Work Plan
Lake Winona TMDL Project
June 2008

Earth Tech Phase II
Scope of Work

Overview

The following Scope of Work includes recommended tasks found in the Lake Winona TMDL Project Phase 1 Report. Recommended work is largely intended to provide information on the nutrient and water budget of Lakes Winona, Agnes and Henry. Phosphorus concentrations in Lake Winona are a key part of the TMDL work, with the largest components of the phosphorus budget of the lake likely being the ALASD discharge, stormwater discharges and internal loading. While there is a sufficient and considerable amount of data related to the ALASD discharge, there is little data related to stormwater discharges and internal loading. The focus of the recommended additional studies is the later two categories, along with water budget data.

For shallow unstratified lakes like Lake Winona, mechanisms that explain internal phosphorus include (Welch, et al, 2004):

- Dissolution of iron- and aluminum- bound phosphorus by high pH, which is caused by high photosynthetic activity.
- Dissolution of iron-phosphorus under reduced conditions during periods of calm weather when anoxia develops at the sediment-water interface, with later entrainment due to wind mixing.
- Mineralization of organic phosphorus into dissolved phosphorus by microbial metabolism driven by temperature.
- Release of dissolved phosphorus directly from bacterial cells or through metabolism of dissolved organic phosphorus excreted from algal cells in the sediments.
- Wind- and wave caused resuspension of particulate phosphorus, with soluble phosphorus desorbing due to the high sediment-water concentration gradient or due to high pH caused by photosynthetic activity.

More than one of the above mechanism is typically responsible for internal loading of shallow lakes. Determining the relative importance of these mechanisms is difficult and has not been done for any specific lake (Welch, et al, 2004). However, there are many examples where the relative magnitude of the individual mechanisms has been demonstrated. Monitoring recommended by Earth Tech is intended to provide information on the relative magnitude of these internal phosphorus loading mechanisms in Lake Winona.

During the Earth Tech review of the Lake Winona watershed, three general land use areas were identified including the Alexandria urban area, the Alexandria airport and the suburban area on the south west side of the lake. Stormwater monitoring recommendations were created to obtain data representing these three areas.

Approach to Selecting Subcontractors

Development of the Phase 2 Work Plan began in April 2008 with the preliminary work plan being submitted to MPCA in April 2008, and updated work plan being submitted to MPCA June 3, 2008. Potential subcontractors were contacted in April and May 2008 to obtain competitive bids such that subcontractor cost could be included in the Phase 2 work plan.

The Phase 2 project involves land survey, which was proposed to be used for the creation of a bathymetric map and to obtain miscellaneous survey related to establishment of vertical and horizontal control points, measuring water levels, locating inlets to Lake Winona and other miscellaneous survey needs. Earth Tech prepared a Request for Proposal (RfP) and Scope of Work for the land survey needs in April 2008. The work primarily involved development of a bathymetric map. Therefore, four survey firms in relatively close proximity to the project site were selected to receive the RfP based on the fact they were experienced in creating bathymetric maps. Four proposals were received, and the lowest cost proposal was included in the preliminary Phase 2 Work Plan. However, based on the cost, MPCA decided not to delete the bathymetric map from the Phase 2 work. Thus, in the final work plan, only miscellaneous survey work was included, and the subcontractor with the lowest survey crew hourly labor rates located in Alexandria, the project site, was selected to complete the work based on the low labor rates and minimal travel costs (other survey firms were located in St. Cloud).

The Phase 2 project involves completion of an aquatic vegetation survey. There are limited people qualified to complete this type of work. Earth Tech located two firms qualified to complete this work, and one professor, Shannon Fisher, at the University of Minnesota-Mankato (UMM) qualified for the work. An RfP was sent to the three potential subcontractors. One private contractor declined to submit a proposal. One of the firms and the professor at UMM submitted proposals. The proposal of the professor had the lowest cost. In addition, the professor is completing similar work for other MPCA TMDL projects. Therefore, on the basis of cost and experience, Earth selected Shannon Fisher of UMM to complete the work.

