Clarks Creek Watershed – 9 Element Watershed Plan Summary

Goal:

To protect and improve the water quality in the Clarks Creek watershed, therefore reducing loading to the Kansas River.

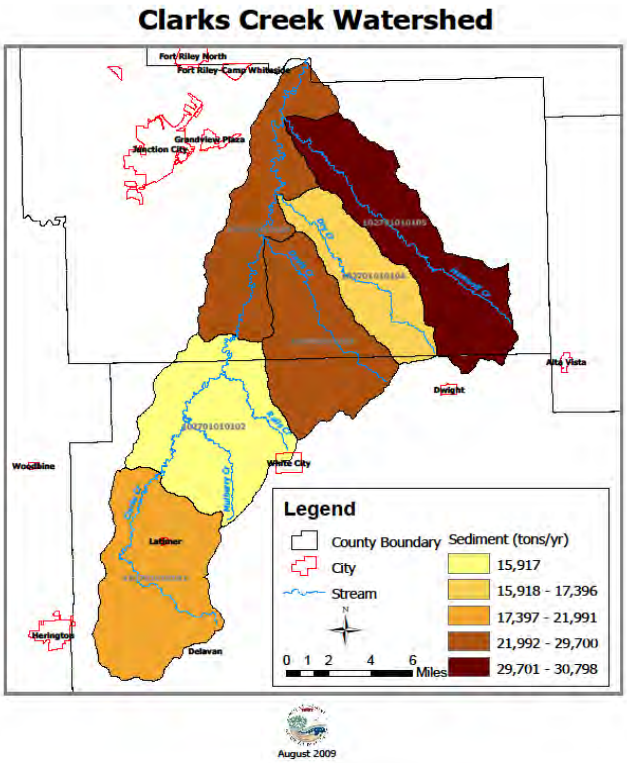
Prioritized Critical Areas for Targeting BMPs

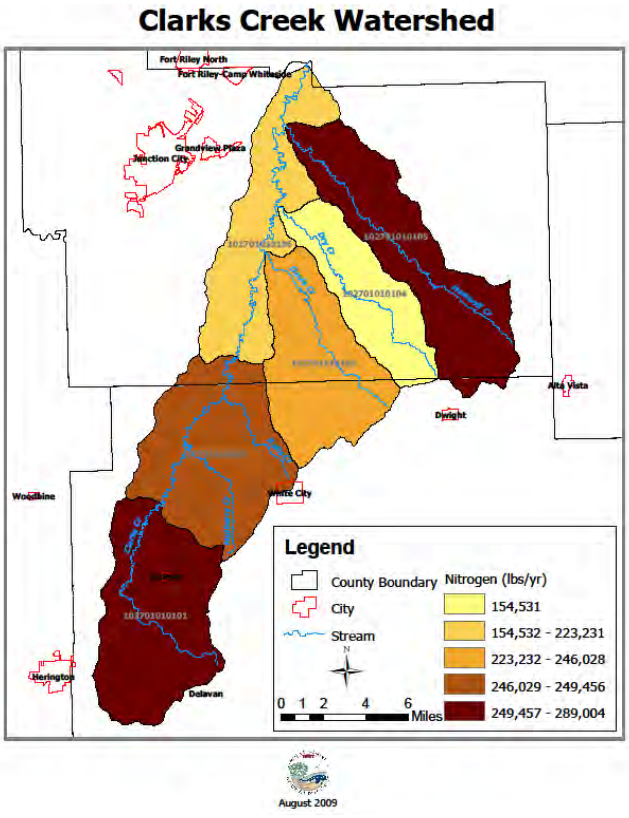
Upper Clarks Creek – 10270101010

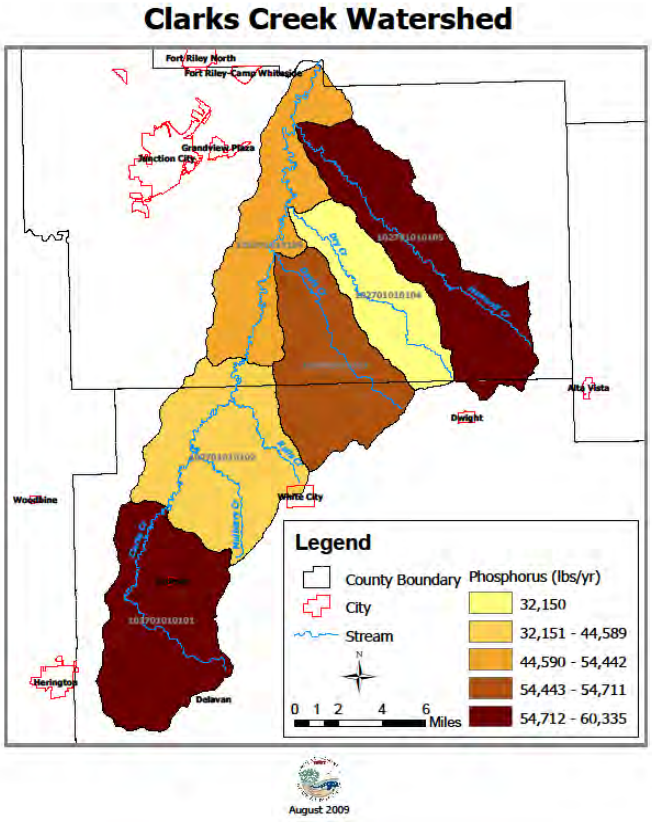
Humboldt Creek - 1027010101050

Targeting considerations:

Cropland and Livestock BMPs will be targeted in the Upper Clarks and Humboldt Creek HUC 12's. These two watershed were chosen as targeted areas based on the STEP-L modeling results. Upper Clarks Creek and Humboldt Creek can potential contribute high levels of nitrogen, phosphorus and sediment.







Clarks Creek Watershed – 9 Element Watershed Plan Summary

Best Management Practices and Load Reduction Goals

Best Management Practices (BMPs) to address phosphorus, sediment and nitrogen in the watershed where chosen by the SLT based on local acceptance/adoptability and the amount of load reduction gained per dollar spent.

Cropland BMPs

- Grasses Waterways
- No-till cultivation practice
- Vegetative Buffers
- Terraces/ Diversions
- Soil Testing/ Nutrient Management

Livestock BMPs

- Vegetative filter strips
- Alternative Watering System (Pond)
- Relocate feeding sites
- Off strem watering sites (Tank or Spring Development)
- Terraces/ Diversions (Placed below feeding sites)

Nitrogen Redcution:

Specific Load Reduction Required
170# per day
1100 # per year

Sediment Reduction:

Specific Load Reduction Required
13268# per day or
36 tons per year

Phosphorus Reducation:

Specific Load Reduction Required
64# per day
395# per year

Clarks Creek WRAPS

CLARKS CREEK WATERSHED RESTORATION AND PROTECTION STRATEGY (WRAPS)

WATERSHED 9-ELEMENT PLAN

Input for this plan came from the Clarks Creek Stakeholder Leadership Team with grateful acknowledgement of the help provided by KDHE and Kansas State University

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March 2012

Cultivating a watershed community

The Kansas Department of Health and Environment has provided financial assistance for this project through an EPA Section 319 Non-Point Source Pollution Control Grant

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INTRODUCTION

On July 4, 1855 Joseph and Cynthia Ann Beavers family arrived by wagon train in the small community of Pawnee, near Ft Riley. Shortly after their arrival, Joseph filed a claim on nearby Humboldt Creek. Humboldt Creek was located in Davis County, (now known as Geary County). Family accounts report that Joseph found the area to be ideal, with gently rolling hills covered in the native tall grass. There were many springs in the area flowing into the creek which was full of fish. The streams were bordered by hardwood stands that were home to many game animals. Extensive limestone deposits in the area would be used by future generations to build the house and a large barn on the homestead site.

Joseph and Cynthia made their home in the area until 1891, during which time; Joseph served with the 11th Regiment, Kansas Calvary during the Civil War. In October of 1855, Cynthia gave birth to their first son, William Henry, who is reported to be the first white child born in Davis County. A second son, Eldridge Robert, was born in August of 1857. Eldridge "Doc" lived all of his life on the family farmstead on Humboldt Creek and he and his family lie at rest in the neighborhood cemetery.

In 1857 James Atkinson and his brother, Steven, came to Morris County and filed two claims near the headwaters of Clarks Creek. There were Native American's in the area and they often traded back and forth with the new settlers. The Atkinson's found the area to be heavily wooded and alive with game and fish in the clear water springs and streams. They established their homesteads and the following year sent word for their father and mother to make the journey from Illinois to join them. Remnant's of Steven's cabin survive today after being moved into Council Grove, KS. James's son Charles was born shortly after their arrival in the area and is reported to be the first white male born in Morris County. Family stories relate histories of large community gatherings where the kids would swim or fish in the creek while their parents and grandparents watched over them.

James made his living as a farmer in the area, tilling the rich bottom ground along Clarks Creek and grazing his small cattle herd on the vast grassland. He is buried in the Clarks Creek cemetery outside of present day Latimer. His grave and the graves of his parents and brother overlook the unbroken tall grass prairie that must still appear much as it did when he arrived. His fifth great-grandsons still till the land and graze cattle nearby.

I offer these two early settler stories as part of the reason for my interest in the restoration and preservation of Clarks Creek and its watershed. Clarks Creek is part of my sons' heritage. Joseph Beavers was my husband's third great-grandfather and James Atkinson was my fourth great-grandfather. The Clarks Creek watershed is still as beautiful and distinctive as it was over 150 years ago, but needs our help to return to the healthy conditions that those early settlers found when they arrived.

This watershed plan will be organized as a journey, much like the one the early Beavers and Atkinson settlers undertook. Back in their homes in the east they had probably heard stories of the richness of the resources that lay to the west that enticed them to attempt the trip.

Before starting, the early settlers formulated a plan to get them where they were going in the most time and cost efficient manner possible;

They knew:

a) their Starting Point
b) Information from Outside Sources
c) some Threats and Obstacles they would face on their trip
d) an idea of the Route to their Destination
e) a Specific Destination
f) Tools and Equipment they would need
g) financial Resources they would need to supply and what support they could count on from others in their community and along the way
h) and a Goalof what they wanted to build and accomplish at their new home.

The Clarks Creek Stakeholder Leadership Team (SLT) is in a very similar situation. The group knows the current conditions in the watershed and has information from other agencies working in the area. They are aware of the threats and obstacles and the resources available to the group and watershed residents. They have formulated a plan of the actions that will need to be undertaken with the support of federal, state and local agencies and organizations. Most importantly, they have a goal of improved water quality conditions for the Clarks Creek Watershed.

Starting Point

Every successful journey begins with an organized leader who can gather and disperse information, make effective decisions and gather available resources. The leader for this journey toward improved water quality will be the Clarks Creek Watershed Restoration and Protection Strategy (WRAPS).

Organization of the Clarks Creek WRAPS Project

History

In 2006, the Geary County Conservation District Board of Supervisors expressed interest in the formation of a WRAPS project for Clarks Creek. Their purpose was to coordinate and focus efforts in the watershed to address the Total Maximum Daily Load (TMDL) for bacteria. Since that time, work has been ongoing through the Geary and Morris County Conservation Districts (CD), Natural Resource Conservation Service (NRCS), Farm Service Agency (FSA), and the Division of onservation of the Kansas Department of Agriculture (DOC) to reduce the bacteria levels in the creek. In 2009, KDHE monitoring indicated that the e.coli levels had declined and the stream was taken off the Environmental Protection Agency (EPA) 303d list of impaired streams. However, these waters do make contributions to the pollutant loads monitored on the Kansas River at station 260 at Wamego. The Kansas River has 303d listings for biology, total suspended solids, total phosphorous and bacteria.

Due to their status as a non-profit organization, the Flint Hills Resource Conservation and Development (RC&D) Council was brought in to serve as the project sponsor. Another factor in having the Flint Hills RC&D sponsor the WRAPS was the cooperation that could be gained from the coordinators of the other four WRAPS projects that the RC&D was sponsoring. The four other WRAPS, Melvern, Marion Lake, Fall River, and Twin Lakes, have since been joined by three more; Neosho Headwaters, Eagle Creek and Toronto. At present, five coordinators are managing these seven projects under the direction of the RC&D council.

A project coordinator was hired for the Clarks Creek WRAPS in 2006. Two public meetings were conducted to gain input and comments about watershed concerns from residents and interested stakeholders. The first of these meetings was held in Junction City in December of 2006 with approximately 40 attendees. The second meeting was held in White City in March 2007 with 13 attending.

Out of those meetings, a core group was recruited to form the Stakeholder Leadership Team (SLT) for the WRAPS project. This group has been instrumental in setting goals/objectives, and in determining the targeted areas for the watershed. This team is made up of 11 watershed residents, producers and supporters. Their diverse range of expertise has been invaluable in providing input for this plan.

Grants Received

To date, four grants from the Environmental Protection Agency (EPA) 319 funds have been received through the Kansas Department of Health and Environment for a total of just over $100,000, and an additional grant of $8,700.00 has been received directly from the EPA. The grants have been used to provide coordination, supplies, and travel for the project. Some of the monies have funded Best Management Practices (BMP) within the watershed.

Partnerships

The project coordinator and SLT have worked closely with many area partners including; the Geary County and Morris County Conservation Districts, Natural Resource Conservation Service in both Morris and Geary County, Kansas State University (KSU) Extension agents in both counties, KSU watershed specialists, both county commissions, and public works departments, area school districts, Flint Hills RC&D, private businesses, KDHE, EPA,SCC, Kansas Alliance for Wetlands and Streams (KAWS), Kansas Forest Service, Kansas Rural Center, Kansas Department of Wildlife and Parks (KDWP), Morris County Rural Water District #1, Geary County Fish and Game Association, Clarks Creek Extension Homemaker's Unit, Geary County Fair Board, Middle Kansas WRAPS, Rural Lakes Region Local Environmental Protection Program (LEPP), The Watershed Institute, Kansas Rural Water Association and the Farm Service Agency (FSA) to move through the Development, Planning and Assessment phases of the WRAPS process.

Stakeholder Leadership Team Goals

After compilation of all of this information and based on their unique knowledge of the area, the Clarks Creek SLT has defined their goals for this project;

1. Education of the watershed residents about how their actions affected the surface and ground water quality in the Clarks Creek Watershed.
2. Reduction in the amount of sediment and nutrients in the surface waters of the watershed that contribute to the TMDLs in the Kansas River.
3. Improvement in wildlife numbers through improved land management practices and increased habitat acres.

Since there are currently no TMDLs, and/or 303d listed waters, for this watershed, these goals are all considered "protection" goals rather than restoration goals. Improvements made in these three areas will all be important milestones in the return of the watershed to a healthy condition. Continued declines in sediment and nutrient loads will allow Clarks Creek to continue to meet its Designated Uses as well as help the overall health of the Kansas River basin.

E. coli bacteria contamination is still considered a concern within the Clarks Creek watershed, but with the improvements already attained in reducing this pollutant, the SLT has decided to focus their resources on reducing the other contaminant loads in the creek. Many of the conservation practices that

will be encouraged by this plan will also help to reduce the bacteria loading to the creek and so, while this will not be directly addressed, e. coli loads should continue to be reduced.

Basic Watershed Information

Sub-watersheds and HUC

Clarks Creek forms the southern drainage area of the Upper Kansas River watershed (Hydrologic Unit Code (HUC) 10270101). Clarks Creek Watershed (HUC 1027010101) covers approximately 250 square miles, or 159,811 acres that is split nearly equally between Morris and Geary Counties. The watershed extends from near Delevan, KS in Morris County to the creek's confluence with the Kansas River just east of Ft. Riley near the Geary County/Riley County border. Portions of 16 townships are included within the drainage area.

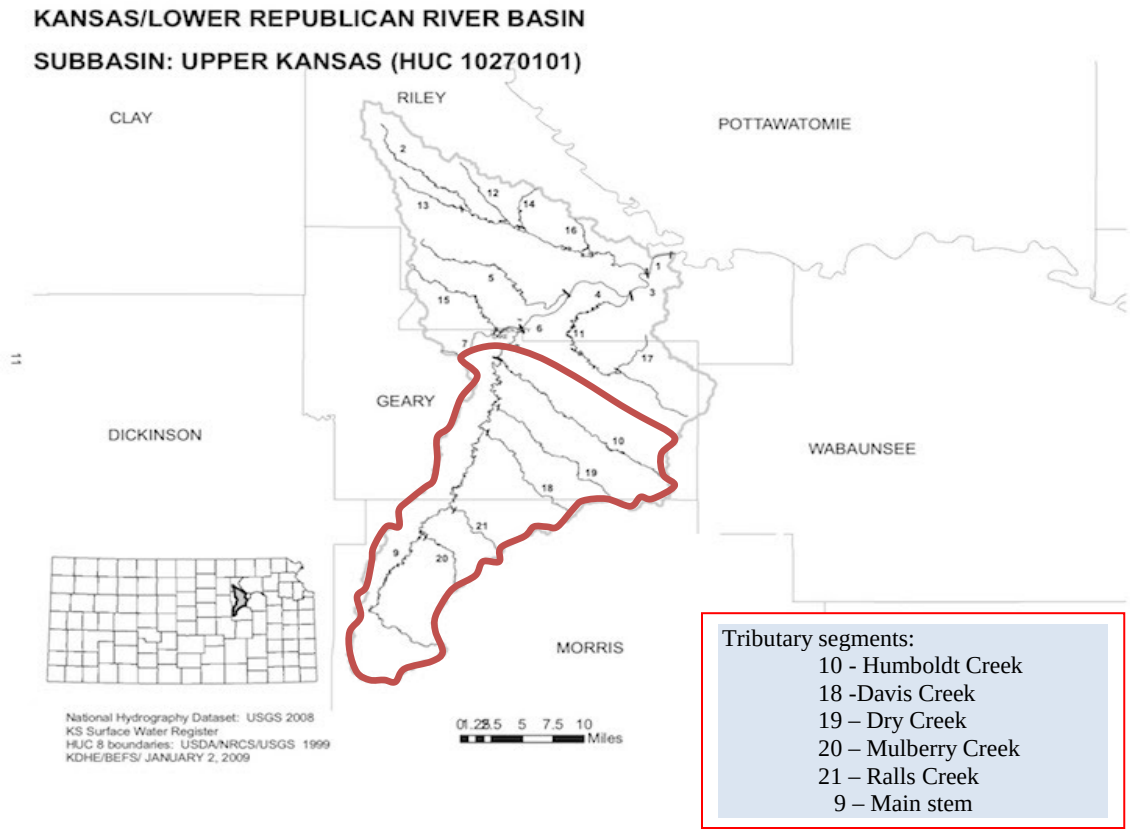
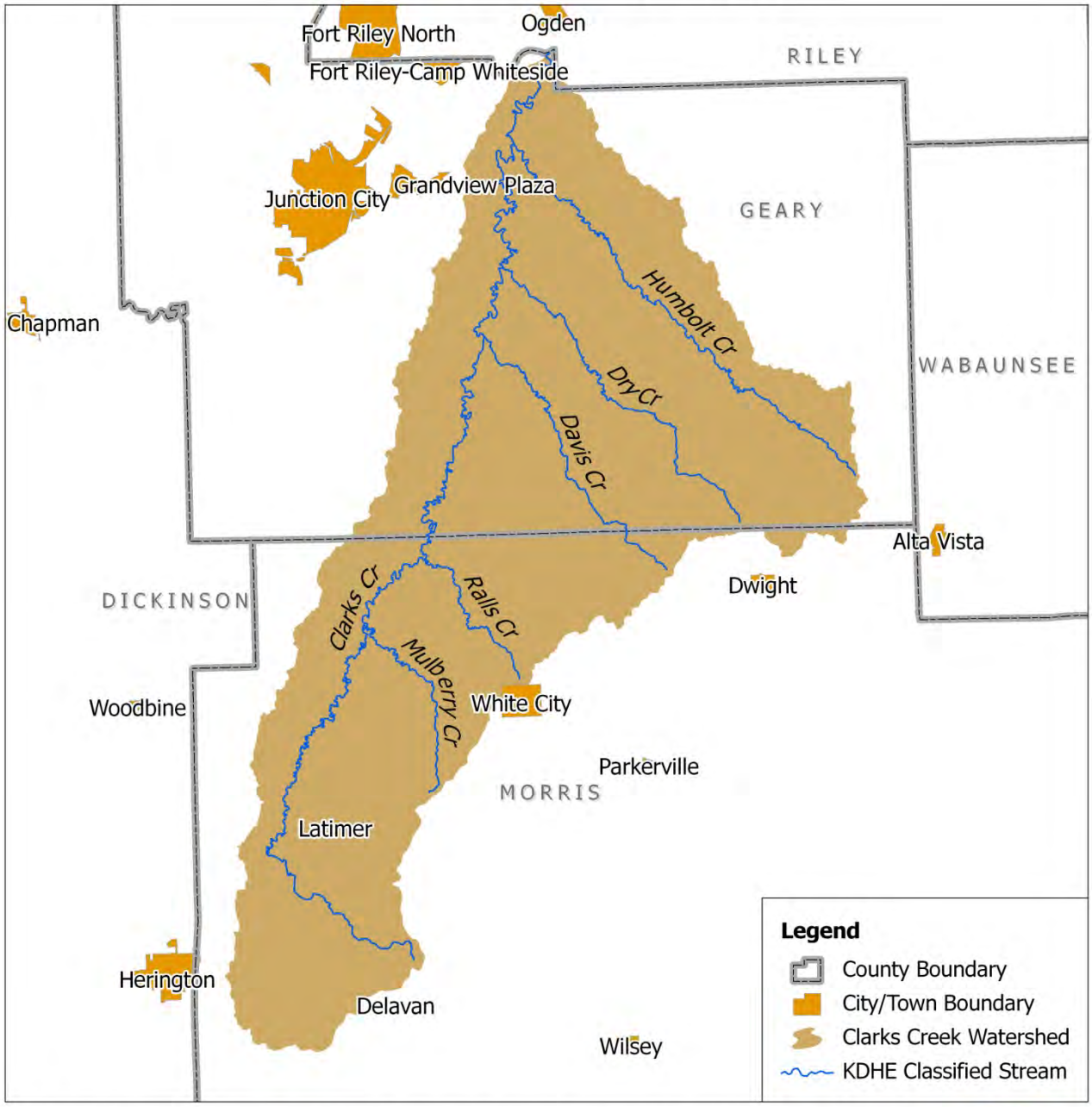


Figure 1 – Clarks Creek Watershed.

Clarks Creek WRAPS Classified Streams



The purpose of this publication is to illustrate general watershed conditions in the state of Kansas. This map product is provided without representation or implied or expressed warranty of accuracy and is intended for watershed planning purposes only. The originating agency is not responsible for publication or use of this product for any other purpose. This product may be corrected or updated as necessary without prior notification.

Kansas Department of Health and Environment

February 2012

The watershed is divided into six HUC 12 sub-watersheds; the main stem of Clarks Creek (102701010106), Humboldt Creek (102701010105), Davis Creek/Thomas Creek (102701010103), Dry Creek (102701010104), Mulberry Creek and Ralls Creek (102701010102),and Upper Clarks Creek (102701010101).

