



**QUALITY ASSURANCE PROJECT PLAN FOR
BROWNFIELDS/VOLUNTARY CLEANUP PROGRAM
SITES**

**Prepared by the
Missouri Department of Natural Resources
Division of Environmental Quality
Hazardous Waste Program
Brownfields/Voluntary Cleanup Section**

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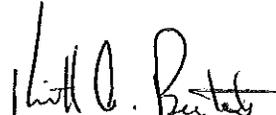
A. PROJECT MANAGEMENT ELEMENTS

A.1 TITLE AND APPROVAL SHEET

Brownfields/Voluntary Cleanup Program
Quality Assurance Project Plan
Missouri Department of Natural Resources
Division of Environmental Quality

Site Name: _____

DEPARTMENT APPROVALS



Division Quality Assurance Manager

November 13, 2014

Date



Director, Hazardous Waste Program

11-7-14

Date



BVCP Quality Assurance Project Officer, HWP

10/30/14

Date

CONTRACTOR APPROVALS

Director, Contractor

Date

Project Manager, Contractor

Date

Project Field Superintendent, Contractor

Date

QA/QC Manager, Contractor

Date

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A.3 DISTRIBUTION LIST

Missouri Department of Natural Resources (MDNR)

Keith Bertels – Quality Assurance Manager, Division of Environmental Quality (DEQ)

Hazardous Waste Program (HWP)

David Lamb– HWP Director

Scott Huckstep –Brownfields/Voluntary Cleanup Program (BVCP) Section Chief and BVCP Unit Chief

Brian McCurren – BVCP Quality Assurance Project Officer

Project Managers – BVCP

Contractor/Consultant (contractor)

Director - Contractor

Project Manager–Contractor

Project Field Superintendent –Contractor

Contractor/Consultant/Laboratory – Quality Assurance Project Plan Coordinator

A.4 PROJECT/TASK ORGANIZATION

The following list identifies key individuals and organizations participating in this project, and discusses their specific roles and responsibilities as they pertain to this Quality Assurance Project Plan (QAPP).

BVCP Quality Assurance Project Officer

Responsibilities: Overall management and coordination of site-specific activities as they relate to this QAPP, including correspondence, communication and scheduling. Review plans, reports, and data to ensure that site-specific activities conducted pursuant to this QAPP meet project specific Data Quality Objectives (DQO).

Project Manager - BVCP

Responsibilities: Management and coordination of site-specific activities as they relate to this QAPP, including correspondence, communication and scheduling. Review plans, reports, and data to ensure that site-specific activities conducted pursuant to this QAPP meet project-specific DQOs.

Keith Bertels – Quality Assurance Manager, DEQ

Responsibilities: Monitors the overall Quality Assurance (QA) operations for the division. Develops and maintains the Quality Management Plan (QMP). Reviews and approves all internal QAPPs for the division.

Project Manager –Contractor

Responsibilities: Supervise and schedule field staff conducting sample collection and site assessment activities. Assures that staff are qualified and trained to perform the work, familiar with the required Standard Operating Procedures (SOP), including those related to Quality Assurance/Quality Control (QA/QC), and have the equipment necessary to perform the work. Reviews reports generated by staff for completeness, clarity and accuracy. Prepare formal reports for BVCP staff review and approval.

Project Field Superintendent - Contractor

Responsibilities: Prepare and/or implement site-specific sampling plans to collect environmental samples according to contractor SOPs at potential and/or confirmed hazardous substance sites. Conduct sample collection by appropriate methods to provide data of sufficient quality and quantity to meet project's DQOs. Prepare and/or implement health and safety plans for investigations conducted by the contractor at potential and/or confirmed hazardous substance sites. May prepare formal reports of sampling investigations for BVCP staff to evaluate.

QA/QC Manager - Contractor

Responsibilities: Reviews site-specific QAPPs and other documents as needed to ensure quality data. Performs field audits of contractor staff who conduct sampling activities in order to verify that staff are following the contractor SOPs for environmental data collection. Prepares audit reports summarizing procedures used and makes recommendations for improvement, if necessary.

Contractor/Consultant/Laboratory – QAPP Coordinator

Responsibilities: Ensures that appropriate analytical methods, Laboratory SOPs, QA/QC procedures, documentation, and training are implemented and routinely followed by all supervisory and technical staff of the contractor. Utilizes data review checklists and QC charts for both precision and accuracy data in the data quality review process. Conducts reviews of data files following review and approval by Laboratory supervisory staff.

Director - Contractor

Responsibilities: Ensures overall validation and final approval of data generated by the contractor. Assists as appropriate in the performance auditing of all activities performed by contractor personnel.

A.5 PROBLEM DEFINITION/BACKGROUND

The Brownfields/Voluntary Cleanup Program, administered by the Missouri Department of Natural Resources, Hazardous Waste Program's BVCP, provides voluntary parties with technical assistance and oversight for the investigation and cleanup of properties contaminated with hazardous substances. The goal of the BVCP is to clean up contaminated properties and bring them back into productive use.

Environmental assessments of commercial and industrial property are part of many real estate transactions and often are required by lenders and buyers as a result of the liability provisions of the federal Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), or Superfund law. If contamination is found, property owners or other interested parties often want not only to clean up the property, but also to obtain a certificate of completion or "clean letter" from the state, which provides a measure of environmental liability protection. Hazardous substance contamination is not always regulated under state and federal laws such as Superfund, the Resource Conservation and Recovery Act (RCRA), or state petroleum storage tank regulations. The contamination may be of a type or concentration that does not warrant enforcement action and may not require cleanup under existing regulations. The BVCP may be

the only program with the authority to provide oversight of the cleanup and a certification of completion.

