DRIVING TOUR OF THE UPPER WAKARUSA WATERSHED

by

ARNOLD WEIR

B.S., Pittsburg State University, 1983

A REPORT

submitted in partial fulfillment of the requirements for the degree

MASTER OF ARTS

Department of Landscape Architecture/Regional and Community Planning
College of Architecture, Planning and Design

KANSAS STATE UNIVERSITY
Manhattan, Kansas

2010

Approved by:

_____
Major Professor
Lee R. Skabelund

Abstract

This report presents one approach for increasing understanding, appreciation and protection of watersheds by individuals living within the urban-to-rural lands interface.

The purpose of the study is to provide guidance to developing and implementing a driving tour of environmentally sensitive land around Clinton Lake and the Upper Wakarusa Watershed (UWW). Although the tour is particular to the UWW, the principles will be useful to planners and watershed advocates working to promote water quality improvement in other geographic areas.

A first step in increasing community involvement to restore and protect watersheds is developing a broader public understanding of what watersheds are and their integral part in daily life. By taking a driving tour (literally or virtually), participants can see firsthand how a watershed functions and the values it provides to people and ecosystems.

Two key ingredients in the planning process are public participation and clearly defined goals. Public participation begins with awareness of an issue that impacts lives. The first step in engaging the public is to develop a framework for making residents aware that watersheds are a critical part of their environment and the health of their community. The driving tour of the Upper Wakarusa Watershed should help residents and visitors experience a "sense of place" related to the watershed by achieving three over-arching goals:

- Develop meaningful themes that engage the residents and visitors in learning about watersheds and give insight to their relationships with the watershed.
- Introduce concepts that are relevant to the lives of residents and visitors and their understanding of a watershed.

- Generate a stronger “sense of place” as it relates to the Upper Wakarusa watershed.

The driving tour in this report has been designed to serve as a broad blueprint for future implementation. The route was devised to take advantage of area resources, especially those on public land, while adhering to guidelines proven successful in promoting rural areas such as the Flint Hills and Cheyenne Bottoms. The actual implementation of the Upper Wakarusa Watershed Driving Tour is expected to be led by local coalitions, and the precise route should be adjusted as necessary.

Table of Contents

List of Figures

List of Tables

ACKNOWLEDGEMENTS

I take this opportunity to express my thanks to Aimee Polson and Alison Rebar at the Kaw Valley Heritage Alliance for providing the inspiration in writing about the Upper Wakarusa Watershed. Thanks to my sister Ann Ricketts for encouraging me to pursue a Master's degree. Finally, thanks to my graduate committee: Professors Lee Skabelund for providing guidance, Al Keithley for encouragement, and John Keller for the great courses I took under him.

CHAPTER 1 - Introduction and Background

Introduction

One of the key elements to the success of local planning is the participation of stakeholders in the decision making process. In attempting to arrive at a desired outcome, the stakeholders need accurate information and a mechanism to construct a plan. Typically, that mechanism is an existing institution or organization, although grassroots organizations may develop in reaction to critical problems.

In the case of urban-to-rural land use planning and management, a clear means of stakeholder involvement often does not exist or does not sufficiently address "four common factors that deter stakeholders from long-term involvement and participation in planning and decision making:" 1) lack of engagement or access to the planning process; 2) cynicism and mistrust of government; 3) the perception of the lack of meaningful follow-up action or progress; and 4) the sense that the issues are too complex to adequately resolve (Randolph, 2004, 64).

Additionally, as a rule, urban-to rural land use planning is a patched together policy of different agencies, counties, towns/municipalities, and local governing bodies. Federal farm and incentive programs may dictate farming practices that may not be based on local conditions, while counties often have zoning practices based on particular economic factors with little regard for ecological processes and the functions of watersheds. In rural Kansas, residents typically form local political and economic allegiances to townships, counties and school districts. In the case of townships and counties, many physical boundaries came about from rectangular surveys done in the nineteenth century and the politics of the time (National Atlas, 2007). Although these long-standing property boundaries indicate who should be involved in decision making, they may not readily provide conditions to meet broader regional and watershed concerns.

The protection and restoration of watersheds is a regional issue since these areas have natural boundaries defined by the topography and these boundaries almost always cross county lines. Watersheds should also be seen as a "part of a complex hydrologic cycle" that directly influence quality of life issues such as the protection and restoration of water quality and the maintenance or creation of well-functioning, interconnected natural systems (Randolph, 2004, 272). Effective watershed planning is thus a central concern.

In Kansas, much of watershed planning is administered through a process known as the Watershed Restoration and Protection Strategy (WRAPS), a program supported by the Kansas Department of Health and Environment (KDHE) and U.S. Environmental Protection Agency. The primary purpose of a WRAPS is coordination of the water quality improvement efforts and the actions of the federal, state and local agencies that have resource conservation mandates. This is done through a six step WRAPS process of: 1) identifying watershed stakeholders, 2) assessing the watershed conditions and needs, 3) preparing a pollutant source inventory, 4) determining watershed goals, 5) preparing an implementation plan, and 6) preparing a "Statement of Adoption" to finalize the process and the WRAPS plan (KDHE, 2010)

While federal, state, and local agencies can offer financial assistance through conservation programs and cost sharing, the majority of the efforts to protect the watershed are through technical and educational programs at the local level. Since many land management endeavors are voluntary, creating partnerships among landowners, agricultural producers, technical experts, and governmental agencies is central in finding solutions to restore and protect the watershed.

Preserving natural areas and well functioning hydrologic systems requires that the landscape not be viewed in isolation as parcels of land, but rather be seen as a whole. This

holistic outlook and the approaches that accompany it recognize the interaction of humans with the physical environment and that both specific and cumulative events and actions happening upstream produce consequences downstream. Creating an awareness of the role a watershed has on the character of the landscape is also seen as crucial in preserving that connection to nature. In addition, the relationship to nature can be highlighted by planners as one of the key elements that distinguishes rural communities as valuable places to live, work and visit.

Overview of the Report

This report presents an approach for increasing understanding of watersheds by those living within the urban-to-rural lands interface. The work associated with this report was done in close cooperation with Kaw Valley Heritage Alliance, which is presently working on both restoration and educational programs within the Upper Wakarusa Watershed.

Chapter One provides a "Discussion of the Problem," discusses the "Purpose of the Study," and provides an overview of the Upper Wakarusa Watershed study area.

Chapter Two provides an overview of watersheds and the primary influences and impacts associated with changing land uses on water quality as a result of activities within the urban-to-rural lands interface. The terms and concepts introduced in this chapter are closely related to topics presented in the driving tour described in Chapter Five.

Chapter Three examines driving tours in Kansas and reviews the literature related to developing a driving tour in urban-to-rural landscape settings. Although the primary target audience is the local and regional population, tourists and other visitors to Kansas may also benefit by learning about the Upper Wakarusa Watershed. Since Kansas is not generally known as a tourist destination, promoting the state to people from outside the region is a challenge. Thus, literature related to creating and promoting local and regional driving tours was briefly

considered in this review. Chapter Three introduces the central issues that should be considered in designing local and regionally focused driving tours by summarizing and adapting key findings from the literature. Literature examined includes websites and documents that the author believed have particular relevance to a driving tour in the Upper Wakarusa Watershed study area. Chapter Three concludes by highlighting the importance of developing a thematic framework for this and other types of driving tours.

Chapter Four describes the approach to developing a framework for the Upper Wakarusa Watershed Driving Tour. This chapter discusses the process for creating GIS maps, exploring the watershed, and considering how to reach the target audience by driving and discussing these experiences with key stakeholders.

Chapter Five provides a detailed description of the actual tour. Given concerns about affordability and feasibility, it focuses on using existing facilities and infrastructure within the Upper Wakarusa Watershed. The Clinton Lake Visitor Center, Coon Creek Wetlands and Wakarusa River Valley Heritage Museum are existing establishments that are integral parts of the tour, while the destinations at Deer Creek and Richland both need significant improvements. Between each stop, important watershed topics such as environmental issues, stormwater and agricultural best management practices, ecosystems as habitats, and political and historical aspects of the watershed, can be introduced to the participant.

Chapter Six is the "Conclusion and Recommendations" for implementation of the Upper Wakarusa Watershed Driving Tour. This chapter provides an assessment of what needs to be been done for implementing the tour as well as discussing other future considerations.

Chapter Seven includes some closing thoughts by the author.

Discussion of the Problem

As previously discussed, watersheds are not normally associated with political or economic identity. For example, the Upper Wakarusa Watershed is located within four different counties. Consequently, there are four separate county planning and zoning departments, four separate farm service agencies and separate conservation districts aligned to the counties. These are the institutions with which rural residents ordinarily deal regarding local land use issues. Moreover, federal and state agencies are often perceived as top-down decision making bodies that impose regulations on private property owners. These perceived barriers sometimes limit public involvement in the planning process and further result in a lack of accurate information about important local and regional planning issues.

Although attaining Water Quality Standards (WQS) through meeting Total Maximum Daily Loads (TMDLS) standards is a legal requirement under the Clean Water Act (EPA, 2005), the mechanism for achieving these standards on private land is often through voluntary participation by landowners. The organizations that provide technical and financial assistance to address water quality can only provide this assistance to volunteering participants. Understanding the issues about how a watershed affects water quality is crucial in gaining participation by private landowners.

The Upper Wakarusa Watershed (UWW) is experiencing pressure for suburban expansion from both Lawrence and Topeka, Kansas. Thus, unless best management practices (BMPs) which aim to reduce runoff and improve water quality are implemented, downstream flooding and water pollution will likely increase. Although zoning laws may influence building and land use practices to an extent, voluntary adoption of BMP's is crucial in protecting the watershed. Having knowledge about the dynamics of a watershed is seen as fundamental to improving and protecting water quality.

The Kaw Valley Heritage Alliance (KVHA) has the primary responsibility for bringing together the diverse governmental agencies, rural landowners, and agricultural producers through the WRAPS process. This nonprofit organization receives grant money primarily through the Kansas Department of Health and Environment (KDHE) for both watershed planning and environmental education. The environmental education programs implemented by KVHA are crucial to increasing the participatory process by improving the local knowledge base. The limited funding received by KHVA requires the organization to adopt innovative teaching tools while relying heavily on volunteers who share common goals. One such teaching tool has been a small park located on Corps land near the Coon Creek wetlands area. KVHA has received a grant to add an educational bulletin board, walking paths and a bench overlooking the wetlands. The intent of this study is to expand the educational tools by connecting additional Corps areas with a driving tour.

A way of further engaging local residents and other stakeholders in the environmental issues of restoration and protection of the watershed is needed. Only when citizens are involved in planning and decision making will change be made on private lands to create long term improvements in the watershed. Creating awareness is viewed as a first step in the process.

Purpose of the Study

The particular idea for this driving tour came about from a discussion about how to increase public awareness about the fact that residents live in a watershed and that their daily activities affect the quality of water. The purpose of this study is to provide guidance to developing and implementing a driving tour of environmentally sensitive land around Clinton Lake and the Upper Wakarusa Watershed. Although the tour is particular to this watershed, the author hopes that the principles can be constructively applied to other geographic areas.

Even though Clinton Lake receives nearly one million visitors a year, much of the surrounding area has been underutilized by visitors. While it is important that these lands to remain natural with little human impact, they also offer a great opportunity to utilize them for public education. Presently, KHVA has made improvements to a site along Coon Creek through a grant and volunteer efforts. By linking together Clinton Lake and Coon Creek wetlands with two unimproved sites with a driving tour, participants can gain a greater appreciation of about the relationship between a watershed (including streams, lakes and land uses) and water quality. Hopefully, further public awareness will also provide an impetus for initiatives to clean up the site around the former community of Richland.

Since residents usually identify their sense of community within the context of existing institutions, a driving tour could help lay the groundwork for expanding their "sense of place." The author believes that it is possible for the existing sense of community, as defined by administrative boundaries, to coexist with the natural geographic boundary defined as the Wakarusa Watershed.

Initially, the tour is to be publicized by the Army Corps of Engineers and KHVA. Consequently, the primary audience of this tour will be Clinton Lake visitors, local residents of the watershed who could be sent a newsletter, and school children involved in KHVA educational programs. It is the author's intention that this report serve as just the first step in laying the framework for the driving tour. It is expected that a collaborative process will continually improve the tour and expand the audiences in order to better inform and engage them in the places they live (helping them understand how they relate to and have an influence on watersheds). Because everyone lives in a watershed, the tour could potentially interest all

citizens in learning about watersheds. However, it is beyond the scope of this study to make detailed breakdown of the target audience using surveys and focus groups.

Study Area/ Upper Wakarusa Watershed

The Upper Wakarusa Watershed (UWW) is part of the Lower Republican basin in northeastern Kansas. It covers 364 square miles in a four county area beginning in eastern Wabaunsee County and ending at Clinton Lake in Douglas County. A large part of southern Shawnee and northern Osage counties are contained within the watershed. The land cover is approximately 56 percent grassland, 27 percent cropland, 12 percent woodland and the remaining 5 percent urban and water. Percentages change to 38 percent grassland and 37 percent cropland within 1/8 mile of most streams in the watershed. Although only three incorporated cities are located within the watershed (with a combined total population of 3,546), the close proximity to Topeka and Lawrence (as well as Clinton Lake) results in a continuous pressure for suburban land development (KVHA, 2003).

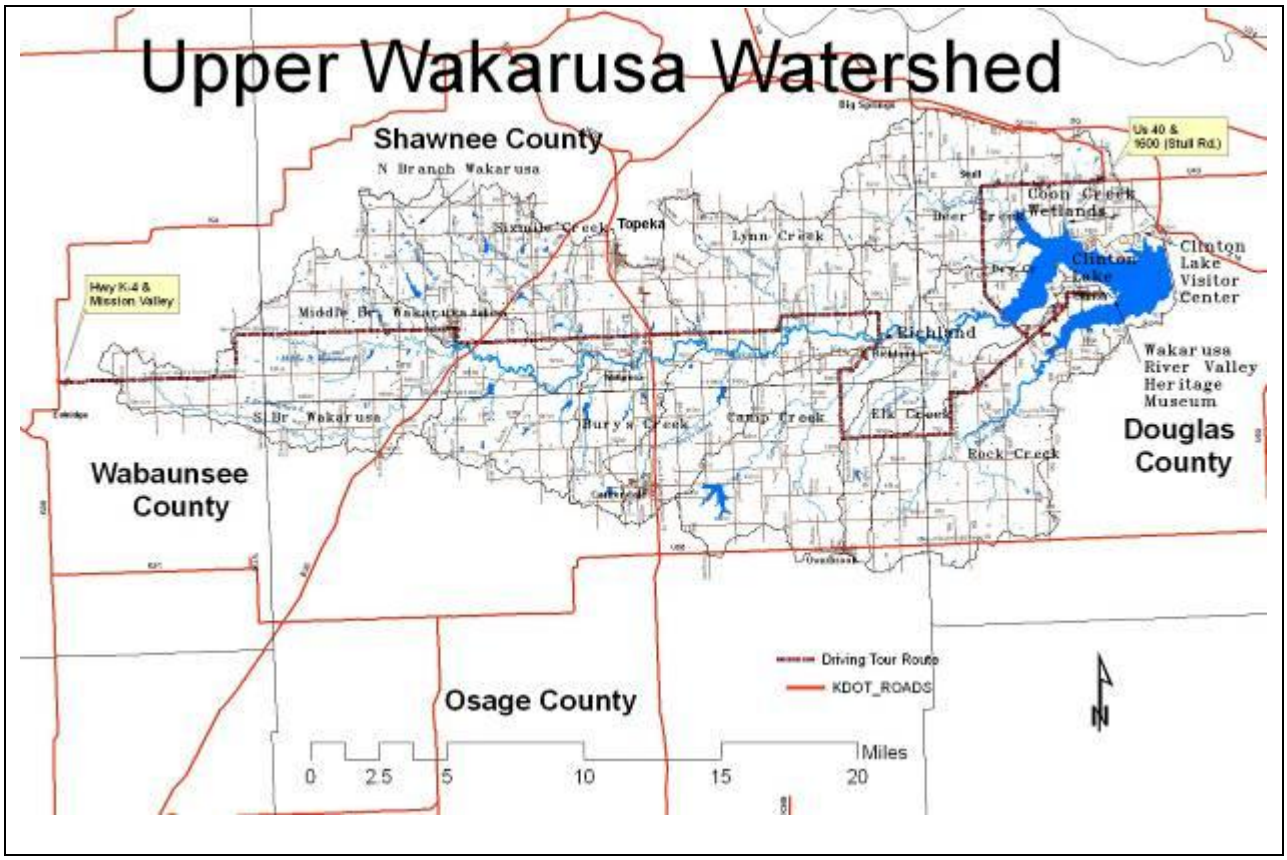
Subwatersheds are smaller drainage areas within the watershed and are defined by named creeks and the surrounding drainage area (see Fig. 1-2). All of these creeks drain into the Wakarusa River but each sub-watershed has its unique characteristics. Consequently, it is important to include these in the discussion to help assess the watershed at a more detailed level.

There are eight subwatersheds in the UWW as defined by U.S. Water Resource Council. The subwatershed of the *Middle and South Branch of the Wakarusa River* is the western headwaters of the UWW and converges in western Shawnee County with the *North Branch* to form the Wakarusa River. *Sixmile Creek* originates in southwestern Shawnee County and enters the Wakarusa River west of the small town of Wakarusa. *Lyn's Creek* drains the southeastern quarter of Shawnee County beginning northeast of Forbes Field. *Bury's Creek* originates near

Carbondale and flows northeasterly to enter the Wakarusa River four miles east of the town of Wakarusa. Both Sixmile and Bury's Creek are in the same subwatershed. *Camp Creek* originates near the town of Overbrook and flows north towards the former town of Richland. Both *Elk Creek* and *Rock Creek* originate in Osage County and flow in a northeasterly direction to the Wakarusa River. *Deer Creek* begins 3.5 miles west of the Shawnee County line and moves east into Douglas County for 8.8 miles before entering the Wakarusa. This subwatershed is closest to paved roads near the rapid western expansion of Lawrence and along with Rock Creek is on the first priority to achieve TMDL goals (KVHA, 2003).

All of the water that drains from the Upper Wakarusa Watershed eventually flows into Clinton Lake. This is an Army Corps of Engineer reservoir located about three miles southwest of Lawrence. Clinton Lake supplies the drinking water for Lawrence and much of the surrounding region. The lake is also a prime source of recreation for the area including boating, fishing, camping, hiking and swimming. Much of the terrain surrounding the lake is public land which is used for hunting or preserved for wildlife habitat.

Figure 1-1 The Upper Wakarusa Watershed



CHAPTER 2 - Watersheds Overview

Watersheds contain a complex physical environment through the interactions of climate, soil, hydrology, and topography. A basic understanding of how these processes work is imperative to the planning process. This chapter introduces some of the watershed concepts that should be introduced in some manner through the driving tour in order to expand the awareness and understanding of residents and visitors. Expanding awareness is seen as the first step in helping protect the vital land and water resources associated with the Upper Wakarusa Watershed (UWW).

Watershed Characteristics

Watersheds are typically defined by topography and drain towards a particular point. The ridgelines or high ground separating two basins is called a watershed divide and determines the direction water will drain. Water draining from a higher portion of a watershed to lower areas will either infiltrate into the ground or follow the natural contours to collect in another water body such as a creek, stream, pond or lake.

The headwaters of a watershed are located in the uppermost reaches (highest elevations) and begin along the ridgelines and move along the upland zones above tributary streams. Unless recharged by groundwater, headwater streams only flow shortly after a rainfall and are referred to as "ephemeral streams." As these streams converge they form intermittent or perennial streams, depending on their tendency to carry water year-round. Intermittent streams only flow after rainfall events and are largely recharged by surface water runoff. Perennial streams flow continuously and are dependent on the movement of groundwater into the channel. Water

flowing through perennial streams and rivers after surface waters have attenuated is called the "base flow" of the stream or river.

Stream Classification

Strahler (1952) refined a hierarchical naming convention using numbers for stream orders, with the headwater stream being a "first order stream." When two first order streams converge it becomes a "second order stream." This convention continues with second order streams converging to become third order streams, and continuing progressively downstream. This convention does not hold true for the confluence of a first order stream and a second order stream or any smaller stream joining a larger order such as a second order and third order stream. In these cases the stream order remains as the larger order stream. In the UWW the Wakarusa River is a fourth order stream or river. Map A-7, in Appendix A, shows second through fourth order streams for the South and Middle Branch of the Wakarusa River while Map A-8 shows the first through fourth order streams. This classification system shows that there are many more first order streams in a watershed than larger streams. Most of the water collected in the larger streams, the Wakarusa River (and eventually Clinton Lake) comes from the many hundreds of small headwater streams. Consequently, there are many places where water quality can be compromised within a watershed from the surrounding land. This is certainly the case for the UWW, where the land uses in headwater areas and first order streams can have a strong influence on the quality of water in lower portions of the UWW, including Clinton Lake. For there to be meaningful improvements in water quality, citizens and residents of an area need to understand that all streams within a watershed, including the very smallest, are important to the quality of the whole. The classification system is one way to illustrate this relationship.

