SMOKY – SALINE RIVER BASIN TOTAL MAXIMUM DAILY LOAD
Water Body: Smoky Hill River from Kanopolis Lake outfall to Salina
Water Quality Impairment: Total Suspended Solids (TSS)

1. INTRODUCTION AND PROBLEM IDENTIFICATION

Subbasin: Lower Smoky Hill **Counties:** Ellsworth, McPherson, Rice, and Saline

HUC 8: 10260008 **HUC 10** (HUC12): 01 (01, 02, 03, 04, 05)
03 (01, 02, 03, 04, 05, 06)

Ecoregion: Central Great Plains/Smoky Hills (27a)
Central Great Plains/Wellington-McPherson Lowland (27d)

Drainage Area: Approximately 496 square miles (**Figure 1**)

Main Stem Segments: WQLS: 13, 14, and 15 (Smoky Hill River) starting near Salina and extending upstream to headwaters below Kanopolis Lake in south-east Ellsworth County.

Designated Uses: Expected Aquatic Life Support; Primary Contact Recreation (Class B); Drinking Water; Food Procurement; Industrial Water Supply; Groundwater Recharge; Irrigation; Livestock Watering for Smoky Hill River (13, 14 & 15).

Expected Aquatic Life Support; Secondary Contact Recreation (Class b); Drinking Water; Food Procurement; Industrial Water Supply; Groundwater Recharge; Irrigation; Livestock Watering for West Kentucky Creek (54).

Expected Aquatic Life Support; Secondary Contact Recreation (Class b) for Sharps Creek (16), Dry Creek (36), Sand Creek (46), Wiley Creek (47), Paint Creek (52), and Pewee Creek (56).

Expected Aquatic Life Support for Kentucky Creek (17).

2008 303(d) Listing: Impaired Lower Smoky Hill River

Impaired Use: Expected Aquatic Life Support

Water Quality Standard: Suspended solids – Narrative: Suspended solids added to surface waters by artificial sources shall not interfere with the behavior, reproduction, physical habitat or other factor related to the survival and propagation of aquatic or semi-aquatic or terrestrial wildlife. (KAR 28-16-28e(c)(2)(B)).

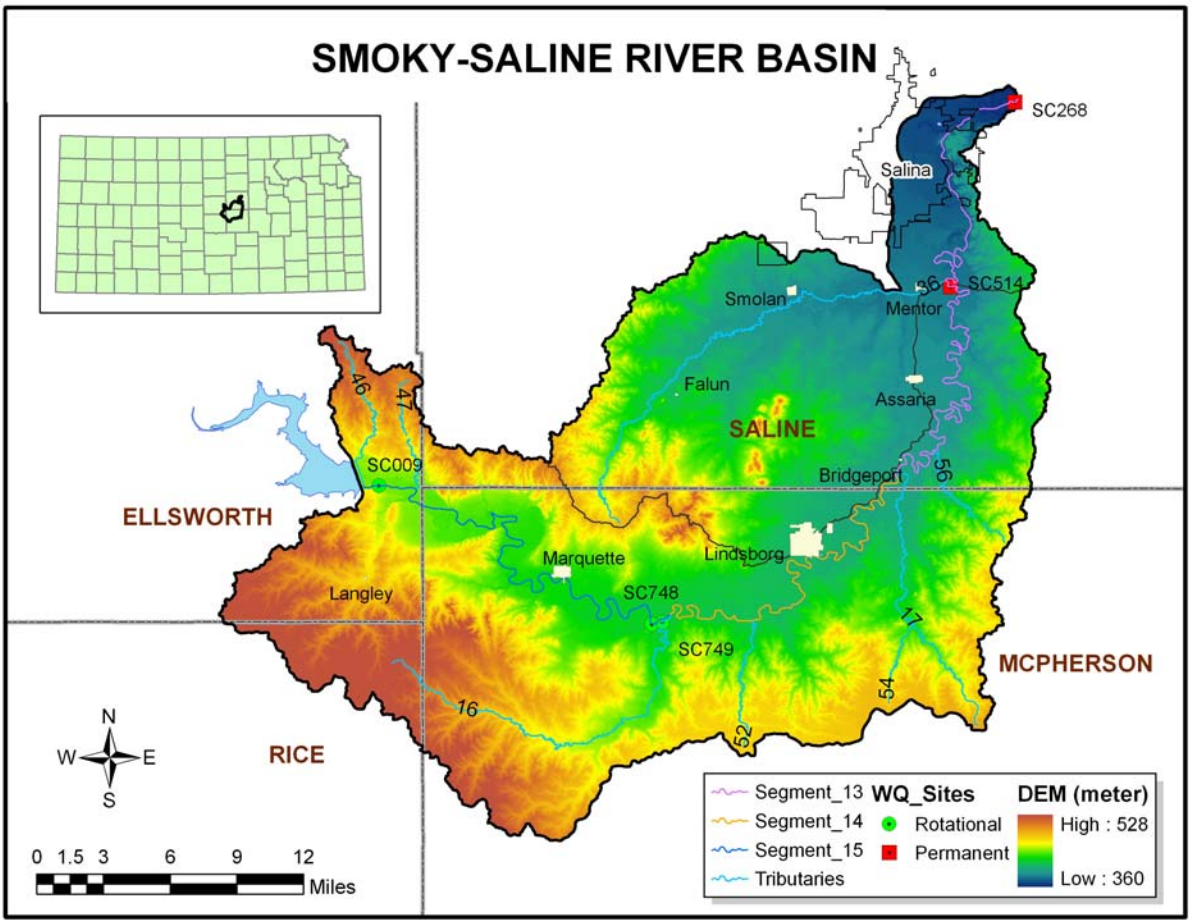

Figure 1. A digital elevation model (DEM) map and water quality sampling sites of lower Smoky Hill River Watershed.

2. CURRENT WATER QUALITY CONDITION AND DESIRED ENDPOINT

Level of Support for Designated Use under 2008 303(d): The median TSS value is 82 mg/L, which is above the threshold value (50 mg/L) listed in the 2008 303(d) methodology, suggesting that the river is not likely to support a rich diversity of aquatic life.

Stream Chemistry Sites: Station SC268 (Salina), bimonthly water quality data, 1997 – 2008; Station SC514 (Mentor), bimonthly water quality data, 1997 – 2008; Stations SC748 and SC749, bimonthly data, 2007; Station SC009 (inactive site), bimonthly water data, 1985 – 1997.

Flow Record: Smoky Hill River near the city of Mentor (USGS Gaging Station 06866500; 1950 – 2008) was used to determine the flow for Water Quality Monitoring Stations SC514 and SC268. In 2002, USGS relocated this gaging station 11.8 miles upstream, where it is presently located two miles southeast of Mentor. Prior to relocating this station it was located downstream of the Dry Creek tributary near the Salina sampling station. Flow for station SC514 near Mentor for dates prior to 2002 is calculated by utilizing the flow from the USGS 06866500 and multiplying this by the drainage area for the Mentor sampling station and dividing this by the drainage area of the Salina sampling station. Since 2002, the actual gage readings reflect the

flow condition at SC514. Since the USGS gage is representative of the flow at the Salina sampling station prior to 2002, the daily gage data is assigned to SC268 for dates prior to 2002. From 2002 to the present, the estimated daily flow values for SC268 were derived by multiplying the actual flow at the USGS gauge by the drainage area for the Salina station and dividing this by the drainage area of the Mentor sampling station. For future analysis, the stream flow data from the USGS gaging station 06866500 will be utilized for the flow at KDHE sampling station SC514. USGS did not rename the gage when it was moved since "the contributing drainage area did not increase appreciably" (Rasmussen, 2010).

Long Term Flow Conditions: The estimated long term flow conditions as calculated from USGS gaging station 06866500 for the Smoky Hill River over the entire period of record are illustrated in **Table 1**.

Table 1. Long Term Flow Conditions on the Smoky Hill River as calculated from USGS Gage 06866500 and the respective drainage areas..

Flow Duration	Smoky Hill R near Salina SC268	Smoky Hill R near Mentor SC514
10%	1000	981
25%	313	307
50 % -Median	125	123
75%	63	62
90%	39	38
Average Flow	384	376

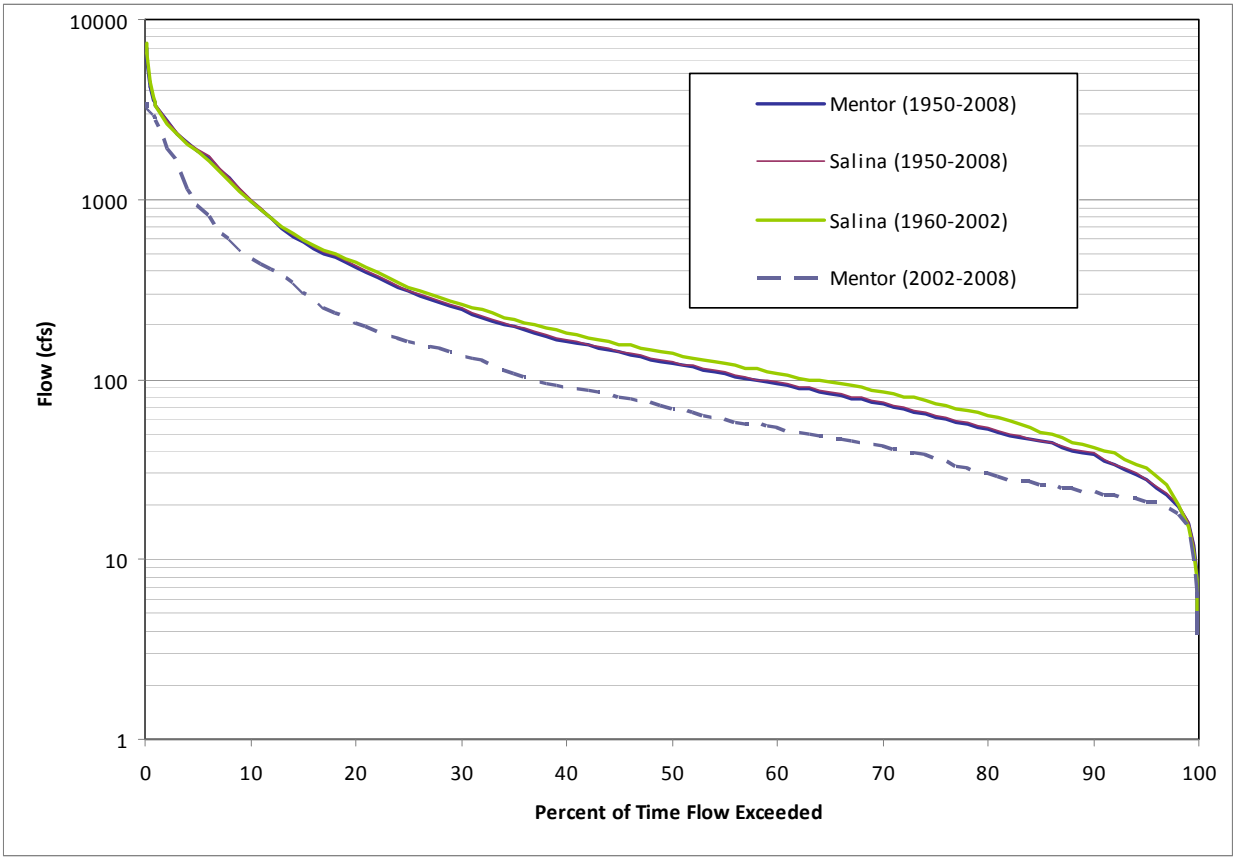

Figure 2. Flow duration curve plots for Smoky Hill River near Salina and Mentor (streamflow values were derived from USGS Gaging Station 06866500).

