Michigan Department of Environmental Quality
Surface Water Quality Division
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Total Maximum Daily Load (TMDL) for Biota of the Coldwater River Isabella County, Michigan

Introduction: Section 303(d) of the federal Clean Water Act (CWA) and the United States Environmental Protection Agency's (USEPA's) Water Quality Planning and Management Regulations (40 Code of Federal Regulations Part 130) provides statutory authority for states to develop TMDLs for waterbodies that are not meeting Water Quality Standards (WQS). The TMDL process establishes the allowable loadings of a pollutant to a waterbody based on the relationship between pollutant sources and in-stream water quality conditions. TMDLs provide states a basis for determining the pollutant reduction necessary from point and/or nonpoint sources to maintain and/or restore the quality of their water resources.

Location Description: The TMDL reach of the Coldwater River, a warmwater designated waterbody, is located in Isabella County and extends from Vernon Road upstream to its origin at Outlet Lake (Figure 1). The TMDL reach is about 3.0 miles in length.

Problem Identification: The TMDL portion of the Coldwater River, identified as waterbody identification number, WBID 210424B, was listed in both Year 1998 and 2000 Section 303(d) reports as a "threatened" waterbody, therefore, requiring a TMDL (Creal and Wuycheck, 1998 and 2000). In this reach, the most sensitive designated use evaluated was aquatic life. Using the Great Lakes and Environmental Assessment Section's Procedure 51 (Michigan Department of Environmental Quality (MDEQ), 1997 and 1998) during a June 10, 1997 biological survey of the Coldwater River, the macroinvertebrate community was characterized as acceptable but with the lowest possible score in the category of -4 (Vidales, 2000). This low score was concluded to be attributable to impaired habitat quality as affected by elevated sedimentation that coated and obscured surfaces of larger substrate (e.g., logs, gravel, and cobble) suitable for macroinvertebrate colonization. This condition is commonly referred to as "embeddedness." Although a Procedure 51 score of -4 is considered "minimally acceptable" and meeting WQS (associated with a score range of -4 to +4), a "threatened" condition was indicated due to degraded habitat quality associated with elevated substrate embeddedness. A macroinvertebrate community score of -5 to -9 equates to a rating of poor (not meeting WQS), and a score range of +5 to +9 equates to a rating of excellent (optimum condition supported).

The June 1997 habitat assessment score was 57 with a rating of "fair" or moderately impaired (a habitat assessment score range of 35 to 70 defines the fair or acceptable rating). Expectations are that with continued, excessive sediment additions, the reach would not be supporting its aquatic life designated use in the near future. Further reduction in sediment loads from controllable upland sources was considered desirable.

A follow-up biological survey was conducted on October 2, 2000, to reassess the macroinvertebrate community and habitat quality. Survey results indicated a macroinvertebrate community score of +1 (Wuycheck, 2000) versus the -4 score in 1997. A habitat score of 68 (fair or moderately impaired) versus the 1997 survey score of 57 (fair or moderately impaired) also implied some improvement. However, soil erosion and sedimentation still threaten the biological community in the Coldwater River, primarily within the reach that extended from Vernon Road upstream and adjacent (both upstream and downstream) to the muck farm fields in the vicinity of Battle Road.

Initial efforts in attempting to develop a TMDL for the Coldwater River involved monitoring both suspended solids and bedload using a DH-48 profile sampler and grab samples. Sampling was conducted five times between May 4, 1999 and July 29, 1999 (Wuycheck, 2001a). Stream conditions during the samplings indicated flow velocities were less than 1.0 feet per second, especially at the Battle, Vernon, and Denver Roads sampling stations. Also, relatively low, average suspended solids in transport (25 milligrams per liter (mg/l)) were associated with each of the four stations. Average bedload solids concentrations among all four stations were relatively low and ranged from 2 to 3 mg/l. When sampled, instantaneous stream flow measurements at the latter three sites ranged from 10 to 16 cubic feet per second (cfs), 11 to 18 cfs, and 13 to 20 cfs, respectively. Overall, these data indicated relatively stable flow conditions and a low tendency for flushing and resuspension of solids in the subject reach.

