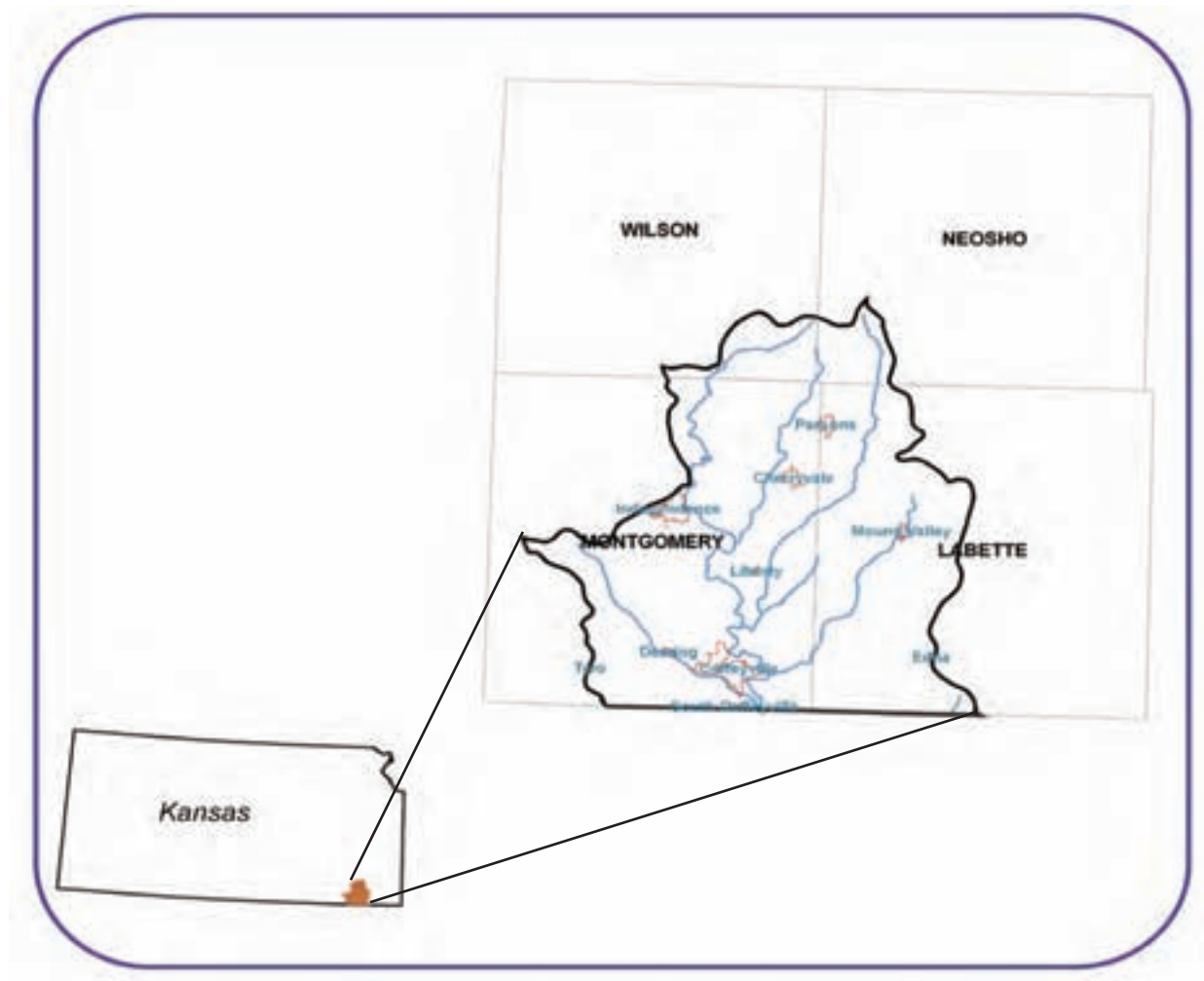


Oologah Watershed Assessment: Preliminary Report



2009

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1.0 Oologah Watershed Assessment

1.1 Watershed Summary

The Oologah Watershed is located in southeastern Kansas and drains areas of Neosho, Labette, Wilson and Montgomery counties. The primary waterway is the Verdigris River, which supplies water to Lake Oologah in Oklahoma. A smaller, but important waterway is Big Hill Creek, which impounds Big Hill Lake, a public drinking water source. Big Hill Lake covers 1,240 acres of water. The Middle Verdigris watershed has been issued a Category I designation by the Kansas Department of Health and Environment (KDHE) indicating that the watershed is in need of restoration and protection to sustain water quality. It is ranked 26th in priority out of 92 watersheds in the state for restoration and protection.

Grassland in the Kansas part of the Oologah Watershed covers 11 percent of land area. The grazing density is considered average in the lower third of the watershed and high in the upper two thirds (32-58 animal units/sq. mile) as compared to the entire Verdigris Basin. Cropland covers 70 percent of the land area. Woodland, which is part of the cross-timbers area of Kansas, covers 11 percent of the watershed. Water and urban areas constitute the remaining 8 percent of land cover. The watershed's population density is average in the lower two thirds and low in the upper third of the watershed when compared to densities across the Verdigris Basin (9-26 persons/sq. mile)¹.

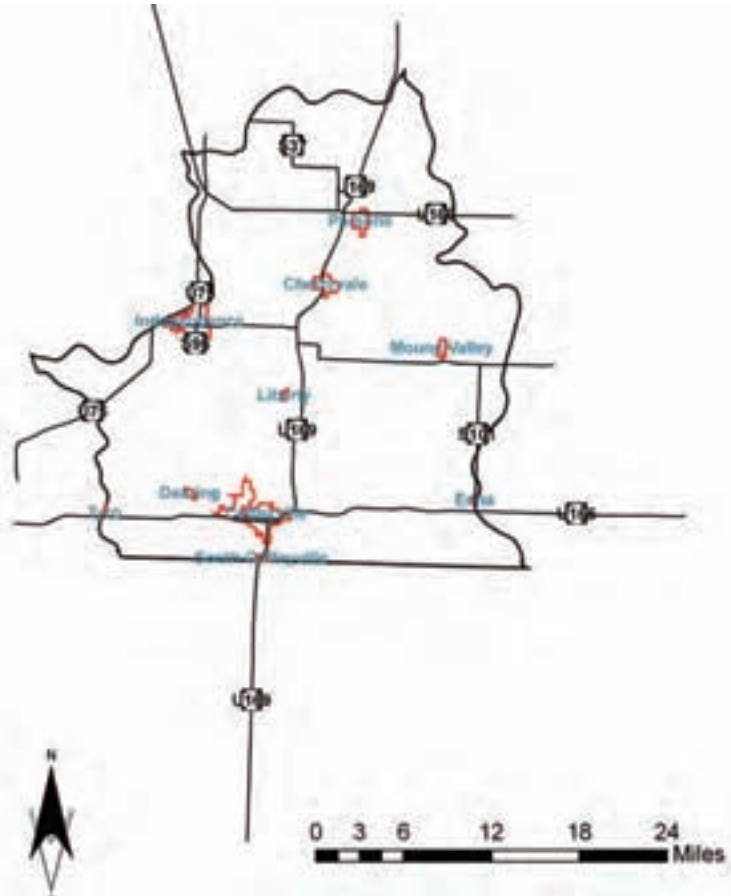


Figure 1. Major roads and cities – Oologah Watershed

1.2 Overview of Water Quality Issues and Potential Pollution Sources

When river segments or lakes that are monitored by 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 (FCB) is present in the digestive tract of all warm blooded animals including humans and animals (domestic and wild). FCB detection in water is a sign that the water has become contaminated with waste. While FCB is not itself harmful to humans, its presence indicates that disease causing organisms, or pathogens, may also be present. A few of these are Giardia, Hepatitis, and cryptosporidium. FCB is listed as a TMDL in the Verdigris River and Big Hill Creek. Potential sources of fecal coliform bacteria include failing septic systems, runoff from livestock production areas, close proximity of animals in riparian areas, and manure application to land if it is applied before a rainfall event or on frozen ground. TMDLs for fecal coliform bacteria have an upper limit of 200 cfu (colony forming units)/100ml of water for primary contact recreation, such as swimming, and an upper limit of 2,000 cfu/100ml of water for secondary, non-contact recreation, such as boating and fishing.

Low dissolved oxygen is an impairment in Big Hill Creek, Onion Creek, Pumpkin Creek and Montgomery County State Fishing Lake. This has resulted in TMDLs aimed at increasing dissolved oxygen concentrations

to provide full support of aquatic life. 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.

Eutrophication is a primary pollutant for the lakes in the watershed. Excess nutrient loading from the watershed creates conditions favorable for algae blooms and aquatic plant growth resulting in low dissolved oxygen rates and an 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.

The Verdigris River has a TMDL for Biology and Montgomery County State Fishing Lake has a TMDL for pH².

2.0 Climate Mapping System

2.1 Precipitation Map⁴



Figure 2. Relief Maps- Oologah Watershed³

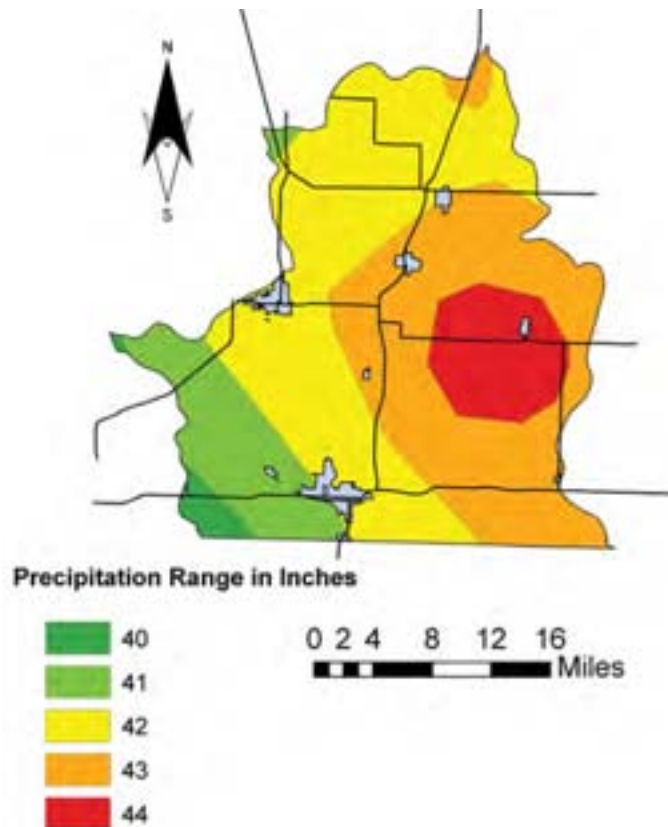


Figure 3. 30-year average annual precipitation in inches, 1971 – 2000.

2.2 30-Year Average Daily Maximum Temperature Map⁵

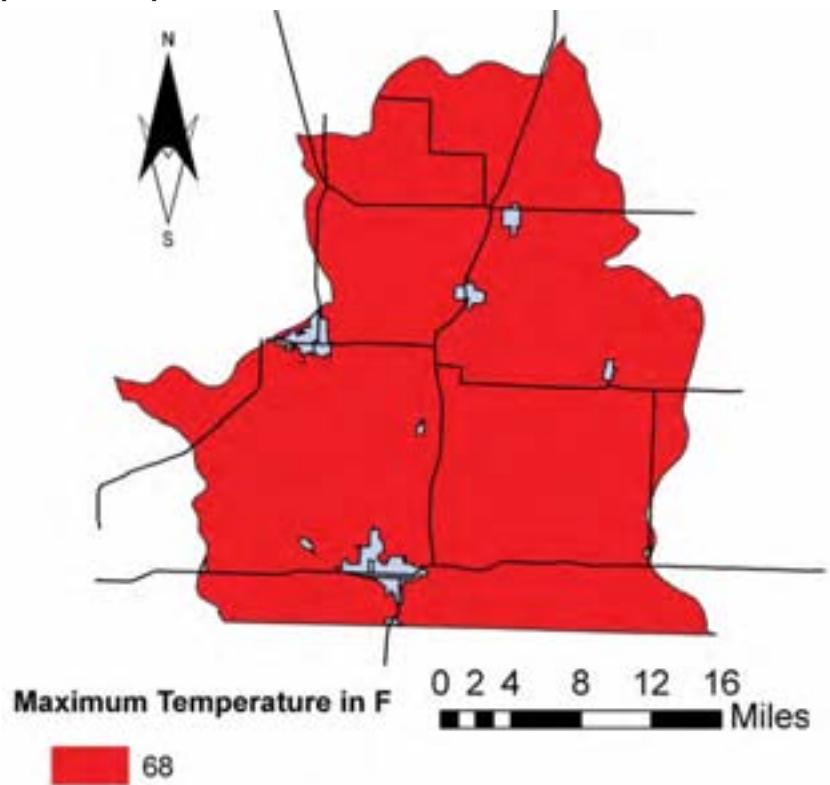


Figure 4. 30-year average daily maximum temperature in degrees Fahrenheit, 1971 – 2000

2.3 30-Year Average Daily Minimum Temperature Map⁶

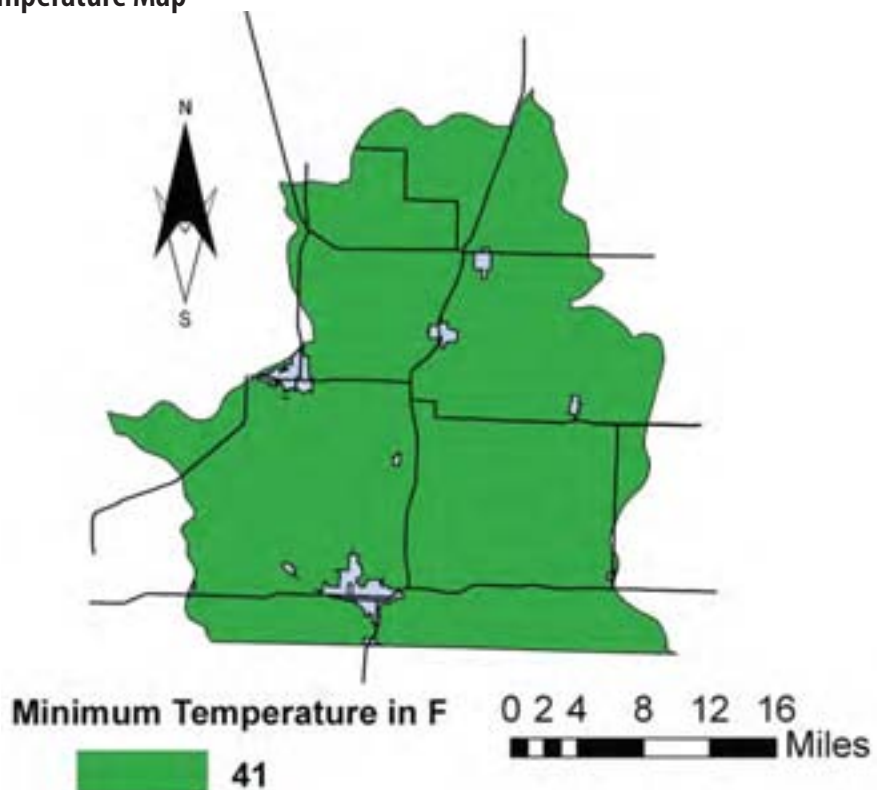


Figure 5. 30-year average daily minimum temperature in degrees Fahrenheit, 1971 – 2000

