CARBONDALE
MAKANDA
COBDEN

CRAB ORCHARD CREEK
PILES FORK CREEK
CAMPUS LAKE

WESTERN CRAB ORCHARD CREEK

WATERSHED-BASED PLAN
INVENTORY AND ASSESSMENT

GREATER EGYPT
REGIONAL PLANNING & DEVELOPMENT COMMISSION

Written and prepared by:

Tyler Carpenter, GIS & Environmental Planning Director
Ruth Ann Fowler, Planner
Ciara Nixon, Planner

Greater Egypt Regional Planning and Development Commission
3000 West DeYoung Street, Suite 800B-3
Marion, IL 62959
http://greateregypt.org/
(618) 997-9351

GERPDC-2020-1039

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, the City of Carbondale, and Western Crab Orchard Creek Watershed landowners and businesses.

Pictured on cover: Indian Creek (photo by Greater Egypt)

Table of Contents

List of Figures

List of Tables

Acronyms and Abbreviations

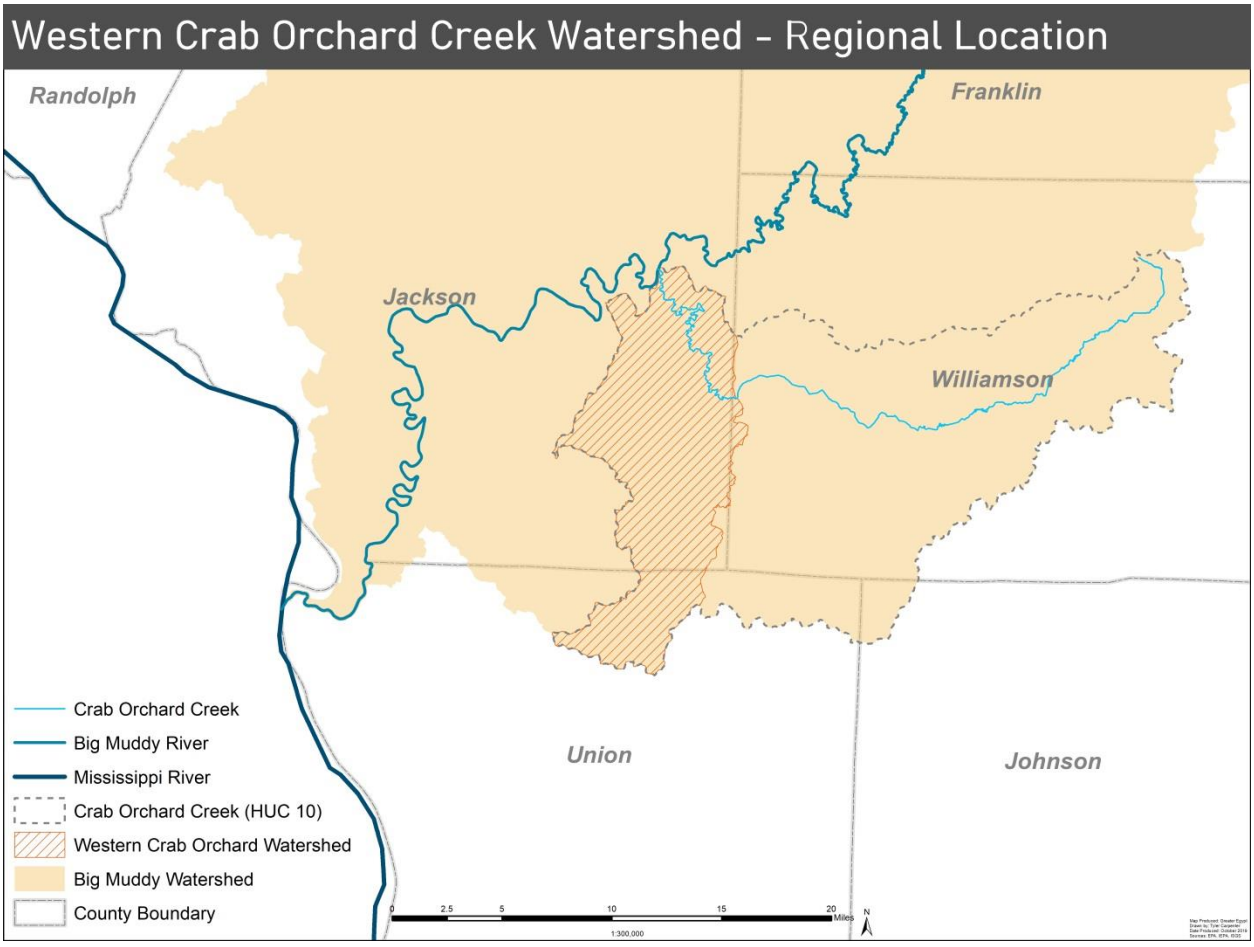
ACS	American Community Survey
AISWCD	Association of Illinois Soil and Water Conservation Districts
AMA	Agricultural Management Assistance Program
BOD	Biochemical Oxygen Demand
CSP	Conservation Stewardship Program
CTA	Conservation Technical Assistance Program
CWA	Clean Water Act
DOI	Department of the 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

1. Watershed Geography & Climate

1.1 Geography

The Western Crab Orchard Creek watershed is a collective area encompassing three individual Hydrologic Unit Code (HUC) 12 subwatersheds. This includes: Drury Creek (071401060807), Indian Creek- Drury Creek (071401060808), and Little Crab Orchard Creek- Crab Orchard Creek (071401060809). This report will reference the Western Crab Orchard Creek watershed as the planning, or study area. This group of subwatersheds represents the western-most portion of the larger Crab Orchard Creek watershed (0714010608). The Western Crab Orchard Creek planning area encompasses 56,533 acres, or around 88 square miles. Figure 1.1 displays the study area and regional major waterbodies.

Figure 1.1



The planning area is located in Jackson, Union, and Williamson County in Illinois. The headwaters of Western Crab Orchard Creek watershed, which is represented by Drury Creek to the south, originates roughly two miles east of the Village of Cobden in Union County, Illinois. Crab Orchard Creek, flowing in from the east, converges with Drury Creek; eventually meeting at the confluence of the Big Muddy River to the north.

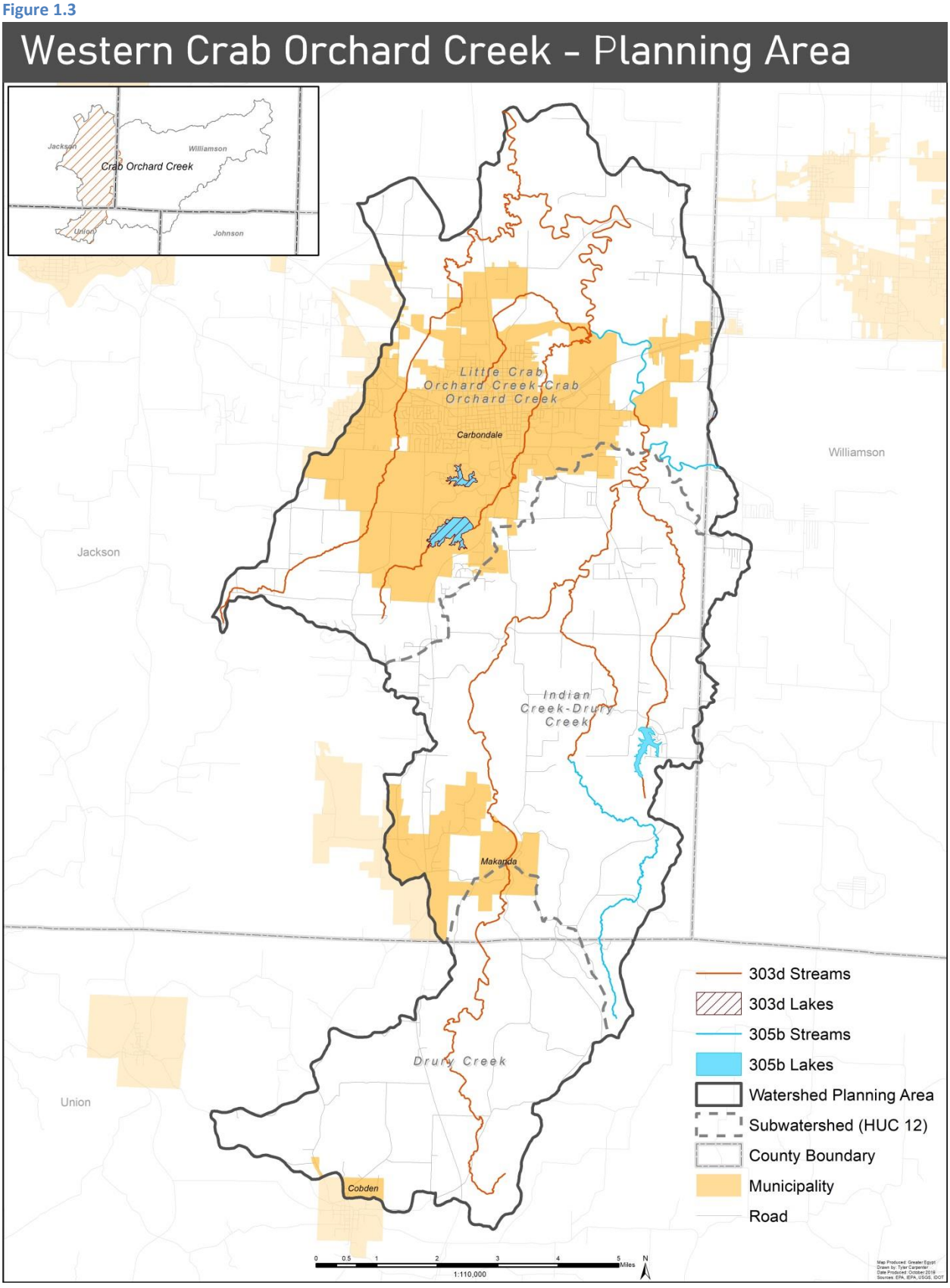
All waterbodies in the planning area eventually flow to the Big Muddy River. This river makes a winding course through Jackson County in a southwest direction eventually discharging into the Mississippi River.

The Western Crab Orchard Creek watershed is generally bound to the north by the Big Muddy River, to the east by Crab Orchard Lake, to the south by the Village of Cobden, and to the west by the western boundary of the City of Carbondale.

Three municipalities are located in the watershed planning area. These include the City of Carbondale, the Village of Makanda, and the Village of Cobden. With a population of nearly 26,000, Carbondale is the largest municipality in the planning area. The city is home to Southern Illinois University- Carbondale.

Figure 1.2- Indian Creek

Figure 1.3


Western Crab Orchard Creek - Planning Area
Jackson
Williamson
Crab Orchard Creek
Union
Johnson
Little Crab Orchard Creek-Crab Orchard Creek
Carbondale
Williamson
Jackson
Indian Creek-Drury Creek
Makanda
Drury Creek
Union
Cobden
303d Streams
303d Lakes
305b Streams
305b Lakes
Watershed Planning Area
Subwatershed (HUC 12)
County Boundary
Municipality
Road
0 0.5 1 2 3 4 5 Miles
N
1:110,000

1.2 Location of Water Bodies

The Western Crab Orchard Creek watershed lies on the divide between the Ohio and Mississippi River basins. There are nearly 91 miles of named streams in the watershed, as identified in the National Hydrography Dataset (NHD). Seven streams and two lakes are listed on the Illinois Environmental Protection Agency's (IEPA) 303(d) List of Impaired Waters. These waterbodies are displayed in Figures 1.3 and 1.4.

Drury Creek (IL_NDC) meanders 21 miles in a northerly direction through the center of the southern two subwatersheds converging with Crab Orchard Creek. Indian Creek (IL_NDCB) runs 11 miles in a similar direction before meeting Drury Creek. Sycamore Creek (IL_NDCA) also runs north, sourced from Spring Arbor Lake, and eventually converging with Drury Creek.

Crab Orchard Creek (IL_ND) flows from the Crab Orchard Lake spillway in the easternmost portion of the planning area, eventually ending at the confluence with the Big Muddy River. Larger tributaries that feed into Crab Orchard Creek include: Piles Fork Creek (IL_NDB), Eek Creek (IL_NDBA), and Little Crab Orchard Creek-West (IL_NDA); all of which are reported on the IEPA 303(d) List of Impaired Waters. Other smaller, unnamed tributaries run throughout the planning area in various directions, all flowing directly or indirectly into the main waterbodies.

Three lakes are also represented in the planning area. These include Carbondale City Lake, Campus Lake, and Spring Arbor Lake. Carbondale City Lake (IL_RNI), or Carbondale Reservoir, serves as a backup water source to Cedar Lake and remains an active recreational location. Campus Lake (IL_RNZH) is located on the campus of Southern Illinois University- Carbondale. While these two lakes are listed on the IEPA 303(d) Report, Spring Arbor Lake (IL_RNZG) is not impaired and remains a private waterbody. However, it is listed as an IEPA 305(b) assessed waterbody.

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 Western Crab Orchard Creek watershed: freshwater emergent, freshwater forested/ shrub, freshwater pond, lake, and riverine. Table 1.1 contains information on the distribution of wetlands. Freshwater forested and shrub wetland is the most apparent wetland classification in the watershed consisting of

2,186 acres, or accounting for nearly four percent of the watershed. Wetlands have also been spatially displayed in Figure 1.5.

Table 1.1- Distribution of Wetlands

Western Crab Orchard Creek Watershed			
Wetland Type	**Acres**	**Percent of Wetland Total**	**Percent of Total Watershed**
Freshwater Emergent	128.14	3.54%	0.23%
Freshwater Forested/ Shrub	2,186.06	60.36%	3.87%
Freshwater Pond	513.55	14.18%	0.91%
Lake	227.13	6.27%	0.40%
Riverine	566.76	15.65%	1.00%
Drury Creek Subwatershed			
Freshwater Emergent	13.41	3.22%	0.02%
Freshwater Forested/ Shrub	205.22	49.29%	0.36%
Freshwater Pond	97.61	23.45%	0.17%
Lake	0	0.00%	0.00%
Riverine	100.07	24.04%	0.18%
Indian Creek- Drury Creek Subwatershed			
Freshwater Emergent	47.47	4.82%	0.08%
Freshwater Forested/ Shrub	491.62	49.91%	0.87%
Freshwater Pond	177.86	18.06%	0.31%
Lake	67.43	6.85%	0.12%
Riverine	200.67	20.37%	0.35%
Little Crab Orchard Creek- Crab Orchard Creek Subwatershed			
Freshwater Emergent	67.25	3.03%	0.12%
Freshwater Forested/ Shrub	1,489.21	67.08%	2.63%
Freshwater Pond	238.07	10.72%	0.42%
Lake	159.7	7.19%	0.28%
Riverine	266	11.98%	0.47%

Source: US Fish and Wildlife Service National Wetlands Inventory

Figure 1.4

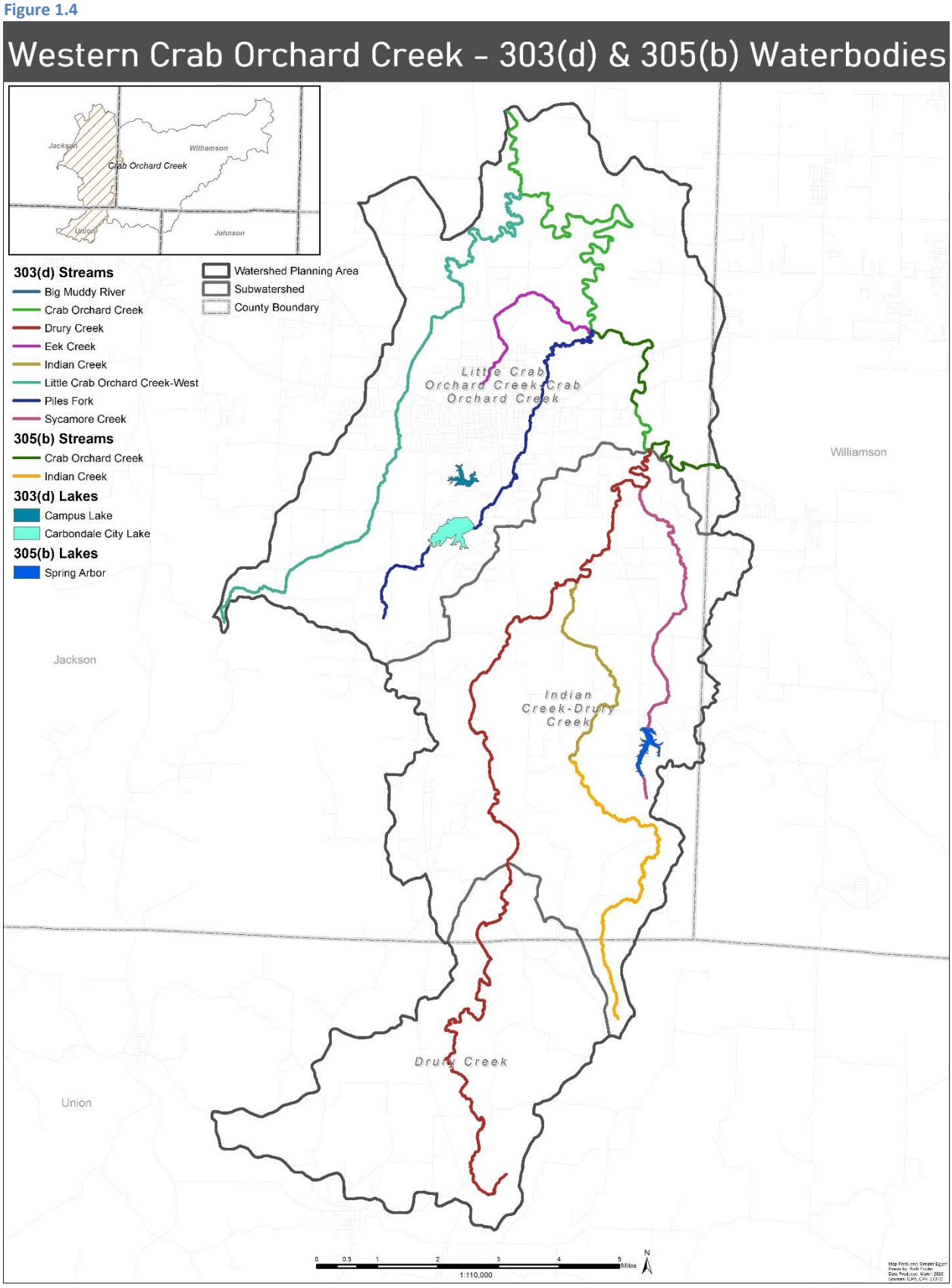
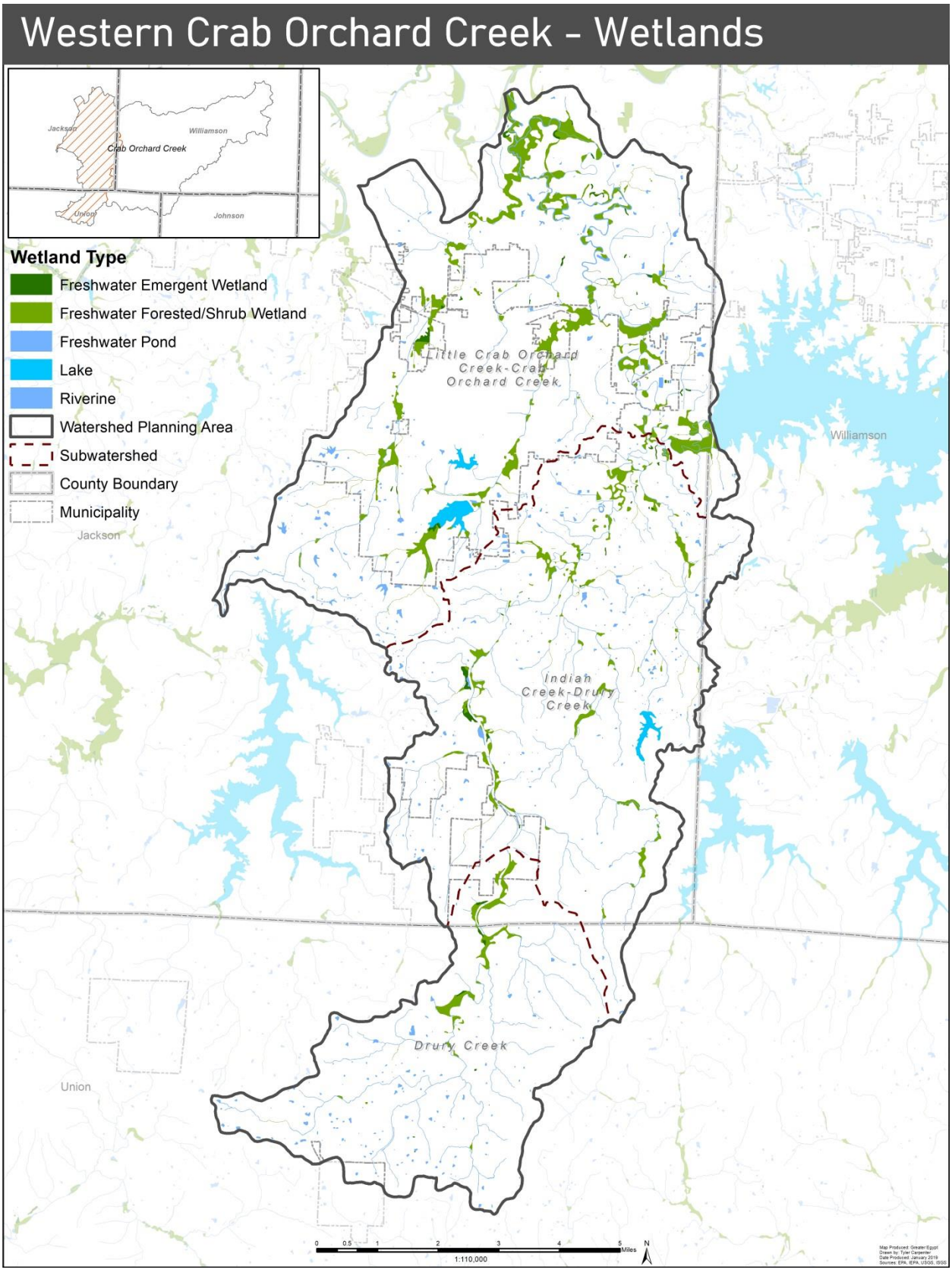

Western Crab Orchard Creek – 303(d) & 305(b) Waterbodies
Jackson
Williamson
Crab Orchard Creek
Union
Johnson
303(d) Streams
Big Muddy River
Crab Orchard Creek
Drury Creek
Eek Creek
Indian Creek
Little Crab Orchard Creek-West
Piles Fork
Sycamore Creek
305(b) Streams
Crab Orchard Creek
Indian Creek
303(d) Lakes
Campus Lake
Carbondale City Lake
305(b) Lakes
Spring Arbor
Watershed Planning Area
Subwatershed
County Boundary
Little Crab Orchard Creek-Crab Orchard Creek
Indian Creek-Drury Creek
Drury Creek
Williamson
Jackson
Union
0 0.5 1 2 3 4 5 Miles
1:110,000
N

Figure 1.5


Western Crab Orchard Creek – Wetlands
Jackson
Williamson
Crab Orchard Creek
Union
Johnson
Wetland Type
Freshwater Emergent Wetland
Freshwater Forested/Shrub Wetland
Freshwater Pond
Lake
Riverine
Watershed Planning Area
Subwatershed
County Boundary
Municipality
Little Crab Orchard Creek-Crab Orchard Creek
Indian Creek-Drury Creek
Drury Creek
Williamson
Jackson
Union
0 0.5 1 2 3 4 5 Miles
1:110,000
N

1.3 Topography

The Western Crab Orchard Creek watershed is situated on the southern limit of the glacial till from the Illinoisan age. A portion of the watershed is relatively flat, with gentle slopes near the headwaters and the southern border. This is most evident in the Little Crab Orchard Creek subwatershed. Indian Creek subwatershed represents the transition to higher elevation. This is more apparent at its southern border.

Drury Creek subwatershed exhibits the most elevated terrain at 890 feet. Its highest elevation occurs at the eastern border of the watershed at the foothills of the Shawnee National Forest. The general topography of the planning area is consistent with the surrounding watersheds of southern Illinois. Figure 1.6 displays the elevation and floodplain of the watershed. The lowest elevations is found in the northern section of Little Crab Orchard subwatershed at the confluence of the Big Muddy River; approximately 353 feet. The watershed features an elongated shape with a mainly dendritic drainage pattern. Other areas in the watershed feature a contorted drainage pattern.

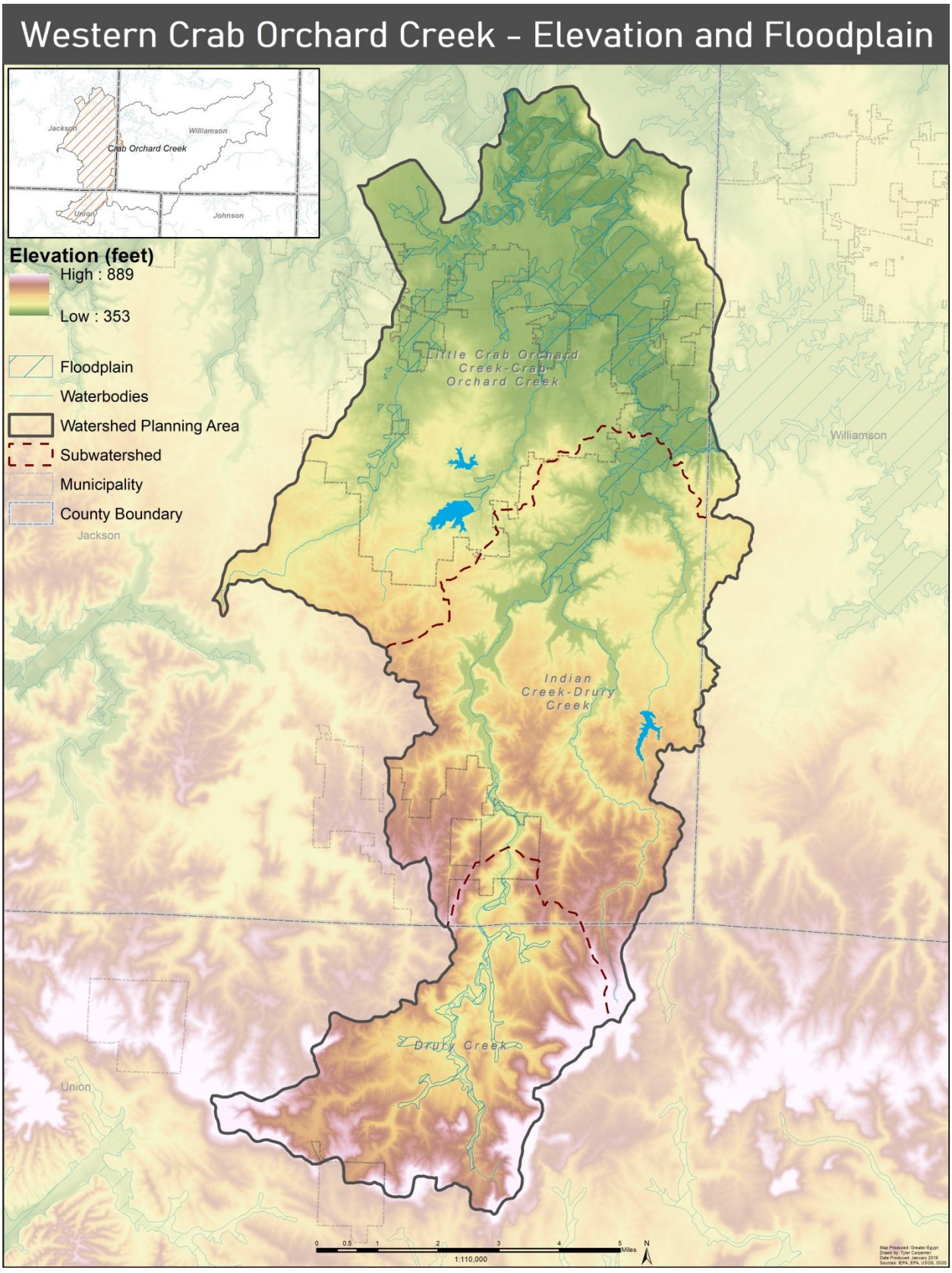
Around 11.84 percent (6,691 acres) of the watershed is in the floodplain. Floodplain information can be found in Table 1.2. Much of the floodplain is located in the northern basin of the Little Crab Orchard subwatershed. While most of this area is agricultural and forested, there are areas in Carbondale within the floodplain. Flooding in these areas tends to be localized.

Table 1.2- Floodplain Distribution by Subwatershed

Floodplain Distribution				
Watershed	Acres	Percent of Total Floodplain	Percent of Total Watershed	Percent of Sub Watershed
Western Crab Orchard Creek	6691.36	100.00%	11.84%	-
Little Crab Orchard	5262.93	78.65%	9.31%	21.45%
Indian Creek	828.77	12.39%	1.47%	4.03%
Drury Creek	599.64	8.96%	1.06%	5.24%

Source: ISWS, ISGS

Figure 1.6


Western Crab Orchard Creek – Elevation and Floodplain
Jackson
Williamson
Crab Orchard Creek
Union
Johnson
Elevation (feet)
High : 889
Low : 353
Floodplain
Waterbodies
Watershed Planning Area
Subwatershed
Municipality
County Boundary
Jackson
Little Crab Orchard Creek-Crab Orchard Creek
Williamson
Indian Creek-Drury Creek
Drury Creek
Union
0 0.5 1 2 3 4 5 Miles
1:110,000
N

1.4 Subwatersheds and Subwatershed Management Units (SMU)

The Western Crab Orchard Creek watershed, specifically the HUC 12 subwatersheds, have been delineated further into 32 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 given a name. This information can be found in Table 1.3, and illustrated in Figure 1.7. This table also provides acreage and the major tributary found within each unit. Detailed information for the subwatersheds can be found in later chapters.

Drury Creek Subwatershed (071401060807)

The Drury Creek subwatershed is the smallest of the three watersheds in the planning area with 11,452 acres. Seven SMUs are located within the Drury Creek subwatershed boundary. At 3,344 acres, the Cobden- North SMU is the largest in area. Drury Creek (IL_NDC) runs in a northerly direction through three of the SMUs; Upper Drury Creek, Shawnee- Drury Creek, and Makanda- South: Drury Creek. A small portion of the Village of Cobden is represented by SMU 2, Cobden – North. The majority of the Drury Creek watershed is situated in Union County, Illinois.

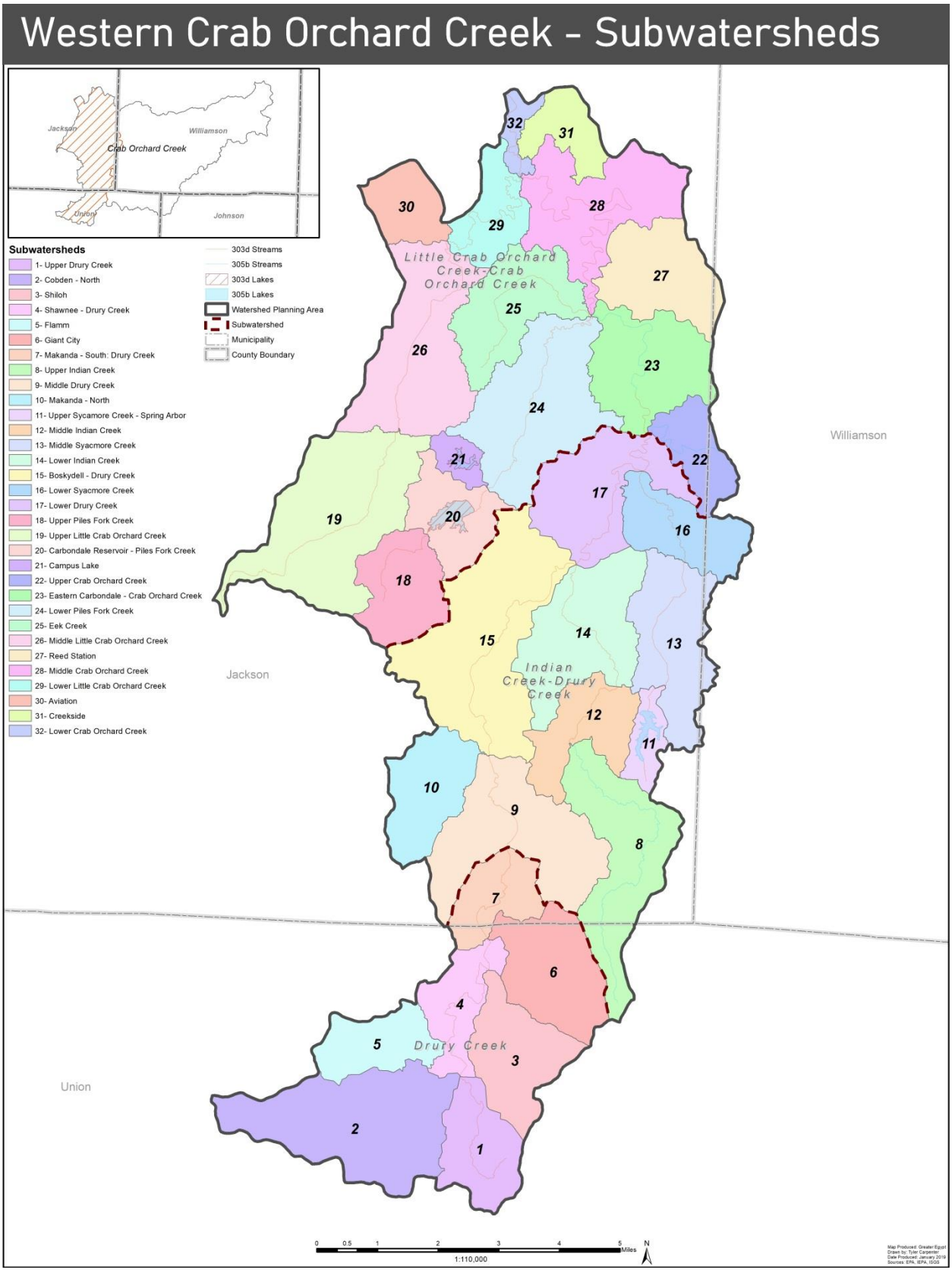
The subwatershed mainly consists of deciduous forest (67 percent) and pasture/hay (21 percent) land use classifications. Developed areas only account for ten percent of the subwatershed total. Since development in the Drury Creek subwatershed is limited, the amount of impervious surfaces is also lower than other HUC 12 subwatersheds in the planning area. Ninety percent of the Drury Creek subwatershed exhibits no impervious features.

The sole water quality impairment in the subwatershed is Dissolved Oxygen. This mainly affects the subwatershed management units in which Drury Creek is located.

Table 1.3- SMU Information

MAP ID	SUBWATERSHED MANAGEMENT UNIT NAME	ACRES	HUC 14 CODE	MAJOR TRIBUTARY
Drury Creek Subwatershed				
1	Upper Drury Creek	1,348.55	07140106080701	Drury Creek
2	Cobden - North	3,344.13	07140106080702	-
3	Shiloh	1,646.71	07140106080703	-
4	Shawnee - Drury Creek	1,117.47	07140106080704	Drury Creek
5	Flamm	1,133.12	07140106080705	-
6	Giant City	1,834.83	07140106080706	-
7	Makanda - South: Drury Creek	1,029.51	07140106080707	Drury Creek
Indian Creek Subwatershed				
8	Upper Indian Creek	2,563.94	07140106080801	Indian Creek
9	Middle Drury Creek	2,759.19	07140106080802	Drury Creek
10	Makanda - North	1,482.13	07140106080803	-
11	Upper Sycamore Creek- Spring Arbor	5,21.372	07140106080804	Sycamore Creek
12	Middle Indian Creek	1,343.18	07140106080806	Indian Creek
13	Middle Sycamore Creek	2,034.89	07140106080805	Sycamore Creek
14	Lower Indian Creek	2,353.19	07140106080807	Indian Creek
15	Boskydell - Drury Creek	3,986.28	07140106080808	Drury Creek
16	Lower Sycamore Creek	1,363.05	07140106080809	Sycamore Creek
17	Lower Drury Creek	2,132.47	07140106080810	Drury Creek
Little Crab Orchard Creek Subwatershed				
18	Upper Piles Fork Creek	1,415.24	07140106080901	Piles Fork Creek
19	Upper Little Crab Orchard Creek	3,661.83	07140106080902	Little Crab Orchard Creek-West
20	Carbondale Reservoir- Piles Fork Creek	1,232.67	07140106080903	Piles Fork Creek
21	Campus Lake	346.65	07140106080904	-
22	Upper Crab Orchard Creek	939.718	07140106080905	Crab Orchard Creek
23	Eastern Carbondale - Crab Orchard Creek	2,024.58	07140106080906	Crab Orchard Creek
24	Lower Piles Fork Creek	2,951.01	07140106080907	Piles Fork Creek
25	Eek Creek	1,820.70	07140106080908	Eek Creek
26	Middle Little Crab Orchard Creek	2,903.56	07140106080909	Little Crab Orchard Creek-West
27	Reed Station	1,755.61	07140106080910	-
28	Middle Crab Orchard Creek	2,443.75	07140106080911	Crab Orchard Creek
29	Lower Little Crab Orchard Creek	1,017.33	07140106080912	Little Crab Orchard Creek-West
30	Aviation	895.507	07140106080913	-
31	Creekside	810.324	07140106080914	-
32	Lower Crab Orchard Creek	320.312	07140106080915	Crab Orchard Creek

Figure 1.7


Western Crab Orchard Creek – Subwatersheds
Jackson
Williamson
Crab Orchard Creek
Union
Johnson
Subwatersheds
1- Upper Drury Creek
2- Cobden - North
3- Shiloh
4- Shawnee - Drury Creek
5- Flamm
6- Giant City
7- Makanda - South: Drury Creek
8- Upper Indian Creek
9- Middle Drury Creek
10- Makanda - North
11- Upper Sycamore Creek - Spring Arbor
12- Middle Indian Creek
13- Middle Syacmore Creek
14- Lower Indian Creek
15- Boskydell - Drury Creek
16- Lower Syacmore Creek
17- Lower Drury Creek
18- Upper Piles Fork Creek
19- Upper Little Crab Orchard Creek
20- Carbondale Reservoir - Piles Fork Creek
21- Campus Lake
22- Upper Crab Orchard Creek
23- Eastern Carbondale - Crab Orchard Creek
24- Lower Piles Fork Creek
25- Eek Creek
26- Middle Little Crab Orchard Creek
27- Reed Station
28- Middle Crab Orchard Creek
29- Lower Little Crab Orchard Creek
30- Aviation
31- Creekside
32- Lower Crab Orchard Creek
303d Streams
305b Streams
303d Lakes
305b Lakes
Watershed Planning Area
Subwatershed
Municipality
County Boundary
Little Crab Orchard Creek-Crab Orchard Creek
Indian Creek-Drury Creek
Drury Creek
0 0.5 1 2 3 4 5 Miles
1:110,000
N

Indian Creek- Drury Creek Subwatershed (071401060808)

At 20,537 acres, the Indian Creek- Drury Creek subwatershed is represented by ten subwatershed management units. The watershed features three streams located on the IEPA 303(d) List of impaired Waters. These include Indian Creek, Sycamore Creek, and the remaining segment of Drury Creek. These waterbodies generally run in a parallel, northerly direction. Spring Arbor Lake also represents the largest lake in the subwatershed; located in the Upper Sycamore Creek- Spring Arbor SMU.

The Indian Creek- Drury Creek subwatershed features a similar land use composition to Drury Creek subwatershed. Deciduous forest accounts for 65 percent of the total land use acreage, or 13,398 acres. Pasture/hay constitutes nearly 16 percent of the total land use. Development in the subwatershed consists of 2,900 acres, or around 14 percent of the subwatershed.

Impaired waterbodies are common in the subwatershed. Drury Creek ends at the confluence of Crab Orchard Creek in the Lower Drury Creek SMU. One reach of Indian Creek (IL_NDCB-01) is impaired by dissolved oxygen. Sycamore Creek (IL_NDCA), the source being Spring Arbor Lake, is also impaired by dissolved oxygen. The waterbody also exhibits impairments by pH.

Little Crab Orchard Creek- Crab Orchard Creek Subwatershed (071401060809)

The Little Crab Orchard Creek- Crab Orchard Creek subwatershed represents the largest HUC 12 watershed in the planning area. With 24,536 acres of mixed land use classes, the watershed exhibits different characteristics than the other HUC 12 watersheds. The watershed features many more waterbodies; most of them being on the IEPA 303(d) List of Impaired Waters.

Land use in the subwatershed is mainly characterized by deciduous forest, development, and pasture/hay. While deciduous forest accounts for nearly 31 percent, or 7,539 acres, of the subwatershed, development is also a major feature in the subwatershed. Because a large percentage of the City of Carbondale is within the subwatershed boundary, almost 30 percent of the area is considered developed. Since 7,265 acres of urban development is present, the amount of impervious surfaces also rises significantly.

Six waterbodies in the Little Crab Orchard Creek- Crab Orchard Creek subwatershed are impaired. Two sections of Crab Orchard Creek are impaired by mercury (IL_ND-01) and other unknown causes (IL_ND-11). This main channel through the subwatershed is where all other tributaries flow. Piles Fork Creek (IL_NDB-03) runs through three separate SMUs and is impaired by methoxychlor. The creek also runs through the Carbondale City Lake (IL_RNI), which is impaired by mercury and total suspended solids (TSS). Eek Creek (IL_NDBA-01) to the north is impaired by dissolved oxygen and water temperature. Similar to Piles Fork Creek, Little Crab Orchard Creek- West (IL_NDA-01) is impaired by methoxychlor. IEPA lists mercury, polychlorinated biphenyls (PCBs), and TSS as impairments to Campus Lake (IL_RNZH).

1.5 Climate

The climate in the Western Crab Orchard Creek watershed borders the Humid Subtropical and Humid Continental climates. Weather in the region is influenced by warm air from the gulf, cold air from Canada, and eastward air from the southwest. The terrain in has no impact on the climate. [1]

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 observation station located at the Carbondale Sewage Plant. The average temperature between 2000 and 2018 was 56.3 degrees Fahrenheit.[2] The average daily high and low were 58.6 and 52.7. Table 1.4 summarizes temperature information for the time between 2000 and 2018.

Table 1.4- 2000-2018 Monthly Average Temperatures

2000-2018 MONTHLY AVERAGE TEMPERATURES (degrees Farenheit)													
	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	73.4	62.1	50.6	45.8	58.6
Average	32.6	35.7	46.1	56.9	66.5	75.1	77.8	76.5	69.1	57.5	46.1	36	56.3
Average Low	25.1	24	38.1	48.8	63	69.6	70.7	71.7	65.4	53.7	37.6	23.4	52.7

Source: NOAA- National Climatic Data Search

The Western Crab Orchard Creek watershed 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 49.29 inches between 2000 and 2018. The wettest months are typically from March to June. Average snowfall amounts in the region are around 11 inches annually. Table 1.5 displays the monthly average precipitation between 2000 and 2018.

[1] David Muir, et al., "Upper Crab Orchard Creek: A Watershed Inventory," Greater Egypt Regional Planning and Development Commission, 1988, 6.
[2] NOAA. "Monthly Mean Avg Temperature for Carbondale Sewage Plant, IL" https://w2.weather.gov /Climate/xmacis.php?wfo=pah. Accessed 25 March 2019.

Table 1.5- 2000-2018 Monthly Average Precipitation

2000-2018 MONTHLY AVERAGE PRECIPITATION (in inches)													
	Jan.	Feb.	Mar.	Apr.	May.	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Annual
Total	2.72	3.24	4.54	5	5.44	4.35	4.76	3.5	3.06	3.65	4.29	4.14	49.29

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 flow into the Mississippi River. 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[3]. Wind speed generally ranges from 3 to 8 miles per hour throughout the year with an average of 6.0 miles per hour in 2018. However, gusts can be 29 to 47 miles per hour in any certain month. There is a prevalent pattern of wind from the south/ southwest. Considering the region is fairly flat, wind direction is caused by incoming weather patterns. Table 1.6 displays the average wind data from the ICN.

Table 1.6- 2018 Wind Data

Month	Average Wind Speed (mph)	Max Speed (mph)	Average Direction (degrees)
Jan	8.0	38.8	225.8
Feb	7.8	42.1	206.8
Mar	7.3	39.2	196.1
Apr	8.3	47.4	184.6
May	5.2	40.2	194.9
Jun	4.6	43.7	202.0
Jul	3.9	29.5	198.5
Aug	4.3	29.3	197.0
Sep	3.8	34.0	169.1
Oct	5.1	30.0	206.3
Nov	6.3	38.5	205.0
Dec	6.8	43.7	202.1
AVG	6.0	38.0	199.0

Source: Illinois Climate Network

[3] ICN, "Water and Atmospheric Resources Monitoring Program," http://www.isws.illinois.edu/warm/datatype.asp. Accessed 25 March 2019.

2. Geology

The Western Crab Orchard 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. [4]

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 2.1.

The Western Crab Orchard Creek watershed encompasses four types of underlying geologic formations. These include: Carbondale (10 percent), Caseyville (8 percent), Tradewater (72), and the Upper Pope Group (10 percent). Accounting for the majority of the underlying formations, Tradewater 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.[5] The Tradewater formation composes the majority of the Little Crab Orchard subwatershed, and nearly the entire area of the Indian Creek- Drury Creek subwatershed. Figure 2.2 displays the geologic units of the Western Crab Orchard Creek watershed and the surrounding area.

The Carbondale formation reaches a thickness of around 500 feet. Gray shales and sandstone compose most of the Carbondale formation.[6] These occur in the northern portion of the watershed in the Little Crab Orchard subwatershed. The Caseyville and Upper Pope Group make up the remaining formations. These are present in the Drury Creek subwatershed to the south.

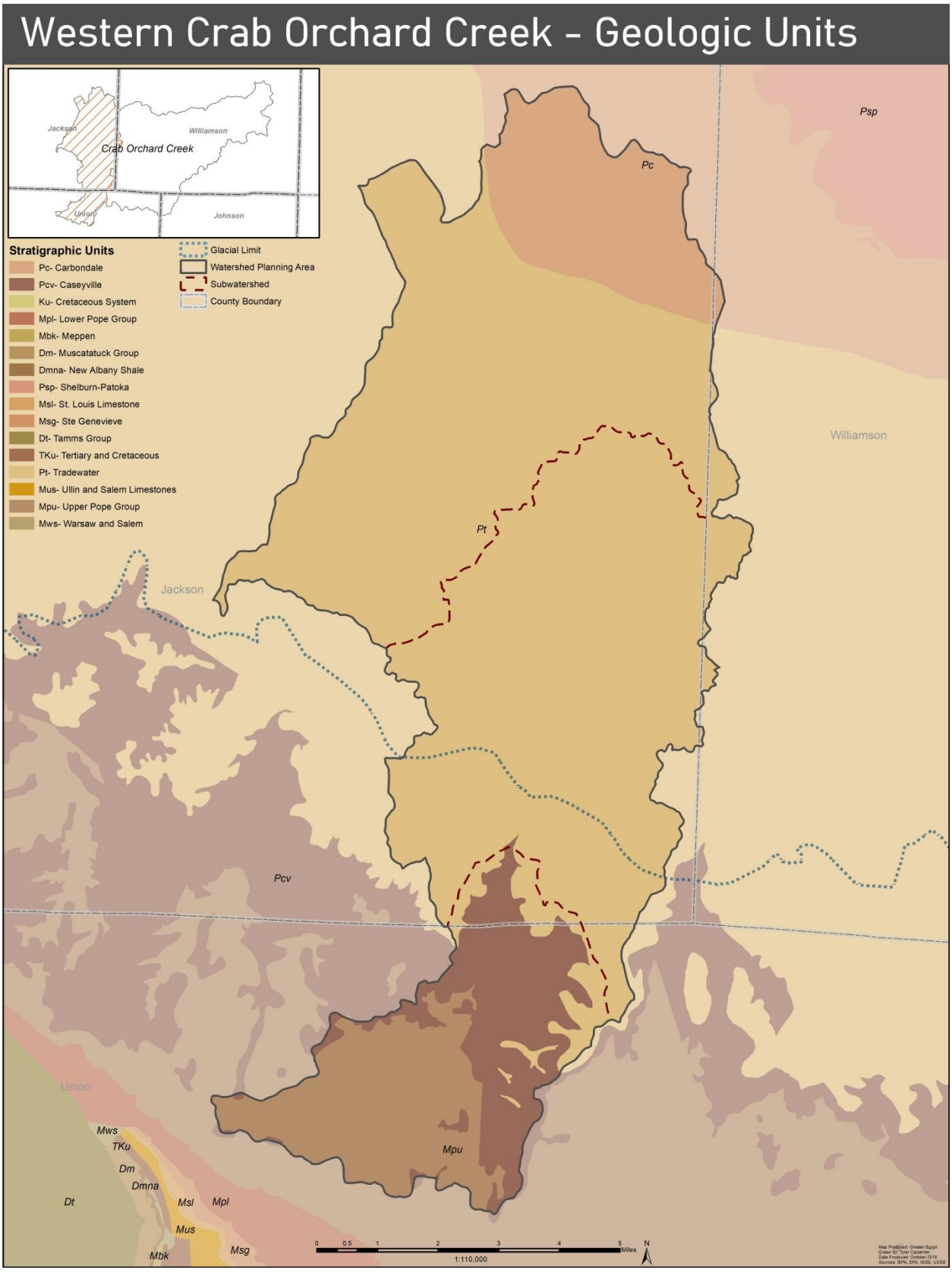
Figure 2.1- Generalized Stratigraphic Column of the Pennsylvanian in Illinois

PENNSYLVANIAN						SYSTEM
MORROWAN	ATOKAN	DESMOINESIAN		MISSOURIAN	VIRGILIAN	SERIES
Racoon Creek Group			McLeansboro			Group
Caseyville	Tradewater	Carbondale	Shelburn	Patoka	Bond / Mattoon	Formation

Source: ISGS (modified)

[4] 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).
[5] 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.
[6] Ibid.

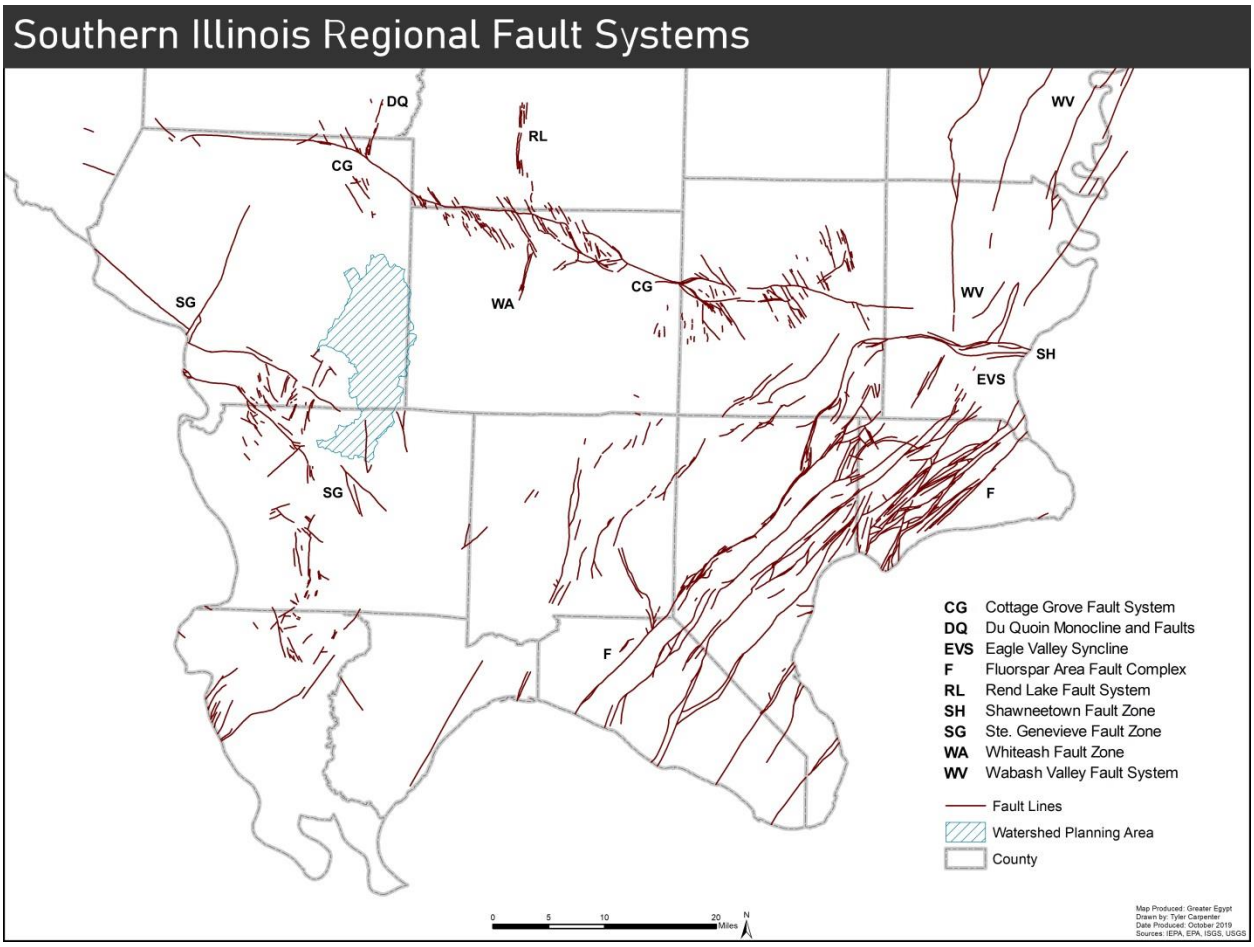
Figure 2.2


Western Crab Orchard Creek – Geologic Units
Jackson
Williamson
Crab Orchard Creek
Union
Johnson
Stratigraphic Units
Pc- Carbondale
Pcv- Caseyville
Ku- Cretaceous System
Mpl- Lower Pope Group
Mbk- Meppen
Dm- Muscatatuck Group
Dmna- New Albany Shale
Psp- Shelburn-Patoka
Msl- St. Louis Limestone
Msg- Ste Genevieve
Dt- Tamms Group
TKu- Tertiary and Cretaceous
Pt- Tradewater
Mus- Ullin and Salem Limestones
Mpu- Upper Pope Group
Mws- Warsaw and Salem
Glacial Limit
Watershed Planning Area
Subwatershed
County Boundary
Psp
Pc
Williamson
Pt
Jackson
Pcv
Union
Mpu
Mws
TKu
Dm
Dmna
Dt
Msl
Mpl
Mus
Mbk
Msg
0 0.5 1 2 3 4 5 Miles
1:110,000
N

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 2.3. Southern Illinois lies just north of the most seismically active area of the Midwest, being the New Madrid Seismic Zone, that lies along the border of Missouri, Arkansas, Kentucky and Tennessee. It also encompasses much of the Wabash Valley Fault Zone.

Figure 2.3



The Western Crab Orchard Creek watershed lies on the eastern edge of the Ste. Genevieve fault zone (Figure 2.3). The fault system runs in a northerly direction extending from Alexander to Randolph County on the Illinois side of the Mississippi River. The planning area is roughly five miles south of the Cottage Grove system.

2.2 Mining

Currently, the watershed does not exhibit any active mining. Mining in the watershed ceased operations in 1977 with the closure of Southern Illinois Minerals, Carbondale No. 1 Mine. Table 2.1 displays mine information for these coal companies. The majority of mining operations occurred during the 1920 to 1930s.[7]

Mining in the area was a comparable combination of surface and underground operations. Two main sites are apparent in Figure 2.4. These occurred southwest of Crab Orchard Lake, and in eastern Carbondale. 430 acres represented the total surface mining in the planning area. Underground mining accounted for 415 acres. The main location of mining activity was divided by Sycamore Creek in the Indian Creek- Drury Creek subwatershed.

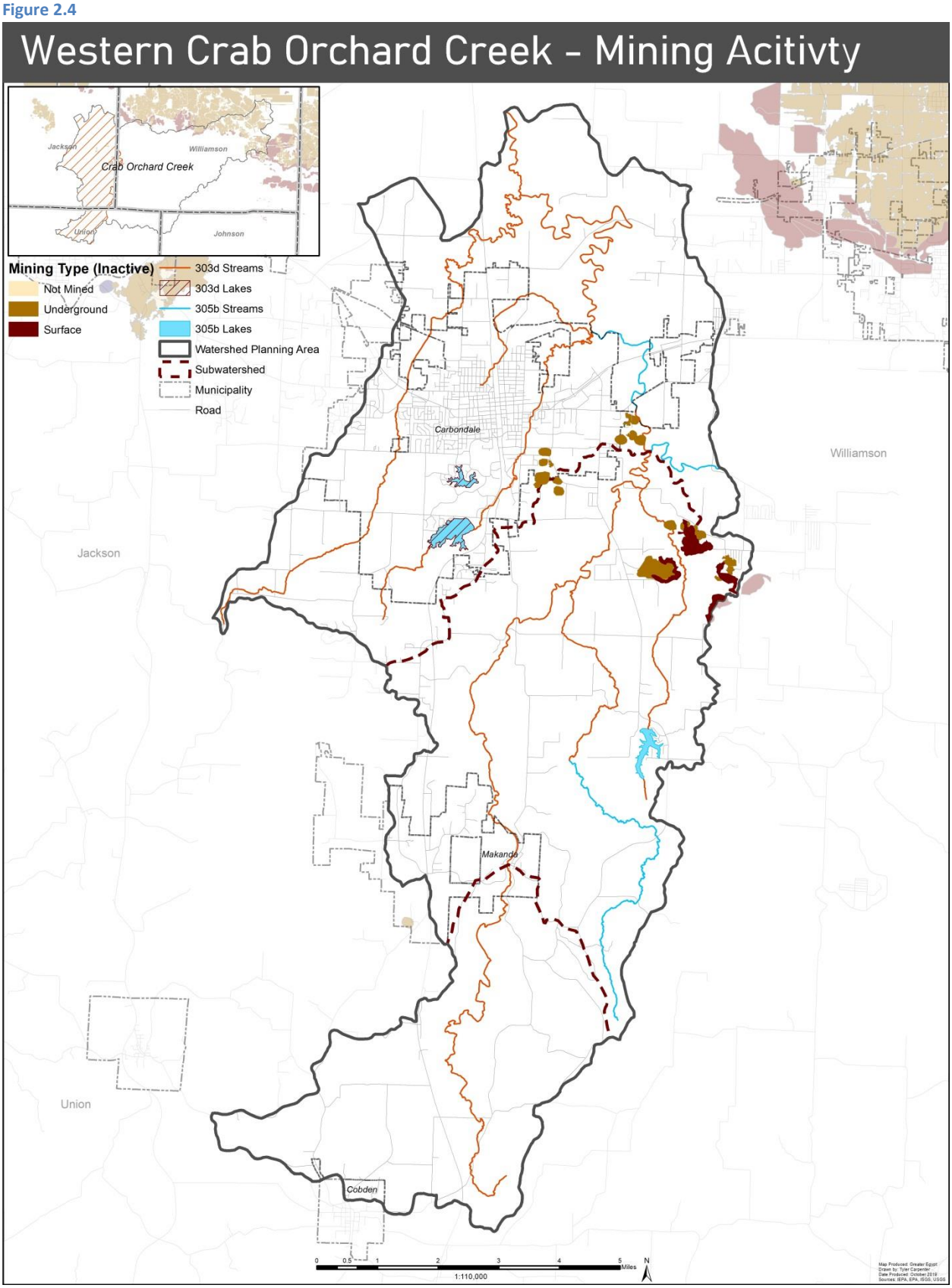
Table 2.1- Mine Company Information

MINING COMPANY	MINE NAME	YEARS ACTIVE	ISGS INDEX NO.
Carbondale Coal Company	Carbondale No.2 Mine	1919-1937	104
Crab Orchard Coal Company	Crab Orchard Mine	1922-1927	2498
Hall & Blake Mine	-	1922-1924	2611
Independent Coal Company	Independent Mine	1927-1935	4233
Jackson County Coal Company	Jackson Mine	1934-1937	2495
John C. Swofford Coal Company	Swofford No.1 Mine	1922-1937	2502
Louis L. McDonald	McDonald Mines	1928-1939	2496
Nu Way Coal Company	Nu Way Mine	1932-1933	7165
Southern Illinois Minerals	Carbondale No.1 Mine	1973-1977	4155
Tab Mining Company	Tab Mine	1967-1972	891
Tregoning Coal Company	Tregoning No.1 Mine	1947-1965	821

Source: Illinois State Geological Survey

[7] Shilts, William, *Directory of Coal Mines in Illinois, 7.5 Quadrangle Series, Carbondale Quadrangle, Jackson County.* Illinois State Geoligical Survey. (Champaign, Illinois, 2008).

Figure 2.4


Western Crab Orchard Creek - Mining Acitivty
Jackson
Williamson
Crab Orchard Creek
Union
Johnson
Mining Type (Inactive)
Not Mined
Underground
Surface
303d Streams
303d Lakes
305b Streams
305b Lakes
Watershed Planning Area
Subwatershed
Municipality
Road
Carbondale
Williamson
Jackson
Makanda
Union
Cobden
0 0.5 1 2 3 4 5 Miles
N
1:110,000

3. Soil Conditions

The United States Department of Agriculture (USDA) Natural Resource Conservation Service (NRCS) soils mapping data (Web Soil Survey) and the Soil Surveys of Jackson, Union, and Williamson Counties (USDA, NRCS) were utilized for the examination of soils within the Western Crab Orchard Creek watershed. The data was utilized to summarize the soil types, hydrologic soil groups, hydric status, soil erodibility, and soil drainage.

3.1. Hydrologic Soil Groups

There are 34 dominant soil types within the Crab Orchard Creek watershed. Figure 3.1 displays the generalized soil series by name and percent of cover in the watershed. Each soil is placed in a specific 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.[8] 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

[8] USDA, NRCS. "Web Soil Survey." http://websoilsurvey.sc.egov.usda.gov/. Accessed: January-December 2019.

potential, soils that have a high water table, soils that have a claypan or clay 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.[9]

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. Information on the hydrologic soil groups and related information can be seen in Table 3.1. These groupings are also spatially depicted in Figure 3.2.

Table 3.1- Hydrologic Soil Groups

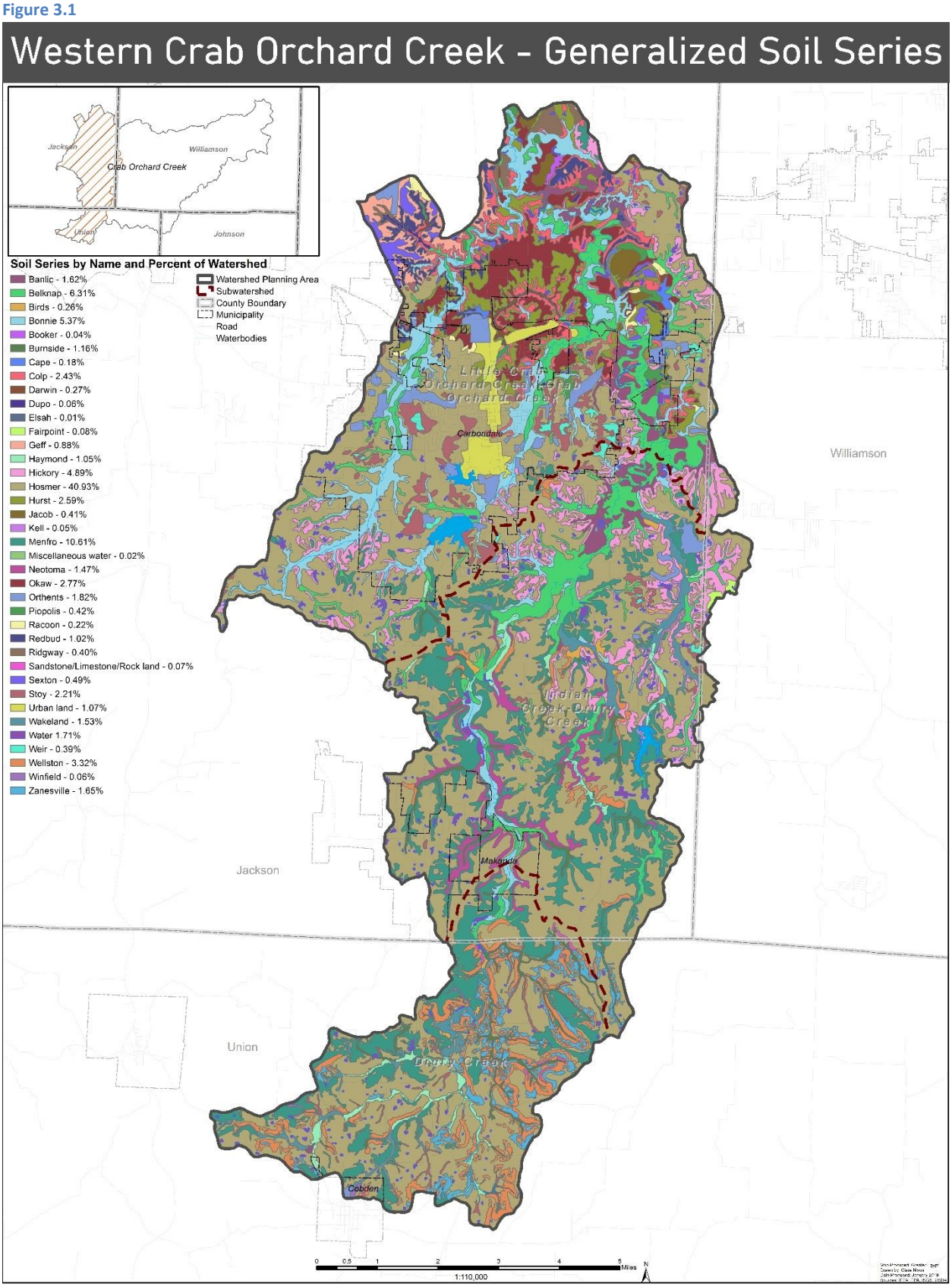
Hydrologic Group	Soil Texture	Drainage	Infiltration	Transmission Rate
A	Sand or Gravel	Deep, Well Drained to Excessively Drained	High	High
B	Moderately Fine to Moderately Coarse	Moderately Deep or Deep, Moderately Well Drained or Well Drained	Moderate	Moderate
C	Moderately Fine to Fine	Layer that Impedes 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 NRCS

Covering approximately 23,142 acres in the Western Crab Orchard Creek watershed, Hosmer is the predominant soil series among the 45 soil types. This also accounts for 41 percent of the watershed. The Menfro soil types are the second most dominant soil type encompassing around 6,001 acres, or around ten percent of the watershed. Menfro soils has three categories in this watershed and consist of Menfro, Menfro-Hickory, and Menfro-Wellston. The Belknap soil type is slightly over half the acreage of Menfro soil, with 3,568 acres, and accounting for six percent of the watershed. Information regarding the Crab Orchard Creek watershed general soil series can be found in Table 3.2. Detailed information for each soil subset is also available in Appendix A.

