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Standard Practice for Generation of Environmental Data Related to Waste Management Activities: Quality Assurance and Quality Control Planning and Implementation[1]

This standard is issued under the fixed designation D5283; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

1. Scope

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

1.2 This practice defines the criteria that must be considered to assure the quality of the field and analytical aspects of environmental data generation activities. Environmental data include, but are not limited to, the results from analyses of samples of air, soil, water, biota, waste, or any combinations thereof.

1.3 DQOs should be adopted prior to application of this practice. Data generated in accordance with this practice are subject to a final assessment to determine whether the DQOs were met. For example, many screening activities do not require all of the mandatory quality assurance (QA) and quality control (QC) steps found in this practice to generate data adequate to meet the project DQOs. 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 practice presents extensive management requirements designed to ensure high-quality environmental 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 practice.

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.*

NOTE 1—A complete table of contents of this practice is given in Appendix X1.

2. Referenced Documents

2.1 *ASTM Standards:*[2]

D1129 Terminology Relating to Water

E1187 Terminology Relating to Conformity Assessment (Withdrawn 2006)[3]

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

SW-846, *Test Methods for Evaluating Solid Waste*, Vol 1, Third Edition (NTIS No. PB88239223/LL), November 1986

QAMS-005/80 (NTIS No. PB83170514/LL), *Interim Guidelines and Specifications for Preparing Quality Assurance Project Plans*, Office of Monitoring Systems and Quality Assurance, December 29, 1980

EPA/QAMS, *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, September 20, 1980

2.3 *Other documents related to the subject matter of this practice are cited in Appendix X2. This list is not intended to be comprehensive.*

3. Terminology

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

3.2 *Definitions of Terms Specific to This Standard:*

[1] This practice is under the jurisdiction of ASTM Committee D34 on Waste Management and is the direct responsibility of Subcommittee D34.01.01 on Planning for Sampling.

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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 Superintendent of Documents, Government Printing Office, Washington, DC 20402.

3.2.1 *background sample*—a sample taken from a location on or proximate to the site of interest and used 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 EPA/QAMS, July 16, 1986).

3.2.4 *environmental data generation activity*— tasks associated with the production of environmental data, including planning, sampling, and analysis.

3.2.5 *equipment rinsate (equipment blank)*—a sample of analyte-free media that has been used to rinse the sampling equipment. This blank is collected after the completion of decontamination and prior to sampling and is useful for documenting the adequate decontamination of sampling equipment.

3.2.6 *field blank*—a sample of analyte-free media similar to the sample matrix that is transferred from one vessel to another or exposed to the sampling environment at the sampling site. This blank is preserved and processed in the same manner as the associated samples and is used to document contamination in the sampling and analysis process.

3.2.7 *field duplicates*—collocated samples that are analyzed independently and are useful in documenting the precision of the sampling and analytical process.

3.2.8 *laboratory control sample*—a known matrix spiked with compound(s) representative of the target analytes and used to document laboratory performance.

3.2.9 *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 use of the construction materials.

3.2.10 *matrix duplicate*—an intralaboratory split sample used to document the precision of a procedure in a given sample matrix.

3.2.11 *matrix spike*—an aliquot of sample spiked with a known concentration of target analyte(s) and used to document the bias of an analytical process in a given sample matrix. The spiking occurs prior to sample preparation and analysis.

3.2.12 *matrix spike duplicates*—intralaboratory split samples spiked with identical concentrations of target analyte(s) and used to document the precision and bias of a procedure in a given sample matrix. The spiking occurs prior to sample preparation and analysis.

3.2.13 *method blank*—an analyte-free media, to which all reagents are added in the same volumes or proportions used in sample processing. The method blank must be carried through the complete sample preparation and analytical procedure and is used to document contamination resulting from the analytical process.

3.2.14 *project*—single or multiple data collection activities that are related through the same planning sequence.

3.2.15 *project planning documents*—all documents related to the definition of the environmental data collection activities associated with a project.

3.2.16 *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.

3.2.17 *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.

3.2.18 *reference material*—a material containing known quantities of target analytes in either solution or a homogeneous matrix and used to document the bias of the analytical process.

