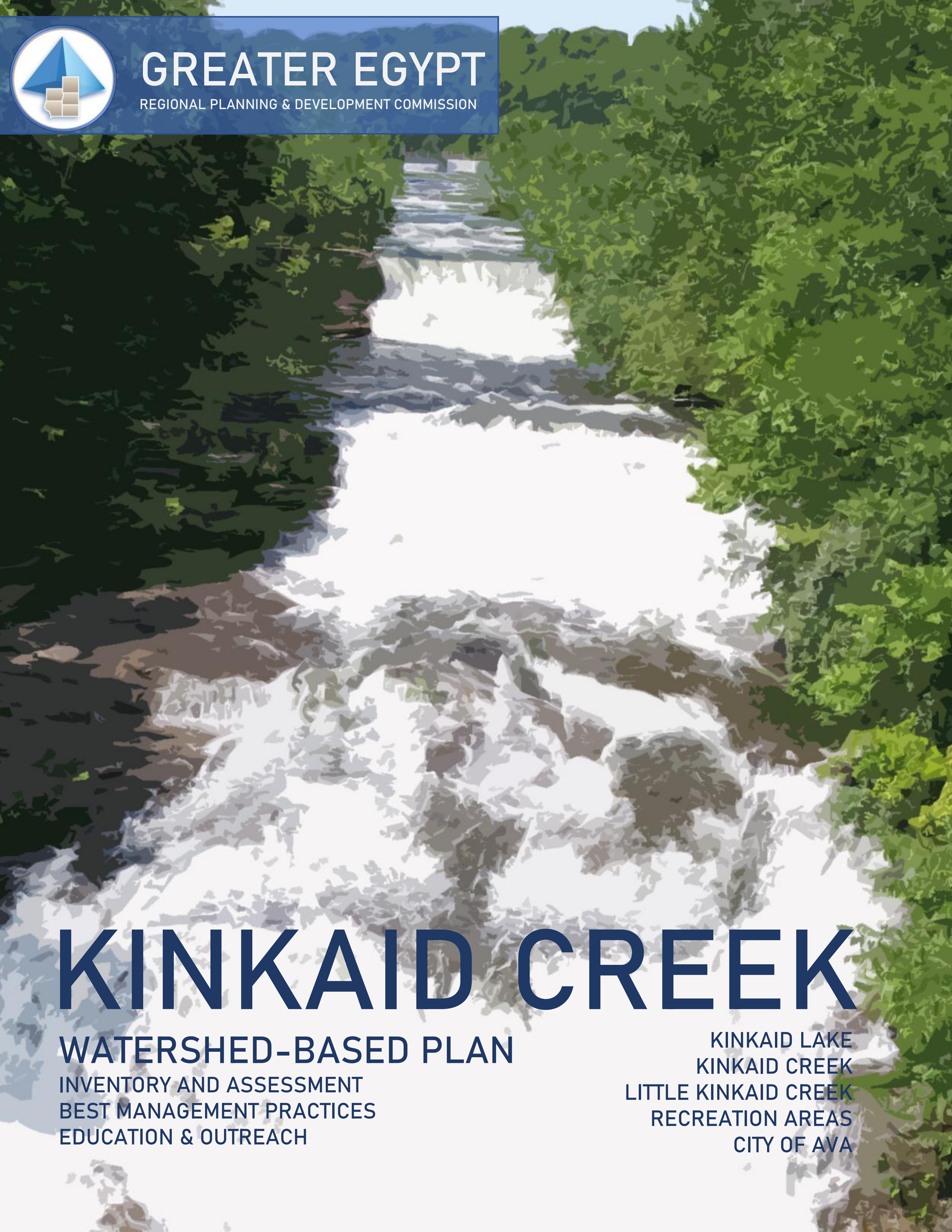

GREATER EGYPT
REGIONAL PLANNING & DEVELOPMENT COMMISSION

KINKAID CREEK

WATERSHED-BASED PLAN

INVENTORY AND ASSESSMENT
BEST MANAGEMENT PRACTICES
EDUCATION & OUTREACH

KINKAID LAKE
KINKAID CREEK
LITTLE KINKAID CREEK
RECREATION AREAS
CITY OF AVA

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GERPDC- 2022 - 1171

Acknowledgements

Funding for this project provided, in part, by the Illinois Environmental Protection Agency through Section 604(b) of the Clean Water Act.

The authors would like to acknowledge the following individuals, groups and agencies for providing knowledge and materials for the completion of this report:

The Illinois Environmental Protection Agency (IEPA), U.S. Environmental Protection Agency, Illinois State Geological Survey, University of Illinois, Southern Illinois University- Carbondale, U.S. Forest Service, Illinois Department of Natural Resources, Jackson County Soil and Water Conservation District, Jackson County Farm Bureau, USDA- NRCS, Kinkaid-Reeds Creek Conservancy District, HMG Engineers, Kinkaid Area Watershed Project, and Kinkaid Creek Watershed landowners and businesses.

Pictured on cover: Kinkaid Lake Spillway (photo by Greater Egypt)

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Acronyms and Abbreviations

ACS	American Community Survey
AISWCD	Association of Illinois Soil and Water Conservation Districts
AMA	Agricultural Management Assistance Program
BOD	Biochemical Oxygen Demand
CSP	Conservation Stewardship Program
CTA	Conservation Technical Assistance Program
CWA	Clean Water Act
DOI	Department of the Interior
EPA	Environmental Protection Agency
EMA	Emergency Management Agency
EQIP	Environmental Quality Incentives program
HAB	Harmful Algal Bloom
HUC	Hydrologic Unit Code
ICN	Illinois Climate Network
IDNR	Illinois Department of Natural Resources
IEPA	Illinois Environmental Protection Agency
ILNLRS	Illinois Nutrient Loss Reduction Strategy
ISGS	Illinois State Geological Survey
JCHD	Jackson County Health Department
LRR	Lateral Recession Rate
MCL	Maximum Contaminant Level
MLCG	Maximum Contaminant Level Goal
MRLC	Multi-Resolution Land Characteristics Consortium
MS4	Municipal Separate Storm Sewer Systems
NFIP	National Flood Insurance Program
NHD	National Hydrography Dataset
NOAA	National Oceanic and Atmospheric Agency
NPDES	National Pollutant Discharge Elimination System
NRCS	Natural Resource Conservation Service
NWI	National Wetland Inventory
PCB	Polychlorinated Biphenyl
RMMS	Resource Management Mapping Service
RUSLE	Revised Universal Soil Loss Equation
SMU	Subwatershed Management Unit
STEPL	Spreadsheet Tool for Estimating Pollutant Loads
SWCD	Soil and Water Conservation Districts
SWPPP	Stormwater Pollution Prevention Plan
TSS	Total Suspended Solids
UAS	Unmanned Aircraft System
USACE	United States Army Corps of Engineers
USDA	United States Department of Agriculture
USFWS	United States Fish and Wildlife Service
USGS	United States Geological Survey
USLE	Universal Soil Loss Equation
VLMP	Volunteer Lake Monitoring Program

Executive Summary

Beginning in the latter part 2019, the Greater Egypt Regional Planning and Development Commission (Greater Egypt) was contracted by the Illinois Environmental Protection Agency (IEPA) to develop a watershed-based plan for the Kinkaid Creek watershed under Clean Water Act Section 604(b) funding.

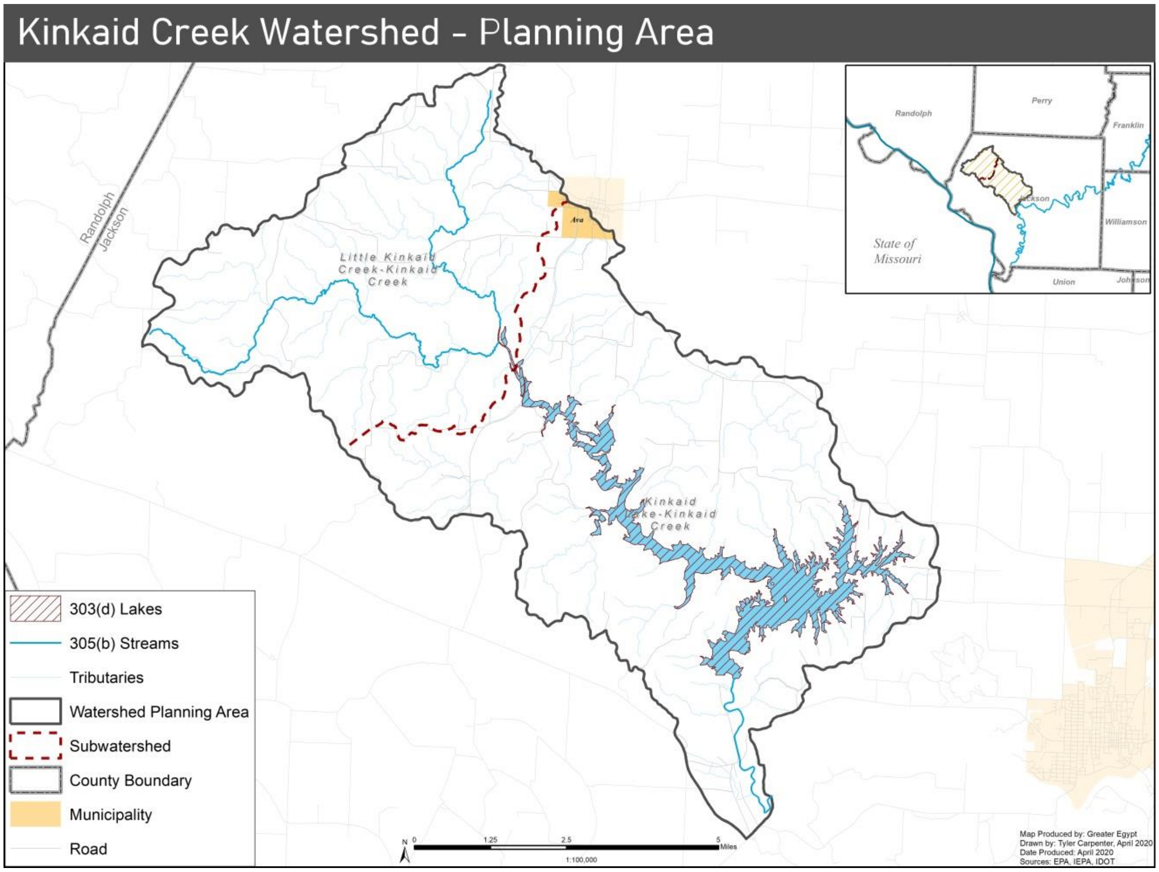
The Kinkaid Creek watershed encompasses nearly 41,225 acres, or roughly sixty-four square miles, and is located in Jackson County, Illinois. It is part of the larger Big Muddy River watershed. The only municipality in the planning area is a small portion of the Village of Ava.

One waterbody in the watershed has been placed on the Illinois Environmental Protection Agency's 303(d) List of Impaired Waters. This list is comprised of waterbodies that do not meet water quality standards. Kinkaid Lake (IL_RNC) has been placed on the list for impairments from mercury. The impaired designated use for mercury is fish consumption.

Following the submission of the *Kinkaid Creek Watershed Inventory and Assessment*, an initial stakeholder meeting was held in 2020 to gain awareness of planning efforts, and to garner membership for the Kinkaid Creek Watershed Planning Committee. The group convened on a quarterly basis and provided guidance throughout the plan. This included discussing existing knowledge of the watershed and suggesting best management practices (BMP) for the plan. The success of the plan relies heavily on the continuation of public involvement. This includes overseeing implementation of the plan and monitoring progress.

Land use in the watershed is represented by large areas of agriculture and forest. Forested areas in the watershed compose over sixty percent of the total land cover (25,300 acres). Pasture/Hay represents 17.6 percent of the land area (7,260 acres) while Cultivated Crops makes up nearly ten percent at 4,050 acres. Open water in the watershed comprises six percent of the land area (2,500 acres).

Figure I - Planning Area



While impervious surfaces in the watershed are low, the Ava and marina areas constitute the largest portion of the watershed's impervious network. The watershed exhibits around four percent of imperviousness features (10 % or more impervious surface).

The Spreadsheet Tool for Estimating Pollutant Loads (STEPL) was utilized to generate existing pollutant loads for the Kinkaid Creek watershed and its subwatersheds. While the program produces general estimates, the baseline data was generated from multiple factors including: land use, climatic indicators, agriculture, septic rates, urban runoff, and streambank erosion using lateral recession rates. In the Kinkaid Creek watershed, estimated pollutant loads are influenced heavily by agricultural areas (see *Table I*).

Table I - Existing Pollutant Loads

Sources	N Load (lb/yr)	Percent of Total N Load	P Load (lb/yr)	Percent of Total P Load	Sediment Load (t/yr)	Percent of Total Sediment Load
Urban	11,832.86	5.95%	1,820.87	4.39%	271.96	0.77%
Cropland	43,772.39	22.02%	13,645.37	32.90%	9,265.99	26.36%
Pastureland	46,777.47	23.54%	6,789.55	16.37%	3,307.70	9.41%
Forest	7,370.98	3.71%	33,52.98	8.08%	903.57	2.57%
Streambank	34,245.29	17.23%	13,184.43	31.79%	21,405.90	60.89%
Groundwater	54,740.79	27.54%	26,81.41	6.47%	0.00	0.00%
Total	**198,739.78**	**-**	**41,474.60**	**-**	**35,155.11**	**-**

Pollutant load reduction targets were also generated for major pollutants. A reduction of nitrogen at fifteen percent, phosphorus at twenty-five percent, and sediment reduction of twenty-five percent were calculated for the plan. Target goals are consistent with the Illinois Nutrient Loss Reduction Strategy (ILNLRS).

To achieve the target goals, BMPs were suggested in regards to the major nutrient contributor in the watershed, agricultural practices. While the plan addresses watershed-wide practices, site-specific BMPs have also been established to manage agricultural pollutants and other impairments on a localized level.

These management efforts confront the impairments of the various waterbodies in the Kinkaid Creek watershed. Some of the measures include: streambank stabilization, agricultural filter strips, and grassed waterways. They have also been categorized by priority based on feasibility, cost, and pollutant load reductions.

The plan incorporates the nine minimum elements required of a watershed-based plan. These elements include: a characterization of the watershed through a resource inventory and assessment to identify nonpoint source pollution, identification of management measures to address those pollutants, identifying funding and technical assistance, an educational component, and a monitoring and evaluation component to track progress and monitor accomplishments.

Funding will mainly be established through EPA Clean Water Act Section 319 grants. Most of the BMPs in the plan are eligible to receive funding through this grant source since their function is the reduction of nonpoint source pollution.

Outreach and education of watershed-related activities are important in promoting awareness of the plan and progression of plan implementation. Some of the outreach components include: holding public meetings, distributing flyers about the plan and agricultural activities, and locating volunteers for litter and debris cleanups.

Implementation of the plan is divided into three phases. Phase I represents the first two years of the plan where most educational and outreach component are implemented; along with selecting site-specific BMPs for grant funding. Phase II will require the watershed action committee to continue submitting grants and starting implementation of BMPs. Phase III represents the last four years of the planning period in which BMP implementation will continue and evaluating the plan will begin.

Interim measurable milestones, water quality benchmarks, and a monitoring component have also been established to track progress and evaluate the success of the plan. Table *II* represents the water quality benchmarks in the plan which focuses on nitrogen, phosphorus, and sediment.

Table II - Water Quality Benchmarks

	Benchmark Reduction Targets					
Benchmark Period	**Nitrogen (percent)**	**Nitrogen (lbs)**	**Phosphorus (percent)**	**Phosphorus (lbs)**	**Sediment (percent)**	**Sediment (tons)**
2 Year (Phase I)	-	-	-	-	-	-
6 Year (Phase II)	7	139,118	10	41,475	10	35,155
10 Year (Phase III)	15	298,110	25	103,688	25	87,888

The monitoring component of the plan features programs offered by IEPA and the Illinois Department of Natural Resources (IDNR). The Ambient Water Quality Monitoring Network (AWQMN) and the Intensive River Basin Surveys are both ways in which water quality can be tested. Results will be analyzed by the watershed action committee to determine success of BMP implementation and the plan itself.

1. Introduction

A watershed is a drainage basin where all water flows into from surrounding elevated lands. Precipitation and runoff drain to a waterbody, usually a lake or stream, which centralizes all flow of the watershed. Watersheds can range from regional land areas that span states to smaller basins that are encompassed within counties. Watershed size is classified by Hydrologic Unit Codes (HUC) which range from 2 (regional) to 12 (subwatershed).

Watershed-based plans provide a framework for improving water quality in a specific watershed. They are often designed to reduce pollutants from nonpoint sources and identify other components that impair water quality. These plans include a characterization of the watershed through a resource inventory and assessment to identify nonpoint source pollution, identification of best management practices (BMPs) to address those sources, and a monitoring and evaluation component to track progress and monitor accomplishments.

One waterbody in the Kinkaid Creek watershed has been placed on Illinois Environmental Protection Agency's 303(d) List of Impaired Waters. This list is comprised of waterbodies that do not meet water quality standards. In particular, Kinkaid Lake (IL_RNC) has been placed on the list because of the mercury impairment.

Watershed-based planning focuses on collaboration among stakeholders and local decision makers. Early in the planning process, an initial stakeholders meeting took place to explain the process of watershed-based planning and gather members for the Kinkaid Creek Watershed Planning Committee. This group met on a quarterly basis to oversee the planning process.

Watershed-based plans must follow guidelines set forth by the U.S. Environmental Protection Agency (EPA). To be successful, watershed-based plans need to include the Nine Minimum Elements of a Watershed-based Plan.[1] The components, information and location within this plan are as follows:

[1] U.S. Environmental Protection Agency, "Appendix C- Minimum Elements of a Watershed-based Plan," in *Nonpoint Source Program and Grants Guidelines for States and Territories* (Washington D.C., 2013.), 63-68.

1. **<u>Element A-</u>** ***Identify causes and sources of pollution.***

   This was completed through an inventory and assessment of the Kinkaid Creek Watershed. The inventory includes a characterization of the watershed including details on: boundaries, geology and climate, soils, jurisdictions, demographics, and land use. It also includes an assessment of waterbodies and water quality which identifies sources of pollution in the watershed. (Section 2)

2. **<u>Element B-</u>** ***Estimate load reductions expected from best management practices.***

   Pollutant load reduction targets were created to meet water quality goals. The load reduction goals for the Kinkaid Creek Watershed-based Plan follow the statewide goals established in the Illinois Nutrient Loss Reduction Strategy. (Sections 2 & 5)

3. **<u>Element C-</u>** ***Describe the nonpoint source best management practices that meet pollutant load reductions.***

   To achieve the load reduction targets, BMPs have to be implemented. A description of each BMP type has been provided in the plan. Information for watershed-wide and site-specific BMPs has also been provided. This includes: location, load reductions, amount, unit, and priority. (Section 5)

4. **<u>Element D-</u>** ***Identify the technical and financial assistance needed to implement the plan.***

   Costs and work associated with the technical and financial assistance have been calculated for each management measure in the plan. Grant funding opportunities and cost match notes for each BMP have also been identified. (Section 6)

5. **<u>Element E-</u>** ***Develop an information and education component.***

   An outreach and educational components were created to gain public involvement which can promote the strategies and implementation measures in the plan. Various activities have been included to inform the public on: watershed planning, BMPs, and nonpoint source pollution. (Section 7)

6. **<u>Element F-</u>** ***Develop a schedule for implementing the nonpoint source best management practices in the plan.***

   A schedule was developed that outlines the BMPs, educational components, and other strategies in the plan. (Section 8.1)

7. **<u>Element G-</u>** ***Describe interim measurable milestones to monitor management measures in the plan.***

   Milestones are to be addressed for each BMP in the plan. These milestones are also developed for the outreach components and other strategies. Milestones were separated by phases throughout the planning period. (Section 8.2)

8. **<u>Element H-</u>** ***Develop criteria to measure progress of loading reductions through management measures.***

   These benchmarks signify whether BMP and other management measures are successful in reducing pollutant loads and are leading to water quality standards. (Section 9.1)

9. **<u>Element I-</u>** ***Develop a monitoring component that evaluates the efficacy of management measures.***

   Elements in the monitoring component determine whether loading reductions are being met and water quality standards are being achieved. (Section 9.2)

The Kinkaid Creek Watershed-based Plan incorporates all of these elements in an effort to reduce pollutant loads and improve water quality within the watershed. The success of the plan largely depends on the collaboration of stakeholders and local officials to implement and oversee the plan's development.

Figure 1.1 - Kinkaid Lake

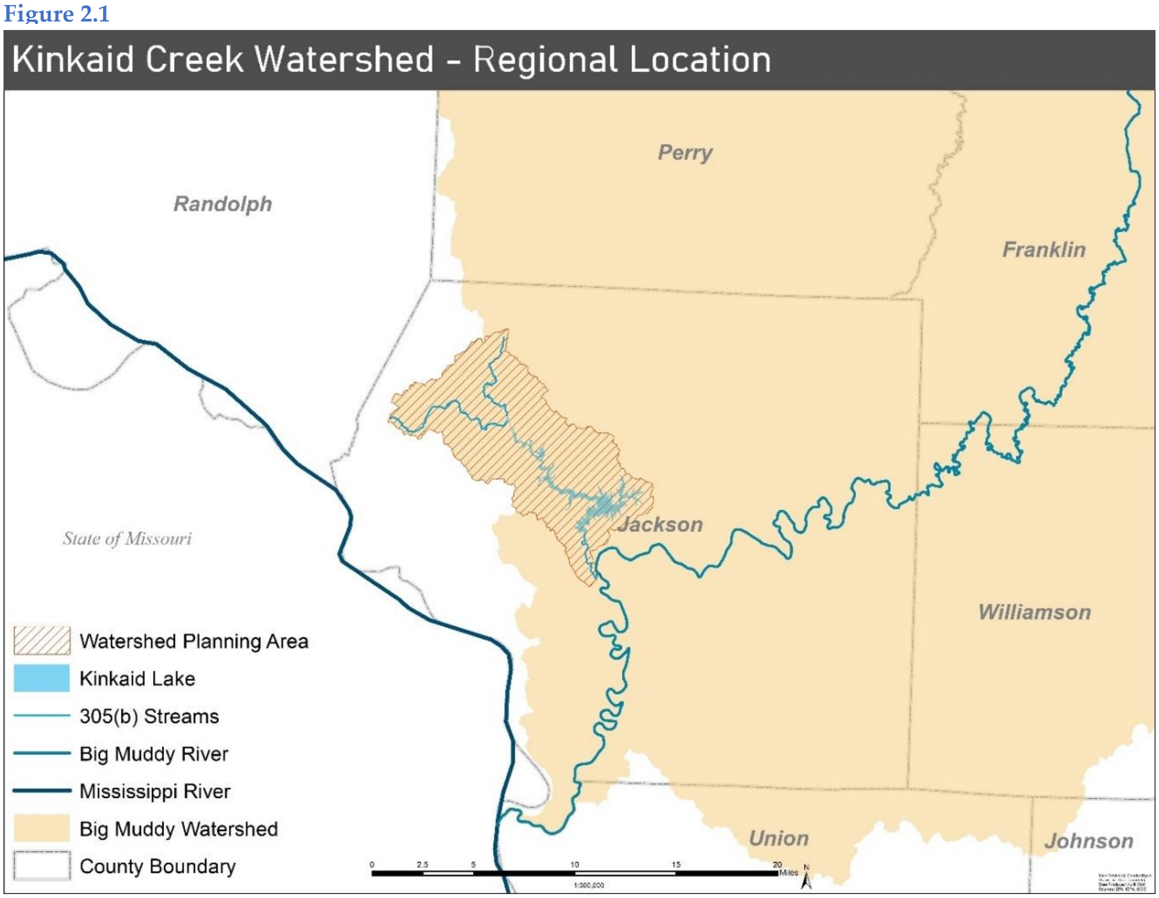
2. Watershed Inventory and Assessment

2.1. Watershed Geography & Climate

2.1.1. ***Geography***

The Kinkaid Creek watershed is a collective area encompassing two individual Hydrologic Unit Code (HUC) 12 subwatersheds. This includes Little Kinkaid Creek-Kinkaid Creek (071401061101) and Kinkaid Lake- Kinkaid Creek (071401061102). The two subwatersheds comprise the HUC 10- Kinkaid Creek watershed (0714010611). This report will reference the cumulative watershed as the Kinkaid Creek watershed, and planning, or study area. The planning area encompasses 41,225 acres, or around sixty-four square miles. *Figure 2.1* displays the study area and major regional waterbodies.

Figure 2.1



The planning area is located in Jackson County, Illinois. The headwaters of Kinkaid Creek watershed, which is represented by Drury Creek to the south, originates roughly four miles northeast of the Village of Rockwood in Randolph County, Illinois. Kinkaid Creek, converging with Little Kinkaid Creek and discharging through the spillway at Kinkaid Lake, meets at the confluence of the Big Muddy River to the south. The planning area is located approximately 4.5 miles west of the City of Murphysboro.

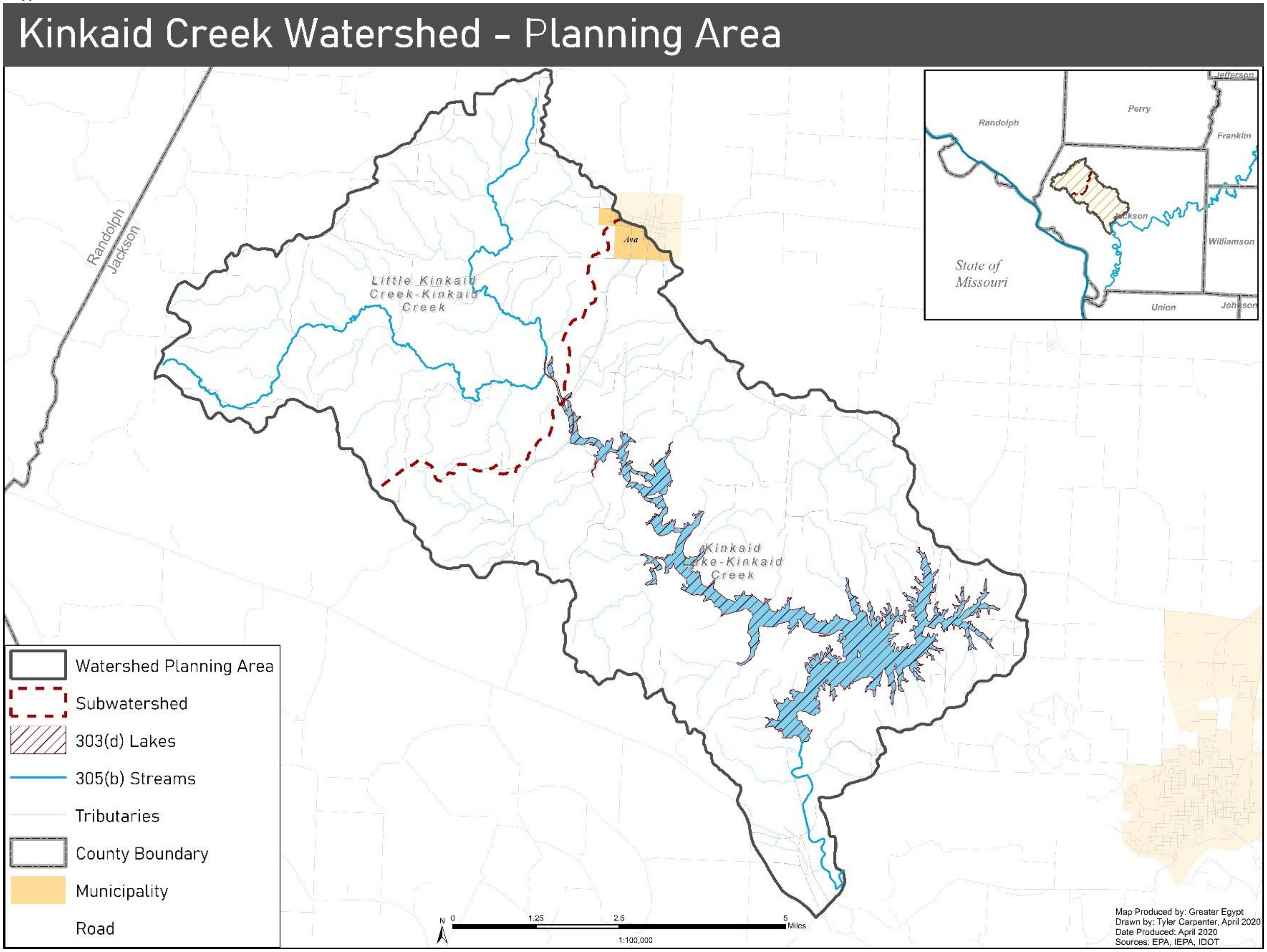
All waterbodies in the planning area eventually flow to the Big Muddy River. This river makes a winding course through Jackson County in a southwest direction eventually discharging into the Mississippi River.

The Kinkaid Creek watershed is generally bound to the north by the Village of Campbell Hill, to the east by Lake Murphysboro State Park, to the south by the Big Muddy River, and to the west by Hog Hill Road.

Only one municipality is located in the watershed planning area: the City of Ava. With a population of 650, the city is similar to other smaller municipalities in southern Illinois. *Figure 2.3* displays the planning area.

Figure 2.2- Kinkaid Lake Spillway- North Facing

Figure 2.3


Kinkaid Creek Watershed - Planning Area
Randolph
Jackson
Little Kinkaid Creek-Kinkaid Creek
Ava
Kinkaid Lake-Kinkaid Creek
Randolph
Perry
Jefferson
Franklin
Jackson
Williamson
State of Missouri
Union
Johnson
Watershed Planning Area
Subwatershed
303(d) Lakes
305(b) Streams
Tributaries
County Boundary
Municipality
Road
0
1.25
2.5
5
Miles
1:100,000
Map Produced by: Greater Egypt
Drawn by: Tyler Carpenter, April 2020
Date Produced: April 2020
Sources: EPA, IEPA, IDOT

2.1.2. ***Location of Water Bodies***

The Kinkaid Creek watershed lies on the divide between the Ohio and Mississippi River basins. There are three major waterbodies in the watershed, as identified in the National Hydrography Dataset (NHD). This includes two streams and a single lake.

Kinkaid Creek and Little Kinkaid Creek are listed on the Illinois Environmental Protection Agency's (IEPA) 305(b) Report which outlines uses and designations for the waterbodies. While being on the 305(b) List, Kinkaid Lake is also listed on IEPA's 303(d) List of Impaired Waters as identified in the 2016 Integrated Water Quality Report. [2] These waterbodies are displayed in *Figure 1.3.*

Kinkaid Creek (IL_NB) meanders 9.7 miles in an easterly direction; flowing into the western point of Kinkaid Lake. The creek continues its course beyond the Kinkaid Lake spillway, traveling another 3.4 miles in a southerly direction before converging with the Big Muddy River. This reach of Kinkaid Creek is referred to as IL_NB-01. According to the 2016 Integrated Report, this reach fully supports aquatic life, primary, and secondary contact.[3] Little Kinkaid Creek (IL_NBA) runs 6.4 miles in a southerly direction before ending at the confluence of Kinkaid Creek and Kinkaid Lake.

Kinkaid Lake (IL_RNC) is one of the largest lakes in Illinois and is listed as an IEPA 303(d) impaired waterbody for mercury. While Kinkaid Lake is a large source of recreation, it also serves as a water source for local communities through the Kinkaid Area Water System.

Wetlands are also a prominent feature throughout the study area. According to the U.S. Fish and Wildlife Service's National Wetlands Inventory (NWI), there are five classifications of wetlands identified in the Kinkaid Creek watershed: freshwater emergent, freshwater forested/ shrub, freshwater pond, lake, and riverine. *Table 1.1* contains information on the distribution of wetlands for the planning area and subwatershed. The lake classification is the most apparent wetland type in the planning area consisting of 2,355 acres, or accounting for nearly six percent of the entire watershed. Wetlands have also been displayed in *Figure 2.4.*

---

[2] Illinois Environmental Protection Agency. *Illinois Integrated Water Quality Report and Section 303(d) List- Volume1: Surface Water- 2-16, Appendix B-2. Specific Assessment Information for Streams, 2016*. PDF. Accessed 2019-2020.

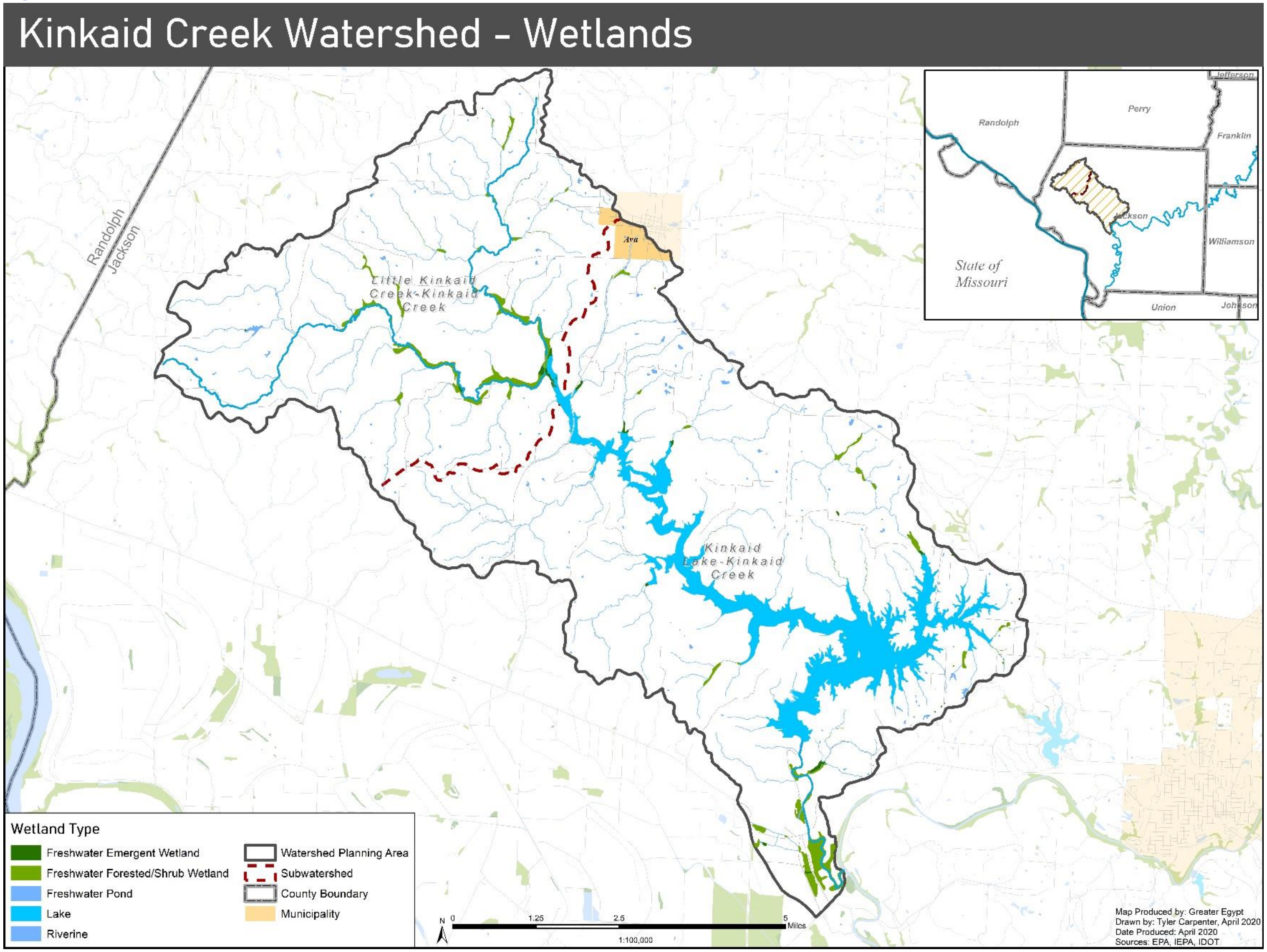
[3] Ibid.

Table 2.1- Distribution of Wetlands

Kinkaid Creek Watershed			
Wetland Type	Acres	Percent of Wetland Total	Percent of Total Watershed Area
Freshwater Emergent	48.63	1.40%	0.12%
Freshwater Forested/ Shrub	603.34	17.40%	1.46%
Freshwater Pond	121.45	3.50%	0.29%
Lake	2354.64	67.91%	5.71%
Riverine	339.40	9.79%	0.82%
Little Kinkaid Creek- Kinkaid Creek Subwatershed (071401061101)			
Freshwater Emergent	19.97	0.58%	0.05%
Freshwater Forested/ Shrub	302.36	8.72%	0.73%
Freshwater Pond	40.41	1.17%	0.10%
Lake	37.96	1.09%	0.09%
Riverine	165.68	4.78%	0.40%
Kinkaid Lake- Kinkaid Creek Subwatershed (071401061102)			
Freshwater Emergent	28.66	0.83%	0.07%
Freshwater Forested/ Shrub	300.98	8.68%	0.73%
Freshwater Pond	81.04	2.34%	0.20%
Lake	2316.68	66.81%	5.62%
Riverine	173.72	5.01%	0.42%

Source: U.S. Fish and Wildlife Service National Wetlands Inventory

Figure 2.4


Kinkaid Creek Watershed - Wetlands
Randolph
Jackson
Little Kinkaid Creek-Kinkaid Creek
Ava
Kinkaid Lake-Kinkaid Creek
Randolph
Perry
Franklin
Jackson
Williamson
State of Missouri
Union
Johnson
Jefferson
Wetland Type
Freshwater Emergent Wetland
Freshwater Forested/Shrub Wetland
Freshwater Pond
Lake
Riverine
Watershed Planning Area
Subwatershed
County Boundary
Municipality
0 1.25 2.5 5 Miles
1:100,000
Map Produced by: Greater Egypt
Drawn by: Tyler Carpenter, April 2020
Date Produced: April 2020
Sources: EPA, IEPA, IDOT

2.1.3. ***Topography***

The Kinkaid Creek watershed is situated approximately three miles north of the southern limit of the glacial till from the Illinoisan age. The planning area features a major variance in slope. This is most evident in the Kinkaid Lake subwatershed. The subwatershed exhibits the most elevated terrain at 785 feet. Its highest elevation occurs at the western reach of Johnson Creek.

The general topography of the planning area is consistent with the surrounding watersheds of southern Illinois. *Figure 2.5* displays the elevation and floodplain of the watershed. The lowest elevation is found in the southern section below the spillway of Kinkaid Lake subwatershed at the confluence of the Big Muddy River; approximately 330 feet. The watershed features an elongated shape with a mostly dendritic drainage pattern.

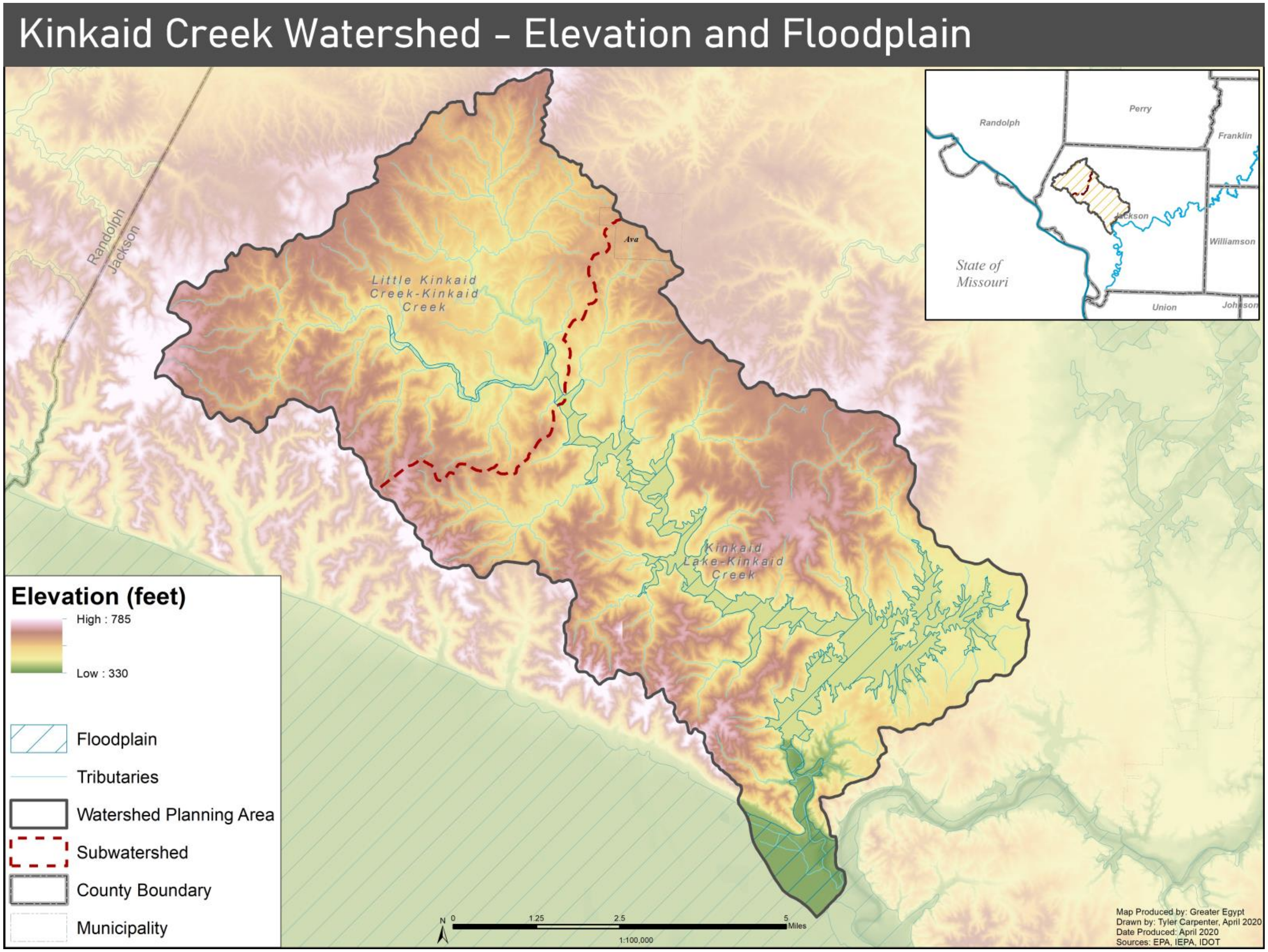
Approximately 9.4 percent (3,894 acres) of the watershed is in the floodplain. Floodplain information can be found in *Table 2.2*. Most of the floodplain is located in the Kinkaid Lake subwatershed (95 %); being represented by Kinkaid Lake.

Table 2.2- Floodplain Distribution by Subwatershed

Kinkaid Floodplain Distribution				
Watershed	Acres	Percent of Total Floodplain	Percent of Subwatershed	Percent of Total Watershed
Kinkaid Creek Watershed	3893.5	100.00%	-	9.44%
Little Kinkaid Creek	210.32	5.40%	1.35%	0.51%
Kinkaid Lake	3683.18	94.60%	14.33%	8.93%

Source: ISWS, ISGS

Figure 2.5


Kinkaid Creek Watershed - Elevation and Floodplain
Randolph
Jackson
Little Kinkaid Creek-Kinkaid Creek
Ava
Kinkaid Lake-Kinkaid Creek
Randolph
Perry
Franklin
Jackson
Williamson
State of Missouri
Union
Johnson
Elevation (feet)
High : 785
Low : 330
Floodplain
Tributaries
Watershed Planning Area
Subwatershed
County Boundary
Municipality
0
1.25
2.5
5
Miles
1:100,000
Map Produced by: Greater Egypt
Drawn by: Tyler Carpenter, April 2020
Date Produced: April 2020
Sources: EPA, IEPA, IDOT

*2.1.4. **Subwatersheds and Subwatershed Management Units (SMU)***

Kinkaid Creek watershed, specifically the HUC 12 subwatersheds, have been delineated further into nineteen smaller subwatershed management units (SMU). Along with the HUC 12 subwatersheds, each SMU will be examined individually in this inventory and assessment. Each subbasin was delineated based on the drainage patterns and the direction of flow of tributaries in the watershed.

A unique identifier (HUC 14 code) was assigned to each subwatershed management unit for classification. Each SMU was also assigned a name. This information can be found in *Table 1.3* and illustrated in *Figure 1.6.* This table also provides acreage and the major tributary found within each unit. Detailed information for the subwatersheds can be found in later chapters.

Little Kinkaid Creek- Kinkaid Creek Subwatershed (071401061101)

With 15,534 acres, the Little Kinkaid Creek- Kinkaid Creek subwatershed (Little Kinkaid Creek) is the smaller of the two subwatersheds in the planning area. Four SMUs are located within the Little Kinkaid Creek subwatershed boundary. At 5,466 acres, the Upper Kinkaid Creek SMU is the largest in area. Kinkaid Creek (IL_NB) originates in this SMU and runs in an easterly direction through the Middle Kinkaid Creek SMU.

The subwatershed mainly consists of deciduous forest (54.6%) and pasture/hay (26.5%) land use classifications. Developed areas only account for approximately 3.5 percent of the subwatershed total. Since development in the Little Kinkaid Creek subwatershed is limited, the number of impervious surfaces is also lower than other HUC 12 subwatersheds in the planning area. Ninety-six percent of the Little Kinkaid Creek subwatershed exhibits no impervious features.

While there are no impairments in the subwatershed, Kinkaid and Little Kinkaid Creeks have been assessed through the 305(b) program. These waterbodies are also examined in the assessment and water quality sections of this report.

Table 2.3- Subwatershed Management Unit Information

MAP ID	SUBWATERSHED MANAGEMENT UNIT NAME	ACRES	HUC 14 CODE	MAJOR WATERBODY
Kinkaid Lake- Kinkaid Creek Subwatershed (071401061102)				
1	Lower Kinkaid Creek	1,946.19	07140106110201	Kinkaid Creek
2	Heiple	743.05	07140106110202	Unnamed Tributary
3	Smaller Shawnee	938.4	07140106110203	Unnamed Tributary
4	Kinkaid Lake - Central Body	3,722.04	07140106110204	Kinkaid Lake
5	Kinkaid Lake - East	1,349.20	07140106110205	Kinkaid Lake
6	Lone Oak	2,028.28	07140106110206	Unnamed Tributary
7	Ash	540.66	07140106110207	Unnamed Tributary
8	Kinkaid Lake - Central Channel	2,679.94	07140106110208	Kinkaid Lake
9	Lakeside	566.94	07140106110209	Unnamed Tributary
10	Larger Shawnee	2,014.95	07140106110210	Unnamed Tributary
11	Campground	2,086.01	07140106110211	Unnamed Tributary
12	Kinkaid Lake - Northwest	1,716.22	07140106110212	Kinkaid Lake
13	Johnson Creek	2,727.65	07140106110213	Johnson Creek
14	Sharp Rock	953.54	07140106110214	Unnamed Tributary
15	Spring Creek	1,695.18	07140106110215	Spring Creek
Little Kinkaid Creek- Kinkaid Creek Subwatershed (071401061101)				
16	Middle Kinkaid Creek	2,979.79	07140106110101	Kinkaid Creek
17	Lower Little Kinkaid Creek	2,166.74	07140106110102	Little Kinkaid Creek
18	Upper Kinkaid Creek	5,466.30	07140106110103	Kinkaid Creek
19	Upper Little Kinkaid Creek	4,921.14	07140106110104	Little Kinkaid Creek

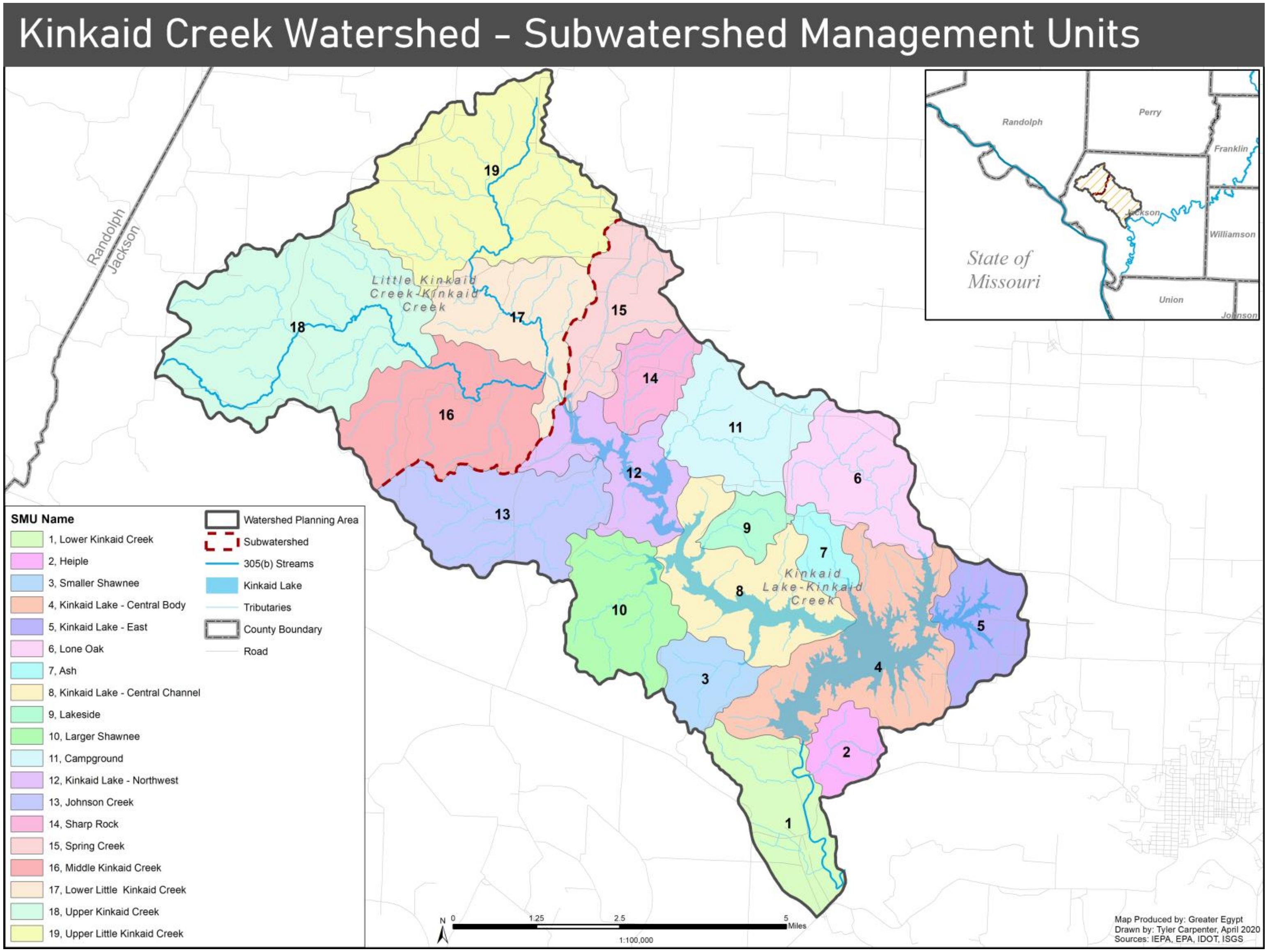
Kinkaid Lake - Kinkaid Creek Subwatershed (071401061102)

At 25,708 acres, the Kinkaid Lake- Kinkaid Creek subwatershed (Kinkaid Lake) is represented by fifteen subwatershed management units. The subwatershed features Kinkaid Lake which is located on the IEPA 303(d) List of Impaired Waters for mercury. Kinkaid Creek also continues past the lake's spillway, ending at the confluence of the Big Muddy River.

The Kinkaid Lake subwatershed features a similar land use composition to the Kinkaid Creek subwatershed with the exception of open water. Because of its large size, Kinkaid

Lake accounts for most of the open water category at nine percent of the subwatershed. Deciduous forest accounts for sixty percent of the total land use acreage, or 15,322 acres.

Figure 2.6



Kinkaid Creek Watershed - Subwatershed Management Units
SMU Name
1, Lower Kinkaid Creek
2, Heiple
3, Smaller Shawnee
4, Kinkaid Lake - Central Body
5, Kinkaid Lake - East
6, Lone Oak
7, Ash
8, Kinkaid Lake - Central Channel
9, Lakeside
10, Larger Shawnee
11, Campground
12, Kinkaid Lake - Northwest
13, Johnson Creek
14, Sharp Rock
15, Spring Creek
16, Middle Kinkaid Creek
17, Lower Little Kinkaid Creek
18, Upper Kinkaid Creek
19, Upper Little Kinkaid Creek
Watershed Planning Area
Subwatershed
305(b) Streams
Kinkaid Lake
Tributaries
County Boundary
Road
Little Kinkaid Creek-Kinkaid Creek
Kinkaid Lake-Kinkaid Creek
Randolph
Jackson
Perry
Franklin
Williamson
Union
Johnson
State of Missouri
0 1.25 2.5 5 Miles
1:100,000
Map Produced by: Greater Egypt
Drawn by: Tyler Carpenter, April 2020
Sources: IEPA, EPA, IDOT, ISGS

2.1.5. *Climate*

The climate in the Kinkaid Creek Watershed Planning area borders the humid subtropical and humid continental climates. Weather in the region is influenced by warm air from the gulf, cold dry air from Canada, and eastward air from the southwest. The terrain has little impact on the climate.[4]

Temperatures in the region can vary significantly due to the effects of warm gulf air from the south and cold Canadian air. Local temperature data was taken from the NOAA weather station located at the Carbondale Sewage Plant. The average temperature between 2000 and 2019 was 56.1 degrees Fahrenheit.[5] The average daily high and low was 63.4 and 49.3. *Table 2.4* summarizes temperature information for the area between 2000 and 2019.

Table 2.4- 2000-2019 Monthly Average Temperatures

2000-2019 MONTHLY AVERAGE TEMPERATURES (degrees Fahrenheit)													
	Jan.	Feb.	Mar.	Apr.	May.	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Annual
Average High	42.7	44.4	58.8	62.3	72.3	79.1	84.3	83.1	75	62.1	50.6	45.8	63.4
Average	32.6	35.8	45.9	54.1	66.5	75	77.8	76.5	69.1	57.5	45.7	36.2	56.1
Average Low	25.1	24	38.1	48.8	63	69.6	70.7	71.7	65.4	53.7	37.6	23.4	49.3

Source: NOAA-National Climatic Data Search

The planning area is subject to considerable rainfall throughout the year. Local precipitation data was taken from the NOAA weather station located at the Carbondale Sewage Plant. The average annual precipitation was 50.94 inches between 2000 and 2019. The wettest months are typically from March to June. Average snowfall amounts in the region are around eleven inches annually. *Table 2.5* displays the monthly average precipitation between 2000 and 2019.

[4] David Muir, et al., "Upper Crab Orchard Creek: A Watershed Inventory," Greater Egypt Regional Planning and Development Commission, 1988, 6.
[5] NOAA. "Monthly Mean Avg Temperature for Carbondale Sewage Plant, IL" https://w2.weather.gov /Climate/xmacis.php?wfo=pah. Accessed 20 March 2020.

Table 2.5- 2000-2019 Monthly Average Precipitation

2000-2019 MONTHLY AVERAGE PRECIPITATION (inches)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Total	2.84	3.38	4.51	5.09	5.53	4.5	4.7	3.48	2.92	3.86	4.31	4.08	50.94

Source: NOAA-National Climatic Data Search

During the spring and summer months, damaging storms and heavy rainfall can be expected. Heavy rainfall usually leads to regional and localized flooding. More severe occurrences of flooding take place along the Big Muddy River and larger tributaries that feed into the waterbody. Like most areas in the Midwest, the watershed is susceptible to tornadoes. Winters can occasionally bring accumulations of snow and ice.

Wind data was obtained from the Illinois Climate Network (ICN) Carbondale Station, located on the SIU farm[6]. Wind speed generally ranges from three to eight miles per hour throughout the year with an average of 5.8 miles per hour in 2019. However, gusts can be twenty-nine to forty-six miles per hour in any certain month. From the data, there seems to be a prevalent pattern of wind SSW (south/ southwest). *Table 2.6* displays the average wind data from the ICN.

[6] ICN, "Water and Atmospheric Resources Monitoring Program," http://www.isws.illinois.edu/warm/datatype.asp. Accessed 30 March 2020.

Table 2.6- 2019 Wind Data

Month	Average Wind Speed (mph)	Max Speed (mph)	Average Direction
Jan	7.3	36.6	220.2
Feb	7.4	42.6	173.4
Mar	7.3	42.6	209.5
Apr	7.5	44.4	195.7
May	5.7	29.9	198.5
Jun	5.1	43.1	192.7
Jul	4.4	37.1	197.3
Aug	3.7	45.9	201.0
Sep	4.0	29.9	191.8
Oct	5.2	32.4	196.3
Nov	5.9	42.1	197.0
Dec	6.0	34.6	200.6
AVG	**5.8**	**38.4**	**197.8**

Source: Illinois Climate Network

2.2. Geology

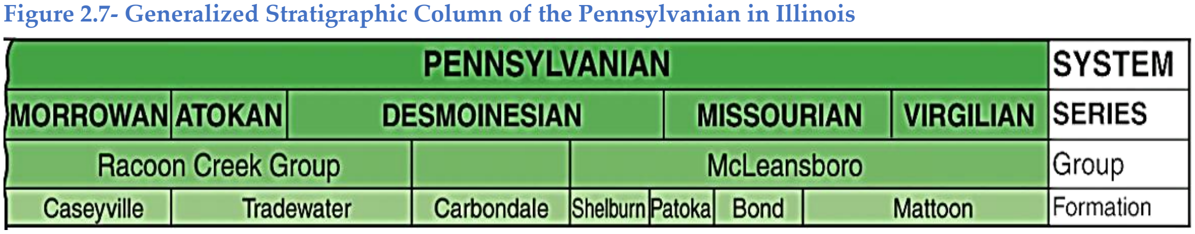
Kinkaid Creek watershed is located between the Shawnee Hills Section of the Interior Low Plateaus Province and the Central Lowland Province, Tills Plains Section. It is also in close proximity to the Ozark Plateaus to the west. The physiographic provinces are further partitioned into divisions. The northern portion of the watershed rests on the southern border of the Mt. Vernon Hill Country Division. [7]

The Pennsylvania System includes the uppermost bedrock in the planning area. It is overlain by relatively thin layers of glacial drift, loess, and alluvial deposits in river valleys. The Pennsylvanian surface is eroded by action of pre-glacial streams. System series, group, and underlying geologic formations can be seen in *Figure 2.7.*

The Kinkaid Creek watershed encompasses three types of underlying geologic formations. These include: Caseyville (65%), Tradewater (31%), and the Upper Pope Group (4%). Accounting for the majority of the underlying formations, Caseyville mainly consists of shale and siltstone. Other deposits include sandstone, coal, and limestone.

General thickness of the Tradewater formation is around 100 to 300 feet in southern Illinois and is abundant in coal.[8] The Upper Pope Group includes Kinkaid Limestone from 0 to 230 feet. *Figure 2.8* displays the geologic units of the Kinkaid Creek watershed and the surrounding area.

Figure 2.7- Generalized Stratigraphic Column of the Pennsylvanian in Illinois

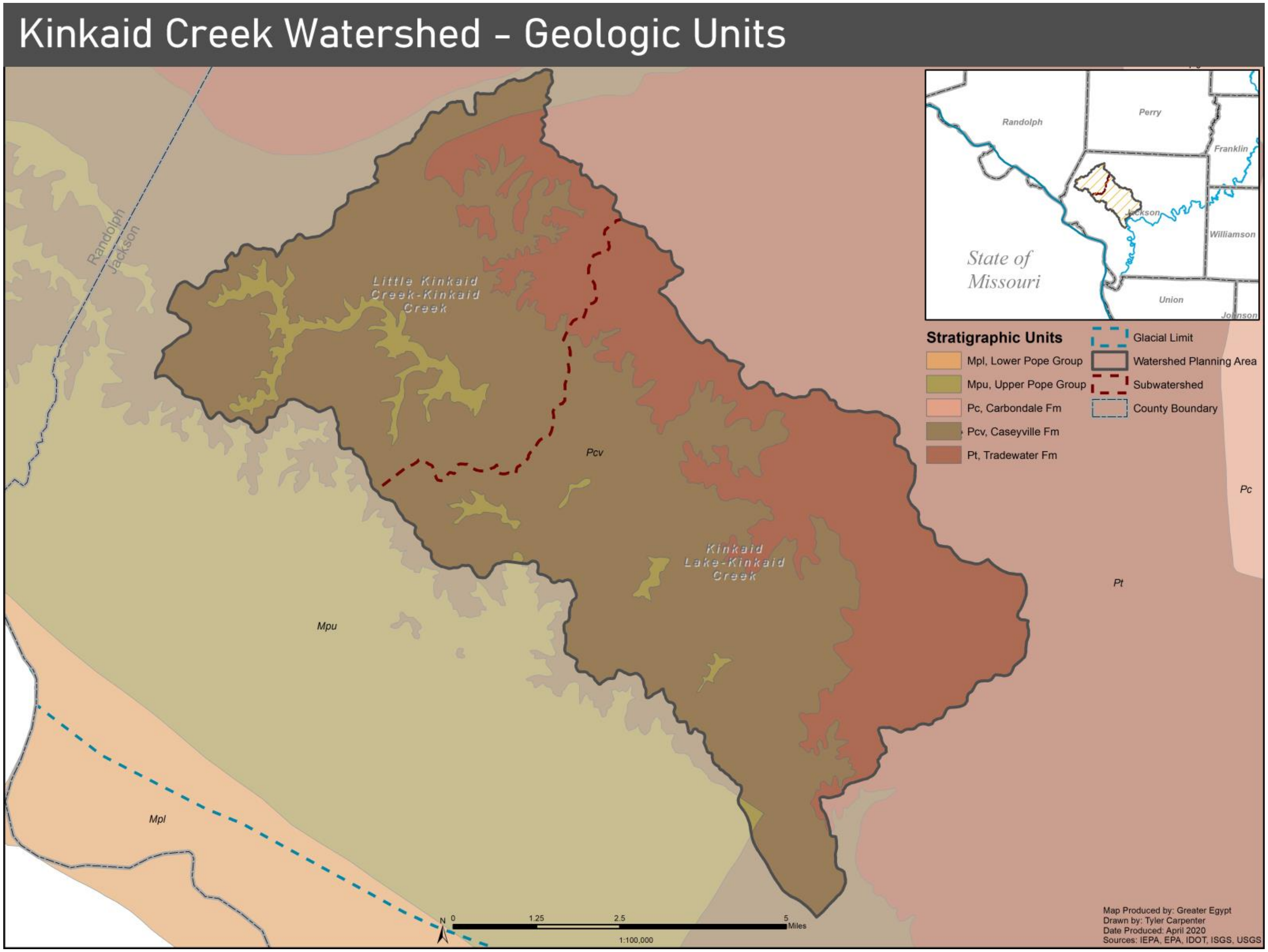


Source: ISGS

[7] Willman, H. B., Elwood Atherton, T. C. Buschbach, Charles Collinson, John C. Frye, M. E. Hopkins, Jerry A. Lineback, and Jack A. Simon, "Handbook of Illinois Stratigraphy," *Illinois State Geological Survey Bulletin* 95, no. 261 (1975).

[8] Tri-State Committee on Correlation of the Pennsylvanian System in the Illinois Basin, *Toward a More Uniform Stratigraphic Nomenclature for Rock Units of the Pennsylvanian System in the Illinois Basin.* (Bloomington: Illinois Basin Consortium, 2001), 16.

Figure 2.8

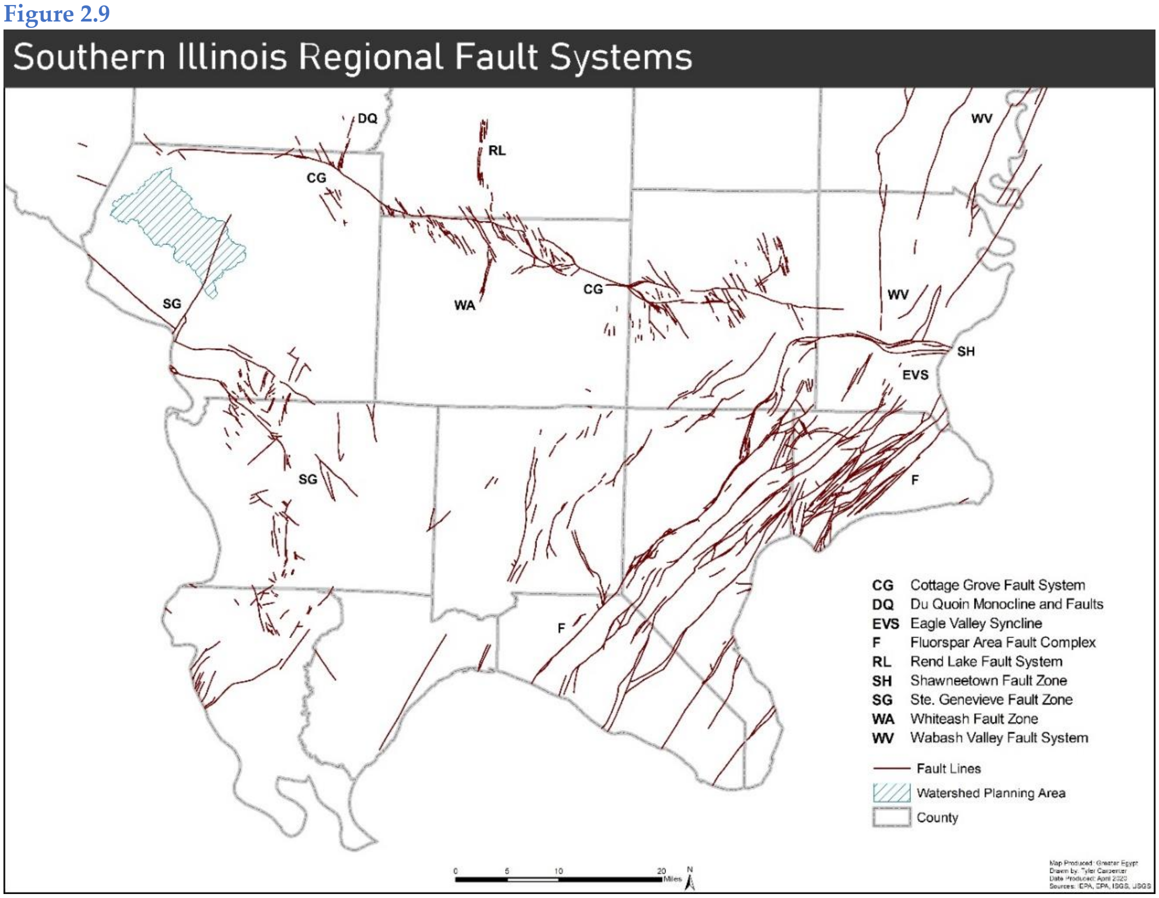


Kinkaid Creek Watershed - Geologic Units
Randolph
Jackson
Little Kinkaid Creek-Kinkaid Creek
Kinkaid Lake-Kinkaid Creek
Pcv
Mpu
Mpl
Pt
Pc
Randolph
Perry
Franklin
Jackson
Williamson
State of Missouri
Union
Johnson
Stratigraphic Units
Mpl, Lower Pope Group
Mpu, Upper Pope Group
Pc, Carbondale Fm
Pcv, Caseyville Fm
Pt, Tradewater Fm
Glacial Limit
Watershed Planning Area
Subwatershed
County Boundary
0 1.25 2.5 5 Miles
1:100,000
Map Produced by: Greater Egypt
Drawn by: Tyler Carpenter
Date Produced: April 2020
Sources: IEPA, EPA, IDOT, ISGS, USGS

2.2.1. ***Geologic Faults***

Regionally, the area exhibits a complex network of fault systems uncommon to most of the Midwestern United States. These zones are displayed in *Figure 2.9*. Southern Illinois lies just north of the most seismically active area of the Midwest, being the New Madrid Seismic Zone, which lies along the border of Missouri, Arkansas, Kentucky and Tennessee. It also encompasses much of the Wabash Valley Fault Zone.

Figure 2.9

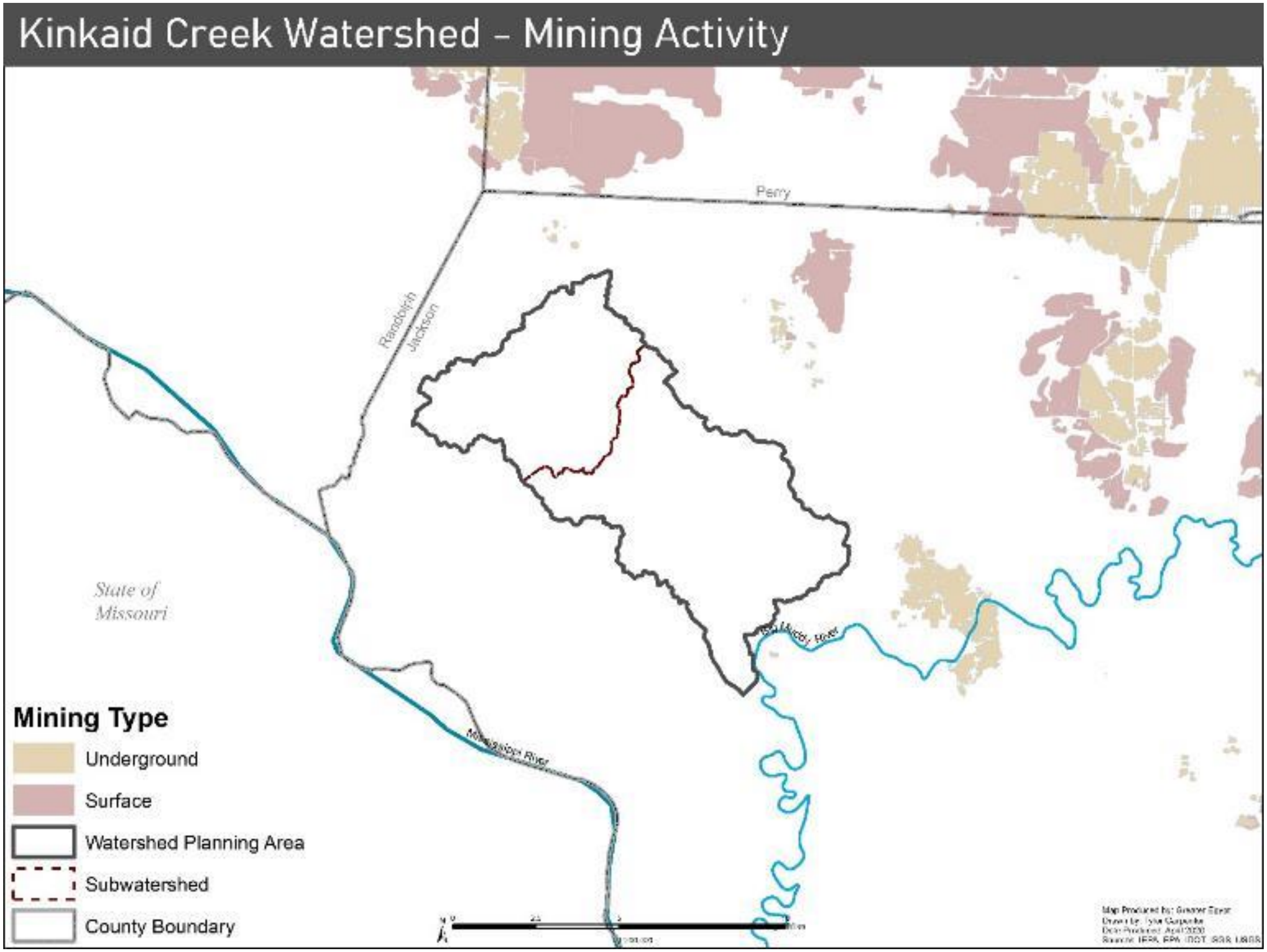


The Kinkaid Creek watershed lies in between the Ste. Genevieve and the Cottage Grove fault zones (*Figure 2.9*). The Ste. Genevieve fault system runs in a northerly direction extending from Alexander to Randolph County on the Illinois side of the Mississippi River. Part of this system runs through the planning area in a northerly direction.