[9] Ibid.

Figure 3.1


Western Crab Orchard Creek - Generalized Soil Series
Jackson
Williamson
Crab Orchard Creek
Union
Johnson
Soil Series by Name and Percent of Watershed
Banlic - 1.62%
Belknap - 6.31%
Birds - 0.26%
Bonnie 5.37%
Booker - 0.04%
Burnside - 1.16%
Cape - 0.18%
Colp - 2.43%
Darwin - 0.27%
Dupo - 0.06%
Elsah - 0.01%
Fairpoint - 0.08%
Geff - 0.88%
Haymond - 1.05%
Hickory - 4.89%
Hosmer - 40.93%
Hurst - 2.59%
Jacob - 0.41%
Kell - 0.05%
Menfro - 10.61%
Miscellaneous water - 0.02%
Neotoma - 1.47%
Okaw - 2.77%
Orthents - 1.82%
Piopolis - 0.42%
Racoon - 0.22%
Redbud - 1.02%
Ridgway - 0.40%
Sandstone/Limestone/Rock land - 0.07%
Sexton - 0.49%
Stoy - 2.21%
Urban land - 1.07%
Wakeland - 1.53%
Water 1.71%
Weir - 0.39%
Wellston - 3.32%
Winfield - 0.06%
Zanesville - 1.65%
Watershed Planning Area
Subwatershed
County Boundary
Municipality
Road
Waterbodies
Carbondale
Williamson
Jackson
Union
Makanda
Cobden
0 0.5 1 2 3 4 5 Miles
1:110,000
N

Soils in the watershed vary within the hydrologic group classification. Only about one percent, or 823 acres, of soils fall under group A,. Group B consists of 15,806 acres, or 28 percent and is the second largest of the groupings. Group C makes up the largest proportion of the watershed soils with 32,389 acres, or 58 percent. Group D hydrologic classification constitutes about 10 percent, or 5,936 acres of the watershed.

Dual hydrologic soil groups account for one third of the watershed. The soil group B/D is comprised of both Belknap and Wakeland soils, and makes up 5 percent of the watershed. The remaining ten soils are associated with soil group C/D. These include: Banlic, Birds, Bonnie, Colp, Dupo, Geff, Hosmer, Piopolis, Racoon, and Sexton. Information on the hydrologic soil groups and other related information is available in Table 3.2.

Figure 3.2

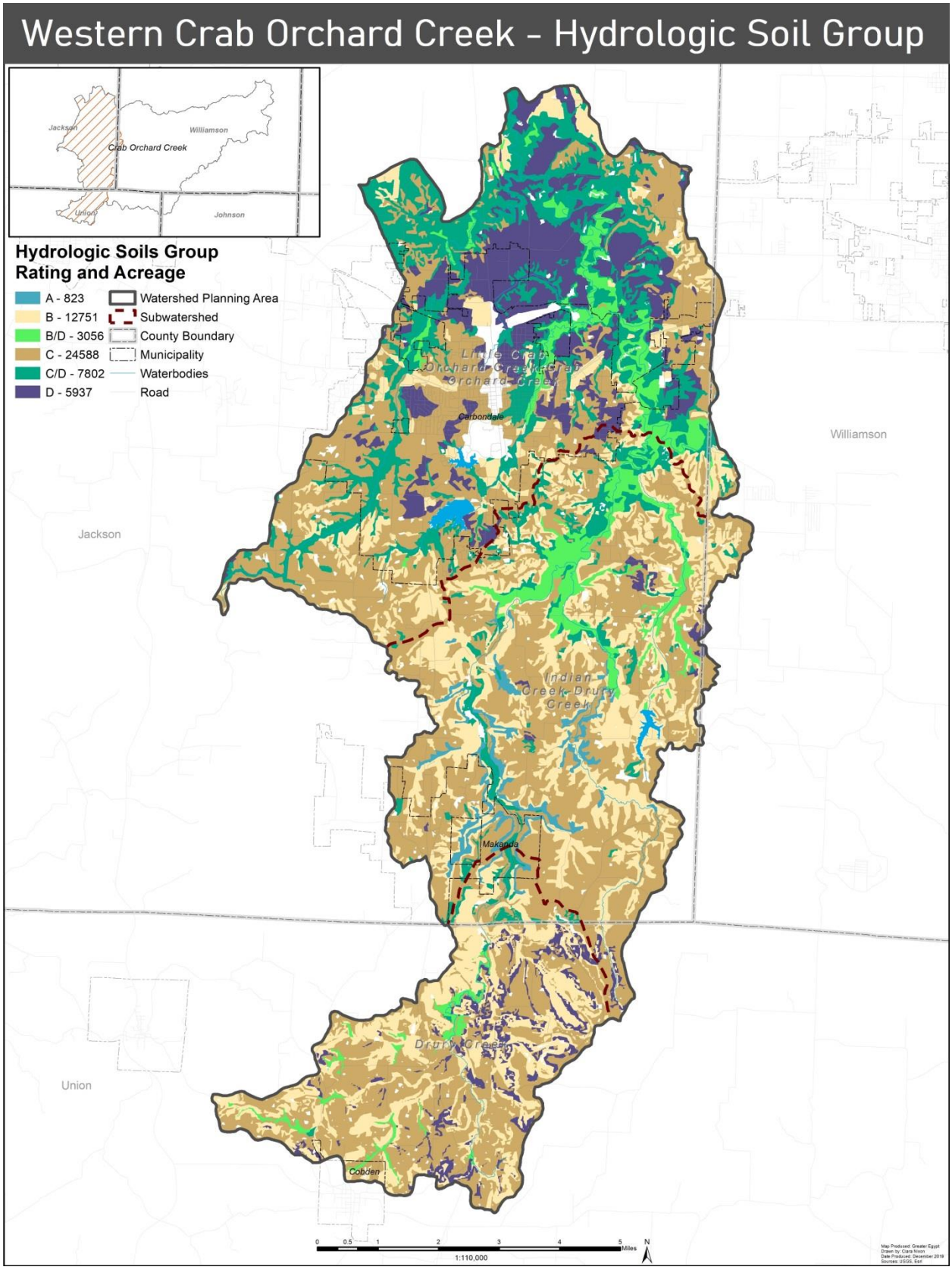

Western Crab Orchard Creek - Hydrologic Soil Group
Jackson
Williamson
Crab Orchard Creek
Union
Johnson
Hydrologic Soils Group Rating and Acreage
A - 823
B - 12751
B/D - 3056
C - 24588
C/D - 7802
D - 5937
Watershed Planning Area
Subwatershed
County Boundary
Municipality
Waterbodies
Road
Little Crab Orchard Creek
Crab Orchard Creek
Carbondale
Williamson
Jackson
Indian Creek-Drury Creek
Makanda
Drury Creek
Union
Cobden
0 0.5 1 2 3 4 5 Miles
1:110,000
N

Table 3.2- Generalized Soils and Classifications

Soil Series	Hydric Y/N	Erodibility K factor	Hydrologic Soil Group	Drainage	Acres	Percent of Watershed
Banlic	N	0.64	C/D	WD	921.2	1.62%
Belknap	N	0.64	B/D	SPD	3,568.1	6.31%
Birds	Y	.49-.55	C/D	PD	147.9	0.26%
Bonnie	Y	0.55	C/D	PD	3,037.7	5.37%
Booker	Y	0.24	D	PD	27.3	0.04%
Burnside	N	0.43	B	WD	659.1	1.16%
Cape	Y	0.43	D	PD	102.6	0.18%
Colp	N	.43-.55	C/D	MWD	1,377.2	2.43%
Darwin	Y	0.37	D	VPD	157.4	0.27%
Dupo	N	0.64	C/D	SPD	35.9	0.06%
Elsah	N	0.49	B	WD	9.8	0.01%
Fairpoint	N	0.28	C	WD	45.7	0.08%
Geff	N	0.55	C/D	SPD	501.4	0.88%
Haymond	N	0.55	B	WD	594.5	1.05%
Hickory	N	.37-.43	B	WD	2,765.4	4.89%
Hosmer	N	0.64	C, C/D	MWD	23,142.2	40.93%
Hurst	N	0.55	D	SPD	1,464.9	2.59%
Jacob	Y	0.24	D	PD	236.4	0.41%
Kell	N	0.43	C	WD	29.8	0.05%
Menfro	N	.43-.64	B, C	WD	6,001.3	10.61%
Miscellaneous water	-	-	-	-	15.6	0.02%
Neotoma	N	0.15	A	WD	835.2	1.47%
Okaw	Y	0.55	D	PD	1,567.2	2.77%
Orthents	N	0.49	B, C	WD	1,029.0	1.82%
Piopolis	Y	0.43	C/D	PD	242.3	0.42%
Racoon	Y	0.49	C/D	PD	125.5	0.22%
Redbud	N	0.55	C	MWD	578.2	1.02%
Ridgway	N	0.43	B	WD	230.0	0.40%
Rock Land	-	-	-	-	41.3	0.07%
Sexton	Y	0.55	C/D	PD	280.3	0.49%
Stoy	N	0.55	D	SPD	1,251.7	2.21%
Urban land	-	-	-	-	609.2	1.07%
Wakeland	N	0.55	B/D	SPD	867.1	1.53%
Water	-	-	-	-	967.8	1.71%
Weir	Y	0.64	D	PD	222.3	0.39%
Wellston	N	0.43	B	WD	1,877.2	3.32%
Winfield	N	.43-.55	C	MWD	32.9	0.06%
Zanesville	N	0.43	C, D	WD	934.0	1.65%

Source: USDA NRCS

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".[10] Of the 34 general soils that comprise the Crab Orchard Creek watershed, 11 are defined as hydric soils. Table 3.3 contains the hydric soils with acreage amounts and percent of watershed. These soils account for 6040.5 acres, or 10.7 percent of the watershed.

At 3,037.7 acres, the Bonnie soil series accounts for the most hydric soil in the watershed. This covers just five percent of the entire watershed. The Okaw soil series is the next largest, covering almost three percent of the watershed, or 1,567.2 acres. The other nine soils cover less than one percent of the watershed. Hydric soils in the watershed are depicted in Figure 3.3.

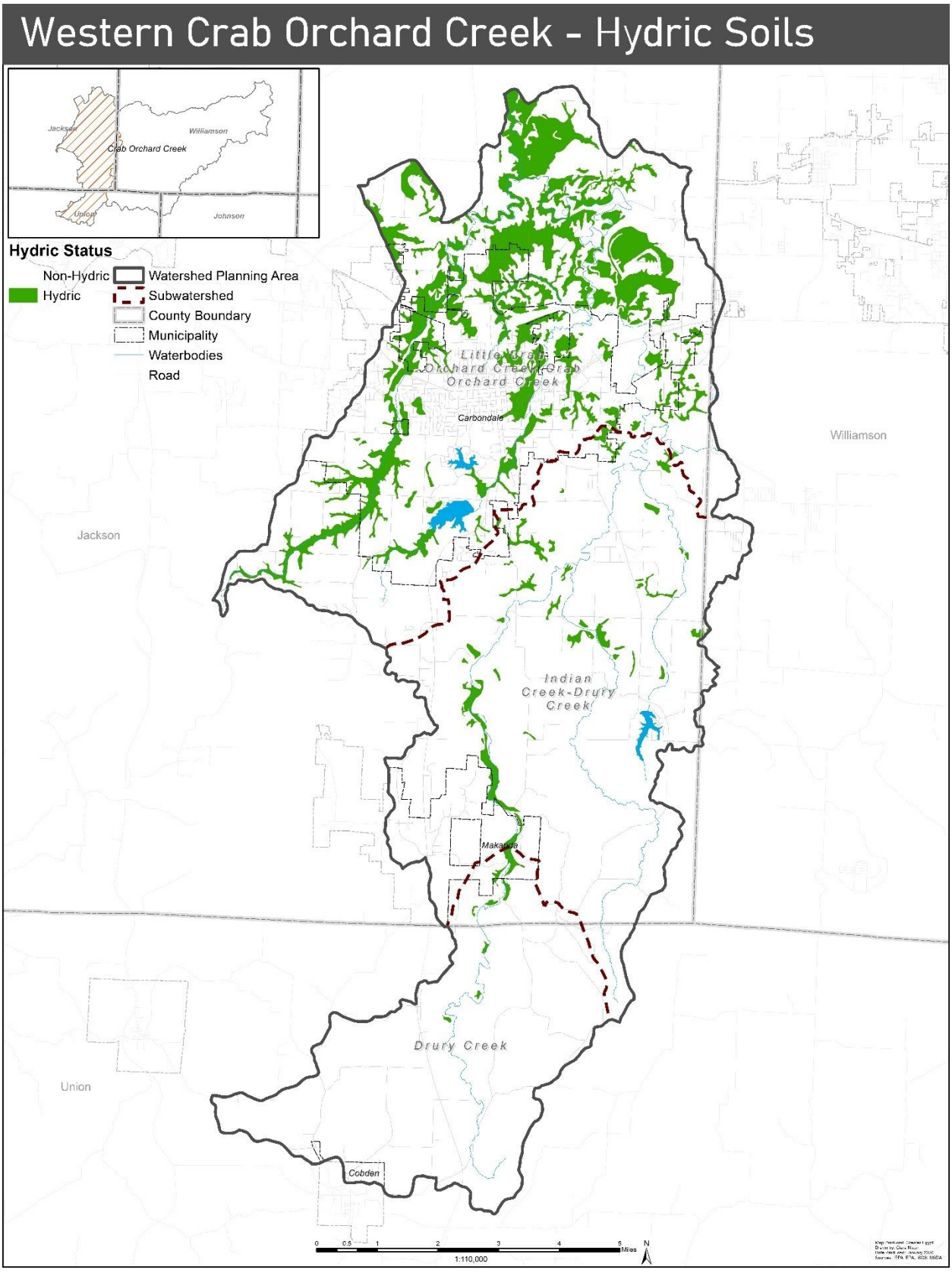
Table 3.3- Hydric Soils

Hydric Soils	Acres	Percent of Watershed
Birds	147.9	0.26%
Bonnie	3037.7	5.37%
Booker	27.3	0.05%
Cape	102.6	0.18%
Darwin	157.4	0.28%
Jacob	236.4	0.42%
Okaw	1567.2	2.77%
Piopolis	242.3	0.43%
Racoon	125.5	0.22%
Sexton	173.8	0.31%
Weir	222.3	0.39%
Totals	**6040.5**	**10.69%**

Source: USDA NRCS

[10] Ibid.

Figure 3.3


Western Crab Orchard Creek - Hydric Soils
Jackson
Williamson
Crab Orchard Creek
Union
Johnson
Hydric Status
Non-Hydric
Hydric
Watershed Planning Area
Subwatershed
County Boundary
Municipality
Waterbodies
Road
Little Crab Orchard Creek-Crab Orchard Creek
Carbondale
Williamson
Jackson
Indian Creek-Drury Creek
Makanda
Drury Creek
Union
Cobden
0 0.5 1 2 3 4 5 Miles
1:110,000
N

3.3 Soil Erodibility

Soil erodibility in the Western Crab Orchard Creek watershed varies by location. The soil erodibility factor (K-factor) was utilized to delineate erodibility. The USDA NRCS defines K-factor as the following:

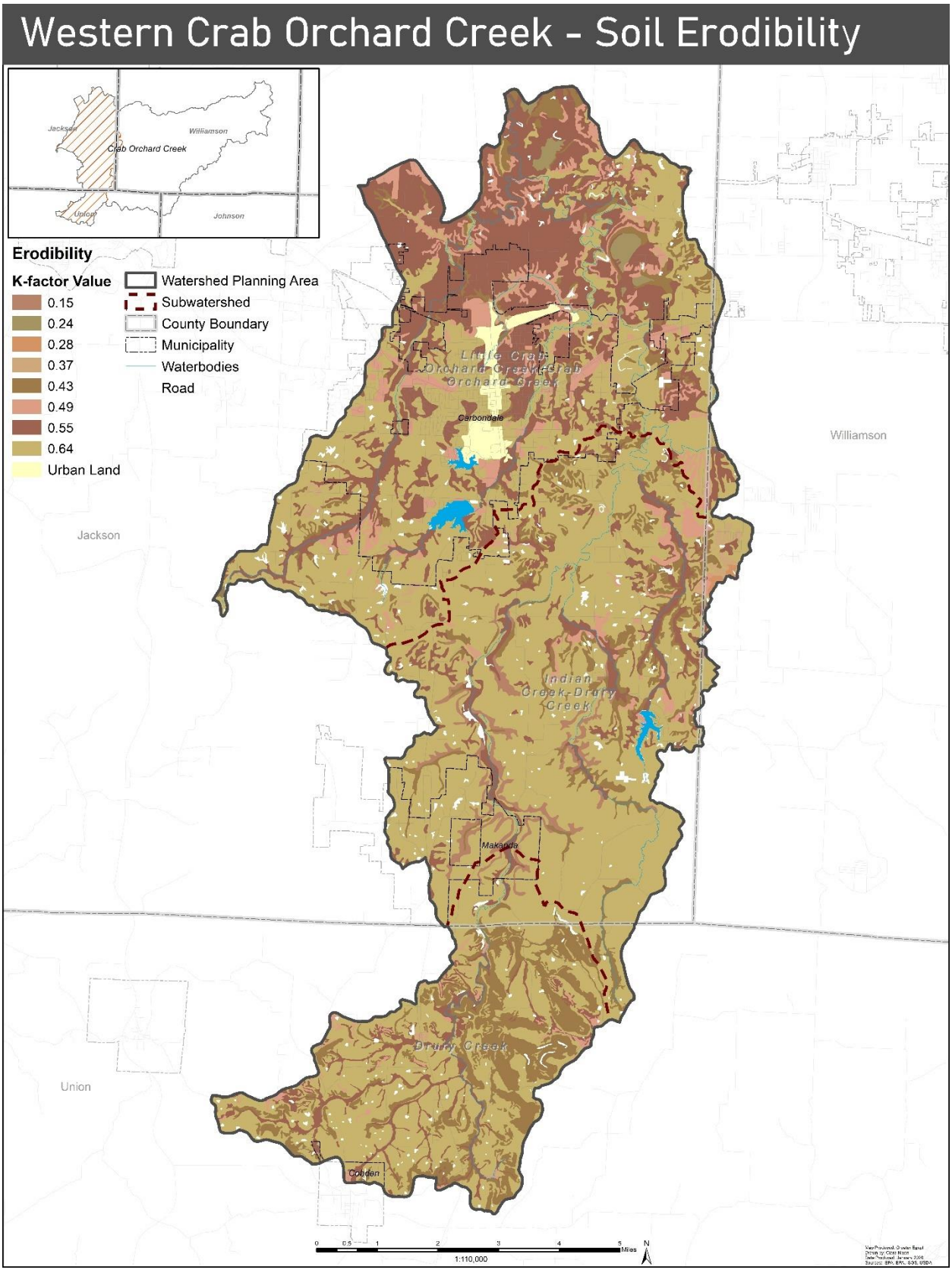
> Erosion factor K indicates the susceptibility of a soil to sheet and rill erosion by water. Factor K is one of six factors used in the Universal Soil Loss Equation (USLE) and the Revised Universal Soil Loss Equation (RUSLE) to predict the average annual rate of soil loss by sheet and rill erosion in 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.[11]

Erodibility correlates with the gradual increase in the K-factor value. The K-factor for soils in the Crab Orchard Creek watershed has eight ranges between .15 to .64. These values usually correlate with other features of the soils including hydric status and drainage classification.

K-factor values can be seen in Table 3.2. The Neotoma series has the lowest K-factor value at .15 while the majority of soils have a K-factor value of .64. Six soil series consist of a K-factor value of .64: Banlic, Belknap, Depo, Hosmer, Menfro, and Weir soil series. These represent the highest erodible soils in the Western Crab Orchard Creek watershed. Soils and their K-factor values are depicted in Figure 3.4.

[11] Ibid.

Figure 3.4


Western Crab Orchard Creek - Soil Erodibility
Jackson
Williamson
Crab Orchard Creek
Union
Johnson
Erodibility
K-factor Value
0.15
0.24
0.28
0.37
0.43
0.49
0.55
0.64
Urban Land
Watershed Planning Area
Subwatershed
County Boundary
Municipality
Waterbodies
Road
Little Crab Orchard Creek-Crab Orchard Creek
Carbondale
Williamson
Jackson
Indian Creek-Drury Creek
Makanda
Drury Creek
Union
Cobden
0 0.5 1 2 3 4 5 Miles
1:110,000
N

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 classes located in the Western Crab Orchard Creek watershed. The USDA defines the classes by the following:

> **Well drained:** 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:** 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 1 m, periodically receive high rainfall, or both.
>
> **Somewhat poorly drained:** 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:** 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.[12]

These five classifications constitute all of the watershed total acreage, excluding the 1.8 percent of water and 609 acres of urban land. Table 3.4 summarizes these values. Most of the soils are moderately well drained at 25,130.5 acres (about 45 percent of the watershed), or well drained at 15,011.1 acres (26 percent). The rest of the watershed is mostly made up of somewhat poorly drained soils at 8,610.3 acres, or (15.4 percent) and poorly drained soils at 6,089.6 acres (10.8 percent). The group with the least representation is very poorly drained soils at 57.4 acres, or 0.1 percent of the watershed. These results are also displayed in Figure 3.5.

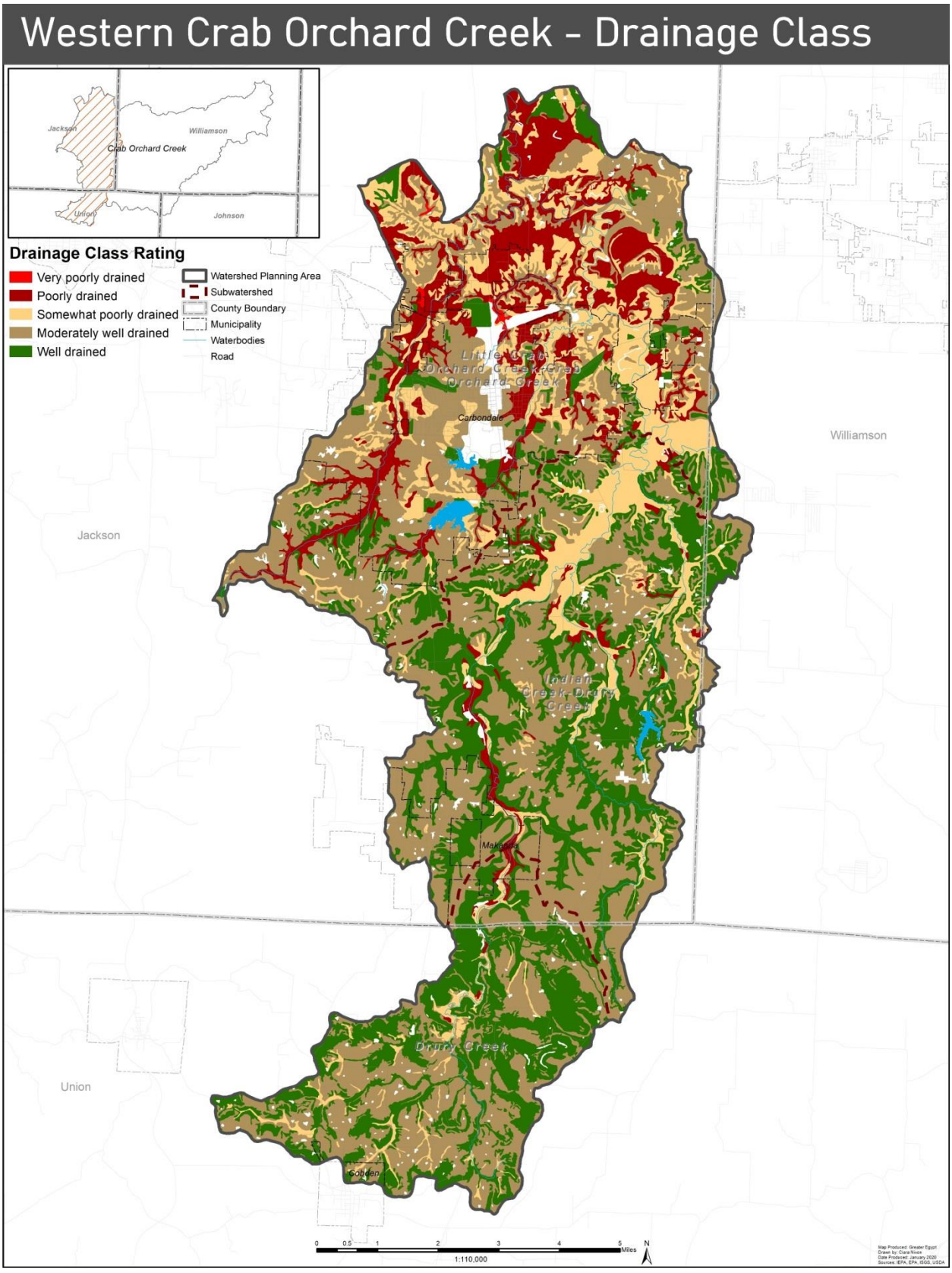
Table 3.4- Drainage Classifications

Drainage Class	Acres	Percent of Watershed
Very Poorly Drained	57.4	0.1%
Poorly Drained	6,089.6	10.8%
Somewhat Poorly Drained	8,610.3	15.4%
Moderately Well Drained	25,130.5	44.9%
Well Drained	15,011.1	26.9%

Source: USDA NRCS

[12] USDA. "Soil Survey Manual." (USDA 1993)

Figure 3.5


Western Crab Orchard Creek – Drainage Class
Jackson
Williamson
Crab Orchard Creek
Union
Johnson
Drainage Class Rating
Very poorly drained
Poorly drained
Somewhat poorly drained
Moderately well drained
Well drained
Watershed Planning Area
Subwatershed
County Boundary
Municipality
Waterbodies
Road
Little Crab Orchard Creek
Crab Orchard Creek
Carbondale
Williamson
Jackson
Indian Creek-Drury Creek
Makanda
Drury Creek
Union
Golden
0 0.5 1 2 3 4 5 Miles
N
1:110,000

4. Watershed Jurisdictions

The Western Crab Orchard Creek watershed lies mainly within Jackson County, with small portions in Williamson and Union Counties. The planning area encompasses the municipalities of Carbondale, Cobden, and Makanda. Only about 22 percent of the watershed is considered municipal.

Civil townships are present in Jackson County while survey townships make up Union and Williamson Counties. Jackson County townships that lie within the watershed include Carbondale, De Soto, Murphysboro, Makanda and Pomona; Cobden precincts One and Two are in Union County; Carterville and Grassy townships are in Williamson County. Table 4.1 displays the townships and their size relative to the watershed while Figure 4.1 spatially depicts the townships. Municipalities are also depicted.

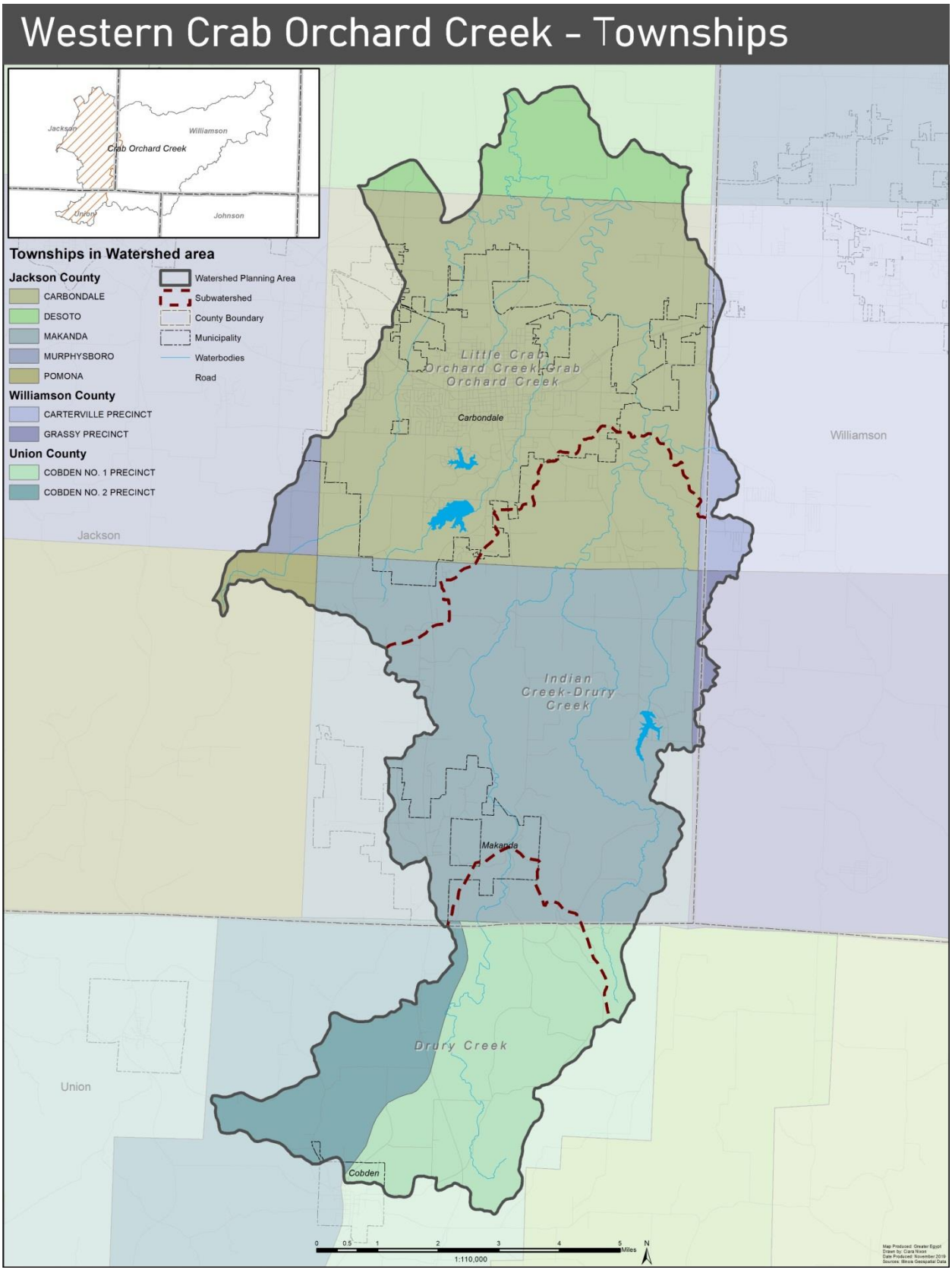
There are two wastewater treatment plants in the watershed, both of which are in Carbondale and are operated by the Carbondale Public Works Department.

Table 4.1 - Jurisdictional Areas

Jurisdiction	Total Acres	Acres in Watershed	Percent of Watershed
County	**940,293**	**56,533**	**100%**
Jackson	385,280	44,136	78%
Union	270,080	10,944	19%
Williamson	284,213	1,451	3%
Municipality	**15,414**	**12,569**	**22%**
Carbondale City	11,211	10,395	18%
Cobden Village	785	166	1%
Makanda Village	3,416	2,007	3%
Township	**196,178**	**56,533**	**100%**
Carbondale	24,481	21,983	40%
Carterville	24,258	1,042	2%
Cobden (No. 1 & 2)	30,137	10,945	19%
DeSoto	15,618	2,867	5%
Grassy	24,200	409	1%
Makanda	23,881	17,976	31%
Murphysboro	23,767	713	1%
Pomona	29,835	597	1%

Sources: US Census Bureau

Figure 4.1


Western Crab Orchard Creek – Townships
Jackson
Williamson
Crab Orchard Creek
Union
Johnson
Townships in Watershed area
Jackson County
CARBONDALE
DESOTO
MAKANDA
MURPHYSBORO
POMONA
Williamson County
CARTERVILLE PRECINCT
GRASSY PRECINCT
Union County
COBDEN NO. 1 PRECINCT
COBDEN NO. 2 PRECINCT
Watershed Planning Area
Subwatershed
County Boundary
Municipality
Waterbodies
Road
Little Crab Orchard Creek-Crab Orchard Creek
Carbondale
Williamson
Jackson
Indian Creek-Drury Creek
Makanda
Drury Creek
Union
Cobden
0 0.5 1 2 3 4 5 Miles
N
1:110,000

4.1. Municipal Ordinances

Municipalities in the Western Crab Orchard Creek watershed have adopted ordinances in regards to flooding. These ordinances include elements of stormwater and erosion control, and often meet the requirements for participation in the National Flood Insurance Plan (NFIP). This program allows homeowners and businesses to purchase flood insurance, as long as the community has adopted and enforced ordinances that reduce the potential for flooding. Since the planning area falls into three different counties and multiple municipalities, each jurisdiction's ordinances will be briefly discussed in this section.

Jackson County jurisdictions in the Western Crab Orchard Creek watershed participate in the NFIP.[13] The Jackson County Flood Damage Prevention Ordinance outlines the requirements to be followed regarding all new and existing developments in the county in order to mitigate and prevent future flood hazards.[14] 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.[15]

Ordinance No. 08-70-31-05 is the Flood Damage Prevention Ordinance for Williamson County. In addition to many other purposes, these ordinances serve to preserve the natural characteristics and functions of watercourses and floodplains in order to moderate flood and stormwater impacts, improve water quality, reduce soil erosion, protect aquatic and riparian habitat, provide recreational opportunities, provide aesthetic benefits and enhance community and economic development.[16] The City of Carterville is listed as a participant in the NFIP.[1]

Union County is also a participant in the NFIP. However, Cobden precincts one and two are not identified in the flood hazard boundary, and therefore do not participate in the program.[17] Cobden's precincts are required to abide by Ordinance No. 08-03-Flood Damage Prevention Ordinance. Municipalities in Union County that do not choose to participate in the NFIP are required by the state to submit a Stormwater Pollution Prevention Plan (SWPPP), under the Illinois Administrative Code Title 35 (Illinois Environmental Protection Act).[4]

[13] 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
[14] Jackson County, IL "Flood Damage Prevention Ordinance" Accessed November, 2019
[15] Greater Egypt Regional Planning and Development Commission, et al. "Jackson County Multi-Hazard Mitigation Plan," Greater Egypt, 2009, 53
[16] Greater Egypt Regional Planning and Development Commission, et al. "Williamson County Multi-Hazard Mitigation Plan," Greater Egypt, 2009, 101-104
[17] Union County, IL "Multi-Hazard Mitigation Plan," Accessed November, 2019

4.2 Local, State and Federal Responsibilities

In the Western Crab Orchard Creek watershed, there are a few 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 Western Crab Orchard Creek watershed, other agencies have programs designated for these purposes, but have not been established for the planning area.

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

Most recently, the Pond Creek Watershed-based Plan was approved by the IEPA in September, 2019. Pond Creek watershed also lies in the larger Big Muddy River watershed. The plan consists of an inventory and assessment and identifies best management practices to control impairments in the watershed. The plan follows the *Nine Minimum Elements of a Watershed Plan* outlined by the EPA.

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 Illinois Department of Natural Resources is responsible for many programs related to water related activities. 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. [18]

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. [19]

Illinois Environmental Protection Agency (IEPA)

The IEPA oversees and implements many programs that target watershed planning, water quality, and nonpoint source pollution. 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:

> 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 5 acres or more or less than 5 acres if they were part of a "larger common plan of development or sale" with a planned land disturbance of 5 acres or greater. Phase II reduced that project size to 1 acre or more.
>
> Phase I of the NPDES Storm Water program began in 1990 and required medium and large municipal separate storm sewer systems (MS4s) to obtain NPDES coverage. The expanded Phase II program began in March 2003 and required small MS4s in urbanized areas to obtain NPDES permits and implement six (6) minimum control measures. An urbanized area as delineated by the Bureau of

[18] IDNR. "Division of Resource Management," https://www.dnr.illinois.gov/WaterResources/Pages/ResMan.aspx. Accessed 11 September 2019.
[19] IDNR, "Permit Program," https://www.dnr.illinois.gov/WaterResources/Pages/PermitPrograms.aspx. Accessed September 2019.

Census is defined as a central place or places and the adjacent densely settled surrounding area that together have a residential population of at least 50,000 people and an overall population density of at least 500 people per square miles.[20]

Western Crab Orchard Creek watershed has a total of 36 outfall locations. These are displayed in Table 4.2. The NPDES Facility locations are also spatially depicted in Figure 4.2. More information on existing and discontinued NPDES facilities can be found in the Water Quality section of this report (Section 8.5).

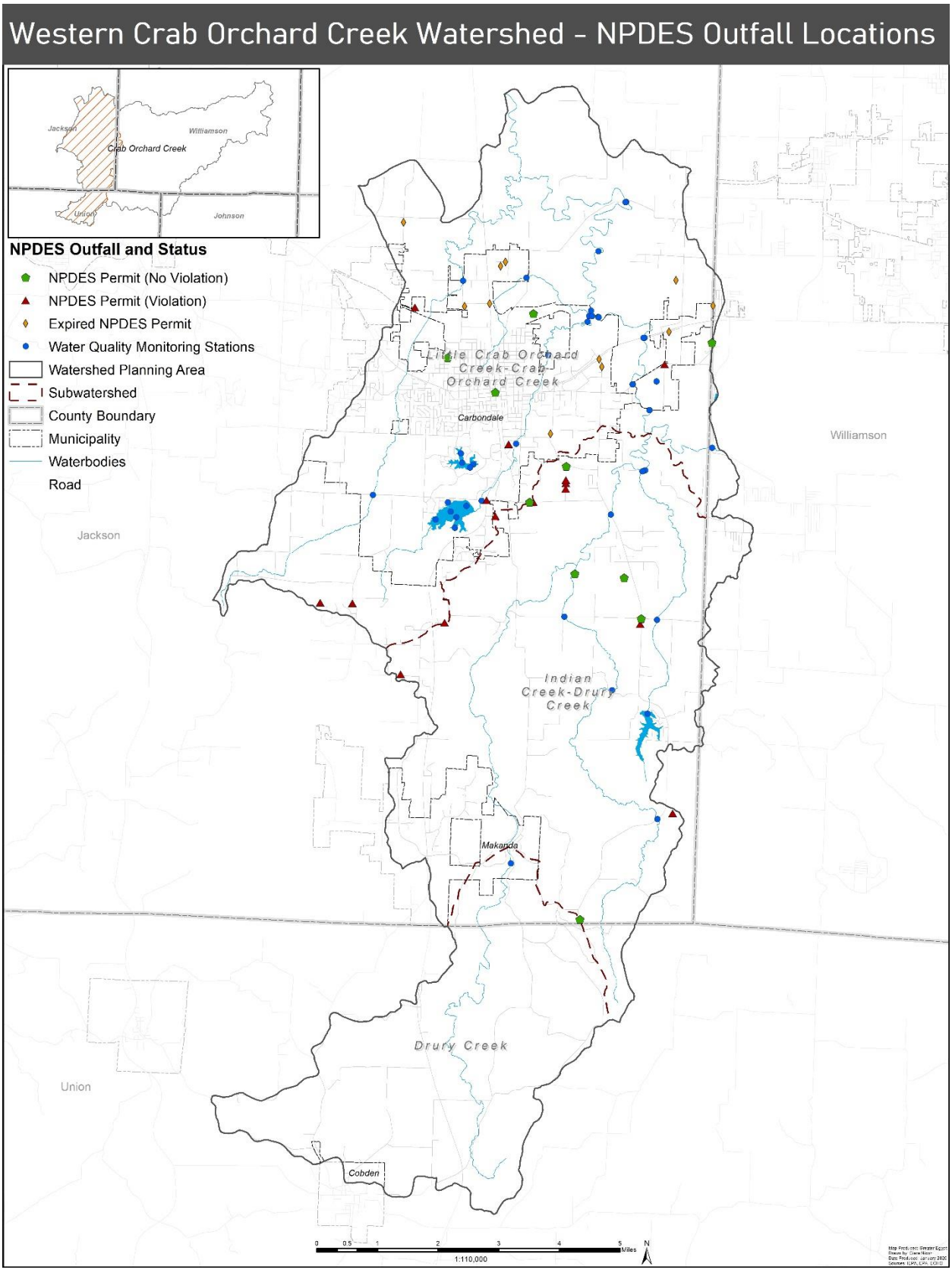
Table 4.2 – NPDES Outfall Locations

NPDES Facility Name	NPDES ID	NPDES Facility Name	NPDES ID
BEAZER EAST INC	IL0000400	JACKSON COUNTY - REED STATION MHP	ILG551008
BECK BUS TRANSPORTATION CORP	ILR006746	KOHLS CARBONDALE	ILR10B215
BUSH MHP STP #1	IL0046078	LAKE INDIAN HILLS SUBDIVISION STP	ILG551075
CARBONDALE BRICK&BLOCK	ILR000263	LENORE BASIN CORP-UNION HILLS	ILG551037
CARBONDALE NORTHWEST WWTP	IL0027871	LILAC BASIN CORP - UNION HILL STP	IL0046221
CARBONDALE, CITY OF	ILR400697	M&M RENTALS MHP	ILG551017
CEDAR LANE MHP #2 STP	ILG551045	PLEASANT HILL MOBILE HOME PARK STP	ILG551059
CHATEAU APARTMENTS	ILG551058	PLEASANT VALLEY MHP - STP	IL0047601
CIMCO RECYCLING CARBONDALE	ILR007139	RACCOON VALLEY MHP	IL0063843
CITY OF CARBONDALE SOUTHEAST STP	IL0027898	S.I. PROPERTIES, LLC	ILG551066
CORNER ONE STOP STP	ILG551016	SALUKI HOMES, LLC STP	IL0038415
CRAB ORCHARD LAKE MHP STP	ILG551019	SIUC PHYSICAL PLANT	IL0072320
FIRST BAPTIST CHURCH	ILR10J477	SIUC-TOUCH OF NATURE ENVIRONMENTAL CENTER	IL0047899
FROST MOBILE HOME PARK STP	IL0047635	SOUTHERN ILL REG SOCIAL SERV	ILR10J647
GIANT CITY SCHOOL DIST 130 STP	IL0025844	SOUTHERN MOBILE HOME PARK STP	ILG551077
GIANT CITY STATE PARK LODGE	IL0049794	TESA TAPE INCORPORATED	ILR001590
HEARTLAND LAKE AND LAND MANAGEMENT	ILG870888	UNITY POINT SCHOOL DIST. 140 STP	IL0045748
ILLINI READY MIX	ILR006463	WILDWOOD MOBILE HOME PARK - STP	IL0037125

Sources: US EPA

[20] Scott Ristau, e-mail message to author, September 9, 2015.

Figure 4.2


Western Crab Orchard Creek Watershed - NPDES Outfall Locations
Jackson
Williamson
Crab Orchard Creek
Union
Johnson
NPDES Outfall and Status
NPDES Permit (No Violation)
NPDES Permit (Violation)
Expired NPDES Permit
Water Quality Monitoring Stations
Watershed Planning Area
Subwatershed
County Boundary
Municipality
Waterbodies
Road
Little Crab Orchard Creek-Crab Orchard Creek
Carbondale
Williamson
Jackson
Indian Creek-Drury Creek
Makanda
Drury Creek
Union
Cobden
0 0.5 1 2 3 4 5 Miles
1:110,000
N

Jackson County Emergency Management Agency (JCEMA)

The Jackson County Emergency Management Agency was established to implement programs that work to reduce community vulnerability to natural hazards. The JCEMA is in charge of 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 building in areas at high risk of floods. 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.[21]

Jackson County Health Department (JCHD)

The Jackson County Health Department has been providing a variety of public health services its residents 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.[22]

Jackson, Williamson and Union County Soil and Water Conservation Districts (SWCD)

The Soil and Water Conservation Districts within each 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 increase environmental sustainability. [23] Duties related to water resources include the conservation and restoration of wetlands, the protection of groundwater resources, and the prevention of soil erosion.

[21] "Flood Damage Prevention Ordinance," http://www.jacksoncounty-il.gov/home/showdocument?id=474 Accessed September 2019
[22] "Jackson County Health Department," http://www.jchdonline.org/ Accessed September 2019
[23] AISWCD. "Association of Illinois Soil and Water Conservation Districts AISWCD," http://www.aiswcd.org/. Accessed September 2019.

Public Works

The City of Carbondale's Public Works department maintains a variety of public spaces within the city. The department is responsible for keeping the streets, sidewalks, and storm sewers in good repair. They operate and maintain the city's wastewater and water plants, are in charge of picking up refuse and recycling, and provide water and wastewater testing. The Public Works Department offers waste collection programs throughout the year such as the Christmas Tree Recycling Program, Extra Solid Waste Collection, Seasonal Leaf Collection, and the Residential Spring Clean-up program. The department includes a Forestry Service that cares for trees, shrubs, and plants throughout the public spaces of Carbondale. This includes rights-of-way, memorials, and beautifying city parks. On the City of Carbondale website, you can find the Public Works information and where to take and dispose of different items such as electronics and chemicals.[24]

United States Fish and Wildlife Service (USFWS)

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. [25]

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. [26]

[24] Public Works-Responsibilities," https://www.ci.carbondale.il.us/165/Public-Works. Accessed September 2019
[25] USFWS. "Water Resource Development- Ecological Services," https://www.fws.gov/ecological-services/energy-development/water.html. Accessed Various Dates 2019.
[26] USFWS. "Ecological Services- Conservation Planning," https://www.fws.gov/ecological-services/about/what-we-do.html. Accessed Various Dates 2019.

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 Western Crab Orchard Creek watershed include Murphysboro and Plumfield, which are located along the Big Muddy River.[27]

The Corps is also responsible for water control operations. These operations consist of four Mississippi River navigation structures and five multi-purpose reservoirs within the district. The district also includes Rend Lake, located northeast of the Western Crab Orchard Creek watershed.[28]

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.[29]

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.[30]

[27] USACE. "St. Louis District- Water Management USACE," http://mvs-wc.mvs.usace.army.mil/. Accessed July 2019.
[28] Ibid.
[29] USDA Natural Resources Conservation Service. "2014 Farm Bill- Financial Assistance Programs-NRCS," https://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/programs/farmbill/?cid=stelprdb1237774. Accessed 20 July 2019.
[30] USDA Natural Resources Conservation Service. "Technical Assistance," https://www.nrcs.usda.gov/wps/portal/nrcs/main/national/programs/technical/. Accessed May 2019.

5. Watershed Demographics

To assess the population of the Western Crab Orchard Creek watershed, each entity was individually examined. The planning area lies within three different counties- Williamson, Jackson, and Union. Although the watershed consists of ten different townships, there are only three municipalities within the watershed's borders. Carbondale is the largest city, while Cobden and Makanda are smaller villages in the southern part of the watershed.

5.1 Population

According to the 2010 Census, Carbondale has a total population of 25,902. Almost all of the municipality is within the watershed. Near the central part of Western Crab Orchard Creek Watershed lies over half of the Village of Makanda. A small portion of Cobden touches the southern-most part of the watershed, and has a population of 1,151 people. The population counts and the Population Estimate of 2018 are depicted in Table 5.1.

Table 5.1- Population Change (2010-2018)

County/Municipality	Population 2010	Population est. 2018	Population Change	Population Change as %
Jackson	60,218	57,419	-2,799	-4.6
Union	17,808	16,841	-967	-5.4
Williamson	66,357	67,056	699	1.1
Carbondale	25,902	25,376	-526	-2.0
Cobden	1,151	1,079	-72	-6.3
Makanda	562	536	-26	-4.6

Source: US Census Bureau

Table 5.2 shows the population estimate for 2018 and a forecast for 2022. According to the forecast, all three counties will see a small increase in population. The data used in these tables reflect the counties as a whole and do not represent the sections only in the Western Crab Orchard Creek watershed.

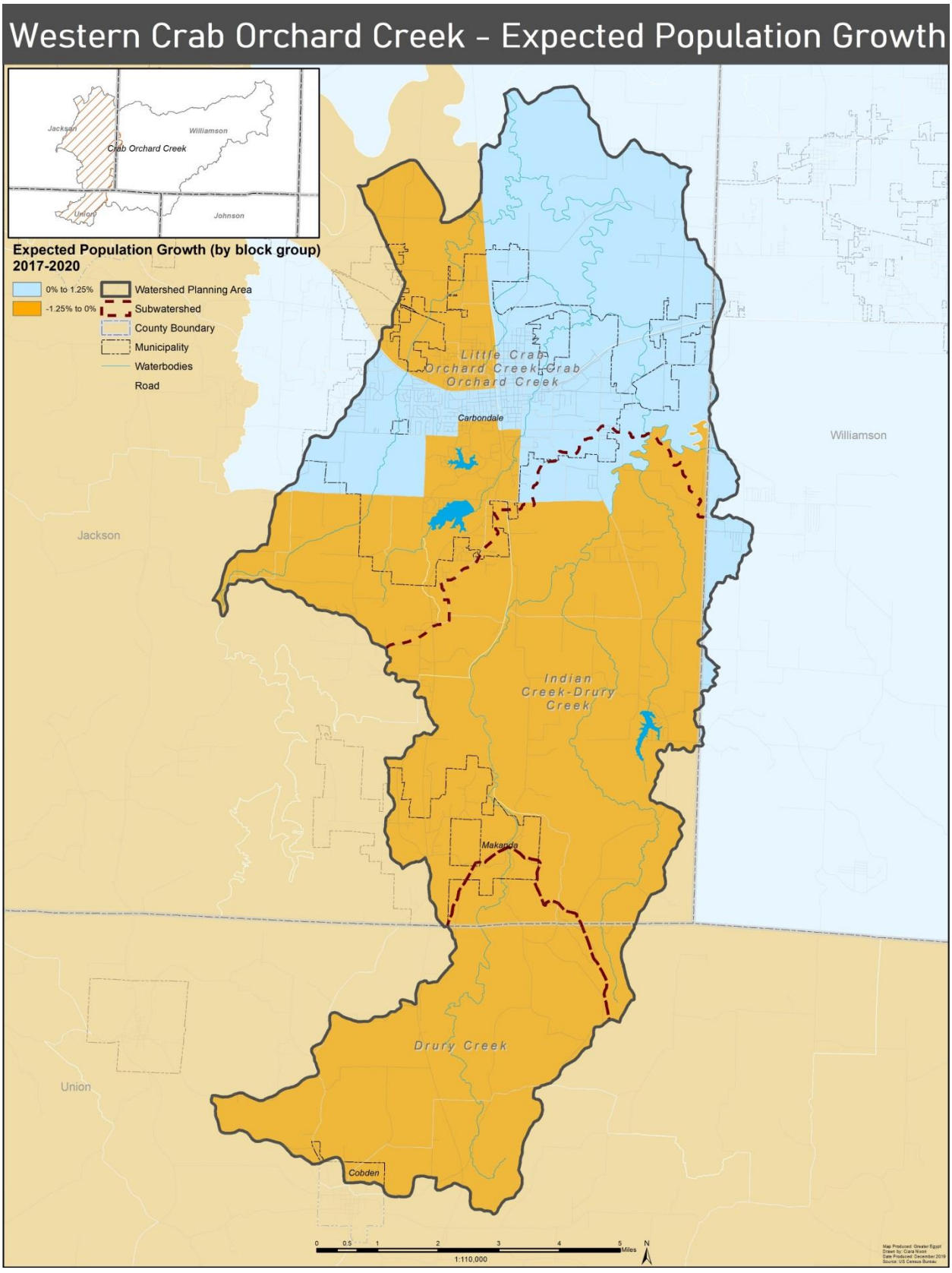
Table 5.2- Population Estimate and Forecast

Municipality/County	July 1, 2018 Estimate	Estimated Population Growth 2010-2017	2025 Forecast	Forecasted Population Growth 2016-2022
Jackson	57,419	-2,799	62,818	4,534
Union	16,841	-967	17,130	130
Williamson	67,056	699	69,246	1,918

Source: US Census Bureau

Along with these estimates, individual Census Block Groups have been analyzed to display the population growth from the period of 2000 to 2010. Figure 5.1 displays the growth by Census Block Groups. This data shares similarities with the previous growth forecast. Population is relatively stagnant with different areas experiencing a small decline and other areas a small growth.

Figure 5.1


Western Crab Orchard Creek – Expected Population Growth
Jackson
Williamson
Crab Orchard Creek
Union
Johnson
Expected Population Growth (by block group) 2017-2020
0% to 1.25%
-1.25% to 0%
Watershed Planning Area
Subwatershed
County Boundary
Municipality
Waterbodies
Road
Little Crab Orchard Creek-Crab Orchard Creek
Carbondale
Williamson
Jackson
Indian Creek-Drury Creek
Makanda
Drury Creek
Union
Cobden
0 0.5 1 2 3 4 5 Miles
N
1:110,000

5.2 Median Age and Income

According to the American Community Survey, Carbondale has the lowest median age of the other two towns. Jackson County has a median age of 31. Union and Williamson counties have higher, similar median ages of 43 and 40, respectively. Makanda has the highest median age of 45, while Cobden has a younger population, with a median age of 34. The median age, per capita income, and the median household income are displayed in Table 5.3.

Table 5.3- Median Age, Per Capita Income and Median Household Income

Municipality/ County	Median Age	Per Capita Income	Median Household Income
Jackson County	31.10	$33,845.00	$36,008.00
Union County	43.50	$45,464.00	$46,716.00
Williamson Co.	40.90	$45,902.00	$48,600.00
Carbondale City	23.80	$19,515.00	$20,873.00
Cobden Village	34.30	$36,786.00	$39,844.00
Makanda Village	45.50	$62,188.00	$63,083.00

Source: US Census Bureau, American Community Survey

Median Household income in the Western Crab Orchard Creek watershed varies. Corresponding to the numbers provided by the 2016 American Community Survey, Carbondale also has the lowest median income at $19,515, while Makanda has the highest median income at $62,188. Union and Williamson counties have similar median incomes. Median Age and Median Household Income have been depicted by block group in Figure 5.2 and Figure 5.3, respectively.

Figure 5.2

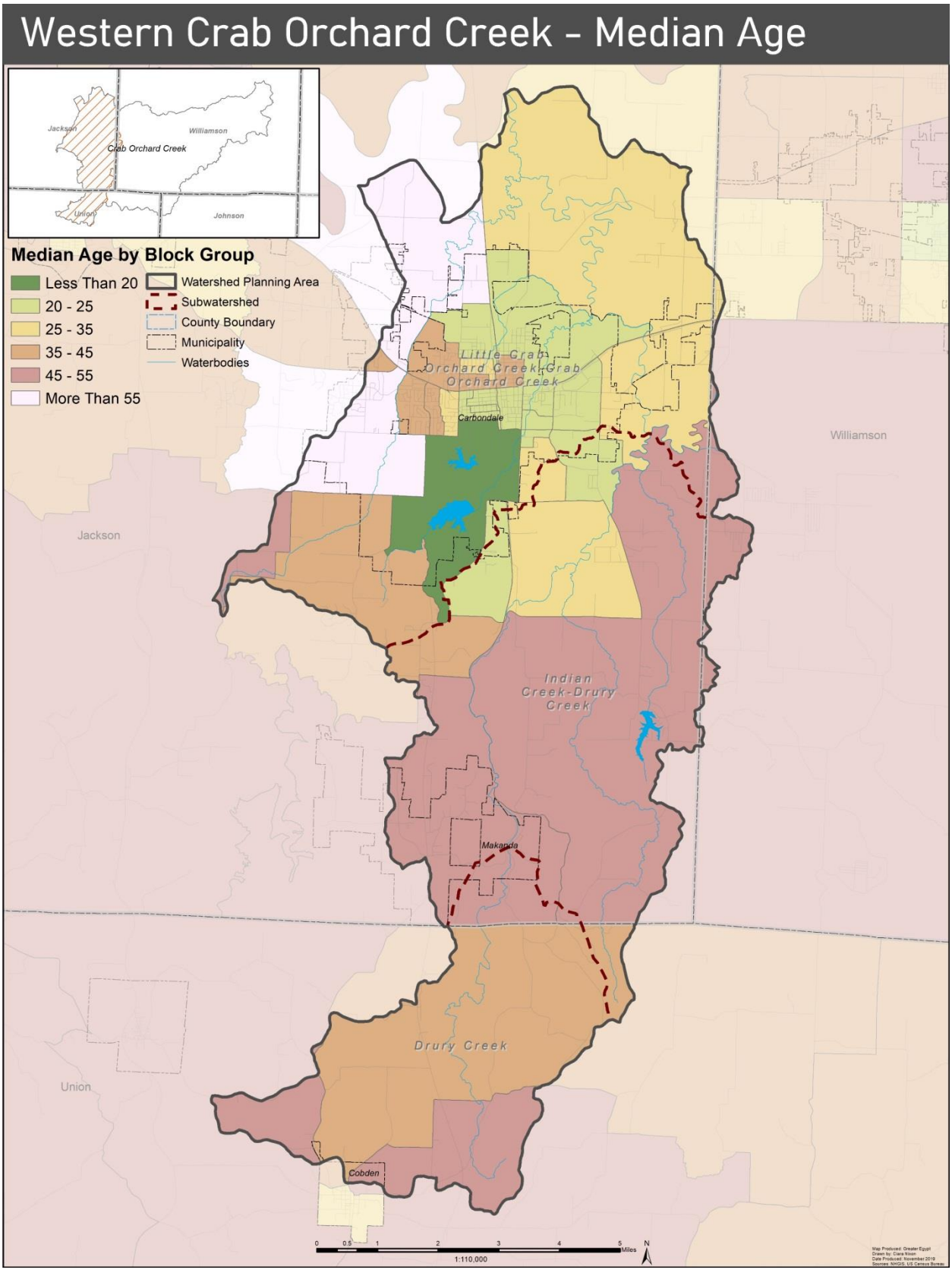
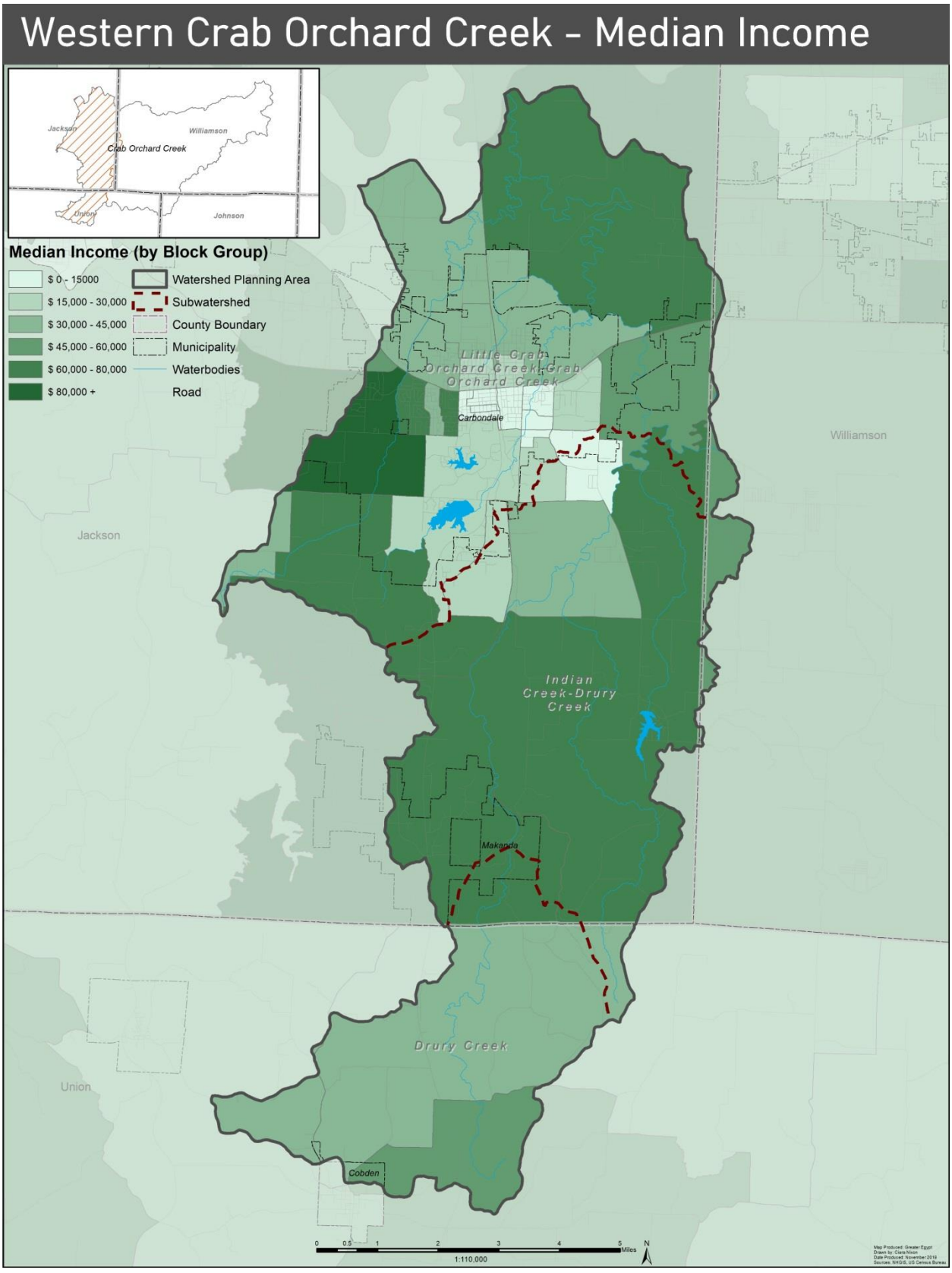

Western Crab Orchard Creek – Median Age
Jackson
Williamson
Crab Orchard Creek
Union
Johnson
Median Age by Block Group
Less Than 20
20 - 25
25 - 35
35 - 45
45 - 55
More Than 55
Watershed Planning Area
Subwatershed
County Boundary
Municipality
Waterbodies
Little Crab Orchard Creek-Crab Orchard Creek
Carbondale
Williamson
Jackson
Indian Creek-Drury Creek
Makanda
Drury Creek
Union
Cobden
0 0.5 1 2 3 4 5 Miles
1:110,000
N

Figure 5.3


Western Crab Orchard Creek – Median Income
Jackson
Williamson
Crab Orchard Creek
Union
Johnson
Median Income (by Block Group)
$ 0 - 15000
$ 15,000 - 30,000
$ 30,000 - 45,000
$ 45,000 - 60,000
$ 60,000 - 80,000
$ 80,000 +
Watershed Planning Area
Subwatershed
County Boundary
Municipality
Waterbodies
Road
Little Crab Orchard Creek-Crab Orchard Creek
Carbondale
Williamson
Jackson
Indian Creek-Drury Creek
Makanda
Drury Creek
Union
Cobden
0 0.5 1 2 3 4 5 Miles
1:110,000
N

5.3 Employment

The 2018 Illinois Department of Employment Security's Unemployment Rate was at 4.6 percent for Jackson County, 5.4 percent in Union County, and at 4.7 percent for Williamson County. This is compared to 4.2 percent for the State of Illinois as a whole, and 3.5 percent for the United States as a whole.

With the Western Crab Orchard Creek watershed featuring higher education and healthcare, most of the population works in office, administration, and educational fields. Data was retrieved through the JobsEQ software developed by Chmura Economics and Analytics. Table 5.4 displays the current employment breakdown of occupations for Carbondale, Illinois. The top three job classifications by employment for the City of Carbondale are: Office and Administration Support (2,758); Education, Training, and Library (2,185); Food Preparation and Serving Related Occupations (1,934).

Table 5.4- Carbondale Employment Information

Title	Number of Employees	Average Annual Salary	Location Quotient	Unemployment Numbers	Unemployment Rate
Management	862	$75,200	0.85	17	2.00%
Business and Financial Operations	591	$56,800	0.68	20	4.30%
Computer and Mathematical	367	$66,900	0.74	11	3.30%
Architecture and Engineering	125	$69,200	0.43	1	1.60%
Life, Physical, and Social Science	253	$51,300	1.82	4	2.60%
Community and Social Service	307	$40,300	1.14	12	2.60%
Legal	102	$66,900	0.74	1	1.20%
Education, Training, and Library	2,185	$59,600	2.3	114	5.30%
Arts, Design, Entertainment, Sports, and Media	263	$49,600	0.86	4	2.70%
Healthcare Practitioners and Technical	1,608	$80,100	1.67	23	2.10%
Healthcare Support	549	$30,800	1.15	14	4.70%
Protective Service	273	$41,300	0.75	5	2.30%
Food Preparation and Serving Related	1,934	$22,700	1.33	85	8.30%
Building and Grounds Cleaning and Maintenance	450	$29,200	0.75	15	6.40%
Personal Care and Service	430	$27,500	0.65	12	5.90%
Sales and Related	1,921	$29,500	1.12	57	5.60%
Office and Administrative Support	2,758	$32,700	1.1	93	5.60%
Farming, Fishing, and Forestry	11	$27,800	0.1	1	7.70%
Construction and Extraction	441	$59,200	0.56	11	5.60%
Installation, Maintenance, and Repair	485	$40,800	0.75	5	3.00%
Production	495	$32,700	0.48	7	5.90%
Transportation and Material Moving	565	$35,700	0.49	17	6.80%
Total - All Occupations	16,973	$44,900	1	n/a	n/a

Source: JobsEQ

Cobden and Makanda are much smaller towns compared to Carbondale. Cobden has a total of 639 employees, while Makanda only has 188. The top three job classifications by employment for Cobden are Management (104), Education, Training, and Library (64), and Production (59). Makanda Township has 58 employees working in Food Preparation and Serving-related jobs. This is followed by 22 employees in Installation, Maintenance, and Repair, and 20 employees in Office Administrive Support. Cobden and Makanda's occupations are broken down in Table 5.5 and Table 5.6.

