Report to the
Advisory Committee on Water Information
by the
National Water Quality Monitoring Council

(Prepared by the Methods and Data Comparability Board,
Water Quality Data Elements Committee)
May 15, 2001

Data Elements for Reporting Water Quality Results of Chemical and Microbiological Analytes

Adopted by ACWI on May 15, 2001

Data Model for the
Water Quality Data Elements

1.0 Contacts (Who is responsible for the monitoring?)
2.0 Results (What was monitored and found?)
3.0 Reason For Monitoring (Why was the monitoring conducted?)
4.0 Location (Where was the monitoring done?)
5.0 Date/Time (When was the monitoring done?)
6.0 Sample Collection (How was the sample collected?)
7.0 Sample Analysis (How was the sample analyzed?)

Implementation

- To be voluntarily implemented by the Council's membership
- U.S. Environmental Protection Agency for consideration as one of the growing list of data standards it is adopting
- May be voluntarily used by other local, state and federal agencies and the private sector, concerned about consistent reporting of water quality results for comparative purposes.

- The Council has concurrent efforts to foster more consistent analytical techniques and more widespread information sharing as a means of reducing costs and increasing the data available for decisions.

- The Council needs to prepare an Outreach Plan to facilitate the use of the data elements.
- The Council will consider volunteer proposals for demonstration projects by its members to show feasibility of the recommendation.
- It will also rely on existing communication mechanisms to promote the use of the recommended data elements, such as through technical organizations and societies, existing newsletters of members and the news media.
- A key feature of the plan is a regular review of implementation of the recommendation to determine whether any aspects of it need to be revised or updated.

Introduction

The National Water Quality Monitoring Council has completed its ~~preparation of a~~ recommended set of Data Elements for Reporting Water Quality Results of Chemical and Microbiological Analytes. This recommendation is the product of two years of development, consultation and public review, which ended on April 30, 2001. The Council prepared this recommended set of data elements to facilitate the consistent reporting ~~and sharing~~ of chemical and microbiological water quality data and promote the sharing of ~~efficiency in the~~ monitoring of results among water resource quality programs. The suggested audiences for use of this recommendation include program managers responsible for developing and using water quality data, researchers, data analysts, and database managers in the public and private sectors ~~and the general public~~ with interests in development and use of water quality data. The Council will prepare and implement a communication and implementation plan for voluntary use of the recommendation by its members and others.

Background

Water quality monitoring is an increasingly important element of water quality management activities. It provides information for an accurate understanding of the conditions of waters and the trends in its ~~observed water~~ quality. Water quality must be understood in order that ~~valid and~~ effective restoration and protection programs can be designed for waterbodies that vary significantly in their vulnerability and pollution stress. Because of the cost of its collection, water quality data must be viewed as a resource worthy of careful management both to preserve it for future analyses by the agency that collects it and to share it among local, state, and federal agencies, and the private sector involved in resource management activities.

The National Water Quality Monitoring Council has identified the standardization of water quality data elements as important in the preservation and use of data and recommends ~~a~~ this list of data elements that ~~offer~~ offers both definitions of each element and lists of related groups of elements needed to provide a complete picture of the sampling and analytical activity. In 1995, the predecessor organization to the Council, the Intergovernmental Task Force on Monitoring Water Quality (ITFM), identified the need for a set of minimum data elements to facilitate sharing and exchange of information (ITFM, 1995a). The ITFM also developed a recommended list of data elements for use in establishing new, or modernizing existing, databases, which served as the starting point for this recommendation (ITFM, 1995b). The attached list of data elelemntns drew from these earlier recommendations. The Council's proposed ~~This~~ list is expected to influence the collection of water quality data by federal, state, and local agencies; academic institutions; the private sector; and citizens who volunteer their efforts. These are the groups that together collect the majority of ambient water quality data in the country.

The Council established under its Methods and Data Comparability Board an *ad hoc* Water

Quality Data Elements Committee charged to develop a recommended set of data elements for reporting water quality results on January 26, 1999. The committee was composed of representatives from a range of organizations and governments who were actively involved in water quality monitoring: ~~3~~ threelocal agencies, ~~6~~ six State agencies, ~~3~~three Federal agencies, one interstate commission, ~~2~~ two private sector organizations, and ~~2~~ two research organizations. These expert representatives are listed in **Appendix 1**. IS THIS BIG ENOUGH TO HAVE AN "APPENDIX AND NOT JUST AN ATTECHMENT? The specific objective given to the committee was ~~to:~~ to develop and recommend a "core" set of data elements for reporting water quality monitoring results, to be voluntarily implemented, that would allow data to be compared regardless of, but recognizing, the purpose of the monitoring activity.

