

MISSOURI RIVER BASIN TOTAL MAXIMUM DAILY LOAD

**Water Body: Brown County State Fishing Lake
Water Quality Impairment: Eutrophication
Bundled with pH, Dissolved Oxygen, and Aquatic Plants**

Subbasin: Tarkio-Wolf **County:** Brown

HUC 8: 10240005 **HUC 11 (HUC 14):** 060 (020)

Drainage Area: Approximately 2.7 square miles.

Conservation Pool: Area = 71.5 acres, Maximum Depth = 4.5 meters

Designated Uses: Secondary Contact Recreation; Expected Aquatic Life Support; Food Procurement

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

Impaired Use: All uses are impaired to a degree by 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)).

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. (KAR 28-16-28e(c)(7)(A)).

Dissolved Oxygen: 5 mg/L (KAR 28-16-28e(c)(2)(A))

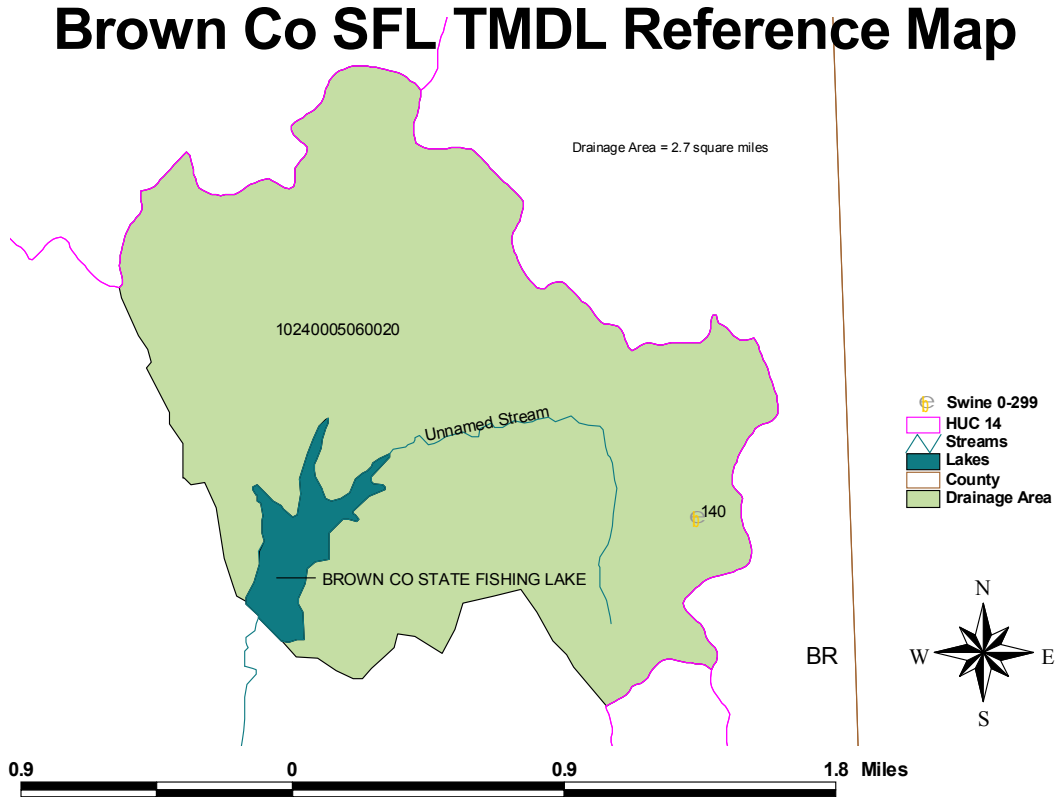
Artificial sources of pollution shall not cause the pH of any surface water outside of a zone of initial dilution to be below 6.5 and above 8.5 (KAR 28-16-28e(c)(2)(C))

2. CURRENT WATER QUALITY CONDITION AND DESIRED ENDPOINT

Level of Eutrophication: Hypereutrophic, Trophic State Index = 66.52

Monitoring Sites: Station 010301 in Brown County SFL (Figure 1).

Figure 1



Period of Record Used: Two surveys from 1989 to 1997.

