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MARYLAND DEPARTMENT OF THE ENVIRONMENT

LAND AND MATERIALS ADMINISTRATION

LAND RESTORATION PROGRAM

QUALITY ASSURANCE PROJECT PLAN
SITE ASSESSMENTS AND CERCLA SITE INSPECTIONS

July 2022

TITLE AND APPROVAL PAGE

Quality Assurance Project Plan for Site Assessments and CERCLA Site Inspections

Land Restoration Program
Land and Materials Administration
Maryland Department of the Environment
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Baltimore, MD 21230

July 2022

Cooperative Agreement Recipient: Barbara Krupiarz

Signature

Barbara Krupiarz 7/7/2022

Printed Name/Date

Project QA Officer: Barbara Brocks

Signature

Barbara Brocks 7/7/2022

Printed Name/Date

U.S. EPA Designated Approving Official: ANEESH GHIMIRE Digitally signed by ANEESH GHIMIRE Date: 2022.07.14 10:09:30 -04'00'

Signature

Printed Name/Date

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ACRONYMS

ASTM	American Society for Testing and Materials
BSA	Brownfields Site Assessment
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act of 1980
CERCLIS	Comprehensive Environmental Response, Compensation and Liability Information System
CHS	Controlled Hazardous Substances
CLP	Contract Laboratory Program
DI	Deionized water
DQI	Data Quality Indicator
DQO	Data Quality Objective
EPA	Environmental Protection Agency
ESAT	Environmental Services Assistance Team
FQAO	Field Quality Assurance Officer
FQCM	Field Quality Control Manager
HRS	Hazard Ranking System
LRP	Land Restoration Program
LMA	Land and Materials Administration
MDE	Maryland Department of the Environment
MQAO	Maryland Quality Assurance Officer
NPL	National Priorities List
ODS	Overnight Delivery Service
PA	Preliminary Assessment
QA	Quality Assurance
QA/QC	Quality Assurance/Quality Control
QAD	Quality Assurance Directive
QAO	Quality Assurance Officer
QAPP	Quality Assurance Project Plan
QC	Quality Control
RSCC	Regional Sampling Coordination Center
SAP	Sampling and Analysis Plan
SEMS	Superfund Enterprise Management System
SI	Site Inspection
SMO	Sample Management Office
SOW	Statement of Work
SPM	Site Project Manager
STC	Sample Transport Container

A. INTRODUCTION

A.1 PURPOSE OF MANUAL

This Quality Assurance Project Plan (QAPP) applies to Site Inspections (SI) and other Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) site work, and Site Assessment investigations conducted in the State of Maryland.

Environmental Protection Agency (EPA) Order 5360.1 A2 and the applicable Federal regulations establish a mandatory Quality System that applies to all EPA organizations and organizations funded by EPA. Organizations, such as the Maryland Department of the Environment (the Department or MDE), must ensure that data collected for the characterization of environmental processes and conditions are of the appropriate type and quality for the intended use and that environmental technologies are designed, constructed, and operated according to defined expectations.

The QAPP integrates all technical and quality aspects of a project, including planning, implementation, and assessment. The ultimate success of an environmental program or project depends on the quality of the environmental data collected and used in decision-making. This QAPP is intended as a generic description of procedures and practices that will be followed by State personnel in conducting typical CERCLA and Sites investigations.

A.2 BACKGROUND

As a result of the Maryland General Assembly's passage of Senate Bill 570 and changes in Health-Environmental Article 7-223, Control of the Disposal of Controlled Hazardous Substances, a Maryland Superfund Program was created on July l, 1984. Recodification of the above-referenced Article during the establishment in the 1987 General Assembly of the new Department of the Environment resulted in the creation of the Environment Article, which utilizes the same subtitles. With the passage of this legislation, the Maryland Department of Health and Mental Hygiene, Office of Environmental Programs, (now the MDE) is required to maintain a master list of sites in the State where the Department has reason to believe or has been notified that Controlled Hazardous Substances (CHS) may be present.

A.2.1 CERCLA Activities

Once the EPA has placed a site on the Comprehensive Environmental Response Liability Information System (CERCLIS) list, a Preliminary Assessment of the site is conducted by the Department's National Priorities List/Site Assessment Section personnel in order to ascertain the potential impact that the site may have on the environment and the public's health. If this investigation determines that CHS are either suspected or known to be present, an SI with the appropriate sampling and monitoring will be initiated. The results of the SI will provide the analytical data necessary to properly assess the site. Sites which meet the criteria needed for ranking using the EPA Hazard Ranking System (HRS) may be placed on the National Priorities List (NPL) for further investigation and possible Federal Superfund remediation. Those sites which do not rank on the NPL or those sites the EPA chooses not to pursue but which the State feels warrant further assessment and possible cleanup will be addressed under the State Superfund program. If at any time during these investigations it is determined that an emergency situation exists, immediate emergency measures will be implemented using the Maryland Hazardous Substance Response Plan, which is consistent with the National Contingency Plan.

In accordance with this basic QAPP, the Department's NPL/Site Assessment Section assists the EPA in conducting SIs in the State of Maryland. The State of Maryland proposes sites for investigation and once approval for the investigation is given by EPA Region III, the QAPP is implemented, and the Sampling and Analysis Plan (SAP) is prepared.

A.2.2 Site Assessments

Brownfields sites are industrial or commercial properties that are either abandoned or underutilized and are located in urban or suburban areas. These sites are suspected or perceived as being contaminated but may be put back into productive use once these concerns are addressed. Brownfields Site Assessments (BSAs) are conducted by the Department's NPL/Site Assessment Section and are funded by the EPA.