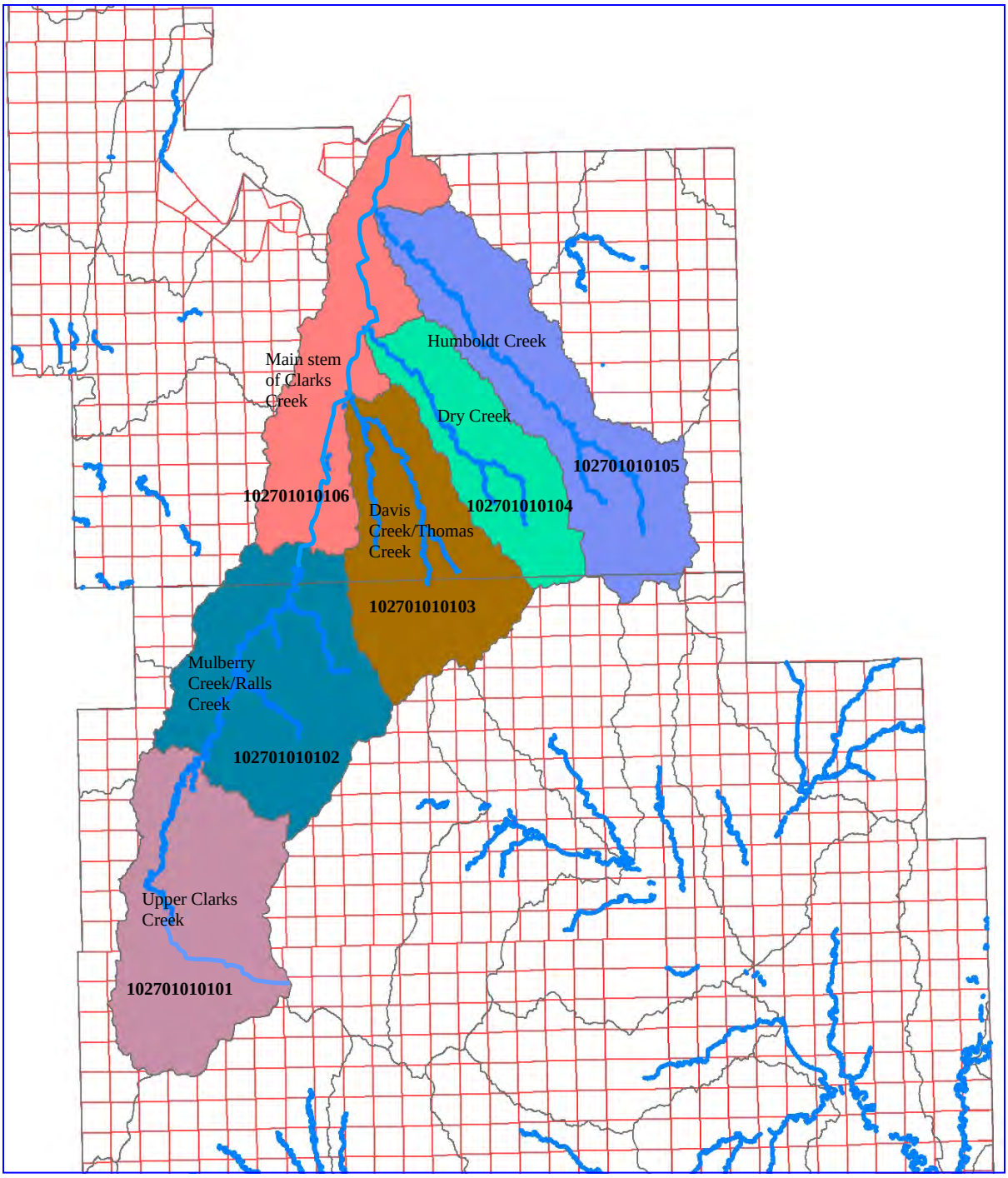


Figure 2: Subwatersheds of Clarks Creek

Land Use

Rangeland

Land use in the watershed is listed as 68.7%, (107,984 acres), permanent grass, most of which is the native tall grass prairie of the Flint Hills ecoregion. These rangeland acres cover primarily the upland areas of the watershed and are used as grazing lands for cattle production. Once these cattle are brought in from the range, the cows are typically wintered in lowland areas, grazing crop residue or winter pasture. Yearling calves are usually weaned and fed in dry lots. Throughout the watershed there are an estimated 80 dry lots, approximately 75% of which lie in close proximity (within 1 mile) to a stream. Anywhere from a few dozen to a few hundred calves are held in these lots for up to 120 days.

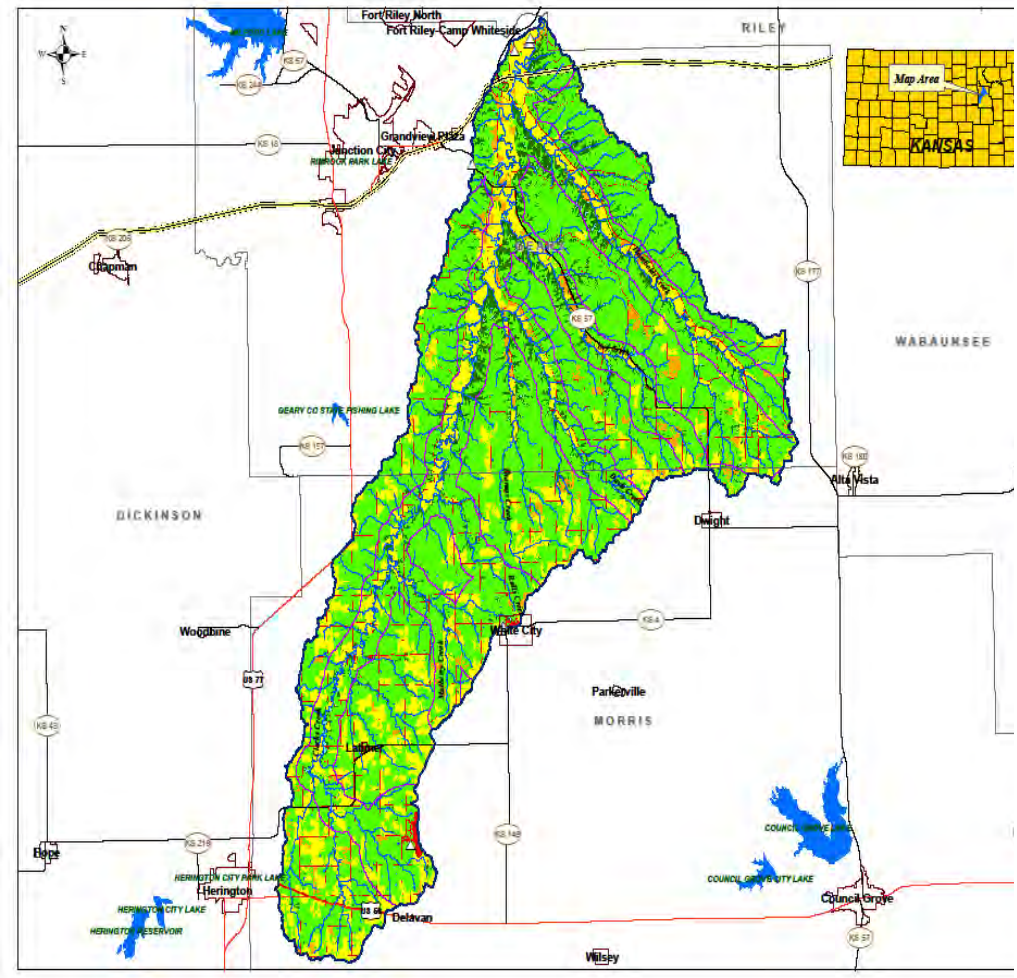


Figure 3 – Land cover map of Clarks Creek

Cropland

Cropland covers 17.6% of the watershed (28,584 acres). Typical crops produced in the area include; corn, soybeans, milo, wheat, alfalfa, and brome hay. As evidenced by land use maps, most of these cropland acres lie in alluvial areas in the lower part of the watershed with the fields being more spread out in the headwaters area. Approximately one quarter of the cropland areas of the watershed are under no-till production. This percentage is growing, though area producers have been slow to adopt this production method. An estimated 90% of the cropland has terrace/waterway systems in place. Many of these are older systems that need to be rebuilt to meet their original design specifications. The majority of the producers do not regularly soil test to determine exiting soil nutrient availability for crop needs. Rather, they apply fertilizer using the assumption that there are no soil nutrients available and they must provide all of the crop needs through application.

Developed Lands

Less than 4% of the area is developed land with White City and Latimer being the only incorporated communities in the watershed. White City is home to approximately 500 residents and is mainly a bedroom community for the workforce of Ft. Riley. Skiddy is an unincorporated community in the area. The total population of the watershed according to the 2000 census was 1,439, most of which live on farms or small rural acreages. Part of the developed area of the watershed is an old army airfield near Delevan.

Remaining Land Use

The remaining land uses in the watershed include 8.6% forest, which lies mainly in the riparian areas around the creeks. Depletion of the historical forested riparian areas around the creek, some of which measured up to 200’ wide, has led to degraded stream banks in many areas. Unstable creek banks are common, especially in the lower part of the watershed. Humboldt Creek has an approximately 2 mile reach that was straightened during the 1950s. This modification has led to further degradation of the condition of the channel banks in this sub-watershed. Using aerial photography it is estimated that there are 17 miles of streambank in the watershed in need of stabilization.

Aerial imagery courtesy of the
2006 National Agricultural Imaging Program.

Figure 4 – Eroding stream bank on Humboldt Creek

Public Water Supplies

There are two public water supplies that draw groundwater from wells located within the Clarks Creek Watershed; The White City Municipal Water System and the Morris County Rural Water District #1.

White City Municipal Water System

The city of White City is served by a series of three wells. One of the wells lies in the Clarks Creek watershed, while the other two lie in the Twin Lakes (Neosho) watershed. Water from all three wells is mixed to serve the community of approximately 500.

Community Water Systems: Water Systems that serve the same people year-round (e.g. in homes or businesses).

Water System Name	County(s) Served	Population Served	Primary Water Source Type	System Status	Date Closed	Water System ID
WHITE CITY, CITY OF	MORRIS	500	Groundwater	Active		KS2012703

Figure 5 – Specs for White City Water System

A Source Water Protection Plan was completed for the system and that plan lists the Susceptibility Likelihood Score (SLS) for several contaminant categories. That plan is attached to this document in the Appendix.

Contaminant Category	A	B	B*	C	C*	D
Susceptibility Likelihood Score	57	52	56	60	56	63
SLS Range	Mid	Mid	Mid	Mid	Mid	Mid

Figure 6 – White City Water system Contaminant Category Rankings

The public water system and the waste water system in White City were upgraded in 2005 with an $850,000.00 grant from the Kansas Department of Commerce and the Kansas Department of Health and Environment.

Figure 7: Sign outside of White City Maintenance Building regarding loan program used to update the public water system and the waste water system.

The Clarks Creek WRAPS and the Twin Lakes WRAPS are listed in this water system's Source Water Protection Plan and the Planning Team "believes that participating in the WRAPS program will benefit the City and its water supply." Efforts continue to be made to have a representative from White City join the SLT.

Figure 8: Location of White City water supply wellheads.

Morris County Rural Water District #1

The second water supply that draws its water from the Clarks Creek Watershed is Morris County Rural Water District (RWD) #1. This District draws its water from three groundwater wells near the mouth of Clarks Creek. The wells lie in a cropland field and are surrounded by a 1.2 acre native grass buffer which the Clarks Creek WRAPS helped to fund. The district services approximately 1,200 homes in Morris, Geary, Wabaunsee and Lyon Counties.

There are several potential sources of contamination within the 2-mile protection area. Interstate 70 and State Highway 18 pass through the middle of the area, Camp Funston, part of the Ft. Riley Military Reservation, lies on the edge of the radius, and the Kansas River passes through the northern portion of the protection area. The wells are located within 500 yards of Clarks Creek.

A susceptibility analysis was performed for the Morris County RWD #1 wells in January of 2011. The overall result of the analysis considers the overall risk to its water source to be in the "low" category. Significant Potential threats to the Quality of the source are listed as abandoned water wells, and the State and Federal highways. The Source Water Plan compiled by the Kansas Rural Water Association and approved by the RWD #1 is attached to this document in Appendix A.

Figure 9 – Location of Morris County RWD #1 wellheads

INFORMATION FROM OUTSIDE SOURCES

Designated Uses of Clarks Creek

Each water body in the state has been assigned a set of Designated Uses which the water quality in the watershed must allow. According to the Kansas Surface Water register, 2009, KDHE has determined the following designated uses for the waters of Clarks Creek:

KANSAS/LOWER REPUBLICAN RIVER BASIN

STREAM SEGMENT NAME	LATITUDE/LONGITUDE UPPER	LOWER	SEG	CLASS	AL	CR	DS	FP	GR	IW	IR	LW
SUBBASIN: UPPER KANSAS (HUC 10270101)												
Clarks Cr	39.0479 96.7309	39.0886 96.7109	8	GP	E	C	X	X	X	X	X	X
Clarks Cr	38.6762 96.8014	39.0479 96.7309	9	GP	E	C	X	X	X	X	X	X
Davis Cr	38.8521 96.6477	38.9605 96.7513	18	GP	S	b	X	X	X	X	X	X
Dry Cr	38.8726 96.6043	38.9918 96.7393	19	GP	S	C	X	X	X	X	X	X
Humboldt Cr	38.8926 96.5359	39.0479 96.7309	10	GP	E	C	X	O	X	X	X	X
Mulberry Cr	38.7528 96.7903	38.8291 96.8241	20	GP	E	b	X	X	X	X	X	X
Ralls Cr	38.8035 96.7355	38.8593 96.7896	21	GP	E	b	X	X	X	X	X	X

HUC = hydrologic unit code
SEG = stream segment
CLASS = antidegradation category
GP = general purpose waters
EX = exceptional state waters
ON = outstanding national resource waters
AL = designated for aquatic life use
S = special aquatic life use water
E = expected aquatic life use water
R = restricted aquatic life use water
CR = designated for contact recreational use
A = Primary contact recreation stream segment is a designated public swimming area
B = Primary contact recreation stream segment is by law or written permission of the landowner open to and accessible by the public
C = Primary contact recreation stream segment is not open to and accessible by the public under Kansas law
a = Secondary contact recreation stream segment is by law or written permission of the landowner open to and accessible by the public
b = Secondary contact recreation stream segment is not open to and accessible by the public under Kansas law
DS = designated for domestic water supply use
FP = designated for food procurement use
GR = designated for ground water recharge
IW = designated for industrial water supply use
IR = designated for irrigation use
LW = designated for livestock watering use
X = referenced stream segment is assigned the indicated designated use
O = referenced stream segment does not support the indicated designated use

Figure 10 – Designated uses of Clarks Creek

Designated Uses

The surface waters in the Clarks Creek Watershed are generally used for aquatic life support, food procurement, domestic water supply, recreational use, groundwater recharge, industrial water supply, irrigation and livestock watering. Surface waters are given certain "designated uses" based on what the waters will be used for as stated in the Kansas Surface Water Register, 2009, issued by KDHE. For example, waters that will come into contact with human skin should be of higher quality than waters used for watering livestock. Therefore, each "designated use" category has a different water quality standard associated with it. When water does not meet its "designated use" water quality standard then the water is considered "impaired."

At this point, the only designated use not being met in the Clarks Creek watershed is food procurement on Humboldt Creek. The special aquatic life that should be supported in the Dry Creek and Davis Creek sub-watersheds is the Topeka Shiner. To date, no biological survey has located the shiner in these waters, but with improved water quality, that species should be able to move easily into these tributaries. There are no exceptional waters located in this watershed.

Modeling

At the request of the Clarks Creek SLT, KDHE completed non-point source pollutant load estimates using a Spreadsheet Tool for Estimating Pollutant Loads (STEPL). The data was converted into maps which the SLT has used to identify target areas for BMP installation that will reduce the amount of sediment, nitrogen and phosphorous loading. The SLT is aware that these models provide only potential loads, not actual measured amounts.

Watershed models are computer generated predictions of how much of a pollutant each sub-watershed has the potential of contributing to the surface waters in the area. Inputs such as land use, land cover, soil types, slopes and other factors are some of the inputs used to generate these predictions.