Hydrologic Unit Codes

In the 1970's, the U.S. Water Resource Council devised a hierarchal numbering system for dividing watershed boundaries and this system is referred to as Hydrologic Unit Codes (HUC). The first two digits (HUC 2) divide regions into major drainage areas. Figure 2-1 shows the 22 HUC 2 regions for the United States. The Upper Wakarusa Watershed is in Region 10, referred to as the Missouri Region. The U.S. Geological Survey (USGS, 1987) defines Region 10 as:

> Missouri Region – The drainage within the United States of: (a) the Missouri River Basin, (b) the Saskatchewan River Basin, and several small closed basins. This area includes all of Nebraska, nearly all of South Dakota, and parts of Colorado, Wyoming, Montana, North Dakota, Minnesota, Iowa, Missouri, and Kansas (USGS 1987, 37).

Figure 2-1 The Major Watershed Boundaries of the United States

Source: USGS Division of Water (2007).

The next two digits (HUC 4) are Subregions. The Upper Wakarusa Watershed is in Subregion 1027. The USGS defines Subregion 1027 as: located within the states of Kansas, Missouri, and Nebraska and comprises of: The Kansas River Basin, excluding the Republican and Smokey Hill River Basins with an area of 15,000 square miles (USGS, 1987, 41).

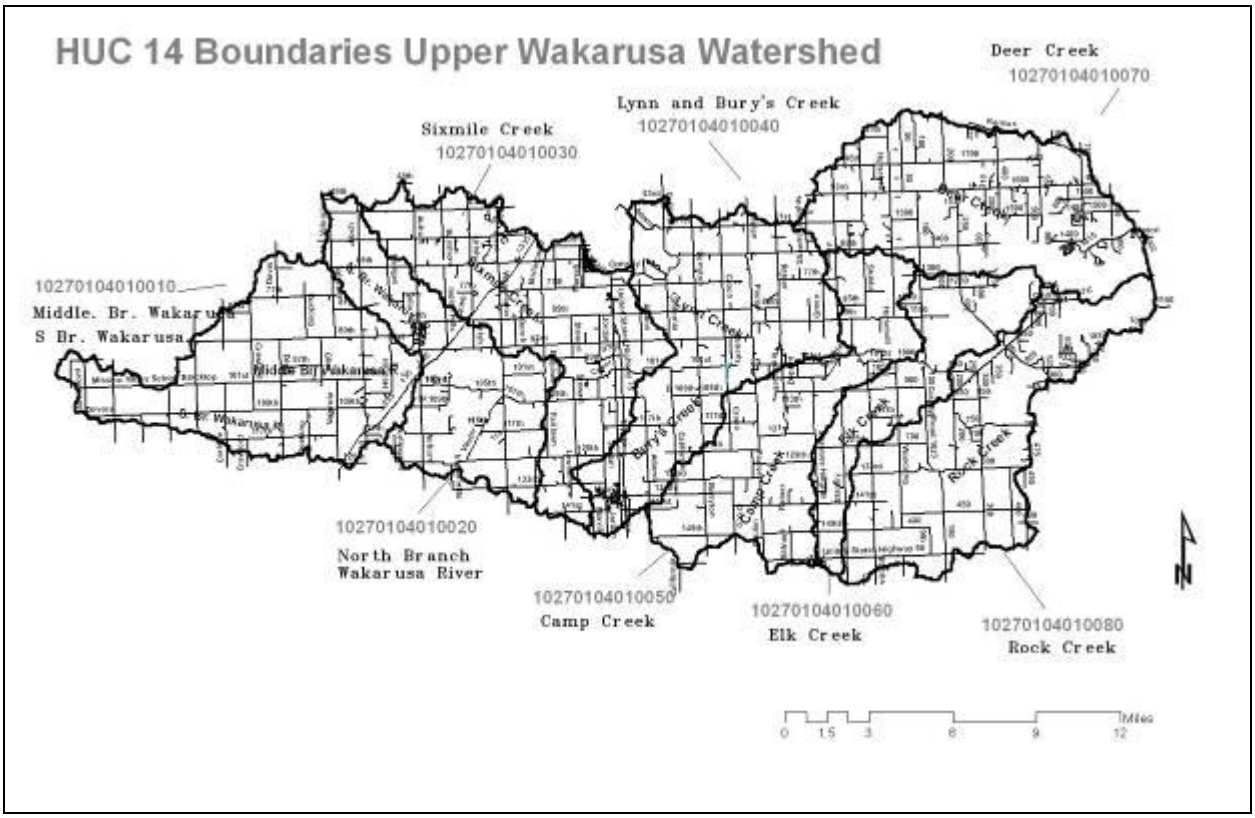
The next two digits (HUC 6) are referred to as Accounting Units. The Upper Wakarusa is in Accounting Unit 102701 and is defined by USGS as being located within the states of Kansas and Missouri and comprises of: The Kansas River Basin, excluding the Big Blue, Republican, and Smokey Hill River Basins with an area of 5,500 square miles.

The next two units (HUC 8) are Cataloging Units. The Upper Wakarusa is in Cataloging Unit 10270104 referred to as Lower Kansas Watershed with an area of 1,640 square miles.

The next three digits (HUC 11) further divide the Cataloging Units into smaller watersheds. The Upper Wakarusa Watershed is HUC 10270104010 with an area of 367 square miles. The last three digits (HUC 14) further divide watersheds into smaller drainage basins. The Upper Wakarusa Watershed has eight HUC 14 units, which constitute no more than three named streams. HUC 14 watershed units will be used throughout the paper and are as follows:

HUC 10270104010010	South & Middle Branch of the Wakarusa River
HUC 10270104010020	North Branch of the Wakarusa River
HUC 10270104010030	Sixmile Creek
HUC 10270104010040	Lyn and Bury's Creek
HUC 10270104010050	Strowbridge and Camp Creek
HUC 10270104010060	Towhead and Elk Creek
HUC 10270104010070	Coon, Deer and Dry Creek
HUC 10270104010080	Rock Creek

Figure 2-2 HUC 14 Boundaries



These long numbers are not used in everyday conversations, nor are they going to be remembered. However, the concept of a hierarchical breakdown of watersheds into smaller and smaller units helps establish the relationship that watersheds have with each other and the numbering classification illustrates this relationship. These numbers are somewhat similar to zip codes, which people understand conceptually as ways to identify very specific areas. People often remember only their own zip code and perhaps a few others they use on a regular basis, but they still understand what a zip code describes.

Although they are useful at one level, the definition and classification of watersheds do not convey the complex relationships a watershed has to the environment. The physical characteristics that make up a watershed are influenced to varying degrees by the geology, soils, hydrology, climate, topography, slope, vegetation, and land use. The common element that

unites all of these factors is water, which creates a hydrological regime shaped by these physical characteristics. Physiography and soils (acted upon by regional climate and influencing hydrology, topography, slope, vegetation, and land use) are primary watershed drivers.

Physiography and Soils

Physiography refers to the physical features of the land such as the terrain, rock type and geological history that created land features. The Kansas Geological Survey divides Kansas into eleven regions with the Upper Wakarusa Watershed lying within two of these, the Osage Cuesta and the Glaciated region (Kansas Geological Survey, 2010).

The Osage Cuestas is an area that was once covered by shallow seas that grew and shrank during changes in ancient sea levels. The seas left behind minerals and sea shells made up of calcium carbonate which eventually formed into limestone. When the rivers deposited mud into the oceans they formed shales. The Osage Cuesta is made up of these alternating layers of limestone and shale with some sandstone. Because limestone is harder than shale it would erode more slowly and where outcrops of limestone occurred they formed escarpment. The hills in this physiographic region rise more gently from the west until they reach escarpments with steeper slopes on the eastern side. In this region rolling hills and flat areas can also be found in the valleys between escarpments (Kansas Geological Survey, 2010).

The eastern portion of the watershed lies in the glaciated region and is characterized by the deposits left behind by glacial drift. Geologists believe that the deposits formed by glacial ice occupied the Kansas River Valley, forming a temporary lake that halted the flow of water to the southern tributaries. Eventually melt water from the glacier moved part of the large sedimentary load and deposited it along larger streams including the Wakarusa. The deposits that settled along the rivers (called alluvium) form a close relationship between the stream flow

and groundwater within associated alluvial aquifers. During times of high stream flow, water may recharge the aquifer; during low stream flow, water may come from the aquifer to the stream and maintain a base flow. The glacial debris also buried valleys, trapping the alluvium beneath sand and gravel. The porosity of the underlying sand and gravel make ideal alluvial aquifers by trapping and holding water (McCauley, 1998).

The physiographic regions play an important part of the hydrologic processes of a watershed. The underlying bedrock will determine how water is transferred to groundwater and has a direct impact on the quality of groundwater and stream base flow. Further, bedrock has a major effect on soil properties, since soils are developed from breakdown of bedrock.

Soils have many physical properties that directly influence the health of the watershed. Made up of mineral and organic material, the ratio and density of each determine characteristics such as permeability, chemical properties, filtering capacity, and erodibility.

Permeability is the soil's capacity to transmit water or air. The National Resource Conservation Service (NRCS) has instituted criteria for Hydrologic Soil Groups (HSGs) which are broken down into four categories. Group A are the soils with low runoff potential and high infiltration rates such a well-drained sands and gravel. Group B are the moderately fine to moderately coarse textured soils that have a moderate infiltration rate even when in a wetted condition. Group C are moderately fine to fine textured soils that have a slow infiltration rate in a wetted condition. Group D are chiefly clay soils that have the slowest infiltration rate (NRCS, 2007). These soil classifications occur on a continuum depending on the percentages of sand, silt and clay will help dictate the infiltration rate of water into the soil. Although conditions can vary within the region, generally the Upper Wakarusa Watershed contains more clay and silt

soils with bedrock layers of limestone and shale which results in slow infiltration rates of water into the terrain (Kansas Geological Survey, 2006).

Hydrologic Cycle and Human-Caused Disturbances

The hydrologic cycle can be defined as the exchange of water between the earth's surface and the atmosphere. This continually moving water goes through processes such as evaporation, condensation in cloud formation, precipitation, runoff, infiltration, and transpiration from vegetation—all fueled by solar energy. Over the long term and in natural conditions, this cycle is generally in a state of dynamic equilibrium, which means that water entering the watershed through precipitation, runoff, recharging of the water table, and surface and groundwater storage will equal the amount leaving the watershed through evaporation, transpiration and outflow. This state of equilibrium is referred to as the water balance (Thornthwaite, 1955).

Due to periods of non-normal precipitation (for example, drought or very heavy rain events), other natural disturbances (prairie fires, tornados, other damaging storms, etc.) and natural processes such as plant community dynamics, the system experiences change.

Floods are one form of natural disturbance that have occurred throughout time. However, as floods receded, streams and rivers generally returned to their functional states of relative equilibrium. Land within a floodplain was restored based on the ability of the ecosystem to heal itself through the process of vegetative succession.

Historical records indicate that the largest flood ever recorded along the Kansas River occurred in 1844 and caused little damage because of ability for wetland and floodplain habitats and adjacent lands to repair these ecosystems in relatively short order. The flooding of the Kansas River in 1951, however, caused an estimated $2.5 billion dollars in damage ($17 billion in 2000 dollars) (USGS, 2001). During the 110 years between these two large flood events, the

amount of human-caused disturbance along the Kansas River was extensive. Thus, the ability of natural systems (such as wetlands, riparian vegetation, and adjacent tallgrass prairie) to return the landscape to a state of equilibrium was seriously compromised. In large part this was due to plowing, construction, and various urban developments.

The large scale loss of property and livelihoods from the 1951 flooding was the impetus for moving forward with flood control along the Kansas River Basin as nine major reservoirs were built by the Army Corps of Engineers. According to the Corps these reservoirs functions include: "flood control, irrigation, water supply, low flow and navigation supplementation, water quality, hydropower, recreation and fish and wildlife" (USACE, 2009, 1). As a result, the water balance is now essentially controlled by manmade structures, and as a consequence, restoring the watershed to a healthy condition will also require human intervention.

As land continues to be extensively developed, human activities cause land disturbances that additionally modify the dynamics of the watershed. Cultivation and construction along the Wakarusa and its tributary streams cause stormwater to runoff more swiftly, carrying topsoil and various pollutants along with it. As a result, sedimentation builds up within the waterway, reducing storage capacity and holding contaminants. Furthermore, due to the isolation of many parcels of ground into fragmented landscape types (primarily agriculture, suburban land, and woodlands) the natural recovery of the Wakarusa River ecosystem has been severely diminished and will not be capable of returning to health without human assistance. Active restoration and management techniques are required to restore the watershed to a more desirable condition. Prairie restoration is seen as particularly helpful in restoring a more stable hydrological system.

The Upper Wakarusa River is in the tallgrass prairie region although very little tallgrass prairie remains within the watershed. Tallgrass prairie vegetation has the ability to go dormant

during stressful conditions and then quickly recover when conditions become more favorable. Historically, the creeping roots of the prairie formed a nearly continuous mat protecting the soil which increased stormwater infiltration, reduced erosion and sedimentation, while also keeping out invasive species. Prairie vegetation also has the ability to withstand stresses such as fire and grazing (National Park Service, 2010).

Another vital step in restoring the Upper Wakarusa Watershed is controlling the sources of contamination from non-point source pollution.

Non-Point Source Pollution

Non-point source pollution (nps pollution) occurs from runoff not related to a single point source (such as a discharge pipe from a factory). Nps pollution from agricultural and urban stormwater runoff is now the largest source of pollution to rivers and lakes.

Solids in surface water come from erosion of soils primarily after a rain event. As suspended solids flow through streams, the water slows down as it enters reservoirs. This slowing down causes some of the suspended solid to settle on the bottom of the lake which in returns causes reduced storage capacity. Studies have indicated that the storage capacity of Clinton Lake will be reduced by six to fourteen percent by the year 2035 (Wang, et al. 1999).

The chemical composition of the runoff is influenced by the land use from which it came. Runoff from agricultural land often carries the fertilizers and herbicides applied during the farming operations. Runoff from livestock production carries the waste products. Nutrients such as nitrogen, phosphorus, and potassium are the basic chemical elements that are required by plants for survival. An overabundance of these nutrients, called "eutrophication," can cause too much aquatic plant growth and algae. In return, this excessive plant growth can cause oxygen depletion which then affects animal life (KVHA, 2003).

The principal sources of pollution found within the Upper Wakarusa Watershed (UWW) are primarily from non-point sources. These sources include cropland, livestock feeding, farmsteads and wastewater systems. KDHE's assessment of the watershed required it to be designated as impaired and consequently placed on the impaired water body list (Section 303d of the Clean Water Act). The UWW has TMDL impairments for fecal coliform bacteria, sediment impact on aquatic life, and nutrient and oxygen demand on aquatic life due to eutrophication (KVHA, 2003). These impairments initiate specific legal mandates associated with the Clean Water Act.

Legal Requirements

The Clean Water Act (CWA) is the basic structure for regulating the flow of pollutants into the waters of the United States. Section 402 of the CWA established the National Pollutant Discharge Elimination System (NPDES) which regulates point sources of pollution. However, as noted, the largest percentage of pollution comes from non-point sources. Section 303 of the CWA uses a water quality based approach by requiring states to assess their water bodies, set Water Quality Standards (WQS), and prioritize and establish Total Maximum Daily Loads (TMDLs) for pollutants. TMDLs set the maximum pollutant load that can enter stream segment without causing a WQS violation (USEPA, 2005).

Through The TMDL process, KDHE's Bureau of Water must submit a written plan that will allow a watershed to attain the Water Quality Standards. Each TMDL that KDHE submits must contain the following sections: a) problem identification, b) current situation and desired outcomes, c) source assessment, d) load allocation, and e) implementation (KDHE, 2009).

KDHE states that in order to decrease NPS pollution "…the focus will be on technical assistance, educational outreach, and directing financial resources toward placing best management practices in critical contributing areas of watersheds." They further state that "most

of these efforts will rely on voluntary, incentive-based approaches that are consistent with the Kansas Water Plan and federal programs" (KDHE, 2009, 1).

Watershed Planning

The U.S. Environmental Protection Agency (USEPA) and state agencies' approach to a cleanup of NPS pollution is through "a watershed approach." The underlying principles of this approach are stakeholder partnerships, geographical focus and sound science. Furthermore, the objective of most watershed planning is to meet TMDLs goals. As previously discussed there are governmental mandates for meeting these TMDL goals.

Using the principles of stakeholder involvement, the USEPA has published several documents on public involvement. *Getting In Step: A Guide for Conducting Watershed Outreach Campaigns* uses techniques like focus groups and phone surveys to first understand and analyze the target stakeholder audience. It then presents outreach campaigns meant to target the specific audiences which would make up new stakeholder partnerships. These stakeholder assessments and campaigns can be very time consuming and resource intensive and may also be limited to a specific issue such as reducing nutrient runoff from residential areas.

The USEPA has also published documents addressing geographic location such as *Community Culture and the Environment: A Guide to Understanding a Sense of Place*. Although this document helps provide a basic understanding of principles, actual implementation again would require considerable time and resources, not readily available to existing agencies and organizations. Smaller communities are particularly hampered in their ability to respond to watershed protection needs by lack of planning and other essential staff.

As previously noted, KDHE is the responsible party for meeting federal and state mandates for implementing TMDLs goals. Kansas is working to implement strategies through

the process known as Watershed Restoration and Protection Strategy (WRAPS). KDHE defines the process as follows: 1) identification of watershed and restoration needs, 2) establishment of watershed and management goals, 3) creation of a cost effective action plan to achieve goals and 4) implementation of the action plan (KDHE 2004).

The WRAPS for the Upper Wakarusa Watershed was formed through a subcommittee of the KVHA called the "Water Quality Subcommittee core group." This subcommittee is made up of representatives from many different agencies, including KDHE, KVHA, NRCS, City of Lawrence, Kansas State University, and the different County Conservation Districts (CCDs).

Through the UWW WRAPS planning process thirteen goals were established for achieving TMDL goals (KVHA 2003, 6):

Table 1 Thirteen goals of WRAPS for obtaining water quality objectives

- Goal 1. Restore Streambank/Riparian Vegetation.
- Goal 2. Increase Percentage of Agriculture Land Covered by a Resource Management Plan (RMP) and promote River Friendly Farms Program.
- Goal 3. Management of KDWP Land Surrounding the Lake.
- Goal 4. Manage Onsite Wastewater System.
- Goal 5 Increase Landowner Participation in Cost Share Programs through Information and Education.
- Goal 6. Establish High Quality Prairie/Grassland Conditions.
- Goal 7. Renew Necessary State and Federal Permits and Monitor permitted Facilities for Permit Compliance.
- Goal 8. Install Water Quality Protection Measures that Simulate Native Grassland Conditions for Cropland.
- Goal 9. Reduce the Amount of Atrazine Leaving Application Sites.
- Goal 10. Study the Effect of Watershed Structures on Phosphorus Loading.
- Goal 11. Manage Urban/Suburban Growth.
- Goal 12. Establish a Clinton Lake Protection Area Overlay with Specific Standards.
- Goal 13. Increase Incentives for Organic Farming.

Best Management Practices

Although landscape architects, ecologists, conservation biologists and planners have proposed many different best management practices for watersheds, in the short term, the plans

that can be most easily implemented are the ones that offer incentives and cost-sharing while also having existing agencies in place to administer these incentive and cost-sharing programs. The thirteen goals developed by the WRAPS for the UWW each have specific objectives associated with them. Implementation is through a cooperative effort of different agencies that provide education along with financial and technical assistance.

The UWW Driving Tour can be designed to introduce and illustrate some of the concepts of how a watershed functions by pointing out places where these processes can be visualized along the route. In doing so, the participant can learn about the how the bordering land and human activity can affect the watershed. One of the tour's aims is to point out activities that have helped to restore the watershed and thus highlight "best management practices" (BMPs). For this driving tour project, BMPs will be demonstrated through descriptions and signage explaining educational programs offered through existing agency partnerships and through financial incentives and technical assistance offered by state and federal programs.

Agricultural cultivation significantly influences the water quality of the UWW by increasing sediment runoff through exposed soil, and increasing NPS pollution through application of pesticides and fertilizers. Farm Service offices within each county customarily deal with landowners in administrating the farm programs, but also execute the Conservation Reserve Program (CRP) which takes erodible marginal agriculture land out of production by giving rental payments. This program has helped reduce erosion into the streams and the isolated parcels of land can often be spotted by the abundance of scrub trees such as Osage Orange and Black Locust.

In Appendix A, Map A-5 shows the parcels of ground placed in the CRP program within the Upper Wakarusa Watershed.

The Continuous Conservation Reserve Program (CCRP) is another incentive and cost sharing program that supports buffers adjacent to crop and pastureland. CCRP is a cost-sharing program that buffers streams from agricultural runoff by planting trees and/or native grasses along narrow riparian corridors. Several places within the watershed have signs promoting conservation buffers which can be pointed out along the tour route (see Figure 2-3) to explain how buffers work in helping to control non point source pollution. This allows tour participants to see for themselves what best management practice entail and why it was adopted for correcting particular watershed impairments. Other BMPs can also be explained as they are encountered along the Upper Wakarusa Watershed.

Figure 2-3 "Conservation Buffers Work" Sign

Source: Arnold Weir

The Wildlife Habitat Incentives Program (WHIP) is managed under the direction of the Natural Resources Conservation Service (NRCS) and Kansas Wildlife and Parks which is "a voluntary program for developing or improving high quality habitat that supports fish and wildlife populations of National, State, Tribal and local significance" (NRCS, 2009, 1). This is a cost-share program for eligible land owners who develop wildlife habitat plans.

The State Conservation Commission (SCC) provides financial assistance in the form of cost sharing to landowners "to apply enduring conservation practices that reduce soil erosion and improve water quality and water conservation" (2009, 1). The following are project types and best management practices (BMPs) listed by the SCC eligible for cost-share.