Table 5.5- Cobden Employment Information

Title	Number of Employees	Average Annual Salary	Location Quotient	Unemployment Numbers	Unemployent Rate
Management	104	$69,600	2.71	3	1.70%
Business and Financial Operations	11	$64,900	0.33	3	4.10%
Computer and Mathematical	4	$72,600	0.21	1	3.30%
Architecture and Engineering	4	$72,500	0.34	0	n/a
Life, Physical, and Social Science	3	$64,400	0.52	0	n/a
Community and Social Service	14	$40,200	1.4	2	2.80%
Legal	1	$67,400	0.21	0	n/a
Education, Training, and Library	64	$41,300	1.78	11	6.20%
Arts, Design, Entertainment, Sports, and Media	6	$30,600	0.53	1	2.90%
Healthcare Practitioners and Technical	39	$58,900	1.09	3	2.20%
Healthcare Support	31	$29,500	1.71	3	5.50%
Protective Service	11	$57,500	0.79	1	3.00%
Food Preparation and Serving Related	25	$22,100	0.45	10	8.80%
Building and Grounds Cleaning and Maintenance	35	$26,800	1.55	4	6.40%
Personal Care and Service	16	$23,600	0.63	3	5.60%
Sales and Related	26	$31,800	0.41	6	5.30%
Office and Administrative Support	57	$32,600	0.6	7	5.60%
Farming, Fishing, and Forestry	49	$23,400	11.52	3	7.90%
Construction and Extraction	27	$50,500	0.91	4	6.10%
Installation, Maintenance, and Repair	17	$45,200	0.7	1	3.50%
Production	59	$36,700	1.51	6	5.80%
Transportation and Material Moving	38	$31,900	0.87	6	7.10%
Total - All Occupations	639	$40,300	1	n/a	n/a

Source: JobsEQ

Table 5.6- Makanda Employment Information

Title	Number of Employees	Average Annual Salary	Location Quotient	Unemployment Numbers	Unemployment Rate
Management	11	$76,900	1.01	1	1.90%
Business and Financial Operations	4	$56,700	0.44	2	3.90%
Computer and Mathematical	2	$67,000	0.37	1	3.60%
Architecture and Engineering	1	$69,000	0.45	0	n/a
Community and Social Service	1	$41,600	0.19	1	3.00%
Legal	1	$64,900	0.43	0	n/a
Education, Training, and Library	1	$56,600	0.06	5	5.80%
Arts, Design, Entertainment, Sports, and Media	3	$49,500	0.78	2	3.30%
Healthcare Practitioners and Technical	6	$77,400	0.54	1	1.90%
Healthcare Support	4	$30,100	0.76	1	4.80%
Protective Service	2	$42,600	0.47	0	n/a
Food Preparation and Serving Related	58	$22,900	3.6	4	8.30%
Building and Grounds Cleaning and Maintenance	5	$29,200	0.81	1	6.60%
Personal Care and Service	7	$27,300	0.96	1	6.00%
Sales and Related	16	$29,300	0.86	4	5.00%
Office and Administrative Support	20	$33,000	0.71	5	5.80%
Farming, Fishing, and Forestry	0	n/a	0	0	n/a
Construction and Extraction	6	$59,900	0.72	1	5.50%
Installation, Maintenance, and Repair	22	$41,800	2.99	0	n/a
Production	7	$33,300	0.63	1	5.60%
Transportation and Material Moving	11	$37,300	0.82	1	6.70%
Total - All Occupations	188	$44,100	1	n/a	n/a

Source: JobsEQ

Jackson County has a total of 25,585 employed persons between 23 occupations. The top three highest paying jobs in the county are: Healthcare Practitioners (2,013), Management (1,505) and, Architecture and Engineering (216). Employment information for Jackson County, IL has also been provided in Table 5.7.

Table 5.7- Jackson County Employment Information

Title	Number of Employees	Average Annual Salary	Location Quotient	Unemployment Number	Unemployment Rate
Management	1,505	$76,900	0.98	34	2.00%
Business and Financial Operations	842	$56,700	0.64	42	4.10%
Computer and Mathematical	488	$67,000	0.65	20	3.40%
Architecture and Engineering	216	$69,000	0.5	5	1.80%
Life, Physical, and Social Science	308	$51,300	1.47	8	2.70%
Community and Social Service	465	$41,600	1.14	19	2.60%
Legal	155	$64,900	0.74	2	1.50%
Education, Training, and Library	3,077	$56,600	2.15	197	5.70%
Arts, Design, Entertainment, Sports, and Media	387	$49,500	0.84	13	3.00%
Healthcare Practitioners and Technical	2,013	$77,400	1.39	44	2.10%
Healthcare Support	819	$30,100	1.14	36	4.90%
Protective Service	476	$42,600	0.87	12	2.60%
Food Preparation and Serving Related	2,641	$22,900	1.2	199	8.30%
Building and Grounds Cleaning and Maintenance	751	$29,200	0.83	43	6.30%
Personal Care and Service	677	$27,300	0.68	39	6.00%
Sales and Related	2,567	$29,300	0.99	136	5.60%
Office and Administrative Support	3,879	$33,000	1.03	209	5.70%
Farming, Fishing, and Forestry	150	$25,200	0.89	8	7.40%
Construction and Extraction	1,140	$59,900	0.96	53	5.60%
Installation, Maintenance, and Repair	906	$41,800	0.93	23	3.10%
Production	979	$33,300	0.63	49	5.30%
Transportation and Material Moving	1,144	$37,300	0.65	73	6.60%
Total - All Occupations	25,585	$44,100	1	n/a	n/a

Source: JobsEQ

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 the USDA's 2017 National Agricultural Statistics Service CropScape for the agricultural portion of the review. The MRLC land cover data differs from the USDA's CropScape data in regard to agricultural values. Any utilization of land use data in this plan will reference the MRLC; except the specific discussion on agriculture.

6.1 Existing Land Use

The largest land use category in the Western Crab Orchard Creek planning area is forest. This category consists of three distinct classifications including deciduous, evergreen, and mixed forest, which in total span 28,957.3 acres, or 51.3 percent of the watershed. Deciduous forest has the largest land area of 28,661.7 acres, or 50.7 percent of the watershed. The breakdown of classifications is available in Table 6.1

The remaining land uses in the watershed are: developed areas (20 percent), open water (1.1 percent), barren land (0.02 percent), grassland/herbaceous (0.9 percent), pasture/hay (18.7 percent), cultivated crops (6.7), and wetlands (1.3 percent).

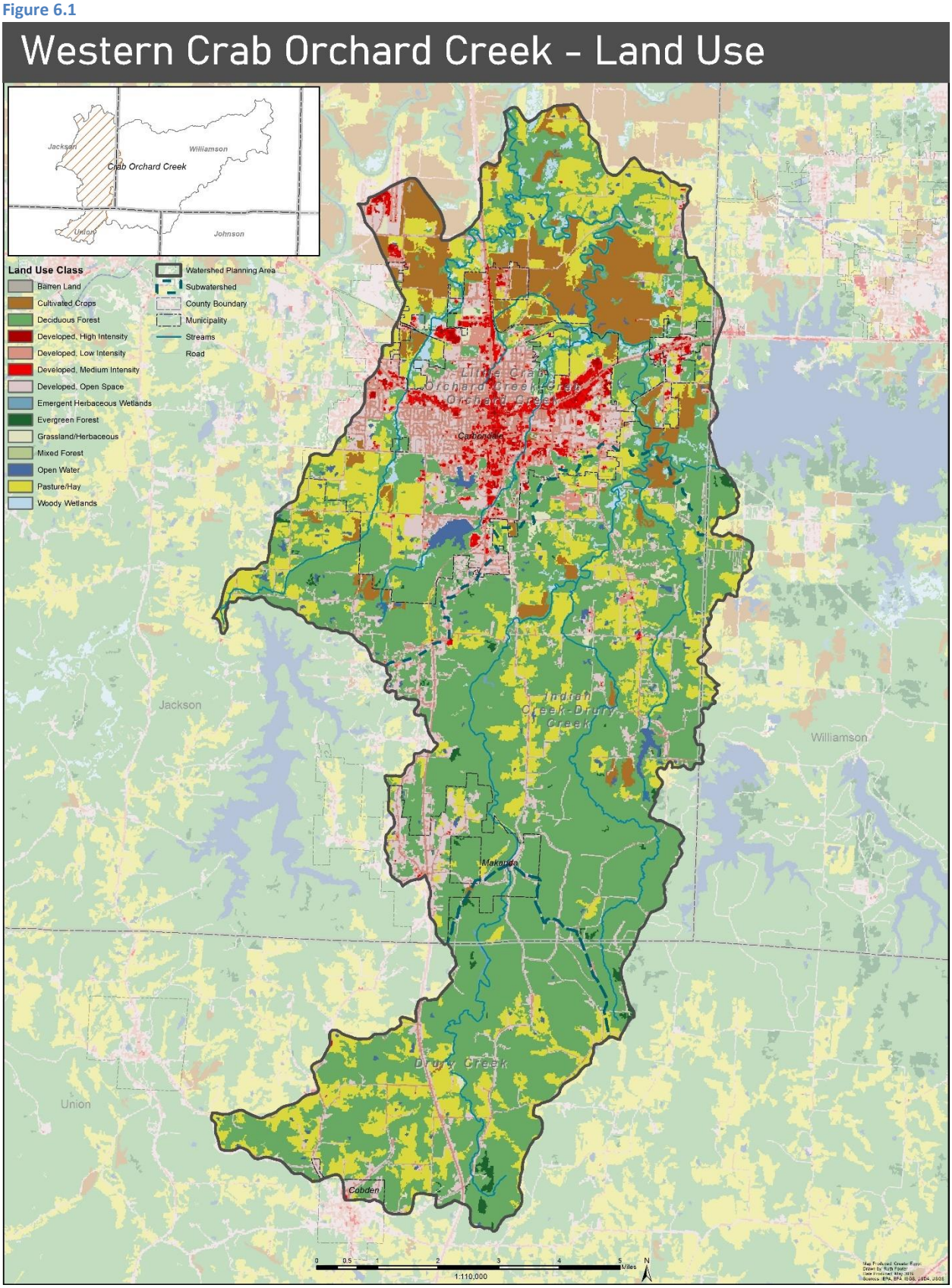
With 25 percent of the watershed being agricultural, there is a high potential for erosion. This is especially true for areas of cropland in the northern portion of the watershed that run alongside multiple waterbodies and creeks.

Table 6.1- Land Use Classification for the Watershed Planning Area

Classification	Acreage	Percent of Watershed
Open Water	622.3	1.1%
Developed, Open Space	6,141.8	10.9%
Developed, Low Intensity	3,852.4	6.8%
Developed, Medium Intensity	1,056.2	1.9%
Developed, High Intensity	257.8	<1%
Barren Land	12.2	<1%
Deciduous Forest	28,661.7	50.7%
Evergreen Forest	274.5	<1%
Mixed Forest	21.1	<1%
Grassland/ Herbaceous	524.4	<1%
Pasture/ Hay	10,552.5	18.7%
Cultivated Crops	3,812.3	6.7%
Woody Wetlands	675.5	1.2%
Emergent Herbaceous Wetlands	68.1	<1%

Source: USGS Multi-Resolution Land Characteristics Consortium

Figure 6.1


Western Crab Orchard Creek – Land Use
Jackson
Williamson
Crab Orchard Creek
Union
Johnson
Land Use Class
Barren Land
Cultivated Crops
Deciduous Forest
Developed, High Intensity
Developed, Low Intensity
Developed, Medium Intensity
Developed, Open Space
Emergent Herbaceous Wetlands
Evergreen Forest
Grassland/Herbaceous
Mixed Forest
Open Water
Pasture/Hay
Woody Wetlands
Watershed Planning Area
Subwatershed
County Boundary
Municipality
Streams
Road
Little Crab Orchard Creek-Crab Orchard Creek
Carbondale
Indian Creek-Drury Creek
Makanda
Drury Creek
Cobden
Jackson
Williamson
Union
0 0.5 1 2 3 4 5 Miles
N
1:110,000

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."[31]

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."[32]

According to the 2012 Census of Agriculture (USDA), farming in Jackson and Union County consists mainly of soybeans, corn, wheat, and forage-land used for all haylage, grass silage, and green chop. Farmers in both Jackson and Union Counties have an average age of 60 years and are predominately white males. [33] It is important to note that although a small area of the watershed includes Williamson County, it does not constitute enough land to be deemed necessary for analysis.

Cultivation within the Western Crab Orchard Creek planning area follows a very similar pattern. Based on the USDA's National Agriculture Statistics Service CropScape[34], the planning area contains approximately 5,552.7 acres of agricultural land. Table 6.2 displays the types of cultivation found within the planning area. Figure 6.2 shows the location of the various crops. Accounting for about 4,334 acres, soybeans are the largest form of cultivation. Corn is also heavily cultivated at about 1,019 acres.

[31] USDA NRCS. "Soil Survey of Jackson County, Illinois," Published Soil Surveys for Illinois, 2009, 146
[32] Ibid., 149.
[33] Census of Agriculture. "2012 Census Publications," USDA, 2012, 1-2.
[34] *CropScape* (2018). USDA. National Agricultural Statistics Service, 2018.

Table 6.2- Agricultural Diversity in the Watershed Planning Area

Agricultural Classification	Acreage	Percent of Agriculture	Percent of Watershed
Corn	1,019.31	18.36%	1.80%
Sorghum	6.89	<1%	0.01%
Soybeans	4,333.89	78.05%	7.67%
Winter Wheat	0.67	<1%	0.00%
Double Crop Winter Wheat/Soybeans	97.42	1.75%	0.17%
Oats	6.67	<1%	0.01%
Alfalfa	1.11	<1%	0.00%
Other Hay/Non-Alfalfa	46.26	<1%	0.08%
Clover/Wildflowers	0.44	<1%	0.00%
Fallow/Idle Cropland	16.46	<1%	0.03%
Apples	4.23	<1%	0.01%
Pecans	0.44	<1%	0.00%
Barren	18.90	<1%	0.03%

Source: USDA CropScape

6.2 Projected Future Land Use

To estimate the future land cover for the Western Crab Orchard Creek planning area, land cover from past datasets have been analyzed. Land cover from 2001 and 2011 datasets were used to compare past changes in land use.

The USGS Multi-Resolution Land Characteristics Consortium (MRLC) has land use data for the year 2006, but for the purpose of this analysis, the period from 2001 to 2011 is the best and most accurate representation of current land use change within the watershed. Table 6.3 displays the acreage and percent of watershed of each land use classification for 2001 and 2011.

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

Assuming development in the area will remain constant, the raw change from 2001 to 2011 was used to calculate the 2021 projected acreage and projected percent change of each classification. The most notable change in the watershed involves the significant

increase in both medium and high intensity developed land cover. Medium intensity developed land cover is projected to increase by 13.4 percent, which accounts for 141 acres, while high intensity developed land is projected to increase by 32.1 percent, which accounts for 83 acres.

Appendix D contains descriptions of the land use categories in the MRLC. It defines medium intensity developed land cover as, "areas with a mixture of constructed materials and vegetation. Impervious surfaces account for 50% to 79% of the total cover. These areas most commonly include single-family housing units."[35] High intensity developed land cover is defined as, "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% of total cover."[36] Although there is a positive trend with medium and high intensity land cover, these classifications together only account for 2.3 percent of the total Western Crab Orchard Creek planning area.

An outlier to the analysis is the barren land classification, which portrayed a sharp increase of 1,000 percent between 2001-2011 and a projected increase of 91 percent by 2021. This seemingly large change only amounts to a projected 23.4 acres by 2021.

[35] Department of Interior (DOI) and USGS. "National Land Cover Database 2011 Product Legend,"https://www.mrlc.gov/data/legends/national-land-cover-database-2011-nlcd2011-legend. Accessed: February 19, 2019.
[36] Ibid.

Figure 6.2

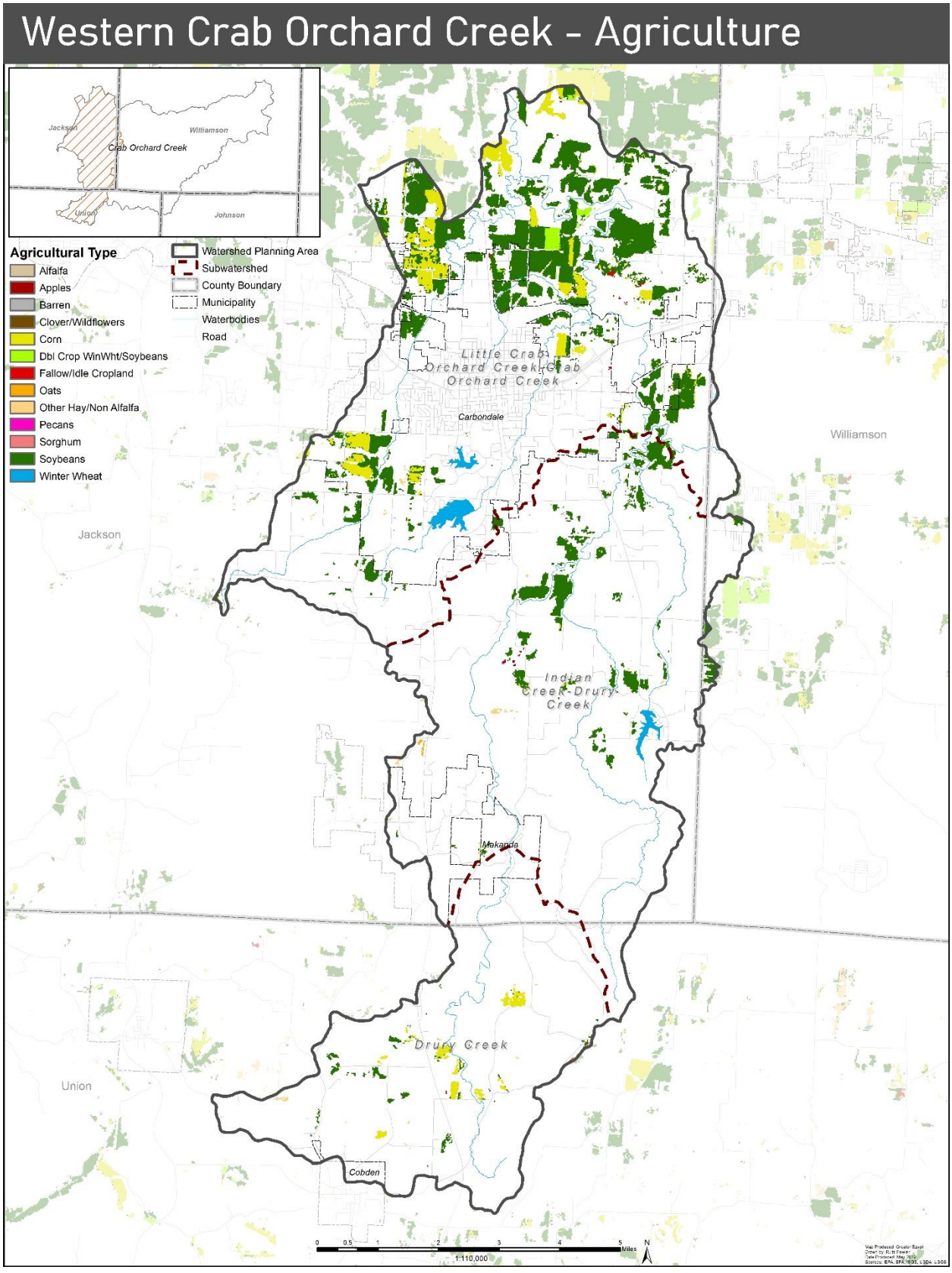

Western Crab Orchard Creek – Agriculture
Jackson
Williamson
Crab Orchard Creek
Union
Johnson
Agricultural Type
Alfalfa
Apples
Barren
Clover/Wildflowers
Corn
Dbl Crop WinWht/Soybeans
Fallow/Idle Cropland
Oats
Other Hay/Non Alfalfa
Pecans
Sorghum
Soybeans
Winter Wheat
Watershed Planning Area
Subwatershed
County Boundary
Municipality
Waterbodies
Road
Little Crab Orchard Creek-Crab Orchard Creek
Carbondale
Williamson
Jackson
Indian Creek-Drury Creek
Makanda
Drury Creek
Union
Cobden
0 0.5 1 2 3 4 5 Miles
1:110,000
N

Table 6.3- Existing and Projected Land Cover for the Planning Area

Land Cover Classification	Western Crab Orchard Creek Watershed							
	2001		2011		2001-2011		2011-2021	
	Acreage	Percent of Watershed	Acreage	Percent of Watershed	Change in Acreage	Percent Change	Projected Acreage (2021)	Projected Percent Change
Open Water	610.7	1.1%	622.3	1.1%	11.6	1.9%	633.9	1.9%
Developed, Open Space	6,186.6	10.9%	6,141.8	10.9%	-44.7	-0.7%	6,097.1	-0.7%
Developed, Low Intensity	3,905.3	6.9%	3,852.4	6.8%	-52.9	-1.4%	3,799.4	-1.4%
Developed, Medium Intensity	915.0	1.6%	1,056.2	1.9%	141.2	15.4%	1197.5	13.4%
Developed, High Intensity	175.0	<1%	257.8	<1%	82.7	47.3%	340.5	32.1%
Barren Land	1.1	0.0%	12.2	<1%	11.1	+100%	23.4	90.9%
Deciduous Forest	28,922.9	51.2%	28,661.7	50.7%	-261.2	-0.9%	28,400.5	-0.9%
Evergreen Forest	274.5	<1%	274.5	<1%	0.0	0.0%	274.5	0.0%
Mixed Forest	21.1	<1%	21.1	<1%	0.0	0.0%	21.1	0.0%
Grassland/ Herbaceous	504.7	<1%	524.4	<1%	19.8	3.9%	544.2	3.8%
Pasture/ Hay	10,532.9	18.6%	10,552.5	18.7%	19.6	0.2%	10,572.1	0.2%
Cultivated Crops	3,781.4	6.7%	3,812.3	6.7%	30.9	0.8%	3,843.3	0.8%
Woody Wetlands	633.7	1.1%	675.5	1.2%	41.8	6.6%	717.3	6.2%
Emergent Herbaceous Wetlands	68.1	<1%	68.1	<1%	0.0	0.0%	68.1	0.0%

Source: USGS MRLC

6.3 Existing and Projected Imperviousness

As a whole, the Western Crab Orchard Creek planning area has a rather low level of imperviousness with 80 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 6.4). These intervals have also been illustrated in Figure 6.3. As stated previously, 45,219 acres, or 80 percent, consists of non-existing impervious cover. This is a major contrast to the amount of land characterized as 90-100 percent impervious, which accounts for less than one tenth percent (0.07 percent) and only 37.6 acres. The more impervious locations in the Western Crab Orchard Creek watershed occur in Carbondale, specifically the Lower Piles Fork Creek, Campus Lake, and Middle Little Crab Orchard Creek SMUs.

Other areas that exhibit imperviousness are the road networks throughout the planning area. This is particularly evident near Hwy 51 that runs north/south and Hwy 13 that runs east/west. There are quite a lot of business and residential buildings on or near this road network, including Southern Illinois University. Another area with a high level of imperviousness is the Southern Illinois Airport in the north-western section of the watershed.

Following the same method to project future land use, impervious land cover from past and existing datasets were analyzed. Impervious land cover from the 2001 and 2011 datasets were utilized to compare past and present variations in imperviousness. Table 6.4 also displays the projected percent of change and acreage to the year 2021. According to the analysis, levels of impervious will continue to rise above 40 percent and become more noticeable over 50 percent imperviousness. The largest increase by percentage is the 90-100 level at 67.5 percent. Although it is expected to have the largest percent change, it constitutes the least amount of acreage at 63 acres, respectively. Levels of impervious ranging from 0-40 percent will see a steady decline from 0-2 percent by 2021. Despite the fact the 0 percent imperviousness level will only decrease by less than half of a percent by 2021, it is projected to decline by a noticeable 127.5 acres.

Figure 6.3

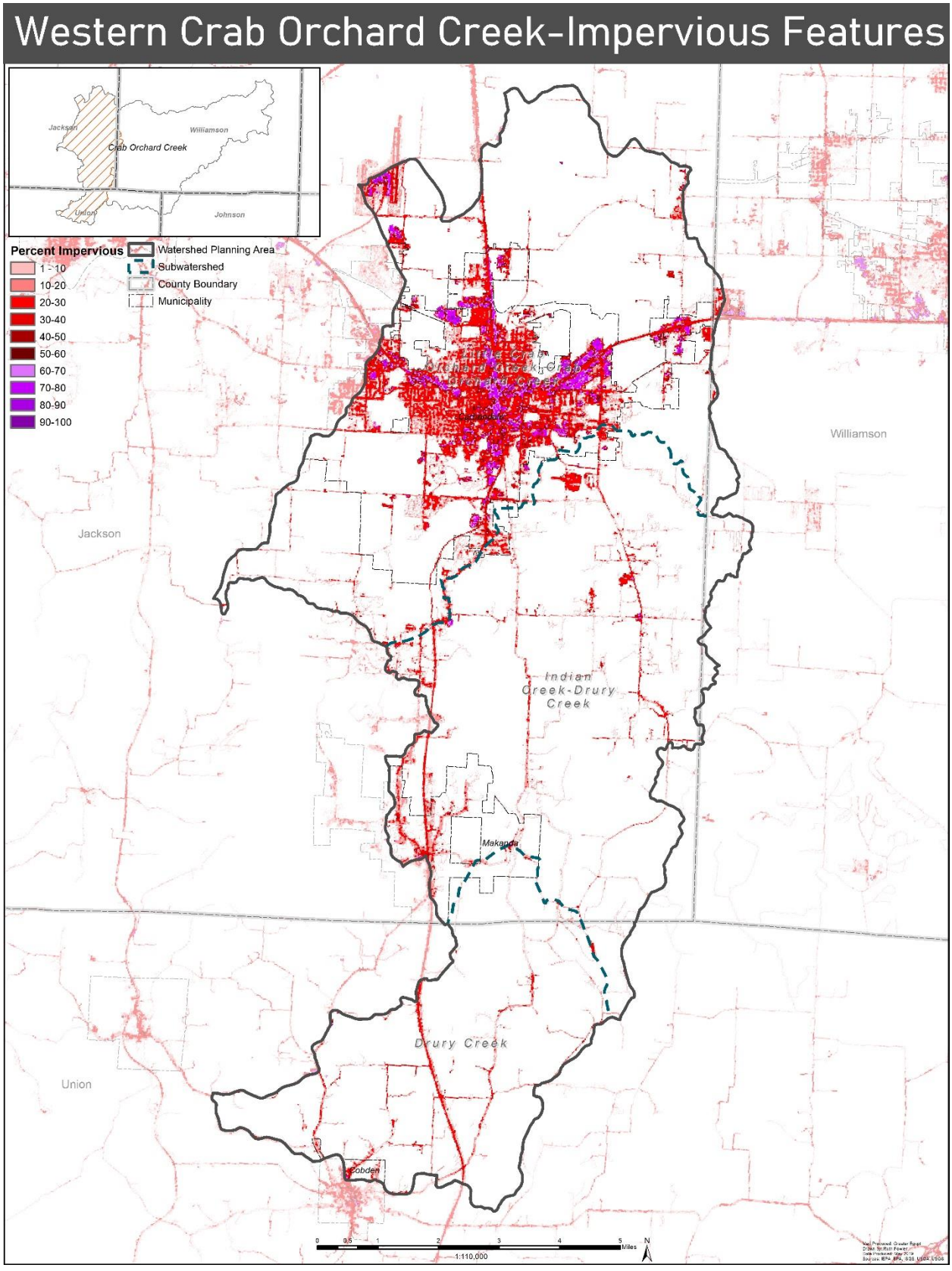

Western Crab Orchard Creek-Impervious Features
Jackson
Williamson
Crab Orchard Creek
Union
Johnson
Percent Impervious
1 - 10
10-20
20-30
30-40
40-50
50-60
60-70
70-80
80-90
90-100
Watershed Planning Area
Subwatershed
County Boundary
Municipality
Crab Orchard Creek
Williamson
Jackson
Indian Creek-Drury Creek
Makanda
Drury Creek
Union
Cobden
0 0.5 1 2 3 4 5 Miles
1:110,000
N

Table 6.4- Existing and Projected Imperviousness of the Watershed Planning Area

Percent Imperviousness	2001		2011		2001-2011		2011-2021	
	Acreage	Percent of Watershed	Acreage	Percent of Watershed	Change (Acres)	Percent Change	Projected Acreage (2021)	Projected Percent Change
0%	45,346.3	80.2%	45,218.8	80.0%	-127.5	-0.3%	45,091.3	-0.3%
0-10%	3,908.4	6.9%	3,899.5	6.9%	-8.9	-0.2%	3,890.6	-0.2%
10-20%	2,500.6	4.4%	2,463.6	4.4%	-36.9	-1.5%	2,426.7	-1.5%
20-30%	1,838.2	3.3%	1,809.3	3.2%	-28.9	-1.6%	1,780.4	-1.6%
30-40%	1,308.4	2.3%	1,286.9	2.9%	-21.6	-1.7%	1,265.3	-1.7%
40-50%	582.1	1.0%	582.3	1.0%	0.2	0.0%	582.5	0.0%
50-60%	381.0	<1%	412.8	<1%	31.8	8.4%	444.6	7.7%
60-70%	290.0	<1%	342.3	<1%	52.3	18.0%	394.6	15.3%
70-80%	222.6	<1%	287.6	<1%	64.9	29.2%	352.5	22.6%
80-90%	143.0	<1%	192.2	<1%	49.2	34.4%	241.3	25.6%
90-100%	12.2	<1%	37.6	<1%	25.4	207.3%	62.9	67.5%

Source: USGS MRLC

6.4 Existing Land Cover and Imperviousness of the Subwatersheds (HUC 12)

Each HUC 12 subwatershed has been delineated by land cover and imperviousness. Table 6.5 displays both the acreage and percentage of each subwatershed by the land use classification. Table 6.6 presents the impervious cover of each subwatershed. Table 6.7 displays the 2021 projected values and percent change in land use of each subwatershed.

The Little Crab Orchard Creek and Indian Creek subwatersheds have the highest percentage of open water at 373.8 and 206.6 acres, respectively. This is largely due to the presence of Campus Lake, Carbondale Reservoir, and Spring Arbor Lake in these subwatersheds.

Because of the location of Carbondale, the Little Crab Orchard Creek and Indian Creek-Drury Creek subwatersheds exhibit the highest percentage of all developed land classifications. The Little Crab Orchard Creek subwatershed exhibits the highest concentrations of all developed land use including open space, low, medium, and high intensity. Together, this makes up around 7,265 acres, or about 30 percent of the subwatershed.

The only barren land within the Western Crab Orchard Creek planning area takes place in the Little Crab Orchard Creek watershed with only 12.2 acres of land cover. The forest cover, by and large, is concentrated in the south with Indian Creek- Drury Creek subwatershed having 13,532.4 acres of forest cover and Drury Creek subwatershed having 7,823 acres. The predominant forest type across all three of the subwatersheds is deciduous. Within the confines of these subwatersheds is the Shawnee National Forest and Giant City State Park.

Table 6.5- Existing Subwatershed Land Use

Land Cover Classification	Little Crab Orchard Creek		Indian Creek -Drury Creek		Drury Creek	
	Acreage	Percent of Watershed	Acreage	Percent of Watershed	Acreage	Percent of Watershed
Open Water	373.8	1.5%	206.6	1.0%	41.8	<1%
Developed, Open Space	2,981.0	12.2%	2,276.6	11.1%	883.4	7.7%
Developed, Low Intensity	3,003.7	12.2%	604.6	2.9%	243.5	2.1%
Developed, Medium Intensity	1,024.5	4.2%	24.5	<1%	7.1	<1%
Developed, High Intensity	255.7	1.0%	1.3	<1%	0.7	<1%
Barren Land	12.2	<1%	0.0	0.0%	0.0	0.00%
Deciduous Forest	7,539.2	30.7%	13,398.4	65.2%	7,720.2	67.4%
Evergreen Forest	57.2	<1%	116.1	<1%	101.2	<1%
Mixed Forest	1.1	0.0%	18.5	<1%	1.6	<1%
Grassland/ Herbaceous	301.8	1.2%	205.5	1.0%	17.1	<1%
Pasture/ Hay	4,944.0	20.2%	3,204.3	15.6%	2,402.8	2 %
Cultivated Crops	3,430.9	14%	366.9	1.8%	14.0	<1%
Woody Wetlands	568.6	2.3%	106.8	<1%	0.0	0.0%
Emergent Herbaceous Wetlands	41.6	<1%	7.3	<1%	19.1	<1%

Source: USGS MRLC

Cultivated crops are largely grown in the Little Crab Orchard Creek watershed and specifically concentrated in the northern region. With Little Crab Orchard Creek subwatershed having both the highest values in both developed land cover as well as highest cultivated crop cover, it can be expected that the surrounding waterways will experience a higher level of impairment.

Pasture/hay land cover roughly covers 15-20 percent of each subwatershed. The acreage is the highest in the Little Crab Orchard Creek subwatershed at 4,944 acres. This land classification is defined by the MRLC as, "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."[37] Pasture/hay land cover may seem like a less likely candidate for erosion, but can be just as damaging to both land and water resources. According to the Illinois

[37] Department of Interior (DOI) and USGS. "National Land Cover Database 2011 Product Legend," https://www.mrlc.gov/data/legends/national-land-cover-database-2011-nlcd2011-legend. Accessed: February 21, 2019.

USDA, "Erosion is not just a cropland problem, but can also occur in hay and pasture systems. Poor grazing management is a major cause of erosion. Trails rutted into the sod, poor control of water drainage from roads, disturbance of natural drainage, livestock trailing, and other land disturbances are also responsible for increasing grassland erosion."[38]

According to the estimations (see Table 6.6), the projected changes to land use in the watersheds are relatively low by in large. Barren land, which projects a 90.91 percent increase within Little Crab Orchard Creek, only accounts for 23.35 acres in total. The only considerable projected increase is within medium and high intensity developed land. Medium intensity land cover is projected to increase 32.35 percent within the Little Crab Orchard Creek subwatershed, which should total 338.47 acres by 2021. Deciduous forested land is projected to decrease across all three subwatersheds. The percent change is relatively small, ranging from 0.52-1.94 percent decrease, but accounts for a total loss of 261 acres by 2021.

Table 6.6- Projected Subwatershed Land Use

Projected Watershed Land Use	Little Crab Orchard Creek		Indian Creek-Drury Creek		Drury Creek	
	Projected Acreage (2021)	Projected Percent Change	Projected Acreage (2021)	Projected Percent Change	Projected Acreage (2021)	Projected Percent Change
Open Water	372.7	-0.3%	219.3	6.1%	41.8	0.0%
Developed, Open Space	2,941.2	-1.3%	2,271.9	-0.2%	883.2	-0.03%
Developed, Low Intensity	2,947.9	-1.9%	607.7	0.5%	243.3	-0.1%
Developed, Medium Intensity	1,158.8	13.1%	30.9	26.4%	7.6	6.3%
Developed, High Intensity	338.5	32.4%	1.3	0.0%	0.7	0.0%
Barren Land	23.4	90.9%	0.0	0.0%	0.0	0.0%
Deciduous Forest	7,393.1	-1.9%	13,328.4	-0.5%	7,675.3	-0.6%
Evergreen Forest	57.2	0.0%	116.1	0.0%	101.2	0.0%
Mixed Forest	1.1	0.0%	18.5	0.0%	1.6	0.0%
Grassland/ Herbaceous	315.3	4.5%	205.5	0.0%	23.4	36.4%
Pasture/ Hay	4,900.6	-0.9%	3,237.2	1.0%	2,432.9	1.3%
Cultivated Crops	3,433.6	0.1%	386.5	5.3%	22.7	61.9%
Woody Wetlands	610.4	7.4%	106.7	0.0%	0.0	0.0%
Emergent Herbaceous Wetlands	41.6	0.0%	7.3	0.0%	19.1	0.0%

Source: USGS MRLC

[38] United States Department of Agriculture. "Grazing Factsheets-General," April 2003. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/il/technical/landuse/Pasture/?cid=nrcs141p2 030611. Accessed: February 21, 2019.

6.4.1 Drury Creek Subwatershed (071401060807)

Existing Land Use

The most prevalent land use classifications are forest, agriculture, and developed land, which accounts for 99.3 percent of the land use. Table 6.7 displays the acreage and percent of SMU. Figure 6.4 displays the name and location of the SMUs geographically.

Drury Creek subwatershed is heavily forested, covering roughly 7,823 acres of forest land or 68.3 percent of the subwatershed. Every SMU contains over 50 percent of forest land. The Drury Creek subwatershed includes parts of Giant City State Park and the Shawnee National Forest. Cobden-North SMU has the most forest acreage, at 1,734.8 acres. Makanda- South Drury Creek is a smaller SMU but has 87.8 percent of forest coverage.

Agriculture is another large part of Drury Creek subwatershed and gets more expansive in the southernmost part. Pasture/hay and cultivated crops cover roughly 2,416.8 acres, or 21.1 percent of the subwatershed. Less than 1 percent of agriculture is cultivated crops, with the majority being pasture/hay. Agriculture is more concentrated in Cobden North and Flamm SMU. Cobden has 1,177.2 acres of agriculture, covering 35.2 percent of the SMU. Flamm has 357.4 acres, covering 31.5 percent of the SMU.

Developed land use within Drury Creek is concentrated to the roadways and a small section of northern Cobden. Together, there is roughly 1,134.7 acres of developed land use, or 9.9 percent of the subwatershed. 77.9 percent of the developed land is considered open space- developed land cover and 21.5 percent is low intensity land cover. Drury Creek subwatershed has a relatively low level of development.

Projected Land Use

Drury Creek subwatershed is projected to experience very low levels of change throughout the subwatershed. The largest land use changes will occur among deciduous forest and pasture/hay. Deciduous forested land is projected to decrease 44.9 acres by 2021 while pasture/hay is projected to increase by roughly 30 acres.

Three out of seven SMUs are projected to experience no change in acreage. The only SMUs that are projected to experience change are: Cobden- North, Shawnee Drury Creek, Flamm, and Makanda-South. The SMU projected to experience the most change is Flamm. Deciduous forest land is projected to decrease by roughly 18.9 acres and increase in pasture/hay by around 10.2 acres.

Figure 6.4

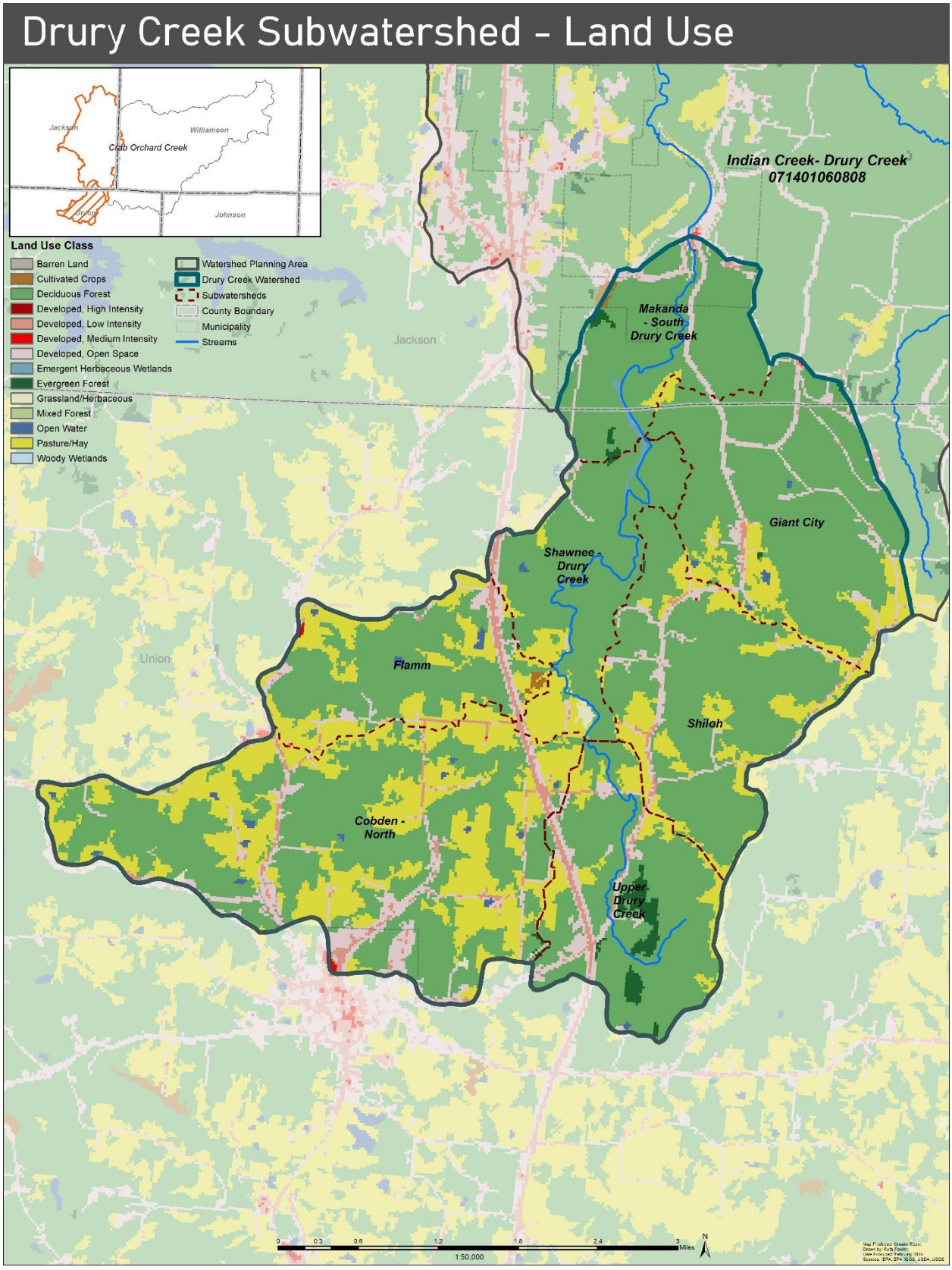

Drury Creek Subwatershed - Land Use
Jackson
Williamson
Crab Orchard Creek
Union
Johnson
Land Use Class
Barren Land
Cultivated Crops
Deciduous Forest
Developed, High Intensity
Developed, Low Intensity
Developed, Medium Intensity
Developed, Open Space
Emergent Herbaceous Wetlands
Evergreen Forest
Grassland/Herbaceous
Mixed Forest
Open Water
Pasture/Hay
Woody Wetlands
Watershed Planning Area
Drury Creek Watershed
Subwatersheds
County Boundary
Municipality
Streams
Indian Creek- Drury Creek
071401060808
Makanda - South Drury Creek
Giant City
Shawnee - Drury Creek
Flamm
Shiloh
Cobden - North
Upper Drury Creek
Jackson
Union
0 0.3 0.6 1.2 1.8 2.4 3 Miles
1:50,000
N

Table 6.7- Existing Drury Creek Subwatershed Land Use

Subwatershed Land Use Classification	Upper Drury Creek		Cobden-North		Shiloh		Shawnee Drury Creek		Flamm		Giant City		Makanda South	
	Acreage	% of SMU	Acreage	% of SMU	Acreage	% of SMU	Acreage	% of SMU	Acreage	% of SMU	Acreage	% of SMU	Acreage	% of SMU
Open Water	1.33	<1%	20.47	<1%	103.20	6.27%	2.22	<1%	10.43	<1%	7.34	<1%	0.00	0.00%
Developed, Open Space	118.79	8.81%	294.81	8.82%	20.68	1.26%	33.37	2.99%	88.53	7.81%	154.44	8.42%	90.39	8.78%
Developed, Low Intensity	39.60	2.94%	105.24	3.15%	0.22	<1%	13.57	1.21%	38.83	3.43%	19.14	1.04%	6.46	<1%
Developed, Medium Intensity	0.00	0.00%	3.56	<1%	0.00	0.00%	0.00	0.00%	2.22	<1%	0.45	<1%	0.67	<1%
Developed, High Intensity	0.00	0.00%	0.22	<1%	0.00	0.00%	0.00	0.00%	0.44	<1%	0.00	0.00%	0.00	0.00%
Deciduous Forest	947.23	70.24%	1732.36	51.80%	1203.23	73.07%	898.34	80.39%	635.23	56.06%	1418.46	77.31%	887.02	86.16%
Evergreen Forest	76.75	5.69%	2.45	<1%	1.11	<1%	1.78	<1%	0.00	0.00%	2.23	<1%	16.92	1.64%
Mixed Forest	0.00	0.00%	1.56	<1%	0.00	0.00%	0.00	0.00%	0.00	0.00%	0.00	0.00%	0.00	0.00%
Grassland/Herbaceous	0.00	0.00%	6.23	<1%	0.00	0.00%	10.90	<1%	0.00	0.00%	0.00	0.00%	0.00	0.00%
Pasture/Hay	164.84	12.22%	1177.23	35.20%	318.27	19.33%	149.50	13.38%	348.79	30.78%	232.78	12.69%	11.35	1.10%
Cultivated Crops	0.00	0.00%	0.00	0.00%	0.00	0.00%	0.00	0.00%	8.65	<1%	0.00	0.00%	5.34	<1%
Emergent Herbaceous Wetlands	0.00	0.00%	0.00	0.00%	0.00	0.00%	7.79	<1%	0.00	0.00%	0.00	0.00%	11.35	1.10%

Table 6.8 Projected Drury Creek Subwatershed Land Use

Subwatershed Land Use Classification	Upper Drury Creek		Cobden-North		Shiloh		Shawnee Drury Creek		Flamm		Giant City		Makanda South	
	Projected Acreage (2021)	Projected Percent Change	Projected Acreage (2021)	Projected Percent Change	Projected Acreage (2021)	Projected Percent Change	Projected Acreage (2021)	Projected Percent Change	Projected Acreage (2021)	Projected Percent Change	Projected Acreage (2021)	Projected Percent Change	Projected Acreage (2021)	Projected Percent Change
Open Water	1.33	0.00%	20.47	0.00%	103.20	0.00%	2.22	0.00%	10.43	0.00%	7.34	0.00%	0.00	0.00
Developed, Open Space	118.79	0.00%	294.81	0.00%	20.68	0.00%	33.37	0.00%	88.53	0.00%	154.44	0.00%	90.17	0.00
Developed, Low Intensity	39.60	0.00%	105.24	0.00%	0.22	0.00%	13.57	0.00%	38.83	0.00%	19.14	0.00%	6.23	-0.03
Developed, Medium Intensity	0.00	0.00%	3.56	0.00%	0.00	0.00%	0.00	0.00%	2.22	0.00%	0.45	0.00%	1.11	0.67
Developed, High Intensity	0.00	0.00%	0.22	0.00%	0.00	0.00%	0.00	0.00%	0.44	0.00%	0.00	0.00%	0.00	0.00
Deciduous Forest	947.23	0.00%	1717.23	-0.87%	1203.23	0.00%	887.44	-1.21%	616.37	-2.97%	1418.46	0.00%	887.02	0.00
Evergreen Forest	76.75	0.00%	2.45	0.00%	1.11	0.00%	1.78	0.00%	0.00	0.00%	2.23	0.00%	16.92	0.00
Mixed Forest	0.00	0.00%	1.56	0.00%	0.00	0.00%	0.00	0.00%	0.00	0.00%	0.00	0.00%	0.00	0.00
Grassland/Herbaceous	0.00	0.00%	12.46	100.00%	0.00	0.00%	10.90	0.00%	0.00	0.00%	0.00	0.00%	0.00	0.00
Pasture/Hay	164.84	0.00%	1186.13	0.76%	318.27	0.00%	160.40	7.29%	359.00	2.93%	232.78	0.00%	11.35	0.00
Cultivated Crops	0.00	0.00%	0.00	0.00%	0.00	0.00%	0.00	0.00%	17.31	100.00%	0.00	0.00%	5.34	0.00
Emergent Herbaceous Wetlands	0.00	0.00%	0.00	0.00%	0.00	0.00%	7.79	0.00%	0.00	0.00%	0.00	0.00%	11.35	0.00

6.4.2 Indian Creek-Drury Creek Subwatershed (071401060808)

Existing Land Use

Indian Creek subwatershed is 65.8 percent forested land, accounting for 13,514.5 acres. Figure 6.5 displays the name and location of the SMUs geographically. Based on acreage values, Upper Indian, Boskydell, and Middle Drury Creek SMUs have the most forest land cover. Table 6.9 displays the acreage and percent of SMU.

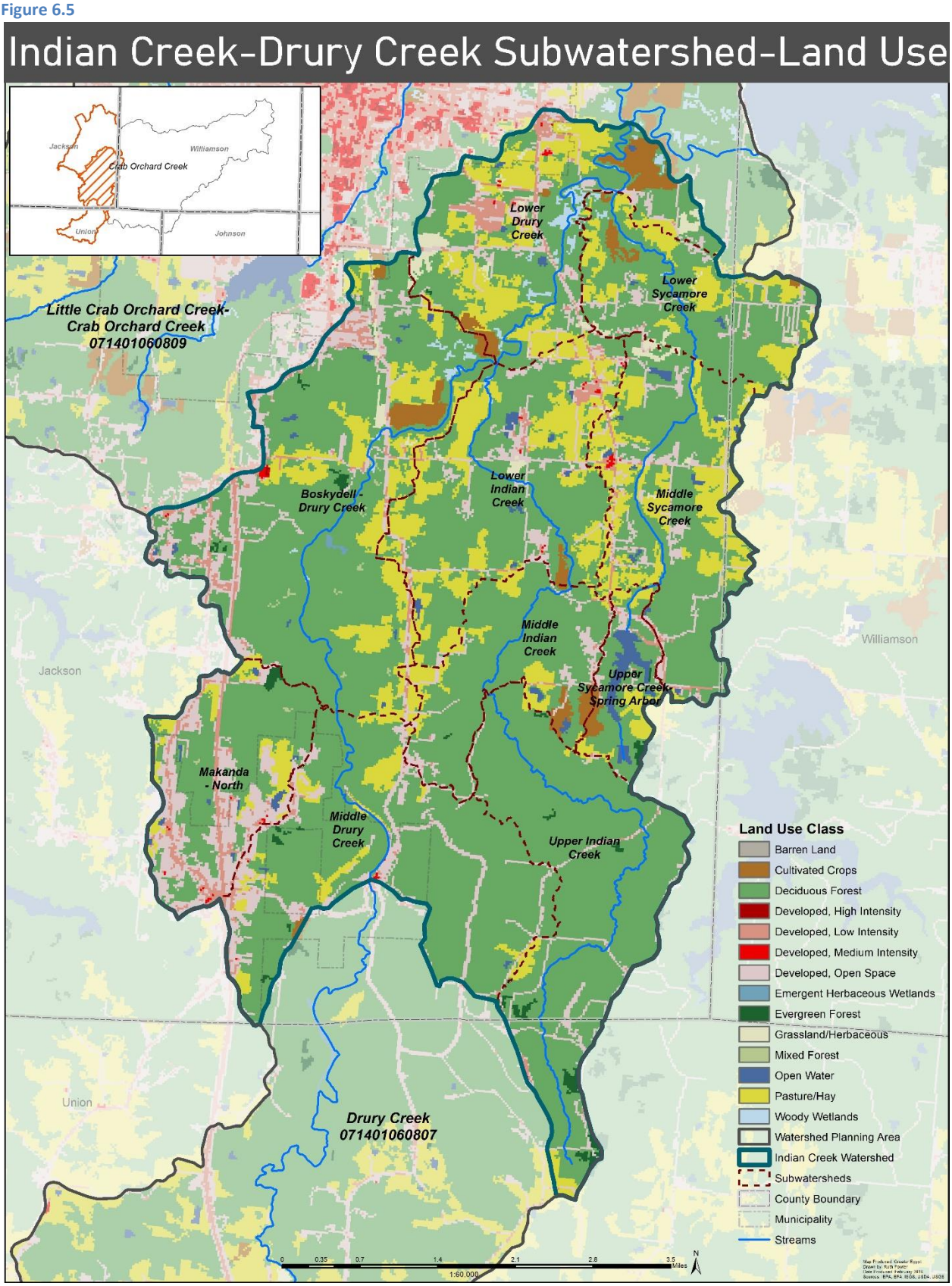
Upper Indian SMU is 91.5 percent forest land, or 2,435.4 acres. The southern half is within the boundaries of Giant City State Park, which explains the large percentage of forested land. Giant City State Park is nestled into the Shawnee National Forest, which has its boundaries in Indian Creek-Drury Creek as well as parts of the Drury Creek subwatershed.

The second largest land cover category is agriculture, which includes pasture/hay and cultivated crops. This accounts for 3,571.2 acres, or 17.4 percent of the subwatershed. Lower Indian Creek, Lower Drury Creek, and Boskydell SMUs have the largest amount of agriculture land use, totaling 1,976.2 acres. Pasture/hay land use is much more prevalent compared to cultivated crops across all three SMUs.

Developed land use is the third largest land use within Indian Creek-Drury Creek subwatershed, but only covers a relatively small amount of land. Approximately 11 percent of the watershed is developed land, but 78.3 percent of this developed land is considered "developed-open space". The MRLC defines it as, "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." [39] Makanda-North and Boskydell SMU hold the most acreage of developed land, totaling 1,196.8 acres. This is largely consisting of open space and low intensity development. Due to their relative locations between Carbondale and Makanda, this contributes to the higher levels of developed land cover.

[39] Department of Interior (DOI) and USGS. "National Land Cover Database 2011 Product Legend," https://www.mrlc.gov/data/legends/national-land-cover-database-2011-nlcd2011-legend. Accessed: March 3, 2019.

Figure 6.5


Indian Creek-Drury Creek Subwatershed-Land Use
Jackson
Williamson
Crab Orchard Creek
Union
Johnson
Little Crab Orchard Creek-
Crab Orchard Creek
071401060809
Lower
Drury
Creek
Lower
Sycamore
Creek
Boskydell -
Drury Creek
Lower
Indian
Creek
Middle
Sycamore
Creek
Middle
Indian
Creek
Upper
Sycamore Creek-
Spring Arbor
Makanda
- North
Middle
Drury
Creek
Upper Indian
Creek
Drury Creek
071401060807
Land Use Class
Barren Land
Cultivated Crops
Deciduous Forest
Developed, High Intensity
Developed, Low Intensity
Developed, Medium Intensity
Developed, Open Space
Emergent Herbaceous Wetlands
Evergreen Forest
Grassland/Herbaceous
Mixed Forest
Open Water
Pasture/Hay
Woody Wetlands
Watershed Planning Area
Indian Creek Watershed
Subwatersheds
County Boundary
Municipality
Streams
0 0.35 0.7 1.4 2.1 2.8 3.5 Miles
1:60,000
N

Projected Land Use

Indian Creek- Drury Creek subwatershed is projected to experience low levels of change by 2021. Table 6.10 displays the 2021 projected values and percent change of land use of each SMU. The only notable changes will be occurring within forest land and pasture. The projected percent change can be deceiving, as deciduous forest is projected to decrease by 70 acres, but only equates to a -0.52 percent change since the land is vastly forested. Pasture is projected to increase by roughly 33 acres sub-watershed wide by 2021.

The only SMU that is projected to have noticeable change is within Lower Indian Creek. Deciduous forest land cover is projected to decrease by 40.23 acres, while agriculture is projected to increase approximately 36 acres.

Table 6.9- Existing Indian Creek-Drury Creek Subwatershed Land Use

Subwatershed Land Use Classification	Upper Indian Creek		Middle Drury Creek		Makanda-North		Upper Sycamore Creek		Middle Indian Creek	
	Acreage	% of SMU	Acreage	% of SMU	Acreage	% of SMU	Acreage	% of SMU	Acreage	% of SMU
Open Water	0.00	0.00%	3.11	<1%	20.02	1.35%	82.33	15.79%	10.26	<1%
Developed, Open Space	137.59	5.37%	361.29	13.09%	448.22	30.24%	40.50	7.77%	107.04	7.97%
Developed, Low Intensity	12.89	<1%	41.55	1.51%	133.24	8.99%	15.13	2.90%	12.49	<1%
Developed, Medium Intensity	0.22	<1%	2.44	<1%	4.67	<1%	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%
Deciduous Forest	2290.32	89.33%	2142.16	77.64%	712.70	48.09%	250.12	47.97%	1010.90	75.26%
Evergreen Forest	55.12	2.15%	12.00	<1%	13.57	<1%	12.46	2.39%	2.23	<1%
Mixed Forest	0.00	0.00%	0.00	0.00%	4.00	<1%	0.00	0.00%	0.00	0.00%
Grassland/Herbaceous	0.00	0.00%	0.00	0.00%	0.00	0.00%	0.00	0.00%	0.00	0.00%
Pasture/Hay	66.68	2.60%	189.53	6.87%	145.70	9.83%	93.46	17.93%	149.42	11.12%
Cultivated Crops	1.11	<1%	7.11	<1%	0.00	0.00%	27.37	5.25%	50.85	3.79%
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%
Subwatershed Land Use Classification	Middle Sycamore		Lower Indian Creek		Boskydell		Lower Sycamore Creek		Lower Drury Creek	
	Acreage	% of SMU	Acreage	% of SMU	Acreage	% of SMU	Acreage	% of SMU	Acreage	% of SMU
Open Water	29.38	1.44%	26.89	1.14%	20.89	<1%	4.45	<1%	9.35	<1%
Developed, Open Space	192.09	9.44%	213.60	9.08%	444.18	11.14%	108.31	7.95%	223.98	10.50%
Developed, Low Intensity	44.52	2.19%	62.90	2.67%	160.65	4.03%	5.34	<1%	116.00	5.44%
Developed, Medium Intensity	3.78	<1%	4.22	<1%	4.44	<1%	0.00	0.00%	4.68	<1%
Developed, High Intensity	0.00	0.00%	0.00	0.00%	1.33	<1%	0.00	0.00%	0.00	0.00%
Deciduous Forest	1209.09	59.42%	1347.41	57.26%	2606.19	65.38%	875.56	64.24%	954.69	44.77%
Evergreen Forest	0.00	0.00%	0.00	0.00%	18.89	<1%	0.00	0.00%	1.78	<1%
Mixed Forest	0.00	0.00%	0.00	0.00%	14.44	<1%	0.00	0.00%	0.00	0.00%
Grassland/Herbaceous	28.71	1.41%	18.89	<1%	38.89	<1%	22.02	1.62%	97.07	4.55%
Pasture/Hay	526.64	25.88%	657.92	27.96%	552.17	13.85%	299.56	21.98%	524.10	24.58%
Cultivated Crops	0.67	<1%	17.56	<1%	91.55	2.30%	38.03	2.79%	132.92	6.23%
Woody Wetlands	0.00	0.00%	3.78	<1%	25.33	<1%	9.79	<1%	67.91	3.18%
Emergent Herbaceous Wetlands	0.00	0.00%	0.00	0.00%	7.33	<1%	0.00	0.00%	0.00	0.00%

Table 6.10- Projected Indian Creek- Drury Creek Subwatershed Land Use

Subwatershed Land Use Classification	Upper Indian Creek		Middle Drury Creek		Makanda-North		Upper Sycamore Creek		Middle Indian Creek	
	Projected Acreage (2021)	Projected Percent Change	Projected Acreage (2021)	Projected Percent Change	Projected Acreage (2021)	Projected Percent Change	Projected Acreage (2021)	Projected Percent Change	Projected Acreage (2021)	Projected Percent Change
Open Water	0.00	0.00	3.11	0.00%	20.02	0.00%	82.33	0.00%	15.16	47.83%
Developed, Open Space	137.59	0.00	360.84	-0.12%	446.00	-0.50%	40.50	0.00%	107.04	0.00%
Developed, Low Intensity	12.89	0.00	41.77	0.53%	133.24	0.00%	15.13	0.00%	12.49	0.00%
Developed, Medium Intensity	0.22	0.00	2.67	9.09%	6.90	47.62%	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%
Deciduous Forest	2290.32	0.00	2142.16	0.00%	712.70	0.00%	250.12	0.00%	1003.99	-0.68%
Evergreen Forest	55.12	0.00	12.00	0.00%	13.57	0.00%	12.46	0.00%	2.23	0.00%
Mixed Forest	0.00	0.00	0.00	0.00%	4.00	0.00%	0.00	0.00%	0.00	0.00%
Grassland/Herbaceous	0.00	0.00	0.00	0.00%	0.00	0.00%	0.00	0.00%	0.00	0.00%
Pasture/Hay	66.68	0.00	189.53	0.00%	145.70	0.00%	93.46	0.00%	149.42	0.00%
Cultivated Crops	1.11	0.00	7.11	0.00%	0.00	0.00%	27.37	0.00%	52.85	3.95%
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%

Subwatershed Land Use Classification	Middle Sycamore		Lower Indian Creek		Boskydell		Lower Sycamore Creek		Lower Drury Creek	
	Projected Acreage (2021)	Projected Percent Change	Projected Acreage (2021)	Projected Percent Change	Projected Acreage (2021)	Projected Percent Change	Projected Acreage (2021)	Projected Percent Change	Projected Acreage (2021)	Projected Percent Change
Open Water	29.38	0.00%	31.12	15.70%	24.44	17.02%	4.45	0.00%	9.35	0.00%
Developed, Open Space	191.65	-0.23%	211.38	-1.04%	444.18	0.00%	108.31	0.00%	224.65	0.30%
Developed, Low Intensity	44.74	0.50%	63.57	1.06%	160.65	0.00%	5.34	0.00%	118.00	1.73%
Developed, Medium Intensity	4.01	5.88%	5.78	36.84%	4.44	0.00%	0.00	0.00%	6.90	47.62%
Developed, High Intensity	0.00	0.00%	0.00	0.00%	1.33	0.00%	0.00	0.00%	0.00	0.00%
Deciduous Forest	1209.09	0.00%	1307.18	-2.99%	2602.63	-0.14%	864.67	-1.24%	946.23	-0.89%
Evergreen Forest	0.00	0.00%	0.00	0.00%	18.89	0.00%	0.00	0.00%	1.78	0.00%
Mixed Forest	0.00	0.00%	0.00	0.00%	14.44	0.00%	0.00	0.00%	0.00	0.00%
Grassland/Herbaceous	28.71	0.00%	18.89	0.00%	38.89	0.00%	22.02	0.00%	97.07	0.00%
Pasture/Hay	526.64	0.00%	676.37	2.80%	552.17	0.00%	310.46	3.64%	527.66	0.68%
Cultivated Crops	0.67	0.00%	35.12	100.00%	91.55	0.00%	38.03	0.00%	132.92	0.00%
Woody Wetlands	0.00	0.00%	3.78	0.00%	25.33	0.00%	9.79	0.00%	67.91	0.00%
Emergent Herbaceous Wetlands	0.00	0.00%	0.00	0.00%	7.33	0.00%	0.00	0.00%	0.00	0.00%

6.4.3 Little Crab Orchard Creek- Crab Orchard Creek Subwatershed (071401060808)

Existing Land Use

The Little Crab Orchard Creek subwatershed has the most diverse landscape compared to the other two subwatersheds. The top three classifications of land cover are agriculture, forest, and developed land cover. These three classifications share relatively equal coverage across the watershed and total approximately 94.7 percent of land use. Agriculture, which includes pasture/hay and cultivated crops, constitutes 8,374.9 acres, or 31.1 percent of the Little Crab Orchard Creek subwatershed. Most of the agriculture is concentrated to the northern region, with the exception of Upper Little Crab SMU. This subwatershed management unit includes 1,605.2 acres of agriculture; accounting for 43.8 percent of its land use. Middle Crab Orchard Creek and Reed Station SMUs together, each have over 50 percent of their SMU used for agriculture, equating to 2,458.6 acres collectively.

Because of the location of Carbondale, Little Crab Orchard Creek subwatershed exhibits the highest percentage of all developed land classifications. Together, this makes up around 7,265 acres, or roughly 30 percent of the subwatershed. The high concentrations of developed land are located primarily in Lower Piles Fork Creek and Middle Little Crab Orchard Creek SMUs, accounting for 3,605.2 acres collectively. Lower Piles Fork has 110.5 acres of high intensity developed land cover, accounting for 3.8 percent of its total land use. This is primarily because it encircles Carbondale and includes a large part of the Southern Illinois University campus.

Forest land is also largely mixed into Little Crab Orchard Creek watershed, accounting for 7,596.3 acres, or approximately 31 percent of land use. The highest concentration of forest land is located in the southern regions, specifically the Upper Piles Fork Creek and Upper Little Crab SMUs. Together, these two subwatersheds total 2,638.3 acres of forest land. Upper Crab Orchard Creek has the largest percent of land area covered in forest, at 73.1 percent, but the third highest in acreage amount at 686.9 acres.

Projected Land Use

Little Crab Orchard Creek subwatershed is projected to experience a relatively moderate percent change by 2021. Table 6.12 displays the 2021 projected values and percent change in land use of each SMU. The overall trend across these SMUs is a decrease in forest land cover with an increase in developed land, specifically of medium and high intensity. Subwatershed wide, medium intensity land cover is projected to increase 32.4 percent, or 338.4 acres. Most of this change will occur in Upper Little Crab Orchard Creek, Carbondale Reservoir, and Eastern Carbondale SMUs. Eastern Carbondale SMU has a misleading value of 100 percent change due to barren land doubling in size. Even though it values a 100 percent change, total projected acreage only accounts for 14.2 acres. This relatively small acreage amount skews the projected percent change value.

