KANSAS-LOWER REPUBLICAN BASIN TOTAL MAXIMUM DAILY LOAD

Waterbody: **Tuttle Creek Lake**
Water Quality Impairment: Eutrophication

1. INTRODUCTION AND PROBLEM IDENTIFICATION

Subbasins: Lower Big Blue & Lower Little Blue

Counties: Marshall, Nemaha, Washington, and Republic

HUC 8s: 10270205 & 10270207

HUC 11s: 10270205: 035, 044, 050, 060, 070, 080, 090, 100, 110, 120, 130, 140, 150, 160, 169
10270207: 031, 074, 083, 090, 100

Drainage Area: Approximately 9,628 square miles.

Conservation Pool: Elevation 1075'; Volume 335,000 acre-feet

Tributary Arms: Big Blue River
Little Blue River
Black Vermillion River
Fancy Creek

Designated Uses: Primary Contact Recreation; Food Procurement; Domestic Water Supply; Expected Aquatic Life Support

1998 303d Listing: Table 4 - Water Quality Limited Lakes

Impaired Use: All uses potentially impaired from Eutrophication

Water Quality Standard: Nutrients: Narrative - 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. (KAR 28-16-28e(c)(2)(B)).

2. CURRENT WATER QUALITY CONDITION AND DESIRED ENDPOINT

Level of Support for Designated Use under 1998 303d: Full Support but Threatened Aquatic Life Support

Monitoring Sites: Station 61201 in Tuttle Creek Lake.

Period of Record Used: 1988, 1991, 1994, 1996, 1997, 1998

Lake Record: 1968-1997 elevations from U.S. Army Corps of Engineers for Tuttle Creek Lake.

Current Condition: Lake has consistently high levels of total phosphorus, averaging 185 ppb in samples taken over the six surveys of the lake. The chlorophyll a content of the lake averages about 2.81 ppb with an associated Trophic State Index value of 40.7. These levels are indicative of oligotrophic conditions, but actually reflect the limitations on productivity induced by excessive turbidity and siltation in the lake. The lake is actually classed argilotrophic to account for these conditions. Total phosphorus levels in the streamflow entering the lake are very high on average. Considerable loadings come from Nebraska.

Average Total Phosphorus Concentrations from Locations in Tuttle Creek Drainage Area

-------Stateline---------		Headwaters			
Little Blue	Big Blue	Blue Rapids	Black Vermillion	Mill Creek	Fancy Creek
522 ppb	753 ppb	700 ppb	320 ppb	261 ppb	228 ppb

The intent of this TMDL is to reduce the average concentration of total phosphorus within the lake over the period 1999-2008.

Desired Endpoints of Water Quality at Tuttle Creek Lake over 2004 - 2008:

1. Average concentrations of total phosphorus within the conservation pool (1075') will be below 50 ppb after 2008.

3. SOURCE INVENTORY AND ASSESSMENT

The primary source of phosphorus within Tuttle Creek Lake is probably runoff from agricultural lands in the Big and Little Blue River Basins and the Black Vermillion Subbasin where phosphorus has been applied. Selection of geographic sources of sediment is a function of a given watershed's proportion of cropland, its proximity to the lake and its propensity to generate runoff. Land use coverage analysis indicates large percentages of cropland in subwatersheds of the Big Blue River Subbasin (HUC8=10270205), particularly along the Big Blue River itself and the Black Vermillion River. Sixty five to seventy percent of the subwatersheds are cropland. Subwatersheds of the Little Blue River Subbasin (HUC8=10270207) are about half cropland, with a greater proportion of grassland than the watersheds to the east. The subwatersheds of the Little Blue which are closer to the headwater of Tuttle Creek Lake have a higher proportion of cropland.

Additionally, manure from livestock may contribute phosphorus loadings to the lake via runoff from the watershed. Grazing densities tend to be higher in the Lower Little Blue Subbasin (37-39 animal units/sq.mi.) than the Big Blue Subbasin (30-42 AU/sq.mi.). A high percentage of subwatersheds close to the lake are in grassland.

Soils in the eastern subwatersheds appear less permeable (average permeability of 0.4"/hr to 0.6"/hr) while those of the Little Blue Subbasin are more permeable (0.7"/hr to 0.9"/hr). Consequently, runoff contributions tend to be generated from the Big Blue River or Black Vermilllion drainages rather than from the western side of the drainage area. Under wet conditions or intense storms, the whole basin contributes runoff. Under moderate or lower conditions, a higher proportion of the eastern watersheds generate runoff than the western watersheds.

