EPA Region 7 TMDL Review

TMDL ID: NP1-L0030 **State:** NE
Document Name: LAKE OGALLALA

Basin(s): MISSOURI - NORTH PLATTE BASIN
HUC(s): 10180014
Water body(ies): LAKE OGALLALA
Tributary(ies): NONE
Pollutant(s): HYDROGEN SULFIDE, MACROPHYTES

Submittal Date: 6/26/2007 **Approved:** Yes

Submittal Letter

State submittal letter indicates final Total Maximum Daily Load(s) (TMDL) for specific pollutant(s)/water(s) were adopted by the state, and submitted to EPA for approval under section 303(d) of the Clean Water Act [40 CFR § 130.7(c)(1)]. Include date submitted letter was received by EPA, date of receipt of any revisions, and the date of original approval if submittal is a phase II TMDL.

Letter for Lake Ogallala, dated June 22, 2007, was received by EPA on June 26, 2007, formally submitting this TMDL for approval.

Water Quality Standards Attainment

The water body's loading capacity (LC) for the applicable pollutant is identified and the rationale for the method used to establish the cause-and-effect relationship between the numeric target and the identified pollutant sources is described. TMDL and associated allocations are set at levels adequate to result in attainment of applicable water quality standards (WQS) [40 CFR § 130.7(c)(1)]. A statement that WQS will be attained is made.

CE-QUAL-W2 modeling efforts have demonstrated the most significant factors contributing to low DO in Lake Ogallala are macrophyte respiration, IOD caused by hydrogen sulfide oxidation, and low DO water from Lake McConaughy's hypolimnion.

The CE-QUAL-W2 water quality model was employed to determine the scenarios that complied with the water quality criteria. The loading capacities, that if achieved, will result in beneficial use attainment were based upon dissolved oxygen loading, instantaneous oxygen demand loading, and macrophyte density and are included in the below table.

Scenario	Macrophyte Density (g dry wt/m^2)	DO Loading – kg/hr	DO Loading – kg/day	IOD Loading – kg/hr	IOD Loading – kg/day
1	344	3302	30663	319	5749
2	172	3302	30663	1032	9582
3	688	4128	38329	1032	9582
4	344	4128	38329	1445	13415
5	688	3302	30663	206	1916

6	344	3302	30663	1032	9582
7	172	2477	22997	206	1916

Implementation of the targeted LC should result in WQS being attained.

Numeric Target(s)

Submittal describes applicable WQS, including beneficial uses, applicable numeric and/or narrative criteria. If the TMDL is based on a target other than a numeric water quality criterion, then a numeric expression, site specific if possible, was developed from a narrative criterion and a description of the process used to derive the target is included in the submittal.

Designated uses assigned to Lake Ogallala include: primary contact recreation; aquatic life coldwater class B; agriculture water supply class A; and aesthetics (NDEQ 2005). Excessive sediment and nutrient inputs have been determined to be impairing of the aesthetic and aquatic life beneficial uses.

The *Aquatic Life* – The site Specific Dissolved Oxygen water quality criterion for Lake Ogallala is not being met. The site specific criteria is as follows:

The following criteria shall apply from July 1 through October 15 as specified. When the Kingsley Hydropower Plant is in operation (generating electricity), these criteria are based on water temperature measurements taken continuously and averaged every hour in the powerhouse of the Kingsley Hydropower Plant and on dissolved oxygen measurements taken continuously and averaged every 10 minutes form Lake Ogallala at the midpoint of the buoy line (1987 location at the outer edge of the stilling basin) at a one meter depth. For the purposes of calculating a seven-day mean, seven day mean minimum and thirty-day mean values at the buoy line, seven-day and thirty day calculation periods shall be based on a sequence of days not to include any day in which Kingsley Hydropower Plant is not in operation. The following criteria may also be based on temperature and dissolved oxygen measurements taken from Lake Ogallala at any location except the metalimnion and hypolimnion when the lake exhibits thermal stratification.

When the daily mean temperatures are 18°C or less the following criteria shall apply:

- *One-day minimum of not less than 3.0 mg/l.*
- *Daily mean of not less than 4.0 mg/l and no more than 20% of the one-day mean values shall not be less than 4.2 mg/l.*
- *Seven-day mean of not less than 4.3 mg/l.*

When daily mean water temperatures exceed 18°C for four consecutive days of operation, the following criteria shall apply for as long as daily mean water temperatures continue to exceed 18°C. These criteria take effect on the fifth day of the daily mean water temperatures exceeding 18°C.

- *One-day minimum of not less than 4.0 mg/l.*
- *Daily mean of not less than 5.0 mg/l.*

When daily mean water temperatures exceed 18°C for fifteen consecutive days of operation or when daily mean water temperature exceeds 20 °C the dissolved oxygen criteria for Class B – Coldwater Aquatic Life shall apply as long as daily mean water temperatures continue to exceed 18°C. These criteria take effect on the sixteenth day of daily mean water temperatures exceeding 18°C or on the first day after daily mean water temperatures exceed 20 °C.

