

# Grouse-Silver Creek WRAPS – 9 Element Watershed Plan

## Summary-Grouse-Silver Creek Watershed District #92

Grouse Creek is an Exceptional State Water due to its high priority fisheries and canoeing use and also has threatened and endangered species i.e Special Aquatic Life Use (SALU).

There are currently TMDLS on Silver Creek for DO, yet it will be delisted.

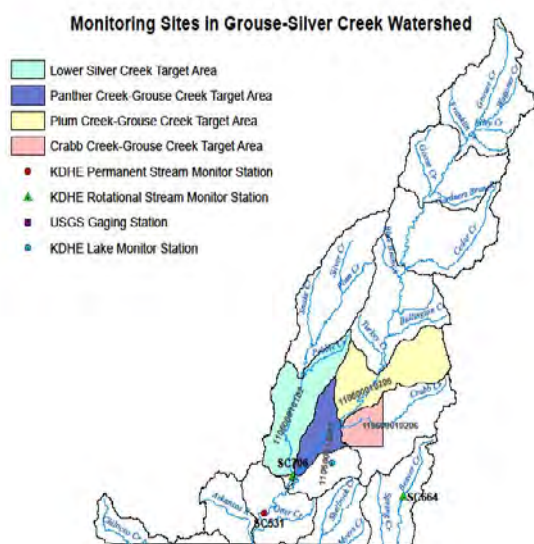
Currently, there are no other impairments.

This is a protection plan so excess sediment and phosphorus will be the pollutants targeted to maintain water quality.

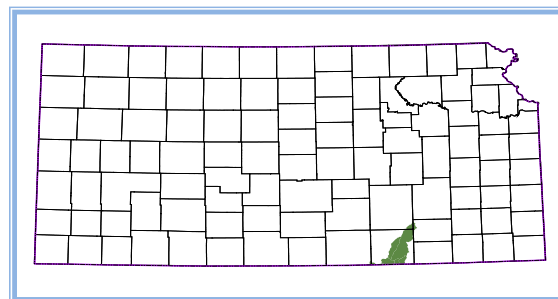
Indirectly addressing dissolved oxygen by using Macroinvertebrate Biotic Index (MBI) and Ephemeroptera, Plecoptera, Trichoptera (ratio of mayflies, stoneflies and caddis flies to other more pollutant tolerant biota) and chlorophyll “a” biology and water quality milestones.

### Considerations for and Prioritizing Critical Areas for Targeting BMPs

- No modeling was completed due to no TMDLs, therefore water monitoring sites were used for targeting BMPs.



- Review of conservation plans
- Riparian Inventory was completed
- Knowledge of local priorities.



### Best Management Practices and Load Reduction Goals

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

Sediment Reducing Cropland BMPs;  
Phosphorus Reducing Cropland, Streambank and Livestock BMPs:

- Riparian and field buffers
- Encouragement of Continuous No-till, reduced tillage and cover crops by producers.
- Convert cropland to grass
- Grassed Waterways w/or w.o. terraces
- Streambank Stabilization case-by-case
- Reduced tillage or no-till farming
- Serecia lespedeza control to avoid concentrating grazing in better parts of the pasture and causing erosion.
- Brine scar remediation to eliminate exposed areas
- Other structural (wetland traps) or management practices that will slow run-off and reduce phosphorus losses.
- Preparation of Nutrient Management Plans with producers

# Grouse-Silver Creek WRAPS – 9 Element Watershed Plan

## Summary-Grouse-Silver Creek Watershed District #92

- Fertilizer/Manure Incorporation
- Retain CRP contracts or retain grass as a grazing/haying system
- Vegetative filter strips between small feeding operations and streams
- Relocation of small feeding operations away from streams
- Relocation of pasture feeding sites away from streams
- Promotion of alternative watering sites away from streams.

### WATER QUALITY GOALS

**Grouse Creek (also includes Panther, Crabb, Wagner and Plum Creeks and Gardener's Branch) *Sediment*** reduction goal to sustain designated uses is 1329 tons per 90 day runoff period for this 10 year plan, however, this goal will be met in 2 to 3 years if all practices are implemented.

Estimated  
9460 tons  
per runoff  
period

Maintaining  
156 mg/l  
TSS for  
average

Reduction  
of 414 tons/  
runoff  
season

**Grouse Creek (also includes Panther, Crabb, Wagner and Plum Creeks and Gardener's Branch) *Phosphorus*** reduction goal to sustain designated uses is 1279 lbs per 90 day runoff period for this 10 year plan, however, this goal will be met in 2 years if all practices are implemented.

18,200  
lbs of  
Total P  
load

Maintaining  
135 ppm tP  
P during  
runoff

1279 lbs  
total P  
reduction

**Silver Creek: *Sediment*** reduction goal to sustain designated uses is 37.8 tons/year for this 10 year plan. However, this goal will be met in 2 to 3 years if all practices are implemented.

Estimated  
256 tons/yr  
load

Maintaining  
45 mg/l  
TSS for  
average

Reduction  
of 37.8  
tons/yr

**Silver Creek: *Phosphorus*** reduction goal to sustain designated uses is 324 lbs/year for this 10 year plan. However, this goal will be met in 1st year if all practices are implemented.

1296  
lbs of  
Total P  
load

Maintaining  
95 ppml  
total P

324lbs  
total P  
reduction

### GROUSE CREEK AQUATIC LIFE GOALS MACRO-INVERTEBRATE INDEX (MBI)

Pollutant tolerant vs. Pollutant intolerant Macros



Current MBI 4.07  
Maintain average MBI  
<4.25 and no sample  
with MBI > 4.5

### Ephemeroptera, Plecoptera, Trichoptera (EPT)



Current % EPT 57. Goal is to maintain %EPT > 55 and no sample with %EPT < 45.

### CHLOROPHYLL A

(Median of data collected during indicated period), ppb or mg/l.

Current  
is 6 ppb

Maintain median  
Chlorophyll a ≤ 6.0

Photo credits:  
<http://www.epa.gov/bioiweb1/html/benthosclean.html>

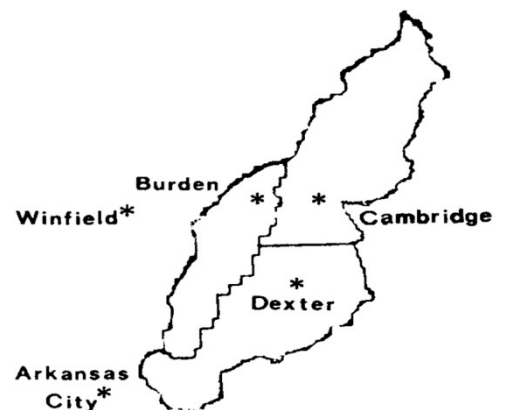
# *Grouse-Silver Creek Watershed Restoration and Protection Plan*



*Grouse Creek*

EPA FFY 2008 GRANT # C9007405-15

In collaboration with The Watershed Institute,  
Kansas Alliance of Wetlands and Streams, K-State  
Research & Ext., Kansas Rural Center, Kansas  
Dept. of Health and Environment, NRCS and  
Cowley County Conservation District



**Watershed Restoration and Protection Strategy  
For The  
Grouse-Silver Creek Watershed**

**January 2013**

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Watershed District # 92*

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# GROUSE-SILVER CREEK WATERSHED RESTORATION AND PROTECTION STRATEGY

HUC 1106000101 (Silver Creek)  
HUC 1106000102 (Grouse  
Creek)

## **I. Introduction & Goals**

The purpose of this Watershed Restoration and Protection Strategy (WRAPS) report for the Grouse-Silver Creek watershed (GSCW) is to outline goals and actions for the watershed. The water quality goals for Grouse and Silver Creek are identified as; **1)** protect surface water, **2)** protect ground water, **3)** maintain “pristine” condition of the watershed and **4)** provide information and education to stakeholders on water quality initiatives. The plan covers the watershed from the top in Butler County to US Highway 166. The area below US Highway 166 is controlled by Kansas Department of Wildlife and Parks and The Army Corps of Engineers.

## **II. Watershed Setting**

### **A. Location**

The GSCW is located in southeastern Kansas within Cowley, Butler and Elk counties. The headwaters of Grouse Creek originate in Butler County, travel southwest approximately 60 miles and drains 249,750 acres including numerous tributaries before emptying into the Arkansas River southeast of Arkansas City, see Figures 1, 2 and 3 below. There are three principal towns in the watershed: Burden, Cambridge and Dexter.

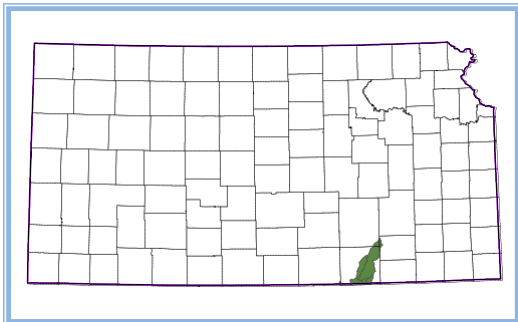


Figure 1

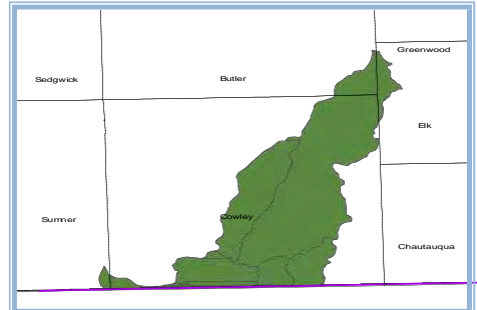


Figure 2

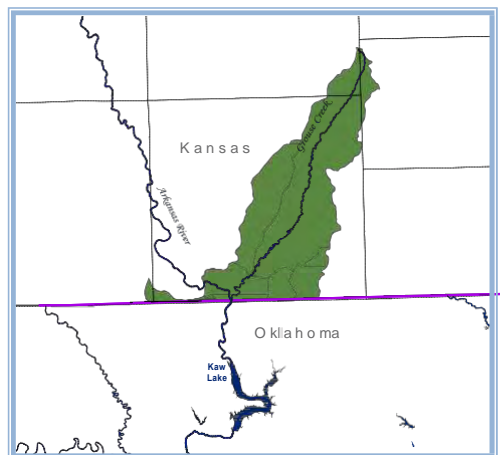


Figure 3



## **B. Water Resources**

Predominant rivers and streams in this watershed are Grouse and Silver Creek. Grouse Creek contains two unnamed and 16 named tributaries, including: Franklin, Gardners Branch, Cedar, School, Bullington, Turkey, Blue Branch, Ferguson, Goose, Otter, Coon, Riley, Wagoner, Panther, Plum and Crabb Creeks. Silver Creek contains three tributaries, Snake Creek, Plum Creek and Pebble Creek. Silver Creek drains into Grouse Creek which then empties into the Arkansas River at the Kaw Wildlife Area.

The Grouse-Silver Creek watershed covers 390 square miles and includes 215.56 linear miles of riparian area on Silver Creek and 489.2 linear miles on Grouse Creek. The watershed also supports six floodwater detention dams that drain 31.8 square miles. These dams were constructed under the management of the Grouse-Silver Creek Watershed District #92 general plan and funded by state and county sources.

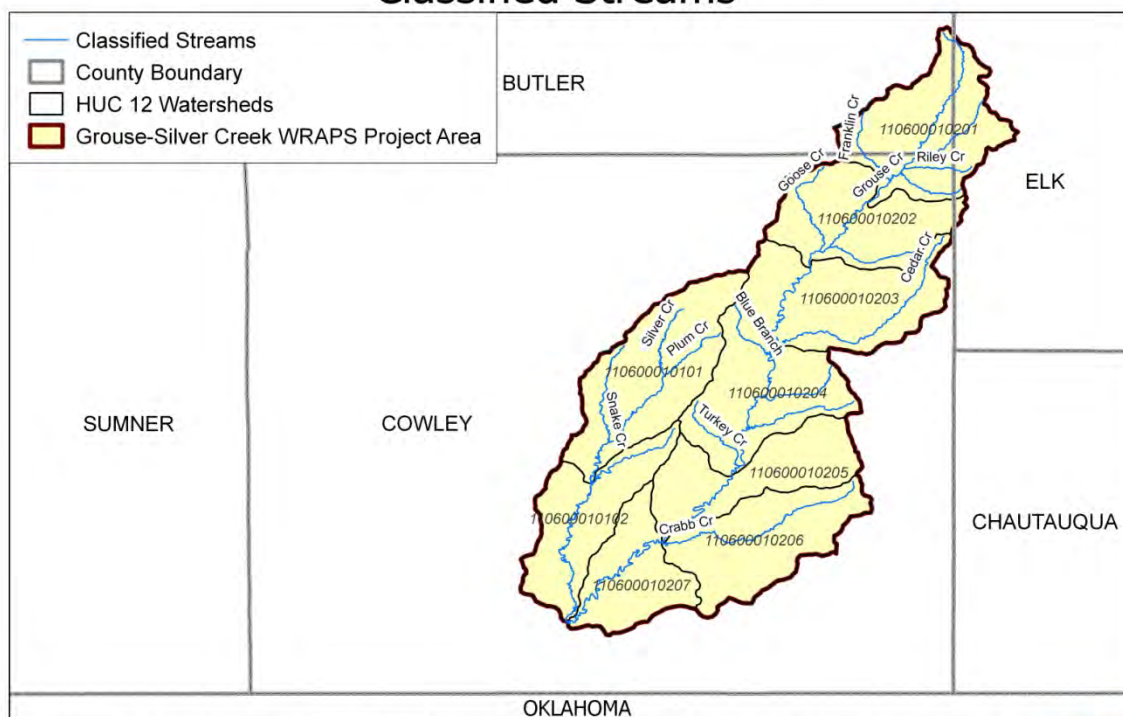
### **Priority Water Resources**

A “priority water resource” is defined as those surface water resources with the following designated uses: domestic water supply (drinking water), primary contact recreation (swimming), food procurement (fishing) and aquatic life support. Aquatic life support includes three categories; expected aquatic life use, restricted aquatic life use and special aquatic life use. Special aquatic life support use refers to water bodies where there are populations of threatened and endangered species or their designated habitats.

Table 1 identifies the designated uses of tributaries in the watershed. Our primary area of emphasis includes Grouse Creek and the lower reaches of Silver Creek. If these areas were to become impaired through area land use, their designated uses would not be met and a TMDL would be written. The Grouse-Silver Creek WRAPS is committed to maintaining or improving water quality in the watersheds.

Grouse Creek is designated as an Exceptional State Water and for *domestic water supply, food procurement* and for *expected aquatic life use*. Silver Creek is general purpose waters designated for *expected aquatic life use* and for *food procurement*. A map of the classified streams and lakes are found in Figure 4 below.

# Grouse Silver Creek WRAPS Classified Streams



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Figure 4

## **Rivers, Streams, and Lakes**

Water Resources	Designated Uses
	Supports the indicated beneficial use
*Grouse Creek	EX, E, C, DS, FP, GR, IW, IR, LW
*Gardners Branch *Plum Creek	GP, E, b, DS, FP, GR, IW, IR, LW
*Crabb Creek *Silver Creek *Wagoner Creek	GP, E, C, DS, FP, GR, IW, IR, LW
Cedar Creek Otter Creek Spring Creek	GP, E, b, DS, GR, IW, IR, LW
Turkey Creek	GP, E, b, FP, GR, LW
Blue Branch Creek Pebble Creek School Creek	GP, E, b, FP, IR, LW
Snake Creek	GP, E, C, FP, IR, LW
Franklin Creek	GP, E, b, FP, LW
Bullington Creek Goose Creek	GP, E, b, IR, LW
Riley Creek Ferguson Creek	GP, E, b
Cowley County State Fishing Lake	GP, L, E, B, DS, FP, IW, IR, LW

\*High Priority HUCs

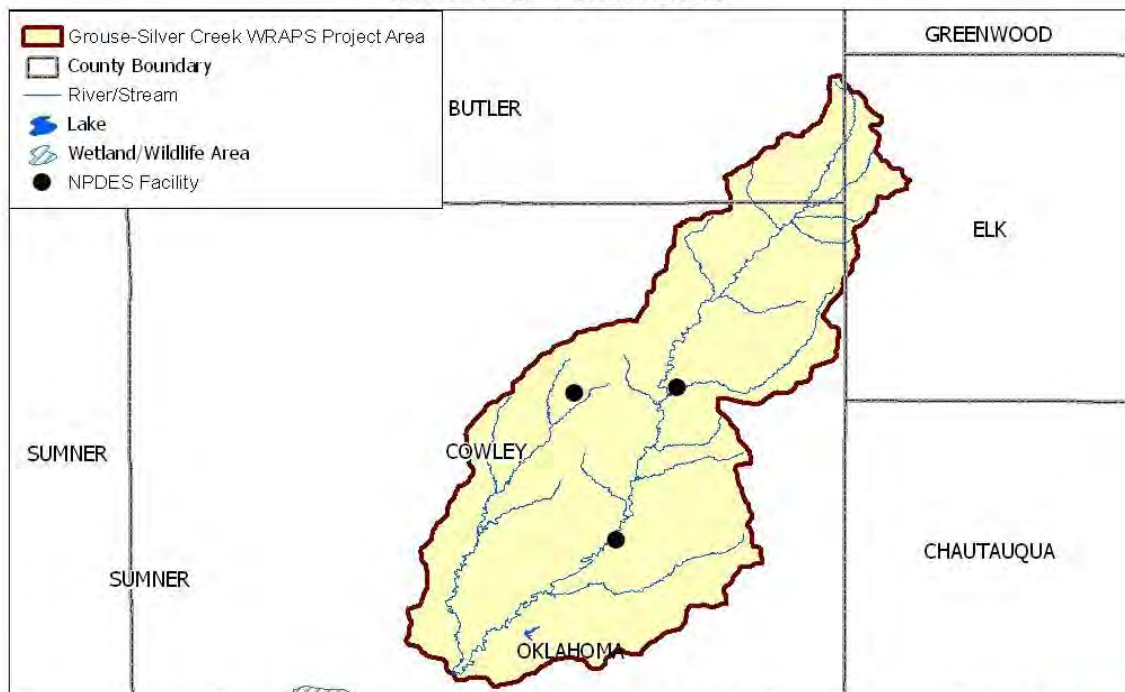
Table 1

Key:	
GP= general purpose waters	DS= designated for domestic water supply use
EX= exceptional state waters	FP= designated for food procurement use
ON= outstanding national resource waters	GR= designated for ground water recharge
S= special aquatic life use water	IW= designated for industrial water supply use
E= expected aquatic life use water	IR= designated for irrigation use
R= restricted aquatic life use water	LW= designated for livestock watering use
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.

