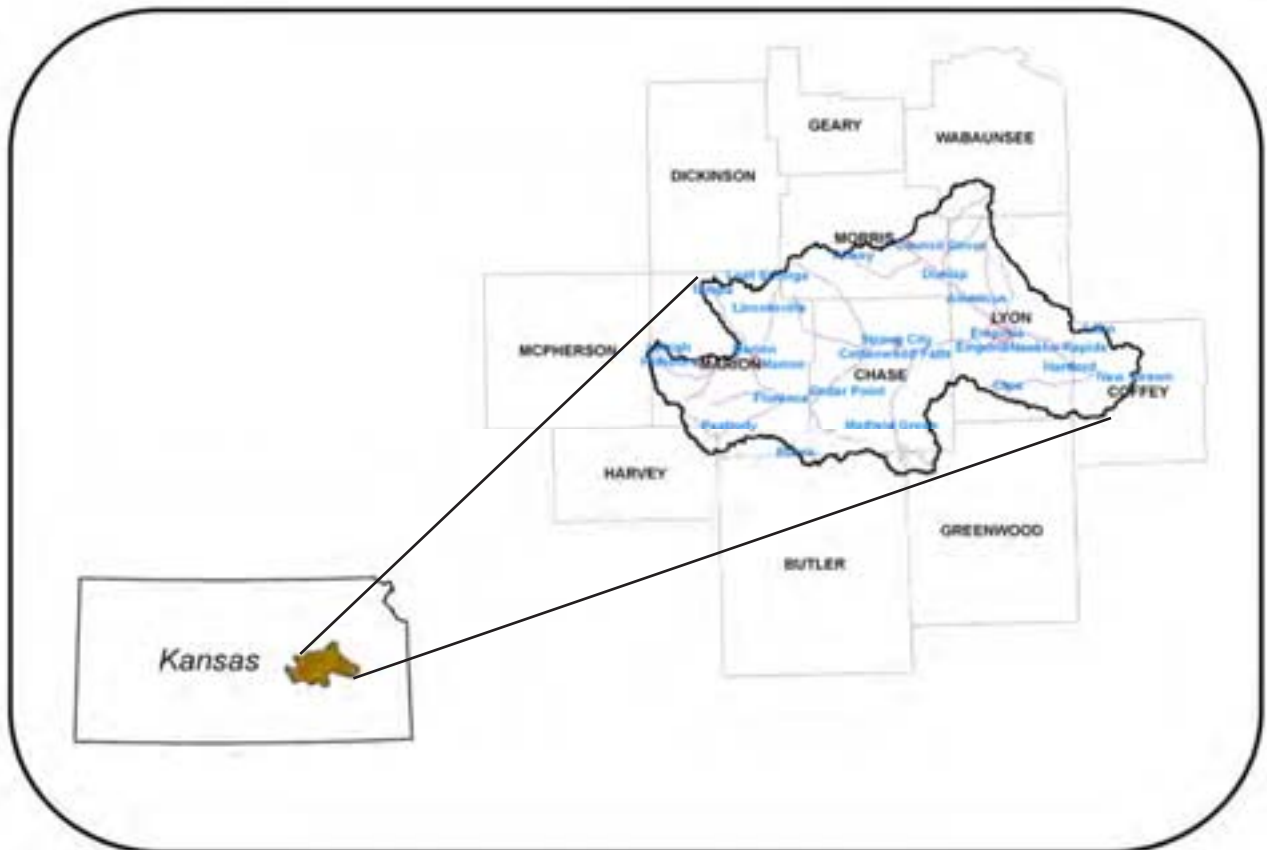


Upper and Lower Cottonwood and Neosho Headwaters Watersheds Assessment: Preliminary Report



2009

Authors:

A. P. Nejadhashemi, R. K. Gali, C. M. Smith,
K. R. Mankin, R. M. Wilson, S. P. Brown, and J. C. Leatherman

Publication # EP-137

Table of Contents

Table of Contents	2
1.0 Upper & Lower Cottonwood and Neosho Headwaters Watersheds.....	4
1.1 Watershed Summary	4
1.2 Overview of Water Quality Issues and Potential Pollution Sources	4
2.0 Climate Mapping System.....	5
2.1 Precipitation Map ⁴	5
2.2 30-Year Average Daily Maximum Temperature Map ⁵	6
2.3 30-Year Average Daily Minimum Temperature Map ⁶	6
3.0 Land Use/Land Cover.....	7
3.1 Land Use (GIRAS 1980s) ⁷	7
3.2 Land Use (NLCD1992) ⁸	8
3.2.1 NLCD 1992 Land Cover Class Definitions.....	9
3.3 Land Use (NLCD 2001) ¹	10
3.3.1 NLCD 2001 Land Cover Class Definitions	10
4.0 River Network ⁹	12
5.0 Hydrologic Soil Groups ¹⁰	12
6.0 Water Quality Conditions	13
6.1 The 303d list of Impaired Waterbodies ²	13
6.2 Water Quality Observation Stations ¹¹	14
6.3 USGS Gage Stations ¹²	18
6.4 Permitted Point Source Facilities ¹⁴	21
6.5 Confined Animal Feeding Operations (CAFOs) ¹⁵	23
6.6 1990 Population and Sewerage by Census Tract ¹⁶	28

7.0. Agricultural Economy	30
7.1 Corn Cost-Return Budget ¹⁷	30
7.2 Soybean Cost-Return Budget ¹⁷	32
7.3 Wheat Cost-Return Budget ¹⁷	34
7.4 Grain Sorghum Cost-Return Budget ¹⁷	36
7.5 Alfalfa Cost-Return Budget ¹⁷	38
7.6 Common Cropland BMPs in Oologah Watershed	40
7.6.1 Vegetative Buffer: Economic Analysis	41
Discussion	41
7.6.2 Streambank Stabilization: Economic Analysis	44
7.7 Economic Contributions of Recreation at John Redmond Lake ^{28, 29, 30, 31, 32, 33, 34, 35}	48
8.0 Modeling.....	55
8.1 Subbasin Map ¹⁹	55
8.2 Input Data.....	57
8.2.1 Neosho Headwaters.....	57
8.2.2 Lower Cottonwood	59
8.2.3 Upper Cottonwood.....	62
8.3 Model Outputs.....	65
8.3.1 Neosho Headwaters.....	65
8.3.2 Lower Cottonwood	66
8.3.3 Upper Cottonwood.....	67
9.0 Acknowledgment:	68
10.0 Footnotes/Bibliography.....	68

1.0 Upper & Lower Cottonwood and Neosho Headwaters Watersheds

1.1 Watershed Summary

The Neosho Headwaters, Upper Cottonwood, and Lower Cottonwood watersheds are located in central Kansas and drain areas of Marion, Morris, Chase, Coffey and Lyon counties. Small drainage areas originate in McPherson, Harvey, Butler, Greenwood, and Wabaunsee counties. Primary waterways are the Neosho River and the Cottonwood River along with numerous tributaries. Three major lakes – Marion Lake, Council Grove Lake and John Redmond Lake are located in the watersheds. All three of the watersheds have a Category I designation indicating that the watersheds are in need of restoration and protection to sustain water quality.

Grassland is the predominant land usage (61.2 percent) for the watersheds. Crop production is the second largest land usage at 28.4 percent. Woodland, water and urban areas constitute the remaining 10.4 percent of land cover¹.

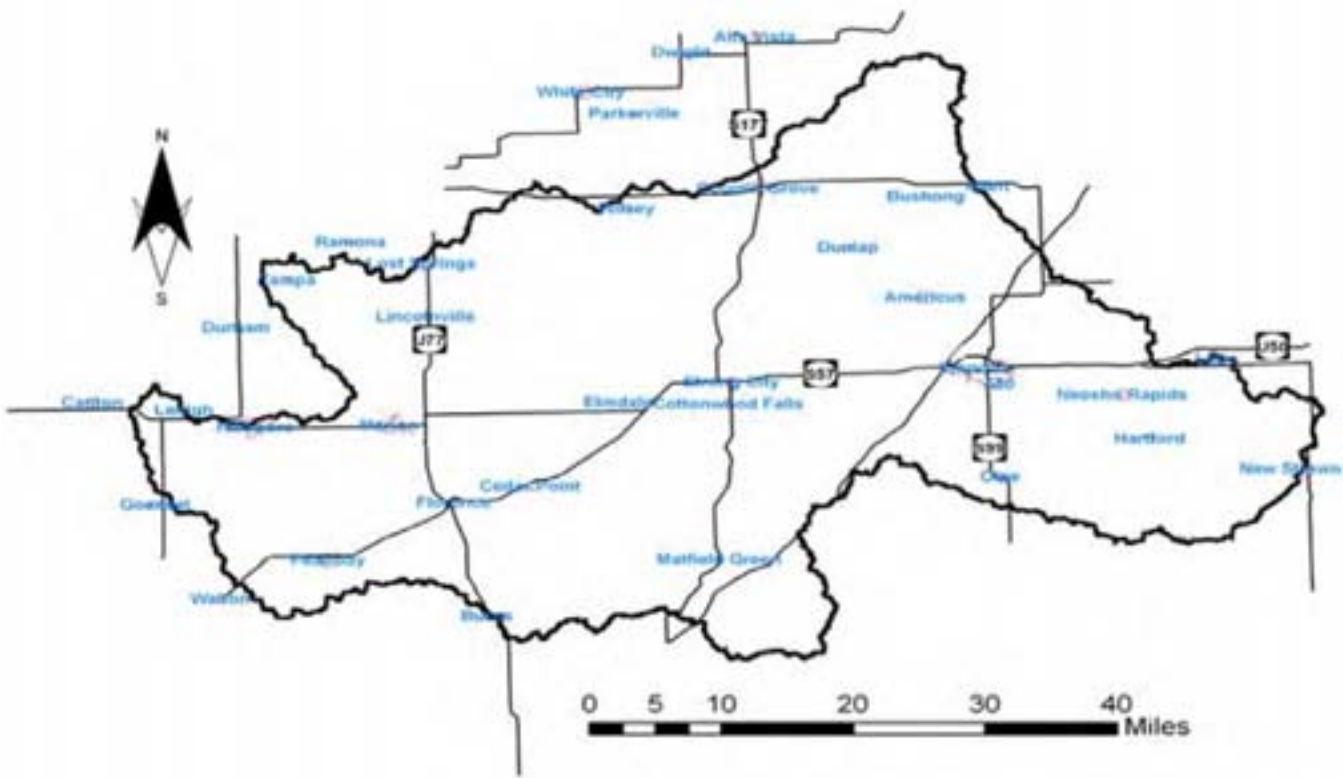


Figure 1. Major roads and cities – Upper & Lower Cottonwood and Neosho Headwaters Watersheds

1.2 Overview of Water Quality Issues and Potential Pollution Sources

When river segments or lakes that are monitored by Kansas Department of Health and Environment (KDHE) have experienced poor quality, a Total Maximum Daily Load (commonly referred to as a TMDL) is established. A TMDL is the maximum amount of pollution that a surface water body can receive and still meet water quality standards.

Fecal coliform bacteria is listed as a TMDL in the Neosho and Cottonwood Rivers, plus Dow and Mud Creeks. Fecal coliform are present in human and animal waste. Potential sources of fecal coliform bacteria include feedlots, wastewater treatment plants, failing septic systems, and wildlife. Target TMDL endpoint is less than 200 colony forming units per 100 ml of water for swimming, and less than 2,000 colony forming units per 100 ml of water for boating and fishing.

Numerous lakes, including John Redmond, Marion, Council Grove, Jones Park, and Olpe City, have a TMDL for eutrophication and siltation. Eutrophication is a natural process creating conditions favorable for algae blooms and plant growth; however excess eutrophication is the result of nutrient loading from the watershed and results in unfavorable habitat for aquatic life. Surplus nutrients originate from manure and

fertilizer runoff in rural and urban areas. Many agricultural producers in the watershed implement best management practices (known as BMPs) to prevent nutrient runoff. Some common BMPs include: the use of conservation tillage and cover crops, maintaining buffer strips along field edges, and proper timing of fertilizer application. Low rates of dissolved oxygen are intertwined with eutrophication and TMDLs have been established for Dow, Eagle, and French Creeks in addition to Marion Lake. Riparian vegetation restoration, grass buffer strips along streams, proper manure storage and distribution, adequately functioning septic systems, and proper chemical fertilizer rates should help improve water quality and raise dissolved oxygen rates.

Additional pollutants in the watersheds are copper, sulfate, chlordane, and mercury. Copper is a naturally occurring mineral that is attached to soil particles. Sulfate is derived from exposed bedrock that leaches into the water stream. Chlordane is a pesticide that was widely used for termite control but has since been banned by EPA. Occurrences of chlordane are linked to runoff from old sites or sediment in the streambed. A low priority TMDL for mercury has been set in the South Cottonwood River. Three sources of mercury loading are: background sources, atmospheric sources (air emissions from coal burning power plants), and non-point sources (former battery recycling facility in Hillsboro). Erosion control BMPs will help lower these pollutants since the mode of entry into rivers and streams is through soil particles that have washed downstream².



Figure 2. Relief Maps – Upper & Lower Cottonwood and Neosho Headwaters Watershed

2.0 Climate Mapping System

2.1 Precipitation Map⁴

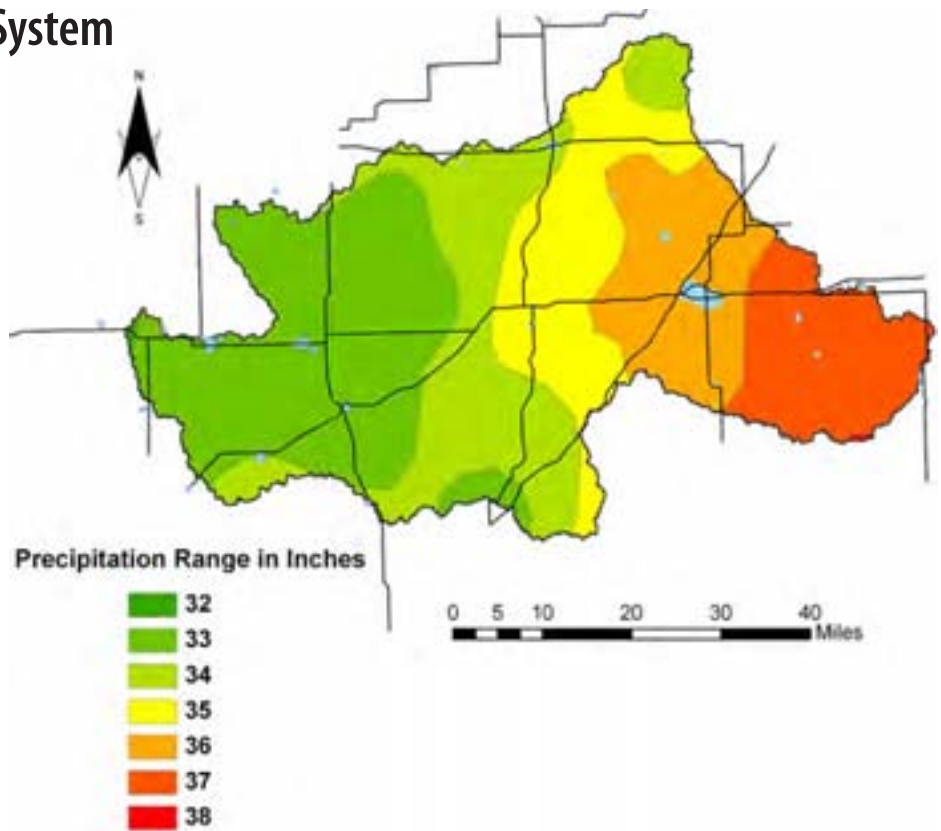


Figure 3. 30-year average annual precipitation in inches, 1971-2000.

2.2 30-Year Average Daily Maximum Temperature Map⁵

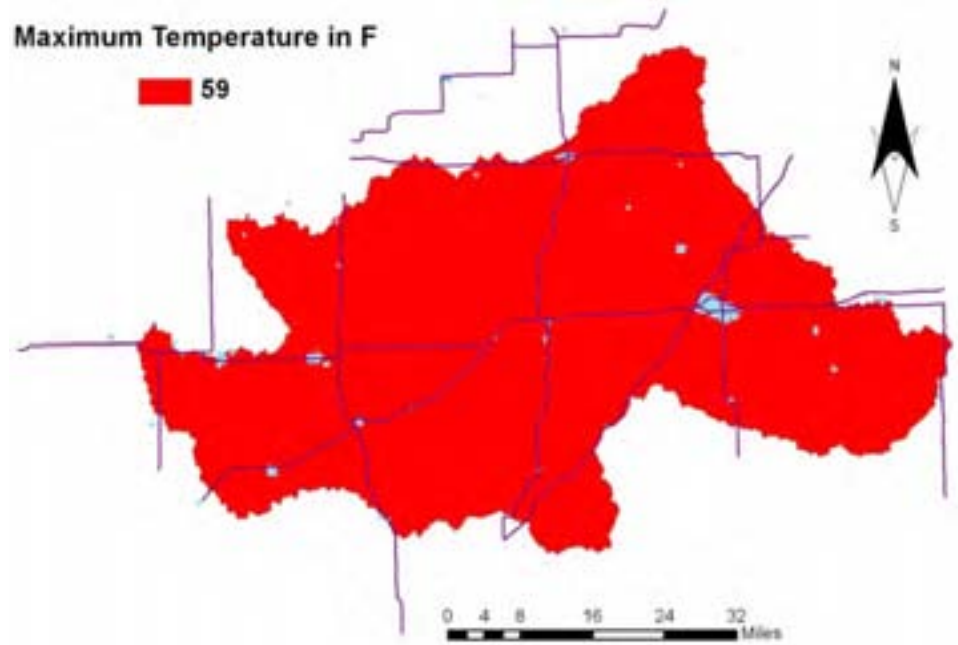


Figure 4. 30-year average daily maximum temperature in degrees Fahrenheit, 1971 – 2000

2.3 30-Year Average Daily Minimum Temperature Map⁶

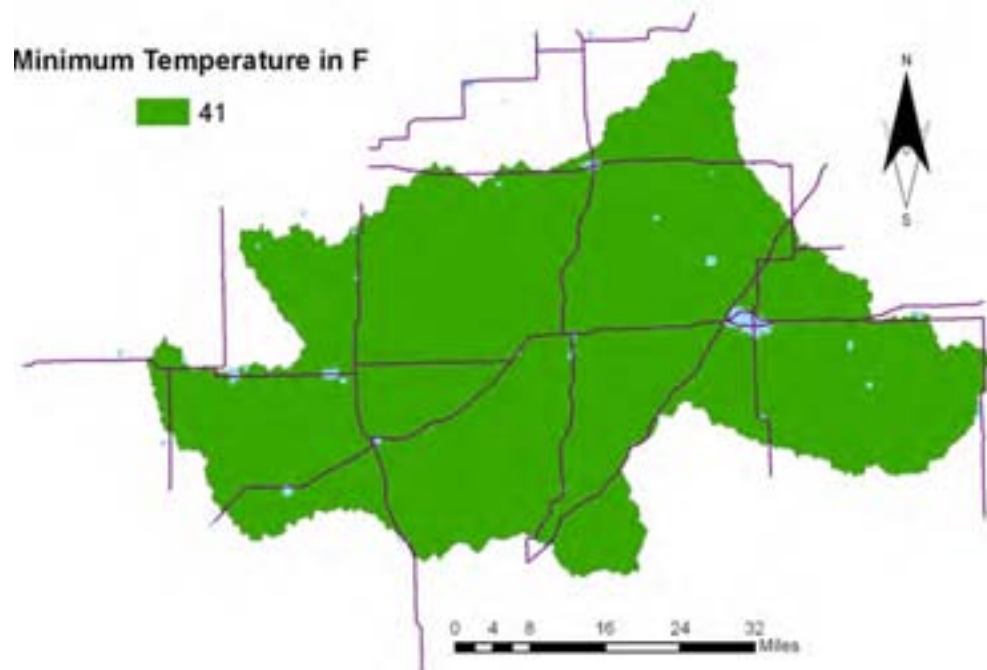


Figure 5. 30-year average daily minimum temperature in degrees Fahrenheit. 1971 – 2000

3.0 Land Use/Land Cover

3.1 Land Use (GIRAS 1980s)

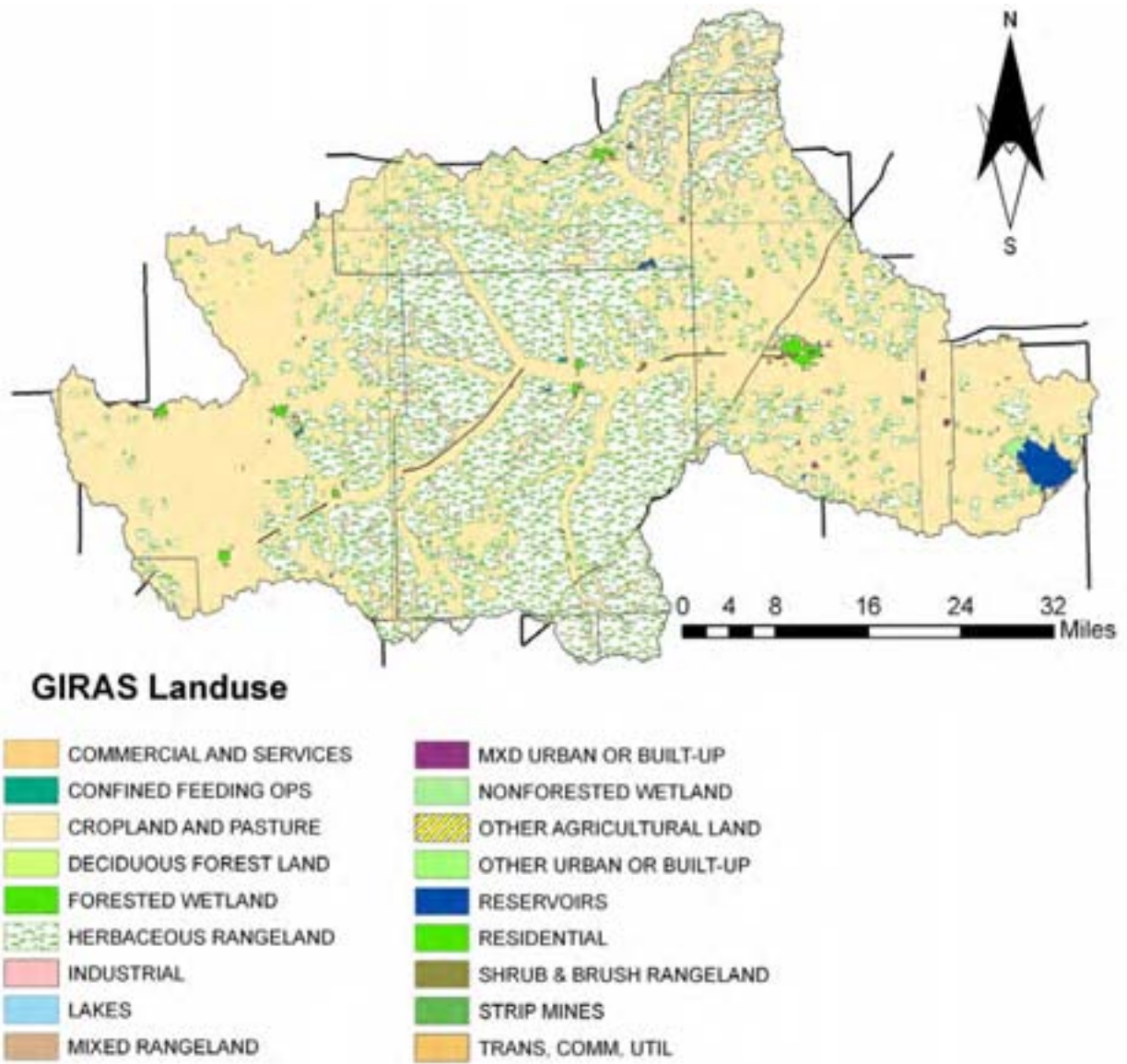
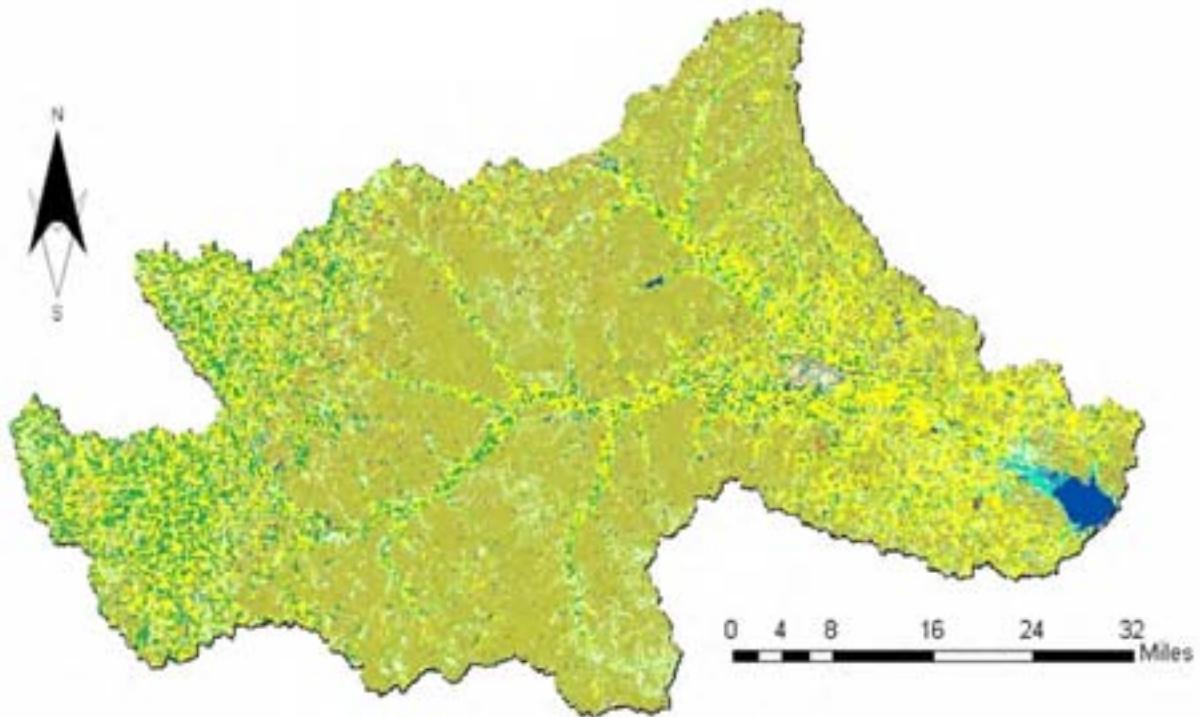


Figure 6. GIRAS 1980s land use classification

3.2 Land Use (NLCD1992)⁸



NLCD 1992 Landuse



Figure 7. NLCD 1992 Land Use Classification

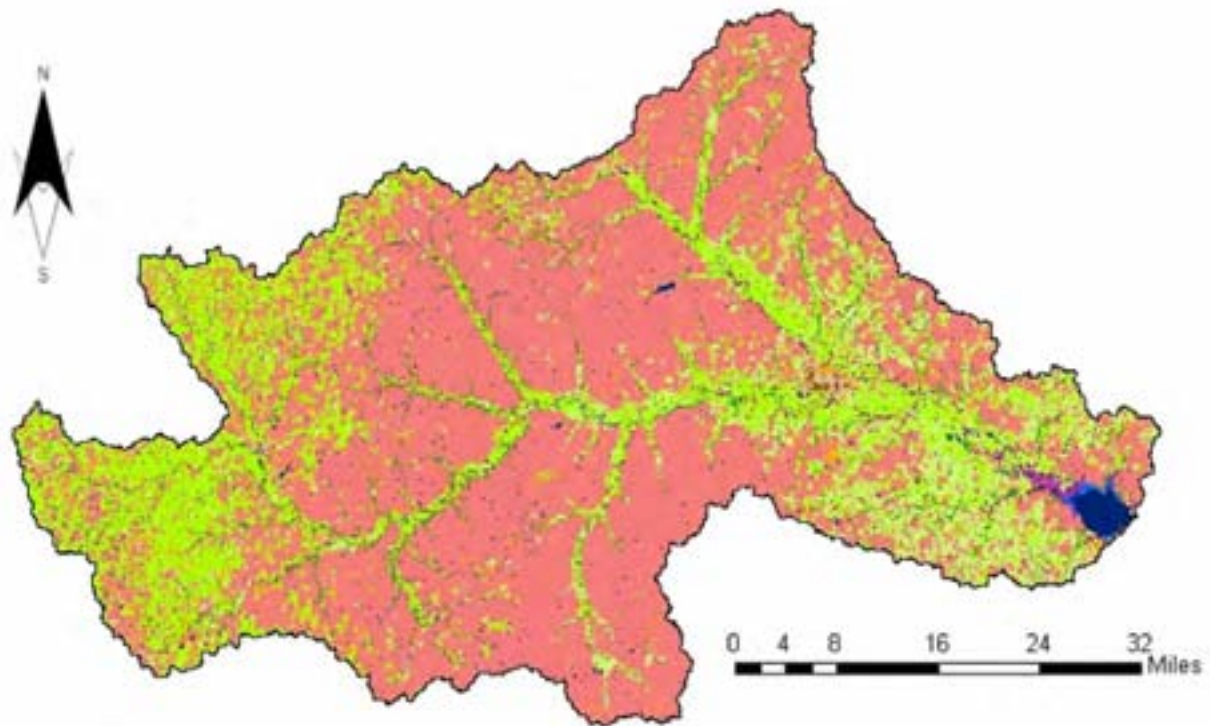
3.2.1 NLCD 1992 Land Cover Class Definitions³⁶

The following definitions are from the EPA's National Land Cover Database, found at: <http://www.epa.gov/mrlc/definitions.html#1992>

11. **Open Water** – all areas of open water, generally with less than 25% cover of vegetation/land cover.
21. **Low Intensity Residential** – Includes areas with a mixture of constructed materials and vegetation. Constructed materials account for 30-80 percent of the cover. Vegetation may account for 20 to 70 percent of the cover. These areas most commonly include single-family housing units. Population densities will be lower than in high intensity residential areas.
22. **High Intensity Residential** – Includes highly developed areas where people reside in high numbers. Examples include apartment complexes and row houses. Vegetation accounts for less than 20 percent of the cover. Constructed materials account for 80 to 100 percent of the cover.

