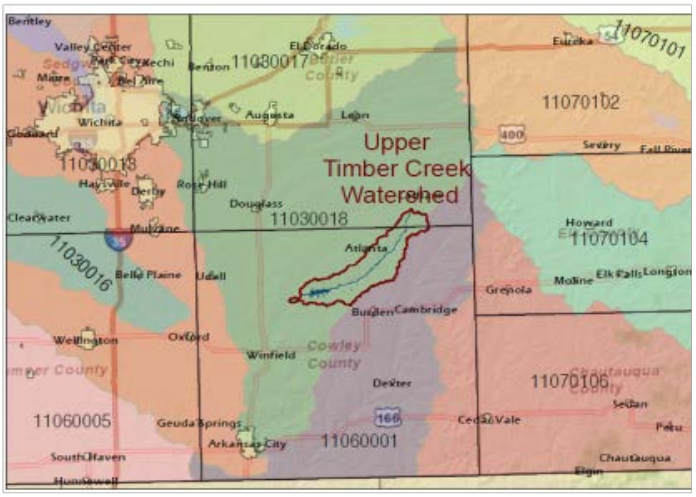
Upper Timber Creek WRAPS 9 Element Plan Overview

The overall goal of the Upper Timber Creek (Winfield City Lake) WRAPS 9 Element Plan is to provide a blueprint of protection and restoration strategies and activities to protect and restore surface waters in the Upper Timber Creek (Winfield City Lake) WRAPS Project Area.



TMDLs or 303 d listed waters within Upper Timber Creek (Winfield City Lake) WRAPS Project Area		
	TMDL Pollutant	Priority
	Eutrophication (Lake)	High
	Ecoli- (Stream)	Indeterminate due to sample size

The primary pollutant concern of this watershed's lake is eutrophication which impacts aquatic life support, drinking water and recreation. However, in the plan the SLT emphasizes the need to address siltation even though it is not a TMDL. Note: Cowley County Conservation and City of Winfield staff and a Producer's Advisory Committee (PAC), along with state agencies have been coordinating to implement BMPs under a watershed approach since 2007 then went through the 9 element plan process to be eligible for state and federal dollars.

Assessments

- Southwestern College in Winfield in May, 2012 utilizing the RASCAL (Rapid Assessment of Stream Conditions Along Length) (including riparian and stream health)
- KSU STEPL Model
- Kansas Biological Survey Bathymetric Study on Winfield City Lake
- City of Winfield monitors in-lake parameters along with KDHE (near intake)

Best Management Practices and Load Reduction Goals

Best Management Practices (BMPs) to address bacteria, nutrients, and sediment in the watershed were chosen by the SLT based on local acceptance/adoption rate and amount of load reduction gained per dollar spent.

Cropland BMPS to reduce Sediment/Phosphorus in the Upper Timber Creek Watershed:

1. No-Till
2. Grassed Waterways
3. Vegetative Buffers
4. Nutrient Management Plans
5. Terraces
6. Permanent Vegetation
7. Streambank stabilization

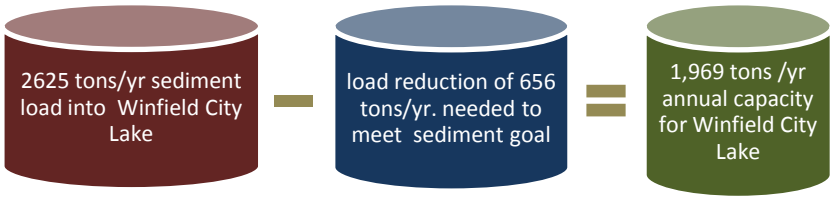
Livestock BMPs to reduce Bacteria and Nutrients (phosphorus) loading Upper Timber Creek Watershed:

1. Vegetative Filter Strip
2. Relocate Pasture Feeding Sites
3. Off Stream Watering Systems
4. Stream Crossings
5. Fence Off Stream/Pond
6. Grazing Management Plans

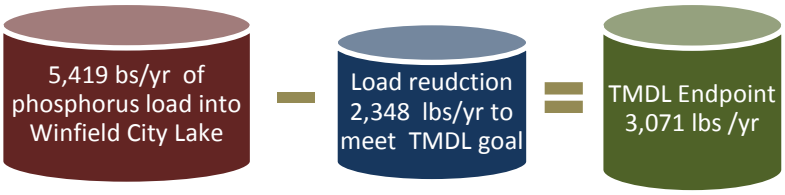
Current Targeted Areas:

Cropland areas within 500 feet of Timber Creek
Livestock practices across watershed due to the distribution of grazing land
Streambank and riparian areas identified in the RASCAL assessment

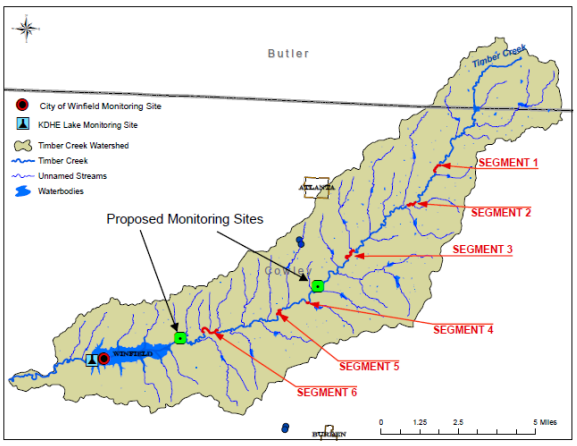
The current estimated sediment load from nonpoint sources to the Winfield City Lake through the Upper Timber Creek Watershed is 2,625 tons per year according to the KDHE prepared STEPL Model. **The total annual load reduction allocated to Winfield City Lake needed to meet the sediment goal is 656 tons of sediment per year**. This equates to approximately 25% of the amount of sediment needing to be removed by targeting BMP implementation in the watershed. This goal is a protection goal and will be monitored throughout plan implementation. The earlier referenced BMPs have been determined as feasible and approved by the SLT.



The current estimated phosphorus load from nonpoint sources to the Winfield City Lake is 5,419 pounds per year according to the Watershed Planning Section (TMDL) of KDHE. **The total annual load reduction allocated to the eutrophication TMDL Endpoint of 3,071 lbs/yr is 2,348 lbs./yr of phosphorus**. This equates to approximately 43% of the amount of phosphorus needing to be removed by targeting BMP implementation in the watershed. The earlier referenced BMPs have been determined as feasible and approved by the SLT.



Proposed and current monitoring sites to confirm targeted areas are most likely to show results. Plus streambank/riparian improvement sites needs.



Funding for the development of this plan was provided through an EPA 319 grant from the Kansas Department of Health and Environment.

Upper Timber Creek Watershed Restoration and Protection Strategy

2013

WINFIELD CITY LAKE

United States Department of Agriculture
Natural Resources Conservation Service

An equal opportunity employer and provider

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I. TABLE OF CONTENTS

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Glossary of Terms

Best Management Practices (BMP): Environmental protection practices used to control pollutants, such as sediment or nutrients, from common agricultural or urban land use activities.

Biological Oxygen Demand (BOD): Measure of the amount of oxygen removed from aquatic environments by aerobic microorganisms for their metabolic requirements.

Biota: Plant and animal life of a particular region.

Chlorophyll a: Common pigment found in algae and other aquatic plants that is used in photosynthesis

Dissolved Oxygen (DO): Amount of oxygen dissolved in water.

E. coli bacteria (ECB): Bacteria normally found in gastrointestinal tracts of animals. Some strains cause diarrheal diseases.

Eutrophication (E): Excess of mineral and organic nutrients that promote a proliferation of plant life in lakes and ponds.

Fecal coliform bacteria: Bacteria that originate in the intestines of all warm-blooded animals.

Municipal Water System: Water system that serves at least 25 people or has more than 15 service connections.

National Pollutant Discharge Elimination System (NPDES) Permit: Required by Federal law for all point source discharges into waters.

Nitrates: Final product of ammonia's biochemical oxidation. Primary source of nitrogen for plants. Originates from manure and fertilizers.

Nitrogen(N or TN): Element that is essential for plants and animals. TN or total nitrogen is a chemical measurement of all nitrogen forms in a water sample.

Nonpoint Sources (NPS): Sources of pollutants from a disperse area, such as urban areas or agricultural areas

Nutrients: Nitrogen and phosphorus in water source.

Phosphorus (P or TP): Element in water that, in excess, can lead to increased biological activity in water. TP or total phosphorus is a chemical measurement of all phosphorus forms in a water sample.

Point Sources (PS): Pollutants originating from a single localized source, such as industrial sites, sewerage systems, and confined animal facilities

Riparian Zone: Margin of vegetation within approximately 100 feet of waterway.

Sedimentation: Deposition of slit, clay or sand in slow moving waters.

Secchi Disk: Circular plate 10-12" in diameter with alternating black and white quarters used to measure water clarity by measuring the depth at which it can be seen.

Producer Advisory Committee (PAC): Organization of watershed residents, landowners, farmers, ranchers, agency personnel and all persons with an interest in water quality.

Total Maximum Daily Load (TMDL); Maximum amount of pollutant that a specific body of water can receive without violating the surface water-quality standards, resulting in failure to support their designated uses

Total Suspended Solids (TSS): Measure of the suspended organic and inorganic solids in water. Used as an indicator of sediment or silt.

Water Quality Standard (WQS): Mandated in the Clean Water Act. Defines goals for a waterbody by designating its uses, setting criteria to protect those uses and establishing provisions to protect waterbodies from pollutants.

II. PREFACE

The purpose of this Watershed Restoration and Protection Strategy (WRAPS) plan for the Upper Timber Creek (UTC) watershed is to outline a plan of restoration and protection goals and actions for the surface waters of the watershed. Watershed goals are characterized as “restoration” or “protection”. Watershed restoration is for surface waters that do not meet water quality standards, and for areas of the watershed that need improvement in habitat, land management, or other attributes. Watershed protection is needed for surface waters that currently meet water quality standards, but are in need of protection from future degradation.

The WRAPS development process involves local communities, landowners and governmental agencies working together toward the common goal of a healthy environment. Local participants or stakeholders provide valuable grass roots leadership, responsibility and management of resources in the process. They have the most “at stake” in ensuring the water quality existing on their land is protected. Agencies bring science-based information, communication, and technical and financial assistance to the table. Together, several steps can be taken towards watershed restoration and protection. These steps involve building awareness and education, engaging local leadership, monitoring and evaluation of watershed conditions, in addition to assessment, planning, and implementation of the WRAPS process at the local level. Final goals for the watershed at the end of the WRAPS process are to provide a sustainable water source for drinking and domestic use while preserving food, fiber, and timber production. Other crucial objectives are to maintain recreational opportunities and biodiversity while protecting the environment from flooding, and negative effects of urbanization and industrial production. The ultimate goal is watershed restoration and protection that will be “locally led and driven” in conjunction with government agencies in order to better the environment for everyone.

This plan is intended to serve as an overall strategy to guide watershed restoration and protection efforts by individuals, local, state, and federal agencies and organizations. At the end of the WRAPS process, the Producer Advisory Committee (PAC) will have the capability, capacity and confidence to make decisions that will restore and protect the water quality and watershed conditions of the UTC watershed.

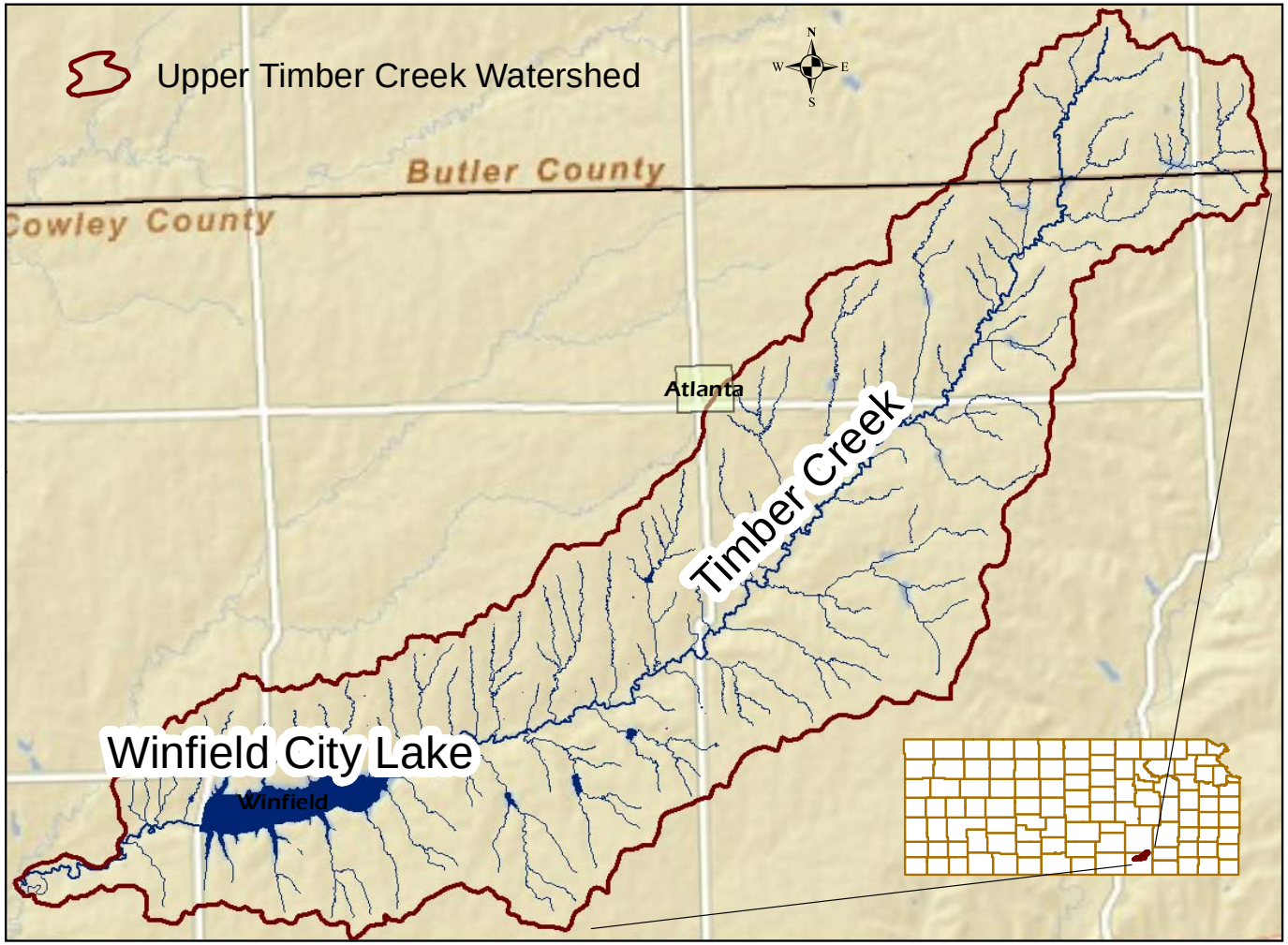


FIGURE 1. UPPER TIMBER CREEK WATERSHED

III. BACKGROUND INFORMATION

A. WHAT IS A WATERSHED?

A watershed is an area of land that catches precipitation and funnels it to a particular creek, stream, and river and so on, until the water drains into an ocean. A watershed has distinct elevation boundaries that do not follow political "lines" such as county, state and international borders. Watersheds come in all shapes and sizes, with some only covering an area of a few acres while others are thousands of square miles across.

Elevation determines the watershed boundaries. The upper boundary of the UTC Watershed has an elevation of 580 meters (1,903 feet) and the lowest point of the watershed has an elevation of 252 meters (829 feet) above sea level.

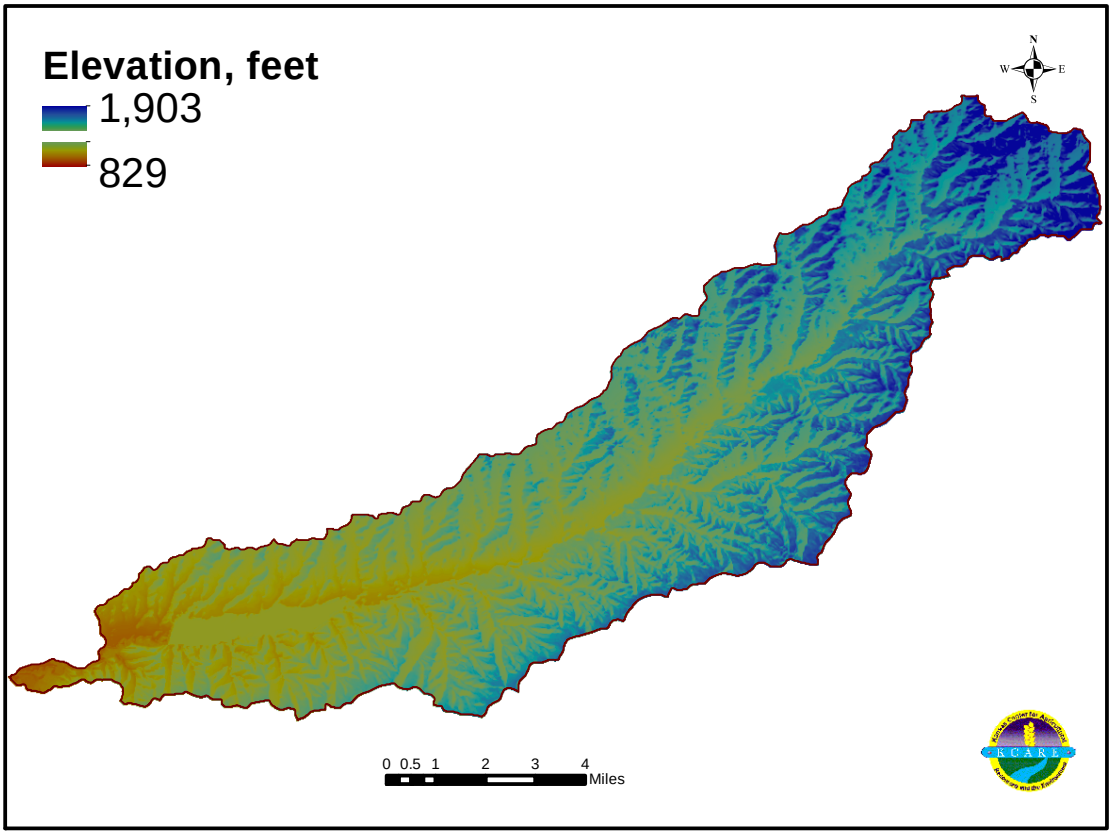


FIGURE 2. RELIEF MAP OF THE WATERSHED [i]

B. WHERE IS THE UPPER TIMBER CREEK WATERSHED?

The scope of this WRAPS project is the UTC Watershed. It is located in Cowley and Butler counties in south-central Kansas. The Hydrologic Unit Codes (HUCs) for the watershed are 110300180402 and 110300180403. The watershed encompasses Timber Creek and it supporting tributaries and Winfield City Lake. It is part of the Walnut Basin (one of twelve basins located in Kansas) which drains the Walnut River and its tributaries into Oklahoma.

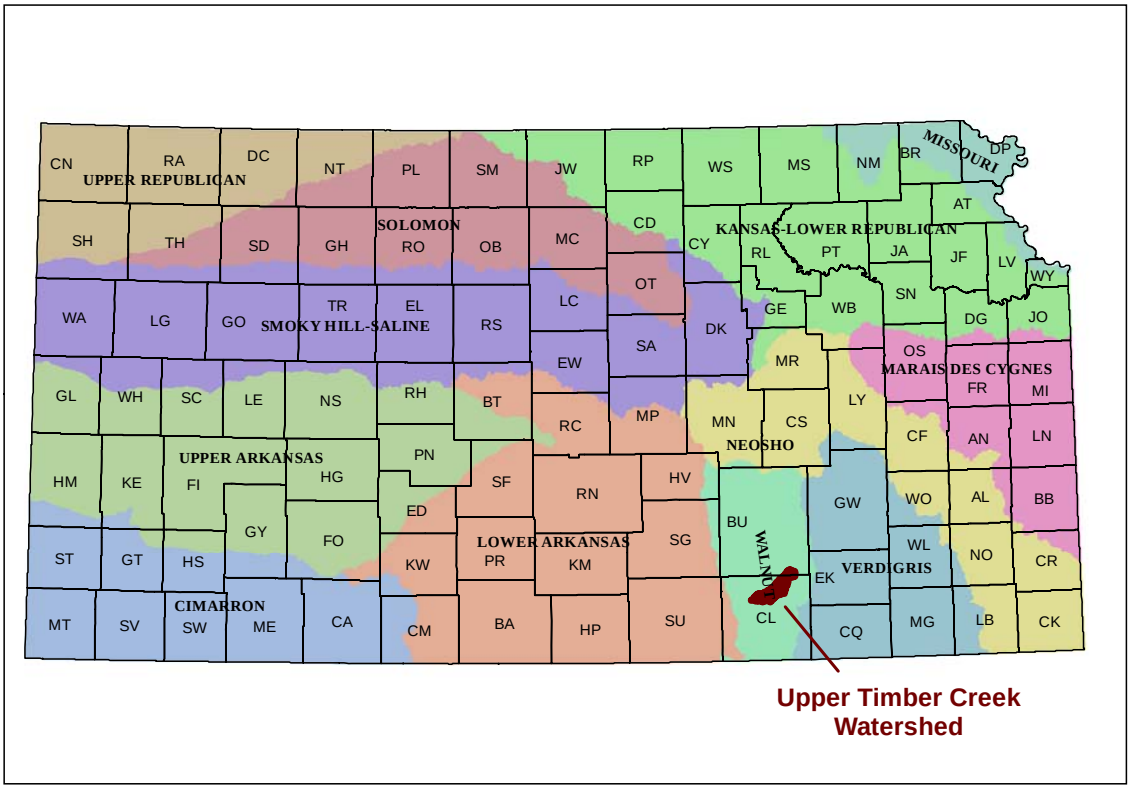


FIGURE 3. TWELVE BASINS WITH UPPER TIMBER CREEK WATERSHED HIGHLIGHTED

C. WHAT IS A HUC?

HUC is an acronym for **H**ydrologic **U**nit **C**odes. HUCs are an identification system for watersheds. Each watershed has a HUC number in addition to a common name. As watersheds become smaller, the HUC number will become larger. The first 2 numbers in the HUC code refer to the drainage region, the second 2 digits refer to the drainage subregion, the third 2 digits refer to the accounting unit and the fourth set of digits is the cataloging unit [ii]. For example:

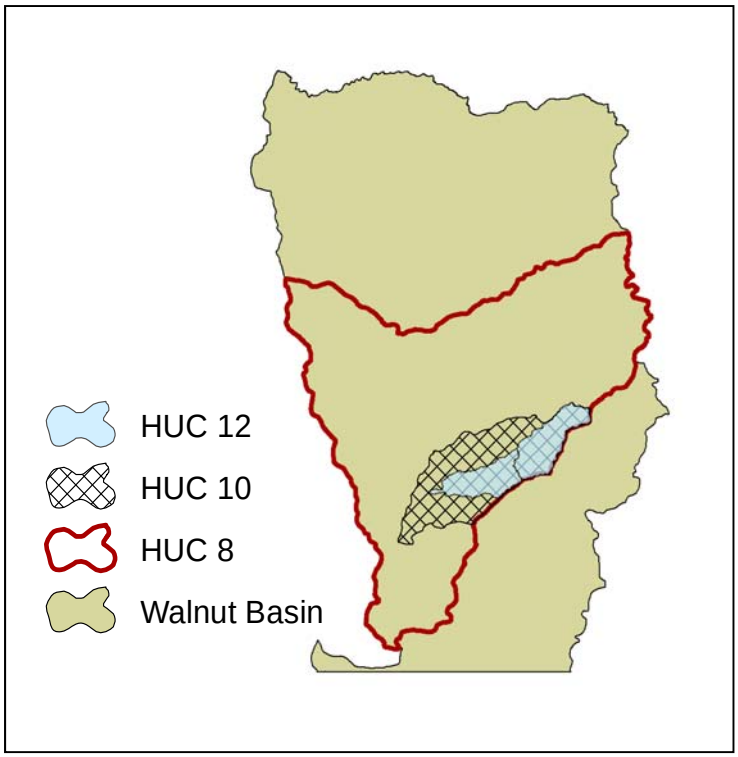
11030018 = Region drainage of the Arkansas, White, and Red Rivers above the Mississippi River. (Area = 245,500 sq. miles)

11**03**0018 = The Arkansas River Basin below it's intersect with the Colorado-Kansas state line to the Walnut River Basin including White Woman Creek closed basin. (Area = 20,200 sq. miles)

1103**00**18 = Accounting unit drainage of the Middle Arkansas in Colorado and Kansas. If the numbers are 00, the sub region equals the accounting unit. (Area = 20,200 sq. miles)

110300**18** = Cataloging units drainage of the Lower Walnut River. (Area = 1,000 sq. miles)

The Walnut Basin is one of twelve basins in the state of Kansas. Within the Walnut Basin are three HUC 8 classifications. The Lower Walnut Watershed, which contains Timber Creek, has an 8 digit HUC number of 11030018. This HUC 8 is then split into smaller watersheds that are given HUC 10 numbers. UTC lies within HUC 10 code number: 1103001803. This HUC 10 watershed is further divided into smaller watersheds with HUC 12 identifiers. The area of this WRAPS project is a combination of the land area covered by two HUC 12s – 110300180402 and 110300180403.



