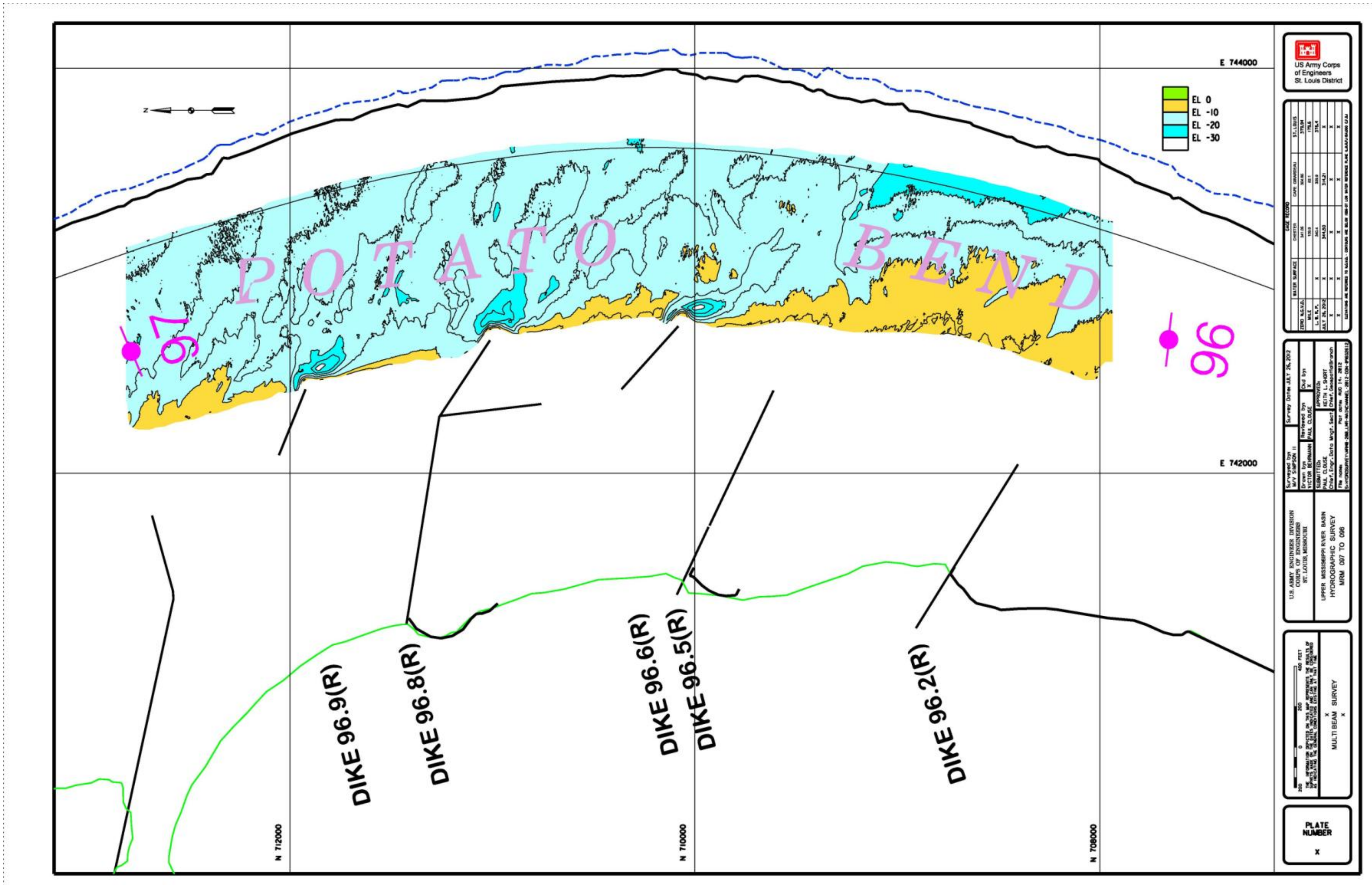

Exhibit 2c. Multibeam bathymetric data collected on July 26, 2012. Water surface elevation limited the area of data acquisition. Elevations are in feet low water reference plane (LWRP).