When the owner or prospective purchaser of a property requests a BSA, MDE initially prepares a Property Questionnaire and submits it to EPA for approval. When EPA has approved the property, MDE then completes a Phase I Site Assessment and submits it to EPA forapproval and determination whether the project should proceed to a Phase II, which includes sampling. If a Phase II is completed, MDE will then prepare a BSA report, which is then submitted to EPA for review and approval.

A.3 OVERVIEW

This QAPP contains general procedures and protocols which will be used by the NPL/Site Assessment Section to assure that suitable analytical results will be obtained during SIs and BSAs that will allow valid conclusions to be drawn from the results. The QAPP covers all areas of field sampling that are subject to review and interpretation as well as laboratory QA objectives and requirements. All current guidelines will be utilized if revisions are made after approval of the QAPP.

A.4 IDENTIFICATION OF STAKEHOLDERS

The following list includes, but is not limited to:

- MDE's Voluntary Cleanup Program
- MDE's Hazardous Waste Program
- MDE's Solid Waste Program
- MDE's Water Management Administration
- Environmental Consulting Industry
- Environmental Protection Agency
- Environmental Remediation Contractors
- Department of Defense
- State Legislature
- County Governments
- Municipal Governments
- Property Owners
- Potential Purchasers
- Lending Institutions
- Developers
- Surrounding Property Owners
- Surrounding Residents

B. PROJECT MANAGEMENT

B.1 PROJECT ORGANIZATION AND RESPONSIBILITY

The organizational chart provided in Figure 1 identifies the general Maryland organization. Figure 2 identifies the Land and Materials Administration (LMA). Figure 3 identifies the individuals within the Land Restoration Program (LRP) responsible for:

- Overall project coordination.
- Overall QA (Maryland Quality Assurance Officer (MDQAO)).
- Sampling operations.
- Sampling QC.
- Laboratory analyses.
- Laboratory QC.
- Data processing activities.
- Data processing QC.
- Data quality review.

Certain key individuals may be responsible for more than one of the aforementioned project functions. The organizational chart provides sufficient evidence that the lines of authority for all referenced organizations are appropriate to accomplish the QA objectives of this report.

The contact information for key individuals in LRP are as follows:

Barbara Brocks	410-537-3497
Barbara Brown	410-537-3212
Barbara Krupiarz	410-537-3459
Brian Dietz	410-537-3488
Jenny Herman	410-537-3319
Kim Lemaster	410-537-3394
Mark Mank	410-537-3436
Ira May	410-537-3458
Peggy Williams	410-537-3192

