

UPPER ARKANSAS RIVER BASIN TOTAL MAXIMUM DAILY LOAD

Waterbody / Assessment Unit (AU): Hamilton County State Fishing Lake and Hamilton Wildlife Area

Water Quality Impairments:

**Hamilton County State Fishing Lake (SFL): Chloride, Sulfate, and Siltation;
Hamilton Wildlife Area (W.A.): Chloride, Sulfate, and Siltation**

1. INTRODUCTION AND PROBLEM IDENTIFICATION

Subbasin: Middle Arkansas-Lake McKinney **County:** Hamilton

HUC 8: 11030001 **HUC 12:** 110300010105

Ecoregion: Western High Plains, Flat to Rolling Cropland (25d)

Drainage Area: Approximately 15.8 square miles

Hamilton County State Fishing Lake Conservation Pool:

Surface Area = 25 acres

Watershed/Lake Ratio = 404:1

Maximum Depth = 2.0 m

Mean Depth = 0.8 m

Storage Volume = 65.5 acre-feet

Estimated Retention Time = 0.296 years (CNET Calculation)

Year Constructed = 1956

Designated Uses: Expected Aquatic Life, Food Procurement Use, Groundwater Recharge, Industrial Water Supply Use; Irrigation Use; Livestock Watering Use; Primary Contact Recreation Class B (Hamilton County SFL); Secondary Contact Recreation Class a (Hamilton W.A.).

303 (d) Listings for Upper Arkansas River Basin:

Hamilton County State Fishing Lake;

Chloride – 2002, 2004, 2008, 2010 and 2012

Sulfate – 2002, 2004, 2008, 2010 and 2012

Siltation – 2008, 2010 and 2012

Hamilton Wildlife Area;

Chloride – 2002, 2004, 2008, 2010 and 2012

Sulfate – 2002, 2004, 2008, 2010 and 2012

Siltation – 2004, 2008, 2010 and 2012

Impaired Use: Expected aquatic life is impaired due to elevated chloride concentrations. Livestock watering use is impaired due to elevated sulfate concentrations. All uses are impaired to some degree due to siltation.

Water Quality Criteria:

Chloride: Acute Aquatic Life criterion = 860 mg/L (K.A.R. 28-16-28e(d), Table 1a).

Sulfate: Livestock Watering Use criterion = 1,000 mg/L (K.A.R. 28-16-28e(d), Table 1a).

In stream segments where background concentrations of naturally occurring substances, including chlorides and sulfates, exceed the water quality criteria listed in table 1a of the “Kansas surface water quality standards: tables of numeric criteria,” at ambient flow, the existing water quality shall be maintained, and the newly established numeric criteria shall be the background concentration, as defined in K.A.R. 28-16-28b(e). Background concentrations shall be established using the methods outlined in the “Kansas Implementation procedures: surface water quality standards,” as defined in K.A.R. 28-16-28b(gg), and available upon request from the department (K.A.R. 28-16-28e(b)(9)).

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

2.0 CURRENT WATER QUALITY CONDITION AND DESIRED ENDPOINT

Monitoring Sites: KDHE Lake Monitoring Stations LM016101 in Hamilton County State Fishing Lake and LM016141 in Hamilton W.A..

Period of Record Used: For Hamilton County State Fishing Lake: three surveys conducted by KDHE in 1997, 1998, and 1999. For Hamilton W.A.: three surveys conducted by KDHE in 1997, 1999, and 2000.

Current Condition: Hamilton County State Fishing Lake has elevated chloride and sulfate concentrations. The lake is often dry, but when water is present the lake water is typically nothing more than a shallow pool confined to the lake bottom. “When enough water is present in the lake to support long-term fish survival, the lake is stocked with Channel catfish, largemouth bass, and sunfish” (KDWP). The lake is spring fed, and lake levels are not maintained by the spring during drought conditions (Carney, 2011). There is currently an Eutrophication and an Aquatic Plants TMDL for Hamilton County State Fishing Lake. Hamilton W.A. currently has TMDLs for Eutrophication and Dissolved Oxygen. No additional samples have been collected since these TMDLs were approved. A summary of the observed sampling data is in Tables 1 and 2. There are no registered classified streams within the watershed.

