Sustainable Rivers Program

Kaskaskia River
Environmental Pool Management
Implementation 2022

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

June 2024

Above: Oxbow with emergent vegetation on the Kaskaskia River (USACE photo)

Contents

1 Introduction 3
1.1 EPM Operations 4
1.1.1 Lake Shelbyville 4
1.1.2 Carlyle Lake 5
1.1.3 Jerry F. Costello Lock and Dam 6
2 Vegetation 8
2.1 Site Selection 8
2.2 Integrated Waterbird Management and Monitoring Vegetation Surveys 11
2.2.1 Methods 11
2.2.2 Results 11
2.2.3 Discussion 14
2.3 Transect Surveys 15
2.3.1 Method 15
2.3.2 Results 15
2.3.3 Discussion 18
2.4 Seedhead Analysis 18
2.4.1 Methods 18
2.4.2 Results 19
2.4.3 Discussion 20
2.5 Conclusion 20
3 Imagery Analysis 21
4 Public Meetings and Outreach 25
5 Literature Cited 27

1 Introduction

The Kaskaskia River Basin encompasses parts or all of 22 counties in Illinois, with 30 main tributaries and 5,840 square miles of drainage (Figure 1). It is a major tributary of the Mississippi River, with headwaters just west of Champaign, Illinois and flows southwesterly across the state for approximately 325 miles to its confluence with the Mississippi River about eight miles north of Chester, Illinois at river mile (RM) 117. Two reservoirs, Lake Shelbyville and Carlyle Lake, and one lock and dam, the Jerry F. Costello Lock and Dam (Jerry Costello L&D) were constructed and are operated by the Corps. As identified in the 2019 Sustainable Rivers Midwest Regional Meeting (USACE 2020), opportunity exists at Carlyle Lake, Lake Shelbyville, and Jerry Costello L&D for the implementation of water level management.

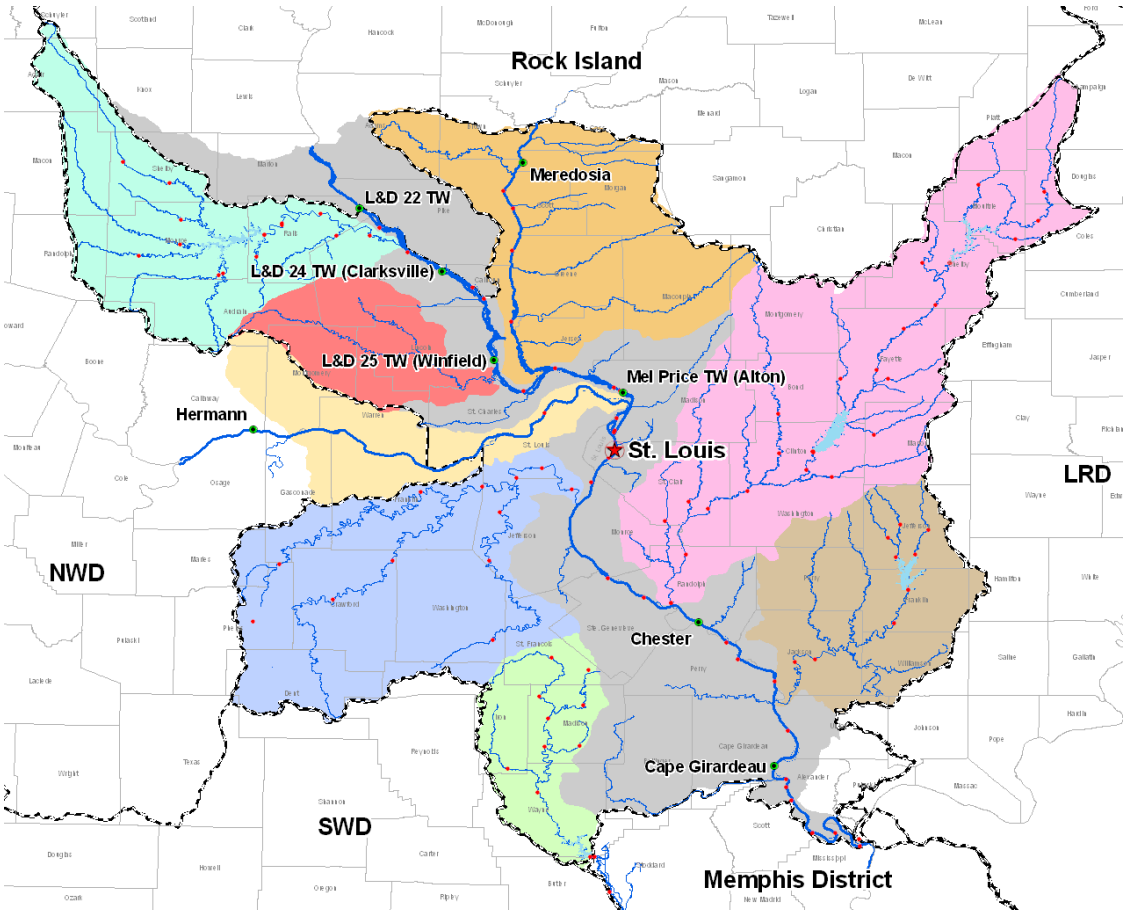

Figure 1. Watershed map of St. Louis District. The Kaskaskia River Basin falls within the pink area.

Lake Shelbyville was completed in 1970 and is approximately 11,100 water surface acres in size. Normal lake levels during the summer are held at a stage of 599.7 feet above mean sea level. The upstream portions, where the Kaskaskia River and West Okaw River flow into the lake, contain areas that would be the most likely to benefit from a drawdown during the growing season. Carlyle Lake was completed in 1967 and is approximately 62,420 water surface acres in size. Normal lake levels during the summer are

held at a stage of 445.0 feet above mean sea level. The upstream portions, where the Kaskaskia River flow into the lake, contain areas most likely to be exposed by and benefit from a drawdown during the growing season.

Downstream of Carlyle Lake, Jerry Costello L&D provides a nine-foot navigation channel for approximately 36 miles from the Mississippi River to Fayetteville, IL. Within this stretch the navigation channel was straightened during construction, resulting in the creation of a large number of remnant oxbows and additional shoreline that could be exposed with water level management to grow vegetation. Normal pool above the Kaskaskia River Lock and Dam is at a stage of 368.8 feet above mean sea level.

This effort would be similar in nature to Environmental Pool Management (EPM) on the Mississippi River, which has been successful nearly every year since 1994. The intent for the Kaskaskia reservoirs was to implement a seasonal 0.5 ft drawdown to evaluate the environmental benefits that could be achieved. This drawdown would be within the operation elevations described in the approved water control plans for all 3 locations. A summary of EPM operations, including target management elevations for the 2021 growing season is provided in Section 1.1 EPM Operations.

Lake Shelbyville and Carlyle Lake are authorized and operate for flood risk management, recreation, navigation, water quality, fish and wildlife conservation and water supply. Jerry Costello L&D is authorized and operates for navigation, recreation, and fish and wildlife conservation.

1.1 EPM Operations

The goal for Lake Shelbyville, Carlyle Lake, and Jerry Costello L&D was to draw pool elevations down to approximately a half a foot during the growing season (May through September). Implementation of drawdowns and the selected drawdown levels at each of the three sites fall within current project authorities and are allowable under the current water control plan. While the goal was the same at each project, the hydrologic and hydraulic constraints vary for each project, which affected the ability to accomplish the desired drawdown at the different pools. The following sections highlight the constraints and what drawdowns, if any, were accomplished at the projects.

1.1.1 Lake Shelbyville

Lake Shelbyville is a headwater flood risk management reservoir with 1,054 mi^2 of unregulated drainage upstream. Lake Shelbyville primary purpose is to reduce flooding downstream with control points at Cowden, Ramsey, and Vandalia. The drainage area between Lake Shelbyville and Vandalia is unregulated and covers 886 mi^2. The constraints of inflow coming into the lake from upstream and regulating for downstream local flows coming into the Kaskaskia River between Lake Shelbyville and Vandalia, drive reservoir pool stages. To accomplish a half foot drawdown during the growing season, relatively low inflows and low local flows downstream are needed for the months of April through September so that reservoir pool stages can be maintained at or near seasonal guide curve and accomplish the desired drawdown. Drier than normal to drought like conditions are the ideal conditions to accomplish the desired drawdown regulation during the growing season.

The 2022 season started off with a pool stage above the seasonable guide curve due to substantial rain events throughout the months of March and April across the Kaskaskia Basin. However, by the end of

April, pool stage was lowered to the seasonal guide curve and was managed to meet fish spawn regulations and EPM for vegetation growth throughout the rest of the growing season. Due to sporadic rain events in July and August, the lake was not able to maintain EPM for a prolonged number of days until late August, when the lake was drawn down for the remainder of the EPM season. Figure 2 shows the 2022 pool stage hydrograph and the zone rules and targets required of the water control plan.

