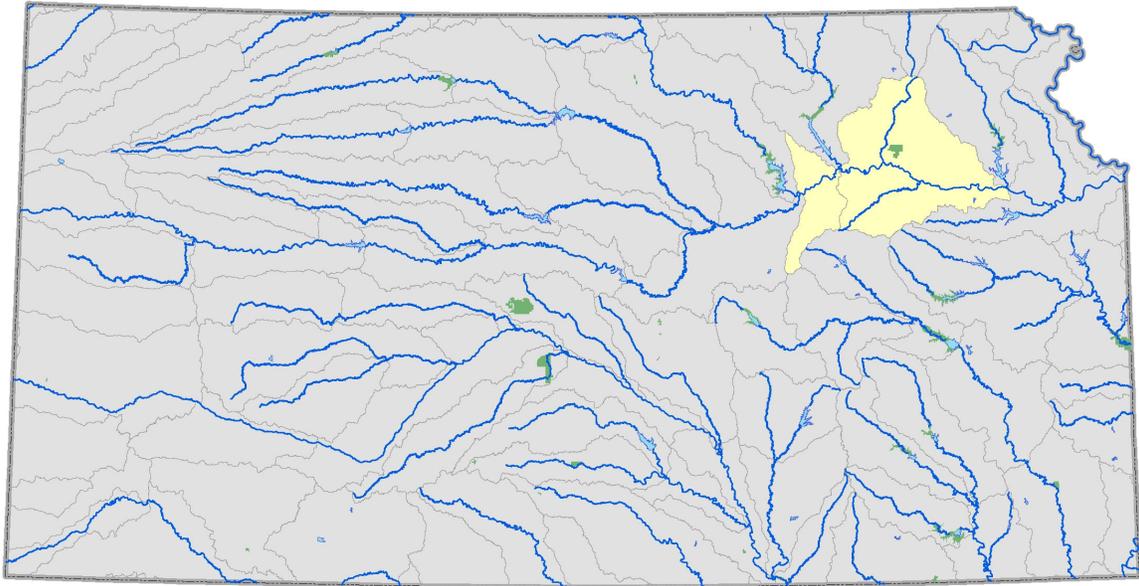


# **The Watersheds of the Middle and Upper Kansas Sub-Basins**

## **A Report on the Water Quality and Lands**



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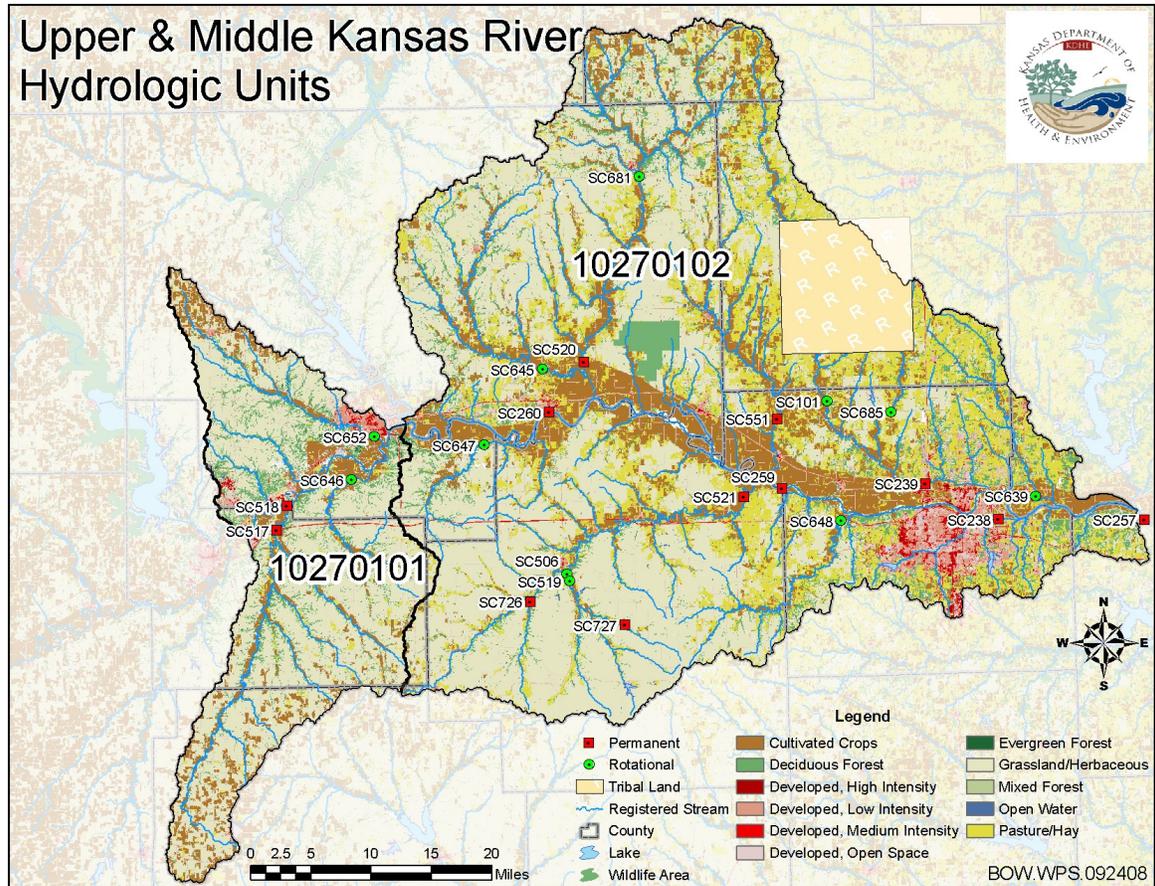
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# A Sub-Basin Overview:

The Upper and Middle Kansas subbasins (10270101 and 10270102, respectively) (Figure 1) cover approximately 2,700 square miles, largely contained in the Middle Kansas subbasin, which is more than 2,150 square miles. These hydrologic units begin at the junction of the Smoky Hill & Republican Rivers in Geary County near Junction City, and extend downstream to the junction of the Kansas River and the Delaware River on the border between Jefferson and Douglas County northwest of Lawrence.



