REMEDIAL PROJECTS SECTION

QUALITY ASSURANCE PROGRAM PLAN

Prepared by

Remedial Projects Section
January 2024
Revision 03

Summary of Revisions

This is a new Remedial Projects Section Program Quality Assurance Program Plan (QAPP) and there are no revisions.

Document Change Log

Revision Number	Date	Responsible Party	Description of Change
0.01		Lowell Carty	New Document; Initial Release
0.02	9/2/2022	Tina LePage	New Document; Initial Release
0.03	1/17/2024	Mary Charlson	Update to signature page & Figures A.1, A.2

A.1 TITLE AND APPROVAL PAGE

Quality Assurance Program Plan for Remedial Projects Section

The Arizona Department of Environmental Quality (ADEQ) has prepared this Quality Assurance Program Plan (QAPP) following the *EPA Requirements for Quality Assurance Project Plans (EPA QA/R-5)* dated March 2001, the *EPA Guidance for Quality Assurance Project Plans (EPA QA/G-5)* dated December 2002, the *EPA Region 9 Requirements for Quality Assurance Program Plan (R9QA/03.2)* dated March 2012, and the *ADEQ Quality Management Plan* dated April 2022.

This QA Program Plan is hereby recommended for approval and commits the Department to follow the elements described within.

Arizona Department of Environmental Quality

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ACRONYMS AND ABBREVIATIONS

AAC	Arizona Administrative Code
ADEQ	Arizona Department of Environmental Quality
ADHS	Arizona Department of Health Services
ADQ	Audit of Data Quality
AQPM	Agency-wide QA/QC Program Management
ARS	Arizona Revised Statutes
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
CSM	Conceptual Site Model
DQA	Data Quality Assessment
DQI	Data Quality Indicator
DQO	Data Quality Objective
EDD	Electronic data deliverable
EPA	Environmental Protection Agency
LCS	Laboratory Control Sample
MDL	Method Detection Limit
MQO	Measurement Quality Objective
MS/MSD	Matrix Spike and Matrix Spike Duplicate
MSR	Management System Review
MPC	Measurement Performance Criteria
PARCCS	Precision, Accuracy, Representativeness, Completeness, Comparability, and Sensitivity
PQL	Practical Quantitation Limit
PRAP	Proposed Remedial Action Plan
PRQL	Project Required Quantitation Limit
QA	Quality Assurance
QAPjP	Quality Assurance Project Plan
QC	Quality Control
QCSR	Quality Control Summary Report
QMP	Quality Management Plan
RCRA	Resource Conservation and Recovery Act
RPD	Relative Percent Difference
RPS	Remedial Projects Section
RSD	Relative Standard Deviation
SDWA	Safe Drinking Water Act
SOP	Standard Operating Procedure
VOC	Volatile Organic Compound
VRP	Voluntary Remediation Program
WQARF	Water Quality Assurance Revolving Fund
WPD	Waste Programs Division

A.3 DISTRIBUTION LIST

This document will be updated at least every five years and reviewed annually. Whenever a new version of this document is approved, the Unit Manager will save it on the Arizona Department of Environmental Quality (ADEQ)'s shared network drive at J:\COMMON\ADEQ QUALITY MANAGEMENT PROGRAM\RPU and send email notification to ADEQ's Quality Management team, plus all members of the Division including staff, managers, and administrative assistants. The roles of these teams, managers, and staff with respect to this project are discussed in Section A.5.

SECTION A PROGRAM MANAGEMENT

A.4 PROGRAM ORGANIZATION

This Quality Assurance Program Plan (Program Plan) establishes the requirements for collecting data as part of the Remedial Projects Section (RPS) Value Stream projects. The purpose of the Program Plan is to establish quality assurance (QA) and quality control (QC) standards and procedures to be applied to RPS projects to produce data that are scientifically valid and defensible, and of known and documented quality.

ADEQ's RPS operates within the Waste Programs Division (WPD) of ADEQ. This Division functions as a consolidated source of environmental cleanup in the State of Arizona, with authorities and responsibilities arising from delegated authorities through Resource Recovery Conservation and Recovery Act (RCRA), the Clean Water Act (CWA) and from cooperative work agreements through CERCLA. The RPS is one component of the WPD and consists of full-time employees and managers/supervisors.

ADEQ's Director has delegated day-to-day responsibility for overseeing the Quality Management Plan to ADEQ's Quality Assurance Manager (QAM). The QAM functions as the Agency's technical QA expert. The QAM has developed a team of QA specialists made up of designated QA/QC personnel from each of the agency's three environmental Divisions and the QAM resides in the Office of Environmental Excellence for reasons of autonomy. The QA Team began biweekly meetings in August 2018. The QAM is not routinely involved with the day-to-day activities of the hazardous waste program or in any of the planning phases of a project or in the review/approval of Site Assessment Plans (SAPs). However, the QAM can be requested to assist in the review of quality assurance and control practices when necessary.

ADEQ's Quality Management System (QMS) requires that all environmental monitoring and measurement efforts mandated or supported by the United States Environmental Protection Agency (EPA) have in place a centrally managed Quality Assurance Program Plan (QAPP). ADEQ's QMS is being implemented to satisfy the policy and program requirements of the EPA Order CIO 2105-P-01-0 which provides requirements for the conduct of quality management practices, including quality assurance (QA) and quality control (QC) for environmental data generation, as a non-EPA organization performing work on behalf of EPA.

The content of this Program Plan fulfills the US EPA requirement for programs receiving Federal grant monies and environmental monitoring and measurement efforts mandated or supported by US EPA have in place a centrally managed Program Plan.

ADEQ's RPS maintains procedures to ensure the precision, accuracy, completeness, comparability and representativeness of data generated for environmental programs operated under the RPS. The environmental programs or Value Streams operated under the RPS include the Remedial Projects Unit (RPU) or the Water Quality Assurance Revolving Fund (WQARF), the Voluntary Remediation Program (VRP) and the Federal Projects Unit (FPU). A current RPS organization chart is provided as Figure A.1.

A.4.1 Remedial Projects Unit Value Stream

The Remedial Projects Unit oversees the WQARF Program. The WQARF Program (Arizona Revised Statute (ARS) Title 49, Chapter 2, Article 5), created under Arizona's Environmental Quality Act of 1986, has remedial action, abatement, and liability provisions. This revolving fund may be used for a variety of purposes, such as: 1) providing funds for costs incurred for remedial actions taken if a responsible party cannot be identified or refuses to undertake remedial actions relating to hazardous substances released into the environment; and 2) providing funds for the costs of conducting site investigations, feasibility studies, health-effects studies and risk assessments. The WQARF Program conducts these efforts throughout Arizona with support from state and federal funds. The WQARF Program also oversees privately-funded cleanup efforts.

A.4.2 Voluntary Remediation Program Value Stream

The Voluntary Remediation Program (ARS § Title 49, Chapter 1, Article 5) was created in 2000 so property owners, prospective purchasers and other interested parties could investigate or clean up a contaminated site in cooperation with ADEQ. VRP provides a streamlined process for participants by having a single point of contact at ADEQ to address applicable cross-program remediation efforts. ADEQ reviews these voluntary remedial actions and provides closure documents for successful site remediation.

A.4.3 Federal Projects Unit Value Stream

The Federal Projects Unit provides oversight of federally managed sites such as Comprehensive Environmental Response Compensation and Liability Act (CERCLA) and Department of Defense (DoD) sites. ADEQ's Federal Projects staff provides oversight of contaminated sites in Arizona that are governed and funded under CERCLA (1980), commonly known as Superfund. The National Priorities List (NPL) is a list of sites that pose the greatest potential threat to human health and the environment. The NPL is the list of national priorities among the known releases or threatened releases of hazardous substances, pollutants, or contaminants throughout the United States and its territories. The NPL guides the EPA in determining which sites warrant further investigation. In addition to the CERCLA sites, the Federal Projects staff provides state review and oversight at DoD sites.

Under this organizational structure, the Section Manager is responsible for overall management, direction, coordination and guidance for all Remedial Project Section Value Streams. The Section Manager is responsible for overseeing the entire RPS program and budget. The three Value Streams (WQARF, FPU and VRP) are led by supervisors who, along with their staff, carry out program tasks. The Administrative Assistant, the Special Projects/Principal Hydrogeologist and Value Stream supervisors all report directly to the Section Manager.

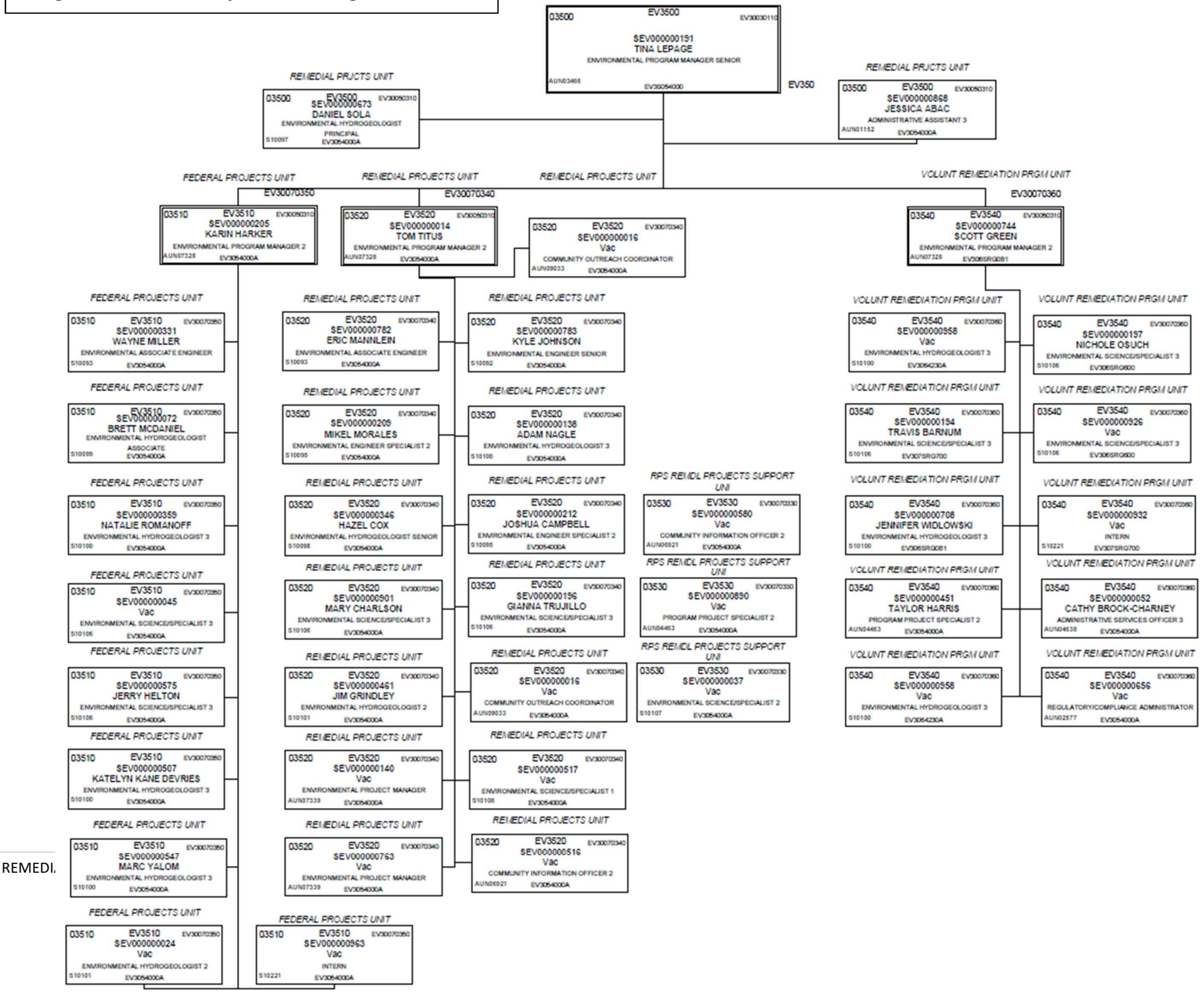
Value Stream Managers are responsible for their individual program's overall development of the sampling design and protocols discussed in this QA program plan, as well as ensuring protocols are followed. On a routine basis, the Value Stream Managers coordinate with their staff and contractors to review field and laboratory roles and responsibilities, sampling and field measurement requirements, analytical requirements, sampling schedule and requirements for field and laboratory documentation. This coordination minimizes potential problems that could

occur. The Value Stream Managers are also responsible for ensuring that any amended versions of the QA program plan are provided to the EPA for approval and then distributed to the appropriate individuals and organizations.

ADEQ may also hire contractors to collect environmental data. ADEQ or contractors staff collect samples and make field measurements according to policies and procedures established in the QA program plan. All staff must follow this QA program plan or other QA plans approved by ADEQ. ADEQ or contractors staff also communicate with the analytical laboratory regarding sample delivery and schedule. Contractors will report and provide data to each Value Stream Manager.

The QAM is independent of the Executive Leadership Team who are the policy making group for ADEQ. With this separation of groups, Leadership Team, Value Stream QA Specialists, and the QAM, autonomy is preserved in fact and appearance. The ultimate responsibility for Quality Assurance for ADEQ lies with the agency Director. Details regarding the roles and responsibilities of the QAM and QA Specialists can be found in A.6 of this QAPP and Section 1.4.2 of ADEQ's Quality Management Plan, 2022.

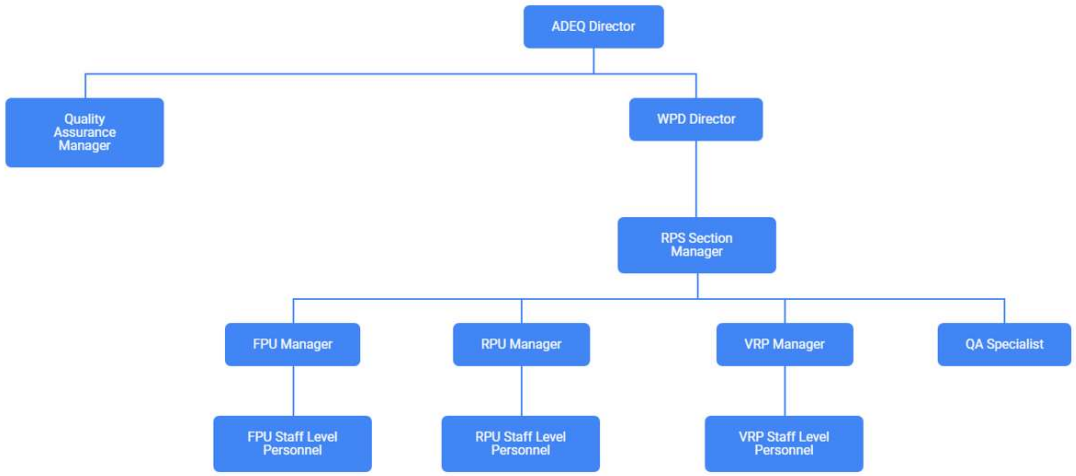
Figure A.1 Remedial Projects Section Organization Chart



The operation of the RPS involves a number of parties/organizations with specific responsibilities related to data quality. These parties/organizations have specific functions related to the operation of the RPS. The following paragraphs discuss these organizations and their general responsibilities, followed by discussions of specific responsibilities held by various individuals within those organizations.

An organizational chart showing all the parties/organizations involved in the data quality system has been included as Figure A.2: Components of the Quality System for ADEQ's RPS. Figure A.2 identifies entities based on their applicable data roles. The defined RPS includes: 1) Section Manager; 2) Federal Projects Unit Manager; 3) Remedial Projects Unit Manager; 4) RPU Support Manager; 5) Voluntary Remediation Program Unit Manager; and 6) staff level personnel.

Figure A.2 Components of the Quality System for ADEQ's RPS



A.5 ORGANIZATIONAL ROLES AND RESPONSIBILITIES

Environmental Protection Agency (EPA)

EPA works closely with Arizona in implementing the WQARF Program by providing grant funding, setting national goals and priorities, and conducting program oversight. Each year, EPA identifies the national priorities for implementing all of its programs, including the CERCLA programs. These priorities form the basis for EPA and ADEQ workload negotiations for the upcoming year as part of the establishment of grant funding. Also, EPA regional staff has oversight responsibilities to promote national consistency in CERCLA implementation, encourage coordination and agreement between EPA and ADEQ on technical and management issues, ensure proper enforcement by the ADEQ and ensure appropriate expenditure of federal grant funds.

Arizona Department of Environmental Quality (ADEQ)

ADEQ is responsible for the operation of the RPS. All RPS programmatic activities reside in the WPD of ADEQ. This section has one designated Section Manager and four Unit Supervisors. Three of the units are involved with collection of environmental data. The other unit is a support unit comprising of a legal team and a community involvement team. The legal team assists with the collection of historical environmental data. These four units within the RPS execute the programmatic activities.

Environmental Laboratory Services

All parties and organizations submitting data generated for and submitted to ADEQ's RPS are required to use analytical laboratories licensed by the Arizona Department of Health Services (ADHS). The licensed analytical laboratories are required to follow all Arizona Administrative Code (AAC) applicable to ADHS laboratories (Appendix A). The data produced from the analysis of environmental samples provide information to make informed decisions relating to the health and welfare of Arizona's citizens. These data must be of known quality, technically sound and legally defensible.

Upon application for an environmental laboratory license, ADHS shall issue the license if, after investigation, ADHS determines that the application conforms to the standards established by ADHS. The ADHS Director shall prescribe rules providing for minimum standards of proficiency, methodology, quality assurance, operation, and safety for environmental laboratories and may prescribe standards for personnel education, training, and experience to meet Federal environmental statutes or regulation. The ADHS Director may also allow reciprocity with other states and prescribe reporting formats for compliance testing results. Development of the rules shall be in cooperation with the Director of ADEQ and shall be consistent with Title 49 (Section 49-101 et seq.). Unless exempted by ARS § 36-495.02, no person may operate or maintain an environmental laboratory without a license issued by the ADHS pursuant to ARS §§ 36-495.03 through 36-495.14.

The RPS relies on the ADHS licensing program for the satisfaction of many of the QA elements associated with laboratory operation and reporting (see Appendix A of this QA Program Plan). ADHS maintains oversight of analytical laboratory QC procedures regarding all environmental samples submitted for meeting requirements of a federal or state regulatory program. QA plans, as required by AAC R9-14-615.B, describe licensed laboratory QA responsibilities. ADHS maintains a list of licensed laboratories and periodically inspects them to ensure compliance.

The RPS also has the option of having audits performed by ADEQ's QAM or QA Specialists on laboratories licensed by ADHS. All ADEQ laboratory audits must be performed in accordance with Section 2.3.2 of ADEQ's April 2022 Quality Management Plan.

Weekly ADHS places an Active Lab Info file in a folder that is added to the Arizona Water Quality Database to ensure license status is verified for data captured in the database and used for decision making.

Facility Owners/Operators, Property Owners and Consultants

As primary data generators, the Facility Owner/Operators and Property Owners – either directly or through their environmental contractors - are responsible for the implementation and documentation of specific QC elements, such as the collection and analysis of field blanks, field duplicates and rinsate samples, to satisfy the requirements of the QA Program Plan.

Please note: Facility Owner/Operators and Property Owners rarely employ staff that are qualified to satisfy the requirements of a QA Program Plan and, therefore, hire environmental contractors to generate environmental data. Also, reports requiring a certified Arizona Board of Technical Registration registrant's seal must meet all of the Arizona Board of Technical Registration requirements under ARS Title 32, Chapter 1 and the rules made under that Chapter.