Table 2 Best Management Practices

BMP Type	**SCC-Listed Best Management Practice**
Sediment Control	Terrace, Grassed Waterway, Diversion
Livestock Waste Management	Waste Treatment Lagoon, Filter Strip, Waste Storage Facility.
Pasture & Rangeland Management	Pond, Well, Pipeline, Tank, Spring Development
Riparian Area Protection	Filter Strip, Fencing, Well, Pipeline, Forest Buffer, Riparian Enhancement.
Wetland Development/Restoration	Wetland Creation, Wetland Restoration, Wetland Restoration/Enhancement
Nutrient Management	Soil Testing, Manure Analysis
On Site Wastewater Systems	Up-grading of failed home septic systems.
Unpermitted Dumpsite Remediation	Clean-up and disposal of materials in an unpermitted dumpsite.

Adapted from the Kansas Conservation Commission (1999)

One of the concerns for the Upper Wakarusa Watershed is the direction and type of suburban growth. This is especially true in the Deer and Rock creek subwatersheds along with

the vicinity immediately surrounding the lake. Consequently, emphasis should be placed ecological friendly development and innovative urban stormwater management strategies, including tools and techniques, now commonly referred to as Low Impact Development strategies. Table 3 gives a selection of water sensitive planning/design strategies and can be highlighted where they occur in a driving tour for the UWW (and encouraged wherever they may be appropriate).

Table 3 Selected Low Impact Development Techniques

- Conserve and/or create woodlands, meadows and prairie.
- Employ site fingerprinting and strategic grading for minimal impact to soil/vegetation.
- Create tree/shrub and turf/lawn depressions to naturally collect stormwater.
- Create bio-retention cells and landscape island storage.
- Create well-placed rain gardens.

- Reduce impervious areas.
- Employ rooftop detention and disconnect roof leaders;
- Minimize culverts, pipes and inlets, and eliminate curb-and-gutter.
- Create more porous surfaces to encourage infiltration.
- Store stormwater beneath driveways, parking areas and sidewalks.
- Amend soils for infiltration and retain surface roughness.

- Maintain well-functioning drainage patterns.
- Plant shoulder vegetation and maximize sheet flow to slow stormwater runoff.
- Create flatter slopes, flatter and wider swales, and long flow paths.
- Use rain barrels and cisterns, and catch basins and seepage pits.
- Retain or create vegetative swales and buffers.
- Create infiltration swales/trenches.

- Prevent pollution – avoid/minimize use of chemicals and fertilizers (and use wisely);
- Do not mow lawns really short.

Source: Skabelund 2010, personal communication

In implementing the driving tour, it is hoped that concepts related to watersheds and achieving goals for restoration and protection can be introduced in a way that will engage and involve the participants.

CHAPTER 3 - Literature Review: Driving Tours and Related Topics

The purpose of this literature review is to provide an overview of what has already been done with driving tours in Kansas in order to build upon the approach taken by others to promote particular interests in Kansas. Also, through a review of studies done by outside agencies on ecotourism and experiential tourism, this section of the report the review endeavors to identify winning strategies for making a watershed driving tour successful. Developing a "Thematic Framework" is one such strategy identified in designing the tour. It is important to note that this literature review is not a complete review of all sources of information—rather it focuses on the particular resources used in developing the Upper Wakarusa Watershed Driving Tour.

Driving Tours in Kansas

Driving tours in Kansas usually emphasize sites of a particular interest (as opposed to driving tours in states like Colorado which promote grand vistas and mountains). These interests include history, geology or nature. The idea is to emphasize the subtle beauty while guiding the participant through historic routes (or offbeat sites such as the world's largest ball of twine). For example, Kansas Magazine's (2002) Civil War driving tour begins in Topeka and takes a route east to Lawrence and then south along the Missouri border to Baxter Springs. This Civil War driving tour includes Constitution Hall in Lecompton (where pro-slavery delegates met) and takes drivers through battlefields and event sites in the Bleeding Kansas era. Other tours include Kansas Cattle Towns, African-American Heritage, Historic Pony Express and Oregon Trail. Although flowery in their rhetoric for the beauty of Kansas, the tours are designed to explore Kansas by targeting audiences with particular interests.

Kansas Scenic Byways are routes designed and promoted to expose residents and visitors to roadways associated with compelling scenic views and vistas (see Fig. 3-1). The designation of a scenic byway involves a multiple step process which includes a management plan for preserving and enhancing the route with oversight from the Kansas Scenic Byways Committee. According to the Committee, one objective of the program "is to designate Kansas scenic roads that represent the diversity of the Kansas landscape" (Kansas Scenic Byways, 2010, 1).

In general, scenic byways should have the following characteristics:

1. Uniformly high visual quality along the entire route;
2. Be paved and able to accommodate tour buses and large recreational vehicles;
3. Have sufficient length to reward users for their drive to the byway, i.e. a byway of 20-30 miles long, unless it is located within 15 miles of an interstate or arterial highway.

Figure 3-1 The Nine Scenic Byways of Kansas

Source: Kansas Dept. of Commerce and Tourism

One of the newest scenic byways travels through the wetlands of Cheyenne Bottoms and Quivira National Wildlife Refuge and largely consists of county roads. Although the tour

emphasizes scenic beauty, it also provides opportunities to view wildlife and especially birds around the Cheyenne Bottoms Wildlife Area.

Another source of promoting local interests is the placement of Historical Markers which are located throughout Kansas along State Highways. These markers are erected by the Kansas Historical Society and the Kansas Department of Transportation with the stated purpose "to create awareness of historically significant and interesting sites in the state and to entertain travelers" (Kansas Historical Society, 2010, 1).

Two books have been written that specifically address driving through the Kaw Valley (a large watershed of 60,000 square miles beginning in Junction City and ending where it joins the Missouri River). The Upper Wakarusa Watershed is just a small part of the Kaw Valley, containing only 1,600 square miles. The first of these books is *Kaw Valley Landscapes* first published in 1977 and later revised in 1988 by James Shortridge. The route described in this book begins in Kansas City, travels north to Leavenworth, west to Wamego, south to Eskridge and then back northeast to Kansas City. The total route is 354 miles and is designed to interpret the cultural landscape of northeast Kansas. The second book is *Exploring the Kaw Valley* by Lynn Byczynski (2002) in conjunction with the Kaw Valley Heritage Alliance. The book explores the watershed through what the author calls a holistic view. Thus watershed issues such as pollution and ecological education are presented along with cultural and historical aspects.

A book called *Kansas Curiosities* by Pam Grant (2002)is a travel guide through Kansas exploring what the author refers to as "offbeat stuff." These include such sites as a fan museum, the world's largest ball of twine (although this has been contested), roadside totem poles, and a dinosaur made out of scrap metal.

Other travel guides for Kansas includes *Roadside Kansas: A Traveler's Guide to Its Geology and Landmarks* (Buchanan, & MaCauley. 1987) which again addresses a specific interest—in this case geology. A web site called "GeoKansas," sponsored by the extension service of the Kansas Geological Survey, also has field trips of geological interest.

Other websites and promotional materials are sponsored by local tourism and have driving tours promoting local regions. Typically these tours are sponsored by regional tourism associations. Links to these sites can be found at the Kansas Department of Tourism.

To make the Upper Wakarusa driving tour a successful venture, it was necessary to understand what has already been endeavored in promoting Kansas as a destination spot for visitors. Although the literature related to driving tours in Kansas covered a wide range of areas, the common theme for tours was to promote a particular interest. These interests included history and culture, geology, nature, scenic roads and curiosities. Introducing a person to watersheds will require efforts to extract what is unique to the area and promoting it to a particular interest the visitor may have.

Ecotourism and Experiential Tourism

The International Ecotourism Society defines ecotourism as "responsible travel to natural areas that conserves the environment and improves the well being of local people" (International Ecotourism Society, 1). Many other definitions exist although all have similar principles which include: nature based tourism which minimizes impact, appreciation of nature and local culture as a primary reason for participating, promotion of environmental education to visitors, and providing a benefit to the local economy (Smith, 2005).

In many parts of the country, ecotourism has been promoted heavily. Many states have contracted to outside agencies to develop plans for ecotourism. The Kansas Department of

Commerce and Tourism has engaged Fermata, Inc., a consulting firm for wildlife watching, conservation programming and nature tourism development, to do two studies within the state. The two studies are the "Experimental Tourism Strategy for the Kansas Flint Hills" and a tourism plan for the wetland complex near Great Bend.

Fermata, Inc. describes the target market for the Flint Hills study to include "the rapidly growing number of US travelers, known as experiential tourists, who are seeking experiences that allow them to learn first hand the lifestyle, culture and history of rural areas" (2005, 5). The concept of experiential tourism fits well in how Kansas has promoted the state by emphasizing specific interests. Although the Flint Hills is a unique area of native prairie within the United States, it is not considered a destination spot for a large number of visitors outside the state. The fairly lengthy Fermata study produced several models and recommendations for tourism opportunities. Several of these concepts will be introduced in the framework of the driving tour for the Upper Wakarusa Watershed.

Another study done by Fermata (2002) was the wetland complex of Cheyenne Bottoms and Quivira National Wildlife Refuge near Great Bend, Kansas. The study produced five specific recommendations for promoting nature tourism within and near the Great Bend area which included (pg.13):

- Recommendation 1: Develop a Theme
- Recommendation 2: Develop a Portal Site for the Bottoms Complex
- Recommendation 3: Partner With Other Kansas Resource Venues
- Recommendation 4: Develop Marketable Itineraries
- Recommendation 5: Develop Regional Web-based Marketing

Although The Upper Wakarusa Watershed Driving Tour is not the same kind of tourist destination as those in the study developed by Fermata, many of the concepts have overlapping applications that can be directly applied to this study.

Further review of ecotourism literature shows that it is mainly focused on promoting travel to natural areas for non-resident visitors. Except for guided tours, no other studies were identified that focus on a driving tour for promoting environmental education to local residents, although an Allegheny College website was of particular interest in its design and approach.

A nature tourism driving tour was developed by Allegheny College in Northwest Pennsylvania. The purpose of the driving tour was promoting ecotourism within the area. An interactive website allows the user to first pick a subject (agriculture, birding, forests, water, etc.) then navigate to a tour of particular interest. Each site has a description of the area and an "environmental issue." The website is of particular interest in its design and educational emphasis, although the purpose was focused on promoting the area to non-resident visitors.

Websites are critical in providing information for potential visitors planning to take a trip. Providing enough information to entice people to visit and then assist them in trip planning is indispensable to making the Upper Wakarusa Driving tour successful. The purpose of looking at other websites that stimulate interest should be to help provide a model in building a website that can promote a rural area such as the Upper Wakarusa Watershed.

Thematic Framework

In 1936 the National Park Service (NPS) adopted a Thematic Framework for evaluating cultural resources within the NPS system. The framework has been revised several times, with the last revision completed in 1997. The framework serves as an outline for evaluating historic properties and enhancing interpretative education (NPS, 2007).

Identified NPS themes are also criteria for qualifying as a National Heritage Area. In Kansas there are currently efforts underway to qualify two National Heritage Areas, including the "Freedom Frontier National Heritage Area," which includes part of Upper Wakarusa Watershed within the heritage study area.

Themes are also an important component of "Experiential Tourism" discussed by the NPS (2007, 13). Themes provide a method to engage the visitor with local environment such as history and nature. Themes are also an effective tool for interpreters to develop stories about place. The National Park Service discusses themes and interpretation as follows:

> An interpreter can use the thematic framework as a conceptual tool to identify themes, make intangible-tangible links, apply Freeman Tilden's (1957) principles of interpretation (which focuses upon firsthand experience rather than factual information), and get to the "knowledge of resources" which is the first part of the Interpretative Equation: (knowledge of resources + knowledge of audience + appropriate technique = interpretation): an effective linking between audience and resource (NPS, 2007, 13).

Target Audience

For practical purposes, the Upper Wakarusa Watershed Driving Tour is an outreach campaign for attaining specific goals and objectives. These goals were briefly mentioned in this paper on page 26 and are spelled out in more detail in the WRAPS report. The USEPA *Guide for Conducting Watershed Outreach Campaigns* (EPA 2003) emphasizes the need to identify the audience to be reached in order to help achieve these goals and objectives. The steps required are segmenting the audience, determining what information is needed, gathering audience profile information, and analyzing and understanding the audience. Since this method is both time consuming and expensive it is also beyond the scope of this paper.

Another technical document compiled by the USEPA, *Community Culture and the Environment: A Guide to Understanding a Sense of Place*, was designed to bring a "…better understanding of community values and processes as they relate to environmental issues…"

(2002, 3). Three concepts, borrowed from the USEPA, were used to define community, namely: sense of place, sense of community, and community culture.

Sense of Place

When thinking of sense of place, it is common to define it in terms of administrative boundaries such as county, township, city or school district. This is not surprising since local residents commonly deal with local issues within this context such as voting, law enforcement, schools, roads, and other civic functions.

Sense of Community:

Sense of community generally involves people who have common links. This can be simply people who interact socially, or religious and community organizations that draw together people of mutual views or goals.

Community Culture

Community culture can be conveyed by the social norms that exist within a community.

It is the premise of this report that people do not identify "sense of place" to a watershed. This driving tour is to introduce what a watershed does as it relates to where we live. When considering these concepts and targeting the audience, it is not necessary to completely redefine "sense of place,"— rather add the concept of "my watershed" as another key aspect of "place." Consequently, besides recognizing administrative boundaries that lend to the sense of one's "home town" or the "city or county where I live," the concept of sense of place can be expanded to include the natural boundaries and names of watersheds and subwatersheds.

CHAPTER 4 - Approach to Developing the Tour

The principal focus of this report is to develop a framework to make people aware that they live in a watershed and that their activities have a direct influence on water quality. Early on in the process, a driving tour was identified as an outreach and educational tool for both residents of the watershed and individuals interested in learning about a watershed. As previously noted, that "awareness" is a necessary first step in a process of engaging citizens in action.

Problem Identification

The initiative for this venture began with a dialogue with Aimee Polson in 2005, who at the time was the WRAPS coordinator for the Upper Wakarusa Watershed. She considered the primary barrier to the watershed planning process to be a lack of awareness by local residents that they live in a watershed and thus have direct and indirect impacts on their watershed. This seemed especially true for the suburban residents who commute to the surrounding communities. At that point a further discussion began about how to best involve the residents in learning about a watershed and relating to it as a living, functioning place. After considerable discussion it was jointly decided that a driving tour of the watershed would be a way to initiate watershed awareness-building among residents in the Upper Wakarusa Watershed (UWW).

Goals and Objectives

Two key ingredients in the planning process are public participation and clearly defined goals. Public participation begins with an awareness of an issue that impacts their lives. Based on this, the first step in engaging the public is to develop a framework for making residents aware that watersheds are a critical part of their environment, future well-being, and community

health. The driving tour of the UWW is intended to help residents, visitors and experience the area more deeply and to address the following over-arching goals:

- Develop meaningful themes that engage the participants in learning about a watershed and give insight to the relationship people have to the watershed.
- Introduce concepts that are relevant to the lives of residents and visitors and their understanding of a watershed.
- Generate the concept of "sense of place" as it relates to a watershed.

Developing the Driving Tour

The first task was to develop an inventory of the natural, cultural, and recreational resources within the area as it pertains to a watershed. This following describes the process to complete this part of study.

Step 1: GIS Data Collection and Thematic Maps

For purposes of identifying information about the watershed, thematic GIS maps were created using online data. The leading source of this material came from downloading data from Kansas Geospatial Community Commons which is a site administered by the Kansas Geological Survey as part of the Data Access and Support Center (DASC). The following sections detail the data layers that were obtained from this site.

Land Cover Data from the Kansas Gap Analysis Program

The first data set came from the Gap Analysis Program (Cully, et al., 2002) which is a national program to provide conservation assessments by identifying gaps in the protection of biodiversity. The Kansas Gap Analysis Project (KS-GAP) is a land cover map developed from remote sensing satellite data of 16 scenes of imagery from three dates from the Landsat Thematic mapper. The natural vegetation classes were identified with supervised classification to include

40 natural vegetation classes. Two semi-natural classes (non-native grassland and CRP) and three built classes (urban, cropland and lakes) were included in the Kansas land cover map.

Data came from a KS-GAP 3.x project that included vector and raster data. Data was downloaded from the Kansas Geospatial webpage and then imported into ArcGIS 9.0 project. The result of the KS-GAP project was land-cover data at a 30 meter resolution for the entire State of Kansas. Landcover data from this dataset is the basis for the vegetative maps presented in Appendix A-Map Section.

Farm Service Agency National Imagery Program

The National Agriculture Imagery Program (USDA 2005) produces images tiled from scanned aerial natural color film or color infrared film during the agricultural growing season. The images were rectified to the UTM coordinate system (NAD 1983), with each mosaic covered a county area. Douglas, Osage and Shawnee counties were in UTM 15 while Wabaunsee County was in UTM 14. These images were downloaded for the UWW from the Kansas Geospatial website.

Administrative Boundaries from 2000 Tiger Files from Bureau of Census

U.S. Bureau of Census Tiger line files were converted into ESRI Arcview Shapefiles by the Data and Access Support Center (DASC, 2002). Of the fourteen themes available, two were used in this project: County Boundaries and Tiger 2000 Roads.

State Highway System from Kansas Department of Transportation

This dataset is a single, centerline highway network of the 10,000 miles of State of Kansas Highways. The vector based dataset is produced by the Kansas Department of Transportation, Bureau of Transportation Planning (KDOT, 2006). Data for the UWW were downloaded from the Kansas Geospatial website as a Shapefile.

HUC Boundaries, 11 Digit Level, 14 Digit Level

The HUC Boundaries data set is a digital hydrological unit boundary originating from the USDA and NRCS (USDA 1993). Data was downloaded from the Kansas Geospatial website using the 11 digit code for the Upper Wakarusa Watershed and the 14 digit codes for the subwatersheds.

Streams and Rivers

Mapped information regarding streams and rivers were obtained from the National Hydrography Dataset (NHD) originating from the U. S. Geological Survey in cooperation with the U. S. Environmental Protection Agency (USGS 2004). The dataset for UWW was downloaded from the Kansas Geospatial website.

Table 4 summarizes data type and source from which it originated.

Table 4 Summary of Data Obtained for Thematic Maps

	Data	Data Type	Source	Year
Boundaries	County Boundaries	Vector	Tiger 2000	2000
	HUC 11 Boundaries	Vector	USDA, NRCS	1993
	HUC 14 Boundaries	Vector	USDA, NRCS	1993
Water	National Hydrological Dataset (Streams)	Vector	US Geological Survey	2004
Roads	County Roads	Vector	Tiger Roads	2000
	State Highways	Vector	KDOT	
Vegetation	Kansas GAP Analysis Program (GAP)	Raster	KARS	2000
Imagery	National Satellite Imagery	Raster	USDA	2005

Data layers covering the Counties, HUC 11 boundary (Upper Wakarusa Watershed) and the HUC 14 boundaries (the eight subwatersheds) were created by clipping the downloaded data for the specific boundary. The clip output generated a data layer for the each of boundaries. Data layers were then combined to produce thematic maps (refer to Appendix A).

The "Appendix A: Map Section" contains maps of rivers and streams, vegetation, aerial imagery and includes maps of the individual subwatersheds. Every map (except A-2) contains either a HUC 11 or HUC 14 Boundary, County Boundaries, County and State Roads, and Streams. Maps A-3 thru A-6 also contains vegetation and aerial imagery. Table 5 summarizes the maps in Appendix A.

Table 5 Maps contained in Appendix A: Map Section

Map A-1	The Upper Wakarusa Driving Tour: HUC 11 Boundary
Map A-2:	HUC 11 & HUC 14 Boundaries
Map A-3:	Vegetation Alliances
Map A-4:	Vegetation Alliances: Forest and Woodlands
Map A-5:	Vegetation Alliances: Cultivated & CRP (Conservation Reserve Program)
Map A-6:	Vegetation Alliances: Prairie, Grassland and Marsh
Map A-7:	HUC 14: South & Middle Branch Wakarusa River (2^{nd}-4^{th} order streams)
Map A-8:	HUC 14: South & Middle Branch Wakarusa River (1st-4^{th} order streams)
Map A-9:	HUC 14: North Branch of the Wakarusa River
Map A-10:	HUC 14: Six Mile Creek
Map A-11:	HUC 14: Lynn & Bury's Creek
Map A-12:	HUC 14: Camp Creek
Map A-13:	HUC 14: Elk Creek
Map A-14:	HUC 14: Deer Creek
Map A-15:	HUC 14: Rock Creek

Step 2: Driving the Watershed

As alluded to earlier, the idea for a driving tour originated from a discussion on December 13, 2005 with Aimee Polson (WRAPS coordinator for the Upper Wakarusa Watershed at that time). Pursuing this exploratory approach to understanding the UWW, the

author embarked on numerous trips through the watershed to first familiarize himself with the watershed and then narrow down options for a driving tour route.

At first, the exercise was somewhat a random process of driving through the many miles of country roads and taking pictures of interesting sites. Driving alone, it became very cumbersome to record places and mileages. This was especially true when driving a narrow blacktop that had no shoulders for pulling off. The thematic GIS maps were used as a guide for traveling through the countryside and routes were usually charted out beforehand. However, holding to a prescribed route was often put aside when an interesting looking road appeared.