Current Condition: The average TSS concentration at Site SC514 is 131 mg/L, ranging from 10 mg/L to 988 mg/L, while the average TSS concentration at Site SC268 is 132 mg/L, ranging from 11 mg/L to 980 mg/L. Total suspended solids is an important indicator typically linked to erosion, siltation, and nutrient transport in aquatic systems (USEPA, 2006). Excess TSS has considerable effects on invertebrate and fish communities and water quality in lakes and streams. According to the Kansas 2006-305(b) report, siltation is the leading cause for diminishing aquatic life in stream systems (KDHE, 2006). Likewise, sedimentation has significantly degraded the values, resources, and benefits of lakes and reservoirs in Kansas (Juracek, 2004; deNoyelles and Jakubauskas, 2008). In 1972, the U.S. EPA approved the numeric TSS standards from the European Inland Fisheries Advisory Commission, and later updated them in 1982 (Doisy and Rabeni, 2004). These values are used as a guideline and listed as follows:

< 25 mg/L – No harmful effects on fisheries or high level of protection
25 – 80 mg/L – Maintain good or moderate fisheries or moderate level of protection
80 – 400 mg/L – Unlikely to support good freshwater fisheries or low level of protection
> 400 mg/L – Support only poor fisheries or very low level of protection

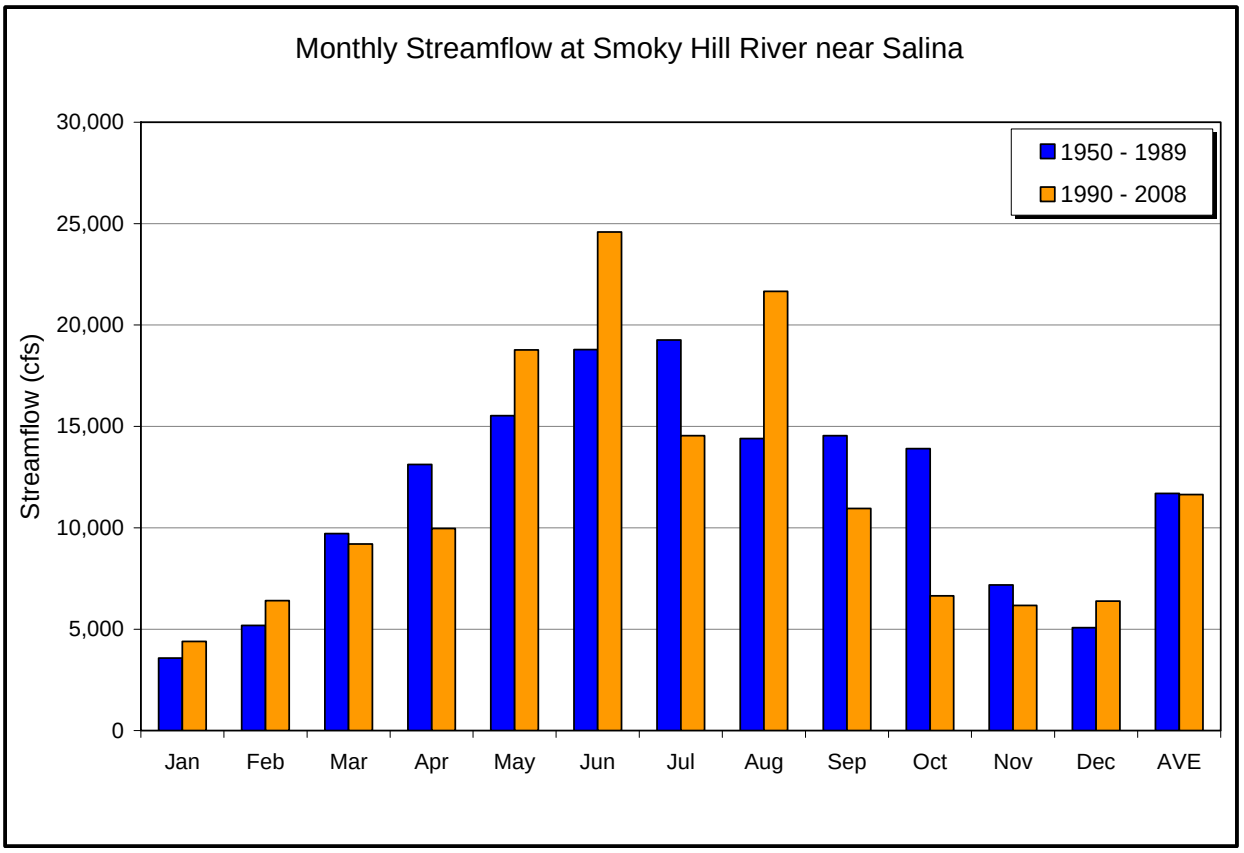

Figure 3. Monthly average daily streamflow values for Smoky Hill River at USGS Gaging Station 06866500.

KDHE analyzed 15 years of suspended solids data and associated biological monitoring data. A strong threshold relationship exists at 50 mg/L median TSS, above which streams are unlikely to support a rich diversity of aquatic life. Species richness is strongly correlated with other measures of aquatic life use support, including proportion of ephemeroptera, plecoptera, and trichoptera species, a long-used indicator of acceptable biological condition in Kansas waters (KDHE, 2008).

Figure 4 shows TSS percentile values for the Monitoring Station Sites SC514 (Mentor) and SC268 (Salina) from 1997 through 2008. The 25th, 50th, and 75th percentile concentrations of TSS at Site SC268 are 39, 82 and 154 mg/L, respectively, which are slightly lower than those observed at Site SC514. The 50th and 75th percentile values are over 50 mg/l.

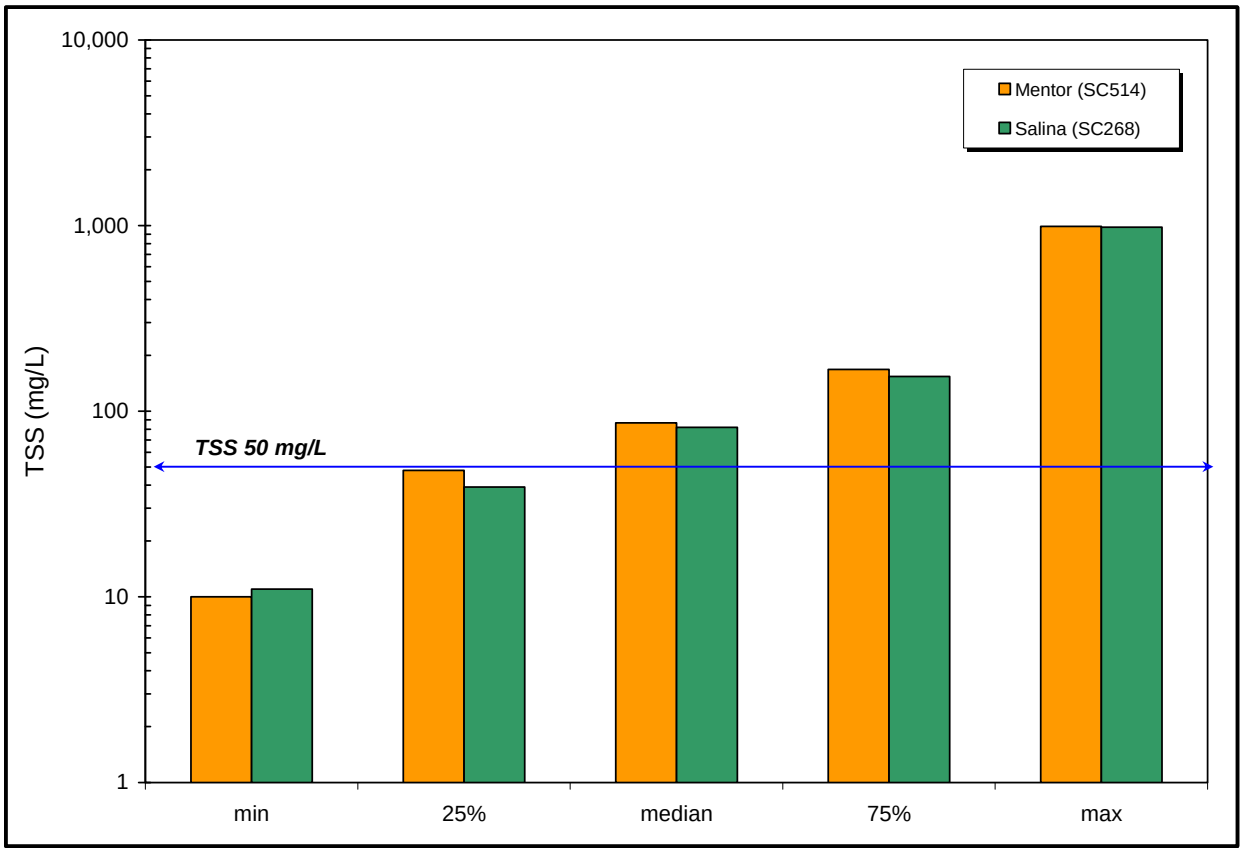

Figure 4. TSS percentile values during 1997 – 2008.

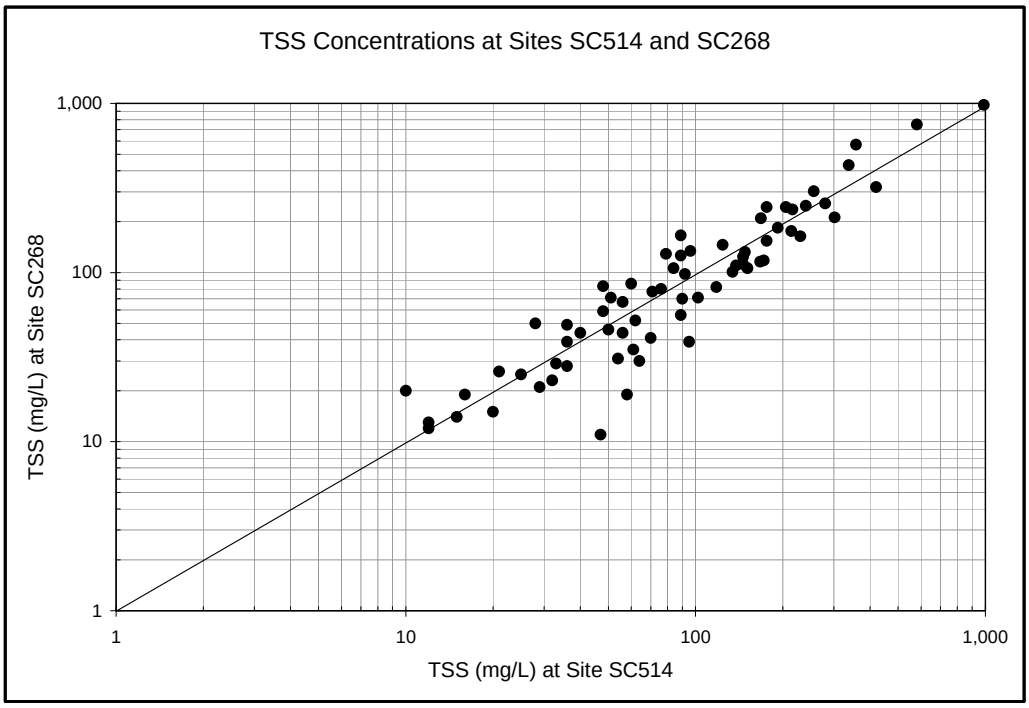

Figure 5a. A scatter plot of TSS concentrations for Sites SC514 and SC268 during 1997 – 2008.

Figure 5a shows TSS values at Site SC514 and its downstream site location near Salina, SC268. The TSS concentrations at Sites SC514 are highly correlated with the TSS values recorded at SC268. This result suggests that the TSS loadings at Site SC268 primarily come from its upstream Site SC514.

Since loading capacity varies as a function of the flow present in the stream, this TMDL represents a continuum of desired loads over all flow conditions, rather than fixed at a single value. Sample data for the sampling sites were categorized for each of the three defined seasons: Spring (Apr – Jul), Summer-Fall (Aug – Oct), and Winter (Nov – Mar). High flows and runoff equate to lower flow durations; baseflow influences generally occur in the 75-100% exceeded flow range while the effect of point sources primarily occur in the 95-100% exceeded flow range. A load curve was established for the TSS target value (50 mg/L) for the respective percent of flow exceedances by multiplying the appropriate flow values (1950 – 2008) by the target concentration (50 mg/L) and the conversion factor (5.4). The load curves represent the TMDL since any point along the curves represents the appropriate water quality to ensure the narrative water quality standard is being achieved at that flow. Historic excursions from the established TMDL are seen as plotted points above the established load curve. Therefore, the points plotting below the applicable load duration curve are definitively in compliance with the established water quality standard (**Figure 5b**).

