

## MARAIS DES CYGNES BASIN TOTAL MAXIMUM DAILY LOAD

**Waterbody: Hundred and Ten Mile Creek**  
**Water Quality Impairment: Dissolved Oxygen**

### 1. INTRODUCTION AND PROBLEM IDENTIFICATION

**Subbasin:** Upper Marais des Cygnes      **County:** Osage

**HUC 8:** 10290101

**HUC 11 (HUC 14):**      **030 (070)**

**Drainage Area:**      56.8 square miles

**Main Stem Segment:**      WQLS: 25; starting at Pomona Lake and traveling upstream to headwaters in northwestern Osage County (**Figure 1**).

**Designated Uses:**      Expected Aquatic Life Support, Primary Contact Recreation; Domestic Water Supply; Food Procurement; Ground Water Recharge; Industrial Water Supply Use; Irrigation Use; Livestock Watering Use for Main Stem Segment

**1998 303(d) Listing:**      Table 1 - Predominant Non-point Source and Point Source Impacts

**Impaired Use:**      Expected Aquatic Life Support

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

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

**Level of Support for Designated Use under 1998 303(d):** Partially Supporting Expected Aquatic Life

**Monitoring Sites:** Station 633 near Scanton

**Period of Record Used:** 1993, 1997, 1999 and 2000 (**Figure 2**)

**Flow Record:** Hundred and Ten Mile Creek near Scanton (USGS Gaging Site 06911700); 1999-2000; Dragoon Creek near Burlingame (USGS Station 06911900); 1970-2000.

