

# Water-Quality Sampling by the U.S. Geological Survey: Standard Protocols and Procedures

## Background

The U.S. Geological Survey (USGS) collects the data necessary for the accurate assessment and wise management of our Nation's surface-water and groundwater resources. Federal and State agencies, water-resource regulators and managers, and many organizations and interested parties in the public and private sectors depend on the reliability, timeliness, and impartiality of the data we collect. In addition, the USGS provides a scientific analysis of the data and the context in which the data can be properly understood. This information is fundamental to protecting and managing water resources and is needed to address questions vital to human and environmental health, such as:

- Is our water of acceptable quality for drinking? swimming? irrigation?
- Why is water quality improving (or worsening) in a reservoir, river, aquifer, or other water body?



Extracting samples for analysis of gases in water.

- What is causing stream pollution or the deterioration of an aquatic habitat?
- How does the quality of one water body compare with others across the State or the country?

Being able to answer such questions involves understanding complex relations among historical and existing environmental factors, and also requires an understanding and knowledge of the data-collection methods that were used.

## Why Document Sampling Practices?

The USGS develops, documents, and mandates the use of scientifically sound, quality-assured field methods, including protocols, procedures, and recommended practices for the collection of water-quality data. These methods are documented in the *National Field Manual for the Collection of Water-Quality Data* (NFM) (see reverse page).

Documenting our methods in a citable reference serves as the basis for maintaining a highly trained work force and enables the USGS to:

- (1) Maintain continuity and understanding of the science-based and field-tested methods required to accomplish data-collection objectives.
- (2) Support consistency in the implementation of these methods in order to produce data that are nationally comparable and transferable.
- (3) Minimize data bias and apply practices that result in data that are reproducible within appropriate limits of variability.

Revisions to the NFM are ongoing, incorporating up-to-date technological and scientific advances to keep the manual current with emerging data needs.

## Who Uses the USGS Water-Quality Field Manual?

While the standard protocols and procedures for USGS water-quality sampling and data collection are developed and documented specifically for use by USGS personnel, users of the NFM also include a broad spectrum of the public and private sectors, including Federal, State, and local agencies; academia and other educational institutions; professional consultants; environmental advocacy groups and volunteer organizations; and scientists and other interested parties throughout the international community.



Teaching sampling procedures in Abu Dhabi, United Arab Emirates.

## USGS protocols and procedures...

- Promote and enhance the comparability of water data collected by numerous organizations.
- Help to standardize, document, and verify data quality.
- Help facilitate sharing of data and resources and avoid costly duplication of effort.
- Provide a scientifically defensible basis for the collection of water data to support the management of our Nation's water resources.
- Are included in the National Environmental Methods Index ([www.nemi.gov](http://www.nemi.gov)).

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

This field manual (the “NFM”) provides the foundation for USGS water-quality training and is a primary reference used by personnel who collect surface-water and groundwater water-quality samples and environmental data. These protocols and procedures address site-specific conditions and considerations, including the methods required when sampling aqueous organic and inorganic constituents at concentrations of parts per billion or less. In addition, the NFM describes the use of quality-assurance measures that address questions such as:

- What is the appropriate equipment for my sampling location and objectives? How should I use and dispose of cleaning solutions? How do I collect a discharge-weighted sample?
- How and when should a well be purged before sampling? Using what equipment? Using what method?
- How are samples for *E. coli* quality controlled? How do I sample safely for microorganisms like *Giardia* or *E. coli*?
- What considerations and criteria are needed to ensure a representative groundwater sample?

## Chapters of the NFM

### 1 Preparations for Water Sampling

- Sampling-site selection
- Considerations for surface-water and groundwater sites
- Data records (electronic and paper)

### 2 Selection of Equipment

- Sample-collection equipment
- Sample-processing equipment
- Equipment maintenance

### 3 Cleaning of Equipment

- Decontamination procedures
- Assessing the efficacy of the cleaning process

### 4 Collection of Water Samples

- Preventing sample contamination
- Isokinetic depth-integration sampling
- Well purging (high and low flow)
- Types/use of quality-control samples

### 5 Processing of Water Samples

- Composite samples and subsamples
- Sample filtration and preservation
- Solid-phase extraction of pesticides
- Analyte-specific sampling

### 6 Field Measurements

- Guidelines and criteria
  - Temperature
  - Dissolved oxygen (DO)
  - Specific electrical conductance (SC)
  - pH
  - Reduction-oxidation potential (Eh/Redox)
  - Alkalinity and acid neutralizing capacity
  - Turbidity
  - Multiparameter instruments
- (For station operation, record computation, and data reporting for continuous water-quality monitors, see Wagner and others (2006) at <http://pubs.usgs.gov/tm/2006/tm1D3/> )

### 7 Biological Indicators

- Five-day biochemical oxygen demand
- Fecal indicator bacteria
- Fecal indicator viruses
- Protozoan pathogens
- Algal biomass indicators
- Cyanobacteria in lakes and reservoirs

### 8 Bottom-Material Samples

- Site selection
- Sampling and processing equipment
- Sampling and processing methods

### 9 Safety in Field Activities

- Policies and job hazard analyses
- Transportation (road, water, air)
- Surface-water and groundwater sites
- Chemical use, storage, disposal
- Protections in polluted water
- Storms, floods, earthquakes, fire
- Hazards from plants and animals

