Sustainable Rivers Program

Kaskaskia River
Modifying Water Levels to Enhance Migratory Shorebird Habitat - 2024

Prepared by: U.S. Army Corps of Engineers, St. Louis District
1222 Spruce Street
St. Louis, Missouri 63103

May 2025

Above: Mudflat located in a backwater of the lower Kaskaskia River (USACE photo).

Contents

1 Introduction

The Upper Mississippi River System is located at the center of one of the primary migratory pathways in North America and is historically significant for migratory shorebirds. Shorebirds depend on shallowly flooded and recently flooded mudflats and sandbars to access invertebrate prey. This is a habitat type that can be limiting on the current landscape in our region due to land use change and altered hydrology of wetlands in the Illinois and Mississippi River watersheds. Mudflats and sandbars are limited partially as a result of the system of locks and dams that are operated to support navigation and other purposes for those rivers. The area above Jerry F. Costello Lock and Dam (Costello Pool) attracts a range of waterbirds, including waterfowl, herons, egrets, and shorebirds when conditions are suitable. This report will summarize SRP funded implementation and monitoring related shorebird work for 2024. In 2024, sampling of sediment moisture and substrate suitability for shorebird foraging occurred in August when water levels exposed mudflats just upstream of Jerry F. Costello L&D (Costello L&D). Ecological responses were monitored by gathering and assessing the following data:

- *Shorebird utilization of exposed sediments*
- *Sediment and invertebrate data from mudflat habitat*
- *Videos and photos of habitat use by shorebirds*

1.1 Kaskaskia River Pool Conditions

Jerry Costello L&D is a navigation lock and dam (L&D) located 0.7 mi upstream of the outlet of the Kaskaskia River basin. There is a total of 5,840 mi^2 of drainage area. 2,717 mi^2 are upstream of Carlyle Dam and 3,123 mi^2 of largely unregulated drainage area are located downstream of Carlyle Lake. Jerry Costello L&D is a hinge point operated, run of the river lock and dam project, and its pool stages are driven by inflow to meet hinge point operating limits and influenced by backwater from the Mississippi River during high flow events. Figure 1 illustrates how Jerry Costello L&D is operated with varying river conditions.

