United States Department of Agriculture
Natural Resources Conservation Service

Little Osage Sub-basin

HUC # 10290103

R A P I D W A T E R S H E D A S S E S S M E N T

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Little Osage Sub-basin

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A rapid watershed assessment (RWA) evaluates resource conditions and needs on an 8-digit hydrologic unit (HU) basis. The assessment identifies the primary resource concerns for the watershed being profiled and provides estimate as to where conservation investments would best address the concerns of landowners, conservation districts, stakeholders, and others. The RWA provides information on which to base decisions about conservation priorities, allocation of resources, and funding for implementation.

Introduction[1]

Rapid watershed assessments (RWAs) provide initial estimates of where conservation investments would best address the concerns of land owners, conservation districts and other stakeholders within drainage sub-basins. These assessments are designed as quick looks over large drainage areas to provide a starting point for area-wide, watershed or site-specific planning. Missouri has 66 sub-basins averaging 628,000 acres in size.

RWAs contain two parts: a resource profile based on readily available resource information and an assessment matrix of current and future resource conditions and related installation and maintenance costs. The resource profiles provide a general description of the location and primary physical attributes of the sub-basin; known resource concerns; and selected agricultural and socio-economic characteristics. The assessment matrices contain condition tables detailing the current level of conservation in the sub-basin; future considerations tables identifying appropriate suites of conservation practices needed to deal with the primary resource concerns for each major land use; and summary tables that summarize the various costs associated with the Resource Management Systems (RMS) identified in the future considerations tables.

This small sub-basin, situated between the drainages of the Marais des Cygnes River to the north and the Marmaton River to the south, covers 342,900 acres (536 square miles) in eastern Kansas and western Missouri. In Kansas, the sub-basin drains 33,000 acres (52 square miles) of northeastern Allen County; 25,900 acres (40 square miles) of southeastern Anderson County; 107,400 acres (168 square miles) of northern Bourbon County; and 73,600 acres (115 square miles) of southern Linn County. In Missouri, the sub-basin drains 10,800 acres (17 square miles) of southern Bates County and 92,200 acres (144 square miles) of northern Vernon County.

The Little Osage River rises near Moran, Kansas in northeastern Allen County and flows 70 miles eastward where it joins the Marais des Cygnes River to form the Osage River. The upper two-thirds of the Little Osage River flows through gently rolling to rolling uplands, formed in Pennsylvanian aged shale and limestone residuums or loess and scarped limestone valleys where local relief can reach 125 feet. Most of the soils have clayey subsoils and loamy, dark surface layers that were formed under prairie vegetation. The lower third of the river drains a much lower and flatter area with local relief typically less than 50 feet and claypan soils, developed under extensive prairie vegetation, are widespread. The Little Osage River occupies a wide, flat alluvial plain with poorly drained soils formed in deep, finely textured alluvium. Flooding and chronically wet soils are common. Cropland has replaced most of the bottomland prairies, marshes and forest.

The Little Osage River sub-basin is predominantly rural in character. Ninety-four percent (320,600 acres) of the sub-basin's land is dedicated to agricultural land covers: 39 percent (132,700 acres) is cropland, led by soybean production and followed by wheat, hay, sorghum and corn in decreasing acreages; 44 percent (149,500 acres) is grazing land; 9 percent (32,200 acres) is in CRP; and 2 percent (6,200 acres) is ungrazed forest. Six percent of the sub-basin's land is covered by non-agricultural uses: 3 percent (10,200 acres) has been developed; 1 percent (4,000 acres) is water; and 2 percent is in minor land uses. Livestock production is dominated by cattle, followed by poultry, hogs and pigs, horses and sheep in decreasing numbers.

Figure 1

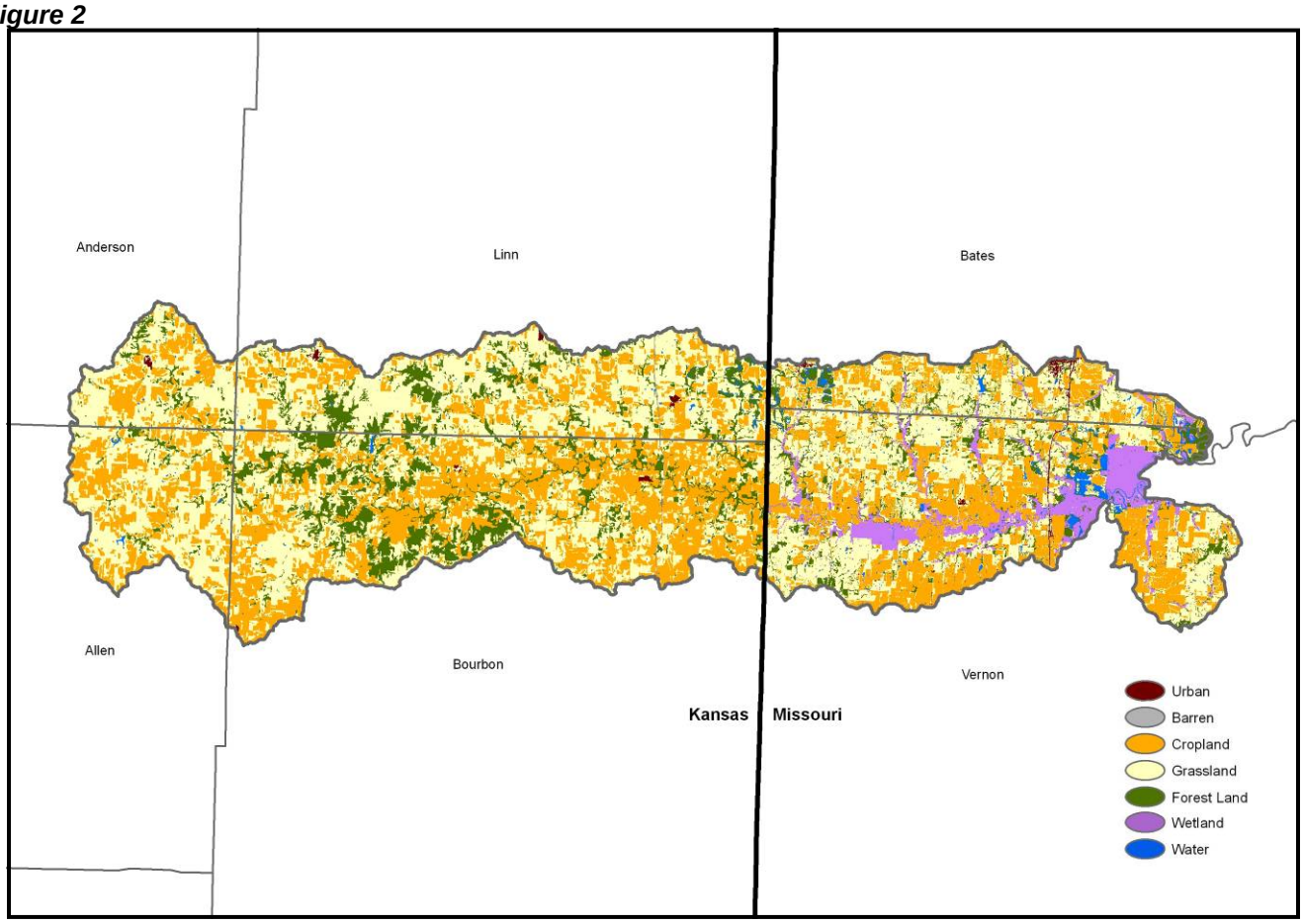
Sub-basin Primary Land Cover/Use Percentages By State

State	Cultivated Cropland	Non-Cultivated Cropland	Pasture Land	CRP Land	Range Land	Forested Land	Developed Land
Kansas	21%	4%	17%	6%	7%	9%	2%
Missouri	13%	1%	9%	3%	0%	4%	1%
Sub-basin Total	34%	5%	26%	9%	7%	13%	3%

Physical Description

A. Land Use/ Land Cover[2]

Figure 2



Land Use/ Land Cover NRI[2]	Urban	Cultivated cropland	Conservation Reserve Program	Non-cultivated cropland	Pastureland	Forest land	Minor land cover/uses	Water
1982 Acres	9,700	154,300	NA	6,600	83,800	42,600	12,100	3,000
1987 Acres	9,700	153,400	5,300	6,600	77,700	44,100	12,100	3,200
1992 Acres	9,800	109,100	34,300	12,800	94,900	44,300	10,000	3,400
1997 Acres	10,200	116,800	32,200	15,900	87,900	43,300	8,100	4,000
Five Year trend 92-97	**Up 4%**	**Up 7%**	**Down 6%**	**Up 24%**	**Down 7%**	**Down 2%**	**Down 19%**	**Up 18%**
Ten year trend 87-97	**Up 5%**	**Down 24%**	**Up 509%**	**Up 141%**	**Up 13%**	**Down 2%**	**Down 33%**	**Up 25%**
Fifteen year trend 82–97	**Up 5%**	**Down 24%**	**NA**	**Up 141%**	**Up 5%**	**Up 2%**	**Down 33%**	**Up 33%**

Land Cover / Land Use Definitions

- Urban – This map category corresponds to the tabled category called Developed Land. Developed Land is a combination of the NRI land cover/use categories large urban and built-up areas, small lbuilt-up areas and rural transportation land. Rural transportation land consists of all highways, roads, railroads and associated right-of-ways outside urban and built-up areas and also includes private roads to farmsteads, logging roads and other private roads.

- Barren – This map category is typically, the surface of sand, rock or exposed soil with less than 5 percent vegetative cover. Barren land acreage is included in the tabled NRI Minor Land category. Minor land is a miscellaneous grouping of land covers and uses that includes farmsteads and farm structures, field windbreaks, and barren land.

- Cropland – This map category most closely corresponds to the tabled category called Cultivated Cropland. Cultivated Cropland comprises land in row crops, close-grown crops and hayland or pastureland in rotation with row or close-grown crops.

- Grassland – This map category includes 4 tabled NRI land cover/use categories:
  Non-cultivated cropland; Conservation Reserve Program (CRP) lands; Pastureland; Rangland. on-cultivated cropland includes permanent hayland and horticultural cropland. The CRP is a federal program established under the 1985 Food Security Act to convert highly erodible cropland to vegetative cover (primarily grass) under 10 year contracts. Pastureland is land managed primarily for the production of introduced forage plants for livestock grazing. Rangeland is land on which the climax or potential plant cover is composed principally of native grasses, grass-like plants, forbs or shrubs suitable for grazing and browsing and introduced forage species that are managed like rangeland.

- Forestland and Woodland – A majority of the acreage for these map categories is captured by the tabled NRI Forestland category, defined as land that is at least 10 percent stocked by single-stemmed woody species of any size that will be at least 4 meters tall a maturity. Ten percent stocked, equates to an areal canopy cover of 25 percent or greater.

- Wetlands – Acreage for this mapped category is not reflected in any of the NRI tabled acreage estimates. The wetland map category is a combination of satellite derived wetland classes, National Wetland Inventory (NWI) acres and Wetland Reserve Program (WRP) acres. (See Wetlands Section for NWI acreage estimates)

- Water – This map category closely corresponds to the NRI table acreage estimate representing water bodies and streams that are permanent open water.

B. Grassland[2]

	Rangeland (acres)			Pastureland (acres)			Grazed Forest Land (acres)		
Year	Total Sub-basin	Missouri	Kansas	Total Sub-basin	Missouri	Kansas	Total Sub-basin	Missouri	Kansas
1997	24,500	0	24,500	87,900	29,000	58,900	41,800		

C. Crop History[2]

	Close Grown Crops (acres)		Row Crops (acres)			Hayland (acres)
Year	Oats	Wheat	Corn	Sorghum	Soybeans	Grass
1997	0	18,400	12,500	16,400	66,200	15,900

D. Public Land[3]

In the Missouri portion of this sub-basin, about 10,802 acres or 7.9% is in public ownership, including 4 conservation areas, 1 river access, and 1 state historic site. No GIS file of public ownership in Kansas was available, but inferences from other map sources indicate very little. The Missouri portion bests Missouri's statewide average of 6.7% public land.

Figure 3

Public Land Ownership (acres)		
	Missouri Department of Conservation	Missouri Department of Natural Resources
Total Acres	10,735	67

E. Soil Capability

Land Capability[2]

Land Capability is a classification system used to identify the erosion potential of farmland. For over forty years the USDA has used land capability classification as a planning tool in laying out conservation measures and practices to farm without serious deterioration from erosion or other causes. The current system includes eight classes of land designated by Roman numerals I through VIII. The first four classes are arable land--suitable for cropland--in which the limitations and the need for conservation measures and management increase from I through IV. The remaining four classes, V through VIII, are not to be used for cropland, but may have uses for pasture, range, woodland, grazing, wildlife, recreation, and aesthetic purposes.