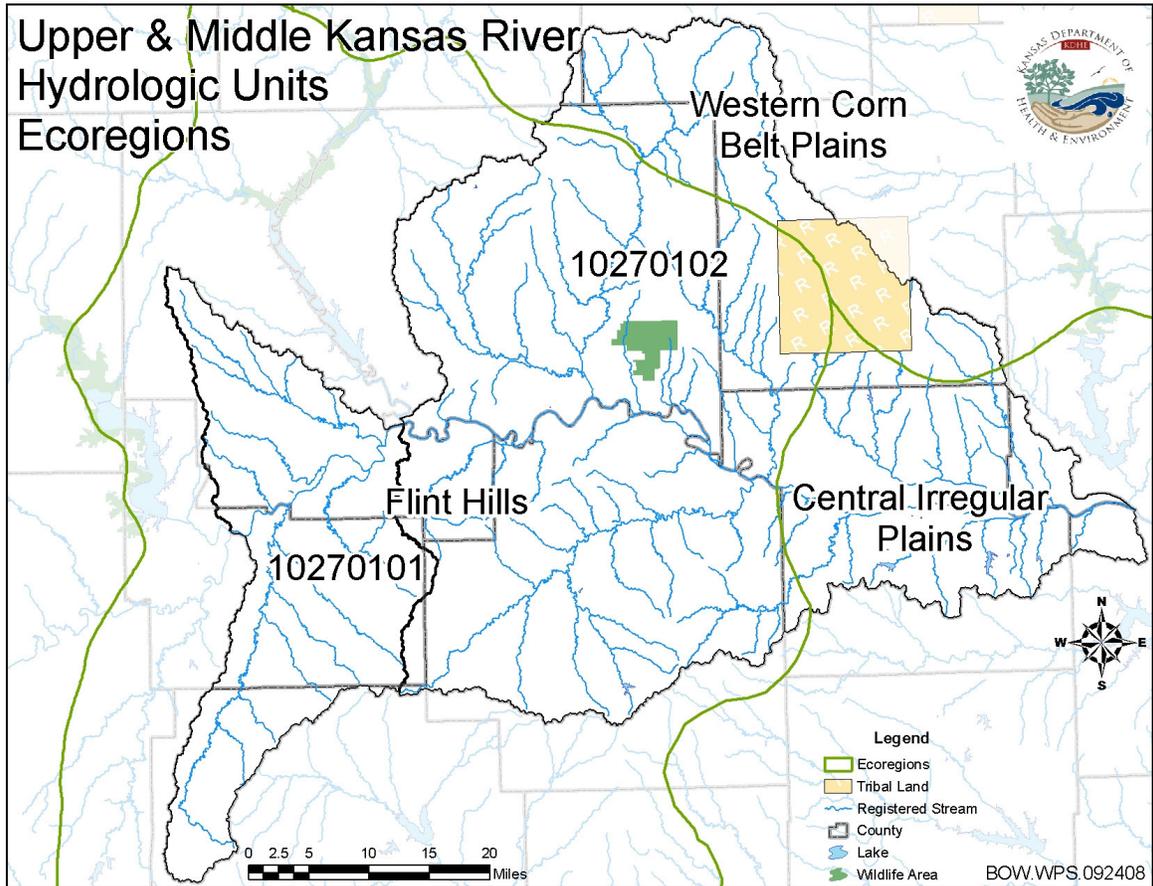
The Upper & Middle Kansas hydrologic units, and associated land uses.

This area contains 22 Kansas Department of Health & Environment (KDHE) stream chemistry monitoring stations, and drains to a 23<sup>rd</sup> station, SC257, which monitors the Kansas River below the junction with the Delaware River. These stations are evenly divided between permanent stations (11), which are sampled six times per year every year, and rotational stations (11), which are sampled six times per year during every fourth year. Three stations monitor the Kansas River, and the remaining 19 monitor tributary streams.

In addition to the tributary streams included in these two hydrologic units, water quality at Kansas River stations is influenced by the Big Blue River, the Republican River and

the Smoky Hill River. The total watershed that drains to this area includes over 50,000 square miles stretching into Nebraska and Colorado.

The area includes parts of three ecoregions (Figure 2), dominated by the Flint Hills (71%), with smaller areas of Western Corn Belt Plains (12%) & Central Irregular Plains (17%) in the east.



