

SMOKY HILL/SALINE RIVER BASIN TOTAL MAXIMUM DAILY LOAD

Water Body: Smoky Hill River (Salina)

Water Quality Impairment: Biology

- Subbasin:** Lower Smoky Hill
- Counties:** Ellsworth, McPherson, Rice, and Saline
- HUC 8:** 10260008 **HUC 11 (14): 010** (010, 020, 030, 040, 050) (Figure 1)
030 (010, 020, 030, 040, 050, 060)
- Ecoregion:** Central Great Plains, Smoky Hills (27a)
- Drainage Area:** Approximately 517 square miles.
- Main Stem Segment:** WQLS: 11, 12, and 13; starting at biological monitoring station 268 (Smoky Hill River near Salina), traveling upstream, and ending at the Kanopolis Lake Dam
- Tributaries:** East Dry Cr (43) and Dry Cr (36)
- Designated Uses:** Primary and Secondary Contact Recreation; Expected Aquatic Life Support; Domestic Water Supply; Food Procurement; Groundwater Recharge; Industrial Water Supply; Irrigation Use; Livestock Watering Use
- 2002 303(d) Listing:** Smoky Hill/Saline River Basin Streams
- Impaired Use:** Aquatic Life Support on Main Stem Segments.
- Water Quality Standard:** General-- Narrative: Surface water shall be free, at all times, from the harmful effects of substances that originate from artificial sources of pollution and that produce any public hazard, nuisance condition or impairment of a designated use. (KAR 28-16-28e(b)(1)).

2. CURRENT WATER QUALITY CONDITION AND DESIRED ENDPOINT

Stream Monitoring Site: Station 268 near Salina (Smoky Hill River)

Period of Record Used: 1980 - 2001 (Stream Biology)

Period of Record Used: 1985 - 2002 (Stream Chemistry)

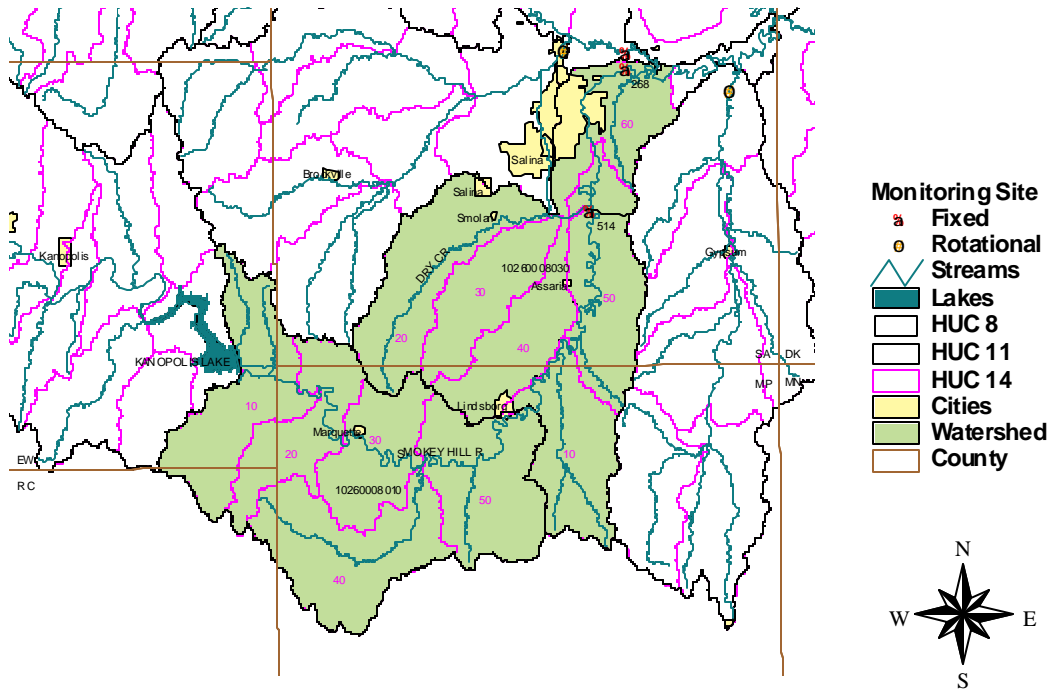
Stream Chemistry Monitoring Site: Station 514 near Mentor (Smoky Hill River)

Period of Record Used: 1990 - 2002

Flow Record: Smoky Hill River near Mentor, KS (USGS Gage 06866500)

Figure 1

Smoky Hill River - Salina TMDL Reference Map



Current Conditions:

Three main parameters (MBI, KBI, and %EPT) were analyzed to address the biology impairment. The Macroinvertebrate Biotic Index rates the nutrient and oxygen demanding pollution tolerance of large taxonomic groups (order and family). Higher values indicate greater pollution tolerances. Along with the number of individuals within a rated group, a single index value is computed which characterizes the overall tolerance of the community. The higher the index values the more tolerant the community is of organic pollution exerting oxygen demands in the stream setting. Index values greater than 5.4 are indicative of non-support of the aquatic life use; values between 4.51 and 5.39 are indicative of partial support and values at or below 4.5 indicate full support of the aquatic life use. The Kansas Biotic Index (KBI) is similar to the MBI in that it indicates the impact of nutrient and oxygen demanding pollutants.

The EPT index is the proportion of aquatic taxa present within a stream belonging to pollution intolerant orders: Ephemeroptera, Plecoptera and Trichoptera (mayflies, stoneflies and caddisflies). Higher percentages of total taxa comprising these three groups indicate less pollutant stress and better water quality.

On February 11, 1994, the City of Salina started diverting flow to a new Wastewater Treatment Plant. The biological community responded positively to the resulting water quality changes. Prior to the

upgrade, the average MBI value was 4.95 (range: 3.93 - 7.71) indicating that the aquatic community was partially impaired. The Smoky Hill River is now fully supporting to aquatic life with an average MBI of 4.00 (range: 3.78 - 4.21) since the new plant began operating. Improvements were seen in the other indices as well. Similar to the MBI, the KBI values declined (from 2.92 to 2.53) confirming that the river is now fully supporting. The percent of EPT taxa count increased from 43% to 63% with the reduction of pollutant stress.

