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# Standard Guide for Quality Planning and Field Implementation of a Water Quality Measurement Program[1]

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## 1. Scope

1.1 This guide covers planning and implementation of the sampling aspects of environmental data generation activities. Environmental data generation efforts are comprised of four parts: (*1*) establishment of data quality objectives (DQOs); (*2*) design of field sampling and measurement strategies and specification of laboratory analyses and data acceptance criteria; (*3*) implementation of sampling and analysis strategies; and (*4*) data quality assessment.

1.2 This guide defines the criteria that must be considered to ensure the quality of the field aspects of environmental data and sample generation activities.

1.3 DQOs should be adopted prior to the application of this guide. The data generated in accordance with this guide are subject to a final assessment to determine whether the DQOs were met. For example, many screening activities do not require all of the quality assurance (QA) and quality control (QC) steps found in this guide to generate data adequate to meet the project needs. The extent to which all of the requirements must be met remains a matter of technical judgement as it relates to the established DQOs.

1.4 This guide presents extensive management requirements designed to ensure high-quality samples and data. The words "must,"" shall," "may," and "should" have been selected carefully to reflect the importance placed on many of the statements made in this guide.

1.5 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

## 2. Referenced Documents

2.1 *ASTM Standards:*[2]

D596 Guide for Reporting Results of Analysis of Water
D1129 Terminology Relating to Water
D2777 Practice for Determination of Precision and Bias of Applicable Test Methods of Committee D19 on Water
D3370 Practices for Sampling Water from Closed Conduits
D3856 Guide for Management Systems in Laboratories Engaged in Analysis of Water
D4210 Practice for Intralaboratory Quality Control Procedures and a Discussion on Reporting Low-Level Data (Withdrawn 2002)[3]
D4447 Guide for Disposal of Laboratory Chemicals and Samples
D4448 Guide for Sampling Ground-Water Monitoring Wells
D4840 Guide for Sample Chain-of-Custody Procedures
D4841 Practice for Estimation of Holding Time for Water Samples Containing Organic and Inorganic Constituents
D5172 Guide for Documenting the Standard Operating Procedures Used for the Analysis of Water
D5283 Practice for Generation of Environmental Data Related to Waste Management Activities: Quality Assurance and Quality Control Planning and Implementation
E29 Practice for Using Significant Digits in Test Data to Determine Conformance with Specifications
E178 Practice for Dealing With Outlying Observations
E1187 Terminology Relating to Conformity Assessment (Withdrawn 2006)[3]

2.2 *U.S. Environmental Protection Agency Documents:*[4]

QAMS-005/80 (NTIS No. PB83170514/LL), Interm Guidelines and Specifications for Preparing Quality Assurance

[1] This guide is under the jurisdiction of ASTM Committee D19 on Water and is the direct responsibility of Subcommittee D19.02 on Quality Systems, Specification, and Statistics. Technical Resources, and Statistical Methods.

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[2] For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

[3] The last approved version of this historical standard is referenced on www.astm.org.

[4] Available from Standardization Documents Order Desk, DODSSP, Bldg. 4, Section D, 700 Robbins Ave., Philadelphia, PA 19111-5098, http://www.dodssp.daps.mil.

Project Plans, Office of Monitoring Systems and Quality Assurance, Dec. 29, 1980

QAMS-500/80. Development of Data Quality Objectives, Description of Stages I and II, July 16, 1986

QAMS-004/80 (NTIS No. PB83219667/LL), Guidelines and Specifications for Preparing Quality Assurance Program Plans, Office of Monitoring Systems and Quality Assurance, Sept. 20, 1980

## 3. Terminology

3.1 *Definitions*—The terms that are most applicable to this guide have been defined in Terminologies D1129 and E1187.

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *background sample*—a sample taken from a location on or proximate to the site of interest. This sample is taken to document baseline or historical information.

3.2.2 *collocated samples*—independent samples collected as close as possible to the same point in space and time and intended to be identical.

3.2.3 *data quality objectives (DQOs)*— statements on the level of uncertainty that a decision maker is willing to accept in the results derived from environmental data (see QAMS-500/80).

3.2.4 *material blank*—a sample composed of construction materials such as those used in well installation. Well development, pump and flow testing, and slurry wall construction. Examples of these materials are bentonite, sand, drilling fluids, and source and purge water. This blank documents the contamination resulting from usage of the construction materials.