2.2.2. ***Mining***

While there has been no mining activity directly in the watershed boundaries, it has occurred in close proximity. This is exhibited by the underground mining to the north and east (Murphysboro seam). Mining operations in neighboring Perry County (two miles north) were some of the most active in the area. This included underground and surface mining from the Herrin seam. Mining areas have been displayed in *Figure 2.10.*

Figure 2.10


Kinkaid Creek Watershed - Mining Activity
Perry
Randolph
Jackson
State of Missouri
Big Muddy River
Mississippi River
Mining Type
Underground
Surface
Watershed Planning Area
Subwatershed
County Boundary

2.3. Soil Conditions

The United States Department of Agriculture (USDA) Natural Resource Conservation Service (NRCS) soils mapping data (Web Soil Survey) and the Soil Survey of Jackson County (USDA, NRCS) was utilized for the examination of soils within the Kinkaid Creek Watershed Planning Area. Soils data was utilized to summarize the hydrologic soil groups, hydric status of soils, soil erodibility by K-Factor value, soil drainage, and the generalized soil types. The planning area consists of thirty-two generalized soil series.

*2.3.1. **Hydrologic Soil Groups***

Each soil is placed in a certain hydrologic group depending on the rate of water infiltration. These factors include whether the soil is protected by vegetation, consistently wet, or receives precipitation from storms. [9] The USDA defines the hydrologic soil groups by the following:

> **Group A**: Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.
>
> **Group B**: Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.
>
> **Group C:** Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.
>
> **Group D:** Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high-water table, soils that have a claypan or clay

[9] U.S.DA, NRCS. "Web Soil Survey." http://websoilsurvey.sc.egov.usda.gov/. Accessed: January-December 2019.

layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.[10]

Soils can also be assigned to a dual hydrologic group (A/D, B/D, or C/D). The first letter represents drained areas while the latter represents undrained areas. Within the planning area, few soils have a dual hydrologic group rating of either B/D, or C/D. None of the soils within the planning area are grouped with the dual rating A/D. Information on the hydrologic soil groups can be seen in *Table 2.7.*

Table 2.7- Hydrologic Soil Groups

Hydrologic Group	Soil Texture	Drainage	Infiltration	Transmission Rate
A	Sand or Gravel	Deep, Well Drained to Excessively Drained	High	High
B	Moderately Fine to Moderately Coarse	Moderately Deep or Deep, Moderately Well Drained or Well Drained	Moderate	Moderate
C	Moderately Fine to Fine	Layer that Impedes the Downward Movement of Water	Slow	Slow
D	Clays	High Shrink-Swell Potential, High Water Table, Claypan Layer Near Surface, Shallow Over Nearly Impervious Surfaces	Very Slow (High Runoff)	Very Slow

Source: USDA

Soils in the planning area vary within all of the hydrologic group classifications. Group A consists of 1,845.1 acres (4.5 %) in the planning area. 24,119.7 acres (58.5 %) make up Group B, the largest group of hydrologic soils. Group C makes up the second largest rating with 9,450 acres (22.9 %), while Group D make up the smallest portion of hydrologic soils with 733 acres (1.8%) in the Kinkaid Creek Watershed Planning Area.

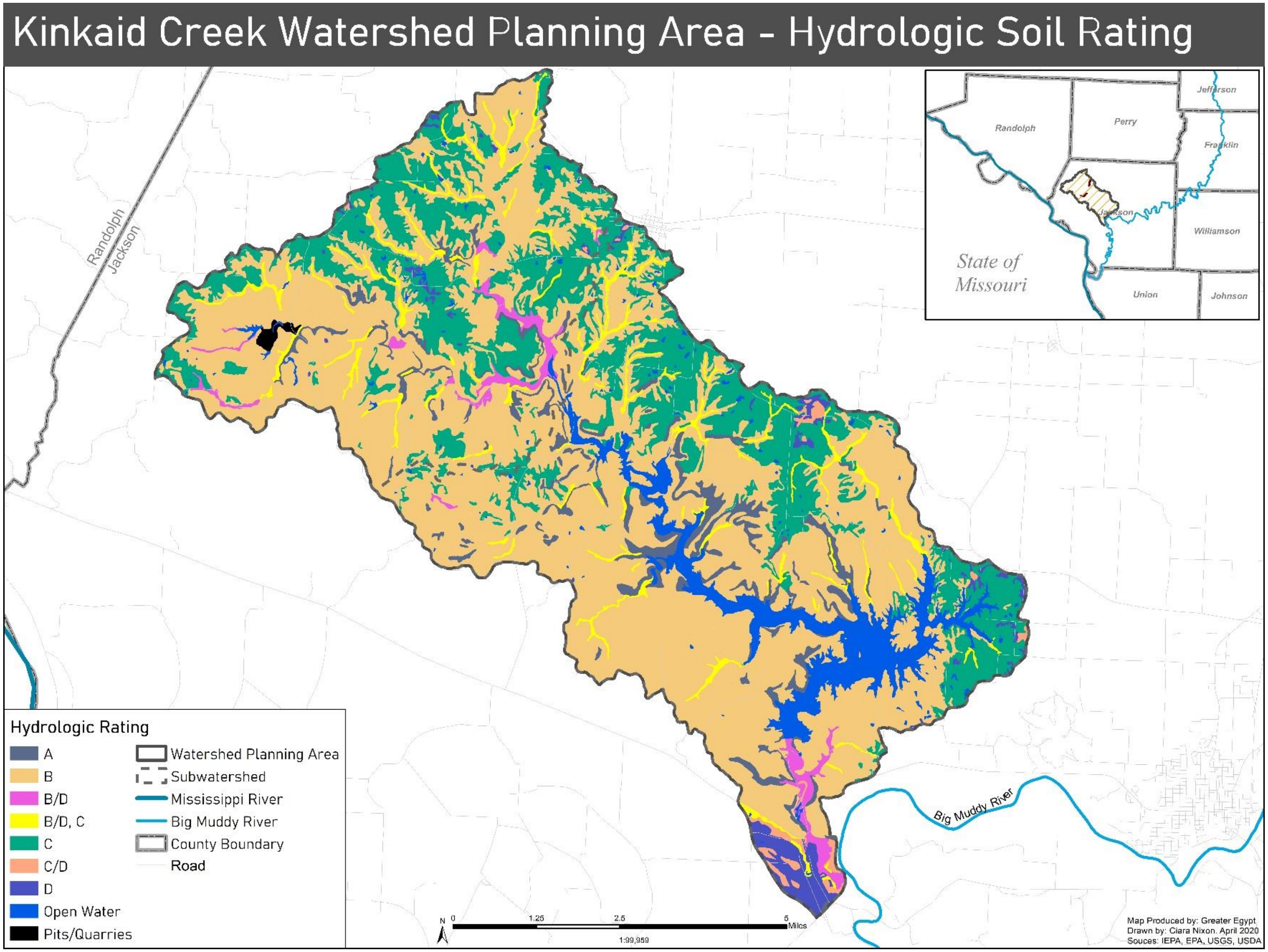
Dual hydrologic soil groups account for 2,453.6 acres, or 5.9 percent of the hydrologic soils in the planning area. Eleven general soils have been assigned a dual hydrologic code. Four soils, Belknap, Burnside, Drury, and Wakeland, compose the group B/D, which together make up 2,180.9 acres, or 5.2 percent of the entire planning area.

[10] Ibid.

Belknap, Burnside, and Drury soils also include the hydrologic group C. Group C/D is composed of seven soils. Combined, these soils cover 272.7 acres, or 0.7 percent within the Kinkaid Creek Watershed Planning Area.

These groupings are also spatially depicted in *Figure 2.11. Table 2.7* summarizes the hydrologic soil groups by general soil name and provides other information regarding soils within the Kinkaid Creek Watershed Planning Area.

Figure 2.11



Kinkaid Creek Watershed Planning Area - Hydrologic Soil Rating
Randolph
Jackson
Jefferson
Perry
Franklin
Williamson
State of Missouri
Union
Johnson
Big Muddy River
Hydrologic Rating
A
B
B/D
B/D, C
C
C/D
D
Open Water
Pits/Quarries
Watershed Planning Area
Subwatershed
Mississippi River
Big Muddy River
County Boundary
Road
N
0
1.25
2.5
5
Miles
1:99,959
Map Produced by: Greater Egypt
Drawn by: Ciara Nixon. April 2020
Souces: IEPA, EPA, USGS, USDA

2.3.2. *Hydric Soils*

The USDA NRCS defines hydric soils as a "soil that formed under conditions of saturation, flooding or ponding long enough during the growing season to develop anaerobic conditions in the upper part".[11] Of the thirty-two general soils that comprise the Kinkaid Creek watershed, ten are defined as hydric soils. *Table 2.8* summarizes the hydric soils with their respective acre and percent cover in the planning area. Hydric soils account for 557.4 acres, or 1.4 percent, of the entire planning area.

Table 2.8- Hydric Soils

Hydric Soils	Acres	Percent of Planning Area
Birds	21	0.1%
Bonnie	10.4	0.0%
Bonnie and Petrolia	6.5	0.0%
Booker	69.2	0.2%
Darwin and Jacob	7.7	0.0%
Jacob	75.5	0.2%
Okaw	209.7	0.5%
Pierron	84	0.2%
Piopolis	2.5	0.0%
Sexton	70.9	0.2%
Total:	**557.4**	**1.4%**

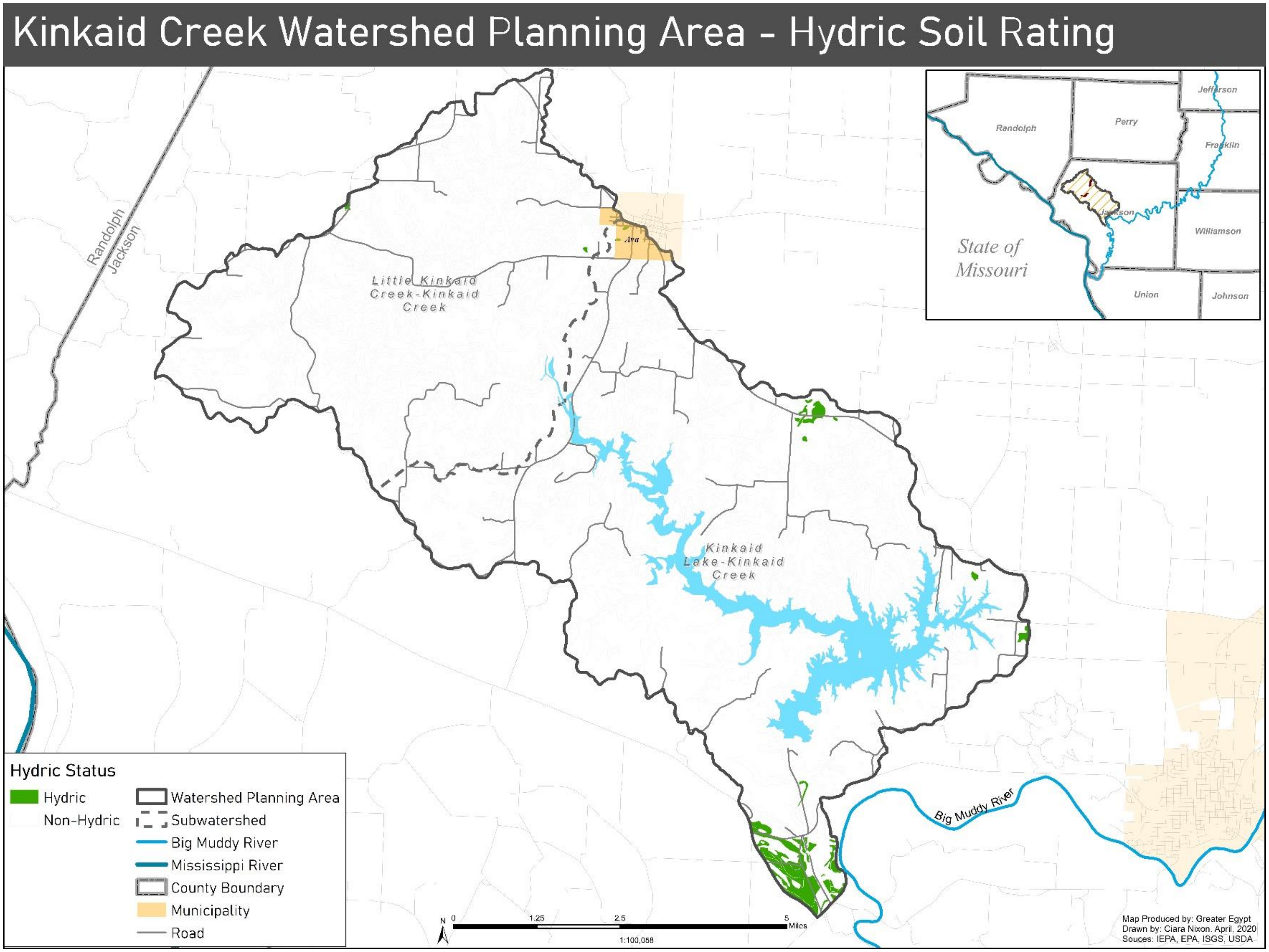
Source: USDA

At 210 acres, the Okaw soil series is the most prominent hydric soil within the border of the Kinkaid Creek Watershed Planning Area. The Okaw soils cover just 0.5 percent of the entire area. The Pierron soil series covers the next largest area with 84 acres, or 0.2 percent of the planning area. Jacob soils cover 75.5 acres, or 0.2 percent, while Booker and Sexton soils cover almost equal acreage with 69.2 acres and 70.9 acres, respectively. The other five soils; Birds (21 acres), Bonnie (10.4 acres), Bonnie and Petrolia (6.5 acres), Darwin and Jacob (7.7 acres), and Piopolis (2.5 acres) soils cover less than 0.2 percent of

[11] Ibid.

the planning area. Hydric soils in the Kinkaid Creek watershed planning area are depicted in *Figure 2.12*.

Figure 2.12


Kinkaid Creek Watershed Planning Area - Hydric Soil Rating
Randolph
Jackson
Little Kinkaid Creek-Kinkaid Creek
Kinkaid Lake-Kinkaid Creek
Ava
Big Muddy River
Jefferson
Randolph
Perry
Franklin
Jackson
Williamson
State of Missouri
Union
Johnson
Hydric Status
Hydric
Non-Hydric
Watershed Planning Area
Subwatershed
Big Muddy River
Mississippi River
County Boundary
Municipality
Road
0
1.25
2.5
5
Miles
1:100,058
Map Produced by: Greater Egypt
Drawn by: Ciara Nixon. April, 2020
Souces: IEPA, EPA, ISGS, USDA

2.3.3. ***Soil Erodibility***

Soil erodibility in the Kinkaid Creek Watershed Planning Area varies by location. The soil erodibility factor (K-factor value) was utilized to delineate erodibility. The USDA NRCS defines K-factor as the following:

> Erosion factor K indicates the susceptibility of a soil to sheet and rill erosion by water. Factor K is one of six factors used in the Universal Soil Loss Equation (USLE) and the Revised Universal Soil Loss Equation (RUSLE) to predict the average annual rate of soil loss by sheet and rill erosion in tons per acre per year. The estimates are based primarily on percentage of silt, sand, and organic matter and on soil structure and saturated hydraulic conductivity (Ksat). Values of K range from 0.02 to 0.69. Other factors being equal, the higher the value, the more susceptible the soil is to sheet and rill erosion by water.[12]

Erodibility correlates with the gradual increase in the K-factor value. The K-factor values for soils in this planning area have eight different values between the ratings of 0.15 and 0.55. These values usually correlate with other features of the soils, including hydric status and drainage classification. K-factor values and other information are listed in *Table 2.10.*

The least erodible soil, having a K-factor value of 0.15, is the Neotoma soil series. Neotoma-Rock soils cover 402.6 acres, or less than one percent of the planning area. Neotoma-Wellston soils cover 1,429.9 acres, or 0.035 percent of the planning area. The following four soil series fall within a rating of 0.24. The Alvin series cover 12.6 acres, or just 0.03 percent of the planning area. Booker soils cover 69.2 acres, or 0.2 percent of the planning area. The Darwin-Jacob series cover 7.7 acres, or just 0.02 percent. The last series with a K-factor value of 0.24 is the Jacob soils, which cover 75.5 acres, or 0.2 percent of the entire watershed planning area. Orthents soil series cover 62.5 acres, only 0.2 percent, and is the only soil series with a K-factor value of 0.3. Two soil series have a drainage rating of 0.32, Hickory and Kell-Hickory. These soil series cover 1,637.2 and 319.3 acres respectively, or roughly four percent and 0.8 percent. Hickory Menfro, Piopolis, and Wellston-Neotoma soil series fall with the 0.4 drainage rating. Hickory Menfro cover 1,201 acres, or 2.9 percent of the planning area.

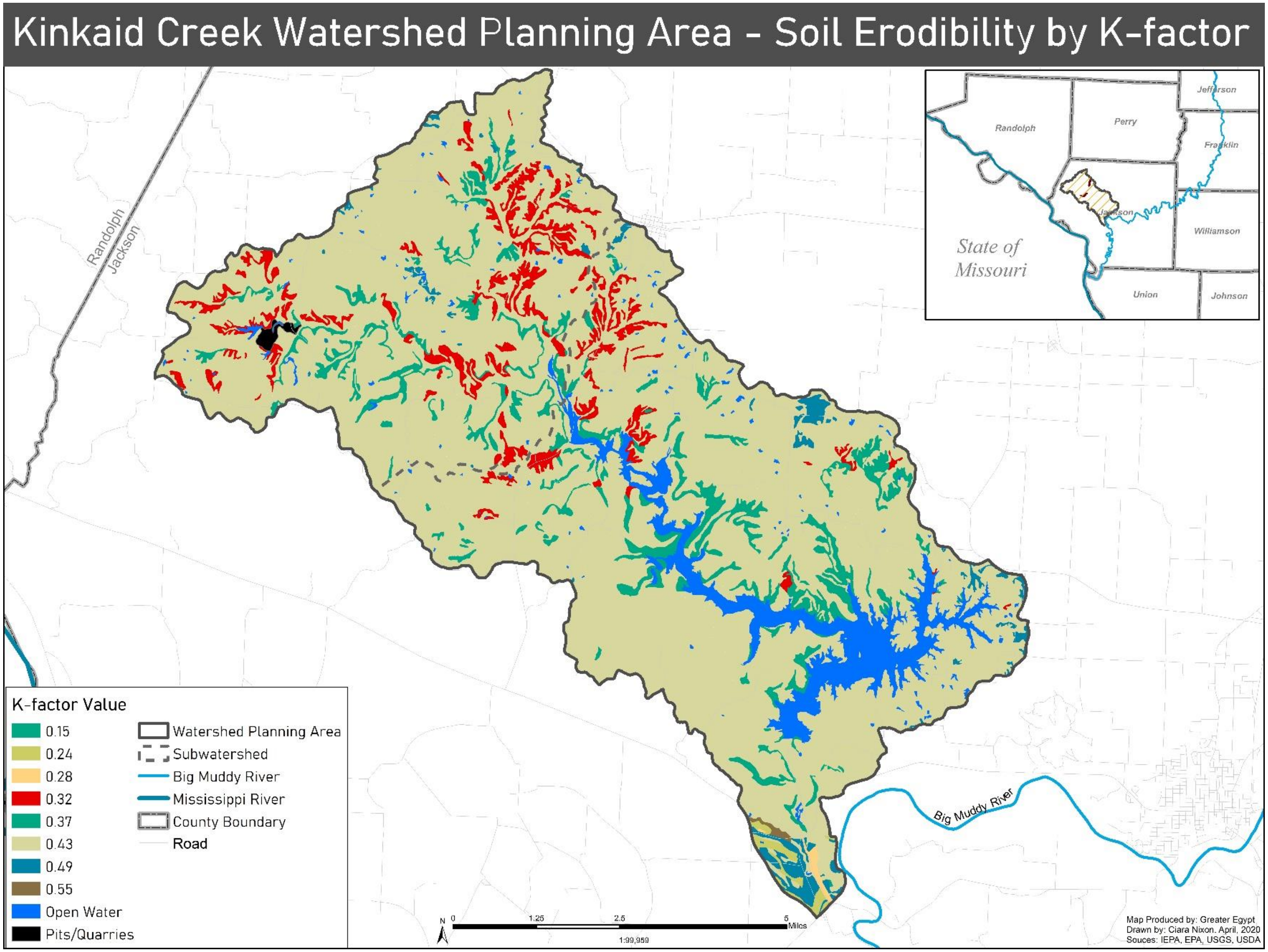
---

[12] Ibid.

The majority of the soils in the Kinkaid Creek Watershed Planning Area are rated with a 0.43 K-factor value. Combined, these soils cover 32,684.8 acres, or 79.3 percent of the entire planning area. The series rated with a 0.4 value are Belknap (391.5 acres), Birds (21 acres), Bonnie (10.4 acres), Bonnie-Petrolia (6.5 acres), Burnside (1,072 acres), Drury (36 acres), Geff (42 acres), Haymond (661.8 acres), Hickory-Homen (388 acres), Homen (9,130.7 acres), Hurst (12 acres), Menfro (14,566 acres), Menfro-Hickory (807.6 acres), Menfro-Wellston (4,856.5 acres), and Wakeland (681.5 acres) soil series. 658.3 acres, or 1.6 percent of the soils in the planning area have a value of 0.49. These soils include Okaw (2.9.8 acres), Pierron (84 acres), Sexton (70.9 acres), and Stoy (293.6 acres). The soil that is rated as having the highest erodibility value is the Dupo soil series, with 37.8 acres, or just 0.1 percent of cover in the planning area and is rated with a K-factor value of 0.55.

Soil erodibility, measured by K-factor value, is displayed in *Figure 2.13.*

Figure 2.13



Kinkaid Creek Watershed Planning Area - Soil Erodibility by K-factor
Randolph
Jackson
Randolph
Perry
Jefferson
Franklin
Jackson
Williamson
State of Missouri
Union
Johnson
Big Muddy River
K-factor Value
0.15
0.24
0.28
0.32
0.37
0.43
0.49
0.55
Open Water
Pits/Quarries
Watershed Planning Area
Subwatershed
Big Muddy River
Mississippi River
County Boundary
Road
N
0
1.25
2.5
5
Miles
1:99,959
Map Produced by: Greater Egypt
Drawn by: Ciara Nixon. April, 2020
Souces: IEPA, EPA, USGS, USDA

2.3.4. Soil Drainage

The USDA also provides information regarding the drainage classifications of each soil type. In this case, these classes are meant to describe the natural drainage characteristics. There are seven classifications ranging from "Excessively drained," to "Very poorly drained." Of the seven, five classes represent the soil drainage classifications located within the Kinkaid Creek watershed planning area. Listed below is the USDA's definition of the soil drainage ratings within the planning area:

> **Well drained (WD):** Water is removed from the soil readily but not rapidly. Internal free water occurrence commonly is deep or very deep; annual duration is not specified. Water is available to plants throughout most of the growing season in humid regions. Wetness does not inhibit growth of roots for significant periods during most growing seasons. The soils are mainly free of the deep to redoximorphic features that are related to wetness.
>
> **Moderately well drained (MWD):** Water is removed from the soil somewhat slowly during some periods of the year. Internal free water occurrence commonly is moderately deep and transitory through permanent. The soils are wet for only a short time within the rooting depth during the growing season, but long enough that most mesophytic crops are affected. They commonly have a moderately low or lower saturated hydraulic conductivity in a layer within the upper first meter, periodically receive high rainfall, or both.
>
> **Somewhat poorly drained (SPD):** Water is removed slowly so that the soil is wet at a shallow depth for significant periods during the growing season. The occurrence of internal free water commonly is shallow to moderately deep and transitory to permanent. Wetness markedly restricts the growth of mesophytic crops, unless artificial drainage is provided. The soils commonly have one or more of the following characteristics: low or very low saturated hydraulic conductivity, a high-water table, additional water from seepage, or nearly continuous rainfall.
>
> **Poorly drained (PD):** Water is removed so slowly that the soil is wet at shallow depths periodically during the growing season or remains wet for long periods. The occurrence of internal free water is shallow or very shallow and common or persistent. Free water is commonly at or near the surface long enough during the

growing season so that most mesophytic crops cannot be grown, unless the soil is artificially drained. The soil, however, is not continuously wet directly below plow-depth. Free water at shallow depth is usually present. This water table is commonly the result of low or very low saturated hydraulic conductivity of nearly continuous rainfall, or of a combination of these

Very Poorly Drained (VPD): Water is removed from the soils so slowly that free water remains at or very near the ground surface during much of the growing season. The occurrence of internal free water is very shallow and persistent or permanent. Unless the soil is artificially drained, most mesophytic crops cannot be grown. The soils are commonly level or depressed and frequently ponded. If rainfall is high or nearly continuous, slope gradients may be greater.[13]

These five classifications constitute most of the planning area, excluding the 2,562 acres (6.2 %) of water, and 77.2 acres (0.2 %) of the pits and quarries classification. *Table 3.4* displays the general soil series with their respective drainage class rating, along with the acreage and percent of coverage within the Kinkaid Creek watershed planning area.

Most of the soils within the planning area's border are rated as being well drained. This drainage class consists of eleven different soils. When combined, the well-drained soils make up 27,382 acres (66.4 %) of the planning area. The Homen soil series is the only rating that falls into the moderately well drainage class with 9,127 acres (22.1 %). 1,520.4 acres (3.7 %) are placed in the somewhat poorly drained class, which consists of seven combined soils. 549.7 acres (1.3 %), between eight combined soil series, are rated as poorly drained. Only one soil series, the Darwin and Jacob series, fall into the very poorly drainage class and constitute only 7.7 acres of the Kinkaid Creek watershed planning area.

Drainage class ratings are summarized in the following table, and spatially displayed in *Figure 2.14*.

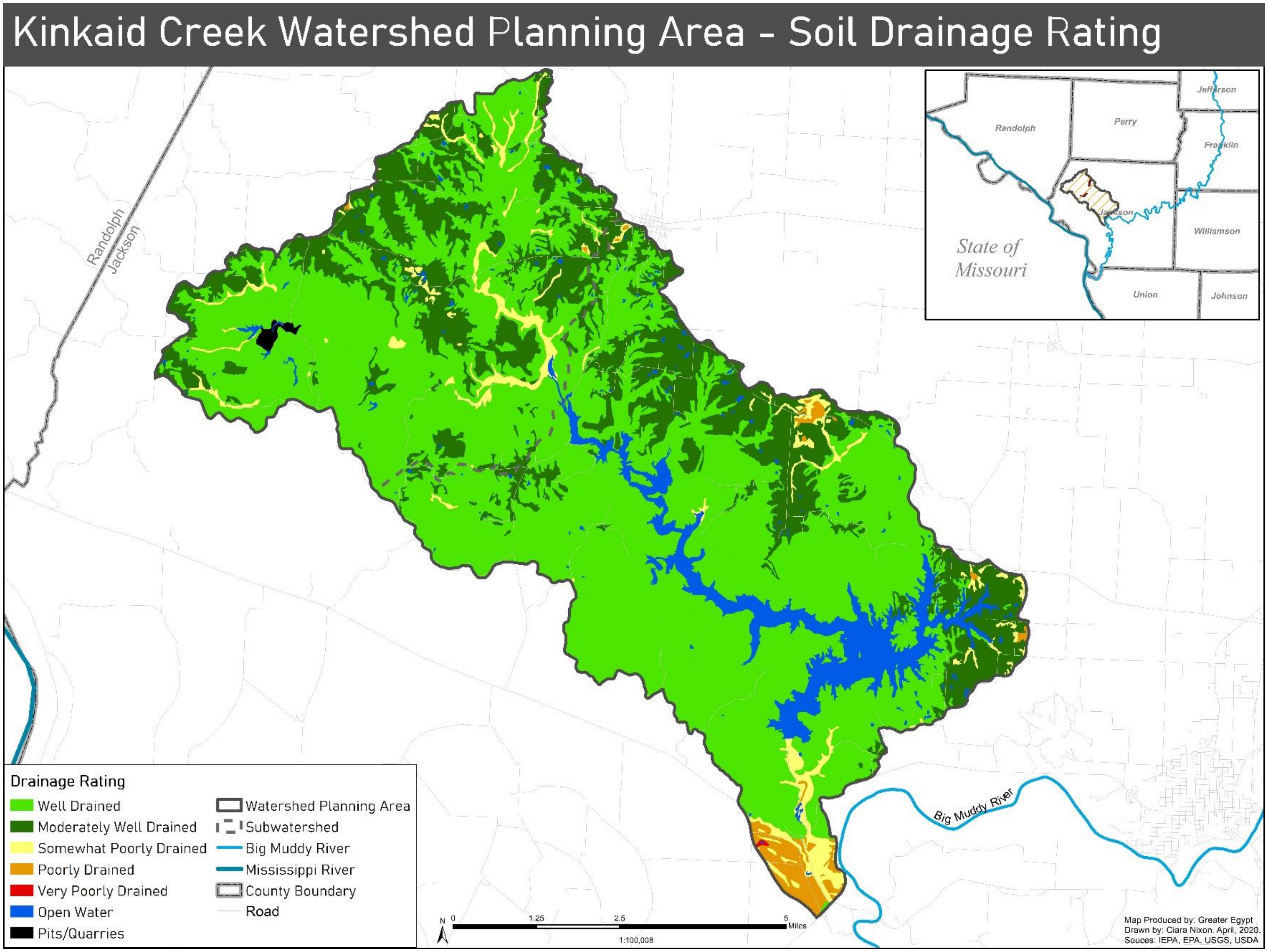
[13] U.S.D.A. "Soil Survey Manual." (USDA 1993)

Table 2.9 - Drainage Classifications

Drainage Class Rating	Acres	Percent of Planning Area
Well Drained	27,382	66.4%
Moderately Well Drained	9,127	22.1%
Somewhat Poorly Drained	1,520.4	3.7%
Poorly Drained	549.7	1.3%
Very Poorly Drained	7.7	0.0%

Source: USDA

Figure 2.14


Kinkaid Creek Watershed Planning Area - Soil Drainage Rating
Randolph
Jackson
Randolph
Perry
Jefferson
Franklin
Williamson
State of Missouri
Union
Johnson
Big Muddy River
Drainage Rating
Well Drained
Moderately Well Drained
Somewhat Poorly Drained
Poorly Drained
Very Poorly Drained
Open Water
Pits/Quarries
Watershed Planning Area
Subwatershed
Big Muddy River
Mississippi River
County Boundary
Road
0
1.25
2.5
5
Miles
1:100,008
Map Produced by: Greater Egypt
Drawn by: Ciara Nixon. April, 2020.
Souces: IEPA, EPA, USGS, USDA

2.3.5. Generalized Soils Information

As previously mentioned, the Kinkaid Creek watershed consists of thirty-two generalized soil series. Generalized soil series are depicted in *Figure 2.15.* Original data from the Jackson County Web Soil Survey consists of fifty different soil descriptions within the planning area. However, some descriptions have been combined to fall under a general soil name. Detailed information regarding individual soil subset data can be found in Appendix A. More information regarding whole soil descriptions can be found within the Soil Survey of Jackson County, Illinois.

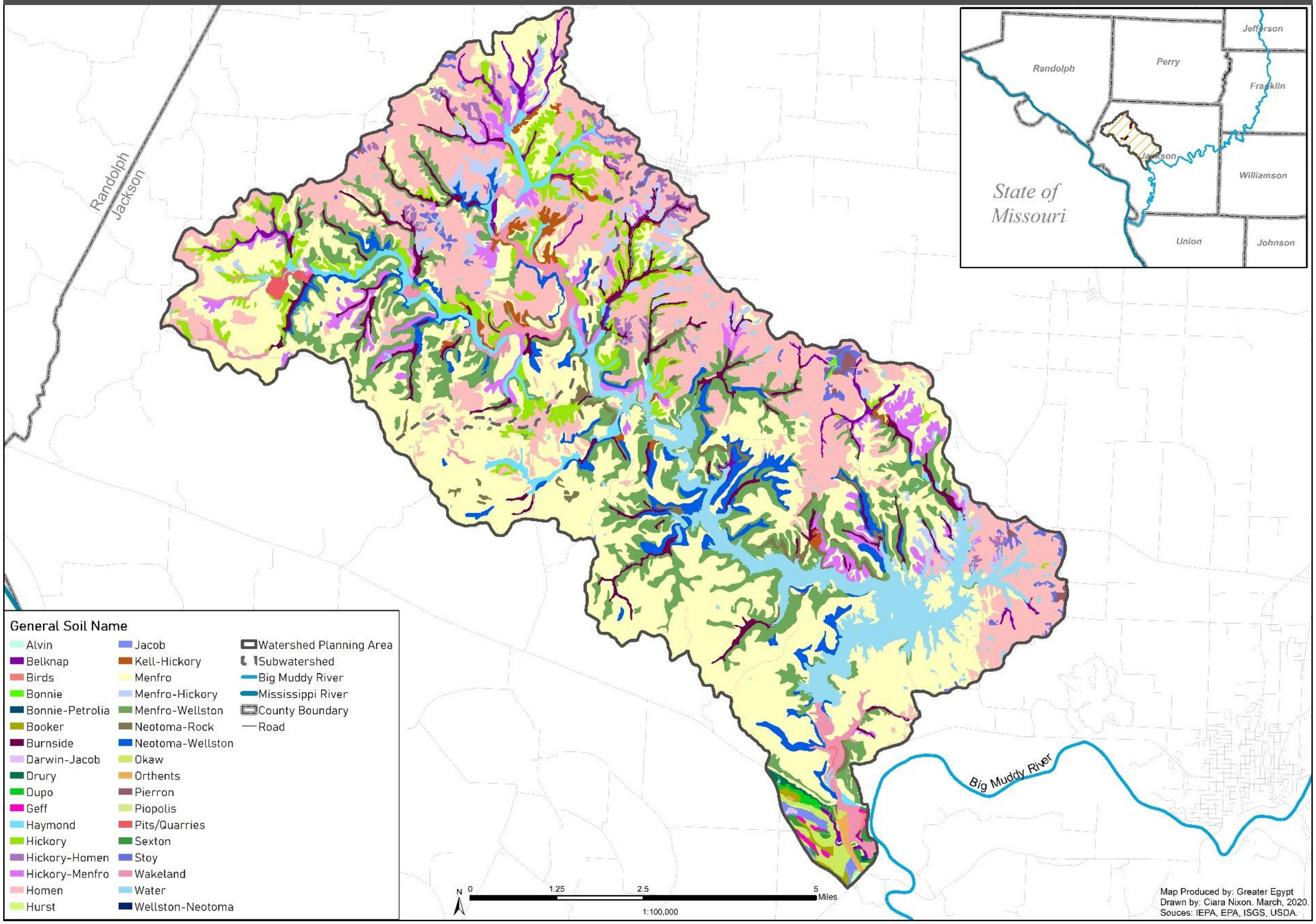
The Menfro soil series cover 14,566.7 acres (35.3%) of the planning area, making this series the most predominant soil within the planning area. This general name consist of seven different discriptions of silt loam soils that range from two to twenty-five percent slopes that differ between having no erosion or being severely eroded. The second predominant soils fall under the Homen series. Homen soils make up 9,130 acres in the area (22.1%), and consists of four descriptions. Homen soils can consist of silt or silty clay loams, range between two to eighteen percent slopes, and have no or severely eroded areas.

Following the Homen soils, the Menfro-Wellston soils cover 4,856.5 acres within the watershed planning area (11.77%). This general soil encompasses two descriptions of silt loam soils that range from eighteen to seventy percent slopes. Hickory soil series constitute the next largest portion of the planning area, covering 1,637.2 acres (3.97%), and has two soil descriptions of silt loam soils that range between eighteen to thirty-five percent slopes and differ from having either low or severely eroded areas.

The Hickory-Menfro soil series consist of 1,201.4 acres (2.91%) of the planning area. This general soil has two descriptions, one of silt loams that range between eighteen and thirty-five percent slopes with no erosion level, and a second description of complex soils that range between eighteen to thirty-five percent slopes with severely eroded areas. The Menfro-Hickory soil series covers 807.6 acres (1.95%) of the Kinkaid Creek watershed planning area. This general soil has two soil descriptions. Menfro-Hickory soils are silt loams or complex soils that range between ten to eighteen percent slopes with areas of low or severe erosion.

Figure 2.15

Kinkaid Creek Watershed Planning Area - Generalized Soil Series



Following the Menfro-Hickory soils, the Wakeland soil series cover 681.4 acres (1.65%)t of the planning area. This general soil has two descriptions. Wakeland soils are silt loams with zero to two percent slopes, that are frequently flooded or occasionally flooded. Haymond series cover 661 acres (1.60%) of the watershed planning area and the general name also consist of two descriptions. Haymond soils are silt loam soils with either zero to two percent slopes that are frequently flooded, or zero to three percent slopes that are occasionally flooded.

The Belknap series cover 391.3 acres (0.95%) of the Kinkaid Creek Watershed Planning Area. The general name has two descriptions of silt loam soils that range between zero to two percent slopes. These frequently, or occassionaly flood. The Stoy series cover 293.6 acres (0.71%) of the planning area. The general name has two descriptions of silt loam soils with zero to two percent slopes, or zero to five percent slopes.

The smallest of the soil series within the watershed planning area that was generalized is the Alvin soil series. This series cover 12.6 acres (0.03%) of the entire planning area. The Alvin soils within the watershed planning area has two soil descriptions of sandy loam soils with either two to five percent slopes, or fifteen to twenty-five percent slopes that rarely flood.

Each soil series within the Kinkaid Creek watershed that was generalized has the same hydric soils rating, erodibility factor, hydrologic group, and drainage rating.

Table 2.10- Generalized Soil Information

General Soil Series Name	Hydric Y/N	Erodibility K factor	Hydrologic Soil Group	Drainage Rating	Acres	Percent of Watershed
Alvin	No	0.24	A	WD	12.6	0.03%
Belknap	No	0.43	B/D, C	SPD	391.3	0.95%
Birds	Yes	0.43	C/D	PD	21	0.05%
Bonnie	Yes	0.43	C/D	PD	10.4	0.03%
Bonnie and Petrolia	Yes	0.43	C/D	PD	6.5	0.02%
Booker	Yes	0.24	D	PD	69.2	0.16%
Burnside	No	0.43	B/D, C	WD	1,071.5	2.59%
Darwin and Jacob	Yes	0.24	D	VPD	7.7	0.01%
Drury	No	0.43	B/D, C	WD	36	0.08%
Dupo	No	0.55	C/D	SPD	37.8	0.09%
Geff	No	0.43	C/D	SPD	42	0.10%
Haymond	No	0.43	B	WD	661.8	1.60%
Hickory	No	0.32	B	WD	1,637.2	3.97%
Hickory-Homen	No	0.43	B	WD	388.3	0.94%
Hickory-Menfro	No	0.37	B	WD	1,201.4	2.91%
Homen	No	0.43	C	MWD	9,130.7	22.14%
Hurst	No	0.43	D	SPD	12.3	0.03%
Jacob	Yes	0.24	D	PD	75.5	0.18%
Kell-Hickory	No	0.32	C	WD	319.2	0.77%
Menfro	No	0.43	B	WD	14,566.7	35.32%
Menfro-Hickory	No	0.43	B	WD	807.6	1.95%
Menfro-Wellston	No	0.43	B	WD	4,856.5	11.77%
Neotoma-Rock	No	0.15	A	WD	402.7	0.98%
Neotoma-Wellston	No	0.15	A	WD	1,430.4	3.47%
Okaw	Yes	0.49	D	PD	209.8	0.51%
Orthents	No	0.28	D	SPD	62.5	0.20%
Pierron	Yes	0.49	C/D	PD	84	0.20%
Piopolis	Yes	0.37	D	PD	2.5	0.0%
Pits and Quarries	No	-	-	-	77.2	0.19%
Sexton	Yes	0.49	C/D	PD	70.9	0.17%
Stoy	No	0.49	D	SPD	293.6	0.71%
Wakeland	No	0.43	B/D	SPD	681.4	1.65%
Water	-	-	-	-	2,562.9	6.21%
Wellston-Neotoma	No	0.37	B	WD	0.1	0.0%
Totals:					**41,242.25**	**100.0%**

2.4. Watershed Jurisdictions

The Kinkaid Creek watershed planning area lies within six townships and one municipality. The City of Ava is the only municipality, with 259.2 of its 682.5 acres being within the borders of the planning area, covering just below one percent of the entire planning area.

The six townships that are within the planning area are: Bradley, Degognia, Kinkaid, Levan, Sand Ridge, and small portion of Ora Township. Levan Township constitutes the most area. The township has a total area of 23,507.6 acres; with 14,537.6 acres inside the Kinkaid Lake watershed. This accounts for thirty-five percent of the total planning area. Kinkaid Township makes up the second largest acreage, with 13,249.1 acres, of its 23,264.6 total acres. This area covers 32.1 percent of the entire planning area. Bradley Township consists of 28,812.50 acres, and 9,460.36 acres are inside the planning area.

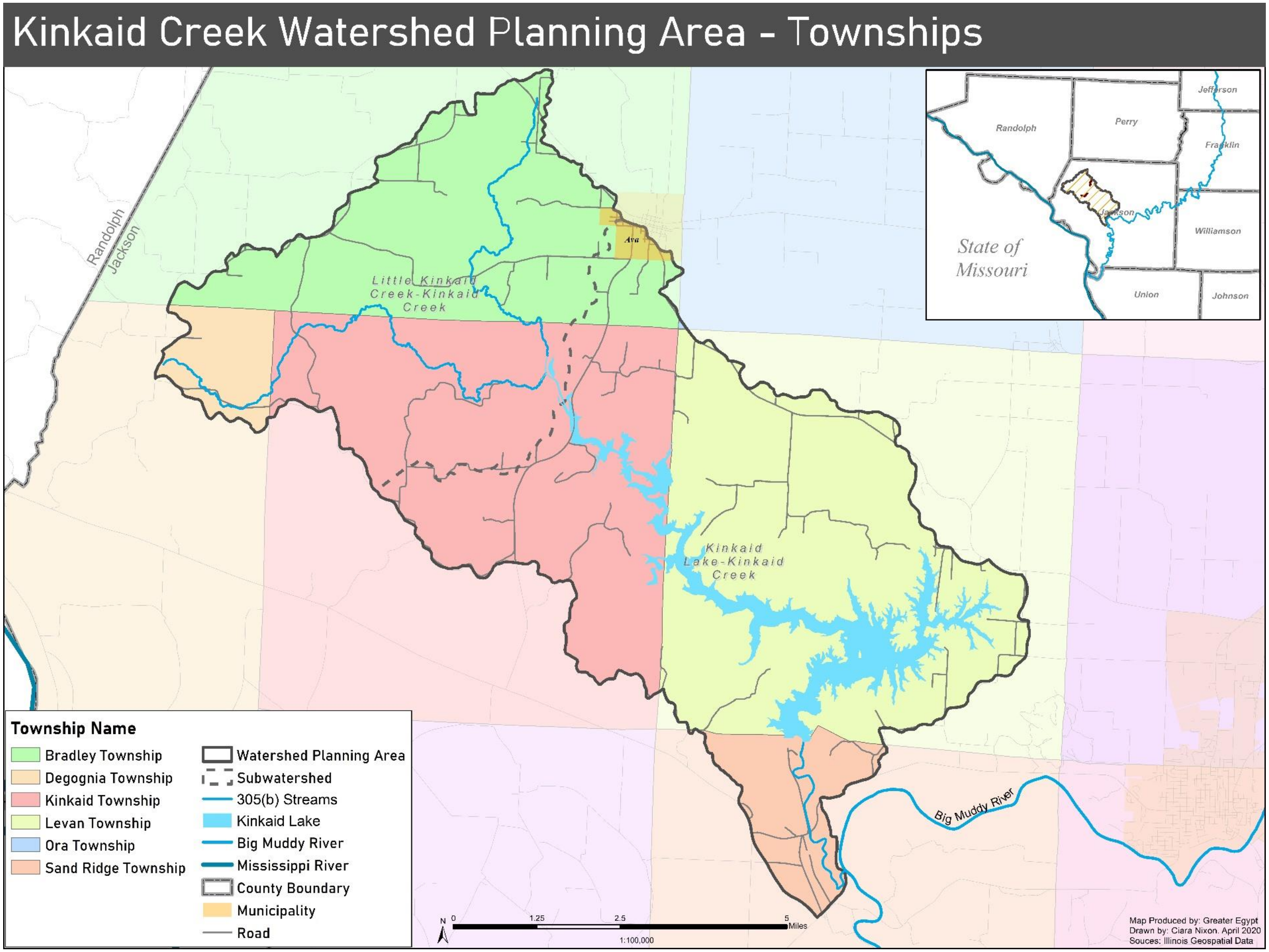
Sand Ridge Township consists of 23,419.4 acres; 2,464.83 acres of which are inside the Kinkaid Creek watershed. Degognia Township has a total acreage of 19,621.8; of which, 1,521.52 acres are within the borders of Kinkaid Creek watershed and make up 3.6 percent of the entire planning area. Ora Township consists of 23,538.9 acres in total, and only 8.7 acres are within the borders. *Table 2.11* summarizes the six townships and their size relative to the Kinkaid Creek watershed. The City of Ava (municipality) and Jackson County are also summarized.

Table 2.11 - Jurisdictional Areas

Jurisdiction	Total Acres	Acres in Planning Area	Percent of Planning Area
County			
Jackson	385,280.00	41,225.90	-
Township			
Bradley	28,812.50	9,460.36	22.90
Degognia	19,621.80	1,521.52	3.69
Kinkaid	23,264.60	13,249.10	32.13
Levan	23,507.60	14,537.60	35.24
Ora	23,538.90	8.70	0.02
Sand Ridge	23,419.40	2,464.83	5.97
Municipality			
Ava	682.59	259.22	0.63

Sources: U.S. Census Bureau

Figure 2.16


Kinkaid Creek Watershed Planning Area - Townships
Randolph
Jackson
Little Kinkaid Creek-Kinkaid Creek
Kinkaid Lake-Kinkaid Creek
Ava
Big Muddy River
Jefferson
Randolph
Perry
Franklin
Jackson
Williamson
State of Missouri
Union
Johnson
Township Name
Bradley Township
Degognia Township
Kinkaid Township
Levan Township
Ora Township
Sand Ridge Township
Watershed Planning Area
Subwatershed
305(b) Streams
Kinkaid Lake
Big Muddy River
Mississippi River
County Boundary
Municipality
Road
0
1.25
2.5
5
Miles
1:100,000
Map Produced by: Greater Egypt
Drawn by: Ciara Nixon. April 2020
Souces: Illinois Geospatial Data

2.4.1. Municipal Ordinances

County representatives within the state of Illinois adopt municipal ordinances to further protect their residents. Information regarding water related ordinances within the Kinkaid Creek watershed planning area, data was obtained from previous Kinkaid Lake plans and by contacting local agencies in or around the planning area.

In Jackson County, A flood damage prevention ordinance has been adopted. The ordinance includes stormwater and erosion control, laying out requirements needed for participation in the National Flood Insurance Plan (NFIP). This program allows homeowners and businesses to purchase flood insurance, if the community has adopted and enforced ordinances that reduce the potential for flooding.

Jackson County participates in the NFIP; however, Ava is not a listed participant on the Federal Emergency Management Agency Community Status Book Report.[14] The Jackson County Flood Damage Prevention Ordinance outlines the requirements to be followed regarding new and existing developments in the county in order to mitigate and prevent future flood hazards.[15] Jackson County ranks 7th out of 102 counties statewide on a Flood Vulnerability Index (FVI), making it's flood risk amongst the highest in the state.

The City of Ava does not currently have any ordinances related to storm water or flood prevention.

2.4.2. Local, State and Federal Responsibilities

In the Kinkaid Creek Watershed Planning Area, there are local, state and federal agencies that implement programs related to watershed planning, water quality, and nonpoint source pollution. While some of these agencies have applied programs that target water related resources specifically for the planning area, other agencies have programs designated for these purposes, but have not been established for the planning area.

[14] FEMA, "Federal Emergency Agency Community Status Book Report-Illinois: Communities Participating in the Nation Flood Insurance Program," https://www.fema.gov/cis/IL.html Accessed January, 2020

[15] Jackson County, IL "Flood Damage Prevention Ordinance" Accessed November, 2019

The following agencies have been described by their roles related to watershed planning, water quality, and nonpoint source pollution within and outside the Kinkaid Creek Watershed Planning Area.

Greater Egypt Regional Planning and Development Commission

Since the 1960s, the Greater Egypt Regional Planning and Development Commission (Greater Egypt) has played an important role in regional water-related issues such as: watershed planning, water quality, and nonpoint source pollution. Greater Egypt has produced watershed inventories and plans for: Rend Lake, Cedar Lake, Atchison Creek, Pinckneyville Reservoir, Upper Crab Orchard, and the Upper Big Muddy watershed. These reports involved describing watershed characteristics and water quality in each particular watershed. Regarding the Kinkaid Creek watershed planning area, Greater Egypt has participated on the Technical Advisory Committee for previous water quality planning initiatives.

Currently, Greater Egypt is working to compile the Western Crab Orchard Creek Watershed-based Plan. This planning area consists of three HUC 12 watersheds that are also part of the larger Big Muddy watershed. Recently, the Western Crab Orchard Creek Watershed- Inventory and Assessment was completed. The inventory and assessment consist of data and other relative information to identify water quality issues in the initial phase of the planning process. The Western Crab Orchard Creek Watershed-based Plan will follow the *Nine Minimum Elements of a Watershed Plan* outlined by the EPA. In doing so, it will recommend best management practices to water quality within the Western Crab Orchard Creek Watershed planning area.

In 1981, the Illinois Environmental Protection Agency established the Volunteer Lake Monitoring Program. This program was established to gather fundamental information on Illinois inland lakes. Greater Egypt coordinates the program for southern Illinois for the ten-county region. Volunteers gather the data on water transparency and water quality.

Illinois Department of Natural Resources (IDNR)

The IDNR Division of Resource Management is responsible for various activities such as: regulating public waters, regulating construction and maintenance of dams, National Flood Insurance Program coordination, and Flood Mitigation Program (nonstructural) administration. [16]

In the Kinkaid Lake Watershed Planning Area, IDNR owns and manages approximately 4,000 acres of surrounding land. The division has assisted with numerous planning and mitigation initiatives that include erosion control measures around Kinkaid Lake.[17]

The Division also has an extensive permitting program in which they are responsible for permits for work along Illinois waterbodies. The four main components of the permitting program are: Floodway/Floodplain Management, Public Water Management, Dam Safety, and Lake Michigan Management. [18]

Illinois Environmental Protection Agency (IEPA)

The IEPA oversees and implements many programs that target watershed planning, water quality, and nonpoint source pollution. Throughout the years, IEPA has assisted with management initiatives in the Kinkaid Creek Watershed Planning Area through the Priority Lake and Implementation Program grant, the Clean Water Act, and the Nonpoint Source Pollution Control Program.

Through the National Pollutant Discharge Elimination System (NPDES), the IEPA handles stormwater and wastewater discharges to waterbodies. NPDES permits are required for discharges of: treated municipal effluents, treated industrial effluents, and stormwater discharged through separate municipal storm sewer systems (MS4s) and construction sites. The IEPA Bureau of Water characterizes NPDES and other stormwater regulations by the following:

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[16] IDNR. "Division of Resource Management," https://www.dnr.illinois.gov/WaterResources/Pages/ResMan.aspx. Accessed 11 August 2015.
[17] IDNR "Kinkaid Lake SFWA" https://www2.illinois.gov/dnr/Parks/Pages/KinkaidLake.aspx
[18] Ibid.

> Under Phase I of the NPDES Storm Water program, operators were required to obtain permit coverage for construction activity that resulted in a total land disturbance of five acres or more or less than five acres if they were part of a "larger common plan of development or sale" with a planned land disturbance of five acres or greater. Phase II reduced that project size to one acre or more.[19]

Kinkaid Creek Watershed Planning Area has only one outfall location. The Kinkaid-Reed's Creek Conservation District, also known at the Kinkaid Water Plant, holds a permit that is located on the eastern side of Lake Kinkaid. This outfall is summarized in *Table 2.12*. The NPDES Facility location is also depicted in *Figure 2.17.*

Table 2.12 – NPDES Outfalls

NPDES Facility Name	NPDES ID
Kinkaid-Reeds Creek Cons. Dist.	ILG640136

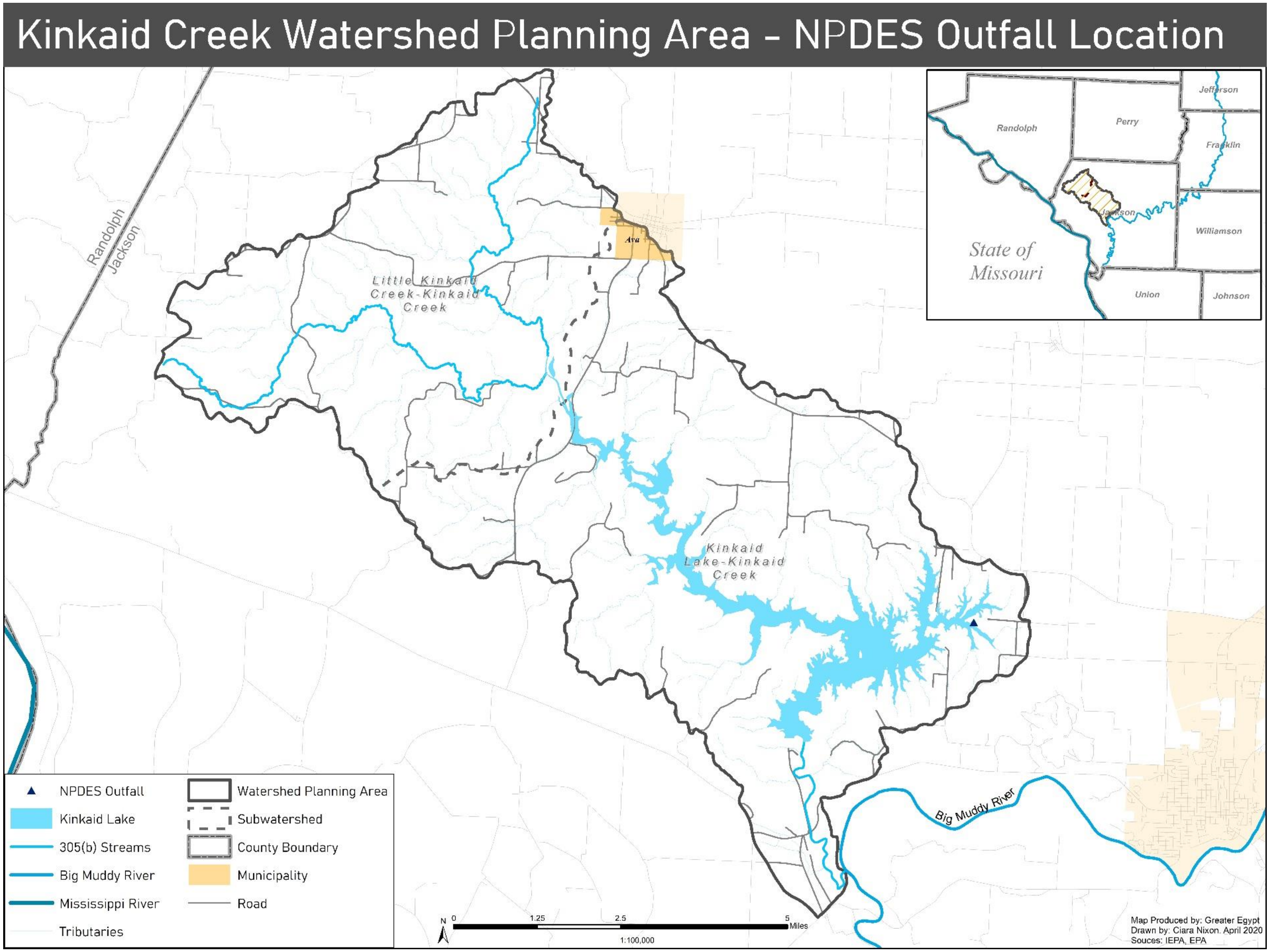
Source: U.S. EPA

Jackson County Emergency Management Agency (JCEMA)

JCEMA was established to implement programs that work to reduce community vulnerability to natural hazards. The JCEMA oversees creating and implementing mitigation and informational frameworks to prevent or lower the impact of natural hazards, such as flooding. Actions carried out by the agency have made federal flood insurance available for the public while outlining important building codes to reduce flood damage and hazards. The agency also works to improve the water quality in Jackson County by reducing soil erosion and protecting aquatic and riparian habitat. Other goals of the agency are to provide recreational opportunities and aesthetic benefits to enhance the community and economic development.[20]

[19] Scott Ristau, e-mail message to author, September 9, 2015.
[20] "Flood Damage Prevention Ordinance," http://www.jacksoncounty-il.gov/home/showdocument?id=474 Accessed September 2019

Figure 2.17


Kinkaid Creek Watershed Planning Area - NPDES Outfall Location
Randolph
Jackson
Little Kinkaid Creek-Kinkaid Creek
Ava
Kinkaid Lake-Kinkaid Creek
Big Muddy River
Randolph
Perry
Jefferson
Franklin
Jackson
Williamson
State of Missouri
Union
Johnson
NPDES Outfall
Kinkaid Lake
305(b) Streams
Big Muddy River
Mississippi River
Tributaries
Watershed Planning Area
Subwatershed
County Boundary
Municipality
Road
N
0
1.25
2.5
5
Miles
1:100,000
Map Produced by: Greater Egypt
Drawn by: Ciara Nixon. April 2020
Souces: IEPA, EPA

Jackson County Health Department (JCHD)

The Jackson County Health Department has provided a variety of public health services to the residents of Jackson County since 1950. One of their main focuses is to protect the environment. The health department has held recycling drop-off services and collaborated with other agencies to form a Climate and Health Plan to help the Jackson County community prepare for the health effects of climate change.[21]

Jackson County Soil and Water Conservation District (JCSWCD)

The Soil and Water Conservation Districts within Jackson County implement several programs in relation to conserving natural resources. Some of their programs include implementing conservation practices for farming that reduce soil loss, and environmental sustainability. [22] Duties related to water resources include the conservation and restoration of wetlands, the protection of groundwater resources, and the prevention of soil erosion.

In the Kinkaid Creek watershed planning area, JCSWCD assisted with an in-depth study of the watershed to identify and map locations of critical erosive areas and sources of sediment. *"Component 1-6 of a Watershed Plan for Kinkaid Lake"* provides a list of structures that JCSWCD assisted with, both technical and financial.

In previous years, JCSWCD sponsored annual programs and workshops that brought students and the community to learn about watershed management along Kinkaid Lake. These programs were discontinued in the area due to the annual Du Quoin State Conservation Fair.[23]

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[21] "Jackson County Health Department," http://www.jchdonline.org/ Accessed September 2019
[22] AISWCD. "Association of Illinois Soil and Water Conservation Districts AISWCD," http://www.aiswcd.org/. Accessed 14 July 2015.
[23] "Components 1-6 of a Watershed Plan for Kinkaid Lake" Accessed December, 2019

Kinkaid-Reed's Creek Conservation District (KRCCD)

The Kinkaid-Reed's Creek Conservancy District oversees 300 acres of land around Kinkaid Lake. The KRCCD runs the water plant that provides drinking water from Lake Kinkaid to residents and businesses in the surrounding area. The district participates in IEPA's Volunteer Lake Monitoring Program, contributing water quality planning and management initiatives within the area.

Throughout the years, KRCCD has assisted with numerous projects, both financially and technically, to evaluate and mitigate siltation and shoreline erosion along Lake Kinkaid. Efforts include, but are not limited to, mapping out erosive areas, utilizing multiple forms of shoreline stabilization techniques, creating an erosion control demonstration area, hosting lake clean-up days, and even purchasing farmland within the surrounding area that was previously a contributor of silt deposition. KRCCD continues their part in improving the water quality of Kinkaid Lake.

On a day-to-day basis, the district oversees operations for the Kinkaid Marina and Campground, Johnson Creek Recreation Area and Paul Ice Recreation Area, dealing closely with erosion and pollution control within these areas. The district administers permits for camping, horseback riding, and ATV use within designated areas around Kinkaid Lake.

Kinkaid Area Watershed Project (KAWP)

The Kinkaid Area Watershed Project was created in 1998 with a goal solely set on improving the water quality of Lake Kinkaid, specifically by combating siltation. KAWP has previously focused on critical areas that have been significantly altered by degradation, such as the Port of Ava. An inventory on the Kinkaid Watershed was published in November of 2000, "*Components 1-6 of a Watershed Plan for Kinkaid Lake*", with a large contribution from the Project's Planning Committee.[24] This plan was then followed by a Final Report, published in May of 2003. "*The Upper Kinkaid Lake Watershed Evaluation- Final Report*" includes a full review of the water quality reports of Kinkaid

[24] Ibid. 10

Lake as well as "Alternatives for Reducing Soil erosion and Sediment Delivery to the Lake".[25]

The KAWP contributed largely to these two reports, and continues to work towards these planning initiatives today by participating in water sampling, watershed planning initiatives, such as forming a Planning Committee and hosting informative workshops, and recommending technical and structural management practices, as well as contributing to receive funding for these projects. Much of the work done by the KAWP is volunteer contribution.[26]

United States Forest Service- Shawnee National Forest (USFS- SNF)

The U.S. Forest Service (USFS) has worked to sustain forests and grasslands of the nation for 115 years. The USFS provides management for a variety of land types to support multiple land uses, including water quality. Grants through the Service are available to assist with financial needs, while agreements are also provided to assist with technical projects.

The U.S. Forest Service- Shawnee National Forest manages approximately 5,000 acres of land within the Kinkaid Creek Watershed Planning Area. The USFS- SNF manages the Johnson Creek Recreation Area, located along the northwest section of Kinkaid Lake. Areas within the USFA- SNF jurisdiction offer designated picnicking, camping, hiking and swimming areas in and around Kinkaid Lake.[27]

Management initiatives completed by the USFS within the planning area include: maintaining trail systems, thinning tree stands, tree harvesting and replanting, site preparation, and prescribed burns. More recently, the Forest Service has continued surveying Kinkaid Lake for troublesome areas that are contributing siltation in the lake.[28]

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[25] "Upper Kinkaid Lake Watershed Evaluation – Final Report (May 3, 2003)" Accessed December, 2019
[26] Ibid. 10
[27] Ibid. 4
[28] USDA-NRCS. "Joint Chiefs' Landscape Restoration Partnership-Illinois" https://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/programs/initiatives/?cid=nrcseprd1455463 Accessed December, 2019.

United States Fish and Wildlife Service (U.S.FWS)

The USFWS works with many facets of government to oversee projects in water resource development, conservation planning, and natural resource damage assessment. In coordination with the United States Army Corps of Engineers (USACE) and other state agencies, the USFWS assists in developing resource projects for federal waters. These projects consist of dams, harbor development, flood control, and water storage. Under a collection of policies, the USFWS and the USACE collaborate to conserve the habitats of fish and wildlife during resource development. [29]

Along with water resource development, the agency also collaborates with multiple agencies by providing conservation planning assistance. USFWS staff assists organizations with developing plans of conservation and restoration that accompany their specific objectives of development. [30]

United States Army Corps of Engineers (USACE)

The United States Army Corps of Engineers St. Louis District is responsible for the preservation and maintenance of waterways within its jurisdiction. Their jurisdiction includes an area which covers eastern Missouri and southwestern Illinois. The Corps is responsible for maintaining the data associated with the waterbodies within its district. Stations in closest proximity to the Kinkaid Creek Watershed Planning Area include Murphysboro and Plumfield which are located along the Big Muddy River.[31]

The Corps is also responsible for water control operations which consist of four Mississippi River navigation structures and five multi-purpose reservoirs within the district that include Rend Lake, located northeast of the Kinkaid Creek Watershed Planning Area.[32]

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[29] USFWS. "Water Resource Development- Ecological Services," https://www.fws.gov/ecological-services/energy-development/water.html. Accessed Various Dates 2018.
[30] USFWS. "Ecological Services- Conservation Planning," https://www.fws.gov/ecological-services/about/what-we-do.html. Accessed Various Dates 2018.
[31] USACE. "St. Louis District- Water Management USACE," http://mvs-wc.mvs.usace.army.mil/. Accessed September 2019.
[32] Ibid.

United States Department of Agriculture Natural Resources Conservation Service (USDA-NRCS)

The NRCS is a branch of the USDA that provides assistance to landowners by financial and technical means. Financial assistance programs provided by the agency include: Environmental Quality Incentives Program (EQIP), Conservation Stewardship Program (CSP) and Agricultural Management Assistance Program (AMA). These programs assist landowners with agricultural and environmental improvements on their land.[33]

Technical assistance through the department is provided through the Conservation Technical Assistance Program (CTA). The CTA covers a variety of components and includes utilizing land management technology and improving and protecting water quality and fish habitat.[34]

In the past, the NRCS has assisted with mapping the shorelines of Kinkaid Lake to form an erosion inventory for the area and locate sources of sedimentation. Recently, the department has partnered up USDA's Forest Service under the Joint Chief's Landscape Restoration Partnership. This grant provided funding for projects aimed at aiding erosion around Kinkaid Lake.[35] This grant has made possible the most recent siltation study available on the area. Recent studies have continued to prioritize problematic areas in preparation for future planning and management initiatives.

[34]USDA-NRCS. "Technical Assistance," https://www.nrcs.usda.gov/wps/portal/nrcs/main/national/programs/technical/. Accessed May, 2019.
[35] USDA-NRCS. "Joint Chiefs' Landscape Restoration Partnership-Illinois" https://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/programs/initiatives/?cid=nrcseprd1455463 Accessed December, 2019.

2.5. Watershed Demographics

To assess the demographics of the Kinkaid Creek watershed planning area, each entity was individually examined. The planning area lies entirely within Jackson County. There are six townships within the borders of the watershed planning area, and just one municipality. The City of Ava is the only municipality within the planning area, and is located in the northern section of the watershed planning area.

2.5.1. Population

According to the 2020 Census, the population of Jackson County is 52,974.[36] Less than half, or 37.9 percent of the municipality, is within the border of the planning area. The city of Ava has a population of 553 people based on the 2020 Census.[37] *Table 2.13* shows the population change from the 2010 Census.

Table 2.13- Population Change (2010-2020)

County/Municipality	Population 2010	Population 2020	Population Change	Population Change (%)
County				
Jackson	60,218	52,974	-7,244	-12%
Municipality				
Ava	654	553	-101	-15%

Source: U.S. Census Bureau

The Illinois Department of Public Health (IDPH) projects the population by state and county in 5-year intervals. *Table 2.14* shows the population projection for Jackson County for the years 2015, 2020 and 2025. According to the forecast, Jackson County may see a slight increase in populations until 2025.[38] IDPH and the U.S. Census Bureau estimations differ slightly, due to having slightly different methods of gathering this data. The data used in these tables reflect Jackson County as a whole and does not represent the sections only within the Kinkaid Creek Watershed Planning Area.

[36] U.S. Census Bureau "Explore Census Data" https://data.census.gov/cedsci/
[37] Ibid.
[38] IDPH "Population Projections" http://dph.illinois.gov/sites/default/files/publications/population-projections-report-final-2014-041516.pdf Accessed March, 2020.

The 2010 population estimate from IDPH was 60,355 people within Jackson County. The 2010 census counted 60,218 people. IDPH estimated that the county population would increase to 61,025, or by 807 people between 2010 and 2015. The 2020 estimation was 62,031 people, a 1,006 person increase between 2015 and 2020. Between 2020 and 2025, IDPH estimates that the population of Jackson County will increase by 787 people, with a total population of 62,818 people.[39]

Table 2.14 - Population Forecast

County	April 1st, 2010 Census	2010 Estimate	2015 Forecast	2020 Forecast	2025 Forecast
Jackson	60,218	60,355	61,025	62,031	62,818

Source: IDPH

2.5.2. Median Age and Income

The tables below summarize the median age and income for Jackson County, Ava, and by township, while the following maps depict this data.

Table 2.15- Median Age and Median Household Income

Area of Interest	Median Age	Median Household Income
Jackson	32.1	$ 39,689
Ava	35.2	$ 47,262

Source: U.S. Census Bureau

Table 2.16 - Median Age and Median Income by Township

[39] Ibid. 3

Township	Median Age Estimate	Median Household Income Estimate
Bradley	40.9	$58,167
Degognia	29.9	$138,750
Kinkaid	51.9	$42,857
Levan	48.1	$70,139
Ora	24.1	$60,417
Sand Ridge	26.5	$46,125

Source: U.S. Census Bureau

2.5.3. Employment

In January 2020, Illinois Department of Employment Security's Unemployment Rate was at 3.5 percent rate for Jackson County. This is compared to the 3.5 percent rate for the state of Illinois, and 3.6 percent rate for the United States.[40]

JobsEQ database was used to gather employment information for Jackson County. In 2019, the county had a total of 26,766 employed persons between twenty-two occupations. That is 1,181 more employed persons than in 2018, when only 25,585 people were employed between twenty-three jobs. The top three occupations that employ the most people are: Office and Administrative Support, employing 3,752 people, Education, Training and Library, which employs 3,249 people, and Food Preparation and Serving Related occupations, which employ 2,597 people. The top three jobs in regards to annual salary is: Management, with an average annual salary of $76,600, Architect and Engineering, which only employs 234 people with an annual salary of $75,200, Healthcare Practitioners and Technical occupations come in third with an annual salary of $74,700. Employment information for Jackson County, IL has also been provided in *Table 2.17.*

The City of Ava, with a population of just over 600, does not meet JobsEQ population minimum to form a complete occupation review.

[40] Illinois Department of Employment Security "Illinois Unemployment Rate by County," Accessed March 31, 2020

Table 2.17 - Jackson County Employment Information

Title	Number of Employees	Average Annual Salary	Location Quotient	Unemployment Numbers	Unemployment Rate
Office and Administrative Support	3,752	$34,100	0.98	145	4.20%
Education, Training, and Library	3,249	$56,600	2.17	135	3.80%
Food Preparation and Serving Related	2,597	$23,900	1.13	151	6.70%
Sales and Related	2,514	$30,300	0.96	131	5.60%
Healthcare Practitioners and Technical	2,184	$74,700	1.42	37	1.70%
Management	1,864	$76,600	1.12	40	2.00%
Transportation and Material Moving	1,313	$36,200	0.7	56	4.80%
Construction and Extraction	1,105	$57,500	0.9	42	4.80%
Business and Financial Operations	1,088	$62,800	0.77	41	3.30%
Installation, Maintenance, and Repair	916	$42,800	0.89	17	2.40%
Healthcare Support	900	$29,500	1.22	27	3.40%
Production	843	$36,200	0.53	28	3.80%
Building and Grounds Cleaning and Maintenance	768	$31,200	0.83	37	5.40%
Personal Care and Service	750	$27,600	0.64	34	4.90%
Protective Service	581	$46,700	1.01	17	2.90%
Computer and Mathematical	565	$64,700	0.72	18	2.90%
Community and Social Service	549	$41,200	1.21	19	2.40%
Arts, Design, Entertainment, Sports, and Media	377	$50,100	0.78	19	4.60%
Life, Physical, and Social Science	330	$53,800	1.55	10	3.10%
Architecture and Engineering	234	$75,200	0.51	6	2.20%
Legal	172	$72,900	0.78	2	1.30%
Farming, Fishing, and Forestry	116	$27,200	0.68	7	7.60%
Total - All Occupations	**26,766**	**$46,100**	**1**	**1,018**	**3.90%**

Source: JobsEQ

2.6. Land Use

For the land use portion of this inventory, the USGS Multi-Resolution Land Characteristics Consortium (MRLC) land cover and impervious datasets were used to complete the analyses, as well as USDA's 2019 National Agricultural Statistics Service CropScape for the agricultural portion of the review.

2.6.1. Existing Land Use

The largest land use category in the Kinkaid Creek planning area is forest. This category consists of three distinct classifications including deciduous, evergreen, and mixed forest, which in total span 25,278 acres, or 61.3 percent of the watershed. Deciduous forest has the largest land area of 23,796 acres, or 57.7 percent of the watershed. The breakdown of classifications is available in *Table 2.18.* Definitions for these land type classifications can be found in Appendix C.