- 23. Commercial/Industrial/Transportation** – Includes infrastructure (e.g. roads, railroads, etc.) and all highly developed areas not classified as High Intensity Residential.
- 31. Bare Rock/Sand/Clay** – Perennially barren areas of bedrock, desert pavement, scarps, talus, slides, volcanic material, glacial debris, beaches, and other accumulations of earthen material.
- 32. Quarries/Strip Mines/Gravel Pits** – Areas of extractive mining activities with significant surface expression.
- 33. Transitional** – Areas of sparse vegetative cover (less than 25 percent of cover) that are dynamically changing from one land cover to another, often because of land use activities. Examples include forest clearcuts, a transition phase between forest and agricultural land, the temporary clearing of vegetation, and changes due to natural causes (e.g. fire, flood, etc.)
- 41. Deciduous Forest** – Areas dominated by trees where 75 percent or more of the tree species shed foliage simultaneously in response to seasonal change.
- 42. Evergreen Forest** – Areas dominated by trees where 75 percent or more of the tree species` maintain their leaves all year. Canopy is never without green foliage.
- 43. Mixed Forest** – Areas dominated by trees where neither deciduous nor evergreen species represent more than 75 percent of the cover present.
- 51. Shrubland** – Areas dominated by shrubs; shrub canopy accounts for 25-100 percent of the cover. Shrub cover is generally greater than 25 percent when tree cover is less than 25 percent. Shrub cover may be less than 25 percent in cases when the cover of other life forms (e.g. herbaceous or tree) is less than 25 percent and shrubs cover exceeds the cover of the other life forms.
- 71. Grasslands/Herbaceous** – Areas dominated by upland grasses and forbs. In rare cases, herbaceous cover is less than 25 percent, but exceeds the combined cover of the woody species present. These areas are not subject to intensive management, but they are often utilized for grazing.
- 81. Pasture/Hay** – Areas of grasses, legumes, or grass-legume mixtures planted for livestock grazing or the production of seed or hay crops.
- 82. Row Crops** – Areas used for the production of crops, such as corn, soybeans, vegetables, tobacco, and cotton.
- 83. Small Grains** – Areas used for the production of graminoid crops such as wheat, barley, oats, and rice.
- 85. Urban/Recreational Grasses** – Vegetation (primarily grasses) planted in developed settings for recreation, erosion control, or aesthetic purposes. Examples include parks, lawns, golf courses, airport grasses, and industrial site grasses.
- 91. Woody Wetlands** – Areas where forest or shrubland vegetation accounts for 25-100 percent of the cover and the soil or substrate is periodically saturated with or covered with water.
- 92. Emergent Herbaceous Wetlands** – Areas where perennial herbaceous vegetation accounts for 75-100 percent of the cover and the soil or substrate is periodically saturated with or covered with water.

3.3 Land Use (NLCD 2001)¹



NLCD 2001 Landuse

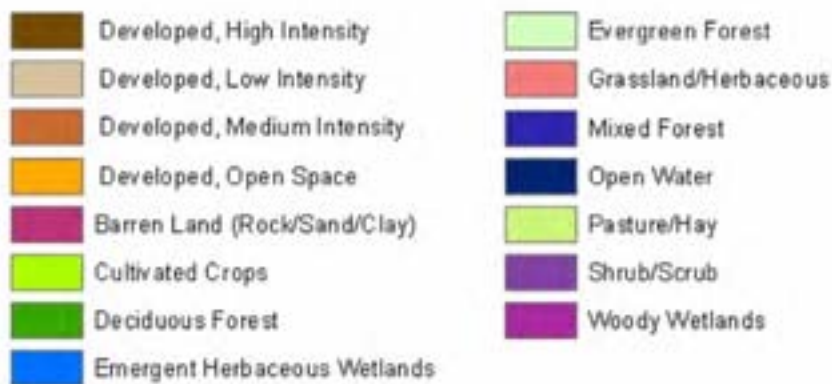


Figure 8. NLCD 2001 Land use classification

3.3.1 NLCD 2001 Land Cover Class Definitions³⁷

The following definitions are from the EPA's National Land Cover Database, found at: <http://www.epa.gov/mrlc/definitions.html#2001>

11. **Open Water** – All areas of open water, generally with less than 25% cover of vegetation or soil.
21. **Developed, Open Space** – Includes areas with a mixture of some constructed materials, but mostly vegetation in the form of lawn grasses. Impervious surfaces account for less than 20 percent of total cover. These areas most commonly include large-lot single-family housing units, parks, golf courses, and vegetation planted in developed settings for recreation, erosion control, or aesthetic purposes.
22. **Developed, Low Intensity** – Includes areas with a mixture of constructed materials and vegetation. Impervious surfaces account for 20-49 percent of total cover. These areas most commonly include single-family housing units.

- 23. Developed, Medium Intensity** – Includes areas with a mixture of constructed materials and vegetation. Impervious surfaces account for 50-79 percent of the total cover. These areas most commonly include single-family housing units.
- 24. Developed, High Intensity** – Includes highly developed areas where people reside or work in high numbers. Examples include apartment complexes, row houses and commercial/industrial. Impervious surfaces account for 80 to 100 percent of the total cover.
- 31. Barren Land (Rock/Sand/Clay)** – Barren areas of bedrock, desert pavement, scarps, talus, slides, volcanic material, glacial debris, sand dunes, strip mines, gravel pits and other accumulations of earthen material. Generally, vegetation accounts for less than 15% of total cover.
- 41. Deciduous Forest** – Areas dominated by trees generally greater than 5 meters tall, and greater than 20% of total vegetation cover. More than 75 percent of the tree species shed foliage simultaneously in response to seasonal change.
- 42. Evergreen Forest** – Areas dominated by trees generally greater than 5 meters tall, and greater than 20% of total vegetation cover. More than 75 percent of the tree species maintain their leaves all year. Canopy is never without green foliage.
- 43. Mixed Forest** – Areas dominated by trees generally greater than 5 meters tall, and greater than 20% of total vegetation cover. Neither deciduous nor evergreen species are greater than 75 percent of total tree cover.
- 52. Shrub/Scrub** – Areas dominated by shrubs; less than 5 meters tall with shrub canopy typically greater than 20% of total vegetation. This class includes true shrubs, young trees in an early successional stage or trees stunted from environmental conditions.
- 71. Grassland/Herbaceous** – Areas dominated by grammanoid or herbaceous vegetation, generally greater than 80% of total vegetation. These areas are not subject to intensive management such as tilling, but can be utilized for grazing.
- 81. Pasture/Hay** – Areas of grasses, legumes, or grass-legume mixtures planted for livestock grazing or the production of seed or hay crops, typically on a perennial cycle. Pasture/hay vegetation accounts for greater than 20 percent of total vegetation.
- 82. Cultivated Crops** – Areas used for the production of annual crops, such as corn, soybeans, vegetables, tobacco, and cotton, and also perennial woody crops such as orchards and vineyards. Crop vegetation accounts for greater than 20 percent of total vegetation. This class also includes all land being actively tilled.
- 90. Woody Wetlands** – Areas where forest or shrubland vegetation accounts for greater than 20 percent of vegetative cover and the soil or substrate is periodically saturated with or covered with water.
- 92. Emergent Herbaceous Wetlands** – Areas where perennial herbaceous vegetation accounts for 75-100 percent of the cover and the soil or substrate is periodically saturated with or covered with water.

Table 1. Summary of land use covers

Land Use Type	Agriculture			Barren Land	Forest Land	Grassland	Urban	Wetlands/Water	Shrub	Total
	Cropland	Pasture	Total							
GIRAS 1980s	931855		931855	901	1080	680348	15741	12119	0	1642044
NLCD 1992	362498	221489	583987	671	34197	920219	10653	39499	52659	1641885
NLCD 2001	315390	150693	466083	683	54819	1004986	72668	40987	335	1640561

4.0 River Network⁹

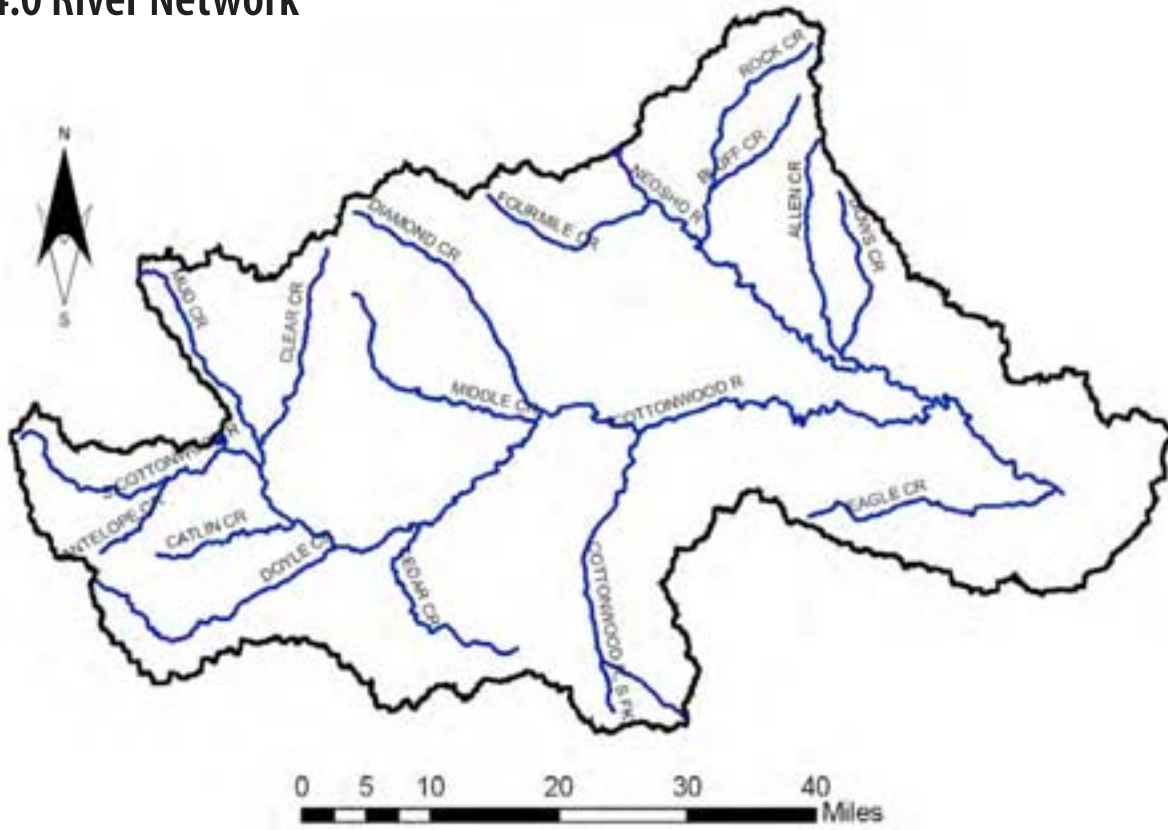


Figure 9. River network – Upper & Lower Cottonwood and Neosho Headwaters Watersheds

5.0 Hydrologic Soil Groups¹⁰

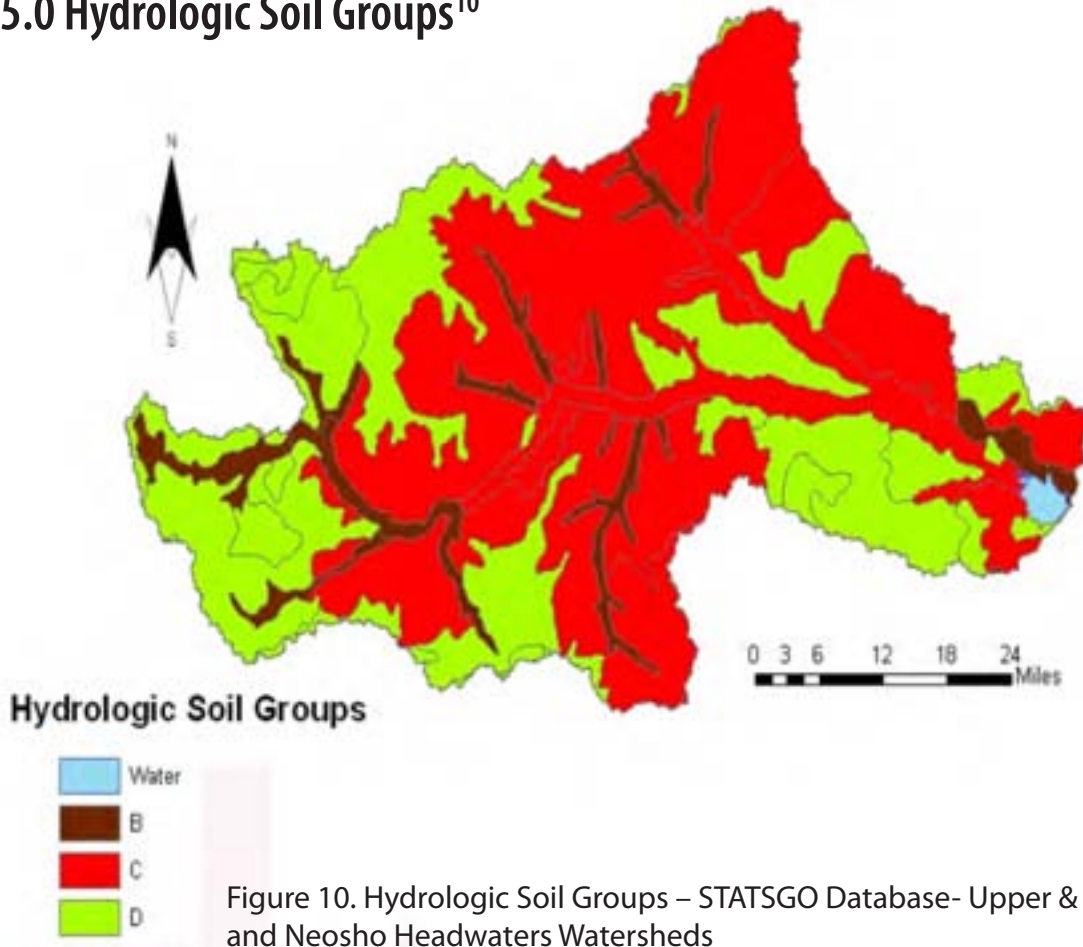


Figure 10. Hydrologic Soil Groups – STATSGO Database- Upper & Lower Cottonwood and Neosho Headwaters Watersheds

6.0 Water Quality Conditions

6.1 The 303d list of Impaired Waterbodies²

This map shows all impaired streams that are not meeting their designated uses (impaired waters) because of excess pollutants as defined in Section 303(d) of the Clean Water Act. The list of impaired waterways is updated by the states every two years. This can be used to identify specific stream segments and lakes for which, in accordance with their priority ranking, TMDLs may need to be developed.

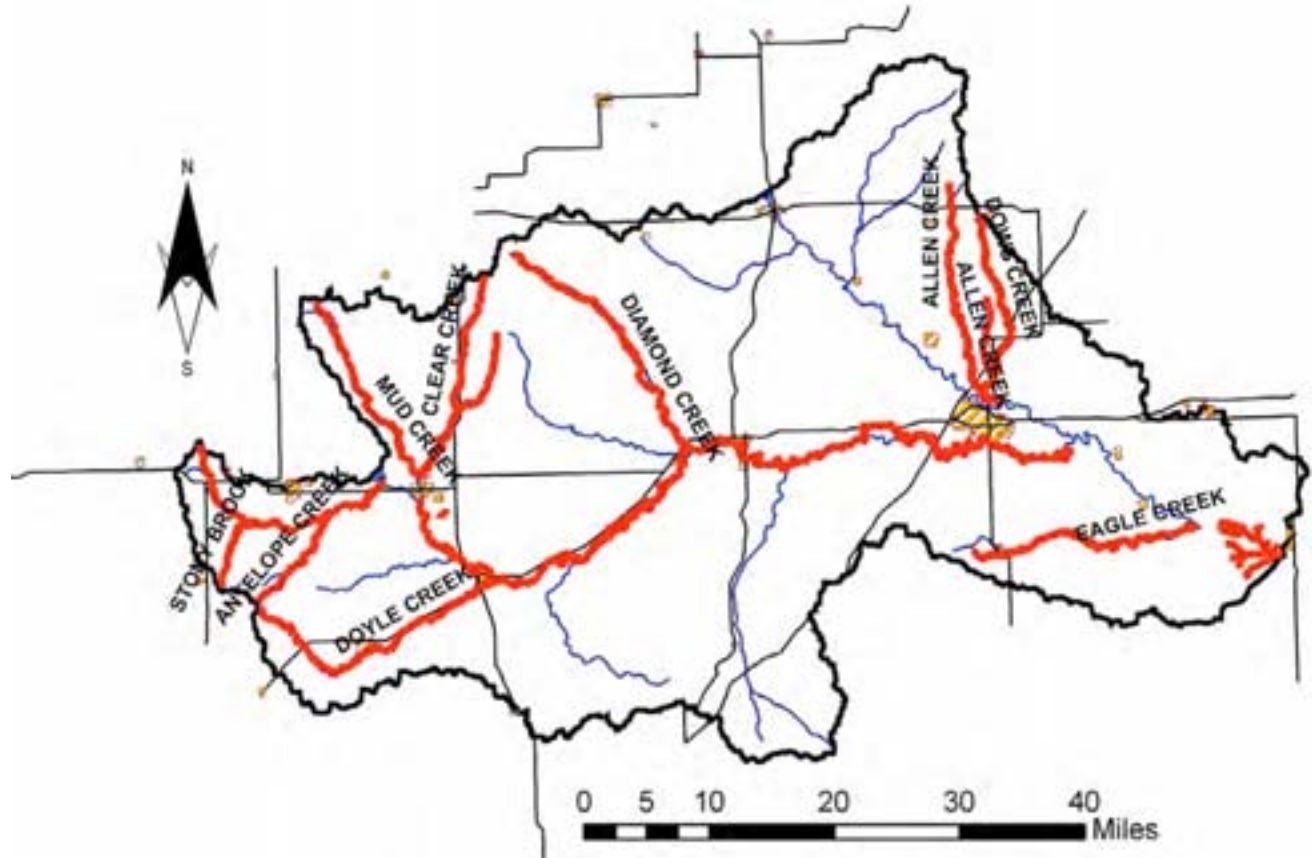


Figure 11. Impaired Waterbodies based on The 303d List – Upper & Lower Cottonwood and Neosho Headwaters Watersheds

Table 2. The 303d list of Impaired Waterbodies

State	Waterbody Name	Impairment
KS	Allen Creek	Pathogens, Organic Enrichment/low DO
KS	Antelope Creek	Pathogens
KS	Clear Creek	Sulfates
KS	Clear Creek, East Branch	Sulfates
KS	Cottonwood River	Pesticides, Sulfates, Pathogens
KS	Cottonwood River, South	Pathogens, Sulfates
KS	Diamond Creek	Pathogens
KS	Doyle Creek	Pathogens, Organic Enrichment/low DO, Unionized Ammonia, Sulfates
KS	Dows Creek	Pathogens, Organic Enrichment/low DO
KS	Eagle Creek	Organic Enrichment/low DO
KS	John Redmond Lake	Organic Enrichment/low DO, Sediment/siltation
KS	Marion Co Lake	Organic Enrichment/low DO
KS	Mud Creek	Pathogens
KS	Stillman Creek	Pathogens, Organic Enrichment/low DO
KS	Stony Brook	Pathogens

6.2 Water Quality Observation Stations¹¹

USEPA Observation-level water quality monitoring data is useful for identifying the location of water quality data in a given watershed.

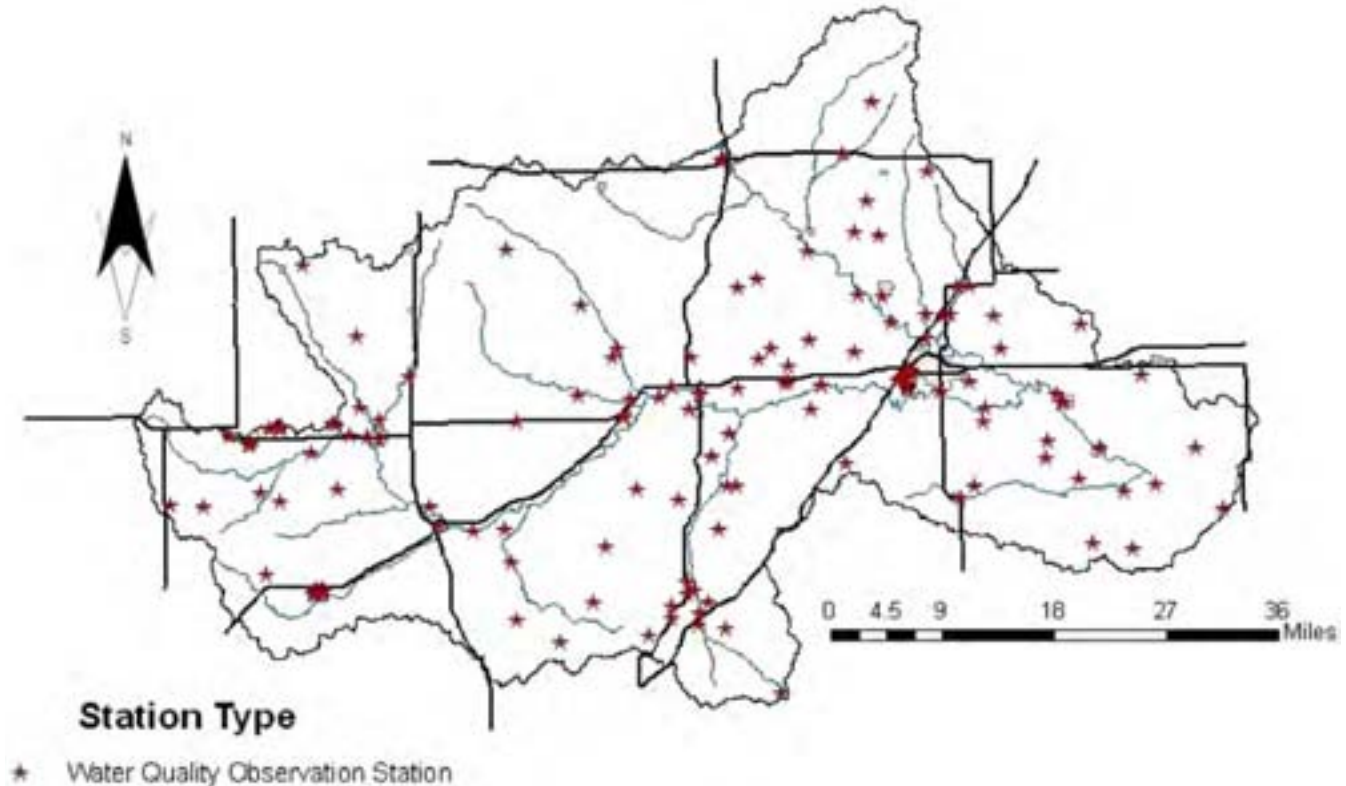


Figure 12. Water Quality Observation Stations - Upper & Lower Cottonwood and Neosho Headwaters Watersheds

Table 3. Water Quality Observation Station

State	Agency	Station ID	Station Location
KS	USGS	07182250	Cottonwood R Nr Plymouth, Ks
KS	KDHE	000274	Cottonwood R. Nr Emporia, Ks.
KS	KDHE	000275	Cottonwood R. Nr Plymouth, Ks.
KS	USGS	07179500	Neosho R At Council Grove, Ks
KS	USGS	07179730	Neosho R Nr Americus, Ks
KS	KDHE	000097	Neosho R. below Council Grove Dam
KS	KDHE	000273	Neosho R. At Neosho Rapids.
KS	KDHE	000580	Neosho River Near Emporia
KS	USGS	07179795	N Cottonwood R Bl Marion Lk, Ks
KS	USGS	07180200	Cottonwood R At Marion, Ks
KS	USGS	07180400	Cottonwood R Nr Florence, Ks
KS	USGS	07180500	Cedar C Nr Cedar Point, Ks
KS	KDHE	000095	Cottonwood R. below Marion Dam
KS	USGS	07181500	M Creek Nr Elmdale, Ks
KS	USGS	07181800	Diamond C Nr Elmdale, Ks
KS	USGS	07182000	Cottonwood R At Cottonwood Falls, Ks
KS	USGS	07182200	Sf Cottonwood R Nr Cottonwood Falls, Ks
KS	USGS	07182260	Cottonwood R At Emporia, Ks

State	Agency	Station ID	Station Location
KS	USGS	380222096254501	23s 09e 21b 01
KS	USGS	380638096371301	22s 07e 25bc 01
KS	USGS	380701096303001	22s 08e 22dcd 01
KS	USGS	380717096325901	22s 08e 20ca 01
KS	USGS	380747096351701	22s 08e 19bab 01
KS	USGS	380810096324301	22s 08e 17db 01
KS	USGS	380839096351701	22s 08e 18bab 01
KS	USGS	380849096315401	22s 08e 09cd 01
KS	USGS	380928096334401	22s 08e 07aa 01
KS	USGS	380944096331101	22s 08e 05cca 01
KS	USGS	381020096334401	22s 08e 06aa 01
KS	USGS	381133097110701	21s 02e 26cbc 01
KS	USGS	381253096405601	21s 07e 21bbc 01
KS	USGS	381353096305201	21s 08e 15bab 01
KS	USGS	381605096342501	20s 08e 31dbb 01
KS	USGS	381656096291001	20s 08e 26dab 01
KS	USGS	381656096380601	20s 07e 27daa 01
KS	USGS	381821096192901	20s 10e 17dcd 01
KS	USGS	381903096311702	20s 08e 16aa 02
KS	USGS	382038096294301	20s 08e 02bdb 01
KS	USGS	382058096070601	19s 12e 32ccc 01
KS	USGS	382148096482901	19s 06e 29ccc 01
KS	USGS	382202096385601	19s 07e 27cbd 01
KS	USGS	382202096390401	19s 07e 27cbc 01
KS	USGS	382202096390402	19s 07e 27cbc 02
KS	USGS	382208096222701	19s 09e 26daa 01
KS	USGS	382222096331601	19s 08e 29bcb 01
KS	USGS	382311096382701	19s 07e 22ac 01
KS	USGS	382327096133901	19s 11e 19aaa 01
KS	USGS	382327096133902	19s 11e 19aaa 02
KS	USGS	382327096321801	19s 08e 20aaa 01
KS	USGS	382327096321802	19s 08e 20aaa 02
KS	USGS	382334096134801	19s 11e 18ddc 01
KS	USGS	382334096134802	19s 11e 18ddc 02
KS	USGS	382340096133901	19s 11e 18dda 01
KS	USGS	382340096133902	19s 11e 18dda 02
KS	USGS	382340096133903	19s 11e 18dda 03
KS	USGS	382346096285301	19s 08e 13cbc 01
KS	USGS	382347096081001	19s 11e 13dad 01
KS	USGS	382347096134801	19s 11e 18dac 01
KS	USGS	382347096134802	19s 11e 18dac 02
KS	USGS	382400096344401	19s 08e 18bdd 01
KS	USGS	382402096244001	19s 09e 16ad 01
KS	USGS	382406096134801	19s 11e 18adb 01
KS	USGS	382406096134802	19s 11e 18adb 02
KS	USGS	382406096142301	19s 11e 18bdb 01
KS	USGS	382406096143201	19s 11e 18bca 01

State	Agency	Station ID	Station Location
KS	USGS	382412096242001	19s 09e 15bbd 01
KS	USGS	382426096131401	19s 11e 08cdc 01
KS	USGS	382426096140501	19s 11e 07dcc 01
KS	USGS	382445096133001	19s 11e 08cbb 01
KS	USGS	382517096242001	19s 09e 03ccd 01
KS	USGS	382547096265001	19s 09e 06ad 01
KS	USGS	382604096182102	19s 10e 04aba 02
KS	USGS	382604096325901	19s 08e 05bab 01
KS	USGS	382629096254901	18s 09e 32dab 01
KS	USGS	382649096392101	18s 07e 33aac 01
KS	USGS	382702096221701	18s 09e 25ccc 01
KS	USGS	382954096423701	18s 06e 12da 01
KS	USGS	383046096283201	18s 08e 01ca 01
KS	USGS	07179710	Neosho R Nr Dunlap, Ks
KS	USGS	07182390	Neosho R At Neosho Rapids, Ks
KS	USGS	07182400	Neosho R At Strawn, Ks
KS	USGS	07182450	John Redmond Re Nr Burlington, Ks
KS	USGS	381141095540901	21s 14e 29cbb 01
KS	USGS	381208095574301	21s 13e 27aab 01
KS	USGS	381539096091701	21s 11e 02aaa 01
KS	USGS	381548095544601	20s 14e 31cc 01
KS	USGS	381624096080401	20s 12e 31bbc 01
KS	USGS	381644095584101	20s 13e 28dcb 01
KS	USGS	381815096013501	20s 12e 24aaa 01
KS	USGS	381837095482201	20s 14e 13da 01
KS	USGS	381854095564501	20s 13e 14bdb 01
KS	USGS	381927096012601	20s 13e 07cbc 01
KS	USGS	382242096002901	19s 13e 19ddd 01
KS	USGS	382349095524901	19s 14e 17da 01
KS	USGS	382604096052401	19s 12e 04abb 01
KS	USGS	382652096120301	18s 11e 33ba 01
KS	USGS	382735095580901	18s 13e 27bcb 01
KS	USGS	382827096102001	18s 11e 22ada 01
KS	USGS	382833096094801	18s 11e 23bad 01
KS	USGS	382840096115101	18s 11e 21abb 01
KS	USGS	382958096154501	18s 10e 12cbb 01
KS	USGS	383004096175607	18s 10e 10bcc 07
KS	USGS	383030096080101	18s 12e 06ccc 01
KS	USGS	383030096090601	18s 11e 01ccc 01
KS	USGS	383122096265401	17s 09e 31ddc 01
KS	USGS	383352096490601	17s 06e 19bbb 01
KS	USGS	383415096155701	17s 10e 14da 01
KS	USGS	383428096180701	17s 10e 16ad 01
KS	USGS	383641096165701	16s 10e 34dda 01
KS	USGS	383839096112401	16s 11e 21daa 01
KS	USGS	384003096185801	16s 10e 09ccc 01
KS	USGS	384332096160701	15s 10e 23dcd 01

State	Agency	Station ID	Station Location
KS	USGS	07179800	S Cottonwood R Nr Canada, Ks
KS	USGS	07180000	Cottonwood R Nr Marion, Ks
KS	USGS	07180050	Mud C Nr Marion, Ks
KS	USGS	07180100	Clear C At Marion, Ks
KS	USGS	380614096450701	22s 06e 26ccb 01
KS	USGS	380753096490201	22s 06e 18dcd 01
KS	USGS	380904096420901	22s 07e 08cbb 01
KS	USGS	380959097062501	22s 03e 04 01
KS	USGS	381002097065401	22s 03e 04bcc 01
KS	USGS	381008097064601	22s 03e 04bca 01
KS	USGS	381008097064602	22s 03e 04bca 02
KS	USGS	381018097060001	22s 03e 04aa 01
KS	USGS	381021097063701	22s 03e 04bab 01
KS	USGS	381021097064601	22s 03e 04bba 01
KS	USGS	381022097060401	22s 03e 04aab 01
KS	USGS	381022097061201	22s 03e 04aba 01
KS	USGS	381419096495501	21s 05e 12caa 01
KS	USGS	381441096554701	21s 05e 07bb 01
KS	USGS	381600096562701	20s 04e 36ca 01
KS	USGS	381617097163101	20s 01e 36b 01
KS	USGS	381626097192801	20s 01e 33abb 01
KS	USGS	381637097094501	20s 02e 25cd 01
KS	USGS	381716097112501	20s 02e 27aa 01
KS	USGS	381721097043301	20s 03e 26bbb 01
KS	USGS	382036097121901	20s 02e 03bcb 01
KS	USGS	382036097122701	20s 02e 04ada 01
KS	USGS	382036097122702	20s 02e 04ada 02
KS	USGS	382042097122701	20s 02e 04aad 01
KS	USGS	382050097004801	20s 04e 05baa 01
KS	USGS	382118097140301	19s 02e 32 01
KS	USGS	382141097094101	19s 02e 36baa 01
KS	USGS	382141097103101	19s 02e 35aba 01
KS	USGS	382147097092401	19s 02e 25dcd 01
KS	USGS	382147097094101	19s 02e 25cdd 01
KS	USGS	382147097095701	19s 02e 25ccd 01
KS	USGS	382511096580401	19s 04e 10aaa 01
KS	USGS	382804097024101	18s 03e 24d 01
KS	USGS	383311097071701	17s 03e 20dc 01