The BVCP can provide guidance so that the cleanup satisfies any applicable state and federal regulations and also provides written assurance when the project is complete. Missouri's Hazardous Substance Environmental Remediation (Voluntary Cleanup Program) Regulations (10 CSR 25-15.010) in accordance with sections 260.565 – 260.575, RSMo, provide the HWP's BVCP with the resources and the authority to provide project oversight and completion letters. Oversight costs are paid to the Department by the participant. By a memorandum of agreement with the U.S. Environmental Protection Agency (EPA), Region 7, the EPA will not pursue federal action with regard to the contamination addressed at the site once the BVCP issues a certificate of completion.

The Missouri Department of Natural Resources operates under its QMP when collecting or overseeing the collection of environmental sampling data. This plan requires that any subgrantees, contractors, or, in some cases, the regulated community, who generate environmental data develop QAPPs or other appropriate quality management tools. The QMP covers all intramural and extramural monitoring and measurement activities that generate and process environmental data for use by the department, including activities at sites participating in the BVCP.

This QAPP is generic in that it applies to several site-specific projects under the oversight of the BVCP. It is ongoing in that the projects are conducted continuously. A site-specific work plan detailing site activities will be submitted to the BVCP Project Manager for approval prior to any work conducted under the oversight of the BVCP. Any deviations from or supplemental activity to the generic QAPP will be documented in a Site-Specific Quality Assurance Project Plan Addendum (SSQA).

A.6 PROJECT/TASK DESCRIPTION

When a site enters the program, the BVCP reviews existing site assessment reports and determines whether or not additional investigation or cleanup is required to meet state standards. The site investigation and any necessary cleanup are conducted by the applicant or their consultants and contractors. Site assessment reports, remedial action plans and a final report are submitted to the BVCP for review and approval. When the BVCP is satisfied that the cleanup has met the objectives, the department provides the applicant with a Certification of Completion or "No Further Action Letter" signed by the Section Chief of BVCP. Applicants pay for the BVCP's oversight costs, which are calculated on an hourly basis. Participation in the program is voluntary and applicants may withdraw at any time.

Activities that may be conducted under this QAPP and with the oversight of the BVCP include site characterization, remedial action, and risk management. These activities will be documented through work plans for site characterization, characterization reports, risk assessment reports, remedial action plans (RAP), risk management plans (RMP), and final reports, all submitted to the BVCP for review and approval. The following include the necessary components for work plans to conduct environmental data collection submitted for BVCP approval and the necessary QA/QC documentation to be submitted after data collection.

A.6.1 Work Plans For Site Characterization

The contractor will submit the written site-specific work plan to BVCP for review and approval prior to implementation. These work plans should include a sampling and analysis plan, a field sampling plan, a health and safety plan, signature page and reference to this generic QAPP and a SSQA if applicable. The work plan will provide general site information, describe the number, type, method, and location of samples to be collected (included on a site sketch) as well as analytical parameters and methods requested for each sample.

A.6.2 Characterization Reports

The contractor will submit the written site-specific characterization report, including risk assessment reports, to the BVCP upon completion of site characterization activities. These reports should include field QA/QC documentation requirements and laboratory QA/QC documentation requirements as described in Section A.9, Documents and Records.

A.6.3 Remedial Action Plans/Risk Management Plans

If the RAP or RMP involves environmental data collection such as further site characterization, confirmatory samples following remedial activities, or monitoring, then the RAP/RMP shall be subject to this QAPP. The contractor will submit the written site-specific RAP/RMP to BVCP for review and approval prior to implementation. These plans should include a sampling and analysis plan, a field sampling plan, documentation of the health and safety plan, signature page and reference to this generic QAPP and a SSQA if applicable. The plan will provide general site information, describe the number, type, method, and location of samples to be collected (included on a site sketch) as well as analytical parameters requested for each sample.

If the RAP/RMP does not involve environmental sampling, then data QA/QC would not be a component.

A.6.4 Remedial Action/Risk Management Reports

If the RAP/RMP involves environmental sampling, then the contractor will submit to the BVCP a written site-specific report that includes field QA/QC documentation requirements and laboratory QA/QC documentation requirements as described in Section A.9, Documents and Records.

A.6.5 Modifications to the Work Plans

BVCP will have the final approval of all individual components of the written work plans revised as specified herein and reserves the right to require modifications, deletions, and or additional elaboration to the written work plans and reports as BVCP deems necessary.

A.6.5.1 BVCP requested changes

If BVCP determines that modifications to the written work plan are necessary or desired, the agency will document the requested changes to the contractor in writing. Such changes may include the need for additional sampling at the site.

Based on the written instructions provided by BVCP, the contractor will revise the written work plan.

A.6.5.2 Contractor requested changes

If the contractor determines that modifications to the written work plan are necessary, the contractor will submit a written request to BVCP for changes. The written request will include the reason for the modification and will detail the contractor's proposed changes to the written work plan. BVCP will review the written request of the contractor and send written notice of approval or disapproval of the request to the contractor.

A.6.5.3 Field Deviations from the Work Plan

Changes in site conditions between the time of the site reconnaissance and the on-site sampling visit and the visual appearance of the substance at the time of sampling may determine the actual number and locations of samples collected. The contractor should contact the BVCP Project Manager to discuss deviations or changes. The deviations or changes will be documented in the final report prepared by the contractor and submitted to the BVCP.