The Phase 2 project involves completion of specialized lake sediment phosphorus testing involving laboratory testing. There are very few laboratory qualified to complete this work. Earth Tech has able to identify three including the St. Anthony Falls Hydraulic Laboratory (SAFHL) of the University of Minnesota, the Army Corps of Engineers Environmental Eau Galle Aquatic Ecology Laboratory, and the University of Wisconsin – Stevens Point Environmental Task Force. All three were contacted to request proposals, but two declined to submit because they felt the project was not large enough. SAHFL did submit a proposal, which was used for the work plan.

The Phase 2 project involves sending water and sediment samples to a laboratory for chemical testing. Earth Tech contacted several laboratories who are under contract with the State of Minnesota for Sampling and Laboratory Analysis Services – Environmental. Earth Tech chose the Minnesota Valley Testing Laboratory for the work based on low cost.

Phase II. Additional Monitoring Data Collection

Task 1: Additional Monitoring and/or Specialized Field Studies

The following additional monitoring and specialized field studies have been recommended by Earth Tech in the Phase 1 Report (Earth Tech, May 2008).

Task 1.1 Initiation of Field Program

Earth Tech will complete a one day field reconnaissance of the project area to locate stormwater sampling sites and review lake sampling access points. Earth Tech will also prepare a Project Health and Safety Plan for the field monitoring program.

Task 1.2 Lake Monitoring

Earth Tech recommends that bimonthly sampling of Lake Winona (2 sample points), Lake Agnes and Lake Henry (1 sample point each) be completed for the June to September 2008 period. Bimonthy sampling is recommended to provide more information on internal nutrient cycling, since sampling on a monthly basis may miss important information. This sampling is intended to supplement the ALASD monitoring program, with the samples to be collected at the same locations as ALASD. However, samples will be collected at discrete depths, instead of the depth averaging method used by ALASD. For Lake Winona, samples would be collected approximately 6-inches off the bottom, and 1 foot from the surface. For the other lakes, three samples would be collected in the vertical, including samples representing the epilimnion, metalimnion and hypolimnion (approximately 1 foot above the bottom). The bimonthly samples would be analyzed for total phosphorus, orthophosphorus, Chlorophyll a, total kjeldahl nitrogen, nitrate-nitrite nitrogen, chlorides, alkalinity, total hardness and total suspended solids. Field measurements would be made for dissolved oxygen, pH, temperature and conductivity (vertical profiles at one or two foot intervals). Seechi depth would also be measured.

In addition to the bimonthly lake monitoring, once a month samples will be collected from Lakes Winona, Agnes and Henry for the months of October and December 2008, and January and February 2009. The monthly samples would be analyzed for total phosphorus, orthophosphorus, Chlorophyll a, total kjeldahl nitrogen, nitrate-nitrite nitrogen, chlorides, alkalinity, total hardness and total suspended solids. Field measurements would be made for dissolved oxygen, pH, temperature and conductivity (vertical profiles at one or two foot intervals). If ice condition allow, samples will be taken at two discrete depths at Lake Winona. However, later in the winter ice conditions may result in only one depth being sampled, which would represent the water between the lake ice and the lake bottom.

One set of bottom sediments would be collected for analysis of total phosphorus, total nitrogen and pH at six locations along the center line of Lake Winona to characterize the nutrient levels and characteristics in the sediments. The sediment samples would be collected with a hand dredge and would represent the top 3 inches of the sediment. Sediment samples will be analyzed

for total phosphorus, total nitrogen, iron, calcium, aluminum, loss-on-ignition, dry density, water content, organic content and carbonate content.

Task 1.3 Screening Stormwater Monitoring Program

The stormwater sampling screening program will include sampling of three storms, including one snow melt period for the chlorides program, using grab sample techniques. To qualify as a storm to be sampled, there would need to be at least a 3 day dry period from the previous storm, and to have a predicted storm depth of at least 0.2 inches. Three sample locations would be selected for each storm, one representing the City of Alexandria urban area (a storm sewer outfall to Lake Winona), one representing runoff entering the lake from the Alexandria airport, and one representing runoff from one of the first order tributaries in the suburban area on the southwest side of the lake. The stormwater samples would be analyze for total phosphorus, total kjeldahl nitrogen, nitrate plus nitrite nitrogen, total suspended solids, and chlorides. Specific conductance and temperature would be measured in the field.