6.3 USGS Gage Stations¹²

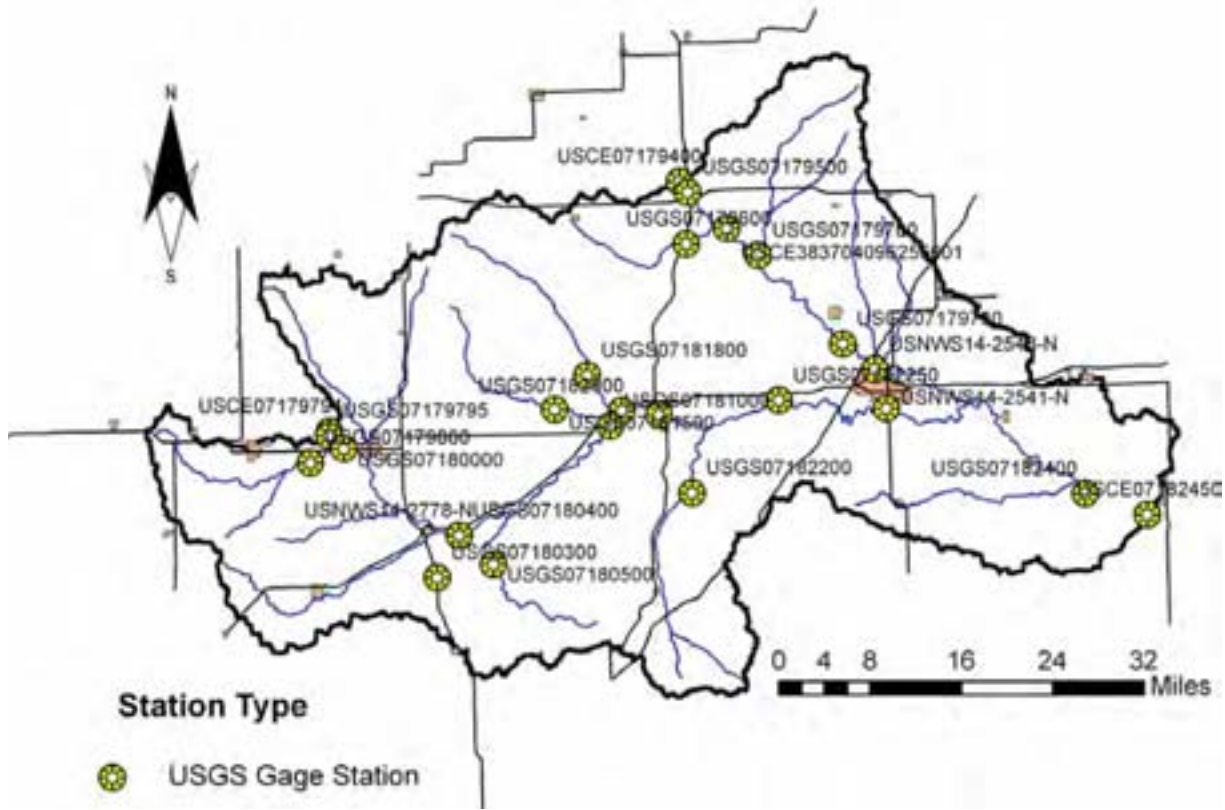


Figure 13. USGS Gage Stations – Upper & Lower Cottonwood and Neosho Headwaters Watersheds

Table 4. USGS Gage Station¹²

Gage ID	Stream Flow (cfs)												
	Mean	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
USCE07179794	-	-	-	-	-	-	-	-	-	-	-	-	-
USGS07179795	84.27	49.08	54.25	106.21	113.65	129.39	168.82	163.50	18.32	28.93	75.23	64.44	26.49
USGS07180000	113.19	56.19	54.90	87.52	156.61	201.80	253.86	185.47	49.06	141.02	83.56	35.67	41.45
USGS07179800	-	-	-	-	-	-	-	-	-	-	-	-	-
USGS07180400	323.34	127.65	202.55	379.18	399.80	432.60	975.90	357.89	86.18	301.64	291.32	184.90	113.27
USNWS14-2778-N	-	-	-	-	-	-	-	-	-	-	-	-	-
USGS07180500	55.05	27.31	36.30	65.60	88.64	76.57	128.49	69.26	20.94	46.34	44.67	26.99	27.66
USGS07150300	-	-	-	-	-	-	-	-	-	-	-	-	-
USGS07181800	-	-	-	-	-	-	-	-	-	-	-	-	-
USGS07182250	855.56	417.94	647.43	1112.47	1210.81	1101.49	2518.28	825.68	196.75	575.85	729.64	495.48	383.42
USGS07181500	46.45	35.03	20.94	42.21	97.76	45.47	67.79	76.91	32.74	29.96	46.88	14.84	39.00
USGS07182000	515.52	232.46	265.62	423.57	750.08	897.42	1036.76	919.51	231.04	541.32	430.78	215.79	235.14
USNWS14-1858-6	-	-	-	-	-	-	-	-	-	-	-	-	-
USNWS14-2541-N	-	-	-	-	-	-	-	-	-	-	-	-	-
USGS07181000	369.07	107.56	138.55	204.81	519.67	535.83	877.27	558.24	392.03	257.89	231.18	372.14	130.58
USGS07182200	-	-	-	-	-	-	-	-	-	-	-	-	-
USCE07179400	-	-	-	-	-	-	-	-	-	-	-	-	-
USGS07179500	123.92	62.08	61.37	111.91	185.68	187.75	237.12	256.42	57.95	98.74	123.08	39.43	55.23
USCE383704096255601	-	-	-	-	-	-	-	-	-	-	-	-	-
USGS07179600	27.14	7.48	15.05	20.95	59.11	24.40	113.06	9.97	1.01	31.14	25.50	10.02	10.29
USGS07179700	-	-	-	-	-	-	-	-	-	-	-	-	-
USGS07179730	311.71	175.83	205.64	332.53	451.73	416.72	674.51	447.47	88.18	236.34	331.83	171.21	179.47
USNWS14-2548-N	-	-	-	-	-	-	-	-	-	-	-	-	-
USGS07182400	1363.99	419.99	636.92	1431.12	1302.84	2741.76	1744.91	3699.87	903.06	1505.99	942.35	658.35	307.46
USCE07182450	-	-	-	-	-	-	-	-	-	-	-	-	-

Table 5. Estimated peak-streamflow frequencies for selected gaging stations with at least 10 years of annual peak-discharge data for unregulated, rural streams in Kansas¹³.

USGS ID	Station Name	Drainage Area (mi ²)	2-year ft ³ /s	5-year ft ³ /s	10-year ft ³ /s	25-year ft ³ /s	50-year ft ³ /s	100-Year ft ³ /s	200-year ft ³ /s
07180000	Cottonwood River near Marion	329	6460	12200	16800	23300	28800	34600	40900
07180500	Cedar Creek near Cedar Point	110	5740	10800	14700	20100	24500	28900	33600
07181500	Middle Creek near Elmdale	92.0	6960	15000	22100	33100	42700	53500	65400
07182000	Cottonwood River at Cottonwood Falls	1330	10300	24500	39000	64400	89500	121000	159000
07179500	Neosho River at Council Grove	250	10100	23000	35900	58000	79600	106000	139000
07179600	Four Mile Creek near Council Grove	55.0	5370	11300	16700	25400	33400	42600	53300
07182400	Neosho River at Strawn	2930	20400	44800	68300	108000	145000	191000	246000

Table 6. USGS gaging stations period of record for Upper & Lower Cottonwood and Neosho Headwaters Watersheds¹²

USGS ID	Drainage Area (mi ²)	Period of record	
		Begin	End
07180000	329	09/30/1938	09/30/1968
07180500	110	09/30/1938	Present
07181500	92	09/30/1938	09/30/1950
07182000	1327	03/31/1932	07/13/1971
07179500	250	09/30/1938	Present
07179600	55	03/31/1963	10/13/1971
07182400	2933	09/30/1948	06/30/1963
07179710	528	09/30/1984	09/30/1985
07179730	622	06/30/1963	Present
07179795	200	06/30/1968	Present
07180200	502	10/31/1984	09/30/1999
07180400	754	06/30/1961	Present
07181000	1045	09/30/1922	09/30/1932
07182250	1740	02/28/1963	Present

6.4 Permitted Point Source Facilities¹⁴

NPDES permit-holding facility information; contains parameter-specific loadings to surface waters computed using the EPA Effluent Decision Support System (EDSS) for 1990-1999. The summary of discharge concentrations and loads allows the user to perform a planning-level assessment of the magnitude and severity of point source contributions. Analyzing the data for different years can provide information to evaluate changes in contributions from various point sources over time and support trend analysis.

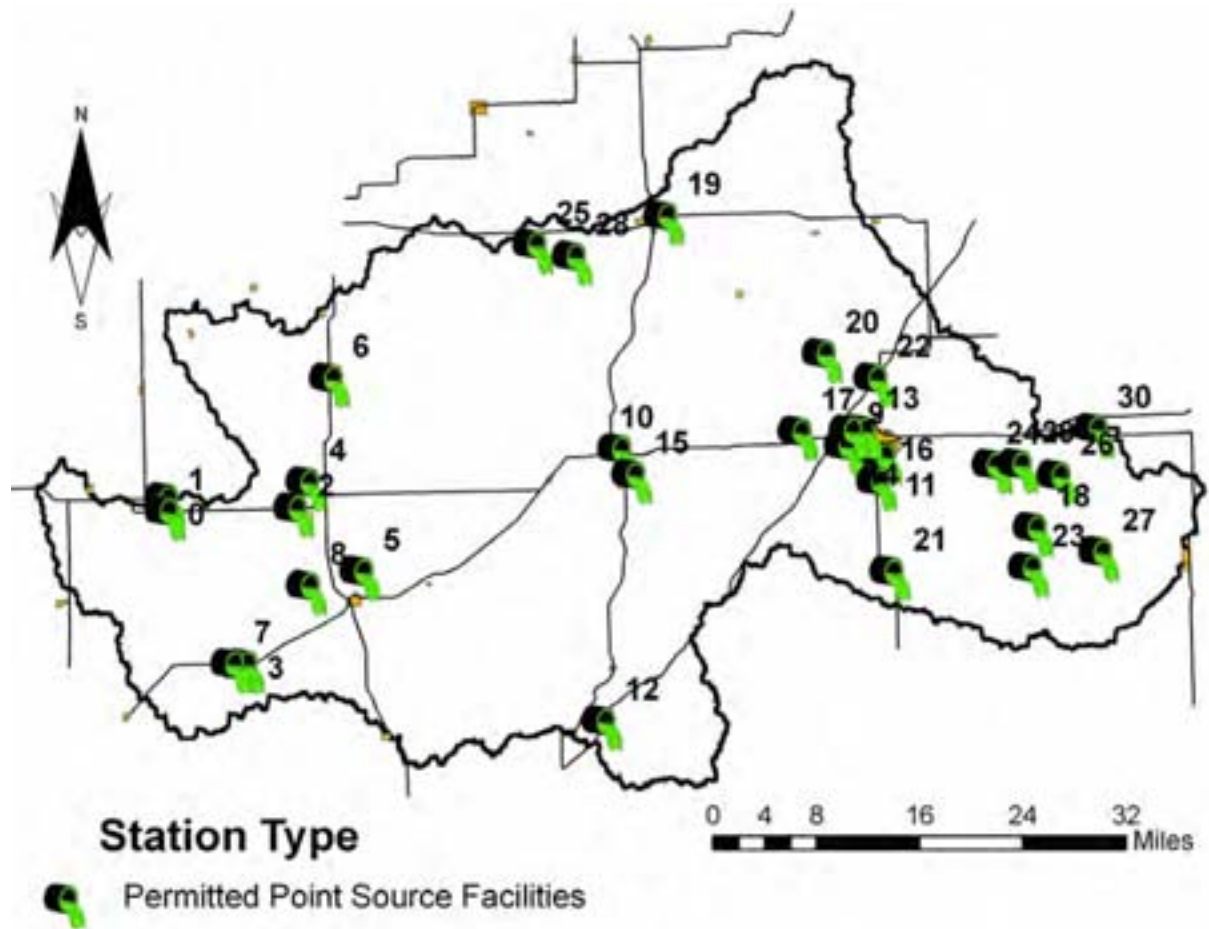


Figure 14. NPDES permit-holding facilities – Upper & Lower Cottonwood and Neosho Headwaters Watersheds

Table 7. Permitted Point Source Facilities¹⁴

ID	NPDES	Facility Name	Ownership	Description	Industrial Classification	City	County	Flow Rate(million gallons/day)
0	KS0001350	Associated Milk Prod. Inc.	Private	Condensed And Evaporated Milk	ON Elg	Hillsboro	Marion	0.00000
1	KS0030589	Hillsboro City Of	Public	Sewerage Systems	Municipal	Hillsboro	Marion	0.00000
2	KS0051691	Marion City Of Stp	Public	Sewerage Systems	Municipal	Marion	Marion	0.54000
3	KS0051705	Peabody Wwtd	Public	Sewerage Systems	Municipal	Peabody	Marion	0.21000
4	KS0087751	Martin Marietta-hett Quarry	Private	Crushed And Broken Limestone	ON Elg	Marion County	Marion	0.00000
5	KS0087769	Martin Marietta-sunflower Quar	Private	Crushed And Broken Limestone	ON Elg	Marion County	Marion	0.00000
6	KS0090581	Lincolnvile City Of Wwtf	Public	Sewerage Systems	Municipal	Lincolnvile	Marion	0.00000
7	KS0093505	Unruh Catering Groundwater Rem	Pub Pri			Peabody	Marion	0.00000
8	KS0115762	Martin Marietta Aggre- Marion	Private	Crushed And Broken Limestone	ON Elg	Marion	Marion	0.00000
10	KS0000817	Ibp, Incorporated	Private	Meat Packing Plants	ON Elg	Emporia	Lyon	3.00000
11	KS0031178	Strong City City Of Wwtp	Public	Sewerage Systems	Municipal	Strong City	Chase	0.00000
12	KS0046728	Emporia, City Of	Public	Sewerage Systems	Municipal	Emporia	Lyon	4.20000
13	KS0053660	Kansas Turnpike Authority Mat	State	Inspection & Fixed Facilitie	Not ON EI	Matfield Green	Chase	0.00000
14	KS0084484	Modine Manufacturing Company	Private	Motor Vehicle Parts & Accessor	ON Elg	Emporia	Lyon	0.00000
15	KS0088544	Didde Web Press Corp.	Private	Commercial Printing, Nec	Not ON EI	Emporia	Lyon	0.00000
16	KS0089664	Cottonwood Falls Wwtf	Public			Cottonwood Falls	Chase	0.00000
17	KS0115584	Country Park Mhc Wwtp	Private	Oper Of Res Mobile Home Sites	Not ON EI	Lyon County	Lyon	0.00000
18	KS0117871	Thunderbird Estates	Private	Oper Of Res Mobile Home Sites	Not ON EI	Emporia	Lyon	0.00000
19	KS0025682	Hartford City Of Stp	Public	Sewerage Systems	Municipal	Hartford	Lyon	0.00000
20	KS0027898	Council Grove City Of Stp	Public	Sewerage Systems	Municipal	Council Grove	Morris	0.40000
21	KS0047406	Americus City Of Stp	Public	Sewerage Systems	Municipal	Americus	Lyon	0.00000
22	KS0047571	Olpe City Of Stp	Public	Sewerage Systems	Municipal	Olpe	Lyon	0.00000

ID	NPDES	Facility Name	Ownership	Description	Industrial Classification	City	County	Flow Rate(million gallons/day)
23	KS0053678	Kansas Turnpike Authority Emp	State	Inspection & Fixed Facilitie	Not ON El	Emporia	Lyon	8.20000
24	KS0086657	J.h. Shears' Sons Inc.-nelson	Private	Crushed And Broken Lime-stone	ON Elg	Lyon County	Lyon	0.00000
25	KS0089842	Holiday 66/ber Shutdown	Pub Pri			Great Bend	Barton	0.00000
26	KS0089907	Wilsey	Pub Pri			Wilsey	Morris	0.00000
27	KS0090174	Kdhe-klepper Oil Service-great	Pub Pri			Great Bend	Barton	0.00000
29	KS0090743	Jacob Creek Wwtf	Public	Sewerage Systems	Municipal	Burlington	Coffey	0.00000
30	KS0092312	Hamm - Loomis Qry #91	Pub Pri			Council Grove	Morris	0.00000
31	KS0117021	Neosho Rapids City Of Wwtp	Public	Sewerage Systems	Municipal	Neosho Rapids	Lyon	0.00000
32	KS0024767	Lebo City Of						0.00000

6.5 Confined Animal Feeding Operations (CAFOs)¹⁵

Animal feeding operations classified as large or presenting a high risk to discharge can be classified as CAFOs and are likely required to have an NPDES permit. This maps shows the locations and permit numbers for these sites in the Upper & Lower and Neosho Headwaters Watersheds.

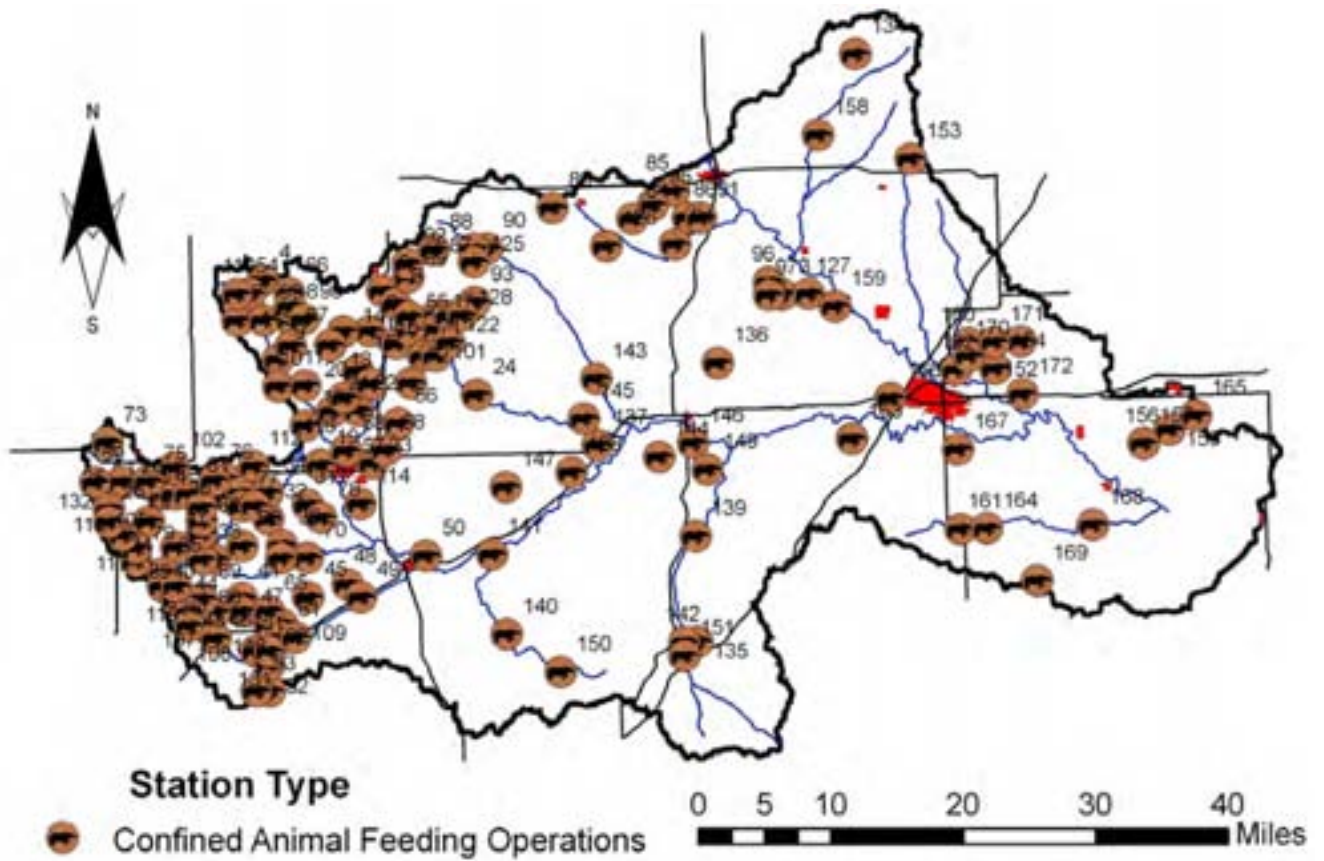


Figure 15. Confined Animal Feeding Operations facilities – Upper & Lower Cottonwood and Neosho Headwaters watersheds

Table 8. Confined Animal Feeding Operations¹⁵

ID	Permit No.	Total Head	Kansas AUS*	Federal AUS*	Animal Type
0	A-NEMN-H001	3600	1440	1440	Swine
1	A-NEMN-C001	4000	3000	4000	Beef
2	A-NEMN-C002	3500	3500	3500	Beef
3	A-NEMR-C002	4000	3500	4000	Beef
4	A-NEMN-BA18	200	200	200	Beef
5	A-NEMN-BA61	200	200	200	Beef
6	A-NEMN-BA17	300	300	300	Beef
7	A-NEMN-BA62	200	200	200	Beef
8	A-NEMN-BA53	150	150	150	Beef
9	A-NEMN-BA80	190	190	190	Beef
10	A-NEMN-BA85	300	225	300	Beef
11	A-NEMN-BA77	140	140	140	Beef
12	A-NEMN-BA71	295	295	295	Beef
13	A-NEMN-SA05	300	120	120	Swine
14	A-NEMN-BA19	600	600	600	Beef
15	A-NEMN-BA70	600	600	600	Beef
16	A-NEMN-BA15	200	150	200	Beef
17	A-NEMN-BA26	990	990	990	Beef
18	A-NEMN-BA07	600	300	600	Beef
19	A-NEMN-BA52	200	200	200	Beef
20	A-NEMN-BA66	150	150	150	Beef
21	A-NEMN-BA69	300	300	300	Beef
22	A-NEMN-BA65	150	150	150	Beef
23	A-NEMN-BA34	300	300	300	Beef
24	A-NEMN-BA90	500	250	500	Beef
25	A-NEMN-BA01	500	500	500	Beef
26	A-NEMN-BA38	200	200	200	Beef
27	A-NEMN-BA28	200	200	200	Beef
28	A-NEMN-MA12	60	84	84	Dairy
29	A-NEMN-MA03	40	56	56	Dairy
30	A-NEMN-BA46	60	60	60	Beef
31	A-NEMN-LA01	1200	120	120	Sheep
32	A-NEMN-BA92	350	175	350	Beef
33	A-NEMN-BA10	90	90	90	Beef
34	A-NEMN-BA40	30	30	30	Beef
35	A-NEMN-SA01	200	80	80	Swine
36	A-NEMN-BA43	230	230	230	Beef
37	A-NEMN-BA58	300	300	300	Beef
38	A-NEMN-BA41	25	25	25	Beef
39	A-NEMN-BA31	400	400	400	Beef
40	A-NEMN-BA37	175	175	175	Beef
41	A-NEMN-CA03	250	250	250	Beef
42	A-NEMN-BA09	120	120	120	Beef
43	A-NEMN-MA01	50	70	70	Dairy
44	A-NEMN-BA39	30	30	30	Beef

* Animal System Unit

ID	Permit No.	Total Head	Kansas AUS*	Federal AUS*	Animal Type
45	A-NEMN-BA51	250	250	250	Beef
46	A-NEMN-BA08	300	300	300	Beef
47	A-NEMN-BA76	200	100	200	Beef
48	A-NEMN-BA60	250	250	250	Beef
49	A-NEMN-BA33	200	200	200	Beef
50	A-NEMN-BA64	200	200	200	Beef
51	A-NEMN-B022	400	400	400	Beef
52	A-NEMN-BA12	299	299	299	Beef
53	A-NEMN-BA13	299	299	299	Beef
54	A-NEMN-BA29	25	25	25	Beef
55	A-NEMN-BA27	450	450	450	Beef
56	A-NEMN-BA35	75	75	75	Beef
57	A-NEMN-BA11	100	100	100	Beef
58	A-NEMN-BA57	200	200	200	Beef
59	A-NEMN-BA03	700	700	700	Beef
60	A-NEMN-FA01	7500	0	0	Chickens Dry
61	A-NEMN-BA67	100	70	70	Beef, Swine
62	A-NEMN-BA14	100	100	100	Beef
63	A-NEMN-BA24	300	300	300	Beef
64	A-NEMN-BA75	120	120	120	Beef
65	A-NEMN-BA21	150	150	150	Beef
66	A-NEMN-BA56	500	500	500	Beef
67	A-NEMN-BA30	25	25	25	Beef
68	A-NEMN-BA50	275	275	275	Beef
69	A-NEMN-BA82	43	43	43	Beef
70	A-NEMN-SA06	200	80	80	Swine
71	A-NEMN-BA47	350	350	350	Beef
72	A-NEMN-BA74	490	295	490	Beef
73	A-NEMN-MA06	30	42	42	Dairy
74	A-NEMN-BA86	175	175	175	Beef
75	A-NEMN-BA87	175	175	175	Beef
76	A-NEMN-BA54	120	120	120	Beef
77	A-NEMN-BA25	80	80	80	Beef
78	A-NEMN-LA02	1200	120	120	Sheep
79	A-NEMN-MA10	25	35	35	Dairy
80	A-NEMN-BA42	700	460	460	Beef, Swine
81	A-NEMN-BA73	30	30	30	Beef
82	A-NEMN-BA81	100	100	100	Beef
83	A-NEMR-SA01	150	60	60	Swine
84	A-NEMR-BA15	325	163	325	Beef
85	A-NEMR-BA06	200	200	200	Beef
86	A-NEMR-BA05	300	300	300	Beef
87	A-NEMR-BA12	270	180	270	Beef
88	A-NEMR-BA13	400	200	400	Beef
89	A-NEMR-MA02	25	35	35	Dairy
90	A-NEMR-BA11	300	300	300	Beef

* Animal System Unit

ID	Permit No.	Total Head	Kansas AUS*	Federal AUS*	Animal Type
91	A-NEMR-BA04	240	240	240	Beef
92	A-NEMR-MA01	20	28	28	Dairy
93	A-NEMR-BA09	350	350	350	Beef
94	A-NEMR-BA10	200	200	200	Beef
95	A-NEMR-BA03	300	300	300	Beef
96	A-NEMR-BA08	299	299	299	Beef
97	A-NEMR-BA07	660	330	660	Beef
98	A-NEMN-B019	3720	449	716	Chickens Dry, Beef
99	A-NEMN-M022	270	248	298	Dairy, Beef
100	A-NEMN-B016	450	300	450	Beef
101	A-NEMN-BD01	450	225	450	Beef
102	A-NEMN-B005	250	250	250	Beef
103	A-NEMN-M024	180	200	220	Dairy
104	A-NEMN-M013	53	61	67	Dairy
105	A-NEMN-M023	240	289	304	Dairy
106	A-NEMN-S025	750	255	310	Beef, Swine
107	A-NEMN-B018	600	600	600	Beef
108	A-NEMN-M025	150	165	182	Dairy
109	A-NEMN-B009	300	150	300	Beef
110	A-NEMN-M015	110	127	134	Dairy
111	A-NEMN-B012	950	950	950	Beef
112	A-NEMN-S011	600	180	160	Swine
113	A-NEMN-S024	1400	422	376	Swine
114	A-NEMN-B001	999	999	999	Beef
115	A-NEMN-S019	458	132	115	Swine
116	A-NEMN-B020	597	237	295	Beef, Swine
117	A-NEMN-M016	250	130	130	Beef, Swine
118	A-NEMN-M027	125	127	147	Dairy
119	A-NEMN-S021	1568	633	645	Beef, Swine
120	A-NEMN-B023	1350	990	990	Swine, Beef
121	A-NEMN-B017	300	200	300	Beef
122	A-NEMN-BD03	600	300	600	Beef
123	A-NEMN-B015	400	400	400	Beef
124	A-NEMR-B007	480	480	480	Beef
125	A-NEMR-B008	260	195	260	Beef
126	A-NEMR-B006	950	950	950	Beef
127	A-NEMR-B005	999	500	999	Beef
128	A-NEMN-S004	442	117	97	Swine
129	A-NEMN-M014	75	105	105	Dairy
130	A-NEMN-S015	500	200	200	Swine
131	A-NEMN-B008	500	500	500	Beef
132	A-LAMN-M002	132	185	185	Dairy
133	A-NEMN-S018	1470	396	348	Swine, Beef
134	A-NEWB-SA01	600	180	160	Swine
135	A-NECS-C001	1900	840	1240	Beef, Swine
136	A-NECS-BA02	750	750	750	Beef

* Animal System Unit

ID	Permit No.	Total Head	Kansas AUS*	Federal AUS*	Animal Type
137	A-NECS-FA01	10000	0	0	Chickens Dry
138	A-NECS-BA07	250	125	250	Beef
139	A-NECS-BA03	250	125	250	Beef
140	A-NECS-BA04	350	263	350	Beef
141	A-NECS-BA08	950	950	950	Beef
142	A-NECS-BA09	150	75	150	Beef
143	A-NECS-BA01	950	950	950	Beef
144	A-NECS-BA10	900	450	900	Beef
145	A-NECS-BA06	240	120	240	Beef
146	A-NECS-BA05	500	250	500	Beef
147	A-NECS-CA02	200	200	200	Beef
148	A-NEHV-EA01	500	0	0	Exotic
149	A-NECS-S010	2430	972	972	Swine
150	A-NECS-M001	60	84	84	Dairy
151	A-NECS-S009	1500	600	600	Swine
152	A-NELY-C003	9500	9500	9500	Beef
153	A-NELY-C006	17600	17600	17600	Beef
154	A-NELY-C005	2000	2000	2000	Beef
155	A-NECF-BA09	500	250	500	Beef
156	A-NECF-BA07	250	250	250	Beef
157	A-NECF-BA08	175	175	175	Beef
158	A-NELY-BA08	950	475	950	Beef
159	A-NELY-BA05	750	750	750	Beef
160	A-NELY-BA06	600	300	600	Beef
161	A-NELY-BA07	600	475	600	Beef
162	A-NELY-BA03	950	950	950	Beef
163	A-NELY-BA04	250	250	250	Beef
164	A-NELY-MA02	50	70	70	Dairy
165	A-NECF-M001	70	98	98	Dairy
166	A-NELY-S015	600	240	240	Swine
167	A-NELY-B006	560	280	560	Beef
168	A-NELY-M002	450	475	550	Dairy
169	A-NELY-B002	950	950	950	Beef
170	A-NELY-B003	900	900	900	Beef
171	A-NELY-B004	700	600	700	Beef

* Animal System Unit

6.6 1990 Population and Sewerage by Census Tract¹⁶

The 1990 Population and Sewerage by Census Tract can be used to examine specific areas for population density and the prevalence of septic systems, which can be significant sources of pathogens, household chemicals, and nutrients (especially nitrate) escaping into groundwater and nearby receiving water bodies.