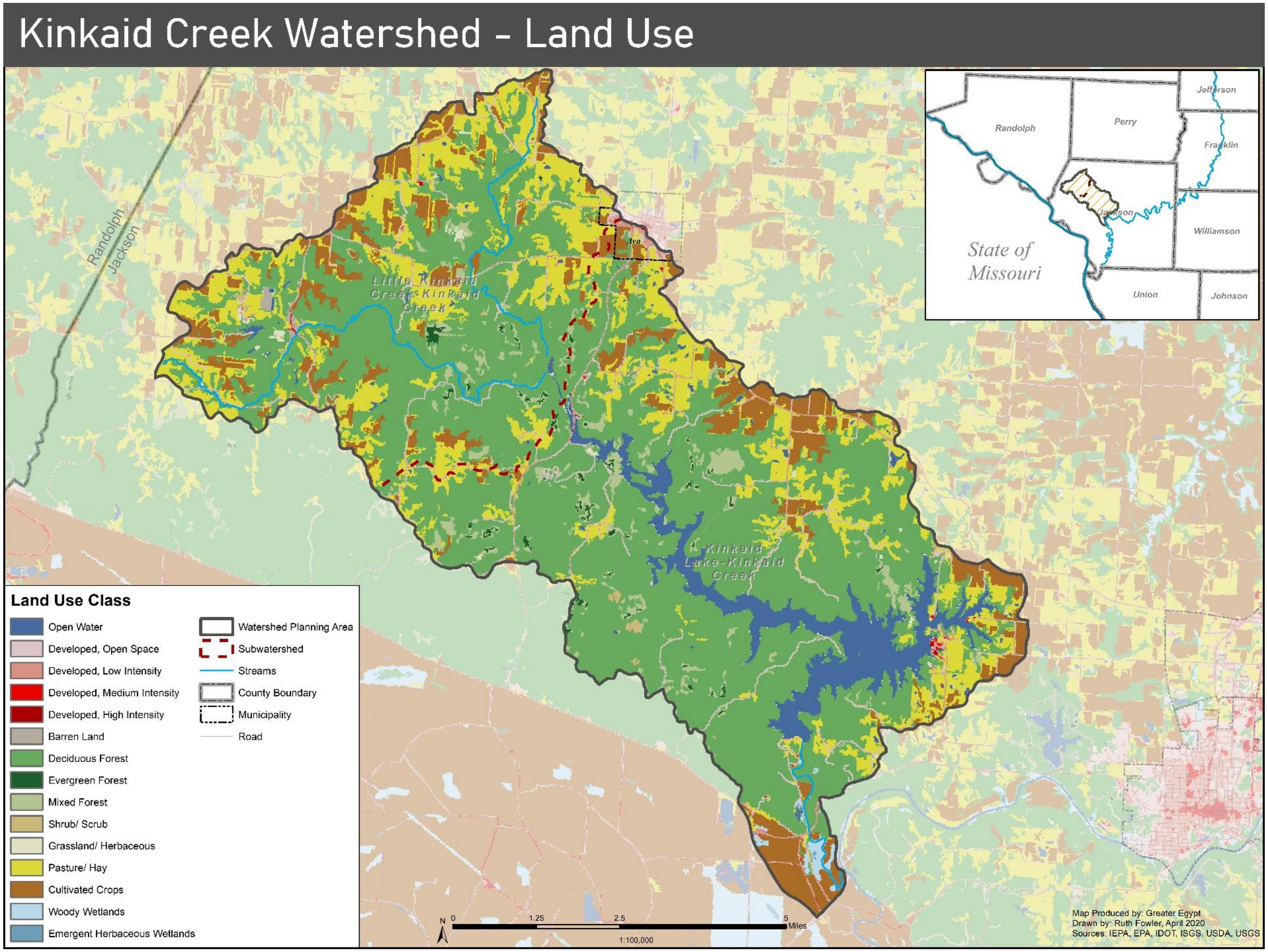
The remaining land uses in the watershed are: developed areas (4 %), open water (6.1 %), barren land (0.19 %), grassland/herbaceous (0.38 %), pasture/hay (17.6 %), cultivated crops (9.8 %), and wetlands (0.38 %).

Table 2.18 - Land Use Classification for Kinkaid Creek Watershed

Classification	Acreage	Percent of Watershed
Open Water	2,500.7	6.1%
Developed, Open Space	1,075.0	2.6%
Developed, Low Intensity	576.9	1.4%
Developed, Medium Intensity	33.4	<1%
Developed, High Intensity	5.3	<1%
Barren Land	77.6	<1%
Deciduous Forest	23,795.8	57.7%
Evergreen Forest	164.3	<1%
Mixed Forest	1,318.1	3.2%
Shrub/Scrub	61.6	<1%
Grassland/ Herbaceous	155.0	<1%
Pasture/ Hay	7,258.4	17.6%
Cultivated Crops	4,047.1	9.8%
Woody Wetlands	140.8	<1%
Emergent Herbaceous Wetlands	16.0	<1%

Source: USGS Multi-Resolution Land Use Characteristics Consortium (MRLC)

Figure 2.18


Kinkaid Creek Watershed - Land Use
Randolph
Jackson
Little Kinkaid Creek-Kinkaid Creek
Kinkaid Lake-Kinkaid Creek
Ava
Jefferson
Randolph
Perry
Franklin
Jackson
Williamson
State of Missouri
Union
Johnson
Land Use Class
Open Water
Developed, Open Space
Developed, Low Intensity
Developed, Medium Intensity
Developed, High Intensity
Barren Land
Deciduous Forest
Evergreen Forest
Mixed Forest
Shrub/ Scrub
Grassland/ Herbaceous
Pasture/ Hay
Cultivated Crops
Woody Wetlands
Emergent Herbaceous Wetlands
Watershed Planning Area
Subwatershed
Streams
County Boundary
Municipality
Road
N
0
1.25
2.5
5
Miles
1:100,000
Map Produced by: Greater Egypt
Drawn by: Ruth Fowler, April 2020
Sources: IEPA, EPA, IDOT, ISGS, USDA, USGS

According to the NRCS Soil Survey of Jackson County, "the main concerns affecting the management of cropland in Jackson County include crusting, flooding, ponding, poor tilth, water erosion, and wetness. Equipment limitations, high pH, limited available water capacity, limited rooting depth, low pH, and restricted permeability are additional concerns."[41]

Along with problems affecting cropland, there are also concerns regarding pastureland. These concerns are, "low fertility, low pH, water erosion, and wetness. Additional management concerns include equipment limitations, excessive permeability, flooding, frost heave, high pH, limited available water capacity, ponding, poor tilth, root-restrictive layers, and wind erosion."[42]

According to the 2017 Census of Agriculture (USDA), farming in Jackson County consists mainly of soybeans, corn, wheat, forage-land used for all haulage, and sorghum for grain. Farmers in Jackson County are predominately middle-aged white males. [43]

Cultivation within the Kinkaid Creek planning area follows a very similar pattern. Based on the USDA's National Agriculture Statistics Service CropScape [44], the planning area contains approximately 5,704 acres of agricultural land. *Table 2.19* displays the types of cultivation found within the planning area. *Figure 2.19* shows the location of the various crops. Accounting for about 2,335 acres, soybeans are the largest form of cultivation. Corn is also heavily cultivated at about 1,887 acres. *Figure 2.20* also shows land use from the most current aerial photographs, provided by the Jackson County Assessor's Office.

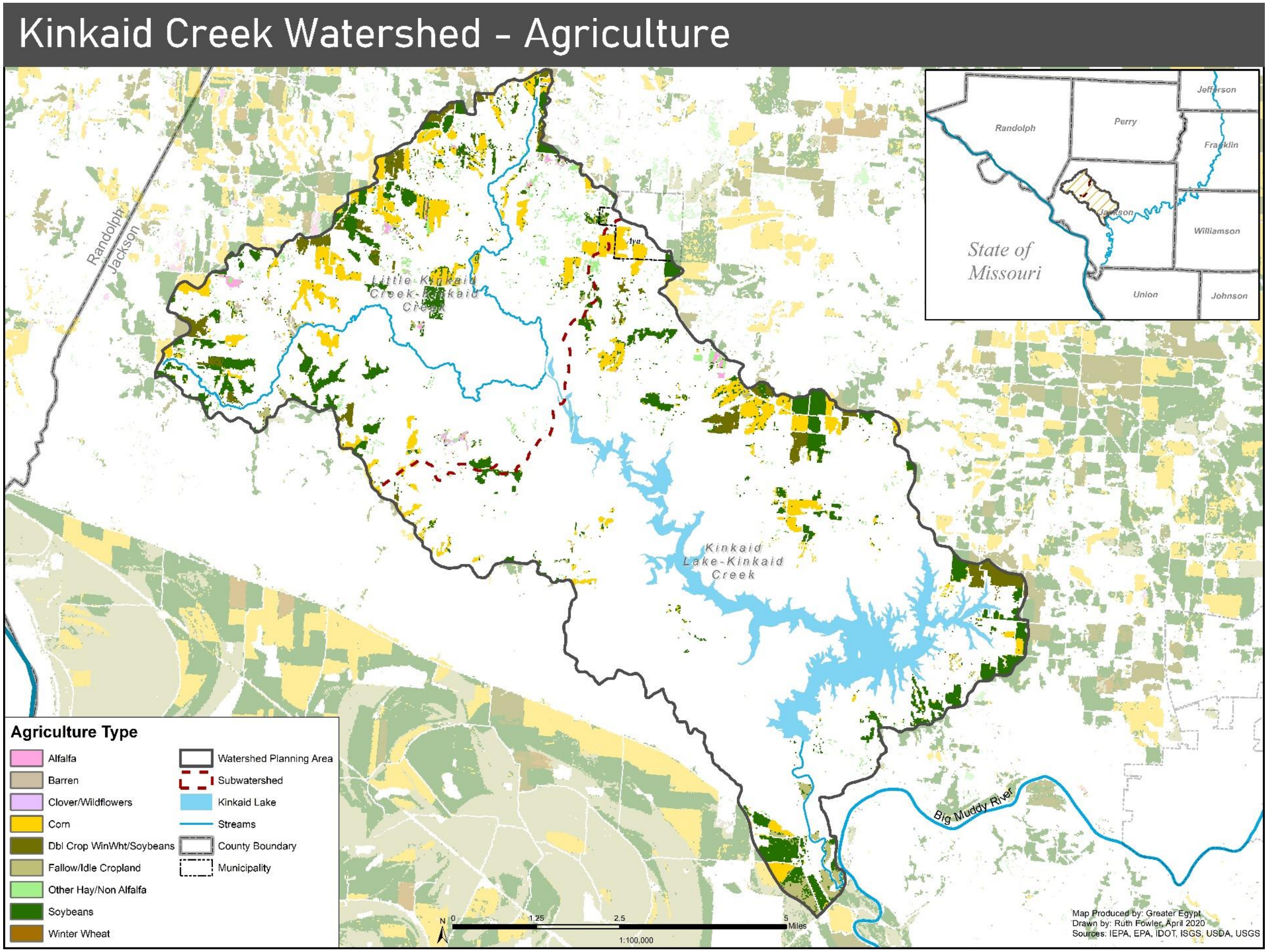
[41] USDA NRCS. "Soil Survey of Jackson County, Illinois," Published Soil Surveys for Illinois, 2009, 146
[42] Ibid., 149.
[43] Census of Agriculture. "2017 Census Publications," USDA, 2017, 1-2.
[44] *CropScape* (2019). USDA. National Agricultural Statistics Service, 2019.

Table 2.19- Agricultural Diversity in Watershed Planning Area

Agricultural Classification	Acreage	Percent of Agriculture	Percent of Watershed
Corn	1,887.7	33.1%	4.58%
Soybeans	2,335.4	40.9%	5.66%
Winter Wheat	20.2	<1%	0.05%
Dbl Crop WinWht/Soybeans	668.3	11.7%	1.62%
Alfalfa	88.3	1.5%	0.21%
Other Hay/Non Alfalfa	346.3	6.1%	0.84%
Clover/Wildflowers	12.0	<1%	0.03%
Fallow/ Idle Cropland	299.3	5.2%	0.73%
Barren	46.7	<1%	0.11%

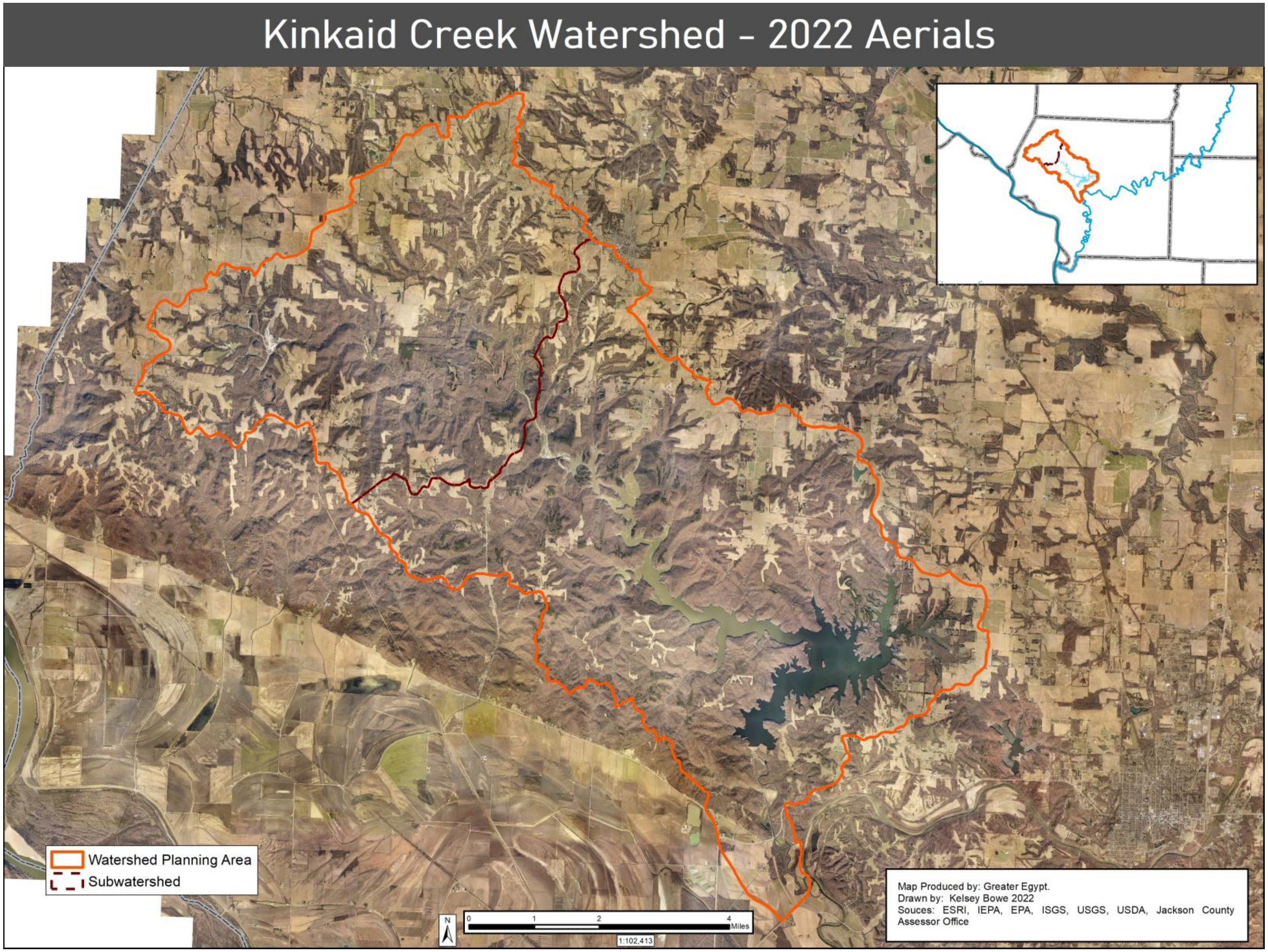
Source: USDA, CropScape

Figure 2.19



Kinkaid Creek Watershed - Agriculture
Randolph
Jackson
Little Kinkaid Creek-Kinkaid Creek
Ava
Kinkaid Lake-Kinkaid Creek
Big Muddy River
Randolph
Perry
Jefferson
Franklin
Jackson
Williamson
State of Missouri
Union
Johnson
Agriculture Type
Alfalfa
Barren
Clover/Wildflowers
Corn
Dbl Crop WinWht/Soybeans
Fallow/Idle Cropland
Other Hay/Non Alfalfa
Soybeans
Winter Wheat
Watershed Planning Area
Subwatershed
Kinkaid Lake
Streams
County Boundary
Municipality
N
0 1.25 2.5 5 Miles
1:100,000
Map Produced by: Greater Egypt
Drawn by: Ruth Fowler, April 2020
Sources: IEPA, EPA, IDOT, ISGS, USDA, USGS

Figure 2.20


Kinkaid Creek Watershed - 2022 Aerials
Watershed Planning Area
Subwatershed
Map Produced by: Greater Egypt.
Drawn by: Kelsey Bowe 2022
Souces: ESRI, IEPA, EPA, ISGS, USGS, USDA, Jackson County Assessor Office
0 1 2 4 Miles
1:102,413
N

2.6.2. Projected Future Land Use

To estimate the future land cover for the Kinkaid Creek planning area, land cover from past datasets have been analyzed. Land cover datasets from 2006 and 2016 were used to compare past changes in land use.

The USGS Multi-Resolution Land Characteristics Consortium (MRLC) has land use data for the year 2008, 2011, and 2013, but for the purpose of this analysis, the period from 2006 to 2016 gives the most accurate representation of current land use change within the watershed. *Table 2.20* displays the acreage and percent of watershed of each land use classification for 2006 and 2016.

The percent of change from those years, predicted acreage, and percent change of each classification are also displayed.

Assuming development in the area will remain constant, the raw change from 2006 to 2016 was used to calculate the 2026 predicted acreage and predicted percent change of each classification. The most notable change in the watershed involves the increase of cultivated crops and decrease in pastureland. Cultivated crops are projected to increase by 356.7 acres (9.7%), whilst pastureland is projected to decrease by 441 acres (5.7%).

Table 2.20 - Past and Projected Land Cover for the Planning Area

Land Use Classification	Kinkaid Creek Watershed Planning Area							
	2006		2016		2006-2016		2016-2026	
	Acreage	Percent of Watershed	Acreage	Percent of Watershed	Change (Acreage)	Percent Change	Projected Acreage (2026)	Projected Percent Change
Open Water	2,464.2	6.0%	2,500.7	6.1%	36.5	1.5%	2,537.2	1.5%
Developed, Open Space	1,075.2	2.6%	1,075.0	2.6%	-0.2	0.0%	1,074.8	0.0%
Developed, Low Intensity	577.1	1.4%	576.9	1.4%	-0.2	0.0%	576.6	0.0%
Developed, Medium Intensity	33.6	<1%	33.4	<1%	-0.2	-0.7%	33.1	-0.7%
Developed, High Intensity	4.7	<1%	5.3	<1%	0.7	14.3%	6.0	12.5%
Barren Land	78.1	<1%	77.6	<1%	-0.4	-0.6%	77.2	-0.6%
Deciduous Forest	23,803.6	57.7%	23,795.8	57.7%	-7.8	0.0%	23,788.0	0.0%
Evergreen Forest	143.0	<1%	164.3	<1%	21.3	14.9%	185.7	13.0%
Mixed Forest	1,316.5	3.2%	1,318.1	3.2%	1.6	0.1%	1,319.6	0.1%
Shrub/Scrub	47.6	<1%	61.6	<1%	14.0	29.4%	75.6	22.7%
Grassland/ Herbaceous	134.3	<1%	155.0	<1%	20.7	15.4%	175.7	13.3%
Pasture/ Hay	7,699.1	18.7%	7,258.4	17.6%	-440.7	-5.7%	6,817.6	-6.1%
Cultivated Crops	3,690.4	9.0%	4,047.1	9.8%	356.7	9.7%	4,403.8	8.8%
Woody Wetlands	141.0	<1%	140.8	<1%	-0.2	-0.2%	140.5	-0.2%
Emergent Herbaceous Wetlands	17.6	<1%	16.0	<1%	-1.6	-8.9%	14.5	-9.7%

Source: USGS MRLC

2.6.3. Existing and Projected Imperviousness

As a whole, the Kinkaid Creek planning area has an extremely low level of imperviousness with ninety-six percent of the total land area being categorized as zero percent impervious. Imperviousness has been characterized by acreage and percent of the planning area by intervals of ten percent (See *Table 2.21*). These intervals have also been depicted spatially in *Figure 2.20*. As stated previously, 39,535 acres, or ninety-six percent, consists of non-existing impervious cover. This is a major contrast to the amount and characterized as 90-100 percent impervious, which is less than an acre. The more impervious locations in the Kinkaid Creek planning area occur near the town of Ava.

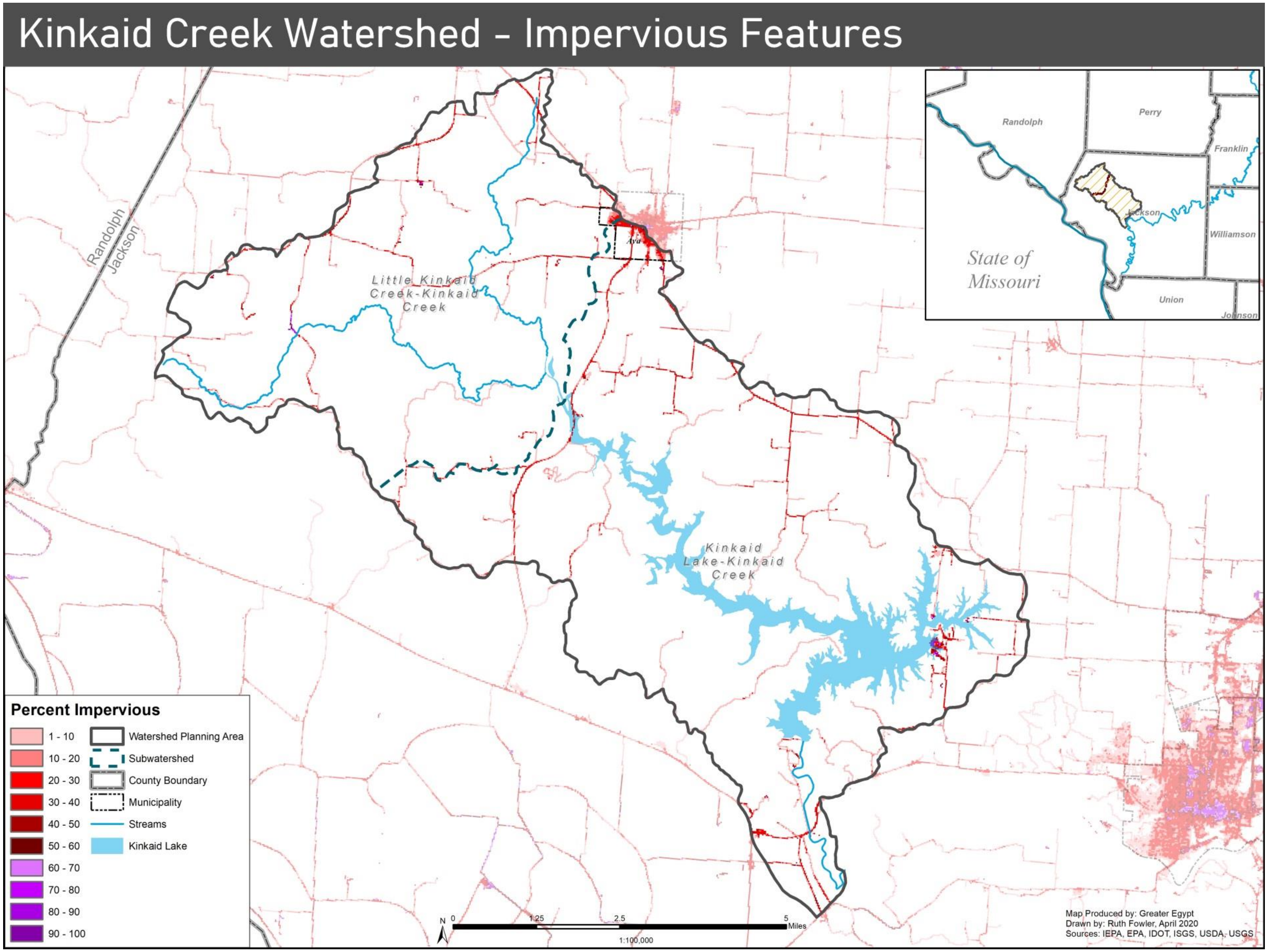
Following the same method to predict future land use, impervious land cover from past and existing datasets was analyzed. Impervious land cover from the 2006 and 2016 datasets were utilized to compare past and present variations in imperiousness. *Table 2.21* also displays the predicted percent of change and acreage to the year 2026. Levels of imperviousness are projected to minimally change by 2026. Projected change will not be noticeable, as no change in imperviousness is projected to be greater than an acre.

Table 2.21 - Existing and Projected Imperviousness in the Watershed

Percent Imperviousness	Kinkaid Creek Watershed							
	2006		2016		2006-2016		2016-2026	
	Acreage	Percent of Watershed	Acreage	Percent of Watershed	Change (Acres)	Percent Change	Projected Acreage (2026)	Projected Percent Change
0%	39,535.4	95.9%	39,535.4	95.9%	0.0	0.0%	39,535.4	0.0%
0-10%	763.4	1.9%	763.2	1.9%	-0.2	0.0%	763.0	0.0%
10-20%	353.4	<1%	353.4	<1%	0.0	0.0%	353.4	0.0%
20-30%	350.5	<1%	350.5	<1%	0.0	0.0%	350.5	0.0%
30-40%	149.9	<1%	149.4	<1%	-0.4	-0.3%	149.0	-0.3%
40-50%	37.4	<1%	37.6	<1%	0.2	0.6%	37.8	0.6%
50-60%	16.7	<1%	16.5	<1%	-0.2	-1.3%	16.2	-1.4%
60-70%	9.1	<1%	9.1	<1%	0.0	0.0%	9.1	0.0%
70-80%	6.0	<1%	6.2	<1%	0.2	3.7%	6.4	3.6%
80-90%	3.8	<1%	4.0	<1%	0.2	5.9%	4.2	5.6%
90-100%	0.4	<1%	0.7	<1%	0.2	50.0%	0.9	33.3%

Source: USGS MRLC

Figure 2.21


Kinkaid Creek Watershed - Impervious Features
Randolph
Jackson
Little Kinkaid Creek-Kinkaid Creek
Kinkaid Lake-Kinkaid Creek
Ava
Randolph
Perry
Franklin
Jackson
Williamson
State of Missouri
Union
Johnson
Percent Impervious
1 - 10
10 - 20
20 - 30
30 - 40
40 - 50
50 - 60
60 - 70
70 - 80
80 - 90
90 - 100
Watershed Planning Area
Subwatershed
County Boundary
Municipality
Streams
Kinkaid Lake
N
0
1.25
2.5
5
Miles
1:100,000
Map Produced by: Greater Egypt
Drawn by: Ruth Fowler, April 2020
Sources: IEPA, EPA, IDOT, ISGS, USDA, USGS

2.6.4. Existing and Projected Land Use of the Subwatersheds (HUC 12)

2.6.4.1. Little Kinkaid Creek- Kinkaid Creek Subwatershed (071401061101)

Land use has been further analyzed by HUC 12 subwatershed. *Table 2.22* displays past, present, and projected land use cover by classification. The projected land cover values are based on the change from 2006 to 2016. *Table 2.22* displays the 2026 predicted values and percent change in land use in Little Kinkaid Creek- Kinkaid Creek subwatershed.

The most prevalent land use classifications in Kinkaid Creek subwatershed are forest and agriculture. Forested land accounts for almost fifty-five percent of the subwatershed and agriculture (includes pasture/hay and cultivated crops) accounts for nearly thirty-seven percent of land cover.

Forested land is most abundant in Middle Kinkaid Creek SMU and Upper Kinkaid Creek SMU. This is largely due to the presence of the Shawnee National Forest in the southern portion of Kinkaid Creek subwatershed. Agriculture land is most abundant in Upper Kinkaid Creek SMU and Upper Little Kinkaid Creek SMU, especially near the perimeter of the watershed boundary. Further analysis of each SMU can be found in *Appendix B.*

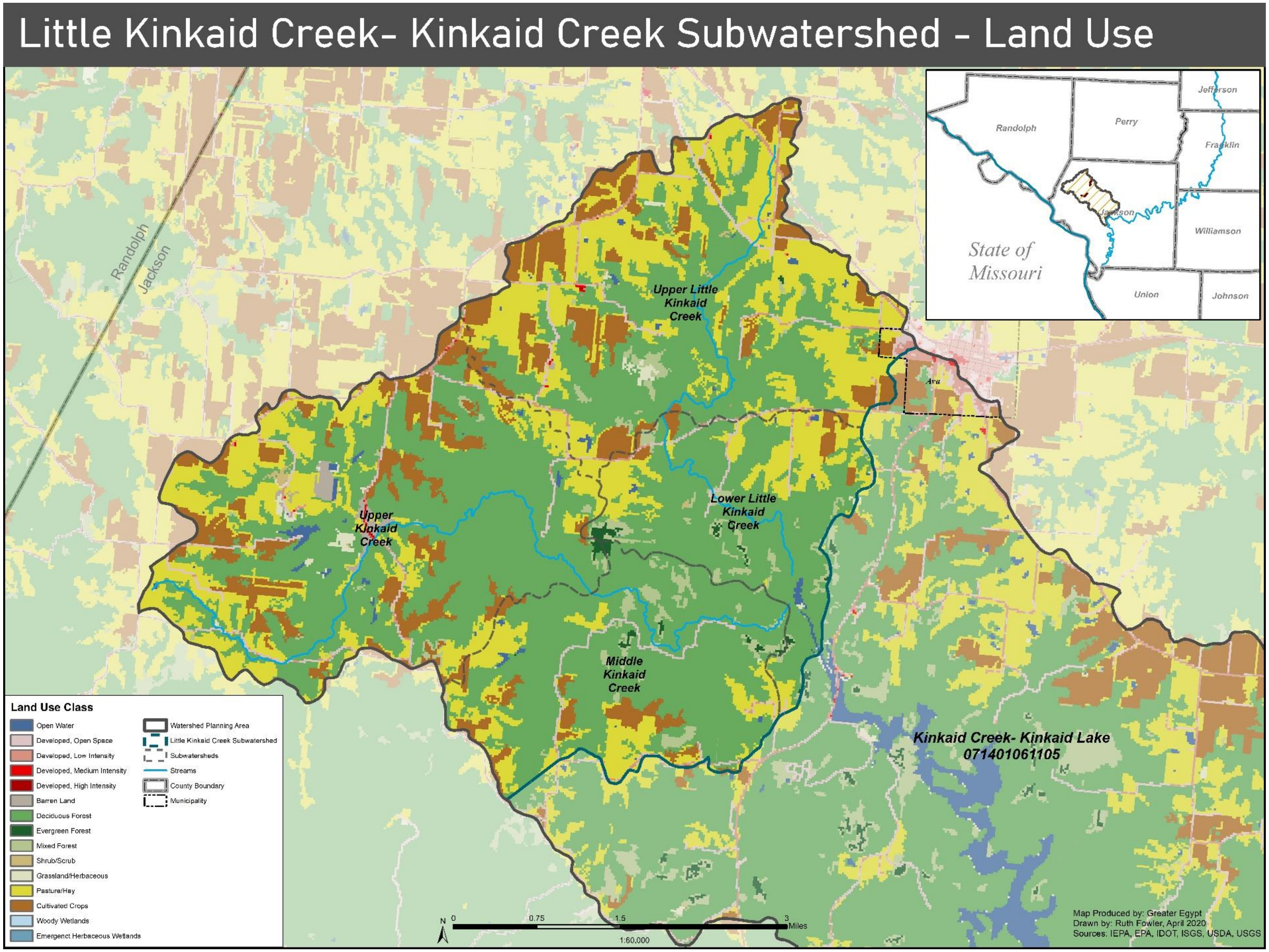
Little Kinkaid Creek subwatershed is projected to experience low levels of change throughout the subwatershed. The largest land use changes will occur among agriculture land use. Pasture/Hay is projected to decrease by almost four percent, or 153 acres, while cultivated crops are projected to increase by seven percent, or 126 acres. The largest change by SMU is projected to take place in Upper Kinkaid Creek SMU. Pasture/Hay is projected to decrease by almost seventy acres, while cultivated crops are projected to increase by nearly fifty acres.

Table 2.22 - Existing and Projected Subwatershed Land Use

Land Use Classification	Little Kinkaid Creek-Kinkaid Creek Subwatershed							
	2006		2016		2006-2016		2016-2026	
	Acreage	Percent of Watershed	Acreage	Percent of Watershed	Change (Acreage)	Percent Change	Projected Acreage (2026)	Projected Percent Change
Open Water	90.07	0.58%	100.52	0.65%	10.45	11.60%	110.98	10.40%
Developed, Open Space	369.40	2.38%	369.41	2.38%	0.00	0.00%	369.41	0.00%
Developed, Low Intensity	171.47	1.10%	171.47	1.10%	0.00	0.00%	171.47	0.00%
Developed, Medium Intensity	10.23	0.07%	10.23	0.07%	0.00	0.00%	10.23	0.00%
Developed, High Intensity	1.78	0.01%	1.78	0.01%	0.00	0.00%	1.78	0.00%
Barren Land	77.17	0.50%	76.51	0.49%	-0.67	-0.86%	75.84	-0.87%
Deciduous Forest	8,481.41	54.62%	8,480.29	54.62%	-1.12	-0.01%	8,479.17	-0.01%
Evergreen Forest	55.82	0.36%	55.82	0.36%	0.00	0.00%	55.82	0.00%
Mixed Forest	383.19	2.47%	383.86	2.47%	0.67	0.17%	384.53	0.17%
Shrub/Scrub	15.12	0.10%	18.68	0.12%	3.56	23.53%	22.24	19.05%
Grassland/ Herbaceous	55.82	0.36%	69.39	0.45%	13.57	24.30%	82.95	19.55%
Pasture/ Hay	4,114.60	26.50%	3,961.81	25.52%	-152.79	-3.71%	3,809.02	-3.86%
Cultivated Crops	1,700.24	10.95%	1,826.57	11.76%	126.33	7.43%	1,952.90	6.92%
Woody Wetlands	0.22	0.00%	0.22	0.00%	0.00	0.00%	0.22	0.00%
Emergent Herbaceous Wetlands	0.44	0.00%	0.44	0.00%	0.00	0.00%	0.44	0.00%

Source: USGS MRLC

Figure 2.22


Little Kinkaid Creek- Kinkaid Creek Subwatershed - Land Use
Randolph
Jackson
Upper Little Kinkaid Creek
Lower Little Kinkaid Creek
Upper Kinkaid Creek
Middle Kinkaid Creek
Ava
Kinkaid Creek- Kinkaid Lake 071401061105
Randolph
Perry
Jefferson
Franklin
Jackson
Williamson
State of Missouri
Union
Johnson
Land Use Class
Open Water
Developed, Open Space
Developed, Low Intensity
Developed, Medium Intensity
Developed, High Intensity
Barren Land
Deciduous Forest
Evergreen Forest
Mixed Forest
Shrub/Scrub
Grassland/Herbaceous
Pasture/Hay
Cultivated Crops
Woody Wetlands
Emergenct Herbaceous Wetlands
Watershed Planning Area
Little Kinkaid Creek Subwatershed
Subwatersheds
Streams
County Boundary
Municipality
N
0 0.75 1.5 3 Miles
1:60,000
Map Produced by: Greater Egypt
Drawn by: Ruth Fowler, April 2020
Sources: IEPA, EPA, IDOT, ISGS, USDA, USGS

2.6.4.2. Kinkaid Lake- Kinkaid Creek Subwatershed (071401061102)

Table 2.23 displays past, present, and projected land use cover by classification. The projected land cover values are based on the change from 2006 to 2016. *Table 2.23* also displays the 2026 predicted values and percent change in land use in Kinkaid Lake-Kinkaid Creek subwatershed.

The most prevalent land use classifications in Kinkaid Creek subwatershed are forest, agriculture, and open water. Forested land accounts for almost sixty- four percent of the subwatershed and agriculture (includes pasture/hay and cultivated crops) accounts for nearly twenty-two percent of land cover. Open water covers over nine percent of the subwatershed due to the presence of Kinkaid Lake. The majority of Kinkaid Lake is within the boundaries of Kinkaid Lake subwatershed.

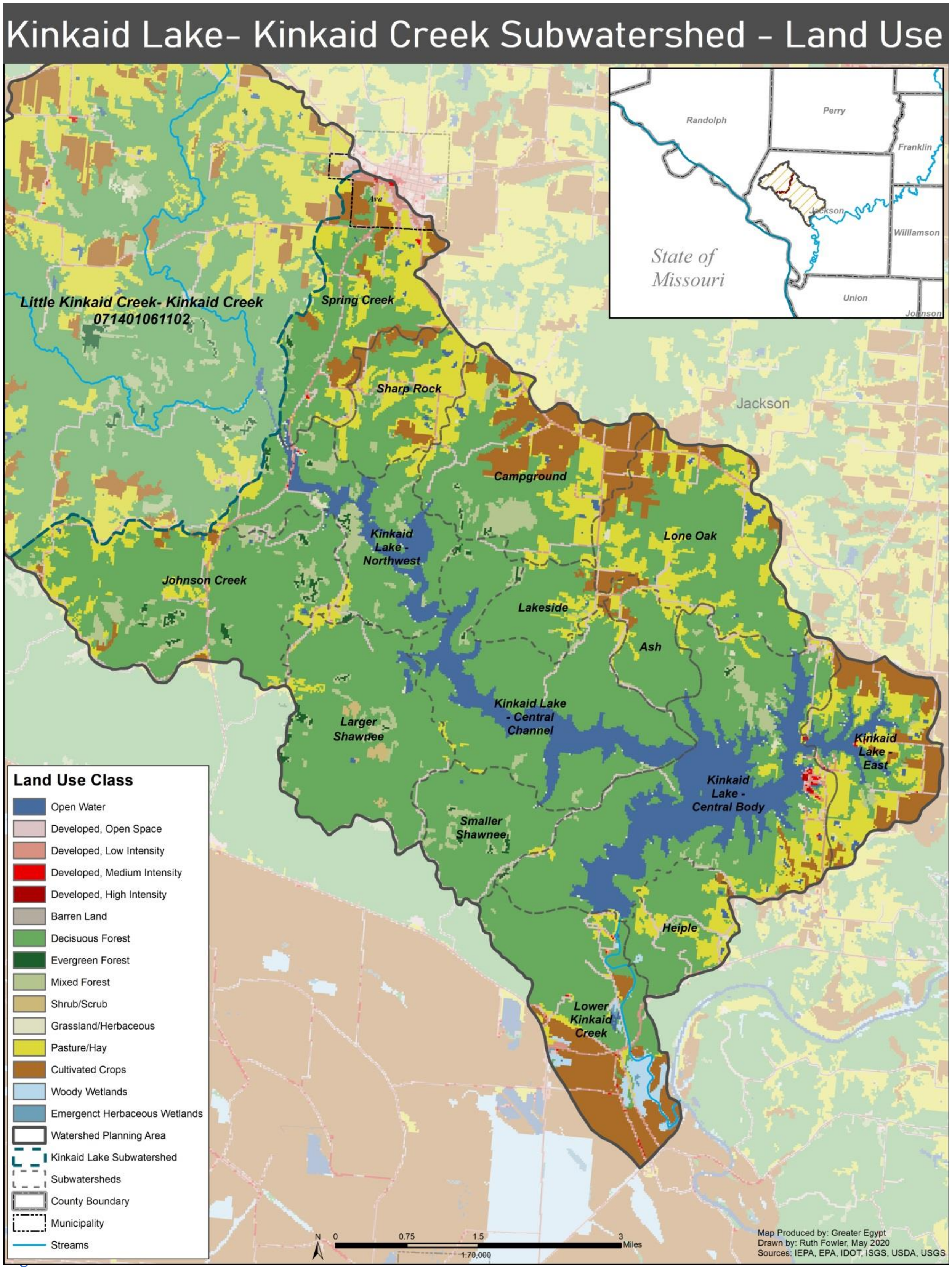
Forested land is most abundant in Johnson Creek, Larger Shawnee, Kinkaid Lake-Central Channel, and Kinkaid Lake- Central Body SMU. This is largely due to the presence of the Shawnee National Forest in the southern portion of Kinkaid Lake subwatershed. Agriculture land is concentrated more in the northern portion of the subwatershed and is most abundant in Sharp Rock, Lone Oak, and Campground SMU. Further analysis of each SMU can be found in Appendix B.

Kinkaid Lake subwatershed is projected to experience low levels of change throughout the subwatershed. Like Kinkaid Creek subwatershed, the largest land use changes will occur among agricultural land use. Pasture/Hay is projected to decrease by around 288 acres, or eight percent, while cultivated crops are projected to increase by around 230 acres, or a change of twelve percent. The largest change by SMU is projected to take place in Campground and Lone Oak SMU.

Table 2.23 - Existing and Projected Subwatershed Land Use

Land Cover Classification	Kinkaid Lake- Kinkaid Creek Watershed							
	2006		2016		2006-2016		2016-2026	
	Acreage	Percent of Watershed	Acreage	Percent of Watershed	Change (Acreage)	Percent Change	Projected Acreage (2026)	Projected Percent Change
Open Water	2,374.05	9.24%	2,400.06	9.34%	26.01	1.10%	2,426.07	1.08%
Developed, Open Space	705.81	2.75%	705.59	2.75%	-0.22	-0.03%	705.36	-0.03%
Developed, Low Intensity	405.61	1.58%	405.39	1.58%	-0.22	-0.05%	405.16	-0.05%
Developed, Medium Intensity	23.35	0.09%	23.13	0.09%	-0.22	-0.95%	22.90	-0.96%
Developed, High Intensity	2.89	0.01%	3.56	0.01%	0.67	23.08%	4.23	18.75%
Barren Land	0.89	0.00%	1.11	0.00%	0.22	25.00%	1.33	20.00%
Deciduous Forest	15,322.11	59.62%	15,315.40	59.60%	-6.71	-0.04%	15,308.69	-0.04%
Evergreen Forest	87.17	0.34%	108.52	0.42%	21.35	24.49%	129.87	19.67%
Mixed Forest	933.30	3.63%	934.19	3.64%	0.89	0.10%	935.07	0.10%
Shrub/Scrub	32.47	0.13%	42.92	0.17%	10.45	32.19%	53.37	24.35%
Grassland/ Herbaceous	78.50	0.31%	85.61	0.33%	7.12	9.07%	92.73	8.31%
Pasture/ Hay	3,584.64	13.95%	3,296.68	12.83%	-287.96	-8.03%	3,008.72	-8.73%
Cultivated Crops	1,990.23	7.74%	2,220.61	8.64%	230.38	11.58%	2,450.99	10.37%
Woody Wetlands	140.76	0.55%	140.54	0.55%	-0.22	-0.16%	140.32	-0.16%
Emergent Herbaceous Wetlands	17.12	0.07%	15.57	0.06%	-1.56	-9.09%	14.01	-10.00%

Source: USGS MRLC


Kinkaid Lake- Kinkaid Creek Subwatershed - Land Use
Randolph
Perry
Franklin
Jackson
Williamson
State of Missouri
Union
Johnson
Ava
Little Kinkaid Creek- Kinkaid Creek
071401061102
Spring Creek
Sharp Rock
Jackson
Campground
Lone Oak
Kinkaid Lake - Northwest
Johnson Creek
Lakeside
Ash
Kinkaid Lake - Central Channel
Larger Shawnee
Kinkaid Lake - East
Kinkaid Lake - Central Body
Smaller Shawnee
Heiple
Lower Kinkaid Creek
Land Use Class
Open Water
Developed, Open Space
Developed, Low Intensity
Developed, Medium Intensity
Developed, High Intensity
Barren Land
Decisuous Forest
Evergreen Forest
Mixed Forest
Shrub/Scrub
Grassland/Herbaceous
Pasture/Hay
Cultivated Crops
Woody Wetlands
Emergenct Herbaceous Wetlands
Watershed Planning Area
Kinkaid Lake Subwatershed
Subwatersheds
County Boundary
Municipality
Streams
N
0 0.75 1.5 3 Miles
1:70,000
Map Produced by: Greater Egypt
Drawn by: Ruth Fowler, May 2020
Sources: IEPA, EPA, IDOT, ISGS, USDA, USGS

2.6.5. ***Existing and Projected Imperviousness of the Subwatersheds (HUC 12)***

2.6.5.1. Little Kinkaid Creek- Kinkaid Creek Subwatershed (071401061101)

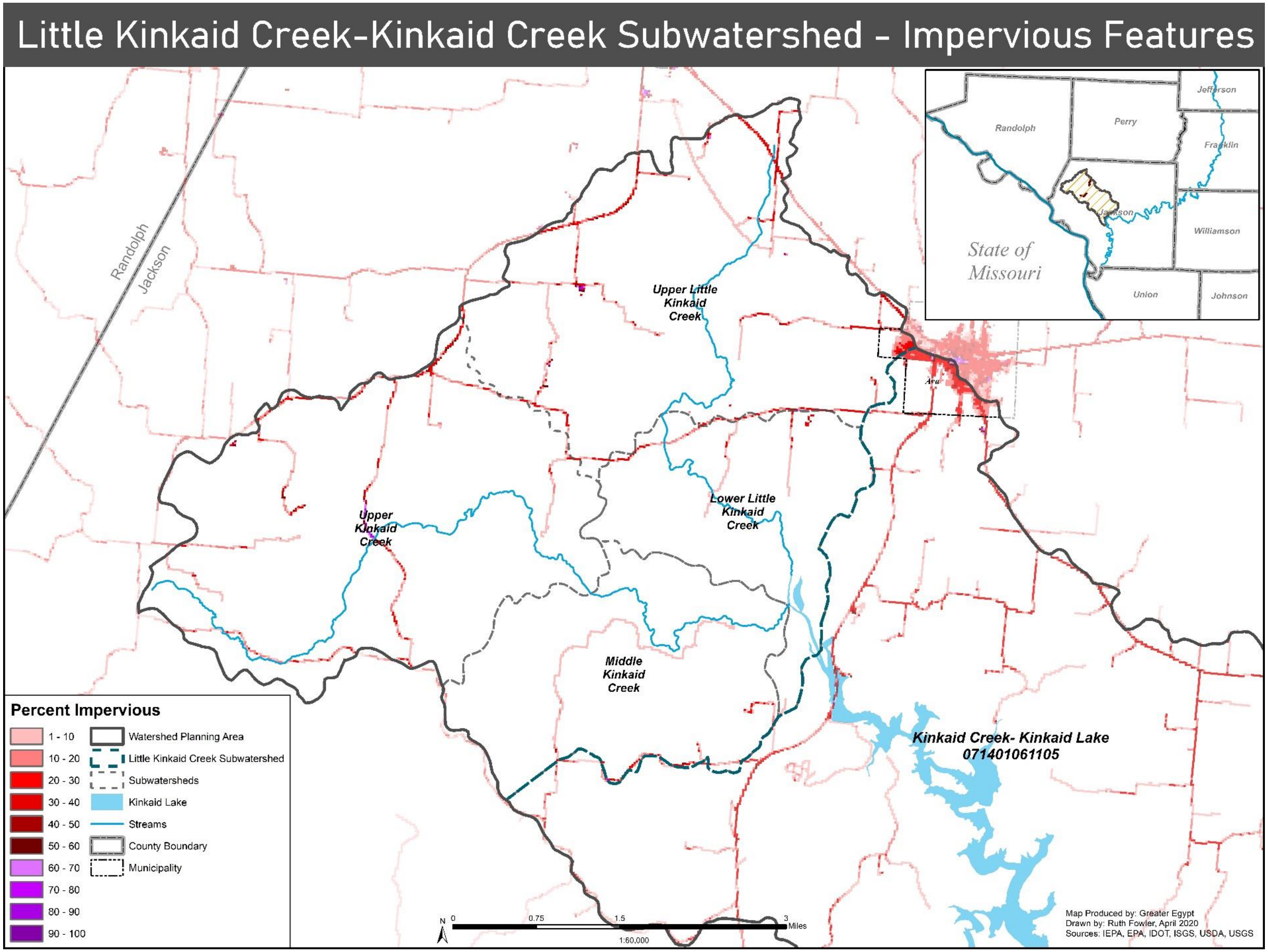
Little Kinkaid Creek- Kinkaid Creek has extremely low levels of imperviousness. A total of fourteen areas, 974 acres (96.4%) of the subwatershed is classified as permeable, or zero percent impervious. This is largely attributed to the vast amount of forested land in the subwatershed. The remaining 3.6 percent of the subwatershed ranges from one to fifty percent impervious. High levels of impervious land cover are completely absent from the subwatershed. *Table 2.24* displays acreage and percent of the subwatershed by intervals of ten percent. *Figure 2.24* displays the current level of imperviousness in the subwatershed.

Following the same method to project future land use, impervious land cover from past and existing datasets was analyzed. Impervious land cover from the 2006 and 2016 datasets were utilized to compare past and present variations in imperviousness. *Table 2.24* also displays the projected percent of change and acreage to the year 2026. According to the analysis, levels of impervious will not change by the year 2026.

Table 2.24 - Existing and Projected Imperviousness

Percent Imperviousness	Little Kinkaid Creek Subwatershed							
	2006		2016		2006-2016		2016-2026	
	Acreage	Percent of Watershed	Acreage	Percent of Watershed	Change (Acres)	Percent Change	Projected Acreage (2026)	Projected Percent Change
0%	14,974.1	96.4%	14,974.1	96.4%	0.0	0.0%	14,974.1	0.0%
0-10%	265.5	1.7%	265.5	1.7%	0.0	0.0%	265.5	0.0%
10-20%	118.1	0.8%	118.1	0.8%	0.0	0.0%	118.1	0.0%
20-30%	107.9	0.7%	107.9	0.7%	0.0	0.0%	107.9	0.0%
30-40%	40.0	0.3%	40.0	0.3%	0.0	0.0%	40.0	0.0%
40-50%	10.0	0.1%	10.0	0.1%	0.0	0.0%	10.0	0.0%
50-60%	3.8	0.0%	3.8	0.0%	0.0	0.0%	3.8	0.0%
60-70%	3.6	0.0%	3.6	0.0%	0.0	0.0%	3.6	0.0%
70-80%	2.4	0.0%	2.4	0.0%	0.0	0.0%	2.4	0.0%
80-90%	1.6	0.0%	1.6	0.0%	0.0	0.0%	1.6	0.0%
90-100%	0.0	0.0%	0.0	0.0%	0.0	0.0%	0.0	0.0%

Figure 2.24


Little Kinkaid Creek-Kinkaid Creek Subwatershed - Impervious Features
Randolph
Jackson
Upper Little Kinkaid Creek
Lower Little Kinkaid Creek
Upper Kinkaid Creek
Middle Kinkaid Creek
Kinkaid Creek- Kinkaid Lake 071401061105
Ava
Randolph
Perry
Jefferson
Franklin
Jackson
Williamson
State of Missouri
Union
Johnson
Percent Impervious
1 - 10
10 - 20
20 - 30
30 - 40
40 - 50
50 - 60
60 - 70
70 - 80
80 - 90
90 - 100
Watershed Planning Area
Little Kinkaid Creek Subwatershed
Subwatersheds
Kinkaid Lake
Streams
County Boundary
Municipality
0 0.75 1.5 3 Miles
1:60,000
N
Map Produced by: Greater Egypt
Drawn by: Ruth Fowler, April 2020
Sources: IEPA, EPA, IDOT, ISGS, USDA, USGS

2.6.5.2. Kinkaid Lake- Kinkaid Creek Subwatershed (071401061102)

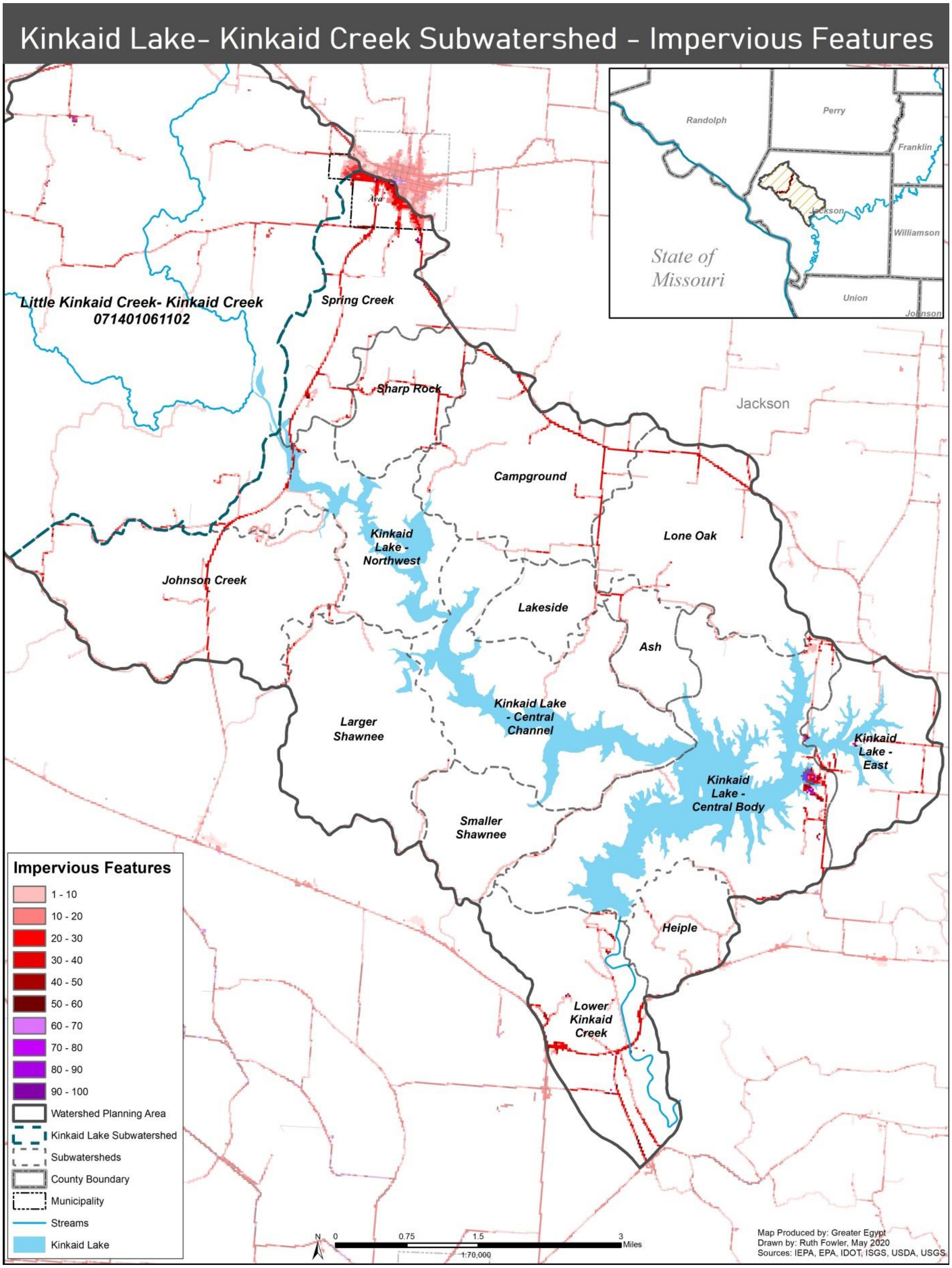
Following the same pattern as Little Kinkaid Creek subwatershed, Kinkaid Lake-Kinkaid Creek subwatershed also has extremely low levels of imperviousness. A total of 24, 561 acres (95.6%) of the subwatershed is classified as permeable, or zero percent impervious. This is largely attributed to the vast amount of forested land in the subwatershed, as well as the presence of Kinkaid Lake. The remaining 4.4 percent of the subwatershed ranges from one to fifty percent impervious. High levels of impervious land cover only amount to 11.8 acres. *Table 2.25* displays acreage and percent of the subwatershed by intervals of ten percent. *Figure 2.25* displays the current level of imperviousness in the subwatershed.

Following the same method to project future land use, impervious land cover from past and existing datasets were analyzed. Impervious land cover from the 2006 and 2016 datasets were utilized to compare past and present variations in imperviousness. *Table 2.25* also displays the projected percent of change and acreage to the year 2026. According to the analysis, levels of impervious will minimally change by the year 2026. The largest change in imperviousness will be a reduction of 0.4 acres of thirty to forty percent impervious land cover.

Table 2.25 - Kinkaid Lake Subwatershed Existing and Projected Imperviousness

Percent Imperviousness	Kinkaid Lake Subwatershed							
	2006		2016		2006-2016		2016-2026	
	Acreage	Percent of Watershed	Acreage	Percent of Watershed	Change (Acres)	Percent Change	Projected Acreage (2026)	Projected Percent Change
0%	24,561.2	95.6%	24,561.2	95.6%	0.0	0.0%	24,561.2	0.0%
0-10%	497.9	1.9%	497.7	1.9%	-0.2	0.0%	497.4	0.0%
10-20%	235.3	0.9%	235.3	0.9%	0.0	0.0%	235.3	0.0%
20-30%	242.6	0.9%	242.6	0.9%	0.0	0.0%	242.6	0.0%
30-40%	109.9	0.4%	109.4	0.4%	-0.4	-0.4%	109.0	-0.4%
40-50%	27.4	0.1%	27.6	0.1%	0.2	0.8%	27.8	0.8%
50-60%	12.9	0.1%	12.7	0.0%	-0.2	-1.7%	12.5	-1.8%
60-70%	5.6	0.0%	5.6	0.0%	0.0	0.0%	5.6	0.0%
70-80%	3.6	0.0%	3.8	0.0%	0.2	6.3%	4.0	5.9%
80-90%	2.2	0.0%	2.4	0.0%	0.2	10.0%	2.7	9.1%
90-100%	0.4	0.0%	0.7	0.0%	0.2	50.0%	0.9	33.3%

Figure 2.25



Kinkaid Lake- Kinkaid Creek Subwatershed - Impervious Features
Little Kinkaid Creek- Kinkaid Creek
071401061102
Spring Creek
Sharp Rock
Campground
Lone Oak
Jackson
Kinkaid Lake - Northwest
Johnson Creek
Lakeside
Ash
Kinkaid Lake - Central Channel
Larger Shawnee
Kinkaid Lake - East
Kinkaid Lake - Central Body
Smaller Shawnee
Heiple
Lower Kinkaid Creek
Randolph
Perry
Franklin
Jackson
Williamson
State of Missouri
Union
Johnson
Impervious Features
1 - 10
10 - 20
20 - 30
30 - 40
40 - 50
50 - 60
60 - 70
70 - 80
80 - 90
90 - 100
Watershed Planning Area
Kinkaid Lake Subwatershed
Subwatersheds
County Boundary
Municipality
Streams
Kinkaid Lake
0 0.75 1.5 3 Miles
1:70,000
Map Produced by: Greater Egypt
Drawn by: Ruth Fowler, May 2020
Sources: IEPA, EPA, IDOT, ISGS, USDA, USGS

2.7. Watershed Drainage and Assessment

To further characterize the waterbodies in the Kinkaid Creek planning area, an assessment was conducted to identify certain impairments of waterbodies. Components assessed are: extent of channelization, condition of riparian and littoral areas, and extent of streambank and shoreline erosion.

Assessment methods include physical field evaluations and analyses of aerial photography from 1938 to 2021. *Figure 2.26* displays the assessed waterbodies, as well as the location of assessment points. *Appendix D* includes the field form that was used for assessments.

For each assessment component, the waterbodies were delineated by their individual reach code. These reach codes identify certain portions of the stream, and represent varying degrees of stream length. Each assessment point was assigned an Assessment ID. *Appendix E* displays the stream name with its corresponding Assessment ID, reach code and length. Streams and tributaries were then categorized by their subwatershed. Kinkaid Lake was assigned shoreline codes for assessment. The planning area was also reviewed for the presence of retention and detention basins. Detailed information regarding each shoreline code can also be viewed in *Appendix E*. Each HUC 12 watershed in the study area will be examined individually.

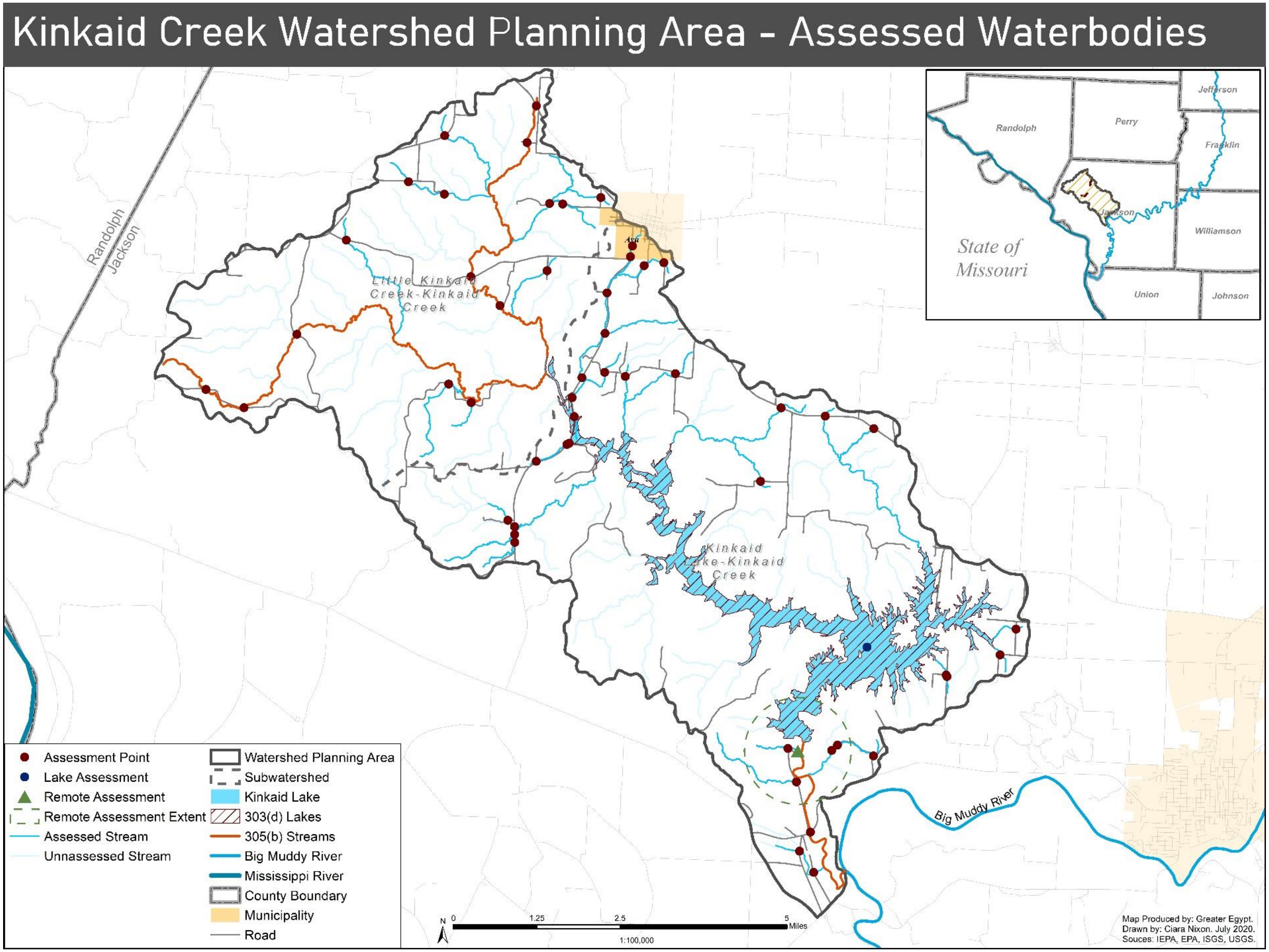
2.7.1. Assessment Components

2.7.1.1. Extent of Erosion

Erosion is the degradation of a streambank or shoreline by natural and non-natural processes. While natural activity can erode a streambank over time, changes to hydrology and land use can escalate this process. Factors such as channelization and loss of riparian habitat can also lead to eroded banks.

Erosion was assessed as none, or low, moderate, and high. In some cases, erosion may also be described as severe if the extent of erosion is extreme. These designations correspond to the lateral recession rate (LRR) category. LRR also correlates to the pollutant load reduction section of this report (*Section 2.8.7*). This characterizes erosion classes as: slight (none or low), moderate (moderate), severe (high), and very severe

Figure 2.26


Kinkaid Creek Watershed Planning Area - Assessed Waterbodies
Randolph
Jackson
Little Kinkaid Creek-Kinkaid Creek
Kinkaid Lake-Kinkaid Creek
Big Muddy River
Randolph
Perry
Jefferson
Franklin
Williamson
Jackson
State of Missouri
Union
Johnson
Assessment Point
Lake Assessment
Remote Assessment
Remote Assessment Extent
Assessed Stream
Unnassessed Stream
Watershed Planning Area
Subwatershed
Kinkaid Lake
303(d) Lakes
305(b) Streams
Big Muddy River
Mississippi River
County Boundary
Municipality
Road
0 1.25 2.5 5 Miles
1:100,000
Map Produced by: Greater Egypt.
Drawn by: Ciara Nixon. July 2020.
Souces: IEPA, EPA, ISGS, USGS.

(severe). *Figure 2.27* displays examples of the various levels of erosion at different assessment points throughout the watershed. Physical assessments included an environmental evaluation for each of the assessment points. Samples evaluations can be viewed in *Appendix D.*

Figure 2.27 - Levels of Eroded Streambank

Levels of Eroded Streambanks: A-None or Low (slight); B- Moderate (moderate); C- Severe (high); D- Very Severe (severe)

If a particular stream reach indicated a large variance in streambank erosion, a new reach identification was created. This includes a unique ID and Reach Code. Results for the streambank and shoreline erosion assessment are summarized in the following section. These results have been delineated by Subwatershed (HUC 12).

2.7.1.2. Condition of Riparian and Littoral Areas

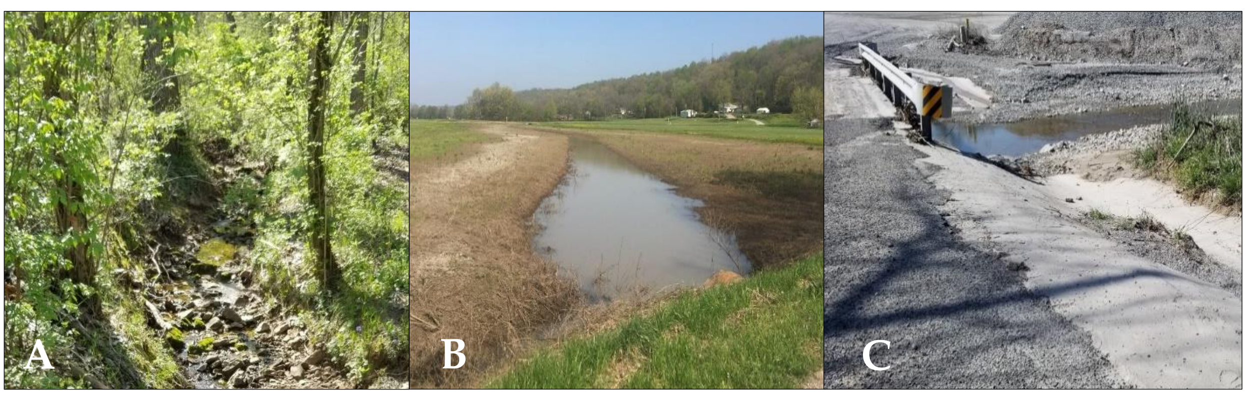
Riparian areas provide a buffer for streams and other waterbodies by filtering pollutants from runoff. These buffers also provide beneficial wildlife habitat. This assessment classifies riparian zones, or buffers, as the area up to 150 feet from the stream on either bank or shoreline.

Stream reaches that have thirty-three percent, or fewer areas with degraded riparian areas have been classified as good, thirty-three to sixty-six percent as fair, and sixty-six percent or more as poor. Lake shores have also been classified with these percentages for the condition of littoral areas.

Generally, the amount of natural habitat is the most critical component in assessing riparian areas. Consideration is also given to development, debris (synthetic), and other environmental factors. Debris, blockages, and other obstructions have also been assessed.

Field assessments and other aerial imagery were used in determining the condition of riparian areas. The figure below represents the various conditions of riparian areas.

Figure 2.28 - Conditions of Riparian and Littoral Areas



Conditions of Riparian Areas: A- Good B- Fair; C- Poor

2.7.1.3. Degree of Channelization

Channelization refers to the reduction of a natural meandering stream channel. While this straightening can sometimes limit the impact of flooding, it can have impacts on erosion and loss of habitat.

Since channelization encourages a non-sinuous course, water flows much faster, resulting in an increase of sediment transport and decrease of riffles and pools that can prevent heavy flow. Streams where one to thirty-three percent of banks are channelized are considered low, thirty-three to sixty-six percent of reach channelized is moderate, and a high degree of channelization is expressed as exhibiting sixty-six percent or more channelized features.

Physical assessments, historical photography and GIS were mainly utilized for the degree of channelization assessment. Comparitive aerial images to highlight channelization are displayed in the figure below.

Figure 2.29 - Historical and Current Aerial of Channelized Stream

2.7.2. ***Little Kinkaid Creek-Kinkaid Creek Subwatershed Stream Assessment Results (071401061101)***

The Little Kinkaid Creek-Kinkaid Creek subwatershed experiences varying levels of erosion. With a majority of the SMU being forested, riparian areas within the subwatershed are generally in good condition, with the exception of the area surrounded by the Kinkaid Stone Company. No reaches exhibit poor riparian conditions. Since the subwatershed is fairly rural, channelization has a minimal impact.

2.7.2.1. Extent of Erosion

The majority of streams within the Little Kinkaid Creek-Kinkaid Creek subwatershed are rated as having a moderate degree of erosion. Out of the twenty-one streams that were assessed throughout the area, seven streams, or thirty-three percent of the streams in the area are rated as having a moderate degree of erosion. Streams rated as having none or low amounts of erosion total to six of the twenty-one streams assessed, or twenty-nine percent of the streams within the subwatershed. Five streams within the area have a high erosion rating, which accounts for twenty-four percent of the streams within the subwatershed. Only three streams, or fourteen percent, of streams within the Little Kinkaid Creek-Kinkaid Creek subwatershed have a severe erosion rating.

The level of erosion that each reach is classified as is decided by what the majority of that reach exhibits. Therefore, one reach may exhibit severe levels of erosion in some areas, but is classified as having a high level of erosion, due to the majority of the reach being high.

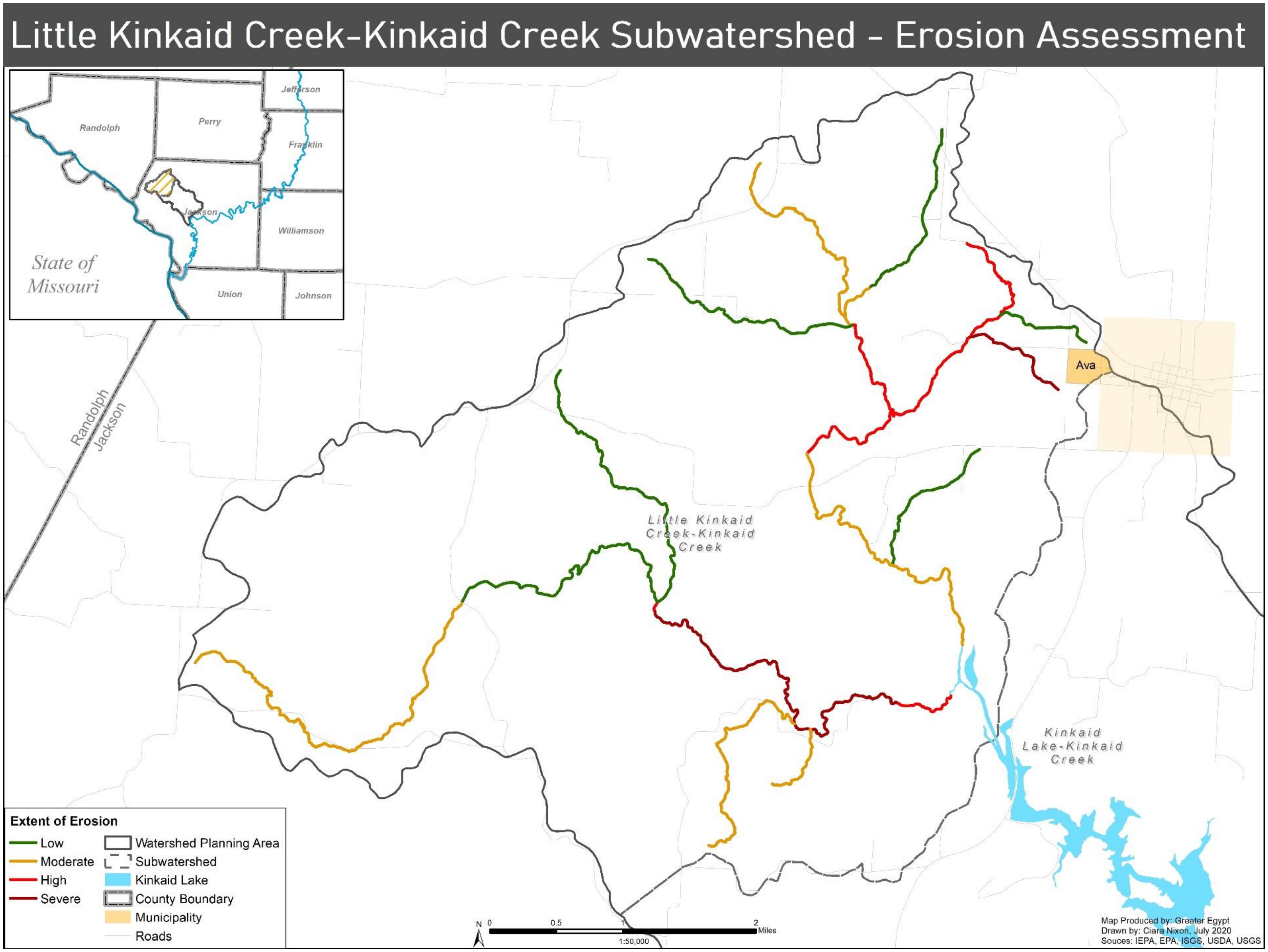
Table 2.26 summarizes the extent of erosion throughout the Little Kinkaid Creek-Kinkaid Creek subwatershed.

