Quality Assurance Project Plan (QAPP)

Poplar River Turbidity Total Maximum Daily Load Quality Assurance Project Plan

Task Order No. 2006-36

Prepared for:

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This quality assurance project plan (QAPP) has been prepared according to guidance provided in *EPA Requirements for Quality Assurance Project Plans* (EPA QA/R-5, EPA/240/B-01/003, U.S. Environmental Protection Agency, Office of Environmental Information, Washington, DC, March 2001) and *EPA Guidance for Quality Assurance Project Plans for Modeling* (EPA QA/G-5M, EPA/240/R-02/007, U.S. Environmental Protection Agency, Office of Environmental Information, Washington, DC, December 2002) to ensure that environmental and related data collected, compiled, and/or generated for this project are complete, accurate, and of the type, quantity, and quality required for their intended use. RTI, International will conduct work in conformance with the quality assurance program described in the procedures detailed in this QAPP.

Approvals:

	3-6-07		3-6-07
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Total Maximum Daily Load (TMDL) Decision Document Template

APPENDIX B

Methodology for developing the Load Duration Curve

APPENDIX C

MPCA Sampling and Analysis Plan (SAP) Development Guidance

ACRONYMS AND ABBREVIATIONS

BEHI	Bank Erosion Hazard Index
cfs	Cubic feet per second
Cl	Chloride
COR	Contracting Officer's Representative
CWA	Clean Water Act
DO	Dissolved Oxygen
DQO	Data Quality Objective
ECT	Environmental Consulting & Technology, Inc.
EPA	United States Environmental Protection Agency
FEMA	Federal Emergency Management Administration
FIRM	Flood Insurance Rate Maps
GIS	Geographic Information System
Hg	Mercury
L	Liter
LA	Load Allocation
LDC	Load Duration Curve
mg	Milligram
mL	Milliliter
MOS	Margin of Safety
MPCA	Minnesota Pollution Control Agency
NHD	National Hydrography Dataset
NPDES	National Pollutant Discharge Elimination System
QA	Quality Assurance
QAPP	Quality Assurance Project Plan
QC	Quality Control
SEH	Short Elliott Hendrickson, Inc.
SOW	Scope of Work
STORET	EPA Storage and Retrieval System
TMDL	Total Maximum Daily Load
TOL	Task Order Leader
TSS	Total Suspended Solids
URS	URS Corporation
USGS	U.S. Geological Survey
WEPP	Water Erosion Prediction Project
WLA	Waste load Allocation

Distribution

This document will be distributed to the following team members involved in this project from U.S. Environmental Protection Agency (EPA) Region 5, the Minnesota Pollution Control Agency (MPCA), RTI International, ECT Incorporated, URS Corporation, and SEH Incorporated.

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1.0 Project Objectives, Organization, and Responsibilities

The primary purpose of this project is to develop a Total Maximum Daily Load (TMDL) report that includes all required elements to address the aquatic life impairments of the Poplar River. This document is the quality assurance project plan (QAPP) for conducting data assessment, conducting a physical channel assessment, and modeling to support TMDL development.

Project Objectives

This QAPP provides a description of the work to be performed to support the development of a TMDL in Poplar Creek. This QAPP outlines procedures for assessing existing water quality data, evaluating model results, conducting the physical channel assessment thus ensuring that the TMDL development procedures are scientifically valid and defensible and that uncertainty has been reduced to a practical minimum. In addition, this QAPP addresses the use of secondary and third-party data collected by EPA for other purposes or collected by organizations not under the direction of EPA to support the development of the TMDL. An extensive amount of data and information will be collected to diagnose causes of turbidity, help quantify the level of existing impairment, and provide a foundation on which restoration activities may be identified and implemented. This QAPP will set forth the objectives, responsibilities, protocols, procedures, and methods for obtaining primary data through the physical channel assessment.

Roles and Responsibilities

U.S. Environmental Protection Agency (EPA) Region 5 is funding this project, through a task order under EPA's Watersheds contract (no. 68-C-02-108) with RTI International; the State of Minnesota Pollution Control Agency (MPCA) is providing technical advice and oversight. The RTI Team includes staff from Environmental Consulting & Technology, Inc. (ECT), Short Elliott Hendrickson, Inc. (SEH), and URS Corporation (URS).

Kevin Pierard, the EPA Region 5 Watersheds and Wetlands Branch Chief, and Jo-Lynn Traub, the EPA Region 5 Water Division Director, will provide oversight for this contract. They will review and approve the QAPP and ensure that all contractual issues are addressed as work is performed on this task order.

Julianne Socha will provide overall project/program oversight for this study as the EPA Region 5 Contracting Officer's Representative (COR). The EPA Region 5 COR will work with Bill Cooter, the RTI task order leader (TOL), to ensure that project objectives are attained. The EPA Region 5 COR will also be responsible for providing oversight for TMDL development, model selection, data selection; coordinating with contractors, reviewers, and others to ensure technical quality; and adhering to project objectives and contract requirements.

The EPA Region 5 QA Officer, Simon Manoyan, will be responsible for reviewing and approving this QAPP. In addition, he will conduct external performance and system audits and participate in Agency QA reviews of the study.

The RTI Team TOL is Bill Cooter. As Project Director, Mr. Cooter will supervise activities conducted under the contract. Dr. Sanjiv Sinha will perform Project Manager duties, including coordination of monthly conference calls with EPA COR, and oversight of the physical channel assessment, water quality data summary, QAPP submission, evaluation of Water Erosion Prediction Project (WEPP) model output, TMDL report, and stakeholder meetings. Dr. Michael Donahue will serve as the QA Officer and Assistant Project Manager and will be responsible for oversight of the following activities: water quality data summary, QAPP development, evaluation of WEPP model output, data assessment summary, source identification summary, and development of the TMDL report. Of these tasks, Troy Naperala will be responsible for the water quality data summary and, with Brian Jacobson, jointly responsible, for the evaluation of the WEPP model, source identification summary and development of the TMDL. Brian Jacobson will also be responsible for QAPP development. Doug Bach will oversee the physical channel assessment activities and the coordination of stakeholder meetings, as well as assist in the coordination of responsibilities within the RTI team. Dan Cazanacli will assist Doug Bach in leading the physical channel assessment; Charlene Johnson will provide support in facilitating stakeholder meetings.

Pat Carey is the Watershed Unit Supervisor in the Minnesota Pollution Control Agency (MPCA), Duluth office. He will provide oversight on this contract. Karen Evens of the MPCA, Duluth office, will be the Task Order manager for MPCA and will support Mr. Carey as the primary MPCA contact. Tom Schaub, of the MPCA, Duluth office, will be the Assistant Project Manager. Greg Johnson of the MPCA, St. Paul office, will provide technical and State policy assistance.

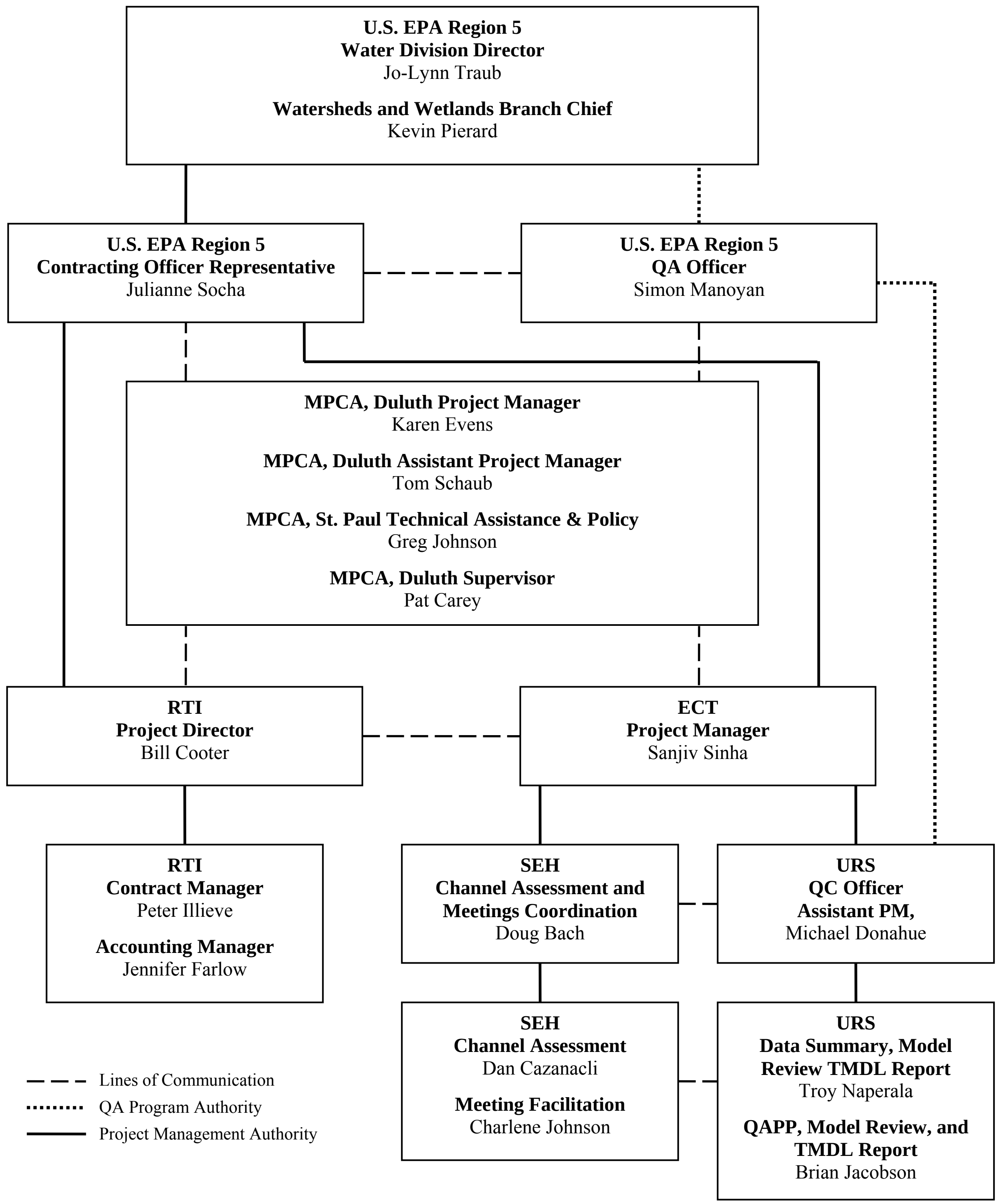

Figure 1. Project Management

2.0 Project Definition/Background

The Poplar River watershed is located in the Lake Superior Basin (Northeast Minnesota) near Lutsen, MN. The entire watershed covers an area of approximately 114 square miles with a river distance of approximately 25.5 miles. The Poplar River originates at the Boundary Waters Canoe Area, Hilly Lake area, and ends at its confluence with Lake Superior. Its watershed includes the Tait Lake/Tait River, Pike Lake, and Caribou Lake (*An Assessment of Representative Lake Superior Basin Tributaries*, MPCA, 2002). The watershed in the Poplar River headwaters area is characterized as having low-gradient slopes and containing a significant wetland area. Downstream of the headwaters area, the watershed narrows considerably as it flows over the escarpment, where the gradient increases greatly and the channel is defined by bedrock, lacustrine beach, and glacial deposits. These most downstream portions of the Poplar River and watershed are characterized as having significant drops in elevation with an average gradient of nearly 41 feet per mile and containing both forested and cleared steep slopes. Minnesota's 2006 integrated report identifies the most downstream 2.73-mile segment of Poplar River, between Superior Hiking Trail Bridge and the outlet to Lake Superior, as not meeting its intended use (aquatic life) based on turbidity violations. This portion of the river will be the focus of the TMDL.