**Long Term Flow Conditions:** 10% Exceedence Flows = 33 cfs, 7Q10 = 1 cfs

# Hundred and Ten Mile Creek Watershed Dissolved Oxygen TMDL HUC and Stream Segments

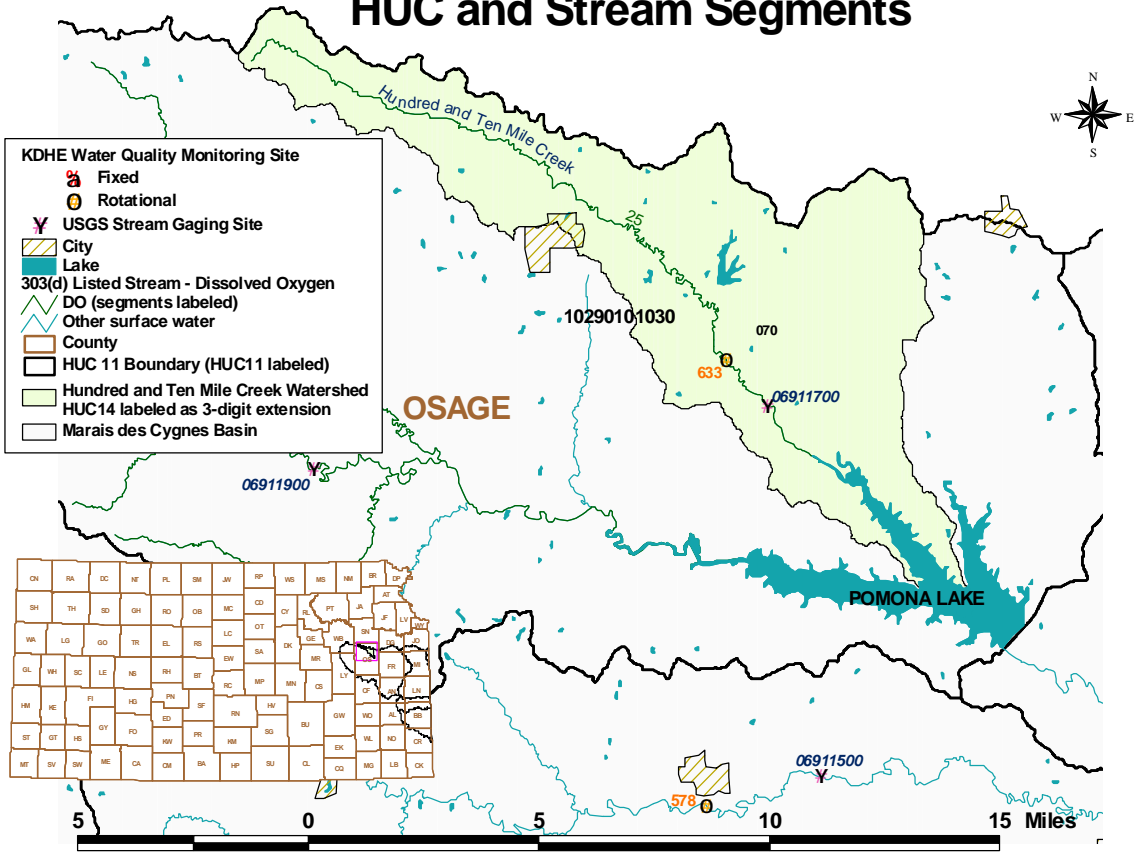


Figure 1

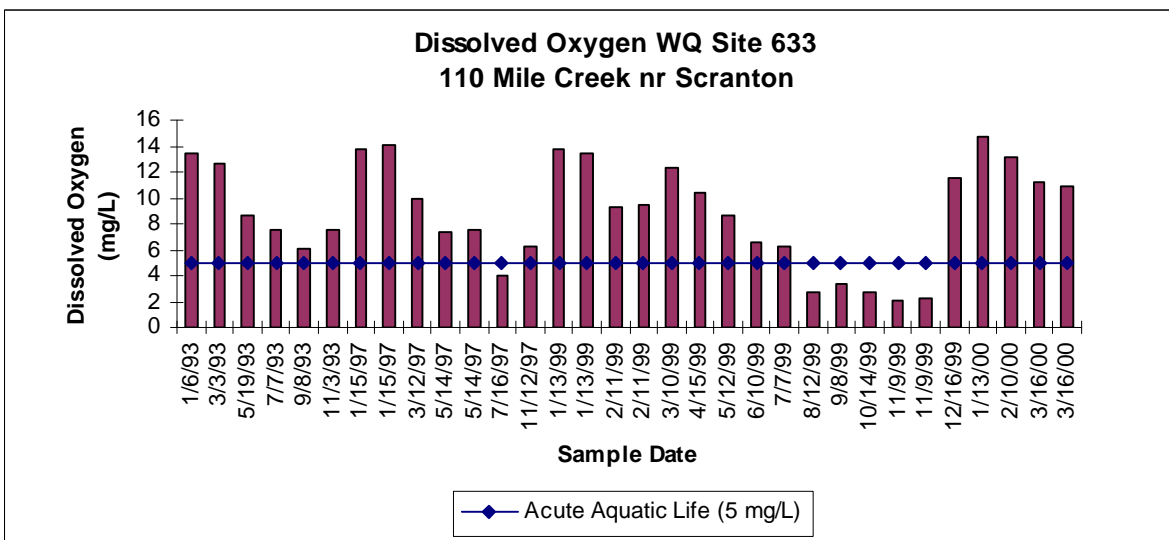
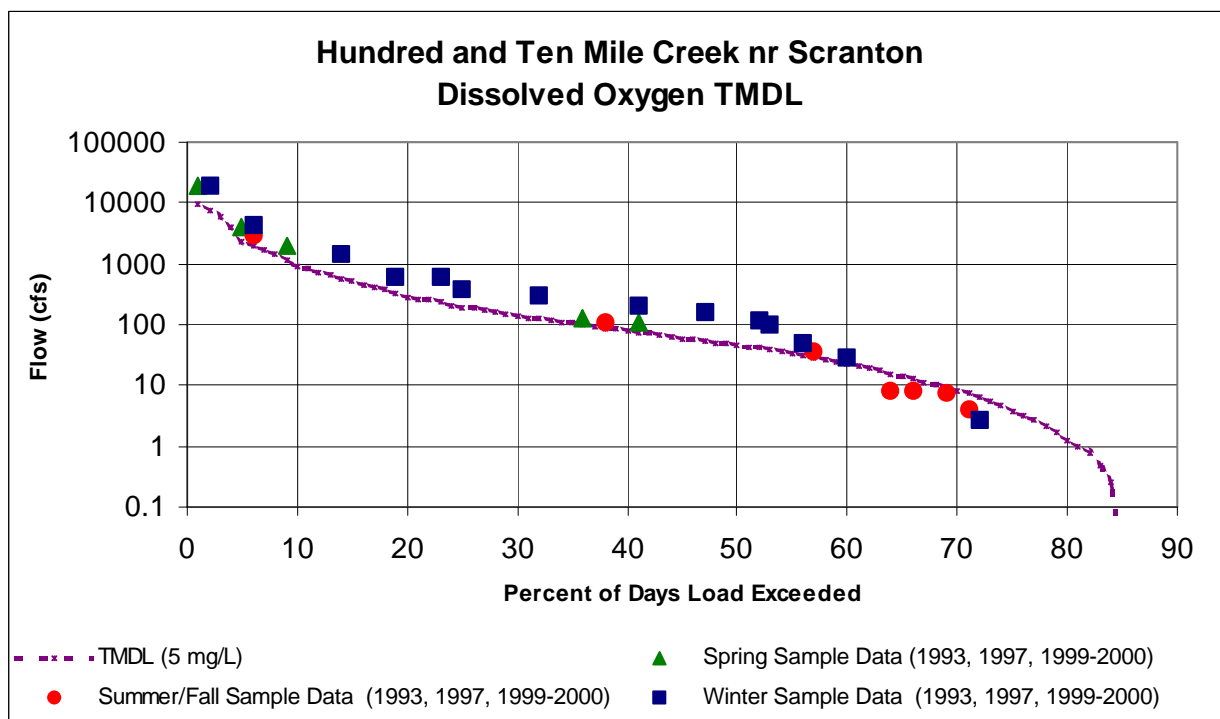


