Appendix A: Evaluation of Monitoring Strategy and USEPA 10 Key Elements

First Element: Monitoring Strategy

Self-Assessment:

Meets or exceeds Level 4 Elements

Elements of a State Water Monitoring Program

1. Monitoring Program Strategy
2. Monitoring Objectives
3. Monitoring Design
4. Core Indicators of Water Quality
5. Quality Assurance
6. Data Management
7. Data Analysis/Assessment
8. Reporting
9. Programmatic Evaluation
10. General Support and Infrastructure

USEPA 10 Elements of a Comprehensive Monitoring Strategy

Wisconsin's vision is that water quality is comprehensively measured to protect beneficial uses and that protection and restoration efforts are adequately evaluated. This will require a comprehensive strategy to meet the water quality management needs of the state waters including streams, rivers, lakes, reservoirs, Great Lakes shorelines, groundwater, and wetlands.

The monitoring strategy outlines a framework that can be extended to a long-term plan with a 5 to 10-year schedule for complete implementation. The strategy is comprehensive in scope, covering monitoring objectives, study design, water quality indicators, quality assurance, data management, data analysis/assessment, reporting, programmatic evaluation, general support, and infrastructure planning.

Second Element: Monitoring Objectives

Self-Assessment:

Wisconsin's Water Monitoring Team has identified a set of monitoring objectives based on the range of regulatory responsibilities and water quality programs with special emphasis on designated use attainment. In 2008, the Water Division Monitoring Team (a precursor to the Water Resources Monitoring Team) identified monitoring objectives critical to the design of a monitoring program that is efficient and effective in generating data that serve management decision needs.

Monitoring objectives include:

- Establishing, reviewing and revising water quality standards,
- Determining water quality standards attainment,
- Determining water quality status and trends,
- Identifying impaired waters,
- Identifying causes and sources of water quality problems,
- Implementing water quality management programs, and
- Evaluating program effectiveness.

Consistent with the Clean Water Act, monitoring objectives reflect decision needs relevant to the range of waters found in the state. See above for Clean Water Act monitoring objectives.

Third Element: Monitoring Design

Self-Assessment:

Wisconsin's strategy reflects media-specific variable designs to maximize the state's ability to meet monitoring objectives with existing resources. The primary design frameworks utilized include:

- Statewide status and trends data collection through long-term trend and reference-site based networks,
- Random stratified sample designs primarily focused on natural communities to establish temporal and spatial variation, identify primary stressors, and to inform future effectiveness studies.
- Reference site monitoring to establish and calibrate course-scale models for extrapolation of condition information;
- Data collection to close of data gaps for assessment studies focused on for phosphorus, chlorophyll a, E. coli, and chlorides and TSI assessment packages;

- Prescriptive monitoring designs (targeted watershed assessments, directed lakes, runoff management/319 studies, and local monitoring needs);
- Intensification monitoring to initiate TMDL model development, calibration or validation;
- Watershed condition monitoring to support integrated reporting and watershed planning;
- Site-specific monitoring to identify and characterize water quality problems.
- Evaluation monitoring to determine the effectiveness of best management practices or restoration progress outlined in resource recovery initiatives.

These key study designs are supplemented by data gathering from lake and stream volunteers, whose data efforts have grown and evolved into gap filling and key assessment data collection work. In the case of lakes monitoring, TSI data is combined with modeled satellite imagery interpretation to provide far greater assessment coverage than what would be available without the citizen volunteers.

The designs mentioned above are explicitly blended with fixed station work for intensive and screening-level monitoring, rotating or "targeted watershed approach", basin monitoring, and targeted and probability designs to meet the full range of information and decision needs.

In the recent past, Wisconsin has carried out some probability-based network design studies for statistical inferences regarding general condition and associated pollutants and other drivers behind quality variation.

Fourth Element: Water Quality Indicators

Self-Assessment:

Wisconsin has a variety of aquatic condition indicators used in various program areas. This strategy inventories what indicators are fully functional and which indicators need more research, development and implementation.