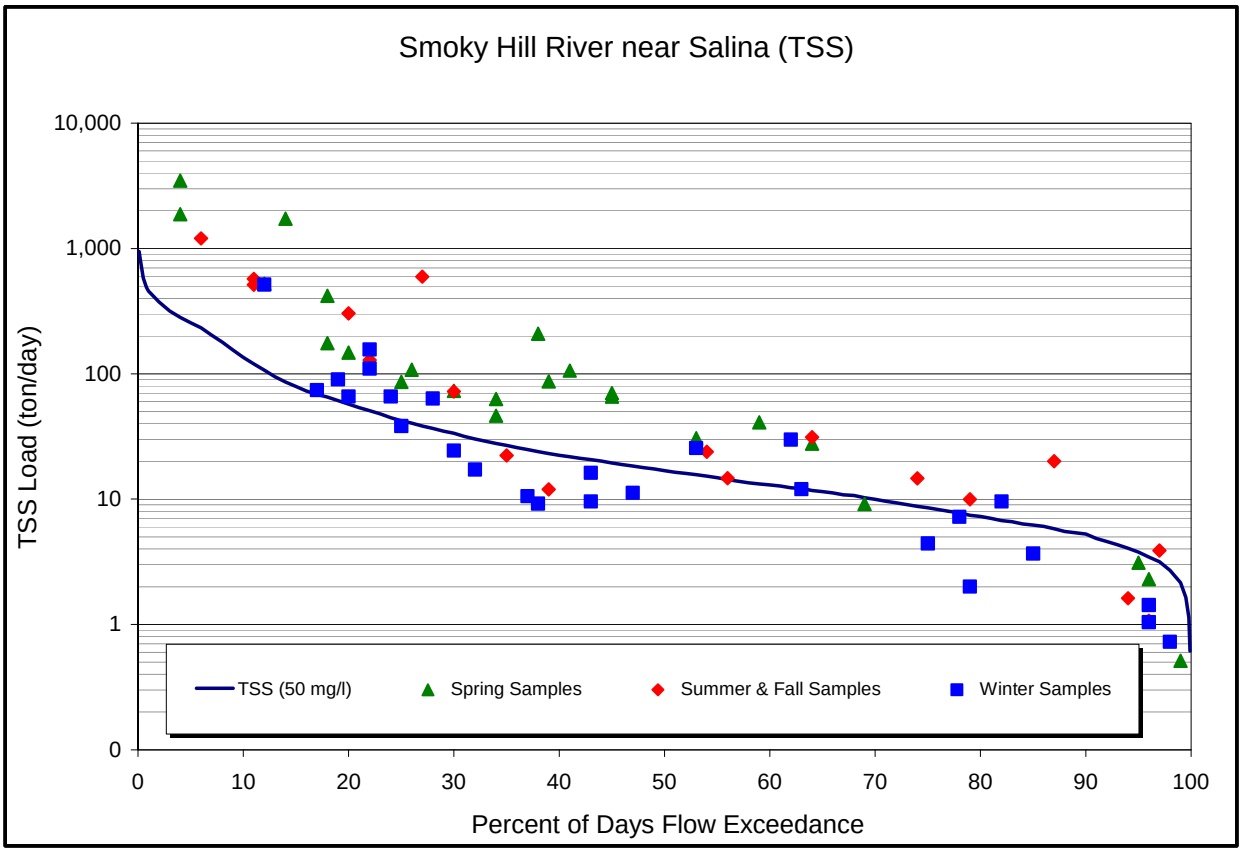

Figure 5b. Seasonal TSS loading at Site SC268 during 1997 – 2008.

Changes in total phosphorus (TP) values are closely associated with the TSS concentrations at Site SC514, but the TP values at Site SC268 do not follow their corresponding TSS concentrations (**Figure 6**). These distinct TSS-TP patterns suggest that point sources located between these two sites greatly affect the TP levels at Site SC268.

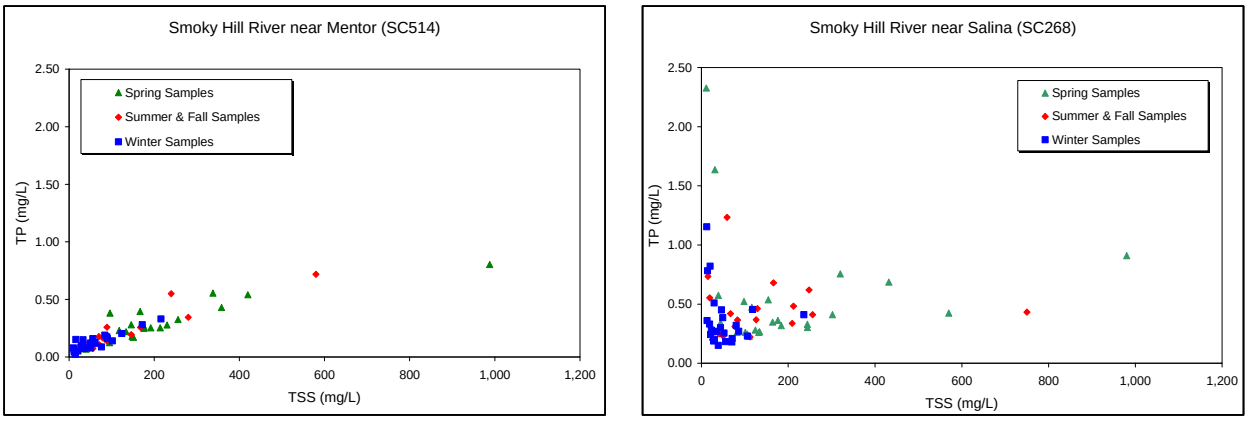

Figure 6. Seasonal scatter plots of TSS and TP concentrations for Sites SC514 and SC268.

In Contrast, changes in total kjeldahl nitrogen (TKN) values at Sites SC514 and SC268 are consistently and closely associated with their respective TSS concentrations (**Figure 7**). As the TSS concentrations increase, the TKN values increase accordingly. The water release from Kanopolis Lake strongly affects the hydrology of the Smoky Hill River, which dictates the TSS concentrations in the Smoky Hill River. The TSS levels are closely associated with the runoff events from the watershed when the discharge from Kanopolis Lake is less than 100 cfs. However, when the discharge values are greater than 100 cfs, the TSS levels decrease sharply as a result of a hydrologic dilution effect, though they are still correlated with streamflow (**Figure 8**). When streamflow in the downstream reach is largely composed of water released from Kanopolis Lake, TSS values increase at a moderate rate with increased streamflow. This modest rate of increase reflects the low TSS content of Kanopolis releases, owing to the trapping and storage of suspended solids behind the dam. Conversely, when downstream flows are generated chiefly by runoff from the intervening drainage between the dam and Salina, those flows are driven by overland runoff, laden with TSS. Hence, increased runoff brings about increased TSS loads and the TSS concentration in the river climbs at significant rate with each increase inflow. This condition is driven by nonpoint source loading.

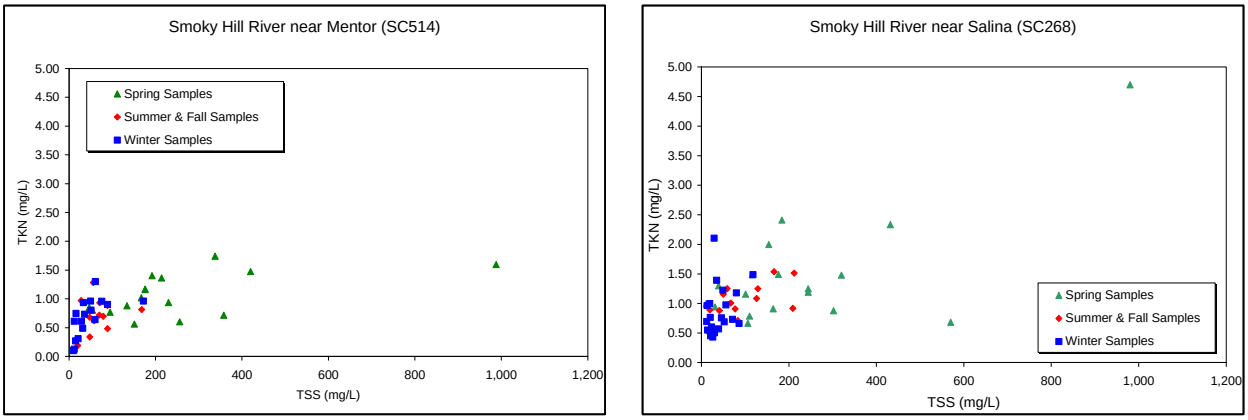

Figure 7. Seasonal scatter plots of TSS and TKN concentrations for Site SC268.

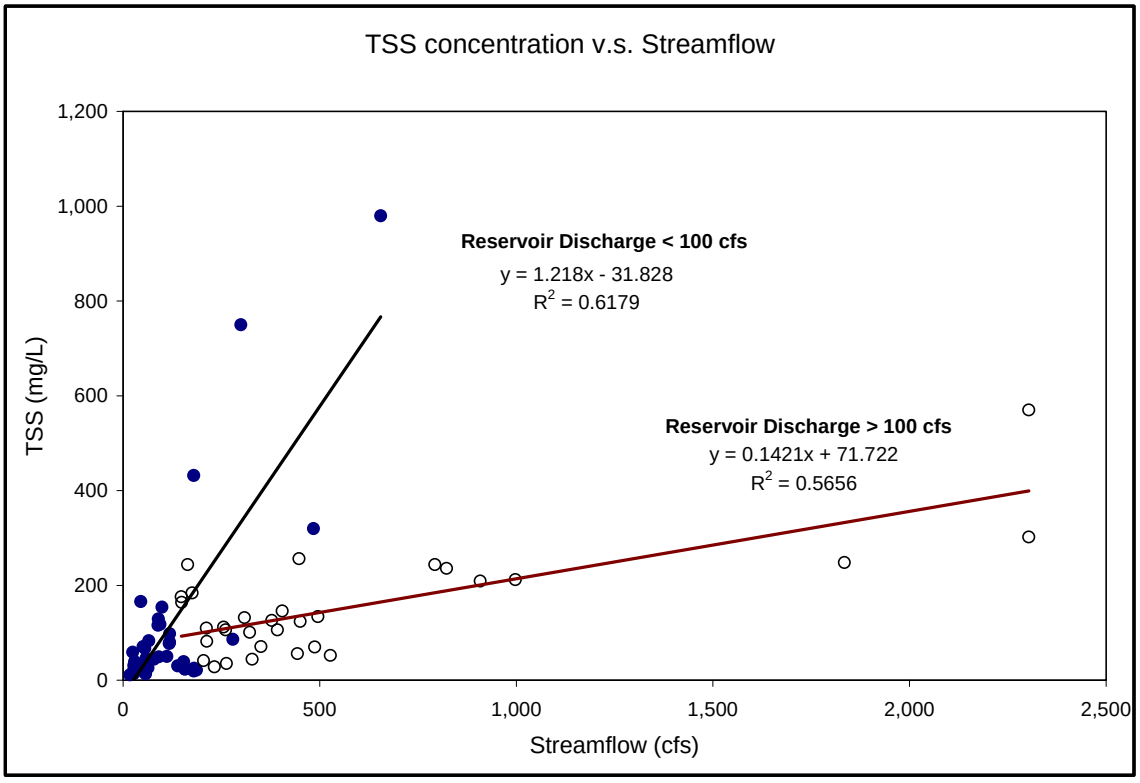

Figure 8. The TSS-streamflow relationship at Site SC268 during 1997 – 2008.