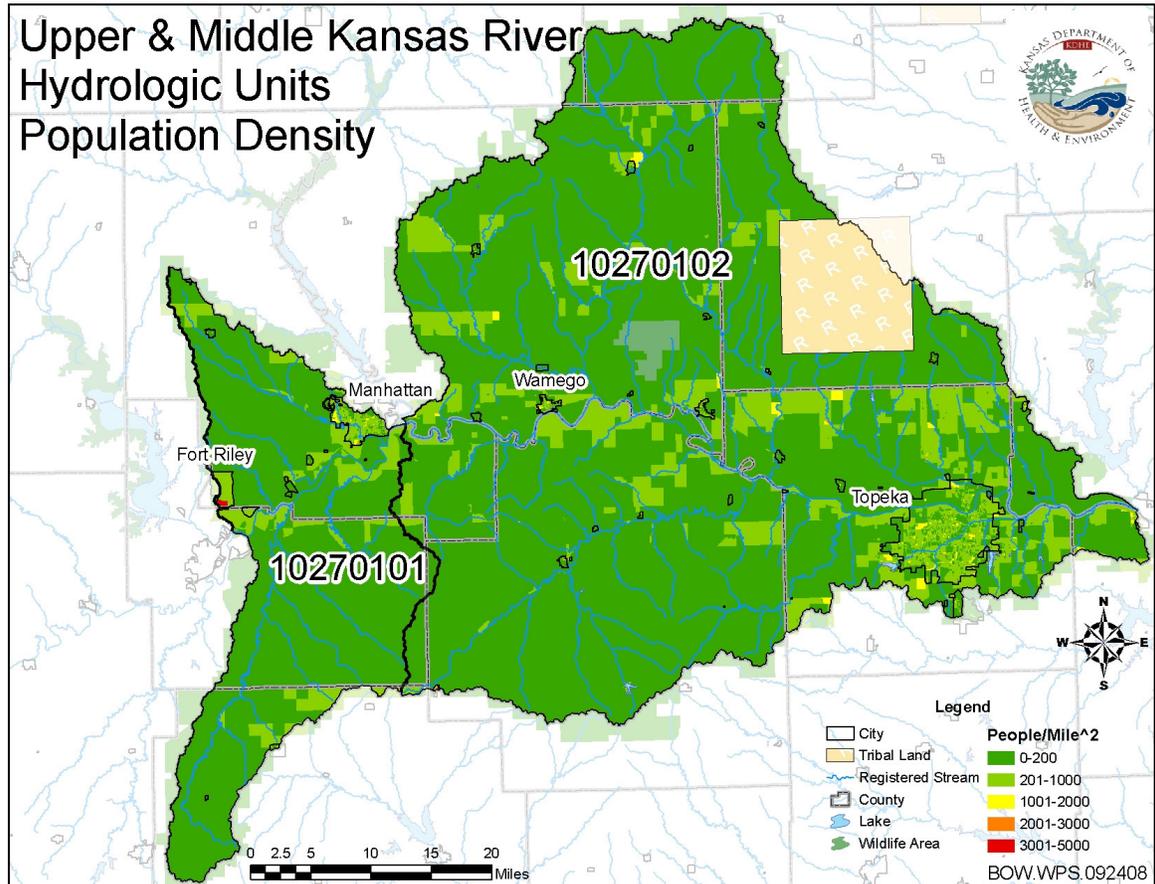
Ecoregions of the Upper & Middle Kansas River hydrologic units.

Land use over the region is dominated by permanent grassland, with significant amounts of row crop production in the alluvial valleys (Table 1, Figure 1). The remainder of the land is largely in woodland areas, typically concentrated around streams and rivers, and developed land concentrated in the cities of the region.

Permanent Grass	65.01%
Cropland	16.08%
Forest	10.29%
Developed Land	7.37%

Land use in the Upper and Middle Kansas hydrologic units. Other minor uses account for the remaining 1% of cover. Land use data drawn from the 2001 National Land Cover Dataset.

As of the 2000 census, the population of the area was slightly more than 250,000 people, largely contained in the cities along the Kansas River (Figure 3). Topeka had nearly half the total population of the area (122,377), Manhattan had nearly 18% (44,831), though some of the Manhattan city limits lie outside these hydrologic units, and the remainder of the population was spread out between smaller cities and the rural areas.



Population density derived from 2000 federal census block figures, and major cities within the Upper and Middle Kansas hydrologic units.

Political jurisdictions in the area include cities, counties, watershed districts, federal lands owned by the Department of Defense, tribal lands within the Prairie Band Pottawatomie reservation, state lands operated by both university and the Kansas Department of Wildlife & Parks, and privately held rural land, which comprises most of the area. The area is completely contained within Kansas' Second Congressional District.

The Mid and Upper-Kansas sub-basins include a large number of subwatershed level boundaries. These hydrologic units, or HUCs, are areas of approximately equal size that share drainage to a common point. They differ from true watersheds in that most have one or more HUC upstream from them, providing water from an area not included in the HUC. In addition a recent change has been made in the identification numbers of the HUCs. A map and explanation of the HUCs of the Mid and Upper-Kansas follows.