Farrand and Bell (1982a and 1982b) characterized the surficial geology, through which the subject reach of the Coldwater River flows, as dominated by ice-contact outwash sand and gravel. Using Rosgen's (1996) stream type classification system, Wuycheck (2001b) concluded that the subject river reach is strongly characteristic of a Rosgen's C-5 type stream. Rosgen's general description for a C-5 stream type includes characteristics such as low gradient (less than 2%), meandering, point bars, riffle-pool sequencing, alluvium deposition, and channels with broad well-defined floodplains. Overall, Rosgen's C-5 type of stream tends to collect sediment deposits, thereby reducing habitat quality essential for optimum biological community development. Therefore, this in part explains why macroinvertebrate and assessment scores for this reach are expected to be less than optimum range (+5 to +9) but yet fall within the acceptable range (-4 to +4).

It was realized that the suspended solids and bedload sampling procedure for developing a TMDL was too resource-intensive and a protracted process. A simpler, more effective and efficient method was needed to develop a TMDL to address the impacts to a biological community affected by sedimentation and increased embeddedness. The USEPA (1999) "Protocol for Developing Sediment TMDLs" subsequently became available and offered a variety of alternatives for developing suitable TMDLs, including a biota TMDL. Since the end point of protection is the biological community, it was concluded that use of Best Management Practices (BMPs) to reduce sediment loadings from identified sources combined with reassessments of the biological community and habitat would be the most appropriate action for this waterbody. BMPs can be used to minimize anthropogenic sources of sediment loadings to the stream. Correspondingly, improvements in stream habitat through reduced substrate embeddedness and a positive response by the biological community would be expected. The response to reduced sediment loadings and embeddedness would be demonstrated through Procedure 51 assessments of the macroinvertebrate community and habitat.

Target Values: The biota TMDL target is to maintain the macroinvertebrate community at an acceptable score equal to or greater than -4 (minimally acceptable). The macroinvertebrate community scores will be evaluated based on at least two Procedure 51 biological assessments conducted in consecutive years following the implementation of BMPs to minimize sediment loadings to the subject TMDL reach. A habitat assessment will also be used to measure stream conditions. A habitat quality score of 65 (the upper end of the fair habitat rating range of 35 to 70) has been established as the target for the habitat quality. This represents a 14% increase over the 1997 score of 57, which was an acceptable habitat score. The habitat assessment target score of 65 will be used to represent adequate control of anthropogenic sediment sources to remove the threatened condition.

Procedure 51's habitat assessment protocol involves nine metrics that are used to characterize habitat quality. Of the nine metrics evaluated, scored, and rated, the embeddedness metric serves to evaluate the relative physical effect of solids deposition on and around large substrate. With increased embeddedness of large substrate types (e.g., logs, cobble, and gravel) of the habitat, the quality of the habitat decreases; therefore, the integrity of the

biological community is diminished. There is, therefore, a direct link and inverse relationship between the quality of a biological community and the percent embeddedness of colonizable substrate.

The Procedure 51 embeddedness metric score range and (ratings) are grouped as follows: 16 to 20 (optimum); 11 to 15 (good); 6 to 10 (fair); and 0 to 5 (poor). The embeddedness rating for the Vernon Road location in June 1997 and October 2000, remained poor based on scores of 0 and 5, respectively. The low scores and poor ratings for the embeddedness metric were attributable to substantial embeddedness of available substrate. The embeddedness metric will also be used to assess the effectiveness of the BMPs in reducing solids loadings to the subject reach of stream. Expectations are that the level of embeddedness should be reduced with reduced loadings resulting in higher, acceptable scores (6 or greater) for the embeddedness metric.

Source Assessment: A source identification survey of the subject reach was made on November 17, 2000, to better define and document soil erosion sites throughout the riparian zone of the TMDL reach, especially in the vicinity of the muck farm located at Battle Road (Wuycheck, 2001b). Visual assessments were made in portions of the 4.5-mile river reach that extends from Woodruff Road upstream to the Littlefield Lake outlet.

Observations in 1997, 1999, and 2000 indicate the wetland dominated, vegetative riparian zone is interrupted in a few places. However, for the most part, the integrity of the vegetative riparian corridor has been maintained. Localized, anthropogenic sources of sediments to the stream originate from multiple erosion runoff sites associated with muck farming land uses and the two gravel road crossings at Battle and Vernon Roads. The road crossing sites appear to have inadequate culvert sizing and armoring, which facilitates erosion at the culverts during high stream flow conditions. This condition has caused the culvert at the upstream side of Battle Road to become perched. The drainage ditch at the adjacent to the south field of the muck farm appears to have stable flows and discharges venting groundwater based on the presence of substantial growths of watercress commonly associated with venting groundwater. It did not appear to be a substantive source of solids to the Coldwater River system.