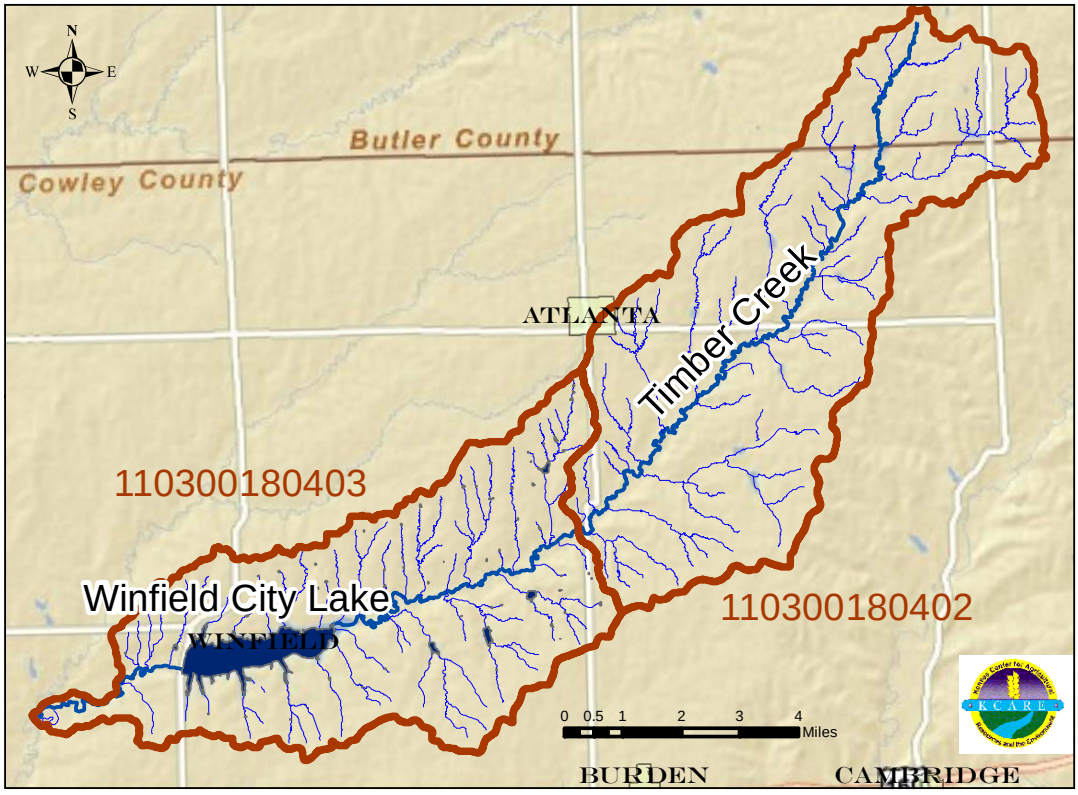


FIGURE 4. HUC 12 DELINEATIONS OF THE TIMBER CREEK WATERSHED.

IV. WATERSHED HISTORY

A. HISTORY OF THE PRODUCERS ADVISORY COMMITTEE (PAC)

In 2002, a group of concerned citizens formed the UTC Watershed Coalition and began discussing local water quality issues. In March of 2004, a more formal group was organized (UTC PAC). They partnered with the City of Winfield in 2005. This volunteer task force consisted of landowners, producers, residents, agency representatives and other stakeholders in the Project Area that were interested in exploring water quality issues and non-point source pollution. The PAC is dedicated to developing a plan for the preservation and protection of the Project Area and the consensus of the group was that preventing sediment and nutrients from entering Winfield City Lake would be the main watershed objective. To assist in this goal, land was purchased surrounding the lake to create a buffer to protect the lake from possible pollutants.

Winfield City Lake serves as a drinking water source for over 60 percent of Cowley County to include the cities of Winfield, Burden and Dexter. Degradation and reduced storage in the lake are primary concerns of the PAC. The City of Winfield is an active partner in the PAC quarterly meetings as well as providing financial resources to accomplish water quality protection in the priority project area above the Winfield City Lake.

Since 2004, many educational activities within the project area have taken place. Meetings to educate citizens about water quality along with tours have been effective tools. The development of brochures and locating signs throughout the watershed has been effective in bringing awareness to citizens in and around the watershed.

The PAC has facilitated several demonstration projects. Two of the demonstrations are: moving a cattle operation to minimize pollution potential to water quality and stabilization of the shoreline at Winfield City Lake. To date several land owner projects have been completed to include well plugging, converting crop ground to permanent grass cover, alternative livestock water systems, buffer strips, terraces and waterways and erosion control dams.

The PAC has also worked with NRCS and the City of Winfield to conduct assessments of the watershed. A nonpoint source watershed plan was conducted to determine possible BMPs and number of acres needed. No Rapid Watershed Assessment has been done in this watershed. Land use/cover and priority areas have been identified through mapping. The City of Winfield maintains a monitoring site near the dam 24 feet below the surface to evaluate water quality conditions at the lake. Elevation of the lake is monitored in the first cove on the south side of the lake at the boat ramps.

The PAC has been very involved and active in implementing BMPs that will address nutrient and sediment contribution to Winfield City Lake. Below is a table of past BMP projects that have been funded by the City of Winfield and independently implemented by the PAC and independent landowners. The City of Winfield collects a user fee from the public water supply customers of the lake. Approximately $20,000 is collected each year to be used for BMP implementation.

TABLE 1. UTC PAC COST SHARE PROJECTS

Practice	Units Installed	Year	Cost Share	Acres Protected	Sediment Reduction/ Year, tons
Pasture Planting	9 acres	2006	1,049	9	99
Pit Pond			4,029		
Sediment Basin	1 structure		2,883	21	294
Sediment Basin	1 structure		1,342	22	308
Steambank Stabilization			2,587	1	50
Terraces	3500'		2,291	44	123
Water Development			1,131		
Well Plugging	2 wells		1,000	0	0
Yearly Total			**$16,312**		**874**
Range Seeding	19.2 acres	2007	935	14	70
Yearly Total			**$935**		**70**
Range Seeding	52 acres	2008	3,198	52	224
Range Seeding	71.1 acres		4,373	71	554
Sediment Basin	1 structure		1,981	20	280
Terraces	1500'		1,024	70	140
Waterway	1 ac		1,350	0.9	11
Yearly Total			**$11,925**		**1,209**
Range Seeding	10.7 ac	2009	794	11	66
Rock Chute	1 structure		2,218	1	35
Rock Chute	1 structure		7,166	3	47
Sediment Basin	1 structure		2,500	8	120
Terraces	797'		544	15	14
Waterway	1 ac		870	0.5	12

Sediment Basin	1 structure		1,364	11	165
Rock Chute	2 structures		7,210	2	98
Yearly Total			**$22,666**		**557**
Terrace, WW Repair	1500', 1 ac	2010	1,563	17	78
Tile Outlet/Gradient Terrace	1775'/608'		7,973	13	53
Waterway Rebuild/Grass Seeding	2 ac/38.2		5,517	40	360
Yearly Total			**$15,052**		**491**
Terraces	5871'	2011	4,359	67	871
Rock Chute	1 structure		1,665	1	15
Terraces	2350'		1,745	19	285
Rock Chute	1 structure		3,202	2	28
Bermuda Sprigging	32 ac		4,980	32	288
WW/Hardened Crossing	1 ac/.5 ac		2,886		Not complete
Waterway	7 ac		9,743		
Yearly Total			**$15,951**		**1,487**
Total			**82,841**		**4,618**
Non UTC Cost Share Projects - Landowner expenditure					
CCRP Buffer*	4.6 ac	2010	442	5	20
Grass Planting-Native*	38.2 ac		3,667	38	152
Grass Planting-Native*	144 ac		13,824		
Yearly Total			**$17,933**		**172**
**These BMP's were completed by landowners to complement the cost-shared practices.*					
$88,224.27 in cost share equals $117,632.36 spent in the county by landowners to complete projects.					
4,618 Total Tons of soil saved/yr with cost share					
567 Total acres protected with cost share					
18 $/Ton of soil saved with cost share					

B. OVERVIEW

The Lower Walnut Watershed is designated as a Category I watershed indicating it is in need of restoration as defined by the Kansas Unified Watershed Assessment 1999 submitted by the Kansas Department of Health and Environment (KDHE) and the United States Department of Agriculture (USDA) in 1999. A Category I watershed does not meet state water quality standards or fails to achieve aquatic system goals related to habitat and ecosystem health. Category I watersheds are also assigned a priority for restoration. The Lower Walnut Watershed is ranked 42nd in priority out of 92 watersheds in the state. As a part of the Lower Walnut Watershed, the UTC Watershed of this WRAPS process is also in need for protection and restoration.

C. ISSUES AND GOALS OF THE PAC

The charge of the UTC PAC has been to create a plan of restoration and protection measures for the watershed. During the time they have been meeting, they have had speakers and discussions to review and learn about watershed issues and concerns. The UTC Watershed has set the following watershed restoration and protection goals to address their watershed issues.

1. To protect the Winfield City Lake and its watershed from pollutants and siltation.
2. To reduce the discharge of toxic pollutants and dissolved solids into the watershed.
3. To minimize pollution caused by organic waste from agricultural runoff.
4. To reduce flood damage in critical areas.
5. To reduce soil erosion.
6. To improve habitat for wildlife and aquatic species.
7. To conserve soil moisture in dry land farming operations.
8. To increase water use efficiency in farming operations.

The purpose of this WRAPS plan is to address the issues and concerns of the PAC, to address and mitigate current TMDLs in the watershed and to proactively improve conditions so that the impairments on the current 303d list will not reach the stage of TMDL development.

What is a Total Maximum Daily Load (TMDL)?

Every state assigns ***designated uses*** for each water body. These designated uses provide for:

- healthy aquatic life,
- safe contact recreation (swimming and boating),
- safe drinking water,
- safe food procurement, and
- adequate ground, irrigation, industrial, and livestock water usage.

Not meeting these uses indicates a failure to meet the Kansas ***Water Quality Standard*** (WQS). When this happens, a ***TMDL*** is developed. TMDL is a regulatory term derived from the US Clean Water Act. The TMDL will set a maximum amount of pollutant that can be discharged into a waterbody while still providing for its designated uses. It is an assessment tool that helps to identify pollutant impairments and determine the amount of pollutant in the water.

TMDLs consist of 3 parts: wasteload allocation (WLA) from point sources, load allocation (LA) from nonpoint sources, and a built in margin of safety (MOS). In this WRAPS plan, we will address the LA from nonpoint sources.

NOTE: In this report, the term BMP (Best Management Practice) will be used frequently. A BMP is defined as an environmental protection practice used to control pollutants, such as sediment or nutrients, from common agricultural or urban land use activities. Common agricultural BMPs are buffer strips, terraces, grassed waterways, utilizing no-till or minimum tillage, conservation crop rotation and nutrient management plans. Definitions of each of these BMPs are found in the appendix of this report.

V. WATERSHED REVIEW

A. LAND COVER/LAND USES

The UTC Watershed covers 43,865 acres. The only town that is in the watershed is a portion of Atlanta. However, there is urban development surrounding Winfield City Lake. The primary land uses in the watershed are grasslands (74.5%), cropland (15.6%), woodlands (5.6%), water (3.8%) and other (0.5%).

One source of phosphorus within Winfield City Lake is runoff from agricultural lands where phosphorus has been applied. Land use coverage analysis indicates that 15 percent of the watershed is cropland. Phosphorus is a contributing factor to the eutrophication levels in Winfield City Lake. Seventy four percent of land around the lake is grassland; the grazing density of livestock is moderate.

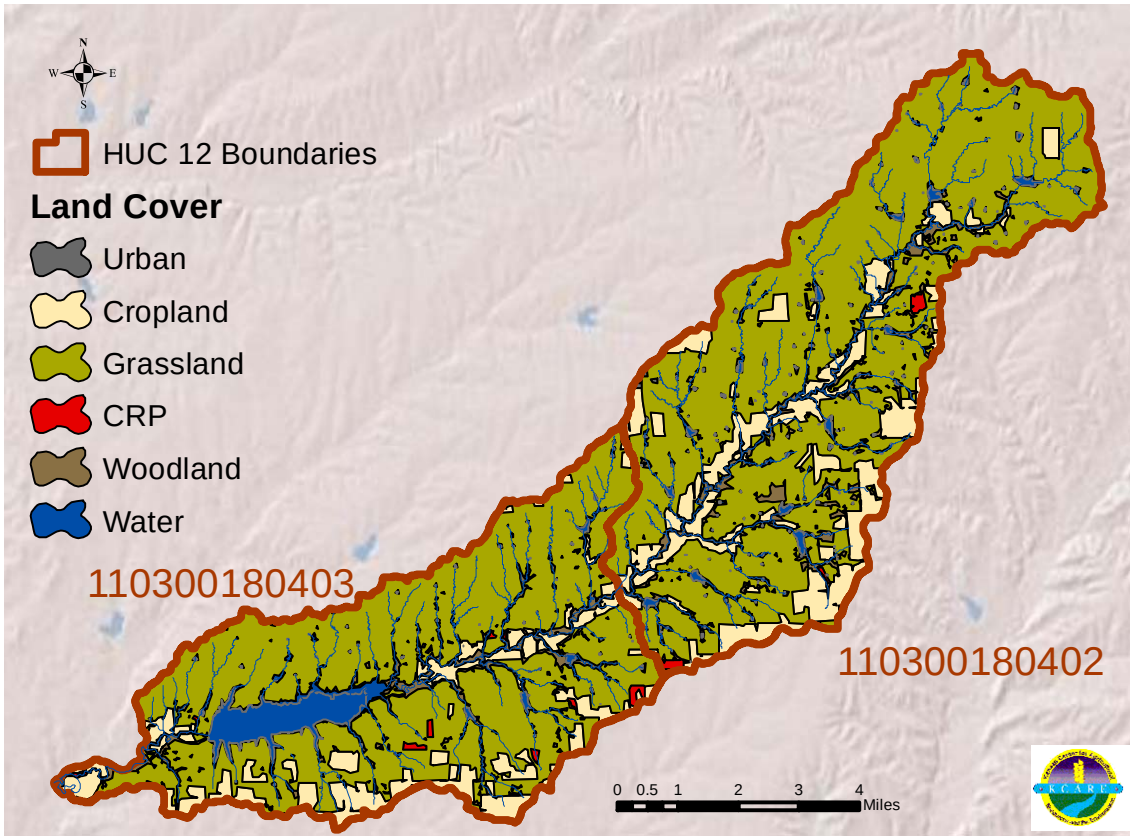


FIGURE 5. LAND USE OF THE UPPER TIMBER CREEK WATERSHED [iii]

TABLE 2. LAND USE IN THE WATERSHED. [III]

Land Use	Acres	% of Watershed
Grassland	32,673	74.5
Cropland	6,831	15.6
Woodland	2,442	5.6
Water	1,657	3.8
CRP	235	0.5
Urban	20	0.0
Residential	6	0.0
Commercial/industrial	1	0.0
Total	**43,865**	**100.0**

According to land cover data, 6,831 acres were planted to crops in the watershed. The type of crop grown will have an effect on nutrient runoff since different crops have different nutrient requirements. The main crop grown in the watershed was wheat (45 percent of all farmable land, which includes crops and trees). Wheat is a moderate user of nitrogen, as is sorghum (24 percent). Some farms apply nitrogen in the fall as anhydrous ammonia. This is usually dependent on whether the crop will be used for winter grazing of stocker calves. Nitrogen may also be applied in the spring. Soybeans (25 percent of the crops grown) are a legume and as such, do not require nitrogen fertilizer. Corn, which is six percent of the harvested land in the watershed, is a heavy user of nitrogen fertilizer in order to support the large amount of biomass produced. All farm ground should be soil tested for the proper amount of phosphorus available in the soil and phosphorus fertilizer should be applied only when needed. It should be applied at planting time and incorporated into the soil where it will attach to soil particles and prevent runoff.

TABLE 3. CROPS GROWN IN COWLEY COUNTY. [iv]

Crop	Acres	% of Crop
Wheat	45,429	45
Soybean	25,230	25
Sorghum	23,886	24
Corn	6,594	6
Total	101,139	100

B. DESIGNATED USES

Surface waters in this watershed are generally used for aquatic life support (fish), human health purposes, domestic water supply, recreation (fishing, boating, swimming), groundwater recharge, industrial water supply, irrigation and livestock watering. These are commonly referred to as “designated uses” as stated in the Kansas Surface Water Register, 2009, issued by KDHE. If the designated uses of a water body are not being

met, the Water Quality Standard for that water body is not being met and therefore, it is impaired. This is important to the plan because it determines whether a waterbody is in need of restoration and possibly a TMDL. This plan addresses the TMDL in Winfield City Lake for eutrophication caused by the lake not meeting the designated uses for domestic water supply, food procurement, groundwater, industrial water, irrigation water, and livestock water.

TABLE 4. DESIGNATED USES FOR THE UPPER TIMBER CREEK WATERSHED. [v]

Designated Uses Table								
Stream Name	**AL**	**CR**	**DS**	**FP**	**GR**	**IW**	**IR**	**LW**
Timber Creek, seg 2	E	C						
Timber Creek, seg 3	E	a	X	X	X	X	X	X
Winfield City Lake	E	A	X	X	X	X	X	X

AL = Aquatic Life Support
CR = Contact Recreation Use
DS = Domestic Water Supply
FP = Food Procurement
GR = Groundwater Recharge
IW = Industrial Water Supply
IR = Irrigation Water Supply
LW = Livestock Water Supply
A=Primary contact recreation lakes that have a posted public swimming area
a=Secondary contact recreation lakes that are by law or written permission of the landowner open to and accessible by the public
C=Primary contact recreation lakes that are not open to and accessible by the public under Kansas law
E = Expected Aquatic Life Use Water
X = Referenced stream segment is assigned the indicated designated use
O = Referenced stream segment does not support the indicated beneficial use

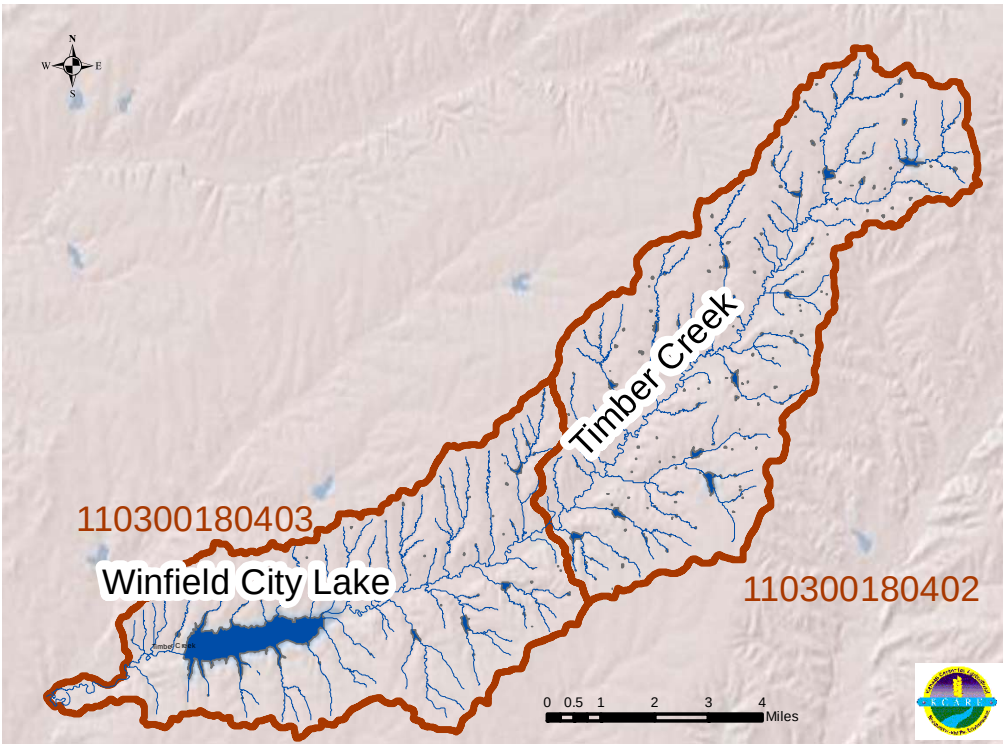


FIGURE 6. CLASSIFIED STREAMS AND LAKES IN THE WATERSHED.

C. SPECIAL AQUATIC LIFE USE WATERS AND EXCEPTIONAL STATE WATERS

Special Aquatic Life Use (SALU) waters are defined as "surface waters that contain combinations of habitat types and indigenous biota not found commonly in the state, or surface waters that contain representative populations of threatened or endangered species". The UTC Watershed does not have any Special Aquatic Life Use waters. **Exceptional State Waters (ESW)** are defined as "any of the surface waters or surface water segments that are of remarkable quality or of significant recreational or ecological value". There are no ESW in this watershed.

D. RAINFALL AND RUNOFF

Rainfall rates and duration will affect sediment and nutrient runoff during high rainfall events. The UTC Watershed averages 35 inches of rainfall yearly. Most high intensity rainfall events will occur in late spring and early summer. This is the time when crop ground is either bare or crop biomass is small. Also,

grassland is short and does not catch runoff. Both of these situations can lead to pollutants entering the waterways.

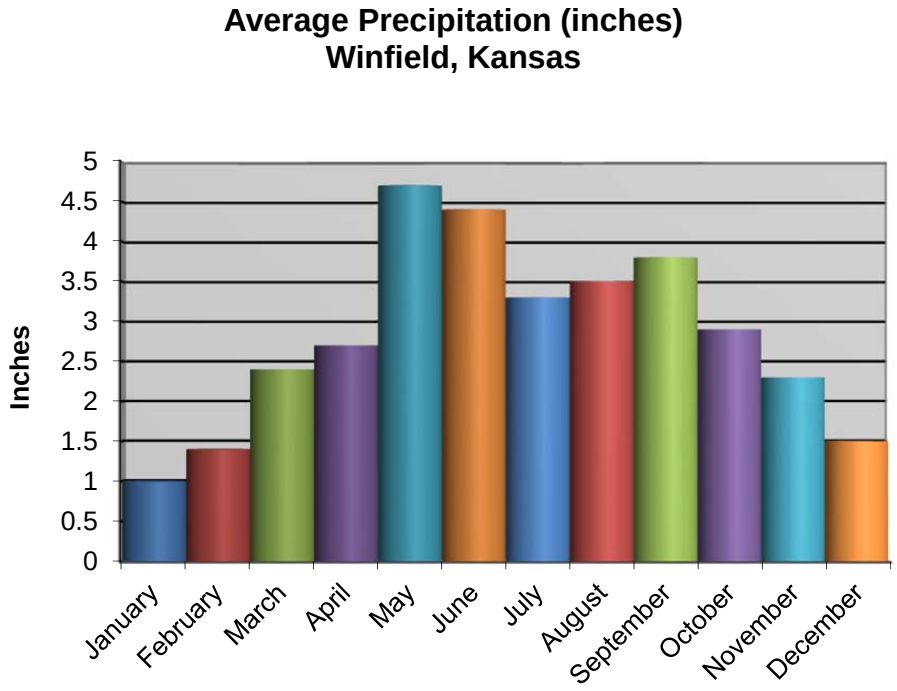


FIGURE 7. AVERAGE PRECIPITATION BY MONTH. [vi]

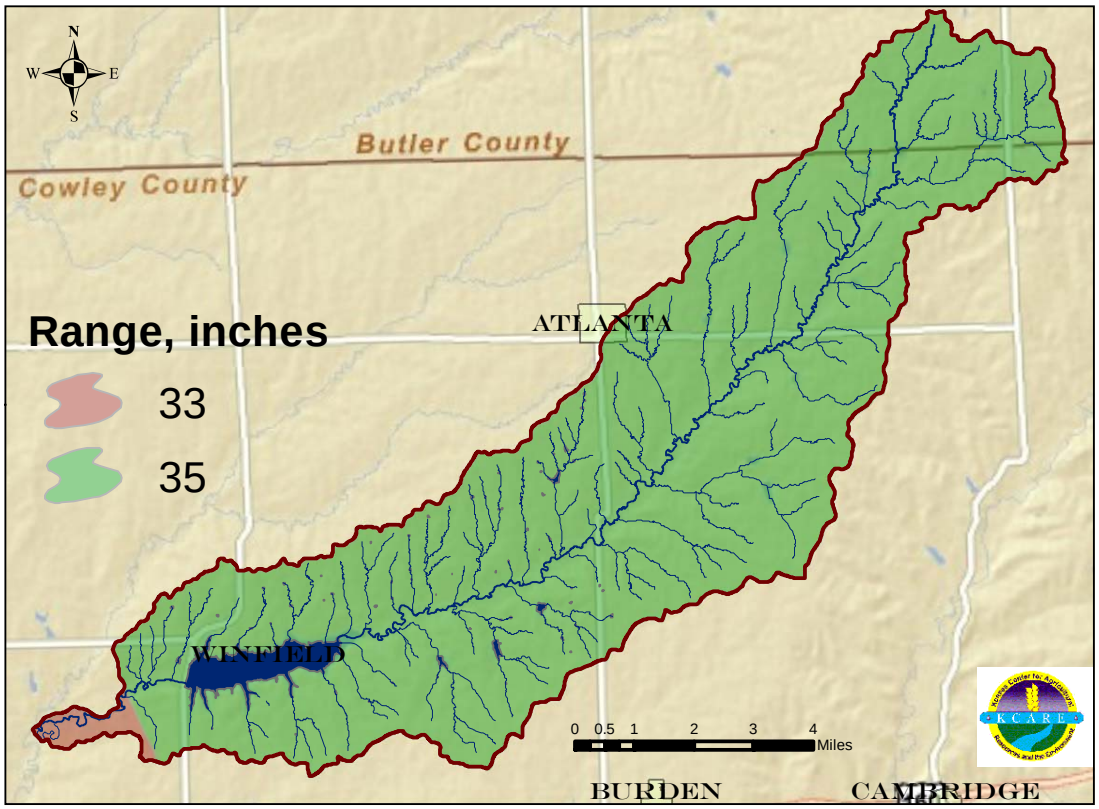


FIGURE 8. YEARLY PRECIPITATION IN THE WATERSHED. [vii]

E. POPULATION AND WASTEWATER SYSTEMS

The number of wastewater treatment systems is directly tied to population, particularly in rural areas that do not have access to municipal wastewater treatment facilities. Failing, improperly installed or lack of an onsite wastewater system can contribute bacteria or nutrients to the watershed through leakage or drainage of untreated sewage. Even though all the counties in the watershed have County Sanitarian Codes, there is no way of knowing how many failing or improperly constructed systems exist in the watershed. Hundreds of onsite wastewater systems may exist in this watershed and the functional condition of these systems is generally unknown. However, best guess would be that ten percent of wastewater systems in the watershed are failing or insufficient. [viii]

Cowley County has a 2006 population estimate of 34,931 people with a population density of 32.3 persons per square mile. Butler County has a population estimate of 63,147 people and a density of 41.7 persons per square mile. The Kansas average is 32.9 persons per square mile. [ix] However, it can be seen from the map below that the watershed has a very low population

compared to the county and statewide averages. Therefore, there should be fewer septic systems than the statewide average.

