Introduction

One of the goals of the Clean Water Legacy Act (CWLA) is to identify impaired waters and those waters in need of additional protection so as to protect, restore, and preserve the quality of Minnesota's surface waters. The Minnesota Pollution Control Agency (MPCA) is identified in the CWLA as the state agency responsible for establishing a strategy for monitoring and assessment and identifying impaired waters under the Clean Water Act. This is accomplished through MPCA monitoring efforts and the efforts of local, state and federal agencies and citizens that also monitor the condition of Minnesota water resources.

The MPCA has established a strategy and goal, recognized by the legislature and Clean Water Council, to assess the condition of Minnesota’s waters via a ten year cycle. The key organizing approach used in this strategy is that of the “major,” or eight digit hydrologic unit code (HUC), watershed. There are 81 major watersheds in Minnesota (see Figure 1). This document outlines the watershed approach to monitoring and explains the ten year cycle for this effort.

Figure 1. Minnesota's 81 major watersheds
Overview of the Watershed Approach

During the last three years, the MPCA has been piloting a watershed approach to its stream monitoring efforts. The pilot studies have shown that this approach integrates water monitoring efforts to provide a more complete assessment of water quality and facilitates data collection for the development of Total Maximum Daily Loads (TMDLs) and protection strategies. While the effort began with streams, the MPCA intends to include lake monitoring in this watershed monitoring framework.

The idea behind the watershed approach is to intensively monitor the streams and lakes within a major watershed to determine the overall health of the water resources, identify impaired waters, and identify those waters in need of additional protection efforts to prevent impairments. Follow up monitoring is then done in biologically impaired subwatersheds to determine the cause(s) of the impairments (the “stressors” impacting the biological community) and to begin to identify pollutant sources.

The intensive nature of this monitoring (i.e. the good coverage of sites within the watershed) leads to one of the significant benefits of the approach – the identification of most, if not all, of the impairment problems at one time. Consequently, there is an opportunity to address the impairments in a watershed through a coordinated TMDL process. This is much different than past monitoring efforts, when limited monitoring resources were not concentrated in defined areas. As a result, MPCA often identified one impairment during one year, and another impairment at the same site a couple years later during follow up monitoring for the TMDL study, necessitating a separate TMDL study or slowing the progress of the one underway. In the same way, impairments on upstream or downstream segments of the same stream were not always identified at the same time, making it difficult to achieve the CWLA goal of developing TMDL studies on a watershed scale.

Another benefit of this watershed approach is that it provides an opportunity for citizens and local government to proactively engage in the monitoring work through volunteer and local monitoring activities. This up front engagement helps set the stage for local involvement in any ensuing TMDLs or protection strategies, and enhances the information available for good planning efforts and successful implementation of restoration/protection strategies.

Finally, the major watershed approach provides predictability in the monitoring schedule. By establishing a schedule for monitoring all of the state’s major watersheds every ten years, the state can accomplish the following:

- Provide advance notice to interested stakeholders, local governments and volunteers regarding monitoring plans.
- Assist local groups in ramping up their monitoring efforts to provide data in advance or in between agency monitoring efforts.
- Provide stakeholders a head’s up as to when they can expect the TMDL study or protection strategy work to begin in their area.
- Insure that comprehensive information on the status of water quality – and water quality management efforts – is collected, evaluated and provided to state and local partners at least one each decade.

Components of the Watershed Monitoring Approach

As noted above, the watershed approach can be applied to stream and lake assessment monitoring, and can also help to organize and encourage local and citizen monitoring efforts. Figure 2 illustrates the relationships between these monitoring components, and how they inform watershed planning (including TMDL development) and implementation activities. The following paragraphs provide more details on each of the monitoring components of the watershed approach.
Major watershed load monitoring network

The first component of this effort is the major watershed load network, which involves permanent flow and chemistry monitoring stations at the outlets (also referred to as “pour points”) of each of the state’s major watersheds. This partnership effort between the MPCA and the Minnesota Department of Natural Resources (DNR), along with the U.S. Geological Survey and the Metropolitan Council, is a cornerstone of the watershed approach in that it involves continuous flow and water quality data collection with the computation of an annual load for each site, each year.

The load defines the amount of a parameter passing through a site per unit time. Loads determined at the outlet (pour point) of watersheds make it possible to compare watersheds across basin and ecoregion boundaries. Watershed loads can also be used to assess trends in the water quality of a specific watershed over time, and to see how data from a given year compares to the long term record for a watershed. This will be particularly helpful in putting the intensive watershed monitoring data (see below) into a longer term context, given that the intensive monitoring will occur once every ten years.