In April, 2008, EPA in conjunction with partner agencies released the complete, nationwide GIS coverage data for consistent watershed boundaries in all fifty states. While Kansas has used a HUC8/11/14 system for some years, our neighboring states, and many others have used a HUC8/10/12 system. The disparity has caused some confusion, and required regular explanations to a variety of stakeholders about the reason Kansas system was not consistent with the numbering system used by our neighbors. To avoid future confusion Kansas is officially adopting the HUC8/10/12 system, which will require some re-education of stakeholders and professionals here in Kansas, to ensure that we successfully adopt this new system. In general, the shift is fairly ordinary, as very few of the actual boundaries of Kansas HUC14s were changed when they received their new numbers as HUC12s. Where changes occurred, they typically involved HUCs that were near, or crossing the state boundary, and were adjusted to ensure consistency between neighboring states.

To convert a HUC14 to a HUC12 you remove the trailing zero on each of the sub-codes, so that HUC14 10270102(090)(010) becomes HUC12 10270102(09)(01). This also means that HUC11 10270102(090) becomes HUC10 10270102(09). Below is a map showing the location of the HUC12s in the Mid and Upper-Kansas area. To simplify reading the map, the individual units have been labeled only with their subcodes, and color coded at each level to clarify which part of the HUC12 number is being specified. The HUC10s are color coded, so that any particular group of HUC12s that belong to the same HUC10 are colored the same color as each other. HUC8 codes are marked in black, HUC10 subcodes are marked in orange and HUC12 subcodes are marked in blue.

**An example of how to determine the HUC12 within this map-**

Westmoreland, located on Highway 99 in Pottawatomie County is on the upper reaches of East Branch Rock Creek. Just north of the town, in small blue numbers is **01**, the HUC12 subcode. Just south of the town, in medium sized orange numbers is **01**, the HUC10 subcode. In the center of the map in large black letters is **10270102**, the HUC8 code. Westmoreland, then, is located in **102701020101**, or in ordinary font, 102701020101.



# Water Quality-

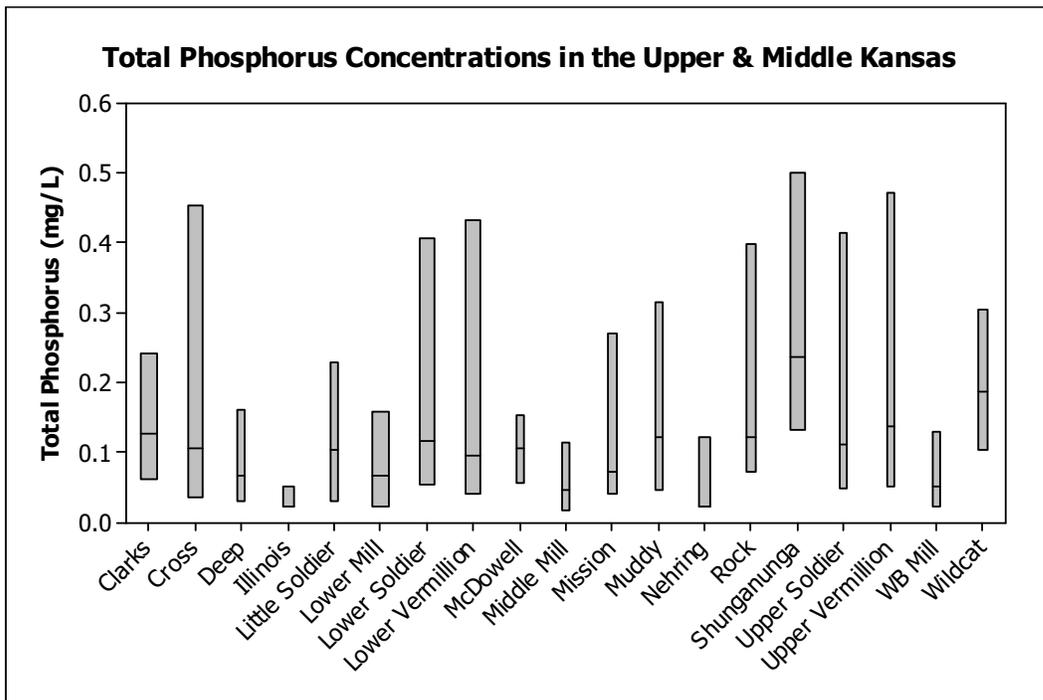
Water quality in the area ranges from exceptional, including a national United States Geological Station benchmark stream to severely degraded. Major influences on the water quality include row crop production, unstable streambanks, cattle grazing, impervious surfaces and urban discharge.