Figure 2

**Current Conditions:** Since loading capacity varies as a function of the flow present in the stream, this TMDL represents a continuum of desired loads over all flow conditions, rather than fixed at a single value. Sample data for the sampling site were categorized for each of the three defined seasons: Spring (Mar-Jul), Summer-Fall (Aug-Oct) and Winter (Nov-Feb). High flows and runoff equate to lower flow durations, baseflow and point source influences generally occur in the 75-99% range. Load curves were established for the Aquatic Life criterion by multiplying the flow values for Hundred and Ten Mile Creek along the curve by the applicable water quality criterion and converting the units to derive a load duration curve of pounds of DO per day. This load curve graphically displays the TMDL since any point along the curve represents the water quality standard at that flow. Historic excursions from water quality standards (WQS) are seen as plotted points below the load curves. Water quality standards are met for those points plotting above the applicable load duration curves (**Figure 3**).



**Figure 3**

Excursions were seen in the Summer-Fall and Winter seasons. Fifty seven percent of the Summer-Fall samples and 7% of Winter samples were below the aquatic life criterion. None of Spring samples were under the aquatic life criterion. Overall, 19% of the samples were under the criterion. This would represent a baseline condition of partial support of the impaired designated use.

No DO violations have been encountered at flows exceeding 0.6 cfs on Hundred and Ten Mile Creek near Scranton, therefore a critical low flow can be identified on Hundred and Ten Mile Creek as those flows of 0.6 cfs or less.

**Table 1**

**NUMBER OF SAMPLES UNDER DISSOLVED OXYGEN STANDARD OF 5 mg/L BY FLOW**

Station	Season	0 to 10%	10 to 25%	25 to 50%	50 to 75%	75 to 90%	90 to 100%	Cum Freq.
110 Mile Creek nr Scranton (633)	Spring	0	0	0	0	0	0	0/5 = 0%
	Summer	0	0	0	4	0	0	4/7 = 57%
	Winter	0	0	0	1	0	0	1/14 = 7%

A watershed comparison approach was taken in developing this TMDL. The Salt Creek watershed (Water Quality Sampling Site 578 in the watershed was not impaired by low DO) has similar land use characteristics and is located to the south of the Hundred and Ten Mile Creek watershed. The relationship of DO to Biochemical Oxygen Demand (BOD), water temperature, turbidity, nitrate, phosphorus and stream flow were used in the comparisons.