## National Pollutant Discharge Elimination System

Wastewater treatment facilities are permitted and regulated through the Kansas Department of Health and Environment (KDHE). These National Pollutant Discharge Elimination System (NPDES) permits specify the maximum amount of pollutants allowed to be discharged to the “waters of the state”. There are currently three NPDES permits in the watershed, Burden, Cambridge and Dexter, Figure 5. The remaining identified sites are outside the GSCW priority area.

### Grouse-Silver Creek WRAPS Project Area NPDES Facilities



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Figure 5

## Public Water Supply

Municipalities in the watershed utilize the Rural Water District for their water supply. The City of Dexter still maintains two wells in the priority area as a backup for their public water supply, Figure 6.

### Grouse-Silver Creek WRAPS Project Area Public Water Sources

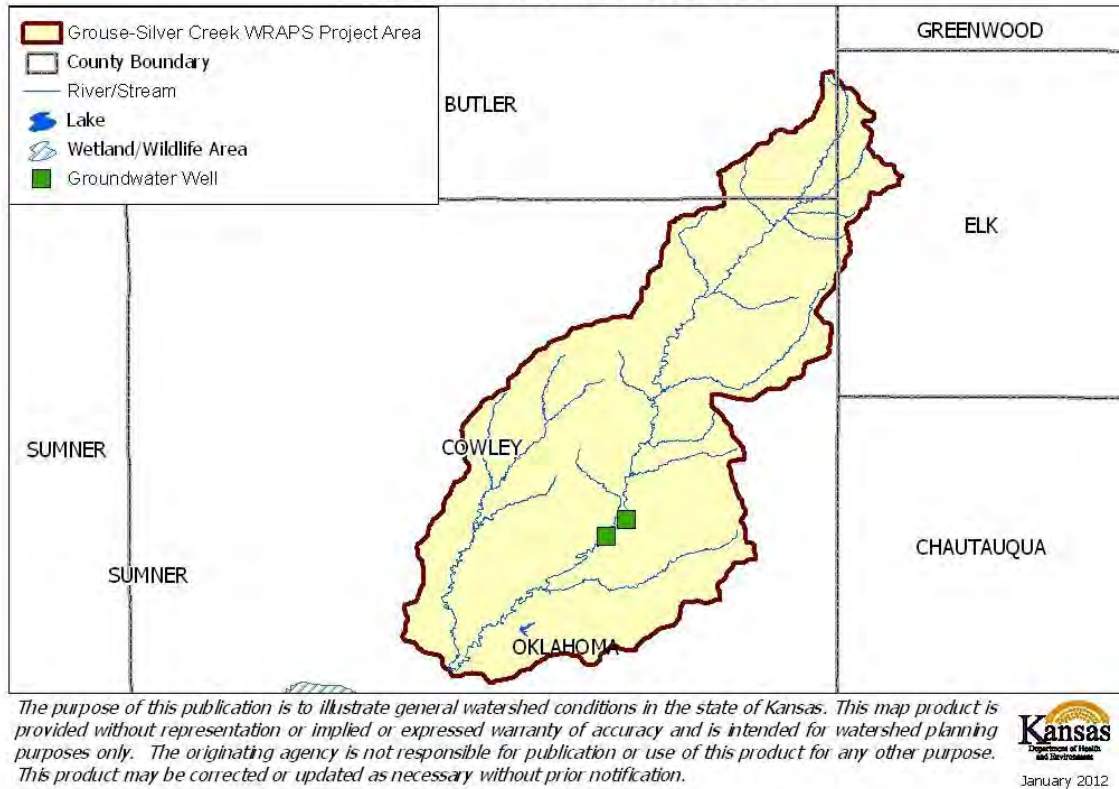


Figure 6

### C. Land Uses and Pollution Potential

GSCW is located in the Bluestem Hills land use area, often referred to as the Flint Hills tall grass prairie. The tall grass prairie is considered to be North America's most altered biome. Less than four percent of this globally unique grassland remains intact. The State of Kansas harbors 80% of the remaining North American tall grass prairie most of which is located in the Flint Hills of Kansas.

The watershed is 85% range and pasture which is primarily native grasses. Approximately 11% of the land area is cropland of which wheat, corn, soybeans, alfalfa and sorghum are the major crops. Approximately three percent of the watershed is in woodland followed by the urban areas with one percent of the total land mass (USGS).

Agricultural production is the primary industry in the watershed. Grasslands in the area support the largest cow herds of any Kansas county and are the destination of thousands of stockers each year. Approximately 52,000 head of cattle graze this prairie. Livestock production has the potential to create water quality concerns primarily in shaded riparian areas where livestock prefer to congregate on hot days. The pollution hazards come from

bacteria present in livestock waste and from erosion caused by livestock movement along streambanks.

The watershed is 11% cropland where grain crops are produced, see table 2 and Figure 7. The cropland is located in both the uplands and the riparian areas (see Figures 8a and 8b). The greatest potential for pollutants is the cropland located in the riparian areas; our main concern is excess nutrients and sediment that are fed into the stream in run off events.

Oilfield drilling and transfer of petroleum products via pipeline are prevalent in Cowley County and can pose problems with salt water and petroleum product spills and leaks. Particularly there are numerous salt water damaged acres which could benefit from remediation.

### **Land Use Inventory**

	<b>Cowley</b>	<b>Butler</b>	<b>Elk</b>
<b>Total Farms</b>	<b>1,004</b>	<b>1,310</b>	<b>410</b>
<b>Wheat harvested, acres</b>	<b>43,200</b>	<b>41,200</b>	<b>N/A</b>
<b>Sorghum harvested, acres</b>	<b>35,500</b>	<b>33,400</b>	<b>10,500</b>
<b>Corn Harvested, acres</b>	<b>8,600</b>	<b>40,100</b>	<b>4,300</b>
<b>Soybeans harvested, acres</b>	<b>67,200</b>	<b>48,100</b>	<b>6,200</b>
<b>Alfalfa harvested, acres</b>	<b>9,700</b>	<b>13,900</b>	<b>3,000</b>
<b>Grass hay harvested, acres</b>	<b>20,000</b>	<b>31,000</b>	<b>9,000</b>

Table 2 Cowley County Conservation District

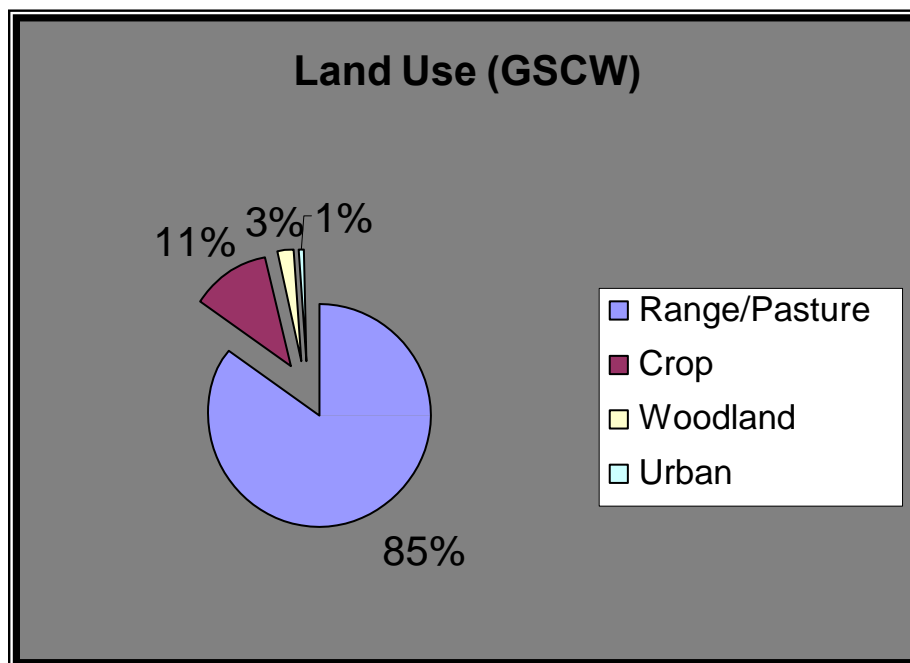
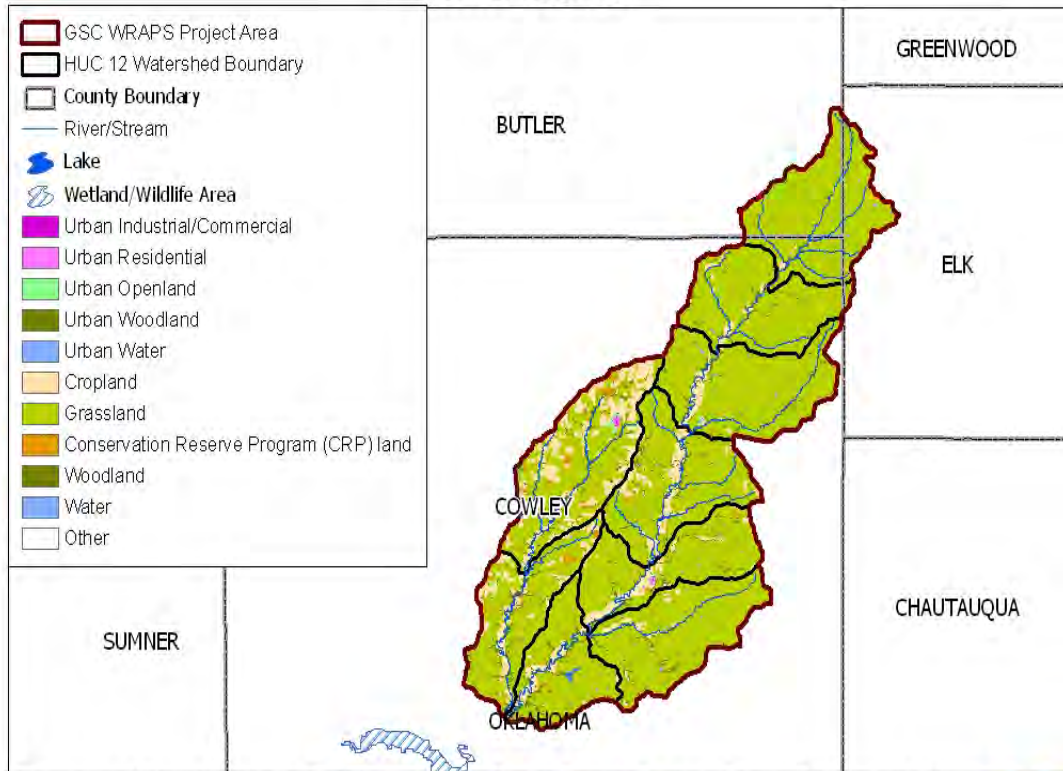


Figure 7



## Grouse-Silver Creek WRAPS Project Area Land Cover



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Figure 8a



# Grouse - Silver Creek Watershed (Cowley, Butler and Elk Counties, Kansas)

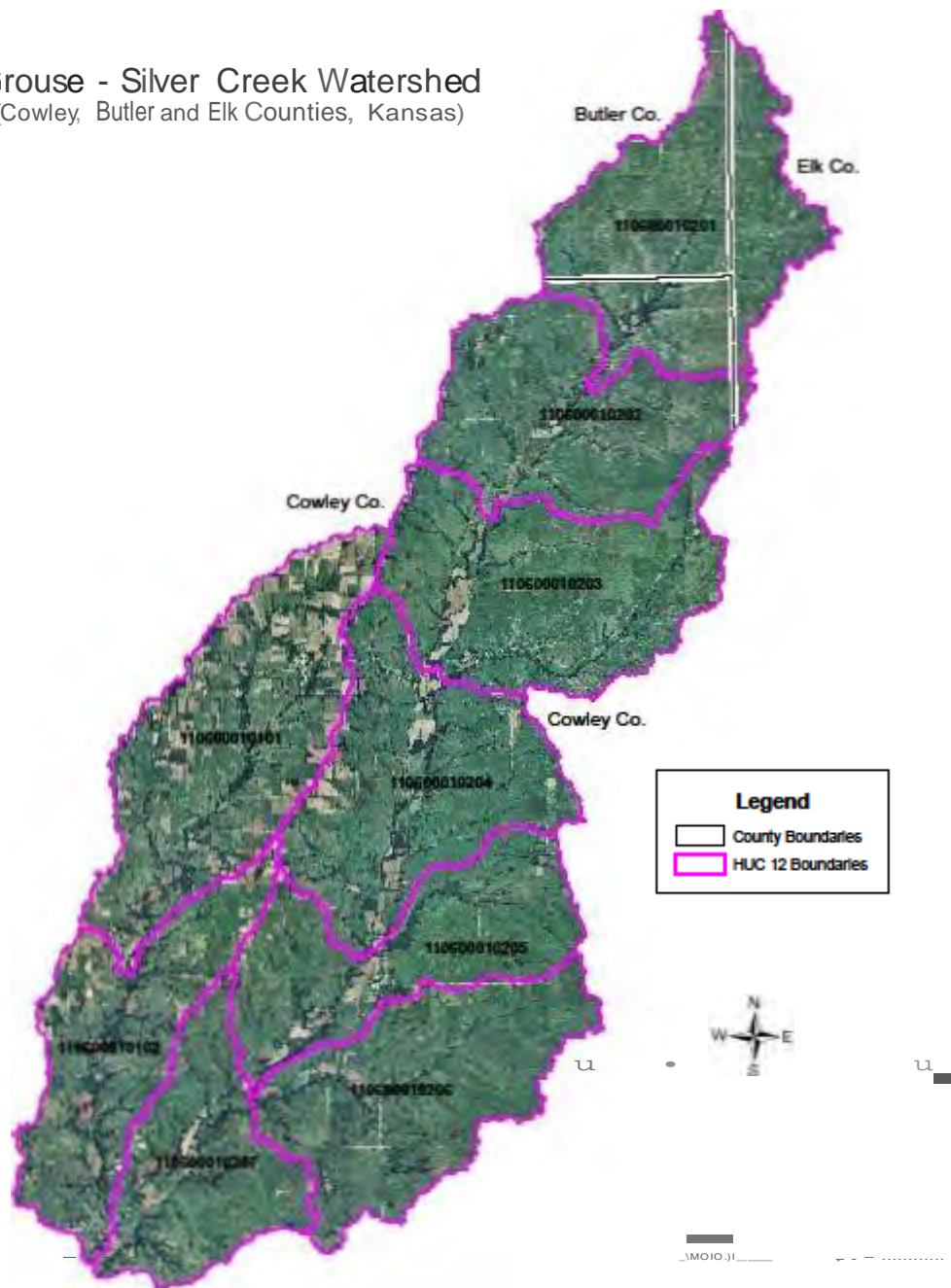


Figure 8b

### Confined Animal Feeding Operations

There are 62 registered confined feeding operations in Cowley County. Of these 62, five are located in GSCW. Three of the five are designated as active, two are inactive. The operations include dairy, beef and swine, see table 3 and Figure 9.