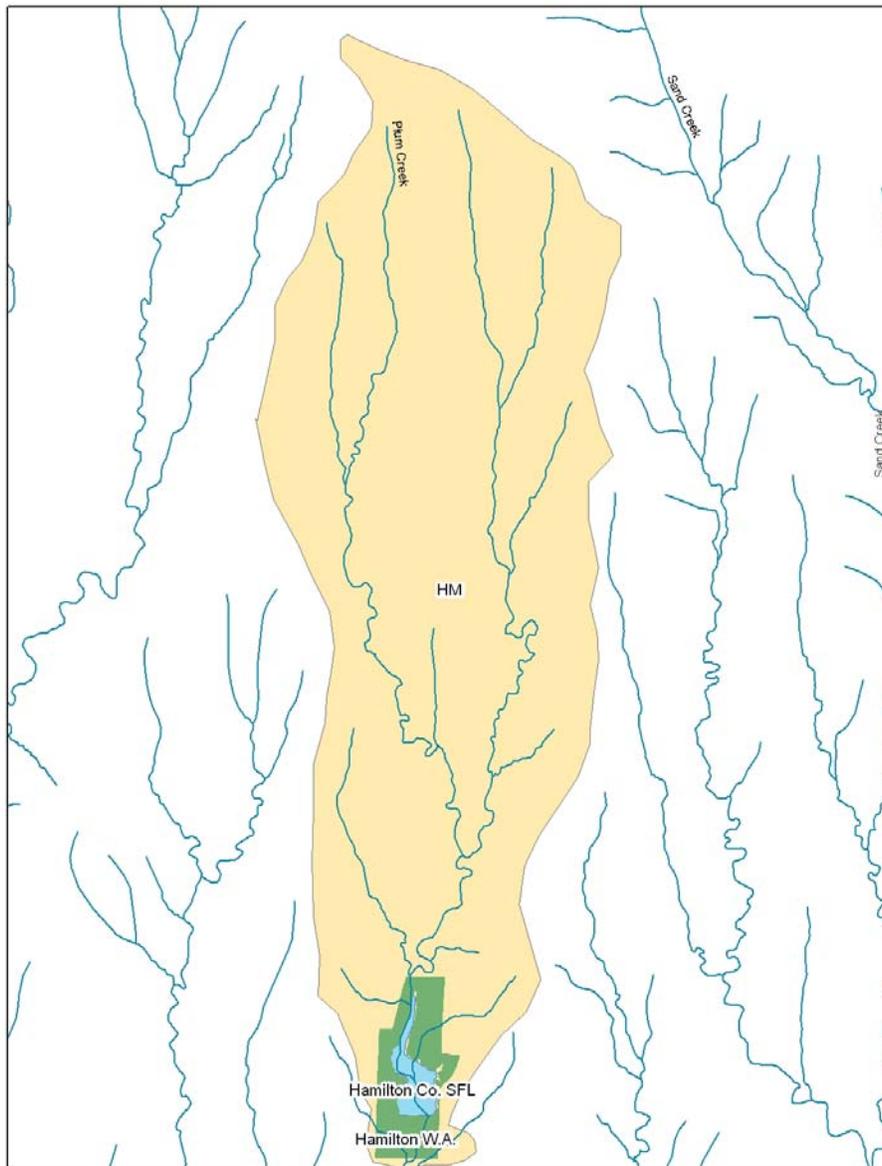


Figure 1. Hamilton County State Fishing Lake and Wildlife Area Contributing Area Base Map with NHD streams.

Sampling Date	Chloride (mg/L)	Dissolved Oxygen (mg/L)	Sulfate (mg/L)	TSS (mg/L)	Turbidity (NTU)	Secchi Depth (m)
8/12/1997	360	12.7	624	5	2.75	0.8
8/25/1998	1194	3.7	1816.5	16	5.05	0.86
8/17/1999	1471	2.9	1796	196	51.5	0.18
Average	1008	6.43	1412	72.3	19.76	0.61

Table 1. Hamilton County State Fishing Lake Sampling Data Summary.

Water quality standard violations are observed in the samples from 1998 and 1999 in the Hamilton County SFL, as concentrations are over the respective chloride and sulfate criteria (as seen in Figure 2). Total Suspended Solids (TSS) concentrations along with Turbidity and Secchi depth values indicate that in 1999 the lake was turbid and influenced by siltation.