FIGURE 1 - GENERAL MARYLAND ORGANIZATIONAL CHART

State of Maryland
Larry Hogan, Governor

Department of the Environment
Horacio Tablada, Secretary

Land and Materials Administration
Kaley Laleker, Director

Land Restoration Program
Barbara Krupiarz, Program Manager

Federal Assessment and Remediation Division
Ira May, Division Chief

NPL/Site Assessment Section
Peggy Williams, Section Head

CLP Manager
Barbara Brocks

Project Managers
Phillip Anderson – Geologist
Jenny Herman – Geologist

FIGURE 2- LAND AND MATERIALS ADMINISTRATION ORGANIZATIONAL CHART

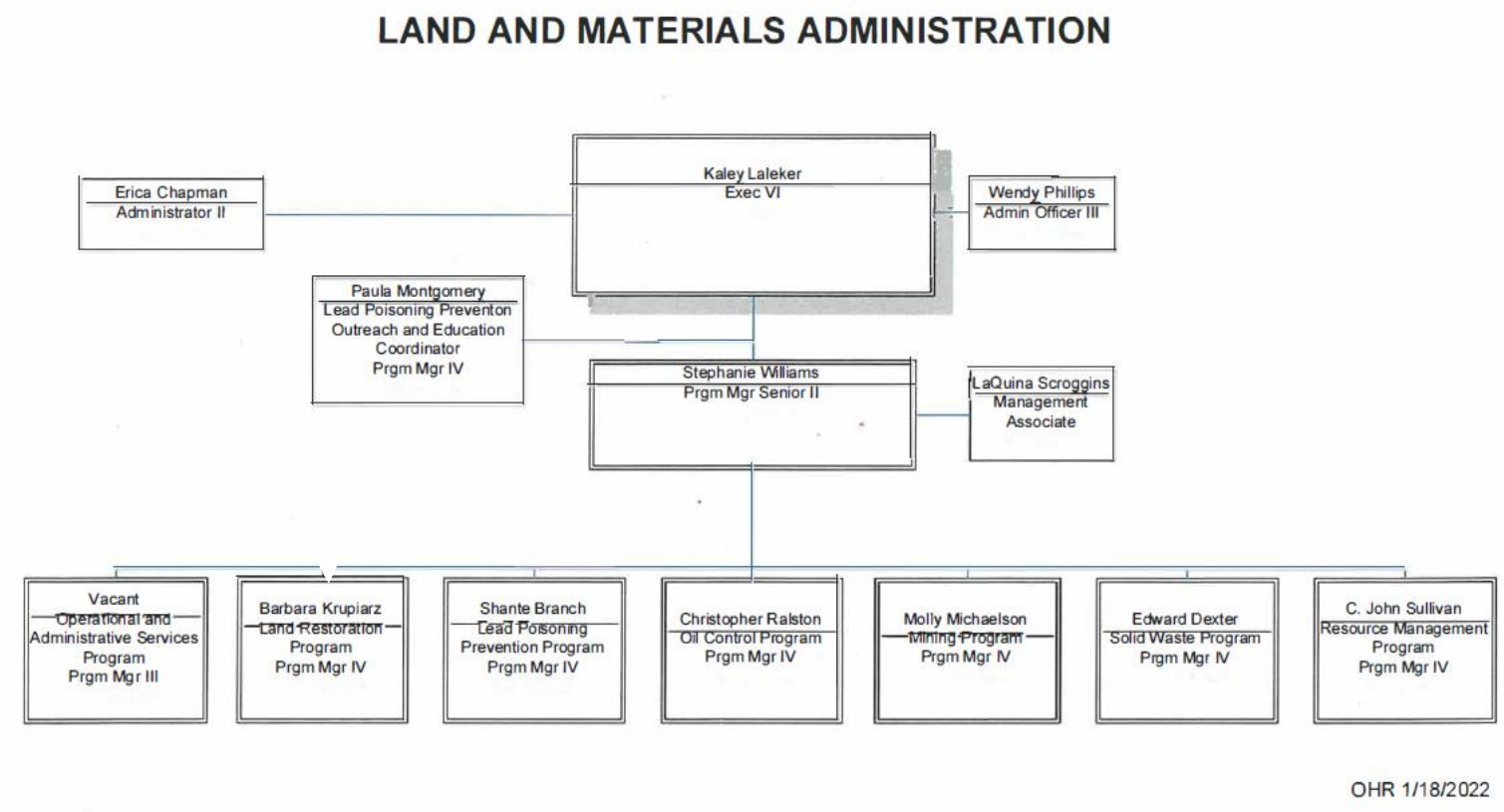
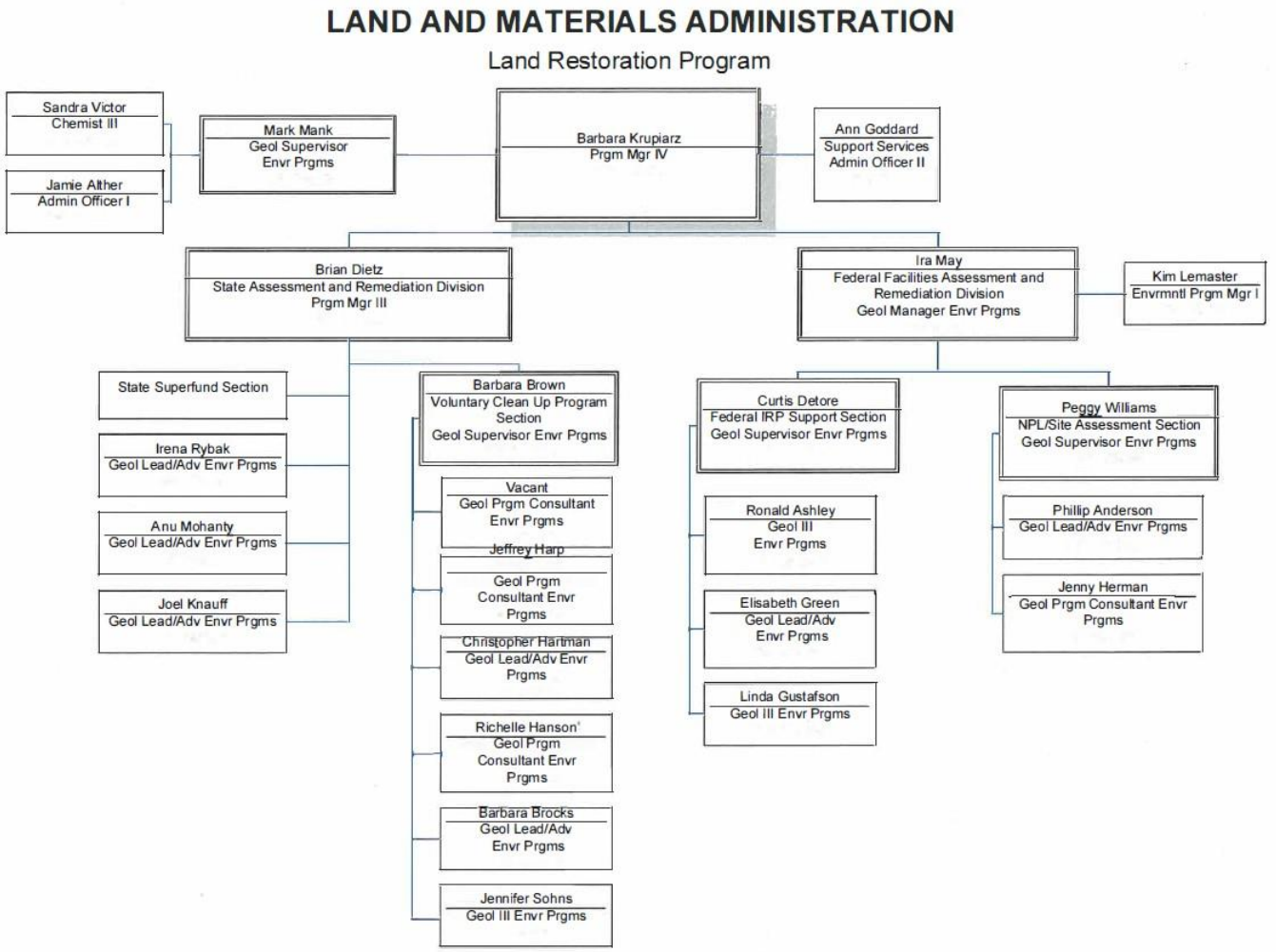


FIGURE 3 – LAND RESTORATION PROGRAM ORGANIZATIONAL CHART



B.2 PROJECT STRATEGY

The Data Quality Objectives (DQO) process allows the SI or Site Assessment team to determine the level of data quality needed for specific data collection activities and to estimate the cost associated with these activities, as appropriate.

