

QUALITY MANAGEMENT PLAN
FOR THE
DEPARTMENT OF ENVIRONMENTAL QUALITY
WATER DIVISION

Commonwealth of Virginia
Department of Environmental Quality
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QUALITY ASSURANCE MANAGEMENT PLAN IDENTIFICATION FORM

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Plan Coverage: This plan describes Virginia Department of Environmental Quality policy and commitment to develop and implement a quality assurance management plan for water quality monitoring sample collection, sample analyses, and the handling of environmental data generated or processed in support of water quality assessment. The quality assurance criteria covered in this plan apply to intramural and extramural environmental monitoring.

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List of Acronyms

CEDS	Comprehensive Environmental Data System
DCLS	Division of Consolidated Laboratory Services
DQA	Data Quality Assessment
DQO	Data Quality Objective
EPA	Environmental Protection Agency
NELAC	National Environmental Laboratory Accreditation Conference
OIS	Office of Information Services
OWP	Office of Water Quality Programs
QA	Quality Assurance
QAPP	Quality Assurance Project Plan
QA/QC	Quality Assurance/Quality Control
QC	Quality Control
QMP	Quality Management Plan
SOP	Standard Operating Procedure
TSA	Technical System Audit
WD	Water Division
WQM	Water Quality Monitoring
WMA	Water Monitoring Assessment Program
VADEQ	Virginia Department of Environmental Quality

1.0 Management and Organization

1.1 Introduction

The Commonwealth of Virginia Department of Environmental Quality (VADEQ) is mandated by the State Water Control Law (Chapter 3.1 Title 62.1 of Code of Virginia section [§62.1-44.2](#)) to protect existing high quality state waters and to provide for the restoration of all other state waters. In accordance with this mandate, the VADEQ established procedures for investigating, monitoring and scientifically evaluating water quality and water problems. The management and staff of VADEQ are committed to producing environmental data and technology consistent with the guidelines presented in the Quality Management Plan (QMP). Adherence to quality system requirements assures that environmental data and technology is suitable for the technical decision making process, protection of the environment, and management of the VADEQ mission.

The purpose of this QMP is to document management policies, goals, objectives and general procedures by which the VADEQ produces and validate acceptable water quality data. Implementation of this plan within the various field and laboratory water quality monitoring and measurement program efforts ensures that decisions made by the agency affecting the Commonwealth's water quality are based upon sound professional principles and environmental data of known and acceptable quality.

This QMP defines and describes the quality assurance and quality control policies and responsibilities prescribed by the Water Division (WD) in accordance with USEPA Order 5360.1" Policy and Program Requirement to Implement the Mandatory Quality Assurance Program", USEPA QA/R-1 "EPA Quality Assurance Requirements for Quality Management Programs", and USEPA QA/R-2 "EPA Requirements for Quality Management Plans". This document links the management policies, objectives and principles of the program with the procedures described in associated Quality Assurance Project Plans (QAPPs) and Standard Operating Procedures (SOPs) which are designed to produce data of known quality. These policies should guide the Project Manager in the uniform implementation of QA/QC requirements for all monitoring programs.

This QMP covers the collection of water quality samples and data for VADEQ's Water Division. Programs collecting samples and data in the WD include VADEQ's Water Quality Standards and Biological Program, Water Monitoring and Assessment Program, the Total Maximum Daily Loads Watershed Program, and the Permitting Water Compliance Program.

1.2 Goals

The goals of the VADEQ's Water Division QA systems are:

- (a) To ensure that all environmental data generated by or for the agency that will be utilized to evaluate water quality is scientifically valid, defensible and of documented and adequate quality.

- (b) To ensure that all water quality monitoring activities performed by or under contract for VADEQ have approved QAPPs prior to the start of collection activities.
- (c) To maintain communication on QA issues and activities among management and staff.
- (d) To perform assessments to determine the effectiveness of the WD quality assurance system. Continued improvement in the quality management system is emphasized.
- (e) To accomplish QA processes in the most cost-effective manner without compromising data quality.

1.3 Policy

It is the intent of the VADEQ WD to implement the following quality assurance policy:

- a) To ensure data generators produce quality data by providing easy access to all necessary documentation and QA training.
- b) Where applicable, ensure staff and external organization generating WQM data follow the requirements outlined in the QMP, subsequent WQM policy and standard operating procedures.
- c) To require a QAPP that describes intended data use, specific quality assurance activities, level of quality to be obtained and data acceptance criteria for field, laboratory and data management activities. These plans are approved prior to and implemented upon initiation of the water quality monitoring program for which they are intended.
- d) To ensure sufficient resources are allocated to guarantee that QA activities provide the desired level of quality.
- e) To conduct annual Technical System Audits (TSA) on monitoring staff and laboratory personnel and contractors to ensure that they comply with the WQM quality management system requirements and to address any highlighted deficiencies in a timely manner.

1.4 Quality Assurance Management

The VADEQ recognizes the importance of the quality assurance to all aspects of its program and activities. Quality assurance is an integral part of the agency management plan and receives strong management support.

A Quality Assurance Coordinator is assigned accountability for the management of the WD quality assurance program. The quality assurance coordinator is provided with resources to develop and implement associated program activities.

1.5 Assignment of Responsibilities

The VADEQ Water Division and the Division of Consolidated Laboratory Services (DCLS) are responsible for their respective sampling and analytical programs. The organizational and management responsibilities, responsible individuals and organizational structures for these agencies are provided in Figures 1 and 2.

1.5.1 Roles and Responsibilities:

Division Director:

The Division Director has the overall responsibility for managing the QA program within the agency in accordance with the VADEQ QMP. The Director has the authority to ensure that adequate resources are provided to support the WD QA program responsibilities.

Program Managers:

The Program Managers coordinate staff to ensure implementation of the quality management system where environmental measurements are to occur.

Regional Office Program Managers:

- a) Implement and oversee the WD QA policies within regional offices.
- b) Disseminate QA information within regional offices.
- c) Assist in the development of QA policies and procedures.
- d) Assist in solving QA related problems

Quality Assurance Coordinator:

- a) Provide general management of the VADEQ WD quality assurance programs.
- b) Identify and respond to QA and QC needs, resolve problems, and answer requests for guidance and assistance.
- c) Provide assistance to VADEQ staff and external data generators in quality assurance related matters (i.e. study design, method selection).
- d) Develop or assist in the development of major program area project plans.
- e) Provide guidance and assistance to Project Managers and external data generators in the development and implementation of specific QAPPs.
- f) Review and approve all internally and externally generated QAPPs.

