UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 5
77 WEST JACKSON BOULEVARD
CHICAGO, IL 60604-3590

APR 25 2011

REPLY TO THE ATTENTION OF: WW-16J

Rebecca J. Flood, Assistant Commissioner
Minnesota Pollution Control Agency
520 Lafayette Road North
St. Paul, MN 551555-4194

Dear Ms. Flood:

The U. S. Environmental Protection Agency has reviewed the final Total Maximum Daily Loads (TMDLs) for Lake Sarah (IDs# 27-0191-01 and 27-0191-02), including supporting documentation and follow up information. Minnesota's submitted TMDLs for total phosphorus address the excess nutrient loads that impair the Recreational Use Support in approximately 553 acres of Lake Sarah in the Pioneer-Sarah Creek watershed. Based on this review, EPA has determined that Minnesota's TMDLs for total phosphorus meet the requirements of Section 303(d) of the Clean Water Act and EPA's implementing regulations at 40 C.F.R. Part 130. Therefore, EPA hereby approves Minnesota's two TMDLs for this impaired lake. The statutory and regulatory requirements, and EPA's review of Minnesota's compliance with each requirement, are described in the enclosed decision document.

We wish to acknowledge Minnesota's effort in submitting these TMDLs and look forward to future TMDL submissions by the State of Minnesota. If you have any questions, please contact Mr. Peter Swenson, Chief of the Watersheds and Wetlands Branch, at 312-886-0236.

Sincerely,

Tinka G. Hyde
Director, Water Division

Enclosure

cc: Jeff Risberg, MPCA
Dave L. Johnson, MPCA

wq-iw8-13g

TMDL: Lake Sarah, Minnesota
Date:

DECISION DOCUMENT
LAKE SARAH PHOSPHORUS TMDL

Section 303(d) of the Clean Water Act (CWA) and U.S. EPA's implementing regulations at 40 C.F.R. Part 130 describe the statutory and regulatory requirements for approvable TMDLs. Additional information is generally necessary for U.S. EPA to determine if a submitted TMDL fulfills the legal requirements for approval under Section 303(d) and U.S. EPA regulations, and should be included in the submittal package. Use of the verb "must" below denotes information that is required to be submitted because it relates to elements of the TMDL required by the CWA and by regulation. Use of the term "should" below denotes information that is generally necessary for U.S. EPA to determine if a submitted TMDL is approvable. These TMDL review guidelines are not themselves regulations. They are an attempt to summarize and provide guidance regarding currently effective statutory and regulatory requirements relating to TMDLs. Any differences between these guidelines and U.S. EPA's TMDL regulations should be resolved in favor of the regulations themselves.

1. Identification of Waterbody, Pollutant of Concern, Pollutant Sources, and Priority Ranking

The TMDL submittal should identify the waterbody as it appears on the State's/Tribe's 303(d) list. The waterbody should be identified/georeferenced using the National Hydrography Dataset (NHD), and the TMDL should clearly identify the pollutant for which the TMDL is being established. In addition, the TMDL should identify the priority ranking of the waterbody and specify the link between the pollutant of concern and the water quality standard (see section 2 below).

The TMDL submittal should include an identification of the point and non-point sources of the pollutant of concern, including location of the source(s) and the quantity of the loading, e.g., lbs/per day. The TMDL should provide the identification numbers of the NPDES permits within the waterbody. Where it is possible to separate natural background from non-point sources, the TMDL should include a description of the natural background. This information is necessary for U.S. EPA's review of the load and wasteload allocations, which are required by regulation.

The TMDL submittal should also contain a description of any important assumptions made in developing the TMDL, such as:

(1) the spatial extent of the watershed in which the impaired waterbody is located;
(2) the assumed distribution of land use in the watershed (e.g., urban, forested, agriculture);
(3) population characteristics, wildlife resources, and other relevant information affecting the characterization of the pollutant of concern and its allocation to sources;
(4) present and future growth trends, if taken into consideration in preparing the TMDL (e.g., the TMDL could include the design capacity of a wastewater treatment facility); and
(5) an explanation and analytical basis for expressing the TMDL through *surrogate measures*, if applicable. *Surrogate measures* are parameters such as percent fines and turbidity for sediment impairments; chlorophyl *a* and phosphorus loadings for excess algae; length of riparian buffer; or number of acres of best management practices.

Comments:

Lake Sarah (Segment IDs# 27-0191-01 for West Bay and 27-0191-02 for East Bay) is a 553-acre lake located approximately 24 miles west of Minneapolis in west central Hennepin County, Minnesota (See Figure 1.1 of final TMDL submitted report). Lake Sarah is a deep (maximum depth of 59 feet and a median depth of 9.7 feet), elongated lake with two bays (West Bay and East Bay). The lake receives runoff from a 4454-acre mixed-use watershed which drains land from portions of five municipalities – Greenfield, Independence, Corcoran, Loretto, and Medina. Lake Sarah was identified on Minnesota's 2008 303(d) list as impaired for excess nutrient/eutrophication, which is the impairment contributing to the nonattainment of the recreational use (swimming). The submitted TMDL report addresses the excess nutrient/ eutrophication impairment (See Table 1 in conclusion section of this decision document).

The Lake Sarah watershed is predominantly an agricultural and residential watershed. Primary land uses throughout the watershed are agriculture (23%), rural residential (22%), medium density residential (7%), wetland (21%), commercial (3%), and pasture/feedlots for horses and cattle (3%) (Figure 1.2 of the final TMDL report). In recent years, agricultural land has been increasingly converted into residential and commercial developments in the Lake Sarah watershed. The Metropolitan Council's 2030 land use plan includes substantial areas that will be zoned for residential and commercial development.