Section 303(d) of the Clean Water Act and Chapter 40 of the Code of Federal Regulations Part 130 require states to develop TMDLs for waters not meeting designated uses under technology-based controls for pollution. The TMDL process quantitatively assesses the impairment factors so that states can establish water-quality based controls to reduce pollution from both point and nonpoint sources, and to restore and protect the quality of their water resources.

Minnesota's Surface Water Quality Standards provide information on beneficial uses assigned to waterbodies, numeric and narrative standards for pollutants, and nondegradation provisions assigned to high-quality and unique waters. All waters of Minnesota are assigned classes, based on their suitability for the following beneficial uses:

1. Domestic consumption
2. Aquatic life and recreation
3. Industrial consumption
4. Agriculture and wildlife
5. Aesthetic enjoyment and navigation
6. Other uses
7. Limited resource value

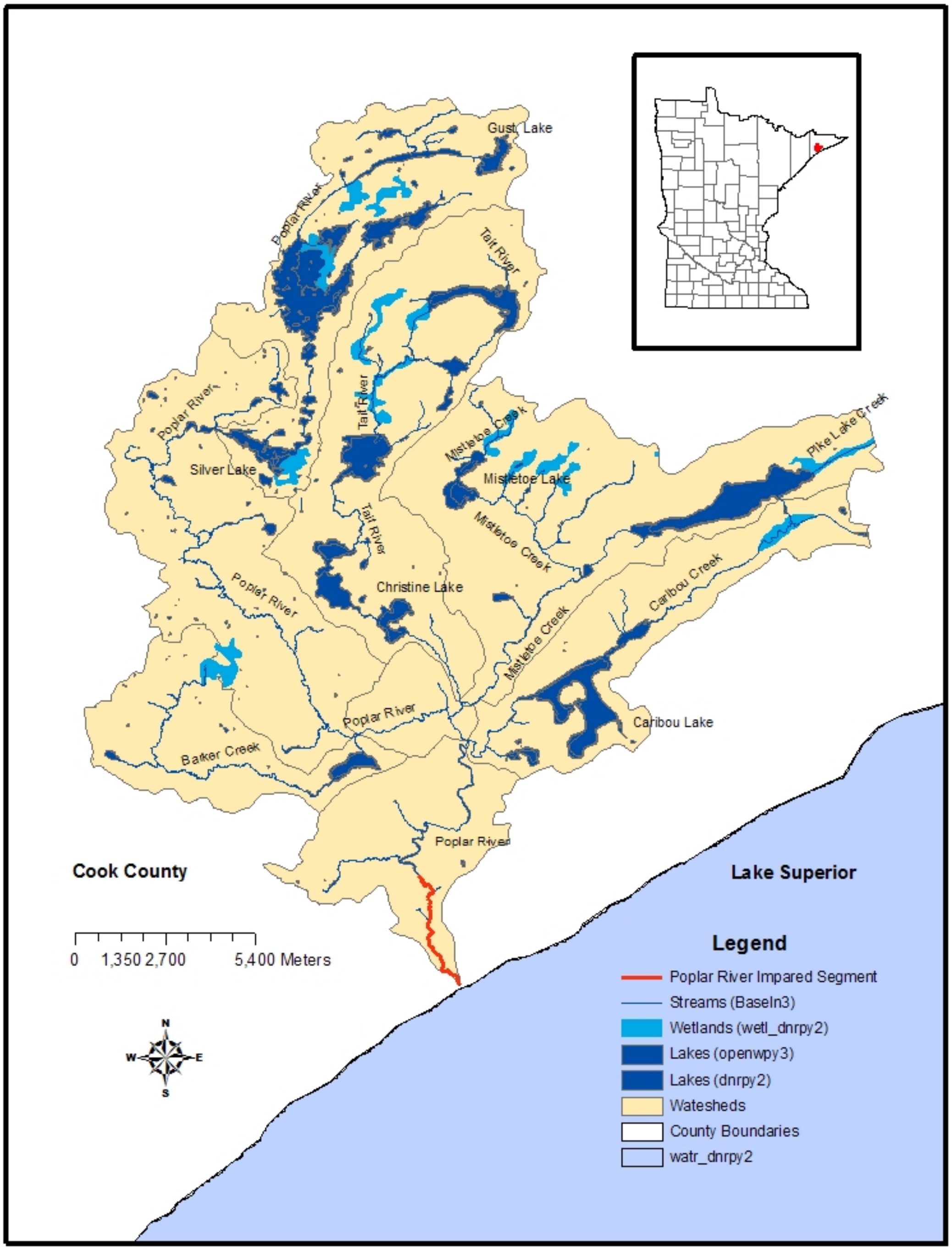

Figure 2. Poplar River Watershed

Minnesota Rules, Chapter 7050.0470, identify classifications for waters in major surface water drainage basin, including those applicable in the Poplar River. Per Chapter 7050.0470, classifications applicable to the Poplar River include Classes 1B, 2A, and 3B. A description of each of these classifications follows.

Class 1B waters. The quality of Class 1B waters of the state shall be such that with approved disinfection, such as simple chlorination or its equivalent, the treated water will meet both the primary (maximum contaminant levels) and secondary drinking water standards issued by the United States Environmental Protection Agency as contained in Code of Federal Regulations, title 40, part 141, subparts B and G, and part 143, (1992); and sections 141.61 and 141.62, as amended through July 17, 1992; except that the bacteriological standards shall not apply.

Class 2A waters. The quality of Class 2A surface waters shall be such as to permit the propagation and maintenance of a healthy community of cold water sport or commercial fish and associated aquatic life, and their habitats. These waters shall be suitable for aquatic recreation of all kinds, including bathing, for which the waters may be usable. This class of surface waters is also protected as a source of drinking water.

Class 3B waters. The quality of Class 3B waters of the state shall be such as to permit their use for general industrial purposes, except for food processing, with only a moderate degree of treatment. The quality shall be generally comparable to Class 1D waters of the state used for domestic consumption, except chlorides (Cl) (100 milligrams per liter), Hardness, Ca + Mg as $CaCO_3$ (250 milligrams per liter), pH value (6.0 - 9.0).

The turbidity standard associated with each of these Classes is provided in Table 1. Of the three, Class 2 is the most restrictive and applicable Class and will be used as the target in developing this TMDL.

Table 1. Turbidity standards associated with Water Classifications 1B, 2A, and 3B.

Water Classification	Minnesota Rules, Chapter	Turbidity Standard (NTU)
Class 1B	7050.0221, subpart 3	Not applicable
Class 2A	7050.0222, subpart 2	10 NTU
Class 3B	7050.0223, subpart 3	No Turbidity Standard

** Per Code of Federal Regulations, title 40, part 141, subparts B and G, and part 143, (1992); and sections 141.61 and 141.62

In 2004 a portion of the Poplar River in the Lake Superior Basin was listed on Minnesota's 303(d) list of impaired waterbodies. The impaired segment (Assessment Unit ID: 04010101-613) includes a 2.73-mile segment of the Poplar River from Superior Hiking Trail bridge to Lake Superior. In 2006, the turbidity impairment in this portion of the Poplar River was carried through on the 2006 303(d) list of impaired waterbodies. The impaired segment and related listing information from Minnesota's approved 2006 303(d) list are provided in Table 2. Although the 2006 List includes both turbidity and mercury as pollutants of concern, the TMDL developed as part of this effort will address turbidity only.

Table 2. Poplar River impaired segment and pollutants listed in Minnesota's approved 2006 303(d) List.

Reach	Description	Year Listed	River ID#	Affected Uses	Pollutant/ Stressor
Poplar River	Superior Hiking Trail bridge to Lake Superior	1998	04010101-613	Aquatic consumption	Hg Water Column
Poplar River	Superior Hiking Trail bridge to Lake Superior	2004	04010101-613	Aquatic life	Turbidity

3.0 Project Description

Existing data on turbidity and total suspended solids concentrations, loads, and sources will be used to accurately quantify the level of impairment, characterize sources of turbidity both spatially and categorically, develop a TMDL that will identify necessary load reductions, and provide recommendations on restoration activities. The RTI Team will conduct a physical channel assessment that will be used to identify site-specific approaches to protecting and improving channel stability in the Poplar River. As identified in the original Task Order Surveillance Plan, the entire project can be divided into multiple performance objectives or tasks. These tasks are identified and discussed in greater detail in the following paragraphs. Specifically, Tasks G.2 through G.11 from the original Surveillance Plan are addressed in this QAPP and have been renumbered to meet the project objectives identified by EPA and in this QAPP.

Task 1: Summary of Existing Water Quality Data and Information

Gathering and evaluating existing data prior to TMDL development is an important step in the process. Using currently available data will improve the scientific validity of the TMDL while reducing redundancy and improving efficiency. With this in mind, the RTI Team will gather existing data, reports, and other literature related to the Poplar River watershed. We will identify potential sources of information by reviewing the websites provided in the EPA SOW and by speaking with each organization. This will include MPCA, counties, municipalities, watershed groups, universities, USGS, and private businesses. This process will likely identify additional sources of information. Our proposed approach to contacting potential sources of data and information is as follows:

1. Review available websites, reports, and memoranda regarding the Poplar River watershed.
2. Contact primary authors via telephone and email to answer any questions the RTI Team may have, request additional data, or request additional data sources.
3. Compile data into a database.
4. Prepare a report that includes an inventory of the compiled data (Table 3), a written summary of this compiled information, and conclusions of available reports and memoranda.