Our vision is to develop a complete set of monitoring indicators and assessment tools with clearly articulated thresholds (measurable standards that we must meet or exceed) to track the status and trends of water quality and to evaluate the effectiveness of management actions to improve water quality in the state. These indicators must be site specific yet reflective of a population of resources geographically and/or categorically.

The Water Quality Program uses water quality standards designated use assessments conducted for the biennial Water Quality Report to Congress ("Integrated Reporting for Sections 305b/303d") to provide statewide summaries of overall condition. Refinements or creation of key indicators within each of these designated use assessments could be developed and advanced on a more fine-scale basis for condition assessments for water type statewide, regionally, and at a local level.

Core indicators are used to assess attainment with applicable water quality standards. In addition, supplemental indicators can be used when there are reasonable expectations that a specific pollutant is present in a watershed, when core indicators suggest impairment, or they can be used to support a special study, such as screening for potential pollutants of concern. The primary parameters used to assess waterbodies are listed in table___ . Generally, key indicators include:

Rivers:

- Chemical/toxicological (TP concentration, chlorides, etc.) and biological/ecological endpoints (large river macro invertebrates and large river fish IBI, fish community assemblage).

Streams

- Physical/habitat (percent embeddedness, turbidity, cover), chemical/toxicological (TP concentration, chlorides, etc.), and biological/ecological endpoints (macro invertebrates and fish community assemblage and indices of biological integrity) .

Lakes

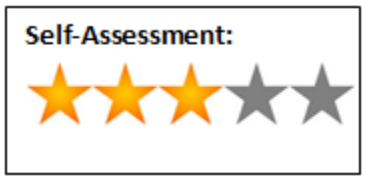
- Catchment development index
- Lake macrophyte index
- In-lake Secchi depth, phosphorus or chlorophyll a (Trophic Status Index)
- Riparian shoreland development factors.

Wetlands

- Floristic Quality Index
- Quantitative Wetland Condition Integrity Index
- Qualitative Wetland Condition Integrity Index

DNR intends to refine core indicators to develop those that accurately indicate water system health at the state, watershed, and project (site-specific) scales. In addition, core indicators can be used to better inform resource managers of the relationship between water quality and land use activity in the surrounding area and the effects of landscape change. An emerging activity is development of Water Quality Standards that include biocriteria to supplement chemical and qualitative criteria to determine water condition are underway. Future monitoring efforts will address these emerging monitoring needs. Development of monitoring designs to support development and implementation of bio-indicators is essential.

Fifth Element: Quality Assurance



Quality assurance covers a broad range of activities from the inception of the study design to the final report write up and publication. The following key areas cover quality assurance aspects throughout the life cycle of study proposal through data sharing and data delivery.

A number of quality assurance elements are in place in Wisconsin's Monitoring Program. However, several enhancements can be incorporated into ongoing activities to improve the value of monitoring data for long-term DNR and data sharing with other agencies and partners. Quality assurance elements currently in place or - ones that are needed (*) identified with an asterisk - are listed below. Quality assurance is covered in greater detail in the body in the document and in the appendix.

Quality Assurance Ongoing Initiatives

The Surface Water Integrated Monitoring System (SWIMS) Database Team is designing a data integrity plan for entry, storage and distribution or sharing of data that will be completed in 2015. The team is also working on completing the automated quality assurance project plans that can be generated the system by project managers.

Key information to be included in automated quality assurance plan:

project purpose, objective, outcome, study design description (random sample design versus targeted study etc.), collection equipment, planned parameters, written protocols, data collectors and project roles, monitoring stations, planned versus collected fieldwork events, flagged data from the study and why, summary information on project timeliness or problems encountered, hyperlinks to relevant documents, photos, or other information, the lab where the

analysis took place and contact information if available. These are but a few of the examples of data that can readily be incorporated into automated reports as long as the project manager ensures that the data is entered into the system.