Stream chemistry improved once the new plant was in operation. Significant differences were seen in several parameters including ammonia, biochemical oxygen demand, nitrate, phosphorus, pH, chloride, and sulfate. These differences are outlined in the table below.

Changes in Concentrations Before and After the Salina MWTP Upgrade

Time Period	No.	MBI	EPT	KBI	NH ₃	TSS	BOD	DO	NO ₃	TP	pH	Temp	F	Cl	SO ₄	TDS
Before Upgrade	69	4.95	43%	2.92	2.104 mg/l	94 mg/L	6.2 mg/L	9.9 mg/L	1.85m g/l	1.145 mg/l	8.11	15.1 EC	0.350 mg/L	159 mg/l	147 mg/l	658 mg/l
After Upgrade	52	4.00	63%	2.53	0.064 mg/l	105 mg/L	2.8 mg/L	9.7 mg/L	1.17 mg/l	0.325 mg/l	7.98	13.1 EC	0.323 mg/L	147 mg/l	168 mg/l	676 mg/l

There appears to be a direct link between elevated levels of biochemical oxygen demand (BOD) and MBI scores indicating partial or full impairment. The BOD load duration curve from before the upgrade (Appendix B) shows excursions at low flows, greater than 70% exceedence. This analysis suggests that the BOD impairment was due to point sources, in this case the former Salina MWTP. Since the upgrade, the number of exceedences in the 70 to 100% range is greatly reduced. The concentrations of ammonia were significantly reduced after the upgrade, as well.

Statistically significant differences were seen in chloride and dissolved oxygen concentrations and temperature levels. The chloride concentrations are well below the water quality standard of 250 mg/L and not cause for concern. At the sampling times when a biological impairment was detected, the water temperature tended to be colder. Greater dissolved oxygen concentrations are seen at colder temperatures. For the other parameters, ambient stream conditions bracketing the biological sampling period are not significantly different when full support or impairment is indicated. Relations between the MBI and the various parameters are displayed in Appendix A.

Average Concentrations under Different Aquatic Life Support Conditions

MBI	No.	EPT	KBI	NH ₃	TSS	BOD	DO	NO ₃	TP	pH	Temp	F	Cl	SO ₄	TDS
Fully Supporting ALS (MBI # 4.5)	11	57%	2.61	0.179 mg/l	177 mg/L	3.0 mg/L	7.7 mg/L	1.04 mg/l	0.464 mg/l	8.1	20.9E C	0.314 mg/L	125 mg/l	135 mg/l	581 mg/l
Partial or No Support of ALS (MBI > 4.5)	6	35%	3.11	0.408 mg/l	72 mg/L	5.1 mg/L	9.6 mg/L	0.98 mg/l	0.450 mg/l	8.1	10.5E C	0.295 mg/L	166 mg/l	158 mg/l	689 mg/l

Biological index values and average nutrient and sediment concentrations were compared for the biological monitoring stations located in the Smoky Hill/Saline Basin. Overall, the average concentrations of nutrients and sediment at these sampling sites tend to be similar.

Comparison of Biological Index Values and Average Nutrient and Sediment Concentrations

Station	MBI	KBI	%EPT	BOD	Ammonia	TSS
SB264 Smoky Hill River at Junction City	4.16	2.65	62	3.6 mg/L	0.066 mg/L	359 mg/L
SB267 Saline River near New Cambria	3.99	2.58	60	4.2 mg/L	0.057 mg/L	330 mg/L
SB268 Smoky Hill River near Salina (February 1994 to present)	4.00	2.53	63	2.8 mg/L	0.064 mg/L	105 mg/L
SB269 Smoky Hill River at Ellsworth	4.36	2.77	60	3.5 mg/L	0.054 mg/L	201 mg/L
SB514 Smoky Hill River near Mentor	3.61	2.22	68	2.8 mg/L	0.057 mg/L	125 mg/L

Desired Endpoints of Water Quality at Site 268 over 2008 - 2012:

The use of biological indices allows assessment of the cumulative impacts of dynamic water quality on aquatic communities present within the stream. As such, these index values serve as a baseline of biological health of the stream. Sampling occurs during open water seasons (April to November) within the aquatic stage of the life cycle of the macroinvertebrates. As such there is no described seasonal variation of the desired endpoint of this TMDL. The endpoint would be to maintain the average MBI values at or below 4.5 over 2008-2012.

Current Condition (February 1994 to Present) and Reductions for Smoky Hill River

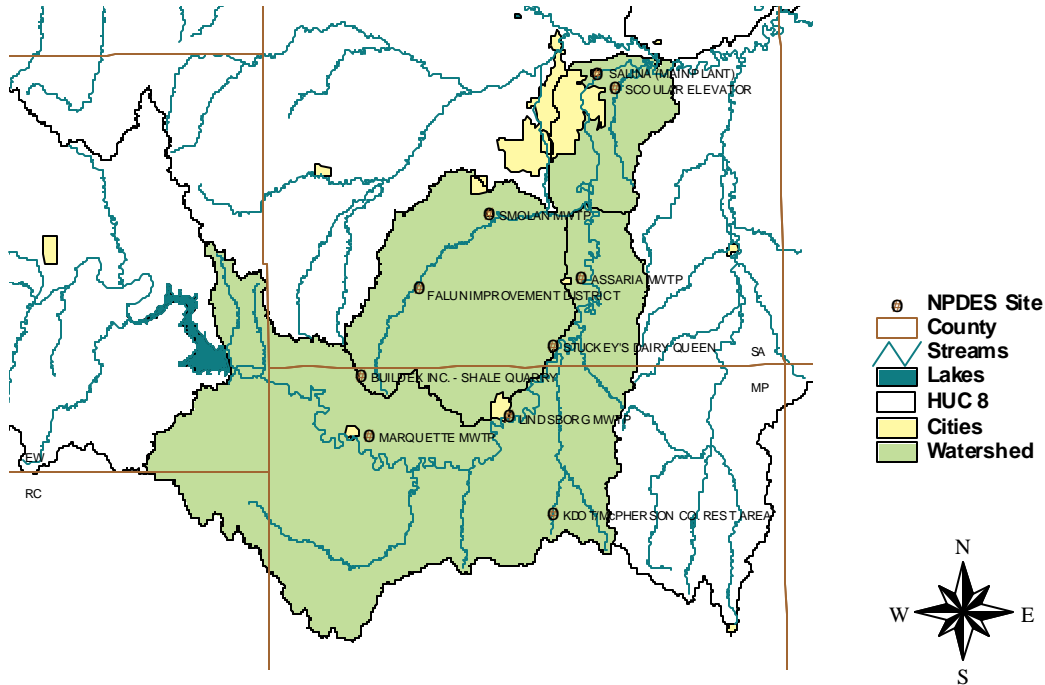
Parameter	Current Condition	TMDL	Percent Change
Biochemical Oxygen Demand (mg/L)	2.8	See Load Duration Curve in Appendix	0 %
Macroinvertebrate Biotic Index	4.00	< 4.50	0 %
EPT Count (%)	63	> 57	0 %