Sediment Model

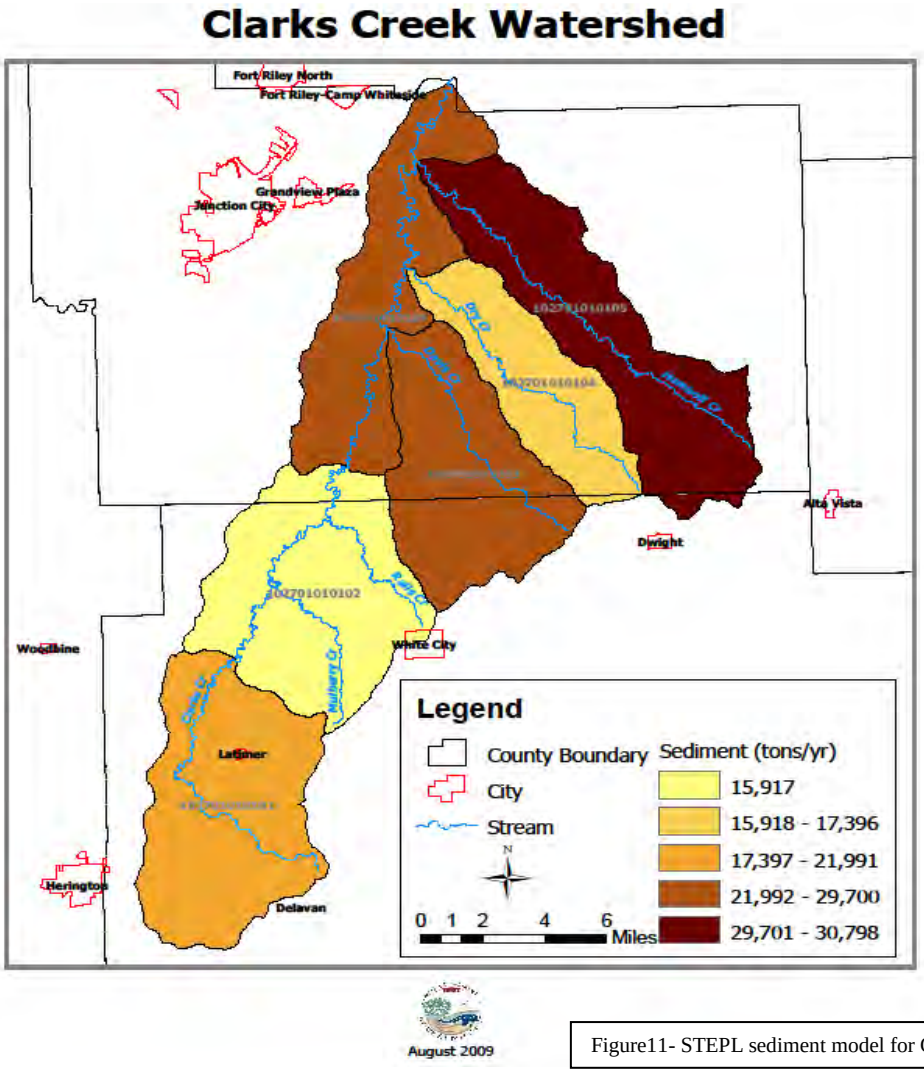


Figure11- STEPL sediment model for Clarks Creek

Nitrogen Model

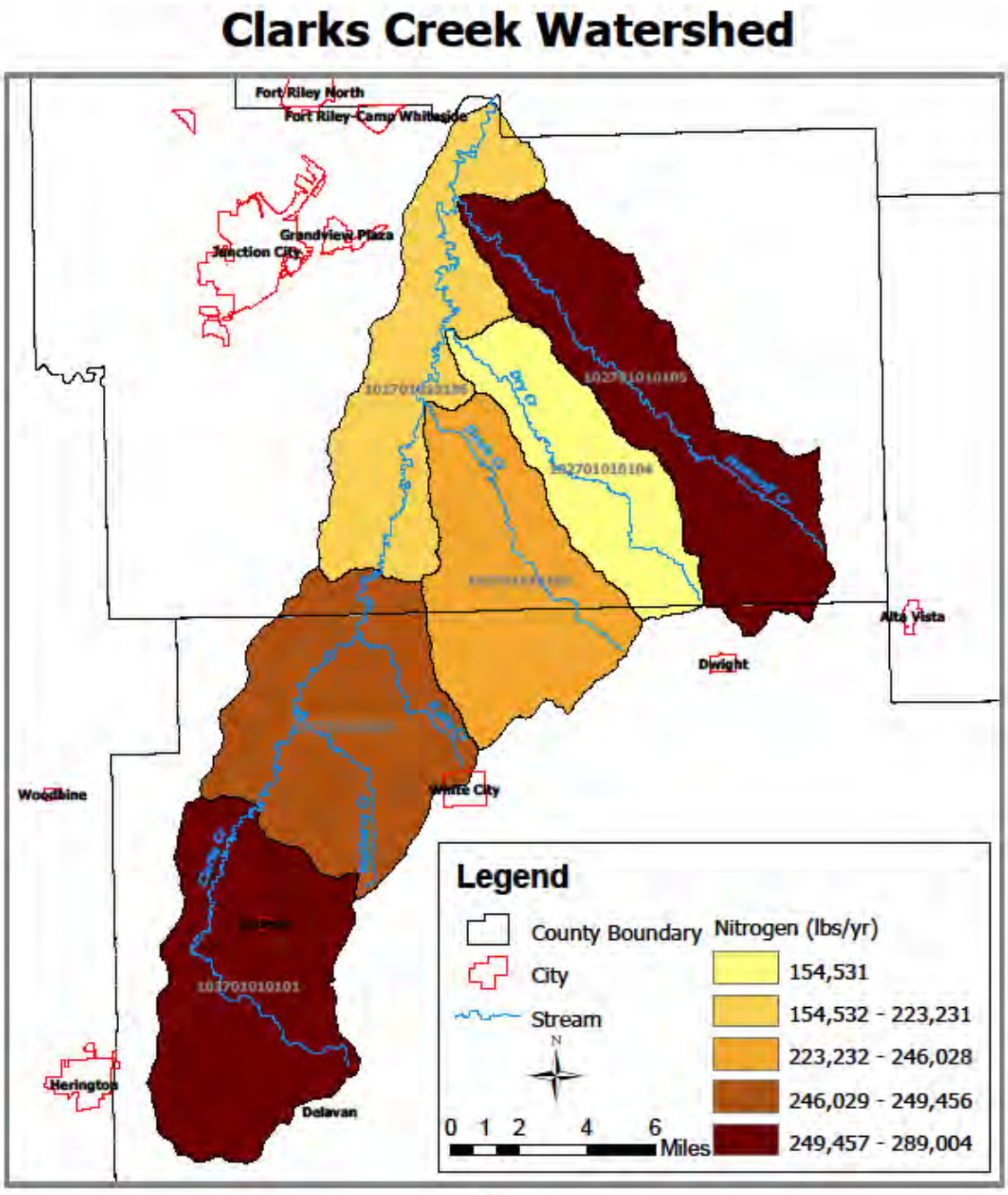


Figure12- STEPL nitrogen model for Clarks Creek

Phosphorus Model

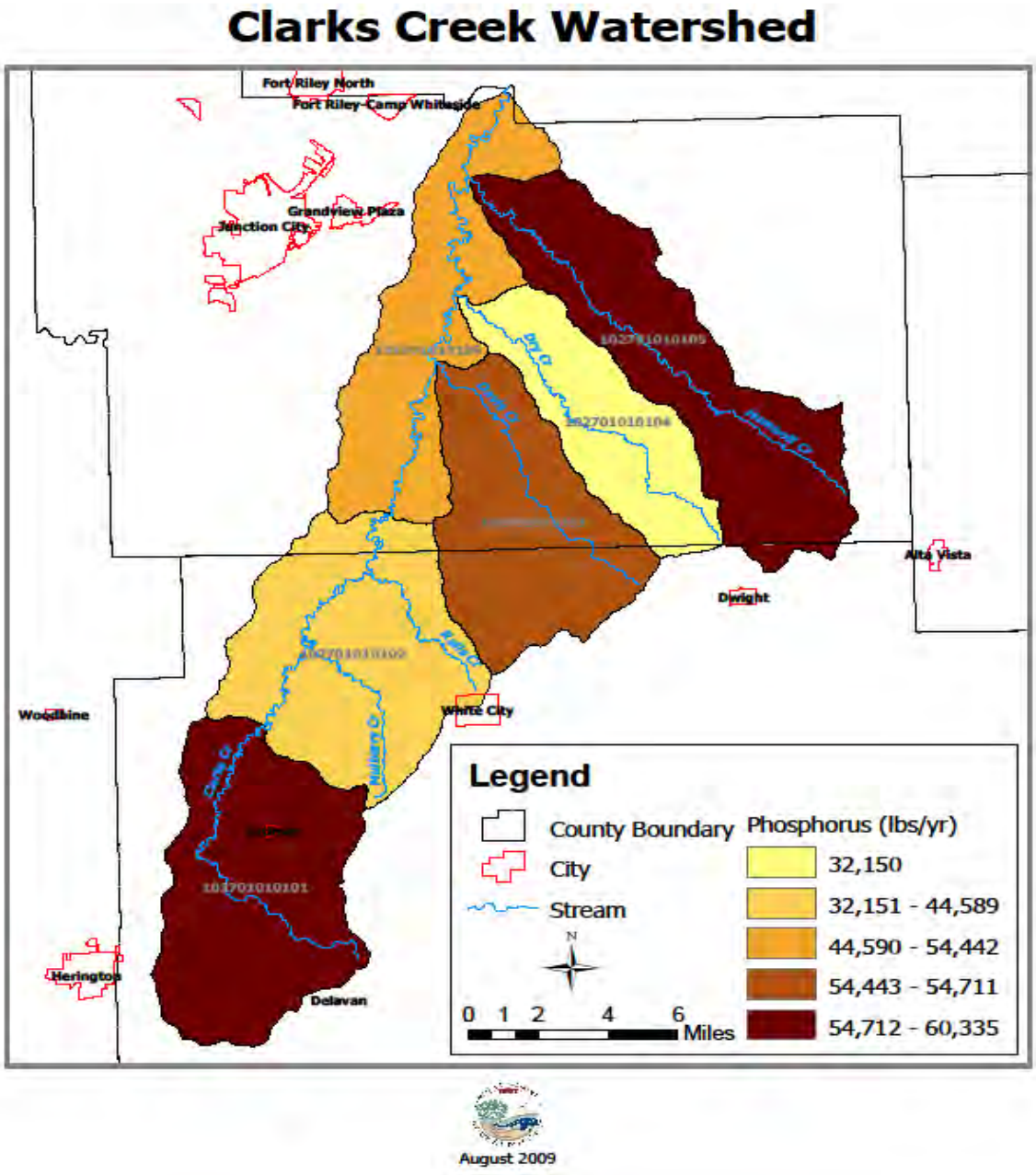
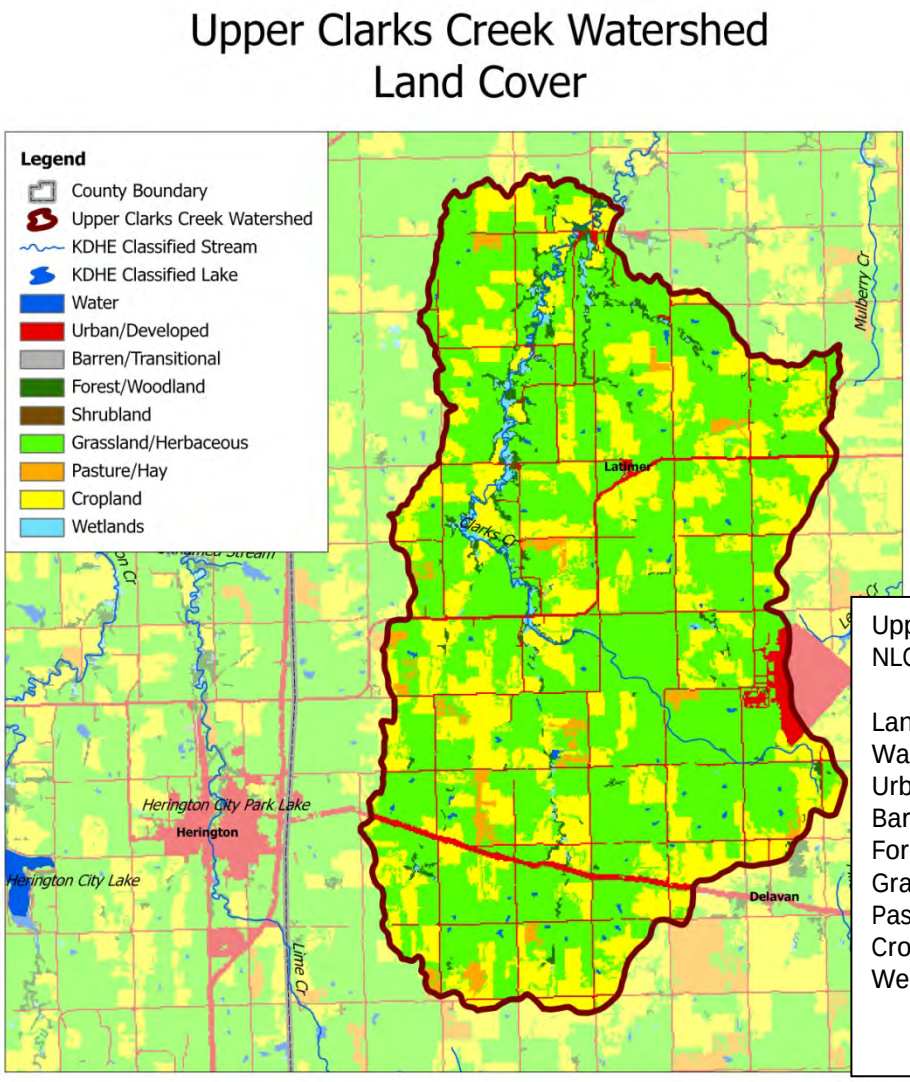


Figure13- STEPL phosphorus model for Clarks Creek

Sub-watershed Targeting

The Clarks Creek Watershed Coordinator and some of the SLT members made trips through the watershed to confirm the accuracy of the data used to compile these models. This ground truthing was then combined with an analysis of the modeling shown in Figures 11, 12 and 13. This scrutiny shows that two sub-watershed have the most potential to contribute sediment and nutrients to the creek. They are the Upper Clarks Creek (HUC 010) and Humboldt Creek (050). These two areas will become the target areas for this project. Projects completed in these two watersheds will have the most potential to make an impact in reducing the amount of pollutants reaching the creek. Project financial and educational resources will be directed toward these sub-watersheds to increase cost-efficiency.

Targeted Sub-Watersheds



Upper Clarks Creek Watershed
NLCD 2001 Land Cover

Land Cover Type	Acres
Water	127.9
Urban/Developed	1629.0
Barren/Transitional	1.6
Forest/Woodland	795.9
Grassland/Herbaceous	18101.5
Pasture/Hay	625.4
Cropland	9008.5
Wetlands	326.0
Total	**30615.9**

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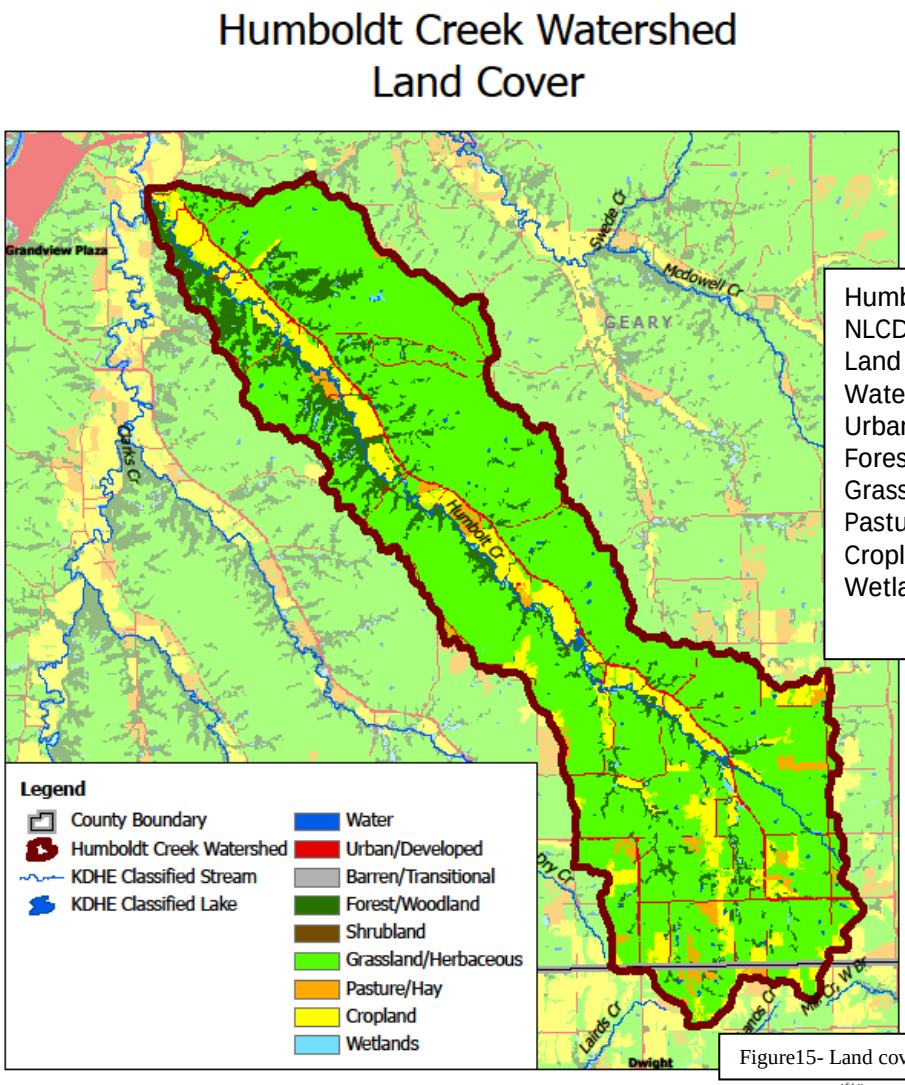
Sept 2010

Figure14- Land cover for Upper Clarks Creek subwatershed

The Upper Clarks Creek sub-watershed (102701010101) is shown in the models in Figures 12 and 13 as having a high potential to contribute nitrogen and phosphorous. This basin contains 30,641 acres which is split nearly in half between crop and livestock production. Land slopes in this area are between 1 and 3% leading to slower run-off and more water and nitrogen infiltration. Cropland fields in this area are spread throughout the basin and do not necessarily lie adjacent to the creek. Riparian areas in this subwatershed are more likely to be native grass with fewer trees than in the lower reaches of the watershed. A majority of the cropland fields are protected by terrace and waterway systems. Maintenance of most of these systems has not kept pace with the prevailing erosion rates and many are in need of reconstruction.

The large beef CAFO and the second largest swine CAFO are located in this headwater basin. Both of these facilities have the potential for ground and surface water contamination with nitrogen and phosphorous as well as bacterial contamination. Both of these facilities have waste management plans and facilities, but both also land apply a portion of the animal waste that is generated at their facilities. If this application is done ahead of a large rainfall event, some of the pollutants could be washed into the surface waters of the basin. Also, if their waste holding facilities were to develop a leak, again contaminants could spill out into surface water sources or leach into ground water aquifers.



Humboldt Creek Watershed NLCD 2001 Land Cover	
Land Cover Type	Acres
Water	115.6
Urban/Developed	1069.7
Forest/Woodland	3286.8
Grassland/Herbaceous	21509.1
Pasture/Hay	754.1
Cropland	3452.4
Wetlands	263.1
	Total 30450.9

Figure15- Land cover map for Humboldt Creek subwatershed

Soil type survey of each sub-basin has been conducted using Natural Resource Conservation Soil Type data. A STEPL model was produced for the Clarks Creek watershed by KDHE. Ground truthing was conducted by the leadership team to further reinforce the results of the modeling. The Humboldt Creek sub-watershed (102702020205) ranks in the highest category for sediment, nitrogen and phosphorous. This basin covers 30,434 acres. The main land uses are grazing land and cropland with the latter being located mainly in the valley along the creek. Humboldt creek flows approximately 19 miles and has an approximately 2 mile area where historically the creek was straightened in several places. High eroding streambanks are the norm in this area. Nearly, 50% of the acres in the area are made up of a combination of Benfield-Florence complex soils with a 5 to 30% slope, Clime silty clay loam with a 20 to 40% slope which is very stony and Clime-Sogn complex with a 3 to 20% slope. These steeper slopes are primarily located in the lower portion of the watershed which is closer to the monitoring station. Most of the

fields have been stabilized with terrace/waterway systems, but some of these are poorly maintained and will not function at peak efficiency. No more than 10% of the fields in this watershed are farmed with a no-till system. Many of these do have field side buffers.

Also within this sub-basin is one of the large swine CAFOs which could potentially contribute nitrogen and phosphorous to the system as described for the CAFOs in the Upper Clarks Creek subwatershed. At the lower end of this drainage increased small homestead development is taking place due to its proximity to Manhattan, Ft. Riley and Junction City. This development will reduce the amount of native grassland that can protect the water quality of the area, increase runoff and has the potential to increase contamination from septic systems.

Ground Water Assessments

A nitrate assessment of ground water wells in the watershed was carried out during the summer of 2008 by a graduate student from the University of Minnesota. Specific locations of high nitrate levels were not obtained, but her results showed that 19% of the water wells that she tested were positive for higher than recommended levels of nitrates in drinking water. A “Test Your Water” project conducted by the SLT during two community events showed a 12% rate of high groundwater nitrate levels. This groundwater contamination is most likely the source of the fairly high stream levels of nitrogen during times of low flow.

THREATS AND OBSTACLES

POLLUTANTS OF CONCERN

Non-Point Source Pollutants

Non-point pollution sources in the watershed are the greatest threat to the stream's improved water quality. The three main contaminants in the watershed are Total Suspended Sediment (TSS), Nutrients mainly nitrogen (N) and phosphorous (P), and bacteria (e-coli). Since the bacteria TMDL has been removed, the WRAPS SLT has chosen to focus their efforts on the reduction of sediment and nutrients. At this point, there are no TMDL and/or 303d listed water bodies in the watershed. This plan is intended to serve as a protection strategy to at least maintain and hopefully to improve the water quality of the surface waters in this watershed.

KDHE has determined Clarks Creek to have a moderate ranking for TSS when compared to other stations in these hydrologic units, a moderately good ranking for *E. coli*, and very poor ranking for total phosphorus and total nitrogen. Clarks Creek experiences its highest pollutant concentrations during the spring season (April-July) some reductions during the summer/fall (August- October), and the lowest concentrations during the winter (November-March). While Clarks Creek does not have an active gauging station, these results are consistent with similar results in other gauged watersheds for areas experiencing runoff and high flow event contamination for sediment, phosphorus and organic nitrogen. Inorganic nitrogen shows no seasonal behavior, with high concentrations occurring throughout the year, suggesting a groundwater input that consistently leaches nitrogen into these streams.

The strong seasonal nature of most of the contaminants suggests that measures targeting soil erosion, including stream bank stabilization, and buffering of streams from cropland will have significant beneficial impacts. Strategies for reducing livestock interaction with streams will likely have positive impacts on the observed bacteria levels. Long-term reductions in dissolved inorganic nitrogen levels may be produced by increased riparian buffering with forest. Once trees develop deep root systems that intercept groundwater flows reductions in inorganic nitrogen loads can be expected. Long-term reductions may occur with increased use of soil testing to ensure that fertilizer application rates do not exceed crop needs. (This information is contained in the KDHE Middle Kansas River Fact Sheet compiled by Eric Banner and is located on the KDHE website.)

	TP Median	TSS Median	Turbidity Median	TOC Median	Kjeldahl Median	*E.Coli* Median	TN Median
Overall	**0.1265 (106)**	**34 (107)**	**13 (107)**	**3.776 (42)**	**0.53 (49)**	**63 (29)**	**1.01 (49)**
Spring	**0.176 (36)**	**62 (37)**	**27 (37)**	**5.688 (15)**	**0.825 (17)**	**231 (9)**	**1.529 (17)**
Summer/Fall	**0.13 (31)**	**35 (31)**	**13 (31)**	**3.105 (13)**	**0.569 (14)**	**68 (10)**	**1.091 (14)**
Winter	**0.074 (39)**	**13 (13)**	**5.85 (39)**	**3.3565 (14)**	**0.3715 (18)**	**<10 (10)**	**0.7105 (18)**

Numbers in parenthesis indicate sample size.

Figure16- Seasonal variations in water quality

The following flow charts demonstrate sources of each of these contaminants and potential BMPs that could address those sources. A chart for bacteria has also been included in this section since many of the BMPs that will reduce sediment, nitrogen or phosphorous also reduce bacterial loads.

The Clarks Creek SLT has selected the most efficient and cost-effective BMPs to fund with cost-share funds received through this project.