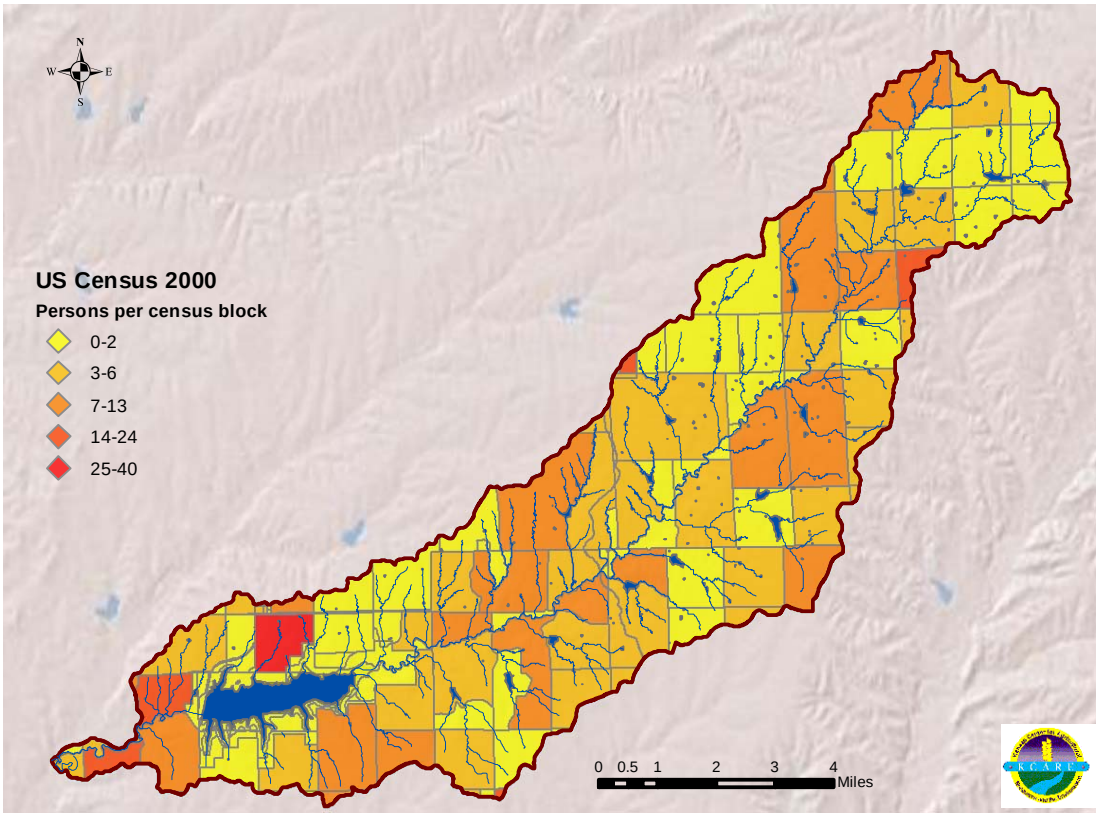


FIGURE 9. CENSUS COUNT, 2000. [x]

F. AQUIFERS

The watershed is underlain with a small portion of alluvial aquifer. No other major aquifers exist in this watershed. An alluvial aquifer is a part of and connected to a river or stream system and consists of sediments deposited by rivers in the stream valleys. A sign of a healthy and sustainable alluvial system is adequate stream flow. The alluvial aquifer in this watershed is connected to Timber Creek downstream from the dam of Winfield City Lake.

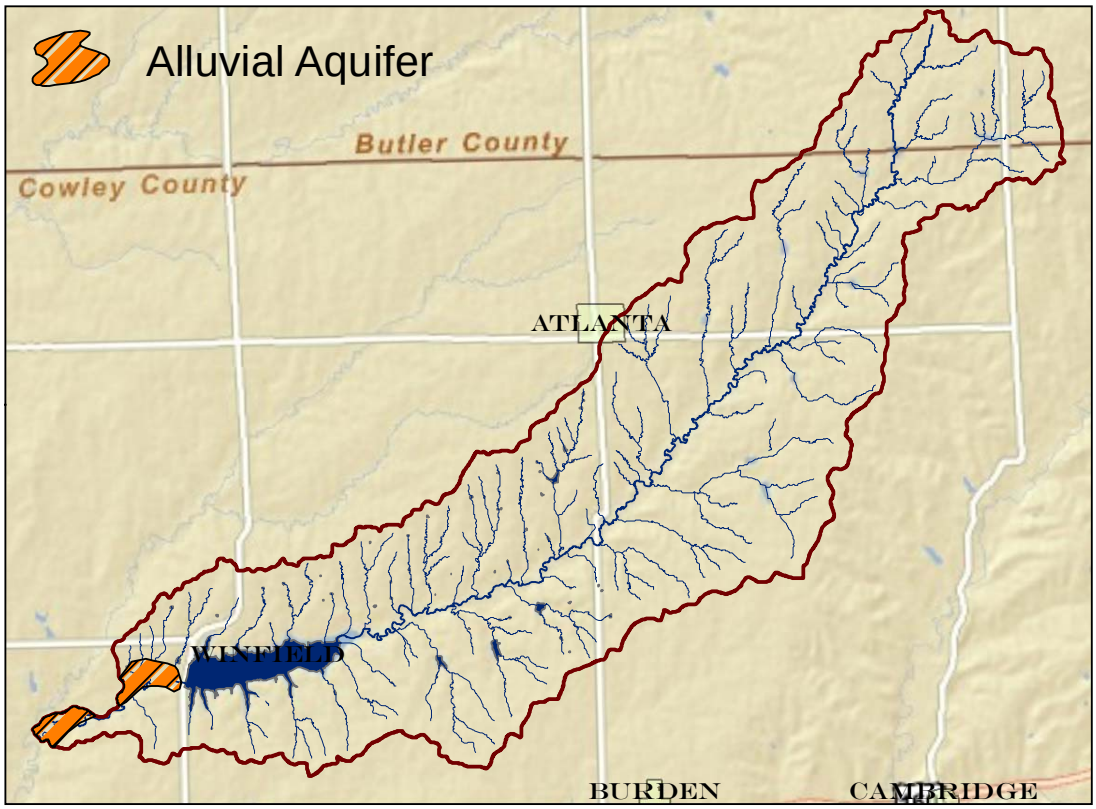


FIGURE 10. ALLUVIAL AQUIFER IN THE WATERSHED. [xi]

G. PUBLIC WATER SUPPLIES (PWS) AND NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEMS (NPDES)

A Public Water Supply (PWS) that derives its water from a surface water supply can be affected by sediment – either in difficulty at the intake in accessing the water or in treatment of the water prior to consumption. Nutrients and BACTERIA will also affect surface water supplies causing excess cost in treatment prior to public consumption. The water diverted from Winfield City Lake benefits nearly 2/3 of Cowley County's population through its system and interconnecting water suppliers. The table below lists the PWS in the UTC Watershed.

TABLE 5. CUSTOMERS SERVED BY WINFIELD CITY LAKE

Customer Served Directly	Customer Served Indirectly
City of Winfield	
RWD #2	

RWD #4	
RWD #5	City of Atlanta City of Cambridge City of Dexter
RWD #7	
RWD #8	
City of Burden	
City of Oxford	not supplying at current date

Wastewater treatment facilities are permitted and regulated through KDHE. National Pollutant Discharge Elimination System (NPDES) permits specify the maximum amount of pollutants allowed to be discharged to surface waters. Having these point sources located on streams or rivers may impact water quality in the waterways. For example, municipal wastewater can contain suspended solids, biological pollutants that reduce oxygen in the water column, inorganic compounds or bacteria. Wastewater will be treated to remove solids and organic materials, disinfected to kill bacteria and viruses, and discharged to surface water. Treatment of municipal wastewater is similar across the country. Industrial point sources can contribute toxic chemicals or heavy metals. Treatment of industrial wastewater is specific to the industry and pollutant discharged. Any pollutant discharge from point sources that is allowed by the state is considered to be Wasteload Allocation. **In the UTC Watershed, there are no NPDES sites.** The only KDHE monitoring site within the watershed is located at Winfield City Lake.

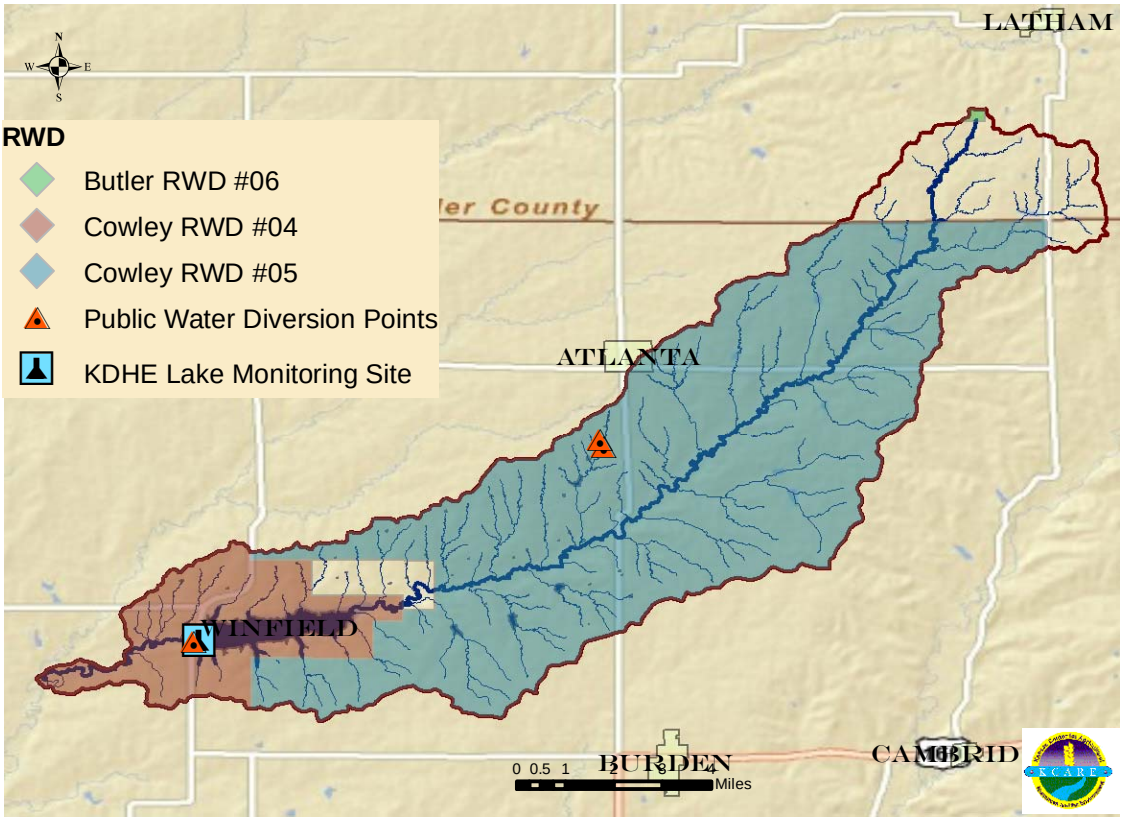


FIGURE 11. PWS DIVERSION POINTS AND RURAL WATER DISTRICTS IN THE WATERSHED. [xii]

H. TOTAL MAXIMUM DAILY LOADS (TMDLS) IN THE WATERSHED

A Total Maximum Daily Load (TMDL) designation sets the maximum amount of pollutant that a specific body of water can receive without violating the surface water-quality standards, resulting in failure to support their designated uses. TMDLs provide a tool to target and reduce point and nonpoint pollution sources. TMDLs established by Kansas may be done on a watershed basis and may use a pollutant-by-pollutant approach or a biomonitoring approach or both as appropriate. TMDL establishment means a draft TMDL has been completed, there has been public notice and comment on the TMDL, there has been consideration of the public comment, any necessary revisions to the TMDL have been made, and the TMDL has been submitted to EPA for approval. The desired outcome of the TMDL process is indicated, using the current situation as the baseline. Deviations from the water quality standards will be documented. The TMDL will state its objective in meeting the appropriate water quality standard by quantifying the degree of pollution reduction expected over time. Interim objectives will also be defined for midpoints in the implementation process. In

summary, TMDLs provide a tool to target and reduce point and nonpoint pollution sources. The goal of the WRAPS process is to address high priority TMDLs.

Winfield City Lake has a high priority TMDL for eutrophication (E) developed in 2009. The Winfield City Lake TMDL will be directly addressed in this watershed plan.

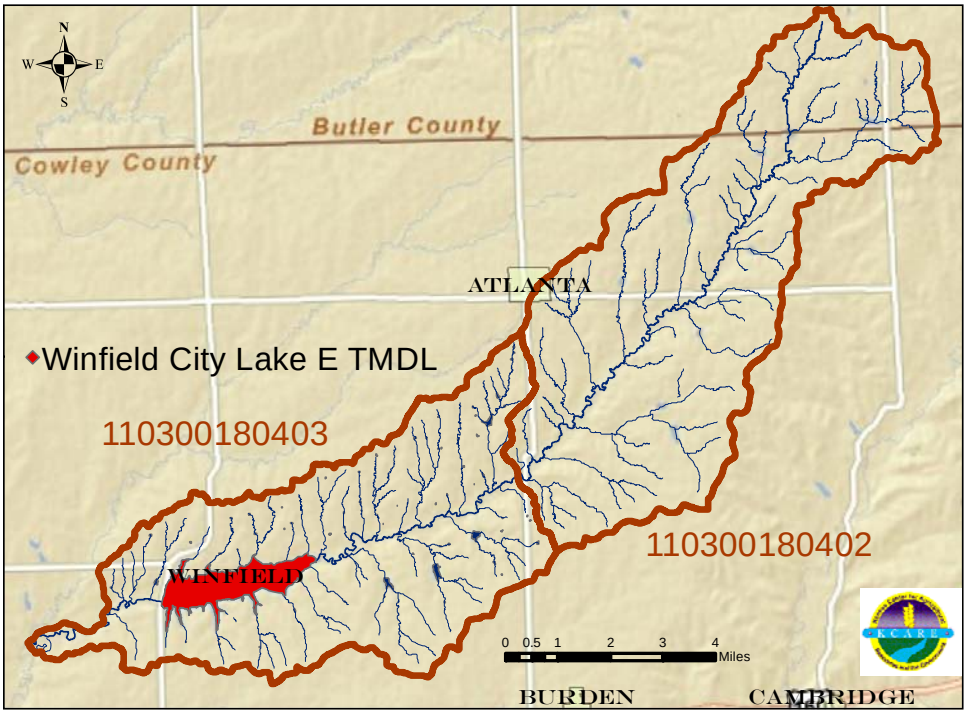


FIGURE 12. EUTROPHICATION TMDL IN TIMBER CREEK WATERSHED.

KDHE reviews TMDLs assigned in each of the twelve basins of Kansas every five years on a rotational schedule. The table below includes the review schedule for the Walnut Basin.

TABLE 6. TMDLS REVIEW SCHEDULE FOR THE WALNUT BASIN. [xiii]

Year Ending in September	Implementation Period	Possible TMDLs to Revise	TMDLs to Evaluate
2013	2014-2023	2002, 2004, 2005	2002, 2004, 2005
2018	2019-2028	2000, 2004, 2005, 2008	2000, 2004, 2005, 2008

Pollutants are assigned "categories" depending on stage of TMDL development: [xiv]

- Category 5 – Waters needing TMDLs

- Category 4a – Waters that have TMDLs developed for them and remain impaired
- Category 4b – NPDES permits addressed impairment or watershed planning is addressing atrazine problem
- Category 4c – Pollution (typically insufficient hydrology) is causing impairment
- Category 3 – Waters that are indeterminate and need more data or information
- Category 2 – Waters that are now compliant with certain water quality standards
- Category 1 – All designated uses are supported, no use is threatened

TABLE 7. TMDLS IN THE WATERSHED. [xv] THE WINFIELD CITY LAKE E TMDL WILL BE DIRECTLY ADDRESSED BY THIS WRAPS PLAN.

Water Segment	TMDL Pollutant	End Goal of TMDL	Priority	Sampling Station
High Priority				
Winfield City Lake	Eutrophication	Chlorophyll a < 10 ug/l	High	LM050801

I. 303D LISTINGS IN THE WATERSHED

The UTC Watershed has no listings on the 2010 "303d list". A 303d list of impaired waters is developed biennially and submitted by KDHE to EPA. To be included on the 303d list, samples taken during the KDHE monitoring program must show that water quality standards are not being met. This in turn means that designated uses are not met. TMDL development and revision for waters of the UTC Watershed is scheduled for 2013. TMDLs will be developed over the subsequent two years for "high" priority impairments. Priorities are set by work schedule and TMDL development timeframe rather than severity of pollutant. If it will be greater than two years until the pollutant can be assessed, the priority will be listed as "low".

Timber Creek near Winfield, which is downstream from Winfield City Lake, is listed for **E. coli bacteria** and **copper**. Although the sampling site for the bacteria impairment is not included in the watershed, the impairment will include the entire length of Timber Creek. E. coli is specific for indicating the potential for human disease. In order to qualify for E. coli listing on the 303d list, water samples have to meet a new requirement: the average of five samples taken over a month will have to exceed the criteria level. In the past, one sample exceedance could require the issuance of a TMDL for bacteria. Therefore, in the future, it will be more difficult for a TMDL for E. coli to be required than it was to

have a TMDL issued for bacteria. The TMDLs for bacteria and lead will be indirectly addressed in this watershed plan.

TABLE 8. 303D LISTING FOR THE WATERSHED.

Water Segment	TMDL Pollutant	Category	Sampling Station
Timber Creek reaches	E. coli bacteria	3 – Indeterminate due to small sample size	SC653
Timber Creek reaches	Lead	5 – Needing TMDL. Last exceedance occurred in most current sample year: 2011	SC653

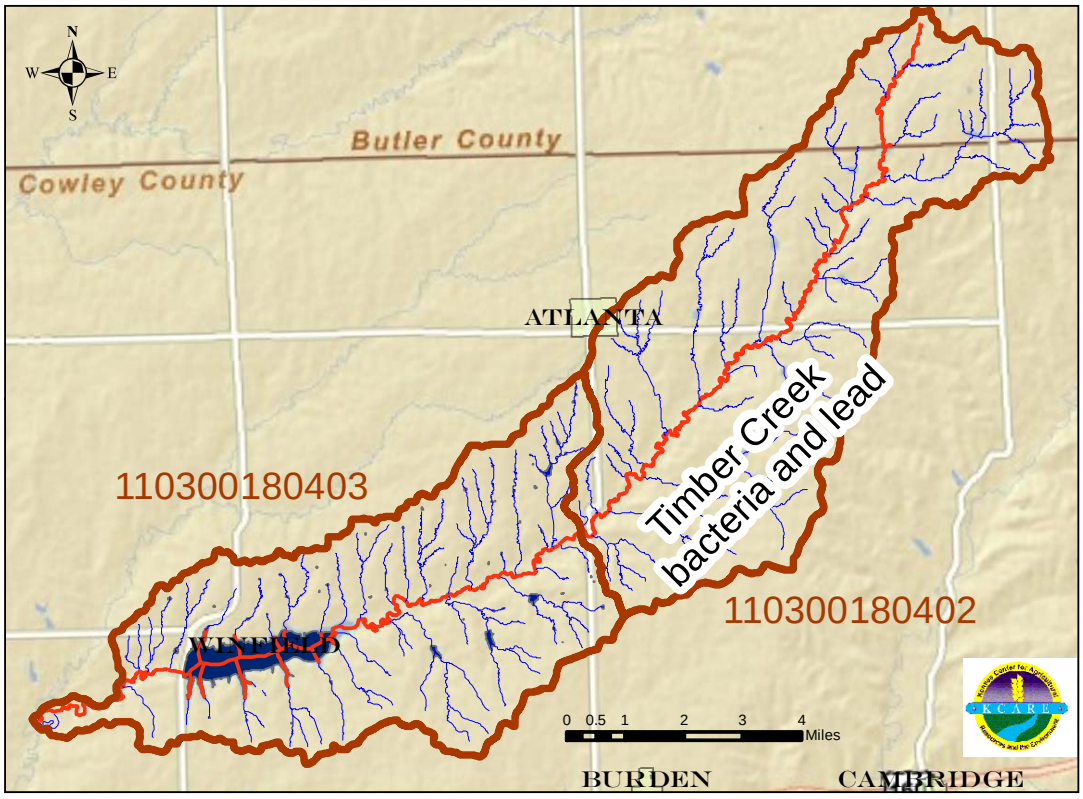


FIGURE 13. 303D LISTING FOR THE WATERSHED.

J. BATHYMETRIC STUDY ON WINFIELD CITY LAKE [xvi]

During November 2007, the Kansas Biological Survey (KBS) performed a bathymetric survey of Winfield City Lake in Cowley County, Kansas. The survey was carried out using acoustic echosounding apparatus linked to a global positioning system.

A pre-impoundment topographic map of the reservoir site dated 1964 was obtained from the City of Winfield. The map was scanned, georeferenced, and the contour lines digitized. A digital elevation model of the pre-impoundment surface was then generated from the digitized contour lines, and digitally compared to the 2007 reservoir bottom topography derived from the bathymetric survey. Results of the comparison indicate that the reservoir has decreased in volume by 1305 acre-feet since construction.

Fourteen sediment cores were extracted from the lake on August 1, 2008 to determine accumulated sediment thickness at locations distributed across the reservoir. Sediment samples were taken from the top six inches of each core and analyzed for particle size distributions.

Sampling sites were distributed across the length and breadth of the reservoir. An effort was made to avoid the original stream channel, which would have likely yielded higher sediment thicknesses not representative of the overall reservoir bottom sediment thickness. The original stream channel generally follows the southern side of the reservoir, resulting in a fairly gentle slope across the northern part and steep dropoffs along the southern shore.

Sediment thickness ranged from a low of 4 centimeters at site WIN-9 (located in the north-central part of the reservoir) to a high of 170 centimeters at site WIN-13 adjacent to the dam. Average sediment thickness across all fourteen sites was 60 centimeters. Contrary to pre-coring expectations, highest sediment thicknesses were not found in the upper end of the reservoir near the inflow, but in the lower end of the reservoir near the dam.

Sample site particle size distributions form distinct trends across the reservoir. Sites in the eastern half generally are dominated by silt, with clay forming a secondary fraction and sand a minor to very minor percentage of the total. Sites in the western half, in contrast, exhibit a high sand percentage with clay again forming a secondary fract, but with strikingly low fractions of silt.

Actual sediment thickness values as determined by coring were compared to values from the 1964-2007 for each sample site. This comparison provides some insight into the validity and accuracy of the preimpoundment map differencing approach. Results suggest that the map differencing generally underestimates the sediment accumulation in this reservoir

VI. TARGETING

“Targeted Areas” are those specific areas that require BMP placement in order to meet load reductions. The Targeted Areas that have been identified in this WRAPS are:

- Cropland areas that lies within 500 feet of Timber Creek will targeted for nutrient and sediment runoff.