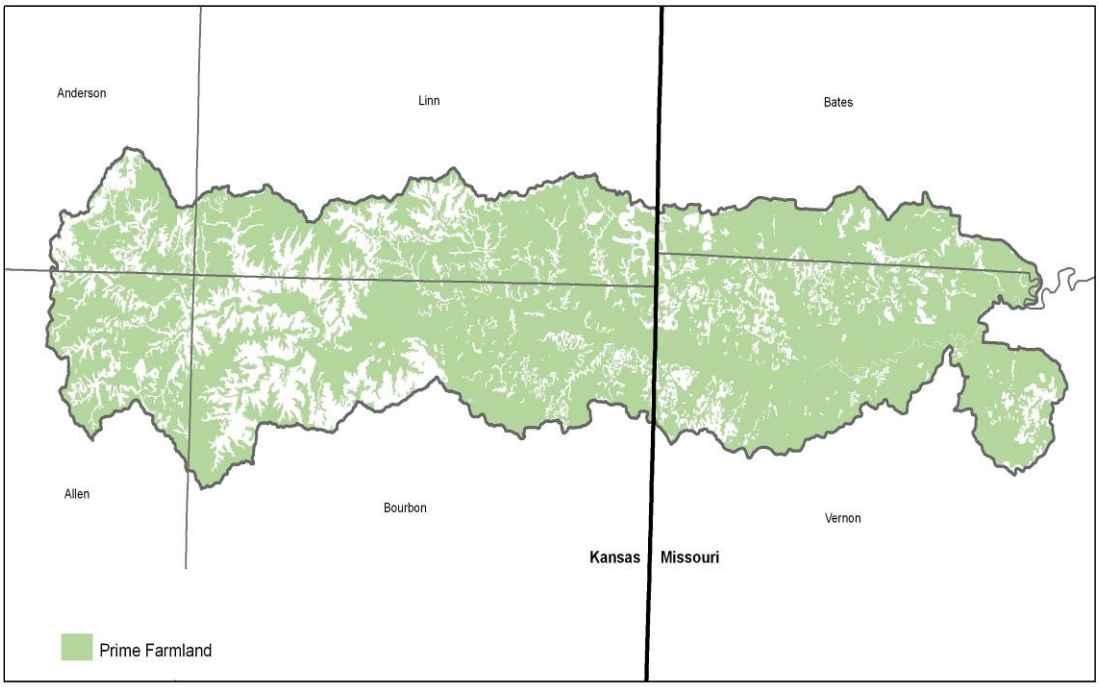
Figure 4

Land Capability Class	Cultivated cropland (acres)	Non-cultivated cropland (acres)	Pastureland (acres)
I - slight limitations	2,000	0	0
II - moderate limitations	48,100	1,200	37,500
III - severe limitations	41,500	8,700	22,800
IV - very severe limitations	15,500	1,700	17,400
V - no erosion hazard, but other limitations	-	-	-
VI - severe limitations, unsuited for cultivation, limited to pasture, range, forest	7,700	4,300	10,200
VII - very severe limitations, unsuited for cultivation, limited to grazing, forest, wildlife	2,000	-	-
VIII - misc. areas have limitations, limited to recreation, wildlife and water supply	-	-	-
Total	**116,800 acres**	**15,900 acres**	**87,900 acres**

Prime Farmland[4,5]

Prime Farmland is land that has the best combination of physical and chemical characteristics for producing food, feed, forage, fiber, and oilseed crops and is also available for these uses. It has the soil quality, growing season, and moisture supply needed to produce economically sustained high yields of crops when treated and managed according to acceptable farming methods, including water management. In general, prime farmlands have an adequate and dependable water supply from precipitation or irrigation, a favorable temperature and growing season, acceptable acidity or alkalinity, acceptable salt and sodium content, and few or no rocks. They are permeable to water and air. Prime farmlands are not excessively erodible or saturated with water for a long period of time, and they either do not flood frequently or are protected from flooding.

Figure 5. Prime Farmland in the Little Osage Sub-basin [5]



Prime Farmland[2]**—Change in Acres from 1982 to 1997**	
1982	255,400 acres
1997	253,500 acres
Difference	**(1,900) acres**

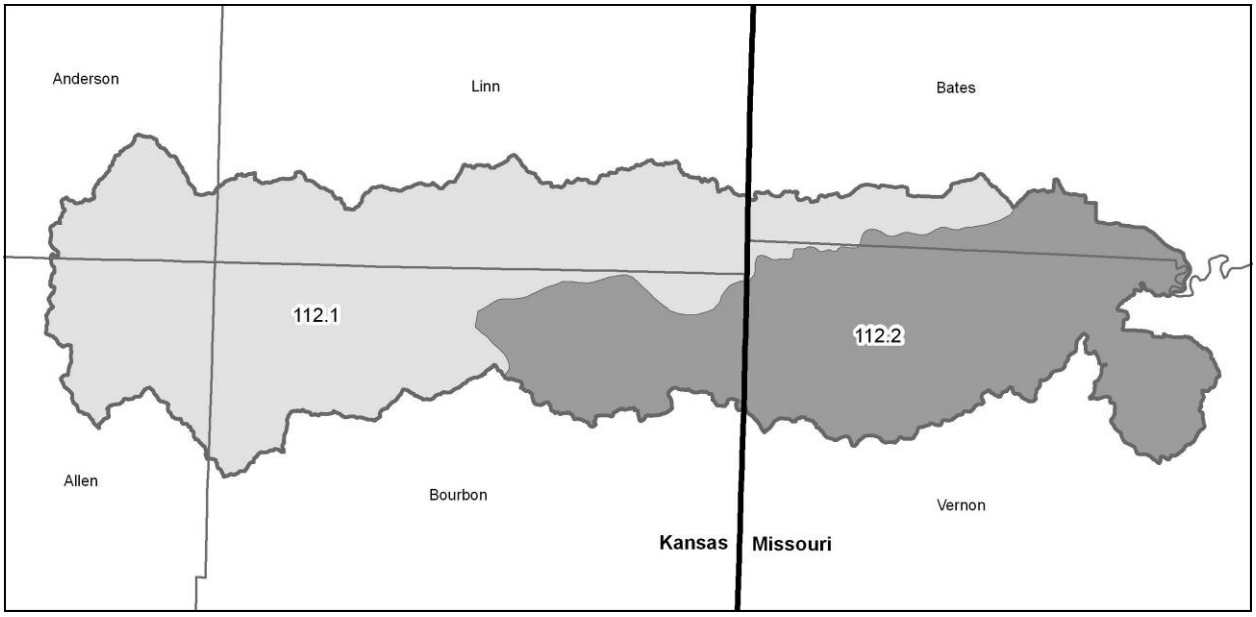
F. Common Resource Areas[6]

NRCS has divided the Nation into ecological type land regions called Major Land Resource Areas (MLRA). MLRAs are defined by their agricultural potential and soils capabilities and provide a spatial framework for addressing national and regional agricultural issues. A Common Resource Area (CRA) is a geographic and ecologic subdivision of an MLRA within which there are similar resource concerns and treatment requirements.

Each Missouri CRA is a grouping of Land Type Associations (LTA) taken directly from the state's ecological classification system (ECS). Missouri's LTAs are primarily differentiated on the basis of local climate, landforms and topography, geologic parent materials, soil types and potential vegetation.

The Little Osage Sub-basin occupies portions of MLRA 112.1 and MLRA 112.2.

Figure 6. Common Resource Areas in the Little Osage Sub-basin



112.1 – Scarped Osage Plains

The Scarped Osage Plains CRA is a smooth plain interrupted by low, ragged escarpments trending southwest-northeast in which limestone bedrock is regularly exposed. Local relief reaches 150 feet in the escarpment zones but elsewhere averages less than 100 feet. Valley bottoms are exceptionally broad for the size of the streams. Geologic parent materials are mainly thin-bedded Pennsylvanian limestones and shales. Pre-settlement vegetation was mostly prairie, with belts of scattered timber along limestone scarps and valleys. Most of the land is farmed, both pasture and cropland. The Kansas City metropolitan area exerts urbanization pressure on the land use in the northwest.

112.2 – Cherokee Plains

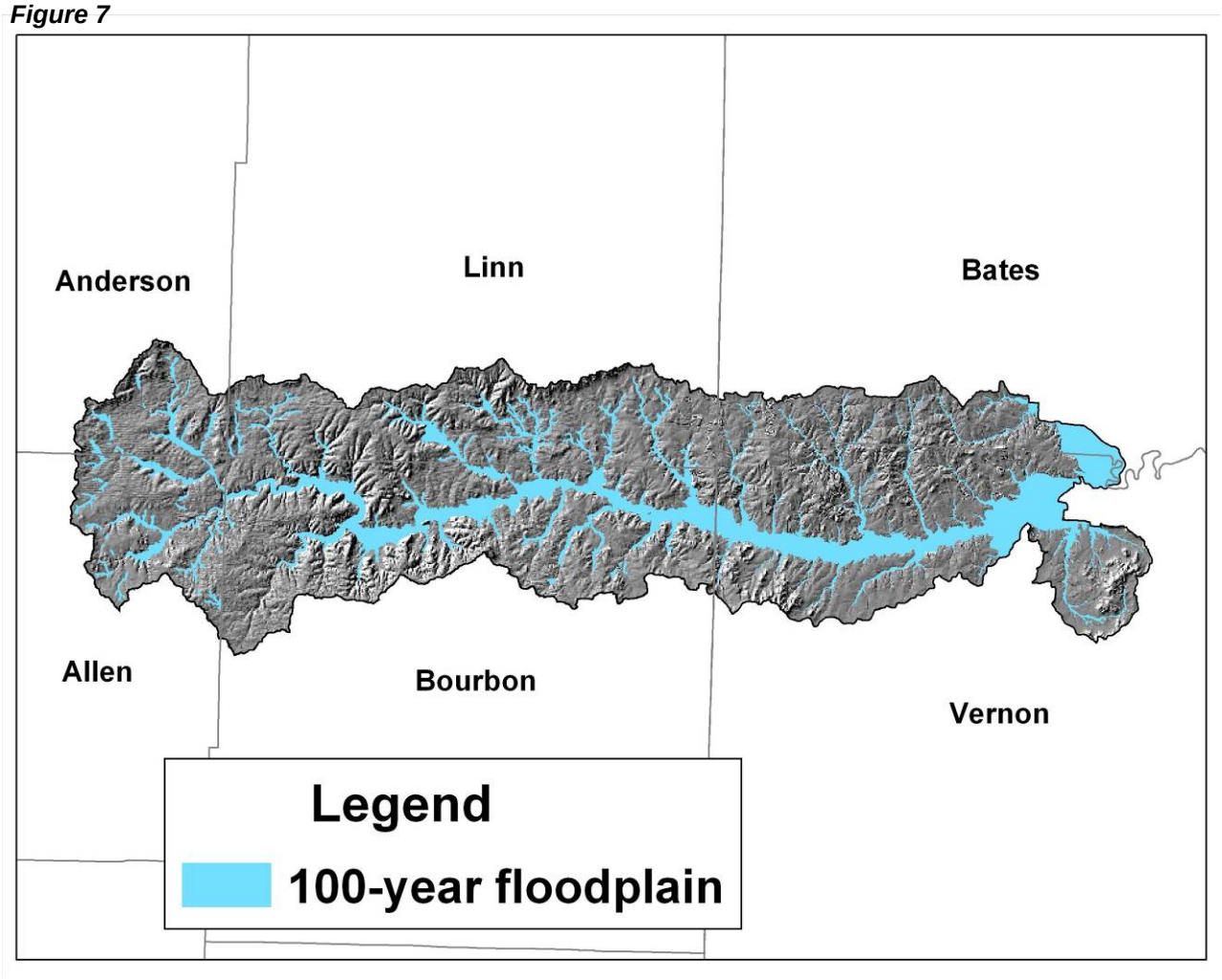
The Cherokee Plains CRA is one continuous plain of very low relief (usually less than 80 feet) mostly on Pennsylvanian sandstones and shales, but with associated thin-bedded limestones and coal. Streams have hardly dissected the surface and valleys are topographically subdued. Wetlands are abundant throughout the wide, flat alluvial plains. Claypan soils add further distinction to the CRA. Pre-settlement vegetation was both upland and wet prairie, with timber confined to narrow strips along the stream courses. Most of the land is in farms, both pasture and cropland, with local areas of extensive strip mines. Substantial prairie remnants occur, many in conservation ownership.

G. Streams

Floodplains[7]

The Federal Emergency Management Agency (FEMA) maps areas of flood vulnerability. FEMA has produced maps for 2 of the 6 counties in this sub-basin. For the remaining counties, the SSURGO soil attribute 'flooding frequency' was used. Flooding frequency documented a rare, occasional, frequent and very frequent cumulatively represent the 1% annual chance of flooding, or 100-year floodplain, as shown from the FEMA data. Using these combined methods, 51,753 acres (14.0%) of the sub-basin are in the 100-year floodplain.

