EPA Region 7 TMDL Review

TMDL ID: IA 02-IOW-02195-L **State:** IA
Document Name: UNION GROVE LAKE

Basin(s): IOWA-CEDAR RIVER BASIN
HUC(s): 07080208, 7080208
Water body(ies): UNION GROVE LAKE
Tributary(ies): DEER CREEK (18), LOWER DEER CREEK, UPPER DEER CREEK
Pollutant(s): ALGAE, E. COLI, PH, TURBIDITY

Submittal Date: 7/7/2009 **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.

This TMDL was formally submitted by the Iowa Department of Natural Resources (IDNR) to the United States Environmental Protection Agency (EPA) on July 16, 2009. Revisions to this document were received by email on December 30, 2009 and September 8, 2010.

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.

The Union Grove Lake TMDL was developed to address algae, turbidity, pH and pathogen indicators (*E. coli)* impairments. A TMDL was developed for Union Grove Lake because it does not meet WQS. The TMDL target is based on the amount of total phosphorus (TP) the lake can assimilate without causing algal blooms and subsequent pH violations of WQS. The cause of nuisance algal blooms and high pH is caused by excessive TP. Algae growth in streams are most frequently assessed based on the amount of chlorophyll a in the water. Algae consumes dissolved oxygen (DO) during respiration at night and have the potential to remove large amounts of DO from the lake. The breakdown of dead, decaying algae also removes oxygen from the water. Lower amounts of oxygen in a water body results in increased amounts of TP. The increase of turbidity and algal photosynthesis increases lake pH by removing carbon dioxide and shifting the carbonate system equilibrium.

TP is the limiting nutrient for algae growth and is used as a translator to reduce algae, turbidity, and pH within the water body.

The current load for TP is 10,170 pounds per year (lbs/yr). The target TP concentration is less than 56 micrograms per liter (ug/l). The target LC is 3,006 lbs/year TP. This is a reduction of 7,164 lbs/year TP from the current load.

While EPA is approving this TMDL phosphorus target, we do not endorse IDNR's best professional judgment used to parameterize the BATHTUB model. However, the TMDL phosphorus target was independently calculated by EPA using different methodologies and the results were within the TMDL MOS of IDNR's target. In other words, the two techniques result in a similar target; therefore EPA approves the TMDL target.

The TMDL recognizes Carlson's Trophic State Index (TSI) values of less than 65 for chlorophyll a and less than 61 for Secchi depth. The targets indicated above translate to a chlorophyll a concentration of 33 ug/L and a Secchi depth greater than 0.8 meters (m). The Secchi depth was selected greater than 0.7 m because a mean value of 0.7 m does not provide adequate protection from episodes of very low transparency. The submittal states that pH shall not be less than 6.5 nor greater than 9.0.

E. coli impairs primary contact recreation and presents human health issues within the water body. The standard for *E. coli* is a geometric mean of 126 organisms/100 milliliters (orgs/100 ml) and a single sample maximum concentration of 235 *E. coli* orgs/100 ml. A reduction of 9.00E+09 organisms/day (org counts/day) from the current load gives a LC of 2.53E+10 org counts/day.

EPA agrees attainment of the LCs should result in the attainment of WQS.

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.

The designated uses listed for Union Grove Lake are Primary Contact Recreation Class A, Aquatic Life Class B (LW), and Human Health Fish Consumption (HH). The specific water quality criteria for these designated uses listed below are published in the Environmental Protection Rule 567, Chapter 61 WQS:

Subrule 61.3(5) for Class A waters and pH states, "The pH shall not be less than 6.5 nor greater than 9.0. The maximum change permitted as a result of a waste discharge shall not exceed 0.5 pH units."

Subrule 61.3(5) 6(1) for Class B (LW) waters and DO is referenced in Table 2 of the IA WQS (Ch.1, p.21). The minimum value at any time during every 24-hour period should be 5.0 mg/L (milligrams per liter). The value of 5.0 mg/L applies only to the upper layer of stratification in lakes.

