

SMOKY HILL-SALINE BASIN TOTAL MAXIMUM DAILY LOAD

**Waterbody / Assessment Unit: Sharps Creek
Water Quality Impairment: Total Phosphorus**

1. INTRODUCTION AND PROBLEM IDENTIFICATION

Subbasin: Lower Smoky Hill

County: McPherson, Rice

HUC 8: 10260008

HUC10 (12): 01 (04)

Ecoregion: Smoky Hills (27a), Wellington-McPherson Lowland (27d)

Drainage Area: Approximately 61.8 square miles

Main Stem Water Quality Limited Segments:

Water Quality Limited Segments Covered Under this TMDL:

<u>Station</u>	<u>Main Stem Segment</u>
SC749	Sharps Creek (16)

2012, 2014, 2016 & 2018 303(d) Listings: Kansas Stream segments monitored by station SC749, Sharps Creek near Freemount, are cited as impaired by Total Phosphorus (TP) for the Smoky Hill-Saline Basin.

Designated Uses: Expected Aquatic Life, Secondary Contact Recreation, Domestic Water Supply, Groundwater Recharge, Industrial Water Supply, Irrigation Use, Livestock Watering

Impaired Use: Expected Aquatic Life, Contact Recreation and Domestic Water Supply.

Water Quality Criteria:

Nutrients – Narratives: The introduction of plant nutrients into streams, lakes, or wetlands from artificial sources shall be controlled to prevent the accelerated succession or replacement of aquatic biota or the production of undesirable quantities or kinds of aquatic life (K.A.R. 28-16-28e(d)(2)(A)).

The introduction of plant nutrients into surface waters designated for primary or secondary contact recreational use shall be controlled to prevent the development of objectionable concentrations of algae or algal by-products or nuisance growths of submersed, floating, or emergent aquatic vegetation (K.A.R. 28-16-28e(d)(7)(A)).

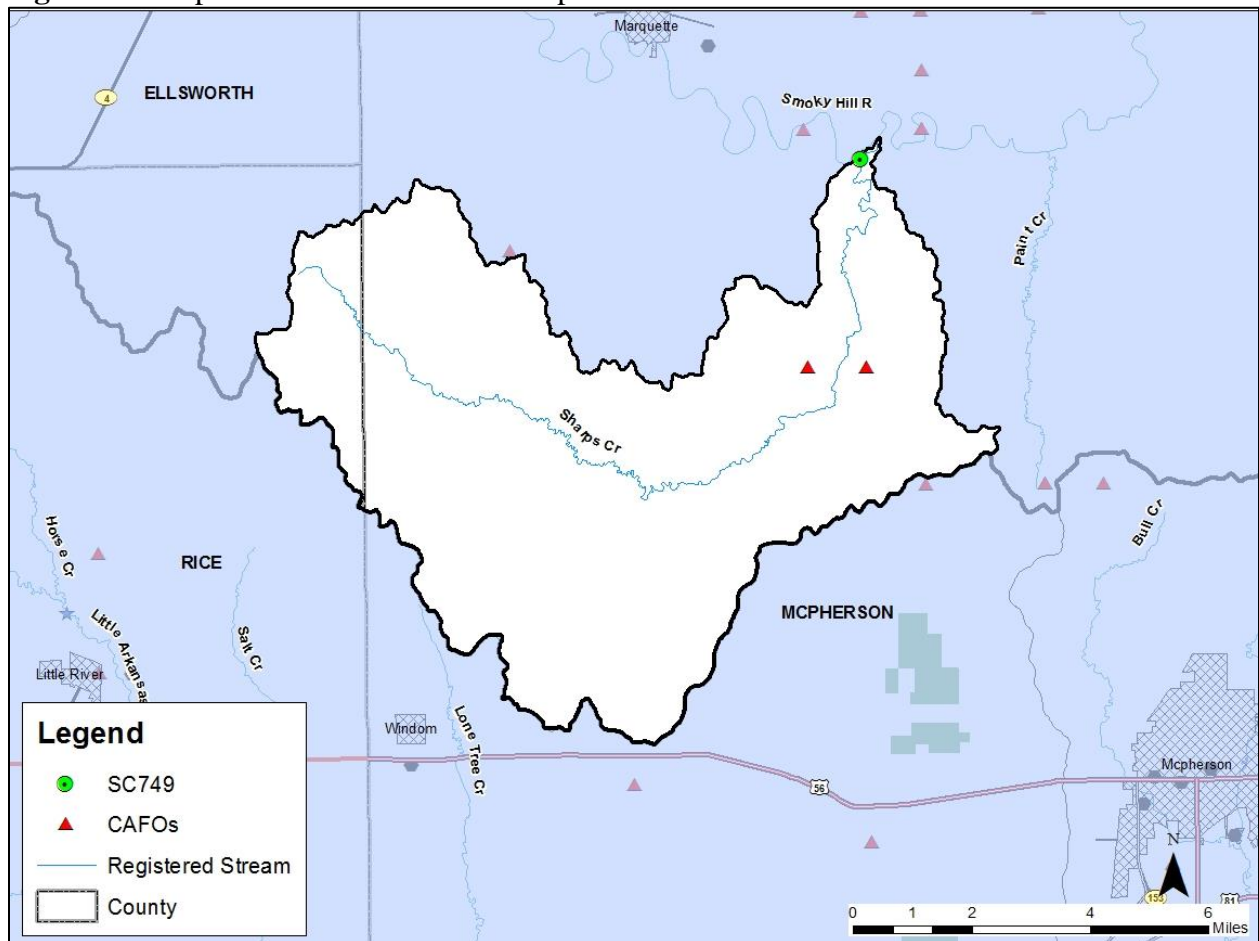
The introduction of plant nutrient into surface waters designated for domestic water supply use shall be controlled to prevent interference with the production of drinking water (K.A.R. 28-16-28e(d)(3)(D)).

Taste-producing and odor-producing substances of artificial origin shall not occur in surface waters at concentrations that interfere with the production of potable water by conventional water treatment processes, that impart an unpalatable flavor to edible aquatic or semiaquatic life or terrestrial wildlife, or that result in noticeable odors in the vicinity of surface waters (K.A.R. 28-16-28e(b)(7)).

Dissolved Oxygen – Numeric: The concentration of dissolved oxygen in surface waters shall not be lowered by the influence of artificial sources of pollution. The Dissolved Oxygen criterion is 5.0 mg/L (K.A.R. 28-16-28e(e) Tables of Numeric Criteria).

pH – Numeric: Artificial sources of pollution shall not cause the pH of any surface water outside of a zone of initial dilution to be below 6.5 and above 8.5 (K.A.R. 28-16-28e (e) Tables of Numeric Criteria)

Figure 1. Sharps Creek watershed base map.



2. CURRENT WATER QUALITY CONDITIONS AND DESIRED ENDPOINT

Level of Support for Designated Uses under the 2018 303(d) List: Phosphorus levels in Sharps Creek near Freemount (SC749) are consistently high. Excessive nutrients are not being controlled and are thus impairing aquatic life, domestic water supply, and contact recreation uses. Achievement of the ALUS index endpoint established by this TMDL will indicate the aquatic life use in the river has been restored with simultaneous achievement of the chlorophyll *a* endpoint indicating restored domestic water supply and contact recreation uses.

Stream Location and Period of Record

Stream Chemistry (SC) Monitoring Station

Sharps Creek Near Freemount (SC749): Active KDHE rotational stream chemistry station located on Sharps Creek 1.25 miles South and 0.5 miles East of Freemount. Period of Record: Six samples taken in 2007 and sampled quarterly in 2011 and 2015.

Streamflow Gage

U.S. Geological Survey 06878000: Chapman Cr near Chapman. Period of record: January 1, 1991 to May 31, 2018. Located near Sharps Creek (SC749).

Hydrology: Long term flow conditions were based on a regression analysis between USGS 06878000 on Chapman Creek near Chapman, and flows for Sharps Creek in McPherson County (segment 1026000816) in the USGS Scientific Investigations Report 2004-5033 (Perry, et. al., 2004). A watershed ratio was performed on this regression for flow at the stream chemistry site. These estimated calculated flows for Sharps Creek are listed in **Table 1**.

Figure 2. Flow duration curve Sharps Creek at SC749 for the period of record 1/1/2000 through 12/31/2017. Estimated using the U.S. Geological Survey (USGS) gage site located in Chapman Creek (06878000).

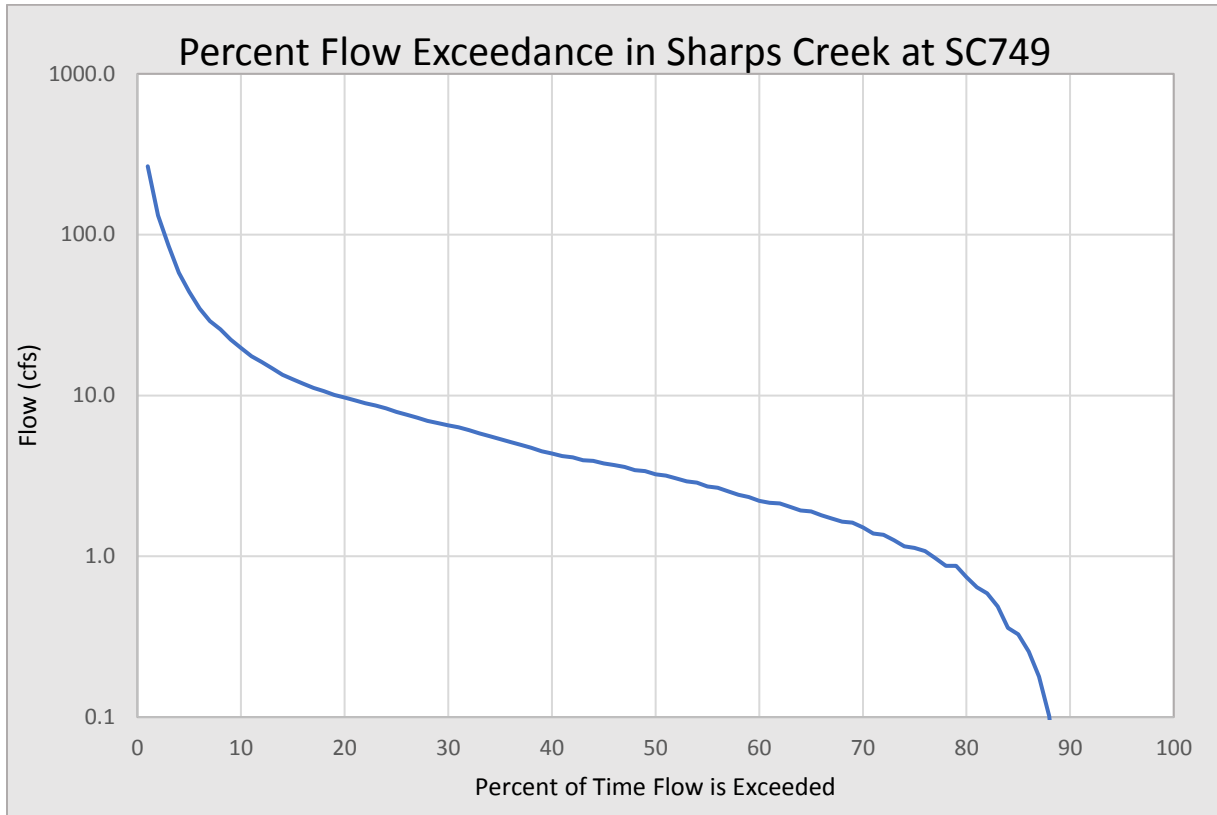


Table 1. Flow conditions at USGS gage 06878000 in Sharps Creek (Perry, et al., 2004) and KDHE stream chemistry station SC749.