Point sources contributing to the excess nutrient/ eutrophication impairment in Lake Sarah include four municipal Separate Storm Sewer Systems (MS4s) (permit #s MS400081, MS400095, MS400105, MS400030), and stormwater from construction activities (permit # MNR100001) (Table 5.3 and Section 5.1 of the final TMDL report).

Nonpoint sources contributing to the excess nutrient/ eutrophication impairment in Lake Sarah include agricultural runoff from cropland and livestock rearing, non-permitted urban runoff, atmospheric deposition and the internal nutrient recycling from the lake bottom sediments.

Internal loading in lakes refers to the phosphorus load that is released from the sediments into the water column. There are two primary sources of internal loading in Lake Sarah – direct sediment release and curlyleaf pondweed senescence (i.e., die off). Water at the sediment-water interface remains hypoxic/anoxic (periods where dissolved oxygen (DO) concentration are at or near zero) for a significant portion of the growing season (Figure 3.8 of the final TMDL report). Under low oxygen conditions, sediments release phosphorus, which accumulates in the deep lake waters, or hypolimnion (Figure 3.9 of the final TMDL report). Phosphorus released from the sediments is mixed throughout the water column as stratification changes throughout the growing season (sudden increase in total phosphorus (TP) concentration following fall turnover in Figures 3.10 and 3.11 of the final TMDL report). Wind mixing and temperature changes are the primary mechanisms that alter stratification patterns within a lake (based on fishery assessments and visual observation, benthic fish do not appear to be a significant source of internal loading). Increased phosphorus release to surface waters often results in more frequent and intense algal blooms and reduced water clarity (Figure 1.7 of the final TMDL report).

Minnesota's 2008 303(d) list includes a projected schedule for TMDL completions. This schedule reflects the state's priority ranking of impaired waters. The schedule for the Lake Sarah TMDL for excess nutrient/ eutrophication has a priority ranking within the top 8% of Minnesota's listed waters.

U.S. EPA finds that the TMDL document submitted by MPCA satisfies all requirements concerning this first element.

2. Description of the Applicable Water Quality Standards and Numeric Water Quality Target

The TMDL submittal must include a description of the applicable State/Tribal water quality standard, including the designated use(s) of the waterbody, the applicable numeric or narrative water quality criterion, and the antidegradation policy. (40 C.F.R. §130.7(c)(1)).
U.S. EPA needs this information to review the loading capacity determination, and load and wasteload allocations, which are required by regulation.

The TMDL submittal must identify a numeric water quality target(s) – a quantitative value used to measure whether or not the applicable water quality standard is attained. Generally, the pollutant of concern and the numeric water quality target are, respectively, the chemical causing the impairment and the numeric criteria for that chemical (e.g., chromium) contained in the water quality standard. The TMDL expresses the relationship between any necessary reduction of the pollutant of concern and the attainment of the numeric water quality target. Occasionally, the pollutant of concern is different from the pollutant that is the subject of the numeric water quality target (e.g., when the pollutant of concern is phosphorus and the numeric water quality target is expressed as Dissolved Oxygen (DO) criteria). In such cases, the TMDL submittal should explain the linkage between the pollutant of concern and the chosen numeric water quality target.

Comments:

Lake Sarah is located in the North Central Hardwood Forest Ecoregion, and is designated as a Class 2B water under Minnesota Rule 7050.0430. Class 2 waters, aquatic life and recreation, includes all waters of the state that support or may

support fish, other aquatic life, bathing, boating, or other recreational purposes and for which quality control is or may be necessary to protect aquatic or terrestrial life or their habitats or the public health, safety, or welfare.

According to Minnesota Rules 7050.0222 Subp 4, the numeric eutrophication water quality standards (WQS) for class 2B waters applicable to deep (i.e., at least 15 feet maximum depth or less than 80% littoral area) lakes and reservoirs in the North Central Hardwood Forest Ecoregion include the following:

- Total Phosphorus: $\leq$40 µg/L
- Chlorophyll-a: $\leq$14 µg/L
- Secchi disc transparency: $\geq$1.4 m

Lakes and reservoirs are to meet the TP, the Chlorophyll-a, and the Secchi disc transparency targets in order to achieve the WQS. The eutrophication standards are compared to data averaged over the summer season (June through September).

In developing the lake eutrophication standards (Minn. Rule 7050), the MPCA evaluated data from a large cross-section of lakes within each of the state's ecoregions (Heiskary and Wilson, 2005). Clear relationships were established between the causal factor total phosphorus and the response variables chlorophyll-a and Secchi disk. Based on these relationships MPCA believes that by meeting the phosphorus target of 40 µg/L for Lake Sarah the chlorophyll-a and Secchi standards (14 µg/L and 1.4 m, respectively) will likewise be met. Therefore, in order to maintain the water quality conditions that warrant full support of the designated uses in Lake Sarah, the submitted TMDL adopted the TP criteria of 40 µg/L average concentration over the summer season (June through September) as the primary TMDL target.

U.S. EPA finds that the TMDL document submitted by MPCA satisfies all requirements concerning this second element.

3. Loading Capacity - Linking Water Quality and Pollutant Sources

A TMDL must identify the loading capacity of a waterbody for the applicable pollutant. U.S. EPA regulations define loading capacity as the greatest amount of a pollutant that a water can receive without violating water quality standards (40 C.F.R. §130.2(f)).