The following table summarizes these three characteristics for the subwatersheds above Tuttle Creek which are most likely to have contributions of sediment loading into the lake. The recommended subwatershed targets are indicated by bold type. Targets are emphasized in the Big Blue River and Black Vermillion Subbasins, close to the headwaters of the lake.

CHARACTERISTICS OF TARGETED SUBWATERSHEDS FOR PHOSPHORUS TMDL

							% of Wtshd w/ Runoff		
HUC 11	**Description**	**%Crop**	**%Grs**	**Graz**	**Avg. Perm**		**Hi**	**Mod**	**Low**
10270205035	**Mission-Murdock**	**65%**	**32%**	**32**	**.6"**	**97**	**93**	**51**	
10270205044	**Hrshoe Crk-Big Blue**	**65%**	**30%**	**33**	**.6"**	**97**	**93**	**51**	
10270205050	**Spring Creek-Marsh**	**66%**	**31%**	**32**	**.6"**	**97**	**93**	**51**	
10270205090	**N.Fork Black Vermill**	**70%**	**28%**	**38**	**.4"**	**99**	**99**	**92**	
10270205100	**Black Vermillion**	**65%**	**29%**	**42**	**.4"**	**99**	**99**	**92**	
10270205070	**Robidoux Creek**	**54%**	**42%**	**32**	**.4"**	**99**	**99**	**92**	
10270205080	Marshall Co - Minor Str	62%	36%	32	.4"	99	99	92	
10270207090	**Lower Little Blue**	**52%**	**42%**	**37**	**.8"**	**91**	**83**	**12**	
10270207100	**Coon-Camp Crks**	**56%**	**39%**	**38**	**.8"**	**91**	**83**	**12**	
10270207083	**Mill Creek**	**54%**	**40%**	**38**	**.9"**	**89**	**54**	**13**	
10270207074	Upper Little Blue	41%	51%	39	.8"	91	83	12	
10270205140	**Fancy Creek**		**44%**	**51%**	**31**	**.7"**	**91**	**83**	**12**
10270205060	**Dutch Crk-Mid Blue**	**44%**	**49%**	**32**	**.6"**	**97**	**93**	**51**	
10270205110	South Fork Blk Verm	38%	51%	33	.4"	99	99	92	
10270205120	**Middle Big Blue**	**37%**	**54%**	**31**	**.6"**	**97**	**93**	**51**	
10270205130	Spring Creek-Pott	18%	72%	39	.6"	97	93	51	
10270205150	North Otter Crk	33%	62%	30	.7"	91	83	12	
10270205160	Lower Big Blue	20%	63%	38	.6"	97	93	51	
10270205169	Lower Tuttle	13%	64%	36	.6"	97	93	51	

Analysis of tributary data in the Black Vermillion watershed indicates elevated levels of total phosphorus consistently seen from the tributaries. Higher concentrations seem related to higher percentages of cropland or higher grazing densities for livestock associated with the North Fork Black Vermillion. Those tributaries tend to drain extensive cropland areas. Generally, two thirds of the samples taken over the three years had elevated total phosphorus solids.

Governor's Water Quality Initiative Data

Site	Number of Samples Over 200 mg/l TP	Average of All Samples
128	51	340 mg/l
129	12	150 mg/l
130	64	350 mg/l
131	29	270 mg/l
132	54	280 mg/l
133	48	310 mg/l
134	71	460 mg/l
141	46	250 mg/l

A phosphorus load of 9570 Tons/year is necessary to maintain the average in lake concentrations seen at Tuttle Creek.

4. ALLOCATION OF POLLUTION REDUCTION RESPONSIBILITY

Point Sources: Since this pollutant is associated with agricultural non-point source pollution, there will be no Wasteload Allocation assigned to point sources for phosphorus under this TMDL.

Non-Point Sources: As described in the Source Assessment, the subwatersheds with high proportion of cropland, strong propensity for runoff and in proximity to the Tuttle Creek headwaters are targeted for implementing this TMDL. The Load Allocation will involve reducing phosphorus loading by 90% to 860 Tons per year from the targeted subwatersheds.

Defined Margin of Safety: The margin of safety provides some hedge against the uncertainty of variable annual total phosphorus loads and the endpoint. Therefore, the margin of safety will be 100 tons per year of total phosphorus taken from the load capacity to ensure that adequate load reduction occurs to meet the endpoint.

State Water Plan Implementation Priority: Because this lake has tremendous importance in influencing the water supply and water quality of the Kansas River, the investment made by the state in the conservation storage of the lake and the need to comprehensively package implementation measures to handle multiple impairments in the lake and watershed, this TMDL will be a High Priority for implementation.