3.0 Land Use/ Land Cover

3.1 Land Use (GIRAS 1980s)

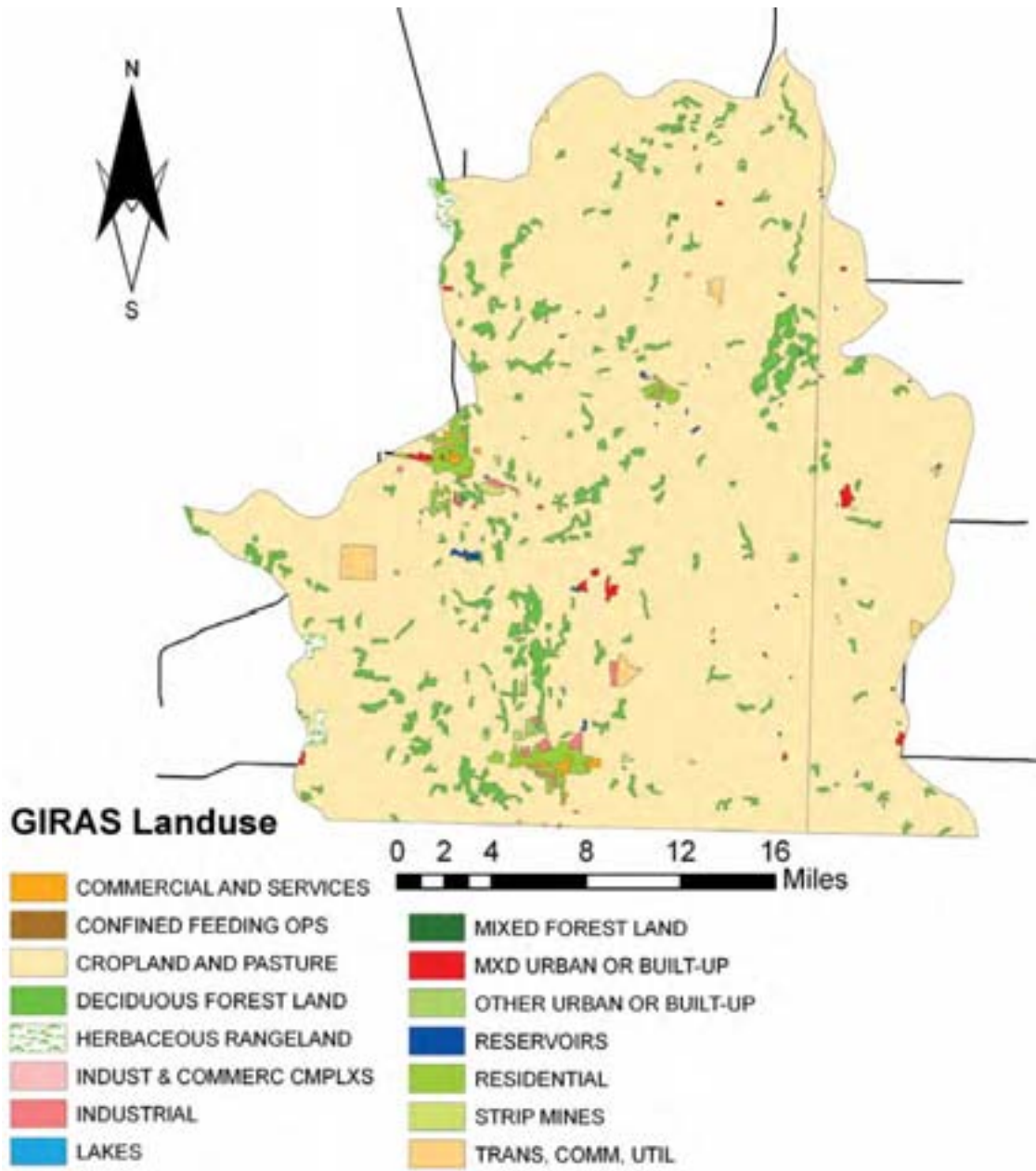


Figure 6. GIRAS 1980s land use classification.

3.2 Land Use (NLCD 1992)⁸

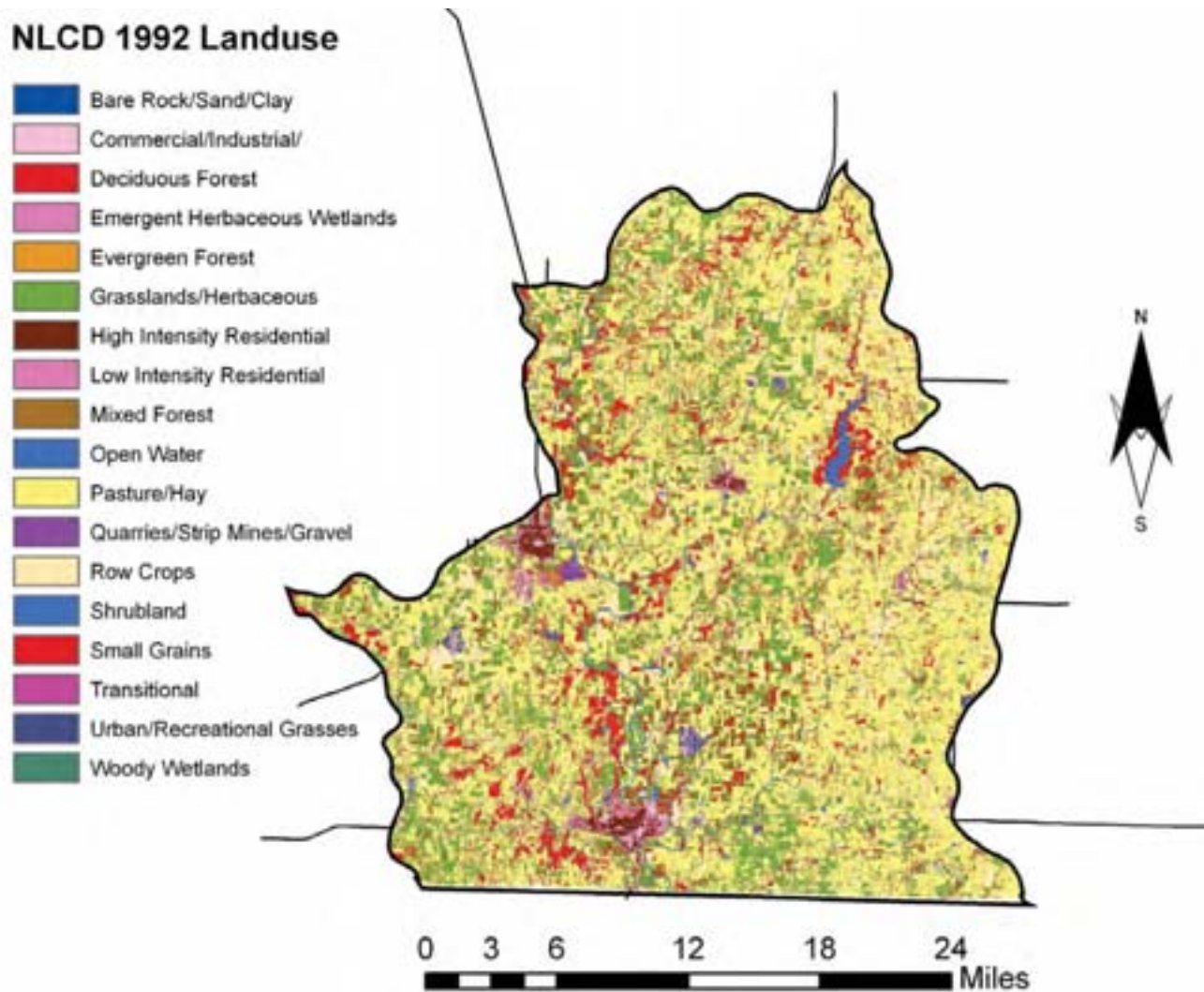


Figure 7. NLCD 1992 land use classification.

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.
- 50. Shrubland** – Areas characterized by natural or semi-natural woody vegetation with aerial stems, generally less than 6 meters tall, with individuals or clumps not touching to interlocking. Both evergreen and deciduous species of true shrubs, young trees, and trees or shrubs that are small or stunted because of environmental conditions are included.
- 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.
- 80. Planted/Cultivated** – Areas characterized by herbaceous vegetation that has been planted or is intensively managed for the production of food, feed, or fiber; or is maintained in developed settings for specific purposes. Herbaceous vegetation accounts for 75-100 percent of the cover.
- 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

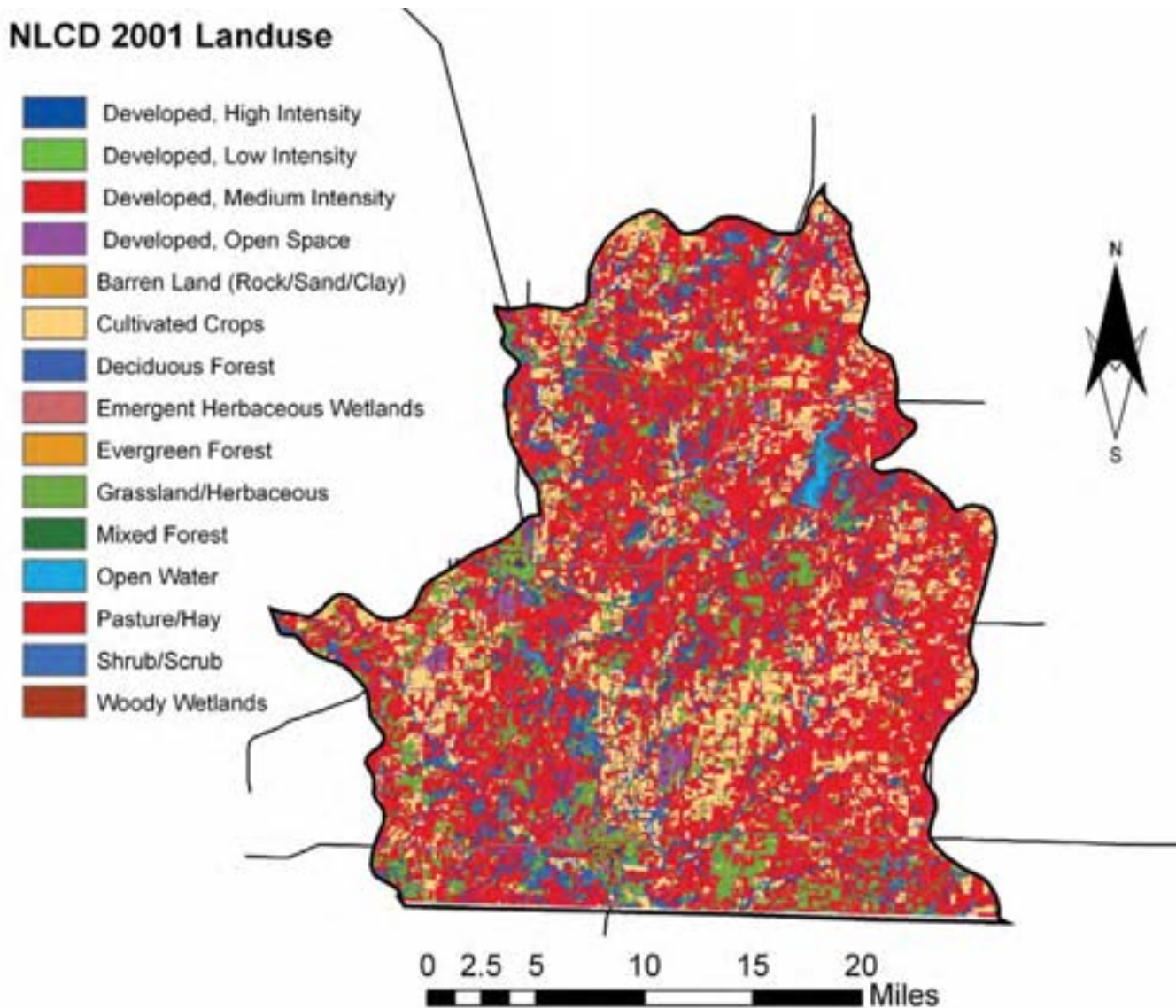


Figure 8. NLCD 2001 land use classification.

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.
- 60. Non-Natural Woody** – Areas dominated by non-natural woody vegetation; non-natural woody vegetative canopy accounts for 25-100 percent of the cover. The non-natural woody classification is subject to the availability of sufficient ancillary data to differentiate non-natural woody vegetation from natural woody vegetation.
- 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	415437		415437	445	23132	1808	10984	750	0	452556
NLCD 1992	86124	203899	290023	612	40096	84229	8902	20504	4885	449251
NLCD 2001	78950	233723	312673	465	47276	48551	33450	7143	152	449710

4.0 River Network⁹

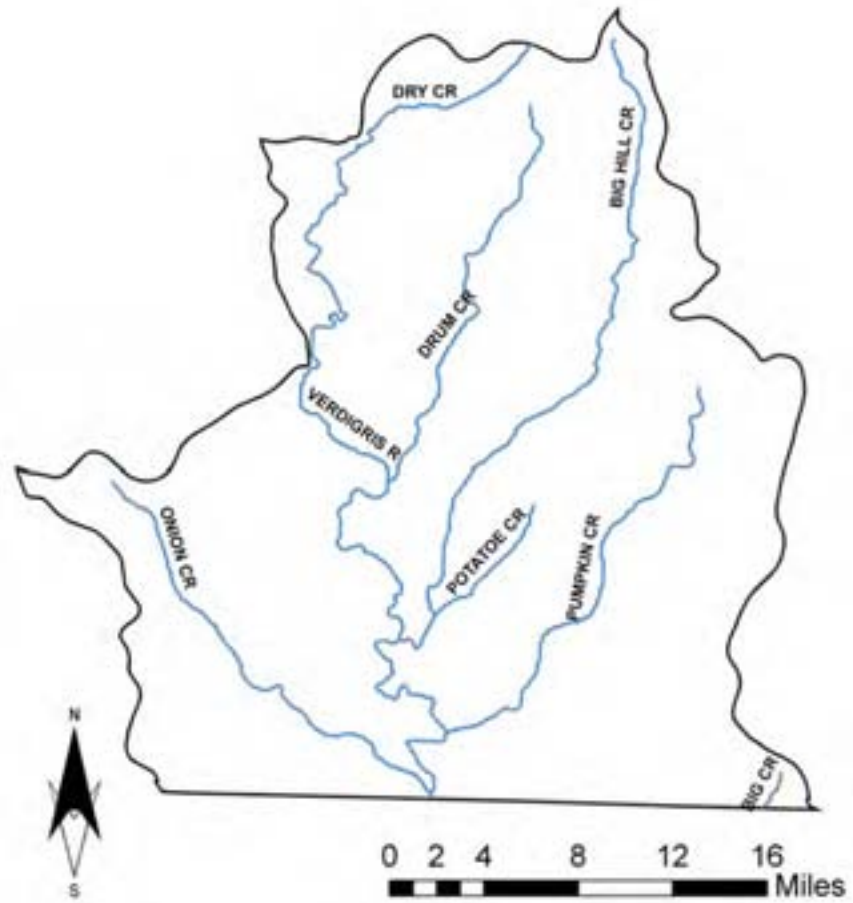


Figure 9. River network –Oologah Watershed.