The author's original idea for the tour was to include the entire watershed beginning at the headwaters and following the Wakarusa River until it reached Clinton Lake. A route was devised on paved roads that included all eight subwatersheds.

The first iteration of the watershed tour would have taken tour participants from the western headwaters, and following the Wakarusa River to Clinton Lake. The idea was to introduce concepts as water moved from the headwaters through the middle reaches and on to the lake. Taken literally, this would have entailed taking the full driving tour—beginning the trip in a remote rural area and driving along two-lane county roads. For the first thirty miles, this route includes only three stopping places with public access. After introducing this idea for the tour to several test participants (including Alison Reber, the Executive Director of KVHA, and other watershed stakeholders), it became obvious that such a formal tour route (point A in the western portion of the UWW to point B north of Clinton Lake) would attract little interest. Although this route could be readily explored via the Internet (virtually), the physical, on-the-ground tour needed rethinking.

After further research, particularly studying Fermata's work (discussed in Chapter 3), it became obvious the tour must incorporate existing infrastructure, local organizations, and a thematic framework that could attract a variety of interests. It was also important that primary stopping places be on public land. At this point, discussions began with the Army Corps of Engineers, Kansas Department of Wildlife and Parks, and the Wakarusa River Valley Heritage Museum. These agencies and organizations strongly supported the driving tour concept and felt that it was within their respective missions to allow their facilities to be used for educational displays and publicizing the tour.

The final route for the tour was derived from looking at factors that would attract the most interest. These factors included having a gathering place to begin the tour, having a method of publicizing the tour at the start, and including stops along the route that offer meaningful educational and recreational opportunities on public land.

Step 3: Reaching the Target Audience

In reaching the target audience the first step is to establish how the tour will be publicized and to then address the interests of likely participants (rural and suburban residents of the UWW and non-residents who visit the region or Clinton Lake facilities).

At the outset, the project may be advertised through the local environmental groups, the Clinton Lake Information Center, and the Wakarusa River Valley Museum. Presence on the Internet will be essential for building awareness of the driving tour, and links from KDHE, KVHA, USACE, and other stakeholder websites is seen as vital. It is recognized that for a number of people, a virtual Internet tour may be their only chance to experience the watershed. This is especially true for those with limited ability to drive the tour and those living in other states or regions.

Initially the audience may primarily be environmentalists and visitors to the lake and museum. However, the project is designed to be an outreach program for defining a watershed as a "sense of place" and thus attempt to reach a broader audience. As the tour becomes established it my take advantage of local newspapers, Kansas Department of Tourism, public bulletin boards, and other forms of community information.

Consequently, the goals are designed to be broad and inclusive while serving as a guide to learn about a watershed. It is expected that participants will take away their own interpretative meaning from their experience of the tour. The job of the designers of the tour is to make the outing interesting to a broad audience.

Per USEPA guidance (2003), it is important for tour planners to employ effective assessment methods to identify the people most likely to participate. Profiling potential users of the UWW Driving Tour is recommended as a first step by those who take this idea further.

Step 4: Identifying Environmental, Historical and Cultural Resources in the Watershed

The United States Environmental Protection Agency (USEPA) "establishes policies and program requirements for water quality planning, management and implementation" (2005, Code of Federal Regulations, Title 40 Volume 21) as part of the Clean Water Act. Although the Act requires a consistent approach for all states, it allows States to implement individual programs that are adapted to local needs. In return, the USEPA provides monies and technical assistance for states to develop programs to restore and protect watersheds. The USEPA has a website that contains a large range of material dedicated to watersheds—ranging from very technical to educational material for children. The website also contains handbooks in PDF format that can be directly downloaded. Information from these resources will be valuable points of reference for those who work to implement watershed tour ideas.

The Kansas Department of Health and Environment (KDHE) has the statutory responsibility to administer the Clean Water Act in order to meet the federal TMDL requirements. Much of the emphasis in implementing restoration and protection has been at the local level, where agencies and local groups receive technical assistance and monies from USEPA through KDHE. In order for this to work on a voluntary basis, public awareness and involvement are crucial. Consequently, KDHE is involved in providing technical assistance and outreach for organizations and stakeholders concerned with watershed issues.

The *Upper Wakarusa Watershed WRAPS (Watershed Restoration and Protection Strategy)* is the document compiled by a core group committee of KVHA. The document discusses the planning and management strategies of the different implementing organizations and identifies the basic strategies for the WRAPS process for the Upper Wakarusa Watershed. To be successful, active, on-going support by KVHA for the Upper Wakarusa Watershed Driving Tour is deemed to be crucial.

National Resource Conservation Service (NRCS) is part of the U. S. Department of Agriculture (USDA) and provides technical services for the conservation of soil, water and natural resources. The NRCS also administers incentive and cost share programs which is a critical component of restoration and protection of watersheds on private land.

United States Army Corps of Engineers (USACE or Corps) manages Clinton Lake, into which all of the rivers and streams of the Upper Wakarusa Watershed flow. Along with the Kansas Department of Wildlife and Parks, the Corps manages an additional 15,000 acres around Clinton Lake. Educational resources are contained within the recreation area including a visitor center and strategically located kiosks.

Kansas Department of Wildlife and Parks (KDWP) manages much of floodplain around Clinton Lake. Some of this land has been re-established as prairie, oak hickory forest or wetlands, while some land has been leased for agricultural use. Conservation practices and wildlife habitat preservation are part of the lease requirements and should continue to be encouraged by KDWP and other stakeholders.

The *Kansas Biological Survey* (KBS) is a research component of Kansas University and the State of Kansas. The mission of the survey is to "gather information on the kinds, distribution, and abundance of plants and animals across the State of Kansas and compile, analyze, interpret and distribute this information" (KBS, 2010, 1). KBS contains an online library and research center that is available to anyone.

Kansas GAP Analysis (KS-GAP) is a cooperative effort of State and Federal agencies to map land cover with satellite data and integrate vertebrate distribution models to the land cover maps. Although GAP analysis was principally designed to identify gaps in the protection of biodiversity, the maps processed through GIS can be a tool for identifying land use for general educational purposes. GIS maps can also be used or adapted to create visual aids for signs, brochures and documents. Visual aids can and should be archived on the internet site for the UWW Driving tour.

The Wakarusa Valley Heritage Museum is small museum located in Bloomington Park just to east of the town of Clinton. The mission of the museum is to preserve the heritage of the Clinton Lake area. It also designated as a facility on the National Parks Service "Underground Network to Freedom."

Step 5: Developing the Thematic Framework

The purpose of categorizing themes for the Upper Wakarusa Watershed Driving Tour is to identify topics that may be introduced along the tour. The themes are to serve as a guide in locating places along the route that create educational opportunities for diverse interests. Further, through particular themes it will be possible to identify topics pertinent to a particular age or interest group. For example, visitors to the tour with a primary interest in history can learn how the watershed influenced settlement patterns in the region. In return, this may inspire interest in how watersheds shaped the region in which visitors live. Introducing themes that stimulate learning by people of diverse backgrounds, ages and interests is crucial in making a driving tour successful.

Watershed Education: Structure and Function of the Upper Wakarusa Watershed

Watershed education provides the basic building blocks of understanding a watershed and how it functions. This theme focuses on how a watershed is a unique place because it is defined by distinctive natural boundaries and the movement of water over different land use types. In discussing watersheds, residents and other visitors should become aware of how watershed boundaries relate to other types of boundaries (for example, physiographic regions, ecoregions and ecosystems and geographic lines drawn for political, jurisdictional, land ownership and other purposes).

Places associated with this theme should include sites that can help visitors recognize what a watershed is and how it functions. For example, at mile 16.5 of the driving tour is a ridgeline that divides two subwatersheds. The water draining to the north flows to Deer Creek in the Deer Creek Subwatershed while the water draining to the south enters the Wakarusa in the Elk Creek Subwatershed. The formation of streams at their headwaters can also be seen from

this vantage point within the UWW. Thus, this one geographic feature can be used to introduce several topics that help explain what a watershed is, how it functions, and its relationship to other types of boundaries.

Environmental Issues in the Upper Wakarusa Watershed

Environmental issues theme addresses the influence humans have on shaping the landscape within the watershed as well as the natural functions and ecosystem services that land and water resources within the watershed can provide. This theme takes into account why these functions are important in providing clean water as well as the importance of restoring and protecting the watershed.

Sedimentation has been a concern related to man-made reservoirs for many years and is a significant challenge given the cost of dams and the need for the services they provide. As a stream enters the lake, the flow of water slows down due to a decrease gradient and much of the suspended sediment settles to the bottom of the lake. Accumulating sediments decrease the amount of water storage in the lake. The chemical properties of the sediment frequently contribute to decreased water quality. Impacts of sediments and other pollutants on aquatic life are significant a concern in Kansas. On County Road 1023 at mile 18.8 the tour passes a causeway over a floodplain at the place where the Wakarusa River enters Clinton Lake. Here the movement of the river is controlled by the lake and the effects of sedimentation can be readily visualized.

Historical and Cultural Aspects

As previously mentioned, Kansas has used history as core theme for attracting visitors to features, sites, communities and scenic byways throughout the state. The Upper Wakarusa Watershed has many important trails and routes the early settlers used for traveling west. This

includes the Oregon Trail and Santa Fe Trail (which are marked by highway signs). The watershed is also part of the area that is included in the proposal for a designation of Freedom Frontier National Heritage Area (FFNHA, 2009). The Clinton Lake Historical Society has done extensive research in the area, and along with many organizations, is contributing to research for the National Heritage region.

Using these many resources of historical scholarship allows for an expansion of themes. The UWW Driving Tour can identify the importance of the watershed in relation to its historical context to in provide greater interest in the tour. The watershed has had a continual interplay between natural features and human activities which is constantly evolving and can be interpreted and re-interpreted through the driving tour. Places associated with settlement, flooding and terrain reflect the importance this watershed has had on the history of the region.

Political and Jurisdictional Landscapes

This theme focuses on the institutions that create public policy and the people and organizations that try to shape these policies. These policies may change to reflect the current conditions and perspectives on the environment and such decisions can have long term consequences. For example, the widespread flooding of 1951 created a strong political climate for building federally-funded dams. Before the flood there were only five federally-funded dams that controlled the Kansas River Basin. Now there are a total of eighteen federally-funded dams that control the flow of the Kansas River. Except for landowners who did not want to sell their property and leave their land, there was little opposition to building the dam associated with Clinton Lake. The political landscape was largely shaped by the response to severe flooding at the time and the decision to build the dam was made accordingly.

More recently, land issues have polarized the political environment between development and environmental concerns. For example, a portion of Kansas Highway 10 (K-10) was to be built as a bypass around the City of Lawrence to connect the western side of town to the four lane portion of K-10 that runs to Kansas City from the southeastern edge of the city. A portion of the highway was built that ends at a bridge over US 59 on the south side of the city. The political controversy concerns' extending the highway through the Baker Wetlands, and thus completing the bypass has been put on hold for years. Literature associated with the UWW Driving Tour can objectively discuss these kinds of issues and point out the pros and cons from differing vantage points.

Ecoregional Context, Ecosystems and the Upper Wakarusa Watershed

Ecoregions are areas that have similar landscape components which include geology physiography, vegetation, climate and soils. Given that ecoregions have common characteristics, it allows for establishing a baseline for environmental assessment and management of the ecosystem within an ecoregion. Omernik (1995) devised a hierarchical classification scheme for dividing the continent into ecological regions with level I being the broadest with 15 regions. Level II classification divides the broad regions into 52 ecoregions while Level III is further subdivides the continent into 98 ecoregions. Level IV classifications are further subdivisions of the Level III ecoregions.

The Upper Wakarusa Watershed is within the Osage Cuestas (Level IV) portion of the Central Irregular Plains (Level III) Ecoregion. The climate for this region is humid with an average rainfall of 28 to 40 inches per year. The natural vegetation is tallgrass prairie and oak hickory forest while the soil supports a land use of crops, woodland and grassland (USEPA 2001), The USEPA considers ecoregions "an effective aid for inventory and assessing national

and regional environmental resources, for setting regional resource management goals, and for developing criteria and water quality standard" (2010, 2) .

The Kansas Department of Wildlife and Parks (KDWP) have developed a "Comprehensive Wildlife Conservation Plan" required by federal legislation. The plan identified broad priorities for protecting species habitat and strategies for dealing with issues that threaten wildlife habitat. KDWP divided the state into three "Conservation Regions" as defined by the North American Bird Conservation Initiative. The three regions are the Short Prairie Conservation Region, the Central Mixed Grass Conservation Region and the Eastern Tallgrass Conservation Region. The Upper Wakarusa Watershed is located within the Eastern Tallgrass Prairie Conservation Region.

As defined by the Kansas Comprehensive Wildlife Conservation Plan, the key habitats for the Eastern Tallgrass Prairie are as follows:

Tallgrass Prairie Habitat, which once covered vast areas of the Great Plains, is rapidly declining. Presently, the largest tracts are in the Flint Hills, while only smaller isolated tracts remain in other regions, including the Upper Wakarusa Watershed.

Herbaceous Wetland Habitat includes habitats of Low and Wet Prairie, Freshwater Marsh, Cattail Marsh and Weedy Marsh. These wetland habitats are found in floodplains of rivers and streams along with the edges around lakes and reservoirs. Around Clinton Lake are several large wetland tracts protected by KDWP.

Aquatic-Eastern Streams/Small Rivers Habitat includes habitat around streams and their tributaries. All waterways within the Upper Wakarusa Watershed are streams or small rivers.

Deciduous Forest and Deciduous Floodplain Habitat is characterized by Oak-Hickory Forest and Mixed Oak Ravine in the upland areas, while Cottonwood Floodplain Forest is dominant in the floodplain areas.

Aquatic Eastern Large Rivers Habitat includes large rivers distinguished by the Kansas River, which the Wakarusa flows into near Eudora, Kansas. Although the Kansas River is not within the Upper Wakarusa Watershed, its quality of habitat is partly determined by the health of the tributaries that flow into it. Thus protecting and restoring the UWW translates into the improving the health of larger watersheds.

For each of the key habitats, KDWP has made a list of "Kansas Species of Greatest Conservation Need Selection and Ranking" and developed issues and strategies related to managing and improving the habitat of the species. These issues and strategies can be found at the KDWP website with the general themes being summarized by KDWP as follows:

> (a) existing data gaps impede effective conservation planning and implementation,
> (b) land management practices have changed the structure of habitats over large areas,
> (c) fragmentation and conversion of habitat is occurring,
> (d) invasive exotic plants and animals is a problem,
> (e) natural resource management may affect habitat conditions, and
> (f) inadequate coordination between government agencies who may have conflicting goals for resource management (KDWP, 2005,pg16).

There are several important reasons for using the KDWP Conservation Plan in identifying habitats in this report. First, KDWP has broad statutory authority for conserving wildlife and its habitats. This gives added weight to implementing best management practices and shares with other agencies strategies such as cost sharing for implementing these practices. Second, KDWP manages much of the public land around Clinton Lake. Much of this land is leased for agriculture using strict management practices.

KDWP has educational resources and expertise that, along with resources and expertise provided by the USACE, can be utilized in the development and implementation of an engaging driving tour. By offering a shared vision of habitat protection within the driving tour, it is hoped this land can be used for educational purposes in cooperation with both KDWP and the USACE.

CHAPTER 5 - The Driving Tour

The driving tour described in this report has been designed to serve as a blueprint for its future implementation. The route was devised to take advantage of the area's resources on public land while adhering to guidelines that have proven successful in promoting rural areas such as the Flint Hills and Cheyenne Bottoms. The actual implementation of the Upper Wakarusa Watershed Driving Tour is expected to be led by local coalitions working closely with state and federal agencies. A critical component will be to coordinate the actual design of displays and brochures. A web-portal would be another key element for successful implementation to the watershed driving tour since many people use the internet to make travel decisions. A web-portal will also allow potential visitors to learn about watersheds by taking a virtual tour and reading relevant information.

CLINTON LAKE VISITOR CENTER

Recommendation 1: Use the existing U. S. Army Corps of Engineers Visitor Center (Project Information Center) at Clinton Lake as a portal for the driving tour.

The term "visitor center" was first coined by the National Park Service in the Mission 66 program. This program was designed to revitalize the National Parks after the years of neglect during World War Two (Allaback, 2000). Since that time visitor centers have expanded to all types of enterprises, including those developed by cities and states. These facilities function as a center for visitor information and orientation to the location along with education delivery.

The Clinton Lake Project Information Center, located northwest of the Clinton Lake dam, serves as a portal for channeling visitors to venues of interest such as camping, hiking, boating

and hunting. Managed by the USACE this visitor center has brochures and a display area for topics such as history of the area, environmental issues, and wildlife.

Discussion with the USACE personnel regarding the concept of the Upper Wakarusa Watershed Driving Tour was well received by David Rhoades, (USACE Director at Clinton Lake) when the author met with him in June of 2006.

It is expected that the Clinton Lake Visitor Center will function as a primary starting point for the driving tour. The driving tour concept fits with the Corps' Environmental Operating Principles which are "to illuminate the ways in which the U. S. Army Corps of Engineers' missions must be integrated with natural resource laws, values, and sound environmental practices" (USACE, 2007, 1).

Figure 5-1 Clinton Lake Visitor Center (Source: Arnold Weir)

The Clinton Lake Visitor Center currently has displays addressing the history of the region, reasons for construction of the dam, and common wildlife in the vicinity of the lake. Environmental themes are also included in visitor center displays—however, there is minimal discussion of watershed structure, function, and values and the importance of watershed protection. An important step in implementing the watershed driving tour would be the design of an exhibit for the visitor center that would convey the educational and recreational benefits of the tour, and encourage visitors to explore the watershed.

For purposes of directing the tour, the visitor center is designated as mile 0.0, and all mileage designations resented in this report are referenced from this starting point.

Figure 5-2 Displays Inside the Clinton Lake Visitor Center (Source: A. Weir)

NORTH SHORE TRAILS AT CLINTON LAKE

Recommendation 2: Use Clinton Lake's North Shore trails for watershed education.

Three tenths of a mile from the Clinton Lake Visitor Center is the North Shore Recreational Area, which includes boat ramps, a marina and swimming area. This area is part of the land administered jointly by the Corps and Kansas Wildlife and Parks.

Large numbers of visitors use the North Shore Recreation Area each year. The Kansas Trails Council designed and built approximately twenty six miles of trails throughout the area and has created a brochure to help hikers and bicyclists navigate the area. The educational themes of the driving tour should utilize the many resources available on public lands by directing visitors to points of interest that relate to a watershed. Currently the trailhead contains a structure with a kiosk (Fig. 5-3) along with another sign that currently talks about the Upper Wakarusa Watershed (UWW) (Fig. 5-4). Additional emphasis can be placed on what residents and visitors can do to protect the UWW and other watersheds.

Figure 5-3 Kiosk at North Shore Trails (Source: A. Weir)

Figure 5-4 Corps of Engineers display of watershed map (Source: A. Weir)

CLINTON LAKE TO COON CREEK WETLANDS

Recommendation 3: Directing the UWW tour from Clinton Lake to Coon Creek Wetlands

The tour is designed to utilize the land between stops for educational opportunities. From Clinton Lake the tour turns onto Kansas Highway 10 (K-10) (mile 1.0) (Fig. 5-5). This section of road was completed in 1999 and begins at the new turnpike exit east of Lawrence and ends at Highway 59 south of Lawrence. A bridge crossing Highway 59 has been built but never utilized. The road was originally designed to bypass Lawrence by creating a limited access highway connecting to K-10 east of Lawrence. Because the second stage of the bypass was designed to go through a wetlands area, litigation between environmental groups and transportation proponents has been ongoing for years. How land is developed is a crucial issue for habitat functions and values in the watershed, and the wetlands controversy brings this to life. These kinds of challenging land use issues can be discussed as part of the driving tour.

The population of Lawrence has nearly doubled since Clinton Lake was finished in 1977. Most of this growth has extended west towards Clinton Lake. The Deer Creek Subwatershed is especially susceptible to urban development pressures since it is located close to major transportation routes and shopping. Consequently, it is important to enforce and/or introduce land planning and conservation measures that preserve riparian areas, wetlands and the hydrology of the area. In order to meet TMDLs, the WRAPS document has given the Deer Creek Subwatershed the first priority along with the area immediately surrounding the lake and Rock Creek Subwatershed.

Highway directional signage around Clinton Lake was designed and installed by the Army Corps of Engineers. Although design needs to be consistent with existing designation signage, an opportunity exists for developing thematic markers that can provide a means of

guiding visitors through the driving tour. The current markers maintained by KDOT for the different scenic byways around Kansas are a model for developing highway-based themes. Developing a signage system that complements existing signs in the region can provide a means of guiding visitors through the tour.

Figure 5-5 Highway K-10 (Source: A. Weir**)**

From K-10, the tour turns west for two miles on US-40 (mile 3.0), then continues west on County Road 442 (mile 5.1). At mile 6.8, drivers can turn left on E550 Road in order to take a side trip to the Coon Creek Wetlands. Currently a sign for the "Coon Creek Boat Ramp" is located at the intersection of County Road 442 and E550. At mile 8.5 is a parking lot that provides ready access to the Coon Creek Wetlands.

COON CREEK WETLANDS AREA

Recommendation 3: Stop at Coon Creek Wetland Area

At the present time, much of the wetland education for school children takes place at the Baker Wetlands area. Baker Wetlands is a 573-acre natural landmark located near Lawrence in the Lower Wakarusa Watershed (Fig. 5-6) that contains boardwalks and access to habitats that provide an optimal teaching/learning lab for wetlands education. The Coon Creek Wetlands could expand this educational framework by illustrating how a watershed functions—with wetlands being vital to the health of individual and interrelated ecosystems (terrestrial, aquatic and transitional).