3. SOURCE INVENTORY AND ASSESSMENT

NPDES: Eight permitted wastewater facilities are located within the watershed (Figure 2). Three are non-overflowing lagoons that are prohibited from discharging and may contribute the BOD load under extreme precipitation events (flow durations exceeded under 5 percent of the time). Such events would not occur at a frequency or for a duration sufficient to cause an impairment in the watershed. According to projections of future water use and resulting wastewater, the non-overflowing lagoons look to have sufficient treatment capacity available.

Figure 2

Smoky Hill River - Salina NPDES Sites



Waste Treatment Plants in the Smoky Hill River Watershed

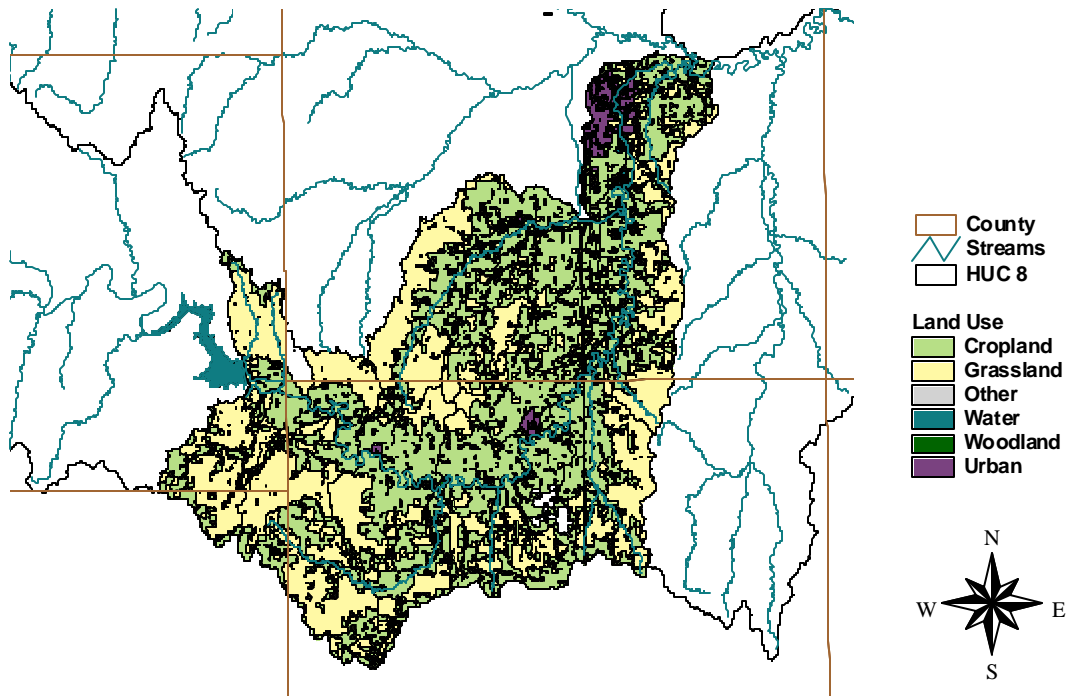
Kansas Permit Number	Name	Type	Design Capacity (MGD)	BOD (mg/L) Monthly Average
C-SH21-NO01	STUCKEY'S DAIRY QUEEN - STORE #363	Two-cell Lagoon	Non-overflowing	0
M-SH02-OO01	ASSARIA MWTP	Two-cell Lagoon	0.06	30
M-SH21-OO01	LINDSBORG MWTP	Activated Sludge, UV Disinfection	0.418	30
M-SH21-OO02	MCPHERSON CO. REST AREA	2 Three-cell lagoons	0.0076	30
M-SH25-OO01	MARQUETTE MWTP	Three-cell Lagoon	0.067	30
M-SH33-IO01	SALINA MWTP	Activated Sludge, UV Disinfection	7.25	Sept. to May - 30 June to Aug. - 25
M-SH36-NO01	SMOLAN MWTP	Two-cell Lagoon	Non-overflowing	0
M-SH51-NO01	FALUN MWTP	Two-cell Lagoon	Non-overflowing	0
		Total	7.8026	

Lindsborg and Salina MWTPs had an average discharge of 0.28 MGD and 4.8 MGD respectively based on monitoring data from 2002. Examination of the discharge monitoring reports indicates no problems in violating permit limits. McPherson Co. Rest Area did not discharge during 2002. In addition, discharge was infrequent from Assaria and Marquette MWTPs.

Land Use: Most of the watershed is grassland (44% of the area), cropland (51%), woodland (2%) or urban use (2%). (See Figure 3).