Site	Watershed	Period of Record	Drainage Area (mi ²)	Mean Flow (cfs)	Percent of Flow Exceedance				
					90% (cfs)	75% (cfs)	50% (cfs)	25% (cfs)	10% (cfs)
USGS 06878000	Chapman Creek near Chapman	1/1/2000-12/31/2017	300	68.0	8.48	13.00	21.80	39.0	83.8
USGS Segment ID: 2930, McPherson County	Sharps Creek	N/A	89.5	21.61	0	1.42	4.67	11.68	28.53
SC749	Sharps Creek near Freemount	1/1/2000-12/31/2017	61.8	15.5	0	1.13	3.23	7.90	19.8

The years with the highest mean flows for Sharps Creek were 2007, 2010, and 2017, with flows of 30.85, 34.91, and 31.76 cubic feet per second (cfs), respectively (**Figure 3**). Annually, the highest median flows occurred in 2010, 2011, and 2016 with flows of 11.77, 7.94, and 7.54 cfs, respectively. The years with the lowest mean flows were 2002, 2003, and 2006, with means of 2.41, 2.26, and 1.43 cfs, respectively. Annual low median flows occurred in 2003, 2004, and 2006, with medians of 0.28, 0.49, and 0.62 cfs, respectively. The largest peak flows for Sharps Creek occurred in 2007 and 2011, with flows of 1,765.80 and 1,932.83 cfs, respectively (**Figure 4**). The lowest annual peak flows occurred in 2002 and 2006, at 48.16 and 44.30 cfs, respectively. Annual peak flows generally correspond to trends in annual mean and median flows. Monthly flows (**Figure 5**) reflect seasonal patterns (**Figure 6**) with the spring months of April, May and June having the highest mean flows and the winter months of November and January having the lowest mean flows. Median flows display a somewhat different pattern with the summer-fall months of July, August, September, and October recording the lowest flows, resulting in the summer-fall season posting the lowest median flow. The summer-fall median is lower than the winter median, while the summer-fall mean is greater than the winter mean which indicates seasonal runoff events during the summer-fall season. However, the mean during the summer-fall season is higher than the winter season, indicating isolated, seasonal runoff events are likely occurring in the watershed.

Figure 3. Mean and median annual flows at SC749 in Sharps Creek and annual total precipitation at National Oceanic and Atmospheric Association station USC00145152 in McPherson, KS.

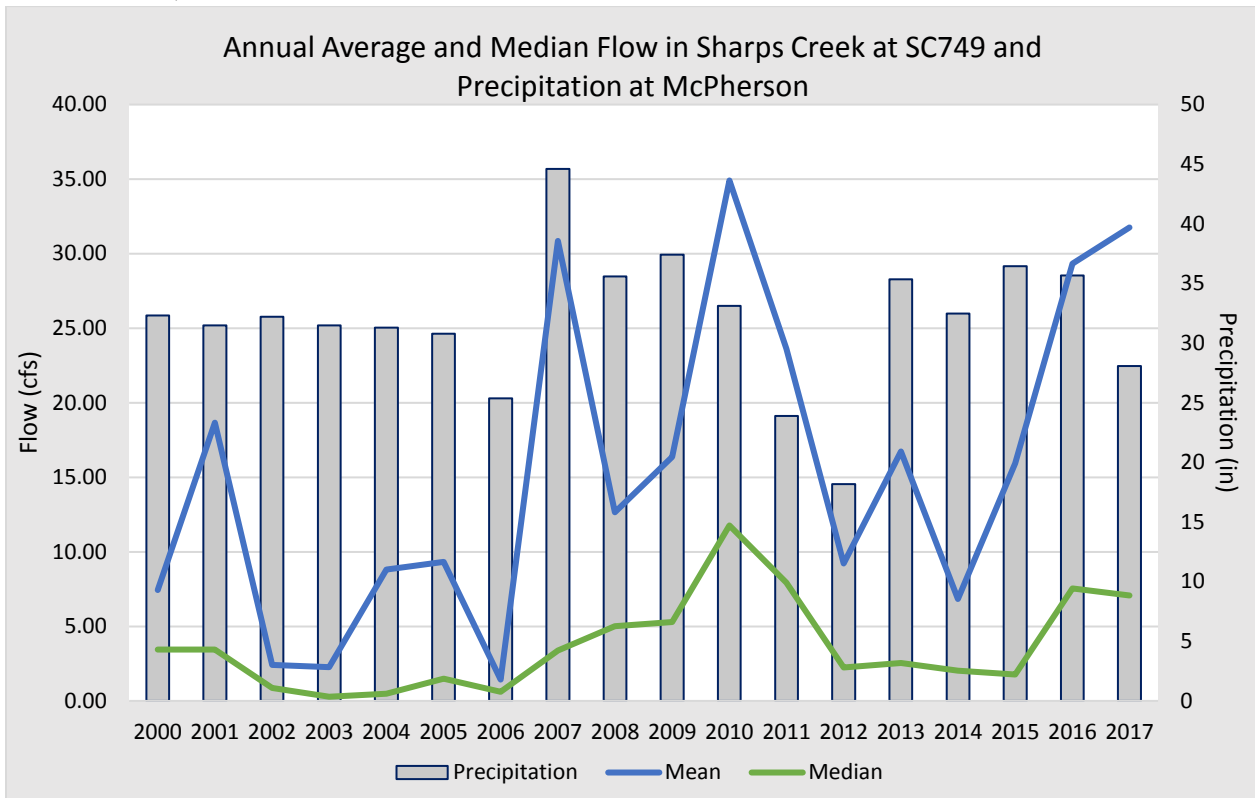


Figure 4. Annual peak flows at SC749 in Sharps Creek.

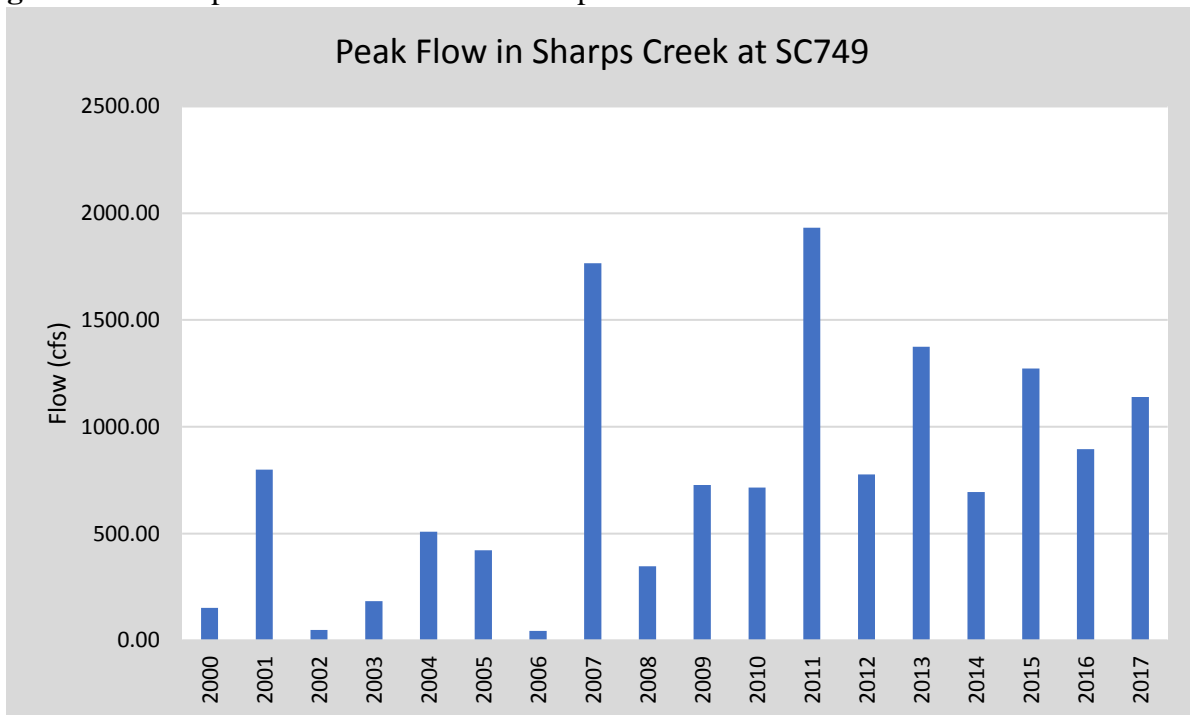


Figure 5. Mean and median monthly flows at SC749 in Sharps Creek.