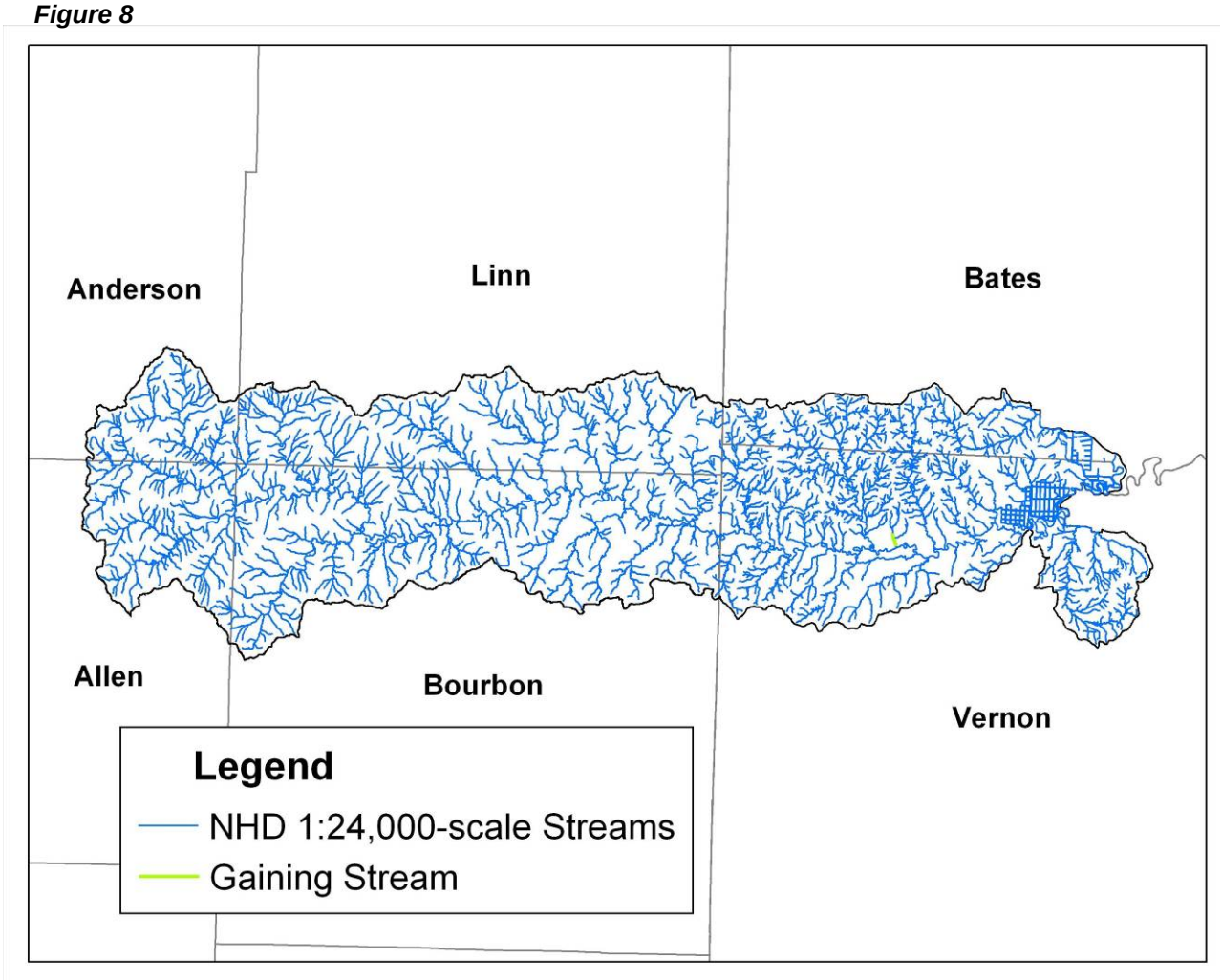
Figure 7



National Hydrography Dataset (NHD) with Gaining Streams and Biological Reference Streams [8 & 15]

High-resolution (1:24,000-scale) data from the National Hydrography Dataset show a total of 1,751 miles of intermittent and perennial streams in this sub-basin. Stream segments are classified 'gaining' or 'losing' by the Missouri Department of Natural Resources (MoDNR), Division of Geology and Land Survey (DGLS). The classification depicts sections of streams which are either losing water flow to the subsurface or gaining water flow from the subsurface, based on change in flow rate over a set distance. One stream segment, about 1 mile in length, in this sub-basin is considered a gaining stream and there are no designated losing streams. Comparable data were not available for the Kansas portion of the sub-basin.

Figure 8



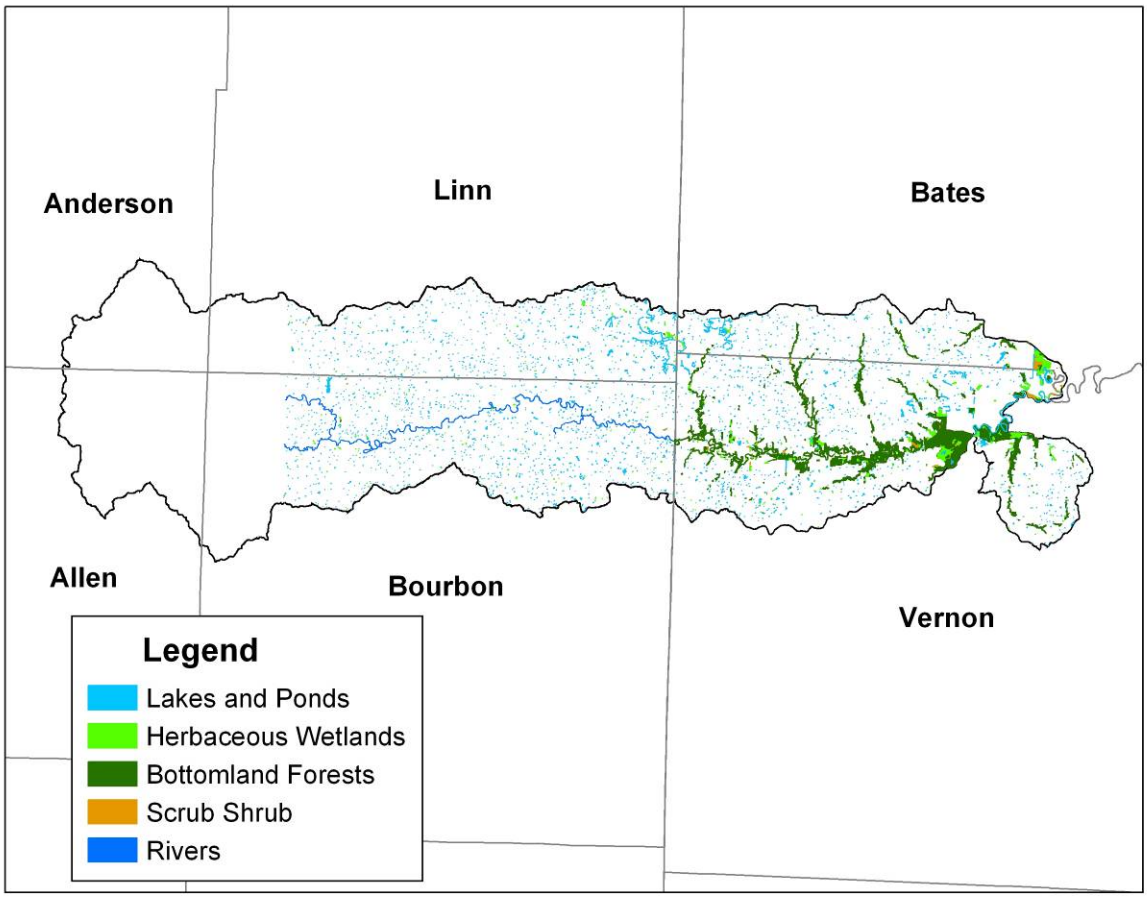
H. Wetlands[9,10]

Wetlands consist of land areas that are flooded or saturated by surface or ground water often enough to support plant and animal lifeforms that are adapted to wet environments.

The National Wetland Inventory (NWI) delineated wetlands from early 1980s aerial photography and classified wetlands using a wetland classification scheme developed by Cowardin, et al. The inventory identifies 14,197 acres of various wetland types within the Little Osage sub-basin. Digital NWI data were not available, however, for the westernmost 24% of the sub-basin.

Figure 9

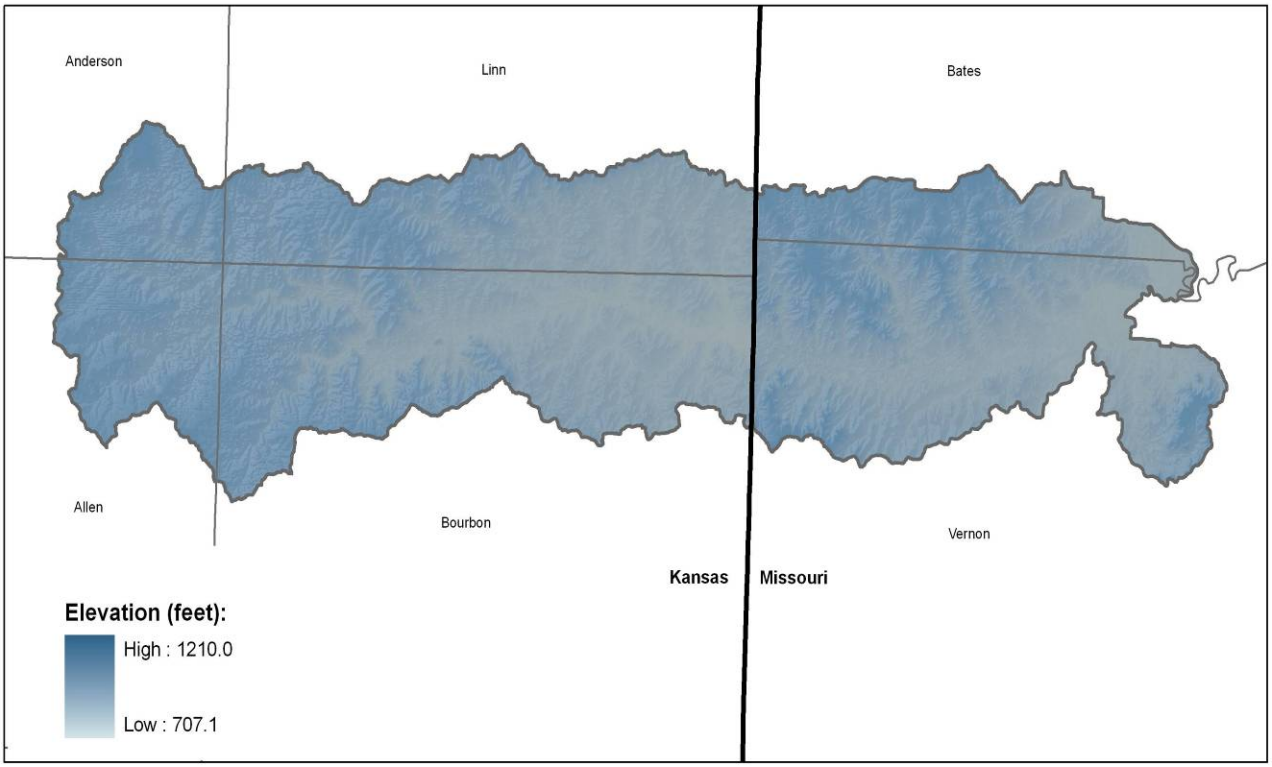
General Wetland Type	Acres	Percent of Sub-basin
Lakes and Ponds	2,708	0.97%
Herbaceous Wetlands	1,894	0.68%
Bottomland Forests	8,647	3.08%
Scrub Shrub	380	0.14%
Rivers	568	0.20%
Total	**14,197 acres**	**5.07%**



I. Relief Map[1,11,12]

The shaded relief map of the Little Osage Sub-basin depicts elevations above sea level. The shaded relief and elevation values were derived from digital elevation models generated from U.S. Geological Survey 7.5 minute elevation contours. The area is an unglaciated, nearly level to gently sloping to rolling plain. It can exhibit low escarpments in areas underlain by erosion resistant limestone units. Elevations can range from approximately 700 feet to near 1,200 feet with local relief of 100 to 150 feet in the escarpment areas and less than 50 feet in the broader plains underlain by sandstones and shales.

Figure 10



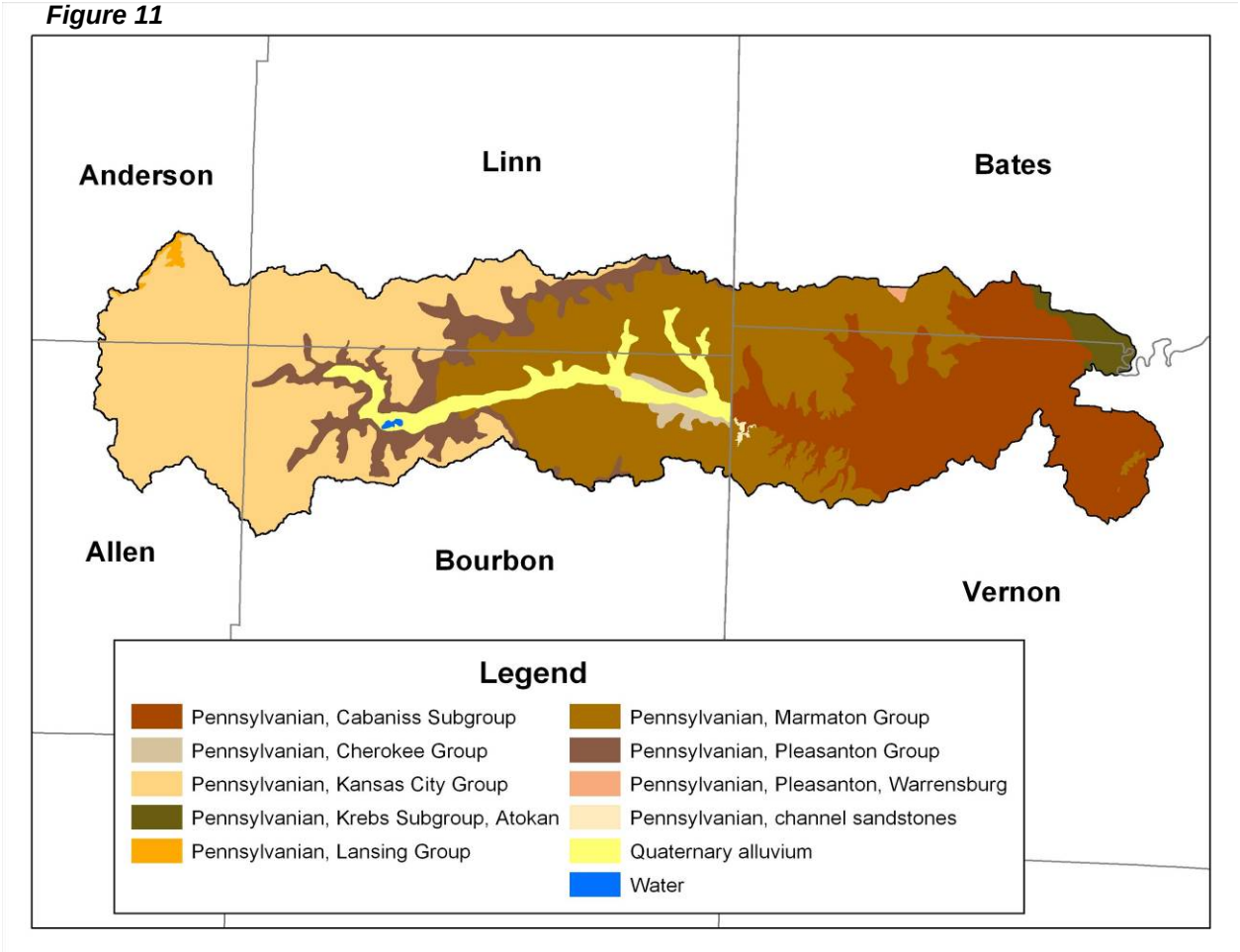
J. Geology[1,13,14,30,31,32]

Geology Map

This composite bedrock geology map is derived from bedrock geology maps of Missouri and Kansas. The Little Osage sub-basin is dominated by Pennsylvanian-age bedrock formations consisting of alternating and cyclic shales, sandstones, limestones, clays, and coal beds. These units dip gently to the northwest away from the Ozark Uplift located to the southeast. The sub-basin is unglaciated. Coal beds near the Missouri and Kansas border are found in this sub-basin and strip pit areas are visible on the landscape.