Figure 3

Smoky Hill River - Salina Land Use



Livestock Waste Management Systems: Thirty-seven operations are registered, certified, or permitted within the watershed (Figure 4). There are 26 beef, 5 swine, 5 dairy, and 1 combination animal feeding operations in the watershed. Four of these facilities are NPDES permitted, non-discharging facilities with 24,361 animal units. All permitted livestock facilities have waste management systems designed to minimize runoff entering their operations or detaining runoff emanating from their areas. Such systems are designed to retain the 25 year, 24 hour rainfall/runoff event, as well as an anticipated two weeks of normal wastewater from their operations. Such a rainfall event typically coincides with stream flows which are exceeded 1-5 percent of the time. Therefore, events of this type, infrequent and of short duration, are not likely to add to chronic impairment of the designated uses of the waters in this watershed. Requirements for maintaining the water level of the waste lagoons a certain distance below the lagoon berms ensure retention of the runoff from the intense, local storms events. In Salina County, where many of the facilities are relatively close to the river, such an event would generate 5.7 inches of rain, yielding 4.6 to 5.3 inches of runoff in a day. Permit compliance data was examined, and no evidence

of spills was detected. Potential animal units for all facilities in the watershed total 32,936 (active: 32,768 animal units; inactive: 168 animal units). The actual number of animal units on site is variable, but typically less than potential numbers.

Livestock Waste Management Systems in the Watershed

Kansas Permit Number	Livestock Waste Management Systems	BOD Monthly Average
A-SHMP-C001	Mcpheerson County Feeders	0 mg/L
A-SHMP-H001	Summit Producers	0 mg/L
A-SASA-H001	Crumbaker Pork LLC	0 mg/L
A-SASA-C001	Smoky Hill Feedlot	0 mg/L

Smoky Hill River - Salina Livestock Waste Management Systems

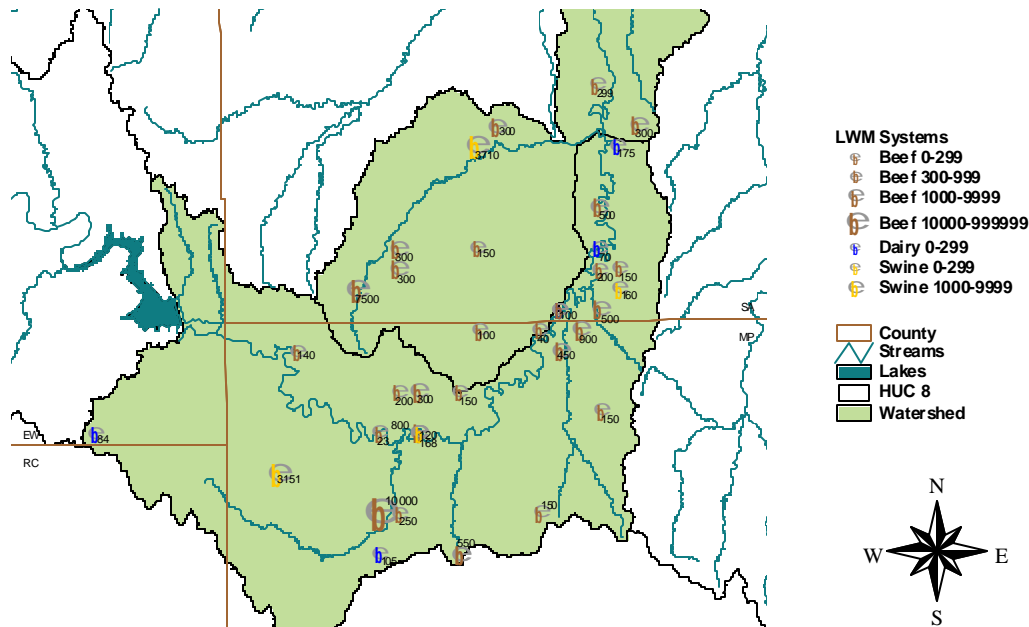


Figure 4

On-site Waste Systems: Ten percent of households in Saline County have septic systems. The population density is high for the watershed area (79.2 people/mi²). Most of the towns in the watershed anticipate a population increase: 2.2% for Assaria, 24.9% for Lindsborg, 14.7% for Salina, and 11.4% for Smolan. The City of Marquette expects to have a 1.5% decline in population. Kansas Water Office projections estimate population growth in the unincorporated areas of the county to increase 6% between

2000 and 2020. This population base will likely utilize on-site wastewater systems. However, the number of failing systems will likely diminish through efforts of the Local Environmental Protection Program and by their low volume nature, only such failing systems close to the streams will likely have an impact on ambient stream water quality.

Background Levels: Two percent of the Smoky Hill River watershed is woodland. Leaf litter falls into the streams and decomposes increasing the oxygen demand.

4. ALLOCATION OF POLLUTANT REDUCTION RESPONSIBILITY

There is a direct relationship between the Salina MWTP upgrade and improvements biological integrity and decreased levels of Biochemical Oxygen Demanding substances. The goal of this TMDL is to maintain the MBI scores below 4.5 and keep BOD levels consistent with those seen since the upgrade. The maintenance of BOD levels will apply over the range of flows encountered on the Smoky Hill River, indicated by the TMDL curves in Appendix B. The area is segregated into allocated areas assigned to point sources (WLA) and nonpoint sources (LA).

Point Sources: The five discharging wastewater facilities in the watershed are permitted for BOD. These facilities should continue to comply with the limits outlined in their permits. Since these sources tend to become dominant under low flow conditions, the area under the load duration curves bounded from 70 - 100% constitutes the Wasteload Allocation for this TMDL. Should future point sources be proposed in the watershed and discharge into the impaired segments, the current Wasteload Allocation will be revised by adjusting current load allocations to account for the presence and impact of these new point source dischargers. As previously noted in the inventory and assessment section, sources such as non-discharging permitted municipal and agricultural facilities located within the watershed do not discharge with sufficient frequency or duration to cause an impairment in the river. The Wasteload Allocation for permitted municipal facilities that do not discharge is zero pounds per day.

Nonpoint Sources: The composition of the watershed indicates that organic material from agricultural and urban nonpoint sources may contribute to the biochemical oxygen demand downstream. These sources tend to become dominant under higher flow conditions. Therefore, the area under the load duration curves bounded from 1 - 70% constitutes the Load Allocation for this TMDL.