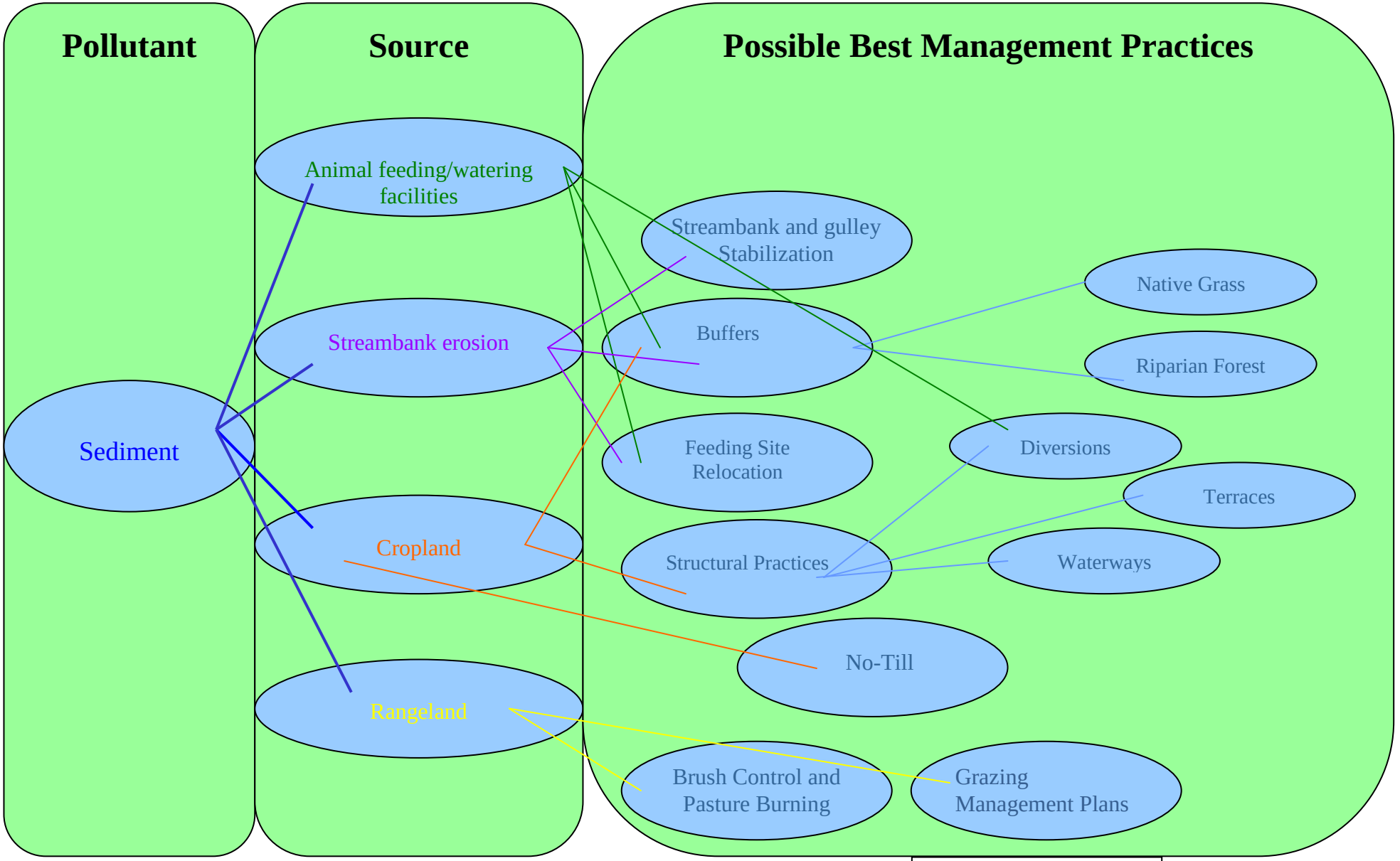


Figure17- Sediment flow chart

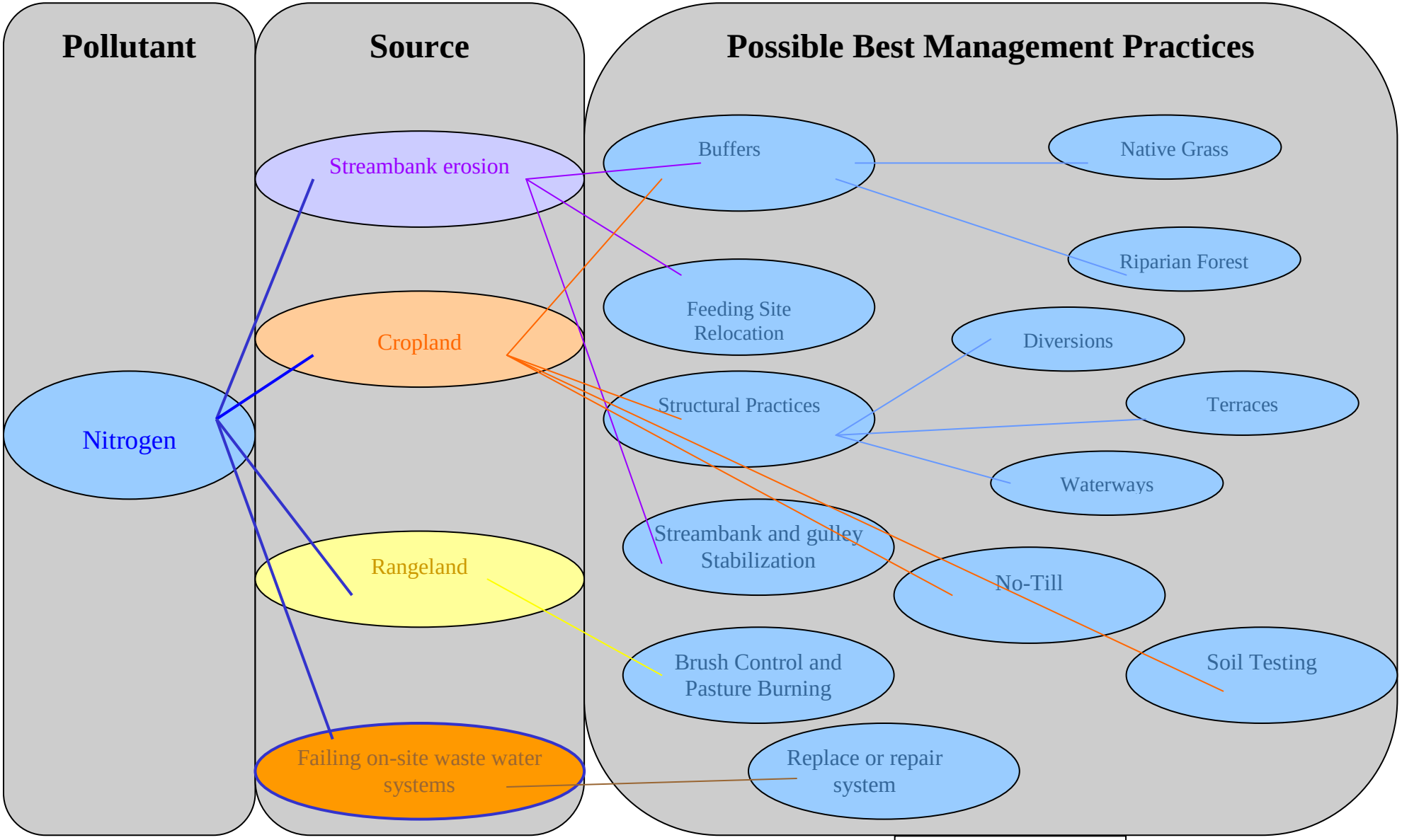


Figure18- Nitrogen flow chart

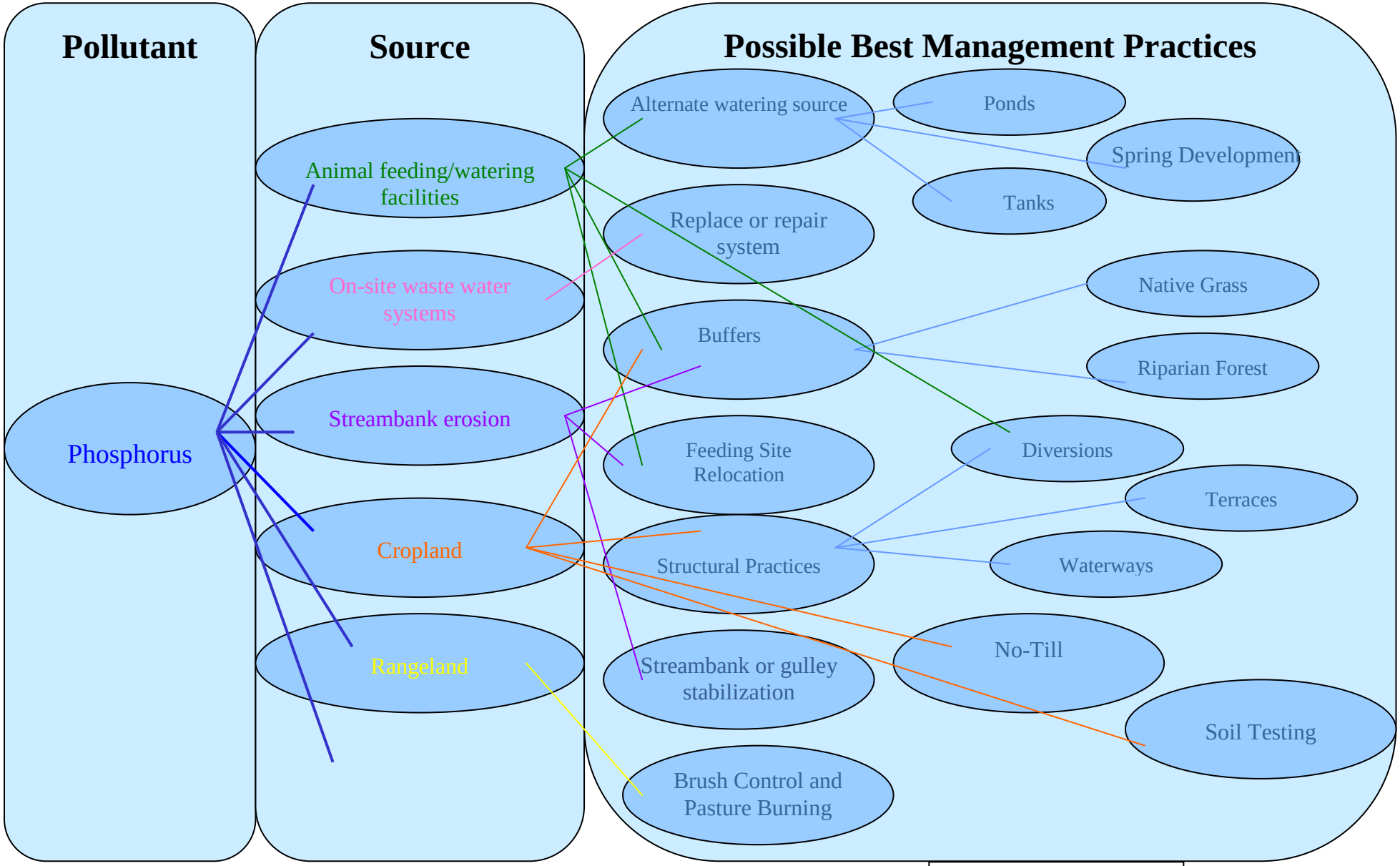
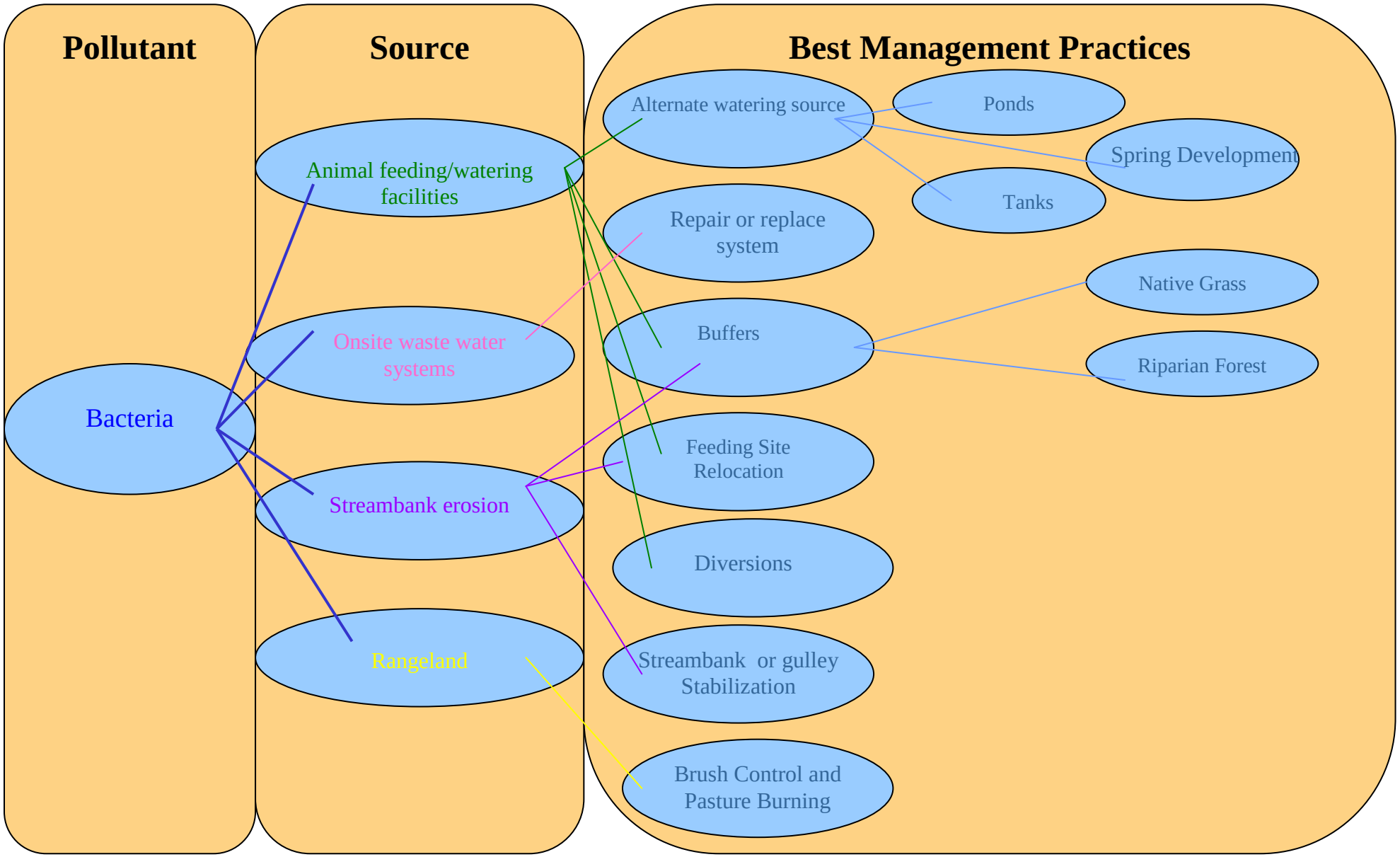


Figure19- Phosphorus flow chart


Pollutant
Source
Best Management Practices
Bacteria
Animal feeding/watering facilities
Onsite waste water systems
Streambank erosion
Rangeland
Alternate watering source
Repair or replace system
Buffers
Feeding Site Relocation
Diversions
Streambank or gulley Stabilization
Brush Control and Pasture Burning
Ponds
Spring Development
Tanks
Native Grass
Riparian Forest

Significant Point Sources of Pollution

Several extensive point source pollution problems have been discovered within the Clarks Creek Watershed. The majority are focused around the headwaters area near the former Herington Army Air Force Base. Since all of the following point sources have caused ground water contamination, they will not be a focus of this Plan. Rather, they are included here for completeness of this document. Since all of these are groundwater contamination sources, they will not be a focus of this Plan. Rather, they are included for completeness of this document.

Raytheon

The Herington airbase was built and used between 1942 and 1945 on 1,728 acres near the headwaters of Clarks Creek. During World War II it served as a staging area for heavy bombers where the planes and crews were paired before being sent to Europe. The Enola Gay, the B29 that would eventually carry the first atomic bomb to Hiroshima, Japan even spent time at the airfield. Once the airfield was decommissioned in 1945 the City of Herington took over site and leased out parts of the area to several private businesses. They kept one runway open and use it as a small municipal airport. This airport was operated by Beech Aircraft (now Raytheon) during the 1950s and 60s.

Figure 21 – Aerial view of the Herington Army Airfield taken in October of 1943.

Groundwater contamination with Trichloroethylene (TCE) was discovered in Latimer in 1989. The contamination source was traced back to the airport where TCE had been used extensively as a degreasing agent for aircraft parts. Subsequent investigation of the site in 1998 and 2001 focused on the former fuel storage area which was identified as the source of approximately 14,000 gallon of high octane aviation fuel that had leaked from a 200,000 gallon above ground storage tank. A groundwater plume of contamination containing benzene, toluene, ethylbenzene, xylenes, total petroleum hydrocarbons, ethylene dibromide and trichloroethene extends approximately 2200' downgradient. The site is being regularly monitored by the US Army Corps of Engineers, and EPA. Raytheon has agreed to address remaining TCE impacts under the Kansas Department of Health and Environment (KDHE) State Cooperative Program. Currently TCE has been detected in the four groundwater aquifers in the area where 92 private wells have been identified. Raytheon is operating a treatment system and all of the houses in the affected vicinity have been connected to the Herington municipal water system.

Latimer Agri-Service

During investigation of this TCE contamination plume, carbon tetrachloride and ethylene dibromide impacts were also detected in the area. The contamination plume was located within the city limits of Latimer and following a comprehensive investigation the contamination source was identified as the former Latimer Agri-Services facility. Long term monitoring status was assigned to the site under the State Water Plan Program in 1998. This site remains an orphan site and was not transferred to another program. In-house treatment systems were installed for the affected homes that were still using private wells for their water source. This seems to be effective in reducing the human impacts of the contamination.

Hodgdon Powder Company

Expanded investigation of the Herington Airport site in 2002 led to the discovery of perchlorate in low levels in monitoring wells. High levels of the chemical were found in stream sediment and water drainage samples from the nearby Hodgdon Powder Co, Pyrodex. Subsequent KDHE investigations showed high levels of perchlorate in soils from abandoned wastewater ponds, in water from the active facility wastewater ponds, in an adjacent livestock pond and in down gradient private wells at low to moderate levels. In September of that year, Hodgdon signed a consent order with KDHE to conduct a remedienal investigation and as a result installed a 1.6 million dollar perchlorate biodegradation treatment system in June of 2003. Groundwater contamination plumes extend up to 5 miles from the facility and at places the plume is 5 miles wide. Home with affected private water wells were connected to rural water in early 2006.

Welch Precious Metals

Welch Precious Metals site was a metal reclaimation operation occurring on a residential/agricultural piece of property located outside of Delevan near the Herington Airbase. Soil contamination with heavy metals and the presence of multiple drums and cans of hydrochloric acid, nitric acid and aqua regia with metal precipitates was discovered in 2007. The property owner entered into KDHE's Voluntary Cleanup and Property Redevelopment Program and work was conducted at the site on July 28 and 29 of 2008. Following the clean-up, soil samples still showed significant contamination with lead and mercury. Clean-up efforts at this site are on-going under the direction of KDHE.

The groundwater and surface water contamination caused by each of the significant point sources discussed before is a significant threat to the health and well being of the residents of the Clarks Creek Watershed. In addition to the health concerns from contaminated water, economic concerns also come into play. Impacted land and home values could become a factor in the area if the remediation efforts do not help to eradicate the toxins. Perchlorate's affects on livestock and crop production was briefly studied in 2003 with the help of research experts from Texas Tech University. Cattle blood sera data showed no evidence of toxic effects. However, samples collected from a home garden in the most contaminated plume area indicated very high toxin concentrations. The concentrations were high enough to recommend limiting or even eliminating consumption of produce grown with this contaminated water.

Most of the homes in the area have drinking water systems that have been connected to the Herington municipal water system that draws its water from the Herington City Lake, a surface water supply. Blue-green algae blooms occur in this lake one to two times per summer making this water non-potable for the customers of the supplier. At times, this leaves residents in this part of the watershed with no viable drinking water source for their homes.

Since these contamination sources are being dealt with by agencies like the Environmental Protection Agency (EPA), US Army Corps of Engineers (COE), KDHE and the companies/ individuals responsible for the pollution, the WRAPS will not include them as part of their planning process. However, the WRAPS will stay apprised of the ongoing groundwater monitoring and clean-up efforts and will help to keep the watershed residents informed of any changes in the status of these toxins. Recently, the city of Herington has had a source water protection assessment completed and a plan written by the Kansas Rural Water Association to try and reduce the incidents of blue-green algae blooms that affect their customers.

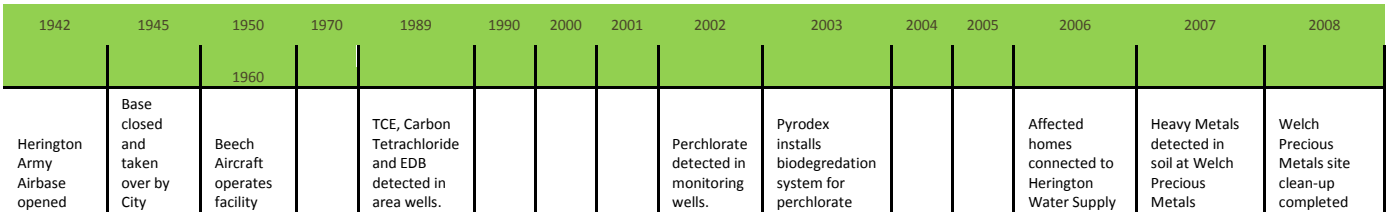
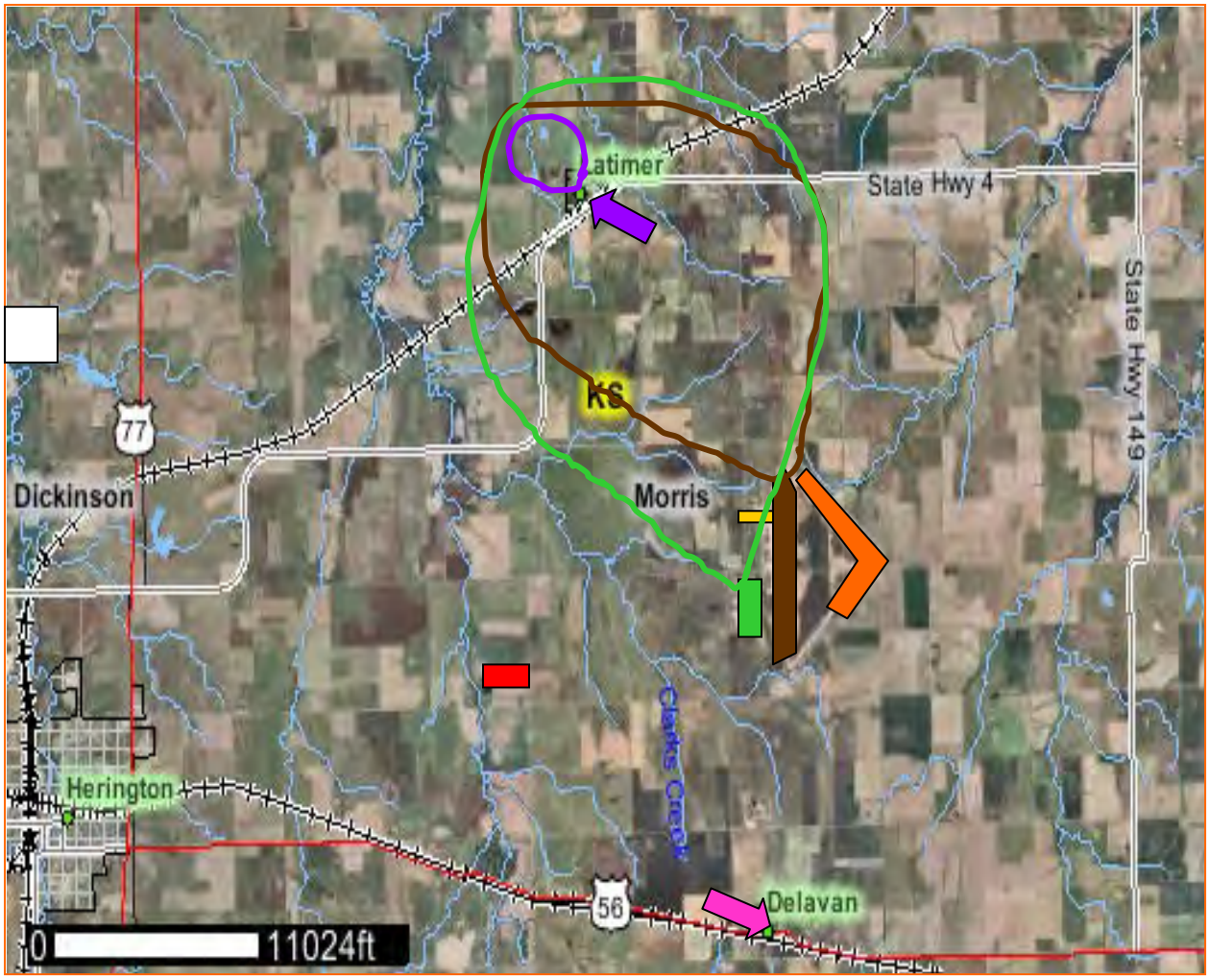


Figure22- Timeline for point source pollution in Clarks Creek



LEGEND

- Tiffany Cattle Company
- U.S. Stone Industries
- Prairie Haven Pork, LLC
- Hodgdon Powder Company (Pyrodex)
- Herington Regional Airport - Raytheon
- Welch Precious Metals
- Latimer Agri-Service
- Contamination plume from Latimer Agri-Service
- Contamination plume from Hodgdon Powder Company
- Contamination plume from Herington Regional Airport

Figure 23– Point source pollutant sources and contamination plumes

Sludge Application Site

Figure24- Aerial map of sludge application area

In HUC102701010106, the lower mainstem of Clarks Creek, NutriJect ground applies wastewater and sludge from the Junction City wastewater plant. Regular complaints are taken from neighbors dealing with odor and trash issues from this application. At the request of the local landowners, KDHE and the local county sanitarian have made site inspections. Additionally, they met with the landowner, company representative, and one of the Clarks Creek WRAPS stakeholder leadership team member who has a nearby drinking water well. Since the applicator is working within his permit, no regulatory action was taken. All parties agreed to stake out a 100' buffer around the well head where no application will occur. The WRAPS group will continue to monitor this situation.

National Pollutant Discharge Elimination System Sites

Within the Clarks Creek Watershed there are three permitted National Pollutant Discharge Elimination Systems (NPDES) industrial permitted facilities; Hamm – Mosier quarry #99, Hodgdon Powder Company, Inc., and U.S. Stone Industries. None of these facilities have discharged, by design or otherwise, to the watershed.

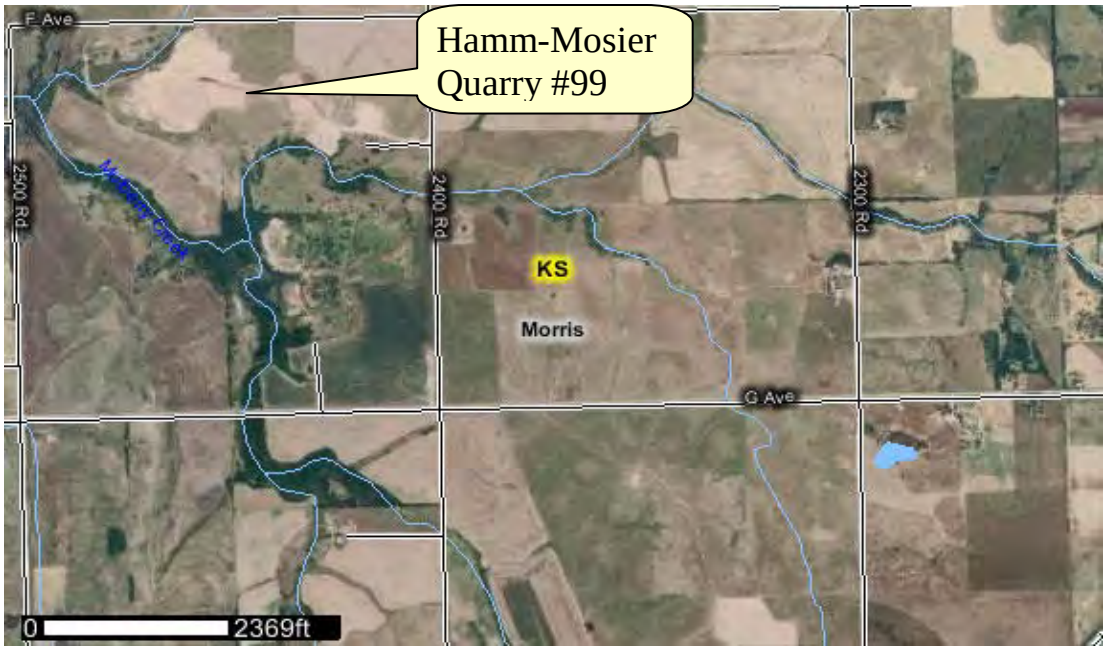


Figure 25 – Locations of NPDES Systems.