Figure 5-6 Baker's Wetlands (Source: A. Weir)

Coon Creek is part of the Deer Creek Subwatershed, a drainage area north of Clinton Lake. Before the construction of Clinton Lake, the land around Coon Creek's juncture with the Wakarusa River was a large wetland area. When the lake was built, the stream channel was widened and flattened to make way for the lake while upstream the channel was contoured to limit flooding. This seriously damaged the native wetland ecosystem. In 2005 a grant was awarded to KVHA to assist in restoring the wetland (National Fish and Wildlife Association, 2010). This created wetland was planted with native sedges, grasses and wetland plants and was likewise terraced to catch sedimentation, allowing some of the pollutants to be absorbed by the wetland vegetation.

Besides the work in re-establishing wetlands, several physical improvements were also made, including the construction of a kiosk (Fig. 5-7), the addition of a park bench (Fig. 5-8) overlooking the wetlands, and trails built then topped with mulch. As mentioned above, a parking lot existed at this location.

The new kiosk serves as a gateway for exploring the site and engaging the visitor in learning about the wetlands and the watershed. Special consideration should be given to part of the display in order to meaningfully address the overall theme of watersheds and the connections between land use, water quality, habitat protection, and ecological and human health.

Figure 5-7 Kiosk at Coon Creek Wetlands (Source: A. Weir)

Figure 5-8 Park Bench overlooking The Coon Creek Wetlands (Source: A. Weir)

COON CREEK TO DEER CREEK

Recommendation 4: Directing the UWW tour from Coon Creek Wetland Area to Deer Creek

Returning north to County Road 1600 (mile 10.2), the tour turns west to the small community of Stull, Kansas. Stull has had a rich history as the center of settlement around Deer Creek. Today Stull consists of a few houses, a cemetery and a machine shop (which was formerly a general store). The Kansas Department of Wildlife and Parks (KDWP) leases an old homestead (built in 1870) and uses this building to administer public land around Clinton Lake.

At Stull, (mile 13.3) the tour turns south on County Road 1023. Just a tenth of a mile from the junction is a parking lot on the left side of the road (Fig. 5-9). This is a public lot maintained by KDWP and is principally used for access to hunting on public lands. Near the parking lot is a kiosk. Deer Creek is just to the south of the lot (Fig. 5-10).

Since the Deer Creek Subwatershed is under large-lot residential development pressure, one of the themes for this stop would be to educate the public about the value of maintaining healthy riparian areas around streams. Where residential development has or will occur in the future, low impact development (also called watershed sensitive design and development) can be strongly encouraged.

The theme of watershed protection will likely resonate with outdoors enthusiasts (including fishers and hunters) since the health of ecosystems on public land is dependent on the activities upstream and in surrounding landscapes.

Figure 5-9 Parking lot looking south toward Deer Creek (Source: A. Weir)

Figure 5-10 Deer Creek looking west from bridge (Source: A. Weir)

The driving tour continues south on County Road 1023. At mile 16.1 the road crosses Dry Creek. Although the Dry Creek now empties directly into Clinton Lake, it had been a tributary of Deer Creek before the lake was built.

At the Woodridge Park, a primitive area maintained by the Corps, the George Latham Trail runs four and a half miles through the park. A section of the trail runs along Dry Creek as it empties into Clinton Lake. The trail was developed and is maintained by the Kansas Trail Council. Signs lead to the park off County Road 1023 and a parking lot serves as a trailhead to the George Latham Trail. This trailhead serves as another possible location for visitor education regarding the functions and values associated with ecosystems nested within watersheds.

At mile 18.8, County Road 1023 crosses the Wakarusa River. The road runs along the western edge of Clinton Lake. Except for Deer Creek and Rock Creek, which empty directly into the lake, nearly all of the water from the UWW flows into Clinton Lake at this location. Because of the retention time of water in the lake, the Wakarusa River flows very slowly as it approaches the lake. In return, the sediment carried by the river settles to the bottom, decreasing the storage space for water in the reservoir. Furthermore, nutrients and chemical-trapped sediment settle into the lake leading to lower water quality (WRAPS, 2003).

To the west of the causeway is the Wakarusa River and Elk Creek floodplain. This area is managed by KDWP and three created wetlands are located within the floodplain (Fig 5-11).

Figure 5-11 Wakarusa and Elk Creek Floodplain (Source: A. Weir)

ELK CREEK TO WAKARUSA RIVER VALLEY HERITAGE MUSEUM

Recommendation 5: Directing the UWW tour from Elk Creek to the Clinton Museum

The watershed driving tour turns northeast at County Road 6. Signs are posted along County Road 1023 directing visitors to Bloomington Park and the Clinton Museum. The museum was originally called the Clinton Lake Museum and was founded in the early 1980s to remember the heritage of the Clinton Lake region after over three hundred families were required to relocate to make room for the reservoir (Lawrence Journal World, March 1987). The name was recently changed to the Wakarusa River Valley Heritage Museum and the museum is presently making plans for constructing a larger facility (Fig 5-12).

At present, an area of eastern Kansas and western Missouri is applying for designation as Freedom Frontier‘s National Heritage Area. The theme centers on the struggle for freedom around the time of the Civil War. Anticipated benefits include drawing additional visitors to the area and building a stronger “sense of place and history” with the local citizens. The Wakarusa River Heritage Museum is doing research on the Underground Railroad and the role that the Wakarusa Valley played in moving slaves to the north and west. The museum is also designated as a destination point on the National Park’s service “Underground Network to Freedom.”

Using the historical theme in the watershed driving tour may draw interest from people touring the National Heritage Area. The natural landscapes that the watershed entails and the evolution of this landscape over time are crucial in understanding the history of the area. For example, the rivers and streams within the valley determined where communities and farms were first settled in the area. Additionally, the vegetation along these waterways offered protection for slaves moving north and westward in an area that was likely a mix of tallgrass prairie and riparian woods and wetlands.

Using displays and brochures at the museum to promote the historical significance that the Upper Wakarusa Watershed plays in the heritage of the region would be within the museum’s mission, the museum con thus promote the importance of the watershed in regards to its sense of place and history.

Figure 5-12 The Wakarusa River Valley Heritage Museum (Source: A. Weir)

WAKARUSA RIVER VALLEY HERITAGE MUSEUM TO RICHLAND

Recommendation 6: Directing the UWW tour from the Wakarusa River Valley Heritage Museum to Richland

The tour returns from Clinton along County Road 6 and resumes on County Road 1023 which continues southwest. This part of the route is in the Rock Creek Subwatershed, with Rock Creek paralleling the road about a mile and a half to the southeast. County Road 1023 jogs west and turns south for a mile and half. The tour then turns west on County Road 460 (mile 33.0). At the Shawnee County line the road name changes to 125th Street. Two and a half miles from the intersection of Road 1023, the route enters the Elk Creek Subwatershed, and in another mile the road crosses Elk Creek (mile 36.6). The headwaters for Elk Creek are roughly four miles south of the town of Overbrook.

Where 125th Street dead-ends, the tour turns north (right) onto Shawnee Heights Road. The paved road turns back to the east and subsequently turns into Shadden Road. At mile 40.9 is a sign to the right in the field stating "Conservation Buffers Work" (Fig. 5-13). This particular project was funded by the USEPA through the Section 319 grant process for addressing non-point source pollution. The signage is used to display Best Management Practice (BMPs) to passersby where conservation practices have been adopted for establishing forest and vegetative filter strips along streams. High priority TMDL areas and land draining into the federal reservoirs are eligible for the program and most UWW lands meet both of these criteria.

Kansas State University has completed research that states "riparian buffers and filter strips are capable of reducing the runoff of sediments, nitrogen, phosphorus, and herbicides by 50 to 85 percent (Barden, et al 2003, 4)." This kind of information should be conveyed on driving tour brochures and signs as well as in information posted on the driving tour website.

Figure 5-13 Conservation Buffers Work (Source: A. Weir)

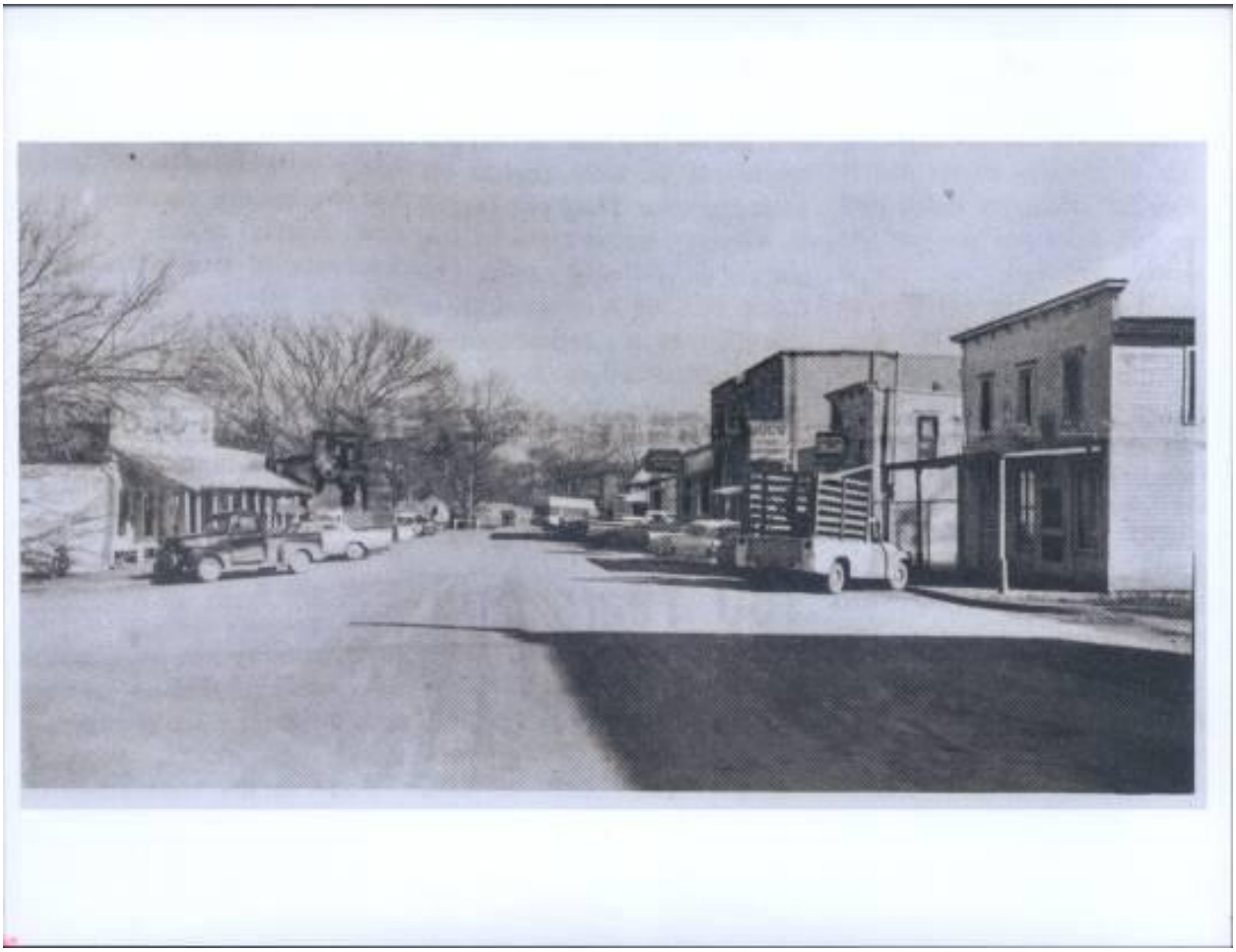
Shadden Road parallels Camp Creek, crosses over deserted Union Pacific Railroad tracks (at mile 41.2), and after that the driving tour turns north. At the point the tour turns north is Camp Creek Road. At this intersection, driving tour visitors could turn right and proceed about a quarter of a mile up the road. On the left is the entrance to the former town of Richland.

Richland, Kansas was first settled along Coon Creek near the confluence with the Wakarusa River (Fig. 5-17). Typical of small communities, the town had its booms, busts, floods and droughts, but this community of approximately 300 residents continued to exist into the 1960s with many small businesses (including a hardware store, gas station, restaurant, barber shop and grain elevator). By 1967, the Army Corps of Engineers began negotiations to buy out the businesses and residents to make way for Clinton Lake. Although the Richland was not part of the proposed lake bed, the town was considered part of the floodplain (Figs. 5-14 & 5-15).

Figure 5-14 Arial view of Richland Kansas in the 1960s

Source: Wakarusa River Valley Heritage Museum

Figure 5-15 Downtown Richland during the 1960's



Source: Wakarusa River Valley Heritage Museum

Today, KDWP manages the land where Richland once stood. While some of the surrounding land is leased to agriculture, it is all considered public land. The actual location where Richland once stood is overgrown with trees and vegetation. Some of the roads remain open to vehicular access and it is possible to drive up to Coon Creek. Other roads have been barricaded but the road embankments and some of the old asphalt still exists. Still other roads have been completely overgrown with vegetation (Fig. 5-16).

Figure 5-16 Remnants of old roadway in Richland (Source: A. Weir)

Figure 5-17 Confluence of Camp Creek and the Wakarusa River at Richland

Source: Arnold Weir

As the last scheduled stop on the Upper Wakarusa Watershed Driving Tour, this report proposes a number of steps to develop the Richland area as a nature center. This would allow travelers to learn firsthand about watersheds, natural systems, and the history of this part of east-central Kansas. Since presently there are severe state budget restraints, a number of private partnerships will be required to jumpstart the process of creating a nature center in this location if it is to be initiated in the near future.

The Landon Nature Trail is currently under construction as part of the Kanza Rails to Trails Conservancy developed under the National Trails Act. This is a 38-mile trail that runs from Topeka to Lomax Junction in Osage County and is being developed along the old Missouri Pacific Railroad line. This same trail passes just west of Richland under Shadden Road, the location of the former Richland grain elevator (Fig. 5-18). The trail is a north-south route and runs along Linn Creek, Camp Creek and the Wakarusa River.

Linking this trail to the former town of Richland could serve several purposes. First, the location could be an intermediate point on the trail where visitors could park and begin using the trail. Second, the Richland location could be used as portal for directing visitors to sites along the trail (which could be supported by kiosks and display maps, similar to the display of trail maps and educational materials at the North Shore Trail of Clinton Lake. The North Shore Trail display materials were purchased by Friends of the Trail Program and assembled as part of an Eagle Scout project and similar partnerships might be facilitated along the UWW Driving Tour. Finally, the Richland area could be used as shorter trail introducing the watershed. The old embankments of the roads would be a good starting point for developing trails to the Wakarusa River. Other trails could then be developed along both Coon Creek and the Wakarusa.

Figure 5-18 Deserted tracks of the Union Pacific Railroad, to become the Landon Trail

Source: Arnold Weir

A number of resources and organizations can be used for educational materials and guidance on developing the framework for the center. These include local organizations that have already developed sites for introducing the participant to experiences in a natural setting such as The Kaw Valley Heritage Alliance, the Audubon Society, North Shore Trails, Kanza Rail Conservancy, and Baker Wetlands.

RICHLAND TO THE HEADWATERS OF THE WAKARUSA RIVER

Recommendation 7: Continuing the UWW tour from Richland to the western headwaters of the Wakarusa River

The Upper Wakarusa River Watershed west of Richland is a rural area along a two lane black top with few places to stop and little public land. The following route gives a brief description of a tour to the western headwaters of the watershed, located some twenty miles to the west of Richland in Wabaunsee County.

Returning to Shadden Road from Richland, the tour turns north (right) to where it dead ends at 89th Street, then turns left on 89th. As the visitor ascends the crest of the hill at Stanley Road, they will enter the Lynn and Bury Creek Subwatershed. The road crosses Lynn Creek just past Tecumseh Road (Mile 46.4). Lynn Creek originates near Forbes Field, just to the south of Topeka, and meanders southeast until it links up with the Wakarusa River just south of the bridge on 89th Street. About a half-mile west of the bridge 89th makes a jog south until it connects with 93rd Street. The tour will follow 93rd Street for about thirteen miles traveling just to the north of the Wakarusa River.

At the crest of the hill just west of California Street, the road enters Sixmile Creek Subwatershed and four miles later (just before Burlingame Road) 93rd Street crosses Sixmile Creek. This creek originates roughly three miles north of Auburn where it flows southeast to connect with the Wakarusa approximately a half-mile southeast of 93rd and Burlingame Road.

The driving tour would remain on 93rd Street until it dead ends at Auburn Road. This is the area where the North, Middle and South branches all meet to form the main channel of the Wakarusa River. At this junction travelers would turn right on Auburn Road (which is the main street of Auburn) and go six-tenths of a mile to 89th Street and turn left. Just a half-mile west on 89th is the Auburn Cemetery. This high ground is at the ridgeline between the North and Middle

branches of the Wakarusa River. The lands to the west drain to the Middle Branch while the lands to the east flow to the North Branch of the Wakarusa River. Looking south from this vantage point it is also possible to see a line of hills in the distance. This is the ridgeline of the southern border of the watershed with the South Branch of the Wakarusa just to the north of the hills. To the south of our westward route on 89th is a line of trees that make up the main channel of Middle Branch of the Wakarusa River. As these first order tributaries join the main channel enough water is supplied to support a continuous (year-round) flow of water.

At Harveyville Blacktop, the route turns south for a mile and a half and then west onto Mission Valley School Blacktop. Just to the east of Mission Valley School and to the north, one can see a wide expanse of rolling hills. Here we are on a ridgeline with the water draining to the north moving to Mission Creek and the water moving to the south draining to the South Branch of the Wakarusa.

Two miles west of Mission Valley School is Bradford Road. Looking north at Bradford Road you can see a line of shrub trees along a streambank. This is the furthest west headwaters of the Wakarusa River. Tributaries in this area are first order streams and drain water from the surrounding landscape into the Wakarusa. Given the relative small size of the drainage area, these tributaries only flow during or shortly after a rainfall. Although just a small, intermittent creek at this point, this is the beginning of the South Branch of the Wakarusa River (Fig. 5-19). Other tributaries merge with it as it flows in a southeasterly direction (for about ten miles) where it turns north joining the Middle and North branches near Auburn to form the Wakarusa River.

Figure 5-19 The Headwaters of the South Branch of the Wakarusa River (Source: A. Weir)

The proposed forty mile route to Richland, Kansas is the focus of this tour. This area around Clinton Lake and the surrounding floodplain offers numerous stop over areas on public land that can offer rewarding educational opportunities. Also, the visitor may take the tour only as far as Clinton Lake and spend rest time in recreational activities. Moving on to Richland, the visitor may want to spend some time hiking on the Landon Trail.

Continuing the thirty miles from Richland to the western headwaters of the Wakarusa River takes the visitor along two lane county roads in a rural countryside. The sightseer traveling on with the tour may turn north on Highway 75 to arrive at Topeka or continue to Auburn and turn north to Highway 70. The tour does not need to be attempted in a single outing and one can join or leave the route at any point.

Although the ultimate goal of watershed planning is to increase community involvement in activities that restore and protect, the first step is developing an understanding of what a watershed is and how it is an integral part of our daily life. It is hoped that by taking the tour, participants can use information from pamphlets and displays to see firsthand what a watershed does. The intent of the driving tour is not to preach or present a negative picture but rather to objectively inform and do so in an engaging way.

CHAPTER 6 - Conclusion and Recommendations

If one were to ask Kansas State University students about their campus, they may talk with pride about the limestone buildings, their classes and the sports teams. If one asked about where they came from, they may talk about their hometown and the attractions it has to offer. And yet, if one were to ask what watershed they lived in they most likely would not know.

Watersheds are the natural boundaries in which we live and in some manner provide each of us with water—the crucial resource of our daily lives. As Jacques Cousteau put it "we forget the water cycle and life cycle are one" (Right Words, 2010, 1). By understanding the watershed as the place we live and a place to be protected in order to have safe drinking water, wildlife habitats and healthier communities, we then begin to perceive watersheds a "sense of place."

Introducing the watershed as a "sense of place" would also be in the concern of citizens and organizations whose interest is to preserve natural areas. These diverse interests may be to unite in helping to preserve habitats for observing wildlife or hunting. Other interests that can be brought to bear on this important issue include bicycle or nature trails for walking, creating cleaner water for fishing and consumption, protecting property values or preserving the environment for future generations. Moreover, many state and federal agencies have a legal mandate for environmental protection. Consequently, understanding the importance a watershed has in protecting natural habitats is in the interest of a diverse group of people.

There are many organizations and agencies located around the Upper Wakarusa Watershed whose common objective is preserving natural habitats. Each organization could possibly contribute to developing the Upper Wakarusa Watershed Driving Tour.