The documentation of all environmental data collection activities must meet the following minimum requirements:

- Documentation of data must be direct, prompt, and legible. All reported data must be uniquely traceable to the raw data. Documentation of all data reduction formulas must occur.
- All original data records include, as appropriate, a description of the data collected, units of measurement, unique sample identification, station or location identification (if applicable), name (signature or initials) of the person collecting the data, and date of data collection.
- Any changes to the original (raw data) entry must not obscure the original entry. The person making the change must document the rationale and initial and date the change.

Development of Standard Operating Procedures (SOPs) for data collection should follow EPA's Guidance for Preparation of Standard Operating Procedures for Quality-Related Operations (EPA, 2007a). SOPs should be included as an appendix of all the Planning Documents and Reports referenced in submitted to ADEQ's RPS. Any QA or QC should be included as an appendix to all planning documents and reports submitted to ADEQ's RPS. The field team should document rationale for any deviations from an SOP and include that documentation in all planning documents and reports submitted to ADEQ's RPS.

A.6 INDIVIDUAL ROLES AND RESPONSIBILITIES

In addition to those general responsibilities maintained by the above organizations, individuals involved in RPS activities have specific QA responsibilities. These individuals are referred to herein by a given project title or position, since these assigned duties will be unaffected by staff changes within these positions. The listed individuals below correspond to the organization structure outlined above. They are described according to the level of direct oversight those individuals provide in the RPS's QA system.

EPA Region 9, Arizona Project Officer

The EPA Arizona Project Officer for grant funding has responsibility to:

- Monitor ADEQ's progress and activities required to meet grant commitments;
- Review progress reports to ensure ADEQ is performing the work as agreed and approved in the grant application;
- Serve as the focal point for programmatic and technical issues;
- Ensure completion of EPA's programmatic terms and conditions; and
- Maintain proper grant documentation.

EPA Region 9, Quality Assurance Office

Prior to the implementation of QA elements as outlined in this QAPP, this document will be reviewed and approved by the EPA Region 9 QA Office. Revisions will be made in accordance with EPA-provided comments until the QAPP is finalized. Once the document is finalized, any proposed revisions to the QAPP will be considered by the EPA Region 9 QA Office prior to inclusion in a revised document. Any substantial deviations from the prescribed performance of QA elements as outlined in the approved QAPP will be documented and submitted as part of a Technical System Audit (TSA) prepared by the ADEQ QAM

Director, Arizona Department of Environmental Quality

The ADEQ Director has overall responsibility for ADEQ's QA Program as outlined in EPA Order CIO 2105.0 (formerly 5360.1 A2). More specifically, the ADEQ Director is responsible for ensuring that QA is an identifiable activity having adequate resources allocated for the accomplishment of the mission's goals for ADEQ's divisions and Southern Regional Office. These goals include providing the resources for the collection of the right type, quantity, and quality of data generated in-house and externally. The Director has delegated this responsibility to the QAM.

Environmental Laboratory Services

The RPS relies on the ADHS licensing program for the satisfaction of many of the QA elements associated with laboratory operation and reporting (see Appendix A of this QA Program Plan). ADHS maintains oversight of analytical laboratory QC procedures regarding all environmental samples submitted for meeting requirements of a federal or state regulatory program. QA plans, as required by AAC R9-14-615.B, describe licensed laboratory QA responsibilities. ADHS maintains a list of licensed laboratories and periodically inspects them to ensure compliance.

The RPS also has the option of having audits performed by ADEQ's QA/QC Manager or QA/QC Representatives on laboratories licensed by ADHS. All ADEQ laboratory audits must be performed in accordance with Section 2.3.2 of ADEQ's April 2022 Quality Management Plan.

Director, Waste Programs Division (WPD) of ADEQ

ADEQ, through its combined authorities from state-delegated environmental programs, oversees all site investigations and cleanups conducted in the State of Arizona. The Director of the Waste Programs Division (Division Director) is responsible for the administration of all these cleanup authorities. In addition, because site cleanup regulations play an integral part in the development of data quality guidelines, the Division Director plays an important function in determining data quality and sufficiency for the WPD which includes the RPS.

The regulations governing investigations and cleanups (ARS Title 49 – The Environment) in Arizona determine, on a general level, the type and amount of data necessary to make decisions regarding issuance of permits, Notice of Violations (NOVs), compliance orders, and the issuance of determination letters (e.g. "No Further Action" letters). The Division Director is responsible for ensuring a consistent application of these regulations across all WPD cleanup sites. All site information is available to the Division Director for review and consideration of site decisions. The Division Director also holds regular supervisor-level meetings to discuss ADEQ issues and WPD operations.

Section Manager, Remedial Projects Section, Waste Programs Division

The Manager of the RPS (Section Manager) is responsible for staff level participation in all the administrative and technical areas of the four units within the section. The Section Manager is responsible for ensuring that the four units perform their functions consistent with WPD policies and procedures. The Section Manager's level of review will routinely consist of ensuring that the proper staff members reviewed, commented and drafted an appropriate decision or comment letter. The Value Stream Managers are also responsible for ensuring that any amended versions of the QA program plan are provided to the EPA for approval and then distributed to the appropriate individuals and organizations. The RPS Manager ensures that the RPS meets program goals.

Unit Supervisor, Remedial Projects Unit Value Stream

The Unit Supervisor of the Remedial Projects Unit is responsible for staff level participation in all the administrative and technical areas of the Remedial Projects Unit. The Unit Supervisor's level of supervision routinely consists of ensuring staff members perform inspections and review, comment on, and draft an appropriate response to submitted planning documents and reports. The Unit Supervisor will also edit, if necessary, decision/response letters. The Unit Supervisor is responsible for final approval of submitted planning documents and reports.

Unit Supervisor, Voluntary Remediation Program Value Stream

The Unit Supervisor of the VRP Value Stream is responsible for staff level participation in all the administrative and technical areas of the VRP Value Stream. The Unit Supervisor's level of review will routinely consist of ensuring staff members carry out document reviews and comment on and draft an appropriate response to submitted planning documents and reports. The Unit Supervisor will also edit, if necessary, comment or decision letter. The Unit Supervisor is responsible for final approval of submitted planning documents and reports.

Unit Supervisor, Federal Projects Unit Value Stream

The Unit Supervisor of the Federal Projects Unit Value Stream is responsible for staff level participation in all the administrative and technical areas of the Federal Projects Unit Value Stream. The Unit Supervisor's level of review will routinely consist of ensuring staff members carry out document reviews and comment on and draft an appropriate response to submitted planning documents and reports. The Unit Supervisor will also edit, if necessary, comment or decision letter. The Unit Supervisor is responsible for final approval of submitted planning documents and reports.

Unit Supervisor, Remedial Projects Support Unit

The Unit Supervisor of the Remedial Projects Support Unit is responsible for staff level participation in ADEQ's RPS community involvement and responsible party identification. The Unit Supervisor's level of review routinely consists of ensuring that proper staff members carry out their assigned duties with respect to community involvement and responsible party identification. This unit is not responsible for any environmental data collection, analysis, quality assurance, or quality control.

Staff Level Personnel - Remedial Projects Unit

Staff level personnel consist of Environmental Hydrogeologists, Engineers and Scientists. Their responsibilities with QC may involve reviewing planning documents and reports submitted by the Facility Owner/Operators – either directly or through their contractors – or WQARF Program contractors assigned by ADEQ to investigate and remediate soil and groundwater contamination. In addition, collection of soil, groundwater and soil gas samples occurs directly by staff during split sampling events at facilities being investigated for entry into the WQARF Program.

During the Preliminary Investigation phase, available data are gathered and reviewed by WQARF Program staff level personnel. Part of this available data normally contains sampling results for soil, soil gas and/or groundwater.

Proposed investigations or remedial actions are typically detailed in a work plan or proposed remedial action plan (PRAP), which is reviewed, commented upon and approved by a Unit Supervisor after resolution of all issues and before the investigation or remedial actions begin. The following is a short list of some of the most common goals for sampling:

a. To document a discharge;
b. To determine the substance discharged;
c. To document the source of discharge;
d. To document the discharge meets certain parameters;
e. To establish the amount/concentration of a substance in a discharge;
f. To document the extent and degree of contamination; or
g. To document that an area is below clean-up standards.

On the infrequent occasions when ADEQ staff collects samples and has them analyzed by an ADHS approved laboratory (i.e. during split sampling events), the Technical Support person is available to assist the various staff level personnel when necessary. The Technical Support person, upon request from the staff level personnel, Unit Supervisor or Section Manager, will review this data with regards to QA Program Plan requirements, sampling goals and data quality objectives (DQO's).

Staff Level Personnel - Federal Projects Unit

Staff level personnel consist of Environmental Hydrogeologists, Engineers and Scientists. Their responsibilities with QC may involve reviewing planning documents and reports submitted by the Property Owner – either directly or through their contractors.

Work plans typically detail proposed investigations or remedial actions. Approval of work plans occur after review, comment, and resolution of all issues and before the investigation or remedial actions begin. The following is a short list of some of the most common goals for sampling:

Federal Projects:

a. To document a discharge;
b. To determine the substance discharged;
c. To document the source of discharge;
d. To document that the discharge meets certain parameters;
e. To establish the amount/concentration of a substance in a discharge;
f. To document the extent and degree of contamination; or
g. To document that an area is below clean-up standards.

On the infrequent occasions when ADEQ staff collects samples and has them analyzed by an ADHS approved laboratory (i.e. during split sampling events), the Technical Support person is available to assist the various staff level personnel when necessary. Technical Support, upon request from staff level personnel, Unit Supervisor or Section Manager, will review this data with regards to QA Program Plan requirements, sampling goals and DQO's.

Staff Level Personnel – Voluntary Remediation Program Unit

Staff level personnel consist of Environmental Hydrogeologists, Engineers and Scientists. Their responsibilities with QC may involve reviewing planning documents and reports submitted by the Property Owner – either directly or through their contractors.

Work plans typically detail proposed investigations or remedial actions. Approval of work plans occur after review, comment, and resolution of all issues and before the investigation or remedial actions begin. The following is a short list of some of the most common goals for sampling:

Voluntary Remediation Program:

a) Site characterization;
b) Determining effectiveness of remedial efforts; and
c) Determining if a No Further Action request is appropriate

Remedial Projects Section Technical Support

Technical Support is available to assist with site assessment and/or remediation issues to ensure the investigation and data collection efforts of the environmental consultant and facility meet QA objectives. Technical Support is technical staff placed in an "Associate", "Senior", or "Principal" position. Described below are three major activities for Technical Support:

1 Review of Planning Documents - Technical Support is available to assist staff members when necessary. Technical Support is available upon request from staff level personnel, Unit Supervisor or Section Manager, and will review and comment on the submitted planning documents with regards to QA Program Plan requirements, project goals and DQO's.

2. Development of DQOs - An initial scoping session may be held with all available /stakeholders to outline project goals and DQOs prior to the preparation of planning documents by the Facility/Responsible Party/Property Owner or its contractor. These initial meetings will roughly follow EPA's 2006 Guidance on Systematic Planning using the Data Quality Objectives Planning Process for guidance on the standard DQO process. The results of these initial meetings will guide the development of the project-specific planning documents.

3. Review of Data Reports - Technical Support will be available to assist the various staff level personnel when necessary. Technical Support is available upon request by staff level personnel, the Unit Supervisor, or the Section Manager. Technical Support will review submittals generated under planning documents with regards to QA Program Plan requirements, project goals, and DQO's.

On the infrequent occasions when ADEQ staff collects samples and has them analyzed by an ADHS approved laboratory (i.e. during split sampling events), the Technical Support person is available to assist the various staff level personnel when necessary. The Technical Support person, upon request from the staff level personnel, Unit Supervisor or Section Manager, will review this data with regards to QA Program Plan requirements, sampling goals and DQO's. When requested by the staff level personnel, the Unit Supervisor, or the Section Manager, Technical Support will prepare comments for revision of the data reports.

Quality Assurance Manager (QAM)

ADEQ's Director has delegated authority for the QMS to the QAM. The QAM resides in the Office of Environmental Excellence, outside of the Divisions, and reports to the Director. The QAM, together with assistance of QA/QC specialists from each Value Stream implements the QMP for each Division within ADEQ. The responsibilities of the QAM include: dispute resolution, managing the implementation of QMS through periodic leadership communications and trainings, updates to the ADEQ QMP, designation of QA Specialists throughout the Agency; reviewing and approving QAPPs, determining internal and external audit schedules and if audit corrective actions have been completed, and conducting management service reviews. Dispute resolution typically will be conducted through utilization of the Arizona Management System, which, depending on the nature of the dispute, can involve escalation to the appropriate Executive Leadership Team member (Division Directors, Director, Deputy Director, and Chief Officers). Quality disputes will be discussed during the bi-weekly QMS meetings to determine if there are impacts that may affect other Divisions and or ADEQ as a whole, however, the QAM retains the authority to make the final decision.

The QAM is responsible for reviewing all internal QA/QC documentation, including QAPPs, Quality Assurance Project Plans (QAPjPs), and audit findings. The QA/QC specialist that oversaw generation of the QAPP may choose to address those comments, or delegate that responsibility to subject matter experts and others within the Value Stream or Unit. Draft review by the QAM will precede all EPA document deliverables.

The QAM may provide assessment of RPS activities through the activities listed below:

- Technical System Audits
- Performance Evaluations
- Audits of Data Quality
- Data Quality Assessments

The QAM reviews and can revise the QAPP. The QAPP will be updated to accommodate new developments in QA/QC as necessary, or every 5 years. Revisions to the QAPP may become necessary through several different routes, and the QAM or the QA/QC Specialists will be responsible for responding and making these revisions when appropriate. During regular contact with the EPA, the EPA QA Officer may make suggestions for improving quality performance that could be incorporated into the QAPP. During a TSA, the QAM will examine the QAPP and the performance of the RPS and may make suggestions for improved performance that can result in revisions to the QAPP. A facility owner/operator, permittee, or, environmental consultant may request revisions to the QAPP in response to changes in industry-wide field methodology or for the addition of new or innovative technologies. Development and acceptance of new and more sophisticated analytical methods that provide lower detection limits, or other improvements can also be acceptable basis(es) for revisions to the QAPP.

The QAM is not be routinely involved with the day-to-day activities of the RPS, does not routinely participate in any of the planning phases of a project, and is not be involved with the review/approval of SAPs. The QAM, though, can be requested to assist in the review of data when necessary.

QA Specialist

The QA specialist provides the bridge between the QAM, the VS, and unit programs. The QA Specialist provides assessment of RPS activities through the processes listed below:

- Oversight of QAPP generation, and amendment;
- Oversight of uniform presentation of SOPs;
- Implementation of QMS Training;
- Planning, scheduling and implementation of the QMS audit program; and
- Generation of standard work for all the QMS processes listed above.

QA Specialists take on the role of auditors for VSs other than their own enabling them to avoid potential conflicts of interest and continue with their routine working responsibilities. QA Specialists are required to have at least one performance goal related to the work they are performing for ADEQ's QMS. Although the QA Specialists will continue to report directly to their Value Stream or Unit Managers, the QAM may be given the opportunity to provide the relevant manager with feedback related to their performance as a QA Specialist.

A.7 PROBLEM DEFINITION/BACKGROUND

ADEQ RPS administers investigative and remedial measures for hazardous substances through the Arizona Revised Statutes and Arizona Administrative Code. The regulations establish a system for identifying, investigating and remediating hazardous substances beginning with discovery of its release into the environment and ending in site closure. In practical terms, this means regulating a large number of facilities that handle hazardous substances. In administering the regulations, the RPS performs targeted education and outreach functions to facilities and the general public.

There are two sets of program activities that are environmental data related, namely sample collection and review of laboratory analytical data. Typically, samples used for generating data on which program decisions are made are collected by facility owners and/or operators, contractors, or RPS staff. The samples are then analyzed by a laboratory licensed by the ADHS.

Analytical data are used by the RPS to make various decisions to determine whether a release to the environment has or has not occurred. To assess compliance with the regulations applicable to this task, the RPS must evaluate laboratory data. The RPS compares laboratory data with regulatory standards such Soil Remediation Standards (SRLs), Aquifer Water Quality Standards (AWQS), Maximum Contaminant Levels (MCLs) and ADEQ's Soil Vapor Sampling Guidance to determine whether a release has occurred to the environment. Evaluation of laboratory data also provides information as to the extent above which a standard is exceeded allowing program staff to gauge the severity of the threat posed by the release to the environment. Table A1 shows contaminants commonly found at RPS facilities.

Table A.1 Common Constituents Found at RPS Facilities in Soil, Groundwater and/or Soil Vapor

Constituent	SOIL	GROUNDWATER	SOIL VAPOR
Volatile Organic Compounds:			
1,2-Dichloroethane (DCA)	X	X	X
1,1-Dichloroethylene (DCE)	X	X	X
1,2-Dichloroethylene (cis)	X	X	X
1,2-Dichloroethylene (trans)	X	X	X
Tetrachloroethylene (PCE)	X	X	X
Trichloroethylene (TCE)	X	X	X
Metals:			
Chromium III	X	X	
Chromium VI	X	X	
Arsenic	X	X	
Selenium	X	X	
Lead	X	X	

A.7.1 Establishment of Media-Specific Regulatory Levels

ADEQ has authority to require owners and operators to conduct remedial actions at the site of a release. A remedial action is defined at ARS § 49-281. The term remedial action refers to actions intended to stop, minimize and mitigate damage to the public health and the environment. ADEQ has the authority to set regulatory levels for investigation and remediation of soil, groundwater and surface water.

Remediation Standards for Soils

AAC Title 18, Chapter 7 Article 2 (Soil Remediation Standards) establishes remediation standards for soils. ADEQ has three standards for soil: Background, Pre-determined and Site Specific. Appendix B contains the weblinks for Arizona's Soil Remediation Standards rule which details how each standard is established. Appendix B also contains a table that list regulatory levels for chemicals found at typical RPS sites.

Water Quality Standards for Groundwater and Surface Water

AAC Title 18, Chapter 11 (Water Quality Standards) establishes remediation standards for groundwater and surface water. Articles 1 and 4 establish water quality standards for surface water and aquifer water, respectively. Appendix B contains the weblinks for Arizona's Water Quality Standards rule. For those chemicals that do not have an established Aquifer Water Quality Standard, the Narrative Aquifer Water Quality Standards (AAC R18-11-405) apply.

A.7.2 Measurement Quality Objectives and Data Quality Indicators

DQIs, as defined by EPA, involve precision, accuracy, representativeness, completeness, comparability, and sensitivity, also known as "PARCCS" parameters. Utilization of DQIs is part of the data evaluation processes. In general, project data quality needs (i.e. the MQOs) determine PARCCS parameters. The extent to which program or project QC results meets MQOs determines whether data are acceptable for the intended use.

Analysis involves the characterization of samples based on chemical and/or physical properties. Analyses result in generating raw data from instrumental analysis, chemical analysis, or physical testing. The analytical methods used will be specific, sensitive enough to answer the question posed by the RPS objectives and meet the data quality goals associated with those objectives. MQOs are the project or program QC criteria defined for various DQIs. During the planning phase, these set pre-determined limits on the acceptability of the data in regards to accuracy/bias, and precision, completeness and sensitivity.

Identifying DQIs and establishing QC samples and Measurement Performance Criteria (MPC) to assess each DQI are key components of project planning and development. These components demonstrate an understanding of how "good" the data need to be to support project decisions, and help to ensure there is a well-defined system in place to assess that data quality once data collection/generation activities are complete.

ADEQ has established the following policies, procedures, and/or guidance for sample collection and analytical techniques. These procedures, where relevant, apply to all analytical data being generated for use by the RPS. These procedures should be followed unless special exceptions

have been requested and approved, and/or deviations are outlined in an RPS SAP. The following documents can be found in their entirety in Appendix C.

