Division of Environmental Response and Revitalization

Guidelines and Specifications for Preparing Quality Assurance Project Plans (QAPPs)

September 1, 1998 - Final

Purpose
This document (1) presents guidelines and specifications that describe the 16 essential elements of a QA Project Plan, (2) specifies the required format to be followed, and (3) specifies how plans will be reviewed and approved.

Policy
Each laboratory/entity generating data has the responsibility to implement minimum procedures which assures that precision, accuracy, completeness, comparability and representative-ness of its data are known and documented. In addition, organization (Agency or responsible party) should specify the quality levels which data must meet in order to be acceptable. To ensure that this responsibility is met uniformly, ALL environmental monitoring and measurement efforts developed, coordinated, or overseen by Remedial Response Program staff must have a written QA Project Plan covering each monitoring or measurement activity within its purview. This Guidance Policy has been adapted from U.S. EPA's "Interim Guidelines and Specifications for Preparing Quality assurance Project Plans", QAMS-005/80.

Background
Since the Division of Environmental Response and Revitalization (DERR) requires an approvable Quality Assurance Project Plan (QAPP) be submitted for all work to be performed at a waste site, the development of a Guidance Policy covering QAPP preparation was implemented. The selected laboratory, contractor and other entities involved in the assessment and/or clean up activities must submit a QAPP to be reviewed and approved before any work can be performed. The QAPP should be prepared in the format specified in the attached Policy.

Procedure
The procedure in which to prepare the QAPP is contained in the attached guidance Policy.

Acknowledgments
This document has been adapted from U.S. EPA's "Interim Guidelines and Specifications for Preparing Quality Assurance Project Plans", QAMS - 005/80, Office of Monitoring Systems and Quality Assurance, Office of Research and Development, U.S. EPA Washington DC 20460. December 29, 1980. Ohio EPA revisions to U.S. EPA's document have been done to better accommodate the Ohio EPA, Division of Emergency and Remedial Response program requirements.

Disclaimer
Mention of trade names or commercial products does not constitute Ohio EPA endorsement or recommendation for use.

DIVISION OF ENVIRONMENTAL RESPONSE AND REVITALIZATION
MODEL QUALITY ASSURANCE PROJECT PLAN

This is a **brief** outline of the minimum required **16 elements and content** for a Quality Assurance Project Plan (QAPP). This was generated to help benefit both Ohio EPA and private contractors so that the creation of, and subsequent review time can be reduced substantially.

TABLE OF CONTENTS

(REQUIRED 16 ELEMENTS)

1 TITLE/SIGNATURE PAGE

The QAPP must contain a Title/Signature Page. This Title Page will document the following:

1) The complete title of the project specifying the location (political and/or geographical);

2) The organization that prepared the plan as well as the organization for who it was prepared;

3) The date and the revision number (the initial draft should be considered Revision 0 and subsequent revisions as Revision 1, 2 etc.);

4) Names and titles of the representatives listed below. Functionally, this page ensures that the desired content and level of detail are achieved through the review and approval (at a minimum) by the following personal:

- Grantee/Contractor QAPP Prepare
- Grantee/Contractor Manager
- Ohio EPA Site Coordinator
- Ohio EPA Quality Assurance/Quality Control Coordinator
- Laboratory Directors
- Laboratory QA/QC Coordinator

Note: The titles and names of all individuals appearing on the title page will be consistent with the references to these people elsewhere in the QAPP (e.g., project organization, corrective action, and QA reports to management sections).

2 TABLE OF CONTENTS

All QAPP sections, tables, figures, and appendices (and contents of individual appendices) shall be included and identified in a Table of Contents. All subsections shall be numbered (e.g., Section 5.2 should correspond to "Accuracy").

Additionally, the QAPP Table of contents shall address each of the following items:

1. If included in the QAPP, an "Introduction" shall be referenced in the QAPP Table of Contents.

2. A serial listing of the 16 QAPP elements shall be presented.

3. A listing of any appendices and subsections which are required to augment the QAPP (i.e., Standard Operating Procedures (SOP's), Field Sampling Plan (FSP) summaries of past data, etc.) shall be presented.

4. Following the list of appendices, a listing of any tables, figures, and pertinent acronyms which are required to clarify the QAPP requirements shall be presented. Page numbers shall be added to the Table of Contents of the submitted QAPP. Furthermore, within the body of the submitted QAPP, page numbers will be presented in accordance with the Document Control Format (DCF). A DCF should be used to individually paginate each QAPP elements to facilitate revisions as well as ensure that no pages are missing. The DCF, to be placed in the upper right hand corner of each page, shall include:

1. Project Name (e.g., Water Quality Monitoring of Clear Creek)
2. Revision Number (e.g., Revision: 0)
3. Revision Date (e.g., Date: November 7, 1993)
4. Section Number (e.g., Section 2)
5. Page Number (e.g., Page 2 of 5)

3 PROJECT DESCRIPTION

The Project Description should include or reference the following material, and must be written such that a technical person who is unfamiliar with the site is able to understand what you have written as well as fully understand the activities to take place during the project:

1. A statement of the decision to be made or the question to be answered;

2. A description of the site, facility, process, (e.g., chemical processes of dischargers in area), and/or operating parameters to be studied (e.g., contaminants expected to be found in study area).