A summary of the DQO process follows:

- State the problem: What is the purpose of the project?
- Identify the decision(s): What are the available options under consideration?
- Identify inputs in the decision(s): What information is needed to make informed, defensible decisions?
- Define the boundaries of the study: What is the geographical extent and time and budget constraints for the project?
- Develop a decision rule: Formulate "if…then" statements that relate the data to the decision to be supported.
- Specify limits on decision errors: Estimate how much uncertainty will be tolerated in the site decision(s).
- Optimize the design: Identify the most cost-effective means to gather the data needed. If obstacles exist, reassess all the steps of the DQO process to refine decisions and goals until a workable roadmap or decision tree is produced.

These seven steps are used during the planning of the SI and Site Assessment processes to ensure that field activities, data collection operations and the resulting data meet the project objectives. The DQO process is iterative, and the output of one step may affect prior steps. This may lead the SI or Site Assessment team to revisit some previous steps but will ultimately lead to a more efficient data collection design.

Application of the DQO process is common-sense approach that translates broad consensus-based goals into specific tasks. In this way, the SI or Site Assessment team uses the DQO process to prepare a road map, which can then guide the project, inform the public and other interested parties and bring newcomers to the project up to speed quickly.

B.3 SAMPLING DESIGN

In general, the following information is typically considered during the design of a sampling event, whether for an SI or a BSA. Specific sampling procedures which shall be used during all sampling events are described in Appendix A - Standard Operating Procedures for Field Operations.

B.3.1 Soils

Soil samples may include, but are not limited to, samples collected from the ground surface (0-1 ft), and subsurface (typically 4-6 ft), or from hand augers or other drilled samples. Actual depths of samples may vary depending upon conditions encountered or historical site practices. In any event, the site-specific SAP will address specific sample depths. In designing the SAP, the following characteristics of soils should be considered prior to choosing sample locations:

- soil type,
- chemical characteristics,
- structure,
- permeability,
- moisture content,
- particle size,
- color,
- profile,
- particle density, and
- parent material.

In addition, the following items should also be considered:

- subsurface geologic and hydrogeologic information,
- topography,
- climate,
- erosion and flooding,
- surface drainage pathways, and
- type of contamination.

The sample locations chosen can be modified in the field by the Site Project Manager (SPM) if variations from the expected soil conditions are encountered. These variations will be explained in the report to EPA.

B.3.2 SEDIMENTS

For purposes of the BSA or SI, sediments are defined as the deposited material underlying or placed by a body of water. In order to assure representativeness, it is important to select sampling locations where the sediments and depositional environment will most likely exhibit the contaminants in question. For example, the physical characteristics of the contaminants is vital in determining the portion of sediments to sample. Heavier contaminants are more likely to be found on the bottom of the watercourse, while lighter contaminants will float on the top of the water. Additionally, lighter organic compounds are more likely to be present in the finer-grained portions of the watercourse because these sediments tend to have a higher content of carbon constituents to which the organic compounds adsorb. In addition, evacuations of inflows, discharges, rocks, and similar physical disturbances should also be taken into account since sediment composition varies depending on these factors. Determining velocity and volume of the watercourse are also essential to selection of sediment sampling points.

B.3.3 Surface Waters

Surface waters can be defined as any fluid body, flowing or otherwise, whose surface is exposed to the atmosphere, and which may include streams, rivers, ponds, point and nonpoint discharges, lagoons, and impoundments. Selection of sample locations must consider the flowing or nonflowing nature of the water body and the physical characteristics of the potential contaminants in water. For example, high molecular weight compounds such as chlorinated solvents would tend to sink in water, where gasoline would tend to float on the water.

B.3.4 Groundwater

Groundwater is that water which occurs below the water table. In obtaining a representative sample of groundwater, it is important to remember that the composition of the water in a monitoring well is probably not representative of the groundwater quality in the aquifer at the site. Even though the monitoring well may have been properly located and installed, the well must be properly evacuated in order to assure that the groundwater sampled is representative of the formation. On those sites where MDE has had no control over the installation of the monitoring wells, the SPM will ensure that research is conducted to determine the adequacy of the placement and installation of the monitoring wells. This information will be used to determine the representativeness of the generated data.

Groundwater may also be collected via direct push technology. The SPM must consider that this may not be representative of groundwater in the water-bearing unit, but it can give important information regarding the presence of contaminants.

B.3.5 CERCLA Activities

The objective of SI sampling is to collect reliable data that will support an evaluation of the subject site under the HRS numerical model. The MDE utilizes the analytical services of the EPA's Contract Laboratory Program (CLP) for CERCLA investigations.

Information from the Preliminary Assessment (PA) of the site (if available), from consultant reports, previous sample results, and any other background knowledge concerning the site, will be used in developing the objectives and in evaluating the data obtained as a result of the site inspection.

Prior to each sample collection effort, the site-specific SAP shall be submitted to EPA Region III for review and approval. The specific details of the project under investigation will be addressed within the SAP.