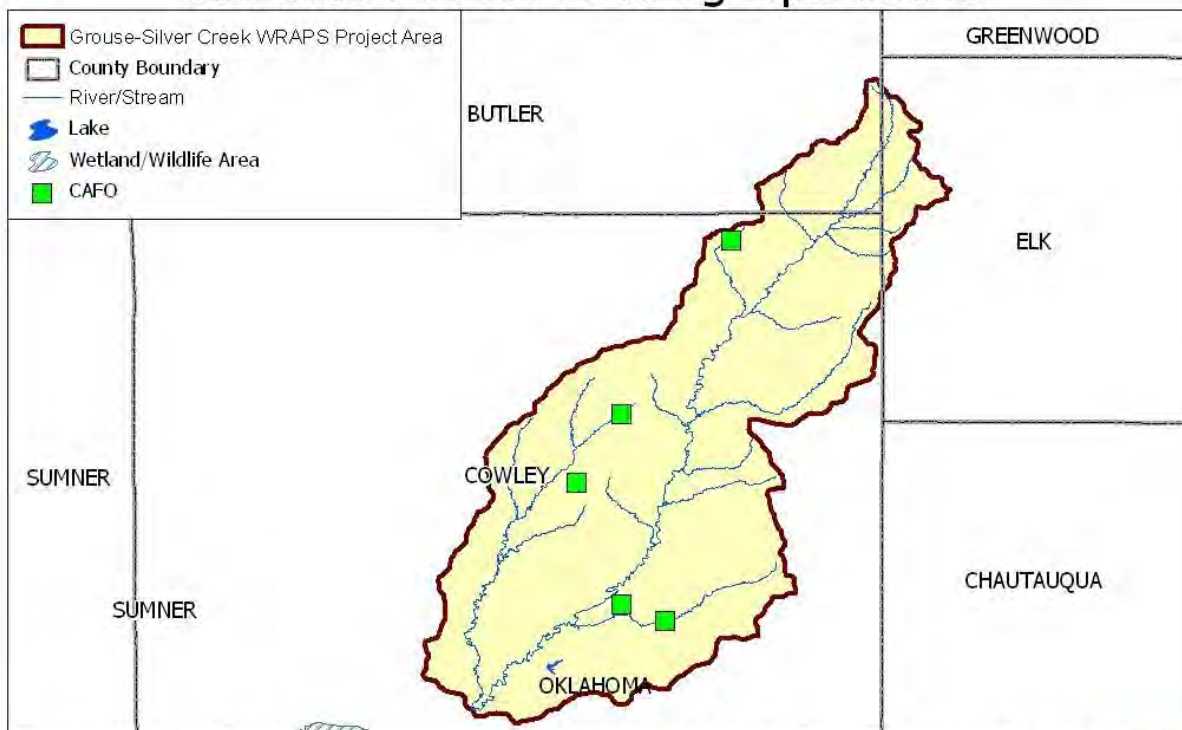
#### Confined Feeding Operations

Type of Operation	# of Operations	# of Animal Units
Dairy Operations	1	450
Beef Operations	3	90-750
Swine Operations	1	990

Table 3

Since the watershed consists predominantly of grassland acres there are also numerous non-confined animal feeding sites associated with grazing activities which can have a negative impact on water quality. Many of these areas consist of winter cattle feeding areas along the riparian zones of intermittent and perennial streams or are seasonal dry lot feeding, weaning and working areas.

### Grouse-Silver Creek WRAPS Project Area Confined Animal Feeding Operations



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Figure 9

#### ***D. Soils***

Soils are developed in residual (weathered) bedrock material, alluvial deposits and loess sediment. A high percentage of the soils of the watershed are shallow, stony, cherty and rocky. Clayey texture predominates, although many of the soils may have a silty clay loam surface. Arable upland soils will vary from two and one half to four or five feet to rock or parent materials. Internal drainage normally is relatively slow. Deep alluvial bottomland soils predominate along riparian corridors. Due to the flinty beds of limestone, large areas are unsuitable for row crop agriculture.

#### **Highly Erodible Land**

Approximately 1.4% of the cropland in Cowley County is considered Highly Erodible Land (HEL) and we estimate that there are 3,465 acres of HEL in Grouse-Silver Creek watershed.

#### **Acres subject to flooding**

There have been four soils identified in GSCW as having a potential for flooding. These include: Ivan, Brewer, Reading and a small percentage of Osage (Kansas FOTG KS-NRCS). The estimated acres are identified in table 4.

#### **Potential Wetlands**

A wetland is an environment at the interface between a terrestrial ecosystem and an aquatic ecosystem. Wetlands are recognized as being of significant environmental and economical importance (Environmental Protection Agency 1999) because they:

- Support a diverse range of plants and animals and provide habitat and refuge for many migratory and threatened species.
- Play an essential role in natural hydrological cycles, provide water passage and storage and may contribute to flood mitigation and the recharge of groundwater.
- Wetlands also act as a purifier by filtering nutrients and sediments in the water.
- They also contribute to the economic productivity of the state by providing essential water sources for agricultural, urban and industrial uses.

#### **Acres Subject to Flooding and Wetland Acres**

<b>7,703</b>	<b><i>Cropland acres subject to flooding in GSCW</i></b>
<b>3,714</b>	<b><i>Potential Wetlands in GSCW (NRI)</i></b>

Table 4



## Conservation Reserve Program (CRP) and Continuous Conservation Reserve Program (CCRP)

The Continuous Conservation Reserve Program and Conservation Reserve Program are voluntary programs that focus on using grasses and trees to protect soil, improve air and water quality and enhance fish and wildlife habitat through the use of buffers, filter strips and windbreaks, table 5a and 5b.

<i>CRP Participation</i>	<i>Total Acres</i>
CRP in Cowley County	7198.7
CRP in GSCW	752.2
CRP in Priority HUCs	306.8

Table 5a

\* Total Acres as of 06/2011

<i>CRP Practice in GSCW Priority HUCs</i>	<i># of Practices</i>	<i>Acres</i>
CP33 - Quail Buffer	6	86.1
CP21 – Filter Strip	6	71.3
CP22 – Riparian Buffer	1	2.1
CP2, CP10- Establish Permanent Native Grass	2	147.3
<i>Total</i>	<i>15</i>	<i>306.8</i>

Table 5b

\* Total Acres as of 06/2011



*Fenced Riparian Buffer (CP22) along Silver Creek*

### **III. Water Quality Condition**

#### ***A. Reference Streams***

Grouse Creek is considered a watershed in need of protection due to its pristine characteristics. Since 1982, Grouse Creek has been listed in the Nationwide Rivers Inventory (N.Ri.I.) compiled by the National Park Service based on the unique scenic, recreational, geological and fish and wildlife attributes. The N.Ri.I. is a source of information for statewide river assessments and federal agencies involved with stream related projects.

The former Kansas Fish and Game Commission designated Grouse Creek as a “highest valued fishery resource.” In Kansas it is listed as “exceptional state water” and “special aquatic life use water” in the Kansas surface water quality standards. It has also been regarded by the Kansas Department of Health and Environment, the Kansas Department of Wildlife and Parks and the Kansas Biological Survey as an eco-regional reference stream. Reference streams provide knowledge of the pre-settlement stream characteristics and the identification and study of minimally disturbed ecosystems to provide for the development of meaningful biological restoration goals.

#### ***B. Total Maximum Daily Load***

Total Maximum Daily Load (TMDL) is the amount of a particular pollutant that a particular stream, lake or other water body can 'handle' without impairing uses and violating state water quality standards. A water body can have a TMDL designation for dissolved oxygen, bacteria or eutrophication as an example. At this time the Grouse-Silver Creek watershed includes 3 impaired waters on the 2012 303 d list as illustrated in Table 6 below. Silver Creek dissolved oxygen TMDL will not be addressed by this watershed plan, the impairment is a result of low flow and temperature issues in-stream (Tom Stiles, KDHE-Watershed planning Section). The Cowley County State Fishing Lake (SFL) has a low priority TMDL for selenium, and a low priority eutrophication impairment. Since it has two low priority impairments, the Cowley County SFL will not be addressed through this watershed plan. The Grouse Silver Creek watershed SLT has focused the efforts of this plan to act as a watershed protection plan in order to focus nonpoint source reduction efforts around protecting the Exceptional State Water, Grouse Creek. The next TMDL review for this basin (Lower Arkansas) will occur in 2016, and again in 2021.

Table 6. The 2012 303d List of Impaired Waters

Name	Impaired Use	Impairment	Station	Counties	Body Type	Priority	Comments
Silver Creek	Aquatic Life	Dissolved Oxygen	SC706	Cowley	Stream	Medium	TMDL Approved on 9/11/2000
Cowley County SFL	Aquatic Life	Eutrophication	LM013401	Cowley	Lake	Low	
Cowley County SFL	Aquatic Life	Selenium	LM013401	Cowley	Lake	Low	TMDL Approved on 11/13/2000

(KDHE, Watershed Planning Section, Approved June 5, 2012)

#### **IV. Aquatic Community**

##### ***A. Macro invertebrates***

There are 36 species of fish in Grouse Creek and 29 in Silver Creek. One hundred three different macro invertebrate taxa have been collected from a site located just downstream of the confluence of Silver and Grouse Creeks. **When compared to the other 178 stream biological monitoring locations in Kansas, this site has demonstrated the highest median Ephemeroptera-Plecoptera-Trichoptera (EPT) score which is a value of 21.** The EPT is an indication of higher water quality. EPT taxa are pollution intolerant. This score is comparable to many higher quality Ozark streams. A total of 36 EPT taxa have been collected from this location. The high quality of the water in the stream is corroborated by the mussel community present. Their diversity, reproduction, distribution of age classes and the stream hydrology that supports this, demonstrates high water quality habitat and ecology. Studies on Grouse Creek and Silver Creek have yielded evidence of 15 of 21 species of fresh water mussel species.

Worldwide, freshwater mussels are one of the most endangered invertebrate groups with significant population declines documented in recent surveys. Reasons for the decline include siltation from agriculture and impoundments that alter the habitat and restrict the movement of fishes. This becomes detrimental to mussel species that rely on the migration of fishes to complete their life cycle. Most fresh water mussels depend on a fish host to complete transformation into juveniles. Larvae attach to the gill filaments, complete metamorphose and drop off to start a new generation. Agricultural runoff is another threat to mussel populations. Many species cannot tolerate pollutants introduced in the water from pesticides, herbicides, and fertilizers. Mussels are also sensitive to heavy metals which accumulate in the tissues.

## ***B. Fish***

The Bigeye Shiner, *Notropis boops* is proposed to be listed as threatened in Kansas. This species is restricted to four localized population clusters in Kansas. The Spring River and several of its tributaries in extreme southeast Kansas comprise one of these clusters. The remaining clusters comprise significantly disjunctive populations even though they are in close geographic proximity. These populations are in Grouse Creek, Elk River, Caney River and their tributaries. The species has not been abundant in recent collections from the Spring River Basin with collections never numbering more than ten specimens. The species has been moderately abundant to abundant in collections from Grouse Creek and Verdigris population centers numbering in the tens of hundreds per site. This species is being proposed for listing not because of declining numbers or dwindling range, but because of the threat leading to its peculiar pattern in this state. The greatest threat leading to its decline is attributed to siltation, increased turbidity and impoundment.

## **V. Riparian Inventory**

The riparian area is that area of land located immediately adjacent to streams, lakes or other surface waters. Some would describe it as the floodplain. The boundary of the riparian area and the adjoining uplands is gradual and not always well-defined. Riparian areas differ from the uplands because of high levels of soil moisture, frequent flooding and the unique assemblage of plant and animal communities found there.

Through the interaction of their soils, hydrology and biotic communities, riparian forests maintain many important physical, biological and ecological functions and social benefits. Research has shown that healthy riparian buffers at least 100 feet wide slow runoff and reduce sediment in surface water runoff as much as 90%. They are also effective in filtering out 80% of Nitrogen and Phosphorus while providing a beneficial and diverse habitat for wildlife.

Data used to obtain our riparian area needs was collected from the National Resources Inventory (NRI), which is a statistical survey of natural resource conditions and trends on non-federal land in the United States. Listed below are the NRI statistical survey definitions of riparian zones.

### **Definitions**

- a. **Forest Land** - Areas adjacent to a stream that contains trees with a canopy cover greater than 51% of the 100 ft. buffer zone.
- b. **Crop Land** – Areas adjacent to a stream where no trees are present and in which 51% or more of the 100 ft. buffer is planted or was planted during the previous growing season to a row crop, small grain or legume.
- c. **Grass Land** – Areas adjacent to a stream in which 51% or more of the 100 ft. buffer contains native or cool season grasses.
- d. **Urban Land** – Areas adjacent to a stream where 51% or more of the 100 ft. buffer contains dwellings or is located in an urban area and no trees are adjacent to the stream.
- e. **Gallery Forest / Grass Mix** – Grasses with a single row of trees next to the stream.
- f. **Gallery Forest / Crop land Mix** – Cropland with a single row of trees next to the stream.

Tables 7a and 7b illustrate the riparian acres along Grouse and Silver Creek in need of restoration practices.



**Table 7a: Riparian Inventory by Land Type and Acres with Treatment Options**

**Silver Creek**

Riparian Land Type	Linear Miles	Acres *	Possible Treatment Options
Forest Land	37.8	916.4	No Treatment Necessary
Gallery Forest & Grass Mix	62.5	1,515.00	Water Development and or Livestock Management
Galley Forest & Cropland	40.26	976	Filter Strips
Grasslands	39.72	963	Water Development and or Livestock Management
Cropland	34.32	832	Riparian Buffer and or Filter Strips
Urban Land	0.96	23	Onsite Waste and Animal Waste Treatment, Plugging of Abandoned Water Wells
<b>Total</b>	<b>215.56</b>	<b>4,309.00</b>	

**Table 7b: Riparian Inventory by Land Type and Acres with Treatment Options**

**Grouse Creek**

Riparian Land Type	Linear Miles	Acres *	Possible Treatment Options
Forest Land	60.34	1,463	No Treatment Necessary
Gallery Forest & Grass Mix	118.24	2,866.00	Water Development and or Livestock Management
Galley Forest & Cropland	65.1	1,578	Filter Strips
Grasslands	214.92	5,210	Water Development and or Livestock Management
Cropland	30.2	732	Riparian Buffer and or Filter Strips
Urban Land	0.4	10	Onsite Waste and Animal Waste Treatment, Plugging of Abandoned Water Wells
<b>Total</b>	<b>489.2</b>	<b>13,395.70</b>	

\* Linear Miles X 200ft. wide (100ft. each side of creek) X 5,280 / 43,560 = Acres

## **VI. Invasive Species**

**A. Invasive Plant Species:** On July 1, 2000 sericea lespedeza (*Lespedeza cuneata*) was labeled as a noxious weed in Kansas. Sericea lespedeza is a non-native invasive plant that threatens the health of prairie and rangeland in the GSCW. The threat to native prairie is the potential for sericea lespedeza to out compete and replace native Kansas prairie plants. In 2004 an inventory was completed indicating that Cowley County has approximately 64,200 grassland acres (17.3%) that are infested with sericea lespedeza. The economic loss is doubled for cattle ranchers. First, there is the tremendous loss of valuable native grasses as forage. Second, the rancher has the responsibility of eradicating sericea lespedeza on his property. Table 8 identifies the costs associated with the most common form of treatment, use of expensive chemicals.

### **Cost estimate to treat Sericea Lespedeza for one year in GSCW**

(Estimates based on the average price of the herbicides Escort and Remedy, labor and equipment included.)

Level of Infestation	Cost/Acre**	%	Infested Acres	Cost*
Sparse	\$1.60	.25	8,271ac	\$13,233.60
Scattered	\$2.26	.25	8,271ac	\$18,692.46
Light	\$3.59	.15	4,963ac	\$17,817.17
Moderate	\$6.78	.10	3,309ac	\$22,435.02
Heavy	\$13.14	.10	3,309ac	\$43,480.26
Severe (Broadcast)	\$19.80	.15	4,963ac	\$98,267.40
<b>Total</b>		<b>100</b>	<b>33,086 ac</b>	<b>\$213,925.91</b>

**Table 8** \*\*Cost analysis of spot spraying (using hired labor @\$25/hr).

\* Conservative estimate compiled from the Cowley County Sericea Lespedeza Inventory

The potential impact of sericea lespedeza on water quality is twofold. 1) Reduced rangeland condition as it displaces native species can have a negative impact on water retention and groundwater recharge and 2) increased sediment loading in surface waters. Control of sericea will require a long-term effort by land managers. Sericea seed can remain viable for more than 30 years and can be spread by water, wildlife and livestock, making eradication unlikely. Control measures must begin as soon as the first plants are detected and yearly treatments will be required to maintain control. Table 9 shows the level of infestation for different regions of Cowley County.

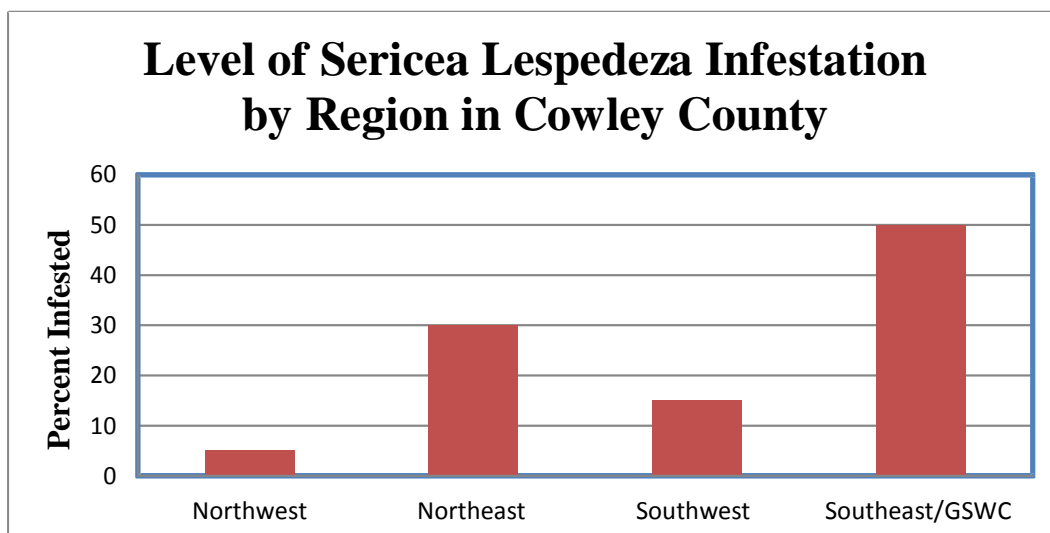


Table 9

### ***B. Invasive Animal Species***

*Sus scrofa* or feral hog populations are on the rise across the United States and are making their presence known in the watershed. Wild hogs can cause extensive damage to property and wildlife and their rooting activities can cause severe soil erosion to river banks and the riparian areas along streams.