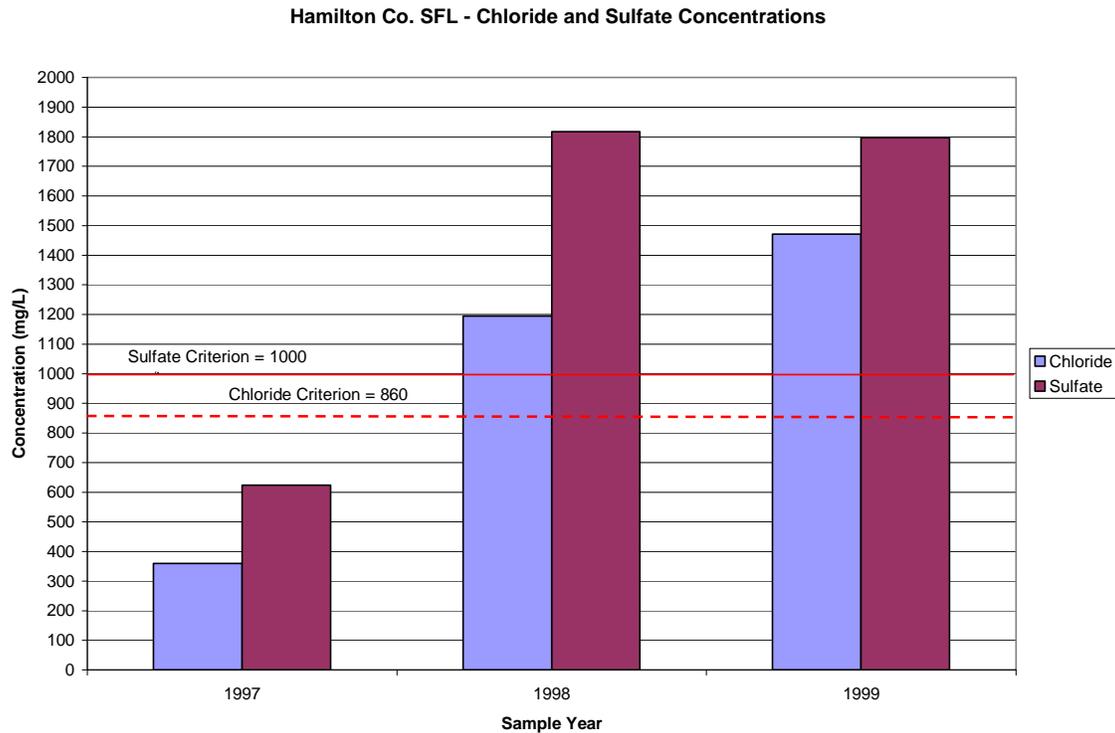


Figure 2. Observed Chloride and Sulfate Concentrations in Hamilton County State Fishing Lake.

Sampling Date	Chloride (mg/L)	Dissolved Oxygen (mg/L)	Sulfate (mg/L)	TSS (mg/L)	Turbidity (NTU)	Secchi Depth (m)
8/12/1997	319	2	1143	15.5	8.8	0.4
8/17/1999	259	3.9	846	7	5.05	0.3
8/29/2000	396	1.5	1604	14	5.25	0.3
Average	325	2.5	1197	12.2	6.37	0.33

Table 2. Hamilton W.A. Sampling Data Summary

The Hamilton Wildlife Area has water quality standard violations for sulfate in 1997 and 2000 (as seen in Figure 3). Though the W.A. area is listed for chloride, there are no aquatic life use chloride criterion violations.

Hamilton Wildlife Area - Sulfate Concentrations

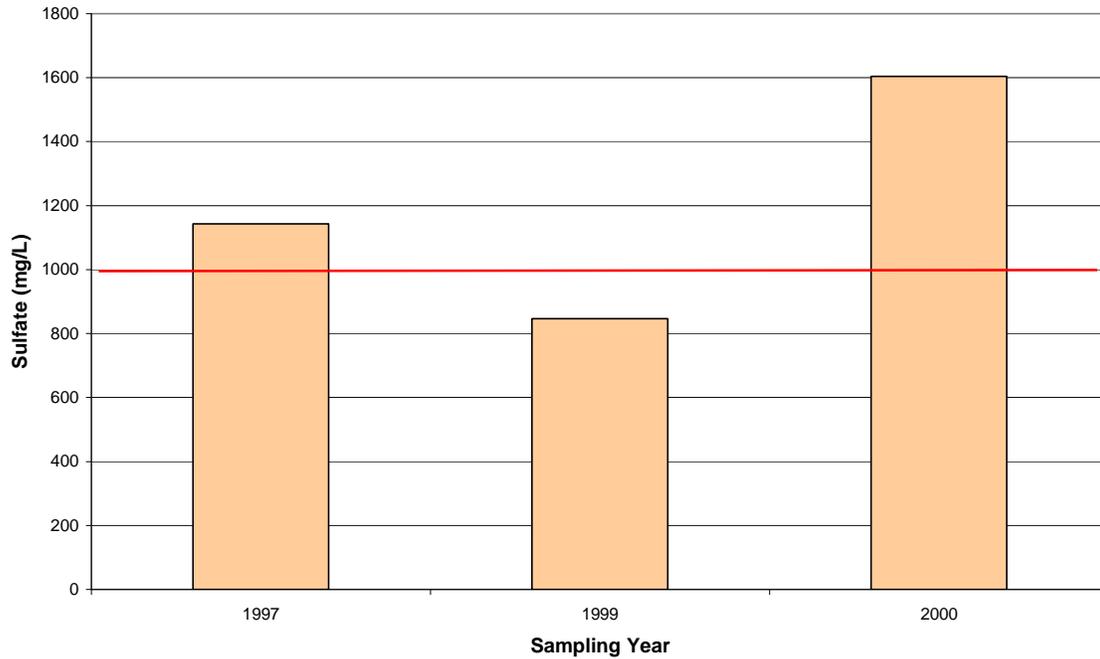


Figure 3. Observed Sulfate Concentrations in Hamilton Wildlife Area.