Table 2.26 – Little Kinkaid Creek-Kinkaid Creek Subwatershed Extent of Erosion

Little Kinkaid Creek-Kinkaid Creek Subwatershed								
Extent of Erosion	None or Low		Moderate		High		Severe	
	Reaches	%	Reaches	%	Reaches	%	Reaches	%
Middle Kinkaid Creek SMU	0	0%	2	10%	1	5%	1	5%
Upper Kinkaid Creek SMU	2	10%	1	5%	1	5%	1	5%
Lower Little Kinkaid Creek SMU	1	5%	1	5%	0	0%	0	0%
Upper Little Kinkaid Creek SMU	3	14%	3	14%	3	14%	1	5%
Total:	**6**	**29%**	**7**	**33%**	**5**	**24%**	**3**	**14%**

Areas of increased erosion occur in every SMU to some degree. The three reaches throughout the Little Kinkaid Creek-Kinkaid Creek subwatershed that exhibit severe levels of erosion occur near land that was farmed sometime throughout the history of the area. Although these areas are no longer agricultural today, the impacts of the historical land use are apparent. *Figure 2.30* spatially depicts the levels of erosion by reach code.

Figure 2.30



Little Kinkaid Creek-Kinkaid Creek Subwatershed - Erosion Assessment
Jefferson
Randolph
Perry
Franklin
Jackson
Williamson
State of Missouri
Union
Johnson
Randolph
Jackson
Ava
Little Kinkaid Creek-Kinkaid Creek
Kinkaid Lake-Kinkaid Creek
Extent of Erosion
Low
Moderate
High
Severe
Watershed Planning Area
Subwatershed
Kinkaid Lake
County Boundary
Municipality
Roads
0
0.5
1
2
Miles
1:50,000
Map Produced by: Greater Egypt
Drawn by: Ciara Nixon, July 2020
Souces: IEPA, EPA, ISGS, USDA, USGS

2.7.2.2. Condition of Riparian Areas

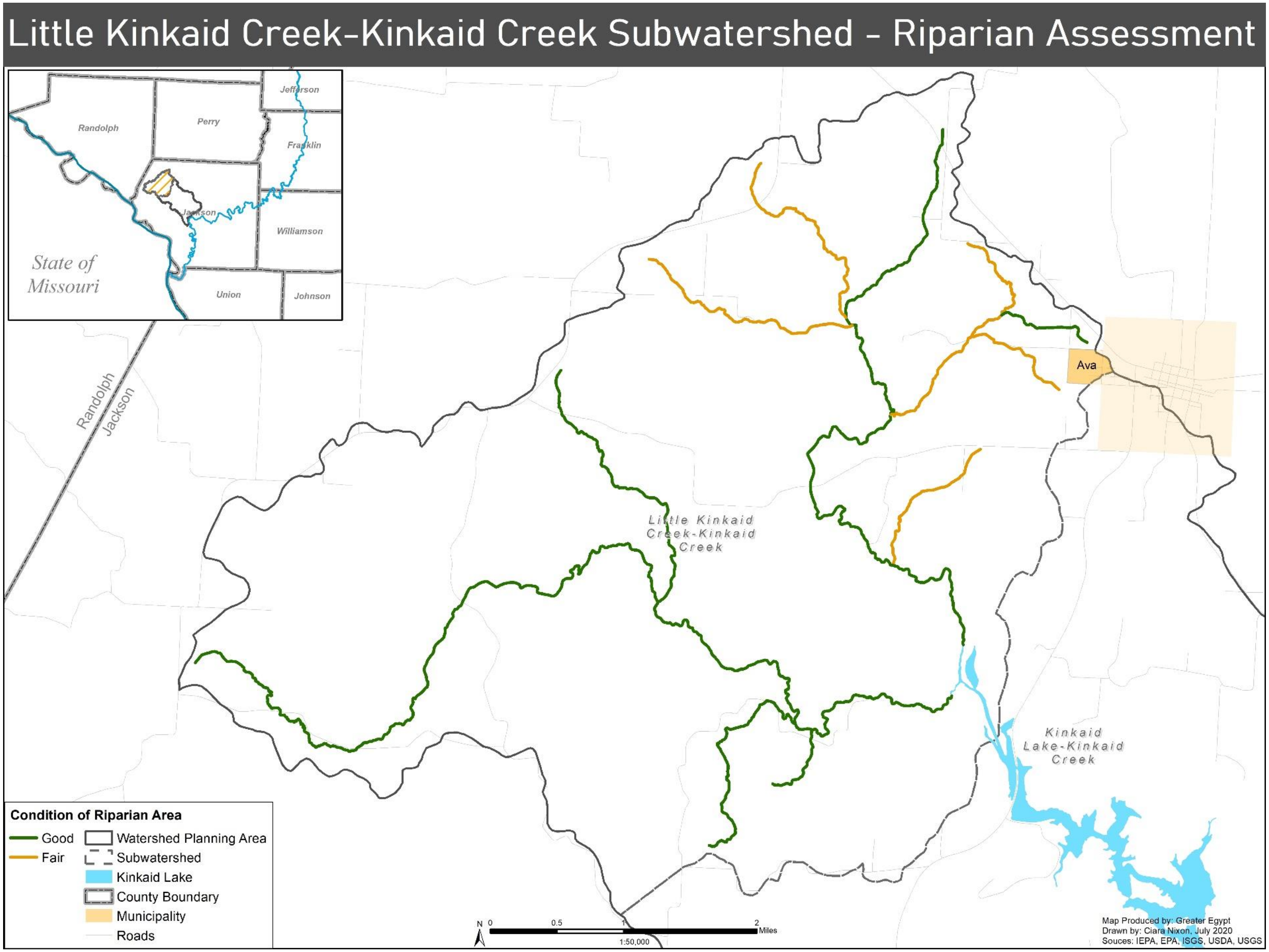
In general, riparian areas within the Little Kinkaid Creek-Kinkaid Creek subwatershed exhibit good riparian conditions. Since forested areas in the entire watershed account for 57.45 percent, while developed and cropland account for only 15.32 percent of the land area, riparian areas throughout the subwatershed have generally been preserved.

Twenty-one reaches were assessed throughout the subwatershed. Of those, sixteen reaches are in good riparian condition, accounting for seventy-six percent of the assessed streams within the subwatershed. The remaining five assessed reaches were rated as being in fair condition, and account for twenty-four percent of the assessed reaches within the Little Kinkaid Creek-Kinkaid Creek subwatershed. *Table 2.27* summarizes this data. It is also illustrated in *Figure 2.31.*

Table 2.27– Little Kinkaid Creek-Kinkaid Creek Subwatershed Condition of Riparian Area

Little Kinkaid Creek-Kinkaid Creek Subwatershed						
Condition of Riparian Area	Good		Fair		Poor	
	Reaches	%	Reaches	%	Reaches	%
Middle Kinkaid Creek	4	19%	0	0%	0	0%
Upper Kinkaid Creek	5	24%	0	0%	0	0%
Lower Little Kinkaid Creek	1	5%	1	5%	0	0%
Upper Little Kinkaid Creek	6	29%	4	19%	0	0%
Total:	**16**	**76%**	**5**	**24%**	**0**	**0%**

Figure 2.31


Little Kinkaid Creek-Kinkaid Creek Subwatershed - Riparian Assessment
Jefferson
Randolph
Perry
Franklin
Jackson
Williamson
State of Missouri
Union
Johnson
Randolph
Jackson
Ava
Little Kinkaid Creek-Kinkaid Creek
Kinkaid Lake-Kinkaid Creek
Condition of Riparian Area
Good
Fair
Watershed Planning Area
Subwatershed
Kinkaid Lake
County Boundary
Municipality
Roads
N
0
0.5
1
2
Miles
1:50,000
Map Produced by: Greater Egypt
Drawn by: Ciara Nixon, July 2020
Souces: IEPA, EPA, ISGS, USDA, USGS

2.7.2.3. Degree of Channelization

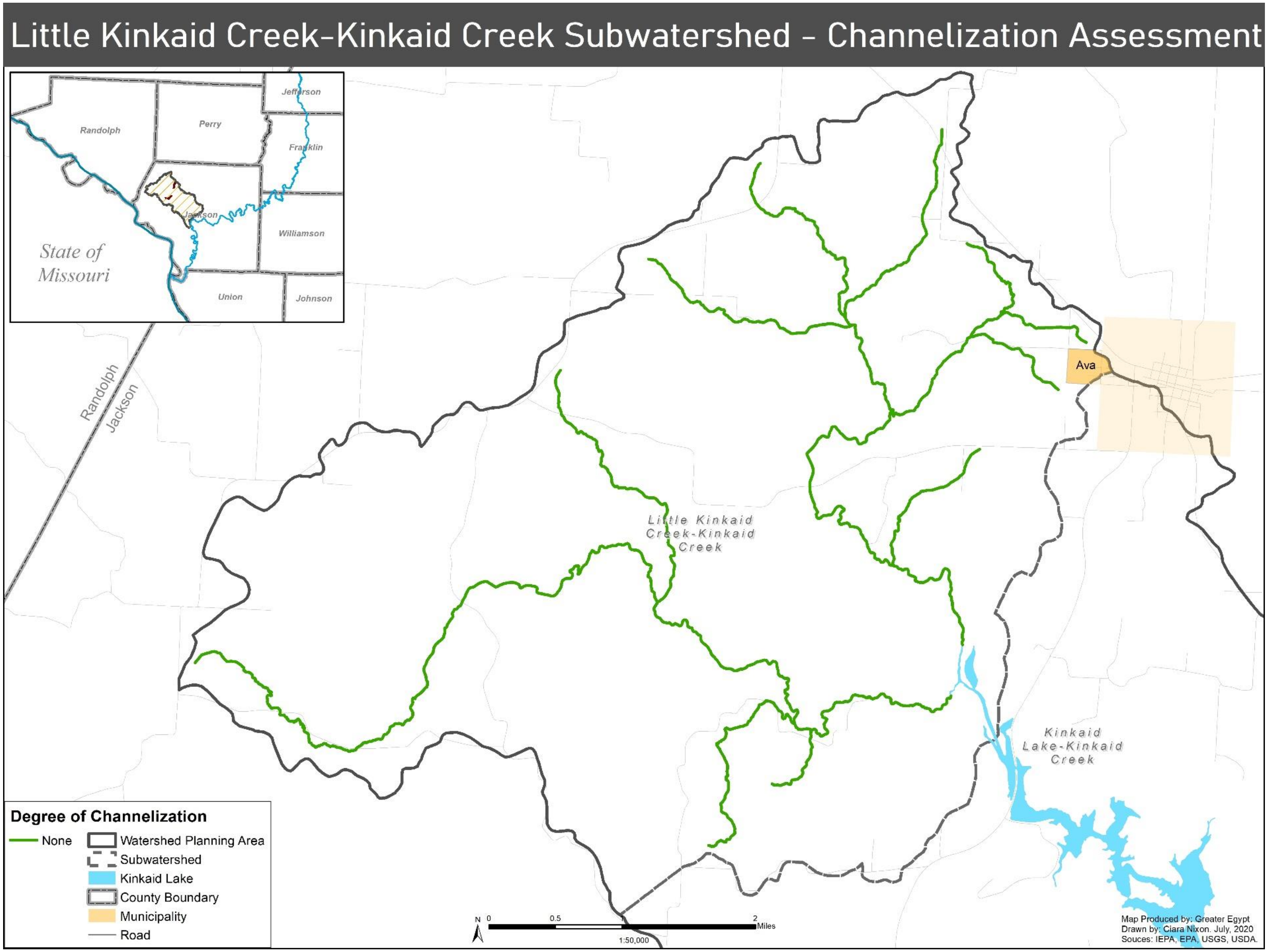
The Little Kinkaid Creek-Kinkaid Creek subwatershed consists of rural and forested land, leaving no channelized features throughout the area. All of the assessed streams within the subwatershed, or all twenty-one assessed streams, have no degree of channelization. To analyze this, an aerial image from 1938 was observed and compared to a 2017 aerial image of the land. No streams appear to have been channelized.

Table 2.28 summarizes the degree of channelization within the Little Kinkaid Creek-Kinkaid Creek subwatershed, while *Figure 2.32* spatially displays this data.

Table 2.28 – Little Kinkaid Creek-Kinkaid Creek Subwatershed Degree of Channelization

Little Kinkaid Creek-Kinkaid Creek Subwatershed								
Degree of Channelization	None		Low		Moderate		High	
	Reaches	%	Reaches	%	Reaches	%	Reaches	%
Middle Kinkaid Creek	4	19%	0	0%	0	0%	0	0%
Upper Kinkaid Creek	5	24%	0	0%	0	0%	0	0%
Lower Little Kinkaid Creek	2	10%	0	0%	0	0%	0	0%
Upper Little Kinkaid Creek	10	48%	0	0%	0	0%	0	0%
Total:	**21**	**100%**	**0**	**0%**	**0**	**0%**	**0**	**0%**

Figure 2.32


Little Kinkaid Creek-Kinkaid Creek Subwatershed - Channelization Assessment
Jefferson
Randolph
Perry
Franklin
Jackson
Williamson
State of Missouri
Union
Johnson
Randolph
Jackson
Ava
Little Kinkaid Creek-Kinkaid Creek
Kinkaid Lake-Kinkaid Creek
Degree of Channelization
None
Watershed Planning Area
Subwatershed
Kinkaid Lake
County Boundary
Municipality
Road
N
0
0.5
2
Miles
1:50,000
Map Produced by: Greater Egypt
Drawn by: Ciara Nixon. July, 2020
Souces: IEPA, EPA, USGS, USDA.

2.7.3. Little Kinkaid Lake-Kinkaid Creek Subwatershed Stream Assessment Results (071401061102)

The Kinkaid Lake-Kinkaid Creek subwatershed exhibits all levels of erosion. The subwatershed is 63.66 percent forest and only 13.07 percent of land is considered developed and crop lands. Therefore, it is expected that the riparian areas are in majority good condition. Channelization also has minimal impact throughout the mostly undeveloped subwatershed.

2.7.3.1. Extent of Erosion

All degrees of erosion are seen throughout the Kinkaid Lake-Kinkaid Creek subwatershed. However, there are a few SMU's that do not exhibit any erosion levels. Of the fifteen SMUs that form the subwatershed, five do not exhibit streams with erosion.

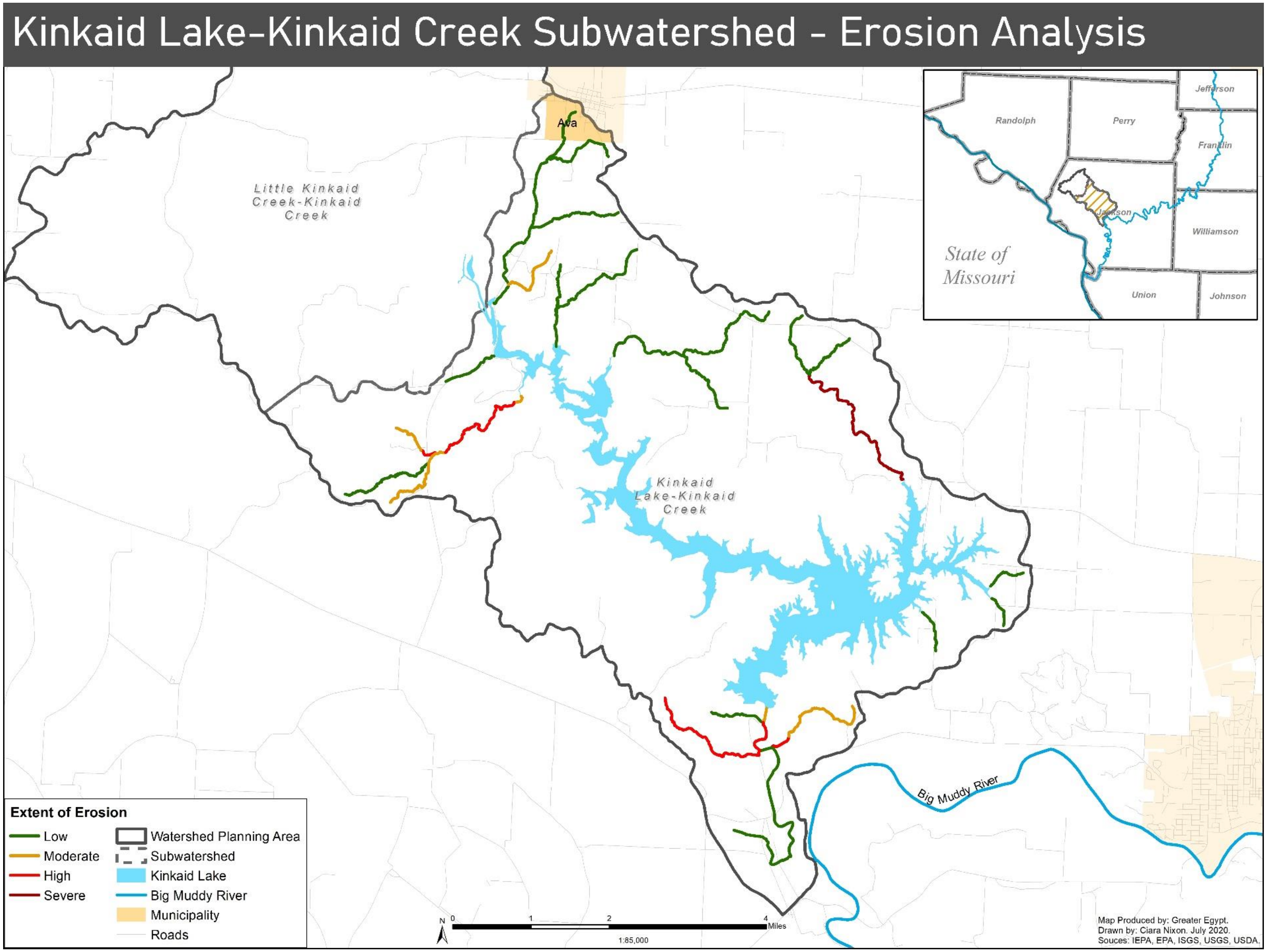
There is a total of thirty-six stream reaches that were assessed within the subwatershed. Of those thirty-six streams, twenty-one stream reaches, or fifty-eight percent of the streams that were assessed exhibit none or low levels of erosion. Nine stream reaches, or twenty-five percent of the streams that were assessed have a moderate level of erosion. Few streams exhibit high and severe levels of erosion. Five out of the thirty-six, or fourteen percent of the assessed streams within the subwatershed exhibit high levels of erosion, while only one out of the thirty-six streams is rated as having severe erosion.

Table 2.29 summarizes the erosion analyses for the Kinkaid Lake-Kinkaid Creek subwatershed. *Figure 2.33* depicts this information.

Table 2.29 – Kinkaid Lake-Kinkaid Creek Subwatershed Extent of Erosion

Kinkaid Lake-Kinkaid Creek subwatershed								
Extent of Erosion	None or Low		Moderate		High		Severe	
	Reaches	%	Reaches	%	Reaches	%	Reaches	%
Lower Kinkaid Creek	5	14%	1	3%	2	6%	0	0%
Heiple	0	0%	2	6%	1	3%	0	0%
Smaller Shawnee	0	0%	0	0%	0	0%	0	0%
Kinkaid Lake - Central Body	1	3%	0	0%	0	0%	0	0%
Kinkaid Lake - East	2	6%	0	0%	0	0%	0	0%
Lone Oak	2	6%	0	0%	0	0%	1	3%
Ash	0	0%	0	0%	0	0%	0	0%
Kinkaid Lake - Central Channel	0	0%	0	0%	0	0%	0	0%
Lakeside	0	0%	0	0%	0	0%	0	0%
Larger Shawnee	0	0%	0	0%	0	0%	0	0%
Campground	2	6%	0	0%	0	0%	0	0%
Kinkaid Lake - Northwest	1	3%	0	0%	0	0%	0	0%
Johnson Creek	1	3%	5	14%	2	6%	0	0%
Sharp Rock	4	11%	0	0%	0	0%	0	0%
Spring Creek	3	8%	1	3%	0	0%	0	0%
Total:	**21**	**58%**	**9**	**25%**	**5**	**14%**	**1**	**3%**

Figure 2.33


Kinkaid Lake-Kinkaid Creek Subwatershed - Erosion Analysis
Ava
Little Kinkaid Creek-Kinkaid Creek
Kinkaid Lake-Kinkaid Creek
Big Muddy River
Jefferson
Randolph
Perry
Franklin
Jackson
Williamson
State of Missouri
Union
Johnson
Extent of Erosion
Low
Moderate
High
Severe
Watershed Planning Area
Subwatershed
Kinkaid Lake
Big Muddy River
Municipality
Roads
N
0
1
2
4
Miles
1:85,000
Map Produced by: Greater Egypt.
Drawn by: Ciara Nixon. July 2020.
Souces: IEPA, EPA, ISGS, USGS, USDA.

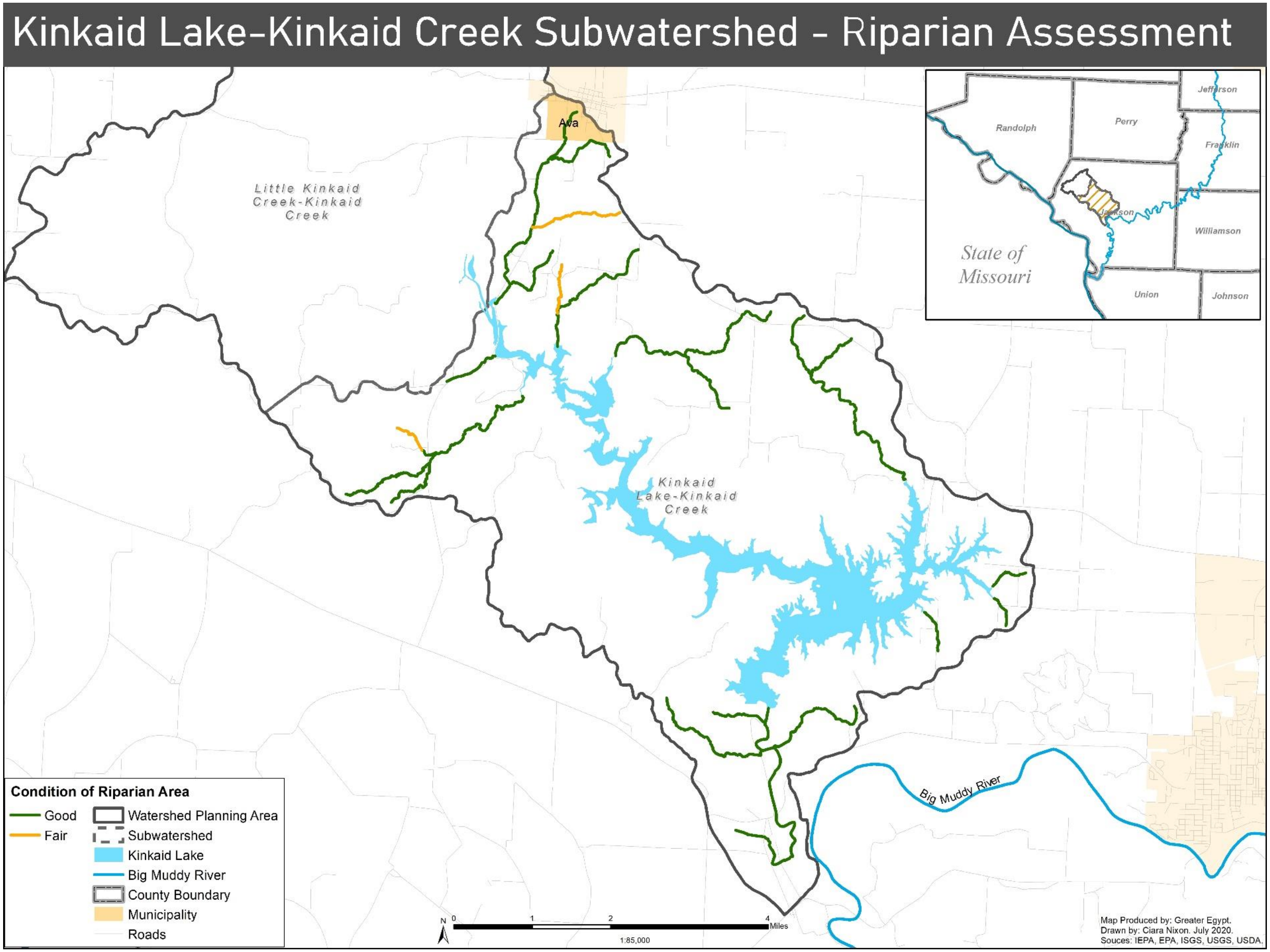
2.7.3.2. Condition of Riparian Areas

Since the majority of the Kinkaid Lake-Kinkaid Creek subwatershed is forested, it is expected that the majority of the riparian areas throughout the subwatershed are in good condition. No areas within the subwatershed exhibit a poor riparian condition. Out of the thirty-six streams that were assessed, thirty-three streams, or ninety-two percent of the assessed streams exhibit a good riparian area. Only three streams were assessed as having a fair riparian area. These streams are mostly surrounded by either farmland or housing developments. *Table 2.30* summarizes the riparian area conditions. *Figure 2.34* displays this data.

Table 2.30 – Kinkaid Lake-Kinkaid Creek Subwatershed Condition of Riparian Area

Little Kinkaid Creek-Kinkaid Creek Subwatershed						
Condition of Riparian Area	Good		Fair		Poor	
	Reaches	%	Reaches	%	Reaches	%
Lower Kinkaid Creek	8	22%	0	0%	0	0%
Heiple	3	8%	0	0%	0	0%
Smaller Shawnee	1	3%	0	0%	0	0%
Kinkaid Lake - Central Body	2	6%	0	0%	0	0%
Kinkaid Lake - East	0	0%	0	0%	0	0%
Lone Oak	3	8%	0	0%	0	0%
Ash	0	0%	0	0%	0	0%
Kinkaid Lake - Central Channel	0	0%	0	0%	0	0%
Lakeside	0	0%	0	0%	0	0%
Larger Shawnee	0	0%	0	0%	0	0%
Campground	2	6%	0	0%	0	0%
Kinkaid Lake - Northwest	1	3%	0	0%	0	0%
Johnson Creek	7	19%	1	3%	0	0%
Sharp Rock	3	8%	1	3%	0	0%
Spring Creek	3	8%	1	3%	0	0%
Total:	**33**	**92%**	**3**	**8%**	**0**	**0%**

Figure 2.34


Kinkaid Lake-Kinkaid Creek Subwatershed - Riparian Assessment
Ava
Little Kinkaid Creek-Kinkaid Creek
Kinkaid Lake-Kinkaid Creek
Big Muddy River
Jefferson
Randolph
Perry
Franklin
Jackson
Williamson
State of Missouri
Union
Johnson
Condition of Riparian Area
Good
Fair
Watershed Planning Area
Subwatershed
Kinkaid Lake
Big Muddy River
County Boundary
Municipality
Roads
N
0 1 2 4 Miles
1:85,000
Map Produced by: Greater Egypt.
Drawn by: Ciara Nixon. July 2020.
Souces: IEPA, EPA, ISGS, USGS, USDA.

2.7.3.3. Degree of Channelization

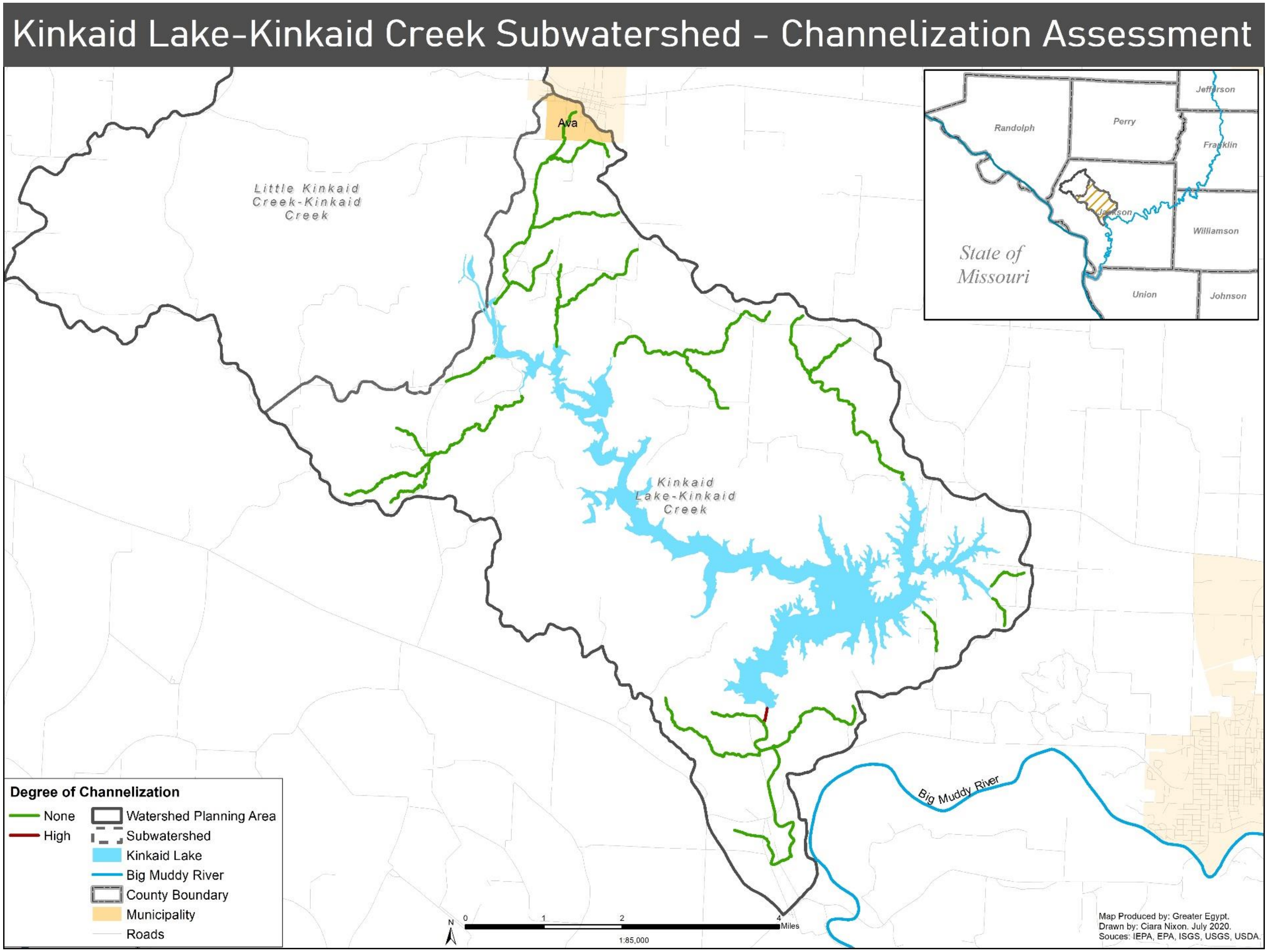
It can also be expected that there are little impacts of stream channelization throughout the Kinkaid Lake-Kinkaid Creek subwatershed. Of the thirty-six streams assessed, thirty-five streams, or ninety-seven percent of the streams exhibit no degree of channelization. The one assessed stream that is rated a high degree of channelization is located at the Kinkaid Lake Spillway. This stream did not exist until after the lake was formed.

Table 2.31 summarized the channelization data for the Kinkaid Lake-Kinkaid Creek subwatershed. *Figure 2.35* displays this data.

Table 2.31 – Kinkaid Lake-Kinkaid Creek Subwatershed Degree of Channelization

Kinkaid Lake-Kinkaid Creek Subwatershed								
Degree of Channelization	None		Low		Moderate		High	
	Reaches	%	Reaches	%	Reaches	%	Reaches	%
Lower Kinkaid Creek	7	19%	0	0%	0	0%	1	3%
Heiple	3	8%	0	0%	0	0%	0	0%
Smaller Shawnee	0	0%	0	0%	0	0%	0	0%
Kinkaid Lake - Central Body	1	3%	0	0%	0	0%	0	0%
Kinkaid Lake - East	2	6%	0	0%	0	0%	0	0%
Lone Oak	3	8%	0	0%	0	0%	0	0%
Ash	0	0%	0	0%	0	0%	0	0%
Kinkaid Lake - Central Channel	0	0%	0	0%	0	0%	0	0%
Lakeside	0	0%	0	0%	0	0%	0	0%
Larger Shawnee	0	0%	0	0%	0	0%	0	0%
Campground	2	6%	0	0%	0	0%	0	0%
Kinkaid Lake - Northwest	1	3%	0	0%	0	0%	0	0%
Johnson Creek	8	22%	0	0%	0	0%	0	0%
Sharp Rock	4	11%	0	0%	0	0%	0	0%
Spring Creek	4	11%	0	0%	0	0%	0	0%
Total:	**35**	**97%**	**0**	**0%**	**0**	**0%**	**1**	**3%**

Figure 2.35


Kinkaid Lake-Kinkaid Creek Subwatershed - Channelization Assessment
Ava
Little Kinkaid Creek-Kinkaid Creek
Kinkaid Lake-Kinkaid Creek
Big Muddy River
Randolph
Perry
Jefferson
Franklin
Jackson
Williamson
Union
Johnson
State of Missouri
Degree of Channelization
None
High
Watershed Planning Area
Subwatershed
Kinkaid Lake
Big Muddy River
County Boundary
Municipality
Roads
0 1 2 4 Miles
1:85,000
Map Produced by: Greater Egypt.
Drawn by: Ciara Nixon. July 2020.
Souces: IEPA, EPA, ISGS, USGS, USDA.

2.7.4. Kinkaid Creek Watershed Lake Assessment Results
Kinkaid Lake (IL_RNC)

Kinkaid Creek Watershed contains one lake listed on the IEPA 305(b) List which is assessed as part of Illinois and Federal EPA standards. Kinkaid Lake is almost entirely located within the Kinkaid Lake-Kinkaid Creek subwatershed, with a very small portion of its shoreline reaching west into the Little Kinkaid Creek-Kinkaid Creek subwatershed. For this section, Kinkaid Lake will be discussed in its entirety, and not by subwatershed. Kayaks were used to assess the majority of the lake's shoreline, while a fishing boat was used to assess areas that were further away from a docking area.

The lake is mostly surrounded by forested land, leaving the littoral area primarily in good condition. Kinkaid Lake is heavily trafficked, causing substantial turbulence that directly effects shoreline erosion and stability.

2.7.4.1. Extent of Erosion

To analyze the erosion level along the entire Kinkaid Lake shoreline, 396,629 feet of shoreline was split up into four sections. Each section was further classified by shore code, or reach. Each shore segment was individually assessed. Prior Kinkaid Lake management initiatives have focused on stabilizing the banks by using rocked barriers in areas that need to be stabilized. For this analysis, the bank was rated for the erosion level that was observed. However, most of the higher erosive areas have bank stabilization where the shoreline is protected.

Kinkaid Lake-East Section - Extent of Erosion

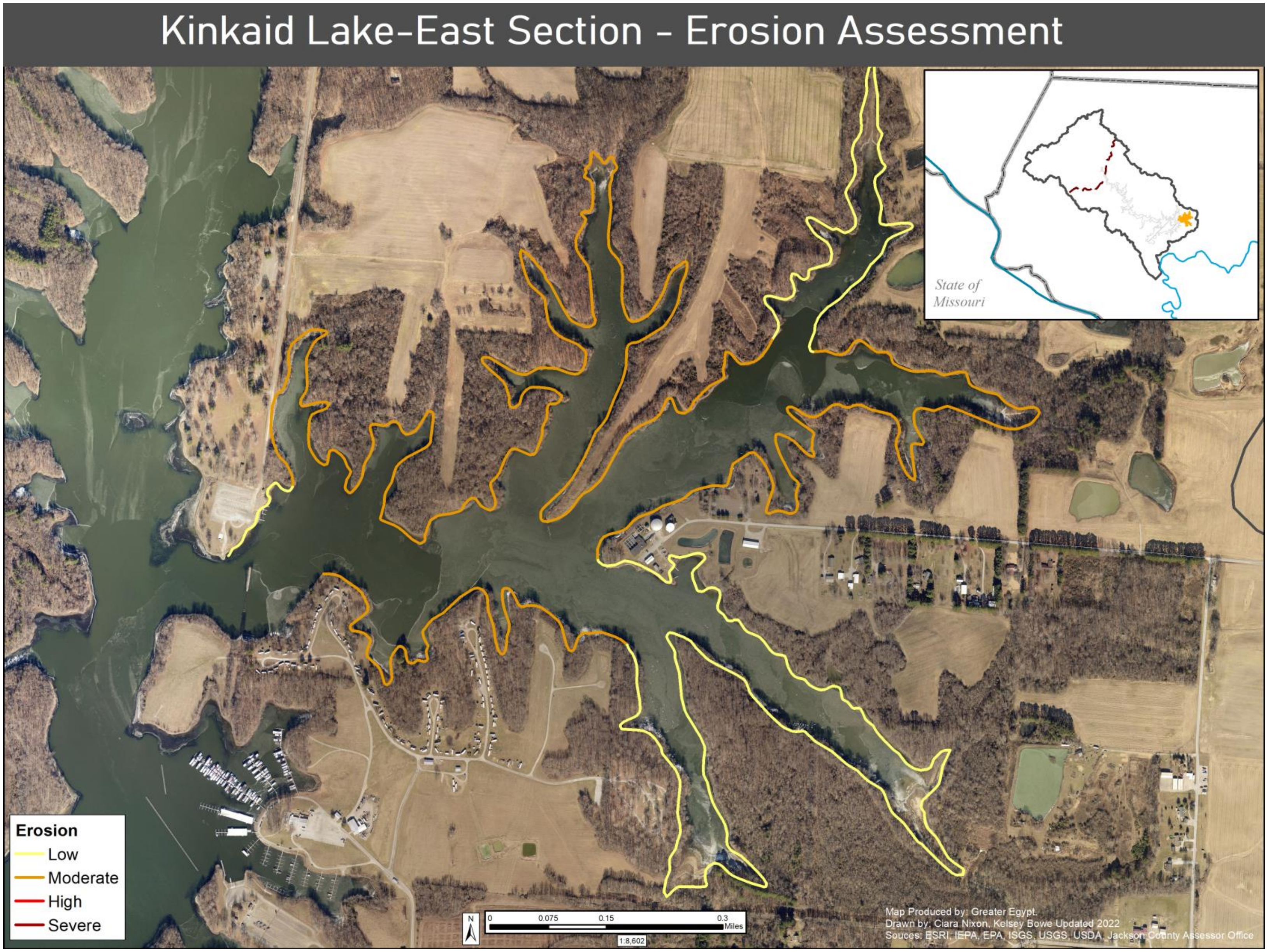
The East section of the lake consists of 49,571 feet. Fourteen shore codes have been created. This section exhibits mostly moderate levels of erosion, with other areas exhibiting low levels of erosion. None of the reaches within the eastern section of shoreline exhibits high or severe levels of erosion.

Within the east section of Kinkaid Lake, five shore codes, or thirty-eight percent of the area's shoreline, exhibit low levels of erosion. Of the fourteen shore codes assessed, nine reaches, or sixty-two percent of the area's shoreline, exhibit moderate levels of erosion. *Table 2.32* summarizes this information. The information is also depicted in *Figure 2.36.*

Table 2.32 – Kinkaid Lake-East Section Extent of Erosion

Kinkaid Lake - East Section			
Kinkaid Lake-Shore Code	**Shoreline Length Assessed (ft)**	**% of Total Shoreline**	**Extent of Erosion**
IL_RNC_205-01	2,409	5%	Moderate
IL_RNC_205-02	2,157	4%	Moderate
IL_RNC_205-03	4,886	10%	Low
IL_RNC_205-04	6,153	12%	Low
IL_RNC_205-05	1,340	3%	Low
IL_RNC_205-06	3,387	7%	Moderate
IL_RNC_205-07	4,573	9%	Moderate
IL_RNC_205-08	5,504	11%	Low
IL_RNC_205-09	2,415	5%	Moderate
IL_RNC_205-10	9,869	20%	Moderate
IL_RNC_205-11	1,005	2%	Moderate
IL_RNC_205-12	1,989	4%	Moderate
IL_RNC_205-13	3,092	6%	Moderate
IL_RNC_205-14	792	2%	Low
Total:	**49,571**	**100%**	

Figure 2.36


Kinkaid Lake-East Section - Erosion Assessment
State of Missouri
Erosion
Low
Moderate
High
Severe
N
0
0.075
0.15
0.3
Miles
1:8,602
Map Produced by: Greater Egypt.
Drawn by: Ciara Nixon, Kelsey Bowe Updated 2022
Souces: ESRI, IEPA, EPA, ISGS, USGS, USDA, Jackson County Assessor Office

Kinkaid Lake-Central Body Section - Extent of Erosion

The Central Body section of the lake consists of 161,139 feet of shoreline. Forty-six shore codes have been created. The erosion around the Central Body mostly ranges from moderate to high. One reach exhibits severe erosion.

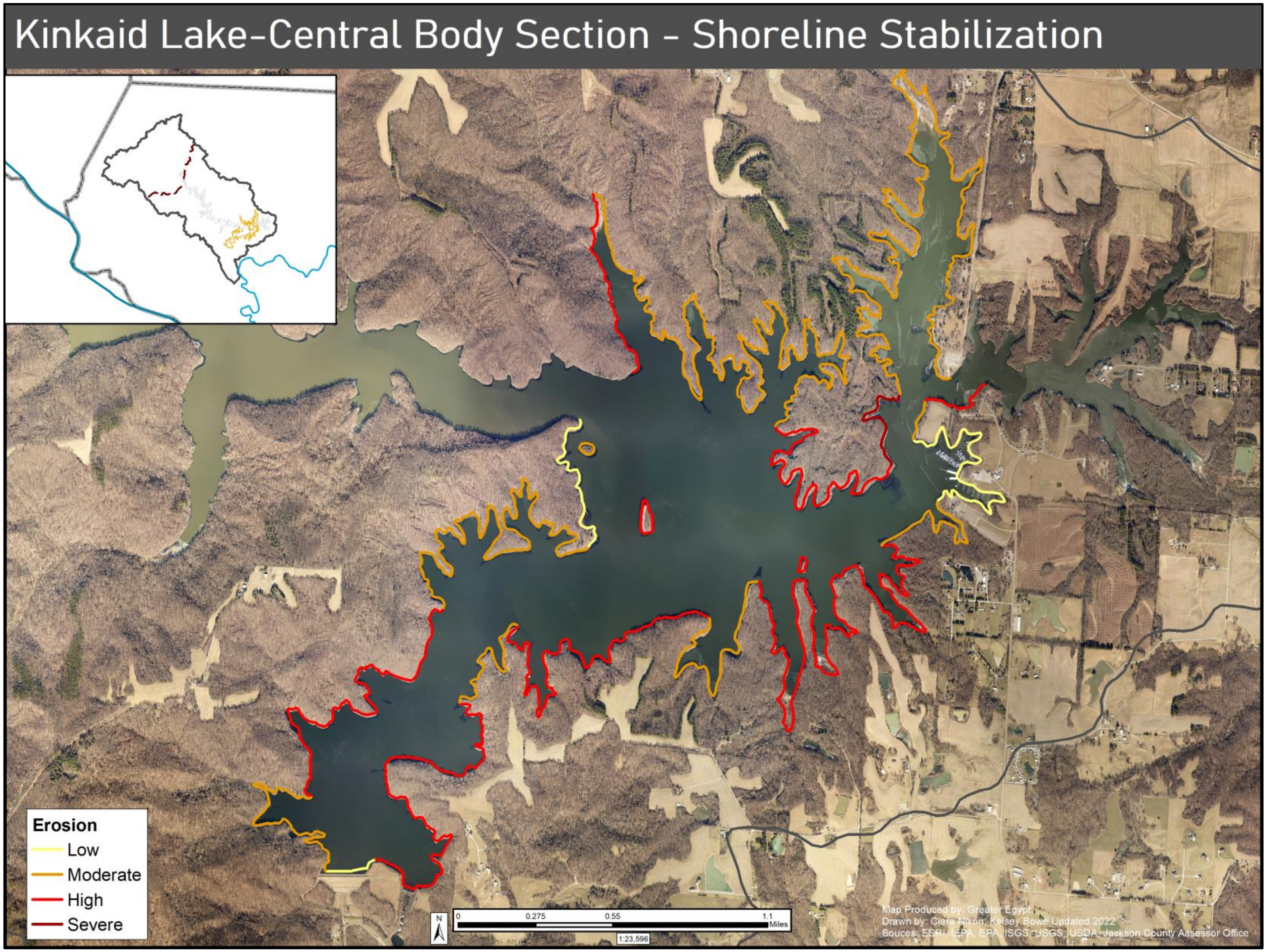
Within the Central Body section of Kinkaid Lake, five shore codes, or 7.5 percent of the area's shoreline, exhibits low levels of erosion. The majority of the shoreline, or ninety-one percent, exhibits moderate to high erosion. *Table 2.33* summarizes this information, while *Figure 2.37* displays the erosion assessment.

Table 2.33 – Kinkaid Lake-Central Body Section Extent of Erosion

Kinkaid Lake-Central Body Section			
Kinkaid Lake Shore Code	Shoreline Length Assessed (ft)	% of Total Shoreline	Extent of Erosion
IL_RNC_204-01	1,048	1%	Low
IL_RNC_204-02 (01)	758	0%	High
IL_RNC_204-02 (02)	1,035	1%	Low
IL_RNC_204-02 (03)	283	0%	High
IL_RNC_204-03	3,110	2%	High
IL_RNC_204-04	3,923	2%	High
IL_RNC_204-05	3,408	2%	Moderate
IL_RNC_204-06	4,984	3%	High
IL_RNC_204-07	3,823	2%	High
IL_RNC_204-08	5,597	3%	Moderate
IL_RNC_204-09	6,524	4%	High
IL_RNC_204-10	5,538	3%	High
IL_RNC_204-11	6,818	4%	High
IL_RNC_204-12	1,104	1%	Moderate
IL_RNC_204-13	2,650	2%	Moderate
IL_RNC_204-14	3,167	2%	Low
IL_RNC_204-15	3,328	2%	Low
IL_RNC_204-16	793	0%	Moderate
IL_RNC_204-17	1,467	1%	High
IL_RNC_204-18	3,271	2%	Moderate
IL_RNC_204-19	3,773	2%	Moderate
IL_RNC_204-20	5,945	4%	Moderate
IL_RNC_204-21	3,516	2%	Moderate
IL_RNC_204-22	2,881	2%	Moderate

Kinkaid Lake-Central Body Section			
Kinkaid Lake Shore Code	Shoreline Length Assessed (ft)	% of Total Shoreline	Extent of Erosion
IL_RNC_204-23	3,255	2%	Moderate
IL_RNC_204-24	2,152	1%	Moderate
IL_RNC_204-25	1,950	1%	Moderate
IL_RNC_204-26	2,470	2%	Severe
IL_RNC_204-27	5,042	3%	High
IL_RNC_204-28	2,963	2%	High
IL_RNC_204-29	7,865	5%	Moderate
IL_RNC_204-30	5,885	4%	Moderate
IL_RNC_204-31	6,773	4%	Moderate
IL_RNC_204-32	5,782	4%	Moderate
IL_RNC_204-33	3,837	2%	High
IL_RNC_204-34	3,478	2%	Low
IL_RNC_204-35	6,846	4%	Moderate
IL_RNC_204-36	7,761	5%	Moderate
IL_RNC_204-37	1,673	1%	High
IL_RNC_204-38	2,314	1%	High
IL_RNC_204-39	4,206	3%	High
IL_RNC_204-40	3,903	2%	Moderate
IL_RNC_204-41	1,296	1%	Moderate
IL_RNC_204-42	1,458	1%	High
IL_RNC_204-43	756	0%	Moderate
IL_RNC_204-44	729	0%	High
Total:	**161,139**	**100%**	

Figure 2.37



Kinkaid Lake-Central Body Section - Shoreline Stabilization
Erosion
Low
Moderate
High
Severe
N
0
0.275
0.55
1.1
Miles
1:23,596
Map Produced by: Greater Egypt
Drawn by: Clara Nixon, Kelsey Bowe Updated 2022
Souces: ESRI, IEPA, EPA, ISGS, USGS, USDA, Jackson County Assessor Office

Kinkaid Lake-Central Channel Section – Extent of Erosion

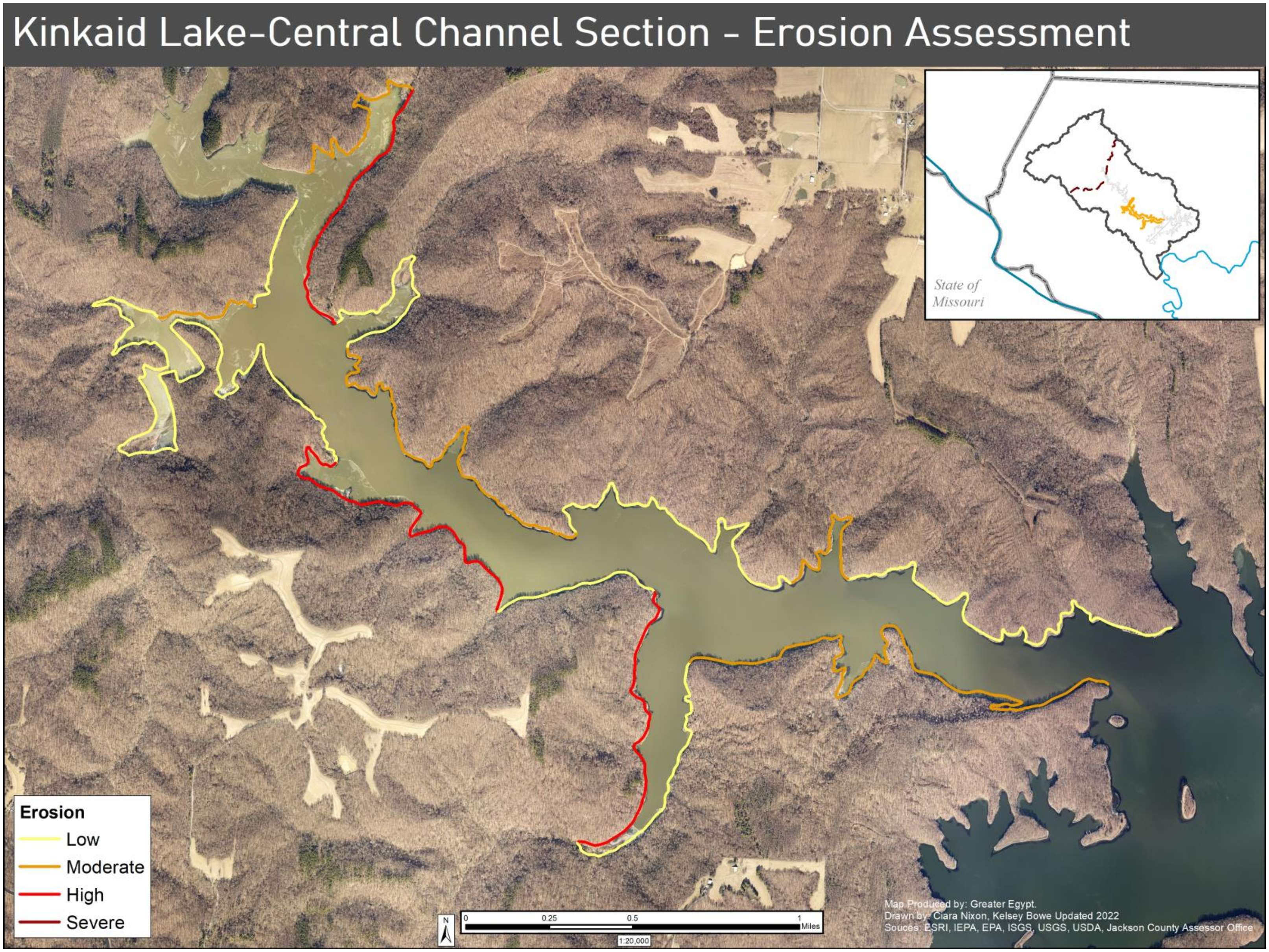
The Central Channel section of the lake consists of 88,884 feet of shoreline. Twenty-nine shore codes have been created. The majority of erosion around the Central Channel ranges from low to moderate.

Within the Central Channel section of Kinkaid Lake, fourteen shore codes, or forty-six percent of the area's shoreline, exhibits low levels of erosion. Ten shore codes, or thirty-four percent of the area's shoreline, exhibit moderate levels of erosion. The remaining ten shore codes, representing twenty percent of the shoreline, exhibit high erosion. *Table 2.34* summarizes this information, while *Figure 2.38* displays the erosion assessment geographically.

Table 2.34 – Kinkaid Lake-Central Channel Section Extent of Erosion

Kinkaid Lake-Central Channel Section			
Kinkaid Lake Shore Code	**Shoreline Length Assessed (ft)**	**% of Total Shoreline**	**Extent of Erosion**
IL_RNC_208-01 (01)	2,095	2%	Low
IL_RNC_208-01 (02)	915	1%	Moderate
IL_RNC_204-02 (01)	2,504	3%	Low
IL_RNC_208-02 (02)	2,053	2%	High
IL_RNC_208-03	3,294	4%	Moderate
IL_RNC_208-04	3,085	3%	Low
IL_RNC_208-05 (01)	2,342	3%	Low
IL_RNC_208-05 (02)	1,479	2%	Moderate
IL_RNC_208-06	3,993	4%	Moderate
IL_RNC_208-07	3,428	4%	Moderate
IL_RNC_208-08	4,221	5%	Low
IL_RNC_208-09	4,544	5%	High
IL_RNC_208-10	4,056	5%	Moderate
IL_RNC_208-11	1,950	2%	Low
IL_RNC_208-12	1,746	2%	Moderate
IL_RNC_208-13	3,288	4%	Low
IL_RNC_208-14	2,422	3%	Low
IL_RNC_208-15	2,820	3%	High
IL_RNC_208-16	3,356	4%	High
IL_RNC_208-17	2,743	3%	Low
IL_RNC_208-18 (01)	5,163	6%	High
IL_RNC_208-18 (02)	2,013	2%	Low
IL_RNC_208-19	4,421	5%	Low
IL_RNC_208-20	2,552	3%	Moderate
IL_RNC_208-21	3,210	4%	Moderate
IL_RNC_208-22	5,284	6%	Moderate
IL_RNC_210-01	3,799	4%	Low
IL_RNC_210-02	4,635	5%	Low
IL_RNC_210-03	1,470	2%	Low
Total:	88,884	100%	

Figure 2.38


Kinkaid Lake-Central Channel Section - Erosion Assessment
State of Missouri
Erosion
Low
Moderate
High
Severe
N
0
0.25
0.5
1
Miles
1:20,000
Map Produced by: Greater Egypt.
Drawn by: Ciara Nixon, Kelsey Bowe Updated 2022
Souces: ESRI, IEPA, EPA, ISGS, USGS, USDA, Jackson County Assessor Office

Kinkaid Lake-Northwest Section – Extent of Erosion

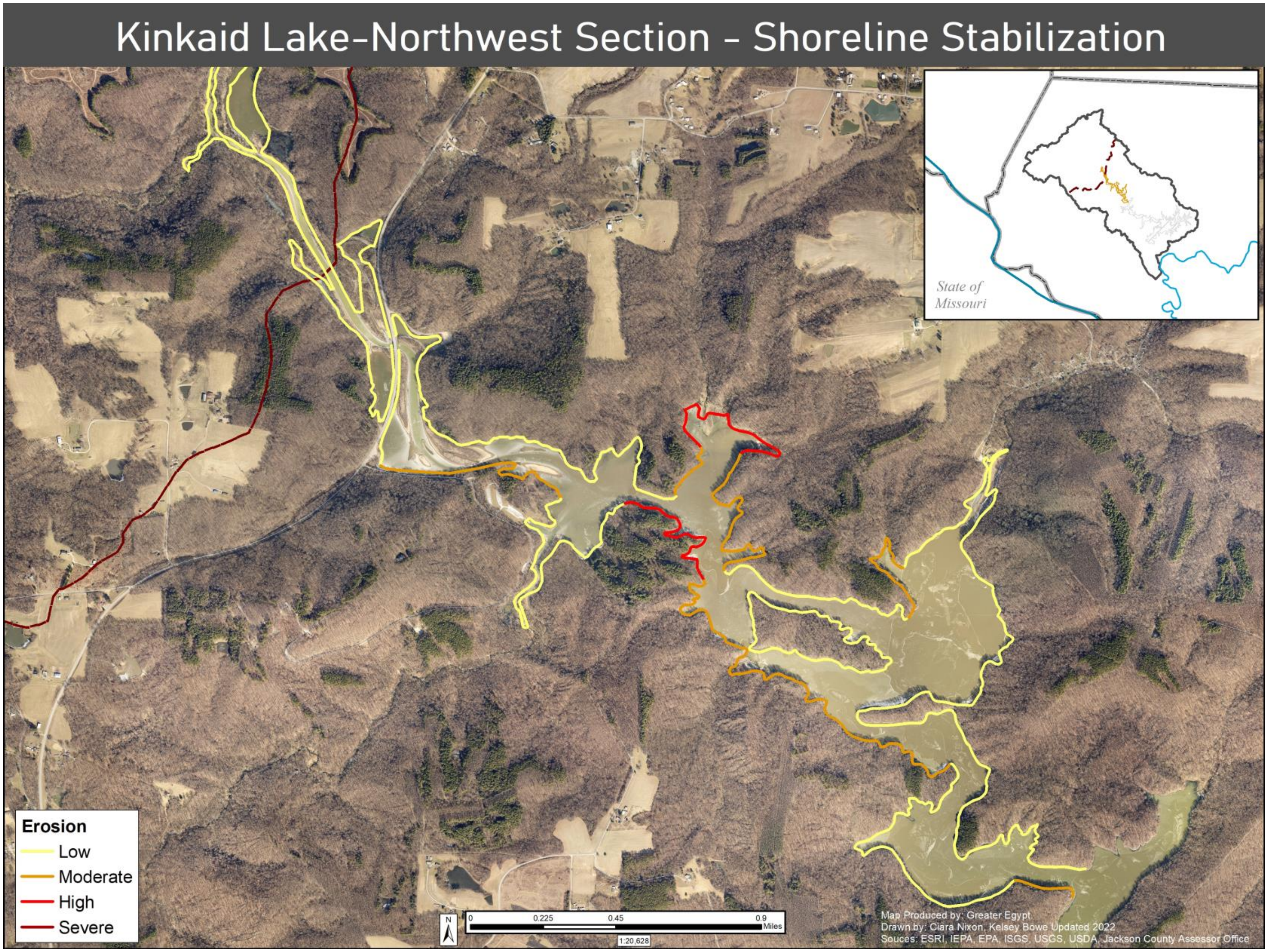
The Northwest section of the lake consists of 97,036 feet of shoreline. Thirty-two shore codes have been created. The erosion around the Central Channel ranges from low to moderate. The lower levels of erosion could be contributed to a majority of this area being a no wake zone. Only smaller fishing boats tend to explore this area due to more shallow water depths.

Within the Northwest section of Kinkaid Lake, twenty-two shore codes, or seventy-five percent of the area's shoreline, exhibits low levels of erosion. Eight shore codes, or nineteen percent of the area's shoreline, exhibit moderate levels of erosion. The remaining two shore codes, representing six percent of the shoreline, exhibit high erosion. *Table 2.35* summarizes this information, while *Figure 2.39* displays the erosion assessment geographically.

Table 2.35 - Kinkaid Lake-Northwest Section – Erosion Assessment

Kinkaid Lake-Northwest Section			
Kinkaid Lake Shore Code	**Shoreline Length Assessed (ft)**	**% of Total Shoreline**	**Extent of Erosion**
IL_RNC_102-01	12,805	13%	Low
IL_RNC_102-02	6,008	6%	Low
IL_RNC_212-01	757	1%	Low
IL_RNC_212-02	2,401	2%	Low
IL_RNC_212-03	2,774	3%	Low
IL_RNC_212-04	1,479	2%	Low
IL_RNC_212-05	2,467	3%	Low
IL_RNC_212-06	2,417	2%	Low
IL_RNC_212-07	4,812	5%	Low
IL_RNC_212-08	2,250	2%	Moderate
IL_RNC_212-09	3,121	3%	Low
IL_RNC_212-10	1,426	1%	Moderate
IL_RNC_212-11	2,342	2%	Moderate
IL_RNC_212-12	3,119	3%	High
IL_RNC_212-13	973	1%	Moderate
IL_RNC_212-14	561	1%	Low
IL_RNC_212-15	2,124	2%	Low
IL_RNC_212-16	2,503	3%	Low
IL_RNC_212-17	3,003	3%	Low
IL_RNC_212-18	5,924	6%	Low
IL_RNC_212-19	1,924	2%	Low
IL_RNC_212-20	3,258	3%	Moderate
IL_RNC_212-21	6,316	7%	Low
IL_RNC_212-22	2,805	3%	High
IL_RNC_212-23	4,478	5%	Moderate
IL_RNC_212-24	2,589	3%	Moderate
IL_RNC_212-25	941	1%	Low
IL_RNC_212-26	2,426	3%	Low
IL_RNC_212-27	2,201	2%	Low
IL_RNC_212-28	887	1%	Moderate
IL_RNC_212-29	3,092	3%	Low
IL_RNC_212-30	2,853	3%	Low
Total:	97,036	100%	

Figure 2.39


Kinkaid Lake-Northwest Section - Shoreline Stabilization
State of Missouri
Erosion
Low
Moderate
High
Severe
N
0
0.225
0.45
0.9
Miles
1:20,628
Map Produced by: Greater Egypt.
Drawn by: Ciara Nixon, Kelsey Bowe Updated 2022
Souces: ESRI, IEPA, EPA, ISGS, USGS, USDA, Jackson County Assessor Office

2.7.4.2. Condition of Littoral Zones

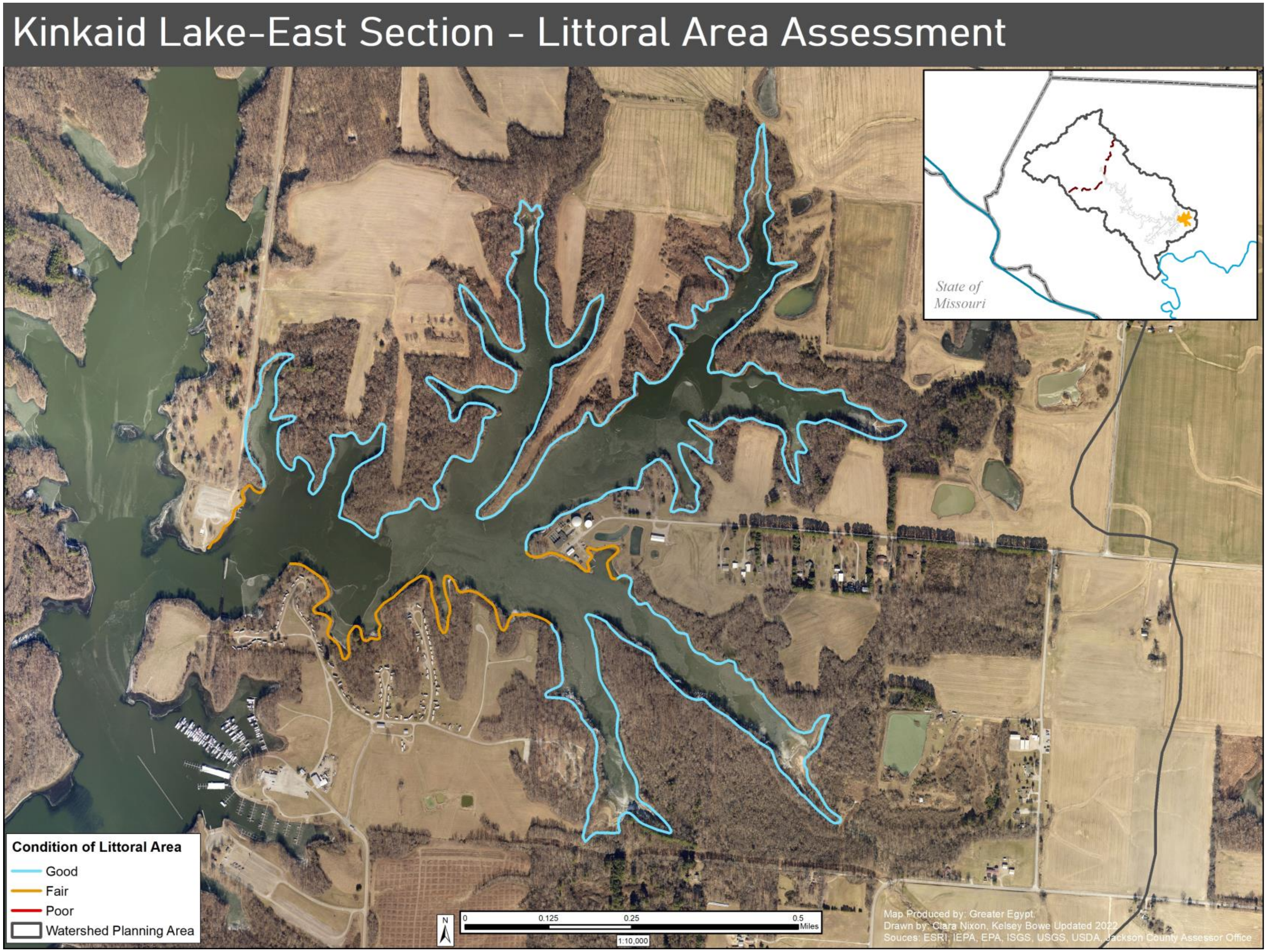
Kinkaid Lake-East – Condition of Littoral Zone

Since the majority of Kinkaid Lake- East is forested, the majority of the littoral areas are in good condition. A total of 49,571 feet of shoreline was assessed and no areas within Kinkaid Lake – East exhibit a poor littoral condition. Even in areas of residential or farmland, a vegetative buffer is present. *Table 2.36* summarizes the littoral area conditions. *Figure 2.40* displays this data.

Table 2.36 - Kinkaid Lake-East Section – Condition of Littoral Area

Kinkaid Lake-East Section			
Kinkaid Lake Shore Code	**Shoreline Length Assessed (ft)**	**% of Total Shoreline**	**Condition of Littoral Area**
IL_RNC_205-01	2,409	5%	Fair
IL_RNC_205-02	2,157	4%	Fair
IL_RNC_205-03	4,886	10%	Good
IL_RNC_205-04	6,153	12%	Good
IL_RNC_205-05	1,340	3%	Fair
IL_RNC_205-06	3,387	7%	Good
IL_RNC_205-07	4,573	9%	Good
IL_RNC_205-08	5,504	11%	Good
IL_RNC_205-09	2,415	5%	Good
IL_RNC_205-10	9,869	20%	Good
IL_RNC_205-11	1,005	2%	Good
IL_RNC_205-12	1,989	4%	Good
IL_RNC_205-13	3,092	6%	Good
IL_RNC_205-14	792	2%	Fair
Total:	**49,571**	**100%**	

Figure 2.40


Kinkaid Lake-East Section - Littoral Area Assessment
State of Missouri
Condition of Littoral Area
Good
Fair
Poor
Watershed Planning Area
0
0.125
0.25
0.5
Miles
1:10,000
N
Map Produced by: Greater Egypt
Drawn by: Clara Nixon, Kelsey Bowe Updated 2022
Souces: ESRI, IEPA, EPA, ISGS, USGS, USDA, Jackson County Assessor Office

Kinkaid Lake-Central Body - Condition of Littoral Zone

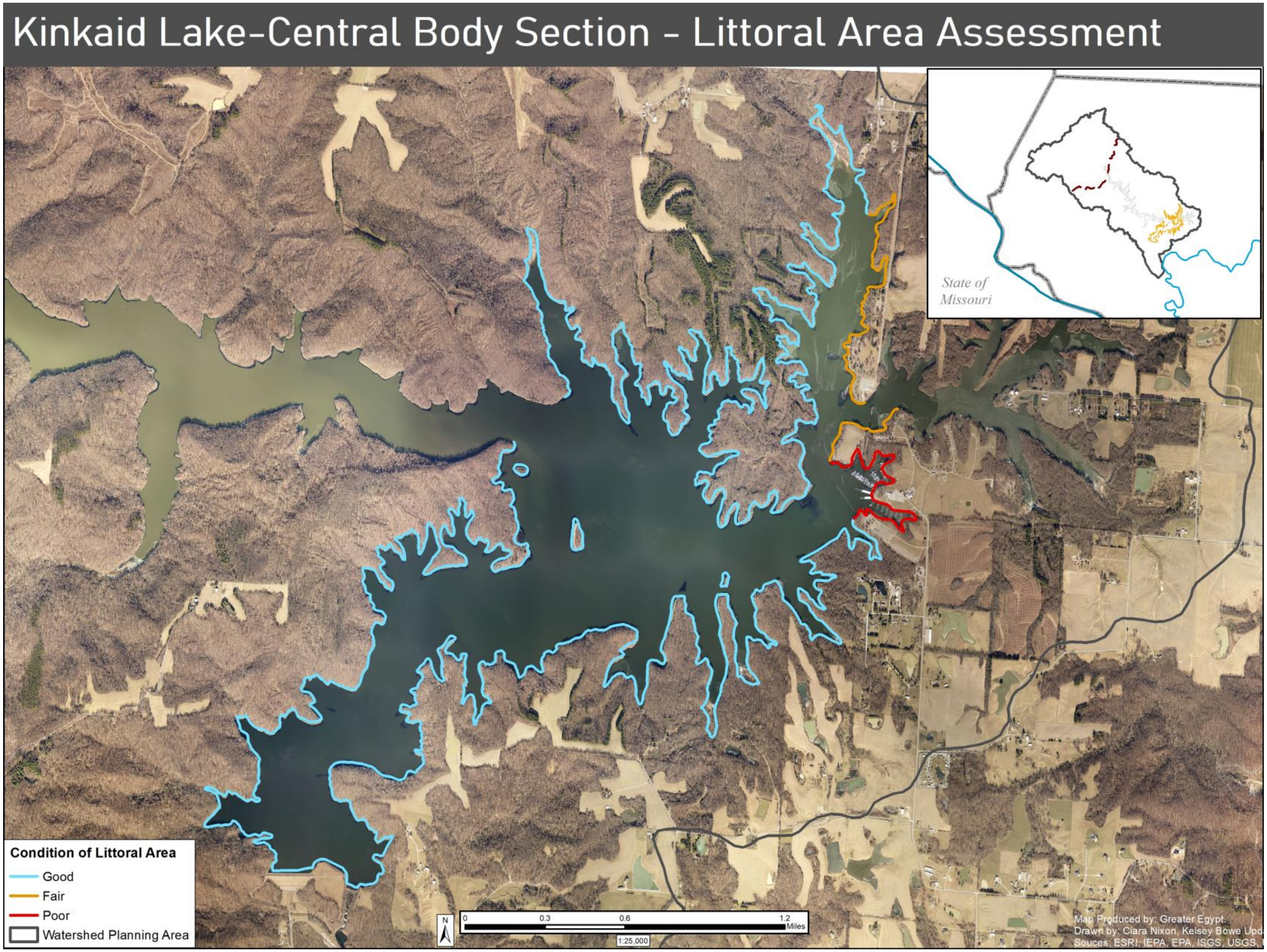
Since the majority of Kinkaid Lake- Central Body is also forested, the majority of the littoral areas are in good condition. A total of 161,139 feet of shoreline was assessed. Within the Central Body section of Kinkaid Lake, forty-one shore codes, or ninety-three percent of the shoreline, exhibits good littoral vegetative buffer. Three shore codes, or three percent of the shoreline, exhibit fair littoral vegetation. The remaining two shore codes, which represent four percent of the shoreline, exhibit poor littoral conditions. *Table 2.37* summarizes the riparian area conditions. *Figure 2.41* displays this data.