Examples of environmental organizations in the area include:

Action Alliance of Lawrence
Friends of the Kaw
Jayhawk Audubon Society of Lawrence
Kansas Canoe Association
Kansas Land Trust
Kansas Native Plant Society
Kansas Sierra Club (Wakarusa Chapter)
Kaw Valley Heritage Alliance
Smart Growth Network

A number of university departments and student organizations whose mission is research or relates to conservation include:

Kansas Biological Survey
KU Biology Club
KU Concerned, Aware & Active Students:
KU Environmental Studies
Environmental Studies at Haskell Indian Nations University
Wetlands Preservation Organization at Haskell

Several local organizations that have an interest in developing trails for bike riding or walking include:

Bicycle Advisory Committee of Lawrence
Kansas Trails Council
Lawrence Bicycle Club
Rails to Trail Coalition of Kansas

Other organizations that have an interest in preserving natural habitats include:

Boy Scouts of America
Kaw Valley Girl Scout Council
Pheasants Forever
Quail & Ducks Unlimited

Federal, State, County and local agencies to involve include:

Douglas County Conservation District
Douglas County Extension Service
Kansas Dept. of Health and Environment & Kansas Water Office
Kansas Dept. of Wildlife and Parks
Kansas State Conservation Commission
U. S. Army Corps of Engineers, Clinton Lake
U. S. Dept. of Agriculture, NRCS
U. S. Environmental Protection Agency
U. S. Geological Survey

The tour itself as described in this report is based on preliminary ideas developed by the author and is an initial attempt to think through the process of creating an interesting tour for the watershed using the existing local infrastructure. It is recommended that the actual thematic framework, pamphlets and displays be developed with additional thought and greater detail—with participation of local organizations that have an interest in making such a tour a success.

Finally, it is recommended that the Richland area be developed as a small walking tour using the theme of watershed education. The area has access off the road where a parking lot could be prepared. The region has embankments and remnants of old roadway where the main trailheads could be lead out. With Richland located at the convergence of Camp Creek and the Wakarusa River, smaller trails could wind around the banks giving the visitor a first hand look using trail map displays. The area is located near the Landon Trail and could be incorporated into the trail system.

CHAPTER 7 - Wrap up

In 1989 the first sighting of a bald eagle breeding pair was reported at Clinton Lake. Since that time numerous other breeding pairs have been documented and during the winter months many migrating bald eagles may be spotted in the Clinton Lake area. Around the lake it is not uncommon site to see a vehicle at the side of the road and a person outside with a pair of binoculars fixed upon a bald eagle. For fourteen years the Jayhawk Audubon Society hosts an annual Kaw Valley Eagle Day which includes programs and field trips to view the eagles. There are blogs on the internet which report sightings of bald eagles. These sightings and other planned and spontaneous events give the impression that the bald eagles have given many visitors a personal connection to the surrounding landscape.

The return of the bald eagles to the Clinton Lake area has been a long road. Its beginnings may have been with the Bald Eagle Act of 1940 which made it criminal offense to take, possess or transport a bald eagle although the act did little to protect its habitat. Twenty-six years later, the bald eagle became one of the first species to be listed on the Endangered Species Act of 1966. This Act sought to preserve and create habitats of such species on the list. Food contamination (mainly from DDT) was another significant cause for the decline in the bald eagle population. The use of DDT was banned in 1972 but by that time there were only a reported 487 nesting pairs reported in the lower 48 States (cjonline.com, 2010). These laws and regulations all had a hand in returning the bald eagle to Clinton Lake, although they would be for naught if the right habitat surrounding this body of water were not present.

Although the landscape of the Upper Wakarusa Watershed has changed immensely with the construction Clinton Lake and the introduction of more agricultural and urban landscape

types in the area, many aspects of the region have actually improved in the last seventy years. Farm practices have improved aided by incentives to practice conservation. Point source pollution has been regulated and municipalities have upgraded their treatment facilities. Lead has been removed from gasoline while emissions have been reduced in automobiles. Wildlife habitats and wetlands have been created on public land. Watershed planning has become part of the mainstream and many municipalities and counties have begun to adopt its principles. This is all good news. The bad news is there are more of us and we are using more resources and producing more waste. We assume that clean water will always be available since we only see what comes out of the tap as drinkable and useful water. In the future it may be that it will require even more stringent environmental laws and regulations to keep up with the increasing demand for resources. Yet stricter regulations have become very unpopular in today's political climate. A second course of action is to educate the local residents, visitors and the general public to be more sensitive to their environment.

Many people have a sense of allegiance to certain places. This allegiance is often formulated through personal experience and awareness of the physical environment. Bringing ourselves closer to the natural landscapes of a watershed helps us to understand why its health is so important to our daily lives (like the ability to obtain a drink of water out of the tap). It also brings rewards (such as seeing a bald eagle) which in return can offer a sense of belonging and pride to our surroundings. Wendell Berry may express it best in his essay, "Watershed and Commonwealth:"

> I live at the lower end of the watershed of the Kentucky River, which drains a considerable portion of eastern and central Kentucky. After watching it daily and thinking about it for a long time, I cannot help but see my native river as a connector of places, regions, and people.

People who live at the lower ends of watersheds cannot be isolationists or not for long. Pretty soon they will notice that water flows, and that will set them to thinking about the people upstream who either do or do not send down their silt and pollutants and garbage. Thinking about people upstream ought to cause further thinking about the people downstream. Such pondering on the facts of gravity and fluidity of water shows us that the golden rule speaks to a condition of absolute interdependency and obligation. People who live on rivers-or, in fact, anywhere in a watershed –might rephrase the rule in this way: Do unto those downstream as you would have those upstream do unto you. (Berry, 2003, 135)

Appropriate words for those who may wish to one day take a driving tour of the Upper Wakarusa Watershed, or contribute to the restoration of watersheds wherever they call home.

Bibliography

Aber, J. S. , and S. W. Aber. 2009. *Kansas Physiographic Regions—Bird's-eye Views*. Kansas Geological Publication, University of Kansas Press.

Allaback, S. 2002. *Mission 66 Visitors Centers: The History of a Building Type.* U. S. Department of Interior, National Park Service. Last retrieved May 2007 from the World Wide Web: http://www.nps.gov/history/online_books/allaback/

Allegheny University.2007. Northwest Pennsylvania Nature Tourism: Driving Tour. A driving tour website last retrieved in May 2007 from the internet: http://naturetourism.allegheny.edu/

Barden, C., W. Geyer, K. Mankin, D. Ngandu, D. Devin and K. McVay. 2003. Assessing the Effectiveness of Various Riparian Buffer Vegetation Types. Kansas State University, Publication ID: SRL 137. K-State publications available at http://oznet.ksu.edu.

Berry, Wendell. 2003. "Watershed and Commonwealth" from *Citizenship Papers: Essays by Wendell Berry.* Shoemaker & Hoard.

Buchanan, R. and J. MaCauley. 1987. *Roadside Kansas: A traveler' Guide to its Geology and Landmarks.* University Press of Kansas.

Byczynski, L.2002. *Exploring the Kaw Valley: A Guide to the National and Historic Treasures of the Kansas River Valley.* Breadbasket Publishing Company.

Cjonline.com. (Topeka Capital Journal). 2010. The Eagles have landed here. Last retrieved in March 2010 from the World Wide Web: http://cjonline.com/sports/outdoors/2010-01-09/the_eagles_have_landed_here

Connell J. and R. Slatyer. 1977. "Mechanisms of Succession in Natural Communities and Their Role in Community Stability and Organization." *The American Naturalist*, Vol. III, No. 982, pgs 1119-1144, University of Chicago Press.

Cully, J., S. Egbert, J. Harrington, T. Hoernemann, G. Kaufman, C. Lauver, E. Martinko, and K. Price. 2002. A Gap Analysis of Kansas. Kansas Cooperative Fish and Wildlife Research Unit, Manhattan, Kansas.

Fermata Inc.. 2005. *Experiential Tourism Strategy for the Kansas Flint Hills* prepared for Kansas Department of Commerce. Last retrieved in May 2007 in PDF format from the World Wide Web: http.fermatainc.com

Fermata Inc.. 2002. *Strategic Plan for Great Bend* prepared for the Kansas Department of Commerce. Last retrieved in May 2007 in PDF format from the World Wide Web: http//www.fermatainc.com/greatbend.html

Freedom Frontier National Heritage Management Plan (FFNHA). 2009. Last retrieved in December 2009 in PDF format from the World Wide Web: http://www.ffnha-hosting.com/

Grant, Pam. 2002. *Kansas Curiosities: Quirky Characters, Roadside Oddities and Other Offbeat Stuff*. The Globe Pequot Press.

International Ecotourism Society. 2010. Last retrieved in February 2010 from the World Wide Web: http//www.ecotourism.org.

Kansas City District Corps of Engineers.(KCACE). 2010. Information on Clinton Lake. Last retrieved in March 2010 from the World Wide Web: http://www.nsk.asace.army.mil/cl/

Kansas Dept. of Commerce and Tourism. 2010. Kansas Scenic Byways. Last retrieved in March 2010 from the World Wide Web: http://www.ksbyway.org.

Kansas Dept. of Health and Environment (KDHE), 2009. Bureau of Water regarding WRAPS and TMDLs in the State of Kansas. Last retrieved in December 2009 from the World Wide Web: http://www.kdheks.gov/tmdl/methodology.htm

Kansas Dept. of Health and Environment (KDHE), 2010. Brochure on the WRAPS process. Last retrieved in March 2010 from the World Wide Web: http://www.kdheks.gov/nps/wraps/wraps_brochure.pdf.

Kansas Dept. of Housing and Commerce. 2002. *Kansas Magazine Getaway Guide*.

Kansas Dept. of Wildlife and Parks (KDWP). 2005. *Kansas Comprehensive Wildlife Conservation Plan.* Last retrieved in May 2007 in PDF format from the World Wide Web: http://www.kdwp.state.ks/news.Other-Services/Wildlife-Conservation-Plan/Kansas-CWCP

Kansas Geological Survey. 2010. Physiographic Regions. Last retrieved in March 2010, from the World Wide Web: http://www.kgs.ku.edu/Extension/Phsio.html

Kansas Geological Survey. 2007. Kansas surface and ground water research. Last retrieved in May 2007, from the World Wide Web: http://www.kgs.ku.edu/HighPlains/atlas.index#Other_Kanas_Water_Resources

Kansas Geospatial Community Commons, Data Access & Support Center (DASC). From the World Wide Web: http.//www.kansasgis.org.

Kansas Historical Society. 2010. Kansas Historical Markers. Last retrieved in March 2010 from the World Wide Web: http://www.kshs.org/tourists/markers.htm

Kansas Trails Council. 2010 Information on North Shore trails. Retrieved from the World Wide Web: http://www.terraworld.net/kansastrails.

Kansas Scenic Byways. 2010. Last retrieved in March 2010 from the World Wide Web: http://www.ksbyways.org/page/index

Kansas State Conservation Commision. 1999. Kansas River and Streams Corridor and Management Guide. Last retrieved in May 2007 in PDF format from the World Wide Web: http:/scc.ks.gov/

Kansas State Conservation Commision. 2007. Last retrieved in May 2007 from the World Wide Web: http:/scc.ks.gov/

Kanza Rail-Trail Conservancy. 2010. Information on rails to trails with links to Landon Trail. Retrieved from the World Wide Web: http://kanzatrails.org/ with links to Landon trail at http://www.landontrail.org/

Kaw Valley Heritage Alliance (KVHA). 2003. Upper Wakarusa Watershed Watershed Restoration and Protection Strategy (WRAPS). Last retrieved in May 2007 from the World Wide Web: http://wakarusawatershed .org/wraps.html

Lawrence Journal World, Section C, page 1, March 8, 1987. History Reclaimed. A story about the formation of the Clinton Museum.

McCauley, James R.. 1998. Kansas Geological Survey: Chapter 1, Development and General Geology of the Kansas River Corridor, from the Kansas River Corridor Study. Last retrieved May 2007 from the World Wide Web: http://www.kgs.ku.edu/publications/KR/kr-geol.html

National Atlas. 2007. The Public Land Survey System. Last retrieved in May 2007 from the internet: http://nationalatla.gov/articles/boundaries/a_plass.html

National Park Service History. 2007. History in the National Park Service Themes and Concepts. Last retrieved May 2007 from World Wide Web: http://www.cr.nps.gov/history/hisnps/NPSThinking/revthem.htm.

National Park Service, Tall Grass Prairie Preserve. 2010. Last retrieved on March 2010 from the World Wide Web: http:://nps.gov/tapr/naturescience/index.htm

National Resource Conservation Service. 2007. Information on CRP program. Last retrieved August 2007 from the World Wide Web: http://www.nrcs.usda.gov/programs/crp/

National Resource Conservation Service. 2007. Information on WHIP program. Last retrieved August 2007 from the World Wide Web: http://www.nrcs.usda.gov/programs/whip/

National Resource Conservation Service. 2007. Information on CRP program. Last retrieved August 2007 from the World Wide Web: http://www.nrcs.usda.gov/technical/water.html/

National Resource Conservation Service. 2007. Part 630 Hydrology National Engineering Handbook: Chapter 7 Hydrologic Soil Groups . Last retrieved March 2010 from the internet: http://directives.sc.egov.usda.gov/viewer/

National National Fish and Wildlife Foundation. 2007. Information on 5-star program for community wetland development. Last retrieved August 2007 from the World Wide Web: http://www.nfwf.org/programs/5sstar-rfp.cfm

Ohio State University. Virtual Watershed Tour. A virtual driving tour website last retrieved in August 2007 from the Internet: http:ohiowatersheds.osu.edu/vtour/stopone.html.

Parker, Martha, and Betty Laird. No date. *Soil of Our Souls: History of the Clinton Lake Area Communities.* Freedom Publishing Company Sixth Edition.

Randolph, John. 2004. *Environmental Land Use Planning and Management*. Island Press, Washington, DC.

Right Words. 2010. Quote of Jacques Cousteau. Last retrieved March 2010 from the Internet: http://www.rightwords.eu/quotes/author/jacques-yves-cousteau--1539/water--8.

Shortridge, James. 1988. *Kaw Valley Landscapes: A Travelers Guide to Northeastern Kansas.* University of Kansas Press.

Skabelund, Lee R. 2010. Kansas State University. Personal communication.

Smith, William L. 2005. Experiential Tourism Around the World and at Home: Definitions and Standards. Emporia State University.

Strahler, A.N. 1952. Dynamic Basis of Geomorphology, Geologic Society of America Bulletin 63, pgs. 923-938,

The River Project. Know Your Watershed: The Los Angeles River Watershed. A watershed website retrieved from the World Wide Web: http://www.theriverproject.org/lariver.html

Thornthwaight, C.W. and J.R. Mather. 1955. The Water Balance Laboratory of Climatology No. 8, Centerton, N.J.

Tilden, F. 1957. *Interpreting Our Heritage*, University of North Carolina Press.

U.S. Army Corps of Engineers. 2007. Environmental Operating Principles, Last retrieved from World Wide Web: http://www.usace.army.mil/ENVIRONMENTAL/pages/eop.aspx

U.S. Environmental Protection Agency (USEPA). 2005. *Code of Federal Regulations Title 40, Volume 2. Revised as of July 2005*, Retrieved from the WAIS Document Retrieval: http://frwebgate4.access.gpo.gov./

U.S. Environmental Protection Agency (USEPA). 2003. *Getting in Step: A Guide for Conducting Community Outreach Programs.* USEPA, Office of Water, Washington DC.

U.S. Environmental Protection Agency (USEPA). 2002. *Community Culture and the Environment: A Guide to Understanding Sense of Place*. USEPA, Office of Water, Washington DC.

U.S. Environmental Protection Agency (USEPA). 1999. *Draft Guidance for Water Quality Based Decisions: The TMDL Process*, Washington DC.

U. S. Geological Survey, (USGS, Water Resource Council). 1987. Water Supply Paper 2294, Hydrologic Unit Maps. Last retrieved in March 2010 from the World Wide Web: http://pubs.gov/wsp2294/pdf/wsp_2294_b.pdf

Wang, S.H., D.G. Huggins, F. deNoyelles and W.S. Kolin. 1997. An Analysis of the Tropic State of Clinton Lake. Lake and Reservoir Management, Vol. 15, Issue 3, pgs 239-250.