Table 3. Existing data and information to be summarized as part of Task 1. This information was provided by EPA, MPCA, and sources external to MPCA during the initial phase of this project.

Documentation	Source	Website location/link
Lower Poplar River Watershed Alternative Urban Area-Wide Review (AUAR)	Cook County Planning and Zoning Department	http://www.co.cook.mn.us/zoning/index.html#LPRW
MPCA Environmental Data Access database	MPCA	http://www.pca.state.mn.us/monitoring/index.html
Climatology Working Group	Climatology Working Group, University of Minnesota	www.climate.umn.edu
An Assessment of Representative Lake Superior Basin Tributaries 2002	MPCA	www.pca.state.mn.us
Poplar River flow, stage, turbidity data, maps	www.lakesuperiorstreams.org	www.lakesuperiorstreams.org
Lake Superior Basin Plan	MPCA	http://www.pca.state.mn.us/water/basins/superior/lsbasin/basin-planning.html
USGS Water Data for Poplar River at Lutsen Mountain	USGS	Available on line at http://waterdata.usgs.gov/mn/nwis/nwisman/?site_no=04012500&agency_cd=USGS
North American Wetland Engineering and SE Group, Environmental Report for Lutsen Mountain, Cook County, Minnesota, October 18, 2005	Report for Lutsen Mountain Resort	Hard copy Only
SE Group memorandum regarding the *Preliminary Summary, Poplar River Impairment Study, dated October 13, 2006*	Summary report for Lutsen Mountain Resort	Available from MPCA
Selected Water Quality Characteristics of Minimally Impacted Streams from Minnesota's Seven Ecoregions, 1993	MPCA	http://www.pca.state.mn.us/publications/tdr-g1-03.pdf
Comprehensive Plan: Cook County Soil and Water Conservation District	Cook County SWCD	http://www.co.cook.mn.us/sw/COMPREHENSIVE_PLAN_2006.pdf
Cook County Local Water Management Plan	Cook County Planning Department	http://www.co.cook.mn.us/sw/wp/LWMPlanapprvd12-13-05.pdf

Task 2: Evaluate Existing WEPP Model Output

The RTI Team will critically review the SE Group Environmental Report prepared for Lutsen Mountain, the *Preliminary Summary, Poplar River Impairment Study*, and will evaluate the existing U.S. Department of Agriculture, Agricultural Research Services, Water Erosion Prediction Project (WEPP) model output and its use in characterizing and estimating the pollutant sources affecting turbidity in the Poplar River. Information that is acceptable for use based on QAPP guidance will be incorporated into the TMDL analysis. Potential uses of the SE Group Memorandum (if it meets QAPP criteria) include allocation of nonpoint source loads to land use types for wet weather events, source identification, location of streamside slumps, quantification of streamside slumping, and comparison to similar watersheds that may be less impacted by development.

As part of this task, the RTI Team will prepare and submit a summary of the existing model output and its anticipated uses, including a summary of the strengths and weaknesses of the existing model output. The RTI Team will determine whether additional watershed and stream modeling is necessary to fully evaluate the factors contributing to the turbidity impairment and, if so, recommend approaches.

The RTI Team will assess the uncertainty associated with model input parameters, model predictions, and spatial sensitivity. In addition, information supporting the scientific validity of the WEPP model application to the Poplar River will be reviewed and assessed. The RTI Team will only utilize the Poplar River WEPP model application if model uncertainty is documented, or a reasonable comparison to site specific field data is provided. Specifically, the RTI Team will assess model sensitivity analyses, ranges of input parameters, and model calibration.

Task 3: Additional Characterization and Estimation of Turbidity Impairment

This task will be initiated in the event that EPA, in consultation with MPCA, provides additional written direction to the RTI Team regarding the need for additional characterization and estimation of the turbidity impairment. If additional modeling efforts or efforts through the use of other tools is directed by EPA, the RTI Team shall conduct these additional efforts. The approved QAPP shall be modified as needed to reflect the project objectives of these additional characterization and estimation efforts. No additional characterization or estimation efforts shall begin until this QAPP has been modified and received EPA approval. Activities completed pursuant to this task will be in accordance with an approved modified QAPP and will be subject to review and comment from EPA, in consultation with MPCA.

Task 4: Data Assessment Summary

The RTI Team will prepare and submit a data assessment summary for EPA and MPCA review. The assessment summary will utilize all available data and obtain additional data acquired during Task 1.

In completing this Task, the RTI Team will rely on a variety of primary and secondary data sets. Primary data sources include geomorphological data collection during physical channel assessment and data collected by MPCA for Section 305(b) reporting. Secondary sources of data include all other relevant data collected within the watershed or in nearby less-impacted watersheds by local governments, local/regional agencies, universities, federal agencies, watershed groups, and other not-for-profit organizations. The RTI team will characterize each data source using the process described in Section 4 of this QAPP, Quality Objectives and Criteria. The RTI Team will use all primary data and assess data from secondary sources. Data that support the Poplar River TMDL goals and objectives will be analyzed before data from other sources. Sources will then be investigated based on their perceived usefulness. Thus, primary sources will be used first, followed by secondary sources. Readily available secondary sources, such as those listed in the SOW, will be investigated first, followed by other data sources. Each data source will be used in a manner consistent with its quality and as described in Section 4 of this QAPP. The information included in these data sources will be used to analyze potential sources of turbidity, the magnitude and frequency of turbidity criteria violations, the magnitude and frequency of discharges from sources, the effectiveness of watershed best management practices, and the geographic extent of water quality issues.

Load duration curves (using total suspended solids as a surrogate for turbidity) will be used, along with other qualitative and quantitative information, to:

- Assess turbidity conditions under different flow conditions, including the rise and fall of the hydrograph, duration and magnitude of water quality criteria exceedances, and seasonality;
- Assess snowmelt, event runoff, and base flow contributions to flow and turbidity levels;
- Assess and/or develop relationships for turbidity to other water quality parameters, especially total suspended solids (TSS); and
- Calculate TSS loads.

The data analysis will evaluate any identifiable temporal or spatial trends in water quality. Evaluation of water quality and other data, including point source data, watershed reports, and geographic information system (GIS) layers, will also be used to more clearly define the watershed characteristics and to preliminarily identify pollutant sources to be considered in the TMDL analysis. The data review will also identify any data gaps and datasets to be excluded in TMDL development. Potential reasons for not considering data include age, geographic area (e.g., remote from area of concern), pollutant, inconsistent methodology, poor quality, and lack of documentation (e.g., no QAPP).

Task 5: Source Identification Summary

A critical step in developing a useful and defensible TMDL is the assessment of potential sources. A watershed-wide review of the impairment data and the sources that contribute to elevated turbidity in Poplar River will be performed as part of this task. After the initial site meeting, the RTI Team will collect and review pertinent available data to provide a framework for assessing site conditions, opportunities, and constraints, including previous reports and studies conducted in the Poplar River watershed; a review of the MPCA 2003 North Shore tributaries report; evaluation of the existing WEPP model; National Pollutant Discharge Elimination System (NPDES) data; previous site investigation data; applicable hydrologic and hydraulic reports, maps, and aerial photography; USGS gage data; regional hydraulic geometry data; and ancillary material, including Federal Emergency Management Administration (FEMA) Flood Insurance Rate Maps (FIRM), zoning maps, existing and proposed land use maps, geologic mapping and data, and other aerial photography. ArcGIS version 9.1 (Environmental Systems Research Institute, Inc. (ESRI)) (or newer version, if available) and digital orthophotos will be used to gain an understanding of the sources within the watershed. Discussions with local jurisdictions and field personnel will identify and quantify potential sources. The results of the review will be summarized to determine whether these sources are point or nonpoint. The RTI Team will further investigate the primary sources to quantify the relative loads from each. Depending on the source, this analysis will be performed to determine frequency of release and the magnitude of the load.

At the conclusion of this task, a summary report will be provided to EPA and MPCA outlining the findings of the watershed-wide review. At a minimum, the summary report will:

- Identify all sources of information used to complete the summary;
- Identify potential point and nonpoint sources, including applicable permit numbers and a description of the source;
- Indicate the potential contribution from each source;
- Indicate any existing controls already in place that would impact the sources' contribution to the turbidity impairment;
- Indicate the impacts of seasonality; and
- Indicate whether a critical condition exists and if that condition impacts the sources' contribution to the impairment.

Task 6. Physical Channel Assessment and Implementation Recommendations

The channel assessment and geomorphology investigation will aid in estimating the sources of suspended sediment from the active channel area and from the out-of-channel sources. Sediment loading from in-stream sources will be evaluated from sample measurements upstream of the study region coupled with examining the condition of stream banks in the study region. The bank conditions will be assessed using the Bank Stability and Toe Erosion Model developed by Landendoen and Simon at National Sedimentation Laboratory in Oxford, Missouri. The model contains geotechnical relationships, customized in a format that allows for a flexible evaluation of river bank stability.

Out-of-channel sediment sources in the watershed (e.g. mass slumping, slope soil erosion, gully valley incision, trails and trail ditches erosion, etc) will be evaluated using direct measurements and observations. The field investigation will document the major slope failures (slumps) located in the vicinity of the channel and the incision depth along the main ravines and gullies tributary to the main channel. The erosion rates from the watershed slopes will be estimated using the Revised Universal Soil Loss Equation (R.U.S.L.E.). The evaluation of soil erosion rates requires a good knowledge of the soil properties, vegetation cover, and a correct assessment of the slopes and slope length. The field inspection will document the soil properties primarily in terms of texture and physical properties. Drainage characteristics and evidences of seepage will be documented as well. Cook County Soil Survey contains a summary of the physical properties of the soil in the area. These properties affect not only the erosion rates on the sloped surfaces but also the potential for slope failure. A high resolution map will be used to quantify the size of the areas that lack vegetation cover and detailed topographic contour map will be used to determine the slopes of the valley walls along the stream.

This information, along with detailed contour maps and aerial photographs, will be used to assess the sediment contribution from the sources outside of the main channel. In-channel and watershed sources will be evaluated to determine the relative contribution of sediment coming from each source as a fraction of the total sediment load. Therefore, the channel assessment and geomorphology assessment in conjunction with the LDC approach and data assessment will allow for TSS sources within the lower Poplar River watershed to be quantified. This information will be used, along with the LDC, in allocating the total required reduction among sources.