Intensive watershed monitoring

The intensive watershed monitoring of rivers/streams aggregates watersheds from a coarse to a fine scale. The foundation of this approach is the 81 major watersheds. Sampling occurs in each major watershed once every ten years. In this approach, intermediate sized (approx. 11 digit HUC) and “minor” (14 digit HUC) watersheds are sampled along with the major watershed outlet to provide a complete assessment of water quality. Sites are selected near the outlet or “pour point” at all watershed scales. This approach provides robust assessment coverage of rivers and streams without monitoring every single stream reach (See Figure 3 for an illustration of the monitoring site coverage within a major watershed).
The outlet of the major watershed (purple dot in Figure 3) is sampled for biology, water chemistry, and fish contaminants to allow for the assessment of aquatic life, aquatic consumption, and aquatic recreation use support. Each 11 digit HUC pour point (green dots in Fig. 3) is sampled for biology and water chemistry for the assessment of aquatic life and aquatic recreation use support. Watersheds at this scale generally consist of major tributary streams with drainage areas ranging from 75 to 150 square miles. Lastly, most minor watersheds (typically 10-20 square miles) are sampled for biology to assess for aquatic life use support (red dots in Fig. 3).

The second step of the intensive watershed monitoring effort consists of follow up monitoring at all 11 digit HUC’s determined to have impaired waters. This follow up monitoring is designed to identify the source(s) and cause(s) of impairment.

In addition to the MPCA’s intensive watershed monitoring effort described above, the Minnesota Department of Agriculture (MDA) monitors pesticides in Minnesota water resources to identify surface water pesticides of concern, trends over time, provide information on the effectiveness of pesticide management plans and best management practices, and provide data needed by the MPCA to assess water quality. This information can also be factored into the watershed framework, further enhancing our understanding of water quality within each watershed.

Lake assessment monitoring

Lake assessment monitoring activities are focused on assessing the recreational use support of lakes and identifying trends over time. MPCA also assesses aquatic consumption use support based on fish tissue and water column concentrations of toxic pollutants; the fish tissue data is provided from monitoring conducted by the DNR and MPCA. Currently the MPCA does not assess aquatic life use support as methods are not available but the DNR is working to develop such methods (lake indices of biotic integrity).

Minnesota has about 12,200 lakes greater than ten acres in size. Of those, about 2,300 are between 100 and 500 acres, and about 700 are 500 acres or larger. Since it would be prohibitively expensive to monitor and assess all the lakes in Minnesota – just like it would be to sample every stream reach – the state must develop an approach for selecting which lakes to sample, and rely on other indices (such as remote sensing information) to provide a snapshot of the water quality of lakes that are not sampled.
The MPCA has a goal of assessing all lakes 500 acres or larger for recreational use support over the next ten years, and at least 25 percent of smaller lakes. Many of these smaller lakes are monitored by local units of government and volunteers, through MPCA and other agency programs (including the work of the Metropolitan Council), or through independent local efforts. Two keys to the success of the lake assessment monitoring effort, then, are 1) the ability to identify priority lakes for monitoring, and 2) the ability to support and engage local lake monitoring efforts on priority lakes.

The MPCA is in the process of aligning its lake monitoring efforts with the major watershed monitoring schedule. The agency intends to schedule its lake monitoring and assessment efforts so that once a major watershed is intensively monitored and assessed for stream water quality, the key lakes within that watershed have also been monitored and assessed. The agency will also explore how to target its local and volunteer monitoring grants to complement the ten year watershed monitoring cycle. In that way, the lake and stream data can be considered together to provide a comprehensive picture of water quality status, and a determination can be made regarding how best to proceed to develop TMDL(s) and protection strategies, rather than being forced by the monitoring timing to address lakes and streams separately.

For lakes 500 acres and larger, the agency will complete its lake monitoring/assessment work in each major watershed by the time the stream monitoring and assessment is complete. For smaller lakes, the MPCA and DNR need to work together to identify priority sites for monitoring and assessment and to engage local governments and volunteers.

The first step in this prioritization process will involve the use of remote sensing and citizen volunteer Secchi disk monitoring data to provide an initial picture of lake water quality. Lakes with significantly better water clarity than state standards (likely 20 percent or more) will be identified as “unimpaired” for recreational use support. Lakes where the water clarity is below standards or is borderline, or where historical data suggests impaired conditions, will be prioritized within each major watershed for follow up monitoring. The goal is to generate enough data on lake water quality within each major watershed to identify which subwatersheds/lakesheds contribute to impaired lakes and streams, and which do not (see Figure 4 for an illustration).