- g) Identify program specific QA related training needs.
- h) Perform QA system audits – systematic on-site qualitative review of facilities, equipment, training, procedures, record keeping, data validation, data management, and the reporting aspects of the total QA system. The audits are designed to insure that the QA program and QAPPs contain approved sample handling and analytical procedures and that those procedures are in use.
- i) Conduct QA performance audits – quantitative analyses or checks with reference samples to determine the accuracy of a measurement system.
- j) Review analytical data and support the collection of QA data to insure that only data of known quality and integrity are available for entry into the database.
- k) Provide and obtain technical assistance from U.S. EPA quality assurance personnel.
- l) Review external project proposals to determine the need for a QAPP.
- m) Provide independent reviews of all regional and contractual QA/QC practices while maintaining open communication with regional and contractual personnel.

1.5.2 Contract Program Manager Responsibilities:

- a) QAPP development, implementation, evaluation, and reporting.
- b) Identification and reporting of QA problems and needs to VADEQ Quality Assurance Coordinator as they occur.

1.5.3 Organizational Responsibilities:

The VADEQ WD has overall management responsibility including:

- a) Program design.
- b) Sample collection, preservation and handling.
- c) Field analysis.
- d) Field quality control.
- e) Data interpretation.
- f) Record keeping and reporting (shared responsibility).
- g) Data entry, validation, and reduction (shared responsibility).

DCLS has the overall responsibility for sample analysis including:

- a) Laboratory related quality assurance program and project plans.
- b) Sample analysis.
- c) Method evaluation and selection.
- d) Determination of accuracy and precision.
- e) Participation in U.S. EPA and/or NELAC system and performance audits.
- f) Record keeping and reporting (shared responsibility).
- g) Data entry, validation and reduction (shared responsibility).

1.6 Communications

The program QA Officers shall notify the Program Managers of any identified problem areas. Corrective action will be taken as needed. A follow-up review of the corrective action will be made by the program QA Officer and the Program Managers to verify that problems have been resolved.

Formal lines of communication regarding the quality assurance program status and needs are essential to ensure that an effective quality assurance program is implemented within VADEQ. The Quality Assurance Coordinator or designee will have direct access to VADEQ and DCLS management on quality assurance matters. The WD will also provide training on an on-going basis in order to ensure that VADEQ personnel responsible for QA functions understand the QA requirements and practices related to their responsibilities.

Figure 1 WD Monitoring & Permitting Activities Organizational Chart - 2010

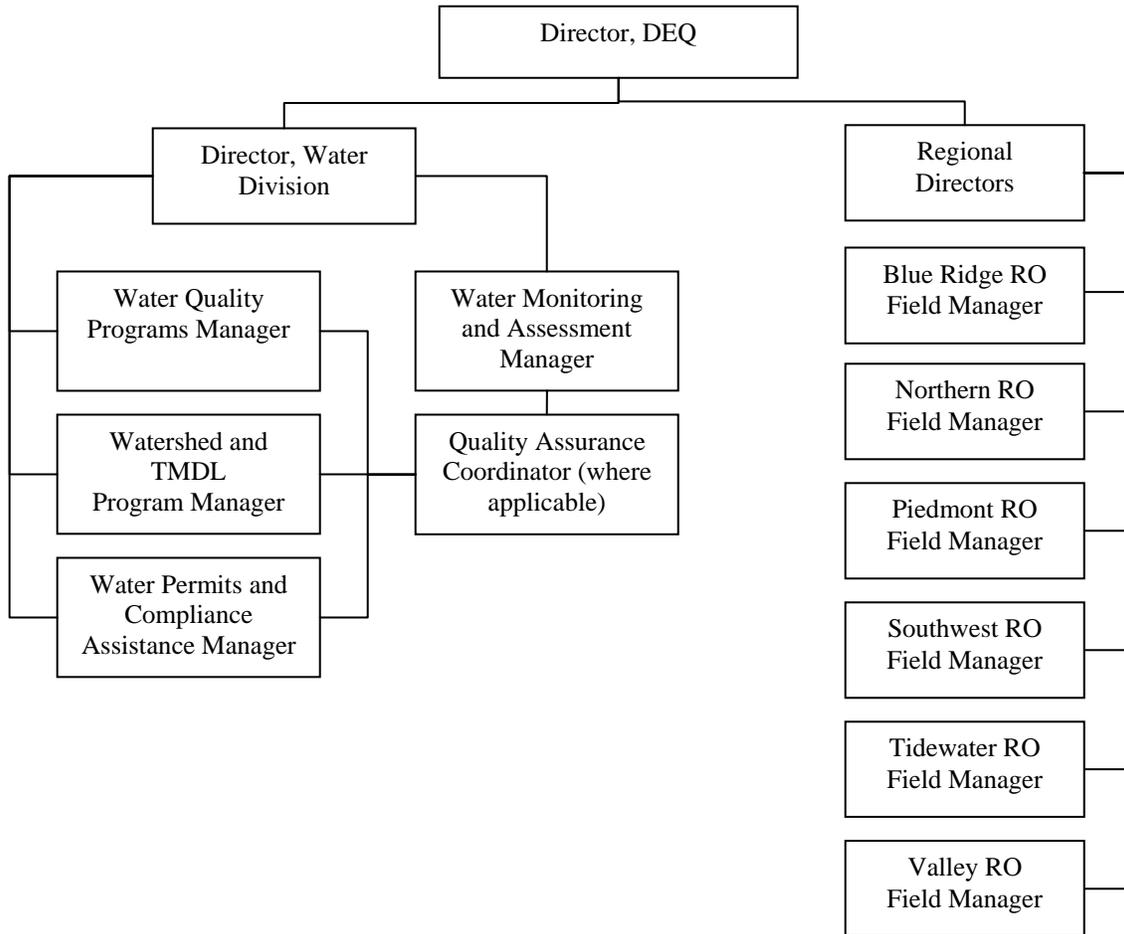
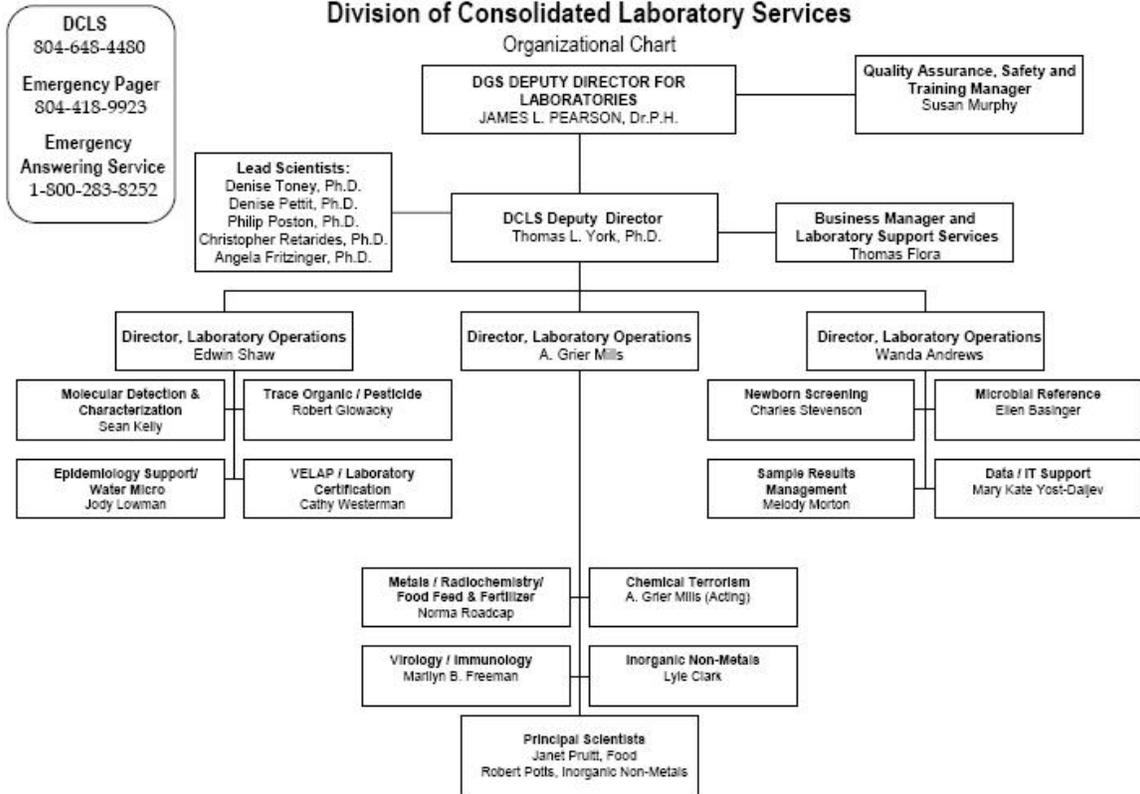