Because this region is largely impacted by nutrients, sediment and bacteria, a ranking approach was used to determine the relative quality at each of the 19 monitoring stations on tributaries. Because these stations have differing record lengths, and because many of these pollutants exhibit a non-normal data distribution, a non-parametric approach similar to the Kruskal-Wallis test was used. The dataset for each included station (1990-2007) was drawn from the KDHE database, and ranked by parameter for total nitrogen (TN), total phosphorus (TP), total suspended solids (TSS) and *E. coli*. The median rank was determined for each site for each parameter. An overall assessment of the condition relative to these four parameters was generated by summing the median rank for each parameter at a site (TN median rank + TP median rank + TSS median rank + *E. coli* median rank). The results of this analysis are presented in Table 2.

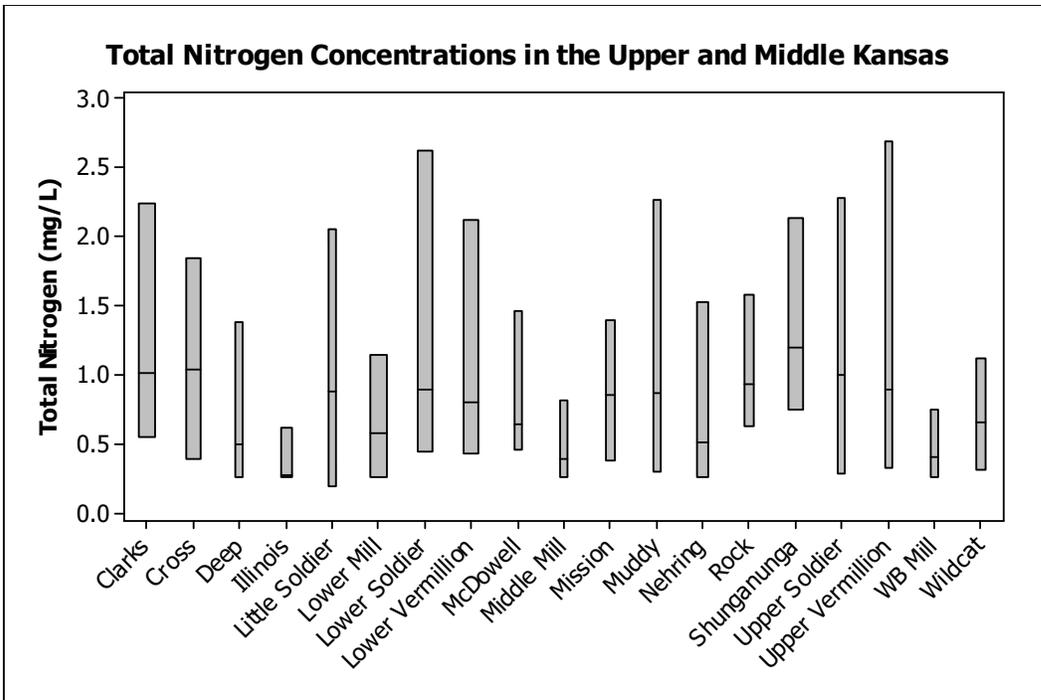
Station	Stream Name	Overall Rank	TP Rank	TN Rank	TSS Rank	<i>E. coli</i> Rank
SC726	Illinois Creek	1	2	1	1.5	3
SC519	Middle Mill Creek	2	3	2	3	1.5
SC506	West Branch Mill Creek	3	4	3	4	1.5
SC727	Nehring Creek	4	1	5	1.5	7
SC647	Deep Creek	5	5	4	6	9
SC521	Lower Mill Creek	6	6	6	9	4
SC646	McDowell Creek	7	10	7	7	5
SC648	Mission Creek	8	7	10	8	16
SC520	Lower Vermillion Creek	9	8	9	17	8
SC685	Little Soldier Creek	10	9	12	5	18
SC652	Wildcat Creek	11	18	8	10	14
SC517	Clarks Creek	12	16	17	11.5	6
SC239	Lower Soldier Creek	13	13	14	13	11
SC681	Upper Vermillion Creek	14	17	13	11.5	10
SC639	Muddy Creek	15	15	11	14.5	17
SC551	Cross Creek	16	11	18	18	12
SC101	Upper Soldier Creek	17	12	16	19	13
SC645	Rock Creek	18	14	15	14.5	19
SC238	Shunganunga Creek	19	19	19	16	15

