

SMOKY HILL/SALINE RIVER BASIN TOTAL MAXIMUM DAILY LOAD

**Water Body: Big Creek Oxbow
Water Quality Impairment: Eutrophication**

Subbasin: Big

County: Ellis

HUC 8: 10260007

HUC 11 (HUC 14): 030 (030)

Ecoregion: Central Great Plains, Rolling Plains and Breaks (27b)

Drainage Area: Approximately 0.4 square mile

Conservation Pool: Area = 2.5 acres
Watershed Area: Lake Surface Area = 102:1
Maximum Depth = 2.0 meters (6.6 feet)
Mean Depth = 0.8 meters (2.6 feet)

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

Authority: City of Hays

2002 303(d) Listing: Smoky Hill/Saline River Basin Lakes

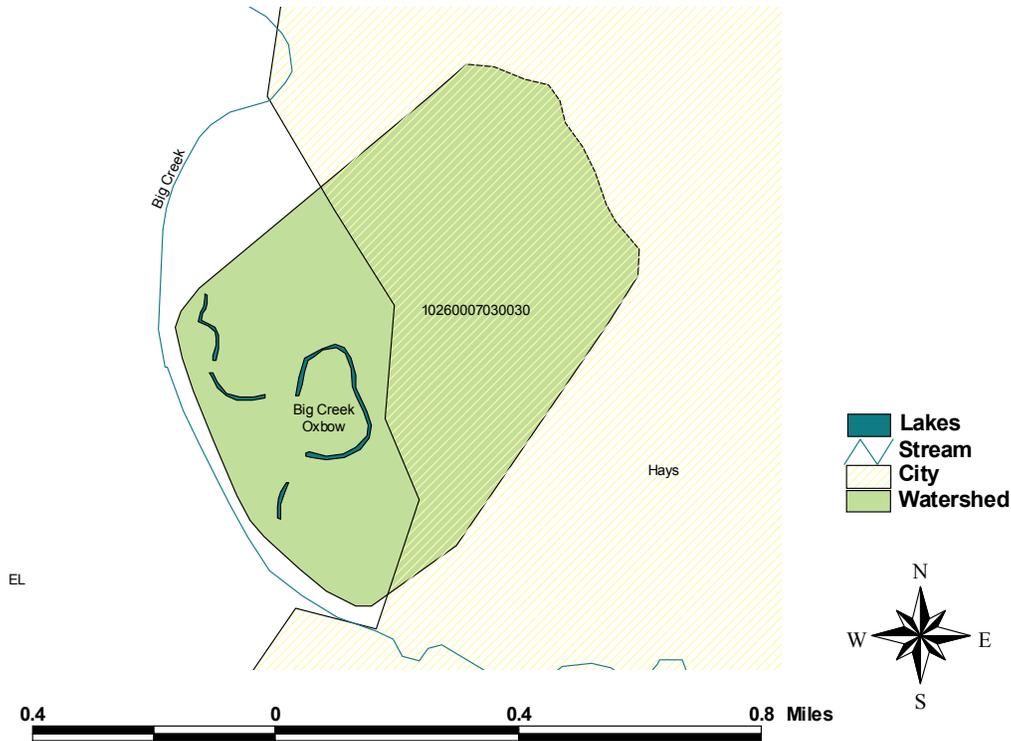
Impaired Use: All uses are impaired to a degree by eutrophication

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)).

Figure 1

Big Creek Oxbow TMDL Reference Map



2. CURRENT WATER QUALITY CONDITION AND DESIRED ENDPOINT

Level of Eutrophication: Very Eutrophic, Trophic State Index = 62.66

Monitoring Sites: Station 070301 in Big Creek Oxbow (Figure 1).

Period of Record Used: One survey during 1989

Current Condition: In 1989, Big Creek Oxbow had chlorophyll a concentrations averaging 26.4 $\mu\text{g/L}$ and ranging from 24.1 $\mu\text{g/L}$ to 28.6 $\mu\text{g/L}$ (Appendix A). The Secchi Disc Depth was 0.3 meter. Nitrogen and phosphorus concentrations were not measured.

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 $\mu\text{g/l}$ and hypereutrophy

occurs at levels over 30 $\mu\text{g/l}$. 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

Interim Endpoints of Water Quality (Implied Load Capacity) at Big Creek Oxbow over 2008 - 2012:

In order to improve the trophic condition of the lake from its current Very Eutrophic status, the desired endpoint will be to maintain summer chlorophyll a concentrations below 12 $\mu\text{g/L}$.