Database Integrity Plan which will include:

- System documentation procedures including enhanced database backup and journaling procedures.
- Enhanced security features for tracking work by multiple backend system users (three file managers).
- Data entry screen quality control tools and enhanced error messaging.
- Greater documentation of errors and user guides on how to solve issues when confronted with problems.
- Long-term data integrity plan by December 2015.
- Finalization of generic quality assurance project plan for all studies in the SWIMS system Spring 2016.

Data Management Procedures:

- Database stored documentation of collectors, training received, and equipment used, methods / protocols employed, QA samples like duplicates, blanks and spikes, and study design description.
- Standard use of locational data standards for GIS data including stations, monitoring locations, resources of interest, and actions.
- Three file managers on SWIMS database with three to four high-level database architects and programmers and GIS analysts support the system.
- In addition, water program managers and users receive database support and training to maximize the appropriate use and consumption of data

Recommended Quality Assurance Work

- *Update quality assurance management plan and quality assurance program plan,* both established in accordance with USEPA policy, to ensure the validity of monitoring and laboratory activities and fulfillment of state reporting requirements with credible and comparable data.
- The updated quality assurance management plan should be updated to include new study designs, project manager perspectives, database capabilities, and requirements from federal, state and local entities.
- Develop quality assurance guidelines for each study design. Recommendations will work through technical teams and will be incorporated into database "controls" to reinforce data entry rules and ability to more readily fill out information.
- Consult with quality assurance project plan officer consultation when *creating quality assurance project plans for large studies.*

Quality assurance project plans (for large studies) or quality assurance checklist (to be developed) could be submitted with project proposals as a prerequisite for funding. The quality assurance program plan may solicit input from partner groups including other state programs, non-profit environmental organizations, and USEPA Region V. The quality assurance program plan should be flexible and well documented and may include a "Quality Assurance Toolbox," a Web site and quality assurance elements put in place for the Surface Water Integrated Monitoring Program (SWIMS), the Fish Management Data base (FMDB), and other relevant database systems.

Sixth Element: Data Management

DNR's vision is to make credible ambient monitoring data available to all customers, stakeholders, and partners in a timely manner. Multiple databases support the state's monitoring and assessment work including:

Self-Assessment: ★★★☆☆

- Fish Management Database
- Fish Contaminants Database → *SWIMS (2015)*
- Bio monitoring Toxicity Laboratory Data → SWIMS
- Sediment chemistry → SWIMS
- Microbiology →SWIMS
- Habitat/biological data → Fish and SWIMS
- Aquatic Invasives→ SWIMS

→ Water Quality Exchange → **USEPA STORET**

All tables in systems that hold monitoring data should have appropriate metadata (consistent with recommendations of the National Water Quality Monitoring Council) and geo-locational standards. DNR oracle systems conduct "journaling" to provide greater auditing functionality; enhanced security for backend users of database tools; and more frequent backups to restore data in the case of catastrophic data loss.

Specific emphasis on communication between data systems has been enhanced over the years, due to mutual dependencies surrounding shared datasets and the bioassessment criteria initiative. With this effort and the clear need for detailed, systematic management of a shared riverine natural community dataset between at least two agencies in multiple IT environments, integration is quite challenging.

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Surface Water Integrated Monitoring System

The Wisconsin DNR stores its ambient water quality data in its Surface Water Integrated Monitoring System (SWIMS), a project based, comprehensive data system which holds chemical, physical, habitat water and sediment chemistry, and aquatic invasive and macroinvertebrate data (and more). Detailed documentation of the SWIMS system is available upon request.

The SWIMS Team has several ongoing sub team initiatives to enhance the quality and completeness of this work including:

- Outreach, help guidance and support team.
- Data integrity and quality assurance.
- System enhancement technical design sub team.
- Short-term user interface improvement team to help with ease of system use.
- Long-term vision team to modernize and enhance system accessibility including mobile options, tablet forms, infield data entry, topical search and display and more.