3.2.5 *quality assurance program plan (QAPP)*—an orderly assemblage of management policies, objectives, principles, and general procedures by which an organization involved in environmental data generation activities outlines how it intends to produce data of known quality.

3.2.6 *quality assurance project plan (QAPjP)*—an orderly assemblage of detailed procedures designed to produce data of sufficient quality to meet the DQOs for a specific data collection activity.

## 4. Summary of Guide

4.1 This guide describes the criteria and activities for organizations involved in obtaining water samples and generating field data in terms of human and physical resources and QC procedures and documentation requirements depending on the DQOs or agreed upon project plan.

## 5. Significance and Use

5.1 Environmental data are often required for making regulatory and programmatic decisions. These data must be of known quality commensurate with their intended use.

5.2 Certain minimal criteria must be met by the field organizations in order to meet the objectives of the water monitoring activities.

5.3 This guide defines the criteria for organizations taking water samples and generating environmental data and identifies other activities that may be required based on the DQOs.

5.4 This guide emphasizes the importance of communication among those involved in establishing the DQOs, planning, and implementing the sampling and analysis aspects of environmental data generation activities, and assessing data quality.

## 6. Project Specification

6.1 *Overall Project Objectives* —The overall objectives of the project must be defined prior to the start of any field and laboratory activities.

6.2 *Data Quality Objectives*—DQOs for the data generation activity should be defined prior to the initiation of field and laboratory work, and they must be compatible with project objectives. It is desirable that the field and laboratory organizations be aware of the DQOs so that the personnel conducting the work are able to make informed decisions during the course of the project.

6.3 *Project Plan*— The project plan should be designed to meet the project objectives and DQOs. The project plan should define the following:

6.3.1 *Specific Project Objectives* —The objectives of the field and laboratory work must be defined clearly, define specific objectives for the sampling location, and describe the intended uses for the data. The project objective may need to be reviewed as information is gathered. Any changes in the project objective affecting field and laboratory activities should be communicated to the field and laboratory personnel.

6.3.2 *Background Information*—Any background information that could affect meeting the project objective or DQOs should be provided. For example, the identification of any regulatory programs governing data collection and analysis and the reason for conducting the sample collection work should be included in the background information.

6.3.3 Project management shall have individuals designated as having responsibility and authority for the following: (*1*) developing project documents that implement the DQOs; (*2*) selecting field and laboratory organizations to conduct the work; (*3*) coordinating communication among the field and laboratory organizations and government agencies, as required; and (*4*) reviewing and assessing the final data.

6.3.4 Sampling requirements shall be specified, including sampling locations, equipment and procedures, and sample preservation and handling.

6.3.5 Analytical requirements shall be specified, including the analytical procedures, analyte list, required detection limits, and required precision and bias values. Regulatory requirements and DQOs shall be considered when developing the specifications.

NOTE 1—The above does not imply that the specified analytical requirements can be met.

6.3.6 The QA and QC requirements shall address both field and laboratory activities. The means for controlling false positives and false negatives shall be specified.

6.3.6.1 The types and frequency of field QC samples to be collected, including field blanks, duplicates, and spikes, trip blanks, equipment rinsates, background samples, reference materials, material blanks, and split samples, should be specified. Control parameters for field activities shall be described (see 7.6.3).

6.3.6.2 The types and frequency of laboratory QC samples, such as laboratory control samples, laboratory blanks, matrix spikes, matrix duplicates, and matrix spike duplicates, shall be specified. Any specific performance criteria shall be specified. Data validation criteria shall be defined.

6.4 *Project Documentation*—All documents required for planning, implementing, and evaluating the data collection effort shall be specified. These may include, although are not limited to, a statement of work, technical and cost proposals, work plan, sampling and analysis plan, QAPjP, health and safety plan, community relations plan, documents required by regulatory agencies, requirements for raw field and analytical records, technical reports assessing the environmental data, and records retention policy. Planning documents shall specify the required level of document control and identify the personnel having access. Document formats that may be required to ensure that all data needs are satisfied shall be specified. In addition, a project schedule that identifies critical milestones and completion dates should be available.