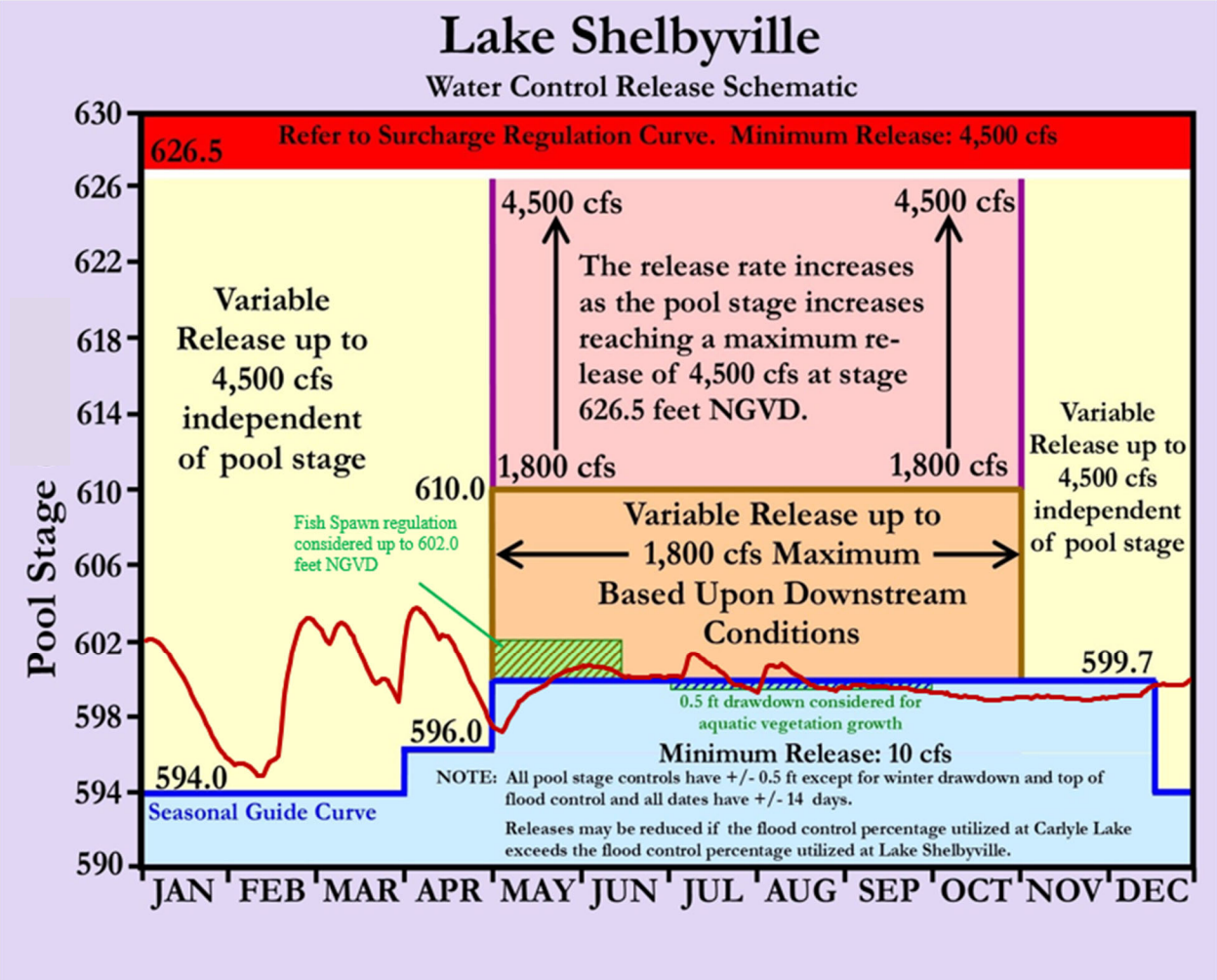

Figure 2. Lake Shelbyville water control plan release schematic and 2022 pool stage hydrograph.

1.1.2 Carlyle Lake

Carlyle Lake is a flood risk management reservoir located approximately in the center of the Kaskaskia River watershed with a total drainage area of 2,717 mi^2, 1,054 mi^2 upstream of Lake Shelbyville and 1,663 mi^2 between Lake Shelbyville and Carlyle Lake. In addition to the upstream drainage area, Carlyle regulates for downstream local flows to Venedy Station, which has a local drainage area of 1,676 mi^2 below Carlyle Dam. Though the Upper Kaskaskia River watershed is regulated by Lake Shelbyville, water that flows into Lake Shelbyville must be released over time. Large inflows can result in sustained releases from Lake Shelbyville and result in sustained elevated inflows to Carlyle Lake, thereby

increasing the chances that local rainfall events between Lake Shelbyville and Carlyle Lake will further elevate inflows resulting in increased Carlyle Lake pool stages. In addition to these upstream factors, release constraints to reduce flooding downstream of Carlyle can also result in higher pool stages.

The 2022 season started off with a pool stage above the seasonable guide curve due to substantial rain events throughout the months of March and April across the Kaskaskia Basin. By the end of April, pool stage was lowered to the seasonal guide curve. However, untimely July and August inflow events resulted in elevated lake stages and a drawdown was not able to be accomplished. Figure 3 shows the 2022 pool stage hydrograph and the zone rules and targets required of the water control plan.

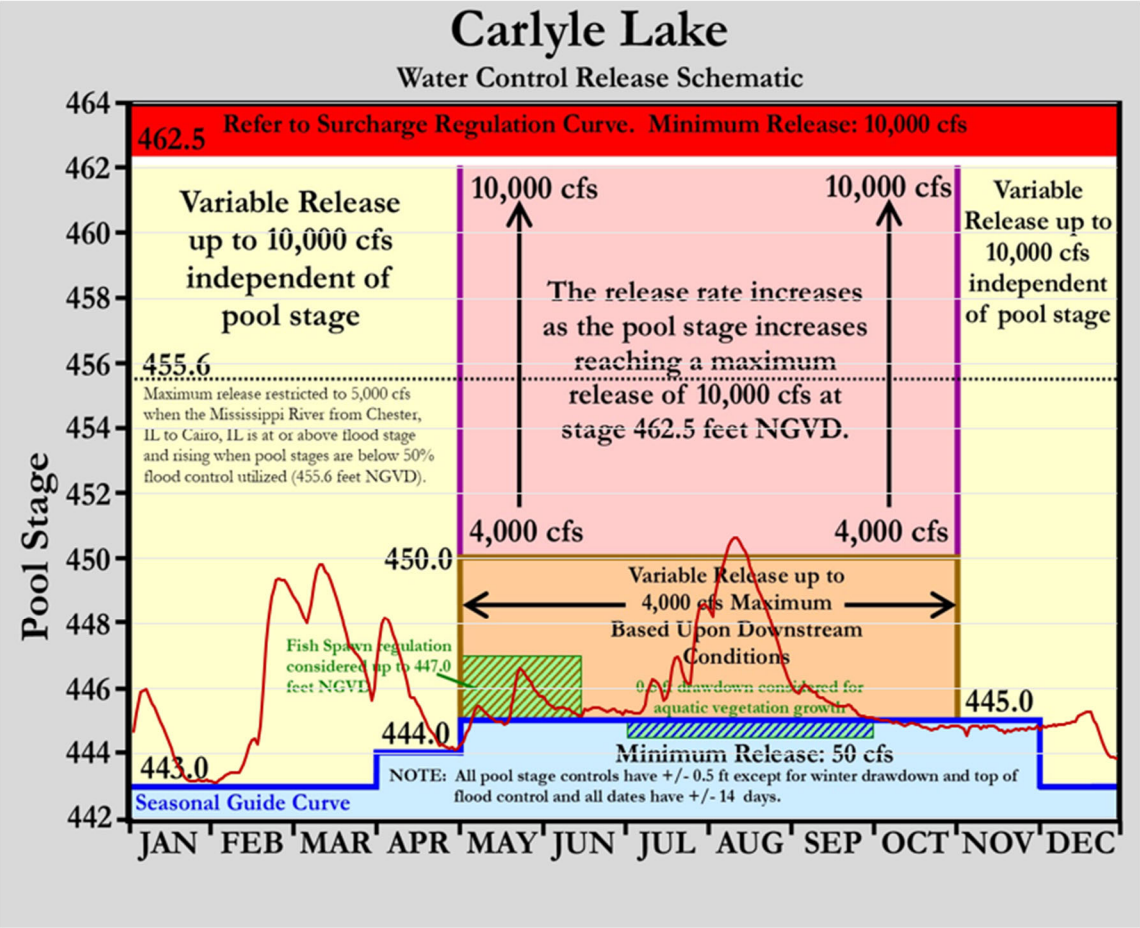

Figure 3. Carlyle Lake water control plan release schematic and 2022 pool stage hydrograph.

1.1.3 Jerry F. Costello Lock and Dam

Jerry Costello L&D is a navigation lock and dam 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 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 4 illustrates how Jerry Costello L&D is operated with varying river conditions.