A.7 DATA QUALITY OBJECTIVES AND CRITERIA

DQOs are qualitative and quantitative statements derived from the Systematic Planning and DQO processes developed by EPA and further described in *Guidance on Systematic Planning Using the Data Quality Objectives Process* and *Systematic Planning: A Case Study for Hazardous Waste Site Investigations*. Data quality indicators as discussed in Section B.5 will be used to ensure quality data for sampling conducted pursuant to this QAPP.

A.7.1 Problem Statement

Properties are enrolled in BVCP for the investigation, remediation, and risk management of hazardous substances. To accomplish that, data is collected during investigation, remediation, and verification sampling activities.

The data collected will contribute to the conceptual site model (CSM), which is a functional description of the contamination problem. The CSM should be maintained and updated throughout the life of the project as information is collected. Key elements of the conceptual site model include:

- The chemical release scenario, source(s), and chemicals of concern (COCs)
- Spatial and temporal distribution of COCs in the various affected media
- Current and future land and groundwater use
- Description of any known existing or proposed land or water use restrictions
- Description of site stratigraphy, determination of the predominant vadose zone soil type, hydrogeology, meteorology, and surface water bodies that may potentially be affected by site COCs
- Remedial activities conducted to date
- An exposure model that identifies the receptors and exposure pathways under current and future land use conditions

A.7.2 Decision Statements

A.7.2.1

Do maximum concentrations of COCS exceed the Missouri-Risk Based Corrective Action (MRBCA) Default Target Levels (DTLs) or appropriate Water Quality Criteria (WQC)?

A.7.2.2

Does risk at the site exceed the allowable risk levels of a MRBCA tiered risk assessment?

A.7.2.3

Has remediation been sufficient to reduce risk to allowable levels and issue a certificate of completion?

A.7.2.4

Is risk management and long-term stewardship (LTS) necessary to issue a certificate of completion?

A.7.3 Inputs into the Decision

The inputs into the decision are any data collected as part of the activities listed in Section A.6. This data will be compared to action levels listed in the MRBCA guidance document and will be used as part of a risk assessment in accordance with the MRBCA guidance.

A.7.4 Study Boundaries

The study boundary is the legal property boundary of the site that has been enrolled in BVCP, unless hazardous substances originating on the enrolled property have migrated to adjacent properties, in which case the study boundary is extended to include the maximum extent of that hazardous substance migration.

A.7.5 Decision Rules

A.7.5.1 Initial Characterization

- Do maximum concentrations of COCS exceed the MRBCA DTLs or appropriate WQC? If no, a certificate of completion may be issued. If yes, a Tier 1 risk assessment must be conducted.

A.7.5.2 Tier 1 Risk Assessment

- Do Tier 1 risks exceed acceptable risk levels? If no, a certificate of completion may be issued. If yes, remediate to acceptable risk levels or manage risks.
- Will risks be managed at the Tier 1 level? If no, a Tier 2 risk assessment must be conducted. If yes, develop and implement a RMP.
- If an RMP is completed and LTS is in place, a certificate of completion may be issued.

A.7.5.3 Tier 2 Risk Assessment

- Do Tier 2 risks exceed acceptable risk levels? If no, a certificate of completion may be issued. If yes, remediate to acceptable risk levels or manage risks.
- Will risks be managed at the Tier 2 level? If no, a Tier 3 risk assessment must be conducted. If yes, develop and implement an RMP.
- If an RMP is completed and LTS is in place, a certificate of completion may be issued.

A.7.5.3 Tier 3 Risk Assessment

- Do Tier 3 risks exceed acceptable risk levels? If no, a certificate of completion may be issued. If yes, remediate to acceptable risk levels or develop and implement an RMP.
- If an RMP is completed and LTS is in place, a certificate of completion may be issued.

A.7.6 Limits on Decision Error

For most projects conducted under this QAPP, the null hypothesis will be that a site is contaminated at levels that require additional investigation and remedial actions. There are two general types of decision errors:

- Type 1 Decision Error (sometimes called a false rejection error): Concluding that a site does not pose a potential threat to human health and the environment), when the site truly does pose a threat.
- Type 2 Decision Error (sometimes called a false acceptance error): Concluding that a site poses a potential threat to human health and the environment, when the site truly does not pose a threat.

The consequences of a Type 1 Decision Error, mischaracterizing a site that truly poses a threat, could have future health implications. This decision error could result in populations being exposed to unsafe levels of contaminants.

The consequences of Type 2 Decision Error, incorrectly identifying a site for further investigation and remediation, would cause the needless expenditure of resources (e.g. funding, time, sampling crew labor, and analytical costs).

When a sufficient number of samples are planned, it may be possible to assign numerical limits on tolerable decision error rates and use a statistical data analysis approach. In such cases, an error tolerance of 95% will be used unless project-specific DQOs specify otherwise. However, numerical values are typically not set when a judgmental sampling approach is used or when limited numbers of sample prevent statistical analysis. In these instances, decision errors are limited in a variety of more general ways.

The probability of making a false rejection decision error, thereby mischaracterizing a site that truly poses an unacceptable risk to human health and the environment, is limited

by several factors. Recognized Environmental Conditions (RECs) will be identified in the Phase I Environmental Site Assessment (ESA), and decision error will be limited by using judgmental sampling to target the worst-case contaminant locations by sampling RECs where the largest contaminant release would have occurred. When contaminants are detected, decision error will also be limited by comparing contaminant concentrations to the conservatively-derived target levels in the MRBCA guidance.