Figure 2 DCLS ORGANIZATION CHART -2010
Division of Consolidated Laboratory Services



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2.0 QUALITY SYSTEM COMPONENTS

The VADEQ WD requires the following:

- a) Each special study project generating environmental data will develop and implement a QAPP that addresses the required major elements and will ensure that adequate resources (both monetary and staff) are provided to support the QA effort. The QA project plan will specify the detailed procedures required to assure quality data. The program QA Officers must approve QA project plans prior to data collection.
- b) All environmental data generated for the water quality monitoring program will be of known and acceptable quality as defined in the data quality objectives. The data quality information developed with all environmental data will be documented and available.
- c) All EPA and state funded environmental data collection efforts will ensure that acceptable QA requirements are included and implemented.
- d) The intended use of the data is defined before the data collection effort begins, so that appropriate QA measures may be applied to ensure a level of data quality commensurate with the monitoring objectives. The determination of this level of data quality shall also consider the prospective data needs of secondary users. Data quality objectives are established to ensure the utility of monitoring data meets its intended uses and as guidance for preparation of QA project plans. The intended data uses, level of quality, specific QA activities, and data acceptance criteria needed to meet the data quality needs of these uses is described in each monitoring activity's QAPP.
- e) Quality assurance activities are designed in the most cost-effective fashion possible without compromising data quality objectives.

2.1 Principle components and tools of the quality management system

The primary QA planning and implementation components include a QMP, establishment of data quality objectives, QAPP, SOP and QA status reports. The components are listed below. Section 8 of this document discusses in detail staff responsibilities for the development of each component. Section 9 of this document covers the tools required for their implementation.

2.1.1 Quality Management Plan (QMP)

The VADEQ WD QMP describes policies, procedures, and systems governing program specific data collection activities. It serves as the general document for QA operations. The QMP will be reviewed annually and revised as necessary.

2.1.2 Data Quality Objectives

Data Quality Objectives (DQOs) are statements of the quality of environmental data required to support program decisions or actions. DQOs establish the level of risk or uncertainty that the

program is willing to accept in the environmental data in order to make a defensible decision. The VADEQ Quality Assurance Coordinator uses EPA QA/G-4 “guidance for the Data Quality Objectives process” when developing DQOs and is submitted to WD management for review and approval. DQOs are updated as needed to reflect changes in environmental policies as defined by management. DQOs for the water quality monitoring program are intended to accomplish the following: 1) Clarify the project objectives, 2) Define the most appropriate types of data to collect, 3) Determine the most appropriate conditions under which to collect the data, and 4) Specify the level of uncertainty that is acceptable as the basis for establishing the quantity and quality of data needed.

2.1.3 Quality Assurance Project Plans

Effective management of a data collection program requires periodic assessment of the quality of the data being obtained to establish a basis to determine when and if corrective action may be needed. To ensure that this assessment occurs, all environmental monitoring planned or conducted within the WD shall have an associated QAPP.

The QAPP shall ensure that:

- a) The level of data quality needed is determined and stated prior to data collection;
- b) All environmental data generated and processed will reflect the quality and integrity established by the QAPP.

The program QA Officers shall notify the Project Managers immediately of any problem areas identified. The QA Officers will jointly outline necessary changes and Project Managers will institute the corrective actions. The program QA Officers will conduct a follow-up review of the required changes. Project managers verify that the identified problems have been corrected.

The project plan is used as a guidance document for Project Managers, who are responsible for the development of QAPPs for all special studies, investigations, and intensive surveys conducted by VADEQ. Any project plans which are developed externally or internally will follow the “EPA Requirements for Quality Assurance Project Plans for Environmental Data Operations, EPA QA/R-5” guidance document and submit them to the program QA Officers for approval prior to initiation of data collection activities. The office of WMA has developed an example template that follows the EPA Requirements for Quality Assurance Project Plans for Environmental Data Operations, EPA QA/R-5 format to aid staff and external organizations in the project plan development and review process.

The QA Officers review and approve submitted QAPPs in the context of the program’s DQOs. Reviews shall follow the QAPP review checklist listed in the “EPA Requirements for Quality Assurance Project Plans for Environmental Data Operations, EPA QA/R-5” guidance document.

Project managers will update project plans for special studies as needed and resubmit the plans to the program QA Officers for review and approval. The Program QA Officers will review WD

project plan annually and update the document as necessary. Updates will be reviewed by a panel consisting of monitoring staff and managers and approved by the Program Managers.

2.1.4 Standard Operating Procedures

The use of Standard Operating Procedures (SOPs) in the WD serves as a mechanism to ensure comparability across programs environmental data collection projects. WD SOPs are incorporated into the WD QAPP and maintained by program QA Officers.

SOPs detail the work processes conducted or followed within the program. The SOPs document the way activities are to be performed to facilitate consistent conformance to technical and quality system requirements and to support data quality. SOPs are intended to be specific to the program whose activities are described and assist the program to maintain its QA/QC processes.