The RTI Team will conduct a field investigation of the impaired waterbody using diagnostic procedures outlined in Montgomery and MacDonald (2002). The field investigation will cover the impaired section (2.73 miles) spanning from the mouth to the rapids west of Eagle Mountain. During the field investigation the following aspects will be documented:

a) Gradient inflections (i.e. rapids vs. less steep reaches)
b) Major channel width variations
c) Presence of pools and pools characteristics including
    - Pool depth
    - Pool volume
    - Pool sediment (median size)
d) Channel bed material in terms of
    - median size range
    - fraction of fine sediment (i.e., sand size)
e) Bank erosion (i.e., sediment slumps)
f) Channel scours

Items a) and b) will be used primarily to determine the channel type. Montgomery and MacDonald (2002) use a simple classification in which the channel types are classified into five categories: 1. Cascade; 2. Step-Pool; 3; Plane Bed; 4. Pool-Riffle, and 5. Dune-Ripple.

Each channel type responds differently to external variations. The main external variations are an increase in the influx of coarse sediment, influx of fine sediment, frequency and/or magnitude of the peak flows. An increased in the influx of fine sediment is a possible cause of the observed turbidity levels within the lower reach of Poplar River. Montgomery and MacDonald provided a summary of the key channel indicators that are likely to change in response to such external variations.

Items c) through f) listed above represent some of better the indicators of an increase in fine sediment influx.

At the conclusion of this task, the RTI Team will provide EPA and MPCA with a channel assessment report which will outline the relative sediment contribution from each source as a fraction of the total sediment influx into the river. The report will discuss the uncertainties associated with determining the relative contribution from each source.

Task 7: Develop TMDL for Poplar River

Load Duration Curves (LDCs) provide a simplified analysis of potential pollutant sources and can be used to estimate pollutant load reductions for a TMDL. This method determines the relative ranking of a given flow based on the percentage of time that historic flows exceed that value. Flow data have been collected by USGS at the primary site (USGS Gage 02140991) from 1985 to the present. Excursions that occur only during low-flow events (flows that are frequently exceeded) are likely caused by continuous or point source discharges, which are generally diluted during storm events. Excursions that occur during high-flow events (flows that are not frequently exceeded) are generally driven by storm-event runoff. A mixture of point and nonpoint sources may cause excursions during normal flows.

Because turbidity is measured as nephelometric turbidity units (NTUs) and not as a concentration, another parameter that is measured as a concentration must be used to represent turbidity loadings in the watershed. For this TMDL, total nonfilterable solids (or total suspended solids (TSS), method 00530) will be selected based on its correlation with turbidity. The correlation will be determined using this formula:

$$\rho_{xy} = \frac{\frac{1}{n}\sum_{i=1}^{n}(x_i - \mu_x)(y_i - \mu_y)}{\sigma_x \cdot \sigma_y}$$

where $-1 \leq \rho_{xy} \leq 1$

ρ_{xy} = correlation coefficient
x and y = array variables
μ_x and μ_y = expected values in arrays
σ_x and σ_y = standard deviations of each array

Given this, a linear regression will be developed between turbidity and TSS to allow for the use of TSS values in developing a LDC. Steps used to develop the LDC are presented in Appendix B.

Ambient water quality measurements obtained by MPCA, and other water quality data deemed to be of "high" quality, will be used to generate the Load Duration Curve (LDC) and quantify TSS loads to the lower Poplar River. The LDC will be used to determine the total TSS reduction needed to meet the turbidity water quality standard, 10 NTU, in the Poplar River. TSS loads at the upstream and downstream monitoring sites, along with channel assessment report (Task 6), will be used to quantify the TSS load from stream bank erosion and out-of-channel sediment sources within the lower Poplar River.

The LDC approach is advantageous because it is applicable in the initial phases of source identification, in water quality assessment to quantify the magnitude of exceedance during critical conditions, and in implementation planning. The RTI Team will use this method, along with field studies, to determine the seasonality and flow regimes during which the exceedances occur and to determine maximum daily loads based on the flow duration and applicable standard.

LDCs for TSS will be based on a cumulative frequency distribution of flow conditions in the watershed. Specifically, the LDC is used to establish a regression model to predict load as a function of flow percentage. A confidence interval on the regression line is then developed with the interval reflecting the allowable level of exceedance (e.g., 10 percent) to the water quality criterion. The exponential regression line and confidence interval are then fit to the values between 10 percent and 95 percent flow exceedance. Although data obtained under extreme flow conditions are not used to develop the TMDL, they may be appropriate for decision making during TMDL implementation. Allowable loading is then calculated at each percentage between 10 percent and 95 percent based on the margin of safety (MOS)-adjusted target concentration and the percentile confidence interval to the regression line. Load reductions are determined by calculating the difference between the assimilative capacity (i.e., Reduced Limit Curve) and corresponding percentile confidence interval based on corresponding flow. Existing and target loadings are then estimated in five flow categories (0%-10% high flows, 10%-40% moist conditions, 40%-60% mid range flows, 60%-95% dry conditions, and 95%-100% low flows). Specific land use allocations will be developed based on information gained from the LDC exercise and the existing WEPP computer modeling study.

The RTI Team will develop a draft TMDL report to address the Poplar River segments impaired for turbidity. The TMDL report will comply with the elements needed for TMDL approval listed in Appendix A. The RTI Team will submit the preliminary draft TMDL report to the EPA Region 5 COR and MPCA contacts for review and approval within 210 days of notification of the EPA Region 5 COR's approval of this QAPP. A draft TMDL report will be prepared and submitted to

EPA and MPCA for review and comment within 45 days of notification of Preliminary Draft Report approval.

The RTI Team will ensure that all EPA Region 5 COR and MPCA comments have been addressed in the TMDL report and will then submit a final version to the EPA Region 5 COR no later than February 15, 2008, or 45 days after the close of the public notice period, whichever is sooner. The final TMDL report will include as an appendix the response to public comments on the draft TMDLs. Along with the final TMDL report, the RTI Team will also submit all applicable data files, spreadsheets/workbooks, and models used to develop the TMDL.

The general schedule for deliverables in preparation of the TMDLs is presented in Table 4. Project activities include producing and then finalizing the QAPP, developing the TMDLs, and writing draft and final reports.

Table 4. General schedule for the Poplar River TMDL deliverables.

Action/Deliverable	**Due date**
Project Kickoff Conference Call	October 30, 2006
Watershed Visit	November 30, 2006
QAPP delivered to EPA and MPCA (Draft)	November 30, 2006
QAPP delivered to EPA and MPCA (Final)	December 22, 2006 (within 7 days of receipt of EPA comment)
QAPP approved by EPA	Mid March 2007
Summary of Water Quality Data and Information delivered to EPA and MPCA (Draft)	November 30, 2006
Summary of Water Quality Data and Information delivered to EPA and MPCA (Final)	December 22, 2006 (within 7 days of receipt of EPA comment)
Evaluation of Existing Model Output (Draft)	Mid-April 2007 (30 days following EPA approval of QAPP)
Evaluation of Existing Model Output (Final)	Late May 2007 (7 days following receipt of EPA comment)
Additional Characterization/Estimation of Turbidity Impairment	To be determined (within 90 days of EPA notification)
Data Assessment Summary (Draft)	Late April 2007 (45 days following EPA approval of QAPP)
Data Assessment Summary (Final)	Late May 2007 (7 days following receipt of EPA comment)
Source Identification Summary (Draft)	Late April 2007 (45 days following notification by EPA of QAPP approval)
Source Identification Summary (Final)	Late May 2007 (7 days following receipt of EPA comment)
Physical Channel Assessment and Implementation Recommendations (Draft)	Late May 2007 (this task was originally scoped to be completed 30 days following EPA approval of QAPP, however, river conditions will require that the assessment be completed after ice out.)
Physical Channel Assessment and Implementation Recommendations (Final)	Late June 2007 (7 days following receipt of EPA comment)
Preliminary TMDL Report (Draft)	September 2007 (210 days following EPA approval of QAPP)
TMDL Report (Draft)	December 31, 2007 (45 days following EPA approval of Draft Preliminary TMDL Report)
Draft TMDL Public Meeting Presentation	January 2008 (within 30 days of public notification)
Draft TMDL Public Meeting Presentation materials provided to EPA/MPCA	Early January 2008 (10 days prior to public meeting)
TMDL Report (Final)	No later than February 15, 2008 (or 45 days after the close of the public notice period, whichever is sooner)

4.0 Quality Objectives and Criteria

This section outlines our approach to applying the DQO process to developing the Poplar River TMDL. The data quality objectives (DQO) process is used to establish performance or acceptance criteria that serve as the basis for designing a plan for collecting data of sufficient quality and quantity to support the goals of a study. The DQO process is the preferred planning approach when data collection is used to determine compliance with a standard (e.g., Surface Water Quality Standard) or used to estimate the condition or health of a waterbody (EPA 240 B-06-001, Guidance on Systematic Planning Using the Data Quality Objectives Process, EPA QA/G-4, February 2006). DQOs are statements that explain the intended use of the data, define the type of data necessary to support the decision, identify the conditions under which the data should be collected, and specify tolerable limits on the probability of making a decision error due to uncertainty in the data.

Quality objectives and criteria for data will be addressed in the context of the following tasks:
1. Summary of water quality data and information
2. Evaluation of existing WEPP model output
3. Data Assessment Summary
4. Source Identification Summary
5. Physical Channel Assessment and Implementation Recommendations

The seven DQO steps are outlined subsequently.

Step 1. Problem Statement, Planning Team, Budget, and Schedule
In 2004, a 2.73-mile portion of the Poplar River was listed as impaired due to violations of the Class 2B (aquatic life) turbidity standard. The impaired stream segment is located between Superior Hiking Trail Bridge and the outlet to Lake Superior. This QAPP will address tasks to summarize existing water quality data, evaluate an existing WEPP model, perform an analysis of source, and conduct a physical channel assessment. The planning team consists of staff from EPA Region 5, MPCA, RTI, ECT, SEH, and URS. Key team members are identified in the distribution list located at the beginning of this document. This project was begun in October 2006 and will conclude in February 2008.

Step 2. Study Goal(s)
The primary goal of this project is to develop a TMDL report that includes all required elements to address the aquatic life impairments of the Poplar River. In support of this goal, several preliminary steps will be taken. The RTI Team will first determine whether the existing Water Erosion Prediction model (WEPP) is adequate to estimate turbidity loading in the Poplar River or whether additional monitoring or analysis to assess turbidity is required. The RTI Team will then develop a source identification summary and recommend restoration activities by conducting physical stream assessments; identifying point and nonpoint sources; and evaluating existing controls, seasonality, and critical conditions. The RTI Team will also identify the extent to which existing conditions in Poplar River (e.g., slumping, high turbidity, and excessive streambank erosion) are due to naturally occurring processes in this region, as opposed to anthropogenic origins.