Desired End-Point of Water Quality at Site SC268 Over 2011 – 2016:

The annual mean for Smoky Hill River near Salina (Site 268) is 132 mg/L of TSS from 1997 to 2008. The ultimate endpoint for this TMDL will be to achieve a median of 50 mg/L of TSS as suggested for supporting full Aquatic Life Uses for all streams within the drainage area of KDHE sampling stations SC514 (Mentor) and SC268 (Salina). The narrative criterion will be successfully met with the utilization of the numeric TMDL target.

The endpoints will be reached as a result of reductions in loading of TSS from the various sources in the watershed resulting from implementation of corrective actions and Best

Management Practices, as directed by this TMDL. Achievement of the endpoints indicates loads are within the loading capacity of the stream, water quality standards are attained and full support of the designated uses of the stream has been restored.

3. SOURCE INVENTORY AND ASSESSMENT

NPDES: There are 12 NPDES permitted facilities within the watershed (**Figure 9**) and nine of these facilities are permitted to discharge effluent to the Smoky Hill River watershed. Among them, five municipal wastewater treatment plants (MWTP) may contribute sediment loads that affect water quality at Site SC268, particularly during the low flow conditions (**Table 2**). They are Assaria, Marquette, Lindsborg, Salina, and Salina County Sewer District. Monthly TSS limits for the Assaria, and Marquette's MWTP facilities as well as the Salina County Sewer Districts' facility are 80 mg/L while monthly TSS permits for Lindsborg and Salina's MWTP facilities are 30 mg/L.

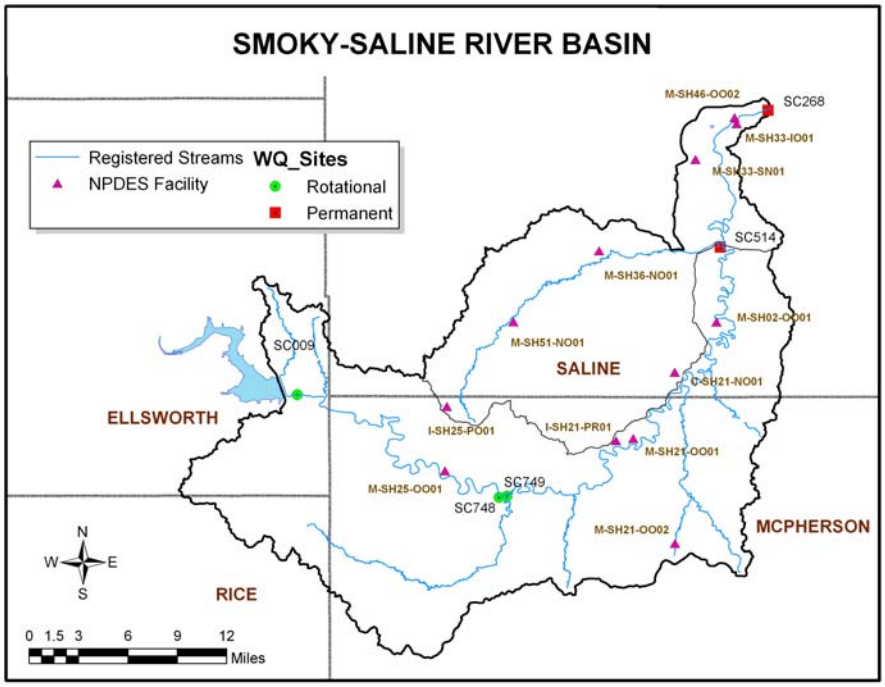

Figure 9. NPDES sites located in the Smoky Hill River Watershed. EDIT

McPherson Concrete Plant is a dry batch, ready mix concrete plant that is permitted to collect wash water. Wastewater is generated from the washing of the inside of the truck mixer drums and the outside of the trucks. The facility utilizes a single cell earthen pond for process water control. The wash water is allowed to evaporate and percolate through the soil. All discharges are to be controlled and monitored. The facility has never reported any discharge, and therefore no TSS loading is expected to be attributable to this facility.

The Salina MS4 NPDES stormwater permit follows a general permit format, requiring the six minimum controls to be implemented throughout the corporate limits of Salina. Part III of the permit lists required best management practices to attenuate specific pollutants loading to

specific waterbodies, with a minimum of one BMP for each listed parameter to be implemented within two years of permit renewal. In the case of this TMDL, the City of Salina will be required to implement at least one BMP to address total suspended solids within two years of their renewal to ensure compliance with the permit. Developed areas and roads within the contributing area of station SC268, which accounts for the portions of Salina that are within the watershed, comprise 4% of the total watershed for the entire HUC8. Therfore, a wasteload allocation for the MS4 will be established as 4% for the intervening loads occurring at flows equal to or greater than the median flow within the Smoky Hill River. The MS4 permit expired on September 30, 2009 and is in the renewal process. The KDHE permitting staff have been advised to account for this TMDL in the newly issued MS4 permit.

The non-overflowing permitted facilities are prohibited from discharging and may contribute a nutrient load under extreme precipitation or flooding events. Such events would not occur at a frequency or for duration sufficient to cause impairment in the watershed.

Table 2. Characteristics of permitted wastewater treatment facility located upstream from Site SC268 in the Smoky Hill River Watershed.

Facility	KS Permit #	Stream Reach	Segment	Design Flow	Type	TSS Limit	Permit Expired
Assaria	M-SH02-OO01	Smoky Hill R.	14	0.0414 MGD*	2-Cell Lagoon	Mo. Avg of 80 mg/L	9–30–2014
Ellsworth Co. RWD 1 – Post Rock	I-SH53-PO01	Unnamed Tributary to Smoky Hill R.	15	0.0255 MGD	Single Cell Lagoon	Mo. Avg of 100 mg/L	12-31-2010
Falun Improvement District	M-SH51-NO01	Non-Discharging	-	-	Non-Overflowing	-	06-10-2010
Lindsborg	M-SH21-OO01	Smoky Hill R.	14	0.418 MGD**	Oxidation Ditch	Mo. Avg. of 30 mg/L	9–30–2014
Marquette	M-SH25-OO01	Smoky Hill R.	15	0.0670 MGD	3-Cell Lagoon	Mo. Avg of 80 mg/L	6–30–2014
McPherson Concrete	I-SH21-PR01	Smoky Hill R.	14	0.0 MGD	Ready Mix Plant with retection Basin	Daily max of 100 mg/L	9–30–2012
McPherson Co. Rest Area	M-SH21-NO01	Non-Discharging	-	-	Non-Overflowing	-	12-31-2014
Salina	M-SH33-IO01	Smoky Hill R.	13	7.2500 MGD	Activated Sludge	Mo. Avg of 30 mg/L	12–31–2014
Salina Co. Sewer District	M-SH46-OO02	Smoky Hill R.	13	0.0100 MGD	2-Cell Lagoon	Mo. Avg of 80 (mg/L)	3–31–2014
Salina Stormwater	M-SH33-SN01	Smoky Hill R.	13	-	Stormwater from MS4	Narrative	9–30–2009
Shale Quarry	I-SH25-PO01	West Dry Cr.	36	0.0 MGD	Dewatering & Stormwater	Narrative	12–31–2014
Smolan	M-SH36-NO01	Non-Discharging	-	-	Non-Overflowing	-	06-30-2010

* - Assaria has a design flow of 0.06MGD but is only has a permitted flow of 0.0414 MGD

** - Lindsburg has a current design flow of 0.418 MGD. When upgrades take place and irrigation to the golf course is permitted their design flow is 0.55 MGD.

Livestock Waste Management Systems: There are 36 registered (either certified or permitted) confined animal feedlot operations (CAFOs), which are primarily located in the east and central portions of the watershed (**Figure 10**). All of these permitted livestock facilities (4 dairy, 27 beef, 4 swine, and 1 mixed of beef and horses) have waste management systems designed to minimize runoff entering their operation or detain runoff emanating from their facilities. In addition, they are designed to retain a 25-year, 24-hr rainfall/runoff event as well as an anticipated two weeks of normal wastewater from their operations. Typically, this rainfall event coincides with streamflow that is less than 1-5% of the time. Though the total potential number of animals is 55,101 head in the watershed, the actual number of animals at the feedlot operations is typically less than the allowable permitted number. It is unlikely TSS loading would be attributable to properly operating permitted facilities; however TSS loading could be extensive if these facilities were in violation and discharged.

The grassland and pastured areas occupy almost half of the watershed area (46%), which is ideal for livestock grazing in the summer and winter. According to the 2002 National Agricultural Statistics Service, the numbers of all agricultural animals, including permitted and non permitted operations, in the watershed are shown in **Table 3**. The watershed area located in McPherson County has the highest livestock number (14,269 head), with a grazing density of 0.19 head/acre. The grazing density values for the areas located in Ellsworth, Rice and Saline Counties are 0.06, 0.07, and 0.13 head/acre, respectively. Non-permitted grazing livestock should not contribute to TSS loading if they are managed properly, however they could significantly contribute to the TSS loading within the watershed if they overgraze and denude pasture, destroy riparian buffers, or are generally not managed properly.

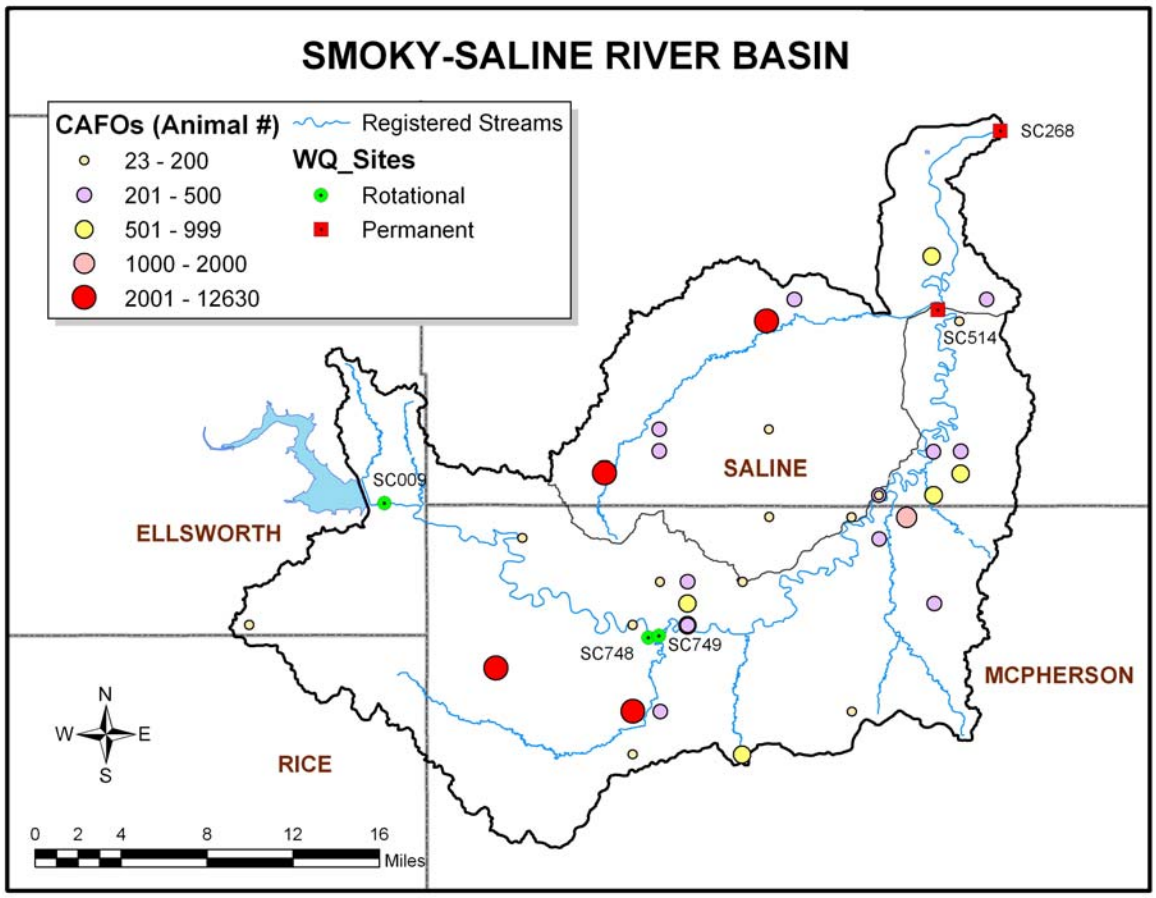

Figure 10. Confined animal operation sites in the Smoky Hill River Watershed.