Defined Margin of Safety: Additional biological measures are necessary to assure indications of good aquatic community health. Therefore, the defined Margin of Safety for this TMDL will be a proportion of EPT individuals making up at least 57% of the sample population, including ammonia intolerant species, when MBI values are 4.5 or lower. This will ensure that the majority of aquatic macroinvertebrate population is composed of pollution intolerant taxa. This measure may also correlate with the availability of adequate habitat in the stream to support such a community.

State Water Plan Implementation Priority: Because it is important to maintain the biological integrity of the Smoky Hill River, this TMDL will be a Medium Priority for implementation.

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

Priority HUC 11s: The priority will be to ensure that the point sources in HUC 10260008010 and 10260008030 comply with their permitted limits.

5. IMPLEMENTATION

Desired Implementation Activities

1. Monitor wastewater discharges for BOD loadings
2. Continue biological monitoring to confirm the full support conditions.

Implementation Programs Guidance

NPDES - KDHE

- a. Monitor effluent from wastewater systems to determine their BOD contributions and ambient concentrations of receiving streams.
- b. Ensure proper monitoring, permitting, and operations of municipal wastewater systems to limit BOD discharges.

Biological Monitoring - KDHE

- a.. Monitor biologic community on Smoky Hill River and identify probable sources of stress impacting the community.

Time Frame for Implementation: Evaluation of local water quality improvements in the watershed should occur prior to 2008.

Targeted Participants: Primary participants for implementation will be wastewater facilities operating within the drainage. Municipal point sources will initiate monitoring and appropriately treat effluent to reduce any excessive BOD or ammonia.

Milestone for 2008: The year 2008 marks the midpoint of the ten-year implementation window for the watershed. At that point in time, adequate source assessment should be complete which allows for protection of the watershed.

Delivery Agents: The primary delivery agents for program participation will be the Municipal Section of the Kansas Department of Health and Environment.

Reasonable Assurances:

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

1. 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.
2. 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.
3. K.S.A. 75-5657 empowers the State Conservation Commission to provide financial assistance for local project work plans developed to control nonpoint source pollution.
4. 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.
5. K.S.A. 82a-951 creates the State Water Plan Fund to finance the implementation of the *Kansas Water Plan*.
6. The *Kansas Water Plan* and the Smoky Hill/Saline 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 pollutant 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. This watershed and its TMDL are a **Medium** Priority consideration.

Effectiveness: Technology exists for BOD and ammonia removal and can be placed in wastewater systems with proper planning and design.

6. MONITORING

KDHE will continue to collect seasonal biological samples from Smoky Hill River for three years over 2003 - 2008 and an additional three years over 2008-2012 to evaluate achievement of the desired endpoint. Monitoring of BOD and ammonia content of wastewater discharged from treatment systems will be expected under new and reissued NPDES and state permits, including ambient monitoring above and below the facilities, and tracking contributions of facilities downstream to the monitoring site.

7. FEEDBACK

Public Meetings: Public meetings to discuss TMDLs in the Smoky Hill/Saline Basin were held January 7 and March 5, 2003 in Hays. 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 Basin.

Public Hearing: A Public Hearing on the TMDLs of the Smoky Hill/Saline Basin was held in Hays on June 2, 2003.

Basin Advisory Committee: The Smoky Hill/Saline Basin Advisory Committee met to discuss the TMDLs in the basin on October 3, 2002, January 7, March 5, and June 2, 2003.

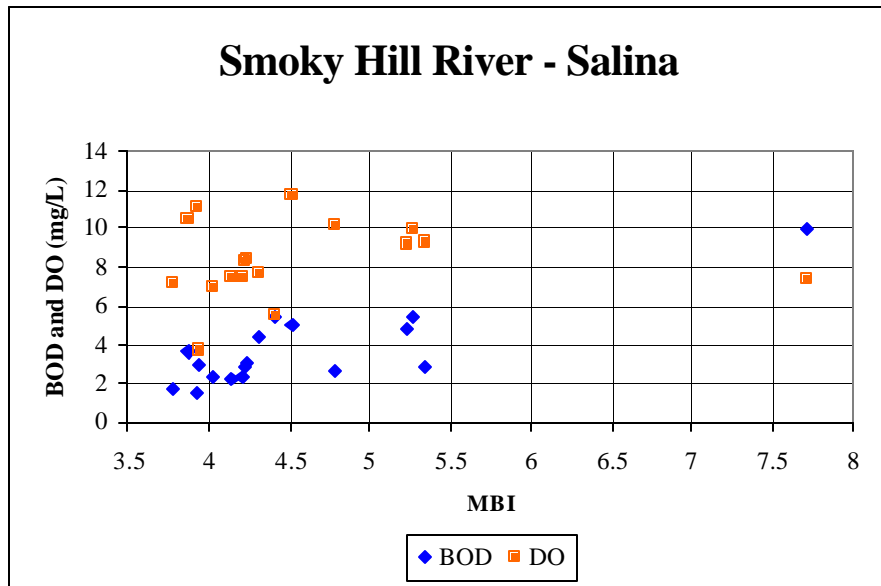
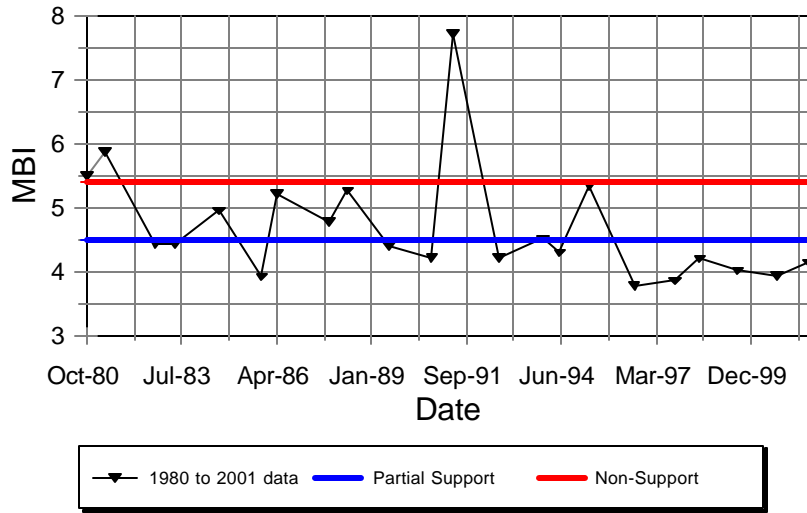
Milestone Evaluation: In 2008, evaluation will be made as to the amount of water quality improvement activity which has occurred within the watershed and current condition of the Smoky Hill River. Subsequent decisions will be made regarding the implementation approach and follow up of additional implementation in the watershed.