- Livestock areas across the watershed will be targeted for nutrients due to the distribution of grazing areas in the watershed.
- Degraded riparian areas and streambanks that have been identified by the Timber Creek stream assessment as discussed in the following section will be targeted for restoration.

1. STREAM ASSESSMENT

The PAC felt that a stream assessment of Timber Creek would be beneficial in determining certain areas that might need restoration. Therefore, a stream assessment was conducted by Will Abernathy, a student at Southwestern College in Winfield in May, 2012 utilizing the RASCAL (Rapid Assessment of Stream Conditions Along Length) stream assessment method. Will was under the supervision of Dr. Rick Cowlishaw. Will walked Timber Creek from the top of Winfield City Lake to a pond dam at the headwaters of the creek. At each point he would assess the stream for flow, hydrologic variability, substrate, channel condition, pool frequency, canopy, embedded, stream habitat, losing flow, right side riparian width, left side riparian width, right side riparian cover type, left side riparian cover type, right side adjacent land use, left side adjacent land use, right side livestock presence, left side livestock presence, bank stability, bank material, bank height, channel pattern, channel form depth, channel form width, riffle frequency, sediment deposit, channel vegetation, bank vegetation and bank erosion. A photograph was taken at each point. At any time during the assessment, if he found a Point of Interest, he would make a notation and take a picture. The data was turned over to Susan Brown, Kansas Center for Agricultural Resources and the Environment. Two aspects of the survey were analyzed. First, the goal was to assess the general health of the stream. To accomplish this task each assessment was compiled and a percentage was calculated for each subtopic under each assessment category. The second aspect of the analysis was to identify potential stretches of the creek that have problems needing to be addressed. In order to do this, the data was sorted by bank stability. There were only 2 sites that were listed as unstable and they were stand-alone sites, so were not utilized. There were 6 different stream segments that popped out when the “moderately unstable” stream points were mapped. These were the segments that were pulled out for stabilization projects for the PAC to focus on for erosion control.

2. GENERAL HEALTH OF THE STREAM

The first goal of the assessment was to determine what the overall health of the stream is. To accomplish this task, a percentage was calculated from the number of entries in

each category. The results are contained in the appendix of this plan. Definitions for stream categories are also included in the appendix.

After summarizing the data, analysis was conducted using the Stream Visual Assessment Protocol. [xvii] This is a qualitative method meant to give analysis to stream and riparian characteristics. The number of criteria under each category is scored with a range of 0 (worst condition) to 10 (best condition). The overall score was the summation of all scored values divided by the number of points assessed. A narrative rating of Good, Average or Poor was then assessed to the overall stream and riparian health.

Note: This data should not be related to any other stream for comparison. Its relevance only applies to Timber Creek and should only be used as a framework for identifying potential causes of stream impairments and recommendations for restoring or protecting Timber Creek.

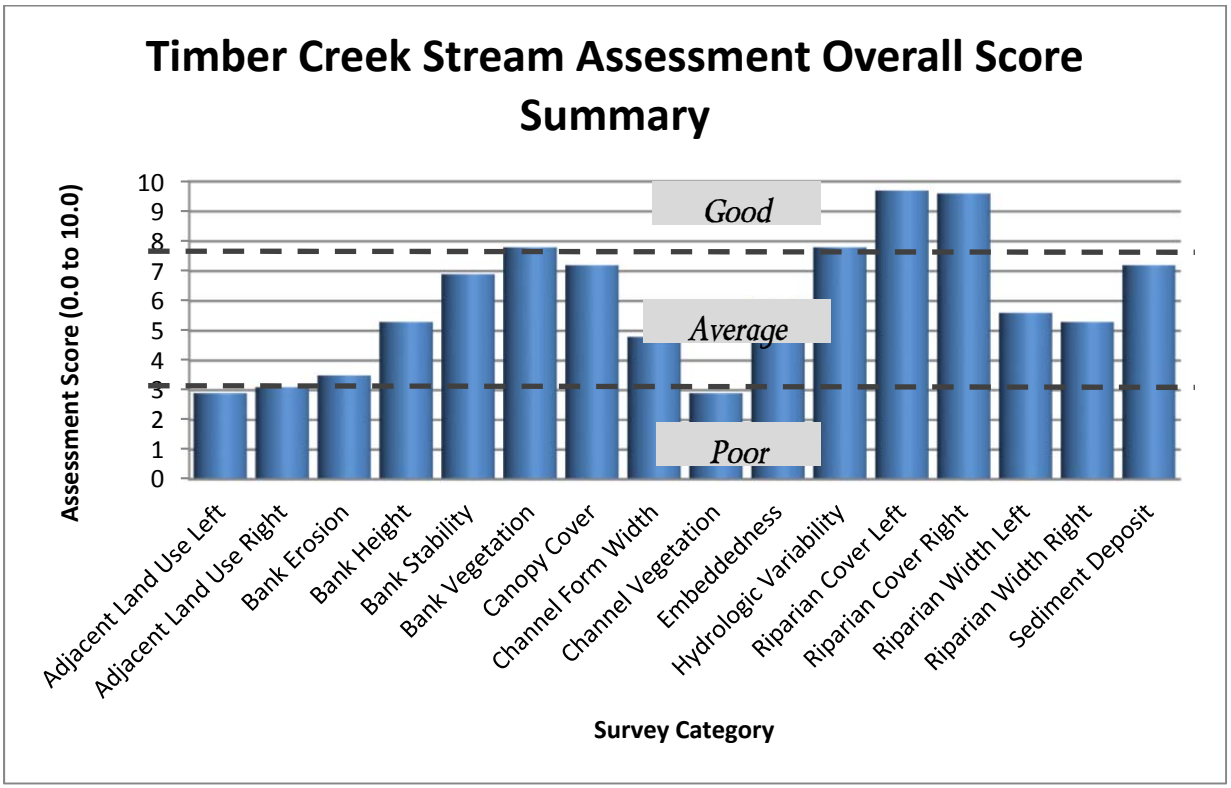


FIGURE 14. STREAM ASSESSMENT OVERALL SCORE

The overall health of Timber Creek and its riparian areas appears to be Average. Poor categories are Adjacent Land Use on the Left Bank and Channel Vegetation. However, Riparian Cover is good on both the left and right sides of the stream overall.

3. POTENTIAL RESTORATION SITES

The second aspect of the analysis was to identify potential segments of the creek that have areas in need of restoration. In order to do this, the data set was sorted by bank stability. There were only 2 sites that were listed as unstable and they were stand-alone sites, so were not utilized. There were 6 different stream segments or clusters of moderately unstable streambanks that popped out when the "moderately unstable" stream points were mapped. These were the segments that were pulled out for potential stabilization projects for the WRAPS to focus on for streambank restoration.

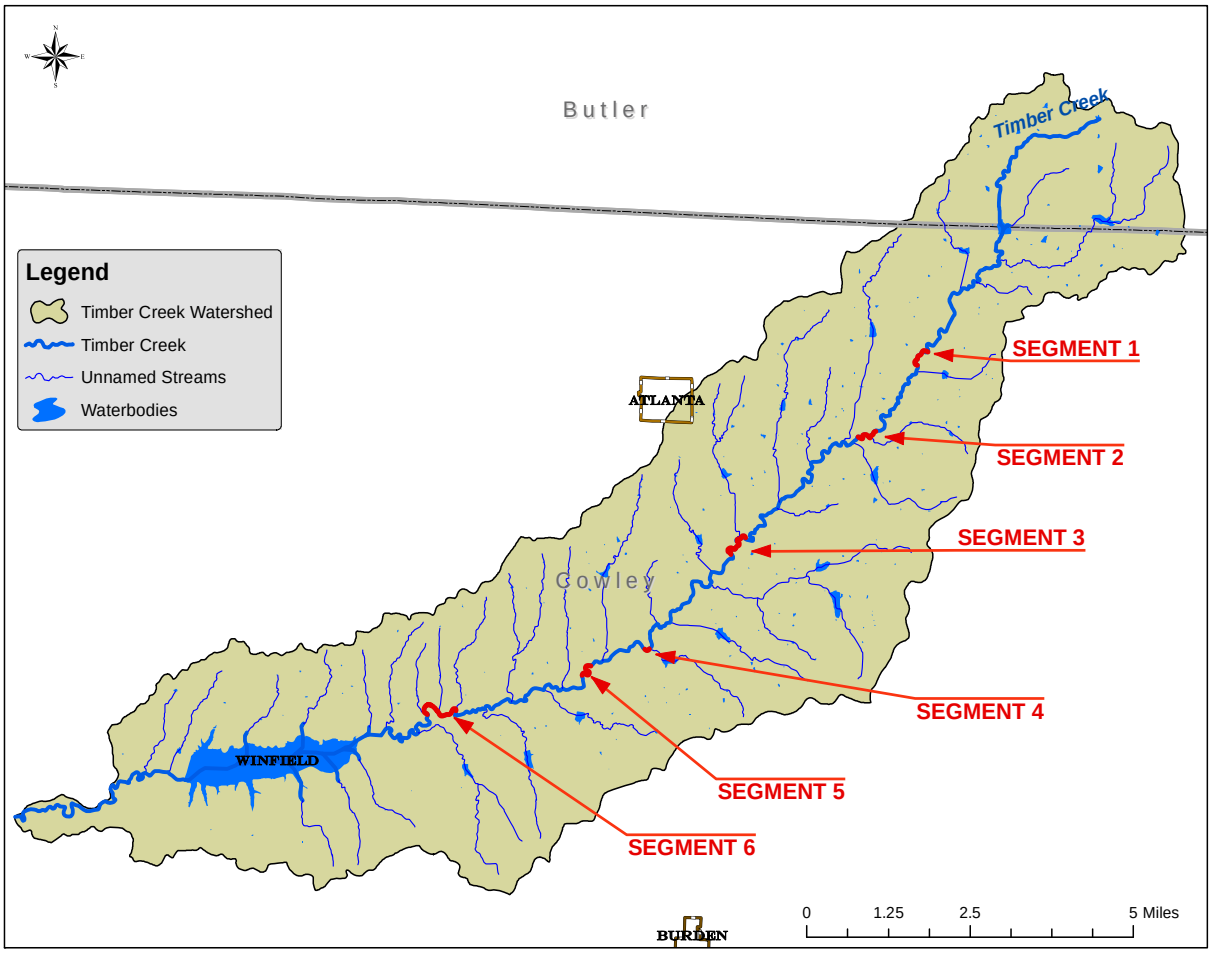


FIGURE 15. POTENTATION RESTORATION SITES ALONG TIMBER CREEK

In October, 2012, Ron Graber, Watershed Specialist, and Sarah McBeth, Water Quality Coordinator, toured the segments that were identified in the assessment and verified the conditions of the segments. The PAC has reviewed this data and conferred that these six segments will be targeted for restoration projects.

There is a total of 15,337 linear feet of streambank degradation in the six sites. The PAC wishes to target the fields and riparian areas along the degraded segments for BMPs explaining that implementing agriculture BMPs would be more economical than restoring the stream sites. This would have the benefit of slowing water and trapping more nutrients prior to entering into the creek. If funding allows, the streambank sites would be addressed also. Approximate segment lengths in linear feet are as follows.

Segment 1 – 2,000 feet
Segment 2 – 3,610 feet
Segment 3 – 3,027 feet
Segment 4 – 542 feet
Segment 5 – 2,100 feet
Segment 6 – 4,058 feet

Note: In the following maps, Points of Interest that were identified in the Moderately Unstable cluster segments are pictured. This does not indicate that all points along these particular stream segments were in need of restoration, only that these were points that were determined to be of interest to Will Abernathy at the time of his assessment. It does not intend to target specific landowners.

The six sites can be reviewed in the following pages.


Legend
Roads
Timber Creek
Unnamed Streams
Waterbodies
Timber Creek
Munson Hill 24000
Minor Gully
Bank Erosion
Log Jam
Minor Gully
Minor Gully
Bridge
SEGMENT 1
2012/05/24
0
0.05
0.1
0.2 Miles


Legend
Timber Creek Watershed
Timber Creek
Unnamed Streams
Waterbodies
Minor Gully
2012/05/24
Timber Creek
Bridge
2012/05/23
County Road 2
SEGMENT 2
Minor Gully
2012/05/23
Oily Appearance on Water
2012/05/24
Log Jam
2012/05/23
0
0.05
0.1
0.2 Miles


Legend
Timber Creek Watershed
Timber Creek
Unnamed Streams
Waterbodies
Baltimore
Timber
Severe Gully
Minor Gully with Field Drain
Severe Gully
SEGMENT 3
Log Jam
Log Jam
Log Jam, Stagnant Water
Van Meter
0
0.05
0.1
0.2 Miles
2012/05/22


Legend
Timber Creek Watershed
Timber Creek
Unnamed Streams
Waterbodies
Timber Creek
Bank Erosion
SEGMENT 4
Bank Erosion moving toward house through cattle pens
Bridge
Bank Erosion
County Road 5
2012/05/22
2012/05/22
2012/05/22
2012/05/22
0 0.05 0.1 0.2 Miles


Legend
Timber Creek Watershed
Timber Creek
Unnamed Streams
Waterbodies
Animal Crossing
County Road 8
Timber Creek
Fence Across Stream
SEGMENT 5
Severe Gully
Severe Gully
2012/05/21
2012/05/21
0


County Road 8
Legend
Timber Creek Watershed
Timber Creek
Unnamed Streams
Waterbodies
Gully out of field
Log jam
Creek crossing
Cowley
Timber Creek
SEGMENT 6
0
0.15
0.3
0.6 Miles

VII. POLLUTANT LOAD REDUCTIONS

The current annual load reduction needed for phosphorus is 2,348 pounds. This is the amount that needs to be removed in the watershed by BMPs in order to address the eutrophication TMDL in Winfield City Lake.

In Winfield Lake, phosphorus is identified as the primary pollutant. Currently 5,419 pounds of phosphorus are entering the lake yearly. The reduction goal to meet the TMDL endpoint of 3,071 pounds is 2,348 pounds. This is a 43 percent reduction.

FIGURE 16. . PHOSPHORUS LOAD REDUCTION NEEDED TO MEET TMDL ENDPOINT IN WINFIELD CITY LAKE.

KDHE has provided a Sediment Reduction Goal for the watershed. This goal was derived from the STEPL model that was utilized for phosphorus determination to attain the eutrophication TMDL. This model determined that there is a sediment load in the lake of 2,625 tons per year. The same reduction rate was applied to sediment reduction as was given the phosphorus reduction and a yearly reduction goal was calculated at 656 tons. This is a 25 percent reduction in sediment.

FIGURE 17. SEDIMENT LOAD REDUCTION NEEDED TO MEET THE SEDIMENT REDUCTION GOAL IN WINFIELD CITY LAKE.

Within the Winfield City Lake Watershed there are two overall causes of the phosphorus and sediment loading: point and nonpoint sources of pollution.

Point source pollution is defined as stationary location from which pollutants are discharged. An example of point source pollution is direct, concentrated discharge such as sewage effluent discharging from a pipe or ditch into a water body. Point sources of pollution require a National Pollutant Discharge Elimination System (NPDES) Permit; a permit required by Federal law for all point sources discharge pipes that discharge into U.S. waters. Authorized by the 1972 Clean Water Act, NPDES is a permit program that controls water pollution by regulating the type and amounts of pollutants that can be discharged into the waters of the United States. Industrial, municipal and other facilities that discharge wastes must obtain permits that require pollution control of any wastes discharged. In Kansas, the program is administered by KDHE. At the time of the publication of this plan, there are no NPDES sites in the watershed.

Nonpoint source (NPS) pollution is defined as pollution discharged other than through a pipe or ditch over a wide land area, originating from different sources, which enters water bodies through runoff or snowmelt and deposits pollutants into ground or surface waters. Within the Winfield City Lake Watershed, the primary NPS pollution issues are related to runoff from agricultural lands as well as non-confined animal grazing.

NOTE: The PAC of UTC Watershed has determined that the focus of this WRAPS process will be on key impairments of Winfield City Lake: **nutrients** and **sedimentation**. All goals for nutrient reduction will be aimed at the addressing the TMDL for eutrophication in the lake. All goals for sedimentation will be aimed at protecting the lake from further degradation from siltation. The following sections in this plan will address these concerns.

VIII. EUTROPHICATION

Winfield City Lake is listed on the "303d list" for an impairment of **eutrophication**. A 303d list of impaired waters is developed biennially and submitted by KDHE to EPA. To be included on the 303d list, samples taken during the KDHE monitoring program must show that water quality standards are not being met. This in turn means that designated uses are not met. (http://www.kdheks.gov/tmdl/download/2008_303d_List.pdf)

Eutrophication is the only impairment by KDHE for Winfield City Lake. Excess nutrient loading (primarily nitrogen and phosphorus) from the watershed creates conditions favorable for algae blooms and aquatic plant growth. While this abundance of algae may temporarily increase oxygen levels, the bloom will eventually die off after the nutrients become in short supply. During die off, dissolved oxygen levels are diminished in the water due to the oxygen being used in algal decomposition. This results in an unfavorable habitat for aquatic life. Desirable criteria for healthy water includes dissolved oxygen rates of 5 mg/L or greater and biological oxygen demand (BOD) less than 3.5 mg/L. Excess nutrients originate from manure and fertilizer runoff in rural and urban areas.

NOTE: The **eutrophication** TMDL in Winfield City Lake is due to excess nutrients in the lake. The term "nutrients" usually includes phosphorus and nitrogen. However, the nutrient that is measured over time for eutrophication is **phosphorus**. Therefore, all nutrient BMPs implemented in this plan will be aimed at reducing phosphorus in Winfield City Lake.

A. POSSIBLE SOURCES OF THE IMPAIRMENT

Nutrient loading can originate in both rural and urban areas. It can be caused by both point and nonpoint sources. For this plan, the focus will be on nutrient loading from livestock contributions from pasture land and cropland contributions from fields near the stream. Cropland will address both eroded phosphorus laden soil and improper fertilizer application.

1. POPULATION

Population of the watershed can have an effect on nutrient runoff. Hundreds of onsite wastewater systems may exist in the basin, mainly in rural areas. Although the functional condition of these systems is generally unknown, this is an area of possible pollution contribution that should be evaluated over time.

2. CONFINED ANIMAL FEEDING OPERATIONS

A) CONFINED LIVESTOCK

Any livestock facility with an animal unit capacity of 300 or more or a facility with a daily discharge regardless of size must register with KDHE. Any facility, no matter what animal capacity, is required to register if KDHE investigates them due to a complaint and the facility is found to pose a significant pollution potential. Facilities which register with KDHE will be site-inspected for significant pollution potential. If the facility is found to not be a significant pollution potential, they can be certified if they follow management practices recommended and approved by KDHE. These include but are not limited to: regular cleaning of stalls, managing manure storage areas, etc. Facilities with 300 animal units up to 999 (known as Confined Feeding Facilities (CFFs) identified with a significant pollution potential must obtain a State of Kansas Livestock Waste Management Permit. Facilities of 1,000 animal units or more, known as Confined Animal Feeding Operations (CAFOs), must obtain an NPDES Livestock Waste Management Permit (Federal). Operations with a daily discharge, such as a dairy operation that generates an outflow from the milking barn on a daily basis, are required to have a permit. [xviii] There is one CAFO registered with KDHE in the watershed. This is an exotic animal CAFO containing 0 to 299 head of animals as can be seen in the figure below.

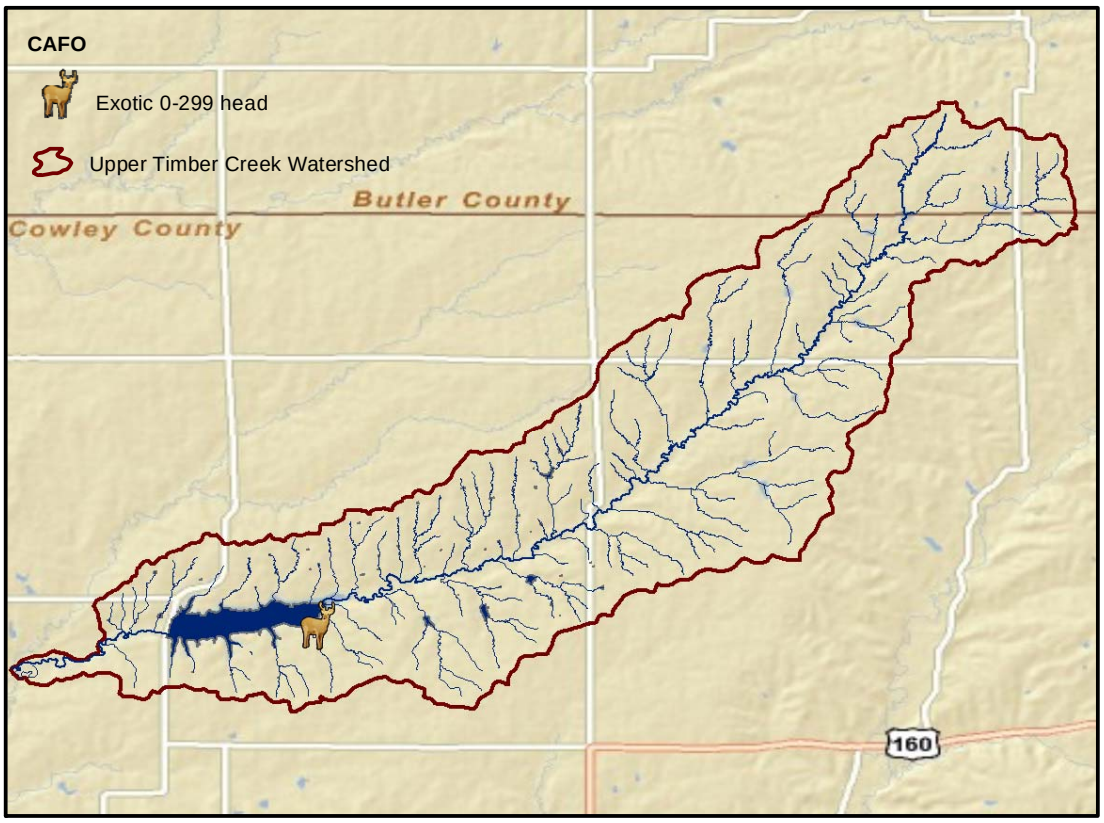


FIGURE 18. CAFO'S IN THE UPPER TIMBER CREEK WATERSHED.

B) UNCONFINED CONCENTRATED ANIMAL AREAS

Unconfined areas of animal concentration such as watering areas, loafing areas or feeding areas can also pose a pollution potential if not managed properly. These are potential sources of nutrients, sediment, and bacteria. Management practices for these areas can include alternative water supplies, rotational grazing, proper mineral and feed placement, and proper manure application to cropland.

3. GRAZING DENSITY

Grasslands consist of approximately seventy-five percent of the watershed. Grassland in this area of the Flint Hills ecosystem is a highly productive forage source for beef cattle. Grazing density will affect grass cover and potential manure runoff. An overgrazed pasture will not have the needed forage biomass to trap and hold manure in a high rainfall event. Also allowing cattle to drink and

loaf in streams will increase the occurrence of nutrients and e. coli bacteria in the waterway. Cowley County has a grazing density of 9.61 cattle per 100 acres and Butler County has a grazing density of 15.33 cattle per 100 acres. [xix]

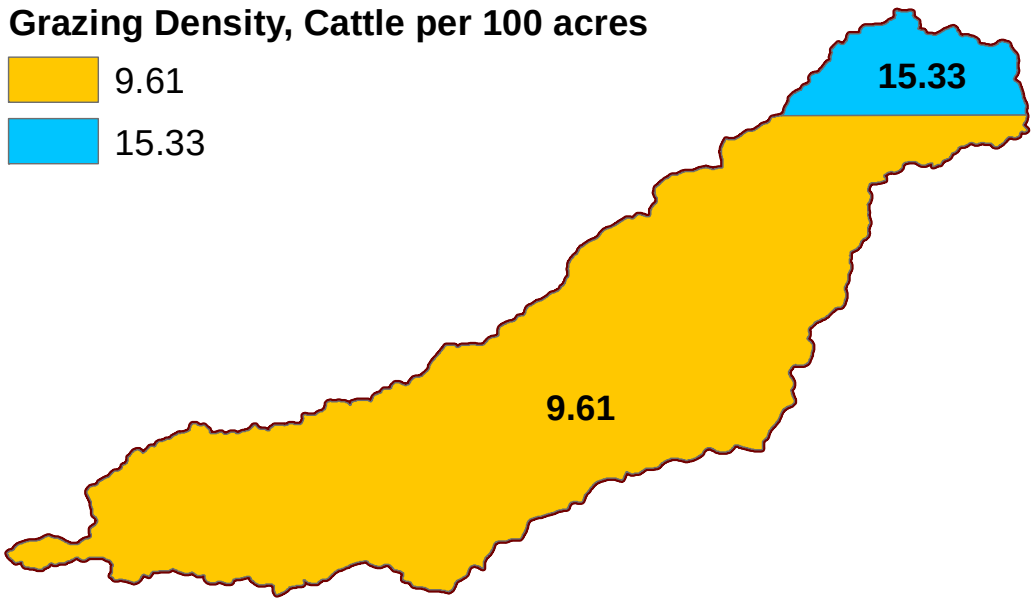


FIGURE 19. GRAZING DENSITY BY COUNTY, 2002

4. LAND USE

Land use activities have a significant impact on the types and quantity of nonpoint source pollutants in the watershed. Construction projects in the watershed and in communities can leave disturbed areas of soil and unvegetated roadside ditches that can wash in a rainfall event. Urban sprawl or the conversion of agricultural land to suburban homes and small acreages farms can have an impact on water quality. These new homes and small acreages mainly occur in close proximity to the lake. In addition, agricultural activities and lack of maintenance of agricultural structures can have cumulative effects on land transformation through sheet and rill erosion.