The pollutant loadings may be expressed as either mass-per-time, toxicity or other appropriate measure (40 C.F.R. §130.2(i)). If the TMDL is expressed in terms other than a daily load, e.g., an annual load, the submittal should explain why it is appropriate to express the TMDL in the unit of measurement chosen. The TMDL submittal should describe the method used to establish the cause-and-effect relationship between the numeric target and the identified pollutant sources. In many instances, this method will be a water quality model.

The TMDL submittal should contain documentation supporting the TMDL analysis, including the basis for any assumptions; a discussion of strengths and weaknesses in the analytical process; and results from any water quality modeling. U.S. EPA needs this information to review the loading capacity determination, and load and wasteload allocations, which are required by regulation.

TMDLs must take into account *critical conditions* for steam flow, loading, and water quality parameters as part of the analysis of loading capacity. (40 C.F.R. §130.7(c)(1)). TMDLs should define applicable *critical conditions* and describe their approach to estimating both point and non-point source loadings under such *critical conditions*. In particular, the TMDL should discuss the approach used to compute and allocate non-point source loadings, e.g., meteorological conditions and land use distribution.

Comments:

MPCA determined that the total loading capacity, i.e., total maximum daily load, of TP for the Lake Sarah (Segment IDs# 27-0191-01 and 27-0191-02) was 3.797 lbs/day (Section 5 and Table 5.1 of the final TMDL report). Modeling results estimated that the Lake Sarah watershed contributes approximately 38% (17% from permitted and 21% from non-permitted sources), internal loading accounts for 59%, and atmospheric deposition accounts for 3% of the total annual TP load to the lake (Table 4.8 of the final TMDL report). Based on the load-response simulation, the watershed TP load must be reduced by ~53% and internal loading must be controlled to background levels for the lake to meet the eutrophication

WQS. Although Lake Sarah has two geographically distinct areas (Figure 1.1 of final TMDL report), it was modeled as a single segment because the results from comparative sampling efforts suggested that there was not a significant difference in water quality between the two bays (Appendix A of the final TMDL report).

A series of lake response models were used to determine the final target phosphorus load reduction: FLUX; Program for Predicting Polluting Particle Passage through Pits, Puddles, and Ponds (P8); Source Loading and Management Model (SLAMM); Soil and Water Assessment Tool (SWAT); Nürnberg anoxic sediment release model; Simple TP model; Land use-specific phosphorus export coefficients; and BATHTUB. The SWAT model was used to model runoff from the agricultural subwatersheds draining to Lake Sarah. The P8 model was used to estimate the pollutant loading from the urban areas within the Lake Sarah watershed and the model outputs were used to calibrate the Hydrologic Response Units (HRUs) that drain urban areas in the SWAT model. The SLAMM model was used to estimate phosphorus loading from residential and rural residential areas that provide direct runoff to Lake Sarah and to estimate dirt loadings from transportation corridors (SLAMM represents sediment, TSS and TP accumulation as a total "dirt" load). Methods described by Nürnberg were used to calculate potential internal loading of phosphorus from sediment release in Lake Sarah. The Simple TP model was used to estimate the sediment release rates for Lake Sarah. The BATHTUB model was used to estimate phosphorus loads from atmospheric deposition and internal nutrient loading, and to ultimately estimate the TMDL phosphorus load based on the average existing phosphorus loads input generated using the series of models mentioned above. Rural areas of the watershed that directly drain to the lake were modeled using land use-specific phosphorus export coefficients because these areas are not effectively modeled with SWAT, P8 or SLAMM.

FLUX is a model that allows estimation of tributary mass discharges (loadings) from sample concentration data and continuous flow records. Loads of each nutrient were calculated with the FLUX32 Load Estimating Software version 2.11 for the Lake Sarah tributary outlet sites (Table 2.1 of the final TMDL report). Concentrations from 2007 and 2008 years were used to determine the relationship between concentration and flow that was applied to the whole time period.

The P8 model estimates watershed phosphorus loading using particle concentrations in the runoff. Particle loads from pervious and impervious areas are computed using a sediment rating model and particle accumulation and washoff equations that are derived from the EPA Stormwater Management Model (SWMM). The water quality components of the model are based upon weight distributions across particle classes. A default file for particle classes and water quality components was used to estimate watershed loads of total phosphorus, total nitrogen, and total suspended solids. Watershed runoff and loading in the model is transported directly to downstream devices such as storm sewer pipes, open channels, and detention ponds to model their effect on water quality. Continuous water-balance and mass-balance calculations were performed to determine nutrient removal efficiencies for each device. In the Lake Sarah watershed, P8 was specifically used to evaluate the urban and residential drainage areas within the City of Loretto. The P8 model estimated run-off volumes, nutrient concentrations, and nutrient loadings using 2007 and 2008 precipitation data. These water volumes and phosphorus export components derived from the P8 model were used to further verify and validate the calibrated watershed-wide SWAT model. See Sections 3.1.2 and 3.1.3 of the final TMDL report for additional info about the P8 model.

The SLAMM model uses empirical relationships between phosphorus build-up, precipitation and runoff to estimate the phosphorus loading that would be expected from different urban land uses (e.g., roofs, sidewalks, driveways, parking lots, streets, etc.) under different precipitation patterns. SLAMM computes nutrient loading using the cumulative mass loads and runoff volumes. Outputs from SLAMM for residential and rural residential areas directly draining to Lake Sarah were input as a phosphorus source into the BATHTUB model. The dirt accumulation estimated in SLAMM was used to calibrate phosphorus loadings for transportation corridors in the SWAT model. See Section 3.1.4 of the final TMDL report for additional info about the SLAMM model.