Figure 6.6

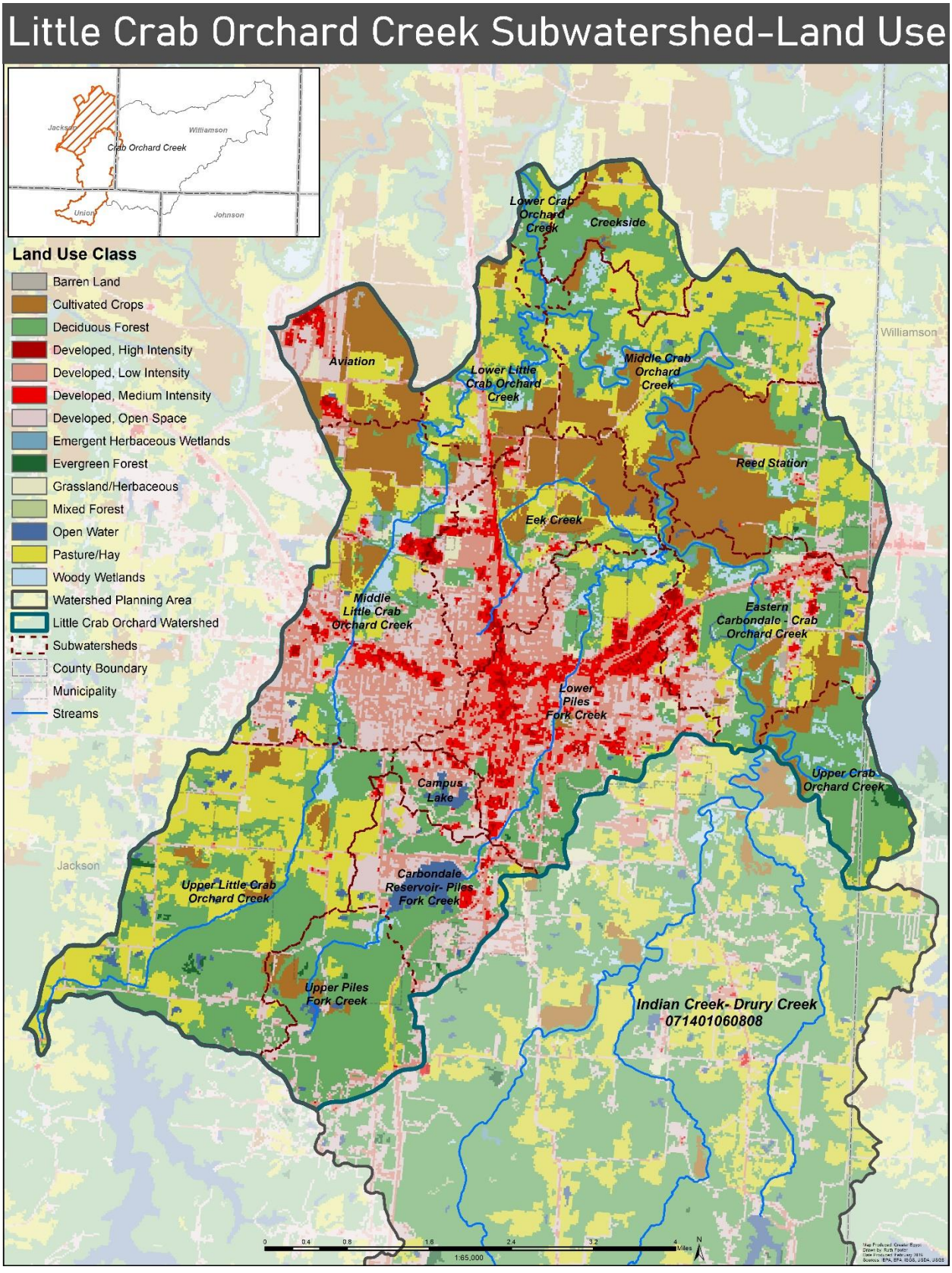

Little Crab Orchard Creek Subwatershed-Land Use
Jackson
Williamson
Crab Orchard Creek
Union
Johnson
Land Use Class
Barren Land
Cultivated Crops
Deciduous Forest
Developed, High Intensity
Developed, Low Intensity
Developed, Medium Intensity
Developed, Open Space
Emergent Herbaceous Wetlands
Evergreen Forest
Grassland/Herbaceous
Mixed Forest
Open Water
Pasture/Hay
Woody Wetlands
Watershed Planning Area
Little Crab Orchard Watershed
Subwatersheds
County Boundary
Municipality
Streams
Lower Crab Orchard Creek
Creekside
Aviation
Lower Little Crab Orchard Creek
Middle Crab Orchard Creek
Reed Station
Eek Creek
Middle Little Crab Orchard Creek
Eastern Carbondale - Crab Orchard Creek
Lower Piles Fork Creek
Campus Lake
Upper Crab Orchard Creek
Carbondale Reservoir- Piles Fork Creek
Upper Little Crab Orchard Creek
Upper Piles Fork Creek
Indian Creek- Drury Creek
071401060808
1:65,000
Miles
N

Table 6.11- Existing Little Crab Orchard Creek- Crab Orchard Creek Subwatershed Land Use

Subwatershed Land Use Classification	Upper Piles Fork		Upper Little Crab		Carbondale Reservoir		Campus Lake		Upper Crab Orchard		Eastern Carbondale		Lower Piles Fork		Eek Creek	
	Acreage	% of SMU	Acreage	% of SMU	Acreage	% of SMU	Acreage	% of SMU	Acreage	% of SMU	Acreage	% of SMU	Acreage	% of SMU	Acreage	% of SMU
Open Water	25.55	1.81%	62.28	1.70%	139.07	11.28%	39.75	11.47%	1.11	<1%	23.35	1.15%	4.89	<1%	10.90	<1%
Developed, Open Space	167.10	11.81%	222.19	6.07%	380.21	30.84%	108.59	31.33%	33.16	3.53%	280.87	13.87%	477.93	16.20%	201.93	11.09%
Developed, Low Intensity	59.33	4.19%	63.83	1.74%	183.42	14.88%	91.71	26.46%	4.01	<1%	207.71	10.26%	942.08	31.92%	441.89	24.27%
Developed, Medium Intensity	1.11	<1%	7.78	<1%	37.89	3.07%	19.76	5.70%	0.00	0.00%	94.96	4.69%	518.86	17.58%	133.88	7.35%
Developed, High Intensity	0.00	0.00%	0.44	<1%	3.34	<1%	3.78	1.09%	0.00	0.00%	34.25	1.69%	110.53	3.75%	41.81	2.30%
Barren Land	0.00	0.00%	0.00	0.00%	0.00	0.00%	0.00	0.00%	0.00	0.00%	7.12	<1%	0.00	0.00%	0.00	0.00%
Deciduous Forest	972.83	68.74%	1637.64	44.72%	371.07	30.10%	78.17	22.55%	662.83	70.54%	641.58	31.69%	531.09	18.00%	165.24	9.08%
Evergreen Forest	5.78	<1%	22.02	<1%	1.34	<1%	0.00	0.00%	24.04	2.56%	0.00	0.00%	2.45	<1%	0.00	0.00%
Mixed Forest	1.11	<1%	0.00	0.00%	0.00	0.00%	0.00	0.00%	0.00	0.00%	0.00	0.00%	0.00	0.00%	0.00	0.00%
Grassland/Herbaceous	1.56	<1%	15.79	<1%	9.58	<1%	4.89	1.41%	14.24	1.52%	36.47	1.80%	37.59	1.27%	54.26	2.98%
Pasture/Hay	80.88	5.72%	1482.17	40.48%	99.18	8.05%	0.00	0.00%	49.41	5.26%	291.10	14.38%	255.76	8.67%	234.40	12.87%
Cultivated Crops	86.22	6.09%	123.00	3.36%	4.01	<1%	0.00	0.00%	108.17	11.51%	336.02	16.60%	10.23	<1%	512.61	28.15%
Woody Wetlands	13.78	<1%	24.69	<1%	2.45	<1%	0.00	0.00%	42.73	4.55%	65.16	3.22%	59.60	2.02%	21.13	1.16%
Emergent Herbaceous Wetlands	0.00	0.00%	0.00	0.00%	1.11	<1%	0.00	0.00%	0.00	0.00%	6.00	<1%	0.00	0.00%	2.67	<1%

Subwatershed Land Use Classification	Middle Little Crab		Reed Station		Middle Crab Orchard		Lower Little Crab		Aviation		Creekside		Lower Crab	
	Acreage	% of SMU	Acreage	% of SMU	Acreage	% of SMU	Acreage	% of SMU	Acreage	% of SMU	Acreage	% of SMU	Acreage	% of SMU
Open Water	8.46	<1%	11.77	<1%	35.83	1.47%	2.22	<1%	2.00	<1%	4.44	<1%	2.45	<1%
Developed, Open Space	655.21	22.57%	151.73	8.64%	90.35	3.70%	53.05	5.21%	144.39	16.12%	10.22	1.26%	5.34	1.67%
Developed, Low Intensity	718.65	24.75%	78.86	4.49%	28.71	1.17%	59.71	5.87%	122.15	13.64%	2.44	<1%	0.22	<1%
Developed, Medium Intensity	144.49	4.98%	4.22	<1%	3.34	<1%	9.55	<1%	48.95	5.47%	0.00	0.00%	0.00	0.00%
Developed, High Intensity	37.40	1.29%	2.44	<1%	0.67	<1%	1.11	<1%	20.02	2.24%	0.00	0.00%	0.00	0.00%
Barren Land	0.00	0.00%	0.00	0.00%	0.00	0.00%	0.00	0.00%	5.12	<1%	0.00	0.00%	0.00	0.00%
Deciduous Forest	410.98	14.15%	430.74	24.54%	726.61	29.73%	305.00	29.98%	11.57	1.29%	390.62	48.20%	203.53	63.54%
Evergreen Forest	0.00	0.00%	1.56	<1%	0.00	0.00%	0.00	0.00%	0.00	0.00%	0.00	0.00%	0.00	0.00%
Mixed Forest	0.00	0.00%	0.00	0.00%	0.00	0.00%	0.00	0.00%	0.00	0.00%	0.00	0.00%	0.00	0.00%
Grassland/Herbaceous	45.86	1.58%	19.77	1.13%	25.37	1.04%	9.77	<1%	23.14	2.58%	3.55	<1%	0.00	0.00%
Pasture/Hay	387.82	13.36%	269.46	15.35%	933.57	38.20%	367.38	36.11%	141.06	15.75%	276.47	34.12%	75.63	23.61%
Cultivated Crops	364.67	12.56%	745.74	42.48%	509.85	20.86%	168.48	16.56%	377.11	42.11%	83.05	10.25%	1.56	<1%
Woody Wetlands	118.44	4.08%	36.43	2.08%	78.34	3.21%	38.62	3.80%	0.00	0.00%	35.75	4.41%	31.59	9.86%
Emergent Herbaceous Wetlands	11.58	<1%	2.89	<1%	11.13	<1%	2.44	<1%	0.00	0.00%	3.78	<1%	0.00	0.00%

Table 6.12- Projected Little Crab Orchard Creek- Crab Orchard Creek Subwatershed Land Use

Subwatershed Land Use Classification	Upper Piles Fork		Upper Little Crab		Carbondale Reservoir		Campus Lake		Upper Crab Orchard		Eastern Carbondale		Lower Piles Fork		Eek Creek	
	Projected Acreage (2021)	Projected Percent Change	Projected Acreage (2021)	Projected Percent Change	Projected Acreage (2021)	Projected Percent Change	Projected Acreage (2021)	Projected Percent Change	Projected Acreage (2021)	Projected Percent Change	Projected Acreage (2021)	Projected Percent Change	Projected Acreage (2021)	Projected Percent Change	Projected Acreage (2021)	Projected Percent Change
Open Water	25.55	0.00%	62.28	0.00%	139.07	0.00%	39.75	0.00%	1.11	0.00%	19.35	-17.14%	4.89	0.00%	10.90	0.00%
Developed, Open Space	166.66	-0.27%	219.75	-1.10%	381.32	0.29%	108.15	-0.41%	33.16	0.00%	269.08	-4.20%	456.81	-4.42%	197.71	-2.09%
Developed, Low Intensity	59.55	0.37%	63.17	-1.05%	185.65	1.22%	89.94	-1.94%	4.01	0.00%	201.92	-2.78%	904.49	-3.99%	434.55	-1.66%
Developed, Medium Intensity	1.33	20.00%	10.45	34.29%	57.95	52.94%	20.65	4.49%	0.00	0.00%	117.42	23.65%	572.90	10.42%	140.11	4.65%
Developed, High Intensity	0.00	0.00%	0.89	100.00%	6.24	86.67%	5.33	41.18%	0.00	0.00%	48.70	42.21%	145.45	31.59%	48.70	16.49%
Barren Land	0.00	0.00%	0.00	0.00%	0.00	0.00%	0.00	0.00%	0.00	0.00%	14.23	100.00%	0.00	0.00%	0.00	0.00%
Deciduous Forest	949.72	-2.38%	1612.96	-1.51%	344.77	-7.09%	78.17	0.00%	662.83	0.00%	616.00	-3.99%	509.07	-4.15%	166.12	0.54%
Evergreen Forest	5.78	0.00%	22.02	0.00%	1.34	0.00%	0.00	0.00%	24.04	0.00%	0.00	0.00%	2.45	0.00%	0.00	0.00%
Mixed Forest	1.11	0.00%	0.00	0.00%	0.00	0.00%	0.00	0.00%	0.00	0.00%	0.00	0.00%	0.00	0.00%	0.00	0.00%
Grassland/Herbaceous	1.56	0.00%	15.79	0.00%	9.58	0.00%	4.89	0.00%	14.24	0.00%	52.71	44.51%	33.36	-11.24%	54.26	0.00%
Pasture/Hay	90.22	11.54%	1482.17	0.00%	96.72	-2.47%	-0.22	*	49.41	0.00%	278.87	-4.20%	243.08	-4.96%	231.95	-1.04%
Cultivated Crops	86.22	0.00%	123.00	0.00%	4.01	0.00%	0.00	0.00%	108.17	0.00%	333.35	-0.79%	18.90	84.78%	512.61	0.00%
Woody Wetlands	27.55	100.00%	49.38	100.00%	4.90	100.00%	0.00	0.00%	42.73	0.00%	66.94	2.73%	59.60	0.00%	21.13	0.00%
Emergent Herbaceous Wetlands	0.00	0.00%	0.00	0.00%	1.11	0.00%	0.00	0.00%	0.00	0.00%	6.00	0.00%	0.00	0.00%	2.67	0.00%

Subwatershed Land Use Classification	Middle Little Crab		Reed Station		Middle Crab Orchard		Lower Little Crab		Aviation		Creekside		Lower Crab	
	Projected Acreage (2021)	Projected Percent Change	Projected Acreage (2021)	Projected Percent Change	Projected Acreage (2021)	Projected Percent Change	Projected Acreage (2021)	Projected Percent Change	Projected Acreage (2021)	Projected Percent Change	Projected Acreage (2021)	Projected Percent Change	Projected Acreage (2021)	Projected Percent Change
Open Water	8.46	0.00%	14.66	24.53%	35.83	0.00%	2.22	0.00%	2.00	0.00%	4.44	0.00%	2.45	0.00%
Developed, Open Space	653.20	-0.31%	148.84	-1.90%	98.59	9.11%	52.61	-0.84%	141.06	-2.31%	10.22	0.00%	5.34	0.00%
Developed, Low Intensity	718.65	0.00%	77.75	-1.41%	30.71	6.98%	59.27	-0.74%	116.58	-4.55%	2.44	0.00%	0.22	0.00%
Developed, Medium Intensity	163.41	13.10%	5.78	36.84%	4.90	46.67%	10.43	9.30%	53.84	10.00%	0.00	0.00%	0.00	0.00%
Developed, High Intensity	52.10	39.29%	4.89	100.00%	1.11	66.67%	1.11	0.00%	24.03	20.00%	0.00	0.00%	0.00	0.00%
Barren Land	0.00	*	0.00	0.00%	0.00	0.00%	0.00	0.00%	10.23	100.00%	0.00	0.00%	0.00	0.00%
Deciduous Forest	393.84	-4.17%	430.74	0.00%	718.37	-1.13%	305.00	0.00%	11.57	0.00%	390.62	0.00%	203.53	0.00%
Evergreen Forest	0.00	0.00%	1.56	0.00%	0.00	0.00%	0.00	0.00%	0.00	0.00%	0.00	0.00%	0.00	0.00%
Mixed Forest	0.00	0.00%	0.00	0.00%	0.00	0.00%	0.00	0.00%	0.00	0.00%	0.00	0.00%	0.00	0.00%
Grassland/Herbaceous	45.86	0.00%	19.77	0.00%	26.93	6.14%	9.77	0.00%	23.14	0.00%	3.55	0.00%	0.00	0.00%
Pasture/Hay	378.92	-2.30%	269.46	0.00%	919.77	-1.48%	367.38	0.00%	141.06	0.00%	276.47	0.00%	75.63	0.00%
Cultivated Crops	361.11	-0.98%	742.85	-0.39%	518.08	1.61%	168.48	0.00%	372.00	-1.36%	83.05	0.00%	1.56	0.00%
Woody Wetlands	117.55	-0.75%	36.43	0.00%	78.34	0.00%	38.62	0.00%	0.00	0.00%	35.75	0.00%	31.59	0.00%
Emergent Herbaceous Wetlands	11.58	0.00%	2.89	0.00%	11.13	0.00%	2.44	0.00%	0.00	0.00%	3.78	0.00%	0.00	0.00%

" * " denotes a growth but Percent Change formula cannot be calculated due to starting value being 0.

6.5 Existing and Projected Imperviousness of the Subwatersheds

6.5.1 Drury Creek Subwatershed (071401060807)

Drury Creek subwatershed has very low levels of imperviousness. This is in large part due to the presence of Giant City State Park and the Shawnee National Forest. A total of 88.3 percent of land cover is deemed permeable, or 0 percent impervious. The remaining 11.8 percent ranges from 1- 50 percent imperviousness. High levels of impervious surface are completely absent from this subwatershed. Figure 6.7 displays the name and location of the SMUs geographically. Table 6.13 presents both the acreage and percentage of each SMU by percent imperviousness.

The SMU with the highest amount of imperviousness is Cobden-North, which totals 12.1 percent of the land area. This is partly because of its close proximity to the village of Cobden. The SMU with the lowest amount of imperviousness is Shawnee-Drury Creek, which totals 4.2 percent of the SMU. Projections have also been made for future imperviousness in the SMUs. These estimates are displayed in Table 6.14.

Figure 6.7

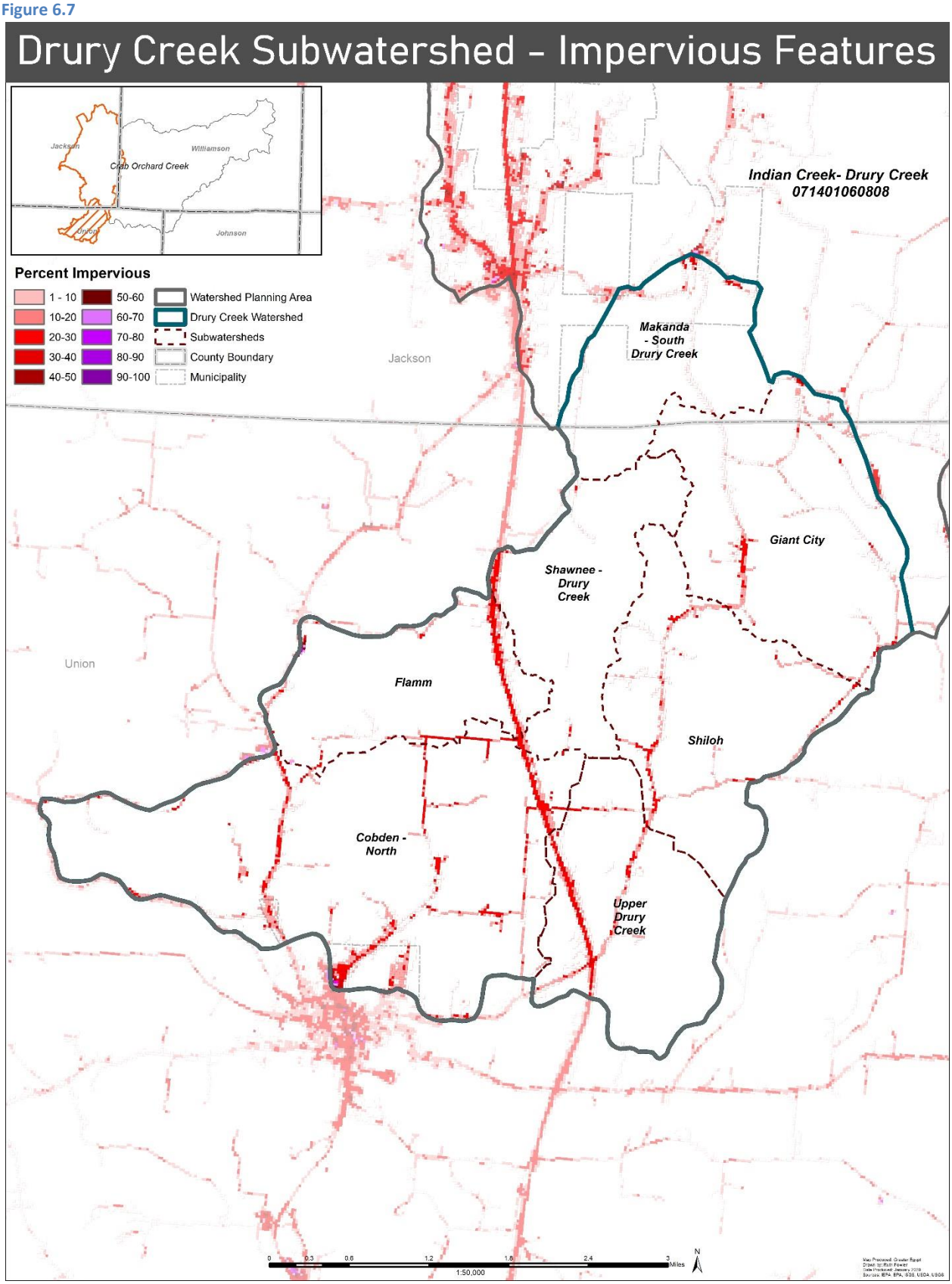

Drury Creek Subwatershed – Impervious Features
Jackson
Williamson
Crab Orchard Creek
Union
Johnson
Percent Impervious
1 - 10
10-20
20-30
30-40
40-50
50-60
60-70
70-80
80-90
90-100
Watershed Planning Area
Drury Creek Watershed
Subwatersheds
County Boundary
Municipality
Indian Creek- Drury Creek
071401060808
Makanda - South Drury Creek
Jackson
Giant City
Shawnee - Drury Creek
Union
Flamm
Shiloh
Cobden - North
Upper Drury Creek
0 0.3 0.6 1.2 1.8 2.4 3 Miles
1:50,000
N

Table 6.13- Existing Drury Creek Subwatershed Imperviousness

2011 Percent Impervious	Upper Drury Creek		Cobden-North		Shiloh		Shawnee Drury Creek		Flamm		Giant City		Makanda South Drury	
	Acreage	% of SMU	Acreage	% of SMU	Acreage	% of SMU	Acreage	% of SMU	Acreage	% of SMU	Acreage	% of SMU	Acreage	% of SMU
0%	1190.16	88.25%	2940.30	87.92%	1522.61	92.46%	1070.31	95.78%	1003.10	88.53%	1660.81	90.52%	931.99	90.53%
0-10%	80.53	5.97%	167.54	5.01%	58.49	3.55%	20.69	1.85%	52.36	4.62%	105.26	5.74%	77.04	7.48%
10-20%	42.93	3.18%	140.40	4.20%	47.15	2.86%	13.79	1.23%	38.83	3.43%	52.74	2.87%	14.47	1.41%
20-30%	24.25	1.80%	67.42	2.02%	16.24	0.99%	9.34	0.84%	20.86	1.84%	12.68	0.69%	3.56	0.35%
30-40%	7.12	0.53%	19.13	0.57%	1.78	0.11%	2.89	0.26%	12.43	1.10%	1.78	0.10%	0.67	0.06%
40-50%	3.56	0.26%	5.78	0.17%	0.44	0.03%	0.44	0.04%	2.88	0.25%	1.11	0.06%	1.11	0.11%
50-60%	0.00	0.00%	1.11	0.03%	0.00	0.00%	0.00	0.00%	1.11	0.10%	0.45	0.02%	0.45	0.04%
60-70%	0.00	0.00%	1.56	0.05%	0.00	0.00%	0.00	0.00%	1.11	0.10%	0.00	0.00%	0.22	0.02%
70-80%	0.00	0.00%	0.67	0.02%	0.00	0.00%	0.00	0.00%	0.00	0.00%	0.00	0.00%	0.00	0.00%
80-90%	0.00	0.00%	0.22	0.01%	0.00	0.00%	0.00	0.00%	0.44	0.04%	0.00	0.00%	0.00	0.00%
90-100%	0.00	0.00%	0.00	0.00%	0.00	0.00%	0.00	0.00%	0.00	0.00%	0.00	0.00%	0.00	0.00%

Table 6.14- Projected Drury Creek Subwatershed Imperviousness

Percent Impervious	Upper Drury Creek		Cobden-North		Shiloh		Shawnee Drury Creek		Flamm		Giant City		Makanda South Drury	
	Projected Acreage (2021)	Projected Percent Change	Projected Acreage (2021)	Projected Percent Change	Projected Acreage (2021)	Projected Percent Change	Projected Acreage (2021)	Projected Percent Change	Projected Acreage (2021)	Projected Percent Change	Projected Acreage (2021)	Projected Percent Change	Projected Acreage (2021)	Projected Percent Change
0%	1190.16	0.00%	2940.30	0.00%	1522.61	0.00%	1070.31	0.00%	1003.10	0.00%	1660.81	0.00%	931.99	0.00%
0-10%	80.53	0.00%	167.54	0.00%	58.49	0.00%	20.69	0.00%	52.36	0.00%	105.26	0.00%	76.81	-0.29%
10-20%	42.93	0.00%	140.40	0.00%	47.15	0.00%	13.79	0.00%	38.83	0.00%	52.74	0.00%	14.47	0.00%
20-30%	24.25	0.00%	67.42	0.00%	16.24	0.00%	9.34	0.00%	20.86	0.00%	12.68	0.00%	3.34	-6.25%
30-40%	7.12	0.00%	19.13	0.00%	1.78	0.00%	2.89	0.00%	12.43	0.00%	1.78	0.00%	0.67	0.00%
40-50%	3.56	0.00%	5.78	0.00%	0.44	0.00%	0.44	0.00%	2.88	0.00%	1.11	0.00%	1.11	0.00%
50-60%	0.00	0.00%	1.11	0.00%	0.00	0.00%	0.00	0.00%	1.11	0.00%	0.45	0.00%	0.67	50.00%
60-70%	0.00	0.00%	1.56	0.00%	0.00	0.00%	0.00	0.00%	1.11	0.00%	0.00	0.00%	0.45	100.00%
70-80%	0.00	0.00%	0.67	0.00%	0.00	0.00%	0.00	0.00%	0.00	0.00%	0.00	0.00%	0.00	0.00%
80-90%	0.00	0.00%	0.22	0.00%	0.00	0.00%	0.00	0.00%	0.44	0.00%	0.00	0.00%	0.00	0.00%
90-100%	0.00	0.00%	0.00	0.00%	0.00	0.00%	0.00	0.00%	0.00	0.00%	0.00	0.00%	0.00	0.00%

6.5.2 Indian Creek-Drury Creek Subwatershed (071401060808)

Indian Creek-Drury Creek subwatershed has a fairly low level of imperviousness. Only 14.2 percent of land cover is impervious, which equates to 2,909 acres. Of this impervious land cover, most of it is falls within the realm of low-level imperviousness. Concentrations of impervious land cover are found in pockets of residential housing and the road network. Figure 6.8 displays the name and location of the SMUs geographically. Table 6.15 presents both the acreage and percentage of each SMU by percent imperviousness.

Makanda-North SMU has the highest level of imperviousness, equaling 586.1 acres, or 39.6 percent of total land use. Roughly 92.5 percent of the impervious land cover ranges from 1-30 percent imperviousness, which is common with residential housing.

Projections have also been made for future imperviousness in the SMUs. These estimates are displayed in Table 6.16. Overall changes within the subwatershed are projected to be very minimal. Total change in acres equals only 9.3 acres with a trend towards an increase in imperviousness.

Figure 6.8

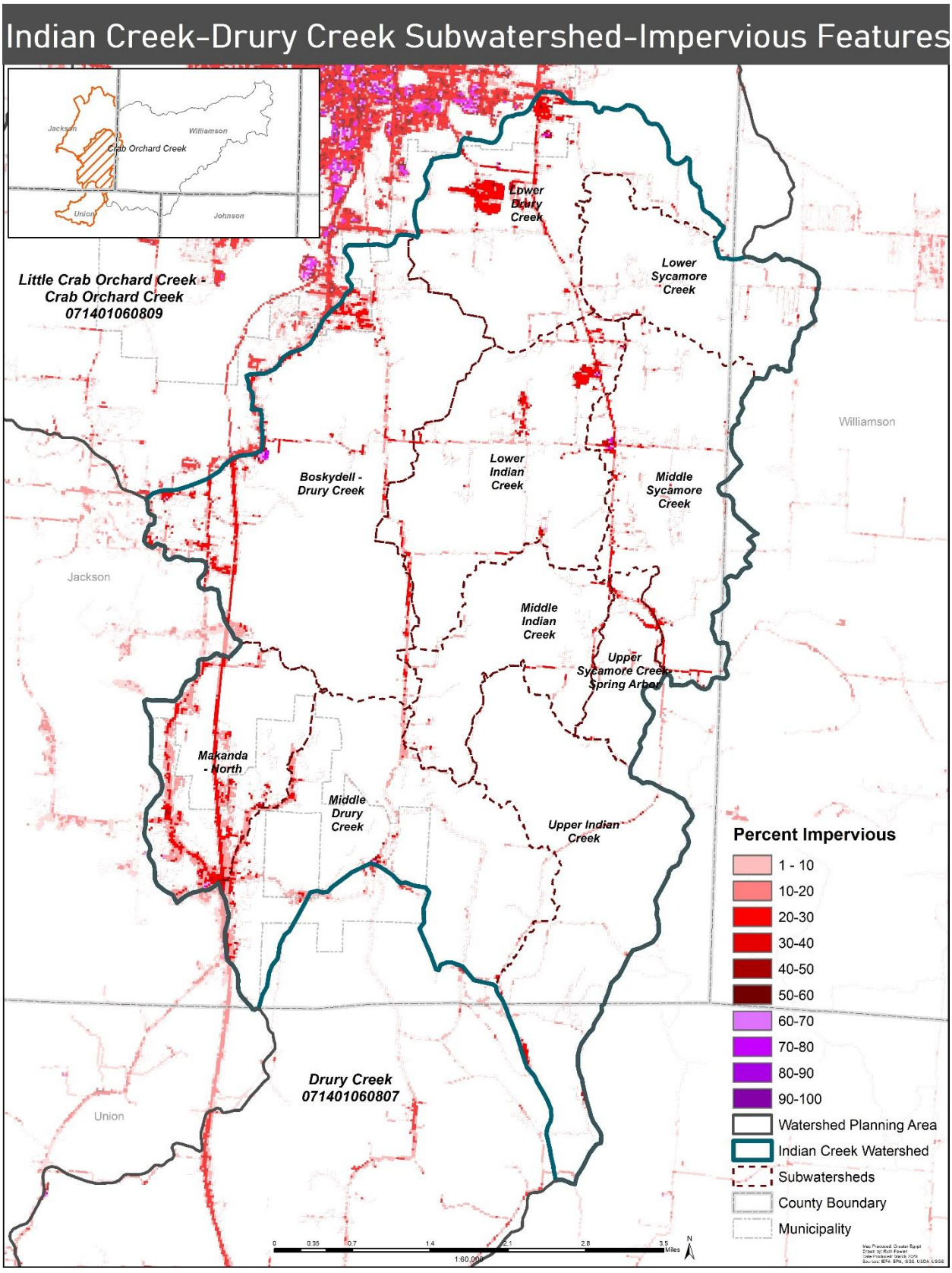

Indian Creek-Drury Creek Subwatershed-Impervious Features
Jackson
Williamson
Crab Orchard Creek
Union
Johnson
Little Crab Orchard Creek - Crab Orchard Creek 071401060809
Lower Drury Creek
Lower Sycamore Creek
Williamson
Boskydell - Drury Creek
Lower Indian Creek
Middle Sycamore Creek
Jackson
Middle Indian Creek
Upper Sycamore Creek - Spring Arbor
Makanda - North
Middle Drury Creek
Upper Indian Creek
Drury Creek 071401060807
Union
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
Indian Creek Watershed
Subwatersheds
County Boundary
Municipality
0 0.35 0.7 1.4 2.1 2.8 3.5 Miles
1:60,000
N

Table 6.15- Existing Indian Creek- Drury Creek Subwatershed Imperviousness

2011 Percent Impervious	Upper Indian Creek		Middle Drury Creek		Makanda North		Upper Sycamore Creek		Middle Indian Creek	
	Acreage	% of SMU	Acreage	% of SMU	Acreage	% of SMU	Acreage	% of SMU	Acreage	% of SMU
0%	2413.24	94.12%	2353.91	85.31%	896.00	60.45%	465.74	89.33%	1223.65	91.10%
0-10%	110.69	4.32%	264.63	9.59%	270.71	18.27%	26.26	5.04%	87.87	6.54%
10-20%	30.67	1.20%	102.65	3.72%	193.08	13.03%	15.13	2.90%	20.07	1.49%
20-30%	5.78	0.23%	27.11	0.98%	78.52	5.30%	9.35	1.79%	10.26	0.76%
30-40%	2.22	0.09%	5.55	0.20%	28.25	1.91%	4.90	0.94%	1.12	0.08%
40-50%	1.11	0.04%	2.89	0.10%	11.12	0.75%	0.00	0.00%	0.22	0.02%
50-60%	0.22	0.01%	1.56	0.06%	2.45	0.17%	0.00	0.00%	0.00	0.00%
60-70%	0.00	0.00%	0.44	0.02%	1.78	0.12%	0.00	0.00%	0.00	0.00%
70-80%	0.00	0.00%	0.44	0.02%	0.22	0.02%	0.00	0.00%	0.00	0.00%
80-90%	0.00	0.00%	0.00	0.00%	0.00	0.00%	0.00	0.00%	0.00	0.00%
90-100%	0.00	0.00%	0.00	0.00%	0.00	0.00%	0.00	0.00%	0.00	0.00%

2011 Percent Impervious	Middle Sycamore Creek		Lower Indian Creek		Boskydell		Lower Sycamore Creek		Lower Drury Creek	
	Acreage	% of SMU	Acreage	% of SMU	Acreage	% of SMU	Acreage	% of SMU	Acreage	% of SMU
0%	1794.27	88.18%	2071.57	88.03%	3375.67	84.68%	1248.52	91.60%	1787.82	83.84%
0-10%	152.03	7.47%	162.04	6.89%	297.75	7.47%	92.96	6.82%	152.29	7.14%
10-20%	43.63	2.14%	57.35	2.44%	162.65	4.08%	17.35	1.27%	76.81	3.60%
20-30%	29.16	1.43%	36.01	1.53%	103.99	2.61%	3.56	0.26%	62.34	2.92%
30-40%	9.13	0.45%	16.67	0.71%	34.22	0.86%	0.67	0.05%	41.63	1.95%
40-50%	3.12	0.15%	5.56	0.24%	6.22	0.16%	0.00	0.00%	6.90	0.32%
50-60%	1.11	0.05%	2.67	0.11%	0.67	0.02%	0.00	0.00%	2.89	0.14%
60-70%	1.11	0.05%	1.11	0.05%	2.67	0.07%	0.00	0.00%	0.67	0.03%
70-80%	1.34	0.07%	0.22	0.01%	1.33	0.03%	0.00	0.00%	1.11	0.05%
80-90%	0.00	0.00%	0.00	0.00%	0.67	0.02%	0.00	0.00%	0.00	0.00%
90-100%	0.00	0.00%	0.00	0.00%	0.44	0.01%	0.00	0.00%	0.00	0.00%

Table 6.16- Projected Indian Creek- Drury Creek Subwatershed Imperviousness

Percent Impervious	Upper Indian Creek		Middle Drury Creek		Makanda North		Upper Sycamore Creek		Middle Indian Creek	
	Projected Acreage (2021)	Projected Percent Change	Projected Acreage (2021)	Projected Percent Change	Projected Acreage (2021)	Projected Percent Change	Projected Acreage (2021)	Projected Percent Change	Projected Acreage (2021)	Projected Percent Change
0%	2413.24	0.00%	2353.91	0.00%	896.00	0.00%	465.74	0.00%	1223.65	0.00%
0-10%	110.69	0.00%	264.19	-0.17%	268.93	-0.66%	26.26	0.00%	87.87	0.00%
10-20%	30.67	0.00%	102.65	0.00%	192.64	-0.23%	15.13	0.00%	20.07	0.00%
20-30%	5.78	0.00%	27.11	0.00%	78.08	-0.57%	9.35	0.00%	10.26	0.00%
30-40%	2.22	0.00%	5.55	0.00%	28.25	0.00%	4.90	0.00%	1.12	0.00%
40-50%	1.11	0.00%	3.11	7.69%	11.79	6.00%	0.00	0.00%	0.22	0.00%
50-60%	0.22	0.00%	1.78	14.29%	2.89	18.18%	0.00	0.00%	0.00	0.00%
60-70%	0.00	0.00%	0.44	0.00%	3.11	75.00%	0.00	0.00%	0.00	0.00%
70-80%	0.00	0.00%	0.44	0.00%	0.44	100.00%	0.00	0.00%	0.00	0.00%
80-90%	0.00	0.00%	0.00	0.00%	0.00	0.00%	0.00	0.00%	0.00	0.00%
90-100%	0.00	0.00%	0.00	0.00%	0.00	0.00%	0.00	0.00%	0.00	0.00%

Percent Impervious	Middle Sycamore Creek		Lower Indian Creek		Boskydell		Lower Sycamore Creek		Lower Drury Creek	
	Projected Acreage (2021)	Projected Percent Change	Projected Acreage (2021)	Projected Percent Change	Projected Acreage (2021)	Projected Percent Change	Projected Acreage (2021)	Projected Percent Change	Projected Acreage (2021)	Projected Percent Change
0%	1794.27	0.00%	2071.57	0.00%	3375.67	0.00%	1248.52	0.00%	1782.92	-0.27%
0-10%	151.58	-0.29%	160.48	-0.96%	297.75	0.00%	92.96	0.00%	152.73	0.29%
10-20%	43.63	0.00%	56.68	-1.16%	162.65	0.00%	17.35	0.00%	77.26	0.58%
20-30%	29.16	0.00%	36.01	0.00%	103.99	0.00%	3.56	0.00%	62.79	0.71%
30-40%	9.13	0.00%	16.67	0.00%	34.22	0.00%	0.67	0.00%	41.86	0.53%
40-50%	3.34	7.14%	6.22	12.00%	6.22	0.00%	0.00	0.00%	8.02	16.13%
50-60%	1.11	0.00%	4.00	50.00%	0.67	0.00%	0.00	0.00%	3.78	30.77%
60-70%	1.34	20.00%	1.33	20.00%	2.67	0.00%	0.00	0.00%	1.34	100.00%
70-80%	1.34	0.00%	0.22	0.00%	1.33	0.00%	0.00	0.00%	1.78	60.00%
80-90%	0.00	0.00%	0.00	0.00%	0.67	0.00%	0.00	0.00%	0.00	0.00%
90-100%	0.00	0.00%	0.00	0.00%	0.44	0.00%	0.00	0.00%	0.00	0.00%

6.5.3 Little Crab Orchard Creek- Crab Orchard Creek Subwatershed (071401060809)

Little Crab Orchard Creek- Crab Orchard Creek subwatershed has a relatively high level of imperviousness compared to the other two HUC 12 subwatersheds. This is in large part due to the presence of Carbondale within its boundaries, which includes multiple businesses and Southern Illinois University. Figure 6.9 displays the name and location of the SMUs geographically. Table 6.17 presents both the acreage and percentage of each SMU by percent imperviousness.

Based on most recent data, Little Crab Orchard Creek- Crab Orchard Creek subwatershed is 29.6 percent impervious. 17.1 percent of the land cover is classified above 50 percent impervious. These high levels of imperviousness are concentrated within Lower Piles Fork, Middle Little Crab Orchard Creek, and Eek Creek SMUs. As previously stated, Little Crab Orchard Creek subwatershed encompasses Southern Illinois University and parts of Southern Illinois Airport. The presence of these facilities, as well as accompanying housing, business, and roadways, contributes largely to the higher levels of imperviousness.

Lower Piles Fork Creek SMU is 69.5 percent impervious, covering roughly 2,049.4 acres of land. This SMU includes the intersection of Highway 13 and Highway 51, which makes it a hub for businesses and residential housing. Projections have also been made for future imperviousness in the SMUs. These estimates are displayed in Table 6.18.

Figure 6.9

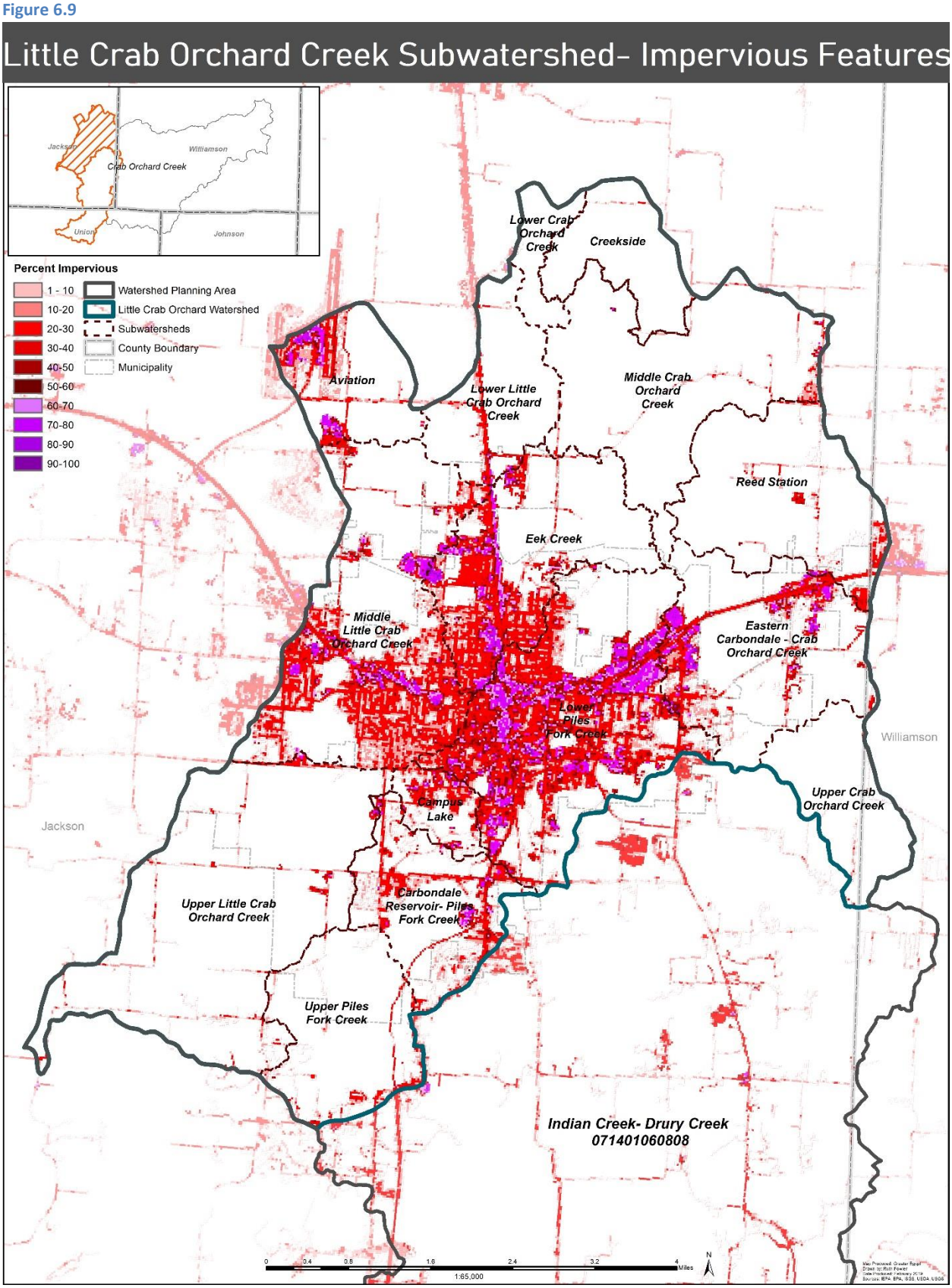

Little Crab Orchard Creek Subwatershed- Impervious Features
Jackson
Williamson
Crab Orchard Creek
Union
Johnson
Percent Impervious
1 - 10
10-20
20-30
30-40
40-50
50-60
60-70
70-80
80-90
90-100
Watershed Planning Area
Little Crab Orchard Watershed
Subwatersheds
County Boundary
Municipality
Lower Crab Orchard Creek
Creekside
Aviation
Lower Little Crab Orchard Creek
Middle Crab Orchard Creek
Reed Station
Eek Creek
Middle Little Crab Orchard Creek
Eastern Carbondale - Crab Orchard Creek
Lower Piles Fork Creek
Williamson
Campus Lake
Upper Crab Orchard Creek
Jackson
Upper Little Crab Orchard Creek
Carbondale Reservoir- Piles Fork Creek
Upper Piles Fork Creek
Indian Creek- Drury Creek
071401060808
0 0.4 0.8 1.6 2.4 3.2 4 Miles
1:65,000
N

Table 6.17- Existing Little Crab Orchard Creek Subwatershed Imperviousness

2011 Percent Impervious	Upper Piles Fork Creek		Upper Little Crab		Carbondale Reservoir		Campus Lake		Upper Crab Orchard		Eastern Carbondale		Lower Piles Fork Creek		Eek Creek	
	Acreage	% of SMU	Acreage	% of SMU	Acreage	% of SMU	Acreage	% of SMU	Acreage	% of SMU	Acreage	% of SMU	Acreage	% of SMU	Acreage	% of SMU
0%	1187.70	83.92%	3367.13	91.95%	626.92	50.86%	122.80	35.43%	902.55	96.04%	1405.91	69.44%	901.60	30.55%	1001.20	54.99%
0-10%	131.32	9.28%	149.46	4.08%	270.11	21.91%	69.29	19.99%	27.82	2.96%	177.91	8.79%	250.42	8.49%	78.06	4.29%
10-20%	40.22	2.84%	76.51	2.09%	122.13	9.91%	43.97	12.68%	6.23	0.66%	113.64	5.61%	254.87	8.64%	140.99	7.74%
20-30%	34.89	2.47%	41.15	1.12%	89.81	7.29%	41.75	12.04%	2.67	0.28%	82.06	4.05%	305.80	10.36%	189.03	10.38%
30-40%	16.89	1.19%	16.90	0.46%	61.29	4.97%	31.53	9.10%	0.45	0.05%	70.94	3.50%	376.30	12.75%	173.91	9.55%
40-50%	3.33	0.24%	2.67	0.07%	23.40	1.90%	14.88	4.29%	0.00	0.00%	48.48	2.39%	250.42	8.49%	66.49	3.65%
50-60%	0.67	0.05%	3.34	0.09%	16.71	1.36%	8.88	2.56%	0.00	0.00%	36.25	1.79%	205.50	6.96%	48.48	2.66%
60-70%	0.22	0.02%	2.00	0.05%	11.37	0.92%	7.33	2.11%	0.00	0.00%	28.69	1.42%	162.80	5.52%	50.48	2.77%
70-80%	0.00	0.00%	2.22	0.06%	8.02	0.65%	2.89	0.83%	0.00	0.00%	30.24	1.49%	146.56	4.97%	34.03	1.87%
80-90%	0.00	0.00%	0.00	0.00%	2.90	0.24%	3.11	0.90%	0.00	0.00%	25.35	1.25%	84.07	2.85%	30.91	1.70%
90-100%	0.00	0.00%	0.44	0.01%	0.00	0.00%	0.22	0.06%	0.00	0.00%	5.11	0.25%	12.68	0.43%	7.12	0.39%

2011 Percent Impervious	Middle Little Crab		Reed Station		Middle Crab		Lower Little Crab		Aviation		Creekside		Lower Crab Orchard	
	Acreage	% of SMU	Acreage	% of SMU	Acreage	% of SMU	Acreage	% of SMU	Acreage	% of SMU	Acreage	% of SMU	Acreage	% of SMU
0%	1346.48	46.37%	1518.36	86.49%	2320.68	94.96%	893.91	87.87%	560.00	62.53%	797.67	98.44%	314.75	98.26%
0-10%	312.13	10.75%	108.18	6.16%	50.07	2.05%	26.86	2.64%	59.40	6.63%	5.33	0.66%	4.45	1.39%
10-20%	378.70	13.04%	47.32	2.70%	42.28	1.73%	27.97	2.75%	93.44	10.43%	5.11	0.63%	0.89	0.28%
20-30%	349.31	12.03%	38.43	2.19%	21.14	0.87%	27.53	2.71%	63.63	7.11%	1.78	0.22%	0.22	0.07%
30-40%	263.37	9.07%	28.43	1.62%	3.78	0.15%	21.98	2.16%	30.93	3.45%	0.22	0.03%	0.00	0.00%
40-50%	79.70	2.74%	8.89	0.51%	2.00	0.08%	9.10	0.89%	20.25	2.26%	0.22	0.03%	0.00	0.00%
50-60%	53.65	1.85%	1.56	0.09%	1.78	0.07%	4.66	0.46%	16.69	1.86%	0.00	0.00%	0.00	0.00%
60-70%	46.53	1.60%	1.56	0.09%	0.89	0.04%	2.22	0.22%	17.58	1.96%	0.00	0.00%	0.00	0.00%
70-80%	39.85	1.37%	1.11	0.06%	0.67	0.03%	2.00	0.20%	14.68	1.64%	0.00	0.00%	0.00	0.00%
80-90%	26.05	0.90%	1.33	0.08%	0.22	0.01%	0.89	0.09%	16.02	1.79%	0.00	0.00%	0.00	0.00%
90-100%	7.79	0.27%	0.44	0.03%	0.22	0.01%	0.22	0.02%	2.89	0.32%	0.00	0.00%	0.00	0.00%

Table 6.18- Projected Little Crab OrchardCreek- Crab Orchard Creek Subwatershed Imperviousness

Percent Impervious	Upper Piles Fork Creek		Upper Little Crab		Carbondale Reservoir		Campus Lake		Upper Crab Orchard		Eastern Carbondale		Lower Piles Fork Creek		Eek Creek	
	Projected Acreage (2021)	Projected Percent Change	Projected Acreage (2021)	Projected Percent Change	Projected Acreage (2021)	Projected Percent Change	Projected Acreage (2021)	Projected Percent Change	Projected Acreage (2021)	Projected Percent Change	Projected Acreage (2021)	Projected Percent Change	Projected Acreage (2021)	Projected Percent Change	Projected Acreage (2021)	Projected Percent Change
0%	1187.70	0.00%	3367.13	0.00%	600.62	-4.19%	122.58	-0.18%	902.55	0.00%	1386.79	-1.36%	871.36	-3.35%	999.65	-0.15%
0-10%	130.88	-0.34%	149.46	0.00%	272.34	0.83%	68.84	-0.64%	27.82	0.00%	173.90	-2.25%	245.53	-1.95%	76.72	-1.71%
10-20%	40.22	0.00%	74.06	-3.20%	120.79	-1.09%	43.97	0.00%	6.23	0.00%	105.85	-6.85%	236.63	-7.16%	137.88	-2.21%
20-30%	34.89	0.00%	40.48	-1.62%	90.48	0.74%	40.42	-3.19%	2.67	0.00%	77.39	-5.69%	287.34	-6.04%	186.58	-1.29%
30-40%	16.89	0.00%	16.90	0.00%	62.18	1.45%	31.53	0.00%	0.45	0.00%	68.27	-3.76%	360.73	-4.14%	171.46	-1.41%
40-50%	3.56	6.67%	2.67	0.00%	25.18	7.62%	14.43	-2.99%	0.00	0.00%	49.81	2.75%	248.20	-0.89%	64.05	-3.68%
50-60%	0.89	33.33%	4.00	20.00%	22.29	33.33%	9.10	2.50%	0.00	0.00%	41.81	15.34%	214.17	4.22%	50.70	4.59%
60-70%	0.22	0.00%	3.11	55.56%	18.94	66.67%	7.77	6.06%	0.00	0.00%	37.14	29.46%	181.03	11.20%	53.37	5.73%
70-80%	0.00	0.00%	3.11	40.00%	14.49	80.56%	3.33	15.38%	0.00	0.00%	40.25	33.09%	177.47	21.09%	35.58	4.58%
80-90%	0.00	0.00%	0.00	0.00%	5.35	84.62%	4.22	35.71%	0.00	0.00%	34.47	35.96%	104.53	24.34%	35.58	15.11%
90-100%	0.00	0.00%	0.89	100.00%	0.00	0.00%	0.44	100.00%	0.00	0.00%	8.90	73.91%	24.02	89.47%	9.12	28.12%

Percent Impervious	Middle Little Crab		Reed Station		Middle Crab		Lower Little Crab		Aviation		Creekside		Lower Crab Orchard	
	Projected Acreage (2021)	Projected Percent Change	Projected Acreage (2021)	Projected Percent Change	Projected Acreage (2021)	Projected Percent Change	Projected Acreage (2021)	Projected Percent Change	Projected Acreage (2021)	Projected Percent Change	Projected Acreage (2021)	Projected Percent Change	Projected Acreage (2021)	Projected Percent Change
0%	1313.53	-2.45%	1518.36	0.00%	2308.44	-0.53%	893.91	0.00%	560.00	0.00%	797.67	0.00%	314.75	0.00%
0-10%	312.80	0.21%	105.52	-2.46%	57.64	15.11%	26.42	-1.65%	58.29	-1.87%	5.33	0.00%	4.45	0.00%
10-20%	377.36	-0.35%	46.87	-0.94%	42.95	1.58%	27.97	0.00%	91.22	-2.38%	5.11	0.00%	0.89	0.00%
20-30%	349.98	0.19%	37.32	-2.89%	22.25	5.26%	27.30	-0.81%	61.41	-3.50%	1.78	0.00%	0.22	0.00%
30-40%	263.60	0.08%	28.21	-0.78%	4.23	11.76%	21.75	-1.01%	28.70	-7.19%	0.22	0.00%	0.00	0.00%
40-50%	79.26	-0.56%	9.33	5.00%	2.45	22.22%	9.10	0.00%	18.91	-6.59%	0.22	0.00%	0.00	0.00%
50-60%	57.44	7.05%	1.78	14.29%	2.67	50.00%	4.88	4.76%	17.13	2.67%	0.00	0.00%	0.00	0.00%
60-70%	54.10	16.27%	2.44	57.14%	1.56	75.00%	2.44	10.00%	19.13	8.86%	0.00	0.00%	0.00	0.00%
70-80%	48.31	21.23%	2.22	100.00%	0.89	33.33%	2.44	22.22%	18.24	24.24%	0.00	0.00%	0.00	0.00%
80-90%	33.62	29.06%	2.67	100.00%	0.45	100.00%	0.89	0.00%	18.24	13.89%	0.00	0.00%	0.00	0.00%
90-100%	13.58	74.29%	0.89	100.00%	0.22	0.00%	0.22	0.00%	4.23	46.15%	0.00	0.00%	0.00	0.00%

7. Watershed Drainage and Assessment

To further characterize the waterbodies in the Western Crab Orchard Creek watershed, an assessment was conducted to identify certain impairments of waterbodies. Components assessed are: extent of channelization, condition of riparian area, and extent of streambank and shoreline erosion.

Assessment methods include physical field evaluations, analyses of aerial photography from 1938 to 2019, and remote analysis utilizing an unmanned aircraft system (UAS). Figure 7.1 displays the assessed waterbodies, as well as the location of assessment points. Less accessible reaches were assessed with UAS (remote assessment). Appendix C 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 B displays the stream name with its corresponding Assessment ID, reach code and length. Streams and tributaries were then categorized by their subwatershed. The assessed lakes in the planning area were also assigned a shoreline code. These waterbodies include Campus Lake, Carbondale Reservoir, and Spring Arbor Lake. If a watershed contained retention or detention basins, these structures were also reported. Detailed information regarding each shoreline code can also be viewed in Section 7.3.1 Each HUC 12 watershed in the overall study area will be examined individually.

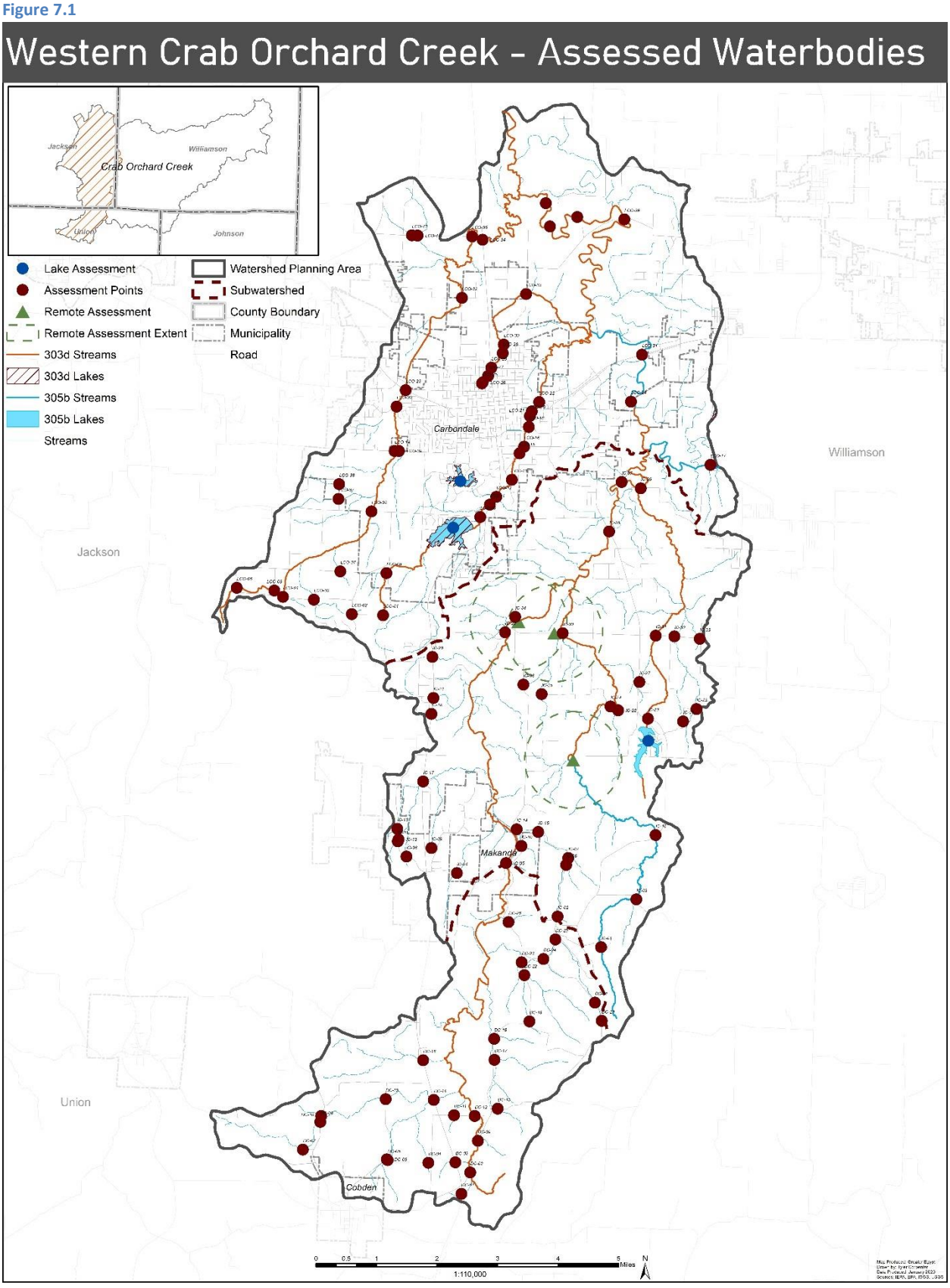
7.1 Assessment Components

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, low, moderate, or high. In some cases, erosion may also be described as severe if the extent of erosion is extreme. These designations

Figure 7.1


Western Crab Orchard Creek – Assessed Waterbodies
Jackson
Williamson
Crab Orchard Creek
Union
Johnson
Lake Assessment
Assessment Points
Remote Assessment
Remote Assessment Extent
303d Streams
303d Lakes
305b Streams
305b Lakes
Streams
Watershed Planning Area
Subwatershed
County Boundary
Municipality
Road
Carbondale
Williamson
Jackson
Makanda
Union
Cobden
0 0.5 1 2 3 4 5 Miles
1:110,000
N

correspond to the lateral recession rate (LRR) category. LRR also correlate to the pollutant load reduction section of this report (Section 8.8). This characterizes erosion classes as: slight (none or low), moderate (moderate), severe (high), and very severe (high). Figure 7.2 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. Sample evaluation forms can be viewed in Appendix C.

Figure 7.2- Levels of Eroded Streambanks

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

If a particular stream reach showed 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).

Condition of Riparian Area and Littoral Zone

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

Stream reaches that have 33 percent, or less areas with degraded riparian areas have been classified as good, 33-66 percent as fair, and 66 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 and littoral zones. Consideration is also given to development, debris (synthetic), and other environmental factors. Debris, blockages, and other obstructions have also been assessed.

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

Figure 7.3- Condition of Riparian Areas and Littoral Zones

Condition: A- Good; B- Fair; C- Poor

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 also 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 hold off heavy flow. Streams where one to 33 percent of banks are channelized are considered low, 33 to 66 percent of reach channelized is moderate, and a high degree of channelization is expressed as exhibiting 66 percent or more channelized features.

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

Figure 7.4- Historical and Current Aerial of Channelized Stream

Source: City of Carbondale, Jackson County

7.2 Drury Creek Subwatershed Assessment (071401060807)

As with most watersheds, the Drury Creek subwatershed experiences varying levels of erosion. Levels of increased erosive activity are not confined to one specific subwatershed. Riparian areas in the watershed are generally in good condition with no reaches exhibitng poor conditions. Since the watershed is fairly rural, with an abundance of forested land, channelization has a minimal impact.

Extent of Erosion

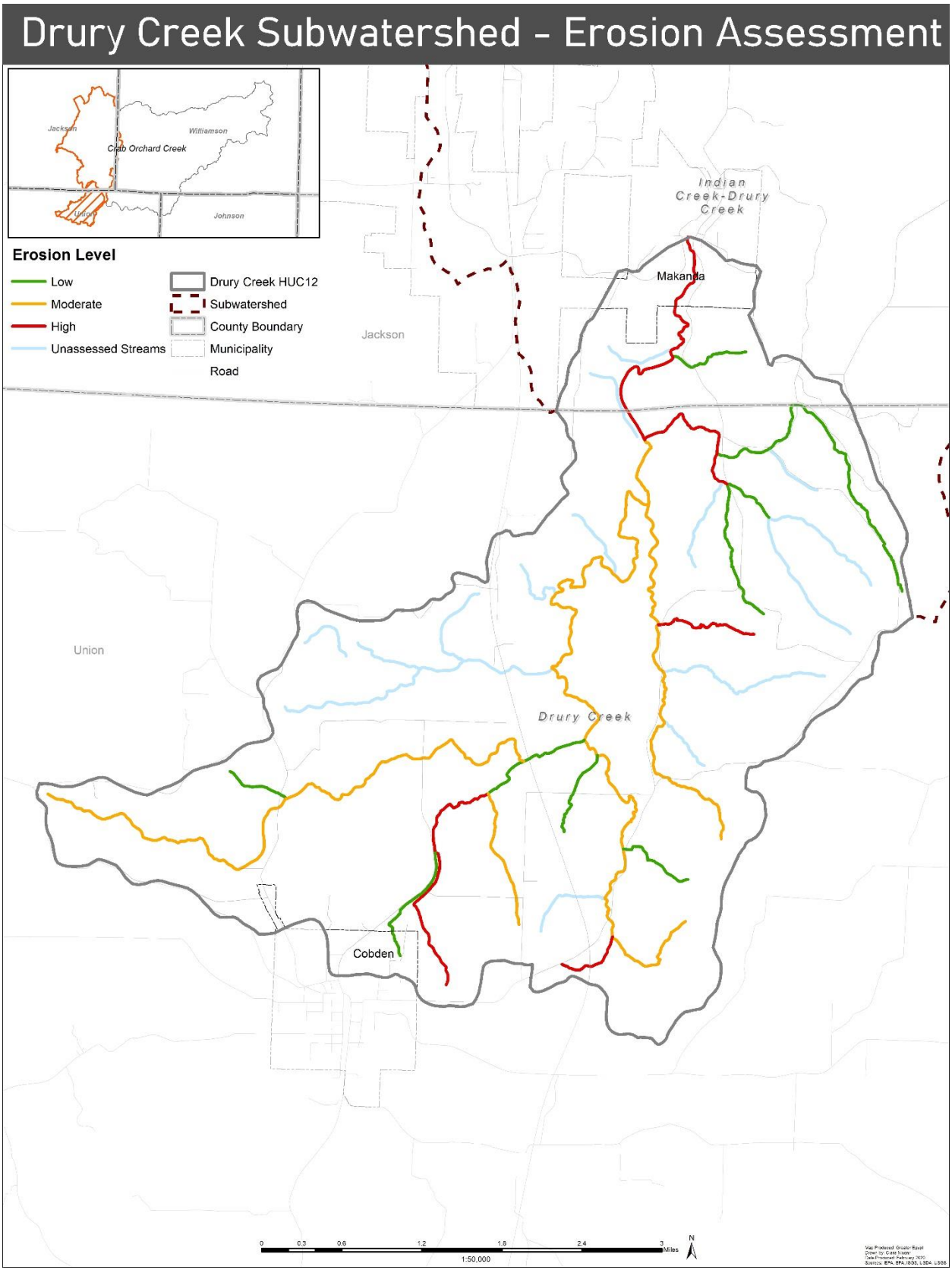
Table 7.1 summarizes the extent of erosion for the Drury Creek watershed. The majority of streams and tributaties in the Drury Creek subwatershed exhibit some degree of streambank erosion. While there are several areas of high erosion, the reach may be classified as moderate because other parts of that particular reach exhibit less erosion.

Areas of increased erosion occur in every subwatershed to some degree, except for in the Flamm SMU. Figure 7.5 depicts the extent of erosion for the Druy Creek subwatershed.

Table 7.1- Drury Creek Subwatershed Extent of Erosion

Drury Creek Subwatershed						
Extent of Erosion	None or Low		Moderate		High	
	Reaches	%	Reaches	%	Reaches	%
Upper Drury Creek	2	25.0%	5	62.5%	1	12.5%
Cobden-North	4	57.1%	2	28.6%	1	14.3%
Shiloh	0	0.0%	2	66.7%	1	33.3%
Shawnee-Drury Creek	0	0.0%	3	100.0%	0	0.0%
Flamm	0	0.0%	0	0.0%	0	0.0%
Giant City	4	80.0%	0	0.0%	1	20.0%
Makanda	1	50.0%	0	0.0%	1	50.0%

Figure 7.5


Drury Creek Subwatershed - Erosion Assessment
Jackson
Williamson
Crab Orchard Creek
Union
Johnson
Erosion Level
Low
Moderate
High
Unassessed Streams
Drury Creek HUC12
Subwatershed
County Boundary
Municipality
Road
Indian Creek-Drury Creek
Makanda
Jackson
Union
Drury Creek
Cobden
0 0.3 0.6 1.2 1.8 2.4 3 Miles
1:50,000
N

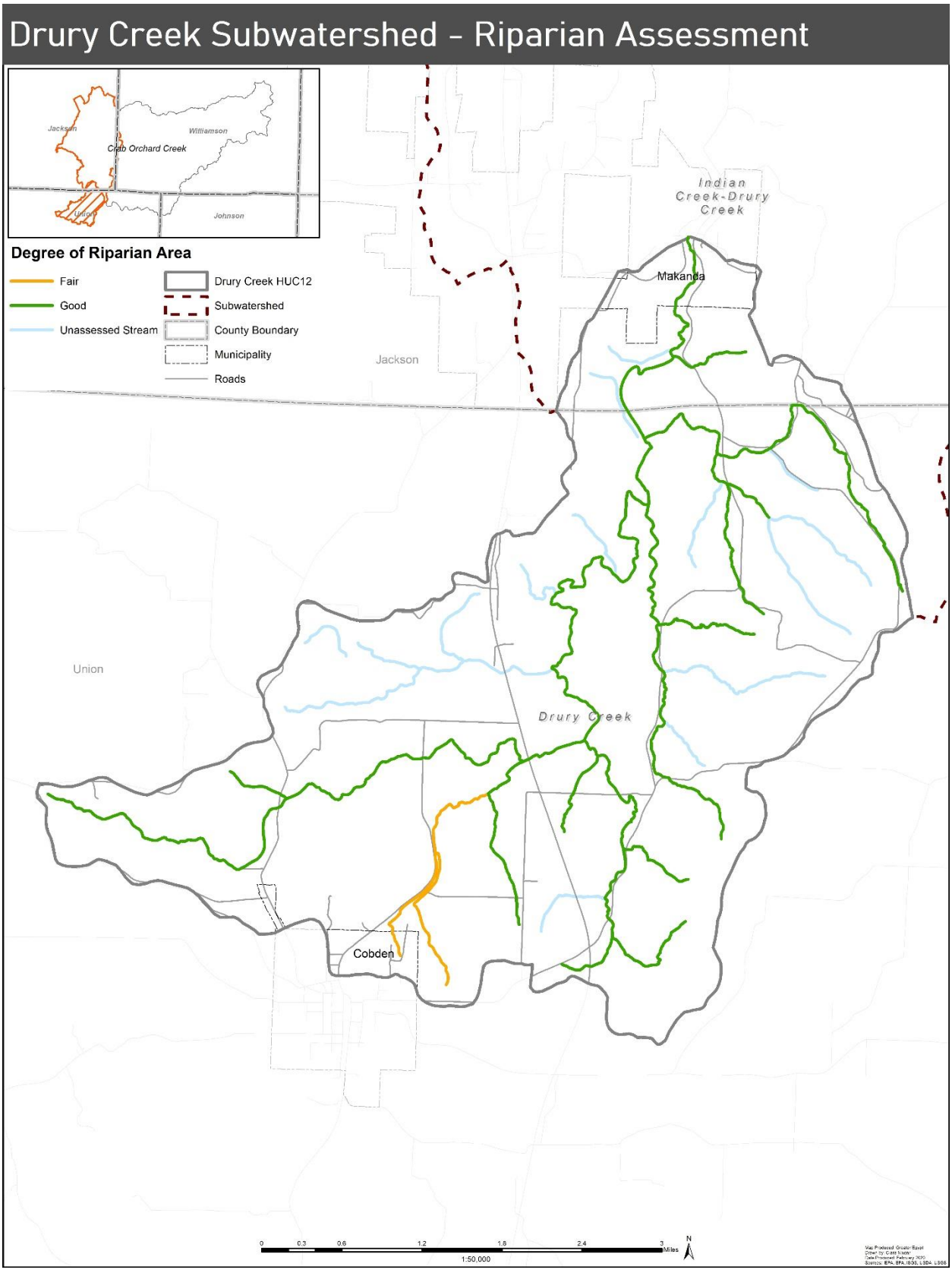
Condition of Riparian Areas

In general, riparian areas in the Drury Creek watershed exhibit good conditions. Since forested areas in the subwatershed account for 67.4 percent, and development and agricultural areas account for 30 percent of land use, riparian areas have generally been preserved. Twenty-five of the twenty-eight reaches examined in the subwatershed have been assessed as good. The remaining reaches are categorized as fair. No reaches were considered to be in poor condition. The condition of riparian areas are summarized in the table below. Riparian conditions of Drury Creek subwatershed can be viewed in Figure 7.6.