The Council believes that by recommending a common set of data elements, agencies collecting water quality data will be spared the task of creating their own systems for organizing data and their own set of definitions of the data elements. When implemented, a standard set of data elements will spare all data users the complex task of reconciling diverse data systems as they draw on multiple data sets to carry out their studies or analyses. The Council believes that the standardization inherent in the use of standard data elements holds the prospect of reducing costly duplicate monitoring efforts. In the future, the Council is planning to develop data elements to address higher level biological indicators of water and habitat quality for ecological analysis.

These data elements are recommended as a guide to define a measure of good practice within the water quality monitoring community. They will encourage greater data consistency, allow the quality of data to be determined by future users, and simplify the process for all who choose to enter these data elements. It is not required that all the recommended data elements be used. Additionally, metadata (information about the data) selected must fit the data they describe. Sampling data from ground water, for instance, is described by several metadata elements that are of no use for surface water samples. Therefore, the Council does not intend to require anyone to provide all of the data elements in order for data to be entered in a federally maintained database. The Council's advocacy of these data elements is not intended to discourage the use of existing water quality data solely because it does not meet these guidelines.

Authority

The Office of Management and Budget memorandum M-92-01, Coordination of Water Resources Information (OMB, 1991), established the Water Information Coordination Program (WICP) to ensure coordination of water information programs.

The Department of the Interior, through the U.S. Geological Survey, was designated as the lead agency for the WICP. The Memorandum M-92-01 directed all other Federal organizations funding, collecting, or using water resources information to assist the U.S. Geological Survey in ensuring the implementation of an effective WICP. The WICP was specifically charged with developing uniform standards, guidelines, and procedures for the collection, analysis,

management, and dissemination of water information in order to improve quality, consistency, and accessibility nationwide.

The WICP created the Advisory Committee on Water Information (ACWI) under the provisions of the Federal Advisory Committee Act (FACA). FACA provides the procedures for an advisory committee to be established in the interest of obtaining advice or recommendations for the President or one or more agencies or officers of the Federal Government. ACWI created the National Water Quality Monitoring Council to make recommendations on how to coordinate and provide guidance and technical support for the voluntary implementation of the recommendations presented in the Strategy for Improving Water Quality Monitoring in the United States (ITFM, 1995b) by government agencies and the private sector.

The intent of the Strategy is to stimulate the monitoring improvements needed to achieve comparable and scientifically defensible information on interpretations, and evaluations of water quality in fresh surface water, estuaries and near coastal water, ground water, and precipitation at local, watershed units, regional, and national levels. The information is required to support decision making at local, state, tribal, interstate, and national scales. The recommended data elements are a step in implementing the Strategy.

Process

The Water Quality Data Elements (WQDE) Committee met from March 1999 through May 2001 to develop the set of recommended data elements for reporting water quality results. The committee set the following goals for the ~~conditions for the~~ data elements it recommended:

5. ~~The data elements must be of a focused, critical nature and not be an exhaustive list of every possible data element that might describe water quality results;~~ I SUGGEST REMOVOING THIS NE SINCE IT IS CONTAINED IN #2
6. The data elements should be recognized as a "core set" essential to encourage sharing data with confidence~~, but~~ by providing secondary users a means of obtaining additional information, if important for the secondary use;
7. The data elements should be developed independent of any particular database; and
8. The data elements should address the fundamental criteria of allowing basic determination of:
   (1) Who is responsible for the water quality results;
   (2) What chemical or microbiological analytes were monitored and results found;
   (3) Why was the monitoring conducted;
   (4) Where was the monitoring done;
   (5) When was the monitoring done;
   (6) How was the sample collection conducted; and
   (7) How was the laboratory analysis done.

These criteria reflect the recognition that metadata (data about the data) are critical in data interpretation and secondary use. The benefits of metadata are seen within an organization when that data is used by those who are unfamiliar with the way it was originally collected, and between organizations when shared data can improve analyses or reduce the cost of monitoring.