Subrule 61.3(3) states, "The waters shall contain no substances in concentrations which will make fish or shell-fish inedible due to undesirable tastes or cause a hazard to humans after consumption." Specific toxic chemical criteria were also available.

The 2006 305(b) Report states that the Class A (Primary Contact Recreation) uses were assessed (monitored) as "not supported" due to 1) extremely poor water transparency that violates IA's WQS protecting objectionable conditions and 2) frequent violations of IA's water quality criterion for pH. In addition, the presence of very large populations of nuisance aquatic life (blue-green algae) likely represents an additional impairment to the Class A uses. The Class B (LW) aquatic uses were assessed as "not supported" due to violations of state water quality criteria for dissolved oxygen (DO) and pH. The Class B (LW) uses were also assessed as "not supported" due to excessive nutrient loading to the water column, nuisance blooms of algae, and re-suspension of sediment.

Algae, pH, and turbidity impairments are linked to the rapid growth of algae which results in the increase of turbidity and algal photosynthesis. The increase of turbidity and algal photosynthesis increases lake pH by removing carbon dioxide and shifting the carbonate system equilibrium. TP is the limiting nutrient for algae growth. The target for TP concentration is less than 56 ug/l. The TMDL recognizes Carlson's TSI values of less than 65 for chlorophyll a and less than 61 for Secchi depth to achieve supporting water quality within the watershed. The targets indicated above translate to a chlorophyll a concentration of 33 ug/L and a Secchi depth greater than 0.8 m. The Secchi depth selected was greater than 0.7 m because a mean value of 0.7 m does not provide adequate protection from episodes of very low transparency. This is how and why the indicated targets are set to assist in the achievement of increased water quality within Union Grove Lake. Chapter 61 of the IA WQS was also used to determine criteria for the water quality and is available at http://www.iowadnr.com/water/standards/files/chapter61.pdf for reference purposes. The criteria used to determine attainment of WQS is explained in the 305 (b) report assessment protocol described in Appendix G of the TMDL.

Carlson's TSI values were used to relate algae as measured by chlorophyll a, transparency as measured by Secchi depth, and TP to each other. It was also used to establish water quality improvement targets for Union Grove Lake. The annual average chlorophyll a and Secchi depth targets are related to TP through the BATHTUB lake nutrient model. BATHTUB helps facilitate eutrophication to morphometrically complex reservoirs. The LC is the annual average TP loading the lake can receive while meeting the chlorophyll a and Secchi depth targets. To calculate a maximum daily load for TP, the BasinSim Generalized Watershed Loading Function (GWLF) watershed model was used. This model evaluates the effect of land use practices on downstream loads of sediment and nutrients. The model used TP from precipitation driven erosion, geese feces, and septic tanks. The LC for TP is 3,006 lbs/year.

For *E. coli*, a load duration curve based on the calibrated flows from the BasinSim GWLF model was used to develop target loads for Union Grove Lake. Evaluation of the flow duration curve and the runoff duration curve resulted in four different flow conditions. The LC for *E. coli* is 2.53 E+10 org counts/day. The standard is a geometric mean of 126 *E. coli* orgs/100 ml and a single sample maximum of 235 *E. coli* orgs/100 ml.

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.

Pollutants of concern for Union Grove Lake are algae, turbidity, pH and *E. coli*. TP is an established link between algae, turbidity, and pH. Excessive TP is stated as the primary reason for blooms of algae resulting in turbidity within the lake. The submittal states that inorganic suspended solids such as non-algal turbidity has also contributed to lake turbidity. TP is often attached to soil particles and TP is the limiting nutrient within this TMDL. TP is used as a translator to reduce algae, turbidity, and pH within the water body. The reduction of TP complements the reduction of both algal and non-algal turbidity caused by inorganic suspended solids.

The target for TP concentration is less than 56 ug/l. Water quality data show that pH is positively correlated to the amount of algae, as represented by a green pigment present in algal cells called chlorophyll a. The TMDL recognizes Carlson's TSI values of less than 65 for chlorophyll a and less than 61 for Secchi depth to achieve supporting water quality within the watershed. The targets indicated above translate to a chlorophyll a concentration of 33 ug/L and a Secchi depth greater than 0.8 m. To achieve attainment of WQS, the submittal states that pH shall not be less than 6.5 nor greater than 9.0.