5.0 Hydrologic Soil Groups¹⁰

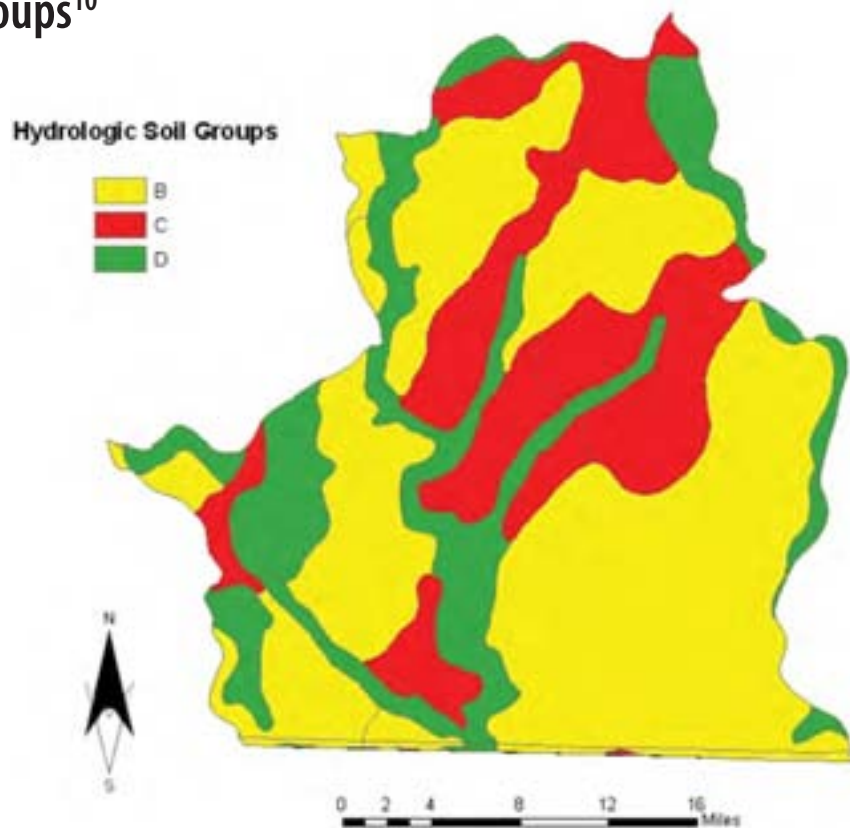


Figure 10. Hydrologic Soil Groups – STATSGO Database – Oologah Watershed.

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.

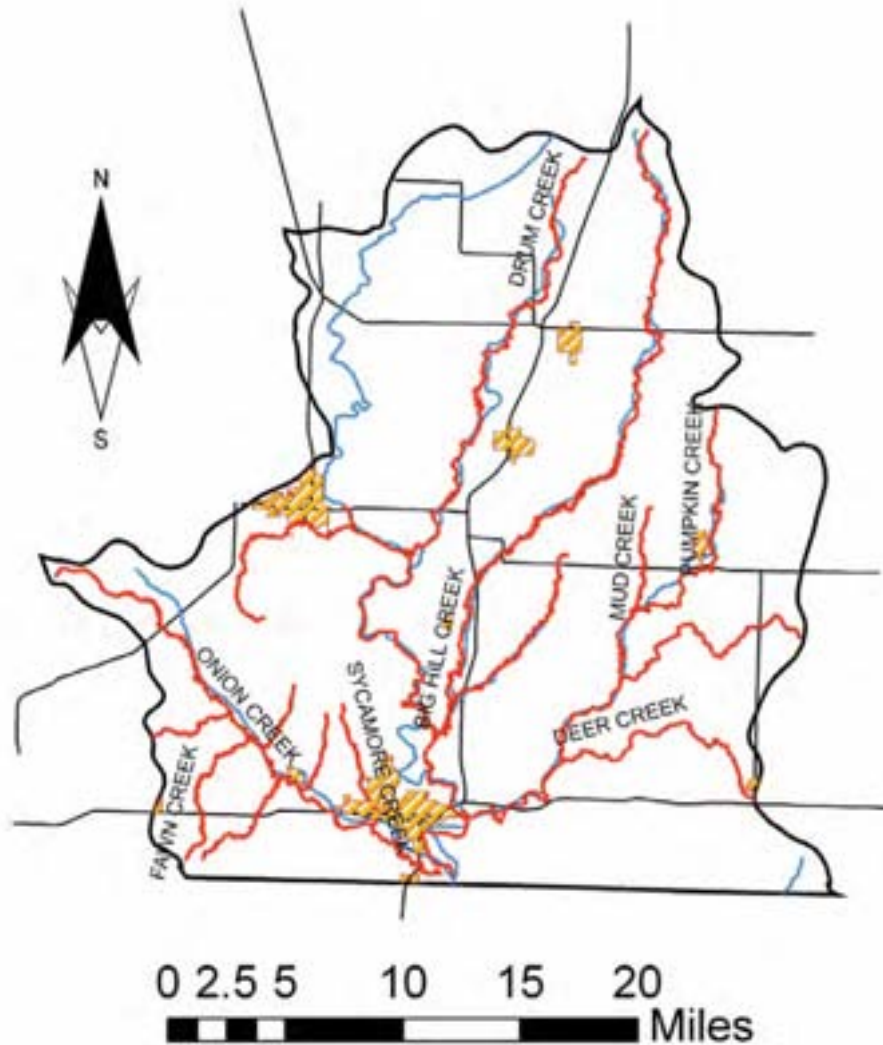


Figure 11. Impaired Waterbodies based on The 303d List – Oologah Watershed.

Table 2. The 303d List of Impaired Waterbodies

State	Waterbody Name	State Impairment	Epa Impairment
KS	Chetopa Creek	Fecal Coliform, Low DO	Pathogens, Organic Enrichment/low DO
KS	Pumpkin Creek	Low Dissolved Oxygen	Organic Enrichment/low DO
KS	Potato Creek	Low Dissolved Oxygen	Organic Enrichment/low DO
KS	Big Hill Creek	Fecal Coliform, Low Dissolved Oxygen	Pathogens, Organic Enrichment/low DO
KS	Verdigris River	Fecal Coliform	Pathogens
KS	Verdigris River	Nutrients Oxygen Demand	Nutrients
KS	Drum Creek	Fecal Coliform, NH3	Pathogens, Unionized Ammonia
KS	Onion Creek	Low Dissolved Oxygen	Organic Enrichment/low DO
KS	Biscuit Creek	Low Dissolved Oxygen	Organic Enrichment/low DO
KS	Spring Creek	Low Dissolved Oxygen	Organic Enrichment/low DO
KS	Fawn Creek	Low Dissolved Oxygen	Organic Enrichment/low DO
KS	Dead Man Creek	Low Dissolved Oxygen	Organic Enrichment/low DO
KS	Mud Creek	Low Dissolved Oxygen	Organic Enrichment/low DO
KS	Deer Creek	Low Dissolved Oxygen	Organic Enrichment/low DO
KS	Verdigris Creek	Fecal Coliform, NH3	Pathogens, Unionized Ammonia
KS	Richland Creek	Low Dissolved Oxygen	Organic Enrichment/low DO
KS	Sycamore Creek	Low Dissolved Oxygen	Organic Enrichment/low DO
KS	Bluff Run	Low Dissolved Oxygen	Organic Enrichment/low DO
KS	California Creek	Pesticides	Pesticides
KS	Cherryvale City Lake	Eutrophication	Organic Enrichment/low DO
KS	Dog Creek	Claremore & Nutrients	Nutrients
KS	Fourmile Creek (Oologah)	Organic Enrichment/low DO	Organic Enrichment/low DO
KS	Lightning Creek	Nutrients, Siltation	Nutrients, Sedimentation/siltation
KS	Little Labette Creek	Low Dissolved Oxygen	Organic Enrichment/low DO
KS	Oologah Lake	Pesticides, Suspended Solids, Siltation	Pesticides, Sedimentation, Siltation
KS	Pawpaw Creek	Unknown Toxicity, Metals, Suspended Solids, Siltation	Unknown Toxicity, Metals, Sediment/siltation
KS	Pryor Creek, Upper	Metals, Suspended Solids, Ph, Siltation	Metals, Sediment/siltation, Ph
KS	Rock Creek	Fecal Coliform	Pathogens
KS	Verdigris River	Pesticides, Siltation	Pesticides, Sedimentation/siltation

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.

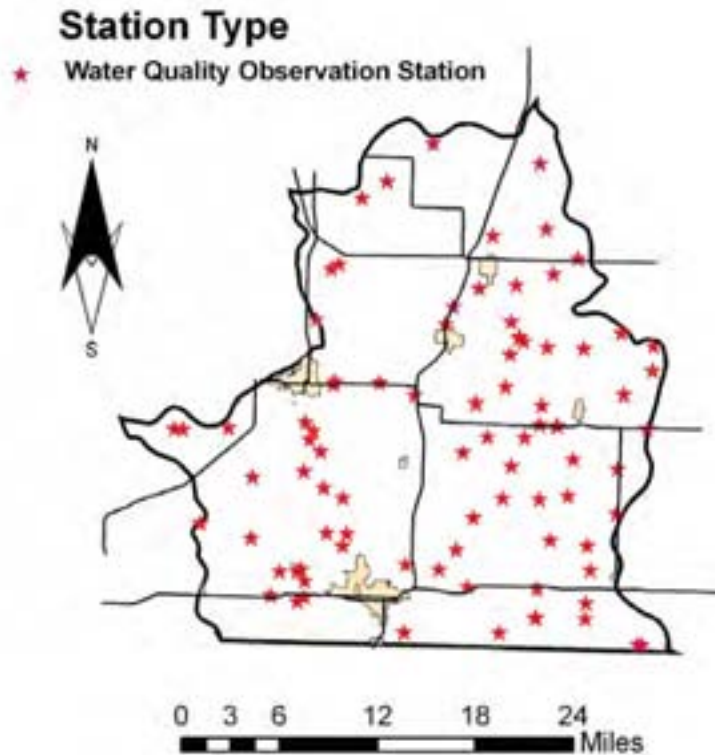


Figure 12. Lakes and Streams Water Quality Observation Stations – Oologah Watershed.

Table 3. Water Quality Observation Station

State	Agency	Station ID	Station Location
KS	USGS	07170500	Verdigris R At Independence, Ks
KS	USGS	07170700	Big Hill C Nr Cherryvale, Ks
KS	KDHE	000105	Verdigris River Near Sycamore
KS	KDHE	000215	Verdigris R. Near Coffeyville.
KS	USGS	07170600	Cherry C Nr Cherryvale, Ks
KS	USGS	07170800	Mud C Nr Mound Valley, Ks
KS	USGS	07170990	Verdigris R At Coffeyville, Ks
KS	USGS	365959095194301	35S 19E 16AC 01
KS	USGS	365959095195901	35S 19E 16BD 01
KS	USGS	370026095291301	35S 17E 12DD 01
KS	USGS	370115095265101	35S 18E 04CCC 01
KS	USGS	370118095233101	35S 18E 01CC 01
KS	USGS	370118095264701	35S 18E 04CC 01
KS	USGS	370149095424101	35S 15E 01ADD 01
KS	USGS	370203095421301	35S 16E 06BA 01
KS	USGS	370206095442801	35S 15E 02BA 01
KS	USGS	370208095232900	Edna City Lake, KS
KS	USGS	370250095264601	34S 18E 33BB 01
KS	USGS	370251095312401	34S 17E 34AA 01
KS	USGS	370255095421301	34S 16E 31BA 01
KS	USGS	370324095424601	34S 15E 25DA 01

State	Agency	Station ID	Station Location
KS	USGS	370324095435401	34S 15E 26DA 01
KS	USGS	370334095422901	34S 16E 30BC 01
KS	USGS	370344095331901	34S 17E 28BB 01
KS	USGS	370355095231501	34S 18E 24CD 01
KS	USGS	370358095353201	34S 17E 19CD 01
KS	USGS	370449095321301	34S 17E 15CC 01
KS	USGS	370452095394701	34S 16E 16DC 01
KS	USGS	370509095455301	34S 15E 15CB 01
KS	USGS	370513095233101	34S 18E 13BC 01
KS	USGS	370527095255701	34S 18E 16AA 01
KS	USGS	370531095393101	34S 16E 16AA 01
KS	USGS	370532095405201	34S 16E 17AB 01
KS	USGS	370551095491701	34S 14E 12DD 01
KS	USGS	370634095310801	34S 17E 02CC 01
KS	USGS	370658095213601	34S 19E 06AD 01
KS	USGS	370726095395101	33S 16E 33DCC 01
KS	USGS	370738095264601	33S 18E 33CB 01
KS	USGS	370738095291301	33S 17E 36DA 01
KS	USGS	370751095245201	33S 18E 34AD 01
KS	USGS	370756095410801	33S 16E 32BD 01
KS	USGS	370825095455301	33S 15E 27CC 01
KS	USGS	370848095422901	33S 16E 30BC 01
KS	USGS	370922095213601	33S 19E 19DA 01
KS	USGS	370923095284101	33S 18E 19CA 01
KS	USGS	370949095243601	33S 18E 23BB 01
KS	USGS	370954095412401	33S 16E 20BB 01
KS	USGS	371003095315701	33S 17E 15CD 01
KS	USGS	371030095420901	33S 16E 18BDD 01
KS	USGS	371052095503801	33S 14E 14AB 01
KS	USGS	371052095511101	33S 14E 14BB 01
KS	USGS	371055095275201	33S 18E 08CC 01
KS	USGS	371055095301901	33S 17E 11DD 01
KS	USGS	371059095415701	33S 16E 07DC 01
KS	USGS	371102095473501	33S 15E 08DC 01
KS	USGS	371126095422901	33S 16E 07BC 01
KS	USGS	371133095194201	33S 19E 09AB 01
KS	USGS	371134095254101	33S 18E 10BB 01
KS	USGS	371137095254501	33S 18E 10BBB 01
KS	USGS	371239095264601	32S 18E 33CC 01
KS	USGS	371240095310801	32S 17E 35CC 01
KS	USGS	371258095351401	32S 17E 31DBB 01
KS	USGS	371318095211901	32S 19E 32BB 01
KS	USGS	371332095291301	32S 17E 25DD 01
KS	USGS	371335095373701	32S 16E 26DC 01
KS	USGS	371336095403601	32S 16E 29DD 01
KS	USGS	371437095192501	32S 19E 21DA 01
KS	USGS	371517095285701	32S 18E 18CC 01

State	Agency	Station ID	Station Location
KS	USGS	371542095240301	32S 18E 14AC 01
KS	USGS	371543095263001	32S 18E 16BD 01
KS	USGS	371555095192501	32S 19E 16AA 01
KS	USGS	371609095282401	32S 18E 07DC 01
KS	USGS	371614095282200	Big Hill Reservoir, KS
KS	USGS	371635095213501	32S 19E 07AD 01
KS	USGS	371650095331901	32S 17E 09BB 01
KS	USGS	371653095415701	32S 16E 07AB 01
KS	USGS	371702095285701	32S 18E 06CC 01
KS	USGS	371847095310801	31S 17E 26CC 01
KS	USGS	371900095284001	31S 18E 30CA 01
KS	USGS	371939095261301	31S 18E 21DC 01
KS	USGS	371952095403201	31S 16E 20DAD 01
KS	USGS	372031095243501	31S 18E 14CC 01
KS	USGS	372137095301901	31S 17E 11DA 01
KS	USGS	372203095264601	31S 18E 09BB 01
KS	USGS	372327095390801	30S 16E 34CBB 01
KS	USGS	372423095372901	30S 16E 26 01
KS	USGS	372533095271701	30S 18E 20AB 01
KS	USGS	372629095342801	30S 17E 17BBA 01

6.3. USGS Gage Stations¹²

USGS inventory of surface water gaging station data including 7Q10 low and monthly mean stream flow.