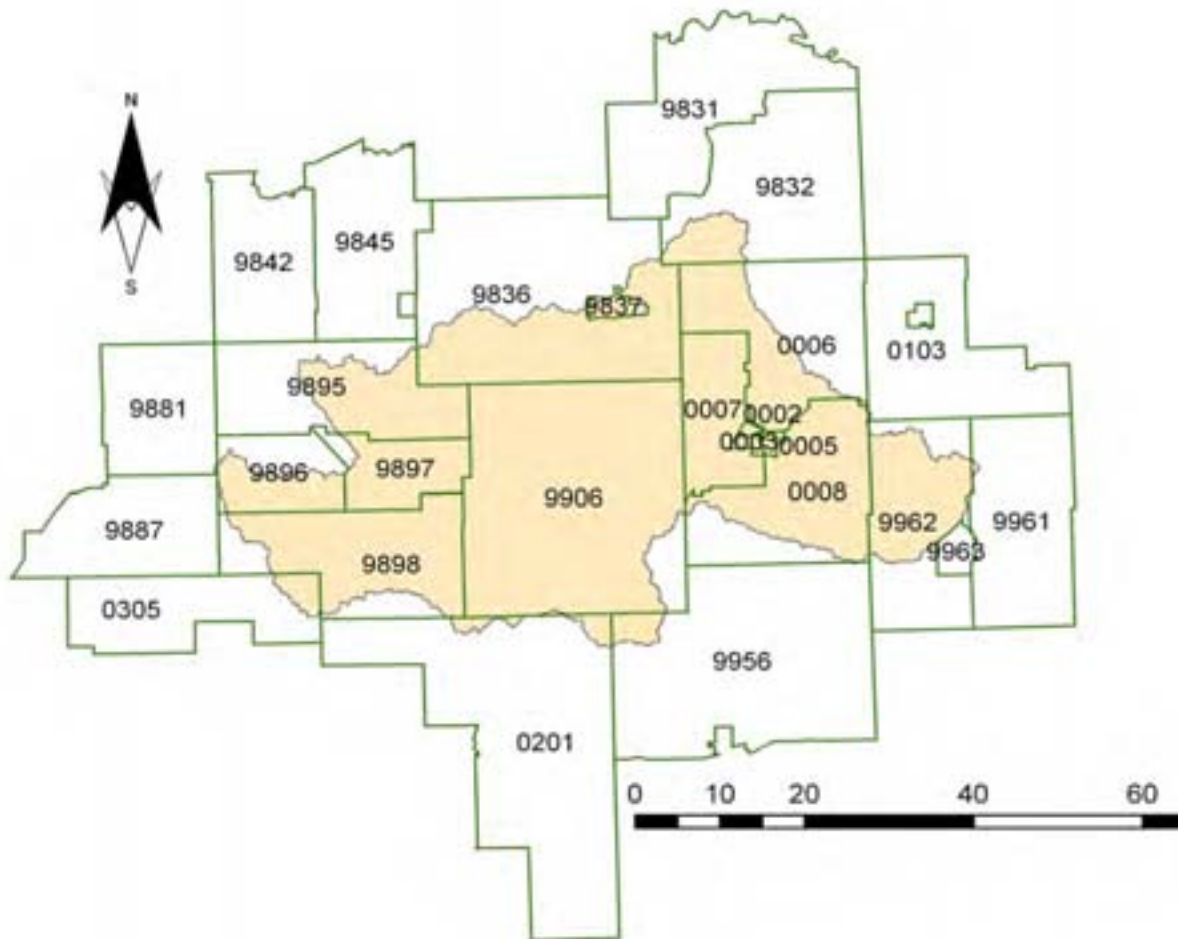


Figure 16. Population and Sewerage by Census-Upper & Lower Cottonwood and Neosho Headwaters Watersheds

Table 9. 1990 Population and Sewerage by Census Tract¹⁶

ID	Tract	Population	House Units	Sewerage Public	Sewerage Septic	Sewerage Other
0	0001	5794	2348	2301	33	14
1	0002	5800	2341	2333	0	8
2	0003	3347	1692	1683	0	9
3	0004	6025	2405	2392	13	0
4	0005	4810	2062	2013	44	5
5	0006	2595	1047	297	693	57
6	0007	2702	1022	448	471	103
7	0008	3659	1429	537	809	83
8	9831	4049	1648	977	657	14
9	9832	2554	1205	384	767	54
10	9836	3562	1936	514	1372	56
11	0103	2181	891	198	675	18
12	9837	2636	1213	996	217	0
13	9906	3021	1547	757	716	74
14	9962	2868	1252	725	475	52
15	9961	2515	1135	584	505	46
16	9963	3021	1325	1221	94	10
17	9956	2605	1356	665	634	57
18	9845	3243	1367	635	660	72
19	9842	2408	1063	446	615	2
20	9895	1879	798	287	499	12
21	9881	2704	1087	666	374	47
22	9897	2786	1412	1131	237	44
23	9896	3697	1531	1183	308	40
24	9887	5584	2139	1139	922	78
25	0305	5711	1993	1126	777	90
26	9898	4526	1918	1224	622	72
27	0201	4602	1898	878	944	76
28	9895	1879	798	287	499	12
29	9956	2605	1356	665	634	37

7.0. Agricultural Economy

7.1 Corn Cost-Return Budget¹⁷

Table 10. Cost-return projections for corn crops in the Neosho Headwaters, Upper and Lower Cottonwood Watersheds, 2006.

Corn	Yield Level (bu)		
	80	110	140
Income Per Acre			
A. Yield per acre	80	110	140
B. Price per bushel	\$2.70	\$2.70	\$2.70
C. Net government payment	\$10.48	\$11.39	\$12.30
D. Indemnity payments			
E. Miscellaneous income			
F. Returns/acre ((AxB)+C+D+E)	\$226.48	\$308.39	\$390.30
Costs Per Acre			
1. Seed	\$32.43	\$32.43	\$36.66
2. Herbicide	33.85	33.85	33.85
3. Insecticide/Fungicide	0.27	0.27	0.27
4. Fertilizer and Lime	37.48	45.40	53.32
5. Crop Consulting			
6. Crop Insurance			
7. Drying			
8. Miscellaneous	7.00	7.00	7.00
9. Custom Hire / Machinery Expense	90.16	98.83	107.50
10. Non-machinery Labor	10.19	11.17	12.15
11. Irrigation			
12. Land Charge/Rent	34.40	43.00	51.60
G. Sub Total	\$245.77	\$271.94	\$302.34
13. Interest on ½ Nonland Costs	9.51	10.30	11.28
H. Total Costs	\$255.28	\$282.25	\$313.63
I. Returns Over Costs (F-H)	-\$28.81	\$26.14	\$76.68
J. Total Costs/bushel (H/A)	\$3.19	\$2.57	\$2.24
K. Return To Annual Cost (I+13)/G	-7.85%	13.40%	29.09%

Table 11. Southeast Kansas Farm Management Association profit Center Analysis: 5-year Average and 2006 Non-irrigated Corn.²⁶

	2001-2005 Average			2006		
Number of Farms	55			38		
Crop Acres	402			529		
Acres Owned	121			155		
Acres Rented	281			374		
Yield / Acre	109			95		
Bushels	36,359			40,404		
Operator Percentage	83.15%			80.47%		
Gross Income / Acre	\$233.40			\$242.68		
Variable Costs / Acre	\$160.45			\$178.68		
Total Expense / Acre	\$230.79			\$248.23		
Gross Income / Bushel	\$2.58			\$3.18		
Total Expense / Bushel	\$2.55			\$3.25		
	Total Dollars	\$/Bushel	\$/Acre	Total Dollars	\$/Bushel	\$/Acre
INCOME:						
Corn (Operator's Share)	\$80,290.82	\$2.21	\$199.63	\$120,532.52	\$2.98	\$227.65
Patronage Refunds	\$266.75	0.01	0.66	\$673.05	0.02	1.27
Government Payments	\$12,131.76	0.33	30.16	\$6,674.57	0.17	12.62
Miscellaneous Income	\$20.08	0.00	0.05	(\$147.10)	(0.00)	(0.28)
Crop Insurance Proceeds	\$1,163.31	0.03	2.89	\$645.16	0.02	1.22
OTHER INCOME	\$13,581.90	\$0.37	\$33.77	\$7,845.68	\$0.19	\$14.83
GROSS INCOME	\$93,672.72	\$2.58	\$233.40	\$128,378.20	\$3.18	\$242.68
EXPENSES:						
Labor Hired	\$3,453.01	\$0.09	\$8.59	\$4,657.12	\$0.12	\$8.80
General Machinery Repairs	\$6,156.94	0.17	15.31	\$8,142.53	0.20	15.39
Interest Paid	\$3,812.10	0.10	9.48	\$6,394.41	0.16	12.09
Seed / Other Crop Expense	\$12,012.77	0.33	29.87	\$18,201.43	0.45	34.41
Crop Insurance	\$2,119.32	0.06	5.27	\$3,501.80	0.09	6.62
Fertilizer / Lime	\$16,167.67	0.44	40.20	\$25,235.64	0.62	47.70
Machine Hire - Lease	\$2,389.04	0.07	5.94	\$2,745.59	0.07	5.19
Farm Org Fees / Travel / Publ	\$655.92	0.02	1.63	\$877.00	0.02	1.66
Gas / Fuel / Oil	\$4,069.75	0.11	10.12	\$7,761.81	0.19	14.67
Crop Storage & Marketing	\$498.96	0.01	1.24	\$551.75	0.01	1.04
Personal Property Tax	\$292.99	0.01	0.73	\$331.64	0.01	0.63
General Farm Insurance	\$1,099.50	0.03	2.73	\$1,398.60	0.03	2.64
Utilities	\$843.34	0.02	2.10	\$974.65	0.02	1.84
Cash Farm Rent	\$3,252.51	0.09	8.09	\$2,491.15	0.06	4.71
Herbicide / Insecticide	\$7,424.28	0.20	18.46	\$10,987.66	0.27	20.77
Conservation	\$42.18	0.00	0.10	\$0.58	0.00	0.00
Auto Expense	\$241.21	0.01	0.60	\$265.72	0.01	0.50
TOTAL VARIABLE COSTS	\$84,531.50	\$1.77	\$160.45	\$94,519.08	\$2.34	\$178.68
RETURN ABOVE VARIABLE COSTS	\$29,341.23	\$0.81	\$72.95	\$33,859.12	\$0.84	\$64.01
Depreciation	\$8,551.91	0.24	21.26	\$11,757.89	0.29	22.23
Real Estate Tax	\$1,014.99	0.03	2.52	\$1,207.60	0.03	2.28
Unpaid Operator Labor	\$6,259.53	0.17	15.56	\$6,854.67	0.16	12.58
Interest Charge *	\$2,730.39	0.08	6.79	\$2,664.72	0.07	5.04
TOTAL FIXED COSTS	\$18,556.82	\$0.51	\$46.14	\$22,284.88	\$0.55	\$42.13
Land Charge **	\$9,735.65	\$0.27	\$24.21	\$14,510.87	\$0.36	\$27.43
TOTAL EXPENSE	\$92,823.97	\$2.55	\$230.79	\$131,314.63	\$3.25	\$248.23
NET RETURN TO MANAGEMENT	\$1,048.75	\$0.03	\$2.61	(\$2,936.63)	(\$0.07)	(\$5.55)
NET RETURN TO LABOR-MGT	\$10,761.29	\$0.30	\$26.76	\$8,375.16	\$0.21	\$15.83

*Interest charge equals: ((8.0% times three-fourths the variable costs) plus (4.0% times depreciation times 8)) minus cash interest paid.

**Land charge represents a charge (equal to landlord's share) on owned land and equals (production from owned acres X price / unit X 33.33%). Crop production paid to the landlord on rented land (already removed above), or cash rent is the charge on rented land.

This crop enterprise is based on the operator's share of production, and thus includes only production expenses paid by the operator. A charge for management is not included in the expenses.

7.2 Soybean Cost-Return Budget¹⁷

Table 12. Cost-return projections for soybean crops in the Neosho Headwaters, Upper & Lower Cottonwood Watersheds, 2006.

Soybeans	Yield Level (bu)		
	25	35	45
Income Per Acre			
A. Yield per acre	25	35	45
B. Price per bushel	\$6.08	\$6.08	\$6.08
C. Net government payment	\$10.48	\$11.39	\$12.30
D. Indemnity payments			
E. Miscellaneous income			
F. Returns/acre ((AxB)+C+D+E)	\$162.48	\$224.19	\$285.90
Costs Per Acre			
1. Seed	\$30.60	\$30.60	\$32.95
2. Herbicide	8.86	8.86	8.86
3. Insecticide/Fungicide			
4. Fertilizer and Lime	16.41	17.70	21.20
5. Crop Consulting			
6. Crop Insurance			
7. Drying			
8. Miscellaneous	7.00	7.00	7.00
9. Custom Hire / Machinery Expense	73.03	77.25	80.22
10. Non-machinery Labor	8.25	8.75	9.06
11. Irrigation			
12. Land Charge / Rent	34.40	43.00	51.60
G. Sub Total	\$178.55	\$193.14	\$210.89
13. Interest on ½ Nonland Costs	6.49	6.76	7.17
H. Total Costs	\$185.03	\$199.89	\$218.06
I. Returns Over Costs (F-H)	-\$22.56	\$24.30	\$67.84
J. Total Costs/bushel (H/A)	\$7.40	\$5.71	\$4.85
K. Return To Annual Cost (I+13)/G	-9.00%	16.08%	35.57%

Table 13. Southeast Kansas Farm Management Association profit Center Analysis: 5-year Average and 2006 Non-irrigated Soybeans.²⁶

	2001-2005 Average			2006		
Number of Farms	71			49		
Crop Acres	476			442		
Acres Owned	113			101		
Acres Rented	362			342		
Yield / Acre	28			26		
Bushels	10,662			8,908		
Operator Percentage	80.73%			78.77%		
Gross Income / Acre	\$149.07			\$148.18		
Variable Costs / Acre	\$94.54			\$105.63		
Total Expense / Acre	\$145.78			\$154.47		
Gross Income / Bushel	\$6.65			\$7.35		
Total Expense / Bushel	\$6.50			\$7.67		

	Total Dollars	\$/Bushel	\$/Acre	Total Dollars	\$/Bushel	\$/Acre
INCOME:						
Soybeans (Operator's Share)	\$58,823.37	\$5.52	\$123.68	\$56,216.35	\$6.31	\$127.19
Patronage Refunds	\$300.71	0.03	0.63	\$402.25	0.05	0.91
Government Payments	\$9,645.70	0.90	20.28	\$5,941.08	0.67	13.44
Miscellaneous Income	\$23.47	0.00	0.05	(\$1.98)	(0.00)	(0.00)
Crop Insurance Proceeds	\$2,103.66	0.20	4.42	\$2,937.50	0.33	6.65
OTHER INCOME	\$12,073.55	\$1.13	\$25.39	\$9,278.85	\$1.04	\$20.99
GROSS INCOME	\$70,896.91	\$8.65	\$149.07	\$65,495.20	\$7.35	\$148.18
EXPENSES:						
Labor Hired	\$2,364.92	\$0.22	\$4.97	\$3,018.89	\$0.34	\$6.83
General Machinery Repairs	\$5,957.40	0.56	12.53	\$5,633.38	0.63	12.75
Interest Paid	\$4,288.15	0.40	9.02	\$4,077.73	0.46	9.23
Seed / Other Crop Expense	\$8,987.19	0.84	18.90	\$10,131.36	1.14	22.92
Crop Insurance	\$2,024.04	0.19	4.26	\$2,890.62	0.32	6.54
Fertilizer / Lime	\$1,917.37	0.18	4.03	\$2,658.14	0.30	6.01
Machine Hire - Lease	\$2,164.97	0.20	4.55	\$1,534.20	0.17	3.47
Farm Org Fees / Travel / Publ	\$659.88	0.06	1.39	\$795.70	0.09	1.60
Gas / Fuel / Oil	\$3,999.51	0.38	8.41	\$5,529.03	0.62	12.51
Crop Storage & Marketing	\$343.58	0.03	0.72	\$290.45	0.03	0.66
Personal Property Tax	\$283.04	0.03	0.60	\$305.12	0.03	0.69
General Farm Insurance	\$1,112.99	0.10	2.34	\$1,079.54	0.12	2.44
Utilities	\$932.89	0.09	1.96	\$797.39	0.09	1.80
Cash Farm Rent	\$3,457.04	0.32	7.27	\$2,897.97	0.33	6.56
Herbicide / Insecticide	\$6,090.26	0.57	12.81	\$4,872.54	0.55	11.02
Conservation	\$44.19	0.00	0.09	\$0.20	0.00	0.00
Auto Expense	\$334.90	0.03	0.70	\$177.81	0.02	0.40
TOTAL VARIABLE COSTS	\$44,962.11	\$4.22	\$94.54	\$46,688.07	\$5.24	\$105.63
RETURN ABOVE VARIABLE COSTS	\$25,934.80	\$2.43	\$54.53	\$18,807.13	\$2.11	\$42.55
Depreciation	\$8,254.98	0.77	17.36	\$8,348.84	0.94	18.89
Real Estate Tax	\$1,057.10	0.10	2.22	\$922.51	0.10	2.09
Unpaid Operator Labor	\$8,002.74	0.75	16.83	\$6,059.39	0.68	13.71
Interest Charge *	\$994.65	0.09	2.09	\$1,152.23	0.13	2.61
TOTAL FIXED COSTS	\$18,309.47	\$1.72	\$38.50	\$16,482.97	\$1.85	\$37.29
Land Charge **	\$6,060.95	\$0.57	\$12.74	\$5,103.12	\$0.57	\$11.55
TOTAL EXPENSE	\$69,332.53	\$6.50	\$145.78	\$68,274.16	\$7.67	\$154.47
NET RETURN TO MANAGEMENT	\$1,564.38	\$0.15	\$3.29	(\$2,778.96)	(\$0.31)	(\$6.29)
NET RETURN TO LABOR-MGT	\$11,932.05	\$1.12	\$25.09	\$6,297.32	\$0.71	\$14.25

*Interest charge equals: ((8.0% times three-fourths the variable costs) plus (4.0% times depreciation times 8)) minus cash interest paid.

**Land charge represents a charge (equal to landlord's share) on owned land and equals (production from owned acres X price / unit X 33.33%). Crop production paid to the landlord on rented land (already removed above), or cash rent is the charge on rented land.

This crop enterprise is based on the operator's share of production, and thus includes only production expenses paid by the operator. A charge for management is not included in the expenses.

7.3 Wheat Cost-Return Budget¹⁷

Table 14. Cost-return projections for wheat crops in the Neosho Headwaters, Upper and Lower Cottonwood Watersheds, 2006.

Wheat	Yield Level (bu)		
	35	45	55
Income Per Acre			
A. Yield per acre	35	45	55
B. Price per bushel	\$4.41	\$4.41	\$4.41
C. Net government payment	\$10.48	\$11.39	\$12.30
D. Indemnity payments			
E. Miscellaneous income			
F. Returns/acre ((AxB)+C+D+E)	\$164.83	\$209.84	\$254.85
Costs Per Acre			
1. Seed	\$9.90	\$9.90	\$9.90
2. Herbicide	2.75	2.75	2.75
3. Insecticide/Fungicide			
4. Fertilizer and Lime	36.65	43.71	52.06
5. Crop Consulting			
6. Crop Insurance			
7. Drying			
8. Miscellaneous	7.00	7.00	7.00
9. Custom Hire / Machinery Expense	60.61	63.62	66.63
10. Non-machinery Labor	6.85	7.19	7.53
11. Irrigation			
12. Land Charge / Rent	34.40	43.00	51.60
G. Sub Total	\$158.16	\$177.17	\$197.47
13. Interest on ½ Nonland Costs	5.57	6.04	6.56
H. Total Costs	\$163.73	\$183.20	\$204.04
I. Returns Over Costs (F-H)	\$1.10	\$26.64	\$50.81
J. Total Costs/bushel (H/A)	\$4.68	\$4.07	\$3.71
K. Return To Annual Cost (I+13)/G	4.22%	18.44%	29.06%

Table 15. Southeast Kansas Farm Management Association profit Center Analysis: 5-year Average and 2006 Non-irrigated Wheat.²⁶

	2001-2005 Average			2006		
Number of Farms	73			48		
Crop Acres	429			524		
Acres Owned	93			126		
Acres Rented	337			398		
Yield / Acre	45			40		
Bushels	15,355			16,758		
Operator Percentage	79.19%			80.78%		
Gross Income / Acre	\$136.15			\$157.92		
Variable Costs / Acre	\$88.81			\$106.21		
Total Expense / Acre	\$133.82			\$156.76		
Gross Income / Bushel	\$3.81			\$4.94		
Total Expense / Bushel	\$3.74			\$4.90		

	Total Dollars	\$/Bushel	\$/Acre	Total Dollars	\$/Bushel	\$/Acre
INCOME:						
Wheat (Operator's Share)	\$50,409.65	\$3.28	\$117.45	\$73,816.79	\$4.40	\$140.87
Patronage Refunds	\$396.25	0.03	0.93	\$692.50	0.04	1.32
Government Payments	\$6,980.10	0.45	16.26	\$6,865.51	0.41	13.10
Miscellaneous Income	\$37.94	0.00	0.09	\$24.76	0.00	0.05
Crop Insurance Proceeds	\$610.26	0.04	1.42	\$1,349.38	0.08	2.58
OTHER INCOME	\$8,028.55	\$0.52	\$18.70	\$8,932.15	\$0.53	\$17.05
GROSS INCOME	\$58,436.20	\$3.81	\$136.15	\$82,748.94	\$4.94	\$157.92
EXPENSES:						
Labor Hired	\$2,566.56	\$0.17	\$5.98	\$3,476.58	\$0.21	\$6.63
General Machinery Repairs	\$5,037.99	0.33	11.74	\$6,209.33	0.37	11.85
Interest Paid	\$3,870.05	0.25	9.02	\$5,123.64	0.31	9.78
Seed / Other Crop Expense	\$2,669.10	0.17	6.22	\$4,401.92	0.26	8.40
Crop Insurance	\$1,180.39	0.08	2.75	\$2,280.47	0.14	4.35
Fertilizer / Lime	\$11,256.34	0.73	26.23	\$18,173.35	1.08	34.68
Machine Hire - Lease	\$1,570.07	0.10	3.66	\$852.43	0.05	1.63
Farm Org Fees / Travel / Publ	\$528.11	0.03	1.23	\$628.46	0.04	1.20
Gas / Fuel / Oil	\$3,361.19	0.22	7.83	\$5,860.11	0.35	11.18
Crop Storage & Marketing	\$286.55	0.02	0.67	\$383.48	0.02	0.73
Personal Property Tax	\$219.98	0.01	0.51	\$282.79	0.02	0.54
General Farm Insurance	\$985.82	0.06	2.30	\$1,416.01	0.08	2.70
Utilities	\$748.60	0.05	1.74	\$778.21	0.05	1.49
Cash Farm Rent	\$2,512.88	0.16	5.85	\$2,920.36	0.17	5.57
Herbicide / Insecticide	\$1,088.84	0.07	2.54	\$2,669.37	0.16	5.09
Conservation	\$46.99	0.00	0.11	\$0.39	0.00	0.00
Auto Expense	\$185.99	0.01	0.43	\$198.85	0.01	0.38
TOTAL VARIABLE COSTS	\$38,115.46	\$2.48	\$88.81	\$55,655.75	\$3.32	\$106.21
RETURN ABOVE VARIABLE COSTS	\$20,320.74	\$1.32	\$47.35	\$27,093.19	\$1.62	\$51.70
Depreciation	\$7,038.32	0.46	16.40	\$9,641.06	0.58	18.40
Real Estate Tax	\$745.82	0.05	1.74	\$1,177.16	0.07	2.25
Unpaid Operator Labor	\$6,218.48	0.40	14.49	\$6,997.50	0.42	13.35
Interest Charge *	\$663.69	0.04	1.55	\$994.86	0.06	1.90
TOTAL FIXED COSTS	\$14,666.31	\$0.96	\$34.17	\$18,810.58	\$1.12	\$35.90
Land Charge **	\$4,654.48	\$0.30	\$10.84	\$7,675.82	\$0.46	\$14.65
TOTAL EXPENSE	\$57,436.25	\$3.74	\$133.82	\$82,142.15	\$4.90	\$156.76
NET RETURN TO MANAGEMENT	\$999.95	\$0.07	\$2.33	\$606.79	\$0.04	\$1.18
NET RETURN TO LABOR-MGT	\$9,785.00	\$0.64	\$22.80	\$11,080.87	\$0.66	\$21.15

*Interest charge equals: ((8.0% times three-fourths the variable costs) plus (4.0% times depreciation times 8)) minus cash interest paid.

**Land charge represents a charge (equal to landlord's share) on owned land and equals (production from owned acres X price / unit X 33.33%). Crop production paid to the landlord on rented land (already removed above), or cash rent is the charge on rented land.

This crop enterprise is based on the operator's share of production, and thus includes only production expenses paid by the operator. A charge for management is not included in the expenses.

7.4 Grain Sorghum Cost-Return Budget¹⁷

Table 16. Cost-return projections for grain sorghum crops in the Neosho Headwaters, Upper and Lower Cottonwood Watersheds, 2006.

Grain Sorghum	Yield Level (bu)		
	70	85	110
Income Per Acre			
A. Yield per acre	70	85	110
B. Price per bushel	\$2.82	\$2.82	\$2.82
C. Net government payment	\$10.48	\$11.39	\$12.30
D. Indemnity payments			
E. Miscellaneous income			
F. Returns/acre ((AxB)+C+D+E)	\$207.88	\$207.88	\$207.88
Costs Per Acre			
1. Seed	\$12.29	\$12.29	\$12.29
2. Herbicide	20.34	20.34	20.34
3. Insecticide/Fungicide	5.90	5.90	5.90
4. Fertilizer and Lime	39.68	43.64	50.24
5. Crop Consulting			
6. Crop Insurance			
7. Drying			
8. Miscellaneous	7.00	7.00	7.00
9. Custom Hire / Machinery Expense	82.39	86.92	94.47
10. Non-machinery Labor	9.31	9.82	10.68
11. Irrigation			
12. Land Charge / Rent	34.40	43.00	51.60
G. Sub Total	\$211.30	\$228.90	\$252.51
13. Interest on ½ Nonland Costs	7.96	8.37	9.04
H. Total Costs	\$219.26	\$237.27	\$261.55
I. Returns Over Costs (F-H)	-\$11.38	\$13.82	\$60.95
J. Total Costs/bushel (H/A)	\$3.13	\$2.79	\$2.38
K. Return To Annual Cost (I+13)/G	-1.62%	9.69%	27.72%

Table 17. Southeast Kansas Farm Management Association profit Center Analysis: 5-year Average and 2006 Non-irrigated Sorghum.²⁶

	2001-2005 Average			2006		
Number of Farms	50			20		
Crop Acres	231			206		
Acres Owned	46			20		
Acres Rented	185			186		
Yield / Acre	80			63		
Bushels	14,154			9,948		
Operator Percentage	76.56%			77.01%		
Gross Income / Acre	\$147.94			\$162.55		
Variable Costs / Acre	\$109.23			\$123.03		
Total Expense / Acre	\$161.11			\$189.51		
Gross Income / Bushel	\$2.42			\$3.37		
Total Expense / Bushel	\$2.63			\$3.51		

	Total Dollars	\$/Bushel	\$/Acre	Total Dollars	\$/Bushel	\$/Acre
INCOME:						
Grain Sorghum (Operator's Share)	\$28,484.90	\$2.01	\$123.10	\$28,576.75	\$2.87	\$138.72
Patronage Refunds	\$183.45	0.01	0.79	\$244.77	0.02	1.19
Government Payments	\$5,171.17	0.37	22.35	\$3,028.68	0.30	14.70
Miscellaneous Income	\$15.62	0.00	0.07	(\$5.39)	(0.00)	(0.03)
Crop Insurance Proceeds	\$377.57	0.03	1.63	\$1,641.25	0.16	7.97
OTHER INCOME	\$5,747.80	\$0.41	\$24.84	\$4,909.31	\$0.49	\$23.83
GROSS INCOME	\$34,232.89	\$2.42	\$147.94	\$33,486.06	\$3.37	\$162.55
EXPENSES:						
Labor Hired	\$776.03	\$0.05	\$3.35	\$1,020.45	\$0.10	\$4.95
General Machinery Repairs	\$2,973.93	0.21	12.85	\$2,416.47	0.24	11.73
Interest Paid	\$1,990.96	0.14	8.60	\$1,830.30	0.18	8.88
Seed / Other Crop Expense	\$2,291.49	0.16	9.90	\$2,124.92	0.21	10.32
Crop Insurance	\$755.85	0.05	3.27	\$892.81	0.09	4.33
Fertilizer / Lime	\$6,805.97	0.48	29.41	\$7,084.17	0.71	34.39
Machine Hire - Lease	\$867.87	0.06	3.75	\$349.53	0.04	1.70
Farm Org Fees / Travel / Publ	\$300.03	0.02	1.30	\$232.82	0.02	1.13
Gas / Fuel / Oil	\$1,957.06	0.14	8.46	\$2,555.35	0.26	12.40
Crop Storage & Marketing	\$159.04	0.01	0.69	\$238.19	0.02	1.16
Personal Property Tax	\$138.23	0.01	0.60	\$155.67	0.02	0.76
General Farm Insurance	\$555.12	0.04	2.40	\$490.42	0.05	2.38
Utilities	\$416.80	0.03	1.80	\$306.05	0.03	1.49
Cash Farm Rent	\$1,021.00	0.07	4.41	\$1,759.59	0.18	8.54
Herbicide / Insecticide	\$4,093.49	0.29	17.69	\$3,824.34	0.38	18.56
Conservation	\$23.29	0.00	0.10	\$0.00	-	-
Auto Expense	\$148.86	0.01	0.64	\$63.88	0.01	0.31
TOTAL VARIABLE COSTS	\$25,275.01	\$1.79	\$109.23	\$25,344.96	\$2.55	\$123.03
RETURN ABOVE VARIABLE COSTS	\$8,957.88	\$0.63	\$38.71	\$8,141.10	\$0.82	\$39.52
Depreciation	\$4,067.63	0.29	17.58	\$3,728.53	0.37	18.10
Real Estate Tax	\$417.68	0.03	1.81	\$335.16	0.03	1.63
Unpaid Operator Labor	\$4,148.64	0.29	17.93	\$3,421.13	0.34	16.61
Interest Charge *	\$809.19	0.06	3.50	\$775.81	0.08	3.77
TOTAL FIXED COSTS	\$9,443.33	\$0.67	\$40.81	\$8,260.63	\$0.83	\$40.10
Land Charge **	\$2,562.55	\$0.18	\$11.07	\$1,313.88	\$0.13	\$6.38
TOTAL EXPENSE	\$37,280.89	\$2.63	\$161.11	\$34,919.47	\$3.51	\$169.51
NET RETURN TO MANAGEMENT	(\$3,048.20)	(\$0.22)	(\$13.17)	(\$1,433.41)	(\$0.14)	(\$8.96)
NET RETURN TO LABOR-MGT	\$1,876.47	\$0.13	\$8.11	\$3,008.17	\$0.30	\$14.60

*Interest charge equals: ((8.0% times three-fourths the variable costs) plus (4.0% times depreciation times 8)) minus cash interest paid.

