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Big Creek Watershed Restoration Plan: A Component of the Cache River Watershed Resource Plan

Mark Guetersloh

Prepared for the: Cache River Watershed Resource Planning Committee

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By
Mark Guetersloh
Big Creek Pilot Watershed Coordinator

Contributing Agencies

Alexander and Pulaski County Soil and Water Conservation District
Union County Soil and Water Conservation District
Illinois Department of Natural Resources -
Office of Resource Conservation
Office of Realty and Environmental Planning-C2000 Program
Southern Illinois University at Carbondale
The Nature Conservancy - Southern Illinois Field Office
USDA - Natural resources Conservation Service
U.S. Fish and Wildlife Service - Cypress Creek NWF

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Matt Nelson - TNC, Southern Illinois Area Director
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Doug Austen-IDNR, Watershed Management Section

Mark Guetersloh
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THE CACHE RIVER WATERSHED

Background

The Cache River watershed once drained 614,100 acres (959 sq. miles) in Union, Johnson, Alexander, Pulaski, and Massac Counties in extreme southern Illinois (Illinois Department of Natural Resources 1997). After the construction of the Cache River levee and Reevesville Levee, portions of the drainage in the easternmost parts of the watershed were diverted by shorter routes into the Ohio River. Today, the Cache Basin still receives runoff from 524,786 acres (835 square miles) (IDNR 1997). From its headwaters near Cobden, Illinois in Union County the Cache River meanders 110 miles through the southernmost part of the state before emptying into the Mississippi River through a diversion ditch near the city of Mounds in Pulaski County (Figure 1).

The diversity of wildlife found in Cache River Watershed ranks among the highest in the eastern United States. The area is one of only six places in the country at the convergence of four or more physiographic provinces (Ozark Plateaus, Upper East Gulf Coastal Plain, Interior Low Plateau, Mississippi River Alluvial Plain) (Figure 2). Each of these ecological units formed under a geographically unique blend of climate, rainfall, bedrock, soils, and topography. (McNab and Avers, 1994).

Another factor affecting the natural character of the area is the Ohio and Mississippi Rivers. These two great rivers bound southern Illinois on the west, east, and south; each flowing southward until they meet at the southern tip of the state. The Cache River floodplain was formed by the catastrophic flow events of these two rivers and this valley was once the ancient bed of the Ohio River. As this big river receded and adopted its present day course, it left the underfit Cache River to meander sluggishly across a vast, wetland-rich floodplain (Hutchison 1984)

This heterogenous blend of physical, chemical, and biological conditions has created and still sustains a diversity of natural features matched nowhere else in Illinois. Sixty Illinois Natural Area Inventory sites, and eight Illinois Nature Preserves occur within the confines of the Cache River Basin (Suloway *et al.* 1996). In addition, 71.7 miles of biologically significant streams occur in the watershed (Table 1) (Page *et al.* 1992).

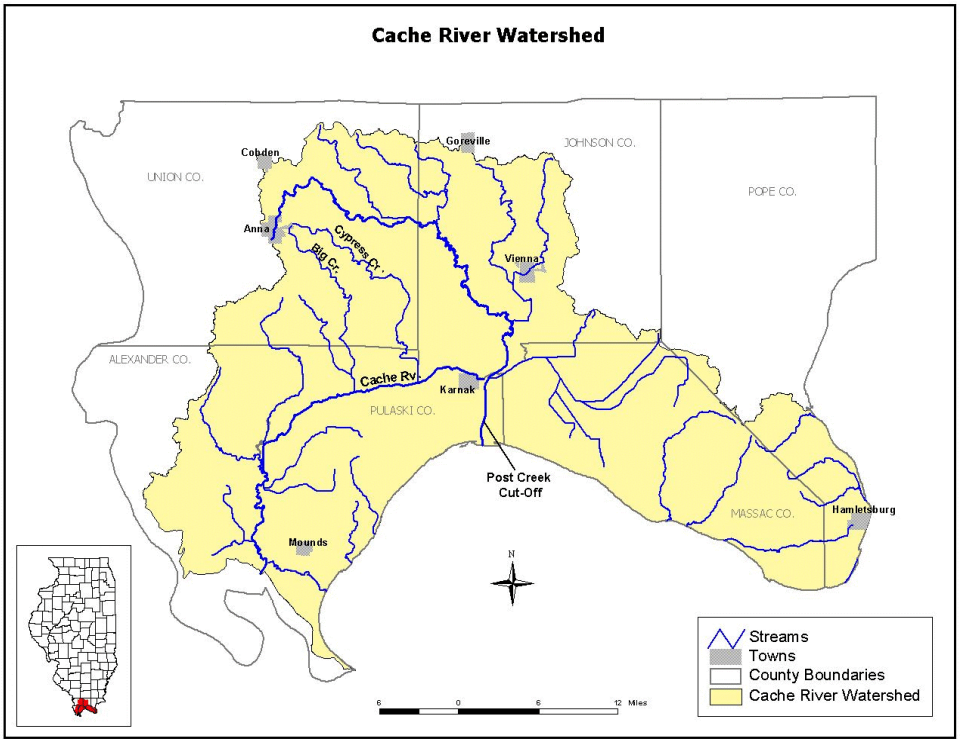

Figure 1. Map of the Cache River Watershed.

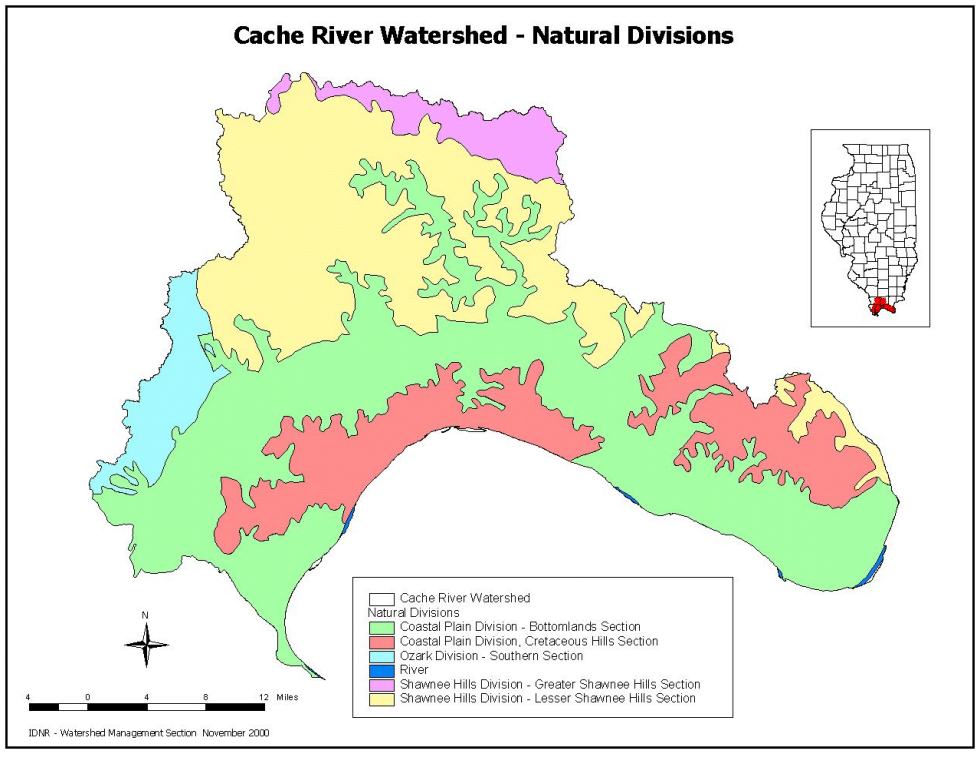

Figure 2. Natural Divisions of the Cache River Basin (Schwegman 1973).

Table 1. Biologically significant stream segments in the Cache River Watershed.

Drainage	County	Segment	Stream Miles
Ohio River	Pulaski	L&D 53 to Mound City	10
Ohio River	Pope	5 mi. above & below the mouth of the Cumberland R.	10
Ohio River	Hardin	Elizabethtown to Cave in Rock	6.8
Ohio River	Massac	Fort Massac State Park, L&D 52 to Metropolis	4.6
Cache River	Alexander	Horseshoe Lake and Lake Creek	22.0
Cache River	Johnson/Pulaski	Big Creek to Karnak	12.8
Cache River	Pulaski	Limekiln Slough	5.5

Also found within the boundaries of this watershed are limestone and sandstone barrens dominated by plants more commonly associated with the prairies of the southern till plain. These dry to xeric plant communities overlook a vast bottomland area that contains bald cypress and tupelo swamps similar to those found in southern states (see Appendix 1 for natural community compositions - The Nature Conservancy, 1995a).

Many plant and animal communities within the Cache River Basin are at the edge of their geographic range. These habitats support over 100 state-endangered or threatened species (Appendix 2), and numerous plants and animals rarely encountered elsewhere in the state. Appendices 3 - 9 provide a complete list of fishes, mussels, birds, mammals, reptiles, and amphibians that occur within the area.

One particularly high value area is the Cypress Creek Wetlands comprising the Cypress Creek NWR (USFWS), the Cache River State Natural Area (IDNR) and The Nature Conservancy properties. The area received international recognition when the United Nations Educational, Scientific, and Cultural Organization added this site to its list of "Wetlands of International Importance Especially as Waterfowl Habitat" during the RAMSAR Convention held in November of 1994. This designation recognized critical wetland habitat remaining throughout the world, concentrating on those areas that provide habitat essential for the continued survival of migratory waterfowl and shorebirds. The Cache River - Cypress Creek Wetlands complex is one of only 15 sites in the United States to receive this designation.

Cache River Watershed Resource Plan

Recognizing the importance of the area's natural, cultural and economic resources, the USDA - Natural Resources Conservation Service and the Nature Conservancy applied for and received a $124,085 wetlands protection grant from the U.S. Environmental Protection Agency to co-sponsor a resource planning initiative for the entire Cache River Basin. To provide assurance that the results of this effort would reflect the concerns of landowners throughout the watershed, local Soil and Water Conservation Districts selected 25 individuals from the five county region to participate as members of a Resource Planning Committee (RPC). The 25 members represent

a diversity of interests, and many own tillable land within the watershed. Members of the RPC are listed below.

Kenneth Bormann - Metropolis
Walter Briggs - Vienna
Glen Brown - Belknap
Rollo Burnett - Metropolis
Wendell Davis - Anna
Preston George - Grand Chain
Don Hankla - (Chairman) Anna
Miles Hartman - Mounds
Les Honey - Cairo
Carlyn Light - Dongola
Phyllis Oliver - Cypress
Bob Osman - Dongola
Barbara Pitts - Buncombe
Charlie Proctor -Karnak
Elott Raffety - Wyatt, MO
Max Ray - Vienna
Fred Terbrak - Dongola
Ned Trovillion - Vienna
Kevin Ulrich - Grand Chain
Greg Webb - Ullin
David Whiteside - Vienna

The RPC was assisted by a technical committee that included 15 resource professionals from 10 state, federal and private conservation agencies. This committee provided scientific data and environmentally-sensitive solutions to resource concerns identified by the RPC. Agencies participating in this planning effort are listed below.

Illinois Department of Natural Resources - Office of Resource Conservation
University of Illinois - Extension
Illinois EPA
Southern Five Regional Planning District
Southern Illinois University at Carbondale
The Nature Conservancy - Southern Illinois Field Office
U.S. Fish and Wildlife Service - Cypress Creek NWR
U.S. Army Corps of Engineers
U.S. Forest Service - Shawnee National Forest
USDA - Natural Resources Conservation Service

The mission statement of the Cache River Watershed RPC is to:

> *"Develop and promote a plan for the Cache River Watershed which will reduce soil erosion and sedimentation, and maintain and/or improve water quality and other natural resources in a manner which is compatible with a healthy economy and high quality of life for this and future generations."*

To identify primary resource concerns throughout the watershed, the RPC visited a diversity of sites to look at terrestrial and aquatic natural communities and channel morphology within the Cache River and its largest tributaries. The group also visited several area farms and discussed the relationship between resource restoration/preservation and agricultural interests. The RPC also held four public meetings and sponsored a telephone survey of residents within the drainage basin (conducted by Southern Illinois University at Carbondale). From these efforts, the RPC identified nine resource concerns that are the subject of the Cache River Watershed Resource

Plan completed in 1995 (Cache River Watershed Resource Planning Committee, 1995). These resource concerns are listed to the right.

RESOURCE CONCERNS IDENTIFIED IN THE CACHE RIVER WATERSHED PLAN (1995)

1) Erosion
2) Open dumping
3) Private property rights
4) Water quality
5) Continuation of government farm conservation programs
6) Post Creek Cutoff
7) Open flow on the Cache River
8) Disseminate accurate and timely information throughout the watershed
9) Impacts of wildlife on farming and vice-versa

A detailed description of these resource concerns and general strategies for reducing their impacts on natural (public and private) and agricultural land can be viewed in the Cache River Watershed Resource Plan (1995). Since Big Creek is a tributary of the Cache River these concerns and solutions also apply in this sub-watershed. Because of its effects on the hydrology of the Cache River, threats to natural, agricultural, and cultural resources, and its potential for restoration, Big Creek was recommended for, and received, designation as a Pilot Watershed.