Water Assessment Tracking and Electronic Reporting System

The Water Assessment Tracking and Electronic Reporting System (WATERS) stores water quality standards, trout classifications, O/ERW designations, and assessment information for Clean Water Act Section 305(b) reports and 303(d)

reporting. Additional fields include narratives regarding basin, watershed and waterbody narratives, priorities and goals for management, and recommendations for management actions. The (GIS) Geospatial data for stations and for assessment units is stored in Wisconsin's GIS Spatial Database Engine "SDE" environment. The SDE environment includes sufficient descriptive metadata for the data to be shared and compared among managers and the public.

Additionally, DNR makes its data available to the public through the Water Quality Exchange Network, online pages, and direct downloads from publicly available interface as well as through the Surface Water Data Viewer maintained by the Department of Water Resources.

DNR FISHERIES PROGRAM

Fish Management Database

The Fisheries Management Database holds a variety of fish, habitat and physical data relating to fisheries surveys. The database is hosted by USGS and is interconnected with the SWIMS system through sharing stations, fish kill locations, and fish stocking sites. The fish program creates parameter calculations that are critical for Clean Water Act reporting and serves those data up through a query tool. The database's reporting mechanism is currently under redesign.
Of critical importance is the role the FMDB has in supporting the validation of streams natural community delineations: through setting up expected fish community assemblages and comparing those species against sample data, the database will provide a critical first step in helping to confirm temperature and flow based community assignments.

Data Management / Database Connectivity

As described above the state's major databases and staff work are integrated. The table below describes some of the cross program efforts to achieve this integration among the Fisheries Database, the Surface Water Integrated Monitoring System (SWIMS), the Waterbody Assessment Tracking and Electronic Reporting System (WATERS), the Register of Waterbodies (ROW), the Hydrolayer (23K Hydrography Database) and other related systems.

Table of Data Management Integration

Element	Description	Outcome
Database Training	Employees are trained in both the Fish DB and SWIMS. Fisheries, Watershed and Water Quality program staff all receive this training.	Standardized protocols are created and used to create uniform stations against the 24K hydrolayer.
Monitoring Protocols	Cross program database station establishment, naming and data entry protocols. Baseline fish data collection monitoring protocols; Safety measures; Equipment preparation and maintenance.	Data integrity for use across programs and bureaus is enhanced.
Station Establishment	Monitoring stations for SWIMS/Fisheries are established using the SWIMS Mapping Tool and cross referenced between the databases. This integration helps tremendously with assessment / condition evaluation.	More readily available datasets on one station helps ensure more time effective condition analyses and gap evaluation for standards attainment.

Monitoring Projects	Specific Monitoring Projects are established in SWIMS and fisheries data collection elements are articulated in the project description.	Monitoring Projects are available online with attached protocols, datasets (DNR staff available) and summary analyses as these are created.
Fieldwork Events	FW Events (sampling events) are electronically established in SWIMS and connected through stations. Users can identify if the FW event with a particular suite of chemistry or macroinvertebrate data has a coincidental fish and/or habitat element.	Users are more aware of additional data within a project that is stored in the fish database and there are electronic "buttons" that can send the users to the fish data on a given station.
Data storage and final reports	Chemistry, Macroinvertebrate, Aquatic Invasive Species, and related – SWIMS; physical parameters, habitat and fisheries datasets – Fish DB. Fish Contaminant monitoring – Fish Contaminant Database.	Final reports are posted online or stored as reports in the database. Data downloads are universally available to water staff and linked to SWIMS, WATERs and Websites.

Seventh Element: Data Analysis/Assessment

Wisconsin DNR's goal is to provide a consistent defensible framework for the evaluation of monitoring data relative to state and regional standards, the protection of water quality standards and beneficial uses, and for tracking the effectiveness of management actions.