Bedrock units in the Little Osage River Sub-basin can be further divided into the following stratigraphic groups in descending order:

Figure 11



Pennsylvanian Sub-System

- Lansing group – Consists of 2 limestone formations and a shale formation. The group forms an escarpment that can be traced across eastern Kansas.
- Kansas City group – Consists of alternating beds of limestone and shale. Occasional beds of sandstone and thin coal beds can be present.
- Pleasanton group – Consists predominantly of clastic materials which have formed sandstones

and shales. Thin beds of coal and conglomerate are sometimes present. Channel-fill sandstone deposits can occur in the upper protion of the Pleasanton Group (often referred to as the Warrensburg Sandstone).

- Marmaton group – Consists of a succession of shales, escarpment-forming limestones, sandstones, clays, and coal beds.
- Cherokee group (Cabaniss Subgroup) – Consists of cyclic deposits of sandstone, siltstone, shale, underclay, limestone and coal beds.
- Cherokee Group (Krebs Subgroup) - Consists of alternating beds of sandstone, siltstone, shale , clay, limestone, and coal beds. Sandstone can make up a greater part of the group in some areas.

Karst features[15]

Karst topography is generally formed over carbonate bedrock such as limestone and dolomite by dissolving or solution. It is often characterized by sinkholes, caves, underground drainage and losing streams. Karst-indicating GIS data layers were consulted for the Missouri portion of the sub-basin but comparable data were not available for Kansas. The Little Osage sub-basin is not a developed karst region. No springs are mapped. No sinkholes or losing streams are identified. One 7.5 minute quadrangle in the sub-basin, Horton, has 2 caves documented.

Resource Concerns

Resource concerns are issues related to the natural environment. Natural resources include soil, water, air, plants, animals, and humans. Field office personnel of the USDA-Natural Resources Conservation Service were asked to complete inventory sheets in order to identify the 4 primary resource concerns for 5 landuse categories within the Little Osage River Watershed (Hydrologic Unit 10290103). The identified concerns are: PASTURE-LAND - (1) water quality-excessive nutrients and organics in surface water; (2) plant condition-productivity, health, and vigor; (3) plant condition-forage quality and palatability; (4) domestic animals-inadequate stock water. CULTI-VATED CROPLAND - (1) soil erosion-sheet and rill; (2) soil erosion-ephemeral gully; (3) soil erosion- classic gully; (4) water quality-excessive nutrients and organics in surface water. DEVELOPED LAND - (1) water quality-harmful levels of heavy metals in groundwater; (2) water quality-excessive nutrients and organics in groundwater; (3) water quality-harmful levels of pathogens in surface water; (4) water quality-harmful levels of petroleum in sur-face water. FORESTLAND - (1) soil erosion-streambank; (2) water quantity-excessive runoff, flooding, or ponding; (3) plant condition-productivity, health, and vigor; (4) fish and wildlife-habitat fragmentation. NON-CULTIVATED CROPLAND - (1) plant condition-plants not adapted or suited; (2) plant condition-threatened or endangered plant species: declining species; (3) plant condition-noxious and invasive plants; (4) fish and wildlife-inadequate food.

Figure 12

Resource Concerns/Issues by Land Use

Soil, Water, Air, Plant, Animal, plus Human (SWAPA+H) Concerns	Specific Resource Concern/Issue	Pasture/Grass	Cropland	Non-Cultivated Cropland	Forestland	Urban	Floodplain	Developed Land	Water
Soil Erosion	48% of all cropland eroding at levels above "T"		X						
	Erosion on streambanks and streambeds	X	X		X	X	X		
	Erosion and runoff from construction sites					X			
	Erosion from ephemeral gullies		X						
	Erosion from classical gullies	X	X		X	X			
Sedimentation	Damages to waterbodies, increased flooding						X		X
Prime Farmland	1,900 acres lost between 1982 and 1997	X	X		X		X		
Soil Quality	Degradation of soil quality		X						X
Water Quality	Cultivated cropland primary nonpoint source of pollutants		X						
	Excessive nutrients and organics in surface water	X							
	Harmful levels of heavy metals in groundwater							X	
	Certain waterbodies are not meeting water quality standards								X
Plants	Plants are not adapted or suited			X					
Floodplains	Nearly 52,000 acres fall within the 100-year flood area						X		
Riparian Corridors	Certain riparian zones unprotected or vulnerable	X	X			X	X	X	

Soil Erosion

- Streambank, streambed, and classical gully erosion occurs on pasture/grassland, cropland, forestland, and urban areas. However, due to a lack of reliable data at the sub-basin (8-digit hydrologic unit) level, the degree and amount of soil loss from these sources is not known.
- Ephemeral gully erosion is occurring primarily on cultivated cropland eroding at levels above the tolerable limit ("T"). No sub-basin level data are available to determine the degree and extent.
- An estimated 48 percent (56,000 acres) of all cultivated cropland is eroding at levels above "T".
- The estimated USLE soil loss on highly erodible, cultivated cropland (eroding above "T") is 10.4 tons/acre/year.
- Erosion and runoff is occurring from construction sites primarily found in and near urban areas.

Sedimentation

- Excessive sedimentation can reduce the useful life of ponds, lakes, reservoirs, and wetlands and can increase the severity and frequency of flooding by reducing the water carrying capacity of streams and rivers.

Soil Quality

- Excessive soil erosion is a primary contributor to soil quality degradation. This limits the productivity and sustainability of the soil resource.

Water Quality

- Highly erodible and cultivated croplands with USLE soil losses above tolerable limits ("T") are a primary non-point source of sediment, nitrogen, and phosphorus pollutants that enter the stream system.
- Ten waterbodies within the Kansas portion of the sub-basin appear on the 303(d) list and are not meeting water quality standards. Pollutants listed include fecal coliform bacteria and eutrophication.

Floodplains

- An estimated 51,753 acres fall within the 100-year return period flood area. This can result in damages to crops, pastures, and other resources, as well as damages to roads, bridges, and buildings.

Riparian Corridors

- The data suggest that about 33 percent of the riparian corridors, primarily in cropland, pasture/grass, and urban areas, are unprotected or vulnerable. Protected riparian corridors can act as filters to trap nutrients, sediment, and other pollutants.

A. Soils

The upland soils of this sub-basin formed in Pennsylvanian age shale, sandstone, or limestone. In many areas these soils are mantled by a thin layer of loess. Soils in these upland settings are predominately moderately deep to very deep and are moderately well drained to somewhat poorly drained.

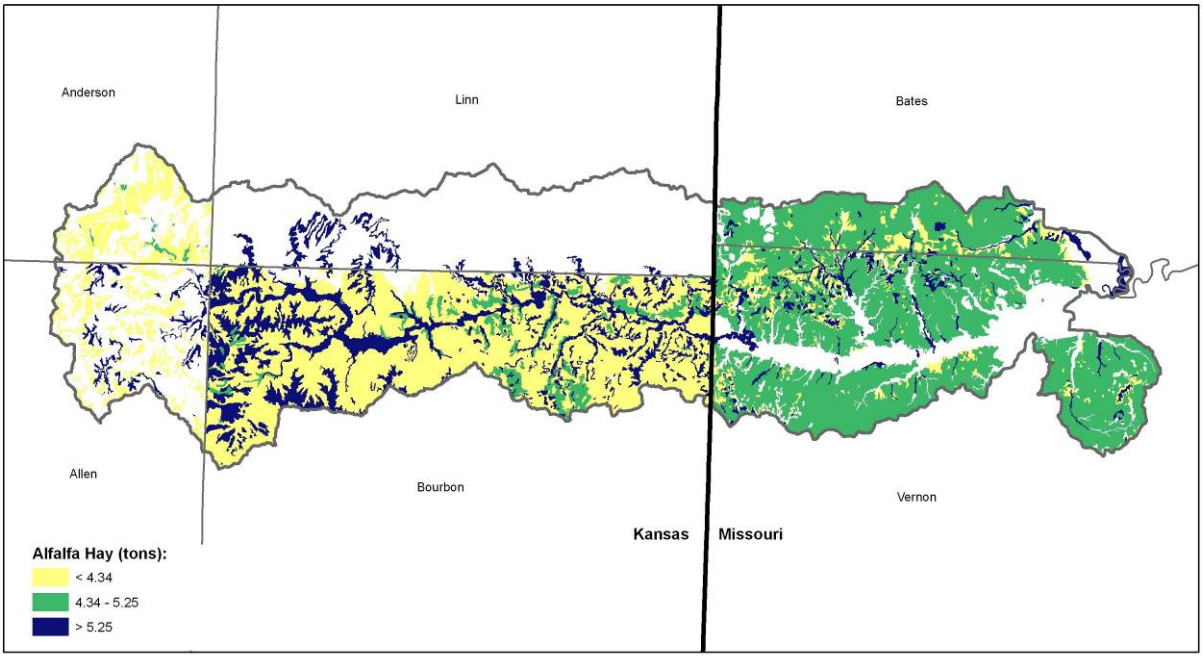
The soils on the nearly level to moderately sloping upland divides typically formed under prairie vegetation, and as a result have a thick dark surface layer. They have silt loam surface textures and clayey subsoil. The soils in the steeper areas on the lower slopes typically formed under forest and savanna vegetation and have thinner silt loam surface layers. They are generally shallower to bedrock.

Most of the alluvial soils in the floodplains are on back swamp areas. They are very deep, and somewhat poorly drained and poorly drained. They have loamy to clayey textures throughout the profile. The soils on the slightly higher natural levees adjacent to the main stream channels are typically better drained, and have less clay in the profile.

Pasture Productivity[5,33]

"Alfalfa is the most productive legume for Missouri, with potential yields exceeding six tons of hay per acre on good soils. Unlike red or white clover, established alfalfa is productive during midsummer except during extreme drought. Alfalfa is a tap-rooted crop and can last five years and longer under proper management. Whether grazed or fed as hay, alfalfa is an excellent forage for cattle and horses. Alfalfa is best adapted to deep, fertile, well-drained soils with a salt pH of 6.0 to 6.5, but it can be grown with conservative management on more marginal soils."

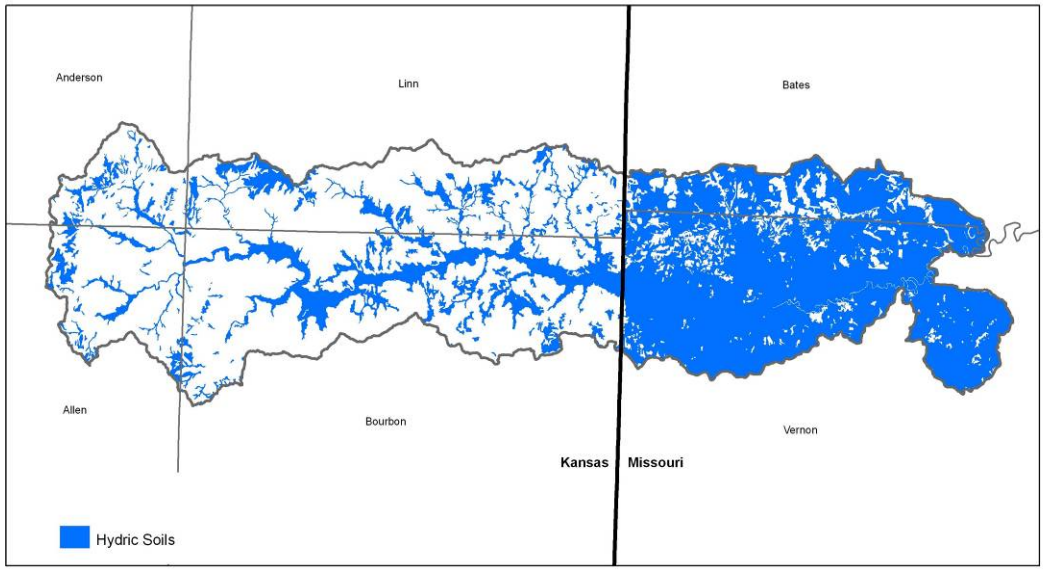
Figure 13—Alfalfa Hay Estimates



Hydric Soils[5]

Hydric soils are those that developed under sufficiently wet conditions (saturation, flooding or ponding long enough during the growing season to develop anaerobic conditions) to support the growth and re-generation of hydrophytic (water-loving) vegetation. Soils that are sufficiently wet because of artificial measures are included in hydric soils.