Relative ranks by parameter and overall condition of the 19 tributary monitoring stations located within the Upper and Middle Kansas hydrologic units. Monitoring stations locations are included in figure 1.

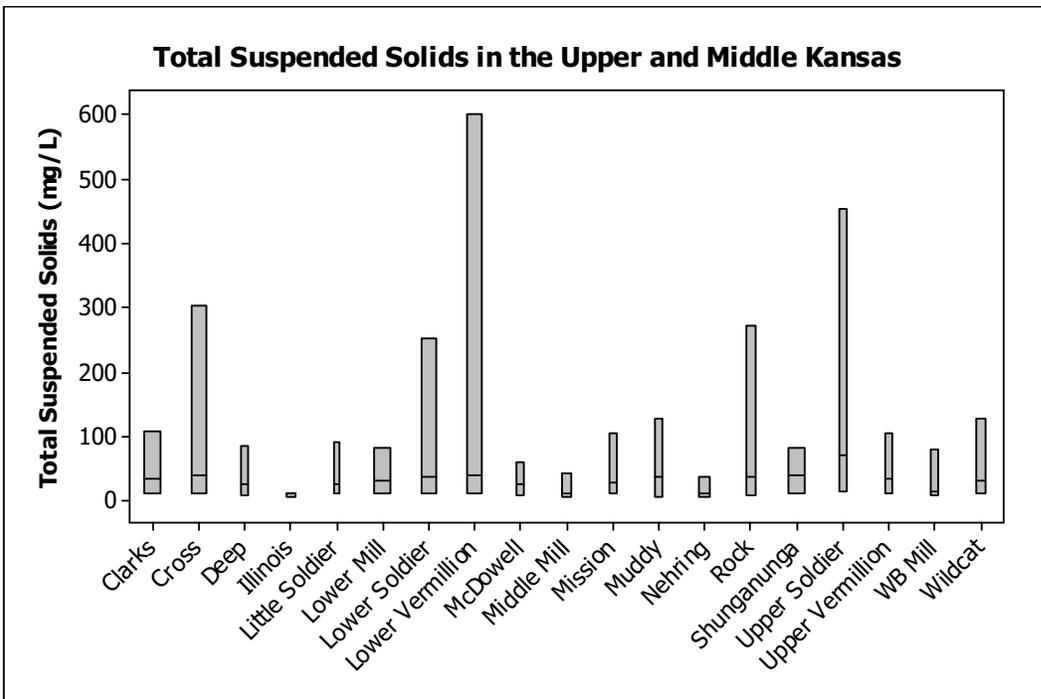
The top 8 overall ranks were assigned to streams draining the south central portion of the area, and represent areas with relatively low cropland uses. The poorest overall rank is assigned to Shunganunga Creek, which captures a large portion of the city of Topeka upstream of the monitoring station. Shunganunga Creek is the receiving stream for wastewater discharge from the Sherwood Improvement District, which is authorized for a design flow 2.4 million gallons per day, and currently receives about a million gallons per day of discharge. During estimated median flow this discharge may account for as much as half of the flow in Shunganunga Creek. Other poorly ranking streams tend to be located in the north-central and northeastern portions of the area, areas dominated by cropland.



