LOWER ARKANSAS RIVER BASIN TOTAL MAXIMUM DAILY LOAD

Water Body: Cheyenne Bottoms WA
Water Quality Impairment: Eutrophication Bundled with Dissolved Oxygen

1. INTRODUCTION AND PROBLEM IDENTIFICATION

Subbasin: Cow **Counties:** Barton and Rush

HUC 8: 11030011 **HUC 11** (HUC 14)**: 010** (010, 020, 030, 040)

Drainage Area: Approximately 231.3 square miles. **(Figure 1)**

Conservation Pool: Area = 4,128 acres, Maximum Depth = approximately 1 meter

Designated Uses: Secondary Contact Recreation, Special Aquatic Life Support, and 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))

Cheyenne Bottoms TMDL Reference Map

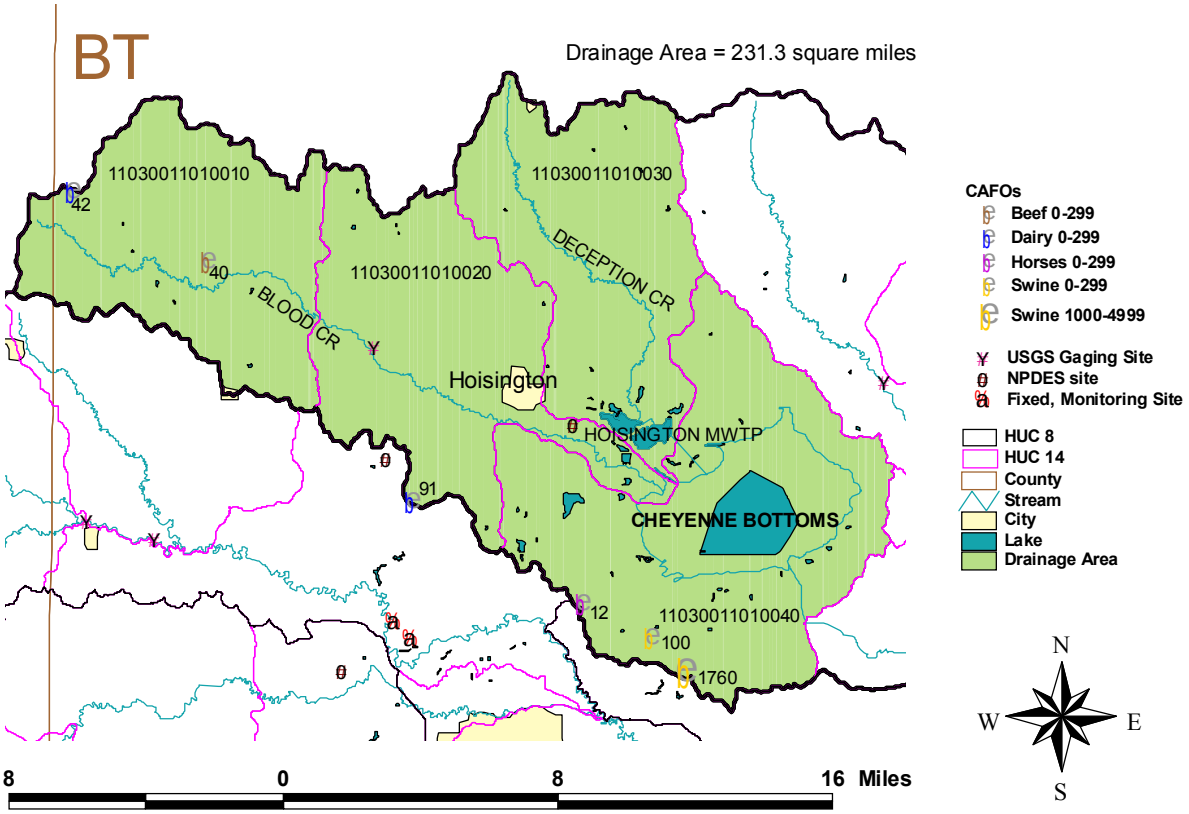

Figure 1

2. CURRENT WATER QUALITY CONDITION AND DESIRED ENDPOINT

Level of Eutrophication: Hypereutrophic, Trophic State Index = 73.02

Monitoring Sites: Station 050401 in Cheyenne Bottoms.