Table 3. Agricultural animals in the Smoky Hill River Watershed.

County	Beef	Dairy	Swine	Sheep	Horse	Chicken	Turkey	Duck
Ellsworth	1,152	0	29	46	26	29	0	0
McPherson	4,175	325	8,284	1,215	264	0	0	6
Rice	244	1	279	14	9	0	0	0
Saline	4,874	45	246	156	267	202	0	2
Total	10,445	371	8,838	1,431	566	231	0	8

Land Use: The predominant land uses in the Smoky Hill River Watershed are grassland (46%) and cultivated cropland (41%), according to 2001 National Land Cover Data. Together, they account for 87% of the total land area in the watershed. Approximately 4% of the land is occupied by deciduous forest, whereas pasture/hay accounts for about 0.4% of the total watershed area. Urban areas, such as residential, commercial and industrial uses as well as open space like roads and lawn grasses, comprises about 7% of the watershed (**Figure 11**).

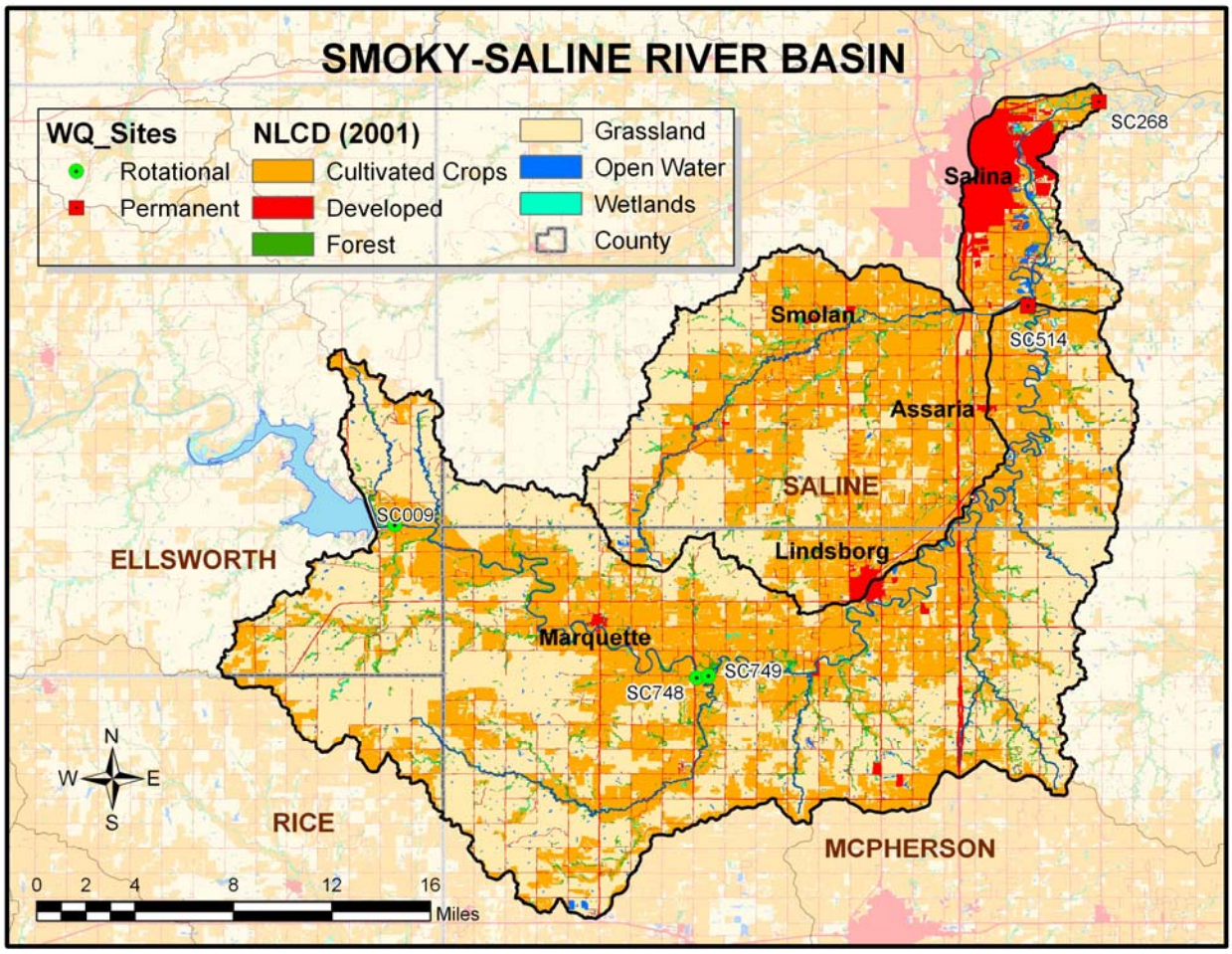

Figure 11. Land use/land cover map (2001 NLCD) of the Smoky Hill River Watershed.

On-Site Waste Systems: The population density of the watershed is 76.7 people per square mile. The population changes for five major cities within the watershed are shown in **Table 4**. Though there are many septic systems scattered in the rural part of this watershed, the failing rate of these systems is 0.93% (National Environmental Service Center, 1998). The failing septic systems are seen as a minor source of TSS to the Smoky Hill River.

Table 4. Expected population change for the cities of Assaria, Lindsborg, Marquette, Smolan, and Salina from 2000 – 2020.

City	Population (2000)	Changes (%)
Assaria	408	2.2
Lindsborg	3,501	24.9
Marquette	589	-1.5
Smolan	201	11.4
Salina	45,425	14.7

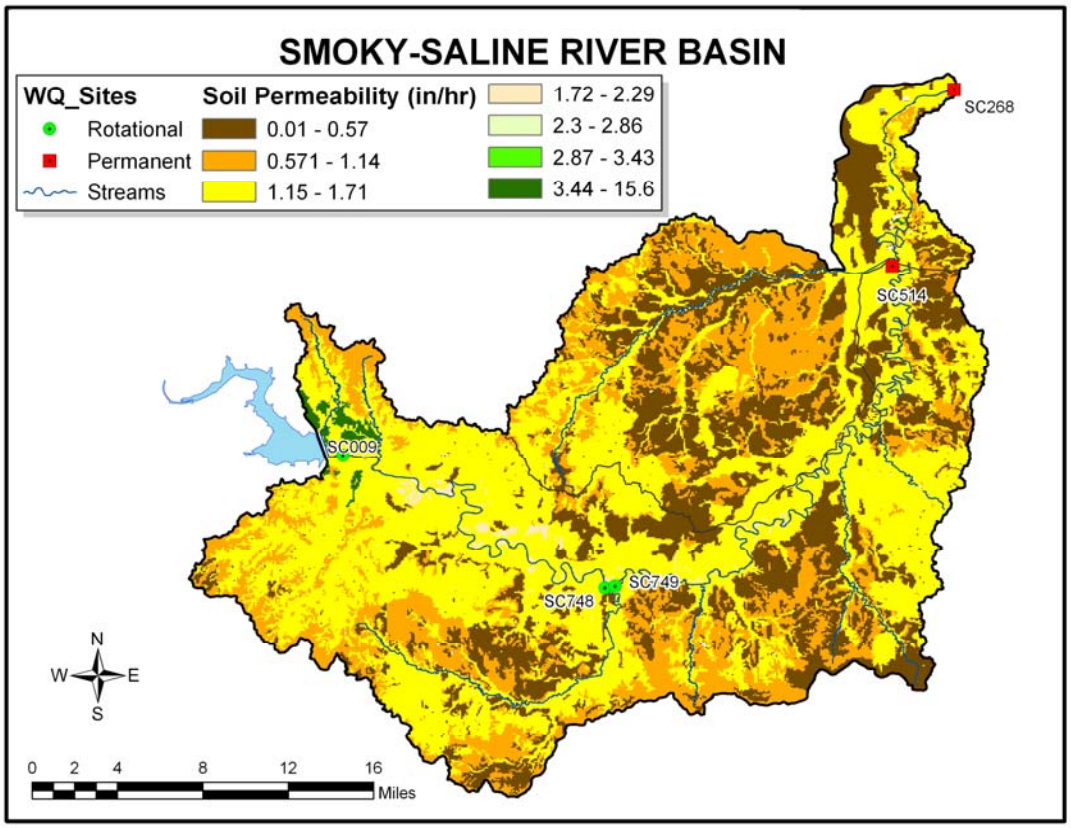

Figure 12. Soil permeability of the Smoky Hill River Watershed.

Contributing Runoff: **Figure 12** shows soil permeability values across the watershed, based on NRCS STATSGO database. The watershed-wide soil permeability averages 0.99"/hr. According to an USGS open-file report (Juracek, 2000), the threshold soil-permeability values that represent very high, high, moderate, low, very low, and extremely low rainfall intensity, were set at 3.43, 2.86, 2.29, 1.71, 1.14, and 0.57"/hr, respectively. The lower rainfall intensities generally occur more frequently than the higher rainfall intensities. The higher soil-permeability thresholds imply a more intense storm during which areas with higher soil permeability potentially may contribute runoff. Runoff is primarily generated as infiltration excess with rainfall intensities that are greater than the respective soil permeability's. As soil profiles become saturated, excess overland flow is produced.

For the Smoky Hill River Watershed, about 99% of the total area has soil permeability values either less than or equal to 1.71"/hr. Under the very low (1.14"/hr) runoff condition, the potential contributing area is about 50% (**Figure 13**). Storms that produce 0.57"/hr of rain will generate runoff from 24% of the watershed area, which is dominated by cropland and grassland.

Background Levels: Sediment and suspended solids are part of the landscape, in the soil profile as well as within the stream channels. There will always be extreme precipitation events that generate erosion from the land surface and transport solids into the stream channel as part of the aggregation/degradation process of fluvial geomorphology.