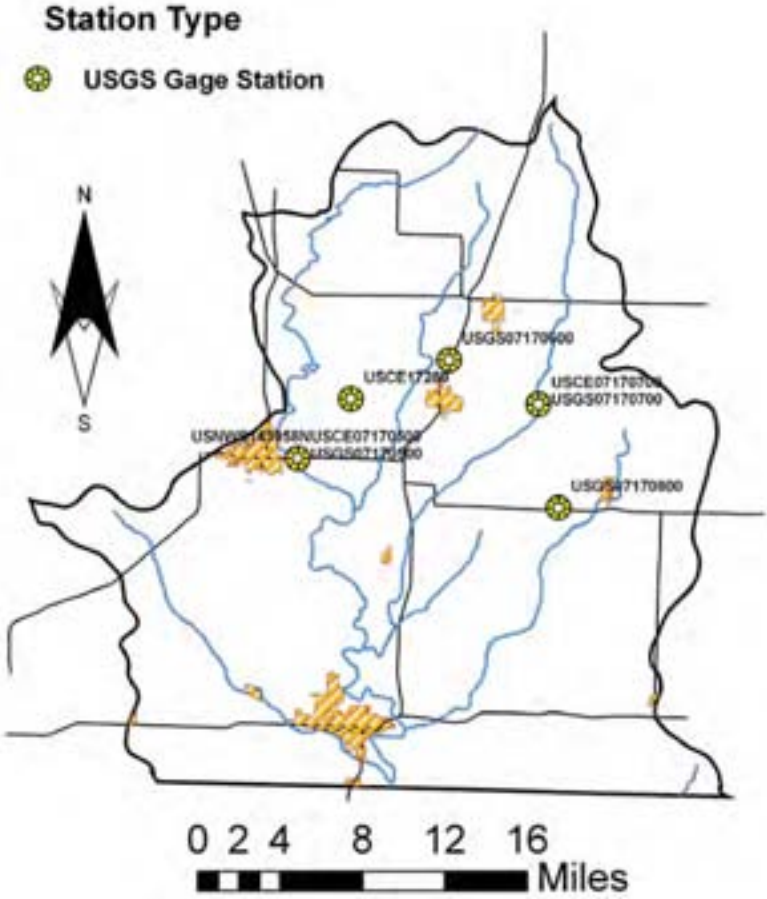


Figure 13. USGS Gage Stations – Oologah Watershed.

6.3. USGS Gage Stations¹²

USGS inventory of surface water gaging station data including 7Q10 low and monthly mean stream flow.

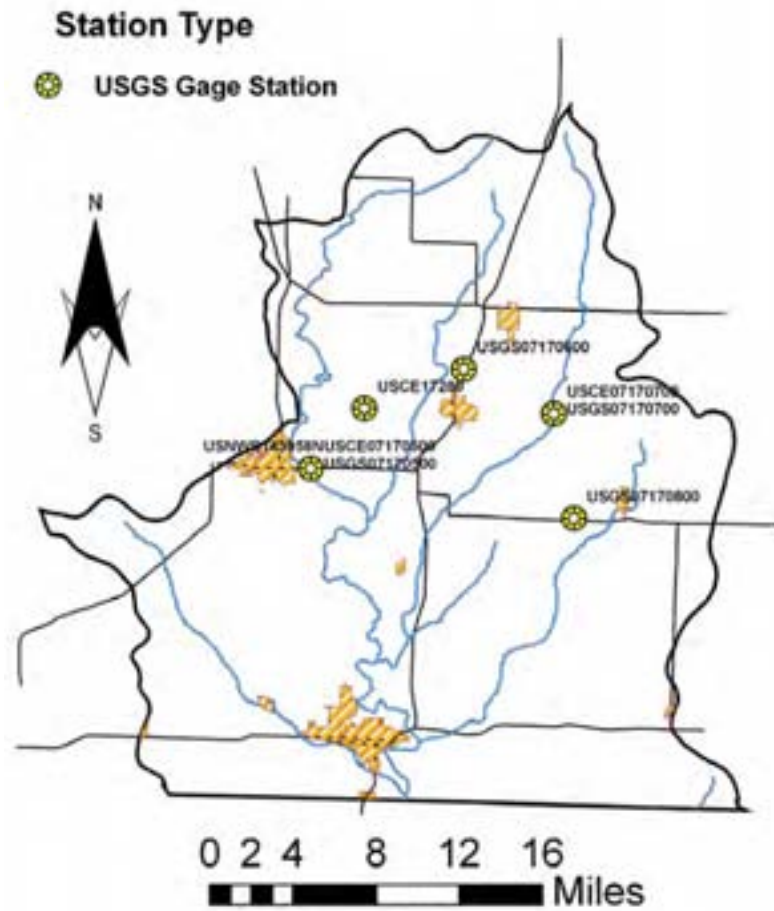


Figure 13. USGS Gage Stations – Oologah Watershed.

Table 4. USGS Gage Station¹²

Gage ID	Stream Flow (cfs)												
	Mean	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
USGS07170600	-	-	-	-	-	-	-	-	-	-	-	-	-
USGS07170700	27.26	21.28	15.18	40.01	35.57	38.39	49.00	35.21	2.59	20.09	21.07	29.82	17.82
USCE17289	-	-	-	-	-	-	-	-	-	-	-	-	-
USGS07170500	1724.13	851.36	932.98	1880.09	2992.36	3147.79	3403.10	1955.63	522.58	1200.57	1409.88	1499.15	798.06
USGS07170800	-	-	-	-	-	-	-	-	-	-	-	-	-
USGS07170990	-	-	-	-	-	-	-	-	-	-	-	-	-

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
07170600	Cherry Creek near Cherryvale	15.0	2530	4580	6230	8640	10700	12900	15300
07170700	Big Hill Creek near Cherryvale	37.0	3540	6770	9510	13600	17200	21200	25700
07170500	Verdigris River at Independence	2890	34400	60400	81000	111000	135000	162000	190000
07170800	Cedar Creek tributary near Hooser	0.56	147	331	485	705	883	1070	1270

Table 6. USGS gaging stations period of record for Oologah Watershed¹²

USGS ID	Drainage Area (mi ²)	Period of record	
		Begin	End
07170500	2892	07/31/1895	Present
07170700	37	09/30/1957	Present
07170990	3342	04/01/2002	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.

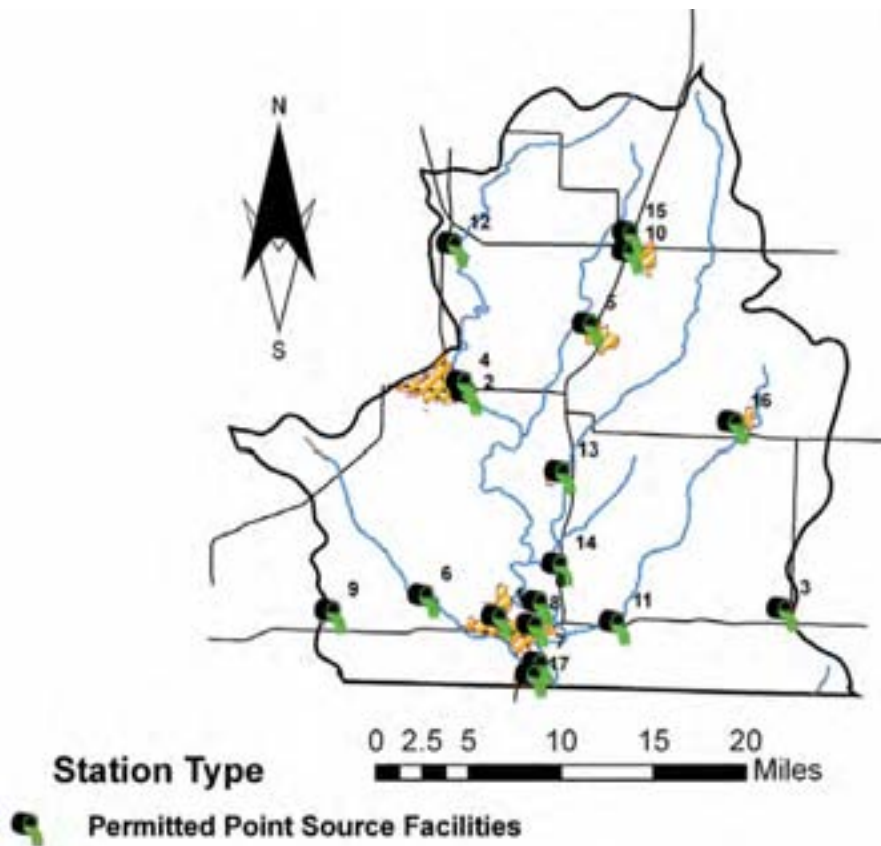


Figure 14. NPDES permit-holding facilities – Oologah Watershed.

Table 7. Permitted Point Source Facilities¹⁴

ID	NPDES	Facility Name	Ownership	Description	Industrial Classification	City	County	Flow Rate (million gallons/day)
0	KS0000248	Farmland-Coffeyville Refinery	Private	Petroleum Refining	Primary O	Coffeyville	Montgomery	0.00000
1	KS0000809	Sherwin Wms Chem, Coffeyville	Private	Inorganic Pigments	Primary O	Coffeyville	Montgomery	0.00000
2	KS0001210	Heartland Cement Company	Private	Cement, Hydraulic	ON Elg	Independence	Montgomery	0.00000
3	KS0024759	Edna, City of WWTP	Public	Sewerage Systems	Municipal	Edna	Labette	0.00000
4	KS0042625	Independence, Municipal WWTF	Public	Sewerage Systems	Municipal	Independence	Montgomery	1.80000
5	KS0045951	Cherryvale, City of STP	Public	Sewerage Systems	Municipal	Cherryvale	Montgomery	0.40000
6	KS0048062	Dearing, City of STP	Public	Sewerage Systems	Municipal	Dearing	Montgomery	0.00000
7	KS0050733	Coffeyville, City of WWTP	Public	Sewerage Systems	Municipal	Coffeyville	Montgomery	4.00000
8	KS0080039	Coffeyville ,City of PWPLI	Pub Pri	Electrical Services	Primary O	Coffeyville	Montgomery	0.00000
9	KS0081264	Tyro, City Of WWTP	Public	Sewerage Systems	Municipal	Tyro	Montgomery	0.01000
10	KS0082074	Midwest Minerals, Inc. Quarry 6	Private	Meat Packing Plants	ON Elg	Montgomery County	Montgomery	0.00000
11	KS0082171	Quarry No. 16-Midwest Minerals	Private	Crushed And Broken Limestone	ON Elg		Montgomery	0.00000
12	KS0086193	Montgomery Canty S.D. #5 TTP	Public	Sewerage Systems	Municipal	Independence	Montgomery	0.07000
13	KS0086223	Liberty	Pub Pri			Liberty	Montgomery	0.01000
14	KS0091171	Aptus Grndwtr Remediation Proj	Public	Water Supply	Not ON El	Coffeyville	Montgomery	0.00000
15	KS0093238	Nelson Quarry - Cherryvale Qua	Pub Pri			Cherryvale	Montgomery	0.00000
16	KS0116980	Mound Valley, City of STP	Public	Sewerage Systems	Municipal	Mound City	Linn	0.03000

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 Oologah watershed.

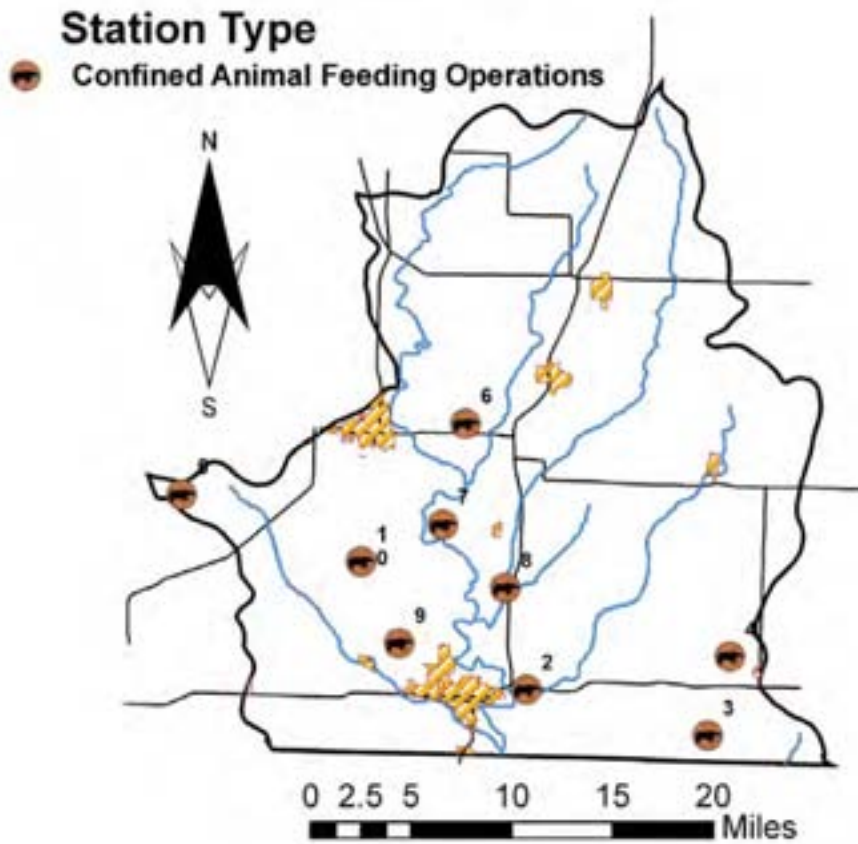


Figure 15. Confined Animal Feeding Operations facilities – Oologah Watershed.

Table 8. Confined Animal Feeding Operations¹⁵

ID	Permit No.	Total Head	FED AUS	KS AUS	Animal Type
0	A-VEMG-MA09	60	76	71	Dairy
1	A-VEMG-BA01	300	300	300	Beef
2	A-VEMG-MA06	25	35	35	Dairy
3	A-VELB-S001	700	200	220	Swine
4	A-VELB-M004	90	126	126	Dairy
5	A-VEMG-S038	2850	500	660	Swine
6	A-VEMG-B001	720	720	360	Beef
7	A-VEMG-S010	2910	864	939	Swine
8	A-VEMG-M002	200	280	280	Dairy
9	A-VEMG-M008	56	78	78	Dairy

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.

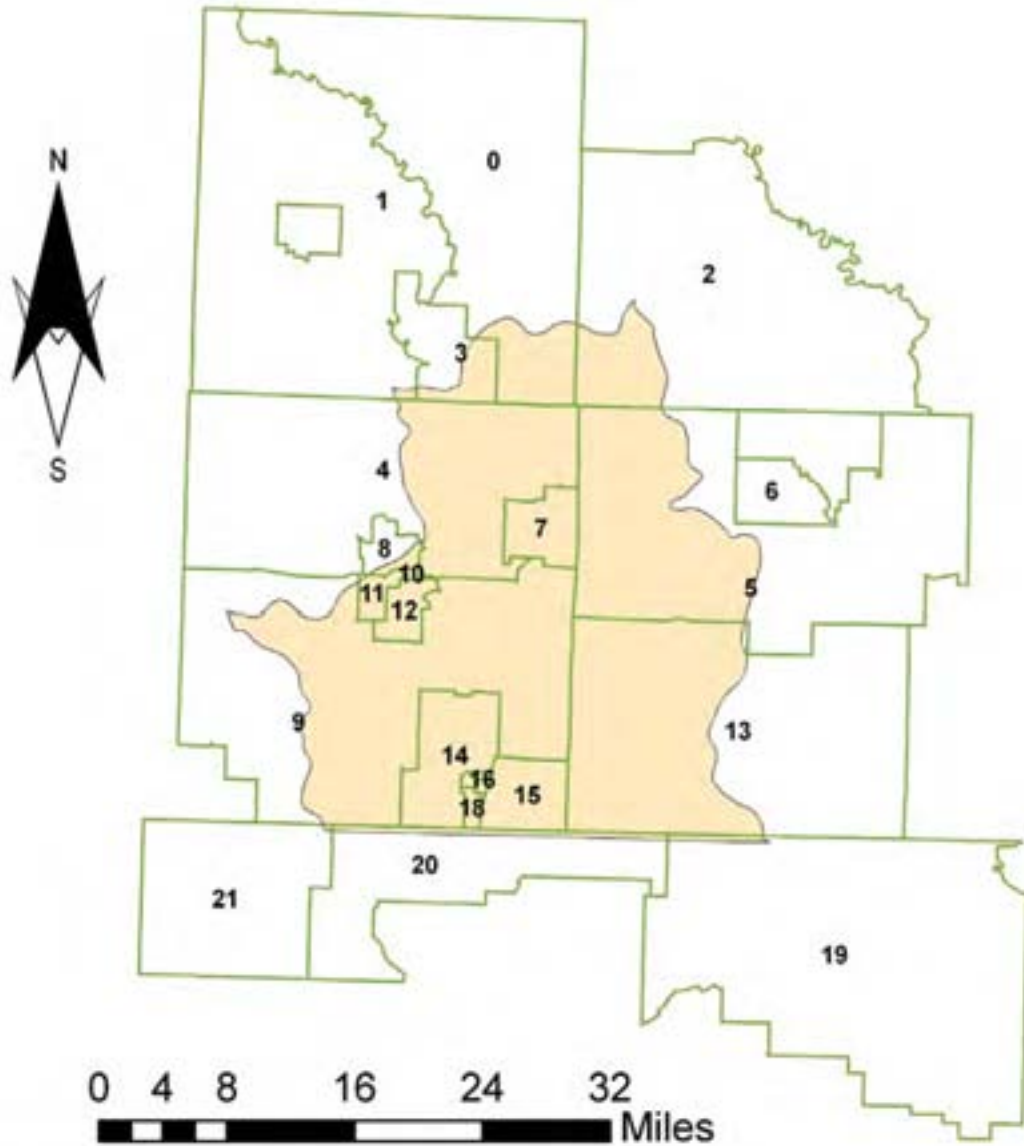


Figure 16. Population and Sewerage by Census – Oologah Watershed.