Current Condition and Reductions for Big Creek Oxbow

Parameter	Current Condition	TMDL	Percent Reduction
Total Phosphorus Load (lb/year)	33.3	10.6	68 %
Total Phosphorus Concentration ($\mu\text{g/L}$)*	94.1	42.9	54 %
Chlorophyll a ($\mu\text{g/L}$)	26.4	< 12	55 %

* Predicted Concentrations from CNET model

3. SOURCE INVENTORY AND ASSESSMENT

Land Use: The watershed around Big Creek Oxbow has a moderate potential for nonpoint source pollutants. An annual phosphorus load of 33.3 pounds per year is necessary to correspond to the concentrations seen in the lake.

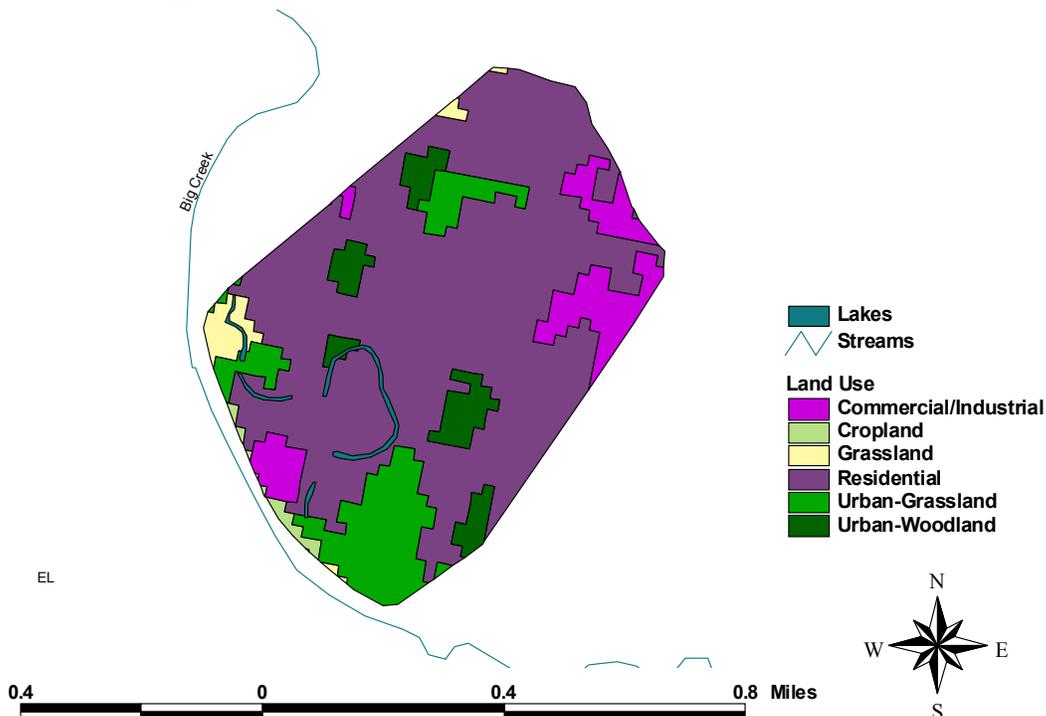
Part of Hays is located within the watershed. The City of Hays anticipates a 13.4% population increase by the year 2020. The average population density in the watershed is 281.2 people per square mile. The watershed is urban consisting of 6% urban woodland, 8% commercial properties, 12% urban grassland, and 71% residential properties. Fertilizer applications to lawns and animal waste are primary contributors to the nutrient load.

Contributing Runoff: The watershed’s average soil permeability is 1.2 inches/hour according to NRCS STATSGO database. About 95.0% of the watershed produces runoff even under relatively low (1.5"/hr) potential runoff conditions. Runoff is chiefly generated as infiltration excess with rainfall intensities greater than soil permeabilities. As the watersheds’ soil profiles become saturated, excess overland flow is produced. Generally, storms producing less than 0.5"/hr of rain will generate runoff from 6.2% of this watershed, chiefly along the stream channels.

Background Levels: The atmospheric phosphorus and geological formations (i.e., soil and bedrock) may contribute to phosphorus loads. Nutrients from wildlife waste are another contributing factor. One percent of land in the watershed is woodland; leaf litter may be contributing to the nutrient loading.