**Figure 4. Conceptual diagram of major watershed with priority lakes identified for monitoring**

![](image)

**Citizen/Local monitoring**

As is evident in the description of lake assessment monitoring above, citizen and local monitoring are important components of the watershed monitoring approach. Like the permanent load monitoring network that will be established at watershed pour points, citizen/local monitoring efforts can provide the long term picture needed to help evaluate current status and trends. For example, long term Secchi disk records for many Minnesota lakes represent the best and most valuable water quality data available for those lakes. Data from citizen and local monitoring programs is also used to help prioritize waters for follow up sampling and to support assessment decisions. Many local groups also conduct detailed sampling efforts following established monitoring protocols, providing data that is used directly in assessments. For example, groups funded through the FY2008 CWLA Surface Water Assessment Grants will sample more than 375 lakes and 90 stream sites to collect data for assessment purposes. Volunteers also provide weather and lake level data necessary for the proper interpretation of monitoring results and the application of lake and watershed models.
One of the challenges in enhancing citizen and local monitoring efforts is recruiting new volunteers. To date, the MPCA and DNR have generally taken a “broadcast” approach to recruitment (with a couple exceptions). While this approach helps to inform the public of opportunities to volunteer, it does not always do a great job matching volunteers with key lakes and stream reaches that are in need of monitoring. Coordinating with local groups to focus monitoring efforts where it will be most effective for Clean Water Legacy planning and tracking purposes will help local citizens/governments see how their efforts are being used to inform water quality management decisions and affect change.

A key benefit of the watershed approach involves the advance identification of lake and stream sites that will be sampled by agency staff. This provides an opportunity to actively recruit volunteers to monitor those sites, too, so that water quality data is available for the years before and after the intensive monitoring effort, and the needed weather and lake level data is also available. This local/citizen collected data will help agency staff interpret the results from the intensive monitoring effort, which only occurs once every ten years. It will also allow interested parties to track any water quality changes that occur in the years between intensive monitoring events.

The watershed approach also provides a framework for encouraging participation in the CWLA Surface Water Assessment Grant program, which provides grants to local governments, educational institutions and nonprofits to monitor lakes and streams. Each year the Request for Proposals (RFP) can identify the major watersheds that are scheduled for intensive monitoring in the next year or two, and additional points can be given to proposals that will monitor lakes and streams in those watersheds. As a result, an even more robust dataset will be available for the watershed planning effort that follows the monitoring (including TMDL development and protection strategy development). In watersheds without active volunteer groups or local monitoring efforts, work can be done in advance of the RFP to generate local interest, train volunteers, and get them up to speed for the application process.

Another opportunity created by the watershed approach involves refining agency volunteer recruitment goals so they align with the data needs for each watershed. In the case of the MPCA, the agency currently has a goal of recruiting volunteers to monitor Secchi disk transparency on all lakes larger than 100 acres (as of 2007, about 1,260 lakes have active volunteers). This has proved challenging, given that not all of those lakes have public accesses or developed shoreline. The identification of priority lakes for monitoring as described above will allow the MPCA to recruit volunteers for specific lakes in addition to the broadcast approach to recruitment. The overall recruitment goal can then be revised to reflect the watershed approach, resulting in a more realistic target and better assurance that key data needs are being met along with the realization of the other benefits of volunteer monitoring, such as increased awareness and engagement. This same approach will also benefit stream transparency tube monitoring, and recruitment of weather and lake level observers.

The watershed approach and schedule also provide a communication tool for informing local government and other interested parties about agency monitoring efforts, and for identifying opportunities for partnership. For example, in the first three years of the intensive watershed monitoring pilot, planning for the monitoring effort in specific watersheds has resulted in a better understanding of local monitoring efforts by state agencies, with the result that local and state monitoring efforts are now better coordinated in those watersheds. Advance knowledge of the monitoring schedule and sites will also allow the Clean Water Council to assist in recruitment and communication efforts for agency monitoring programs and grant opportunities. The Clean Water Council consists of representatives from diverse CWLA stakeholders, presenting a great opportunity for getting the word out about monitoring needs.

Finally, it is important to note that citizen volunteers and local groups (including local governments) are not just interested in collecting monitoring data. They also want to see that the data is used. One outcome of the watershed monitoring effort will be the use of citizen and local data in the identification of impaired and “at-risk” lakes and streams and the subsequent initiation of TMDL studies and protection planning efforts. A second likely outcome of the intensive watershed monitoring will be the development of watershed specific monitoring reports. These reports can include local and volunteer monitoring results in addition to agency monitoring results. Both of these outcomes will further illustrate the connection between local, citizen and agency monitoring efforts, and show how all of this work is important to our understanding of water quality.