A.7.7 Design Optimization

For each project, contractors and BVCP will review the DQO output from Sections A.7.1 through A.7.6 together with existing environmental data for the site, and develop a sample collection design based on this review. The sample collection design will specify the type, location, frequency, analyses per sample, analytical methods, and QC samples. Rationale for the location of samples and types of analyses will be thoroughly developed and supported.

A.8 SPECIAL TRAINING/CERTIFICATION

Sample collectors are required to successfully complete a 40-hour Hazardous Waste Operations and Emergency Response (HAZWOPER) site safety course in accordance with 40 CFR Part 311, which references 29 CFR 1910.120. Staff are also expected to be trained on sampling for hazardous materials as well as read and be familiar with applicable SOPs, the generic QAPP, the site-specific work plan(s) and the SSQA prior to performing actual sample collection. Some sample collectors may need to be licensed inspectors for asbestos-containing material (ACM) and lead-based paint (LBP).

Specific training requirements may be necessary for personnel operating field analytical or sampling equipment or specialized equipment, such as an X-ray Fluorescence (XRF) analyzer or geophysical instruments. Manufacturer's requirements and recommendations should be followed.

The contractor will ensure and provide for the protection of the personal safety and health of all its workers on site, including the selection, provision, testing, decontamination, and disposal of all Personal Protective Equipment (PPE) and any required medical monitoring. The contractor will comply with all applicable worker safety and health laws and regulations. At all times during performance of services, the contractor will exercise reasonable professional judgment regarding safety and will use professional judgment as a criterion for cessation of services for safety reasons.

A.9 DOCUMENTS AND RECORDS

Work plans and final reports will be generated and submitted to BVCP for review and approval.

Field QA/QC documentation for site characterization reports and/or remedial action/risk management reports must consider the following details:

- Calibration and maintenance records for field instrumentation,
- Documentation of sample collection procedures,
- Reporting of any variances made in the field to sampling plans, SOPs or other applicable

- guidance documents,
- Reporting of all field analysis results,
 - Documentation of sample custody (provide copies of chain-of-custody documents),
 - Documentation of sample preservation, handling and transportation procedures,
 - Documentation of field decontamination procedures (and if applicable, collection and analysis of equipment rinsate blanks),
 - Collection and analysis of all required duplicate, replicate, background and trip blank samples, and
 - Documentation of disposal of investigation-derived wastes.

Laboratory QA/QC documentation for site characterization reports and/or remedial action/risk management reports must consider the following details:

- If the published analytical method used specifies QA/QC requirements within the method, those requirements must be met and the QA/QC data reported with the sample results;
- At a minimum, QA/QC samples must consist of the following items (where applicable): method/instrument blank, extraction/digestion blank, initial calibration information, initial calibration verification, continuing calibration verification, laboratory fortified blanks/laboratory control samples, duplicate, and matrix spikes/matrix spike duplicates. The site characterization and/or remedial action/risk management reports must include a discussion of data quality.
- Documentation of appropriate instrument performance data such as internal standard and surrogate recovery.

B: DATA GENERATION AND ACQUISITION

B.1 SAMPLING PROCESS DESIGN

This QAPP is generic, covering many different projects and a large number of analytes in various complex sample matrices. The sampling design will vary depending on the goal of the sampling activity, such as site characterization or confirmatory sampling. Therefore, the sampling process design will be described in detail in the site-specific work plan and/or SSQA. Some considerations when developing a plan for a sampling design, particularly a judgmental sampling design, include potential contaminant(s) and locations based on past property uses, soil properties that affect contaminant migration, physical and chemical nature of potential contaminant(s), the manner in which contaminant(s) may have been released, and timing, duration and amount of potential release(s). Since this QAPP is generic in the sense that it is intended to apply broadly to a number different specific sites, it is not possible to provide specific sampling design details. However, the following sampling design elements will be considered and discussed in the site-specific sampling plans or SSQA as describe in A.6 written for each investigation.

- Description of the design strategy, including size/volume of area to be sampled
- Type and total number of samples to be collected
- Locations of samples to be collected and rationale for selection.
- Identify anticipated sources of variability in the data and how it will be controlled.

All QC samples will be collected in accordance with EPA guidance and described in the site-specific work plan and/or SSQA. All QC samples will be documented in the sampling report. See Section B.5 for more information on QC samples.

B.2 SAMPLING METHODS

The field investigations and sample collection activities under the project will adhere to applicable SOPs and available EPA guidance and will be described in the site-specific work plan and/or SSQA. The site-specific work plan will indicate the location, type, number and media of the samples.

Manufacturer's specifications and operational instructions, other agency SOPs, other methods, instructions, including professional or scientific technical standards, may also be used for specific field analytical equipment, geophysical equipment, surveying instruments, etc. with no existing SOPs or EPA guidance upon approval of the BVCP Project Manager. The site-specific work plan will specify sampling methodologies and procedures used.

B.3 SAMPLE HANDLING AND CUSTODY

Sample handling and custody will be accomplished according to SOPs and using standard forms developed by contractor's laboratories. Sample container selection will be according to appropriate method guidance and/or SOPs. The site-specific work plan will specify sample handling procedures, sample containers, preservation, holding times, chain-of-custody and field documentation, handling of samples in the field, and transport of samples to the laboratory. All analyses will be conducted within the method-specified maximum sample holding time limits. Any data obtained from analyses conducted on samples after the specified holding time limit will be qualified by the laboratory in sample result documentation and discussed in the sampling report.

