Water Information Strategies

- Water Quality Assessment & Statistics
- Data Management and Access
- Program Development and Network Design
- Ad Hoc Projects

Activities

1. NJ Survey of Water Quality Indices

Water Quality Indices Questionnaire

A. Are you currently in the process of **developing** a composite water quality index or report card to communicate the condition of a water resource? If so, please briefly describe the index and include the water body type.

B. Chemical, Physical, Microbiological Composite Indices

1. Does your organization currently use any composite water quality indices for chemical, physical and/or microbiological water column parameters?

   If so, what parameters comprise the index (e.g. DO, TN, T, fecal coliform), and for what water body types? (e.g. estuarine waters, streams, lakes)
2. What were the primary objective(s) in developing this index?
3. How was the index developed and what entities were involved? Was there a public, stakeholder or scientific peer review process used in its development?
4. How is the index calculated, and what, if any, criteria/standards or thresholds are utilized in the index determination? Is there weighting used in the calculation?
5. Describe the monitoring program design and type of data used for the index (e.g. summer sampling probabilistic design, quarterly sampling fixed station network)
6. What are the primary uses of the index and who are the primary audiences? Is the index used to evaluate progress toward strategic environmental or sustainability goals for your state/region?
7. How and on what frequency is the index reported?
8. What are the primary strengths and limitations of the index? How successful do you believe the use of such an index has been?
9. Please provide website addresses or other references for the index.

C. Biological or Eutrophic Condition Indices

1. Does your organization use any multimetric, biological indices? If so, for what trophic levels (e.g. benthics, fish, phytoplankton) and what water body types (e.g. estuarine waters, streams, lakes)?
2. If you have more than one trophic level index, does your organization aggregate any of the biological indices (e.g. benthics and fish)? If so, which ones and how?
3. Do you use an index that combines any biological indices with other water quality and/or habitat data for a consolidated indicator? If so, which ones and how?
4. Do you use any indices of eutrophic conditions? If so, what parameters comprise the index and for what water body types?
5. If answers to any of above questions in Section B. are yes, please provide general information on objectives of the index, its development and use as in Section A above. If information in Section A. is applicable to the Biological or Eutrophic Condition indices, please indicate as the same.
6. Please provide website addresses or other references for biological or eutrophic indices above.

D. Sediment Quality Indices

1. Does your organization use a sediment quality index? If so, for what parameters (e.g. sediment contaminants, sediment toxicity)., water types, and describe the index.
2. If yes, please provide general information on objectives of the index, its development and use as in Section A. If information in Section A. is applicable to the Sediment Quality Index, please indicate as the same.
3. Please provide website address or other references for sediment quality index.

E. Overall Condition Indices

1. Does your organization use an overall composite index, or combine any of the above into an overall condition index? If so, for what parameters (e.g. water quality, biological, sediment, and habitat) water types, and describe the index.
2. If yes, please provide general information on objectives of the index, its development and use as in Section A. If information in Section B. is applicable to the Overall Condition Index, please indicate as the same.
3. Please provide website address or other references for Overall Condition Index.

F. Indices Contacts in Your Organization or Other Organizations

Are you aware of anyone else in your organization we should speak to regarding water quality indices? Are you aware of other organizations, particularly state/interstate/tribal organizations that are using water quality indices? If so, could you provide contact information?

G. Would you like a copy of the Summary information from this water quality index questionnaire? If so, please provide email address.

Contact :

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Water Quality Indices/Report Cards Questionnaire Participants