Table 2.37 - Kinkaid Lake-Central Body Section – Condition of Littoral Area

Kinkaid Lake-Central Body Section			
Kinkaid Lake Shore Code	Shoreline Length Assessed (ft)	% of Total Shoreline	Condition of Littoral Area
IL_RNC_204-01	1,048	1%	Good
IL_RNC_204-02 (01)	758	0%	Good
IL_RNC_204-02 (02)	1,035	1%	Good
IL_RNC_204-02 (03)	283	0%	Good
IL_RNC_204-03	3,110	2%	Good
IL_RNC_204-04	3,923	2%	Good
IL_RNC_204-05	3,408	2%	Good
IL_RNC_204-06	4,984	3%	Good
IL_RNC_204-07	3,823	2%	Good
IL_RNC_204-08	5,597	3%	Good
IL_RNC_204-09	6,524	4%	Good
IL_RNC_204-10	5,538	3%	Good
IL_RNC_204-11	6,818	4%	Good
IL_RNC_204-12	1,104	1%	Good
IL_RNC_204-13	2,650	2%	Good
IL_RNC_204-14	3,167	2%	Poor
IL_RNC_204-15	3,328	2%	Poor
IL_RNC_204-16	793	0%	Fair
IL_RNC_204-17	1,467	1%	Fair
IL_RNC_204-18	3,271	2%	Fair
IL_RNC_204-19	3,773	2%	Good
IL_RNC_204-20	5,945	4%	Good
IL_RNC_204-21	3,516	2%	Good

Kinkaid Lake-Central Body Section			
Kinkaid Lake Shore Code	**Shoreline Length Assessed (ft)**	**% of Total Shoreline**	**Condition of Littoral Area**
IL_RNC_204-22	2,881	2%	Good
IL_RNC_204-23	3,255	2%	Good
IL_RNC_204-24	2,152	1%	Good
IL_RNC_204-25	1,950	1%	Good
IL_RNC_204-26	2,470	2%	Good
IL_RNC_204-27	5,042	3%	Good
IL_RNC_204-28	2,963	2%	Good
IL_RNC_204-29	7,865	5%	Good
IL_RNC_204-30	5,885	4%	Good
IL_RNC_204-31	6,773	4%	Good
IL_RNC_204-32	5,782	4%	Good
IL_RNC_204-33	3,837	2%	Good
IL_RNC_204-34	3,478	2%	Good
IL_RNC_204-35	6,846	4%	Good
IL_RNC_204-36	7,761	5%	Good
IL_RNC_204-37	1,673	1%	Good
IL_RNC_204-38	2,314	1%	Good
IL_RNC_204-39	4,206	3%	Good
IL_RNC_204-40	3,903	2%	Good
IL_RNC_204-41	1,296	1%	Good
IL_RNC_204-42	1,458	1%	Good
IL_RNC_204-43	756	0%	Good
IL_RNC_204-44	729	0%	Good
Total:	161,139	100%	

Figure 2.41



Kinkaid Lake-Central Body Section - Littoral Area Assessment
State of Missouri
Condition of Littoral Area
Good
Fair
Poor
Watershed Planning Area
0
0.3
0.6
1.2
Miles
1:25,000
N
Map Produced by: Greater Egypt

Kinkaid Lake-Central Channel – Condition of Littoral Zone

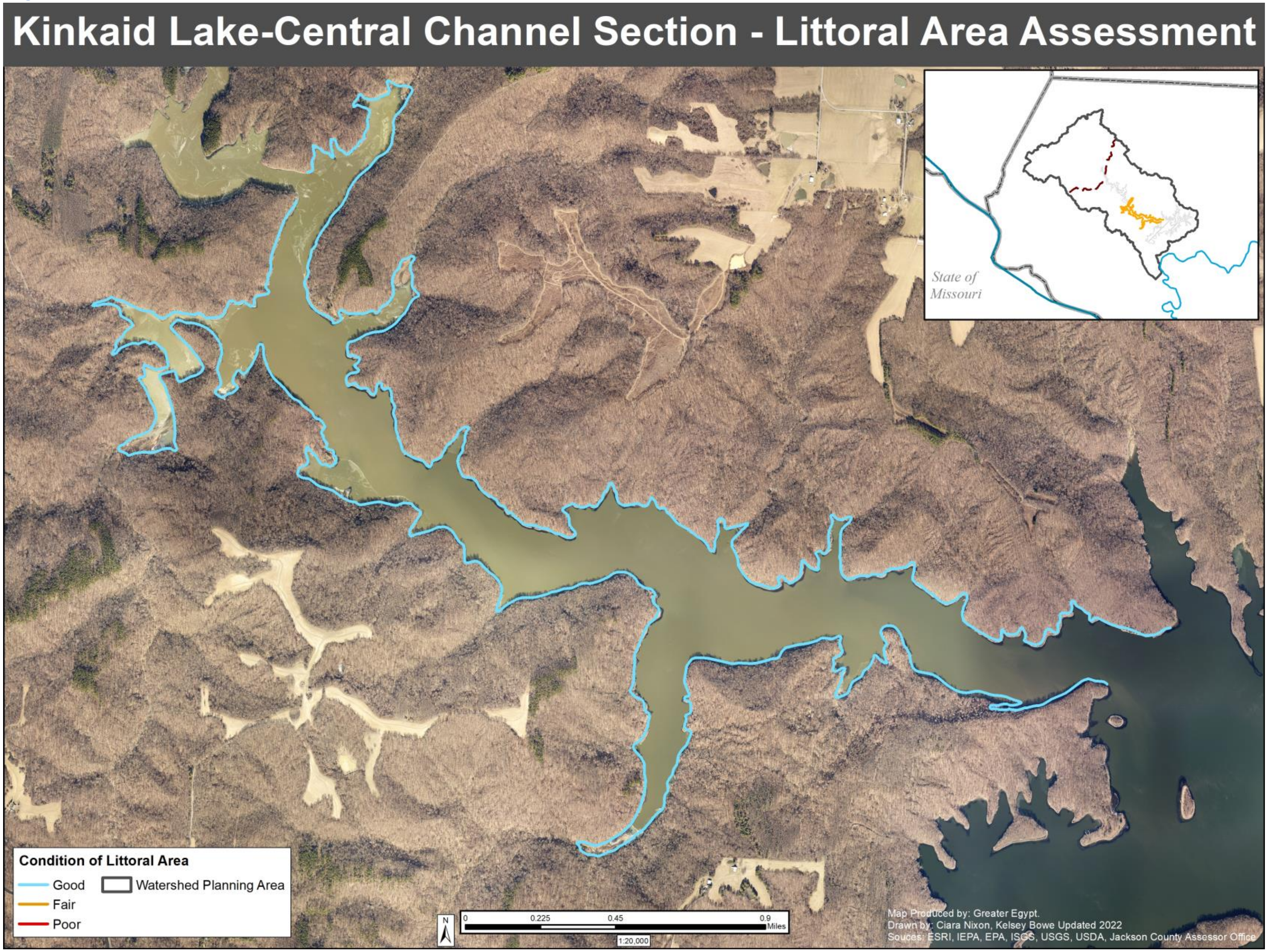
Since the majority of Kinkaid Lake- Central Channel is forested, it is expected that the majority of the littoral areas are in good condition. A total of 88,884 feet of shoreline was assessed and no areas within Kinkaid Lake – Central Channel exhibit fair or poor littoral condition. *Table 2.38* summarizes the riparian area conditions. *Figure 2.42* displays this data.

Table 2.38 - Kinkaid Lake-Central Channel Section – Condition of Littoral Area

Kinkaid Lake-Central Channel Section			
Kinkaid Lake Shore Code	Shoreline Length Assessed (ft)	% of Total Shoreline	Condition of Littoral Area
IL_RNC_208-01 (01)	2,095	2%	Good
IL_RNC_208-01 (02)	915	1%	Good
IL_RNC_204-02 (01)	2,504	3%	Good
IL_RNC_208-02 (02)	2,053	2%	Good
IL_RNC_208-03	3,294	4%	Good
IL_RNC_208-04	3,085	3%	Good
IL_RNC_208-05 (01)	2,342	3%	Good
IL_RNC_208-05 (02)	1,479	2%	Good
IL_RNC_208-06	3,993	4%	Good
IL_RNC_208-07	3,428	4%	Good
IL_RNC_208-08	4,221	5%	Good
IL_RNC_208-09	4,544	5%	Good
IL_RNC_208-10	4,056	5%	Good
IL_RNC_208-11	1,950	2%	Good
IL_RNC_208-12	1,746	2%	Good
IL_RNC_208-13	3,288	4%	Good
IL_RNC_208-14	2,422	3%	Good
IL_RNC_208-15	2,820	3%	Good
IL_RNC_208-16	3,356	4%	Good
IL_RNC_208-17	2,743	3%	Good
IL_RNC_208-18 (01)	5,163	6%	Good
IL_RNC_208-18 (02)	2,013	2%	Good
IL_RNC_208-19	4,421	5%	Good
IL_RNC_208-20	2,552	3%	Good
IL_RNC_208-21	3,210	4%	Good
IL_RNC_208-22	5,284	6%	Good

Kinkaid Lake-Central Channel Section			
Kinkaid Lake Shore Code	**Shoreline Length Assessed (ft)**	**% of Total Shoreline**	**Condition of Littoral Area**
IL_RNC_210-01	3,799	4%	Good
IL_RNC_210-02	4,635	5%	Good
IL_RNC_210-03	1,470	2%	Good
Total:	**88,884**	**100%**	

Figure 2.42



Kinkaid Lake-Central Channel Section - Littoral Area Assessment
State of Missouri
Condition of Littoral Area
Good
Fair
Poor
Watershed Planning Area
N
0
0.225
0.45
0.9
Miles
1:20,000
Map Produced by: Greater Egypt.
Drawn by: Ciara Nixon, Kelsey Bowe Updated 2022
Souces: ESRI, IEPA, EPA, ISGS, USGS, USDA, Jackson County Assessor Office

Kinkaid Lake-Northwest - Condition of Littoral Zone

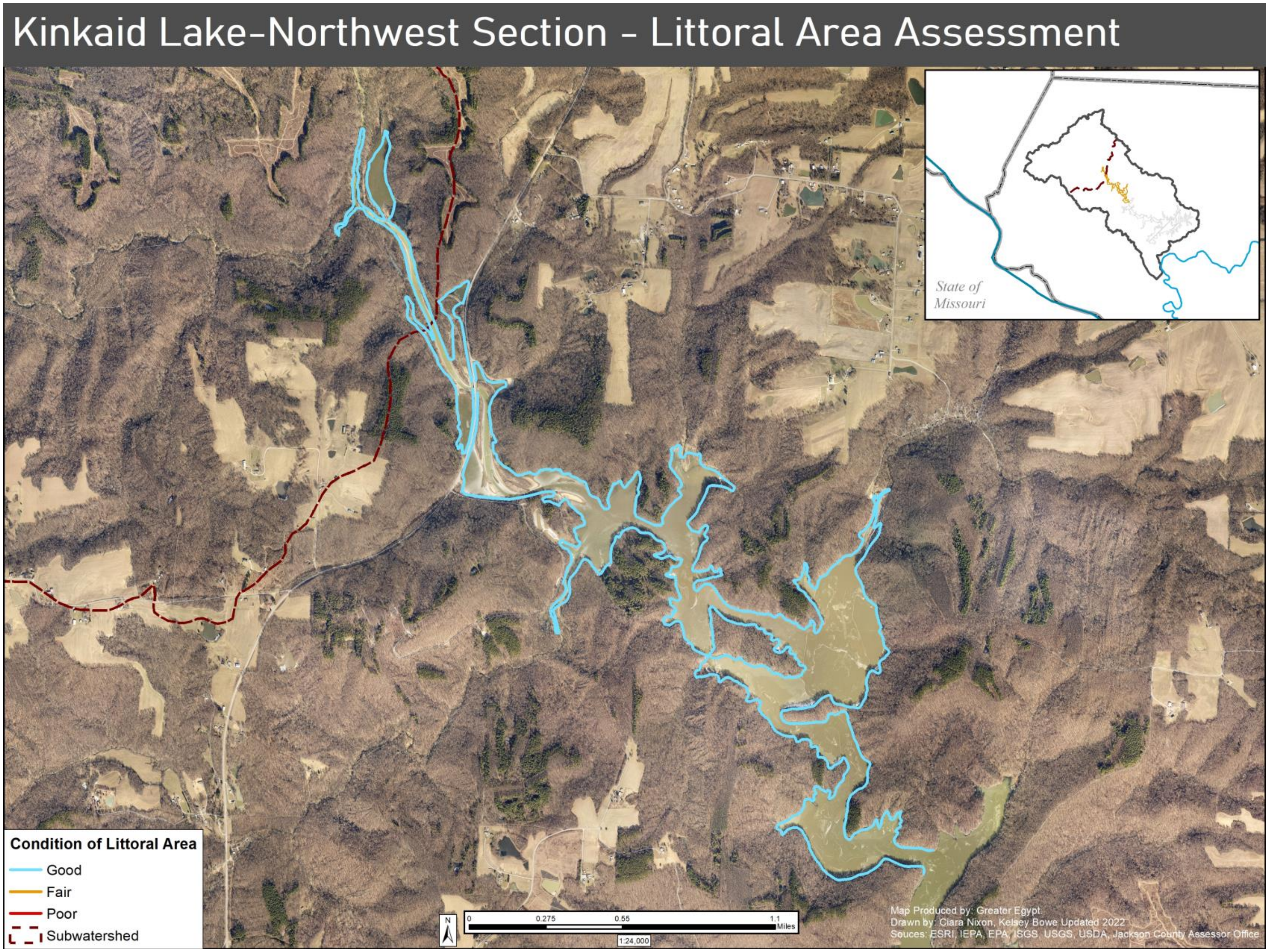
Since the majority of Kinkaid Lake- Northwest is forested, the majority of the littoral areas are in good condition. A total of 97,036 feet of shoreline was assessed and the entire length is classified as good littoral area. *Table 2.39* summarizes the littoral area conditions. *Figure 2.43* displays this data.

Table 2.39 - Kinkaid Lake-Northwest Section – Condition of Littoral Area

Kinkaid Lake-Northwest Section			
Kinkaid Lake Shore Code	**Shoreline Length Assessed (ft)**	**% of Total Shoreline**	**Condition of Littoral Area**
IL_RNC_102-01	12,805	13%	Good
IL_RNC_102-02	6,008	6%	Good
IL_RNC_212-01	757	1%	Good
IL_RNC_212-02	2,401	2%	Good
IL_RNC_212-03	2,774	3%	Good
IL_RNC_212-04	1,479	2%	Good
IL_RNC_212-05	2,467	3%	Good
IL_RNC_212-06	2,417	2%	Good
IL_RNC_212-07	4,812	5%	Good
IL_RNC_212-08	2,250	2%	Good
IL_RNC_212-09	3,121	3%	Good
IL_RNC_212-10	1,426	1%	Good
IL_RNC_212-11	2,342	2%	Good
IL_RNC_212-12	3,119	3%	Good
IL_RNC_212-13	973	1%	Good
IL_RNC_212-14	561	1%	Good
IL_RNC_212-15	2,124	2%	Good
IL_RNC_212-16	2,503	3%	Good
IL_RNC_212-17	3,003	3%	Good
IL_RNC_212-18	5,924	6%	Good
IL_RNC_212-19	1,924	2%	Good
IL_RNC_212-20	3,258	3%	Good
IL_RNC_212-21	6,316	7%	Good
IL_RNC_212-22	2,805	3%	Good
IL_RNC_212-23	4,478	5%	Good
IL_RNC_212-24	2,589	3%	Good
IL_RNC_212-25	941	1%	Good

Kinkaid Lake-Northwest Section			
Kinkaid Lake Shore Code	**Shoreline Length Assessed (ft)**	**% of Total Shoreline**	**Condition of Littoral Area**
IL_RNC_212-26	2,426	3%	Good
IL_RNC_212-27	2,201	2%	Good
IL_RNC_212-28	887	1%	Good
IL_RNC_212-29	3,092	3%	Good
IL_RNC_212-30	2,853	3%	Good
Total:	97,036	100%	

Figure 2.43


Kinkaid Lake-Northwest Section - Littoral Area Assessment
State of
Missouri
Condition of Littoral Area
Good
Fair
Poor
Subwatershed
N
0
0.275
0.55
1.1
Miles
1:24,000
Map Produced by: Greater Egypt
Drawn by: Ciara Nixon, Kelsey Bowe Updated 2022
Souces: ESRI, IEPA, EPA, ISGS, USGS, USDA, Jackson County Assessor Office

2.7.5. Basins and Blockages

Basins have also been assessed as part of this report. Detention basins are usually dry structures that temporarily store water during a heavy period of stormwater runoff. These types of basins can also release the detained water at a controlled rate. Although their primary purpose is to store water, they can also be constructed in a manner that provides benefits to habitats and water quality.

Retention basins, also known as wet basins, also serve to manage stormwater runoff, but store water on a permanent basis. Like detention basins, retention areas can also reduce, or prevent flooding, and improve water quality.

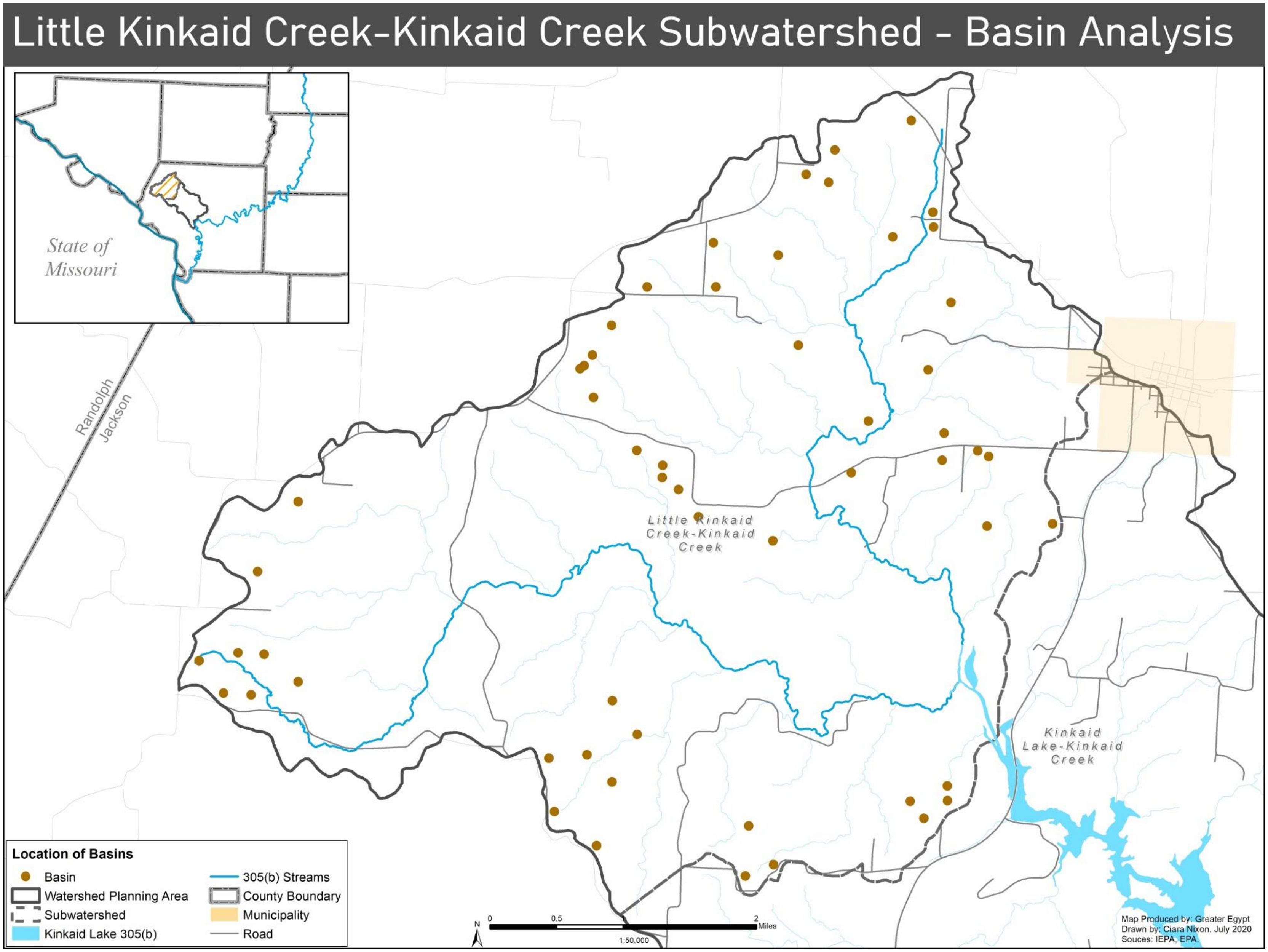
Detention basins are more prevalent in the planning area. Basins in the Kinkaid Creek watershed are displayed in *Figure 2.44 and 2.45*.

The following tables summarize the basins by type and location (latitude/longitude). Basins were assigned an identification number. There are 105 basins in the watershed planning area. The majority of these features occur in the Little Kinkaid Creek- Kinkaid Creek watershed. Basins are also displayed in *Table 2.40* with Basin IDs.

Table 2.40 - Basin Identification

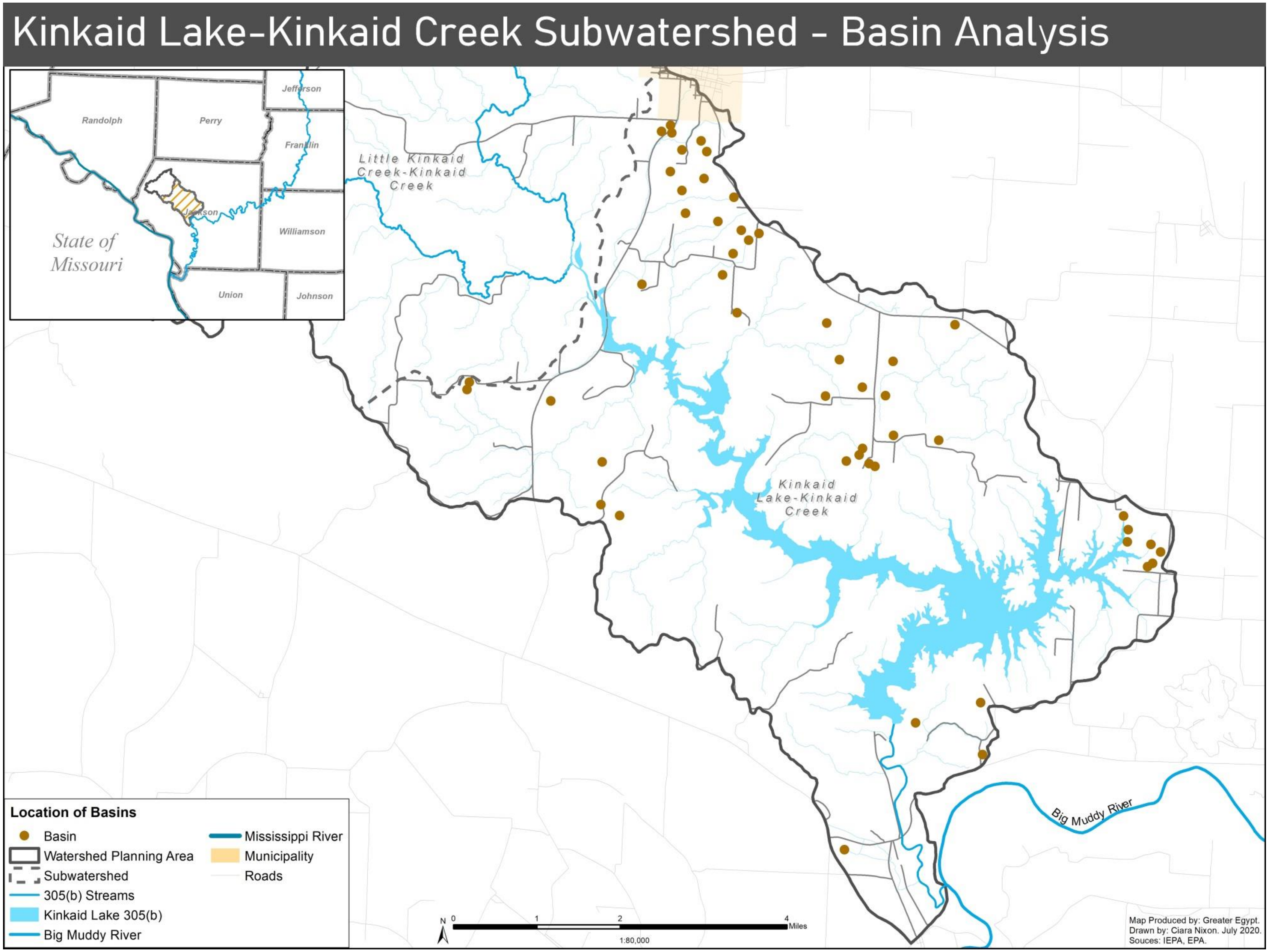
Basin Type	Basin ID	Latitude	Longitude
Detention	1	37.846197	-89.579082
Detention	2	37.846683	-89.573868
Detention	3	37.849044	-89.567071
Detention	4	37.852634	-89.570587
Detention	5	37.833976	-89.551712
Detention	6	37.835299	-89.547886
Detention	7	37.839439	-89.551429
Detention	8	37.844367	-89.524365
Detention	9	37.842766	-89.524275
Detention	10	37.842578	-89.529373
Detention	11	37.840772	-89.527447
Detention	12	37.843804	-89.570354
Detention	13	37.870488	-89.549174
Detention	14	37.872887	-89.559483
Detention	15	37.875793	-89.562336
Detention	16	37.890156	-89.574624
Detention	17	37.888988	-89.575734
Detention	18	37.885548	-89.57432
Detention	19	37.888622	-89.576303
Detention	20	37.879922	-89.568182
Detention	21	37.878384	-89.564591
Detention	22	37.877039	-89.564599
Detention	23	37.893435	-89.572118
Detention	24	37.897735	-89.567381
Detention	25	37.902716	-89.558456
Detention	26	37.897921	-89.557943
Detention	27	37.891839	-89.546423
Detention	28	37.878139	-89.538686
Detention	29	37.883794	-89.536542
Detention	30	37.873178	-89.510873
Detention	31	37.872738	-89.519869
Detention	32	37.880308	-89.519883
Detention	33	37.88089	-89.521419
Detention	34	37.882707	-89.526101
Detention	35	37.879756	-89.526253
Detention	36	37.889548	-89.528525
Detention	37	37.896939	-89.525619
Detention	38	37.906699	-89.528453
Detention	39	37.9051	-89.528317
Detention	40	37.903893	-89.533881
Detention	41	37.910444	-89.546005
Detention	42	37.909634	-89.542872
Detention	43	37.913181	-89.542127
Detention	44	37.855723	-89.627415
Detention	45	37.856724	-89.622108
Detention	46	37.85227	-89.623954
Detention	47	37.852178	-89.620166
Detention	48	37.856627	-89.618543
Detention	49	37.853732	-89.613765
Detention	50	37.865602	-89.619751
Detention	51	37.87331	-89.614457
Detention	52	37.901564	-89.54952
Detention	53	37.916598	-89.531769
Detention	54	37.83682	-89.572216
Detention	55	37.840398	-89.578127
Detention	56	37.833355	-89.545201
Detention	57	37.834652	-89.544741
Detention	58	37.831792	-89.526769
Detention	59	37.852495	-89.507499
Detention	60	37.847973	-89.486441
Detention	61	37.854494	-89.489857
Detention	62	37.858255	-89.487674
Detention	63	37.86065	-89.484368
Detention	64	37.862346	-89.486022
Detention	65	37.861885	-89.482136
Detention	66	37.863801	-89.491205
Detention	67	37.865051	-89.498374
Detention	68	37.86898	-89.499271
Detention	69	37.871198	-89.494504
Detention	70	37.868064	-89.487811
Detention	71	37.872228	-89.501919
Detention	72	37.879167	-89.504081
Detention	73	37.878991	-89.501845
Detention	74	37.880271	-89.502146
Detention	75	37.877708	-89.495338
Detention	76	37.875876	-89.494058
Detention	77	37.87607	-89.499494
Detention	78	37.822679	-89.461668
Detention	79	37.823825	-89.458881
Detention	80	37.824946	-89.458148
Detention	81	37.822364	-89.456668
Detention	82	37.821906	-89.45533
Detention	83	37.826721	-89.441505
Detention	84	37.827386	-89.451464
Detention	85	37.833892	-89.466596
Detention	86	37.835595	-89.458578
Detention	87	37.834268	-89.453462
Detention	88	37.846618	-89.466762
Detention	89	37.840313	-89.463762
Detention	90	37.840238	-89.451999
Detention	91	37.846916	-89.438631
Detention	92	37.781307	-89.430841
Detention	93	37.814379	-89.400579
Detention	94	37.812029	-89.399481
Detention	95	37.809928	-89.399608
Detention	96	37.809581	-89.394413
Detention	97	37.808302	-89.392238
Detention	98	37.806288	-89.393946
Detention	99	37.805693	-89.395037
Detention	100	37.821417	-89.515175
Detention	101	37.813979	-89.515185
Detention	102	37.812155	-89.511032
Detention	103	37.777473	-89.444965
Detention	104	37.772266	-89.43013
Detention	105	37.755082	-89.459811

Figure 2.44



Little Kinkaid Creek-Kinkaid Creek Subwatershed - Basin Analysis
State of Missouri
Randolph
Jackson
Little Kinkaid Creek-Kinkaid Creek
Kinkaid Lake-Kinkaid Creek
Location of Basins
Basin
Watershed Planning Area
Subwatershed
Kinkaid Lake 305(b)
305(b) Streams
County Boundary
Municipality
Road
0
0.5
2
Miles
1:50,000
N
Map Produced by: Greater Egypt
Drawn by: Ciara Nixon. July 2020
Souces: IEPA, EPA.

Figure 2.45


Kinkaid Lake-Kinkaid Creek Subwatershed - Basin Analysis
Jefferson
Randolph
Perry
Franklin
Jackson
Williamson
State of Missouri
Union
Johnson
Little Kinkaid Creek-Kinkaid Creek
Kinkaid Lake-Kinkaid Creek
Big Muddy River
Location of Basins
Basin
Watershed Planning Area
Subwatershed
305(b) Streams
Kinkaid Lake 305(b)
Big Muddy River
Mississippi River
Municipality
Roads
N
0 1 2 4 Miles
1:80,000
Map Produced by: Greater Egypt.
Drawn by: Ciara Nixon. July 2020.
Souces: IEPA, EPA.

2.7.5.1. Debris Blockages

Many areas in the Kinkaid Creek watershed planning area exhibit different types of debris blockages. These impediments are both natural and synthetic. Downed vegetation represents the majority of the blockages. *Figure 2.46* displays some of the obstructions occurring in tributaries that flow into Kinkaid Lake.

Figure 2.46 - Watershed Waterbody Obstructions

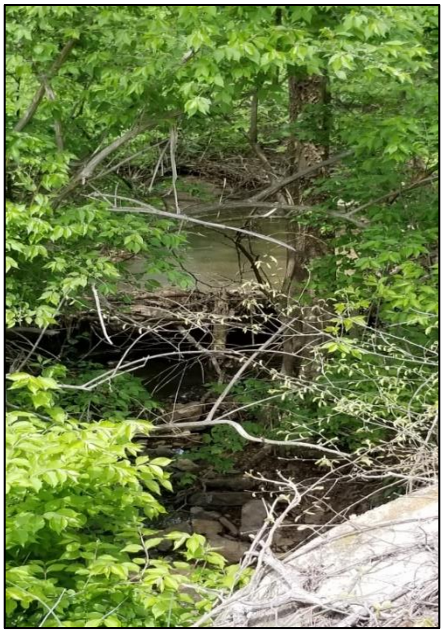


Figure 2.47 - Waterbody Dump Site

Dumping and litter is also prevalent in many portions of the watershed. This is typically evident around stream crossings and rural areas. *Figure 2.47* reveals an area where dumping has occurred along a tributary that feeds into Kinkaid Creek.

2.8. Water Quality Assessment

For this assessment, water quality of the waterbodies with available data that are within the Kinkaid Lake Watershed planning area have been analyzed. A water quality assessment has also been completed for Ava, the only municipality within the planning area.

In conforming to the regulations of the Federal Clean Water Act (CWA) sections 303(d) and 305(b), the Illinois Environmental Protection Agency (IEPA) is required to inform the U.S. Environmental Protection Agency on water quality of Illinois waterbodies. While Section 303(d) requires the IEPA to provide a list of waterbodies whose designated uses are considered impaired, Section 305(b) entails an inventory of water quality of Illinois waterbodies and groundwater sources.

There are seven designated uses in Illinois, and six apply within the Kinkaid Creek planning area. These are: Aquatic Life, Fish Consumption, Primary Contact, Public and Food Processing Water Supplies, Secondary Contact, and Aesthetic Quality. Indigenous Aquatic Life is not a designated use for the planning area.

2.8.1. Water Quality Impairments and Monitoring

303(d) and 305(b) Waterbodies

The streams assessed for water quality impairments under Section 305(b) include Kinkaid Creek (IL_NB, IL_NB-01) and Little Kinkaid Creek (IL_NBA). Kinkaid Lake is the only lake within the planning area and constitutes the only waterbody on the Section 303(d) Impaired List. A depiction of 303(d) waterbodies and IEPA monitoring stations can be viewed in *Figure 2.48.*

Water quality assessments for these impaired waterbodies have been detailed for this report. Data provided from the IEPA, municipalities, and other sources have been utilized for this assessment.

Figure 2.48

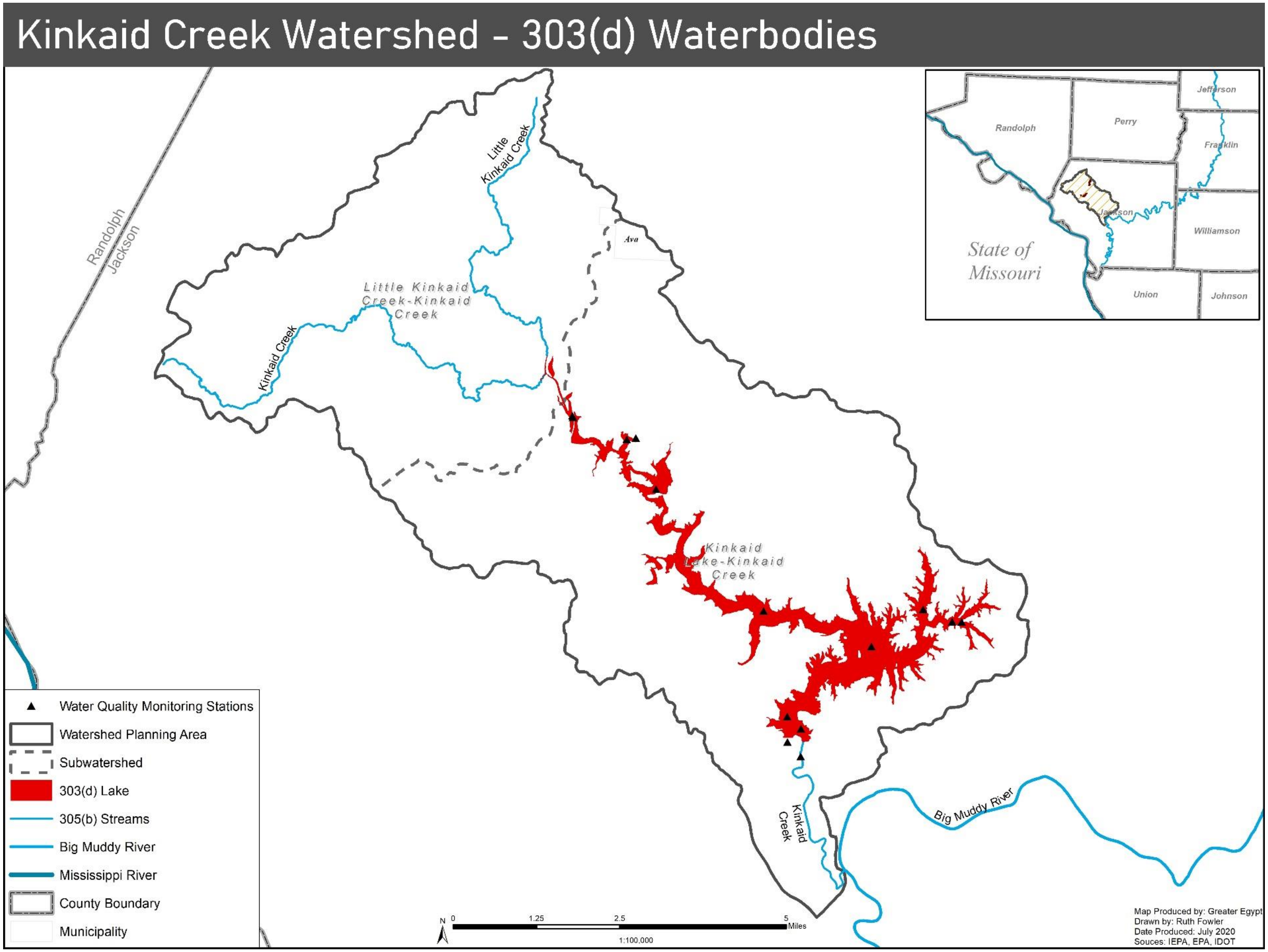

Kinkaid Creek Watershed - 303(d) Waterbodies
Randolph
Jackson
Little Kinkaid Creek
Little Kinkaid Creek-Kinkaid Creek
Kinkaid Creek
Ava
Kinkaid Lake-Kinkaid Creek
Kinkaid Creek
Big Muddy River
Randolph
Perry
Jefferson
Franklin
Jackson
Williamson
State of Missouri
Union
Johnson
Water Quality Monitoring Stations
Watershed Planning Area
Subwatershed
303(d) Lake
305(b) Streams
Big Muddy River
Mississippi River
County Boundary
Municipality
N
0
1.25
2.5
5
Miles
1:100,000
Map Produced by: Greater Egypt
Drawn by: Ruth Fowler
Date Produced: July 2020
Souces: IEPA, EPA, IDOT

Table 2.41 outlines the designated uses and assessment status of waterbodies within the Kinkaid Creek Watershed, as identified in the Illinois Integrated Water Quality Report and Section 303(d) List for 2016. This includes two streams and one lake.

The Illinois Integrated Water Quality Report categorizes Kinkaid Lake (IL_RNC) as having six designated uses: aquatic life, fish consumption, public and food processing water supplies, primary contact, secondary contact, and aesthetic quality. Primary and secondary contacts were not assessed in the 2016 report. The only designated use not being fully supported is fish consumption.

Kinkaid Creek (IL_NB and IL_NB-01) and Little Kinkaid Creek (IL_NBA) are categorized as having five designated uses: aquatic life, fish consumption, primary contact, secondary contact, and aesthetic quality. The only creek that was assessed in the 2016 report is Kinkaid Creek (IL_NB-01). The designated uses being fully supported are aquatic life, primary contact, and secondary contact. All other designated uses within the three creeks were not assessed in the IEPA's water quality report.

Table 2.41 - Assessment Status of Kinkaid Lake (IL_RNC)

Waterbody Name & Assessment ID	Designated Use	Use ID	Assessed in 2016 Integrated Report	Use Attainment
Kinkaid Lake (IL_RNC)	Aquatic Life	582	Yes	Fully Supporting
	Fish Consumption	583	Yes	Not Supporting
	Public and Food Processing Water Supplies	584	Yes	Fully Supporting
	Primary Contact	585	No	N/A
	Secondary Contact	586	No	N/A
	Aesthetic Quality	590	Yes	Fully Supporting
Kinkaid Creek (IL_NB)	Aquatic Life	582	No	N/A
	Fish Consumption	583	No	N/A
	Primary Contact	585	No	N/A
	Secondary Contact	586	No	N/A
	Aesthetic Quality	590	No	N/A
Kinkaid Creek (IL_NB-01)	Aquatic Life	582	Yes	Fully Supporting
	Fish Consumption	583	No	N/A
	Primary Contact	585	Yes	Fully Supporting
	Secondary Contact	586	Yes	Fully Supporting
	Aesthetic Quality	590	No	N/A
Little Kinkaid Creek (IL_NBA)	Aquatic Life	582	No	N/A
	Fish Consumption	583	No	N/A
	Primary Contact	585	No	N/A
	Secondary Contact	586	No	N/A
	Aesthetic Quality	590	No	N/A

Source: 2016 IEPA integrated Water Quality Report and 303(d) Lists

Kinkaid Lake is the only waterbody within the planning area that is impaired and has been placed on the IEPA's 303(d) List of Impaired Waters due to the presence of mercury. Sources of impairments are atmospheric deposition-toxins and other unknown sources. Information from the 305(b) Assessment (*Appendix B-3*) can be found in *Table 2.42*.

Table 2.42 - Assessment Information for Waterbodies

Waterbody	Assessment Unit ID	Size	Causes of Impairment(s)	Sources of Impairment(s)
Kinkaid Lake	IL_RNC	3,475 ac	Mercury	Atmospheric Deposition-Toxics, Source Unknown
Little Kinkaid Creek	IL_NBA	16.9 mi	N/A	N/A
Kinkaid Creek	IL_NB	9.66 mi	N/A	N/A
Kinkaid Creek	IL-NB-01	3.38 mi	N/A	N/A

Source: 2016 IEPA integrated Water Quality Report and 303(d) Lists

The information contained in the 303(d) section also lists the impaired designated use and cause of impairment. The following table summarizes the cause of impairment for Kinkaid Lake. The only impaired designated use is fish consumption, which is caused by mercury. The other waterbodies were not fully assessed in the 2016 report, and therefore information for the streams is not applicable.

Table 2.43 - 303(d) Information for Waterbodies

Waterbody	Assessment Unit ID	Size	Impaired Designated Use	Causes of Impairment
Kinkaid Lake	IL_RNC	3,475 ac	Fish Consumption	Mercury
Kinkaid Creek	IL_NB	9.66 mi	N/A	N/A
Kinkaid Creek	IL_NB-01	3.38 mi	N/A	N/A
Little Kinkaid Creek	IL_NBA	6.41 mi	N/A	N/A

2.8.2. Supplementary Monitoring and Strategies

In accordance with the Clean Water Act, impaired waterbodies are required to have a Total Maximum Daily Load (TMDL) be developed for each pollutant. In other cases, a watershed-based plan must be created if a TMDL does not exist. That is the purpose of this planning process.

The *Illinois Nutrient Loss Reduction Strategy* (ILNLRS) is a collaborative effort between the Illinois Water Resources Center, IEPA, and the Illinois Department of Agriculture. The strategy prioritizes watersheds that are expected to have the greatest capacity to reduce high volumes of nutrient loss annually. Both of the HUC 12 watersheds in the planning area are located within the larger Big Muddy River watershed (HUC 07140106), which is an IEPA priority watershed for addressing total phosphorus losses from nonpoint sources. Further information regarding the ILNLRS can be found in *Section 8.8*.

2.8.2.1. Volunteer Lake Monitoring Program

Since 1984, Greater Egypt has coordinated the VLMP for southern Illinois' ten-county region. This volunteer-based program is maintained by the IEPA. The monitoring season begins May 1st and concludes October 31st with volunteers monitoring their lakes twice a month. Program participants are required to have access to a boat and anchor. Training is provided by the Regional Coordinator for southern Illinois.

Volunteers are divided into three tiers. Tier I is the most basic, while Tier II and III require previous participation in the program. Participation is dependent on funding and supplies from IEPA. The level of monitoring is dependent on the tier level of the volunteer.

Tier I:

Basic lake monitoring. Volunteers measure lake water clarity with a Secchi Disk and make other basic lake observations. Volunteers record the level of aquatic plant growth, record the siting of any invasive species, the lake water level, weather, and watershed conditions at the time of monitoring.

Tier II:

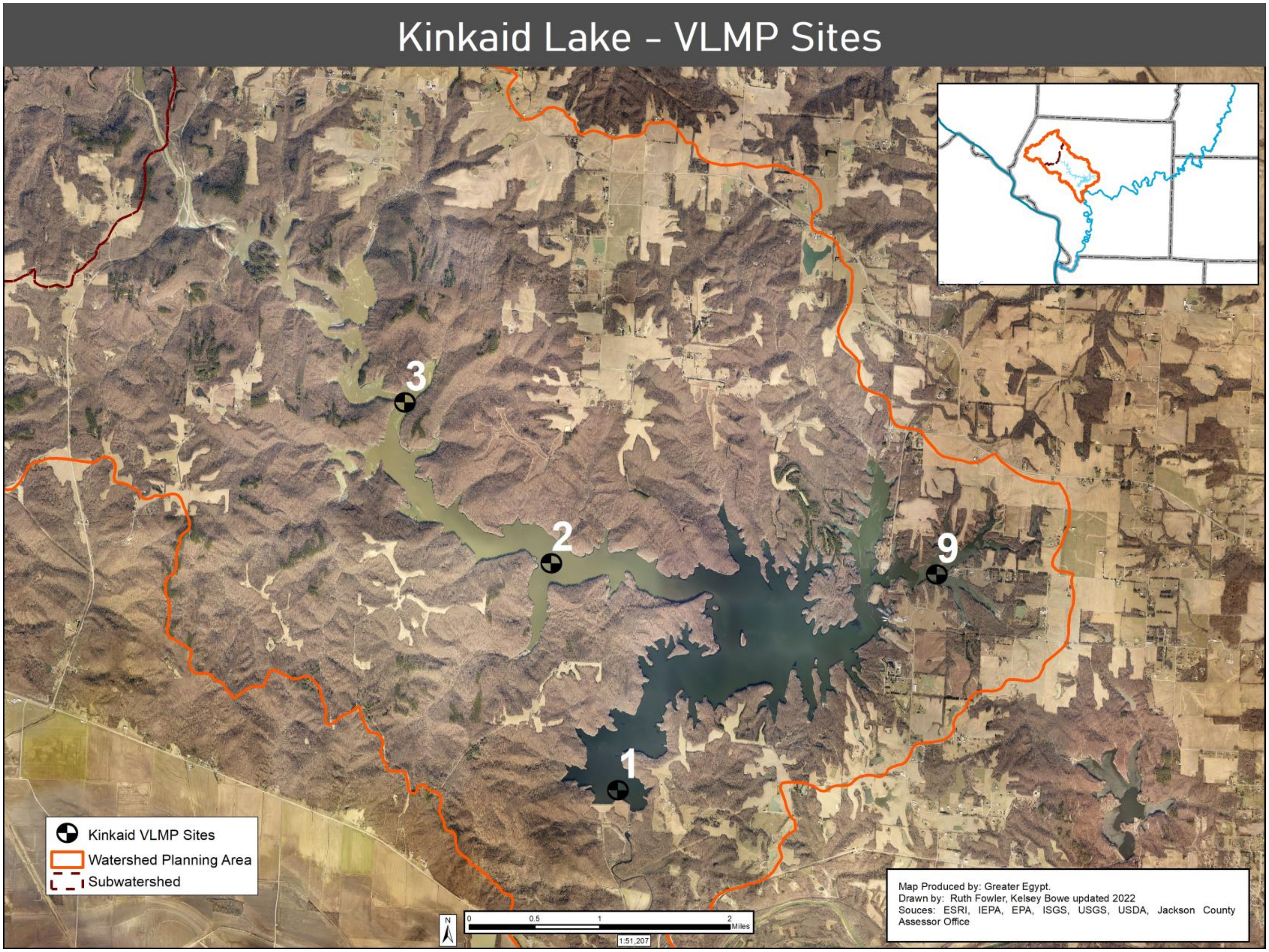
After actively participating in Tier I, volunteers are eligible for Tier II monitoring. Tier II volunteers complete Tier I monitoring while also taking lake water samples.

Tier III:

In addition to collecting water samples, volunteers also collect chlorophyll samples as well as measure oxygen levels and water temperatures.

Kinkaid-Reed's Creek Conservancy District has been participating in the program with Tier III responsibilities. The VLMP Site map can be viewed in *Figure 2.49*.

Figure 2.49


Kinkaid Lake - VLMP Sites
3
2
9
1
Kinkaid VLMP Sites
Watershed Planning Area
Subwatershed
N
0
0.5
1
2
Miles
1:51,207
Map Produced by: Greater Egypt.
Drawn by: Ruth Fowler, Kelsey Bowe updated 2022
Souces: ESRI, IEPA, EPA, ISGS, USGS, USDA, Jackson County Assessor Office

2.8.2.2. Prior Reports and Studies

Previous reports were reviewed regarding watershed planning, best management practices, and impairments. The studies include the following documents.

Lake Kinkaid Erosion and Sediment Watershed Inventory

Roger Windhorn, Soil Scientist - USDA NRCS, July 2000

The goal of this inventory was to estimate an average annual rate of total suspended sediment load within Kinkaid Lake. The entire Kinkaid Lake watershed was divided into three Geomorphic Units, which are defined as, "landscape units that are similar in geology, slope, soil, etc. and in anticipated response to erosion". (**Add Source**) Many types of erosion were evaluated and discussed, including sheet and rill, ephemeral, gully, stream bank, and shoreline erosion. Suggestions were made for control of erosion and sediment deposit.

Components 1-6 of a Watershed Plan for Kinkaid Lake

Kinkaid Area Watershed Project, Inc. (KAWP) – November, 2000

The Kinkaid Area Watershed Project, Inc. formed this plan with the mission to reduce siltation in the watershed by sixty percent and to improve the water quality of Kinkaid Lake. This plan summarizes the history of the watershed, lists completed watershed projects, identifies problem areas, and offers possible solutions for improvement. It concluded that agriculture was probably the leading source of sediment and nutrient loading to Kinkaid Lake.

Upper Kinkaid Lake Watershed Evaluation

Cochran & Wilken - May, 2003

Cochran & Wilken, Inc, a consulting engineering and scientist firm located in Murphysboro, prepared this report for the Kinkaid Area Watershed Project through the Illinois Department of Natural Resources Conservation 2000 Ecosystem Restoration Program. The purpose of this study was to survey the sedimentation load of four subwatersheds that feed into Kinkaid Lake. Potential management practices were identified to remove current sediment, as well as the removal of future sediment load. Five types of erosion were evaluated: sheet, rill, gully, and stream bank.

Comparison of Mercury in Atmospheric Deposition and in Illinois and U.S.A Soils

E.C. Krug and D. Winstanley - Illinois State Water Survey- January, 2004

The study compares atmospheric deposition and Illinois soil levels of mercury. The report rejects the notion that most mercury in Illinois soils is anthropogenic, or pollution derived from human activity.

Big Muddy River TMDL Report

Illinois Environmental Protection Agency, Bureau of Water – October 2004

Illinois EPA partnered with Camp Dresser & McKee (CDM Smith) to develop TMDLs for the Big Muddy River and Kinkaid Lake. Impaired water bodies are assessed, which includes identifying sources of impairments, necessary reductions of these impairments, and implementation procedures to mitigate impairments. Illinois is required to develop or revise water quality standards every three years. Kinkaid Lake is impaired by pH and Mercury, which are addressed in this report and a TMDL is assigned for these impairments.

Phase 1 Diagnostic/Feasibility Study of Kinkaid Lake, Jackson County, IL

Cochran & Wilken – September, 2006

Cochran & Wilkin, Inc, assisted by the Illinois EPA and Kinkaid-Reed's Creek Conservancy District, conducted a study of Kinkaid Lake to evaluate the health of the lake, explore restoration techniques to improve water quality, and develop a comprehensive management plan. Multiple water quality factors were analyzed and a hydrologic budget was created. The study concluded that high concentrations of nutrients were present in the lake, including nitrogen and phosphorus. Biologic resources were out of balance, which included a noticeably high algal growth in the summer months.

Phase 2 Feasibility Study of Kinkaid Lake

Cochran & Wilken – September, 2006

This study is a continuation of Phase 1 Diagnostic/Feasibility Study with the goal, "to address the problems identified in the previous section, to protect and enhance existing lake uses, to increase recreational access and opportunities, and to improve the overall water quality". This study acts as a lake management plan and proposes certain actions to take place to reach these goals. Estimated costs of proposed actions are also included.

Kinkaid Lake TMDL Best Management Practices Implementation
HDR/Cochran & Wilken – August, 2007

Kinkaid-Reed's Creek Conservancy District submitted this report, which was prepared by Cochran & Wilken, Inc., to the Illinois EPA. This report lists BMPs to be implemented and the associated costs for implementation. There is an operation and maintenance plan include, which discusses continual work after implantation. The plan was approved and completed work was documented and photographed. BMPs that were implemented include: riprap for shoreline stabilization, sediment/nutrient detention basins, and gully stabilization structures.

Wetland Habitat Enhancement and Shoreline Stabilization Using Riprap Breakwaters on a Midwestern Reservoir
John Severson (SIU), Jack Nawrot, Michael Eicholz, David Fligor (KRCCD) – November,2006

A study conducted by John P. Severson, Jack Nawrot, and Mike Eichholz, assessed the implemented shoreline stabilization techniques for effectiveness of reducing erosion and the its benefits for vegetation communities. A cost benefit analysis was conducted, which factored in several cost considerations and resulting benefits. The results of the study were positive, claiming breakwaters as successful at reducing erosion and may improve water quality and aquatic life.

2.8.3. ***Water Quality of Kinkaid Watershed Lakes and Streams***

2.8.3.1. Kinkaid Lake (IL_NA)

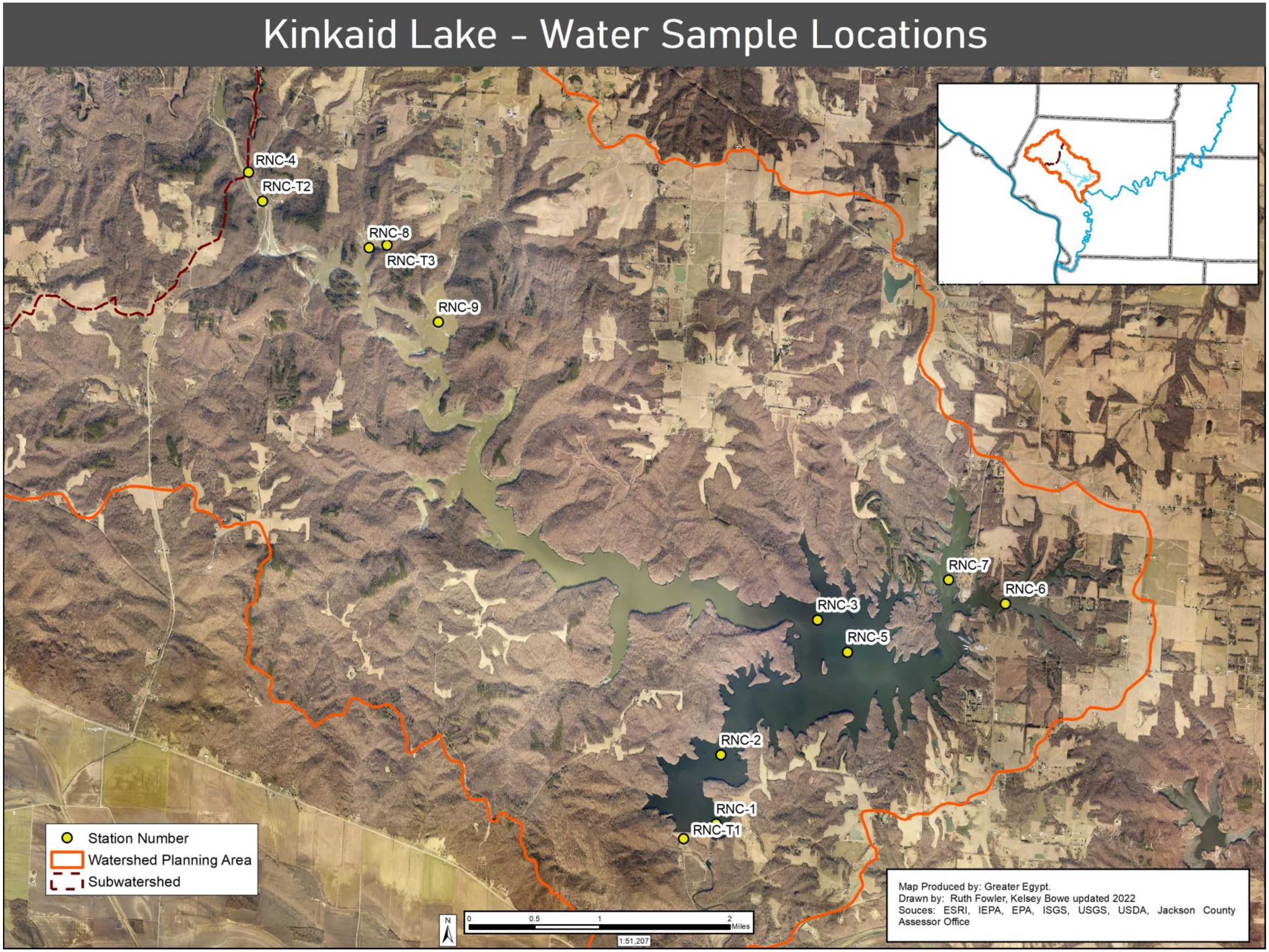
The 2016 Illinois Integrated Water Quality Report states the designated use of Kinkaid Lake to be aquatic life, fish consumption, public and food processing water supplies, primary contact, secondary contact, and aesthetic quality. Fish consumption is not being supported due to mercury. Potential sources of this impairment include atmospheric deposition-toxins and an unknown source. The IEPA has established twelve monitoring stations within Kinkaid Lake, which are displayed in *Table 2.44*. Locations of these sites are detailed in the following table.

Table 2.44 - Kinkaid Lake IEPA Monitoring Stations

Station Code	County	Station Location
RNC-1	Jackson	S. Extension by Spillway
RNC-2	Jackson	Directly N. and Above Site RNC-1
RNC-3	Jackson	N.W. of Site RNC-2
RNC-4	Jackson	Kinkaid Site 4
RNC-5	Jackson	Kinkaid Site 5
RNC-6	Jackson	Kinkaid Site 6
RNC-7	Jackson	Kinkaid Site 7
RNC-8	Jackson	Kinkaid Site 8
RNC-9	Jackson	Kinkaid Site 9 (1978)
RNC-T1	Jackson	Kinkaid Tributary 1
RNC-T2	Jackson	Kinkaid Tributary 2
RNC-T3	Jackson	Kinkaid Tributary 3

Source: 2018 IEPA integrated Water Quality Report and 303(d) Lists

Figure 2.50


Kinkaid Lake - Water Sample Locations
RNC-4
RNC-T2
RNC-8
RNC-T3
RNC-9
RNC-7
RNC-6
RNC-3
RNC-5
RNC-2
RNC-1
RNC-T1
Station Number
Watershed Planning Area
Subwatershed
0 0.5 1 2 Miles
1:51,207
N
Map Produced by: Greater Egypt.
Drawn by: Ruth Fowler, Kelsey Bowe updated 2022
Souces: ESRI, IEPA, EPA, ISGS, USGS, USDA, Jackson County Assessor Office

Water Quality data for Kinkaid Lake was provided by IEPA and includes data for the years 2008 through 2018. Mercury is the only impairment for Kinkaid Lake, but limited data is available for review. The following assessment will feature nutrients and other water quality parameters that have more available data.

Mercury

Mercury is the cause of impairment for fish consumption within Kinkaid Lake. The only available data for mercury is from years 2008 and 2011. The results are from three different stations around the lake. Results are displayed in *Table 2.45*. A technical support document published by the EPA in 2006 describes mercury as, "a toxic metal that is of significant concern as an environmental pollutant. It exists in the environment naturally and as a product of man-made processes, including waste incineration and fossil fuel combustion. Mercury is a persistent environmental contaminant, which cannot be degraded or destroyed".[45]

Table 2.45 - Kinkaid Lake Mercury Results

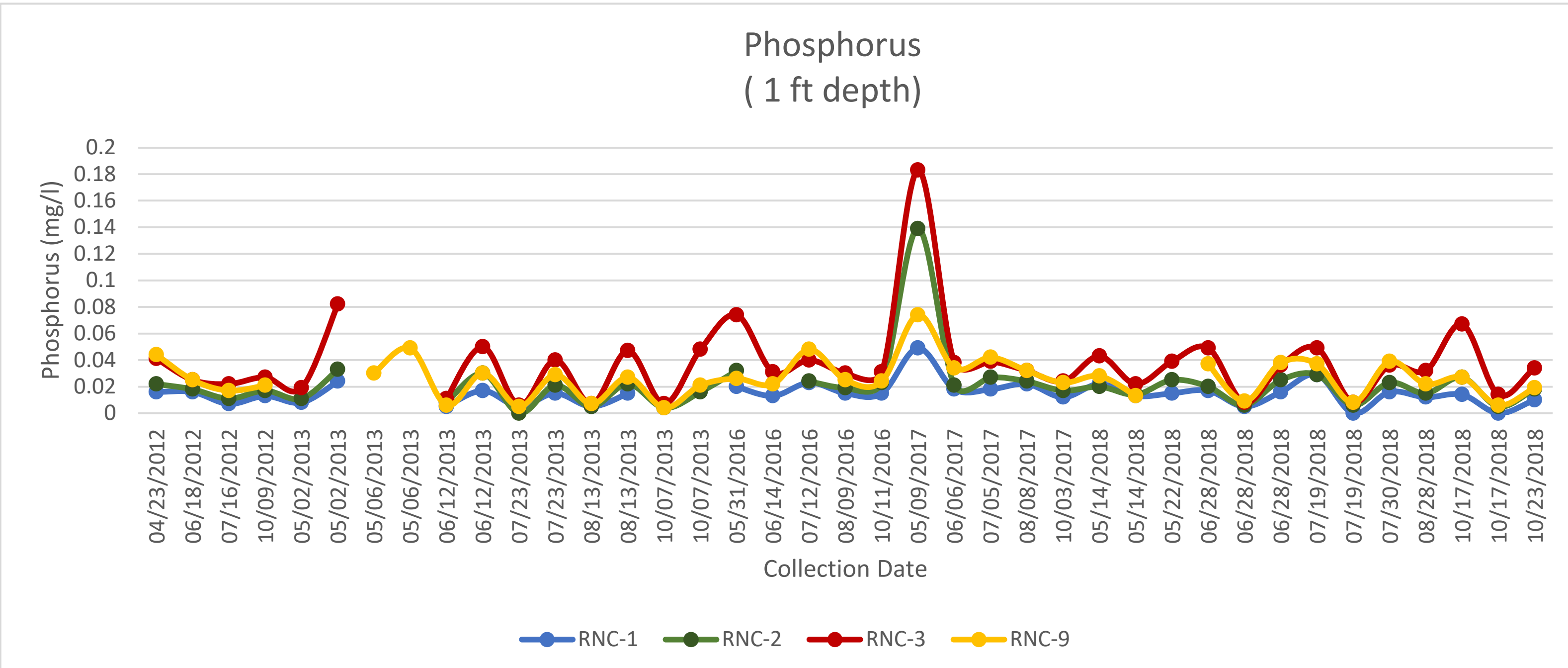
Station Code	Sample Depth (ft)	Collection Date	Results (mg/kg)	Weight Basis	Result Particle Size Basis
RNC-1	51	8/08/2008	0.05	dry	Unsieved
RNC-4	10	8/08/2008	0.01	dry	Unsieved
RNC-9	24	8/08/2008	0.04	dry	Unsieved
RNC-1	64	7/11/2011	0.1	dry	

[45] EPA. *Technical Support Document for Reducing Mercury Emissions from Coal-Fired Electric Generating Units.* Springfield, IL: EPA, March 14, 2006. PDF

Phosphorus

The Illinois Water Quality Standard for phosphorus is not the exceed 0.05 mg/L for any reservoir or lake with a surface area of 8.1 hectares (20 acres) or more.[46] Most phosphorus samples are below the water quality standard. These values in the graph are recorded at varying intervals based on available data. Some years are missing from the data. Samples were taken at Station Code: RNC-1, RNC-2, RNC-3, and RNC-9.

Figure 2.51 - Phosphorus

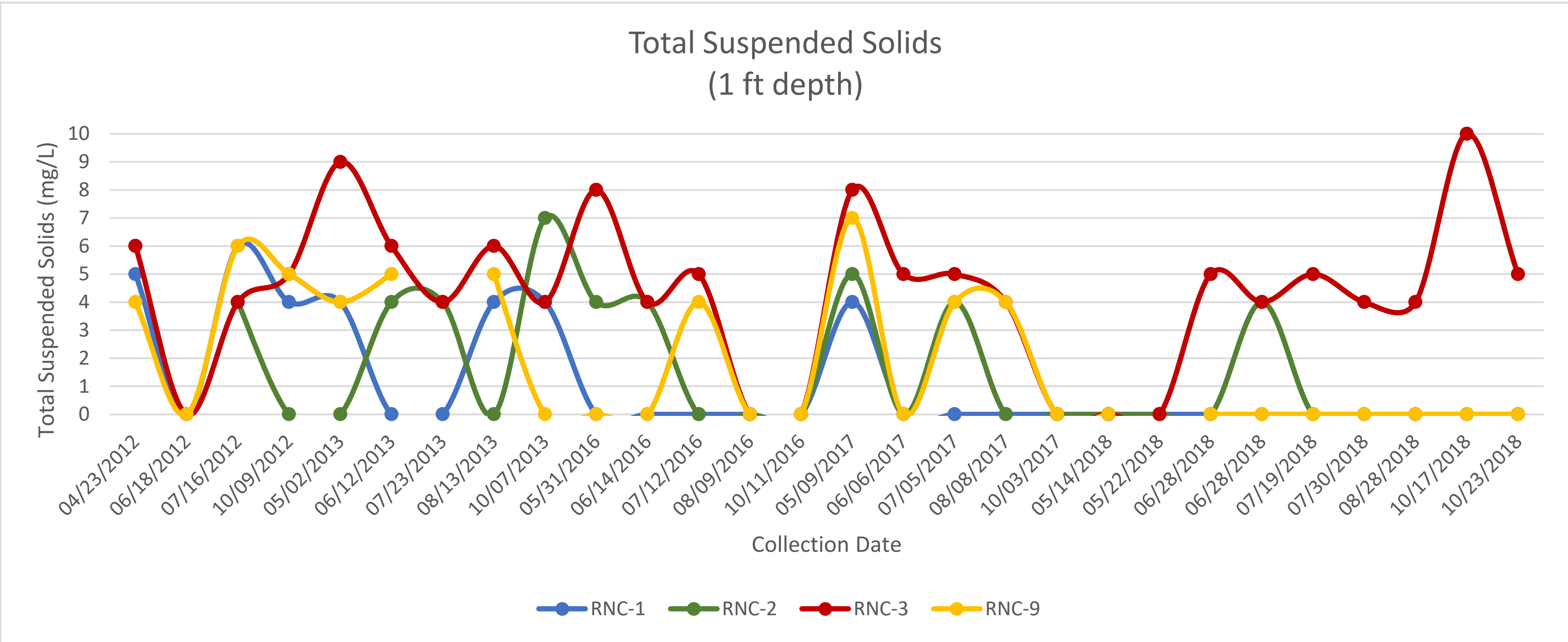


46 Illinois Pollution Control Board. *Title 35: Environmental Protection- Subtitle C: Water Pollution- part 302 Water Quality Standards, Subpart A: General Water Quality Provisions.* PDF. Accessed March 2020.

Total Suspended Solids

Currently there is no numeric standard for total suspended solids. TSS values in the graphs are recorded at varying intervals and some years are missing from available data. Samples were taken at Station Code: RNC-1, RNC-2, RNC-3, and RNC-9. Samples were taken at varying depths, but for ease of comparison, all data is displayed at a one-foot depth.

Figure 2.52 - Total Suspended Solids



Dissolved Oxygen

The IEPA recommends that dissolved oxygen levels should not be less than the following:

1) During the period of March through July,
    a. 5.0 mg/L at any time; and
    b. 6.0 mg/L as a daily mean averaged over 7 days.
2) During the period of August through February,
    a. 3.5 mg/L at any time;
    b. 4.0 mg/L as a daily minimum averaged over 7 days; and
    c. 5.5 mg/L as a daily mean averaged over 30 days.