**Land charge represents a charge (equal to landlord's share) on owned land and equals (production from owned acres X price / unit X 33.33%). Crop production paid to the landlord on rented land (already removed above), or cash rent is the charge on rented land.

This crop enterprise is based on the operator's share of production, and thus includes only production expenses paid by the operator. A charge for management is not included in the expenses.

7.5 Alfalfa Cost-Return Budget¹⁷

Table 18. Cost-return projections for alfalfa crops in the Neosho Headwaters, Upper and Lower Cottonwood Watersheds, 2006.

Alfalfa	Yield Level (ton)		
	3.0	3.5	4.0
Income Per Acre			
A. Yield per acre	3.0	3.5	4.0
B. Price per bushel	\$101.00	\$101.00	\$101.00
C. Net government payment	\$12.30	\$13.37	\$14.44
D. Indemnity payments			
E. Miscellaneous income			
F. Returns/acre ((AxB)+C+D+E)	\$315.30	\$366.87	\$418.44
Costs Per Acre			
1. Seed	\$10.17	\$10.17	\$10.17
2. Herbicide	2.51	2.51	2.51
3. Insecticide/Fungicide	7.08	7.08	7.08
4. Fertilizer and Lime	19.90	26.89	33.88
5. Crop Consulting			
6. Crop Insurance			
7. Drying			
8. Miscellaneous	6.38	6.38	6.38
9. Custom Hire / Machinery Expense	109.42	118.08	126.61
10. Non-machinery Labor	12.36	13.34	14.31
11. Irrigation			
12. Land Charge / Rent	31.60	39.50	47.40
G. Sub Total	\$199.43	\$223.96	\$248.34
13. Interest on ½ Nonland Costs	7.55	8.30	9.04
H. Total Costs	\$206.98	\$232.26	\$257.38
I. Returns Over Costs (F-H)	\$108.32	\$134.61	\$161.06
J. Total Costs/bushel (H/A)	\$68.99	\$66.36	\$64.35
K. Return To Annual Cost (I+13)/G	58.10%	63.81%	68.50%

Table 19. Southeast Kansas Farm Management Association profit Center Analysis: 5-year Average and 2006 Non-irrigated Alfalfa.²⁶

	2001-2005 Average			2006		
Number of Farms	13			10		
Crop Acres	141			158		
Acres Owned	31			10		
Acres Rented	110			148		
Yield / Acre	3.3			2.4		
Tons	400			317		
Operator Percentage	84.86%			83.95%		
Gross Income / Acre	\$233.47			\$246.44		
Variable Costs / Acre	\$157.84			\$169.51		
Total Expense / Acre	\$227.09			\$226.92		
Gross Income / Ton	\$82.37			\$122.83		
Total Expense / Ton	\$80.12			\$113.10		
	Total Dollars	\$/Ton	\$/Acre	Total Dollars	\$/Ton	\$/Acre
INCOME:						
Alfalfa (Operator's Share)	\$30,456.04	\$76.10	\$215.69	\$36,468.80	\$115.04	\$230.82
Patronage Refunds	\$146.31	0.37	1.04	\$81.22	0.26	0.51
Government Payments	\$2,240.67	5.60	15.87	\$2,558.32	8.07	16.19
Miscellaneous Income	\$122.68	0.31	0.87	(\$171.53)	(0.54)	(1.09)
OTHER INCOME	\$2,509.66	\$6.27	\$17.77	\$2,468.01	\$7.79	\$15.62
GROSS INCOME	\$32,965.70	\$82.37	\$233.47	\$38,936.81	\$122.83	\$246.44
EXPENSES:						
Labor Hired	\$1,925.16	\$4.81	\$13.63	\$2,961.95	\$9.34	\$18.75
General Machinery Repairs	\$2,912.30	7.28	20.63	\$2,898.55	9.14	18.35
Interest Paid	\$2,045.40	5.11	14.49	\$2,090.90	6.60	13.23
Seed / Other Crop Expense	\$1,719.19	4.30	12.18	\$2,812.50	8.87	17.80
Crop Insurance	\$371.29	0.93	2.63	\$60.00	0.19	0.38
Fertilizer / Lime	\$2,595.20	6.48	18.36	\$2,223.55	7.01	14.07
Machine Hire - Lease	\$3,509.54	8.77	24.86	\$4,540.56	14.32	28.74
Farm Org Fees / Travel / Publ	\$639.87	1.60	4.53	\$306.15	0.97	1.94
Gas / Fuel / Oil	\$1,209.12	3.02	8.56	\$1,786.21	5.63	11.31
Crop Storage & Marketing	\$180.84	0.45	1.28	\$147.76	0.47	0.94
Personal Property Tax	\$185.47	0.46	1.31	\$187.51	0.59	1.19
General Farm Insurance	\$539.39	1.35	3.82	\$825.63	2.60	5.23
Utilities	\$796.46	1.99	5.64	\$204.08	0.64	1.29
Cash Farm Rent	\$1,851.47	4.63	13.11	\$3,112.69	9.82	19.70
Herbicide / Insecticide	\$1,683.03	4.21	11.92	\$2,497.13	7.88	15.80
Conservation	\$24.43	0.06	0.17	\$0.13	0.00	0.00
Auto Expense	\$99.50	0.25	0.70	\$126.75	0.40	0.80
TOTAL VARIABLE COSTS	\$22,287.65	\$55.69	\$157.84	\$26,782.25	\$84.49	\$169.51
RETURN ABOVE VARIABLE COSTS	\$10,678.05	\$26.68	\$75.62	\$12,154.56	\$38.34	\$76.93
Depreciation	\$3,138.56	7.84	22.23	\$4,010.39	12.65	25.38
Real Estate Tax	\$373.53	0.93	2.65	\$279.01	0.88	1.77
Unpaid Operator Labor	\$3,236.12	8.09	22.92	\$2,916.00	9.20	18.46
Interest Charge *	\$314.16	0.79	2.22	\$687.45	2.17	4.35
TOTAL FIXED COSTS	\$7,062.36	\$17.65	\$50.02	\$7,892.85	\$24.90	\$49.95
Land Charge **	\$2,715.60	\$6.79	\$19.23	\$1,178.81	\$3.72	\$7.46
TOTAL EXPENSE	\$32,065.61	\$80.12	\$227.09	\$35,653.91	\$113.10	\$226.92
NET RETURN TO MANAGEMENT	\$900.09	\$2.25	\$6.37	\$3,082.90	\$9.73	\$19.51
NET RETURN TO LABOR-MGT	\$6,061.36	\$15.15	\$42.93	\$8,960.85	\$28.27	\$56.71

* Interest charge equals: ((8.0% times three-fourths the variable costs) plus (4.0% times depreciation times 8)) minus cash interest paid.

** Land charge represents a charge (equal to landlord's share) on owned land and equals (production from owned acres X price / unit X 33.33%). Crop production paid to the landlord on rented land (already removed above), or cash rent is the charge on rented land.

This crop enterprise is based on the operator's share of production, and thus includes only production expenses paid by the operator. A charge for management is not included in the expenses.

7.6 Common Cropland BMPs in Upper and Lower Cottonwood and Neosho Headwaters Watersheds

BMPs help reduce the amount of soil and nutrients that run off of cropland fields. Keeping these valuable inputs (soil and nutrients) in the field can be of benefit to both the landowner/producer and to society as a whole. Here are just a couple of the benefits:

1. Top soil savings can result in higher yields and lower fertilizer costs
2. Certain BMPs can offer both water quality protection and wildlife habitat

Below are some of the more popular BMPs in use throughout the state of Kansas and in the Oologah Watershed.

Contour farming²⁴ is farming the land, tillage and planting of the crop, on the level around the hill. By doing this, each furrow or ridge left by the different implements acts as a miniature dam, trapping water, allowing more to soak into the ground. Each row of crop also slows the water. Combined, less water runs off. Soil erosion is reduced. Crop yields are increased in arid areas.

Grassed waterways²⁵ are used as outlets to prevent silt and gully formation. The vegetation cover slows the water flow and minimizes channel surface erosion. They can also be used as outlets for water from terraces.

Vegetative buffers²⁵ are areas of land that are maintained in permanent vegetation to help reduce nutrient and sediment loss from agricultural fields, improve runoff water quality, and provide habitat for wildlife. Because of these societal benefits, there are several federal and state programs that encourage the installation and maintenance of vegetative buffers.

No-till²⁵ is a form of conservation tillage in which chemicals are used in place of tillage for weed control and seedbed preparation. In other words, the soil surface is never disturbed except for planting or drilling operations in a 100 percent no-till system. Two other forms of tillage, reduced tillage and rotational no-till, involve a light to moderate use of tillage equipment. These forms of tillage also control erosion and nutrient runoff, but are not as effective as 100 percent no-till.

Terraces²⁵ are embankments constructed perpendicular to the slope of the field and are designed to reduce the length of a field slope and catch water flowing off the slope. Terraces reduce the rate of runoff and allow soil particles to settle out.

Streambank stabilization²⁵ projects can reduce the amount of streambank erosion and help prevent the loss of valuable cropland. Stabilization techniques reduce streambank erosion through diverting and/or slowing the movement of water in a stream channel. Some methods that can be employed include bendway-weirs, stone toes, pools and riffles, stream barbs, and willow post plantings.

The following pages contain typical BMP budgets and economic analyses for vegetative buffers and streambank stabilization projects in the Oologah Watershed. These reports were generated using the KSU-Vegetative Buffer and KSU-Streambank Stabilization Decision-Making Tools²⁷.

7.6.1 Vegetative Buffer: Economic Analysis

Your project area is located in Chase County, Kansas. Your project area (buffer size) is 1.0 acres.

The results are based upon the following assumptions:

One time Costs: \$187.28	One time Cost-Share Payments: \$268.55	Time Period Selected: 10 years
Annual Costs: \$6.67	Annual Incentive Payments: \$82.62	Opportunity Cost of Your Money: 5.00%

The first year out-of-pocket costs of the vegetative buffer would be **\$0.00** this accounts for any cost-share payments you may receive.

Based on the information you have provided, a vegetative buffer on the project area would **return \$85.27** per acre annually.

Based on the information you have provided, a vegetative buffer on the project area would **return \$85.27** annually.

Based on the information you have provided, cropland on the project area would return **\$57.98** per acre annually.

Based on the information you have provided, cropland on the project area would return **\$57.98** annually.

Take Home Message:

You would be **\$27.29** per year **better off** installing this area to a vegetative buffer versus using it for crop production.

Discussion

In order to effectively compare scenarios which occur over multiple years (10 to 15 years), we must convert all costs and returns to today's dollars (e.g., 2008 dollars).

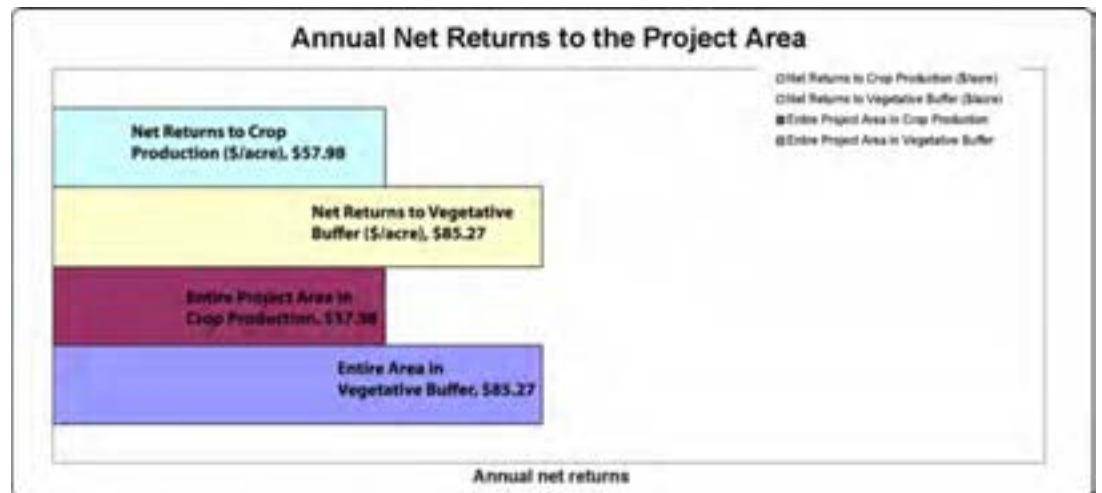
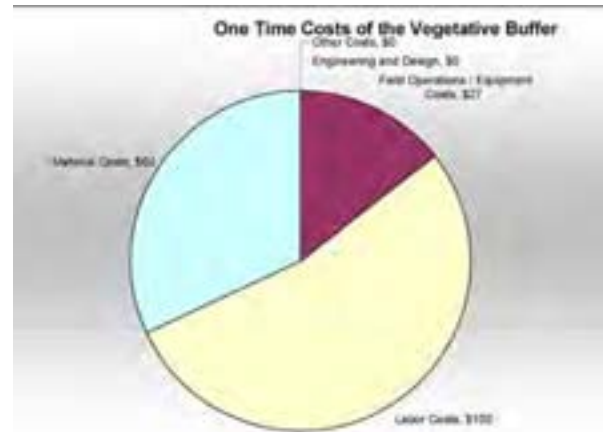
Net Present Value calculations convert future values into today's dollars. The net present value analysis uses a discount factor to equate a series of future cash flows into an equivalent amount of cash today. For example, if you are considering enrolling land into a 15 year Continuous Conservation Reserve Program (CRP) program, the projected net income in years 2 through 15 is discounted back to its equivalent value in today's dollars. Because a dollar today can earn interest until next year, it will be valued more highly than a dollar received in the future.

For more information regarding the economics of vegetative buffers, check out K-State Research and Extension publication MF-2536 "Using Conservation Buffers to Protect Water Quality and Enhance Agricultural Profitability." <http://www.oznet.ksu.edu/library/h20ql2/mf2536.pdf>

For vegetative buffer assistance, be sure to contact your local county conservation district. A Kansas Conservation District Directory can be found at: http://scc.ks.gov/index.php?option=com_content&task=view&id=779&Itemid=178

If you have any questions regarding this decision-making tool, please contact:

Craig Smith
Ph.D. Graduate Student
Kansas State University
craigsmith@agecon.
ksu.edu



Budget information for the vegetative buffer project

General Data For Vegetative Buffer			
Discount Rate	5.00%		
Cropland Rental Rate - not CCRP rental rate	\$51.03	per acre/year	
Annual Cropland Rental Growth Rate	3.07%		
Total Annual Costs	\$6.67	per acre/year	
Inflation Rate of Annual Costs	4.00%		
Project Length (feet)	660		
Project Width (feet)	66		
Acres (length x width/43,560)	1.00		
Length of analysis (years)	10		
Cropland Property Tax (\$/acre)	\$5.00		
Tame Grass Property Tax (\$/acre)	\$5.00		
Costs		Payments Received	
Total one-time	\$187.28	Total one-time	\$268.55
Total annual	\$6.67	Total annual	\$82.62

Net Present Value Table: Vegetative Buffer (per acre)					
Year	One Time Costs	Annual Costs	One Time Payments	Annual Payments	Net Property Tax Impact
0	\$187.28	\$0.00	\$268.55	\$0.00	\$0.00
1	\$0.00	\$6.67	\$0.00	\$82.62	\$0.00
2	\$0.00	\$6.94	\$0.00	\$82.62	\$0.00
3	\$0.00	\$7.21	\$0.00	\$82.62	\$0.00
4	\$0.00	\$7.50	\$0.00	\$82.62	\$0.00
5	\$0.00	\$7.80	\$0.00	\$82.62	\$0.00
6	\$0.00	\$8.12	\$0.00	\$82.62	\$0.00
7	\$0.00	\$8.44	\$0.00	\$82.62	\$0.00
8	\$0.00	\$8.78	\$0.00	\$82.62	\$0.00
9	\$0.00	\$9.13	\$0.00	\$82.62	\$0.00
10	\$0.00	\$9.49	\$0.00	\$82.62	\$0.00
11	\$0.00	-	\$0.00	-	\$0.00
12	\$0.00	-	\$0.00	-	\$0.00
13	\$0.00	-	\$0.00	-	\$0.00
14	\$0.00	-	\$0.00	-	\$0.00
15	\$0.00	-	\$0.00	-	\$0.00
Sum totals	\$187.28	\$80.08	\$268.55	\$826.24	\$0.00
Present Value	\$187.28	\$60.87	\$268.55	\$638.00	\$0.00
Net Present Value	\$658.40				
Annualized Value	\$85.27				

NPV Table: Cropland Rent (per acre)	
Year	Rent
0	\$0.00
1	\$51.03
2	\$52.60
3	\$54.21
4	\$55.88
5	\$57.59
6	\$59.36
7	\$61.18
8	\$63.06
9	\$65.00
10	\$66.99
11	-
12	-
13	-
14	-
15	-
Sum totals	\$586.89
Present Value	\$447.71
Net Present Value	\$447.71
Annualized Value	\$57.98

Net Present Value Table: Vegetative Buffer (total project area)					
Year	One Time Costs	Annual Costs	One Time Payments	Annual Payments	Net Property Tax Impact
0	\$187.28	\$0.00	\$268.55	\$0.00	\$0.00
1	\$0.00	\$6.67	\$0.00	\$82.62	\$0.00
2	\$0.00	\$6.94	\$0.00	\$82.62	\$0.00
3	\$0.00	\$7.21	\$0.00	\$82.62	\$0.00
4	\$0.00	\$7.50	\$0.00	\$82.62	\$0.00
5	\$0.00	\$7.80	\$0.00	\$82.62	\$0.00
6	\$0.00	\$8.12	\$0.00	\$82.62	\$0.00
7	\$0.00	\$8.44	\$0.00	\$82.62	\$0.00
8	\$0.00	\$8.78	\$0.00	\$82.62	\$0.00
9	\$0.00	\$9.13	\$0.00	\$82.62	\$0.00
10	\$0.00	\$9.49	\$0.00	\$82.62	\$0.00
11	\$0.00	-	\$0.00	-	\$0.00
12	\$0.00	-	\$0.00	-	\$0.00
13	\$0.00	-	\$0.00	-	\$0.00
14	\$0.00	-	\$0.00	-	\$0.00
15	\$0.00	-	\$0.00	-	\$0.00
Sum totals	\$187.28	\$80.08	\$268.55	\$826.24	\$0.00
Present Value	\$187.28	\$60.87	\$268.55	\$638.00	\$0.00
Net Present Value	\$658.40				
Annualized Value	\$85.27				

NPV Table: Cropland Rental Rate (total project area)	
Year	Rent
0	\$0.00
1	\$51.03
2	\$52.60
3	\$54.21
4	\$55.88
5	\$57.59
6	\$59.36
7	\$61.18
8	\$63.06
9	\$65.00
10	\$66.99
11	-
12	-
13	-
14	-
15	-
Sum totals	\$586.89
Present Value	\$447.71
Net Present Value	\$447.71
Annualized Value	\$57.98

7.6.2 Streambank Stabilization: Economic Analysis

Your project area is located in Montgomery County, Kansas on a 80 acre field. Your project area is: 4.55 acres in size.

The results are based upon the following assumptions:

One time Costs: **\$18,495.60** One time Cost-Share Payments: **\$9,702.30** Time Period Selected: **10 years**
 Annual Costs: **\$30.32** Annual Incentive Payments: **\$367.05** Opportunity Cost of Your Money: **5.00%**

The first year out-of-pocket costs of the streambank project would be **\$8,793.30**. This accounts for any cost-share payments you may receive.

Based on the information you have provided, a streambank stabilization project could potentially save **2.00** acres annually.

Take Home Message:

If you consider the asset value of the land that is preserved by the streambank stabilization project, then the take-home message is:

You would be **\$2,781.52** per year **better off** by stabilizing this streambank versus doing nothing.

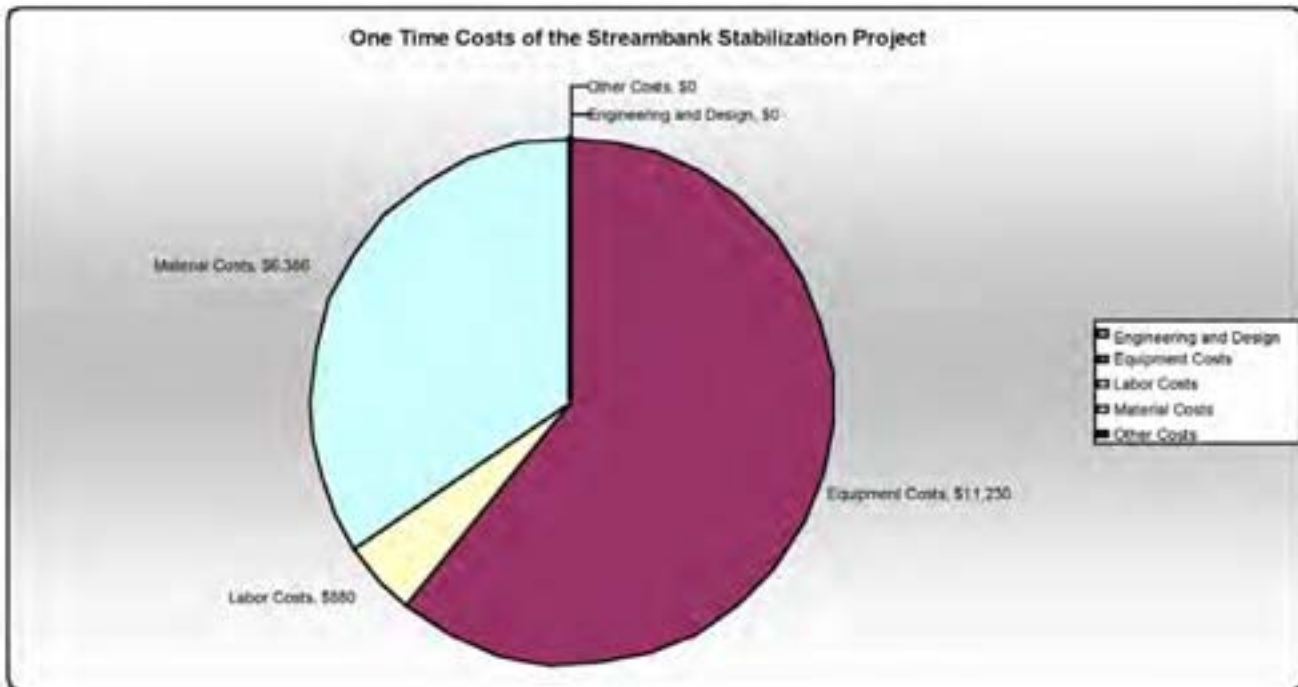
A streambank project would **return** **\$21,478.13** in total over the 10 year time period you have selected.

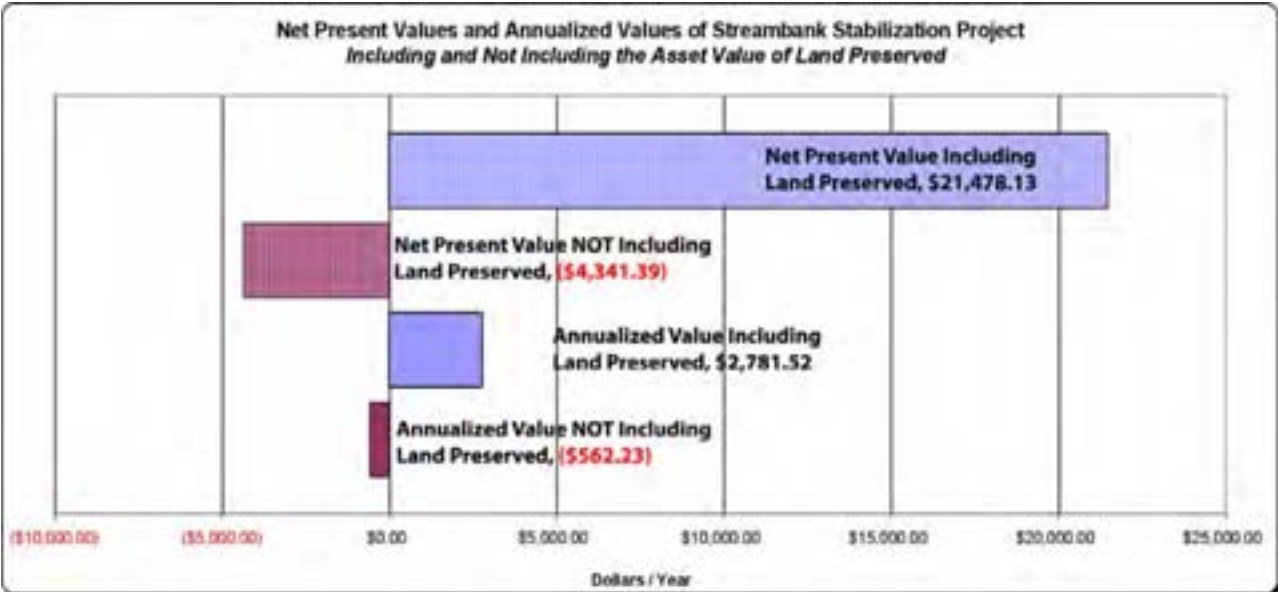
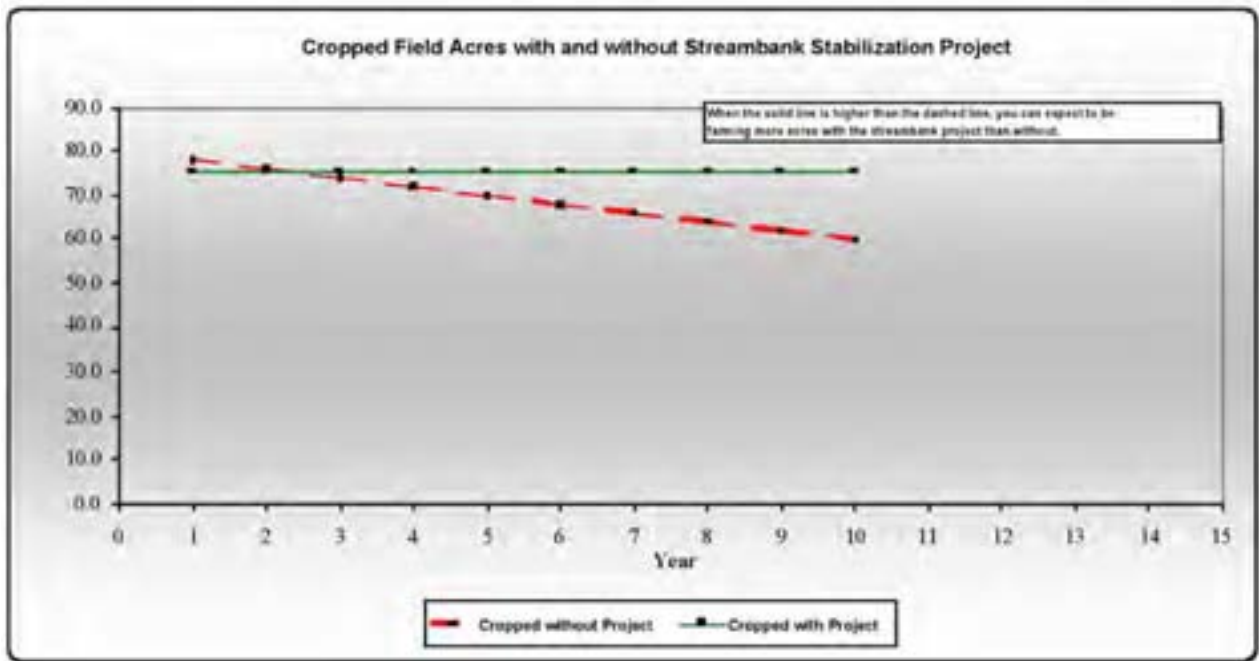
If you DO NOT consider the asset value of the land that is preserved by the streambank stabilization project, then the take-home message is:

You would be **(\$562.23)** per year **worse off** by stabilizing this streambank versus doing nothing.

A streambank project would **lose** **(\$4,341.39)** in total over the 10 year time period you have selected.

The asset value of the land that is preserved by the project is a real value that should probably be considered in your decision-making. It is, however, a value that would not be realized as cash until the property is sold.





Discussion

In general, the **benefits** of a streambank stabilization project come in the form of: value of acres not lost to erosion, income from being able to crop the preserved acres not in CCRP acres, cost-share and incentive payments, and tax breaks from the reclassification of ag land.

The **costs** of a streambank stabilization project come in the form of: one time installation costs, annual maintenance costs, and the initial loss of cropping income from cropland being taken out of production and enrolled into CCRP.

In order to effectively compare scenarios which occur over multiple years (10 to 15 years), we must convert all costs and returns to today's dollars (e.g., 2008 dollars).

Net Present Value calculations convert future values into today's dollars. The net present value analysis uses a discount factor to equate a series of future cash flows into an equivalent amount of cash today. For example, if you are considering enrolling land into a 15 year Continuous Conservation Reserve Program (CRP) program, the projected net income in years 2 through 15 is discounted back to its equivalent value in today's dollars. Because a dollar today can earn interest until next year, it will be valued more highly than a dollar received in the future

For streambank stabilization assistance, be sure to contact your local county conservation district. A Kansas Conservation District Directory can be found at: http://scc.ks.gov/index.php?option=com_content&task=view&id=779&Itemid=178

If you have any questions regarding this Decision-Making Tool, please contact:
 Craig Smith
 Ph.D. Graduate Student Kansas State University
 craigsmith@agecon.ksu.edu

Budget information for the streambank stabilization project

General Data For Streambank Stabilization			
Discount Rate	5.00%		
Cropland Value	\$1,375.00	per acre	
Annual Cropland Value Growth Rate	4.34%		
Cropland Rental Rate - not CCRP rental rate	\$51.03	per acre / year	
Annual Cropland Rental Growth Rate	3.07%		
Total Annual Costs	\$6.67	per acre / year	
Inflation Rate of Annual Costs	4.00%		
Project Length (feet)			1,980
Project Width (feet)			100
Acres (length x width/43,560)			4.55
Estimated acreage lost over time period			20.00
Value of estimated acreage lost	20 acres	@ \$1,375.00 per acre	\$27,500.00
Estimated average annual acreage lost over period of	10 yr.		2.00
Estimated acreage preserved over	10 yr.		20.00
Value of estimated acres preserved	20.00 acres	@ \$2,102.86 per acre	\$42,057.26
Cropland Property Tax (\$/acre)			\$9.88
Tame Grass Property Tax (\$/acre)			\$9.88
Costs		Payments	
Total one-time	\$18,495.60	Total one-time	\$9,702.30
Total annual	\$30.32	Total annual	\$367.05

7.7 Economic Contributions of Recreation at John Redmond Lake^{28, 29, 30, 31, 32, 33, 34, 35}

This study estimated the regional economic effects arising from recreation at John Redmond Lake (Figure 17). This analysis can help local Watershed Restoration & Protection Strategies leaders and others appreciate the value of preserving recreational amenities at John Redmond Lake.