Figure 2

Big Creek Oxbow Land Use



4. ALLOCATION OF POLLUTANT REDUCTION RESPONSIBILITY

Total Phosphorus is allocated under this TMDL, because a phosphorus reduction will have a large effect on the managing the algal community. The Load Capacity is 10.6 pounds per year of phosphorus and was calculated using the CNET model. More detailed assessment of sources and confirmation of the trophic state of the lake must be completed before detailed allocations can be made. The general inventory of sources within the drainage does provide some 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

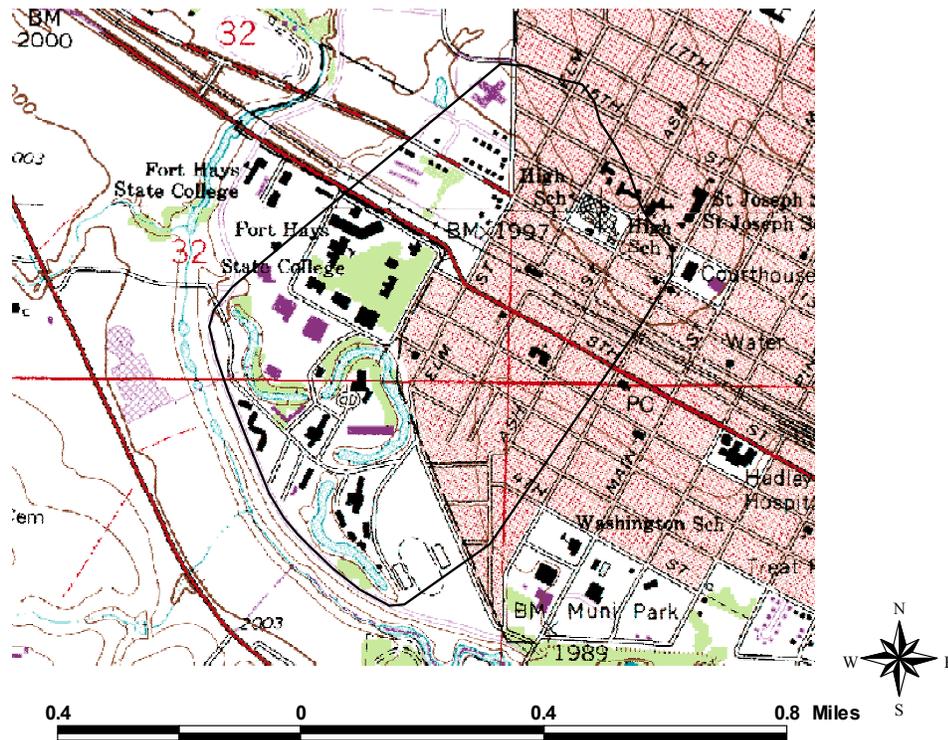
revised by adjusting current load allocations to account for the presence and impact of these new point source dischargers.

Nonpoint Sources: Water quality violations are partially due to nonpoint source pollutants. Background levels may be attributed to atmospheric deposition and geological sources. The assessment suggests that cropland and animal waste contribute to the elevated total phosphorus concentrations in the lake. Generally a Load Allocation of 9.6 pounds of total phosphorus per year, leading to a 68% 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 load and the chlorophyll a endpoint. Therefore, the margin of safety will be 1.1 pounds per year of total phosphorus, 10% of the load capacity, 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.

Figure 3

Big Creek Oxbow



State Water Plan Implementation Priority: Because of the lack of recent monitoring data, this TMDL will be a Low Priority for implementation.

Unified Watershed Assessment Priority Ranking: Big Creek Oxbow lies within the Big (HUC 8: 10260007) with a priority ranking of 56 (Low Priority for restoration).

Priority HUC 11s: The HUC 11 (030) encompasses the Big Creek Oxbow watershed, and thus this subwatershed should take priority.

5. IMPLEMENTATION

Desired Implementation Activities

The potential exists for meeting full use support in Big Creek Oxbow. The small size of the watershed may limit the amount and type of best management practices that can be utilized. Given the low total loads very little absolute reduction in nutrients should provide good benefits. Some of the recommended practices are as follows:

1. Implement animal waste management plans to urban grassland and residential areas.
2. Implement soil sampling to recommend appropriate fertilizer applications to lawns and planting beds.
3. Some in-lake management might be able to reduce nutrient cycling within the lake.

Implementation Programs Guidance

Nonpoint Source Pollution Technical Assistance - KDHE

- a. Provide technical assistance on nutrient management in vicinity of the lakes.
- b. Develop a Watershed Restoration and Protection Strategy for HUC 10260007.