## 7. Standard Guide for Environmental Field Operations

7.1 *Purposes*—the field organization must conduct its operations in such a manner as to provide reliable information that meets the DQOs. To achieve this goal, certain minimum policies and procedures must be implemented in order to meet the DQOs.

7.2 *Organization*— The field organization shall be structured such that each member of the organization has a clear understanding of his or her duties and responsibilities and the relationship of those responsibilities to the total effort. The organizational structure, functional responsibilities, levels of authority, job descriptions, and lines of communication for activities shall be established and documented. One person may cover more than one organizational function.

7.2.1 *Management*—The management personnel of the field organization is responsible for establishing organizational, operational, health and safety, and QA policies. Management shall ensure that the following requirements are met: (*1*) the appropriate methodologies are followed, as documented in the standard operating procedures (SOPs); (*2*) personnel understand clearly their duties and responsibilities; (*3*) each staff member has access to appropriate project documents; (*4*) any deviations from the project plan are communicated to project management; and (*5*) communication occurs between the field, laboratory, and project managements, as specified in the project plan. Management shall foster an attitude within the organization that emphasizes the importance of quality and supports implementation of the QAPjP.

7.2.2 *Quality Assurance Function* —The organization shall appoint an individual(s) to be responsible for monitoring field operations in order to ensure that the site facilities, equipment, personnel, procedures, practices, and documentation are in conformance with the organization's QAPP and any applicable QAPjP. The QA monitoring function should be entirely separate from and independent of personnel engaged in the work being monitored. The QA function shall be responsible for the QA review in accordance with 7.7.

7.2.3 *Personnel*—It is the responsibility of the organization to establish personnel qualifications and training requirements for all positions. Each member of the organization shall possess the education, training, technical knowledge, and experience, or a combination thereof, to enable that individual to perform his or her assigned functions. Personnel qualifications shall be documented in terms of education, experience, and training. Training shall be provided for all staff members, as necessary, so that they can perform their functions properly.

7.2.4 *Subcontractors*— The use of subcontractors shall not jeopardize data quality. The field organization is therefore responsible for ensuring that its subcontractors are in compliance with the requirements of this section as is appropriate to the specific task(s) they are performing.

7.3 *Field Logistics:*

7.3.1 *General*—Sampling site facilities shall be examined prior to the start of work in order to ensure that all required items are available. The actual sampling area shall be examined to ensure that trucks, drilling equipment, and personnel have access to the site. Security, health and safety, and protection of the environment shall be controlled at the site support areas and sampling site.

7.3.2 *Field Measurements*—Project planning documents shall both address the type of field measurements to be performed and plan for the appropriate area to perform the work. Planning documents shall address ventilation, protection from extreme weather and temperatures, access to stable power, and provisions for water and gases of required purity. Plans shall be made to identify and supply applicable safety equipment, as specified in the project health and safety plan.

7.3.3 *Sample Handling, Shipping, and Storage Area*—The determination of whether sample shipping is necessary shall be made during project planning. This need is established by evaluating the analyses required, holding times (see Practice D4841), and location of the site and laboratory. Shipping or transporting of the samples to a laboratory shall be completed in a timely manner, ensuring that the laboratory is allowed sufficient time to perform its analysis within any required holding times.

7.3.3.1 Samples shall be packaged, labeled, and documented in an area that minimizes sample contamination and provides for safe storage. The level of custody and whether sample storage is required shall be outlined in the planning documents.

7.3.4 *Chemical Storage*— Safe storage areas for solvents, reagents, standards, and reference materials shall be adequate to preserve their identity, concentration, purity, and stability prior to use.

7.3.5 *Decontamination*— Decontamination of sampling equipment may be performed at the location at which sampling occurs, prior to transfer to the sampling site, or in designated areas near the sampling site. Project documentation shall specify where this work will be performed and how it will be accomplished. Water and solvents of appropriate purity shall be available if decontamination is to be conducted at the site. This method of accomplishing decontamination of materials, solvents, and water purity shall be specified in the planning documents or SOPs.

7.3.6 *Waste Storage Area*—Waste materials may be generated during both the sampling process and on site or in situ analysis. Planning documents and SOPs shall outline the method for storage and disposal of these waste materials. Adequate facilities shall be provided for the collection and storage of all wastes. These facilities shall be operated so as to minimize environmental contamination. Waste storage and disposal facilities shall comply with applicable federal, state, and local regulations.