Cropland typically lies along the streams since historic flooding events deposited rich soils as the streams flooded. Even though this watershed only has 15 percent cropland, it is important to implement agricultural BMPs to mitigate any further soil loss. Fertilizer that is applied before a rainfall event, or over applied can easily be transported into waterways and downstream to the lake. Cropland

BMPs are important methods to prevent runoff of fertilizer. BMPs that will assist in reducing nutrient runoff to the stream and have been adopted by the PAC are adopting no-till cultivation practices, building and repairing terraces, planting permanent vegetation, and establishing buffers and waterways.

Livestock nutrient contribution to phosphorus in the lake can come from many different management sources. Manure can run into the waterways from overgrazed pastures that do not contain sufficient biomass to slow rainfall. Cattle that are allowed loafing access to small streams will contribute nutrients through manure. BMPs that will assist in reducing the amount of time that cattle spend close to the stream and have been adopted by the PAC are fencing off streams and ponds, adopting grazing management plans, providing alternate watering sources other than the streams, and relocating feeding sites in pastures.

CRP (Conservation Reserve Program) land is marginal farm ground that has been removed from production and planted to grass cover. The owner of the land receives a government payment as incentive for allowing the land to be removed from production. This is the best way to stop runoff of sediment as well as nutrients through erosion. CRP lands are scattered throughout the watershed. According land use data, CRP comprised only 0.5 percent of the farmable land in the watershed. If more marginal farmland were enrolled in CRP, there would be less erosion and subsequent sediment in Winfield City Lake.

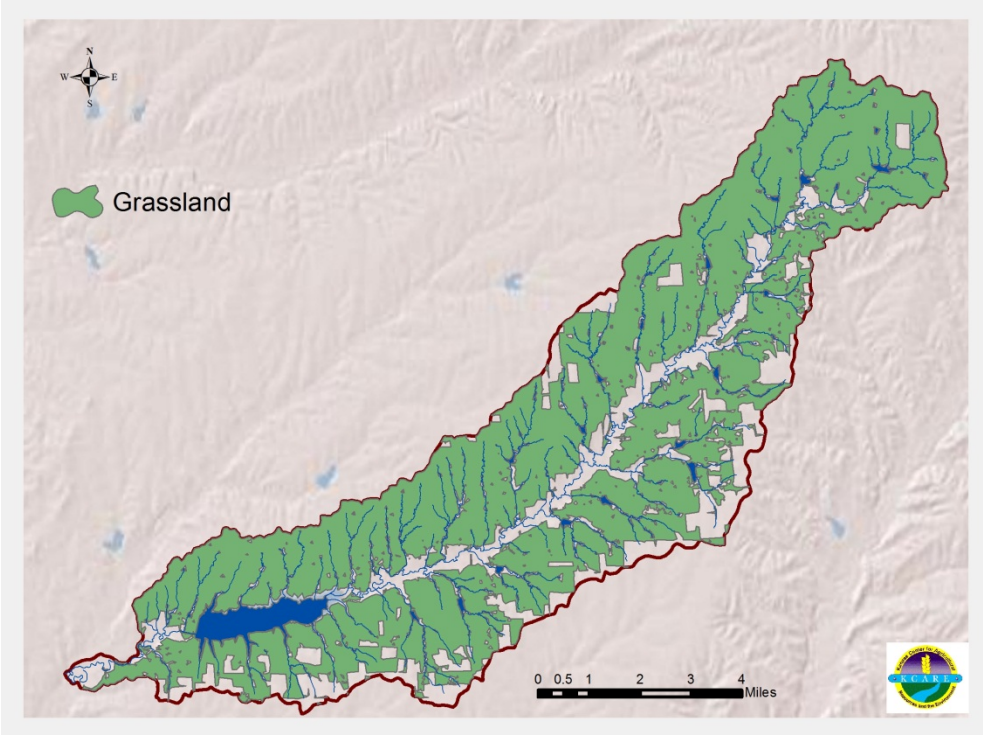


FIGURE 20. GRASSLAND IN THE WATERSHED. [III]

5. RAINFALL AND RUNOFF

Rainfall amounts and subsequent runoff can affect nutrient runoff from agricultural areas and urban areas into streams and Winfield City Lake. Manure runoff from livestock that are allowed access to stream or manure applied before a rainfall or on frozen ground is affected by the amount and timing of rainfall events. Therefore it is important to maintain adequate grass density to slow the runoff of manure over the pasture.

IX. SEDIMENTATION

Silt or sediment accumulation in lakes and wetlands reduces reservoir volume and limits public access for boating in the lake. In addition to the problem of sediment loading in lakes, pollutants can be attached to the suspended soil particles in the water column causing higher than normal concentrations. Furthermore, accelerated erosion and sedimentation increases the likelihood of nuisance aquatic plant infestation impairing recreation use and requiring chemical control. Reducing erosion is necessary for a reduction in sediment. Agricultural BMPs such as no-till, conservation tillage, grass buffer strips around cropland, terraces, grassed waterways and reducing activities within the riparian areas will reduce erosion and improve water quality.

NOTE: Even though Winfield City Lake is not listed as having a TMDL for **sedimentation**, the PAC believes that sediment and silt are currently present and increasing in the lake and are therefore addressing this issue in this WRAPS plan.

A. POSSIBLE SOURCES OF THE IMPAIRMENT

Activities performed on the land affects sediment that is transported downstream to the lakes. Physical components of the terrain are important in sediment movement, such as:

- Slope of the land, propensity to generate runoff and soil type
- Streambank erosion and sloughing of the sides of the river and streambank. A lack of riparian cover can cause washing on the banks of streams or rivers and enhance erosion.
- Animal movement, such as livestock that regularly cross the stream or follow trails in pastures, can cause pathways that will erode.
- Silt that is present in the stream from past activities and is gradually moving downstream with each high intensity rainfall event.

Activities performed on the land affects sediment that is transported downstream to the lakes. Agricultural BMPs that will help reduce sediment deposition in waterways are (in no particular order, many other BMPs exist):

- No-till
- Vegetative buffers and riparian areas
- Grassed waterways
- Grassed terraces
- Establishing permanent vegetative cover

1. LAND USE

Land use activities have a significant impact on the types and quantity of sediment transfer in the watershed. Construction projects in the watershed and in communities can leave disturbed areas of soil and unvegetated roadside ditches that can wash in a rainfall event. In addition, agricultural cropland that is under conventional tillage practices activities and lack of maintenance of agricultural BMP structures can have cumulative effects on land transformation through sheet and rill erosion. Cropland typically lies along the streams and rivers since historic flooding events deposited rich soils as the streams flooded. Even though this watershed only has 15 percent cropland, it is important to implement agricultural BMPs to mitigate any further soil loss.

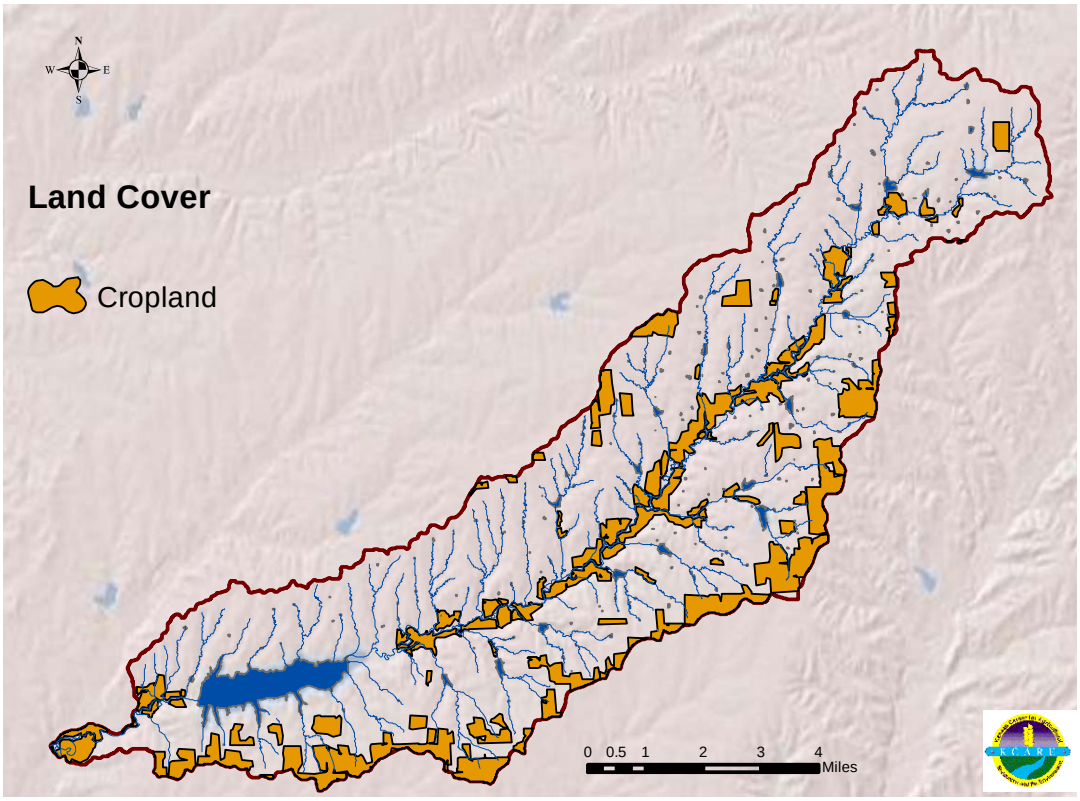


FIGURE 21. CROPLAND IN THE WATERSHED. [III]

2. RIPARIAN QUALITY

Sediment can originate from streambank erosion and sloughing of the sides of the river and stream bank. A lack of riparian cover can cause washing on the banks of streams or rivers and enhance erosion.

An adequately functioning and healthy riparian area will reduce sediment flow from cropland and rangeland. Riparian areas can be vulnerable to runoff and erosion from livestock induced activities in pastureland and overland flow from bare soil on cropland. Buffers and filter strips along with additional forested riparian areas can be used to impede erosion and streambank sloughing. Livestock restriction along the stream will prevent livestock from entering the stream and degrading the banks. Cropland needs buffer and filter strips adjacent to the stream in order to impede the flow of sediment off of fields. Conservation tillage practices are also effective for slowing the flow of rain water off of crop fields.

3. RAINFALL AND RUNOFF

Rainfall amounts and subsequent runoff can affect sediment runoff from agricultural and disturbed areas into Timber Creek and Winfield City Lake. High rainfall events can cause cropland erosion and sloughing of streambanks, which add sediment to the Creek and ultimately end in Winfield City Lake.

X. BMPS NEEDED TO BE IMPLEMENTED TO ADDRESS WATER QUALITY IMPAIRMENTS

The PAC has laid out specific BMPs that they have determined will be acceptable to watershed residents as listed below. Local knowledge of the watershed was utilized to assess the needs in the watershed. Meetings were conducted by the PAC on September 18 and December 10, 2012 to discuss this topic. Specific acreages or projects that need to be implemented have been determined through economic analysis and approved by the PAC as listed below. Even though the phosphorus goal will be reached at the end of year 5 if all BMPs are implemented, the duration of this plan is ten years. This allows for additional revisions and additional BMPs as needed. The sediment goal will be characterized as “protection” instead of “restoration”.

TABLE 9. BMPS AND ACRES OR PROJECTS NEEDED TO REDUCE NUTRIENT AND SEDIMENT CONTRIBUTION IN WINFIELD LAKE FOR THE LIFE OF THE WRAPS PLAN

Protection Measures	Best Management Practices and Other Actions	Acres Needed to be Implemented
Prevention of nutrient contribution from cropland	1. No-Till	342 acres addressed
	2. Grassed Waterways	342 acres treated by BMP
	3. Vegetative Buffers	342 acres treated by BMP
	4. Nutrient Management Plans	342 acres addressed
	5. Terraces	342 acres treated by BMP
	6 Permanent Vegetation	68 acres addressed
Protection Measures	**Best Management Practices and Other Actions**	**Projects Needed to be Implemented**
Prevention of nutrient contribution from livestock	1. Vegetative Filter Strip	1
	2. Relocate Pasture Feeding Sites	5
	3. Off Stream Watering Systems	5

	Stream Crossings	1
	4. Fence Off Stream/Pond	5
	5. Grazing Management Plans	8
Protection Measures	**Best Management Practices and Other Actions**	**Linear Feet Needed to be Implemented**
Prevention of nutrient contribution from streambanks	Restoration BMPs Applied in Fields Along the Streambank	1,553

Implementing these BMPs will have an estimated phosphorus load reduction of 545 pounds per year. Implementing these BMPs will have an additional estimated sediment load reduction of 163 tons per

The streambank assessment performed was based off of point in time observations. It identified the need for riparian, cropland, and livestock BMPs as well as some minor streambank stabilization work. Recommendations for riparian, cropland, and livestock BMPs were integrated into the cropland scenarios. Since the sediment reduction goal is relatively small, it is reached by implementing cropland BMPs. Therefore, streambank stabilization BMPs were not included in the sediment or phosphorus scenarios.

Note: In the following tables, the phosphorus goal will be met at the end of Year 5. Therefore, the years 6 through 10 will be printed in green, as an indication that they are protection goals and not restoration goals. The sediment reduction goal is not a TMDL, but a goal to achieve to prevent a TMDL from being implemented. This goal will be met in Year 5 of the plan, also. Therefore, years 6 through 10 of the plan will be protection of the watershed instead of restoration.

TABLE 10. PHOSPHORUS REDUCTION BY CROPLAND BMP IMPLEMENTATION

Annual Phosphorus Reduction (pounds)							
Year	**No-Till**	**Grassed Waterways**	**Vegetative Buffers**	**Nutrient Mgmt Plans**	**Terraces**	**Permanent Vegetation**	**Total**
1	27	27	34	17	20	13	139
2	55	55	68	34	41	26	279
3	82	82	102	51	61	39	418
4	109	109	137	68	82	52	557
5	137	137	171	85	102	65	697
6	164	164	205	102	123	78	836
7	191	191	239	120	143	91	975

8	219	219	273	137	164	104	1,115
9	246	246	307	154	184	117	1,254
10	273	273	342	171	205	130	1,394

TABLE 11. SEDIMENT REDUCTION RATES BY CROPLAND BMP IMPLEMENTATION

Annual Soil Erosion Reduction (tons)							
Year	No-Till	Grassed Waterways	Vegetative Buffers	Nutrient Mgmt Plans	Terraces	Permanent Vegetation	Total
1	51	27	34	17	20	13	163
2	102	55	68	34	41	26	327
3	154	82	102	51	61	39	490
4	205	109	137	68	82	52	653
5	256	137	171	85	102	65	816
6	307	164	205	102	123	78	980
7	359	191	239	120	143	91	1,143
8	410	219	273	137	164	104	1,306
9	461	246	307	154	184	117	1,469
10	512	273	342	171	205	130	1,633

TABLE 12. PHOSPHORUS LOAD REDUCTION RATES

Annual Phosphorous Reduction				
Year	Cropland Reduction	Livestock Reduction	Total Reduction (lbs)	% of TMDL
1	139	406	545	23%
2	279	811	1,090	46%
3	418	1,217	1,635	70%
4	557	1,622	2,180	93%
5	697	2,028	2,725	116%
6	836	2,434	3,270	139%
7	975	2,839	3,815	162%
8	1,115	3,245	4,360	186%
9	1,254	3,650	4,905	209%
10	1,394	4,056	5,450	232%
Phosphorous TMDL:		2,348	Pounds	

Phosphorus TMDL reduction met.

Annual Sediment Load Reduction

Year	Cropland Reduction	Total Reduction (lbs)	% of Goal
1	163	163	25%
2	327	327	50%
3	490	490	75%
4	653	653	99%
5	816	816	124%
6	980	980	149%
7	1,143	1,143	174%
8	1,306	1,306	199%
9	1,469	1,469	224%
10	1,633	1,633	249%
		Sediment Load Reduction Goal:	656 Tons

Sediment Load Reduction Goal met.

TABLE 13. PHOSPHORUS LOAD REDUCTION BY CATEGORY

Winfield City Lake Phosphorus TMDL				
Best Management Practice Category	Total Load Reduction (lbs) at the End of 5 Years	% of Phosphorous TMDL at the End of 5 Years	Total Load Reduction (lbs) at the End of 10 Years	% of Phosphorous TMDL at the End of 10 Years
Livestock	2,028	86%	1,394	59%
Cropland	697	30%	4,056	173%
Total	**2,725**	**116%**	**5,450**	**232%**

XI. INFORMATION AND EDUCATION.

1. I&E ACTIVITIES AND EVENTS

The PAC has determined which I&E activities will be needed in the watershed. These activities are important in providing the residents of the watershed with a higher awareness of watershed issues. This will lead to an increase in adoption rates of BMPs. I&E activities are categorized according to BMP implementation activities.

TABLE 14. I&E ACTIVITIES AND EVENTS AS REQUESTED BY THE PAC IN SUPPORT OF MEETING THE TMDLS

BMP	Target Audience	Activity/Event	Time Frame	Estimated Costs	Sponsor/ Responsible Agency
Livestock BMP Implementation					
Vegetative Filter Strips	Small Livestock Producers	Demonstration Project Tour/Field Day	Annual - Summer	$2,000	City of Winfield K-State Research and Extension Conservation Districts NRCS Watershed Coordinator Watershed Specialist
	Small Livestock Producers	One on One technical assistance for producers in targeted areas	Annual - Ongoing	No cost	
Relocate Pasture Feeding Sites	Small Livestock Producers Small Livestock Producers	Demonstration Project Tour/Field Day	Annual - Summer	$2,000	City of Winfield K-State Research and Extension Conservation Districts NRCS Watershed Coordinator Watershed Specialist
	Small Livestock Producers	One on One technical assistance for producers in targeted areas	Annual - Ongoing	No Cost	
Off Stream Alternative Watering Systems	Small Livestock Producers	Demonstration Project Tour/Field Day	Annual - Summer	$2,000	City of Winfield K-State Research and Extension Conservation Districts NRCS Watershed Coordinator Watershed Specialist
	Small Livestock Producers	One on One technical assistance for producers in targeted areas	Annual - Ongoing	No cost	
Stream Crossing	Small Livestock Producers	Tour/Field Day/Workshop	Annual - Summer	$2,000	City of Winfield K-State Research and Extension Conservation Districts NRCS Watershed Coordinator Watershed Specialist
	Small Livestock Producers	One on One technical assistance for producers in targeted areas	Annual - Ongoing	No cost	

Grazing Management Plans	Small Livestock Producers	Tour/Field Day/Workshop	Annual - Summer	$2,000	City of Winfield K-State Research and Extension Conservation Districts NRCS Watershed Coordinator Watershed Specialist
	Small Livestock Producers	One on One technical assistance for producers in targeted areas	Annual - Ongoing	No cost	
Fence Off Stream or Pond	Small Livestock Producers	Tour/Field Day/Workshop	Annual - Summer	$2,000	City of Winfield K-State Research and Extension Conservation Districts NRCS Watershed Coordinator Watershed Specialist
	Small Livestock Producers	One on One technical assistance for producers in targeted areas	Annual - Ongoing	No cost	
BMP	Target Audience	Activity/Event	Time Frame	Estimated Costs	Sponsor/ Responsible Agency
Cropland BMP Implementation					
Permanent Vegetation	Farmers/Landowners	Demonstration Project/Field Day/ Tour	Annual	$2,000	City of Winfield K-State Research and Extension Conservation Districts NRCS Watershed Coordinator Watershed Specialist
	Farmers/Landowners	Demonstration Project/Field Day/ Tour	Annual	No cost	
Grassed Waterways	Farmers/Landowners	Demonstration Project/Field Day/ Tour	Annual	$2,000	City of Winfield K-State Research and Extension Conservation Districts NRCS Watershed Coordinator Watershed Specialist
	Farmers/Landowners	Demonstration Project/Field Day/ Tour	Annual	No cost	

No-Till	Farmers/Landowners	Demonstration Project/Field Day/ Tour	Annual - Spring	$2,000	City of Winfield K-State Research and Extension Conservation Districts NRCS Watershed Coordinator Watershed Specialist
	Farmers/Landowners	One on One technical assistance for producers in targeted areas	Annual - Ongoing	No cost	
Nutrient Management Plans	Farmers/Landowners	Demonstration Project/Workshop/Field Day	Annual - Spring	$2,000	City of Winfield K-State Research and Extension Conservation Districts NRCS Watershed Coordinator Watershed Specialist
	Farmers/Landowners	One on One technical assistance for producers in targeted areas	Annual - Ongoing	No cost	
Terraces	Farmers/Landowners	Demonstration Project/Field Day/ Tour	Annual - Spring	$2,000	City of Winfield K-State Research and Extension Conservation Districts NRCS Watershed Coordinator Watershed Specialist
	Farmers/Landowners	One on One technical assistance for producers in targeted areas	Annual - Ongoing	No cost	
BMP	**Target Audience**	**Activity/Event**	**Time Frame**	**Estimated Costs**	**Sponsor/ Responsible Agency**
General/Watershed Wide Information and Education					
Educational Activities Targeting Youth	Educators, K-12 Students	Environthon	Annual	No cost	City of Winfield K-State Research and Extension Conservation Districts NRCS Watershed Coordinator Watershed Specialist
		Day on the Farm	Annual	No cost	
		Poster, Essay, and Speech Contests	Annual	No cost	
		Water Festival	Annual	$3,000	

Educational Activities Targeting Adults	Watershed Residents	City Lake Field Day	Annual	$2,000	City of Winfield K-State Research and Extension Conservation Districts NRCS Watershed Coordinator Watershed Specialist
		Water Plant Tour	2 to 3 per year	$2,000	
		River Friendly Farms	Annual	$2,000	
		Focus Groups and Workshops	Annual - Ongoing	$1,000	
		Newsletters, Press Releases, Advertisements, and Producer Mailings, Signage, Brochure	As Needed	$1,000	
		Total Cost for I&E Activities			$34,000

2. EVALUATION OF I&E ACTIVITIES

All service providers conducting I&E activities funded through the UTC WRAPS will be required to include an evaluation component in their project proposals and PIPs. The evaluation methods will vary based on the activity.

At a minimum, all I&E projects must include participant learning objectives as the basis for the overall evaluation. Depending on the scope of the project, development of a basic logic model identifying long-term, medium-term, and short-term behavior changes or other outcomes that are expected to result from the I&E activity may be required.

Specific evaluation tools or methods may include (but are not limited to):

- Feedback forms allowing participants to provide rankings of the content, presenters, useful of information, etc.
- Pre and post surveys to determine amount of knowledge gained, anticipated behavior changes, need for further learning, etc.
- Follow up interviews (one-on-one contacts, phone calls, e-mails) with selected participants to gather more in-depth input regarding the effectiveness of the I&E activity.

All service providers will be required to submit a brief written evaluation of their I&E activity, summarizing how successful the activity was in achieving the

learning objectives, and how the activity contributed to achieving the long-term WRAPS goals and/or objectives for pollutant load reductions.

XII. COSTS OF IMPLEMENTING BMPS AND POSSIBLE FUNDING SOURCES

The PAC has reviewed all the recommended BMPs for cropland, livestock areas and streambank restoration. It has been determined by the PAC that specific BMPs will be the target of implementation funding for each category. Most of the BMPs that are targeted will be advantageous to more than one impairment, thus being more efficient.

Summarized Derivation of Cropland BMP Cost Estimates

No-Till: After being presented with information from K-State Research and Extension (Craig Smith and Josh Roe) on the costs and benefits of no-till, the PAC decided that a fair price to entice a producer to adopt no-till would be to pay them $10 per acre for 10 years, or a net present value of $77.69 per acre upfront assuming the NRCS discount rate of 4.75%.

Grassed Waterway: $2,200 per acre was arrived at using average cost of installation figures from the conservation districts within the watershed and updated costs of brome grass seeding from Josh Roe.

Vegetative Buffer Strips: The cost of $1,000 per acre was arrived at using average cost of installation figures from the conservation districts within the watershed and cost estimates from the KSU Vegetative Buffer Tool developed by Craig Smith.

Nutrient Management Plans: After being presented with information from K-State Research and Extension (Craig Smith and Josh Roe) on the costs and benefits of nutrient management plans, the PAC decided that a fair price to entice a producer to adopt nutrient management plans would be to pay them $7.30 per acre for 10 years, or a net present value of $56.71 per acre upfront assuming the NRCS discount rate of 4.75 percent.