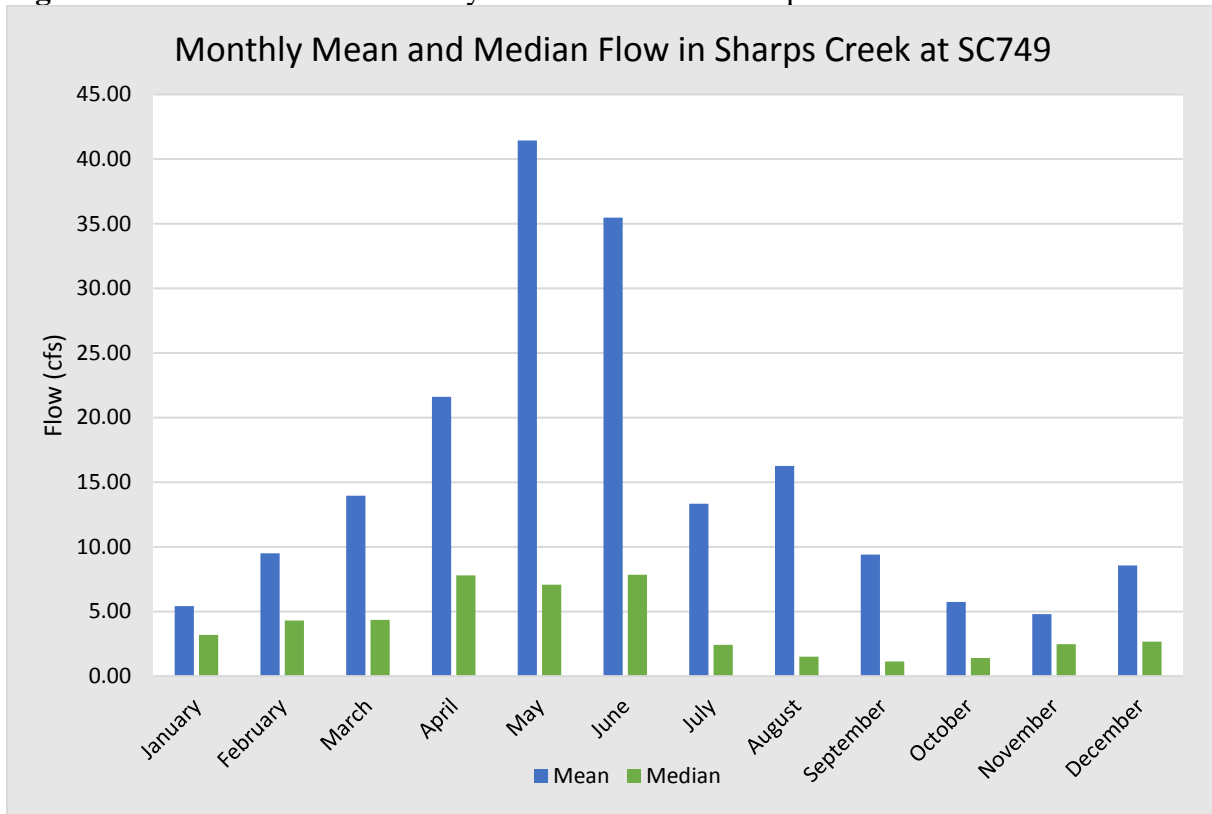
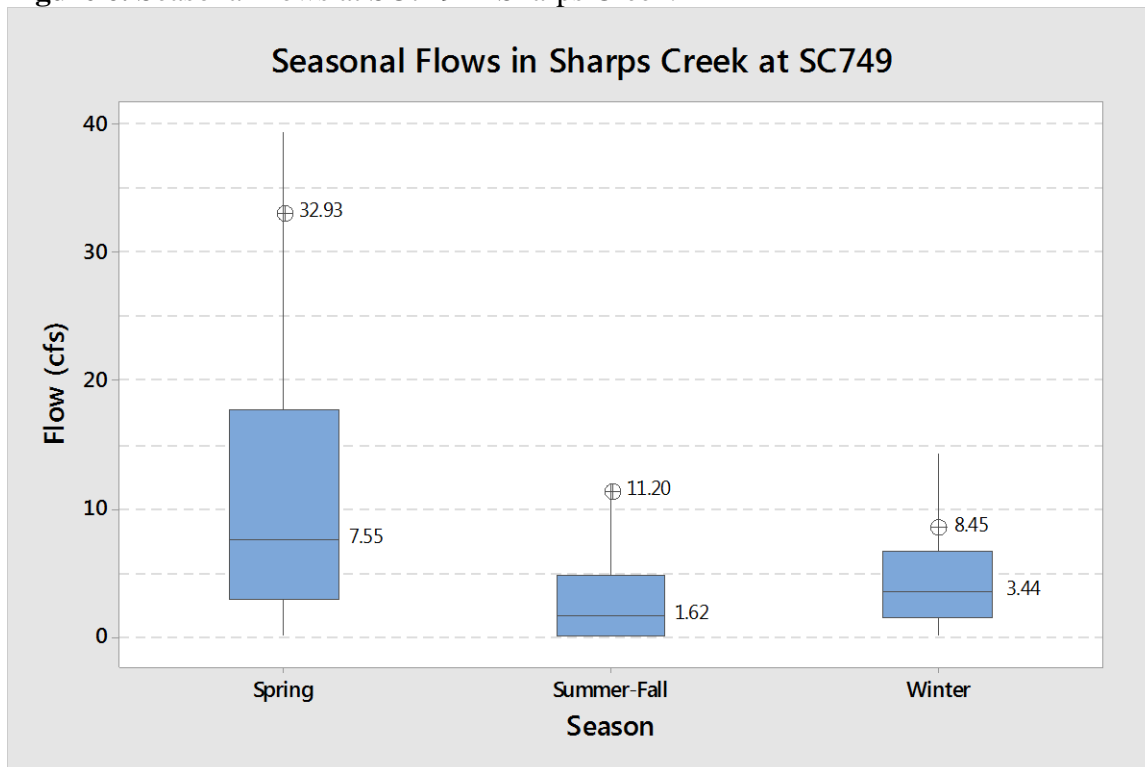


Figure 6. Seasonal flows at SC749 in Sharps Creek.



Sharps Creek has been sampled 14 times over the period of record. Six times in 2007, four times in 2011, and four times in 2015. Seasonal analysis of total phosphorus (TP) concentrations in Sharps Creek shows summer-fall season (July-October) recorded the highest mean and median TP while the winter season (November-March) recorded the lowest (**Figure 7**). TP concentrations across the flow range can be seen **Figure 8**. The high summer-fall TP of 0.714mg/L displayed in **Figure 9** is skewing the mean and median TP at 26-50% flow condition seen in **Figure 8**. The mean and median TP concentrations are 0.206 mg/L and 0.217 mg/L, respectively under all flow conditions (**Table 2a and Table 2b**).

Figure 7. Total phosphorus concentration by season at SC749, 2007-2015.

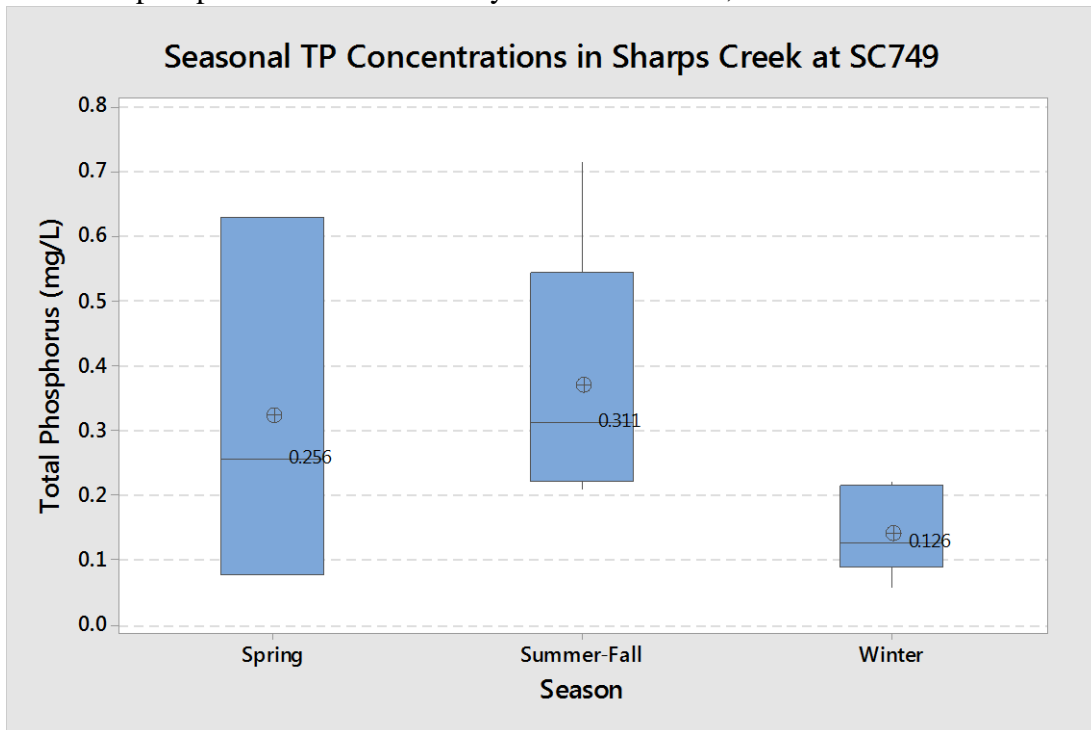


Figure 8. Total phosphorus concentration by flow range at SC749, 2007-2015.

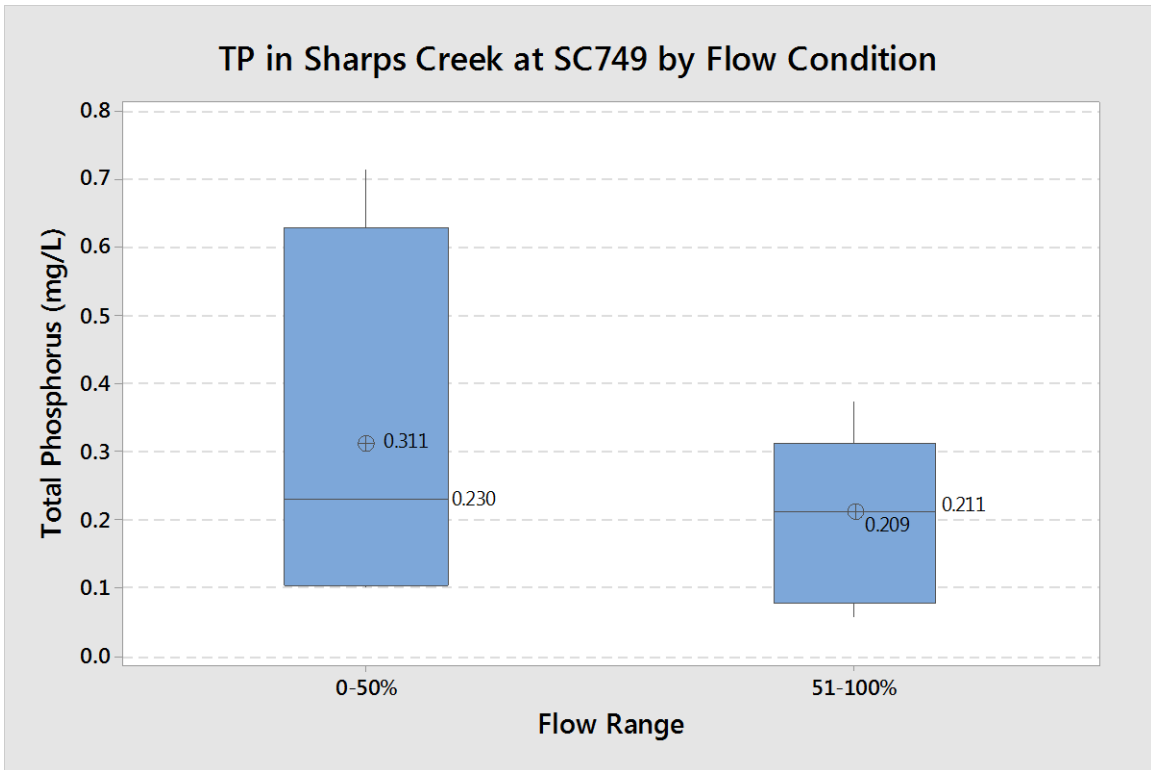


Figure 9. Total phosphorus concentrations by season in Sharps Creek at SC749.

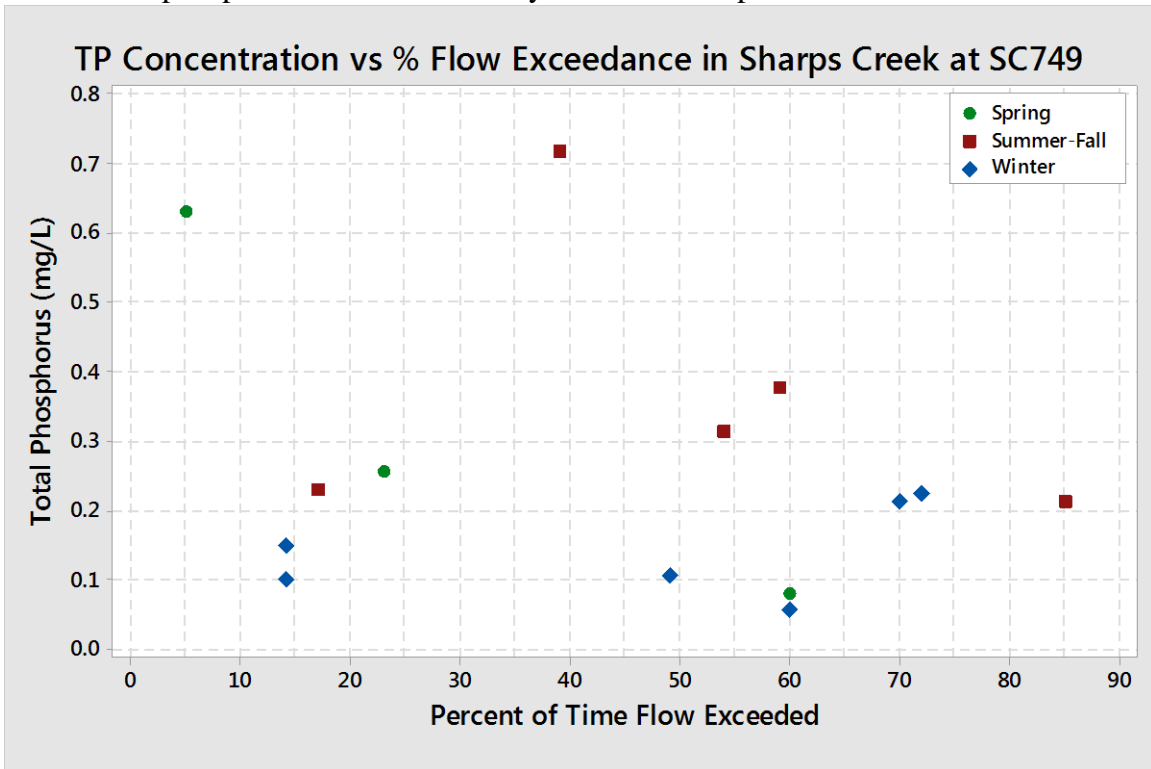


Table 2a. Mean and median total phosphorus concentration with number of samples (N) in Sharps Creek at SC749 by season and flow condition, 2007-2015.