The best written SOPs will fail if not followed. Therefore, the use of SOPs needs to be reviewed and reinforced by the monitoring staff managers. Current copies of SOPs also need to be readily accessible for reference in the work area of those individuals actually performing the activity, either in hard copy or electronic format. To ensure availability, SOPs are available on DEQnet; an internal webpage designed to provide all the necessary documents required by VADEQ staff to conduct their daily operations.

SOPs need to remain current. Whenever field procedures or analytical requirements are changed, the SOPs should be updated, reviewed and re-approved as soon as possible rather than waiting for an annual review. Changes or modifications may be made only to the pertinent section of a SOP, but the process must indicate the changed date and/or revision number in the document control notation.

It is the responsibility of the program QA Officers to ensure that WD program policies and procedures are current and any changes communicated to the program staff to implement in their environmental data operations. SOPs undergo annual review to ensure any procedures not updated to reflect changes in field procedures or analytical requirements are brought up to date.

2.1.5 Quality Assurance (QA) Status Reports

The WD QAPP for data collection will include the frequency, content and format of the required QA status reports. The Quality Assurance Coordinator or program QA Officers, submit QA status reports to the regional Program Managers and used to help track QA progress. Whenever possible, status reports will be produced quarterly and will address the following elements if applicable:

- 1) Changes that occurred in program activities (sampling, QC control measures, analytical methods).
- 2) A summary of performance and system audits as they apply.
- 3) Any corrective actions taken.
- 4) Any organizational changes.

- 5) Reports of the assessment of data quality indicators (precision, accuracy, completeness, representativeness and comparability).

3.0 PERSONNEL QUALIFICATION AND TRAINING

3.1 Training Policy

All VADEQ personnel associated with Water Quality Monitoring and DCLS personnel who generate data must have adequate knowledge and skills in their technical specialties and applicable quality assurance practices to ensure quality data is generated.

The VADEQ WD has developed and implemented a program of internal training to ensure staff has the appropriate knowledge and skills to perform their assigned responsibilities.

3.2 Training Qualifications and Documentation

Entry level training is provided for new employees to ensure quality-related qualifications in field methods (such as instrument operation, approved sample collection, preservation, handling, field testing, quality assurance procedures) and in computer skills such as station establishment, sample scheduling and data entry and retrieval by Central Office personnel. Training in field methods is provided by the Quality Assurance Coordinator or designee and experienced regional personnel. A team of qualified personnel provides training in computer skills and all training documentation is retained in the office of training.

In addition, the WD requires staff to undergo periodic training and recertification WD program's SOP. New hires must successfully complete the training modules before they collect chain of custody samples and no later than 12 months after their date of hire. After successfully completing the SOP training, field personnel are required to pass a retest, and take a refresher class if needed, every two years thereafter. Any existing staff person who does not successfully complete the training must discontinue collecting water quality samples and be retrained and retested until they can successfully complete the testing.

New hires that do not successfully complete the training are paired with a mentor until they can successfully complete the testing. The training course consists of a combination of a repeatable video format and hands-on training. The course content includes training on all aspects of the WD SOP as well as the use of the water monitoring module of the agency database (CEDDS) and chain of custody procedures.

3.3 Continued Proficiency

To ensure continued proficiency in QA/QC procedures an annual field audit of all field sampling staff is conducted by the agency Quality Assurance Coordinator or designee qualified to perform audit tasks. The aforementioned certification program will require re-certification in field methods every 2 years.

3.4 Laboratory Personnel Training

A written position description for each job in the laboratory is kept on record within the laboratory division. The position descriptions include the knowledge, skills, abilities and duties required of the position. A performance plan is prepared annually for each employee and their performance is evaluated by one interim and one final evaluation. Training is conducted at the division and group level. Performance evaluation samples are routinely used to determine proficiency in an area. It is the responsibility of the group manager to ensure orientation and rotation of workstation schedules. The division maintains a training record documenting each employee's credentials regarding education, seminars, workshops and on-site training. In order to assure competency and the ability to work independently, each employee is required to demonstrate completion of the following requirements:

- 1) Instruction in or prior knowledge of sample preparation, analysis and instrumentation principal associated with the method.
- 2) Instruction on the principles of laboratory safety associated with the method including review of associated MSDS forms.
- 3) Has read and understands the methods and SOPs associated with the analyses.
- 4) Instruction in or has prior knowledge of the instrument for the method.
- 5) Demonstrated performance of the method under the direct supervision of the trainer.
- 6) Instruction in or has prior knowledge of instrument and computer maintenance.
- 7) Independent successful completion of demonstration of capability.
- 8) Independent analysis of three sets of samples.

4.0 PROCUREMENT OF ITEMS AND SERVICES

4.1 Quality System Requirement for Items:

Conducting sufficient planning activities ensures purchased items meet predefined standards and specifications for quality. Technical staff directly involved in the use of the items will decide if items meet the necessary quality standards required to generate quality data unless a specific quality standard is specified in a regulatory document such as an analytical method. Standard and specifications, if not predefined, are developed in the planning process and included in the program QAPP. Upon receipt of purchased items, the monitoring staff inspects each item for adherence to the specifications required by the program QAPP. Specific guidance is available in the program SOPs. The program QA Officer monitors and summarizes QC data to relay to Program Managers the effectiveness of the item to provide data consistency and exclude external contamination. Data summaries are provided to the Program Managers for review.

4.2 Quality System Requirements for Services

VADEQ personnel conduct all services related to water quality monitoring activities in-house.

5.0 DOCUMENTS AND RECORDS

5.1 Identification of quality-related documents and Records

Quality-related documents and records consist of QMP, QAPPs and SOPs and in the regional offices, field data sheets, and calibration/maintenance logbooks. All monitoring staff has access to these documents and records.

Organized and well-maintained files are critical to the proper functioning of programs within the Water Division.

5.2 Maintenance of Records

Each program QA Officer is responsible to ensure the program's QMP, QAPP, SOP and other specific quality practices are stored in the Oracle database and made available to outside interested parties through VADEQ's FTP site. Each regional office Program Manager is responsible for developing a master document log in order to maintain a comprehensive and current inventory of the program related field records. The DCLS QA Officer is responsible for the maintenance of laboratory QA documents as specified in their Project Plan.

All the documents and records are archived in a safe and secure place and special care is taken to preserve the integrity of documents. Currently, the regional offices enter field data into VADEQ's central database, CEDS, where the data is secure and retrievable. Regional offices keep all hardcopies of field data sheets, calibration and equipment maintenance log sheets on file for seven years after which the regions dispose of the records.