Table 9. 1990 Population and Sewerage by Census Tract¹⁶

ID	Tract	Population	House Units	Sewerage Public	Sewerage Septic	Sewerage Other
0	9786	3944	1876	1290	490	96
1	9791	2905	1176	462	669	45
2	9802	4574	1846	1179	594	73
3	9792	4045	1891	1611	260	20
4	9787	3129	1479	813	634	32
5	9793	2547	1191	839	330	22
6	9794	2208	1011	537	397	77
7	9803	2671	1160	567	552	41
8	9581	4271	1831	711	1099	21
9	0001	6191	2758	1437	1257	64
10	0004	3816	1706	769	848	89
11	0001	4589	1882	582	1244	56
12	0002	6705	2588	2237	329	22
13	0004	4444	705	690	0	15
14	0005	4583	1996	1988	8	0
15	9947	3654	1420	600	739	81
16	9936	4065	1688	724	897	67
17	9978	3317	1674	973	648	53
18	9952	3193	1475	1012	421	42

7.0. Agricultural Economy

7.1 Corn Cost-Return Budget¹⁷

Table 10. Cost-return projections for corn crops in the Oologah Watershed, 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 Nonirrigated 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	\$227.85
Patronage Refunds	\$266.75	0.01	0.66	\$673.05	0.02	1.27
Government Payments	\$12,131.78	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	\$14.63
GROSS INCOME	\$93,872.72	\$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	\$8,156.94	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	\$16,167.87	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	\$6,654.67	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	\$131,314.83	\$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 Oologah Watershed, 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 Nonirrigated Soybeans.²⁶

	2001-2005 Average			2006		
Number of Farms	71			49		
Crop Acres	478			442		
Acres Owned	113			101		
Acres Rented	362			342		
Yield / Acre	28			26		
Bushels	10,662			8,906		
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	\$6.65	\$149.07	\$65,495.20	\$7.35	\$148.18
EXPENSES:						
Labor Hired	\$2,364.92	\$0.22	\$4.97	\$3,016.89	\$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	1.80
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	\$932.69	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	\$8,059.39	0.88	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 B)) 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 Oologah Watershed, 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 Nonirrigated 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	\$138.15			\$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	\$398.25	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	\$810.26	0.04	1.42	\$1,349.38	0.08	2.58
OTHER INCOME	\$8,026.55	\$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	\$1.16
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 Oologah Watershed, 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 Nonirrigated 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			\$169.51		
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	\$34,232.69	\$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	\$8,957.68	\$0.63	\$38.71	\$8,141.10	\$0.82	\$39.52
Depreciation	\$4,067.83	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)	(\$6.96)
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 Oologah Watershed, 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 Nonirrigated 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	\$2,981.95	\$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	18.38	\$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	\$625.63	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	\$3,112.89	9.82	19.70
Herbicide / Insecticide	\$1,683.03	4.21	11.92	\$2,497.13	7.88	15.60
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	\$35,853.91	\$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 Oologah Watershed

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 Montgomery 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: \$80.75	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 \$83.39** per acre annually.

Based on the information you have provided, a vegetative buffer on the project area would **return \$83.39** annually.

Based on the information you have provided, cropland on the project area would **return \$44.41** per acre annually.

Based on the information you have provided, cropland on the project area would **return \$44.41** annually.

Take Home Message:

You would be **\$38.98** 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

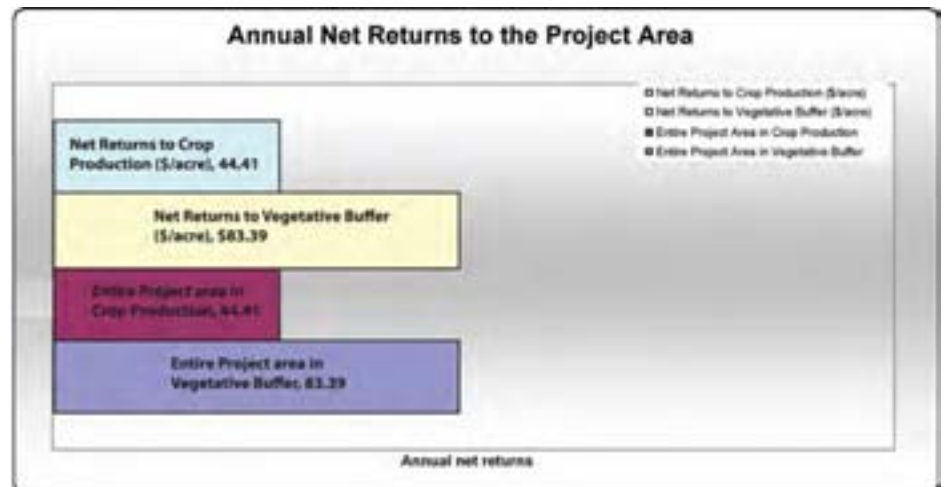
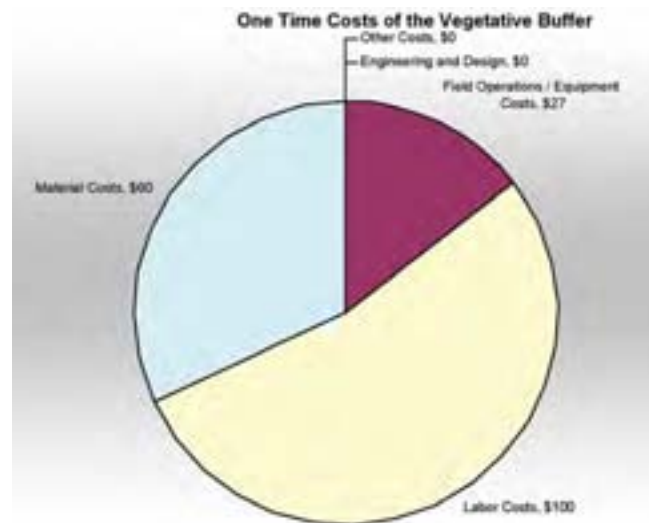
For more information regarding the economics of vegetative buffers, check out K-State Research and Extension publication MF-2536 "Using Conservation Buffers to Protect Water Quality and Enhance Agricultural Profitability." <http://www.oznet.ksu.edu/library/h20ql2/mf2536.pdf>

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	\$39.09	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	\$80.75

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	\$80.75	\$0.00
2	\$0.00	\$6.94	\$0.00	\$80.75	\$0.00
3	\$0.00	\$7.21	\$0.00	\$80.75	\$0.00
4	\$0.00	\$7.50	\$0.00	\$80.75	\$0.00
5	\$0.00	\$7.80	\$0.00	\$80.75	\$0.00
6	\$0.00	\$8.12	\$0.00	\$80.75	\$0.00
7	\$0.00	\$8.44	\$0.00	\$80.75	\$0.00
8	\$0.00	\$8.78	\$0.00	\$80.75	\$0.00
9	\$0.00	\$9.13	\$0.00	\$80.75	\$0.00
10	\$0.00	\$9.49	\$0.00	\$80.75	\$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	\$807.52	\$0.00
Present Value	\$187.28	\$60.87	\$268.55	\$623.55	\$0.00
Net Present Value	\$643.95				
Annualized Value	\$83.39				

NPV Table: Cropland Rent (per acre)	
Year	Rent
0	\$0.00
1	\$39.09
2	\$40.29
3	\$41.53
4	\$42.80
5	\$44.12
6	\$45.47
7	\$46.87
8	\$48.30
9	\$49.79
10	\$51.32
11	-
12	-
13	-
14	-
15	-
Sum totals	\$449.57
Present Value	\$342.95
Net Present Value	\$342.95
Annualized Value	\$44.41

Net Present Value Table: Vegetative Buffer (total project area)					
Year	One Time Costs	Annual Costs	One Time Payments	An-nual Pay-ments	Net Property Tax Impact
0	\$187.28	\$0.00	\$268.55	\$0.00	\$0.00
1	\$0.00	\$6.67	\$0.00	\$80.75	\$0.00
2	\$0.00	\$6.94	\$0.00	\$80.75	\$0.00
3	\$0.00	\$7.21	\$0.00	\$80.75	\$0.00
4	\$0.00	\$7.50	\$0.00	\$80.75	\$0.00
5	\$0.00	\$7.80	\$0.00	\$80.75	\$0.00
6	\$0.00	\$8.12	\$0.00	\$80.75	\$0.00
7	\$0.00	\$8.44	\$0.00	\$80.75	\$0.00
8	\$0.00	\$8.78	\$0.00	\$80.75	\$0.00
9	\$0.00	\$9.13	\$0.00	\$80.75	\$0.00
10	\$0.00	\$9.49	\$0.00	\$80.75	\$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	\$807.52	\$0.00
Present Value	\$187.28	\$60.87	\$268.55	\$623.55	\$0.00
Net Present Value	\$643.95				
Annualized Value	\$83.39				

NPV Table: Cropland Rental Rate (total project area)	
Year	Rent
0	\$0.00
1	\$39.09
2	\$40.29
3	\$41.53
4	\$42.80
5	\$44.12
6	\$45.47
7	\$46.87
8	\$48.30
9	\$49.79
10	\$51.32
11	-
12	-
13	-
14	-
15	-
Sum totals	\$449.57
Present Value	\$342.95
Net Present Value	\$342.95
Annualized Value	\$44.41

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 **\$1,850.22** per year **better off** by stabilizing this streambank versus doing nothing.

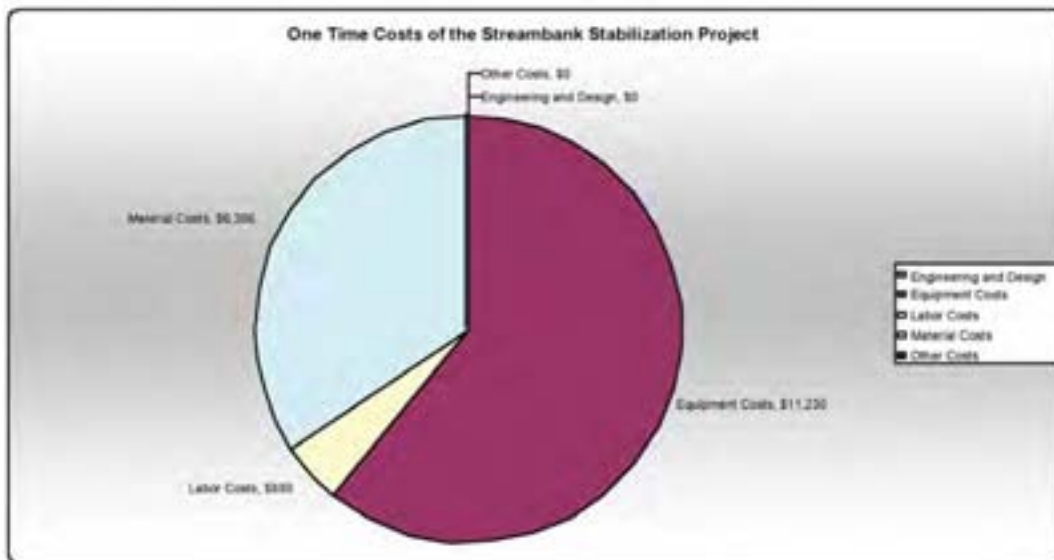
A streambank project would **return** **\$14,286.92** in total over the 10 year time period you have selected.

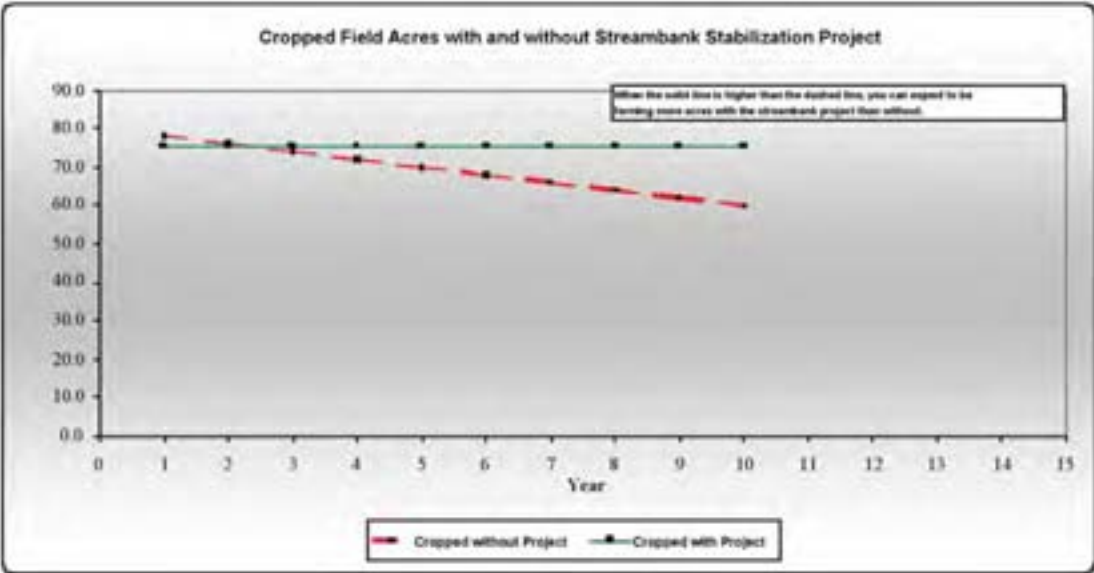
If you DO NOT consider the asset value of the land that is preserved by the streambank stabilization project, then the take-home message is:

You would be **(\$649.68)** per year **worse off** by stabilizing this streambank versus doing nothing.

A streambank project would **lose** **(\$5,016.69)** 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	\$1,028.00	per acre	
Annual Cropland Value Growth Rate	4.34%		
Cropland Rental Rate - not CCRP rental rate	\$39.09	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	@ \$1,028.00 per acre	\$20,560.00
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	@ \$1,572.18 per acre	\$31,443.54
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 Big Hill Lake^{28, 29, 30, 31, 32, 33, 34, 35}

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

Big Hill Lake is a 1,192 acre impoundment located in southeastern Kansas in the Verdigris River Basin. The watershed supplying the lake consists of 37 square miles in Neosho and Labette counties. Big Hill Lake was built in 1981 by the U.S. Army Corps of Engineers (COE) for flood control, water supply, recreation, and fish and wildlife.