The SWAT model is a partially physically-based and partially empirically-based watershed model that simulates the hydrologic cycle accounting for the following processes: precipitation, overland runoff, infiltration, percolation through one or more soil layers, evaporation, plant transpiration, interaction with the shallow aquifer, and loss to a deep aquifer. Water is delivered to the stream as overland runoff, lateral flow, and groundwater flow and is routed through defined stream channels to the watershed outlet. SWAT also models off-channel, surface-water bodies such as wetlands and ponds and on-channel bodies such as reservoirs. Sediment export from uplands is calculated with the Modified Universal Soil Loss Equation (MUSLE) which includes a peak flow component that is used to determine the amount of eroded

sediment reaching the stream from a uniform land area during a single storm event. Factors that control sediment export predicted by the MUSLE are surface runoff, peak flow, soil erodibility, biomass and residue present, cropping practices, slope length, and percentage of coarse fragments (i.e., stones) of soil. Simulation of phosphorus and nitrogen cycles in SWAT uses inputs of inorganic fertilizer, organic fertilizer, plant residue, and, for nitrogen, rainwater. SWAT also allows for direct plant growth modeling based on simplified crop growth equations from the Erosion Productivity-Impact Calculator (EPIC) with controlling inputs including temperature, solar radiation, nutrient availability, and water. In addition, SWAT allows input of specific management rotations for agricultural land, providing opportunities for modeling alternative scenarios to guide management decisions. The spatial inputs for the Lake Sarah SWAT model included digital elevation, land use, and soils. The SWAT model was calibrated to two years of monitoring data (2007 and 2008) for the East and West Tributaries. The calibrated SWAT model was used to track the portion of phosphorus loading conveyed to Lake Sarah from the City of Loretto for the 10-year average precipitation conditions. See Section 3.1.5 of the final TMDL report for additional info about the SWAT model.

The Nürnberg anoxic sediment release model uses the Nürnberg equation to estimate the internal phosphorus load by multiplying an internal loading rate (calculated by multiplying the sediment release rates by an anoxic factor) by the lake area. The anoxic factor represents the number of days that a sediment area, equal to the whole-lake surface area, is overlain by anoxic water (< 1 mg O2/L). See page 41 of the final TMDL report for additional info about the Nürnberg anoxic sediment release model.

The Simple TP Model, which was used to calculate the sediment release rates for Lake Sarah, uses mass balance calculations to track the estimated epilimnetic and hypolimnetic concentrations of total phosphorus on a time series basis. The Simple TP model uses a series of algorithms to calculate the mass balance within and between each segment layer (epilimnion and hypolimnion) based on the in-lake stratification conditions. See pages 41 - 42 of the final TMDL report for additional info about the Simple TP model.

BATHTUB is an empirical model that estimates lake and reservoir eutrophication using several different algorithms. The model estimates in-lake water quality conditions based on the lake morphological characteristics and a mass-balance of nutrient loading to the lake. The BATHTUB model was used to estimate the overall nutrient loading from atmospheric deposition, internal and watershed sources. Input data, output files and diagnostic parameters used for BATHTUB modeling are summarized in Appendix C of the final TMDL report.

The watershed load entered into the BATHTUB model was developed from both modeling efforts and monitoring data (Table 4.4 of the final TMDL report). The BATHTUB model calculated watershed load for each tributary by multiplying an annual flow by an average concentration. TP loads from the individual land use models were combined to estimate an average cumulative watershed load (2108 lb/yr), based on 10-year average precipitation conditions (Table 3.11 of the final TMDL report). TP internal load estimates were also derived using the BATHTUB model. The BATHTUB model was calibrated to in-lake total phosphorus concentrations using data from 2004 through 2008 (Section 4.2 of the final TMDL report). An additional internal loading calibration adjustment, which represented an additional internal load that was greater than the implicit background level already considered in the BATHTUB model, was added to achieve a stronger correlation between modeled and observed water quality conditions. The additional internal load required to calibrate the BATHTUB model was consistent with the internal load estimated from the Nürnberg equation and curlyleaf pondweed senescence. The calibrated BATHTUB model was then validated using in-lake water quality data and SWAT/SLAMM watershed load estimates from 2007 and 2008 (Section 4.3 of the final TMDL report). Following calibration/validation, an in-lake load-response simulation was performed to determine the assimilative capacity for Lake Sarah. The load response procedure was performed to evaluate the in-lake water quality response to varying phosphorus loads from the watershed, and estimate the watershed TP load consistent with achieving specific water quality goals for Lake Sarah. The load response analysis was performed with the internal loading rate set to zero, which indicated that the maximum internal load that will result in compliance with the in-lake water quality goals can be no higher than the background levels of internal loading represented in the BATHTUB model (Section 4.2 of the final TMDL report). With the internal load set to zero, the watershed phosphorus loads were incrementally reduced to identify the watershed load that resulted in an in-lake TP concentration of 40 µg/L. The output from the load response analysis also included predictions of chlorophyll-*a* concentrations and secchi depth that would be anticipated when the in-lake phosphorus concentration reached the TMDL goal (with the MOS).

The critical environmental conditions for the phosphorus impairments in Lake Sarah correspond to the summer growing season (May through September), when observed phosphorus concentrations in the lake tend to be the highest. Surface runoff contains nutrients which are transported into the lake during summer rain events. Nutrients can also be internally loaded to the lake, resulting from aquatic plant senescence or direct sediment release from hypolimnetic water during summer mixing events.