3. The anticipated uses of the data, through proper development of Data Quality Objectives which are consistent with U.S. EPA's "Guidance for the Data Quality Objectives Process", EPA QA/G-4, September 1994.

4. A list of all environmental measurements to be preformed.

5. A project schedule, indicating when samples are expected to be submitted to the laboratory;

6. A summary table covering the following for each sampling location;

- Investigative samples
- Quality Control samples
- Total number of samples
- Split samples
- Type of sample matrix (water, soil, air)
- A list of all environmental measurements to be preformed.
- Location of where and how all sample points will be decided.
- A brief statement of intended data use (will this meet the intended use?)

3.1 SITE HISTORY/BACKGROUND INFORMATION

The Site History and Background section or this element should document the known contaminants at the site. A summary of any previous sampling and analysis efforts, data overview of these results or copies of previous reports should be appended to the QAPP. It must include as much information as possible about the site at the present time and past history (e.g., previous site owners and what type of jobs did they perform). Also included in the site history should be a very detailed site description. The site description should include **everything** (e.g., what are the borders and boundaries, any streams, ponds, lagoons and buildings) that could give the reader a better mental view of the site. Topographical maps provide a very useful tool in site description.

4 PROJECT ORGANIZATION AND RESPONSIBILITIES

This section will contain the following items, including address and phone numbers for each.

- 1. Project Manager
- 2. Overall QA/QC
- 3. Field Contact
- 4. PRP Contact
- 5. Key laboratory contact personal
- 6. Laboratory QA/QC manager

This section should also list the pertinent responsibilities that each of the separate entities/individuals is to complete.

1. MANAGEMENT RESPONSIBILITIES
All managers and their responsibilities will be listed. This includes the grantee, its contractors, and State management requirements that would be clearly documented in the pre-QAPP meeting.

2. QA/QC RESPONSIBILITIES
The responsibilities of all QA/QC personal involved in this project will be listed. As part of the detail of this section, the QA/QC personnel responsible for the following will be specified:

a. data validation
b. data assessment
c. internal performance and system audits

The QA/QC personnel working for the grantee/contractor are responsible for assessment of their data. The Ohio EPA QA/QC Coordinator is responsible for approving the QAPP.

3. FIELD RESPONSIBILITIES
This section should list the responsibilities of field personnel and any of the day to day duties.

4. LABORATORY RESPONSIBILITIES
Laboratory responsibilities will be outlined in this section. This includes stating the location of the laboratory (city and state) and the analytes and matrices that will be tested at the facility **(on and/or off site laboratories)**. Language will also provide indication of the primary laboratory staff responsibilities (e.g., laboratory QA/QC manager, sample custodian, etc.).

5. LABORATORY AND FIELD AUDIT RESPONSIBILITIES
Included in this section will be a description of the project personnel responsible for performing the laboratory and field performance and system audits. Internal audits will be the responsibility of the grantee/contractor project manager. External audits are the responsibilities of the Ohio EPA QA/QC Coordinators.

6. PROJECT ORGANIZATION DIAGRAM
This diagram will include **ALL** personnel discussed in the aforementioned text and will show the lines of authority and communication.

5 QA OBJECTIVES FOR MEASUREMENT DATA

The overall QA objective is to develop and implement procedures for field sampling, chain-of-custody, laboratory analysis, and reporting, that will provide results that are legally defensible in a court of law. The purpose of this section is to address project-specific objectives for accuracy, precision, completeness, representativeness, and comparability.

This section will include the following:

5.1 Discussion of Quantitative QA Objectives

a. Summary Tables

A table will have the QA limits required for the project (Project Action levels (PALs)). Also, this table will include the laboratory method detection limits. If this table is presented in the Project Description section, then a reference to that section will be given.

A table of control limits will be supplied in this section. The control limits for all QC samples (e.g., matrix spikes/ matrix spike duplicates, surrogates, etc.) for all analytes to be quantified will be stated.

b. Precision

Precision is measure of degree to which two or more measurements are in agreement. A description of how precision will be assessed for field and laboratory measurements will be presented. Precision of laboratory analysis is assessed by comparing the analytical results between matrix spike/matrix spike duplicate for organic analysis, and laboratory duplicate analyses for inorganic analysis. The relative percent difference (RPD) will be calculated for each pair of duplicate analyses as indicated below:

$$\underline{\mathbf{RPD= (S-D) \times 100}}$$
$$\mathbf{(S + D)/2}$$

where:

S = First sample value original or matrix spike value)
D = Second sample value (duplicate or matrix spike duplicate value)

Field precision is assessed through the collection of field duplicates or co-located samples. Field precision will be reported as the RPD between two co-located field duplicates.

c. Accuracy

Accuracy is the degree to which an observed value and an accepted reference value agree. A description of how accuracy will be assessed for field and laboratory measurements will be presented.