The distinction between natural and anthropogenic sources of turbidity will be evaluated by assessing the potential impact human activities could have on each identified source. For example, increased runoff from impervious surfaces, decreased vegetation, soil compaction, and other sources may lead to increased sediment wash-off from the land surface, gully erosion, and stream bank erosion. Development or drainage pathways suspected of causing increased erosion will be noted during the watershed visit and geomorphological site visit. A visual comparison between the

Poplar River and the nearby Onion River may help discerning between the natural processes and humanly induced ones. Onion River is a smaller stream and its watershed is largely unaffected by human activities. While there is a difference in scale, there are sufficient similarities to allow for a comparison between the two systems. As part of a different research project, Dr. Joe Magner (MPCA) has agreed to coordinate an investigation of the Onion River, and will provide the RTI team with detailed field data that could be used for a comparison.

In completing the aforementioned assessments and TMDL document, the ultimate goal is to achieve turbidity values below the standards for aquatic life support in the Poplar River and to remove the Poplar River turbidity listing from Minnesota's list of impaired waterbodies.

The principal study questions for this TMDL project are as follows:

- What are the primary causes and sources of turbidity impairment in the impaired section of the Poplar River?
- What is the current TSS load to the Poplar River, and how does this correspond to turbidity levels in the impaired river segment?
- What is the maximum allowable TSS or sediment load that the Poplar River can assimilate and not exceed its Aquatic Life uses?
- What reduction in TSS or sediment load is necessary to attain Class 2A, Aquatic Life turbidity requirements?
- What actions should be taken to reduce TSS and sediment loading to Poplar River?
- Are the sediment reductions achievable?

Step 3. Information Inputs

The Load Duration Curve (LDC) approach will be based on existing hydrologic data and water quality data for turbidity and total suspended solids (TSS). A record of daily mean discharge data collected from 1928 to 1993 is available at U.S. Geological Survey (USGS) flow station 04014500, located on the Baptism River near Beaver Bay, MN. This gaging station is located approximately 40 miles southwest of the Poplar River watershed. Discharge data at USGS station 0401530, the Poplar River at Lutsen, MN, collected from 1912 to 1961 will be used to develop a discharge correlation between Baptism River and Poplar River. In addition, the MPCA has collected several months of stream stage data and generated discharge estimates in the Poplar (Online at: datahttp://www.lakesuperiorstreams.org/streams/data/Java/SMUPoplar.html).

In selecting stream flow data to generate the flow duration curve, it is preferable to use a dataset that contains several years of data (ideally 30 years) and is located at or near the water quality station. In the event that these conditions are not met, estimates of flow at the water quality station of interest can be developed by identifying a nearby gage with sufficient data and developing a correlation between the two stations. For the Poplar River TMDL, insufficient flow data are available at the Poplar River water quality station, thus a correlation will be generated between the overlapping years at this station and the Baptism River station. The overlapping years are 1928 through 1961. This correlation will be used to develop flow estimates at the Poplar River station for the most recent 30 years (approximately 1976-2006). Confirmation of these estimates will be made using MPCA stream discharge estimates. After successful confirmation, the 1976-2006 flow estimates at the Poplar River station will be used to generate the flow and load duration curves.

An extensive amount of data and information will need to be collected to support decisions based on the geomorphology investigation. A determination of the nature, extent, and causes of elevated turbidity, as well as identification of appropriate restoration goals will be obtained by addressing the channel network, channel type and associated controlling indicators, temporal variability in inputs, soil conditions, stability and vegetation cover of the valley slopes, confinement, entrenchment, riparian vegetation, bank condition, channel pattern, gravel bars, channel dimensions, pool characteristics, and bed material. Please refer to Task 6 (Project Description) for additional information.

Data and information will be used collectively to diagnose causes of turbidity, help quantify the level of existing impairment, and provide a foundation on which restoration activities may be identified and implemented. Secondary data sources (i.e., existing data intended for a different purpose) will be reviewed for prospective use to develop the TMDL.

Step 4. Study Boundaries

The Poplar River watershed covers an area of approximately 114 square miles. It originates from the Boundary Waters Canoe Area, Hilly Lake area, and includes the Tait Lake/Tait River watershed, and Pike Lake and Caribou Lake watersheds (An Assessment of Representative Lake Superior Basin Tributaries, MPCA, 2002). Minnesota's 2006 integrated report identifies the most downstream 2.73-mile segment of Poplar River, between Superior Hiking Trail Bridge and the outlet to Lake Superior, as not meeting its intended use (aquatic life) based on turbidity violations. The primary study area to be addressed in this TMDL includes the entire 2.73-mile impaired section. Adjacent watersheds, such as the Brule River watershed, the Caribou River watershed, the Onion River watershed, and the upper Poplar River watershed, will likely be used in evaluating natural or background conditions and region-specific geomorphologic features.

Step 5. Analytic Approach

Development of the Poplar River TMDL will require a combination of data analysis, geomorphological analysis, computer model evaluation and interpretation, simple modeling (LDC approach), and a practical understanding of watershed process leading to violations of Minnesota's in-stream turbidity criteria.

The technical approach for development of the Poplar River turbidity TMDL will be guided by the following set of principles:

1. The TMDL must be based on scientific analysis and reasonable and acceptable assumptions.
    a. All major assumptions will be based on available data and made in consultation with MPCA and EPA.
    b. The scientific methods proposed will have been used and successfully applied in other TMDLs or similar studies.
2. The TMDL must use the best available data.
    a. All available primary and secondary data for the watershed will be reviewed and used in the analysis, where appropriate and consistent with QAPP guidelines.
    b. Data from nearby, less-impaired watersheds will be reviewed and incorporated into the analysis where appropriate.
3. Computer models and results should be applied where appropriate.
    a. The needs for the model to predict turbidity or TSS with accuracy and precision will be balanced with the needs of the TMDL and regulatory objectives.
    b. Simple spreadsheet analysis and empirical relationships are proposed to estimate loads and identify sources.
    c. Existing computer model results and the nature of the suspected sources (e.g., slumping) suggest that additional watershed modeling will not be needed.
4. Methods should be clear and as simple as possible to facilitate stakeholder understanding.

a. All methods, data, analysis, and major assumptions used to develop the TMDL will be described in detail.
b. The TMDL report will be written to be easily understood by a wide range of audiences, including stakeholders. The analytical approach used to estimate the loading capacity, existing loads, and allocations among sources of turbidity will rely on the previous principles, thereby ensuring a scientifically defensible TMDL.

The proposed modeling strategy for developing the TMDL in the Poplar River is the LDC approach in conjunction with land use, point source, and nonpoint source analyses. The LDC will be used to identify the relative load reductions necessary under various flow conditions. Necessary reductions in load are calculated as the maximum distance between the confidence bound on the regression line and the limit curve. TMDL allocations will be developed for point and nonpoint sources based on the data assessment summary, source identification summary, physical channel assessment, and load duration curve(s) findings.

The advantages of the LDC approach are as follows: (1) the available loading capacity (TMDL) is determined for the full range of flows instead of for the more traditional single critical flow; (2) determination of the critical condition is not necessary, which is important for wet-weather related impairment sources; (3) the consideration of all types of pollutant sources, consistent with the intent of the TMDL process; (4) the capture of yearly, seasonal, and daily variations; (5) the approach has been used and approved by EPA elsewhere for turbidity TMDLs; and (6) the clear and understandable nature of this method, which provides a framework with which to communicate data and results to stakeholders and other interested parties. Existing data can be added to the LDC to show the flow condition(s) under which exceedances occur and the deviation between the existing in-stream quality and the TMDL. The likely types of impairing sources are also highlighted, based on the problematic flow condition(s), to help guide implementation activities.

The LDC method has been widely and successfully applied in numerous TMDLs approved by EPA. In addition, the LDC approach will be supplemented by a thorough geomorphological investigation that will quantify the source, frequency, and magnitude of stream bank slumping that contributes to high turbidity levels. The use of past studies and additional geomorphological studies may mitigate some of the weakness associated with the LDC. These studies can be used to assign nonpoint sources of turbidity to land use types or stream bank erosion. This additional information will provide a method for allocating the calculated TMDL to different sources.

Step 6. Performance or Acceptance Criteria
The RTI Team will rely on a variety of primary and secondary data previously collected and reported by several agencies, universities, local governments, and not-for-profit groups. The criteria using existing data will follow these principles:

1. All available data and other information will be reviewed by the project team for applicability to Poplar River TMDL development.

2. Data and information will be placed in hierarchical categories.

   High-quality data: This data will be used to develop the Load Duration Curve (LDC), wasteload and load allocations, identify water quality indicators and target values (e.g. TSS and turbidity relationship), assess and identify sources, and implementation decisions. Data that are categorized as "high-quality" will have the following characteristics:

- Data collected by the project team under an approved QAPP.
- Water quality data collected to support TMDL, modeling, or basin planning by MPCA, USGS, or any group under an approved QAPP that meets EPA requirements set forth in USEPA, 2001(EPA Requirements for Quality Assurance Project Plans. EPA QA/R-5, EPA/240/B-01/003).
- Watershed data (e.g. landuse, soils, topography, precipitation) collected by the State of Minnesota or other state or federal agency.
- Data collected to support TMDL modeling efforts that were collected under a QAPP that meets USEPA, 2001 requirements.
- Quantitative or qualitative watershed assessment information collected in the Poplar River Basin that was collected to support TMDL development or modeling studies and was collected under a QAPP meeting EPA, 2001 requirements. Quantitative information conducted by a MPCA-approved laboratory.
- Water quality modeling results and related water quality information used to estimate sediment loading in the Northern Lake and Forest Ecoregion in cases where the data collection and modeling application were developed under MPCA or USEPA oversight and under a QAPP meeting EPA, 2001 requirements. Model documentation with respect to model calibration and sensitivity analyses must be provided.