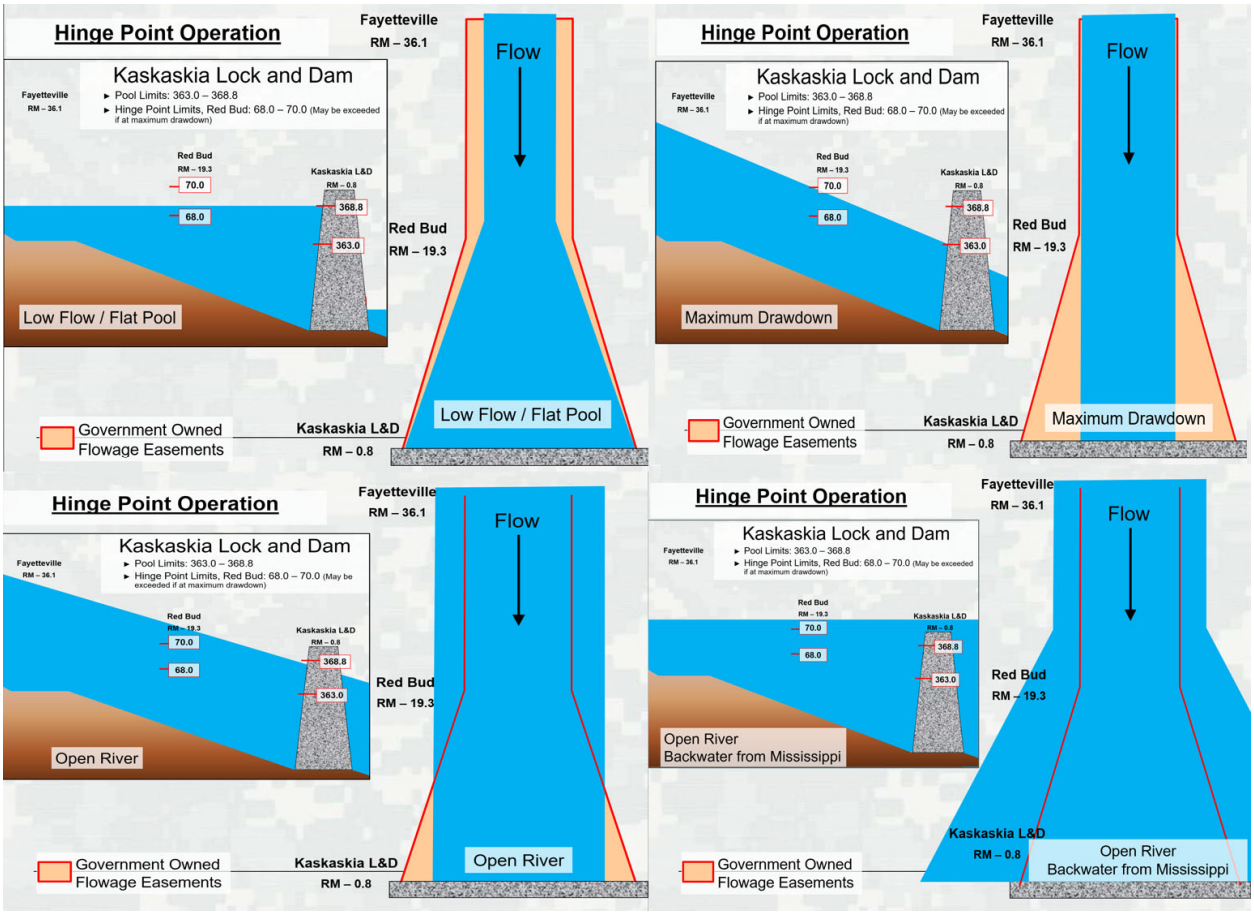

Figure 4. Jerry F. Costello Lock and Dam illustrative operating limits.

Accomplishing environmental pool management (EPM) at Jerry Costello L&D requires high enough inflows (>1,500 cfs) to sustain sufficient navigation depths while accomplishing a half foot drawdown and inflows cannot be too high (>10,000 cfs) to maintain hinge point stage low enough to attain the desired drawdown benefits. Additionally, the Mississippi River must remain low enough not to cause open river conditions due to backwater. Ideal conditions for regulating Jerry Costello L&D for EPM involves relatively low Mississippi River stages/flows and sustained inflows above 1,500 cfs either from timely events downstream of Carlyle Lake or events that cause sustained elevated outflows from Lake Shelbyville and/or Carlyle Lake.

Conditions leading into the 2022 growing season were favorable until two high volume events on the Mississippi and Kaskaskia Rivers occurred in mid-May and mid-July that resulted in open river conditions. Conditions became more favorable later in the growing season, which resulted in a successful nearly 50-day half-foot drawdown. Figure 5 shows the 2022 pool stage hydrograph and operating constraints throughout the year.

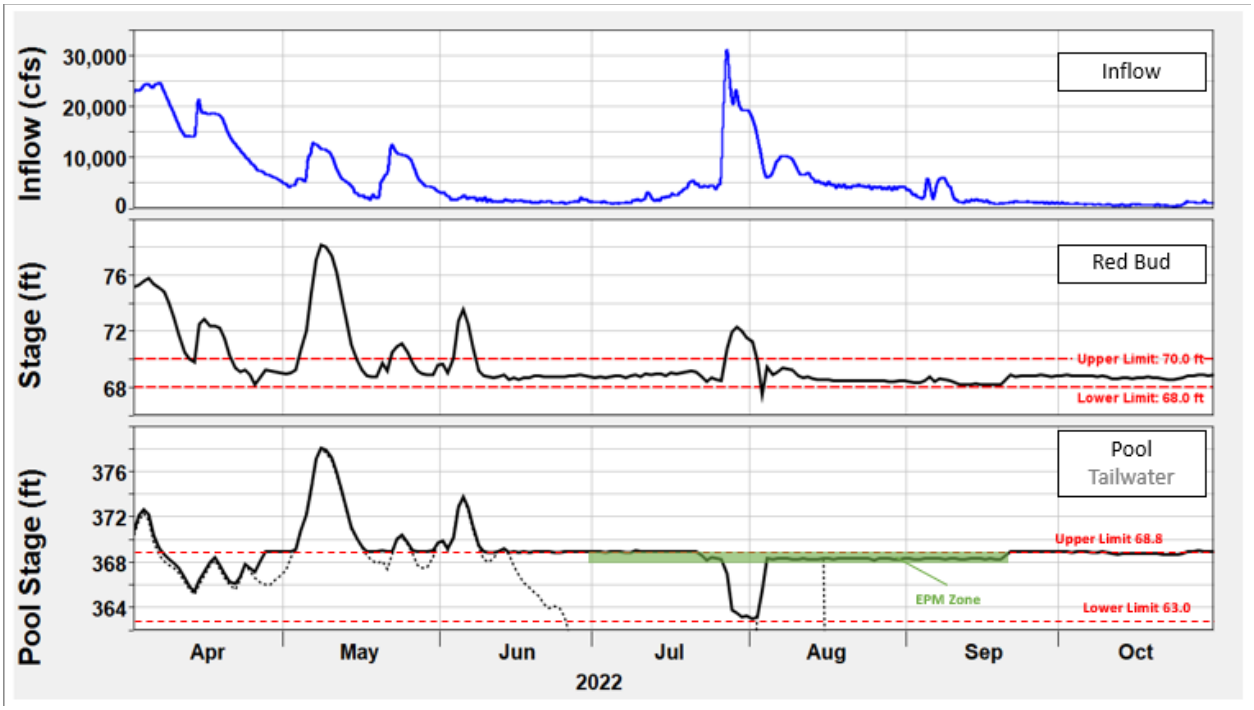

Figure 5. Jerry F. Costello Lock and Dam 2022 pool stage hydrograph and operating constraints.

2 Vegetation

2.1 Site Selection

Four sites sampled in 2021 (USACE 2023) on the Lower Kaskaskia River (RM 7.5-18) (Figure 6; sites 3-6) were revisited on 09 Sept 2022 to assess plant response from the current growing season. A second site visit occurred on 16 Sept 2022 to gather seedhead samples from location 5 (Figure 6). At Lake Shelbyville, an aerial imagery assessment was conducted to locate areas with exposed mudflat during previous years when water surface elevations were below normal pool conditions. Aerial imagery was accessed through Digital Globe and Google Earth. At Shelbyville, 12 sites were visited on 28 September 2022 to assess conditions and to identify potentially suitable areas for sampling (Figure 7). Sites disconnected from the river or lake that contained a water control structure of some sort were not included due to a difference in hydrology compared to the river or lake levels, respectively. Potential sites were then screened for accessibility. Vegetation from four locations (sites 2, 10, 11, and 12) were sampled on 28 September 2022 with the Integrated Waterbird Monitoring and Management protocol while vegetation was still developing. Those four sites were revisited on 13 October 2022 to assess conditions. Transect data was gathered at two locations (sites 10 and 11), and seedhead data gathered at one location (site 10) on 13 October 2022.