Accuracy of the laboratory results will be assessed for compliance with the established quality control criteria that are cited in Section 3 of the QAPP using the analytical results of method blanks, reagent/preparation blanks, matrix spike/matrix spike duplicate samples, field blanks,

and bottle blanks. The percent recovery (%R) of matrix spike samples is calculated as indicated below:

$$\%R = \frac{(A - B) \times 100}{C}$$

where:

A = The analyte concentration determined experimentally from the spiked sample
B = The background level determined by a separate analysis of the un-spiked sample
C = The amount of the spike added

Accuracy in the field will be assessed through the use of field and trip blanks, and through the adherence to all sample handling, preservation, and holding times.

d. Completeness

Completeness is a measure of the amount of valid data obtained from a measurement system compared to the amount that was expected to be obtained for that measurement. The percent of completeness to be obtained for the project will be stated for both field and laboratory analyses. Data completeness will be assessed for compliance with the amount of data required for decision making.

The percent completeness is calculated as indicated below:

$$\%\ \text{Completeness} = \frac{(\text{number of valid measurements}) \times 100}{(\text{number of measurements planned})}$$

where:

"valid measurements" refers to numbers of investigational samples obtained or to be obtained for specific purpose, or in order to satisfy a particular project objective.

5.2 Discussion of Qualitative QA Objectives

a. Representativeness

Representativeness expresses the degree to which data accurately and precisely represents a characteristic of a population, parameter variations at a sampling point, a process condition, or an environmental condition. The measures to be employed to ensure representativeness for field and laboratory measurements will be stated.

Representativeness of field data is dependent upon the proper design of the sampling program and will be satisfied by ensuring that the field sampling plan is followed and that proper sampling techniques are used.

Representativeness in the laboratory is ensured by using the proper analytical procedures, meeting sample holding times and analyzing and assessing field duplicate samples.

b. Comparability

Comparability is an expression of the confidence with which one data set can be compared with another data set. The measures to be employed to ensure comparability for field and laboratory measurements will be stated. Field and laboratory analytical data will be comparable when similar sampling and analytical methods are used and documented in the QAPP. Comparability is also dependent on similar QA objectives.

6 SAMPLING PROCEDURE

This section will provide detailed, step-by-step sampling procedures for each matrix (soil boring, sediment, surface water, ground water, air, biota, etc.) to be evaluated. A matrix will be defined as a unique stratum which may be solid, liquid, gaseous, animal or vegetable. Solid matrices may be similar (i.e., soil boring and sediment) but are considered separate matrices. Each sampling procedure will specify:

1. All equipment necessary to sample the matrix.

2. Detailed, "cookbook"/step-wise procedures to collect investigative samples.

3. Explicit instructions for collecting each applicable type of QC sample for each matrix and associated analytical parameter. These QC samples will include field duplicates, field blanks, trip blanks, trip blanks (for volatile samples), matrix spike /matrix spike duplicates, etc.

    a. List the appropriate collection frequency for QA/QC samples (e.g., 1 out of 10, or 1 out of 20 should be duplicates).

4. The order of analytical parameter sample fraction collection (i.e., "volatiles first, followed by extractable organics...") for each matrix.

5. Sample containers for each analytical fraction, matrix type, and concentration level. Specifically, the following will be addressed:

    a. container type,
    b. container volume,
    c. number of containers required for each analysis, and
    d. specific chemical/temperature preservations required.

6. Obtaining contaminate-free sample containers. Specifically, the following will be addressed:

    a Detailed procedure used to prepare contaminate-free sample containers for each container/analytical fraction type,
    b. The criteria all containers must meet (i.e., "benzene <1 ppb" etc.),
    c. How the criteria are verified and the frequency of the verification (i.e., "{Laboratory} will conduct a GC/MS analysis at a frequency of one volatile and semi-volatile container per lot of 100 sample containers."),
    d. Who will prepare the containers (i.e., "Containers will be prepared by [Sample Container Company]), and
    e. How the criteria are documented (i.e., "[Sample Container Company] will provide a certified analysis for each sample container lot").

7. Decontamination procedures for field and sampling equipment.

8. Any ancillary procedures such as monitoring well installation or hydro punch work.

9. Sample packaging and shipping procedures to be used as part of the field chain-of-custody procedures since many considerations of sample shipping are integral to custody.