Plans are underway to modify the Oracle database to capture calibration and instrument maintenance. Once the database modification is complete, the regions will dispose of hardcopies of calibration and instrument maintenance every seven years as well. The Quality Assurance Coordinator will review the QMP, QAPPs and SOPs annually. Revisions to remove obsolete practices and include new field techniques are made as needed and reviewed by a committee consisting of key WQM staff from the central office and regional field offices. Final approval of the Quality Control documents is the responsibility of the Director of the Water Division. Each new QA document is clearly identified with revision date and version identification. The current document is then issued to all regional water quality monitoring managers for distribution to field personnel who should dispose of all previous versions. To ensure documentation of historical water quality monitoring practices, a copy of all documents are stored and available to VADEQ personnel via the CEDS database.

Because routine samples collected for the WMA are not utilized for legal purposes, formal chain of custody procedures is not necessary. However, samples must meet specific criteria as outlined in the DCLS QAPP in order to be analyzed. DCLS sample and record management personnel reject samples not meeting those criteria. Samples requiring chain of custody follow procedures outlined in the WMA SOP manual.

6.0 COMPUTER HARDWARE AND SOFTWARE

The exchange of data between the regional offices, central office, DCLS and other laboratories, and the EPA is vital to many of VADEQ's missions. VADEQ utilizes a Comprehensive Environmental Data System (CEDS) which was designed to store all the data generated by the agency. The CEDS database was designed to have a unique module for each of the environmental media monitored by the agency. Teams were selected from each media to work with developers to ensure their module was designed to meet core business needs. CEDS is on an Oracle base dual client server system allowing complete backup of the system at all times and seamless transition from one server to the other in case one system fails. The Oracle database is compatible with the DCLS Laboratory Identification Management System (LIMS) and EPA STORET and the new WQX database enabling better connectivity with those entities.

The Office of Information Systems (OIS) is responsible for managing VADEQ's technology infrastructure and components. All information management system development, improvements, and updates are submitted to a CEDS steering committee consisting of VADEQ personnel from each media who generate and utilize the data. The tasks are prioritized and given to OIS for implementation. Prior to implementing changes in the production database, it is thoroughly tested by groups picked from the respective media to ensure changes perform as expected and meet the user requirements.

To ensure compatibility with existing programs, OIS staff review and install all software and hardware purchases within the agency.

VADEQ's data standards and regulations vary within water quality monitoring programs, some of which receive funding from federal grants. Every water quality monitoring program is required to have a QAPP specifying their specific standards and regulations. However, a Quality Assurance module has been included in the CEDS system including station and parameter specific range checks, high and low acceptance criteria for data entry screens and inter-parameter checks. Error reports are readily available to all data users for review.

7.0 PLANNING

7.1 Planning Goals and Objectives

As outlined in the 2007 Virginia Water Quality Monitoring Strategy, the goal of the strategy is to “provide representative data that will permit the evaluation, restoration and protection of the quality of the Commonwealth’s waters at a level consistent with such multiple uses as prescribed by Federal and State laws.” The planning objective of the WQM is to ensure sufficient quantities of quality data are collected to support the use of the data. The planning process is intended to document all activities related to the generation, analysis, and use of data.

7.2 Identification of Data Users and Suppliers

VADEQ water quality monitoring program data users include: environmental assessment planners and managers, EPA, regulated facilities and other external groups. Data suppliers include sampling groups (such as citizen monitoring groups), environmental agencies, contract laboratories as well as other external data generators.

7.3 Scheduling and Resources

Each regional office submits annual monitoring plans based on VADEQ’s water quality monitoring strategy. The current monitoring strategy, revised in 2007, will undergo scheduled reviews in the future and be further revised as needed. Each region is responsible for identifying the available resources and ensuring those resources are utilized in the most efficient manner to meet VADEQ’s monitoring strategy goals.

7.4 Performance Criteria

The WQM planning process specifies the performance criteria for measuring quality. Data obtained from WQM programs is assessed, verified and qualified according to its intended use. Criteria or measures should include:

- 1) The objective for measurement data in terms of precision, accuracy, completeness, comparability and representativeness,
- 2) Data quality assessments,
- 3) Validation/verification of results, and
- 4) Documentation establishing the requirements for those objectives.

7.5 QA/QC activities

The WQM planning process specifies which QA and QC activities are necessary to assess the quality performance criteria (e.g. QC samples for the field and laboratory, audits, technical assessments, and performance evaluations etc.). Key variables that determine or directly affect

the quality of results are identified and controlled according to the specifications determined during the planning or design process.

7.6 External Data

The VADEQ must also coordinate the collection and use of environmentally related data across numerous government agencies, contractors, academic and private organizations and trained volunteers. Close coordination and planning is essential to ensure that the data are of sufficient quality to support the intended use. The VADEQ encourages data sharing whenever possible, providing adequate data quality indicators are available so that quality of data are sufficiently known to support the applicable decisions.

7.7 Analysis, Evaluation and Assessment of Data

The WQM QAPP serves as the basis for the analysis, evaluation, assessment against the intended use, and quality performance criteria of acquired data. Data not meeting the criteria as specified in the project plan is flagged in the database.

7.8 QAPP reviewing, approving, and revising

Any WQM project (including special studies) involving the collection of environmental samples by VADEQ personnel or external organizations, is required to have an approved QAPP prior to collection and analysis of any samples. QAPPs are reviewed and approved by the program QA Officer and QA Coordinator. The VADEQ WQM QAPP will be reviewed annually, updated if needed or revised within 30 days of significant changes.

8.0 IMPLEMENTATION OF WORK PROCESSES

8.1 Operating Policies and Procedures

The WD has developed and uses the appropriate policy and procedures as needed for its programs. The QAPP and SOP for water quality monitoring are documented in writing and are accessible to all persons involved in the implementation of the program. DCLS has also developed its analytical method manual.

Where the program uses data generated by external entities, the external data undergoes the same evaluation and documentation procedure, as would WD program data before it is used by the WD. This ensures that data fit within the margins of error constraints as established by the VADEQ program management.

8.2 Program Implementation

Program data operations are implemented in accordance with an approved QAPP. Changes to the QAPP are documented and approved in writing through an amended QAPP. The QAPP may be revised as necessary or revised and reissued within 30 days of significant changes, whichever occurs first. The latest approved version of the QAPP will remain in effect until a revised version has been approved.

The Program Managers oversee the program. Program Managers work in conjunction with program QA Officer to ensure that project proceeds in the correct direction and generates the appropriate documentation.

8.3 SOP Implementation

All standardized procedures used for sampling and analytical techniques are documented in the program SOP. The SOP ensures standardization of a task for consistency in data generation across the regions. The program QA Officer, who is familiar with the procedures being described, writes the program SOPs. A panel consisting of experienced program monitoring staff and managers from central and regional offices reviews the SOPs. The Director of Water Division approves the final documents.

Personnel who perform an activity or function use procedures covered by the appropriate SOP. It is the responsibility of the regional Program Managers to ensure program SOPs are properly implemented. It is the responsibility of the individual users to follow the procedures contained in the SOP, or document any deviations. The implementation of SOPs is assessed through internal field audits.