- ADEQ Temperature/Preservation Guidance;
- Substantive Policy 0154 - Addressing Spike and Surrogate Recovery As They Relate To Matrix Effects In Water, Air, Sludge And Soil Matrices Policy; and
- Substantive Policy 0170 - Implementation of EPA Method 5035 - Soil Preparation For EPA Method 8015B, 8021B and 8260B.

DQIs, as defined by EPA, involve precision, accuracy, representativeness, completeness, comparability, and sensitivity, also known as "PARCCS" parameters. Utilization of DQIs is part of the data evaluation processes. In general, project data quality needs (i.e. the MQOs) determine PARCCS parameters. The extent to which program or project QC results meets MQOs determines whether data are acceptable for the intended use.

MQOs are the acceptance thresholds or goals for project data, usually based on the individual DQIs for each matrix and analyte group or analyte. MQOs are project-or method-specific quality acceptance criteria established to support project-specific DQOs, as well as decisions made based on the quality of the data. MQOs define whether the data are usable and meet project needs. Like DQOs, MQOs can be quantitative or qualitative statements.

MQOs specify what the QC acceptance criteria are for each analysis. AAC R9-14-615 details QA requirements for ADHS licensed laboratories. Regardless of how the laboratory evaluates performance, the laboratory's acceptance criteria must meet the needs of each project. This QA Program Plan provides general requirements, but individual planning documents will provide project or site-specific requirements.

ADEQ Project/Case Managers may consult with the ADEQ QAM, or research a variety of published or written materials, to aid them in selecting or developing measurement technologies. RPS staff professional knowledge is used to identify appropriate analytical procedures. General DQIs for RPS are provided in Table A2 below.

Table A.2 Example of Soil and Water Samples Analyzed Using EPA Method 8260B.

Compound (Laboratory Method - EPA Method 8260B)	**Matrix Spike (% Recovery Limits)**	**Laboratory Control Sample (% Recovery Limits)**	**Method Blank Result (ug/l)**	**Surrogates (% Recovery Limits)**
	Matrix Spike Duplicate (Relative % Difference)	**Laboratory Control Sample Duplicate (Relative % Difference)**	**Method Detection Limit (ug/l)**	
Benzene	68-131	68-130	ND	
	32	20	2.0	
Carbon Tetrachloride	65-147	60-150	ND	
	35	25	5.0	
PCE	67-131	70-130	ND	
	31	20	2.0	
TCE	66-132	70-130	ND	
	29	20	2.0	
Dibromofluoromethane				70-130
Toluene				70-130
4-Bromofluorobenzene				70-130

PCE = tetrachloroethylene
TCE = trichloroethylene
ND = Not detected at laboratory reporting limits
ug/l = micrograms per liter
% = percent

A.7.3 QUALITY OBJECTIVES AND CRITERIA FOR MEASUREMENT OF DATA

This section is broken into two parts, consistent with EPA Region 9 guidance for QA Program Plans. The first section documents regulatory levels that are specific to the ADEQ; these regulatory levels serve as the driver for site assessments and cleanup. The second section discusses Measurement Quality Objectives (MQOs) and Data Quality Indicators (DQIs) under the RPS.

The Data Quality Objective (DQO) process is used to systematically plan for generating environmental data of a known quality to support decisions. This is done through focused, documented sampling, testing, and data evaluation activities. It entails using a systematic planning approach that includes hypothesis testing to differentiate between two or more clearly defined alternatives.

Each scenario for which data is to be generated is unique because of the various variables that must be considered, including regulatory requirements, waste characteristics, facility-specific characteristics, and others. Therefore, the DQO process for the RPS is intended to yield qualitative and quantitative statements that answer four basic questions:

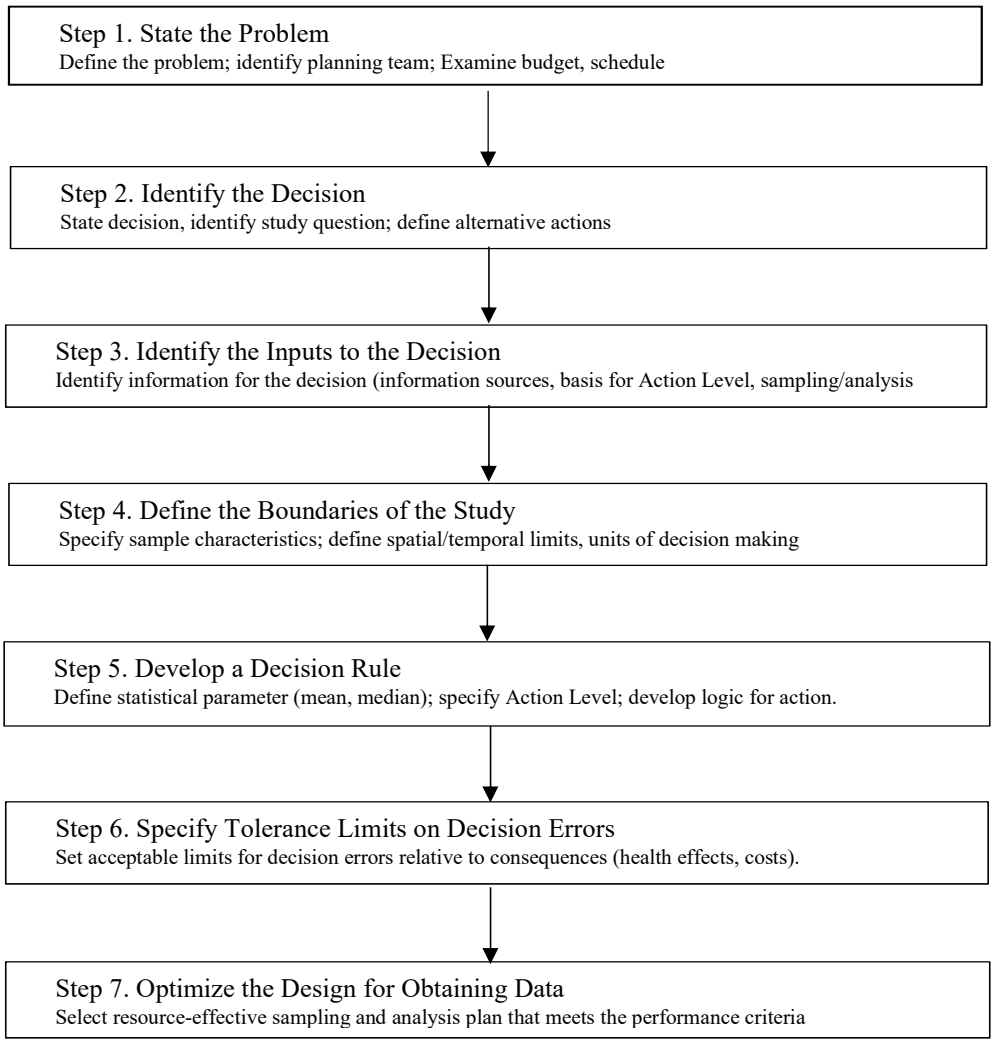
- What data is needed?
- Why is it needed?
- How will the data be used?
- What tolerance is allowed for decision errors?

After the verification and validation of data, evaluation of the data against project DQOs occurs. Implementation of the DQA process completes the data life cycle by providing the assessment needed to determine achievement of project objectives. Two 2006 EPA guidance documents on DQA are available from EPA at: https://www.epa.gov/quality/agency-wide-quality-system-documents.

DQA is the scientific and statistical evaluation of environmental data to determine if they meet the planning objectives of the project, and thus are of the right type, quality, and quantity to support their intended use. The document Data Quality Assessment - A Reviewers Guide (EPA, 2006b) broadly describes the statistical aspects of DQA in evaluating environmental data sets. Data Quality Assessment - Statistical Methods for Practitioners (EPA, 2006c), the companion guidance document on statistical methods for practitioners, provides a more detailed discussion on implementation of graphical and statistical tools. These EPA guidance documents discuss the use of DQA to support environmental decision-making (e.g., compliance determinations).

The DQO Process consists of seven planning steps as shown in Figure A.3.

Figure A.3 Data Quality Objective Process



The outputs of the DQO process are used to define the quality control requirements for sampling, analysis, and data assessment. These requirements are then incorporated into a site-specific QAPP, WAP, SAP, or similar planning document. The RPS utilizes the DQO Process in its sampling plans and is encouraging facility owners, operators, consultants, and contractors to incorporate it their plans for sample collection.

The RPS notes that one of the most important features of the DQO process is that it is iterative. It is not critical to "get it right the first time." If the initial design is not feasible, then an iteration can be done on one or more of the earlier planning steps to identify a sampling design that will meet the budget and generate data that are adequate for the decision. Failure to establish DQOs prior to implementing field and laboratory activities can result in undesirable outcomes such as inefficiencies, increased or unnecessary costs, or the generation of unusable data.

A.8 SPECIAL TRAINING/CERTIFICATION

ADEQ's Unit Supervisors are responsible for ensuring each staff member involved with collecting or analyzing environmental data has the necessary technical, quality assurance, and project management training required for his or her assigned tasks and functions. Section Managers are also responsible for ensuring that technical staff maintains the necessary level of proficiency to effectively meet ADEQ's QA/QC responsibilities. ADEQ's Quality Management System training programs defines QA/QC training needs and is being transitioned to computer-based training. All staff are required to take basic QMS training as a part of their onboarding requirements.

Core training will be coordinated through the QAM in conjunction with various Division supervisory personnel. Intermediate and advanced skill training will be arranged when the appropriate Agency staff identify the need. The QAM or QA Specialist, in conjunction with Program management, will identify continuing professional training requirements and address those requirements utilizing external resources for the latest technological advances and evolution in industry standards.

ADEQ staff members are encouraged by their managers/supervisors to draw upon their educational background, experience, technical training, and on-the-job training to enhance their understanding and performance of QA-related procedures.

ADEQ's training program will offer, or arrange for through a third-party vendor, courses on the following subject matter on a schedule and frequency suited to meet the needs of ADEQ's staff with QA responsibilities:

- An Orientation to Quality Assurance Management
- Establishing Data Quality Objectives
- Preparing Quality Assurance Project Plans
- How to Perform an Audit of Data Quality and Data Quality Assessment

Staff will be encouraged to attend meetings and seminars, and to take formal training, in accordance with ADEQ's training policy, to enhance their understanding of Program specific QA requirements within the Programs they work. QA training records are maintained by the Office of Environmental Excellence and will be transitioned to Tracor, the Arizona state training software as the QMS training is transitioned to a computer-based format. In addition, all planning documents and reports listed in Figure A.3 are required (AAC R1812-264) to have an Arizona Professional Registrant's signature and seal.

A.9 DOCUMENTS AND REPORTS

Throughout the life of the RPS, there may be changes to program requirements, or modifications to the way environmental data are collected, or changes to the definitions of enforcement activities. Therefore, this QA Program Plan is a dynamic document that is subject to revision, as needed. RPS personnel, Technical Support and QA/QC personnel will examine and revise this QA Program Plan annually. Re-submittal of this plan to the EPA Region 9 QA manager for

review, though, will occur once every five years or as otherwise needed. Dissemination of approved revisions include personnel on the Distribution List.

A.9.1 Environmental Data Documentation

This QA Program Plan and referenced policy, guidance and SOPs include written procedures for all methods and procedures related to the collection, processing, analysis, reporting, and tracking of environmental data. All data generated for and submitted to ADEQ's RPS, including data from split sampling and inspections, must be of sufficient quality to withstand challenges to their validity, accuracy and legibility. To meet this objective, utilization of standardized formats and prescribed procedures occurs to record data. The documentation of all environmental data collection activities must meet the following minimum requirements:

- Document data directly, promptly, and legibly. All reported data must be uniquely traceable to the raw data. Document all data reduction formulas.
- All original data records include, as appropriate, a description of the data collected, units of measurement, unique sample identification, station or location identification (if applicable), name (signature or initials) of the person collecting the data, and date of data collection.
- Any changes to the original (raw data) entry must not obscure the original entry. Document the reason for the change. The person making the change initials and dates the change.

Discussions of other specific documentation requirements are throughout this QA Program Plan and referenced in SOPs.

A.9.2 Field Documentation and Forms

Completion of appropriate field documentation and forms for each sample is the responsibility of the field personnel. Field personnel accomplish the following: 1) maintain records for each field activity to ensure that samples and data are traceable and defensible; 2) document field records on field forms or in designated field logbooks to provide a secure record of field activities, observations and measurements during sampling; and 3) record field data and observations in real time on activity-specific data forms.

A.9.3 Project Files

RPS personnel are responsible for the maintenance of the project file. The project file will consist of all site documents specifically listed in Section A5 of this QA Program Plan. Additionally, RPS personnel will collect and include in the project file all other relevant project documentation in the file. These additional documents may include any official correspondence that does not correspond to any of those previously listed documents. The project file will also include all information not related to data generation, including documentation of all public involvement or community notification efforts.

A.9.4 Routine Records Management Quality Assurance

ADEQ Records Management Process addresses the system employed by the Agency for handling documents. This plan outlines the roles and responsibilities for management and staff concerning chain of custody procedures and records management.

ADEQ document control procedures require that documents generated, or obtained, by Agency personnel are accounted for when a project is completed. ADEQ's Records Management System dictates the procedures for checking-in and checking-out files for ADEQ staff, external clients, and the public. ADEQ managers/supervisors/directors will ensure achievement that the objectives of the Records Management Process. These objectives include the following:

- Prevent the creation of unnecessary records in any media;
- Promote the continuous development of filing systems and structures that allow for the efficient organization, maintenance, and retrieval of records;
- Ensure that records of continuing value are preserved, but that valueless or noncurrent information is disposed of or transferred to storage in a timely manner in accordance with ADEQ and/or ADHS records retention requirements;
- Ensure that the acquisition and use of all direct paper to microform systems and equipment, or electronic digital imaging, are technically feasible, cost-effective, and most importantly, satisfy Program needs;
- Preserve and protect information that is vital to the essential functions or mission of the organization. Preserve and protect information that is essential to the legal rights and interests of individual citizens and the government.

ADEQ maintains an internal electronic database to track project related documents. This database, **A**ri**z**ona **U**nified **R**epository for **I**nformational **T**racking of the **E**nvironment or AZURITE, maintains lists of project related documents. Electronic back-up of this database occurs on a nightly basis.

ADEQ currently maintains an internal electronic groundwater quality database to track groundwater sampling results collected from RPS projects. Electronic back-up of this database occurs on a nightly basis.

ADEQ data that is cloud based or stored in the State Data Center is considered secure. Data loss mitigation efforts include Uninterruptible Power Supplies (UPS) and backup generators. Source data for RPS is obtained from laboratory data sheets and reports or data submitted by contractors. RPS takes appropriate measures to prevent and address data loss at the source by electronic storage/scan of paper documents.

The current electronic mail (e-mail) tool, Google Mail, is a cloud-based storage system that is considered secure. Employee's inbox storage space is unlimited. E-mail messages that are considered critical artifacts to a program should be saved as a PDF and stored in the appropriate program folder/file location. Electronic mail messages that are moved to "trash" are archived

after 30 days, but can be retrieved via an Information Technology Service Desk Request. Microsoft Outlook e-mail files have been saved to the J:/Drive and also can be retrieved as needed with a Service Desk Request.

A.9.5 Revisions to the QA Program Plan

Throughout the life of ADEQ's RPS, there may be changes to program requirements, or modifications to the way environmental data are collected, or changes to how enforcement activities are defined. Therefore, this QAPP is recognized as a dynamic document that is subject to revision, as needed. The RPS personnel, Technical Support and QA/QC personnel will examine and revise this QAPP annually, although the plan will only be resubmitted to EPA Region 9 QA manager for review once every five years or as otherwise needed. Approved revisions will be disseminated to personnel included on the Distribution List (page 7).

SECTION B DATA GENERATION AND ACQUISITION

B.1 SAMPLING PROCESS (NETWORK) DESIGN

RPS conducts site investigations to determine if site media are contaminated. Multiple phases of investigation may be necessary to determine characteristics of the contamination if the initial site assessment finds evidence of contamination. Site characterization includes evaluating the threat posed by the contamination and determining potential solutions for cleanup of the contamination. This QA Program Plan documents the planning, implementation, and assessment procedures for data generated for and submitted to ADEQ's RPS. It describes specific applications of QA and QC activities throughout the course of investigations and cleanup.

A RPS site investigation routinely involves one or more of the following activities: a background investigation on the history of site use, a field investigation that includes sample collection and analysis, an evaluation of cleanup options and costs and an assessment of the usability of resulting data. Typically, the first step is to investigate site history to identify past uses of the property, including types and amounts of chemicals that may have been used onsite and any disposal activities that may have contributed to contamination.

This QA Program Plan includes requirements for measurements collected for a typical facility. The conceptual site model (CSM) largely dictates the specific design and extent of a facility site investigation, resource needs, and the required level of data quality and QC. Planning documents outline and describe project-specific DQOs and sampling design.

The following sections describe sampling and analysis requirements in the RPS. Site-specific information required in project-specific planning documents includes the number and location of samples, types of samples to be collected, measurement parameters, sampling frequencies, design of sampling networks for monitoring and the time period over which sampling activities are to occur. Review and approval by RPS personnel is required for all project-specific planning documents.

B.1.1 Sampling Design

A sampling design specifies the number and location of samples collected at a site. Study objectives guide sampling design strategies. Sampling design strategies should factor in the conditions unique to the site, including data gaps in the CSM, exposure potential, projected site reuse, and available resources. As noted above, identification of sampling design strategies occurs during the systematic planning process and the project-specific planning document contains descriptions of the sampling design strategy.

Typical designs for the collection of samples at RPS sites include biased sampling, statistically based sampling, one-time events, and ongoing (multi-phase) events. Biased sampling specifies sampling locations based on the judgment of the field team leader and sampling plan designer. Statistically based sampling designs use random or systematic sampling locations designed to avoid bias, as with investigation exposure area decision units at mining sites. A key distinction

in sampling design is between judgmental sampling (also called authoritative or biased sampling), in which sample numbers and locations are selected based on expert knowledge of the problem, and probability-based sampling, in which sample numbers and locations are selected based on randomization and each member of the target population has a known probability of being included in the sample. Judgmental sampling has advantages for source area decision unit investigations, such as investigations involving dry cleaners.

Probabilistic sampling typically takes more effort to implement than judgmental sampling. However, a probability-based sampling design has the advantage of allowing the use of statistical tests, which permit specification of confidence and uncertainty of the results. Probability-based designs do not preclude the use of expert knowledge or the use of existing data to establish the sampling design. An efficient sampling design is one that uses all available prior information to stratify the site (in order to improve the representativeness of the resulting samples) and set appropriate parameters. Common types of probabilistic sampling designs include simple random, stratified, systematic and grid, composite, and others.

Please note that a single sampling event may not provide an adequate characterization of the contamination onsite, especially when the CSM contains significant data gaps. In these situations, multievent sampling may be helpful. The systematic planning process should help identify the need for this sort of investigation.

Additional information on the development of sampling strategies is available in ADEQ's Site Investigation Guidance Manual (ADEQ, 2014), EPA's Guidance on Choosing a Sampling Design for Environmental Data Collection (EPA, 2002b), EPA's Guidance on Systematic Planning Using the Data Quality Objectives Process (EPA, 2006a), and EPA's Guidance for Developing Standard Operating Procedures (EPA, 2007b).