10. Site background, detailed enough to help benefit the sampling procedures.

11. List types of samples (e.g., grab or composite).

12. If possible, included, or reference a map with perspective sample locations.

13. List or reference of calibration requirements for field instruments (e.g., PID and FID).

14. Sample custody and/or chain-of-custody procedures - list the person(s) responsible for carrying out these duties.

15. Show examples of C-O-C, sample labels, etc.

16. Make reference to forms, field notebooks and procedures to be used to record sample history, sample conditions and daily sampling activities.

NOTE: During preparation of the Field Sampling Plan (FSP), the information to be supplied in the QAPP can be appropriately referenced to the field FSP. However, the information in the FSP must: 1) address ALL requirements stated in this section, 2) provide detailed information, and 3) provide the specific reference to the FSP where the requested information is located. If these criteria cannot be met by the FSP, then this information must be detailed in this section of the QAPP.

7 CUSTODY PROCEDURES

Chain of custody is defined as the sequence of persons who have the item/sample in custody. Chain of custody will be demonstrated by documenting that the item in question was always in a state of custody. This will be accomplished through combination of field and laboratory records that demonstrate possession and transfer of custody. Projects requiring legally defensible data will require more rigorous chain of custody than projects that are purely for assessment purposes.

This section shall provide detailed procedures for chain of custody of field activities, laboratory activities, and final evidence files as follows:

7.1 Field Custody Procedures

Detailed custody procedures will be stated for evidence collected in the field. All documents, logbooks, photographs, measurements, analyses, samples collected, etc. must be addressed in the field custody procedures. Detailed explanations will include:

a. Procedures for transfer of custody between individuals.
b. A sample numbering system (if not presented in another QAPP section).
c. Sample packaging and shipment procedures to an off site laboratory.
d. Chronological sequences and instructions for completing all field custody documents as well as copies of each document (as applicable):

1) Field logbooks: The field logbook entry shall provide all information pertinent to the collection of field samples including locations, number/types of samples, measurements, sampling/atmospheric conditions, observations, etc. The field logbook will be a bound volume assigned to an individual field team member. All entries will be completed with a permanent ink pen with no erasures or white-out used. All entries will be signed/dated. Any entry which is to be deleted shall use a single cross out which is signed/dated.

2) Sample labels, are required on every sample. The sample label must include the following (date and time sample was collected, number, matrix description, if preserved [if so with what] and initials of who collected the sample along with witness.

3) Chain of custody record form: A chain-of-custody record form is the form used to record information pertinent to all samples being shipped together (i.e. extractable organics or metals) to the same laboratory. The form will also include spaces for transfers of custody by the field team as well as for log-in by the lab sample custodian.

4) Shipping cooler custody seals: Shipping cooler custody seals are placed on the edges of the cooler between the lid and sides to determine whether coolers may have been tampered with. The custody record form, along with all associated samples, preservative (i.e. ice) and packing material are placed in the cooler prior to sealing with at least two or more seals (one placed on the side that opens and the other on the hinged side. Also seals should not be placed over tape, because the seal can be removed without it breaking.

5) Air bills: Air bills used by the shipping company are often overlooked in the custody chain. Air bills are the only means to document and ensure continuity in custody between the shipment of samples from the field until their arrival at the laboratory. Copies of all completed Air bills must be included as part of the final custody documentation.

7.2 Laboratory Custody Procedures

Detailed laboratory custody procedures specific to each laboratory associated with the project will be stated. The grantee and its field contractor must ensure continuity between field and lab custody procedures. Laboratory custody procedures will:

a. begins when samples are received by the laboratory.
b. maintains the chain of custody initiated in the field.
c. provides the chronological sequence from sample log-in through sample analysis and disposal.
d. provides detailed log-in procedures.
e. details the internal sample tracking and numbering systems.
f. identifies the sample custodian.
g. detail transfers of custody within the laboratory.
h. provides examples of internal documents (with instructions for completion).
i. specifies how and where samples are stored.
j. specifies how and when samples, extracts, and digestates are disposed.
k. specifies how custody of analytical data is maintained.

l. specifies how analytical data and custody records are "purged" from the custody of the lab to the final evidence file.

7.3 Final Evidence Files.

This section will specify:

a. The contents of the final evidence file.
b. The identification of the file custodian.
c. The location where the file will be maintained in a secure, limited access area.
d. The length of time (as mandated by Ohio EPA) that the file will be maintained. This may be specified in the order, contract etc. The file must be offered to Ohio EPA prior to disposal.