Terraces: In consulting with numerous conservation districts it was determined by Josh Roe that the average cost of building a terrace at this point in time is $1.25 per foot.

Establish Permanent Vegetation: The cost of $150 an acre was calculated based on K-State Research and Extension estimates of the cost of planting and maintaining native grass.

Summarized Derivation of Livestock BMP Cost Estimates

Vegetative Filter Strip: The cost of $714 an acre was calculated by Josh Roe and Mike Christian figuring the average filter strip in the watershed will require four hours of bulldozer work at $125 an hour plus the cost of seeding one acre in permanent vegetation estimated by Josh Roe.

Relocated Pasture Feeding Site: The cost of moving a pasture feeding site of $2,203 was calculated by Josh Roe figuring the cost of building ¼ mile of fence, a permeable surface, and labor.

Off-Stream Watering System: The average cost of installing an alternative watering system of $3,500 was estimated by Herschel George, Marais des Cygnes Watershed Specialist, who has installed numerous systems and has detailed average cost estimates.

Stream Crossings: Actual data from Greenwood County as determined by Herschel George, Watershed Specialist.

Fence Off-Streams and Ponds: The average cost of ½ mile of fence at $4,106 was determined by current fencing and labor prices, assuming the fence has a 20 year life, and taking the net present value of future repairs at the NRCS discount rate of 4.75%.

Grazing Management Plans: A price of $3 an acre for 4 years might be adequate to persuade a livestock producer to adopt a grazing management plan.

TABLE 15. ESTIMATED COSTS BEFORE COST SHARE FOR CROPLAND IMPLEMENTED BMPS.

Total Annual Cost Before Cost-Share, Cropland BMPs							
Year	No-Till	Grassed Waterways	Vegetative Buffers	Nutrient Mgmt Plans	Terraces	Permanent Vegetation	Total Cost
1	$2,654	$5,465	$2,277	$1,937	$3,484	$1,025	$16,841
2	$2,733	$5,629	$2,345	$1,995	$3,588	$1,055	$17,346
3	$2,815	$5,798	$2,416	$2,055	$3,696	$1,087	$17,866
4	$2,900	$5,972	$2,488	$2,117	$3,807	$1,120	$18,402
5	$2,987	$6,151	$2,563	$2,180	$3,921	$1,153	$18,954
6	$3,076	$6,335	$2,640	$2,245	$4,039	$1,188	$19,523
7	$3,168	$6,525	$2,719	$2,313	$4,160	$1,223	$20,109
8	$3,263	$6,721	$2,800	$2,382	$4,285	$1,260	$20,712
9	$3,361	$6,923	$2,884	$2,454	$4,413	$1,298	$21,333
10	$3,462	$7,130	$2,971	$2,527	$4,546	$1,337	$21,973

TABLE 16. ESTIMATED COSTS AFTER COST SHARE FOR CROPLAND IMPLEMENTED BMPS.

Total Annual Cost After Cost-Share, Cropland BMPs							
Year	No-Till	Grassed Waterways	Vegetative Buffers	Nutrient Mgmt Plans	Terraces	Permanent Vegetation	Total Cost
1	$1,619	$2,732	$228	$968	$1,742	$512	$7,801
2	$1,667	$2,814	$235	$998	$1,794	$528	$8,035
3	$1,717	$2,899	$242	$1,027	$1,848	$544	$8,277
4	$1,769	$2,986	$249	$1,058	$1,903	$560	$8,525
5	$1,822	$3,075	$256	$1,090	$1,961	$577	$8,781
6	$1,876	$3,168	$264	$1,123	$2,019	$594	$9,044
7	$1,933	$3,263	$272	$1,156	$2,080	$612	$9,315
8	$1,991	$3,361	$280	$1,191	$2,142	$630	$9,595
9	$2,050	$3,461	$288	$1,227	$2,207	$649	$9,883
10	$2,112	$3,565	$297	$1,264	$2,273	$668	$10,179

TABLE 17. ESTIMATED COSTS FOR LIVESTOCK IMPLEMENTED BMPS.

Total Annual WRAPS Cost for Livestock BMPs	
Year	Total Annual Cost
1	$3,925
2	$4,043
3	$4,164
4	$4,289
5	$4,418
6	$4,550
7	$4,687
8	$4,828
9	$4,972
10	$5,121

TABLE 18. TECHNICAL ASSISTANCE NEEDED TO IMPLEMENT BMPS.

BMP		Technical Assistance	Projected Annual Cost
Cropland	1. No-till	Watershed Coordinator Watershed Specialist	**WRAPS Coordinator $20,000** **Watershed Specialist $12,000**
	2. Grassed waterways		
	3. Vegetative buffers		
	4. Nutrient Management Plans		

	5. Terraces		
	6. Permanent Vegetation		
Livestock	1. Vegetative filter strips	Watershed Coordinator Watershed Specialist	
	2. Relocate pasture feeding sites		
	3.Off stream watering		
	4. Stream Crossing		
	5. Fence off Streams/Ponds		
	6. Grazing Management Plan		
Streambank	Streambank restoration	Watershed Coordinator Watershed Specialist	
Total			**$32,000**

TABLE 19. COSTS BY CATEGORY FOR IMPLEMENTED BMPS

Total Annual WRAPS Cost after Cost-Share by BMP Category			
Year	**Cropland**	**Livestock**	**Total Annual Cost**
1	$7,801	$3,925	$11,727
2	$8,035	$4,043	$12,078
3	$8,277	$4,164	$12,441
4	$8,525	$4,289	$12,814
5	$8,781	$4,418	$13,198
6	$9,044	$4,550	$13,594
7	$9,315	$4,687	$14,002
8	$9,595	$4,828	$14,422
9	$9,883	$4,972	$14,855
10	$10,179	$5,121	$15,301

TABLE 20. TOTAL ANNUAL COST FOR WRAPS PLAN BY CATEGORY

Total Annual WRAPS Cost* after Cost-Share by Category					
Year	**Cropland**	**Livestock**	**Technical Assistance**	**Information and Education**	**Total Annual Cost**
1	$7,801	$3,925	$32,000	$34,000	$77,726
2	$8,035	$4,043	$32,960	$35,020	$80,058
3	$8,277	$4,164	$33,949	$36,071	$82,460

4	$8,525	$4,289	$34,967	$37,153	$84,933
5	$8,781	$4,418	$36,016	$38,267	$87,481
6	$9,044	$4,550	$37,097	$39,415	$90,106
7	$9,315	$4,687	$38,210	$40,598	$92,809
8	$9,595	$4,828	$39,356	$41,816	$95,593
9	$9,883	$4,972	$40,537	$43,070	$98,461
10	$10,179	$5,121	$41,753	$44,362	$101,415
	***3% Annual Inflation**				

TABLE 21. POTENTIAL BMP FUNDING SOUCES

Potential Funding Sources	Potential Funding Programs
City of Winfield	Upper Timber Creek Cost Share Program
Natural Resources Conservation Service	Environmental Quality Incentives Program (EQIP) Wetland Reserve Program (WRP) Conservation Reserve Program (CRP) Wildlife Habitat Incentive Program (WHIP) Forestland Enhancement Program (FLEP) State Acres for Wildlife Enhancement (SAFE) Grassland Reserve Program (GRP) Farmable Wetlands Program (FWP) Conservation Security Program (CSP)
EPA/KDHE	319 Funding Grants KDHE WRAPS Funding Clean Water Neighbor Grants
Kansas Alliance for Wetlands and Streams	
Kansas Dept of Ag – Division of Conservation	State Cost Share
Conservation Districts	
No-Till on the Plains	
Kansas Forest Service	
US Fish and Wildlife	
National Wild Turkey Federation	
Ducks Unlimited	
Quail and Pheasants Forever	
Kansas Rural Center	

Kansas Department of Wildlife and Parks	

TABLE 22. SERVICE PROVIDERS FOR BMP IMPLEMENTATION.

BMP		Services Needed to Implement BMP		Service Provider *
		Technical Assistance	Information and Education	
Cropland	1. No-till	Design, cost share and maintenance	BMP workshops, tours, field days	*City of Winfield* Natural Resource Conservation Service (NRCS) *Farm Service Agency (FSA)* KS Department of Conservation (DOC) *Kansas Forest Service (KFS)* Kansas State Research and Extension (KSRE) *Conservation Districts (CD)* Resource Conservation and Development (RC&D) *Kansas Dept. of Wildlife and Parks (KDWP)*
	2.Waterways	Design, cost share and maintenance	BMP workshops, tours, field days	
	3. Vegetative buffers	Development of management plan	BMP workshops	
	4. Nutrient management plans	Design, cost share and maintenance	BMP workshops, tours, and field days	
	5. Terraces	Design, cost share and maintenance	BMP workshops, field days, tours	
	6. Permanent vegetation	Design, cost share and maintenance	BMP workshops, field days, tours	
Livestock	1. Vegetative filter strips	Design, cost share and maintenance	BMP workshops, field days, tours	City of Winfield KSRE NRCS DOC *Kansas Alliance of Wetlands and Streams (KAWS)* CD RC&D KDWP
	2. Relocate pasture feeding sites	Design, cost share and maintenance	BMP workshops, field days, tours	
	3. Establish off stream watering systems	Design, cost share and maintenance	BMP workshops, field days, tours	
	4. Stream Crossing	Design, cost share and maintenance	BMP workshops, field days, tours	
	5. Fence of Streams/Ponds	Design, cost share and maintenance	BMP workshops, field days, tours	
	6. Grazing Management Plans	Design, cost share and maintenance	BMP workshops, field days, tours	
a m	Streambank	Design, cost share and	BMP workshops, field	City of Winfield

	Restoration	maintenance	days, tours	KSRE NRCS DOC KAWS CD RC&D KDWP

** All service providers are responsible for evaluation of the installed or implemented BMPs and/or other services provided and will report to PAC for completion approval.*

1. TIMEFRAME

The plan will be reviewed every five years starting in 2017. In 2014, the PAC will request a review of data by KDHE for the Walnut Basin. 2013 is the year that the TMDLs will officially be reviewed for additions or revisions. The timeframe of this document for BMP implementation to meet the phosphorus TMDL would be ten years from the date of publication of this plan. Possible trends can be reviewed in 2017 for phosphorus reductions in the water column, but due to a lag time from implementation of BMPs and resulting improvements in water quality they might not be noticeable. The PAC will examine BMP placement and implementation in 2017 and every subsequent five years after.

TABLE 23. REVIEW SCHEDULE FOR POLLUTANTS AND BMPS

Review Year	Sediment	Phosphorus	BMP Placement
2017			X
2022	X	X	X

The timeframe for all BMP implementation would be ten years from the date of publication of this plan. Targeting and BMP implementation might shift over time in order to achieve TMDLs.

- The WRAPS estimate timeframe for reaching the **phosphorus portion of the E TMDL in Winfield City Lake** will be year 5 of the plan. After the phosphorus TMDL is achieved, the process will become one of protection instead of restoration.
- Prevention of sedimentation in Winfield City Lake is a protection goal instead of a restoration goal. However, progress on sediment control will be monitored.

XIII. MEASUREABLE MILESTONES

A. ADOPTION RATES FOR BMP IMPLEMENTATION

Milestones will be determined by number of acres treated, projects installed, contacts made to residents of the watershed and water quality parameters at the end of every five years. The PAC will examine these criteria to determine if adequate progress has been made from the current BMP implementations. If they determine that adequate progress has not been made, they will readjust the implementation projects in order to achieve the TMDL. Below are tables outlining the expected adoption rates of BMPs in order to attain impairment reduction goals.

TABLE 24. SHORT, MEDIUM AND LONG TERM GOALS FOR BMP CROPLAND ADOPTION RATES.

	Total Cropland BMP Adoption Rates, Treated Acres							
	Year	No-Till	Grassed Waterways	Vegetative Buffers	Nutrient Mgmt Plans	Terraces	Permanent Vegetation	Total Adoption
Short Term	1	34	34	34	34	34	7	178
	2	34	34	34	34	34	7	178
	3	34	34	34	34	34	7	178
	Total	102	102	102	102	102	21	
Med-ium Term	4	34	34	34	34	34	7	178
	5	34	34	34	34	34	7	178
	6	34	34	34	34	34	7	178
	Total	205	205	205	205	205	42	
Long Term	7	34	34	34	34	34	7	178
	8	34	34	34	34	34	7	178
	9	34	34	34	34	34	7	178
	10	34	34	34	34	34	7	178
	Total	*342*	*342*	*342*	*342*	*342*	*68*	*1,776*

TABLE 25. SHORT, MEDIUM, AND LONG TERM GOALS FOR BMP LIVESTOCK ADOPTION RATES

	Total Livestock BMP Adoption Rates, Projects						
	Year	Vegetative Filter Strip, Acres	Relocate Pasture Feeding Sites	Off Stream Watering Systems	Stream Crossings	Fence Off Stream, Pond	Grazing Management Plan

Short Term	1	.1	.5	.5	.1	.5	.8
	2	.1	.5	.5	.1	.5	.8
	3	.1	.5	.5	.1	.5	.8
	Total	.3	1.5	1.5	.3	1.5	2.4
Med-ium Term	4	.1	.5	.5	.1	.5	.8
	5	.1	.5	.5	.1	.5	.8
	6	.1	.5	.5	.1	.5	.8
	Total	.6	3	3	.6	3	4.8
Long Term	7	.1	.5	.5	.1	.5	.8
	8	.1	.5	.5	.1	.5	.8
	9	.1	.5	.5	.1	.5	.8
	10	.1	.5	.5	.1	.5	.8
	Total	*1*	*5*	*5*	*1*	*5*	*8*

TABLE 26. SHORT MEDIUM AND LONG TERM GOALS FOR FIELD BMPS ALONG THE STREAMBANK SITES

	Length of Streambank in which Adjacent Field Restoration BMPs could be Applied, Linear Feet	
	Year	**Streambank Restoration**
Short Term	1	1,553
	2	1,553
	3	1,553
	Total	4,659
Med-ium Term	4	1,553
	5	1,553
	6	1,553
	Total	9,318
Long Term	7	1,553
	8	1,553
	9	1,553
	10	1,553
	Total	*15,537*

B. WATER QUALITY MILESTONES USED TO DETERMINE IMPROVEMENTS

1. WATER QUALITY MILESTONES TO DETERMINE IMPROVEMENTS

The goal of the Upper Timber Creek WRAPS plan is to restore water quality for uses supportive of aquatic life, domestic water supply, irrigation, livestock watering, and recreation for the Winfield City Lake. The plan specifically addresses the high priority eutrophication TMDL for the lake. In order to reach the load reduction goals associated with this impairment, a BMP implementation schedule spanning ten years has been developed. The TMDL goal will be met after year 6 if all BMPs are implemented. After year 6, this will become a protection plan instead of a restoration plan.

2. WATER QUALITY MILESTONES FOR WINFIELD CITY LAKE

As previously stated, this plan estimates that it will take 6 years to implement the planned BMPs necessary to meet the load reduction goals for the impairment being addressed in the Winfield City Lake watershed. The table below includes 5 and 10-year water quality goals for various parameters monitored in Winfield City Lake.

TABLE 27. WATER QUALITY MILESTONES FOR WINFIELD CITY LAKE

	Current Condition (1988 - 2005) Average TP	5-Year Goal		10-Year Goal		Current Condition (1988 - 2005) Chlorophyll a	5-Year Goal	10-Year Goal
		Improved Condition (2012 - 2017) Average TP	Total Reduction Needed	Improved Condition Average TP	Total Reduction Needed		Improved Condition (2012 - 2017) Chlorophyll a	Improved Condition Chlorophyll a
Sampling Site	**Total Phosphorus (average of data collected at lake surface during indicated period), ppb**					**Chlorophyll a (average of data collected during indicated period), ppb**		
Winfield City Lake LM050801	38	35	**3**	32	**6**	11.8	10.9	**Maintain Average Chlorophyll a < 10**

	Current Condition (1988 - 2005) Average TN	5-Year Goal		10-Year Goal			
		Improved Condition (2012 - 2017) Average TN	Total Reduction Needed	Improved Condition Average TN	Total Reduction Needed		
Sampling Site	**Total Nitrogen (average of data collected at lake surface during indicated period), ppb**						
Winfield City Lake LM050801	438	408	**7%**	378	**14%**		

3. ADDITIONAL WATER QUALITY INDICATORS

In addition to the monitoring data, other water quality indicators can be utilized by KDHE and the SLT. Such indicators may include anecdotal information from the SLT and other citizen groups within the watershed (skin rash outbreaks, fish kills, nuisance odors), which can be used to assess short-term deviations from water quality standards. These additional indicators can act as trigger-points that might initiate further revisions or modifications to the WRAPS plan by KDHE and the SLT.

- Occurrence of algal blooms in Winfield City Lake
- Visitor traffic to Winfield City Lake
- Trends of quantity and quality of fishing in Winfield City Lake
- Beach closings

XIV. MONITORING WATER QUALITY PROGRESS

KDHE continues to monitor water quality in the Winfield City Lake by maintaining the monitoring station located within the lake. If funds become available, two new sites would be proposed. These would be requested from KDHE and would not require additional funds from the PAC. They would split the length of Timber Creek. The first would come downstream of Segments 1 through 3 of the streambank restoration. This would allow the PAC to monitor progress in the upper part of the watershed. The second would be upstream of the upper end of the lake. This would allow the PAC to monitor the lower half of the watershed along with providing a comparison of pre-entry water quality to exit water quality in the lake.

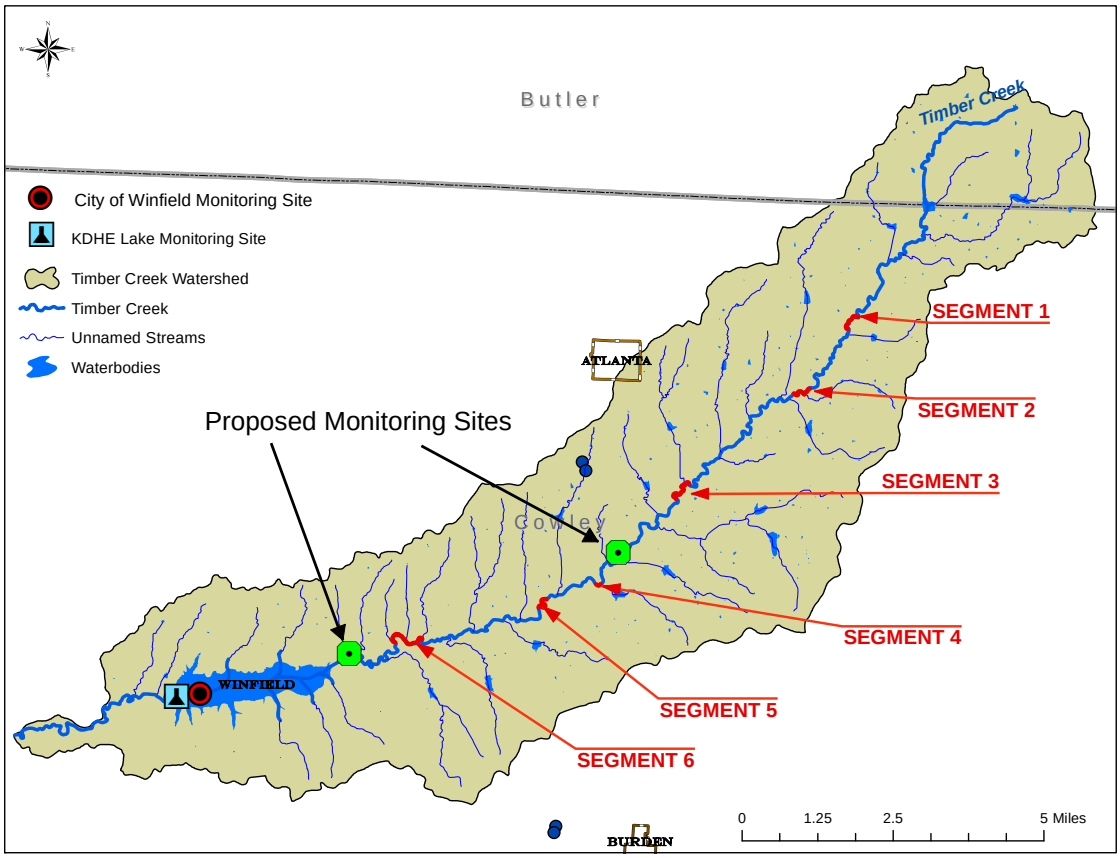


FIGURE 22. CURRENT MONITORING SITES WITH PROPOSED MONITORING SITES

The map above shows the KDHE monitoring station located in Winfield City Lake. The site is sampled for nutrients, e. Coli bacteria, chemicals, turbidity, alkalinity, dissolved oxygen, pH, ammonia and metals. The pollutant indicators tested may vary depending on the season at collection time and other factors.

The City of Winfield monitors the lake water prior to treatment and distribution. They monitor daily for pH, alkalinity, hardness, chlorides, turbidity and temperature. They monitor weekly for lake level. They monitor monthly for total organic carbons. Additionally, monitoring is conducted yearly for alkalinity as $CaCO_3$, aluminum, antimony, arsenic, barium, beryllium, cadmium, calcium, chloride, chromium, copper, corrosivity, fluoride, iron, lead, magnesium, manganese, mercury, nickel, nitrate, potassium, selenium, silica, silver, sodium, specific conductivity, sulfate, thallium, total dissolved solids, total hardness, total phosphorus, turbidity, zinc and pH.

A. EVALUATION OF MONITORING DATA

Monitoring data in the UTC Watershed will be used to determine water quality progress, track water quality milestones, and to determine the effectiveness of the BMP implementation outlined in the plan. The schedule of review for the monitoring data will be tied to the water quality milestones that have been developed for each watershed, as well as the frequency of the sampling data.

The BMP implementation schedule and water quality milestones for the UTC Watershed extend through a ten-year period. Throughout the plan period, KDHE will continue to analyze and evaluate the monitoring data collected. After the first five years of monitoring and BMP implementation, KDHE will evaluate the available water quality data to determine whether the water quality milestones have been achieved. KDHE and the PAC can address any necessary modifications or revisions to the plan based on the data analysis. At the end of the plan, a determination can be made as to whether the water quality standards have been attained.

In addition to the planned review of the monitoring data and water quality milestones, KDHE and the PAC may revisit the plan in shorter increments. This would allow KDHE and the PAC to evaluate newer available information, incorporate any revisions to applicable TMDLs, or address any potential water quality indicators that might trigger an immediate review.

XV. REVIEW OF THE WATERSHED PLAN IN 2017

This plan will begin in 2012. In the year 2017, the plan will be reviewed and revised according to results acquired from monitoring data. At this time, the PAC will review the following criteria in addition to any other concerns that may occur at that time:

1. The PAC will request from KDHE a report on the milestone achievements in phosphorus load reductions. The 2017 milestone for phosphorus should be based on available data at the time in the trend of the phosphorus concentration in Winfield City Lake.
2. The PAC will ask KDHE for a report on the milestone achievements in sediment load reductions. The 2017 milestone for sediment should be based on the available data at the time in the trend of total suspended solids concentration in Winfield City Lake.

3. The PAC will request a report from KDHE concerning the revisions of the TMDLs from 2012.
4. The PAC will request a report from KDHE and the City of Winfield on trends in water quality in Winfield City Lake.
5. The PAC will report on progress towards achieving the adoption rates listed in Section XIII of this plan.
6. The PAC will report on progress towards achieving the benchmarks listed in Section XIII of this plan.
7. The PAC will report on progress towards achieving the milestones in Section XIII of this plan.
8. The PAC will discuss impairments on the 303d list and the possibility of addressing these impairments prior to them being listed as TMDLs.
9. The PAC will discuss the effect of implementing BMPs aimed at specific impairments listed on the 303d list.
10. The PAC will discuss necessary adjustments and revisions needed in the targets listed in this plan.

XVI. APPENDIX

A. BMP DESCRIPTIONS

(Reduction explanations are provided in Section 7)

Cropland

No-Till:

-A management system in which chemicals may be used for weed control and seedbed preparation.
-The soil surface is never disturbed except for planting or drilling operations in a 100% no-till system.
-75% erosion reduction efficiency, 40% phosphorous reduction efficiency.
-WRAPS groups and KSU Ag Economists have decided $10 an acre for 10 years is an adequate payment to entice producers to convert, 50% cost-share available from NRCS.

Grassed Waterway:

-Grassed strip used as an outlet to prevent silt and gully formation.
-Can also be used as outlets for water from terraces.
-On average for Kansas fields, 1 acre waterway will treat 10 acres of cropland.
-40% erosion reduction efficiency, 40% phosphorous reduction efficiency.
-$800 an acre, 50% cost-share available from NRCS.

Vegetative Buffer Strips:

-Area of field maintained in permanent vegetation to help reduce nutrient and sediment loss from agricultural fields, improve runoff water quality, and provide habitat for wildlife.
-On average for Kansas fields, 1 acre buffer treats 15 acres of cropland.
-50% erosion reduction efficiency, 50% phosphorous reduction efficiency
-Approx. $1,000/acre, 90% cost-share available from NRCS.