B.1.2 Sample Types and Matrices

Sample types typically include surface soil, subsurface soil, groundwater and surface water. Some sites require sampling of sediment, pore water, sludge, air (soil gas or vapors) and other non-routine matrices such as building materials. Samples collected can be discrete (grab) or composite samples. Discrete samples are useful for identifying and quantifying chemicals in areas of a site where there is suspected contamination. The number of discrete samples should be determined during the systematic planning process. Composite samples are useful for identifying the average concentrations of contaminants across a site. Composite samples are composed of more than one discrete sample collected from different locations. Submittal to the analytical laboratory as a single sample occurs after mixture of the samples into a single homogeneous sample. Multi-increment (MI) samples represent a specific type of composite sample (Interstate Technical Regulatory Committee, 2012). The number of composite samples and the number of individual samples within a composite sample should be based on the goals established during the DQO process.

Background samples should be collected from the same media as site samples, from areas on or near the site that are unlikely to be contaminated by site-related chemicals. Analysis of background samples for the same parameters as the site samples assists in determining

background concentrations of chemicals. Typically, collection of background data for naturally occurring inorganic chemicals, such as metals, occurs. The typical assumption for manmade organic chemicals background concentrations is 0%. It is the responsibility of the applicant to demonstrate if there is an "anthropogenic background" for organic chemicals that is unrelated to site activities.

B.1.3 Sampling Locations and Frequencies

Identification of sampling locations and schedule for sampling occurs during the systematic planning process. The sampling duration and frequency or whether the work will be done in phases is also determined during the systematic planning process. For instance, if initial investigations indicate that contaminant levels in soils are below regulatory thresholds, no additional sampling would be required. If initial investigations indicate contaminant levels in soils are above cleanup standards, additional sampling would be required during remedial activities and/or post remedial activities.

B.1.4 Sampling Event Planning

Advance planning for field sampling events is required to ensure that the necessary arrangements are in place and that equipment is ready. Listed are considerations when planning a sampling event:

1. Sample Handling and Custody Procedures - Field personnel will make arrangements with the appropriate laboratory for proper sample containers and custody procedures (described further in Section B3).

2. Equipment - Prior to collection of any sample, field personnel will ensure that all sampling equipment has been properly assembled, decontaminated, calibrated and is functioning properly prior to use. Field personnel must use equipment according to manufacturer's instructions and decontaminate equipment according to the appropriate SOPs (Appendix D).

3. Field Forms - Prior to the sampling event, field personnel will assemble all necessary field forms, such field log books, soil and groundwater sampling forms, and boring logs. Site specific needs establish the need for developing site specific forms.

4. Health and Safety - Field personnel will ensure that all site-specific health and safety procedures are considered and that personal protective equipment (PPE) is gathered.

5. Investigation-Derived Waste - Field personnel will plan for the generation of investigation-derived waste (IDW), and should assemble the appropriate IDW containers prior to the sampling event.

6. Field Audits —-Field personnel will plan to conduct periodic field system audits for ongoing sampling events.

7. Paperwork and Permits - Field personnel will also ensure prior to the sampling event that other applicable paperwork is in order, such as permits and access agreements.

8. Site Access - Site access will be obtained by either the RPS Facility owner/operator's consultant or by RPS Project Managers for State Lead program sites. The RPS program has standard work for site access, which includes the process for escalation to management for assistance. J:\WPD\REMEDIAL\1. RPS SW\RPSU SW\Legal Support\Access Agreement.

B.2 SAMPLING METHODS

The systematic planning process and project-specific planning documents establish site-specific sampling methods as well as the numbers and types of samples collected. Details of sample collection methods will depend upon site conditions, equipment limitations, chemicals of concern, sample matrices, and cost. Collection methods will follow an ADEQ or EPA approved sampling protocol, unless unforeseen circumstances do not allow for an approved collection method. The following sections present general information on sampling methods for various media, including surface water, groundwater, drinking water, soil, soil vapor, sediment, pore water, sludge, air, and non-routine matrices such as building materials.

Additional methods may be used with approval of the RPS. General guidelines for field sampling are included in the EPA Standard Operating Procedure (SOP) on General Field Sampling Guidelines (Appendix D). EPA SOPs for field sampling methods are available for download at: https://clu-in.org/publications/db/db_search.cgi?title=1&submit_search=1&cat=18.

B.2.1 Soil Samples

Soil samples collected at RPS sites may include surface and subsurface samples. Sample types may be discrete or composite samples. There are a variety of acceptable methods for collection of soil samples. Selection of an appropriate method will depend on site conditions and the sampling design. Methods commonly used to collect soil samples include drilling soil borings, digging test pits, sampling via hand auger, and digging with a shovel or trowel. Additional information on the collection of soil samples can be found in EPA's Preparation of Soil Sampling Protocols: Sampling Techniques and Strategies (EPA, 1992b) and in the referenced EPA SOP for soil sampling (Appendix D).

B.2.2 Groundwater Samples

Groundwater sample collection is typical during RPS site investigations and cleanups. Collection of groundwater samples may be one-time or ongoing and periodic. Groundwater sample collection can occur from soil borings, temporary well points, monitoring wells, and existing wells (e.g., municipal or community supply wells, domestic water wells, irrigation wells, or industrial supply wells). Shallow, intermediate, deep, and perched aquifers contain groundwater.

Groundwater samples collected from soil borings at specific depth intervals assist in location selection for future monitoring wells. Collection of these one-time samples using a direct-push groundwater sampling method is typical. Appendix D of this QA Program Plan contains an SOP for direct-push groundwater sampling.

Groundwater sample collection from permanently installed monitoring wells is typical. Proper installation according to state regulations (see ARS Title 45, Chapter 2, Article 10) and proper development according to an Arizona Department of Water Resources (ADWR), ADEQ, or EPA-approved protocol of monitoring wells is required. Field logbooks and subsequent reports must note non-standard wells or problems encountered during well installation and sampling. SOPs describing groundwater monitoring well sampling, monitoring well installation and monitoring well development are included in Appendix D.

B.2.3 Surface Water Samples

Surface water sample collection is typical during RPS site investigations and cleanups when evaluating whether contaminants have migrated to nearby surface water bodies. Physical evidence such as odors, organic films on water surfaces, and soil discoloration in the vicinity of surface water are indicators of possible contamination. Surface water samples include representative liquid samples collected from streams, brooks, rivers, lakes, ponds, lagoons, seeps, estuaries, drainage ways, sewers, channels, wetlands, surface water impoundments, and other surface water bodies. Sample collection occurs at the surface or at depth within the water body. Surface water samples will be collected in general accordance with the SOP for surface water sampling included in Appendix D.

B.2.4 Pore Water Samples

Pore water is water contained within the upper few centimeters of sediments just below the surface water/sediment interface. This interface is the hyporheic zone. Typical equipment utilized for sampling of this zone are seepage meters and push-point pore water samplers or lysimeters. Discharge of groundwater to surface water through the hyporheic zone is unlikely to be homogeneous; therefore, determining locations for pore water sampling can involve additional investigative steps.

B.2.5 Sediment Samples

Sediment sample collection occurs for the analysis of biological, chemical, or physical parameters in sediments. There are many factors to consider when choosing sediment sampling equipment including, but not limited to, site access, sample volume requirements, sediment texture, target depth for sediment collection, and flowing versus standing water. In general, use of piston samplers are best for soft, fine-grained sediments where sediments at depth are required. Grab/dredge samplers are best for coarse, shallow sediments and where large volumes of sediment are required. The SOP for sediment sampling provides additional information on the collection of sediment samples (Appendix D).

B.2.6 Sludge Samples

Sampling of sludge could involve a number of different situations and will likely depend upon site conditions. Therefore, project-specific planning document will detail collection of sludge samples. Catch basins and drywells are common settings where sludge sampling occurs.

B.2.7 Air/Soil Vapor Samples

Collection of air sampling is typical at sites where vapor inhalation of contaminants is or may be an exposure issue. Collection of soil vapor samples is routine to investigate releases of VOCs. Air sampling and soil vapor sampling is more complex than soil or water sampling because of the reactivity of chemical compounds in the gas matrix and sample interaction with the sampling equipment and media. A number of factors, including site conditions, sampling objectives, chemicals of concern, analytical methods, and cost, forms the basis for selecting air and soil vapor sampling equipment. Methods to sample air at active facilities include, but are not limited to, soil gas sampling or sampling with flux chambers. Typical sampling containers include tedlar bags, stainless steel Summa canisters, gas tight syringes, and glass sorbent traps used with sampling pumps. Sources of information for air and soil vapor sampling and analysis are: http://www.airtoxics.com in EPA's SOP for general air sampling guidelines (Appendix D) and ADEQ's Soil Vapor Sampling Guidance.

B.2.8 Building Materials Samples

Sampling at RPS sites can involve non-routine sampling of unusual sample matrices, such as building materials. These matrices include concrete slabs or other types of building materials. Development of site-specific sample collection procedures occurs, if needed, for sampling such non-routine matrices. Sampling personnel will coordinate with the analytical laboratory on the anticipated sample collection and handling methods to ensure that the sample data will meet all QA/QC requirements. Additional information on the collection of non-routine sample matrices is in EPA's SOP for chip, wipe and sweep sampling (Appendix D).

B.3 SAMPLE HANDLING AND CUSTODY

Chain of custody procedures differ among laboratories. Title 9, Chapter 14, Article 6 of the Arizona Administrative Code (R9-14-615) details the necessary documentation for sample control activities at an ADHS licensed laboratory. Identification of custody procedures of the analyzing laboratory occurs prior to field activities. Field personnel must arrange with the appropriate laboratory for proper sample containers, preservatives, holding times and chain of custody forms. The custody of a sample must be traceable from the time of sample collection to the reporting of results. Chain of custody procedures provide a mechanism for documenting information related to sample collection and handling. Completion of a chain-of-custody form must occur after sample collection and prior to sample shipment or release. Cross-checking of the chain-of-custody form, sample labels and field documentation is necessary to verify sample identification, date and time sample was collected, type of analyses, number of containers, sample volume, preservatives and type of containers. Additional information on sample handing and custody procedures is in EPA's SOPs for specific sample collection methods. Appendix D of this QA Program Plan references SOPs and forms for sample handling, custody (chain-of-custody forms), and transport.

B.4 ANALYTICAL METHODS

All analytical methods used to analyze samples must comply with relevant requirements of applicable federal or state programs for which they were collected, such as the CWA, SDWA, RCRA, Clean Air Act, or use other EPA-approved alternate methods. The most recently

approved methods under the CWA and SDWA are located in the Code of Federal Regulations under 40 CFR Part 136. The EPA website at https://www.epa.gov/RPS-sw846/sw-846-compendium contains the current approved methods under RCRA SW-846. Exhibit 1 of Title 9, Chapter 14 of the Arizona Administrative Code details ADHS approved methods with corresponding analytes. ADHS weekly provides an update of the licensed laboratories, methods and analytes that is captured in the database. This allow for checks on any data captured in the database.

ADHS exceptions are permitted under ARS § 36-495.02 for the federal projects unit where laboratories certified under the National Environmental Laboratory Accreditation Conference (NELAC) may be used.

B.5 QUALITY CONTROL

QC requirements are integral to the success of a QA program. QC covers the overall system of technical activities that measure the performance of a process against defined standards to verify that they meet predefined requirements. Because errors can occur in the field, laboratory, or office, it is necessary for QC to be part of each of these functions. This QA Program Plan describes and defines the general quality objectives of the RPS. Project-specific planning documents define site-specific quality objectives. This approach to quality system management ensures conducting quality activities throughout the data generation process but allows for the flexibility to tailor quality-related activities to individual site-specific data needs.

QA and QC parameters apply to the two primary types of data - definitive and non-definitive data - regardless of whether the data collection activity is associated with field measurements or laboratory measurements. Non-definitive data are frequently collected during the first stage of a multi-phase screening investigation, using rapid, less precise methods of analysis with less rigorous sample preparation. Non-definitive data can provide analyte identification and quantification, although both may be relatively imprecise. Typically, confirmation of 5 to 10 percent of non-definitive samples or all critical samples occurs using analytical methods, QA/QC procedures, and criteria associated with definitive data. Non-definitive data without associated confirmation data are of unknown quality. Qualitative, nondefinitive data identify the presence of contaminants and classes of contaminants and can help focus the collection of definitive data, which is generally the more expensive of the two. Some data uses, such as risk assessments, require definitive data.

Use of EPA's Guidance for Preparation of Standard Operating Procedures for Quality Related Operations (EPA, 2007a) is typical for developing SOPs. SOPs should be included as an appendix of all planning documents and reports generated for and submitted to ADEQ's RPS. The project field team should document reasoning for any deviations from an SOP and include that documentation in all planning documents and reports generated for and submitted to ADEQ's RPS. The Arizona Department of Health Services (ADHS) is responsible for reviewing the standard operating procedures developed by and used for environmental laboratories. ADHS is also responsible for licensing of environmental laboratories under Title 9, Chapter 14, Article 6 – Licensing of Environmental Laboratories.

B.5.1 Quality Control in the Field

Description of QC parameters in detail for each step of field work should also include specific corrective actions for difficulties encountered in the field. Evaluation of field sampling procedures requires the collection and evaluation of field QC samples. To provide a means of assessing data quality resulting from the field sampling program, collection and submittal to the analytical laboratory includes trip blanks, rinsate blanks, field duplicates, and extra volume for matrix spikes and matrix spike duplicates. Subsequent paragraphs contained in this section of this QA Program Plan note collection frequencies for field QC samples.

Field QC requirements and documentation of all field sampling and observations are critical for providing a historical record for analysis of the usability of the data produced. The official field log book will contain documentation of field activities that involve the collection and measurement of environmental data. Recording related field activities as explained below can require developing additional forms.

SOPs delineate the step-by-step approach that field personnel must follow in collecting samples, taking field measurements, decontaminating equipment, handling investigative derived waste (IDW), and calibrating instruments. Most qualified sampling contractors and State and Federal certified laboratories develop SOPs and analytical methods as part of their overall QA program. Use of EPA's Guidance for Preparation of Standard Operating Procedures for Quality-Related Operations (EPA, 2007a) is typical for developing SOPs. SOPs should be included as an appendix of all planning documents and reports generated for and submitted to ADEQ's RPS. The project field team should document reasoning for any deviations from an SOP and include that documentation in all planning documents and reports generated for and submitted to ADEQ's RPS. Typically, sampling is conducted by contractors who follow the SOPs chosen for the site.

B.5.2 Field Documentation

The field team should record field activities in indelible ink, in a permanently bound notebook with prenumbered pages or on a preprinted form. For each sampling event, the field team must provide the site name, physical location, date, sampling start and finish times, names of field personnel, level of protection, documentation of any deviation from protocol, and signatures of field personnel. For individual samples, field teams should ensure that field logbooks document the exact location and time the sample was taken, any measurement made (with real-time equipment), a physical description of the sample, sample ID number, sampling depth, sample volume, sample type, and the equipment used to collect the sample. This information can be critical to later evaluations of the resulting data's usability.

Complete and accurate documentation is necessary to demonstrate that field measurement and sampling procedures are in accordance with this QA Program Plan and any project specific planning document. Field personnel will use permanently bound field logbooks with sequentially numbered pages to record and document field activities. The logbook will list the contract name and number, the project name, the site name, and the names of subcontractors, the service client, and the project manager. The contractors performing field work should develop field forms to

record field activities. At a minimum, the field logbook must document the following information:

- Name and affiliation of all on-site personnel or visitors
- Weather conditions during the field activity
- Summary of daily activities and significant events
- Notes of conversations with coordinating officials
- References to other field logbooks or forms that contain specific information
- Discussions of problems encountered and their resolution
- Discussions of deviations from the project-specific planning document or other governing documents
- Description of all photographs taken

The contractors performing field work are expected to develop field forms to record field activities. Labeling individual samples should occur in the field. Labels should include sample location, sample number, date and time of collection, sample type, sampler's name, and method used to preserve the sample, if applicable. Sample preservation involves the treatment of a sample usually through the addition of a compound that adjusts pH to retain the sample properties, including concentrations of substances, until analysis of the sample. The field team should create a table listing the total number of samples, types of sample matrices, all analyses planned for each sample differentiating critical measurements and other information that may be relevant to later assessments of the data usability. Typically, report submittals to ADEQ contain copies of field forms that contain field data.

B.5.3 Trip Blanks

Trip blank samples help evaluate whether the shipping and handling procedures are introducing contaminants into the samples or if cross-contamination in the form of migration of VOCs between the collected samples. One trip blank submitted to the laboratory for analysis is necessary each day that samples are collected. Trip blanks for soil and water samples are volatile organic analysis (VOA) vials filled with purged deionized water that remain closed while transported to the field and then returned to the laboratory without being opened.

B.5.4 Rinsate Blanks

Rinsate blanks help evaluate the potential for cross-contamination of samples during collection. Collection of rinsate blanks occurs at a rate of one per day per matrix when using non-dedicated and nondisposable sampling equipment in the field. Collection of equipment rinsate blanks occurs by passing organic-free water through or over the decontaminated sampling equipment and collecting the rinse water in appropriate sample containers.

Rinsate blank analysis is for the same parameters as the associated field samples. Rinsate blanks should not contain detectable concentrations of target analytes greater than the Project Required Quantitation Limit (PRQL) for the compound. Any detection of target analytes in a rinsate blank will result in an investigation to determine effect on overall data usability. Affected results will be qualified as estimates or as non-detects at an elevated PRQL as appropriate.

B.5.5 Field Duplicate Samples

Collection of field duplicate water and air samples occurs simultaneously in separate containers. The purpose of field duplicates is to allow evaluation of the contribution of random error from sampling to the total error associated with the data. One set of field duplicates will be collected and submitted for every twenty field samples collected (and at least one per sampling day if less than twenty are collected) for water, soil, and air. Field duplicate precision will be evaluated as described below.

B.5.6 Matrix Spike/Matrix Spike Duplicates (Field Requirements)

Double sample volume should be collected at a rate of one per twenty samples per matrix (minimum of once per sampling event) to ensure that the laboratory has sufficient volume to perform matrix spikes and matrix spike duplicates (MS/MSDs).

B.5.7 Inter-laboratory Split Samples (Field Requirements)

Inter-laboratory split samples are field duplicates (liquid matrices) or split samples (solid matrices) submitted to both the primary laboratory and a secondary or QC laboratory. Collection of inter-laboratory split samples occurs simultaneously with a sample from the same source under identical conditions into separate containers. Results from the split samples help assess laboratory performance by comparison of qualitative and quantitative results from the two laboratories, including indications of matrix interferences such as elevated PRQLs. In order to provide useful information, however, the split sample must be directly associated with the original (primary) sample to evaluate laboratory performance. Field personnel determine the association and maintain the association during the data import process.

B.5.8 Quality Control in the Laboratory

Compliance monitoring on ADHS licensed laboratories is conducted by the ADHS as described in Title 9, Chapter 14, Article 6 of the Arizona Administrative Code (AAC R9-14-605 – Compliance Monitoring). ADEQ also conducts Technical Systems Audits on ADHS licensed laboratories (ADEQ contract laboratories and contract laboratories of contractors who submit analytical data to ADEQ). The primary goals of TSAs will be to review the laboratory organization, operation, and capabilities; determine the reliability of data; and note corrective action for any apparent deficiencies. The ADEQ QA/QC Manager or QA/QC Representatives selects auditors for TSAs based on their technical proficiency in the subject area. The designated auditors will be responsible for planning and conducting the audit, and reporting the findings to the laboratory manager and to the ADEQ QA/QC Manager or QA/QC Representatives.

B.6 INSTRUMENT/EQUIPMENT TESTING, INSPECTION AND MAINTENANCE

Calibration of all analytical instrumentation is required to ensure that the analytical system is operating correctly and functioning at the sensitivity that is required to meet project-specific DQOs. Each instrument will be calibrated with standard solutions appropriate to the instrument and analytical method, in accordance with the methodology specified and at the QC frequency specified in laboratory or field sampling SOPs.