8 CALIBRATION PROCEDURES

This section will include a description of the calibration procedures and the frequency with which these procedures will be preformed for both field and laboratory instruments. This section will include the following:

1. Field Instrument Calibration

- Initial calibration
- Continuing calibration

2. Laboratory Instrument Calibration

- Initial calibration for each instrument by, 3 or 5 point calibration [Note: The Inductive Coupled Plasma (ICP) only requires a 1-point initial calibration.]
- Initial calibration verification
- Continuing calibration

Each calibration procedure will also include the acceptance criteria and the conditions that will require re-calibration. The accuracy and traceability of the calibration standards used must be properly documented.

Note: The SOPs for all the analyses that will be preformed on the samples collected for this project will include a section on instrument calibration. The appropriate format is described in "Guidance for The Preparation of Standard Operating Procedures (SOPs) For Field and Laboratory Measurements" (see Appendix C).

Any deviation from the SOP must be explained and justified in this section. It must be specified whether the deviation to the SOP is only temporary for the purpose of this project investigation. Otherwise, if the change is permanent, then the SOP will have to be revised and resubmitted to the Ohio EPA.

9 ANALYTICAL PROCEDURES

This section will describe the field and laboratory analytical procedures to be used for the site investigation. **Field analytical procedures** are those procedures which generate analytical data

to be used in a decision-making process involved with sample selection or site screening (e.g., field screening with a GC to determine particular constituent concentrations). **Laboratory analytical procedures** include organic and inorganic constituents as well as characteristic matrix concentrations (e.g., BOD, COD, TOC, TOX, TPH, TCLP, etc.). These procedures will provide information for the purpose of meeting defined project data quality objectives (as specified in Section/Element 3 of the QAPP).

The following information will be stated in this section:

1. The analytical parameters and matrices to be tested will be stated for each laboratory involved in the project, with method detection limits and reported volumes.

2. Standard Operating Procedures (SOPs) for sample preparation (i.e., extraction, concentration, etc., for organics; if not included in the determinative SOPs) will be stated in this section of the QAPP. Determinative SOPs are those that describe the qualitative/quantitative analysis of specific analyte groups which may or may not include the sample preparation and cleanup of the extracts. For example, in The Test Methods for Evaluating Solid Waste (SW-846), the sample preparation and cleanup methods are cited independent of the determinative instrumental methods.

3. SOPs for all analyses that will be performed on the samples collected from the site under investigation will be stated. The SOPs may be based on SW-846, or other EPA methods, such as those promulgated under Clean Water Act (e.g., EPA 600 Series Organic Methods) and Safe Drinking Water Act (e.g., EPA 500 Series Methods) provided that the methods are sufficient to meet any defined project objectives. Some SOPs for organic analysis may be based on EPA-600/4-79-020 "Method for Chemical Analysis of Water and Wastes." The SOPs must be detailed and specify analytes and matrices of interest for this project. **If any referenced sections offer several options, the option selected must be clearly stated.** To the extent possible, all SOPs should follow a definite format as described in the EPA Region 5 document "Guidelines for the Preparation of Standard Operating Procedures (SOPs) for Field and Laboratory Measurements" (see Appendix C).

4. Standard Operating Procedures (SOPs) to be used for confirmatory analysis of detected compounds, if applicable, will be stated in this section. The basis for these SOPs will be the EPA SW-846, 600 or 500 Series Methods, as stated earlier. For example, if a compound determined by GC/EC will be confirmed using a different detector system (such as FID, NPD, MS, etc.), then the SOP will have to be included in the QAPP.

5. An explanation of how the method validation study (including detection limit study) was conducted. This should be based on laboratory SOPs and must include the criteria for acceptance, rejection or qualification of data.

6. Summary tables of analyte groups of interest (e.g., volatile, acid/base/neutrals, metals, nutrients, etc.), including the appropriate laboratory SOP numbers and EPA method reference shall be included in this section. For each analyte group on a matrix-specific basis, all the applicable sample preparation, cleanup and analysis SOPs will be included in a table format. In addition, list each of the project target compounds in each analyte group that will be measured and reported.

7. The quantities and types of QC samples to be taken for each analyte group, on a matrix-specific basis, will be included in this section. This list will reflect the specific needs of the

project. The laboratory SOP will have a QC section which address minimum QC requirements. Any additional project requirements must be addressed. (NOTE: Pertinent sections of the QAPP may be referenced to satisfy these requirements.)

NOTE: The SOPs and method validation studies should be sent under separate cover, submitted along with the QAPP, and referenced as an attachment in the document, but should be spatially distinct from the QAPP to facilitate laboratory audit procedures.

10 DATA REDUCTION, VALIDATION, AND REPORTING

Data reduction, validation and reporting, for both field and laboratory activities, will be explained in this section of the QAPP. **Data reduction** is the process of converting raw analytical data to final results in proper reporting units. In most cases, data reduction will be primarily concerned with the equation used to calibrate results. **Data validation** is the process of qualifying analytical/measurement data on the performance of the field and laboratory quality control measures incorporated into the sampling and analysis procedures. **Data reporting** is the detailed description of the data deliverables used to completely document the analysis, calibration, quality control measures and calculations. Individuals responsible for implementing data reduction, validation, and reporting for the project will be identified in section **"Project Organization and Responsibilities"** of the QAPP.