Destruction of native vegetation occurs as the hogs dig for food, travel in herds, and create wallows for nesting. They will eat native animals, such as ground nesting birds and their eggs and are responsible for displacing native wildlife species. They also act as crop pests causing damage each year as they procure food.

### **VII. NRI Rangeland Condition**

The primary use of the land area is range and pasture, which is largely in native grasses. Well managed native grass rangelands provide a stable source of diverse plants supporting the livestock industry, upland wildlife and water quality. The NRI data that was compiled in 1992 indicates that approximately 47% Cowley County's pasture and rangeland acres are in need of treatment due to declining rangeland conditions, increase of brush and trees and invasion of invasive and noxious plant species see Table 10.

Producers have been completing practices to control brush, invasive species and declining range conditions through NRCS supported programs. The acres that have been left untreated have continued to experience an increase in brush and invasive species encroachment; this creates a static situation that will require continued treatment. By using BMP's which include Prescribed Grazing, Pest Management, Brush Management and Livestock Water Developments, we can address problems facing the pasture/rangeland in the Grouse-Silver Creek Watershed.

#### **Rangeland Condition Inventory\*\***

Land Descriptions	Acres	Percentage
Total Cowley County Acres	<b>724,845</b>	<b>---</b>
Total Cowley County Pasture/Rangeland Acres	<b>409,400</b>	<b>56.6%</b>
Total Cowley County Pasture/Rangeland Acres Needing Treatment	<b>194,577</b>	<b>47.5%</b>
Total Grouse-Silver Creek Watershed Acres	<b>249,750</b>	<b>----</b>
Total Pasture/Rangeland Acres in Grouse-Silver Creek Watershed	<b>212,287.5</b>	<b>85%</b>
Total Pasture/Rangeland Acres in Grouse-Silver Creek Watershed Needing Treatment	<b>100,836.5</b>	<b>47.5%</b>

Table 10

\*\* Figures are based on the assumption that the average acres of range/pastureland in Cowley County needing treatment is at the same rate as the range/pastureland in GSCW.

## **VIII. Transportation**

The transportation system within the watershed consists of paved, gravel and dirt roads as well as a rail system, see Table 11. Thirty two percent of the paved roads are maintained by the Kansas Department of Transportation with Cowley County Road and Bridge maintaining the remaining paved roads. Townships within the watershed are responsible for the maintenance of the dirt and gravel roads. The primary potential pollutant sources from the paved roads are runoff of de-icing products, herbicide residue from roadside spraying, and sand or gravel that is applied throughout the year.

The rail system in Grouse-Silver Creek Watershed is 17 miles of track that are utilized to transport mainly grain. Potential pollution from the railroad is herbicide residue from right of way spraying.

**Transportation Inventory**

System Description	Miles	Percentage
Paved Roads in County State Maintained	159	35%
Paved Roads in County County Maintained	295	65%
Paved Roads in Watershed State Maintained	37	30%
Paved Roads in Watershed County Maintained	90	70%
Dirt/Gravel Roads in County	1321	----
Dirt/Gravel Roads in Watershed	295	22%
Railroad in County	66	----
Railroad in Watershed	17	26%

Table 11

## **IX. Recreation**

The two cities in the watershed, Burden and Dexter, have city parks and sports facilities at the local schools. The potential for pollution from these facilities comes from runoff of herbicide and fertilizer applied to the grassed areas. Recommendations are made to the entities responsible for maintenance, reinforcing proper application procedures for the chemicals utilized.

Water recreation in the watershed is limited to non-motorized vessels on both Grouse and Silver creeks as well as fishing and swimming activities. The SLT is gathering information regarding additional recreation opportunities for landowners to pursue, but no additional activities are planned at this time.

## **X. WRAPS Goal and Targeted Areas**

The goal of this plan is to reduce Total Phosphorus and Total Suspended Solids loading to improve or maintain water quality for protection of designated uses in the Grouse-Silver Creek Watershed. Priority areas are designated by Hydrologic Unit Code (HUC) which is the numeration of drainage areas, the smaller the drainage area the higher the HUC number.

### ***A. Targeted HUCs.***

The stakeholder leadership team for the Grouse-Silver Creek Watershed has identified four initial priority hydrologic unit code twelve's in the watershed to target their protection efforts. These areas were identified for their proximity of cropland to the streams. Cropland appears to be the primary sources of pollutants having the greatest potential to cause impairments to the waters. Run off and flood events of this cropland that is directly adjacent to the streams provide a potential source of pollution from excess nutrients and sediment. KDHE sampling sites are also located in proximity to these areas and can be used for monitoring progress. The HUCs identified are 110600010102 Lower Silver Creek, 110600010205 Plum Creek-Grouse Creek, 110600010206 Crabb Creek-Grouse Creek, and 110600010207 Panther Creek-Grouse Creek. The priority HUCs are all located in the lower portion of the watershed ending at U.S. Hi-way 166.

The SLT also indentified two additional drainage areas in the upper reaches of the watershed due to characteristics of a high quality heritage stream. These areas will be targeted for protection to maintain these characteristics that can be adversely affected during seasonal run off events. The HUC 12's are 110600010201 Wagoner Creek and 110600010202 Gardners branch. Figure 10 depicts targeted areas on page 24.

### ***B. Load Reductions***

#### **Grouse Creek and Silver Creek Estimated Total Phosphorus and Total Suspended Solids Loads**

Flow estimates for Grouse Creek and Silver Creek were based on a regression equation between observed flows on the Walnut River at Winfield in Cowley County at USGS gauging station 07147800 and the USGS estimated flows calculated for Grouse Creek and Silver Creek priority areas (Perry, 2004) (Tables 12a-12d). Because Grouse Creek streams are typically good in water quality, load reductions were focused on runoff conditions during April through June (i.e. 90 days). This is what is referred to as "seasonally" in the table below.

#### **Grouse Creek, KDHE Permanent Sampling Station SC531 (1990-2010):**

Total Phosphorus (TP) concentrations in Grouse Creek average 0.104 mg/l over all flow conditions. Generally concentrations increase as flows increase. The current phosphorus target loads are based on maintaining an average TP concentration of .135 mg/l of TP under run off conditions.

Grouse Creek TP Seasonal Loading Estimates and Needed Reductions:

Sub-Watershed	Time Period	Current	Desired	Reduction
<b>Panther Creek</b>	Seasonally	495#	396#	99#
<b>Crabb Creek</b>	Seasonally	1980#	1575#	405#
<b>Plum Creek</b>	Seasonally	657#	522#	135#
<b>Wagoner Creek</b>	Seasonally	1362#	1042#	320#
<b>Gardners Branch</b>	Seasonally	1363#	1043#	320#

Table 12a

Table 12b below shows Total Suspended Solids (TSS) concentrations in Grouse Creek average 74 mg/l, with a median concentration of 25 mg/l. TSS concentrations increase as flows increase. The TSS target loads are based on maintaining an average TSS concentration of 156 mg/l under run off conditions.

Grouse Creek TSS Seasonal Loading Estimates and Needed Reductions:

Sub-Watershed	Time Period	Current	Desired	Reduction
<b>Panther Creek</b>	Seasonally	257.8 Tons	227.2 Tons	30.6 Tons
<b>Crabb Creek</b>	Seasonally	1032.3 Tons	909.9 Tons	122.4 Tons
<b>Plum Creek</b>	Seasonally	344.25 Tons	303.3Tons	40.95 Tons
<b>Wagoner Creek</b>	Seasonally	945 Tons	835 Tons	110 Tons
<b>Gardners Branch</b>	Seasonally	945 Tons	835Tons	110 Tons

Table 12b

**Silver Creek, KDHE Rotational Sampling Station SC706 (1996-2008):**

Table 12c below shows Total Phosphorus (TP) concentrations in Silver average 0.106 mg/l over all flow conditions. Generally concentrations increase as flows increase. The current phosphorus target loads are based on maintaining an average TP concentration of 0.1 mg/l of TP under all flow conditions.

Silver Creek TP Seasonal Loading Estimates and Needed Reductions:

Sub-Watershed	Time Period	Current	Desired	Reduction
<b>Lower Silver</b>	Seasonally	1296#	972#	324#

Table 12c

Table 12d below shows Total Suspended Solids (TSS) concentrations in Silver Creek average 46 mg/l, with a median concentration of 17 mg/l. Generally, TSS concentrations increase as flows increase. The TSS target loads are based on maintaining an average TSS concentration of 46 mg/l under all flow off conditions.

Silver Creek TSS Seasonal Loading Estimates and Needed Reductions:

Sub-Watershed	Time Period	Current	Desired	Reduction
<b>Lower Silver</b>	Seasonally	256.5 Tons	218.7 Tons	37.8 Tons

Table 12d

### Targeted Areas Grouse-Silver Creek Watershed

This map illustrates the Grouse-Silver Creek Watershed, divided into several color-coded target areas. The watershed includes numerous creeks such as Silver Cr., Plum Cr., Snake Cr., Rabbit Cr., Turkey Cr., Bullington Cr., Crabtree Cr., Beaver Cr., Spring Cr., Myers Cr., Shadbrook Cr., Little Bear Cr., Otter Cr., Kaw W.A., Chillicothe Cr., Frenchlin Cr., Grouse Cr., Hogover Cr., Bailey Cr., Ferguson Cr., Cedar Cr., and Gardner's Branch. Specific locations are marked with green dots and labeled: SC706 near Conway Co. SFL, SC531 near Kaw W.A., and SC664 near Beaver Cr.

Figure 10



## XI. Best Management Practices

All BMPs below were selected by the SLT identified priority management practices to help achieve water quality goals. Cost-share and/or technical assistance will be provided in the manner outlined in Table 13, all projects will be required to meet NRCS specifications. Only practices with a “\*” are included in the BMP implementation schedule with load reductions and therefore will be eligible for EPA Section 319 funds.

**Table 13: Best Management Practices**

Best Management Practice	Description of Practice
*Grazing-plans/rotational	Manage the controlled harvest of vegetation with grazing animals. Improve or maintain water quality and quantity. Reduce accelerated soil erosion, and maintain or improve soil condition. T/A to operators for the development of grazing and rotational grazing plans.
Water development	To provide water for livestock, fish and wildlife, recreation, fire control, and other related uses and to maintain or improve water quality. T/A for site selection and design. C/S for components necessary for functional system.
*Off stream watering system (fencing may be included)	A water impoundment made by constructing an embankment or by excavating a pit or dugout. T/A for design. C/S for components necessary for functional system.
Sericea Lespedeza control	Utilize environmentally sensitive prevention, avoidance, monitoring and suppression strategies to manage weeds, and other invasive species. Minimize negative impacts of pest control on soil resources, water resources, air resources, plant resources, animal resources and/or humans. C/S for chemical control.
Brush Management	Utilize environmentally sensitive prevention, avoidance, monitoring and suppression strategies to remove, reduce or manipulate non-herbaceous plants. Minimize negative impacts of pest control on soil resources, water resources, air resources, plant resources, animal resources and/or humans. C/S for mechanical or chemical control.
*Relocate Unconfined Livestock feeding-loafing areas (fencing may be included)	Stabilization of areas frequently and intensively used by animals by establishing vegetative cover, by surfacing with suitable materials, and/or installing needed structures. To reduce soil erosion, improve water quantity and quality. T/A for site selection and design. C/S for construction of hardened use area or access road to move feeding site to diverse locations.
*Stream Bank Stab	Treatment used to stabilize and protect banks of streams. To prevent the loss of land or damage to land uses or other facilities adjacent to the banks. Maintain the flow or storage capacity of the water body or to reduce the offsite or downstream effects of sediment resulting from bank erosion. T/A for design. C/S for excavation, trees, seedings, rock or other components necessary for functional system could include riparian restoration.

Best Management Practice	Description of Practice
*Riparian Restoration	Restoration can range from actively seeding and/or planting to passively allowing restoration through appropriate management and/or natural regeneration. The purpose is to reduce excessive amounts of sediment, organic material, nutrients, and pesticides in surface runoff and reduce excessive nutrients and other chemicals in shallow ground water flow. Improve stream bank stability, decrease velocity of stream flow during flooding, mitigate flood damage, and flatten flood peaks. T/A for design. C/S for trees, grass seeding, fences or other components necessary for functional system.
*Forest Stand Improvement	The manipulation of species composition, stand structure, and stocking by cutting or killing selected trees and understory vegetation. T/A for improvement planning.
*Cropland Structural-Terraces and Waterways	Install structures to reduce soil erosion and retain runoff for moisture conservation. T/A for design. C/S for construction of terraces or waterways that meet NRCS specifications
*Nutrient management-Crop rotation, cover crops, testing, etc.	Manage the amount, source, placement, form and timing of the application of nutrients and soil amendments. To minimize agricultural non-point source pollution of surface and ground water resources. T/A for implementation of crop rotations. C/S for soil testing.
*Cropland non-structural-no- till, cover crops, minimum till, contour farming, etc.	Manage the amount, orientation, and distribution of crop and other plant residues on the soil surface year-round, while growing crops in narrow slots, or tilled or residue free strips in soil previously untilled by full-width inversion implements. The intent is to reduce sheet and rill erosion, wind erosion and maintain or improve soil organic matter content. T/A for conversion to sustainable tillage practices.
*Grass Buffers	Install grass and riparian buffers to reduce excessive amounts of sediment, organic material, nutrients, and pesticides in surface runoff and reduce excessive nutrients and other chemicals in shallow ground water flow. Improve stream bank stability, decrease velocity of stream flow during flooding, mitigate flood damage, and flatten flood peaks. Establishment of woody vegetation may be from natural regeneration, live cuttings or tree/shrub plantings. C/S for riparian and grass buffers to include seed mixes and or trees, drill rental and planting fees.
*Native grass plantings-HEL/marginal cropland	Establishment or adapted perennial vegetation such as grasses, forbs, legumes and shrubs on HEL or marginal cropland to reduce soil erosion by wind or water. C/S for seed, drill rental and planting fees.
Brine scar remediation	Reducing or redistributing harmful concentrations of salt and/or sodium in a soil to maintain a chemical balance to permit desirable plants to grow and maintain or improve soil structure. C/S for critical area shaping, necessary amendments, seed mixes, drill rental and planting fees.

<b>Best Management Practice</b>	<b>Description of Practice</b>
Prevention or management of salt water intrusion	Control of toxic aqueous discharge from oil mining facilities. Improve water quality, eliminate unsightly residues, reduce erosion, and restore areas to beneficial use. T/A to landowners and leaseholders for remediating salt water spills and intrusion
Management of energy resource development	Review plans and make recommendations to KCC for development of energy production in the Grouse-Silver Creek Watershed.
Plugging of abandoned oil/gas wells	Provide contact information to the Kansas Corporation Commission. KCC regulates plugging of oil and gas wells.
Plugging of abandoned water wells	Plugging of abandoned water wells to decrease potential for pollution of ground water. C/S for components to properly plug wells.
Management of onsite-waste water	To biologically treat waste, such as manure and wastewater, and thereby reduce pollution potential by serving as a treatment component of a waste management system. C/S for repair of failing onsite-waste systems.
*Wetland creation/restoration	Restore hydric soil conditions, hydrologic conditions, hydrophytic plant communities, and wetland functions that occurred on the disturbed wetland site prior to modification to the extent practicable. C/S for planting wetland specific species of grass, drill rental and planting fees.

The following tables 12a-47 located between pages 25-48 contains the annual and 5 year cumulative implementation schedule scenarios utilizing the SLT selected (\* 319 eligible) BMPs above and respective estimated load reductions. Estimations are made for the entire WRAPS service area and broken out by targeted HUC 12 watersheds. They were provided by Kansas State University by request. As the load reduction goals are to help maintain good water quality conditions concentrating on runoff events, any proper implementation of BMPs will assist in protecting the water quality of the streams.

## **XII. Priority Watershed Treatment Needs**

- A. Inventories were completed in various parts of Grouse-Silver Creek Watershed to determine treatment needs to address water quality. This data was used to extrapolate the estimated needs for the priority HUCs based on percentage of acres in the watershed and land use. The Table 14 below identifies the treatment needs for WRAPS priority areas.

**Table 14. 5 Year Cropland Scenario**

<b>Grouse Creek WRAPS</b>	
<b>Acres of Cropland</b>	10,535
<b>BMP Implementation (treated acres)</b>	<b>Acres</b>
No-Till	1,550
Grassed Waterways	425
Vegetative Buffers	525
Nutrient Mgmt Plans	650
Terraces	425
Permanent Vegetation	30
Wetlands	13
<b>Total</b>	<b>3,618</b>
<b>Estimated Cost</b>	
<b>Total Investment Cost</b>	\$326,881
<b>Available Cost-Share</b>	\$168,882
<b>Net Cost</b>	<b>\$157,999</b>
<b>Estimated Annual Runoff Reduction</b>	
<b>Soil Erosion (tons)</b>	3,835
<b>Phosphorus (pounds)</b>	2,750
<b>Estimated Average Annual Runoff</b>	
<b>Soil Erosion (tons/acre)</b>	2.00
<b>Phosphorus (pounds/acre)</b>	2.00

The SLT in consultation with KDHE and others have decided on the BMPs within these tables will help them meet their load reduction goals to protect the targeted HUC 12 watersheds.