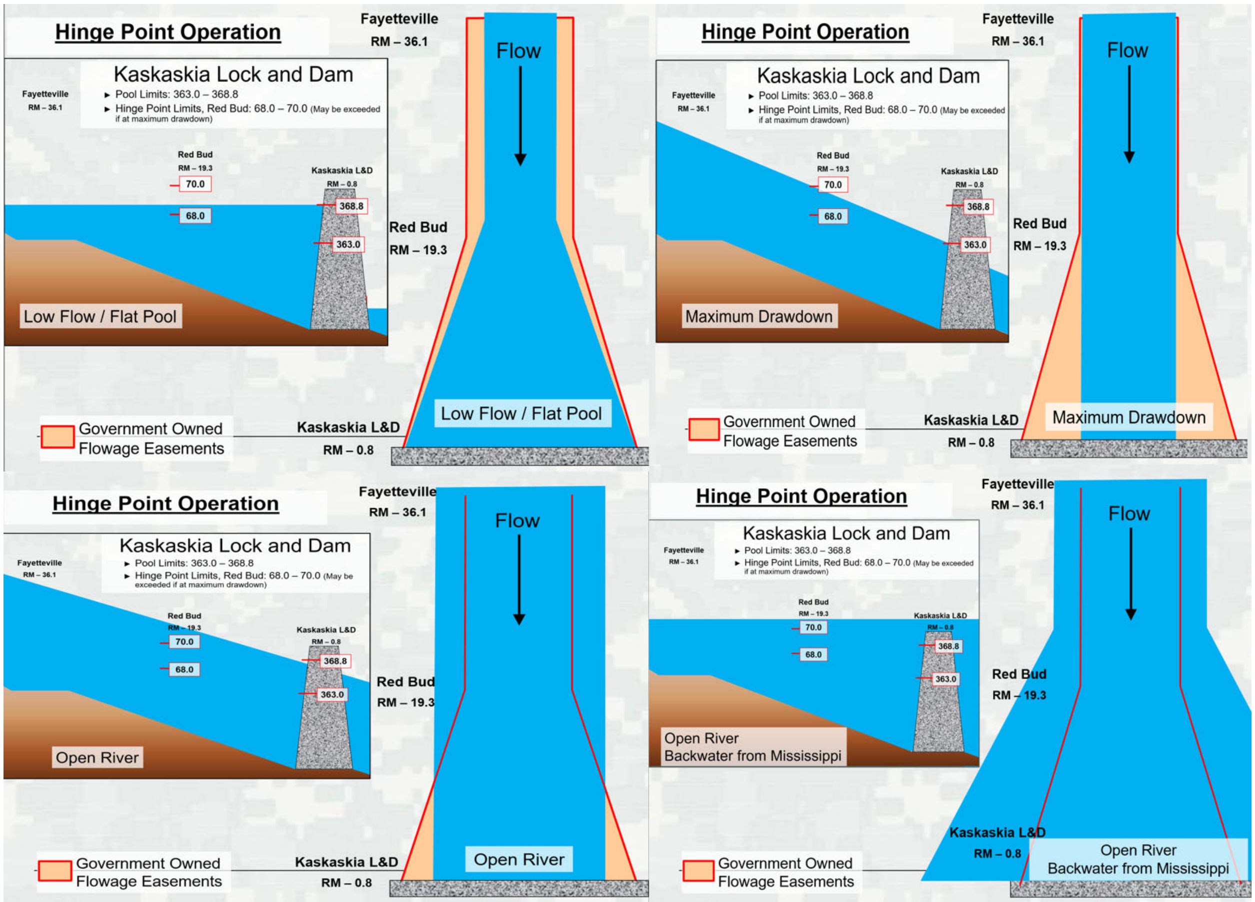

Figure 1. Jerry F. Costello Lock and Dam illustrative operating limits.

Figure 2 shows Costello pool stages during July and August of 2024. Substantial rains across the Kaskaskia River Basin in early July provided opportune conditions to attempt exposing mudflats upstream of Jerry Costello L&D for migratory shorebird habitat. With enough upstream inflow from surrounding tributaries and reservoirs within the basin, the L&D pool was able to be held 0.5 ft below its normal pool stage (368.80 ft) for over two weeks in the beginning of August. However, dry conditions following the July rains caused the flows of upstream tributaries to recede while, simultaneously, outflows from Lakes Shelbyville and Carlyle were reduced for the sake of conserving their water. In turn, Jerry Costello was required to begin raising its pool back to normal stage on August 22nd to provide adequate channel depth for river navigation.