% Flow Exceedance	Total Phosphorus (mg/L)			
	<i>Mean</i>	<i>Med</i>	<i>Max</i>	<i>N</i>
0-25%	0.272	0.230	0.629	5
26-50%	0.409	0.409	0.714	2
51-75%	0.209	0.217	0.375	6
76-100%	0.210	0.210	0.210	1
All Flows	0.260	0.217	0.714	14

Table 2b. Mean and median total phosphorus concentration with number of samples (N) in Sharps Creek at SC749 by season and flow condition, 2007-2015.

% Flow Exceedance	Total Phosphorus (mg/L)			
	<i>Mean</i>	<i>Med</i>	<i>Max</i>	<i>N</i>
0-50%	0.311	0.230	0.714	7
51-100%	0.209	0.211	0.375	7
All Flows	0.260	0.217	0.714	14

The single sample with high TP concentrations under normal flow conditions occurred on July 30, 2007 with a concentration of 0.714 mg/L and on June 20, 2011 with a concentration of 0.629 mg/L under high flow conditions (**Figure 10**). The 2007 and 2011 single sample highs contributed to 2007 and 2011 recording the highest annual means at 0.314 mg/L and 0.297 mg/L, respectively. Additionally, annual high median values occurred in 2007 and 2011 at 0.239 mg/L under normal flow conditions and 0.230 mg/L TP under high flow conditions, respectively (**Figure 11**). As there are only 14 samples for Sharps Creek,

Figure 10. Total phosphorus concentrations in Sharps Creek at SC749.

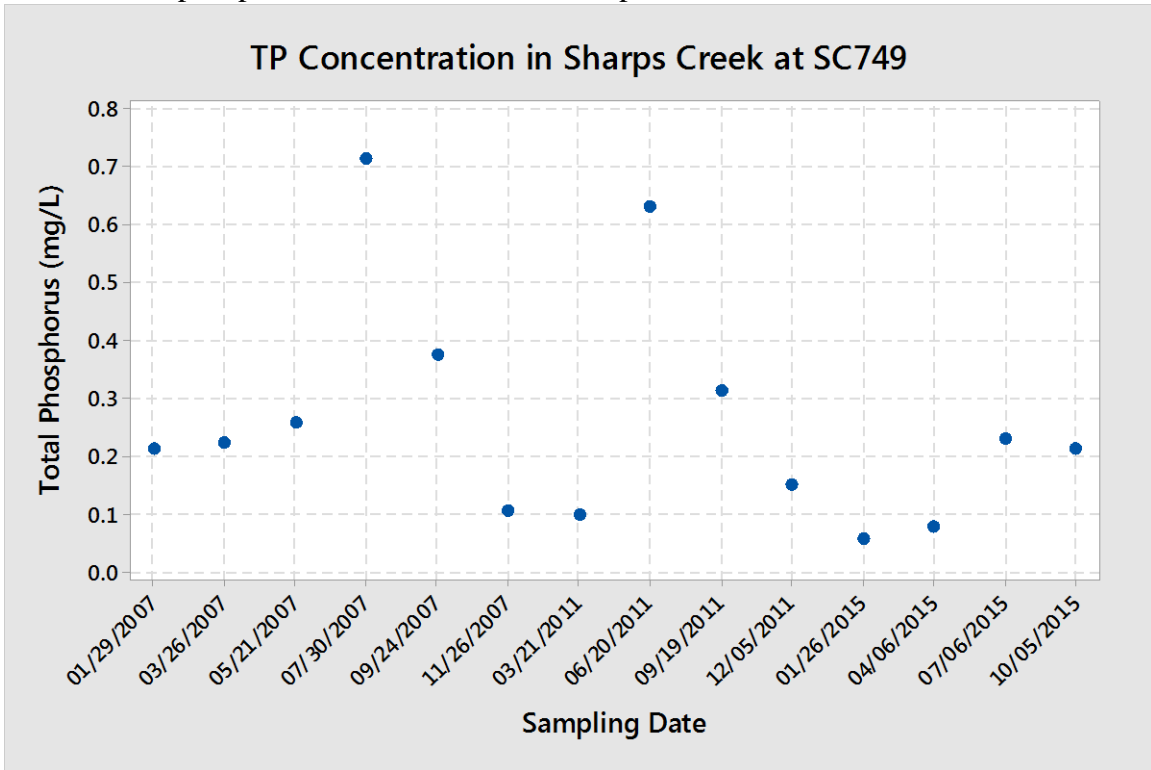
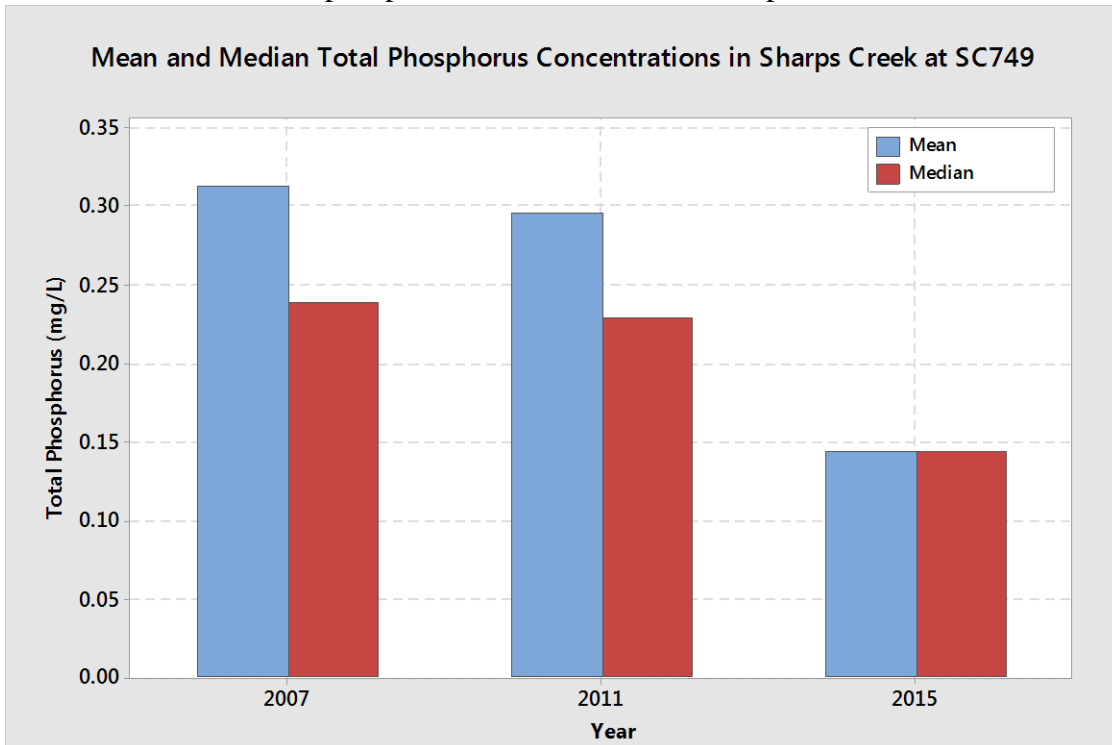
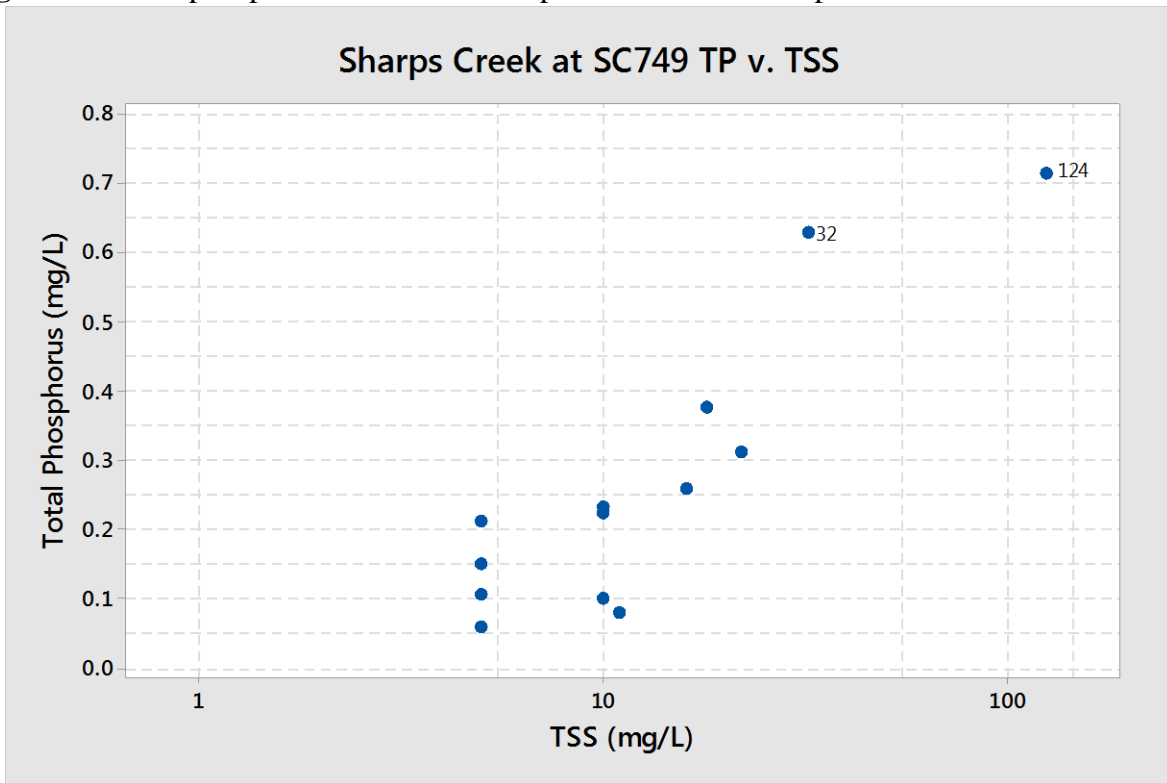


Figure 11. Mean and median phosphorus concentrations in Sharps Creek at SC749.



Phosphorus is typically linked to sediment or total suspended solids (TSS) because of the propensity of those solids to adsorb phosphorus. As seen in **Figure 12**, TSS levels on Sharps Creek are poorly correlated with phosphorus concentrations when TSS concentrations are near the reporting limit of 10 mg/L. As TSS concentrations increase over 10 mg/L, the TP concentrations trend upward proportionately, which is indicative of nonpoint source and wetter flow conditions

Figure 12. Total phosphorus versus total suspended solids in Sharps Creek at SC749.