Nutrient Management Plans:

-Managing the amount, source, placement, form and timing of the application of nutrients and soil amendments.
-Intensive soil testing
-25% erosion and 25% P reduction efficiency.
-WRAPS groups and KSU Ag Economists have decided $7.30 an acre for 10 years is an adequate payment to entice producers to convert, 50% cost-share is available from NRCS.

Terraces:

-Earth embankment and/or channel constructed across the slope to intercept runoff water and trap soil.
-One of the oldest/most common BMPs
-30% Erosion Reduction Efficiency, 30% phosphorous reduction efficiency
-$1.02 per linear foot, 50% cost-share available from NRCS

Establish Permanent Vegetation:

The cost of $150 an acre was calculated based on K-State Research and Extension estimates of the cost of planting and maintaining native grass.

Subsurface Fertilizer Application:
-Placing or injecting fertilizer beneath the soil surface.
78
-Reduces fertilizer runoff.
-0% soil and 50% P reduction efficiency.
-$3.50 an acre for 10 years, no cost-share.
-WRAPS groups and KSU Ag Economists have decided $3.50 an acre for 10 years is an adequate payment to entice producers to convert, 50% cost-share is available from NRCS.

Livestock

Vegetative Filter Strip

-A vegetated area that receives runoff during rainfall from an animal feeding operation.
-Often require a land area equal to or greater than the drainage area (needs to be as large as the feedlot).
-10 year lifespan, requires periodic mowing or haying, average P reduction: 50%.
-$714 an acre

Relocate Pasture Feeding Sites

-Feedlot- Move feedlot or pens away from a stream, waterway, or body of water to increase filtration and waste removal of manure. Highly variable in price, average of $6,600 per unit.
-Pasture- Move feeding site that is in a pasture away from a stream, waterway, or body of water to increase the filtration and waste removal (eg. move bale feeders away from stream). Highly variable in price, average of $2,203 per unit.
-Average P reduction: 30-80%

Alternative (Off-Stream) Watering System

-Watering system so that livestock do not enter stream or body of water.
-Studies show cattle will drink from tank over a stream or pond 80% of the time.
-10-25 year lifespan, average P reduction: 30-98% with greater efficiencies for limited stream access.
-$3,795 installed for solar system, including present value of maintenance costs.

Stream Crossing

Actual data from Greenwood County as determined by Herschel George, Watershed Specialist.

Fence Off Streams and Ponds

-Fencing out streams and ponds to prevent livestock from entering.
-95% P Reduction.
-25 year life expectancy.
-Approximately $4,106 per ¼ mile of fence, including labor, materials, and maintenance.

Grazing Management Plans:

Grazing management plan to avoid over grazing of pastures and improved grazing distribution..
-Average P reduction: 25-30%
-$1,600 average cost

B. STREAM ASSESSMENT

1. RASCAL STREAM ASSESSMENT VARIABLES

Channel Variables:

Flow: The volume of water carried by a stream, relative to average, at the time of assessment.

Low, Normal, High or No Flow

Losing Flow: Primarily a function of karst geology, losing flow is characterized by stream segments losing flow to cracks in bedrock or stream sinks. Yes or No

Channel Pattern:

Straight, Braided, or Meandering

Channel Condition:

Natural, Past Channel Alteration, Recent Alteration or Artificial

Stream Type:

Riffle, Run, Pool/Glide, Pond or Dry Channel

In-Stream Habitat: Examples of in-stream habitat include logs, fallen trees, backwater pools, deep pools, overhanging vegetation, riffles, floating leaf matter, aquatic vegetation, root mats, undercut banks, etc.

Excellent, Average or Poor

Pool Frequency: Pools are defined as areas of slow moving water with depths greater than three feet.

None, < 1 Pool Every 250', 2-3 Pools Every 250', or >3 Pools Every 250'

Riffle Frequency: Riffles are defined as areas exhibiting shallow, broken, fast moving water, usually with coarse substrate.

None, < 1 Riffle Every 250', 2-3 Riffles Every 250', or >3 Riffles Every 250'

Dominant Substrate: The dominant material that forms the bed of the stream segment.

Bedrock, Boulder, Cobble, Gravel, Sand, Clay/Hard Pan, Silt/Mud

Embeddedness: Degree to which large particles (boulders, cobble, gravel) are surrounded or covered by silt or fine sediment.

Completely Exposed, Partially Exposed, Mostly Embedded, Complete Embedded, or NA

Canopy Cover: Percent of stream channel area shaded or covered by vegetation during full leaf-on conditions.

0-10%, 10-25%, 25-50%, 50-75%, or 75-100%

Riparian Variables

Riparian Zone Width: The width of the transition zone between the water and the upland zone, typically the width of natural vegetation (trees or grass).

<10 Feet, 10-30 Feet, 30-60 Feet, >60 Feet

Riparian Zone Cover: Land cover in the transition zone between the water and the upland zone.

Grass, Trees, Pasture, CRP, Residential, Commercial, Farmstead, Cliff, or Other

Adjacent Land Use: Land cover in the upland areas outside the riparian zone.

Row Crop, Trees, Grass, Pasture, CRP, Residential, Commercial, Farmstead, Cliff, or Other

Livestock Access: Specifies livestock accessibility to stream segment.

Yes or No

Bank Variables

Bank Vegetation:

None, Overhanging Only, Dislodged, Partially Established, Well Established

Bank Erosion:

None, Both Banks, Alternate Banks, or Random

Stream Bank Height: The high bank distance in feet from the bottom of the stream channel to the top of the stream bank (not necessarily the high water mark).

Stream Bank Stability: This characterizes the stability of the banks and reflects the degree to which the bank is laterally eroding.

Stable, Moderately Stable, Moderately Unstable, Unstable, or Artificially Stable

Stream Bank Material: This defines the dominant material that makes up both stream banks.

Rock/Rip Rap, Cobble/Gravel, Sand, or Soil/Silt

Advanced Channel Variables:

Channel Forming Depth:

1-3 Feet, 3-5 Feet, 5-8 Feet, or >8 Feet

Channel Forming Width:

<10 Feet, 10-15 Feet, 15-20 Feet, 20-30 Feet, 30-50 Feet, or >50 Feet

Sediment Deposition:

None, Isolated Sediment Bar, Unvegetated Point Bar, or Vegetated Point Bars

Channel Vegetation:

None, Isolated Pockets, Well Established, or Vegetated Point Bars

Points of Interest:

Points of Interest mark the location of potential point source pollution impacts to the waterbody as well as general points the surveyor wishes to inventory. The following list should be used as guidance; if a point of interest type is not in the list please use the "Other" category and the comments field to describe the location.

Bank Erosion

Bridge

Stream Xing (Mach.)

Stream Xing (Animal)

Fence Across Stream

Gully Minor

Gully Severe

In-Stream Debris/Log Jam

Water Clarity- Algae

Manure

Water Clarity- Chemical

Water Clarity- Stagnate

Nick Point

Beaver Dam

Odor- Chemical

Odor- Manure

Boating Access

Other

Concrete/Rock Waste

Seep

Confluence

Sinkhole

Construction Activity

Spring

Culvert

Storm Sewer

Dam/Barrier

Stream Sink

Dead Animal

Dead Fish

Drainage Ditch Suspicious Activity

Drums/Barrels

Tile Outlet

Trash- Other

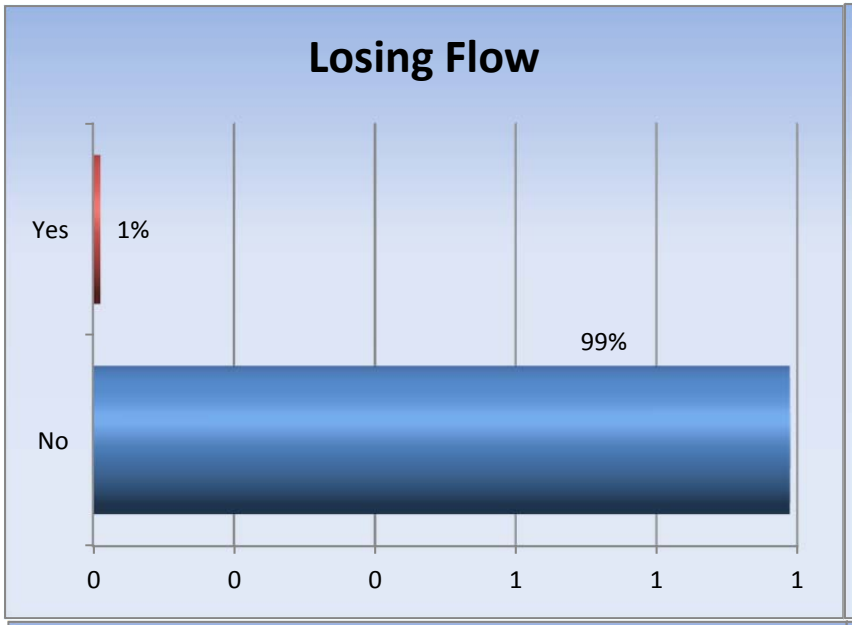
Unknown

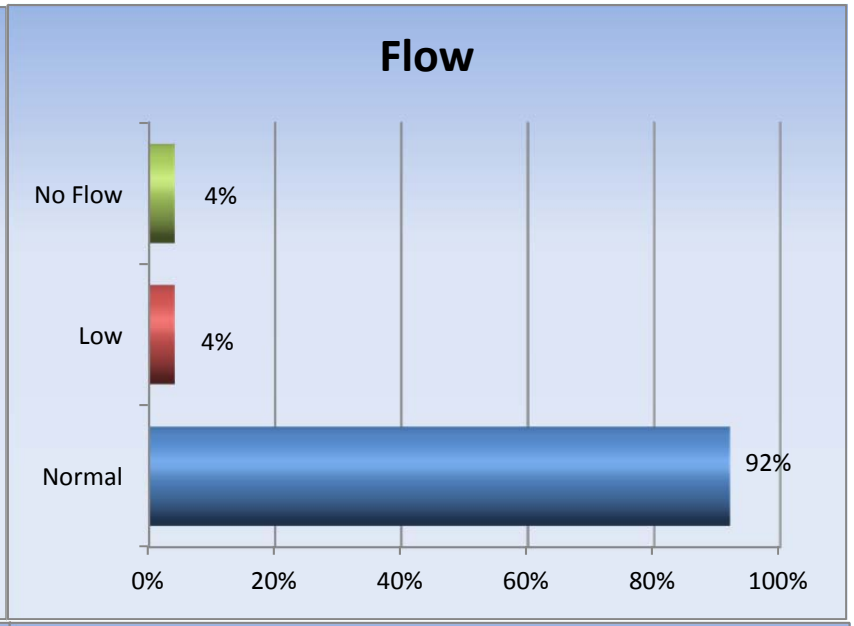
Wastewater

Metal/Cars

2. STREAM HEALTH DATA

On the next few pages are the charts that were developed from the streambank assessment.


Losing Flow
Yes
1%
99%
No
0
0
0
1
1
1


Flow
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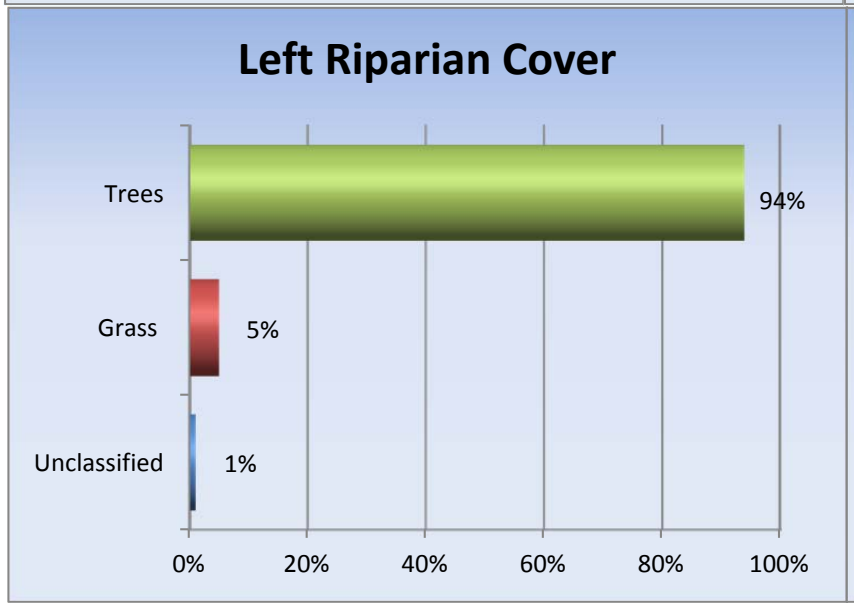
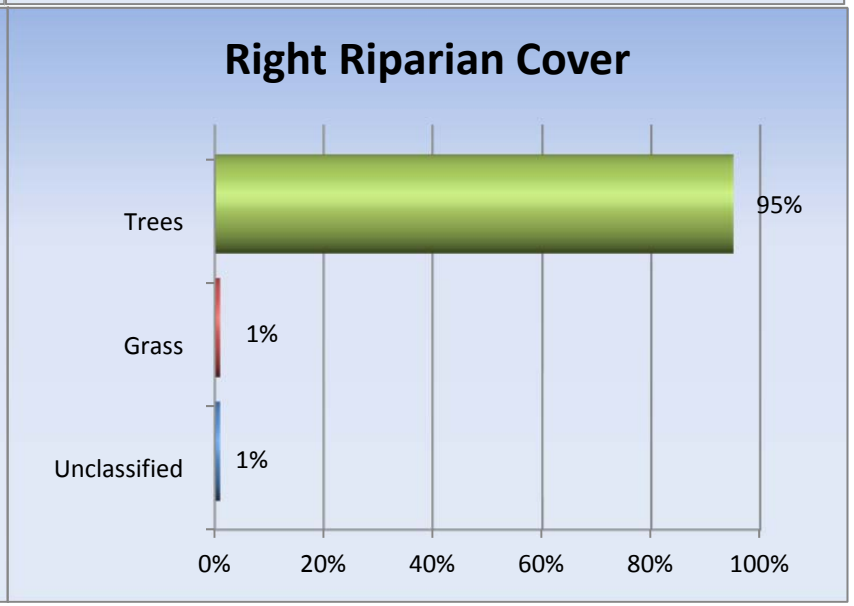
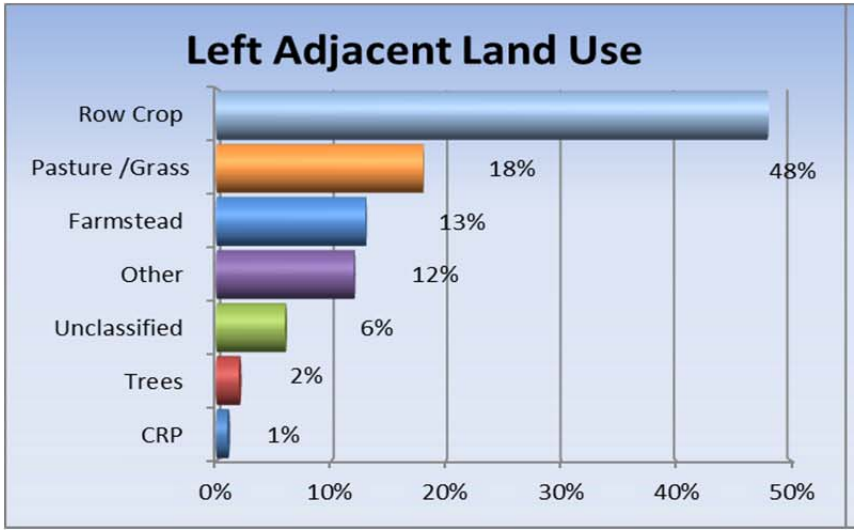
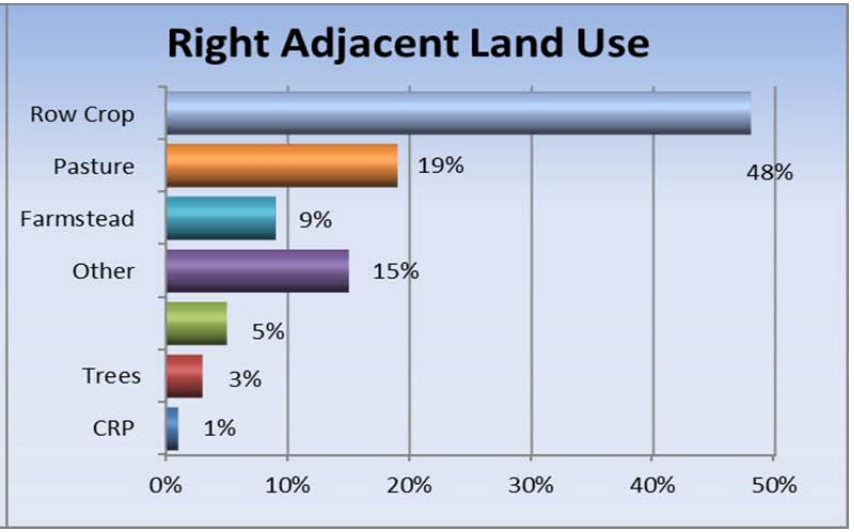
4%
Low
4%
Normal
92%
0%
20%
40%
60%
80%
100%


Left Riparian Cover
Trees
94%
Grass
5%
Unclassified
1%
0%
20%
40%
60%
80%
100%


Right Riparian Cover
Trees
95%
Grass
1%
Unclassified
1%
0%
20%
40%
60%
80%
100%


Left Adjacent Land Use
Row Crop
Pasture /Grass
Farmstead
Other
Unclassified
Trees
CRP
48%
18%
13%
12%
6%
2%
1%
0%
10%
20%
30%
40%
50%


Right Adjacent Land Use
Row Crop
Pasture
Farmstead
Other
Trees
CRP
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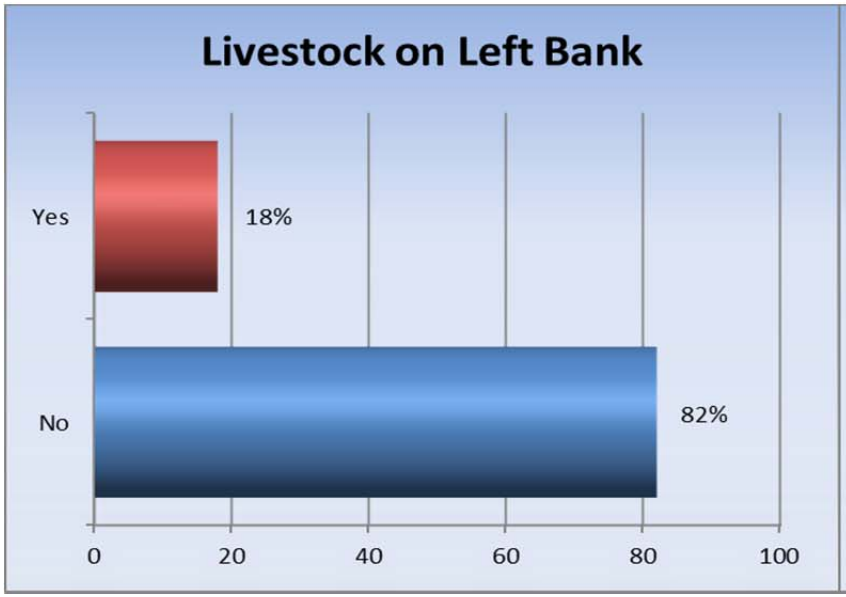
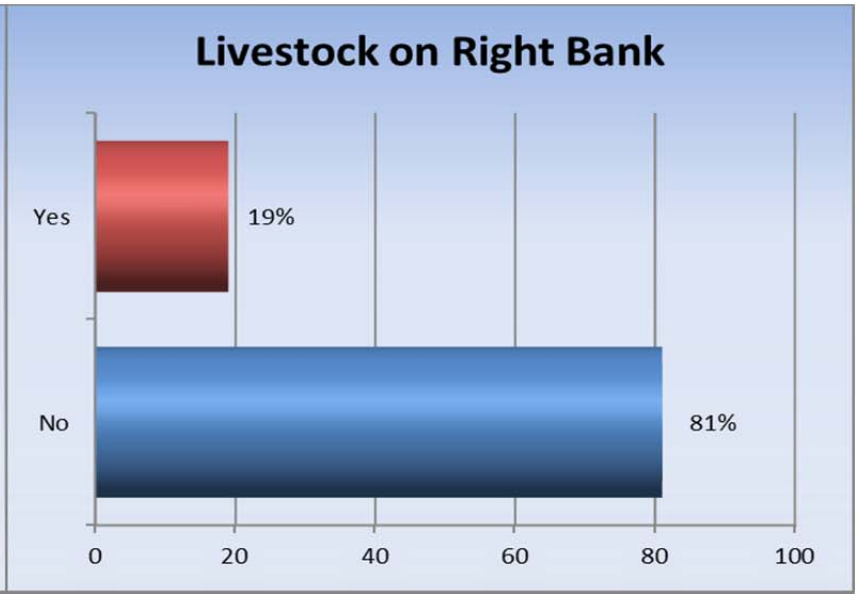
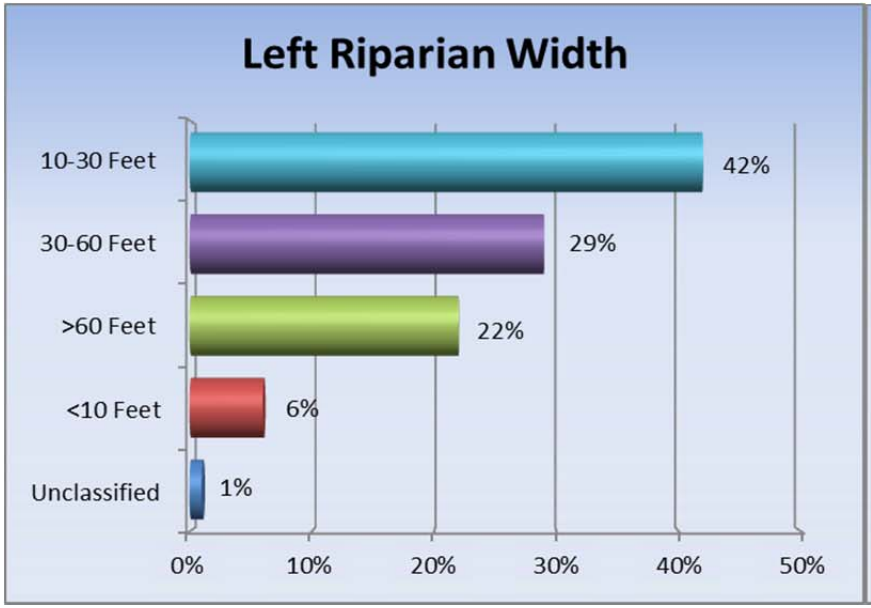
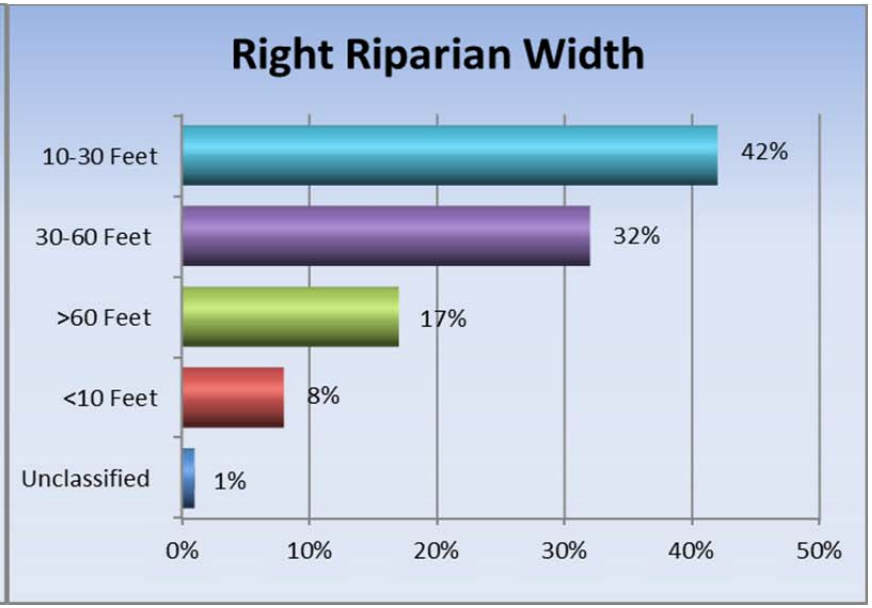
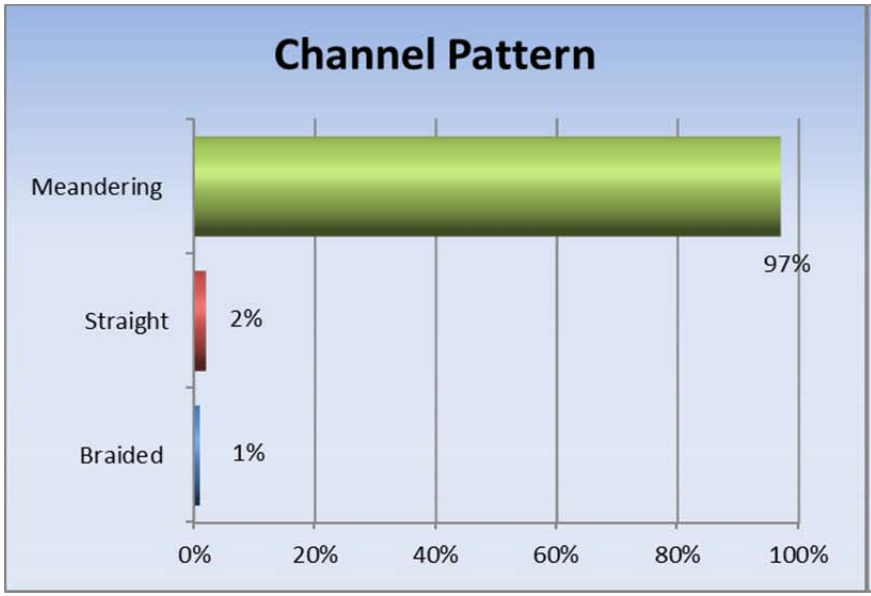
19%
9%
15%
5%
3%
1%
0%
10%
20%
30%
40%
50%