The rainfall data for month of August for the three sampling years are detailed in Figure 4. Rainfall was the greatest during 1997, which contributes to much lower observed chloride and sulfate concentrations than during the other two sampling years with less rainfall. The higher rainfall amounts dilute the chloride and sulfate concentrations. During drier periods, the sulfate and chloride concentrations become more concentrated with a lack of lake inflow and through lake water evaporation. The 1997 TSS concentration in Hamilton SFL is the lowest of the three sampling years, and indicates the TSS was mainly inorganic.

August Rainfall - Leoti, KS

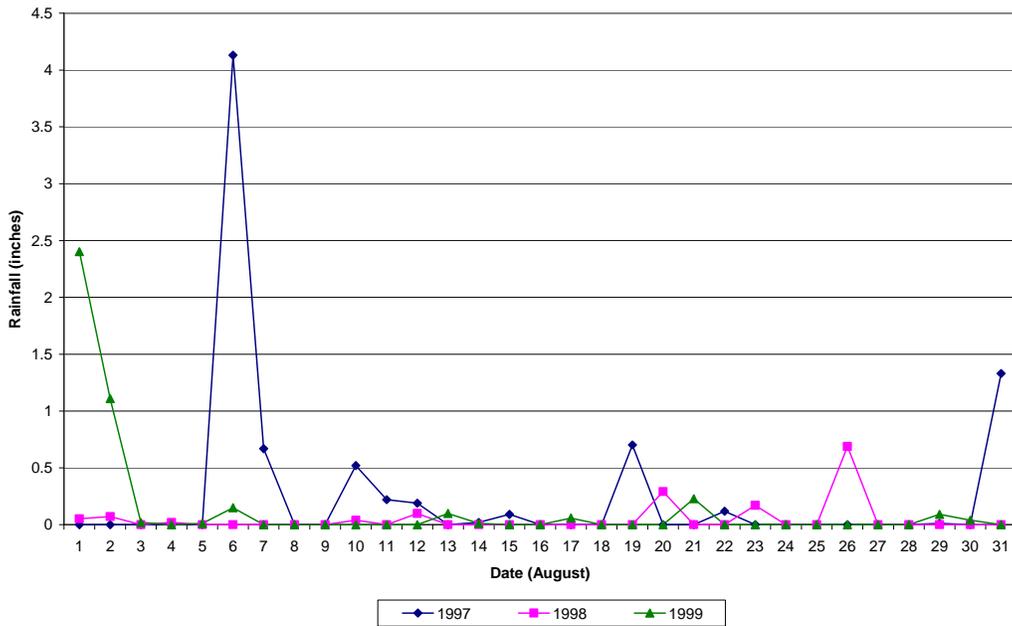


Figure 4. August Rainfall for Leoti, KS during 1997, 1998, and 1999 (National Climatic Data Center).

As seen in Figure 5, the secchi disk depth in 1999 was the lowest of the three sampling years, which corresponds to when the Turbidity values within the lake were the highest. Desirable secchi depth reading in 1997 and 1998 correspond with lower Turbidity values within the lake.

A bioassay project conducted by the Kansas Biological Survey evaluated 19 small Kansas lakes sampled in 2002-2003. Figure 5 details a comparison between secchi disk depths and the turbidity values in the 19 lakes in the study and the data collected from Hamilton SFL. The desired secchi disk depth in Hamilton SFL is 0.7 m, which was not achieved in the 1999 sampling year. Based on a regression of the data in Figure 5, the turbidity values in Hamilton SFL should be reduced to 14 NTU in order for the lake to achieve a secchi disk depth of 0.7 m.