In implementing the criteria, if an interruption in the operation of Kingsley Hydropower Plant exceeding 24 hours occurs during the count of days leading to a change in criteria, the count of days shall be suspended until the plant in back in operation. The first new day of operation shall be counted as the next consecutive day in the original count of days.

Dissolved Oxygen Criteria for Class B – Coldwater Aquatic Life Shall apply during the periods of October 16 through June 30.

The Class B – Coldwater Aquatic Life Dissolved Oxygen Criteria

- *One-day minimum of not less than 5.0 mg/l from April 1 through June 30.*
- *One-day minimum of not less than 4.0 mg/l from July 1 through March 31.*
- *Seven-day mean minimum of not less than 5.0 mg/l from July 1 through March 31.*
- *Seven-day mean of not less than 6.5 mg/l from April 1 – June 30.*
- *Thirty-day mean of not less than 6.5 mg/l from July 1 – June 30.*

Lake Ogallala was first included on the 2002 Nebraska Section 303(d) list as impaired by low dissolved oxygen. The waterbody remained assessed as impaired due to low dissolved oxygen and was included in Category 5 of both the 2004 and 2006 Nebraska Surface Water Quality Integrated Reports (NDEQ 2004, NDEQ 2006).

Pollutant(s) of concern

An explanation and analytical basis for expressing the TMDL through surrogate measures (e.g., parameters such as percent fines and turbidity for sediment impairments, or chlorophyll-a and phosphorus loadings for excess algae) is provided, if applicable. For each identified pollutant, the submittal describes analytical basis for conclusions, allocations and margin of safety (MOS) that do not exceed the LC. If submittal is a phase II TMDL there are refined relationships linking the load to WQS attainment. If there is an increase in the TMDL there is a refined relationship specified to validate the increase in TMDL (either load allocation (LA) or waste load allocation (WLA)). This section will compare and validate the change in targeted load between the versions.

The pollutant causing the impairment(s) of the water quality standard and designated beneficial use is low dissolved oxygen.

Water discharged from Kingsley Dam contains extremely high Immediate Oxygen Demand (IOD) during the "critical period" in late summer when dissolved oxygen levels are at or near zero in the hypolimnetic waters draining from Lake McConaughy (Hoagland, et. al. 2000).

Dissolved oxygen concentrations are not a direct result of pollutant loads rather a response to pollutants, climatic and physical influences on the waterbody. Circulation, water quality monitoring and modeling have shown Lake Ogallala to be quite unique from a hydrologic, hydraulic and management standpoint. CE-QUAL-W2 modeling efforts have demonstrated the most significant factors contributing to low DO in Lake Ogallala are macrophyte respiration, IOD caused by hydrogen sulfide oxidation and low DO water from Lake McConaughy's hypolimnion (Kozimor, et. al. 2004).

Source Analysis

Important assumptions made in developing the TMDL, such as assumed distribution of land use in the watershed, population characteristics, wildlife resources, and other relevant information affecting the characterization of the pollutant of concern and its allocation to sources, are described. Point, nonpoint and background sources of pollutants of concern are described, including magnitude and location of the sources. Submittal demonstrates all significant sources have been considered. If this is a phase II TMDL any new sources or removed sources will be specified and explained.

Based on the configuration of Lake Ogallala, the entire pollutant load originates from Lake McConaughy. Both point and nonpoint sources of instantaneous oxygen demand (sulfides, ammonia, etc.) contribute to the North Platte River and ultimately Lake McConaughy. Point sources include wastewater treatment facilities and animal feeding operations. Nonpoint

sources include, stormwater discharges from sites not covered by NPDES permits and other agriculture, urban, and rural run-off.

No point sources discharge to Lake Ogallala and due to the limited watershed, a majority of the water delivered is from Lake McConaughy. In March 1982 the 8th Circuit Court ruled in *Missouri vs. the Department of the Army* that reduction of oxygen caused by the dam did not constitute the "addition" of a pollutant from a "point source". Based on this finding, the entire source of the pollutants in Lake Ogallala is due to nonpoint sources.

Although natural sources of organic loading do exist in the watershed, it is difficult to differentiate these contributions from the nonpoint source loading. Therefore, for this TMDL, natural sources will be combined into the load allocation.

It seems all sources have been identified.

Allocation - Loading Capacity

Submittal identifies appropriate WLA for point, and load allocations for nonpoint sources. If no point sources are present the WLA is stated as zero. If no nonpoint sources are present, the LA is stated as zero [40 CFR § 130.2(i)]. If this is a phase II TMDL the change in LC will be documented in this section.

CE-QUAL-W2 modeling efforts have demonstrated the most significant factors contributing to low DO in Lake Ogallala are macrophyte respiration, IOD caused by hydrogen sulfide oxidation and low DO water from Lake McConaughy's hypolimnion. For this TMDL, the loading was estimated using a combination of models and chemical data. CE-QUAL-W2 was the water quality model used.

No point sources discharge to Lake Ogallala and due to the limited watershed, a majority of the water delivered is from Lake McConaughy. Based on this finding, the entire source of the pollutants in Lake Ogallala is due to nonpoint sources.

Because no point sources discharge directly to Lake Ogallala the wasteload allocation will be zero (0).