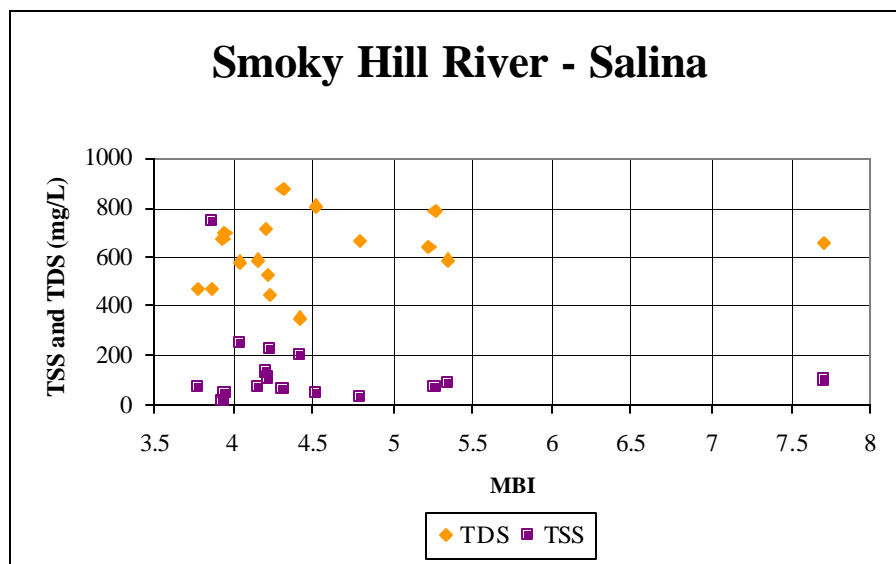
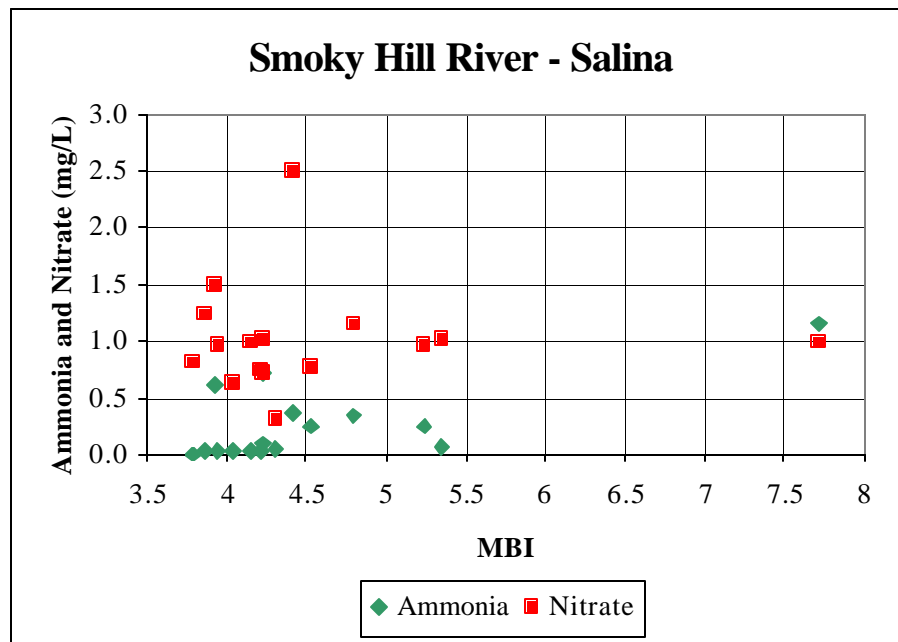
Consideration for 303(d) Delisting: The lake will be evaluated for delisting under Section 303(d), based on the monitoring data over the period 2008-2012. Therefore, the decision for delisting will come about in the preparation of the 2012 303(d) list. Should modifications be made to the applicable water quality criteria during the ten-year implementation period, consideration for delisting, desired endpoints of this TMDL and implementation activities may be adjusted accordingly.