A list of the applicable SOPs is provided in Appendix A.

8.4 Implementation of the Analytical Methods Manual

DCLS analytical personnel use the analytical methods manual to document procedures. The group managers are responsible for ensuring personnel utilize approved methods as specified in the analytical method manual. Implementation of the analytical methods manual procedures are ensured through blind performance evaluation samples and a NELAC accrediting entity.

Under Virginia Administrative Code [§ 2.2-1105](#), Virginia has implemented a NELAC type laboratory accreditation program with DCLS being the accrediting authority for the Commonwealth. VADEQ will no longer conduct biannual lab audits on DCLS and non-exempt laboratories. The Quality Assurance Coordinator or designee will regularly conduct audits of laboratories exempt from DCLS accreditation/inspection as outlined in 1 VAC 30-45-30 who submit water quality data to VADEQ. This will ensure data submitted by such a laboratory meets DQOs for the WD program which utilizes the data.

9.0 ASSESSMENT AND RESPONSE

This section of the QMP describes how the VADEQ OWP will assess the effectiveness of its quality management system by using a variety of technical reviews and performance evaluations and QA audits to make sure that the procedures in this QMP are implemented successfully.

9.1 Review of VADEQ Quality Assurance Program

The program QA Officer will conduct internal assessments of their respective program Quality Assurance program every two years. The evaluations are submitted to the regional Program Managers in a written memo. The reviews are intended to accomplish the following objectives:

- 1) Identify any data quality problems.
- 2) Propose recommendations for resolving quality problems and confirm implementation and effectiveness of any recommended corrective actions.

Assessment personnel are knowledgeable in all areas of water quality monitoring and independent from regional personnel to avoid conflict of interest. Assessment personnel attend training seminars, workshops and forums to maintain assessment proficiency. Assessment personnel will have access to all Program Managers, records, and documents pertaining to water quality monitoring. Assessment personnel have the authority to modify the database for QA purposes.

All assessment summaries are given to the regional Program Managers for their review. The regional Program Managers will prepare a written response to the reviewer's memo. If the program QA Officer recommends corrective actions, the regional Program Managers should address those recommendations within 30 days and include a schedule for making any appropriate changes in its quality assurance procedures. Once the corrective actions are implemented, the program QA Officer will document the effectiveness of the corrective actions; either requesting further action or indicating the problem has been resolved.

If a regional Program Manager disagrees with the program Quality Assurance Officer's findings and recommendations, a panel of regional monitoring personnel familiar with the issues will be assembled to resolve the issue. Should the panel be unable to conclude the issue, the WD Director from central office will be asked to arbitrate a resolution.

9.2 Technical Systems Audits (TSAs)

A TSA assesses the sampling and analytical quality control procedures used to generate environmental data. The program QA Officer will use TSAs to evaluate the procedures used by field monitoring staff and laboratory contractors. TSAs may entail a comprehensive on site evaluation of field equipment and laboratory instrument calibration; record keeping procedures; and data validation, data management and reporting.

9.2.1 Laboratory TSAs

DCLS has instituted a separate division to conduct TSA of environmental laboratories using procedures outlined by NELAC. VADEQ will no longer conduct TSA of DCLS laboratories and most contacted laboratories who submit data to the agency. DCLS will conduct TSAs of non-exempt laboratories who submit analytical data to VADEQ every two years, or as needed.

Citizen monitoring and related laboratories exempt from the DCLS inspection (1 VAC 30-45-30) and who submit water quality data to VADEQ are inspected by VADEQ once every two years, or as needed. The primary goals of TSAs are to review the laboratory organization, operation and capabilities, determine the reliability of the data and note corrective action for any apparent deficiencies. The program QA Officer is responsible for planning and conducting the audits and reporting the findings to the laboratory directors and VADEQ Program Managers.

9.2.2 Field TSAs

Oversight of field operations is an important part of the quality assurance process, and the program QA Officer conducts QA audits of field sample activities, both for its own field operations and its contractors. Field TSAs are conducted for each regional office annually and the findings reported to the regional Program Managers.

9.2.3 Performance Evaluations

Performance evaluations are conducted to assess the ability of a laboratory or field measurement system to obtain reliable data. The evaluation consists of providing a reference or “blind” sample to the laboratory for analysis. The performance evaluation sample contains known concentrations of chemical constituents or pollutants of interest, normally found in the appropriate media. The analytical results obtained by the laboratory are compared to the known concentrations of the specific parameters contained in the performance samples to determine if the laboratory demonstrated its ability to properly identify and quantify pollutants within established or calculated control limits.

9.3 Data Quality Evaluations

9.3.1 Data Quality assessments

A Data Quality assessment (DQA) is a statistical process used to determine whether the quality of a given data set is adequate for its intended use. The program QA Officers routinely review and validate data generated by DCLS and other contracted laboratories. These data validation activities use checklists, standard operating procedures and standardized qualification codes to determine data quality. The use of checklists and SOPs help standardize the data validation process and minimize any discrepancy that may result between data validators within WD and DCLS laboratory personnel. The data quality assessment SOP and checklist are listed in Appendix B.

9.3.2 Data Completeness

A data quality audit assessment primarily involves a completeness check of the generation of field and analytical data. The VADEQ Oracle database automatically checks data entry for field results and laboratory results for parameter completeness. Incomplete field data is allowed into the database as instrument failures can occur resulting in missing field parameters. The database generates an error report that is then reviewed by central office personnel. Incomplete analytical results are also allowed into the database, as analytical results are batch uploaded. The Laboratory Liaison is responsible for reviewing the report for the missing analytical results and for contacting either OIS to determine the cause of the problem or the DCLS for data corrections.

10.0 QUALITY IMPROVEMENT

The OWP actively supports quality improvement by encouraging the both VADEQ staff and DCLS laboratory staff to:

- 1) Continually evaluate the effectiveness of current procedures and practices.
- 2) Apply innovative approaches to maintaining integrity and accuracy.

The above goals can be achieved by committing resources to the quality management system to enable the constant evaluation of the water quality monitoring program and individual staff performance. The quality management system is designed to identify opportunities for improving the measurement process. Improvement can take the form of preventing quality problems from occurring by adjusting current work processes or by seeking out better ways to do the work. The goal is to prevent quality problems from occurring or recurring. Every attempt is made to ensure quality assurance problems are identified and resolved quickly by encouraging open communication between field personnel and central office personnel as well as laboratory personnel and associated quality assurance officers.

The program QA Officers is responsible for coordinating and evaluating water quality monitoring program quality improvement activities.

The program QA Officers and regional Program Managers annually review all the QA activities of field staff, e.g. reviewing SOPs for adequacy and revising them if necessary. All deviations and discrepancies noted during the assessment review are corrected promptly.