7/30/2014

Organization	Applied Composite Water Quality Index or Report Card	Assesment Tool	Area	Waterbody type	Contact
University of Maryland Center for Environmental Sciences-Integration and Application Network	YES	Water Quality Index	Chesapeake Bay, MD coastal Bays, Great Barrier Reef, Gulf of Mexico, Baltimore Harbor	Coastal bays and estuaries, rivers, lakes	Heath Kelsey
South Carolina Dept. Health & Environmental Control	YES	Water Quality Index	South Carolina Estuary and Coastal Habitats	Coastal tidal rivers and bays	David Chesnut
Massachusetts Department of Environmental Protection	YES	Report Card	Massachusetts	Freshwater streams	Warren Kimball
McMaster University	YES	Water Quality Index	Laurentian Great Lakes	Great Lakes wetlands	Patricia -Chow Fraser
Oregon Department of Environmental Quality	YES	Water Quality Index	Oregon	Freshwater streams (4th and 5th order)	Lesley Merrick
Iowa Department of Natural ResourcesNR	YES	Water Quality Index	Iowa	Iowa rivers and streams	Mary Skopec
California State Water Resources Control Board	YES	Report Card	San Diego River Watershed	Freshwater streams	Lilian Busse
Vermont DEC	YES	Vermont Lake Scorecard	Vermont	Lakes	Neil Kamman
USEPA (National Coastal Condition Assessment)	YES	Water Quality Index (National Aquatic Resource Surveys)	Nationwide	National Coastal Condition Assessment	Sarah Lehmann
USGS (NAWQA Program)	NO	Pesticide Toxicity Index	National Water-Quality Assessment (NAWQA) Program	Rivers and streams	Karen Beaulieu
Wisconsin Department of Natural Resources	NO	Water Action Volunteers Stream Monitoring Program- Biotic Index	Wisconsin statewide	Freshwater streams	Kris Stepenuck
New Jersey Pinelands Commission	NO	Multiple-indicator ecological-integrity scores	NJ Pinelands	Pinelands streams and impoundments	Sarah Smith
Ohio River Valley Sanitation Commission (ORSANCO)	NO	Ohio River Fish Index , Ohio River Macroinvertebrate Index, Ohio River Diatom Index	Ohio River Basin (IL,IN,KY,OH,WV,VA,PA,NY)	Freshwater rivers and streams	Jeff Thomas
Florida Department of Environmental Protection	NO	Multiple biological indices	Florida statewide	Florida streams, rivers, macrophytes,lakes, wetlands	Joy Jackson
Indiana Department of Environmental Management	NO	Monitoring program	Indiana statewide	Freshwater streams	Stacey Sobat
Kentucky Department of Environmental Protection	YES	Watershed Health Reports	Kentucky	Rivers and streams	Katie McKone
Virginia Department of Environmental Quality	NO	Water Quality Trend Analysis	Virginia	Rivers and streams	Roger Stewart

Approaches for Disseminating Water Quality Information: Development and Use of Applied Water Quality Indices and Report Cards

Brian Henning and Leslie McGeorge
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Abstract - A questionnaire was developed by the New Jersey Department of Environmental Protection with input from the National Water Quality Monitoring Council to gather available information on composite water quality indices and report cards used by governmental environmental agencies and other water quality practioners to disseminate results to various audiences. We received 17 completed questionnaires from state and federal agencies and academia from across North America. The goal of our survey was to better our understanding of the uses, strengths and limitations, development process, and the applicability of each method to convey water monitoring information in an integrated manner. Several participants in the survey utilized Water Quality Indices(WQI) in freshwater rivers and streams, estuarine, coastal embayments, and Laurentian Great Lakes. The most popular parameters used in a WQI are dissolved oxygen, pH, chlorophyll *a*, total nitrogen and total phosphorus. Contrary to WQI, Water Quality Report Cards were also utilized by participants as an approach to assess the condition of freshwater streams, rivers and lakes. The Water Quality Report Card (WQRC) concept was originally developed by Warren Kimball, formerly of the Massachusetts DEP, and is becoming a popular model used by a number of water resource agencies. The WQRC uses 10 indicators pertaining to aquatic life, recreation, and fish edibility that are color coded to provide an assessment of a waterbody based on standardized 305(b) reporting procedures. Regardless of the approach, both Water Quality Indices and Water Quality Report Cards appear to be useful tools to provide an overall evaluation of a water resource and present the data in a manner that is quickly and easily understood by multiple audiences.

Water Quality Indices

Generally, a single value (score) used to summarize water quality and resource condition for a particular time and location. Indices are typically composed of several parameters (4-12) of importance to water quality and are then aggregated and calculated into an overall score. Indices reported include measures of water column chemistry, sediment, biology and habitat.

Example of a composite water column WQI for Oregon rivers

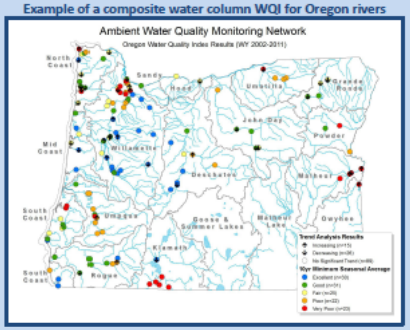


Figure 1. Example of spatial display of Oregon's WQI and trends results. Source: Merrick, L. and S. Hubler, 2013. Oregon Water Quality Index Summary Report, Water Years 2002-2011 and 2003-2012.

Applications and objectives of WQI

Frequently used to communicate water quality conditions to the public, stakeholders, local officials, water resource managers and also to track progress of management practices and strategic goals. Most WQI's are not used for an regulatory purposes in part because many parameters often have no water quality standards.

Table 1. Participants of questionnaire that use a "Water Quality Index." Note: Biological multimetric indices that do not integrate additional water quality parameters were not included here.