The committee conducted a process of information review, discussion, proposal, and public input. The committee first reviewed data reporting fields in major water quality databases to determine what information was already being reported. It held committee meetings approximately every three months to review its findings and discuss proposals for the data elements. The committee's first draft proposal was presented to the public at the Second National Water Quality Monitoring Conference ~~Annual Conference of the National Water Quality Monitoring Council~~ in Austin, Texas, in April 2000. At that conference, approximately 60 participants discussed the draft ~~reviewed a proposed set of~~ data elements in a workshop format, recommended some changes, but and strongly endorsed their development. ~~The committee received comments on specific changes and additions at the workshop.~~

After addressing comments from the workshop, the Committee asked its members to review the proposal within their organizations. This action provided a further check on implementability of the recommendation. The result of this review was to refine the recommendation's data model and add data elements that were viewed as enhancing interpretation by secondary users. The data model in presented in **Table 1**. The recommendation was also presented to the Water Environment Research Foundation (WERF) for further checking to determine its usefulness. Again, this review resulted in an informal support of the recommendation. Once complete, the U.S. Geological Survey published the draft recommendation for the data elements in the *Federal Register* on March 16, 2001. The public comment period ended on April 30, 2001. Concurrent with the public comment period, the Council held four public meetings to obtain further input: Chicago, IL, on March 23, 2001; Menlo Park (San Francisco Bay Area), CA, on March 27, 2001; Denver, CO, on March 28, 2001; and Washington, DC, on April 4, 2001. The comments from the public review and meetings are held in an official docket at the Environmental Protection Agency, Water Docket Number W-01-02.

Comments from the public review and meetings ~~notably~~ contained strong ~~strongly~~ supported the establishment of a consensus derived set of data elements but there was concerned that the existing organization of some monitoring programs still separate responsibilities for some of the data elements (e.g. those dealing with quality assurance) in the proposes set, thus increasing the cost of creating data sets containing all of them. Others noted that their data management systems were not capably of conveniently storing both the sample results and the metadata in the proposed list. These concerns were also expressed generally as concerns that the use of the proposed data elements would be too costly. ~~for reporting water quality results to encourage the consistent reporting of data and the secondary use of data to minimize duplicate monitoring efforts.~~ ~~The single aspect of the set of data elements that received the most comment was that the 99 data elements should be recognized as an important and useful long-term goal, but a subset might be~~

~~identified as a critical near-term objective to encourage improving data being reported more immediately.~~ ~~Furthermore, the data element list should not be used to judge the quality of previous data since most organizations have taken steps to ensure that they provide the best data possible, even though they might not have used a common set of data elements.~~ WE HAVE ALREADY SAID WE THE EXISTENCE OF THE NEW ELEMENTS SHOULDN'T PREJUDICE PEOPLE AGAINST LESS DOCUMENTED DATA, SO WE SHOULD'T HAVE TO REPEAT IT HERE. WE DO APPOLOGIZE FOR THEM, AND I DON'T THINK THAT IS NECESSARY AND MAY NOT BE CONE PRECEISLY. ~~The comments from the public review and meetings are held in an official docket at the Environmental Protection Agency, Water Docket Number W-01-02.~~

With the reaction to the organizational and data management changes that might be needed to implement the proposed list of data elemtnts,

~~With these comments in mind,~~ the Council has organized its recommendation for a set of common data elements into tiers reflecting first the structure of the data element list, then the major categories within that structure, and finally the detailed choices that it believes define the appropriate level of detail. This tiered structure both better explains the data elements the Council recommends and allows those wishing to adopt them over time a roadmap linking fewer elements to the larger list. ~~the critical nature of common fundamental information at each tier that should be recognized by the reporting organization in the process of improving data quality and expanding information sharing. The concept is that an organization should demonstrate that it has successfully satisfied the recommendation for reporting in the sequence of tiers, reflecting its level resources that allow for as complete a reporting as possible. Furthermore, the tiers are developed around the data model, suggesting that a monitoring organization could evolve its data enhancements in particular aspects of the model in a "modular" approach, rather than addressing an entire tier all at once, and as resources permit.~~

Table 1.
Data Model for the
Water Quality Data Elements

1.0 Contacts (Who is responsible for the monitoring?)
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Recommended Data Elements

The recommended set of 99 Data Elements for Reporting Water Quality Results of Chemical and Microbiological Analytes cover wells, surface water stations, and precipitation. This list is

intended to standardize the preservation of data and to facilitate its sharing by standardizing ~~definitions and by defining~~ the list of data, metadata and their descriptive definitions . A data element is the name of a set of information with the same attribute. A data element may be a data field in a database such as a laboratory name, an analyte, or the sampling station identification number. Examples of metadata elements ~~(information about the data)~~ include such things as sampling and laboratory procedures, quality controls, and locational measurement accuracy.