BIG CREEK PILOT WATERSHED

The Interagency Pilot Watershed Program

Recognizing the need for multi-disciplinary pro-active management the multi-agency Pilot Watershed Focus Group, along with local agency staff, non-governmental organizations and concerned citizens, designated Big Creek as a Pilot Watershed. This designation encourages cooperation among private landowners, the Illinois Department of Natural Resources, U.S. Fish and Wildlife Service, The Nature Conservancy, Natural Resources Conservation Service, the Illinois EPA and local Soil and Water Conservation Districts, and provides special funding for restoration projects, research, and monitoring. The Interagency Pilot Watershed Program is a voluntary, incentive-based initiative to promote a reduction in soil erosion, improvement in grazing practices and livestock waste management, a reduction in streambank erosion, establishment of riparian buffer strips, and the creation/restoration of habitat for both game and non-game fish and wildlife species. By encouraging cooperation between state, federal and local resource managers, and private landowners, the Pilot Watershed Program hopes to build on a growing awareness of human dependence on natural resources with a view towards a better future.

Background

Big Creek is a tributary of the Lower Cache River with a drainage area of 33,088 acres (51.7 square miles). This stream originates in Union County in the Lesser Shawnee Hills Section of the Shawnee Hills Natural Division (Schwegman, 1973), within the Interior Low Plateau Ecoregion (McNab and Avers, 1994) (Figure 3). It empties into the Cache River in Pulaski County in the Bottomlands Section of the Coastal Plain Natural Division within the Upper East Gulf Coastal Plain Ecoregion. Land use changes in the Big Creek watershed (land clearing, drainage efforts) have significantly increased the discharge (flow volume and velocity) of this tributary (Demissie *et al.* 1990), resulting in excessive sediment suspended and transported in the water column during periods of high flow. Large quantities of this sediment are deposited in aquatic and wetland habitat found in the Lower Cache River, threatening to eliminate the high quality natural communities that inspired the designation of this area as a State Natural Area and Land and Water Reserve, a National Natural Landmark, an Important Bird Area, and a Wetland of International Importance (RAMSAR Wetland). Land cover in Big Creek is dominated by agriculture, primarily rural grasslands, row crops and small grains. Natural resource habitats are predominantly forests and a variety of wetlands (Figure 4).

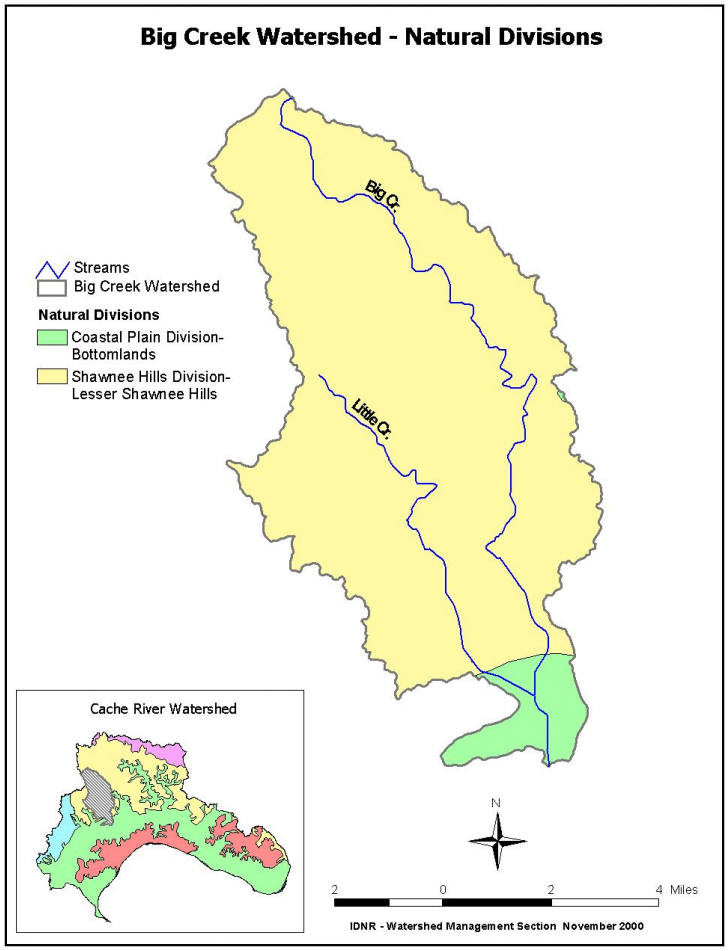

Figure 3. Map of Big Creek showing natural divisions.

Resource Issues

Sediment

Big Creek has been identified by the Illinois State Water Survey (ISWS) as a major source of sediment entering the Lower Cache River (Demissie *et al.* 1992). The majority of this

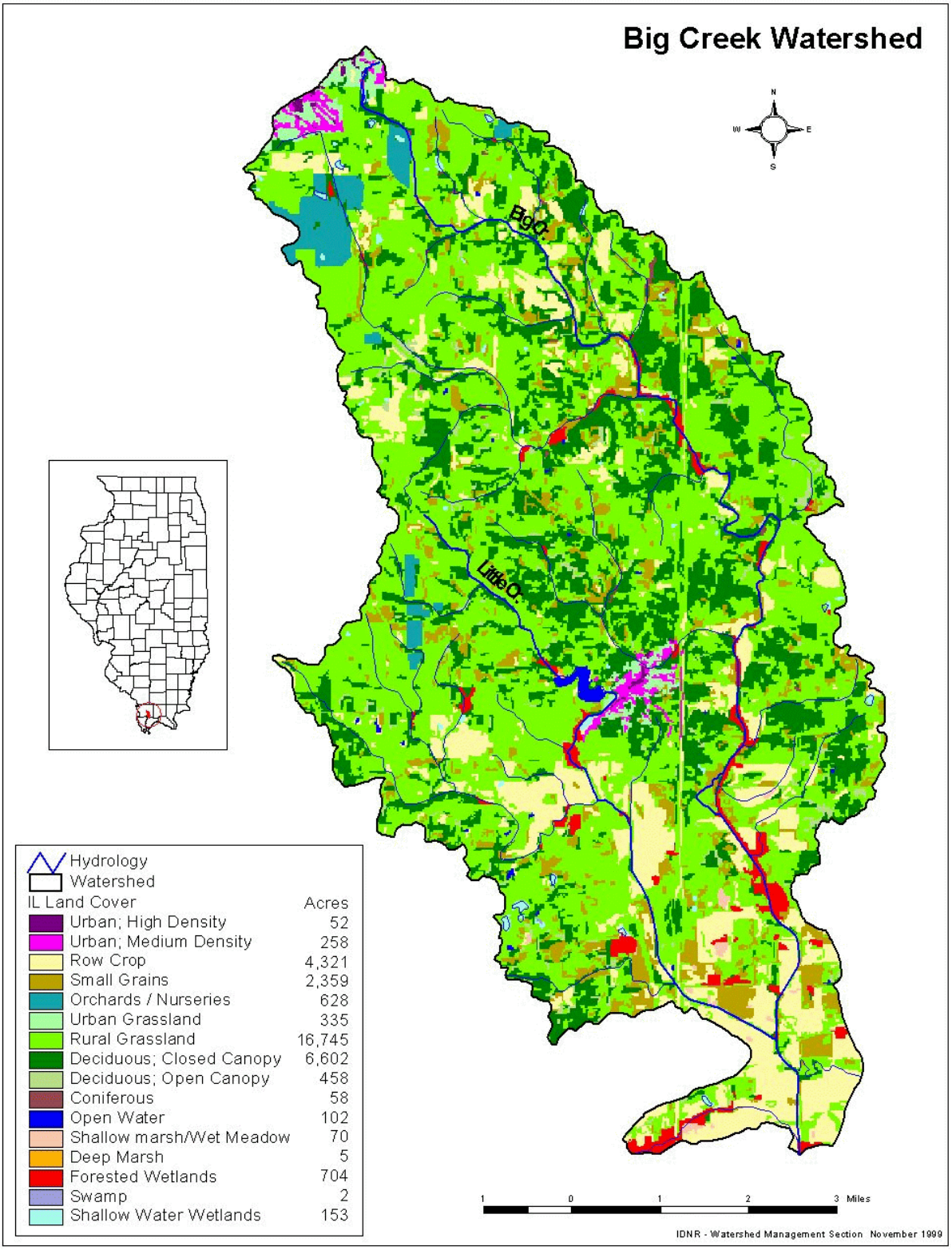

Figure 4. Landcover in the Big Creek Watershed (IDNR 1996).

sediment is transported during infrequent, but annually occurring flood events (96.3% of the sediment is moved in 5% of the time; Demissie *et al*., 1990a). Maximum annual suspended sediment loads recorded for Big Creek during a 4-year study (1985-1988) conducted by Demissie *et al.* (1990a) ranged from a low of 7,229 tons in Water Year (WY) 1987 to a high of 50,840 tons in WY 1986 (Figure 5).

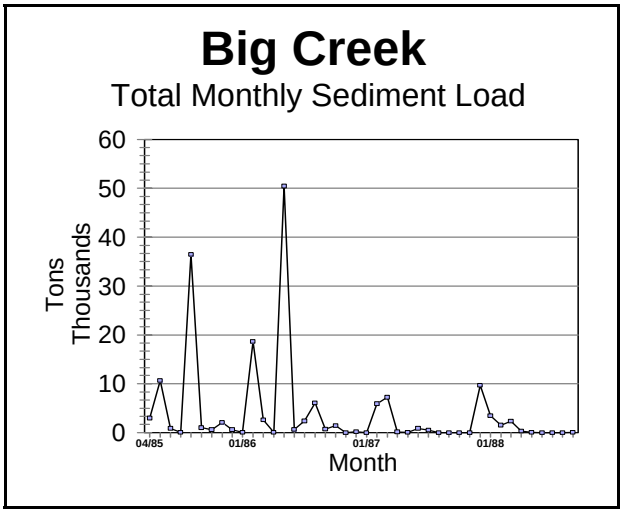

Figure 5. Total monthly sediment load from Big Creek during the period April 1985 through September 1988.

Compared to other tributaries, Big Creek is a major contributor of sediment to the lower Cache River (Demissie, *et al.* 1992; Demissie *et al.* 1990a). Evaluated based on a "per area" of watershed above each gage (i.e., tons per 10 acres of watershed), Demissie *et al.* (1990a) observed that within in any water year, gaging stations on other Cache River tributaries (i.e., in Cypress Creek and Main Ditch) yielded lower amounts of sediment compared to Big Creek (Table 2).

Table 2. Sediment loads, tons per 10 acres of watershed, for three Cache River tributaries WY86 - WY88 (Demissie *et al.* 1990a).

	Big Creek (Station 502)	Cypress Creek (Station 503)	Main Ditch (Station 505)
Drainage Area[a]	31 miles^2	24 miles^2	97 miles^2
Water Year			
1986	43.048	5.313[b]	8.448
1987	8.292	2.624	1.455
1988	8.799	3.919	3.994

a-Area above stream gage
b-partial record

The ISWS also measured basic water quality parameters (temperature, pH, Dissolved oxygen, and conductivity) in Big Creek during water years 1986 - 1988 (Table 3). Sediment deposited in the Lower Cache River during storm events originates from overland flow (sheet, rill, and gully erosion - primarily from cultivated cropland), and in-stream sediments from streambank and streambed instability. Sediment from all of these sources threatens the ecological integrity of riparian ecosystems throughout the Lower Cache River.

Table 3. Water quality data for Big Creek (Station 502), WY86 - WY88 (Demissie *et al.* 1990).