Relationship between Phosphorus and Biological Indicators: The narrative criteria of the Kansas Surface Water Quality Standards are based on conditions of the prevailing biological community. Excessive primary productivity may be indicated by extreme swings in dissolved oxygen (DO) or pH as the chemical reaction of photosynthesis and respiration alter the ambient levels of oxygen or acid-base balance of the stream. Dissolved Oxygen (DO) concentrations in Sharps Creek relative to the sampling date are represented in **Figure 13**. DO concentrations have fallen below the water quality standard (WQS) of 5.0 mg/L only once, on June 20, 2011. **Figure 13** shows that, generally, as stream temperature increases, dissolved oxygen concentrations decrease. **Figure 14** illustrates the relationship between stream pH and the TP concentration at SC749. Higher pH values tend to occur during periods when photosynthesis intensifies. pH has never exceeded the criterion of 8.5 at the sampling station.

Figure 13. Dissolved oxygen and temperature in Sharps Creek at SC749.

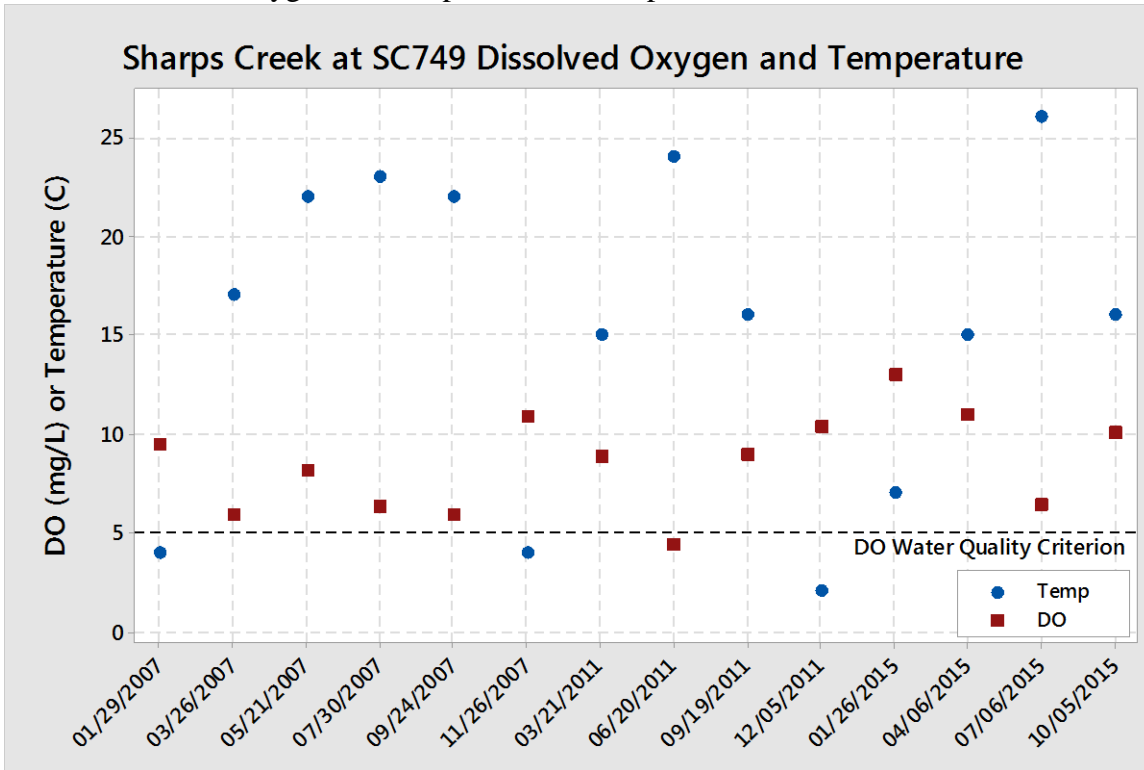
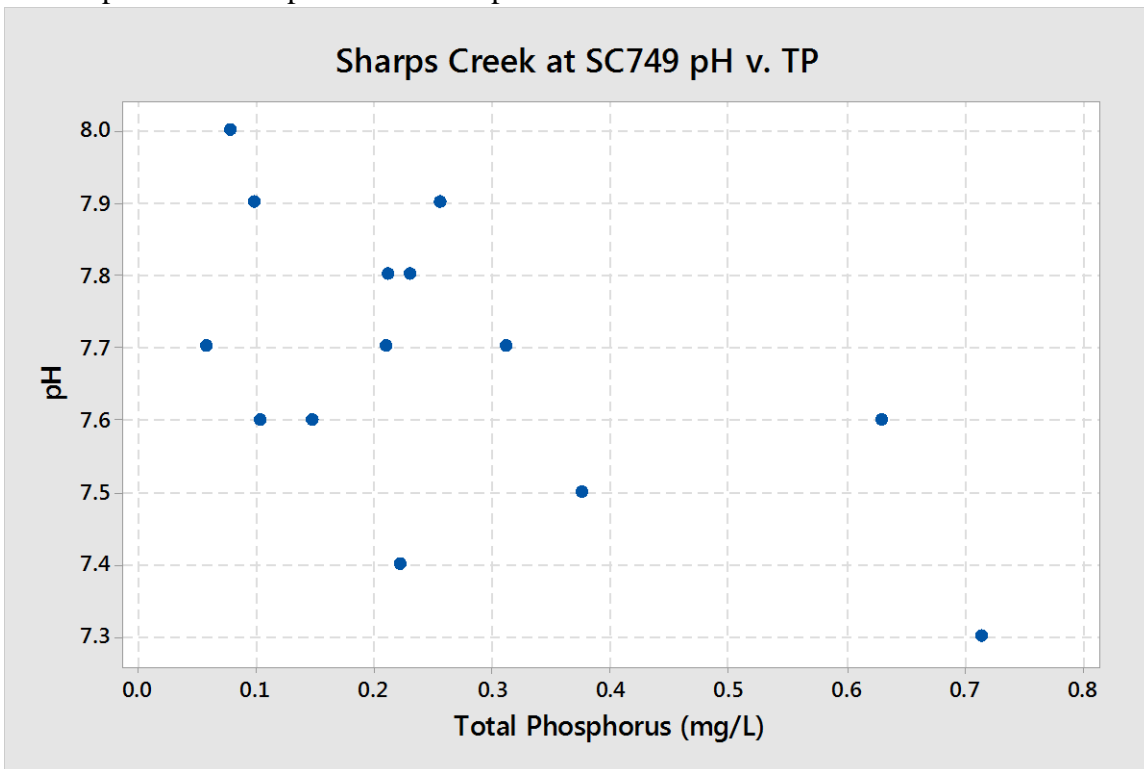


Figure 14. pH versus temperature in Sharps Creek at SC749.



Desired Endpoint: The ultimate endpoint of this TMDL will be to achieve the Kansas Surface Water Quality Standards by eliminating the objectionable flora and other impacts to aquatic life, domestic water supply, or recreation associated with excessive phosphorus as described in the narrative criteria pertaining to nutrients. There are no existing numeric phosphorus criteria currently in Kansas. The U.S. EPA suggested benchmark for stream TP in the South Central Cultivated Great Plains Nutrient Ecoregion V is 0.067 mg/L over the ten-state aggregate of Level III ecoregions.

The Sharps Creek watershed lies within U.S. EPA Level IV Ecoregion of the Central Great Plains (27). Assessment of TP data from the 129 KDHE monitoring stations located in the Central Great Plains ecoregion for the 2000 through 2018 period of record was used to establish TP milestones for the TMDL included in this document

Table 3. TP summary data of ecoregion 27 stream chemistry stations located in Kansas for total phosphorus, 2000- April 2018.

Ecoregion	Number of Stations	Number of Samples	Median of Station Medians (mg/L)	Q1 of Station Medians (mg/L)	Q3 of Station Medians (mg/L)
27	129	7,248	0.200	0.130	0.374

Data regarding macroinvertebrate organisms and community are collected at KDHE stream biology (SB) stations. There are currently no SB stations located in the Sharps Creek watershed, thus all SB stations in EPA ecoregion 27 were evaluated. KDHE’s Stream Biological Monitoring Program uses the Aquatic Life Use Support Index (ALUS Index) to assess stream biology described in Kansas’ 2018 303(d) Methodology. The ALUS Index consists of five categorizations of biotic condition that, once measured, are assigned a score (**Table 4**). Scores are then tallied, and a support category is assigned according to **Table 5**.

1. Macroinvertebrate Biotic Index (MBI): A statistical measure that evaluates the effects of nutrients and oxygen demanding substances on macroinvertebrates based on the relative abundance of certain indicator taxa (orders and families).
2. Ephemeroptera, Plecoptera, and Trichoptera (EPT) abundance as a percentage of the total abundance of macroinvertebrates.
3. Kansas Biotic Index for Nutrients (KBI-N): Mathematically equivalent to the MBI, however, the tolerance values are species specific and restricted to aquatic insect orders.
4. EPT Percent of Count (EPT % CNT): The percentage of organisms in a sample consisting of individuals belonging to the EPT orders.

5. Shannon’s Evenness (SHN EVN): A measure of diversity that describes how evenly distributed the numbers of individuals are among the taxa in a sample.

Table 4. ALUS Index metrics with scoring ranges.

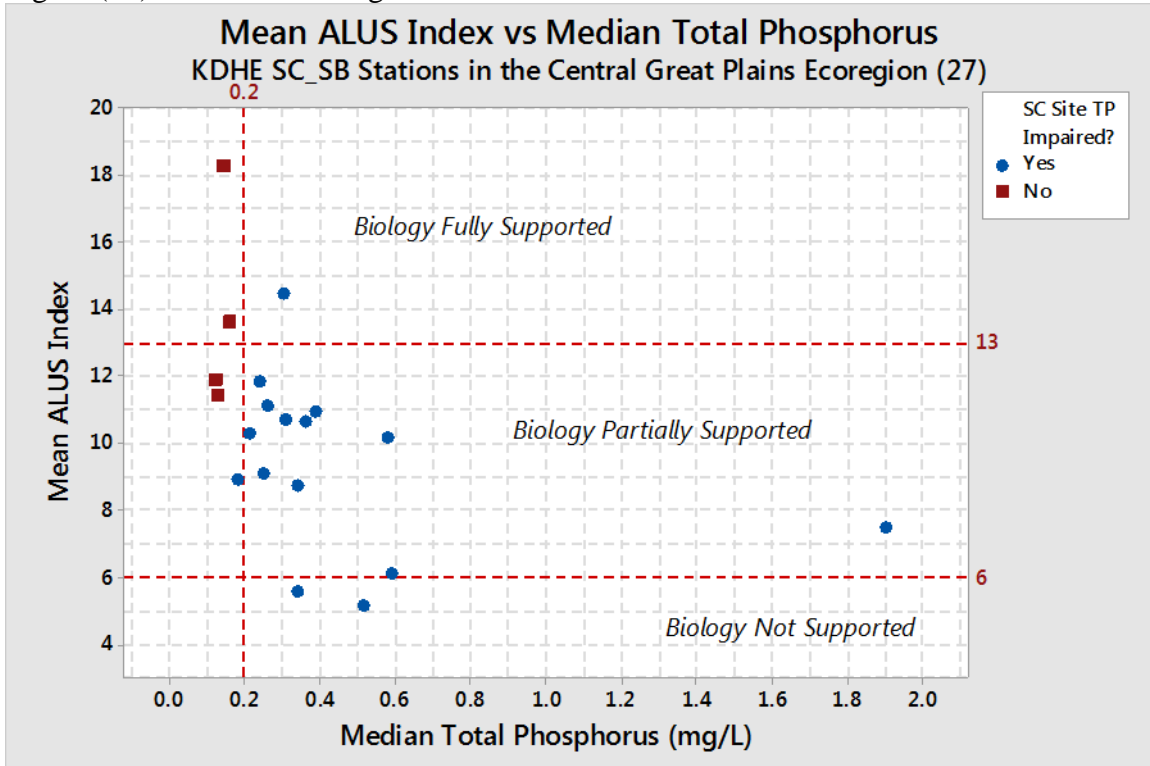
MBI	KBI-N	EPT	EPT % CNT	SHN EVN	Score
<= 4.18	<= 2.52	>= 16	>= 65	>= 0.849	4
4.19-4.38	2.53-2.64	14-15	56-64	0.826-0.848	3
4.39-4.57	2.65-2.75	12-13	48-55	0.802-0.825	2
4.58-4.88	2.76-2.87	10-11	38-47	0.767-0.801	1
>= 4.89	>= 2.88	<= 9	<= 37	<= 0.766	0

Table 5. ALUS Index score range, interpretation of biotic condition, and supporting, partial, and no supporting categories.