U.S. EPA finds that the TMDL document submitted by MPCA satisfies all requirements concerning this third element.

4. Load Allocations (LAs)

U.S. EPA regulations require that a TMDL include LAs, which identify the portion of the loading capacity attributed to existing and future non-point sources and to natural background. Load allocations may range from reasonably accurate estimates to gross allotments (40 C.F.R. §130.2(g)). Where possible, load allocations should be described separately for natural background and non-point sources.

Comments:

MPCA determined that the total load allocation (LA) of TP for the Lake Sarah was 2.082 lbs/day (Section 5.2 and Table 5.4 of the final TMDL report). This LA (2.082 lbs/day) corresponds to an approximately 83% reduction (10.385 lbs/day) from the estimated existing TP load by nonpoint sources (12.467 lbs/day). The existing nonpoint sources contributing to the LA include agricultural runoff from cropland and livestock rearing, non-permitted urban runoff, atmospheric deposition and the internal nutrient recycling from the lake bottom sediments.

The total LA (2.082 lbs/day) is composed of 1.676 lbs/day from non-permitted watershed load (1.606 lbs/day from the City of Greenfield, 0.047 lbs/day from Mn/DOT, 0.023 lbs/day from Hennepin County), 0.405 lbs/day from atmospheric deposition and 0 lbs/day from internal loading. Setting the internal load value in the TMDL equation to zero does not imply there is no internal load, instead it indicates that the internal load that will allow Lake Sarah to meet WQS can be no higher than the background levels of internal loading already represented in the BATHTUB model. Currently the total load from existing nonpoint sources (12.467 lbs/day) is composed of 3.235 lbs/day from non-permitted watershed load, 8.827 lbs/day from internal loading and 0.405 lbs/day from atmospheric deposition. In order to meet the TMDL water quality goals, MPCA determined that the TP load from non-permitted watershed, internal (above the background level), and atmospheric deposition sources will have to be reduced by an average of 1.558 lbs/day (48%), 8.827 lbs/day (100%), and 0 lbs/day respectively. Because the City of Greenfield, Hennepin County and Minnesota Department of Transportation (Mn/DOT) are not currently regulated MS4s within the watershed, their respective TP loads were included in the LA.

U.S. EPA finds that the TMDL document submitted by MPCA satisfies all requirements concerning this fourth element.

5. Wasteload Allocations (WLAs)

U.S. EPA regulations require that a TMDL include WLAs, which identify the portion of the loading capacity allocated to individual existing and future point source(s) (40 C.F.R. §130.2(h), 40 C.F.R. §130.2(i)). In some cases, WLAs may cover more than one discharger, e.g., if the source is contained within a general permit.

The individual WLAs may take the form of uniform percentage reductions or individual mass based limitations for dischargers where it can be shown that this solution meets WQSs and does not result in localized impairments. These individual WLAs may be adjusted during the NPDES permitting process. If the WLAs are adjusted, the individual effluent limits for each permit issued to a discharger on the impaired water must be consistent with the assumptions and requirements of the adjusted WLAs in the TMDL. If the WLAs are not adjusted, effluent limits contained in the permit must be consistent with the individual WLAs specified in the TMDL. If a draft permit provides for a higher load for a discharger than the corresponding individual WLA in the TMDL, the State/Tribe must demonstrate that the total WLA in the TMDL will be achieved through reductions in the remaining individual WLAs and that localized impairments will not result. All permittees should be notified of any deviations from the initial individual WLAs contained in the TMDL. U.S. EPA does not require the establishment of a new TMDL to reflect these revised allocations as long as the total WLA, as

expressed in the TMDL, remains the same or decreases, and there is no reallocation between the total WLA and the total LA.

Comments:

MPCA determined that the total waste load allocation (WLA) of TP for the Lake Sarah was 1.064 lbs/day (Section 5.1 and Table 5.3 of the final TMDL report). This WLA (1.064 lbs/day) corresponds to an approximately 58% reduction (1.477 lbs/day) from the estimated existing phosphorus load by point sources (2.54 lbs/day). The existing point sources contributing to the WLA include the Municipal Separate Storm Sewer Systems (MS4's) from four municipalities (Corcoran, Independence, Loretto and Medina), and stormwater from construction activities. The TP WLAs for the Corcoran (permit# MS400081), Independence (permit# MS400095), Loretto (permit# MS400030) and Medina (permit# MS400105) MS4s are 101.04 lbs/day, 173.49 lbs/day, 19.37 lbs/day and 92.92 lbs/day respectively. The TP WLA for the stormwater from construction activities (permit# MNR100001) is 0.004 lbs/day.

The individual WLAs for each of the permitted MS4s throughout the watershed were assigned based on the watershed area represented by the MS4 community. The construction stormwater WLA was estimated based on a 10-year estimate of the median number of construction site acres present throughout the Lake Sarah watershed. Ten-year median construction acres (6.45 in the Lake Sarah watershed) were divided by the total watershed area (4454 acres) to identify the percent watershed area anticipated to be in construction in any given year (0.145%). The 10-year median construction percentage was multiplied by the TMDL watershed load export to identify the construction WLA (0.004 lbs/day).

U.S. EPA finds that the TMDL document submitted by MPCA satisfies all requirements concerning this fifth element.

6. Margin of Safety (MOS)

The statute and regulations require that a TMDL include a margin of safety (MOS) to account for any lack of knowledge concerning the relationship between load and wasteload allocations and water quality (CWA §303(d)(1)(C), 40 C.F.R. §130.7(c)(1)). U.S. EPA's 1991 TMDL Guidance explains that the MOS may be implicit, i.e., incorporated into the TMDL through conservative assumptions in the analysis, or explicit, i.e., expressed in the TMDL as loadings set aside for the MOS. If the MOS is implicit, the conservative assumptions in the analysis that account for the MOS must be described. If the MOS is explicit, the loading set aside for the MOS must be identified.