John Redmond Lake is a 8,084 acre impoundment located in east-central Kansas in the Neosho River Basin. The watershed consists of 3,015 square miles in Butler, Chase, Coffey, Greenwood, Harvey, Lyon, McPherson, Marion, Morris, Osage, and Wabaunsee counties. John Redmond Lake was built in 1964 by the U.S. Army Corps of Engineers (COE) for flood control, water supply, water quality, recreation, and fish and wildlife.

This analysis estimated two types of regional recreation effects associated with John Redmond Lake. The first type includes the economic impact to the region arising from direct recreation expenditures in the area and the associated indirect effects which occur as the money “ripples” throughout the region. This impact is modeled using an economic accounting system that charts the financial connections between businesses, governments and households in the region.

In 2007, the Army COE reported 127,486 visits to John Redmond Lake for a total of 1,193,936 visitor-hours from 10/2006 to 9/2007. Using this data (together with visitor-type and expenditure profiles shown in Tables 20 and 21 and Figure 18) and accounting for imported purchases, it was estimated that visitor expenditures generated \$1.09 million (2007\$) in direct economic activity (sales) within the regional economy, \$0.48 million in all types of income associated with the production of economic activities, and 24 area full- and part-time jobs. After calculating the indirect economic impacts, it was estimated that visitor expenditures were closely associated with \$1.43 million (2007\$) in overall economic activity, \$0.67 million in total income, and 28 jobs in the region. The total economic contributions to the local region are displayed in Table 22.

Not all of the economic effects of recreation are captured by observable market transactions. A second type of economic effect considered here includes certain non-market benefits derived through the self-reported value of participation in recreation activities. This notion acknowledges the value of benefit an individual experiences through participation in an activity exceeds what it actually costs, thereby motivating participation. These benefits are estimated through a process known as non-market valuation. Through surveys, economists have developed general estimates of what people report being willing to pay over and above what they actually are required to spend. This net willingness-to-pay value represents the additional incremental value of benefits afforded to the recreation participant. Net willingness-to-pay has been acknowledged by a U.S. governmental interagency committee as an appropriate measure of the economic benefits associated with outdoor recreation programs. Accepting the legitimacy of purported and generalized willingness-to-pay values and applying them to John Redmond Lake recreation, it was estimated that John Redmond Lake visitors receive up to \$2.99 million (2007\$) in additional non-market recreation benefits annually. The values by recreation activity are reported in Table 23.

On average, the annual visitation rates for John Redmond Lake has remained stable from 1996-2007 (Figure 19). Among the 17 Army COE Lakes in Kansas, John Redmond Lake ranked 15th in number of visits and 15th in terms of visitor-hours in 2007. A graphical comparison of visits and visitor-hours for all 17 Army COE reservoirs in Kansas can be found in Figures 20 and 21.

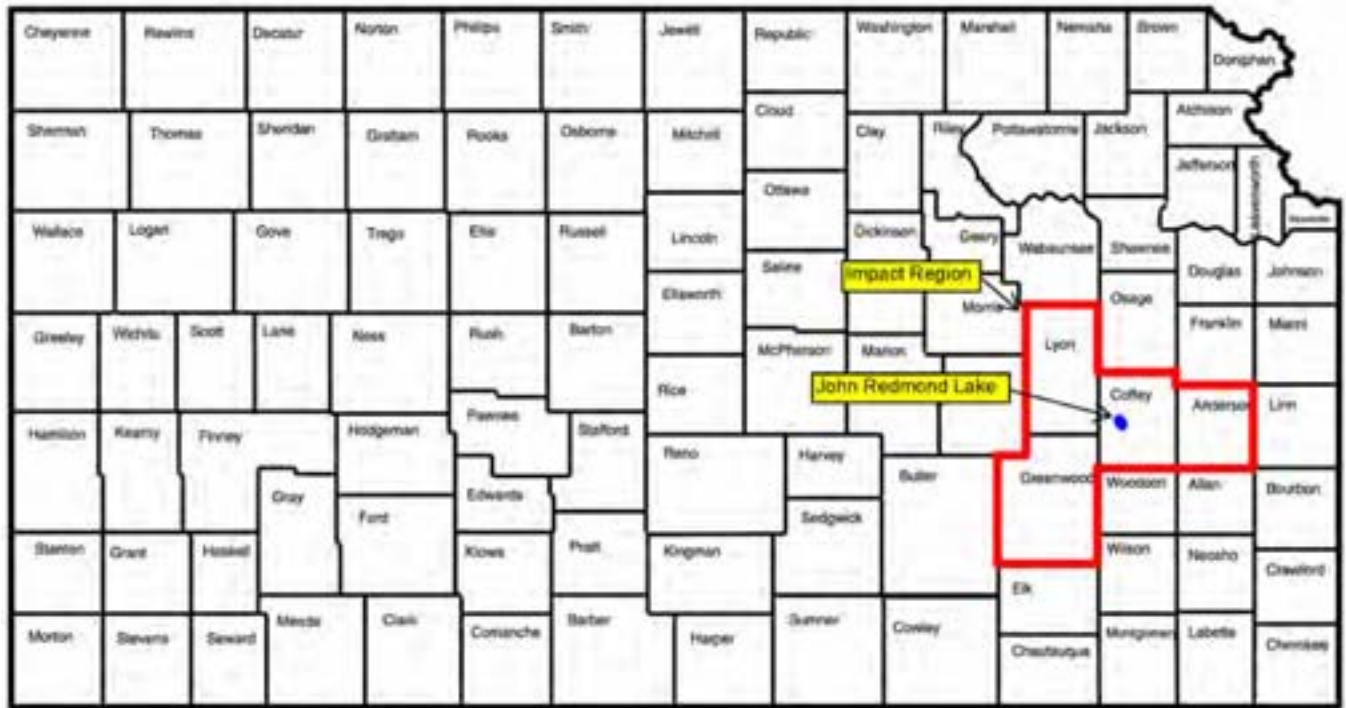


Figure 17. John Redmond Lake economic impact region

Table 20. Visitation and spending for visits made to John Redmond Lake, 2007

Visitation	Camper		Day User		Other Overnight		Total
	Boater	Nonboater	Boater	Nonboater	Boater	Nonboater	
Percent of Total	0.0%	1.8%	1.9%	93.4%	0.1%	2.8%	100.0%
2007 John Redmond visits	44	2,290	2,430	119,096	72	3,555	127,486
Spending	\$3,219	\$143,122	\$54,452	\$1,605,254	\$6,837	\$197,153	\$2,010,037

Table 21. Spending categories by visitor type (dollars per visit, 2007\$)

Spending Category	Campers		Day Users		Other Overnight		Weighted Average
	Boater	Nonboater	Boater	Nonboater	Boater	Nonboater	
Hotels, motels, cabins, B&B, and rental homes	0.83	0.12	0.00	0.00	19.46	20.17	0.58
Camping fee	15.47	16.01	0.00	0.00	0.11	0.03	0.29
Restaurants, bars, etc.	8.00	9.18	2.66	3.32	14.14	15.84	3.77
Groceries and take out food	20.41	16.62	4.39	4.39	14.71	6.31	4.67
Gas & oil	12.62	8.71	6.96	2.75	15.36	7.39	3.08
Other auto expenses	0.97	1.51	1.70	0.31	6.09	0.00	0.35
Other boat expenses	4.97	0.00	2.13	0.00	12.19	0.00	0.05
Entertainment and recreation fees	2.34	2.91	0.97	0.52	4.35	1.66	0.61
Sporting goods and boat equipment	4.76	1.51	3.09	0.86	4.95	2.37	0.96
Other expenses	3.34	5.94	0.50	1.33	3.37	1.69	1.41
Total (within 30 miles)	\$73.71	\$62.51	\$22.41	\$13.48	\$94.74	\$55.46	\$15.77

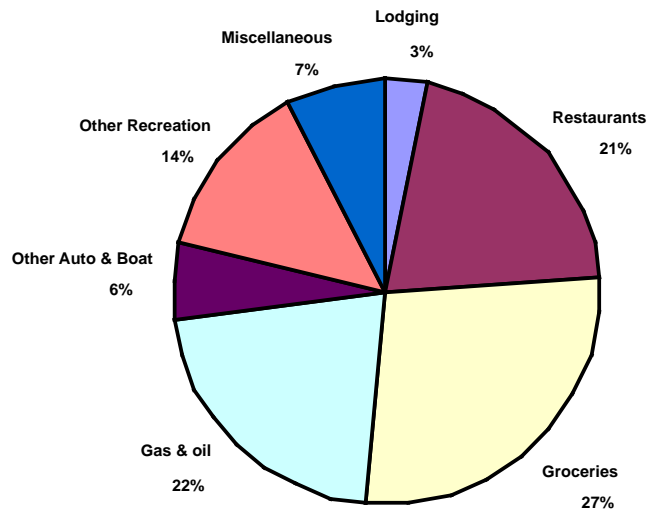


Figure 18. Trip spending by category

Table 22. John Redmond Lake total economic contributions

Impact Measure	Direct	Indirect	Total
Output	\$1,085,654	\$346,387	\$1,432,041
Total Value Added	\$482,677	\$185,441	\$668,118
Employment	24	4	28

Table 23. Non-market benefits of John Redmond Lake recreation, 2007\$

Activity	Days Spent in Activity	Activity Value per Day (2007\$)	Total Value per Year
Fish	41,987	\$38.58	\$1,619,887
Swim	22,685	\$19.75	\$447,977
Camp	12,138	\$29.54	\$358,551
Boat	8,159	\$27.45	\$223,932
Picnic	4,676	\$30.42	\$142,242
Other	9,850	\$19.94	\$196,389
Total	99,495	-----	\$2,988,979

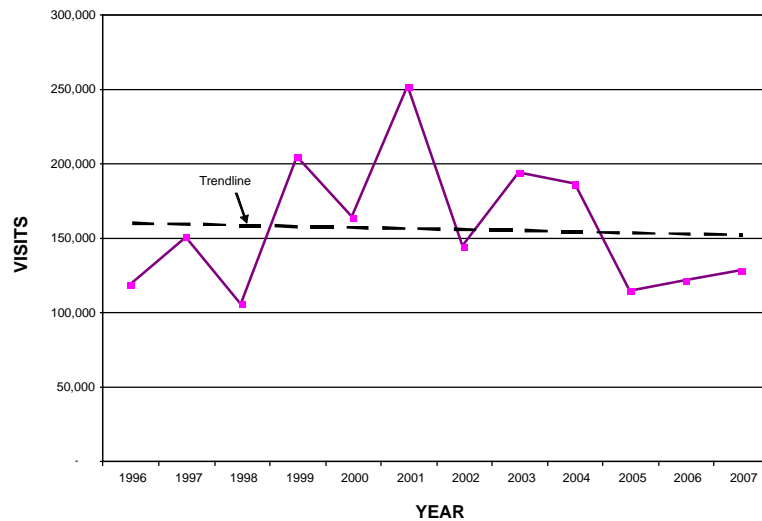


Figure 19. Trends in John Redmond Lake visitation

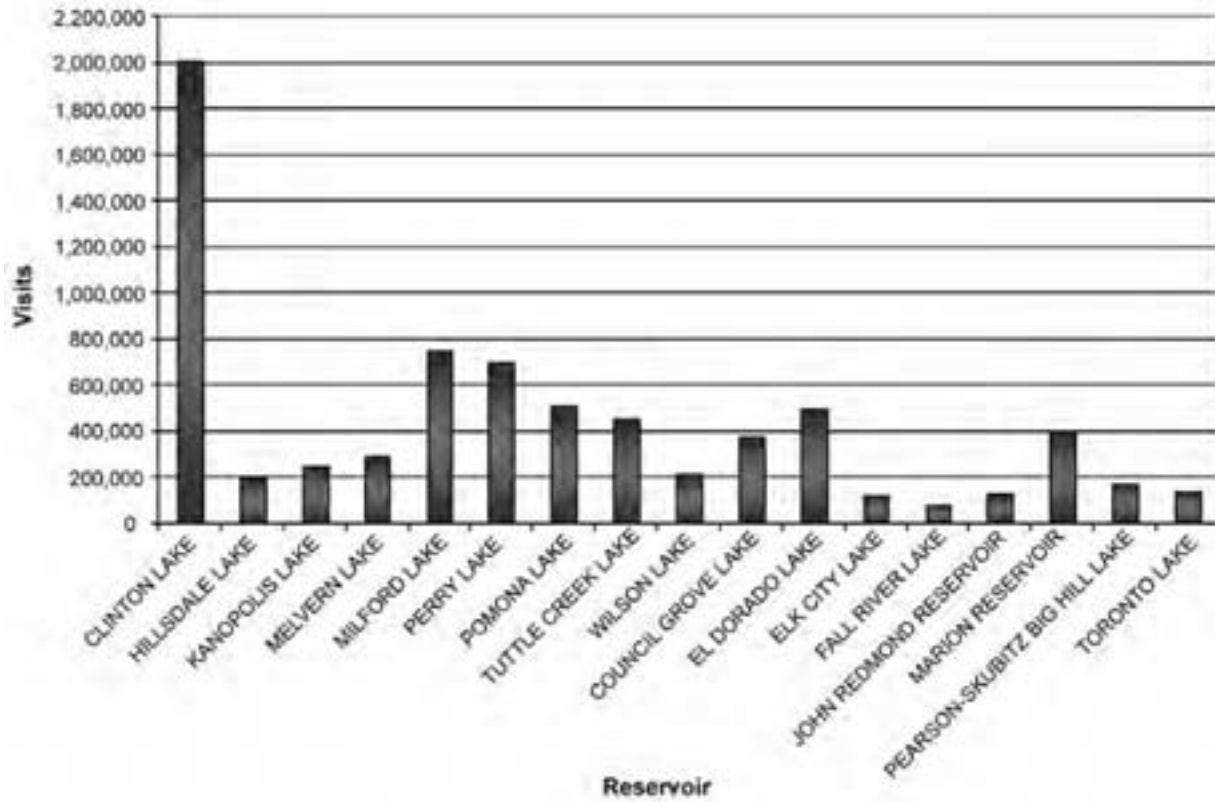


Figure 20. Visits to Kansas Reservoirs in 2007

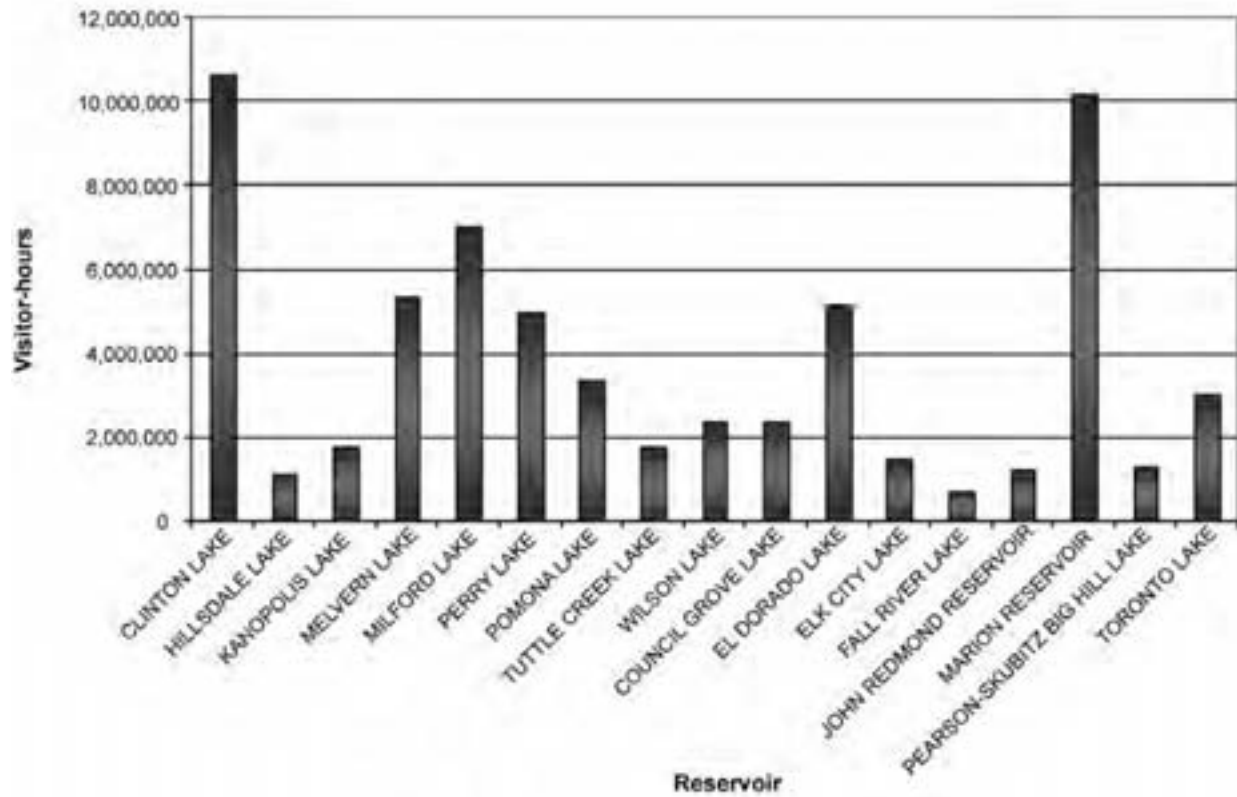


Figure 21. Visitor-hours at Kansas Reservoirs in 2007

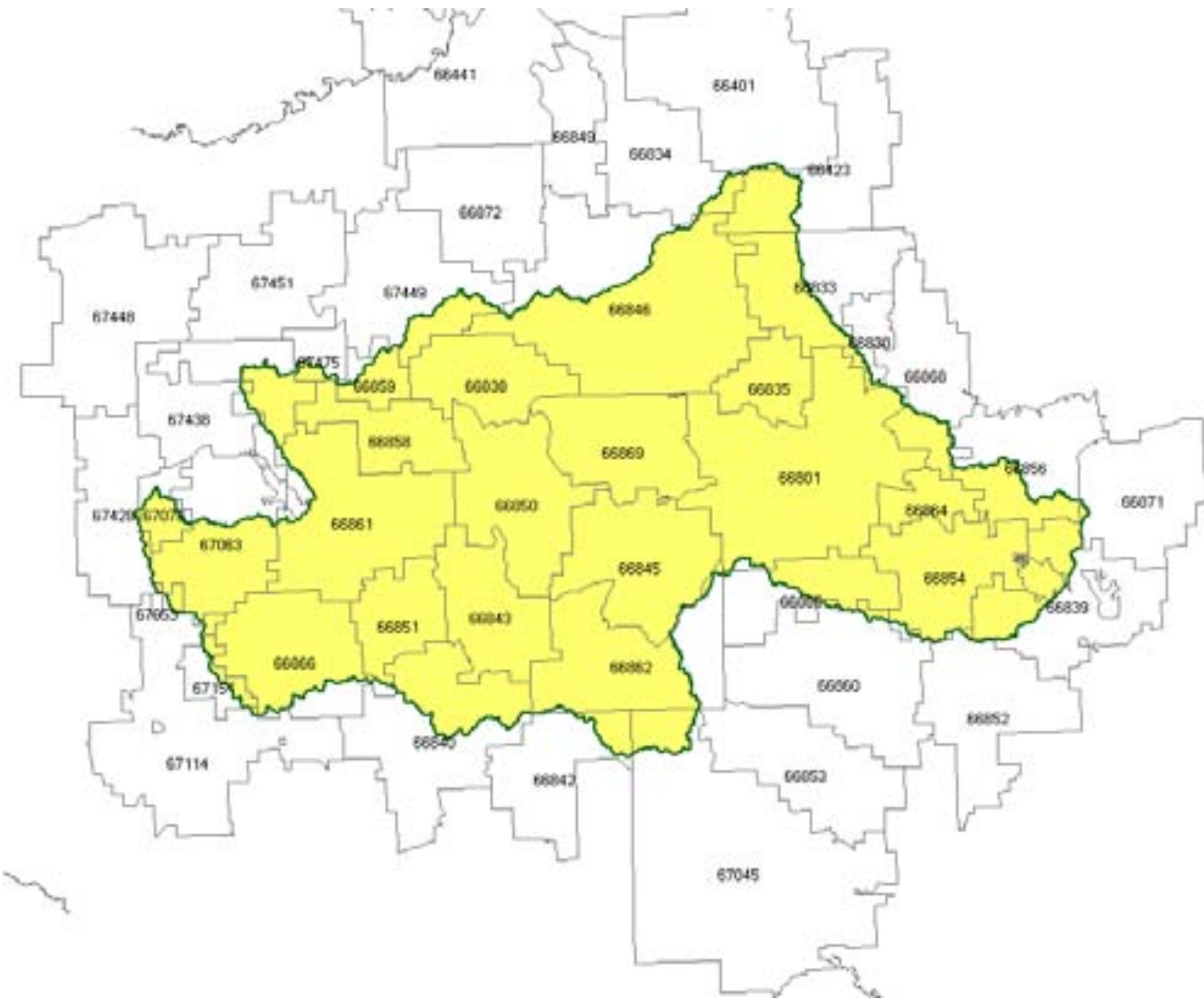


Figure 22. Zip Code Boundary Map.

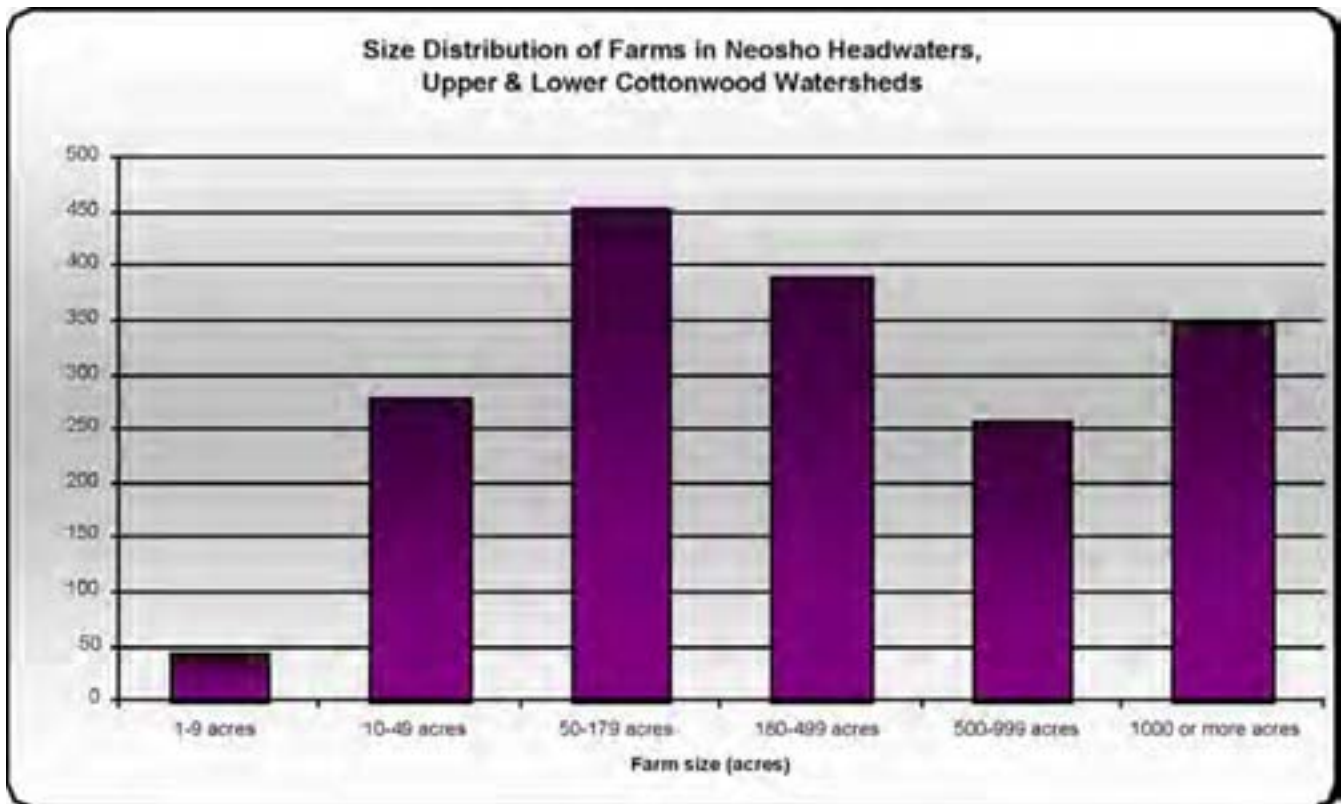


Figure 23. Size Distribution of Farms in Neosho Headwaters, Upper and Lower Cottonwood Watersheds, 2002¹⁸

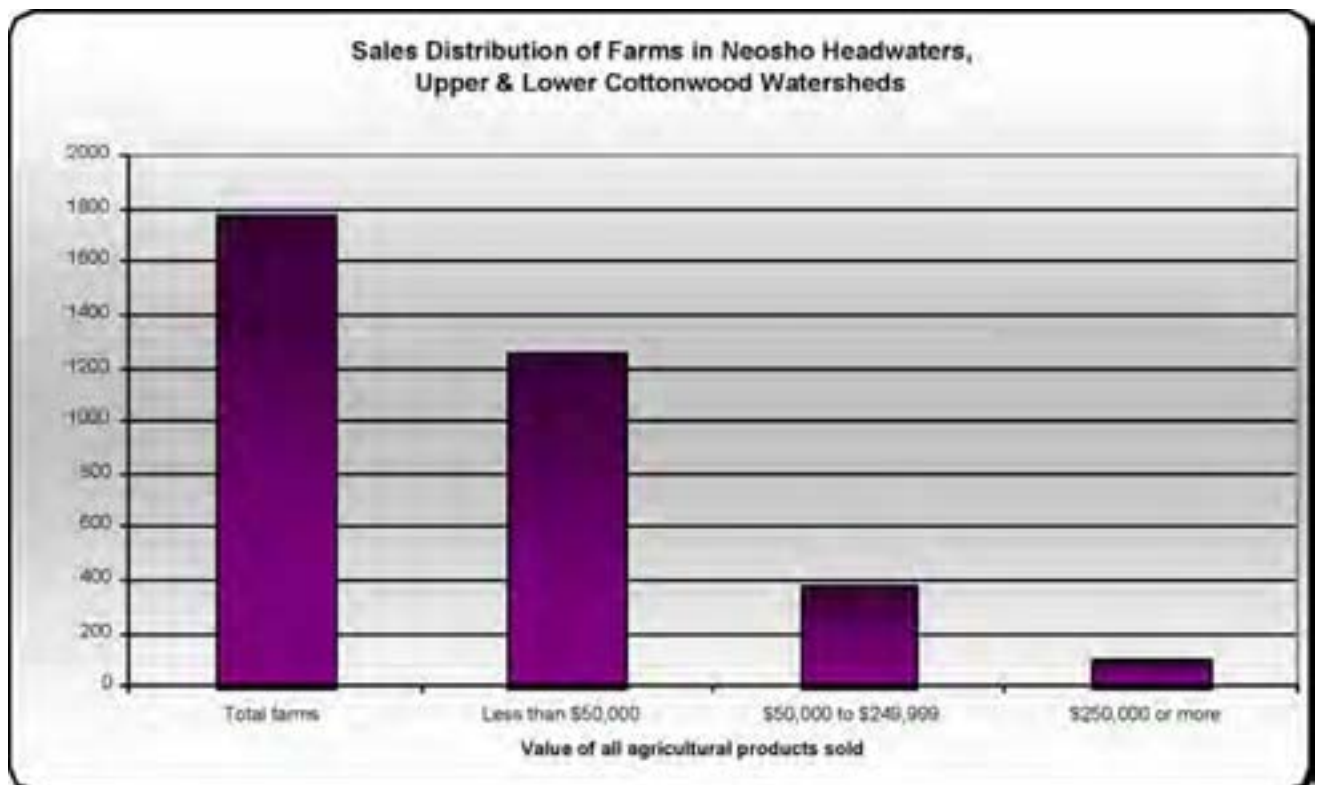


Figure 24. Sales Distribution of Farms in in Neosho Headwaters, Upper and Lower Cottonwood Watersheds, 2002¹⁸

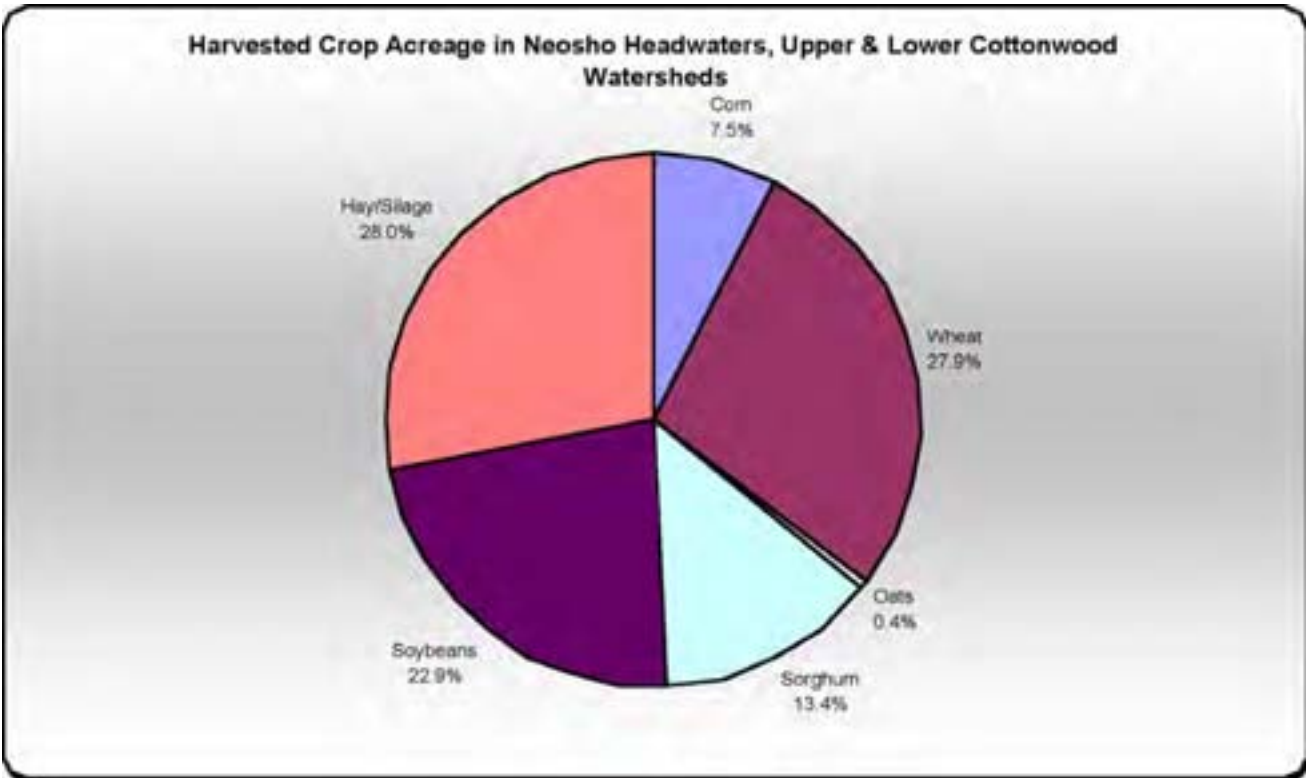


Figure 25. Harvested Crop Acreages in Neosho Headwaters, Upper and Lower Cottonwood Watersheds, 2002¹⁸