Background information on individual projects is included in the site-specific SAP submitted to EPA prior to project initiation. Information included in site specific SAP includes, but is not limited to:

- Project dates
- Objectives
- Site description
- Site history, including previous investigations
- Monitoring network design
- Sample site location
- Maps of past and proposed sampling events
- Information on depth to groundwater
- Maps showing groundwater flow direction
- Design justification
- Intended sample matrices
- Sample point locations
- Frequency of collection
- List of field parameters
- List of laboratory parameters
- List of sample type by matrix
- Rationale for data requirements, including how site-specific analytes were chosen
- Laboratory location
- Shipping period of samples
- Timeline and audit schedules*

** [for CLP laboratories]. The Department does not have this type of program for non-CLP laboratories.*

A site-specific project organizational chart showing personnel involved in the site inspection and a description of their assigned tasks will be included. As much as possible, a time schedule of proposed operations will also be included, with the understanding that changes will undoubtedly occur. Site contacts, such as owners, owners' agents, facility operators, appropriate State, County, and local personnel, etc. will be included along with addresses and phone numbers.

In the Site Health and Safety Plan (example in Appendix F), all necessary safety contacts, including the local fire department, police department, hospital and emergency services, and State police, will be listed with emergency phone numbers. A description of the personnel protection level anticipated and equipment on-site, as well as provisions for upgrading the level of protection, will be included along with the necessary contingency information. The Maryland Hazardous Substance Response Plan, which identifies State, County, and Federal responsibilities designated to minimize damage to human health, natural resources, and property caused by the release or potential release of hazardous substances, is available for reference at MDE and will be implemented should an emergency situation arise.

Samples will be collected in a manner consistent with the *Sampler's Guide Contract Laboratory Program Guidance for Field Samplers* (Appendix E). The Scribe documentation software will be used to generate sample labels and tags, chain of custody forms, and to manage and save analytical data. The data collected during the investigation will be compared to the applicable or relevant and appropriate standards in Appendix I, unless EPA Region III requests that other standards be used. The specific standards that may be utilized will be detailed in the site-specific SAP.

B.3.6 Site Assessments

When required, samples will be collected and screened by the MDE laboratory for the parameters detailed in the site-specific SAP. Appendix A-Standard Operating Procedures will be followed. The laboratory SOPs for the respective immunoassay and XRF laboratory procedures are included in Appendices G and H.

The objective of a Site Assessment is to identify potential and/or perceived areas of contamination on abandoned or underutilized industrial/commercial properties and to collect reliable data that will support an evaluation of the subject site. The MDE utilizes the analytical services of several private laboratories for Phase II Site Assessments. If MDE selects another laboratory, a QAPP for that laboratory will be submitted to EPA.

A Phase I Site Assessment typically includes a deed search, review of information available from MDE's Water Management Administration, Air and Radiation Management and other programs within the Land and Materials Administration, a site history, site description, review of geology, Sanborn fire insurance maps, flood insurance maps, reports prepared by consultants, and other information as available. It will also include recommendations on whether to proceed to a Phase II. The Phase I is then submitted to the EPA for review and approval/recommendations.

A Phase II Site Assessment site-specific sampling plan will typically include the following information:

- Project Dates
- Objectives
- Site Description (and map)
- Site History
- Monitoring network design
- Sample site location
- Design justification
- Intended sample matrices
- Sample point locations
- Frequency of collection
- List of field parameters
- List of laboratory parameters
- List of sample type by matrix
- Rationale for data requirements

B.4 PROJECT ORGANIZATION

The Administrator of the Land Restoration Program (LRP) will have overall responsibility for SIs and BSAs conducted by the Site Assessment Section (Figure 1).The Site Assessment Section will be responsible for the planning and implementation of all sampling events. The Chief of the Federal Assessment and Remediation Division and the Section Head of the Site Assessment Section will be responsible for supervising the sampling efforts conducted as part of grants obtained from the EPA.

B.4.1 CERCLA Activities

The Site Project Manager (SPM) will design each SAP sampling activity. The SPM will submit a written SAP to the Section Head of the Site Assessment Section for review. The CLP manager will then review the SAP to ensure compliance with CLP sampling specifications. Once the SAP has been approved by the Section Head, it will be reviewed by the Chief of the Federal Assessment and Remediation Division. Following approval by the Division Chief, the SAP will be submitted for review and approval to the LRP Administrator. The SAP will then be submitted to the LMA Director for review and approval before it is submitted to the EPA for review.

Following review by the EPA, the Site Assessment Section Head will ensure that the SPM incorporates any EPA comments into the sampling plan, as appropriate.

MDE uses EPA's CLP services as part of the overall CERCLA Site Inspection process. EPA officials determine the laboratories utilized for a given project. Utilization of the CLP services will conform to all directions published in *Region III Sample Submission Guidelines* (Appendix D) and any other directives or guidance as received from the Regional Sampling Coordination Center (RSCC). Note that personnel of the EPA Region III RSCC and Sample Management Office (SMO) perform Quality Assurance Officer (QAO) functions for CLP services.

CLP services include third party data validation and QA/QC procedures that will be adhered to throughout the project. Once all analyses of samples have been completed, the QAO (an individual independent of the data generation group) will initiate a quality assurance review of the results. The QAO will perform data review, assign codes to the data, and determine its useability as per the National Functional Guidelines 2020 (Appendix J). The QAO will submit the results and a Quality Assurance Report to EPA Region III's Maryland Project Officer. The report will include data review and data processing quality control. The QAO will perform an in-house audit. In addition, the laboratory will participate in the quarterly Performance Evaluations (blind samples) conducted by the EPA.