APPENDIX

Appendix A List of SOP title and their locations

SOP title	Location
VADEQ Ambient Water Quality Monitoring QAPP	Central database, CEDS
VADEQ WQM SOP	Central database, CEDS
QAPP for the VA River Input Monitoring Program	www.chesapeakebay.net
QAPP for Chesapeake bay mainstem and Elizabeth River Water Quality Monitoring Program	www.chesapeakebay.net
VA Tributary Monitoring Program QAPP	www.chesapeakebay.net
VA CBP Non-tidal Network Monitoring Program QAPP	www.chesapeakebay.net
Acidity in water	DCLS building , room 327
Alkalinity in water	DCLS building , room 327
Anions- Ion Chromatography	DCLS building , room 327
Biochemical Oxygen Demand	DCLS building , room 327
Particulate Nitrogen/Carbon	DCLS building , room 327
Chlorophyll	DCLS building , room 327
Color	DCLS building , room 327
Free Cyanide	DCLS building , room 327
Total Cyanide	DCLS building , room 327
Cyanides – amenable to Chlorination	DCLS building , room 327
Fluoride	DCLS building , room 327
Calcium Hardness	DCLS building , room 327
Total Hardness	DCLS building , room 327
Nitrogen - Ammonia	DCLS building , room 327
Nitrogen - Nitrite and Nitrate	DCLS building , room 327
Nitrogen – Total Kjeldahl	DCLS building , room 327
Oil and Grease	DCLS building , room 327
Total Organic Carbon	DCLS building , room 327
Particle size	DCLS building , room 327
PH	DCLS building , room 327
Total Phenols	DCLS building , room 327
Particulate Phosphorus	DCLS building , room 327
Total Phosphorus	DCLS building , room 327
Silica	DCLS building , room 327
Total Suspended Solids	DCLS building , room 327
Total Dissolved Solids	DCLS building , room 327
Settleable Solids	DCLS building , room 327
Total Solids	DCLS building , room 327
Sulfide	DCLS building , room 327
Tannin and Lignin	DCLS building , room 327
Turbidity	DCLS building , room 327
Reactivity	DCLS building , room 327
Nitrogen- Urea	DCLS building , room 327
Sediment TOC	DCLS building , room 327
Acid Volatile Sulfide	DCLS building , room 327
Suspended Sediment	DCLS building , room 327

SOP title	Location
Cations – Ion Chromatograph	DCLS building , room 327
Total Nitrogen	DCLS building , room 327
Particulate Inorganic Carbon	DCLS building , room 327
Particulate Inorganic Phosphorus	DCLS building , room 327
Extractable Organic in Soils	DCLS building , room 368
Accelerated Solvent Extraction	DCLS building , room 368
Gel Permeation Chromatography Cleanup	DCLS building , room 368
Semi-Volatile Organics by GC/MS	DCLS building , room 368
Chlorinated Herbicides by GC/MS	DCLS building , room 368
Organophosphorus Compounds by GC	DCLS building , room 368
Polychlorinated Biphenyls by GC	DCLS building , room 368
Organochlorinated Pesticides by GC	DCLS building , room 368
Preparation of Sediments, Sludges, and Oils by Microwave Assisted Acid Digestion	DCLS building , room 357A
Digestion of Water	DCLS building , room 357A
Determination of Trace Metals in Waters by Flame AA	DCLS building , room 357A
Mercury by Cold Vapor Flameless AA	DCLS building , room 357A
Determination of Trace Metals in water by ICP/MS	DCLS building , room 357A
Determination of Trace Metals in Sediment by ICP/MS	DCLS building , room 357A
Mercury in Water by Cold Vapor Atomic Fluorescence Spectroscopy	DCLS building , room 357A
The Analysis of Trace Metals Concentrations of As, Se, Sb in ambient water, Salt Water, and Wastewater Samples by Hydride Generation and Atomic Absorption Detection Using Clean Techniques	DCLS building , room 357A
The Analysis of Trace Metals Concentrations of Al, Cd, Cu, Mn, Ni, Pb, and Zn in Salt Water, and Wastewater Using Ion Extraction Matrix Separation with ICP-MS Detection and Utilizing Clean Techniques	DCLS building , room 357A
Fecal Coliform MPN	DCLS building , room 231
Fecal Coliform by Membrane Filtration	DCLS building , room 231
Enterococci by Membrane Filtration	DCLS building , room 231
E. Coli by Membrane Filtration	DCLS building , room 231

Appendix B Data Quality Assessment SOP and Checklist

Any time data are generated, their quality must be assessed prior to use. The type and degree of assessment required depends upon the project DQOs. Several different levels of data assessment exist, including data verification, data qualification/review, data evaluation, and data validation.

Data verification: data verification is confirmation by examination and provision of objective evidence that specified requirements have been fulfilled. Data verification is the process of evaluating the completeness, correctness and conformance/compliance of a specific data set against the method, procedural, or contractual requirements.

Data review. Data review is next step in the data assessment hierarchy. Data review is the process of data assessment performed to produce the QA reports. Data review includes an assessment of summary QC data provided by the laboratory. Data review includes examination of primary and QA laboratory data, internal QC and QA sample results to ascertain the effects on the primary laboratory's data. Table 1 shows more detail on the specifics of data review. Data review documents possible effects on the data that result from various QC failures. It does not determine data usability nor does it include assignment of data qualification.

- 1) The initial inspection of the data is for errors and inconsistencies. The lab personnel checks the chain of custody forms, sample-handling procedures, analyses requested, sample ID. The lab personnel then verified that the data with were checked by the Lab Manager or QA Officer. Sample holding times and preservation are checked and noted.
- 2) The next phase of data quality review is examination of the actual data. By examining data from lab matrix duplicates, blind duplicates, trip blanks, equipment blanks, lab method blanks, lab control samples, matrix spike samples, matrix spike duplicate samples, surrogate and internal standard recoveries. The lab personnel can determine whether the data are of acceptable quality.
- 3) The laboratory should provide initial calibration and continuing calibration checks to the data user. The lab performs a continuing calibration check standard daily to verify the calibration curve. One or more compounds may fail the continuing calibration check standards, but if the majority is within allowable limits, the calibration is considered good. The compounds that fail the continuing calibration check standards are flagged accordingly and their results considered estimated.
- 4) Both laboratory control samples (LCSs) and matrix duplicates are examined during data review. The precision of the data is quantified by the RPD between two results obtained for the sample. The sample may be either internal lab QC samples or field samples. A high RPD in an LCS/LCSD pair is an indication of overall method failure, and may result in the rejection of entire data set. Lab matrix spike and matrix spike duplicate are also assessed by their RPD values. High RPD values indicate a lack of reproducibility, and such data may be qualified or rejected. Any such results should be noted in the assessment of data quality.