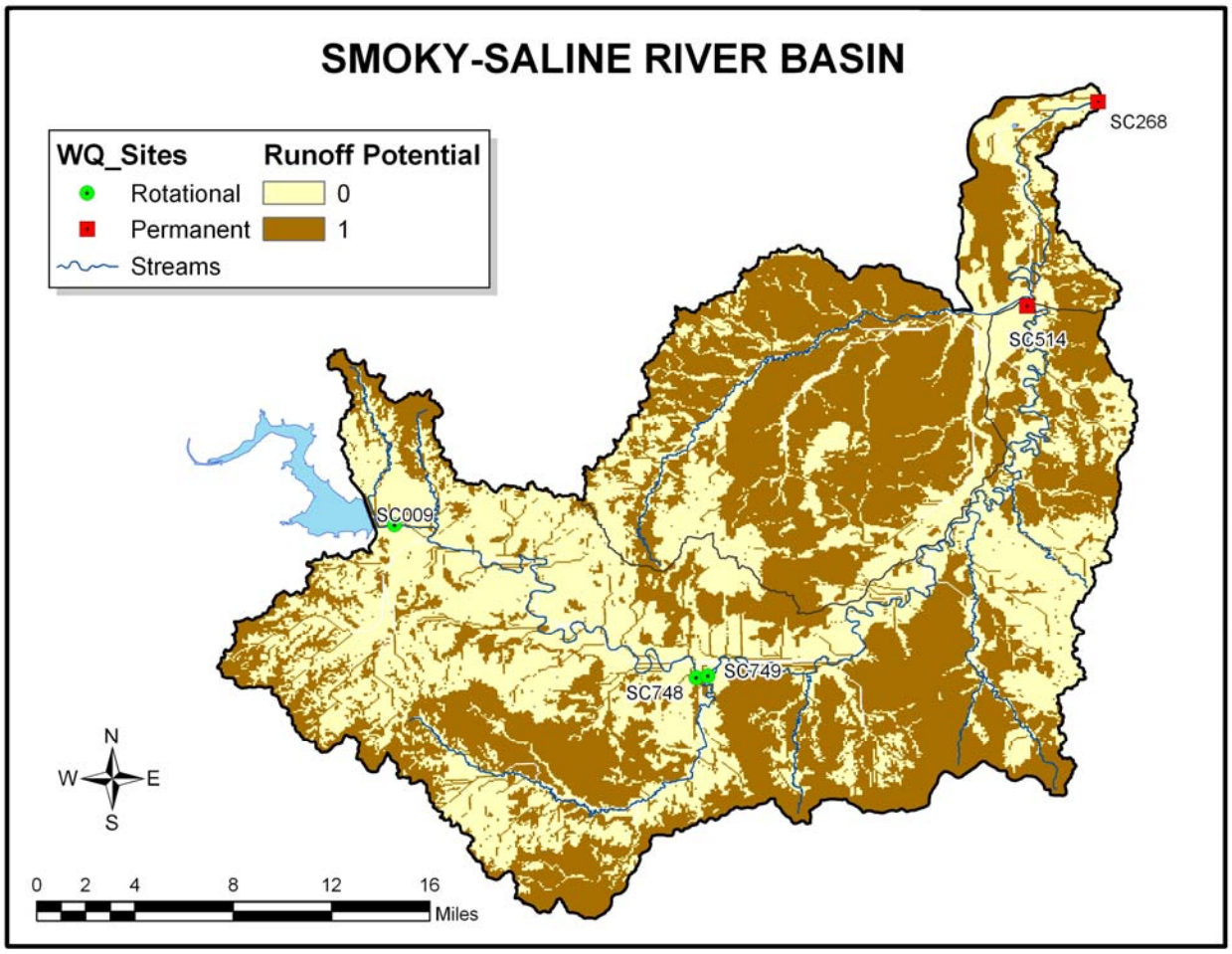

Figure 13. Estimated Runoff potential based on the very low (1.14"/hr) runoff condition (a value of 1 depicts potential contributing area, and 0 is for potential noncontributing area).

4. ALLOCATION OF POLLUTANT REDUCTION RESPONSIBILITY

Point Sources: This allocation is associated with the wastewater treatment facilities. Ongoing inspections and monitoring of these NPDES sites will be made to ascertain the contributions that have been made by the sources. These wastewater treatment plants should comply with any future permit conditions. The total Waste Load Allocation (WLA) for the six wastewater treatment plants is one ton per day, based on the monthly permit criteria (**Figure 14**). The WLAs for the individual facilities are listed in **Appendix A**. In general, WLAs are established for the low flow conditions which are most susceptible to point source discharges. Typically, these conditions are deemed to be ten times the combined design flow of the facilities or the 7Q10, whichever is greater. Though there is a very large combined design flow of the point sources (12.1 cfs, see **Table 2**) in the Smoky Hill River watershed, the effect of point sources on TSS levels is minor because of large flows released from Kanopolis Lake. Thus, under normal circumstances, the influence of these point sources on TSS typically occur in the 95-100% exceeded flow range.

NPDES and state permitted non-discharging livestock waste management facilities will all have a WLA of zero, given that these facilities will not discharge to receiving streams throughout the

majority of hydrologic conditions - defined by the curve ranging from 5 to 100% of the time (**Appendix A**). Depending on the real extent of the storm creating a 25 year, 24-hour precipitation event, the associated stream flows would be exceeding less than 1 – 5% of the time. Therefore, ongoing inspections and monitoring of these systems will be made to ensure that minimal contributions have been made by these sources.

The Wasteload Allocation for Salina MS4 stormwater will be set at 4% of the TMDL for flows at and above median flow conditions within the Smoky Hill River.

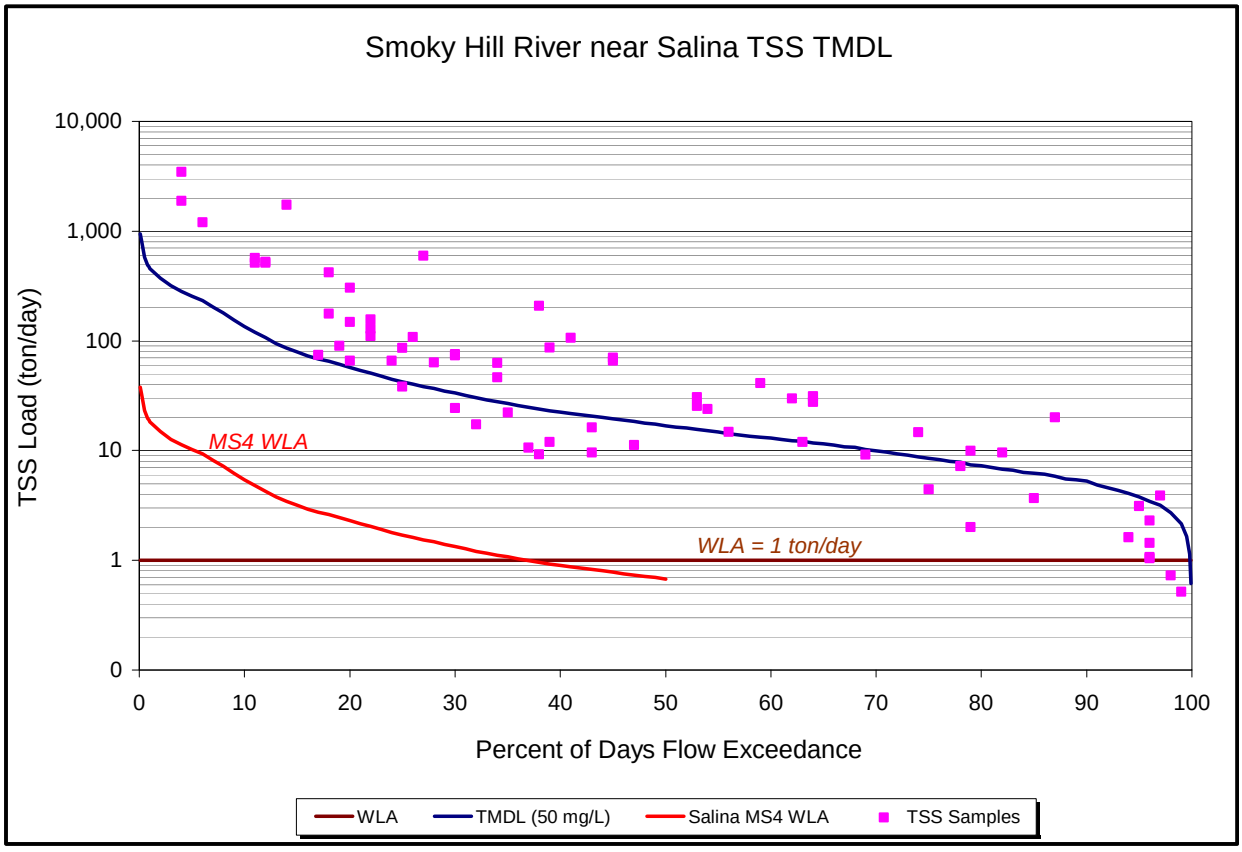

Figure 14. Smoky Hill River TSS TMDL near Salina.

Nonpoint Sources: High Flow determined by bankful discharge (1.5-year recurrence interval flow, $Q_{1.5}$) reflects the flood discharging capacity of river channels (Simon et al., 2004), which indicates that the TSS impairment beyond this discharge value may not be technically and/or economically feasible for management. The bankful discharge of the Smoky Hill River is 1,757 cfs and its corresponding flow exceedance is approximately 6%. Excess TSS loading comes predominantly from nonpoint pollution sources (**Figure 5b**). The report of the historical evidence of riparian forests in the Great Plains indicates that the Smoky Hill River used to be well shaded by abundant hardwoods in the early 1800's (West and Ruark, 2004). According to an 1857 land survey, the river was usually clear and filled with a variety of fish species (KSLS, 2008). The Trails of the Smoky Hill River documented that a vast prairie change from buffalo

prairies to farmland began in the mid-1800's (Hickey, 2008). Therefore, the alteration of land use plays an important role affecting today's water quality conditions of the Smoky Hill River.

To manage the nonpoint source TSS loading, the flow exceedance range from 6% through 95% should be targeted. The relationship between the TSS loads and respective flows is displayed in Figure 15. A regression analyses was performed to validate the strength of these relationships. The resulting regression formula was then utilized to calculate the load duration curve for SC514 and SC268 in Figure 16 under all flow conditions. The respective load reduction and Load Allocation (LA) required to achieve the TMDL, are shown in **Table 5**.

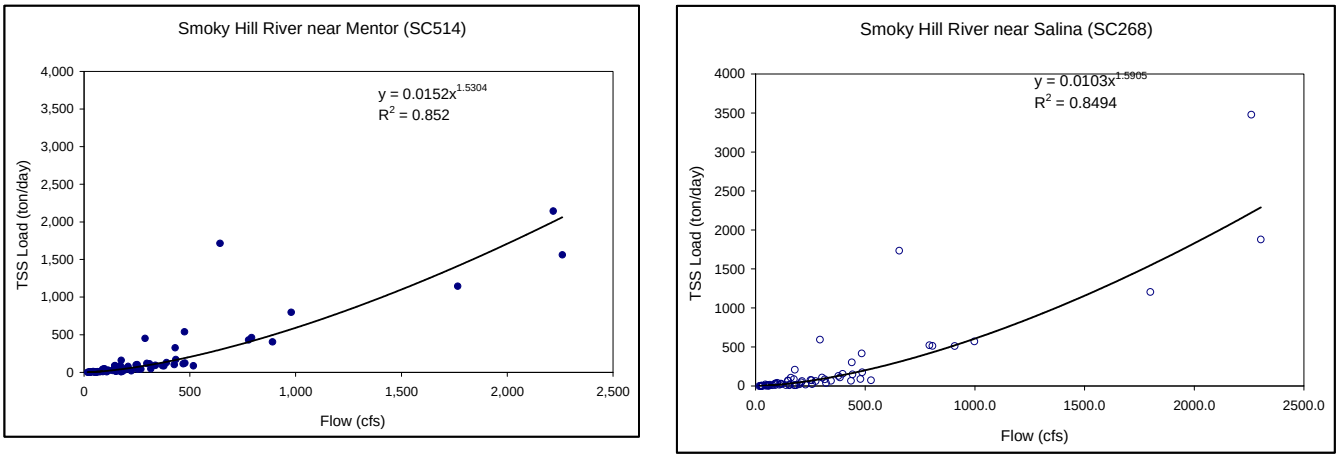

Figure 15. The relationships between flows and associated TSS loads for the Smoky Hill River at Sites SC514 and SC268.

