

# KANSAS-LOWER REPUBLICAN BASIN TOTAL MAXIMUM DAILY LOAD

## Waterbody: Mary's Lake Water Quality Impairment: Eutrophication

### 1. INTRODUCTION AND PROBLEM IDENTIFICATION

**Subbasin:** Lower Kansas

**County:** Douglas

**HUC 8:** 10270104

**HUC 11:** 020

**Drainage Area:** Approximately 0.26 square miles.

**Conservation Pool:** Elevation 880; Volume 49.2 acre-feet

**Designated Uses:** Primary Contact Recreation; Expected Aquatic Life Support

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

**Impaired Use:** Both 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)).

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)).

pH less than 6.5 and greater than 8.5 (KAR 28-16-28e(c)(2)(C))

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

### 2. CURRENT WATER QUALITY CONDITION AND DESIRED ENDPOINT

**Level of Eutrophication:** Slightly Eutrophic - Trophic State Index = 53.5

**Monitoring Sites:** Station 061401 in Mary's Lake.

**Period of Record Used:** Four previous surveys in 1994. Precipitation was close enough to long-term average during 1994 that the surveys are felt to be representative of mean summer condition.

**Current Condition:** The lake has elevated chlorophyll a concentrations during summer months, average concentration is 14.8 ppb, indicating slightly eutrophic conditions. Total phosphorus data are varied, but tend to be elevated in the lake, averaging 60.4 ppb. Phosphorus is the likely primary limiting factor (Total N/Total P = 16.8, >12 indicates phosphorus is limiting). Inorganic turbidity is moderate, but light is abundant within the water column. Chlorophyll-to-phosphorus yield is moderate.

The Trophic State Index of 53.5 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 are seen with chlorophyll a concentrations over 12 ug/l and hypereutrophy occurs at levels over 20 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       |

In Mary's Lake, the dissolved oxygen concentration decreases with increased depth. (See attached table). At the surface, the average concentration was 8.2 mg/L, a sufficient amount of dissolved oxygen for aquatic life support. However, near the bottom of the lake, the average concentration dropped to 0.9 mg/L. The low dissolved oxygen concentrations are due to the accumulation of organic material in the lower depths resulting from lake productivity reflective of its slightly eutrophic state.

During the summer of 1994, the pH was high thirty-seven percent of the time. The average pH was 8.11 ranging from 6.76 to 9.12. The high summer pH occurrences are related to periods of large phytoplankton productivity.

**Interim Endpoints of Water Quality (Implied Load Quantity) at Mary's Lake over 2004 - 2008:**

In order to improve the trophic condition of the lake from its current slightly eutrophic status, the desired endpoint will be summer chlorophyll a concentrations at or below 12 ug/l, corresponding to a trophic state of slightly eutrophic conditions by 2008. Achievement of this endpoint should result in higher concentrations of dissolved oxygen in the water column of the lake as well as pH values between 6.5 and 8.5. Refined endpoints will be developed in 2004 to reflect additional sampling and artificial source assessment and confirmation of impaired status of lake.

### 3. SOURCE INVENTORY AND ASSESSMENT

**Land Use:** The primary source of phosphorus within the Mary's Lake watershed is probably runoff from urban lands where phosphorus has been applied. Land use coverage analysis indicates that 52% of the watershed is urban and 48% is wooded. Population projections to the year 2040 indicate significant growth. With the rising populations, the acreage devoted to suburban homes and businesses will increase. Fertilizer applications will increase in response to this change. (9,631 tons of fertilizer were bought in Douglas County in 1998.) An annual phosphorus load of 88 pounds per year is necessary to correspond to the concentrations seen in the lake.

**Contributing Runoff:** Soils in the watershed appear to be low in permeability (average permeability of 0.6"/hr). Under high runoff conditions, 92% of the watershed contributes runoff to the lake, as conditions dry to more moderate conditions, 91% of the watershed continues to experience runoff. Under dry conditions, 71% of the watershed will contribute runoff.