The linkage for *E. coli* is direct. *E. coli* pollutant loading are divided into two components, episodic and continuous. Continuous loading include discharges from septic tanks and manure from cattle. At high runoff conditions, loads are stated to increase. It is also at this time watershed bacteria are washed off by storm events. In high flow conditions, bacteria concentrations are normally higher when runoff occurs. Therefore, *E. coli* should be reduced by 9.00E+09 org counts/day. The standard for *E. coli* is a geometric mean of 126 orgs/100 ml and a single sample maximum concentration of 235 *E. coli* orgs/100 ml. Targets for this TMDL were determined based on EPA's Bacteria Indicator Tool (BIT) modeling fecal coliform. Fecal coliform is a subset to *E. coli*.

The criteria used to determine attainment of WQS is explained in the 305(b) report assessment protocol described in Appendix G of the TMDL.

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.

Union Grove Lake watershed consists of 6,949 acres, which includes the lake. Excluding the lake, the watershed has a drainage if 6,834 acres and a watershed to lake ratio 59:1. There are no cities or NPDES permitted point sources in the watershed, but there are 69 residences adjacent to the lake. All residences utilize onsite septic tank systems for wastewater treatment. Many are not functioning properly and discharging directly to surface drainage. The submittal states that Union Grove State Park has "unimproved" sanitary facilities and 25 campsites.

Land use for Union Grove Lake is comprised of 2 % grassland, 2 % farmstead, 3 % forest (ungrazed), 2 % hayland, 4 % parkland/wildlife, 5 % pasture, 1 % residential, 1 % road, 77 % rowcrop, 2 % water, and 1 % wetland. There are two animal feeding operations within the watershed. Union Grove Lake contains three soil types: Tama Association, Muscatine-Tama-Garwin Association and Fayette-Downs Association.

Pollutants of concern for this watershed include algae, pH, turbidity, and *E. coli.* An excess in TP is the primary reason for blooms of algae, thus resulting in turbidity. Summer algal blooms directly relates to the TP load, but is not the only factor in algal production. Turbidity within this lake is also caused by inorganic suspended solids due to the fact that most TP is attached to soil particles. Potential nonpoint sources for these pollutants include: agricultural activities, inadequate on-site septic tank treatment systems, wildlife, runoff from the lakeshore residential area, atmospheric deposition, ground water, and internal recycling loads. TP is noted to have four significant sources: watershed land use areas draining into the lake, ground water seeping into the lake from fractured rock, phosphorus recycled from lake sediments, and natural background atmospheric direct deposition. Livestock sources within the watershed were estimated using assessments made by IDNR. Livestock numbers include 399 beef cattle, 1,440 swine (hog), and 36 sheep. Natural background sources are comprised of atmospheric deposition to the lake surface.

Any (Concentrated Animal Feeding Operation) CAFO that does not obtain a National Pollutant Discharge Elimination System (NPDES) permit must operate as a no discharge operation. Any discharge from an unpermitted CAFO is a violation of Section 301. It is EPA's position that all CAFOs should obtain a NPDES permit because it provides clarity of compliance requirements, authorization to discharge when the discharges are the result of large precipitation events (e.g., in excess of 25-year and 24-hour frequency/duration) or are from a man-made conveyance. However, many large CAFOs (mostly the poultry and swine sectors) contend that they do not discharge nor propose to discharge therefore are not required to obtain an NPDES permit. It is EPA's opinion that many of the "no discharge" CAFOs do not have adequate land application area to ensure the agronomic uptake of land applied waste or are not designed, constructed, operated or maintained so that they do not discharge or propose to discharge. Furthermore, there are many Animal Feeding Operations (AFOs) that meet the definition of a medium CAFO (i.e., discharge via a man-made conveyance) but are unpermitted and have not limited their impact on waters by applying Best Professional Judgment to effluent reductions.