Table 7.2- Drury Creek Subwatershed Condition of Riparian Area

Drury Creek Subwatershed						
Condition of Riparian Area	Good		Fair		Poor	
	Reaches	%	Reaches	%	Reaches	%
Upper Drury Creek	7	87.5%	1	16.7%	0	0.0%
Cobden-North	5	71.4%	2	25.0%	0	0.0%
Shiloh	3	100.0%	0	0.0%	0	0.0%
Shawnee-Drury Creek	3	100.0%	0	0.0%	0	0.0%
Flamm	0	0.0%	0	0.0%	0	0.0%
Giant City	5	100.0%	0	0.0%	0	0.0%
Makanda	2	100.0%	0	0.0%	0	0.0%

Figure 7.6


Drury Creek Subwatershed – Riparian Assessment
Jackson
Williamson
Crab Orchard Creek
Union
Johnson
Degree of Riparian Area
Fair
Good
Unassessed Stream
Drury Creek HUC12
Subwatershed
County Boundary
Municipality
Roads
Indian Creek-Drury Creek
Makanda
Jackson
Union
Drury Creek
Cobden
0 0.3 0.6 1.2 1.8 2.4 3 Miles
1:50,000
N

Degree of Channelization

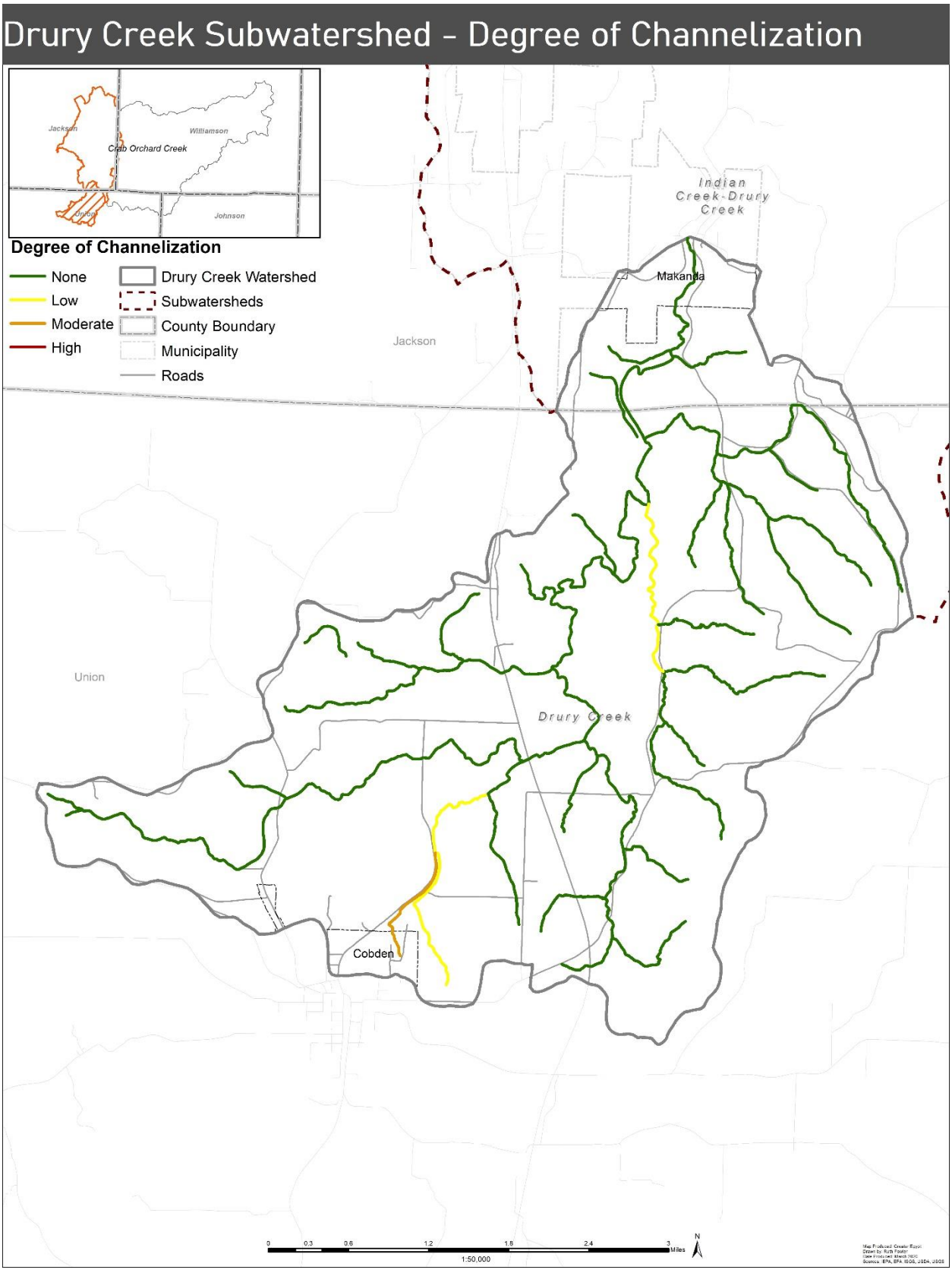
The Drury Creek subwatershed is mostly rural and forested land, leaving little channelized features in the area. Forty-two out of the forty-five reaches assessed exhibit no channelization. Two reaches have a low degree, while only one reach is characterized as exhibiting a moderate degree of channelization. Channelization is typically more prevalent in cropland areas or urban areas. Since Drury Creek is fairly undeveloped and has a considerable amout of forested land, channelization of streams is uncommon.

Table 7.3 summarizes the degree of channelization, categorized by SMUs in Drury Creek subwatershed. The degree of channelization is also displayed in Figure 7.7.

Table 7.3- Drury Creek Subwatershed Degree of Channelization

Drury Creek Subwatershed								
Degree of Channelization	None		Low		Moderate		High	
	Reaches	%	Reaches	%	Reaches	%	Reaches	%
Upper Drury Creek	9	100.0%	0	0.0%	0	0.0%	0	0.0%
Cobden-North	6	75.0%	1	12.5%	1	12.5%	0	0.0%
Shiloh	4	80.0%	1	20.0%	0	0.0%	0	0.0%
Shawnee-Drury Creek	5	100.0%	0	0.0%	0	0.0%	0	0.0%
Flamm	4	100.0%	0	0.0%	0	0.0%	0	0.0%
Giant City	10	100.0%	0	0.0%	0	0.0%	0	0.0%
Makanda	4	100.0%	0	0.0%	0	0.0%	0	0.0%

Figure 7.7


Drury Creek Subwatershed – Degree of Channelization
Jackson
Williamson
Crab Orchard Creek
Union
Johnson
Degree of Channelization
None
Low
Moderate
High
Drury Creek Watershed
Subwatersheds
County Boundary
Municipality
Roads
Indian Creek-Drury Creek
Makanda
Jackson
Union
Drury Creek
Cobden
0 0.3 0.6 1.2 1.8 2.4 3 Miles
1:50,000
N

7.3 Indian Creek- Drury Creek Subwatershed Assessment (071401060808)

The Indian Creek-Drury Creek subwatershed is the second largest watershed that was assessed. The watershed has varying categories of erosion; however, the most erosive areas are found within its three main streams: Indian Creek, Drury Creek, and Sycamore Creek. The majority of riparian areas in the watershed are considered in good condition. Alike Drury Creek watershed, the Indian Creek-Drury Creek subwatershed has little channelization of its streams.

Extent of Erosion

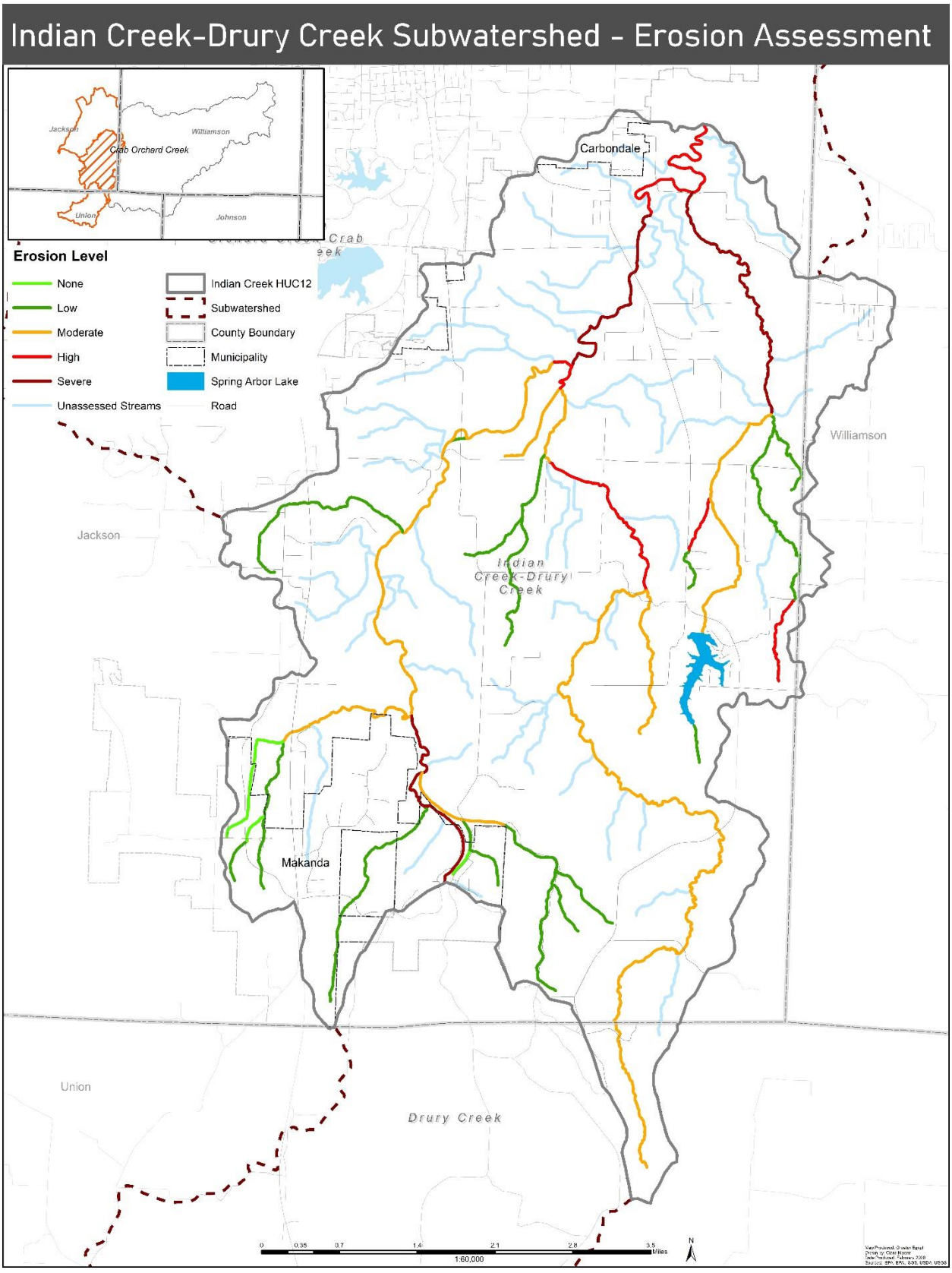
Table 7.4 displays the extent of erosion for the Indian Creek-Drury Creek subwatershed. The majority of streams and tributaties in the Indian-Drury Creek subwatershed exhibit some degree of streambank erosion. There was an added classification of "severe", as there were assessed portions of certain reaches that exhibited extremely high levels of erosion. No subwatered is completely exempt from erosion. Areas of increased erosion occur in every SMU to some degree.

Table 7.4 summarizes the extent of erosion, categorized by Indian-Drury Creek SMUs. Figure 7.8 displays the erosion assessment.

Table 7.4- Indian Creek- Drury Creek Subwatershed Extent of Erosion

Indian Creek- Drury Creek Subwatershed						
Extent of Erosion	None or Low		Moderate		High	
	Reaches	%	Reaches	%	Reaches	%
Upper Indian Creek	0	0%	4	100%	0	0%
Middle Drury Creek	8	57%	2	14%	4	29%
Makanda-North	4	67%	2	33%	0	0%
Upper Sycamore Creek	1	50%	1	50%	0	0%
Middle Indian Creek	0	0%	2	100%	0	0%
Middle Sycamore Creek	4	50%	2	25%	0	0%
Lower Indian Creek	2	25%	3	38%	0	0%
Boskydell-Drury Creek	2	50%	1	25%	0	0%
Lower Sycamore Creek	0	0%	0	0%	1	100%
Lower Drury Creek	0	0%	0	75%	1	25%

Figure 7.8


Indian Creek-Drury Creek Subwatershed - Erosion Assessment
Jackson
Williamson
Crab Orchard Creek
Union
Johnson
Erosion Level
None
Low
Moderate
High
Severe
Unassessed Streams
Indian Creek HUC12
Subwatershed
County Boundary
Municipality
Spring Arbor Lake
Road
Carbondale
Williamson
Jackson
Indian Creek-Drury Creek
Makanda
Union
Drury Creek
0 0.35 0.7 1.4 2.1 2.8 3.5 Miles
1:60,000
N

Condition of Riparian Areas

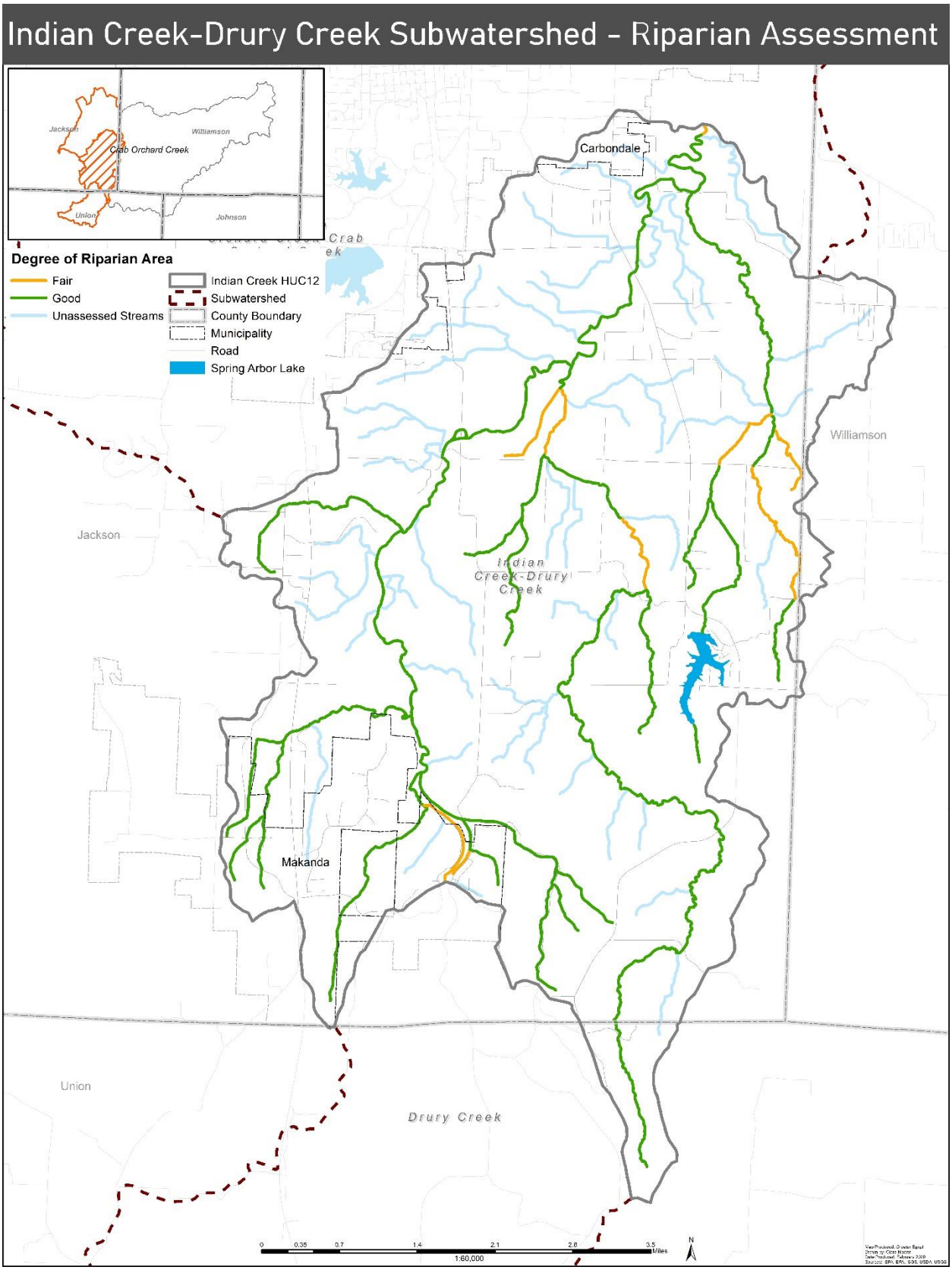
In general, riparian areas in the Indian Creek-Drury Creek subwatershed exhibit good conditions. Indian Creek-Drury Creek is also heavily forested, covering 65.8 percent of the watershed.

A total of 117 reaches were examined in the subwatershed. Ninety-one percent of those are categorized as being in good condition. The remaining ten reaches are categorized as fair. Nine of these ten reaches flow through agricultural fields and have little to no buffer. One area considered as having a fair riparian area is located in the southern most part of the watershed and flows near Makanda boardwalk area. No reaches were considered to be in poor condition. The condition of riparian areas are summarized in the table below. Results are also shown in Figure 7.9

Table 7.5- Indian Creek- Drury Creek Subwatershed Condition of Riparian Areas

Indian Creek- Drury Creek Subwatershed						
Condition of Riparian Area	Good		Fair		Poor	
	Reaches	%	Reaches	%	Reaches	%
Upper Indian Creek	4	100%	0	0%	0	0%
Middle Drury Creek	11	79%	3	21%	0	0%
Makanda-North	6	100%	0	0%	0	0%
Upper Sycamore Creek	2	100%	0	0%	0	0%
Middle Indian Creek	2	100%	0	0%	0	0%
Middle Sycamore Creek	5	63%	3	38%	0	0%
Lower Indian Creek	5	63%	3	39%	0	0%
Boskydell-Drury Creek	4	100%	0	0%	0	0%
Lower Sycamore Creek	1	100%	0	0%	0	0%
Lower Drury Creek	3	75%	1	25%	0	0%

Figure 7.9


Indian Creek-Drury Creek Subwatershed - Riparian Assessment
Jackson
Williamson
Crab Orchard Creek
Union
Johnson
Degree of Riparian Area
Fair
Good
Unassessed Streams
Indian Creek HUC12
Subwatershed
County Boundary
Municipality
Road
Spring Arbor Lake
Carbondale
Williamson
Jackson
Indian Creek-Drury Creek
Makanda
Union
Drury Creek
0 0.35 0.7 1.4 2.1 2.8 3.5 Miles
1:60,000
N

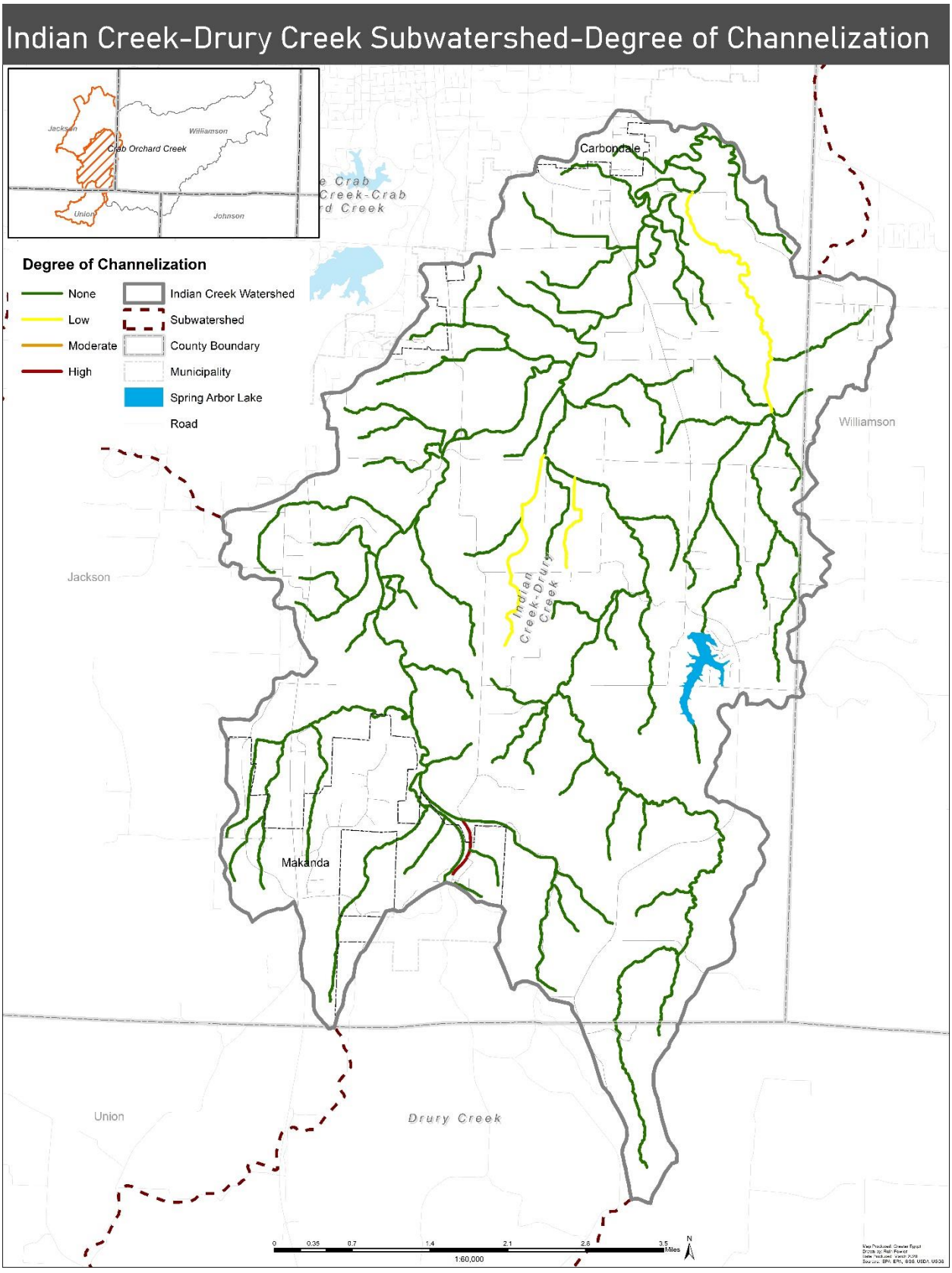
Degree of Channelization

The majority of reaches in the Indian Creek-Drury Creek subwatershed have no degree of channelization. Ninety-six percent of the reaches assessed exhibit no channelization. Three reaches are categorized as having a low degree. These three reaches flow through agricultural fields. The remaining two reaches have high degrees of channelization. Channelization is typically more prevalent in cropland or developed areas of the watershed. The condition of riparian areas are summarized in Table 7.6 and illustrated in Figure 7.10.

Table 7.6- Indian Creek- Drury Creek Subwatershed Degree of Channelization

Indian Creek- Drury Creek Subwatershed								
Degree of Channelization	None		Low		Moderate		High	
	Reaches	%	Reaches	%	Reaches	%	Reaches	%
Upper Indian Creek	9	100%	0	0%	0	0%	0	0%
Middle Drury Creek	15	88%	0	0%	0	0%	2	12%
Makanda-North	7	100%	0	0%	0	0%	0	0%
Upper Sycamore Creek	3	100%	0	0%	0	0%	0	0%
Middle Indian Creek	7	100%	0	0%	0	0%	0	0%
Middle Sycamore Creek	12	100%	0	0%	0	0%	0	0%
Lower Indian Creek	14	88%	2	12%	0	0%	0	0%
Boskydell-Drury Creek	27	100%	0	0%	0	0%	0	0%
Lower Sycamore Creek	4	80%	1	20%	0	0%	0	0%
Lower Drury Creek	14	100%	0	0%	0	0%	0	0%

Figure 7.10


Indian Creek-Drury Creek Subwatershed-Degree of Channelization
Jackson
Williamson
Crab Orchard Creek
Union
Johnson
Degree of Channelization
None
Low
Moderate
High
Indian Creek Watershed
Subwatershed
County Boundary
Municipality
Spring Arbor Lake
Road
Carbondale
Williamson
Jackson
Indian Creek-Drury Creek
Makanda
Union
Drury Creek
0 0.35 0.7 1.4 2.1 2.8 3.5 Miles
1:60,000
N

7.3.1 Indian Creek- Drury Creek Subwatershed Lake Assessment

Spring Arbor Lake (IL_RNZG)

Indian Creek- Drury Creek subwatershed contains one lake listed on the IEPA 305(b) List which is assessed as part of Illinois and Federal EPA standards. A motorized pontoon boat was used to assess the lake shoreline.

Erosion Assessment

Nearly the entire east side of the lake is developed for residential housing. The west side of the lake is mostly forested; however, the majority of this side of the lake is categorized as having moderate or high erosion. This may be due to the lack of developed land on the west side, making the area unmanaged compared to the residential side.

There are forty shore codes that make up the shoreline. Half of the shorelines, or twenty shore codes, are categorized as none, or low. The majority of shores that exibited low erosion are on the residential side of the lake, where properties owners are more likely to use some form of erosion mitigation, such as riprap. Two of the twenty shorelines are categorized as no erosion. These two shore codes make up the spillway and beachfront that are located at the northern most part of the lake.

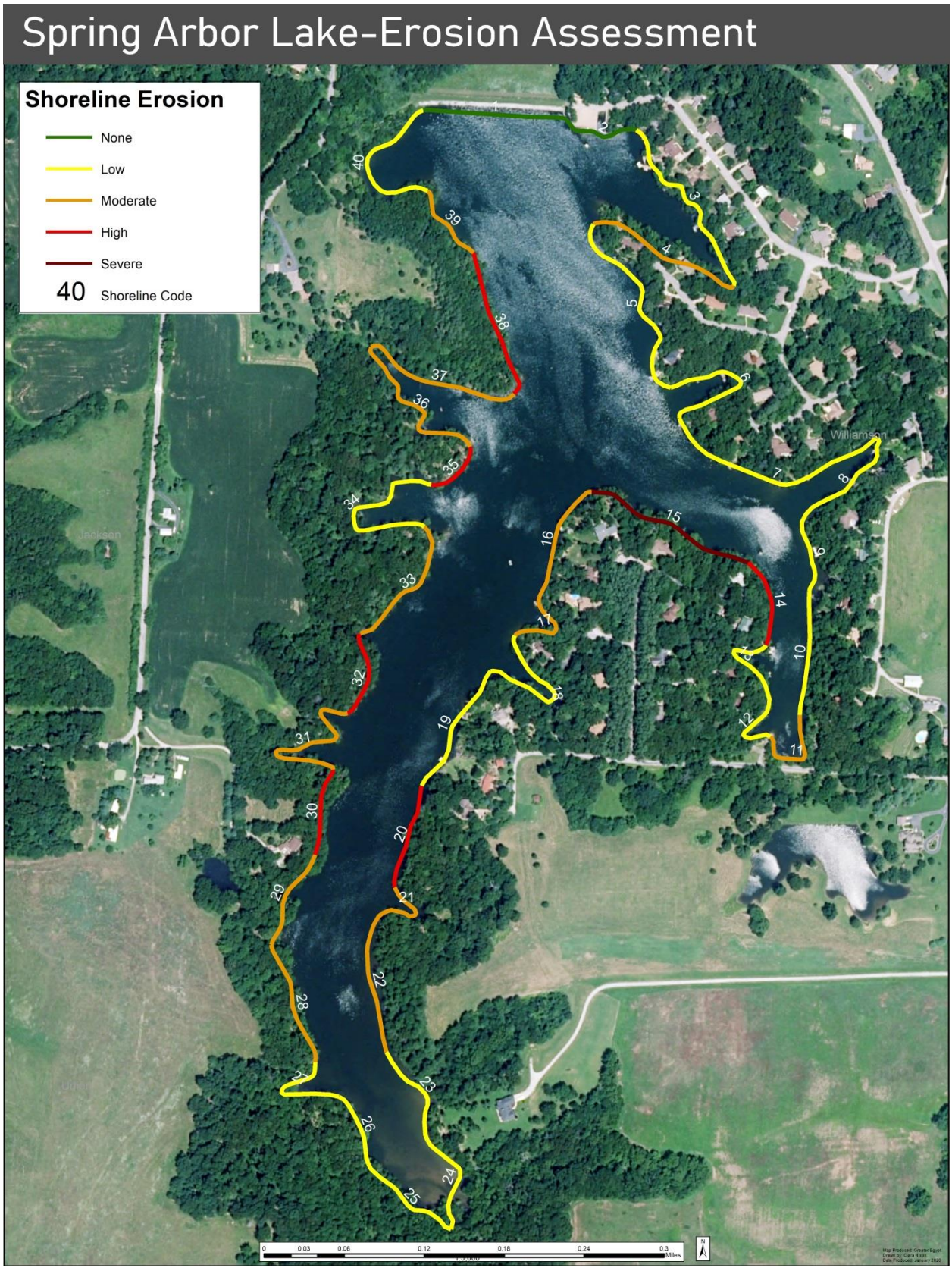
Thirteen shores are considered moderate, while six have a high rating. The last remaining shore has a severe rating. The location of this particular area makes it more prone to erosive conditions as it is along a north/northeast facing bank that is located in a wide corridor, where the typical southeast/south air flow can tunnel through. Flowing air is typically dry, causing drier soil conditions that are more prone to erosion.

The Spring Arbor Lake assessment is summarized in Table 7.7. The erosion assessment is displayed in Figure 7.11.

Table 7.7- Spring Arbor Lake Erosion and Littoral Assessment

Spring Arbor Lake Shore Code	Shoreline Length Assessed (ft)	Degree of Erosion	Condition of Riparian Area
IL_RNZG-01	567	None	Good
IL_RNZG-02	314	None	Fair
IL_RNZG-03	786	Low	Fair
IL_RNZG-04	634	Moderate	Fair
IL_RNZG-05	823	Low	Fair
IL_RNZG-06	602	Low	Fair
IL_RNZG-07	930	Low	Fair
IL_RNZG-08	461	Moderate	Good
IL_RNZG-09	316	Low	Good
IL_RNZG-10	491	Low	Good
IL_RNZG-11	375	Moderate	Good
IL_RNZG-12	315	Low	Good
IL_RNZG-13	368	High	Good
IL_RNZG-14	361	High	Good
IL_RNZG-15	708	Severe	Good
IL_RNZG-16	504	Moderate	Good
IL_RNZG-17	315	Moderate	Good
IL_RNZG-18	604	Moderate	Good
IL_RNZG-19	543	Low	Good
IL_RNZG-20	420	High	Good
IL_RNZG-21	286	Moderate	Good
IL_RNZG-22	571	Moderate	Good
IL_RNZG-23	421	Low	Good
IL_RNZG-24	426	Low	Good
IL_RNZG-25	433	Low	Good
IL_RNZG-26	299	Low	Good
IL_RNZG-27	436	Low	Good
IL_RNZG-28	505	Moderate	Good
IL_RNZG-29	409	Moderate	Good
IL_RNZG-30	351	High	Good
IL_RNZG-31	744	Moderate	Good
IL_RNZG-32	349	Moderate	Good
IL_RNZG-33	562	Moderate	Good
IL_RNZG-34	719	Low	Good
IL_RNZG-35	243	Low	Good
IL_RNZG-36	665	Moderate	Good
IL_RNZG-37	639	Low	Good
IL_RNZG-38	600	Moderate	Good
IL_RNZG-39	324	Moderate	Good
IL_RNZG-40	638	Low	Good
Total	**20,057**		

Figure 7.11

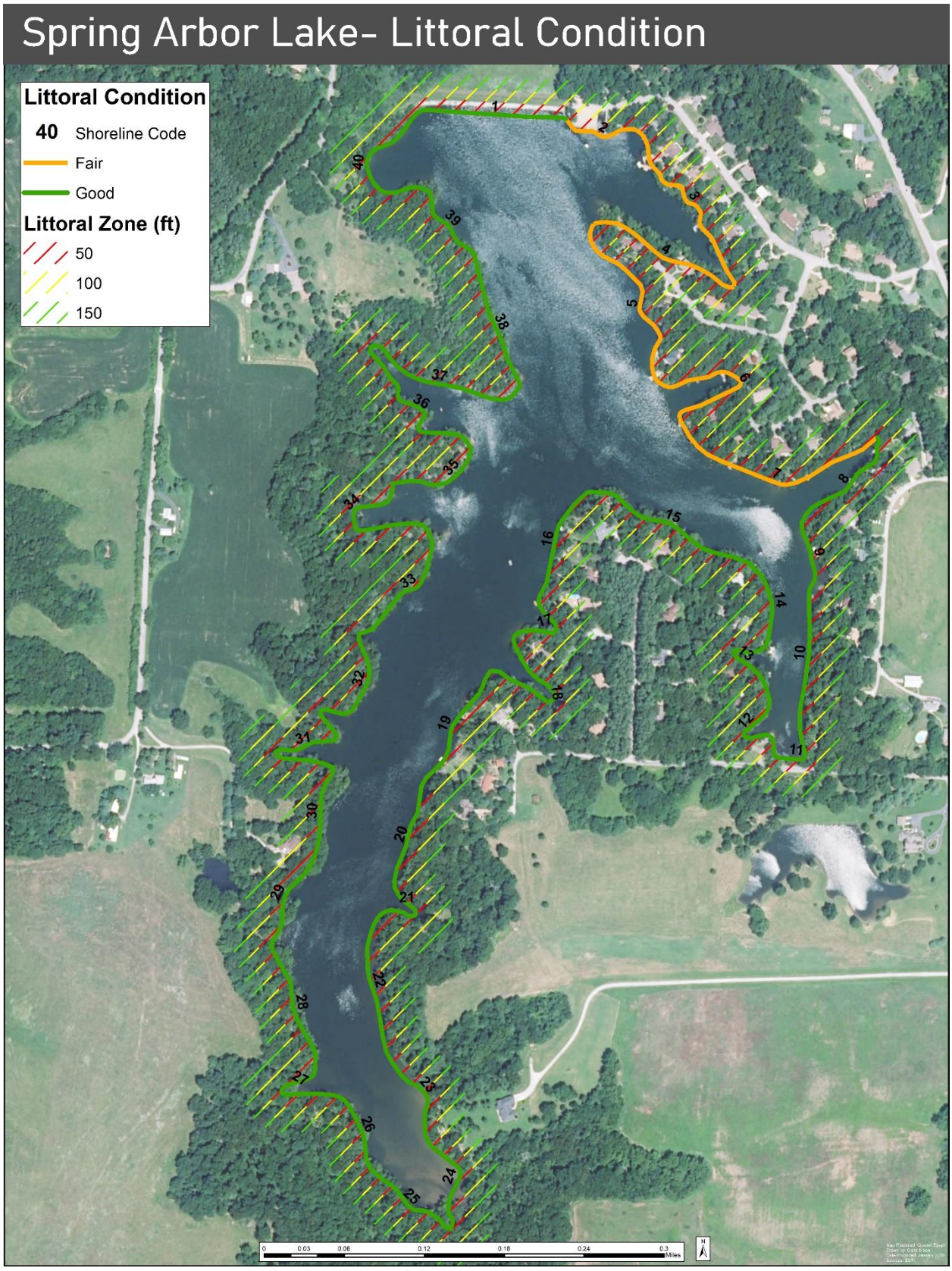

Spring Arbor Lake-Erosion Assessment
Shoreline Erosion
None
Low
Moderate
High
Severe
40 Shoreline Code
Williamson
Jackson
0 0.03 0.06 0.12 0.18 0.24 0.3 Miles
N

Condition of Littoral Zone

Table 7.7 also summarizes the littoral condition along Spring Arbor Lake. Since the area surrounding the lake is heavily forested, the Spring Arbor features a generally good littoral zone. Out of the 40 reaches, 34 reaches are considered to have a good littoral area. That accounts for 78 percent of the total shoreline as having being in good condition.

The remaining six shorelines are categorized as having a fair littoral area. These six shorelines are located along the northeast side of the lake. In this area, there is a cluster of residential homes that are both closer together, and closer to the shoreline, than elsewhere on the lake. In other areas of residental homes, the properties are more spread out from each other and are farther back from the lake shore, giving these areas better conditions. Littoral conditions are displayed in Figure 7.12.

Figure 7.12


Spring Arbor Lake- Littoral Condition
Littoral Condition
40 Shoreline Code
Fair
Good
Littoral Zone (ft)
50
100
150
0 0.03 0.06 0.12 0.18 0.24 0.3 Miles

7.4 Little Crab Orchard Creek-Crab Orchard Creek Stream Assessment (071401060809)

Little Crab Orchard Creek-Crab Orchard Creek subatershed is the largest of the three subwatersheds assessed. This subwatershed contains two lakes. The erosion levels in the subwatershed vary from none to severe. The riparian areas, like the other subwatersheds, vary between good and fair, with no areas displaying poor conditions. Channelization in the watershed varies between none to high, and has the highest amount of channelized streams compared to the other subwatersheds.

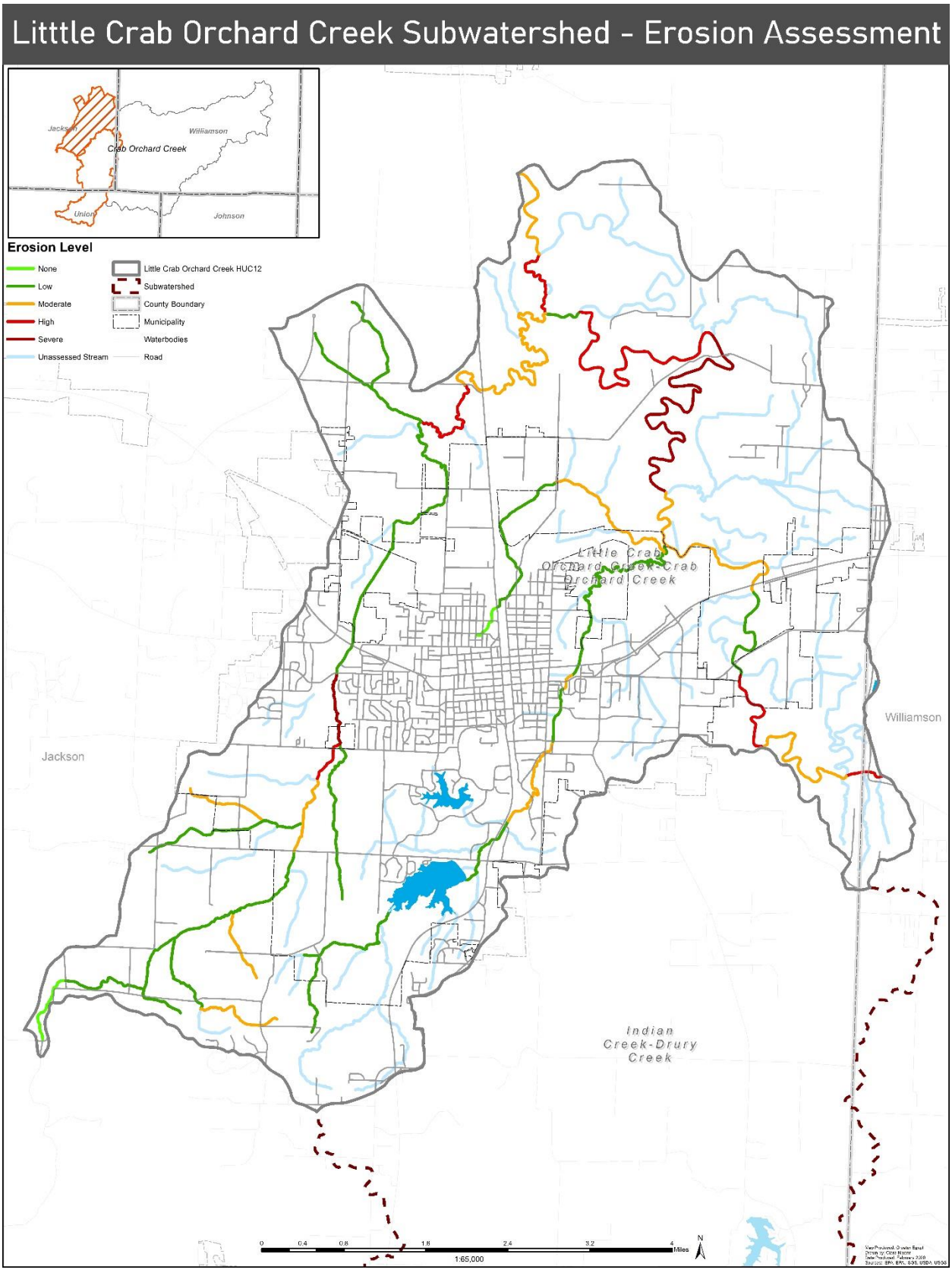
Extent of Erosion

Table 7.7 summarizes the extent of erosion in the Little Crab Orachard Creek-Crab Orchard Creek subwatershed. The majority of the reaches exhibit none or low erosion. Seventeen reaches exhibit moderate erosion. Reaches that exhibit high erosion are in undeveloped areas where streambank management is minimal. Figure 7.13 displays the extent of erosion.

Table 7.8- Little Crab Orchard Creek- Crab Orchard Creek Subwatershed Extent of Erosion

Little Crab Orchard Creek- Crab Orchard Creek Subwatershed						
Extent of Erosion	None or Low		Moderate		High	
	Reaches	%	Reaches	%	Reaches	%
Upper Piles Fork Creek	4	100%	0	0%	0	0%
Upper Little Crab Orchard Creek	7	54%	5	38%	0	0%
Carbondale Reservoir	6	100%	0	0%	0	0%
Campus Lake	0	0%	0	0%	0	0%
Upper Crab Orchard Creek	0	0%	1	20%	0	0%
Eastern Carbondale-Crab Orchard Creek	1	33%	1	33%	0	0%
Lower Piles Fork	8	62%	5	38%	0	0%
Eek Creek	5	83%	1	17%	0	0%
Middle Little Crab Orchard Creek	3	75%	0	0%	1	25%
Reed Station	0	0%	0	0%	0	0%
Middle Crab Orchard Creek	1	25%	1	25%	1	25%
Lower Little Crab Orchard Creek	0	0%	2	67%	0	0%
Aviation	2	100%	0	0%	0	0%
Creekside	0	0%	0	0%	0	0%
Lower Crab Orchard Creek	0	0%	1	50%	0	0%

Figure 7.13


Litttle Crab Orchard Creek Subwatershed - Erosion Assessment
Jackson
Williamson
Crab Orchard Creek
Union
Johnson
Erosion Level
None
Low
Moderate
High
Severe
Unassessed Stream
Little Crab Orchard Creek HUC12
Subwatershed
County Boundary
Municipality
Waterbodies
Road
Little Crab Orchard Creek-Crab Orchard Creek
Williamson
Jackson
Indian Creek-Drury Creek
0 0.4 0.8 1.6 2.4 3.2 4 Miles
1:65,000
N

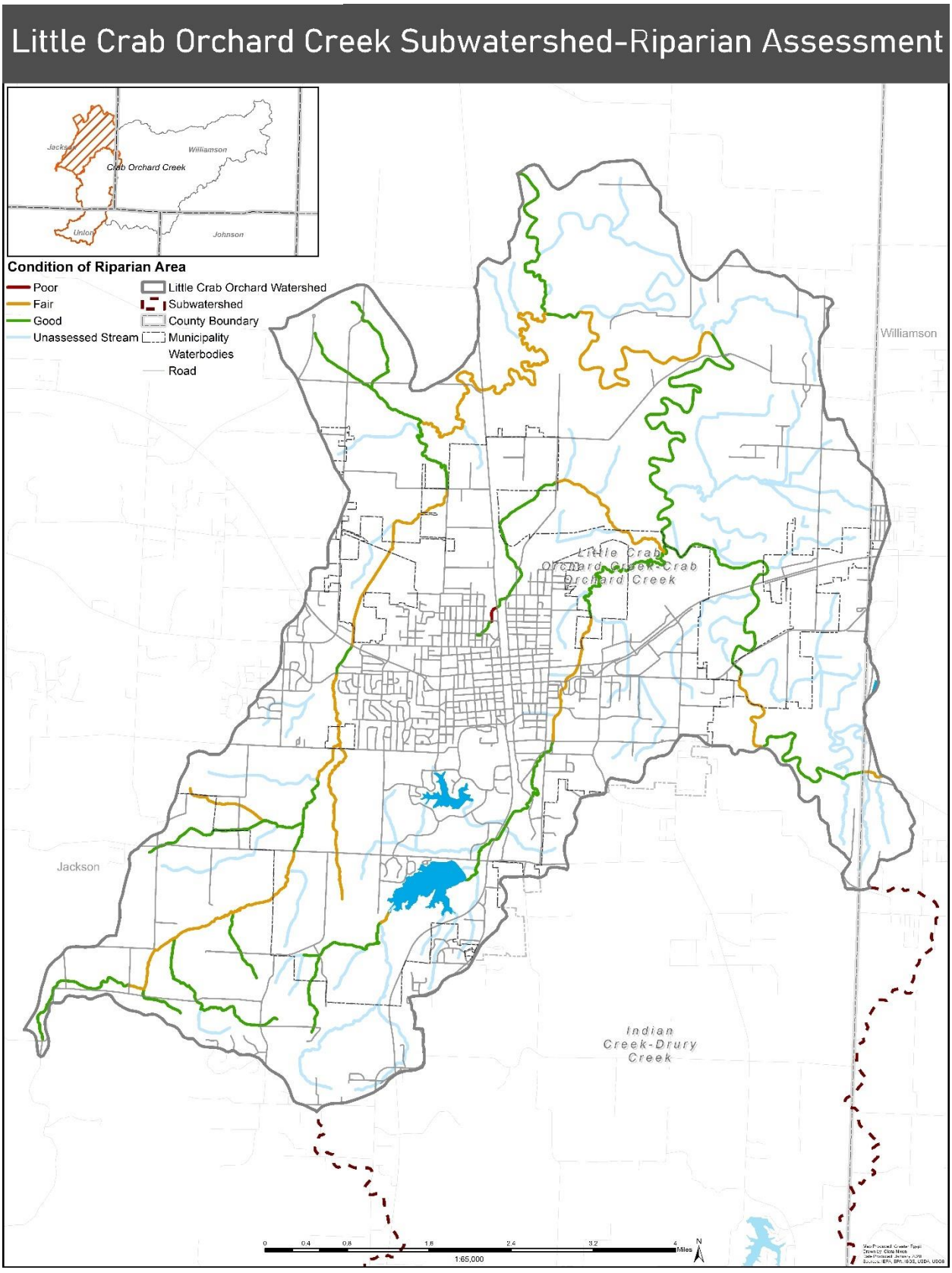
Condition of Riparian Areas

The riparian areas in the Little Crab Orchard Creek-Crab Orchard Creek subwatershed range between good and fair, with no areas exibiting poor conditions. The watershed consists of the largest urbanized area between the three subwatersheds; however, the majority of riparian areas are in good condition, with 39 reaches in that category. Twenty-five reaches exhibit fair riparian condition because the reach either flows through an agricultural field, or is surrounded mostly by developed land.Table 7.8 summarizes the condition of riparian areas in the subwatershed.

Table 7.9- Little Crab Orchard Creek- Crab Orchard Creek Subwatershed Condition of Riparian Areas

Little Crab Orchard Creek- Crab Orchard Creek Subwatershed						
Condition of Riparian Area	Good		Fair		Poor	
	Reaches	%	Reaches	%	Reaches	%
Upper Piles Fork Creek	4	100%	0	0%	0	0%
Upper Little Crab Orchard Creek	9	69%	4	31%	0	0%
Carbondale Reservoir	3	50%	3	50%	0	0%
Campus Lake	0	0%	0	0%	0	0%
Upper Crab Orchard Creek	2	40%	3	60%	0	0%
Eastern Carbondale-Crab Orchard Creek	2	67%	1	33%	0	0%
Lower Piles Fork	6	46%	7	54%	0	0%
Eek Creek	4	67%	1	17%	1	17%
Middle Little Crab Orchard Creek	2	50%	2	50%	0	0%
Reed Station	0	0%	0	0%	0	0%
Middle Crab Orchard Creek	3	75%	1	25%	0	0%
Lower Little Crab Orchard Creek	0	0%	3	100%	0	0%
Aviation	2	100%	0	0%	0	0%
Creekside	0	0%	0	0%	0	0%
Lower Crab Orchard Creek	2	0%	0	0%	0	0%

Figure 7.14


Little Crab Orchard Creek Subwatershed-Riparian Assessment
Jackson
Williamson
Crab Orchard Creek
Union
Johnson
Condition of Riparian Area
Poor
Fair
Good
Unassessed Stream
Little Crab Orchard Watershed
Subwatershed
County Boundary
Municipality
Waterbodies
Road
Williamson
Little Crab Orchard Creek-Crab Orchard Creek
Jackson
Indian Creek-Drury Creek
0 0.4 0.8 1.6 2.4 3.2 4 Miles
1:65,000
N

Degree of Channelization

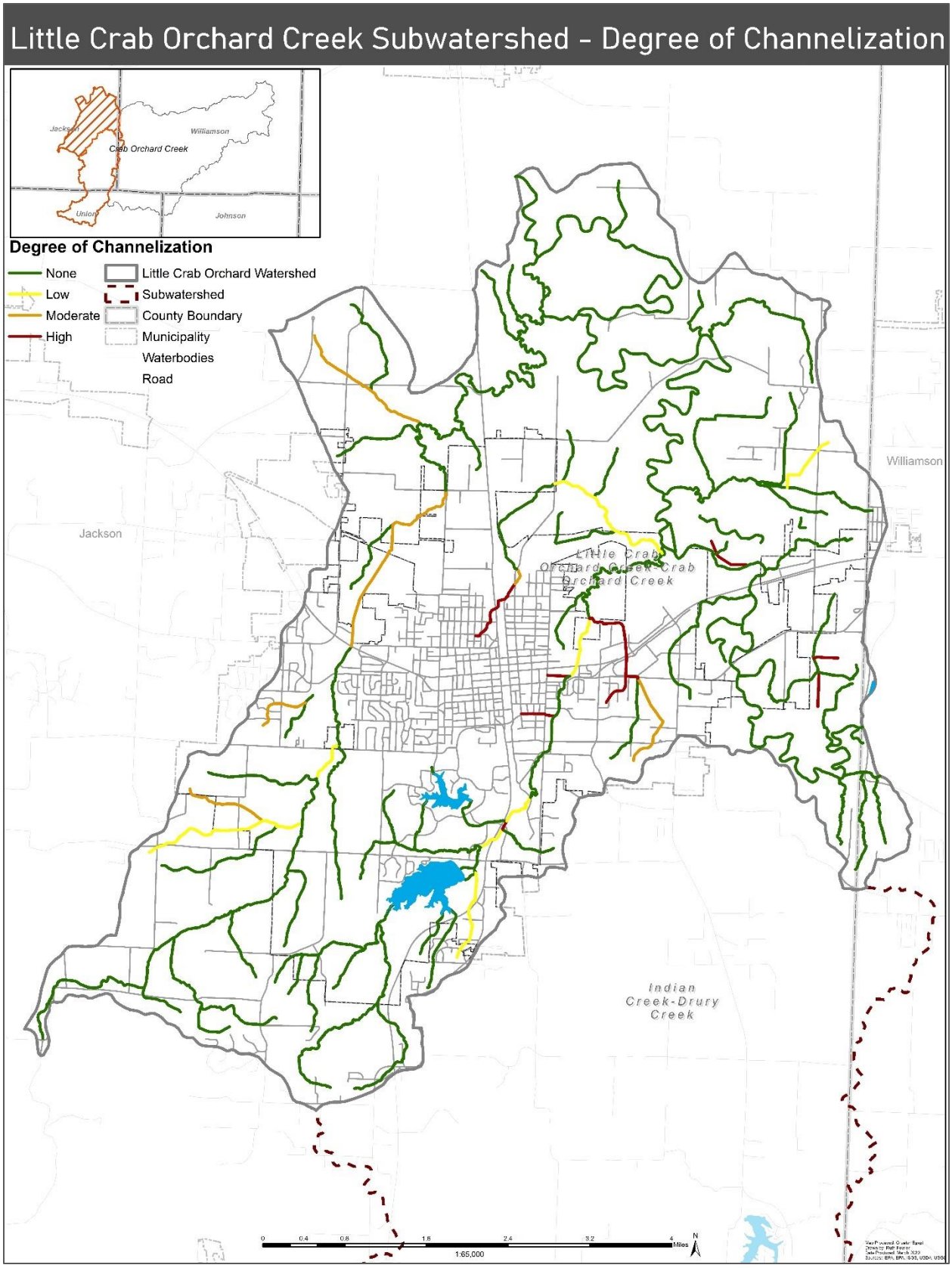
With six of reaches characterized as moderate and twelve characterized as high, the Little Crab Orchard Creek-Crab Orchard Creek subwatershed exibits the most reaches with those ratings. However, the majority of the reaches in the watershed are rated none, or low. Eighty-two percent of the reaches have no channelized features.

The degree of channelization in the subwatershed is summarized in Table 7.9. Figure 7.15 displays the degree of channelization in the Little Crab Orchard Creek-Crab Orchard Creek subwatershed.

Table7.10- Little Crab Orchard Creek- Crab Orchard Creek Subwatershed Degree of Channelization

Little Crab Orchard Creek- Crab Orchard Creek Subwatershed								
Degree of Channelization	None		Low		Moderate		High	
	Reaches	%	Reaches	%	Reaches	%	Reaches	%
Upper Piles Fork Creek	10	100%	0	0%	0	0%	0	0%
Upper Little Crab Orchard Creek	14	82%	2	12%	1	6%	0	0%
Carbondale Resovoir	17	94%	1	6%	0	0%	0	0%
Campus Lake	5	100%	0	0%	0	0%	0	0%
Upper Crab Orchard Creek	11	100%	0	0%	0	0%	0	0%
Eastern Carbondale-Crab Orchard Creek	11	73%	0	0%	0	0%	4	27%
Lower Piles Fork	13	59%	3	14%	1	4%	5	23%
Eek Creek	4	45%	1	11%	1	11%	3	33%
Middle Little Crab Orchard Creek	7	78%	0	0%	2	22%	0	0%
Reed Station	10	91%	1	9%	0	0%	0	0%
Middle Crab Orchard Creek	6	100%	0	0%	0	0%	0	0%
Lower Little Crab Orchard Creek	6	100%	0	0%	0	0%	0	0%
Aviation	1	50%	0	0%	1	50%	0	0%
Creekside	2	100%	0	0%	0	0%	0	0%
Lower Crab Orchard Creek	4	0%	0	0%	0	0%	0	0%

Figure 7.15


Little Crab Orchard Creek Subwatershed - Degree of Channelization
Jackson
Williamson
Crab Orchard Creek
Union
Johnson
Degree of Channelization
None
Low
Moderate
High
Little Crab Orchard Watershed
Subwatershed
County Boundary
Municipality
Waterbodies
Road
Williamson
Jackson
Little Crab Orchard Creek-Crab Orchard Creek
Indian Creek-Drury Creek
0 0.4 0.8 1.6 2.4 3.2 4 Miles
1:65,000
N

7.4.1 Little Crab Orchard Creek- Crab Orchard Creek Subwatershed Lake Assessment

Little Crab Orchard Creek watershed contains two lakes listed on the IEPA 303(d) List of Impaired Waters. These include Campus Lake and Carbondale Reservoir; both located in the City of Carbondale. The waterbodies differ in size, but experience similar issues regarding erosion, littoral conditions, and other environmental risks.

Campus Lake (IL_RNZH)

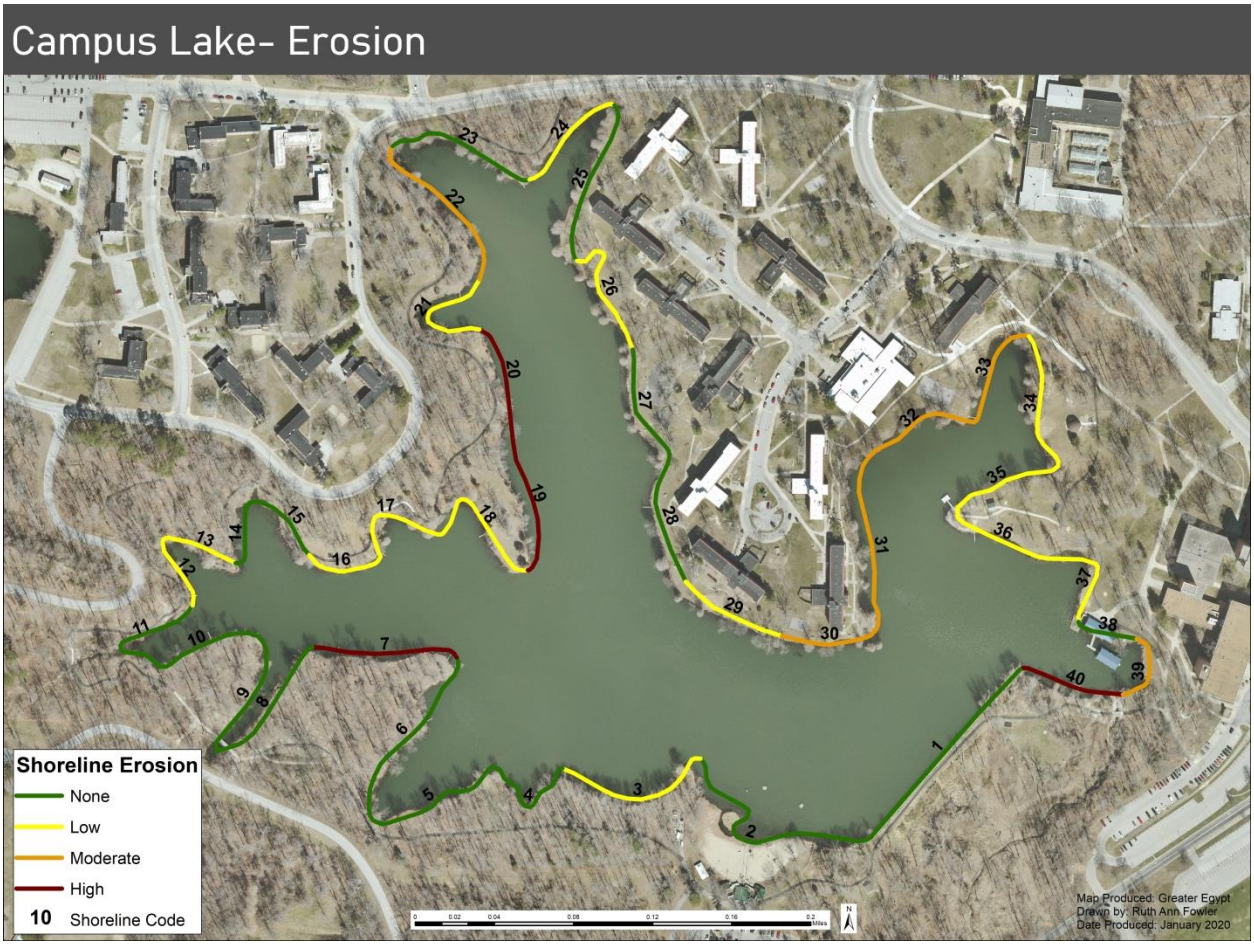
Campus Lake is located on the grounds of Southern Illinois University of Carbondale. The lake is primarily used for recreation. While the waterbody is only 40 acres, it does exhibit varying levels of erosion and conditions to its riparian areas. Harmful algal blooms (HAB) are also an environmental issue for the lake. When a HAB is suspected, the lake is tested, and is typically shut down for use until the event is resolved.

Table 7.10 contains information regarding the extent of erosion for Campus Lake. While much of the lake was observed as having low to no erosion, there are a few areas where higher levels of erosion are evident. These typically occur around the prominent points of the lake. Results are also displayed in Figure 7.16.

Table 7.11 Campus Lake Erosion and Littoral Assessment

Shore Code	Shoreline Length Assessed (ft)	Degree of Erosion	Condition of Littoral Zone
IL_RNZH-01	621	None	Good
IL_RNZH-02	652	None	Good
IL_RNZH-03	435	Low	Good
IL_RNZH-04	300	None	Good
IL_RNZH-05	385	None	Good
IL_RNZH-06	507	None	Good
IL_RNZH-07	396	High	Good
IL_RNZH-08	390	None	Good
IL_RNZH-09	358	None	Good
IL_RNZH-10	325	None	Good
IL_RNZH-11	316	None	Good
IL_RNZH-12	203	Low	Good
IL_RNZH-13	207	Low	Good
IL_RNZH-14	191	None	Good
IL_RNZH-15	218	None	Good
IL_RNZH-16	203	Low	Good
IL_RNZH-17	300	Low	Good
IL_RNZH-18	399	Low	Good
IL_RNZH-19	424	High	Good
IL_RNZH-20	265	High	Good
IL_RNZH-21	338	Low	Good
IL_RNZH-22	471	Moderate	Good
IL_RNZH-23	408	None	Good
IL_RNZH-24	316	Low	Good
IL_RNZH-25	445	None	Fair
IL_RNZH-40	278	High	Good
IL_RNZH-26	372	Low	Fair
IL_RNZH-27	314	None	Fair
IL_RNZH-28	361	None	Fair
IL_RNZH-29	300	Low	Fair
IL_RNZH-30	256	Moderate	Fair
IL_RNZH-31	467	Moderate	Fair
IL_RNZH-32	338	Moderate	Poor
IL_RNZH-33	301	Moderate	Fair
IL_RNZH-34	374	Low	Fair
IL_RNZH-35	322	Low	Good
IL_RNZH-36	256	Low	Good
IL_RNZH-37	308	Low	Good
IL_RNZH-38	167	None	Poor
IL_RNZH-39	208	Moderate	Fair
Total	**13,695**		

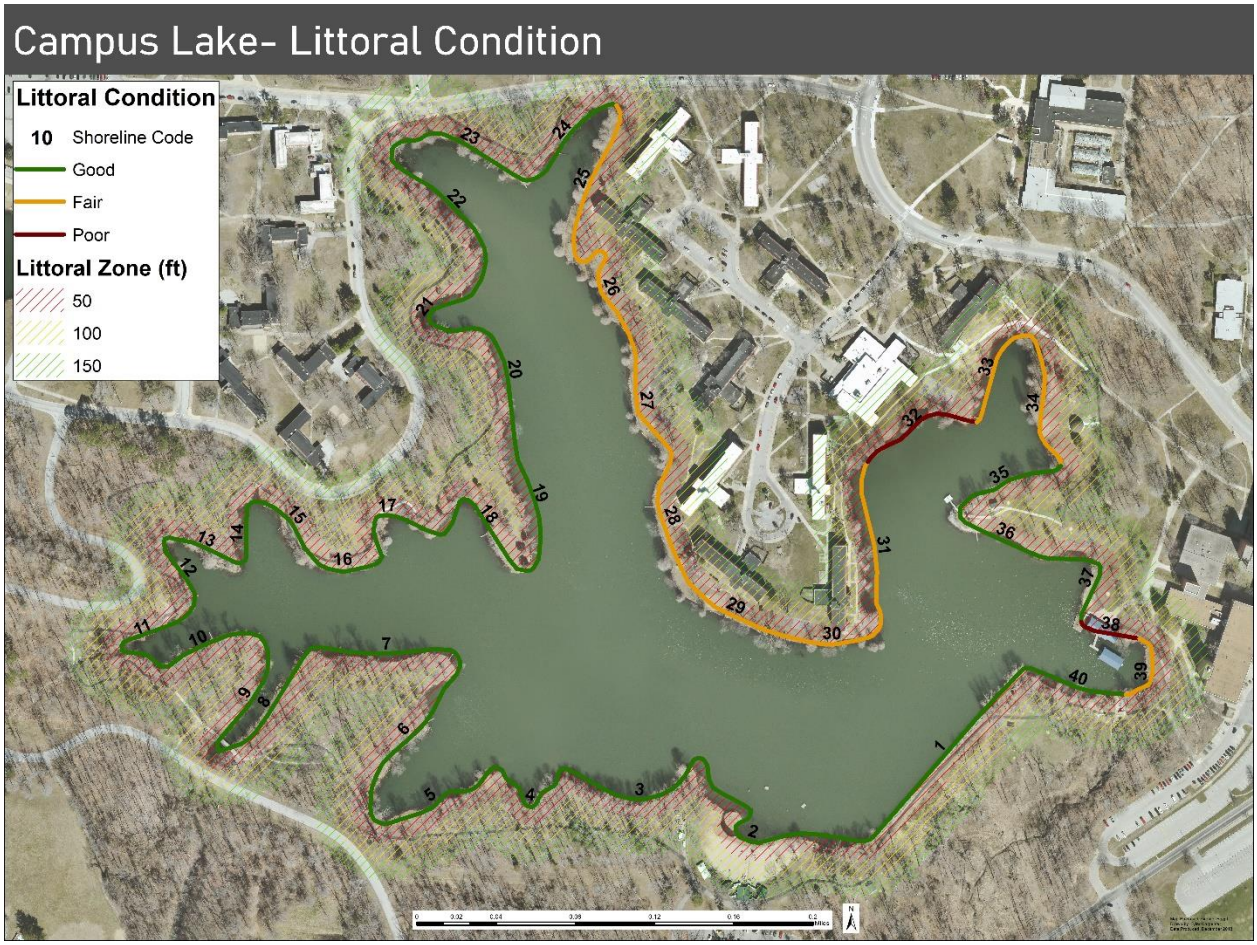
Figure 7.16



The littoral buffer around Campus Lake tends to be in good condition. Areas that exhibit fair or poor conditions are generally located near development on the campus. This includes Thompson Point, which separates the east part of the lake. This area of development includes university housing, where littoral areas have been reduced that contribute to the impervious surfaces around the lake.