ALUS Index Score	Biotic Condition	Support Category
>16 - 20	Very Good	Supporting
>13 - 16.0	Good	
>7 - 13.0	Fair	Partially Supporting
>3 - 6.0	Poor	Non-Supporting
3.0 - 0	Very Poor	

Figure 15 displays the relationship between median phosphorus values and ALUS Index scores within the Central Great Plains (27) Ecoregion. Higher ALUS Index scores are indicative of higher quality biological communities. There are 19 KDHE monitoring stations located in the Central Great Plains Ecoregion that have corresponding biology and TP datasets over the 1990 through 2016 period of record. When median TP concentrations are compared to the mean ALUS Index for those stations, the resulting plot reveals three stations as fully supporting biology with median TP values ranging from 0.140 to 0.300 mg/L, while stations partially supporting biology have TP concentrations ranging from to 0.180 to 1.90 mg/L. The three stations in the ecoregion currently unimpaired for TP have a mean ALUS Index of 15.4; meanwhile, the impaired stations on the 303(d) list for TP demonstrate less support for biology with a mean ALUS Index of 9.4.

Figure 15. Median total phosphorus (TP) versus mean Aquatic Life Use Score (ALUS) Index for stream chemistry/stream biology (SC/SB) stations located in Kansas' Central Great Plain Ecoregion (27) from 1990 through 2016.



The greatest complication in setting an endpoint is establishing the linkage of phosphorus levels to applicable biologic response variables. Displayed in **Figure 15** is a noisy relationship between the ALUS Index and phosphorus that defies establishing a solitary threshold value and supports an adaptive management approach to reduce current phosphorus loads and concentrations; this adaptive management approach requires observing and responding to improvement in biological metrics and sestonic chlorophyll-*a* prior to further reductions. Therefore, the primary measure of reduction in nutrient loading to the impaired segments in the TMDL watershed will be the ALUS Index. The ALUS Index will serve to establish if the biological community at the SC stations in the watershed reflect recovered, renewed diversity and minimal disruption by the impacts described in the narrative criteria for nutrients on aquatic life, recreation, and domestic water supply.

Additionally, the concentration of floating sestonic phytoplankton in the water column at SC749 as determined by measuring the sestonic chlorophyll *a* concentrations in Sharps Creek will indicate if primary productivity has moderated to reduce the impacts described in the narrative criteria for nutrients on aquatic life, recreation, and domestic water supply along the reaches of Sharps Creek.

Secondary indicators of the health of the in-stream biological community include:

1. Dissolved oxygen concentrations greater than 5.0 mg/L and the percent dissolved oxygen not more than 110%. Percent dissolved oxygen saturation is the measure of oxygen in the water relative to the water's potential dissolved oxygen concentration. Dissolved oxygen concentrations below 5.0 mg/L put aquatic life under stress while dissolved oxygen percent saturation levels greater than 110% are indicative of over-active primary productivity.
2. Instream pH values remain below 8.5. Excessive nutrients can induce vigorous photosynthesis which will cause pH to rise above 8.5, the current Kansas criterion.

Therefore, the numeric endpoints for this TMDL indicating attainment of water quality standards within the watershed are:

1. An ALUS Index score greater than 13 at SB stations.
2. Maintain median sestonic chlorophyll *a* concentration equal to or below 10 µg/L at SC stations.
3. Dissolved oxygen concentrations greater than 5.0 mg/L at SC stations.
4. Dissolved oxygen saturation below 110% at SC stations.
5. pH values within the range of 6.5 to 8.5.

All five endpoints have to be initially maintained over three consecutive years to constitute full support of the designated uses of Sharps Creek. After the endpoints are attained, simultaneous digression of these endpoints more than once every three years, on mean, constitutes a resumption of impaired conditions in the stream unless the TP impairment is delisted through the 303(d) process.

There are no existing numeric phosphorus criteria currently in Kansas. Hence, the series of endpoints established by this TMDL will be the measures used to indicate full support of the creek's designated uses. These endpoints will be evaluated periodically as phosphorus levels decline in the watershed over time with achievement of the ALUS index endpoint indicating restored status of the aquatic life use in the river.

This TMDL looks to establish phased total phosphorus endpoints that will be the cue to examine for altered, improved biological conditions in the creek. Assessment of the biological community in the creek will be initiated once concentrations approach the Phase I management milestone of a median concentration of 0.200 mg/L, representing the 50th percentile of the median TP concentrations for stream chemistry stations located in the Level III ecoregion of the Central Great Plains (27). Should the biological community fail to respond to Phase I reductions in total phosphorus, Phase II will commence with a TP milestone of a median concentration of 0.130 mg/L, representing the lower quartile of the median TP concentrations for stream chemistry stations located in the Central Great Plains Ecoregion. Simultaneous achievement of the chlorophyll *a*, dissolved oxygen, oxygen saturation, and pH endpoints will signal phosphorus reductions are addressing the accelerated succession of aquatic biota and the development of objectionable concentrations of algae and algae byproducts thereby restoring the domestic water supply, aquatic life and contact recreation uses in the creek.

Table 13. Total Phosphorus (TP) at current condition (2007 through 2015) and Phase I and Phase II TP milestones for Sharps Creek.

Stream Chemistry Station	Current Condition	TMDL Phase I		TMDL Phase II	
	Median TP (mg/L)	TP Milestone (mg/L)	Reduction in TP from Current Concentration	TP Milestone (mg/L)	Reduction in TP from Current Concentration
Sharps Creek near Freemount (SC749)	0.217	0.200	8%	0.130	40%

3. SOURCE INVENTORY AND ASSESSMENT

Point Sources: There are no NPDES permitted facilities in the Sharps Creek watershed

Land Use: The approximate land area of the SC749 watershed is 61.8 square miles. Land use within the Sharps Creek watershed is mostly grassland (56%) with some cultivated crops (34.8%) according to the 2011 National Land Cover Database (**Figure 16 & Table 7**). As detailed in **Figure 16**, the location of the cropland within the watershed is in the areas adjacent to the stream corridors. Cropland within the watershed has the potential to contribute significant TP loads to Sharps Creek.

Figure 16. Land use map for Sharps Creek watershed (NLCD, 2011).

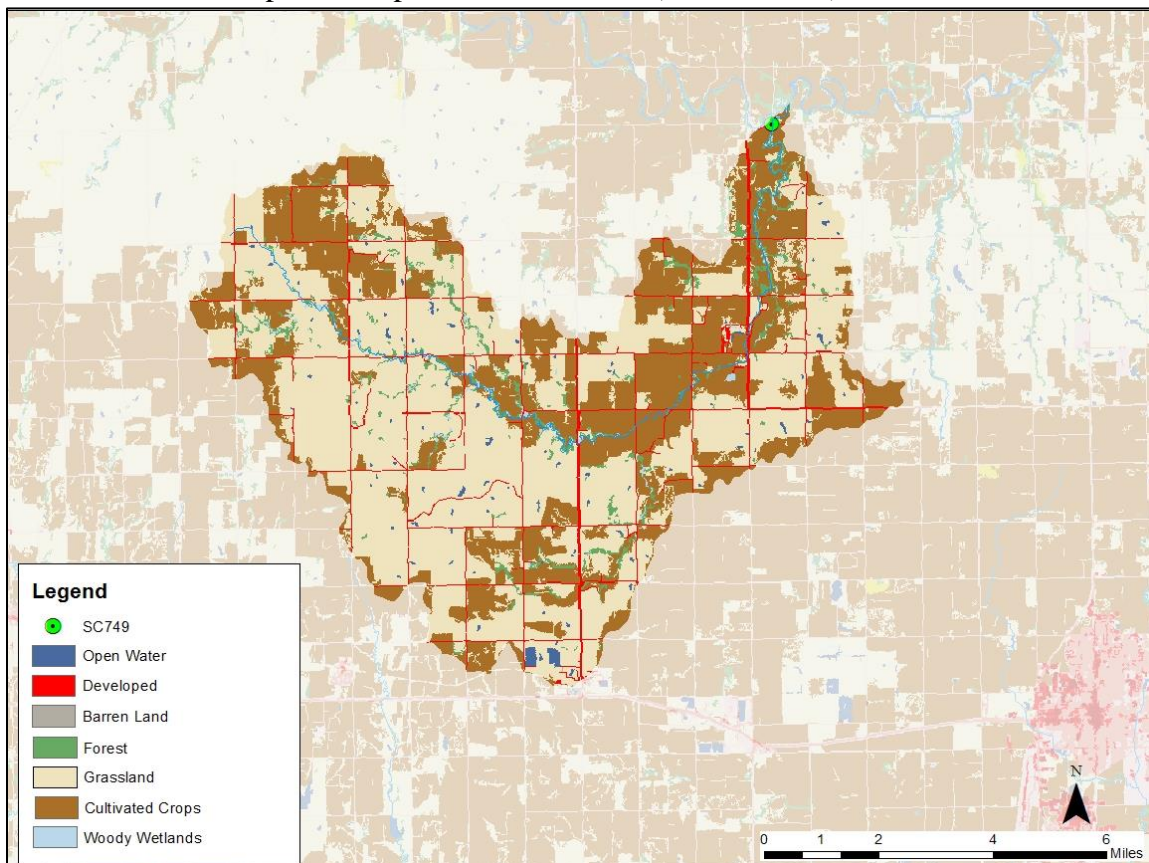


Table 6. Land use data for the Sharps Creek watershed (NLCD, 2011).

Watershed	Approximate Land Area (mi ²)	Grassland/Pasture	Cultivated Crops	Developed Land	Forest	Open Water	Wetlands	Barren Land
SC749 Sharps Creek	61.8	56.0%	34.8%	4.3%	3.5%	0.7%	0.7%	0.0%

Livestock Waste Management Systems: There is one certified and one federally permitted confined animal feeding operation (CAFO) within Sharps Creek watershed (Table 8). These livestock facilities have waste management systems designed to minimize runoff entering their operation and detain runoff emanating from their facilities. In addition, they are designed to retain a 25-year, 24-hour rainfall/runoff event as well as an anticipated two weeks of normal wastewater from their operations. Typically, this rainfall event coincides with streamflow that occurs less than 1-5% of the time. It is likely that there are some smaller, unregistered livestock operations in the area and, depending on their proximity to the streams in the watershed, runoff from feedlots and grazing lands may be contributing to the total phosphorus impairment in Sharps Creek. All CAFOs are assigned a wasteload allocation of zero in Section 4.

Table 7. U.S. Census results and population projections from the Kansas Water Office (KWO) for McPherson and Rice counties.