Comparison of 19 Small Lakes in Kansas and Hamilton SFL

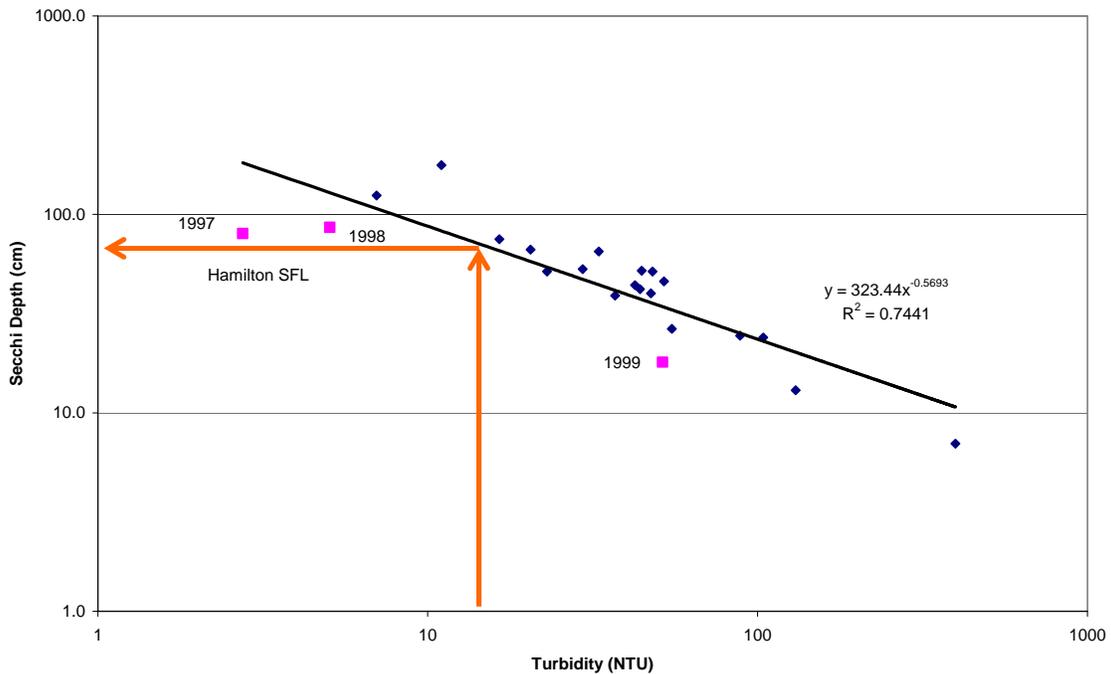


Figure 5. Comparison of Turbidity and Secchi depths in 19 small Kansas Lakes from the Bioassay Project conducted by the Kansas Biological Survey and Hamilton SFL.

Desired Endpoint: The ultimate endpoint of the TMDL is to achieve the Kansas Water Quality Standards to fully support all designated uses of Hamilton County State Fishing Lake and Hamilton Wildlife Area. The endpoint should result in chloride concentrations under 860 mg/l and sulfate concentrations under 1000 mg/l. The endpoint to address the siltation impairment will be established based on a TSS concentration of 50 mg/L. According to the 2002 report from the KDHE’s Lake and Wetland Monitoring Program, 0.7 meters of secchi depth is considered full-support for Primary Contact Recreation use for a lake that is impaired by turbidity, which is the most stringent criterion for all the designated uses for Hamilton County State Fishing Lake. Hamilton County State Fishing Lake is not a conventional lake system because it is often dry, but when water is present the lake water is typically nothing more than a shallow pool confined to the lake bottom. Thus, the desired secchi disk depth is 0.7 meters for the TMDL. The secchi endpoint will be achieved when turbidity values are 14 NTU in Hamilton SFL, which is equivalent to a TSS concentration of 50 mg/L. In addition, maintain the current concentration average of 12.5 mg/L of TSS at the Hamilton Wildlife Area. Refined endpoints may be established in the future as more data becomes available.

The TSS concentration of 50 mg/L for Hamilton County State Fishing Lake will also support full Aquatic Life Uses for all streams within the drainage area of the lake. 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.

Seasonal variation has been incorporated in this TMDL for chloride and sulfate since rainfall throughout the year influence these concentrations. The critical period for chloride and sulfate concentrations are during the drier months when concentrations become concentrated through reduced lake inflow and evaporation.

Sediment will be managed on an annual average load, and therefore seasonal variation in the endpoint is not established with the TSS TMDL. The TSS endpoint can be reached as a result of sediment loading reductions from various source sin the watershed resulting from the implementation of corrective actions and best management practices.

3.0 SOURCE INVENTORY AND ASSESSMENT

Point Sources: There are no NPDES facilities in the watershed.

Land Use: Landuse with the HUC 12 watershed is dominated by 40% grassland, 37% cropland, and 17% shrub/scrub. More specifically, the landuse in the Hamilton County SFL watershed is approximately 77% grassland and 22% cropland. Landuse within the watershed is illustrated in Figure 6.