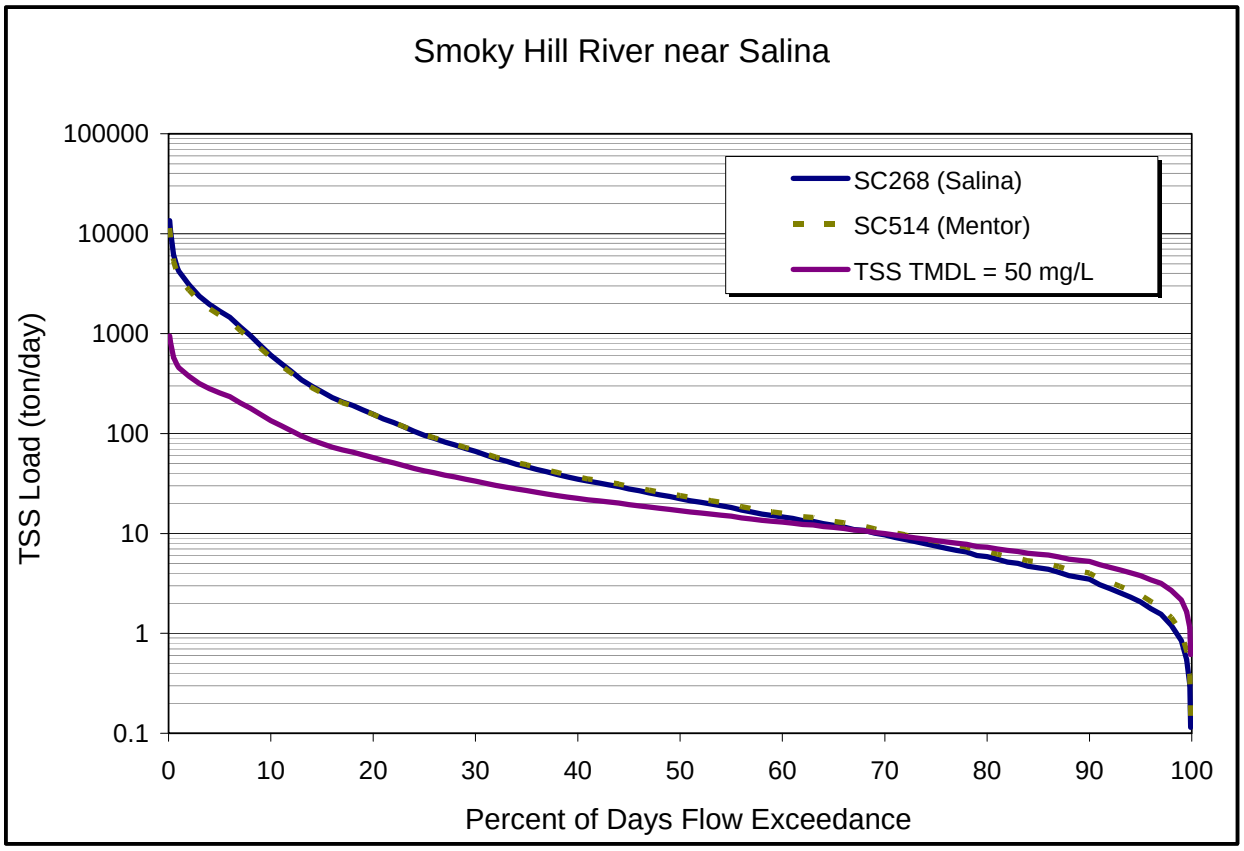

Figure 16. The daily TSS loads and TMDL's Load Allocation (LA) for the Smoky Hill River at Sites SC514 and SC268.

Table 5. Current daily TSS loads calculated using a regression technique and reductions needed to meet the TMDL for the Smoky Hill River at Site SC514 (Mentor) and SC268 (Salina).

Flow	Streamflow (cfs)		TMDL (ton/day)				Current/Existing Loading (ton/day)		(tons/day)		Reduction (ton/day)	
Exceedance	Mentor	Salina	Mentor	Salina	Salina	Salina	Mentor	Salina	Salina	Salina	Mentor	Salina
(%)	1950-2008	1950-2008			WLA	MS4			MOS	LA		
95	27.47	28.00	3.71	3.78	1		2.42	2.06	0.38	2.40	-	-
90	38.26	39.00	5.17	5.27	1		4.02	3.49	0.53	3.74	-	-
80	52.98	54.00	7.15	7.29	1		6.61	5.86	0.73	5.56	-	-
70	72.60	74.00	9.80	9.99	1		10.71	9.68	1.00	7.99	0.91	-
60	94.19	96.00	12.72	12.96	1		15.95	14.64	1.30	10.66	3.24	1.68
50	122.64	125.00	16.56	16.88	1	0.68	23.89	22.28	1.69	13.51	7.34	5.41
40	162.86	166.00	21.99	22.41	1	0.90	36.88	34.99	2.24	18.27	14.90	12.58
30	243.31	248.00	32.85	33.48	1	1.34	68.18	66.25	3.35	27.79	35.33	32.77
20	416.97	425.00	56.29	57.38	1	2.30	155.47	156.06	5.74	48.34	99.18	98.68
10	981.39	1000.30	132.49	135.04	1	5.40	576.18	608.89	13.50	115.13	443.69	473.85
6	1697.30	1730.00	229.14	233.55	1	9.34	1332.50	1455.29	23.36	199.85	1103.37	1221.74

Defined Margin of Safety: The margin of safety is explicit and provides some hedge against the uncertainty of daily allocated TSS loading. For this TSS TMDL, the margin of safety will be 10% of the current TSS load at SC268 (**Table 5**).

State Water Plan Implementation Priority: Because the Smoky Hill River is a Primary Contact Recreation stream and has a large magnitude and a high frequency of TSS excursions from the water quality standards, this TMDL will thus be a High Priority for implementation.

Unified Watershed Assessment Priority Ranking: This watershed lies within the Lower Smoky Hill River (HUC 8: 10260008) with a priority ranking of 35 (Medium Priority for restoration).

Priority HUC 12s: There are seven HUC12 subwatersheds in the Smoky Hill River Watershed. **Table 7** summarizes selected watershed conditions that may influence the TSS loading. The Revised Universe Soil Loss Equation (RUSLE) was used to calculate the potential TSS (or sediment) load from the individual subwatersheds. The parameters used in the RUSLE calculation were from the USDA NRCS at Salina Office. The subwatershed sediment delivery ratios (SDRs) were calculated using a model developed from the USDA SCS (1983). The model is listed as follows:

$$SDR = 0.51 * A^{(-0.11)}$$, where A = drainage area in square miles

The unit TSS (or sediment) loads from the subwatersheds were derived from the following equation:

$$\text{Unit TSS Load} = (\text{RUSLE}*\text{SDR})/(\text{Watershed Area})$$

Figure 17 shows the relationship between the unit TSS load and percent cropland area in a watershed. In general, as the percent cropland area of a watershed increases, the TSS load per unit area increases, indicating that the arable land is an important source of the TSS load. To prioritize best management practices for these subwatersheds, the unit TSS load and percent cropland area were used. Subwatersheds 4 and 12, that have the highest unit TSS loads and the livestock grazing densities (0.19 and 0.13 head/ac, respectively, see **Livestock Waste Management Systems Section**), are ranked first for implementing the conservation practices whereas Subwatersheds 1, 5, 6, 7, 8, 9, 10, and 11 that generate moderate TSS loads are considered the second priority for management. Subwatersheds 2 and 3 are ranked the lowest priority because their unit TSS loads and percent cropland areas are the smallest in these watersheds (**Table 6** and **Figure 18**).

Table 6. Selected watershed characteristics for prioritizing subwatershed management.

ID	Watershed (%)		RUSLE (ton/yr)	Sediment Delivery Ratio	Sediment Load (ton/yr)	Unit Sediment Load (ton/ac/yr)	Rank
	Cropland	Grassland					
1	44	45	80,525	0.338	27,237	1.018	2
2	26	65	84,819	0.327	27,747	0.765	3
3	27	64	59,091	0.342	20,209	0.835	3
4	35	49	117,689	0.336	39,578	1.403	1
5	48	41	71,906	0.342	24,570	1.007	2
6	47	40	121,934	0.328	39,976	1.125	2
7	35	56	125,020	0.324	40,551	1.035	2
8	43	47	121,977	0.327	39,871	1.092	2
9	57	33	86,448	0.343	29,645	1.255	2
10	62	25	75,654	0.343	25,933	1.094	2
11	39	42	18,746	0.397	7,448	1.203	2
12	30	10	75,278	0.367	27,650	2.186	1

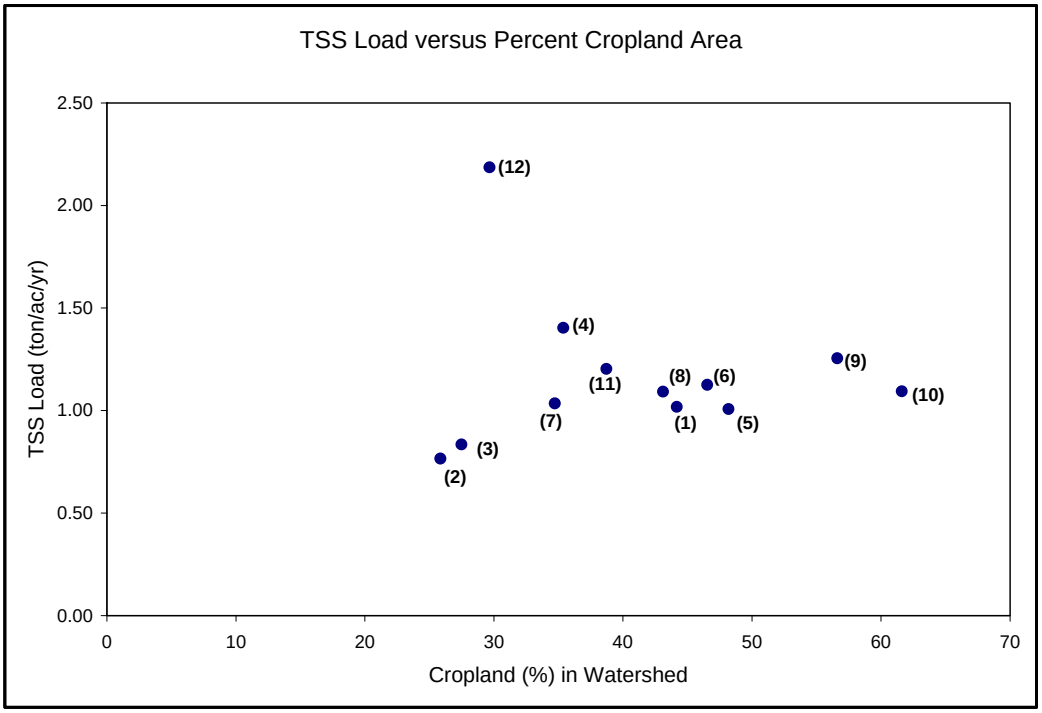

Figure 17. A scatter plot of TSS loads and percent cropland areas. The values in parenthesis are watershed identification (ID) numbers.

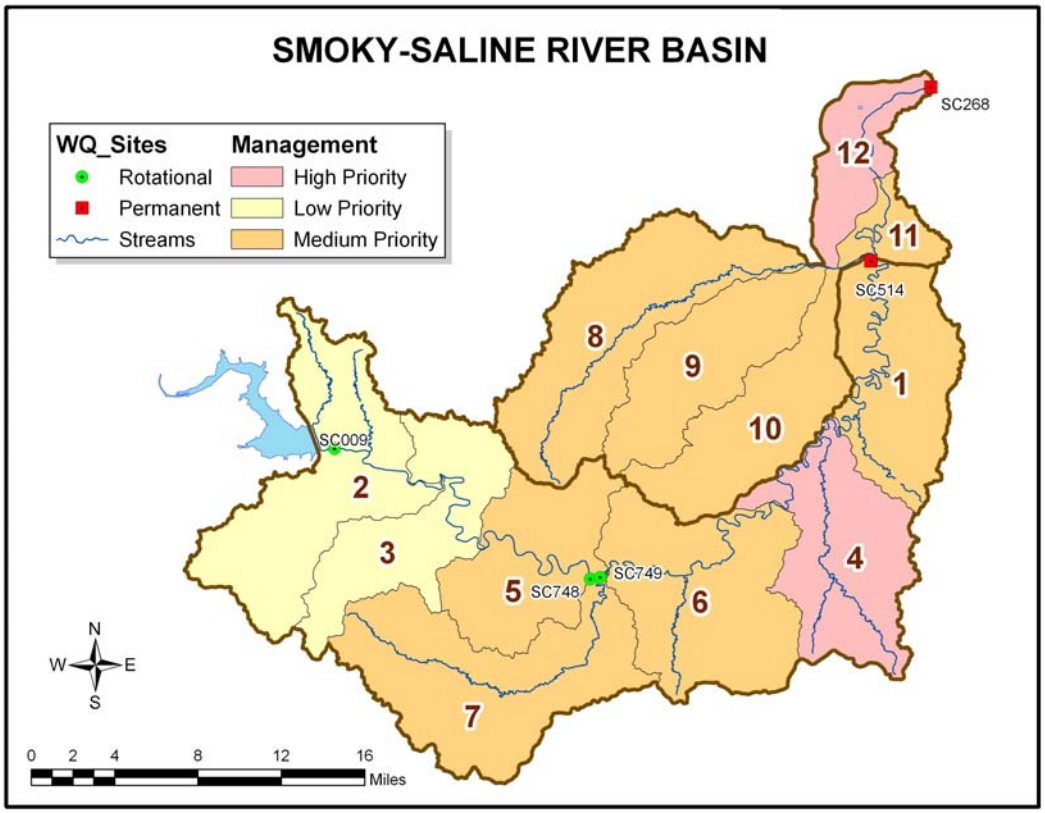

Figure 18. Management priority for the Smoky Hill River Watershed.