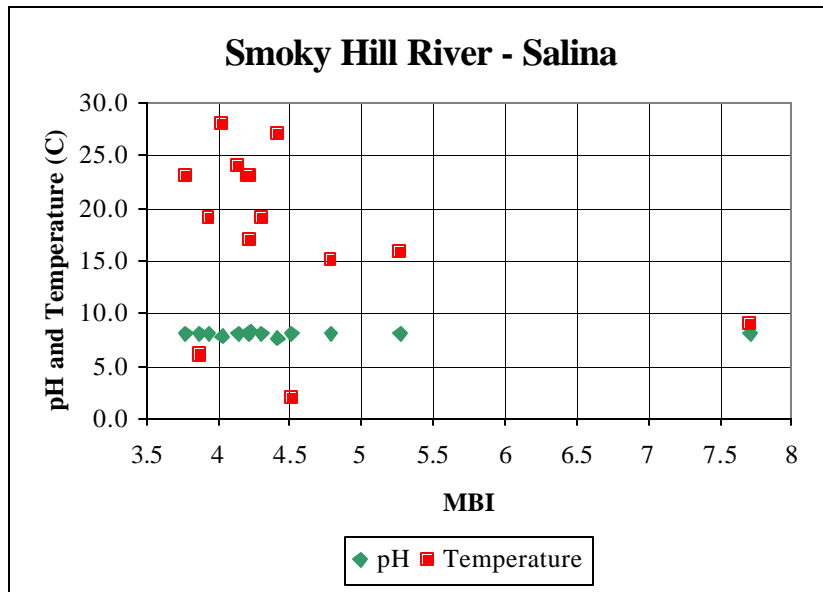
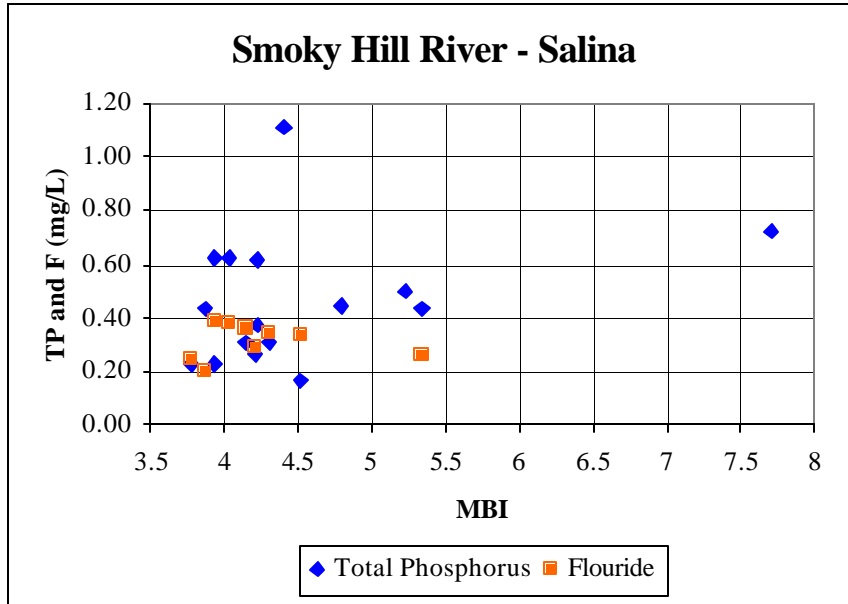
Incorporation into Continuing Planning Process, Water Quality Management Plan and the Kansas Water Planning Process: Under the current version of the Continuing Planning Process, the next anticipated revision will come in 2004 which will emphasize revision of the Water Quality Management Plan. At that time, incorporation of this TMDL will be made into both documents. Recommendations of this TMDL will be considered in *Kansas Water Plan* implementation decisions under the State Water Planning Process for Fiscal Years 2004-2008.

APPENDIX A

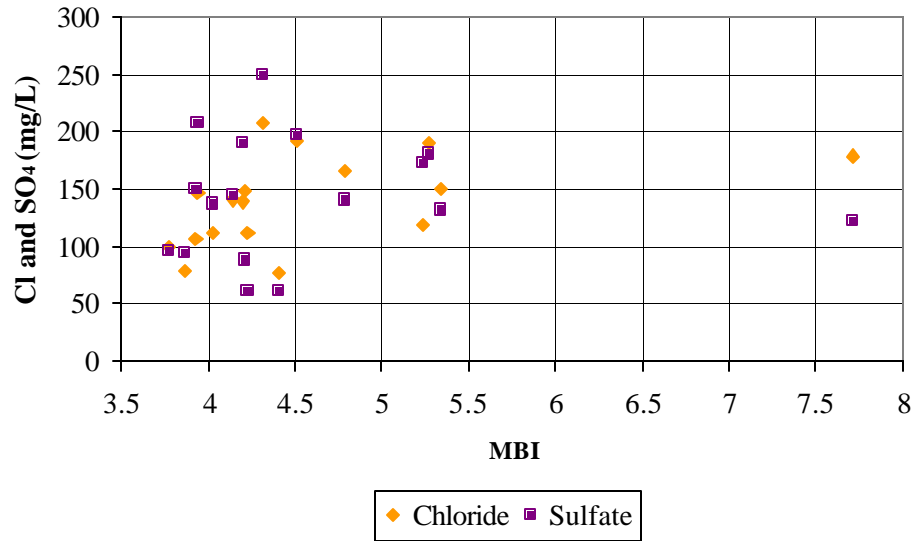
Smoky Hill River - Salina
Biology TMDL - Station 268