Permitted CAFOs identified in this TMDL are part of the assigned WLA. AFOs and unpermitted CAFOs are considered under the LA because we do not currently have enough detailed information to know whether these facilities are required to obtain NPDES permits. This TMDL does not reflect a determination by EPA that such facility does not meet the definition of a CAFO nor that the facility does not need to obtain a permit. To the contrary, a CAFO that discharges or proposes to discharge has a duty to obtain a permit. If it is determined that any such operation is an AFO or CAFO that discharges, any future WLA assigned to the facility must not result in an exceedance of the sum of the WLAs in this TMDL as approved.

E. coli is divided into two source components. One is considered to be episodic and is comprised of livestock and wildlife fecal material occasionally being transported to the lake during precipitation occurrences. The other is continuous, this includes discharges from leaking septic tank systems and manure from cattle in and around streams. Loads are at maximum existence when runoff flow concentrations are highest. Increased loads and flows cause bacteria concentration to exceed the criteria. Another condition resulting in criteria violations occur during long hydraulic residence time within the lake such as when flows are minimal, from continuous loads from livestock, local wildlife, and when lakeshore septic tanks accumulate and cause an issue.

Based on the information before us, the states decision to apply the discharges associated with unpermitted point sources to the LA, as opposed to the WLA for purposes of this TMDL is acceptable. The decision to allocate these sources to the LA does not reflect any determination by EPA as to whether these discharges are, in fact, unpermitted point sources treated as LA; EPA is not determining that these discharges are exempt from NPDES permitting requirements. If sources of all the allocated pollutant in this TMDL are found to be, or become, NPDES-regulated discharges, their loads must be considered as part of the calculated sum of the WLA in this TMDL. WLA in addition to that allocated here is not available.

EPA agrees this submittal considers all known sources.

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.

While EPA is approving this TMDL phosphorus target, we do not endorse IDNR's best professional judgment used to parameterize the BATHTUB model. However, the TMDL phosphorus target was independently calculated by EPA using different methodologies and the results were within the TMDL MOS of IDNR's target. In other words, the two techniques result in a similar target; therefore EPA approves the TMDL target.

The LC for TP is 3,006 lbs/yr, or 768 lbs/day. TP is a translator that relates pH, Secchi depth and chlorophyll a.

There are no permitted point sources within the watershed, therefore the WLA is zero.

The LA for TP is 2,706 lbs/yr, or 691 lbs/day TP.

The LA for pH shall be no less than 6.5 nor greater than 9.0. Secchi depth and chlorophyll a concentration has a LA of 0.8 m and 33 ug/l, respectively.

The MOS for all TMDLs is an explicit 10 percent. For TP, the MOS is 77 lbs/yr TP.

The LC for *E. coli* is 2.53 E+10 org counts/day. The LC for *E. coli* was calculated using the single sample maximum of *E. coli* 235 orgs/100 ml.

For *E. coli*, the LA was designed for four design flow recurrence intervals. Within the mixed, 30 percent to 80 percent design flow, the LA is 2.28E+10 org counts/day. The MOS is 2.53E+9 org counts/day.

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.

There are no permitted point sources within the watershed, therefore the WLA is zero.

EPA agrees this is an appropriate WLA.

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.

TP is used as a translator to relate pH, Secchi depth and chlorophyll a. For TP the LA is 2,706 lbs/yr, or 691 lbs/day TP. The LA for pH shall not be less than 6.5 nor greater than 9.0. The LA for Secchi depth is 0.8 m. Chlorophyll a concentration has a LA of 33 ug/l.

For *E. coli*, the LA was designed for four design flow recurrence intervals. In the mixed, 30 percent to 80 percent design flow, the LA is 2.28E+10 org counts/day.

EPA agrees this is an appropriate LA.

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.

The MOS is an explicit 10 percent and is 77 lbs/year for TP.

The MOS for *E. coli* was designed for four design flow recurrence intervals. Within the mixed, 30 percent to 80 percent design flow, the MOS is 2.53 E+9 orgs counts/day.

EPA agrees this is an appropriate MOS.

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.

Seasonal variation and critical conditions for algae, turbidity, and pH are considered during the growing season of May-September. It is during this time that nuisance algal blooms are common.