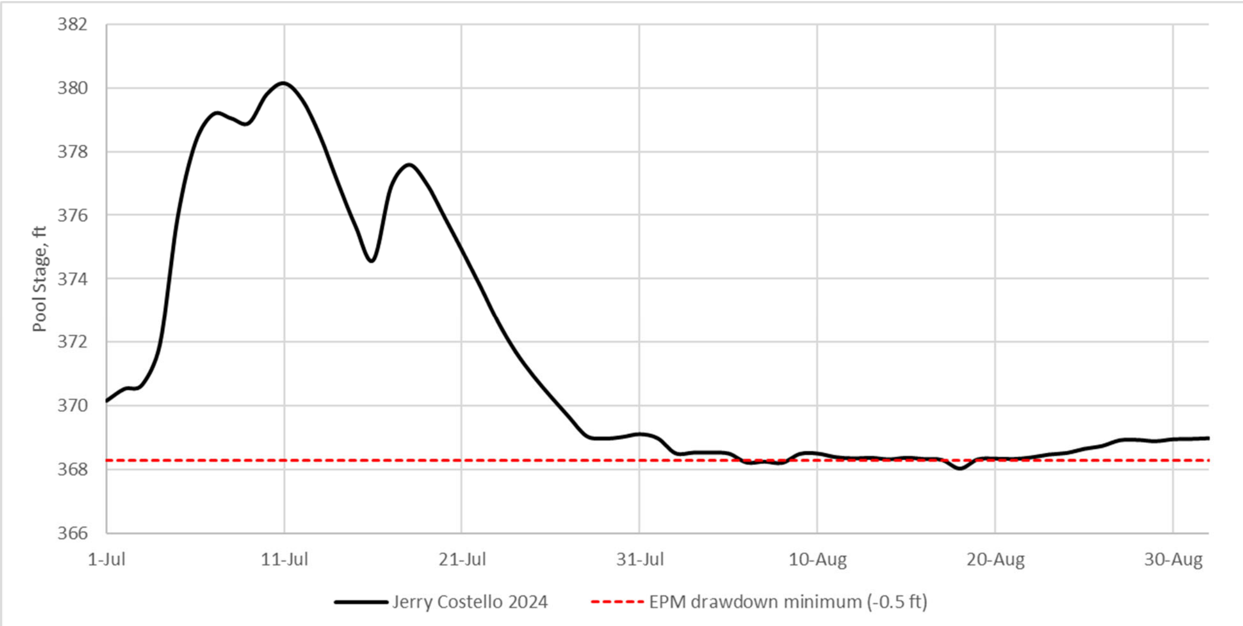

Figure 2. July-August pool stages (in feet), Costello Lock and Dam, 2024.

2 Methods

Potential habitat available for shorebird foraging is present in oxbows of the Lower Kaskaskia River due to the prevalence of relatively flat, shallow off-channel areas that are exposed as pool levels are reduced (Figure 3). Conditions within the study area were evaluated utilizing several methodologies to assess direct use of habitats and to assess habitat conditions when birds are absent. This evaluation was done because "good" habitat conditions do not always correlate with high bird-use of habitats due to the migratory nature of shorebird species and the generally patchy distribution of habitat on the landscape.

Shorebird use was monitored via visual observations in August 2024. Sediment, soil moisture, and macroinvertebrate samples were collected at one site, three transects per site, three samples per transect for a total of nine samples, on seven separate dates. Samples were gathered on August 7, 8, 9, 13, 14, 20, and 21. The seven dates overlapped with the beginning of an attempted pool drawdown for environmental pool management (EPM).

Figure 3. Aerial image of backwaters and oxbows directly upstream of Costello L&D. Areas likely to be influenced by the water management in the river for shorebirds shown in tan.

2.1 Shorebird Use

Shorebird surveys followed the Integrated Waterbird Management and Monitoring (IWMM) protocol (USFWS, 2021) to assess shorebird use and were conducted on the mornings of sediment, macroinvertebrate, and moisture sampling days. Backwater sites at river mile 2 and river mile 3) were both sampled from a vantage point where the entire unit could be seen from a single point (Figure 3 white diamonds). All waterbird species utilizing the unit were identified and total number was recorded per species.

2.2 Sediment Sampling

Sediment samples were taken along transects oriented perpendicular to the shoreline, starting at the water surface/shoreline intersection. Soil moisture and invertebrate samples were taken at 1.6 ft (0.5 m), 8.2 ft (2.5 m), and 14.8 ft (4.5 m) from the shoreline and away from the water on 7, 8, 13, 14, and 20 August 2024. On 9 and 21 of August, samples were gathered from reinundated areas. Soil moisture samples were gathered from the top 1.5 in (3.8 cm) with a square tablespoon that gathered a sediment sample of approximately 0.90 in^3 (14.78 cm^3). Each sediment sample was transferred to a labeled plastic bag and processed at the end of the day. Macroinvertebrate samples were gathered utilizing a 4.0 in (10.2 cm) diameter PVC Schedule 30 pipe to a depth of 2.0 in (5.0 cm). Sediment was scooped from the PVC tube sample area and transferred to separate labeled gallon plastic bags and placed in a cooler to prevent desiccation or damage to macroinvertebrates until samples could be processed later the same day. The volume of each sample was approximately 19.8 in^3 (324 cm^3). Equipment was cleaned and dried between sample collections.