3.2.19 *split samples*—aliquots of sample taken from the same container and analyzed independently. These are usually taken after mixing or compositing and are used to document intra- or interlaboratory precision.

3.2.20 *standard addition*—the practice of adding a known amount of an analyte to a sample immediately prior to analysis, typically used to evaluate matrix effects.

3.2.21 *standard operating procedures (SOPs)*—the established written procedures of a given organization. Special project plans may require procedures different from the established SOPs.

3.2.22 *surrogate*—an organic compound that is similar to the target analyte(s) in chemical composition and behavior in the analytical process, but is not normally found in environmental samples.

3.2.23 *trip blank*—a sample of analyte-free media taken from the laboratory (or appropriate point of origin) to the sampling site and returned to the laboratory unopened. A trip blank is used to document the contamination attributable to shipping and field handling procedures and is also useful in documenting the contamination of volatile organics samples.

4. Summary of Practice

4.1 This practice describes the criteria and activities for field and laboratory organizations involved in generating environmental data in terms of human and physical resources, QA and QC procedures, and documentation requirements depending on the DQOs.

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 Data generation efforts involve the following: establishment of the DQOs; design of the project plan to meet the DQOs; implementation of the project plan; and assessment of the data to determine whether the DQOs have been met.

5.3 Certain minimal criteria must be met by the field and laboratory organizations generating environmental data. Additional activities may be required based on the DQOs of the data collection effort.

5.4 This practice defines the criteria for field and laboratory organizations generating environmental data and identifies some other activities that may be required based on the DQOs.

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

5.6 Environmental field operations are discussed in Section 7, and environmental laboratory operations are discussed in Section 8.

6. Project Specification

6.1 Project activities should be defined prior to the start of any field or laboratory activities. At a minimum, project specifications should address the following topics:

6.2 *Data Quality Objectives*—DQOs for the data generation activity should be defined prior to the initiation of field and laboratory work. 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 should be designed to meet the DQOs, and the project plan should define the following:

6.3.1 *Project Objectives*—Project objectives provide background information, state reasons for the data collection effort, identify any regulatory programs governing data collection, define specific objectives for each sampling location, and describe the intended uses for the data.

6.3.2 *Project Management*—A person(s) shall be 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.

6.3.3 *Sampling Requirements*—Sampling locations, equipment, and procedures and sample preservation and handling requirements shall be specified.

6.3.4 *Analytical Requirements*—The analytical procedures, analyte list, required detection limits, and required precision and bias values shall be specified. Regulatory requirements and DQOs shall be considered when developing the specifications.

NOTE 2—This does not imply that the specified analytical requirements can be met.

6.3.5 *Quality Assurance and Quality Control Requirements*—The QA and QC requirements shall address both field and laboratory activities. The means for controlling false positives and false negatives shall be specified. Standard practices for field and laboratory operations as described in Sections 7 and 8 of this practice shall be required.

6.3.5.1 *Field Quality Control*—The types and frequency of field QC samples to be collected, including field blanks, trip blanks, equipment rinsates, field duplicates, background samples, reference materials, material blanks, and split samples, shall be specified. Control parameters for field activities shall also be described (see 7.6.4).

6.3.5.2 *Laboratory Quality Control*—The types and frequency of use 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 not limited to, a statement of work, technical and cost proposals, work plan, sampling and analysis plan, quality assurance project 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 Practices for Environmental Field Operations

7.1 *Purpose*—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 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 clearly understand 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 management, 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 quality assurance program plan (QAPP).

7.2.2 *Quality Assurance Function*—The organization shall appoint a person or persons 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, as per 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. Therefore, subcontractors shall comply with the requirements of Sections 7 and 8, as 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, 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. If decontamination is to be conducted at the site, water and solvents of appropriate purity shall be available. The method of accomplishing decontamination and the materials, solvents, and water purity shall be specified in planning documents or standard operating procedures (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.

7.3.7 *Data Storage Area*—Planning documents shall specify the location of long- and short-term storage for field records. The storage environment shall be maintained to ensure the integrity of the data. Access shall be limited to authorized personnel only.