B.4 ANALYTICAL METHODS

Field analytical measurements will be according to SOPs and manufacturer's operational instructions, such as immunoassay kit instructions, photoionization detector (PID) instructions, XRF manual, etc. Calibration and other QA/QC actions will be accomplished according to SOPs, manufacturer's minimum recommendations/requirements and other appropriate scientific or technical standards. Appropriate EPA guidance, SOPs, best professional judgment and accepted industry and scientific practices will be used when correlating field analytical data to laboratory data.

Laboratory measurements will be performed by the selected laboratory according to the method requested, generally according to container, preparation, and analytical methods specified by EPA SW-846 Solid Waste Test Methods. The QC procedures specified in these methods must be followed. The detection limits of the selected analytical methods generally will be able to achieve the concentrations of interest needed. Analytical parameters will vary by project; therefore, the analytical methods used for the parameters of concern should be specified in the site-specific work plan and/or SSQA. Analytical results obtained for projects conducted under this QAPP will be compared to the Department's MRBCA Guidance. Ideally, the laboratory reporting limits would be at or below the MRBCA target levels in each environmental media. However, these risk-based levels do not take into account analytical feasibility. Even using the

best available measurement technology, laboratory-reporting limits will exceed benchmarks for some analytes in some environmental media. There may be special circumstances where a higher level of sensitivity for some analytes will be required. Data that do not meet the laboratory reporting limits will be qualified as described in the applicable verification/validation procedure, and documented in the project report.

Any non-standard analytical methods, along with associated validation procedures, should be specified in the site-specific work plan and/or SSQA, and will need prior approval by the BVCP. An explanation as to why non-standard methods are being proposed should also be included in the site-specific work plan and/or SSQA.

All QC documentation must be provided with each analytical deliverable package. The contractor will be responsible for ensuring all analytical data provided by the contractor's laboratory for the project meets the contract requirements and the requirements of this QAPP.

B.5 QUALITY CONTROL

A number of field and laboratory QC checks will be required to ensure data meet the project DQOs. The principal quality attributes important to site assessment projects are precision, accuracy, comparability, representativeness, and completeness. Criteria for these attributes are discussed below.

B.5.1 Principal Quality Attributes

1. Data Precision

Data Precision is a measure of the reproducibility of analytical results and is typically expressed in terms of the standard deviation among a set of data or as the relative percent difference between two measurements. Overall precision will be measured using the Relative Percent Difference (RPD) between duplicate or replicate split samples.

$$RPD = 100 \left[\frac{x_1 - x_2}{x} \right]$$

- The criterion for RPD between primary and duplicate aqueous samples for each contaminant measured above the laboratory reporting level is $\leq 30\%$.
- The criterion for RPD between primary and replicate split non-aqueous samples and for duplicate non-aqueous volatile organic compounds (VOC) samples will be $\leq 50\%$.
- The criterion for RPD between primary and duplicate air samples will be 25% .

If data fall within these limits, then the overall precision of the sampling and analytical process is adequate to meet the project DQOs. Data that do not meet these precision criteria will be qualified as described in the applicable validation procedure (Section D), and discussed in the project report.

2. Laboratory Precision

Precision of laboratory analyses is assessed by the analysis of Matrix Spike/Spike Duplicates (MS/MSD), laboratory duplicate samples, and blind performance evaluation samples. The frequency with which laboratory precision is assessed, and the performance criteria vary by

analyte, analytical method, and environmental media. The criteria and methods for assessment of laboratory precision are specified in the analytical methods.

3. Accuracy

Accuracy is a measure of the bias that exists in a measurement system. The accuracy of laboratory analyses will be assessed by analysis of preparation/method blanks, laboratory control samples, surrogates, internal standards, matrix spikes, and blind performance samples. The frequency with which laboratory accuracy is assessed, and the performance criteria vary by analyte, analytical method, and environmental media. Criteria for laboratory accuracy are specified in the analytical methods.

Field accuracy will be assessed through the analysis of trip blanks and field equipment rinse blanks. Contaminants should not be detected above the laboratory reporting level in trip blanks and equipment rinse blanks. Any data that do not meet these accuracy criteria will be qualified as described in the applicable validation procedure. The BVCP Project Manager and applicant's contractor will evaluate all qualified data on a project-specific basis, and determine how/whether to use the data.

4. Data Comparability

Comparability is the degree of confidence with which one data set can be compared to another. The objective of comparability for this QAPP is to ensure that sampling data developed during the project investigation may be readily compared to each other and to the appropriate screening benchmarks. All data will be reported as degrees Celsius (flash point); pH units; $\mu\text{g/l}$ or mg/l for water, liquids or Toxicity Characteristic Leachate Procedure (TCLP); $\mu\text{g/kg}$ or mg/kg for soil, sediment or other solids; and $\mu\text{g/m}^3$ for air. Comparability is further addressed by using appropriate field and laboratory methods that are consistent with current standards of practice as approved by EPA.

5. Data Representativeness

Representativeness is the degree to which sampling data accurately and precisely depicts selected characteristics such as parameter variations at a sampling point or an environmental condition and is ensured for projects under this QAPP in several specific ways:

- Use of correct sampling procedures and equipment
- Adherence to QA and QC requirements for ensuring sampling integrity
- Collection of an adequate amount of sampled material
- Selection and implementation of appropriate analytical measurement method, including sample preparation

6. Data Completeness

Completeness is the measure of the amount of valid data obtained from a measurement system compared to the amount that was expected to be obtained under "normal" conditions and is expressed as a percentage of the amount of valid data obtained compared to the amount that was planned. One hundred percent of data completeness is desired for the collection of field samples for all project investigations. If less than 100 percent is received, the BVCP Project Manager will decide if the valid data obtained from a measurement system

compared to the amount that was expected to be obtained under normal conditions is sufficient to meet the project DQOs. If not, additional sampling may be required.