Target and Source Linkage: Increased embeddedness resulting from excessive sedimentation has been demonstrated to impair the biological integrity of rivers (Waters, 1995) by obscuring or reducing the suitability of colonizable or useable substrate by stream biota. With a reduction in sedimentation, the macroinvertebrate community typically responds with an increase in species diversity and an increase in the number of individuals of each species. This commonly results from increased habitat diversity as sedimentation rates decline. As a result, the Procedure 51 assessment scores and ratings for quality of the macroinvertebrate community and habitat are expected to increase as sedimentation rates decline, embeddedness decreases and habitat diversity increases. These latter characteristics would serve to demonstrate improvement in habitat conditions, continued WQS attainment, better overall river quality, and removal of the “threatened” condition.

Allocations: Pollutant loadings are allocated among three categories.

Wasteload Allocation (WLA): There are no permitted point source discharges to this waterbody. Therefore, the WLA equals zero.

Load Allocation: The anthropogenic sources of sediment loadings to the river are attributable to periodic nonpoint source erosion and runoff from muck farming and erosion from two road crossings. The nonpoint source and background contributions comprise 100% of the loadings. Therefore, the load allocation represents 100% of the TMDL loading capacity. It is unnecessary to quantify the sediment load because the reductions through implementation of

BMPs will be sufficient to maintain and improve overall habitat and biological community quality within the TMDL reach.

Margin of Safety (MOS): The MOS in a TMDL is used, in part, to account for variability of source inputs to the system. An MOS is implicit for a biota TMDL because the quality of the biological community, its integrity, and overall composition represent an integration of the effects of the variability in sediment loadings in the aquatic environment. Based on the October 2000 biological community and habitat quality assessments, conditions have improved since 1997 in the TMDL reach. Therefore, the implementation of BMPs to reduce sediment loadings to the stream should only further improve and protect designated use support of the Coldwater River. To replicate sampling conditions experienced in 1997, follow-up biological and habitat assessments will be conducted in the June-August timeframe, during stable flow conditions to provide the most comparable assessment results. The results collected will best reflect an MOS that is implicit and express an integration of the effects of the variability in sediment loadings in the aquatic environment and minimize seasonal variability.

In addition, the habitat target chosen is a 14% increase over the score found in the baseline year (1997). This is a conservative assumption, since the condition in the baseline year was determined to be meeting WQS. This level of conservation is appropriate for this specific situation because this waterbody is threatened, versus impaired (and needing to be improved in quality).

Reasonable Assurance: The focus of the actions to protect the Coldwater River is directed towards installing BMPs to minimize and control anthropogenic sediment loadings to the TMDL reach of the Coldwater River. MDEQ district staff will contact the Isabella County Road Commission and muck farm owner(s) to coordinate necessary programs that will assess, develop, and implement BMPs that best minimize or prevent soil erosion from the muck farms and the two gravel road crossings to the Coldwater River. Various sources of financial assistance for planning and structural solutions are available. These include CWA Section 319 and Clean Michigan Initiative Program grants and Natural Resource and Conservation Service assistance.

The MDEQ's Guidebook of BMPs for Michigan Watersheds (Peterson et al., 1983, as modified) will be used to develop BMP elements that should include:

- Upgrade and maintain the current vegetative riparian zone to reduce soil erosion and loadings to the Coldwater River from muck farmland sources. BMPs need to be employed within the riparian zone adjacent to the muck farmland to minimize the loss, through erosion and direct runoff, thereby minimizing habitat impairment of the Coldwater River and preserving farmland soils.
- Proper road maintenance and culvert sizing, alignment, and armoring to minimize continued soil loss at the road crossings.

MDEQ approval of BMPs and implementation plans will be required prior to implementation of proposed structural improvements.