Figure 2.53 - RNC-1 Dissolved Oxygen

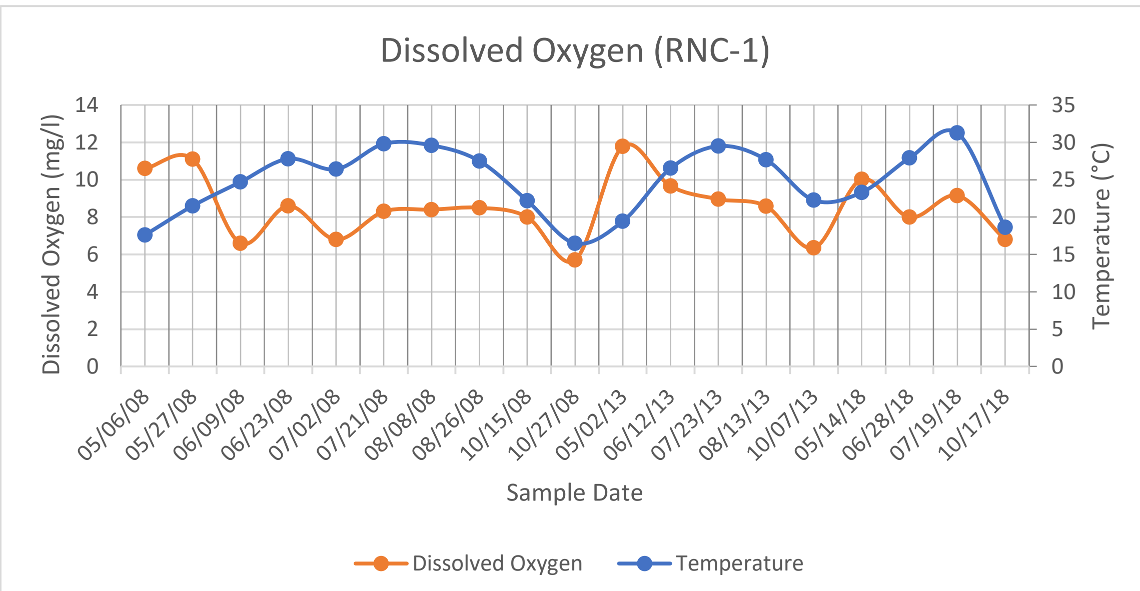


Figure 2.54 - RNC-2 Dissolved Oxygen

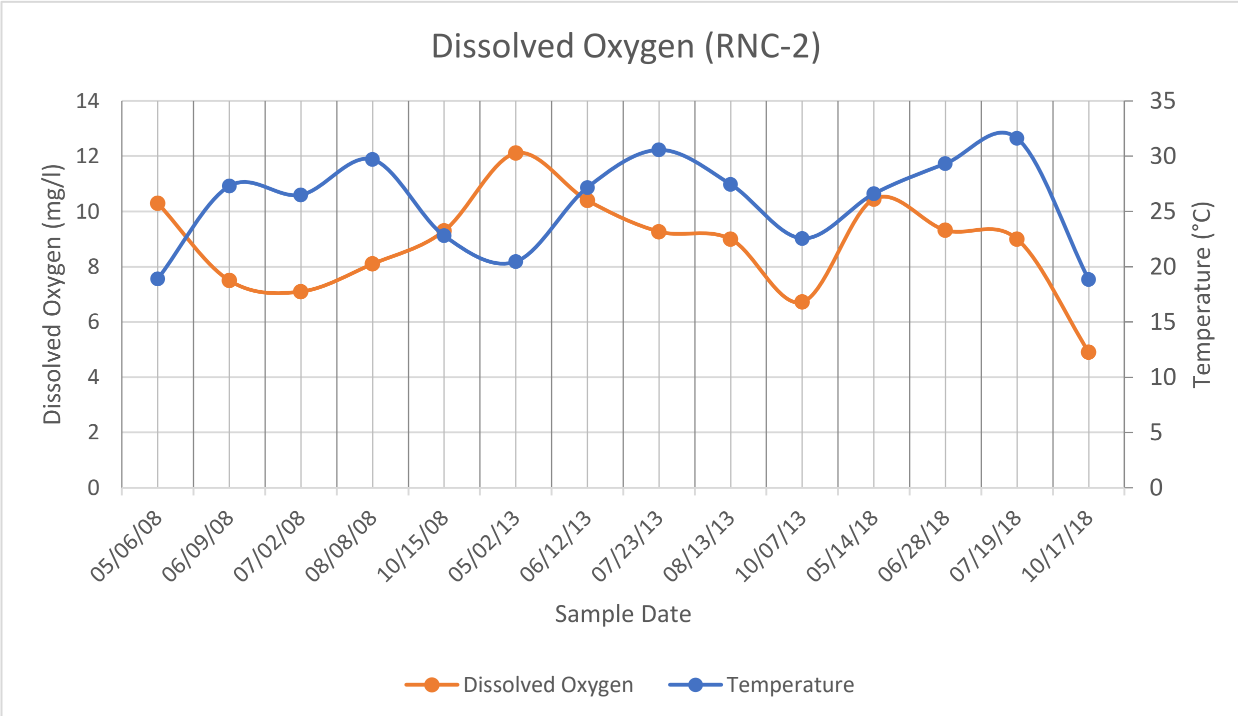


Figure 2.55 - RNC-3 Dissolved Oxygen

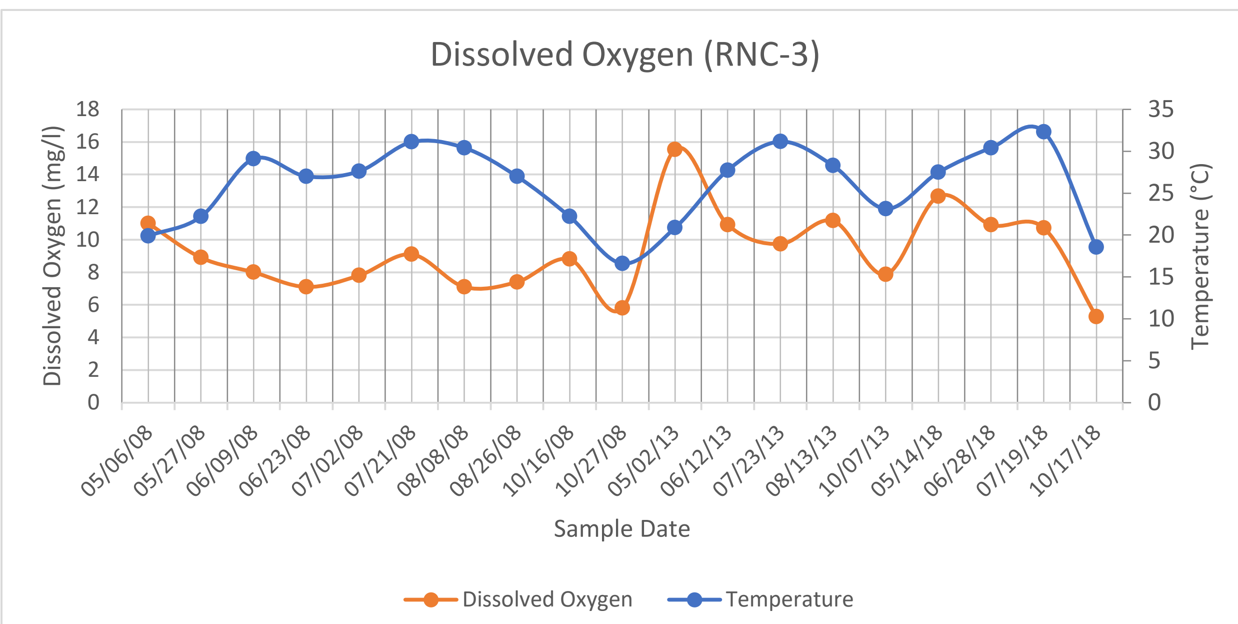
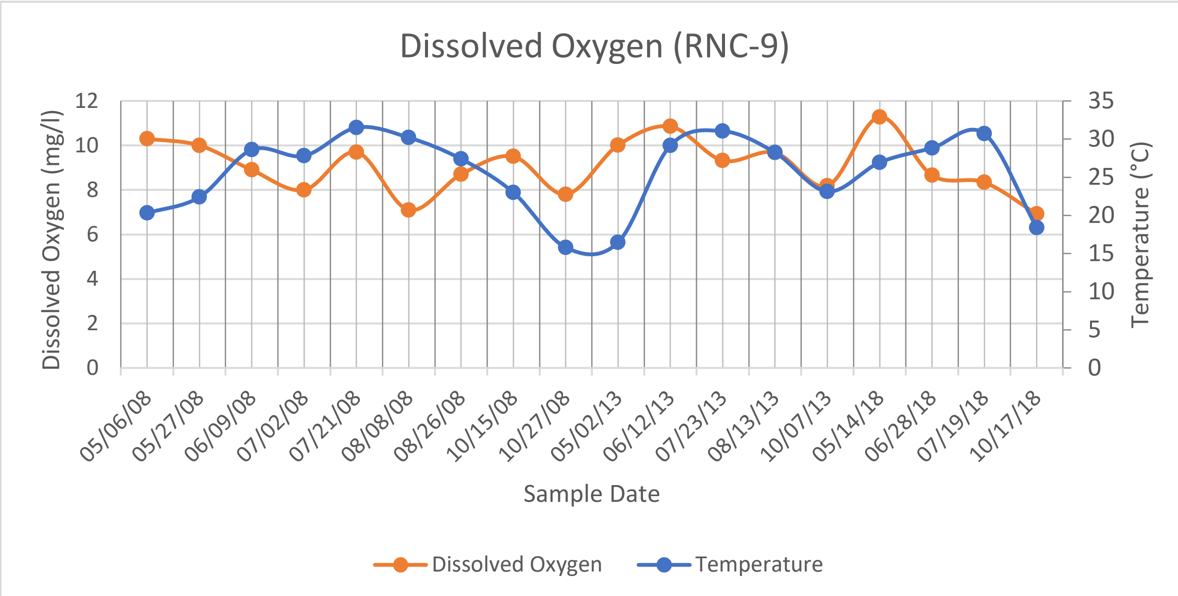


Figure 2.56 - RNC-9 Dissolved Oxygen



2.8.4. Local Water Quality Assessment

To address water quality at the local level, an assessment has been completed for Ava and the Kinkaid Area Water System. Kinkaid Lake is the local water source for Ava and the surrounding municipalities. This assessment was designed to review the latest water quality report submitted.

Each municipality is required to test certain organic and inorganic contaminants. Regulated contaminants consist of lead, copper, chloramines, haloacetic acids, and total trihalomethanes. The following key represents the factors used in each water quality report.

> **Action Level (AL):** The concentration of a contaminant which, if exceeded, triggers treatment or other requirements which a water system must follow.
>
> **Maximum Contaminant Level Goal (MCLG):** The level of a contaminant in drinking water below which there is no known or known or expected risk to health. MCLGs allow for a margin of safety.
>
> **Maximum Contaminant Level (MCL):** The highest level of a contaminant that is allowed in drinking water. MCLs are set as close to the MCLGs as feasible using the best available treatment technology.
>
> **ppb:** Micrograms per liter or parts per billion.
>
> **ppm:** Milligrams per liter or parts per million.
>
> **NTU:** Nephelometric Turbidity Unit, used to measure cloudiness in drinking water.

Table 2.46 displays the water quality report for lead and copper. Ava has a MCLG value of 1.3 ppm for copper and a MCLG value of 0 ppb for lead. Action levels are set at 1.3 ppm for copper and 15 ppb for lead. While the 2019 report was used for analysis, copper has not been tested since July 19, 2018, and lead has not been tested since August 15th, 2012.

According to the water quality report, there is no violation of lead or copper levels. Likely sources of lead consist of corrosion of household plumbing systems, and erosion of natural deposits. Sources of copper include erosion of natural deposits, leaching from wood preservatives, and corrosion of household plumbing systems.

Table 2.46 - Lead and Copper Information

Municipality	Contaminants	Date Sampled	MCLG	Action Level (AL)	90th Percentile	Sites Over Lead AL	Units	Violation	Likely Source of Contaminaion
Ava	Copper	7/19/2018	1.3	1.3	0.23	0	ppm	No	Erosion of natural deposits; leaching from wood preservatives; corrosion of household plumbing systems
	Lead	8/15/2012	0	15	1.1	0	ppb	No	Corrosion of household plumbing systems; Erosion of natural deposits

Along with lead and copper, other regulated contaminants that are reported are chloramines, haloacetic acids, and total trihalomethanes. The source of chloramines is likely a water additive used to control microbes. Haloacetic acids and trihalomethanes are by-products of drinking water disinfection. Information of these contaminants can be found in the table below. Ava is within the limits for each contaminant, and no violations have occurred.

Table 2.47 - Municipal Water Quality: Regulated

Contaminant		Collection Date	Highest Level Detected	Range of Levels Detected	MCLG	MCL	Units	Violation	Typical Source
Disinfectants & Disinfection By-Products	Chloramines	2019	2.5	2.5 - 2.5	MRDLG = 4	MRDL = 4	ppm	N	Water additive used to control microbes
	Haloacetic Acids (HAA5)	2019	41	17 - 73.2	No goal for the total	60	ppb	N	By-product of drinking water disinfection
	Total Trihalomethanes (TTHM)	2019	38	4.9 - 54	No goal for the total	80	ppb	N	By-product of drinking water disinfection

2.8.5. Kinkaid Area Water System

As stated previously, Ava purchases their water from Kinkaid Area Water System, operated by Kinkaid Reed's Creek Conservancy District. The water report includes the parameters from Ava's water quality report identified as regulated contaminants. In addition, inorganic contaminants were also reported. This category includes substances such as fluoride, nitrate (as N), and sodium. The contaminants in all categories are within the regulated range designated by the EPA; therefore, no violations have occurred. Results are displayed in *Table 2.48.*

Table 2.48 - Kinkaid Area Water System 2019 Report

Contaminant		Collection Date	Highest Level Detected	Range of Levels Detected	MCLG	MCL	Units	Violation	Likely Source of Contamination
Disinfectants & Disinfection By-Products	Chloramines	2019	3.3	3.3 - 3.3	MRDLG=4	MRDL=4	ppm	N	Water additive used to control microbes
	Chlorite	2019	0.83	0.29 - 0.83	0.8	1	ppm	N	By-product of drinking water disinfection
	Haloacetic Acids (HAA5)*	2019	22	21.5 - 21.5	No goal for the total	60	ppm	N	By-product of drinking water disinfection
	Total Trihalomethanes (TTHM)	2019	25	24.5 - 24.5	No goal for the total	80	ppb	N	By-product of drinking water disinfection
Inorganic	Fluoride	2019	0.7	0.73 - 0.73	4	4.0	ppm	N	Erosion of natural deposits; Water additive which promotes strong teeth: Discharge from fertilizer and aluminum factories
	Nitrate [measured as Nitrogen]	2019	0.08	0.08 - 0.08	10	10	ppm	N	Runoff from fertilizer use; Leaching from septic tanks, sewage; Erosion of natural deposits
	Sodium	2019	11	10.6 - 10.6			ppm	N	Erosion from naturall occurring deposits: Used in water softener regeneration
Radioactive	Combined Radium 226/228	11/16/2015	1.05	1.05 - 1.05	0	5	pCi/L	N	Erosion of natural deposits.
	Gross alpha excluding radon and uranium	11/16/2015	0.35	0.35 - 0.35	0	15	pCi/L	N	Erosion of natural deposits.
Synthetic organic contaminants including pesticides and herbicides	Atrazine	2019	0.7	0.2 - 0.7	3	3	ppb	N	Runoff from herbicide used on row crops
	Simazine	2019	0.14	0 - 0.14	4	4	ppb	N	Herbicide runoff

Turbidity	Limit (Treatment Technique)	Level Detected	Violation	Likely Source of Contamination
Highest single measurement	1 NTU	0.26 NTU	N	Soil runoff
Lowest Monthly % meeting limit	0.3 NTU	100%	N	Soil runoff

2.8.6. National Pollutant Discharge Elimination Systems (NPDES) Outfall Locations

The National Pollution Discharge Elimination System (NPDES) permit program is set in place to regulate point source pollutions that are being discharged into U.S. waters.

Kinkaid Creek Watershed Planning Area has only one NPDES outfall location. The outfall is permitted for the Kinkaid Area Water System, and the discharge is located on the eastern side of Kinkaid Lake near the Water Conservancy District. This location is within the Kinkaid Lake – East SMU. *Figure 2.57* displays the NPDES outfall location within the planning area. NPDES permits are active for five years from the effective date and facilities are required to reapply for an extension. They must do so within 180 days of the expiration date. The Kinkaid Area Water System NPDES permit is active. The expiration date given on ECHO is May 31 of 2022.

Effluent Exceedance

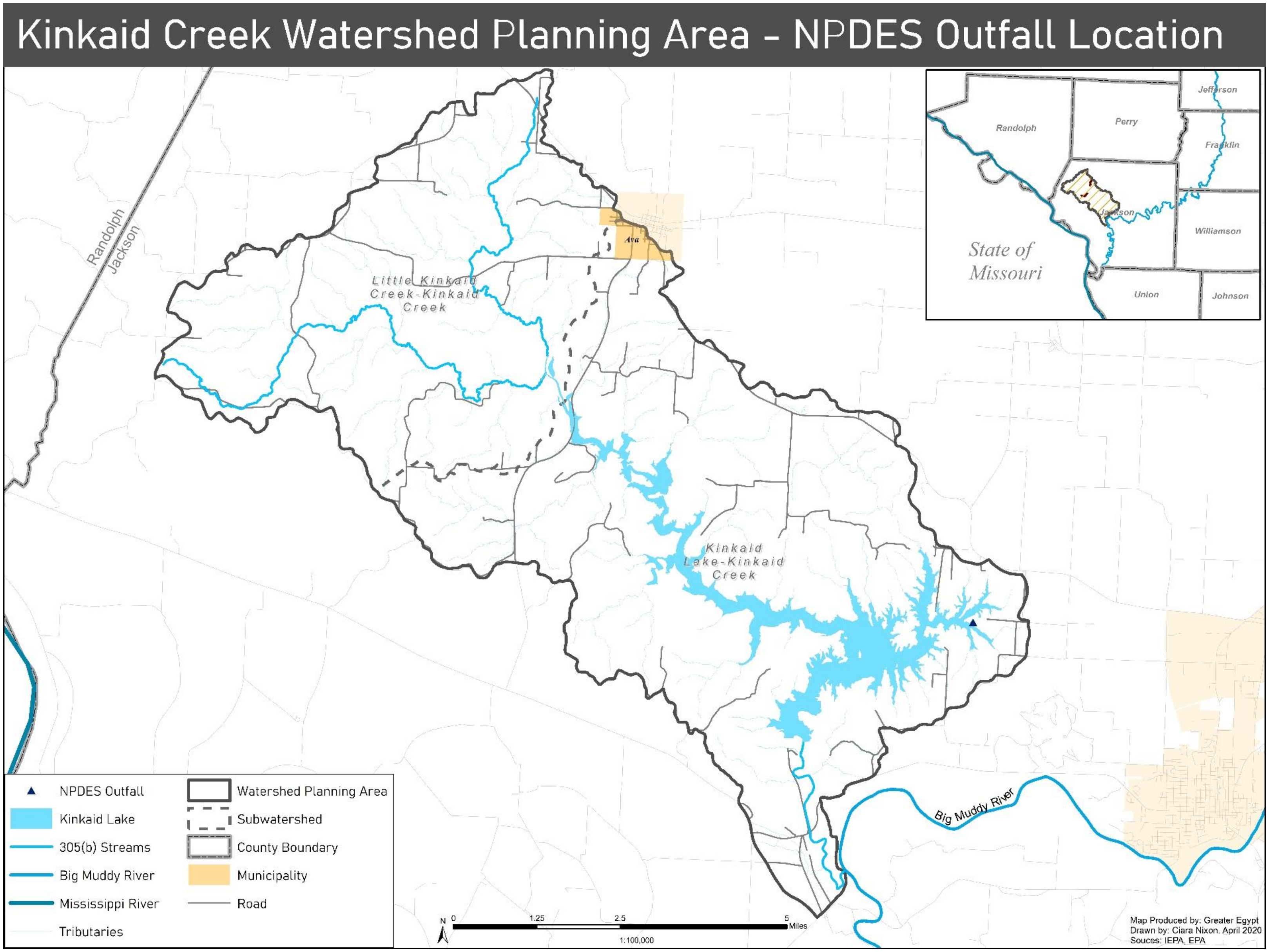
The Kinkaid Area Water System has recorded no violations since Quarter 1, 04/01-06/30/2017. *Table 2.49* displays the information for the most recent twelve quarters.

Table 2.49 - Outfall Effluent Violations

Facility Name	Outfall	QTR 1	QTR 2	QTR 3	QTR 4	QTR 5	QTR 6
		04/01-0/30/17	07/01-09/30/17	10/01-12/31/17	01/01-03/31/18	04/01-06/30/18	07/01-09/30/18
Kinkaid Area Water System	001	NVI	NVI	NVI	NVI	NVI	NVI
Facility Name	**Outfall**	**QTR 7**	**QTR 8**	**QTR 9**	**QTR 10**	**QTR 11**	**QTR 12**
		10/01-12/31/18	**01/01-03/31/19**	**04/01-06/30/19**	**07/01-09/30/19**	**10/01-12/31/19**	**01/01-03/31/20**
Kinkaid Area Water System	001	NVI	NVI	NVI	NVI	NVI	NVI

Pollutant KEY	
No Violation Identified	NVI

Figure 2.57


Kinkaid Creek Watershed Planning Area - NPDES Outfall Location
Randolph
Jackson
Little Kinkaid Creek-Kinkaid Creek
Ava
Kinkaid Lake-Kinkaid Creek
Big Muddy River
Jefferson
Randolph
Perry
Franklin
Jackson
Williamson
State of Missouri
Union
Johnson
NPDES Outfall
Kinkaid Lake
305(b) Streams
Big Muddy River
Mississippi River
Tributaries
Watershed Planning Area
Subwatershed
County Boundary
Municipality
Road
N
0
1.25
2.5
5
Miles
1:100,000
Map Produced by: Greater Egypt
Drawn by: Ciara Nixon. April 2020
Souces: IEPA, EPA

2.8.7. *Pollutant Load Analysis*

The Spreadsheet Tool for Estimating Pollutant Loads (STEPL) modeling tool was used to estimate the existing nonpoint source nutrient loads (nitrogen & phosphorus) and sediment loads for the Kinkaid Creek watershed. This includes an analysis of the watershed planning area, individual HUC 12 subwatersheds, and HUC 14 subwatershed management units.

STEPL utilizes land cover category types, precipitation data, soil information, existing best management practices, stream and lake erosion, and other data input for calculating pollutant loads. The program does not incorporate land uses such as water (2,500 acres), barren land (78 acres), and wetlands (156 acres). These classes have been excluded from this analysis.

To calculate the sediment load, or degree of streambank erosion, the STEPL model utilizes: streambank length, height, soil type, and lateral recession rate (LRR). *Table 2.50* characterizes these classifications for the LRR. Four categories reflect the degree of streambank and shoreline erosion in the model: slight, moderate, severe, and very severe.

Table 2.50 - LRR Categories and Values

Category	Description	Lateral Recession Rate (ft/yr)	Medium Value
Slight	Some bare bank but active erosion not readily apparent. Some rills but no vegetative overhang. No exposed tree roots.	0.01-0.05	0.03
Moderate	Bank is predominantly bare with some rills and vegetative overhang.	0.06-0.2	0.13
Severe	Bank is bare with rills and severe vegetative overhang. Many exposed tree roots and some fallen trees and slumps or slips. Some changes in cultural features such as fence corners missing and realignment of roads or trails. Channel cross-section becomes more U-shaped as opposed to V-shaped.	0.3-0.5	0.4
Very Severe	Bank is bare with gullies and severe vegetative overhang. Many fallen trees, drains and culverts eroding out and changes in cultural features as above. Massive slips or washouts common. Channel cross-section is U-shaped and stream course or gully may be meandering.	0.5+	0.5

Source: EPA- STEPL

LRR categories have been applied to the assessed values from the erosion assessment in Chapter Seven. For the purpose of continuity between data, all streams have been assigned the medium value for LRR rates. *Table 2.51* represents the correlation between assessed streams and assigned LRR values.

Table 2.51 - LRR and Assessment Values

Assessment Criteria	LRR Category	LRR (ft/yr)	Medium Value
None or Low	Slight	0.01-0.05	0.03
Moderate	Moderate	0.06-0.2	0.13
High	Severe	0.3-0.5	0.4
Severe	Vere Severe	0.5+	0.5

Source: EPA- STEPL

Table 2.52 represents the STEPL model for the Kinkaid Creek watershed-wide existing pollutant loads. The model estimations suggest groundwater accounts for nearly twenty-eight percent of the nitrogen load for the entire planning area. Pastureland constitutes twenty-four percent of the nitrogen load, while cropland makes up the remaining highest percentage at twenty-two percent.

The majority of the phosphorus load in the planning area originates from cropland, at nearly thirty-three percent. Streambank erosion contributes the second largest amount of the nutrient load at thirty-two percent. Pastureland presents the third most contributing land class at sixteen percent.

Because erosion from streambanks and shorelines is a prevalent issue in the planning area, the model suggests that sixty-one percent of the sediment load is due to these sources. Other source contributors include cropland (26 %) and pastureland (9 %).

Table 2.52 - Kinkaid Creek Watershed-wide Existing Pollutant Loads

Source	N Load (lb/yr)	Percent of Total Load	P Load (lb/yr)	Percent of Total Load	Sediment Load (t/yr)	Percent of Total Load
Urban	11,832.9	5.95%	1,820.9	4.39%	272.0	0.77%
Cropland	43,772.4	22.02%	13,645.4	32.90%	9,266.0	26.36%
Pastureland	46,777.5	23.54%	6,789.5	16.37%	3,307.7	9.41%
Forest	7,371.0	3.71%	3,353.0	8.08%	903.6	2.57%
Streambank	34,245.3	17.23%	13,184.4	31.79%	21,405.9	60.89%
Groundwater	54,740.8	27.54%	2,681.4	6.47%	0.0	0.00%
Total	**198,739.8**	**-**	**414,74.6**	**-**	**35,155.1**	**-**

Source: EPA- STEPL

Table 2.53 breaks down the nutrient loads by HUC 12 subwatersheds. Because of its large size and various land uses, Kinkaid Lake- Kinkaid Creek subwatershed produces the majority of the nutrient loading in the planning area. This subwatershed accounts for fifty-six percent of the total nitrogen load, sixty percent of the total phosphorus load, and sixty-three percent of the sediment load in the Kinkaid Creek watershed planning area.

Table 2.53 - HUC 12 Existing Pollutant Loads

Subwatershed	N Load	Percent of Total N Load	P Load	Percent of Total P Load	Sediment Load	Percent of Total Sediment Load
Little Kinkaid Creek- Kinkaid Creek	87,549.9	44.05%	16,604.6	40.04%	13,176.0	37.48%
Kinkaid Lake- Kinkaid Creek	111,189.9	55.95%	24,870.0	59.96%	21,979.1	62.52%
Total	**198,739.8**	**-**	**41,474.6**	**-**	**35,155.1**	**-**

Source: EPA- STEPL

2.8.8. Subwatershed Pollutant Load Analysis

Subwatersheds have also been individually modeled in STEPL. This includes the two HUC 12 subwatersheds and their corresponding subwatershed management units. The HUC 12 subwatersheds and SMUs will also be examined individually. Pollutant loads generally reflect the dominant land use categories and size of each subwatershed.

2.8.8.1. Little Kinkaid Creek- Kinkaid Creek Subwatershed Existing Pollutant Loads

Table 2.54 displays the STEPL model for Little Kinkaid Creek- Kinkaid Creek subwatershed. The majority of the nitrogen load in the subwatershed comes from the Upper Little Kinkaid Creek SMU (42 %). This is followed by Upper Kinkaid Creek SMU at thirty-two percent.

Phosphorus totals follow a similar path with Upper Little Kinkaid Creek exhibiting forty-two percent of the total phosphorus load and Upper Kinkaid Creek at thirty percent.

Table 2.54 - Little Kinkaid Creek- Kinkaid Creek Subwatershed Existing Pollutant Loads by SMU

Subwatershed Management Unit	SMU ID	N Load	Percent of N Load	P Load	Percent of P Load	Sediment Load	Percent of Sediment Load
Middle Kinkaid Creek	16	12,495.1	14.3%	2,751.8	16.6%	2,588.3	19.6%
Lower Little Kinkaid Creek	17	9,242.8	10.6%	1,945.7	11.7%	1,874.2	14.2%
Upper Kinkaid Creek	18	28,341.2	32.4%	5,021.0	30.2%	3,171.5	24.1%
Upper Little Kinkaid Creek	19	37,470.8	42.8%	6,886.1	41.5%	5,542.1	42.1%
Total		**87,549.9**	**-**	**16,604.6**	**-**	**13,176.0**	**-**

Source: EPA- STEPL

Because erosion is a concern in the subwatershed, Upper Little Kinkaid Creek accounts for forty-two percent of the sediment load while Upper Kinkaid Creek exhibits twenty-four percent of the total load.

2.8.8.2. Kinkaid Lake- Kinkaid Creek Subwatershed Existing Pollutant Loads

While this subwatershed is heavily forested, pastureland and cropland account for a majority of the remaining land use. The Kinkaid Lake- Central Body SMU exhibits the most nitrogen load at 14.2 percent. This is followed by the Campground and Spring Creek SMUs at 12.7 percent each.

The phosphorus loads in the subwatershed mainly stem from Kinkaid Lake- Central Body (17.9 %), Spring Creek (13 %), and Lower Kinkaid Creek (12 %).

Table 2.55 - Kinkaid Lake- Kinkaid Creek Subwatershed Existing Pollutant Loads

Subwatershed Management Unit	SMU ID	N Load	Percent of N Load	P Load	Percent of P Load	Sediment Load	Percent of Sediment Load
Lower Kinkaid Creek	1	12,363.3	11.1%	2,994.8	12.0%	2,245.8	10.2%
Heiple	2	3,042.0	2.7%	542.7	2.2%	424.0	1.9%
Smaller Shawnee	3	982.6	0.9%	228.3	0.9%	106.1	0.5%
Kinkaid Lake- Central Body	4	15,842.9	14.2%	4,456.8	17.9%	5,826.2	26.5%
Kinkaid Lake East	5	12,304.4	11.1%	2,527.6	10.2%	1,865.2	8.5%
Lone Oak	6	11,974.5	10.8%	2,326.5	9.4%	1,797.8	8.2%
Ash	7	1,799.1	1.6%	386.4	1.6%	242.5	1.1%
Kinkaid Lake- Central Channel	8	4,739.9	4.3%	1,464.7	5.9%	1,795.6	8.2%
Lakeside	9	1,556.7	1.4%	303.0	1.2%	184.6	0.8%
Larger Shawnee	10	2,050.7	1.8%	442.2	1.8%	180.9	0.8%
Campground	11	14,070.6	12.7%	2,784.6	11.2%	1,646.8	7.5%
Kinkaid Lake- Northwest	12	3,275.5	2.9%	817.4	3.3%	842.2	3.8%
Johnson Creek	13	6,941.4	6.2%	1,389.0	5.6%	1,055.7	4.8%
Sharp Rock	14	6,158.0	5.5%	994.5	4.0%	557.7	2.5%
Spring Creek	15	14,088.2	12.7%	3,211.5	12.9%	3,208.0	14.6%
Total		**111,189.9**	-	**24,870.0**	-	**21,979.1**	-

Source: EPA- STEPL

Sediment loading in the subwatershed is primarily from the Kinkaid Lake- Central Body SMU. This accounts for more than a quarter of the total load at nearly twenty-seven percent. It is followed by Spring Creek (14.6 %) and Lower Kinkaid Creek (10.2 %). Results for the SMU pollutant loading are also displayed in the following figures.

Figure 2.58

Kinkaid Creek Watershed Planning Area - Nitrogen Load Analysis

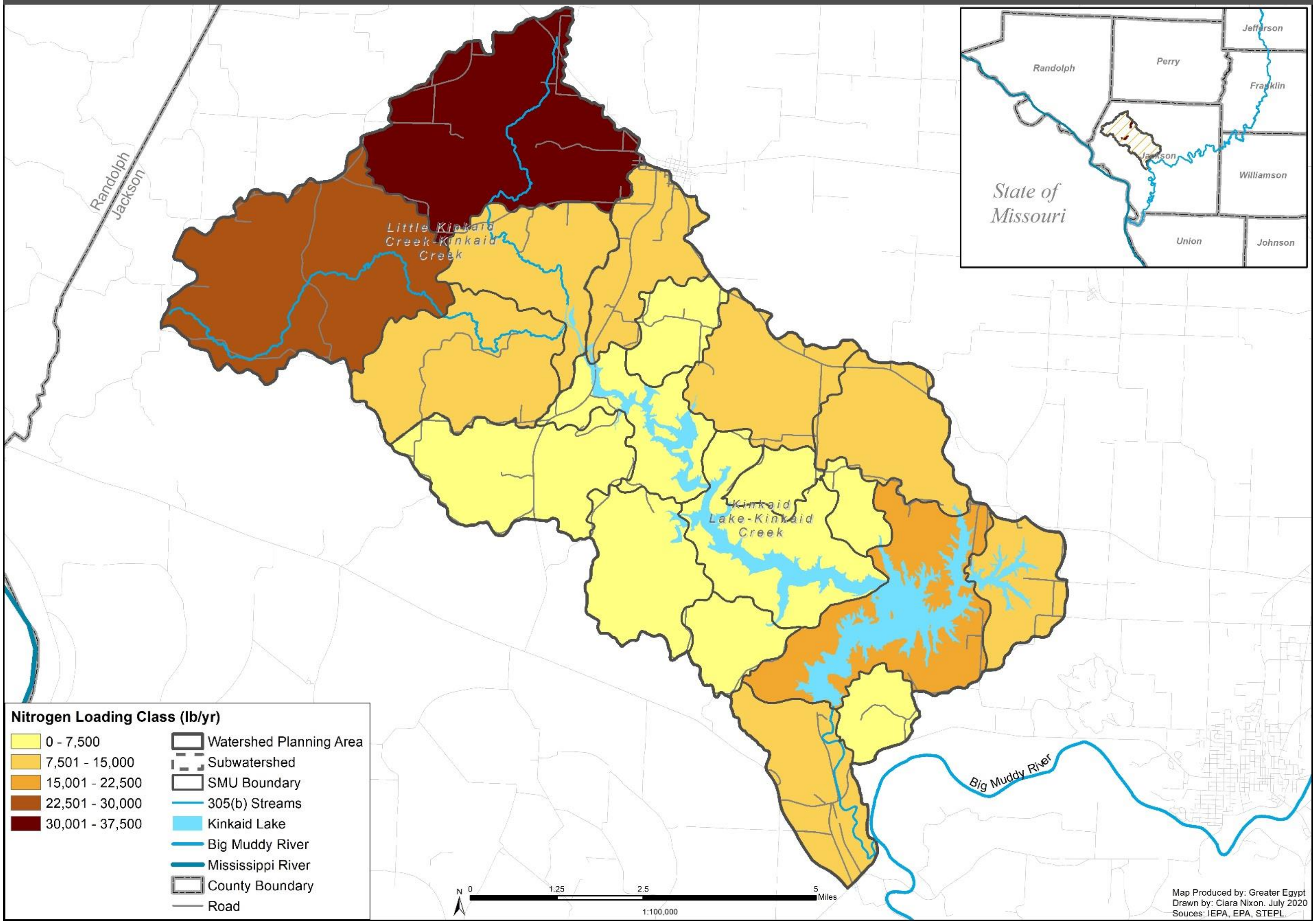
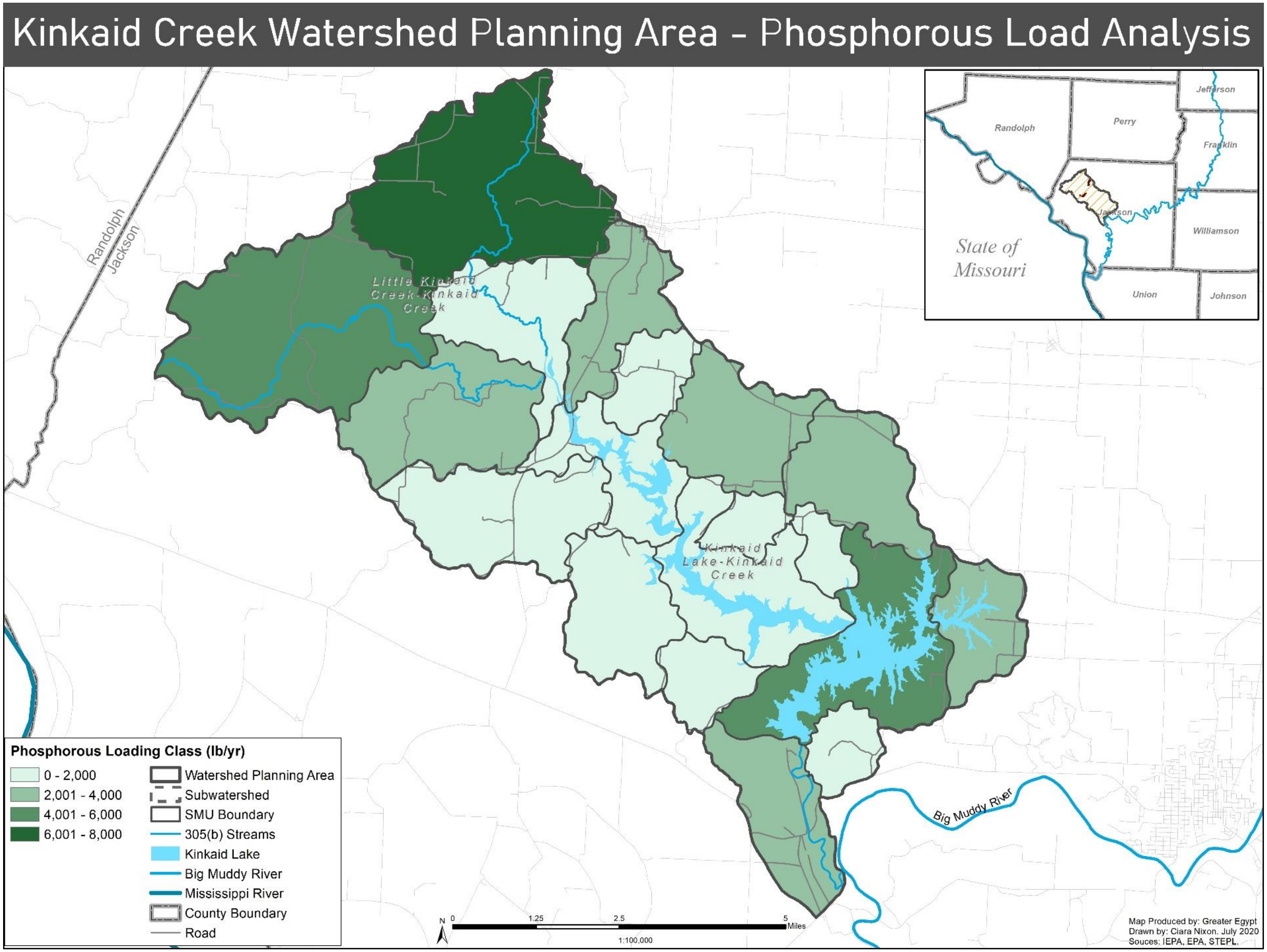
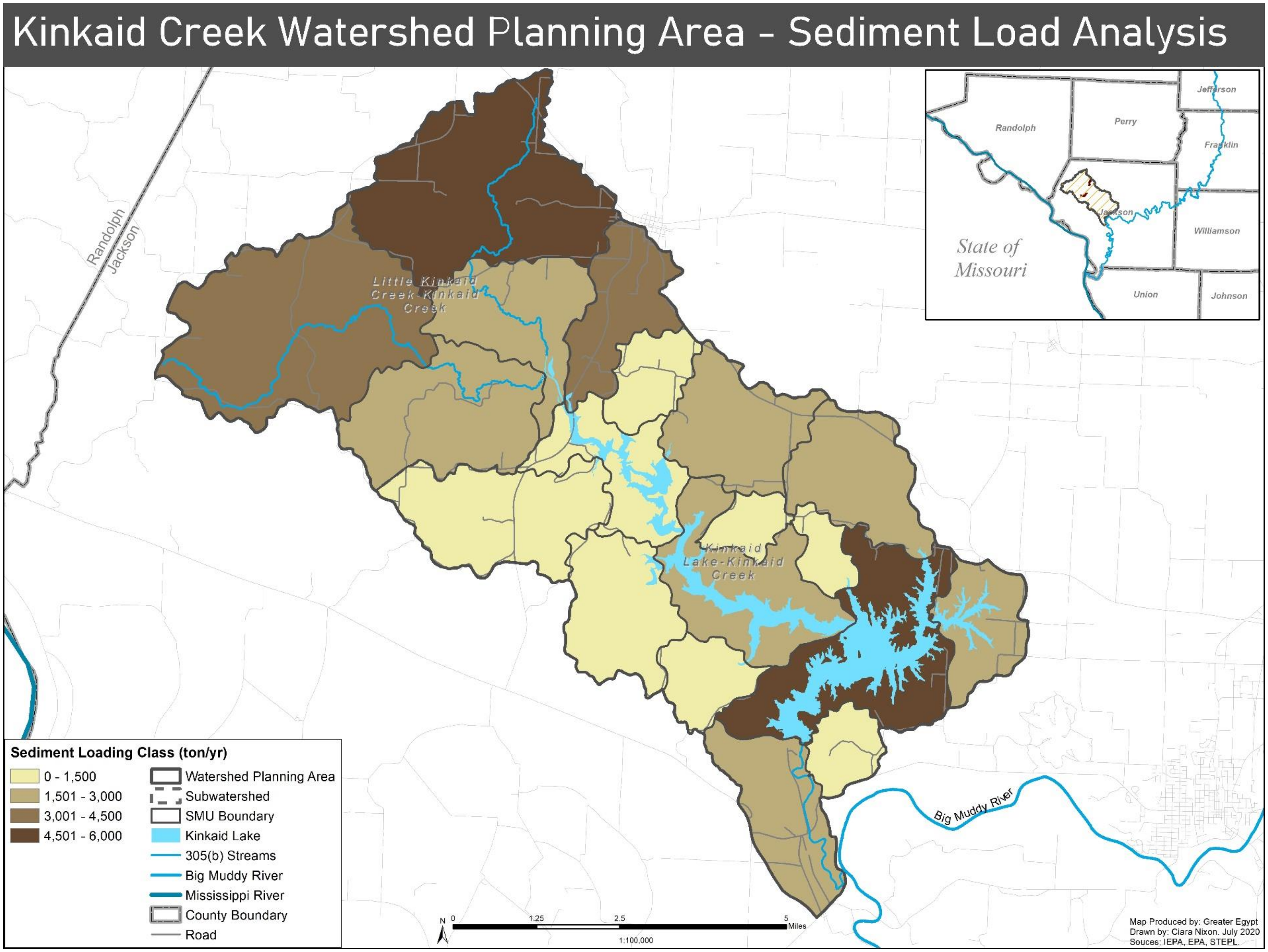


Figure 2.59



Kinkaid Creek Watershed Planning Area - Phosphorous Load Analysis
Randolph
Jackson
Little Kinkaid Creek-Kinkaid Creek
Kinkaid Lake-Kinkaid Creek
Big Muddy River
Jefferson
Randolph
Perry
Franklin
Jackson
Williamson
State of Missouri
Union
Johnson
Phosphorous Loading Class (lb/yr)
0 - 2,000
2,001 - 4,000
4,001 - 6,000
6,001 - 8,000
Watershed Planning Area
Subwatershed
SMU Boundary
305(b) Streams
Kinkaid Lake
Big Muddy River
Mississippi River
County Boundary
Road
0
1.25
2.5
5
Miles
1:100,000
Map Produced by: Greater Egypt
Drawn by: Ciara Nixon. July 2020
Souces: IEPA, EPA, STEPL.

Figure 2.60


Kinkaid Creek Watershed Planning Area - Sediment Load Analysis
Randolph
Jackson
Little Kinkaid Creek-Kinkaid Creek
Kinkaid Lake-Kinkaid Creek
Big Muddy River
Jefferson
Randolph
Perry
Franklin
Jackson
Williamson
State of Missouri
Union
Johnson
Sediment Loading Class (ton/yr)
0 - 1,500
1,501 - 3,000
3,001 - 4,500
4,501 - 6,000
Watershed Planning Area
Subwatershed
SMU Boundary
Kinkaid Lake
305(b) Streams
Big Muddy River
Mississippi River
County Boundary
Road
N
0
1.25
2.5
5
Miles
1:100,000
Map Produced by: Greater Egypt
Drawn by: Ciara Nixon. July 2020
Souces: IEPA, EPA, STEPL

2.8.9. Pollutant Load Reduction Targets

The Kinkaid Creek Watershed-based Plan will address the problematic areas in the watershed by proposing best management practices (BMP) to limit the nutrient runoff and other impairments. In order to better plan for these measures, pollutant load reduction targets are set to offer a benchmark for BMP effectiveness. While BMPs can be site-specific and cover a wide range of techniques, they should target the major impairments in the watershed.

According to the 2016 Illinois Integrated Water Quality Report, there are many known and potential causes and sources of water pollution in the planning area. The 303(d) and 305(b) information from Section 8.1 summarizes the causes and sources based on the Illinois Integrated Water Quality Report and other factors identified in this inventory and assessment.

As described in Section 8.1, the Illinois Nutrient Loss Reduction Strategy (ILNLRS) was designed to provide a framework for BMP implementation and reduction of nitrogen and phosphorus in Illinois waterbodies. The plan sets a Phase I milestone of state-wide nutrient reduction of nitrate-nitrogen of fifteen percent. The reduction target for phosphorus is twenty-five percent. These targets are to be met by 2025, with an overall target of forty-five percent for both nutrients. [47]

Pollutant load reduction targets for the Kinkaid Creek watershed will conform to the targets presented in the ILNLRS. *Table 8.22* provides a summary of the pollutant load reduction targets for the planning area and subwatersheds for a ten-year period. While the plan provides information on limiting sediment in waterbodies, it does not provide a reduction target. However, a target of twenty-five percent has been assigned for the Kinkaid Creek watershed. These targets are also presented in the following tables.

The summary suggests that with a fifteen percent reduction in nitrogen, the planning area 's total load would be reduced by 29,811 pounds annually. At a twenty-five percent reduction, phosphorus loads will be reduced by 10,369 pounds per year. The summary also includes an annual reduction of sediment of 8,789 tons (25%).

[47] IEPA. *NLRS- Executive Summary.* PDF. Accessed: May 2019.

To meet these pollutant load reduction targets, best management practices will have to be suggested and implemented in the planning area. BMP considerations will be a component of the Kinkaid Creek Watershed-based Plan.

Table 2.56 -Kinkaid Creek Watershed-Wide Pollutant Load Reduction Targets

Subwatershed	Nitrogen (percent of total)	Nitrogen Load Reduction Target	Phosphorus (percent of total)	Phosphorus Load Reduction Target	Sediment (percent of total)	Sediment Load Reduction Target
Kinkaid Creek	**15%**	**29,810.97**	**25%**	**10,368.65**	**25%**	**8,788.78**
Subwatershed Load Reduction Targets						
Little Kinkaid Creek- Kinkaid Creek	44.05%	13,132.49	40.04%	4,151.15	37.48%	3,294.01
Kinkaid Lake- Kinkaid Creek	55.95%	16,678.48	59.96%	6,217.51	62.52%	5,494.77
Total	-	**29,810.97**	**-**	**10,368.65**	**-**	**8,788.78**

Source: EPA- STEPL

2.8.10. Subwatershed Pollutant Load Reduction Targets

Reduction targets have also been assessed for the subwatershed management units within each HUC 12 subwatershed in the planning area. The following graphs illustrate the SMU reductions in nitrogen, phosphorus, and sediment.

Table 2.57 - Little Kinkaid- Kinkaid Creek Subwatershed Pollutant Load Reduction Targets

Watershed	SMU ID	Nitrogen (percent of total)	Nitrogen Load Reduction Target	Phosphorus (percent of total)	Phosphorus Load Reduction Target	Sediment (percent of total)	Sediment Load Reduction Target
Little Kinkaid Creek- Kinkaid Creek	**-**	**15**	**13,132.49**	**25**	**4,151.15**	**25**	**3,294.00**
Subwatershed Management Unit Load Reduction Target							
Middle Kinkaid Creek	16	14.3%	1,874.27	16.6%	687.94	19.6%	647.08
Lower Little Kinkaid Creek	17	10.6%	1,386.42	11.7%	486.44	14.2%	468.54
Upper Kinkaid Creek	18	32.4%	4,251.18	30.2%	1,255.25	24.1%	792.86
Upper Little Kinkaid Creek	19	42.8%	5,620.62	41.5%	1,721.52	42.1%	1,385.52
Total		-	**13,132.49**	-	**4,151.15**	-	**3,294.01**

Source: EPA- STEPL

Table 2.58 -Kinkaid Lake- Kinkaid Creek Subwatershed Pollutant Load Reduction Targets

Watershed	SMU ID	Nitrogen (percent of total)	Nitrogen Load Reduction Target	Phosphorus (percent of total)	Phosphorus Load Reduction Target	Sediment (percent of total)	Sediment Load Reduction Target
Kinkaid Lake- Kinkaid Creek	**-**	**15%**	**16,678.48**	**25%**	**6,217.51**	**25%**	**5,494.80**
Subwatershed Management Unit Load Reduction Target							
Lower Kinkaid Creek	1	11.1%	1,854.49	12.0%	748.70	10.2%	561.46
Heiple	2	2.7%	456.30	2.2%	135.68	1.9%	106.01
Smaller Shawnee	3	0.9%	147.39	0.9%	57.08	0.5%	26.52
Kinkaid Lake- Central Body	4	14.2%	2,376.44	17.9%	1,114.19	26.5%	1,456.54
Kinkaid Lake East	5	11.1%	1,845.66	10.2%	631.89	8.5%	466.30
Lone Oak	6	10.8%	1,796.17	9.4%	581.63	8.2%	449.45
Ash	7	1.6%	269.87	1.6%	96.59	1.1%	60.63
Kinkaid Lake- Central Channel	8	4.3%	710.99	5.9%	366.17	8.2%	448.89
Lakeside	9	1.4%	233.50	1.2%	75.75	0.8%	46.14
Larger Shawnee	10	1.8%	307.61	1.8%	110.56	0.8%	45.22
Campground	11	12.7%	2,110.59	11.2%	696.15	7.5%	411.69
Kinkaid Lake- Northwest	12	2.9%	491.33	3.3%	204.35	3.8%	210.56
Johnson Creek	13	6.2%	1,041.21	5.6%	347.26	4.8%	263.93
Sharp Rock	14	5.5%	923.71	4.0%	248.64	2.5%	139.43
Spring Creek	15	12.7%	2,113.22	12.9%	802.86	14.6%	802.00
Total		-	**16,678.50**	-	**6,217.50**	-	**5,494.80**

Source: EPA- STEPL

3. Climate Change

Illinois joined the U.S. Climate Alliance in January 2019. This is a bipartisan coalition of 24 governors with commitment to implementing policies that advance the goals the Paris Agreement, track and report progress of each state to the global community, and advance new and existing policies to promote clean energy and reduce carbon pollution.[48]

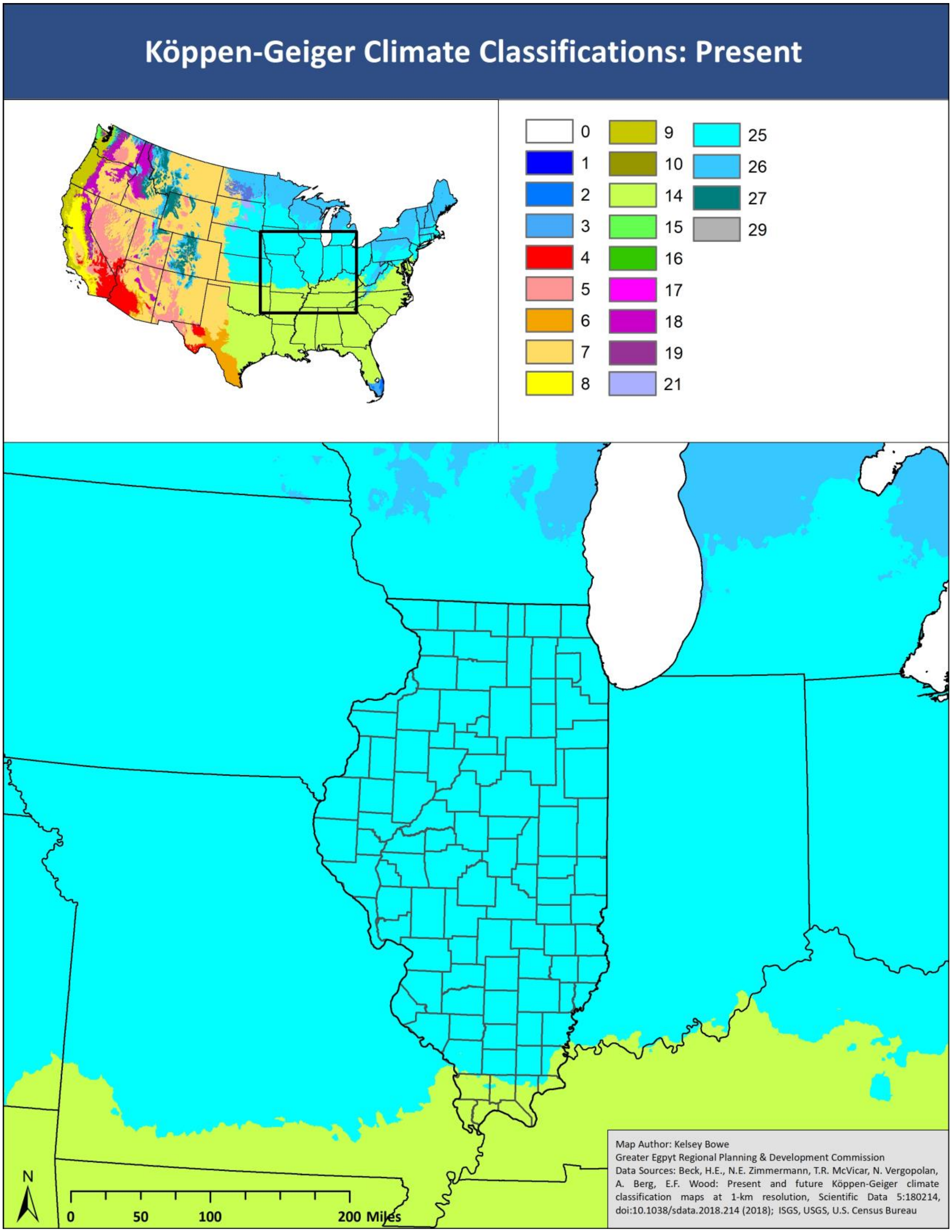
Global average temperature has increased by 1.8^{0}F from 1901 to 2016. Evidence consistently points to human related activities, mainly greenhouse gas emissions, as the cause[49]. Climate change is no longer a future problem as effects are being felt in the present time around the world, and events and trends associated with climate change are only expected to continue to increase in number of events and in severity[50] .

In the Midwest, climate change is driving more dramatic shifts in seasonal wet/dry regimes. Areas are experiencing severe storms, floods, and extreme heat waves within generally short time periods. All of these factors can have an effect on water quality, infrastructure stability, agriculture productivity, and general community resiliency to natural hazards, as well as alter historic hydrologic regimes. Southern Illinois currently encompasses regions within Köppen-Geiger climate types Dfa (hot-summer humid continental) and Cfa (humid subtropical); but future models suggest most of the state will be classified as Cfa by 2071[51] *Figures 3.1 and 3.2* show the Köppen-Geiger climate classifications of Illinois and surrounding areas for present day (based on data from 1980-2016) and projected climate types for the future (based on 32 different climate models for years 2071-2100)[53].

[48] Igusky, K., "Illinois Governor J. B. Pritzker Joins U.S. Climate Alliance", United States Climate Alliance, 2019.
[49] Hayhoe, K. et al., 2018: Our Changing Climate. In Impacts, Risks, and Adaptation in the United States: Fourth National Climate Assessment, Volume II U.S. Global Change Research Program, Washington, DC, USA, pp. 72–144.
[50] Gray, E. and Merzdorf J. "Earth's Freshwater Future: Extreme Floods and Drought", NASA Global Climate Change, 2019.
[51] Beck, H.E., N.E. Zimmermann, T.R. McVicar, N. Vergopolan, A. Berg, E.F. Wood: Present and future Köppen-Geiger climate classification maps at 1-km resolution, Scientific Data 5:180214, doi:10.1038/sdata.2018.214 (2018).

Table 3.1 - Köppen-Geiger Climate classification definitions and color codes

	1: Af Tropical, rainforest
	2: Am Tropical, monsoon
	3: Aw Tropical, savannah
	4: BWh Arid, desert, hot
	5: BWk Arid, desert, cold
	6: BSh Arid, steppe, hot
	7: BSk Arid, steppe, cold
	8: Csa Temperate, dry summer, hot summer
	9: Csb Temperate, dry summer, warm summer
	10: Csc Temperate, dry summer, cold summer
	11: Cwa Temperate, dry winter, hot summer
	12: Cwb Temperate, dry winter, warm summer
	13: Cwc Temperate, dry winter, cold summer
	14: Cfa Temperate, no dry season, hot summer
	15: Cfb Temperate, no dry season, warm summer
	16: Cfc Temperate, no dry season, cold summer
	17: Dsa Cold, dry summer, hot summer
	18: Dsb Cold, dry summer, warm summer
	19: Dsc Cold, dry summer, cold summer
	20: Dsd Cold, dry summer, very cold winter
	21: Dwa Cold, dry winter, hot summer
	22: Dwb Cold, dry winter, warm summer
	23: Dwc Cold, dry winter, cold summer
	24: Dwd Cold, dry winter, very cold winter
	25: Dfa Cold, no dry season, hot summer
	26: Dfb Cold, no dry season, warm summer
	27: Dfc Cold, no dry season, cold summer
	28: Dfd Cold, no dry season, very cold winter
	29: ET Polar, tundra
	30: EF Polar, frost



Köppen-Geiger Climate Classifications: Present
0
1
2
3
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5
6
7
8
9
10
14
15
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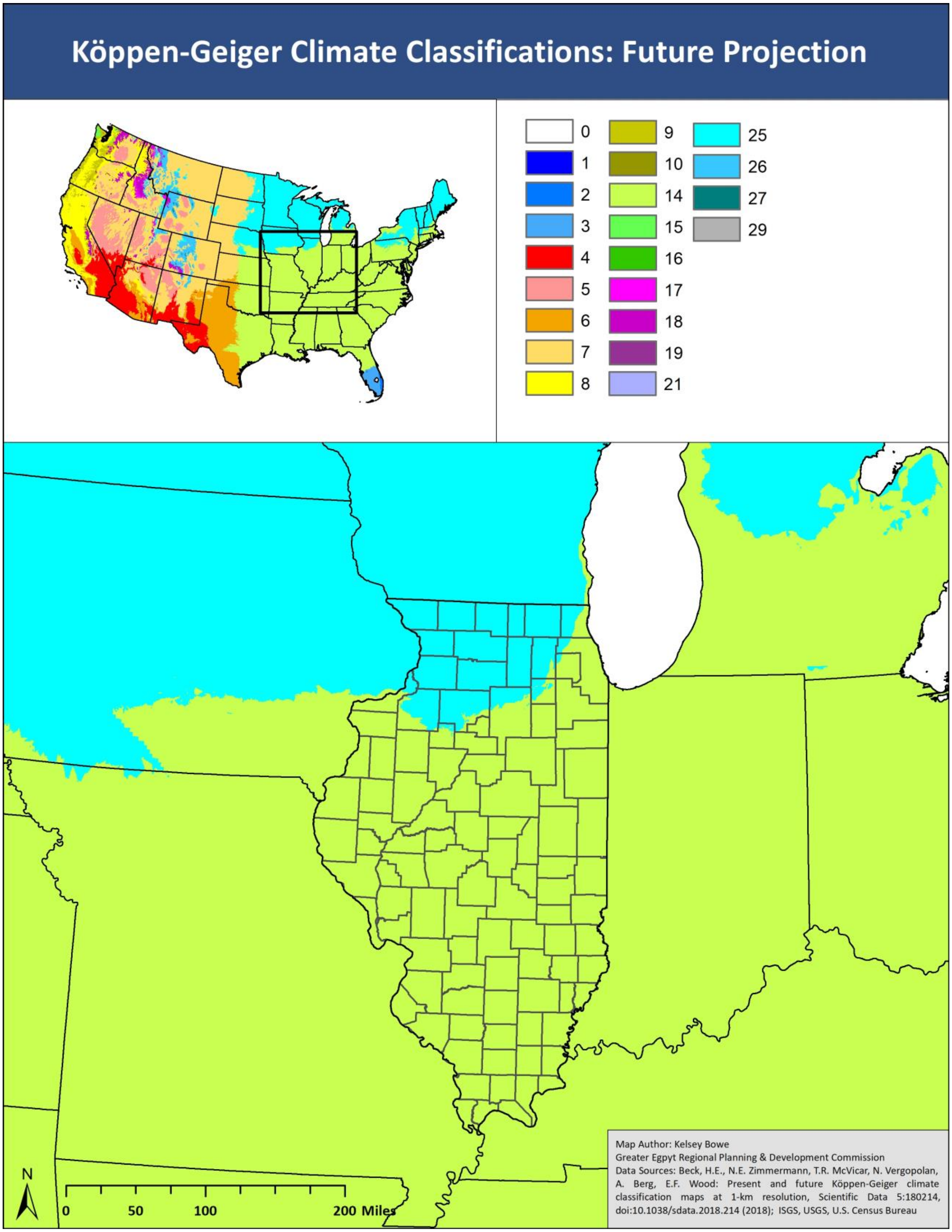
17
18
19
21
25
26
27
29
N
0
50
100
200 Miles
Map Author: Kelsey Bowe
Greater Egpyt Regional Planning & Development Commission
Data Sources: Beck, H.E., N.E. Zimmermann, T.R. McVicar, N. Vergopolan, A. Berg, E.F. Wood: Present and future Köppen-Geiger climate classification maps at 1-km resolution, Scientific Data 5:180214, doi:10.1038/sdata.2018.214 (2018); ISGS, USGS, U.S. Census Bureau

Figure 3.1


Köppen-Geiger Climate Classifications: Future Projection
0
1
2
3
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5
6
7
8
9
10
14
15
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17
18
19
21
25
26
27
29
N
0
50
100
200 Miles
Map Author: Kelsey Bowe
Greater Egypt Regional Planning & Development Commission
Data Sources: Beck, H.E., N.E. Zimmermann, T.R. McVicar, N. Vergopolan, A. Berg, E.F. Wood: Present and future Köppen-Geiger climate classification maps at 1-km resolution, Scientific Data 5:180214, doi:10.1038/sdata.2018.214 (2018); ISGS, USGS, U.S. Census Bureau

Figure 3.2

3.1. Flooding & Severe Weather

Extreme precipitation is expected to increase with the warming climate, which in turn increases the frequency and intensity of floods. Springtime precipitation is expected to increase in southern Illinois by 10-15% by 2050, with Illinois already experiencing dramatic increases in extreme precipitation events over the past two decades [52].

2019 was the second wettest year ever documented in the U.S., with extreme flooding events occurring along the Arkansas, Missouri, and Mississippi river basins. These floods affected fifteen states, and had an estimated combined cost of twenty billion dollars[53]. The Mississippi River experienced its longest lasting flood in 2019, with river gauges at or above flood stage for record breaking periods in Iowa, Illinois, Mississippi, and Louisiana[54]. Similarly, the Big Muddy River at Murphysboro (U.S.GS Stream Gauge 05599490) was at or above flood stage (22ft) for a total of 143 days during 2019. Peak water height was recorded at 31ft on June 11, 2019[55].

2021 had an above average number of tornados recorded, with December having a record-breaking number of 193 tornados across the United States[56]. National average tornado frequency has remained relatively constant, but the spatial distribution has been shifting; with positive trends in the Midwest and Southeast, and negative trends in the Great Plains region[57]. The Eastern U.S. is expected to see an increase in days with favorable conditions for severe thunderstorms with the changing climate, which would also lead to an increased risk of tornado occurrence[58].

[52] Frankson, R.K. et al., Illinois State Climate Summary, NOAA Technical Report, 2017.
[53] National Oceanic and Atmospheric Administration, " 2019 was the 2nd wettest year on record for the U.S." January 8, 2020.
[54] Donegan, Brian, The Weather Channel, "2019 Mississippi River Flood the Longest-Lasting Since the Great Flood of 1927 in Multiple Locations" May, 22, 2019.
[55] USGS National Water Information System: Web Interface, USGS 05599490 Big Muddy River at RTE 127 at Murphysboro, IL
[56] NOAA, "Contiguous U.S. ranked fourth warmest during 2021; 20 billion-dollar disasters identified", January 10, 2022.
[57] Gensini, V.A. and Brooks, H.E., Nature, "Spatial trends in United States tornado frequency", 2018.
[58] NASA - Global Climate Change, "Severe thunderstorms and climate change", April 7, 2013.

3.2. Heat Waves

Drought and excessive heat can severely harm freshwater habitats. Heat waves can increase the risk of Harmful Algal Blooms (HABs). HABs in freshwater systems are usually a result of cyanobacteria, a type of blue-green algae that can reproduce, or bloom, rapidly in nutrient-rich warm waters such as ponds and reservoirs. Cyanobacteria occur naturally across the U.S., but HABs only occur under certain conditions. Another major factor that increases risk of HABs are fertilizer runoff from agricultural and urban areas.

Some cyanobacteria produce toxins that cause skin irritation and can be deadly if ingested. Swimming and even playing on beaches are not recommended during HABs. Additionally, the EPA recommends waiting two weeks after a HAB ends before eating fish from the waterbody. Other side effects from HABs include lowered dissolved oxygen and increased turbidity of water, which can lead to die-offs of fish, invertebrates, and submerged freshwater plants. The economic impacts from HABS can be significant, causing public beach closures and damaging fishery populations. One EPA report from Ohio estimated that a HAB caused an estimated loss of over $37 million from decreased tourism.

Drought can also dry up water bodies completely, with small streams and shallow wetlands being most at risk. When this occurs, populations of freshwater organisms can die off and community structure may be altered.

Evidence suggests that the frequency and severity of droughts in the U.S. will increase with climate change; in the Midwest droughts are expected to occur in late summer months.[59] Increases in temperature, precipitation, and evaporation will continue in Illinois, leading to frequent and more intense floods and droughts[60].

Jackson County, IL has had 52 records of heat from 1997-2021, 11 records of excessive heat from 2010-2019, and 21 records of drought from 1998-2012[61]. Definitions of heat and excessive heat vary by weather station, but they generally count any day that is over 90 degrees, and days where the heat index is over 105 degrees respectively. Lake

[59] Angel, J. et al. 2018: Midwest. In Impacts, Risks, and Adaptation in the United States: Fourth National Climate Assessment, Volume II U.S. Global Change Research Program, Washington, DC, USA, pp. 872–940.
[60] "Climate Change in Illinois" Illinois State Water Survey/Prairie Research Institute
[61] NOAA Storm Events Database

Kinkaid has had one occurrence with low levels of toxins from cyanobacteria appearing in water testing, but the possibility of HABs in the lake may increase with climate change.

4. Dam Safety

Kinkaid Lake Dam was completed in 1972, the earthen dam is 980 feet long and 96 feet high. The National Inventory of Dams (NID) storage size for the reservoir is 153,00 acre-feet, Kinkaid Lake is the largest lake in Jackson County and 3rd largest in southern Illinois, following Rend Lake and Crab Orchard Lake. The reservoir supplies drinking water to much of the county, and provides many recreational opportunities.

Kinkaid is one of 7 dams in Jackson County with a high hazard potential. Dam hazard potential is not the probability of failure, rather it is an estimation of the types and cost of damages that would occur in the event of failure. High hazard potential dams would likely cause loss of human life; in addition, large economic loss, environment and utility damages are also expected. Significant hazard potential would lead to heavy economic loss, environmental damage, or disruption of lifeline facilities but no deaths. Low hazard potential dams would have very small economic damage, typically limited to the owner's property[62]. Kinkaid Lake Dam is owned by the Illinois Department of Natural Resources, and was last inspected on 11/21/2018. The dam has an Emergency Action Plan (EAP) in place, and the last revision of the plan was 01/01/1998. The condition assessment for this dam is not currently available from the NID database. The Kinkaid Reeds Creek Conservancy District runs the water plant and has their own safety plans for severe weather and risk management. The KRCCD also actively participates in the Jackson County Multi-Hazard Mitigation Plan.

Most dam failures are caused by overtopping (floods that exceed the capability of the dam), internal erosion, and mechanical failure. The risk of an incident or failure depends of many factors including height of the dam, size of reservoir, age of dam, and frequency of floods and seismic events that can weaken the structural integrity of dams. The amount of damage also depends on the amount/type of infrastructure and number of people living in the potential hazard zone. There are no reported incidents for the Kinkaid Lake Dam in the incident databases maintained by the Association of Dam Safety Officials (ASDSO) and the National Performance of Dams Program (NPDP).

While the causes and impacts of climate change have been widely studied and reported on, there is far less information available regarding the effects of climate change on infrastructure. Lack of specific, localized climate models can make it challenging for

[62] FEMA, "Federal Guidelines for Dam Safety", April 2004.

engineers to effectively plan designs[63]. Increased frequency in severe weather can put extra stress on dams, levees, and other water infrastructure, likely leading to increased risk of breaches and other damages.

4.1. Funding Opportunities

The Federal Emergency Management Agency (FEMA) runs the National Dam Safety Program, which provides grant money to states on a variety of projects including:

- Dam safety training for state personnel
- Increase in the number of dam inspections
- Increase in the submittal and testing of Emergency Action Plans
- More timely review and issuance of permits
- Improved coordination with state emergency preparedness officials
- Identification of dams to be repaired or removed
- Conduct dam safety awareness workshops and creation of dam safety videos and other outreach materials

Detailed information on the program and funding eligibility can be found at FEMA.gov and grants.gov

[63] Olsen, R., "Adapting Infrastructure and Civil Engineering Practice to a Changing Climate", American Society of Civil Engineers, 2015.

5. Best Management Practices and Pollutant Load Reductions

Best Management Practices (BMPs) have been separated into watershed-wide and site-specific classes. BMPs were suggested based on several factors including: reduction loads, need, feasibility, cost, and labor.

Pollutant load reductions have been calculated for each site-specific practice by implementing the Region 5 Model. Reductions were also estimated for watershed-wide BMPs. However, estimations for site-specific BMPs may be more accurate considering the variables used for those calculations pertain to a particular area.

Each BMP suggested in the plan has been characterized and described further by methodology. As previously stated, management measures address the major pollutants in the watershed derived from the original pollutant loads outlined in the watershed resource inventory. Further information on the recommended BMPs can be found in the Illinois Urban Manual, as well as the NRCS Field Office Technical Guide. The Illinois Urban Manual outlines specifications about the purpose of the BMPs, as well as guidance for construction.[64] The NRCS Field Office Technical Guide is state specified guidance that covers general information on the area, natural resources, conservation management systems, practice standards and specifications, and conservation effects. [65]

64 *Illinois Urban Manual.* Association of Illinois Soil & Water Conservation, 2013. PDF File.
65 NRCS and USDA. "Field Office Technical Guide," https://efotg.sc.egov.usda.gov/#/. Accessed August 16, 2019.

5.1. Forestry BMPs

Forestry BMPs are designed to protect the forests, soil, and water while allowing for appropriate use of forest resources. In Southern Illinois, forestry practices are often for the purpose of removing overstocked pine stands and restoring native oak-hickory stands. This is one of the main goals of the 2006 Land and Resource Management Plan for the Shawnee National Forest and the demonstration project at Trail of Tears State Forest, which is land owned by IDNR south of the Kinkaid Creek Watershed.

BMPs listed in this section are summarized from the Shawnee National Forest webpage resources and from the *IDNR Forestry Best Management Practices Guide*.

5.1.1. Prescribed Burns

Southern Illinois' prescribed burns typically take place between the months of October and May and generally fall into one or more of the following goals[66]:

- To stimulate growth of native vegetation that are well-adapted to fire, and impede vegetation that is not.
- To improve wildlife habitat.
- To improve the visual quality of the area.
- To reduce the likelihood and severity of a wildfire, thereby increasing safety for the public and firefighters in case of a wildfire.

BMPs for prescribed burns include careful planning, implementation, and follow-up maintenance. Fire locations should be planned to minimize sediment runoff into waterbodies and wetlands and seasonally timed for optimal nutrient uptake and revegetation of desired species. Following a burn, erosion control and soil stabilization practices should be chosen appropriate to the site. Prescribed burns should only be conducted by experienced personal[67].

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[66] 'Fire Management", Shawnee National Forest, fs.usda.gov/main/Shawnee/fire.

[67] Forestry Best Management Practices Guide, - 3rd Edition, published in cooperation with Illinois Department of Natural Resources, Illinois Forestry Development Council, Southern Illinois University Carbondale, and University of Illinois; revised and reprinted in 2012. https://academics.siu.edu/agriculture/_common/documents/forestry-publications/il-bmp-manual.pdf

5.1.2. Timber Harvesting

Timber harvesting or logging is an important tool is forest management. Timber harvest has a variety of benefits including removing unwanted tree species, opening up sunlight to the forest floor, thinning overcrowded forest stands, and raising funds for other management programs. The following list is an overview of Best Management Practices that can be used during logging operations to minimize damage and pollution to the habitat while maximizing benefit. Detailed information can be found in the full Forestry Best Management Practices Guide.

5.1.2.1. Planning

When planning a timber harvest, there should be the fewest possible number of skid trails, stream crossings, and landings. Landings and skid trails should avoid wetlands whenever possible. Equipment should be appropriate for the site and weather conditions.

5.1.2.2. Harvesting

- Do not operate equipment in areas that would cause excessive compaction or rutting, on steep slopes, winch logs instead of skidding to avoid erosion.
- Utilize sediment control structures, seeding and mulch, and fill in ruts as needed to avoid erosion and sedimentation.
- Do not pile slash in drainage areas.
- Place landings outside of Streamside Management Zones, in well drained soils, restore landings after harvesting operations are complete.
- Keep skid grades less than 15% or use drainage structures and soil-stabilization.

5.2. Agricultural BMPs

Figure 5.1- Examples of Agricultural BMPs

Source: USDA NRCS, Ohio

According to the existing pollutant loads derived from the STEPL model, agricultural practices (cropland/pastureland) account for 45.6% of the nitrogen load, 49.3% of the total phosphorus load, and 35.8% of the total sediment load in the watershed. *Figure 5.1* displays various agricultural BMPs presented in this plan.

5.2.1. Agricultural Filter Strips

Agricultural filter strips protect water quality by naturally filtering nutrients and sediment. With the amount of agricultural runoff taking place within the watershed, agricultural filter strips are particularly effective in reducing pollutant loads.

Figure 5.2 - Agricultural Filter Strip

5.2.2. Conservation Tillage

Conversation tillage can include mulch-till, no-till, and strip-till practices. These forms of conservation tillage usually leave a residual of the previous layer of crops. Each method varies in practice, but the benefits are typically consistent with the others. Any form of conservation tillage paired with contour farming brings added benefit. Major benefits of implementing some form of conservation tillage include reduction in soil erosion and improved water quality. This management practice is a low to moderate cost to place within the area of interest.

5.2.3. Cover Crops

Cover crops provide benefits to agricultural land by improving water quality and reducing erosion. These are usually planted following seasonal harvests. Cover crops serve to protect soil surface from raindrop impact, improve infiltration relative to bare soil, and trap eroded particles. Cover crops are typically small grains, specifically planted to provide soil cover during the winter. This practice is tailored to the specific crop benefits and/or soil concerns of the farmer. Cover crops control erosion by protecting the soil from wind and water. They can also be used for excess nutrient uptake, increased soil nutrients and organic matter, and weed suppression.