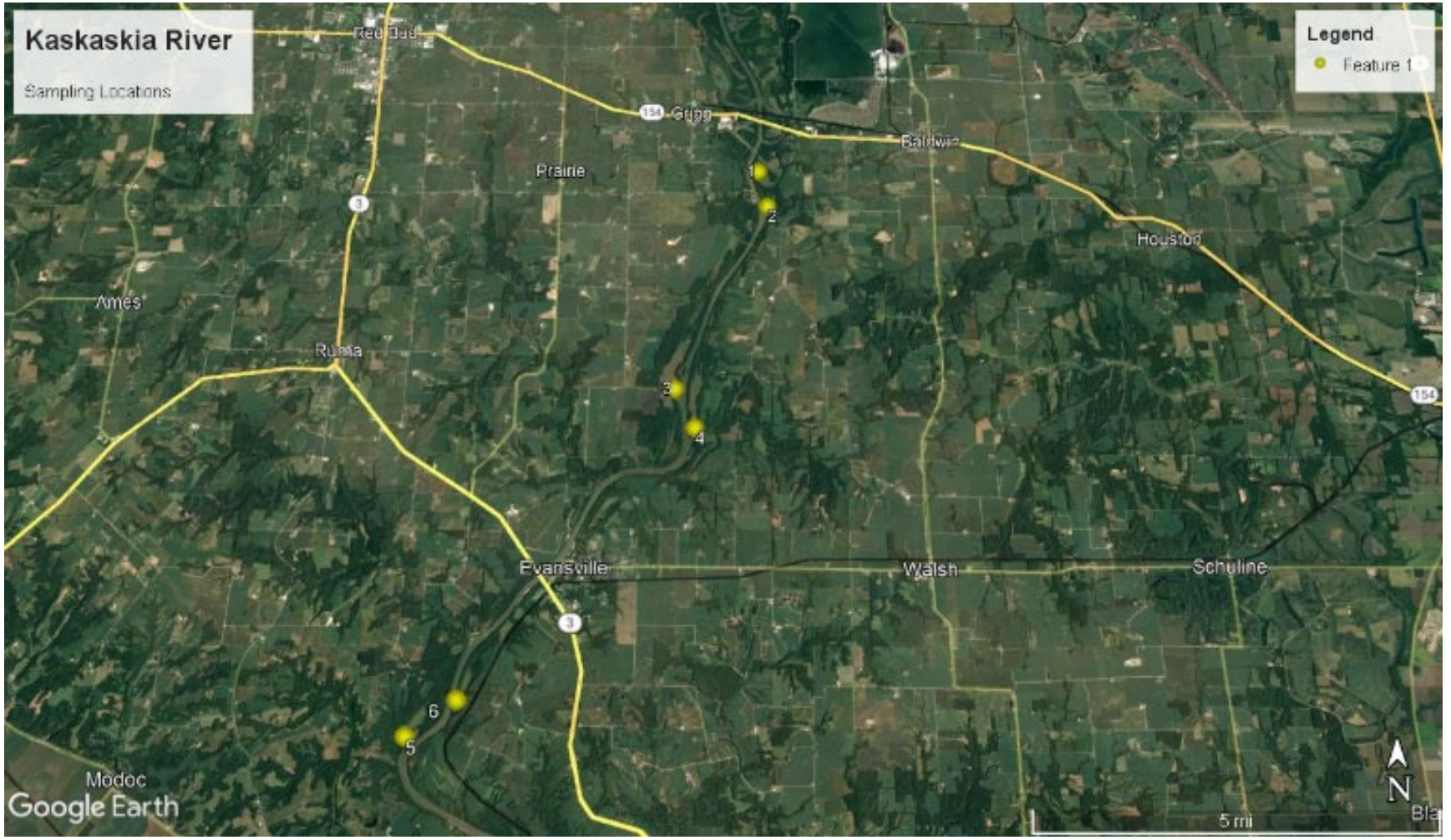

Figure 6. 2022 sample sites along the lower Kaskaskia River with exposed sediment supporting emergent vegetation.

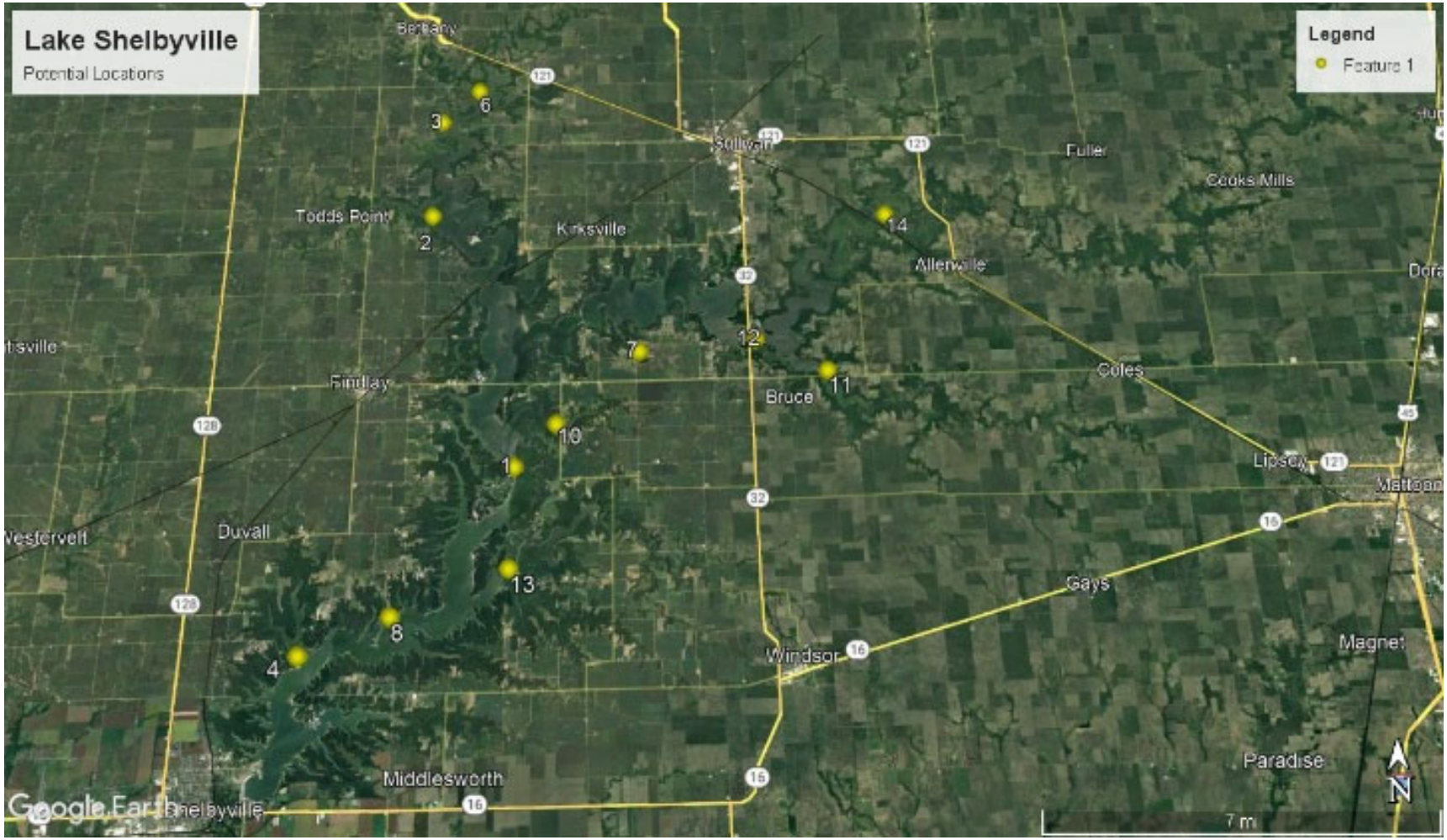

Figure 7. 2022 sample sites visited at Lake Shelbyville with potential for supporting emergent vegetation.

2.2 Integrated Waterbird Management and Monitoring Vegetation Surveys

2.2.1 Methods

A total of 8 sites were surveyed to assess individual emergent plant species cover at the Lower Kaskaskia River (4 sites) and Lake Shelbyville (4 sites), as described in Section 2.1. The Kaskaskia River was visited during near optimal conditions on 9 September as much of the vegetation had produced seed and reached peak coverage. Lake Shelbyville vegetation was sampled twice due to the relatively immature stage of growth present during the 28 September sampling date (i.e., only ~14 days of drawdown). The second sampling date occurred on 13 October as plant growth was slowing towards the end of the growing season. Results were similar across survey visits, so data from 28 September are used since more sites were sampled on that date. The Integrated Waterbird Management and Monitoring (IWMM) protocol was utilized to assess species abundance and percent cover (USFWS 2021). Only emergent vegetation from the current growing season was assessed. To complete the vegetation surveys while adhering to the protocol, two assessments were completed: 1) percent cover of emergent vegetation within the survey unit and 2) species inventory and species-specific percent cover within the areas of emergent vegetation.

To complete the first assessment, locations of all emergent vegetation areas throughout each survey unit were identified visually. After areas of emergent vegetation were identified, an estimate of the percent cover of the survey unit by emergent vegetation was completed. Percent cover is defined as the percentage of the survey unit covered by vertical projections from the outermost perimeter of the plants' foliage (Anderson 1986).

To complete the second assessment, a list of all common emergent vegetation species was compiled, and an estimate of each species' percent cover was completed. For this estimate, percent cover is defined as above except that it is estimated as a percentage of emergent vegetation area, not as a percentage of the total survey unit area. For example, a survey unit might contain a single emergent vegetation species that covers 50% of the total survey unit area and 100% of the emergent vegetation area within the survey unit. Therefore, 100% would be recorded for this assessment. Total cover across species can exceed 100% due to stratification of plant species with varying heights and growth habits.

2.2.2 Results

Results of the IWMM surveys are provided in Table 1 and Figures 8 to 11.

Table 1. Species encountered at Kaskaskia River and Lake Shelbyville sampling sites, 9 and 28 September 2022, respectively.