The list of data elements is not specific to any particular database, but is intended to be used voluntarily by agencies, organizations and individuals to guide their reporting, storage, and sharing of water quality data. This list is intended primarily to guide the collection of ambient water quality data, but many of the allowable sample location and sample type descriptions are versatile enough to be useful in collecting these data in other settings.

The list of data and metadata elements is divided into categories using the data model in Table 1 that describe who collected and analyzed the sample, what was analyzed, why the sampling was undertaken, when the sample was collected and analyzed, where the sampling occurred, and how the analysis was done. The list is presented in tiers, indicating fundamental elements for each tier. This "tier and modular" approach is presented in **Figure 1**, and constitutes the final recommendation of the Council to ACWI. The list is intended to describe the breadth of information needed to ensure the continuing utility of the information both within an organization and between organizations as information is stored and shared, but without being an exhaustive list of every possible data element that could be reported. The Council devoted great efforts to focus the set of data elements on the essential data needed across programs, recognizing that if more extensive data from a particular monitoring program were collected, it could be made available as well.

Implementation

The recommended set of Data Elements for Reporting Water Quality Results of Chemical and Microbiological Analytes is expected to be voluntarily implemented by the Council's membership. They are also available to the U.S. Environmental Protection Agency for consideration as one of the growing list of data standards it is adopting and may be voluntarily used by other local, state and federal agencies and the private sector, and even international organizations concerned about consistent reporting of water quality results for comparative purposes. The Council has concurrent efforts to foster more consistent analytical techniques and more widespread information sharing as a means of reducing costs and increasing the data available for decisions.

The Council also intends to prepare a Communication and Implementation Plan to facilitate the use of the data elements. The Council will consider volunteer proposals for demonstration projects by its members to show feasibility of the recommendation. It will also rely on existing communication mechanisms to promote the use of the recommended data elements, such as through technical organizations and societies, existing newsletters of members and the news

media. A key feature of the plan is a regular review of implementation of the recommendation to determine whether any aspects of it need to be revised or updated.

References

Office of Management and Budget. 1991. Coordination of Water Resources Information. Memorandum M-92-01 (dated December 10, 1991).

Intergovernmental Task Force on Monitoring Water Quality. 1995a. Strategy for Improving Water-Quality Monitoring in the United States, Final Report of the Intergovernmental Task Force on Monitoring Water Quality. http://water.usgs.gov/wicp/lopez.main.html

Intergovernmental Task Force on Monitoring Water Quality. 1995b. Strategy for Improving Water-Quality Monitoring in the United States, Final Report of the Intergovernmental Task Force on Monitoring Water Quality; Technical ~~Appendices.~~ Appendix M "Data Elements Glossary " http://water.usgs.gov/wicp/appendixes/AppendM.html

Figure 1

Water Quality Data Elements

(Insert the WQDE list)

Appendix 1

Water Quality Data Elements Committee Members

The Recommended Set of Data Elements for Reporting Water Quality Results was developed through a collaborative effort with representatives from the following local, State, and Federal agencies and the water industry, which are members of the Council:

- East Bay Municipal Utility District (California) - Robert Berger
- Hampton Roads Sanitation District (Virginia) - Norm LeBlanc
- Orange County Water District (California) -
- Merck, Inc. -
- National Water Research Institute - Ron Linsky
- George Washington University -
- Association of Public Health Laboratories - Lynn Bradley

- Delaware River Basin Commission - Ed
- Florida Department of Environmental Protection -
- Virginia Department of Environmental Quality - Roger Stewart
- New Jersey State Geological Survey -
- New York Department of Health -
- Washington State Department of Ecology - Lynn Singleton
- Arizona Department of Environmental Quality -
- National Institute of Standards and Technology - John
- US Geological Survey - Glenn Patterson, Charles Peters
- US Environmental Protection Agency - Charles Job, Charles Spooner