Moderate Quality Data: This data will not be used to develop the LDC and allocations. To the extent that moderate data fill a high quality data "data gap," this information will be used to support decisions in source identification, sediment loading estimates from landuses and other sources, and implementation activities such as BMP placement. In addition, moderate quality data may be used to qualitatively compare the Poplar River watershed to other north shore tributaries. Data that are categorized as "moderate-quality" will have the following characteristics:

- Data collected in the Northern Lakes and Forests Ecoregion by researchers to support peer reviewed scientific journal publications that do not include an MPCA or EPA-approved QAPP but include a QA plan.
- Data collected to support sediment and erosion control and hydromodification studies in the Northern Lake and Forest Ecoregion that do not include an MPCA or EPA-approved QAPP but include a QA plan.
- Qualitative or quantitative watershed assessment information collected in the Poplar River Basin or Northern Lake and Forest Ecoregion that was collected for purposes other than supporting TMDL development and was collected without an MPCA or EPA-approved QAPP or outside the oversight of MPCA or USEPA staff but include a QA plan.
- Water quality modeling results and related water quality information used to estimate sediment loading in the Northern Lake and Forest Ecoregion for purposes other than supporting TMDL development and was conducted without a MPCA or EPA-approved QAPP or outside the oversight of MPCA or USEPA staff but included a QA Plan. At a minimum a QA plan should include discussion of management objectives, technical approach, parameter estimation, and uncertainty analysis.

Low-quality data: This data will not be used to develop the LDC and allocations. Data in this category will be used to make decisions on identifying pollution sources, identifying the need for additional data collection, and evaluating seasonal trends. Data that are categorized as "low-quality" will have the following characteristics:

- Data or information collected without a QA plan or QAPP by an agency that has a history of providing data or has standard operating procedures and a training program for staff.
- Water quality modeling results and related water quality information used to estimate sediment loading in the Northern Lake and Forest Ecoregion for purposes other than supporting TMDL development and was conducted without a QAPP or QA Plan, but is well documented. At a minimum the documentation must include discussion of management objectives, technical approach, parameter estimation, uncertainty analysis, assumptions, limitation, results, conclusions, and recommendations for additional analyses, if required.

Models are generally considered acceptable when they are able to simulate field data within predetermined statistical measures. The modeling approach and the TMDL focus determine applicable statistical criteria. In the case of the LDC model, empirical data are used to generate a regression on which the TMDL and load reductions are directly based. As such, model calibration and validation procedures are not applicable.

This TMDL will be supported by summary statistics and analyses of observed water quality data. For example, the RTI Team will evaluate central tendencies of data, percentiles of stream flow and pollutant loads, and correlation coefficients for relationships between parameters. Most significant will be the statistical relationship between TSS and turbidity. An initial assessment of this relationship, using a linear regression on data collected between March 2002 and June 2006, has yielded an R^2 value of 0.928, suggesting a strong correlation between the two parameters (Figure 3). The LDC approach will also generate existing and allowable loads and percent reductions for TSS. The RTI Team QC Officer will review these generated data to make sure they are correct and reasonable before submitting the TMDL report to EPA.

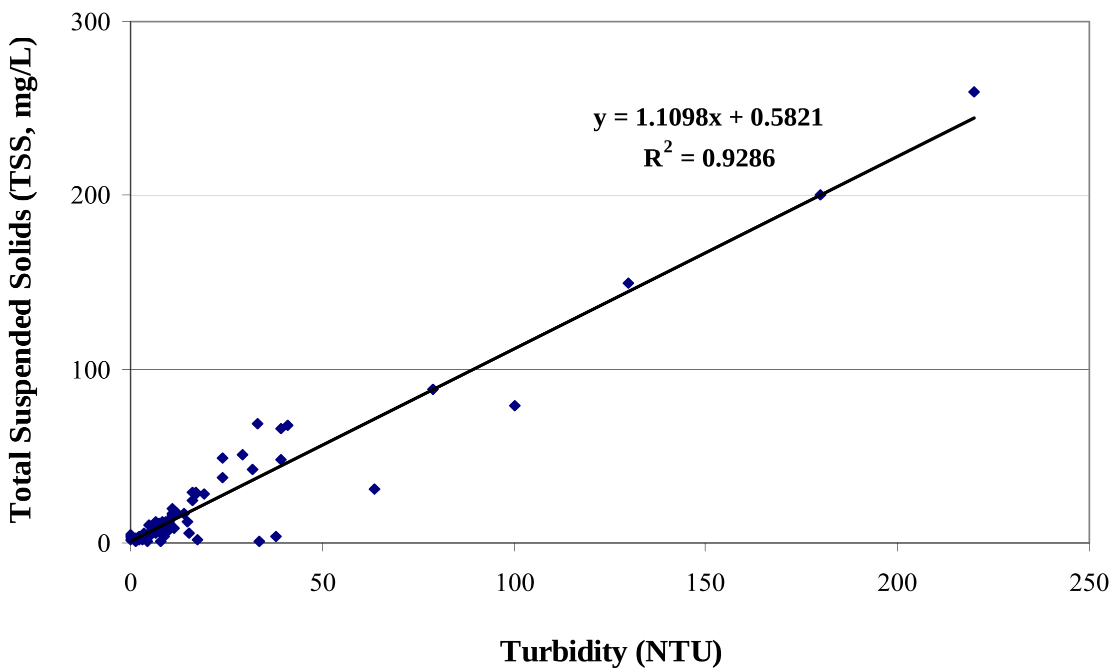

Figure 3. Relationship between TSS and Turbidity at MPCA EDA site S000-261, Poplar River downstream using data collected between March 2002 and June 2006.

Step 7. Plan for Obtaining Data

The overall goal of the DQO process is to develop a design for field investigation and data collection that optimizes efforts and yields data useful in making decisions. The RTI Team will rely on a variety of primary and secondary data for development of the Poplar River TMDL.

Existing (Secondary) Data Sources

Secondary data include all other relevant data collected within the watershed or in nearby less-impacted watersheds by local governments, local/regional agencies, universities, federal agencies, watershed groups, and other not-for-profit organizations. It is expected that the Poplar River TMDL will use secondary data to satisfy project objectives. Data and information provided may be used to analyze potential sources of turbidity, the magnitude and frequency of turbidity criteria violations, the magnitude and frequency of discharges from sources, the effectiveness of watershed best management practices, and the geographic extent of water quality issues, assessing long-term geomorphological stability of the watershed, identifying loading capacity of the river, developing load allocations and waste load allocations, and determining if seasonal variations exist.

Secondary sources will be organized into a standard application database. A screening process (outlined in Section 4.0, Step 6) will be used to check the database and identify outstanding issues, including values outside typical ranges generally found in the literature expected in the Poplar River. Potential reasons for not considering data include age, geographic area (e.g., remote from area of concern), pollutant, inconsistent methodology, poor quality, and lack of documentation (e.g., no QAPP).

Primary Data

The goal of additional data collection is that data be gathered in accordance with MPCA data collection and quality assurance protocols such that it can support TMDL development and implementation in the Poplar River watershed. The sampling process design is discussed in Section 7 of the QAPP.

As part of the channel physical (geomorphological) assessment, the main channel geometry within the impaired reach (reference reach) will be determined using local field measurements, aerial photographs, contour maps, and any other relevant information that may be available from other studies and/or surveys.

The following parameters will be estimated: drainage area size and boundaries, channel bankfull width, channel bankfull depth, valley width and slopes, sinuosity and meander length ratio. The geometry of the main tributary valleys will also be determined. A sediment transport capacity and channel stability analysis will be performed to determine the size range of the particles to be entrained at bankfull discharge conditions.

The QAPP will be reviewed by MPCA to help ensure that data generated for the purposes described herein are scientifically valid and legally defensible. Data will also be evaluated continuously by the RTI Team throughout the project to ensure that they are of sufficient quality and quantity to meet project goals. If the data do not meet the goals specified in Section 4.0 of the QAPP, they will not be used in decision making. MPCA and EPA will be informed of any data that was determined to be unacceptable and therefore not used in TMDL development.

5.0 Special Training Requirements

The RTI Team has experience in developing and reviewing datasets for model development, developing TMDLs, and conducting field assessments using diagnostic principles outlined in Section 3.0, Step 6 of this QAPP.

William Cooter, Ph.D. will be RTI's Task Order leader and has over 30 years of experience with EPA water quality programs. He has directed technical support in the creation and maintenance of data systems for 303(d) impaired waters and 305(b) assessed water, along with GIS mapping layers for these assessment data systems.

Sanjiv Sinha, Ph.D., P.E. will be the overall Task Order Director within ECT responsible for communications with RTI, URS, SEH, MPCA and the EPA. Dr. Sinha has over fifteen years of experience in river geomorphology and assessment, and storm water management. Dr. Sinha recently successfully concluded two of the largest geomorphology projects for the State of Michigan; both are being used as demonstration projects by the Michigan Department of Environmental Quality.

Michael J. Donahue, Ph.D., is the corporate Vice President of Water Resources and Environmental Services for URS Corporation. He will serve as Task Order Director within URS, as liaison to RTI and ECT, and as QA Officer. Dr. Donahue holds three degrees from the University of Michigan (including a doctorate in Urban and Regional Planning). As president/CEO of the Great Lakes Commission, he worked closely with MPCA on water quality issues ranging from local watershed plans to Great Lakes Basin programs.

Brian Jacobson is an Environmental Scientist with URS. During 2000 to 2005, Mr. Jacobson was employed as TMDL modeler in New Jersey and North Carolina State agencies responsible for TMDL development. He has developed TMDL reports for 174 waterbodies to address fecal coliform, turbidity, and nutrient impairments, and was involved in numerous other TMDLs that addressed pH, metals, dissolved oxygen, mercury, TSS, and biological impairments. He is skilled in both simple-approach tools and complex modeling tools.

Troy Naperala, P.E., a Civil and Environmental Engineer with URS, brings expertise in hydrologic analysis, water quality modeling and analysis, watershed management, and TMDL development. Watershed and water quality assessment and management are principal areas of expertise for Mr. Naperala. He has developed simple to complex linked watershed/water quality models to simulate the impacts of development and to assess the effectiveness of best management practices (BMPs). He has applied these tools to assist decision-makers and stakeholders with the development of TMDLs, local land use ordinances, and waste load allocations. Mr. Naperala was part of a team that applied biological indices and watershed modeling to predict habitat. In addition, he co-authored the WERF report, *Navigating the TMDL Process: Evaluation and Improvements*, a comprehensive study that reviewed and analyzed over 100 TMDLs.

Charlene Johnson is a Water Resources Scientist based in SEH's Duluth office. She has served as a facilitator and public outreach specialist for varied environmental programs administered by governmental clients. Ms. Johnson currently serves as the area liaison for the development of delisting criteria to address impairments in the St. Louis River Area of Concern, an EPA-funded project in the Duluth/Superior metro region. She has also represented the City of Superior, Wisconsin, as part of the St. Louis River TMDL-Hg Partnership Board.

Dan Cazanacli, P.E., is a Water Resources Engineer with SEH who specializes in geomorphology and channel dynamics. He received his Masters Degree in Civil Engineering from the St. Anthony Falls Hydraulic Laboratory of the University of Minnesota, and also holds a Masters Degree in Geomorphology from the University of Illinois at Chicago. His research work on river environments focused on sediment transport, erosion and deposition processes, and channel dynamics.