Water Year	Temp[1] (C)	pH	DO (mg/l)	Cond. (u-MHOS)	# of Samples
1986	23.5	7.3	7.5	300	6
1987	16.9	7.5	8.4	375	10
1988	15.5	7.4	8.4	344	18
1986 (min/max)	16.1/28.0	7.1/7.9	6.3/9.6	217/452	
1987 (min/max)	3.5/25.8	7.1/8.4	4.7/13.4	312/428	
1988 (min/max)	4.3/25.7	6.8/7.9	3.8/12.0	145/431	

Sediment deposition posts monitored by a concerned local citizen (Anice Corzine) suggest that the overall deposition rate for a section of the Lower Cache River known as Buttonland Swamp (a National Natural Landmark) during the period from 1982-1987 varied by site from 0.8 to 2.0 inches per year (average for this period was 1.2 inches/year). Mr. Corzines observations suggest average annual deposition from 1987 -1994 was 0.3 inches/year. Research conducted by the ISWS from 1986 - 1988 supports Mr. Corzine's observational data. In an analysis of two methods to estimate sedimentation rates in Buttonland Swamp, Demissie et al. (1992) found similar results among the methods tested. Using a sediment budget model, they estimated that deposition rates ranged from 0.06 to 0.13 inches/year, whereas a radiometric dating technique found slightly higher rates of 0.13 inches to 1.08 inches of sediment per year. This research documented an estimated 65.7 tons/year (average of WY's 1986-1988) of sediment

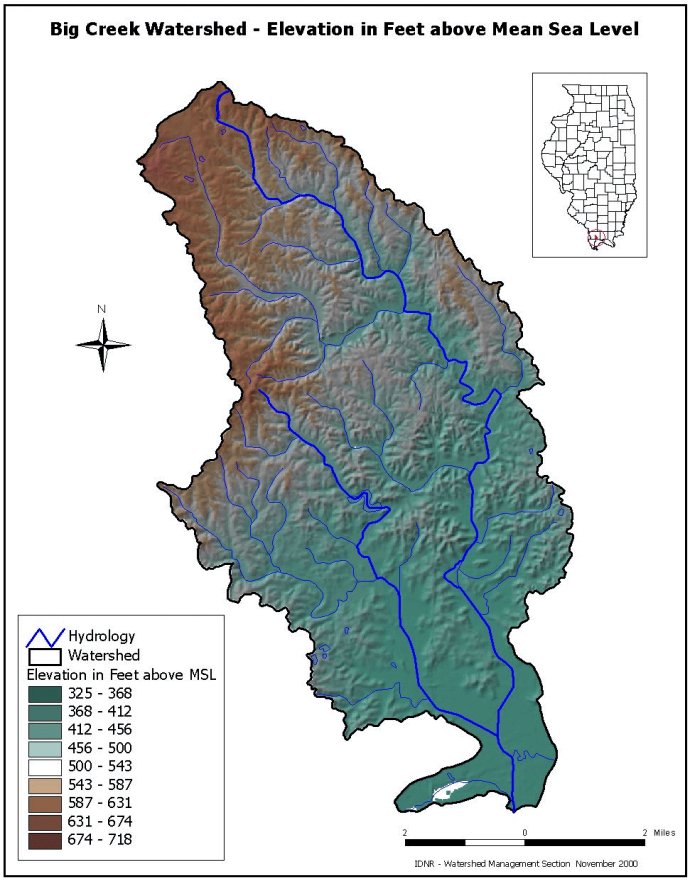

Figure 6. Shaded relief map of the Big Creek Watershed based on 30 M Digital Elevation Model (DEM).

accumulating in Buttonland Swamp. This sedimentation is enhanced by reverse flows (Demissie *et al.* 1990b) that occur during flood events occur when water from Big Creek enters the Cache River and exceeds the capacity of the Cache River to maintain a westerly (downstream) flow. Each year, during these few major flood events, sediment-laden Big Creek water flows eastward (upstream) into Buttonland Swamp.

Topography, as reflected by moderate changes in relief (Figure 6), is an important component of the hydrology and sedimentation issues in this watershed. The channel of Big Creek has a relatively steep gradient (0.338%) (Illinois Streams Information System, 1999) (Figure 7) that drains a basin covering 33,088 acres in Union, Alexander, and Pulaski counties. This gradient contributes to the erosive capabilities of water as it moves from the uplands to the mouth of Big Creek.

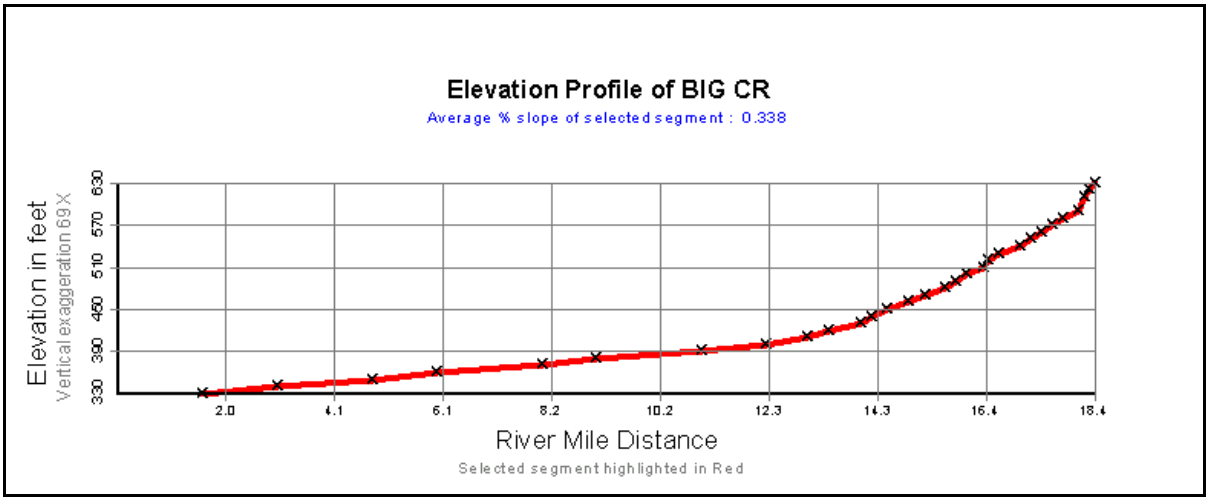

Figure 7. Elevation profile of Big Creek. Source: IDNR-Watershed Management Section, Illinois Streams Information System.

In the last 100 years, conversion of forested land to cropland, pasture, and rural areas, coupled with the channelization of the lower reaches of Big Creek, and the loss of floodplain due to levees has resulted in dramatic changes in basin hydrologic response. Runoff now reaches Big Creek and its tributaries rapidly, and is discharged into the Cache River much more quickly than the system can effectively handle. During periods of heavy rainfall this results in excessive flow (discharge) capable of transporting large amounts of sediment to the Lower Cache River. Excessive sediment carried by Big Creek during these periods of high flow threatens the integrity of this valuable resource by:

1) dramatically accelerating sediment deposition in backwater swamps and sloughs, threatening rare and/or high quality natural communities and species that the public wants to protect,
2) exceeding the swamps capacity to hold floodwater and thus increasing the depth and duration of

flooding, in the swamps and on adjacent land in the floodplain,
3) decreasing habitat diversity and eliminating special habitat types that support numerous wetland dependent species of wildlife, including many rare, threatened and endangered species,
4) reducing groundwater recharge and aquifer levels,
5) transporting excessive amounts of pollutants into the swamps and onto the floodplain,
6) encouraging the invasion of pollution tolerant exotic and/or invasive species, and
7) accelerating degradational fluvial processes that will permanently alter all natural communities within the floodplain.

Sediment carried by Big Creek, along with large volumes of water traveling at erosive velocity also threatens moist-soil management at the Bellrose Waterfowl Reserve (USFWS - Cypress Creek National Wildlife Refuge) when levees are overtopped. Water entering the moist soil units during draw-down periods allows undesirable woody species to become established, and inhibits the growth of desirable forbs and grasses. Prolonged wet conditions (especially if they occur in successive years) can severely compromise the ecological benefits provided by moist-soil vegetation and invertebrate rich organic substrate. In addition to problems resulting from inundation, silt deposited in the moist soil units remains after flooding subsides. This silt inhibits the establishment of desirable plants within the moist-soil units, decreasing their value as migratory waterfowl and shorebird habitat.

Stream Quality: Instream Habitat and Fish Communities

Habitat

In 1992, the Illinois Environmental Protection Agency and the Illinois Department of Conservation (now IDNR) conducted an intensive stream quality investigation at 34 sites in the Cache River basin (Muir *et al.* 1995). This survey included one station (IEPA code IXJ-01) on Big Creek, located 1 mile east of Dongola on Shake Rag Road (Figure 8). From this 1992 survey at IXJ-01, the IEPA rated the overall quality of stream habitat as "good". Although data are not available for direct comparison, more recent observations (Dodd *et al.* 2000, Roseboom *et al.* unpublished data,) indicate that this reach of the stream is incising. Comparisons with upstream reaches that have not undergone this

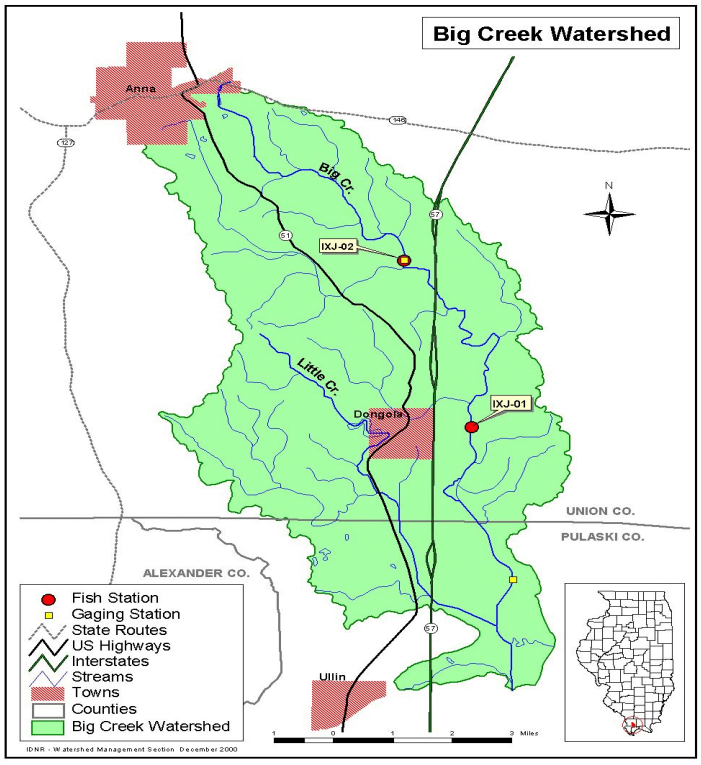

Figure 8. Infrastructure map of Big Creek (showing sampling stations, gaging stations etc.)

excessive incision suggest that habitat quality at IXJ-01 is reflective of a degraded system.

These recent data were collected as part of the Pilot Watershed Monitoring Network for which two sampling stations were established on Big Creek. The downstream station is in the reach established in 1992 for (IXJ-01) and the upstream station (IEPA code IXJ-02) is located at Big Creek Church Road (Figure 9, 10). Major physical differences between these stations are attributable to the excessive channel incision that has occurred in the downstream station. Instream habitat data support this characterization of downstream station (IXJ-01) as a degraded stream channel. In this reach, stream banks are exceeding critical bank height and contributing to substantial bank sloughing. Habitat providing cover for fish in the downstream station typically consisted of unembedded woody cover (i.e., logs). This would be expected considering the extensive bank sloughing and trees falling into the stream. In this reach, substrate consists primarily of smaller particle materials of clay, silt and sand (Table 4) (Dodd *et al.* 2000).

The stream reach encompassed by the upstream station has not undergone this excessive incision process. Here substrate material consists of gravel and cobble (Table 4) and contains various types of rock (i.e., flat & round) for fish cover, that were not recorded in the downstream station (Dodd *et al.* 2000). Other physical characteristics such as width/depth ratio showed that the downstream station was narrower and deeper than the upstream station (Table 4). While greater depth might be considered beneficial to fish, general observations indicate a lack diversity in physiognomic and hydraulic conditions (i.e. low diversity of riffle & pool habitats) (Dave Day Pers. Observations).

Table 4. Physical characteristics of Big Creek at two Pilot Watershed Monitoring stations (Dodd *et al.* 2000).

Big Creek	Downstream Station		Upstream Station	
Year	1998	1999	1998	1999
Average Width (m)	5.2	3.9	8.4	7.9
Average Depth (mm)	507.4	306.8	239.2	210.4
Width/Depth Ratio	10.2	12.8	35.0	37.5
Mean Particle Size	0.4	2.2	52.9	29.9

Fish

The differences in physical features between these two stations are also reflected in the fish community. Fish samples collected at the downstream station in 1998 and 1999, yielded Index of Biotic Integrity (IBI) scores of "34" in both years (Table 5) (Dodd *et al.* 2000) . According the Biological Stream Characterization rating (Bertrand *et al.* 1996), this value is indicative of a "C" or a "moderate aquatic resource". Sampling of the fish community in 1992

Figure 9. Picture of Big Creek downstream fish monitoring station (IEPA code IXJ-01), 20 August, 2000. Above bridge, looking downstream.

Figure 10. Big Creek upstream fish monitoring station (IEPA code IXJ-02), 7 September, 2000. Above bridge, looking downstream.

Table 5. Fish species collected in Big Creek at Shake Rag Road (IEPA Station IXJ-01) and Big Creek Church Road (IEPA Station IXJ-02).