KS Permit #	NPDES Permit	County	Animal Total	Permit Type	Animal Type
829	In process	McPherson	500	Registration	Beef
A-SHMP-C001	KS0116351	McPherson	13,000	Renewal	Beef

On-Site Waste Systems: The Sharps Creek watershed is predominantly rural. Urban populations are typically served by municipal sewer systems; however, rural populations may not be connected to the municipal sewer system. According to the U.S. Environmental Protection Agency’s Spreadsheet Tool for Estimating Pollutant Load (STEPL), there are a total of 151 septic systems located in this watershed. Septic systems in the state of Kansas typically have an estimated 10-15% failure rate (Electric Power Research Institute provided by U.S. Environmental Protection Agency, 2017). Failing on-site septic systems have the potential to contribute to nutrient loading in the watershed. However, because of their small flows and the proclivity of phosphorus to adsorb to soil, failing on-site septic systems are considered a minor source of TP loading within the watershed and are not likely to significantly contribute to the TP impairment in Sharps Creek.

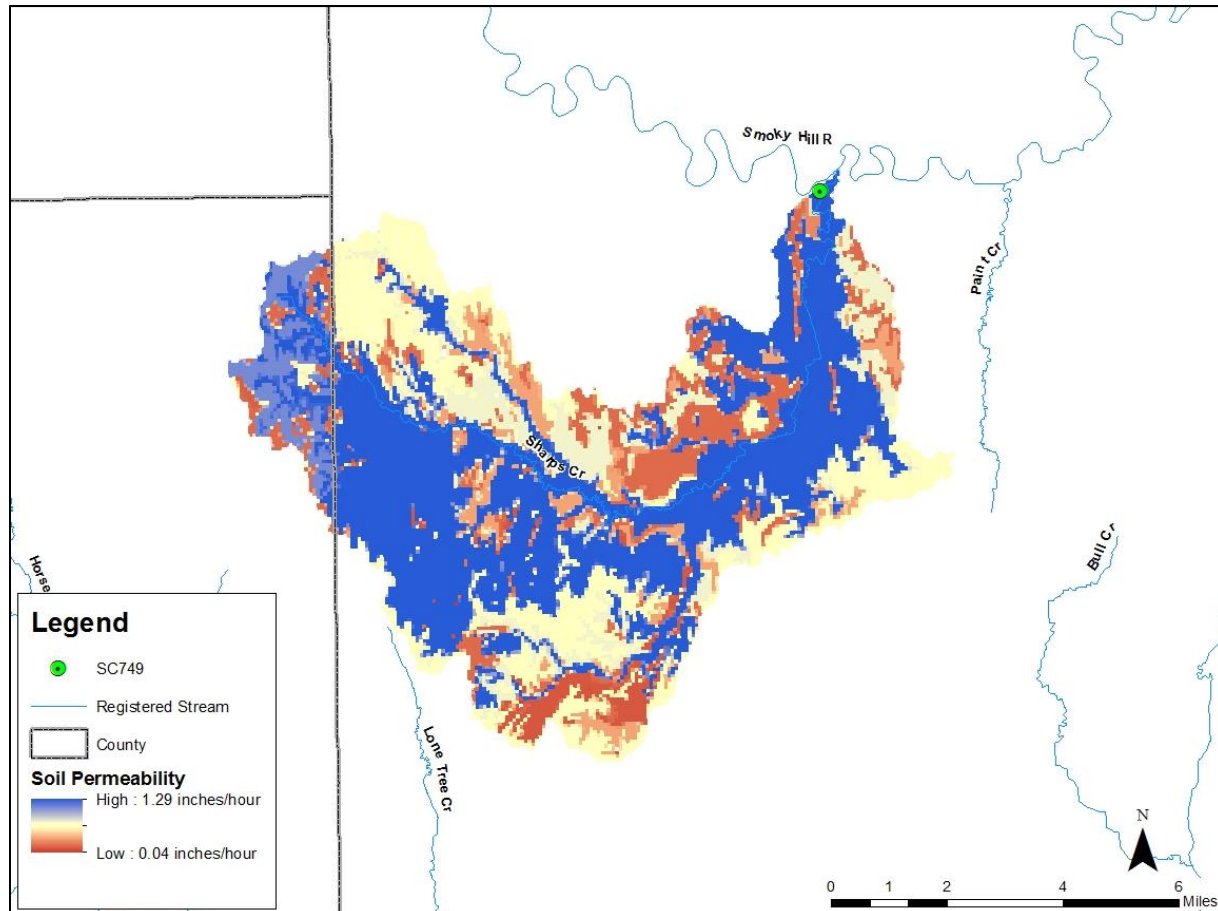
Population Density: According to the 2010 census tract data from the U.S. Census Bureau, the population of the Sharps Creek watershed is approximately 258 people giving a population density of about 4 people/square mile. This is a decrease of about 12% over the 2000 census tract results. Population within the counties where the watershed lies is on the decline in Rice county and increasing in McPherson county according to the 2000 and 2010 census (**Table 9**).

Table 8. U.S. Census results and population projections from the Kansas Water Office (KWO) for McPherson and Rice counties.

County	Year				
	2000	2010	2020	2030	2040
McPherson	28,862	30,429	31,996	33,563	35,130
Rice	10,319	10,111	9,926	9,759	9,615

Contributing Runoff: According to the NRCS STATSGO database, the Sharps Creek watershed has a mean soil permeability of 0.88 inches/hour (**Figure 17**). Permeability in the watershed ranges from 0.04 to 1.29 inches/hour with approximately 61% of the watershed having a very low soil permeability of 1.29 inches/hour. According to a USGS open-file report (Juracek, 2000), the threshold soil-permeability values are set at 3.43 inches/hour for very high, 2.86 inches/hour for high, 2.29 inches/hour for moderate, 1.71 inches/hour for low, 1.14 inches/hour for very low, and 0.57 inches/hour for extremely low soil-permeability. Approximately 36% of the Sharps Creek watershed is below the 1.14 inches/hour very low threshold. Runoff is primarily generated as infiltration excess with rainfall intensities greater than soil permeability. As the watershed’s soil profiles become saturated, excess overland flow is produced.

Figure 17. Soil permeability in Sharps Creek (SC749)



Background and Natural Sources: Phosphorus is present over the landscape and in the soil profile. It is also present in terrestrial and aquatic biota. Wildlife can contribute to phosphorus loadings, particularly if they congregate to a density that exceeds the assimilative capacity of the land or water.

4. ALLOCATION OF POLLUTANT REDUCTION RESPONSIBILITY

The endpoints for this TMDL are based on the biological condition, pH, sestonic chlorophyll *a* and dissolved oxygen concentrations; all of which should improve to a level of full attainment of designated uses in Sharps Creek as phosphorus concentrations decrease in the creek.

This TMDL is established as two phases to reduce phosphorus loading and total phosphorus concentration with periodic assessment of the biological condition in the creek. The Phase I TMDL TP milestone is set at a median concentration of 0.200 mg/L. Once TP concentrations in Sharps Creek, as measured at SC749, approaches the Phase I milestone of a median TP concentration of 0.200 mg/L, an intensive assessment of macroinvertebrate abundance and diversity will be performed to determine compliance with the narrative nutrient criteria. Presuming one or more of the numeric endpoints are not met at the end of Phase I, Phase II will commence with a TP milestone of a median concentration of 0.130 mg/L with additional reductions in loads and phosphorus concentrations accomplished through enhanced implementation of controls on sources in the watersheds.

Point Sources: There are no point sources in the watershed, therefore the current wasteload allocation is zero. Should future point sources be proposed in the Sharps Creek watershed, the current wasteload allocation may be revised by adjusting the current load allocation down to account for the presence and impact of the new point source dischargers. This reallocation from load to wasteload will not affect the endpoint established in Section 3, nor the Phase I and Phase II TP management milestones. Additionally, all CAFOs are assigned a wasteload allocation of zero by this TMDL.

Nonpoint Sources: The load allocation for nonpoint sources is the remaining load capacity after wasteloads have been accounted for. However, due to lack of point sources in the watershed, the load allocation is equivalent to the load capacity under all flow conditions. The load allocation grows proportionately as normal conditions occur and continues to increase with wet weather conditions, thereby accounting for increasing runoff from contributing areas. Phase I and Phase II nonpoint source reductions in phosphorus loading are expected to be achieved by implementation of agricultural best management practices in the contributing areas of the watershed.

Figure 18. Phase I and Phase II total phosphorus TMDL at terminus of Sharps Creek based on flows measured at USGS 06878000 over the 1/1/2000 through 12/31/2017 period of record with seasonal observed current loads.

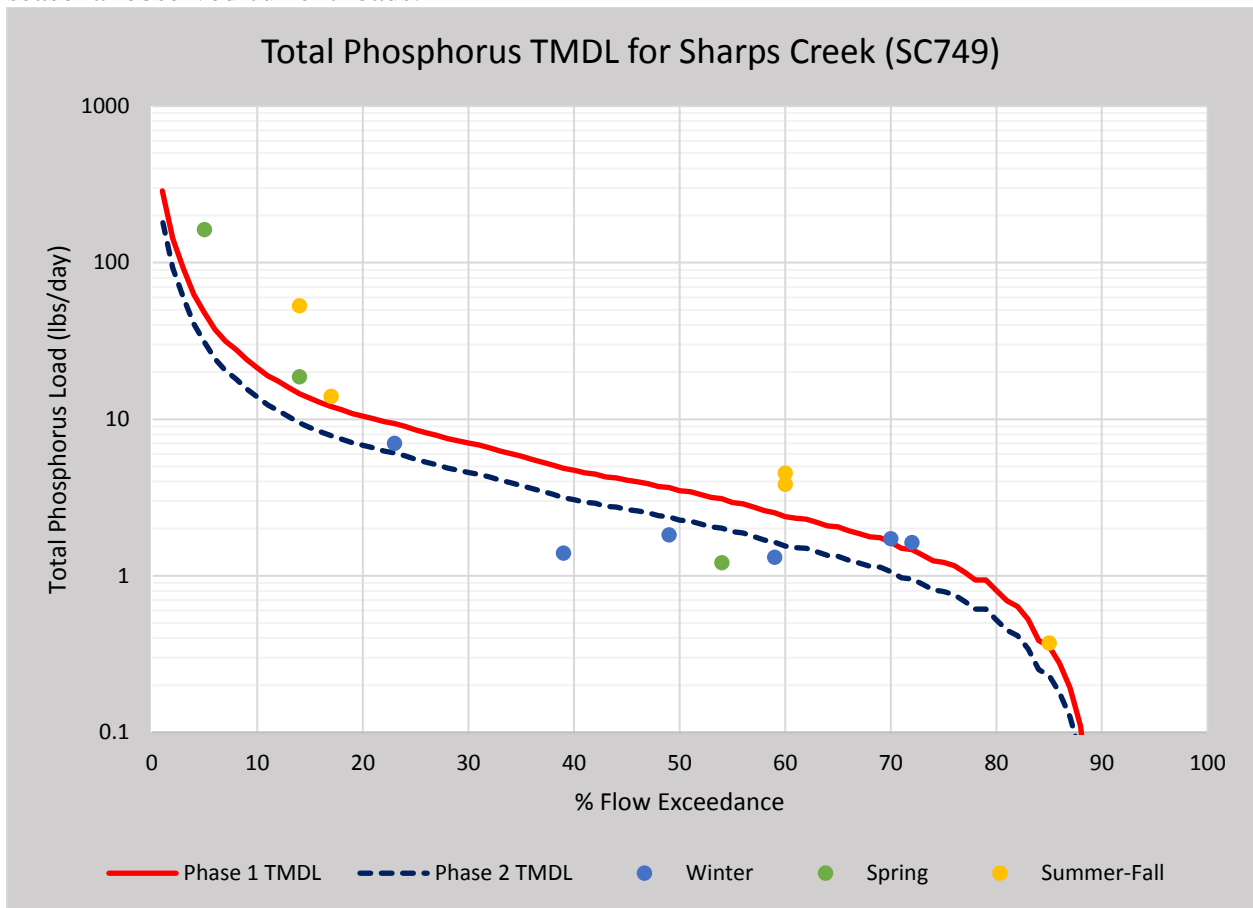


Table 9. Phase I and II load capacity (TMDL) and allocations for Sharps Creek. The current condition loads were developed using a total phosphorus concentration of 0.217 mg/L, the 2007-2015 period of record median concentration at SC749. Flows are based on USGS 06878000 over the 1/1/2000 through 12/31/2017 period of record.