Confined Animal Feeding Operations

The watershed, however, does contain fifteen permitted Confined Animal Feeding Operations (CAFOs). Of these fifteen permitted CAFOs, only 8 are still in operation, (one dairy, two swine, one combined and four cattle). Animal units that are permitted in these operations total 17,775 on the grounds of the old Herington Airfield. This site regularly holds 10,000 head of cattle

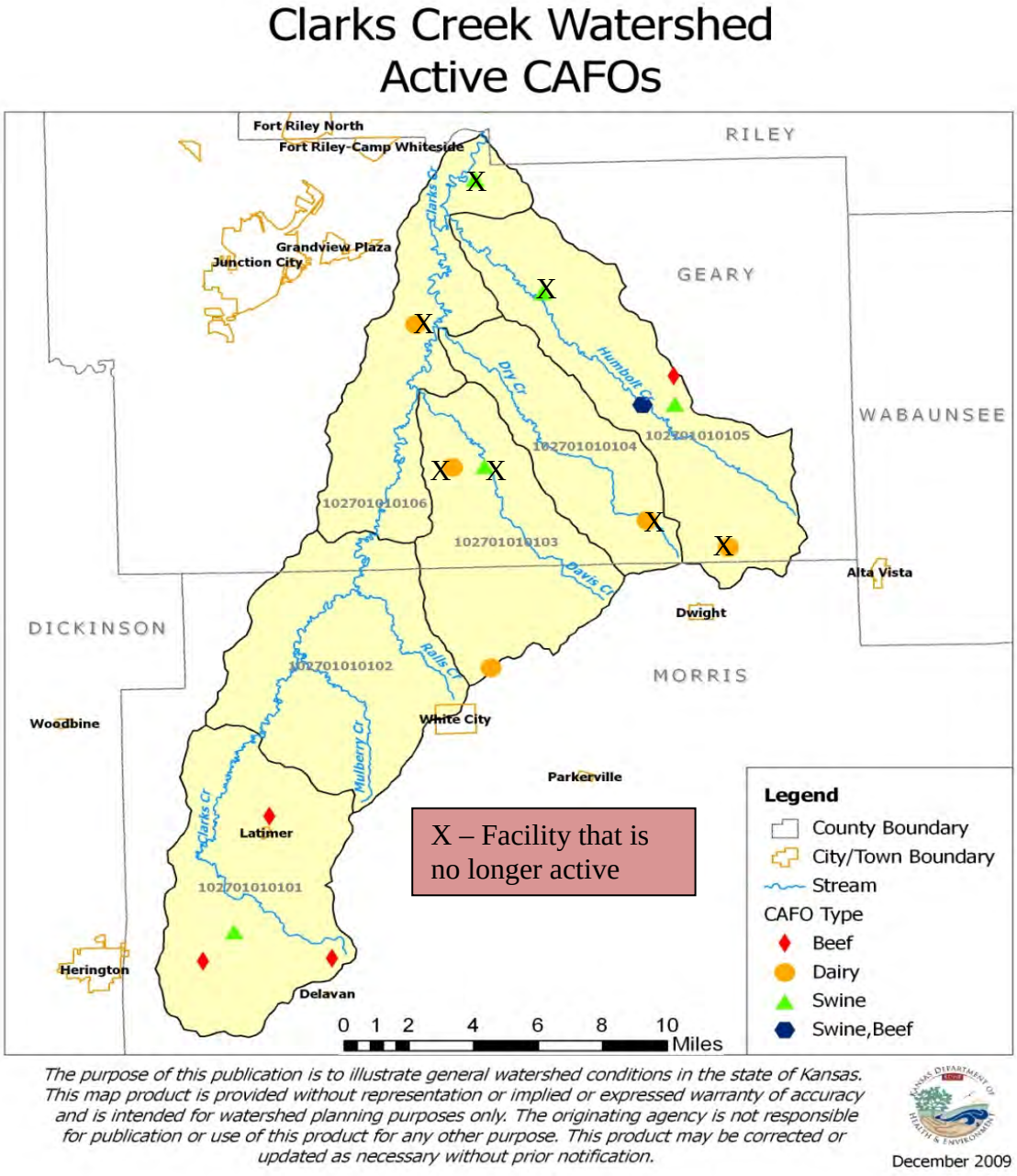
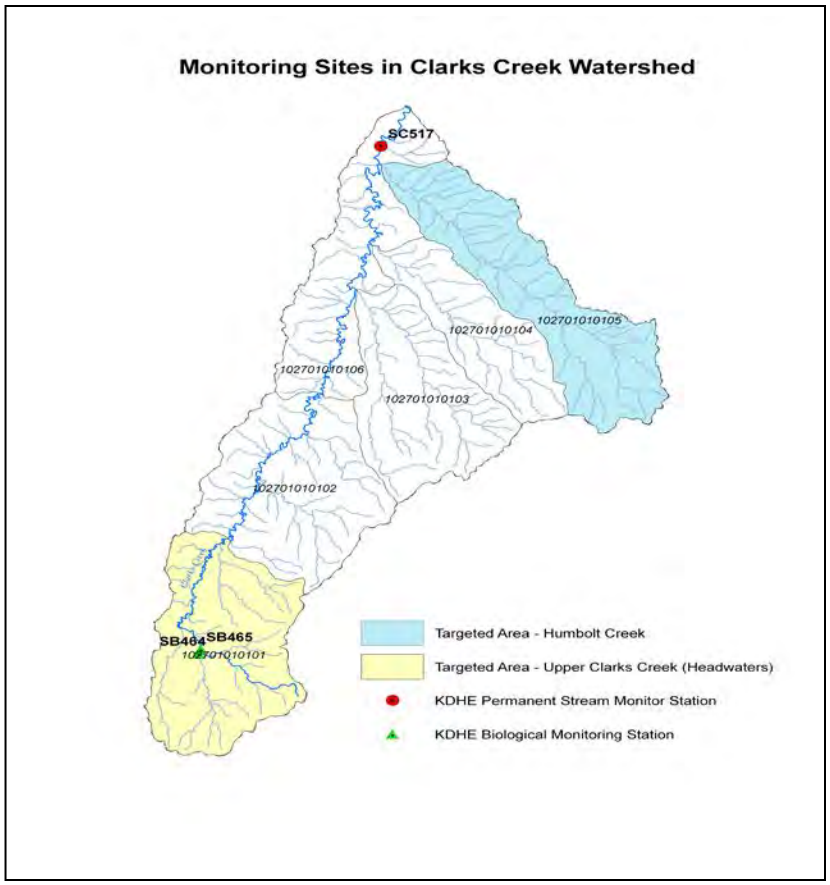


Figure 26- Permitted CAFOs in Clarks Creek watershed

Permitted facilities must adhere to the guidelines for animal numbers and waste management set forth in their permits, however, pollutant contributions to the watershed can still be made to the area. Most notable of these livestock based contaminants are e.coli bacteria, nitrates, phosphorous Groundwater as well as surface water resources can be impacted through these facilities.

Water Quality Monitoring

Regular monitoring of the watershed is done at KDHE monitoring station SC517 which is near the mouth of the creek where it empties into the Kansas River. Data collected from this station between 1990 and 1999 was used to develop the TMDL for fecal coliform bacteria. This TMDL was approved and adopted in January of 2000. Monitoring continued each year over the next ten years. The surface water was evaluated again in 2009. The result of the analysis was that Clarks Creek was found to be attaining bacterial water quality standards in April of 2010. The Kansas Lower Republican River Basin, which includes Clarks Creek, is again scheduled for TMDL development in 2015 and 2020. Current data from the monitoring is included in Table 12.



The map indicates that there is one permanent KDHE monitoring stations within the watershed. The site is sampled for nutrients, *E. Coli* bacteria, chemicals, turbidity, alkalinity, dissolved oxygen, pH, ammonia and metals. The pollutant indicators tested for at each site may vary depending on the season at collection time and other factors.

Evaluation of Monitoring Data

Monitoring data in the Clarks Creek watershed will be used to determine whether the water quality standards continue to be met, and to determine the effectiveness of the BMP implementation outlined in the plan. As previously stated, since this is a protection plan, KDHE and the SLT will review the monitoring data in 2017 in order to determine the effectiveness of the protection measures implemented by the WRAPS plan. At that time, KDHE and the SLT can consider any necessary modifications or revisions to the plan based on the data analysis, as well as any other water quality indicators observed by KDHE and/or the SLT.

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

Water Quality Milestones to Determine Improvements

The goal of the Clarks Creek WRAPS plan is to protect water quality for uses supportive of aquatic life and recreation for Clarks Creek. In order to reach the load reduction goals associated with the Clarks Creek plan, a BMP implementation schedule spanning 10 years has been developed.

The selected BMPs included in the plan will be implemented throughout the targeted areas within the Clarks Creek watershed, including the Humboldt Creek (102701010105), Headwaters (102701010101), since these are the major tributaries in the Clarks Creek watershed. While there are no 303 (d) listed water quality impairments in the Clarks Creek watershed BMP implementation will focus on maintaining water quality within the watershed and improve water quality leading into the Kansas River.

Since this is a protection plan, short term water quality milestones and indicators have been developed in order to track maintenance of water quality standards. It is recommended that after five years of plan implementation, the water quality data collected be analyzed by KDHE to determine whether the water quality standards have been maintained. At that time, KDHE and the SLT can make any necessary adjustments to the milestones and/or BMP implementation schedules.

Water Quality Milestones for Clarks Creek

As previously stated, in order to reach the load reduction goals for Clarks Creek, a BMP implementation schedule spanning 10 years has been developed. Several water quality milestones and indicators have been developed for Clarks Creek, as included herein, to determine the effectiveness of the BMPs implemented as part of the load reduction goals outlined in the plan.

Water Quality Milestones for Clarks Creek - TSS, TN, TP & Bacteria						
	Current Condition (2000 - 2011)* TSS (Med)	Improved Condition (2012 - 2016) TSS (Med)	Current Condition (2000 - 2011)* TP (Med)	Improved Condition (2012 - 2016) TP (Med)	Current Condition (2000 - 2011)* TN (Med)	Improved Condition (2012 - 2016) TN (Med)
Sampling Sites	**Total Suspended Solids (TSS) (median of data collected during indicated period) mg/l**		**Total Phosphorus (TP) (median of data collected during indicated period) ppb**		**Total Nitrogen (TN) (median of data collected during indicated period), mg/l**	
Clarks Creek SC 517	30	**Maintain Median TSS ≤ 30**	124	**Maintain Median TP ≤ 124**	1	**Maintain Median TN ≤ 1**
	Current Condition (2000 - 2011)* E-coli (CFU/100ml)	**Improved Condition (2012 - 2016) E-coli (CFU/100ml)**				
Sampling Sites	**E-coli (geomean of data collected during indicated period) CFU/100ml**					
Clarks Creek SC 517	70 (overall) 140 (Apr.-Oct.)	**Maintain mean of 70 (overall) 140 (Apr.-Oct.)**				

*The period of record for SC517 includes data from 2000 - 2011

Water Quality Milestones for Bacteria

For Clarks Creek since the creek is a Primary Contact Recreation Class C in April-October (435 colonies per 100ml) at sampling stations SC517. Currently the water quality sample show during the months of April-October 140 colonies per 100ml. The Clarks Creek bacteria milestone is to maintain or improve that level of bacteria.

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.

Monitoring Water Quality Progress

KDHE continues to monitor water quality in the Clarks Creek watershed by maintaining the monitoring stations located within the watershed. The map below indicates the locations of the monitoring sites located within the Clarks Creek watershed, as well as the BMP targeted areas that have been identified and discussed in previous sections of this plan.

ROUTE TO THE DESTINATION

TMDL INFORMATION

Derived from the Clarks Creek Load Reduction Targets for total Suspended Solids, total Nitrogen and total Phosphorous at KDHE Sampling Station SC517 Prepared by Trevor Flynn TMDL Section, KDHE

Daily flow values from Mill Creek at Paxico (USGS Gage 06888500) were utilized to estimate the percent of flow exceedance for each sample along Clarks Creek. Median concentrations for total suspended solids (TSS), total phosphorous (TP), and total nitrogen (TN) were established based on the flow condition. The assigned flow condition established a range to account for possible differences between the actual daily flows in Clarks Creek and the assigned % of flow exceedance values derived from the Mill Creek gage data. The USGS published calculated flow values for the 10th, 25th, 50th, 75th, and 90th % estimated flow duration values were expanded by assigning a flow condition range so all samples were accounted for so a current load for each flow condition could be established based on the median value for the specified flow condition. The following Tables and Figures detail the estimated current loads and the targeted desired loads for Clarks Creek at KDHE stream sampling station SC517 for the described five flow conditions.

Clarks Creek Flow Regime (Perry, 2004)

% of Flow Exceedance	Assigned Flow Condition	USGS Calculated Flow (cfs)
10	Wet (0-15%)	189
25	High (16-39%)	62.2
50	Normal (40-60%)	18.7
75	Low (61-84%)	4.29
90	Dry (85-100%)	0.36

Figure 27- Flow data for Clarks Creek

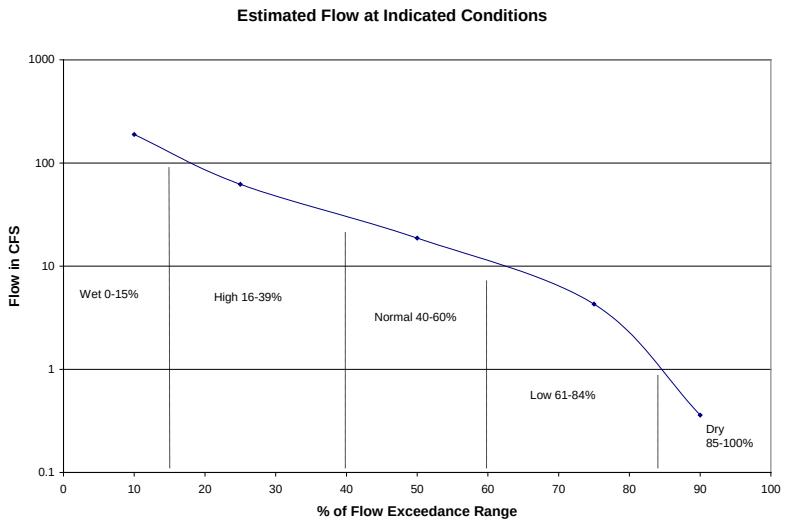


Figure 28- Estimated flow data

Total Suspended Solids (TSS) Targeted Load for Clarks Creek based on a desired TSS concentration of 45 mg/L.

Flow Condition	TSS Median Conc. (mg/L)	Current Load (lb/day)	Targeted Desired Load (lbs/day)	% Reduction Needed to meet Target
Wet (0-15%)	58	59195	45927	22.4%
High (16-39%)	43	14443	15115	0%
Normal (40-60%)	39.5	3989	4544	0%
Low (61-84%)	15	347	1043	0%
Dry (85-100%)	29.5	57	87	0%

Figure 29- Sediment target loads for Clarks Creek

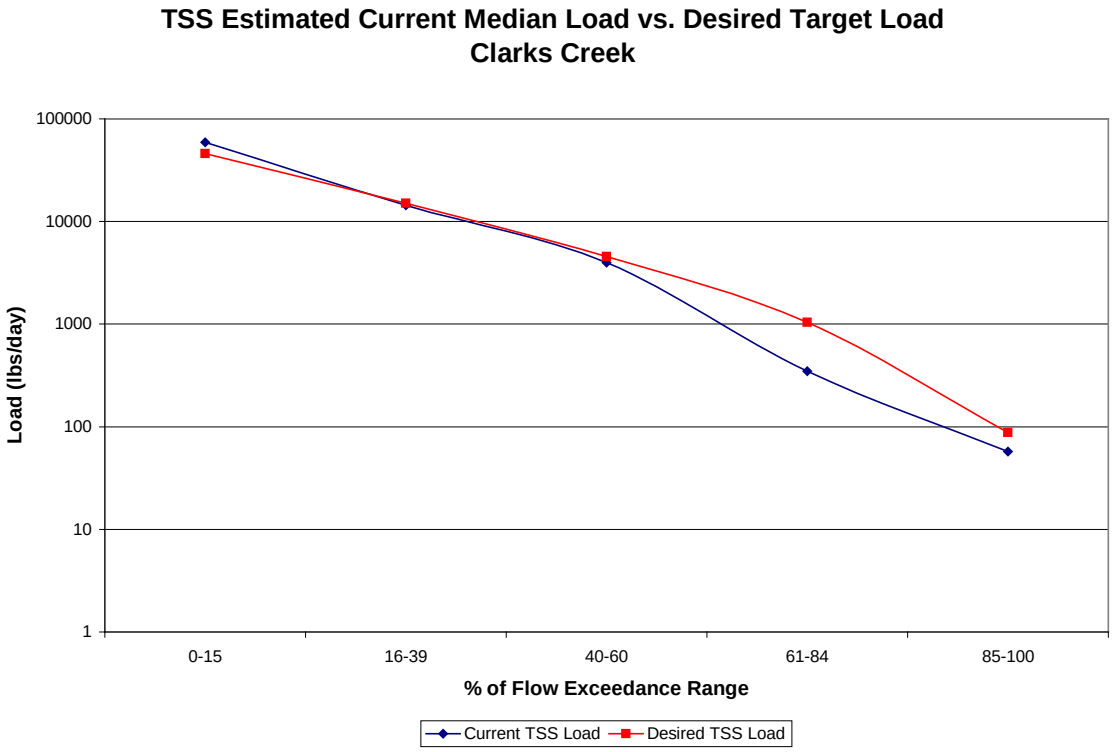


Figure 30- Sediment load target

Total Phosphorus (TP) Targeted Load for Clarks Creek based on a desired TP concentration of 0.090 mg/L.

Flow Condition	TP Median Conc. (mg/L)	Current Load (lb/day)	Targeted Desired Load (lbs/day)	% Reduction Needed to meet Target
Wet (0-15%)	0.14	143	91.9	36%
High (16-39%)	0.12	40.3	30.2	25%
Normal (40-60%)	0.122	12.3	9.08	26%
Low (61-84%)	0.1	2.3	2.08	10%
Dry (85-100%)	0.132	0.26	0.17	32%

Figure 31- Total Phosphorus target load for Clarks Creek

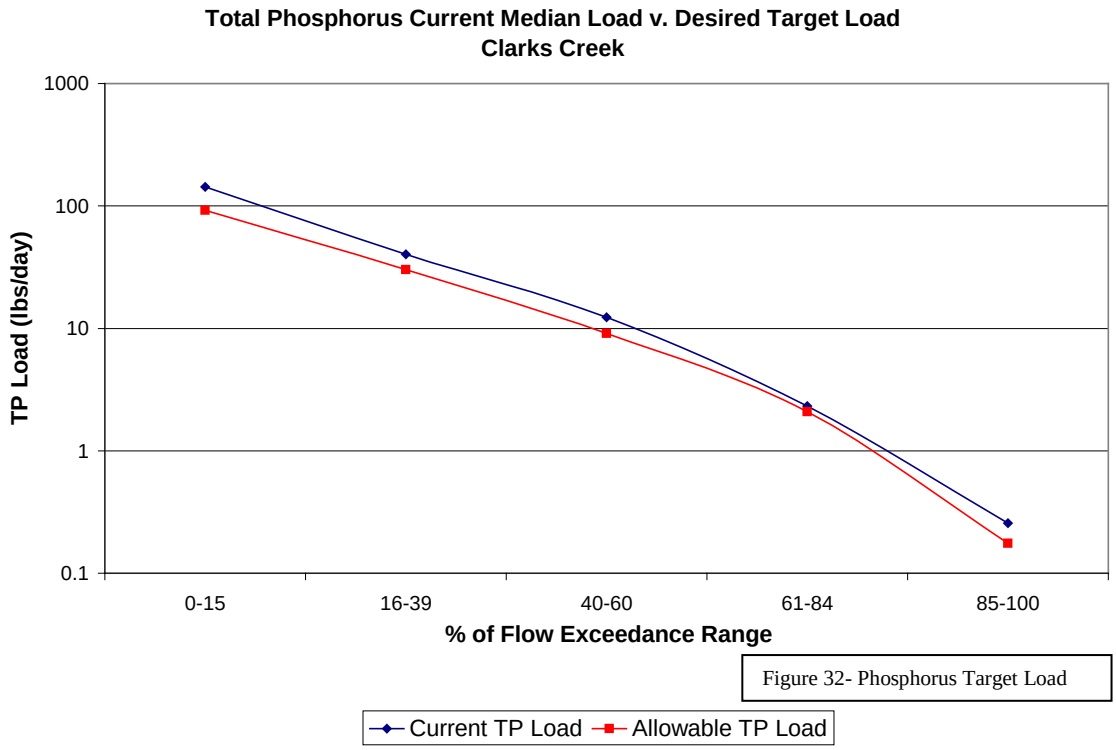


Figure 32- Phosphorus Target Load

Total Nitrogen (TN) Targeted Load for Clarks Creek based on a desired TN concentration of 0.90 mg/L

Flow Condition	TN Median. Conc. (mg/L)	Current Load (lb/day)	Targeted Desired Load (lbs/day)	% Reduction Needed to meet Target
Wet (0-15%)	1.02	1041	918.5	11.8%
High (16-39%)	1.04	349	302	13.5%
Normal (40-60%	0.81	82	91	0%
Low (61-84%)	0.8	18.5	21	0%
Dry (85-100%)	1.61	3.1	1.75	44%

Figure 33- Total Nitrogen Target Load

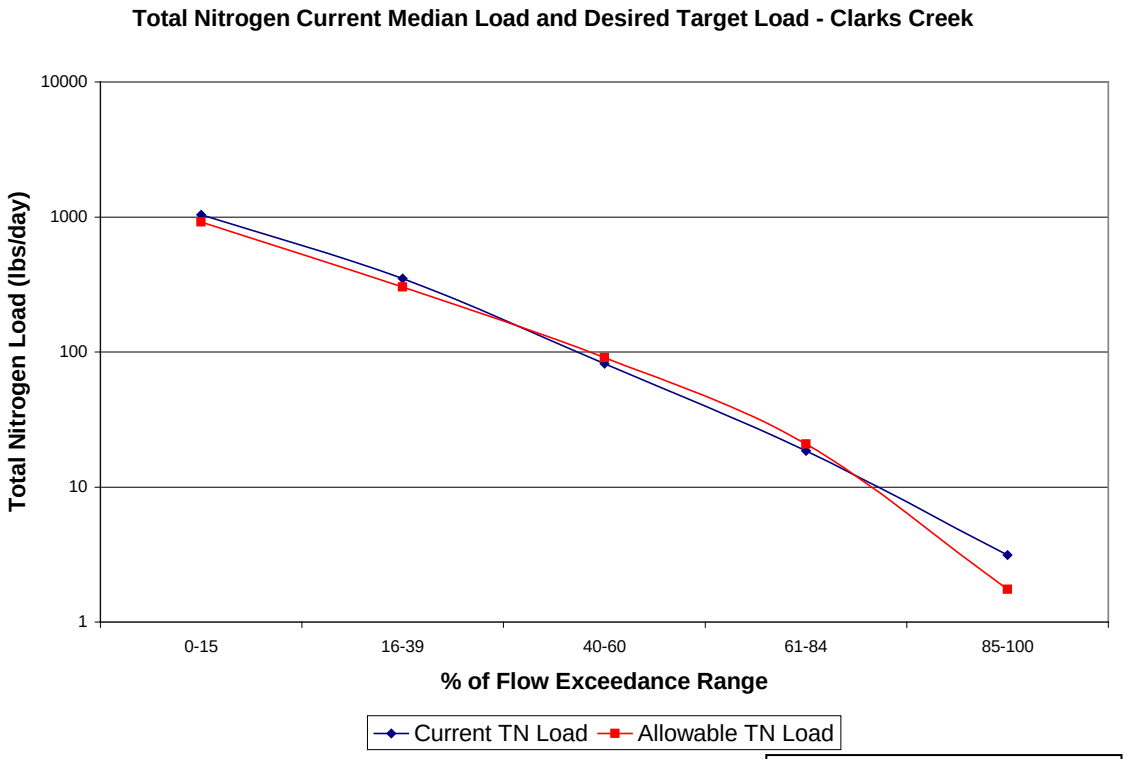


Figure 34- Nitrogen Target Load

The contribution of the TSS, TP, and TN loads derived from Clarks Creek account for less than 0.75% of the total loads in the Kansas River at the KDHE sampling station along the Kansas River near Wamego (SC260) when flow conditions are similar. Loads along the Kansas River at Ogden and Wamego were calculated to determine the contribution of the total downstream load that is associated with Clarks Creek. KDHE sampling station SC518 along the Kansas River near Ogden lies upstream of the confluence with Clarks Creek and therefore represents conditions prior to Clarks Creek's loadings. The following figures and tables detail the loads in the Kansas River at Ogden and Wamego and how the loads originating from Clarks Creek impact the Kansas River. The table's scenario 1 estimates the load from Clarks Creek if an isolated runoff (wet conditions) event occurred while conditions were normal in the Kansas River, which indicates that the loads from Clarks Creek contributes 4-7% of the load reaching Wamego. Scenerio 2 estimates the load from Clarks Creek during isolated high flow conditions when the Kansas River is in the dry flow condition, which results in Clarks Creek accounting for 4-15% of the load reaching Wamego.

