

**U.S. Geological Survey
Techniques of Water-Resources Investigations**

**Book 9
Handbooks for Water-Resources Investigations**

**National Field Manual
for the Collection of
Water-Quality Data**



**Chapter A6.
FIELD
MEASUREMENTS**

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FIELD MEASUREMENTS

National Field Manual for the Collection of Water-Quality Data Chapter A6.

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Chapter A6.

FIELD MEASUREMENTS

Edited by F.D. Wilde

ABSTRACT

The *National Field Manual for the Collection of Water-Quality Data (National Field Manual)* is comprised of nine chapters that provide guidelines and standard procedures for U.S. Geological Survey (USGS) personnel who collect data used to assess the quality of the Nation's surface-water and ground-water resources. This chapter presents procedures and guidelines for the collection of water data on temperature, dissolved-oxygen concentration, specific electrical conductance, pH, reduction-oxidation potential, alkalinity, and turbidity, and for the use of multiparameter instruments for taking such measurements.

Each chapter of the *National Field Manual* is published separately and revised periodically. Newly published and revised chapters are posted on the Web on the USGS page "National Field Manual for the Collection of Water-Quality Data" (<http://pubs.water.usgs.gov/twri9A>).

INTRODUCTION

The mission of the Water Resources Discipline of the U.S. Geological Survey (USGS) is to provide the information and understanding needed for wise management of the Nation's water resources. Inherent in this mission is the impartial collection of quality-assured data that accurately describe the physical, chemical, and biological attributes of environmental water systems. The quality assurance of data is essential to the credibility of the water-resources appraisals

carried out by the USGS. These data are available to, and used by, environmental agencies, scientific organizations, and the general public.

Documentation of the methods used by USGS personnel serves to maintain consistency and technical quality in our data-collection activities. The *National Field* is Section A of Book 9 of the USGS publication series "Techniques of Water-Resources Investigations" (TWRI) and consists of individually published chapters that are designed to be used in conjunction with each other. Other chapters of the *National Field Manual* are referred to in the text by the abbreviation "NFM" and the specific chapter number (or chapter and section number). For example, NFM 6.4 refers to the section in NFM 6 that pertains to pH data collection.

PURPOSE AND SCOPE

The *National Field Manual* provides guidelines and standard procedures to be used by USGS personnel for field activities related to water-quality data collection and analysis. This manual is targeted specifically toward data collectors in order to (1) establish and communicate scientifically sound methods and procedures, (2) encourage consistency in the use of field methods for the purpose of producing nationally comparable data, and (3) provide methods that minimize data bias and, when properly applied, result in data that are reproducible within acceptable limits of variability, and (4) provide citable documentation for USGS water-quality data-collection protocols.

Data collectors must have formal training and field apprenticeship in order to correctly implement the procedures described in this report. The *National Field Manual* is meant to guide and complement such training. Chapter A6 provides procedures, protocols, and guidelines for the collection of those standard physical and chemical properties of water that are, in general, routinely collected for USGS water-quality investigations. These include measurement of water temperature, pH, specific electrical conductance, dissolved oxygen, Eh, alkalinity, and turbidity.

It is impractical to provide guidance that would encompass the entire spectrum of data-collection objectives, site characteristics, environmental conditions, and technological advances related to water-quality studies. It is the fundamental responsibility of data collectors to select methods that are compatible with the scientific objective for the field work and to use procedures that are consistent with USGS standard procedures to the extent possible. Under some circumstances, data collectors may have to modify standard procedures. Whenever a standard procedure is modified or is not used, a description of the procedure that is used and the supporting quality-assurance information are to be reported with the data.

REQUIREMENTS AND RECOMMENDATIONS

As used in the *National Field Manual*, the terms **required** and **recommended** have the following USGS-specific meanings.

Required (require, required, or requirements) pertains to USGS protocols and indicates that USGS Office of Water Quality policy has been established on the basis of research and (or) consensus of the technical staff and has been reviewed by water-quality specialists and selected Water Science Center¹ or other professional personnel, as appropriate. Technical memorandums or other documents that define the policy pertinent to such requirements are referenced in this manual. Personnel are instructed to use required equipment or procedures as described herein. Departure from or modifications to the stipulated requirements that might be necessary to accomplishing specific data-quality requirements or study objectives must be based on referenced research and good field judgment, and be quality assured and documented in permanent and readily accessible records.

Recommended (recommend, recommended, recommendation) pertains to USGS protocols and indicates that USGS Office of Water Quality policy recognizes that one or several alternatives to a given procedure or equipment selection are acceptable on the basis of research and (or) consensus. References to technical memorandums and selected publications pertinent to such recommendations are cited in this chapter to the extent that such documents are available. Specific data-quality requirements, study objectives, or other

¹"Water Science Center" refers to an organizational unit of the USGS in any of the States or Territories of the United States.

constraints can affect the choice of recommended equipment or procedures. Selection from among the recommended alternatives should be based on referenced research and good field judgment. Departure from or modifications to recommended procedures must be quality assured and documented in permanent and readily accessible records.

FIELD MANUAL REVIEW AND REVISION

Chapters of the *National Field Manual* are reviewed, revised, and reissued periodically to correct any errors, update information, incorporate technical advances, and address additional water-quality topics. Dates of revisions appear in the footer of each chapter section. Each chapter's revision history can be found under "Comments and Errata" on the *National Field Manual's* Home Page (<http://pubs.water.usgs.gov/twri9A/>). Comments on the *National Field Manual*, and suggestions for updates or revisions, should be sent to nfm-owq@usgs.gov.

ACKNOWLEDGMENTS

This *National Field Manual* responds to advances in technology and science and to the developing needs for water-quality monitoring through an ongoing process of review and revision. In the course of time, the expertise of numerous scientists has been tapped to provide scientifically sound guidance to personnel who collect and report field-measurement and field-analytical water-quality data. Our greatest debt of gratitude goes to the following early authors, editors, and reviewers of this field manual, without whom this project could not have succeeded: D.B. Radtke, J.V. Davis, J.B. Kurklin, R.T. Iwatsubo, K.A. Pearsall, W.E. Webb, I.M. Collies, and the analysts of the USGS National Water Quality Laboratory.

Special appreciation is due our colleagues and collaborators from the Hach and Hydrolab Companies, In-Situ Incorporated, and YSI Incorporated, who have given of their time and expertise.

It also is imperative to acknowledge the rich resources that formed the foundation of this "Field Measurements" chapter, as well as other *National Field Manual* chapters. The authors and editors have relied

on the broad spectrum of colleague expertise found in unpublished USGS and U.S. Environmental Protection Agency training and field manuals and technical memorandums, in addition to the references cited at the end of each section of Chapter A6.

Many thanks go to T.L. Miller and former Chiefs of the Office of Water Quality whose encouragement, faith, and practical support have been the force behind our ability to produce and maintain a national field manual for water-quality studies.