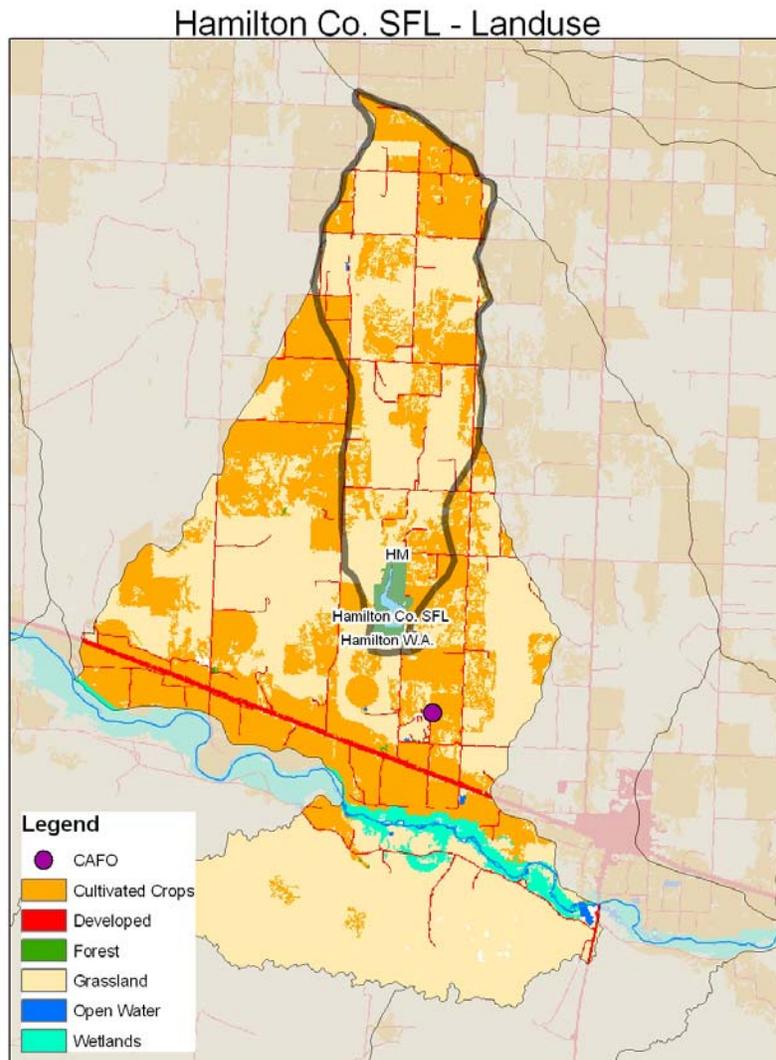


Figure 6. Landuse map for Hamilton Co. SFL watershed and for HUC12 – 110300010105.

Livestock Waste Management: There are no certified or permitted confined animal feedlot operations located within the Hamilton County SFL watershed. However, there is one large permitted CAFO (permit # A-UAHM-C004) in the HUC12 containing the lake, which is permitted for 27,800 head of cattle. It is possible that cattle from this operation will have access to land within the lake watershed. This livestock facility has a waste management system designed to minimize runoff entering their operation and detain runoff emanating from the facility. The facility is designed to retain a 25-year, 24-hour rainfall/runoff event as well as an anticipated two weeks of normal wastewater from their operation. The actual number of animals at the feedlot operation is typically less than the allowable permitted number. Small livestock operations located within the watershed

may contribute significant nutrients, particularly during runoff events. However, based on the size of this watershed the potential number of grazing livestock remains low.

Contributing Runoff: The watershed of Hamilton County SFL has a mean soil permeability value of 1.27 inches/hour, ranging from 0.21 to 1.29 inches/hour according to the NRCS STATSGO database. According to a USGS open-file report (Juracek, 2000), the threshold soil permeability values that represents 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" / hour 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 may potentially contribute runoff. Runoff is chiefly generated as infiltration excess with rainfall intensities greater than the soil permeability. As soil profiles become saturated, excess overland flow is produced. The entire watershed has a low soil permeability value, which will produce runoff with rainfall events that produce 1.29 inches/hour of rain. Runoff generated from cropland and grassland likely contribute to the siltation impairment within Hamilton County SFL and Hamilton W.A..

Irrigation: The only point of diversion identified in the watershed is at the Hamilton County State Fishing Lake according to the Water Information Management and Analysis System (WIMAS). There does not appear to be any irrigation practices taking place above the lake since there are no identified points of diversion in this area of the watershed.

On-Site Waste Systems: There are approximately 21 on-site septic systems located in the HUC12 containing this watershed. Significant nutrient loading may occur if a system fails and is located near the lake or near streams entering the lake. If the on-site septic systems are in working order and not located near a drainage to the lake then on-site waste systems are not a source contributing to the impairments in the watershed.