B.5.2 QC Samples

QC samples will be required to verify the validity of analytical results and to assess whether the samples were contaminated from sources not directly attributable to releases at the site (such as improper decontamination, cross-contamination, laboratory contamination, etc.). The field QC samples proposed for collection will be included in the site-specific work plan. Field QC samples include the following as appropriate:

- Trip blanks indicate if any activities after obtaining the trip blank may have contaminated samples during transport.
- Field blanks are samples obtained in the field to determine if contaminants were introduced by sample containers, preservatives, sampling procedures, etc.
- Rinsate samples are obtained to verify adequate decontamination of sampling equipment.
- Replicate samples (split samples) are obtained by dividing or splitting one sample that has been mixed or homogenized into two samples for separate analysis. Replicate samples primarily assess precision associated with analytical procedures, and to a lesser extent, sample handling procedures. Replicate split samples of soils or other non-aqueous materials are not recommended if volatile organics analyses are requested due to the potential loss of the volatiles during the mixing process. If soil samples will be analyzed for VOCs, duplicate samples should be collected prior to mixing. However, please note that there may be a greater potential for inconsistency due to the heterogeneous nature of soils or other non-aqueous media
- Duplicate water samples are used primarily to assess precision associated with sampling methodology, and to a lesser extent sample heterogeneity and analytical procedures. Duplicate soil samples are used primarily to determine the variability or heterogeneity of the sampled media.

For all projects involving the collection of aqueous samples, a trip blank will be included at a frequency of one per cooler if the proposed analysis includes VOCs or semi-volatile organic compounds (SVOCs). An equipment rinsate blank will be collected for projects where the sampling equipment is decontaminated in the field for reuse. The equipment rinsate blank will be collected at a frequency of one per separate sampling event (mobilization) for each different combination of sampling equipment; decontamination method, and analytical parameter. Duplicate or replicate samples for each media (groundwater, surface water, soil/sediment, air) should be collected at a frequency of 10% of the total number of samples, with a medium of one duplicate or replicate per medium per sampling event.

BVCP will collect duplicate or replicate samples from the site, including, but not necessarily limited to, post-remediation verification samples at BVCP sites. The goal is to enhance the credibility of BVCP cleanups by documenting MDNR's direct oversight of verification

sampling, as well as confirming the analytical results. BVCP will collect a limited number of samples (approximately 10% of the total number of samples), and pass the analytical costs back to the sites as oversight costs, as allowed by our regulations.

Contaminants should not be detected above the laboratory reporting level in trip blanks, field blanks, and equipment rinse blanks. Any data that do not meet these accuracy criteria will be qualified on sample results. The BVCP Project Manager and contractor personnel will evaluate all qualified data on a project-specific basis, and determine how/whether to use the data.

All QC samples will be documented in the sampling report.

Laboratory QC samples include duplicates, spikes, laboratory blanks, and performance evaluation samples, and are performed by the fixed laboratory according to the approved laboratory QA/QC plans.

B.6 INSTRUMENT/EQUIPMENT TESTING, INSPECTION AND MAINTENANCE

Field analytical instruments used during this project will be maintained and calibrated according to instructions provided by the instrument manufacturer, and other appropriate scientific and technical guidance and standards pertinent to the specific instrument in use. The contractor will be responsible for performing operational checks on all field equipment prior to use in the field. An operational problem with any field instrumentation will be noted by the contractor in the field notebook. Daily or regular calibration of field instrumentation will be according to applicable SOPs and manufacturer's instructions and indicated or referenced in the site-specific work plan.

Fixed laboratory equipment for contract laboratories used for quantitative sample analysis will be tested, inspected, calibrated and maintained according to the specific analytical equipment requirements as stated in the SOPs of the laboratory, in accordance with manufacturer-specified procedures or method-specified procedures, as appropriate.

B.7 INSTRUMENT/EQUIPMENT CALIBRATION AND FREQUENCY

Maintenance and calibration procedures will be conducted in accordance with manufacturers' instrument manuals, method-specified procedures and the laboratory SOPs, as appropriate.

B.8 INSPECTION/ACCEPTANCE OF SUPPLIES AND CONSUMABLES

Inspection and acceptance of supplies and consumables will be conducted according to applicable SOPs. Any supplies and consumables used in the sample collection process or instrument calibration such as sample bottles, bailers, dedicated tubing, deionized water, calibration gases, etc., will be inspected upon receipt and prior to use.

B.9 NON-DIRECT MEASUREMENTS

Several types of data and information may be obtained from non-measurement sources for use in projects conducted under this QAPP. The primary types of non-measurement data are Phase I ESAs, site reconnaissance, interviews of site owners or operators, published reference books and resources, databases, and internet resources. These data may be used to design sampling plans and may be used with the directly measured data collected during each project to evaluate the potential need for further site characterization, remediation and/or suitability for development.

Non-direct measurement data will be documented and referenced in any document for which they are used.

B.10 DATA MANAGEMENT

Data management, including chain-of-custody review and correction, data review, reduction and transfer to data management systems, quality control charts, quality control procedures, and sample receipt, storage and disposal, will be in accordance with applicable SOPs and accepted industry practices.