5. IMPLEMENTATION

The excess TSS loads in the Smoky Hill River Watershed are closely associated with the areas used for crop production. The largest TSS loads typically occur during spring runoffs, followed by the higher summer and fall TSS loads. The TSS loads are smallest in the winter months because of the appearance of lowest streamflow (**Figure 14**). To control TSS loads, there is a good potential that best management practices will improve the water quality. Some of the recommended practices are as follows.

Desired Implementation Activities

1. Implement and maintain conservation farming, including conservation tilling, contouring strips and no till farming to reduce suspended solids loads from tributaries to Smoky Hill River.
2. Improve riparian conditions along stream systems by installing grass and/or forest buffer strips to trap suspended solids, and reducing livestock activities within riparian areas to reduce stream bank erosion.
3. Install pasture management practice, including proper stock density, to reduce soil erosion and storm runoff.
4. Minimize road and bridge construction impacts on streams.
5. Monitor wastewater discharges for excessive suspended solids loadings.
6. Incorporate this TMDL into the Upper Lower Smoky Hill River Basin WRAPS projects.

7. Establish urban and construction stormwater management practices to abate sediment loading in Salina.

Implementation Programs Guidance

NPDES - Municipal Program – KDHE

a. Monitor effluent from wastewater treatment plants to determine their total suspended solids contributions.
b. Ensure proper monitoring, permitting, and operations of municipal wastewater systems to reduce total suspended solids discharges.
c. Incorporate sediment control in Salina stormwater NPDES permit.

Nonpoint Source Pollution Technical Assistance - KDHE

a. Support Section 319 demonstration projects for reduction from livestock operations,

b. Provide technical assistance on practices geared to establishment of vegetative buffer strips,

c. Provide technical assistance on sediment and pasture management in vicinity of streams,

d. Support Watershed Restoration and Protection Strategy (WRAPS) efforts for the Upper Lower Smoky Hill River Watershed,

e. Incorporate the provisions of this TMDL into any Upper Lower Smoky Hill River's WRAPS documents, especially the 9-element watershed plan.

Water Resource Cost Share Nonpoint Source Pollution Control Program - SCC

a. Apply conservation farming practice, including terraces and waterways, sediment control basins, and constructed wetlands within the watershed.
b. Provide sediment control practices to minimize erosion and sediment transport from cropland and grassland in the watershed.

Riparian Protection Program - SCC

a. Establish or restore natural riparian systems, including vegetative filter strips and streambank vegetation along Smoky Hill River and its tributaries.
b. Develop riparian restoration projects along targeted stream segments, especially those areas with baseflow.
c. Promote wetland construction to reduce runoff and assimilate sediment loadings.
d. Coordinate riparian management within the watershed.

Buffer Initiative Program - SCC

a. Install grass buffer strips near streams,

b. Leverage Conservation Reserve Enhancement Program to hold riparian land out of production.

Extension Outreach and Technical Assistance - Kansas State University

a. Educate agricultural producers on riparian and sediment management techniques,
b. Provide technical assistance on sediment management,
c. Continue Section 319 demonstration projects on sediment management,
d. Support outreach efforts by Upper Lower Smoky Hill River WRAPS.

Time Frame for Implementation: Pollutant reduction practices should be installed within the top priority subwatersheds (4 and 12) before 2012, with follow-up implementation, including other subwatersheds over 2012 – 2016.

Targeted Participants: Primary participants for implementation will likely be agricultural producers operating within the drainage of priority subwatersheds. Implementation activities should target those areas with greatest potential to impact the river's TSS levels:

1. Total rowcrop acreage and gully locations
2. Conservation compliance on highly erodible areas
3. Acreage of poor rangeland or overstocked pasture
4. Livestock use of riparian areas and condition of riparian areas
5. Unvegetated or graded roadside ditches
6. Construction projects without erosion control techniques
7. Uncontrolled entry points for urban runoff
8. Impervious area generating increased runoff

Some inventory of local needs should be conducted in 2010 to identify such activities. Such an inventory would be done by local program managers with appropriate assistance by commodity representatives and state program staff in order to direct state assistance programs to the principal activities influencing the quality of the river and its tributaries in the watershed during the implementation period of this TMDL.

Milestone for 2014: The year 2014 marks the midpoint of the ten-year implementation window for the watershed. At that point in time, sampled data from the Smoky Hill River should indicate evidence of reduced TSS levels relative to the conditions seen over 2000 – 2009.

Delivery Agents: The primary delivery agents for program participation will be conservation districts for programs of the State Conservation Commission and the Natural Resources Conservation Service. Producer outreach and awareness will be delivered by Kansas State Extension and Upper Lower Smoky Hill River WRAPS. Implementation decisions and scheduling will be guided by planning documents prepared through Lower Smoky Hill River WRAPS.

Reasonable Assurances:

Authorities: The following authorities may be used to direct activities in the watershed to reduce pollution.

1. K.S.A. 65-164 and 165 empowers the Secretary of KDHE to regulate the discharge of sewage into the waters of the state.

2. K.S.A. 65-171d empowers the Secretary of KDHE to prevent water pollution and to protect the beneficial uses of the waters of the state through required treatment of sewage and

established water quality standards and to require permits by persons having a potential to discharge pollutants into the waters of the state.

3. K.A.R. 28-16-69 to -71 implements water quality protection by KDHE through the establishment and administration of critical water quality management areas on a watershed basis.

4. K.S.A. 2-1915 empowers the State Conservation Commission to develop programs to assist the protection, conservation and management of soil and water resources in the state, including riparian areas.

5. K.S.A. 75-5657 empowers the State Conservation Commission to provide financial assistance for local project work plans developed to control non-point source pollution.

6. K.S.A. 82a-901, *et seq*. empowers the Kansas Water Office to develop a state water plan directing the protection and maintenance of surface water quality for the waters of the state.

7. K.S.A. 82a-951 creates the State Water Plan Fund to finance the implementation of the *Kansas Water Plan*.

8. The *Kansas Water Plan* and the Smoky Hill River Basin Plan provide the guidance to state agencies to coordinate programs intent on protecting water quality and to target those programs to geographic areas of the state for high priority in implementation.

Funding: The State Water Plan Fund annually generates $16-18 million and is the primary funding mechanism for implementing water quality protection and pollution reduction activities in the state through the *Kansas Water Plan*. The state water planning process, overseen by the Kansas Water Office, coordinates and directs programs and funding toward watersheds and water resources of highest priority. Typically, the state allocates at least 50% of the fund to programs supporting water quality protection through the WRAPS program. This watershed and its TMDL are a High Priority consideration.

Effectiveness: Sediment control has been proven effective through conservation tillage, contour farming and use of grass waterways and buffer strips. The key to success will be widespread utilization of conservation farming within the watersheds cited in this TMDL.

6. MONITORING

Ongoing bimonthly sampling will continue at SC514 and SC268. Future stream sampling will occur bimonthly at rotational sites (SC748 and SC749) twice between 2009 and 2015. Monitoring of tributary levels of TSS during runoff events will help direct abatement efforts toward major contributors. Additionally, tracking of TSS loads from the existing municipal lagoons should be done to confirm their small contribution to the river. Monitoring of TSS should be a condition of the Salina MS4 stormwater permit.

7. FEEDBACK

A public meeting to discuss this TMDL in the upper Lower Smoky Hill River Basin was held on August 13, 2009 in Assaria. An active Internet Web site was established at http://www.kdhe.state.ks.us/tmdl/ to convey information to the public on the general establishment of TMDLs and specific TMDLs for the Smoky Hill – Saline River Basin.

Public Hearing: Public Hearings on the TMDL of the Smoky Hill – Saline River Basin were held in Assaria on February 11, 2010.

Discussion with Interest Groups: The staff of Watershed Management Section of KDHE were briefed on the implications of this TMDL on February 3, 2010, and the Upper Lower Smoky Hill River WRAPS on August 13 and October 22, 2009.

Basin Advisory Committee: The Smoky Hill – Saline River Basin Advisory Committee met to discuss the TMDLs in the basin on July 6, 2009 in Hays and October 2, 2009 in Hays.

Milestone Evaluation: In 2014, evaluation will be made as to the degree of implementation which has occurred within the watershed. Subsequent decisions will be made through the Upper Lower Smoky Hill River WRAPS, regarding the implementation approach and follow up of additional implementation in the watershed.

Consideration for 303(d) Delisting: The Smoky Hill River will be evaluated for delisting under Section 303(d), based on the monitoring data over the period 2009 – 2019. Therefore, the decision for delisting will come about in the preparation of the 2020 303(d) list. Should modifications be made to the applicable water quality criteria during the ten-year implementation period, consideration for delisting, desired endpoints of this TMDL and implementation activities may be adjusted accordingly.

Incorporation into Continuing Planning Process, Water Quality Management Plan and the Kansas Water Planning Process: Under the current version of the Continuing Planning Process (CPP), the next anticipated revision will come in 2010 which will emphasize implementation of WRAPS activities. At that time, incorporation of this TMDL will be made into the WRAPS. Recommendations of this TMDL will be considered in *Kansas Water Plan* implementation decisions under the State Water Planning Process after Fiscal Years 2011– 2019.

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Appendix A. Wasteload allocation for the wastewater treatment facilities and CAFO sites.

Facility	Permit #	Waste Load Allocation ton/day (lbs/day)
MWTP		
Assaria	KS-0082295 (M-SH02-OO01)	0.01385 (27.7)
Lindsborg	KS-0022462 (M-SH21-OO01)	0.0524 (104.8)
Marquette	KS-0021873 (M-SH25-OO01)	0.02245 (44.9)
Ellsworth Co. RWD 1 – Post Rock	KS-0099287 (I-SH53-PO01)	0.01065 (21.3)
Salina	KS-0038474 (M-SH33-IO01)	0.908 (1816)
Salina Co. Sewer District	KS-0093009 (M-SH46-OO02)	0.00335 (6.7)
Total		*1.01 (2,021.4)*
CAFO		
Beef (999)	A-SHMP-B005	0
Beef (600)	A-LAMP-BA20	0
Dairy (80)	A-SHMP-M004	0
Beef (150)	A-SHMP-BA07	0
Beef (10,000)	A-SHMP-C001 (KS01116351)	0
Swine (11,364)	A-SHMP-H001 (KS0086291)	0
Beef (800)	A-SHMP-B004	0
Swine (300)	A-SHMP-S001	0
Beef (23)	A-SHMP-BA05	0
Dairy (60)	A-SHEW-MA01	0
Beef, Horses (603)	A-SHMP-B003	0
Beef (460)	A-SHMP-BA10	0
Beef (300)	A-SHMP-BA04	0
Beef (150)	A-SHMP-BA03	0
Beef (200)	A-SHMP-BA09	0
Beef (450)	A-SHMP-BA01	0
Beef (140)	A-SHMP-BA02	0
Beef (40)	A-SHMP-BA08	0
Beef (2,000)	A-SHMP-C002 (KS0099597)	0
Beef (100)	A-SAMP-BA01	0
Beef (299)	A-SHSA-B009	0
Beef (200)	A-SHSA-BA17	0
Dairy (180)	A-SHSA-M006	0
Beef (750)	A-SHSA-B007	0
Swine (600)	A-SHSA-S004	0
Beef (9,000)	A-SHSA-C001 (KS0045489)	0
Beef (250)	A-SHSA-B006	0
Beef (300)	A-SHSA-B008	0
Beef (300)	A-SASA-BA13	0
Beef (150)	A-SASA-BA10	0
Beef (300)	A-SASA-BA01	0
Dairy (125)	A-SHSA-M001	0
Swine (12,630)	A-SASA-H001 (KS0038041)	0
Beef (300)	A-SHSA-BA05	0
Beef (300)	A-SASA-BA12	0
Beef (598)	A-SHSA-BA01	0