

Tier I Surface Water Monitoring Activities  
Bureau of Watershed Quality  
Wisconsin Department of Natural Resources  
2012-2013

This document summarizes the Bureau of Water Quality's surface water quality monitoring activities, providing a brief description of Tier I monitoring goals, funding sources and detailing specific Tier I monitoring activities. Additional information can be found in the Water Division Monitoring Strategy (WDNR 2008).

The Environmental Protection Agency (EPA) describes the use of water quality data including the characterization of waters, identification of trends over time, identification of emerging problems, determination of whether pollution control programs are working, helping direct pollution control efforts to where they are most needed, and responding to emergencies such as floods and spills (<http://water.epa.gov/type/watersheds/monitoring/index.cfm>).

Wisconsin needs to collect water quality data for the same reasons as identified by the EPA. Collection of this data is accomplished through a three Tiered approach to monitoring including;

- ▶ Tier 1 – General Assessment
- ▶ Tier 2 – Targeted Monitoring
- ▶ Tier 3 – Evaluation Monitoring

This summary focuses on statewide Tier I assessments. Descriptions of Tier 2 and Tier 3 monitoring activities can be found in the 2006 Water Division Monitoring Strategy at the WDNR Webpage (<http://dnr.wi.gov/topic/surfacewater/monitoring.html>).

### **Tier I Assessment & Monitoring Goal:**

General assessment or Tier I monitoring is designed to provide information about the condition of Wisconsin's surface waters, including lakes, rivers and streams on a statewide and watershed scale, using a standardized condition assessment procedure (Wisconsin's Consolidated Assessment and Listing Methodology 2014). Specifically, data collected through Tier I monitoring is used to

- 1) identify streams and rivers meeting their designated uses,
- 2) flag streams and river potentially not meeting their designed uses for follow up Tier II monitoring
- 3) establish condition assessment trends and metric variation over a longer-period of time (5 or more years)

### **Assessment & Monitoring Objectives**

#### **Tier 1. General Assessment Objectives**

- Balance monitoring and assessment work among regional stream biologists throughout the state.
  - Rationale: Stream biologists (~ 15 statewide) are stationed at field offices scattered throughout the state and have assigned areas ranging in size between four to eight counties. Field biologists are knowledgeable about the condition of their streams for multiple program purposes (e.g. federal and state permitting, spill and compliant response, grant issuance and 305b/303d reporting). This objective allocates Tier I sampling sites and work relatively equally among the field biologists

- providing an opportunity for field biologist to sample streams and rivers, building first-hand knowledge of streams and rivers within their assigned coverage areas.
- Develop a monitoring and assessment framework that is applicable across all stream and rivers miles within the state by natural community types.
    - Rationale: There are approximately 83,500 miles of wadeable stream miles within the state of Wisconsin mapped at the 24K hydro-layer scale. Funding and staff are not sufficient to sample all stream miles in Wisconsin, which necessitates some level of probabilistic sampling and extrapolation of the data.
- Wisconsin's Consolidated Assessment and Listing Methodology (WisCALM – 2014) specifies the use of 10 different wadeable stream natural communities for assessing fish and aquatic life use potential (i.e. condition assessment). Consequently, sampling sites are selected to represent Natural Communities in proportion to their occurrence on the landscape based on stream miles – this allows comparable assessment of the full range of thermal and size conditions of Wisconsin's streams.
- Design a Tier I monitoring framework for streams and rivers with an annual budget less than or equal to approximately \$300,000.
    - Rationale: Based upon historical expenditures of time and money, the Bureau of Watershed has approximately \$300,000 allocated for Tier 1 stream and river monitoring. Paralleling this allotment, the Bureau of Watershed field biologist have the capacity to recon, sample and enter data for approximately 300 wadeable sites statewide and approximately 20 river sites and continue to accomplish their other core program work.
  - Design a monitoring and assessment framework that accounts for year to year variations in general assessment metrics and water condition trends of Wisconsin's streams and rivers.
    - Rationale: Annual monitoring of the same site provides a measure of year to year variability among the metrics and "flags" abnormal years due to regional weather conditions. Over a longer period of time, the information can also elucidate long-term trends.

### **Tier I – Wadeable Streams Monitoring Framework**

#### *Natural Community Stratified-Random Monitoring*

The 2012-2013 Tier I wadeable stream monitoring framework includes 100 sites per year randomly selected, stratified by the number of stream miles within each Natural Community Classification within each 8-digit Hydrologic Unit Code (comparable to DNR's Water Management Unit). Assessment information monitored at each site includes fish IBI, macroinvertebrate IBI, qualitative habitat, instantaneous temperature, pH, dissolved oxygen, conductivity and total phosphorus. The collection of continuous temperature data is recommended if equipment is available.