Species Code	Common Name	Scientific Name	Kaskaskia	Shelbyville
AMCO	purple ammania	*Ammannia coccinea*	X	X
AMTU	water hemp	*Ameranthus tuberculatus*	X	X
BARO	roundleaf water hyssop	*Bacopa rotundifolia*	X	

BICE	nodding marigold	*Bidens cernua*	X	X
CYES	yellow nutsedge	*Cyperus esculentus*	X	X
CYSP	flatsedge species	*Cyperus* sp.		X
ECCR	wild millet	*Echinochloa crusgalli*	X	X
ECPR	yerba de tajo	*Eclipta prostrata*	X	X
ELNY	aunt lucy	*Ellisia nyctelea*		X
ELOB	blunt spikerush	*Eleocharis obtusa*		X
ERHY	teal lovegrass	*Eragrostis hypnoides*	X	X
LEMU	Obe-Wan-Conobea	*Leucospora multifida*		X
LEPA	Amazon sprangletop	*Leptochloa panicoides*	X	
LIDU	false pimpernel	*Lindernia dubia*	X	X
LUPE	water primrose	*Ludwigia peploides*		X
PADI	fall panicgrass	*Panicum dichotomiflorum*		X
PASP	panicgrass species	*Panicum* sp.		X
POLA	nodding smartweed	*Polygonum lapathifolium*		X
ROPA	marsh yellow cress	*Rorippa palustris var. fernaldiana*		X
RUSP	dock species	*Rumex* sp.		X
SALA	arrowhead	*Saggitaria latifolia*		X
SANI	black willow	*Salix nigra*	X	
TYLA	cattail	*Typha latifolia*		X
XAST	cocklebur	*Xanthium strumarium*		X

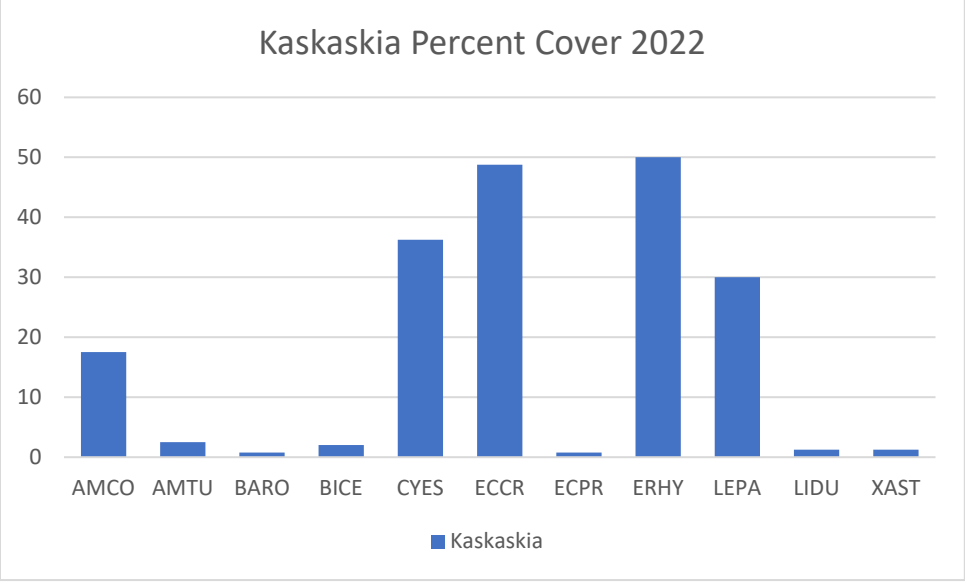

Figure 8. Average percent plant cover by species (>5%), per four samples, Kaskaskia River sites (IWMM), sampled 9 September 2022.

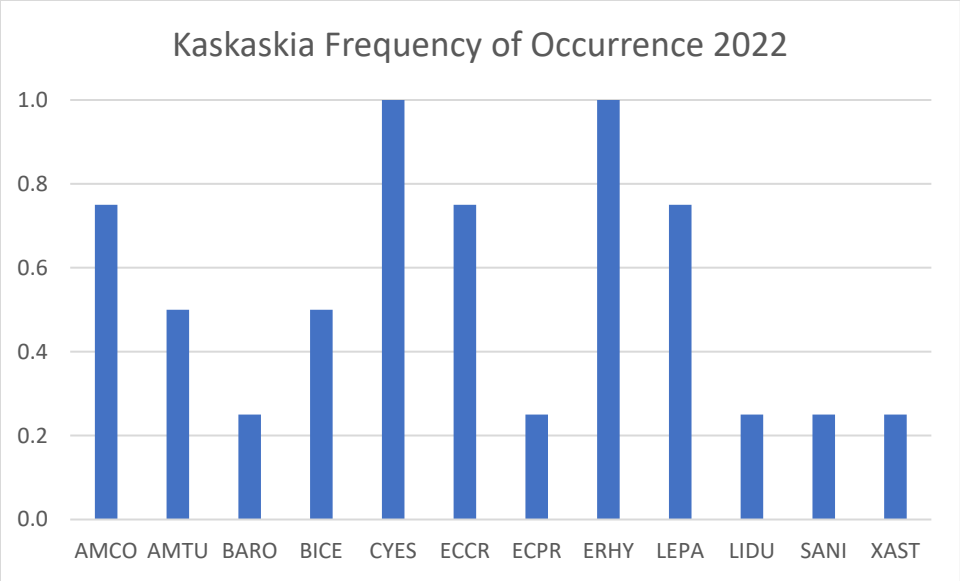

Figure 9. Frequency of occurrence by species, per four samples, Kaskaskia River sites (IWMM), sampled 9 September 2022.

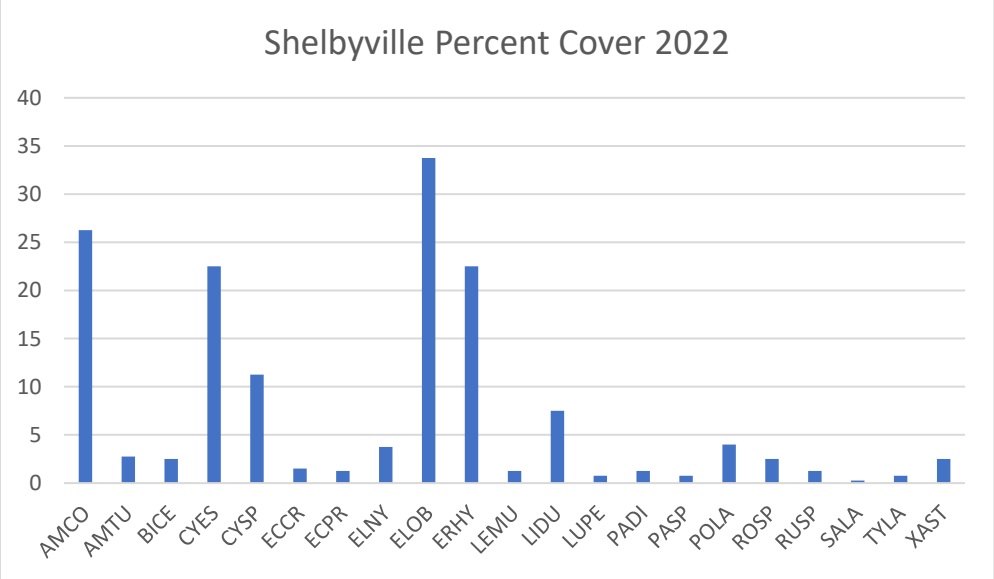

Figure 10. Average percent plant cover by species (>5%), per four samples, Lake Shelbyville sites (IWMM), sampled 28 September 2022.

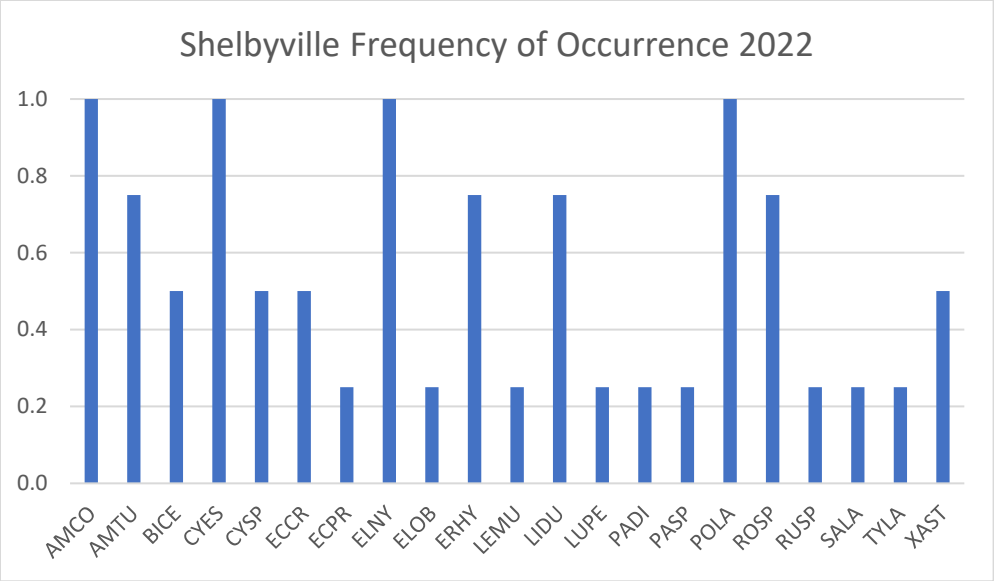

Figure 11. Frequency of occurrence by species, per four samples, Lake Shelbyville sites (IWMM), sampled 28 September 2022.

2.2.3 Discussion

Kaskaskia River sampling sites were comprised primarily of mid- to late-season germinating species such as redroot sedge (*Cyperus erythrorhizos*), Amazon sprangletop (*Leptochloa panicoides*), and teal lovegrass (*Eragrostis hypnoides*). The timing and response to a mid-summer drawdown was similar to 2021 and resulted in dense growth of emergent vegetation in exposed areas protected from frequent wave action. Seven of the twelve recorded species occurred in at least two of the four sample sites. The drawdown was gradual enough to keep undesirable species and woody species to low levels of cover and frequency of occurrence (i.e., willow and cocklebur).