Documentation will be in accordance with applicable SOPs and accepted industry practices, and will include the sampling reports, copy of the chain-of-custody, and field notes or other supporting documentation with the analytical results. Data reduction will occur in accordance with contractor analytical SOPs for each parameter. If difficulties are encountered during sample collection or sample analyses, a brief description of the problem will be provided in the sampling report prepared by contractor. Data reporting will be in accordance with applicable SOPs and will include, at a minimum:

- Sample documentation (location, date and time of collection and analysis, etc.)
- Chain-of-custody forms
- Initial and continuing calibration
- Determination and documentation of detection limits
- Analyte(s) identification
- Analyte(s) quantitation
- Quality Control sample results

Adequate precautions will be taken during the reduction, manipulation, and storage of data in order to prevent the introduction of errors or the loss or misinterpretation of data.

C: ASSESSMENT AND OVERSIGHT

C.1 ASSESSMENTS AND RESPONSE ACTIONS

This section describes the internal and external checks necessary to ensure that all elements of the QAPP are implemented correctly as prescribed, that the quality of the data generated by implementation of the QAPP is adequate, and that any necessary corrective actions are implemented in a timely manner.

C.1.1 Laboratory Performance Assessment

Laboratories will comply with all of the EPA and the National Environmental Laboratory Accreditation Conference (NELAC) requirements for laboratory QA programs. Data resulting from the participation in the NELAC program shall be reviewed by the laboratory Quality Assurance Manager and any problems shall be addressed.

C.1.2 Field Performance Assessment

The auditor in charge of field QA will conduct audits of field activities according to contractor QA field auditing procedures. The process of choosing when field audits are conducted is not based on a particular project or site-sampling event, but rather on

assuring that each person involved in sample collection is audited at least once per year. The contractor's field QA auditor will have the responsibility for initiating and implementing response actions associated with findings identified during the field audit. The field personnel shall properly address any response actions needed.

C.1.3 Overall Project Performance Assessment

EPA VII conducts periodic QA audits of the state's environmental programs. These evaluations normally include some type of review of the program's quality system, and may include review of QAPPs.

C.1.4 Data Validation

All field and laboratory data will be subject to validation to review for accuracy, precision, completeness, representativeness and comparability. Data validation is discussed in more detail in Section D. The acceptance criteria for measurement data are discussed in Section B.5.

C.2 REPORTS TO MANAGEMENT

Data from the contractor's laboratory will be submitted to the BVCP Project Manager as an appendix to the final report using the laboratory analytical report sheets. The report sheets will include documentation of the sampling location, sample description, date of collection, collector, analysis performed and results, date of analysis, and analytical method used. A copy of the chain-of-custody and the lab results should also be attached to the final report. In addition, a discussion of data quality should be provided with the sampling report.

Field performance assessment audits will be documented by the contractor's field QA auditor in a written report that will be kept on file at the contractor's office. Results from the laboratory's audit studies will be kept on file at the contractor's office.

Comments and recommendations from the EPA Region VII periodic QA audits of state environmental programs are provided to the Department QA manager and used by Department management and staff to take any corrective actions which may be needed.

D: DATA VALIDATION AND USABILITY

D.1 DATA REVIEW, VERIFICATION AND VALIDATION

To ensure that measurement data generated when performing environmental sampling activities are of an appropriate quality, all data will be validated. Data validation is a systematic procedure for reviewing a body of data against a set of established criteria to provide a specified level of assurance of its validity prior to its intended use. The techniques used must be applied to the body of the data in a systematic and uniform manner. The process of data validation must be objective and independent of the data production process. All data, as applicable, will be validated in accordance with EPA *Guidance on Environmental Data Verification and Data Validation, Data Quality Assessment: A Reviewers Guide*, and *Data Quality Assessment: Statistical Tool for Practitioners*. Any deviations will be documented and provided with the analytical data report.

D.2 VERIFICATION AND VALIDATION METHODS

D.2.1 Documentation, Data Reduction and Reporting

Documentation will include the sampling reports, copy of the chain-of-custody, and field notes or other supporting documentation with the analytical results. Data reduction will occur in accordance with the laboratory's analytical SOPs for each parameter. If difficulties are encountered during sample analyses, a brief description of the problem will be provided.

Data derived from sampling events undertaken for projects under the oversight of the BVCP will be reported to the BVCP Project Manager as discussed in Section C.2, Reports to Management.

D.2.2 Data Validation

Data validation will occur as described in the analytical SOPs for each parameter and the laboratory SOPs for data review. Data validation is accomplished using control charts and data review checklists. Discrepancies are noted in the analytical file and appropriate data flags are used. If data is determined to be outside of control limits, the data is flagged on the report of analysis.

The laboratory personnel and contractor will look at matrix spikes/matrix spike duplicates, lab blanks, and lab duplicates to ensure they are acceptable. The sample collector will compare the sample descriptions with the field sheets for consistency and ensure that any anomalies in the data are documented. The contractor will perform a final review and approval to ensure that the data meets the quality objectives of this QAPP as discussed in Section B.5. and, if applicable, the SSQA. The contractor's review and approval is a check on the reviews conducted by the laboratory to ensure consistency of all field and analytical data that is generated by the contractor.