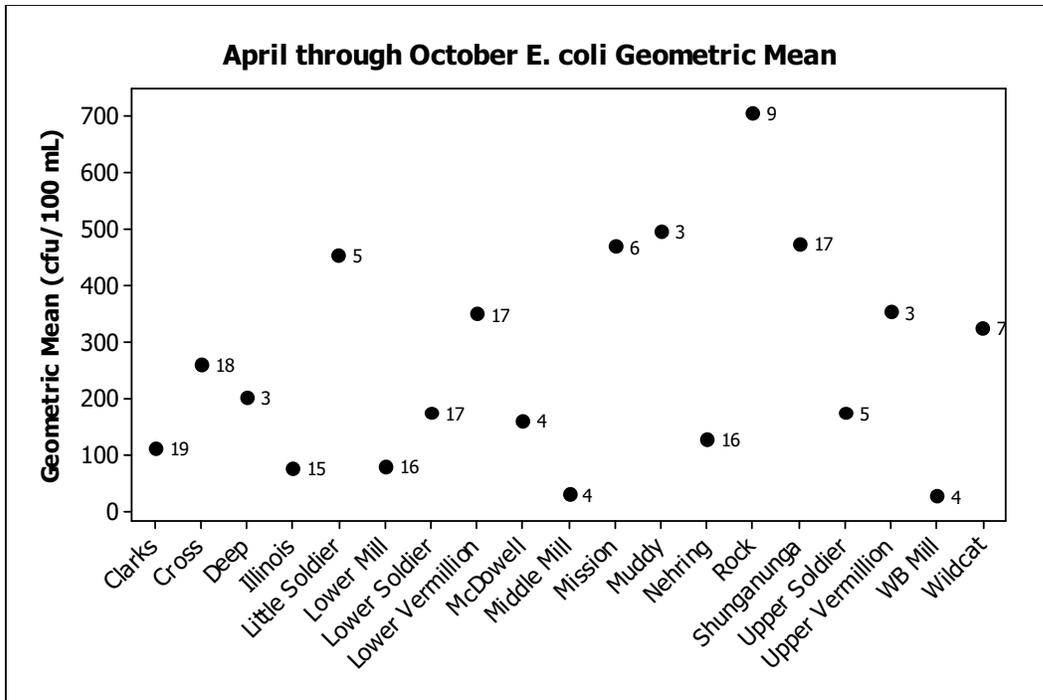
Total phosphorus concentrations in tributary streams in the Upper and Middle Kansas hydrologic units. Box indicates the 10<sup>th</sup>, 50<sup>th</sup> and 90<sup>th</sup> percentiles of the data. Box width is proportional to sample size.



Total nitrogen concentrations in tributary streams in the Upper and Middle Kansas hydrologic units. Box indicates the 10<sup>th</sup>, 50<sup>th</sup> and 90<sup>th</sup> percentiles of the data. Box width is proportional to sample size.



Total suspended solids concentrations in tributary streams in the Upper and Middle Kansas hydrologic units. Box indicates the 10<sup>th</sup>, 50<sup>th</sup> and 90<sup>th</sup> percentiles of the data. Box width is proportional to sample size.



Geometric mean of *E. coli* concentrations in tributary streams in the Upper and Middle Kansas hydrologic units during the months of the primary recreation season. Data labels indicate sample size.)

A detailed description of selected watersheds, their monitoring stations and their contributing areas follows.