- 5) Data from blank samples are examined to determine if sample contamination occurred either during or after sample collection. Equipment or rinsate blanks consist of reagent water pass through or over sampling equipment following sample collection and sample equipment decontamination. Contaminated equipment blanks indicate inadequate decontamination between samples and strong likelihood of cross contamination between samples. Method blanks are blank samples prepared in the lab and analyzed along with project samples. If analytes are detected in a method blank, it is a strong indication of laboratory contamination. This would raise the possibility that project sample aliquots were contaminated in the lab as well. Trip blanks are samples of pure water that accompany the project samples from the field to the lab. Trip blanks accompany each shipment of water samples to be analyzed for volatile organic compounds. Analyses of trip blanks indicate whether sample contamination occurred during shipment and/or storage.
- 6) Surrogate recoveries are scrutinized to ensure they fall within an acceptable range. Adequate surrogate recoveries in QC samples indicate that sample extraction procedures were effective, and that overall instrument procedures were acceptable. Surrogate recoveries in field samples are a measurement of possible matrix effects can indicate complete digestion or extraction of a sample. Surrogate recoveries outside control limits may result in qualified or rejected data.
- 7) A LCS is an aliquot of a clean matrix (i.e. clean water or sand) which contains a known quality of an analyte. Good recoveries from an LCS indicate that analytical methods are in control and that the laboratory is capable of generating acceptable data. The evaluation of possible matrix effects and accuracy of the data are monitored by analysis of MS/MSD samples. A MS sample is prepared by adding a known quality of an analyte to a field sample. The MSD is prepared in an identical manner. MS/MSD should be analyzed at least once per every twenty five samples, or one per preparation batch, whichever is greater. Recovery of the MS indicates the matrix effects and is another measure of data accuracy. Comparison of the MS/MSD results provides an indication of data precision. All MS/MSD data should be examined. Low or high spike recoveries are evidence of matrix effects and poor accuracy; a high RPD for duplicates is evidence of low precision; all such results should be reported in the data review.
- 8) Analysis a blind duplicate QC samples provides a measure of sample homogeneity and intra-laboratory variations. An additional replicate sample is provided to an independent QA laboratory, to provide a further test of sample homogeneity and a test of inter-laboratory accuracy.

Data evaluation:

Data evaluation follows data review. During data evaluation, the QA Officer uses the results of data review as summarized in the QA report to determine the usability of the data. The QA report the potential effects of QA/QC failures on the data, and the Project Manager assesses their impact on attainment of DQOs.

Data qualification:

Data assessment will result in documentation of the quality and usability of the data. Data qualification is the process of flagging analytical data (both detects and non-detects), according to a set of pre-established functional guidelines, to reflect any QC failures. The procedure includes flagging each sample to reflect any failures for the sample itself (e.g. extended holding time) and any failure of a QC sample referenced to the sample (e.g. blank contamination). Normally, the procedures used are those found in the USEPA Contract Laboratory Program National Functional Guidelines for Organic data Review and guidelines for Inorganic data Review.

Table 1 Data Validation Element

QC element	Type of failure	Possible cause	Possible effect on data
Instrument calibration records	No accurate record of instrument calibration	Missing	Incomplete data
Chain of Custody	Chain broken or not kept	Missing signatures, missing seals, missing date/times	Incomplete data
Sample labeling	Sample labels unreadable, missing or not attached to containers	Failure to protect from moisture, failure to use appropriate labels, failure to label samples	Invalidation of affected sample results
	Sample mislabeled	Sampler error	Invalidation of all sample results collected on sample run
Sample containers	Plastic container for organic analytes	Samplers unaware of requirements	False positives, false negatives, high or low bias, phthalate interference
Preservation	No preservatives or wrong pH	No preservatives added or improper amount/strength of preservative added	False negatives, low bias
	Too warm (>4°C)	Insufficient ice, shipping container inadequately insulated, samples not pre-chilled prior to shipping, transit time too long	False negatives, high or low bias
Holding time	Holding times exceeded	Excessive analysis time, tardy ship date, inappropriate shipping method	False negatives, high or low bias
Detection limit (DL)	DL too high	Insufficient measures to combat interference, insufficient sample, high dilution factor, wrong or inappropriate method	False negatives, low sensitivity
Equipment blank	Contamination > DL	Improper decontamination of field sampling equipment., contaminated rinsate water, containers, or preservatives	False positives, high bias
Trip blank	Contamination > DL	Cross contamination during sample shipping or storage, contaminated reagent water, glassware, or preservatives	False positives, high bias
Method blank (MB)	Contamination > DL	Contaminated reagents, gases, glassware, ambient contamination, poor lab technique	False positives, high bias
Field QC sample	Field and QC sample concentrations do not compare within acceptable limits	Sample inhomogeneity, insufficient mixing in the field or lab, sample do not split but collocated.	Non-representative sample, poor precision (high or low bias)
	QA sample results do not agree with project and/or QC sample results	Improper SOP, inadequate cleanup, inadequate background correction, ;an contamination, preservative problem, sample misidentification, method failure, sample inhomogeneity , etc.	Various
Surrogate in samples	Low recoveries	Matrix effects, inappropriate method, method failure, improper spiking, degraded spiking solution, failed spiking device.	False negatives, low bias
	High recoveries	Matrix effects, inappropriate method, method failure, improper spiking, degraded spiking solution, failed spiking device, contaminated reagents, glassware etc.	High bias, false positives

QC element	Type of failure	Possible cause	Possible effect on data
Lab control sample / duplicate (LCS/LCSD)	Low recoveries	Method failure, improper spiking, degraded spiking solution, failed spiking device	False negatives, low bias
	High recoveries	Method failure, improper spiking, degraded spiking solution, failed spiking device, contaminated reagents, glassware etc.	High bias, possible false positives
	High RPDs	Method failure, improper spiking, failed spiking device, contaminated reagents, glassware etc.	Poor precision (high variability)
Surrogates in MB,LCS and LCSD	Low recoveries	Method failure, improper spiking, degraded spiking solution, failed spiking device	False negatives, low bias
	High recoveries	Method failure, improper spiking, degraded spiking solution, failed spiking device, contaminated reagents, glassware etc.	High bias, possible false positives
Matrix spike / duplicate (MS/MSD)	Low recoveries	Matrix effects, inappropriate method, method failure, inadequate cleanup, inadequate background correction, fail to use method of standard additions, improper spiking, and degraded spiking solution, failed spiking device.	False negatives, low bias
	High recoveries	Matrix effects, inappropriate method, method failure, inadequate cleanup, inadequate background correction, fail to use method of standard additions, improper spiking, and degraded spiking solution, failed spiking device, contaminated reagents, glassware etc.	High bias, false positives
	High RPDs	Sample inhomogeneity, inadequate sample mixing in the lab, sample misidentified, method failure, improper spiking, and degraded spiking solution, failed spiking device, contaminated reagents, glassware etc.	Non-representative sample, poor precision (high variability)