	IXJ-01			IXJ-02	
Species	(1992)	(1998)	(1999)	(1998)	(1999)
Banded sculpin (*Cottus carolinae*)		7	3	142	341
Pirate perch (*Aphredoderus sayanus*)	3	2			
Central stoneroller (*Campostoma anomalum*)	1		9	195	926
Creek chubsucker *(Erimyzon oblongus)*			3	4	3
Creek chub *(Semotilus atromaculatus)*			20	38	484
Mosquitofish (*Gambusia affinis*)		3			
Red shiner (*Notropis lutrensis*)	21		1	1	
Redfin shiner (*Notropis umbratilis*)	37		31	11	10
Bluntnose minnow (*Pimaphales notatus*)	76		212	76	106
White sucker (*Catostomus commersoni*)	4		10	15	82
Tadpole madtom (Notorus gyrinus)			8		
Yellow bullhead (*Ictalurus natalis*)	1	1			4
Blackspotted topminnow (*Fundulus olivaceus*)	11	32	28	24	30
Redear sunfish (*Lepomis microlophus*)				1	
Green sunfish (*Lepomis cyanellus*)	1	5	1	2	6
Bluegill (*Lepomis macrochirus*)	2	9	38	94	28
Longear sunfish (*Lepomis megalotis*)	48	48	53	7	4
Largemouth bass (*Micropterus salmoides*)	13	1	3	5	16
Spotted bass *(Micropterus punctulatus)*				2	2
Hybrid bluegill (*Lepomis hybrid*)	1				1
Fantail darter (*Etheostoma flabellare*)				56	40
Fringed Darter (*Etheostoma crosspterum*)		2		15	21
Total individuals	216	111	244	688	2104
Total species	11	10	15	17	17
Index of Biotic Integrity	34	34	34	42	44

Source: 1992 (Muir *et al.* 1995)
1998 (Dodd *et al.* 1999)
1999 (Dodd *et al.* 2000)

at this same location also yielded an IBI of "34". This documents stability in the overall quality of the fish community in this stream segment from 1992 through 1999. Invertebrate samples from this site produced a Macroinvertebrate Community Index (MCI) value of 4.9, indicating good water quality conditions (Muir *et al.* 1995).

By comparison, sampling of the fish community at the upstream station produced IBI ratings of "42" in 1998 and "44" in 1999 (Dodd *et al.* 2000) (Table 5). Compared to the downstream station, these scores indicate a higher quality fish community, with species density and diversity warranting a "B" rating, and a BSC description as a "highly valued aquatic resource".

It is important to note that in 1992, IDNR/EPA sampled only one segment of Big Creek, and the official stream rating given at that time (C) is based only on those data. More recent sampling at this site, and sampling at an additional station (upstream) shows that the aquatic resources of this reach of the stream are of high quality. This indicates a need for restoration to protect instream resources as well as downstream resources found in the Lower Cache River Swamps.

Ongoing and Potential Restoration Activities

Davie and Lant (1994) indicate a reduction in upland erosion of 24% in the Big Creek Watershed. This reduction is attributed to enrollment of highly erodible land in the Conservation Reserve Program (CRP). Despite this improvement, a negligible decrease (0.0125%) in sediment load has occurred (Davie and Lant, 1994). Although unexpected, these results should be viewed in the context of spatial and temporal considerations. Research suggests that suspended sediment response to CRP land treatment is likely delayed for a considerable period as in-stream and near-stream sources once again enter the water column (Davie and Lant 1994). Further, the relative success of CRP in reducing sediment entering Big Creek could be attributable to the spatial distribution of land treatment. According to Davie and Lant (1994) only 7% of the total CRP acreage in the Big Creek watershed is in the riparian zone.

From the report on erosion and sedimentation in the Cache River Watershed (NRCS, 1995), Big Creek (includes sediment from Big and Little Creek) contains 5,811 acres of cultivated cropland that contribute 7.9 tons (Big Creek) and 6.7 tons (Little Creek) per acre per year, respectively (Table 6). Considering sediment transport efficiencies for each watershed, 2.5 tons per acre annually of that total soil loss is delivered downstream as sediment.

Although the implementation of Best Management Practices (BMP's) has significantly reduced cropland erosion, approximately 4,590 acres of highly erodible land (HEL) remain in agricultural production in the Little, Big, and Cypress Creek watersheds. Soil loss on this HEL cropland averages 11.5 tons/acre annually (Table 7). After accounting for the sediment transport efficiencies of these watersheds, an average of 3.7 tons per acre of the total soil loss is delivered annually offsite in the form of sediment (sediment yield). This sediment, along with in-stream sediment continues to saturate the water column of these tributary streams during periods of high flow (storm events).

Table 6. Total Annual Soil Loss from tributary watersheds that drain into the Lower Cache River (USDA-NRCS, 1995).

	Cultivated Cropland		CRP		Total tons soil loss (All cropland sources)
	Acres	Tons/Acre	Acres	Tons/Acre	
Little Creek	1,329	6.7	2,382	0.4	11,444 (81% reduction)*
Big Creek	4,482	7.9	1,287	0.5	36,787 (65% reduction)*
Cypress Creek	5,264	6.5	5,258	0.4	36,895 (82% reduction)*

*percent reduction is based upon comparison with 1987 survey

Table 7. Total annual soil loss (Tons/Acre) from HEL in Big Creek, Little Creek, and Cypress Creek, 1987-1995 (USDA-NRCS, 1995).

	1987	1987	1995	1995
Tributary	HEL Acres	Tons/Acre	HEL Acres	Tons/Acre
Little Creek	1,801	28.5	372	14.8
Big Creek	3,645	23.7	1,949	12.6
Cypress Creek	6,624	25.3	2,269	10.1

Certainly the extensive implementation of current Best Management Practices on agricultural land has reduced the degradation of the Big Creek watershed and the sediment delivery to the Lower Cache River. Nevertheless, there is a need to incorporate multiple restoration efforts to restore a more natural, self-sustaining hydrologic response. It is important that initial restoration projects deal with watershed processes, using process-driven structural and functional management techniques (Samson and Knopf, 1996; Gore and Shields, 1995). Restoration of watershed processes will establish physical and biological interactions that will protect valuable cropland, and maintain aquatic and terrestrial riparian natural communities by sustaining natural recovery processes. At the same time, areas within the watershed where erosion is severe should be identified and mitigated on-site (Rosgen, 1994). Off-site remediation is costly and often short-lived.

Stream flow from a watershed is a consequence of precipitation, but it is also highly dependent on other factors such as landform (terrain configuration), bedrock, soil type, vegetative cover, and erosive processes. Changes in basin hydrologic response can be attributed to alterations in

any of these factors. Prior to human disturbance, land in Union and Pulaski Counties was predominantly forested. Today, only 40.7% of the land in Union County and 14.6% of the land in Pulaski County remains under forest cover (Illinois Department of Natural Resources, 1996). This conversion of forested acreage to row crops and pasture (Union County - 20.4% cropland, 28.2% grassland; Pulaski County - 46.2% cropland, 25.2% grassland) (Illinois Department of Natural Resources, 1996) has dramatically increased the streams maximum annual discharge. This increase in flow volume and velocity, coupled with increased drainage efforts/channelization and cropland/pasture acreage have contributed to severe channel incision and lateral gullying/widening, and have increased both the sediment supply within the Big Creek watershed and the energy the stream has to transport sediment suspended in the water column.

The reduction in basin storage capacity is a result of the loss of floodplain acreage (due to leveeing) and the loss of permanent vegetative cover (forested and wetland). This has resulted in increased runoff, sheet and rill erosion, stream bed/bank instability, contributions of in-stream sediment, and increased transport capacity (discharge). To reverse these environmentally damaging processes, resource managers must restore basin storage capacity, reduce channel incision and assist private landowners to implement BMP's on their property. Since it is unrealistic to restore large forested tracts now in agricultural production (row crops, pasture) other alternatives must be found to provide storage capacity on limited acreage. These alternatives include:

1) **Increased Water Storage**: Creating/restoring wetlands and impoundments designed to intercept and release rainwater slowly.
2) **Stream Bed Stabilization**: Installing riffle weirs in the stream channel where degradation processes (incision, lateral gullying/widening) are active.
3) **Enhance Vegetation Coverage**: Restoring permanent vegetative cover (native trees, grasses, forbs) within:
    a. the riparian corridor
    b. on highly erodible land

Application of these measures within the Big Creek Watershed will increase stormwater infiltration, reduce peak discharge, reduce stream channel degradation, increase the base flow of the stream, and provide habitat for fish and wildlife.

It is important to recognize that the natural character of a watershed is a reflection of basin hydrology. This understanding requires that restoration goals be based on the reestablishment of watershed processes. This restoration should use predisturbance conditions as an example (Gore and Shields, 1995; Bayley, 1995), to establish restoration goals (especially if the goal is preservation of existing natural communities and species). Changes in land use and socioeconomic considerations make this difficult, so the challenge becomes restoring watershed processes to a level that will require minimal maintenance, will preserve target resources, and will be socio-economically feasible and acceptable . These constraints demand that landscape scale hydrologic restoration deal with the entire watershed if it is to be successful.

Resource Issues, Goals and Objectives for the Big Creek Watershed

Issue 1 - Increased discharge (flow volume and velocity) during flood events.

Prior to human disturbance, the Big Creek watershed was almost entirely forested. The clearing of forests for farming and rural development has dramatically increased the delivery of precipitation to streams. This results in excessive runoff, and a subsequent increase in erosion and transport of overland and in-stream sediments.

A. Restoration Goal: Modify the hydrology of the Big Creek Watershed to reduce run-off rates and associated erosion to sustainable levels.

1. Objective: By 2002, review the proposed stormwater detention alternatives modeled by the Illinois State Water Survey and select those to be implemented based on predicted effectiveness, ecological benefits, and landowner approval/cooperation.

Site selection will be determined by an *interdisciplinary* team comprising NRCS/IDNR personnel. Design criteria will be location-specific, but will emphasize storage capacity, reduced discharge, and land treatment that will maximize benefits to fish and wildlife and provide for recreational opportunities.

2. Objective: By 2010, reduce peak flow reversal by 30 - 60% for the 2-year flood event.

Use data collected by the Illinois State Water Survey to identify strategic locations for construction of artificial stormwater retention basins. This objective will include site selection and special design considerations to assure these basins provide maximum storage and controlled discharge of stormwater, and high quality habitat for fish and wildlife. Additional benefits of these retention basins includes improved water quality and increased base flow in Big Creek during periods of seasonal drought.

Issue 2 - Excessive channel degradation (channel incision, widening, and lateral gullying).

Channelization in the Cache River (below the mouth of Big Creek), and the lower six miles of Big Creek has contributed to significant channel incision/widening and lateral gullying throughout the Big Creek watershed. This channel degradation threatens to eliminate both natural and agricultural land as streambanks collapse and material is washed downstream. This process is a source of tremendous volumes of silt carried into the Lower Cache River during storm events. Channel incision also increases stream gradient and subsequently stream discharge, increasing the amount of sediment suspended in the water column.

Installation of rock weirs will reduce further additional upstream progression of the channel incision process. Reducing channel incision will have benefits for the entire watershed by arresting channel widening and lateral gullying, protecting valuable cropland, and terrestrial and aquatic habitat for fish and wildlife. It will also provide shoreline stability, allowing for and sustaining site specific streambank stabilization.

A. Restoration Goal: Restore channel bottom elevations in deeply incised reaches of Big Creek.

1. Objective: By 2003, conduct and complete an intensive survey of Big Creek to identify locations where active channel degradation is occurring.

2. Objective: By 2005, install rock weirs (e.g., Newbury weirs) on Big Creek and its tributaries, where documented channel incision is occurring.

Issue 3 - Loss of floodplain in the lower reaches of Big Creek due to leveeing.

Nearly all of Big Creek from where the stream leaves the uplands and enters the floodplain to its junction with the Cache River has been channelized and leveed. This greatly increases the hydrologic gradient and the volume/velocity of water delivered to the Lower Cache River.

A. Restoration Goal: Restore floodplain structure and function.

1. Objective: Where feasible, remove levees along Big Creek.

2. Objective: From willing sellers, and as it becomes available, continue to acquire land in the Cache River/Big Creek floodplain.

3. Objective: Encourage landowners to restore/maintain flood prone areas by enrolling in conservation programs (WRP, CRP).

Issue 4 - Loss of aquatic/terrestrial habitat for fish and wildlife (game and non-game species).

Conversion of forested land to cropland, ditching, draining and channelization throughout the Big Creek watershed (especially within the riparian corridor) has dramatically reduced the quantity and quality of habitat available for both game and non-game fish and wildlife.

A. Restoration Goal: Restore forest or wetland habitat throughout the riparian zone of Big Creek to reduce erosion, provide stream bank stability and provide high quality habitat for fish and wildlife.

1. Objective: By 2005, enroll 200a.of riparian habitat adjacent to Big Creek currently in pasture/cropland, into a permanent conservation program (WRP/CRP).

