Executive Summary

The purpose of the project was to provide guidance for future biota TMDLs in the Red River Valley (RRV) and to critically assess geomorphic methods for use in determining the causes of impaired biota.

Components of biotic TMDLs are discussed in Section 2, including background on biotic TMDLs in Minnesota, water quality standards, and watershed-based TMDLs.

Section 3 presents background information on the RRV, including geology, geomorphology, soils, land use, land cover, hydrology, aquatic and riverine habitat, and aquatic biota. The background information was compiled primarily from sources found on the internet and other readily available databases.

Information available for biotic TMDLs in the RRV is presented in Section 4. This information should be reviewed at the onset of RRV biotic TMDLs to summarize what resources and data already exist and to identify data gaps. Lists of literature and technical references include local water plans, TMDL reports, agency guidance documents, materials currently being developed, and related reports and resources. A summary of the monitoring data within the watershed provides an overview of the types of data available and their distribution. The models section provides lists of the available models within the RRV: hydrologic and hydraulic models are dominated by HEC-1 and HEC-2 models, and water quality models include SWAT, AnnAGNPS, WASP, and Bathtub. The data gaps discussion highlights the categories of data that are lacking in the watershed: hydrologic data, geomorphic data, and biotic data are generally less available than water quality data. Long-term monitoring data, currently lacking, would be helpful to characterize changes in geomorphology and the biota over time, and to better understand the relationships between them.

Section 5 provides recommendations for writing biotic TMDLs in the RRV. A list of potential stressors were identified as likely leading to biotic impairments in the RRV: instream sediment from field and gully erosion, intermittent stream flow, channelization, pesticides, low dissolved oxygen, high temperature, and fish passage blockage. The steps needed to complete a TMDL are discussed, and the following are the summary recommendations of each step:

Establish Advisory Groups

- Establish a Technical Advisory Committee (TAC): The TAC should meet at the beginning of the project to discuss the data needs, proposed technical approach, and overall project direction. Additional meetings should be held at points throughout the project where technical input is needed, such as during or towards the end of the stressor ID phase, during development of the TMDL allocations, and during development of the implementation plan.
- Establish a Citizen Advisory Committee (CAC): The CAC should meet at the initiation of the project to introduce the project to local stakeholders, throughout the project as needed, and as the implementation plan is being developed. The CAC should meet more frequently during more controversial projects.

Stressor Identification Process

- Using the EPA's Causal Analysis/Diagnosis Decision Information System (CADDIS), or other tools as they become available, as a structure to lead the investigator through the process, identify the stressors that have led to the impairment(s) in question. The starting point of the stressor ID can be the list of stressors identified in *Section 5.1: Stressors*.
- The initial phase of the stressor ID can occur without the collection of additional data. Available data should be examined to determine the stressors to the extent possible. Additional knowledge about the watershed from local sources should supplement the analysis. A reconnaissance level field survey, such as that outlined in the Watershed Assessment of River Stability and Sediment Supply (WARSSS), can provide information as well. Reconnaissance surveys should include observations and preliminary measurements to identify key sediment sources and aquatic biota stressors.
- If the initial phase does not provide enough evidence regarding the stressors, additional data should be collected (as described in *Section 5.2.4: Monitoring and Source Assessment*), after which the stressor ID should be completed.
- Consider long-term stressors (such as land use changes and channelization) in addition to existing and recent stressors.

Assess Data Gaps

- Assess data gaps to determine if additional data are needed to identify the stressors, to calculate the TMDL allocations, and to develop the implementation plan.
- *Section 5.2.4: Monitoring and Source Assessment* should be used to identify the data needed to evaluate the biotic impairment(s).
- IBI data is usually scarce in comparison to hydrologic and water quality data and it is impossible do determine any trends over time. To alleviate this data gap, long-term IBI studies are needed or at least, repeat IBI surveys should be done in the same stream reaches.