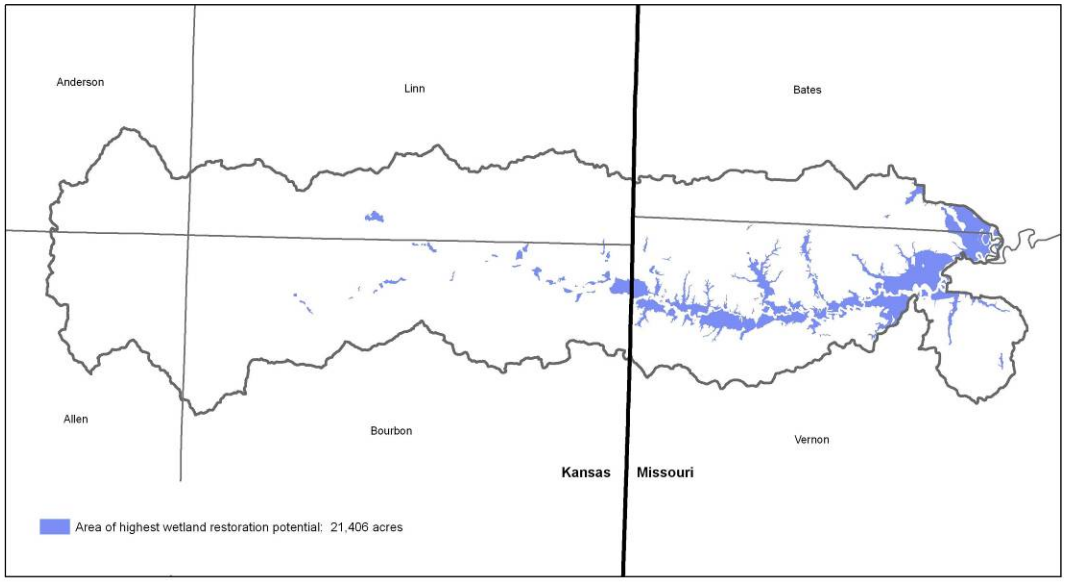
Figure 14



Wetland Restoration Potential[5]

Soils with the greatest potential for wetland restoration are located on flood plains, have a high runoff potential when thoroughly wet. Typically, they have greater than 40 percent clay, less than 50 percent sand, and have clayey textures. In some areas, they also have high shrink-swell potential.

Figure 15



B. Soil Erosion[16]

The objectives of this section are to profile cropland erosion rates and identify cropland areas within the Little Osage River sub-basin that would benefit the most from the application of conservation practices to limit sediment loss.

"**The production practices and inputs used by agriculture can result in a number of pollutants entering water resources, including sediment, nutrients, pathogens, pesticides and salts." (USDA-Economic Research Service).**

"Sediment is the largest contaminant of surface water in the United States by weight and volume (Koltun et al., 1997) and the second leading pollution problem in rivers and streams and third leading problem in lakes" (USEPA, 2002).

Sediment losses from soil erosion on cropland, streambanks and streambeds and runoff from construction sites and developed land are an ongoing resource concern throughout the Little Osage River sub-basin. Cultivated cropland is the primary nonpoint source of sediment loss in this heavily cropped sub-basin and accounts for 34 percent of the sub-basin's total surface area**.** In sub-basins like the Little Osage River, the acres most in need of conservation treatment are those with waterborne sediment, nitrogen and phosphorus losses.

The consequences of excessive soil erosion are well known. Waterborne sediments are inextricably linked to degraded water quality through turbidity and loss of fertilizers and pesticides attached to soil particles. Suspended sediments degrade aquatic habitats, increase water treatment costs and marginalize water recreation. Sedimentation reduces the useful life of ponds, lakes and reservoirs; increases the probability and severity of flooding; and clogs drainage networks. Excessive soil erosion is a primary contributor to soil quality degradation, limiting the productivity and sustainability of the soil.

This assessment concentrates on sheet and rill erosion on cropland for which there are scientifically based soil erosion estimates for the entire sub-basin. This focus does not suggest that sedimentation related to urban stormwater runoff, stream bank erosion, classical gully erosion and ephemeral gully erosion on cropland is not significant in volume or impact. However, there is a lack of reliable data at the sub-basin level for these other sources of sediment. The erosion rate data have been extracted from the 1997 National Resources Inventory (NRI). Erosion rates and their relationship to "T" values are reported in tons/acre/year for cultivated cropland and non-cultivated cropland on highly erodible and non-highly erodible land. Also included are erosion rates and their relationship to "T" values for pastureland.

Universal Soil Loss Equation (USLE) Cropland Erosion Rates in Tons/Acre/Year[2]

USLE - This table reports estimated soil loss rates from the 1997 NRI based on the Universal Soil Loss Equation (USLE). USLE estimates average annual sheet and rill soil movement down a uniform slope using rainfall energy as the erosive force acting on the soil. Soil characteristics and slope for the fields in which the NRI sample points fall or those portions of the fields surrounding the points that would be considered in conservation planning are used in the NRI USLE calculations.

"T" FACTOR – This is the maximum rate of annual soil erosion that will still permit crop productivity to be sustained economically and indefinitely.

HEL – Highly erodible land (HEL) is land that has an erodiblity index (EI) value of 8 or more. The EI index provides a numerical expression of the potential for a soil to erode, considering the physical and chemical properties of the soil and climatic conditions where it occurs. The higher the index value, the greater the investment needed to maintain the sustainability of the soil if intensively cropped.

Figure 16

USLE Cropland Erosion Rates Tons/Acre/Year[2]

CROPLAND CATEGORY	CULTIVATED CROPLAND	NON-CULTIVATED CROPLAND
HIGHLY ERODIBLE LAND (HEL)		
HEL Eroding at or below "T"	0	0.34
HEL Eroding above "T"	10.43	0
All HEL	10.43	0.34
NON-HIGHLY ERODIBLE LAND (Non-HEL)		
Non-HEL Eroding at or below "T"	0.49	0.3
Non-HEL Eroding above "T"	5.75	0
All Non-HEL	4.05	0.3
ALL CROPLAND		
All Land Eroding at or below "T"	2.95	0.31
All Land Eroding above "T"	7.17	0
All Land	4.92	0.31

Cropland Erosion in Relationship to "T"[2]

This table reports acres and percentages of cultivated cropland, non-cultivated cropland and all cropland by HEL and "T" categories for the sub-basin.

Cultivated Cropland

CROPLAND CATEGORY	Total Acres	% of Cropland Category	% of all Cropland	% of Sub-basin
HEL				
Highly Erodible Cropland at or below "T"	0	0%	0%	0%
Highly Erodible Cropland above "T"	17,100	100%	100%	5%
TOTALS FOR HIGHLY ERODIBLE CROPLAND	**17,100**	**100%**	**100%**	**5%**
NON-HEL				
Non-Highly Erodible Cropland at or below "T"	60,400	61%	100%	18%
Non-Highly Erodible Cropland above "T"	39,300	39%	100%	11%
TOTALS FOR NON-HIGHLY ERODIBLE CROPLAND	**99,700**	**100%**	**100%**	**29%**
GRAND TOTALS	**116,800**	**100%**	**100%**	**34%**

Non-Cultivated Cropland

CROPLAND CATEGORY	Total Acres	% of Cropland Category	% of all Cropland	% of Sub-basin
HEL				
Highly Erodible Cropland at or below "T"	1,700	100%	100%	0.004%
Highly Erodible Cropland above "T"	0	0%	0%	0%
TOTALS FOR HIGHLY ERODIBLE CROPLAND	**1,700**	**100%**	**100%**	**0.004%**
NON-HEL				
Non-Highly Erodible Cropland at or below "T"	14,200	100%	100%	4%
Non-Highly Erodible Cropland above "T"	0	0%	0%	0%
TOTALS FOR NON-HIGHLY ERODIBLE CROPLAND	**14,200**	**100%**	**100%**	**4%**
GRAND TOTALS	**15,900**	**100%**	**100%**	**4.004%**

All Cropland

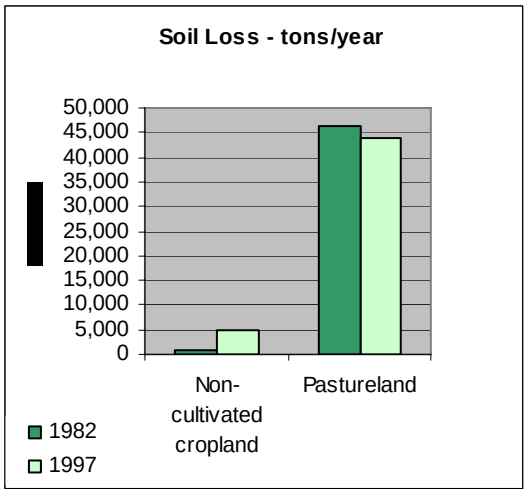
CROPLAND CATEGORY	Total Acres	% of Cropland Category	% of all Cropland	% of Sub-basin
HEL				
Highly Erodible Cropland at or below "T"	1,700	9%	100%	0.003%
Highly Erodible Cropland above "T"	17,100	91%	100%	5%
TOTALS FOR HIGHLY ERODIBLE CROPLAND	**18,800**	**100%**	**100%**	**5.003%**
NON-HEL				
Non-Highly Erodible Cropland at or below "T"	74,600	65%	100%	22%
Non-Highly Erodible Cropland above "T"	39,300	35%	100%	11%
TOTALS FOR NON-HIGHLY ERODIBLE CROPLAND	**113,900**	**100%**	**100%**	**33%**
GRAND TOTALS	**132,700**	**100%**	**100%**	**38.003%**

Pastureland Erosion[2]

This table reports USLE rates and acres in relationship to “T” for pastureland (tons/acre/year).

PASTURELAND CATEGORY	Total Acres	% of Category	USLE tons/acre/year	% of Sub-basin
HEL				
Highly Erodible Cropland at or below "T"	0	0%	0	0%
Highly Erodible Cropland above "T"	0	0%	0	0%
TOTALS FOR HIGHLY ERODIBLE CROPLAND	**0**	**00%**	**0**	**0%**
NON-HEL				
Non-Highly Erodible Cropland at or below "T"	148,500	93%	0.47	31%
Non-Highly Erodible Cropland above "T"	11,300	7%	3.05	2%
TOTALS FOR NON-HIGHLY ERODIBLE CROPLAND	**159,800**	**100%**	**0.65**	**33%**
GRAND TOTALS	**159,800**	**100%**	**-**	**33%**

USLE Soil Loss Rates (tons/year)[2]



Non-cultivated Cropland

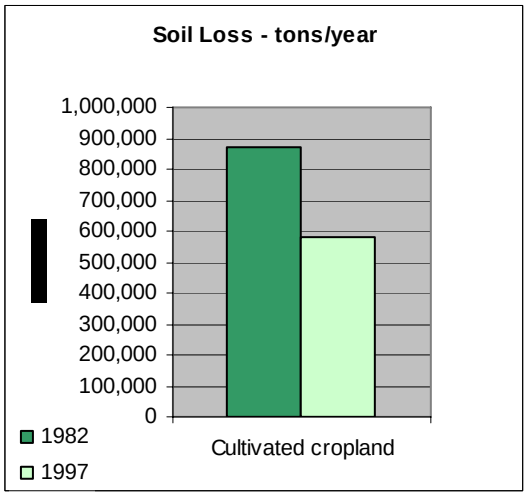
1982 1,000 tons per acre

1997 4,900 tons per acre

Pastureland

1982 46,200 tons per acre

1997 43,900 tons per acre



Cultivated Cropland

1982 871,400 tons per acre

1997 583,100 tons per acre

C. Water Quality

303d Listed Waters[17,35]

Section 303(d) of the federal Clean Water Act requires that each state identify waters that are not meeting water quality standards and for which adequate water pollution controls have not been required. Water quality standards protect such beneficial uses of water as whole body contact and secondary contact recreation, maintaining fish and other aquatic life, and providing drinking and processing water for people, wildlife, livestock and industry. The 303(d) list helps state and federal agencies keep track of waters that are impaired but not addressed by normal water pollution control programs.