B. Restoration Goal: Reduce runoff and delivery of sediments from drainage ditches in cropped fields, and provide upland habitat for terrestrial wildlife.

1. Objective: Provide information to all landowners on the importance of establishing grassed waterways in permanent and semipermanent field drainage ditches.

2. Objective: Promote the use of native grasses and trees for restoration projects.

Issue 5 - Remove highly erodible land (class 4e and 6e) from production.

Despite significant improvements in cropland management (conservation tillage), a large amount of highly erodible land is still being planted to row crops each year.

A. Restoration goal: Through voluntary incentive-based programs, help promote the removal all highly erodible land from row crop production.

1. Objective: By 2010, remove 300 acres of class 4e and 6e land from cultivation, and establish permanent vegetative cover at these locations (CRP-WHIP/EQIP, WRP, voluntary implementation of BMP's).

Issue 6 - Environmental education and outreach.

Many landowners within the Big Creek watershed are unaware of the environmental costs associated with farm management based solely on production oriented agricultural practices. Likewise, these landowners are also unaware of conservation efforts, funding sources, and manpower available to assist them with implementation of conservation applications on their property.

A. Education Goal: Increase awareness and participation by stakeholders in issues regarding natural resources.

1. Objective: Identify the stakeholders that the planning committee considers to be highest priority for education activities.

2. Objective: Develop appropriate activities to provide awareness and education to the identified groups (e.g., media tours, newspaper articles, workshops, brochures, etc.).

Issue 7 - Document results of restoration efforts through research and monitoring.

Because landscape scale restoration is a relatively new concept involving the implementation of practices that may not be reflected in improvements in environmental quality for many years, it is important to use the best available information to establish management goals and projects, and then document the results of these efforts. This will require cooperation between various resource agencies. To assure standardization, the Illinois State Water Survey should oversee hydrologic sampling procedures, data tabulation & analysis.

A. Research/monitoring goal: Collect baseline information on stream discharge and suspended sediment at selected locations in Big Creek.

1.Objective: Establish a network of stream gaging stations at selected locations in Big Creek and maintain these stations for at least 5 - 10 years to document improvements in water quality and flow dynamics.

B. Research/monitoring goal: Collect information on the distribution, habitat preference, and life history of the fringed darter (*Etheostoma crossopterum*).

1. Objective: Work with Southern Illinois University at Carbondale to conduct intensive research on *E. crossopterum* in the Big Creek and Cypress Creek watersheds. This research will emphasize relative abundance, recruitment, and habitat preference of this species, and relate ecological parameters to improvements of in-stream aquatic habitat associated with riparian restoration implemented in these watersheds.

C. Research/monitoring goal: Collect information on selected mammals, birds, reptiles and amphibians, and relate species density, diversity and recruitment to improvements in terrestrial and aquatic habitat.

1. Objective: Coordinate research needs with Southern Illinois University at Carbondale, the Natural History Survey, and the Illinois Department of Natural Resources to collect data on selected species within the Big Creek watershed.

D. Research/monitoring goal: Collect data on fish and invertebrate populations, and relate species density, diversity, and recruitment with improvements in water quality.

1. Objective: Expand IEPA/IDNR sampling protocol to include monitoring stations throughout the Big Creek watershed. Encourage inter/intra agency cooperation to assure timely dissemination of study results and prevent duplication of efforts.

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Appendix 1. Vegetation classification (modified from: The Nature Conservancy, 1995a).

The Nature Conservancy vegetation classification showing the natural communities described for southern Illinois (modified from: The Nature Conservancy, 1995a).

VEGETATION CLASSIFICATION	SYNONYM NAME
Swamp Forests	
TAXODIUM DISTICHUM FOREST ALLIANCE	
Taxodium distichum/Lemna minor Forest	Bald Cypress Swamp
NYSSA AQUATICA-(TAXODIUM DISTICHUM) FOREST ALLIANCE	
Nyssa aquatica Forest	Water Tupelo Swamp
Taxodium distichum-(Nyssa aquatica)/Forestiera acuminata Forest	Bald Cypress-(Water Tupelo) Swamp
ACER RUBRUM-GLEDITSIA AQUATICA-(PLANERA AQUATICA) FOREST ALLIANCE	
Acer rubrum-Gleditsia aquatica-Planera aquatica-Fraxinus profunda Forest	Red Maple-Water Locust Mixed Bottomland Forest
Swamp Shrublands	
CEPHALANTHUS OCCIDENTALIS SHRUBLAND ALLIANCE	
Cephalanthus occidentalis/Carex spp. Southern Shrubland	Southern Buttonbush Swamp
Seasonally Flooded Forest Types	
QUERCUS LYRATA-LIQUIDAMBAR STYRACIFLUA FOREST ALLIANCE	
Quercus lyrata-Liquidambar styraciflua/Forestiera acuminata Forest	Overcup Oak-Sweetgum Forest
ACER SACCHARINUM FOREST ALLIANCE	
Acer saccharinum-Celtis laevigata-Carya illinoiensis Forest	Silver Maple-Hackberry-Pecan Terrace Forest
QUERCUS PALUSTRIS-(Q. BICOLOR) FOREST ALLIANCE	
Quercus palustris-(Q. stellata)-Q. pagoda/Isoetes spp. Flatwoods Forest	Mesic Lowland Flatwoods
QUERCUS (michauxii, pagoda, shumardii)-LIQUIDAMBAR STYRACIFLUA FOREST ALLIANCE	
Quercus michauxii-Q. shumardii-Liquidambar styraciflua/Arundinaria gigantea Forest	Swamp Chestnut Oak-Sweetgum Forest
ACER SACCHARUM-CARYA CORDIFORMIS FOREST ALLIANCE	
Acer saccharum-Carya cordiformis/Asimina triloba Floodplain Ridge and Terrace Forest	Maple-Hickory Floodplain Ridge and Terrace Forest

Mesic and Dry-mesic Upland Forests

FAGUS GRANDIFOLIA-ACER SACCHARUM-(LIRIODENDRON TULIPIFERA) FOREST ALLIANCE

Fagus grandifolia-Acer saccharum-Liriodendron Unglaciated Forest	Unglaciated Beech-Maple Forest

QUERCUS ALBA-Q. RUBRA-CARYA (ovata, glabra, alba) FOREST ALLIANCE

Quercus alba-Q. rubra-Q. muehlenbergii/Cercis canadensis Forest	White Oak/Redbud Dry-mesic Alkaline Forest

QUERCUS VELUTINA-Q. ALBA-CARYA (glabra, ovata) FOREST ALLIANCE

Quercus velutina-Q. alba-Carya spp. (glabra, ovata)/Cornus florida Forest	Black Oak-White Oak-Hickory Forest

QUERCUS FALCATA-Q. ALBA-(Q. STELLATA)-CARYA TEXANA FOREST ALLIANCE

Quercus falcata-Q. alba-Carya spp. Interior Plateau Forest	Interior Plateau Southern Red Oak-Hickory Forest

QUERCUS PRINUS-Q. COCCINEA-Q. VELUTINA FOREST ALLIANCE

Quercus prinus-(Q. coccinea)-Q. velutina/Smilax spp. Forest	Chestnut Oak Forest

Dry and Xeric Upland Forests

QUERCUS STELLATA-Q. MARILANDICA FOREST ALLIANCE

Quercus stellata-Q. marilandica-Carya texana/Vaccinium arboreum Forest	Post Oak-Blackjack Oak Forest
Quercus stellata-(Q. marilandica)-Q. muehlenbergii Lesser Shawnee Forest	Lesser Shawnee Post Oak-Chinquapin Oak Forest

PINUS ECHINATA-QUERCUS (alba, falcata, stellata, velutina) FOREST ALLIANCE

Pinus echinata-Quercus velutina-Q. stellata/Vaccinium spp. Forest	Shortleaf Pine-Black Oak Forest

Woodland Barrens

QUERCUS STELLATA-Q. MARILANDICA WOODLAND ALLIANCE

Quercus stellata-Q. marilandica-Carya texana/Schizachyrium scoparium Woodland Barrens	Post Oak-Blackjack Oak/Little Bluestem Woodland Barrens

Open Barrens

QUERCUS STELLATA-Q. MARILANDICA SPARSE WOODLAND ALLIANCE

Quercus stellata-Q. marilandica/Schizachyrium scoparium Sparse Woodland	Post Oak Central Dry Barrens

QUERCUS STELLATA-Q. VELUTINA-Q. ALBA-(Q. FALCATA) SPARSE WOODLAND ALLIANCE

Quercus stellata-Q. alba-Q. velutina-(Q. falcata)/Schizachyrium scoparium Sparse Woodland Barrens	Cretaceous Hills Dry-mesic
Quercus stellata-Q. velutina-Q. alba-(Q. falcata)/Schizachryium scoparium Sparse Woodland	Cretaceous Hills Dry Barrens

Open Glades

QUERCUS MARILANDICA-JUNIPERUS VIRGINIANA SPARSE WOODLAND ALLIANCE

Quercus marilandica-Juniperus virginiana/Schizachyrium scoparium-Hypericum gentianoides Sparse Woodland	Shawnee Sandstone Glade
Quercus marilandica-Juniperus virginiana/Schizachyrium scoparium-Danthonia spicata Sparse Woodland	Central Shale Glade

QUERCUS MUEHLENBERGII-JUNIPERUS VIRGINIANA SPARSE WOODLAND ALLIANCE

Quercus muehlenbergii-Juniperus virginiana/Schizachyrium scoparium-Bouteloua curtipendula Sparse Woodland	Central Limestone Glade

Hill Prairies	
SCHIZACHYRIUM SCOPARIUM-SORGHASTRUM NUTANS HERBACEOUS ALLIANCE	
Schizachyrium scoparium-Sorghastrum nutans-Bouteloua curtipendula Loess-capped Hill Herbaceous Vegetation	Loess-capped Hill Prairie
Seeps	
CAREX CRINITA-OSMUNDA SPP.-SPHAGNUM SPP. HERBACEOUS ALLIANCE	
Carex crinita-Osmunda spp./Sphagnum spp. Herbaceous Vegetation	Acid Gravel Seep
Floodplain Forests	
ACER RUBRUM-FRAXINUS (nigra, pennsylvanica) FOREST ALLIANCE	
Acer rubrum-Fraxinus spp.-(Ulmus americana) Forest	Red Maple-Ash-(Elm) Swamp Forest
FRAXINUS PENNSYLVANICA-(ULMUS AMERICANA)-CELTIS (occidentalis, laevigata) FOREST ALLIANCE	
Fraxinus pennyslvanica-Ulmus americana-Celtis laevigata Forest	Southern Green Ash-Elm-Hackberry Forest
POPULUS DELTOIDES-SALIX NIGRA FOREST ALLIANCE	
Populus deltoides-Salix nigra Forest	Cottonwood-Black Willow Forest
QUERCUS PHELLOS FOREST ALLIANCE	
Quercus phellos-(Q. lyrata) Flatwoods Forest	Willow Oak Bottomland Forest
Upland Forests	
QUERCUS VELUTINA-Q. ALBA-CARYA (glabra, ovata) FOREST ALLIANCE	
Quercus velutina-Q. prinus-Carya spp. Ozark Forest? No CCA completed	Ozark Black Oak-Chestnut Oak Dry Forest?
Herbaceous Wetlands	
SCIRPUS SPP.-TYPHA SPP.-SPARGANIUM SPP. HERBACEOUS ALLIANCE	
Scirpus acutus-Typha spp. Mixed Inland Midwest Herbaceous Vegetation	Inland Mixed Emergent Marsh

Appendix 2. State Listed Threatened and Endangered Species.

State threatened or endangered species reported from the four counties (Union, Johnson, Alexander, and Pulaski) encompassing the Cache River Wetlands area, which includes the proposed Cache River Land and Water Reserve.