Background Levels: Elevated sulfate concentrations have been observed in the Arkansas River and within the groundwater along the river for decades. It is likely that natural levels contributed from the interaction of the Arkansas River with gypsum deposits in the Pierre Shale in eastern Colorado and in the Permian deposits underlying the Ogallala aquifer may contribute to higher sulfate levels. Natural background concentrations of sulfate have been established at 1,875 mg/l along the Arkansas River below the lake. Prolonged dry periods tend to dry up the lake and this natural hydrologic occurrence may significantly contribute to the impairments within Hamilton County SFL and Hamilton W.A.. Though infrequent, high runoff events may temporarily increase the background chloride concentrations in the streams during higher flow events as soil salts are flushed. Additionally, the decline in the Ogallala aquifer contributes to a reduction in its relatively freshwater contribution to the surface water, which may increase the background chloride and sulfate concentrations in the watershed.

4.0 ALLOCATION OF POLLUTION REDUCTION RESPONSIBILITY

Point Sources: A current Wasteload Allocation of zero is established by this TMDL because of the lack of point sources in the watershed. Should future point sources be proposed in the watershed, the current wasteload allocation will be revised by adjusting current load allocations to account for the presence and impact of any new point source discharges.

Nonpoint Sources: Water quality impairments are exclusively from nonpoint sources. The load allocations and TMDL summary are illustrated in Tables 3a, 3b and 4. There are no classified streams entering Hamilton County SFL and therefore the CNET model (Appendix A) was utilized to calculate a drainage area based flow for the ephemeral streams contributing to the inflow of the lake and wildlife area within the watershed. Due to the lack of certainty on the annual inflow to the lake and wildlife area this is a concentration based TMDL. However, to estimate daily loads the flow value of 0.51 cfs was utilized as the inflow value to the both the Hamilton County SFL and W.A. to derive daily loads. The TSS TMDL for Hamilton SFL, as seen in Table 3b, is based on the TSS concentration in the lake. As indicated above, controlling the stream TSS concentration at 50 mg/L should meet the lake target. As further assessments and information become available to validate lake inflow it may prove necessary to refine the daily load allocations. Regardless, the established TMDL concentrations will likely remain unchanged.

Parameter	Current Avg. Lake Concentration mg/L	Current Load (lbs/day)	TMDL Concentration mg/L	Load Allocation (lbs/day)	Margin of Safety (lbs/day)	TMDL (lbs/day)	Percent Reduction
Chloride	1008	2,277	860	2131.6	236.8	2,368	14.7%
Sulfate	1412	3,889	1000	2478.6	275.4	2,754	29.2%

Table 3a. TMDL for Hamilton County State Fishing Lake.

Parameter	TMDL Concentration in Lake (mg/L)	Load Allocation (lbs/day)	Margin of Safety (lbs/day)	TMDL (lbs/day)
TSS	50	124.2	13.8	138

Table 3b. TSS TMDL for Hamilton County State Fishing Lake.

Parameter	Current Avg. Lake Concentration mg/L	Current Load (lbs/day)	TMDL Concentration (mg/L)	Load Allocation (lbs/day)	Margin of Safety (lbs/day)	TMDL (lbs/day)	Percent Reduction
Chloride	325	894	860	2131.6	236.8	2,368	0%
Sulfate	1197	3297	1000	2478.6	275.4	2,754	16.5%
TSS	12.2		12.2	30.15	3.35	33.5	

Table 4. TMDL for Hamilton County W.A..

Defined Margin of Safety: The margin of safety provides some hedge against the uncertainty of variable annual loads and the desired endpoints. Therefore, the margin of safety is set explicitly at 10% of the total allocations for chloride, sulfate, and TSS, which compensates for the lack of knowledge about the relationship between the allocated loadings and the resulting water quality. The margin of safety for the parameters addressed in this TMDL are displayed in Tables 3a, 3b and 4.

State Water Plan Implementation Priority: Since more detailed source assessments and additional monitoring data are needed, and the lake is a marginal water, this TMDL will be Low Priority for implementation.

Unified Watershed Assessment Priority Ranking: This watershed lies within the Middle-Arkansas-Lake McKinney Subbasin (HUC 8: 11030001) with a priority ranking of 31 (Medium Priority for restoration work).

Priority HUC12s: The entire watershed lies within a portion of the HUC12 110300010105.

5.0 IMPLEMENTATION

Desired Implementation Activities: The lack of water from inadequate hydrologic production appears to be the main cause contributing to the poor water quality conditions found in the lake and wildlife area. Further assessing the watershed to determine the frequency of the lake drying up along with collecting additional monitoring data would assist in establishing more detailed implementation activities.

Implementation Program Guidance: Until additional assessments are conducted no guidance can be provided.

Time Frame for Implementation: Pollutant reduction strategies and pollutant source assessment should be initiated within the Hamilton County SFL watershed by 2015.

Targeted Participants: The primary participants for implementation will be agricultural and livestock operations within the watershed. Kansas Department of Wildlife and Parks and KDHE will help further assess the conditions within the watershed.