Comments:

The Lake Sarah TMDL incorporated an explicit margin of safety (MOS) of 17% (0.652 lbs/day) in the allowable pollutant load calculation to account for the uncertainty in the estimated loads based upon the data available. The explicit MOS value was developed by identifying and adopting an in-lake TP goal of 36 µg /L, which is 10% lower than the Minnesota State TP standard of 40 µg/L (Section 4.6 of the final TMDL report). The explicit MOS was considered to be appropriate based upon the generally good agreement between the water quality models predicted and observed values that was demonstrated during the calibration and validation processes. In other words, the models reasonably reflected the conditions in the lake watershed.

U.S. EPA finds that the TMDL document submitted by MPCA contains an appropriate MOS satisfying all requirements concerning this sixth element.

7. Seasonal Variation

The statute and regulations require that a TMDL be established with consideration of seasonal variations. The TMDL must describe the method chosen for including seasonal variations. (CWA §303(d)(1)(C), 40 C.F.R. §130.7(c)(1)).

Comments:

Water quality in Lake Sarah and phosphorus loads from the surrounding watershed vary within and among years (Figures

1.4 through 1.7 and 2.2 of the final TMDL report). The Lake Sarah TP TMDL accounted for seasonal variation by addressing the intra and interannual variability in the TMDL calculations. Intra-annual variability was addressed in the TMDL by basing lake condition assessments on the average growing-season TP concentration. Although TP concentrations vary significantly throughout the summer months, the growing-season average integrates ecosystem variability over time. Interannual variability was reflected in the TMDL by basing the model calibrations on long-term averages in precipitation/ watershed loading and in-lake response, and thus integrating long-term trends.

U.S. EPA finds that the TMDL document submitted by MPCA satisfies all requirements concerning this seventh element.

8. Reasonable Assurances

When a TMDL is developed for waters impaired by point sources only, the issuance of a National Pollutant Discharge Elimination System (NPDES) permit(s) provides the reasonable assurance that the wasteload allocations contained in the TMDL will be achieved. This is because 40 C.F.R. 122.44(d)(1)(vii)(B) requires that effluent limits in permits be consistent with "the assumptions and requirements of any available wasteload allocation" in an approved TMDL.

When a TMDL is developed for waters impaired by both point and non-point sources, and the WLA is based on an assumption that non-point source load reductions will occur, U.S. EPA's 1991 TMDL Guidance states that the TMDL should provide reasonable assurances that non-point source control measures will achieve expected load reductions in order for the TMDL to be approvable. This information is necessary for U.S. EPA to determine that the TMDL, including the load and wasteload allocations, has been established at a level necessary to implement water quality standards.

U.S. EPA's August 1997 TMDL Guidance also directs Regions to work with States to achieve TMDL load allocations in waters impaired only by non-point sources. However, U.S. EPA cannot disapprove a TMDL for non-point source-only impaired waters, which do not have a demonstration of reasonable assurance that LAs will be achieved, because such a showing is not required by current regulations.

Comments:

Sections 5.3, 6 and 7 of the final TMDL report present reasonable assurances and implementation alternatives for resolving the water quality problems associated with phosphorus in Lake Sarah. Additionally, detailed information on BMPs options, removal effectiveness, and implementation relative cost was included in Appendix D, Appendix E and Appendix F of the final TMDL report.

Reasonable assurances for achieving the necessary WLAs will be through the state NPDES program. The Minnesota MS4 general permit requires that all regulated MS4s develop and implement a Stormwater Pollution Prevention Program (SWPPP). Each MS4 (in consultation with MPCA) must determine if current activities are in compliance with the WLA, and if not, modify the SWPPP to reflect the necessary changes. General MS4 permits are reviewed by MPCA every five years and reports are submitted by the permit holder and reviewed by MPCA annually to track implementation activities. Reasonable assurance for nonpoint source load allocations include a series of best management practices (BMPs) related to row crop agriculture, feedlot and manure management; urban runoff management; residential and commercial development runoff management; stream, wetland and shoreline habitat restoration; curlyleaf pondweed control; and in-lake phosphorus sequestration/removal. Progress toward TMDL implementation will be tracked through a comprehensive monitoring program.

Implementation of the Lake Sarah TMDL will be facilitated through MPCA, Minnesota Board of Water and Soil Resources (BWSR), Pioneer-Sarah Creek Watershed Commission (PSCWC) and incentive-based programs (i.e cost-share grants for shoreline stabilization/restoration, erosion control, conservation buffers, technical assistance and rain garden installation). Minnesota Rules Chapter 8410 requires that watershed management plans (which are updated every ten years and reviewed by BWSR) be developed to address specific goals and policies that address: Water Quantity; Water Quality; Natural Resource Protection; Erosion and Sediment Control; Wetland Protection; Shoreland Management; and Floodplain Management. Permitted MS4s are required to update their Local Surface Water Management Plans to align with the current Pioneer-Sarah Creek Watershed Management Plan. The PSCWC 2nd Generation Plan contains a non-degradation policy that requires no increase in phosphorus discharge during development and redevelopment activities.