E = Endangered T = Threatened
*Species known to occur within the project area

Status	Scientific Name	Common Name
Plants		
E*	*Aristolochia serpentaria* var. *hastata*	Virginia snakeroot
T	*Asplenium bradleyi*	Bradley's spleenwort
T*	*Asplenium resiliens*	black spleenwort
E*	*Bartonia paniculata*	screwstem
E	*Botrychium biternatum*	southern grape fern
E*	*Carex decomposita*	sedge
E	*Carex gigantea*	sedge
E*	*Carex intumescens*	sedge
E*	*Carex oxylepis*	sedge
E	*Carex physorhyncha*	sedge
E	*Carex prasina*	sedge
E	*Carex striatula*	sedge
E	*Carya pallida*	pale hickory
E	*Castanea dentata*	American chestnut
E	*Cladrastis lutea*	yellowood
E*	*Clematis crispa*	blue jasmine
E*	*Clematis viorna*	leatherflower
E*	*Cyperus lancastriensis*	galingale
T*	*Dennstaedtia punctilobula*	hay-scented fern
E*	*Dryopteris celsa*	log fern
T*	*Euonymus americanus*	strawberry bush
E*	*Eupatorium incarnatum*	thoroughwort
E*	*Fimbristylis baldwiniana*	Baldwin's fimbristylis
E	*Glyceria arkansana*	manna grass
E*	*Habenaria flava*	tubercled orchid
E*	*Halesia carolina*	silverbell tree
T*	*Helianthus angustifolius*	narrow-leaved sunflower
E	*Heteranthera reniformis*	mud plantain
T*	*Hydrastis canadensis*	goldenseal
E	*Hydrocotyl ranunculoides*	water-pennywort
E*	*Hydrolea uniflora*	one-flowered hydrolea

E*	*Hypericum densiflorum*	St. John's-wort
E*	*Iresine rhizomatosa*	bloodleaf
T*	*Iris fulva*	swamp red iris
E	*Juniperus horizontalis*	trailing juniper
E*	*Justicia ovata*	water willow
E*	*Lysimachia radicans*	creeping loosestrife
E*	*Melanthera nivea*	white melanthera
E*	*Melothria pendula*	squirting cucumber
T*	*Panax quinquefolius*	ginseng
E	*Panicum hians*	panic grass
E	*Panicum joori*	panic grass
E	*Panicum ravenelii*	panic grass
E	*Panicum stipitatum*	panic grass
E	*Panicum yadkinense*	panic grass
E	*Paspalum bushii*	hairy bead grass
E	*Paspalum dissectum*	bead grass
E*	*Paspalum lentiferum*	bead grass
E	*Pinus echinata*	shortleaf pine
T*	*Planera aquatica*	water elm
E	*Plantago heterophylla*	small plantain
E*	*Polygonum longistylum*	smartweed
E	*Potentilla millegrana*	cinquefoil
E*	*Ptilimnium costatum*	mock bishop's weed
E*	*Ptilimnium nuttallii*	mock bishop's weed
E	*Puccinellia pallida*	grass
E	*Pycnanthemum albescens*	white mountain mint
E	*Pycnanthemum torrei*	mountain mint
E*	*Quercus nuttallii*	Nuttall's oak
T*	*Quercus phellos*	willow oak
T	*Quercus prinus*	rock chestnut oak
E	*Rhynchospora macrostachya*	beak rush
E	*Rubus enslenii*	arching dewberry
E*	*Sagittaria longirostra*	arrowhead
T*	*Salvia azurea* subsp. *pitcheri*	blue sage
T*	*Scirpus polyphyllus*	bulrush
E*	*Scirpus verecundus*	bulrush
E	*Solidago arguta*	goldenrod
E	*Sparganium chlorocarpum*	green-fruited burreed
E	*Spiranthes vernalis*	spring ladies' tresses
E	*Stachys clingmanii*	hedge nettle
T	*Stenanthium gramineum*	grass-leaved lily
T*	*Styrax americana*	storax
E*	*Styrax grandifolia*	bigleaf snowball bush

E*	*Thalia dealbata*	powdery thalia
E	*Thelypteris phegopteris*	long beech fern
E*	*Tilia heterophylla*	white basswood
E	*Trillium cuneatum*	trillium
T	*Trillium viride*	green trillium
E*	*Urtica chamaedryoides*	nettle

Mammals

T*	*Lynx rufus*	bobcat
T*	*Lutra canadensis*	river otter
E	*Neotoma floridana*	eastern woodrat
T*	*Ochrotomys nuttalli*	golden mouse
T*	*Oryzomys palustris*	rice rat

Birds

E*	*Accipiter cooperii*	Cooper's hawk
E	*Aimophilia aestivalis*	Bachman's sparrow
E*	*Buteo lineatus*	red-shouldered hawk
E	*Casmerodius albus*	great egret
E*	*Circus cyoneus*	northern harrier
E*	*Ictinia mississippiensis*	Mississippi kite
T*	*Lanius ludovicanus*	loggerhead shrike
T*	*Limnothlypis swainsonii*	Swainson's warbler
T*	*Thryomanes bewickii*	Bewick's wren
E*	*Tyto alba*	barn owl

Amphibians

E*	*Desmognathus fuscus*	dusky salamander
T*	*Pseudacris streckeri*	Strecker's chorus frog

Reptiles

E*	*Thamnophis sauritis* subsp. *septentrionalis*	eastern ribbon snake

Fish

T*	*Lepisosteus spatula*	alligator gar
T*	*Lepomis symmetricus*	bantam sunfish
T	*Lepomis miniatus*	redspotted sunfish
E	*Hybognathus hayi*	cypress minnow
E*	*Notropis hubbsi*	bluehead shiner
E	*Notropis boops*	bigeye shiner
E	*Platygobio gracilis*	flathead chub

Source: U. S. Fish and Wildlife Service. 1990. Cypress Creek National Wildlife Refuge: environmental assessment. 236 p.

Appendix 3. Native Woody Plant Species

Native woody plants (trees, shrubs, and vines) found in the four counties (Union, Johnson, Alexander, and Pulaski) encompassing the Cache River Wetlands area, which includes the proposed Cache River Land and Water Reserve.

Scientific Name	**Common Name**
Acer negundo	box elder
Acer saccharinum	silver maple
Acer saccharum	sugar maple
Acer rubrum	red maple
Acer rubrum var. *drummondii*	swamp red maple
Aesculus discolor	Ohio buckeye
Amelanchier arborea	shadbush
Amorpha fruticosa	indigo bush
Ampelopsis cordata	raccoon grape
Aralia spinosa	Hercules club
Aristolochia serpentaria var. *hastata*	Virginia snakeroot
Arundinaria gigantea	giant cane
Asimina triloba	pawpaw
Betula nigra	river birch
Bignonia capreolata	cross vine
Brunnichia cirrhosa	lady's eardrops
Campsis radicans	trumpet creeper
Carpinus caroliniana	blue beech
Carya aquatica	water hickory
Carya cordiformis	bitternut hickory
Carya glabra	pignut hickory
Carya illinoensis	pecan
Carya laciniosa	kingnut hickory
Carya ovalis	sweet pignut hickory
Carya tomentosa	mockernut hickory
Catalpa speciosa	catalpa
Celastrus scandens	bittersweet
Celtis laevigata	southern hackberry
Celtis occidentalis	hackberry
Cephalanthus occidentalis	buttonbush
Cercis canadensis	redbud
Cocculus carolinus	snailseed
Cornus amomum	swamp dogwood
Cornus drummondi	rough-leaved dogwood
Cornus florida	flowering dogwood
Cornus foemina	dogwood
Corylus americana	hazelnut

Crataegus phaenopyrum	hawthorn
Crataegus viridis	green hawthorn
Diospyros virginiana	persimmon
Euonymus americanus	strawberry bush
Euonymus atropurpureus	wahoo (burning bush)
Euonymus obovatus	running strawberry bush
Fagus grandifolia	beech
Forestiera acuminata	swamp privet
Fraxinus americana	white ash
Fraxinus pennsylvanica	green ash
Fraxinus tomentosa	pumpkin ash
Gleditsia aquatica	water locust
Gleditsia triacanthos	honey locust
Hypericum spathulatum	shrubby St. John's-wort
Ilex decidua	deciduous holly
Itea virginica	Virginia willow
Juglans cinerea	butternut
Juglans nigra	black walnut
Lindera benzoin	spicebush
Liquidambar styraciflua	sweet gum
Liriodendron tulipifera	tulip tree (yellow poplar)
Lonicera japonica	Japanese honeysuckle
Lonicera maackii	amur honeysuckle
Menispermum canadensis	moonseed
Mikania scandens	climbing hemp
Morus rubra	mulberry
Nyssa aquatica	tupelo gum
Nyssa sylvatica	black gum
Ostrya virginiana	hop hornbeam
Parthenocissus quinquefolia	Virginia creeper
Phoradendron flavescens	mistletoe
Planera aquatica	water elm
Platanus occidentalis	sycamore
Populus deltoides	cottonwood
Populus heterophylla	swamp cottonwood
Prunus americana	American plum
Prunus serotina	wild black cherry
Ptelea trifoliata	wafer ash (hoptree)
Quercus alba	white oak
Quercus bicolor	swamp white oak
Quercus falcata	southern red oak
Quercus falcata var. *pagodaefolia*	cherrybark oak
Quercus lyrata	overcup oak

Quercus macrocarpa	bur oak
Quercus michauxii	swamp chestnut oak
Quercus muhlinbergii	chinkapin oak
Quercus palustris	pin oak
Quercus phellos	willow oak
Quercus rubra	red oak
Quercus shumardii	Shumard's red oak
Quercus stellata	post oak
Quercus velutina	black oak
Rhus copallina	winged sumac
Rhus glabra	smooth sumac
Robinia pseudoacacia	black locust
Rosa palustris	swamp rose
Rubus allegheniensis	blackberry
Rubus occidentalis	raspberry
Salix nigra	black willow
Sambucus canadensis	elderberry
Sassafras albidum	sassafras
Smilax bona-nox	catbrier
Smilax hispida	catbrier
Smilax rotundifolia	round-leaved catbrier
Smilax sp.	catbrier
Staphylea trifolia	bladdernut
Styrax americana	storax
Taxodium distichum	baldcypress
Tilia americana	basswood
Toxicodendron radicans	poison ivy
Trachelospermum difforme	climbing dogbane
Ulmus alata	winged elm
Ulmus americana	American elm
Ulmus rubra	slippery elm
Viburnum prunifolium	black haw
Vitis cinerea	sweet winter grape
Vitis palmata	catbird grape
Vitis riparia	riverbank grape
Vitis vulpina	frost grape
Wisteria macrostachia	wisteria
Zanthoxylum americanum	prickly ash

Source: U. S. Fish and Wildlife Service. 1990. Cypress Creek National Wildlife Refuge: environmental assessment. 236 p.

Appendix 4. Aquatic and Non-Woody Plant Species

Aquatic and other vascular plant species found in the four counties (Union, Johnson, Alexander, and Pulaski) encompassing the Cache River Wetlands area, which includes the proposed Cache River Land and Water Reserve.

Scientific Name	Common Name
Acalypha gracilens	slender three-seeded mercury
Acalypha ostryaefolia	three-seeded mercury
Acalypha virginica	Virginia three-seeded mercury
Achillia millefolium	yarrow
Agrimonia rostellata	agrimony
Alisma subcordatum	water plantain
Allium canadense	wild onion
Allium vineale	field garlic
Amaranthus tuberculatus	water hemp
Ambrosia artemisiifolia	common ragweed
Ambrosia trifida	giant ragweed
Ammania coccinea	loosestrife
Ampelamus albidus	climbing bluevine
Anemone virginiana	common anemone
Apios americana	groundnut
Apocynum cannabinum	Indian hemp
Arisaema dracontium	green dragon
Arisaema triphyllum	Jack-in-the-pulpit
Aristolochia serpentaria	Virginia snakeroot
Artemisia annua	annual wormwood
Arundinaria gigantea	giant cane
Asarum canadensis	wild ginger
Asclepias perennis	swamp milkweed
Asclepias syrica	common milkweed
Aster spp.	aster
Bidens aristosa	swamp marigold
Bidens connata	beggars-tick
Bidens frondosa	common beggars-tick
Blephilic hirsuta	pagoda plant
Boehmeria cylindrica	false nettle
Brunnichia cirrhosa	climbing buckwheat
Cacalia atriplicifolia	Indian plantain
Campanula americana	bellflower
Capsella bursa-pastoris	shepherds purse
Cardomine parviflora	small-flowered letter-cress
Carex crus-corvi	sedge
Carex frankii	sedge

Carex grayii	sedge
Carex lupuliformis	sedge
Carex lupulina	sedge
Carex muskingumensis	sedge
Carex rosea	sedge
Carex squarrosa	sedge
Carex tribuloides	sedge
Carex typhina	sedge
Carex vulpinoidea	sedge
Chasmanthium latifolium	sea-oats
Chenopodium album	lambs-quarters
Chrysanthemum leucanthemum	ox-eye daisy
Cicuta maculata	water hemlock
Cinna arundinacea	wood reedgrass
Cocculus carolinus	snailseed
Convolvulus arvensis	field bindweed
Cryptotaenia canadensis	honewort
Cuscuta coryli	dodder
Cynoglossum virginianum	wild comfrey
Cyperus erythrorhizos	sedge
Cyperus esculentus	sedge
Cyperus ovularis	sedge
Cyperus strigosus	sedge
Daucus carota	Queen Anne's lace
Dentaria laciniata	toothwort
Desmodium sp.	tick-trefoil
Dicliptera brachiata	acanthus
Dioscorea quaternata	wild yam
Dioscorea villosa	wild yam
Echinochloa pungens	barnyard grass
Echinodorus cordifolius	water plantain
Echinodorus radicans	water plantain
Eclipta alba	small daisy
Eleocharis acicularis	spike rush
Eleocharis obtusa	spike rush
Eleocharis tenuis	spike rush
Elephantopus carolinianus	elephant's foot
Elymus villosus	slender rye root
Elymus virginicus	wild rye
Eragrostis hypnoides	love-grass
Erigeron annuus	daisy fleabane
Erigeron philadelphicus	fleabane
Eupatorium coelestinum	mistflower