7.4 *Equipment and Instrumentation :*

7.4.1 *Equipment and Instrumentation* —The equipment, instrumentation, and supplies required at the sampling site shall be appropriate to accomplish the activities planned. The equipment and instrumentation shall meet the requirements of pertinent specifications, methods, and SOPs. Before the field staff arrives at the site, a list of required items shall be prepared and checked to ensure availability at the site.

7.4.2 *Maintenance and Calibration of Equipment and Instrumentation*—An SOP or operation and maintenance manual shall set forth the methods, materials, and schedules to be used in the routine inspection, cleaning, maintenance testing, and calibration of the equipment and instrumentation used in performing geophysical, analytical, or in situ measurements. Procedures or manuals may outline typical problems for common malfunctions. Procedures shall designate a person(s) or organizations responsible for maintenance and calibration. Records of all inspections, maintenance, repairs, testing, and calibration shall be maintained.

7.5 *Standard Operating Procedures*—The organization shall have written SOPs for all procedures performed routinely that affect data quality. Guide D5172 contains information for documenting standard operating procedures. SOPs shall be available for the following areas and shall contain the information described:

7.5.1 *Sample Management*—The SOPs describe the numbering and labeling systems, chain-of-custody procedures, and tracking of samples from collection to shipment or relinquishment to the laboratory. Sample management includes the specification of holding times, volume of sample required by the laboratory, preservatives, and shipping requirements.

7.5.2 *Reagent and Standard Preparation*—These SOPs describe the procedures used to prepare standards and reagents. Information should include the specific grades of materials used in reagent and standard preparation, appropriate glassware and containers for preparation and storage, labeling and record keeping for stocks and dilutions, and safety precautions to be taken.

7.5.3 *Decontamination*— These SOPs describe the procedures used to clean field equipment before and during the sample collection process. The SOPs should include the cleaning materials used, order of washing and rinsing with the cleaning materials, requirements for protecting or covering cleaned equipment, procedures for disposing of cleaning materials, and safety considerations.

7.5.4 *Sample Collection Procedures* —SOPs for sample collection procedures shall describe how the procedures are actually performed in the field and shall not be a simple reference to a standard sampling method, unless the procedure is performed exactly as described in the published sampling method. If possible, industry-recognized sample collection methods from source documents published by the U.S. Environmental Protection Agency, ASTM, U.S. Department of the Interior, National Water Well Association, American Petroleum Institute, or other recognized organizations should be used. The SOP for sample collection procedures should include the following information:

7.5.4.1 Applicability of the procedure.

7.5.4.2 Equipment and reagents required.

7.5.4.3 Detailed description of the procedures to be followed when collecting the samples (see Guide D4448 and Practices D3370 for sampling guidance and common practices).

7.5.4.4 Common problems encountered.

7.5.4.5 Precautions to be taken.

7.5.4.6 Health and safety considerations.

7.5.5 *Equipment Calibration and Maintenance*—These SOPs describe the procedures used to ensure that field equipment and instrumentation are in working order. The SOPs describe calibration and maintenance procedures and schedules, maintenance logs, service contracts or service arrangements for equipment, and spare parts available in-house. The calibration and maintenance of field equipment and instrumentation should be in accordance with the manufacturer's specifications and shall be documented.

7.5.6 *Field Measurements*—These SOPs describe all methods used in the field to determine a chemical or physical parameter.

7.5.7 *Corrective Action*—These SOPs describe procedures used to identify and correct deficiencies in the sample collection process. These should include specific steps to take when correcting deficiencies such as performing additional decontamination of equipment, resampling, or additional training or field personnel in methods procedures. The SOP shall specify that each corrective action must be documented with a description of the deficiency, corrective action taken, and person(s) responsible for implementing the corrective action.

7.5.8 *Data Reduction and Validation*—These SOPs describe procedures used to compute the results from field measurements and to review and validate these data. They should include all formulas used to calculate the results and procedures used to verify independently that the field measurement results are correct.

7.5.9 *Reporting*—These SOPs describe the process for reporting the results of field activities (see Practices E29 and D4210 for additional information).

7.5.10 *Records Management*—These SOPs describe the procedures for generating, controlling, and archiving field records. The SOPs should describe the responsibilities for record generation and control and the policies for record