**Table 15. Annual Adoption (treated acres), Cropland BMPs**

Year	No-Till	Grassed Waterways	Vegetative Buffers	Nutrient Mgmt Plans	Terraces	Permanent Vegetation	Wetland Creation	Total Adoption
1	310	85	105	130	85	6	3	<b>724</b>
2	310	85	105	130	85	6	3	<b>724</b>
3	310	85	105	130	85	6	3	<b>724</b>
4	310	85	105	130	85	6	3	<b>724</b>
5	310	85	105	130	85	6	3	<b>724</b>
<b>Total</b>	<b>1,550</b>	<b>425</b>	<b>525</b>	<b>650</b>	<b>425</b>	<b>30</b>	<b>13</b>	<b>3,618</b>

**Table 16a. Sub Watershed Lower Silver Creek #102 Annual Adoption (treated acres), Cropland BMPs**

Year	No-Till	Grassed Waterways	Vegetative Buffers	Nutrient Mgmt Plans	Terraces	Permanent Vegetation	Wetland Creation	Total Adoption
1	100	25	23	20	25	1.0	0.5	<b>194</b>
2	100	25	23	20	25	1.0	0.5	<b>194</b>
3	100	25	23	20	25	1.0	0.5	<b>194</b>
4	100	25	23	20	25	1.0	0.5	<b>194</b>
5	100	25	23	20	25	1.0	0.5	<b>194</b>
<b>Total</b>	<b>500</b>	<b>125</b>	<b>113</b>	<b>100</b>	<b>125</b>	<b>5</b>	<b>3</b>	<b>970</b>

**Table 16b. Sub Watershed Wagoner Creek #201 Annual Adoption (treated acres), Cropland BMPs**

Year	No-Till	Grassed Waterways	Vegetative Buffers	Nutrient Mgmt Plans	Terraces	Permanent Vegetation	Wetland Creation	Total Adoption
1	50	10	23	20	10	1.0	0.5	<b>114</b>
2	50	10	23	20	10	1.0	0.5	<b>114</b>
3	50	10	23	20	10	1.0	0.5	<b>114</b>
4	50	10	23	20	10	1.0	0.5	<b>114</b>
5	50	10	23	20	10	1.0	0.5	<b>114</b>
<b>Total</b>	<b>250</b>	<b>50</b>	<b>113</b>	<b>100</b>	<b>50</b>	<b>5</b>	<b>3</b>	<b>570</b>

**Table 16c. Sub Watershed Gardener's Branch #202 Annual Adoption (treated acres), Cropland BMPs**

Year	No-Till	Grassed Waterways	Vegetative Buffers	Nutrient Mgmt Plans	Terraces	Permanent Vegetation	Wetland Creation	Total Adoption
1	80	25	23	20	25	1.0	0.5	<b>174</b>
2	80	25	23	20	25	1.0	0.5	<b>174</b>
3	80	25	23	20	25	1.0	0.5	<b>174</b>
4	80	25	23	20	25	1.0	0.5	<b>174</b>
5	80	25	23	20	25	1.0	0.5	<b>174</b>
<b>Total</b>	<b>400</b>	<b>125</b>	<b>113</b>	<b>100</b>	<b>125</b>	<b>5</b>	<b>3</b>	<b>870</b>

**Table 16d .Sub Watershed Plum Creek-Grouse Creek #205 Annual Adoption (treated ac.), Crop BMPs**

Year	No-Till	Grassed Waterways	Vegetative Buffers	Nutrient		Permanent Vegetation	Wetland Creation	Total Adoption
				Mgmt Plans	Terraces			
1	10	5	8	10	5	1.0	0.5	<b>39</b>
2	10	5	8	10	5	1.0	0.5	<b>39</b>
3	10	5	8	10	5	1.0	0.5	<b>39</b>
4	10	5	8	10	5	1.0	0.5	<b>39</b>
5	10	5	8	10	5	1.0	0.5	<b>39</b>
<b>Total</b>	<b>50</b>	<b>25</b>	<b>38</b>	<b>50</b>	<b>25</b>	<b>5</b>	<b>3</b>	<b>195</b>

**Table 16e. Sub Watershed Crabb Creek-Grouse Creek #206 Annual Adoption (treated ac.), Crop BMPs**

Year	No-Till	Grassed Waterways	Vegetative Buffers	Nutrient		Permanent Vegetation	Wetland Creation	Total Adoption
				Mgmt Plans	Terraces			
1	20	10	15	10	10	1.0	0.3	<b>66</b>
2	20	10	15	10	10	1.0	0.3	<b>66</b>
3	20	10	15	10	10	1.0	0.3	<b>66</b>
4	20	10	15	10	10	1.0	0.3	<b>66</b>
5	20	10	15	10	10	1.0	0.3	<b>66</b>
<b>Total</b>	<b>100</b>	<b>50</b>	<b>75</b>	<b>50</b>	<b>50</b>	<b>5</b>	<b>1</b>	<b>331</b>

**Table 16f. Sub Watershed Panther Creek-Grouse Creek #207 Annual Adoption (treated ac.), Crop BMPs**

Year	No-Till	Grassed Waterways	Vegetative Buffers	Nutrient		Permanent Vegetation	Wetland Creation	Total Adoption
				Mgmt Plans	Terraces			
1	50	10	15	50	10	1.0	0.3	<b>136</b>
2	50	10	15	50	10	1.0	0.3	<b>136</b>
3	50	10	15	50	10	1.0	0.3	<b>136</b>
4	50	10	15	50	10	1.0	0.3	<b>136</b>
5	50	10	15	50	10	1.0	0.3	<b>136</b>
<b>Total</b>	<b>250</b>	<b>50</b>	<b>75</b>	<b>250</b>	<b>50</b>	<b>5</b>	<b>1</b>	<b>681</b>

**Table 17. Total Cropland BMP Adoption Milestones**

	Year	No-Till	Grassed Waterways	Vegetative Buffers	Nutrient		Permanent Vegetation	Wetland Creation	Total Adoption
					Mgmt Plans	Terraces			
<b>Short Term</b>	1	310	85	105	130	85	6	3	724
	2	310	85	105	130	85	6	3	724
	3	310	85	105	130	85	6	3	724
	4	310	85	105	130	85	6	3	724
	5	310	85	105	130	85	6	3	724
<b>Total</b>		<b>1,550</b>	<b>425</b>	<b>525</b>	<b>650</b>	<b>425</b>	<b>30</b>	<b>13</b>	<b>3,618</b>

**Table 18. Annual Soil Erosion Reduction (tons)**

Year	No-Till	Grassed Waterways	Vegetative Buffers	Nutrient		Permanent Vegetation	Wetland Creation	Total
				Mgmt Plans	Terraces			
1	465	68	105	65	51	11	2	<b>767</b>
2	930	136	210	130	102	23	3	<b>1,534</b>
3	1,395	204	315	195	153	34	5	<b>2,301</b>
4	1,860	272	420	260	204	46	6	<b>3,068</b>
5	2,325	340	525	325	255	57	8	<b>3,835</b>

**Table 19a. Sub Watershed Lower Silver Creek #102 Annual Soil Erosion Reduction (tons)**

Year	No-Till	Grassed Waterways	Vegetative Buffers	Nutrient		Permanent Vegetation	Wetland Creation	Total
				Mgmt Plans	Terraces			
1	150	20	23	10	15	2	0.3	<b>220</b>
2	300	40	45	20	30	4	0.6	<b>439</b>
3	450	60	68	30	45	6	0.9	<b>659</b>
4	600	80	90	40	60	8	1.2	<b>879</b>
5	750	100	113	50	75	10	1.5	<b>1,099</b>

**Table 19b. Sub Watershed Wagoner Creek #201 Annual Soil Erosion Reduction (tons)**

Year	No-Till	Grassed Waterways	Vegetative Buffers	Nutrient		Permanent Vegetation	Wetland Creation	Total
				Mgmt Plans	Terraces			
1	75	8	23	10	6	2	0.3	<b>124</b>
2	150	16	45	20	12	4	0.6	<b>247</b>
3	225	24	68	30	18	6	0.9	<b>371</b>
4	300	32	90	40	24	8	1.2	<b>495</b>
5	375	40	113	50	30	10	1.5	<b>619</b>



**Table 19c. Sub Watershed Gardener's Branch #202 Annual Soil Erosion Reduction (tons)**

Year	No-Till	Grassed Waterways	Vegetative Buffers	Nutrient		Permanent Vegetation	Wetland Creation	Total
				Mgmt Plans	Terraces			
1	120	20	23	10	15	2	0.3	<b>190</b>
2	240	40	45	20	30	4	0.6	<b>379</b>
3	360	60	68	30	45	6	0.9	<b>569</b>
4	480	80	90	40	60	8	1.2	<b>759</b>
5	600	100	113	50	75	10	1.5	<b>949</b>

**Table 19d. Sub Watershed Plum Creek-Grouse Creek #205 Annual Soil Erosion Reduct. (tons)**

Year	No-Till	Grassed Waterways	Vegetative Buffers	Nutrient		Permanent Vegetation	Wetland Creation	Total
				Mgmt Plans	Terraces			
1	15	4	8	5	3	2	0.3	<b>37</b>
2	30	8	15	10	6	4	0.6	<b>73</b>
3	45	12	23	15	9	6	0.9	<b>110</b>
4	60	16	30	20	12	8	1.2	<b>147</b>
5	75	20	38	25	15	10	1.5	<b>184</b>

**Table 19e. Sub Watershed Crabb Creek-Grouse Creek #206 Annual Soil Erosion Reduct. (tons)**

Year	No-Till	Grassed Waterways	Vegetative Buffers	Nutrient		Permanent Vegetation	Wetland Creation	Total
				Mgmt Plans	Terraces			
1	30	8	15	5	6	2	0.2	<b>66</b>
2	60	16	30	10	12	4	0.3	<b>132</b>
3	90	24	45	15	18	6	0.5	<b>198</b>
4	120	32	60	20	24	8	0.6	<b>264</b>
5	150	40	75	25	30	10	0.8	<b>330</b>

**Table 19f. SubWatershed Panther Creek-Grouse Creek#207 Annual Soil Erosion Reduct (tons)**

Year	No-Till	Grassed Waterways	Vegetative Buffers	Nutrient		Permanent Vegetation	Wetland Creation	Total
				Mgmt Plans	Terraces			
1	75	8	15	25	6	2	0.2	<b>131</b>
2	150	16	30	50	12	4	0.3	<b>262</b>
3	225	24	45	75	18	6	0.5	<b>393</b>
4	300	32	60	100	24	8	0.6	<b>524</b>
5	375	40	75	125	30	10	0.8	<b>655</b>

**Table 20. Annual Phosphorus Reduction (pounds)**

Year	No-Till	Grassed Waterways	Vegetative Buffers	Nutrient		Permanent Vegetation	Wetland Creation	Total
				Mgmt Plans	Terraces			
1	248	68	105	65	51	11	2	<b>550</b>
2	496	136	210	130	102	23	3	<b>1,100</b>
3	744	204	315	195	153	34	5	<b>1,650</b>
4	992	272	420	260	204	46	6	<b>2,200</b>
5	1,240	340	525	325	255	57	8	<b>2,750</b>

**Table 21a. Sub Watershed Lower Silver Creek #102 Annual Phosphorus Reduction (lbs)**

Year	No-Till	Grassed Waterways	Vegetative Buffers	Nutrient		Permanent Vegetation	Wetland Creation	Total
				Mgmt Plans	Terraces			
1	80	20	23	10	15	2	0.3	<b>150</b>
2	160	40	45	20	30	4	0.6	<b>299</b>
3	240	60	68	30	45	6	0.9	<b>449</b>
4	320	80	90	40	60	8	1.2	<b>599</b>
5	400	100	113	50	75	10	1.5	<b>749</b>

**Table 21b. Sub Watershed Wagoner Creek #201 Annual Phosphorus Reduction (lbs)**

Year	No-Till	Grassed Waterways	Vegetative Buffers	Nutrient		Permanent Vegetation	Wetland Creation	Total
				Mgmt Plans	Terraces			
1	40	8	23	10	6	2	0.3	<b>89</b>
2	80	16	45	20	12	4	0.6	<b>177</b>
3	120	24	68	30	18	6	0.9	<b>266</b>
4	160	32	90	40	24	8	1.2	<b>355</b>
5	200	40	113	50	30	10	1.5	<b>444</b>

**Table 21c. Sub Watershed Gardener's Branch #202 Annual Phosphorus Reduction (lbs)**

Year	No-Till	Grassed Waterways	Vegetative Buffers	Nutrient		Permanent Vegetation	Wetland Creation	Total
				Mgmt Plans	Terraces			
1	64	20	23	10	15	2	0.3	<b>134</b>
2	128	40	45	20	30	4	0.6	<b>267</b>
3	192	60	68	30	45	6	0.9	<b>401</b>
4	256	80	90	40	60	8	1.2	<b>535</b>
5	320	100	113	50	75	10	1.5	<b>669</b>

**Table 21d. Sub Watershed Plum Creek-Grouse Creek #205 Annual Phosphorus Reduction (lbs)**

Year	No-Till	Grassed Waterways	Vegetative Buffers	Nutrient		Permanent Vegetation	Wetland Creation	Total
				Mgmt Plans	Terraces			
1	8	4	8	5	3	2	0.3	<b>30</b>
2	16	8	15	10	6	4	0.6	<b>59</b>
3	24	12	23	15	9	6	0.9	<b>89</b>
4	32	16	30	20	12	8	1.2	<b>119</b>
5	40	20	38	25	15	10	1.5	<b>149</b>

**Table 21e. Sub Watershed Crabb Creek-Grouse Creek #206 Phosphorus Reduction (lbs)**

Year	No-Till	Grassed Waterways	Vegetative Buffers	Nutrient		Permanent Vegetation	Wetland Creation	Total
				Mgmt Plans	Terraces			
1	16	8	15	5	6	2	0.2	<b>52</b>
2	32	16	30	10	12	4	0.3	<b>104</b>
3	48	24	45	15	18	6	0.5	<b>156</b>
4	64	32	60	20	24	8	0.6	<b>208</b>
5	80	40	75	25	30	10	0.8	<b>260</b>

**Table 21f. Sub Watershed Panther Creek-Grouse Creek#207 Annual Phosphorus Reduction (lbs)**

Year	No-Till	Grassed Waterways	Vegetative Buffers	Nutrient		Permanent Vegetation	Wetland Creation	Total
				Mgmt Plans	Terraces			
1	40	8	15	25	6	2	0.2	<b>96</b>
2	80	16	30	50	12	4	0.3	<b>192</b>
3	120	24	45	75	18	6	0.5	<b>288</b>
4	160	32	60	100	24	8	0.6	<b>384</b>
5	200	40	75	125	30	10	0.8	<b>480</b>

**Table 22. Total Annual Cost Before Cost-Share, Cropland BMPs**

Year	No-Till	Grassed Waterways	Vegetative Buffers	Nutrient		Permanent Vegetation	Wetland Creation	Total Cost
				Mgmt Plans	Terraces			
1	\$24,084	\$13,600	\$7,000	\$7,372	\$8,670	\$900	\$3,750	<b>\$65,376</b>
2	\$24,806	\$14,008	\$7,210	\$7,593	\$8,930	\$927	\$3,863	<b>\$67,337</b>
3	\$25,551	\$14,428	\$7,426	\$7,821	\$9,198	\$955	\$3,978	<b>\$69,358</b>
4	\$26,317	\$14,861	\$7,649	\$8,056	\$9,474	\$983	\$4,098	<b>\$71,438</b>
5	\$27,107	\$15,307	\$7,879	\$8,298	\$9,758	\$1,013	\$4,221	<b>\$73,581</b>

**Table 23a. Sub Watershed Lower Sliver Cr. #102 Total Annual Cost Before Cost-Share, Crop BMPs**

Year	No-Till	Grassed Waterways	Vegetative Buffers	Nutrient		Permanent Vegetation	Wetland Creation	Total Cost
				Mgmt Plans	Terraces			
1	\$7,769	\$4,000	\$1,500	\$1,134	\$2,550	\$150	\$750	<b>\$17,853</b>
2	\$8,002	\$4,120	\$1,545	\$1,168	\$2,627	\$155	\$773	<b>\$18,389</b>
3	\$8,242	\$4,244	\$1,591	\$1,203	\$2,705	\$159	\$796	<b>\$18,940</b>
4	\$8,489	\$4,371	\$1,639	\$1,239	\$2,786	\$164	\$820	<b>\$19,509</b>
5	\$8,744	\$4,502	\$1,688	\$1,277	\$2,870	\$169	\$844	<b>\$20,094</b>