2.2.1 Soil Moisture Processing

Small aluminum tins 2.9 inches (7.4 cm) in diameter were labeled for each soil moisture sample. Sample tins were weighed utilizing an electronic scale (± 0.00035 ounces; ± 0.001 grams) and recorded. Samples were then transferred to the corresponding tin and weighed to record wet weight (+ tin weight). Next samples were transferred to a low temperature (100ºF/38ºC) heating mat and dried over approximately 48 hours until the weight of samples were stable (i.e., no additional water loss from samples). Samples were then transferred to a sealed container with a layer of silica desiccation beads under sample tins until samples returned to room temperature to prevent resorption of water. Samples were then weighed to provide dry weights (+ tin weight). Percent moisture by weight was calculated utilizing the following formula:

Percent moisture = ((wet weight - tin weight) - (dry weight - tin weight)) / (wet weight - tin weight) * 100

2.2.2 Macroinvertebrate Sample Processing

Macroinvertebrate samples were processed the same day that samples were collected utilizing a fog nozzle (0.6 gallons per minute; 1.9 liters per minute) to gently rinse sediment through a series of soil sieves (#5, #10, #40, #60) with corresponding mesh diameters of 0.1575 in, 0.0787 in, 0.0157 in, 0.0098 in (4 mm, 2 mm, 0.4 mm, 0.25 mm) to separate invertebrates from substrate components. Macroinvertebrates were identified with the aid of a 10X loupe when needed, tallied by type utilizing counters, and transferred to glass collection vials containing 90% isopropyl alcohol to preserve samples for later identification. Unknown samples were keyed out under a dissecting scope (10-30X) to at least family level.

2.3 Trail Cameras and Video

Two Bushnell™ cameras (Trophy Cam E3) were programmed at a maximum resolution (16 megapixel) to take pictures when activated by motion of bird use during the late summer-fall shorebird migration period. Placement of cameras occurred on 7 August 2024. One camera was located at the western edge of RM-3 backwater and one camera was placed on the west side of RM-2 backwater (Figure 4). The cameras were secured to small trees approximately 6 feet above the maximum regulated pool level. Small branches were removed from the camera's field of view to help capture more of the mudflat area.

The cameras were recovered on 21 August 2024 as the sampling window was ending due to rising water levels which inundated mudflats. The cameras were not triggered by movement during the two-week deployment. This may have been due to the low number of shorebirds utilizing the sites or due to distance from the camera to motion. A personal camera was utilized during the sampling periods and site visits to capture some of the shorebird use at the site (Figures 5 and 6).

Figure 4. Trail cam sampling locations at river mile 2 (RM-2) and river mile 3 (RM-3) backwaters on the Kaskaskia River.

Figure 5. Two killdeer utilizing mudflat at RM-3 on the Kaskaskia River 21 August 2024 (USACE photo).

Figure 6. Sandpipers utilizing the water edge at RM-3 on the Kaskaskia River 21 August 2024 (USACE photo).

3 Monitoring Results

Shorebird use data recorded in August 2024 is provided below in Table 1. Sediment and macroinvertebrate samples were gathered to evaluate conditions and substrate suitability (Figure 7, Table 2, and Table 3).

Table 1. Shorebird observations at Kaskaskia sampling sites August 2024.

Species	**# observed**
Killdeer	52
Semipalmated Sandpiper	4
Solitary Sandpiper	3
Spotted Sandpiper	3
White-rumped Sandpiper	2
Calidris sp.	2