At Shelbyville, a more variable species composition and diverse set of species were observed. Twenty-one species were recorded compared to twelve at Kaskaskia. This was likely due to the greater topographic and substrate diversity at Shelbyville. Numerous sandy shoreline areas were encountered along with coves and tributary confluences with a mix of silty, clay, and sandy substrates. Species composition at Lake Shelbyville also included many species characteristic of late-season drawdowns, including scarlet toothcup (*Ammania coccinea*), flatsedges (*Cyperus spp.*), teal lovegrass (*Eragrostis hypnoides*), and false pimpernel (*Lindernia dubia*). These species can establish when drawdowns start earlier in the summer and continue through the August or September if conditions are suitable (adequate light reaching ground layer and adequate moisture to promote germination). Over half of the species (11 of 21) were recorded at two or more of the four sampling sites. Undesirable species and woody species were held to marginal levels of canopy cover while approximately half the sites had some individuals establish. No cocklebur seed production occurred in the late-season drawdown areas.

2.3 Transect Surveys

2.3.1 Method

Following the Illinois Natural History Survey, Critical Trends Assessment Protocol for Wetland sites (INHS 2002), a transect is placed perpendicular to the long axis of the wetland. A random distance along the transect is then selected to establish a baseline. When lying the transect, the tape measure is pulled taut, but laid on the ground at all points along its length. Herbaceous vegetation is sampled in ¼ m^2 quadrats at an interval of every 2 m along the transect, starting 2 m from the baseline (Figure 12). A total of 20 quadrats are sampled per site. Quadrats are placed 1 m from the transect on alternate sides, starting on the left at the 2 m point (e.g. the first quadrat covers the area from 2-2.5 m along the transect, at a distance covering 1-1.5 m left of the transect). At each quadrat, all species present were identified and assigned a percent cover rating between 1 and 7. The cover rating related to species percent cover is as follows: 1) <1%, 2) 1-5%, 3) 6-25%, 4) 26-50%, 5) 51-75%, 6) 76-95%, and 7) 96-100%. Average species percent cover and frequency of occurrence by site were calculated. Data were collected at four transects (sites 3-6) on 09 September for the Lower Kaskaskia River and at two transects (sites 10 and 11) on 13 October 2022 for Lake Shelbyville.

Figure 12. Quadrat layout along transect.

2.3.2 Results

Results of the transect surveys are provided in Table 2 and Figures 13 to 16.

Table 2. Species recorded at Kaskaskia River and Lake Shelbyville sampling sites, 13 October 2022.

Species Code	Common Name	Scientific Name	Kaskaskia	Shelbyville
AMCO	purple ammania	*Ammannia coccinea*	X	X
AMTU	water hemp	*Ameranthus tuberculatus*	X	X
BARO	roundleaf water hyssop	*Bacopa rotundifolia*	X	
BIAR	bearded beggarticks	*Bidens aristosa*	X	
BICE	nodding marigold	*Bidens cernua*		X
BIDE	beggarticks species	*Bidens* sp.	X	
CYES	yellow nutsedge	*Cyperus esculentus*	X	X
CYSP	flatsedge species	*Cyperus* sp.		X
ECCR	wild millet	*Echinochloa crusgalli*	X	
ECPR	yerba de tajo	*Eclipta prostrata*	X	X
ELEO	spikerush species	*Eleocharis* sp.	X	

ELNY	aunt Lucy	*Ellisia nyctelea*	X	
ELOB	blunt spikerush	*Eleocharis obtusa*		X
ERHY	teal lovegrass	*Eragrostis hypnoides*	X	X
LEMU	Obe-Wan-Conobea	*Leucospora multifida*		X
LEOR	rice cutgrass	*Leersia oryzoides*	X	X
LEPA	Amazon sprangletop	*Leptochloa panicoides*	X	
LIDU	false pimpernel	*Lindernia dubia*	X	X
PASP	panicgrass species	*Panicum* sp.		X
PESE	ditch stonecrop	*Penthorum sedoides*		X
POLA	nodding smartweed	*Polygonum lapathifolium*	X	X
ROSP	yellow cress species	*Rorippa* sp.	X	X
RUSP	dock species	*Rumex* sp.		X
SALA	arrowhead	*Saggitaria latifolia*	X	
SYLA	calico aster	*Symphyotrichum laterifolium*		X
XAST	cocklebur	*Xanthium strumarium*	X	

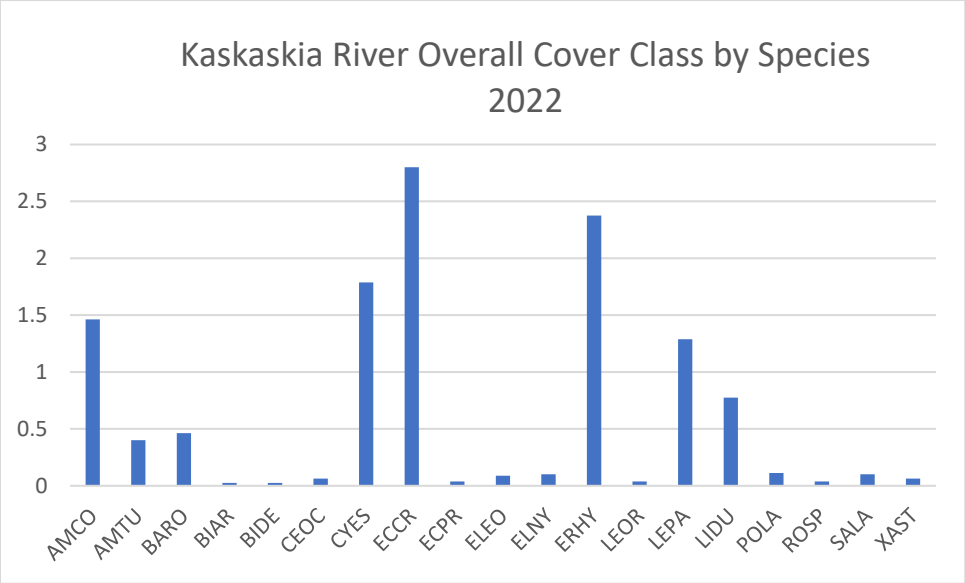

Figure 13. Average plant cover class by species, per four samples, Kaskaskia River sites (Transect), sampled 9 September 2022.

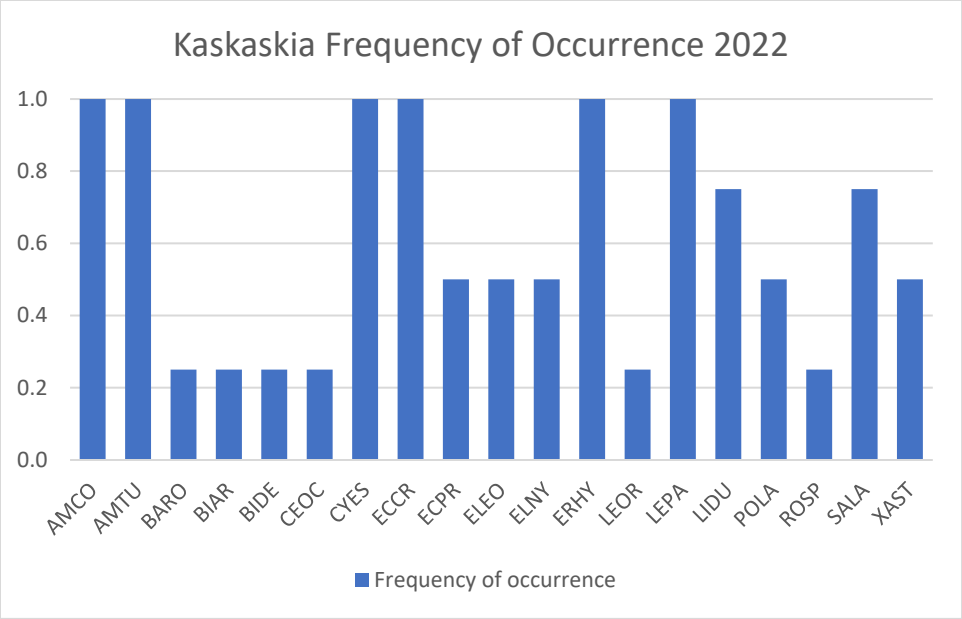

Figure 14. Frequency of occurrence by species, per four samples, Kaskaskia River sites (Transect), sampled 9 September 2022.

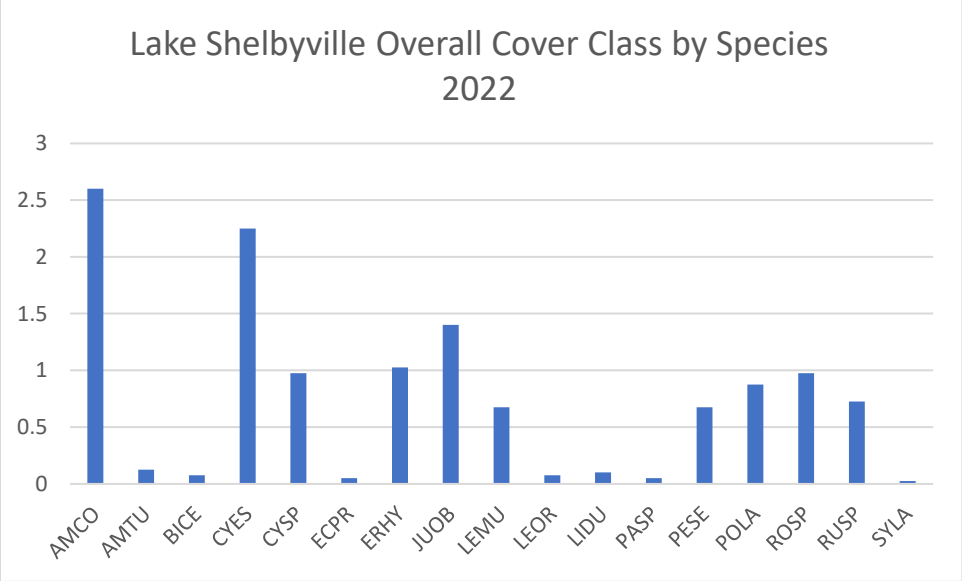

Figure 15. Average percent cover class by species, per two samples, Lake Shelbyville sites (Transect), sampled 13 October 2022.