Owners and/or operators and their contractors may use field equipment such as pH meters, dissolved oxygen meters, PIDs, and others to take environmental measurements. Such equipment

must be properly maintained, calibrated, and tested prior to use according to written SOPs, and follow the equipment manufacturer's recommendations. Testing, maintenance, inspection, and calibration, schedule should be included in the SAP as applicable.

B.7 INSTRUMENT/EQUIPMENT CALIBRATION AND FREQUENCY

B.7.1 Field-Based Instruments

Appropriate operation and maintenance of field equipment and documentation of such is the responsibility of the operator. When this equipment is owned by a contractor or a rental company, the operator is responsible for ensuring proper maintenance and calibration procedures are followed prior to use in data collection efforts. The operator is also responsible for documentation of conditions of use upon conducting routine inspection, typically prior to use. Typically the operator will be a contractor, either to ADEQ or the responsible party.

Field equipment, if used, will be calibrated at the beginning of the field effort and at prescribed intervals. The calibration frequency depends on the type and stability of equipment, the intended use of the equipment and the recommendation of the manufacturer. Detailed calibration procedures for field equipment are available from the specific manufacturers' instruction manuals, and general guidelines are included in SOPs. All calibration information will be recorded in a field logbook or on field forms. A label that specifies the scheduled date of the next calibration will be attached to the field equipment. If this type of identification is not feasible, equipment calibration records will be readily available for reference. Field-based analytical instruments, such as turbidimeters and pH electrodes must be calibrated following manufacturers' instructions and frequency recommendations (or following appropriate SOPs) before they may be used for collecting data.

Sampling and analysis generally require the use of different pieces of equipment and tools in the gathering of environmental data. A field preventive maintenance protocol involves ensuring that all field equipment has been properly calibrated, charged, and inspected prior to and at the end of each working day and that replacement parts are available.

Inspection of all field equipment is required to determine if it is adequate and appropriate for the media, parameters, and required testing. Data may be generated onsite through the use of real-time equipment, such as photoionization detectors (PIDs), organic vapor analyzers, and pH meters.

For field-testing, examination of equipment occurs to ensure that it is in working condition and properly calibrated. The team is required to track the transfer of samples. Staff calibrate field instruments according to the method and schedule specified in an SOP. The manufacturer's operating manual usually forms the basis for these types of SOPs. Calibration of field equipment occurs more often than specified in the SOP when using equipment under adverse or extreme field conditions.

All field instruments should be tested, inspected, and maintained according to the manufacturer's guidelines and recommendations. Data collected from improperly functioning equipment will not

be used. ADEQ contractors, Owner/Operator contractors, and property owner contractors typically are the ones that collect field data and are responsible for the correct operation of their equipment. ADEQ staff, on rare occasion, does collect field data. ADEQ staff should follow the equipment manufacturers operating manual for ensuring proper operation of any utilized equipment.

Maintenance of records for equipment testing, inspection, and maintenance occurs in a bound logbook for each piece of equipment. Recorded in the logbook are the date, time, name of inspector, equipment inspected, and the results of testing and inspection. Inspection occurs on all equipment or systems requiring periodic maintenance.

Preventive maintenance for most field equipment is carried out in accordance with procedures and schedules recommended in (1) the equipment manufacturer's literature or operating manual or (2) SOPs that describe equipment operation associated with particular applications of the instrument. However, critical measurements for field equipment may require more stringent testing, inspection, and maintenance procedures. Unscheduled testing, inspection, and maintenance occurs on equipment whose condition is suspect. Reporting in the daily field QC report occurs for any significant problems with field equipment.

B.7.2 Laboratory Instruments

Calibration and maintenance of analytical instruments will be conducted in accordance with the QC requirements identified in each laboratory SOP and in QA manuals, along with the manufacturers' instructions. General requirements are discussed below.

The history of calibration and maintenance for instruments in the subcontract laboratory is an important aspect of the project's overall QA/QC program. As such, all initial and continuing calibration procedures will be implemented by trained personnel following the manufacturer's instructions and in accordance with applicable EPA protocols to ensure the equipment is functioning within the tolerances established by the manufacturer and the method-specific analytical requirements.

The laboratory will obtain calibration standards from commercial vendors for both inorganic and organic compounds and analytes. Stock solutions for surrogate standards and other inorganic mixes will be made from reagent-grade chemicals or as specified in the analytical method. Stock standards will also be used to make intermediate standards that will be used to prepare calibration standards. Special attention will be paid to expiration dating, proper labeling, proper refrigeration and freedom from contamination. Documentation on receipt, mixing and use of standards will be recorded in the appropriate laboratory logbook. Logbooks must be permanently bound. Additional specific handling and documentation requirements for the use of standards may be provided in subcontractor laboratory QA plans.

The verification standards for initial calibrations should be analyzed after the instrument calibration to verify the preparation and concentration of the calibration standards. The verification standards for continuing calibrations should be analyzed (as per method requirements) to verify the calibration of the analytical system over time.

Analytical balances will be calibrated annually according to manufacturer's instructions and have a calibration check before each use by laboratory personnel. Balance calibration shall be documented in hardbound logbooks with pre-numbered pages.

All refrigerators and incubators will be monitored for proper temperature by measuring and recording internal temperatures on a daily basis. At a minimum, thermometers used for these measurements will be calibrated annually, according to manufacturer's instructions.

The subcontract laboratories will maintain an appropriate water supply system that is capable of furnishing ASTM Type II polished water to the various analytical areas.

B.8 INSPECTION/ACCEPTANCE OF SUPPLIES AND CONSUMABLES

The laboratory shall inspect supplies and consumables prior to their use in analysis. The description of materials provided in the method shall be used as a guideline for establishing the acceptance criteria for these materials. Purity of reagents shall be monitored by analysis of LCSs. An inventory and storage system for these materials shall assure use before manufacturers' expiration dates and storage under safe and chemically compatible conditions.

Analytical laboratories are required to provide certified clean containers for all analyses. These containers must meet EPA standards described in Specifications and Guidance for Obtaining Contaminant-Free Sampling Containers (EPA, 1992c).

Procedures for receiving supplies and consumables in the field are similar. When supplies are received, the project manager or field team leader will log the supplies into a supply logbook and then inspect all items against the acceptance criteria. The laboratory will provide sample containers, labels, chain-of-custody forms, and coolers, as requested by the program. Properly cleaned sample containers must be provided so that no target compound contamination occurs from contact with the sample container. Equally important is that where applicable, the laboratory must provide preservative reagents that are free of target analytes or other contaminants. Any deficiencies or problems will be noted in the field logbook, and deficient items will be returned for immediate replacement.

B.9 NON-DIRECT-MEASUREMENTS

Environmental data generation typically involves planning, sampling, analysis, investigation, and data review. In planning their investigations, project teams generally use existing data to develop sampling designs and to decide how much and what type of data to collect. The term existing data are synonymous with "secondary data" and "non-direct measurements". Existing data may come from a number of sources, including other studies, government databases, etc. The original purpose for collecting these secondary data may be very different from that of the current investigation. Also, these secondary data may have been collected using different sampling methods (composite vs. grab, random vs. hot spot sampling), and/or analytical methods than those selected for the current investigation.

Basing decisions on existing data may result in errors if secondary data were not generated for the same purpose or using the same methods as the current investigation. Biased data can impact final conclusions. Therefore, before using secondary data, project team members should evaluate the data to identify any limitations on their use. Also, to ensure transparency in decision making, project team members clearly document criteria and reasons for ***including*** and ***excluding*** certain data from use. Failure to clearly document why data are included or excluded can result in the appearance of biased data selection and diminish the product's credibility.

Sources of secondary data include the following:

- Environmental indicator data obtained from federal/state/local databases and records
- Existing sampling and analytical data from a previous investigation of the area
- Computer model simulations and applications pertaining to other studies
- Historical data (e.g., from organization's/facility's corporate records and/or federal/state local records pertaining to previous monitoring events, site investigations, etc.)
- Background information/data from organization's/facility's corporate records and/or federal/state/local records pertaining to site-specific industrial processes, process by-products, past and current chemical uses, raw material and finished product testing, waste testing and disposal practices, and potential chemical breakdown products
- Data generated to verify innovative technologies and methods
- Data obtained from computer databases (such as manufacturers' process/product information, waste management or effluent information, and EPA or state data bases)
- Literature files/searches
- Publications
- Photographs
- Topographical maps
- Meteorological data

B.10 DATA MANAGEMENT

Field staff record field data generated for RPS, such as sample ID and latitude/longitude coordinates, groundwater monitor well data on field data sheets or hand-held computers. Field data are reported to the Project Manager through submission of field notebooks or field sampling data sheets by RPS field staff or contractor field staff.

Laboratory analytical reports will include QC results and any other necessary analytical information, enabling reviewers to determine data quality. Laboratory data should be submitted to the ADEQ Project Manager in both printed and electronic form. Rapid turnaround data from the laboratory are reported to the Project Manager, if requested, but rapid turnaround is generally not required. Copies of field logs, a copy of chain-of-custody forms, original preliminary and final lab reports and electronic media reports must be kept by contractors for review by ADEQ.

The field crew must retain original field logs. The contract laboratory shall retain chain-of-custody forms. Logs and lab reports are maintained in facility files as hard copies, and are also maintained on ADEQ's common J:\ drive in facility-specific folders. The contract laboratory will retain copies of the preliminary and final data reports.

Project files follow the ADEQ's retention schedule outlined in State policies. The retention policy provides essential information, guidance and tools necessary for ADEQ to manage and operate an effective records management system and disposition program. Individual project files are located in the Record Center, on the first floor of ADEQ's Phoenix office. ADEQ's Record Retention Schedule is attached as Appendix C.

SECTION C ASSESSMENT AND OVERSIGHT

C.1 ASSESSMENT AND RESPONSE ACTIONS

Assessment and response actions are part of the quality system for ensuring and documenting that procedures required by this QA Program Plan are being followed during the generation of data to be included in all planning documents and reports generated for and submitted to RPS.

During the planning process, many options for sampling, sample handling, sample analysis and data reduction are evaluated. Selection of specific options depends on the nature of the corrective action or monitoring activity. This section of the QA Program Plan describes the internal and external checks necessary to ensure correct implementation of all elements. In addition, needed checks ensure adequate data quality and implementation of timely and effective corrective actions. Documenting all internal assessments is a critical component of the quality system.

ADEQ employs several QA assessment tools designed to provide a better understanding of the components of, and the basis for improving, the ADEQ Quality Management System. Internal (Programmatic) and External QA audits are one of the principal tools for determining the effectiveness of the ADEQ QA/QC components. QA/QC specialists current conduct Audits of Data Quality and Technical Systems Audits of programs whose staff collect data used for compliance, assessment and prevention purposes. These audit types are discussed in greater detail in subsequent subsections. Data Quality Assessments will be conducted on a project-by-project basis. QA audit frequency and scheduling will vary with the type of review conducted. Assessment activities are scheduled and conducted at the direction of the QAM in accordance with the internal audit standard work requirements (ADEQ, 2019). The internal audit standard work is maintained at J:\Common\ADEQ Quality Management Program\Projects. All audit findings are shared with the Value Stream Managers and are tracked by the audit team until the VS implements successful countermeasures.

C.1.1 Management Systems Review (MSR)

An MSR is an independent assessment of a Program's QA management practices and data collection procedures. Generally, the ADEQ QA/QC Manager or QA/QC Representatives performs the MSR. The EPA QA Office can also conduct MSRs. The MSR will qualitatively assess a program to determine if the ADEQ Quality Management System is adequate to ensure the quality of the Program's data. MSRs address the effectiveness of management controls in achieving and assuring data quality, the adequacy of resources and personnel devoted to QA functions, the effectiveness of training and assessments, and the applicability of data quality requirements. While MSRs can identify significant QA concerns and areas of needed improvement, they also point out noteworthy accomplishments.

Most MSRs will examine the following items:

- Assessment of the overall effectiveness of the QA management system, as measured by its adherence to the approved QMP;
- Procedures for developing Data Quality Objectives (DQOs);

- Procedures for developing and approving QA Program Plans and Quality Assurance Project Plans (QAPjPs);
- Effectiveness of existing QA Program Plan guidance and QAPjPs;
- Procedures for developing and approving SOPs;
- Procedures, criteria, and schedules for conducting QA audits;
- Tracking systems for assuring that the QA Program is operating effectively, and that corrective actions disclosed by QA audits have been taken;
- Responsibilities and authorities of various line managers and QA personnel for implementing the QA program;
- Degree of management support;
- Level of financial and other resources committed to implementing the QA Program.

The ADEQ QA/QC Manager or QA/QC Representatives utilizes EPA's Guidance on Assessing Quality Systems (Management Systems Review Process, 2003) for conducting MSRs.

The following lists the objectives of reviews for any ADEQ related Quality Assurance Programs:

- Identify any data quality problems;
- Identify benchmark practices for use in other Agency Programs;
- Propose recommendations for resolving quality problems;
- Confirm implementation and effectiveness of any recommended corrective actions.

C.1.2 Assessment of Program Activities

Technical Systems Audits (TSAs)

The purpose of a Technical Systems Audit is to assess the sampling and analytical quality control procedures used to generate environmental data. TSAs entail a comprehensive, on-site evaluation of the field equipment; sampling and analyses procedures; documentation; data validation; and training procedures for collecting or processing environmental data. TSAs occur for both laboratory and field activities.

Laboratory TSAs

TSAs occur on entities that submit analytical data to ADEQ. These entities are the ADEQ contract laboratories, and contract laboratories of Owner/Operator contractors. The primary goals of TSAs will be to review the laboratory organization, operation, and capabilities; determine the reliability of data; and note corrective action for any apparent deficiencies. ADHS, rather than ADEQ, is responsible for licensing environmental laboratories and can conduct audits and inspections at environmental laboratories. ADEQ's QA\QC staff can work with ADHS to identify laboratories to audit/inspect.

Field TSAs

Oversight of field operations is an important part of the quality assurance process. The ADEQ QA/QC Manager or QA/QC Representatives will conduct QA audits of field sampling activities, both for its own field operations, and on those contractors that collect samples for RPS Programs. ADEQ will specify frequency and procedures for conducting field TSAs within specific Program areas. When project-specific planning documents are reviewed, and also during any MSRs or other QA audits, ADEQ's QA/QC Manager or QA/QC Representatives will determine the necessity of field TSAs. Specific items observed during the audit may include:

- Availability of approved project plans such as the project-specific planning document and Health and Safety Plan (HASP) to all project members
- Documentation of personnel qualifications and training
- Sample collection, identification, preservation, handling and shipping procedures
- Decontamination procedures used to clean sampling equipment
- Equipment calibration and maintenance
- Completeness of logbooks and other field records (including nonconformance documentation)

Performance Evaluations

Use of Performance Evaluation (PE) samples help assess the ability of a laboratory, or field measurement system, to provide reliable data. PE samples are for laboratories providing analytical services, directly or indirectly, for ADEQ and will be traceable, whenever possible, through the National Institute of Standards and Technology (NIST). The evaluation consists of providing a reference "blind" or "double blind" sample to the laboratory for analysis. A PE sample contains known concentrations of chemical constituents, or pollutants, of interest and will normally be in the appropriate media (e.g., soil, water, air). The analytical results obtained by the laboratory are compared to the known concentrations of the chemical constituents contained in the PE sample(s) as a means of determining if the laboratory demonstrated its ability to properly identify, and quantify, pollutants within established, or calculated, control limits.

The RPS schedules PE samples on an as-needed basis depending on the laboratory. All PE studies performed for ADEQ, whether required on a regular basis or performed on a one-time basis, will be coordinated through or requested from the ADEQ QA/QC Manager or QA/QC Representatives or designee. For external projects requiring PEs, the Task/Work Assignment, Task/Delivery Order, or similar document needs to outline the specific details of the Performance Evaluation so the associated costs can be included in the contractor proposal. The results of PEs provide a means for assessing overall data integrity and used as criteria for selecting candidates for on-site evaluations.

Audits of Data Quality

EPA 2001 Guidance for Quality Assurance Project Plans defines an audit of data quality (ADQ) as "a qualitative and quantitative evaluation of the documentation and procedures associated with environmental measurements to verify that the resulting data are of acceptable quality." This assessment primarily involves an evaluation of the completeness of the documentation of field and analytical procedures and quality control results. Also, it usually involves tracing the paper

trail accompanying the data from sample collection and custody to analytical results and entry into a database. This technique is the common verification process involved in entering data residing in large regulatory databases.

Results of both Data Quality Assessments (DQAs) and data quality audits can be used in at least two ways. One use is in making recommendations for changes in the design and performance of data collection efforts and in the use and documentation of QC procedures. A second use is as a guide for the planning and acquisition of supplemental data for the project and potentially for other related projects. Problems identified through DQAs may trigger the need for an MSR to determine management deficiencies or a TSA to identify technical problems.

Data Quality Assessments (DQAs)

A DQA refers to the process used to determine whether the quality of a given data set is adequate for its intended use. DQAs may occur on selected projects and/or data generation processes. The purpose of this type of evaluation is to determine whether the data collected are acceptable to the decision-maker or end user. Assessments generally take during the data generation process. As data accumulates, aspects of the project such as surveillance of field and laboratory operations, consistency of the data with MQOs, successfully completing performance evaluation sample studies, and so forth, helps assess whether the data are valid and acceptable. ADEQ disregards rejected or questionable data in its decision making, except in limited circumstances, such as a rough site screening.

Once data are of known and acceptable quality, then evaluation of the results in the context of the Data Quality Objectives for the project occurs. For most circumstances involving source area decision units, sample results involve a 1:1 sample comparison to regulatory standards or laboratory detection limits. For circumstances involving exposure area decision units, the RPS typically use statistics on sample results (e.g. metal contaminants in soils from windblown deposits emanated from tailings piles or smokestack plumes). EPA's Data Quality Assessment - A Reviewers Guide (EPA, 2006b) and Data Quality Assessment - Statistical Methods for Practitioner (EPA, 2006c) discusses the types and uses of statistical analyses.

An assessment also occurs as to whether there is a sufficient quantity of data to support program or project decisions, and whether the original sampling design was appropriate. In some cases, the data may suggest that additional data are required to achieve a higher statistical confidence level. This could be because of overlooking too many invalidated data points, not collecting samples over a long enough time period, or missing a vital sampling area not previously considered important. In other cases, an assessment might show that data of a different type are required, or that the sensitivity of the instrument used in the measurement was not adequate to meet project objectives. If necessary, ADEQ's QA/QC Manager or QA/QC Representatives can review data generated by contract laboratories, for the ADEQ RPS Programs. These data review activities should use checklists, standard operating procedures, and standardized qualification codes to indicate data quality.

Peer Reviews

Peer reviews are not strictly an internal QA function; rather, they are technical scientific reviews that evaluate assumptions, calculations, methods, and conclusions. The ADEQ will use internal expertise to evaluate different technical aspects of the reports produced by contractors and Owner/Operators.

C.1.3 Documentation of Investigations

Once every four years every major Agency Program attempts an MSR. TSA's occur if specifically requested by ADEQ's Project/Case Manager, the findings of another audit or review necessitate another, or if the ADEQ QA/QC Manager or QA/QC Representatives plans one. MSRs and TSAs are generally conducted by ADEQ's QAM and focuses on RPS adherence to the approved Agency QMP and its QAPP. Results will be reported to the audited organization in the form of a written report within 14 calendar days of the completion of the audit, or a mutually agreed upon alternative. Written comments by ADEQ's Project/Case Manager must be supplied to ADEQ's QA/QC Manager or QA/QC Representatives within 14 calendar days of receipt of the audit findings, or a mutually agreed upon alternative. Copies of the TSA Audit Final Report will be stored in the project file and also with ADEQ's QA/QC Manager or QA/QC Representatives. Distribution of additional copies occurs as appropriate.