Monitoring and Source Assessment

- <u>Standard monitoring parameters</u>: Use monitoring guidelines in Table 23 to identify data gaps and fill in the monitoring holes.
- <u>Fish</u>: Use the IBI developed for the Lake Agassiz Plain Ecoregion by Niemela et al. (1998) to evaluate recovery of impaired reaches, or to assess additional reaches. Focus on functional groups or guilds to help to reduce variability in the data. When attempting to establish relationships between IBI scores and geomorphic metrics, there is much variability (Niemela et al. 1998). Focusing on guilds of fishes (groups of species that have similar life histories or feeding patterns) such as the simple lithophilic spawning group may help to eliminate variability in the data and establish stronger cause-and-effect relationships. The simple lithophiles, such as some shiners, dace, redhorse, and walleye, use rock substrates for spawning and are therefore sensitive to siltation and embeddedness.
- <u>Macroinvertebrates</u>: Use the statewide family-level biotic index (FBI) currently being developed by the MPCA for all of Minnesota (expected to be completed in fall of

2009). Use the Hilsenhoff Index (HBI) when finer taxonomic resolution is needed and to detect differences in invertebrate tolerances to pollution. Maintain consistency in monitoring methods to allow for data comparability between sites and over time. Where possible, establish long-term studies in order to be able to establish historical trends. Include monitoring of fresh water mussels as they are especially useful in describing water quality trends because they act as "canaries in the coalmine" due to their sensitivity to high TSS loads.

- <u>Aquatic plants</u>: Should be used more in biotic assessment as they are often ignored yet are good indicators of aquatic ecosystem health. Aquatic plant metrics may be particularly useful in assessing headwater sloughs or flow-through wetlands that have properties of both streams and wetlands.
- <u>Instream physical habitat and the stream corridor</u>: (see Table 27 through Table 29). Use multiple lines of evidence (due to high variability in data) to obtain stream erosion sediment loads.

TMDL Allocations

- Use of translators: After the stressors are identified, if they are not easily expressed as load-based pollutants, translators must be selected (see *Section 5.2.5.1: Use of Translators* for a discussion about translators). Table 31 presents translator options to address potential stressors found in the RRV:

- Assimilative capacity: The assimilative capacity will be estimated as the product of the instream flow and the concentration-based standard/goal of the stressor or translator. Or, if the stressor/translator is flow, the assimilative capacity can be developed using the attainment watershed approach, as done in the Potash Brook TMDL in Vermont. The loading capacity and allocations should be presented for multiple flow-based intervals with the use of flow and load duration curves.

  If the translator being used for the TMDL is TSS, a TSS goal has to be set since there are no instream TSS standards in MN. There are several options for developing a concentration-based TSS goal that will be used for the TMDL allocations:

  - Use instream TSS and turbidity monitoring data to develop a TSS equivalent of the turbidity standard for the waterbody in question. This was done for the Brown's Creek Biotic TMDL (in progress) in the St. Croix Basin. The advantages of this approach are that it is relatively simple and only requires instream TSS, turbidity, and flow data. One disadvantage is that the turbidity standard is under state review and may be updated in the near future. Another is that the use of the turbidity standard as the basis for the allocations may not be appropriate if the stressor is not turbidity per se but rather embeddedness or poor habitat quality.
  - Use a model or a combination of models to estimate the instream TSS concentration after implementation of all practicable BMPs, both watershed and instream. This approach is labor intensive as it requires the development of in-depth models. An option is to use this approach on a representative subwatershed within the Red River Basin (RRB) and use the modeled TSS concentration as the TSS goal for the sediment-based TMDLs in the other

subwatersheds. Existing models of subwatersheds within the RRB should be used. Watershed models such as SWAT or AnnAGNPS can be used to model the goal scenario of the watershed load. An instream model such as Concepts can be used to model the instream concentration, taking into account the watershed BMPs (using the watershed model as input into Concepts) and instream BMPs.
  - Complete a WARSSS analysis through all steps of the PLA, which will provide a validated estimate of instream sediment loads under existing and reference conditions. This approach is also labor and time intensive and is not recommended here due to the lack of appropriate reference conditions and sufficient bedload data.

- Wasteload allocations:
  - Obtain list from MPCA of NPDES permitted facilities and sources within the watershed. Confirm this list by examining locations, as some location information may not be accurate. Determine which sources are relevant to the pollutant in question and develop WLAs for each relevant regulated source.
  - Municipal and industrial wastewater can receive WLAs based on their permit limits. Alternatively, if reductions from these sources need to be made, stricter WLAs can be assigned, after which the permit will need to be revised.
  - Regulated stormwater WLAs can be developed with various approaches, such as dividing the allocations according to area under regulation. Regulated stormwater includes regulated construction stormwater, regulated industrial stormwater, and regulated municipal stormwater. See *MPCA Policy for Setting Wasteload Allocations for Regulated Stormwater* for guidance from MPCA.
  - The wasteload allocation is zero for permitted feedlots because NPDES feedlot permits allow for zero discharge.