For **field activities**, data reduction, validation, and reporting must be tailored to the nature of the instrumentation being utilized. For direct reading instruments (e.g., pH meters, thermometers), where no calculations are involved, there will ordinarily be no data reduction. Therefore, the QAPP may simply state that there is no calculation involved. In order to address data validation for direct reading instruments, it must be ensured that transcription errors have not occurred as data are copied from log books to results forms. Also, there should be review of field logs to ensure that calibration was done as defined in the SOP. Field data are usually reported through report summary sheets tabulating results and field logbooks which document calibrations.

However, for field analytical instruments where data reduction may be necessary, such as in the case of a field gas chromatograph, the level of information concerning data reduction, validation, and reporting must be comparable to that required for laboratory instrumentation, as discussed below.

For laboratory activities, the following items must be addressed in this section:

1. Data Reduction

a. Analytical procedures will contain or reference the equation(s) used to calculate results.
b. Reduction procedures (as well as analytical procedures) must include the equations applicable for each matrix to be analyzed.

2. Data Validation

a. Sampling and analysis procedures must be complete to prepare and review for validation procedures.
b. Validation procedures must specify the verification process of every quality control measure used in the field and laboratory.

c. A 100% laboratory data validation must be preformed by an entity independent of the laboratory, (i.e., engineering firm or laboratory's QA officer).
d. A validation procedure should be prepared for each analytical procedure.
e. All qualifiers used in the validation report as well as the contents of the validation report must be defined.
f. As outlined below, a data deliverables package documenting analyses is necessary for complete validation.

3. Data Reporting

a. Data deliverables should completely document the analysis (i.e., recreate the analysis on paper).
b. Data deliverables should be based upon the method as well as the established project DQOs.
c. The QAPP should provide a listing of data deliverables and examples of forms that will be used to tabulate the information.
d. Data deliverables are necessary for complete data validation.
e. Hardcopy data deliverables should be generated at the time of analysis and not "available upon request." For legally defensible data, one complete package (for all samples) must be provided to the grantee and be made available to U.S. EPA, upon request.
f. Data deliverables typically include, but are not necessarily limited to:

1) case narrative
2) calibration (initial/continuing) summary and raw data
3) mass spectrometer tuning data
4) gas chromatograms
5) mass spectra
6) quality control summary forms and raw data
7) ICP, AA and graphite furnace data outputs
8) blank data results
9) method and instrumental detection limit results

11 INTERNAL QUALITY CONTROL CHECKS

This section describes all specific quality control checks to be addressed for both field and laboratory analysis in order to comply with the requirements of the project investigation. Field Quality Control Checks are measures used to assess the quality of the field procedures used in obtaining and handling the samples.

Laboratory Quality Control Checks are measures used to assess the quality of the data resulting from the analytical procedures. The section will include, but not be limited to the following information:

1. Field Quality Control Checks

- Replicate measurements per sample (if applicable)
- Duplicate samples
- Reference standards (used in calibrating field instruments such as pH meters, specific conductance or conductivity meters, potentiometer for Eh measurements, HNu GC for organics, Nephelometric method for turbidity measurements, etc.)

- For temperature measurements, thermometer is compared with NIST traceable thermometer
- Munsell color chart for color checks
- Field blanks (Field blanks of ASTM Type II de-ionized water are used to assess bias and to check for contamination introduced during sampling procedures).
- Trip blanks (Trip blanks of ASTM Type II de-ionized water are included with each shipment when sampling for volatiles to assess potential contamination introduced during sample shipment and storage).
- Matrix spike/matrix spike duplicates (Provide information about the effect of the sample matrix on the digestion and measurement methodology. Matrix spikes are used only for organic samples. Matrix spike duplicates provide a check for analytical reproducibility).
- Field duplicates (Field duplicates are co-located samples used to assess the reproducibility of field sampling procedures and the precession of the results).

The general level of QC effort should be one field duplicate and one field blank for every ten or fewer investigative samples; however, this will be determined on a project-by-project basis.