Table 2a outlines those water quality data for the samples taken on the same date for the two sites of interest between 1999 and 2000 when DO was *below* the aquatic life criterion for sample site 633 and *above* the aquatic life criterion for comparison site 578. At sampling site 633 the average BOD, nitrate, phosphorus, temperature, turbidity and flow were much the same as that of sampling site 578. This indicates that climatically driven factors triggering extremely low flow and high water temperature can be considered the primary cause driving the occasional DO excursion.

Table 2b outlines those water quality data for the sample taken on the same date for the two sites of interest between 1999 and 2000 when DO was below the aquatic life criterion for both sites. Again, at sampling site 633 the BOD, nitrate, phosphorus, temperature, turbidity and flow were much the same as that of sampling site 578, which reinforces the indication that low flow and high temperature are the primary factors in the watershed driving the occasional DO excursion.

**Table 2a**

COL DATE	DO (mg/L)		BOD (mg/L)		TEMP Degrees C		TURBIDITY (FTU)		NITRATE (mg/L)		TPHOS (mg/L)		Flow (cfs)	Flow (cfs)
	WQ site	WQ site	WQ site	WQ site	WQ site	WQ site	WQ site	WQ site	WQ site	WQ site	WQ site	WQ site	06911900	06911500
633 & 578	633	578	633	578	633	578	633	578	633	578	633	578	633	578
8/12/99	2.7	5.9	1.0	1.9	25	27	6.1	30	0.59	1.56	0.08	0.18	2.7	2.2
10/14/99	2.8	6.2	3.8	2.8	12	16	4.3	9.3	0.56	0.2	0.14	0.12	1.6	0.7
11/9/99	2.2	5.3	3.7	2.8	13	14	2.9	7.3	0.19	0.08	0.31	0.17	1.5	6.3
Average	2.55	5.8	2.8	2.5	16.7	19.0	4.4	15.3	0.45	0.61	0.18	0.16	1.9	3.1

**Table 2b**

COL DATE	DO (mg/L)		BOD (mg/L)		TEMP Degrees C		TURBIDITY (FTU)		NITRATE (mg/L)		TPHOS (mg/L)		Flow (cfs)	Flow (cfs)
	WQ site	WQ site	WQ site	WQ site	WQ site	WQ site	WQ site	WQ site	WQ site	WQ site	WQ site	WQ site		
633 & 578	633	578	633	578	633	578	633	578	633	578	633	578	633	578
9/8/99	3.3	2.9	1.0	1.0	21	24	30	13	0.44	0.33	0.23	.09	2.4	0.39

**Desired Endpoints of Water Quality at Site 633 over 2005 - 2009**

The ultimate endpoint for this TMDL will be to achieve the Kansas Water Quality Standard for dissolved oxygen of 5 mg/l to fully support Aquatic Life.

Seasonal variation is accounted for by this TMDL, since the TMDL endpoint is sensitive to the low flow and/or higher temperature conditions, generally occurring in the Summer and Fall seasons.

This endpoint will be reached as a result of expected, though unspecified, improvements in tributary buffer strip conditions which will filter sediment before reaching the stream. Improvements to buffer strip conditions will result from implementation of corrective actions and Best Management Practices, as directed by this TMDL. Achievement of this endpoint will provide full support of the aquatic life function of the creek and attain the dissolved oxygen water quality standard.

Since BOD is not considered a factor in the occasional DO excursion at this site, the BOD target will be to maintain the historical average in stream BOD of 2.6 mg/L or less at the sampling site.

**3. SOURCE INVENTORY AND ASSESSMENT**

**NPDES:** There are no NPDES permitted wastewater dischargers within the watershed that would impact DO levels.

**Livestock Waste Management Systems:** Five operations are registered, certified or permitted within the watershed. Facility types are swine or beef. These facilities are mainly located in the lower portion of the watershed. Potential animal units for all facilities in the watershed total 522. The actual number of animal units on site is variable, but typically less than potential numbers (**Figure 4**).

**Land Use:** Most of the watershed is grassland (47% of the area), cropland (45%), and woodland (4%). Most of the cropland is located in the lower half of the watershed. The grazing density estimate is low (23 animal units/mi<sup>2</sup>) when compared to densities across the Marais des Cygnes and Missouri Basins (**Figure 5**).