Organization	Water Resource	Media	Contact
Iowa Department of Natural Resources	Rivers and streams	Water column	Mary Skopec
Kentucky Department of Environmental Protection	Rivers and streams	Water column, sediment	Katie McKone
McMaster University	Great Lakes coastal marshes	Water column	Patricia -Chow Fraser
Oregon Department of Environmental Quality	Rivers (4th and 5th order)	Water column	Lesley Merrick
South Carolina Estuarine and Coastal Assessment Program (SCECAP)	Coastal tidal rivers and bays	Water column, sediment, biology	David Chesnut
University of Maryland Center for Environmental Sciences-Integration and Application Network	Estuaries,coastal bays	Water column, biology	Heath Kelsey
USEPA (National Coastal Condition Assessment)	Estuaries	Water column, sediment, biology, habitat, fish tissue	Sarah Lehmann
Vermont Department of Environmental Conservation	Lakes	Water column, biology, habitat	Neil Kamman
USGS National Water-Quality Assessment (NAWQA) Program (Pesticides only)	Rivers and streams	Water column	Karen Beaulieu

Parameters generally used in WQI

Chemical/Physical (water column)

- The most common parameters shared among water quality indices are dissolved oxygen, pH, chlorophyll *a*, total nitrogen and total phosphorus
- Additional parameters such as temperature, fecal coliform, total solids, biochemical oxygen demand, ammonia + nitrate nitrogen, specific conductivity and pesticides are often used

Biological

- A few WQI's incorporate a biological component into the overall composite WQI
- A benthic macroinvertebrate index is most commonly used when biological assessments are incorporated into a WQI

Sediment

- Parameters used in WQI's include contaminants, toxicity, total organic carbon, TSS, turbidity, embeddedness

Development Process and Calculation of WQI

- Many are developed by agency scientists with input from a panel of experts, and peer reviewed internally or published in a peer reviewed journal.
- Methods for aggregating subindices/parameters into an overall cumulative index calculation include weighted means, unweighted harmonic square means, and averaging ranked subindices into an overall score
- When standards exist, they are generally applied
- When no standards exist, published findings, best professional judgment, or thresholds derived from percentiles of historical data are commonly used to set breakpoints among rating categories (e.g. good, fair , poor)

Example of a composite index integrating three indices into an overall Habitat Index for the South Carolina Estuarine and Coastal Assessment Program

Figure 2. Percentage of South Carolina's estuarine habitats that scored as good, fair, or poor for the Integrated Habitat Quality Index during 2009-2010. Source: R.F. Van Dolah, D.M. Sanger, G.H.M. Riekerk, S.E. Crowe, M.V. Levisen, D.C. Bergquist, D.E. Chestnut, W. McDermott, M.H. Fulton, E. Wirth. 2013. The Condition of South Carolina's Estuarine and Coastal Habitats During 2009-2010: Technical Report. Charleston, SC: South Carolina Marine Resources Division. Technical Report No. 107. 64 p.

Limitations

- May not align with state's 305(b)/303(d) Integrated Report assessments
- Generally not used for regulatory purposes
- Many do not include toxics, habitat, fish tissue or biological indices
- Single parameters of importance may lose significance in composite index

Strengths

- Summarizes large amounts of data for a variety of audiences
- May include information for parameters for which there are no regulatory standards
- Enables spatial display of ratings
- Enables trends analysis of WQI score
- Generally understood by public, however calculation of index may be confusing

Water Quality Report Cards

The WQRC's described here, use ten indicators pertaining to aquatic life, recreation, and fish edibility uses that are color coded to provide an assessment of a waterbody based on the standardized 305(b) reporting procedures. The ten indicators are biology, chemistry, nutrients, toxics, sediments, flow, habitat, bacteria, aesthesis, and fish tissue.

Applications and Objectives of WQRC

These are used to communicate water quality conditions to public, stakeholders, local officials and water resource managers. The WQRC condenses the 305(b) assessment into a one page summary of a water resource. It can be used to assess the effectiveness of management practices, guide decision makers, identify monitoring needs and coordinate monitoring programs.

Development

The WQRC concept was originally developed by Warren Kimball of the Massachusetts DEP

- Uses ten indicators pertaining to aquatic life, recreation, and fish edibility that are color coded to provide an assessment of a waterbody based on the standardized 305(b) reporting procedures
- Each individual state's water quality standards and criteria are used to determine condition rating

Table 2. Participants of questionnaire that use a "Water Quality Report Card."