When validated laboratory data is received by MDE, the CLP manager will review the data and contact the SMO with any questions. Then the SPM will review and submit it to a LRP toxicologist for a toxicological evaluation. When the toxicological evaluation is complete, the SPM will prepare a draft SI Report for review by the Section Head, Site Assessment Section. When the Section Head's review is complete, the report will then be reviewed by the Federal Assessment and Remediation Division Chief and the LRP Manager, and submitted to EPA Region III for review and comments. Once comments have been incorporated, a final report will be submitted to the Regional Site Assessment Manager for EPA Region III.

B.4.2 SITE ASSESSMENTS

Before conducting a BSA, a site-specific SAP is prepared which is consistentwith the *EPA Region III Brownfields Site-Specific Sampling and Analysis Plan Template* (Appendix K) and is sent to EPA Region III for review and approval.

This SAP shall:

- Logically evaluate available site information.
- Specify site-specific Measurement Quality Objectives (MQOs) for precision, accuracy and completeness for each parameter being measured.
- Select an appropriate sampling design.
- Select and utilize suitable geophysical, analytical screening and sampling techniques.
- Employ proper sample collection and preservation techniques.
- Collect and analyze appropriate quality assurance/quality control (QA/QC) samples.
- Logically present and interpret analytical and geophysical data.
- Define data usability criteria.

The LRP currently has a Remedial Management Services (RMS) contract in place which provides a multi-year fixed-price contract for project management and technical services to support MDE's remedial response and sampling activities. Laboratory services for sample analysis are included in the RMS contract. Samples will be submitted to the fixed laboratory in a manner consistent with the Standard Operating Procedures in Appendix A and Appendix D.

If required or determined to be necessary, soil and sediment samples are screened by MDE's field screening laboratory for any of the following: metals, carcinogenic polynuclear aromatic hydrocarbons (cPAHs), benzene-ethylbenzene-toluene-xylenes (BTEX), and polychlorinated biphenyls (PCBs). A subset will then be selected to send to the fixed laboratory, based on the screening results. Typically, 35% of the samples will be selected, unless there are less than 20, in which case 50% will be submitted. The SOPs for collecting field screening samples are in Appendix A.

When the data is received from the fixed laboratory, it will then be submitted for third party validation to a contractor that has won the bid. The data validation will be conducted in a manner consistent with the National Functional Guidelines 2020 (Appendix J). A QAPP for the contractor selected for the third-party validation will be submitted to EPA as an addition to the MDE QAPP.

The data will also be reviewed by the SPM, input into a database, and submitted to an MDE toxicologist for a toxicological evaluation. When the toxicological evaluation is complete, the SPM will prepare a draft Site Assessment Report for review by the Section Head, Site Assessment Section. When the Section Head's review is complete, the report will then be reviewed by the Chief of the Federal Assessment and Remediation Division and the Administrator of the LRP. Once comments have been incorporated,a final report will be submitted to the Regional Site Assessment Manager for EPA Region III.

B.5 QUALIFICATIONS OF STATE OF MARYLAND PERSONNEL

The qualifications of the Site Assessment Section are available on file at:

State of Maryland
Department of the Environment
Office of Personnel Services
1800 Washington Boulevard
Baltimore, Maryland 21230

Attention: Ms. Michelle Romney, Director of Human Resources

B.6 TRAINING COURSES

Training courses typically attended by State of Maryland personnel includes, but is not limited to:

Hazardous Materials Incident Response Operations
Treatment Technologies for Superfund
Air Monitoring for Hazardous Materials
Introduction to Groundwater Investigations
HRS Guidance and Superscreen Software Training
State Site Managers Training
CERCLA Removal Training
Aeration Technologies for Soil and Groundwater Remediation
Sampling for Hazardous Materials
Risk Assessment Guidance for Superfund
Remediation of Chlorinated and Recalcitrant Compounds

B.7 QUALITY OBJECTIVES AND CRITERIA FOR MEASUREMENT DATA

Data collected from Site Assessments will be used to:

- Ascertain if there is a threat to public health or the environment.
- Locate and identify potential sources of contamination.
- Ascertain if contamination present equals or exceeds MDE Cleanup Standards for Soil and Groundwater, EPA Region III Risk Based Concentrations, Safe Drinking Water Act Maximum Contaminant Levels, or other applicable or relevant and appropriate standards.

When conducting an SI or BSA, all measurements will be made so that results are reflective of the medium and conditions being measured. Prior to all environmental measurement activities, site-specific Data Quality Objectives (DQOs) and measurement performance criteria will be determined. DQOs are qualitative and quantitative statements that specify the quality of the environmental monitoring data required to support decisions. DQOs are predicated in accordance with the anticipated end uses of the data that are to be collected. DQOs are applicable to phases and aspects of the data collection process including site investigation, design, construction and remedy operations. It is important to note that the level of detail and data quality needed will vary with the intended use of the data.

DQOs are typically assessed by evaluating precision, accuracy, representativeness, completeness and comparability of all aspects of the data collection process. These Data Quality Indicators (DQIs) are defined as:

- ***Precision***; a measure of the reproducibility of analyses under a given set of conditions.
- ***Accuracy***; a measure of the bias that exists in a measurement system.
- ***Representativeness***; the degree sampling data accurately and precisely depict selected characteristics.
- ***Completeness***; 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.
- ***Comparability***; the degree of confidence with which one data set can be compared to another.