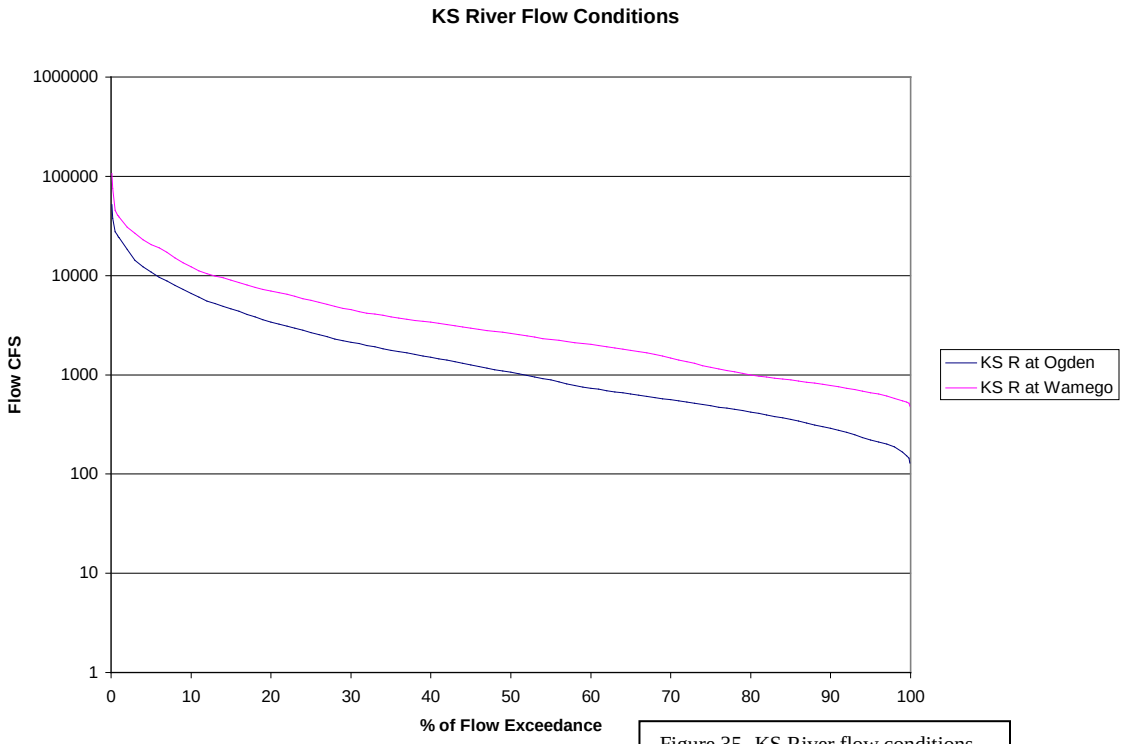


Figure 35- KS River flow conditions

Clarks Creek TSS load contribution to loads along the Kansas River at Wamego.

Flow Condition	Clarks Cr TSS Load lbs/day	Kansas River at Wamego TSS Load lbs/day	% of Load at KS River Wamego from Clarks Creek
Wet	59195	11822760	0.50 %
High	14443	3374622	0.43%
Normal	3989	831546	0.48%
Low	348	340578	0.10%
Dry	57	96752	0.06%
Scenerio 1: Clarks Cr Wet, KS R Wamego Normal	59195	831546	7.12%
Scenerio 2: Clarks Cr High, KS R Wamego Dry	14443	96752	14.93%

Figure 36- Clarks Creek sediment contribution to the Kansas River

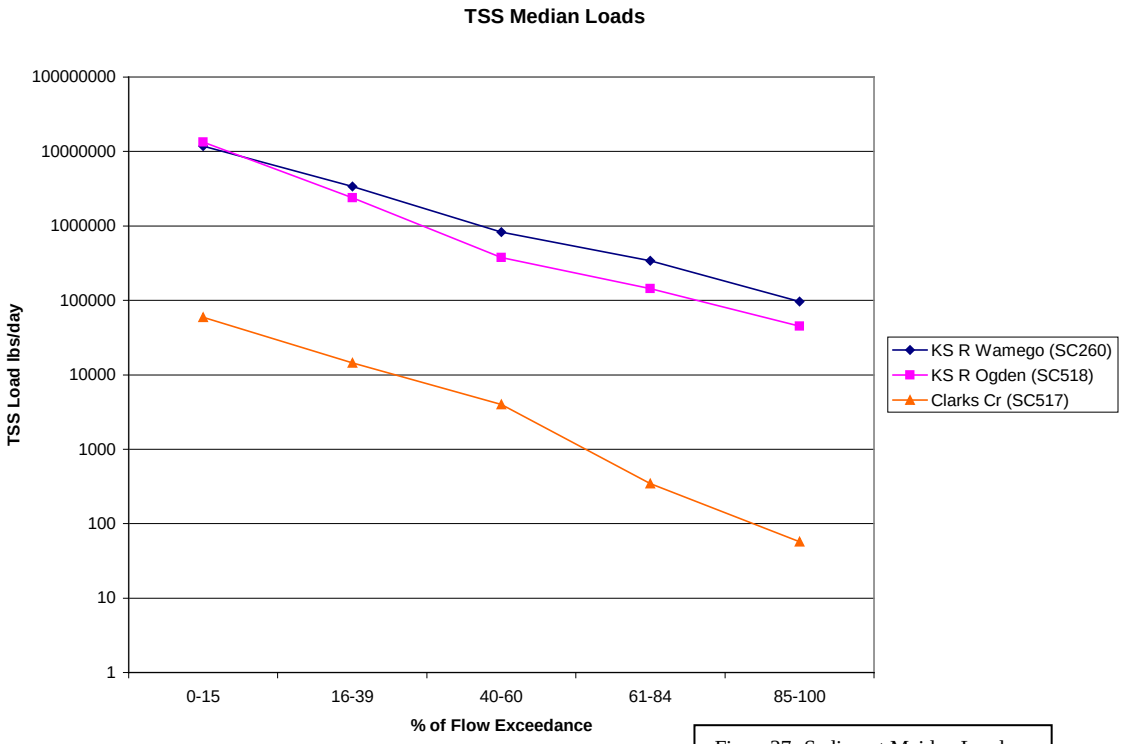


Figure37- Sediment Meidan Loads

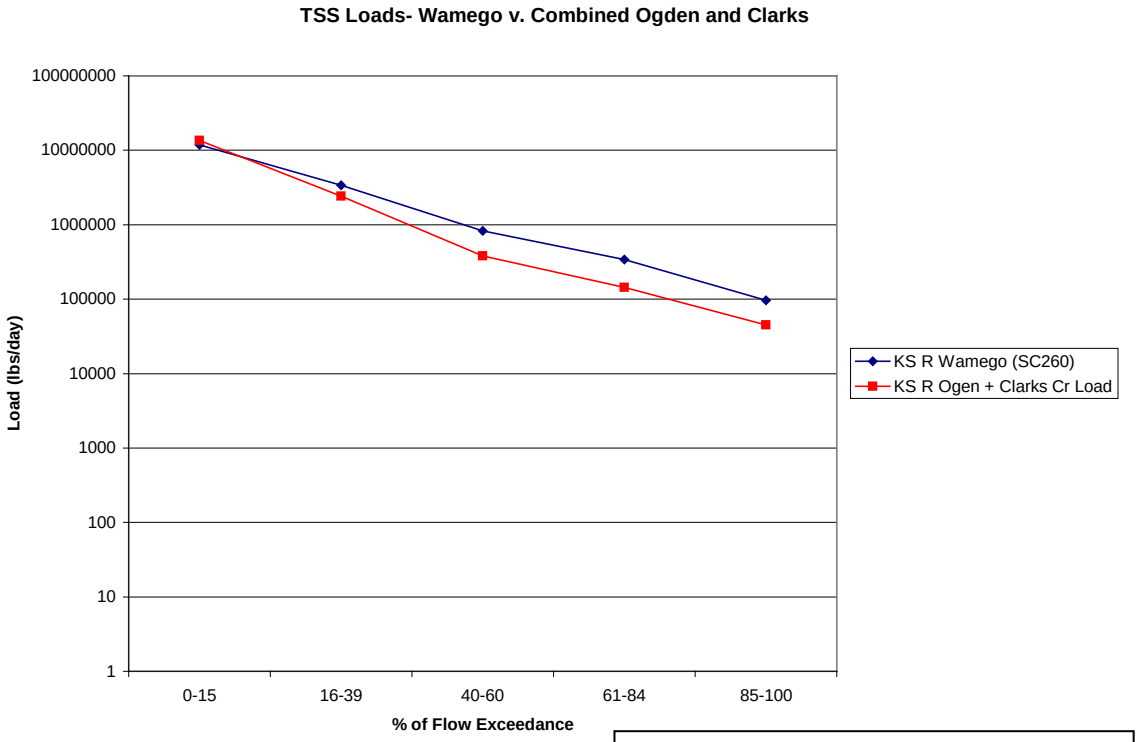


Figure 38- Sediment loads in the Kansas River at Wamego vs. near mouth of Clarks Creek

Clarks Creek TP load contribution to loads along the Kansas River at Wamego

Flow Condition	Clarks Cr TP Load lbs/day	Kansas River at Wamego TP Load lbs/day	% of Load at KS River Wamego from Clarks Creek
Wet	143	29291	0.48%
High	40.3	9121	0.44%
Normal	12.3	3594	0.34%
Low	2.3	1600	0.14%
Dry	0.26	961	0.03%
Scenerio 1: Clarks Wet, KS R Wamego Normal	143	3594	3.98%
Scenerio 2: Clarks High, KS R Wamego Low	40.3	961	4.19%

Figure 39- Clarks Creek phosphorus contribution to Kansas River

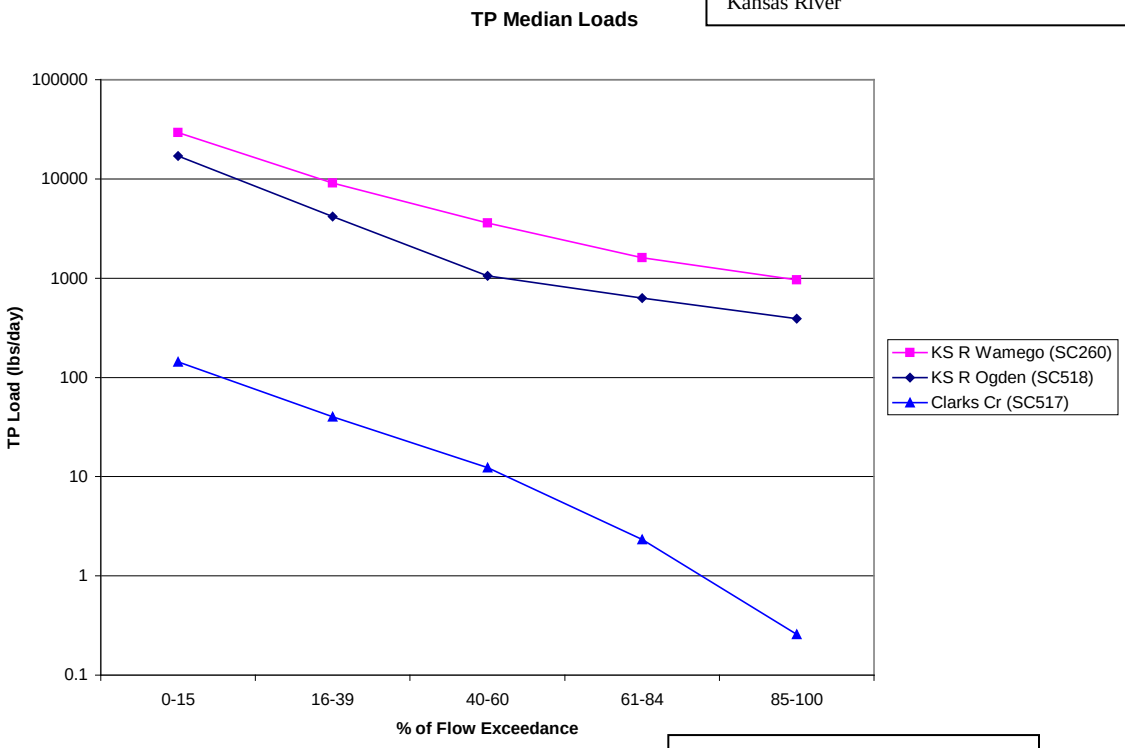


Figure 40- Phosphorus median loads

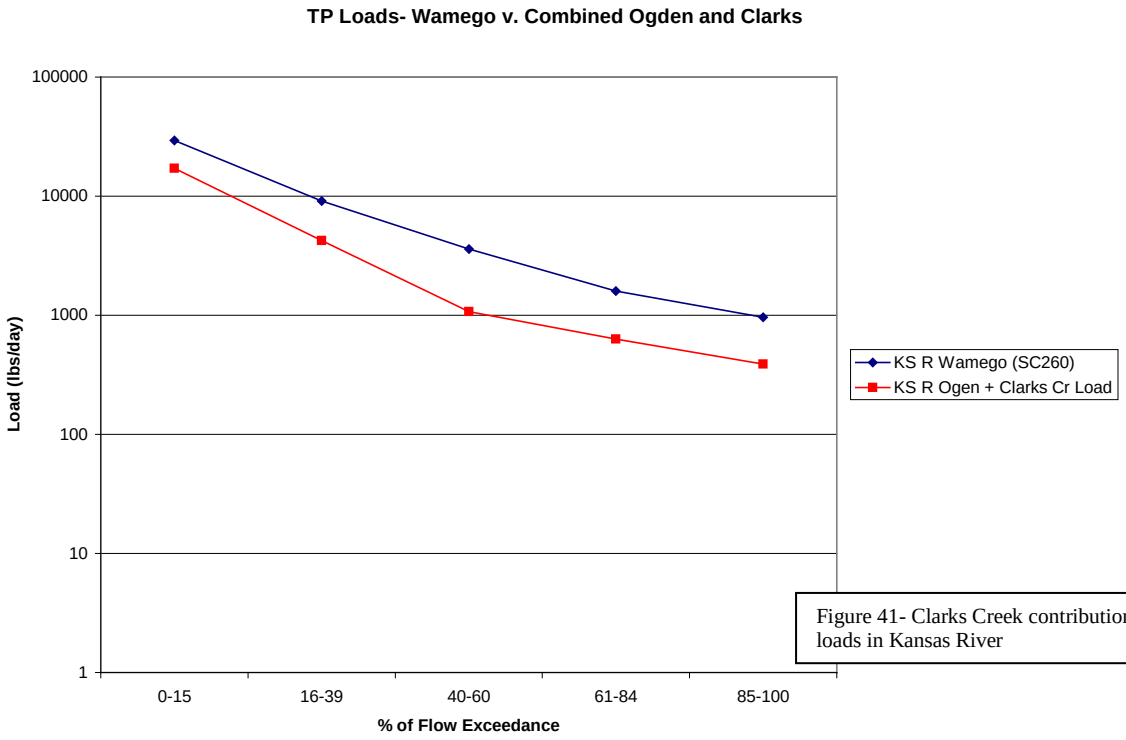


Figure 41- Clarks Creek contribution to phosphorus loads in Kansas River

Clarks Creek TN load contribution to loads along the Kansas River at Wamego

Flow Condition	Clarks Cr TN Load lbs/day	Kansas River at TN Wamego Load lbs/day	% of Load at KS River Wamego from Clarks Creek
Wet	1041	186241	0.56%
High	349	61655	0.57%
Normal	82	25397	0.32%
Low	18	11027	0.17%
Dry	3.1	5771	0.05%
Scenerio 1 Clarks Wet/ KS R Wamego Normal	1041	25397	4.10%
Scenerio 2: Clarks High, KS R Wamego Dry	349	5771	6.05%

Figure 42- Clarks Creek contribution to phosphorus loads in Kansas River

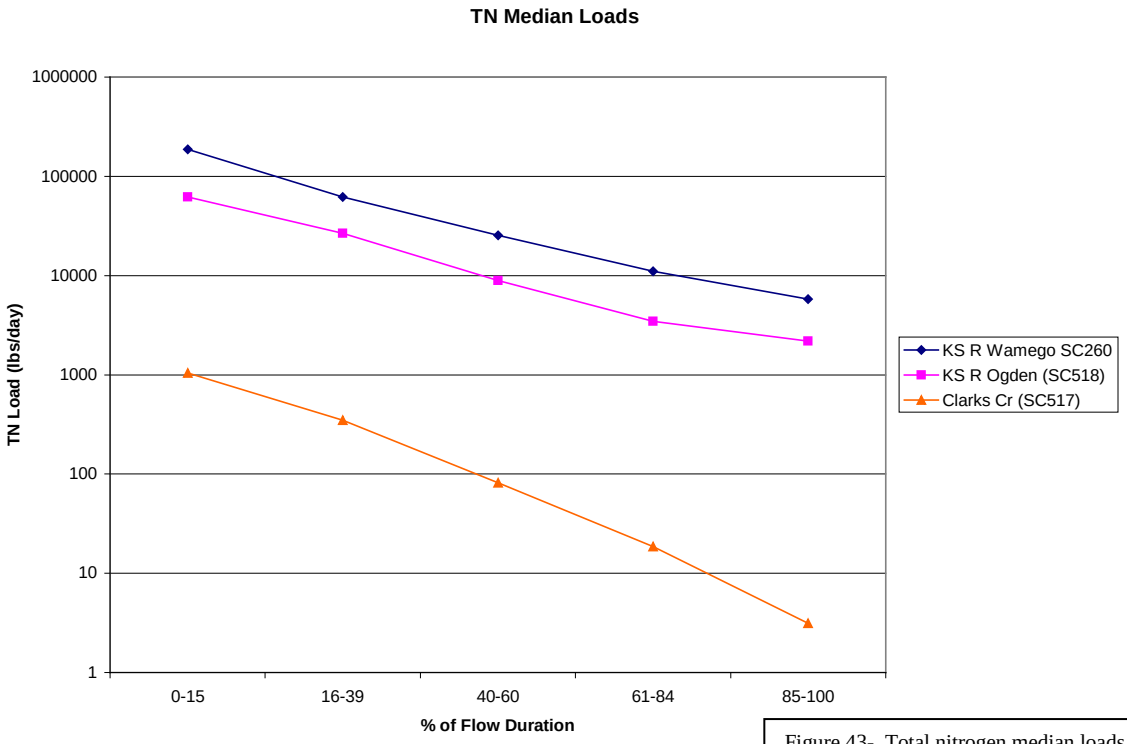


Figure 43- Total nitrogen median loads in Clarks Creek

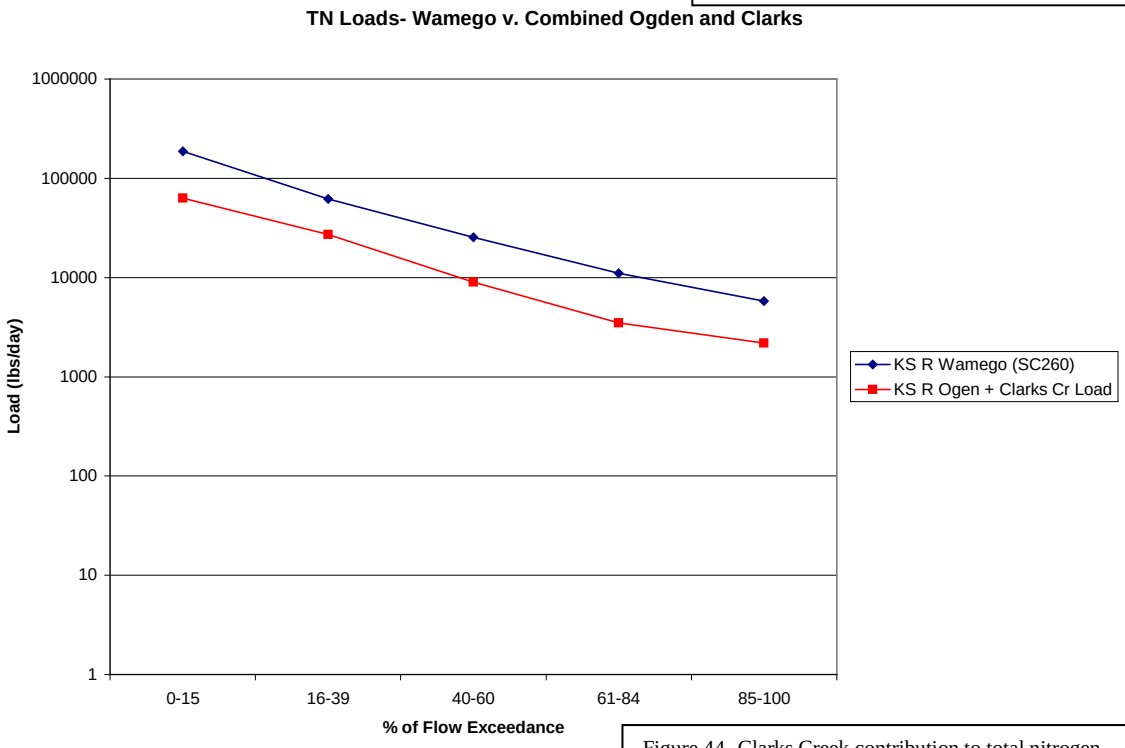


Figure 44- Clarks Creek contribution to total nitrogen loads in Kansas River

The table below provides estimated incremental loadings between Ogden and Wamego during average flow conditions utilizing average total phosphorus concentrations (where available). The load reaching Wamego that is attributed to Clarks Creek is 1.5% of the total load during these conditions.