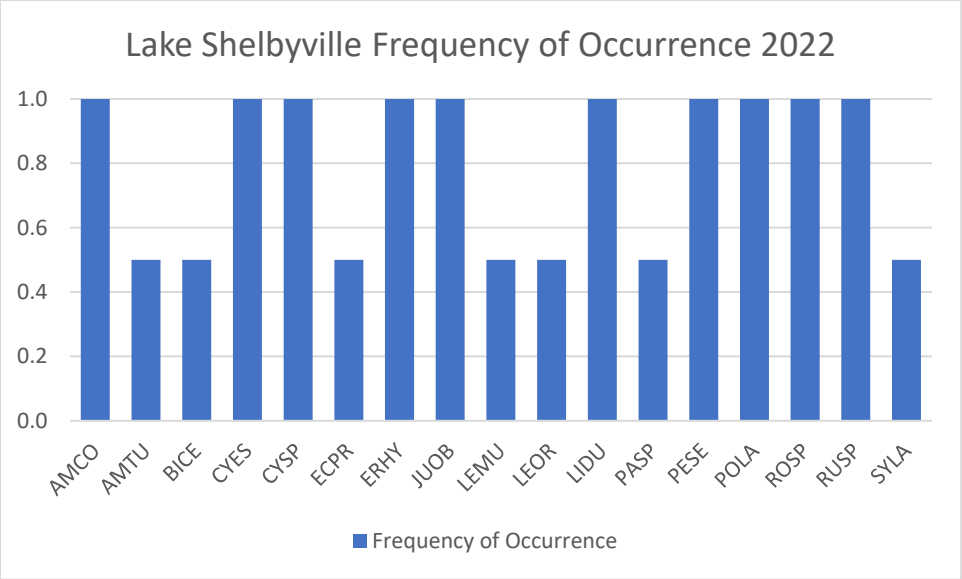

Figure 16. Frequency of occurrence by species, per two samples, Lake Shelbyville sites (Transect), sampled 13 October 2022.

2.3.3 Discussion

At Kaskaskia sampling sites, 19 species were recorded along transects and consisted primarily of valuable species for waterfowl, including flatsedges, millet (*Echinochloa crusgalli*), Amazon sprangletop and teal lovegrass (Figure 13). These four species made up most of the canopy cover at the sampling sites. Thirteen of the recorded species occurred at over half the sampling sites, and six species were only recorded at one site (Figure 14).

At Shelbyville, a similar number of species (17) were recorded compared to transects at Kaskaskia (Figure 15). However only two locations were sampled with the transect methodology due to time constraints. Three species made up most of the canopy cover at sampling sites. Ten of the recorded species occurred at both transect survey sampling sites.

2.4 Seedhead Analysis

2.4.1 Methods

A seed analysis was conducted to quantify the amount of seed produced by emergent aquatic plant species. One site each at the Lower Kaskaskia River and Lake Shelbyville were sampled due to the short duration of the drawdown which narrowed the suitable sampling window. The Kaskaskia River site was sampled on 16 September 2022 and the Lake Shelbyville site was sampled 13 October 2022. Lake Shelbyville samples were from less mature plants, and sample weights were below levels that the model could calculate results for. As a result, only results from the Kaskaskia River site are presented here.

Sampling occurred when the majority of the plants had produced seed heads and before shattering. To accomplish the seed head analysis, randomly placed 1 m^2 plots were established at each site. Within

each plot, the number of seed-producing plant stems were counted. Only the seven species that currently have a model built for seed production were counted, following Gray et al. 2009. These species include: flatsedge (*Cyperus erythrorhizos*), barnyard grass (*Echinochloa crusgalli*), Walter's millet (*E. walteri*), Amazon sprangletop (*Leptochloa panicoides*), rice cutgrass (*Leersia oryzoides*), fall panicum (*Panicum dichotomiflorum*), and curlytop smartweed (*Polygonum lapathifolium*). One randomly selected plant stem specimen from each species was collected from each plant. In cases with multiple seed heads per stem, all seed heads were collected. Once seed heads were collected, they were placed into plastic bags while in the field. Upon returning from the field, samples were separated and pressed in a plant press to promote drying. Drying was necessary to prevent mold from growing on the collected seed heads between sampling and during shipping of the specimens. Samples were sent to the Two River National Wildlife Refuge for analysis utilizing the Gray et al. 2009 method to quantify kilograms of dry seed produced per hectare, duck-energy-days (Kaminski et al. 2003), total kilograms of seed produced per site, and total duck-energy-days (DEDs) per site.

2.4.2 Results

Results of the seed analysis are provided in Tables 3 and 4.

Table 3. Seed analysis results per plot, Lower Kaskaskia River, site 5, sampled 16 September 2022.

Kaskakia			2022			
plot	Sum of KG/ha	Sum of Kcal/ha	Sum of DED/ha (IL fall dabblers)	Sum of DED/ha (Mallard)	Lbs/acre	DEDs/acre (IL fall dabblers)
1	930.2	2,297,707.6	7,868.9	5,078.5	829.9	3,184.4
2	1,174.0	2,899,893.6	9,931.1	6,409.5	1,047.5	4,019.0
3	392.6	994,755.8	3,406.7	2,198.6	350.3	1,378.6
4	1,245.4	3,076,039.2	10,534.4	6,798.8	1,111.1	4,263.1
5	1,010.3	2,495,396.5	8,545.9	5,515.4	901.4	3,458.4
6	890.8	2,200,345.2	7,535.4	4,863.3	794.8	3,049.5
7	872.4	2,172,777.8	7,441.0	4,802.4	778.3	3,011.3
8	1,138.4	2,811,852.9	9,629.6	6,214.9	1,015.7	3,897.0
9	1,500.3	3,705,860.9	12,691.3	8,190.8	1,338.5	5,136.0
10	912.8	2,259,637.6	7,738.5	4,994.3	814.4	3,131.7

Table 4. Seed production (lbs/acre) and duck-energy-days (DEDs/acre), Lower Kaskaskia River, site 5, sampled 16 September 2022.

Kaskakia	2022		
Lbs/acre		*DEDs/acre (IL fall dabblers)*	
Mean	898.2	Mean	3452.9
Standard Error	82.5	Standard Error	313.4
Minimum	350.3	Minimum	1378.6
Maximum	1338.5	Maximum	5136.0
Count	10	Count	10

2.4.3 Discussion

Seed analysis results show that areas exposed by a drawdown result in high seed production rates. Average seed production at the Kaskaskia River site was approximately 900 pounds per acre (Table 4). Most of the seed production in samples came from sprangletop which was at peak production. Teal lovegrass and scarlet toothcup also were abundant within plots but seed production weight models have not been developed for those species, so reported seed production rates are less than the actual amount of seed available.

Overall, the Kaskaskia River is supporting emergent plant growth and production at the level of highly productive moist-soil units which typically result from intensive management methods such as discing and water level management via gates and pumps (Heitmeyer 2010). Next year we plan to gather enough samples from teal lovegrass and scarlet toothcup (and other abundant species if present) to generate seed production models to help illustrate a more complete picture of seed production along the Kaskaskia River system. This will result in refined seed production estimates and increase applicability to other locations as plant composition and seed production varies depending on drawdown timing and duration.

2.5 Conclusion

The Kaskaskia River and Lake Shelbyville showed positive responses to the relatively brief late-season drawdowns. The 0.5 ft drawdown elevation was initiated at the Kaskaskia River a couple weeks earlier than at Lake Shelbyville due to suitable flows and this resulted in extensive stands of productive flatsedges, sprangletop, and teal lovegrass. Although the drawdown occurred a couple weeks later at Lake Shelbyville, several locations with finer sediments responded positively with dense emergent vegetation germination. Additionally, mudflats were found on the fringe of exposed areas that were being utilized by late shorebird migrants. Areas that did not produce emergent vegetation were

impacted regularly by wave action or were comprised of largely unsuitable substrates such as loose, shifting sand. Overall, Lake Shelbyville plant growth was reduced due to the later start which resulted in shorter day length and lower average temperatures as fall approached. The response from the seedbank at both locations show that a wide diversity of species can be supported through implementation of environmental flow methods.

3 Imagery Analysis

Understanding the extent of impact from a drawdown is one of the key requirements for both operationalizing water level management and conducting effective public outreach with the diverse stakeholder groups at all 3 locations. This year the team finished up aerial imagery analysis at all three locations.

Imagery was requested from digital globe when water levels were at summer guide curve and at the 0.5 ft drawdown level. The water line was then digitized at each location from acquired imagery into separate polygon files. Imagery was acquired for the Kaskaskia at drawdown near the end of September 2021 and at guide curve for Kaskaskia and Lake Carlyle in November 2021. Shelbyville Lake imagery acquisition occurred in July 2022 which provided the last missing dataset needed to complete the work. The Geospatial team delineated the waterline for the July 2022 imagery dataset. Acreage exposed was calculated for each of the three sites by subtracting the drawdown polygon from the normal water level polygon (Figure 17; Table 5). This data is critical for our public outreach efforts. The next step is to pair the acreage data with seed production estimates at each of the three project locations over a couple years to develop an average seed production rate in response to drawdowns. This year we were able to estimate seed production at a location on the Kaskaskia River. Next year we hope to achieve drawdowns at all three sites, gather seedhead data, and develop estimates for all three locations. This will help us describe and quantify potential habitat quality for migratory waterfowl which is an important wildlife group in our region.