For field seasons 2010 and 2011, monitoring efforts for the two smallest stream classes (Macroinvertebrate Streams and streams mapped on the 24K, but not mapped on the 100K) were not evaluated in order to keep within available hours and budget. This reduced effort on small streams will be re-assessed after the collection of 1 or 2 years of data.

Data will be used to "flag" streams with poor biological condition ratings for additional sampling to evaluate potential for 303d listing. Condition assessments from individual stream sites may also be combined spatially and within stream natural community types to estimate the overall condition. For example, sufficient sites (~35 to 50) will have been sampled within a 5 year period, for each 8-digit HUC to draw conclusions about the condition of each of the natural community types within the basin. Site condition assessments can also be evaluated based upon different geomorphologic or land-use characteristics.

The total cost per site is estimated at \$548 including limited term employee (LTE) time, macroinvertebrate analysis at University of Stevens Point Aquatic Biomonitoring Laboratory, and travel and supplies (S-line).

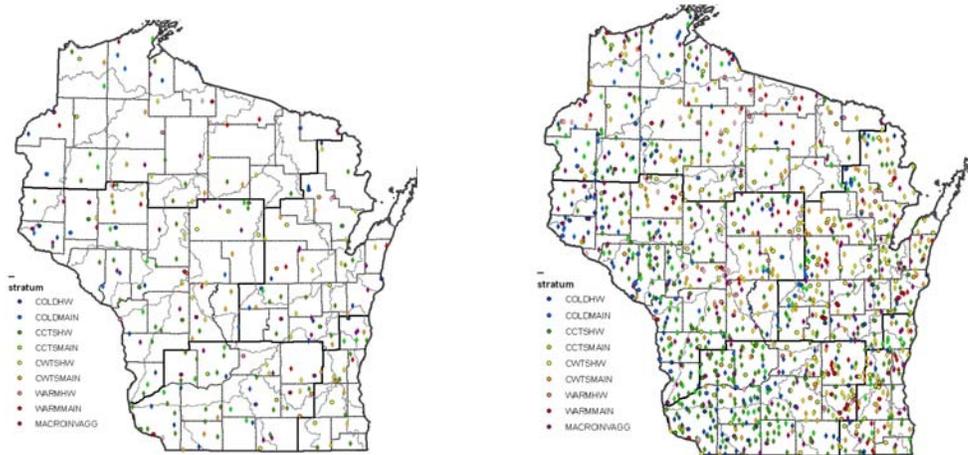


Figure 1. Natural Community Stratified Random Site Coverage in year 1 and year 5 of monitoring program.

### Wadeable Stream Long-term Trend Sites

Forty two wadeable stream sites will be monitored on annual basis to establish biological, physical and chemical trends over time. These sites will be selected from a suite of “reference” sites monitored in either 2008 or 2009 and include two sites in each of the following stream classes from each of the five WDNR regions:

- Cold and/or Cold-Cool Headwaters
- Cold and/or Cold-Cool Mainstem
- Warm and/or Warm-Cool Headwaters
- Warm and/or Warm-Cool Mainstem

Monitoring parameters at the long-term trend stream sites include fish IBI, macroinvertebrate IBI, quantitative habitat, and base flow water chemistry (total phosphorus, ammonia nitrogen, nitrate-nitrite, total Kjeldahl nitrogen and total suspended solids).

Data for these 42 sites will require 5 to 10 years of collection before a sufficient number of samples have been collected to evaluate trends. However, within a couple of years, the data may be used qualitatively to identify “abnormal” climatic years when trend reference data may vary dramatically from other years.

The total cost per site is estimated at \$1,200 including LTE labor, macroinvertebrate analysis at University of Stevens Point Aquatic Biomonitoring Laboratory, water chemistry analysis at the State Lab of Hygiene and travel and supplies (S-line).

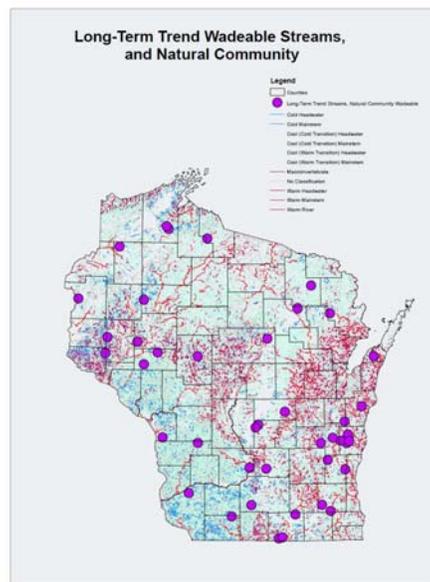


Figure 2. Location of Long Term Trend wadeable stream sites. Streams are colored to represent natural community types