Appendix A - Map Section

Figure A-1 The Upper Wakarusa Watershed Driving Tour

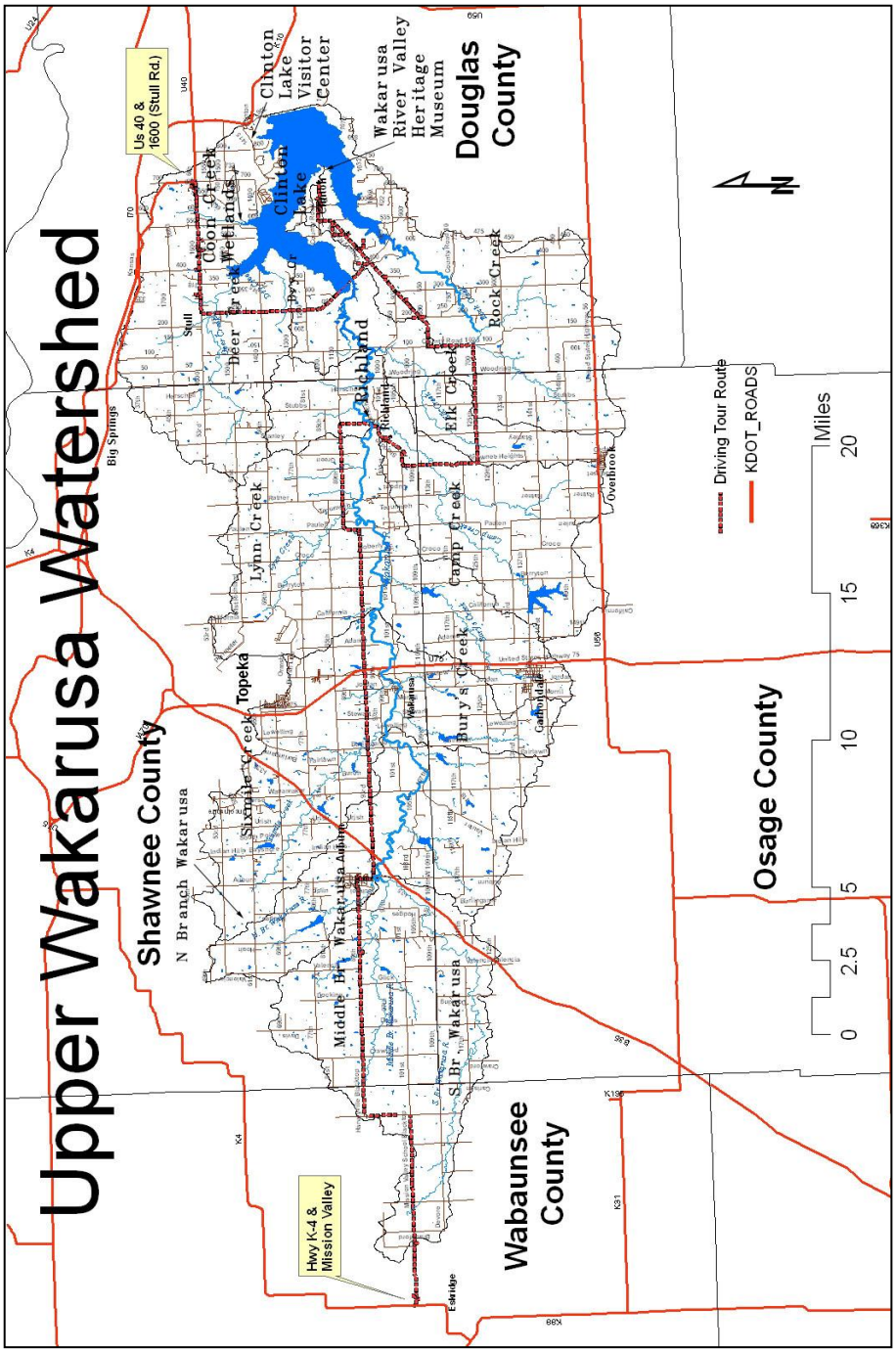


Figure A-2 HUC 14 Boundaries of The Upper Wakarusa Watershed

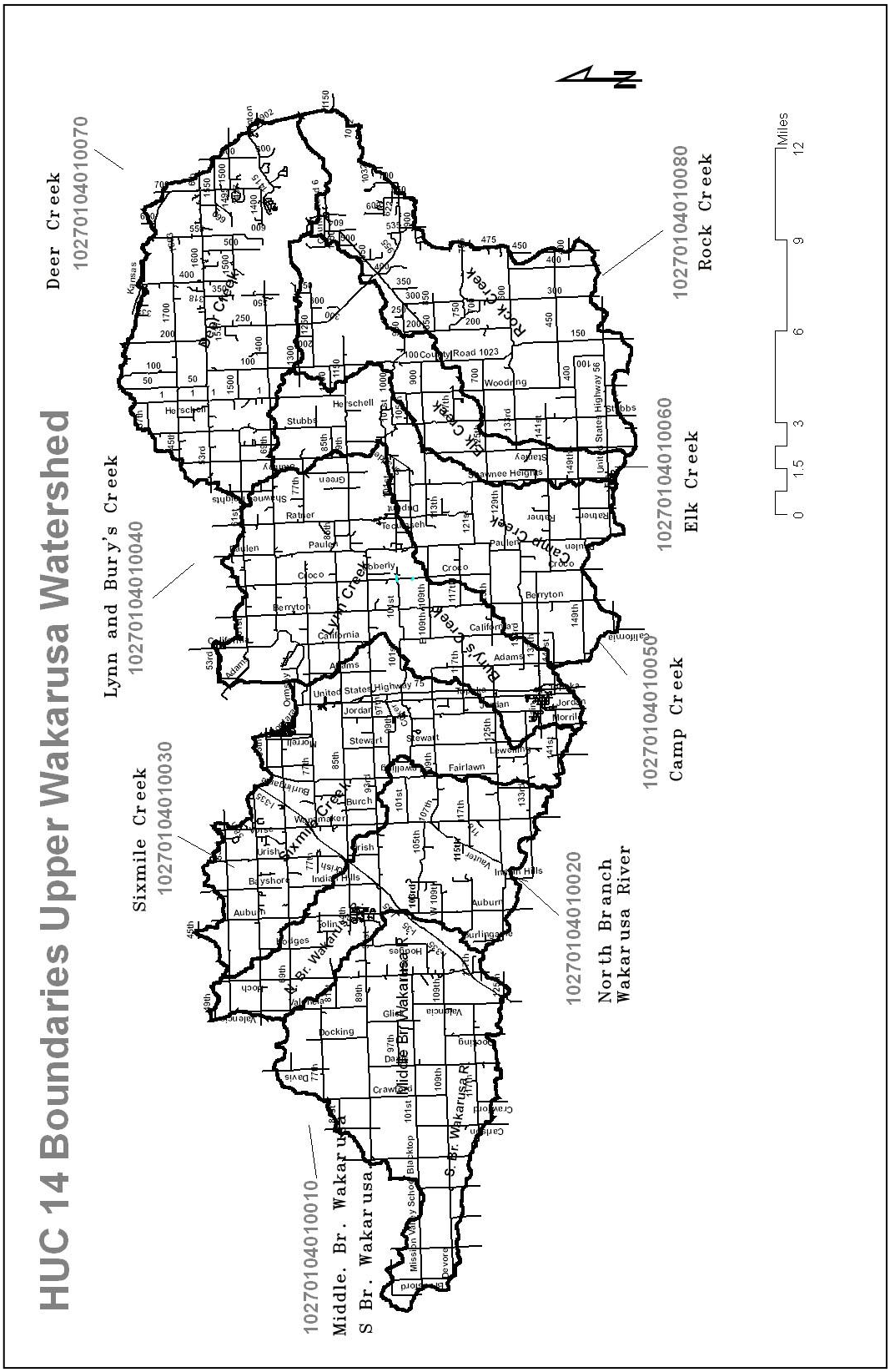


Figure A-3 Vegatation Alliances: Upper Wakarusa Watershed

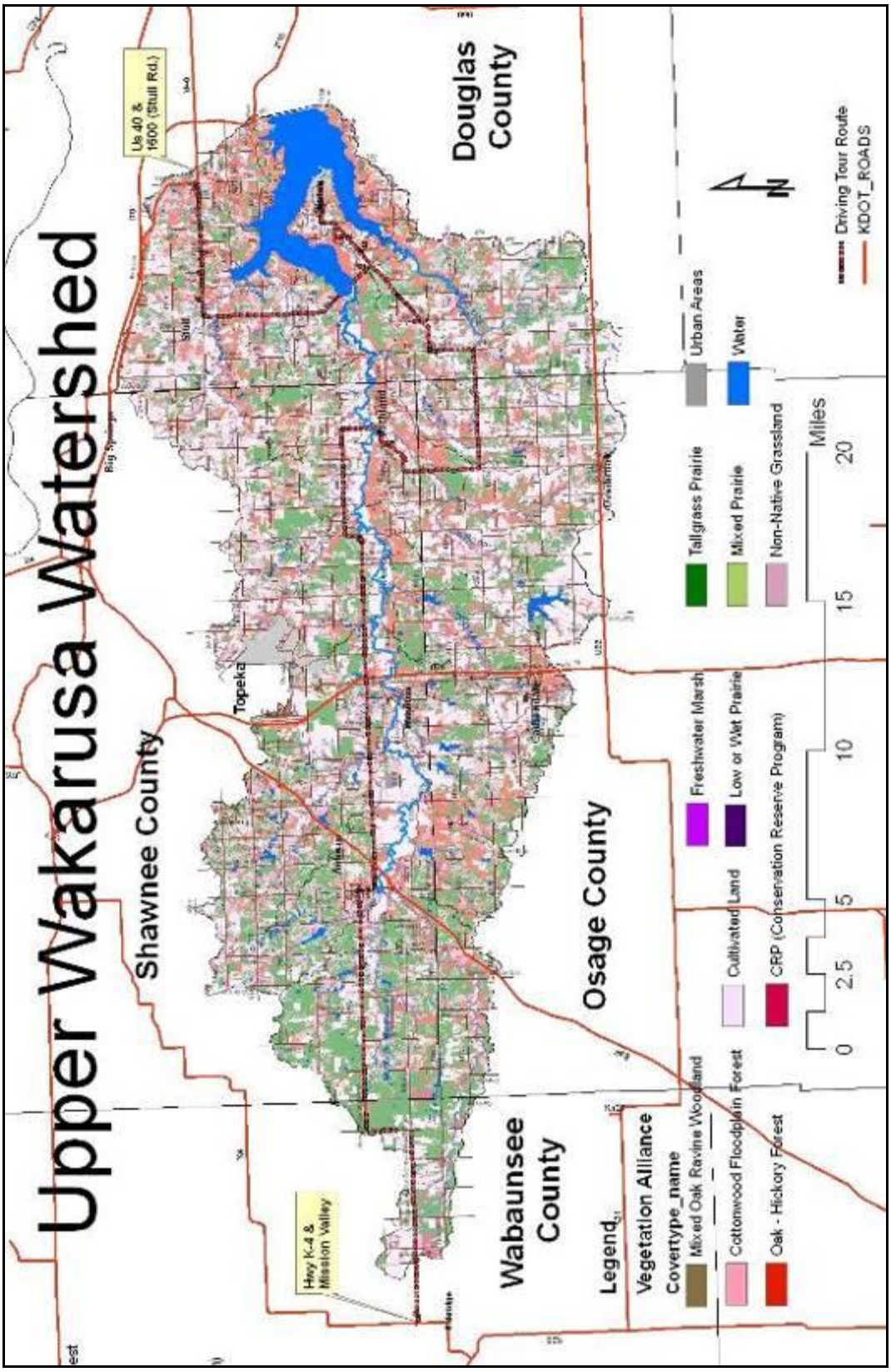


Figure A-4 Woodland Vegetation Alliances: Upper Wakarusa Watershed

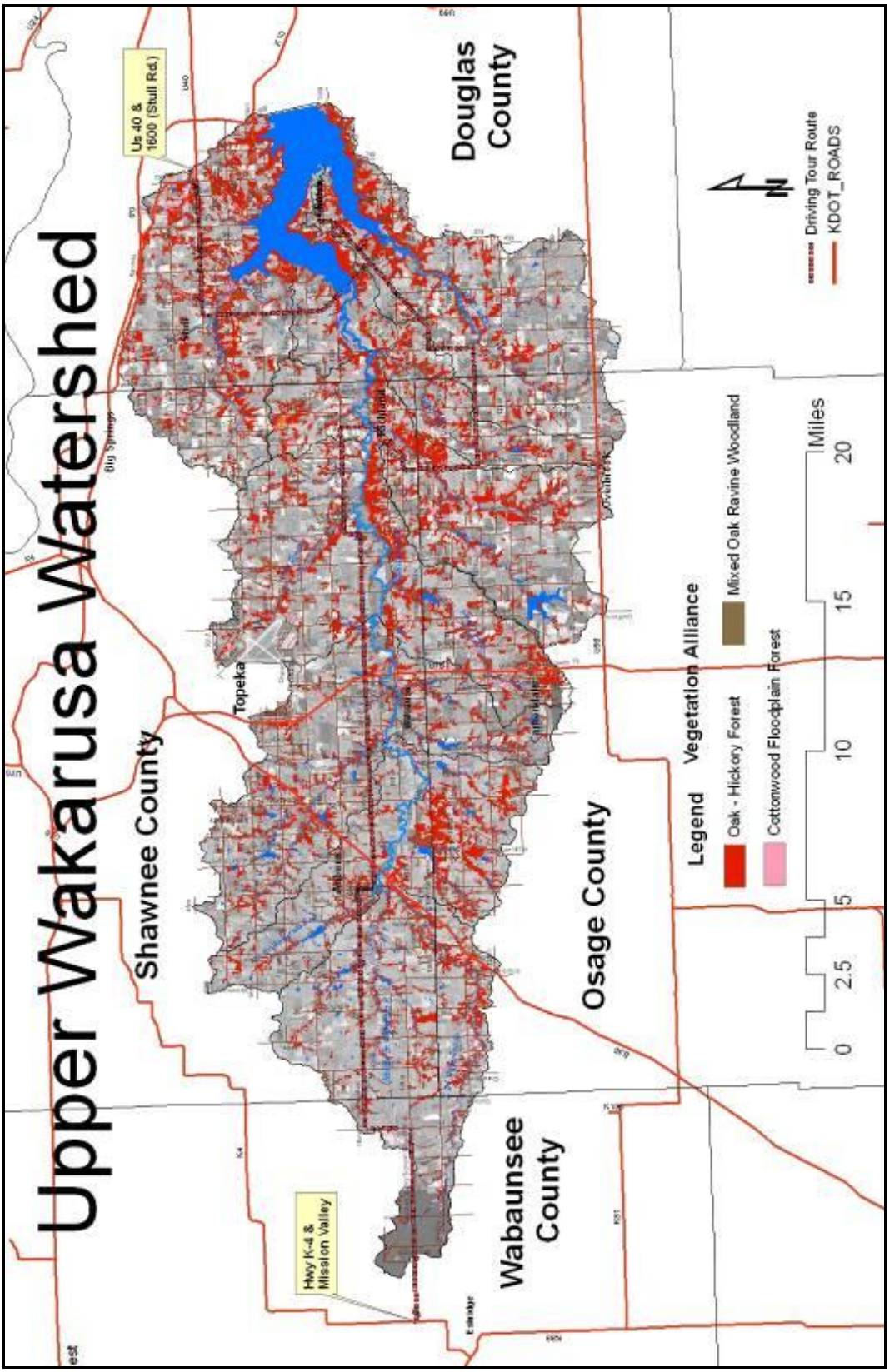


Figure A-5 Cultivated Land and CRP: Upper Wakarusa Watershed

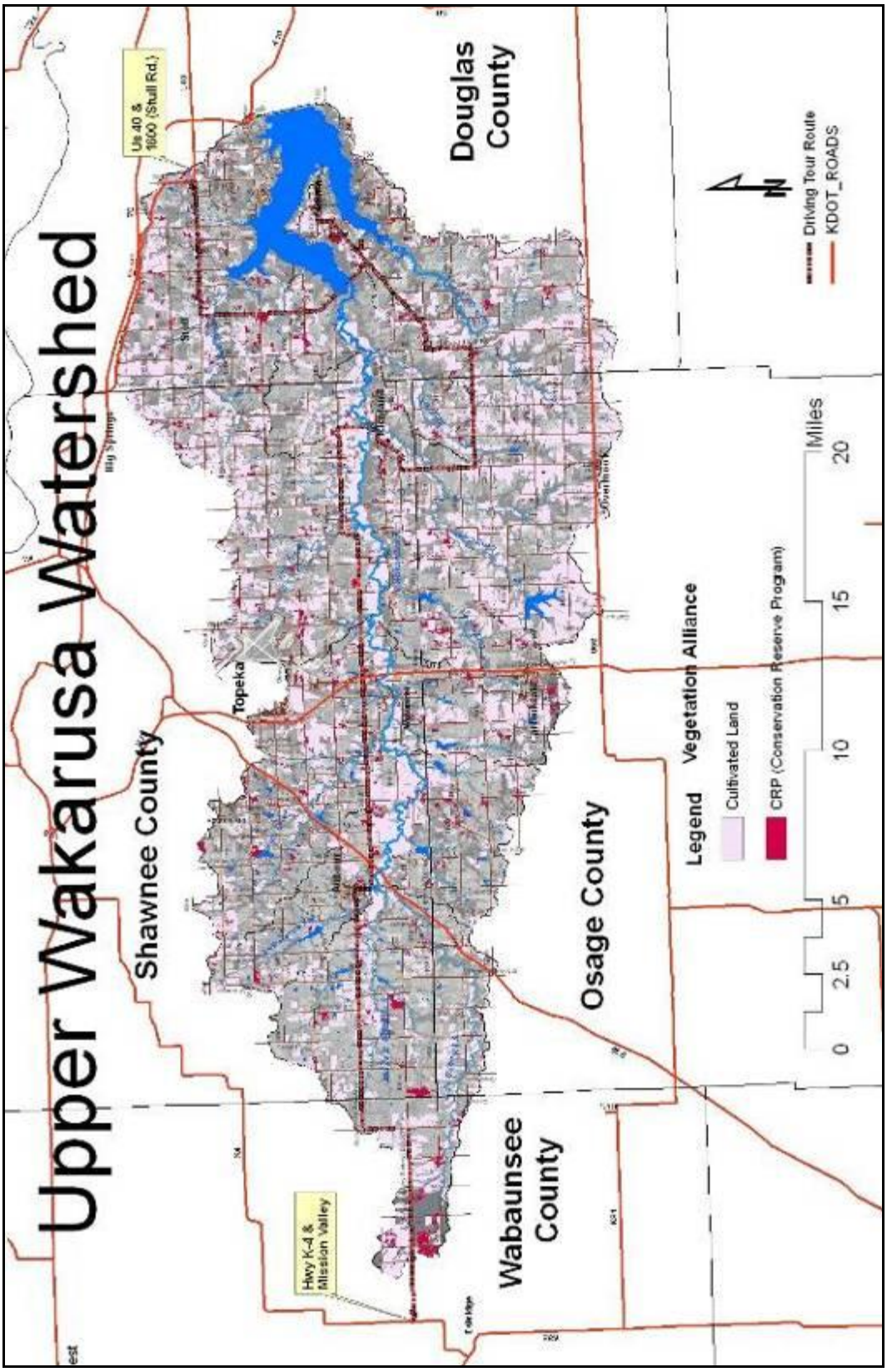


Figure A-6 Prairies, Grassland and Marsh: Upper Wakarusa Watershed

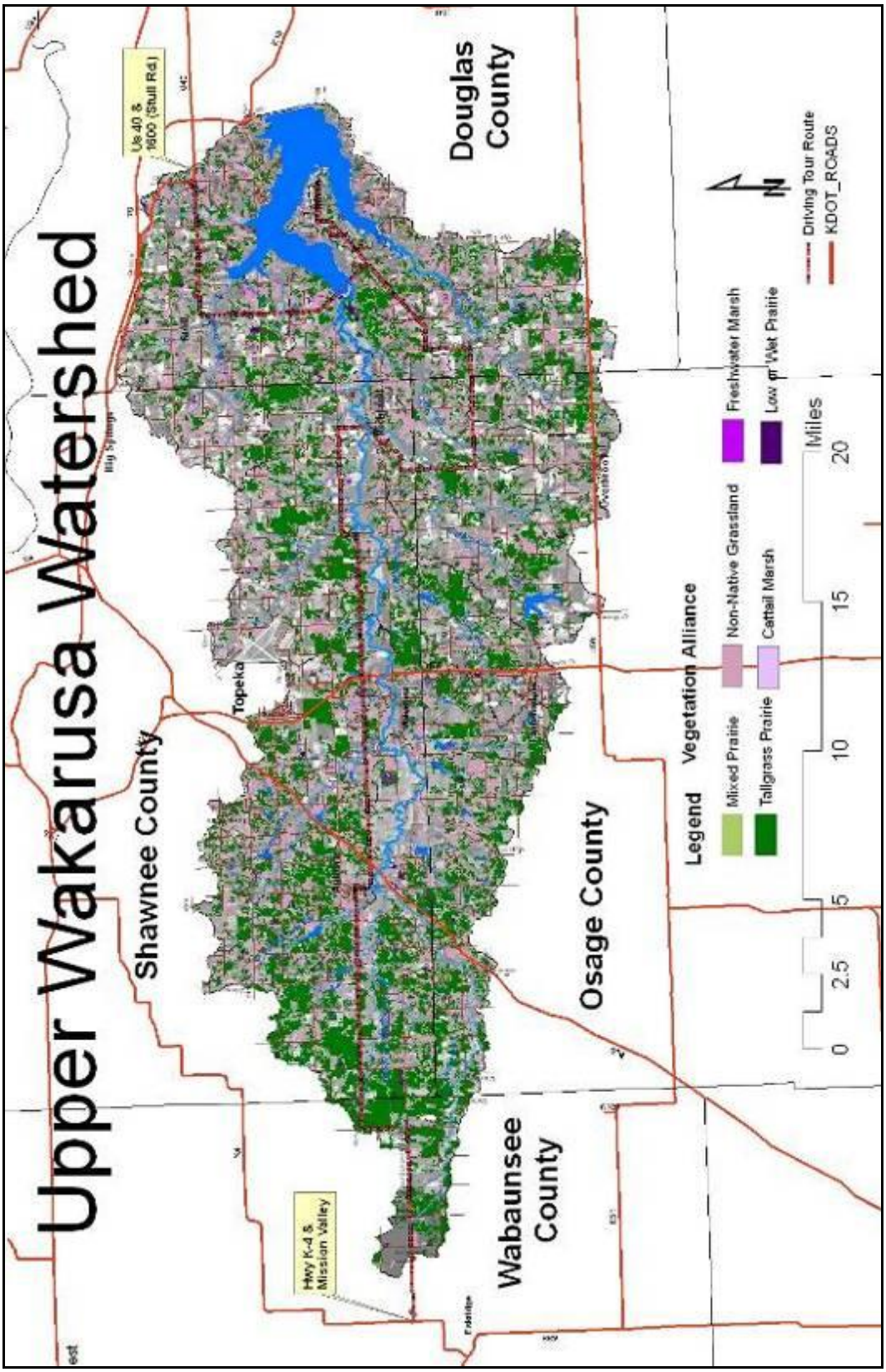


Figure A-7 Second thru Fourth order streams in the South and Middle Branch of the Wakarusa River

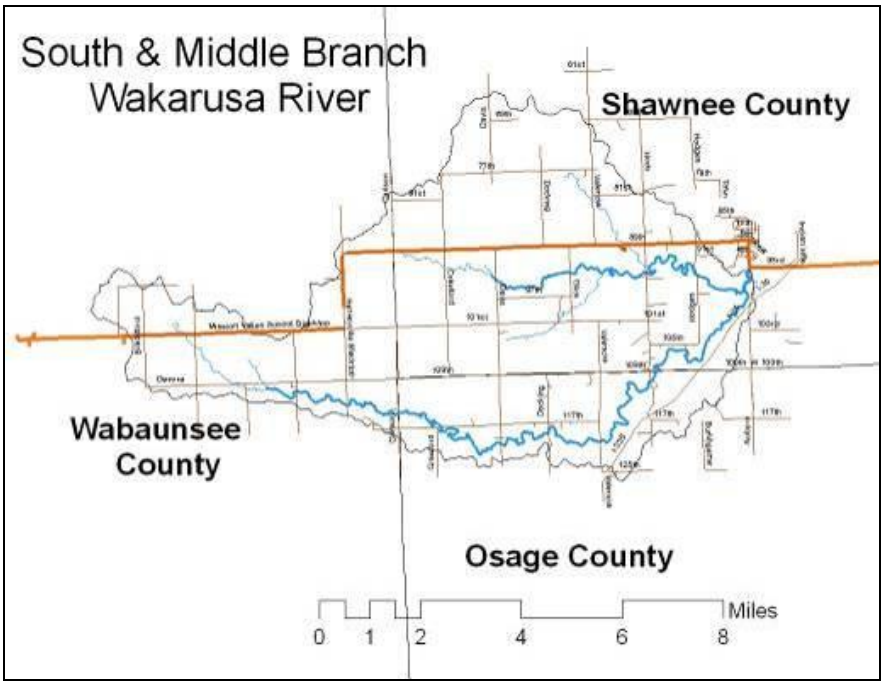


Figure A-8 First thru Fourth order streams in the South and Middle Branch of the Wakarusa River