Period of Record Used: Six surveys during 1988 - 1999

Current Condition: Cheyenne Bottoms has an elevated chlorophyll a concentration averaging 75.8 ppb. This relates to a Trophic State Index of 73.02, indicating hypereutrophic conditions. The chlorophyll a concentration has fluctuated over time. During the 1988 through 1994 surveys, the average concentration was 57.4 ppb. The highest concentrations (averaging 123.4

ppb) were seen in 1997 and 1998. In the 1999 survey, the average chlorophyll a concentration dropped to 35.8 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 12 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

The total nitrogen to total phosphorus ratio is equal to 4.5, indicating that nitrogen is the primary limiting factor. The average concentration of ammonia is 56.5 ppb; the average concentration of nitrate is 97.5 ppb. The total phosphorus concentrations are high, averaging 556 ppb. All of the phosphorus samples are over 100 ppb. The chlorophyll a to total phosphorus yield is low. Light is not indicated as a limiting factor, despite relatively high turbidity.

Cheyenne Bottoms	Date	Depth (ft)	Dissolved Oxygen (mg/L)
050401	18-Jun-91	0	11.000
050401	28-Jun-94	0	0.500
050401	11-Aug-97	0	5.500
050401	11-Aug-97	0.327999	5.500
050401	24-Aug-98	0	4.500
050401	24-Aug-98	0.327999	4.500
050401	02-Aug-99	0	4.000

The availability of dissolved oxygen has declined over time. In 1991 and 1997, the concentration of dissolved oxygen was sufficient to support aquatic life. In 1994, 1998, and 1999, the dissolved oxygen concentrations fell below the water quality standard (5 mg/L). (See above table). Low dissolved oxygen problems may be endemic to such a stagnant wetland environment. The dissolved oxygen environment is particularly of concern since it tends to drive outbreaks of avian botulism, which have occurred in the past at Cheyenne Bottoms.

Interim Endpoints of Water Quality (Implied Load Capacity) at Cheyenne Bottoms over 2005 - 2010:

In order to improve the trophic condition of the wetland 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 levels above 5 mg/L. Refined endpoints will be developed

in 2005 to reflect additional sampling and artificial source assessment and confirmation of impaired status of wetland.