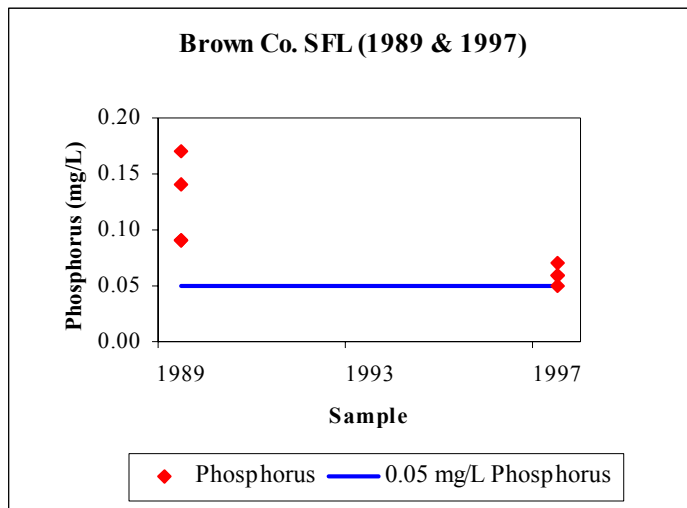
Current Condition:

The Brown County SFL has elevated chlorophyll a concentrations averaging 39.05 ppb. This relates to a Trophic State Index of 66.52, indicating hypereutrophic conditions. The chlorophyll a concentration was the highest in 1997 averaging 54.0 ppb. During the other survey, the concentration averaged 24.1 ppb.

The Trophic State Index is derived from the chlorophyll a concentration. Trophic state assessments of potential algal productivity were made based on chlorophyll a concentrations, nutrient levels and values of the Carlson Trophic State Index (TSI). Generally, some degree of eutrophic conditions is seen with chlorophyll a concentrations over 7 ug/l and hypereutrophy occurs at levels over 30 ug/L. The Carlson TSI, derives from the chlorophyll concentrations and scales the trophic state as follows:

- 1. Oligotrophic TSI < 40
- 2. Mesotrophic TSI: 40 - 49.99
- 3. Slightly Eutrophic TSI: 50 - 54.99
- 4. Fully Eutrophic TSI: 55 - 59.99
- 5. Very Eutrophic TSI: 60 - 63.99
- 6. Hypereutrophic TSI: ≥ 64

Figure 2



The total phosphorus concentrations are high, averaging 91.3 ppb (Figure 2). One hundred percent of the samples are 50 ppb or greater. The chlorophyll a to total phosphorus yield is high. The total nitrogen to total phosphorus ratio is 16.4, indicating that phosphorus is the limiting factor.

Ninety percent of Brown County SFL is covered with aquatic plants. Nuisance growth of aquatic plants (for recreation use) is defined as greater than 70% cover. According to the 1997 survey, the macrophyte community (submersed and

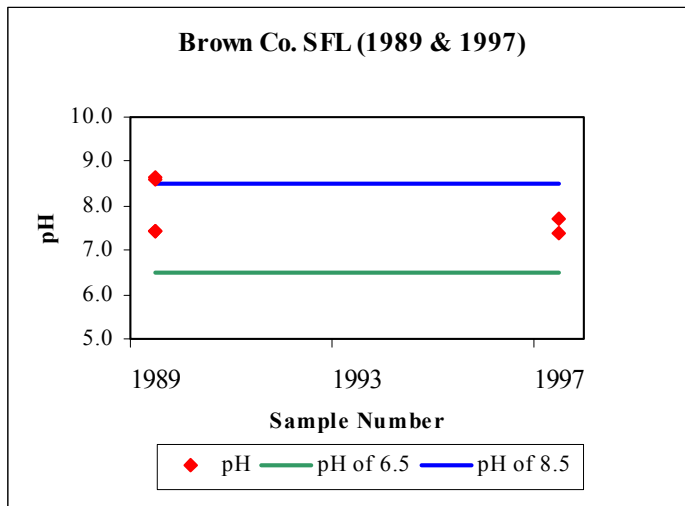
floating-leaved aquatic plants) consists of the following:

% Species Cover	Scientific Name	Common Name
30%	<i>Ceratophyllum demersum</i>	Coontail
10%	<i>Potamogeton pectinatus</i>	Pondweed
90%	<i>Potamogeton foliosus</i>	Pondweed

(Due to the overlap in species cover, the percent of community composition does not equal 100%).

Station Number	Date	Depth (feet)	Dissolved Oxygen
10301	7/10/89	0.00	6.00
10301	7/10/89	1.64	5.80
10301	7/10/89	3.28	5.60
10301	7/10/89	6.56	4.80
10301	7/10/89	9.84	4.40
10301	7/10/89	13.12	0.40
10301	7/10/89	16.40	0.40
10301	7/7/97	0.00	11.00
10301	7/7/97	1.64	11.50
10301	7/7/97	3.28	11.80
10301	7/7/97	6.56	6.50
10301	7/7/97	9.84	3.50
10301	7/7/97	13.12	1.30
10301	7/7/97	14.76	0.00

Figure 3



Decomposition of plant material has lowered the dissolved oxygen concentrations in the lake. The dissolved oxygen concentrations decreased with increased depth. (See above table). At the surface, the average concentration was 8.5 mg/L, a sufficient amount of dissolved oxygen for aquatic life support. However, near the bottom of the lake, the concentration approaches zero mg/L.