Water Quality Biologists and central office professional staff are responsible for preparation of technical reports that summarize the findings of watershed assessments and special studies. The Water Management structure transmits these reports to the USEPA for certification as part of the state's Areawide Water Quality Management Plan after a required public review and comment period. The Water Monitoring Section staff is responsible for technical reports that summarize the findings of statewide assessments.

This information is used in the preparation of Wisconsin Water Quality Report to Congress through the "Integrated Reporting Process" under the Clean Water Act Section 305(b) reports and 303(d) listings.

The Water Quality Bureau biennially publishes updates to its Wisconsin Consolidated Assessment and Listing Methodology (WisCALM) which may change to reflect new scientific findings or other changes required by state resources or USEPA. WisCALM outlines how to assess attainment of water quality standards based on analysis of various types of data (chemical, physical and biological) from various sources, for all state waters. The Water Evaluation Section through WisCALM establishes listing and delisting criteria for the Section 303(d) list of Impaired Waters. The WES Section also contains criteria to assist in establishing priorities for developing total maximum daily loads, guidelines for acceptability of data, and other measures necessary to facilitate the completion of total maximum daily loads.

Eighth Element: Reporting

Wisconsin's vision is to provide all collected data in a usable format, and in a timely and publicly accessible manner. A variety of reports are used to convey the results of Wisconsin's work by the Water Monitoring, Evaluation, and Implementation Program projects.

Most reports are available to the public in electronic format online. The types of reports include fact sheets, monitoring study summary reports, data downloads and reports, quality assurance reports, interpretative reports, and the 305(b)/303(d) Integrated Report.
http://dnr.wi.gov/topic/surfacewater/ir2014.html

These reports provide analyses and interpretation of the data collected. The technical reports have written descriptions of the study design, methods used, graphical, statistical, and textual descriptions of the data, and interpretation of the data including comparisons to relevant water quality goals. These reports are available to all interested parties through the DNR's website "Explore Wisconsin's Water" at
http://dnr.wi.gov/water/

Self-Assessment:

The state has worked to produce timely, complete, and technically valid water quality reports and lists called for under the Clean Water Act Sections 305(b) and 303(d). The current emphasis on updating the state's strategic monitoring plan and the 'rebranding' of the water resources program to convey the continuity of the monitoring, assessments, planning and implementation work should facilitate this. The state also submits monthly data submittals through the Water Quality Exchange Network to STORET in support of the federal Clean Water Act 106 grant. The monthly transfer of monitoring data to the national STORET database via the Wisconsin Environmental Data Exchange Network satisfies this requirement.

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Ninth Element: Programmatic Evaluation

Wisconsin intends to conduct periodic reviews of each aspect of the monitoring program to evaluate its scientific validity, whether the program is being implemented as designed, and how well the program serves water resources decision needs of the state.

Self-Assessment:

The Monitoring Section in consultation with the Water Resources Policy and Management Team (WR PMT) and Environmental Management Division leadership will initiate a formal review in FY2018 (July 1, 2017 – June 30, 2018) to determine how well the monitoring program serves its water quality decision needs. This review will involve evaluating the monitoring program and all its constituent elements to determine how well each of the elements is being addressed and determining how to incorporate necessary changes and additions into future monitoring cycles, and potential updates to the strategy in 2020.

Core Implementation Tactics

- Develop and promote the use of multiple monitoring tools, such as statistically based surveys, judgmental surveys, predictive modeling, risk assessments, expert analyses, and newer information and monitoring technologies.

- Continue working with partnership monitoring and linking with federal partners through the Environmental Data Exchange Network hosted by the Water Division to increase data comparability, increase potential for collaboration with other entities collecting ambient water quality information, and make data available to the public.

- Build stronger partnerships with agencies, watershed groups, volunteer monitors, and others to facilitate the sharing of information, the collection of comparable data, and the use of monitoring tools.