Monitoring Plan: Monitoring will be conducted by the MDEQ to assess progress towards meeting the biota TMDL targets. Following implementation of applicable BMPs, annual sampling of the macroinvertebrate community and habitat quality at Denver Road, Vernon Road, Battle Road, and Coleman Road will be conducted until assessment results from two consecutive years demonstrate attainment of TMDL targets. Such monitoring will be conducted during stream conditions similar to those experienced in 1997 for best comparative purposes.

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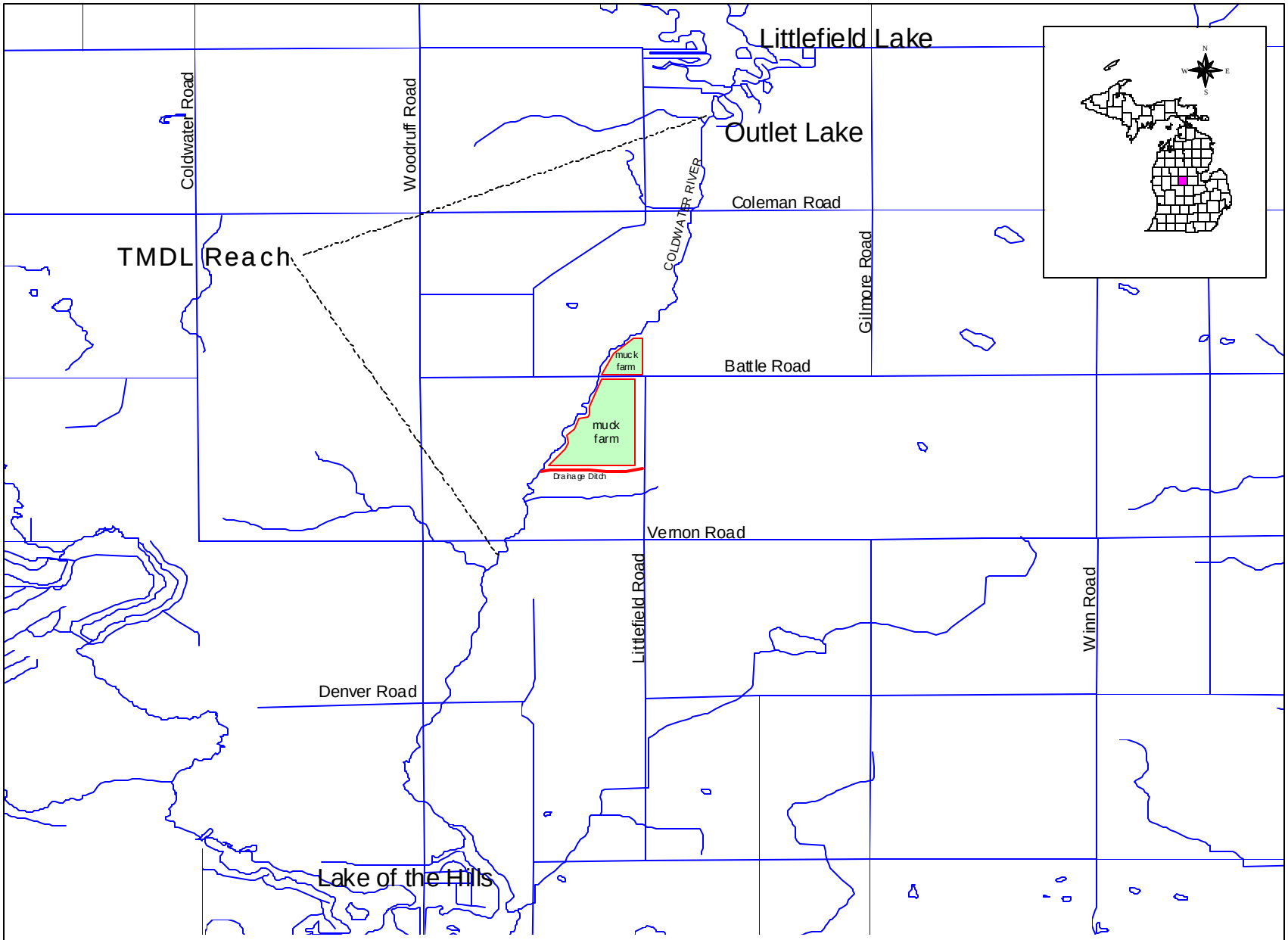

Figure 1. The TMDL reach of the Coldwater River (Isabella County, Michigan).