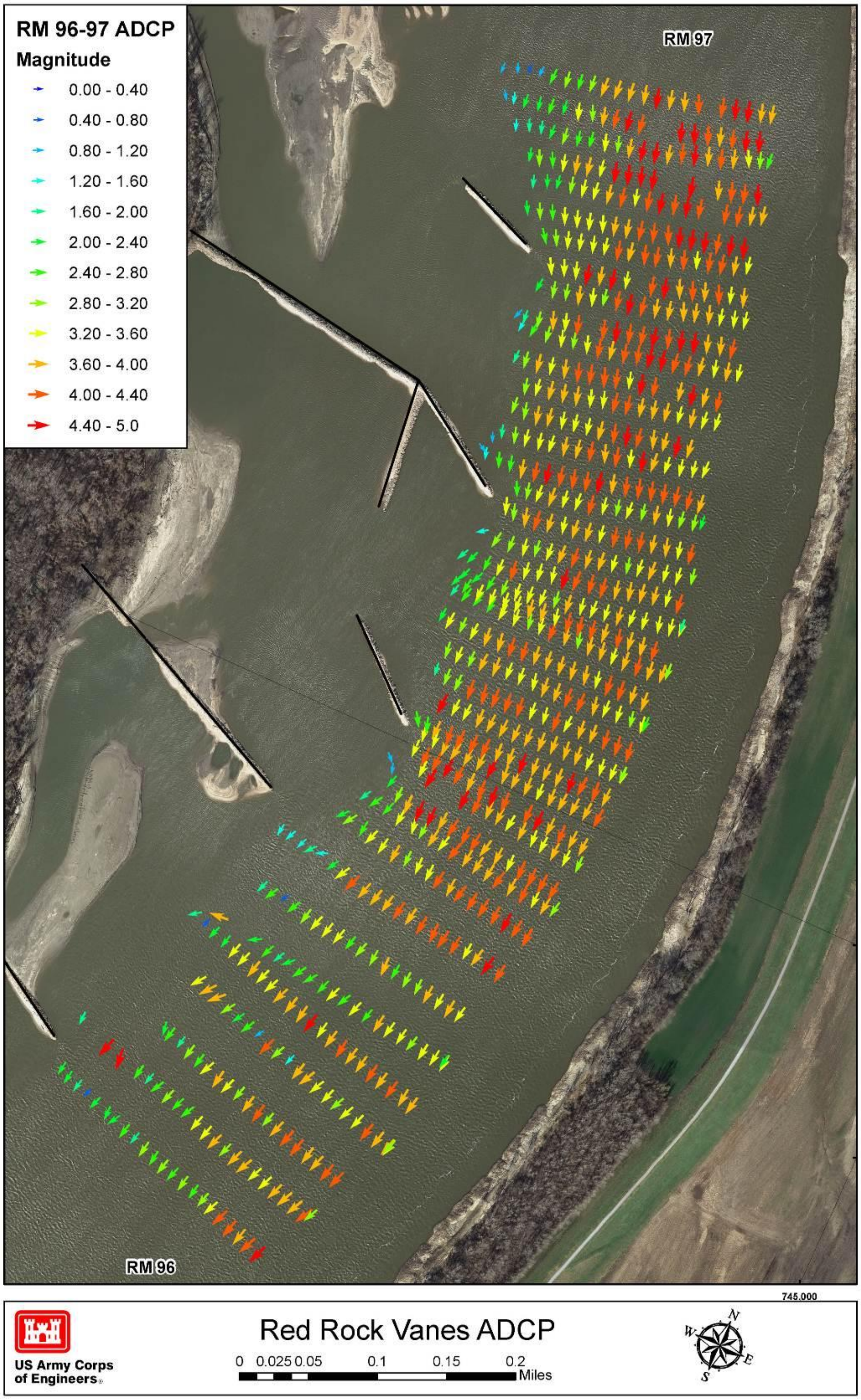

Exhibit 3. Acoustic Doppler Current Profile (ADCP) data (ft./sec) collected on July 26, 2012 in the vicinity of the Devil's Island dike field. Water surface elevation limited the area of data acquisition.

Exhibit 4. Sediment survey conducted on 16 & 17 August 2012 around the dike extensions at Mississippi River Mile 97. The first letter of abbreviations indicates F-fines, S-sand, G-gravel, and C-cobble classified into different size classes (2nd letter) f-fine, s-small, m-medium, c-coarse, and l-large.