Extension Outreach and Technical Assistance - Kansas State University

- a. Encourage annual soil testing to determine capacity of soil to hold phosphorus.

Time Frame for Implementation: Continued monitoring over the years from 2003 to 2008. After 2008, the monitoring results will be evaluated, and the allocations will be adjusted if needed.

Targeted Participants: Primary participants for implementation will be residents who are within the drainage of the lake. A detailed assessment of sources will be conducted by KDHE over 2003-2008.

Milestone for 2008: The year 2008 marks the midpoint of the ten-year implementation window for the watershed. At that point in time, sampled data from Big Creek Oxbow will be reexamined to confirm the impaired status of the lake. Should the case of impairment remain, source assessment, allocation, and implementation activities will ensue.

Delivery Agents: The primary delivery agents for program participation will be the City of Hays. 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 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 Low Priority consideration and should not receive funding.

Effectiveness: The key to success will be utilization of nutrient management within the watershed cited in this TMDL.

6. MONITORING

Additional data, to further determine source loading and mean summer lake trophic condition, would be of value prior to 2008. Further sampling and evaluation should occur twice before 2008.

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 degree of implementation which has occurred within the watershed and current condition of Big Creek Oxbow. Subsequent decisions will be made regarding the implementation approach and follow up of additional implementation in the watershed.

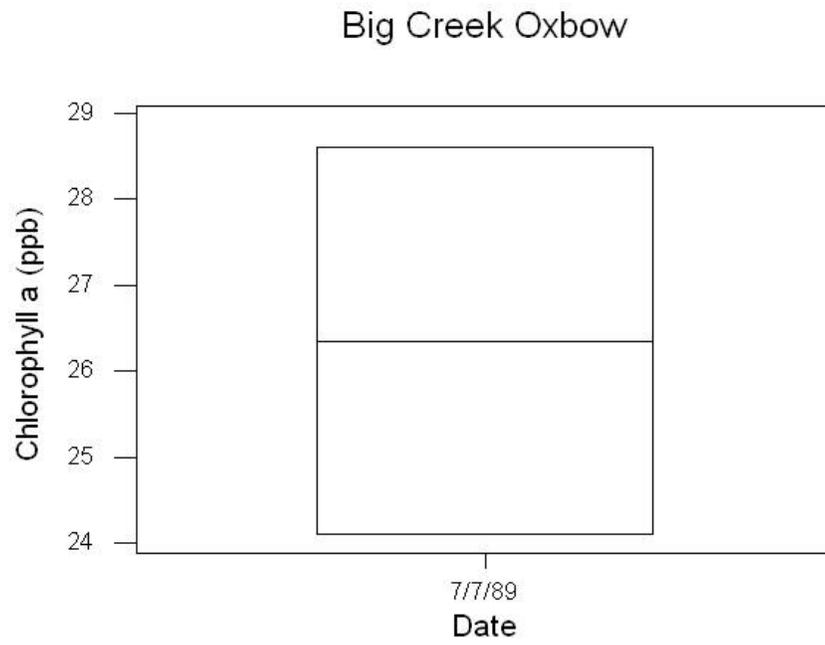
Consideration for 303(d) Delisting: The lake will be evaluated for delisting under Section 303(d), based on the monitoring data over the period 2008-2012. Therefore, the decision for delisting will come about in the preparation of the 2012 303(d) list. Should modifications be made to the applicable water 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.

Bibliography

Lisceck, Bonnie C. Methodology Used in Kansas Lake TMDLs [web page] Jul. 2001; <http://www.kdhe.state.ks.us/tmdl/eutro.htm> [Accessed 30 September 2002].

Appendix A - Boxplot



Appendix B - Input for CNET Model

Parameter	Value Input into CNET Model
Drainage Area (km²)	1.04
Precipitation (m/yr)	0.56
Evaporation (m/yr)	1.59
Unit Runoff (m/yr)	0.03
Surface Area (km²)	0.01
Mean Depth (m)	0.8
Depth of Mixed Layer (m)	0.6
Depth of Hypolimnion (m)	0.2
Observed Phosphorus (ppb)	N/A
Observed Chlorophyll-a (ppb)	26.4
Observed Secchi Disc Depth (m)	0.3

Output from CNET Model

Parameter	Output from CNET Model
Load Capacity (LC)*	10.6 lb/yr
Waste Load Allocation (WLA)	0 lb/yr
Load Allocation (LA)	9.6 lb/yr
Margin of Safety (MOS)	1.1 lb/yr

*LC = WLA + LA + MOS

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