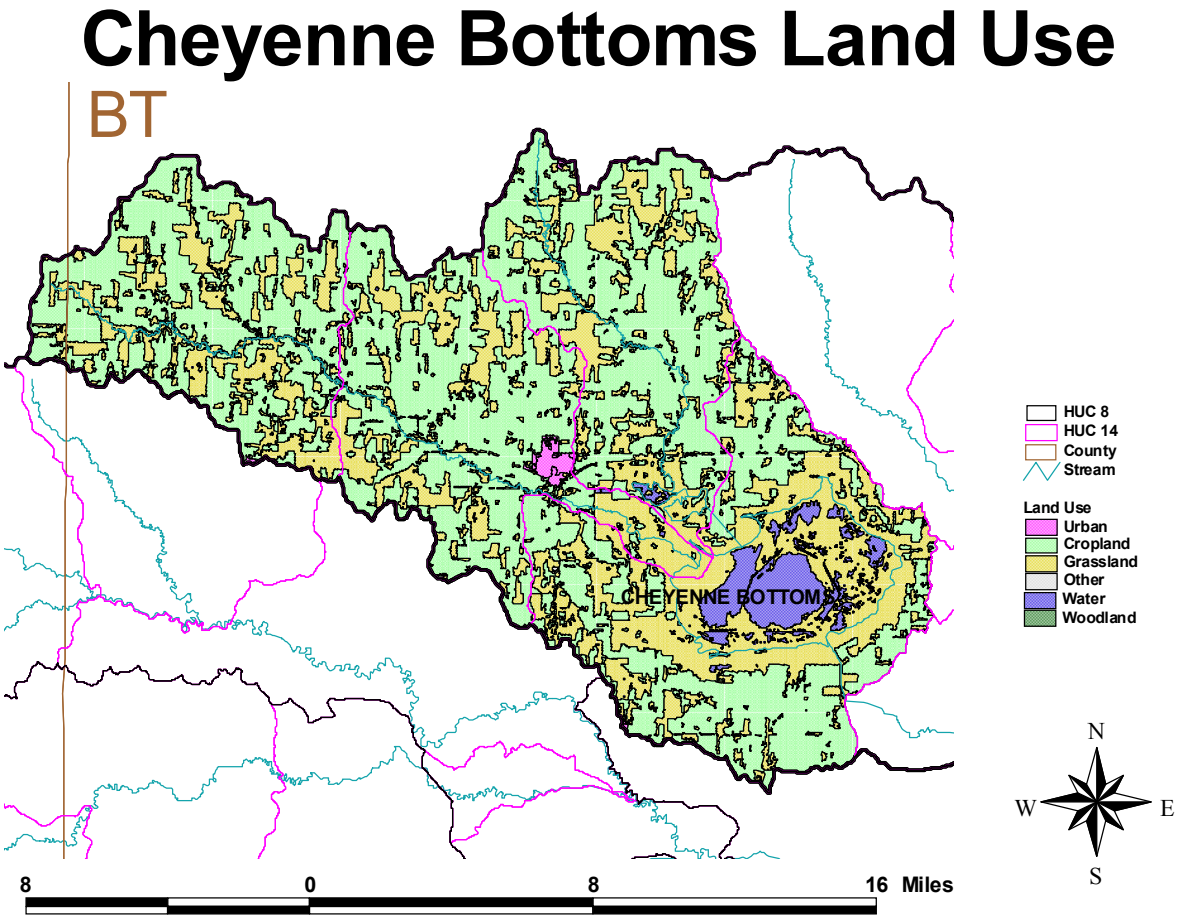

Figure 2

3. SOURCE INVENTORY AND ASSESSMENT

NPDES: One NPDES permitted facility, Hoisington MWTP, is located within the watershed. This facility has a three-cell, lagoon system with a 120-day detention and contributes an estimated 2% of the total annual phosphorus load.

Population projections indicate slow growth for Hoisington (9.6%) to the year 2020. According to projections of future water use and resulting wastewater, Hoisington MWTP looks to have sufficient treatment capacity available. Given the design flow of this lagoon system, this municipal point source seems to have minimal impact on the watershed.

Livestock Waste Management Systems: Six operations are permitted within the watershed, accounting for a potential of up to 2,045 animal units. There are one cattle, two dairy, one horse, and two swine operations in the watershed. 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 for the 25 year, 24 hour rainfall/runoff event, which would be indicative of flow durations well under 10 percent of the time. The actual number of animal units on site is variable, but typically less than permitted numbers.

Land Use: Cheyenne Bottoms has a high potential for nonpoint source pollutants. An annual phosphorus load of 277,780 pounds per year is necessary to correspond to the concentrations seen in the wetland. The annual nitrogen load is 917,114 lb/yr. **(Figure 2)**

A primary source of phosphorus within Cheyenne Bottoms is probably runoff from agricultural lands where phosphorus has been applied. Land use coverage analysis indicates that 59.3% of the watershed is cropland; the majority of that cropland lies within Barton County. In 1998, 34,458 tons of fertilizer were sold in Barton County. Assuming that the drainage area of Cheyenne Bottoms covers 26 percent of the county, then 8,948 tons of fertilizer were bought and potentially used with the watershed.

Animal waste adds to the phosphorus load going into Cheyenne Bottoms. Thirty-six percent of land around the wetland is grassland. The summer and winter grazing densities of livestock are high. In 1997 - 1998, inventories of milk cows, cattle, and swine were as follows:

County	# of Milk Cows	# of Cattle	# of Swine
Barton	725	127,700	6,700
Cheyenne Bottoms Watershed	189	33,202	1,742

Contributing Runoff: The watershed's average soil permeability is 1.8 inches/hour according to NRCS STATSGO data base. About 79% of the watershed produces runoff even under relative low (1.5''/hr) potential runoff conditions. Under very low (<1"/hr) potential conditions, this potential contributing area is reduced (15%). 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 only 5% of this watershed, chiefly along the stream channels.

Background Levels: Waterfowl, shorebirds, sandhill cranes, bald eagles, whooping cranes, and Mississippi kites travel through the Cheyenne Bottoms during their migration. Their waste, as well as waste from numerous other types of wildlife, increases the levels of phosphorus in the wetland.

Six hundred fifty acres of woodland are located around Cheyenne Bottoms; leaf litter may be adding to the nutrient load. There is the potential for wind and carp to resuspend bottom sediments in this wetland. Nutrient recycling from the sediments in the wetland is likely contributing available phosphorus to the wetland for algal uptake. Geological formations contain small amounts of phosphorus (up to 0.5% of total weight), and may contribute to phosphorus loads.

4. ALLOCATION OF POLLUTANT REDUCTION RESPONSIBILITY

More detailed assessment of sources and confirmation of the trophic state of the wetland 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: This impairment is partially associated with a municipal waste treatment plant. Ongoing inspections and monitoring of this NPDES site will be made to ascertain the contributions that have been made by this source. The Wasteload Allocation should be at 833 pounds per year, a decrease of 85%, which should result in a decrease in available phosphorus. The nitrogen load should be reduced by 7.6%, which would result in a nitrogen load of 16,948 pounds per year.

Nonpoint Sources: The assessment suggests that cropland and animal waste contribute to the hypereutrophic state of the wetland. Water quality violations are partially due to migratory birds. Generally a Load Allocation of 36,667 pounds per year, leading to an 85% reduction in available phosphorus is necessary to reach the endpoint. The Load Allocation for nitrogen is 745,723 pounds per year, resulting in a 7.6% reduction.