Unified Watershed Assessment Priority Ranking: This lake's watersheds encompass both the Lower Big Blue Subbasin (HUC8: 10270205) and the Lower Little Blue Subbasin (HUC8: 10270207). The Unified Watershed Assessment assigned a priority ranking of 2 to the Lower Big Blue and 10 to the Lower Little Blue subbasins (Both Highest Priority for restoration work.)

Priority HUC 11s and Stream Segments: Because of their high proportion of cropland, proximity to the lake and ability to generate runoff, the following subwatersheds are highest priority:

Big Blue River Subbasin		Priority Stream Segments
10270205035	**Mission-Murdock**	**22,41,42**
10270205044	**Hrshoe Crk-Big Blue**	**26,17,18,20,21**
10270205050	**Spring Creek**	**19**
10270205090	**N.Fork Black Vermillion**	**15**
10270205100	**Black Vermillion**	**13,14**
10270205070	**Robidoux Creek**	**16,47,53**
10270205140	**Fancy Creek**	**29,59,60,61,67**
10270205060	**Dutch Crk-Mid Blue**	**43,44**
10270205120	**Middle Big Blue**	**2,7**
Little Blue River Subbasin		
10270207090	**Lower Little Blue**	**1,2,37,38,39,40,42,43,45**
10270207100	**Coon-Camp Crks**	**23,44**
10270207083	**Mill Creek**	**14,16,18,20,22**

5. IMPLEMENTATION

Desired Implementation Activities

1. Implement necessary soil sampling to recommend appropriate fertilizer applications on cropland.
2. Maintain necessary conservation tillage and contour farming to minimize cropland erosion.
3. Install necessary grass buffer strips along streams.
4. Reduce activities within riparian areas .
5. Install proper manure storage.
6. Implement nutrient management plans to manage manure application to land.
7. Monitor wastewater discharges for excessive nutrient loadings.

Implementation Programs Guidance

Industrial Program KDHE

a. Ensure proper permitting and inspection of livestock waste management systems

Municipal Program - KDHE

a. Ensure proper permitting and operations of municipal wastewater systems to minimize nutrient discharges.

Non-Point Source Pollution Technical Assistance - KDHE

a. Support Section 319 demonstration projects for reduction of sediment runoff from agricultural activities as well as nutrient management.
b. Provide technical assistance on practices geared to establishment of vegetative buffer strips.
c. Provide technical assistance on nutrient management in vicinity of streams.
d. Guide federal programs such as the Environmental Quality Improvement Program, which are dedicated to priority subbasins through the Unified Watershed Assessment, to priority subwatersheds and stream segments within those subbasins identified by this TMDL.

Local Environmental Protection Program - KDHE

a. Support inspection of on-site wastewater systems to minimize nutrient loadings

Water Resource Cost Share & Non-Point Source Pollution Control Programs - SCC

a. Apply conservation farming practices, including terraces and waterways, sediment control basins, and constructed wetlands.
b. Provide sediment control practices to minimize erosion and sediment and nutrient transport
c. Provide livestock waste management systems for proper manure storage, disposal and land application.
d. Provide livestock watering sites to reduce use of streams
e. Repair failing septic systems in proximity to streams
g. Coordinate with USDA/NRCS Environmental Quality Improvement Program in providing educational, technical and financial assistance to agricultural producers.

Riparian Protection Program - SCC

a. Establish or reestablish natural riparian systems, including vegetative filter strips and streambank vegetation.
b. Develop riparian restoration projects
c. Promote wetland construction to assimilate nutrient loadings

Buffer Initiative Program - SCC

a. Install grass buffer strips near streams.
b. Leverage Conservation Reserve Enhancement Program to hold riparian land out of production.

Extension Outreach and Technical Assistance - Kansas State University

a. Educate agricultural producers on sediment, nutrient and pasture management
b. Educate livestock producers on livestock waste management and manure applications and nutrient management planning
c. Provide technical assistance on livestock waste management systems and nutrient management plans.

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

Big Blue River Compact - KDA

a. Continue to support bistate efforts to reduce sediment runoff

Timeframe for Implementation: Pollution reduction practices should be installed within the priority subwatersheds and along the priority stream segments during the years 2000-2004, with minor follow up implementation, including other subwatersheds over 2004-2008.

Targeted Participants: Primary participants for implementation will be agricultural producers operating within the drainages of the priority subwatersheds. Implemented activities should be targeted at those areas with greatest potential to impact the lake. Nominally, this would be activities located within one mile of the streams including:

1. Total rowcrop acreage
2. Cultivation alongside stream
3. Drainage alongside or through animal feeding lots
4. Livestock use of riparian areas
5. Fields with manure applications
6. On-site wastewater discharges to stream

Some inventory of local needs should be conducted in 2000 to identify such activities. Such an inventory would be done by local program managers with appropriate assistance by commodity representatives and state program staff in order to direct state assistance programs to the principal activities influencing the quality of the streams in the watershed during the implementation period of this TMDL.