The recreation season, March 15 - November 15, was used in the development of the pathogen indicator, *E. coli*, for this TMDL.

Seasonality and any critical conditions have been addressed in the submittal.

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 first public meeting providing information on the water quality improvement plan was held on April 26, 2007, at the Youth Center adjacent to the lake. On May 28, 2008, an event was held at the Youth Center to kick-off the 319 Nonpoint Source Watershed Improvement Project.

During the public comment period of May 28 - June 29, 2009, one letter was received. All comments were considered accordingly. Refer to Appendix H of the TMDL for a copy of the comments and IDNR's response.

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 will consist of three to six samples taken in the growing season and will provide information used in the annual 305(b) water quality assessment. Weekly beach monitoring for *E. coli* is likely to continue. Samples collected at two Deer Creek sites and three sites in the lake began in Spring 2008. This sampling was performed biweekly from June 2 to October 20, 2008. These samples were analyzed for the nitrogen, phosphorus, and suspended solids series as well as *E. coli* and Secchi depth. Both tributary and in-lake data were used to parameterize the Watershed Analysis Simulation Program (WASP) model. This monitoring will be done through the life of the project.

Future monitoring for Union Grove Lake include erosion and sediment control which will be performed two years before and five years after Best Management Practices (BMP) installation at tributary sites. Carp removal effectiveness will be measured three years after removal at a deep lake site. Empirical/mass, balance lake eutrophication and BATHTUB modeling will also be conducted for five years at a deep lake site. Mechanistic lake eutrophication WASP modeling will be performed for two years at a deep lake site. A load duration curve of bacteria will calculate five years of precipitation and discharge data. Dredging for thermal stratification five years after the project completion will also be performed at a deep lake site.

Reference Table 24 and Table 25 of the TMDL for additional monitoring.

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.

EPA believes that point source permitting authority and nonpoint source measures discussed in the implementation plan provides reasonable assurances that the TMDL allocations can be achieved.

IDNR has the authority to issue and enforce state operating permits. Inclusion of effluent limits into a state operating permit and requiring that effluent and instream monitoring be reported to IDNR should provide reasonable assurance that instream WQS will be met. Section 301(b)(1)(C) requires that point source permits have effluent limits as stringent as necessary to meet WQS. However, for WLAs to serve that purpose, they must themselves be stringent enough so that (in conjunction with the water body's other loadings) they meet WQS. This generally occurs when the TMDL's combined nonpoint source LAs and point source WLAs do not exceed the WQS-based LC and there is reasonable assurance that the TMDL's allocations can be achieved. Discussion of reduction efforts relating to nonpoint sources can be found in the implementation section of the TMDL.

While EPA is approving this TMDL phosphorus target, we do not endorse IDNR's best professional judgment used to parameterize the BATHTUB model. However, the TMDL phosphorus target was independently calculated by EPA using different methodologies and the results were within the TMDL MOS of IDNR's target. In other words, the two techniques result in a similar target; therefore EPA approves the TMDL target.

With cropland accounting for roughly 77 percent of the land area in the watershed, erosion from row crop land use and the internal resuspension and recycling of silt and phosphorus are a chief component of algae and turbidity nonpoint source contributions. *E. coli* nonpoint source contributions include septic systems, livestock grazing, manure applications and wildlife. To further reduce the loading and effect of TP, algae, turbidity, and *E. coli* in Union Grove Lake, local watershed managers, citizens, and farmers could be encouraged to adopt BMPs. The concept of BMPs is one of a voluntary and site-specific approach to water management, nutrient management, riparian buffers, and erosion control. A 319 project was outlined in Table 23 of the TMDL. The erosion control BMPs will inventory and evaluate existing structures, as well as construct new BMPs. These projects began approximately May 2009 and will run until May 2012. A program for livestock controls that will provide livestock watering and that will fence out livestock from streams has been established. The approximate timeline for these projects is June 2009 through September 2011. A focus on septic tanks that inspects and evaluates residential septic tank systems, assesses best wastewater treatment approach, and maintains existing septic systems, was also included as a BMP. The timeline for these projects is May 2011 through May 2015.