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. For common malfunctions, procedures or manuals may outline typical problems, methods of trouble-shooting, and possible corrective actions to be taken. 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. SOPs shall be available for the following areas and shall contain the information described:

7.5.1 *Sample Management*—These SOPs describe the numbering and labeling system, chain-of-custody procedures, and tracking of samples from collection to shipment or relinquishment to the laboratory. Sample management also 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 be included concerning 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, the 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 standard test methods, unless a procedure is performed exactly as described in the published test method. If possible, industry-recognized test 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 in collecting the samples,

7.5.4.4 Common problems encountered,

7.5.4.5 Precautions to be taken, and

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 generally be in accordance with manufacturers' 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. The SOPs shall address criteria from Section 8, as appropriate.

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 in correcting deficiencies, such as performing additional decontamination of equipment, resampling, or additional training of field personnel in methods procedures. The SOP shall specify that each corrective action must be documented with a description of the deficiency, the corrective action taken, and the 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.

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 retention, including type, time, security, and retrieval and disposal authorities. Records should include project-specific and field operations records.

7.5.10.1 Project-specific records relate to field work performed for a group of samples. Project records may include correspondence, chain-of-custody, field notes, all reports issued as a result of the work, project planning documents, and procedural SOPs used.

7.5.10.2 Field operations records document overall field operations. These records may include equipment performance and maintenance logs, personnel files, general field SOPs, and corrective action reports.

7.5.11 *Waste Disposal*— These SOPs describe policies and procedures for the disposal of waste materials resulting from field operations. The disposal of all wastes must conform to federal, state, and local regulations, including those associated with the Resource Conservation and Recovery Act, Superfund Act Reauthorization and Amendments, Department of Transportation, and Occupational Safety and Health Administration.

7.5.12 *Health and Safety*—These SOPs describe policies and procedures designed both to provide a safe and healthy working environment for field personnel and to comply with federal and state regulations.

7.6 *Field Quality Assurance and Quality Control Requirements:*

7.6.1 *Quality Assurance Program Plan*—The field organization shall have a written QAPP that describes the organization's QA policy. The plan shall specify the responsibilities of the field management and field staff and the QA function in the areas of QA and QC, and it shall also describe the QC procedures followed by the organization (see EPA QAMS-004/80 for an example).

7.6.2 *Quality Assurance Project Plan*—Some projects, particularly those that are large or complex, require a QAPjP. The QAPjP details the QA and QC goals and protocol for a specific data collection activity to ensure that the data generated by sampling and analysis activities are of quality commensurate with their intended use. QAPjP elements should include a discussion of the quality objectives of the project, identification of those involved in the data collection and their responsibilities and authorities, enumeration of the QC procedures to be followed, and reference to the specific SOPs that will be followed for all aspects of the project. Elements may be added or removed, as required by the project or the end-user of the data (see EPA QAMS-005/80 for an example).

7.6.3 *Control Samples*— Control samples are QC samples that are introduced into a process to monitor the performance of the system. Control samples, which may include blanks, duplicates, spikes, analytical standards, and reference materials, can be used in different phases of the overall process, beginning with sampling and continuing through transportation, storage, and analysis. The types of control samples used, and the frequency of usage, are dependent on the DQOs of the data collection effort and must be specified for each project.

7.6.4 *Procedures for Establishing Acceptance Criteria*—Procedures shall be in place for establishing acceptance criteria

for field activities, as required in the project planning documents. Acceptance criteria may be qualitative or quantitative. Field events or data that fall outside of the established acceptance criteria may indicate a problem with the sampling process that must be investigated.

7.6.5 *Deviations*—Any activity not performed in accordance with the SOPs or project planning documents is considered a deviation from the plan. Deviations from the plan may or may not affect data quality. All deviations from the plan shall be documented as to the extent of, and reason for, the deviation.

7.6.6 *Corrective Action*—Errors, deficiencies, deviations, or field events or data that fall outside the established acceptance criteria require investigation. Corrective action may be necessary to resolve the problem and restore proper functioning to the system in some instances. Investigation of the problem and any subsequent corrective action taken shall be documented.