**On-site Waste Systems Sites:** There are a number of on-site wastewater systems in place in Douglas county. Inspection and complaint numbers for on-site systems are over 200 per year in 1998 and 1999. Proliferation of on-site systems and the concomitant potential for loading of nutrients is highly probable in the watershed.

**Background Levels:** Nutrient recycling from the sediments in the lake is likely contributing available phosphorus to the lake 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 POLLUTION REDUCTION RESPONSIBILITY

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:** Since this impairment is primarily associated with urban non-point source pollution, there will be no Wasteload Allocation assigned to point sources for nutrients under this TMDL.

**Non-Point Sources:** Water quality violations are predominantly due to non-point source pollution. Background levels may be attributed to geological sources. The assessment suggests that urban areas throughout the watershed contribute to the trophic state of the lake. Given the runoff characteristics of the watershed, overland runoff can easily carry phosphorus into the streams. Generally a Load Allocation of 44 pounds per year, leading to a 45% reduction in available phosphorus 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 endpoint. Therefore, the margin of safety will be 5 pounds 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:** This TMDL will be a Medium Priority for implementation because of the multiple impairments caused by eutrophic conditions in Mary's Lake, a small lake under state jurisdiction and a more detailed source assessments and additional in-lake monitoring of nutrient and algal content is needed.

**Unified Watershed Assessment Priority Ranking:** This watershed lies within the Lower Kansas Subbasin (HUC 8: 10270104) with a priority ranking of 1 (Highest Priority for restoration work).

**Priority HUC 11s:** The entire watershed is with HUC 11 (020).

## **5. IMPLEMENTATION**

### **Desired Implementation Activities**

Implementation of BMPs within this small watershed have the potential to achieve full use support. Dredging to deepen the lake might improve oxygen depletion rate somewhat, but is projected to have rather small impacts on water quality. Dredging should not be the primary goal of lake management at Mary's Lake. In actuality, the City of Lawrence has already planned for some BMP activity within the portion of the watershed they own. A land swap kept some area on the east side of the lake from being developed, while a sediment pond was being planned for the upstream end of their property. The City also has voiced plans to use the park for local environmental education.

### **Implementation Programs Guidance**

#### **Non-Point Source Pollution Technical Assistance - KDHE**

- a. Support Section 319 demonstration projects for nutrient management.

#### **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. Repair failing septic systems in proximity to streams

#### **Riparian Protection Program - SCC**

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

**Buffer Initiative Program - SCC**

- a. Leverage Conservation Reserve Enhancement Program to hold riparian land out of production.

**Extension Outreach and Technical Assistance - Kansas State University**

- a. 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 2004.

**Targeted Participants:** Primary participants for implementation will be the City of Lawrence and homeowners within the drainage.

**Milestone for 2004:** The year 2004 marks the mid-point of the ten year implementation window for the watershed. At that point in time, adequate source assessment should be complete which allows an allocation of resources to responsible activities contributing to the eutrophy problem. Additionally, sampled data from Mary's Lake should indicate evidence of reduced phosphorus levels in the conservation pool elevations relative to the conditions seen in 1994.

**Delivery Agents:** Depending upon confirmation of impairment and assessment of probable sources, the primary delivery agents for program participation will be Lawrence city officials.

**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.

**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 Medium Priority consideration and should not receive funding until after 2004.

**Effectiveness:** Effectiveness of corrective actions will depend upon the sources which contribute to the impairment at the lake.

## 6. MONITORING

KDHE will collect nutrient and chlorophyll a samples from Mary's Lake in 2001 and 2003. Additional data, to establish nutrient ratios, source loading and further determine mean summer lake trophic condition, would be of value prior to 2004. Further sampling and evaluation should occur in 2005 and 2007..

## 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

**Milestone Evaluation:** In 2004, evaluation will be made as to the degree of implementation which has occurred within the drainage and current condition of Mary's Lake. Subsequent decisions will be made regarding implementation approach and follow up of additional implementation.

**Consideration for 303d Delisting:** Mary's 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 nutrient criterion 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 after Fiscal Year 2004.

Approved January 26, 2000.