Development, adoption and implementation of shoreland management controls is also required and regulated by Minnesota Department of Natural Resources (MNDNR) for all riparian communities (*Minnesota Rules 6120.2500 – 3900*). Hennepin County Environmental Services (HCES), Natural Resource Conservation Service (NRCS) and the Lake Sarah Improvement Association (LSIA) have been actively involved in a number of projects throughout the watershed to engage landowners in water resource stewardship activities. The PSCWC is also an active participant in the regional Education and Public Outreach Committee (EPOC) to increase voluntary participation in watershed stewardship activities.

U.S. EPA finds that the TMDL document submitted by MPCA adequately addresses this eighth element.

9. Monitoring Plan to Track TMDL Effectiveness

U.S. EPA's 1991 document, *Guidance for Water Quality-Based Decisions: The TMDL Process* (U.S. EPA 440/4-91-001), recommends a monitoring plan to track the effectiveness of a TMDL, particularly when a TMDL involves both point and non-point sources, and the WLA is based on an assumption that non-point source load reductions will occur. Such a TMDL should provide assurances that non-point source controls will achieve expected load reductions and, such TMDL should include a monitoring plan that describes the additional data to be collected to determine if the load reductions provided for in the TMDL are occurring and leading to attainment of water quality standards.

Comments:

Monitoring is necessary to determine whether sufficient progress is being made toward attaining WQS. Monitoring will assess BMP implementation, in-lake condition, watershed loading and aquatic plant community composition. In-lake monitoring will be conducted annually following completion of the Lake Sarah TMDL. Samples will be collected biweekly (April thru October) following the MPCA protocols for eutrophic lake assessment. Lake monitoring (i.e. sediment phosphorus levels and aquatic macrophyte monitoring) will continue to be cooperatively implemented by Pioneer-Sarah Creek Watershed Commission (PSCWC) and Three Rivers Park District.

In addition, BMP implementation monitoring will be conducted by the PSCWC. Each year member communities will submit a summary of BMP projects and the anticipated phosphorus reductions to the PSCWC in conjunction with Stormwater Pollution Prevention Program (SWPPP) reporting. BMPs will be cataloged to monitor progress toward the individual load reduction goals.

MPCA also recommends that five years after the TMDL approval, a detailed watershed load monitoring study should be conducted, through a cooperative arrangement between PSCWMC and Three Rivers Park District, to quantify the relative load reduction associated with various BMPs so as to validate the predicted phosphorus removal efficiencies and facilitate an adaptive approach to the design/ implementation of future BMPs. See Section 6 of the final TMDL report for additional information on monitoring strategy.

U.S. EPA finds that this ninth element has been adequately addressed in the TMDL document submitted by MPCA, although U.S. EPA is not approving these recommendations for monitoring or any other aspect of Minnesota's monitoring program through this decision.

10. Implementation

U.S. EPA policy encourages Regions to work in partnership with States/Tribes to achieve non-point source load allocations established for 303(d)-listed waters impaired by non-point sources. Regions may assist States/Tribes in developing implementation plans that include reasonable assurances that non-point source LAs established in TMDLs for waters impaired solely or primarily by non-point sources will in fact be achieved. In addition, U.S. EPA policy recognizes that other relevant watershed management processes may be used in the TMDL process. U.S. EPA is not required to and does not approve TMDL implementation plans.

Comments:

Section 7 of final TMDL report presents some implementation alternatives for resolving the water quality problems

associated with phosphorus in Lake Sarah by focusing on reducing both internal and external phosphorus loads. The recommended strategy for achieving the phosphorus reductions from the external load involves implementing a series of best management practices (BMPs) related to row crop agriculture, feedlot and manure management (i.e. nutrient management based on soil tests, edge-of-field filter strips, manure application guidance, barnyard management) and urban, residential and commercial development, supplemented with restoration of stream, wetland and shoreline habitat. The recommended strategy for achieving the phosphorus reductions from the internal load involves implementing a curlyleaf pondweed control program (i.e. harvesting and low dose aquatic herbicide treatment) and/or in-lake phosphorus sequestration/removal (i.e. alum treatment and hypolimnetic withdrawal and treatment/irrigation). Estimates of potential internal phosphorus load from sediment release and curlyleaf pondweed senescence were used by MPCA to identify/quantify the potential benefits of different in-lake options for water quality management. For further detail on BMPs options, removal effectiveness, and implementation relative cost see Appendix D, Appendix E and Appendix F of final TMDL report.

Implementation alternatives considered for the point sources include:

- The four municipalities (Corcoran, Independence, Loretto and Medina) within the Lake Sarah watershed, that have been designated as Municipal Separate Storm Sewer Systems (MS4s) by MPCA, will be responsible for developing and implementing a SWPPP that will reduce phosphorus and other pollutants to the "maximum extent practicable" as a part of the NPDES program. These SWPPP's are required to incorporate six "minimum control measures" intended to ensure adequate storm water management and pollution prevention by designated MS4s. These minimum control measures include:
    - Public Education and Outreach on Stormwater
    - Public Involvement and Participation
    - Illicit Discharge Detection and Elimination
    - Construction Site Runoff Control
    - Post-Construction Storm Water Management in New Development and Redevelopment
    - Pollution Prevention and Good Housekeeping for Municipal Operations

  Within 18 months of TMDL approval by EPA, each MS4 (in consultation with MPCA) must determine if current activities are in compliance with the WLA, and if not, modify the SWPPP to reflect the necessary changes. General MS4 permits are reviewed by MPCA every five years and reports are submitted by the permit holder and reviewed by MPCA annually to track implementation activities.
- Construction stormwater activities must obtain a Construction General Permit under the NPDES program and properly select, install and maintain all BMPs required under the permit, including any applicable additional BMPs required in Appendix A of the Construction General Permit for discharges to impaired waters, or meet local construction stormwater requirements if they are more restrictive than requirements of the State General Permit.