WLA Comment

Submittal lists individual WLAs for each identified point source [40 CFR § 130.2(h)]. If a WLA is not assigned it must be shown that the discharge does not cause or contribute to WQS excursions, the source is contained in a general permit addressed by the TMDL, or extenuating circumstances exist which prevent assignment of individual WLAs. Any such exceptions must be explained to a satisfactory degree. If a WLA of zero is assigned to any facility it must be stated as such [40 CFR § 130.2(i)]. If this is a phase II TMDL any differences in phase I and phase II WLAs will be documented in this section.

Because no point sources discharge directly to Lake Ogallala the wasteload allocation will be zero (0).

LA Comment

Includes all nonpoint sources loads, natural background, and potential for future growth. If no nonpoint sources are identified the LA must be given as zero [40 CFR § 130.2(g)]. If this is a phase II TMDL any differences in phase I and phase II LAs will be documented in this section.

Establishment of the load allocation (LA) identifies the dynamic and unique nature of Lake Ogallala and the incoming water from Lake McConaughy and will be established according to the macrophyte density. The load allocations will also include the contribution from

background sources. The LA can be found in Table 2.4.2.

Table 2.4.2 Load Allocation Based on Observed Macrophyte Density

Macrophyte Density (g dry wt/m^2)	DO Loading – kg/hr	DO Loading – kg/day	IOD Loading – kg/hr	IOD Loading – kg/day
172	3302	30663	1032	9582
688	4128	38329	1032	9582
344	4128	38329	1445	13415
688	3302	30663	206	1916
344	3302	30663	1032	9582
172	2477	22997	206	1916

Margin of Safety

Submittal describes explicit and/or implicit MOS for each pollutant [40 CFR § 130.7(c)(1)]. If the MOS is implicit, the conservative assumptions in the analysis for the MOS are described. If the MOS is explicit, the loadings set aside for the MOS are identified and a rationale for selecting the value for the MOS is provided. If this is a phase II TMDL any differences in MOS will be documented in this section.

This TMDL contains an implicit margin of safety. During periods of low dissolved oxygen that corresponds with the stratification of Lake McConaughy, water is regularly discharged through the Howell-Bunger valve in order to maintain the DO at the buoy line. However, for this modeling event, all incoming flows were run strictly through the hydro facility and aeration through the Howell-Bunger was not performed. The modeling assumption assumes a worst-case situation of incoming water DO concentration.

Seasonal Variation and Critical Conditions

Submittal describes the method for accounting for seasonal variation and critical conditions in the TMDL (s) [40 CFR § 130.7(c)(1)]. Critical conditions are factors such as flow or temperature which may lead to the excursion of WQS. If this is a phase II TMDL any differences in conditions will be documented in this section.

The low dissolved oxygen has been observed to occur when Lake McConaughy stratifies. All modeling and allocations were determined based on the period of stratification. Critical condition could occur between July 1 to October 15 based on historical measurements.

Public Participation

Submittal describes required public notice and public comment opportunity, and explains how the public comments were considered in the final TMDL(s) [40 CFR § 130.7(c)(1)(ii)].

The availability of the TMDLs in draft form was published in Ogallala-Keith County News and several other newspapers with the public comment period running from May 14, 2007 to June 18, 2007. These TMDLs were also made available to the public on the NDEQ's Internet site and electronic announcements were sent to interested stakeholders. No comments were received.

Monitoring Plan for TMDL(s) Under Phased Approach

The TMDL identifies a monitoring plan that describes the additional data to be collected to determine if the load reductions required by the TMDL lead to attainment of WQS, and a schedule for considering revisions to the TMDL(s) (where phased approach is used) [40 CFR § 130.7].

Monitoring of Lake Ogallala and Lake McConaughy will be conducted in the future to determine if the water quality and aquatic life is improving, degrading or remaining status

quo. As well, monitoring will be conducted to evaluate the effectiveness of implemented management practices. Monitoring planned and the entities responsible are described in Table 5.0 from the TMDL and reproduced below.

Table 5.0 Future TMDL Related Monitoring Activities for Lake Ogallala and Lake McConaughy

Agency Responsible	Action	Frequency
NPPD	Vegetation Surveys[1]	At least once annually during anticipated peak of growing season
CNPPID	Buoy Line Dissolved Oxygen Monitoring[1]	June -October 15: When Hydro is Online
CNPPID	Dissolved Oxygen Profile Monitoring[1]	Weekly June-October 15
NGPC	Creel, Angler and Salmonid Population Survey[1]	Once Annually
NDEQ	Water Quality Monitoring[2]	Once Monthly, May-October
NDEQ	Watershed Monitoring[3]	Bi-weekly April-September, Monthly October-March

[1] Lake Ogallala
[2] Lake McConaughy and Lake Ogallala
[3] Ambient Stream Monitoring program

Reasonable Assurance

Reasonable assurance only applies when less stringent WLAs are assigned based on the assumption of nonpoint source reductions in the LA will be met [40 CFR § 130.2(i)]. This section can also contain statements made by the state concerning the state's authority to control pollutant loads.

There are no point sources for this TMDL and the WLA is set at zero, reasonable assurances are not necessary.