Figure 7.17 displays the condition of the littoral zone for Campus Lake. The map also displays the critical littoral zone in fifty foot increments.

Figure 7.17


Campus Lake- Littoral Condition
Littoral Condition
10 Shoreline Code
Good
Fair
Poor
Littoral Zone (ft)
50
100
150

Carbondale Reservoir (IL_RNI)

Also located within the City of Carbondale is the Carbondale Reservoir, or City Lake. While the waterbody once served as a source of public water, it is now used for recreation. The city owns the lake, and the municipalitie's water quality laboratory is located on the southwest portion of the lake.

The waterbody is 137 acres and it displays many areas of erosion. Most notably, shoreline sections in the southern portion of the lake have been classified as high and severe. An example of one of these severe areas is pictured below.

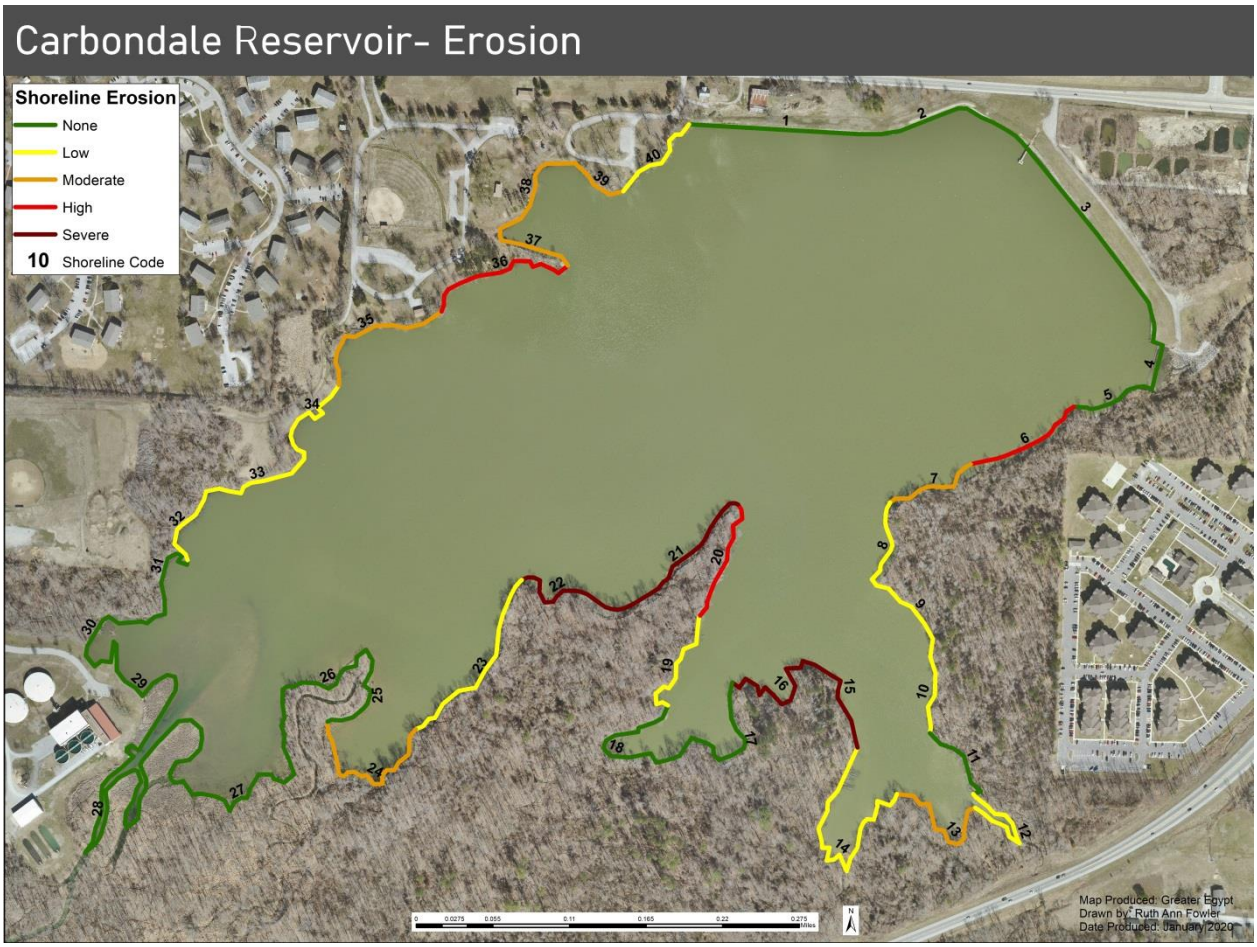
Figure 7.18- Carbondale Reservoir Severe Erosion

Table 7.11 contains the extent of erosion for Carbondale Reservoir. Other areas with increased levels of erosion occur along the northwestern portion. This area includes development comprised of an apartment complex, roads, and the lake boat ramp. Results are also displayed in Figure 7.19.

Table 7.12- Carbondale Reservoir Erosion and Littoral Assessment

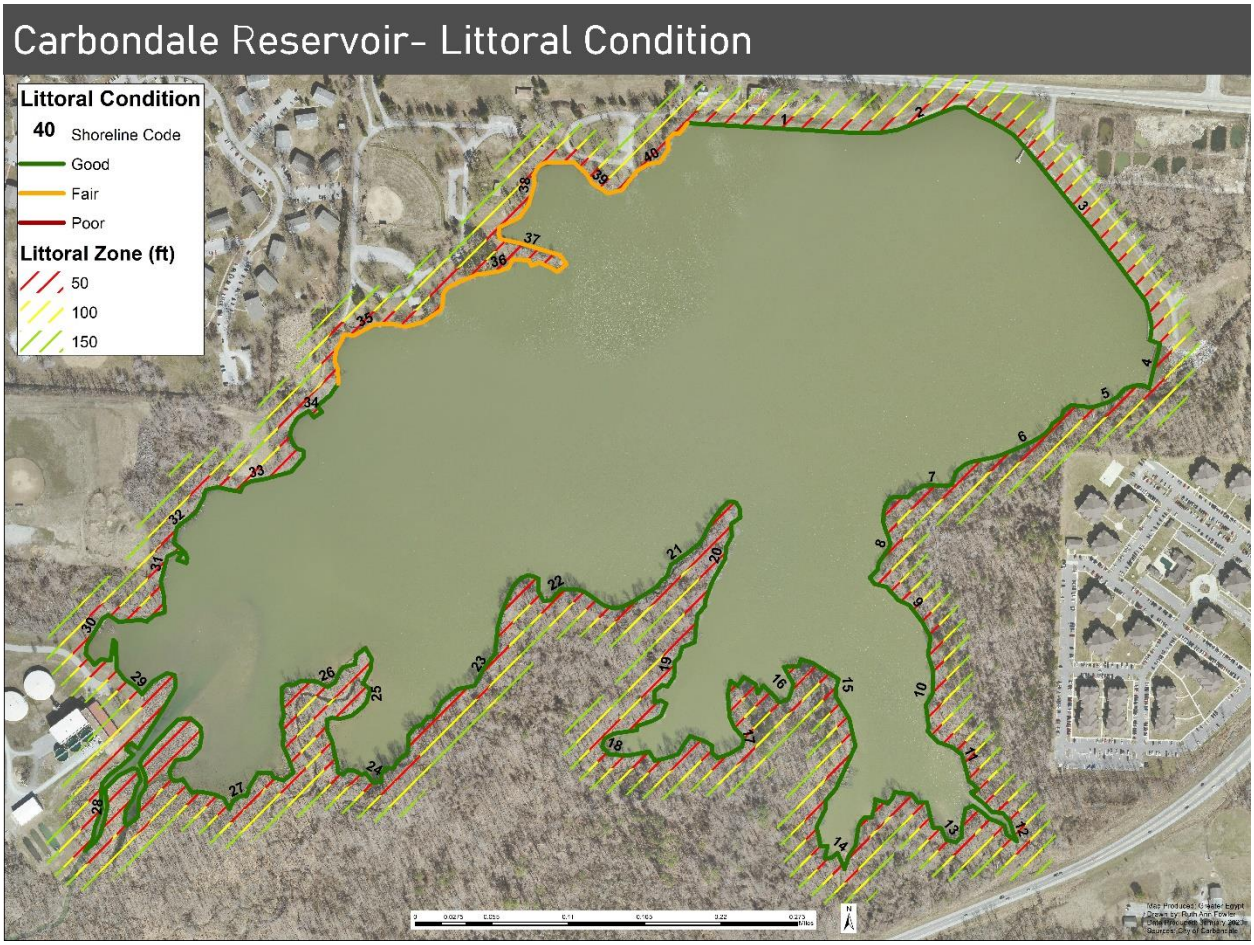
Shore Code	Shoreline Length Assessed (ft)	Degree of Erosion	Condition of Riparian
IL_RNI-01	730	None	Good
IL_RNI-02	346	None	Good
IL_RNI-03	1,169	None	Good
IL_RNI-04	243	None	Good
IL_RNI-05	292	None	Good
IL_RNI-06	466	High	Good
IL_RNI-07	373	Moderate	Good
IL_RNI-08	325	Low	Good
IL_RNI-09	406	Low	Good
IL_RNI-10	301	Low	Good
IL_RNI-11	343	None	Good
IL_RNI-12	498	Low	Good
IL_RNI-13	524	Moderate	Good
IL_RNI-14	1,038	Low	Good
IL_RNI-15	513	Severe	Good
IL_RNI-16	466	Severe	Good
IL_RNI-17	521	None	Good
IL_RNI-18	736	None	Good
IL_RNI-19	476	Low	Good
IL_RNI-20	477	High	Good
IL_RNI-21	635	Severe	Good
IL_RNI-22	479	Severe	Good
IL_RNI-23	747	Low	Good
IL_RNI-24	677	Moderate	Good
IL_RNI-25	411	None	Good
IL_RNI-26	413	None	Good
IL_RNI-27	1,229	None	Good
IL_RNI-28	2,092	None	Good
IL_RNI-29	408	None	Good
IL_RNI-30	610	None	Good
IL_RNI-31	361	None	Good
IL_RNI-32	325	Low	Good
IL_RNI-33	449	Low	Good
IL_RNI-34	425	Low	Good
IL_RNI-35	591	Moderate	Fair
IL_RNI-36	610	High	Fair
IL_RNI-37	325	Moderate	Fair
IL_RNI-38	436	Moderate	Fair
IL_RNI-39	234	Moderate	Fair
IL_RNI-40	386	Low	Fair
Total	**22,085**		

Figure 7.19



The only areas around Carbondale Reservoir in which littoral conditions are not considered to be in good conition occur along the stretch of shoreline previously mentioned. Reduced littoral vegetation coincides with the impervious surfaces in the area. The remaining areas were assessed as being in good condition. Figure 7.20 displays the condition of littoral areas for Carbondale Reservoir.

Figure 7.20



Like nearby Campus Lake, Carbondale Reservoir experiences harmful algal blooms. These typically occur during summer months, when the temperatures are conducive for a bloom to occur. Increased runoff and the presence of nutrients may also contribute to the development of these environmental hazards.

Figure 7.21- Lake Closure Signs

7.5 Basins and Blockages

Basins have also been assessed as part of this report. These include detention and retention basins. 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.

Both types of structures are prevalent in the planning area, with specific focus around the City of Carbondale. Basins in the Western Crab Orchard Creek watershed are displayed in Figure 7.22

The following tables summarize the basins by type, jurisdiction, and location (latitude/longitude). Basins were assigned an identification number. There are 73 basins in the watershed. The majority of these features occur in the Little Crab Orchard Creek-Crab Orchard Creek watershed. One of the largest detention areas is located at the Carbondale Superblock Sports Complex. Basins are also displayed in Table 7.12 with Basin IDs.

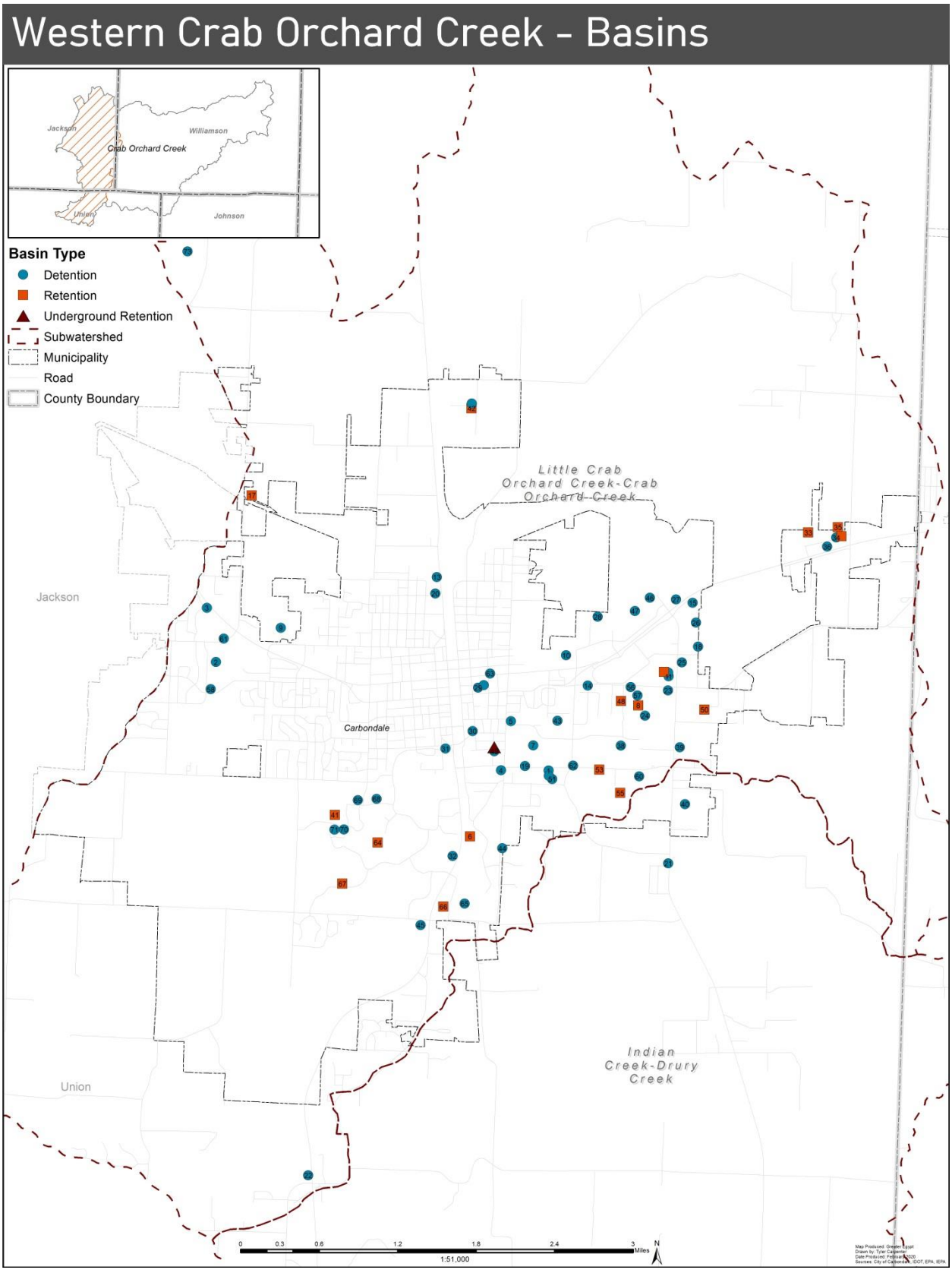
Table 7.13 Basin Identification

Basin Type	Basin ID	Jurisdiction	Latitude	Longitude
Detention	1	Carbondale	-89.202631	37.717245
Detention	2	Carbondale	-89.249421	37.728381
Detention	3	Carbondale	-89.250847	37.734358
Detention	4	Carbondale	-89.209267	37.717137
Detention	5	Carbondale	-89.208043	37.722619
Retention	6	Carbondale	-89.213375	37.709739
Detention	7	Carbondale	-89.204869	37.719986
Retention	8	Carbondale	-89.190329	37.724703
Detention	9	Jackson County	-89.240473	37.732343
Detention	10	Carbondale	-89.200575	37.730051
Detention	11	Carbondale	-89.186202	37.727979
Detention	12	Carbondale	-89.186276	37.728411
Detention	13	Carbondale	-89.218872	37.738383
Detention	14	Carbondale	-89.197449	37.72675
Detention	15	Carbondale	-89.183103	37.736198
Retention	16	Carbondale	-89.186851	37.728469
Retention	17	Jackson County	-89.244986	37.74694
Detention	18	Carbondale	-89.182193	37.731364
Detention	19	Carbondale	-89.20593	37.717682
Detention	20	Carbondale	-89.219032	37.736563
Detention	21	Jackson County	-89.185651	37.707266
Detention	22	Jackson County	-89.23482	37.671777
Detention	23	Carbondale	-89.186233	37.726435
Detention	24	Carbondale	-89.189373	37.723564
Detention	25	Carbondale	-89.1844	37.729574
Detention	26	Carbondale	-89.182543	37.734006
Detention	27	Carbondale	-89.185425	37.736515
Detention	28	Carbondale	-89.196284	37.7344
Detention	29	Carbondale	-89.21274	37.726238
Detention	30	Carbondale	-89.213369	37.721417
Detention	31	Carbondale	-89.217109	37.719398
Detention	32	Carbondale	-89.215745	37.707527
Retention	33	Carbondale	-89.167188	37.744282
Detention	34	Carbondale	-89.163272	37.74379
Retention	35	Jackson County	-89.163061	37.744947
Detention	36	Carbondale	-89.164507	37.742768
Retention	37	Carbondale	-89.162524	37.743945

Table 7.13 (Cont'd) - Basin Identification

Basin Type	Basin ID	Jurisdiction	Latitude	Longitude
Detention	38	Carbondale	-89.192634	37.720183
Detention	39	Carbondale	-89.184426	37.720152
Detention	40	Carbondale	-89.18348	37.713866
Retention	41	Carbondale	-89.232295	37.711766
Retention	42	Carbondale	-89.214598	37.757168
Detention	43	Carbondale	-89.20157	37.722787
Detention	44	Carbondale	-89.208845	37.708513
Detention	45	Carbondale	-89.219991	37.699789
Detention	46	Carbondale	-89.189062	37.736638
Detention	47	Carbondale	-89.191108	37.735136
Retention	48	Carbondale	-89.192773	37.725127
Detention	49	Carbondale	-89.210276	37.719235
Retention	50	Carbondale	-89.181102	37.724403
Detention	51	Carbondale	-89.202109	37.716302
Detention	52	Carbondale	-89.202577	37.716673
Retention	53	Carbondale	-89.195564	37.717479
Detention	54	Carbondale	-89.211965	37.726527
Retention	55	Carbondale	-89.19259	37.714951
Detention	56	Carbondale	-89.191463	37.726695
Detention	57	Carbondale	-89.190474	37.725787
Detention	58	Carbondale	-89.250047	37.725359
Detention	59	Carbondale	-89.214574	37.757684
Detention	60	Carbondale	-89.18999	37.716841
Detention	61	Carbondale	-89.248392	37.73099
Detention	62	Carbondale	-89.199241	37.71786
Detention	63	Carbondale	-89.21112	37.727826
Retention	64	Carbondale	-89.226258	37.708817
Detention	65	Carbondale	-89.213909	37.702292
Retention	66	Carbondale	-89.216874	37.701893
Retention	67	Carbondale	-89.231049	37.704171
Detention	68	Carbondale	-89.22653	37.713644
Detention	69	Carbondale	-89.229159	37.713458
Detention	70	Carbondale	-89.230983	37.710186
Detention	71	Carbondale	-89.23232	37.710133
Underground Retention	72	Carbondale	-89.210289	37.719696
Detention	73	Jackson County	-89.254763	37.773787

Figure 7.22


Western Crab Orchard Creek – Basins
Jackson
Williamson
Crab Orchard Creek
Union
Johnson
Basin Type
Detention
Retention
Underground Retention
Subwatershed
Municipality
Road
County Boundary
Little Crab Orchard Creek-Crab Orchard Creek
Jackson
Carbondale
Indian Creek-Drury Creek
Union
0 0.3 0.6 1.2 1.8 2.4 3 Miles
1:51,000
N

Debris Blockages

Many areas in the Western Crab Orchard Creek watershed exhibit different types of debris blockages. These impediments are both natural and synthetic. Downed vegetation represents the majority of the blockages. Figure 7.23 displays some of the obstructions in Little Crab Orchard Creek and Piles Fork Creek. Residents near the area have expressed concerns over flooding and other impairments related to the occurrences.

Figure 7.23- Watershed Waterbody Obstructions

Dumping and litter is also prevalent in many portions of the watershed. This is typically evident around stream crossings and rural areas. Figure 7.24 reveals an area where dumping has occurred at crossing along Indian Creek.

Figure 7.24- Watershed Waterbody Dumping Site

8. Water Quality Assessment

For this assessment, water quality of Western Crab Orchard Creek waterbodies with available data have been analyzed. A water quality assessment has also been completed for local municipalities within the Western Crab Orchard Creek 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) require 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 Crab Orchard Creek planning area. These are: Aquatic Life, Fish Consumption, Primary Contact, Secondary Contact, Public and Food Processing Water Supplies, and Aesthetic Quality. Indigenous Aquatic Life is not a designated use for the planning area.

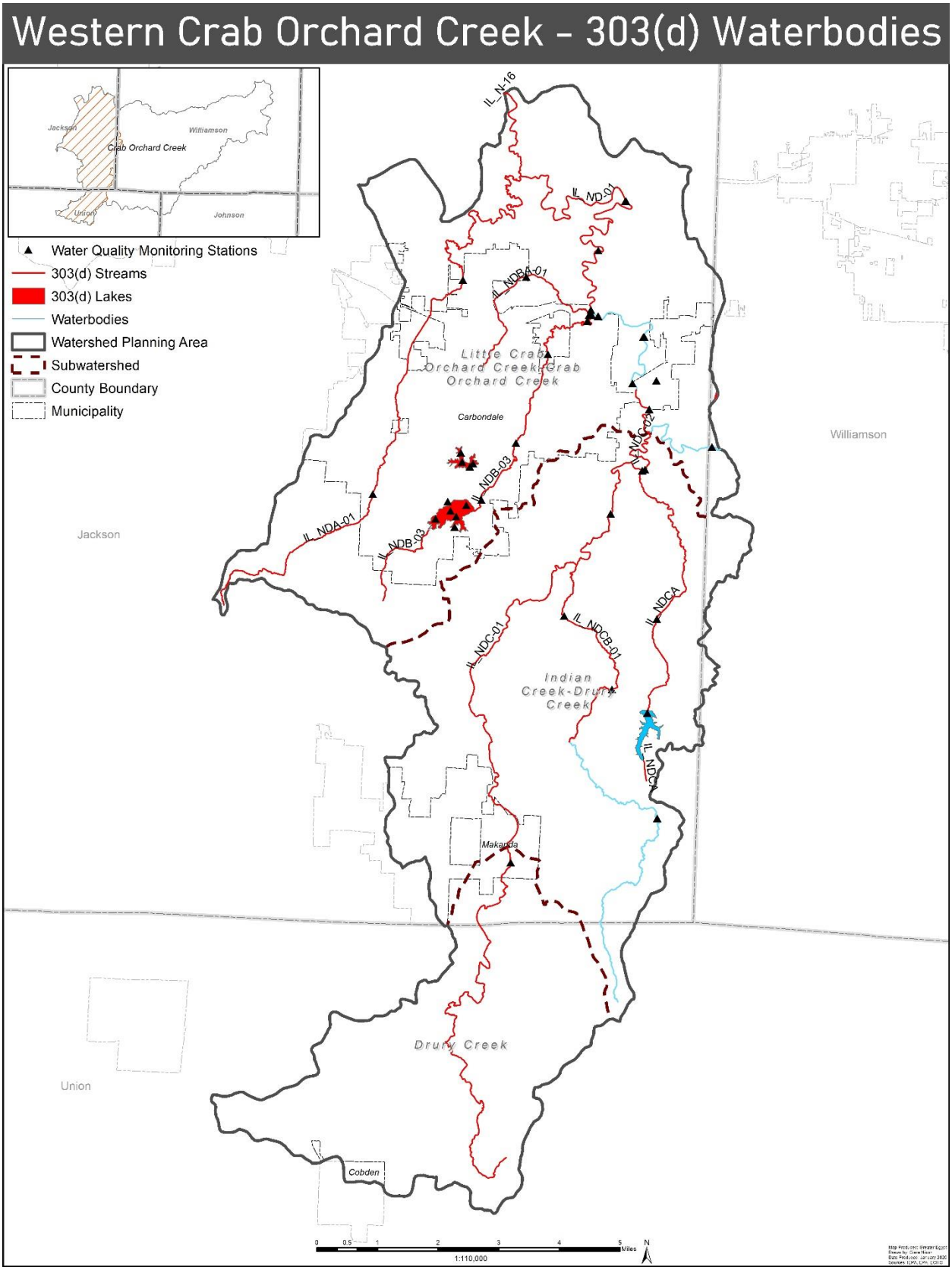
8.1 Water Quality Impairments and Monitoring

303(d) and 305(b) Streams

The streams assessed for water quality impairments under Section 303(d) include: Big Muddy River, Crab Orchard Creek, Drury Creek, Eek Creek, Indian Creek, Little Crab Orchard Creek-West, Piles Fork Creek, and Sycamore Creek. Lakes assessed for impairments include: Carbondale City Lake and Campus Lake. A depiction of 303(d) waterbodies and IEPA monitoring stations can be viewed in Figure 8.1.

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. Waterbody information has been analyzed by Subwatershed (HUC 12).

Figure 8.1- Western Crab Orchard Creek 303(d) Waterbodies



Drury Creek Subwatershed (071401060807)

Table 8.1 outlines the designated uses and assessment status of 305(b) waterbodies within Drury Creek subwatershed, as identified in the Illinois Integrated Water Quality Report and Section 303(d) List for 2016. Drury Creek (IL_NDC-01) was the only assessed waterbody in the report. It was assessed solely for aquatic life, which is not supported. Drury Creek continues into Indian Creek-Drury Creek subwatershed.

Table 8.1- Drury Creek Subwatershed 305(b) Streams

Drury Creek- 071401060807				
Waterbody Name & Assessment ID	**Designated Use**	**Use ID**	**Assessed in 2016 Integrated Report**	**Use Attainment**
Drury Creek (IL_NDC-01)	Aquatic Life	582	Yes	Not Supporting
	Fish Consumption	583	No	N/A
	Primary Contact Recreation	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

Drury Creek has been placed on the IEPA's 303(d) List of Impaired Waters. This is due to several impairments. Information from the 305(b) Assessment (Appendix B-3) can be found in Table 8.2. Causes of impairment include: alteration in stream-side or littoral vegetation covers and dissolved oxygen. The sources for impairment are loss of riparian habitat and an unknown source.

Table 8.2- 305(b) Assessment Information for Drury Creek Subwatershed

Waterbody	Assessment Unit ID	Size	Causes of Impairment(s)	Sources of Impairment(s)
Drury Creek	IL-NDC-01	19.39	Alteration in stream-side or littoral vegetative covers, Dissolved Oxygen	Loss of Riparian Habitat, Source Unknown

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 causes and sources of impairment for Drury Creek (NDC-01). The impaired designated use is aquatic life, which is caused by dissolved oxygen.

Table 8.3- 303(d) Information for Drury Creek Subwatershed

Waterbody	Assessment Unit ID	Size	Impaired Designated Use (s)	Causes of Impairment(s)
Drury Creek	IL_NDC-01	19.39	Aquatic Life	Dissolved Oxygen

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

Indian Creek – Drury Creek Subwatershed (071401060808)

Table 8.4 outlines the designated uses and assessment status of 305(b) waterbodies within Indian Creek - Drury Creek subwatershed, as identified in the Illinois Integrated Water Quality Report and Section 303(d) List for 2016. This includes four stream reaches and one lake. There are a total of five designated uses, with only two designated uses being assessed. Aquatic Life was evaluated for all waterbodies, and only fully supported for Indian Creek (NDBC-02). Aesthetic Quality was assessed for Drury Creek and Sycamore Creek, but only fully supported for Drury Creek. Spring Arbor Lake was assessed for Aquatic Life and Aesthetic Quality but had insufficient information.

Table 8.4- Indian Creek- Drury Creek Subwatershed 305(b) Waterbodies

Indian Creek- Drury Creek- 071401060808				
Waterbody Name & Assessment ID	**Designated Use**	**Use ID**	**Assessed in 2016 Integrated Report**	**Use Attainment**
Drury Creek (IL_NDC-02)	Aquatic Life	582	Yes	Not Supporting
	Fish Consumption	583	No	N/A
	Primary Contact Recreation	585	No	N/A
	Secondary Contact	586	No	N/A
	Aesthetic Quality	590	Yes	Fully Supporting
Indian Creek (IL_NDBC-01)	Aquatic Life	582	Yes	Not Supporting
	Fish Consumption	583	No	N/A
	Primary Contact Recreation	585	No	N/A
	Secondary Contact	586	No	N/A
	Aesthetic Quality	590	No	N/A
Indian Creek (IL_NDBC-02)	Aquatic Life	582	Yes	Fully Supporting
	Fish Consumption	583	No	N/A
	Primary Contact Recreation	585	No	N/A
	Secondary Contact	586	No	N/A
	Aesthetic Quality	590	No	N/A
Sycamore Creek (IL_NDCA)	Aquatic Life	582	Yes	Not Supporting
	Fish Consumption	583	No	N/A
	Primary Contact Recreation	585	No	N/A
	Secondary Contact	586	No	N/A
	Aesthetic Quality	590	Yes	Fully Supporting
Spring Arbor Lake (IL_RNZG)	Aquatic Life	582	Yes	Insufficient Information
	Fish Consumption	583	No	N/A
	Primary Contact Recreation	585	No	N/A
	Secondary Contact	586	No	N/A
	Aesthetic Quality	590	Yes	Insufficient Information

Drury Creek, Indian Creek, and Sycamore Creek have been placed on the IEPA's 303(d) list of impaired waters. This is due to several impairments. Information from the 305(b) Assessment (Appendix B-3) can be found in Table 8.5. Dissolved oxygen impairs all three streams. The sources of impairment vary by waterbody.

Table 8.5- 305(b) Assessment Information for Indian Creek- Drury Creek Subwatershed

Waterbody	Assessment Unit ID	Size	Causes of Impairment(s)	Sources of Impairment(s)
Drury Creek	IL_NDC-02	1.43	Dissolved Oxygen	Acid Mine Drainage, Highway/Road/Bridge Runoff (Non-construction Related), Impacts from Abandoned Mine Lands (Inactive), Streambank Modifications/destabilization, Crop Production (Crop Land or Dry Land), Agriculture
Indian Creek	IL_NDCB-01	4.37	Alteration in stream-side or littoral vegetative covers, Low flow alterations, Dissolved Oxygen, Changes in Stream Depth and Velocity Patterns	Streambank Modifications/destabilization, Habitat Modification-other than Hydromodification, Loss of Riparian Habitat, Crop Production (Crop Land or Dry Land), Agriculture
Sycamore Creek	IL_NDCA	5.66	Dissolved Oxygen, pH	Acid Mine Drainage, Impacts from Abandoned Mine Lands (Inactive), Loss of Riparian Habitat, Crop Production (Crop Land or Dry Land), Agriculture

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 causes of impairment. The following table summarizes the causes and sources of impairment for Drury Creek, Indian Creek, and Sycamore Creek. Aquatic Life is the only impaired designated use for all three 303(d) waterbodies. Dissolved oxygen is the cause of impairment for all three waterbodies, while Sycamore Creek is also impaired due to pH.

Table 8.6- 303(d) Information for Indian Creek- Drury Creek Subwatershed

Waterbody	Assessment Unit ID	Size	Impaired Designated Use (s)	Causes of Impairment(s)
Drury Creek	IL_NDC-01	19.39	Aquatic Life	Dissolved Oxygen
Indian Creek	IL_NDCB-01	4.37	Aquatic Life	Dissolved Oxygen
Sycamore Creek	IL_NDCA	5.66	Aquatic Life	Dissolved Oxygen, pH

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

Little Crab Orchard Creek Subwatershed (071401060809)

Table 8.8 outlines the designated uses and assessment status of 305(b) waterbodies within Little Crab Orchard Creek subwatershed, as identified in the Illinois Integrated Water Quality Report and Section 303(d) List for 2016.

There are five streams and two lakes that were assessed in the report. They are Big Muddy River, Eek Creek, Little Crab Orchard Creek- West, Piles Fork Creek, Crab Orchard Creek; which had five assessed reaches, Campus Lake, and Carbondale City Lake. Aquatic Life was assessed for all nine stream reaches and both lakes; and was only fully supported in Crab Orchard Creek (Reach IL_ND-01, 12, & 13), Campus Lake, and Carbondale City Lake. Fish Consumption was assessed in 2016 for Big Muddy River, Crab Orchard Creek (ND-01, ND-02, ND-12, ND-13), Campus Lake, and Carbondale City Lake. Fish Consumption was only Fully Supported in Crab Orchard Creek, Reach ND-12 and ND-13. Aesthetic Quality was only fully supported for Crab Orchard Creek (ND-01), Eek Creek, and Piles Fork Creek.

Information from the 305(b) Assessment (Appendix B-3), regarding the cause and source for waterbody impairments can be found in Table 8.9. The common causes of impairment are dissolved oxygen, mercury, methoxychlor, and alterations in streamside or littoral vegetation cover. The common source of impairment is caused by agriculture.

The information contained in the 303(d) section, lists the impaired designated use and cause of impairment. The following table summarizes the causes and sources of impairment for Big Muddy River, Crab Orchard Creek, Eek Creek, Little Crab Orchard Creek- West, Piles Fork Creek, Carbondale City Lake, and Campus Lake, as identified in the 303(d) list (Appendix A-1) of the 2016 Integrated Report.

Table 8.7- 303(d) Information for Little Crab Orchard Creek- Crab Orchard Creek Subwatershed

Waterbody	Assessment Unit ID	Size (miles)	Impaired Designated Use (s)	Causes of Impairment(s)
Big Muddy River	IL_N-16	11.79	Aquatic Life	Sedimentation/Siltation, Dissolved Oxygen
Big Muddy River	IL_N-16	11.79	Fish Consumption	Mercury
Crab Orchard Creek	IL_ND-01	10.41	Fish Consumption	Mercury
Crab Orchard Creek	IL_ND-11	1.01	Aquatic Life	Cause Unknown
Eek Creek	IL_NDBA-01	3.61	Aquatic Life	Dissolved Oxygen, Water Temperature
Little Crab Orchard Creek-West	IL_NDA-01	13.92	Aquatic Life	Methoxychlor
Piles Fork Creek	IL_NDB-03	7.2	Aquatic Life	Methoxychlor
Carbondale City Lake	IL_RNI	135.6	Aesthetic Quality	Total Suspended Solids (TSS)
Carbondale City Lake	IL_RNI	135.6	Fish Consumption	Mercury
Campus	IL_RNZH	40.0	Aesthetic Quality	Total Suspended Solids (TSS)
Campus	IL_RNZH	40.0	Fish Consumption	Mercury, Polychlorinated biphenyls

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

Table 8.8- Little Crab Orchard Creek- Crab Orchard Creek Watershed 305(b) Waterbodies

Little Crab Orchard Creek- Crab Orchard Creek- 071401060809				
Stream Name & Assessment ID	**Designated Use**	**Use ID**	**Assessed in 2016 Integrated Report**	**Use Attainment**
Big Muddy River (IL_N-16)	Aquatic Life	582	Yes	Not Supporting
	Fish Consumption	583	Yes	Not Supporting
	Primary Contact Recreation	585	No	N/A
	Secondary Contact	586	No	N/A
	Aesthetic Quality	590	No	N/A
Crab Orchard Creek (IL_ND-01)	Aquatic Life	582	Yes	Fully Supporting
	Fish Consumption	583	Yes	Not Supporting
	Secondary Contact	586	No	N/A
	Aesthetic Quality	590	Yes	Fully Supporting
Crab Orchard Creek (IL_ND-02)	Aquatic Life	582	Yes	Not Supporting
	Fish Consumption	583	Yes	Not Supporting
	Primary Contact Recreation	585	No	N/A
	Secondary Contact	586	No	N/A
	Aesthetic Quality	590	No	N/A
Crab Orchard Creek (IL_ND-11)	Aquatic Life	582	Yes	Not Supporting
	Fish Consumption	583	No	N/A
	Secondary Contact	586	No	N/A
	Aesthetic Quality	590	No	N/A
Crab Orchard Creek (IL_ND-12) (IL_ND-13)	Aquatic Life	582	Yes	Fully Supporting
	Fish Consumption	583	Yes	Fully Supporting
	Aesthetic Quality	590	No	N/A
Eek Creek (IL_NDBA-01)	Aquatic Life	582	Yes	Not Supporting
	Fish Consumption	583	No	N/A
	Primary Contact Recreation	585	No	N/A
	Secondary Contact	586	No	N/A
	Aesthetic Quality	590	Yes	Fully Supporting
Little Crab Orchard Creek-West (IL_NDA-01)	Aquatic Life	582	Yes	Not Supporting
	Fish Consumption	583	No	N/A
	Primary Contact Recreation	585	No	N/A
	Secondary Contact	586	No	N/A
	Aesthetic Quality	590	Yes	Fully Supporting

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

Table 8.8 (Cont'd)- Little Crab Orchard Creek- Crab Orchard Creek Watershed 305(b) Waterbodies

Little Crab Orchard Creek- Crab Orchard Creek- 071401060809				
Stream Name & Assessment ID	**Designated Use**	**Use ID**	**Assessed in 2016 Integrated Report**	**Use Attainment**
Piles Fork Creek (IL_NDB-03)	Aquatic Life	582	Yes	Not Supporting
	Fish Consumption	583	No	N/A
	Primary Contact Recreation	585	No	N/A
	Secondary Contact	586	No	N/A
	Aesthetic Quality	590	Yes	Fully Supporting
Campus Lake (IL_RNZH)	Aquatic Life	582	Yes	Fully Supporting
	Fish Consumption	583	Yes	Not Supporting
	Primary Contact Recreation	585	No	N/A
	Secondary Contact	586	No	N/A
	Aesthetic Quality	590	Yes	Not Supporting
Carbondale City Lake (IL_RNI)	Aquatic Life	582	Yes	Fully Supporting
	Fish Consumption	583	Yes	Not Supporting
	Public and Food Processing Water Supplies	584	Yes	Fully Supporting
	Primary Contact Recreation	585	No	N/A
	Secondary Contact	586	No	N/A
	Aesthetic Quality	590	Yes	Not Supporting

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

Table 8.9- 305(b) Information for Western Crab Orchard Creek Watershed

Waterbody	Assessment Unit ID	Size	Causes of Impairment(s)	Sources of Impairment(s)
Big Muddy River	IL_N-16	11.79	Dissolved Oxygen, Sedimentation/Siltation, Mercury	Non-irrigated Crop Production, Natural Sources, Atmospheric Deposition- Toxics, Source Unknown
Crab Orchard Creek	IL-ND-01	10.4	Mercury	Atmospheric Deposition-Toxics, Source Unknown
Crab Orchard Creek	IL-ND-02	2.1	Manganese, Other flow regime alterations, Dissolved Oxygen	Source Unknown, Impacts from Hydro structure Flow Regulations/modification, Upstream Impoundments
Crab Orchard Creek	IL-ND-11	1	Dissolved Oxygen, Cause Unknown	Source Unknown
Eek Creek	IL_NDBA-01	3.6	Alteration in stream-side or littoral vegetative covers, Dissolved Oxygen, Water Temperature, Loss of Instream Cover	Channelization, Industrial Land Treatment, Loss of Riparian Habitat, Rcra Hazardous Waste Sites, Crop Production (Crop Land or Dry Land), Agriculture, Habitat Modification- other than Hydromodification
Little Crab Orchard Creek- West	IL_NDA-01	13.9	Alteration in stream-side or littoral vegetative covers, Methoxychlor, Dissolved Oxygen	Loss of Riparian Habitat, Streambank Modifications/destabilization, Crop Production (Crop Land or Dry Land), Urban Runoff/Storm Sewers, Livestock (Grazing or Feeding Operations)
Piles Fork	IL_NDB-03	7.2	Alteration in stream-side or littoral vegetative covers, Methoxychlor, Other flow regime alterations, Dissolved Oxygen	Highway/Road/Bridge Runoff (Non-construction related), Impacts from Hydro structure Flow Regulations/modification, Streambank Modifications/destabilization, Urban Runoff/Storm Sewers, Upstream Impoundments
Campus Lake	IL_RNZH	41.2 ac	Mercury, Polychlorinated biphenyls, Total Suspended Solids (TSS), Phosphorus (Total)	Atmospheric Deposition-Toxics, Source Unknown, Other Spill Related Impacts, Waterfowl, Urban Runoff/Storm Sewers, Runoff from Forest/Grassland/Parkland
Carbondale City Lake	IL_RNI	132.9 ac	Mercury, Total Suspended Solids (TSS), Phosphorus (Total)	Atmospheric deposition-Toxics, Source Unknown, Littoral/shore Area Modifications (Non-riverine), Municipal Point Source Discharges, Urban Runoff/Storm Sewers, Runoff from Forest/Grassland/Parkland

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

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. CDM Smith, an engineering and construction firm, developed a TMDL for Crab Orchard Watershed in 2008. The Crab Orchard watershed is a 185,000-acre watershed that encompasses all three HUC 12 watersheds in our planning area. *The Crab Orchard Watershed TMDL Report* [40] was designed to provide detailed information for HUC 12 watersheds within the planning area.

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. All three HUC 12 watersheds in our planning area are located in the Big Muddy River Watershed (HUC 07140106), which is an IEPA priority watershed for addressing total phosphorus losses from nonpoint sources. Further information about the ILNLRS can be found in Section 8.8.

In 2004, Southern Illinois University Carbondale, in cooperation with Illinois Environmental Protection Agency, completed the *Phase 1 Diagnostic/Feasibility Study of Campus Lake, Jackson County, Illinois*[41]. The objective of this study was to gauge the quality of the lake and identify any pollutants. Implementation strategies for remediation were proposed.

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

[40] CDM. *Crab Orchard Watershed TMDL Report.*
[41] SIUC,EPA. *Phase 1 Diagnostic/Feasibility Study of Campus Lake, Jackson County, Illinois.* Charles Muchmore et al. Springfield, IL , 2004. PDF File

and supplies from IEPA. The level of monitoring is dependent on the tier level of the volunteer.

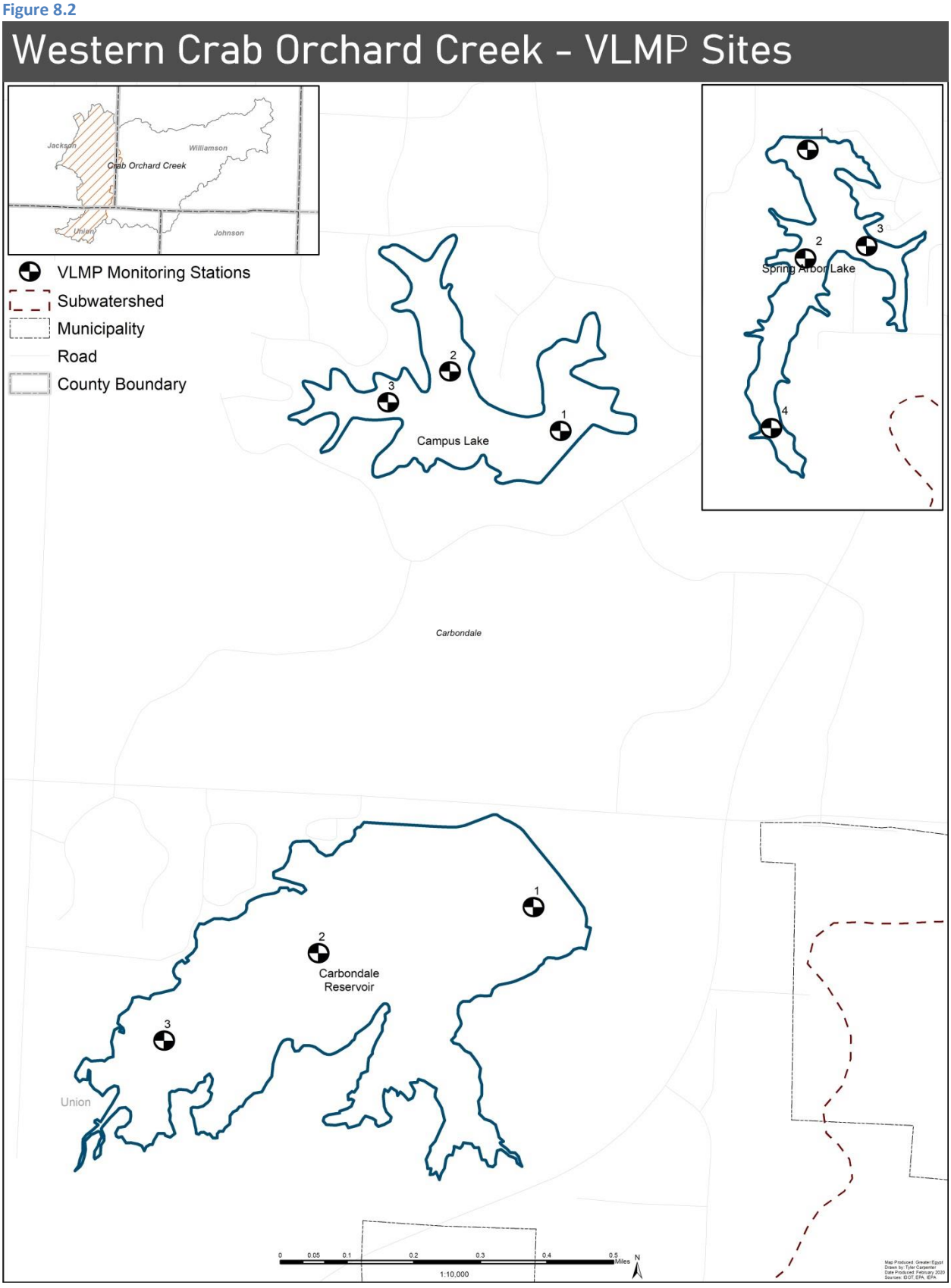
Tier I:
Basic lake monitoring. Volunteers measure lake water clarity with a Secchi Disk and make other basic lake observations. Volunteers record the level of aquatic plant growth, record the siting of any invasive species, the lake water level, weather, and watershed conditions at the time of monitoring.

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.

Three lakes in the Western Crab Orchard Creek watershed have been participants in the program with Tier II status. These include Campus Lake, Carbondale Reservoir, and Spring Arbor Lake. Nearby Cedar Lake, the water supply for Carbondale and Makanda, is also monitored through the program. A site map for the lake locations can be viewed in Figure 8.2.

Figure 8.2


Western Crab Orchard Creek – VLMP Sites
Jackson
Williamson
Crab Orchard Creek
Union
Johnson
VLMP Monitoring Stations
Subwatershed
Municipality
Road
County Boundary
Campus Lake
Spring Arbor Lake
Carbondale
Carbondale Reservoir
Union
0 0.05 0.1 0.2 0.3 0.4 0.5 Miles
1:10,000
N

8.3 Water Quality of Impaired Lakes and Streams

8.3.1 Lakes

Campus Lake (IL_RNZH)

The 2016 Illinois Integrated Water Quality Report states the designated uses of Campus Lake to be aquatic life, fish consumption, primary contact recreation, secondary contact, and aesthetic quality. Designated uses not being fully supported are fish consumption and aesthetic quality. The causes of impairment include: total suspended solids (TSS), mercury, and polychlorinated biphenyls. Potential sources of these impairments include: atmospheric deposition-toxics, source unknown, other spill related impacts, waterfowl, urban runoff/ storm sewers, and runoff from forest/grassland/parkland. The IEPA has established four monitoring stations within Campus Lake, which are displayed in Table 8.11. Locations of these sites are detailed in the following table.

Table 8.10- Campus Lake IEPA Monitoring Stations

Station Code	County	Station Location
RNZH-1	Jackson	Site 1 Near Dam
RNZH-2	Jackson	Site 2 Mid Lake Confl with W Arm
RNZH-3	Jackson	Site 3 Middle N Arm
RNZH-4	Jackson	Site 4 Near Dam

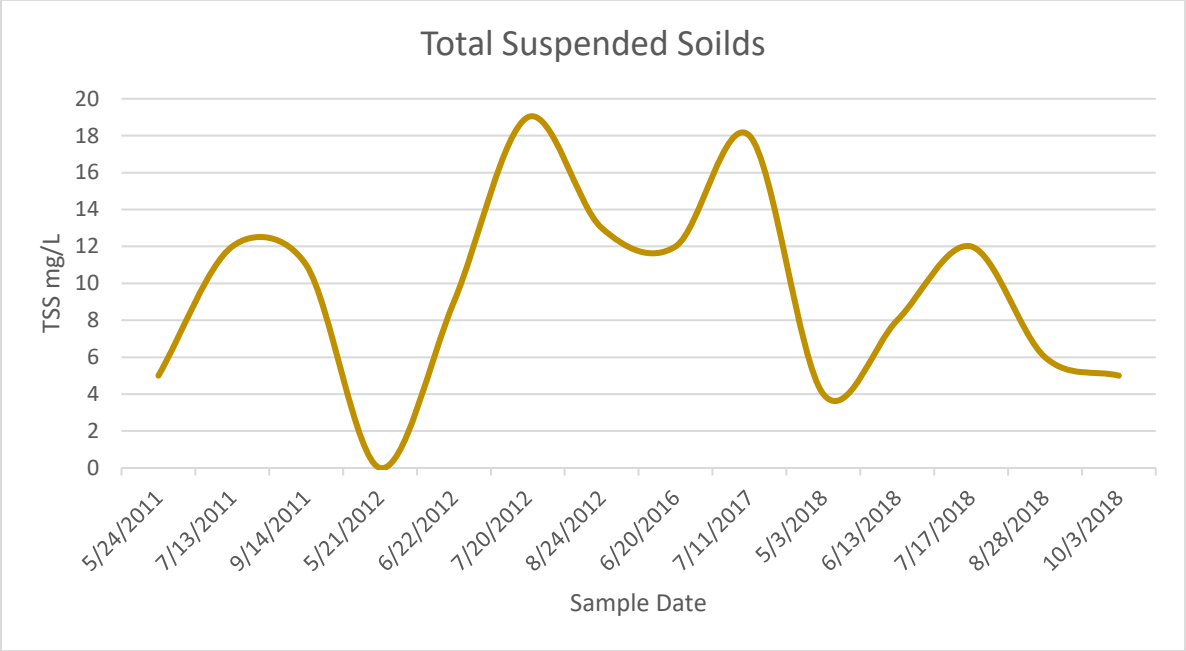
Source: RMMS (IEPA)

Water Quality data for Campus Lake was provided by IEPA and includes years 2011, 2012, 2016, 2017, 2018, and 2019. While a variety of analytes were tested, focus will be directed towards nutrients causing the impairments. It is important to note that data for Campus Lake has a qualifier of "W", which is defined as " Quality assurances/quality control of sample collection, handling, or processing is not sufficient to justify Illinois EPA use of this result for Clean Water Act sections 305(b)/303(d) reporting and related purposes". Since it is the only data available to us, we decided it was still useful to include in this report.

Total Suspended Solids

Total suspended solids are the cause of impairment for aesthetic quality. Currently there is no numeric standard for total suspended solids. TSS values in the graph are recorded at varying intervals and some years are missing from available data. Samples were taken at Station Code: RNZH-1.

Figure 8.3- RNZH-1 Total Suspended Solids



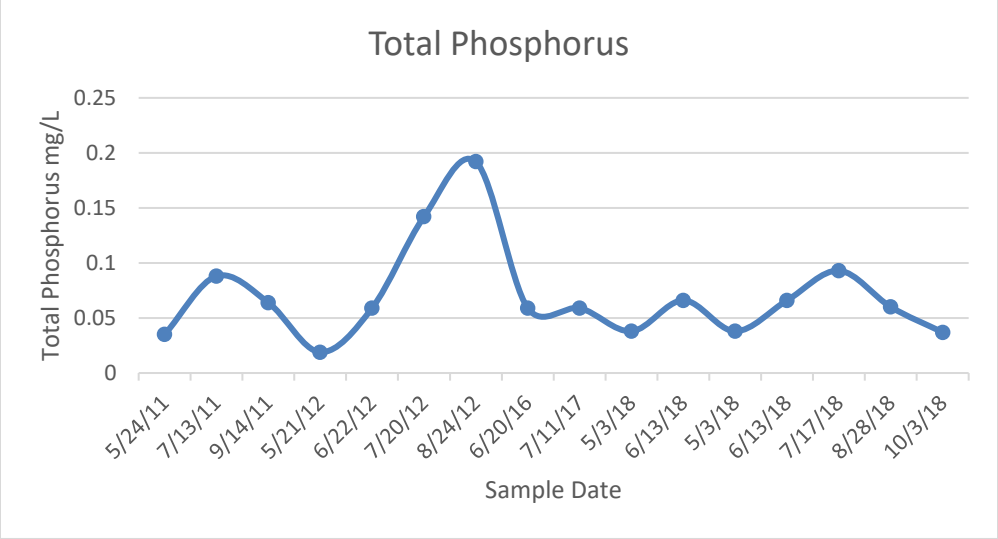
Source: IEPA

Total Phosphorus

The Illinois Water Quality Standard for Phosphorus is not to exceed 0.05 mg/L for any reservoir or lake with a surface area of 8.1 hectares (20 acres) or more.[42] Several readings for Campus Lake exceed the water quality standard for phosphorus. Total phosphorus 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: RNZH-1.

[42] 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.

Figure 8.4- RNZH-1 Total Phosphorus

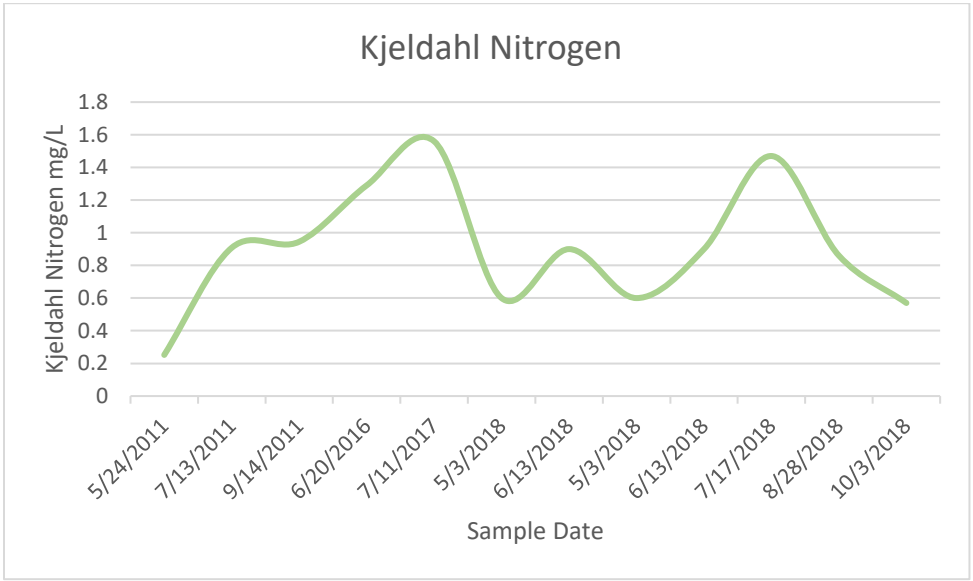


Source: IEPA

Total Kjeldahl Nitrogen

Illinois currently has no water quality standard for total kjeldahl nitrogen related to aquatic life use. TKN 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: RNZH-1.

Figure 8.5- RNZH-1 Kjeldahl Nitrogen



Source: IEPA

Mercury

Mercury is the cause of impairment for fish consumption within Campus Lake. The only available data for mercury in Campus Lake comes from year 2007. The results are from three different stations around the lake. Results are displayed in Table 8.12. 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".[43]

Table 8.11- 2007 Mercury Sample Results

Station Code	Sample Depth (ft)	Collection Date	Result (mg/kg)	Weight Basis	Result Particle Size Basis
RNZH-2	11	9/21/2007	0.11	dry	Unsieved
RNZH-3	5	9/21/2007	0.04	dry	Unsieved
RNZH-4	16	9/21/2007	0.1	dry	Unsieved

Source: IEPA

Carbondale Reservoir (IL_RNI)

The 2016 Illinois Integrated Water Quality Report states the designated use of Carbondale Reservoir to be aquatic life, fish consumption, public and food processing water supplies, primary contact recreation, secondary contact, and aesthetic quality. Designated uses not being fully supported are fish consumption and aesthetic quality. The causes of impairment include: mercury, total suspended solids (TSS), and total phosphorus. Potential sources of these impairments include: atmospheric deposition-toxics, source unknown, littoral/shore area modifications (non-riverine), municipal point source discharges, urban runoff/storm sewers, and runoff from forest/grassland/parkland.

The IEPA has established six monitoring stations within Carbondale Reservoir, which are displayed in Table 8.13. Locations of these sites are detailed in the following table.

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

Table 8.12- Carbondale Reservoir IEPA Monitoring Stations

Station Code	County	Station Location
RNI-1	Jackson	Site 1 near dam
RNI-2	Jackson	Site 2 mid lake
RNI-3	Jackson	Site 3 SW end of lake
RNI-4	Jackson	Site 4- 1978
RNI-101	Jackson	-
RNI-102	Jackson	-

Source: IEPA

Water quality data for Carbondale Reservoir was provided by IEPA and includes years 2008, 2011, 2013, and 2018. While a variety of analytes were tested, focus will be directed towards nutrients causing the impairments.

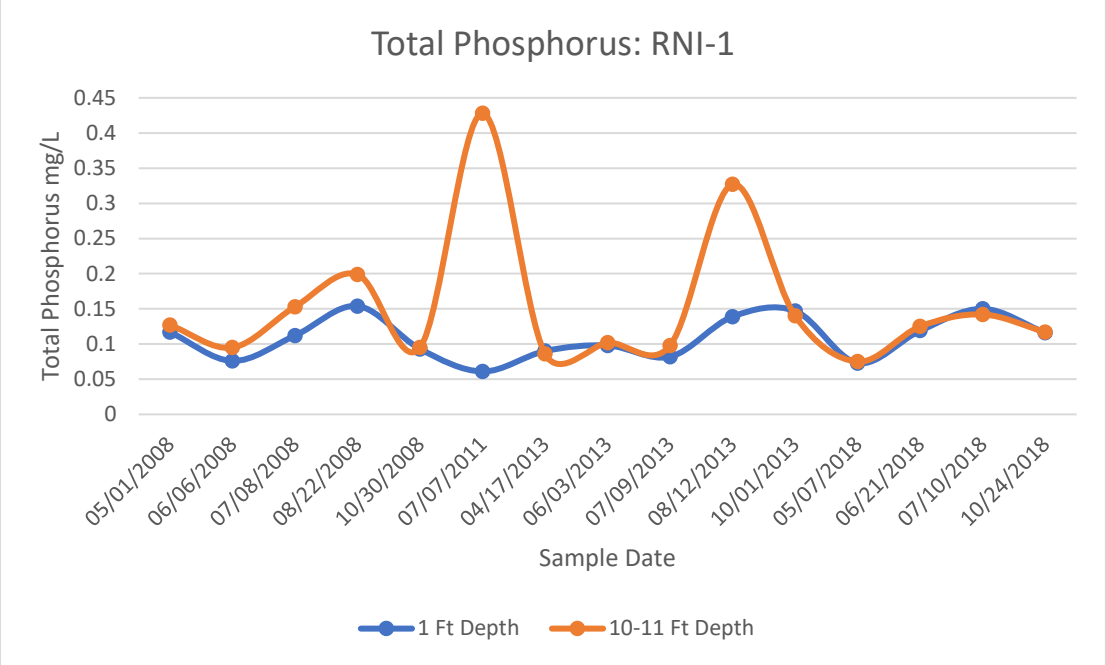
Total Phosphorus

The Illinois Water Quality Standard for phosphorus is not to exceed 0.05 mg/L for any reservoir or lake with a surface area of 8.1 hectares (20 acres) or more.[44] Several readings for Carbondale Reservoir exceed the water quality standard for Phosphorus. Total phosphorus 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: RNI-1, RNI-2, and RNI-3. Separate graphs were created for the 3 different locations.

Station code RNI-1 has readings from sample depth of 1 ft, 10 ft, and 11ft. Depths of 10ft and 11ft were combined for this graph.

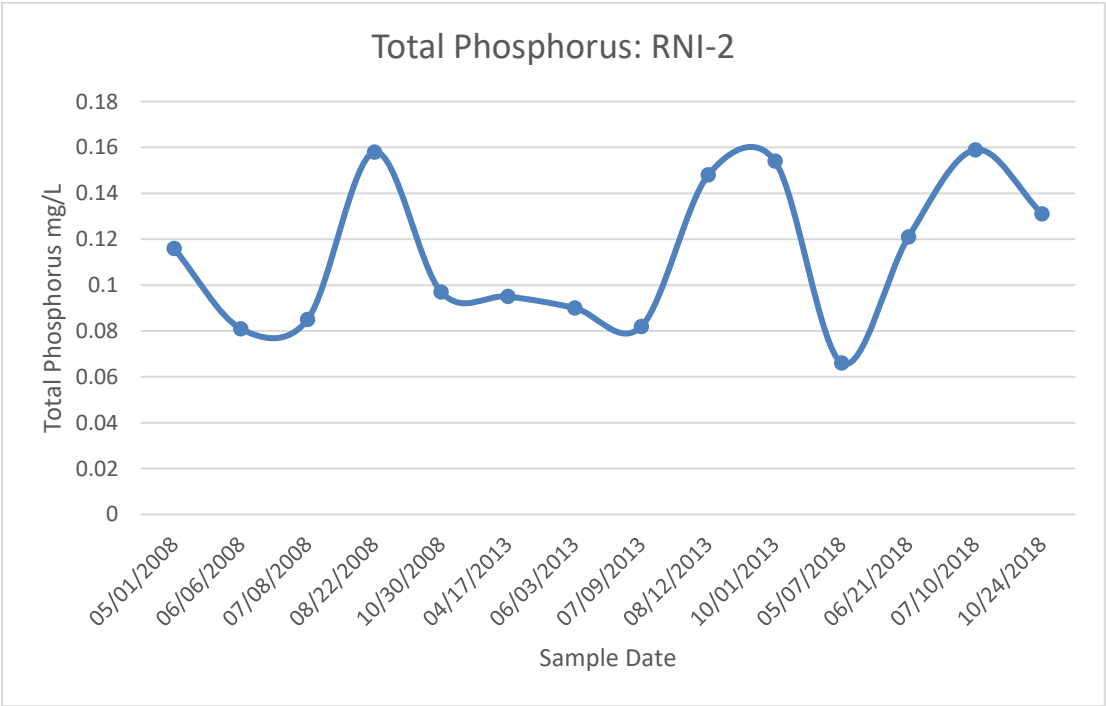
[44] Illinois Pollution Control Board. *Title 35: Environmental Protection-Subtitle C: Water Pollution-part 302 Water Quality Standards, Subpart A: General Water Quality Provisions.* PDF. Accessed March 2020.