5.2.4. Critical Area Planting

Critical Area Planting involves establishing permanent vegetation on land that is currently eroded or expected to erode in the near future. Usually, these are places that are highly eroded and are unable to be farmed. This practice is most commonly used on steep slopes and areas of bare ground; especially along streams, channels, and shorelines. The benefit of this practice is to increase soil cover and reduce erosion from wind or rain. Areas where this BMP may apply include active or abandoned mined lands, areas needing stabilization before or after natural disasters such as floods, hurricanes, tornados, and wildfires, eroded banks of natural channels, banks of newly constructed channels, and lake shorelines. Establishing permanent cover helps to stabilize the soil structure, therefore reducing runoff and improving water quality.[68]

5.2.5. Crop Rotation

Crop rotation involves cycling two or more crops on the same ground over a period of time. The changing sequence of crops between years allows for increased soil health, as well as reducing sheet, rill and wind erosion. Rotating another crop into the cycle with a larger rooting depth will support further intake of excess nutrients the previous crop

68 USDA-NRCS, "Critical Planting Area*," Conservation Practice Standard,* Code 342 (September, 2010)

could not reach. The outcome is enhanced water quality due to nutrients being used for their intended purpose of crop production instead of running off into nearby waterways. Using cover crops during fallow seasons provides additional nutrient retention. Crop rotation can be combined with many other conservation efforts for enhanced benefits to land and streams. [69]

5.2.6. Drainage Water Management

Drainage water management (DWM) is a practice used in conjunction with existing tile drained fields on flatter landscapes. A water control structure is installed which allows for control of water level by draining excess water or retaining it for future use. This allows for seasonal variation of the crops water needs. By retaining water for future use, crops are given the opportunity to capture water and nutrients for their benefit; thus, decreasing direct flow of nutrients into surrounding waterbodies. This aids in crop production, as well as improved water quality. DWM is most effective on flat uniform fields that already have tile drainage systems in place[70].

Figure 5.3 - Grassed waterway

5.2.7. Grassed Waterways

Grassed waterways prevent erosion in areas prone to consistent water flow. They can also serve as a filtering mechanism for nutrients.

Implementation of grassed waterways is assuming at least a 60-foot width per gully.

69 USDA-NRCS," Conservation Crop Rotation," *Conservation Practice Standard,* Code 328 (October, 2015)
70 USDA-NRCS, "Drainage Water Management Fact Sheet". (Accessed July, 2019).

5.2.8. Livestock Crossings

Livestock frequently crossing through a stream can cause erosion to the streambank and impair the water via increased sedimentation and nutrient loading. Livestock crossings can be constructed by varies means, but with the purpose in mind to stabilize the stream. In many cases, farmers will fence off a portion of the stream to help minimize disturbance.

Figure 5.4 - Livestock crossing

5.2.9. Pasture/ Hay Planting

A pasture is an area planted with grass or legumes to provide forage for livestock. As a best management practice, specific species are selected to improve forage production, enhance livestock nutrition, and protect the soil from erosion. Converting cropland into pasture or hay production not only benefits local wildlife, but improves water quality as well. The hay/pasture fields filter out nutrients and sediment before entering the stream.[71]

5.2.10. Riparian Buffers

A riparian buffer is land following along streams, lakes, and wetlands that is managed for perennial vegetation (grass, shrubs, and/or trees) to improve and guard aquatic resources from the hostile impacts of agricultural practices. Riparian buffers are similar to filter strips, and have additional benefits. Like filter strips, buffers reduce sediment and nutrients by filtering the water that flows through it. Since buffers are generally larger than agricultural filters, they can reduce the flow of water at a higher pace. Since implementation of buffers are more expensive than normal filter strips, they were suggested sparingly.

Figure 5.5 - Riparian Buffer

71 USDA- NRCS, "Pasture and Hayland Planting," *NRCS Job Sheet*. (December, 2009).

5.2.11. Water & Sediment Control Basins

Water and Sediment Control Basins (WASCOB) function quite similar to terraces, but are more geared towards irregular topography where farmers cannot easily plow on the contours. An earth embankment is constructed perpendicular to a gently sloped waterway in order to trap runoff. The sediment is allowed to settle within the basin, while the remaining runoff slowly releases into a stable outlet. The WASCOB prevents rill erosion and increased sedimentation in waterways by slowing down runoff, especially after a heavy rain. [72]

[72] USDA-NRCS, "Water and Sediment Control Basin" *Conservation Practice Standard*, Code 638. (October, 2017)

5.3. Urban BMPs

The Kinkaid Creek watershed has very few urbanized areas, however these suggestions may be useful for the City of Ava, homeowners' associations, or private landowners to improve water quality and stormwater drainage in their local areas.

5.3.1. Raingardens/Bioswales

Raingardens and Bioswales hold or slow down excess stormwater, relieving stress on sewer systems. They also act as a filter for stormwater pollutants. Swales are effective in trapping sediment and other nutrients before releasing the water flow into other areas. Depending on the contributing area for the practice, bioswales are generally a suitable structure to reduce total suspended solids.

5.3.2. Urban Trees

Urban trees can reduce stormwater flow, lower risk of flash floods, and improve water quality by filtering pollutants. Urban trees also reduce the Urban Heat Island effect, improve air quality, reduce energy usage of nearby buildings, provide wildlife habitat, and improve city aesthetics[73].

5.3.3. Rain Barrels

Rain barrels are containers which capture the rain flowing off your roof through a downspout. It is safe to use for watering gardens, lawns, and trees, and also for washing cars or outdoor areas. Rain barrels with a drainage valve can be used to store water for use between rain events. When the valve is opened, the water is able to empty from the barrel slowly, thus reducing the amount of runoff and increasing infiltration during storm events.

5.3.4. No Spray Zones (NSZ)

As its name implies, these areas would implement a no spray, or reduced spray, approach to fertilizer use and other chemical use for a particular space. Among other nutrients, this would reduce the amount of nitrogen and phosphorus in runoff. This approach can be useful in suburbs, commercial districts, universities and golf courses.

[73] U.S. Environmental Protection Agency, "Stormwater trees technical memorandum", 2016

5.3.5. Debris & Litter Removal

Some areas in the Kinkaid Creek watershed exhibit some form of blockages. While this is sometimes overlooked, it can be detrimental to the health of a stream or lake. Depending on the flow, a blockage can alter the stream channel and cause erosion on the streambank. Removing debris allows for reduced flooding, and increased streamflow. Areas with major blockages can also exhibit flooding. The natural materials that are taken from these blockages can be utilized in other management practices to benefit the watershed area and to reduce the cost of planning for managing the watershed. There are different methods of litter collection and removal BMPs, as well as methods for preventing litter from entering storm drains and waterbodies in the first place; these will be described in the following sections.

The following litter capture and removal strategies were adapted from the U.S. EPA website[74]

5.3.5.1. Storm Drain Capture

There are a wide variety of designs that capture litter at the entrance of a storm drain. These can prevent the clogging of stormwater pipes and keep litter out of waterbodies.

Figure 5.6– Catch basin with hood

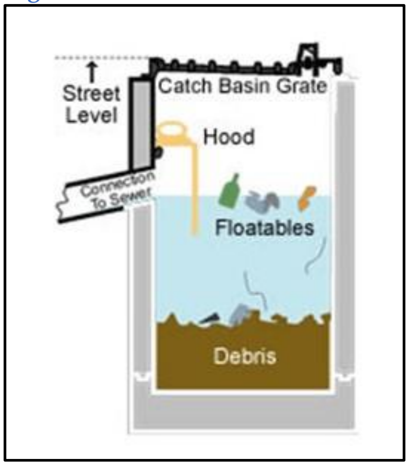


Photo source: U.S. EPA

Curb Inlet Covers: Screens or plastic covers that keep trash on the street to be picked up by street sweepers.

Catch Basin Outlet Screens or Fabric Inserts: Basket-like structures placed just inside the entrance of a storm drain to capture litter before it goes into the pipes. Must be emptied frequently to be effective and prevent overflows.

Catch Basin Hoods: Hoods over the sewer connection within a storm drain to prevent floating litter from entering. This measure is only useful for storm drains that have catch basins.

[74] U.S. EPA "Trash Capture Technologies" https://www.epa.gov/trash-free-waters/trash-capture-technologies#drain

5.3.5.2. Netting Systems

Netting systems may be in-line or at the pipe outlet. Generally, these are large mesh nets or wire cages that trap all large debris from entering a waterbody. These structures require regular emptying and repairs to be effective, especially in urban stormwater systems.

5.3.5.3. Open Water Trash Capture

There are several open water methods that may be useful in the watershed.

Litter boons and bandalong traps are floating structures that guide litter into collection areas. Both of these structures can be customized to fit the needs of the site. They are typically anchored to the bottom and may have areas that allow for movement of fish and wildlife under the water.

Figure 5.7 – Litter Boon

Figure 5.8 - Bandalong Trap

Photo sources: U.S. EPA

5.4. Hydrologic BMPs

5.4.1. Infiltration/Detention Basins

For the purpose of reducing flooding and other water quality issues, infiltration basins have been proposed for the plan. An Infiltration Basin is a shallow impoundment that stores and infiltrates runoff over a level, uncompacted, (preferably unobstructed zone) with comparatively permeable soils. Development of these basins will mitigate future flooding occurrences in areas prone to the back-up of water flow. Infiltration Basins use the existing soil mantle to decrease the volume of stormwater runoff through infiltration and evapotranspiration. The quality of the runoff is also improved by the natural cleansing processes of the existing soil mantle and by the vegetation planted in the basins. The key to promoting infiltration is to provide enough surface area for the volume of runoff to be absorbed. These may also be referred to as Water and Sediment Control Basins, or wascobs.

5.4.2. Wetland Conversion

Converting frequently flooded cropland into wetlands proves to be highly beneficial for improving water quality and reducing soil erosion. Wetlands capture water and filter out excess nutrients before slowing releasing it back into the waterways. This action helps mitigate flooding downstream. Not only do wetland conversions help to improve water quality, but it helps to bring more biodiversity into the environment.

Figure 5.9 - Restored wetland at SIU's Campus Lake

Photo Source: rec.siu.edu

5.4.3. Gully Stabilization

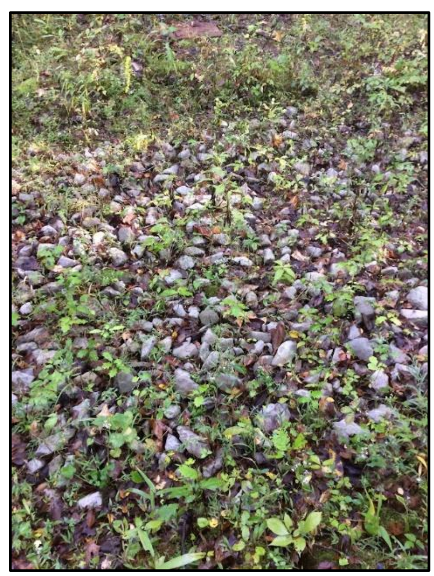
Gullies are a hydrological formation of water channels that occur over time through the force of water and erosion. It is a trench or ravine which has a deep channel, and can cause flooding events to happen much more frequently and severely depending on their location. They are usually found within higher elevation areas like hillsides or, and are associated excessive run-off. There are many methods to fill and stabilize gullies.

5.4.3.1. Brush Fills

Brush fill is a continuous filling mechanism on small gullies with brush debris. This includes materials like branches of trees or the stems of bushy vegetation. If brush is placed across the gully, it is called a "brush plug". Brush fill work starts at the head of the gully. The first step in constructing the brush plug is by lining the gully bed with small tree and shrub branches, in order to protect the soil. The next step is placing larger branches over the smaller tree and shrub branches.

A brush fill should rise above the gully banks so it can be weighted down with rocks or heavier limbs to condense the brush. It is helpful to use green limbs to permit the formation of the desired shape due to their malleability. The brush should be compacted in order to allow for compost placement. The main purpose of brush fills is to eradicate the gully with the soil that brush holds.

Figure 5.10 - A rip rap and earthen gully plug along the upper Cache River, Johnson County IL.



5.4.3.2. Earth Plugs

Earth plugs are small structures that are constructed across the width of gullies. Their main purpose is to hold water and allow for it to infiltrate into the ground. In humid regions, earth plugs must be combined with short diversions. The placement of earth plugs depends on the gully channel's gradient.

The earth plugs are raised above the ground level. The short diversion ditches lead overflow away from the ends of the plugs to prevent erosion damage and to spread the water. Finally, the water is either held or infiltrated by the gully or by the soil on the spreading areas. For this BMP, sufficient plant cover must be maintained due to silt deposits gradually reducing the available storage capacity of the small ponds. The amount of diverted overflow increases and may erode the discharge areas if precautions are not taken.

5.4.3.3. Woven-Wire Check Dams

Woven-wire check dams are small barriers which are usually constructed to hold fine material in the gully. They are used in gullies with moderate slopes (not more than ten percent) and small drainage areas that do not have flood flows which carry rocks and boulders. The dam is either constructed straight across the gully or in a crescent shape with its open end upstream. The crescent shape check dam is commonly used to allow a longer spillway than is possible on a straight one. At the same time, it anchors and protects the ends of the dam. An offset equal to about one-sixth of the gully's width at the dam site will generally provide sufficient curvature.

5.4.3.4. Brushwood Check Dams

Brushwood check dams are made of posts and brush which are placed across the gully. The main objective of brushwood check dams is to hold fine material carried by flowing water in the gully. Small gully heads, which are no deeper than one meter, can also be stabilized by brushwood check dams. Brushwood check dams are considered as temporary structures and should not be used to treat ongoing problems such as concentrated run-off from roads or cultivated fields. They can be employed in connection with land use changes such as reforestation or improved range management until vegetative and slope treatment measures become effective.

There are many types of brushwood check dams, but whichever one is chosen- the spillway crest of the dam must be kept lower than the ends. This allows water to flow over the dam rather than around it.

Figure 5.11 Stone Check Dam

Photo source: State of Minnesota Stormwater Manual

5.4.3.5. Loose Stone Check

Loose stone check dams are made of relatively small rocks that are placed across the gully. The main objectives for these dams are to control channel erosion along the gully bed, and to stop waterfall erosion by stabilizing gully heads. Loose stone check dams are utilized in order to stabilize the incipient and small gullies and the branch gullies of a continuous gully or gully network. The length of the gully channel is not more than 100 m and the gully catchment area is two ha or less. These dams can be used in all regions. The maximum effective height of the dam is 1.0 m and its foundation depth is at least 0.5 m[75].

5.4.4. Streambank and Shoreline Stabilization

Varying degrees of erosion occur on all waterbodies. Stabilization of shorelines and streambanks is important to reduce the progress of erosion and mitigate any future occurrences. Stabilization measures can also reduce pollutant loads from runoff; according to the existing pollutant loads derived from the STEPL model, streambanks account for 17.2% of the nitrogen load, 31.8% of the total phosphorus load, and 60.9% of the total sediment load in the watershed.

While streambank stabilization measures are useful tools to protect and restore natural stream habitats, they only treat the symptoms of erosion, not the main cause. Watershed wide BMPs used to reduce storm runoff, gully formation, and surface erosion should be used in combination with the methods listed in this section.

The Region 5 Model uses various parameters to estimate load reductions for shoreline and streambank stabilization. Soil, length and height are components included in the model. Lateral recession rates (LRR) are also used in determining the effectiveness of stabilization. *Table 5.1* displays the modified LRR characterization used in the STEPL Region 5 Model.

75 Organization, Food and Agriculture. "Principals of Gully Control." III. Specific Treatment Measures, 2000, www.fao.org/3/AD082E/AD082e03.htm.

Table 5.1 - Modified Lateral Recession Rate Diagram in STEPL Region 5 Model

LRR (ft/yr)	Category	Median Value	Description
0.01 - 0.05	Slight	0.03	Some bare bank but active erosion not readily apparent
0.06 - 0.2	Moderate	0.13	Bank is predominantly bare with some rills and vegetative overhang
0.3 - 0.5	Severe	0.4	Bank is bare with rills and severe vegetative overhang
0.5+	Very Severe	0.5	Bank is bare with gullies and severe vegetative overhang

Source: EPA, IEPA

For consistency, LRRs used for streambank and shoreline stabilization were set at median values: Slight (0.03), Moderate (0.13), Severe (0.4). Efficiency parameters were set at 1 (100 percent efficiency). In most cases, this strategy was used for both banks of a reach unless otherwise noted.

5.4.4.1. Rip Rap and Rock Weirs/Artificial Riffles

Rip rap is one of the most common methods of streambank and shoreline stabilization. Recycled concrete or large rocks are used to protect banks from erosion and are most useful for low to moderately eroded streams and shorelines. Rip Rap is already used in many areas of the Kinkaid Creek watershed.

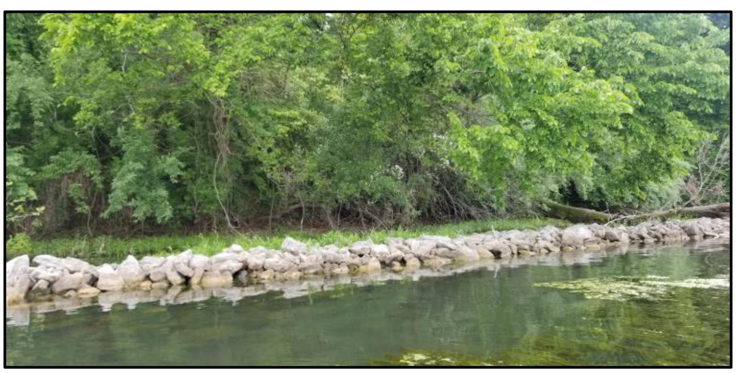
Figure 5.12 - Rip Rap along a stream in the Kinkaid Creek Watershed

In addition to stabilizing a single length of bank, rip rap can be used to restore riffle habitat and provide stabilization along both sides of a stream. This creates habitat heterogeneity; benefitting insects, fish, and some bird species[76].

5.4.4.2. Breakwaters

While using traditional rip rap directly along shorelines does reduce erosion, the use of breakwaters for reservoirs with shore erosion are generally even more effective. Breakwaters are rip rap structures placed between 10 and 40 feet from an eroded reservoir bank. These structures are designed to reduce wave energy and allow for natural recolonization of aquatic and wetland vegetation on the banks. Vegetated banks provide more wildlife habitat, better water quality, and more aesthetically pleasing shorelines[77]. Breakwaters should be built with gaps along intervals to allow for exchange of water and movement of wildlife. Breakwaters are already in use along some areas of Lake Kinkaid.

Figure 5.13 - breakwater structures at Lake Kinkaid



[76] Henrich et. al, "Cascading ecological responses to an in-stream restoration project in a midwestern river", Restoration Ecology, 2014.
[77] Severson, J., "Wetland habitat enhancement and shoreline stabilization using rip rap breakwaters on Kinkaid Lake in southern Illinois", Southern Illinois University at Carbondale, 2007.

5.4.4.3. Tree revetments

While riprap may be a suitable option for mitigation strategies for stabilization of a stream, there are more environmentally beneficial options to choose from that still provide the same streambank care as riprap. The strategy of using tree revetments in order to reduce the sediment load, erosion rates, and nutrient uptake is a good alternative to riprap. This material involves rows of cut trees anchored to the toe of a stream bank, and it can be installed using hand tools or light powered machinery.

Tree revetment materials can be scavenged within the watershed as a part of the debris removal; which cuts the cost of materials needed. It can also be harvested or purchased at a lower cost than riprap. The tree revetments allow for biodegradable materials to be put in place and serves as a way for vegetation to grow along the banks of streams. The revetments serve as a filtration system for pollutants, overabundance of nutrients, and filtering large sediment loads to reduce the erosion of the streambank.

5.4.4.4. Coconut Fiber Roll

The use of the coconut fibers within a streambank helps to stabilize it by preventing erosive activity. The use of this material helps by improving on plant life root systems along the bank for a more stable stream. This material is used in a log form that is comprised of coconut hull fibers. These logs are staked at the toe of the stream bank and can be easily built using hand tools.

The cost of this mitigation strategy is moderate to low cost, and is cheaper than other methods of stabilization. The coconut fibers tend to have a high-water retention rate, and become heavier with the more water they uptake; which in turn acts as a means to anchor during a flooding event. The coconut also allows for vegetation growth, and provides a filtration system to take more nutrients/pollutants out of the water.

5.4.4.5. Gabion Baskets

Figure 5.14 – Gabion Baskets along Western Crab Orchard Creek

Gabion baskets consist of wire mesh cages filled with cobble. Typically, the baskets are cube shaped and stacked along stream banks to provide stabilization. To further strengthen gabion baskets, live branches are sometimes placed within the basket, over time the roots grow throughout the structures and into the bank. This BMP is useful where banks are steep and construction space is limited. Gabion baskets tend to cost more than rip rap and coconut fiber rolls, and are only recommended for extremely eroded areas.

5.4.4.6. Deflectors

This BMP is an instream structures used to deflect water away from the eroding bank. These structures can also increase stream habitats by creating meanders in channelized areas, and by creating deeper pools. This can be beneficial to many aquatic species[78]. Deflectors are commonly made from logs or rip rap. In large rivers, these structures may be used to deepen channels for navigation. Other names for this BMP are jetties, wing dams, and dikes. The use of deflectors is recommended in channelized streams with moderate to high bank erosion.

[78] Ohio Stream Management Guide no 19

5.4.4.7. Regrade and Revegetate

Often the most effective BMP, this involves regrading a streambank with machinery, and replanting the new banks with native vegetation. There are different methods and types of plants that can be used for this activity. Revegetation practices can include seeding, live stakes, or planting whole shrubs and trees. Specific projects will require consultants. Since this is a multi-step process and requires significant manpower, it can be very expensive. This method is recommended for short sections of streams with extreme erosion and channelization problems.

Figure 5.15 - A regraded streambank that has been seeded

Photo source: Iowa DNR

5.5. Past, in-progress, and proposed BMPs

There have been many forest management and water quality projects in the Kinkaid Creek watershed. These practices continue to be implemented. Below is a selected summary provided by members of the Watershed Planning Committee or found through public notices.

5.5.1. Kinkaid-Reed's Creek Conservancy District

Since 1968, the KRCCD has held the responsibility to "further the maintenance of safe and health conditions; prevent and control water pollution; protect spawning grounds, fish, and aquatic life; control building sites, placement of structures and land uses; and preserve shore cover and natural beauty"[79] In addition to their normal operations, the KRCCD has undertaken many projects since the late 1990s to combat shoreline erosion.

Prior to 1998, 2,300 feet of riprap was installed as revetments along eroding shores near the marina and dam. From 1999-2007 29,400 feet of riprap breakwaters have been installed for shoreline stabilization[80].

In 2008 KRCCD was awarded an Illinois EPA Section 319 grant to construct a sediment basin and stabilize 7,495 linear feet of shoreline; and in 2015 they were awarded Section 319 funds to stabilize 1,470 feet of gully and construct a grassed waterway, and stabilize 3,109 feet of eroding shoreline[81]. The Conservancy District plans to continue to utilize this grant program as needed for future BMP projects.

Figure 5.17 shows approximate locations of shoreline stabilization and other BMPs surrounding Lake Kinkaid. Shapefiles were created from georeferencing reports that were provided by KRCCD and HMG Engineers, and by visually identifying BMP locations from the 2022 Jackson County aerials provided from the county assessor's office. *Figure 5.16* shows a current educational sign near the lake that describes active BMPs.

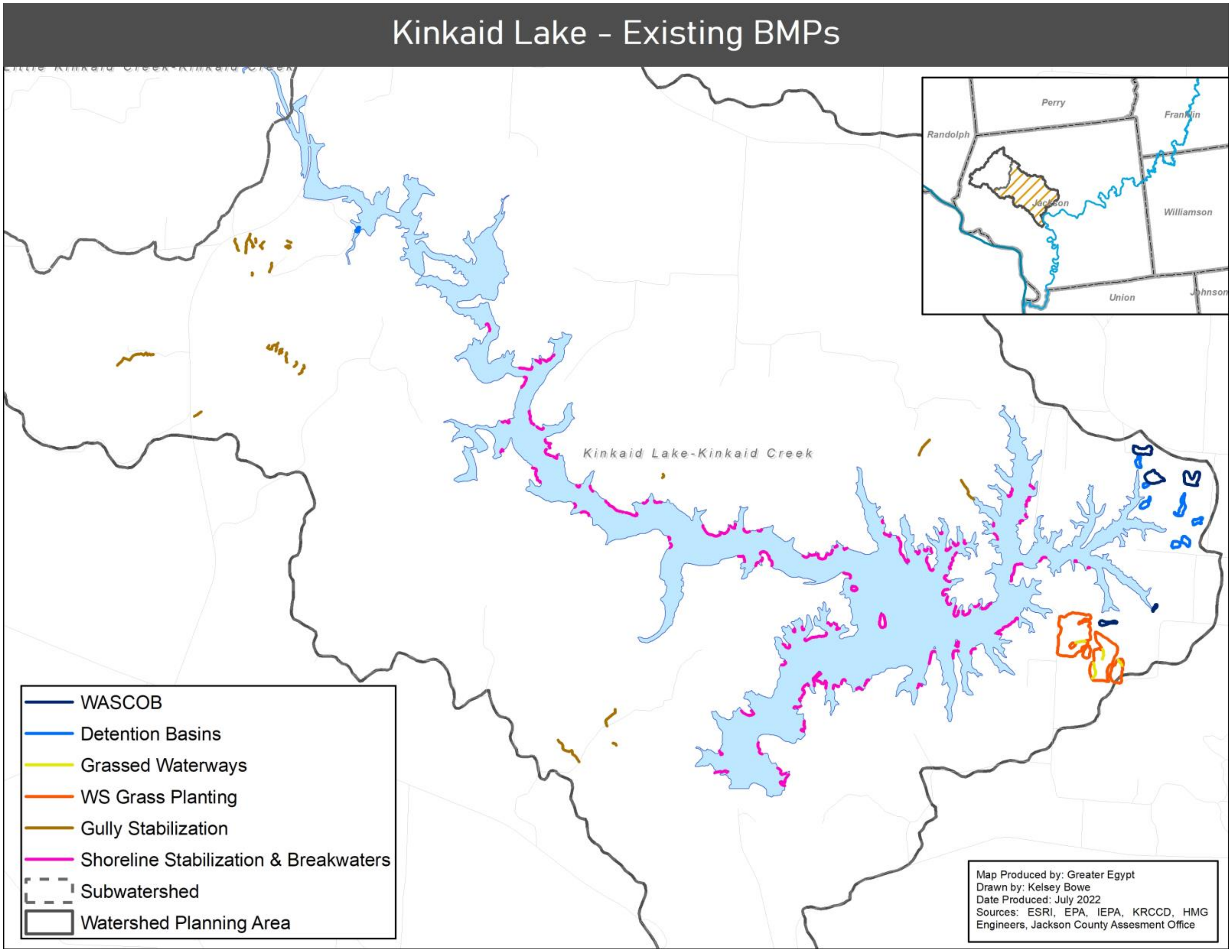
[79] "Kinkaid Shoreline Regulations", 1968, accessed from Greater Egypt Document Archives.
[80] Severson, J., "WETLAND HABITAT ENHANCEMENT AND SHORELINE STABILIZATION USING RIPRAP BREAKWATERS ON KINKAID LAKE IN SOUTHERN ILLINOIS" Thesis, Department of Zoology, SIUC, 2007.
[81] IEPA Section 319 Biannual Report, Appendices 3 & 4, September 2020.

A summary of active BMPs for the KRCCD are as follows:

- 28 gullies stabilized, totaling 11,926 linear feet
- 41, 708 linear feet of shoreline have been stabilized with either revetments or breakwaters
- Eight detention basins
- Five water and sediment control basins
- Four fields of warm season grass planting

Figure 5.16

Figure 5.17


Kinkaid Lake - Existing BMPs
Perry
Randolph
Franklin
Jackson
Williamson
Union
Johnson
Kinkaid Lake-Kinkaid Creek
WASCOB
Detention Basins
Grassed Waterways
WS Grass Planting
Gully Stabilization
Shoreline Stabilization & Breakwaters
Subwatershed
Watershed Planning Area
Map Produced by: Greater Egypt
Drawn by: Kelsey Bowe
Date Produced: July 2022
Sources: ESRI, EPA, IEPA, KRCCD, HMG Engineers, Jackson County Assesment Office

5.5.2. Shawnee National Forest

5.5.2.1. Prescribed Burns

2 Burns were completed in the Kinkaid Creek Watershed in 2021, and several are planned for 2022. See *figures 5.18 and 5.19.*

5.5.2.2. Sharp Rock Oak Habitat Project

On May 21, 2022, a legal notice and Findings of No Significant Impact (FONSI) were released for the Sharp Rock Oak Habitat Project. A summary of the proposed project is below:

"The Forest Service is proposing an ecological restoration project on about 3,500 acres of the Shawnee National Forest around the Kinkaid Lake area, in Jackson County, Illinois. Restoration is needed to improve wildlife habitat, native plant communities, watershed health, the forest transportation system, and oak-hickory ecosystem resilience in the Sharp Rock Oak Habitat project area. The Sharp Rock Oak Habitat Project is designed to achieve multiple-resource benefits and work towards desired future conditions described in the Shawnee National Forest Land and Resource Management Plan (Forest Plan)(U.S.DA Forest Service 2006). It includes proposed activities that work towards meeting the Forest Plan goals and objectives. The Forest Plan is the guiding document for forest management across the Shawnee National Forest and is summarized and quoted throughout this assessment (40 CFR 1502.20)."[82]

This proposed project will include commercial tree harvest, prescribed burning, planting, seeding, and road work. These actions were developed to meet the goals of the Forest Plan.

The documentation for this project is publicly available and can be found at https://www.fs.usda.gov/project/?project=60429

[82] United States Department of Agriculture, Forest Service, Shawnee National Forest, "Sharp Rock Oak Habitat Project: Environmental Assessment, Finding of No Significant Impact, and Draft Decision Notice", Responsible Official: Tim Pohlman, District Ranger, Contact Person: Danielle Stephenson, Shawnee National Forest, 602 N. First Street, Vienna, IL 62995, (618) 658-2111, danielle.stephenson@usda.gov, May 2022.

Table 5.2 – descriptions of project activities

Action Description	Proposed Activity	Amount
Commercial Harvest	1st entry Shelterwood Harvest May include mechanical or manual site preparation activities for natural regeneration, supplemental planting as needed to improve species diversity	2,000 acres
	2nd entry Shelterwood Harvest several years after the 1st entry To create young early successional habitat	Up to 25% of the acres treated above, or 500 acres
	Commercial Thinning	310 acres
	Total	2,310 acres
Prescribed Burning	Follow-up treatments to a mechanical or manual vegetation treatment	1,820 acres
	Prescribed burning only	528 acres
	Total	2,348 acres
Planting	Supplemental enrichment planting (as needed)	Up to 2,310 acres
Seeding	Seeding of native pollinator plant species on roads and landings (Locations are unknown at this time and would be determined during implementation of the proposed harvest activities)	Up to 200 acres
Road Work	Temporary Road Construction	2.12 miles
	Road Reconstruction (Realignment of existing roads to suitable location)	3.97 miles
	New Construction	0.60 miles
	Road Decommission	0.70 miles
	New Gates	2

Source: USDA Forest Service

5.5.2.3. Other Forestry Work

Within the Kinkaid Lake area, the Shawnee National Forest has three other ongoing activities that have been previously approved by NEPA:

- Herbicide applications for non-native invasive species control. Applications will be prioritized in areas at risk of greatest spread such as parking lots; and imperiled habitats including barrens, glades, and oak woodlands.
- Stand improvement activities including chainsaw, brush saw, or ax cutting to selectively remove undesired saplings; as well as stump cutting and herbicide application. These actions are to open up sunlight in certain areas to favor native oak growth.
- Gully restoration, with priority at areas of severe erosion and that are easily accessible. This work will continue as funds allow.

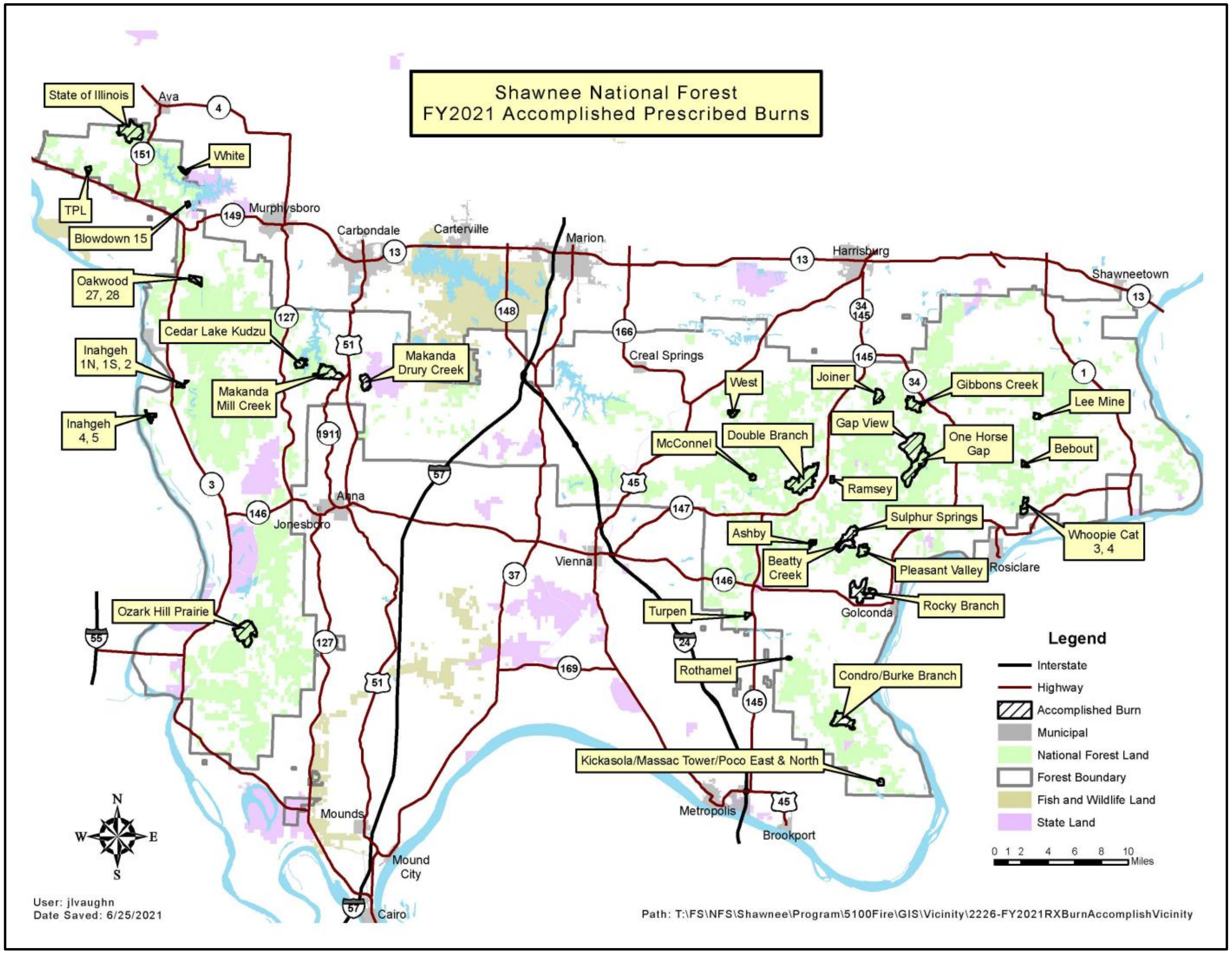
*Details on these activities are outlined in the *Sharp Rock Project Documentation*, and are on the Shawnee National Forest Webpage.

5.5.2.4. Trail Maintenance

There are 32 miles of trails in Forest Service land within the Kinkaid Creek Watershed, approximately 13 miles of the trail system is in need of maintenance to some degree. There are two miles surrounding stream approaches in the greatest need. Additionally, trails with horse traffic tend to have more erosion problems[83]. There is a wide variety of trail maintenance practices to reduce erosion and improve visitor safety. Site specific reviews would have to be conducted to determine which methods are appropriate for the areas in question.

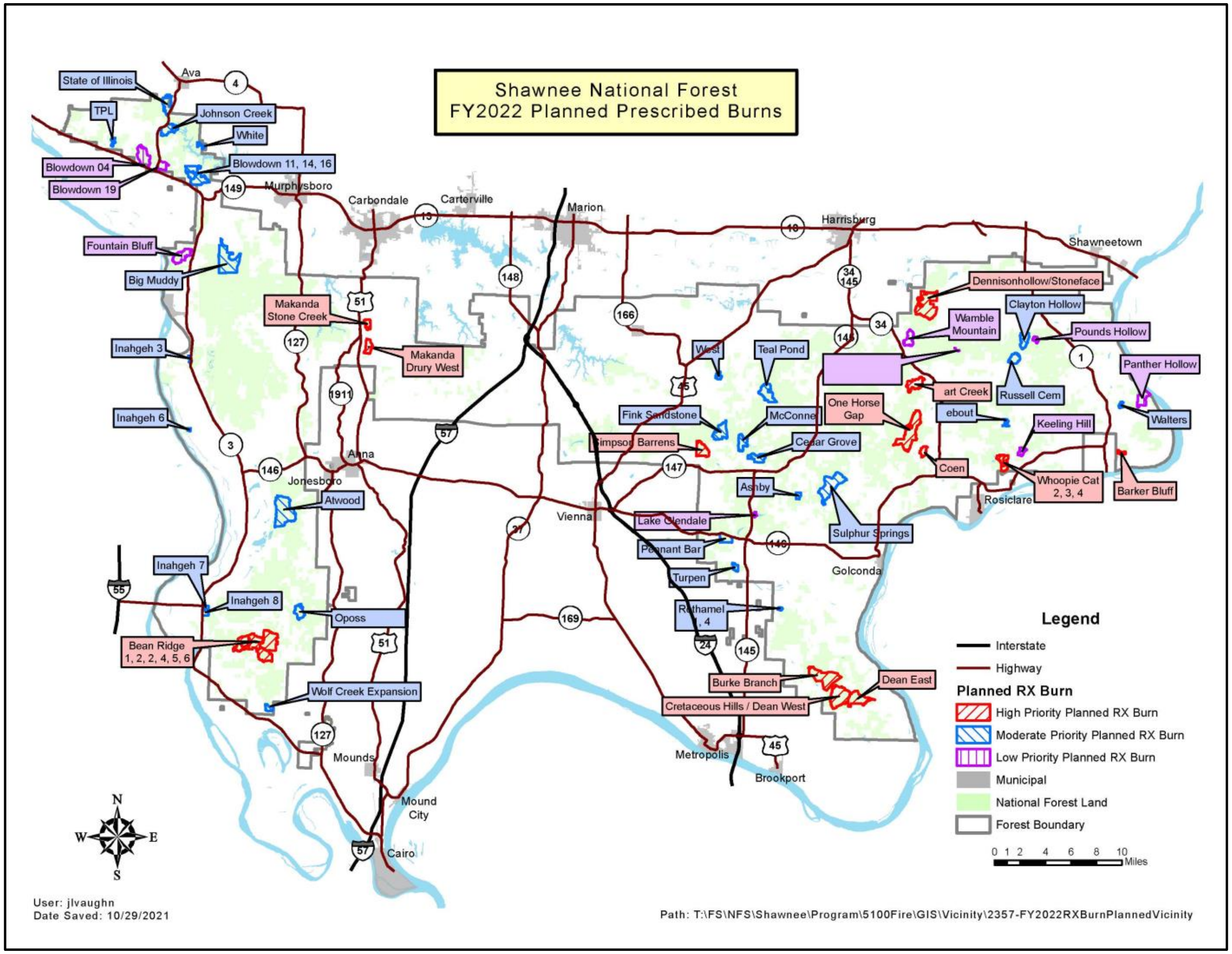
[83] Email correspondence with Brooke Hagarty, 03.16.22

Figure 5.18



Source: USDA Forest Service

Figure 5.19



Source: USDA Forest Service

5.6. BMP Recommendations

Best management practices for the Kinkaid Creek watershed have been proposed by land use categories. BMPs previously described are further subdivided by watershed-wide and site-specific areas. 57.7% of the watershed is deciduous forest, 27.4% is agriculture, and 6.1% is open water; the majority of suggested BMPs are forestry and agriculture practices, as well as shoreline stabilization of Lake Kinkaid.

*The region 5 model was designed for agricultural and urban areas of EPA Midwest Region 5. The models do not have the capability to estimate pollution loads for forestry BMPs. Because the Kinkaid Creek watershed is heavily forested, many of the agriculture estimations and stabilization estimations may be exaggerated. It is still a useful tool to plan BMPs and get rough estimations of pollution loads and their possible reductions. Agencies should conduct nutrient and sediment sampling pre and post construction of BMPs.

5.6.1. Watershed-wide BMPs

As previously stated, BMPs suggested in the plan are separated into watershed-wide and site-specific categories. Watershed-wide BMPs include forestry BMPs, agricultural BMPs, and stabilization methods. Load reductions are symbolized by N (Nitrogen), P (Phosphorus), TSS (Total Suspended Solids), BOD (Biological Oxygen Demand), and COD (Chemical Oxygen Demand).

Much of the agriculture in the Kinkaid Creek watershed is pasture/hay, which has lower pollutant inputs than cultivated cropland. The Kinkaid Lake- Kinkaid Creek subwatershed has the highest number of cultivated crops at 2,220 acres, and the Little Kinkaid Creek subwatershed has 1,826 acres. The following has been suggested for nutrient load reductions:

- Thirty (30) percent of cropland to take part in nutrient management planning
- Twenty (20) percent of cultivated cropland to implement conservation cover, cover crops, no-till, and strip-till farming
- Fifteen (15) percent to introduce critical planting
- Five (5) percent of cropland to convert to pasture or hayland

The Shawnee National Forest and Kinkaid-Reeds Creek Conservancy District have their own BMP plans for the forests and waterbodies within their jurisdictions and were outlined in section 5.5.

Table 5.3 – Watershed-wide BMP Load Reductions

BMP	Amount	Unit	Load Reductions- lbs/ yr (N, P) ton/yr-(Sediment)		
			N	P	Sediment
Conservation Cover, Cover Crops, Conservation Tillage	809	acre	12,504	6,247	7,474
Critical Planting	607	acre	9,655	4,824	5,813
Nutrient Management Plan	1,214	acre	-	-	-
Pasture/Hayland Planting	202	acre	-	-	-
		TOTALS:	**21,159**	**11,071**	**13,287**
			N	P	Sediment

5.6.2. Site Specific BMPs

5.6.2.1. Streambank and gully stabilization

Shoreline, streambank, and gully stabilization have been recommended as site specific BMPs.

Load reductions for stream stabilization are based on both sides of banks being stabilized for watershed-wide and site-specific categories. The method used for stabilization will depend on erosion severity, cost effectiveness, and the aesthetic desires of landowners or local officials. Load reduction numbers for streambanks can be found in appendix F. Stabilization recommendations are displayed in the following table.

Table 5.4 – BMP Streambank stabilization recommendations

Erosion Severity	% Of streambank to be stabilized
Low	10
Moderate	25
High	50
Severe	75

A priority ranking was also established for each site-specific practice. Rankings were based on load reductions. The following table summarizes the rankings and load reductions by category. Rankings are based on Nitrogen reduction targets.

Table 5.5 – Streambank and gully BMP priority ranking

Priority	Description	Stabilization Criteria (NLR)	
		Streambank	Gully
L	Low	0-500	0-10
M	Medium	501-1,000	11-50
H	High	1,001+	51+

10 gullies were identified outside of the Forest Service assessment, if they were all stabilized estimated pollutant loads would be as follows:

Table 5.6 – Gully stabilization load reductions

Map ID	Length (Ft)	Years Active	SLR (tons/year)	PLR (lbs./year)	NLR (lbs./year)
2	1191	17	65.5	65.5	131
5	226	17	12.4	12.4	24.9
13	892	24	34.8	34.8	69.5
14	220	11	12.1	12.1	24.1
15	739	17	40.6	40.6	81.3
16	803	17	44.2	44.2	88.3
17	921	17	50.7	50.7	101.3
18	1181	29	38.1	38.1	76.2
19	448	17	24.6	24.6	49.3
22	378	23	15.4	15.4	30.7
TOTAL			**338.4**	**338.4**	**676.6**

The Shawnee National Forest has their own priority ranking for gully stabilization based on severity of erosion, ease of access for equipment and staff, and cost effectiveness (see section 5.2.2). If all high-ranking gullies were stabilized (severity 3 and 4 on their scale of 1-4)[84], the total estimated reduction in pollutants would be as follows:

Table 5.7 – FS Gully stabilization load reductions

SLR (tons/year)	PLR (lbs./year)	NLR (lbs./year)
8058	8058	16128

[84] Gully data was provided by Brooke Hagarty of the U.S. Forest Service

5.6.2.2. Shoreline Stabilization

BMP recommendations and priority ranking for shoreline stabilization are as follows, these are based on erosion severity and the goals of the Illinois Nutrient Loss Reduction Strategy. The KRCCD has advanced knowledge of the Lake and surrounding areas and installs revetments and breakwaters in areas most prone to wave action, erosion, and degraded littoral habitat. Actual BMP implementation may not reflect these recommendations exactly.

Table 5.8 – Shoreline stabilization recommendations

Erosion Severity	% Of shoreline to be stabilized
Low	none
Moderate	25
High	50
Severe	75

Table 5.9 – Shoreline stabilization priority ranking

Shoreline Condition	Priority
Existing BMPs	No stabilization needed
Low Erosion	No stabilization needed
Partially stabilized, moderate erosion	Low
Moderate erosion, not stabilized	Medium
Partially stabilized, high erosion	Medium
High erosion, not stabilized	High

Current shoreline stabilization methods at Lake Kinkaid have already reached an estimated 37% of the proposed pollutant load reductions:

Table 5.10 – Current shoreline stabilization estimated load reductions

SLR (tons/year)	PLR (lbs./year)	NLR (lbs./year)
1160.6	1160.6	2321.3

The following figures represent the site-specific BMPs in the plan. For site-specific management measures for the subwatershed management units please see Appendix F.

Figure 5.20

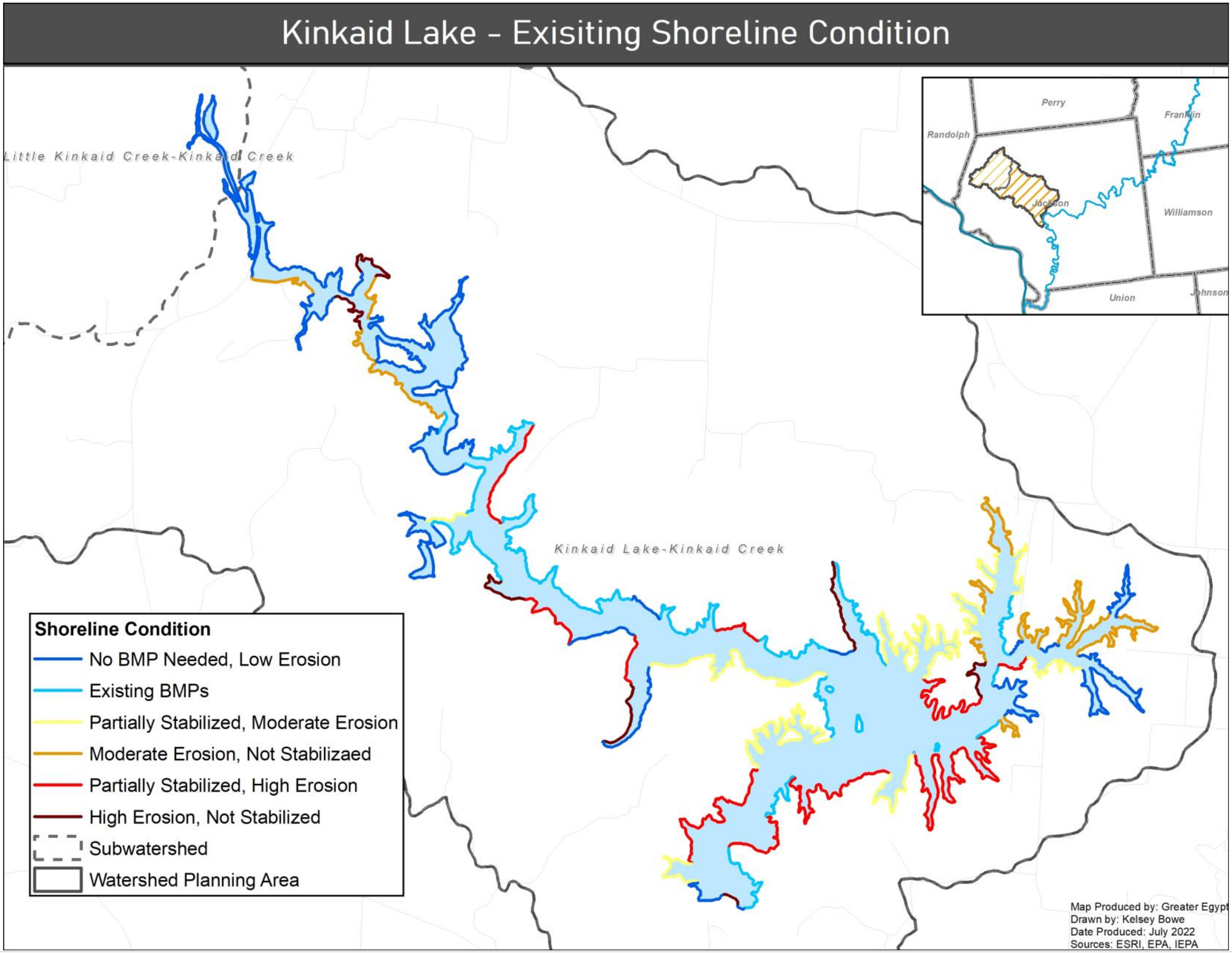

Kinkaid Lake - Exisiting Shoreline Condition
Little Kinkaid Creek-Kinkaid Creek
Kinkaid Lake-Kinkaid Creek
Perry
Randolph
Franklin
Jackson
Williamson
Union
Johnson
Shoreline Condition
No BMP Needed, Low Erosion
Existing BMPs
Partially Stabilized, Moderate Erosion
Moderate Erosion, Not Stabilizaed
Partially Stabilized, High Erosion
High Erosion, Not Stabilized
Subwatershed
Watershed Planning Area
Map Produced by: Greater Egypt
Drawn by: Kelsey Bowe
Date Produced: July 2022
Sources: ESRI, EPA, IEPA

Figure 5.21

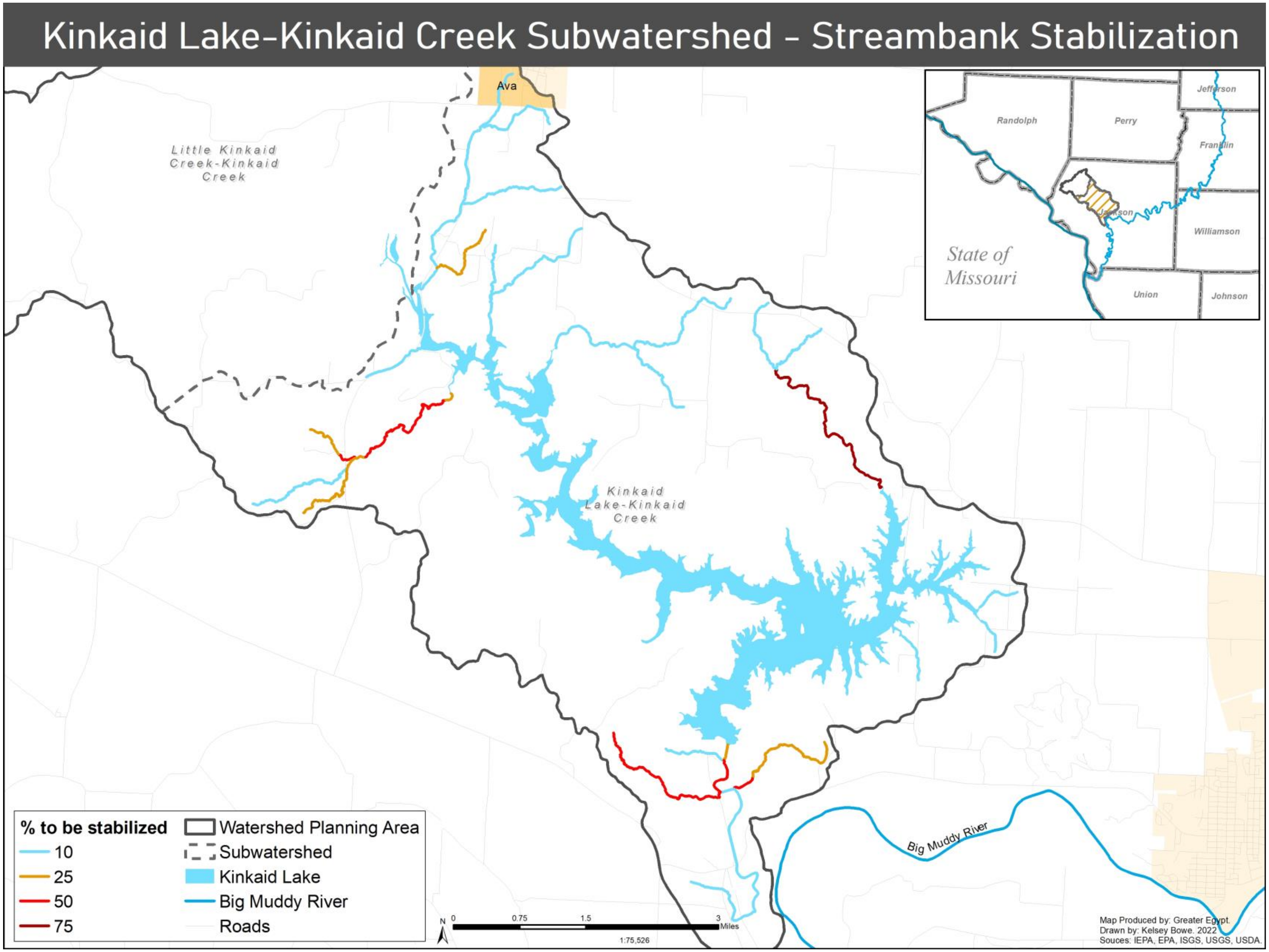

Kinkaid Lake-Kinkaid Creek Subwatershed - Streambank Stabilization
Ava
Little Kinkaid Creek-Kinkaid Creek
Kinkaid Lake-Kinkaid Creek
Big Muddy River
Randolph
Perry
Jefferson
Franklin
Williamson
Union
Johnson
State of Missouri
% to be stabilized
10
25
50
75
Watershed Planning Area
Subwatershed
Kinkaid Lake
Big Muddy River
Roads
0
0.75
1.5
3
Miles
1:75,526
Map Produced by: Greater Egypt
Drawn by: Kelsey Bowe. 2022
Souces: IEPA, EPA, ISGS, USGS, USDA

Figure 5.22

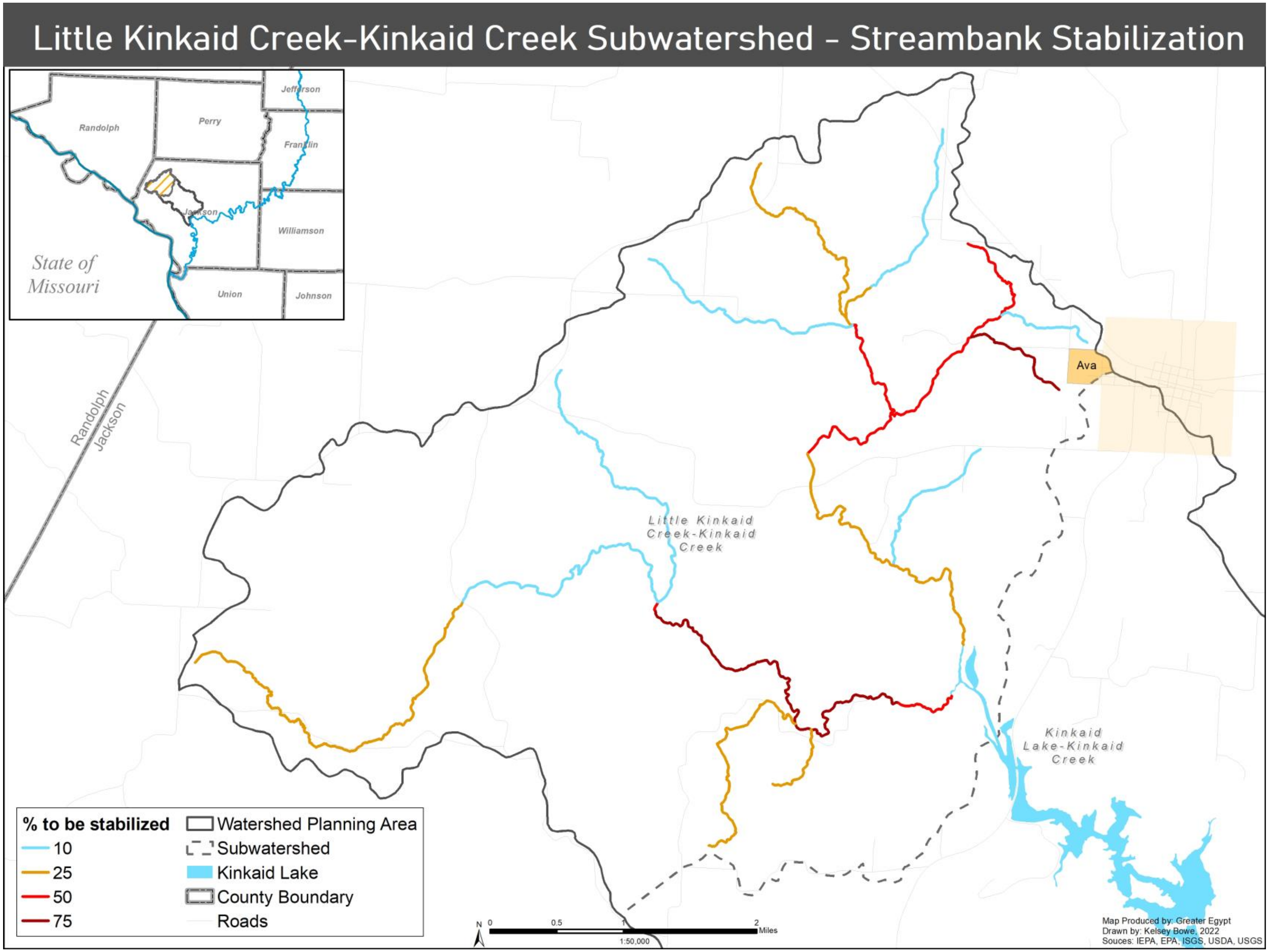
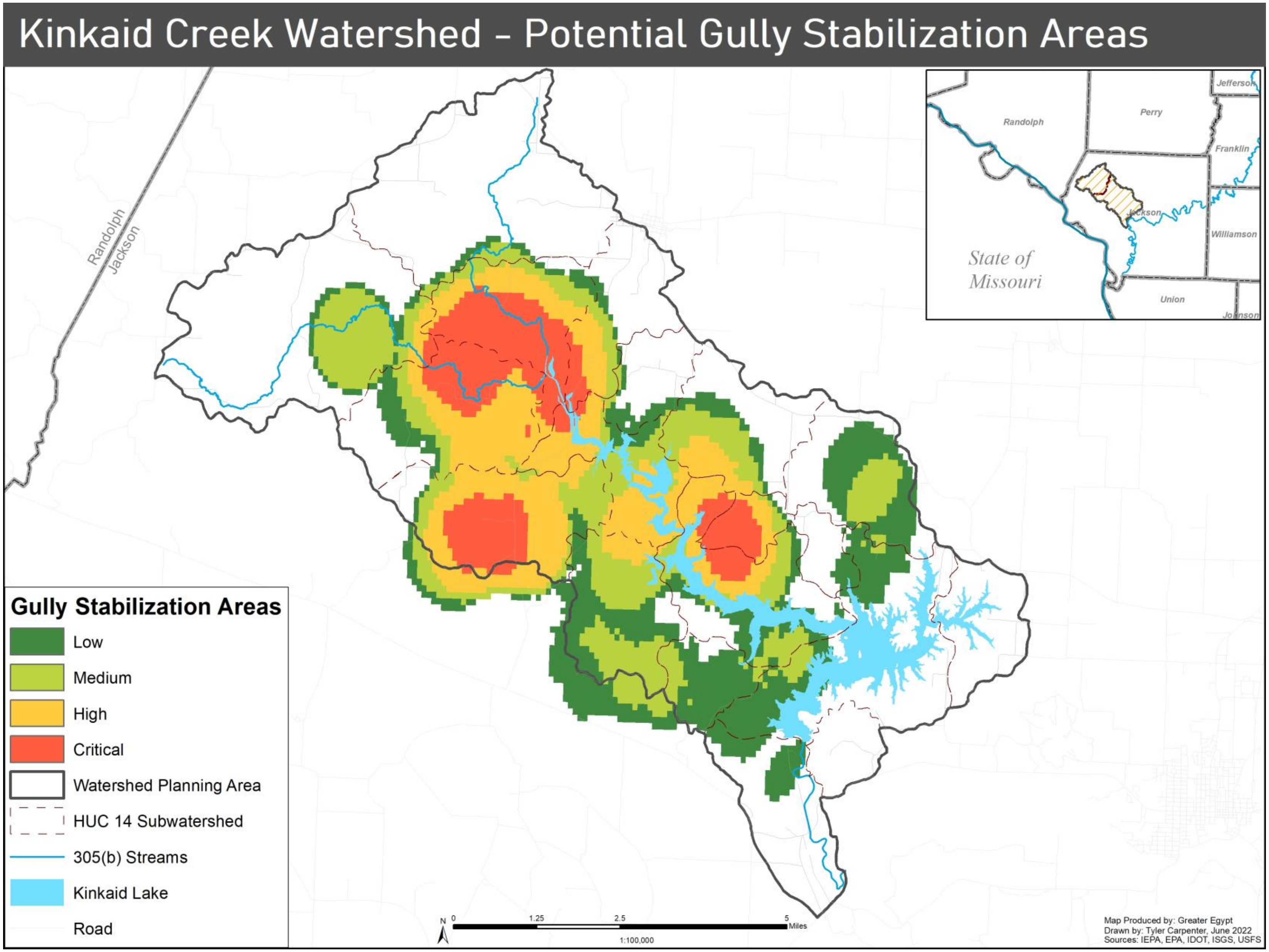

Little Kinkaid Creek-Kinkaid Creek Subwatershed - Streambank Stabilization
Jefferson
Randolph
Perry
Franklin
Jackson
Williamson
State of Missouri
Union
Johnson
Randolph
Jackson
Ava
Little Kinkaid Creek-Kinkaid Creek
Kinkaid Lake-Kinkaid Creek
% to be stabilized
10
25
50
75
Watershed Planning Area
Subwatershed
Kinkaid Lake
County Boundary
Roads
Miles
1:50,000
Map Produced by: Greater Egypt
Drawn by: Kelsey Bowe, 2022
Souces: IEPA, EPA, ISGS, USDA, USGS

Figure 5.23


Kinkaid Creek Watershed - Potential Gully Stabilization Areas
Randolph
Jackson
Randolph
Perry
Jefferson
Franklin
Williamson
State of Missouri
Union
Gully Stabilization Areas
Low
Medium
High
Critical
Watershed Planning Area
HUC 14 Subwatershed
305(b) Streams
Kinkaid Lake
Road
0
1.25
2.5
5
Miles
1:100,000
Map Produced by: Greater Egypt
Drawn by: Tyler Carpenter, June 2022
Sources: IEPA, EPA, IDOT, ISGS, USFS

6. Technical and Financial Assistance

Each BMP in the plan has also been described by the technical and financial assistance needed to implement each measure. While technical assistance comes from a few select groups, the financial assistance for management measures comes from a variety of different sources. It is important to note that most BMP projects will have to be customized to the specific location and needs of the agency overseeing the implementation; therefore, the costs outlined in the tables of this chapter should only be used as a general estimate. Detailed costs will have to be determined from stakeholders, contractors, engineers, and materials suppliers and are outside the scope of this Plan.

6.1. Technical Assistance

The labor to execute the BMPs will largely come from local municipalities, public works, landowners, and Greater Egypt Regional Planning and Development Commission (Greater Egypt). State and federal agencies such as the USDA/NRCS and the Jackson, Williamson and Union County Soil and Water Conservation Districts will also be utilized.

The type of technical assistance largely depends on which type of BMP is being implemented. For agricultural BMPs, the USDA and Soil and Conservation Districts will be able to provide their services. If the BMP is municipal, local public works can offer their support. However, for most management measures, drawings and surveys will likely be required by an engineer.

Greater Egypt could also provide technical assistance for some of the BMPs. This includes: GIS services, site plans and drawings, and grant writing and administration.

6.2. Funding Sources

A majority of the management measures described in Chapter 4 will require funding. The major source of funding will be through the Clean Water Act Section 319 Grant Program. This would be granted through the IEPA. Section 319 grants can cover up to sixty percent of the costs. The other forty percent would be met through a local match (municipal, landowner, etc.)

While 319 funding covers most BMPs in the plan, other funding sources have to be considered for the remaining measures. The USDA Natural Resource Conservation Service offers many funding and easement opportunities through programs such as: Agriculture Management Assistance (AMA), Conservation Stewardship Program (CSP), Environmental Quality Incentives Program (EQIP), and Agricultural Conservation Easement Program (ACEP). Through the USDA Farm Service Agency (FSA), funding is offered through programs such as: Conservation Reserve Program (CRP), Conservation Reserve Enhancement Program (CREP), and Farmable Wetlands Program (FWP). Emergency Conservation and Emergency Forest Restoration Programs offer funding and technical assistance, also through USDA FSA, to restore lands that have been damaged by natural disasters.

The Illinois Department of Agriculture offers funding such as: Conservation Practices Program (CPP), Well Decommissioning Program (WDP), Streambank Stabilization and Restoration (SSRP), Nutrient Management Program (NMP), Soil and Water Conservation District Grants Program, and Vegetative Filter Strip Assessment Law. Another funding source aimed particularly at reducing soil loss and protecting water quality is offered through the Bureau of Land and Water Resources through the Partners for Conservation Program.

Other grants offered through the Illinois Department of Natural Resources include: Open Space Lands Acquisition & Development and Land & Water Conservation Programs, Park and Recreational Facility Construction Grant Program, Federal Recreational Trails Program, Bike Path Grant Program, Schoolyard Wildlife Habitat Grant Program, and the Illinois Biodiversity Field Trip Grant Program.

Illinois EPA provides multiple funding opportunities to finance the design and construction of both, wastewater and nonpoint source pollution projects through grants and low-interest loan programs that include: Illinois Green Infrastructure Grant Program for Stormwater Management (IGIG), Nonpoint source Grants, Wastewater/Stormwater and Drinking Water Loans, Driving a Cleaner Illinois, and Illinois Clean Energy Community Foundation.

In most cases, these programs will not cover the entire cost of the selected BMPs. The remaining costs would have to be funded by landowners, municipalities, businesses, and other entities.

6.3. Implementation

The associated cost of each BMP is displayed in the following tables. Costs largely depend on which BMP is being implemented. To implement all BMPs suggested in the plan, the total would be $42,546,862.43. Costs generally take into account the technical and financial assistance needed along with the maintenance following implementation. Infiltration Basin and streambank stabilization are the top two most costly BMPs, with detention basin being the third, respectively. Conservation cover, grassed waterways, and pasture/hayland planting are the following largest costs.

The cost for filter strips (agricultural, urban vegetated) is dependent on whether the entity is using existing or natural vegetation compared to planting new vegetation.

Table 6.1 – Estimated costs for agricultural BMPs

BMP	Cost	Unit	Technical Assistance	Funding Source(s)	Source:
Agricultural Filter Strip	$176.23	acre	Farm Bureau, Landowner, NRCS, SWCD	IEPA 319, NRCS, USDA	NRCS Agent
Agricultural Management Workshop	$1,950.00	workshop	Planning Commission, Farm Bureau, NRCS, USDA, SWCD	IEPA 319	Planning Commission
Contour Farming	$7.44	acre	NRCS, USDA	IEPA 319, NRCS, USDA	Franklin County SWCD
Cover Crops	$85.24	acre	Farm Bureau, NRCS, USDA, SWCD	IEPA 319, NRCS, USDA	NRCS Agent
Critical Area Planting	$184.95	acre	NRCS, USDA	IEPA 319, NRCS, USDA	Franklin County SWCD
Crop Rotation	$14.90	acre	Farm Bureau, NRCS, USDA	NRCS, USDA	Franklin County SWCD
Debris Removal	$500.00	site	Volunteers, landowners, public works, contractor	Volunteers, landowners, public works, contractor	Local Contracts
Detention Basin	$0.74	cubic foot	Landowner, IDOT, contractor, municipality, public works	Landowners, municipality	EPA (Based on Brown and Scheuler (1997b))- Adjusted for inflation
Drainage Water Management	$9.55	acre	Farm Bureau, NRCS, USDA	NRCS, USDA	Franklin County SWCD
Grassed Waterways	$3,252.00	acre	Farm Bureau, Landowner, NRCS, SWCD	IEPA 319, NRCS, USDA	Franklin County SWCD
Litter Cleanup	$0.00	acre	Volunteers	-	N/A
No-Till Farming	$20.81	acre	NRCS, USDA	IEPA 319, NRCS, USDA	Franklin County SWCD
Nutrient Management Planning	$4.00	acre	Farm Bureau, NRCS, USDA, SWCD	IEPA, NRCS, USDA	Franklin County SWCD
Pasture and Hayland Planting	$393.00	acre	Farm Bureau, NRCS, USDA	NRCS, USDA	Franklin County SWCD
Public Education on Water Quality	$0.50 each / $150.00 per 300	flyer/brochure	Planning Commission	IEPA 319 Grant, Planning Commission	IEPA
Public Education on Stormwater/Agricultural Management	$0.50 each / $150.00 per 300	flyer/brochure	Planning Commission	IEPA 319 Grant, Planning Commission	IEPA
Streambank Stabilization*	$75.30	linear feet	Landowner, volunteer, contractor	IEPA 319 Grant	Franklin County SWCD
Strip-Till Farming	$20.81	acre	NRCS, USDA	IEPA 319, NRCS, USDA	Franklin County SWCD
Terrace Farming	$3.89	linear feet	Farm Bureau, NRCS, USDA, SWCD	NRCS, USDA	Franklin County SWCD

Table 6.2 – Estimated Urban BMP Costs

BMP	Cost	Unit	Technical Assistance	Funding Source(s)	Notes	Source:
Bioswale/ Infiltration trench	$11.00	cubic ft	City planners	EPA 319, City Budget, IDOT/U.S. Infrastructure grants, State Community grant programs	*unit price is is per cubic foot of water filtered by the BMP	Barr Engineering, Minnesota Pollution Control Agency 2011
Detention basin	$58-145	cubic ft	City planners	EPA 319, City Budget, IDOT/U.S. Infrastructure grants, State Community grant programs	*unit price is per cubic foot of water filtered by the BMP	Barr Engineering, Minnesota Pollution Control Agency 2011
Retention/Filtration basin	$15.00	cubic ft	City planners	EPA 319, City Budget, IDOT/U.S. Infrastructure grants, State Community grant programs	*unit price is per cubic foot of water filtered by the BMP	Barr Engineering, Minnesota Pollution Control Agency 2011
Rain Barrel	$15-40	barrel	Extension office, workshop events	landowners, 604b (workshops)		Barrel/hardware prices
Rain Garden	$3-40	sq ft	Extension office, workshop events	EPA 319, City Budget, landowner, 604b (workshops)	varies widely depending on use of contractors/landscapers, and variety of plants chosen	https://web.uri.edu/riss/files/Abridged_ServiceManual.pdf
No Spray Zone	$0.00		City parks depts, SIU facilities, golf course site managers, Homeowners Associations		Regular land maintenance would still be needed, but removing the use of fertilizers and pesticides saves money	
Urban Trees	$8,000-10,000	tree pit	City or University Sustainability Planners, private contractors	EPA 319, City Budget, IDOT/U.S. Infrastructure grants, State Community grant programs	includes tree, other materials, and installation labor	Charles River Watershed Association Low Impact Best Management Practice (BMP) Information Sheet

Table 5.3 – Estimated Litter Removal BMP Costs

BMP	Cost	Unit	Technical Assistance	Funding Source(s)	Source:
Storm Drain Capture	design and size of storm drain effect which capture designs are feasible, cost may vary		City planners, IDOT, road commissions, engineers	EPA 319, City Budget, IDOT/U.S. Infrastructure grants, State Community grant programs	
Bandalong Trap	$50-100,000	unit installation	City or University Sustainability Planners, private contractors	EPA 319, City Budget, IDOT/U.S. Infrastructure grants, State Community grant programs	EPA Aquatic Trash Prevention Great Practices Compendium (2015)

7. Outreach and Education

The success of the Kinkaid Creek Watershed-based Plan is largely dependent on public outreach and educational measures. During the planning phase, public and Watershed Planning meetings were held to provide guidance and raise awareness of the plan. Greater Egypt also hosted public events such as the Rain Garden Workshop and assisted the Forest Service in their educational programming for local schools. to engage community members within the planning area. These activities will continue after the plan is approved and will support the success of the plan.