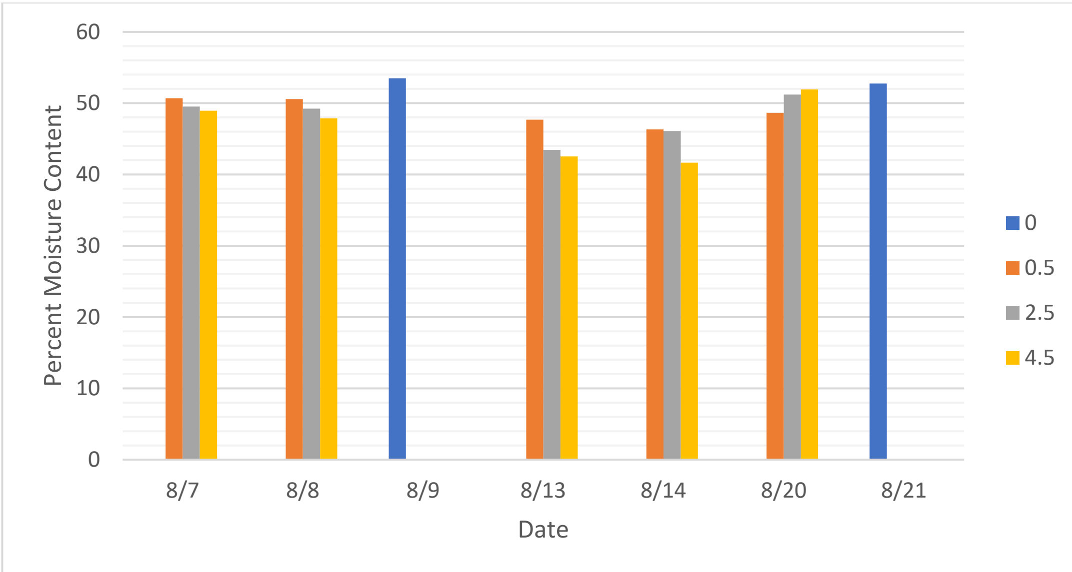

Figure 7. Percent moisture content by distance along transects away from water. 0 = 0 ft (0 m) 0.5 = 1.6 ft (0.5 m), 2.5 = 8.2 ft (2.5 m), 4.5= 14.8 ft (4.5 m).

Table 2. Invertebrate count by distance and sample along transects.

Date	Sample	Distance (ft)	Aquatic Worms	Midge (Chironomid)	Black Fly	Sample Total
8/7/2024	1A	1.6	0	2	0	2
8/7/2024	1B	8.2	1	0	0	1
8/7/2024	1C	14.8	0	0	0	0
8/7/2024	2A	1.6	0	0	0	0
8/7/2024	2B	8.2	0	0	0	0
8/7/2024	2C	14.8	0	0	0	0
8/7/2024	3A	1.6	1	0	0	1
8/7/2024	3B	8.2	0	0	0	0
8/7/2024	3C	14.8	0	0	0	0
8/8/2024	4A	1.6	7	0	0	7
8/8/2024	4B	8.2	0	0	0	0
8/8/2024	4C	14.8	0	0	0	0
8/8/2024	5A	1.6	0	0	0	0
8/8/2024	5B	8.2	0	0	0	0
8/8/2024	5C	14.8	0	0	0	0
8/8/2024	6A	1.6	0	0	0	0
8/8/2024	6B	8.2	0	0	0	0
8/8/2024	6C	14.8	27	0	0	27
8/9/2024	7	0	0	0	0	0
8/9/2024	8	0	4	0	1	5
8/9/2024	9	0	1	0	0	1

8/9/2024	10	0	1	0	0	1
8/9/2024	11	0	0	0	0	0
8/9/2024	12	0	0	0	0	0
8/9/2024	13	0	3	0	0	3
8/9/2024	14	0	1	0	0	1
8/9/2024	15	0	1	0	0	1
8/13/2024	16A	1.6	5	0	0	5
8/13/2024	16B	8.2	2	0	0	2
8/13/2024	16C	14.8	3	0	0	3
8/13/2024	17A	1.6	0	0	0	0
8/13/2024	17B	8.2	2	0	0	2
8/13/2024	17C	14.8	0	0	0	0
8/13/2024	18A	1.6	1	0	0	1
8/13/2024	18B	8.2	2	0	0	2
8/13/2024	18C	14.8	0	0	0	0
8/14/2024	19A	1.6	1	0	0	1
8/14/2024	19B	8.2	11	0	0	11
8/14/2024	19C	14.8	2	0	0	2
8/14/2024	20A	1.6	1	0	0	1
8/14/2024	20B	8.2	1	0	0	1
8/14/2024	20C	14.8	1	0	0	1
8/14/2024	21A	1.6	0	0	0	0
8/14/2024	21B	8.2	0	0	0	0
8/14/2024	21C	14.8	0	0	0	0
8/20/2024	22A	1.6	2	0	0	2
8/20/2024	22B	8.2	7	0	0	7
8/20/2024	22C	14.8	21	0	0	21
8/20/2024	23A	1.6	0	0	0	0
8/20/2024	23B	8.2	0	0	0	0
8/20/2024	23C	14.8	1	0	0	1
8/20/2024	24A	1.6	0	0	0	0
8/20/2024	24B	8.2	1	0	0	1
8/20/2024	24C	14.8	2	0	0	2
8/21/2024	25	0	7	0	0	7
8/21/2024	26	0	6	0	0	6
8/21/2024	27	0	10	0	0	10
8/21/2024	28	0	10	0	0	10
8/21/2024	29	0	32	0	0	32
8/21/2024	30	0	7	0	0	7
8/21/2024	31	0	14	0	0	14
8/21/2024	32	0	10	0	0	10
8/21/2024	33	0	17	0	0	17
Overall total by species			226	2	1	229