Severely Impacted Sites 2012 & 2013

Figure 1. 100 wadeable stream sites were selected per year in 2012 and 2013 that represented the most severely impacted stream sites in Wisconsin. Site selection was stratified among natural community types and major basin (HUC 8) to achieve some spatial balance and to assure all stream types were represented in the population. Severity of impacts was determined using a human disturbance gradient model that predicts potential impacts to stream water quality (Wang et al. 2008). This data set will be used ID the most impacted streams in the State and compare in contrast to reference stream condition (2008-2009 Tier 1 project). The data will then be used to derive expected changes in water quality and biologic condition from least impacted to most impacted streams. This site list will also provide an optimal candidate list for impaired waters (303(d)) list.

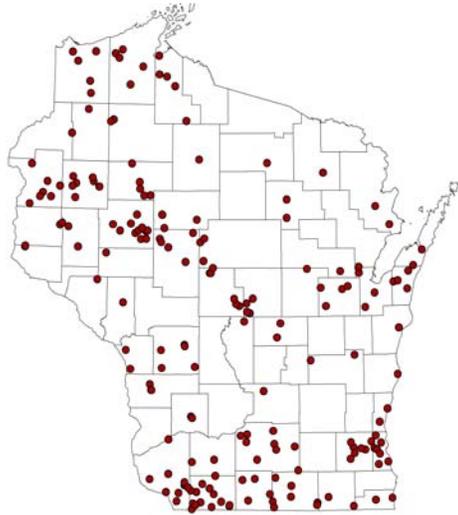


Figure 3. Location of 100 Severely Impacted stream sites monitored in 2012-2013

Biologists will collect water quality samples for temperature, dissolved oxygen, conductivity, pH and total phosphorus as well as survey qualitative physical habitat and macroinvertebrate and fish biologic communities. The total cost per site is estimated at \$548 including limited term employee (LTE) time, macroinvertebrate analysis at University of Stevens Point Aquatic Biomonitoring Laboratory, and travel and supplies (S-line).



Figure 4. Location of Long Term Trends Rivers fixed station monitoring sites.

**Tier I – River Monitoring Framework**

Long-Term Trend River Sites (Nonwadeable LTT)

The current Long-term Trend (LTT) water quality-monitoring network, rejuvenated in 2001, consists of 42 sites, with a minimum of one site per major river basin, generally located near the mouth of each river. Most of these sites were part of an earlier trend monitoring program with data available from as far back as the 1970s. Selection of the 42 trend monitoring sites considered different land coverage in the state varying from urban areas in the southeast, heavy agricultural use in central and southwest and forest cover dominating in the north. Just over half the sites (24) are sampled monthly and the other sites are sampled quarterly. Monthly sites are generally located near the mouth of major rivers, whereas, quarterly sites are often located at additional sites on major rivers some distance above the mouth.

The number of water quality measurements for some sites on the Mississippi River (Lock and Dams (LD) 3 and 4) were reduced due to the availability of monitoring data from other agencies. Water quality samples are analyzed for nutrients, solids, specific conductance, pH, hardness, alkalinity, bacteria, chlorophyll, and annually for triazine herbicides following approved U.S. EPA methods. Low level metal sampling using “clean hands” techniques is conducted quarterly at a subset of the monthly monitoring sites and biannual sampling of triazine is done during winter and summer periods.

The total cost per site per year is estimated at \$2,845 including LTE labor, water chemistry analysis at the State Lab of Hygiene and travel and supplies. The total annual cost for this monitoring program is approximately \$119,500 the majority of which is water chemistry analysis conducted by the Wisconsin State Lab of Hygiene.

#### Large River Macroinvertebrate Sites (Biotic Integrity River Sites) – 2011-2019

From 2002 to 2006, between 86 and 111 river stations were sampled for fish IBI plus an additional 44 to 62 river stations were sampled for gamefish-endangered-threatened (GET) species. This sampling was conducted primarily by Bureau of Fisheries Management staff and supplemented by ISS staff, and in SCR region by Watershed Bureau staff. During this same time, macroinvertebrate samples were collected from 125 sites and used to develop a “nonwadeable rivers” macroinvertebrate IBI (Weigel and Dimick 2011).

In 2011, the Watershed Bureau started an 8 year program to revisit 125 river sites including five sites that are sampled each year (long-term trend sites) and 15 rotational sites. The five long-term trend sites will represent least impacted conditions based upon previous sampling results and watershed condition knowledge of biologists. Three rotational sites per region will be selected for sampling each year. Hester – Dendy artificial substrates (3 per site) will be placed at the sites for six weeks and the samples of colonizing macroinvertebrates processed at the UW-Stevens Point Entomology Laboratory using a 500-target sub-sorting procedure plus a large-rare taxa search. Due to inconsistencies in field sample collection among biologists in the Bureau of Fisheries Management, the use of fish-IBI data for large river condition assessment will be on a case by case basis.