Upper – Middle Kansas Total Phosphorus Average Loads – 1990-2009					
Location	**Avg Conc (mg/l)**	**Avg Flow(cfs)**	**Avg Load (#/d)**	**% Wamego Load**	**% Wamego Flow**
KS River Ogden	0.383	2726	5637.9	69.0%	51.0%
Clarks Cr	0.181	125	122.2	1.5%	2.3%
Sevenmile*	0.2	21.8	23.5	0.3%	0.4%
McDowell	0.106	51.0	29.2	0.4%	1.0%
Wildcat	0.228	42.3	52.1	0.6%	0.8%
Big Blue R*	0.16825	2356	2140.5	26.2%	44.0%
Sand Cr*	0.2	9.0	9.7	0.1%	0.2%
Blackjack Cr*	0.2	6.1	6.6	0.1%	0.1%
Deep Cr*	0.075	39	15.8	0.2%	0.7%
Antelope Cr*	0.2	4.8	5.2	0.1%	0.1%
Emmons Cr*	0.2	7.7	8.3	0.1%	0.1%
Manhattan WW	3.085	7.5	124.9	1.5%	0.1%
Kansas River – Wamego	0.283	5350	8175.9	100%	100.9%

Figure 45- Kansas River total phosphorus average loads

*- Estimated Concentration of 0.2 mg/l used as default since there is not a monitoring station.

Using the data provided by KDHE in the above tables and narratives, very specific load reductions goals have been set. By meeting these load reduction goals, Clarks Creek can reduce its contributions of sediment, nitrogen, phosphorous to the larger Kansas River Watershed. It will also allow Clarks Creek to meet its designated uses for primary and secondary contact recreation, food procurement aquatic life support, domestic and livestock water supply.

To meet the designated uses three primary impairments will need to be reduced; suspended sediment, phosphorous and nitrogen.

SPECIFIC DESTINATION

Suspended Sediment Reduction

According to KDHE the desired level for total suspended solids is 45 mg/L. Within the larger Upper and Middle Kansas River Watershed, this load places Clarks Creek eighth on the list of streams. Based on measurements taken at KDHE gauge station 517, the current median concentration is 58 ml/L. The current load, measured in pounds per day is 59,195 and the desired target is 45,927. To meet this goal a 22% reduction is needed. Based on a ten year implementation plan, this would mean that sediment loading would need to be reduced by 36 ton/year.

Possible Best Management Practices (BMPs) that could be used to meet this load reduction are those listed in Figure 19; buffer installation, feeding site relocation, structural practices on cropland, streambank and gulley stabilization and range management. Of these potential practices, the SLT has decided to focus their efforts and resources on;

a) Buffer installation – both native grass and riparian forest buffers
b) Cropland structural practices – terraces, waterways, diversions
c) Conversion to no-till farming practices

Based on KDHE modeling the sub-basin with the most potential to contribute sediment to the system is Humboldt Creek (102701010105).

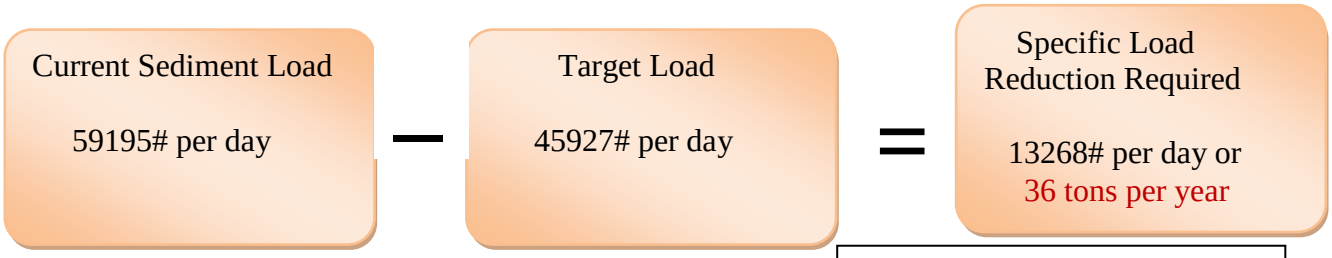


Figure 46- Sediment load reduction required

Excessive sediment (TSS) loads are generated during the two month period with the highest runoff (May and June). Any necessary reductions should be seen during these two months.

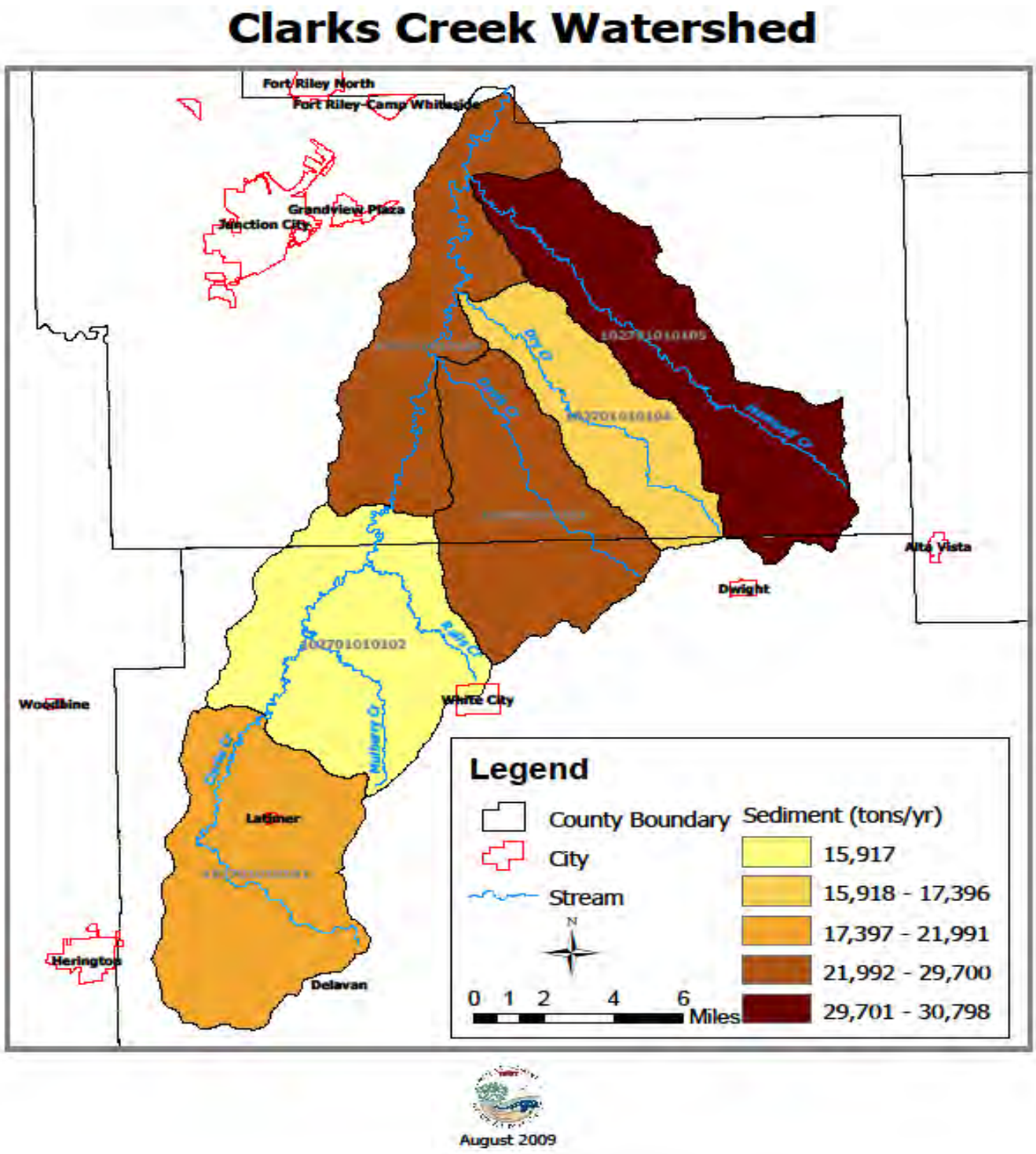


Figure 47- STEPL sediment model for Clarks Creek

Nitrogen Reduction

The KDHE data shows that the desired level for nitrogen concentration is 0.90 mg/L. Based on current stream monitoring, the current level ranges from 0.8 to 1.61 mg/L over all flow conditions. This level places Clarks Creek third highest amongst all of the streams in the Upper and Middle Kansas River basin. Under the wettest conditions t his translates into a current load of 1041 lb/day with a desired level of 918.5 lbs/day which is an 11.8% reduction. Reductions of 1100# TN per year are necessary to meet the recommended levels. These reductions are needed during the wetter portions of the year, March through July.

Possible best management practices for the reduction of nitrogen in surface waters as shown in Figure 18 are installation of buffers, animal feeding and watering site relocation, cropland structural practices, streambank and gulley stabilization, range management, and on-site wastewater system maintenance. Of these potential practices, the SLT has decided to focus their efforts and resources on;

a) Buffer installation – both native grass and riparian forest buffers
b) Cropland structural practices – terraces, waterways, diversions
c) Conversion to no-till farming practices
d) Soil testing to determine appropriate cropland nutrient needs

KDHE's STEPL modeling shows that focus for these practices should be in the Humboldt Creek (102701010105) and Headwaters sub-watersheds (102701010101) as they have the most potential to contribute nitrogen.

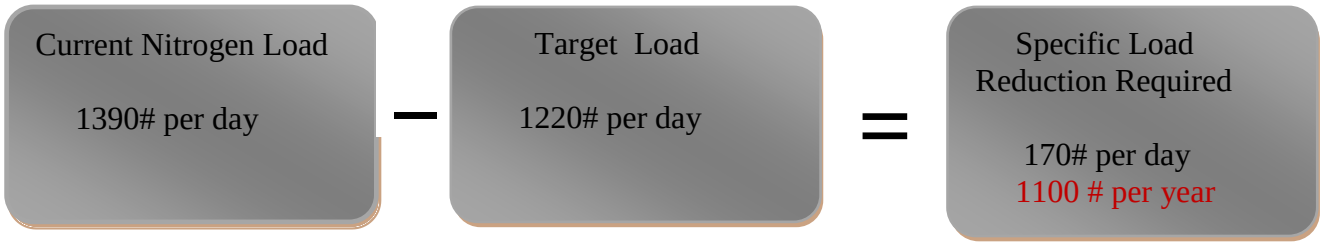


Figure 48- Nitrogen load reduction required

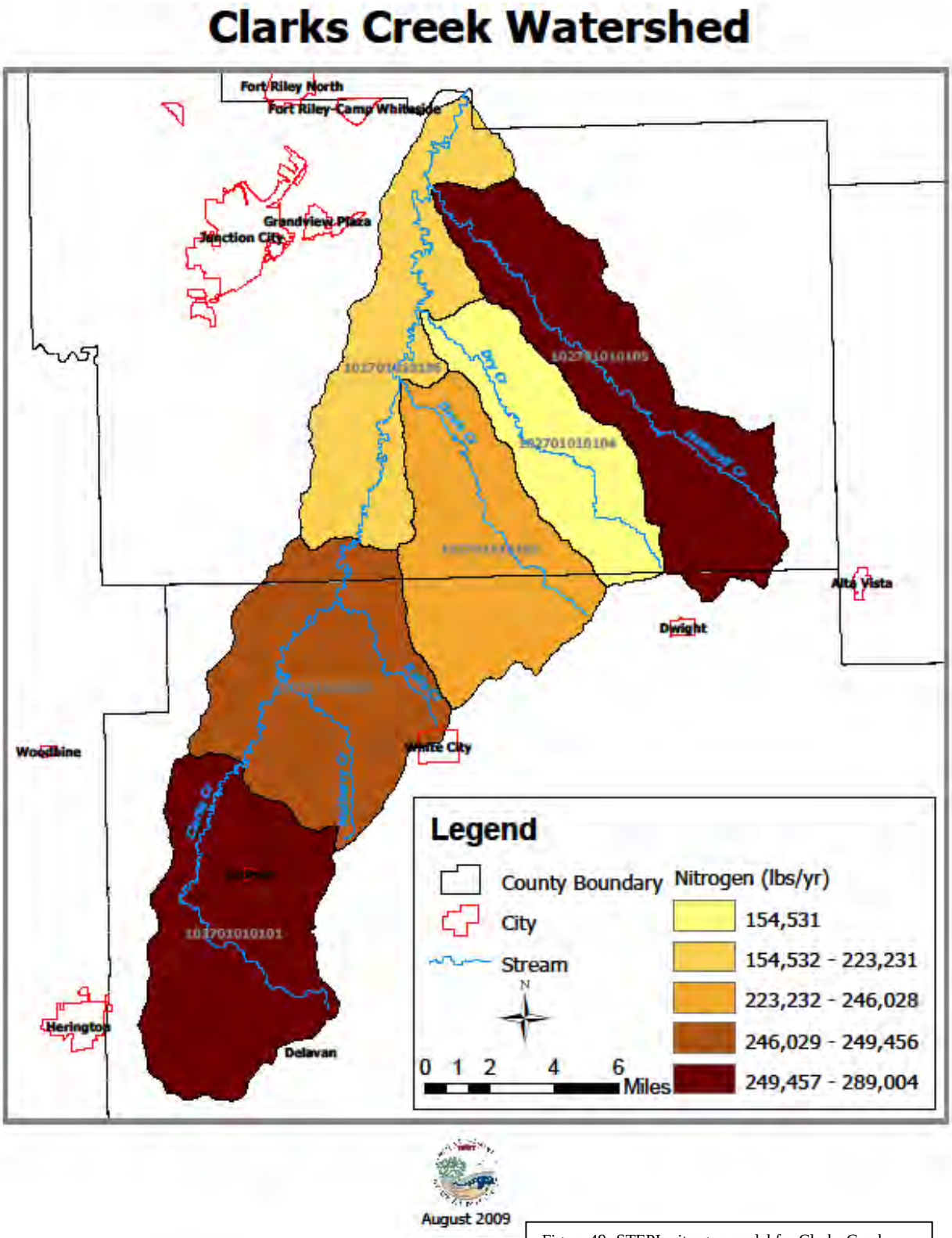


Figure 49- STEPL nitrogen model for Clarks Creek

Phosphorus Reduction

The pollutant of the most concern in the watershed is phosphorus. The desired goal is a concentration for total phosphorous of .090 mg/L. Currently, there is a median concentration of 0.14 mg/L which places the creek fourth on the list of streams in the Upper and Middle Kansas River basin. This concentration translates into a load under runoff conditions of 143 lb/day day which is 36% above the desired concentration of 91.9 lbs/day. Conversely, under baseflow conditions, current loads are 2.6#TP per day and would only need to be reduced by 0.3# per day. Over the seven month period, March through September, that typically display normal to high flows, the current daily load in 195# TP per day and the desired level is 131# per day. Over the course of the year, the necessary reduction for phosphorus during this period should be 395# per year. Based on the modeling, areas of focus should be in the Humboldt Creek (102701010105) and Headwaters (102701010101) sub-watersheds.

Potential BMPS that will help with phosphorus reduction in surface waters as shown in Figure 19 are relocation of animal feeding and watering sites, maintenance of onsite waste water systems, installation of buffers, cropland structural practices, streambank and gulley stabilization and rangeland management. Of these potential practices, the SLT has decided to focus their efforts and resources on;

a) Buffer installation – both native grass and riparian forest buffers
b) Relocation of animal feeding and watering sites – installation of alternate watering facilities
c) Cropland structural practices – terraces, waterways, diversions
d) Conversion to no-till farming practices
e) Soil testing to determine appropriate cropland nutrient needs

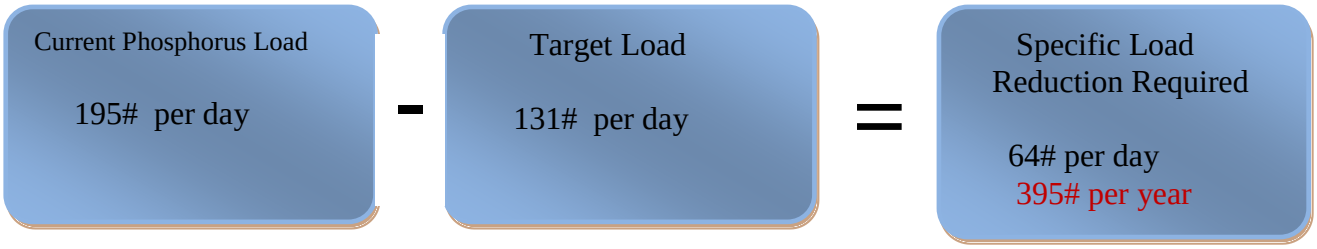


Figure 50- Phosphorus load reduction required

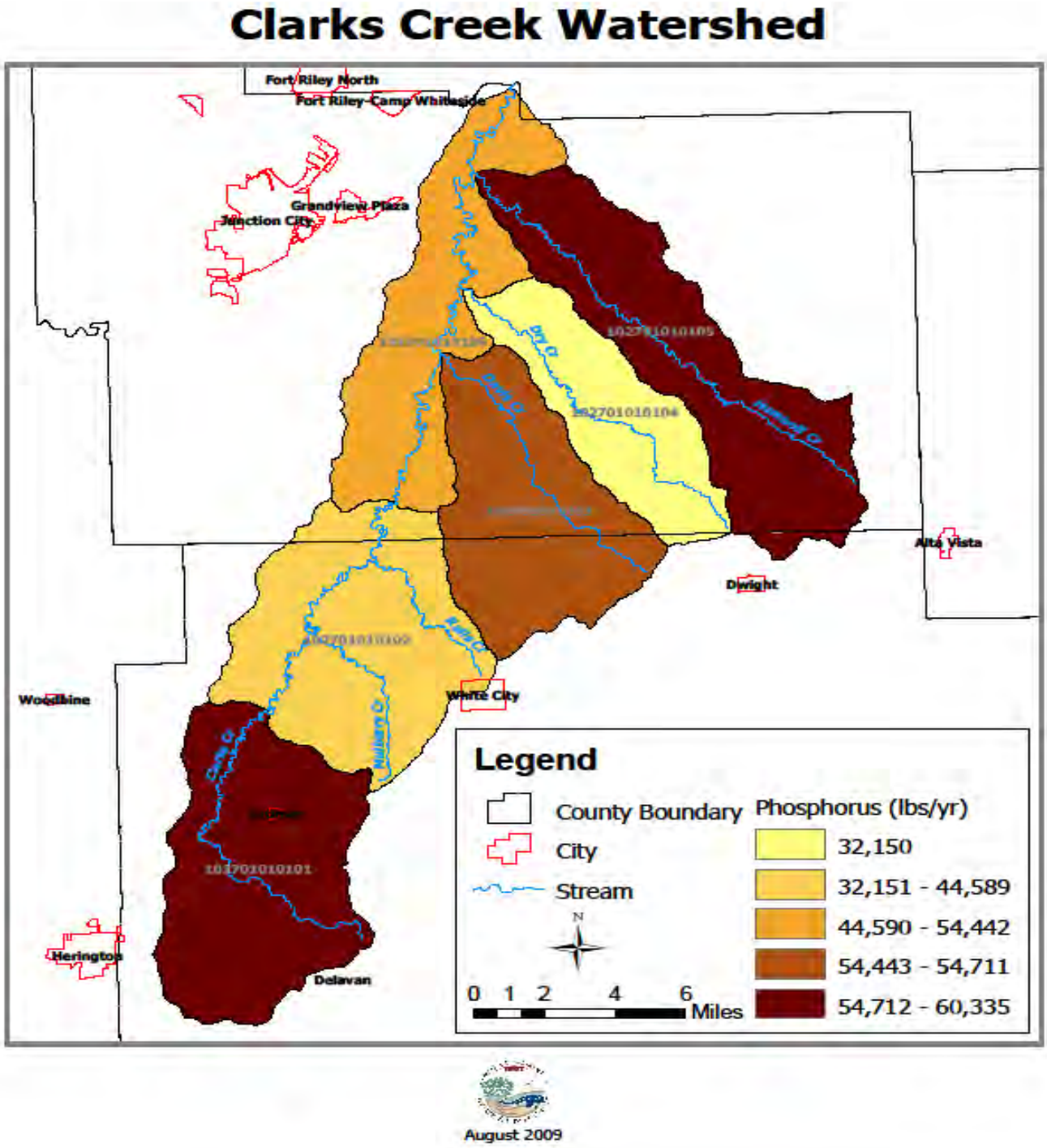


Figure 51- STEPL phosphorus model for Clarks Creek

TOOLS AND EQUIPMENT

BEST MANAGEMENT PRACTICES (BMP)

Pollutant Sources

Best Management Practices are defined as "Environmental protection practices used to control pollutants, such as sediment or nutrients, from common agricultural or urban land use activities" by Kansas State University. The Clarks Creek WRAPS Stakeholder Leadership Team has determined that their priorities in the watershed center on the reduction of sediment, phosphorus and nitrogen.

Pollutant Sources	N	P	TSS	Bacteria
Animal feeding/watering facilities		X	X	X
Failing on-site waste water systems	X	X		X
Eroding streambanks	X	X	X	
Cropland erosion	X	X	X	
Cropland nutrient runoff	X	X		
Rangeland erosion		X	X	X
Unpermitted dumpsites			x	
Abandoned well plugging	X	X		X

Figure 52- Pollutant sources

The agricultural pollutants typically appear at concerning levels during the spring when rainfall events are more frequent and more overwhelming. Nitrogen can be found in both ground and surface water sources, where phosphorous is most often found in surface waters. Ground water contamination often occurs through the conduits of abandoned wells and failing septic systems, while surface water impairment more often comes from agricultural production of crops and livestock or from wildlife sources.

By looking at the flow charts seen earlier in this Plan, conservation practices that can help to reduce each of the above pollutants can be easily found. Load reduction amounts vary with each practice, so the Clarks Creek SLT has tried to focus on the most effective and cost-efficient practices to include in this plan.

Needs Inventory

In looking at the two targeted watersheds, Upper Clarks Creek (102701010101) and Humboldt Creek (102701010105), there are;

Upper Clarks Creek – In this sub-watershed, the cropland and rangeland acres are interspersed throughout the area.

Cropland – 9,634 acres
Rangeland – 18,102 acres

Humboldt Creek – In this sub-watershed, the cropland all lies adjacent to the creek at the bottom of the valley and the rangeland is located farther away on the hilly slopes of the valley walls.

Cropland – 4,207 acres
Rangeland – 21,509 acres

Acres in need of BMP treatment in the watersheds were determined by a combination of SLT, NRCS and Conservation District input and the ground truthing that was described earlier.

Upper Clarks Creek –
- Cropland – 2,480 acres
- Rangeland – 2,560 acres

Humboldt Creek –
- Cropland – 1,050 acres
- Rangeland – 3,585 acres

Over the course of a 10 year planning cycle, the Clarks Creek WRAPS SLT has estimated that the BMP amounts can realistically be obtained, thus meeting the load reduction requirements as outlined above. Definitions for each of these practices are included in Appendix B of this plan.