**Table 23b. Sub Watershed Wagoner Cr. #201 Total Annual Cost Before Cost-Share, Cropland BMPs**

Year	No-Till	Grassed Waterways	Vegetative Buffers	Nutrient		Permanent Vegetation	Wetland Creation	Total Cost
				Mgmt Plans	Terraces			
1	\$3,885	\$1,600	\$1,500	\$1,134	\$1,020	\$150	\$750	<b>\$10,039</b>
2	\$4,001	\$1,648	\$1,545	\$1,168	\$1,051	\$155	\$773	<b>\$10,340</b>
3	\$4,121	\$1,697	\$1,591	\$1,203	\$1,082	\$159	\$796	<b>\$10,650</b>
4	\$4,245	\$1,748	\$1,639	\$1,239	\$1,115	\$164	\$820	<b>\$10,970</b>
5	\$4,372	\$1,801	\$1,688	\$1,277	\$1,148	\$169	\$844	<b>\$11,299</b>

**Table 23c. Sub Watershed Gardener's Branch #202 Total Annual Cost Before Cost-Share, Crop BMPs**

Year	No-Till	Grassed Waterways	Vegetative Buffers	Nutrient		Permanent Vegetation	Wetland Creation	Total Cost
				Mgmt Plans	Terraces			
1	\$6,215	\$4,000	\$1,500	\$1,134	\$2,550	\$150	\$750	<b>\$16,299</b>
2	\$6,402	\$4,120	\$1,545	\$1,168	\$2,627	\$155	\$773	<b>\$16,788</b>
3	\$6,594	\$4,244	\$1,591	\$1,203	\$2,705	\$159	\$796	<b>\$17,292</b>
4	\$6,792	\$4,371	\$1,639	\$1,239	\$2,786	\$164	\$820	<b>\$17,811</b>
5	\$6,995	\$4,502	\$1,688	\$1,277	\$2,870	\$169	\$844	<b>\$18,345</b>

**Table 23d. Sub Watershed Plum Cr.-Grouse Cr. #205 Total Annual Cost Before Cost-Share, Crop BMPs**

Year	No-Till	Grassed Waterways	Vegetative Buffers	Nutrient		Permanent Vegetation	Wetland Creation	Total Cost
				Mgmt Plans	Terraces			
1	\$777	\$800	\$500	\$567	\$510	\$150	\$750	<b>\$4,054</b>
2	\$800	\$824	\$515	\$584	\$525	\$155	\$773	<b>\$4,176</b>
3	\$824	\$849	\$530	\$602	\$541	\$159	\$796	<b>\$4,301</b>
4	\$849	\$874	\$546	\$620	\$557	\$164	\$820	<b>\$4,430</b>
5	\$874	\$900	\$563	\$638	\$574	\$169	\$844	<b>\$4,563</b>

**Table 23e. Sub Watershed Crabb Cr.-Grouse Cr. #206 Total Annual Cost Before Cost-Share,Crop BMPs**

Year	No-Till	Grassed Waterways	Vegetative Buffers	Nutrient		Permanent Vegetation	Wetland Creation	Total Cost
				Mgmt Plans	Terraces			
1	\$1,554	\$1,600	\$1,000	\$567	\$1,020	\$150	\$375	<b>\$6,266</b>
2	\$1,600	\$1,648	\$1,030	\$584	\$1,051	\$155	\$386	<b>\$6,454</b>
3	\$1,648	\$1,697	\$1,061	\$602	\$1,082	\$159	\$398	<b>\$6,647</b>
4	\$1,698	\$1,748	\$1,093	\$620	\$1,115	\$164	\$410	<b>\$6,847</b>
5	\$1,749	\$1,801	\$1,126	\$638	\$1,148	\$169	\$422	<b>\$7,052</b>

**Table 23f. SubWatershed Panther Cr.-Grouse Cr. #207 Total Annual Cost Before Cost-Share,Crop BMPs**

Year	No-Till	Grassed Waterways	Vegetative Buffers	Nutrient		Permanent Vegetation	Wetland Creation	Total Cost
				Mgmt Plans	Terraces			
1	\$3,885	\$1,600	\$1,000	\$2,836	\$1,020	\$150	\$375	\$10,865
2	\$4,001	\$1,648	\$1,030	\$2,921	\$1,051	\$155	\$386	\$11,191
3	\$4,121	\$1,697	\$1,061	\$3,008	\$1,082	\$159	\$398	\$11,527
4	\$4,245	\$1,748	\$1,093	\$3,098	\$1,115	\$164	\$410	\$11,872
5	\$4,372	\$1,801	\$1,126	\$3,191	\$1,148	\$169	\$422	\$12,229

**Table 24. Total Annual Cost After Cost-Share, Cropland BMPs**

Year	No-Till	Grassed Waterways	Vegetative Buffers	Nutrient		Permanent Vegetation	Wetland Creation	Total Cost
				Mgmt Plans	Terraces			
1	\$14,691	\$6,800	\$700	\$3,686	\$4,335	\$450	\$938	<b>\$31,600</b>
2	\$15,132	\$7,004	\$721	\$3,797	\$4,465	\$464	\$966	<b>\$32,548</b>
3	\$15,586	\$7,214	\$743	\$3,911	\$4,599	\$477	\$995	<b>\$33,524</b>
4	\$16,053	\$7,431	\$765	\$4,028	\$4,737	\$492	\$1,024	<b>\$34,530</b>
5	\$16,535	\$7,653	\$788	\$4,149	\$4,879	\$506	\$1,055	<b>\$35,566</b>

**Table 25a. Sub Watershed Lower Sliver Cr. #102 Total Annual Cost After Cost-Share, Crop BMPs**

Year	No-Till	Grassed Waterways	Vegetative Buffers	Nutrient Mgmt Plans	Terraces	Permanent Vegetation	Wetland Creation	Total Cost
1	\$4,739	\$2,000	\$150	\$567	\$1,275	\$75	\$188	<b>\$8,994</b>
2	\$4,881	\$2,060	\$155	\$584	\$1,313	\$77	\$193	<b>\$9,264</b>
3	\$5,028	\$2,122	\$159	\$602	\$1,353	\$80	\$199	<b>\$9,541</b>
4	\$5,179	\$2,185	\$164	\$620	\$1,393	\$82	\$205	<b>\$9,828</b>
5	\$5,334	\$2,251	\$169	\$638	\$1,435	\$84	\$211	<b>\$10,122</b>

**Table 25b. Sub Watershed Wagoner Cr. #201 Total Annual Cost Before Cost-Share, Crop BMPs**

Year	No-Till	Grassed Waterways	Vegetative Buffers	Nutrient Mgmt Plans	Terraces	Permanent Vegetation	Wetland Creation	Total Cost
1	\$2,370	\$800	\$150	\$567	\$510	\$75	\$188	<b>\$4,659</b>
2	\$2,441	\$824	\$155	\$584	\$525	\$77	\$193	<b>\$4,799</b>
3	\$2,514	\$849	\$159	\$602	\$541	\$80	\$199	<b>\$4,943</b>
4	\$2,589	\$874	\$164	\$620	\$557	\$82	\$205	<b>\$5,091</b>
5	\$2,667	\$900	\$169	\$638	\$574	\$84	\$211	<b>\$5,244</b>

**Table 25c. SubWatershed Gardener's Branch #202 Total Annual Cost Before Cost-Share, Crop BMPs**

Year	No-Till	Grassed Waterways	Vegetative Buffers	Nutrient Mgmt Plans	Terraces	Permanent Vegetation	Wetland Creation	Total Cost
1	\$3,791	\$2,000	\$150	\$567	\$1,275	\$75	\$188	<b>\$8,046</b>
2	\$3,905	\$2,060	\$155	\$584	\$1,313	\$77	\$193	<b>\$8,287</b>
3	\$4,022	\$2,122	\$159	\$602	\$1,353	\$80	\$199	<b>\$8,536</b>
4	\$4,143	\$2,185	\$164	\$620	\$1,393	\$82	\$205	<b>\$8,792</b>
5	\$4,267	\$2,251	\$169	\$638	\$1,435	\$84	\$211	<b>\$9,056</b>

**Table 25d. SubWatershed PlumCr.-Grouse Cr. #205 Total Annual Cost Before Cost-Share, Crop BMPs**

Year	No-Till	Grassed Waterways	Vegetative Buffers	Nutrient Mgmt Plans	Terraces	Permanent Vegetation	Wetland Creation	Total Cost
1	\$474	\$400	\$50	\$284	\$255	\$75	\$188	<b>\$1,725</b>
2	\$488	\$412	\$52	\$292	\$263	\$77	\$193	<b>\$1,777</b>
3	\$503	\$424	\$53	\$301	\$271	\$80	\$199	<b>\$1,830</b>
4	\$518	\$437	\$55	\$310	\$279	\$82	\$205	<b>\$1,885</b>
5	\$533	\$450	\$56	\$319	\$287	\$84	\$211	<b>\$1,941</b>

**Table 25e. SubWatershed CrabbCr.-Grouse Cr#206 Total Annual Cost Before Cost-Share,Crop BMPs**

Year	No-Till	Grassed Waterways	Vegetative Buffers	Nutrient Mgmt Plans	Terraces	Permanent Vegetation	Wetland Creation	Total Cost
1	\$948	\$800	\$100	\$284	\$510	\$75	\$94	<b>\$2,810</b>
2	\$976	\$824	\$103	\$292	\$525	\$77	\$97	<b>\$2,894</b>
3	\$1,006	\$849	\$106	\$301	\$541	\$80	\$99	<b>\$2,981</b>
4	\$1,036	\$874	\$109	\$310	\$557	\$82	\$102	<b>\$3,071</b>
5	\$1,067	\$900	\$113	\$319	\$574	\$84	\$106	<b>\$3,163</b>

**Table 25f. SubWatershed PantherCr.-GrouseCr #207 Total Annual Cost After Cost-Share,Crop,BMPs**

Year	No-Till	Grassed Waterways	Vegetative Buffers	Nutrient Mgmt Plans	Terraces	Permanent Vegetation	Wetland Creation	Total Cost
1	\$2,370	\$800	\$100	\$1,418	\$510	\$75	\$94	\$5,366
2	\$2,441	\$824	\$103	\$1,460	\$525	\$77	\$97	\$5,527
3	\$2,514	\$849	\$106	\$1,504	\$541	\$80	\$99	\$5,693
4	\$2,589	\$874	\$109	\$1,549	\$557	\$82	\$102	\$5,864
5	\$2,667	\$900	\$113	\$1,596	\$574	\$84	\$106	\$6,040

**Table 26. WRAPS Target Areas Annual Sediment Reduction**

Year	Cropland Reduction	Streambank	Brine Scar	Total Reduction (tons)	% of Goal
1	767	460	125	<b>1,352</b>	299%
2	1,534	920	250	<b>2,704</b>	598%
3	2,301	1,380	375	<b>4,056</b>	897%
4	3,068	1,840	500	<b>5,408</b>	1196%
5	3,835	2,300	625	<b>6,760</b>	1495%

**Sediment Goal:** 452 Tons

**Table 27. WRAPS Target Areas Annual Phosphorous Reduction**

	Cropland Reduction	Livestock Reduction	Streambank	Brine Scar	Total Reduction (lbs)	% of Goal
1	550	405	28	8	990	62%
2	1,100	810	55	15	1,980	123%
3	1,650	1,214	83	23	2,969	185%
4	2,200	1,619	110	30	3,959	247%
5	2,750	2,024	138	38	4,949	309%

Phosphorous  
Goal: 1,603 Pounds **Goal met**

**Table 28. Total Annual WRAPS Cost\* after Cost-Share by Category**

Year	Cropland	Livestock	Technical Assistance	Information and Education	Total Annual Cost
1	\$31,600	\$15,397	\$20,000	\$34,000	<b>\$100,997</b>
2	\$32,548	\$15,859	\$20,600	\$35,020	<b>\$104,027</b>
3	\$33,524	\$16,335	\$21,218	\$36,071	<b>\$107,148</b>
4	\$34,530	\$16,825	\$21,855	\$37,153	<b>\$110,362</b>
5	\$35,566	\$17,329	\$22,510	\$38,267	<b>\$113,673</b>

\*3% Annual Inflation

**Table 29. Grouse Silver Creek WRAPS Streambank Load Reductions and Cost**

Year	Streambank Stabilization (feet)	Soil Load Reduction (tons)	Cumulative Erosion Reduction (tons)	Phosphorous Reduction (lbs)	Cumulative P Load Reduction (lbs)	Cost*
1	230	460	460	28	28	\$22,213
2	230	460	920	28	55	\$22,880
3	230	460	1,380	28	83	\$23,566
4	230	460	1,840	28	110	\$24,273
5	230	460	2,300	28	138	\$25,001



**Table 30. Grouse Silver Creek WRAPS Brine Scar Load Reductions and Cost**

<b>Year</b>	<b>Brine Scar Remediation (acres)</b>	<b>Soil Load Reduction (tons)</b>	<b>Cumulative Erosion Reduction (tons)</b>	<b>Phosphorous Reduction (lbs)</b>	<b>Cumulative P Load Reduction (lbs)</b>	<b>Cost*</b>
1	2.5	125	125	8	8	\$3,750
2	2.5	125	250	8	15	\$3,863
3	2.5	125	375	8	23	\$3,978
4	2.5	125	500	8	30	\$4,098
5	2.5	125	625	8	38	\$4,221

**Table 31. Annual WRAPS Priority Area Livestock BMP adoption**

<b>Year</b>	<b>Relocate Pasture Feeding Site</b>	<b>Off Stream Watering System</b>	<b>Grazing Mgmt Plan</b>	<b>Total</b>
1	3	3	8	14
2	3	3	8	14
3	3	3	8	14
4	3	3	8	14
5	3	3	8	14
<b>Total</b>	<b>15</b>	<b>15</b>	<b>40</b>	<b>70</b>

**Table 32. Annual Cost\* Before Cost-Share of Implementing livestock BMPs**

<b>Year</b>	<b>Relocate Pasture Feeding Site</b>	<b>Off Stream Watering System</b>	<b>Fence off Stream or Pond</b>	<b>Grazing Mgmt Plan</b>	<b>Annual Cost</b>
1	\$3,305	\$5,693	\$16,800	\$11,200	<b>\$36,997</b>
2	\$3,404	\$5,863	\$17,304	\$11,536	<b>\$38,107</b>
3	\$3,506	\$6,039	\$17,823	\$11,882	<b>\$39,250</b>
4	\$3,611	\$6,220	\$18,358	\$12,239	<b>\$40,428</b>
5	\$3,719	\$6,407	\$18,909	\$12,606	<b>\$41,640</b>

*3% Annual Cost  
Inflation*

**Table 33. Annual Cost\* After Cost-Share of Implementing Livestock BMPs**

<b>Year</b>	<b>Relocate Pasture Feeding Site</b>	<b>Off Stream Watering System</b>	<b>Fence off Stream or Pond</b>	<b>Grazing Mgmt Plan</b>	<b>Annual Cost</b>
1	\$1,652	\$2,846	\$8,400	\$5,600	<b>\$18,499</b>
2	\$1,702	\$2,932	\$8,652	\$5,768	<b>\$19,053</b>
3	\$1,753	\$3,020	\$8,912	\$5,941	<b>\$19,625</b>
4	\$1,805	\$3,110	\$9,179	\$6,119	<b>\$20,214</b>
5	\$1,860	\$3,203	\$9,454	\$6,303	<b>\$20,820</b>

3% Annual Cost  
Inflation

**Table 34. WRAPS Priority Areas Annual Phosphorous Load Reductions (lbs)**

<b>Year</b>	<b>Relocate Pasture Feeding Site</b>	<b>Off Stream Watering System</b>	<b>Grazing Mgmt Plan</b>	<b>Annual Load Reduction</b>
1	180	180	2,248	<b>2,608</b>
2	360	360	2,248	<b>2,968</b>
3	540	540	2,248	<b>3,328</b>
4	720	720	2,248	<b>3,688</b>
5	900	900	2,248	<b>4,048</b>

**Table 35. WRAPS Priority Areas Annual Nitrogen Load reduction (lbs)**

<b>Year</b>	<b>Relocate Pasture Feeding Site</b>	<b>Off Stream Watering System</b>	<b>Grazing Mgmt Plan</b>	<b>Annual Load Reduction</b>
1	339	339	4,234	<b>4,912</b>
2	678	678	4,234	<b>5,590</b>
3	1,017	1,017	4,234	<b>6,268</b>
4	1,356	1,356	4,234	<b>6,946</b>
5	1,695	1,695	4,234	<b>7,624</b>

**Table 36. Grouse-Silver Creek WRAPS Priority Area Livestock Implementation**

<b>Priority Area</b>	<b>Relocate Pasture Feeding Site</b>	<b>Off- Stream Watering System</b>	<b>Grazing Mgmt Plans</b>	<b>Total</b>
Implementation (number of practices)	15	15	40	<b>70</b>
Cost Before Cost Share (2012 \$'s)	\$33,045	\$56,925	\$64,000	<b>\$153,970</b>
Cost After Cost Share (2012 \$'s)	\$16,523	\$28,463	\$32,000	<b>\$76,985</b>
Phosphorous Reduction (lbs)	900	900	11,240	<b>13,040</b>
Nitrogen Reduction (lbs)	1,695	1,695	21,171	<b>24,561</b>

**Table 37. Grouse Silver Creek Livestock BMP Adoption by Sub Watershed**

<b>Sub Watershed</b>	<b>Relocate Pasture Feeding Site</b>	<b>Off- Stream Watering System</b>	<b>Grazing Mgmt Plans</b>	<b>Total Adoption</b>
102	3	3	7	<b>13</b>
201	3	3	7	<b>13</b>
202	3	3	7	<b>13</b>
205	2	2	7	<b>11</b>
206	2	2	6	<b>10</b>
207	2	2	6	<b>10</b>
<b>Total</b>	15	15	40	<b>70</b>