Eupatorium serotinum	white snakeroot
Euphorbia corollata	flowering spurge
Festuca pratensis	meadow fescue
Festuca obtusa	nodding fescue
Gallium aparine	goosegrass
Galium circaezans	wild licorice
Galium obtusum	bedstraw
Geranium carolinianum	wild cranesbill
Geranium maculatum	wild geranium
Geum canadense	avens
Geum vernum	avens
Glyceria striata	fowl meadow grass
Hedeoma pulegioides	mock pennyroyal
Helenium flexuosum	sneezewood
Heliotropium indicum	heliotrope
Heuchera hirsoticavlis	tall alumroot
Hibiscus militaris	halberd-leaved rose mallow
Hordeum pusillum	little barley
Hottonia inflata	featherfoil
Hydrangea arborescens	hydrangea
Hymenocallis occidentalis	spiderlily
Hypericum mutilum	St. John's-wort
Hypericum punctatum	spotted St. John's-wort
Impatiens punctatum	orange spotted touch-me-not
Ipomoea hederacea	ivy-leaved morning glory
Ipomoea lacunoa	small-flowered morning glory
Ipomoea pandurata	wild sweet potato
Iris spp.	iris
Isopyrum biternatum	false rue-anemone
Itea virginica	Virginia willow
Juncus acuminatus	rush
Juncus biflorus	rush
Juncus brachycarpus	rush
Juncus effusus	rush
Juncus interior	rush
Juncus tenuis	rush
Juncus torreyi	rush
Jussiaea diffusa	water evening primrose
Jussiaea repens	creeping primrose willow
Justicia americana	water willow
Lactuca floridana	woodland lettuce
Leersia oryzoides	rice cut grass
Leersia virginica	white grass

Lemna minor	duckweed
Lepidium virginicum	common peppergrass
Leucospora multifida	figwort
Limnobium spongia	sponge plant
Lindernia anagallidea	figwort
Lindernia dubia	false pimpernel
Lippia lanceolata	–
Lithospermum latifolium	American gromwell
Lobelia cardinalis	cardinal flower
Lobelia inflata	Indian tobacco
Lobelia siphilitica	great blue cardinal flower
Ludwigia palustris	seedbox
Lycopus americana	common water horehound
Lysimachia ciliata	fringed loosestrife
Lysimachia nummularia	moneywort
Melilotus officinalis	yellow sweet clover
Mikania scandens	climbing hempweed
Mimulus alatus	monkey-flower
Mollugo verticillata	carpetweed
Monarda fistulosa	wild bergamot
Oenothera biennis	evening primrose
Oxalis stricta	wood sorrel
Panicum boscii	panic grass
Panicum microcarpon	small panic grass
Paronychia canadensis	forked chickweed
Paspalum dissectum	creeping paspalum
Paspalum fluitans	swamp beadgrass
Peltandra virginica	arrow-arum
Penstemon digitalis	foxglove penstemon
Penthorum sedoides	ditch stonecrop
Phalaris arundinacea	reed canary grass
Phlox divaricata	blue phlox
Phlox glaberrima	smooth phlox
Phlox paniculata	garden phlox
Phryma leptostachya	lopseed
Physalis subglabrata	smooth ground cherry
Phytolacca americana	pokeweed
Plantago rugellii	Rugel’s plantain
Pluchea camphorata	marsh fleabane
Poa pratensis	Kentucky bluegrass
Podophyllum peltatum	mayapple
Polemonium reptans	Jacob’s ladder
Polygonatum biflorum	Solomon’s seal

Polygonum hydropiperoides	mild water pepper
Polygonum lapathifolium	smartweed
Polygonum pennsylvanicum	smartweed
Polygonum punctatum	smartweed
Polygonum setaceum	smartweed
Polygonum virginianum	Virginia's knotweed
Potentilla recta	cinquefoil
Prunella vulgaris	selfheal
Pycnanthemum flexuosum	mountain-mint
Pycnanthemum pycnanthemoides	mountain-mint
Ranunculus abortivus	small-flowered buttercup
Ranunculus scleratus	cursed crowfoot
Ranunculus septentrionalis	swamp crowfoot
Rhynchospora corniculata	beaked rush
Rorippa islandica	marsh yellow-cress
Rorippa sylvestris	creeping yellow-cress
Rosa carolina	pasture rose
Rotala ramosior	loosestrife
Rudbeckia laciniata	goldenglow
Rumex crispus	curly dock
Rumex obtusifolia	bitter dock
Rumex verticillata	swamp dock
Sagittaria latifolia	duck potato
Sanguinaria canadenis	bloodroot
Sanicula canadenis	short-styled snakeroot
Sanicula gregaria	common snakeroot
Saururus cernuus	lizard-tail
Scirpus atrovirens	bulrush
Scirpus cyperinus	bulrush
Scutellaria incana	downy skullcap
Scutellaria lateriflora	mad-dog skullcap
Scutellaria ovata	heart-leaved scullcap
Senecio aureus	golden ragwort
Senecio glabellus	butterweed
Setaria faberii	foxtail
Setaria lutescens	foxtail
Seymeria macrophylla	mullein foxglove
Sicyos angulatus	bur cucumber
Silene stellata	widow's frill
Sisyrinchium angustifolium	blue-eyed grass
Smilacina racemosa	false Solomon's seal
Solanum americanum	American nightshade
Solanum carolinense	horse nettle

Solidago spp.	goldenrod
Sonchus oleraceus	common sow-thistle
Sorghum halepense	Johnsongrass
Spermacoce glabra	smooth buttonweed
Spigelia marilandica	Indian pink
Spirodella spp.	duckweed
Stachys clingmanii	hedge-nettle
Stachys tenuifolia	common hedge-nettle
Stylophorum diphyllum	celadine poppy
Teucrium canadense	wood sage
Trachelospermum difforme	climbing dogbane
Tradescantia subaspera	spiderwort
Triadenum walteri	marsh St. John's-wort
Trifolium dubium	little hop-clover
Trifolium incarnatum	crimson clover
Trifolium repens	white cloverd
Triodanis perfoliata	Venus looking-glass
Triticum vulgare	wheat
Uniola latifolia	sea-oats
Urtica gracilis	nettle
Valerianella radiata	corn salad
Verbena urticifolia	white vervain
Verbesina alternifolia	yellow ironweed
Vernonia fasciculata	ironweed
Veronica serpyllifolia	thyme-leaved speedwell
Viola papilionacea	violet
Wisteria macrostachya	wisteria
Wolffia spp.	water-meal
Xanthium strumarium	cocklebur

Ferns

Adiantum pedatum	maidenhair
Asplenium platyneuron	ebony spleenwort
Azollo mexicana	mosquito fern
Botrychium dissectum	cat-leaved grape fern
Botrychium virginianum	rattlesnake fern
Cystopteris fragilis	fragile fern
Dryopteris hexagonoptera	broad beech fern
Equisetum arvense	common horsetail
Onoclea sensibilis	sensitive fern
Polypodium polypodioides	resurrection fern
Polystichum acrostichoides	Christmas fern

Source: U. S. Fish and Wildlife Service. 1990. Cypress Creek National Wildlife Refuge: environmental assessment. 236 p.

Appendix 5. Fish Species

Fish species found in the four counties (Union, Johnson, Alexander, and Pulaski) encompassing the Cache River Wetlands area, which includes the proposed Cache River Land and Water Reserve.

Scientific Name	Common Name
Ambloplites rupestris	rock bass
Amia calva	bowfin
Aphredoderus sayanus	pirate perch
Aplodinotus grunniens	freshwater drum
Campostoma anomalum	central stoneroller
Carpiodes carpio	river carpsucker
Catostomus commersoni	white sucker
Centrarchus macropterus	flier
Chologaster agassizi	spring cavefish
Cottus carolinae	banded sculpin
Cyprinus carpio	common carp
Dorosoma cepedianum	gizzard shad
Elassoma zonatum	banded pygmy sunfish
Erimyzon oblongus	creek chubsucker
Esox americanus	grass pickerel
Etheostoma asprigene	mud darter
Etheostoma chlorosomum	bluntnose darter
Etheostoma flabellare	fantail darter
Etheostoma gracile	slough darter
Etheostoma kennicotti	stripetail darter
Etheostoma nigrum	Johnny darter
Etheostoma proeiaire	cypress darter
Etheostoma spectabile	orangethroat darter
Etheostoma squamiceps	spottail darter
Fundulus notatus	blackstripe topminnow
Fundulus olivaceus	blackspotted topminnow
Gambusia affinis	mosquitofish
Hiodon tergisus	mooneye
Hybognathus hayi	cypress minnow
Hybognathus nuchalis	silvery minnow
Hybopsis storeriana	silver chub
Ictalurus melas	black bullhead
Ictalurus natalis	yellow bullhead
Ictalurus nebulosus	brown bullhead
Ictalurus punctatus	channel catfish
Ictiobus bubalus	smallmouth buffalo
Ictiobus cyprinellus	bigmouth buffalo
Ictiobus niger	black buffalo
Labidesthes sicculus	brook silverside

Lepisosteum oculatus	spotted gar
Lepisosteus platostomus	shortnose gar
Lepomis cyanellus	green sunfish
Lepomis gibbosus	pumpkinseed
Lepomis gulosus	warmouth
Lepomis humilis	orangespotted sunfish
Lepomis macrochirus	bluegill
Lepomis megalotis	longear sunfish
Lepomis microlophus	redear sunfish
Lepomis miniatus	redspotted sunfish
Lepomis symmetricus	bantam sunfish
Micropterus punctulatus	spotted bass
Micropterus salmoides	largemouth bass
Minytrema melanops	spotted sucker
Morone chrysops	white bass
Moxostoma erythrurum	golden redhorse
Notemigonus crysoleucas	golden shiner
Notropis atherinoides	emerald shiner
Notropis blennius	river shiner
Notropis boops	bigeye shiner
Notropis buchanani	ghost shiner
Notropis chrysocephalus	striped shiner
Notropis emiliae	pugnose shiner
Notropis fumeus	ribbon shiner
Notropis lutrensis	red shiner
Notropis spilopterus	spotfin shiner
Notropis umbratilis	redfin shiner
Notropis venustus	blacktail shiner
Notropis volucellus	mimic shiner
Notropis whipplei	steelcolor shiner
Noturus gyrinus	tadpole madtom
Noturus miurus	brindled madtom
Noturus nocturnus	freckled madtom
Percina caprodes	logperch
Percina maculata	blackside darter
Percina phoxocephala	slenderhead darter
Phenacobius mirabilis	suckermouth minnow
Pimephales notatus	bluntnose minnow
Pimephales promelas	fathead minnow
Pimephales vigilax	bullhead minnow
Platygobio gracilis	flathead chub
Pomoxis annularis	white crappie
Pomoxis nigromaculatus	black crappie
Pylodictis olivaris	flathead catfish
Semotilus atromaculatus	creek chub

Umbra limi	central mudminnow

Source: U. S. Fish and Wildlife Service. 1990. Cypress Creek National Wildlife Refuge: environmental assessment. 236 p.

Appendix 6. Mussel Species

Mussel species found in the four counties (Union, Johnson, Alexander, and Pulaski) encompassing the Cache River Wetlands area, which includes the proposed Cache River Land and Water Reserve.

Scientific Name	Common Name
Amblema plicata	threeridge
Anodonta grandis	giant floater
Anodonta imbecilis	paper pondshell
Anodonta suborbiculata	flat floater
Arcidens confragosus	rock-pocketbook
Corbicula fluminea	unknown
Lampsilis orbiculata	pink mucket pearly mussel
Lampsilis teres	yellow sandshell
Lasmigona complanata	white heelsplitter
Ligumia subrostrata	pondmussel
Loptodea fragilis	fragile papershell
Megalonaias nervosa	washboard
Plethobasis cooperianus	orange-footed pearly mussel
Potamilus alatus	pink heelsplitter
Quadrula quadrula	mapleleaf
Toxolasma parvus	lilliput
Toxolasma texasensis	Texas lilliput
Tritogonia verrucosa	unknown
Truncilla truncata	deertoe

Source: U. S. Fish and Wildlife Service. 1990. Cypress Creek National Wildlife Refuge: environmental assessment. 236 p.

Appendix 7. Bird Species

Bird species found in the four counties (Union, Johnson, Alexander, and Pulaski) encompassing the Cache River Wetlands area, which includes the proposed Cache River Land and Water Reserve.