Thirty-three percent of the pH samples exceeded the criteria during the period of record (Figure 3). The average pH was 7.86.

Interim Endpoints of Water Quality (Implied Load Capacity) at Brown County SFL over 2005 - 2009:

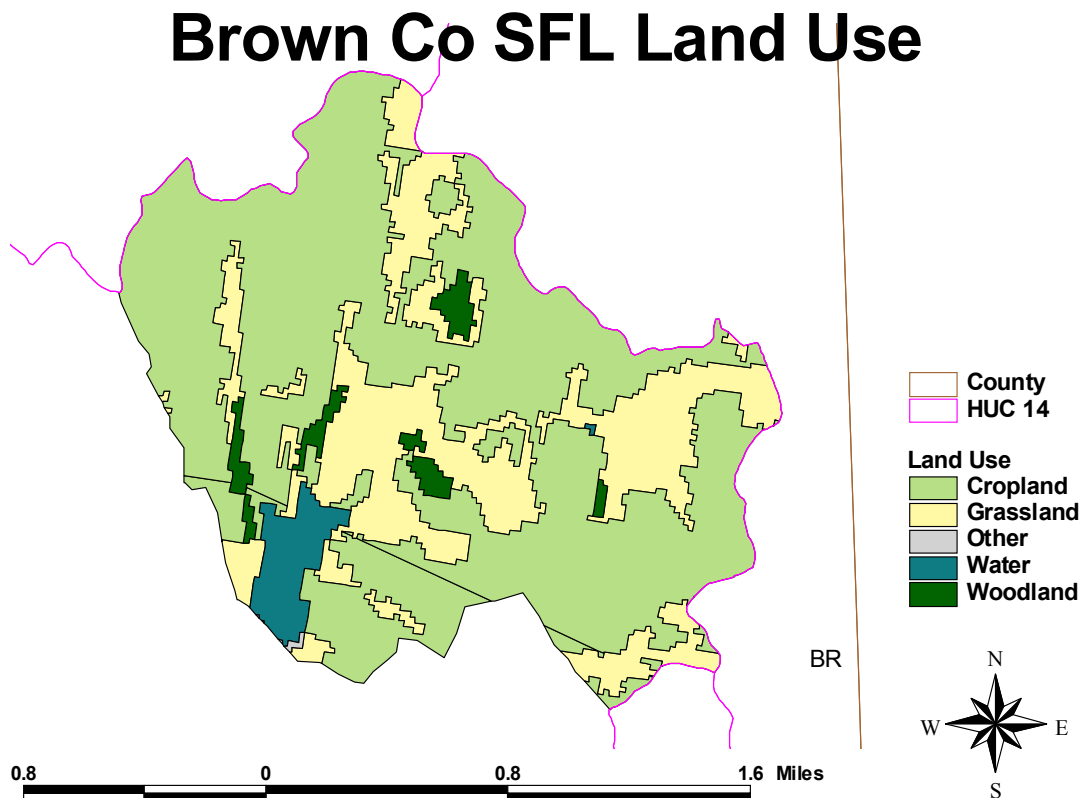
In order to improve the trophic condition of the lake from its current hypereutrophic status, the desired endpoint will be summer chlorophyll a concentrations at or below 20 ug/l, corresponding to a trophic state of eutrophic conditions by 2009. Achievement of this endpoint should also result in dissolved oxygen concentrations above 5 mg/L, pH readings between 6.5 and 8.5, and a 30 - 40% cover of aquatic plants. Refined endpoints will be developed in 2005 to reflect additional sampling and artificial source assessment and confirmation of impaired status of the lake.

3. SOURCE INVENTORY AND ASSESSMENT

Land Use: The watershed around Brown County SFL has a moderate potential for nonpoint source pollutants. An annual phosphorus load of 2,469.2 pounds per year is necessary to correspond to the concentrations seen in the lake.

The primary source of phosphorus within Brown County SFL is probably runoff from agricultural lands where phosphorus has been applied. Land use coverage analysis indicates that 67.5% of the watershed is cropland (Figure 4). In 1999, 24,197 tons of fertilizer were sold in Brown County. Since the watershed takes up approximately 0.48% of Brown County, 115 tons of fertilizer were bought and potentially used with the watershed.