Percent Flow Exceedance	Flow at Terminus (cfs)	Current Condition (lbs/day)	Phase I Load Capacity (lbs/day)	Phase I Load Allocation (lbs/day)	Phase II Load Capacity (lbs/day)	Phase II Load Allocation (lbs/day)	Phase I & II Wasteload Allocation (lbs/day)
90%	0	0	0	0	0	0	0
75%	1.13	1.32	1.22	1.22	0.79	0.79	0
50%	3.23	3.78	3.49	3.49	2.27	2.27	0
25%	7.91	9.24	8.54	8.54	5.55	5.55	0
10%	19.75	23.09	21.33	21.33	13.87	13.87	0

Defined Margin of Safety: The Margin of Safety provides some hedge against the uncertainty in phosphorus loading into Sharps Creek. This TMDL uses an implicit margin of safety, relying on conservative assumptions. Firstly, there are five endpoints that are established by this TMDL. Secondly, the sestonic chlorophyll *a* and biological endpoints used to assess compliance with the narrative criteria have to be maintained for three consecutive years before attainment of water quality standards can be claimed.

State Water Plan Implementation Priority: Early implementation of this TMDL will focus on riparian management to effectively reduce the phosphorus loading to the stream. Due to the need to reduce the high nutrient loads in the watershed, this TMDL will be **High Priority** for implementation.

Nutrient Reduction Framework Priority Ranking: This watershed lies within Lower Smoky Hill (HUC 8: 10260008) Subbasin which is among the top sixteen HUC 8s targeted for state action to reduce nutrients.

Priority HUC 12s: This watershed is comprised of only one HUC 12 (102600080104) thus, a priority HUC 12 has not been identified. The priority areas within this HUC12 will be further refined to the riparian corridors of the cropland areas and livestock facilities adjacent to the streams within the watershed.

5. IMPLEMENTATION

Desired Implementation Activities:

1. Implement and maintain conservation farming, including conservation tilling, contour farming, and no-till farming to reduce runoff and cropland erosion.
2. Improve riparian conditions along stream systems by installing grass and/or forest buffer strips along the stream and drainage channels in the watershed.
3. Perform extensive soil testing to ensure excess phosphorus is not applied.
4. Ensure land applied manure is being properly managed and is not susceptible to runoff by implementing nutrient management plans.
5. Install pasture management practices, including proper stock density to reduce soil erosion and storm runoff.
6. Ensure livestock feeding sites and pens are away from streams and waterways to increase filtration and waste removal of manure.
7. Ensure proper on-site waste system operations in proximity to the main stream segments.
8. Ensure that labeled application rates of chemical fertilizers are being followed and implement runoff control measures.
9. Renew state and federal permits and inspect permitted facilities for permit compliance.
10. The stakeholder leadership team for the Upper Lower Smoky Hill WRAPS will coordinate BMPs to address:
 - a. Livestock: vegetative filter strips, relocate feeding sites, relocate pasture feeding sites off-stream and alternate watering system.
 - b. Cropland: grassed waterways, terraces, conservation crop rotations and water retention structures.

Nonpoint Source Pollution Technical Assistance – KDHE

- a. Support Section 319 implementation projects for reduction of phosphorus runoff from agricultural activities as well as nutrient management.
- b. Provide technical assistance on practices geared to the establishment of vegetative buffer strips.
- c. Provide technical assistance on nutrient management for livestock facilities in the watershed and practices geared toward small livestock operations, which minimize impacts to stream resources.
- d. Support the implementation efforts of the Upper Lower Smoky Hill WRAPS and incorporate long-term objectives of this TMDL into their 9-element watershed plan.

Water Resource Cost Share and Nonpoint Source Pollution Control Program – KDA-DOC

- a. Apply conservation farming practices and/or erosion control structures, including no-till, terraces, and contours, sediment control basins, and constructed wetlands.
- b. Provide sediment control practices to minimize erosion and sediment transport from cropland and grassland in the watershed.
- c. Install livestock waste management systems for manure storage.
- d. Implement manure management plans.

Riparian Protection Program – KDA-DOC

- a. Establish or re-establish natural riparian systems, including vegetative filter strips and streambank vegetation.
- b. Develop riparian restoration projects along stream segments
- c. Promote wetland construction to reduce runoff and assimilate sediment loadings.
- d. Coordinate riparian management within the watershed and develop riparian restoration projects.

Buffer Initiative Program – KDA-DOC

- 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 sediment, nutrient, and pasture management.
- b. Educate livestock producers on livestock waste management, land applied manure applications, and nutrient management planning.
- c. Provide technical assistance on livestock waste management systems and nutrient management planning.
- d. Provide technical assistance on buffer strip design and minimizing cropland runoff.
- e. Encourage annual soil testing to determine capacity of field to hold phosphorus.
- f. Educate resident, landowners, and watershed stakeholders about nonpoint source pollution.

- g. Promote and utilize the WRAPS efforts for pollution prevention, runoff control and resource management. The WRAPS coordinator is also an extension watershed specialist that will provide technical assistance and outreach to producers for BMP implementation. Other entities for this task include NRCS and local conservation districts

Timeframe for Implementation: Reduction strategies will begin by 2020 to ensure nutrients are being addressed. Pollutant reduction practices should be installed within the watershed before 2024 with follow up implementation over 2024-2028. Phase I of this TMDL will occur from 2020 to 2039. If biology in Sharps Creek has not responded to Phase I reductions by 2039 then Phase II implementation will commence in 2040.

Targeted Participants: The primary participants for implementation will be agricultural and livestock producers operating immediately adjacent to Sharps Creek. Watershed coordinators and technical staff of the WRAPS, along with Conservation District personnel and county extension agents should assess possible sources adjacent to streams. Implementation activities to address nonpoint sources should focus on those areas with the greatest potential to impact nutrient concentrations in the creek.

Targeted Activities to focus attention toward include:

1. Overused grazing land adjacent to the streams.
2. Sites where drainage runs through or adjacent to livestock areas.
3. Sites where livestock have full access to the stream as a primary water supply.
4. Poor riparian area and denuded riparian vegetation along the stream.
5. Unbuffered cropland adjacent to the stream.
6. Conservation compliance on highly erodible areas.
7. Total row crop acreage and gully locations.

Milestone for 2025: By 2025, advancement of necessary and appropriate measures to decrease the contribution of nonpoint sources phosphorus loading in Sharps Creek should be in progress. At that point in time, phosphorus data from the Sharps Creek stream chemistry station SC749 should show indication of declining concentrations relative to the pre-2019 data, particularly during low and normal flow conditions.

Delivery Agents: The primary delivery agents for program participation will be KDHE and the Upper Lower Smoky Hill 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.S.A. 2002 Supp. 82a-2001 identifies the classes of recreation use and defines impairment for streams.
4. K.A.R. 28-16-69 through 71 implements water quality protection by KDHE through the establishment and administration of critical water quality management areas on a watershed basis.
5. K.S.A. 2-1915 empowers the Kansas Department of Agriculture, Division of Conservation to develop programs to assist the protection, conservation and management of soil and water resources in the state, including riparian areas
6. K.S.A. 75-5657 empowers the Kansas Department of Agriculture, Division of Conservation to provide financial assistance for local project work plans developed to control nonpoint source pollution.
7. 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.
8. K.S.A. 82a-951 creates the State Water Plan Fund to finance the implementation of the Kansas Water Plan, including selected Watershed Restoration and Protection Strategies.
9. The Kansas Water Plan and the Kansas Regional Planning Area 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 implementation.

Funding: The State Water Plan annually generates \$12-13 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 watershed and water resources of highest priority. Typically, the state allocates at least 50% of the fund to programs supporting water quality protection. This watershed and its TMDL are located within a **High** Priority area and should receive support for pollution abatement practices that lower the loading of sediment and nutrients.

Effectiveness: Nutrient control has been proven effective through conservation tillage, contour farming and use of grass waterways and buffer strips. In addition, the proper implementation of

comprehensive livestock waste management plans has proven effective at reducing nutrient runoff associated with livestock facilities.

6. MONITORING

Future stream chemistry sampling will continue on a rotational basis with quarterly samples collected every four years at sampling station SC749 with sestonic chlorophyll *a* monitoring commencing once stream TP concentrations approach 0.200 mg/L.

Once TP concentrations approach the Phase I milestone of 0.200 mg/L in Sharps Creek, macroinvertebrate sampling will be performed at accessible locations to assess the biotic integrity of the stream. If the biological endpoints are achieved over 2022-2027 within the watershed, the conditions described by the narrative nutrient criteria will be viewed as attained and Sharps Creek will be moved to Category 2 on the 2028-303(d) list. However, if at the end of Phase I implementation, biological endpoints in Sharps Creek are not achieved, Phase II reductions will commence.

Once the water quality standards are attained, the adjusted ambient phosphorus concentrations in Sharps Creek will be the basis for establishing numeric phosphorus criteria through the triennial water quality standards process to protect the restored biological and chemical integrity of the stream.

7. FEEDBACK

Public Notice

An active website is established at http://www.kdheks.gov/tmdl/planning_mgmt.htm to convey information to the public on the general establishment of TMDLs and to provide specific TMDLs by river basin. This TMDL was posted to the Smoky-Saline River Basin on this site on November 29, 2018 for public review.

Public Hearing

A public hearing on this TMDL will be held on December 14, 2018 in Salina, Kansas to receive public comments. No comments were received.

Milestone Evaluation

In 2029, evaluation will be made as to the degree of implementation that occurred within the watershed. Subsequent decisions will be made through consultation with local stakeholders and the WRAPS team regarding implementation of nonpoint source reduction strategies and development of additional implementation strategies for the watershed.

Consideration for 303(d) Delisting

The Sharp's Creek segment covered by this TMDL will be evaluated for delisting under Section 303(d) based on the monitoring data from 2019-2029. Therefore, the decision for delisting will ensue in the preparation for the 2030 Section 303(d) list. Should modifications be made to the applicable water quality criteria during the implementation period, consideration for delisting, desired endpoints of this TMDL, and implementation activities may be adjusted accordingly.

Incorporation into the TMDL Vision Process, Water Quality Management Plan, and the Kansas Water Planning Process

Under the current version of the Kansas TMDL Vision Process, the next anticipated revision will be after 2024. The revision will emphasize implementation of WRAPS activities and further reduction of nutrients in wastewater discharged by NPDES facilities. By that time, incorporation of this TMDL will be made into the WRAPS plan. Recommendations for this TMDL will be considered in the *Kansas Water Plan* implementation decisions under the State Water Planning Process for fiscal years 2019-2029.

Developed: February 18, 2019

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- Watershed Restoration and Protection Strategy 9 Element Plan, Upper Lower Smoky Hill River. http://www.kswraps.org/files/attachments/upperlowersmoky_plansummary.pdf