Drone imagery was gathered by the MVS survey team during the last week of September at several Kaskaskia River sites and in mid-October at Lake Shelbyville sites exposed by the drawdown. Only still images were gathered at Kaskaskia locations due to equipment and access issues (Figure 18). A combination of video and still images were taken at several Lake Shelbyville sites to better capture the extent of plant coverage compared to normal pool conditions (Figures 19 and 20). An example area is provided in Figure 19 at a tributary input on the east side of the lake that was positively impacted by the 0.5 ft drawdown. Images and video captured by the drone team will be utilized in public outreach.

Figure 17. Drawdown aerial imagery for a section of Lake Shelbyville bankline with guide curve (purple) and 0.5 ft drawdown (green) waterlines delineated.

Table 5. Potential emergent vegetation, mudflat, and sandbar acres created with 0.5 ft drawdown at each project location on the Kaskaskia River system.

Location	Area Exposed (acres)
Kaskaskia River	225
Carlyle Lake	1,633
Lake Shelbyville	472

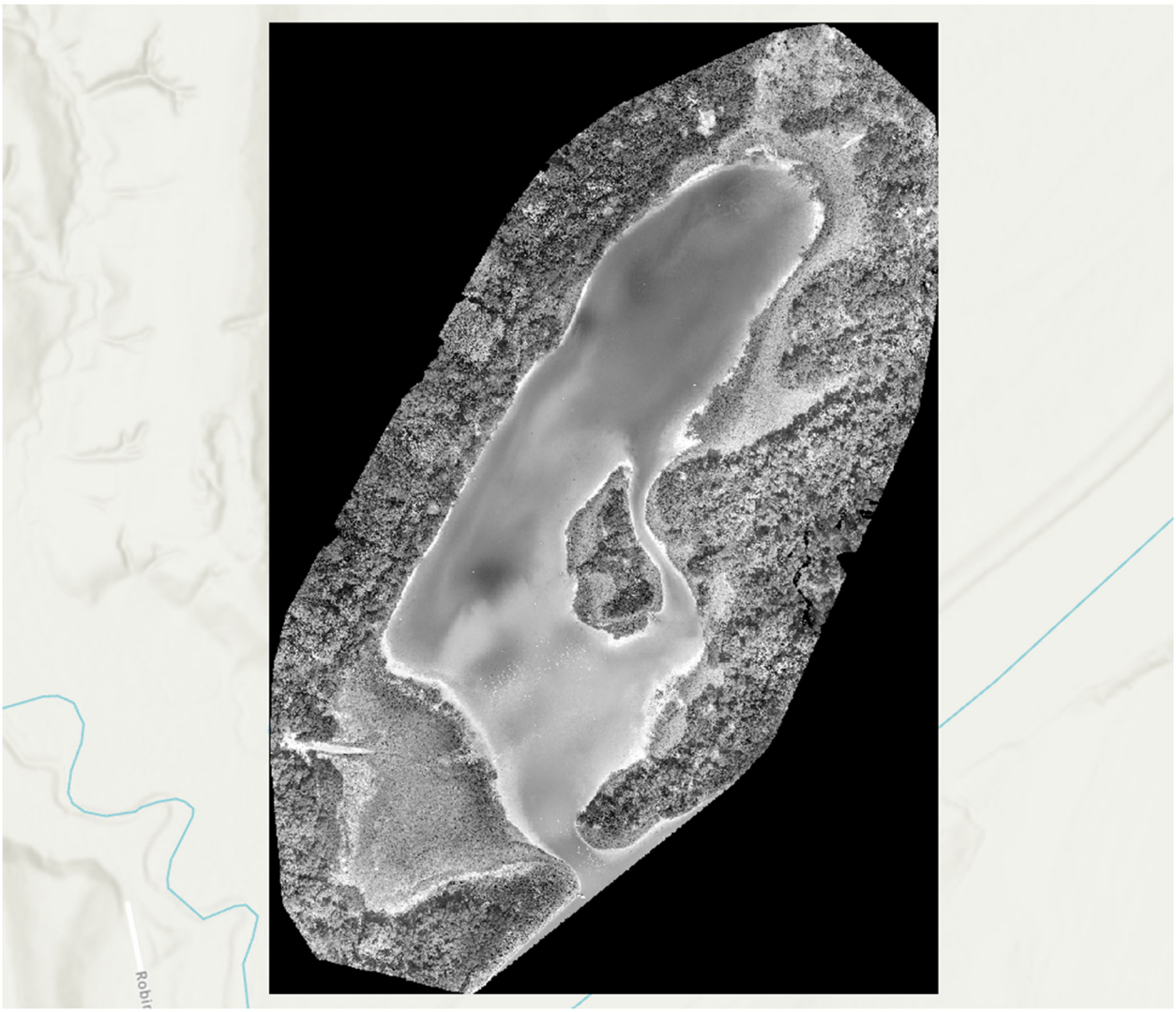

Figure 18. Drone imagery at site 5 on the Lower Kaskaskia River.

Figure 19. Drone imagery taken at Lake Shelbyville site 11 (USACE photo).

Figure 20. Overhead view of emergent vegetation at Lake Shelbyville site 11 (USACE photo).

4 Public Meetings and Outreach

We held two public meetings in 2022 for the Kaskaskia project. The first occurred at Lake Shelbyville on December 1 and consisted of 11 individuals representing businesses, outreach groups, and adjacent landowners. The second occurred in Carlyle, IL, on December 12 to discuss the drawdown at Carlyle Lake as well as a dam safety summary and other mission updates for USACE authorizations at the reservoir. The second meeting consisted of approximately 12 individuals representing businesses as well as user groups at Carlyle Lake. A third meeting for the Kaskaskia River was scheduled and then rescheduled to July 26, 2023.

At the Shelbyville meeting, Water Control provided an update on lake management during the previous year as well as anticipated management during the winter. This was followed with a summary of benefits provided by the trial late-season drawdown and images of vegetation production. No concerns

were brought up during the meeting although we did have some discussions with IDNR and project staff on revegetation efforts along eroded banklines, which has been a problem for many years.

At the Carlyle meeting, Water Control provided an update on lake management. Questions raised about the drawdown occurred primarily on a one-to-one basis after all presentations were finished. One business owner voiced concerns on impacts to his marina during certain periods of time. This was followed by a discussion to better understand the conditions that occurred at these times. In the end, the business owner shared that the drawdown was fine but there is little room for fluctuation around this level before he notices launching impacts at the marina. Another marina owner asked several questions related to understanding when the lake will be at certain water surface elevations and relayed general support for the effort. Finally, several representatives from a local waterfowl group enthusiastically supported continued drawdowns and agreed with the benefits provided by the drawdown this year. The waterfowl group asked if drawdown duration could be extended to earlier in the growing season. The marina owners noted that boat use declines after the fourth of July so waiting until mid- to late- summer results in fewer impacts at marinas during higher-use periods.

Additional coordination will be needed at Carlyle Lake due to the more diverse interest groups and their respective desires for how the lake is managed for multiple uses. At the conclusion of the meeting, all attendees were open to future drawdowns although further discussion on timing and duration would be beneficial.

The Kaskaskia River meeting held July 2023 was attended by approximately 30 resident and recreational users. There was widespread support for the 0.5 ft drawdowns with requests to continue efforts and coordination in the future. Questions of concern that came up were primarily limited to other Corps projects in the region and private development plans that could affect public land access near Baldwin, IL. Information was shared to direct them to the appropriate points of contact for those projects.

5 Literature Cited

Anderson, E.W. 1986. A guide for estimating cover. *Rangelands Archives*, 8(5):236-238.

Gray, M.J., M.A. Foster, and L.A. Pena Peniche. 2009. New technology for estimating seed production of moist-soil plans. *Journal of Wildlife Management,* 73:1229-1232.

Heitmeyer, M.E. 2010. A manual for calculating duck-use-days to determine habitat resource values and waterfowl population energetic requirements in the Mississippi Alluvial Valley. Prepared for: U.S. Army Corps of Engineers Memphis District. Greenbriar Wetland Services Report 10-01. 69 pps.

Hill, M.O. 1973. Diversity and evenness: a unifying notation and its consequences. *Ecology,* 54.2:427-432.

Illinois Natural History Survey (INHS). 2002. Critical Trends Assessment Program Monitoring Protocols. Illinois Natural history Survey, Office of the Chief Technical Report: 2002-2.

Kaminski, R.M., J.B. Davis, H.W. Essig, P.D. Gerard, and K.J. Reinecke. 2003. True metabolizable energy for wood ducks from acorns compared to other waterfowl foods. *Journal of Wildlife Management*, 67(3):542-550.

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

USACE. 2020. Environmental Opportunities for Rivers and Reservoirs in the Upper Midwest – Regional Operations and Water Management Meeting. U.S. Army Corps of Engineers. January 2020. https://www.hec.usace.army.mil/sustainablerivers/publications/docs/Upper%20Midwest%20-%20Environmental%20opportunities%20at%20USACE%20reservoirs.pdf

USACE. 2023. Kaskaskia River Environmental Pool Management Implementation 2021. U.S. Army Corps of Engineers, St. Louis District. 37 pps. https://www.hec.usace.army.mil/sustainablerivers/publications/docs/Kaskaskia%20-%20Environmental%20pool%20management%20-%202021.pdf