Load Reduction Estimates

Load Reductions for Clarks Creek based on a ten year implementation plan

BMP	Quantity	Unit	N (lb/yr)	P (lb/yr)	S (ton/yr)
Grass Buffers	42	acres	159	79	58
Riparian Forest Buffers	12	acres	811	417	280
Alternative Watering System		A.U.s		2736	
Terraces	30,000	linear feet	147	73	59
Grassed Waterways	30	acres	117	59	43
Diversion	18,000	feet	93	46	37
Ponds	12	each		1368	
Brush Management	600	acres	N/A	N/A	N/A
Pasture and CRP Burning	18,000	acres	N/A	N/A	N/A
Streambank stabilization	1,200	linear feet	192	96	96
Soil testing	8,000	acres	2649	1327	N/A
No till	3,000	acres	14203	7111	4748
Feeding site relocation		A.U.s		995	
Totals			18,371	14,307	5,321
Required load reductions over 10 year period			11,000	3950	360

Figure 53- Load reduction estimates

BMP Definitions

Cropland BMPs

Vegetative Buffer (Grass or Forest)
-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 federal or state funds

Terraces/Diversions
-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 federal or state funds

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.
-$1,600 an acre, 50% cost-share available from federal or state funds.

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 federal or state funds.

Soil Testing as part of a Nutrient Management Plan
-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 federal or state funds.

Livestock BMPs

Vegetative Filter Strip (Native or tame grass)
-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%.
-Approx. $1,000/acre, 90% cost-share available from federal or state funds

Terraces/Diversions – (Placed below feeding sites)
-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 federal or state funds

Relocate Feeding Sites
-Feeding Pens- 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 (Tank or Spring Development)
-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. 50% cost-share available from federal or state funds

Alternate Watering Source (Pond)
-Water impoundment made by constructing an earthen dam.
-Traps sediment and nutrients from leaving edge of field.
-Provides source of water.
-50% P Reduction.
-Approximately $12,000 50% cost-share available from federal or state funds

Annual Implementation Estimates

Breaking these numbers down on an annual basis, the following amounts of BMP implementation will be set as yearly deliverable amounts. Efforts to install these practices will be focused on the two target watersheds, the Headwaters (010) and Humboldt Creek (050). While BMPs will most certainly be installed in the four other sub-watersheds, only those in the two targeted watersheds will be eligible for Implementation funding.

BMP	Per year	10 yr total	units
Buffers	4.2	42	ac
Riparian	1.2	12	ac
Alternative water source	2	20	ea
Terraces	3000	30000	lf
Waterway	3	30	ac
Diversion	1800	18000	lf
Soil testing	800	8000	ac
Feeding site relocation	1	10	ac
No-till	300	3000	ac

Figure 54- Annual BMP installation goals

As the BMPs are implemented at the above rates, load reductions for sediment, nitrogen and phosphorous will be cumulative. The following charts demonstrate the total load reductions by practice following each implementation year.

It should be noted that the total sediment and phosphorous predicted load reductions are higher than those target reductions. These BMP amounts are included in this plan in order to be able to accumulate enough nitrogen reduction to reach that target load.

Annual Load Reduction Targets

The following tables estimate the amount of sediment, nitrogen and phosphorus that can be kept from reaching Clarks Creek's waters if the above BMP implementation targets are met. Again, the target areas for implementation of these practices will be in the Headwaters (010) and the Humboldt Creek (050) sub-watersheds.

Sediment (tons)										
Year	1	2	3	4	5	6	7	8	9	10
Buffers	5.8	11.6	17.4	23.2	34.8	40.6	46.4	52.2	58	63.8
Riparian	28	56	84	112	168	196	224	252	280	308
Alt water	0	0	0	0	0	0	0	0	0	0
Terraces	5.9	11.8	17.7	23.6	35.4	41.3	47.2	53.1	59	64.9
Waterway	4.3	8.6	12.9	17.2	25.8	30.1	34.4	38.7	43	47.3
Diversion	3.7	7.4	11.1	14.8	22.2	25.9	29.6	33.3	37	40.7
Soil testing	0	0	0	0	0	0	0	0	0	0
No-till	474.8	949.6	1424.4	1899.2	2848.8	3323.6	3798.4	4273.2	4748	5222.8
						Total load reduction (tons)				5747.5

Reduction goal of 360 ton met.

Figure 55- Sediment load reduction by year of plan

Nitrogen (lbs)										
Year	1	2	3	4	5	6	7	8	9	10
Buffers	15.9	31.8	47.7	63.6	95.4	111.3	127.2	143.1	159	174.9
Riparian	81.1	162.2	243.3	324.4	486.6	567.7	648.8	729.9	811	892.1
Terraces	14.7	29.4	44.1	58.8	88.2	102.9	117.6	132.3	147	161.7
Waterway	11.7	23.4	35.1	46.8	70.2	81.9	93.6	105.3	117	128.7
Diversion	9.3	18.6	27.9	37.2	55.8	65.1	74.4	83.7	93	102.3
Soil testing	264.9	529.8	794.7	1059.6	1589.4	1854.3	2119.2	2384.1	2649	2913.9
No-till	1420.3	2840.6	4260.9	5681.2	8521.8	9942.1	11362.4	12782.7	14203	15623.3
						Total load reduction (lbs)				19996.9

Figure 56- Nitrogen load reduction by year of plan

Reduction goal of 11,070 lbs. met.

Phosphorus (lbs)										
Year	1	2	3	4	5	6	7	8	9	10
Buffers	7.9	15.8	23.7	31.6	47.4	55.3	63.2	71.1	79	86.9
Riparian	41.7	83.4	125.1	166.8	250.2	291.9	333.6	375.3	417	458.7
Alt water	273.6	547.2	820.8	1094.4	1641.6	1915.2	2188.8	2462.4	2736	3009.6
Terraces	7.3	14.6	21.9	29.2	43.8	51.1	58.4	65.7	73	80.3
Waterway	5.9	11.8	17.7	23.6	35.4	41.3	47.2	53.1	59	64.9
Diversion	4.6	9.2	13.8	18.4	27.6	32.2	36.8	41.4	46	50.6
Soil testing	132.7	265.4	398.1	530.8	796.2	928.9	1061.6	1194.3	1327	1459.7
Riparian	99.5	99.5	199	199	298.5	298.5	398	398	497.5	597
No-till	711.1	1422.2	2133.3	2844.4	3555.5	4266.6	4977.7	5688.8	6399.9	7111
						Total load reduction (lbs)				12918.7

Reduction goal of 3,970 lbs. met.

Figure 57- Phosphorus load reduction by year of plan

RESOURCE REQUIREMENTS

BMP Funding Needs

By using these figures and cost-estimates based on SLT recommendations, NRCS and Conservation District cost-share lists, funding needs for the project can be computed.

BMP	Technical Assistance Provider	Per year	Units	Cost/unit	Cost/year
Buffers	FSA, DOC NRCS, Conservation				
Native Grass	Districts, KDWP, Kansas	4.2	acres	$ 1,000.00	$ 4,200.00
Riparian Forest	Forest Service	1.2	acres	$ 1,000.00	$ 1,200.00
	NRCS, DOC, KSU, KRC				
Feeding Site Relocation (one completed every-other year)	NRCS, Conservation District	1	each	$ 6,600.00	$ 6,600.00
Structural Practices					
Diversions		1800	lf	$ 1.02	$ 1,836.00
Terraces		3000	lf	$ 1.02	$ 3,060.00
Waterways		3	acres	$ 1,600.00	$ 4,800.00
Conversion to No-till	DOC, NRCS, No-till on the Plair	300	acres	$ 10.00	$ 3,000.00
Soil Testing	KSU Extension, EPA, NRCS	800	acres	$ 7.30	$ 5,840.00
Alternate Watering Systems	NRCS, DOC, Conservation				
Ponds	District, KSU, KRC	2	each	$ 6,000.00	$ 12,000.00
Tanks		1	each	$ 3,795.00	$ 3,795.00
Spring Developments		1	each	$ 3,000.00	$ 3,000.00
Pond fencing		2000	lf	$ 2.00	$ 4,000.00
	Total BMP funding needs				$ 53,331.00
Anticipated cost-share from other sources	DOC, NRCS, Conservation				$ 38,150.00
	Districts, KFS, KDHE, EPA, KRC				
	Landowner in-kind funding				
	Balance needed from WRAPS				$ 15,181.00

Figure 58- BMP funding needs

INFORMATION AND EDUCATION FUNDING NEEDS

Information dissemination and education of the watershed landowners and residents will play a vital role in the success of the Clarks Creek WRAPS project. Many of these education efforts will be undertaken with the other WRAPS and WRAPS coordinators that are sponsored by the Flint Hills RC&D. Some will also be undertaken with the Middle Kansas WRAPS as that is the larger basin for this stream. The tables below outline the informative efforts that will be undertaken either individually or collectively showing the timing, responsible parties, technical service providers that will need to be involved and the overall funding requirements for these efforts. They are also tied to specific BMPs that the SLT has deemed necessary to meet the load reduction requirements set forth by KDHE.

BMP	Target Audience	Information/Education Activity/Event	Time Frame	Estimated Costs	Sponsor/Responsible Agency
Cropland BMP Implementation					
Buffers	Landowners and Farmers	Demonstration Project	Annual	$5,000 per demonstration project	Kansas Rural Center Buffer Coordinator
		Tour/Field Day to Highlight Buffers	Annual	$500 per tour or field day	Flint Hills RC&D Buffer Coordinator Conservation District
		Newspaper Articles	Annual - Ongoing	No Charge	Conservation Districts
		Newsletter Article	Quarterly	$500	Flint Hills RC&D Conservation Districts Kansas Research and Extension
		One on One Meetings with Producers	Annual - Ongoing	Cost included in Technical Assistance for Coordinator	Flint Hills RC&D Conservation Districts, Kansas Research and Extension and Buffer Coordinators
		Scholarships for	Annual –	$150 per person	No-till on the Plains

		producers to attend No-Till Winter Conference	Winter		
Soil Testing/Nutrient Management	Farmers	Cost Share for 600 Soil Tests	Annual - Ongoing	$3,000 ($5 per test)	Conservation District and Kansas State Research and Extension
		Newsletter Article	Annual	$500	Flint Hills RC&D Conservation Districts Kansas Research and Extension
		One on One Meetings with Producers	Annual - Ongoing	Cost included with Technical Assistance for Coordinator	Flint Hills RC&D NRCS Conservation District Kansas State Research and Extension
Structural Practices Terraces Waterways Diversions	Farmers	Demonstration Project	Annual	$5,000 per demonstration project	Kansas Rural Center NRCS
		Newsletter Article	Annual	$500	Flint Hills RC&D Conservation Districts Kansas Research and Extension
		One on One Meetings with Producers	Annual - Ongoing	Cost included with Technical Assistance for Coordinator	Flint Hills RC&D NRCS Conservation District Kansas State Research and Extension

BMP	Target Audience	Information/Education Activity/Event	Time Frame	Estimated Costs	Sponsor/Responsible Agency
Livestock BMP Implementation					
Vegetative Filter Strips	Landowners and Ranchers	Demonstration Project	Annual	Combined with buffer demonstration	Flint Hills RC&D Kansas Rural Center Buffer Coordinator Kansas State Research and Extension
		Tour/Field Day	Annual	Combined with buffer tour or field day	Flint Hills RC&D Kansas Rural Center Buffer Coordinator Kansas State Research and Extension
		Workshop/Tour	Annual	$500 per workshop	Flint Hills RC&D Kansas Rural Center Buffer Coordinator Kansas State Research and Extension
		Livestock Filter Strip and Feedlot Relocation Demonstration/Tour	Annual	$300 per demonstration or tour	Conservation Districts NCRS
Relocated Feedlot	Landowners and Small Feedlot Operators	Demonstration Project	Annual	$5,000 per demonstration project	Flint Hills RC&D Kansas Rural Center Buffer Coordinator Kansas State Research and Extension
		Tour/Field Day	Annual	$500 per tour or field day	Flint Hills RC&D Kansas Rural Center Buffer Coordinator Kansas State Research and Extension

		Cost-Share Program Promotion	Annual	No Charge	Flint Hills RC&D Kansas Rural Center Buffer Coordinator Kansas State Research and Extension

BMP	Target Audience	Information/Education Activity/Event	Time Frame	Estimated Costs	Sponsor/Responsible Agency
Livestock BMP Implementation, Cont.					
Relocate Pasture Feeding Site	Ranchers	Demonstration Project	Annual – Spring	$5,000 per demonstration project	Kansas Rural Center
		Tour/Field Day	Annual - Summer	$500 per tour or field day	Kansas Rural Center Conservation Districts
		Grazing Informational Meeting	Annual - Fall	$250 per meeting	Conservation Districts Kansas Rural Center
		Tour/Field Day			
Alternate Watering System	Ranchers	Demonstration Project	Annual – Spring	$5,000 per demonstration project	Kansas Rural Center
		Tour/Field Day	Annual - Summer	$500 per tour or field day	Kansas Rural Center Conservation Districts
		Grazing Informational Meeting	Annual - Fall	Combined with relocating pasture feeding site meeting	Conservation Districts Kansas Rural Center

BMP	Target Audience	Information/Education Activity/Event	Time Frame	Estimated Costs	Sponsor/Responsible Agency
Watershed Wide Information and Education					
Education of Youth	Educators, K-12 Students	Day on the Farm	Annual – Spring	$500 per event	Conservation Districts Kansas Farm Bureaus Kansas FFA Kansas State Research and Extension
		Poster, essay and speech contests	Annual – Spring	$200	Conservation Districts
		Envirothon	Annual - Spring	$250	Conservation Districts
Education of Adults	Educators, Adult Education	Newsletter Article	Annual	$500	Flint Hills RC&D Conservation Districts Kansas Research and Extension
		Presentation at annual meeting	Annual – Winter	No charge	Conservation District
		River Friendly Farms producer notebook	Annual – Ongoing	$250 per notebook	Flint Hills RC&D Kansas Rural Center
		Media campaign to promote healthy watersheds (brochures, news releases, TV, radio, web-based)	Ongoing	$1,000 per year	Flint Hills RC&D
Watershed Wide Information and Education, Cont.					
		Meeting with Soil and Grassland Awards	Annual – Ongoing	No charge	Conservation Districts
		Media campaign to promote healthy watersheds (brochures, news releases, TV, radio, web-based)	Ongoing	$1,000 per year	Flint Hills RC&D

		Media campaign to address urban nutrient runoff (flyers or handouts addressing phosphate and nitrate pollution from urban areas)	Annual – Ongoing	$500 per campaign	Local Environmental Protection Program
		Watershed display for area events	Annual – Ongoing	No charge	Flint Hills RC&D Conservation Districts Kansas State Research and Extension
Total annual cost for Information and Education if all events are implemented					**$40,200.00**

BIBLIOGRAPHY

CLARKS CREEK WATERSHED FACT SHEET -
kdheks.gov/tmdl/download/eval_assessment/ClarksFactSheet.pdf

http://www.kdheks.gov/tmdl/download/eval_assessment/ClarksCreekChapter.pdf

KANSAS-LOWER REPUBLICAN BASIN TOTAL MAXIMUM DAILY LOAD
http://www.kdheks.gov/tmdl/klr/ClarksCkFCB.pdf

THE WATERSHEDS OF THE MIDDLE AND UPPER KANSAS SUBBASINS
http://www.kdheks.gov/tmdl/download/eval_assessment/OverviewChapter.pdf

A WATERSHED CONDITIONS REPORT FOR THE STATE OF KANSAS HUC 10270101 (UPPER KANSAS) WATERSHED
http://www.kdheks.gov/nps/wc_reports/10270101.pdf

1998 WATER QUALITY-LIMITED SURFACE WATERS (303(d) LIST) TABLE
http://www.kdheks.gov/befs/303d/table1.htm

CATEGORY 4 WATERS IN KANSAS –IMPAIRED WATERS WITH AN EXISTINGTMDL OR ADDRESSED BY ALTERNATIVE MEANS OR IMPAIRED BY POLLUTION December 2006
http://www.kdheks.gov/tmdl/download/2006_CAT_4_WATERS_IN_KANSAS.pdf

CLARKS CREEK LOAD REDUCTION TARGETS FOR TOTAL SUSPENDED SOLIDS,TOTAL NITROGEN, AND TOTAL PHOSPHORUS AT KDHE SAMPLING STATION SC517 – Trevor Flynn, KDHE 2009

SOURCE WATER PROTECTION PLAN, CITY OF WHITE CITY – Jim Jackson, Rural Water Association 2005

SOURCE WATER PROTECTION PLAN, MORRIS COUNTY RWD NO. 1 - Katie Miller, Rural Water Association 2010

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): The amount of oxygen dissolved in water.
E. coli bacteria: 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 (FCB): 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.
NPDES Permit: Required by Federal law for all point source discharges into waters.
Nitrates: Final product of ammonia's biochemical oxidation. It is the primary source of nitrogen for plants and is contained in 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.
Nutrients: Nitrogen and phosphorus in water source.
Phosphorus (P or TP): Element in water that, in excess, can lead to increased biological activity.
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.
Stakeholder Leadership Team (SLT): Organization of watershed residents, landowners, farmers, ranchers, agency personnel and all persons with an interest in water quality.
Total Suspended Solids (TSS): Measure of the suspended organic and inorganic solids in water. Used as an indicator of sediment or silt.

Service Provider List

Organization	Programs	Purpose	Technical or Financial Assistance	Phone	Website address
Environmental Protection Agency	Clean Water State Revolving Fund Program Watershed Protection	Provides low cost loans to communities for water pollution control activities. To conduct holistic strategies for restoring and protecting aquatic resources based on hydrology rather than political boundaries.	Financial	913-551-7003 913-551-7003	www.epa.gov
Flint Hills RC&D	Natural resource development and protection	Plan and Implement projects and programs that improve environmental quality of life.	Technical	620-340-0113 ext. 9	www.flinthillsrcd.com/
Kansas Dept. of Agriculture	Watershed structures permitting.	Available for watershed districts and multipurpose small lakes development.	Technical and Financial	785-296-2933	www.accesskansas.org/kda
Kansas Forest Service	Conservation Tree Planting Program Riparian and Wetland Protection Program	Provides low cost trees and shrubs for conservation plantings. Work closely with other agencies to promote and assist with establishment of riparian forestland and manage existing stands.	Technical	785-532-3312 785-532-3310	www.kansasforests.org

Organization	Programs and Technical Assistance	Purpose	Technical or Financial Assistance	Phone	Website address
Kansas Dept. of Health and Environment	**Nonpoint Source Pollution Program** Municipal and livestock waste Livestock waste Municipal waste State Revolving Loan Fund	Provide funds for projects that will reduce nonpoint source pollution. Compliance monitoring. Makes low interest loans for projects to improve and protect water quality.	Technical and Financial	785-296-5500	www.kdhe.state.ks.us
Kansas Water Office	**Public Information and Education**	Provide information and education to the public on Kansas Water Resources	Technical and Financial	785-296-3185	www.kwo.org
No-Till on the Plains	**Field days, seasonal meetings, tours and technical consulting.**	Provide information and assistance concerning continuous no-till farming practices.	Technical	888-330-5142	www.notill.org
Kansas Rural Center	**The Heartland Network** **Clean Water Farms-River Friendly Farms** **Sustainable Food Systems Project** **Cost share programs**	The Center is committed to economically viable, environmentally sound and socially sustainable rural culture.	Technical and Financial	785-873-3431	http://www.kansasruralcenter.org

Organization	Programs and Technical Assistance	Purpose	Technical or Financial Assistance	Phone	Website address
Kansas Department of Wildlife, Parks and Tourism	Land and Water Conservation Funds	Provides funds to preserve develop and assure access to outdoor recreation.	Technical and Financial	620-672-5911	www.kdwp.state.ks.us/about/grants.html
	Conservation Easements for Riparian and Wetland Areas	To provide easements to secure and enhance quality areas in the state.		785-296-2780	
	Wildlife Habitat Improvement Program	To provide limited assistance for development of wildlife habitat.		620-672-5911	
	North American Waterfowl Conservation Act	To provide up to 50 percent cost share for the purchase and/or development of wetlands and wildlife habitat.		620-342-0658	
	MARSH program in coordination with Ducks Unlimited	May provide up to 100 percent of funding for small wetland projects.		620-672-5911	
	Chickadee Checkoff	Projects help with eagles, songbirds, threatened and endangered species, turtles, lizards, butterflies and stream darters. Funding is an optional donation line item on the KS Income Tax form.			
	Walk In Hunting Program	Landowners receive a payment incentive to allow public hunting on their property.			
	F.I.S.H. Program	Landowners receive a payment incentive to allow public fishing access to their ponds and streams.			

Kansas State Research and Extension	Water Quality Programs, Waste Management Programs Kansas Center for Agricultural Resources and Environment (KCARE)	Provide programs, expertise and educational materials that relate to minimizing the impact of rural and urban activities on water quality.		785-532-7108 785-532-5813	www.kcare.ksu.edu www.ksre.ksu.edu/kelp
	Kansas Environmental Leadership Program (KELP)	Educational program to develop leadership for improved water quality.		785-532-2643	www.ksre.ksu.edu/olg
	Kansas Local Government Water Quality Planning and Management	Provide guidance to local governments on water protection programs.		785-532-0416	
	Rangeland and Natural Area Services (RNAS)	Reduce non-point source pollution emanating from Kansas grasslands.	Technical	785-532-2732	
	Kansas Pride: Healthy Ecosystems/Healthy Communities	Help citizens appraise their local natural resources and develop short and long term plans and activities to protect, sustain and restore their resources for the future.		785-532-3039	www.kansasprideprogram.ksu.edu/healthyecosystems/
	Citizen Science	Education combined with volunteer soil and water testing for enhanced natural resource stewardship.		785-532-1443	www.ksre.ksu.edu/kswater/

Organization	Programs and Technical Assistance	Purpose	Technical or Financial Assistance	Phone	Website address
Kansas Rural Water Association	Technical assistance for Water Systems with Source Water Protection Planning.	Provide education, technical assistance and leadership to public water and wastewater utilities to enhance the public health and to sustain Kansas' communities	Technical	785-336-3760	http://www.krwa.net
US Army Corps of Engineers	Planning Assistance to States Environmental Restoration	Assistance in development of plans for development, utilization and conservation of water and related land resources of drainage Funding assistance for aquatic ecosystem restoration.	Technical	816-983-3157 816-983-3157	www.usace.army.mil
US Fish and Wildlife Service	Fish and Wildlife Enhancement Program Private Lands Program	Supports field operations which include technical assistance on wetland design. Contracts to restore, enhance, or create wetlands.	Technical	785-539-3474 785-539-3474	www.fws.gov
The Watershed Institute		Survey and Design of streambank and grade stabilization projects	Technical	785-228-3148	www.watershedinstitute.biz
Wild Horse Riverworks		Survey and Design of streambank and grade stabilization projects	Technical	785-213-3778	riverworker@yahoo.com

Organization	Programs and Technical Assistance	Purpose	Technical or Financial Assistance	Phone	Website address
NRCS, **FSA,** **Division of Conservation, and Conservation Districts**	Water Resources Cost Share	Provide cost share assistance to landowners for establishment of water conservation practices.	Technical and Financial	Geary Morris Riley Lyon Pottawatomie Saline	www.accesskansas.org/kscc http://www.kacdnet.org/
	Nonpoint Source Pollution Control Fund	Provides financial assistance for nonpoint pollution control projects which help restore water quality.			
	Riparian and Wetland Protection Program	Funds to assist with wetland and riparian development and enhancement.			
	Stream Rehabilitation Program	Assist with streams that have been adversely altered by channel modifications.			
	Kansas Water Quality Buffer Initiative	Compliments Conservation Reserve Program by offering additional financial incentives for grass filters and riparian forest buffers.			
	Watershed district and multipurpose lakes	Programs are available for watershed district and multipurpose small lakes.			

List of Figures