

**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 A7.

BIOLOGICAL INDICATORS

**Franceska D. Wilde
Managing Editor**



U.S. DEPARTMENT OF THE INTERIOR
KEN SALAZAR, *Secretary*

U.S. GEOLOGICAL SURVEY
Suzette M. Kimball, *Acting Director*

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For additional information write to:
Chief, Office of Water Quality
U.S. Geological Survey
12201 Sunrise Valley Drive
Mail Stop 412
Reston, VA 20192

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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 of the *National Field Manual* includes guidelines for the determination of (1) biochemical oxygen demand (using a 5-day bioassay test), (2) fecal indicator bacteria, (3) fecal indicator viruses (coliphages), (4) protozoan pathogens, (5) algal biomass, and (6) cyanobacterial taste-and-odor compounds.

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 Manual* 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 7 refers to chapter A7 entitled *Biological Indicators*, and NFM 7.3 refers to the section in NFM 7 that pertains to the collection of samples for protozoan pathogens.

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, (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 chapter. The *National Field Manual* is meant to guide and complement such training. Chapter A7 contains standard USGS procedures, protocols, and guidelines for collecting data on biological indicators, such as biological oxygen demand; indicator bacteria, viruses, and protozoans; and algal biomass and cyanobacterial taste-and-odor compounds. A description of the determination for ultimate carbonaceous biochemical oxygen demand is beyond the scope of Section 7.0 (Five-Day Biochemical Oxygen Demand), but is provided in Stamer and others (1979, 1983). The information provided in Section 7.1 (Fecal Indicator Bacteria) and in Section 7.2 (Fecal Indicator Viruses) is to be used in conjunction with *Methods for Collection and Analysis of Aquatic Biological and Microbiological Samples* edited by L.J. Britton and P.E. Greeson (TWRI, Book 5, Chapter A4, 1989), the 20th edition of *Standard Methods for the Examination of Water and Wastewater*, and with the other chapters of this *National Field Manual* series.

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 is 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 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.

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

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.

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The information included in this *National Field Manual* is based on existing manuals, a variety of reference documents, and a broad spectrum of colleague expertise. In addition to the references provided, important source materials include unpublished USGS training and field manuals.

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