Scientific Name	Common Name
Actitis macularia	least sandpiper
Agelaius phoeniceus	red-winged blackbird
Aix sponsa	wood duck
Ammodramus savanarum	grasshopper sparrow
Anas acuta	common pintail
Anas americana	American widgeon

Anas clypeata	northern shoveler
Anas crecca	green-winged teal
Anas discors	blue-winged teal
Anas platyrynchos	mallard
Anas rubripes	American black duck
Anas strepera	gadwall
Archilochus colubris	ruby-throated hummingbird
Ardea herodias	great blue heron
Aythya affinis	lesser scaup
Bombycilla cedrorum	cedar waxwing
Branta canadensis	Canada goose
Bubo virginianus	great horned owl
Bubulcus ibis	cattle egret
Bucephala albeola	bufflehead
Buteo lagopus	rough-legged hawk
Buteo lineatus	red-shouldered hawk
Buteo jamaicensis	red-tailed hawk
Buteo platypterus	broad-winged hawk
Butorides striatus	green-backed heron
Calidris melanotos	pectoral sandpiper
Calidris minutilla	least sandpiper
Calidris pusilla	semipalmated sandpiper
Capella gallinago	common snipe
Caprimulgus carolinensis	Chuck-will's-widow
Caprimulgus vociferus	whip-poor-will
Cardinalis cardinalis	northern cardinal
Carduelis pinus	pine siskin
Carduelis tristis	American goldfinch
Carpodacus purpureus	purple finch
Casmerodius albus	great egret
Cathartes aura	turkey vulture
Catharus fuscescens	veery
Catharus guttatus	hermit thrush
Catharus minimus	gray-cheeked thrush
Catharus ustulatus	Swainson's thrush
Ceryle alcyon	belted kingfisher
Chaetura pelagica	chimney swift
Charadrius vociferus	killdeer
Chen caerulescens	snow goose
Chordeiles minor	common nighthawk
Circus cyaneus	northern harrier
Coccothraustes vespertinus	evening grosbeak
Coccyzus americanus	yellow-billed cuckoo
Coccyzus erythropthalmus	black-billed cuckoo
Colaptes avratus	northern flicker

Colinus virginianus	northern bobwhite
Columbia livia	rock dove
Contopus virens	eastern wood-pewee
Coragyps atratus	black vulture
Corvus brachyrhynchos	American crow
Corvus ossifragus	fish crow
Cyanocitta cristata	blue jay
Dendroica caerulea	cerulean warbler
Dendroica caerulescens	black-throated blue warbler
Dendroica castanea	bay-breasted warbler
Dendroica coronata	yellow-rumped warbler
Dendroica discolor	prairie warbler
Dendroica dominica	yellow-throated warbler
Dendroica fusca	blackburnian warbler
Dendroica magnolia	magnolia warbler
Dendroica palmarum	palm warbler
Dendroica pensylvanica	chestnut-sided warbler
Dendroica petechia	yellow warbler
Dendroica pinus	pine warbler
Dendroica striata	blackpoll warbler
Dendroica virens	black-throated green warbler
Dryocopus pileatus	pileated woodpecker
Dumetella carolinensis	grey catbird
Egretta caerulea	little blue heron
Empidonax alnorum	alder flycatcher
Empidonax minimus	least flycatcher
Empidonax traillii	willow flycatcher
Empidonax virescens	acadian flycatcher
Eremophila alpestris	horned lark
Euphagus carolinus	rusty blackbird
Falco sparverius	American kestrel
Fulica americana	American coot
Geothlypis trichas	common yellowthroat
Guiraca caerulea	blue grosbeak
Haliaectus leucocephalus	bald eagle
Helmitheros vermivorus	worm-eating warbler
Hirundo rustica	barn swallow
Hyocichla mustelina	wood thrush
Icteria virens	yellow-breasted chat
Icterus galbula	northern oriole
Icterus spurius	orchard oriole
Ictinia mississippiensis	Mississippi kite
Junco hyemalis	dark-eyed junco
Lanius ludovicianus	loggerhead shrike
Larus delawarensis	ring-billed gull

Limnthlypis swainsonii	Swainson's warbler
Lophodytes cucullatus	hooded merganser
Melanerpes carolinus	red-bellied woodpecker
Melanerpes erythrocephalus	red-headed woodpecker
Meleagris gallopavo	wild turkey
Melospiza georgiana	swamp sparrow
Melospiza lincolnii	Lincoln's sparrow
Melospiza melodia	song sparrow
Minus polyglottus	northern mockingbird
Mniotilta varia	black-and-white warbler
Molothrus ater	brown-headed cowbird
Myiarchus crinitus	great crested flycatcher
Nyctanassa violacea	yellow-crowned night heron
Olor columbianus	tundra swan
Oporornis formosus	Kentucky warbler
Oxyura jamaicensis	ruddy duck
Pandion haliaetus	osprey
Parula americana	northern parula
Parus bicolor	tufted titmouse
Parus carolinensis	Carolina chickadee
Passer domesticus	house sparrow
Passerella iliaca	fox sparrow
Passerina cyanea	indigo bunting
Pheucticus ludovicianus	rose-breasted grosbeak
Philohela minor	common snipe
Picoides pubescens	downy woodpecker
Picoides villosus	hairy woodpecker
Pipilo erythropthalmus	rufous-sided towhee
Podilymbus podiceps	pied-billed grebe
Polioptila caerulea	blue-gray gnatcatcher
Prianga olivacea	scarlet tanager
Prianga rubra	summer tanager
Progne subis	purple martin
Prothonotaria citres	prothonotary warbler
Quiscalus quiscula	common grackle
Regulus calendula	ruby-crowned kinglet
Regulus satrapa	golden-crowned kinglet
Sayornis phoebe	eastern phoebe
Seiurus aurocapillus	ovenbird
Seiurus motacilla	Louisiana waterthrush
Seiurus noveboracensis	northern waterthrush
Setophaga ruticilla	American redstart
Sialia sialis	eastern bluebird
Sitta carolinensis	white-breasted nuthatch
Sphyrapicus varius	yellow-bellied sapsucker

Spiza americana	dickcissel
Spizella arborea	American tree sparrow
Spizella passerina	chipping sparrow
Spizella pusilla	field sparrow
Stelgidopteryx ruficollis	northern rough-winged swallow
Sterna antillarum	least tern
Strix varia	barred owl
Sturnella magna	eastern meadowlark
Sturnus vulgaris	European starling
Tachycineta bicolor	tree swallow
Thryothorus ludovicianus	Carolina wren
Toxostoma rufum	brown thrasher
Tringa flavipes	lesser yellowlegs
Tringa melanoleuca	greater yellowlegs
Tringa solitaria	solitary sandpiper
Troglodytes aedon	house wren
Troglodytes troglodytes	winter wren
Turdus migratorius	American robin
Tyrannus tyrannus	eastern kingbird
Tyto alba	common barn owl
Vermivora celata	orange-crowned warbler
Vermivora chrysoptern	golden-winged warbler
Vermivora peregrina	Tennessee warbler
Vermivora pinus	blue-winged warbler
Vermivora ruficapilla	Nashville warbler
Vireo flavifrons	yellow-throated vireo
Vireo gilvus	warbling vireo
Vireo griseus	white-eyed vireo
Vireo olivaceus	red-eyed vireo
Vireo philadelphicus	Philadelphia vireo
Vireo solitarus	solitary vireo
Wilsonia canadensis	Canada warbler
Wilsonia citrina	hooded warbler
Wilsonia pusilla	Wilson’s warbler
Zenaida macroura	mourning dove
Zonotrichia albicollis	white-throated sparrow
Zonotrichia leucophrys	white-crowned sparrow

Source: U. S. Fish and Wildlife Service. 1990. Cypress Creek National Wildlife Refuge: environmental assessment. 236 p.

Appendix 8. Mammal Species

Mammal species found in the four counties (Union, Johnson, Alexander, and Pulaski) encompassing the Cache River Wetlands area, which includes the proposed Cache River Land and Water Reserve.

Scientific Name	Common Name
Blarina brevicauda	short-tailed shrew
Canis latrans	coyote
Castor canadensis	beaver
Cryptotis parva	least shrew
Didelphis virginiana	Virginia opossum
Eptesicus fuscus	big brown bat
Glaucomys volans	southern flying squirrel
Lasiurus borealis	red bat
Lasiurus cinereus	hoary bat
Lutra canadensis	river otter
Lynx rufus	bobcat
Marmota monax	woodchuck
Mephitis mephitis	striped skunk
Microtus pennsylvanicus	meadow vole
Mus musculus	house mouse
Mustela frenata	long-tailed weasel
Mustela vison	mink
Myotis austroriparius	southeastern bat
Myotis grisescens	gray bat
Myotis keenii	Keen's bat
Myotis licifugus	little brown bat
Myotis sodalis	Indiana bat
Neotoma floridana	eastern woodrat
Nycticeius humeralis	evening bat
Ochrotomys nuttalli	golden mouse
Odocoileus virginianus	white-tailed deer
Ondatra zibethicus	muskrat
Oryzomys palustris	rice rat
Peromyscus gossypinus	cotton mouse
Peromyscus leucopus	white footed mouse
Peromyscus maniculatus	deer mouse
Pipistrellus subflavus	eastern pipistrel
Pitymys pinetorum	woodland vole
Plecotus rafinesquii	southeastern big-eared bat
Procyon lotor	raccoon
Rattus norvegicus	Norway rat
Scalopus aquaticus	eastern mole
Sciurus carolinensis	eastern gray squirrel
Sciurus niger	eastern fox squirrel

Sorex longirostris	southeastern shrew
Sylvilagus aquaticus	swamp rabbit
Sylvilagus floridanus	eastern cottontail
Synaptomys cooperi	southern bog lemming
Tamias striatus	eastern chipmunk
Urocyon cinereoargenteus	grey fox
Vulpes vulpes	red fox
Zapus hudsonius	meadow jumping mouse

Source: U. S. Fish and Wildlife Service. 1990. Cypress Creek National Wildlife Refuge: environmental assessment. 236 p.

Appendix 9. Reptile and Amphibian Species

Reptile and amphibian species found in the four counties (Union, Johnson, Alexander, and Pulaski) encompassing the Cache River Wetlands area, which includes the proposed Cache River Land and Water Reserve.

Scientific Name	**Common Name**
Acris crepitans blanchardi	Blanchard's cricket frog
Agkistrodon contortrix mokasen	northern copperhead
Agkistrodon piscivorus leucostoma	western cottonmouth
Ambystoma maculatum	spotted salamander
Ambystoma opacum	marbled salamander
Ambystoma talpoideum	mole salamander
Ambystoma texanum	small-mouthed salamander
Ambystoma tigrinum tigrinum	tiger salamander
Bufo americanus charlesmithi	drawf American toad
Bufo woodhousii fowleri	Fowler's toad
Carphophis amoenus	worm snake
Chelydra serpentina	common snapping turtle
Chrysemys picta marginata	midland painted turtle
Cnemidophorus sexlineatus sexlineatus	six-lined racerunner
Coluber constrictor flaviventris	blue racer
Crotalus horridus	timber rattlesnake
Desmognathus fuscus	dusky salamander
Diadophis punctatus subsp.	ringneck snake
Elaphe obsoleta spiloides	gray rat snake
Eumeces fasciatus	five-lined skink
Eumeces laticeps	broad-headed skink
Eurycea longicauda longicauda	long-tailed salamander
Eurycea lucifuga	cave salamander
Farancia abacura reinwardtii	western mud snake
Heterodon platirhinus	eastern hognose snake
Hyla avivoca	bird-voiced treefrog

Hyla cinerea	green treefrog
Hyla versicolor	gray treefrog
Kinosternon subrubrum subrubrum	eastern mud turtle
Lampropeltis getulus subsp.	kingsnake
Nerodia erythrogaster nelglecta	copperbelly water snake
Nerodia rhombifera rhombifera	diamond-backed water snake
Nerodia sipedon pleuralis	midland-water snake
Notophthalmus viridescens louisianensis	red-spotted newt
Opheodrys aestivus	rough green snake
Plethodon glutinosus	slimy salamander
Pseudacris crucifer	spring peeper
Pseudacris feriarun feriarun	upland chorus frog
Pseudacris streckeri	Strecker's chorus frog
Rana areolata circulosa	gopher frog
Rana clamitans melanota	green frog
Rana sphenocephala	southern leopard frog
Scaphiopus holbrookii	eastern spadefoot
Sceloporus undulatus hyacinthinus	northern fence lizard
Scincella lateralis	ground skink
Siren intermedia nettingi	western lesser siren
Sternotherus odoratus	stinkpot
Terrapene carolina carolina	eastern box turtle
Thamnophis sauritus subsp. *septentrionalis*	eastern ribbon snake
Thamnophis sirtalis sirtalis	eastern garter snake
Trachemys scripta elegans	red-eared turtle
Trionyx spinirferus spiniferus	eastern spiny softshell
Virginia valeriae elegans	western earth snake

Source: U. S. Fish and Wildlife Service. 1990. Cypress Creek National Wildlife Refuge: environmental assessment. 236 p.