Addressing nonconformance to practices and procedures outlined in this QA Program Plan or a project specific planning document submitted to ADEQ by an Owner/Operator should happen in a timely manner to ensure correction of nonconforming issues or deficiencies. The ultimate responsibility to ensure that all issues and deficiencies are satisfactorily resolved rests with the Unit Supervisors and Section Manager. Arizona Administrative Code allows Owner/Operators to satisfactorily correct deficiencies in a planning document.

The RPS will have 30 days to prepare a written response to the reviewer's assessment memorandum. If the evaluation report recommends corrective actions, the RPS should address these recommendations and include a schedule for making any appropriate changes in its quality assurance procedures. The ADEQ Leadership team uses these reviews to gauge the effectiveness of the Agency QMP and of the RPS approach to data quality management.

C.2 REPORTS TO MANAGEMENT

Effective management of environmental data collection requires (1) timely assessment and review of all activities and (2) open communication, interaction, and feedback among all project participants. This section outlines the reporting requirements for activities conducted under the RPS, including Owner/Operator led projects. Required reports provide a structure for evaluating the management of program schedules, assessing the effect of deviations from approved program or project-specific planning document on data quality, and determining the potential uncertainties in decisions made based on the data. Senior technical staff, case/project managers, and the QA/QC Representative review these reports and provide summaries on any identified data quality issue. Typically, these summaries are in memo form for specific projects or, for program concerns, presented orally at unit or section meetings where discussion occurs. Required reports keep managers and project members informed on the performance of QA/QC activities. Data quality summaries by ADEQ staff provide the results of project-specific audits,

list any significant problems and discuss the solutions and corrective actions implemented or to be implemented to resolve QA/QC problems.

C.2.1 Frequency, Content and Distribution of Reports

Field, technical, laboratory or QA personnel generate QA/QC reports and send them to the RPS, as required throughout the duration of the project. These QA/QC reports are in written memo or oral form, depending on the problems observed. A summary of the information included in these QA reports is normally included in ADEQ's required reporting (See Figures A2).

The contractor field team will record daily activities in a field log book to summarize activities throughout the field investigation. This daily log book will describe sampling and field measurements, equipment used, subcontractor personnel on site, QA/QC and health and safety activities, problems encountered, corrective actions taken, deviations from the QA Program Plan or project-specific planning document, and explanations for the deviations. The field team leader prepares the daily log book and submits it to the RPS, if requested. The final report for field investigations will summarize the content of the daily log book.

The required reports submitted for the project should include discussion of the following QA/QC report elements, if appropriate:

- Sampling and support equipment that were used, other than those specified in the approved QA Program or project-specific planning document.
- Preservation or holding-time requirements for any sample that were not met
- QC checks (field and laboratory) that were found to be unacceptable
- Analytical requirements for precision, accuracy, or method detection limit/practical quantitation limit (MDL/PQL) that were not met
- Sample collection protocols or analytical methods specified in the QA Program Plan that were not met
- Any activity or event that affected the quality of the data
- Any corrective actions that were initiated as a result of deficiencies
- Any internal or external systems or performance audits that were conducted

The QA/QC report contains an emphasis on evaluating whether project MQOs and data are of adequate quality to support the required decisions stated in the project DQOs. The following example contains a list of recommended topics for use in developing a comprehensive QA/QC report, if necessary. The information listed below should be contained within a QA Report, if appropriate.

C.2.2 Identify Responsible Organizations and Individuals

The facility owner, operator, property owner, or state or federal government – either directly or through its contractor - is responsible for preparing planning documents and reports and

incorporating any comments received from RPS personnel. These parties are responsible for ensuring that a complete environmental laboratory report is included in all planning documents and reports, if applicable, generated for and submitted to the RPS.

SECTION D DATA VALIDATION AND USABILITY

D.1 DATA VERIFICATION AND VALIDATION REQUIREMENTS

This section describes the planned procedures to review, verify and validate field and laboratory data. This section also discusses procedures for verifying that data are sufficient to meet DQOs and MQOs for the project. Data verification, validation, and assessment ensures that environmental programs and decisions are supported by the type and quality of data needed and expected for the intended use.

Data verification and validation confirms the integrity of the data generated over the life of the project. The process for determining if the data satisfy program-defined requirements involves evaluating and interpreting the data, in addition to verifying meeting QC requirements. The systematic planning approaches described in ADEQ's Waste Programs Division Site Investigation Guidance Manual – the DQO Process and the Triad Approach - should produce data that provide answers to critical study questions. ADEQ's RPS utilizes the Triad Approach which contains some elements of the DQO Process.

EPA's Guidance on Environmental Data Verification and Data Validation (EPA, 2002c) presents the process for verifying and validating data. Section 5 of this EPA guidance provides tools and techniques for data verification and validation: https://www.epa.gov/quality/agency-wide-quality-system-documents.

D.1.1 Data Verification

Data verification is the process of evaluating the completeness, correctness, conformance, and compliance of a specific data set against the method, procedural or contractual requirements. Data verification evaluates adherence to data generation sampling protocols, SOPs, analytical methods, and project specific planning documents. Verification also involves examining the data for errors or omissions. Field and laboratory staff can verify that the work is producing appropriate outputs.

Project team personnel, whether they are ADEQ contractors, ADEQ staff, or Owner/Operators, will verify field data through reviews of data sets to identify inconsistencies or anomalous values. Any inconsistencies discovered will be resolved as soon as possible by seeking clarification from field personnel responsible for data collection. To obtain defensible and justifiable data, all field personnel will be responsible for following the sampling and documentation procedures described in the project-specific planning document.

Laboratory personnel will verify analytical data at the time of analysis and reporting and through subsequent reviews of the raw data for any non-conformances to the requirements of the analytical method. Laboratory personnel will make a systematic effort to identify any outliers or errors before they report the data. Outliers are corrected if found to be the result of errors. The case narrative section of the analytical data package clearly identifies outliers not attributed to errors in analysis, transcription, or calculation. The laboratory must verify all analytical data generated for and submitted to the RPS.

Verified data are checked for a variety of topics including transcription errors, correct application of dilution factors, appropriate reporting of dry weight versus wet weight, and correct usage of conversion factors, among others. Verified data may have laboratory qualifiers. Verified data are one output of this process.

A second output from the verification process is documentation, which may include a certification statement signed by the laboratory manager and included in the data package. Narratives on technical issues, non-compliance and any corrective action taken are included in the laboratory data package. Records from field activities are likely to be logbooks or handwritten notes, all of which require dates and signatures.

A laboratory QA manual is used to assist in accepting, rejecting, or qualifying the data generated by the laboratory. ADEQ, though, makes the decision on whether or not to use the data. The laboratory management is responsible for validating the data generated by the laboratory. The laboratory personnel must verify that the measurement process was "in control" (i.e., all specified MQOs for the DQIs were met, or acceptable deviations are explained) for each batch of samples before proceeding with analysis of a subsequent batch. In addition, each laboratory must establish a system for detecting and reducing transcription and/or calculation errors prior to reporting data. When deviations are noted, the laboratory shall submit data that have acceptable deviations explained. When there are unmet QA requirements, reanalysis of the sample occurs when possible. Only the results of the reanalysis will be submitted, provided these results are acceptable.

D.1.2 Data Validation

Data validation is a systematic process for reviewing a body of data against a pre-established set of acceptance criteria defined in this QAPP and in project-specific SAPs. Data validation is an analyte- and sample-specific process that extends the evaluation of data beyond data verification and is performed to determine the analytical quality of a specific data set.

The RPS performs a partial validation on selected analytical data routinely generated for and submitted to RPS. This partial validation involves an examination of the data package to determine whether MQOs for precision, accuracy and sensitivity have been met. Partial validation is based on discrepancies noted during the verification step. For example, perhaps some, but not all, surrogates in a method requiring an organic extraction are outside method defined acceptance criteria, but other QC data such as precision of the measurements and blank data are acceptable. This might lead to a review that is centered on surrogate recoveries. The intent of the partial validation is to qualify data so that the user is alerted that s/he should understand the limitations when making decisions based on the data. Full data validation should occur if results are used in court cases.

D.1.3 Data Quality Assessment

A Data Quality Assessment (DQA) refers to the process used to determine whether the quality of a given data set is adequate for its intended use. DQAs can be performed on all, or selected projects and/or data generation processes. The purpose of this type of evaluation is to determine whether the data collected are acceptable to the decision-maker or end user. Assessments

generally take place at one of two points in the data generation process. First, as data are generated, aspects of the project such as surveillance of field and laboratory operations, consistency of the data with MQOs, successfully completing performance evaluation sample studies, and so forth, can be used to arrive at an assessment of whether the data are valid and acceptable. Rejected or questionable data cannot be used by ADEQ in its decision making, except in limited circumstances, such as a rough site screening.

Once data have been examined and assessed, and they are found to be of known and acceptable quality, then the results can be evaluated in the context of the DQO's for the project. In some, but not all, cases this may involve a statistical evaluation such as null hypotheses testing. In others, it may involve a comparison to regulatory action levels. An assessment must also be made as to whether there is a sufficient quantity of data to support program or project decisions, and whether the original sampling design was appropriate. In some cases, the data may suggest that additional data are required to achieve a higher statistical confidence level. This could be because too many data points were invalidated, that samples were not collected over a long enough time period, or that a vital sampling area not previously considered important, was missed. In other cases, an assessment might show that data of a different type are required, or that the sensitivity of the instrument used in the measurement was not adequate to meet project objectives. Thus, both types of assessments are vital to the successful completion of a project.

These data review activities use checklists, SOPs, and standardized qualification codes to indicate data quality. The use of checklists and SOPs help standardize the data review process. The extent and level of verification for individual data sets should clearly be defined in the project's SAP or other planning document.

D.2 APPROACHES TO VERIFICATION, VALIDATION AND ASSESSMENT

The integrity of the data generated over the life of the project is confirmed by data verification and validation. The process for determining if the data satisfy program-defined requirements involves evaluating and interpreting the data, in addition to verifying that QC requirements were met. Projects planned using EPA's DQO process should produce data that provide answers to critical study questions.

The process for verifying and validating data is presented in EPA Guidance on Environmental Data Verification and Data Validation (EPA, 2002c). Section 5 of this EPA guidance provides tools and techniques for data verification and validation: https://www.epa.gov/quality/guidance-environmental-data-verification-and-data-validation.

D.2.1 Approaches to Data Verification

Project team personnel will verify field data through reviews of data sets to identify inconsistencies or anomalous values. Any inconsistencies discovered will be resolved as soon as possible by seeking clarification from field personnel responsible for data collection. All field personnel will be responsible for following the sampling and documentation procedures described in the project SAP so that defensible and justifiable data are obtained.

Laboratory personnel will verify analytical data at the time of analysis and reporting and through subsequent reviews of the raw data for any non-compliance with the requirements of the analytical method. Laboratory personnel will make a systematic effort to identify any outliers or errors before they report the data. Outliers that are found to be the result of errors will be identified and corrected; outliers that cannot be attributed to errors in analysis, transcription, or calculation will be clearly identified in the case narrative section of the analytical data package. All analytical data generated for and submitted to ADEQ's RPS are to be verified by the laboratory.

Verified data are checked for a variety of topics including transcription errors, correct application of dilution factors, appropriate reporting of dry weight versus wet weight and correct usage of conversion factors, among others. Verified data may have laboratory qualifiers. Verified data are one output of this process.

A second output from the verification process is documentation, which may include a certification statement signed by the laboratory manager and included in the data package. Narratives on technical issues, non-compliance and any corrective action taken are included in the laboratory data package. Records from field activities are likely to be logbooks or handwritten notes, all of which should be dated and signed.

The laboratory QA manual must be used to accept, reject or qualify the data generated by the laboratory. ADEQ, though, makes the decision on whether or not to use the data. The laboratory management is responsible for validating the data generated by the laboratory. The laboratory personnel must verify that the measurement process was "in control" (i.e., all specified MQOs for the DQIs were met, or acceptable deviations are explained) for each batch of samples before proceeding with analysis of a subsequent batch. In addition, each laboratory must establish a system for detecting and reducing transcription and/or calculation errors prior to reporting data. Only data that have acceptable deviations explained, should be submitted by the laboratory. When QA requirements have not been met, the samples should be reanalyzed when possible, and only the results of the reanalysis will be submitted, provided these results are acceptable.

D.2.2 Approaches to Data Validation

Data validation determines the analytical quality of data within a specific data set; it is an analyte- and sample-specific process based on achieving the MQOs set forth in the planning documents for the project. Validation assesses whether data quality goals specified in the planning phase have been achieved. Unlike data verification, which may be done by the laboratory, data validation is typically performed by a qualified person who is not affiliated with the laboratory. Validation of analytical data generated for and submitted to ADEQ's RPS is performed by the Unit Manager, staff level personnel or, upon request, Technical Support.

The level of data validation depends on the size and complexity of the project and the decisions to be made. Basically, data validation is the process of evaluating the available data against the project MQOs to make sure that the objectives are met. Cursory validation is performed on data generated for and submitted to ADEQ's RPS. If full data validation is ever needed on an RPS project, the QAM will be notified. Criteria for data validation are summarized in Table D-1.

The personnel validating the data should be familiar with the project-specific MQOs. So, the validator should have access to the QAPP, SAPs, SOPs and approved analytical methods. The validator must identify these and other project records, obtain records produced during data verification, and validate the records by determining whether the data quality meets goals established in the planning documents.

Data validation generally includes the following steps:

Validation of Field Data

1. Evaluate field records for completeness and consistency;
2. Review field QC information;
3. Summarize deviations and determine effects on data quality;
4. Summarize number and type of samples collected.

Validation of Laboratory Data

1. Assemble planning documents and data to be validated. Review data records to determine method, procedural and contractual QC compliance or noncompliance;
2. Review verified, reported sample results collectively for the data set as a whole, including laboratory qualifiers;
3. Summarize data and QC deficiencies and evaluate the impact on overall data quality.

Any field or laboratory data that did not meet the quality goals established in the planning documents are summarized in a comment letter to the party responsible for performing the Site Assessment.

D.2.3 Approaches to Data Assessment

The purpose of a data assessment is to integrate all aspects of data generation to determine the usability of the data. The final step in the process is to compare the data obtained to the DQOs established by the program in its QAPP or else in project-specific planning documents. Aspects of the sampling program evaluated during the data assessment include sampling design, sample collection procedures and sample handling. Analytical procedures (both field and laboratory) and QC procedures are also reviewed during the process. Field and laboratory instrument calibration logbooks are maintained by the environmental consultant and laboratories, respectively, and are reviewed by the appropriate personnel (Unit Manager, staff level personnel, Technical Support and/or QAM) on an as needed basis. Criteria for evaluating all aspects are provided in the following paragraphs.

D2.3.1 Sampling Design

Samples should conform to the type and location specified in the project-specific SAP or other planning document. Any deviations should be noted, along with the likely effect on the usability of the data for its intended purpose. EPA also provides guidance in its Guidance on Choosing a Sampling Design for Environmental Data Collection (EPA, 2002b).

D2.3.2 Sample Collection Procedures

The data reviewer (i.e. typically the field team leader from the contracted environmental

consultant) should verify that the appropriate specified methods were used during sampling. The reviewer should:

1 Evaluate the field records for consistency;
2 Review QC information;
3 Summarize deviations and determine their effect on data quality;
4 Summarize the samples collected;
5 Prepare a field data verification summary.

Improper field practices can compromise the usability of a data set. Specific issues to look for include mislabeling of sample containers, problems with field instruments, improper documentation (such as failure to properly fill in the log book), improper collection of VOC samples (such as leaving a cap off a container or collecting VOC samples from a well-mixed composite sample), biasing sampling locations or forgetting to obtain location information for each sample, improper purging of monitoring wells, improper decontamination procedures or intentionally cutting corners by collecting many samples from one location to save time.

For preparation of the field data verification summary, the field team leader should evaluate field records and notebooks for consistency with field methods and procedures described in the SAP to ensure that these procedures were followed properly or that deviations from the procedures will still yield data of acceptable quality. The verification summary should include observations on (1) the consistency and completeness of field records, (2) the adequacy of field QC information, (3) any deviations from SAP procedures and the probable effect of the deviations on data quality and (4) the number and types of samples collected and how this compares with specifications in the SAP. The different parts of the data verification summary are typically incorporated into the final deliverable to the RPS personnel for review. The RPS personnel can request from the RPS facility owner or operator copies of field records and notebooks for their own review on an as needed basis.

Most qualified sampling contractors, State and Federally certified laboratories develop SOPs and analytical methods as part of their overall QA program. SOPs should be developed following EPA 2007 Guidance for Preparation of Standard Operating Procedures for Quality-Related Operations. The field team should document which SOPs they are using in the field and any deviations from an SOP.

D2.3.3 Sample Handling

QA personnel should confirm that samples were handled in accordance with protocols required in the QAPP, SAP, or other planning documents. Sample containers and preservation methods should be confirmed as appropriate for the nature of the sample and type of data generated from the sample. Chain-of-custody records and storage conditions should be checked to ensure the representativeness and integrity of the samples.

D2.3.4 Analytical Procedures

Section B4 of this QAPP identified the requirements of analytical methods used to generate the data. Each sample should be verified to ensure that the procedures used to generate the data were

implemented as specified. Acceptance criteria for these data follow those used in data validation, with suitable codes to characterize any deviations from the procedure.

D2.3.5 Quality Control

Section B5 of this QAPP specifies the QC checks that should be performed during sample collection, handling and analysis. Here, the QA reviewer should confirm that results for QC samples were evaluated against acceptance criteria (i.e., MQOs) specified in Section B.

D2.3.6 Calibrations

Section B7 of this QAPP addressed the calibration of instruments and equipment and the information required to ensure that the calibrations (1) were performed within an acceptable timeframe prior to generation of measurement data; (2) were performed in proper sequence, included the proper number of calibration points; (3) were performed using standards that bracketed the range of reported measurements (i.e., were within the linear working range of the instrument) and (4) had acceptable linearity checks to ensure the measurement system was stable when the calibration was performed. The environmental consultant performing the field work for the RPS facility owner or operator is responsible for the calibration of all field sampling equipment. Contracted environmental laboratories are responsible for the calibration of all laboratory equipment used to analyze samples collected for and submitted to ADEQ's RPS. All equipment and instrument calibrations shall be recorded in an appropriate log book and be made available to the RPS personnel upon request.

D2.3.7 Data Reduction and Processing

Internal checks by laboratory staff should verify the integrity of the raw data generated by the analyses. Electronic data deliverables (EDDs) automatically produced by the laboratory should help minimize data entry errors. Steps in data reduction should be clearly documented so that the validity of the analysis can be properly assessed.

Data should be cross-checked to confirm consistency or comparability in analytical methods and detection limits, units of measurement, compatibility of file types or software and other critical factors that affect how the data will ultimately be interpreted to influence conclusions and recommendations.

D.3 RECONCILIATION WITH DATA QULAITY OBJECTIVES

After the data have been verified and validated, the data are evaluated against project DQOs. Implementation of the DQA process completes the data life cycle by providing the assessment needed to determine if project objectives were achieved.

Two 2006 EPA guidance documents on DQA are available from EPA at http://www.epa.gov/quality/qa_docs.html. DQA is the scientific and statistical evaluation of environmental data to determine if they meet the planning objectives of the project, and thus are of the right type, quality and quantity to support their intended use. Data Quality Assessment - A Reviewers Guide broadly describes the statistical aspects of DQA in evaluating environmental data sets. A more detailed discussion on implementation of graphical and statistical tools is found in the companion guidance document on statistical methods for practitioners Data Quality

Assessment - Statistical Methods for Practitioners (EPA, 2006c), *see* https://nepis.epa.gov/Exe/ZyPDF.cgi/900B0D00.PDF?Dockey=900B0D00.PDF.
These EPA guidance documents discuss the use of DQA to support environmental decision-making (e.g., compliance determinations).