Figure 8.6- RNI-1 Total Phosphorus



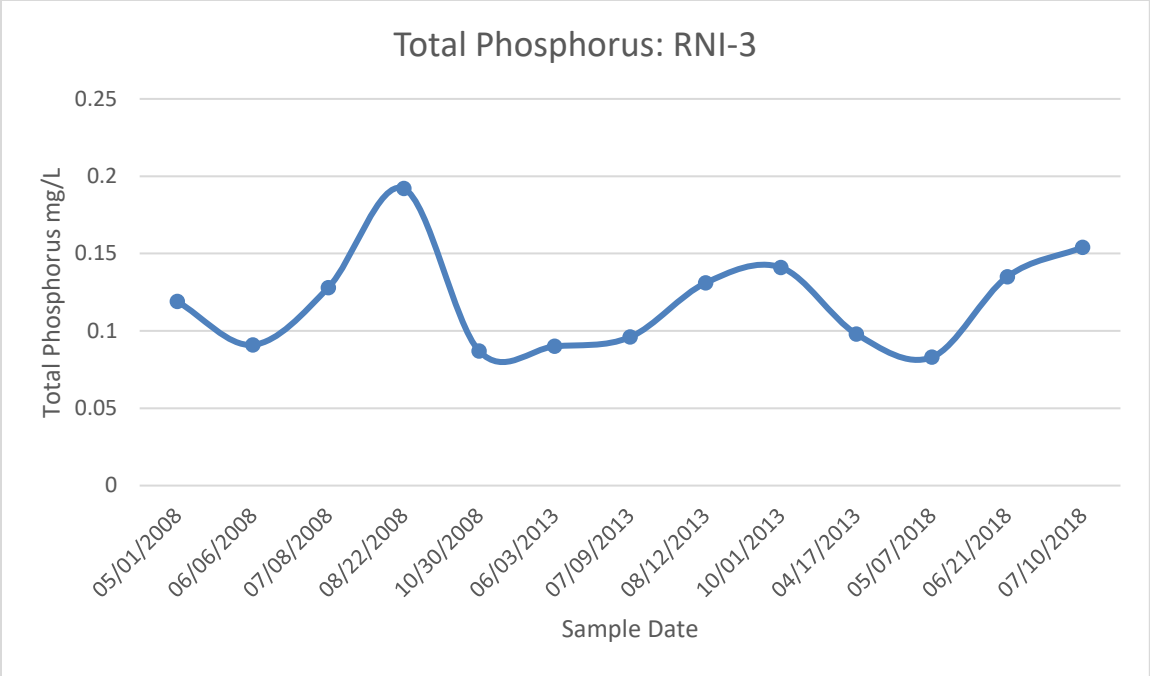
Source: IEPA

Figure 8.7- RNI-2 Total Phosphorus



Source: IEPA

Figure 8.8- RNI-3 Total Phosphorus

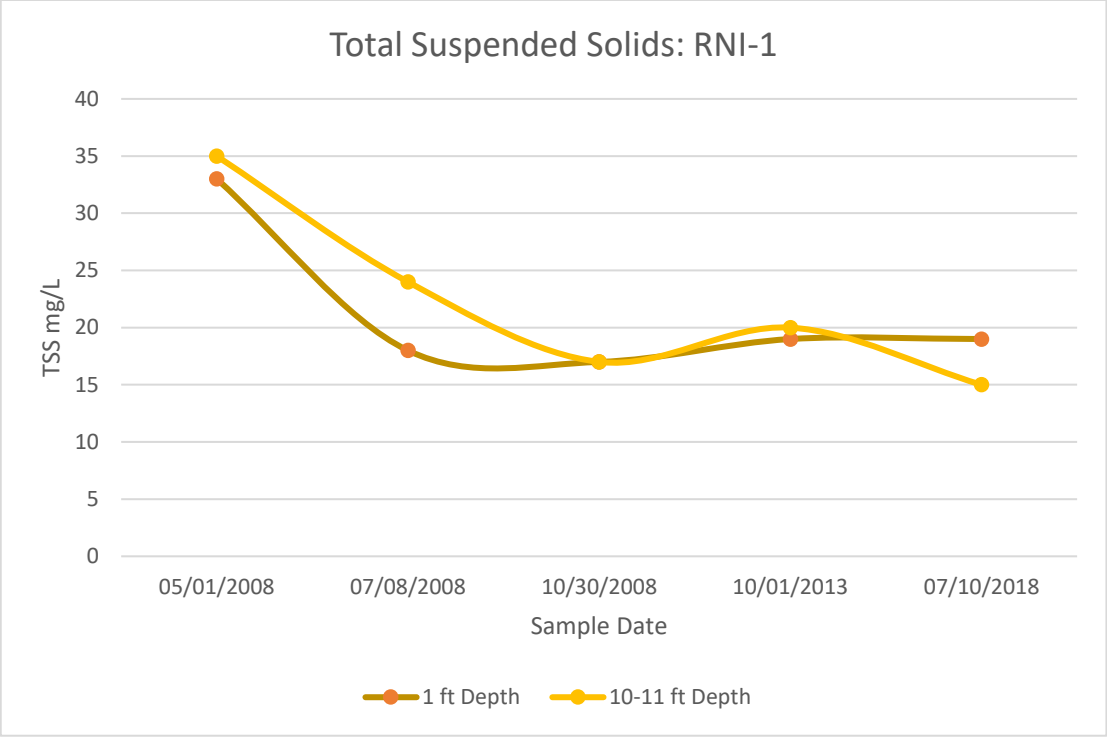


Source: IEPA

Total Suspended Solids

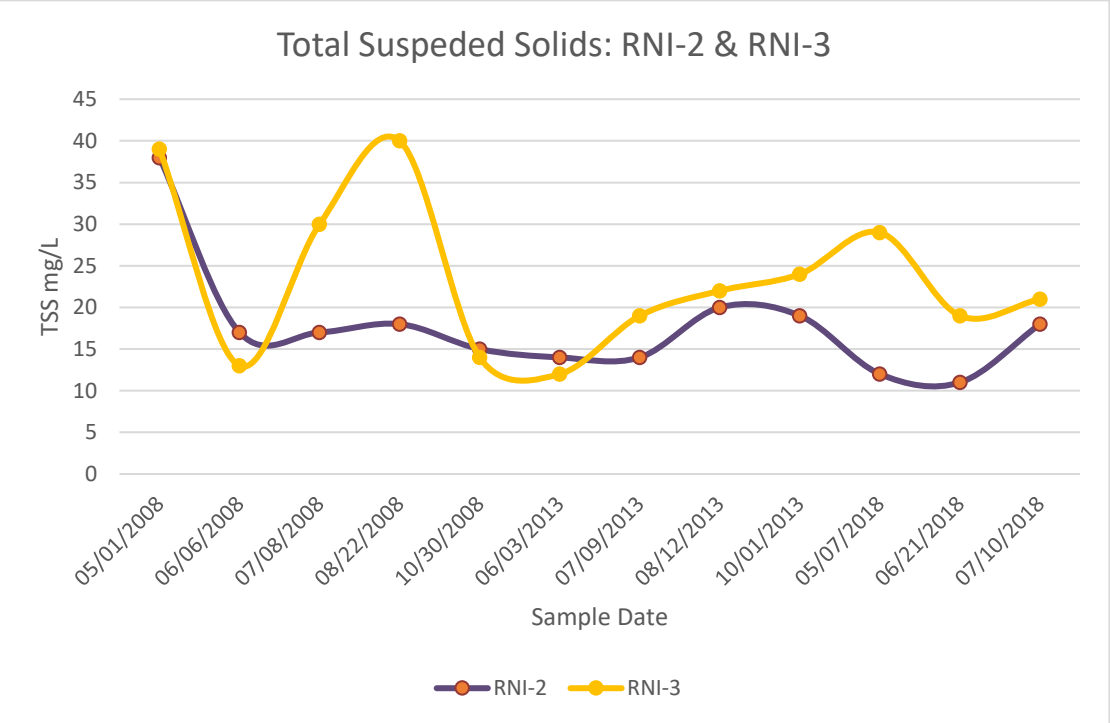
Total suspended solids are the cause of impairment for aesthetic quality. Currently there is no numeric standard for total suspended solids. TSS values in the graph are recorded at varying intervals and some years are missing from available data. Samples were taken at Station Code: RNI-1, RNI-2, and RNI-3. Station RNI-1 had more limited sample dates and could not be combined with the other stations in the graph. RNI-1 also had water samples taken at different depths, whereas RNI-2 and RNI-3 solely had water samples taken at 1ft depth.

Figure 8.9- RNI-1 Total Suspended Solids



Source: IEPA

Figure 8.10- RNI-2 & 3 Total Suspended Solids



Source: IEPA

Mercury

Mercury is the cause of impairment for fish consumption within Carbondale Reservoir. Data is limited for mercury and has not been tested since 2011.

Table 8.13- Carbondale Reservoir Mercury Sample Results

Station Code	Sample Depth (ft)	Collection Date	Result (mg/kg)	Weight Basis	Result Particle Size Basis
RNI-1	13	08/22/2008	0.07	dry	Unsieved
RNI-3	3	08/22/2008	0.05	dry	Unsieved
RNI-1	13	07/07/2011	0.08	dry	

Source: IEPA

Crab Orchard Creek (IL_ND-01)

The only stream segment with sufficient data from multiple years is for Crab Orchard Creek. The 2016 Illinois Integrated Water Quality Report states the designated uses of Crab Orchard Creek to be aquatic life, fish consumption, secondary contact, and aesthetic quality. The designated use not being fully supported is fish consumption. The cause of impairment is mercury and potential sources of impairment are atmospheric deposition-toxics and an unknown source.

The IEPA has established two monitoring stations for Crab Orchard Creek, which are displayed in Table 8.15. Locations of these sites are detailed in the following table.

Table 8.14- NDA-01 IEPA Water Monitoring Stations

Station Code	County	Station Location
ND-01	Jackson	Dillinger Rd, 1.1 mi W of reed station Rd and 3 mi NE of Carbondale
ND-99	Williamson	Below Crab Orchard LK Dam NR Carterville

Source: IEPA

Mercury

Data for mercury testing in Crab Orchard Creek is sparse. The last available reading is from 2008. The results are displayed in the table below.

Table 8.15- Crab Orchard Creek Mercury Sample Results

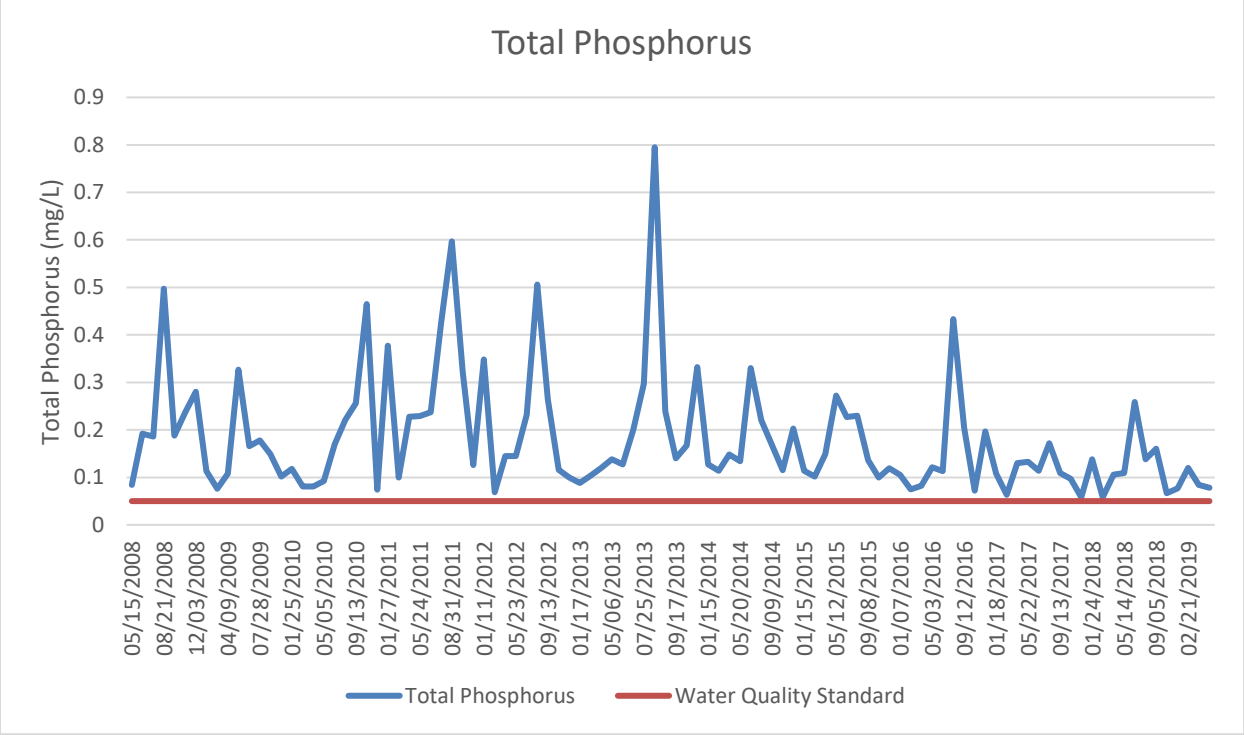
Station Code	Collection Date	Result (mg/kg)	Weight Basis	Result Particle Size Basis
ND-01	8/21/2008	0.04	dry	Wet sieve (<63u)

Source: IEPA

Total Phosphorus

Total phosphorus values in the graph are recorded at varying intervals based on available data. All water samples tested are above the water quality standard set at 0.05mg/L.

Figure 8.11- IL_ND-01 Total Phosphorus

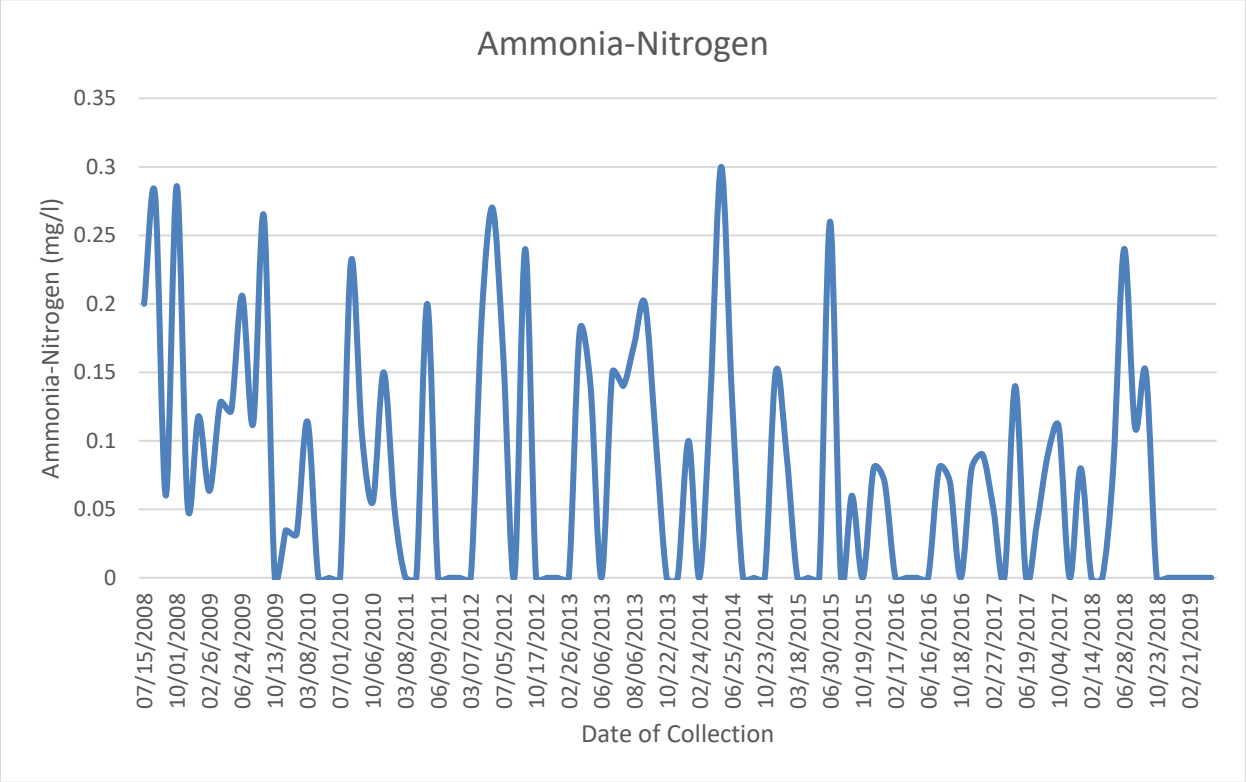


Source: IEPA

Ammonia-Nitrogen

Total ammonia-nitrogen was measured from year 2008 to 2019. The Illinois Water Quality Standard for Total ammonia nitrogen is 15 mg/L.[45] All readings are well below the EPA recommended level. Ammonia is a form of nitrogen that exists in aquatic environments and is toxic to aquatic life. [46]

Figure 8.12- IL_ND-01 Ammonia Nitrogen



Source: IEPA

[45] 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.
[46] United States Environmental Protection Agency. *Aquatic Life Ambient Water Quality Criteria for Ammonia- Freshwater.* Washington D.C: August 2013. PDF.

8.4 Local Water Quality Assessment

To address water quality at the local level, an assessment has been completed for the municipalities within the Western Crab Orchard Creek planning area. This assessment was designed to review the latest water quality reports submitted by those municipalities. Carbondale City obtains water from two source lakes. Their main and primary source of water is Cedar Lake, with a backup source being the City Reservoir. Makanda Village includes the South Highway Water District and Buncombe Water District, which both purchase their water from the City of Carbondale. Cobden Village sources their drinking water from three ground water wells. The City of Carbondale report and the Cobden Village report have been utilized for this assessment.

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 8.17 displays the water quality reports for lead and copper. Both Carbondale and Cobden have 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 within each

municipality and jurisdiction. While the reports for Carbondale and Cobden are for 2018, Carbondale sampled for both Copper and Lead in 2017. Cobden sampled for Copper and Lead on July 15th, 2016. Both Carbondale and Cobden are under triennial monitoring due to favorable monitoring history, specific high-tech treatment processes, regular sampling and quality laboratory testing. According to the water quality reports, no jurisdiction was in 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 materials.[47][48]

Table 8.16 – Lead and Copper Information

Municipality	Contaminants	MCLG	Action Level (AL)	90th Percentile	Sites Over Lead AL	Units	Violation	Likely Source of Contaminaion
Carbondale	Copper	1.3	1.3	0.0365	0	ppm	No	Erosion of natural deposits; leaching from wood preservatives; corrosion of household plumbing systems
	Lead	0	15	1.22	0	ppb	No	Corrosion of household plumbing systems; Erosion of natural deposits
Cobden	Copper	1.3	1.3	0.21	0	ppm	No	Erosion of natural deposits; leaching from wood preservatives; corrosion of household plumbing systems
	Lead	0	15	2.1	0	ppb	No	Corrosion of household plumbing systems; Erosion of natural deposits

Source: Carbondale and Cobden Water Quality Reports

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 Table 8.18. Both Carbondale and Cobden are within the limits for each contaminant, and no violations have occurred.

[47] Public Works Department, City of Carbondale. 2019. "Water Quality Report." Accessed September 9. https://explorecarbondale.com/Archive/ ViewFile/Item/397
[48] Village of Cobden. 2019. "Annual Drinking Water Quality Report." Accessed September 9. http://cobdenil.com/pdfs/information/CCR%202018% 20to%20mail%202019.pdf

Table 8.17- Municipal Water Quality: Regulated Contaminants

Municipality	Contaminant	Highest Level Detected	Range of Levels Detected	MCLG	MCL	Units	Violation	Likely Source of Contamination
Carbondale	Total Trihalomethanes	25.0	18.9-31.7	N/A	80	ppb	No	By-product of drinking water chlorination
	Haloacetic Acids	34.0	20.9-36.9	N/A	60	ppb	No	By-product of drinking water chlorination
	Chloramines	3.0	2.0-3.0	4.0	4.0	ppm	No	Water additive used to control microbes
Cobden	Total Trihalomethanes	5.0	5.0-5.0	N/A	80	ppb	No	By-product of drinking water chlorination
	Haloacetic Acids	1.0	1.07-1.07	N/A	60	ppb	No	By-product of drinking water chlorination
	Chlorine	1.4	0.55-1.73	MRDLG - 4	MRDL - 4	ppm	No	Water additive used to control microbes

Source: Carbondale and Cobden

8.4.1 City of Carbondale Water Quality Report

Carbondale obtains drinking water from two source lakes. Their main and primary source being Cedar Lake, while the City Reservoir serves as a backup water supply. Buncombe Public Water District and South Highway Water District both serve Makanda's drinking water supply. They both purchase drinking water from the city of Carbondale.

The water report includes the parameters from the previous municipal water quality reports identified as regulated contaminants. In addition, inorganic contaminants were also reported. This category includes substances such as: Fluoride, Nitrate (As N), and Barium. Secondary/ State Regulated Contaminants included in the report are: Manganese, Chloride, Sodium, and Sulfate. The contaminants in all categories are within the regulated range designated by the EPA; therefore, no violations have occurred.

Turbidity, which is a measure of the cloudiness of the water caused by suspended particles, did get a single measurement exceeding the standard. It is noted in the water quality report that levels returned to normal within 24 hours and the water was safe to drink at all times. Results are displayed in Table 8.19.

Table 8.18- 2019 Carbondale Water Quality Report

Contaminant		Highest Level Detected	Range of Levels Detected	MCLG	MCL	Units	Violation	Likely Source of Contamination
Disinfectants & Disinfection By-Products	Total Trihalomethanes	25.0	18.9-31.7	N/A	80	ppb	No	By-product of drinking water chlorination
	Haloacetic Acids	34.0	20.9-36.9	N/A	60	ppb	No	By-product of drinking water chlorination
	Chloramines	3.0	2.0-3.0	4.0	4.0	ppm	No	Water additive used to control microbes
Inorganic	Fluoride	0.70	0.65 - 0.70	4.0	4.0	ppm	No	Erosion of natural deposits; Water additive which promotes strong teeth; Fertilizer discharge and aluminum factories
	Nitrate	0.23	0.23 - 0.23	10.0	10.0	ppm	No	Runoff from fertilizer use; Leaching from septic tanks; sewage; Erosion of natural deposits
	Barium	0.022	0.022 - 0.022	2.0	2.0	ppm	No	Discharge of drilling wasters; Discharge from metal refineries; Erosion of natural deposits
Synthetic Organic	Simazine	0.38	0 - 0.38	4.0	4.0	ppb	No	Herbicide runoff
Secondary/ State Regulated	Manganese	2.4	2.4-2.4	150.0	150.0	ppb	No	Erosion of naturally occuring deposits
	Chloride	8.4	8.0-8.0	250	250	ppm	No	Erosion of naturally occuring deposits; used in water softener regeneration
	Sodium	17	17-17	N/A	N/A	ppm	No	Erosion of naturally occuring deposits; used in water softener regeneration
	Sulfate	26	26-26	250	250	ppm	No	Erosion of naturally occuring deposits / Water treatment

Turbidity	Limit (Treatment Technique)	Level Detected	Violation	Typical Source
Highest Single Measurement	1.0 NTU	2.47 NTU	Yes	Soil Run-Off
Lowest monthly % meeting limit	0.3 NTU	98%	No	

Source: City of Carbondale

8.4.2 Village of Cobden Water Quality Report

The source of drinking water used by Cobden is ground water. In the Annual Drinking Water Quality Report, Cobden lists three wells as their ground water source. The water quality report includes the parameters from the previous municipal water quality reports identified as regulated contaminants. In addition, inorganic contaminants were also reported. This category includes substances such as: barium, fluoride, manganese, nitrate (measured as nitrogen), sodium, and zinc. Radioactive contaminants reported include combined radium and gross alpha (excluding radon and uranium). The contaminants in all categories are within the regulated range designated by the EPA; therefore, no violations have occurred. Results are displayed in Table 8.20.

Table 8.19- Village of Cobden Water Quality Report

Contaminant		Highest Level Detected	Range of Levels Detected	MCLG	MCL	Units	Violation	Likely Source of Contamination
Disinfectants & Disinfection By-Products	Total Trihalomethanes	5.0	5.0-5.0	N/A	80	ppb	No	By-product of drinking water disinfection
	Haloacetic Acids	1.0	1.07-1.07	N/A	60	ppb	No	By-product of drinking water disinfection
	Chlorine	1.4	0.55-1.73	MRDLG - 4	MRDL - 4	ppm	No	Water additive used to control microbes
Inorganic	Barium	0.038	0.038-0.038	2	2	ppm	No	Discharges of drilling wastes; Discharges from metal refineries; Erosion of natural deposits
	Fluoride	0.937	0.937-0.937	4	4	ppm	No	Erosion of natural deposits; water additive which promotes strong teeth; Discharge from fertilizer and aluminum
	Manganese	1	1.0-1.0	150	150	ppb	No	This contaminant is not currently regulated by the USEPA. However, the state regulated. Erosion of natural deposits.
	Nitrate (measured as Nitrogen)	1	1.0-1.0	10	10	ppm	No	Runoff from fertilizer use; Leaching from septic tanks, sewage; Erosion of natural deposits
	Sodium	17	17-17	-	-	ppm	No	Erosion from naturally occuring deposits. Used in water softener regeneration
	Zinc	0.018	0.018-0.018	5	5	ppm	No	This contaminant is not currently regulated by the USEPA. However, the state regulates. Naturally occurring; discharge from metal
Radioactive	Combined Radium	1.45	1.45-1.45	0	5	pCi/L	No	Erosion of natural deposits.
	Gross alpha excluding radon and uranium	1.27	1.27-1.27	0	15	pCi/L	No	Erosion of natural deposits.

Source: Village of Cobden

8.4.3 Cedar Lake Water Quality Report

Cedar Lake is the primary source of drinking water for the city of Carbondale. Water samples from Cedar Lake are collected and tested at three different locations every month. The most recent report at the time of this review was January 22, 2020. Water quality reports are posted on a monthly basis, with no annual water quality review. The most up to date water quality test results can be found at explorecarbondale.com. Results from January's water quality test can be found below.

Table 8.20- Cedar Lake January 2020 Water Quality Report

Sample #	pH	Ammonia, mg/L	Turbidity, NTU	Alkalinity, mg/L	D.Oxygen	Nitrite (NO2-N) IC SM 4110B"m:LOQ 0.15 mg/L	Nitrite (NO3-N) IC SM 4110B"m:LOQ 0.11 mg/L	Total Kjeldahl Kjeldahl Nitrogen, mg/L	Total Nitrogen-N, mg/L	Total Phosphorus, mg/L	
122019005	7.74	<.1	5.7	42	10.4	<0.15	0.42	3.4	4.4	0.04	
122019006	7.69	<.1		40	10.6	<0.15	0.47	1.6	2.6	0.04	
122019007	7.63	<.1	10.4	40	10.8	<0.15	0.49	2.8	4	0.11	
Sample #	**Total Suspended Solids mg/L**	**Volatile Total Suspended Solids, mg/L**	**Volatile Total suspended solids, %**	**E Coli*, col/100-mL**	**Fecal Colform*, col/100-mL**	**Sample Collector**	**Weather**	**Lake Elevation, ft**	**Rainfall within 48 hours, in.**	**Depth of sample**	**Field Temp, oF**
12220026	5	3	60%	8	4	Eric Stead	Overcast, cloudy	433	0	1 foot	40.7
12220027	8	8	100%	10	10	Eric Stead	Overcast, cloudy		0	1 foot	
12220028	9	7	78%	10	10	Eric Stead	Overcast, cloudy		0	15 foot	

Sample #	Sample Description	Sample Location GPS Coordinates	Date/time collected	Date/time received	composite	Grab	Date/Time Processed	Sample condition
12220026	NW Cedar Lake	37 o40'31.31N by 89 o17'11.97W	1/22/2020 1127	1/22/2020 1250		X	1/22/2020 1300	ACCEPTABLE
12220027	NE Cedar Lake	37 o40'6.52N by 89 o16'15.94W	1/22/2020 1135	1/22/2020 1250		X	1/22/2020 1300	ACCEPTABLE
12220028	Intake	37 o39'43.43N by 89 o16'28.91W	1/22/2020 0802	1/22/2020 1250		X	1/22/2020 1300	ACCEPTABLE

Source: City of Carbondale

8.5 Harmful Algal Blooms

In the past year (2019), both the Carbondale Reservoir and Campus Lake experienced microcystin levels above the recommended value set by the EPA to protect public health. A news release from EPA on May 22nd, 2019 states, "Based on the latest scientific information, EPA has established recommended water concentrations, at or below which protects public health, for the cyanotoxins microcystins (8 micrograms per liter) and cylindrospermopsin (15 micrograms per liter). EPA's recommendations are protective of all age groups and are based on peer-reviewed and published science"[49].

The Illinois Department of Public Health describes microcystin as," the most well-known toxin produced during a harmful algal bloom, and it can cause a variety of symptoms by affecting the skin, liver, GI tract, and nervous system. Ingestion, inhalation, or direct contact with contaminated water may cause illness".[50]

Water quality data from Carbondale Reservoir and Campus Lake was provided by the Illinois EPA. The microcystin levels have been graphed for both lakes.

Campus Lake

Campus Lake has had a long history with the presence of blue-green algae in its waters. A Phase 1 Diagnostic/Feasibility Study of Campus Lake, Jackson County, Illinois; prepared by SIU-C in 2003, stated a seasonal trend of blue-green algal blooms in months July and August. [51]

Microcystin levels were measured in year 2015, 2018, and 2019. These values are recorded in Table 8.22. The highlighted columns in the table are values that are above the EPA recommended water concentration of 8 micrograms per liter. These values occurred on May 19, 2015 and September 16, 2019. Figure 8.13 shows the location of the water sampling sites on Campus Lake.

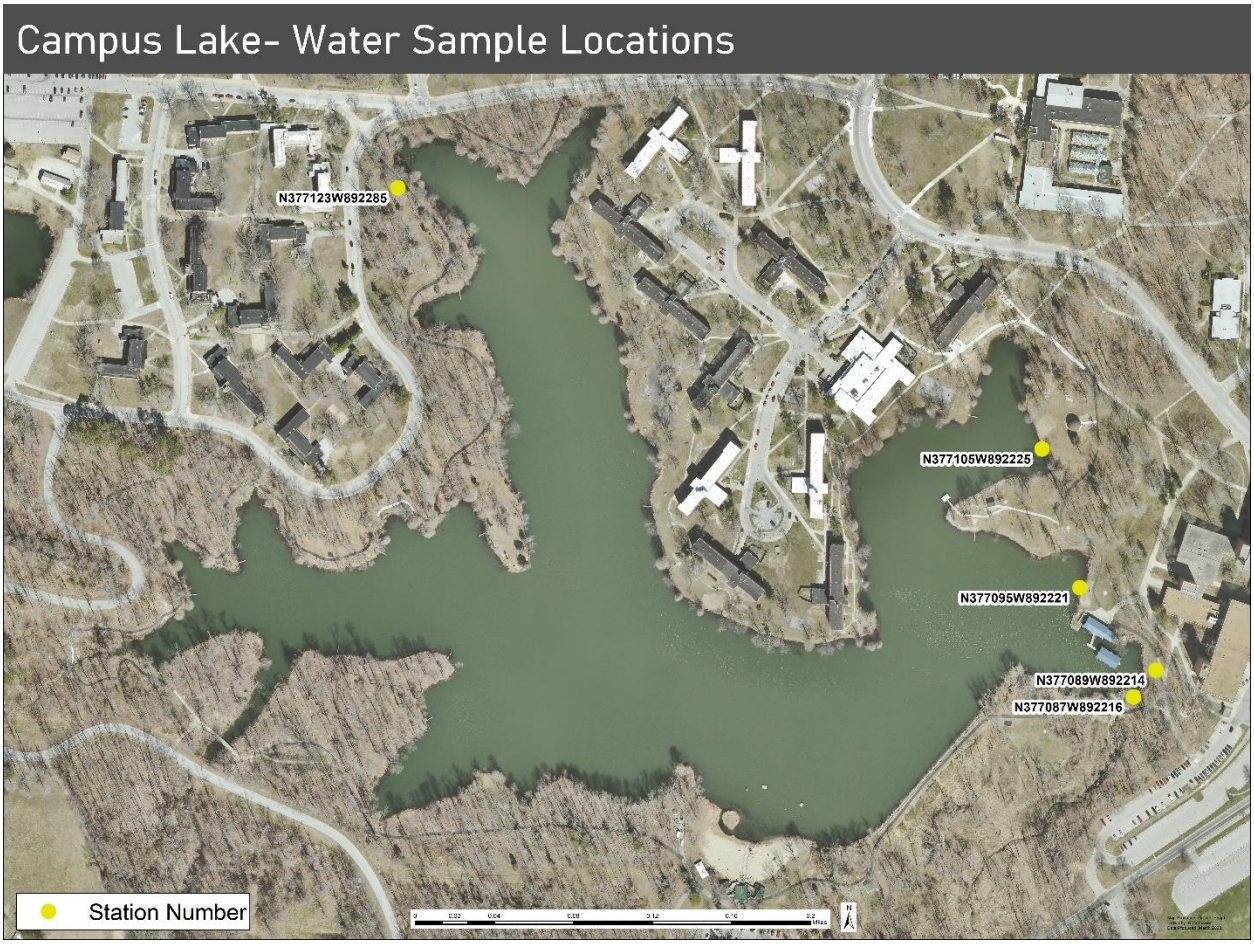
[49] "EPA Issues Recommendations for Recreational Water Quality Criteria and Swimming Advisories for Cyanotoxins." *United States Environmental Protection Agency,* 22 May 2019, https://www.epa.gov/newsreleases/ epa-issues-recommendations-recreational-water-quality-criteria-and-swimming-advisories. News release.
[50] "Harmful Algal Blooms (HABs)." Harmful Algal Blooms (HABs) | IDPH. Illinois Department of Public Health. Accessed March 11, 2020.http://www.dph.illinois.gov/topics-services/environmental-health-protection/toxicology/habs.
[51] Charles Muchmore et al.," *Diagnostic/ feasibility Study of Campus Lake, Southern Illinois University Carbondale, Jackson County, Illinois,"United States Environmental Protection Agency. (March 2004). PDF.*

Table 8.21- Campus Lake Microcystin Values

Campus Lake		
DATE	Microcystin (ug/l)	Station #
5/19/2015	9.93	N377089W892214
5/19/2015	0.65	N377123W892285
7/16/2018	2.83	N377087W892216
7/16/2018	ND	N377105W892225
9/16/2019	15.6	N377095W892221
10/3/2019	1.03	N377095W892221
11/14/2019	ND	N377087W892214

Source: IEPA **(*ND=Not Detected)**

Figure 8.13- Campus Lake Water Sample Locations



Carbondale Reservoir

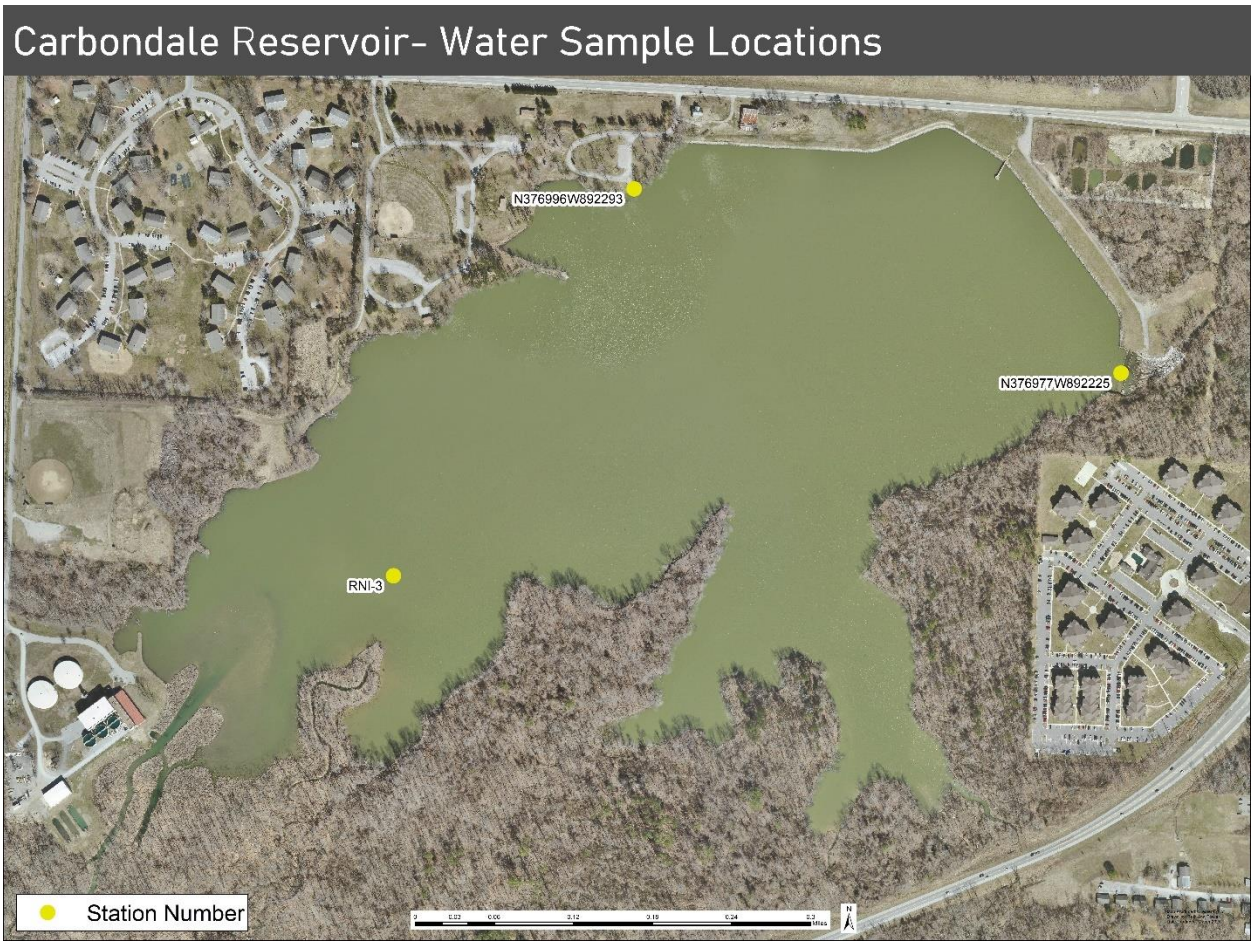
Microcystin levels were measured in Carbondale Reservoir by IEPA during the year 2018 and 2019. These values are recorded in Table 8.23. The highlighted columns in the table below are values that are above the EPA recommended water concentration of 8 micrograms per liter. The highest reported value occurred on October 21, 2019, with a value of 7,760 ug/l. Figure 8.14 shows the location of the water sampling sites on Carbondale Reservoir.

Table 8.22- Carbondale Reservoir Microcystin Values

Carbondale Reservoir		
DATE	Microcytin (ug/l)	Station #
6/21/2018	0	RNI-3
7/10/2018	0.88	N376977W892225
7/10/2018	0.64	RNI-3
8/1/2018	1.69	RNI-3
10/24/2018	2.65	RNI-3
9/17/2019	6.07	N376996W892293
10/3/2019	10.4	N376996W892293
10/21/2019	7,760	N376996W892293
10/31/2019	9.93	N376996W892293
11/14/2019	0	N376996W892293
12/3/2019	74.5	N376996W892293
12/12/2019	3.45	N376996W892293
12/18/2019	0.59	N376996W892293

Source: IEPA

Figure 8.14- Carbondale Reservoir Water Sample Locations



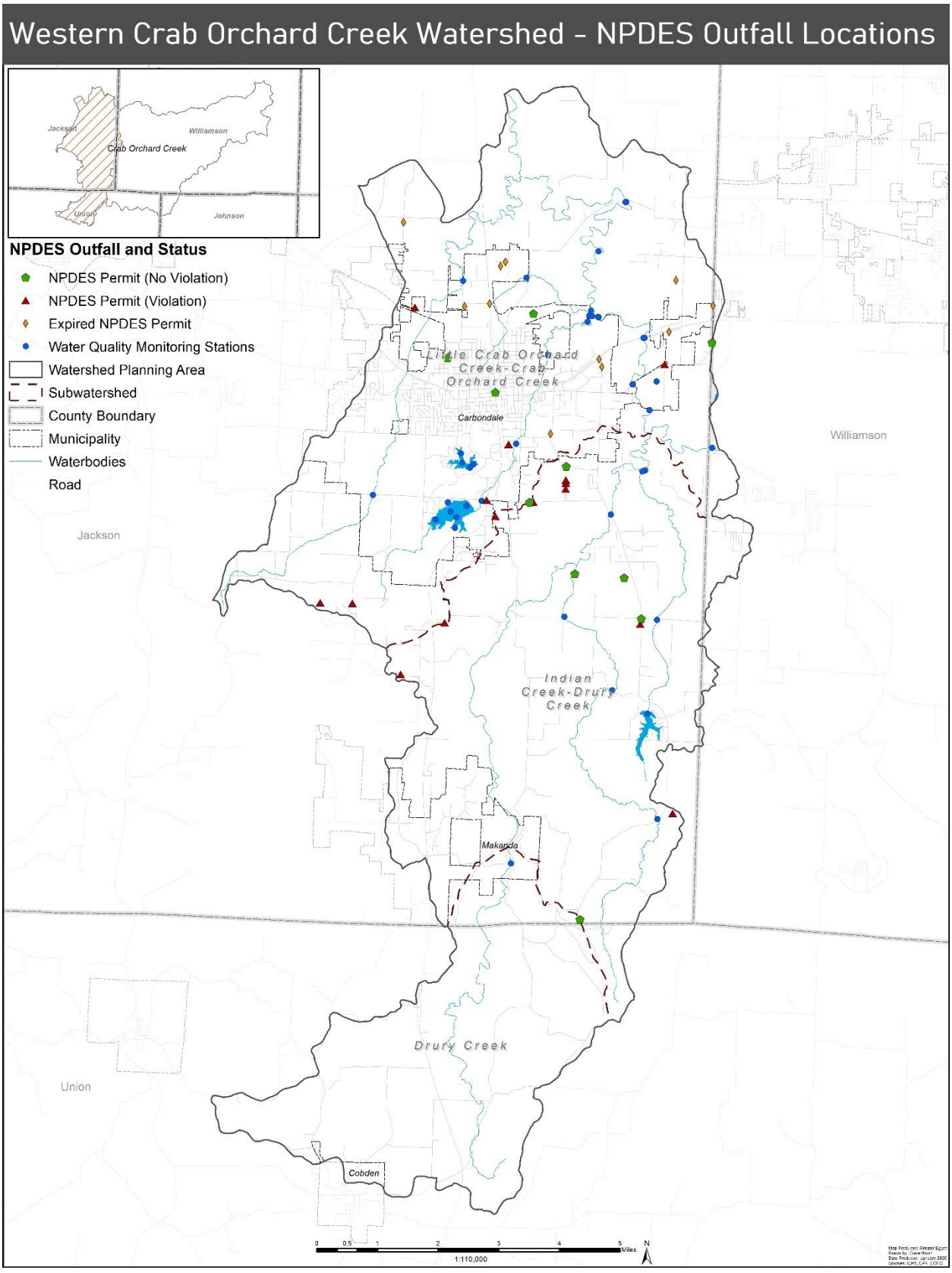
8.6 National Pollutant Discharge Elimination Systems (NPDES) Outfall Locations

The National Pollution Discharge Elimination Systems (NPDES) permit program is set in place to regulate point source pollutions that are being discharged into US waters. The Western Crab Orchard Creek watershed has a total of 36 NPDES outfall locations. Majority of these outfalls are located in Little Crab Orchard Creek subwatershed, while no outfalls are located in Drury Creek subwatershed. The NPDES outfall locations are displayed in Figure 8.15 and categorized by permit and violation status. NPDES permits are active for five years from the effective date and facilities have the option to reapply for an extention. They must do so with 180 days of the expiration date. Some permits are listed as expired and may no longer discharge into a waterway; however, these sites are still monitored for water qualtiy purposes.

Thirteen of the thirty-six outfalls in the area are in current violation status for exceeding effluents. Outfall locations are tested and recorded quarterly throughout the year. The most recent twelve quarters with pollutant violations are displayed in Table 8.24. Saluki Homes, LLC STP has the most violations in the area, with 61 total violations since the permit was issued on April 4, 2015. During the last twelve quarters, Saluki Homes, LLC STP has had violations of nitrogen, total suspended solids, and dissolved oxygen. Pleasant Valley MHP-STP follows with the second highest number of total violations; 28 since its effective date, and has recently been recorded for exceeding effluents of BOD, dissolved oxygen and total suspended solids. Southern Mobile Home Park STP has seventeen violations of total suspended solids and dissolved oxygen. Lilac Basin follows closely with 16 violations of nitrogen and total suspended solids. SIUC-Touch of Nature Environmental Center has twelve violations of nitrogen and dissolved oxygen.

Racoon Valley MHP along with Lenore Basin Corp-Union Hills both have a total of 8 violations. Racoon Valley MHP has had effluent violations of fecal coliform, while Lenore Basin has exceeded in dissolved oxygen. Both have met these exceedances during six of the recent twelve quarters. Pleasant Hill Mobile Home Park STP has had seven violations of dissolved oxygen and total suspended solids. City of Carbondale Southeast exceeded total suspended solids and Unity Point School Distict 140 STP exceeded nitrogen; both have six violations.

Figure 8.15


Western Crab Orchard Creek Watershed - NPDES Outfall Locations
Jackson
Williamson
Crab Orchard Creek
Union
Johnson
NPDES Outfall and Status
NPDES Permit (No Violation)
NPDES Permit (Violation)
Expired NPDES Permit
Water Quality Monitoring Stations
Watershed Planning Area
Subwatershed
County Boundary
Municipality
Waterbodies
Road
Little Crab Orchard Creek-Crab Orchard Creek
Carbondale
Williamson
Jackson
Indian Creek-Drury Creek
Makanda
Drury Creek
Union
Cobden
0 0.5 1 2 3 4 5 Miles
1:110,000
N

Effluent Exceedance

Cedar Lane MHP #2 STP has a total of three violations since its permit issue date in 2014. Due to an exceedance of dissolved oxygen, one of those violations has been within the last twelve quarters. Giant City School District 130 STP has had the second lowest number of violations with three violations of total suspended solids since January of 2017. Carbondale Northwest WWTP has the lowest number of violations, with only one recorded violation due to nitrogen.

The NPDES outfalls in the watershed have effluent violations of BOD, nitrogen, total suspended solids, dissolved oxygen, and fecal coliform. A pollutant key is provided below to assist with understanding the effluent violations.

Table 8.23 – Outfall Effluent Violations

Facility Name	Outfall	QTR 1 01/01-03/31/17	QTR 2 04/01-06/30/17	QTR 3 07/01-09/30/17	QTR 4 10/01-12/31/17	QTR 5 01/01-03/31/18	QTR 6 04/01-06/30/18	QTR 7 07/01-09/30/18	QTR 8 10/01-12/31/18	QTR 9 01/01-03/31/19	QTR 10 04/01-06/30/19	QTR 11 07/01-09/30/19	QTR 12 10/01-01/17/20
CARBONDALE NORTHWEST WWTP	001											N	
CEDAR LANE MHP #2 STP	001											DO	
CITY OF CARBONDALE SOUTHEAST STP	001		TSS			TSS				TSS			
GIANT CITY SCHOOL DIST 130 STP	001								N DO TSS				
LENORE BASIN CORP-UNION HILLS	001				DO	DO	DO	DO	DO				DO
LILAC BASIN CORP - UNION HILL STP	001		N TSS	N		N			N		N TSS	N TSS	N TSS
PLEASANT HILL MOBILE HOME PARK STP	001			DO				DO	DO	TSS		DO	
PLEASANT VALLEY MHP - STP	001	BOD	DO	DO BOD TSS	DO TSS	TSS	DO	DO	DO	BOD TSS	DO	DO	DO
RACCOON VALLEY MHP	001			FC			FC	FC		FC	FC	FC	
SAUKI HOMES LLC STP	001	N	N	N DO	N	N	N DO	N DO TSS	N DO TSS	N TSS	N	N	N TSS
SIUC-TOUCH OF NATURE ENVIRONMENTAL CENTER	001			DO N			N	N DO				N	N
SOUTHERN MOBILE HOME PARK STP	001	TSS	DO	DO TSS	TSS	DO		DO	DO			DO	
UNITY POINT SCHOOL DIST 140 STP	001					N			N				N

Source: EPA- ECHO

Pollutant KEY	
BOD, carbonaceous	BOD
Nitrogen	N
TSS	TSS
Dissolved Oxygen	DO
Fecal Coliform	FC

Two of the thirty-six outfalls are listed as being in current violation, but are not related to effluent pollutants. Bush MHP STP #1 is listed for Failure to Report DNR, while the SIUC Physical Plant is listed for Reportable Noncompliance. Violators of these permits may be held accountable by federal laws that provide various methods of taking enforcement actions. These actions may include monetary penalties, mandatory injunctions, and/or jail sentences. Lawful actions may be taken by the public if concerns of violations are not already being handled by the EPA or state regulatory agencies, as these documents are posted under the EPA website for public use.

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 Western Crab Orchard 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 (622 acres), barren land (12 acres), and wetlands (744 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 8.25 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 8.24-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 8.26 represents the correlation between assessed streams and assigned LRR values.

Table 8.25- 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 8.27 represents the STEPL model for the Western Crab Orchard Creek watershed-wide existing pollutant loads. The model estimations suggest urban land use accounts for nearly 25 percent of the nitrogen load for the entire planning area. Groundwater constitutes 24 percent of the nitrogen load, while pastureland makes up the remaining highest percentage at 21 percent.

The majority of the phosphorus load in the planning area originates from streambank erosion, at nearly 37 percent. Urban land use contributes the second largest amount of the nutrient load at 21 percent. Cropland and pastureland are almost identical in representing the remaining sizeable phosphorus loads at 14.95 and 14.88 percent, respectively.

Because erosion from streambanks and shorelines is a prevalent issue in the planning area, the model suggests that 75 percent of the sediment load is due to these sources. Other source contributors include cropland (11.7 percent) and pastureland (7.8 percent).

Table 8.26- Western Crab Orchard 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 (tons/yr)	Percent of Total Load
Urban	81,390.36	24.88%	12,527.90	20.79%	1,870.49	3.91%
Cropland	31,256.72	9.56%	9,009.52	14.95%	5,606.23	11.71%
Pastureland	70,201.03	21.46%	8,968.51	14.88%	3,733.30	7.80%
Forest	8,619.41	2.64%	3,998.50	6.63%	845.65	1.77%
Groundwater	78,323.21	23.94%	3,696.34	6.13%	0.00	0.00%
Streambank	57,308.84	17.52%	22,063.91	36.61%	35,818.03	74.82%
Total	**327,099.55**		**60,264.68**		**47,873.69**	

Source: EPA- STEPL

Table 8.28 breaks down the nutrient loads by HUC 12 subwatersheds. Because of its large size and various land uses, including urban development and cropland, Little Crab Orchard Creek subwatershed produces the majority of the nutrient loading in the planning area. This subwatershed accounts for nearly 56 percent of the total nitrogen load, 52 percent of the total phosphorus load, and 44 percent of the sediment load in the Western Crab Orchard Creek watershed.

Table 8.27- HUC 12 Existing Pollutant Loads

Subwatershed	SMU ID	Size (acres)	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
Drury Creek	1	11454.32	48033.13	14.68%	8857.94	14.70%	7066.57	14.76%
Indian-Drury Creek	2	20539.69	96639.38	29.54%	20245.48	33.59%	19511.20	40.76%
Little Crab Orchard Creek	3	24538.79	182427.04	55.77%	31161.25	51.71%	21295.92	44.48%
Total		**56,532.80**	**327,099.55**		**60,264.67**		**47,873.69**	

Source: EPA- STEPL

The model suggests that the Indian Creek- Drury Creek subwatershed exhibits the second highest level of nutrient loading in the planning area. This subwatershed accounts for 30 percent of the nitrogen load, 34 percent of the phosphorus load, and nearly 41 percent of the overall sediment load in the planning area.

The remaining pollutant loads in the Western Crab Orchard Creek watershed occur in the Drury Creek subwatershed. Nitrogen, phosphorus, and sediment loads account for 14.7 percent of the overall total for the planning area.

8.8 Subwatershed Pollutant Load Analysis

Subwatersheds have also been individually modeled in STEPL. This includes the three 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.

8.8.1 Drury Creek Subwatershed Existing Pollutant Loads

Table 8.29 displays the STEPL model for Drury Creek subwatershed. Pastureland represents the majority of the nitrogen load in the subwatershed at 41 percent. Streambank erosion contributes nearly 20 percent of the total nitrogen load while urban and groundwater sources account for the remaining majority at 16.75 percent each.

Table 8.28- Drury Creek Subwatershed Existing Pollutant Loads

Source	N Load (lb/yr)	Percent of Total Load	P Load (lb/yr)	Percent of Total Load	Sediment Load (tons/yr)	Percent of Total Load
Urban	8,046.82	16.75%	1,241.63	14.02%	184.80	2.62%
Cropland	130.08	0.27%	37.20	0.42%	22.92	0.32%
Pastureland	19,665.92	40.94%	2,257.60	25.49%	788.97	11.16%
Forest	2,735.93	5.70%	1,297.06	14.64%	192.69	2.73%
Groundwater	8,050.88	16.76%	404.12	4.56%	0.00	0.00%
Streambank	9,403.50	19.58%	3,620.35	40.87%	5,877.19	83.17%
Total	**48,033.13**		**8,857.95**		**7,066.57**	

Source: EPA- STEPL

Because erosion is a concern in the subwatershed, streambanks account for 41 percent of the phosphorus load and 83 percent of the sediment load. Other major land use contributors to the phosphorus load include pasture (25 percent) and forest (15 percent).

The Drury Creek subwatershed has been delineated further by its subwatershed management units. Table 8.30 represents the various SMUs and their corresponding pollutant loads.

Table 8.29- Drury Creek Subwatershed Existing Pollutant Loads by SMU

Subwatershed Management Unit	SMU ID	Size (acres)	N Load (lb/yr)	P Load (lb/yr)	Sediment Load (t/yr)
Upper Drury Creek	1	1348.55	5543.41	1284.08	1264.86
Cobden North	2	3344.13	20244.36	3325.16	2493.92
Shiloh	3	1646.71	5325.85	1019.55	827.52
Shawnee-Drury Creek	4	1117.47	2397.05	331.35	94.13
Flamm	5	1133.12	5087.12	621.83	220.28
Giant City	6	1834.83	6000.16	1214.64	914.89
Makanda-South Drury Creek	7	1029.51	3435.18	1061.34	1250.95
Total		**11,454.32**	**48,033.13**	**8,857.94**	**7,066.57**

Source: EPA- STEPL

8.8.2 Indian Creek-Drury Creek Subwatershed Existing Pollutant Loads

While this subwatershed is heavily forested, urban spaces and pasture account for a majority of the remaining land use. This is evident in the pollutant loading model displayed in Table 8.31. Sources of nitrogen in the subwatershed include: urban (20 percent), pasture (22 percent), groundwater (23 percent), and the majority coming from streambank at nearly 27 percent.

Phosphorus sources in the watershed are primarily from streambank erosion (49 percent). However, 30 percent of the load originates from urban and pastureland uses.

Table 8.30- Indian Creek-Drury Creek Subwatershed Existing Pollutant Loads

Source	N Load (lb/yr)	Percent of Total Load	P Load (lb/yr)	Percent of Total Load	Sediment Load (tons/yr)	Percent of Total Load
Urban	19,378.32	20.05%	2,981.98	14.73%	445.38	2.28%
Cropland	4,159.49	4.30%	1,310.57	6.47%	899.65	4.61%
Pastureland	20,912.93	21.64%	3,098.82	15.31%	1,542.70	7.91%
Forest	3914.26	4.05%	1,780.59	8.79%	479.72	2.46%
Groundwater	22,444.38	23.22%	1,128.97	5.58%	0.00	0.00%
Streambank	25,830.00	26.73%	9,944.55	49.12%	16,143.75	82.74%
Total	**96,639.38**		**20,245.48**		**19,511.20**	

Source: EPA- STEPL

Similar to Drury Creek subwatershed, Indian Creek- Drury Creek subwatershed's main source of sediment load is from streambanks at 83 percent. Pastureland also contributes a small portion at around eight percent. Table 8.32 displays the SMU nutrient loading for the Indian Creek- Drury Creek subwatershed.

Table 8.31-Indian Creek- Drury Creek Subwatershed Existing Pollutant Loads by SMU

Subwatershed Management Unit	SMU ID	Size (acres)	N Load (lb/yr)	P Load (lb/yr)	Sediment Load (t/yr)
Upper Indian Creek	8	2,563.94	5,116.37	1,298.72	1,262.04
Middle Drury Creek	9	2,759.19	9,391.82	2,069.16	1,960.40
Makanda-North	10	1,482.13	7,449.93	1,192.64	624.14
Upper Sycamore Creek-Spring Arbor	11	521.37	2,877.19	646.83	633.77
Middle Indian Creek	12	1,343.18	5,043.21	1,084.86	938.74
Middle Sycamore Creek	13	2,034.89	10,159.71	1,811.12	1,562.54
Lower Indian Creek	14	2,353.19	12,430.77	2,177.99	1,834.88
Boskydell-Drury Creek	15	3,986.28	15,638.47	2,791.57	1,960.88
Lower Sycamore Creek	16	1,363.05	10,277.58	2,715.98	3,463.07
Lower Drury Creek	17	2,132.47	18,254.33	4,456.62	5,270.73
Total		**20,539.69**	**96,639.38**	**20,245.48**	**19,511.20**

Source: EPA- STEPL

8.8.3 Little Crab Orchard Creek Subwatershed Existing Pollutant Loads

At 24,539 acres, the Little Crab Orchard Creek subwatershed is the largest subwatershed in the planning area and consists of multiple land uses. Because of these characteristics, pollutant load sources differ from the other two subwatersheds and exhibit the largest contribution of pollutant loads in the planning area. Existing pollutant loads are displayed in Table 8.33.

With a dense urban environment, largely attributed to the City of Carbondale, nearly 30 percent of the nitrogen load comes from this classification. Groundwater also accounts for a high proportion of nitrogen at 26 percent. The remaining sources include: pasture (16 percent), cropland (15 percent), and streambank (12 percent).

Table 8.32- Little Crab Orchard Creek Subwatershed Existing Pollutant Loads

Source	N Load (lb/yr)	Percent of Total Load	P Load (lb/yr)	Percent of Total Load	Sediment Load (tons/yr)	Percent of Total Load
Urban	53,965.21	29.58%	8,304.29	26.65%	1,240.31	5.82%
Cropland	26,967.16	14.78%	7,661.75	24.59%	4,683.65	21.99%
Pastureland	29,622.18	16.24%	3,612.08	11.59%	1,401.63	6.58%
Forest	1,969.22	1.08%	920.86	2.96%	173.24	0.81%
Groundwater	47,827.94	26.22%	2,163.25	6.94%	0.00	0.00%
Streambank	22,075.34	12.10%	8,499.00	27.27%	13,797.09	64.79%
Total	**182,427.04**		**31,161.25**		**21,295.92**	

Source: EPA- STEPL

Phosphorus sources are evenly split between streambank (27 percent), urban development (27 percent), and cropland (25 percent). With many waterbodies in the subwatershed, streambank erosion accounts for nearly 65 percent of the total sediment load. Cropland constitutes the majority of the remaining load at 22 percent.

Table 8.33-Little Crab Orchard Creek Subwatershed Existing Pollutant Loads by SMU

Subwatershed Management Unit	SMU ID	Size (acres)	N Load (lb/yr)	P Load (lb/yr)	Sediment Load (t/yr)
Upper Piles Fork Creek	18	1,415.24	4,376.29	731.05	308.34
Upper Little Crab Orchard Creek	19	3,661.83	21,374.73	2968.01	1,976.92
Carbondale Reservoir-Piles Fork Creek	20	1,232.67	13,458.63	2055.56	946.47
Campus Lake	21	346.65	3,962.88	595.44	210.92
Upper Crab Orchard Creek	22	939.718	3,565.60	874.52	888.75
Eastern Carbondale-Crab Orchard Creek	23	2,024.58	13,678.88	2395.80	1,572.83
Lower Piles Fork Creek	24	2,951.01	20,444.83	2865.83	914.36
Eek Creek	25	1,820.7	15,790.70	2615.36	1,318.44
Middle Little Crab Orchard Creek	26	2,903.56	22,706.20	3621.60	1,911.17
Reed Station	27	1,755.61	13,756.73	2410.45	1,239.56
Middle Crab Orchard Creek	28	2,443.75	24,923.00	5509.67	6,223.68
Lower Little Crab Orchard Creek	29	1,017.33	8,920.32	1739.79	1,710.36
Aviation	30	895.507	8,647.01	1428.02	654.90
Creekside	31	810.324	4,103.71	551.31	264.30
Lower Crab Orchard Creek	32	320.312	2,717.54	798.85	1,154.93
Total		**24,538.79**	**182,427.04**	**31,161.25**	**21,295.92**

Source: EPA- STEPL

Pollutant loading for the subwatersheds and SMUs have also displayed in the following figures. These include nitrogen, phosphorus, and sediment loading.

Figure 8.16

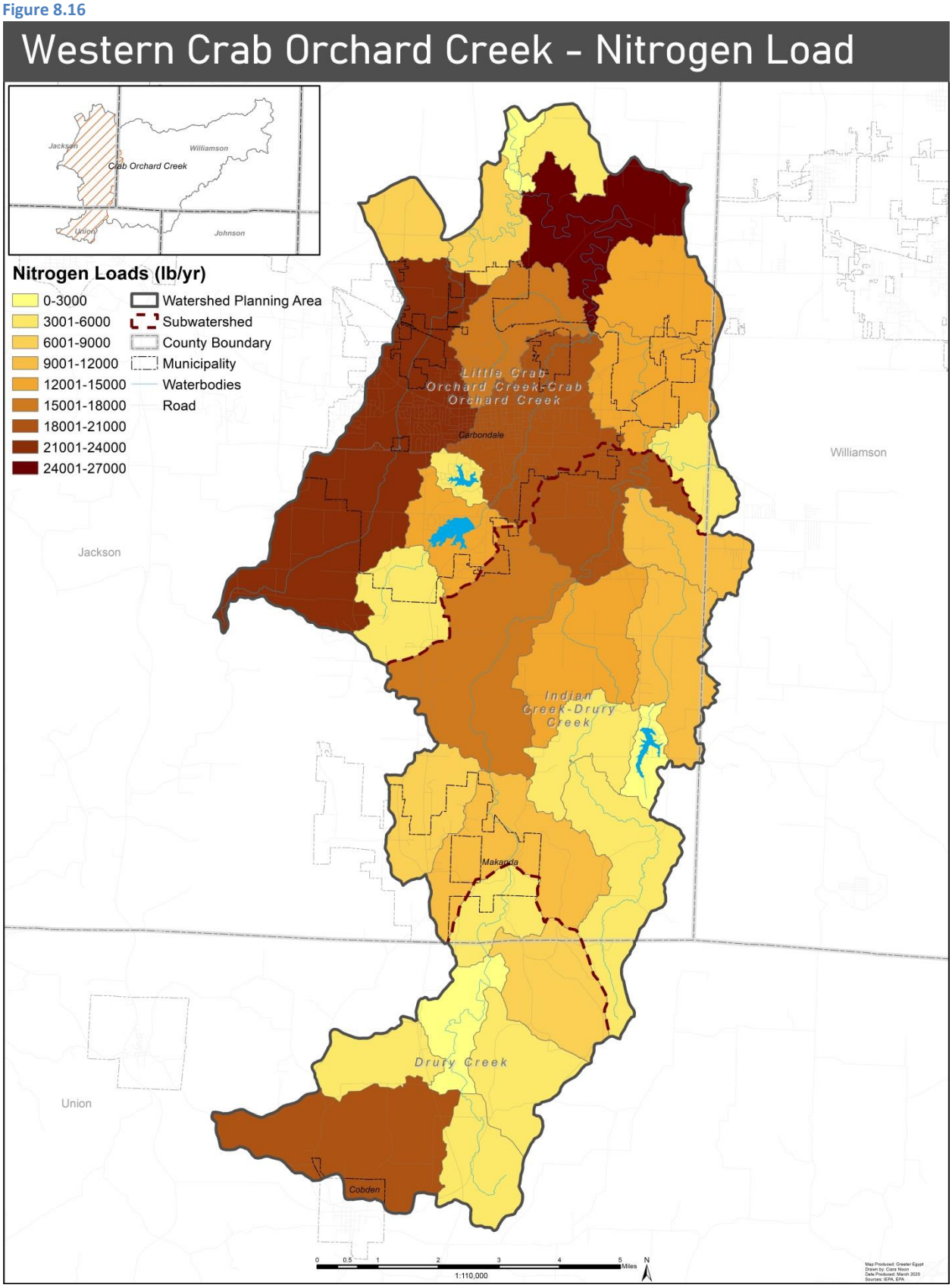

Western Crab Orchard Creek - Nitrogen Load
Jackson
Williamson
Crab Orchard Creek
Union
Johnson
Nitrogen Loads (lb/yr)
0-3000
3001-6000
6001-9000
9001-12000
12001-15000
15001-18000
18001-21000
21001-24000
24001-27000
Watershed Planning Area
Subwatershed
County Boundary
Municipality
Waterbodies
Road
Little Crab Orchard Creek-Crab Orchard Creek
Carbondale
Williamson
Jackson
Indian Creek-Drury Creek
Makanda
Drury Creek
Union
Cobden
0 0.5 1 2 3 4 5 Miles
N
1:110,000

Figure 8.17

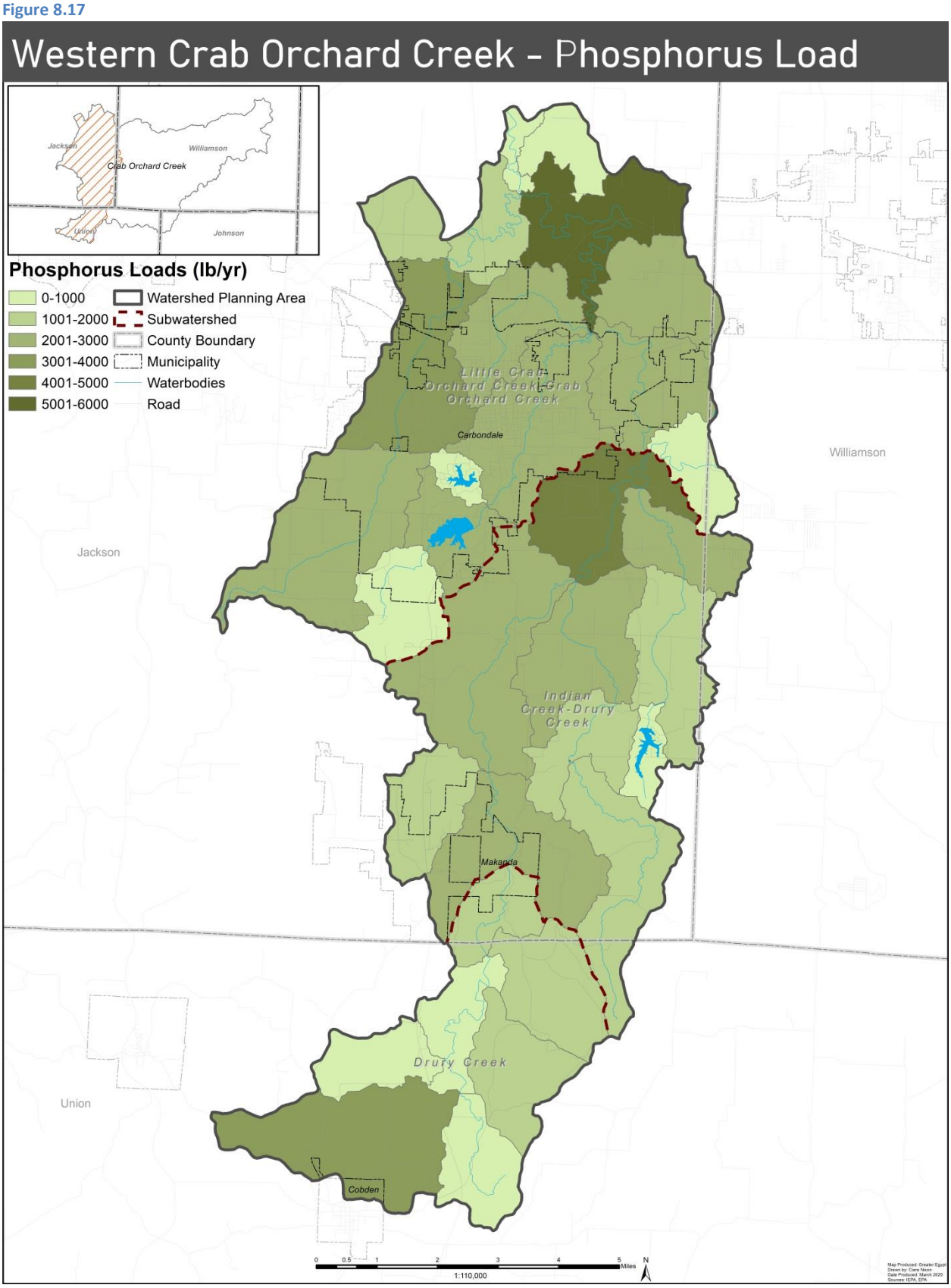
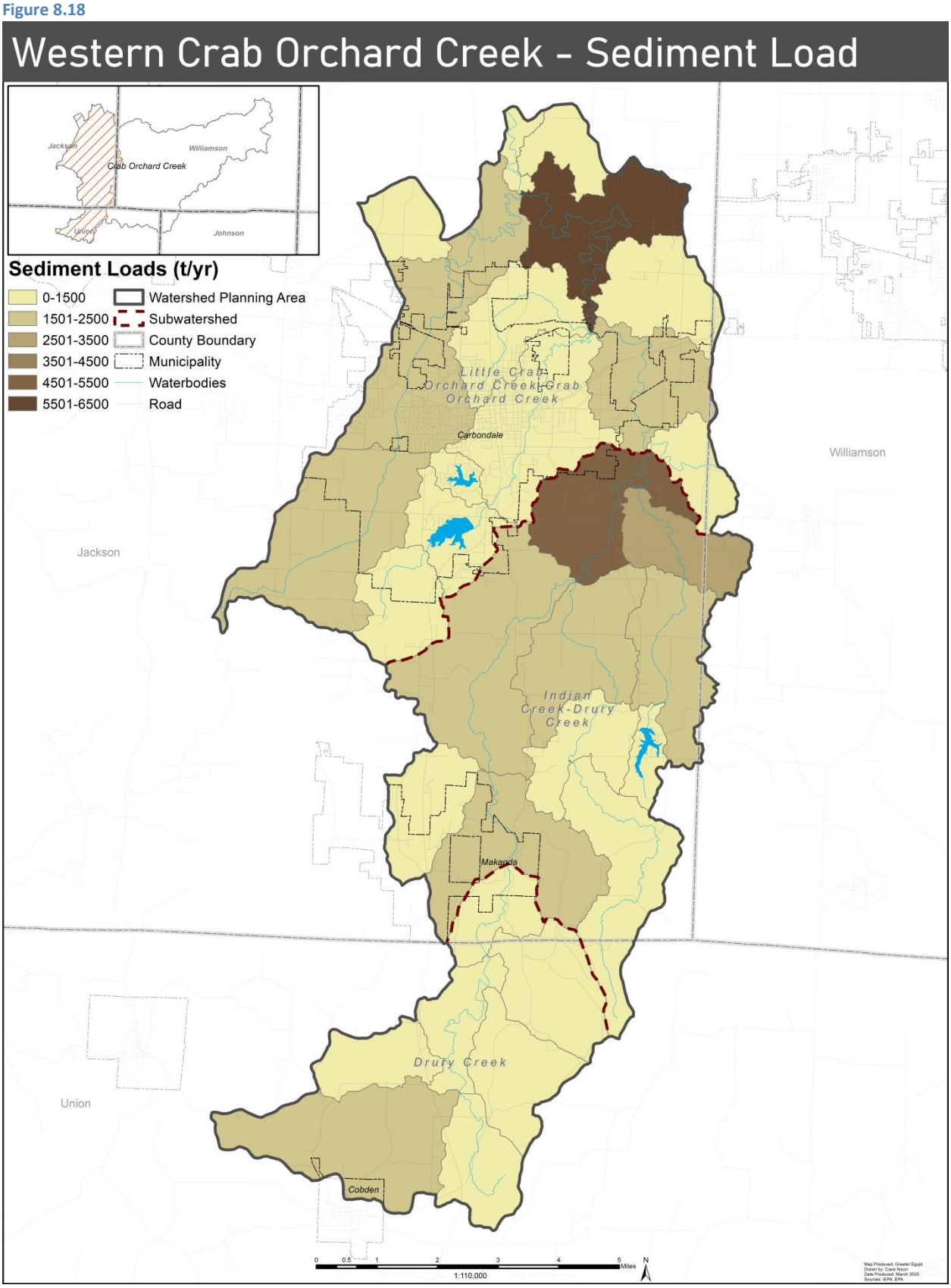

Western Crab Orchard Creek - Phosphorus Load
Jackson
Williamson
Crab Orchard Creek
Union
Johnson
Phosphorus Loads (lb/yr)
0-1000
1001-2000
2001-3000
3001-4000
4001-5000
5001-6000
Watershed Planning Area
Subwatershed
County Boundary
Municipality
Waterbodies
Road
Little Crab Orchard Creek-Crab Orchard Creek
Carbondale
Williamson
Jackson
Indian Creek-Drury Creek
Makanda
Drury Creek
Union
Cobden
0 0.5 1 2 3 4 5 Miles
N
1:110,000

Figure 8.18


Western Crab Orchard Creek – Sediment Load
Jackson
Williamson
Crab Orchard Creek
Union
Johnson
Sediment Loads (t/yr)
0-1500
1501-2500
2501-3500
3501-4500
4501-5500
5501-6500
Watershed Planning Area
Subwatershed
County Boundary
Municipality
Waterbodies
Road
Little Crab Orchard Creek-Grab Orchard Creek
Carbondale
Williamson
Jackson
Indian Creek-Drury Creek
Makanda
Drury Creek
Union
Cobden
0 0.5 1 2 3 4 5 Miles
N
1:110,000

8.9 Pollutant Load Reduction Targets

The Western Crab Orchard 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 15 percent. The reduction target for phosphorus is 25 percent. These targets are to be met by 2025, with an overall target of 45 percent for both nutrients. [52]

Pollutant load reduction targets for the Western Crab Orchard Creek watershed will conform to the targets presented in the ILNLRS. Table 8.35 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 25 percent has been assigned for the Western Crab Orchard Creek watershed. These targets are also presented in the following tables.