Milestone for 2004: The year 2004 marks the mid-point of the ten year implementation window for the watershed. At that point in time, milestones should be reached which will have at least fifty percent of the producers responsible for the land use activities cited in the local assessment participating in the implementation programs provided by the state. Additionally, sampled data from Tuttle Creek should indicate evidence of reduced phosphorus levels in the conservation pool elevations relative to the conditions seen over 1988-1998.

Delivery Agents: The primary delivery agents for program participation will be the conservation districts for programs of the State Conservation Commission and the Natural Resources Conservation Service. Producer outreach and awareness will be delivered by Kansas State Extension.

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. 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.

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

5. 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.

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

7. The *Kansas Water Plan* and the Kansas-Lower Republican 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.

8. K.S.A. 82a-529 is the Big Blue River Compact which supports bistate pollution abatement in the Big Blue River Basin.

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

In State Fiscal Year 1999, the state provided to Washington, Marshall and Nemaha counties, $446,662 of State Water Plan Funds for non-point source pollution reduction, which included $5600 for buffer strip installation. The Commission will decide State Fiscal Year 2000 allocations in May 1999 and is expected to direct similar amounts of funding to the three counties for the next fiscal year

Effectiveness: Nutrient control has been proven effective through conservation tillage, contour farming and use of grass waterways and buffer strips as well as runoff control around animal feeding operations. The key to success will be widespread utilization of conservation farming and waste management within the watersheds cited in this TMDL.

Should participation significantly lag below expectations over the next five years or monitoring indicates lack of progress in improving water quality conditions from those seen over 1990-1998, the state may employ more stringent conditions on agricultural producers in the watershed through establishment of a Critical Water Quality Management Area in order to meet the desired endpoints expressed in this TMDL. The state can also push improvement in nutrient loadings from Nebraska through the Big Blue River Compact.

6. MONITORING

KDHE will continue to collect seasonal samples from Tuttle Creek Lake twice in the five year period 2000-2004 and three times during 2005-2008. The USGS should be employed to take sediment cores and determine phosphorus loading in the reservoir sediments. Using markers placed in the existing sediments in 2000, a revisit to those sites and additionally coring in 2008 will assess the rate of nutrient accumulation within the lake.

Periodic monitoring of nutrient content of wastewater discharged from treatment systems will be expected under reissued NPDES and state permits.

7. FEEDBACK

Public Meetings: Public meetings to discuss TMDLs in the KLR Basin were held March 10, 1999 in Topeka, April 27 in Lawrence and April 29 in Manhattan. 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 Kansas-Lower Republican Basin.

Public Hearing: A Public Hearing on the TMDLs of the Kansas-Lower Republican Basin was held in Topeka on June 3, 1999.

Basin Advisory Committee: The Kansas-Lower Republican Basin Advisory Committee met to discuss the TMDLs in the basin on December 3, 1998; January 14, 1999; February 18, 1999; March 10, 1999; May 20, 1999 and June 3, 1999.

Discussion with Interest Groups: Meetings to discuss TMDLs with interest groups include:

Agriculture: November 10, 1998; December 18, 1998; February 10, 1999; April 10, 1999, May 4, 1999, June 8, 1999 and June 18, 1999.

Municipal: November 12, 1998, January 25, 1999; March 1, 1999; May 10, 1999 and June 16, 1999.

Environmental: November 3, 1998; December 16, 1998; February 13, 1999; March 15, 1999, April 7, 1999 and May 3, 1999.

Conservation Districts: March 16-18, 24-25, 1999

Task Force: A special task force to examine the issues of establishing a TMDL on Tuttle Creek met on November 9, 1998; January 5, 1999 and February 15, 1999. Additionally, subcommittees met to discuss implementation, biological impacts, municipal impacts and data analysis.

Blue River Compact: The water quality committee of the Compact and the Compact Administration met on May 7 and May 23, 1999 to discuss this TMDL.

Milestone Evaluation: In 2004, evaluation will be made as to the degree of implementation which has occurred within the drainage and current condition of the Tuttle Creek Lake. Subsequent decisions will be made regarding implementation approach, follow up of additional implementation and implementation in the non-priority subwatersheds.

Consideration for 303d Delisting: Tuttle Creek Lake will be evaluated for delisting under Section 303d, based on the monitoring data over the period 2004-2008. Therefore, the decision for delisting will come about in the preparation of the 2008 303d 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 2002 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 2000-2004.

Approved January 26, 2000.