The DQA process is built on a fundamental premise: data quality is meaningful only when it relates to the intended use of the data. Data quality does not exist in a vacuum. A reviewer needs to know in what context a data set is to be used, in order to establish a relevant yardstick for judging whether or not the data are acceptable. By applying the DQA process, a reviewer can answer four important questions:

1 Can a decision (or estimate) be made with the desired level of certainty, given the quality of the data?
2 How well did the sampling design perform?
3 If the same sampling design strategy is used again for a similar study, would the data be expected to support the same intended use with the desired level of certainty?
4 Is it likely that sufficient samples were taken to enable the reviewer to see an effect if there really were an effect? That is, is the quantity of data sufficient?

D.3.1 Purpose/Background

This section outlines methods for evaluating the results obtained from the sampling and analysis. Scientific and statistical evaluations of the data are used to determine if the data collected are of the right type, quantity and quality to support their intended use and to adequately address the primary study questions.

Please note that statistical evaluations of data generated for and submitted to ADEQ's RPS are rarely employed. This is because judgmental sampling is most always the appropriate method for collecting samples for situations encountered. The goal of judgmental sampling is to use process or site knowledge to choose one or more sampling locations to represent the average concentration or typical property. Commonly, in the RPS, judgmental sampling is done by all RPS staff, and is done under circumstances such as the following:

- Preliminary information is needed about a waste stream or site to facilitate planning;
- Site assessment to identify a potential or actual release;
- Determining the chemical makeup of a spilled material;
- Screening samples in the field to identify "hot" samples for subsequent analysis in a laboratory;
- Support development of an enforcement case.

Generally, based on knowledge of the facility processes, and discussions with the RP, the RPSICU compliance staff would identify sample locations and determine the number and type, i.e., grab, or composite, samples to collect to the DQOs.

For the rare occasion when a project needs a statistical evaluation, confidence intervals (step 3 of the "Five Steps of Statistical DQA" in Section D3.2 below) is the statistic that would most likely best fit the project. If statistical evaluation other than confidence intervals is needed, a contractor may be selected to perform independent statistical evaluations in accordance with the DQA process outlined in this QAPP.

D.3.2 Reconciling Results with Program Objectives or DQOs

EPA guidance documents for data evaluation (EPA 2006) describe an iterative five-step process called the "Five Steps of Statistical DQA":

1. Review the DQOs and sampling design described in the project planning documents;

2. Conduct a preliminary data review or exploratory data analysis to understand the character and structure of the data set and to evaluate whether there are any anomalies in the data that may not have been noticed during data verification and validation. Are there outliers or other anomalies that should be further investigated before continuing with statistical testing?

3. Select a statistical test. Choose appropriate statistical tests based on the characteristics of the data and the questions that the investigation was intended to address.

4. Verify the assumptions of the statistical tests and assess the effect that violations of test assumptions may have on the result (i.e., is the test sufficiently robust to provide a valid result at a reasonable level of confidence?) and consider other factors (i.e., Are there effects of seasonality that must be considered? Would alternative statistical tests be better suited to the data than the tests proposed in the planning documents?).

5. Draw conclusions from the data. Using multiple lines of evidence, the results of statistical tests and professional judgment, the data analyst should be able to provide conclusions and recommendations for the site. In some cases, the conclusion may be that more data are needed to answer the primary study questions.

If DQOs have not been adequately developed, the RPS compliance and technical support staff may need to review the planning documents and sampling design, and then define the statistical hypotheses to be tested and establish tolerable limits on decision errors.

When the DQOs are qualitative, judgmental sampling is utilized and statistical tools are not appropriate, the ADEQ will still systematically assess data quality and data usability. This DQA assessment – Four Steps of DQA for Qualitative DQOs - will include the following:

1. A review of the sampling design and sampling methods to verify that these were implemented as planned and are adequate to support project objectives;
2. A review of project-specific MQOs for precision, accuracy, representativeness, completeness, comparability and quantitation limits to evaluate whether acceptance

criteria have been met;

3. A review of project-specific DQOs to assess whether they have been achieved by the data collected; and
4. An evaluation of any limitations associated with the decisions to be made based on the data collected. For example, if data completeness is only 90 percent compared to a project-specific completeness objective of 95 percent, the data may still be usable to support a decision, but at a lower level of confidence.

D3.2.1 Review DQOs and Sampling Design

Step 1 of the DQA process should (1) document or define the project specific DQOs, (2) verify that the hypothesis is consistent with project objectives and (3) identify any deviations from the sampling plan and assess the potential effect of the deviations.

The objectives of the study should be reviewed in order to provide a context for analyzing the data. If a systematic planning process has been implemented before the data are collected, then this step reviews the study objectives to evaluate whether project goals have been met and whether the study questions have been adequately answered. If no clear planning process was used, the reviewer should:

- Develop a concise definition of the problem (DQO Step 1) and of the methodology of how the data were collected (DQO Step 2). These two steps should provide the fundamental reason for collecting the environmental data and identify all potential actions that could result from the data analysis.
- Identify the target population and determine if any essential information is missing (DQO Step 3). If so, either collect the missing information before proceeding, or select a different approach to resolving the problem.
- Specify the scale of determination (any subpopulations of interest) and any boundaries on the study (DQO Step 4) based on the sampling design. The scale of determination is the smallest area or time period to which the conclusions of the study will apply. The apparent sampling design and implementation may restrict how small or how large the scale of determination can be.
- Evaluate whether the data support the conclusions offered (DQO Step 5). The overall type of sampling design and the manner in which data were collected will likely place constraints on how the data can be used and interpreted. The data analyst should assess whether features of the design support or contradict the stated objectives of the study. Were there deviations from the planned design? What might be the effect of these deviations? Are data adequate to address the primary study questions? How do these objectives translate into statistical hypotheses (null and alternative hypotheses)?

The design and sampling strategy should be discussed in clear detail in the SAP. The overall type of sampling design and the manner in which samples were collected or measurements were taken will place conditions and constraints on how the data can be used and interpreted.

A key distinction in sampling design is between judgmental sampling (also called authoritative or biased sampling), in which sample numbers and locations are selected based on expert

knowledge of the problem, and probability-based sampling, in which sample numbers and locations are selected based on randomization, and each member of the target population has a known probability of being included in the sample. Judgmental sampling has some advantages and is appropriate in some cases. This type of sampling should be considered when the objectives of the investigation are not of a statistical nature (for example, when the objective of a study is to identify specific locations of leaks/hot spots or when the study is focused solely on the sampling locations themselves). Generally, conclusions drawn from judgmental samples apply only to those individual samples.

Probabilistic sampling typically takes more effort to implement than judgmental sampling, because systematic or random locations must be selected for sampling. However, a probability-based sampling design has the advantage of allowing the use of statistical tests, which permit confidence and uncertainty of the results to be specified. Probability-based designs do not preclude the use of expert knowledge or the use of existing data to establish the sampling design. An efficient sampling design is one that uses all available prior information to stratify the site (in order to improve the representativeness of the resulting samples) and set appropriate parameters. Common types of probabilistic sampling designs include the following:

- Simple random sampling – the method of sampling where samples are collected at random times or locations throughout the sampling period or study area.
- Stratified sampling – a sampling method where a population is divided into non-overlapping subpopulations called "strata," and sampling locations are selected randomly within each stratum using a random or systematic sampling design.
- Systematic and grid sampling – a randomly selected unit (in space or time) establishes the starting place of a systematic pattern that is repeated throughout the population. With some important assumptions, can be shown to be equivalent to simple random sampling.
- Ranked set sampling – a field sampling design where expert judgment or an auxiliary measurement method is used in combination with simple random sampling to determine which locations should be sampled.
- Adaptive cluster sampling – a sampling method in which some samples are taken using simple random sampling, and additional samples are taken at locations where measurements exceed some threshold value.
- Composite sampling – a sampling method in which multiple samples are physically mixed into a larger sample and samples for analysis drawn from this larger sample. This technique can be highly cost-effective (but at the expense of variability estimation) and had the advantage it can be used in conjunction with any other sampling design. (Multi-increment sampling is a particular form of composite sampling, and may be an effective design for certain types of sites to answer certain types of questions).

Regardless of the type of sampling scheme, the reviewer should review the description of the sampling design and look for design features that support the project objectives. For example, if the goal of the study is to make a decision about the average (defined here as the arithmetic mean) concentration of a contaminant in an effluent stream over time, then composite samples

may be an appropriate sampling design. If the goal of the study is to find hot spots of contamination or sources of contamination, compositing should be used with caution, to avoid "averaging away" hot spots.
The reviewer should also look for potential problems in the implementation of the sampling design. For example, if simple random sampling was used to collect the data, can the reviewer be confident that the sampling locations or data points were truly random? Small deviations from a sampling plan probably have minimal effect on the conclusions drawn from the data set, but the effects of significant or substantial deviations should be carefully assessed. Finally, the reviewer should verify that the data are consistent with the project-specific SAP and the overall objectives of the study.

D3.2.2 Conduct Preliminary Data Review

For Probabilistic sampling, Step 2 of the DQA process reviews graphical representations of the data and calculates some basic statistical quantities. By reviewing the data both numerically and graphically, the reviewer can understand the structure of the data, and thereby identify appropriate use of the data. For judgmental sampling there is no probability-based theory for reliably estimating the magnitude of sampling errors. Any inference is confined to the sample locations judgmentally selected in the field.

Nevertheless, it is still possible to commit decision errors. Measurement errors can occur during sample analysis. Sampling errors can be caused by variability of contaminant concentrations in visibly stained soil areas. In the case of judgmental sampling, the magnitude of sampling errors cannot be reliably estimated, however, measurement error can be quantified. Assessments for judgment sampling data are done initially by the RPS compliance staff, and a final review is performed by the program's technical support staff.

Statistical quantities numerically describe the data. The quantities that are typically calculated include the arithmetic or geometric mean, the median and other percentiles and the standard deviation. These quantities provide estimates of characteristics for the sample population and allow one to make inferences about the population from which the data were drawn. Graphical representations permit the reviewer to identify patterns and relationships within the data, confirm or disprove assumptions and identify potential problems.

The preliminary data review allows the reviewer to understand the structure and characteristics of the data set and the population from which these data were drawn. Graphical depictions of the data permit the analyst to identify anomalies that may require further investigation or perhaps even reanalysis by the laboratory. Output from DQA Step 2 typically includes (1) tables of summary statistics and (2) graphs and/or statistical plots of the data.

D3.2.3 Select Statistical Test

Under Step 3 of the DQA process, the data analyst selects the most appropriate statistical test or method for evaluating the data. The statistical method will be selected based on the sampling plan used to collect the data, the type of data distribution and the assumptions made in setting the DQOs, noting any deviations from these assumptions. Conclusions about other aspects of the data set or the stated null hypothesis are made based on the results of this evaluation. EPA DQA

guidance provides a discussion (with mathematical formulas and examples for conducting statistical tests) of the process for statistically evaluating environmental data. Detailed technical information that reviewers can use to select appropriate procedures may be found in Chapter 3 of EPA's 2006 Data Quality Assessment: Statistical Methods for Practitioners (EPA, 2006c).

For the rare occasion when an RPS project needs a statistical evaluation, confidence intervals (step 3 of the "Five Steps of Statistical DQA" in Section D3.2 above) is the statistic that would most likely best fit the RPS project. For example, the project's objective may be to estimate the average level of pollution for a particular contaminant. A reviewer can describe the desired (or achieved) degree of uncertainty in the estimate by establishing confidence limits within which one can be reasonably certain that the true value will lie. When interpreting a confidence interval statement such as "The 95% confidence interval for the mean is 19.1 to 26.3", the implication is that the best estimate for the unknown population mean is 22.7 (halfway between 19.1 and 26.3), and that we are 95% certain that the interval 19.1 to 26.3 captures the unknown population mean.

If a particular statistical procedure was specified in the project SAP, the reviewer should use the results of the preliminary data review to determine if the procedure is appropriate for the data collected. If not, then the reviewer should document why the procedure is deemed inappropriate, and then select a different method. The EPA's Quality Assessment guidance document (EPA 2006) provides alternatives for several statistical procedures. If a particular procedure has not been specified, then the reviewer should select a statistical test or method based on the study objectives, results of the preliminary data review, and key assumptions necessary for the method.

All statistical tests make assumptions about the data. For instance, the t-test, which is a parametric test used to compare two data sets, assumes that each data set approximates a normal distribution and that the two data sets have approximately equal variance. In contrast to parametric tests like the t-test, nonparametric tests make much weaker assumptions about the distributional form of the data. However, both parametric and nonparametric tests assume that the data are derived from statistically independent samples. Common assumptions of statistical tests include distributional form of the data, independence, dispersion characteristics, approximate homogeneity and the basis for randomization in the sampling design. For example, the one-sample t-test assumes random and independent samples, an approximately normal distribution, no outliers and no more than a small percentage of non-detections.

Statistical methods that are insensitive to small or moderate departures from the assumptions are called "robust." However, some tests rely on the data meeting certain key assumptions in order for the test results to be valid. The reviewer should note any sensitive assumptions where relatively small deviations could jeopardize the validity of the test results.

After completing Step 3 of the DQA process, the data analyst or reviewer should have selected appropriate statistical tests and noted the critical assumptions of the statistical tests.

D3.2.4 Verify Assumptions of Statistical Tests

The validity of a statistical test or method depends on the key assumptions underlying the test, and whether the data violate these assumptions. Minor deviations from assumptions are usually not critical if the statistical technique is sufficiently robust to compensate for such deviations. If the data do not show serious deviations from the key assumptions of the statistical method, then the DQA process continues to Step 5, 'Draw Conclusions from the Data.' However, it is possible that if one or more of the assumptions are called into question, this could require a re-evaluation of which test may be most appropriate for the data. It is true that some deviations do not invalidate the results of a statistical test, but this should be confirmed here in Step 4 of the DQA process. For example, deviation from normality may not be seriously important for a large sample size, but could be critically important for a small sample size.

This step in the DQA process is an important check on the validity and reliability of the conclusions that are drawn. Outputs from this step include documentation of the method used to verify assumptions and verification that the test results are valid. Additionally, the reviewer should provide a description of any corrective actions that were taken.

D3.2.5 Draw Conclusions from Data

Step 5 of the DQA process represents the culmination of the planning, implementation and assessment phases of the project operations. In this step, the data analyst draws conclusions that address the project objectives. All of the analysis and review conducted in Steps 1 through 4 should ensure that the conclusions drawn in Step 5 adequately address project objectives in a scientifically defensible manner.

In Step 1, the project objectives are reviewed (or developed retrospectively) and the sampling design is evaluated. In Step 2, the implementation of the sampling scheme is reviewed and a preliminary picture of the data set is developed. In Step 3, the appropriate statistical tests are selected. Finally, the underlying assumptions of the statistical test are verified in Step 4.

Conclusions drawn in the final step of the DQA process allow the reviewer or data analyst to present valid statistical results with a specified level of significance. The confidence and power of the tests are stated, along with the study conclusions in plain English. Finally, the data analyst provides an assessment of the overall performance of the sampling design and identifies additional data that may be needed (that is, data gaps are identified).

If data were collected using a judgmental sampling design or if few samples were collected, professional judgment rather than formal statistical testing may be applied to draw conclusions. Or, statistical tests may be applied, recognizing that the results may present a biased "worst-case scenario." For example, if the data from biased samples (e.g., selective sampling of visibly stained soils) are used in a one-sample statistical test to compare concentrations against a cleanup standard or action level, and test results show that concentrations do not exceed the action level, then a conclusion can be drawn. If test results show that concentrations do exceed the action level, then, in formulating conclusions, the reviewer should balance the test results against the knowledge that the data were biased toward the sampling of "hot spots."

Table D.1 – Criteria for Partial and Full Data Validation

Analytical Group	Criteria for Partial Data Validation	Criteria for Full Data Validation
Organic Analyses	• Holding times • Calibration • Blanks • Surrogate recovery • Matrix spike and matrix spike duplicate recovery • Laboratory control sample or blank spike • Internal standard performance • Field duplicate sample analysis • Temperature • Overall assessment of SDG data	• Holding times • Gas Chromatography/Mass • Spectroscopy tuning • Calibration • Blanks • Surrogate recovery • Matrix spike and matrix spike duplicate recovery • Laboratory control sample or blank spike • Internal standard performance • Field duplicate sample analysis • Compound identification • Target compound list identification • Compound quantitation and reported detection limits • Tentatively identified compounds • System performance • Temperature • Overall assessment of SDG data
Inorganic Analyses	• Holding times • Calibration • Blanks • Matrix spike recovery • Matrix duplicate sample analysis • Laboratory control sample or blank • Field duplicate sample analysis • Temperature • ICP serial dilution • Overall assessment of SDG data	• Holding time • Calibration • Blanks • ICP interference check sample • Matrix spike recovery • Matrix duplicate sample analysis • Laboratory control sample • Field duplicate sample analysis • Graphite furnace atomic absorption QC • Sample result verification • Temperature • ICP serial dilution • Detection limits • Overall assessment of SDG data

Notes:
ICP = Inductively coupled plasma (emission spectroscopy)
SDG = Sample delivery group
QC = Quality Control

REFERENCES

ADEQ, 2022. Quality Management Plan, April

ADEQ, 2014. Site Investigation Guidance Manual

ADEQ, 2019. Internal; Standard Work Requirements

EPA, 1992a. Guidance for Performing Site Inspections Under CERCLA (EPA/540-R-92-021), September

EPA, 1992b. Preparation of Soil Sampling Protocols: Sampling Techniques and Strategies

EPA, 1992c. Specifications and Guidance for Obtaining Contaminant-Free Sampling Containers

EPA, 2001. Requirement for Quality Assurance Project Plan for Environmental Data Operations (QA/R-5), March

EPA, 2002a. Guidance for Quality Assurance Project Plans (QA/G-5), December

EPA, 2002b. Guidance on Choosing a Sampling Design for Environmental Data Collection

EPA,2002c. Guidance on Environmental Data Verification and Data Validation

EPA, 2003. Guidance on Assessing Quality Systems (Management Systems Review Process)

EPA, 2006a. Guidance on Systematic Planning using the Data Quality Objectives Planning Process

EPA, 2006b. Data Quality Assessment- A Reviewer's Guide

EPA, 2006c. Data Quality Assessment – Statistical Methods for Practitioners

EPA, 2007a. Guidance for Preparation of Standard Operating Procedures for Quality Related Operations (EPA/600/B-07/0001), April

EPA, 2007b. Guidance for Developing Standard Operating Procedures

EPA, 2012. Guidance for Quality Assurance Project Plans (R9QA/032), March

APPENDICES

Appendix A Arizona Administrative Code Applicable to ADHS Laboratories
Appendix B Arizona Administrative Code for Soil Remediation Standards and Water Quality Standards
Appendix C ADEQ Specific Quality Assurance Guidance and Policies
Appendix D Standard Operating Procedures

Appendix A Arizona Administrative Code Applicable to ADHS Laboratories

Below is the hyperlink to the Arizona Administrative Code for Title 9 (Health Services) Chapter 14 (Department of Health Services Laboratories):

http://apps.azsos.gov/public_services/Title_09/9-14.pdf

Appendix B Arizona Administrative Code for Soil Remediation Standards and Water Quality Standards

Below is the hyperlink to the Arizona Administrative Code for Title 18 (Environmental Quality) Chapter 7 (Department of Environmental Quality Remedial Action) Article 2 (Soil Remediation Standards):

http://apps.azsos.gov/public_services/Title_18/18-07.pdf

Below is the hyperlink to the Arizona Administrative Code for Title 18 (Environmental Quality) Chapter 11 (Department of Environmental Quality Water Quality Standards):

http://apps.azsos.gov/public_services/Title_18/18-11.pdf

Appendix C ADEQ Specific Quality Assurance Guidance and Policies

ADEQ's Waste Programs Division Site Investigation Guidance is available at the following link:

http://legacy.azdeq.gov/environ/waste/download/SI_Guidance_Manual_Final.pdf

ADEQ's Soil Vapor Sampling Guidance dated May 2011 is available at the following link:

http://static.azdeq.gov/legal/subs_policy_svsg.pdf

The Arizona Department of Health Services (ADHS) issued information Update #119 (VOCs in 8260B) on May 15, 2014 and is available at the following link:

http://www.azdhs.gov/documents/preparedness/state-laboratory/lab-licensure-certification/technicalresources/information-updates/information-update-119.pdf

ADHS issued an update in November 2011 for VOCs to be added to the EPA Method TO-15 (the original list was dated July 1999). The information update is available at the following link:

http://www.azdhs.gov/documents/preparedness/state-laboratory/lab-licensure-certification/technicalresources/information-updates/2011.pdf

ADEQ Temperature/Preservation Guidance (see following pages);

Substantive Policy 0154 - Addressing Spike And Surrogate Recovery As They Relate To Matrix Effects In Water, Air, Sludge And Soil Matrices Policy; and

Substantive Policy 0170 - Implementation of EPA Method 5035 - Soil Preparation for EPA Method 8015B, 8021B and 8260B.