Milestone for 2016: In accordance with the Kansas TMDL development schedule, the year 2016 marks the next cycle of 303(d) activities in the Upper Arkansas Basin to review information from Hamilton County State Fishing Lake and Wildlife Area. By this time, additional monitoring data and source assessments should be available and adjustments to the established allocations may be necessary.

Delivery Agents: Depending upon confirmation of impairment and assessment of probable sources, the primary delivery agents for program participation will be KDHE,

Kansas Wildlife and Parks, the State Conservation Commission, the Kansas State University Extension Service and local interest groups.

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 State Conservation Commission 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 State Conservation Commission 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 Upper Arkansas 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 watershed 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 Low Priority consideration for funding.

Effectiveness: Effectiveness will depend upon the sources which contribute to the impairment at the lake. The key to success will be widespread utilization and maintenance of conservation farming and proper livestock waste management within the watershed cited in this TMDL.

6.0 MONITORING

KDHE will resume collecting samples at Hamilton County State Fishing Lake and Wildlife Area in order to assess the impairments within lake once it has been determined the lake is sufficiently maintaining water. In order to evaluate the sediment loading in the watershed it is important to monitor the frequency of when the lake dries up and establish sedimentation rates.

7.0 FEEDBACK

Public Notice: An active internet website was established at <http://www.kdheks.gov/tmdl/index.htm> to convey information to the public on the general establishment of TMDLs and specific TMDLs for the Upper Arkansas Basin.

Public Hearing: A Public Hearing on the Upper Arkansas Basin TMDLs was held on September 20, 2012 in Garden City to receive comments. No comments were received throughout the August 20, 2012 through September 26, 2012 comment period.

Basin Advisory Committee: The Upper Arkansas Basin Advisory Committee met to discuss these TMDLs on April 4, 2012 in Jetmore and September 20, 2012 in Garden City.

Milestone Evaluation: In 2016, evaluation will be made as to the degree of implementation which has occurred within the watershed. Further assessments will determine if impairments are associated with poor water quality or primarily due to lack of consistent inflows. Subsequent decisions will be made regarding the implementation approach, priority of allotting resources for implementation and the need for additional or follow up implementation in this watershed at the next TMDL delisting cycle for this basin in 2021 with consultation from local stakeholders.

Consideration for 303(d) Delisting: Hamilton County SFL and Hamilton W.A. will be evaluated for delisting under section 303(d), based on additional source assessment and monitoring. Therefore, the decision for delisting will come about in the preparation of the 2022 – 303(d) list. Should modifications be made to the applicable endpoints during the implementation period, consideration for delisting, desired endpoints of this TMDL and the implementation activities might 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 would come in 2012, which will emphasize implementation of WRAPS activities. Recommendations of this TMDL will be considered in the Kansas Water Plan implementation decisions under the State Water Planning Process for Fiscal years 2012-2020.

Rev April 15, 2013

Carney, Edward. Kansas Department of Health and Environment, Lake Monitoring Program. Correspondence regarding Hamilton County State Fishing Lake, July 14, 2011.

Carney, E., 2002. Lake and Wetland Monitoring Program: Annual Report. Watershed, Planning, and Assessment Section, Bureau of Water, Topeka, KS.

Dzialowski, A.R., S.H. Wang, N.C. Lim, W.W. Spotts and D.G. Huggins. TMDL Lakes – Bioassay Project. Variability of Nutrient Limitation on Phytoplankton Growth in Small and Medium Kansas Lakes. Central Plains Center for BioAssessment, Kansas Biological Survey; University of Kansas. KBS Publication No. 120.

Kansas Department of Wildlife and Parks. Hamilton State Fishing Lake Information available on the web. Accessed at <http://www.kdwp.state.ks.us/news/KDWP-Info/Locations/State-Fishing-Lakes/Region-3/Hamilton> on April 20, 2011.

National Climatic Data Center. Precipitation Data for Station GHCND:USC00144665 – Leoti 1 SE, KS US. Accessed on the web at <http://www.ncdc.noaa.gov/land-based-station-data/find-station> on March 5, 2013.

Water Information Management and Analysis System (WIMAS) for the Web. Accessed on the web at http://hercules.kgs.ku.edu/geohydro/wimas/query_setup.cfm on April 20, 2011.

Appendix A. CNET Water Balance

WATER BALANCE...			
Precipitation Flow	hm ³ /yr	0.04	0.04
NonPoint Flow	hm ³ /yr	0.41	0.41
Point Flow	hm ³ /yr	0.00	0.00
Total Inflow	hm ³ /yr	0.45	0.45
Evaporation	hm ³ /yr	0.17	0.17
Outflow	hm ³ /yr	0.27	0.27