To assess if environmental monitoring measurements are of an appropriate quality, the general DQI requirements found in Section E.3 of this document and site-specific MQOs for precision, accuracy and completeness will be compared to the site-specific quality objectives and measurement performance criteria. Additionally, to ensure that the decision threshold requirements for analytes are met for each matrix, appropriate analytical and extraction methods will be chosen. Whenever possible, the level of reporting will be 10X below the decision level.

C. MEASUREMENT/DATA ACQUISITION

C.1 SAMPLING METHODS REQUIREMENTS

The purpose of performing a BSA and/or SI is to determine the presence and identity of contaminants along with the extent to which they have become integrated into the surrounding environment. The objective of this effort is to collect and analyze a sample that is representative of the media under investigation. The methods and equipment used for sampling environmental matrices vary with the associated physical and chemical properties.

Samples from the organic solid matrix requiring volatile organic compound (VOC) analysis will be collected via SW-846 Method 5035A utilizing pre-tared closed-sampling vessels containing 5 grams of soil. CLP protocol will be followed throughout the sample collection and submittal process (U.S. EPA, "Contract Laboratory Program Guidance for Field Samplers," November 2020).

To ensure that uniform and acceptable sampling protocols for each project are being used, the sampling requirements found in Appendix A, Appendix D or the selected laboratory QAPP will be utilized. Sample containers, preservation techniques, sample volumes, and holdingtimes are summarized in Table 1. A similar table will be included in all site-specific Sampling Plans.

TABLE 1 – REQUIREMENTS FOR CONTAINERS, PRESERVATION TECHNIQUES, SAMPLE VOLUMES AND HOLDING TIMES

Name	Analytical Method	Container	Water Sample Preservation	Minimum Sample Volume or Weight	Maximum Holding Time
Cyanide	335.4	P, G, T	≤6°C; NaOH to pH>12	500 mL (water) 4 oz. (soil)	14 days (water) 28 days (soil)
Hexavalent Chromium	218.6	P, G, T	≤6°C $(NH_4)_2SO_4$ to pH 9.3-9.7	500 mL (water) 4 oz. (soil)	28 days (water) 30 days (soil)
Mercury	245.5 (soil) SW-7471A 245.1 (water) SW-7470A	P, G, T	HNO3 to pH<2; ≤6°C	250 mL (water) 4 oz. (soil)	28 days (water and soil)
Metals (except Cr+6 and Hg)	6020 SW-846 AA methods	P, G, T	HNO3 to pH<2; ≤6°C	1 L (water) 8 oz. (soil)	180 days (water and soil)
TPH-volatile fraction	8015 modified	G, Teflon-lined septum, T, inert composite polymer	≤6°C; HCl to pH<2	3 x 40 mL (water) 4 x Encore ® samplers or equivalent + 1 – 40 mL vial for soil moisture (soil)	14 days (water and soil); 7 days if unpreserved by acid
TPH-semi-volatile fraction	8015 modified	G, amber, T	≤6°C	1 L (water) 8 oz. (soil)	7 days until extraction and 40 days after extraction (water) 14 days until extraction and 40 days after extraction (soil)

Name	Analytical Method	Container	Water Sample Preservation	Minimum Sample Volume or Weight	Maximum Holding Time
Halogenated volatiles	8021B	G, Teflon-lined septum, T, inert composite polymer	≤6°C; HCl to pH<2	3 x 40 mL (water) 4 x Encore ® samplers or equivalent + 1 – 40 mL vial for soil moisture (soil)	14 days (water and soil); 7 days if unpreserved by acid
Nitrosamines	8070A	G, Teflon-lined cap, T	≤6°C	1 L (water) 8 oz. (soil)	7 days until extraction and 40 days after extraction (water); 14 days until extraction and 40 days after extraction (soil)
Chlorinated herbicides	8151A	G, Teflon-lined cap, T	≤6°C; pH 5-9	1 L (water) 8 oz. (soil)	7 days until extraction and 40 days after extraction (water); 14 days until extraction and 40 days after extraction (soil)
Organochlorine pesticides	8081B	G, Teflon-lined cap, T	≤6°C; pH 5-9	1 L (water) 8 oz. (soil)	7 days until extraction and 40 days after extraction (water); 14 days until extraction and 40 days after extraction (soil)
PCBs	8082A	G, Teflon-lined cap, T	≤6°C; pH 5-9	1 L (water) 8 oz. (soil)	7 days until extraction and 40 days after extraction (water); 14 days until extraction and 40 days after extraction (soil)
Organophosphorus pesticides/compounds	8141B	G, Teflon-lined cap, T	≤6°C; pH 5-9	1 L (water) 8 oz. (soil)	7 days until extraction and 40 days after extraction (water); 14 days until extraction and 40 days after extraction (soil)
SVOCs including Polynuclear aromatic hydrocarbons (PAHs)	8270D	G, Teflon-lined cap, T	≤6°C	1 L (water) 8 oz. (soil)	7 days until extraction and 40 days after extraction (water); 14 days until extraction and 40 days after extraction (soil)
VOCs	8260C	G, Teflon-lined septum, T, inert composite polymer	≤6°C, HCl to pH<2	3 x 40 mL (water) Closed vial system, 5g, 3x pre-tared vial + 1-40 mL vial for soil moisture (soil)	14 days (water and soil); 24hours if unpreserved soil
Dioxins and Furans	8280B 8290A	G, Teflon-lined cap, T	≤6°C	1 L (water) 8 oz. (soil)	30 days until extraction and 45 days after extraction (water and soil)
Explosive residues	8330A	P, G, T	≤6°C	1 L (water) 8 oz. (soil)	7 days to extraction (water); 14 days to extraction (soil); analyze within 40 days after extraction
Explosives by Gas Chromatography	8095	Amber G, Teflon-lined cap	≤6°C, keep in dark	(water) (soil)	14 days to extraction.
VOCs (air)	TO-15	SUMMA® canister	Na	Na	Analyze within 30 days.
VOC's (air)	TO-17	Sorbent tube	Na	Na	Analyze within 30 days.
Perchlorate	314.0 6850	G, P	≤6°C	250 mL (water) 4 oz (soil)	28 days holding time
Nitroaromatics	8330	A, G	≤6°C	1000 mL (water) 4 oz (soil)	14 days to extraction (water)
Perfluorooctane Sulfonate (PFOS)	537.1	Polypropylene	unknown	250 mL	To be determined by method
Perfluorooctanoic Acid (PFOA)	537.1	Polypropylene	unknown	250 mL	To be determined by method
Glyphosate	unknown	unknown	unknown	Unknown	To be determined by method