**Table 38. Grouse Silver Cr Livestock BMP Cost\* Before Cost-Share by Sub watershed**

<b>Sub Watershed</b>	<b>Relocate Pasture Feeding Site</b>	<b>Off- Stream Watering System</b>	<b>Grazing Mgmt Plans</b>	<b>Total Cost</b>
102	\$6,609	\$11,385	\$11,200	<b>\$29,194</b>
201	\$6,609	\$11,385	\$11,200	<b>\$29,194</b>
202	\$6,609	\$11,385	\$11,200	<b>\$29,194</b>
205	\$4,406	\$7,590	\$11,200	<b>\$23,196</b>
206	\$4,406	\$7,590	\$9,600	<b>\$21,596</b>
207	\$4,406	\$7,590	\$9,600	<b>\$21,596</b>
<b>Total</b>	\$33,045	\$56,925	\$64,000	<b>\$153,970</b>

\*2012

Dollars

**Table 39. Grouse Silver Creek Livestock BMP Cost After Cost-Share by Sub Watershed**

<b>Sub Watershed</b>	<b>Relocate Pasture Feeding Site</b>	<b>Off-Stream Watering System</b>	<b>Grazing Mgmt Plans</b>	<b>Total Cost</b>
102	\$3,305	\$5,693	\$5,600	<b>\$14,597</b>
201	\$3,305	\$5,693	\$5,600	<b>\$14,597</b>
202	\$3,305	\$5,693	\$5,600	<b>\$14,597</b>
205	\$2,203	\$3,795	\$5,600	<b>\$11,598</b>
206	\$2,203	\$3,795	\$4,800	<b>\$10,798</b>
207	\$2,203	\$3,795	\$4,800	<b>\$10,798</b>
<b>Total</b>	<b>\$16,523</b>	<b>\$28,463</b>	<b>\$32,000</b>	<b>\$76,985</b>
<i>*2011 Dollars</i>				

**Table 40. Grouse Silver Creek Livestock BMP Phosphorous Load Reduction by Sub Watershed (lbs)**

<b>Sub Watershed</b>	<b>Relocate Pasture Feeding Site</b>	<b>Off-Stream Watering System</b>	<b>Grazing Mgmt Plans</b>	<b>Total Load Reduction</b>
102	180	180	1,967	<b>2,327</b>
201	180	180	1,967	<b>2,327</b>
202	180	180	1,967	<b>2,327</b>
205	120	120	1,967	<b>2,207</b>
206	120	120	1,686	<b>1,926</b>
207	120	120	1,686	<b>1,926</b>
<b>Total</b>	<b>900</b>	<b>900</b>	<b>11,240</b>	<b>13,040</b>

**Table 41. Grouse Silver Creek BMP Nitrogen Load Reduction by Sub Watershed (lbs)**

<b>Sub Watershed</b>	<b>Relocate Pasture Feeding Site</b>	<b>Off-Stream Watering System</b>	<b>Grazing Mgmt Plans</b>	<b>Total Load Reduction</b>
102	339	339	3,705	<b>4,383</b>
201	339	339	3,705	<b>4,383</b>
202	339	339	3,705	<b>4,383</b>
205	226	226	3,705	<b>4,157</b>
206	226	226	3,176	<b>3,628</b>
207	226	226	3,176	<b>3,628</b>
<b>Total</b>	<b>1,695</b>	<b>1,695</b>	<b>21,171</b>	<b>24,561</b>

**Table 42. Grouse Silver Creek  
Streambank Stabilization and Brine  
Scar Remediation by Sub Watershed**

<b>Sub Watershed</b>	<b>Streambank Stabilization (feet)</b>	<b>Brine Scar Remediation (acres)</b>
102	240	2.5
201	240	2.5
202	240	2.5
205	240	2.5
206	95	1.25
207	95	1.25
<b>Total</b>	<b>1150</b>	<b>12.5</b>

**Table 43. Grouse Silver Creek  
Streambank Stabilization and Brine  
Scar Remediation Cost Before Cost  
Share**

<b>Sub Watershed</b>	<b>Streambank Stabilization</b>	<b>Brine Scar Remediation</b>	<b>Total Cost</b>
102	\$23,179	\$3,750	<b>\$26,929</b>
201	\$23,179	\$3,750	<b>\$26,929</b>
202	\$23,179	\$3,750	<b>\$26,929</b>
205	\$23,179	\$3,750	<b>\$26,929</b>
206	\$9,175	\$1,875	<b>\$11,050</b>
207	\$9,175	\$1,875	<b>\$11,050</b>
<b>Total</b>	<b>\$111,067</b>	<b>\$18,750</b>	<b>\$129,817</b>
<i>*2012 Dollars</i>			

**Table 44. Annual Livestock, Streambank and Gully BMP Adoption Milestones**

	Year	Relocate Pasture Feeding Site	Off Stream Watering System	Grazing Mgmt Plans	Streambank(ft)	Gullies
<b>Short-Term</b>	1	3	3	8	230	2.5
	2	3	3	8	230	2.5
	3	3	3	8	230	2.5
	4	3	3	8	230	2.5
	5	3	3	8	230	2.5
	<i>Total</i>	<i>15</i>	<i>15</i>	<i>40</i>	<i>1,150</i>	<i>12.5</i>

**Table 45. Grouse Silver Creek Streambank Stabilization and Brine Scar Remediation P Reduction**

Sub Watershed	Streambank Stabilization	Brine Scar Remediation	Total Load Reduction
102	29	8	<b>36</b>
201	29	8	<b>36</b>
202	29	8	<b>36</b>
205	29	8	<b>36</b>
206	11	4	<b>15</b>
207	11	4	<b>15</b>
<b>Total</b>	<b>138</b>	<b>38</b>	<b>176</b>

**Table 46. Grouse Silver Creek Streambank Stabilization and Brine Scar Remediation Sediment Reduction**

Sub Watershed	Streambank Stabilization	Brine Scar Remediation	Total Load Reduction
102	480	125	<b>605</b>
201	480	125	<b>605</b>
202	480	125	<b>605</b>
205	480	125	<b>605</b>
206	190	63	<b>253</b>
207	190	63	<b>253</b>
<b>Total</b>	<b>2,300</b>	<b>625</b>	<b>2,925</b>

### **XIII. Stakeholder Participation**

Public participation is vital to watershed restoration and protection. Private, urban and rural landowners should be provided adequate educational information concerning pollutants, best management practices and financial assistance. From September 2004 to June 2011 meetings, tours, workshops and newsletters have been conducted with local and regional stakeholders participating. Table 47 lists the meetings, tours, field days and newsletters that were available for the public to learn more about the health of the watershed. Plans are in place to hold quarterly meetings to update stakeholders on activities in the watershed.

<b>Event</b>	<b>Cooperating Agencies</b>	<b>Explanation of Event</b>	<b>Location</b>	<b>Date</b>	<b>Number Attending</b>
Newsletter	CCCD, NRCS	Quarterly newsletter sent out to Cowley County landowners and producers highlighting conservation practices and available programs.	Cowley County	07/04, 1/05, 4/05, 9/05, 1/06, 8/06, 1/08, 12/08, 12/09, 1/11	1500 mailed each time
Conservation Field Day	CCCD, NRCS, KSRE, CCFB, FFA, RC&D, KDWP, SWC	Field day for elementary school students from Cowley County to learn conservation techniques.	Winfield City Lake	09/04, 9/05, 9/06, 9/07, 9/08, 9/09, 9/10	350 350 120 100
2 Sessions Conservation Showcase Tour	CCCD, NRCS, KSRE, CCFB	Filter strip, contour buffer strip, erosion dam, and frost free tank behind pond dam, portable water tank supplied by gravity fed pipe line. Rotation grazing system, no-till., grassed waterways/ soil savers, 2 spring developments with frost free and rubber tire tanks, CRP, controlling Sericea.	County-Wide Tour	10/04	55
Programs and Water Quality Seminar	CCCD, NRCS, GSCW	Presentation on different programs offered to producers and landowners in the Cowley County area.	Winfield & Dexter	01/05	60
Stakeholder Meeting	GSCW, KSRE, KCARE, CCCD, NRCS	Information and Education about watershed management and discussion concerning the change of direction of the watershed board.	Burden	03/05	40
Series of 3 Range Management Workshops	CCCD, NRCS, KSRE, CCFB, KDWP, CCNW	Sericea Lespedeza and Brush Control, Grazing Management and Keys to Cattle Profitability.	Cambridge	5/05-6/05	85
Series of Neighborhood Tours	CCCD, NRCS, KSRE, CCFB	No-Till Tour, Waterway Maintenance and Rebuilding, Wildlife Enhancement.	County Wide Tour	08/05-09/05	150
Women's Livestock and Wildflower Tour	CCCD, NRCS, KSRE, CCFB	Tour of alternative livestock operation and wildflower identification.	Burden and Dexter	06/06	35
Watershed Conservation Management Tour	CCCD, NRCS, KSRE, CCFB, City of Winfield, UTC-PAC	Watershed BMP informational tour	Atlanta	08/06	65

Brush Control Rodeo/Tour	CCCD, NRCS, CCFB, KSRE, GSCW	Demonstration of brush clearing techniques and chemical usage. Information on production loss due to tree and brush invasion	Dexter	5/07	50
Brush Control Rodeo/Tour	CCCD, NRCS, CCFB, KSRE, GSCW	Analysis of range condition after brush clearing, information on programs and techniques for brush/invasive species control using livestock, chemical or mechanical means.	Dexter	5/08	35
Buffer Postcard	GSCW	Postcard touting the benefits of CCRP buffers	GSCW	6/08	200
Flint Hills/Lower Ark KAWS	GSCW, KAWS	Tour of water quality projects in the Grouse-Silver Creek Watershed in conjunction with KAWS chapter meeting.	Cambridge, Atlanta	6/05	12
GSCW Stakeholder Meeting	GSCW, KCARE	Meeting for stakeholders with representatives from KDHE, and the Kansas Water Office to discuss needs and progress in the watershed.	Burden	10/08	25
Sunflower RC&D Conservation Tour	CCCD, NRCS, Sunflower RC&D	Tour cropping systems with information on sustainability and water quality.	Cowley County	7/09	30
Women's Farm Tour	CCCD, CCFB, NRCS, UTC-PAC, GSCW	Tour water quality BMP's in Upper Timber Creek and Grouse-Silver Creek Watersheds	UTC/GSCW	9/09	25
Wildflower Tour	CCCD, NRCS, KSRE, CCFB, GSCW, UTC-PAC, KNPS	Identification of native wildflowers and their roles in the prairie ecosystem. Presentation on water quality initiatives of GSCW.	Dexter	6/10	85
Wildflower Tour	CCCD, NRCS, KSRE, CCFB, GSCW, UTC-PAC, KNPS	Identification of native wildflowers and their roles in the prairie ecosystem. Presentation on water quality initiatives of GSCW and SLT activities.	Dexter	6/11	40

Table 47

**Key:**

**KCARE=Kansas State Research and Extension**  
**KSRE=Kansas State Research and Extension**  
**CCCD=Cowley County Conservation District**  
**NRCS=Natural Resource Conservation Service**  
**GSCW=Grouse-Silver Creek Watershed District**  
**CCFB=Cowley County Farm Bureau**  
**SWC=Southwestern College**  
**UTC-PAC=Upper Timber Creek Producer Advisory Committee**  
**KDWP=Kansas Department of Wildlife and Parks**



#### **XIV. Information and Education Activities**

The GSCW stakeholder leadership team sponsors various information and education activities. These events are planned based on the current needs and activities of the watershed. Assistance is provided to conservation partners as well to promote water quality and conservation throughout the entire county.

Successful events have included a conservation tour of completed projects in the watershed, a county wide wildflower tour that includes presentations on watersheds and their protective features. The GSCW water quality coordinator (WQC) also teaches 5<sup>th</sup> graders at the Cowley County Conservation District (CCCD) annual field day about water quality in their watershed. All completed WRAPS demonstration projects are identified with signs that indicate the partners involved with the project that helps protect water quality. The signs are 4' x 16' and are placed near the project along a public roadway.

The stakeholder leadership team has quarterly public meetings to discuss watershed activities and future plans for protection. Emphasis is always placed on person to person contact with landowners and producers in the watershed. These opportunities are used to inquire about current needs of stakeholders, field questions on watershed activities and educate about current options available for technical and financial assistance.



## **XV. Information and Education in Support of BMPS**

The SLT has determined the information and education activities that implement in the watershed. These activities are utilized to create a higher awareness of watershed issue which will lead to an increase in adoption rates of BMP's. Table 48 below lists the activities, their estimated costs and possible partnership service providers.

Table 48: Information and Education Activities and Events as Requested by the SLT.

Livestock BMP Implementation					
					Estimated Costs
Grazing Systems: Rotations & Water Developments	Ranchers	Tour/Field Day	Annual-Spring	\$500	NRCS, CCCD K-State Research & Ext Cowley County Farm Bureau, Kansas Rural Center
Brush and Invasive Species Management	Ranchers	Tour/Field Day	Annual-Spring	\$500	NRCS, CCCD K-State Research & Ext Cowley County Farm Bureau
		Seasonal Informational Meetings	Annual-Spring	\$400	NRCS, CCCD K-State Research & Ext Cowley County Farm Bureau
Rangeland Feeding/Loafing Area Management	Ranchers	Technical Assistance for Landowners	Ongoing	No Cost	Conservation District Kansas Rural Center NRCS,

Streambank Stabilization					
				Estimated Costs	
Streambank Projects	Landowners	Tour of Successful Projects	Annual	\$400	Conservation District KAWS
		Technical Assistance for Landowners	Ongoing	\$400	Kansas Forest Service CCCD, KAWS The Watershed Institute

Cropland BMP Implementation					
BMP	Target Audience	Activity/Event	Time Frame	Estimated Costs	Service Providers
Buffers	Landowners and farmers	Demonstration Projects	Annual-Spring	\$1,200	Conservation District Kaws
		Tour/Field Day highlighting grassed buffers	Annual - Fall	\$400	Conservation District NRCS
		Technical Assistance for Landowners	Ongoing	No Cost	Conservation District Farm Bill Biologist
Non Structural Practices: No-till, Cover Crops	Farmers and Rental Operators	Scholarships for 2 farmers to attend No-Till workshop	Annual-Winter	\$400	South Central Kansas Residue Alliance No-Till on the Plains
		Tour/Field Day	Annual-Summer	\$500	Conservation District K-State Research & Ext.
		Technical Assistance for Landowners	Ongoing	No Cost	NRCS, CCCD K-State Research & Ext Cowley County Farm Bureau

Cropland BMP Implementation					
BMP	Target Audience		Time Frame	Estimated Costs	
Non Structural Practices: No-till, Cover Crops	Farmers and Rental Operators	Seasonal Informational Meetings	Annual	\$300	NRCS, CCCD K-State Research & Ext Cowley County Farm Bureau
Structural Practices: Terraces, Waterways	Farmers and Rental Operators	Tour/Field Day	Annual - Fall	\$500	Conservation District NRCS
Nutrient Management	Farmers and Rental Operators	Technical Assistance for Landowners	Ongoing	No Cost	NRCS, CCCD K-State Research & Ext Cowley County Farm Bureau

Energy Resources BMP Implementation					
				Estimated Costs	
Brine Scar Remediation	Landowners, Tenants, Leaseholders	Tour of Successful Projects	Annual-Spring	\$300	NRCS, CCCD K-State Research & Ext Cowley County Farm Bureau
		Technical Assistance for Landowners	Ongoing	No Cost	NRCS, CCCD K-State Research & Ext Cowley County Farm Bureau
		Demonstration Project	Biennial	\$1,000	Conservation District NRCS

General Watershed/Water Quality Information and Education					
				Estimated Costs	
Educational Activities Targeting Youth	Educators, K-12 Students	Conservation Field Day	Annual-Fall	\$100	Conservation District
		Envirothon	Annual-Spring	\$200	Conservation District
		Environmental Education	Ongoing	\$100	Conservation District
Educational Activities Targeting Adults	Watershed Residents	Newsletter	Annual-Winter	\$400	Conservation District
		Wildflower Tour	Annual-Summer	\$200	Conservation District
		Womens Tour	Annual-Fall	\$200	Conservation District, Cowley County Farm Bureau, K-State Research & Ext

## **XVI. Water Quality Milestones to Determine Improvements**

The goal of the Grouse-Silver Creek WRAPS plan is to protect water quality for uses supportive of aquatic life and recreation for Silver Creek and Grouse Creek. There is a medium priority TMDL for dissolved oxygen on Silver Creek that was developed in 2000. Based on water quality data collected and analyzed since the development of the TMDL, KDHE anticipates that the TMDL for dissolved oxygen will be taken off Silver Creek in the near future and eventually be removed from the 303(d) list.

Cowley County State Fishing Lake has a low priority TMDL for selenium and a low priority 303(d) list impairment for eutrophication. This plan includes BMP Implementation outside of this drainage area and therefore it is not being addressed through its activities.

KDHE has identified several indicators that can be utilized for tracking water quality for the Grouse-Silver Creek watershed – including concentrations of total phosphorus and total suspended solids (TSS). Water quality milestones have been developed in order to evaluate the effectiveness of the BMP implementation schedule set forth in this protection plan. The milestones also provide a means for KDHE and the SLT to identify and address any potential water quality concerns based on monitoring data collected throughout the monitoring period.