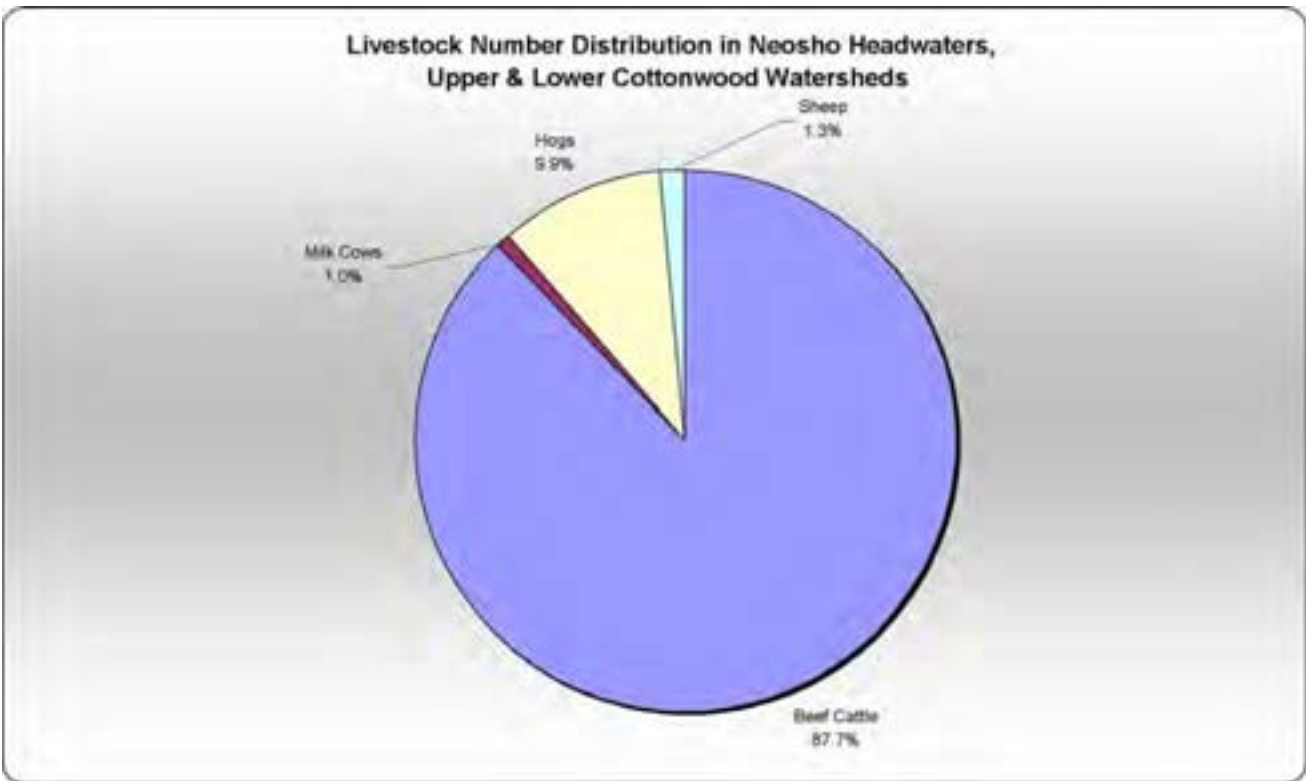


Figure 26. Livestock Number Distribution in Neosho Headwaters, Upper and Lower Cottonwood Watersheds, 2002¹⁸

8.0 Modeling

8.1 Subbasin Map¹⁹

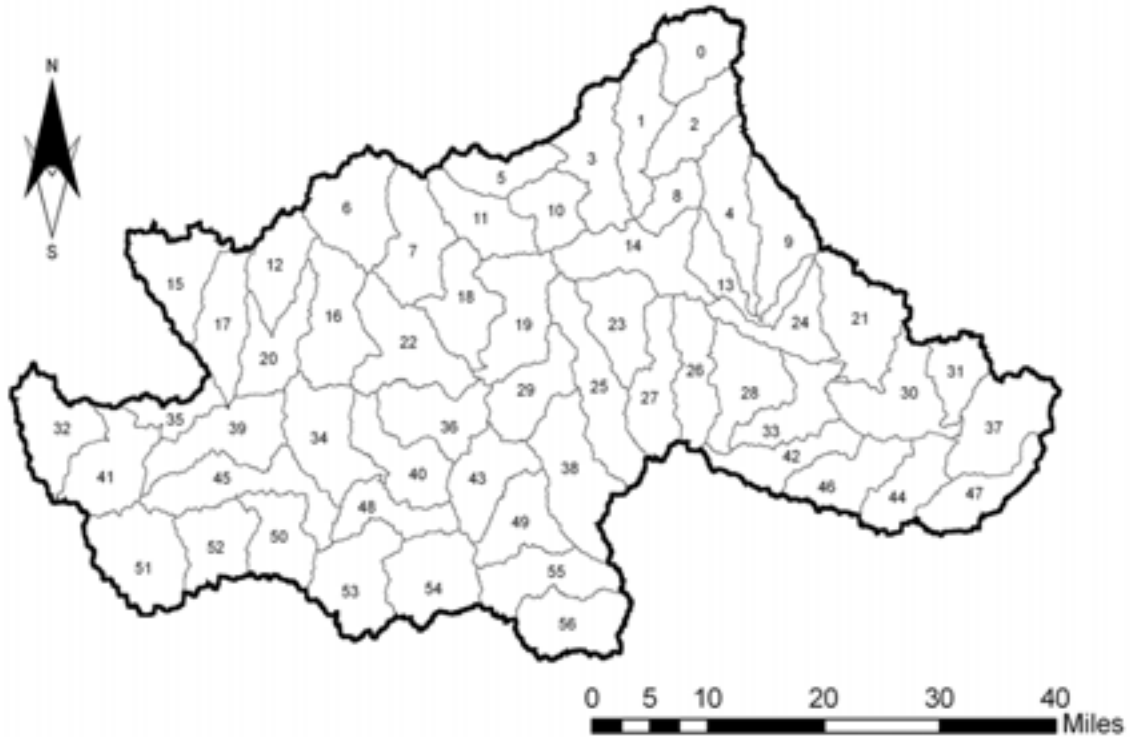


Figure 27. Subbasin Map – Upper & Lower Cottonwood and Neosho Headwaters Watersheds

Table 24. Upper & Lower Cottonwood and Neosho Headwaters Watersheds

Subbasin	State	HUC ID	Area (acres)
0	KS	11070201020040	26759
1	KS	11070201020060	28885
2	KS	11070201020050	24134
3	KS	11070201020070	33367
4	KS	11070201030010	31519
5	KS	11070201020010	19602
6	KS	11070203020010	35814
7	KS	11070203020020	33501
8	KS	11070201020080	13230
9	KS	11070201030020	28902
10	KS	11070201020030	20052
11	KS	11070201020020	24991
12	KS	11070202020030	23835
13	KS	11070201030030	20077
14	KS	11070201020090	36216
15	KS	11070202020010	31101
16	KS	11070203010030	35749
17	KS	11070202020020	27600

Subbasin	State	HUC ID	Area (acres)
18	KS	11070203020030	27974
19	KS	11070203020040	35068
20	KS	11070202020040	25760
21	KS	11070201030050	38199
22	KS	11070203010040	38269
23	KS	11070203040020	27615
24	KS	11070201030040	22553
25	KS	11070203040010	37307
26	KS	11070203040040	25925
27	KS	11070203040030	28126
28	KS	11070203040050	31112
29	KS	11070203020050	25554
30	KS	11070201040020	35799
31	KS	11070201040010	17599
32	KS	11070202010060	30803
33	KS	11070203040060	24711
34	KS	11070202040050	35055
35	KS	11070202010080	13627
36	KS	11070203010020	29450
37	KS	11070201040060	37248
38	KS	11070203030050	40368
39	KS	11070202020050	34150
40	KS	11070203010010	28172
41	KS	11070202010070	31942
42	KS	11070201040030	23560
43	KS	11070203030040	26536
44	KS	11070201040050	23388
45	KS	11070202040010	36995
46	KS	11070201040040	26645
47	KS	11070201040070	23333
48	KS	11070202040040	20370
49	KS	11070203030030	25124
50	KS	11070202030030	24966
51	KS	11070202030010	38648
52	KS	11070202030020	25839
53	KS	11070202040030	34700
54	KS	11070202040020	33528
55	KS	11070203030020	29572
56	KS	11070203030010	30120

8.2 Input Data

8.2.1 Neosho Headwaters

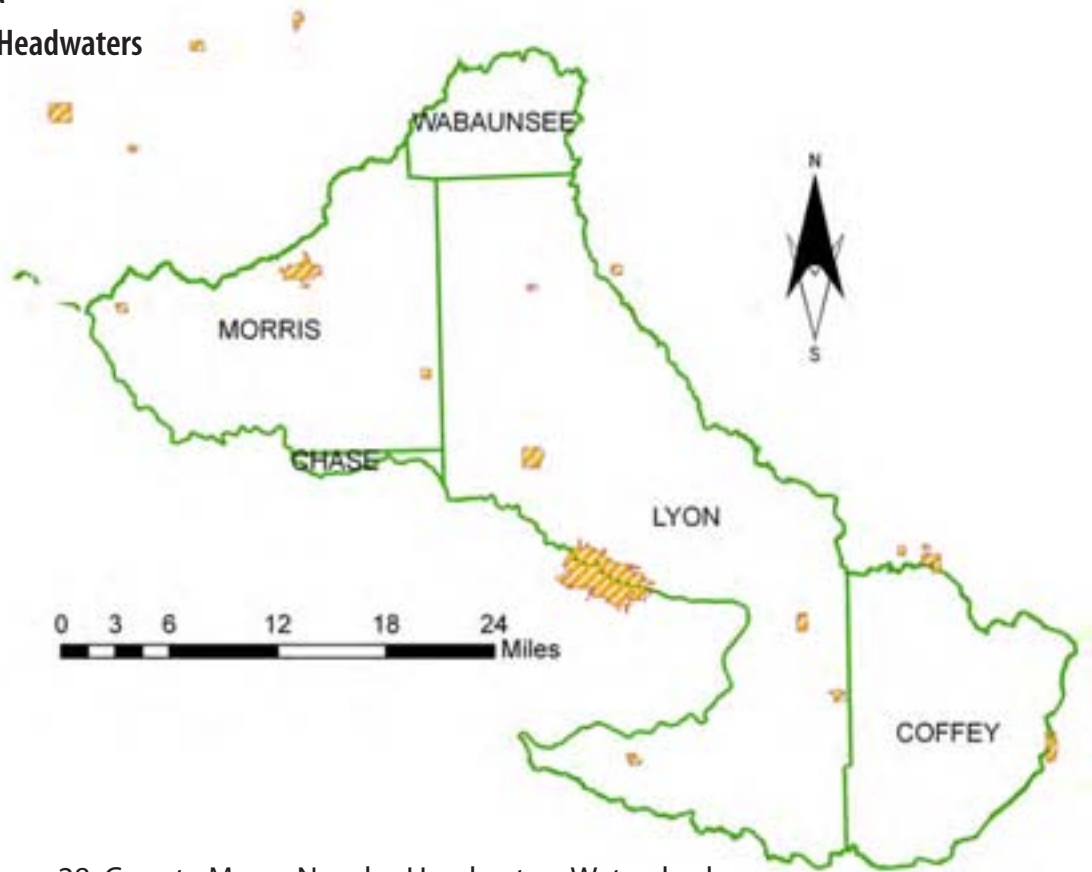


Figure 28. County Map – Neosho Headwaters Watersheds

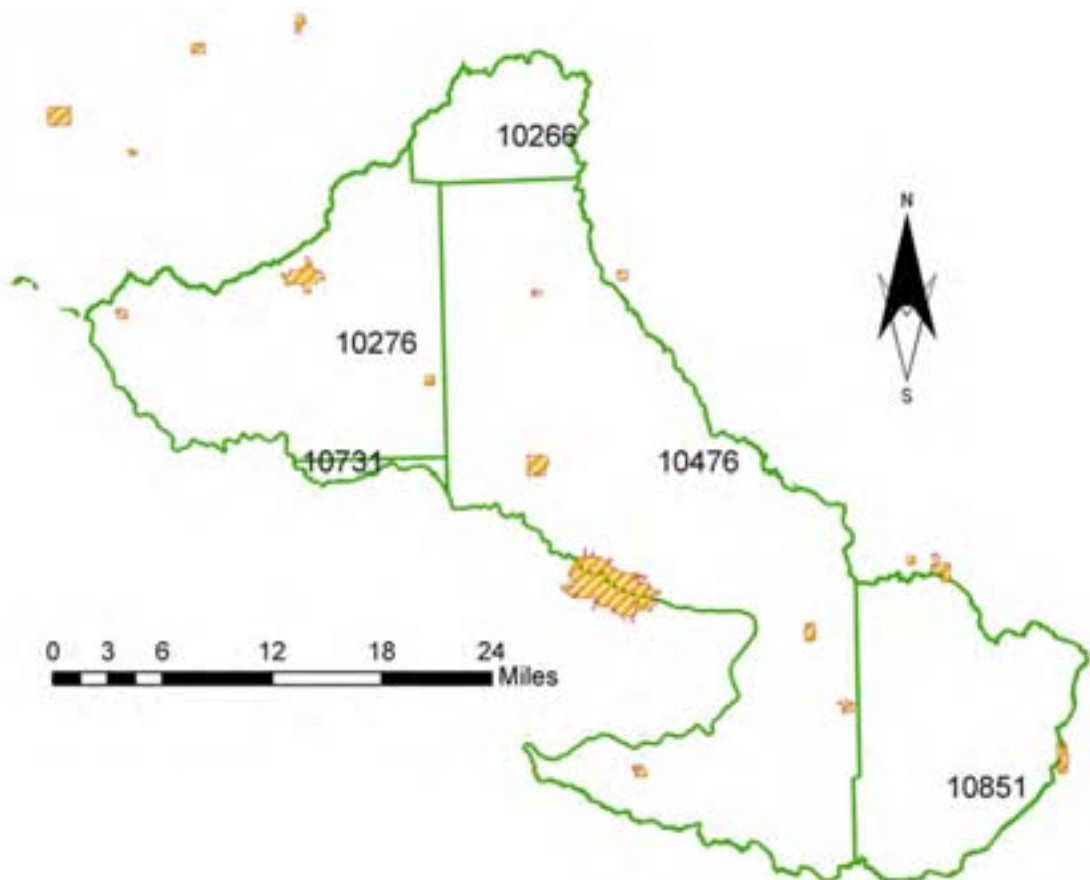


Figure 29. HUCO Map (overlay of county and 8-digit hydrologic unit boundary) – Neosho Headwaters Watershed²³

Table 25. Neosho Headwaters Watershed Summary²³

Polygon ID	County Name	State	HUC	HUC NAME	Area (acre)
10266	Wabaunsee	KS	11070201	Neosho headwaters	35639.7
10276	Morris	KS	11070201	Neosho headwaters	131007.7
10476	Lyon	KS	11070201	Neosho headwaters	283911.8
10731	Chase	KS	11070201	Neosho headwaters	1398.49
10851	Coffey	KS	11070201	Neosho headwaters	101631.5

Table 26. Landuse Area (acre)²⁰

Polygon ID	Urban/ Transportation	Cropland	Pasture/ Rangeland	Forest	User Defined	Feedlots	Water
10266	390	7800	23205	0	0	0.0585	325
10276	4324	44556	79853	3948	0	3.3934	2256
10476	12300	117900	113100	18500	0	6.95	1800
10731	0	0	7100	0	0	0	400
10851	1600	36000	33300	8100	0	1.65	7700
Total	18614	206256	256558	30548	0	12.0519	12481

Table 27. Agricultural Animals¹⁸

Polygon ID	Beef Cattle	Dairy Cattle	Swine (Hog)	Sheep	Horse	Chicken	Turkey	Duck
10266	D	D	159	D	0	37	0	0
10276	5317	49	219	91	192	109	0	1
10476	8922	218	2661	386	615	316	27	8
10731	D	D	7	D	0	0	0	0
10851	2446	11	D	440	153	26	0	0
Total	16685	278	3046	917	960	488	27	9

D = data withheld to avoid disclosing information for individual farms

Table 28. Septic System²¹

Polygon ID	No. of Septic Systems	Population per Septic System	Septic Failure Rate, %
10266	152	2.31	0.93
10276	990	1.97	0.93
10476	1063	2.42	0.93
10731	1	1.95	0.93
10851	259	2.26	0.93
Total	2465	2.18	0.93

Table 29. Hydrologic Soil Group²²

Polygon ID	Hydrological Group
10266	C
10276	C
10476	C
10731	C
10851	C

A = well to excessively drained soil

B = moderately-well to well drained soil

C = poorly drained soil

D = very poorly drained soil

Table 30. Modify the Universal Soil Loss Equation (USLE) parameters²³

Polygon ID	Land Cover	R	K	LS	C	P
10266	Crop land	200.00	0.33	0.233	0.21	0.86
10276	Crop land	200.00	0.34	0.235	0.23	0.76
10476	Crop land	225.00	0.37	0.220	0.24	0.83
10731	Crop land	225.00	0.32	0.205	0.24	0.96
10851	Crop land	225.00	0.38	0.191	0.25	0.76
10266	Pasture Land	200.00	0.37	0.187	0.00	1.00
10276	Pasture Land	200.00	0.33	0.266	0.05	1.00
10476	Pasture Land	225.00	0.39	0.301	0.03	1.00
10731	Pasture Land	225.00	0.32	0.281	0.02	1.00
10851	Pasture Land	225.00	0.38	0.268	0.01	1.00
10266	Forest	200.00	0.32	0.220	0.003	1.000
10276	Forest	200.00	0.33	0.220	0.003	1.000
10476	Forest	225.00	0.32	0.220	0.003	1.000
10731	Forest	225.00	0.30	0.220	0.003	1.000
10851	Forest	225.00	0.34	0.220	0.003	1.000

8.2.2 Lower Cottonwood



Figure 30. County Map – Lower Cottonwood Watershed

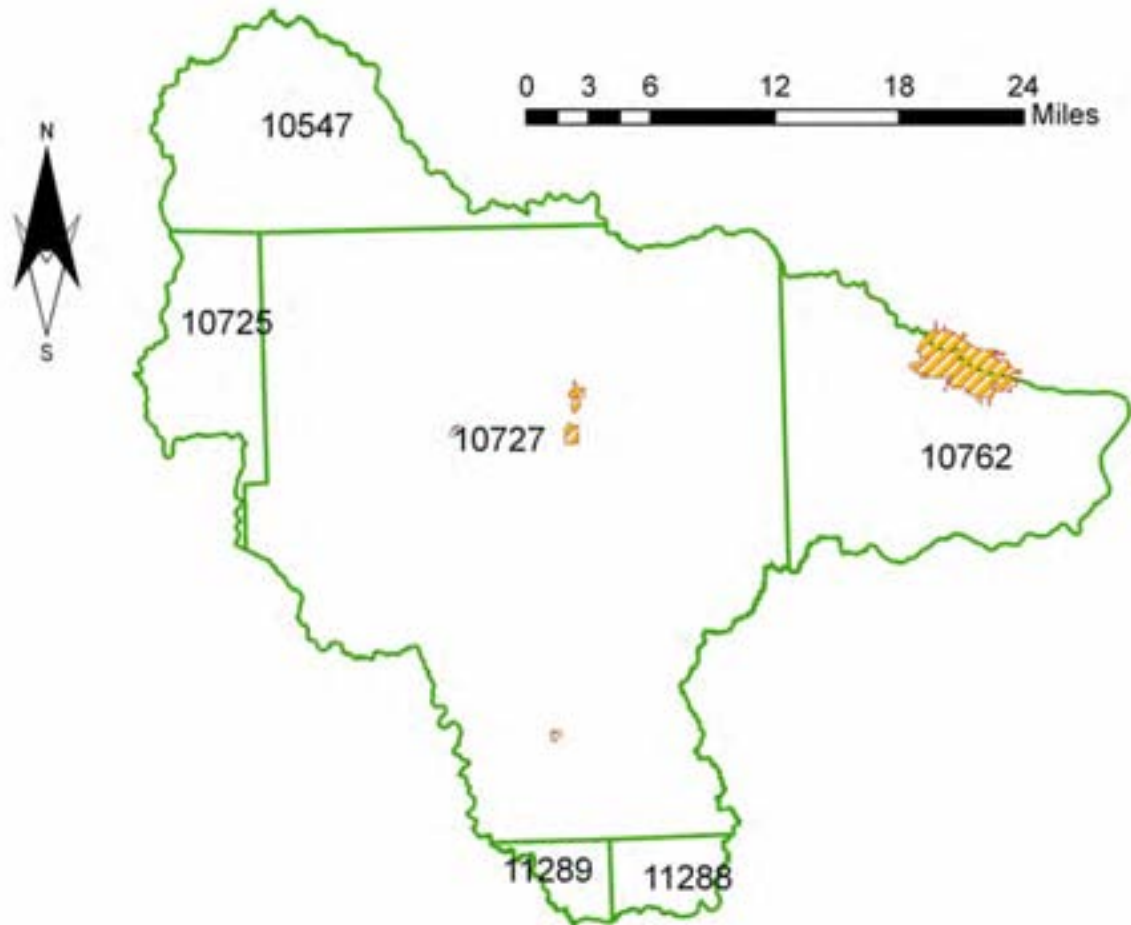


Figure 31. HUCO Map (overlay of county and 8-digit hydrologic unit boundary) – Lower Cottonwood Watershed²³

Table 31. Lower Cottonwood Watershed Summary²³

Polygon ID	County Name	State	HUC	Area (acre)	% in County	% in HUC
10547	Morris	KS	11070203	81401.63	18.21%	13.39%
10725	Marion	KS	11070203	33164.50	5.51%	5.45%
10727	Chase	KS	11070203	382424.97	78.31%	62.88%
10762	Lyon	KS	11070203	95497.09	17.34%	15.70%
11288	Greenwood	KS	11070203	9719.78	1.33%	1.605
11289	Butler	KS	11070203	5960.73	0.64%	0.98%

Table 32. Landuse Area (acre)²⁰

Polygon ID	Urban/ Transportation	Cropland	Pasture/ Rangeland	Forest	Feedlots	Water	Others
10547	600	14900	44300	2000	2.11	400	300
10725	600	8200	21100	0	1.18	100	300
10727	4700	45200	336100	4700	1.19	9500	1400
10762	7000	53000	46900	0	2.34	3800	800
11288	200	0	22300	0	0.23	200	0
11289	0	0	6200	0	0.24	0	0
Total	13100	121300	476900	6700	7.27	14000	2800

Table 33. Agricultural Animals¹⁸

Polygon ID	Beef Cattle	Dairy Cattle	Swine (Hog)	Sheep	Horse	Chicken	Turkey	Duck
10547	3303	30	136	56	118	67	0	1
10725	1128	122	1034	149	30	117	1	1
10727	D	D	2155	D	427	243	0	1
10762	3001	73	895	129	206	106	9	2
11288	349	6	21	5	12	6	D	0
11289	172	1	344	6	18	10	0	0
Total	7953	232	4585	345	811	549	10	5

D = data withheld to avoid disclosing information for individual farms

Table 34. Septic System Data²¹

Polygon ID	No. of Septic Systems	Population per Septic System	Septic Failure Rate, %
10547	289	1.97	0.93
10725	91	2.28	0.93
10727	560	1.95	0.93
10762	357	2.42	0.93
11288	19	1.85	0.93
11289	36	2.52	0.93
Total	1352	2.11	0.93

Table 35. Hydrologic Soil Group²²

Polygon ID	Hydrological Group
10547	C
10725	C
10727	C
10762	B
11288	C
11289	C

A = well to excessively drained soil

B = moderately-well to well drained soil

C = poorly drained soil

D = very poorly drained soil

Table 36. Modify the Universal Soil Loss Equation (USLE) parameters²³

Polygon ID	Land Cover	R	K	LS	C	P
10547	Crop Land	200.00	0.34	0.235	0.23	0.76
10725	Crop Land	200.00	0.32	0.240	0.23	0.92
10727	Crop Land	225.00	0.32	0.205	0.24	0.96
10762	Crop Land	225.00	0.37	0.220	0.24	0.83
11288	Crop Land	225.00	0.35	0.166	0.24	0.95
11289	Crop Land	225.00	0.33	0.208	0.23	0.91
10547	Pasture Land	200.00	0.33	0.266	0.05	1.00
10725	Pasture Land	200.00	0.31	0.372	0.02	1.00
10727	Pasture Land	225.00	0.32	0.281	0.02	1.00
10762	Pasture Land	225.00	0.39	0.301	0.03	1.00
11288	Pasture Land	225.00	0.36	0.341	0.02	1.00
11289	Pasture Land	225.00	0.35	0.208	0.02	1.00
10547	Forest	200.00	0.33	0.205	0.003	1.000
10725	Forest	200.00	0.32	0.205	0.003	1.000
10727	Forest	225.00	0.30	0.205	0.003	1.000
10762	Forest	225.00	0.32	0.205	0.003	1.000
11288	Forest	225.00	0.32	0.205	0.003	1.000
11289	Forest	225.00	0.32	0.205	0.003	1.000

8.2.3 Upper Cottonwood

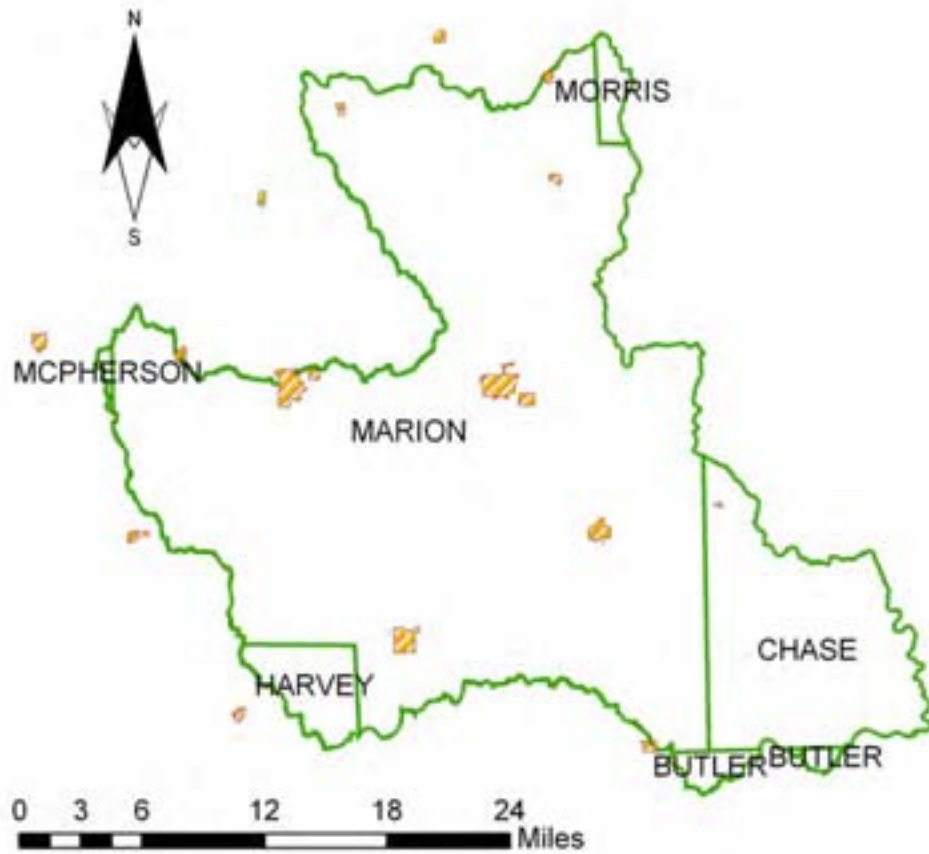


Figure 32. County Map – Upper Cottonwood Watershed

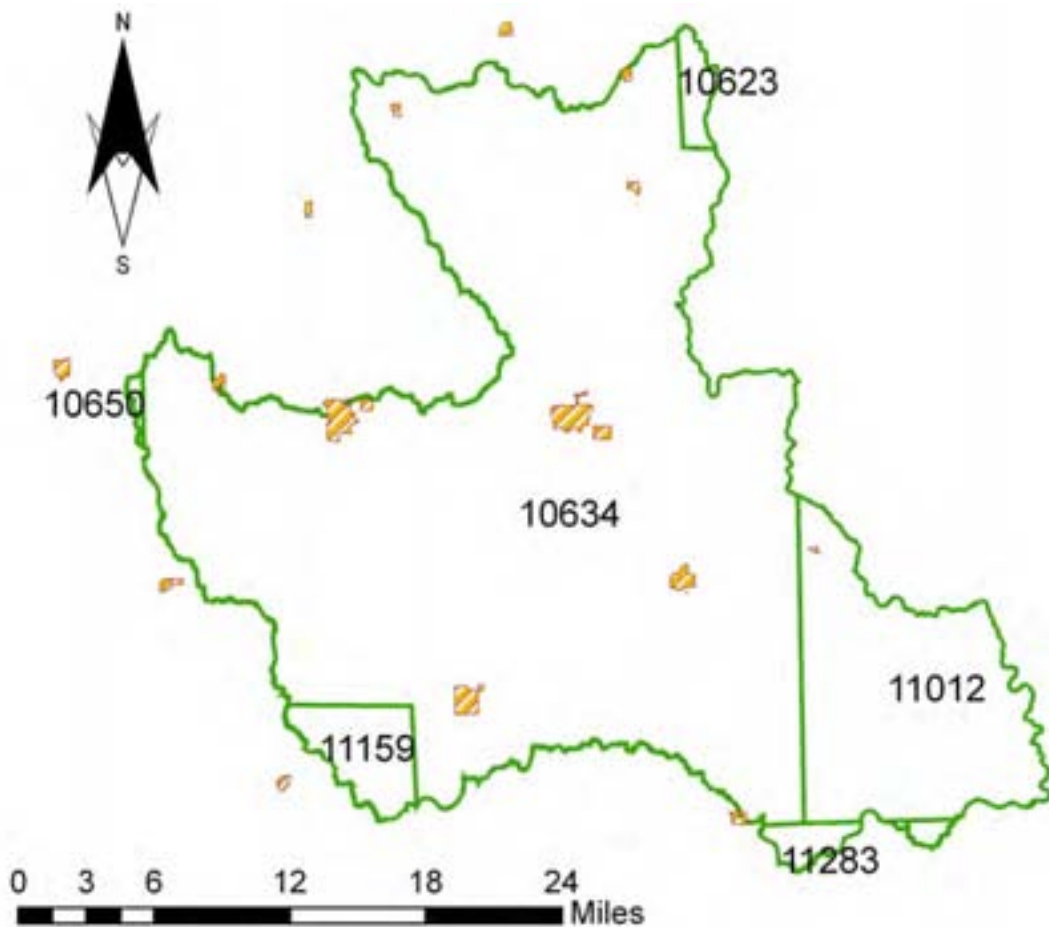


Figure 33. HUCO Map (overlay of county and 8-digit hydrological unit boundary) – Upper Cottonwood Watershed²³