Task 1.4 Miscellaneous Survey

Earth Tech will obtain miscellaneous site survey using Douglas County coordinates to provide bench mark and horizontal control data needed for the project. The survey may also obtaining miscellaneous survey shots for project area features such as outfalls, culverts or other feature of importance to the project.

Task 1.5 Macrophyte Survey

Earth Tech would complete a survey of macrophytes in Lake Winona. Macrophytes would be identified using either the point or line intercept method (Madsen, 1999). In total, there would be 70 to 100 sample points, depending on field conditions. A map would be prepared showing the species found, areas of infestation with invasive species. There would also be a listing of species found by location, including an estimate of relative abundance. The identified species would be used to compute the Floristic Quality Index for the lake. A short report will be prepared that describes methods used and results of the survey.

Task 1.6 Sediment Phosphorus Release Rates

Earth Tech will complete laboratory analysis of sediment samples to determine phosphorus release rates from the sediment. A total of ten sediment cores, each 40-50 cm in length, will be taken using the Aquatic Instruments gravity corer with the 120 cm long clear polycarbonate barrel. The collected cores will be stored in an icebox at 4°C and immediately transported to the laboratory. The overlaying water within 0.2 meters above each sediment core will also be collected.

The collected lake water will be filtered and loaded into the column above the sediment core. Columns will be wrapped in aluminum foil to prevent algal growth. Five of the test cores will be tested under aerobic conditions and five will be tested under anaerobic conditions. In order to

provide an anaerobic environment, nitrogen gas will be bubbled through the water column of five test columns to strip the water of oxygen. Air will be bubbled into the water column in the other five test columns to provide an aerobic environment.

For all ten columns, 5 mL water samples will be taken at different intervals from the water above the sediment. The water samples will be filtered and analyzed for dissolved ortho-phosphate. Dissolved oxygen (DO) concentrations will also be monitored in the water column during the course of the experiments. The experiments will be run for a duration of approximately 3 days. The results will be used to determine the phosphorus release rate from the sediment under aerobic and anaerobic conditions.

Task 2. Additional Monitoring Data Review, Analyses, and Summary

Review, analyze, and interpret the additional flow and water quality monitoring data collected in Phase II. Results from Phases I and II will be compared to confirm conclusions drawn in Phase I or to identify anomalies between Phase I and Phase 2 data. The combined Phase I and II data set will be used to define initial input parameter values for the model(s), and prepare summaries.

Task 3. Prepare Phase II Report

Data collected during Phase 2 will be compiled in a report, which will combine all data from collected during Tasks 1 and 2, and will include appropriate tabulations, colored maps, charts, and figures, and attachments. Six copies of a draft report for MPCA staff and stakeholder's review and comments will be submitted to MPCA. The report will be finalized based on review comments received from MPCA staff and stakeholders. Electronic copies shall also be provided for posting on the MCPA Website.

Task 4. Project Meetings

Attend two project meetings in the watershed to disseminate Phase II results to the MPCA staff and local stakeholders and to review watershed conditions. The first meeting will occur midway through the data collection program (late July to mid August time frame). The second meeting will occur near the end of the data collection activities. Both meetings will involve a discussion of project progress.

References

Madsen, John, 1999, Point Intercept and Line Intercept Methods for Aquatic Plant Management, Aquatic Plant Control Technique Note MI-02.

Welch, E.B., J.M. Jacoby, T. Lindel, 2004, Pollutant Effects in Freshwater, Spon Press.

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Earth Tech Project Personnel
Primary Assignment

Roger Clay, PE, PH, CPSWQ – Project Manager
Kevin Muellerleile, EIT – Scientist (Data Analysis, Monitoring Programs)
Ryan Edison, PE – Project Engineer (Model Selection)
John Voorhees, PE, PH – Hydrologist (Data Analysis, Model Selection)
Cathy Larson – Hydrologist (Data Analysis)
Samuel Tweh – GIS/Field Technician (Data Analysis, Monitoring Programs)
Don Waxmunski – GIS/Field Technician (Data Analysis, Monitoring Programs)
Jane Newberg – GIS/Field Technician (Data Analysis, Monitoring Programs)

Earth Tech has other personnel who could be assigned to the project