Ron Leaf, P.E., leads SEH's Water Resource Engineering Practice Center based in St. Paul. In this role, he directs engineers and scientists in problem solving for a broad range of hydraulic, hydrologic, and natural resource issues. Ron brings extensive experience in water resources monitoring, assessment modeling, and design from his years of experience with both MPCA and SEH.

6.0 Documentation and Records

The RTI Team will prepare monthly progress reports that will address task and subtask milestones, deliverables, adherence to schedule, and financial progression at the end of each full month while the task order for this project is open. Monthly conference calls will also be conducted to convey project progress and resolve outstanding problems. Data and assumptions used to develop the TMDL models will be recorded and provided to EPA for inclusion in the TMDL report.

The RTI Team will develop a complete repository of all the data and information used to develop the TMDLs in a central project file concurrently with TMDL development. All information used in TMDL calculations for this project will be submitted with the final TMDL report. The central file to be provided with the final TMDL report will contain copies of all applicable data files, model input files, a working version of the model(s) used, and copies of all references used in developing the TMDLs. A copy of the central file will be maintained at RTI's Research Triangle Park office for at least 3 years (unless otherwise directed by the EPA Region 5 COR). The EPA Region 5 COR and RTI TOL will maintain files, as appropriate, as repositories for information and data used to develop the TMDL and for the preparation of any reports and documents during the project. Electronic project files will be maintained on network computers and backed up periodically. The RTI TOL will supervise the use of materials in the central file. If requested by EPA, RTI will provide this information in an administrative record at a later date.

The following information will be included in the hard copy or electronic project files in the central file:

- All EPA-approved versions of the QAPP
- Any reports and documents prepared
- Contract and task order information
- Electronic copies of model input/output (for model calibration and allocation scenarios)
- Results of technical reviews, model tests, data quality assessments of output data, and audits
- Documentation of response actions during the project to correct model development or implementation problems
- Assessment reports for acquired data
- Statistical goodness-of-fit methods and other rationale used to decide which statistical distributions should be used to characterize the uncertainty or variability of model input parameters

- Communications (memoranda; internal notes; telephone conversation records; letters; meeting minutes; and all written correspondence among the project team personnel, subcontractors, suppliers, or others)
- Maps, photographs, and drawings
- Studies, reports, documents, and newspaper articles pertaining to the project
- Spreadsheet data files: physical measurements, analytical chemistry data (hard copy and on diskette).

Copies of formal reports generated from the data and submitted to EPA will be maintained in the central file (diskette and hard copy) at RTI's Research Triangle Park, NC office. The data reports will include a summary of the types of data collected, sampling dates, and any problems or anomalies observed during sample collection.

Sampling sheets are completed on-site at the time sampling occurs. Sampling collection records, field notebooks, and all records of field activity shall be retained by the Poplar River TMDL Project staff for five years following completion of the project.

7.0 Sampling Process Design

Channel bed material will be evaluated every 1000 feet and at any places where a significant change in bed material characteristics is observed. In areas where steep, exposed banks are present in the vicinity of the channel, the bank material will be evaluated as well.

The sampling plan will follow guidance provided by MPCA in a document titled "Sampling and Analysis Plan (SAP) Development Guidance, September 2005. This guidance is based upon USEPA Quality Assurance Project Plan (QAPP) requirements, USEPA QA/R-5, and the EPA Region 5 model QAPP guidance. This guidance is provided in Appendix C.

8.0 Sampling Methods

The size of the channel bed material will be estimated through field measurements aimed at determining the representative particle size (i.e., D50). The bed material is anticipated to be mostly in the range of boulders, cobbles, and gravel. Photographs will be taken and a reference measuring object such as a ruler will be used. If finer material is encountered, samples will be collected using water tight sample bags.

9.0 Sample Handling and Custody

Field photographs will be stored on ftp site in central location accessible to all team members, USEPA and MPCA. Sediment samples, if any will be stored in central location.

10.0 Analytical Methods

As part of the channel physical (geomorphological) assessment, the main channel geometry within the impaired reach (reference reach) will be determined using local field measurements, aerial photographs, contour maps, and any other relevant information that may be available from other studies and/or surveys.

The following parameters will be estimated: drainage area size and boundaries, channel bankfull width, channel bankfull depth, valley width and slopes, sinuosity and meander length ratio. The geometry of the main tributary valleys will be also determined. The sediment transport capacity will be performed to determine the size range of the particles to be entrained at bankfull discharge conditions and a channel stability analysis will be performed.

11.0 Quality Control

An internal peer review of the channel physical assessment will be performed by a qualified individual.

12.0 Instrument/Equipment Testing, Inspection, and Maintenance

All instruments and equipment will be inspected and tested for appropriate use.

13.0 Instrument/Equipment Calibration and Frequency

The RTI Team will perform calibration of the instruments, as needed, by following any manufacturer's instructions

14.0 Inspection/Acceptance of Supplies and Consumables

Not Applicable.

15.0 Non-Direct Measurements

Non-direct data can be published or unpublished and can come from a number of sources, but the non-direct data most often used in TMDL modeling projects are typically obtained from the USGS stream gauge database, EPA's Storage and Retrieval System (STORET), EPA's Permit Compliance System, and databases maintained by state agencies. Stream flow data collected by the USGS may be used to assist in estimating loads of TSS. These data will be obtained from the USGS web site. These data are considered provisional for some time after their collection, generally until the publication of the annual water summary. Because the intended use of the data is only to explore the potential magnitude of TSS loads in runoff, these data will be satisfactory. If these data were to be used to set permit limits or load allocations, the flow measurements will only be used once the provisional qualifier has been removed.

Sampling conducted by the MPCA, Cook County Planning and Zoning Department, Cook County SWCD, Climatology Working Group, University of Minnesota, and other organizations, is not covered under this QAPP and will not be reported to the MPCA Data Manager. However, data collected by these organizations that meet the data quality objectives of this project may be useful in satisfying the data and informational needs of the TMDL.

16.0 Data Management

Data will be stored in a central location (ftp site) that will be accessible to all team members, USEPA, and MPCA. All numerical data will be integrated in spreadsheet format. Each data file will include a worksheet titled "readme" that will describe the nature of the data, method and date(s) of collecting/sampling, and any other relevant information.

17.0 Assessment and Response Actions

The following table presents the types of assessments and response action for data collection activities applicable to the QAPP.

Table 5. Assessments and Response Actions

Activity	Responsible Party	Scope	Response Requirements
Project Status, updates, and oversight	RTI and ECT	Monitoring of the project status and records to ensure requirements are being fulfilled. Monitoring and review of contract laboratory performance and data quality.	Report to EPA and MPCA on a monthly basis via reports and conference calls. Ensure project requirements are being fulfilled.
Summary of Water Quality Data and Information	URS	Identify and summarize all existing water quality data and information related to the Poplar River.	Provide draft and final reports on schedule. Coordinate with EPA and MPCA on technical questions and document edits.
QAPP Submission to EPA and MPCA	URS	Develop plan for conducting data assessment, monitoring, and modeling to support TMDL development.	Provide draft and final reports on schedule. Coordinate with EPA and MPCA on technical questions and document edits.
Evaluate Existing Model Output	URS	Obtain and evaluate existing WEPP model output.	Provide draft and final reports on schedule. Coordinate with EPA and MPCA on technical questions and document edits.
Data Assessment Summary	URS	Prepare and submit an assessment of all available, relevant data.	Provide draft and final reports on schedule. Coordinate with EPA and MPCA on technical questions and document edits.
Source Identification Summary	URS	Prepare and submit a summary of potential sources contributing to the turbidity impairment.	Provide draft and final reports on schedule. Coordinate with EPA and MPCA on technical questions and document edits.
Physical Channel Assessment	SEH	Using diagnostic principles, conduct a physical channel assessment.	Provide draft and final reports on schedule. Coordinate with EPA and MPCA on technical questions and document edits.
TMDL Report	URS	Prepare and submit a TMDL document that includes all applicable elements needed for TMDL approval.	Provide draft and final reports on schedule. Coordinate with EPA and MPCA on technical questions and document edits.
Public Meetings	SEH and URS	Attend and participate in up to two meetings with EPA and MPCA	Lead presentations, and support technical questions.

If problems arise in the process of completing the aforementioned activities, the RTI project manager will determine the appropriate long-term or short-term action to be taken. Steps to address the problem could include: investigation and determining the cause of the problem, implementing a corrective action, following-up with team members to ensure that the appropriate corrective action has been taken and that the problem has been resolved. If these steps do not adequately address the problem, the Project QC Officer will be responsible for corrective action and will inform the RTI Team TOL as appropriate.

18.0 Reports to Management

Monthly progress reports will be provided by RTI to the EPA Region 5 COR. These progress reports will describe the status of the project and work completed as well as anticipated work to be completed during the next reporting period.

The RTI Team will provide a summary of existing water quality data and information to the EPA Region 5 COR for review and approval in the initial stages of development of the TMDL. Following this summary, the RTI Team will evaluate the existing WEPP model, conduct a data assessment summary, conduct a source identification summary, and conduct a physical channel assessment. At the conclusion of each task the RTI Team TOL will submit technical memoranda to the EPA Region 5 COR for review and approval. The draft and final TMDL documents will identify all data and information sources used in the development of the TMDL, including the data sources, original intent in collecting the data, and any available QA associated with the data. The TMDL document will also include a summary of QA procedures used in data collected as part of this project.

19.0 Data Review, Verification and Validation methods

All data used in the development of the TMDL will be reviewed for completeness and correctness. Raw data that is received in electronic format will be screened using visual inspection of the data (scanning for values outside of the typical ranges) and electronically (data statistics in Microsoft Excel). Any data received in hard copy will be assessed by comparing the original data to the entered electronic data. Additional steps for data and model evaluation are discussed in Sections 4.0, 11.0 and 17.0.

All sampling results will be cross checked against the field notebook, sample tags, and chain of custody documents to ensure that the data summary is correct. Analytical results will also be compared to the chain of custody documents to ensure that the data are complete. The RTI Team Project Manager will work with the MPCA Project Manager and, if necessary, the MPCA WQ QA/QC Coordinator, to determine if the data meets the QAPP objectives. Preliminary decisions to accept or qualify data are made by the Project Leader and Project Manager.

20.0 Reconciliation with user Requirements

RTI Team staff will review the results of the LDC and other technical tools used for the TMDL for consistency and reasonableness with the TMDL development process.