7.6.7 *Data Handling Procedures:*

7.6.7.1 *Data Reduction*—All field measurement data are reduced according to protocol described in the appropriate SOP. Computer programs used for data reduction shall be validated before use and verified on a regular basis. All information used in the calculations shall be recorded to enable reconstruction of the final result at a later date.

7.6.7.2 *Data Review*—All data are reviewed according to SOPs to ensure that the calculations are correct and to detect transcription errors. Spot checks are performed on computer calculations to verify program validity.

7.6.7.3 *Data Reporting*—Data are reported in accordance with the requirements of the end-user.

7.7 *Quality Assurance Review:*

7.7.1 *General*—The QA review consists of internal and external assessments to ensure that both QA and QC procedures are in use and field staff conform to these procedures. Planning documents shall specify the requirements for internal, external, and on-site assessment. These documents shall specify the frequency and documentation of these assessments.

7.7.1.1 *Internal Assessment*—Personnel responsible for performing field activities are responsible for continually monitoring individual compliance with the QA and QC programs and planning documents. A QA officer or an appropriate management designee shall review the field results and findings for compliance with the QA and QC programs and planning documents. The results of this internal assessment should be reported to management with requirements for a plan to correct the observed deficiencies.

7.7.1.2 *External Assessment*—The field staff may be reviewed by personnel external to the organization. The results of the external assessment should be submitted to management with requirements for a plan to correct the observed deficiencies.

7.7.1.3 *On-Site Evaluation*—On-site evaluations may be conducted as part of both internal and external assessments. On-site evaluations may include, but are not limited to, a complete review of the facilities, staff, training, instrumentation, SOPs, methods, field analysis, sample collection, QA and QC policies, and procedures related to the generation of environmental data. Records of each evaluation shall be maintained until superseded or according to policy. These records should include the date of the evaluation, area or site, areas reviewed, person performing the evaluation, findings and problems, actions recommended and taken to resolve the problems, and scheduled date for re-inspection. Any problems identified that are likely to affect data integrity shall be brought to the attention of management immediately.

7.7.2 *Evaluation of Field Records*—The review of field records shall be conducted by one or more persons knowledgeable in the field activities, evaluating the following subjects at a minimum:

7.7.2.1 *Completeness of Field Reports*—This review ensures that all requirements for field activities in the planning documents have been fulfilled, that complete records exist for each field activity, and that the procedures specified in the planning documents have been implemented. The emphasis on field documentation will help assure sample integrity and sufficient technical information to recreate each field event. The results of this completeness check shall be documented, and environmental data affected by incomplete records shall be identified.

7.7.2.2 *Identification of Invalid Samples*—This review involves interpretation and evaluation of the field records to detect problems affecting the representativeness of environmental samples. Examples of items that could indicate invalid samples include improper well development, improperly screened wells, instability of pH or conductivity, and collection of volatiles near combustion engines. The field records shall be evaluated against planning documents and SOPs. The reviewer shall document the sample validity and identify the environmental data associated with poor or incorrect field work.

7.7.2.3 *Correlation of Field Test Data*—The results of field measurements obtained by more than one method shall be compared. For example, surface geophysics may be surveyed using both ground penetrating radar and a resistivity survey.

7.7.2.4 *Identification of Anomalous Field Test Data*—Anomalous field test data should be identified. For example, a water temperature for one well that is five degrees higher than any other well temperature in the same aquifer should be noted. The impact of anomalous field measurement results on the associated environmental data shall be evaluated.

7.7.2.5 *Validation of Field Analysis*—All data from field analysis that are generated *in situ* or from a mobile laboratory shall be validated per 8.7.2. The results of the validation shall be reported. The report shall discuss whether the QC checks meet the acceptance criteria and whether corrective actions were taken for any analysis performed when acceptance criteria were not met.

7.7.3 *Quality Assurance Reports to Management*—The QA program shall provide for the periodic reporting of pertinent QA and QC information to management to allow assessment of the overall effectiveness of the QA program. There are three major types of QA reports to management:

7.7.3.1 *Report on Measurement Quality Indicators*—This report shall include the assessment of QC data (such as that generated per 7.6.3) gathered over the period, the frequency of repeating work due to unacceptable performance, and corrective action taken.