Figure 17

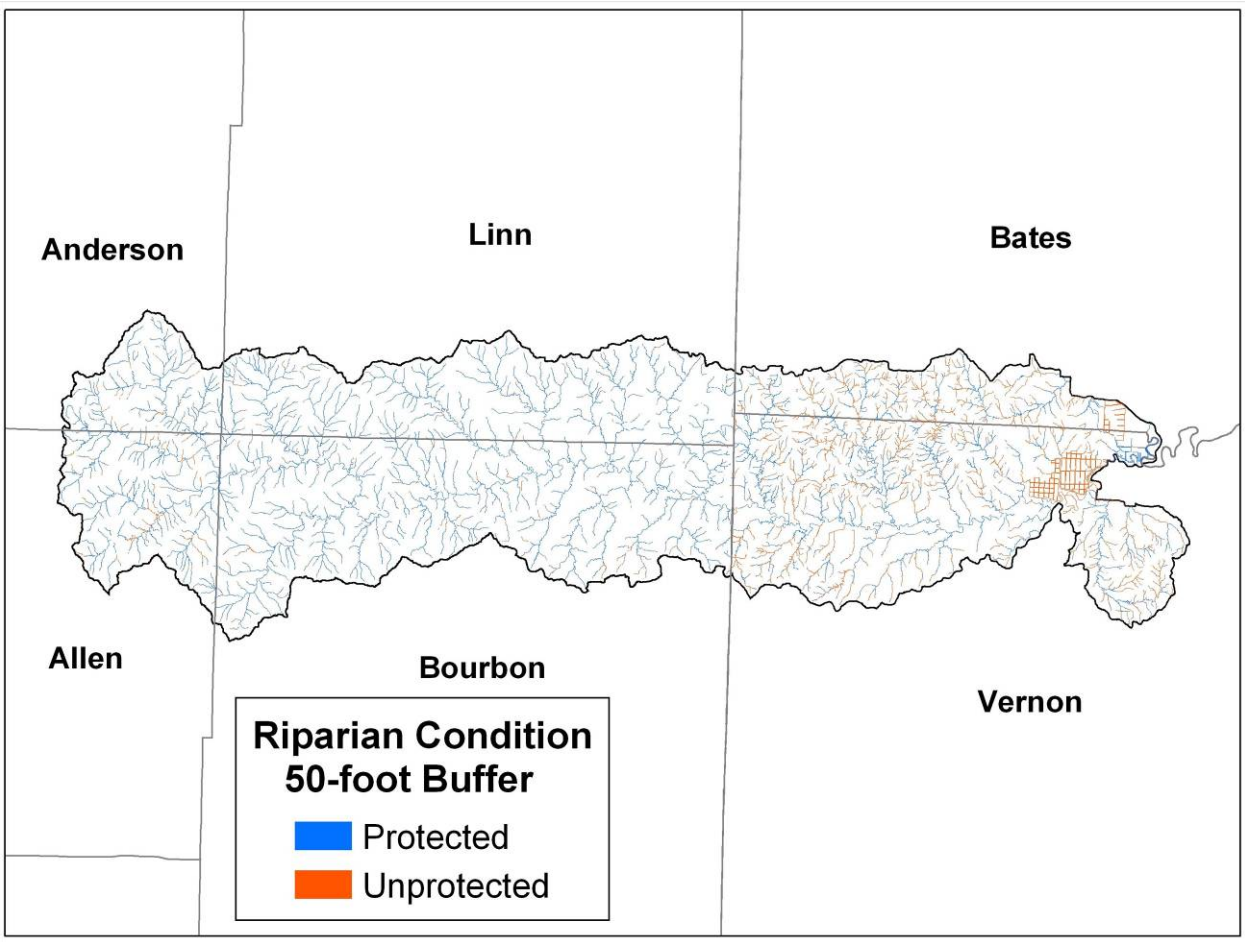
Water Body	State	County	Pollutant(s)
Clever Creek	Kansas	Bourbon	Fecal Coliform Bacteria
Elk Creek	Kansas	Bourbon, Linn	Fecal Coliform Bacteria
Fish Creek	Kansas	Bourbon	Fecal Coliform Bacteria
Laberdie Creek—East	Kansas	Bourbon, Linn	Fecal Coliform Bacteria
Limestone Creek	Kansas	Allen, Bourbon	Fecal Coliform Bacteria
Little Osage River	Kansas	Allen, Bourbon	Fecal Coliform Bacteria
Lost Creek	Kansas	Bourbon, Linn	Fecal Coliform Bacteria
Owl Creek	Kansas	Bourbon, Linn	Fecal Coliform Bacteria
Reagan Branch	Kansas	Bourbon	Fecal Coliform Bacteria
Prescott City Lake	Kansas	Linn	Fecal Coliform Bacteria

Riparian Corridor Condition[8,18]

The condition of the riparian zone adjacent to streams has a critical impact on water quality. Permanent and deeply-rooted streambank vegetation slows run-off of nutrients and pollutants, and reduces sedimentation and solar heating. NRCS riparian practice standards specify 50-feet vegetated buffers along first and second order streams and 100-feet for third order and higher streams.

The 1:24,000 National Hydrologic Dataset (NHD) stream network is the highest resolution stream representation available consistently for the sub-basin states. Stream order is not an attribute of these data; therefore, the streams were all buffered by 50-feet to give the most conservative representation of riparian condition. Buffered streams were used to subset the common land unit (CLU) data, land parcel data developed and maintained by the USDA-Farm Service Agency. The land cover attribute in the CLU was used to characterize the vegetative condition of the buffers. Cropland (which includes pasture and hayland), urban, mined and barren cover types were considered “unprotected” or vulnerable riparian conditions, while forestland, rangeland and water were considered “protected”. Results are presented by county and sub-basin in the table and map below.

Figure 18



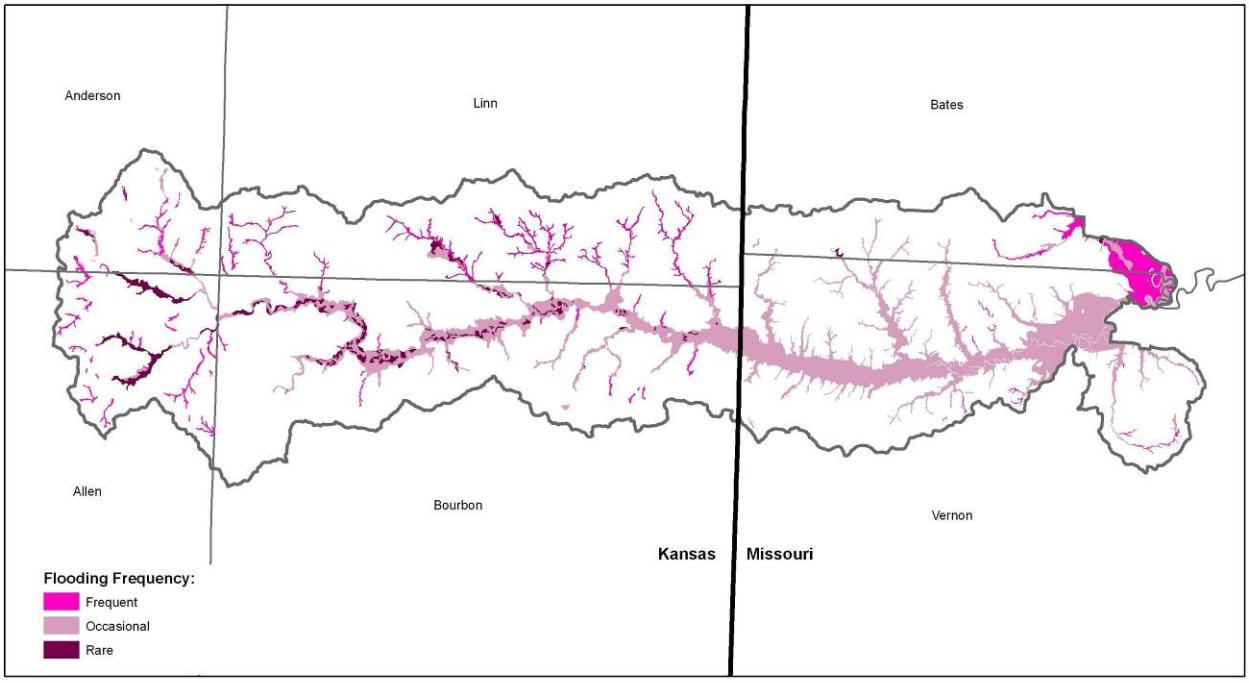
County	State	Stream Miles (in sub-basin)	50-ft. Stream Buffer (in acres)	Percent Protected
Anderson	Kansas	93	1,073	86%
Bates	Missouri	182	2,142	37%
Vernon	Missouri	635	7,457	44%
Bourbon	Kansas	435	5,045	90%
Linn	Kansas	251	2,939	93%
Allen	Kansas	155	1,816	81%
Total in Sub-basin		**1,751**	**20,472**	**67%**

Flooding Frequency[5]

Flooding frequencies are defined by the number of times flooding occurs over a period of time and expressed as a class. The classes of flooding are defined as follows:

- Rare—Flooding unlikely but possible under unusual weather conditions; 1 to 5 percent chance of flooding in any year or nearly 1 to 5 times in 100 years
- Occasional—Flooding is expected infrequently under usual weather conditions; 5 to 50 percent chance of flooding in any year or 5 to 50 times in 100 years.
- Frequent—Flooding is likely to occur often under usual weather conditions; more than a 50 percent chance of flooding in any year or more than 50 times in 100 years, but less than a 50 percent chance of flooding in all months in any year.

Figure 19



D. Water Quantity

Public Water Supply[20,21,22,23]

Missouri's 5.8 million residents draw their water supplies from ground and surface sources that vary tremendously in both quality and quantity. These variations are, to a large extent, controlled by geology and land use. North of the Missouri River, herbicides, sediments, and nutrients are the primary concerns in surface water sources while well sources contend with heavy mineralization, nitrates, and pesticides. In the Ozark Highlands, ground water, the primary water supply source, is vulnerable to aquifer degradation from contaminated surface runoff and leachates through highly permeable soils and bedrock. Missouri's alluvial aquifers supply large quantities of high quality water, primarily to population centers located near the larger rivers and the Mississippi embayment covering most of the southeastern corner of the state. Shallow wells are vulnerable to nitrate and pesticide contamination and the deeper wills in highly urbanized areas are at risk from a wide variety of chemical pollutants.

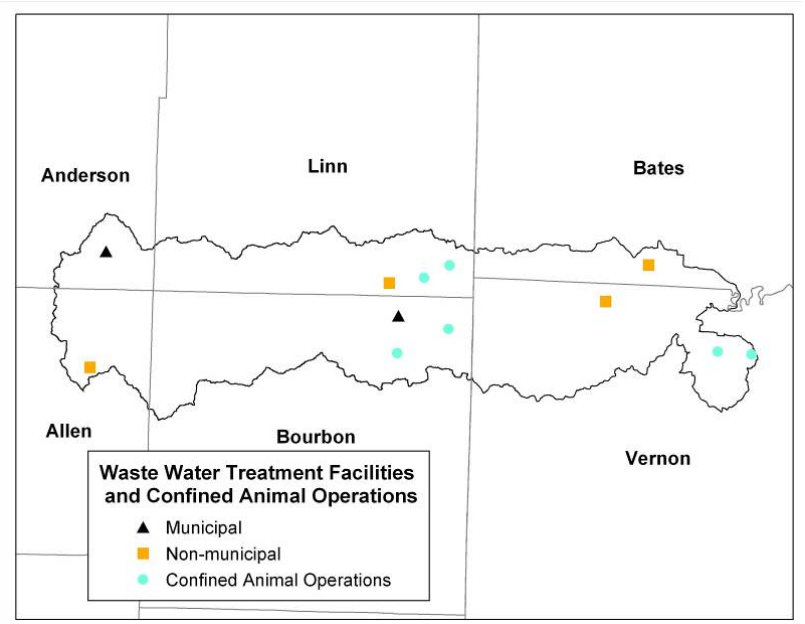
Detailed information is available for individual public drinking supply systems and the spatial distribution of other drinking water supply features (wells, intakes, tanks, treatment plants, pumping stations, springs, and lakes) from MDNR. The 2006 Missouri Water Quality Report provides current water quality assessments and summarizes water quality issues around the state. The 2007 Census of Missouri Public Water Systems is a comprehensive description of city, water district, subdivision, and non-community water systems including type of treatment processes and chemical analyses of community water systems. The 2005 Missouri Water Supply Study provides detailed technical hydrologic and water resource engineering data for drought planning for 34 community water systems in north and west central Missouri.

Waste Water Treatment Facilities and Concentrated Animal Feeding Operations[19]

The National Pollutant Discharge Eliminations System (NPDES) facilities database is a point data set depicting outfall locations of waste water facilities requiring and holding NPDES operating permits. One type of NDPES facility is a concentrated animal feeding operation, or CAFO. A CAFO is defined as having more than 7000 animal units confined in an area with less than 50% vegetation ground cover. Smaller animal unit operations may be designated a CAFO if they discharge directly into waters of the State or have a post history of discharge violations. The animal unit is a unit of measurement to compare waste produced by various animal types, using one beef feeder as a reference.

The Little Osage sub-basin has 4 dairy and 2 poultry CAFOs. It has 2 municipal and 4 non-municipal waste water facilities. The municipal sites are for sewage treatment while the non-municipal sites are small rural industry.

Figure 20



D. Forestry

Forests cover about a third of Missouri - forests containing some of the finest oak, walnut, and red cedar found anywhere. Forests are Missouri's greatest renewable resource, providing many economic, environmental and social benefits. They protect hillsides from erosion, keeping streams and rivers clean. They filter the air, soften the extremes of the weather, and add beauty to cities and towns. Much of Missouri's recreation and tourism industry is centered in the forested regions of the state. And forests are a diverse resource of plants, animals, birds, and other life forms. Annual growth of forests in Missouri far exceeds the amount harvested, ensuring ample forests for future generations. The majority of tree species are hardwoods with softwoods locally important in certain regions of the state. Forest products are also important to Missouri. Harvesting and processing trees into wood products gives thousands of people jobs and contributes about $3 billion each year to Missouri's economy. Private landowners control 85 percent of the forest land in Missouri. Most of these private forested acres in Missouri are not following a management plan.