D.3 RECONCILIATION WITH USER REQUIREMENTS

Once the final report is submitted, the BVCP Project Manager will review the field QA samples to determine if they appear to indicate a problem with meeting quality objectives. If problems are indicated, the BVCP Project Manager will contact the contractor to discuss and attempt to reconcile the issue. Completeness will also be evaluated to determine if the completeness goal for this project has been met. If data quality indicators do not meet the project's requirements as outlined in this QAPP and applicable SSQA, the data may be discarded and re-sampling may occur. The BVCP Project Manager will determine the cause of the failure (if possible) and make the decision to discard the data and re-sample. If the failure is tied to the analyses, calibration and maintenance techniques will be reassessed as identified by the appropriate lab personnel. If the failure is associated with the sample collection and re-sampling is needed, the sampling methods and procedures will be reassessed as identified by the field audit process.

Corrective action will be undertaken by all parties to address specific problems as they arise. Corrective actions required will be identified through the use of control charts for chemical

analyses, precision and accuracy data, through performance auditing, and through systems audits.

REFERENCES

- EPA Guidance on Environmental Data Verification and Data Validation (G-8), EPA/240/R-02/004, November 2002
- EPA Guidance Data Quality Assessment: A Reviewer's Guide (G-9R), EPA/240/B-06/002, February 2006
- EPA Guidance Data Quality Assessment: Statistical Tools for Practitioners (G-9S), EPA/240/B-06/003, February 2006
- EPA Guidance on Systematic Planning Using the Data Quality Objective Process (G-4), EPA/240/B-06/001, February 2006
- EPA Guidance for Quality Assurance Project Plans (G-5), EPA/240/R-02/009, December 2002.
- EPA Requirements for Quality Assurance Project Plans (R-5), EPA/240/B-01/003, March 2001
- EPA Systematic Planning: A Case Study for Hazardous Waste Site Investigations (CS-1), EPA/240/B-06/004, February 2006
- MDNR-ESP-210-Quality Assurance/Quality Control for Environmental Data Collection

APPENDIX A: LISTING OF ACRONYMS & TERMS

ACM	Asbestos-Containing Material
BVCP	Brownfields/Voluntary Cleanup Program
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
COCs	Contaminants of Concern
CSM	Conceptual Site Model
DEQ	Division of Environmental Quality
DTL	Default Target Level
DQO	Data Quality Objectives
EPA	United States Environmental Protection Agency
ESA	Environmental Site Assessment
HAZWOPER	Hazardous Waste Operations and Emergency Response
HWP	Hazardous Waste Program
LBP	Lead-Based Paint
LTS	Long-term Stewardship
MCL	Maximum Contaminant Level
MDNR	Missouri Department of Natural Resources
MRBCA	Missouri Risk-based Corrective Action Process
MS/MSD	Matrix Spike/Spike Duplicates
NELAC	National Environmental Laboratory Accreditation Conference
PID	Photoionization Detector
PPE	Personal Protection Equipment
QA	Quality Assurance
QAPP	Quality Assurance Project Plan
QC	Quality Control
QMP	Quality Management Plan
RAP	Remedial Action Plan
RCRA	Resource Conservation and Recovery Act
REC	Recognized Environmental Conditions
RMP	Risk Management Plan
RPD	Relative Percent Difference
SOP	Standard Operating Procedure
SSQA	Site-Specific Quality Assurance Project Plan Addendum
SVOC	Semi-Volatile Organic Compound
TCLP	Toxic Characteristic Leaching Procedure
VOA	Volatile Organic Analysis
VOC	Volatile Organic Compound
WQC	Water Quality Criteria
XRF	X-ray Fluorescence

Duplicate or co-located sample is a sample obtained from the same location, at the same time, and of the same material as the original sample. Duplicate water samples are used primarily to assess precision associated with sampling methodology, and to a lesser extent sample heterogeneity and analytical procedures. Duplicate soil samples are used primarily to determine

the variability or heterogeneity of the sampled media. Due to the heterogeneity of soils, caution must be used if attempting to assess precision associated with sampling methodology or analytical procedures.

Hazardous Substance means a substance defined as hazardous pursuant to federal rule 40 CFR 302.4, which includes asbestos and Polychlorinated Biphenyls (PCBs); any substance designated pursuant to Section 311(b)(2)(A) of the federal Water Pollution Control Act; any toxic pollutant listed under Section 307(a) of the federal Water Pollution Control Act; any hazardous air pollutant listed under Section 112 of the Clean Air Act; any imminently hazardous chemical substance or mixture with respect to which the Administration of EPA has taken action pursuant to Section 7 of the Toxic Substances Control Act; any hazardous waste; any hazardous material designated by the Secretary of the U.S. Department of Transportation under the Hazardous Materials Transportation Act; any radioactive materials; or any petroleum product.

Hazardous waste means waste defined to be hazardous pursuant to the Missouri Hazardous Waste Management Law Section 260.350 to Section 260.430 or pursuant to federal rule 40 CFR 261.

Replicate split sample is obtained by dividing or splitting one sample that has been mixed or homogenized into two samples for separate analysis. A replicate split is collected primarily to assess precision associated with analytical procedures and to a lesser extent sample handling procedures. Replicate split samples of soils or other non-aqueous materials are not recommended if volatile organics analyses are requested due to the potential loss of the volatiles during the mixing process. Duplicate samples for volatile organics analyses are sometimes collected prior to mixing, however, there may be a greater potential for inconsistency due to the heterogeneous nature of soils or other non-aqueous media.

APPENDIX B: ANALYTICAL REQUIREMENTS

The detection limits, as specified in 40 CFR 136 Appendix A and the EPA SW-846 Methods, are sufficient for most project under the oversight of the BVCP. The accuracy and precision of each analytical method are determined by using spikes and spike duplicate analyses, as specified in the EPA SW-846 methods.