The summary suggests that with a 15 percent reduction in nitrogen, the planning area's total load would be reduced by 49,065 pounds annually. At a 25 percent reduction, phosphorus loads will be reduced by 15,066 pounds per year. The summary also includes an annual reduction of sediment of 11,968 tons (25 percent).

[52] 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 overall Western Crab Orchard Creek Watershed-based Plan.

Table 8.34-Western Crab Orchard Creek Watershed-Wide Pollutant Load Reduction Targets

Watershed	SMU ID	Nitrogen (percent of total)	Nitrogen Load Reduction Target (lbs)	Phosphorus (percent of total)	Phosphorus Load Reduction Target (lbs)	Sediment (percent of total)	Sediment Load Reduction Target (tons)
Western Crab Orchard Creek	**-**	**15.00%**	**49064.93**	**25.00%**	**15066.17**	**25.00%**	**11968.42**
Subwatershed Load Reduction Targets							
Drury Creek	**1**	14.68%	7204.97	14.70%	2214.49	14.76%	1766.64
Indian Creek- Drury Creek	**2**	29.54%	14495.91	33.59%	5061.37	40.76%	4877.80
Little Crab Orchard Creek	**3**	55.77%	27364.06	51.71%	7790.31	44.48%	5323.98
TOTAL			**49064.93**		**15066.17**		**11968.42**

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 8.35-Drury Creek Subwatershed Pollutant Load Reduction Targets

Watershed	SMU ID	Nitrogen (percent of total)	Nitrogen Load Reduction Target (lbs)	Phosphorus (percent of total)	Phosphorus Load Reduction Target (lbs)	Sediment (percent of total)	Sediment Load Reduction Target (tons)
Drury Creek Subwatershed	-	**15.00%**	**7204.97**	**25.00%**	**2214.49**	**25.00%**	**1766.64**
Subwatershed Management Unit Load Reduction Targets							
Upper Drury Creek	**1**	11.54%	831.51	14.50%	321.02	17.90%	316.22
Cobden North	**2**	42.15%	3036.65	37.54%	831.29	35.29%	623.48
Shiloh	**3**	11.09%	798.88	11.51%	254.89	11.71%	206.88
Shawnee-Drury Creek	**4**	4.99%	359.56	3.74%	82.84	1.33%	23.53
Flamm	**5**	10.59%	763.07	7.02%	155.46	3.12%	55.07
Giant City	**6**	12.49%	900.02	13.71%	303.66	12.95%	228.72
Makanda-South Drury Creek	**7**	7.15%	515.28	11.98%	265.34	17.70%	312.74
TOTAL			**7204.97**		**2214.49**		**1766.64**

Table 8.36-Indian Creek- Drury Creek Subwatershed Pollutant Load Reduction Targets

Watershed	SMU ID	Nitrogen (percent of total)	Nitrogen Load Reduction Target (lbs)	Phosphorus (percent of total)	Phosphorus Load Reduction Target (lbs)	Sediment (percent of total)	Sediment Load Reduction Target (tons)
Indian Creek- Drury Creek Subwatershed	-	**15.00%**	**14495.91**	**25.00%**	**5061.37**	**25.00%**	**4877.80**
Subwatershed Management Unit Load Reduction Targets							
Upper Indian Creek	**1**	5.29%	767.46	6.41%	324.68	6.47%	315.51
Middle Drury Creek	**2**	9.72%	1408.77	10.22%	517.29	10.05%	490.10
Mankanda-North	**3**	7.71%	1117.49	5.89%	298.16	3.20%	156.04
Upper Sycamore Creek-Spring Arbor	**4**	2.98%	431.58	3.19%	161.71	3.25%	158.44
Middle Indian Creek	**5**	5.22%	756.48	5.36%	271.21	4.81%	234.68
Middle Sycamore Creek	**6**	10.51%	1523.96	8.95%	452.78	8.01%	390.64
Lower Indian Creek	**7**	12.86%	1864.62	10.76%	544.50	9.40%	458.72
Boskydell-Drury Creek	**8**	16.18%	2345.77	13.79%	697.89	10.05%	490.22
Lower Sycamore Creek	**9**	10.63%	1541.64	13.42%	678.99	17.75%	865.77
Lower Drury Creek	**10**	18.89%	2738.15	22.01%	1114.16	27.01%	1317.68
TOTAL			**14495.91**		**5061.37**		**4877.80**

Table 8.37 Little Crab Orchard Creek Subwatershed Pollutant Load Reduction Targets

Watershed	SMU ID	Nitrogen (percent of total)	Nitrogen Load Reduction Target (lbs)	Phosphorus (percent of total)	Phosphorus Load Reduction Target (lbs)	Sediment (percent of total)	Sediment Load Reduction Target (tons)
Little Crab Orchard Creek Subwatershed	-	**15.00%**	**27364.06**	**25.00%**	**7790.31**	**25.00%**	**5323.98**
Subwatershed Management Unit Load Reduction Targets							
Upper Piles Fork Creek	**1**	2.40%	656.44	2.35%	182.76	1.45%	77.09
Upper Little Crab Orchard Creek	**2**	11.72%	3206.21	9.52%	742.00	9.28%	494.23
Carbondale Resovoir-Piles Fork Creek	**3**	7.38%	2018.79	6.60%	513.89	4.44%	236.62
Campus Lake	**4**	2.17%	594.43	1.91%	148.86	0.99%	52.73
Upper Crab Orchard Creek	**5**	1.95%	534.84	2.81%	218.63	4.17%	222.19
Eastern Carbondale-Crab Orchard Creek	**6**	7.50%	2051.83	7.69%	598.95	7.39%	393.21
Lower Piles Fork Creek	**7**	11.21%	3066.72	9.20%	716.46	4.29%	228.59
Eek Creek	**8**	8.66%	2368.60	8.39%	653.84	6.19%	329.61
Middle Little Crab Orchard Creek	**9**	12.45%	3405.93	11.62%	905.40	8.97%	477.79
Reed Station	**10**	7.54%	2063.51	7.74%	602.61	5.82%	309.89
Middle Crab Orchard Creek	**11**	13.66%	3738.45	17.68%	1377.42	29.22%	1555.92
Lower Little Crab Orchard Creek	**12**	4.89%	1338.05	5.58%	434.95	8.03%	427.59
Aviation	**13**	4.74%	1297.05	4.58%	357.00	3.08%	163.72
Creekside	**14**	2.25%	615.56	1.77%	137.83	1.24%	66.07
Lower Crab Orchard Creek	**15**	1.49%	407.63	2.56%	199.71	5.42%	288.73
TOTAL			**27364.06**		**7790.31**		**5323.98**

APPENDIX A- Soil Subset Data

Western Crab Orchard Creek- Union County							
Soil Symbol	Soil Name	Hydrologic Soil Group	Hydric Status	k-Factor Rating	Drainage Class	Acres	Percent of Watershed
79B	Menfro silt loam, 2 to 5 percent slopes	C	No	0.49	Well drained	245.9	0.40%
79C2	Menfro silt loam, 5 to 10 percent slopes, eroded	B	No	0.55	Well drained	275.6	0.50%
79C3	Menfro silt loam, 5 to 10 percent slopes, severely eroded	B	No	0.64	Well drained	98	0.20%
79D2	Menfro silt loam, 10 to 18 percent slopes, eroded	B	No	0.64	Well drained	257.7	0.50%
79D3	Menfro silt loam, 10 to 18 percent slopes, severely eroded	B	No	0.64	Well drained	226.3	0.40%
79E2	Menfro silt loam, 18 to 25 percent slopes, eroded	B	No	0.64	Well drained	40.7	0.10%
79E3	Menfro silt loam, 18 to 25 percent slopes, severely eroded	B	No	0.64	Well drained	7.6	0.00%
79F	Menfro silt loam, 25 to 35 percent slopes	B	No	0.64	Well drained	0.9	0.00%
99G	Sandstone and Limestone rock land, 35 to 90 percent slopes	-	-	-	-	32.6	0.10%
164A	Stoy silt loam, 0 to 2 percent slopes	D	No	0.55	Somewhat poorly drained	3.3	0.00%
164B	Stoy silt loam, 2 to 5 percent slopes	D	No	0.55	Somewhat poorly drained	158.2	0.30%
214B	Hosmer silt loam, 2 to 5 percent slopes	C	No	0.64	Moderately well drained	960	1.70%
214C2	Hosmer silt loam, 5 to 10 percent slopes, eroded	C	No	0.64	Moderately well drained	1,153.70	2.00%
214C3	Hosmer silt loam, 5 to 10 percent slopes, severely eroded	C	No	0.64	Moderately well drained	1,005.90	1.80%
214D2	Hosmer silt loam, 10 to 18 percent slopes, eroded	C	No	0.64	Moderately well drained	856.1	1.50%
214D3	Hosmer silt loam, 10 to 18 percent slopes, severely eroded	C	No	0.64	Moderately well drained	1,259.00	2.20%
477B	Winfield silt loam, 2 to 5 percent slopes	C	No	0.55	Moderately well drained	4.6	0.00%
477C2	Winfield silt loam, 5 to 10 percent slopes, eroded	C	No	0.55	Moderately well drained	28.3	0.10%
692D	Menfro-Wellston silt loams, 10 to 18 percent slopes	B	No	0.43	Well drained	4.8	0.00%
692D2	Menfro-Wellston silt loams, 10 to 18 percent slopes, eroded	B	No	0.64	Well drained	218.6	0.40%
692F	Menfro-Wellston silt loams, 18 to 35 percent slopes	B	No	0.64	Well drained	310.9	0.60%
801B	Orthents, silty, undulating	B	No	0.49	Well drained	15.2	0.00%

Western Crab Orchard Creek- Union County							
Soil Symbol	Soil Name	Hydrologic Soil Group	Hydric Status	k-Factor Rating	Drainage Class	Acres	Percent of Watershed
834F	Wellston-Westmore silt loams, 18 to 35 percent slopes	B	No	0.43	Well drained	970.9	1.70%
940D	Zanesville-Westmore silt loams, 10 to 18 percent slopes	C	No	0.43	Well drained	9.8	0.00%
940D2	Zanesville-Westmore silt loams, 10 to 18 percent slopes, eroded	D	No	0.43	Well drained	923.9	1.60%
977F	Wellston-Neotoma complex, 18 to 35 percent slopes	B	No	0.43	Well drained	556	1.00%
5079B2	Menfro silt loam, karst, 2 to 5 percent slopes, eroded	B	No	0.43	Well drained	13	0.00%
5079C3	Menfro silt loam, karst, 5 to 10 percent slopes, severely eroded	B	No	0.43	Well drained	26.8	0.00%
5079D3	Menfro silt loam, karst, 10 to 18 percent slopes, severely eroded	B	No	0.64	Well drained	46.2	0.10%
5079E3	Menfro silt loam, karst, 18 to 25 percent slopes, severely eroded	B	No	0.64	Well drained	12.6	0.00%
8331A	Haymond silt loam, 0 to 3 percent slopes, occasionally flooded	B	No	0.55	Well drained	303.4	0.50%
8333A	Wakeland silt loam, 0 to 2 percent slopes, occasionally flooded	B/D	No	0.55	Somewhat poorly drained	347.6	0.60%
8334A	Birds silt loam, 0 to 2 percent slopes, occasionally flooded	C/D	Yes	0.49	Poorly drained	16.4	0.00%
8427B	Burnside silt loam, 1 to 4 percent slopes, occasionally flooded	B	No	0.43	Well drained	346.9	0.60%
8475B	Elsah silt loam, 1 to 4 percent slopes, occasionally flooded	B	No	0.49	Well drained	9.8	0.00%
8787A	Banlic silt loam, 0 to 2 percent slopes, occasionally flooded	C/D	No	0.64	Somewhat poorly drained	8.2	0.00%
W	Water	-	-	-	-	111.2	0.20%
Subtotals for Soil Survey Area						**10,866.60**	**19.10%**

Western Crab Orchard Creek Watershed- Jackson County							
Soil Symbol	Soil Name	Hydrologic Soil Group	Hydric Status	k-Factor Rating	Drainage Class	Acres	Percent of Watershed
8F	Hickory silt loam, 18 to 35 percent slopes	B	No	0.43	Well drained	327.5	0.60%
8F3	Hickory clay loam, 18 to 35 percent slopes, severely eroded	B	No	0.37	Well drained	125.6	0.20%
79B2	Menfro silt loam, 2 to 5 percent slopes, eroded	B	No	0.55	Well drained	411.7	0.70%
79C2	Menfro silt loam, 5 to 10 percent slopes, eroded	B	No	0.55	Well drained	40.5	0.10%
79C3	Menfro silt loam, 5 to 10 percent slopes, severely eroded	B	No	0.64	Well drained	31	0.10%
79D	Menfro silt loam, 10 to 18 percent slopes	B	No	0.64	Well drained	35.1	0.10%
79D2	Menfro silt loam, 10 to 18 percent slopes, eroded	B	No	0.64	Well drained	60.5	0.10%
79D3	Menfro silt loam, 10 to 18 percent slopes, severely eroded	B	No	0.64	Well drained	237.7	0.40%
79E	Menfro silt loam, 18 to 25 percent slopes	B	No	0.64	Well drained	580.6	1.00%
79E3	Menfro silt loam, 18 to 25 percent slopes, severely eroded	B	No	0.64	Well drained	66.6	0.10%
84A	Okaw silt loam, 0 to 2 percent slopes	D	Yes	0.55	Poorly drained	1,212.20	2.10%
99G	Sandstone and limestone rock land, 35 to 90 percent slopes	-	-	-	-	8.6	0.00%
109A	Racoon silt loam, 0 to 2 percent slopes	C/D	Yes	0.49	Poorly drained	94.6	0.20%
122B	Colp silt loam, 2 to 5 percent slopes	C/D	No	0.55	Moderately well drained	26.2	0.00%
122B2	Colp silt loam, 2 to 5 percent slopes, eroded	C/D	No	0.43	Moderately well drained	44.9	0.10%
122C2	Colp silt loam, 5 to 10 percent slopes, eroded	C/D	No	0.43	Moderately well drained	129.8	0.20%
122D	Colp silt loam, 10 to 18 percent slopes	C/D	No	0.55	Moderately well drained	46.8	0.10%
122D3	Colp silty clay loam, 10 to 18 percent slopes, severely eroded	C/D	No	0.49	Moderately well drained	787.2	1.40%
164A	Stoy silt loam, 0 to 2 percent slopes	D	No	0.55	Somewhat poorly drained	397.9	0.70%
164B	Stoy silt loam, 2 to 5 percent slopes	D	No	0.55	Somewhat poorly drained	669.9	1.20%
165A	Weir silt loam, 0 to 2 percent slopes	D	Yes	0.64	Poorly drained	216.9	0.40%
208A	Sexton silt loam, 0 to 2 percent slopes	C/D	Yes	0.55	Poorly drained	272.8	0.50%
214B	Hosmer silt loam, 2 to 5 percent slopes	C	No	0.64	Moderately well drained	8,685.40	15.40%
214C2	Hosmer silt loam, 5 to 10 percent slopes, eroded	C/D	No	0.64	Moderately well drained	892.8	1.60%

Western Crab Orchard Creek Watershed- Jackson County							
Soil Symbol	Soil Name	Hydrologic Soil Group	Hydric Status	k-Factor Rating	Drainage Class	Acres	Percent of Watershed
214C3	Hosmer silt loam, 5 to 10 percent slopes, severely eroded	C	No	0.64	Moderately well drained	4,223.70	7.50%
214D2	Hosmer silt loam, 10 to 18 percent slopes, eroded	C/D	No	0.64	Moderately well drained	176.9	0.30%
214D3	Hosmer silt loam, 10 to 18 percent slopes, severely eroded	C	No	0.64	Moderately well drained	3,453.00	6.10%
338A	Hurst silt loam, 0 to 2 percent slopes	D	No	0.55	Somewhat poorly drained	575.3	1.00%
338B2	Hurst silt loam, 2 to 5 percent slopes, eroded	D	No	0.55	Somewhat poorly drained	540.9	1.00%
432A	Geff silt loam, 0 to 2 percent slopes	C/D	No	0.55	Somewhat poorly drained	501.3	0.90%
434A	Ridgway silt loam, 0 to 2 percent slopes	B	No	0.43	Well drained	152.2	0.30%
434B2	Ridgway silt loam, 2 to 5 percent slopes, eroded	B	No	0.43	Well drained	14.8	0.00%
434C2	Ridgway silt loam, 5 to 10 percent slopes, eroded	B	No	0.43	Well drained	15.6	0.00%
434D3	Ridgway silty clay loam, 10 to 18 percent slopes, severely eroded	B	No	0.43	Well drained	47.4	0.10%
437B	Redbud silt loam, 2 to 5 percent slopes	C	No	0.55	Moderately well drained	574.5	1.00%
533	Urban land	-	No	-	-	609.1	1.10%
692D2	Menfro-Wellston silt loams, 10 to 18 percent slopes, eroded	B	No	0.64	Well drained	37.1	0.10%
692F	Menfro-Wellston silt loams, 18 to 35 percent slopes	B	No	0.64	Well drained	2,315.90	4.10%
692G	Menfro-Wellston silt loams, 35 to 70 percent slopes	B	No	0.64	Well drained	9.7	0.00%
701D	Menfro-Hickory silt loams, 10 to 18 percent slopes	B	No	0.64	Well drained	175.6	0.30%
701D3	Menfro-Hickory complex, 10 to 18 percent slopes, severely eroded	B	No	0.64	Well drained	212.6	0.40%
701F	Hickory-Menfro silt loams, 18 to 35 percent slopes	B	No	0.49	Well drained	535.9	0.90%
701F3	Hickory-Menfro complex, 18 to 35 percent slopes, severely eroded	B	No	0.43	Well drained	106.1	0.20%
797D	Hickory-Homen silt loams, 10 to 18 percent slopes	B	No	0.55	Well drained	292.8	0.50%
797D3	Hickory-Homen silty clay loams, 10 to 18 percent slopes, severely eroded	B	No	0.43	Well drained	1,039.30	1.80%
801B	Orthents, silty, undulating	B	No	0.49	Well drained	861.2	1.50%
802F	Orthents, loamy, hilly and very hilly	C	No	0.49	Well drained	138.2	0.20%
908G	Kell-Hickory silt loams, 35 to 70 percent slopes	C	No	0.43	Well drained	29.8	0.10%

Western Crab Orchard Creek Watershed- Jackson County							
Soil Symbol	Soil Name	Hydrologic Soil Group	Hydric Status	k-Factor Rating	Drainage Class	Acres	Percent of Watershed
940D2	Zanesville-Westmore silt loams, 10 to 18 percent slopes, eroded	D	No	0.43	Well drained	0.1	0.00%
976G	Neotoma-Rock outcrop complex, 35 to 70 percent slopes	A	No	0.15	Well drained	386.5	0.70%
977F	Wellston-Neotoma complex, 18 to 35 percent slopes	B	No	0.43	Well drained	350	0.60%
977G	Neotoma-Wellston complex, 35 to 70 percent slopes	A	No	0.15	Well drained	448.6	0.80%
1843A	Bonnie and Petrolia soils, undrained, 0 to 2 percent slopes, frequently flooded	C/D	Yes	0.55	Poorly drained	416.2	0.70%
1845A	Darwin and Jacob silty clays, undrained, 0 to 2 percent slopes, frequently flooded	D	Yes	0.37	Very poorly drained	57.4	0.10%
3071A	Darwin silty clay, 0 to 2 percent slopes, frequently flooded	D	Yes	0.37	Poorly drained	100	0.20%
3085A	Jacob silty clay, 0 to 2 percent slopes, frequently flooded	D	Yes	0.24	Poorly drained	236.4	0.40%
3108A	Bonnie silt loam, 0 to 2 percent slopes, frequently flooded	C/D	Yes	0.55	Poorly drained	1,066.30	1.90%
3180A	Dupo silt loam, 0 to 2 percent slopes, frequently flooded	C/D	No	0.64	Somewhat poorly drained	35.9	0.10%
3331A	Haymond silt loam, 0 to 3 percent slopes, frequently flooded	B	No	0.55	Well drained	6.7	0.00%
3333A	Wakeland silt loam, 0 to 2 percent slopes, frequently flooded	B/D	No	0.55	Somewhat poorly drained	8.4	0.00%
3334A	Birds silt loam, 0 to 2 percent slopes, frequently flooded	C/D	Yes	0.55	Poorly drained	6.2	0.00%
3382A	Belknap silt loam, 0 to 2 percent slopes, frequently flooded	B/D	Yes	0.64	Somewhat poorly drained	2,161.00	3.80%
3420A	Piopolis silty clay loam, 0 to 2 percent slopes, frequently flooded	C/D	Yes	0.43	Poorly drained	229.4	0.40%
3422A	Cape silty clay, 0 to 2 percent slopes, frequently flooded	D	Yes	0.43	Poorly drained	102.6	0.20%
3457A	Booker silty clay, 0 to 2 percent slopes, frequently flooded	D	Yes	0.24	Poorly drained	27.3	0.00%
3787A	Banlic silt loam, 0 to 2 percent slopes, frequently flooded	C/D	No	0.64	Somewhat poorly drained	834.8	1.50%
7084A	Okaw silt loam, 0 to 2 percent slopes, rarely flooded	D	Yes	0.55	Poorly drained	354.8	0.60%
7109A	Racoon silt loam, 0 to 2 percent slopes, rarely flooded	C/D	Yes	0.49	Poorly drained	30.9	0.10%
7122B	Colp silt loam, 2 to 5 percent slopes, rarely flooded	C/D	No	0.55	Moderately well drained	10.5	0.00%
7122B2	Colp silt loam, 2 to 5 percent slopes, eroded, rarely flooded	C/D	No	0.43	Moderately well drained	19.5	0.00%
7122C2	Colp silt loam, 5 to 10 percent slopes, eroded, rarely flooded	C/D	No	0.43	Moderately well drained	13.3	0.00%

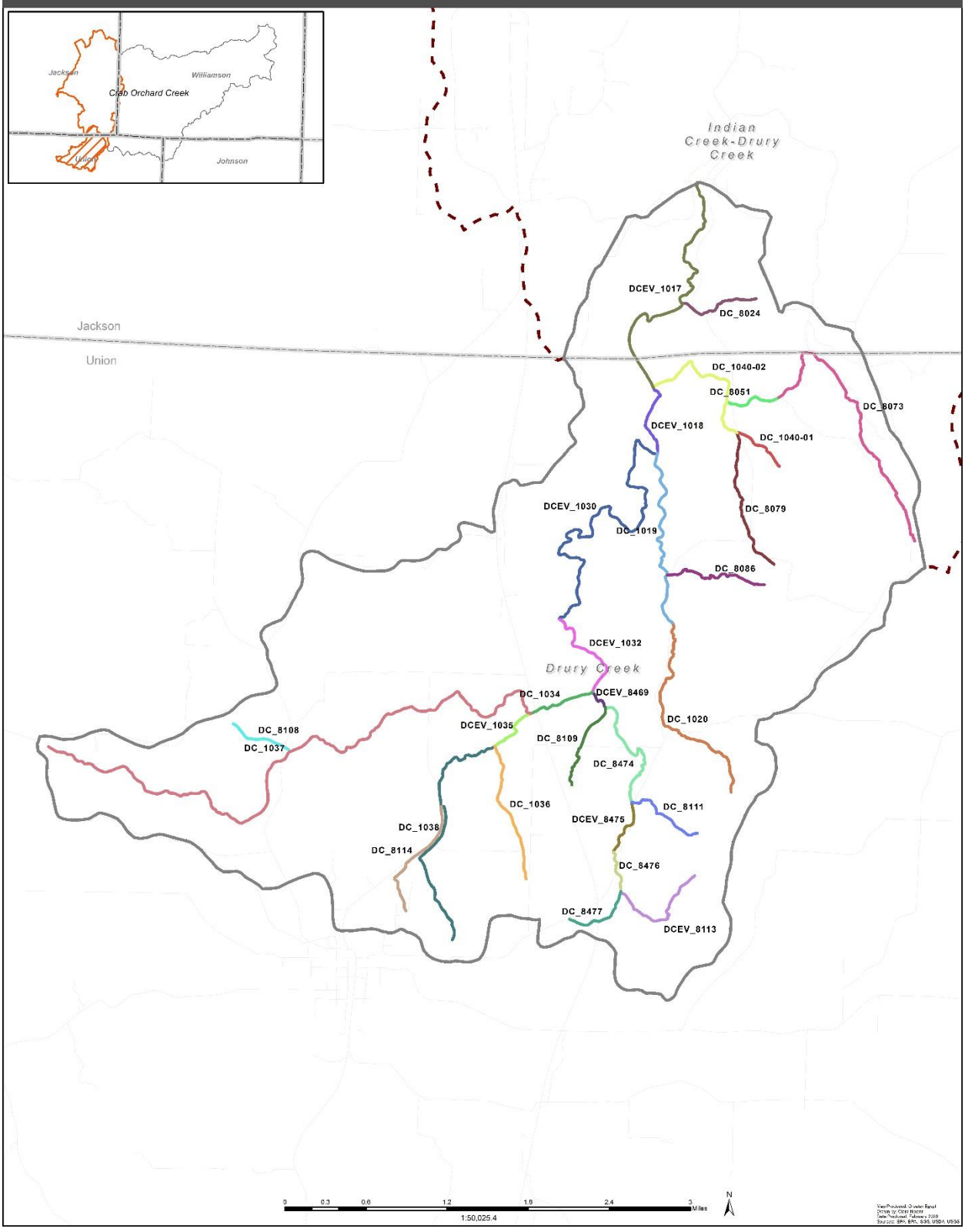
Western Crab Orchard Creek Watershed- Jackson County							
Soil Symbol	Soil Name	Hydrologic Soil Group	Hydric Status	k-Factor Rating	Drainage Class	Acres	Percent of Watershed
7122D	Colp silt loam, 10 to 18 percent slopes, rarely flooded	C/D	No	0.55	Moderately well drained	58.8	0.10%
7122D3	Colp silty clay loam, 10 to 18 percent slopes, severely eroded, rarely flooded	C/D	No	0.49	Moderately well drained	240	0.40%
7208A	Sexton silt loam, 0 to 2 percent slopes, rarely flooded	C/D	Yes	0.55	Poorly drained	7.5	0.00%
7338A	Hurst silt loam, 0 to 2 percent slopes, rarely flooded	D	No	0.55	Somewhat poorly drained	19.1	0.00%
7338B2	Hurst silt loam, 2 to 5 percent slopes, eroded, rarely flooded	D	No	0.55	Somewhat poorly drained	329.4	0.60%
7437B	Redbud silt loam, 2 to 5 percent slopes, rarely flooded	C	No	0.55	Moderately well drained	3.6	0.00%
8108A	Bonnie silt loam, 0 to 2 percent slopes, occasionally flooded	C/D	Yes	0.55	Poorly drained	1,554.80	2.80%
8331A	Haymond silt loam, 0 to 3 percent slopes, occasionally flooded	B	No	0.55	Well drained	284.4	0.50%
8333A	Wakeland silt loam, 0 to 2 percent slopes, occasionally flooded	B/D	No	0.55	Somewhat poorly drained	510.9	0.90%
8334A	Birds silt loam, 0 to 2 percent slopes, occasionally flooded	C/D	Yes	0.49	Poorly drained	125.2	0.20%
8382A	Belknap silt loam, 0 to 2 percent slopes, occasionally flooded	C	No	0.64	Somewhat poorly drained	1,366.60	2.40%
8420A	Piopolis silty clay loam, 0 to 2 percent slopes, occasionally flooded	C/D	Yes	0.43	Poorly drained	12.9	0.00%
8427B	Burnside silt loam, 1 to 4 percent slopes, occasionally flooded	B	No	0.43	Well drained	312.1	0.60%
8787A	Banlic silt loam, 0 to 2 percent slopes, occasionally flooded	C/D	No	0.64	Somewhat poorly drained	53.4	0.10%
M-W	Miscellaneous water	-	-	-	-	15.6	0.00%
W	Water	-	-	-	-	845.7	1.50%
Subtotals for Soil Survey Area						**44,684.50**	**78.90%**

Western Crab Orchard Creek Watershed- Williamson County							
Soil Symbol	Soil Name	Hydrologic Soil Group	Hydric Status	k-Factor Rating	Drainage Class	Acres	Percent of Watershed
8F	Hickory silt loam, 18 to 35 percent slopes	B	No	0.43	Well drained	24.1	0.00%
164A	Stoy silt loam, 0 to 2 percent slopes	D	No	0.55	Somewhat poorly drained	1.8	0.00%
164B	Stoy silt loam, 2 to 5 percent slopes	D	No	0.55	Somewhat poorly drained	14.3	0.00%
164B2	Stoy silt loam, 2 to 5 percent slopes, eroded	D	No	0.55	Somewhat poorly drained	6.2	0.00%
165A	Weir silt loam, 0 to 2 percent slopes	D	Yes	0.64	Poorly drained	5.4	0.00%
214B	Hosmer silt loam, 2 to 5 percent slopes	C	No	0.64	Moderately well drained	193.4	0.30%
214C2	Hosmer silt loam, 5 to 10 percent slopes, eroded	C/D	No	0.64	Moderately well drained	54.5	0.10%
214C3	Hosmer silt loam, 5 to 10 percent slopes, severely eroded	C	No	0.64	Moderately well drained	203	0.40%
214D3	Hosmer silt loam, 10 to 18 percent slopes, severely eroded	C	No	0.64	Moderately well drained	21.5	0.00%
701F	Hickory-Menfro silt loams, 18 to 35 percent slopes	B	No	0.49	Well drained	36.6	0.10%
754D	Fairpoint gravelly silt loam, 7 to 20 percent slopes	C	No	0.28	Well drained	45.7	0.10%
797D	Hickory-Homen silt loams, 10 to 18 percent slopes	B	No	0.55	Well drained	2.2	0.00%
797D3	Hickory-Homen silty clay loams, 10 to 18 percent slopes, severely eroded	B	No	0.43	Well drained	32.6	0.10%
802F	Orthents, loamy, hilly and very hilly	C	No	0.49	Well drained	14.3	0.00%
908D2	Hickory-Kell silt loams, 10 to 18 percent slopes, eroded	B	No	0.37	Well drained	101.2	0.20%
908F	Hickory-Kell silt loams, 18 to 35 percent slopes	B	No	0.55	Well drained	141.2	0.20%
3382A	Belknap silt loam, 0 to 2 percent slopes, frequently flooded	B/D	No	0.64	Somewhat poorly drained	9.6	0.00%
3787A	Banlic silt loam, 0 to 2 percent slopes, frequently	C/D	No	0.64	Somewhat poorly drained	24.6	0.00%
8382A	Belknap silt loam, 0 to 2 percent slopes, occasionally flooded	C	No	0.64	Somewhat poorly drained	30.5	0.10%
W	Water	-	-	-	-	10.7	0.00%
Subtotals for Soil Survey Area						**973.4**	**1.60%**
Totals for Area of Interest						**56,525.10**	**100.00%**

APPENDIX B- Assessed Stream Reach Information

Drury Creek Subwatershed- Assessed Stream Reach Information					
Reach Code	Stream Name	Subwatershed Management Unit	STEPL ID	IEPA ID	Stream Length (ft.)
7140106001019		Shiloh	DC_1019		7941.15
7140106001020		Shiloh	DC_1020		8942.99
7140106001034		Cobden-North	DC_1034		2647.97
7140106001036		Cobden-North	DC_1036		5649.85
7140106001037		Cobden-North	DC_1037		25659.1
7140106001038		Cobden-North	DC_1038		10185
7140106001040		Giant City	DC_1040-01		2251.76
7140106001040		Giant City	DC_1040-02		6155.92
7140106008024		Makanda-South Drury Creek	DC_8024		3325.76
7140106008051		Giant City	DC_8051		2275.57
7140106008073		Giant City	DC_8073		11670.3
7140106008079		Giant City	DC_8079		5909.99
7140106008086		Shiloh	DC_8086		4443.7
7140106008108		Cobden-North	DC_8108		2614.58
7140106008109		Upper Drury Creek	DC_8109		3662.84
7140106008111		Upper Drury Creek	DC_8111		3322.79
7140106008114		Cobden-North	DC_8114		5015.49
7140106008474	Drury Creek	Upper Drury Creek	DC_8474	IL_NDC-01	5457.82
7140106008476	Drury Creek	Upper Drury Creek	DC_8476	IL_NDC-01	1752.82
7140106008477		Upper Drury Creek	DC_8477		2834
7140106001017	Drury Creek	Makanda-South Drury Creek	DCEV_1017	IL_NDC-01	11421.9
7140106001018	Drury Creek	Shawnee Drury Creek	DCEV_1018	IL_NDC-01	3009.95
7140106001030	Drury Creek	Shawnee Drury Creek	DCEV_1030	IL_NDC-01	15204.7
7140106001032	Drury Creek	Shawnee Drury Creek	DCEV_1032	IL_NDC-01	4243.3
7140106001035		Cobden-North	DCEV_1035		2121.39
7140106008113	Drury Creek	Upper Drury Creek	DCEV_8113	IL_NDC-01	4600.41
7140106008469	Drury Creek	Upper Drury Creek	DCEV_8469	IL_NDC-01	905.118
7140106008475	Drury Creek	Upper Drury Creek	DCEV_8475	IL_NDC-01	2333.39

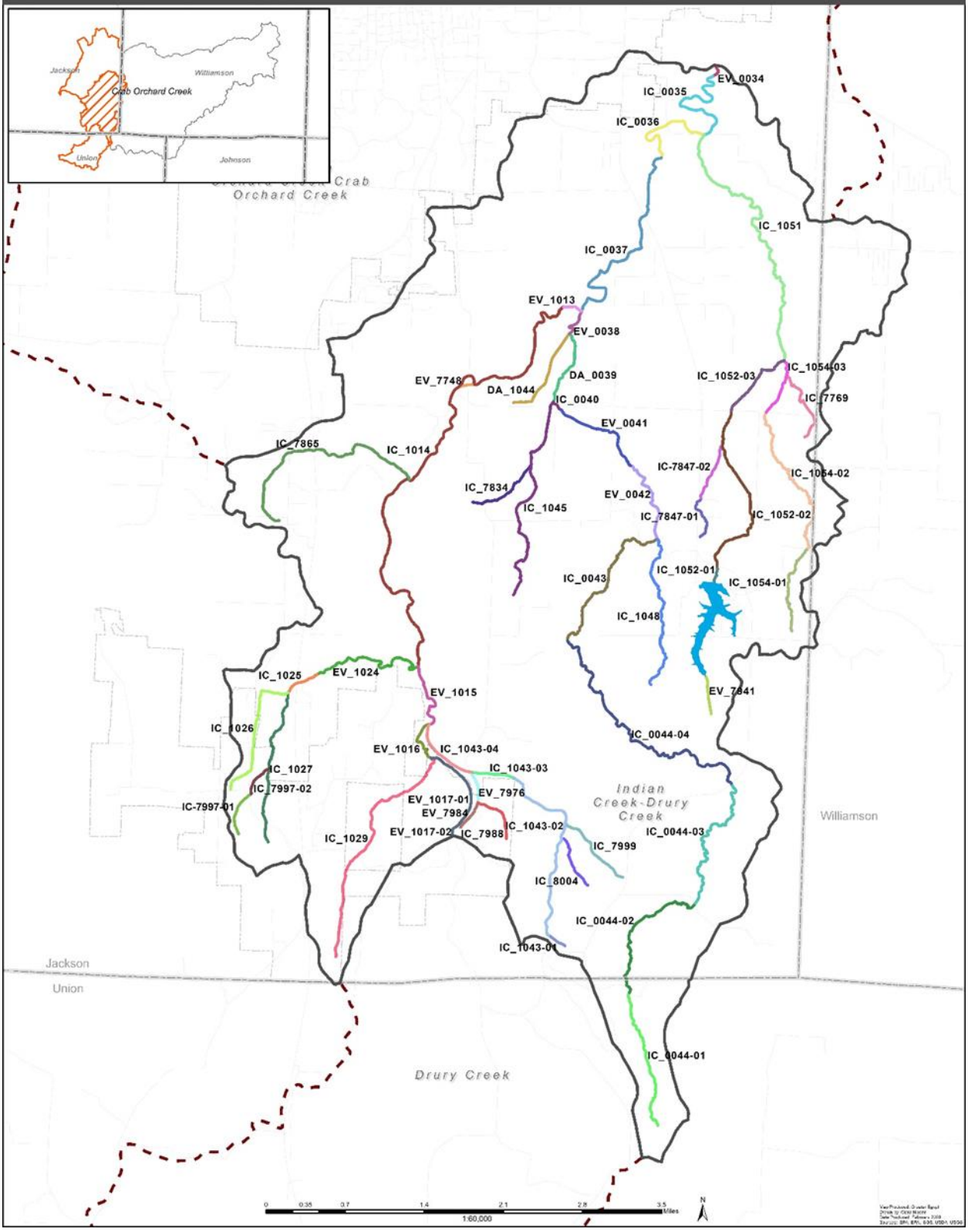
Drury Creek Subwatershed – Assessment STEPL ID



Indian Creek- Drury Creek Subwatershed- Assessed Stream Reach Information					
Reach Code	Stream Name	Subwatershed Management Unit	STEPL ID	IEPA ID	Stream Length (ft.)
7140106000034	Drury Creek	Lower Drury Creek	EV_0034		673.292
7140106000035	Drury Creek	Lower Drury Creek	IC_0035		6825.71
7140106000036	Drury Creek	Lower Drury Creek	IC_0036	IL_NDC-01	5177.35
7140106000037	Drury Creek	Lower Drury Creek	IC_0037	IL_NDC-01	11091.8
7140106000038	Indian Creek	Lower Indian Creek	EV_0038	IL_NDCB-01	1550.04
7140106000039	Indian Creek	Lower Indian Creek	DA_0039	IL_NDCB-01	3711.12
7140106000040	Indian Creek	Lower Indian Creek	IC_0040	IL_NDCB-01	403.187
7140106000041	Indian Creek	Lower Indian Creek	EV_0041	IL_NDCB-01	4881.48
7140106000042	Indian Creek	Lower Indian Creek	EV_0042	IL_NDCB-01	4533.61
7140106000043	Indian Creek	Middle Indian Creek	IC_0043	IL_NDCB-01	7988.86
7140106000044	Indian Creek	Upper Idian Creek	IC_0044-01	IL_NDCB-01	6946.11
7140106000044	Indian Creek	Upper Idian Creek	IC_0044-02	IL_NDCB-01	7255.38
7140106000044	Indian Creek	Upper Idian Creek	IC_0044-03	IL_NDCB-01	8278.33
7140106000044	Indian Creek	Upper Idian Creek	IC_0044-04	IL_NDCB-01	13623
7140106001013	Drury Creek	Boskeydale- Drury Creek	EV_1013	IL_NDC-01	922.405
7140106001014	Drury Creek	Boskeydale- Drury Creek	IC_1014	IL_NDC-01	25431.3
7140106001015	Drury Creek	Middle Drury Creek	EV_1015	IL_NDC-01	3562.55
7140106001016	Drury Creek	Middle Drury Creek	EV_1016	IL_NDC-01	2337.37
7140106001017	Drury Creek	Middle Drury Creek	EV_1017-01	IL_NDC-01	4959.78
7140106001017	Drury Creek	Middle Drury Creek	EV_1017-02	IL_NDC-01	46.7841
7140106001024		Makanda-North	EV_1024		6552.98
7140106001025		Makanda-North	IC_1025		1686.86
7140106001026		Makanda-North	IC_1026		6463.3
7140106001027		Makanda-North	IC_1027		7626.95
7140106001029		Middle Drury Creek	IC_1029		11794.9
7140106001043		Middle Drury Creek	IC_1043-01		932.727
7140106001043		Middle Drury Creek	IC_1043-02		9442.9
7140106001043		Middle Drury Creek	IC_1043-03		1910.24
7140106001043		Middle Drury Creek	IC_1043-04		3371.69
7140106001044		Lower Indian Creek	DA_1044		4580.59
7140106001045		Lower Indian Creek	IC_1045		10947.5
7140106001048		Middle Indian Creek	IC_1048		8019.44
7140106001051	Sycamore Creek	Lower Sycamore Creek	IC_1051	IL_NDCA	14593.3
7140106001052	Sycamore Creek	Upper Sycamore Creek	IC_1052-01	IL_NDCA	821.104
7140106001052	Sycamore Creek	Middle Sycamore Creek	IC_1052-02	IL_NDCA	8930.28
7140106001052	Sycamore Creek	Middle Sycamore Creek	IC_1052-03	IL_NDCA	3750.19
7140106001054		Middle Sycamore Creek	IC_1054-01		4532.77

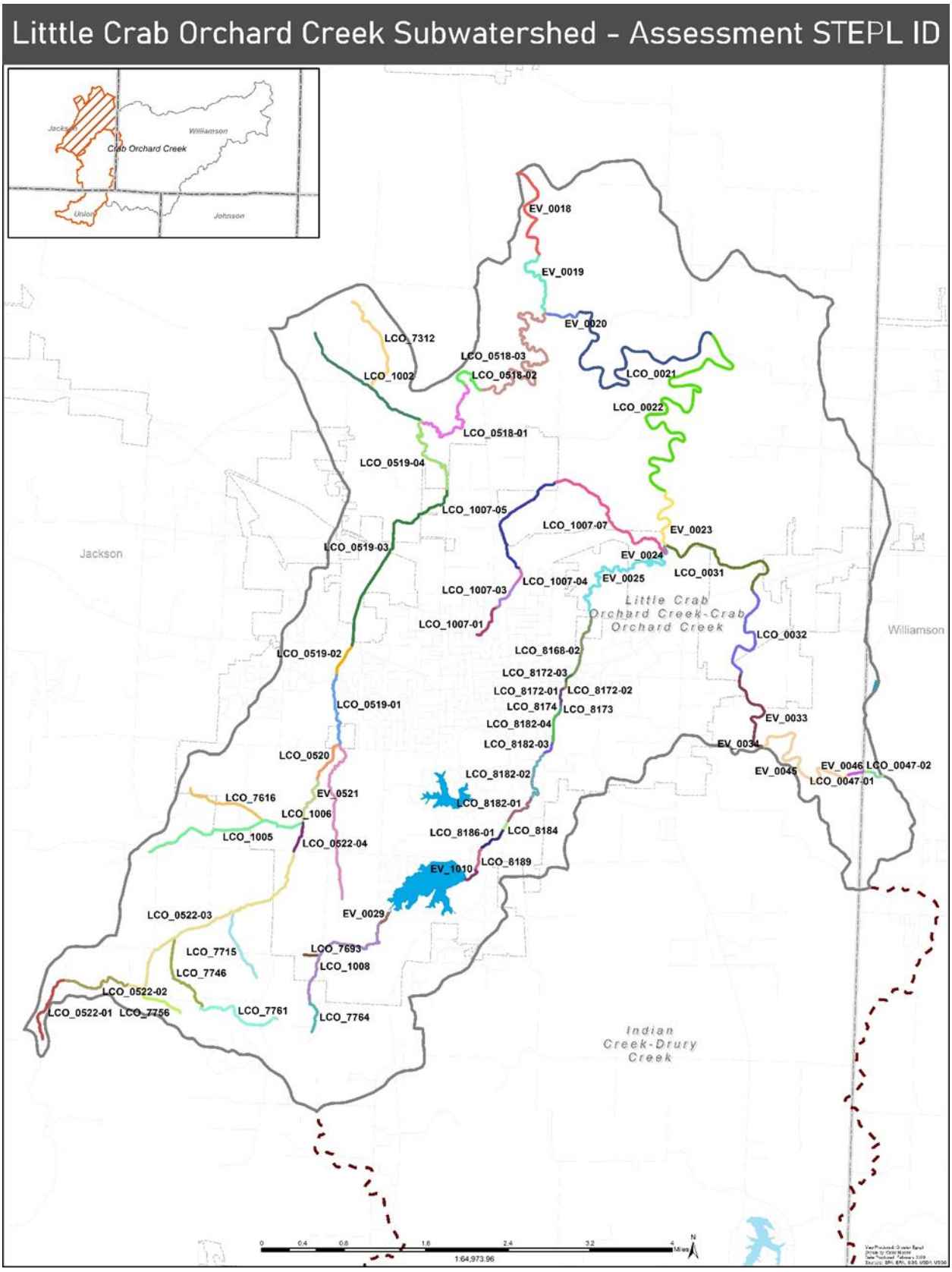
Indian Creek- Drury Creek Subwatershed- Assessed Stream Reach Information					
Reach Code	Stream Name	Subwatershed Management Unit	STEPL ID	IEPA ID	Stream Length (ft.)
7140106001054		Middle Sycamore Creek	IC_1054-02		8185.93
7140106001054		Middle Sycamore Creek	IC_1054-03		2853.76
7140106007748		Boskeydale- Drury Creek	EV_7748		821.134
7140106007769		Middle Sycamore Creek	IC_7769		3904.74
7140106007834		Lower Indian Creek	IC_7834		3629.95
7140106007847		Middle Sycamore Creek	IC_7847-01		2305.15
7140106007847		Middle Sycamore Creek	IC-7847-02		2790.5
7140106007865		Boskeydale- Drury Creek	IC_7865		10976.8
7140106007941	Sycamore Creek	Upper Sycamore Creek	EV_7941	IL_NDCA	1794.98
7140106007976		Middle Drury Creek	EV_7976		1545.92
7140106007984		Middle Drury Creek	EV_7984		1436.92
7140106007988		Middle Drury Creek	IC_7988		2492.5
7140106007997		Makanda-North	IC-7997-01		2222.37
7140106007997		Makanda-North	IC_7997-02		1568.24
7140106007999		Middle Drury Creek	IC_7999		3955.31
7140106008004		Middle Drury Creek	IC_8004		2711.82

Indian Creek Subwatershed - Assessment STEPL ID



Western Crab Orchard Creek Subwatershed- Assessed Stream Reach Information					
Reach Code	Stream Name	Subwatershed Management Unit	STEPL ID	IEPA ID	Stream Length (ft.)
7140106000029	Piles Fork	Carbondale Reservoir- Piles Fork Creek	EV_0029	IL_NDB-03	789.861
7140106000025	Piles Fork	Lower Piles Fork Creek	EV_0025	IL_NDB-03	10040.7
7140106000019	Crab Orchard Creek	Lower Crab Orchard Creek	EV_0019	IL_ND-01	4667.05
7140106001010	Piles Fork	Carbondale Reservoir- Piles Fork Creek	EV_1010	IL_NDB-03	1016.39
7140106000046	Crab Orchard Creek	Upper Crab Orchard Creek	EV_0046	IL_ND-01	1028.47
7140106000045	Crab Orchard Creek	Upper Crab Orchard Creek	EV_0045	IL_ND-01	8861.68
7140106000018	Crab Orchard Creek	Lower Crab Orchard Creek	EV_0018	IL_ND-01	5999.07
7140106000024	Piles Fork	Lower Piles Fork Creek	EV_0024	IL_NDB-03	683.855
7140106000020	Crab Orchard Creek	Middle- Crab Orchard Creek	EV_0020	IL_ND-01	2037.27
7140106000021	Crab Orchard Creek	Middle- Crab Orchard Creek	LCO_0021	IL_ND-01	16475.5
7140106000022	Crab Orchard Creek	Middle- Crab Orchard Creek	LCO_0022	IL_ND-01	21699
7140106000023	Crab Orchard Creek	Middle- Crab Orchard Creek	EV_0023	IL_ND-01	4084
7140106000031	Crab Orchard Creek	Eastern Carbondale- Crab Orchard Creek	LCO_0031	IL_ND-01	8441.8
7140106000032	Crab Orchard Creek	Eastern Carbondale- Crab Orchard Creek	LCO_0032	IL_ND-01	6354.75
7140106000033	Crab Orchard Creek	Eastern Carbondale- Crab Orchard Creek	EV_0033	IL_ND-11	5335.53
7140106000034	Drury Creek	Upper Crab Orchard Creek	EV_0034	IL_NDC-02	41.9101
7140106000047	Crab Orchard Creek	Upper Crab Orchard Creek	LCO_0047-01	IL_ND-01	878.503
7140106000047	Crab Orchard Creek	Upper Crab Orchard Creek	LCO_0047-02	IL_ND-01	185.811
7140106000518	Little Crab Orchard Creek	Lower Little Crab Orchard Creek	LCO_0518-01	IL_NDA-01	6085.78
7140106000518	Little Crab Orchard Creek	Lower Little Crab Orchard Creek	LCO_0518-02	IL_NDA-01	2769.34
7140106000518	Little Crab Orchard Creek	Lower Little Crab Orchard Creek	LCO_0518-03	IL_NDA-01	15417.7
7140106000519	Little Crab Orchard Creek	Middle Little Crab Orchard Creek	LCO_0519-01	IL_NDA-01	4058.2
7140106000519	Little Crab Orchard Creek	Middle Little Crab Orchard Creek	LCO_0519-02	IL_NDA-01	1679.4
7140106000519	Little Crab Orchard Creek	Middle Little Crab Orchard Creek	LCO_0519-03	IL_NDA-01	10748.6
7140106000519	Little Crab Orchard Creek	Middle Little Crab Orchard Creek	LCO_0519-04	IL_NDA-01	5268.52
7140106000520	Little Crab Orchard Creek	Upper Little Crab Orchard Creek	LCO_0520	IL_NDA-01	2360.14
7140106000521	Little Crab Orchard Creek	Upper Little Crab Orchard Creek	EV_0521	IL_NDA-01	2793.77
7140106000522	Little Crab Orchard Creek	Upper Little Crab Orchard Creek	LCO_0522-01	IL_NDA-01	3863.53
7140106000522	Little Crab Orchard Creek	Upper Little Crab Orchard Creek	LCO_0522-02	IL_NDA-01	3945.82
7140106000522	Little Crab Orchard Creek	Upper Little Crab Orchard Creek	LCO_0522-03	IL_NDA-01	12936.9
7140106000522	Little Crab Orchard Creek	Upper Little Crab Orchard Creek	LCO_0522-04	IL_NDA-01	1581
7140106001002		Aviation	LCO_1002		7549.38
7140106001005		Upper Little Crab Orchard Creek	LCO_1005		8865.21
7140106001006		Upper Little Crab Orchard Creek	LCO_1006		8926.26
7140106001007	Eek Creek	Eek Creek	LCO_1007-01	IL_NDBA-01	1167.58
7140106001007	Eek Creek	Eek Creek	LCO_1007-01	IL_NDBA-01	872.115
7140106001007	Eek Creek	Eek Creek	LCO_1007-03	IL_NDBA-01	1769.74
7140106001007	Eek Creek	Eek Creek	LCO_1007-04	IL_NDBA-01	903.863
7140106001007	Eek Creek	Eek Creek	LCO_1007-05	IL_NDBA-01	6383.12
7140106001007	Eek Creek	Eek Creek	LCO_1007-07	IL_NDBA-01	7981.69
7140106001008	Piles Fork	Upper Piles Fork	LCO_1008	IL_NDB-03	7279.4
7140106001009	Piles Fork	Upper Piles Fork	LCO_7764	IL_NDB-03	1386.48
7140106007312		Aviation	LCO_7312		5803.78
7140106007616		Upper Little Crab Orchard Creek	LCO_7616		4413.2
7140106007693		Upper Piles Fork	LCO_7693		788.921
7140106007715		Upper Little Crab Orchard Creek	LCO_7715		3868.81
7140106007746		Upper Little Crab Orchard Creek	LCO_7746		4616.89
7140106007756		Upper Little Crab Orchard Creek	LCO_7756		2582.15
7140106007761		Upper Little Crab Orchard Creek	LCO_7761		4797.93

Western Crab Orchard Creek Subwatershed- Assessed Stream Reach Information					
Reach Code	Stream Name	Subwatershed Management Unit	STEPL ID	IEPA ID	Stream Length (ft.)
7140106007764	Piles Fork	Upper Piles Fork	LCO_7764	IL_NDB-03	406.674
7140106008168	Piles Fork	Lower Piles Fork Creek	LCO_8168-02	IL_NDB-03	3340.79
7140106008172	Piles Fork	Lower Piles Fork Creek	LCO_8172-02	IL_NDB-03	483.85
7140106008172	Piles Fork	Lower Piles Fork Creek	LCO_8172-03	IL_NDB-03	445.754
7140106008172	Piles Fork	Lower Piles Fork Creek	LCO_8172-01	IL_NDB-03	764.764
7140106008173	Piles Fork	Lower Piles Fork Creek	LCO_8173	IL_NDB-03	284.133
7140106008174	Piles Fork	Lower Piles Fork Creek	LCO_8174	IL_NDB-03	449.49
7140106008182	Piles Fork	Lower Piles Fork Creek	LCO_8182-01	IL_NDB-03	2011
7140106008182	Piles Fork	Lower Piles Fork Creek	LCO_8182-02	IL_NDB-03	3220.06
7140106008182	Piles Fork	Lower Piles Fork Creek	LCO_8182-03	IL_NDB-03	789.726
7140106008182	Piles Fork	Lower Piles Fork Creek	LCO_8182-04	IL_NDB-03	1388.42
7140106008184	Piles Fork	Lower Piles Fork Creek	LCO_8184	IL_NDB-03	458.899
7140106008186	Piles Fork	Carbondale Reservoir- Piles Fork Creek	LCO_8186-01	IL_NDB-03	1587.08
7140106008189	Piles Fork	Carbondale Reservoir- Piles Fork Creek	LCO_8189	IL_NDB-03	1186.88


Litttle Crab Orchard Creek Subwatershed - Assessment STEPL ID
Jackson
Williamson
Crab Orchard Creek
Union
Johnson
EV_0018
EV_0019
EV_0020
LCO_7312
LCO_0518-03
LCO_1002
LCO_0518-02
LCO_0021
LCO_0022
LCO_0518-01
LCO_0519-04
LCO_1007-05
LCO_1007-07
EV_0023
LCO_0519-03
EV_0024
EV_0025
LCO_0031
LCO_1007-04
LCO_1007-03
Little Crab Orchard Creek-Crab Orchard Creek
LCO_1007-01
LCO_0032
Williamson
LCO_0519-02
LCO_8168-02
LCO_8172-03
LCO_8172-01
LCO_8172-02
LCO_0519-01
LCO_8174
LCO_8173
LCO_8182-04
EV_0033
LCO_8182-03
EV_0034
LCO_0520
LCO_8182-02
EV_0045
EV_0046
LCO_0047-02
LCO_0047-01
LCO_7616
EV_0521
LCO_8182-01
LCO_1006
LCO_8186-01
LCO_8184
LCO_1005
LCO_0522-04
EV_1010
LCO_8189
LCO_0522-03
EV_0029
LCO_7715
LCO_7693
LCO_1008
LCO_7746
LCO_0522-02
LCO_0522-01
LCO_7756
LCO_7761
LCO_7764
Indian Creek-Drury Creek
0 0.4 0.8 1.6 2.4 3.2 4 Miles
1:64,973.96
N

APPENDIX C- Inventory and Assessment Forms

WESTERN CRAB ORCHARD CREEK WATERSHED LAKE INVENTORY

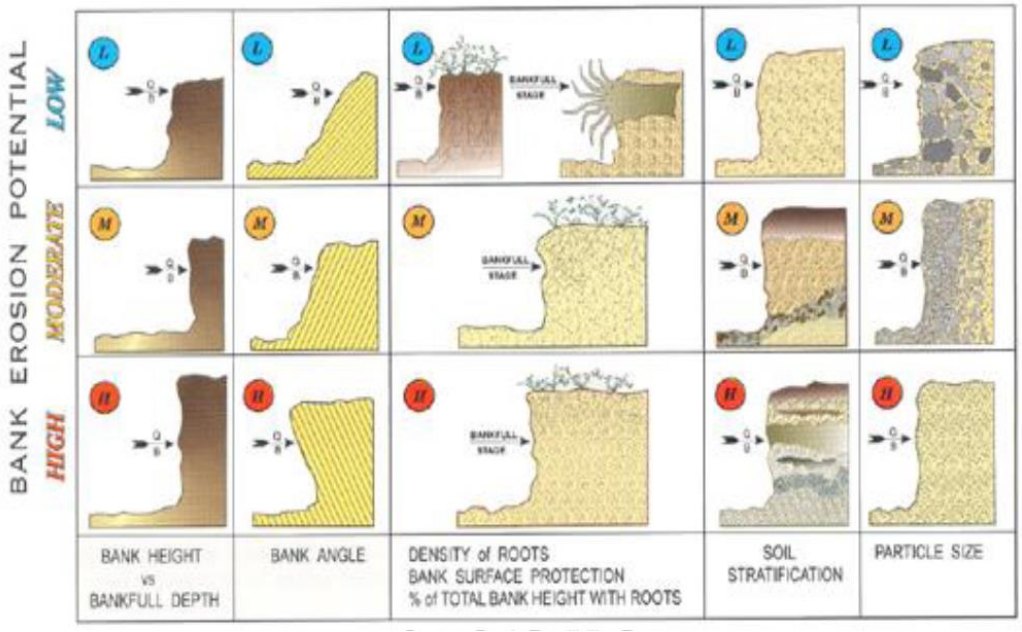
DATE: _____LAKE NAME: _____SHORE ID: _____

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: _____

WESTERN CO CREEK WATERSHED STREAM INVENTORY

DATE: _____STREAM NAME: _____REACH ID: _____

MAP ID: _____SMU ID: _____ASSESSMENT UNIT ID:_____

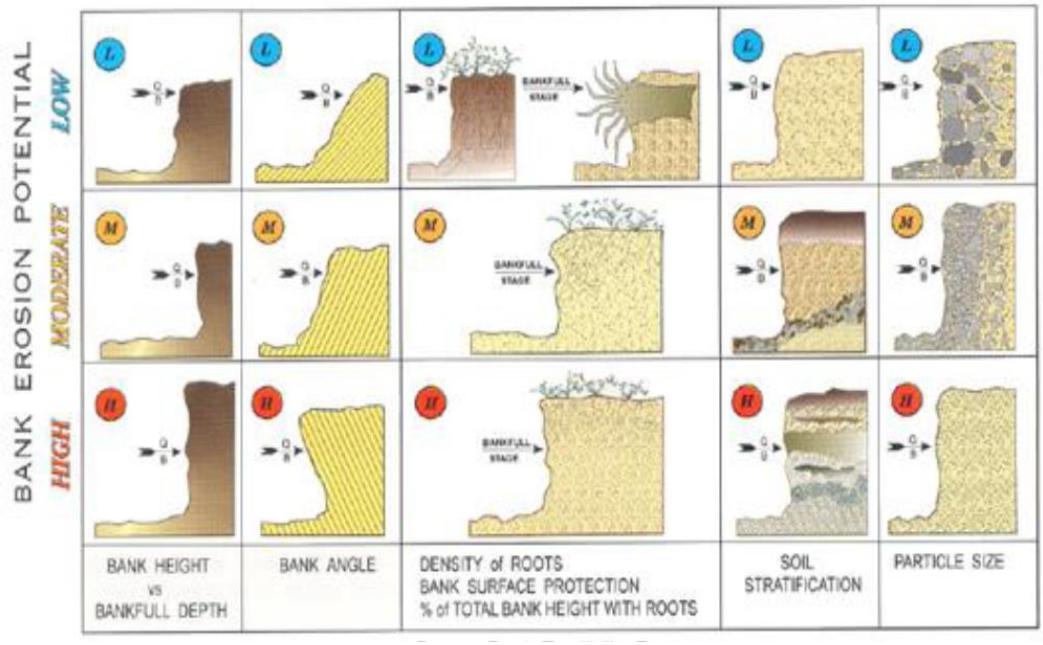
PHOTOS: _____ APPROXIMATE LENGTH: _____ FIELD ASSESSOR: _____

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: _____

APPENDIX D- MRLC Land Cover Classifications

Class\ Value	Classification Description
Water	
11	**Open Water** - areas of open water, generally with less than 25% cover of vegetation or soil.
12	**Perennial Ice/Snow** - areas characterized by a perennial cover of ice and/or snow, generally greater than 25% of total cover.
Developed	
21	**Developed, Open Space** - areas with a mixture of some constructed materials, but mostly vegetation in the form of lawn grasses. Impervious surfaces account for less than 20% 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** - areas with a mixture of constructed materials and vegetation. Impervious surfaces account for 20% to 49% percent of total cover. These areas most commonly include single-family housing units.
23	**Developed, Medium Intensity** - areas with a mixture of constructed materials and vegetation. Impervious surfaces account for 50% to 79% of the total cover. These areas most commonly include single-family housing units.
24	**Developed High Intensity** -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% of the total cover.
Barren	
31	**Barren Land (Rock/Sand/Clay)** - 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.
Forest	
41	**Deciduous Forest** - areas dominated by trees generally greater than 5 meters tall, and greater than 20% of total vegetation cover. More than 75% 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% 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% of total tree cover.
Shrubland	
51	**Dwarf Scrub** - Alaska only areas dominated by shrubs less than 20 centimeters tall with shrub canopy typically greater than 20% of total vegetation. This type is often co-associated with grasses, sedges, herbs, and non-vascular vegetation.
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.
Herbaceous	
71	**Grassland/Herbaceous** - areas dominated by gramanoid 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.
72	**Sedge/Herbaceous** - Alaska only areas dominated by sedges and forbs, generally greater than 80% of total vegetation. This type can occur with significant other grasses or other grass like plants, and includes sedge tundra, and sedge tussock tundra.
73	**Lichens** - Alaska only areas dominated by fruticose or foliose lichens generally greater than 80% of total vegetation.
74	**Moss** - Alaska only areas dominated by mosses, generally greater than 80% of total vegetation.
Planted/Cultivated	
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% 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% of total vegetation. This class also includes all land being actively tilled.
Wetlands	
90	**Woody Wetlands** - areas where forest or shrubland vegetation accounts for greater than 20% 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% of vegetative cover and the soil or substrate is periodically saturated with or covered with water.

Source: MRLC