# Hundred and Ten Mile Creek Watershed Dissolved Oxygen TMDL Livestock Waste Management Facilities

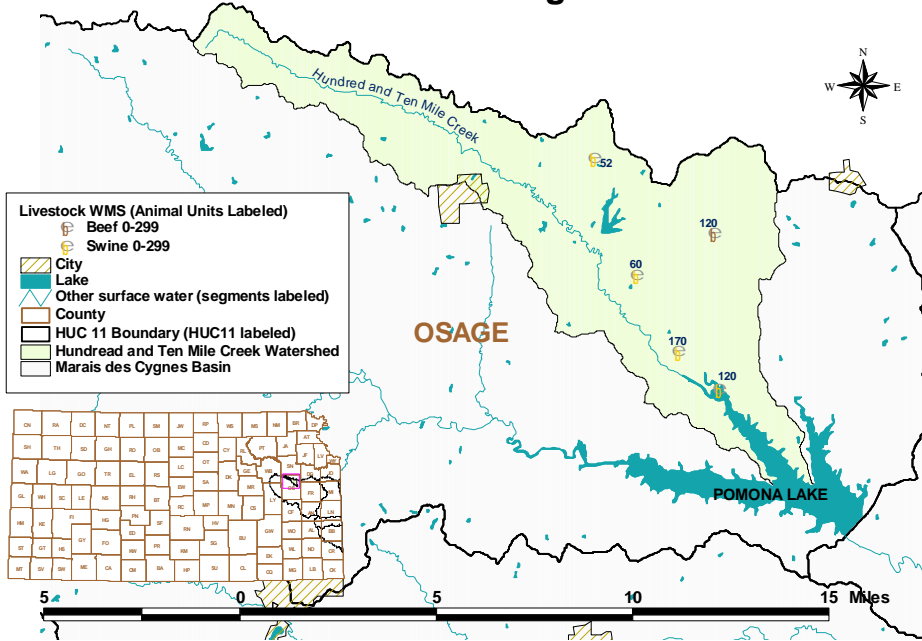


Figure 4

# Hundred and Ten Mile Creek Watershed Dissolved Oxygen TMDL - Land Use Map

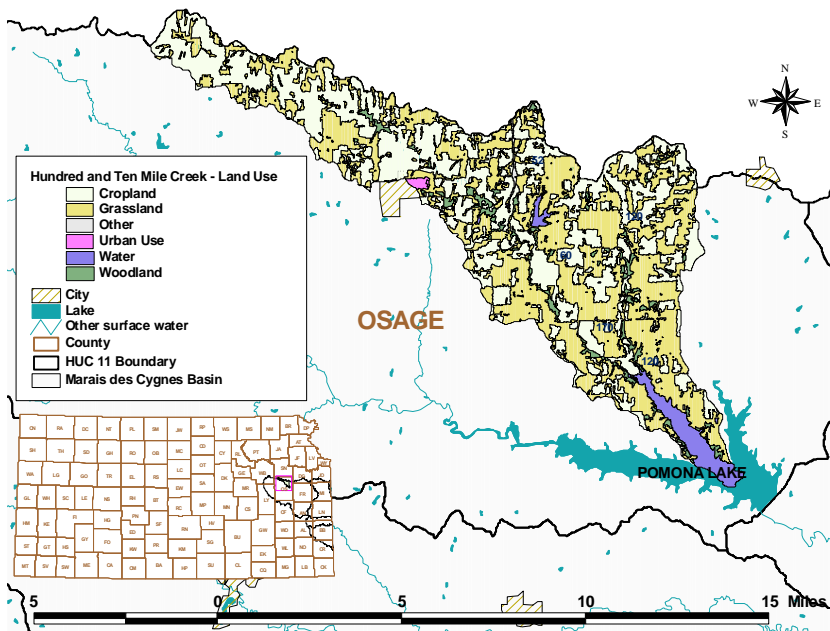


Figure 5

**On-Site Waste Systems:** The watershed's population density is average (22 person/mi<sup>2</sup>) when compared to densities across the Marais des Cygnes and Missouri Basins. The rural population projection for Osage County through 2020 shows substantial growth (48% increase).