2. Laboratory Quality Control Checks

- Method Blanks (Generated within the laboratory, by passing clean matrix through all the analytical method steps, and used to assess contamination resulting from laboratory procedures.)
- Surrogate spikes (Compounds similar to the target analyte but not normally found in environmental samples which are added to each organic sample to assess the accuracy of the analytical procedures.)
- Laboratory duplicates
- Laboratory control standards
- Matrix spikes/matrix spike duplicates
- Analytical spikes (Graphite furnace)
- Regent/preparation blanks (applicable to inorganic analysis)
- Instrument blanks
- Internal standard areas for GC/MS analysis; control limits
- Mass tuning for GC/MS analysis
- Endrin/DDT degradation checks for GC/EC analysis
- Second, dissimilar column confirmation for GC/EC analysis

Generally, the frequency of spiked samples and spike duplicates should be one matrix spike/matrix spike duplicate for every twenty or fewer investigative samples for each matrix (e.g., water, sediment, etc.) The required laboratory SOPs will include a QC section which describes the specific QC requirements for the method.

3. Quality Control for Biological Tests

This section should include the activities conducted to verify that the performance of the biological tests (e.g., sediment toxicity, bioaccumulation, biological survey, etc.) meets the stated requirements. This section should include a discussion of the following: reference toxicants and/or standard reference material testing, controls, acceptable survival, organism verification, organism cultures and handling, and replicates.

12 PERFORMANCE SYSTEM AUDITS

The purpose of performance and system audits is to verify that the sampling and analysis are performed in accordance with the procedures established in the QAPP and FSP. Audits confirm that the quality assurance/quality control programs are strictly followed by the appropriate personnel during the field activities (e.g., sample collection, preservation, and transportation) and laboratory activities (e.g., sample preparation, instrument calibration, sample analysis, data validation, and final evidence documentation).

The internal audits will be preformed by the organization primarily responsible for performing the project tasks. The external audits will be preformed by Ohio EPA.

The performance audit is an independent check to evaluate the quality of sample activity being generated. The system audit is on-site review and evaluation of the facilities, instrumentation, quality control practices, data validation, and documentation practices.

This element will address the following information:

1. Field Performance and System Audits

a. Internal and external performance and system audits to be performed.
b. The frequency of the audits and who will be conducting the audits.
c. The audit procedures (including a checklist) and the documentation of audit procedures.

Internal audits of field activities (sampling and measurement) will be conducted by (name of contractor) QA Officer and/or Field Team Leader. The audits will include examination of field sampling records, sample collection, handling and packaging in compliance with the established procedures, maintenance of QA procedures, chain of custody, etc. These audits will occur at the onset of the project to verify that all established procedures are followed. Follow-up audits will be conducted to identify and correct deficiencies as well as to verify that QA procedures are maintained throughout the project. The audits will involve review of field measurement records, instrumentation calibration records, and sample documentation.

External audit(s) may be preformed by the Ohio EPA, Division of Environmental Response and Revitalization QA Coordinator and/or Laboratory Coordinator.

2. Laboratory Performance and System Audits

a. Internal and external performance and system audits to be performed.
b. The frequency of the audits.
c. The audit procedures (including a checklist) and the documentation of audit procedures.

The internal performance and system audits of the laboratory will be conducted by the (laboratory name) QA officer or other designated person(s). The system audits, which will be performed on an annual basis, will include examination of laboratory documentation on sample receiving, sample log-in, sample storage, chain of custody procedures, sample preparation and storage, instrument operation records etc. The performance audits will be conducted on a quarterly basis. Blind QC samples will be prepared and submitted along with project samples to the laboratory for analysis throughout the project. The QA officer will evaluate the analytical

results of the blind performance samples to ensure the laboratory maintains adequate performance.

External system audits may be performed by the Ohio EPA DERR QA/QC and Laboratory Coordinators. The laboratory must supply the Ohio EPA DERR QA/QC Coordinator with the results of the quarterly Performance Evaluation results for the duration of the project.

13 PREVENTATIVE MAINTENANCE

The following types of preventative maintenance will be described in this section:

1. Field Instrument Preventative Maintenance

Maintenance procedures for all data-gathering instruments will be addressed. The use of HNu detectors and organic vapor analyzer systems will be addressed in this section of the QAPP. It will be indicated how frequently such instruments are checked (possibly as part of daily calibration), and where and how frequently such checks will be documented. Lists of critical spare parts such as tape, pH probes and batteries should be presented in the QAPP, in tabular format (this table can be included in an appendix). Any other means for ensuring that equipment to be used in the field is routinely serviced, maintained or repaired will be stated.

2. Laboratory Instrument Preventative Maintenance

These procedures are designed to minimize the occurrence of instrument failure and other system malfunctions and will also be included in this section of the QAPP or referenced to the appropriate laboratory QAPP. The laboratory's schedule for maintenance of each instrument to be used during implementation of the project will be presented in tabular format. A list of critical spare parts necessary for maintaining this equipment will also be presented in tabular format. Although it is understood that laboratory instruments are usually maintained in accordance with manufacturer's specifications, it is **not acceptable** to submit copies of instrument manuals to satisfy the intent of this element. If preventative maintenance is performed through a vendor contract, this information will be stated.