Table 3. Average density per 1 m^2 (10.7 ft^2) sample by distance along transects.

Transect Distance (ft)	Aquatic worms	Midge	Black fly
0	674.0	0.0	4.9
1.6	61.5	6.8	0.0
8.2	92.3	0.0	0.0
14.8	194.8	0.0	0.0

4 Discussion

Coordination with the Water Control Section, St. Louis District, U.S. Army Corps of Engineers, occurred through spring and summer 2024 to identify periods when water level fluctuations could be implemented for the project while maintaining conditions within operational limits identified in the Costello L&D Water Control Plan. Implementation of the mudflat management effort was delayed much of the spring and summer due to unfavorable conditions. A narrow range of dates exposed sediment briefly in April due to drought conditions in the region, but surveys could not start until the end of that one week period of time. Several large storm events in July created the first multi-week opportunity to expose mudflats in the area just upstream of Costello L&D. Over a three-week period, there were two opportunities to modify pool management to inundate exposed mudflats for an extended period before reexposing them. Communication about anticipated conditions allowed us to gather some baseline data on mudflats in our study area in August to assess overall suitability of shorebird habitat.

4.1 Shorebird Use

Bird observations recorded during fall migration sampling dates were comprised of 66 shorebirds representing 6 species. Killdeer were the most frequently observed, accounting for just under 80% of observations. The remaining 20% of observations included Semipalmated Sandpiper, Solitary Sandpiper, Spotted Sandpiper, White-rumped Sandpiper, and *Calidris* spp.

4.2 Sediment Moisture

Sediment moisture samples were gathered along the perimeter of mudflats to evaluate sediment moisture conditions near the transition zone between water and land where shorebirds spend most of their time foraging. Samples were gathered at 1.6 ft (0.5 m), 8.2 ft (2.5 m), and 14.8 ft (4.5 m) on 8/7, 8/8, 8/13, 8/14, 8/20 sampling dates. Samples were gathered in reinundated areas on 8/9 and 8/21 due to temporary changes in water management that inundated the entire backwater. Overall, moisture values were quite variable within and across distance intervals and as a result there were no significant differences in percent sediment moisture among intervals. The lack of differences may have been due to differences in sediment composition across sites, variation in topography among sites, and wave-related effects from barge traffic or windfetch.

4.3 Trail Cameras and Video

Trail cameras deployed for the 2024 season were unsuccessful at capturing the types of images we sought to collect. As a result, we were only able to collect photos during sampling events (Figure 4, 5, 8, 9, 10, 11, and 12 for examples). Additionally, several short videos were captured during sampling that illustrate the interaction of barge related wave action and water levels in backwater areas of the Kaskaskia River. The wave-induced water level changes could expose or inundate up to at least 15 ft of shoreline. This influence was separate from water level management changes.

Figure 8. Barge traveling upstream on the Kaskaskia River. Wave action from the barge changes the location of the water-mudflat interface temporarily by up to at least 15 ft after passing the backwater connection to the river 21 August 2024 (USACE photo).

Figure 9. Image of the backwater at river mile 3 on the Kaskaskia River 21 August 2024 (USACE photo).


Figure 10. Backwater at river mile 3 on the Kaskaskia River approximately two weeks after drawdown started, 15 August 2024 (USACE photo).