This analysis estimated two types of regional recreation effects associated with Big Hill 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 174,075 visits to Big Hill Lake for a total of 1,290,608 visitor-hours from October 2006 to September 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 \$1.72 million (2007\$) in direct economic activity (sales) within the regional economy, \$0.79 million in all types of income associated with the production of economic activities, and 35 area full- and part-time jobs. After calculating the indirect economic impacts, it was estimated that visitor expenditures were closely associated with \$2.32 million (2007\$) in overall economic activity, \$1.09 million in total income, and 41 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 Big Hill Lake recreation, it was estimated that Big Hill Lake visitors receive up to \$3.23 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 Big Hill Lake has increased steadily from 1996-2007 (Figure 19). Among the 17 Army COE Lakes in Kansas, Big Hill Lake ranked 13th in number of visits and 14th 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.

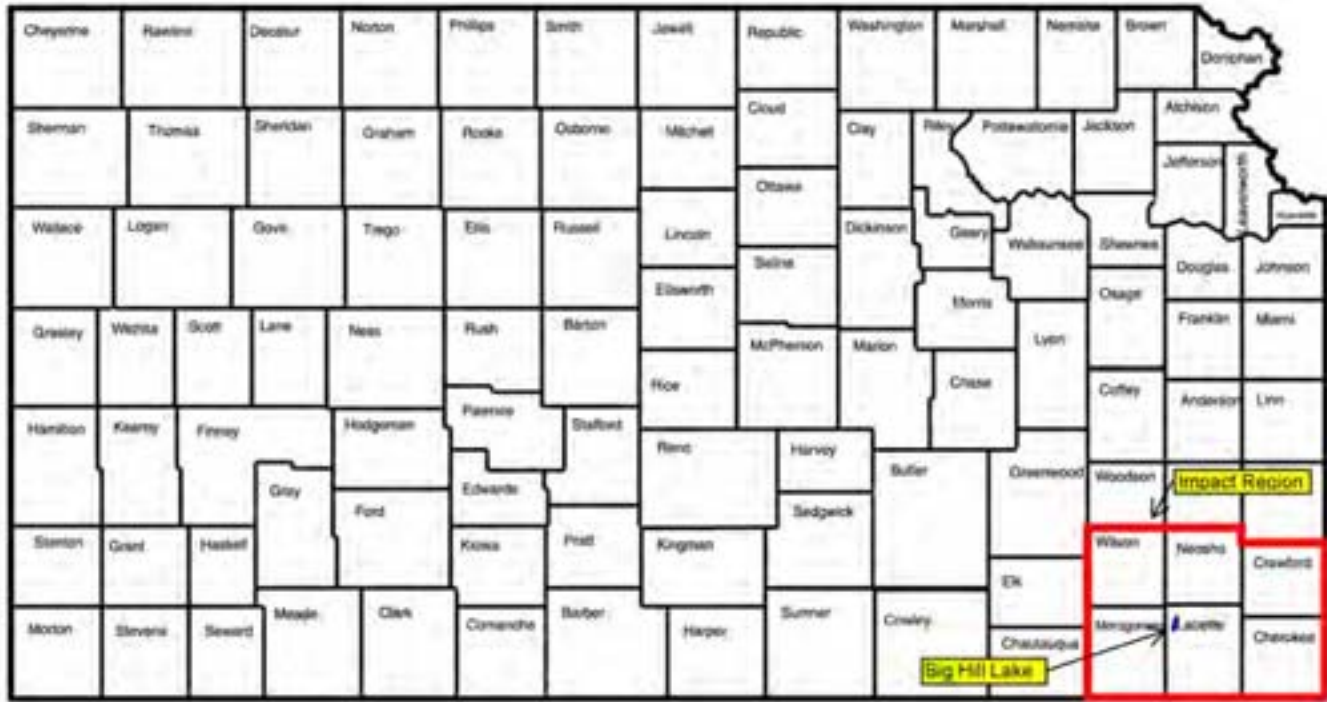


Figure 17. Big Hill Lake economic impact region

Table 20. Visitation and spending for visits made to Big Hill Lake, 2007

Visitation	Camper		Day User		Other Overnight		Total
	Boater	Nonboater	Boater	Nonboater	Boater	Nonboater	
Percent of Total	0.6%	3.6%	13.0%	80.0%	0.4%	2.4%	100.0%
2007 Big Hill visits	1,038	6,352	22,670	139,208	673	4,155	174,097
Spending	\$76,543	\$397,066	\$508,069	\$1,876,335	\$63,792	\$230,447	\$3,152,252

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	0.57
Camping fee	15.47	16.01	0.00	0.00	0.11	0.03	0.68
Restaurants, bars, etc.	8.00	9.18	2.66	3.32	14.14	15.84	3.82
Groceries and take out food	20.41	16.62	4.39	4.39	14.71	6.31	5.02
Gas & oil	12.62	8.71	6.96	2.75	15.36	7.39	3.74
Other auto expenses	0.97	1.51	1.70	0.31	6.09	0.00	0.55
Other boat expenses	4.97	0.00	2.13	0.00	12.19	0.00	0.35
Entertainment and recreation fees	2.34	2.91	0.97	0.52	4.35	1.66	0.72
Sporting goods and boat equipment	4.76	1.51	3.09	0.86	4.95	2.37	1.25
Other expenses	3.34	5.94	0.50	1.33	3.37	1.69	1.42
Total (within 30 miles)	\$73.71	\$62.51	\$22.41	\$13.48	\$94.74	\$55.46	\$18.11

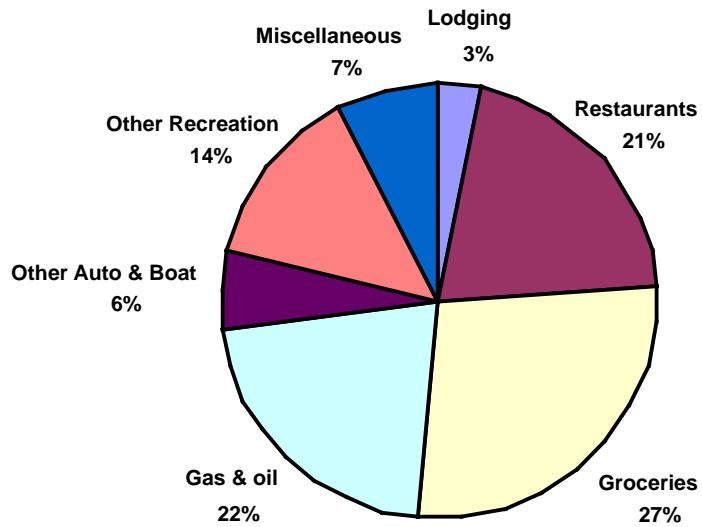


Figure 18. Trip spending by category

Table 22. Big Hill Lake total economic contributions

Impact Measure	Direct	Indirect	Total
Output	\$1,724,103	\$592,313	\$2,316,416
Total Value Added	\$786,549	\$306,923	\$1,093,472
Employment	35	6	41

Table 22. Big Hill Lake total economic contributions

Activity	Days Spent in Activity	Activity Value per Day (2007\$)	Total Value per Year
Fish	45,386	\$38.58	\$1,751,048
Swim	24,522	\$19.75	\$484,250
Camp	13,121	\$29.54	\$387,583
Boat	8,819	\$27.45	\$242,063
Picnic	5,055	\$30.42	\$153,759
Other	10,648	\$19.94	\$212,290
Total	107,551	-----	\$3,230,994