**Watershed Monitoring Schedule**

The MPCA has developed an initial schedule for intensively monitoring all of the major watersheds once every ten years to aid in the transition to the watershed approach. The first ten year schedule was drafted by the MPCA based on the following criteria, which include the CWLA prioritization criteria and additional factors identified by agency watershed staff:

- risk to human and aquatic health
- probability of impairment based on existing data (including land use information)
- alignment with TMDL schedules
MPCA staff sought input from the Clean Water Council on these priorities prior to developing the schedule. In many cases MPCA regional staff also consulted with basin partners as the schedule was developed. The initial draft schedule is as follows:

<table>
<thead>
<tr>
<th>Year</th>
<th>North Monitoring Unit</th>
<th>South Monitoring Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>2008</td>
<td>Upper Red/Lower Red River; Sauk River; Little Fork River</td>
<td>Mississippi River (Red Wing); Root River; Le Sueur River</td>
</tr>
<tr>
<td>2009</td>
<td>Buffalo River; Mississippi River (St. Cloud); St. Louis River</td>
<td>St. Croix River (Stillwater); Cedar River; Shell Rock River Chippewa River</td>
</tr>
<tr>
<td>2010</td>
<td>Grand Marais River; Bois de Sioux River; Crow Wing River; Big Fork River</td>
<td>Mississippi River (Winona); Minnesota River (Granite Falls)</td>
</tr>
<tr>
<td>2011</td>
<td>Sandhill; Snake River (Red Basin); Long Prairie River; Nemadji River; Lake Superior South</td>
<td>Cannon River; Rock, Little Sioux, Big Sioux (Pipe Stone, Medary Creek)</td>
</tr>
<tr>
<td>2012</td>
<td>Two Rivers; Marsh River; Mississippi River (Brainerd); Rainy River (Headwaters)</td>
<td>Mississippi River; Zumbro River; Lac Qui Parle River</td>
</tr>
<tr>
<td>2013</td>
<td>Wild Rice River; Mississippi River (Headwaters); Lake Superior North</td>
<td>Rum River; Watonwan River; Cottonwood River</td>
</tr>
<tr>
<td>2014</td>
<td>Mustinka River; Redeye River; Vermilion River (Rainy Basin); Cloquet River</td>
<td>Minnesota River (Shakopee); Des Moines River (East and West); Winnebago River</td>
</tr>
<tr>
<td>2015</td>
<td>Thief River; Red Lake River; Mississippi River (Sartel); Rainy River (Rainy Lake)</td>
<td>Kettle River; Upper Iowa, Mississippi River (La Crescent, Reno); Minnesota River (Headwaters, Mankato)</td>
</tr>
<tr>
<td>2016</td>
<td>Otter Tail River; Roseau River; Mississippi River (Grand Rapids); Rapid River; Rainy River (Manitou, Baudette)</td>
<td>St. Croix River (Upper); Redwood River</td>
</tr>
<tr>
<td>2017</td>
<td>Clearwater River; Red Lake; Leech Lake; Pine River; Lake of the Woods</td>
<td>South Fork Crow River; Blue Earth River</td>
</tr>
</tbody>
</table>

Other Monitoring Efforts

It is important to note that the activities described above do not encompass all of the condition monitoring activities underway in Minnesota. Other ongoing monitoring efforts include:

- Monitoring the concentration of various water quality indicators at designated river sites over a long period of time, following a rotating basin approach. Some of the sites have data back to the 1950’s.
- Probabilistic (random) surveys of Minnesota lakes, streams and wetlands to determine water quality condition and trends over time on a statewide, ecoregion or basin scale. Probabilistic studies allow the MPCA and others to gather in depth information on sites that are representative of the state, ecoregion or basin as a whole.
- Special studies designed to answer specific questions, such as the nutrient concentrations of shallow lakes, or the concentrations of trace metals in Minnesota rivers and streams.

The data from these activities can also be factored into the watershed framework.

Summary

The watershed monitoring approach presents a number of opportunities to further the CWLA goal of protecting, restoring and preserving the quality of Minnesota’s surface waters. It provides a framework for implementing the ten year monitoring cycle, and for identifying key monitoring sites. Most importantly, it provides a communication tool that can inform stakeholders, engage volunteers, and help coordinate local/state/federal monitoring efforts so the data necessary for effective water resource planning is available, citizens and stakeholders are engaged in the process, and citizens and governments across Minnesota can evaluate the progress that is being made on a regular basis.