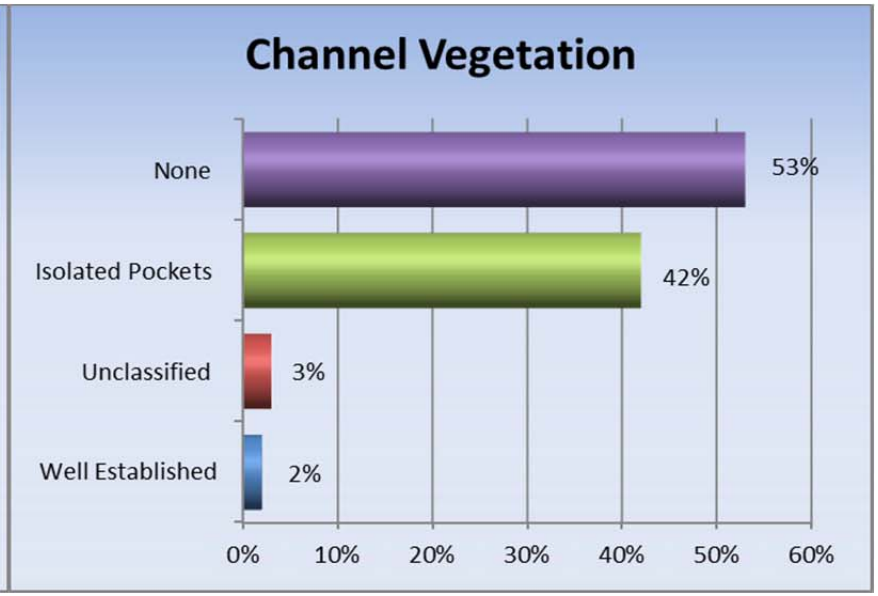

Livestock on Left Bank
Yes
No
18%
82%
0
20
40
60
80
100

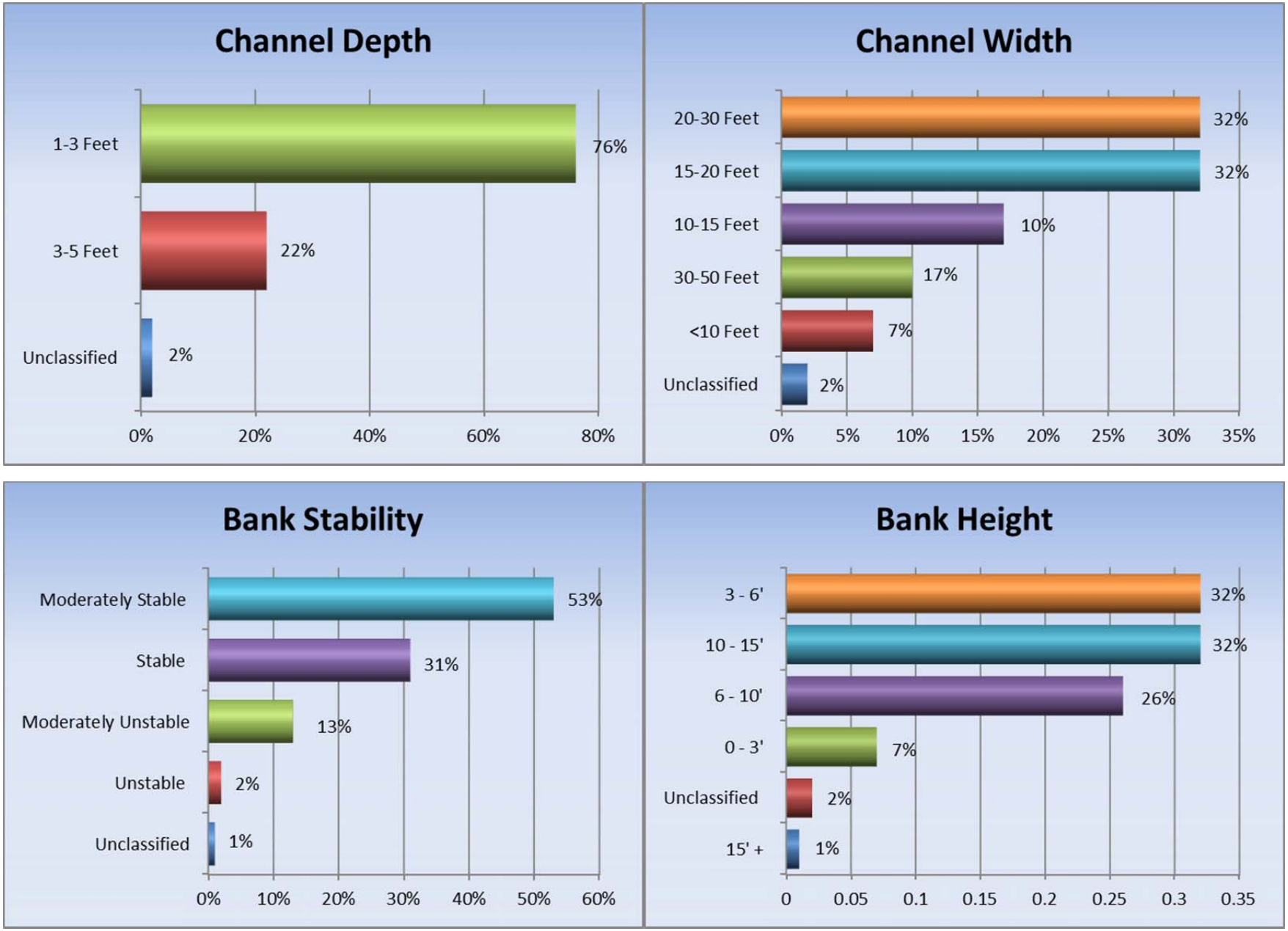

Livestock on Right Bank
Yes
No
19%
81%
0
20
40
60
80
100

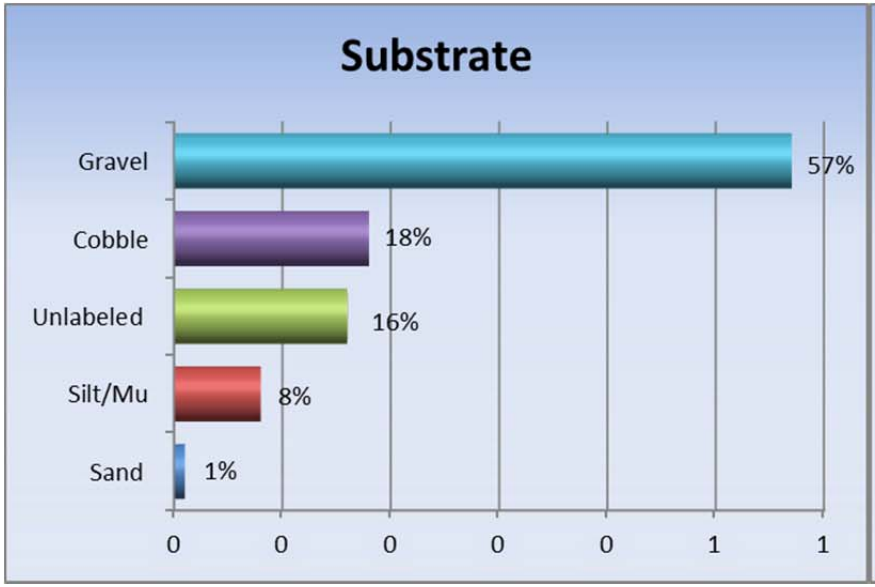

Left Riparian Width
10-30 Feet
30-60 Feet
>60 Feet
<10 Feet
Unclassified
42%
29%
22%
6%
1%
0%
10%
20%
30%
40%
50%

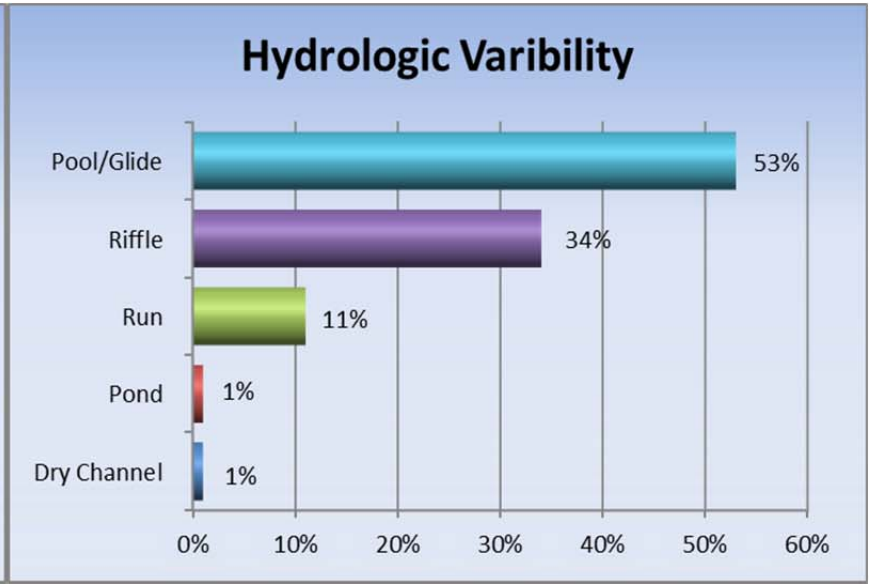

Right Riparian Width
10-30 Feet
30-60 Feet
>60 Feet
<10 Feet
Unclassified
42%
32%
17%
8%
1%
0%
10%
20%
30%
40%
50%

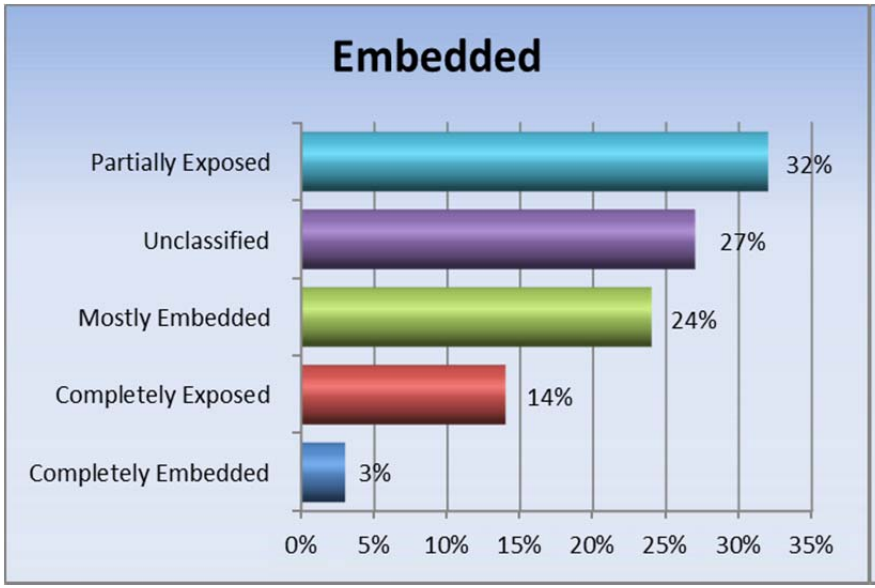

Channel Pattern
Meandering
Straight
Braided
97%
2%
1%
0%
20%
40%
60%
80%
100%

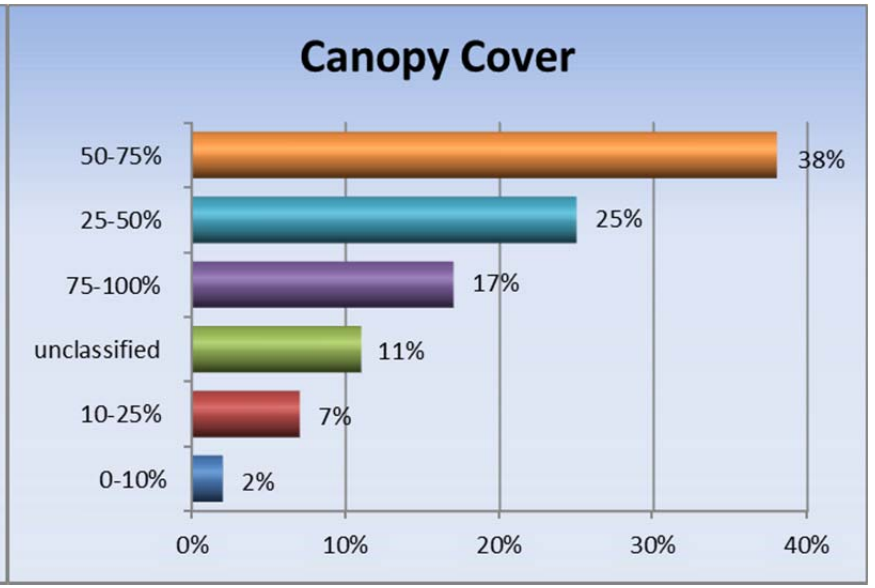

Channel Vegetation
None
Isolated Pockets
Unclassified
Well Established
53%
42%
3%
2%
0%
10%
20%
30%
40%
50%
60%

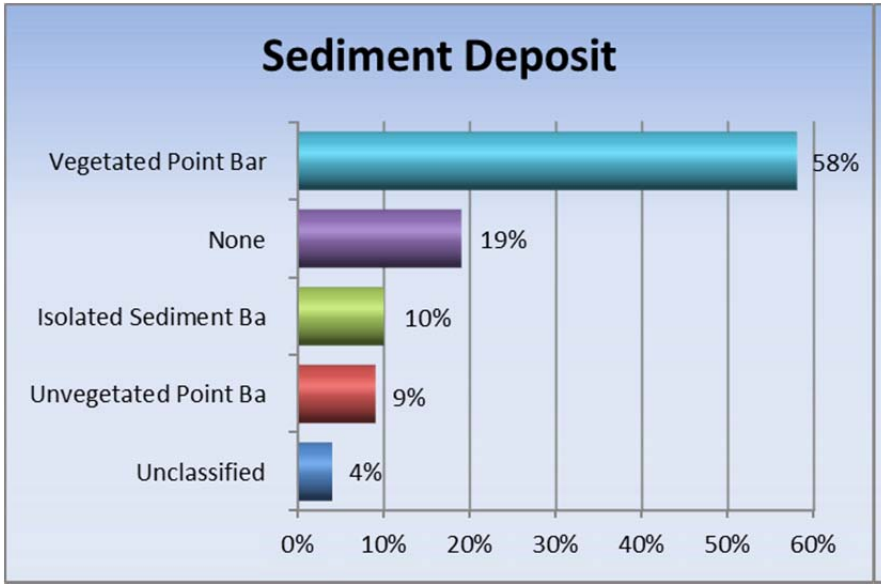

Channel Depth
1-3 Feet
76%
3-5 Feet
22%
Unclassified
2%
0%
20%
40%
60%
80%
Channel Width
20-30 Feet
32%
15-20 Feet
32%
10-15 Feet
10%
30-50 Feet
17%
<10 Feet
7%
Unclassified
2%
0%
5%
10%
15%
20%
25%
30%
35%
Bank Stability
Moderately Stable
53%
Stable
31%
Moderately Unstable
13%
Unstable
2%
Unclassified
1%
0%
10%
20%
30%
40%
50%
60%
Bank Height
3 - 6'
32%
10 - 15'
32%
6 - 10'
26%
0 - 3'
7%
Unclassified
2%
15' +
1%
0
0.05
0.1
0.15
0.2
0.25
0.3
0.35

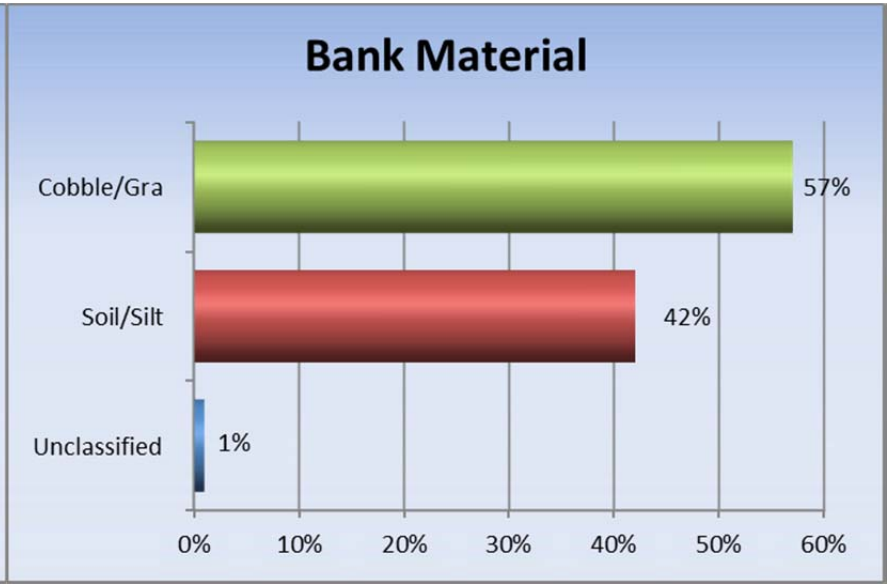

Substrate
Gravel
Cobble
Unlabeled
Silt/Mu
Sand
57%
18%
16%
8%
1%
0
0
0
0
0
1
1

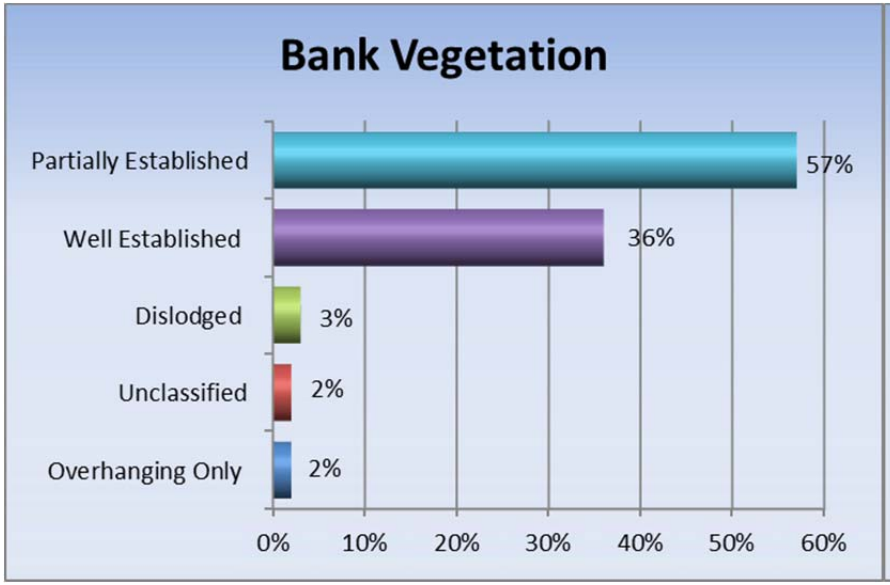

Hydrologic Varibility
Pool/Glide
Riffle
Run
Pond
Dry Channel
53%
34%
11%
1%
1%
0%
10%
20%
30%
40%
50%
60%

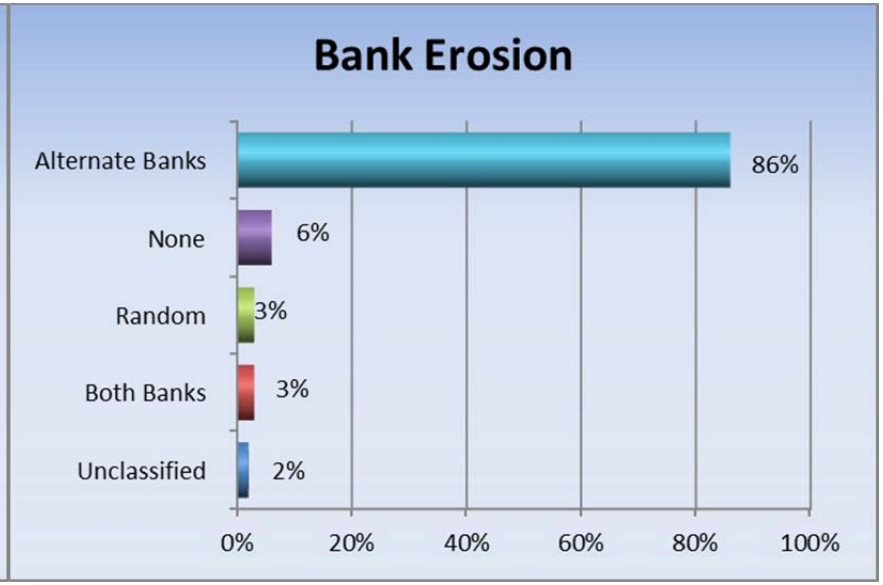

Embedded
Partially Exposed
Unclassified
Mostly Embedded
Completely Exposed
Completely Embedded
32%
27%
24%
14%
3%
0%
5%
10%
15%
20%
25%
30%
35%


Canopy Cover
50-75%
25-50%
75-100%
unclassified
10-25%
0-10%
38%
25%
17%
11%
7%
2%
0%
10%
20%
30%
40%


Sediment Deposit
Vegetated Point Bar
None
Isolated Sediment Ba
Unvegetated Point Ba
Unclassified
58%
19%
10%
9%
4%
0%
10%
20%
30%
40%
50%
60%


Bank Material
Cobble/Gra
Soil/Silt
Unclassified
57%
42%
1%
0%
10%
20%
30%
40%
50%
60%


Bank Vegetation
Partially Established
Well Established
Dislodged
Unclassified
Overhanging Only
57%
36%
3%
2%
2%
0%
10%
20%
30%
40%
50%
60%


Bank Erosion
Alternate Banks
None
Random
Both Banks
Unclassified
86%
6%
3%
3%
2%
0%
20%
40%
60%
80%
100%

XVII. BIBLIOGRAPHY

[i] National Elevation Dataset, East Central Kansas, Kansas Geospatial Community Commons. http://www.kansasgis.org/catalog/catalog.cfm

[ii] United States Geological Survey. http://water.usgs.gov/GIS/huc_name.txt

[iii] Kansas Applied Remote Sensing Program,2005, Kansas Geospatial Community Commons.

[iv] National Agricultural Statistical Service, US Department of Agriculture, 2007.

[v] Kansas Surface Water Register, 2009. Kansas Department of Health and Enviornment. http://www.kdheks.gov/befs/download/Current_Kansas_Surface_Register.pdf

[vi] Rainfall data records. http://countrystudies.us/united-states/weather/kansas/winfield.htm

[vii] USDA/NRCS National Water and Climactic Center.

[viii] EPA estimates "10 to 20 % of onsite wastewater systems malfunction each year". http://cfpub.epa.gov/owm/septic/septic.cfm?page_id=265 The KSU technical team used best professional guess to claim the number of failing septic systems to be 10%.

[ix] US Census Bureau, 2008. http://quickfacts.census.gov/qfd/states/2006.html

[x] Kansas Geospatial Commons. US Census Bureau. Tiger 2000 Census Blocks. http://www.kansasgis.org/catalog/catalog.cfm

[xi] Kansas Geospatial Community Commons. http://www.kansasgis.org/catalog/catalog.cfm

[xii] Kansas Geospatial Community Commons. Kansas Department of Health and Environment. Rural Water Districts, 2006, Public Water Supply, 1994. These sites include those that are currently in use and those that have been functional in the past. NPDES Treatment Facilities, 1994. http://www.kansasgis.org/catalog/catalog.cfm

[xiii] Kansas Department of Health and Environment. Kansas TMDL Development Cycle. 2009. http://www.kdheks.gov/tmdl/download/Kansas_TMDL_Development_Cycle.pdf

[xiv] Kansas Department of Health and Environment. 2010 303d list. http://www.kdheks.gov/tmdl/

[xv] Kansas Department of Health and Environment, 2010.

[xvi] Bathymetric and Sediment Survey of Winfield City Lake, Cowley County, Kansas. Kansas Biological Survey, 2009. http://www.kwo.org/reservoirs/ReservoirBathymetry/Winfield%20Lake_report_final_revised_Jan2010.pdf

[xvii] Stream Visual Assessment Protocol. http://www.ririvers.org/wsp/WSP_PDF/Class3/Intro%20to%20SVAP.pdf

[xviii] Livestock Waste Management Section, Kansas Department of Health and Environment.

[xix] *National Agricultural Statistics Service, 2002.*