Table 37. Upper Cottonwood Watershed²³

Polygon ID	County Name	State	HUC	HUC NAME	Area (acre)
10623	Morris	KS	11070202	Upper Cottonwood	4832.6
10634	Marion	KS	11070202	Upper Cottonwood	367947.6
10650	Mcperson	KS	11070202	Upper Cottonwood	222.5
11012	Chase	KS	11070202	Upper Cottonwood	70829.2
11159	Harvey	KS	11070202	Upper Cottonwood	10059.5
11283	Butler	KS	11070202	Upper Cottonwood	3813.3

Table 38. Landuse Area (acre)²⁰

Polygon ID	Urban/ Transportation	Cropland	Pasture/ Rangeland	Forest	Feedlots	Water	Others
10623	0	0	0	0	0.12	0	0
10634	10800	228525	99075	5325	13.065	6075	22050
10650	0	0	0	0	0.00846	0	0
11012	600	0	65100	0	0.22	400	400
11159	400	5700	6000	0	0.26	100	2500
11283	300	0	12300	0	0.15	100	100
Total	12100	234225	182475	5325	13.82346	6675	25050

Table 39. Agricultural Animals¹⁸

Polygon ID	Beef Cattle	Dairy Cattle	Swine (Hog)	Sheep	Horse	Chicken	Turkey	Duck
10623	196	1	8	3	7	4	0	0
10634	12515	1358	11475	1659	333	1302	12	15
10650	5	0	11	1	0	0	D	0
11012	D	D	399	D	79	45	0	0
11159	153	23	360	29	20	19	D	0
11283	109	0	219	4	11	6	0	0
Total	12978	1382	12472	1696	450	1376	12	15

D = data withheld to avoid disclosing information for individual farms

Table 40. Septic System Data²¹

Polygon ID	No. of Septic Systems	Population per Septic System	Septic Failure Rate, %
10623	17	1.97	0.93
10634	1019	2.28	0.93
10650	1	2.49	0.93
11012	103	1.95	0.93
11159	52	2.52	0.93
11283	22	2.52	0.93
Total	1214	2.29	0.93

Table 41. Hydrologic Soil Group²²

Polygon ID	Hydrologic Group
10623	B
10634	B
10650	C
11012	C
11159	B
11283	C

A = well to excessively drained soil

B = moderately-well to well drained soil

C = poorly drained soil

D = very poorly drained soil

Table 42. Modify the Universal Soil Loss Equation (USLE) parameters²³

Polygon ID	Land Cover	R	K	LS	C	P
10623	Crop Land	200.00	0.34	0.235	0.23	0.76
10634	Crop Land	200.00	0.32	0.240	0.23	0.92
10650	Crop Land	200.00	0.35	0.174	0.21	0.90
11012	Crop Land	225.00	0.32	0.205	0.24	0.96
11159	Crop Land	200.00	0.32	0.171	0.20	0.88
11283	Crop Land	225.00	0.33	0.208	0.23	0.91
10623	Pasture Land	200.00	0.33	0.266	0.05	1.00
10634	Pasture Land	200.00	0.31	0.372	0.02	1.00
10650	Pasture Land	200.00	0.34	0.264	0.04	1.00
11012	Pasture Land	225.00	0.32	0.281	0.02	1.00
11159	Pasture Land	200.00	0.29	0.197	0.01	1.00
11283	Pasture Land	225.00	0.35	0.208	0.02	1.00
10623	Forest	200.00	0.33	0.240	0.003	1.000
10634	Forest	200.00	0.32	0.240	0.003	1.000
10650	Forest	200.00	0.32	0.240	0.003	1.000
11012	Forest	225.00	0.30	0.240	0.003	1.000
11159	Forest	200.00	0.28	0.240	0.003	1.000
11283	Forest	225.00	0.32	0.240	0.003	1.000

8.3 Model Outputs

8.3.1 Neosho Headwaters

Table 43. Total Pollution Load²³

Polygon ID	N Load (lb/year)	P Load (lb/year)	BOD Load (lb/year)	Sediment Load (t/year)
10266	215683.6	20389.0	657010.5	1017.0
10276	872714.7	95227.0	2564509.7	9071.5
10476	1586602.5	201166.4	4439672.1	26938.5
10731	53369.8	4106.3	173034.7	104.3
10851	455863.0	57072.5	1259560.9	6741.0
Total	3184233.6	377961.3	9093787.9	43872.4

Table 44. Total Load by Land Uses²³

Sources	N Load (lb/yr)	P Load (lb/yr)	BOD Load (lb/yr)	Sediment Load (t/yr)
Urban	129462.09	20029.60	505928.06	2971.47
Cropland	1055349.53	187952.11	2211907.62	29333.82
Pastureland	1937389.18	151798.18	6270329.40	6546.36
Forest	24993.21	10648.96	54449.78	5020.77
Feedlots	36389.84	7277.97	48519.78	0.00
User Defined	0.00	0.00	0.00	0.00
Septic	649.77	254.49	2653.22	0.00
Gully	0.00	0.00	0.00	0.00
Streambank	0.00	0.00	0.00	0.00
Groundwater	0.00	0.00	0.00	0.00
Total	3184233.61	377961.30	9093787.85	43872.42

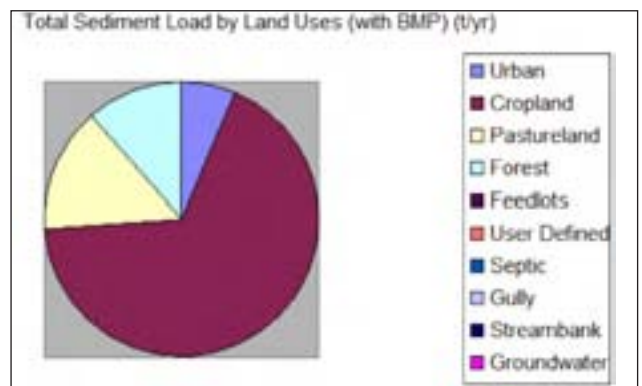
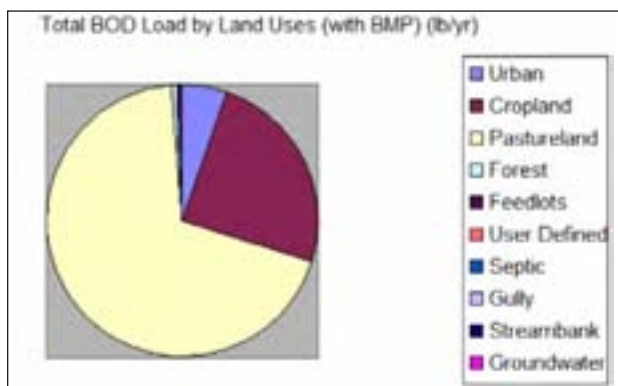
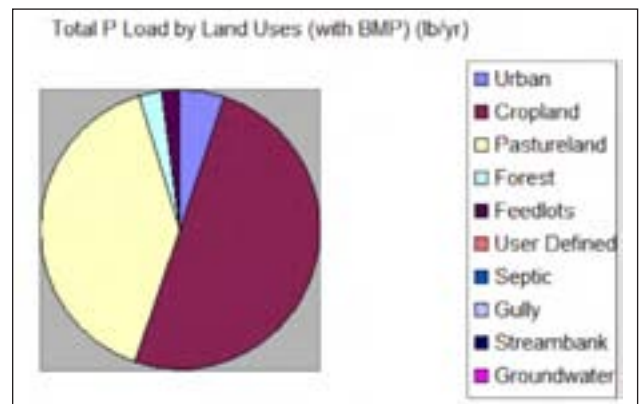
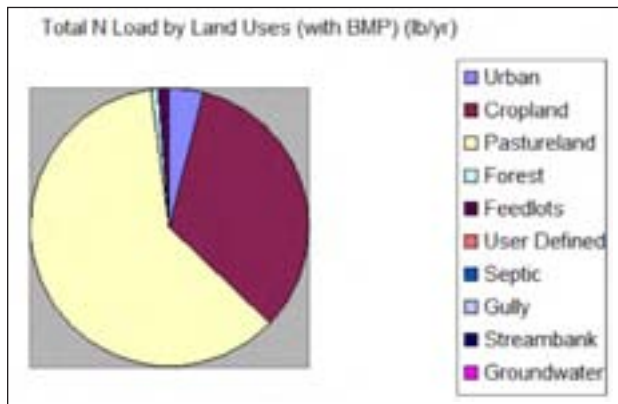


Figure 34. Total Load by Land Uses – Neosho Headwaters Watershed.

8.3.2 Lower Cottonwood

Table 45. Total Pollution Load²³

Polygon ID	N Load (lb/year)	P Load (lb/year)	BOD Load (lb/year)	Sediment Load (t/year)
10547	448426.1	44101.0	1350658.9	2980.6
10725	221827.6	22275.7	664176.8	1548.5
10727	2978331.4	255982.5	9396851.4	11090.6
10762	525040.0	68452.0	1462485.9	9755.8
11288	181499.5	14226.8	587751.3	438.3
11289	50493.3	3952.0	162332.8	62.3
Total	4405617.9	408990.1	13624257.3	25876.0

Table 46. Total Load by Land Uses²³

Sources	N Load (lb/yr)	P Load (lb/yr)	BOD Load (lb/yr)	Sediment Load (t/yr)
Urban	86969.91	13431.11	338700.72	1995.37
Cropland	581064.05	103334.28	1217922.02	15944.33
Pastureland	3710858.82	286176.84	12028587.82	7925.84
Forest	2138.25	1065.27	5328.87	10.47
Feedlots	24246.78	4849.36	32329.05	0.00
User Defined	0.00	0.00	0.00	0.00
Septic	340.12	133.21	1388.81	0.00
Gully	0.00	0.00	0.00	0.00
Streambank	0.00	0.00	0.00	0.00
Groundwater	0.00	0.00	0.00	0.00
Total	4405617.93	408990.08	13624257.29	25876.01

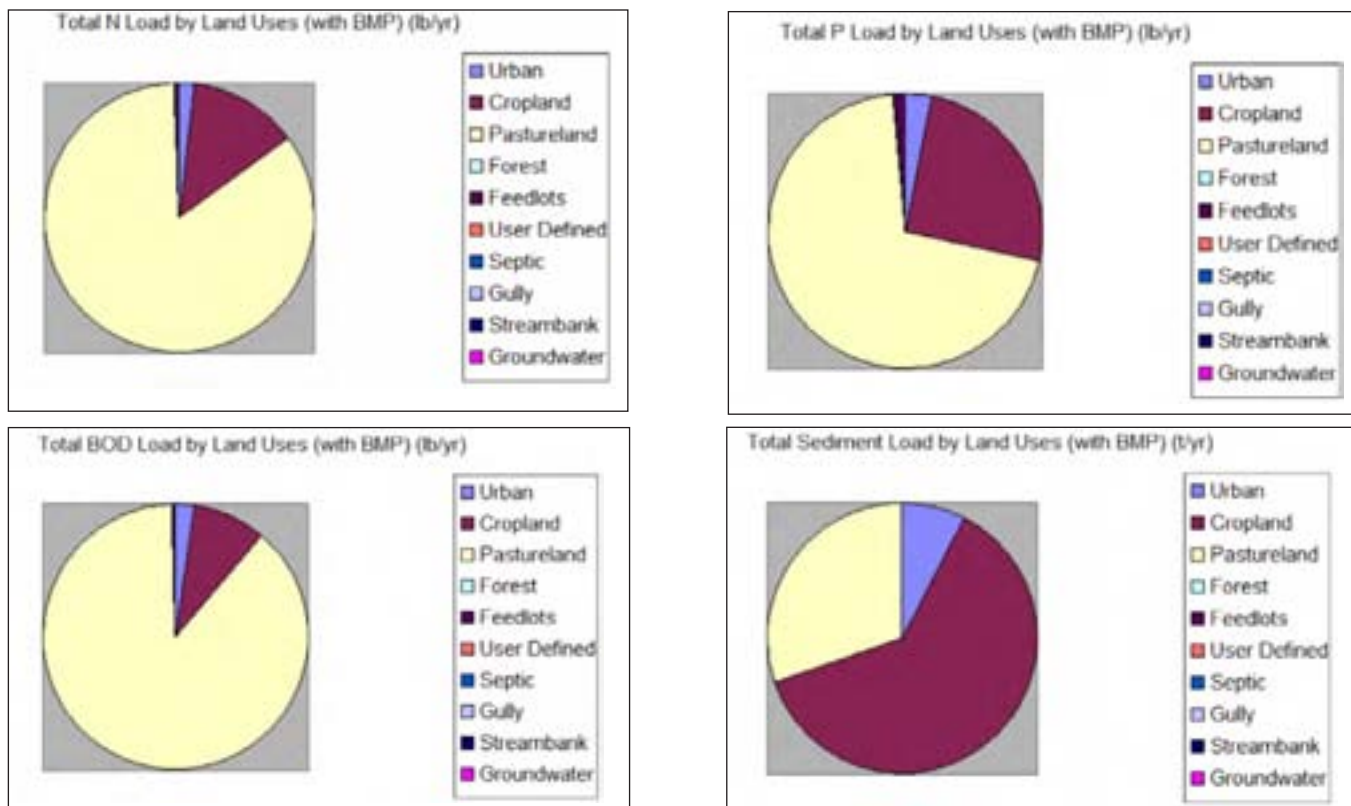


Figure 35. Total Load by Land Uses - Lower Cottonwood Watershed.

8.3.3 Upper Cottonwood

Table 47. Total Pollution Load²³

Polygon ID	N Load (lb/year)	P Load (lb/year)	BOD Load (lb/year)	Sediment Load (t/year)
10623	411.5	83.1	559.6	0.0
10634	1618281.8	239059.3	4102841.0	38198.0
10650	29.0	5.9	39.5	0.0
11012	535822.5	41672.2	1738753.6	1143.4
11159	59174.4	7043.3	165871.4	610.9
11283	102821.6	8101.0	334057.1	200.1
Total	2316540.8	295964.8	6342122.3	40152.4

Table 48. Total Load by Land Uses²³

Sources	N Load (lb/yr)	P Load (lb/yr)	BOD Load (lb/yr)	Sediment Load (t/yr)
Urban	75720.48	11670.55	293792.36	1736.60
Cropland	975958.91	179302.67	2042968.34	34680.91
Pastureland	1216494.61	94930.93	3938713.01	3723.62
Forest	1096.22	543.94	2722.43	11.33
Feedlots	46943.79	9388.76	62591.72	0.00
User Defined	0.00	0.00	0.00	0.00
Septic	326.79	127.99	1334.40	0.00
Gully	0.00	0.00	0.00	0.00
Streambank	0.00	0.00	0.00	0.00
Groundwater	0.00	0.00	0.00 </td <td>0.00</td>	0.00
Total	2316540.80	295964.83	6342122.27	40152.45

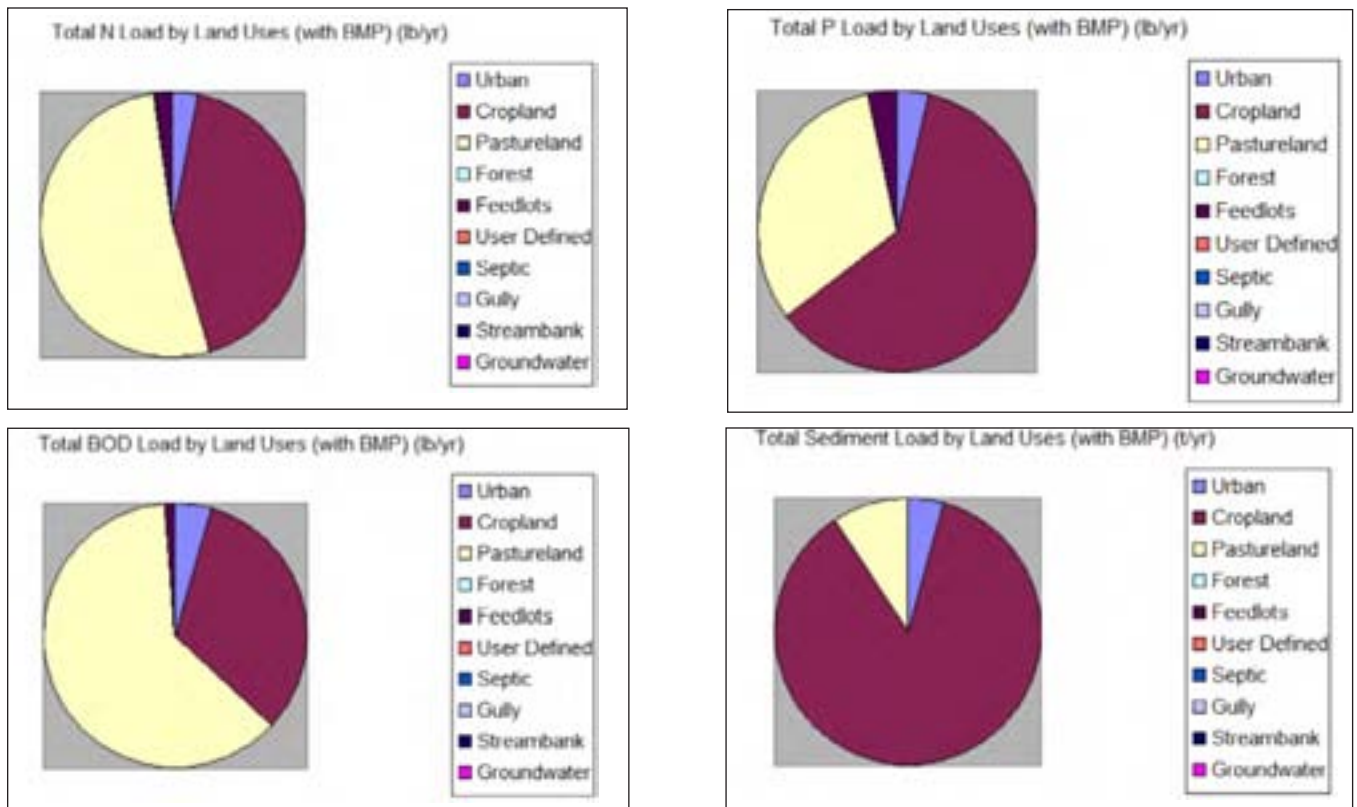


Figure 36. Total Load by Land Uses - Upper Cottonwood Watershed.

9.0 Acknowledgment:

The authors would like to acknowledge Dr. William Hargrove, Dr. Danny Rogers, Ms. Judy Willingham, and Mr. Don Snethen for their help and comments.

Funding for this project was provided in part by Kansas Water Office, Kansas Water Plan Funds, and EPA 319 funds through Kansas Department of Health and Environment, Watershed Management Section.

10.0 Footnotes/Bibliography

1. *National Land Cover Database 2001 (NLCD 2001)*: “NLCD 2001 products include 21 classes of Land Cover, Percent Tree Canopy and Percent Urban Imperviousness at 30 m cell resolution.”

Online reference information available at: http://www.mrlc.gov/mrlc2k_nlcd.asp

2. *Neosho Basin Total Maximum Daily Load*: “Twenty-six watershed and 16 lake TMDLs were developed. The high priority TMDLs were submitted to EPA on July 5, 2002. Twelve of the medium and low priority lake TMDLs were submitted on August 29, 2002. These submitted TMDLs have been approved by EPA. The medium and low priority stream TMDLs were submitted to EPA on November 7, 2002 and were approved on December 13, 2003. The John Redmond Lake TMDLs were approved on February 27, 2003. TMDLs done in 2004 were approved on January 5th and February 24th, 2005.”

Online reference information available at: <http://www.kdheks.gov/tmdl/neosho.htm>

3. *National Elevation Dataset*: “The USGS National Elevation Dataset (NED) has been developed by merging the highest-resolution, best quality elevation data available across the United States into a seamless raster format. NED is the result of the maturation of the USGS effort to provide 1:24,000-scale Digital Elevation Model (DEM) data for the conterminous U.S.”

Online reference information available at: <http://ned.usgs.gov/>

4. *Precipitation Map*: “Point estimates of precipitation originated from some or all of the following sources: 1) National Weather Service (NWS) Cooperative (COOP) stations, 2) Natural Resources Conservation Service (NRCS) SNOTEL, 3) United States Forest Service (USFS) and Bureau of Land Management (BLM) RAWS Stations, 4) Bureau of Reclamation (AGRIMET) stations, 5) California Data Exchange Center (CDEC) stations, 6) Storage gauges, 7) NRCS Snowcourse stations, 8) Other State and local station networks, 9) Estimated station data, 0) Canadian stations, 10) Upper air stations, and 11) NWS/Federal Aviation Administration (FAA) Automated surface observation stations (ASOS). All COOP station data were subjected to quality control checks by the National Climatic Data Center (NCDC). All COOP, SNOTEL and other data were subjected to further quality control checks by the PRISM Group.”

Online reference information available at: http://prism.oregonstate.edu/docs/meta/ppt_30s_meta.htm#7

5. *Maximum Temperature Map*: “Point estimates of temperature originated from some or all of the following sources: 1) National Weather Service (NWS) Cooperative (COOP) stations, 2) Natural Resources Conservation Service (NRCS) SNOTEL, 3) United States Forest Service (USFS) and Bureau of Land Management (BLM) RAWS Stations, 4) Bureau of Reclamation (AGRIMET) stations, 5) California Data Exchange Center (CDEC) stations, 6) Storage gauges, 7) NRCS Snowcourse stations, 8) Other State and local station networks, 9) Estimated station data, 0) Canadian stations, 10) Upper air stations, and 11) NWS/Federal Aviation Administration (FAA) Automated surface observation stations (ASOS). All COOP station data were subjected to quality control checks by the National Climatic Data Center (NCDC). All COOP, SNOTEL and other data were subjected to further quality control checks by the PRISM Group.”

Online reference information available at: http://prism.oregonstate.edu/docs/meta/tmax_30s_meta.htm

6. *Minimum Temperature Map*: “Point estimates of temperature originated from some or all of the following sources: 1) National Weather Service (NWS) Cooperative (COOP) stations, 2) Natural Resources Conservation Service (NRCS) SNOTEL, 3) United States Forest Service (USFS) and Bureau of Land Management (BLM) RAWS Stations, 4) Bureau of Reclamation (AGRIMET) stations, 5) California Data Exchange Center (CDEC) stations, 6) Storage gauges, 7) NRCS Snowcourse stations, 8) Other State and local station networks, 9) Estimated station data, 0) Canadian stations, 10) Upper air stations, and 11) NWS/Federal

Aviation Administration (FAA) Automated surface observation stations (ASOS). All COOP station data were subjected to quality control checks by the National Climatic Data Center (NCDC). All COOP, SNO-TEL and other data were subjected to further quality control checks by the PRISM Group.”

Online reference information available at: http://prism.oregonstate.edu/docs/meta/tmin_30s_meta.htm

7. *Land Use (GIRAS 1980s)*: “This is land use/land cover digital data collected by USGS and converted to ARC/INFO by the EPA. This data which resides in EPA’s Spatial Data Library (ESDLs), is useful for environmental assessment of land use patterns with respect to water quality analysis, growth management, and other types of environmental impact assessment. GIRAS LU/LC is being used in EPA’s, Office of Water/OST BASINS water quality assessment model.”

Online reference information available at: <http://www.epa.gov/waterscience/basins/metadata/giras.htm>

8. *National Land Cover Database 1992 (NLCD 1992)*: “Derived from the early to mid-1990s Landsat Thematic Mapper satellite data, the National Land Cover Data (NLCD) is a 21-class land cover classification scheme applied consistently over the United States. The spatial resolution of the data is 30 meters and mapped in the Albers Conic Equal Area projection, NAD 83. The NLCD are provided on a state-by-state basis. The state data sets were cut out from larger “regional” data sets that are mosaics of Landsat TM scenes. At this time, all of the NLCD state files are available for free download as 8-bit binary files and some states are also available on CD-ROM as a Geo-TIFF. “

Online reference information available at: http://landcover.usgs.gov/us_map.php

9. *River Network*: “The National Hydrography Dataset (NHD) is a comprehensive set of digital spatial data that contains information about surface water features such as lakes, ponds, streams, rivers, springs and wells. The NHD is based upon the content of USGS Digital Line Graph (DLG) hydrography data integrated with reach-related information from the EPA Reach File Version 3 (RF3). The stream network was generated based on the USEPA Reach File, Version 1 and National Hydrography Dataset (NHD).”

Online reference information available at: <http://nhd.usgs.gov/>

USEPA Reach File, Version 1.0.

Online reference information available at: <http://www.epa.gov/>

10. *Hydrologic Soil Groups*: The Natural Resources Conservation Service (NRCS) – “National Cartography and Geospatial Center (NCGC) previously archived and distributed the State Soil Geographic (STATSGO) Database. The STATSGO spatial and tabular data have been revised and updated. STATSGO has been renamed to the U.S. General Soil Map (STATSGO).”

Online reference information available at: <http://www.ncgc.nrcs.usda.gov/products/datasets/statsgo/>

11. *Water Quality Observations Stations*: “Observation-level water quality monitoring data for selected locations and parameters. Better Assessment Science Integrating Point & Nonpoint Sources (BASIN v. 4.0).”

Online reference information available at: <http://www.epa.gov/waterscience/basins/index.html>

12. *USGS Gage Stations*: “Inventory of surface water gaging station data including 7Q10 low and monthly mean stream flow. Better Assessment Science Integrating Point & Nonpoint Sources (BASIN v. 4.0).”

Online reference information available at: <http://www.epa.gov/waterscience/basins/index.html>

13. *Estimated Peak-Streamflow Frequencies*: “Estimated peak-streamflow frequencies for selected gaging stations with at least 10 years of annual peak-discharge data for unregulated, rural streams in Kansas.”

Online reference information available at: <http://ks.water.usgs.gov/Kansas/waterwatch/flood/flood-freq.html>

14. *Permitted Point Source Facilities*: “BASINS also includes information on pollutant loading from point source discharges. The location, type of facility, and estimated loading are provided. These loadings are also used to support evaluation of watershed-based loading summaries combining point and nonpoint sources.”

Online reference information available at: <http://www.epa.gov/waterscience/basins/index.html>

15. *Confined Animal Feeding Operations*: Obtained from Watershed Planning Section -Kansas Department of Health and Environment.

16. *The 1990 Population and Sewerage by Census Tract*: “Summarizes the selected area by census tract ID. For each census tract, the report lists the population, number of housing units, type of residential sewer system, and spatial percentage of that tract located within the subject watershed area.”
Online reference information available at: <http://www.epa.gov/waterscience/basins/index.html>
17. *Cost-Return Budget*: Data acquired from Sarah L. Fogleman and Stewart R. Duncan, for Different Crop Cost-Return Budget in Southeast Kansas, Kansas State University.
18. *Census Data*: “Data was derived from the 2002 Census of Agriculture. The data presented here serves only as an estimate for agricultural activity in the Upper and Middle Neosho watershed. Since watersheds do not follow political boundaries, the estimates were made based on proportion assumptions of county and zip code census data.”
Online reference information available at: http://www.nass.usda.gov/Census_of_Agriculture/index.asp
19. *Subbasin Map*: This map was provided based on USGS Hydrologic Unit Level 14 Code Boundaries. United States Department of Agriculture/Natural Resources Conservation Service.
Online reference information available at: <http://www.kansasgis.org/catalog/catalog.cfm>
20. *USDA Natural Resources Conservation Service 1997 National Resources Inventory*.
21. *National Environmental Service Center*: 1992 and 1998 summary of the status of onsite wastewater treatment systems in the United States.
22. *USDA State Soil Geographic (STATSGO) database*.
23. *STEPL v4 model default values*
24. *Shawnee County Conservation District*.
Online reference information available at: <http://www.sccdistrict.com/>
25. Williams, J.R. and C.M. Smith. *A Sedimentation White Paper: Economics of Watershed Protection and Reservoir Rehabilitation*. White Paper developed for the Kansas Water Resources Institute and presentation at the 2007 Water and Future of Kansas Conference. May 2007.
26. *Kansas Farm Management Association: 2006 Enterprise Summaries*.
Online reference information available at: <http://www.agmanager.info/farmmgmt/income/enterprise/2006/default.asp>
27. *KSU-Streambank Stabilization Decision-Making Tools*.
Online reference information available at:
<http://www.agmanager.info/policy/water/KSU-VegetativeBuffer.xls>
<http://www.agmanager.info/policy/water/KSU-StreambankStabilization.xls>
28. Chang, Wen-Huei, D.B. Propst, D.J. Stynes, and R.S. Jackson, 2003. *Recreation Visitor Spending Profiles and Economic Benefit to Corps of Engineers Projects*. US Army Corps of Engineers Environmental Laboratory, Publication ERDC/EL TR-03-21.
29. Franco, Sammy, 2008. *Army Corps of Engineers Operations and Maintenance Business Information Link (OMBIL)* visitation data via personal communication, Engineer Development Research Center.
30. Gaunt, Philip M., 2001. *Water Recreation Needs Assessment Report to the Kansas Water Office*, Wichita State University (2001).
31. Kansas Water Office, 2008, *John Redmond Lake Reservoir Fact Sheet*.
Online reference information available at:
http://www.kwo.org/ReservoirInformation/ReservoirFactSheets/John_Redmond_Lake.pdf
32. Loomis, John B. and Richard G. Walsh, 1997. *Recreation Economic Decisions: Comparing Benefits and Costs*, Second Edition. Venture Publishing, Inc.
33. Rosenberger, R.S. and J.B. Loomis, 2001. *Benefit Transfer of Outdoor Recreation Use Values*, USDA Forest Service.

34. Stynes, Daniel, 1996, *Recreation and Tourism Spending and Economic Impact*.
Online reference information available at: <http://www.msu.edu/user/stynes/mirec/index.htm>
35. Smith, C.M, and J.C. Leatherman, 2008. *Economic Contributions of Recreation at John Redmond Lake*.
36. *1992 Land Cover Class Definitions*. Online reference information available at:
<http://www.epa.gov/mrlc/definitions.html#1992>
37. *2001 Land Cover Class Definitions*. Online reference information available at:
<http://www.epa.gov/mrlc/definitions.html#2001>

Brand names appearing in this publication are for product identification purposes only. No endorsement is intended, nor is criticism implied of similar products not mentioned.

Publications from Kansas State University are available on the World Wide Web at: www.oznet.ksu.edu

Contents of this publication may be freely reproduced for educational purposes. All other rights reserved. In each case, credit A.P. Nejadhashemi, et. al, *Upper and Lower Cottonwood and Neosho Headwaters Watersheds Assessment: Preliminary Report*, Kansas State University, February 2009.

Kansas State University Agricultural Experiment Station and Cooperative Extension Service

EP137

February 2009

K-State Research and Extension is an equal opportunity provider and employer. Issued in furtherance of Cooperative Extension Work, Acts of May 8 and June 30, 1914, as amended. Kansas State University, County Extension Councils, Extension Districts, and United States Department of Agriculture Cooperating, Fred A. Cholick, Director.