Defined Margin of Safety: The margin of safety provides some hedge against the uncertainty of variable annual total phosphorus and nitrogen loads and the chlorophyll a endpoint. Therefore, the margin of safety will be 4,167 pounds per year of total phosphorus and 84,741 pounds per year of nitrogen taken from the load capacity to ensure that adequate load reduction occurs to meet the endpoint.

State Water Plan Implementation Priority: Because Cheyenne Bottoms is an outstanding national resource water, this TMDL will be a High Priority for implementation.

Unified Watershed Assessment Priority Ranking: This watershed lies within the Cow subbasin (HUC 8: 11030011) with a priority ranking of 27 (Medium Priority for restoration).

Priority HUC 11s: The entire watershed is within HUC 11 (010).

5. IMPLEMENTATION

Desired Implementation Activities

It is not likely that this water body can be brought to such a low trophic state that full support of all beneficial uses will result. However, a significant reduction in nonpoint and point source loads can be achieved. There is good potential that the percent of the summer with impaired conditions could be reduced to roughly half. 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. Install grass buffer strips along streams.
4. Reduce activities within riparian areas.
5. Implement nutrient management plans to manage manure application to land.

Additionally, continued water level management at the Bottoms, which control macrophyte production, can lead to decreased nutrient cycling.

Implementation Programs Guidance

Public Lands - KDWP

a. Continue water level management in the pools at the Bottoms to control cattail production and cycling of water through the wetland complex.

NPDES - KDHE

a. Ensure proper monitoring, permitting, and operations of municipal wastewater systems to limit nutrient and BOD discharges.

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.

Water Resource Cost Share Program - SCC

a. Apply conservation farming practices, including terraces and waterways, sediment control basins, and constructed wetlands.

Nonpoint Source Pollution Control Program - SCC

a. Provide sediment control practices to minimize erosion and sediment and nutrient transport.

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 wetland drainage after evaluation of nutrient sources to the wetland and identification of potential management techniques and should occur prior to 2005.

Targeted Participants: Primary participants for implementation will be state fisheries and public lands managers for Cheyenne Bottoms and agricultural producers within the drainage of the wetland. Source assessment and control implementation would occur over 2000-2005. Initial work should include local assessments by conservation district personnel and county extension agents to locate within the wetland drainage:

1. Total rowcrop acreage
2. Cultivation alongside lake
3. Drainage alongside or through animal feeding lots
4. Livestock use of riparian areas
5. Fields with manure applications

Delivery Agents: The primary delivery agents for program participation will be the Kansas Department of Wildlife and Parks, 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.

Milestone for 2005: The year 2005 marks the midpoint of the ten-year implementation window for the watershed. At that point in time, sources should have been assessed and implementation measures should be underway to targeted sources.

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 Upper Arkansas 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.

7. K.S.A. 32-807 authorizes the Kansas Department of Wildlife and Parks to manage lake resources.

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 High 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

KDHE will collect nutrient, pH, dissolved oxygen, and chlorophyll a samples from Cheyenne Bottoms in 2000. Additional data, to establish nutrient ratios, source loading and further determine mean summer lake trophic condition, would be of value prior to 2005. Further sampling and evaluation should occur once before 2005 and twice between 2005 and 2010.

7. FEEDBACK

Public Meetings: Public meetings to discuss TMDLs in the Lower Arkansas Basin were held March 9, 2000 and April 26-27, 2000 in Wichita, Hutchinson, Arkansas City and Medicine Lodge. 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 Lower Arkansas Basin.

Public Hearing: A Public Hearing on the TMDLs of the Lower Arkansas Basin was held in Wichita on June 1, 2000.

Basin Advisory Committee: The Lower Arkansas Basin Advisory Committee met to discuss the TMDLs in the basin on September 27, 1999, November 8, 1999, January 13, 2000, March 9, 2000 and June 1, 2000.

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

Ground Water Management District No. 5: August 10, September 9, 1999 and May 11, 2000.
Agriculture: January 12, February 2 and 29, April 6, 2000
Environmental: March 9, 2000
Conservation Districts: November 22, 1999

Milestone Evaluation: In 2005, evaluation will be made as to the degree of implementation which has occurred within the watershed and current condition of Cheyenne Bottoms. Subsequent decisions will be made regarding the implementation approach and follow up of additional implementation in the watershed.

Consideration for 303d Delisting: Cheyenne Bottoms will be evaluated for delisting under Section 303d, based on the monitoring data over the period 2005-2009. Therefore, the decision for delisting will come about in the preparation of the 2010 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 2001-2005.

Approved September 11, 2000.