Figure 4



Phosphorus from animal waste is a secondary contributing factor. Twenty-seven percent of land around the lake is grassland; the grazing density of livestock is low. There is one swine facility with 140 animal units in the watershed.

Background Levels: Three percent of land in the watershed is woodland; leaf litter may be contributing to the nutrient loading. The nutrient recycling, atmospheric deposition, and geological formations (i.e., soil and bedrock) may contribute to phosphorus loads.

4. ALLOCATION OF POLLUTANT REDUCTION RESPONSIBILITY

Phosphorus is the limiting nutrient in Brown County SFL and allocated under this TMDL. The general inventory of sources within the drainage does provide guidance as to areas of load reduction.

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 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.

Nonpoint Sources: Water quality violations are predominantly due to nonpoint source pollutants. Background levels may be attributed to nutrient recycling and leaf litter. The assessment suggests that cropland and animal waste contribute to the elevated total phosphorus concentrations in the lake. Generally a Load Allocation of 529.8 pounds of total phosphorus per year, leading to a 76.2% reduction, is necessary to reach the endpoint.

Defined Margin of Safety: The margin of safety provides some hedge against the uncertainty of variable annual total phosphorus loads and the chlorophyll a, dissolved oxygen, pH, and aquatic plant endpoints. Therefore, the margin of safety will be 58.9 pounds of total phosphorus per year taken from the load capacity subtracted to compensate for the lack of knowledge about the relationship between the allocated loadings and the resulting water quality.

State Water Plan Implementation Priority: Because Brown County SFL is a wildlife area, this TMDL will be a Medium Priority for implementation.

Unified Watershed Assessment Priority Ranking: This watershed lies within the Tarkio-Wolf (HUC 8: 10240005) with a priority ranking of 13 (High Priority for restoration).

Priority HUC 11s: The watershed is within HUC 11 (060).

5. IMPLEMENTATION

Desired Implementation Activities

There is potential that agricultural best management practices will improve the condition of Brown County SFL. Some of the recommended agricultural practices are as follows:

1. Implement soil sampling to recommend appropriate fertilizer applications on cropland.
2. Maintain conservation tillage and contour farming to minimize cropland erosion.
3. Maintain grass buffer strips along streams and install more buffer strips where needed.
4. Reduce activities within riparian areas.
5. Implement nutrient management plans to manage manure application to land.

Implementation Programs Guidance

Nonpoint 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 watersheds and stream segments within those subbasins identified by this TMDL.

Local Environmental Protection Program - KDHE

- a. Inspect on-site waste systems within one mile of main tributary streams.

Fisheries Management - KDWP

- a. Assist evaluation in-lake or near-lake potential sources of nutrients to lake.
- b. Advise city on application lake management techniques which may reduce nutrient loading and cycling in lake.

Water Resource Cost Share & Nonpoint 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. Develop improved grazing management plans
- d. Implement manure management plans
- e. Install replacement on-site waste systems
- f. 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.

Time Frame for Implementation: Pollution reduction practices should be installed within the lake drainage after the year 2006. Evaluation of nutrient sources to lake and identification of potential management techniques should occur prior to 2006.

Targeted Participants: Primary participants for implementation will be agricultural producers within the drainage of the lake.

Milestone for 2006: The year 2006 marks the midpoint of the ten-year implementation window for the watershed. At that point in time, sampled data from Brown County SFL should indicate probable sources of nutrients and plans in place to initiate implementation.

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

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

6. MONITORING

Further sampling and evaluation should occur once before 2005 and once between 2005 and 2009. The Kansas Department of Health and Environment is planning to survey the lake in 2001.

7. FEEDBACK

Public Meeting: A public meeting to discuss TMDLs in the Missouri Basin was held February 28, 2001 in Atchison. 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 Missouri Basin.

Public Hearing: A Public Hearing on the TMDLs of the Missouri Basin was held in Hiawatha on May 29, 2001.

Basin Advisory Committee: The Missouri Basin Advisory Committee met to discuss the TMDLs in the basin on October 4, 2000, February 28 and May 29, 2001.

Milestone Evaluation: In 2006, evaluation will be made as to the degree of implementation which has occurred within the watershed and current condition of the Brown County SFL. Subsequent decisions will be made regarding the implementation approach and follow up of additional implementation in the watershed.

Consideration for 303d Delisting: The lake will be evaluated for delisting under Section 303(d), based on the monitoring data over the period 2005-2009. Therefore, the decision for delisting will come about in the preparation of the 2010 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 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 2002-2006.

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