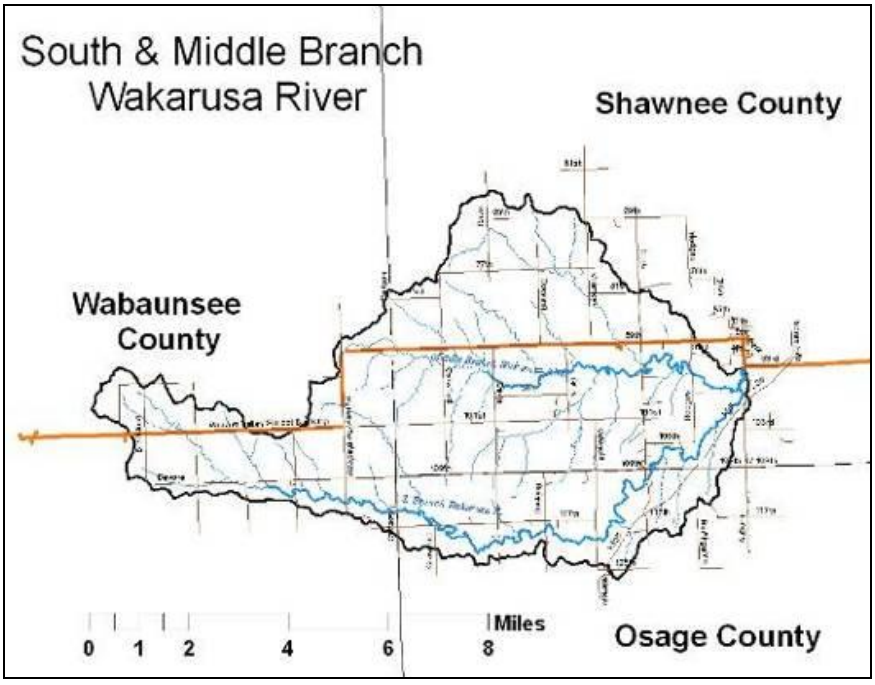


Figure A-9 HUC 14: North Branch of The Wakarusa River

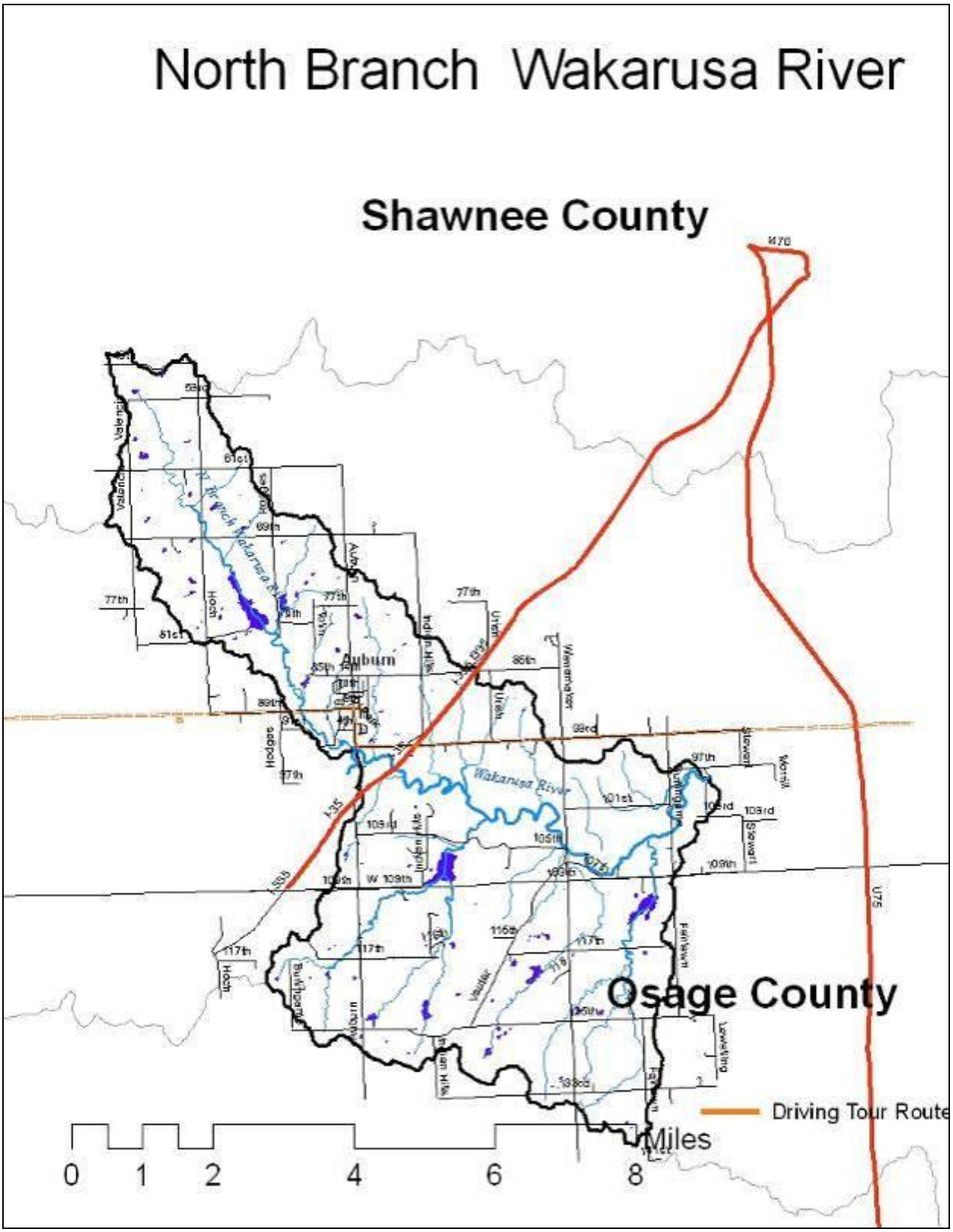


Figure A-10 HUC 14: Six Mile Creek

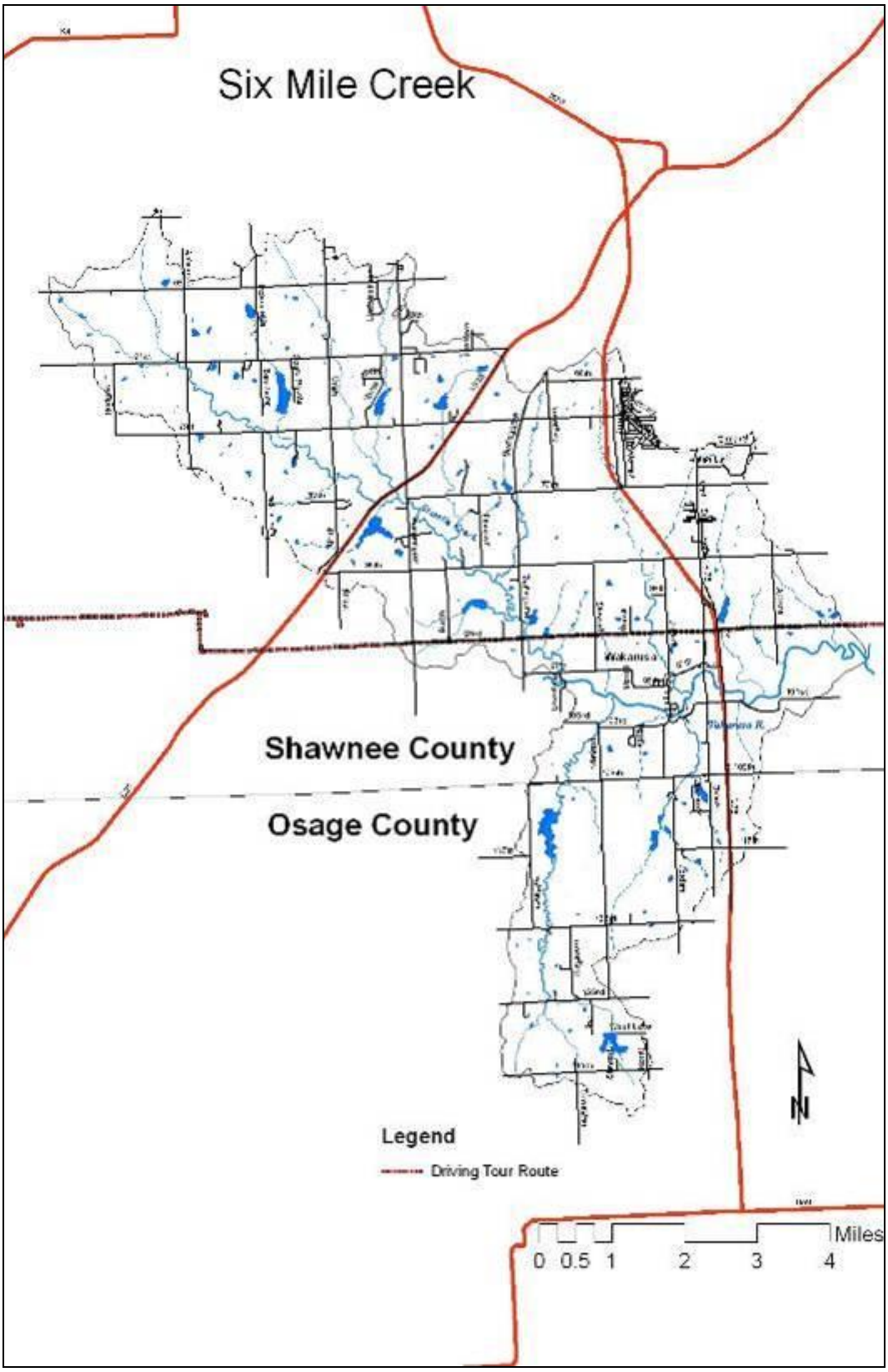


Figure A-11 HUC 14: Lynn & Bury's Creek

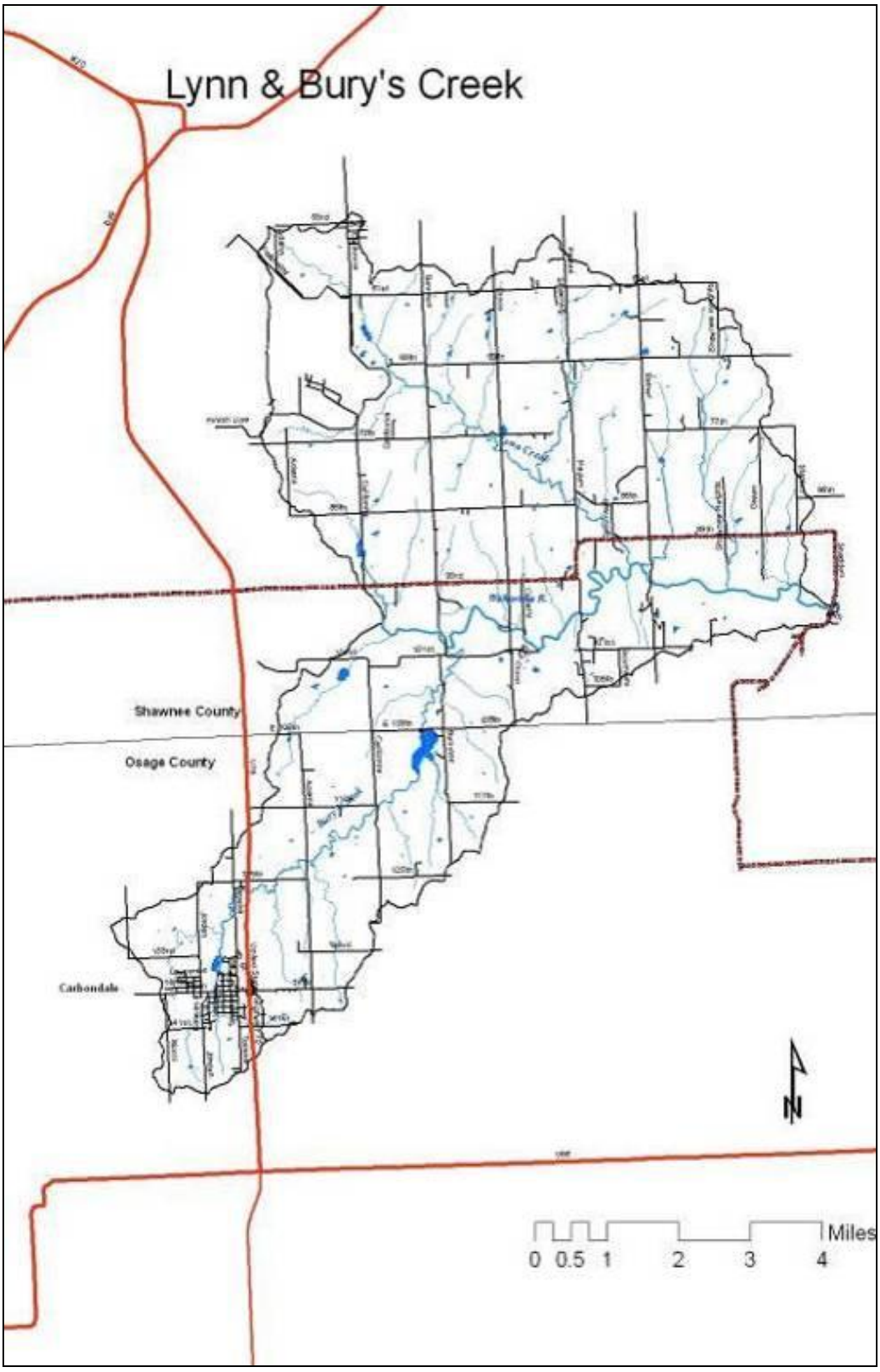


Figure A-12 HUC 14: Camp Creek

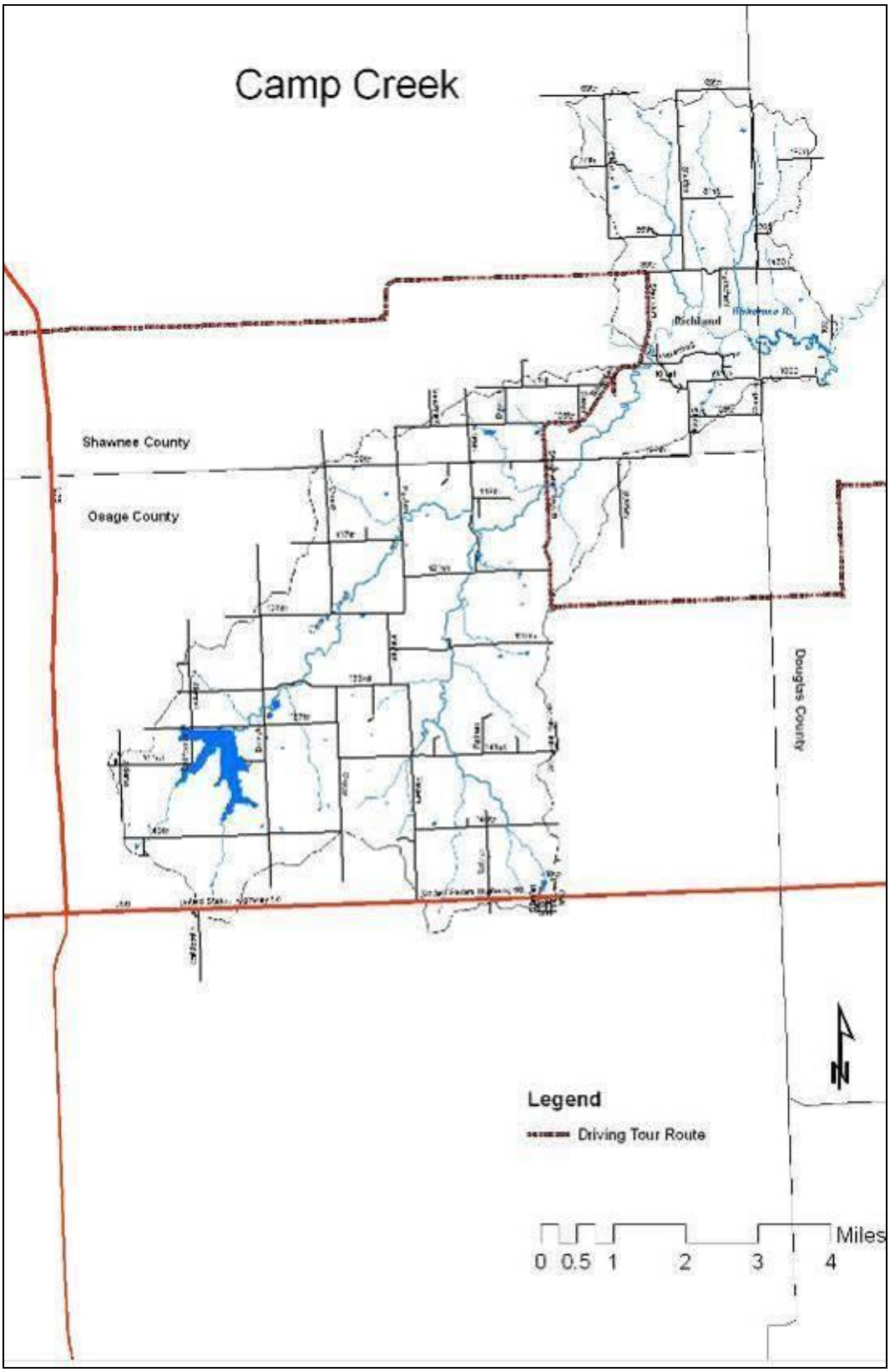
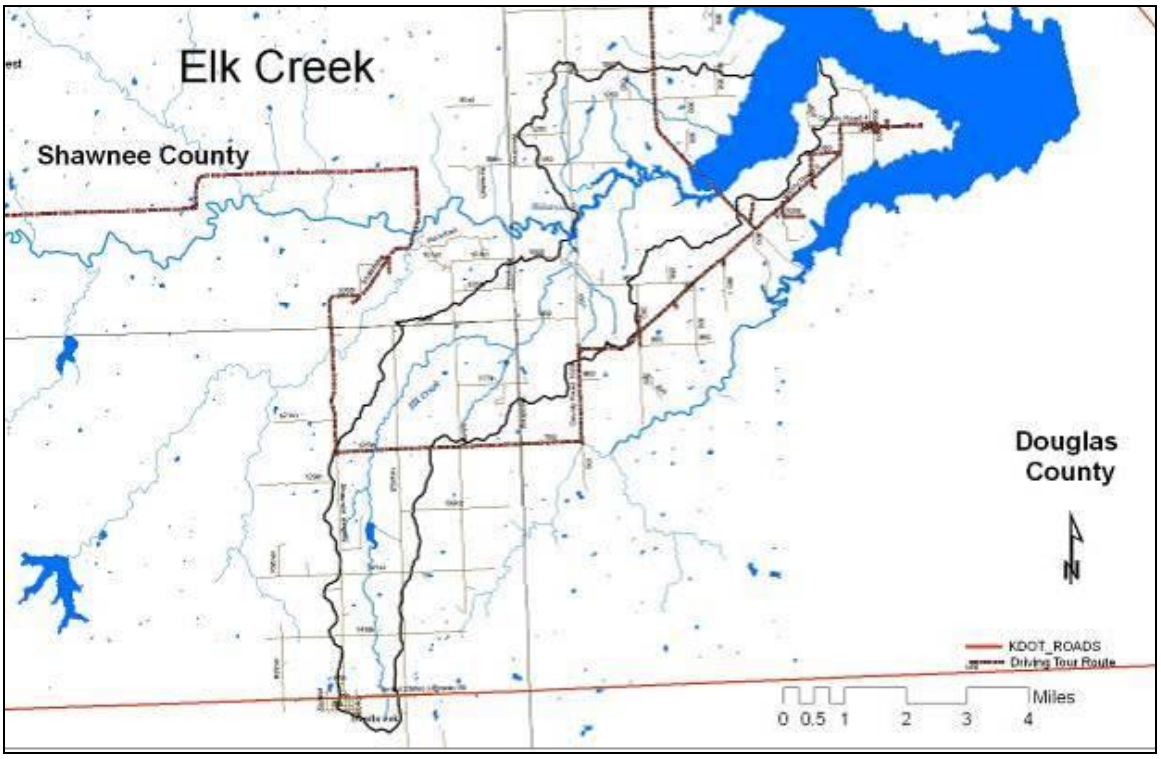


Figure A-13 HUC 14: Elk and Deer Creek



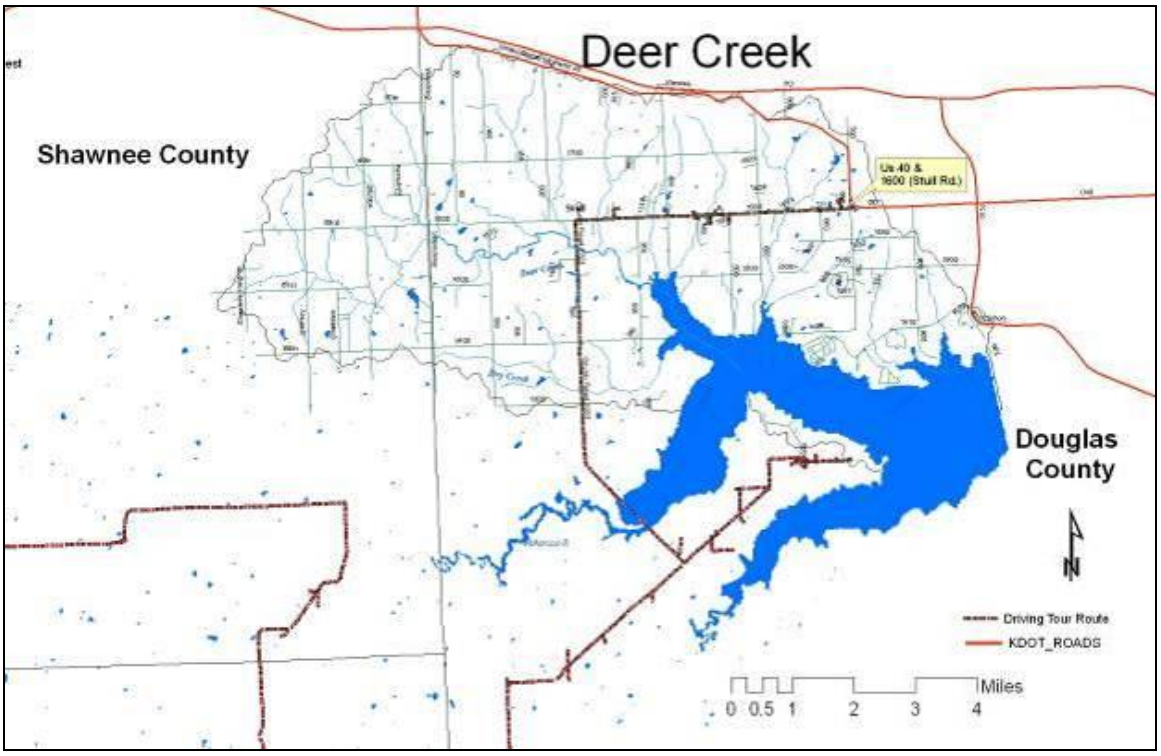


Figure A-14 HUC 14: Rock Creek