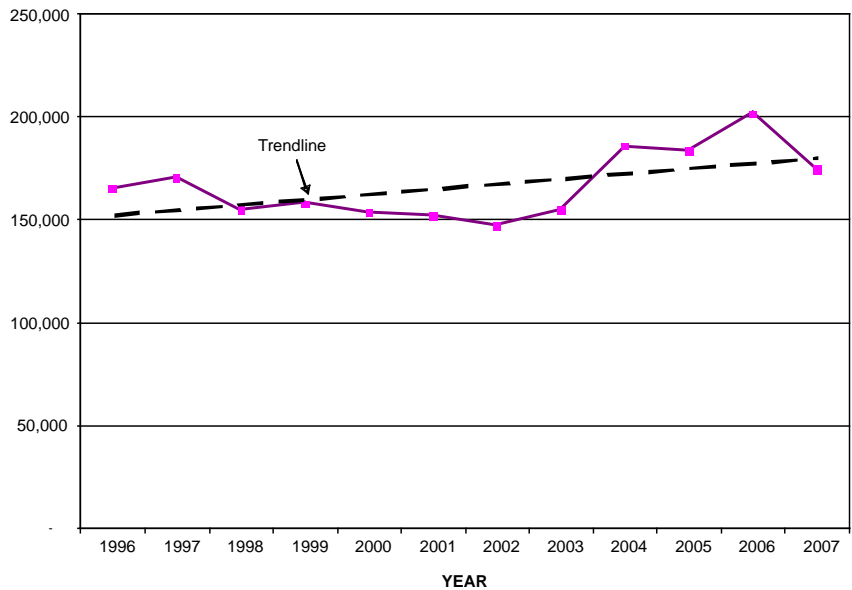


Figure 19. Trends in Big Hill Lake visitation

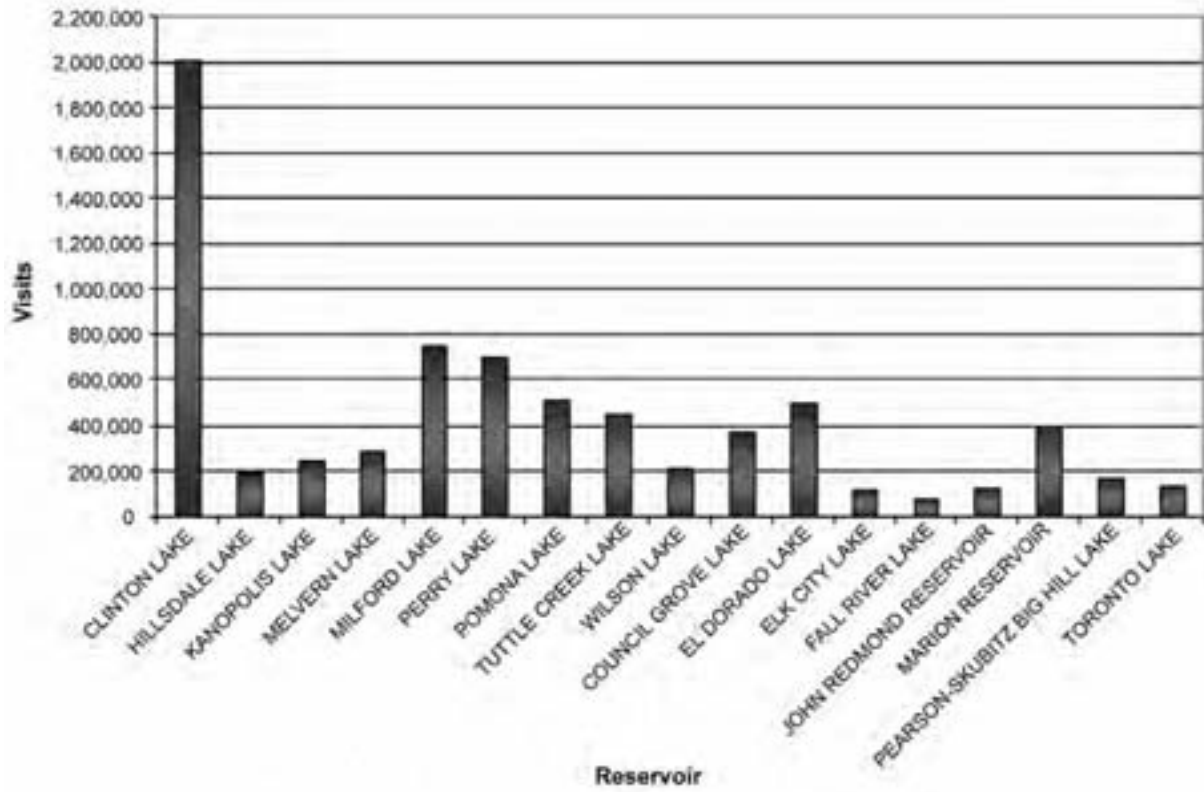


Figure 20. Visits to Kansas Reservoirs in 2007

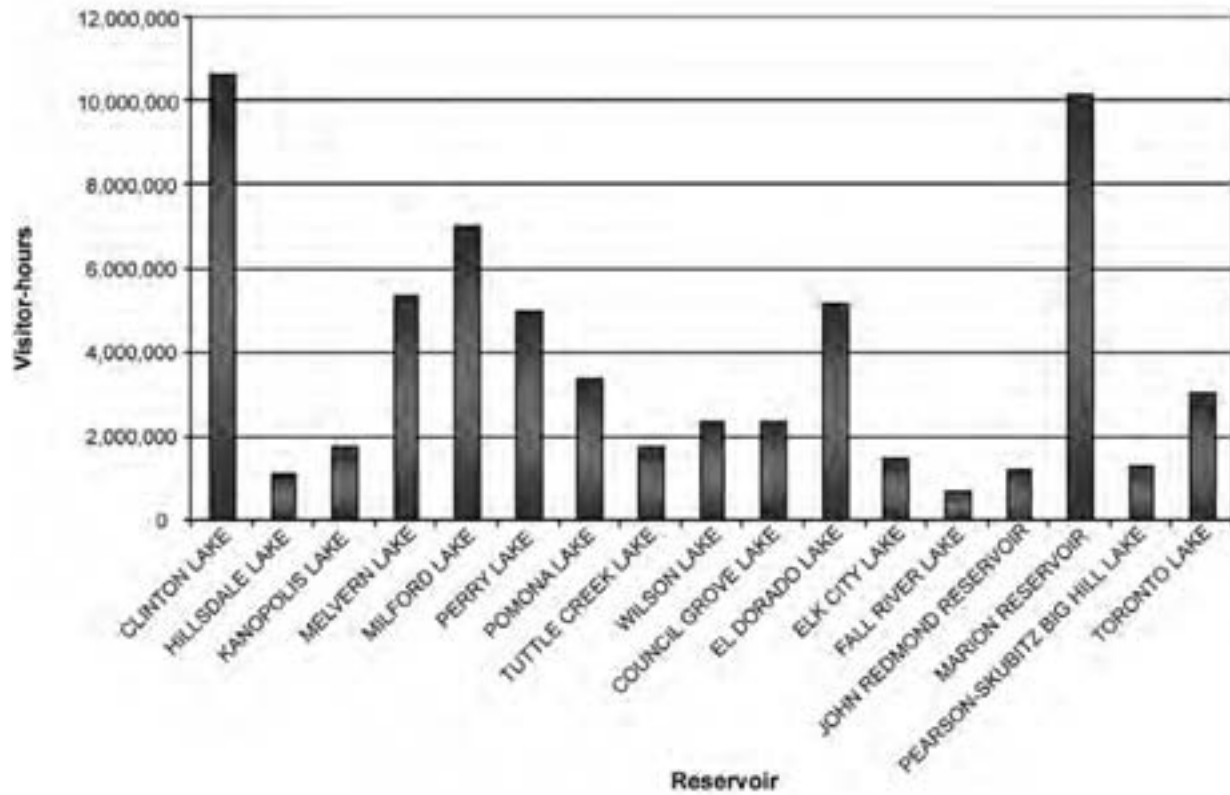


Figure 21. Visitor-hours at Kansas Reservoirs in 2007

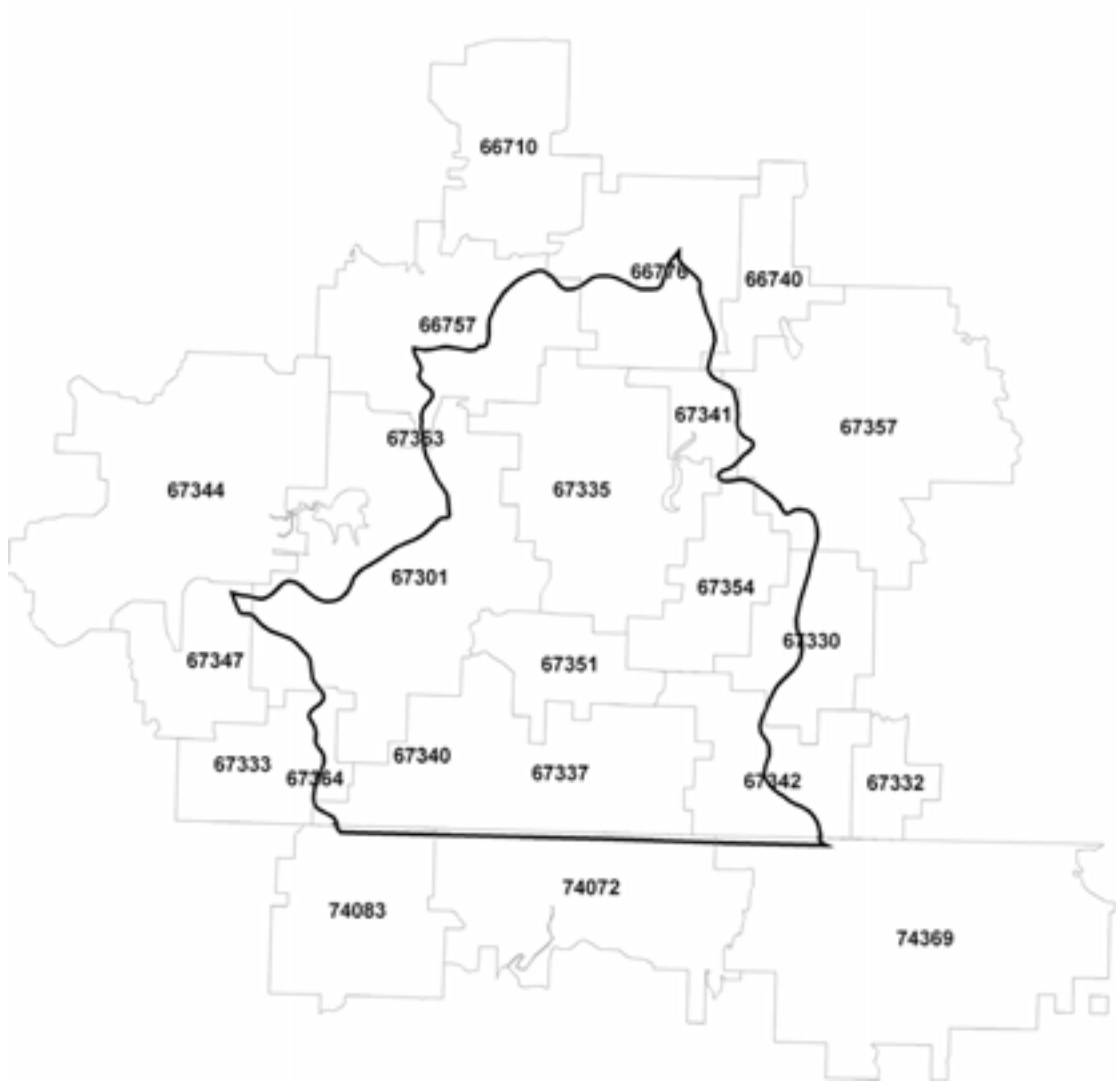


Figure 22. Zip Code Boundary Map

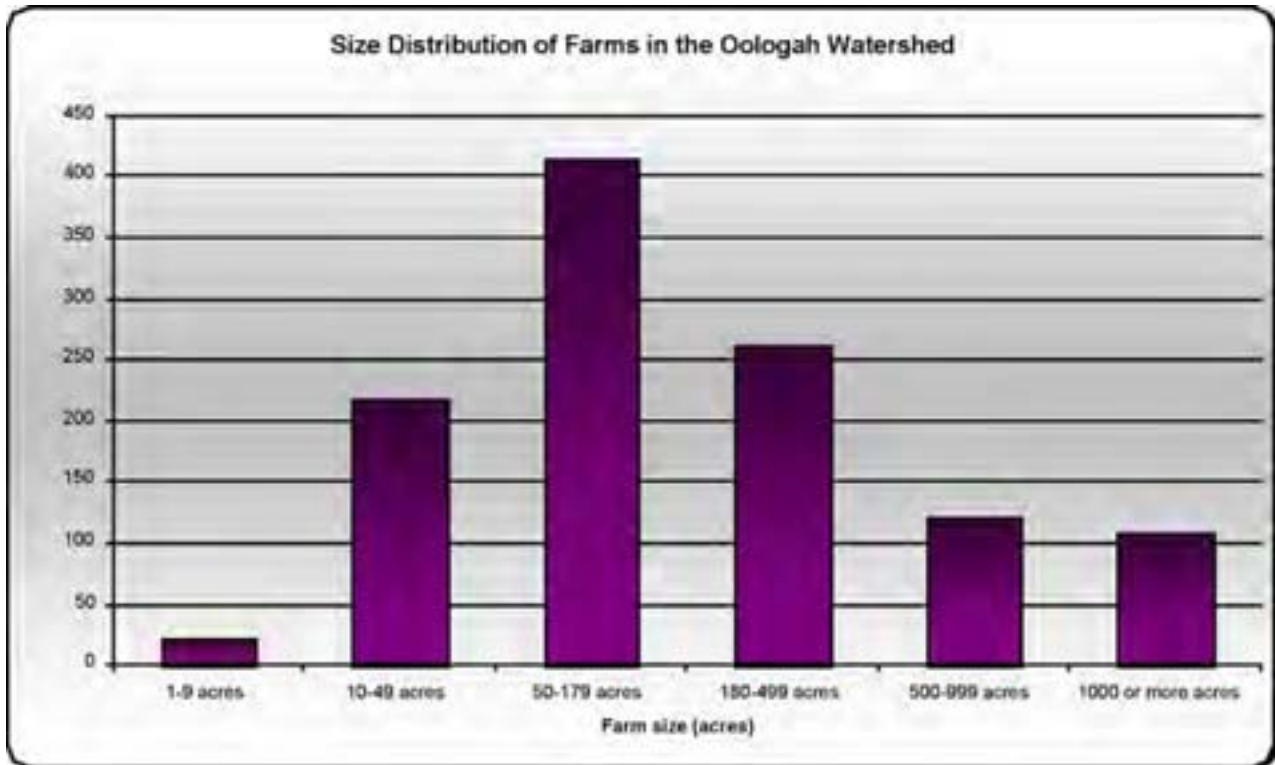


Figure 23. Size Distribution of Farms in Oologah Watershed, 2002¹⁸

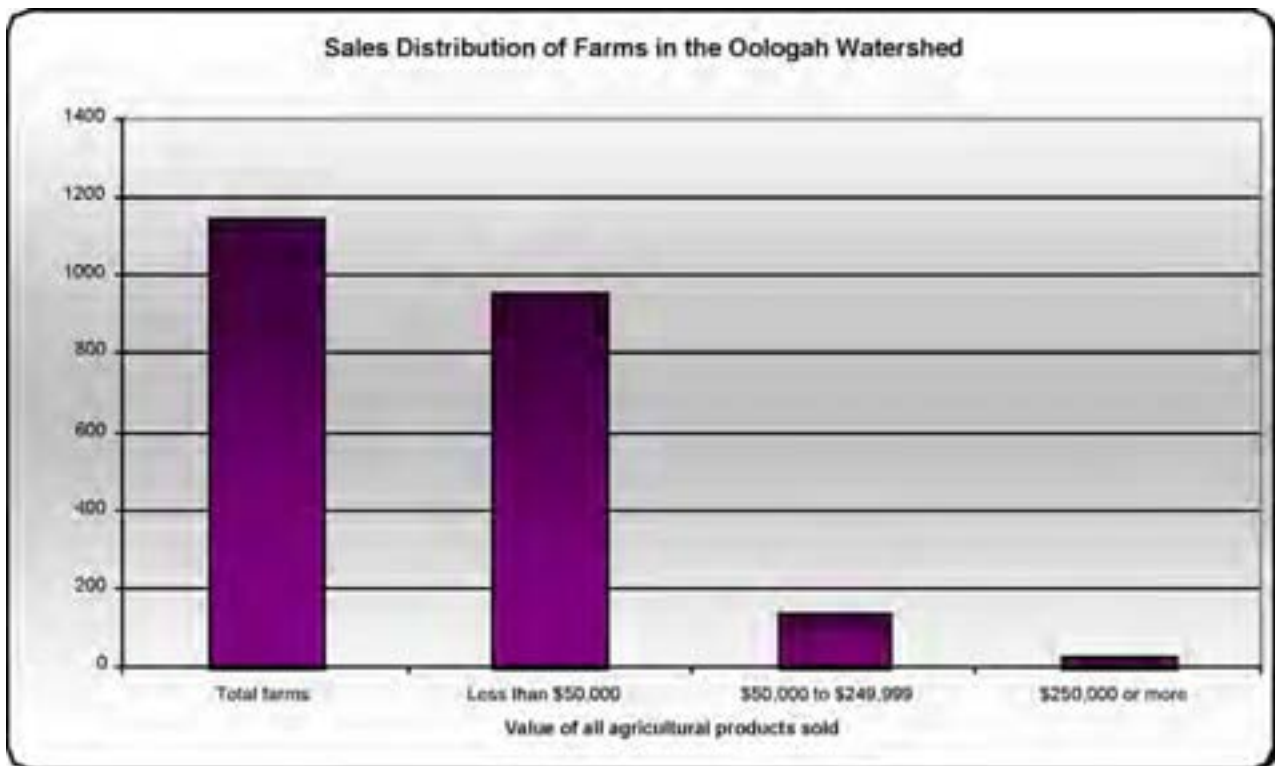


Figure 24. Sales Distribution of Farms in Oologah Watershed, 2002¹⁸

Harvested Crop Acreage in the Oologah Watershed

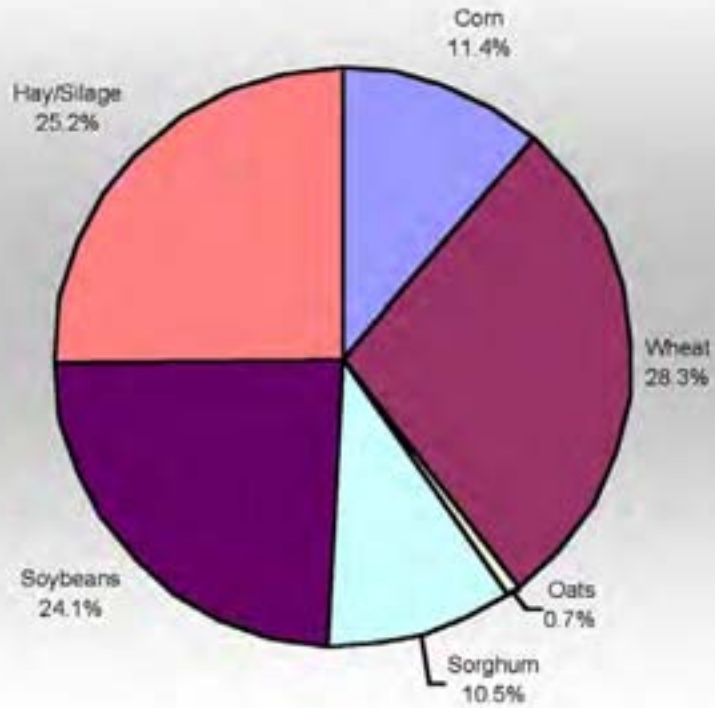


Figure 25. Harvested Crop Acreage in Oologah Watershed, 2002¹⁸

Livestock Number Distribution in the Oologah Watershed

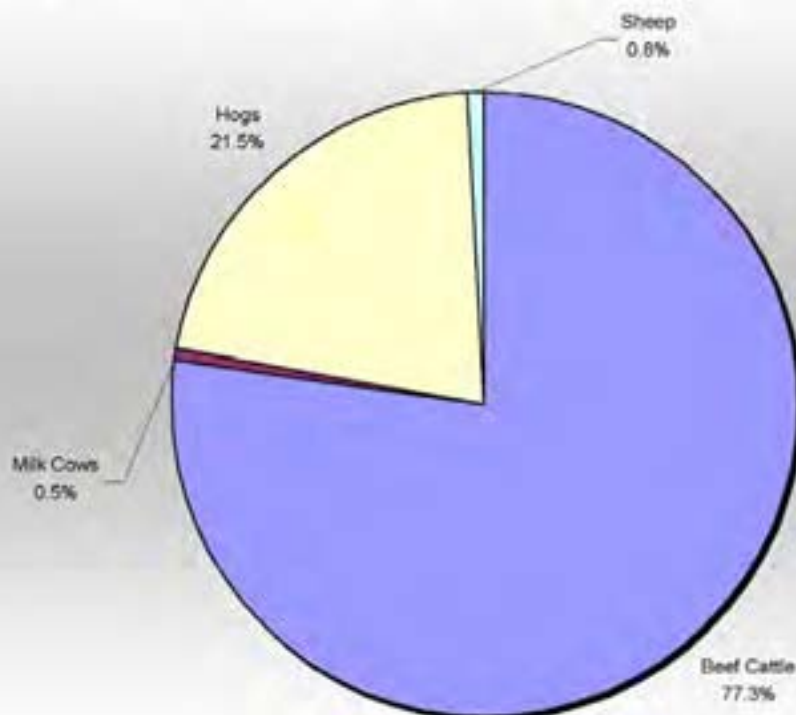


Figure 26. Livestock Number Distribution in Oologah Watershed, 2002¹⁸

8.0 Modeling

8.1 Subbasin Map¹⁹

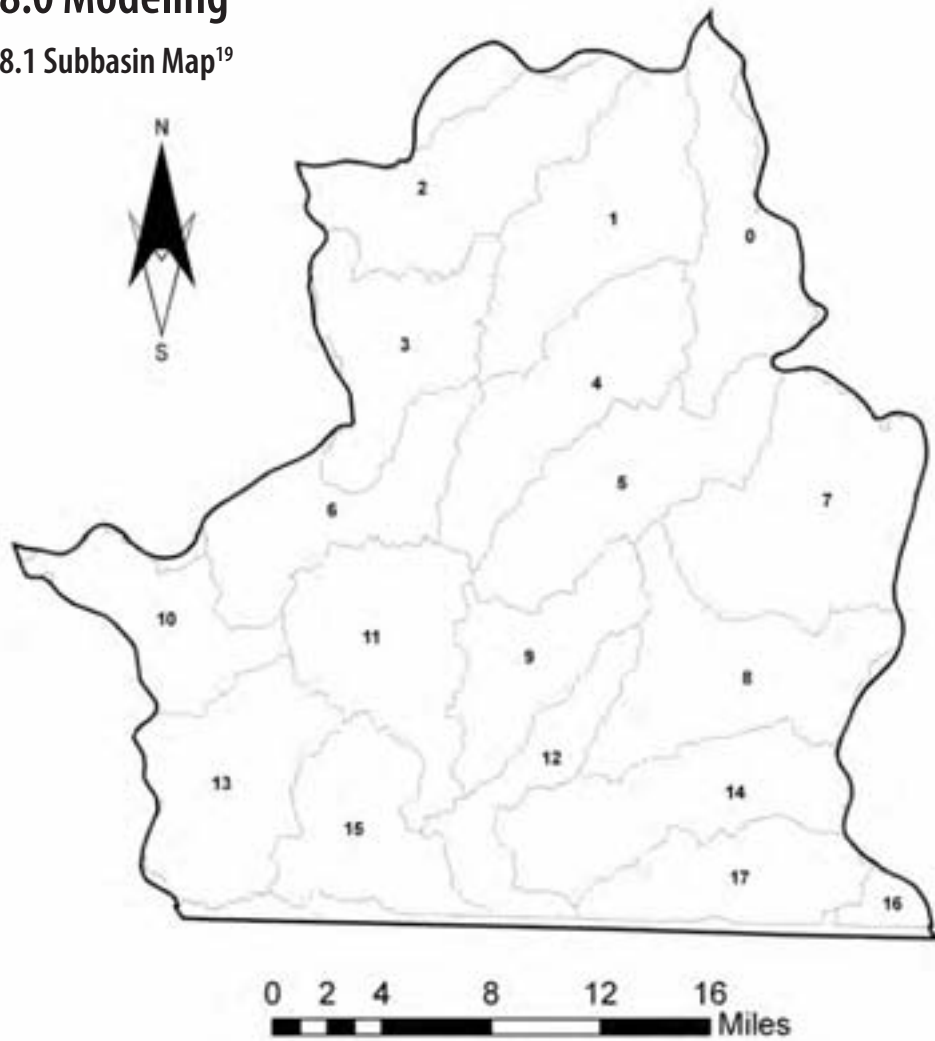


Figure 27. Subbasin Map
– Oologah Watershed

Table 24. Oologah Watershed Subbasin Area

Subbasin	State	HUC ID	Area (acres)
0	KS	11070103010060	22548
1	KS	11070103010040	29965
2	KS	11070103010010	27276
3	KS	11070103010020	22380
4	KS	11070103010050	26467
5	KS	11070103010070	27415
6	KS	11070103010030	22490
7	KS	11070103020040	35459
8	KS	11070103020050	29840
9	KS	11070103010080	19132
10	KS	11070103020010	17859
11	KS	11070103010090	27308
12	KS	11070103020070	14979
13	KS	11070103020020	26270
14	KS	11070103020060	26842
15	KS	11070103020030	20312
16	KS	11070103040010	3037
17	KS	11070103030020	18241
Total	KS		417820