Although a formal implementation plan is not required as a condition for TMDL approval under the current U.S. EPA regulations, U.S. EPA finds that the TMDL document submitted by MPCA adequately addresses this tenth element.

11. Public Participation

U.S. EPA policy is that there should be full and meaningful public participation in the TMDL development process. The TMDL regulations require that each State/Tribe must subject calculations to establish TMDLs to public review consistent with its own continuing planning process (40 C.F.R. §130.7(c)(1)(ii)). In guidance, U.S. EPA has explained that final TMDLs submitted to U.S. EPA for review and approval should describe the State's/Tribe's public participation process, including a summary of significant comments and the State's/Tribe's responses to those comments. When U.S. EPA establishes a TMDL, U.S. EPA regulations require U.S. EPA to publish a notice seeking public comment (40 C.F.R. §130.7(d)(2)).

Provision of inadequate public participation may be a basis for disapproving a TMDL. If U.S. EPA determines that a State/Tribe has not provided adequate public participation, U.S. EPA may defer its approval action until adequate public participation has been provided for, either by the State/Tribe or by U.S. EPA.

Comments:

The Lake Sarah TMDL was developed in conjunction with an extensive public participation process. Starting in January of 2008, ten stakeholder meetings were conducted to inform TMDL development. Minutes and presentations from all TMDL stakeholder meetings are posted on the MPCA Lake Sarah TMDL project website http://www.pca.state.mn.us/water/tmdl/project-lakesarah-nutrients.html. Meetings were coordinated by the Lake Sarah Stakeholders Committee and attended by representatives from local governments, local citizens, the Lake Sarah Improvement Association, Pioneer-Sarah Creek Watershed Management Commission, Hennepin County Environmental Services, Board of Water and Soil Resources, Minnesota Department of Natural Resources, Minnesota Pollution Control Agency and Three Rivers Park District.

In addition to the broad Stakeholder Group meetings, a series of directed stakeholder meetings/ presentations (15 in total) were conducted with local government city councils and/or planning commissions to discuss the TMDL process and identify opportunities for BMP implementation. Directed stakeholder meetings were conducted with the City of Media, City of Loretto, City of Independence, City of Corcoran and City of Greenfield. Minutes and presentations from meeting with city councils and planning commissions are archived with the associated meeting summaries.

The Lake Sarah TMDL was public noticed from October 11 to November 10, 2010. The public was made aware of the TMDL public meetings and public notice through local press releases to local media outlets and letters of invitation to interested parties. Copies of the draft TMDL Report for Lake Sarah were available to the public upon request and on the MPCA website at http://www.pca.state.mn.us/water/tmdl.html#drafttmdl. As part of the final TMDL submittal, the state provided to U.S. EPA copies of the press releases of public notice, the mailing list of interested parties, and copies of the written public comment letters received during the public comment period and the state responses to these comments. MPCA received five (5) written public comments during Lake Sarah TMDL public comment period, and all of these comments were adequately addressed by MPCA.

U.S. EPA finds that the TMDL document submitted by MPCA satisfies all requirements concerning this eleventh element.

12. Submittal Letter

A submittal letter should be included with the TMDL submittal, and should specify whether the TMDL is being submitted for a *technical review* or *final review and approval*. Each final TMDL submitted to U.S. EPA should be accompanied by a submittal letter that explicitly states that the submittal is a final TMDL submitted under Section 303(d) of the Clean Water Act for U.S. EPA review and approval. This clearly establishes the State's/Tribe's intent to submit, and U.S. EPA's duty to review, the TMDL under the statute. The submittal letter, whether for technical review or final review and approval, should contain such identifying information as the name and location of the waterbody, and the pollutant(s) of concern.

Comments:

The U.S. EPA received the formal submission of the final Lake Sarah TMDL on March 2, 2011 along with a cover letter from Rebecca J. Flood, Assistant Commissioner, MPCA dated February 22, 2011. The letter stated that the Lake Sarah TMDL was a final TMDL submitted under Section 303(d) of CWA for EPA review and approval. The letter also contained the waterbody segment name, and the cause/pollutant of concern as they were identified on the Minnesota's 303(d) list.

U.S. EPA finds that the TMDL document submitted by MPCA satisfies all requirements concerning this twelfth element.

13. Conclusion

After a full and complete review, U.S. EPA finds that the TMDL for Lake Sarah (Segment IDs# 27-0191-01 and 27-0191-02) satisfies the elements of an approvable TMDL. This approval addresses two (2) segments for one (1) pollutant for a total of two (2) TMDLs addressing one (1) impairment (see Table 1 below).

Table 1

Impaired Reach Name	Assessment Unit ID	Pollutant	Impairment (s) Addressed by TMDL
Lake Sarah (West Bay)	27-0191-01	Total phosphorus	excess nutrients/ eutrophication
Lake Sarah (East Bay)	27-0191-02	Total phosphorus	excess nutrients/ eutrophication

U.S. EPA's approval of the Lake Sarah TMDLs extend to the waterbodies which are identified in this decision document and the TMDL study with the exception of any portions of the waterbodies that are within Indian Country, as defined in 18 U.S.C. Section 1151. U.S. EPA is taking no action to approve or disapprove the State's TMDL with respect to those portions of the waters at this time. U.S. EPA, or eligible Indian Tribes, as appropriate, will retain responsibilities under Section 303(d) for those waters.