ADEQ Recommended Methodology for Locational Data (see following pages)

ADEQ Retention Schedule (see following pages)

Retention Work Instruction

General Records Series	General Ret Total	General Ret Remarks
Duplicates / Copies	------	Not longer than official record is kept
Working Papers/Feeder Documents	------	After final document has been created or administrative or reference value has been served, whichever is longer
Publications	1 year	After superseded or obsolete (Obtain publication number from ADEQ Communications Office)
Email/Correspondence:		
Non-Case or Project	------	After administrative or reference value has been served
Program:		
Official Record	------	Retain with, and for same period as required for, Program record series
Copies	------	Not longer than official record is kept
Databases:		
Field/Data Collection Sheets	------	After entered data is verified or after administrative or reference value has been served, whichever is later
Electronic Data	------	After superseded or obsolete or after administrative or reference value has been served, whichever is later
Legislation Records:		
Case Files for legislation proposed by agency	Permanent	Preserve pursuant to ARS §39-101
Legislation Tracking Files	1 year	After either calendar year or fiscal year passed into law or defeated
Litigation	------	No record shall be destroyed that is part of an ongoing litigation
Personnel:		
Hiring Selection Records	Not longer than 2 years 6 months	After either calendar year or fiscal year created or received
Section/Supervisor Personnel Files	between 6 months and 5 years	After either calendar year or fiscal year employee terminated or transferred
Employee Leave and Time Records	Between 1 and 3 years	After fiscal year created or received
Travel Claims	Between 1 and 3 years	After fiscal year created or received
Budget Records	Not longer than 3 years	After fiscal year covered by budget
Purchase Orders	Between 1 and 3 years	After fiscal year created or received
Contracts, ISAs, and IGAs etc.	Not Longer than 6 Years	After either calendar year or fiscal year fulfilled, cancelled or revoked

Audits	Not Longer than 7 Years	After fiscal year report completed or after reference value has been served, whichever is later
ADEQ Annual Reports	Not longer than 10 years	After either calendar year or fiscal year reported or after reference value has been served, whichever is later.
ADEQ Strategic Plans and Goal Records (including 5-year, 10-year and long range planning records)	Not longer than 5 years	After either calendar year or fiscal year created or received or after administrative value has been served, whichever is later
Transitory Materials:		
Lists, Logs, and Reading/Reference Files	------	After administrative or reference value has been served
Appointment Calendars/Planners	1 Year	After calendar year of last entry or after administrative or reference value has been served, whichever is later
Grants:		
Historically Significant	Permanent	Preserve pursuant to ARS §39-101
All Other Program Records	3 years	After fiscal year quarterly, annual or final expenditure report submitted and approved or after funding agency requirements are met, whichever is longer
Unsuccessful Grant Application Records	1 year	After rejected or withdrawn or after administrative or reference value has been served, whichever is later
Committee, Board, Commission, Council, or Task Force Records (Decision Making):		
Meeting minutes (including information needed to clarify minutes)	Permanent	Preserve pursuant to ARS §39-101
Reports/Studies resulting in no action	5 years	After either calendar year or fiscal year submitted or after administrative value has ended, whichever is later
Reports/Studies resulting in a project	------	File with project records
Everything other than meeting minutes and reports/studies	3 years	After either calendar year or fiscal year created or received
Committee or Task Force Records (Non-Decision Making):	------	After administrative or reference value has been served
Progress/ Activity/Statistical Reports (including weekly or monthly reports to supervisors and managers and status reports but not including official agency annual report)	------	After administrative or reference value has been served
Rule Making Records	1 year	After either calendar year or fiscal year rule is rejected, superseded or no longer in effect, or after administrative or reference value has been served, whichever is later
Customer Service Records (including customer surveys)	------	After administrative or reference value has been served
Maps		
With Publication Number	1 year	After superseded or obsolete (Obtain publication number from ADEQ Communications Office)
Without Publication Number	------	After administrative or reference value has been served
Federal Mandates	------	Retain for time period required by Federal Agency

Outreach Materials	------	After administrative or reference value has been served

Division *WPD* **Office** Remedial Projects Section

Records Series	*Ret Total*	*Ret Remarks*
1. Water Quality Assurance Revolving Fund Files	30	After fiscal year quarterly, annual or final expenditure report submitted and approved or after funding agency requirements are met, whichever is longer
2. Department of Defense	30	After fiscal year quarterly, annual or final expenditure report submitted and approved or after funding agency requirements are met, whichever is longer
3. National Priority List	10	After site closure
4. Potentially Responsible Party	30	After case resolved
5. Prospective Purchaser Agreement	30	After case resolved
6. Voluntary Remediation Program Site Files	30	After facility closed 40 C.F.R. 258.61(a) (2013)

ARIZONA DEPARTMENT OF ENVIRONMENTAL QUALITY

DATE: January 24, 2002

ADEQ TEMPERATURE/PRESERVATION GUIDANCE POLICY

To help assure the validity and documentation of data generated for use by ADEQ, the QA Unit requires that the elements listed below be fulfilled. If the requirements listed below are not fulfilled, the data *may* be considered unacceptable for compliance or enforcement purposes.

Temperature Documentation Requirements

The documentation of the presence of "wet" ice with samples is not a substitute for measuring temperature. At a minimum, the temperature of a temperature blank must be recorded for each cooler upon sample receipt. The preferred procedure for documenting sample temperature is to record the temperature on the chain of custody.

It is, however, *recommended* that the temperature of each sample be recorded upon sample receipt. The measurement of a temperature blank is not required if each sample temperature is documented.

The sole use of "blue" ice is strongly discouraged for use by laboratories generating data that will be submitted to ADEQ. "If 'blue' ice is used, it should be frozen at the time of sampling, the sample should be chilled before packing, and special notice must be taken at sample receipt to be certain the required temperature (4C) has been maintained." ***Manual for the Certification of Laboratories Analyzing Drinking Water***, page IV-3, section 6.2. There must be documentation substantiating that the "blue" ice was frozen at the time of sampling and that the sample was chilled before packing.

The QA Unit acknowledges that all samples may not have time to equilibrate to 4±2°C due to an insufficient time between sample collection and sample submittal to the laboratory. The rejection of data in these situations will not be automatic. Each of these occurrences will be evaluated on an individual basis to determine if a good faith effort has been made to maintain the samples at the required temperatures.

Chemical Preservation Requirements

All pH adjustments performed by the laboratory must be recorded.

The pH of a sample must be recorded by the laboratory either upon receipt or before analysis, as appropriate to the specific method. Recording the pH of a sample may be documented on the chain of custody or some other appropriate form.

In lieu of a laboratory verifying that a sample has been preserved to the appropriate pH in the field, written documentation such as a laboratory copy of a sampler's field notes also provides adequate documentation of proper preservation.

Rev 20210923

ADEQ Recommended Methodology for Locational Data

Preferred
Use:
For Water Level purposes and latitude/longitude and legal description/location, property boundaries, etc. (legal purposes)
Methodology: Line Survey
Elevation accuracy 0.01 ft
Latitude and longitude: 1.00 ft

Acceptable/Adequate (no water level measurements planned)
Water Level not required and latitude/longitude (specific location needed)
Methodology: GIS Receivers, RTK GPS, High Accuracy GPS
Elevation less than 1.00 ft
Latitude and longitude less than 3.00 ft

Better than less accurate methods (Lots of older data with these methods may need to be identified for enhancements with above methods)
Water level not required and latitude and longitude needed for general location
Methodology: Autonomous GPS, GPS Post Processing, other
Elevation less than 100.00 ft
Latitude and Longitude less than 6.00 to 15.00 ft

We can and should do better than this
Ability to find property not well on property, may search for well or have residents
Grant access and identify well on property
Address
Geocoding
Digitized
Similar to ADWR Cadastral Coordinates

Preferred
For Water Level purposes and latitude/longitude and legal description/location, property boundaries, etc. (legal purposes)
Methodology: Line Survey
Elevation accuracy 0.01 ft
Latitude and longitude: 1.00 ft

Acceptable/Adequate (no water level measurements planned)
Use
Water Level not required and latitude/longitude (specific location needed)
Methodology: GIS Receivers, RTK GPS, High Accuracy GPS
Elevation less than 1.00 ft
Latitude and longitude less than 3.00 ft

Appendix D Standard Operating Procedures

This appendix contains references and web addresses for numerous standard operating procedures (SOPs) from the U.S. Environmental Protection Agency (EPA). General sampling guidelines are included in the EPA SOP on General Field Sampling Guidelines. SOPs delineate the step-by-step approach that field personnel must follow in collecting samples, taking field measurements, decontaminating equipment, handling IDW and calibrating instruments. Most qualified sampling contractors and State and Federally certified laboratories develop SOPs and analytical methods as part of their overall QA program. EPA's April 2007 Guidance for Preparation of Standard Operating Procedures for Quality-Related Operations (EPA/600/B-07/0001) is a guide for developing SOPs. The field team should document which SOPs they are using in the field and any deviations from an SOP.

EPA SOPs for field sampling methods are available for download at:

https://clu-in.org/publications/db/db_search.cgi?title=1&submit_search=1&cat=18

Field personnel will ensure that all sampling equipment has been properly assembled, decontaminated and calibrated, and is functioning properly prior to use. Equipment use and decontamination is in accordance to manufacturer's instructions and in accordance to the EPA SOP for Sampling Equipment Decontamination. The following list provides references and web addresses for a variety of SOPs provided by the EPA.

Analysis of Polynuclear Aromatic Hydrocarbons (PAHs) in Air by GC/MS **Published 03/13/2002**

Provides guidance on the requirements for the analysis of Polynuclear Aromatic Hydrocarbons (PAH) compounds in air samples using gas chromatography/mass spectrometry (GC/MS). Download (667KB/29pp/)

Analysis of Polynuclear Aromatic Hydrocarbons (PAHs) in Dust by GC/MS-SIM **Published 03/14/2005**

Outlines the preparation and analysis of polynuclear aromatic hydrocarbons (PAHs) in dust matrices using gas chromatography/mass spectrometry (GC/MS) in the select ion monitoring (SIM) mode. Download (467KB/29pp/PDF)

Data Validation Procedures for Routine Volatile Organic Analysis **Published 01/13/2004**

Outlines a protocol for evaluation and validation of the volatile organic compound data generated by the Response Engineering and Analytical Contract laboratory as well as VOC data generated by subcontracted labs. Download (1KB/53pp/PDF)

Description and Identification of Soils

Published 06/11/2020

Outlines a consistent method for describing oils that are to be sampled and analyzed in the course of a site investigation. Soil descriptions and identifications provide key information when investigating RPS sites.
https://www.epa.gov/sites/default/files/2015-06/documents/Soil-Sampling.pdf

Determination of Granular Soil Permeability (Constant Head)

Published 06/27/2003

Outlines the procedure for the determination of the coefficient of permeability by a constant-head method for granular soils. Download (572KB/14pp/PDF)

Drum Sampling

Published 11/16/1994

Provides technical guidance on implementing safe and cost-effective response actions at hazardous waste sites containing drums with unknown contents. Download (806KB/32pp/PDF)

Field Analysis of Volatile Organic Compounds in Tedlar Bag AIR Samples by GC/MS (Triad GC/MS - Based on EPA TO-15A)

Published 01/19/2006

Describes the field gas GC/MS analysis of air sample collected in Tedlar bags. This procedure generates field screening data in ppbv and is based on EPA Compendium Method TO-15. Download (360KB/17pp/PDF)

GC/MS Analysis of Sorbent Tubes and Canisters (EPA TO-15 and TO-17)

Published 03/24/2006

Outlines the steps for the analysis of air samples collected on either sorbent tubes or in SUMMA® canisters by Gas Chromatography/Mass Spectrometry (GC/MS). Download (2KB/34pp/PDF)

General Air Sampling Guidelines

Published 03/30/2016

Provides guidance in developing and implementing sampling plans to assess the impact of hazardous waste sites on ambient air.
https://www.epa.gov/sites/default/files/2016-04/documents/ambient_air_sampling303_af.r5.pdf

Groundwater Well Sampling

Published 04/26/2017

Provides general information on sampling groundwater wells and ensures that the sample is representative of the particular groundwater zone being sampled

https://www.epa.gov/sites/default/files/2017-07/documents/groundwater_sampling301_af.r4.pdf

Handling Potentially High Hazard Environmental Samples

Published 10/24/1994

Describes safe lab practices for the preparation and analysis of samples which may contain unknown concentrations of hazardous materials. It will focus on the practices for a mobile High Hazard lab. Download (271KB/11pp/PDF)

Indoor Air Analysis of Volatile Organic Compounds by Gas Chromatography/Mass Spectrometry

Published 06/03/2002

Provides guidance on the requirements needed to analyze Volatile Organic Compounds (VOCs) in air samples using gas chromatography/mass spectrometry (GC/MS). Download (606KB/25pp/PDF)

Investigation-Derived Waste Management

Published 05/08/2020

IDW includes soil cuttings, drilling muds, purged groundwater, decontamination fluids (water and other fluids), disposable sampling equipment, and disposable personal protective equipment (PPE).
https://www.epa.gov/sites/default/files/2015-06/documents/Management-of-IDW.pdf

Manual Water Level Measurements

Published 12/10/2002

Provides guidelines for the determination of the depth to water measurements in an open borehole, a cased borehole, a monitor well, or a piezometer. Download (106KB/8pp/PDF)

Mobile Laboratory VOC GC/MS Analysis of WTC Tedlar Bag Air Samples

Published 11/19/2001

Describes the Gas Chromatography/Mass Spectrometry (GC/MS) analysis of air samples collected using Tedlar bags. The methods are applicable to the analysis of Volatile Organic Compounds (VOCs). Download (333KB/13pp/PDF)

Monitor Well Development

Published 09/06/2001

Provides guidance on the development of groundwater monitor wells to ensure removal of fine-grained sediments (fines) from the vicinity of the well screen. The most common well development methods are: surging, jetting, over pumping, and bailing. Download (214KB/7pp/PDF)

Monitor Well Installation

Published 01/16/2018

Methods used for the installation of the wells. Monitor well installation creates a permanent access for the collection of samples to assess groundwater quality and the hydrogeologic properties of the aquifer, in which contaminants may exist.

https://www.epa.gov/sites/default/files/2016-01/documents/design_and_installation_of_monitoring_wells.pdf

Operation of the Hapsite Field Portable Gas Chromatograph/Mass Spectrometer (GC/MS) (Triad GC/MS - Based on EPA/TO-15A)

Published 01/26/2006

Describes the operation of the Inficon HAPSITE field-portable gas chromatograph/mass spectrometer (GC/MS). Download (1KB/47pp/PDF)

Procedures for Automated Summa Canister Cleaning

Published 12/31/2008

Intended for use when cleaning polished stainless-steel SUMMA type or glass-lined Silco type canisters. Download (497KB/14pp/PDF)

Processing Air Samples with the Portable Sample Concentrator

Published 12/22/1994

Defines the means of processing air samples with a portable sample concentrator. The sample concentrator is a field portable sorption tube concentration device used to concentrate dilute air samples prior to chromatographic analysis. Download (277KB/13pp/PDF)

Quality Assurance/Quality Control Samples

Published 08/11/1994

Describes typical Quality Assurance/Quality Control (QA/QC) samples that are collected in the field, or prepared for or by the laboratory. The QA/QC samples identified in this SOP are representative for soil, water and air matrices. Download (198KB/12pp/PDF)

Retrieving Meteorological Information

Published 12/04/1994

Defines the protocol for retrieving meteorological information to be used as inputs to categorize on-site field conditions in 'real-time.' Download (64KB/5pp/PDF)

Routine Analysis of Semivolatiles in Soil/Sediment by GC/MS (EPA/SW-846 -846 Methods 3600C/3640A - Optional)

Published 01/03/2006

Outlines the preparation and analysis of base/neutral/acid extractable (BNA) compounds in soil/sediment matrices using a gas chromatograph/mass spectrometer (GC/MS). Download (574KB/34pp/PDF)

3500B/3510C/8000B/8270C)

Published 01/23/2006

Outlines the preparation and analysis of base/neutral/acid (BNA) compounds in water matrices using a gas chromatograph/mass spectrometer (GC/MS). Download (671KB/32pp/PDF)

Routine Analysis of Semivolatiles in Water by GC/MS (EPA/SW-846 Methods

Sample Documentation

Published 09/14/2002

Defines the procedures for preparing and maintaining documentation which provides the details of field sampling activities.
Download (596KB/19pp/PDF)

Sampling Equipment Decontamination

Published 06/22/2020

Provides a description of the methods used for preventing, minimizing, or limiting cross-contamination of samples due to inappropriate or inadequate equipment decontamination.

https://www.epa.gov/sites/default/files/2016-01/documents/field_equipment_cleaning_and_decontamination205_af.r3.pdf

Sample Storage, Preservation and Handling

Published 08/11/1994

Provides general guidelines for the storage and preservation of water and soil/sediment samples. Download (214KB/7pp/PDF)

Sample Packing and Shipment

Published 08/23/2020

Summarizes requirements for the packaging, marking/labeling, and shipping of environmental and hazardous mat samples.

https://www.epa.gov/sites/default/files/2015-06/documents/Shipping-Environmental-and-Waste-Samples.pdf

The following list provides references and web addresses for a variety of SOPs provided by ASTM:

ASTM D 5088- 02(2008) Standards Practice for Decontamination of Field Equipment Used at Waste Sites

ASTM D 5679-95a. 1995. Standard Practice for Sampling Consolidated Solids in Drums or Similar Containers

ASTM D 5680-95a. 1995. Standard Practice for Sampling Unconsolidated Solids in Drums or Similar Containers.

ASTM D 5743-97. 1997. Standard Practice for Sampling Single or Multilayered Liquids, With or Without Solids, in Drums or Similar Containers

ASTM D 6063-96. 1996. Standard Guide for Sampling of Drums and Similar Containers by Field Personnel

ASTM D6232 - 2008 Standard Guide for Selection of Sampling Equipment for Waste and Contaminated Media Data Collection Activities