Study Design Documentation – Protocols, Methods, Procedures

A major element of Monitoring Strategy implementation work will involve completion of an ongoing inventory and strategic gap analysis of monitoring protocols, methods and procedures. Not only will the presence of a documented procedure be evaluated but the training and implementation of that documented procedure will be evaluated to ascertain whether sufficient training and support is provided for new and veteran staff to carry out their work successfully.

Laboratory Analyses - Contract Labs for State Monitoring Analysis Work

WDNR contracts with a variety of laboratories for analysis work. The primary labs used for surface water are described in the Laboratory Systems, Section 7. As contracts are renewed each year, the DNR programs should evaluate the work received against the proposed scope of work to identify any issues for improvement. This process regularly occurs for USGS, SLOH, UWSP, and other contract labs.

Tenth Element: General Support and Infrastructure

Wisconsin's vision is to provide funding and support needed to implement a coordinated and comprehensive monitoring and assessment program conducted by citizens, state staff, stakeholders, and federal and state agency partners. Wisconsin receives a mix of federal and state funding amounting to approximately $700,000 (down from nearly $900,000 in previous years) that is used for monitoring and analysis work. This annual allocation covers everything from lab analysis for chemical, biological, toxicological data to data interpretation and research of satellite data to funding USGS gage stations, LTE support, equipment, supplies and travel.

Many items that are perceived as important or fundamental Wisconsin's water management do not have a dedicated funding source. The following, for example, are funded through the Clean Water Act 106 "extra" allocation above the base funding level or other ad hoc sources.

- Volunteer stream monitoring
- Biocriteria development
- Enhancements to NARS (shoreland assessment, wetland condition)
- Pilot Watershed projects
- Lake temperature methods evaluation
- Nitrogen stream monitoring project
- Enhancing remote sensing of lakes
- Monitoring Strategy support
- Bioassessment Program Review
- Database maintenance and enhancements.

The following items are listed as monitoring program needs based on the lack of a reliable or stable funding source or have been listed due to historical budget reductions. These items are not listed in priority order.

Mississippi River CWA Collaborative Interstate

This initiative is a one-time pilot-project to implement portions of the UMR CWA monitoring strategy and would be coordinated with similar efforts proposed by the Minnesota Pollution Control Agency. This proposal builds on existing Mississippi River budget allocations, and is tiered to allow flexibility in allocation of budget resources.

Citizen-based Water Quality Monitoring Data

Provide stable funding and support for volunteer water monitoring to ensure that the data being collected are useful for Department decision-making. This work is currently supported by LTE employees through the EPA Monitoring Initiative funding.

Water Resources Monitoring Technicians

- This request would create 4 new technician level positions to conduct baseline and targeted monitoring of lakes, wetlands, streams, and rivers throughout the state.
- Having dedicated permanent staff to develop expertise and capacity to conduct monitoring activities where needed will provide efficiency, consistency and quality assurance, free up time for biologists to be project managers, and reduce the need for LTE retraining. This funding would supplement or replace current spending on LTEs.

Support for Water Quantity Information

- Support existing contracts with USGS, UW Extension volunteer monitoring programs, and LTE support to increase the capacity for lake and wetland water level and stream flow monitoring, and identify and upload historical data.
- This funding would build capacity for water quantity information required under the Great Lakes Compact and to assist with water withdrawal permitting decisions - water levels, stream flows and springs)

Water Information Systems enhancements

- This request funds programming support to implement needed integration and upgrades to core water information systems used for federal and state reporting, permit decisions, and condition information (SWIMS, WATERS, SWDV)
- Supplemental to existing funding (WWI) which has been static and not keeping up with increased demands.

Baseline water quality monitoring for lakes, wetlands, and streams

- Additional funding will allow WI to move toward a targeted watershed approach, address emerging monitoring needs, and enable more waterbodies and watersheds to be sampled on an annual basis.
- These funds would be used to augment existing funds for lab analysis, contracts, equipment and supplies, travel, and LTE support.