14 DATA ASSESSMENT PROCEDURES

Field Measurements

Field data, assessed by the project Quality Control (QC) Officer will review the field results for compliance with the established QC criteria that are specified in the QAPP and FSP. Accuracy of the field measurements will be assessed using daily instrument calibration, calibration check, and analysis of blanks. Precision will be assessed on the basis of reproducibility by multiple readings of a single sample. Data completeness (C) will be calculated using the following equation:

$$C = \frac{\text{Valid Data Obtained} \times 100}{\text{Total Data Planned}}$$

Laboratory Data

Laboratory results will be assessed for compliance with required precision, accuracy, completeness and sensitivity as follows:

Precision

Precision of laboratory analysis will be assessed by comparing the analytical results between matrix spike/matrix spike duplicate (MS/MSD) for organic analysis, and laboratory duplicate analysis for inorganics. The relative percent difference (%RPD) will be calculated for each pair of duplicate analysis using the following equation:

$$\%RPD = \frac{(S - D)}{(S + D)/2} \times 100$$

Where:

S = first sample value
D = second sample value

Accuracy

Accuracy of laboratory results will be assessed for compliance with the established QC criteria that are described in the QAPP using the analytical results of method blanks, reagent/preparation blanks, MS/MSD results, field blanks and bottle blanks. The percent recovery (%R) of MS samples will be calculated using the following equation:

$$\%R = \frac{A - B}{C} \times 100$$

Where:

A = analyte concentration determined experimentally from the spiked sample;
B = background level determined by a separate analysis of the un-spiked sample;
C = the amount of spike added.

Completeness

The data completeness of laboratory analysis results will be assessed for compliance with the amount of data required for decision making. Completeness is calculated using the equation found in Section 5 "QA Objectives for Measurement".

15 CORRECTIVE ACTION

Information included in this QAPP element will be pertinent to the entire project, not just the laboratory operation. More specifically, corrective action will focus on three general areas; 1) Field Corrective Action; 2) Laboratory Corrective Action; and 3) Corrective Action during Data Validation and Data Assessment. For each of the three areas, certain procedures and mechanisms must be stated including:

1. The mechanism of triggering the initiation of corrective actions;
2. The proper procedures to be used for initiating, developing, approving, and implementing the corrective actions;

3. Alternate corrective actions to be taken; and
4. The documentation process for this corrective action.

Corrective actions may be required for two classes of problems; 1) analytical and field equipment problems and 2) non-compliance problems. Analytical and equipment problems may occur during sampling and sample handling, sample preparation, laboratory instrumental analysis, and data review.

NOTE: Any corrective action issue noted above which directly impacts project data quality objectives will be reported immediately to the grantee/contractor project manager and Ohio EPA site coordinator or QA/QC coordinator.

16 QUALITY ASSURANCE REPORTS

Quality assurance reports must be submitted on a periodic basis (i.e., monthly, at a minimum) to the Ohio EPA Site Coordinator or QA/QC Coordinator during the course of the project. This is done to ensure that problems arising during the sampling and analysis phases of the project are investigated and corrected. This report can be part of the monthly progress report and will contain:

1. Data validation and assessment results since the last report;
2. Field and laboratory audit results performed since the last report;
3. Significant QA/QC problems, recommended solutions, and results of corrective actions; and
4. Status of report on data quality assessment (DQA), i.e., stating the extent to which the DQOs were satisfied.

The content and nature of all QA reports that will be generated should be indicated in this section of the QAPP. For instance, the type of report, written or oral, interim versus final, should be specified in the QAPP. Furthermore, the contents of the QA reports should be specified. Some examples of relevant topics which may appear in QA reports are given below:

1. Minor changes in QAPP (NOTE: Major changes to procedures or responsibilities require approval from the Ohio EPA Site/QA/QC Coordinators):
2. Summary of QA/QC programs, training and other miscellaneous accomplishments:
3. Results of technical systems and performance evaluation audits;
4. Data quality assessment in terms of precision, accuracy, representativeness, completeness, comparability, and method detection limits;
5. Indication of whether the QA objectives were met; and
6. Limitations on use of the measurement data.

REFERENCES

Quality Assurance Handbook for Air Pollution Measurement Systems, Volume I – Principles, EPA-600/9-76-005, March 1976.

Quality Assurance Handbook for Air Pollution Measurement Systems - Volume II - Ambient Air Specific Methods, EPA-600/4-77-02a, May 1977.

Model Quality Assurance Project Plan, Region V Office of RCRA. May 1991.

Content Requirements for Quality Assurance Project Plans for Water Division Programs, August 1994.

Guidelines and Specifications for Preparing Quality Assurance Project Plans, DERR-00-RR-008, March 5, 1990.

Guidance for the Data Quality Objectives Process, EPA QA/G-4, September 1994.