**Contributing Runoff:** The watershed's average soil permeability is 0.4 inches/hour according to NRCS STATSGO data base. The entire watershed produces runoff even under relative low (1.71"/hr) potential runoff conditions. Under very low (1.14"/hr) potential conditions, this potential contributing area is reduced slightly (88.5%). 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 0.57"/hr of rain will generate runoff from 71.7% of this watershed, chiefly from the upper half of the watershed.

**Background Levels:** Some organic enrichment may be associated with environmental background levels, including contributions from wildlife and stream side vegetation, but it is likely that the density of animals such as deer is fairly dispersed across the watershed and that the loading of oxygen demanding material is constant along the stream. In the case of wildlife, this loading should result in minimal loading to the streams below the levels necessary to violate the water quality standards. In the case of stream side vegetation, the loading should be greater toward the lower half of the watershed with its larger proportion of woodland near the stream.

#### **4. ALLOCATION OF POLLUTION REDUCTION RESPONSIBILITY**

This is a phased TMDL. Additional monitoring over time will be needed to further ascertain the relationship between improvements in tributary buffer strip conditions which should filter sediment before reaching the stream, reduce SOD and consequently improve DO levels during the critical periods of concern. In Phase One of this TMDL the following allocations apply:

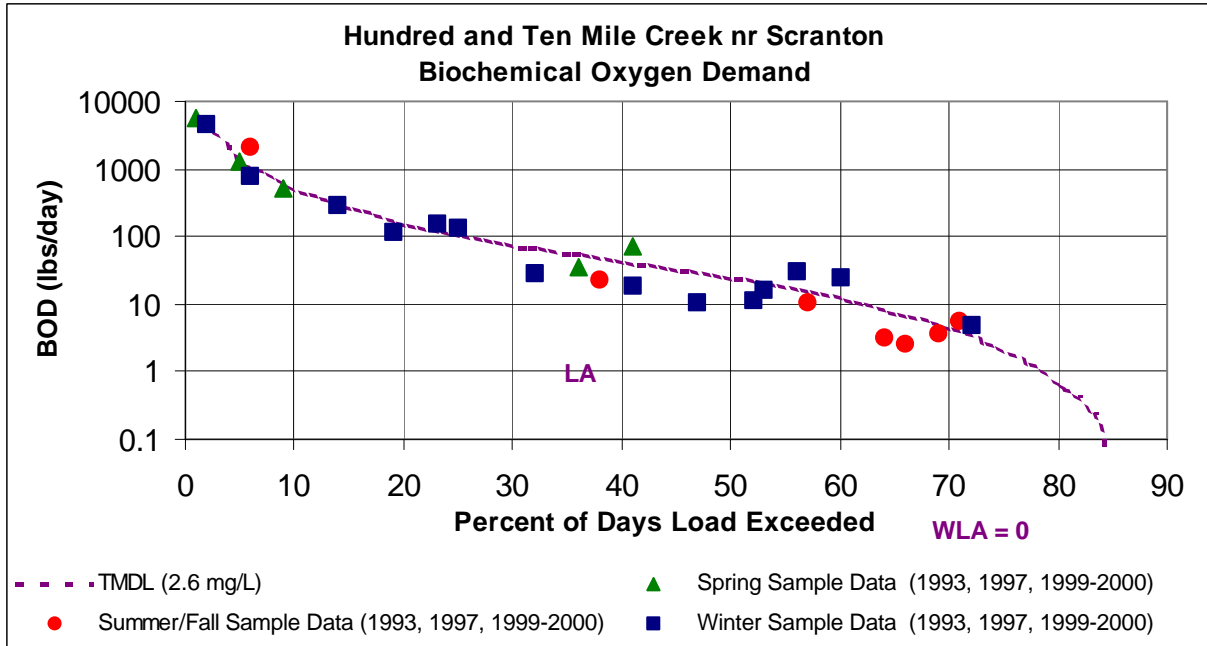
**Point Sources:** A current Wasteload Allocation of zero is established by this TMDL because of the lack of point sources in the watershed. Should future point sources be proposed in the watershed and discharge into the impaired segments, the current Wasteload Allocation will be revised by adjusting current load allocations to account for the presence and impact of these new point source dischargers.