The protection plan includes separate BMP implementation schedules for four HUC 12 sub watersheds that have been targeted – Lower Silver Creek in the Silver Creek watershed, and Panther Creek, Plum Creek and Crabb Creek in the lower portion of the Grouse Creek watershed. 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 Total Suspended Solids and Total Phosphorus***

As previously stated, samples from the monitoring stations are analyzed for total phosphorus (TP) and TSS concentrations, both of which can be utilized as indicators of water quality. In general, the concentration of pollutants increases with an increase in flow. Therefore, the milestones for TP and TSS have been broken out into separate values for normal flows and runoff flows. Normal flows (which include base flow) are flows exceeded at least 35% of the time, and runoff flows are flows exceeded less than 35% of the time. Since the runoff flows of TP and TSS can present the biggest threats to the watershed, separate milestones for runoff flows have been developed in order to better evaluate water quality. Table 47 on the following page includes water quality goals for TP and TSS for the Grouse-Silver Creek watershed.

Water Quality Milestones for Grouse•Silver Creek – TP & TSS for Normal and Runoff Flows								
	Current Condition (1990 • 2010)* Average TP (average of data collected during indicated period), ppb		Improved Condition (2011 • 2016) Average TP (average of data collected during indicated period), ppb		Current Condition (1990 • 2010)* Average TSS (average of data collected during indicated period), ppm		Improved Condition (2011 • 2016) Average TSS (average of data collected during indicated period), ppm	
	Normal Flows	Runoff Flows	Normal Flows	Runoff Flows	Normal Flows	Runoff Flows	Normal Flows	Runoff Flows
Sampling Sites	(1990 • 2010)* Average TP	(1990 • 2010)* Average TP	(2011 • 2016) Average TP	(2011 • 2016) Average TP	(1990 • 2010)* Average TSS	(1990 • 2010)* Average TSS	(2011 • 2016) Average TSS	(2011 • 2016) Average TSS
Silver Creek SC706	95	123	Maintain Average TP ≤ 95	111	44	49	Maintain Average TSS ≤ 45	45
Grouse Creek SC531	75	170	Maintain Average TP ≤ 75	153	24	177	Maintain Average TSS ≤ 25	159

Table 49

\*The period of record for SC706 (rotational site) includes data from 1996, 2000, 2004 and 2008.

### ***Water Quality Milestones for MBI, EPT and Chlorophyll***

In addition to the water quality milestones listed in the table above for TSS and phosphorus, KDHE will continue to monitor other indicators of water quality, including biological sampling in the Grouse-Silver Creek watershed. Values of the Macro-invertebrate Biotic Index (MBI), chlorophyll a concentration, and the percent EPT can all be used to assess the water quality of a particular water body. Table 49 below includes water quality goals for MBI, % EPT, and Chlorophyll a for the Grouse-Silver Creek watershed.

Water Quality Milestones for Grouse Creek - MBI, Chlorophyll & EPT						
	Current Condition (1994 - 2005)* MBI (Avg)	Improved Condition (2011 - 2016) MBI (Avg)	Current Condition (1994 - 2005)* % EPT (Avg)	Improved Condition (2011 - 2016) % EPT (Avg)	Current Condition (1994 - 2005)* Chlorophyll a	Improved Condition (2011 - 2016) Chlorophyll a
Sampling Sites	Macro-invertebrate Index (MBI) Average (data collected during indicated period)		Average % EPT (data collected during indicated period)		Chlorophyll a (median of data collected during indicated period), ppb	
Grouse Creek SC531	4.07	Maintain Average MBI < 4.25 and no sample with MBI > 4.5	57	Maintain Average % EPT > 55 and no sample with % EPT < 45	6	Maintain Median Chlorophyll a ≤ 6.0

Table 50

### ***Additional Water Quality Indicators***

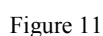
The following additional indicators can be utilized by KDHE to determine whether the water quality standards are continuing to be achieved:

- DO (Dissolved Oxygen) concentrations > 5.0 mg/l
- ECB (E. Coli Bacteria) - at least 80-85% of samples taken between April and October < 262 cfus/100 ml



## Monitoring Water Quality Progress

The map below, Figure 11, indicates the locations of the monitoring sites located within the Grouse-Silver Creek watershed. The map shows both the permanent and rotational KDHE monitoring stations. The permanent monitoring sites are continuously sampled, while the rotational sites are typically sampled every four years. The sites are sampled for nutrients, E. coli bacteria, chemicals, turbidity, alkalinity, dissolved oxygen, pH, ammonia and metals. The pollutant indicators tested for each site may vary depending on the season at collection time and other factors.



### ***Monitoring Network – Silver Creek Targeted Area***

The map below, Figure 12, shows the existing monitoring sites located specifically within or downstream of the Silver Creek watershed. The highlighted area of the watershed is comprised of the HUC 12 that is being targeted by this plan for sediment and phosphorus load reductions through BMP implementation. The HUC 12 included is 110600010102.

As shown on the map above, KDHE has a rotational monitoring station SC706 located in Silver Creek, just upstream of the Grouse Creek confluence. This site will continue to be sampled and monitored by KDHE to evaluate the water quality of Silver Creek.

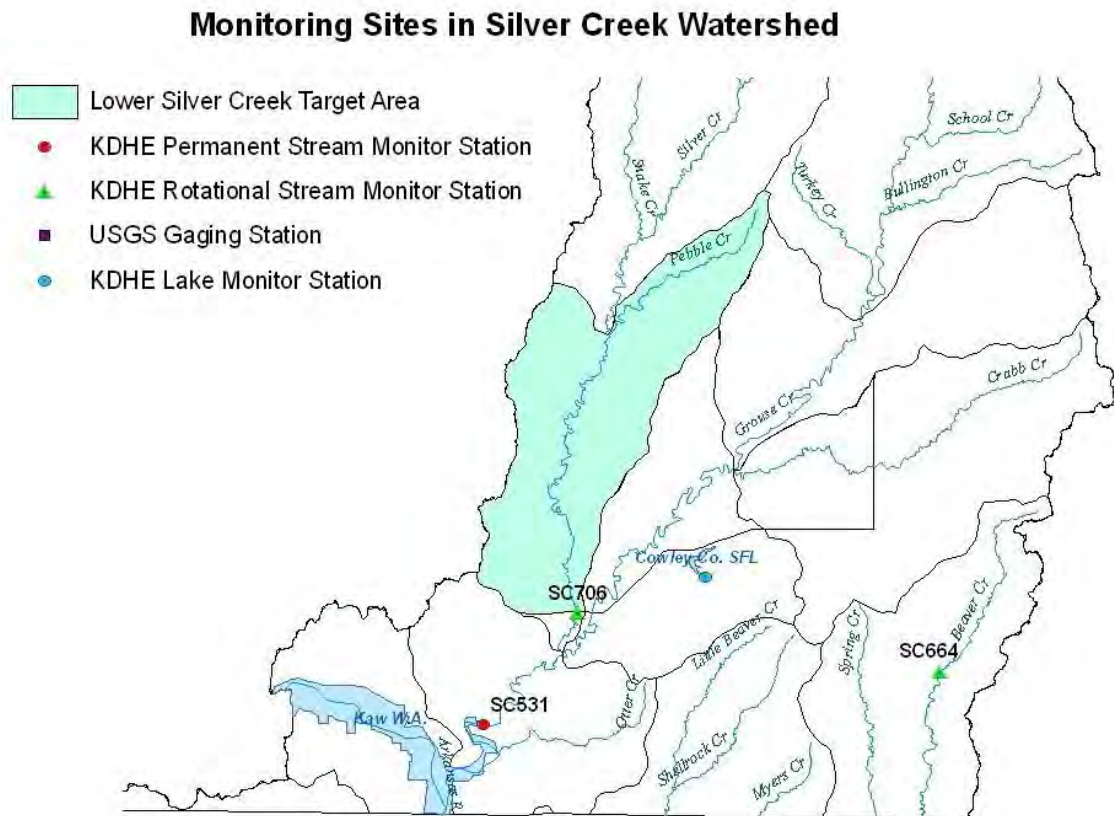


Figure 12

### ***Monitoring Network – Grouse Creek Targeted Area***

The map below, Figure 13, shows the existing monitoring sites located within and downstream of the targeted areas of the Grouse Creek watershed. The highlighted area of the watershed is comprised of the three HUC 12s that are being targeted by this plan to protect Grouse Creek through BMP implementation. The HUC 12s included are 110600010205, and portions of 110600010206 and 110600010207.

As shown on the map above, KDHE has a permanent monitoring station SC531 located on Grouse Creek downstream of the Grouse-Silver Creek confluence. This site will continue to be sampled and monitored by KDHE to evaluate the water quality of Grouse Creek.

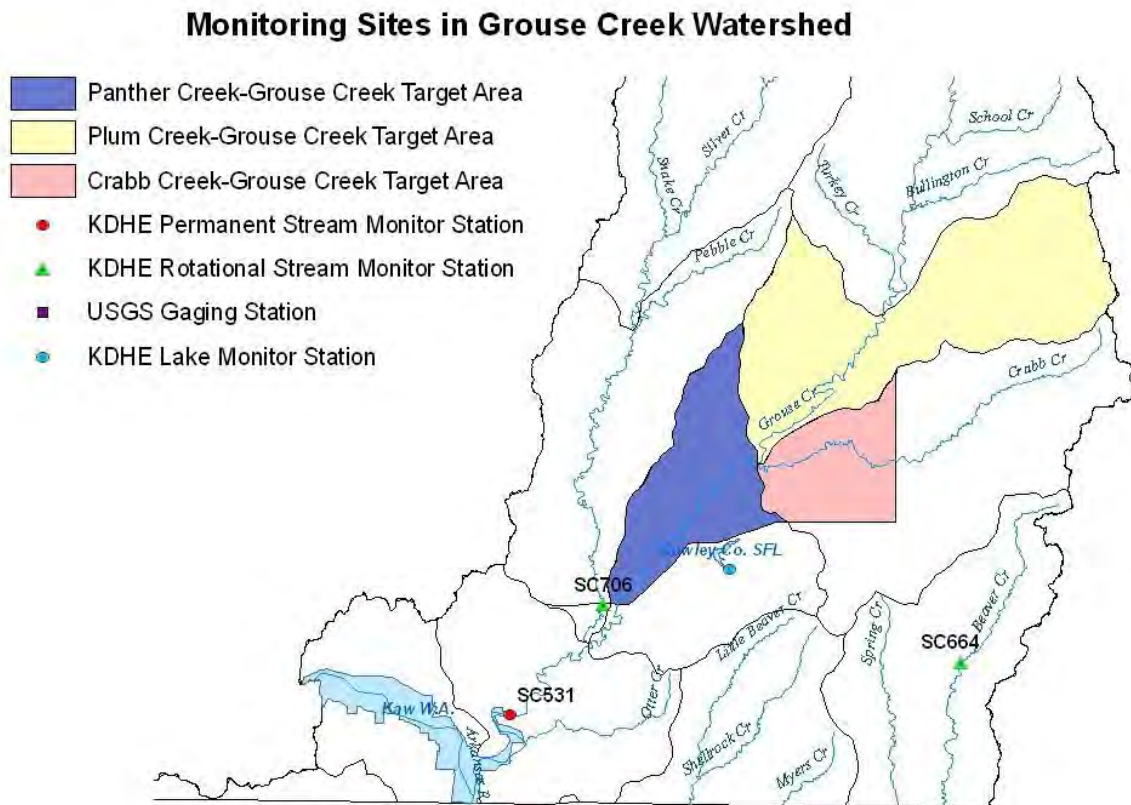


Figure 13

In addition to the above permanent monitoring site, there is also a KDHE lake monitoring site at Cowley County State Fishing Lake, as shown on the above map. While this plan is not specifically targeting the lake impairments, KDHE will continue to monitor this station, and can utilize water quality data from the lake as an additional indicator of attainment of water quality standards within the watershed.

### ***Evaluation of Monitoring Data***

Monitoring data in the Grouse-Silver 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 2016 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.

### ***Additional Monitoring***

Developments in the non targeted areas of the watershed have created a need to begin monitoring stream segments to evaluate the effects of gravel harvesting on the ecosystem. GSW is partnering with Southwestern College and their Biology Research Associates to develop and conduct a multi-year study of biological factors affected by harvesting processes. This long term study is being developed to meet KDHE specified and accepted protocols.

## **XVII. Water Quality Goals, Implementations and Actions in Support of Implementation**

A. Local stakeholders in the Grouse-Silver Creek Watershed identified specific goals needed to achieve the desired endpoint of overall water quality improvement. Implementation of best management practices, as well as monetary incentives and cost-share programs will, over time, aid in maintaining GSCW aesthetic value and protect surface and ground water. Table 51 lists specific actions needed to improve the water quality goals identified as concerns by the public, the estimated costs for implementation, how the funds will be utilized as well as potential funding sources. **Only practices with an "\*" are included in the BMP implementation schedule with load reductions and therefore will be eligible for EPA Section 319 funds.**

**Table 53: Average Annual Implementation Goals for Grouse-Silver Creek Watershed**

Protection Measure	Best Management Practices and Other Actions	Projected Annual Implementation (treated acres)	Projected Annual Cost for Implementation	Use of Funds (after cost- share)	Potential Funding Sources
Protect surface water in Grouse-Silver Creek Watershed	1. Grazing plans/rotational*	8 units	\$5,946	Technical Assistance (T/A)	EQIP, GSCW, WRAPS
	2. Livestock water development* (may include fencing)	3 units	\$11,941	T/A, development components	EQIP, NPS, GSCW, WRAPS
	3. Sericea Lespedeza control	54 acres	\$424	\$7.86/ac for chemical and labor	EQIP
	4. Brush management	155 acres	\$17,050	\$110/ac for mechanical treatment	EQIP
	5. Unconfined livestock feeding-loafing areas*	3 units	\$1,7545	\$1769/ac for components	EQIP, NPS, GSCW, WRAPS
	6. Stream bank stabilization*	230 feet	\$22,213	96/ft for components	GSCW, WRAPS
	7. Riparian Restoration*	2 acres	\$800	\$400/ac for trees and installation	GSCW, WRAPS, CCRP
	8. Forest stand improvement	2.4 acres	\$300	Technical Assistance	GSCW, WRAPS, KFS
	9. Cropland structural-terraces, waterways*	170 acres	\$1,390	T/A, \$8.00 /ac	GSCW, WRAPS, NPS
	10. Nutrient management-crop rotation, cover crops, soil testing*	130 acres	\$1,505	T/A, soil testing	EQIP, CSP, GSCW, WRAPS
	11. Cropland non-structural- no till, cover crops, minimum till contour farming*	310 acres	\$2,516	Technical Assistance	EQIP, GSCW, WRAPS
	12. Grass buffers- native and riparian*	105 acres	\$106	/ac for components	CCRP, GSCW, WRAPS, NPS
	13. Native grass plantings-Hel/marginal cropland*	6 acres	\$80	\$/ac for components	CCRP, GSCW, WRAPS, NPS
	14. Brine scar remediation*	2.5 acres	\$3,750	\$2460/ac for components	GSCW, WRAPS, NPS
	15. Wetland creation//restoration*	3 acres	\$100	\$31//ac for components	GSCW, WRAPS, KAWS, CCRP

**Total Projected Costs**

**\$69,875**



Protection Measure	Best Management Practices and Other Actions	Projected Annual Implementation	Projected Annual Cost for Implementation	Use of Funds	Potential Funding Sources
Protect ground water in Grouse-Silver Creek Watershed	16. Plugging of abandoned oil/gas wells	1 site	\$500	T/A only, KCC mandates plugging	GSCW, WRAPS, KCC
	17. Plugging of abandoned water wells	1 site	\$500	T/A, components-max of \$500	GSCW, WRAPS, NPS
	18. Management of on-site waste water	1 site	\$2,300	T/A, components- max of \$2300	GSCW, WRAPS, NPS

**Total Projected Costs**

**\$3,300**

Protection Measure	Best Management Practices and Other Actions	Projected Annual Implementation	Projected Annual Cost for Implementation	Use of Funds	Potential Funding Sources
Maintain pristine condition of Grouse-Silver Creek Watershed	19. Prevention or management of salt water intrusion	1 site	\$500	Technical Assistance	GSCW, WRAPS, KCC
	20. Review of energy resource development plans.	1000 acres	\$500	Technical Assistance	GSCW, WRAPS, KCC

**Total Projected Costs**

**\$1,000**

Protection Measure	Best Management Practices and Other Actions	Projected Annual Implementation	Projected Annual Cost for Implementation	Use of Funds	Potential Funding Sources
Provide information and education to GSCW stakeholders on water quality initiatives	21. Watershed tour highlighting water quality projects.	1 tour	\$400	Transportation and refreshments for attendees	GSCW, WRAPS, CD
	22. Newsletter	1 newsletter	\$200	Printing and postage	GSCW, WRAPS, CD
	23. Stakeholder Meeting	1 meeting	\$200	Refreshments for attendees	GSCW, WRAPS, CD
	24. One on one producer contact	12 contacts	\$7920	Salary for Water Quality Coordinator for time spent with producer.	GSCW, WRAPS, CD

**Total Projected Costs**

**\$8,720**