The following tables for this sub-basin are based on data compiled from The Forest Inventory and Analysis (FIA) Program of the U.S. Department of Agriculture (USDA) Forest Service. Information from USDA-Forest Service, National Forest Inventory and Analysis Database, 2005 is available at www.fia.fs.fed.us/tools-data/default.asp.

Area of Forestland by Ownership in Sub-Basin

Private	30,745 acres
Federal	0 acres
State	0 acres
County and municipal	0 acres
Other	0 acres
Total	30,745 acres

Area of Forestland by Stocking Class in Sub-Basin

Overstocked	0 acres
Fully stocked	5,687 acres
Medium stocked	6,098 acres
Poorly stocked	18,729 acres
Non-stocked	231 acres
Total Growing Stock	30,745 acres

Area of Forestland by Productivity Site Class in Sub-Basin

165-224	0 acres
120-164	5,687 acres
85-119	4,351 acres
50-84	17,364 acres
0-49	9,031 acres
Total	30,745 acres

Net Volume of Growing Stock on Forestland by Species Type in Sub-Basin

Softwoods	47,004 cubic feet
Hardwoods	30,263,214 cubic feet
Other	0 cubic feet
Total	30,310,218 cubic feet

E. Threatened and Endangered Species[20,35]

The Missouri and Kansas Natural Heritage databases store locations, population status and habitat information about species and communities of conservation concern. The table below is a subset of the Heritage records that occur in the Little Osage sub-basin, restricted to federally threatened, endangered or candidate and state threatened or endangered species. While Heritage data can not prove the absence of a species in an area, it is the best collection available of known locations of sensitive species and is used to assess potential impacts of various land management activities in the region.

Figure 21

Species Common Name	Scientific Name	Threatened, Endangered, or Candidate	Federal or State Listing
Birds			
Barn Owl	Tyto alba	Endangered	State-MO
Greater Prairie Chicken	Tympanchus cupido	Endangered	State-MO
Mammals			
Plains Spotted Skunk	Spilogale putorius interrupta	Endangered	State-MO
Black-tailed Jackrabbit	Lepus californicus	Endangered	State-MO
Plants			
Mead's Milkweed	Asclepias Meadii	Threatened/ Endangered	Federal/ State-MO

Census and Social Data

A. Census Bureau[21]

Block group-level GIS data files from the 2000 Census were used to illustrate population, income and the agricultural cohort for the sub-basin. Spatial files were clipped by the sub-basin boundary. The percent of the block group falling in the watershed was calculated, and population figures were prorated by this value. Although this technique erroneously assumes even spatial distribution of population, it is a more accurate population count for the sub-basin than including the entire block group population.

Figure 22a. 1990 Population.

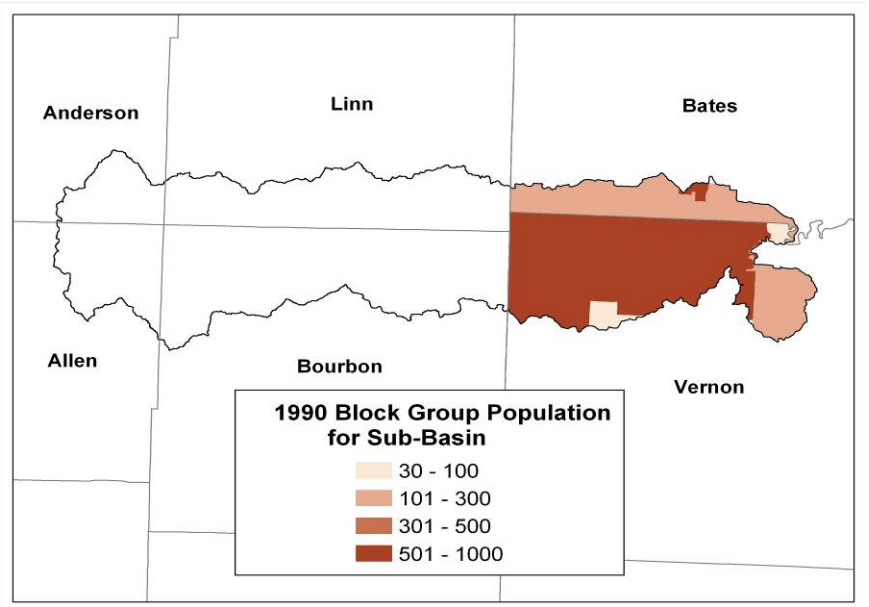
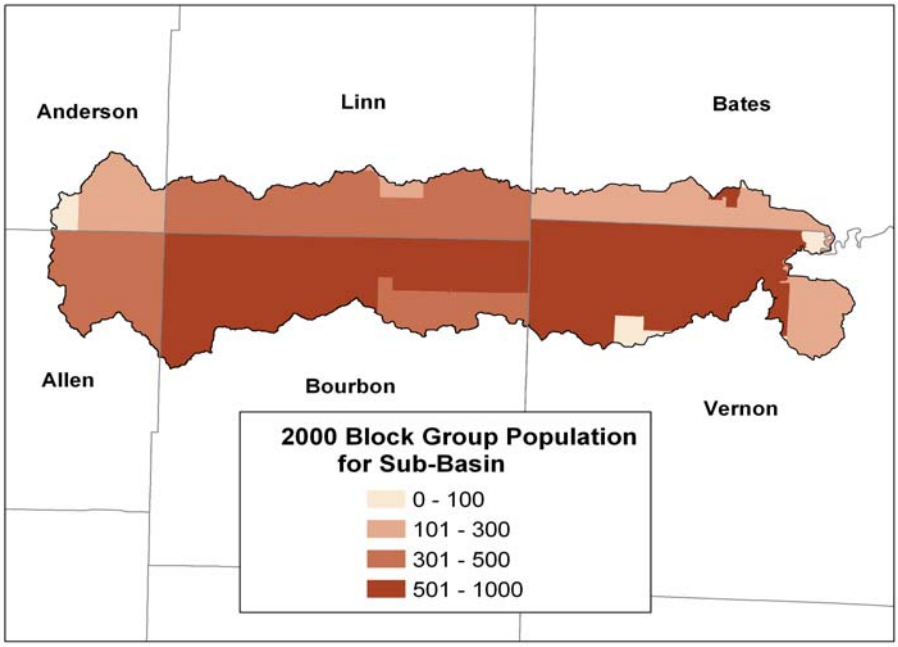


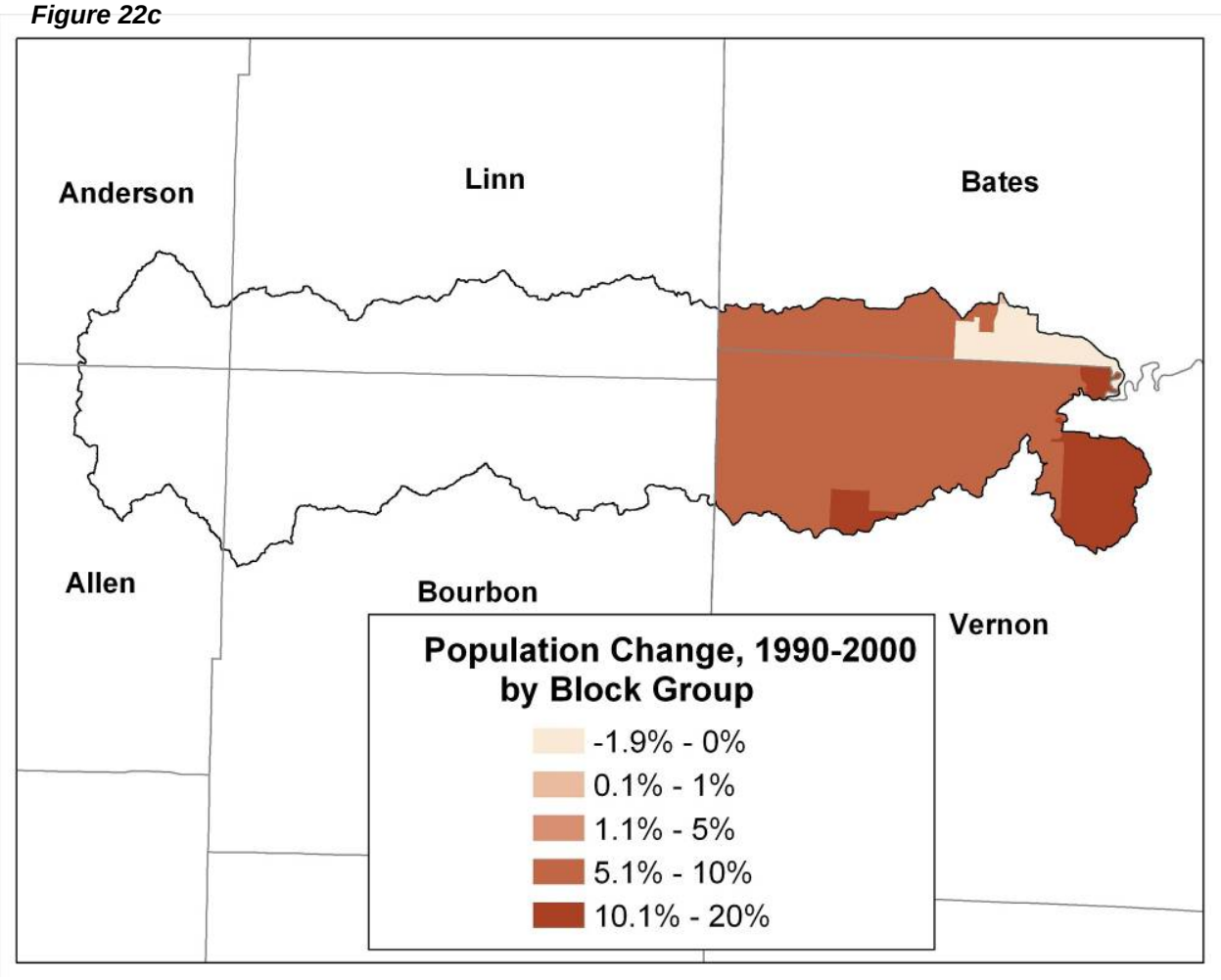
Figure 22b. 2000 Population.



Change in Population

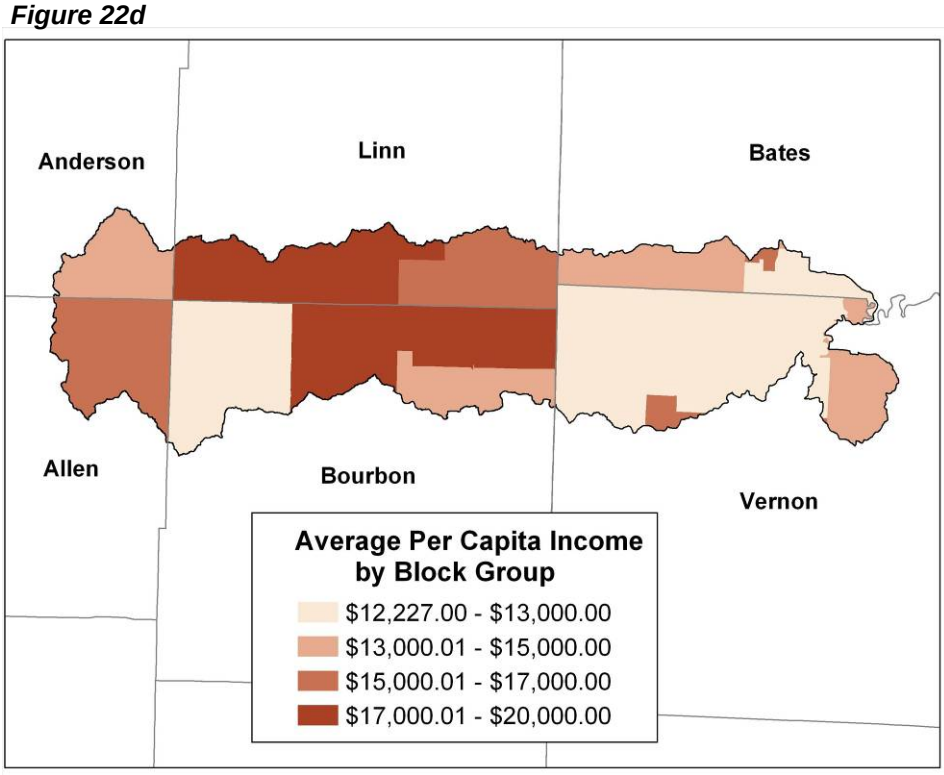
The 1990 Census information was not available for Kansas, so change in population for the entire sub-basin was not calculated or mapped. For the Missouri portion of the sub-basin, population changed from 2,189 in 1990 to 2,378 in 2000, for a growth of 9 per cent. Per capita income and per cent living on farms by block groups are also illustrated.