**Non-Point Sources:** Because of the indication that low flow and higher seasonal temperatures are the driving factors causing the occasional excursion from the water quality standard rather than BOD, non-point sources are also not seen as a significant source of DO excursion in the watershed. The Load Allocation assigns responsibility for maintaining the historical average in stream BOD levels at site 633 to 2.6 mg/L or less across all flow conditions (**Figure 6**).

To address the DO violations outlined in Tables 2a and 2b at water quality sampling site 633, buffer strips should be installed on directly contributing tributaries to filter sediment before reaching the stream.

**Defined Margin of Safety:** The margin of safety will be established in anticipation of any new

point sources which may locate within the watershed. The margin of safety will explicitly reduce the revised Wasteland Allocation by 10% to ensure that the resulting oxygen sag created by any new effluent discharge does not create dissolved oxygen conditions in the stream below 5 mg/L.



**Figure 6**

**State Water Plan Implementation Priority:** Because this watershed has indicated some problem with dissolved oxygen which has short term and immediate consequences for aquatic life, this TMDL will be a High Priority for implementation.

**Unified Watershed Assessment Priority Ranking:** This watershed lies within the Upper Marais des Cygnes Basin (HUC 8: 10290101) with a priority ranking of 5 (High Priority for restoration work).

**Priority HUC 11s and Stream Segments:** Priority should be directed toward baseflow generating and conducting stream segments especially the main stem of Hundred and Ten Mile Creek.

## 5. IMPLEMENTATION

### Desired Implementation Activities

1. Where needed, create/restore buffer strips along contributing tributaries.

### Implementation Programs Guidance



## **Buffer Initiative Program - SCC**

- a. Install grass buffer strips near streams.

**Timeframe for Implementation:** Buffer strips should be installed on directly contributing tributaries to the main stem over the years 2002-2006.

**Targeted Participants:** Primary participants for implementation will be landowners immediately adjacent to the listed stream segments. Implemented activities should be targeted to those stream segments with greatest potential contribution to baseflow. Nominally, this would be most likely be:

1. Unbuffered cropland adjacent to contributing tributaries.

Some inventory of local needs should be conducted in 2002 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 2006:** The year 2006 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 two-thirds of the landowners responsible for buffer strips installation cited in the local assessment participating in the implementation programs provided by the state.

**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 County staff managing.

### **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.A.R. 28-16-69 to -71 implements water quality protection by KDHE through the establishment and administration of critical water quality management areas on a watershed basis.

4. 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 areas where buffer strips may be needed..

5. 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.

6. 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.

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

8. The *Kansas Water Plan* and the Marais des Cygnes 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 TMDL is a High Priority consideration.

**Effectiveness:** Buffer strips are touted as a means to filter sediment before it reaches a stream. The key to effectiveness is participation within a finite subwatershed to direct resources to the activities influencing water quality. The milestones established under this TMDL are intended to gauge the level of participation in those programs implementing this TMDL.

Should participation significantly lag below expectations over the next five years, the state may employ more stringent conditions on landowners in the watershed in order to meet the desired endpoints expressed in this TMDL. The state has the authority to impose conditions on activities with a significant potential to pollute the waters of the state under K.S.A. 65-171. If overall water quality conditions in the watershed deteriorate, a Critical Water Quality Management Area may be proposed for the watershed, in response.

## 6. MONITORING

KDHE should collect bimonthly samples at Station 633 in 2005 and 2009 and beyond in order to assess progress and success in implementing this TMDL in reaching its endpoint.

Local program management needs to identify its targeted participants of state assistance programs for implementing this TMDL. This information should be collected in 2002 in order to support appropriate implementation projects.

## 7. FEEDBACK

**Public Meeting:** The public meeting to discuss TMDLs in the Marais des Cygnes Basin was held February 28, 2001 in Ottawa. 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 Marais des Cygnes Basin.

**Public Hearings:** Public Hearings on the TMDLs of the Marais des Cygnes Basin were held in Fort Scott on May 30 and Ottawa on May 31, 2001.

**Basin Advisory Committee:** The Marais des Cygnes Basin Advisory Committee met to discuss the TMDLs in the basin on October 4, 2000, February 28 and May 30, 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 Hundred and Ten Mile Creek. Subsequent decisions will be made regarding the implementation approach and follow up of additional implementation in the watershed.

**Consideration for 303(d) Delisting:** The creek 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.