8.2 Input Data

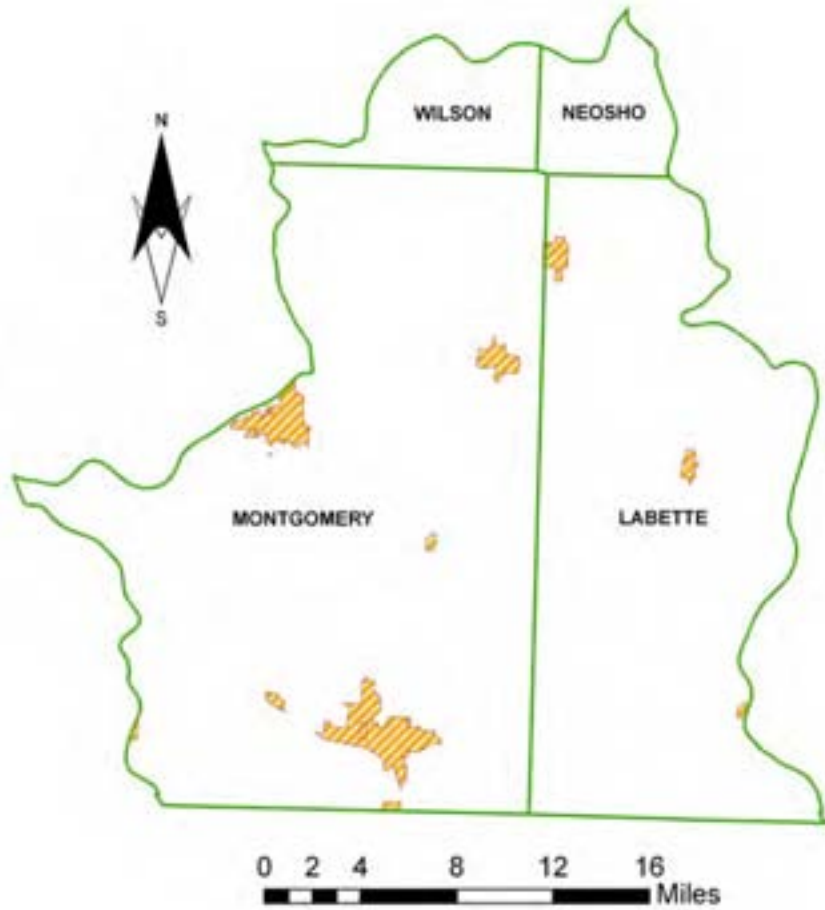


Figure 28. County Map
– Oologah Watershed.

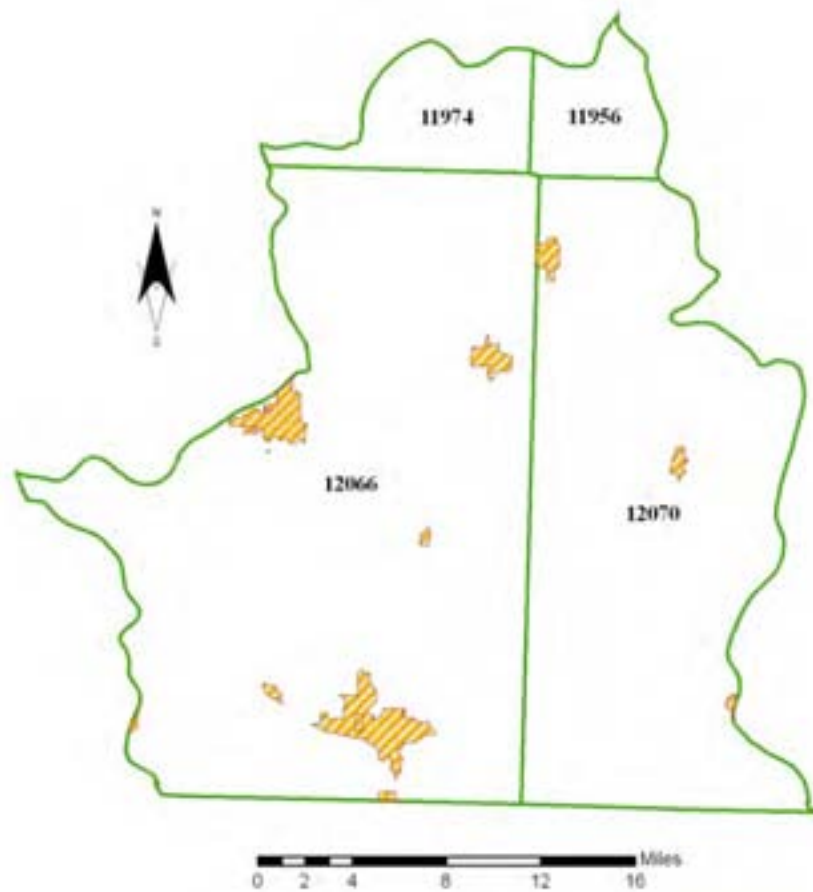


Figure 29. HUCO Map (over-
lay of county and 8-digit
hydrologic unit boundary)
– Oologah Watershed²³

Table 25. Oologah Watershed Summary²³

Polygon ID	County Name	State	HUC	Area (acre)	% in County
11956	Neosho	KS	11070103	24020.87	6.46%
11974	Wilson	KS	11070103	24481.88	6.73%
12066	Montgomery	KS	11070103	253030.8	60.80%
12070	Labette	KS	11070103	159924.7	37.88%

Table 26. Landuse Area (acre)²⁰

Polygon ID	Urban/ Transportation	Cropland	Pasture/ Rangeland	Forest	Feedlots	Water	Others
11956	500	0	2500	3000	0	0	4800
11974	800	3200	10700	1100	0.81	300	1800
12066	21600	97500	97300	17000	15.47	3600	4500
12070	4100	63700	86500	9700	6.79	2500	5200
Total	27000	164400	197000	30800	23.07	6400	16300

Table 27. Agricultural Animals¹⁸

Polygon ID	Beef Cattle	Dairy Cattle	Swine(Hog)	Sheep	Horse	Chicken	Turkey	Duck
11956	1431	35	215	99	49	22	D	1
11974	1157	19	374	D	0	41	D	0
12066	14170	175	17836	222	952	388	32	15
12070	10767	128	204	265	362	210	D	5
Total	27525	357	18629	586	1363	661	32	21

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,%
11956	139	2.2	0.93
11974	122	2.02	0.93
12066	2247	2.17	0.93
12070	937	2.23	0.93
Total	3445	2.18	0.93

Table 29. Hydrological Soil Group²²

Polygon ID	Hydrological Group
11956	B
11974	C
12066	C
12070	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
11956	Cropland	250.00	0.39	0.184	0.25	0.89
11974	Cropland	250.00	0.37	0.202	0.24	0.92
12066	Cropland	250.00	0.37	0.214	0.24	0.88
12070	Cropland	250.00	0.39	0.188	0.25	0.92
11956	Pastureland	250.00	0.36	0.352	0.03	1.00
11974	Pastureland	250.00	0.36	0.299	0.02	1.00
12066	Pastureland	250.00	0.34	0.318	0.04	1.00
12070	Pastureland	250.00	0.37	0.272	0.03	1.00
11956	Forest land	250.00	0.32	0.279	0.003	1.000
11974	Forest land	250.00	0.29	0.341	0.003	1.000
12066	Forest land	250.00	0.30	0.346	0.003	1.000
12070	Forest land	250.00	0.33	0.255	0.003	1.000

8.3 Model Outputs

Table 31. Total Pollution Load²³

Polygon ID	N Load (lb/year)	P Load (lb/year)	BOD Load (lb/year)	Sediment Load (t/year)
11956	20170.5	2213.3	66833.4	203.6
11974	130452.5	13333.4	397648.3	1082.9
12066	1785733.3	228820.3	5073630.0	27965.9
12070	1279150.0	149292.9	3647373.2	16325.3
Total	3215506	393660	9185485	45578

Table 32. Total Load by Land Uses²³

Sources	N Load (lb/yr)	P Load (lb/yr)	BOD Load (lb/yr)	Sediment Load (t/yr)
Urban	231890.77	35871.85	905930.55	5322.42
Cropland	1050447.26	189251.71	2200625.91	32187.19
Pastureland	1835511.11	145562.92	5933557.95	7963.29
Forest	11030.38	5476.64	27408.33	104.77
Feedlots	85732.31	17146.46	114309.74	0.00
User Defined	0.00	0.00	0.00	0.00
Septic	894.46	350.33	3652.37	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	3215506	393660	9185485	45578

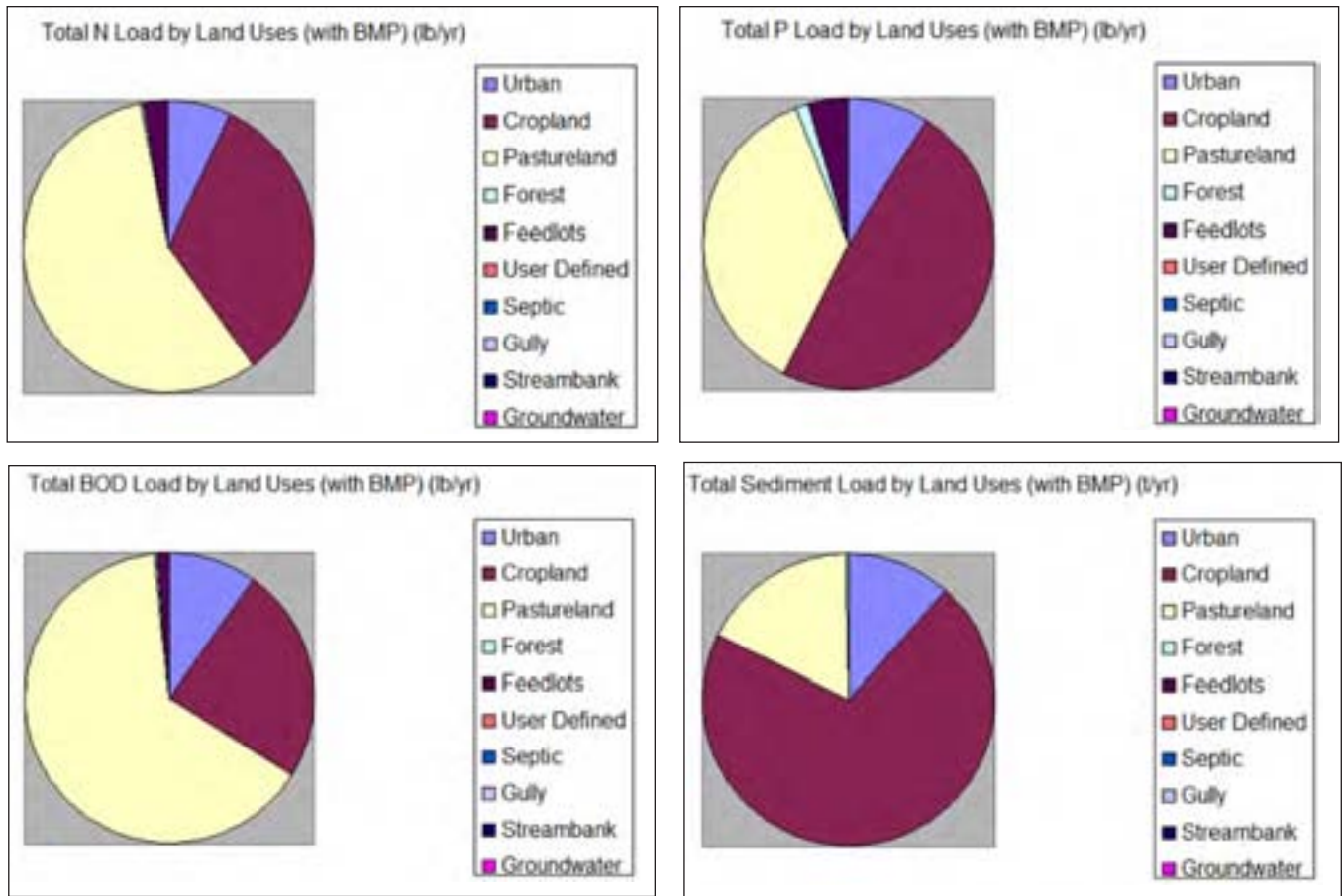


Figure 30. Total Load by Land Uses – Oologah Watershed

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. *Verdigris Basin TMDLs*: “The Section 303(d) list submitted to and approved by EPA in 1998, identifies 48 river segments and 5 lakes in the Verdigris River Basin as water quality impaired. Among the streams, the greatest number of impairments was caused by excessive levels of fecal coliform bacteria and dissolved oxygen depletion. Among the lakes, eutrophic conditions indicative of excessive algae production and dissolved oxygen depletion were the predominant cause of impairment. Other pollutants limiting the use of the Verdigris River Basin streams include ammonia and nutrient oxygen demand. Additional lake impairments were caused by pH and fecal coliform bacteria. Each parameter causing impairment requires a TMDL. Many of the stream segments, configured in a watershed setting, have a TMDL applied to them as a whole. Fourteen watershed and 6 lakes TMDLs have been developed. These TMDLs were submitted to EPA on June 27, 2002 and have been approved.”

Online reference information available at: <http://www.kdbeks.gov/tmdl/verdigris.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, 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/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*: “Field mapping methods using national standards are used to construct the soil maps in the Soil Survey Geographic (SSURGO) database. Mapping scales generally range from 1:12,000 to 1:63,360; SSURGO is the most detailed level of soil mapping done by the Natural Resources Conservation Service (NRCS). SSURGO digitizing duplicates the original soil survey maps. This level of mapping is designed for use by landowners, townships, and county natural resource planning and management. The user should be knowledgeable of soils data and their characteristics.”
Online reference information available at: <http://www.ncgc.nrcs.usda.gov/products/datasets/ssurgo/>
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 Oologah 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, *Big Hill Lake Reservoir Fact Sheet*.
Online reference information available at:
http://www.kwo.org/ReservoirInformation/ReservoirFactSheets/BigHill_Pearson_Skubitz_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 Big Hill Lake*.
36. *1992 Land Cover Class Definitions*. Online reference information available at:
<http://www.epa.gov/mrlc/definitions.html#1992>
36. *2001 Land Cover Class Definitions*. Online reference information available at:
<http://www.epa.gov/mrlc/definitions.html#2001>

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