- Load allocations: Unregulated sources that fall under the LA will include stormwater runoff and instream sources such as channel erosion. The LA should be presented as one allocation that includes all unregulated sources. The assessments of watershed sources and instream sources will not be used to set actual loading goals for each individual source; rather the assessments will be used to identify the water quality issues and to target implementation activities.

- Margin of safety: Use an implicit MOS by incorporating conservative assumptions into the analysis/modeling.

Assessment of Geomorphic Tools

- Do not used "canned" approaches that are generic to all watersheds; rather use a suite of methods tailored to individual watersheds or ecoregions. For the RRB, an integrated approach is recommended incorporating the watershed assessment framework of WARSSS with the focused quantification of streambank material properties of the USDA-ARS in combination with other tools. WARSSS examines more processes at the watershed scale than the USDA-ARS approach and provides a more holistic investigation of watershed-channel relations. However WARSSS provides less detail and less precise quantification of streambank and bed erodibility that allows for more accurate prediction of channel erosion rates. In order for the two to be comparable, the WARSSS procedure would need to be carried all the way through the PLA stage, which may be time and cost prohibitive for many local and state agencies and/or consultants.

- Develop a Minnesota graph for BEHI/BANCS for ease of calculating sediment load from streams.
- Develop a table of physical channel properties (cohesive strength, shear strength, soil particle size) and their relationship to channel erosion rates.
- Results from the geomorphic assessments will help identify appropriate implementation options

Implementation Options

Restoration and management actions need to be identified that will ultimately result in the streams attaining the IBI threshold values for unimpaired waters in the RRB. This section describes implementation options for biotic TMDLs in the RRB, divided based on geographic and geologic differences within the basin, and focusing on sediment-related stressors. The following table summarizes the options.

Category	Example	Characteristic	Implementation Options
Watershed Size			
< 10 mi2	Mostly ditches and field gullies	1st order streams and sloughs	Restore grass swales; control gully erosion in fields; re-meander channelized streams
10-200 mi2	Lawndale Creek	Small streams	Restore grass swales; control gully erosion in fields; re-meander channelized streams; two-stage ditches
200-1500 mi2	South Branch Buffalo, upper portions of Otter Tail, Buffalo and others	2nd to 5th order streams (approximately)	Control reaches of excessive streambank erosion; narrowing overwidened channels to scour aggraded sediment; add large wood debris; improve connectivity for fish passage
>1500 mi2	Red River, lower portions of Red Lake River, Otter Tail, Buffalo and Wild Rice Rivers	Large alluvial channels (Hobbs and Goebel 1982)	Control reaches of excessive streambank erosion; improve connectivity for fish passage
East-West gradient			
River mouth	End of Wolverton Creek	near Red river junction; has reverse flow at high flow levels in Red	Control excessive mass-wasting of streambanks; gully control in small tributaries cutting down to level of incised channel
Lake plain	Flat part of Agassiz Lake Plain	Fine-textured soils, flat	Aggradation / embeddedness management in upper lake plain;

Category	Example	Characteristic	Implementation Options
		topography; sediment aggradation and embeddedness	mass wasting control in lower
Beach ridge	Slight ridge rising out of lake plain	Coarse soils, steeper; high potential for channel incision and bank collapse	Streambank stabilization; bed erosion control
Channel Material Geology			
Alluvial	Red, lower Red Lake, Wild Rice, Otter Tail, and Buffalo Rivers	Sandy soils prone to mass-wasting / bank collapse	Control excessive mass-wasting of streambanks
Glacial till and moraine	Upper parts of Otter Tail, Buffalo and Thief Rivers	More cohesive; less mass-wasting / bank collapse	Control excessive streambank erosion when necessary; protect gravel spawning reaches
Location with respect to backwater from Red River			
Lower tributaries with backwater flow	Wild Rice River, Lower reaches of Wolverton Creek	Increased depth and duration of bank saturation, greater risk for bank collapse	Higher priority placed on controlling channel erosion (grade-control dams, streambank bioengineering, etc.)
Upper tributaries	South Branch Buffalo River	Lower risk for bank collapse	Higher priority placed on controlling field erosion