Figure 11. Aquatic worms were frequently encountered at the water sediment surface or in tunnels near the surface, 9 August 2024 (USACE photo).

Figure 12. Exposed mudflat with emergent vegetation starting to establish during the brief drawdown period on the lower Kaskaskia River, 9 August 2024 (USACE photo).

4.3 Macroinvertebrates

Macroinvertebrates captured per sample varied widely and included a variety of aquatic worms, midge larvae, and black fly. Midge larvae make up a significant dietary component of many species of waterbird while aquatic worms (oligochaetes) tend to be eaten at lower levels despite their availability (Smith et al., 2012). The target midge density for managed shorebird habitat is 100 or more midge larvae per meter squared surface area of mudflat (Eldridge, 1992). Based on our sampling size 0.785 midges per sample would be needed to meet this threshold. Overall, midge larvae varied from 0-0.05 per sample at the various transect distances. Only four percent of samples at 0.0 ft and 2% at 1.6 ft met the minimum number of midges needed to provide suitable shorebird habitat. No midges were found at 8.2 and 14.8 ft locations. Aquatic worm densities ranged from 61.5 to 674 per 10.7 ft^2 (i.e., per 1 m^2) (Table 3) and were greatest in areas with standing water followed by samples taken 14.8 ft from the water surface.

5 Conclusion

Unsuitable conditions during the spring and much of the summer made it challenging to implement a pulse trial to rewet the edges of mudflat in backwaters and oxbows of the Kaskaskia River until August. Over a two-week period the team took advantage of an opportunity to adjust water levels for two 12+ hour periods in an attempt to rehydrate sediments exposed by the drawdown. Sampling found that the average midge larvae density was below the target levels needed to support migratory shorebirds. Aquatic worm densities were also relatively low except in areas with standing water and the outer edge of the backwater (14.8 ft from water surface edge). Observations of shorebirds utilizing the mudflats primarily occurred in shallowly flooded areas. However, killdeer and sandpipers were also observed frequently eating spiders and insects from the surface of the drying sediment and biofilm layers. Our invertebrate sampling only quantified a portion of the shorebird diet at sampling sites and it is unknown whether aquatic or terrestrial invertebrates contributed more to their diet on the Kaskaskia. Observations of terrestrial invertebrates on the mudflats primarily included various ground spiders and beetles. Sampling at a different period of time (spring migration) may create different results. On the Kaskaskia River, modifying management to rehydrate mudflats changed aquatic worm density for shorebirds but did not increase midge larvae densities over the short-term evaluation period in August. Implementing this type of management throughout the growing season may result in a different aquatic macroinvertebrate response. Based on district evaluations, Pool 26 on the Mississippi River (above Melvin Price Locks and Dam) appears to have greater potential for management due to the higher midge densities and greater shorebird use compared to results reported here for the Kaskaskia River (USACE 2024a, USACE 2024b).

6 References

Eldridge, J. (1992). Management of Habitat for Breeding and Migrating Shorebirds in the Midwest. Waterfowl Management Handbook 11. 7pgs.

Smith, R., Stafford, J., Yetter, A., Horath, M., Hine, C., & Hoover, J. (2012). *Foraging ecology of fall-migrating shorebirds in the Illinois River Valley. PLOS ONE 7(9): e45121. doi: 10.1371/journal/pone.0045121.*

USACE. (2000). Melvin Price Locks and Dam Water Control Manual. U.S. Army Corps of Engineers. St. Louis District. 90 pgs.

USACE. (2024a). *Mississippi River (Pool 26) Modifying Water Levels to Enhance Migratory Shorebird Habitat - 2022. U.S.Army Corps of Engineers, Sustainable Rivers Program.* 17 pgs.

USACE. (2024b). *Mississippi River (Pool 26) Modifying Water Levels to Enhance Migratory Shorebird Habitat- 2023. U.S. Army Corps of Engineers Sustainable Rivers Program. In Press.*

USFWS. (2021). National Protocol Framework for the Inventory and Monitoring of Nonbreeding Waterbirds and their Habitats. Version 2.1: July 2021.