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APPENDIX A

Total Maximum Daily Load (TMDL) Decision Document Template

U.S. EPA provided the following template to be followed for this task order as Attachment 3 of the "Task Order 2006-47 Statement of Work for Development of Total Maximum Daily Load (TMDL) for Poplar River."

TOTAL MAXIMUM DAILY LOAD (TMDL)
DECISION DOCUMENT TEMPLATE

Section 303(d) of the Clean Water Act (CWA) and 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 EPA to determine if a submitted TMDL fulfills the legal requirements for approval under Section 303(d) and 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 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 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 nonpoint 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 nonpoint sources, the TMDL should include a description of the natural background. This information is necessary for 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.

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)). 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.

3. Loading Capacity - Linking Water Quality and Pollutant Sources

A TMDL must identify the loading capacity of a waterbody for the applicable pollutant. 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. 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 nonpoint source loadings under such critical conditions. In particular, the TMDL should discuss the approach used to compute and allocate nonpoint source loadings, e.g., meteorological conditions and land use distribution.

4. Load Allocations (LAs)

EPA regulations require that a TMDL include LAs, which identify the portion of the loading capacity attributed to existing and future nonpoint 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 nonpoint sources.

5. Wasteload Allocations (WLAs)

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 permitees should be notified of any deviations from the initial individual WLAs contained in the TMDL. 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.

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)). 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.

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)).

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 nonpoint sources, and the WLA is based on an assumption that nonpoint source load reductions will occur, EPA's 1991 TMDL Guidance states that the TMDL should provide reasonable assurances that nonpoint source control measures will achieve expected load reductions in order for the TMDL to be approvable.

This information is necessary for EPA to determine that the TMDL, including the load and wasteload allocations, has been established at a level necessary to implement water quality standards.

EPA's August 1997 TMDL Guidance also directs Regions to work with States to achieve TMDL load allocations in waters impaired only by nonpoint sources. However, EPA cannot disapprove a TMDL for nonpoint 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.

9. Monitoring Plan to Track TMDL Effectiveness

EPA's 1991 document, Guidance for Water Quality-Based Decisions: The TMDL Process (EPA 440/4-91-001), recommends a monitoring plan to track the effectiveness of a TMDL, particularly when a TMDL involves both point and nonpoint sources, and the WLA is based on an assumption that nonpoint source load reductions will occur. Such a TMDL should provide assurances that nonpoint 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.

10. Implementation

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

11. Public Participation

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, EPA has explained that final TMDLs submitted to 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 EPA establishes a TMDL, EPA regulations require 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 EPA determines that a State/Tribe has not provided adequate public participation, EPA may defer its approval action until adequate public participation has been provided for, either by the State/Tribe or by EPA.

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 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 EPA review and approval. This clearly establishes the State's/Tribe's intent to submit, and 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.

13. Conclusion

APPENDIX B

Methodology for developing the Load Duration Curve

Methodology for developing the Load Duration Curve

The load duration curve method is based on comparison of the frequency of a given flow event with its associated water quality load. In the case of applying the NTU criteria, a correlation is necessary between NTU and TSS to allow for calculation of a load in mass per time units. Correlation coefficients were determined using the below formula:

$$\rho_{xy} = \frac{\frac{1}{n}\sum_{i=1}^{n}(x_i - \mu_x)(y_i - \mu_y)}{\sigma_x \cdot \sigma_y}$$

where $-1 \leq \rho_{xy} \leq 1$

ρ_{xy} = correlation coefficient
x and y = array variables
μ_x and μ_y = expected values in arrays
σ_x and σ_y = standard deviations of each array

Given this information, a regression is developed between turbidity and TSS to allow for the use of TSS values in developing a LDC.

A LDC can be developed using the following steps:

1. Plot the Flow Duration Curve, Flow vs. % of days flow exceeded.
2. Develop TSS-turbidity correlation.
3. Translate turbidity values to equivalent TSS values using the linear regression equation from the correlation.
4. Translate the flow-duration curve into a LDC by multiplying the water quality standard (as equivalent TSS concentration), the flow and a units conversion factor; the result of this multiplication is the maximum allowable load associated with each flow.
5. Graph the LDC, maximum allowable load vs. percent of time flow is equaled or exceeded.
6. Water quality samples, expressed as estimated TSS values, are converted to loads (sample water quality data multiplied by daily flow on the date of sample).
7. Plot the measured loads on the LDC

APPENDIX C

MPCA Sampling and Analysis Plan (SAP) Development Guidance

MPCA
Sampling and Analysis Plan (SAP)
Development Guidance
September 2005

Revision 0
September 19, 2005

Following is an outline for use in developing a Sampling and Analysis Plan (SAP) for Minnesota Pollution Control Agency (MPCA) environmental projects with environmental sampling and analysis. This guidance is based upon USEPA Quality Assurance Project Plan (QAPP) requirements, *USEPA QA/R-5,* and the EPA Region 5 model QAPP guidance.

Development of a project-specific SAP helps ensure that project sampling and analytical methods are adequately documented and are appropriate for the project scope and purpose. The SAP is considered a legally binding document and must be signed by all involved parties. A SAP is developed when decisions will be made based upon the analytical data, the project purpose is to identify possible human health and/or environmental impacts, or the project work is relatively innovative or sensitive. Consult the MPCA Project Manager or Quality Assurance Coordinator (QAC) for confirmation that a SAP is the appropriate project quality document.

At a minimum a SAP is comprised of the following sections. Sections may be added to provide additional information or to address other project issues. Using the following format will expedite the MPCA SAP review and approval process.

I. Signature Page

1. Project Title including the Site name.
2. Printed Name, Title, Company or Agency, Signature, and Signature Date of all of the following
   a. Environmental Consultant
   b. Property Owner, Responsible Party, or Voluntary Party
   c. Laboratory Manager

II. Personnel, Responsibilities and Communication

1. Identify the following parties and their primary duties
   a. Site owner and/or representative
2. Environmental consulting firm and project staff
   a. Project manager
   b. Field manager
   c. Quality assurance manager
3. Analytical laboratory and staff
   a. Laboratory manager
   b. Quality assurance manager
4. EPA and/or MPCA project staff
   a. Subcontractors
   b. Sampling contractors
   c. Data reviewer
5. Identify the on-site quality assurance manager
6. Describe the responsibilities of the major on-site decision-makers
7. Submit an organizational chart showing the lines of communication

III. Project Background and Scope

1. Describe the current status, physical characteristics, and history of the site
2. Summarize the environmental problem(s) and chemicals of concern at the site
3. Provide a detailed site map
4. State the Data Quality Objectives (DQOs) for the part of the project addressed by the SAP
5. Describe the scope and objectives of the site sampling, any spatial or temporal sampling limitations, and any data limitations
6. Describe any program-specific requirements for the selected methods, e.g., NPDES–required method or Superfund requirements
7. Note any non-standard methods or procedures to be used
8. Include a schedule of activities

IV. Sampling and Analysis Design

1. Identify the sampling type(s) and equipment to be used
2. Describe the sampling design and rationale, including how sampling locations and depths will be determined
3. Include a site diagram showing sampling locations
4. List and describe the quality assurance procedures to be used during sampling, e.g., sample duplicates, sampler blanks
5. Specify criteria to determine whether the quality assurance samples meet requirements
6. Describe decontamination procedures for sampling equipment and specify if dedicated or disposable equipment
7. Identify field instruments to be used, if any, and instrument calibration, operation, and maintenance (SOPs)
8. Describe any field recordkeeping requirements, e.g., logbooks, type of information to be recorded, equipment manuals
9. Reference laboratory Quality Assurance Manual (QAM) and SOPs sections containing laboratory instrument calibration and maintenance information
10. Submit a table containing laboratory analytical methods, sample holding times, types of sample containers, and sample preservation methods
11. Describe chain of custody procedures to be used. Provide sample shipping, sample documentation, and sample security information
12. Reference the laboratory QAM internal custody procedures section

V. Internal Quality Assurance

1. Describe environmental consultant procedures to ensure operations quality assurance, e.g., data audits, project folders review
2. Describe number and scope of planned field audits
3. Describe or reference procedures to ensure laboratory data quality, e.g., data audits, laboratory audits, accreditation requirements, performance evaluation studies

VI. Contingencies for SAP Variances

1. Describe the process to be used for making necessary changes discovered during implementation of the SAP. Reference the appropriate section of the laboratory QAM.
2. Identify the individual who will sign off on the deviations.
3. Describe any forms and logs to be used to track deviations for documentation in the project file.

VII. Data Assessment

1. Describe the contents of implementation report(s)
2. Identify the contents of interim and final reports
3. Describe any data reduction or manipulations methods
4. Describe data review and validation methods
5. Describe data acceptance and rejection criteria
6. Provide tables of spike and surrogate sample recovery limits and duplicate sample relative percent differences (RPDs)
7. Describe data storage and retrieval methods
8. Reference laboratory QAM sections for data reduction, validation and reporting
9. Describe how the DQOs will be measured and the criteria for determining if the DQOs meet end-user requirements

VIII. General Information:

1. Referenced laboratory QAMs and SOPs must be filed at the MPCA or submitted by the environmental consultant.
2. Each laboratory is responsible for ensuring a current copy of all such documents is available to MPCA staff.
3. Information deemed proprietary must be labeled as such and submitted with a letter to the MPCA Commissioner requesting that the information be kept non-public and referencing the statute that qualifies the information as non-public. If the commissioner determines the information is proprietary as defined by the Data Practices Act it will be classified and handled as confidential.
4. The laboratory QAM and SOP must be submitted to MPCA for review for any project analytical method not certified by the Minnesota Department of Health (MDH).
5. Project DQOs must meet the minimum requirements of the MPCA Data Quality Objectives Memorandum available at http://www.pca.state.mn.us/programs/pubs/qa-dqomemo.pdf .
6. The project SAP must meet the minimum requirements of the MPCA Laboratory Data Checklist available at http://www.pca.state.mn.us/programs/pubs/qa-chklst.pdf .
7. The SAP must reference specific laboratory QAM sections. A general reference to the QAM itself is not acceptable.
8. The SAP signature page must be signed by authorized representatives of all parties involved in the project.
9. This SAP guidance is intended for MPCA projects only. If project findings are be submitted to other regulatory agencies for review and use, the consultant should verify in advance that a SAP meets their project quality requirements.
10. Questions about this guidance should be directed to Luke Charpentier, MPCA QAC, at (651) 296-8445 or luke.charpentier@pca.state.mn.us . Direct project-specific questions to the MPCA Project Manager.