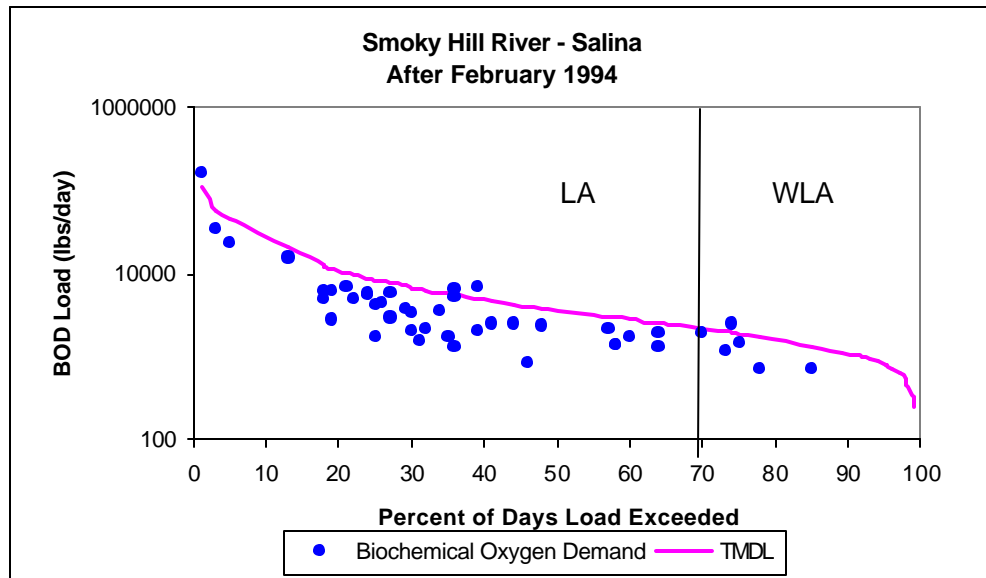
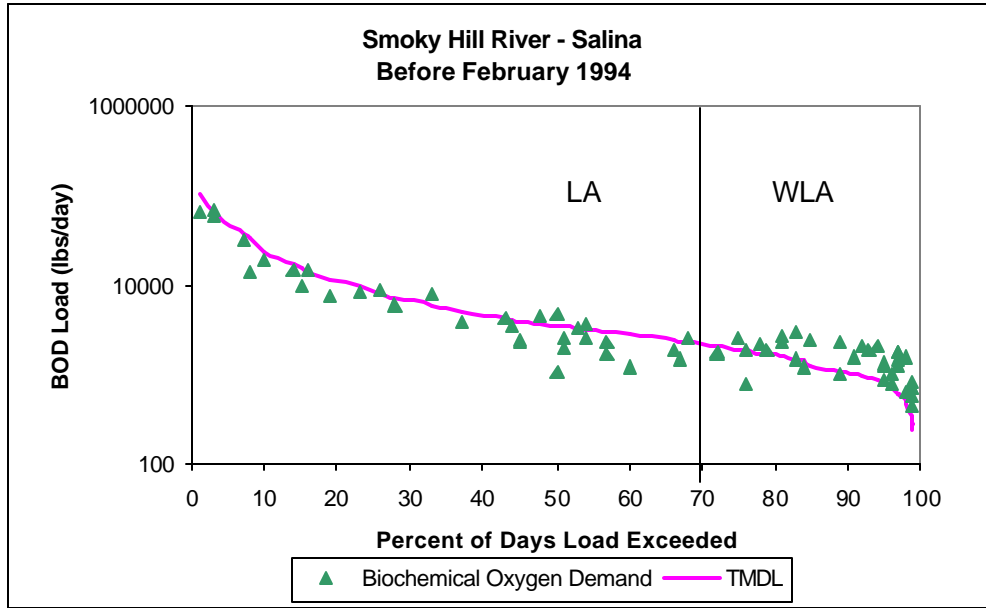


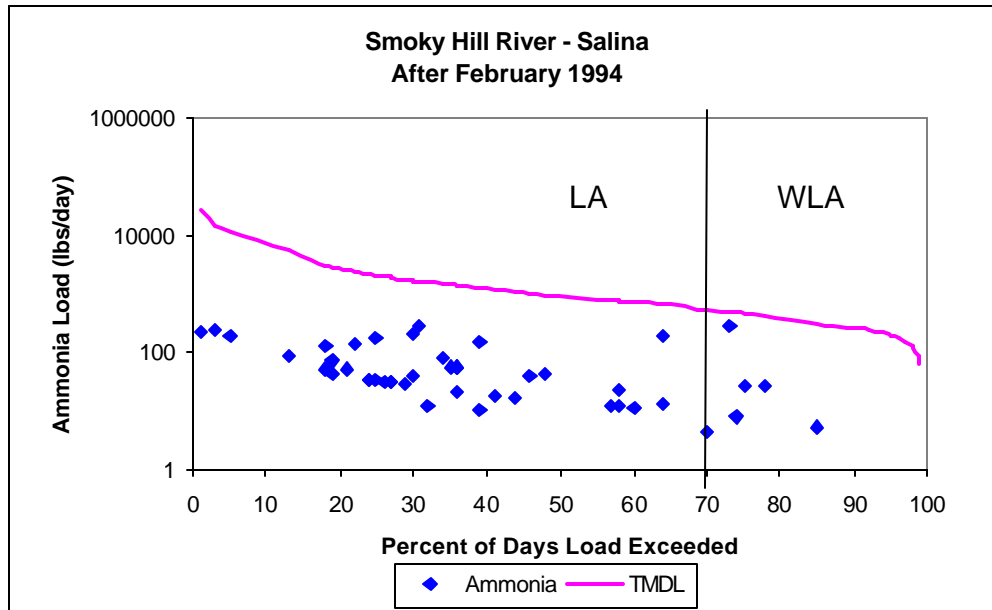
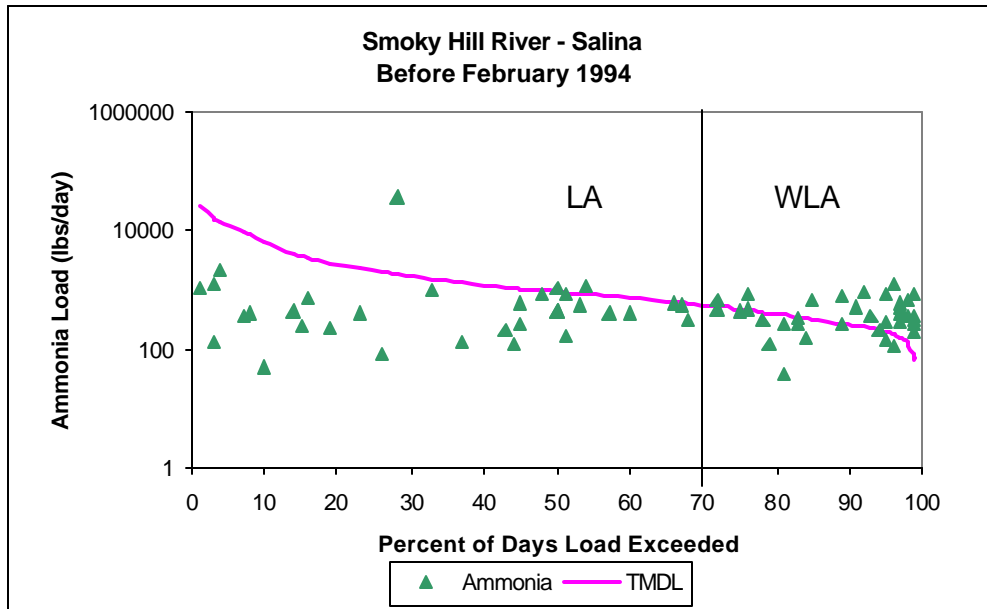


Smoky Hill River - Salina



APPENDIX B





Approved March 3, 2004