The data will be compared to historical data collected prior to 2006 to determine if large river conditions have changed. Sites with poor macroinvertebrate IBIs will be flagged for comprehensive sampling in order to evaluate their potential as 303d impaired waters. In addition, within three to five years of collection, a sufficient number of samples (~50 to 75) will be collected to make inferences about the condition of Wisconsin’s large rivers.

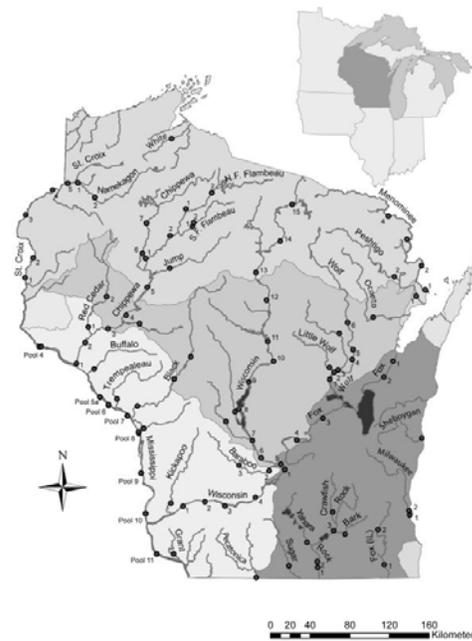


Figure 5. Location of the Large River Macroinvertebrate monitoring sites on the major rivers of Wisconsin. Shaded areas represent Level 3 Omernik Ecoregions.

The estimated cost for Large River Macroinvertebrate monitoring is \$18,500 per year, or about \$880 per site, this includes the cost of analysis at the UW-Stevens Point Aquatic Biomonitoring Laboratory of \$495 per sample.

### Continuous Flow Gauging Stations

WDNR has funded selected USGS flow gauging sites since the 1970s. Some of these sites have data records for over 100 years. WDNR directly funds 14 of 120 USGS long-term gages statewide as well as short-term gauging stations to support development of Total Maximum Daily Loads (TMDLs). USGS supplies all staff time for this monitoring program.

Data from these gauging stations are used for:

- Dam safety warnings during floods
- Safety and usefulness for recreational purposes
- Statistical regressions for flood flows and low flows at ungaged locations statewide
- Long-term trends analysis
- Calculating pollutant loads
- Interpreting water quality monitoring data
- Management of dams to protect upstream and downstream resources



Estimated Sampling Costs Add flow gauging costs to table (~ \$90K/year). Should provide a total cost of all Tier I monitoring somewhere in the document.

**Unit Costs**

|           |    |  |                       |                  |
|-----------|----|--|-----------------------|------------------|
|           | 3  | person crew on average   |                       |                  |
|           | 10 | Total LTE hours per fish and macroinvertebrate site                          |                       |                  |
|           | 20 | Total LTE hours per fish, macroinvertebrate and water chemistry site         |                       |                  |
| \$15.00   |    | LTE salary pay   |                       |                  |
| \$18.69   |    | Fringe @ 24.58% of salary  |                       |                  |
| \$20.82   |    | Indirect @ 11.43% of salary + fringe   |                       |                  |
| \$20.82   |    | LTE hourly cost to project   |                       |                  |
|           | 1  | FTE day = 10 hours   |                       |                  |
|           | 1  | Data entry time for fish data (hrs)  |                       |                  |
|           | 3  | Data entry time for habitat data (hrs)                                       |                       |                  |
|           |    | Miles per day round trip average (5 hours travel max assuming 50mph average) |                       |                  |
| 200 - 250 |    |  |                       |                  |
| \$0.72    |    | Fleet rate for 4x4 Regular SUV or Truck                                      |                       |                  |
| \$9       |    | Cost per meal per staff  |                       |                  |
| \$136     |    | SLOH costs   |                       |                  |
| \$165     |    | Cost for bug sample  |                       |                  |
| \$495     |    | Cost for river hester-dendy sample   |                       |                  |
|           |    |  | Water Chemistry Costs |                  |
|           |    |  | Ammonia               | \$ 25.89         |
|           |    |  | N2-N3                 | \$ 27.00         |
|           |    |  | TKN                   | \$ 32.99         |
|           |    |  | TP                    | \$ 23.60         |
|           |    |  | TSS                   | \$ 18.80         |
|           |    |  | Field                 | \$ 6.35          |
|           |    |  |                       | <b>\$ 134.63</b> |