Figure 22c



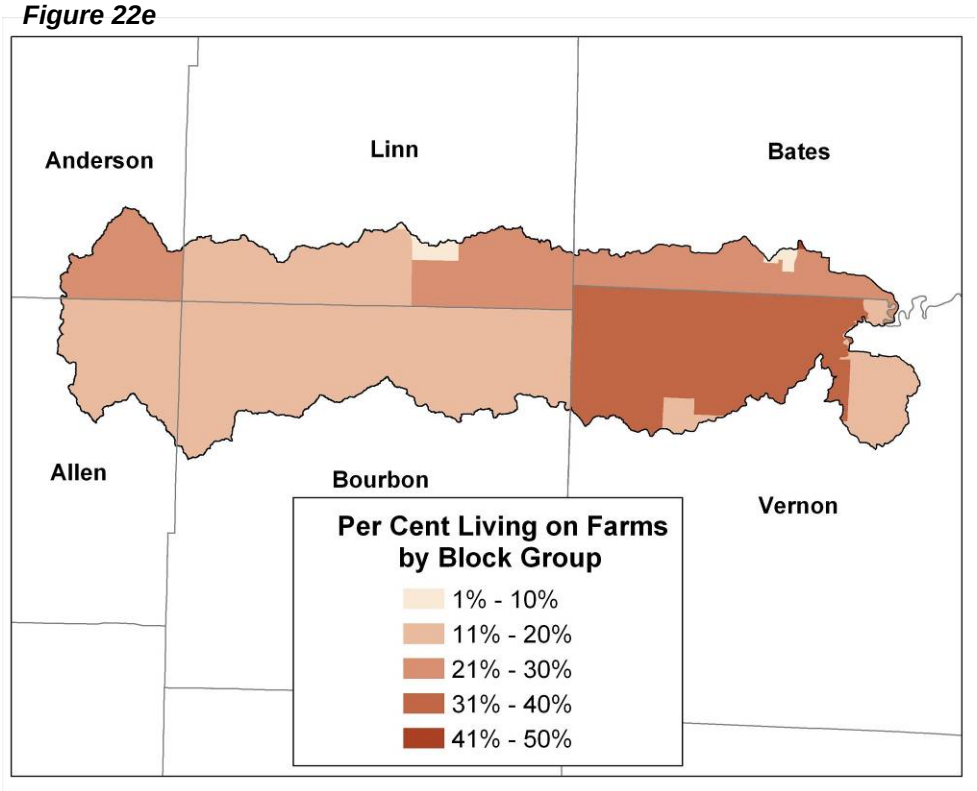
Income

Figure 22d



Farms

Figure 22e



B. Agricultural Census[23]

The data shown in the table are totals for complete counties. County land area acreages and percentages are supplied to assist the user in calculating sub-county estimates. Grazing livestock includes cattle, sheep, horses and ponies and goats.

Figure 23

COUNTY SUMMARY HIGHLIGHTS, 2002						
	Bates, MO	**Vernon, MO**	**Allen, KS**	**Anderson, KS**	**Bourbon, KS**	**Linn, KS**
Farms	1,293	1,399	619	654	838	903
Land in Farms	468,118	426,450	280,479	378,786	339,073	310,836
Hogs & Pigs	11,090	135,141	1,103	3,694	unavailable	6,084
Poultry	3,071	194,910	338	3,532	1,292	862
Cattle	81,384	62,046	34,746	34,746	59,696	42,233
Sheep	1,217	1,399	246	716	327	125
Horses & Ponies	2,034	1,495	575	796	208	1,208
Goats	125	907	234	8	59	unavailable
Cropland Used only for Pasture or Grazing	68,898 acres	49,187 acres	22,721 acres	30,354 acres	38,214 acres	30,313 acres
Woodland pastured	15,393 acres	18,552 acres	8,957 acres	12,809 acres	13,370 acres	15,368 acres
Permanent Pastureland and Rangeland	98,268 acres	94,227 acres	87,094 acres	111,980 acres	140,883 acres	86,549 acres
Pastureland, All Types	182,559 acres	161,966 acres	118,772 acres	155,143 acres	189,989 acres	132,230 acres
Percent Pastureland to All Land in Farms	39%	38%	42%	41%	56%	43%
Sum of All Grazing Live-stock	84,760	65,847	35,801	36,266	57,290	43,566
Pastureland per Animal	2.2 acres	2.5 acres	3.3 acres	4.3 acres	3.3 acres	3 acres

Status of Resources

A. PRS[24]

NRCS' Performance Results System (PRS) is a consolidated reporting system of conservation activities. The following tables summarize conservation systems and practices planned and applied in the sub-basin for the designated time periods. PRS data, in conjunction with other information, are used to assess the current state of the resources in the sub-basin and past efforts to address resource concerns.

FY = Fiscal Year

PRS Data	FY 2000	FY 2001	FY 2002	FY 2003	FY 2004	FY 2005	FY 2006	FY 2007	Average per Year
Total Acres Conservation Systems Applied	5,804	9,757	5,423	7,476	Not reported by Hydrologic Unit (HU)	7,418	8,773	7,743	7,978

Figure 24. Conservation Practices Applied

Summary Conservation Practices (PRS Number)	2005	2006	2007
Animal Mortality Facility (316)		1	
Brush Management (314)	335 acres	104 acres	136 acres
Comprehensive Nutrient Management Plan (100)	1		
Conservation Cover (327)	110	15	645
Conservation Crop Rotation (328)	1,916 acres	1,242 acres	1,508 acres
Contour Farming (330)	93 acres	229 acres	
Critical Area Planting (342)	8 acres	14 acres	15 acres
Dike (356)			3,860 feet
Diversion (362)	2,110 feet	1,627 feet	200 feet
Early Successional Habitat Development/Management (647)		142 acres	79 acres
Fence (382)	4,821 feet	6,422 feet	14,892 feet
Field Border (386)	57,212 feet	129,953 feet	43,799 feet
Filter Strip (393)	3 acres		2 acres
Forage Harvest Management (511)	839 acres	316 acres	254 acres
Forest Stand Improvement (666)			6 acres
Grade Stabilization Structure (410)		1	3
Grassed Waterway (412)	17 acres	117 acres	8 acres
Nutrient Management (590)	975 acres	264 acres	339 acres
Pasture and Hay Planting (512)	395 acres	101 acres	67 acres

Conservation Practices Applied (continued)

Summary Conservation Practices	2005	2006	2007
Pest Management (595)	1,286 acres	836 acres	439 acres
Pipeline (516)	2,094 feet	5,630 feet	900 feet
Pond (378)	5	7	7
Prescribed Burning (338)	178 acres	177 acres	1,027 acres
Prescribed Grazing (528)	1,629 acres	1,600 acres	521 acres
Prescribed Grazing (528A)	68 acres		
Residue and Tillage Management, Mulch Till (345)			306 acres
Residue and Tillage Management, No-Till/Strip Till/ Direct Seed (329)			517 acres
Residue Management, Mulch Till (329B)	665 acres	1,151 acres	92 acres
Residue Management, No-Till/Strip Till (329A)	464 acres	287 acres	378 acres
Residue Management, Seasonal (344)	414 acres	605 acres	214 acres
Restoration and Management of Declining Habitats (643)	540 acres	384 acres	296 acres
Riparian Forest Buffer (391)	71 acres		
Terrace (600)	42,105 feet	94,076 feet	19,374 feet
Tree/Shrub Establishment (612)		35 acres	5 acres
Underground Outlet (620)	4,505 feet	610 feet	
Upland Wildlife Habitat Management (645)	1,125 acres	1,907 acres	1,950 acres
Use Exclusion (472)	1,400 acres	1,442 acres	1,658 acres
Water Well (642)			1
Watering Facility (614)	2	13	9
Wetland Restoration (657)	201 acres		76 acres
Wetland Wildlife Habitat Management (644)	48 acres	1 acre	

B. Watershed Projects

In addition to conservation activities itemized for individual land units, state and Federal watershed programs contribute to the current state of resources. Past and current activities within this sub-basin are summarized in the table below.

Figure 25

AgNPS SALT Project Name[25]	Status
Osage Plains	In-Progress

C. Farm Bill Program Lands[26]

USDA programs involving long-term contracts or long-term to permanent easements on land units allow for sustained conservation and restoration goals. In this sub-basin, the Conservation Reserve and Wetlands Reserve programs have considerable participation, as summarized in the table below.

Figure 26

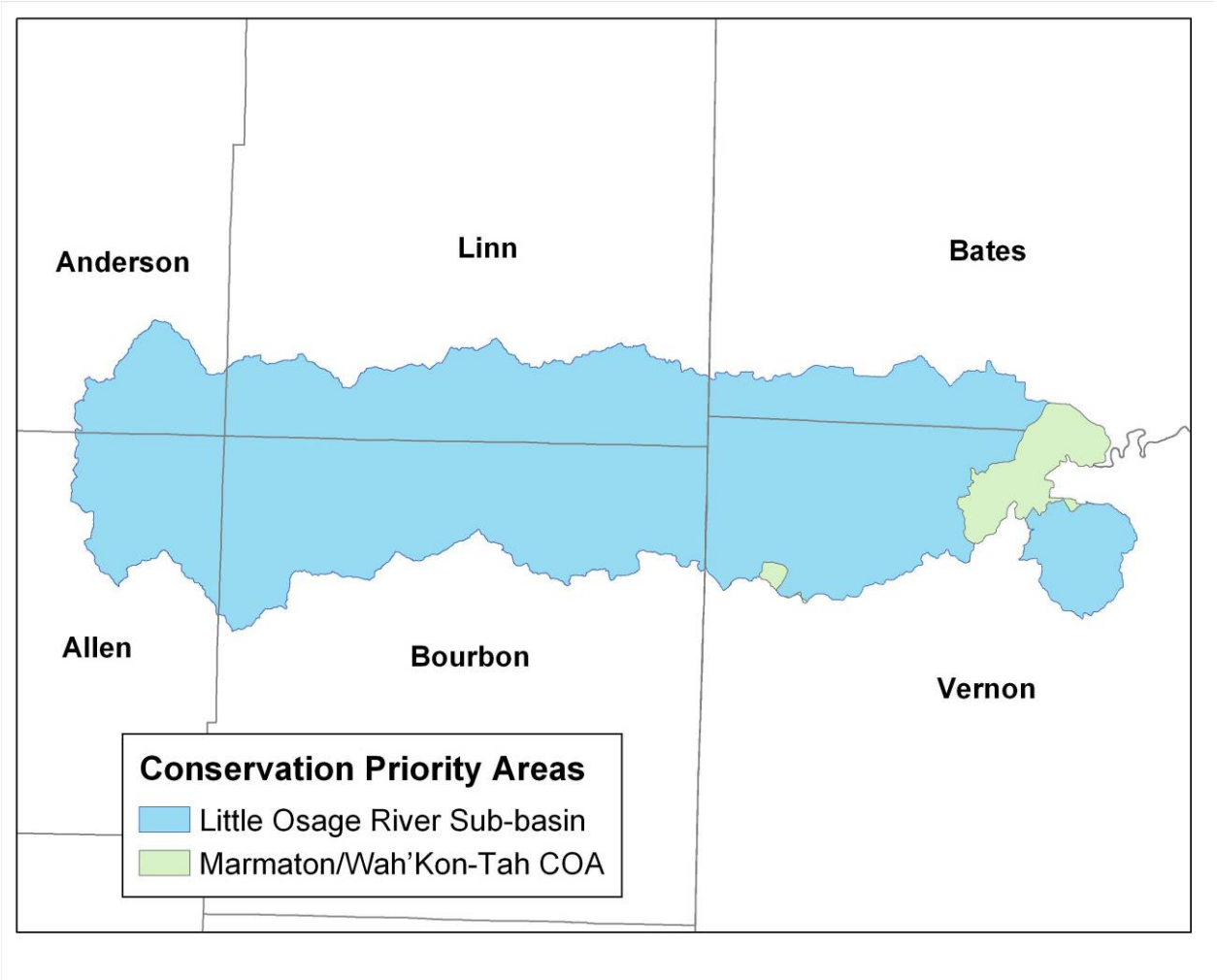
Program	Number of Acres	Number of Contracts or Easements
Conservation Reserve Program (CRP)	28,021	NA
Wetland Reserve Program (WRP)	9,213	8 easements

D. Conservation Opportunity Areas[27]

The Missouri Department of Conservation joined with resource partners to take an "all conservation" approach via a framework referred to as Conservation Opportunity Areas (COAs). COAs identify the best places where partners can combine technology, expertise and resources for all conservation, with such focused efforts providing enhanced results. Various future funding opportunities for resource projects will give priority to work addressing the conservation goals within COAs.

Stakeholder groups have been formed and resources profiles developed for thirty-three of the highest priority COAs in Missouri. The Little Osage River sub-basin contains a portion of the 197,672-acres Marmaton/Wah'Kon-Tah COA in Bates and Vernon counties in Missouri. The Marmaton/Wah'Kon-Tah COA is the last remaining wet prairie and bottomland forest expanses in Missouri. Data similar to the Missouri COA project were not available for Kansas.

Figure 27



E. Environmental Protection Agency Priority Watersheds[28,29]

The Environmental Protection Agency (EPA) has worked in conjunction with Kansas Department of Health and Environment and Missouri Departments of Natural Resources to identify priority watersheds in each state. The prioritization process paid particular attention to those watersheds where there is a high potential to accomplish measurable water quality improvements in a relatively short time. The target watersheds are used to target requests for Clean Water Act 319 funds. The Little Osage sub-basin has no priority watersheds in Missouri. In Kansas, the entire Marais des Cygnes River basin has been identified as a priority watershed, of which the Little Osage River sub-basin in a part.

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Index of Maps and Graphics