Early in the planning phase, an initial stakeholders meeting was held to gather local knowledge of the watershed and define preliminary goals including identifying key areas of watershed impairments. Another goal of the initial meeting was to gather members for the Kinkaid Creek Watershed Planning Committee. Meetings were usually held quarterly, and were designed to provide guidance for the plan. Committee members provided local knowledge of water-related activities and identified BMPs that were suggested in the plan.

The Kinkaid Creek Watershed-based Plan has several public awareness and educational components. The schedule for implementing the educational and informational components of the plan is further detailed in the following chapter.

7.1. Establish a Kinkaid Creek Watershed Action Committee.

This assembly would serve much like the planning committee during the development of the plan. The goal of a steering committee would be to promote awareness of the watershed plan and monitor and oversee the progress of plan implementation. Committee members would also be in charge of making revisions to the plan if:

a) Implementation schedule is not meeting expectations;

b) Interim measurable milestones are not being met;

c) Benchmarks for load reduction targets are not satisfactory.

7.2. Gather Public Input

7.2.1. Hold Public Meetings

An initial public meeting would serve to inform the public on implementation of the plan and garner membership for the steering committee. Like the public meetings during the planning phase, flyers, newspaper ads, and PSAs could be used to inform the public of meeting dates.

7.3. Website

Greater Egypt maintains an updated webpage with information regarding all of our watershed-planning activities. Plan documents, meeting dates and minutes, and any other important information can be easily found at http://greateregypt.org/watershed-based-planning/.

7.4. Volunteer Litter Cleanup Days

Litter cleanup events are a great way for organizations to participate in team building and community service. We recommend the planning team coordinate with existing groups such as local scout groups, 4-H, and rotary club.

Figure 7.1 – Volunteer litter clean-up day in Piles Fork Creek

Photo source: Stephanie Eichholz

7.5. Education Programs

7.5.1. Rainscaping Program

In partnership with the University of Illinois Extension at Jackson County, Greater Egypt hosted a Rainscaping workshop which included four classes on rain gardens and stormwater landscaping and a fifth in person session to weed and add new plants to the demonstration rain garden at the Jackson County Extension grounds.

Figure 7.2 – Rainscaping Workshop - Jackson County Extension

Similar programs should continue to educate and provide resources for landowners to manage stormwater on their own properties. This will further benefit the Watershed as raingardens and other stormwater management measures will reduce pollution and sediment runoff.

7.5.2. Enviroscape Lessons

Greater Egypt owns two Enviroscape models which can be used to teach lessons on a variety of topics including:

- Basic water cycle and watershed concepts
- Non-point source pollution (Urban and Agricultural)
- Point source pollution
- Stormwater runoff
- Best Management Practices

Figure 7.3 – Enviroscape Models presented for Murphysboro School District students

These models are useful for field trips and classroom visits. Lessons can be tailored to a variety of age groups, but work best for elementary school groups. Greater Egypt presented the Enviroscape models for students of the Murphysboro School District in partnership with the Shawnee NFS and Illinois DNR for their annual field trip days.

7.6. Volunteer Lake Monitoring Program

Since 1984, Greater Egypt has coordinated the VLMP for southern Illinois' ten-county region. This volunteer-based program is maintained by the IEPA. The monitoring season begins May 1st and concludes October 31st with volunteers monitoring their lakes twice a month. Program participants are required to have access to a boat and anchor. Training is provided by the Regional Coordinator for southern Illinois.

*This program has currently been suspended by the IEPA, but we expect it to make a comeback in the following years.

Volunteers are divided into three tiers. Tier I is the most basic, while Tier II and III require previous participation in the program. Participation is dependent on funding and supplies from IEPA. The level of monitoring is dependent on the tier level of the volunteer.

Tier I:

Basic lake monitoring. Volunteers measure lake water clarity with a Secchi Disk and make other basic lake observations. Volunteers record the level of aquatic plant growth, record the siting of any invasive species, the lake water level, weather, and watershed conditions at the time of monitoring.

Tier II:

After actively participating in Tier I, volunteers are eligible for Tier II monitoring. Tier II volunteers complete Tier I monitoring while also taking lake water samples.

Tier III:

In addition to collecting water samples, volunteers also collect chlorophyll samples as well as measure oxygen levels and water temperatures.

8. Implementation and Milestones

To be successful, watershed-based plans require designing a thorough monitoring and evaluation component. These elements include: an implementation schedule which identifies key intervals for management measures (Element F), a description of interim measurable milestones for nonpoint source management (Element G), benchmarks to monitor the effectiveness of BMP load reductions (Element H), and the overall monitoring component to evaluate the progress of implementation (Element I). Elements H and I will be discussed in Chapter 7 of this plan.

8.1. Implementation Schedule

The implementation schedule reflects the general goals in the Kinkaid Creek Watershed-based plan. Components of the schedule have been classified into three separate phases as seen in Table 6.1.

Phase I signifies the short-term actions to be taken in the first two years of the plan. These goals include establishing a watershed action council which would serve to implement the plan and track progress. The other educational and informational components of the plan largely fall under this phase.

Phase II constitutes the mid-term implementation of the plan. Components in this phase should be completed within the sixth year of plan implementation. Key elements of this phase include the continuation of public involvement, and submitting grant applications for BMPs suggested in the plan. The implementation and execution of BMPs will also fall under this segment of the plan.

Phase III indicates the final stage of the plan. This is characterized by continuing efforts in BMP implementation and evaluating accomplishments throughout the plan.

Site-specific BMPs have been characterized by a priority ranking in Chapter 3. These priority rankings follow the phases of the implementation schedule. Generally, BMPs with a high priority ranking will be the first to have grant submissions written for them. Grant submissions, implementation, and execution of high priority BMPs will be considered mainly Phase II components. Subsequently, medium and low priority BMPs will be implemented in the latter part of Phase II and beginning of Phase III depending on available funding.

Table 8.1- Implementation Schedule

Implementation Schedule										
Target	Phase I Short-term (2 yr)		Phase II Mid-term (3-6 yr)				Phase III Long-term (7-10 yr)			
	1	2	3	4	5	6	7	8	9	10
Establish watershed action committee	X									
Hold public meetings to gain input	X	X	X	X	X	X				
Post watershed signage for public awareness and BMP implementation	X	X	X	X	X	X	X	X	X	X
Create a website for watershed activities and key dates		X								
Educational/Outreach Components	X	X	X	X	X	X	X	X	X	X
Continue researching funding and technical assistance	X	X	X							
Select site-specific BMP for preliminary designs	X	X	X							
Submit grant applications based on BMP in plan		X	X	X	X	X	X	X		
Meet with landowners to review BMP in plan	X	X	X	X	X	X	X	X		
Implement and execute BMP			X	X	X	X	X	X	X	X
Monitor BMP implementation				X	X	X	X	X	X	X
Announce success of plan implementation					X	X	X	X	X	X

8.2. Interim Measurable Milestones

To determine whether nonpoint source best management practices are being implemented, interim measurable milestones have been designed to monitor success. The educational and outreach components have also utilized the milestone matrix. These milestones follow the same phases as the implementation schedule with three phases distinguishing varying degrees of BMP implementation. Interim measurable milestones are displayed in Table 8.2.

Table 8.2 - Interim Measurable Milestones

Interim Measurable Milestones				
Goal	**Indicator**	**Short (2-year)**	**Mid (6-yr)**	**Long (10-yr)**
Address Impairments from Urban & Agricultural Practices/ Improve Water Quality	Linear Feet of Streambank Stabilized	-	15,000	30,000
	Linear Feet of Shoreline Stabilized	-	15,000	30,000
	Agricultural Filter Strips Created	-	10	20
	Acres to Implement Critical Planting	-	150	300
	Acres Converting to Conservation Tillage	-	150	300
	Acres Converting to No-Till	-	200	400
	Pasture/Hayland Planting	-	100	200
	Acres Converting to Strip-Till	-	200	400
	Acres to Implement Cover Crops	-	150	300
	Nutrient Management Planning Partnerships	1	3	6
	Gullies Stabilized	-	20	60
	Drainage Water Management Partnerships	1	3	6

Table 8.2 - Interim Measurable Milestones (Cont'd)

Interim Measurable Milestones				
Goal	**Indicator**	**Short (2-year)**	**Mid (6-yr)**	**Long (10-yr)**
Outreach and Education	Educational Brochures for Agricultural Management	500	1000	1500
	Number of Litter Cleanup Days	5	10	20
	Public Meetings Held	5	10	15
Reduce/Mitigate Flooding	Detention Basins	-	-	1

Understanding that every BMP in the plan may not be implemented is important in identifying the measurable milestones. Feasibility of each BMP has to be considered when distinguishing milestones. If BMP implementation is progressive throughout the plan, the interim measurable milestones in this plan are attainable over a ten-year implementation period.

Progress in achieving the milestone goals will be evaluated periodically by the Kinkaid Creek Watershed Action Committee. If milestones are not being met, there may be need for adjustments. Adjustments may come in the form of establishing new BMPs, or adjusting the interim measurable milestones to adhere to current progress. Since these milestones are originally established to document progress, any changes should not be significant.

9. Evaluation and Monitoring

Along with the implementation schedule and interim measurable milestones, water quality benchmarks (Element H) and a monitoring component (Element I) are required to evaluate the implementation and the overall success of the plan.

9.1. Evaluation Criteria (Water Quality Benchmarks)

The benchmarks provided in Table 8.1 are based on the implementation of all BMPs in the plan. Practices that were ranked as high priority, as seen in Chapter 3, will be completed by the sixth year; or Phase II of the planning period. Those with a medium or low priority ranking will be implemented by the tenth year. This characterizes Phase III. Determining success and achieving these benchmarks will be dependent on the number of BMP that are actually implemented in the planning period.

Benchmarks in this plan target nitrogen, phosphorus, and sediment. This is largely due to the availability of data from models and nutrient loading information, and the impairments gully and shoreline degradation in the Kinkaid Creek Watershed.

Since Phase I of the plan extends to the end of the second year, benchmarks have not been assigned. This is due partly to the activities in that phase not having an immediate impact on nutrient load reductions (workshops, flyers, etc.). Load reductions that do occur in this period will be minimal.

Table 9.1 Benchmarks for Determining Plan Progress

	Benchmark Reduction Targets					
Benchmark Period	Nitrogen (percent)	Nitrogen (lbs)	Phosphorus (percent)	Phosphorus (lbs)	Sediment (percent)	Sediment (tons)
2 Year (Phase I)	-	-	-	-	-	-
6 Year (Phase II)	7	228,970	10	60,265	10	47,880
10 Year (Phase III)	15	490,649	25	150,662	25	119,699

While many of the high-priority BMPs will be implemented in Phase II, benchmarks have been set to around half of the overall nutrient load reduction targets. Considering

Phase II ends at the sixth year of the planning period, effects of some BMPs implementation may not be apparent until Phase III of the plan.

Phase III benchmarks account for the total reductions of nutrients in the plan. Phase III BMPs should be implemented by the tenth year of the plan. These include any remaining high-priority BMPs and the medium and low BMPs according to the priority index.

9.2. Monitoring Component

A monitoring component is essential to a watershed-based plan in order to determine progress in achieving water quality. Several elements represent the monitoring component for the plan. These items will provide water quality data that can be used to assess the efficacy of the Kinkaid Creek Watershed-based Plan. The monitoring strategy components are as follows:

1. **Ambient Water Quality Monitoring Network (AWQMN) -** 146 fixed stations are set up along streams throughout Illinois to routinely collect water quality data.[85] Samples of water are collected in 6-week intervals and are analyzed for a variety of parameters, including temperature and dissolved oxygen. Since the planning area experiences various impairments including dissolved oxygen, the AWQMN would be an important component in monitoring the progress of water quality in the watershed.
2. **Dissolved Oxygen Monitoring –** Measuring dissolved oxygen can be a good indicator for other water quality impairments. Maintaining a healthy aquatic environment is also key for the lake's recreational uses. Dissolved oxygen measurements would likely be taken from Kinkaid-Reed's Creek Conservancy District or IEPA.
3. **Intensive River Basin Surveys -** Every five years IEPA and IDNR conduct intensive basin surveys of various watersheds in Illinois. IDNR completes testing

[85]IEPA. *River and Stream Monitoring:* Springfield, IL: IEPA. https://www2.illinois.gov/epa/topics/water-quality/monitoring/Pages/river-and-stream.aspx
Accessed: June, 2019

of aquatic species while the IEPA monitors instream habitats and water quality. The TMDL for the Upper Big Muddy Watershed was completed in 2018.[86]

4. **National Pollutant Discharge Elimination Systems Permit Reviews -** Reviewing NPDES Permits from discharges in the watershed would assist in examining effluent limit exceedance of harmful pollutants. See Chapter 2.8.6 for more information regarding the NPDES facilities in the watershed. The only outfall in the watershed is Kinkaid-Reed's Creek Conservancy.

5. **Sediment Monitoring –** In collaboration with the Illinois State Water Survey (ISWS), sediment monitoring stations would be installed to provide baseline data, and continued annual sediment reports. Since some waterbodies in the planning area, and the larger Big Muddy watershed, exhibit sedimentation and siltation, obtaining accurate sediment loading data would be crucial in analyzing the efficacy of management measures; specifically gully and streambank stabilization methods.

6. **Volunteer Lake Monitoring Program (VLMP)** - Volunteers are recruited and trained to monitor the health of their lakes by taking various measurements of water quality. The program is structured by a tiered approach and administered by the IEPA. Kinkaid Lake was monitored by the Kinkaid-Reed's Creek Conservancy District. The program was suspended in 2019.

[86] Fertaly, Margaret. IEPA. Personal Correspondence to the Author (phone). June, 2019.

Table 9.2 - Schedule for Monitoring Components

Monitoring Schedule										
Monitoring Component	Phase I		Phase II				Phase III			
	1	2	3	4	5	6	7	8	9	10
Ambient Water Quality Monitoring Network		X					X			
Dissolved Oxygen Monitoring			X	X	X	X	X	X	X	X
Intensive River Basin Surveys				X					X	
NPDES Permit Reviews	X	X	X	X	X	X	X	X	X	X
Sediment Monitoring (Big Muddy Stations)	X	X	X	X	X	X	X	X	X	X
*Volunteer Lake Monitoring Program (VLMP)	X	X	X	X	X	X	X	X	X	X

APPENDIX A – Soil Subset Data

Kinkaid Creek Watershed Planning Area-Jackson County				
Soil Symbol	Soil Name	Soil Description	Acres	Percent of Watershed
7131B	Alvin	Alvin fine sandy loam, 2 to 5 percent slopes, rarely flooded	10	0
7131E	Alvin	Alvin fine sandy loam, 18 to 25 percent slopes, rarely flooded	2.6	0
3382A	Belknap	Belknap silt loam, 0 to 2 percent slopes, frequently flooded	10.8	0
8382A	Belknap	Belknap silt loam, 0 to 2 percent slopes, occasionally flooded	380.5	0.009
3334A	Birds	Birds silt loam, 0 to 2 percent slopes, frequently flooded	21	0.001
8108A	Bonnie	Bonnie silt loam, 0 to 2 percent slopes, occasionally flooded	10.4	0
1843A	Bonnie and Petrolia	Bonnie and Petrolia soils, undrained, 0 to 2 percent slopes, frequently flooded	6.5	0
8457A	Booker	Booker silty clay, 0 to 2 percent slopes, occasionally flooded	69.2	0.002
8427B	Burnside	Burnside silt loam, 1 to 4 percent slopes, occasionally flooded	1071.5	0.026
1845A	Darwin and Jacob	Darwin and Jacob silty clays, undrained, 0 to 2 percent slopes, frequently flooded	7.7	0
75B	Drury	Drury silt loam, 2 to 5 percent slopes	36	0.001
8180A	Dupo	Dupo silt loam, 0 to 2 percent slopes, occasionally flooded	37.8	0.001

Kinkaid Creek Watershed Planning Area-Jackson County				
Soil Symbol	Soil Name	Soil Description	Acres	Percent of Watershed
7432A	Geff	Geff silt loam, 0 to 2 percent slopes, rarely flooded	42	0.001
3331A	Haymond	Haymond silt loam, 0 to 2 percent slopes, frequently flooded	12.4	0
8331A	Haymond	Haymond silt loam, 0 to 3 percent slopes, occasionally flooded	649.1	0.016
8F	Hickory	Hickory silt loam, 18 to 35 percent slopes	1357.1	0.033
8F3	Hickory	Hickory clay loam, 18 to 35 percent slopes, severely eroded	279.4	0.007
797D3	Hickory-Homen	Hickory-Homen silty clay loams, 10 to 18 percent slopes, severely eroded	388.3	0.009
701F	Hickory-Menfro	Hickory-Menfro silt loams, 18 to 35 percent slopes	1161.8	0.028
701F3	Hickory-Menfro	Hickory-Menfro complex, 18 to 35 percent slopes, severely eroded	39.2	0.001
582B	Homen	Homen silt loam, 2 to 5 percent slopes	4706.7	0.114
582C2	Homen	Homen silt loam, 5 to 10 percent slopes, eroded	753.2	0.018
582C3	Homen	Homen silty clay loam, 5 to 10 percent slopes, severely eroded	2154.1	0.052
582D3	Homen	Homen silty clay loam, 10 to 18 percent slopes, severely eroded	1513	0.037
7338B2	Hurst	Hurst silt loam, 2 to 5 percent slopes, eroded, rarely flooded	12.3	0
8085A	Jacob	Jacob silty clay, 0 to 2 percent slopes, occasionally flooded	75.5	0.002
908G	Kell-Hickory	Kell-Hickory silt loams, 35 to 70 percent slopes	319.2	0.008
79B2	Menfro	Menfro silt loam, 2 to 5 percent slopes, eroded	4090.2	0.099

Kinkaid Creek Watershed Planning Area-Jackson County				
Soil Symbol	Soil Name	Soil Description	Acres	Percent of Watershed
79C2	Menfro	Menfro silt loam, 5 to 10 percent slopes, eroded	2485.6	0.06
79C3	Menfro	Menfro silt loam, 5 to 10 percent slopes, severely eroded	752.1	0.018
79D2	Menfro	Menfro silt loam, 10 to 18 percent slopes, eroded	891.5	0.022
79D3	Menfro	Menfro silt loam, 10 to 18 percent slopes, severely eroded	1893.8	0.046
79E	Menfro	Menfro silt loam, 18 to 25 percent slopes	4067.5	0.099
79E3	Menfro	Menfro silt loam, 18 to 25 percent slopes, severely eroded	386.2	0.009
701D	Menfro-Hickory	Menfro-Hickory silt loams, 10 to 18 percent slopes	371.8	0.009
701D3	Menfro-Hickory	Menfro-Hickory complex, 10 to 18 percent slopes, severely eroded	435.5	0.011
692F	Menfro-Wellston	Menfro-Wellston silt loams, 18 to 35 percent slopes	4398.8	0.107
692G	Menfro-Wellston	Menfro-Wellston silt loams, 35 to 70 percent slopes	455.8	0.011
976G	Neotoma-Rock	Neotoma-Rock outcrop complex, 35 to 70 percent slopes	402.6	0.01
977G	Neotoma-Wellston	Neotoma-Wellston complex, 35 to 70 percent slopes	1429.9	0.035
7084A	Okaw	Okaw silt loam, 0 to 2 percent slopes, rarely flooded	209.7	0.005
805D	Orthents	Orthents, clayey, sloping	62.5	0.002
31A	Pierron	Pierron silt loam, 0 to 2 percent slopes	84	0.002
3420A	Piopolis	Piopolis silty clay loam, 0 to 2 percent slopes, frequently flooded	2.5	0
864	Pits	Pits, quarries	77.2	0.002

Kinkaid Creek Watershed Planning Area-Jackson County				
Soil Symbol	Soil Name	Soil Description	Acres	Percent of Watershed
7208A	Sexton	Sexton silt loam, 0 to 2 percent slopes, rarely flooded	70.9	0.002
164A	Stoy	Stoy silt loam, 0 to 2 percent slopes	93.6	0.002
164B	Stoy	Stoy silt loam, 2 to 5 percent slopes	199.8	0.005
3333A	Wakeland	Wakeland silt loam, 0 to 2 percent slopes, frequently flooded	283.9	0.007
8333A	Wakeland	Wakeland silt loam, 0 to 2 percent slopes, occasionally flooded	397.2	0.01
W	Water	Water	2562	0.062
977F	Wellston-Neotoma	Wellston-Neotoma complex, 18 to 35 percent slopes	0.1	0
Total:			**41,242.20**	**100%**

APPENDIX B – Subwatershed Land Use Data

Subwatershed Land Use Classification	Lower Kinkaid Creek		Lower Little Kinkaid Creek		Upper Kinkaid Creek		Upper Little Kinkaid Creek	
	Acreage	% of SMU	Acreage	% of SMU	Acreage	% of SMU	Acreage	% of SMU
Open Water	9.34	0.31%	22.48	1.04%	47.19	0.86%	21.57	0.44%
Developed, Open Space	64.30	2.16%	36.27	1.67%	127.99	2.34%	141.00	2.87%
Developed, Low Intensity	12.68	0.43%	12.46	0.57%	50.75	0.93%	95.63	1.94%
Developed, Medium Intensity	0.22	0.01%	0.00	0.00%	5.79	0.11%	4.23	0.09%
Developed, High Intensity	0.00	0.00%	0.00	0.00%	1.34	0.02%	0.44	0.01%
Barren Land	0.00	0.00%	0.00	0.00%	74.79	1.37%	1.78	0.04%
Deciduous Forest	2,077.59	69.72%	1,423.53	65.69%	3,023.58	55.32%	1,959.77	39.82%
Evergreen Forest	19.58	0.66%	27.59	1.27%	7.12	0.13%	1.56	0.03%
Mixed Forest	141.28	4.74%	132.63	6.12%	42.29	0.77%	67.83	1.38%
Shrub/Scrub	0.00	0.00%	2.23	0.10%	11.57	0.21%	4.89	0.10%
Grassland/Herbaceous	0.89	0.03%	3.56	0.16%	38.95	0.71%	26.02	0.53%
Pasture/Hay	460.55	15.45%	427.93	19.75%	1,263.83	23.12%	1,810.99	36.80%
Cultivated Crops	193.56	6.50%	77.66	3.58%	770.81	14.10%	785.29	15.96%
Woody Wetlands	0.00	0.00%	0.22	0.01%	0.00	0.00%	0.00	0.00%
Emergent Herbaceous Wetlands	0.00	0.00%	0.45	0.02%	0.00	0.00%	0.00	0.00%

Subwatershed Land Use Classification	Conservancy		Johnson Creek		Lower Kinkaid Creek		NW Kinkaid Lake		Larger Shawnee	
	Acreage	% of SMU	Acreage	% of SMU	Acreage	% of SMU	Acreage	% of SMU	Acreage	% of SMU
Open Water	149.91	11.11%	9.79	0.36%	10.23	0.53%	330.20	19.24%	27.12	1.35%
Developed, Open Space	39.65	2.94%	89.19	3.27%	76.02	3.91%	40.75	2.37%	39.35	1.95%
Developed, Low Intensity	20.49	1.52%	34.03	1.25%	67.80	3.48%	16.48	0.96%	2.89	0.14%
Developed, Medium Intensity	3.12	0.23%	0.00	0.00%	4.89	0.25%	1.56	0.09%	0.00	0.00%
Developed, High Intensity	0.00	0.00%	0.00	0.00%	0.00	0.00%	0.00	0.00%	0.00	0.00%
Barren Land	0.00	0.00%	0.00	0.00%	0.44	0.02%	0.00	0.00%	0.00	0.00%
Deciduous Forest	286.90	21.26%	2,069.76	75.88%	997.66	51.26%	1,033.78	60.24%	1,739.07	86.31%
Evergreen Forest	0.00	0.00%	36.48	1.34%	0.00	0.00%	16.92	0.99%	24.23	1.20%
Mixed Forest	27.40	2.03%	169.48	6.21%	7.11	0.37%	178.57	10.40%	96.48	4.79%
Shrub/Scrub	0.00	0.00%	2.22	0.08%	0.00	0.00%	0.00	0.00%	39.13	1.94%
Grassland/Herbaceous	11.36	0.84%	4.45	0.16%	0.22	0.01%	16.03	0.93%	2.00	0.10%
Pasture/Hay	437.04	32.39%	270.01	9.90%	61.58	3.16%	81.27	4.74%	44.68	2.22%
Cultivated Crops	373.33	27.67%	42.26	1.55%	567.74	29.17%	0.67	0.04%	0.00	0.00%
Woody Wetlands	0.00	0.00%	0.00	0.00%	136.93	7.04%	0.00	0.00%	0.00	0.00%
Emergent Herbaceous Wetlands	0.00	0.00%	0.00	0.00%	15.56	0.80%	0.00	0.00%	0.00	0.00%

Subwatershed Land Use Classification	Smaller Shawnee		Heiple		Spring Creek		Sharp Rock		Camprground	
	Acreage	% of SMU	Acreage	% of SMU	Acreage	% of SMU	Acreage	% of SMU	Acreage	% of SMU
Open Water	1.78	0.19%	6.00	0.81%	13.79	0.81%	14.25	1.49%	25.58	1.23%
Developed, Open Space	33.17	3.53%	42.24	5.69%	79.62	4.70%	21.37	2.24%	62.29	2.99%
Developed, Low Intensity	0.22	0.02%	6.23	0.84%	108.98	6.43%	24.04	2.52%	44.27	2.12%
Developed, Medium Intensity	0.00	0.00%	0.00	0.00%	5.34	0.31%	0.00	0.00%	0.00	0.00%
Developed, High Intensity	0.00	0.00%	0.00	0.00%	0.00	0.00%	0.00	0.00%	0.00	0.00%
Barren Land	0.00	0.00%	0.00	0.00%	0.22	0.01%	0.00	0.00%	0.00	0.00%
Deciduous Forest	830.43	88.49%	505.37	68.01%	774.20	45.67%	417.79	43.81%	848.46	40.67%
Evergreen Forest	9.80	1.04%	0.00	0.00%	3.11	0.18%	18.47	1.94%	6.01	0.29%
Mixed Forest	56.10	5.98%	4.67	0.63%	37.81	2.23%	0.00	0.00%	144.60	6.93%
Shrub/Scrub	0.00	0.00%	0.00	0.00%	0.22	0.01%	0.00	0.00%	1.33	0.06%
Grassland/Herbaceous	0.67	0.07%	3.34	0.45%	4.00	0.24%	0.89	0.09%	2.00	0.10%
Pasture/Hay	6.23	0.66%	168.31	22.65%	422.80	24.94%	369.26	38.73%	416.67	19.97%
Cultivated Crops	0.00	0.00%	3.34	0.45%	245.09	14.46%	87.47	9.17%	534.80	25.64%
Woody Wetlands	0.00	0.00%	3.56	0.48%	0.00	0.00%	0.00	0.00%	0.00	0.00%
Emergent Herbaceous Wetlands	0.00	0.00%	0.00	0.00%	0.00	0.00%	0.00	0.00%	0.00	0.00%

Subwatershed Land Use Classification	Lone Oak		Ash		Kinkaid Lake- Central Channel		Lakeside		Kinkaid Lake- Central Body	
	Acreage	% of SMU	Acreage	% of SMU	Acreage	% of SMU	Acreage	% of SMU	Acreage	% of SMU
Open Water	21.35	1.05%	1.78	0.33%	579.12	21.61%	0.67	0.12%	1,209.39	32.49%
Developed, Open Space	46.25	2.28%	17.57	3.25%	43.13	1.61%	5.36	0.95%	69.85	1.88%
Developed, Low Intensity	28.24	1.39%	4.00	0.74%	0.22	0.01%	2.46	0.43%	45.15	1.21%
Developed, Medium Intensity	0.00	0.00%	0.00	0.00%	0.00	0.00%	0.00	0.00%	8.23	0.22%
Developed, High Intensity	0.00	0.00%	0.00	0.00%	0.00	0.00%	0.00	0.00%	3.56	0.10%
Barren Land	0.22	0.01%	0.00	0.00%	0.00	0.00%	0.00	0.00%	0.22	0.01%
Deciduous Forest	1,142.78	56.34%	423.68	78.36%	1,950.54	72.78%	457.53	80.70%	1,842.45	49.50%
Evergreen Forest	0.00	0.00%	0.00	0.00%	7.56	0.28%	0.67	0.12%	3.78	0.10%
Mixed Forest	7.12	0.35%	2.45	0.45%	48.69	1.82%	9.38	1.65%	126.34	3.39%
Shrub/Scrub	0.00	0.00%	0.00	0.00%	0.00	0.00%	0.00	0.00%	0.00	0.00%
Grassland/Herbaceous	8.01	0.39%	0.22	0.04%	4.67	0.17%	0.45	0.08%	27.36	0.74%
Pasture/Hay	528.58	26.06%	50.26	9.30%	41.13	1.53%	72.12	12.72%	328.54	8.83%
Cultivated Crops	245.72	12.11%	40.70	7.53%	4.89	0.18%	18.31	3.23%	57.17	1.54%
Woody Wetlands	0.00	0.00%	0.00	0.00%	0.00	0.00%	0.00	0.00%	0.00	0.00%
Emergent Herbaceous Wetlands	0.00	0.00%	0.00	0.00%	0.00	0.00%	0.00	0.00%	0.00	0.00%

APPENDIX C- MRLC Classifications A

Value	Definition
11	Open Water - All areas of open water, generally with less than 25% cover or vegetation or soil
21	Developed, Open Space - Includes areas with a mixture of some constructed materials, but mostly vegetation in the form of lawn grasses. Impervious surfaces account for less than 20 percent of total cover. These areas most commonly include large-lot single-family housing units, parks, golf courses, and vegetation planted in developed settings for recreation, erosion control, or aesthetic purposes.
22	Developed, Low Intensity -Includes areas with a mixture of constructed materials and vegetation. Impervious surfaces account for 20-49 percent of total cover. These areas most commonly include single-family housing units.
23	Developed, Medium Intensity - Includes areas with a mixture of constructed materials and vegetation. Impervious surfaces account for 50-79 percent of the total cover. These areas most commonly include single-family housing units.
24	Developed, High Intensity - Includes highly developed areas where people reside or work in high numbers. Examples include apartment complexes, row houses and commercial/industrial. Impervious surfaces account for 80 to 100 percent of the total cover.
31	Barren Land (Rock/Sand/Clay) - Barren areas of bedrock, desert pavement, scarps, talus, slides, volcanic material, glacial debris, sand dunes, strip mines, gravel pits and other accumulations of earthen material. Generally, vegetation accounts for less than 15% of total cover.
41	Deciduous Forest - Areas dominated by trees generally greater than 5 meters tall, and greater than 20% of total vegetation cover. More than 75 percent of the tree species shed foliage simultaneously in response to seasonal change.
42	Evergreen Forest - Areas dominated by trees generally greater than 5 meters tall, and greater than 20% of total vegetation cover. More than 75 percent of the tree species maintain their leaves all year. Canopy is never without green foliage.
43	Mixed Forest - Areas dominated by trees generally greater than 5 meters tall, and greater than 20% of total vegetation cover. Neither deciduous nor evergreen species are greater than 75 percent of total tree cover.
52	Shrub/Scrub - Areas dominated by shrubs; less than 5 meters tall with shrub canopy typically greater than 20% of total vegetation. This class includes true shrubs, young trees in an early successional stage or trees stunted from environmental conditions.
71	Grassland/Herbaceous - Areas dominated by grammanoid or herbaceous vegetation, generally greater than 80% of total vegetation. These areas are not subject to intensive management such as tilling, but can be utilized for grazing.
81	Pasture/Hay - Areas of grasses, legumes, or grass-legume mixtures planted for livestock grazing or the production of seed or hay crops, typically on a perennial cycle. Pasture/hay vegetation accounts for greater than 20 percent of total vegetation.
82	Cultivated Crops - Areas used for the production of annual crops, such as corn, soybeans, vegetables, tobacco, and cotton, and also perennial woody crops such as orchards and vineyards. Crop vegetation accounts for greater than 20 percent of total vegetation. This class also includes all land being actively tilled.
90	Woody Wetlands - Areas where forest or shrub land vegetation accounts for greater than 20 percent of vegetative cover and the soil or substrate is periodically saturated with or covered with water.
95	Emergent Herbaceous Wetlands - Areas where perennial herbaceous vegetation accounts for greater than 80 percent of vegetative cover and the soil or substrate is periodically saturated with or covered with water.

APPENDIX D- Assessment Forms

KINKAID CREEK WATERSHED STREAM INVENTORY

DATE: ___________STREAM NAME: __________________REACH ID: ________________

MAP ID: __________SMU ID: ____________ASSESSMENT UNIT ID:__________________

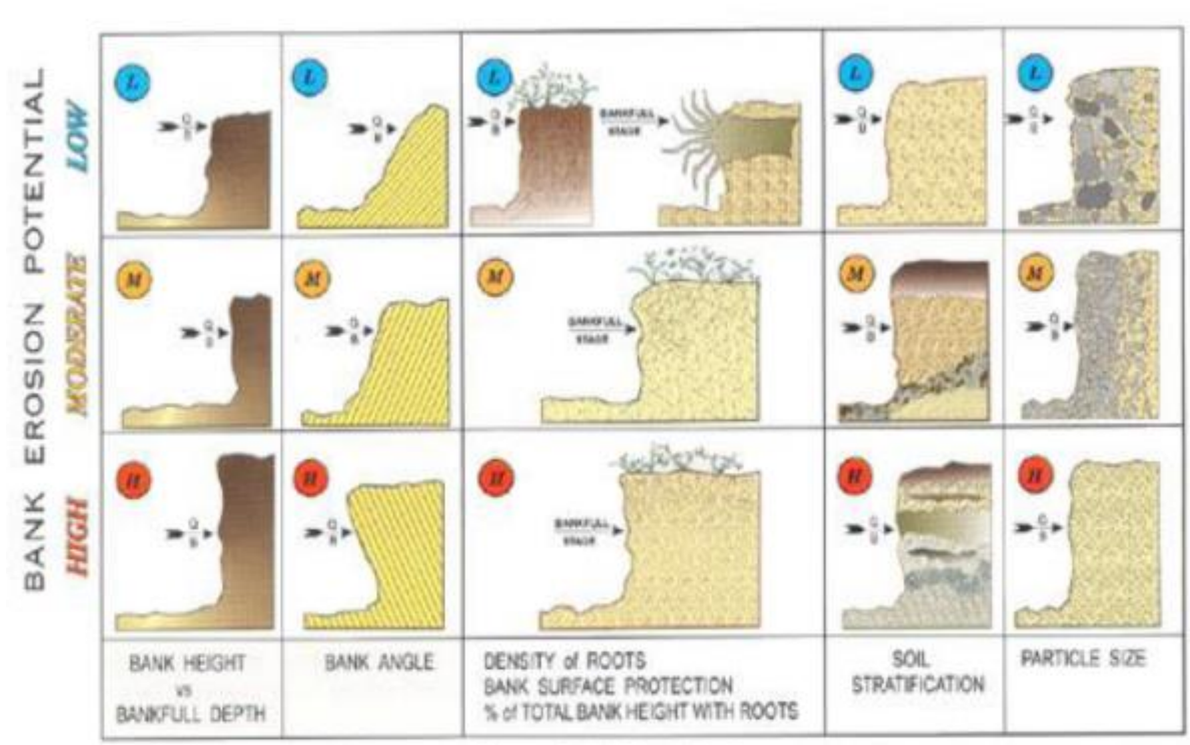
PHOTOS: ________ APPROXIMATE LENGTH: ________ FIELD ASSESSOR: ___________

DEGREE OF STREAMBED EROSION

NONE	LOW	MODERATE	HIGH
Stable: less than 5% of banks affected	Moderately Stable: 5-33% banks have areas of erosion	Moderatley Unstable: 33-66% of banks have areas of erosion	Unstable: 66-100% of banks have high levels of erosion

DEGREE OF STREAMBANK EROSION

NONE	LOW	MODERATE	HIGH
Stable: less than 5% of banks affected	Moderately Stable: 5-33% banks have areas of erosion	Moderatley Unstable: 33-66% of banks have areas of erosion	Unstable: 66-100% of banks have high levels of erosion



MEAN BANK HEIGHT AND CHANNEL WIDTH (in feet, facing downstream)

LEFT BANK HEIGHT	MEAN CHANNEL WIDTH	RIGHT BANK HEIGHT

CONDITION OF RIPARIAN AREA

Land Cover (%): Scrub/Shrub: _____ Lawn: _____ Wetlands: ______ Crops: _______
Wooded: ______ Pasture: _______ Impervious: __________ Prairie: _________

ENVIRONMENTAL CONDITION OF RIPARIAN AREA: Good: ___Fair:____ Poor: ____
COMMENT**:**____
____

DEGREE OF CHANNELIZATION

NONE: ___________LOW: ___________ MODERATE: _________ HIGH: ___________

DEBRIS BLOCKAGES (Instream/ Overbank)
LOW: ________ MODERATE: ________ HIGH: _________
COMMENT: ____

KINKAID CREEK WATERSHED LAKE INVENTORY

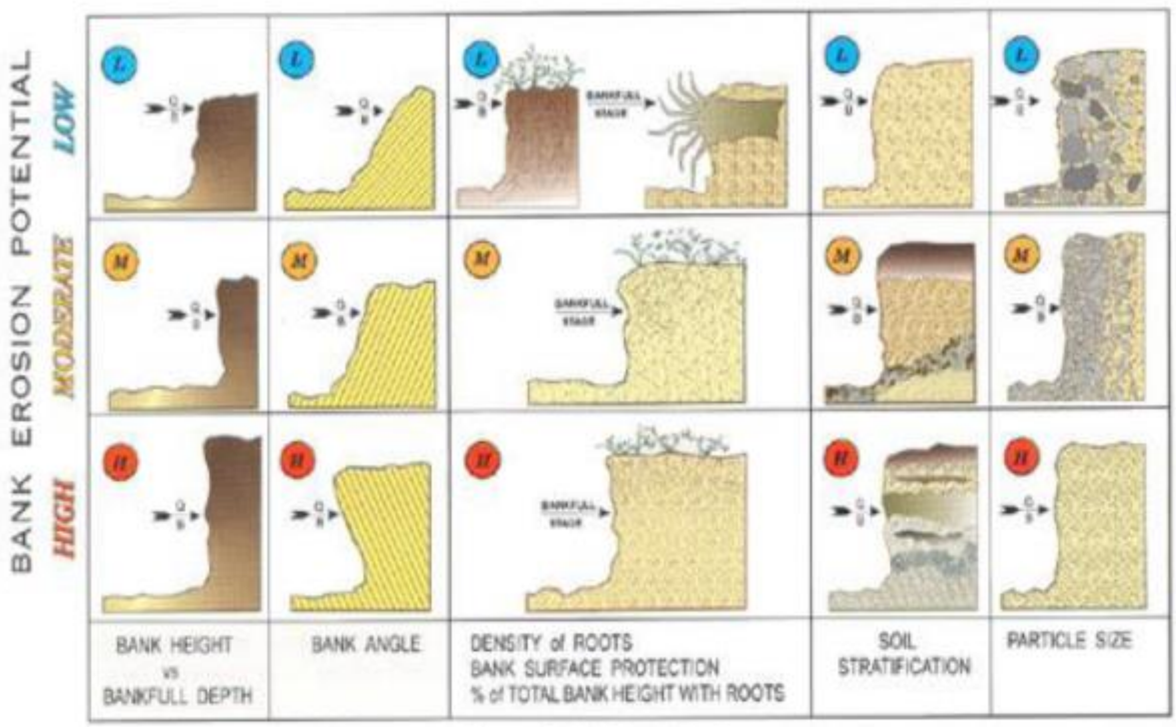
DATE: ___________LAKE NAME: __________________SHORE ID: ___________________

MAP ID: __________SMU ID: ____________ASSESSMENT UNIT ID:__________________

PHOTOS: ________ APPROXIMATE LENGTH: ________ FIELD ASSESSOR: ___________

DEGREE OF SHORELINE EROSION

NONE	LOW	MODERATE	HIGH
Stable: less than 5% of banks affected	Moderately Stable: 5-33% banks have areas of erosion	Moderatley Unstable: 33-66% of banks have areas of erosion	Unstable: 66-100% of banks have high levels of erosion



MEAN BANK HEIGHT: ________________________

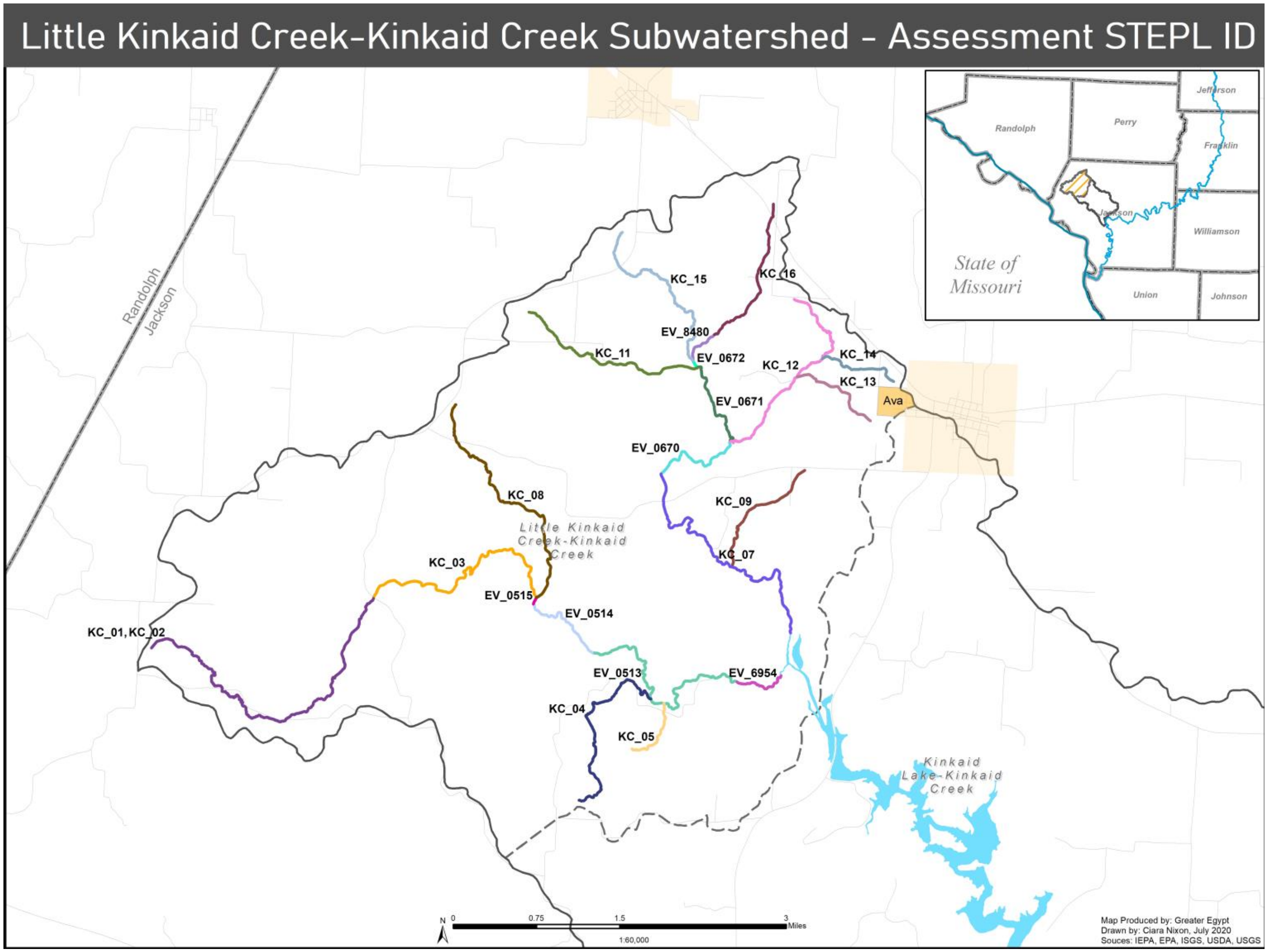
CONDITION OF RIPARIAN AREA

Land Cover (%): Scrub/Shrub: _____ Lawn: _____ Wetlands: ______ Crops: _______
Wooded: ______ Pasture: _______ Impervious: __________ Prairie: _________

ENVIRONMENTAL CONDITION OF RIPARIAN AREA: Good: ___Fair:____ Poor: ____
COMMENT**:**____
____

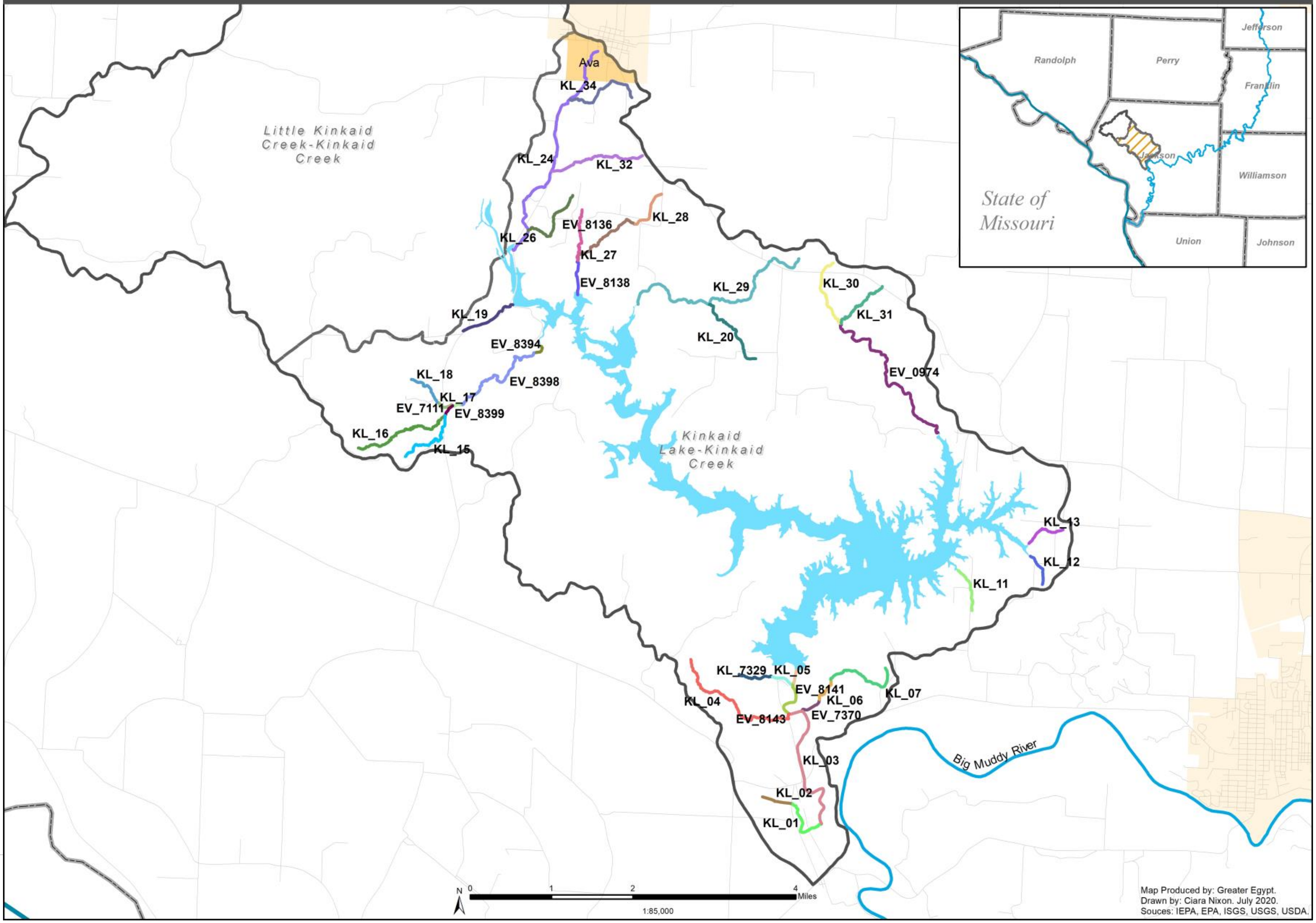
DEBRIS BLOCKAGES (Overbank)
LOW: ________ MODERATE: ________ HIGH: _________
COMMENT: ____

APPENDIX E- Assessed Stream Reach Information



Little Kinkaid Creek - Kinkaid Creek Subwatershed - Assessed Stream REACH Information					
Reach Code	Stream Name	Subwatershed Management Unit	STEPL ID	IEPA ID	Stream Length (ft)
7140106000513	Kinkaid Creek	Middle Kinkaid Creek	EV_0513	IL_NB	12,116.40
7140106006954	Kinkaid Creek	Middle Kinkaid Creek	EV_6954	IL_NB	2,652.22
7140106007038		Middle Kinkaid Creek	KC_04		10,362.30
7140106007002		Middle Kinkaid Creek	KC_05		3,442.09
7140106000514	Kinkaid Creek	Upper Kinkaid Creek	EV_0514	IL_NB	4,390.05
7140106000515	Kinkaid Creek	Upper Kinkaid Creek	EV_0515	IL_NB	353.12
7140106000516	Kinkaid Creek	Upper Kinkaid Creek	KC_03	IL_NB	12,562.40
7140106000517	Kinkaid Creek	Upper Kinkaid Creek	KC_01, KC_02	IL_NB	18,163.30
7140106000956		Upper Kinkaid Creek	KC_08		12,941.30
7140106006874		Lower Little Kinkaid Creek	KC_09		6,687.14
7140106000669	Little Kinkaid Creek	Lower Little Kinkaid Creek	KC_07	IL_NBA	14,260.40
7140106008480	Little Kinkaid Creek	Lower Little Kinkaid Creek	EV_8480	IL_NBA	1,829.03
7140106000672	Little Kinkaid Creek	Upper Little Kinkaid Creek	EV_0672	IL_NBA	412.40
7140106000670	Little Kinkaid Creek	Upper Little Kinkaid Creek	EV_0670	IL_NBA	4,961.92
7140106000671	Little Kinkaid Creek	Upper Little Kinkaid Creek	EV_0671	IL_NBA	4,707.20
7140106000965		Upper Little Kinkaid Creek	KC_12		11,069.40
7140106006792		Upper Little Kinkaid Creek	KC_13		4,727.79
7140106006765		Upper Little Kinkaid Creek	KC_14		4,209.53
7140106008479		Upper Little Kinkaid Creek	KC_16		7,705.65
7140106000967		Upper Little Kinkaid Creek	KC_11		9,946.69
7140106000966		Upper Little Kinkaid Creek	KC_15		9,779.98

Kinkaid Lake-Kinkaid Creek Subwatershed - STEPL ID



Kinkaid Lake - Kinkaid Creek Subwatershed - Assessed Stream REACH Information					
Reach Code	Stream Name	Subwatershed Management Unit	STEPL ID	IEPA ID	Stream Length (ft)
7140106007472	Lower Kinkaid Creek	Lower Kinkaid Creek	KL_02		2,042.36
7140106007329	Lower Kinkaid Creek	Lower Kinkaid Creek	KL_7329		2,401.10
7140106007336	Lower Kinkaid Creek	Lower Kinkaid Creek	KL_05		1,493.28
7140106008141		Lower Kinkaid Creek	EV_8141	IL_NB-01	1,020.96
7140106008161	Lower Kinkaid Creek	Lower Kinkaid Creek	KL_01		3,642.18
7140106000509	Lower Kinkaid Creek	Lower Kinkaid Creek	KL_03	IL_NB-01	10,159.00
7140106008143		Lower Kinkaid Creek	EV_8143	IL_NB-01	2,648.76
7140106000977	Lower Kinkaid Creek	Lower Kinkaid Creek	KL_04		9,778.32
7140106007370		Heiple	EV_7370		1,530.48
7140106007359	Heiple	Heiple	KL_06		1,774.89
7140106007322	Heiple	Heiple	KL_07		5,512.67
7140106007249	Kinkaid Lake-Central Body	Kinkaid Lake-Central Body	KL_11		3,047.33
7140106007182	Kinkaid Lake-East	Kinkaid Lake-East	KL_13		2,789.55
7140106007222	Kinkaid Lake-East	Kinkaid Lake-East	KL_12		2,213.11
7140106000974		Lone Oak	EV_0974		12,628.70
7140106000975	Lone Oak	Lone Oak	KL_30		5,023.07
7140106006998	Lone Oak	Lone Oak	KL_31		4,345.16
7140106000971	Campground	Campground	KL_29		15,464.80
7140106007036	Campground	Campground	KL_20		5,584.61
7140106007035	Kinkaid Lake-Northwest	Kinkaid Lake-Northwest	KL_19		3,887.84
7140106008400	Johnson Creek	Johnson Creek	KL_17		1,287.56
7140106008399		Johnson Creek	EV_8399		703.09
7140106008398		Johnson Creek	EV_8398		7,998.83
7140106008397	Johnson Creek	Johnson Creek	KL_18		2,587.43
7140106007111		Johnson Creek	EV_7111		832.40
7140106008394		Johnson Creek	EV_8394		690.93
7140106007152	Johnson Creek	Johnson Creek	KL_16		7,511.92

Kinkaid Lake - Kinkaid Creek Subwatershed - Assessed Stream REACH Information					
Reach Code	Stream Name	Subwatershed Management Unit	STEPL ID	IEPA ID	Stream Length (ft)
7140106007158	Johnson Creek	Johnson Creek	KL_15		5,121.01
7140106008136		Sharp Rock	EV_8136		5,321.83
7140106008138		Sharp Rock	EV_8138		2,383.46
7140106006961	Sharp Rock	Sharp Rock	KL_27		3,750.68
7140106008135	Sharp Rock	Sharp Rock	KL_28		2,991.10
7140106000969	Spring Creek	Spring Creek	KL_24		16,127.20
7140106006935	Spring Creek	Spring Creek	KL_26		5,111.26
7140106006885	Spring Creek	Spring Creek	KL_32		6,630.22
7140106006833	Spring Creek	Spring Creek	KL_34		5,629.55

APPENDIX F – Load Reductions by SMU

Streambank Stabilization

Subwatershed Name	SMU ID	ReachCode	Length (ft)	Length of stabilization (ft)	EROSION	SLR	PLR	NLR	Priority
Lower Kinkaid Creek	1	07140106000509	10159	1015.9	LOW	5	5	10	Low
		07140106000977	9778.320313	4889.160156	HIGH	474	474	948	Medium
		07140106007329	2401.100098	240.1100098	LOW	1.2	1.2	2.4	Low
		07140106007336	1493.280029	149.3280029	LOW	0.8	0.8	1.6	Low
		07140106007472	2042.359985	204.2359985	LOW	0.5	0.5	1	Low
		07140106008141	1020.960022	255.2400055	MODERATE	8.5	8.5	17	Low
		07140106008143	2648.76001	1324.380005	HIGH	135	135	270	Low
		07140106008161	3642.179932	364.2179932	LOW	0	0	0	Low
Heiple	2	07140106007322	5512.669922	1378.16748	MODERATE	43.5	43.5	87	Low
		07140106007359	1774.890015	443.7225037	MODERATE	14	14	28	Low
		07140106007370	1530.47998	765.2399902	HIGH	78	78	156	Low
Kinkaid Lake - Central Body	4	07140106007249	3047.330078	304.7330078	LOW	0.8	0.8	1.6	Low
Kinkaid Lake - East	5	07140106007182	2789.550049	278.9550049	LOW	0.7	0.7	1.4	Low
		07140106007222	2213.110107	221.3110107	LOW	1.1	1.1	2.2	Low
Lone Oak	6	07140106000974	12628.7002	9471.525146	SEVERE	1207.5	1207.5	2415	High
		07140106000975	5023.069824	502.3069824	LOW	2.4	2.4	4.8	Low
		07140106006998	4345.160156	434.5160156	LOW	3.2	3.2	6.4	Low

Subwatershed Name	SMU ID	ReachCode	Length (ft)	Length of stabilization (ft)	EROSION	SLR	PLR	NLR	Priority
Campground	11	07140106000971	15464.7998	1546.47998	LOW	3.8	3.8	7.6	Low
		07140106007036	5584.609863	558.4609863	LOW	5.4	5.4	10.8	Low
Kinkaid Lake - Northwest	12	07140106007035	3887.840088	388.7840088	LOW	1.9	1.9	3.8	Low
		07140106025693	2454.590088	245.4590088	LOW	1.2	1.2	2.4	Low
Johnson Creek	13	07140106007111	832.4019775	208.1004944	MODERATE	7	7	14	Low
		07140106007152	7511.919922	751.1919922	LOW	5.5	5.5	11	Low
		07140106007158	5121.009766	1280.252441	MODERATE	40.25	40.25	80.5	Low
		07140106008394	690.9320068	172.7330017	MODERATE	6	6	12	Low
		07140106008397	2587.429932	646.8574829	MODERATE	27.25	27.25	54.5	Low
		07140106008398	7998.830078	3999.415039	HIGH	408	408	816	Medium
		07140106008399	703.0939941	175.7734985	MODERATE	6	6	12	Low
		07140106008400	1287.560059	643.7800293	HIGH	62.5	62.5	125	Low
Sharp Rock	14	07140106006961	3750.679932	375.0679932	LOW	1.8	1.8	3.6	Low
		07140106008135	2991.100098	299.1100098	LOW	1.5	1.5	3	Low
		07140106008136	5321.830078	532.1830078	LOW	0	0	0	Low
		07140106008138	2383.459961	238.3459961	LOW	0	0	0	Low
Spring Creek	15	07140106000969	16127.2002	1612.72002	LOW	4	4	8	Low
		07140106006833	5629.549805	562.9549805	LOW	1.4	1.4	2.8	Low
		07140106006885	6630.220215	663.0220215	LOW	1.6	1.6	3.2	Low
		07140106006935	5111.259766	1277.814941	MODERATE	26.75	26.75	53.5	Low
Middle Kinkaid Creek	16	07140106000513	12116.40039	9087.300293	SEVERE	1931.25	1931.25	3862.5	High
		07140106006954	2652.219971	1326.109985	HIGH	90	90	180	Low
		07140106007002	3442.090088	860.522522	MODERATE	54.25	54.25	108.5	Low
		07140106007038	10362.2998	2590.574951	MODERATE	149.5	149.5	299	Low

Subwatershed Name	SMU ID	ReachCode	Length (ft)	Length of stabilization (ft)	EROSION	SLR	PLR	NLR	Priority
Lower Little Kinkaid Creek	17	07140106000669	14260.40039	3565.100098	MODERATE	252.5	252.5	505	Medium
		07140106006874	6687.140137	668.7140137	LOW	3.3	3.3	6.6	Low
Upper Kinkaid Creek	18	07140106000514	4390.049805	3292.537354	SEVERE	699.75	699.75	1399.5	High
		07140106000515	353.118988	176.559494	HIGH	18	18	36	Low
		07140106000516	12562.40039	1256.240039	LOW	13	13	26	Low
		07140106000517	18163.30078	4540.825195	MODERATE	131	131	262	Low
		07140106000956	12941.2998	1294.12998	LOW	9.4	9.4	18.8	Low
Upper Little Kinkaid Creek	19	07140106000670	4961.919922	2480.959961	HIGH	253	253	506	Medium
		07140106000671	4707.200195	2353.600098	HIGH	240	240	480	Low
		07140106000672	412.3989868	103.0997467	MODERATE	3.5	3.5	7	Low
		07140106000965	11069.40039	5534.700195	HIGH	1073	1073	2146	High
		07140106000966	9779.980469	2444.995117	MODERATE	167	167	334	Low
		07140106000967	9946.69043	994.669043	LOW	4.8	4.8	9.6	Low
		07140106006765	4209.529785	420.9529785	LOW	3	3	6	Low
		07140106006792	4727.790039	3545.842529	SEVERE	1002	1002	2004	High
		07140106008479	7705.649902	770.5649902	LOW	4.2	4.2	8.4	Low
		07140106008480	1829.030029	457.2575073	MODERATE	15	15	30	Low

Shoreline Stabilization

Shore Code	Shoreline Length (ft)	Length to be stabilized (ft)	Shoreline Condition	Priority	SLR Final	PLR Final	NLR Final
KL_204-02-01	757.6900024	378.85	High erosion, not stabilized	High	24.5	24.5	49
KL_204-26	2469.699951	1852.27	High erosion, not stabilized	High	112.5	112.5	225
KL_204-33	3836.699951	1918.35	High erosion, not stabilized	High	62	62	124
KL_208-15	2820.060059	1410.03	High erosion, not stabilized	High	68.5	68.5	137
KL_208-18-01	5163.25	2581.63	High erosion, not stabilized	High	125	125	250
KL_212-12	3119.310059	1559.66	High erosion, not stabilized	High	50.5	50.5	101
KL_212-22	2805.23999	1402.62	High erosion, not stabilized	High	68	68	136
KL_204-13	2650.23999	662.56	Moderate erosion, not stabilized	Medium	10.5	10.5	21
KL_204-20	5945.490234	1486.37	Moderate erosion, not stabilized	Medium	23.5	23.5	47
KL_204-22	2880.909912	720.23	Moderate erosion, not stabilized	Medium	11.5	11.5	23
KL_204-25	1949.76001	487.44	Moderate erosion, not stabilized	Medium	8	8	16
KL_205-06	3386.949951	846.74	Moderate erosion, not stabilized	Medium	9	9	18
KL_205-07	4573.02002	1143.26	Moderate erosion, not stabilized	Medium	18	18	36
KL_205-09	2415.280029	603.82	Moderate erosion, not stabilized	Medium	6.5	6.5	13
KL_205-10	9869.419922	2467.35	Moderate erosion, not stabilized	Medium	38.75	38.75	77.5
KL_205-12	1989.319946	497.33	Moderate erosion, not stabilized	Medium	8	8	16
KL_205-13	3091.840088	772.96	Moderate erosion, not stabilized	Medium	12.25	12.25	24.5
KL_212-11	2342.300049	585.58	Moderate erosion, not stabilized	Medium	6.25	6.25	12.5
KL_212-20	3257.699951	814.42	Moderate erosion, not stabilized	Medium	8.5	8.5	17
KL_212-23	4478.089844	1119.52	Moderate erosion, not stabilized	Medium	17.75	17.75	35.5
KL_212-24	2589.25	647.31	Moderate erosion, not stabilized	Medium	10.25	10.25	20.5
KL_204-04	3922.98999	1448.49	Partially Stabilized, high erosion	Medium	93.8602	93.8602	187.7204
KL_204-06	4983.950195	890.98	Partially Stabilized, high erosion	Medium	57.5754	57.5754	115.1508
KL_204-07	3822.76001	1263.38	Partially Stabilized, high erosion	Medium	81.6392	81.6392	163.2784
KL_204-09	6524.419922	2939.21	Partially Stabilized, high erosion	Medium	190.1342	190.1342	380.2684
KL_204-10	5537.959961	2316.98	Partially Stabilized, high erosion	Medium	112.6006	112.6006	225.2012
KL_204-11	6818.279785	3239.14	Partially Stabilized, high erosion	Medium	209.518	209.518	419.036
KL_204-17	1467.099976	335.55	Partially Stabilized, high erosion	Medium	16.2169	16.2169	32.4338

Shore Code	Shoreline Length (ft)	Length to be stabilized (ft)	Shoreline Condition	Priority	SLR Final	PLR Final	NLR Final
KL_204-27	5042.370117	595.19	Partially Stabilized, high erosion	Medium	29.1853	29.1853	58.3706
KL_204-28	2962.77002	269.39	Partially Stabilized, high erosion	Medium	17.7048	17.7048	35.4096
KL_204-37	1673.349976	704.67	Partially Stabilized, high erosion	Medium	34.1046	34.1046	68.2092
KL_204-38	2314.449951	974.22	Partially Stabilized, high erosion	Medium	47.13365	47.13365	94.2673
KL_204-39	4206.100098	1354.05	Partially Stabilized, high erosion	Medium	65.71095	65.71095	131.4219
KL_208-02-02	2053.419922	692.71	Partially Stabilized, high erosion	Medium	33.8177	33.8177	67.6354
KL_208-09	4544.450195	1505.23	Partially Stabilized, high erosion	Medium	72.83885	72.83885	145.6777
KL_208-16	3356.129883	1127.06	Partially Stabilized, high erosion	Medium	54.80405	54.80405	109.6081
KL_208-18-02	5163	2242.50	Partially Stabilized, high erosion	Medium	108.5755	108.5755	217.1509
KL_204-08	5596.810059	516.20	Partially Stabilized, moderate erosion	Low	8.096061	8.096061	16.19212
KL_204-19	3772.659912	682.16	Partially Stabilized, moderate erosion	Low	10.89023	10.89023	21.78046
KL_204-21	3516.310059	440.08	Partially Stabilized, moderate erosion	Low	7.087396	7.087396	14.17479
KL_204-23	3255.27002	737.82	Partially Stabilized, moderate erosion	Low	11.80329	11.80329	23.60657
KL_204-24	2152.449951	227.11	Partially Stabilized, moderate erosion	Low	3.602916	3.602916	7.205833
KL_204-29	7865.290039	572.32	Partially Stabilized, moderate erosion	Low	11.98297	11.98297	23.96594
KL_204-30	5884.609863	1281.15	Partially Stabilized, moderate erosion	Low	27.01095	27.01095	54.0219
KL_204-31	6773.029785	371.26	Partially Stabilized, moderate erosion	Low	11.86692	11.86692	23.73383
KL_204-35	6845.52002	680.38	Partially Stabilized, moderate erosion	Low	10.76562	10.76562	21.53123
KL_204-36	7760.919922	476.23	Partially Stabilized, moderate erosion	Low	7.44749	7.44749	14.89498
KL_204-40	3903.179932	350.79	Partially Stabilized, moderate erosion	Low	5.658594	5.658594	11.31719
KL_205-01	2408.98999	440.25	Partially Stabilized, moderate erosion	Low	6.949108	6.949108	13.89822
KL_205-02	2157.040039	341.26	Partially Stabilized, moderate erosion	Low	5.382243	5.382243	10.51449
KL_208-12	1746.27002	198.57	Partially Stabilized, moderate erosion	Low	3.252393	3.252393	6.504785
KL_208-20	2552.47998	429.12	Partially Stabilized, moderate erosion	Low	6.709034	6.709034	13.41807
KL_208-21	3210	220.50	Partially Stabilized, moderate erosion	Low	3.585683	3.585683	7.171365
KL_208-22	5283.75	236.94	Partially Stabilized, moderate erosion	Low	4.99142	4.99142	9.98284
KL_204-02-02	1034.650024	0.00	Existing BMP	None	0	0	0
KL_204-03	3109.969971	0.00	Existing BMP	None	0	0	0
KL_204-05	3408.050049	0.00	Existing BMP	None	0	0	0

Shore Code	Shoreline Length (ft)	Length to be stabilized (ft)	Shoreline Condition	Priority	SLR Final	PLR Final	NLR Final
KL_204-12	1104.280029	0.00	Existing BMP	None	0	0	0
KL_204-16	793.1920166	0.00	Existing BMP	None	0	0	0
KL_204-18	3270.939941	0.00	Existing BMP	None	0	0	0
KL_204-32	5782.209961	0.00	Existing BMP	None	0	0	0
KL_204-34	3478.030029	0.00	Existing BMP	None	0	0	0
KL_204-42	1457.920044	0.00	Existing BMP	None	0	0	0
KL_204-43	756.2630005	0.00	Existing BMP	None	0	0	0
KL_204-44	728.5339966	0.00	Existing BMP	None	0	0	0
KL_208-01-01	2095.310059	0.00	Existing BMP	None	0	0	0
KL_208-02-01	2504.360107	0.00	Existing BMP	None	0	0	0
KL_208-03	3294.429932	0.00	Existing BMP	None	0	0	0
KL_208-04	3084.929932	0.00	Existing BMP	None	0	0	0
KL_208-05-01	2342.129883	0.00	Existing BMP	None	0	0	0
KL_208-06	3992.659912	0.00	Existing BMP	None	0	0	0
KL_208-07	3428.290039	0.00	Existing BMP	None	0	0	0
KL_208-08	4220.879883	0.00	Existing BMP	None	0	0	0
KL_208-10	4055.870117	0.00	Existing BMP	None	0	0	0
KL_208-11	1950.430054	0.00	Existing BMP	None	0	0	0
KL_208-13	3287.679932	0.00	Existing BMP	None	0	0	0
KL_208-14	2422.48999	0.00	Existing BMP	None	0	0	0
KL_212-01	757.190979	0.00	Existing BMP	None	0	0	0
KL_212-25	940.927002	0.00	Existing BMP	None	0	0	0
KL_212-28	887.0319824	0.00	Existing BMP	None	0	0	0
KL_102-01	12804.59961	0.00	Low erosion, No BMP Needed	None	0	0	0
KL_102-02	6008.439941	0.00	Low erosion, No BMP Needed	None	0	0	0
KL_204-01	1047.77002	0.00	Low erosion, No BMP Needed	None	0	0	0
KL_204-02-03	283.2070007	0.00	Low erosion, No BMP Needed	None	0	0	0
KL_204-14	3166.879883	0.00	Low erosion, No BMP Needed	None	0	0	0
KL_204-15	3327.679932	0.00	Low erosion, No BMP Needed	None	0	0	0

Shore Code	Shoreline Length (ft)	Length to be stabilized (ft)	Shoreline Condition	Priority	SLR Final	PLR Final	NLR Final
KL_204-41	1296.160034	0.00	Low erosion, No BMP Needed	None	0	0	0
KL_205-03	4886.459961	0.00	Low erosion, No BMP Needed	None	0	0	0
KL_205-04	6152.790039	0.00	Low erosion, No BMP Needed	None	0	0	0
KL_205-05	1339.900024	0.00	Low erosion, No BMP Needed	None	0	0	0
KL_205-08	5503.910156	0.00	Low erosion, No BMP Needed	None	0	0	0
KL_205-11	1004.840027	0.00	Low erosion, No BMP Needed	None	0	0	0
KL_205-14	791.5159912	0.00	Low erosion, No BMP Needed	None	0	0	0
KL_208-05-02	1479.23999	0.00	Low erosion, No BMP Needed	None	0	0	0
KL_208-17	2742.709961	0.00	Low erosion, No BMP Needed	None	0	0	0
KL_208-19	4420.859863	0.00	Low erosion, No BMP Needed	None	0	0	0
KL_210-01	3799.129883	0.00	Low erosion, No BMP Needed	None	0	0	0
KL_210-02	4635.399902	0.00	Low erosion, No BMP Needed	None	0	0	0
KL_210-03	1469.790039	0.00	Low erosion, No BMP Needed	None	0	0	0
KL_212-02	2401.030029	0.00	Low erosion, No BMP Needed	None	0	0	0
KL_212-03	2773.570068	0.00	Low erosion, No BMP Needed	None	0	0	0
KL_212-04	1478.689941	0.00	Low erosion, No BMP Needed	None	0	0	0
KL_212-05	2466.899902	0.00	Low erosion, No BMP Needed	None	0	0	0
KL_212-06	2417.139893	0.00	Low erosion, No BMP Needed	None	0	0	0
KL_212-07	4811.689941	0.00	Low erosion, No BMP Needed	None	0	0	0
KL_212-08	2250.149902	0.00	Low erosion, No BMP Needed	None	0	0	0
KL_212-09	3121.139893	0.00	Low erosion, No BMP Needed	None	0	0	0
KL_212-10	1425.829956	0.00	Low erosion, No BMP Needed	None	0	0	0
KL_212-13	972.5640259	0.00	Low erosion, No BMP Needed	None	0	0	0
KL_212-14	561.2199707	0.00	Low erosion, No BMP Needed	None	0	0	0
KL_212-15	2123.820068	0.00	Low erosion, No BMP Needed	None	0	0	0
KL_212-16	2502.810059	0.00	Low erosion, No BMP Needed	None	0	0	0
KL_212-17	3003.439941	0.00	Low erosion, No BMP Needed	None	0	0	0
KL_212-18	5924.080078	0.00	Low erosion, No BMP Needed	None	0	0	0
KL_212-19	1924.140015	0.00	Low erosion, No BMP Needed	None	0	0	0

Shore Code	Shoreline Length (ft)	Length to be stabilized (ft)	Shoreline Condition	Priority	SLR Final	PLR Final	NLR Final
KL_212-21	6315.939941	0.00	Low erosion, No BMP Needed	None	0	0	0
KL_212-26	2426.25	0.00	Low erosion, No BMP Needed	None	0	0	0
KL_212-27	2200.800049	0.00	Low erosion, No BMP Needed	None	0	0	0
KL_212-29	3091.689941	0.00	Low erosion, No BMP Needed	None	0	0	0
KL_212-30	2853.370117	0.00	Low erosion, No BMP Needed	None	0	0	0
LK_208-01-02	914.8300171	0.00	Low erosion, No BMP Needed	None	0	0	0