Organization	Water Resource	Media	Contact
California State Water Resources Control Board	Rivers and streams	Water column, sediment, biology, habitat	Lilian Busse
Massachusetts Department of Environmental Protection	Rivers and streams	Water column, sediment, biology, habitat	Warren Kimball

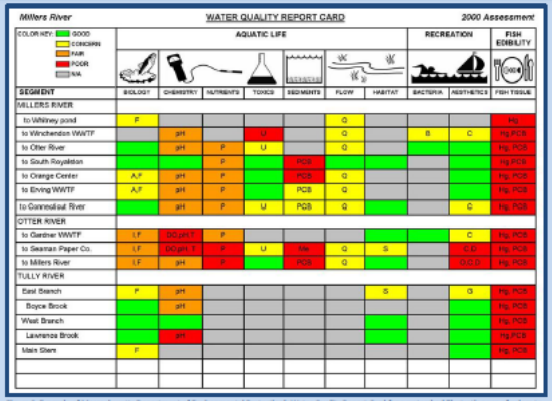


Figure 3. Example of Massachusetts Department of Environmental Protection's Water Quality Report Card for a watershed illustrating use of colors to assess water quality for each indicator and causes of impairment. Source: Kimball, W. (2012, Sept. 12). Water Quality Report Cards- Assessments made accessible, the Massachusetts experience [Webinar]. http://ecwl.gov/monitoring/webinars/index.html. Webinar to the National Water Quality Monitoring Council.

Limitations

- No overall rating category (e.g. good, fair, poor) of waterbody or segment
- Lack of spatial display of rating
- Limited trends analyses

Strengths

- Summarizes large amounts of water quality data
- Complements 305(b)/303(d) Integrated Report
- Identifies monitoring gaps (gray areas in Figure 3)
- Includes toxics, habitat, fish tissue and biological assessments
- Identifies reasons for impairment (e.g. Hg, PCB)
- Generally understood by public

Conclusions and Next Steps

- Both WQI and WQRC approaches seek to provide a integrated evaluation of the condition of the water resources they are assessing
- Many participants felt that the public, stakeholders and policy makers are more likely to get involved to help improve water quality if clear summaries of water resource conditions are made available through WQI's
- Participants expressed that these approaches can be great tools to educate the public about water quality and promote volunteers and watershed groups to protect and restore water quality
- A report will be prepared summarizing all questionnaires received and will be made available on the National Water Quality Monitoring Council 's website

**Thank you to all of the participants that completed the questionnaire. A copy of the WQI questionnaire and a complete list of participants is located in the folder attached to this poster.

***Only questionnaires that were representative of these two approaches (WQI and WQRC) were displayed here. Biological indices alone were not included in this poster.

Fact Sheet on WQI's

Draft has been prepared and will be distributed to the Council in a few weeks for review and comment.

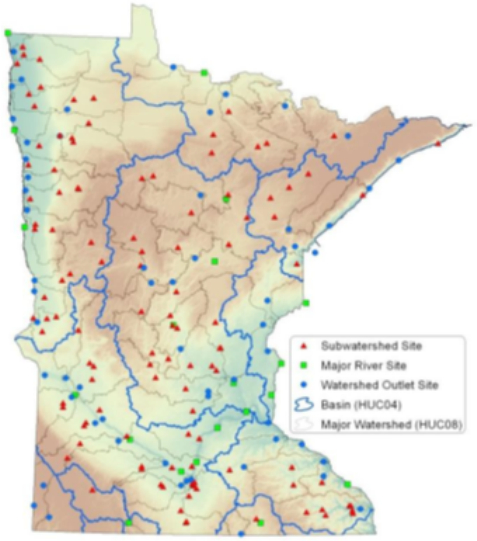
2. What My Manager Needs to Know Fact Sheet Series

#1 Purposes of Fixed Site, Trend Monitoring Network

Purposes of a Fixed-site, Trend Monitoring Network

A fixed-site, trend monitoring network is a water monitoring approach that uses a set of monitoring sites that remain in place and are monitored over the course of many years. Such a network is important for describing long term water quality conditions. Depending on frequency of water chemistry monitoring and environmental conditions, statistical trends in water quality can begin to be seen after about a decade of monitoring. Even before statistical trends can be determined, fixed station monitoring yields useful information on on-going water quality conditions. Biological monitoring can also be performed repeatedly at fixed sites to compare changes in biological health over time. Seeing changes in water quality over time through fixed site monitoring can give an indication of positive or negative changes in water quality resulting from land use changes, best management practices implementation, regulations, extreme weather events, or other influences. Quantifying success of implementation efforts can be a major benefit of this type of monitoring. Data from fixed station monitoring, while specific to the site(s) where the data are collected, can be used to create and improve water quality models that can predict water quality conditions in other non-monitored locations.

Minnesota's Watershed Pollutant Load Monitoring Network - each site is permanent, has water samples taken regularly, and includes a flow gage to record water quantity measurements:



Other WYMNTK Fact Sheets to Date

- Overview Fact Sheet
- Probabilistic – Randomized Monitoring
- Water Quality Portal
- Load template on to the web for use….

On Deck…

- Targeted Monitoring
- Program Effectiveness (i.e. 319)
- Other Ideas?

4. Monitoring Extreme Events

- Lessons Learned & Tips and Tricks
- Session at Cincinnati Conference (Monty Porter organized).