P-polyethylene; G-glass; T-brass sleeves in sample barrel; A- amber.

C.2 SAMPLE HANDLING AND CUSTODY REQUIREMENTS

Sample labels will be securely affixed to each sample container. Sample labels will be generated using Scribe software. Sample labels will clearly identify the individual sample and delineate the following information, as appropriate:

- Site name and designated project number. Note CLP sites will not show site name.
- Sample identification number.
- Date and time the sample was collected.
- Sample preservation method.
- Analysis requested.
- Sampling location.

All samples will be maintained in accordance with the following chain of custody procedures. A sample is under custody when it is:

- In a person's physical possession.
- In view of that person after he/she has taken possession.
- Secured by that person so that no one can tamper with the sample.
- Secured by that person in an area that is restricted to authorized personnel.

A chain-of-custody record must always be maintained from the time of sample collection until final deposition. Scribe software will be used to generate chain of custody forms. Examples of chain-of-custody forms can be found in Appendix D. Every transfer of custody will be noted and signed for with a copy of the record being kept for each individual who endorsed it. At a minimum, the chain-of-custody record will include the following information:

- Contractor name and address.
- Lab name and address.
- Sample identification number.
- Sample location.
- Sample collection date and time.
- Sample information, i.e., matrix, number of bottles collected, container type, etc.
- Names and signatures of samplers.
- Signatures of all individuals who have had custody of the samples.

When preparing sample containers for shipment they will be securely sealed. Samples will then be put in an appropriate transport container and packed with an appropriate absorbent material. Samples placed in the sample transport container (STC) (e.g., coolers) will be packed ina manner that will prevent breakage. All sample containers will be packed to maintain a temperature of $\leq$6°C. A temperature blank will be added to each STC. This container of blank water will be used to verify that the temperature within the STC was maintained at $\leq$6°C.

All sample documentation will be affixed to the underside of each STC lid. The STC lid will then be closed and affixed with a custody seal accordingly. Samplers will transport environmental samples directly to the laboratory within 24 hours of sample collection or utilize an overnight delivery service within 24 hours of sample collection.

Custody seals on the STC will be used to demonstrate that the STC has not been opened or tampered with. The individual who has sample custody shall always sign, date and affix the custody seal to the container in such a manner that it cannot be opened unless it is broken. When samples are not under direct control of the individual responsible for them, they will be stored in a container that will be affixed with a custody seal. When the STC is received in the laboratory, the laboratory sample custodian will remove the temperature blank to measure the temperature within the STC.

All appropriate U.S. Department of Transportation (DOT) regulations for packaging, marking/labeling and shipping hazardous materials and wastes will be followed. Air carriers that transport hazardous materials, in particular FEDERAL EXPRESS, will comply with the current edition of the International Air Transport Association (IATA) Dangerous Goods Regulations. The IATA regulations detail the procedures to be used to enable the proper shipment and transportation of hazardous materials by a common air carrier. Following all current IATA regulations will ensure compliance with DOT.

C.3 ANALYTICAL METHODS REQUIREMENTS

Analytical methods will be selected that are adequately sensitive to achieve project objectives and protect public health and the environment. Each site-specific SAP will identify analytical method numbers and required detection limits for each field parameter (see Example Tables 2C and 2D). Method detection levels must be below MDE Soil and Groundwater Cleanup Standards and EPA Region III Risk Based Concentration table values when practically attainable (Appendix I). The analytical methods have established practical quantitation limits for the target parameters as part of the method. All reporting limits are typically achievable for most soil and water matrix samples, but some samples may contain chemical or physical interferences that may raise these levels. The laboratory will undertake all reasonable efforts to maintain these levels. Analytes detected exceeding the method detection limits but below the practical quantitation limits will be reported as estimated values and annotated accordingly in the data deliverables. Extraction and/or digestion numbers, method detection limits and quantitation limits are included for each field parameter. This SAP will also identify method numbers with detection limits for each field parameter. Non-EPA approved methods will be included as an appendix to the SAP. Analytical methods, parameters and preparatory methods typically used are summarized in Table 2.

TABLE 2A – ANALYTICAL METHODS

Analytical Method	Parameter	Preparatory Methods
8015C	TPH volatile and extractable (water and soil)	volatiles-5030B, 5031, 5035 extractables-6510C, 3520C, 3545C, 3541, 3545, 3550B
8021B	Aromatic and halogenated volatile organics (water and soil)	3585, 5021, 5030B, 5035
8070A	Nitrosamines (water and soil)	3510C, 3520C, 3540C, 3541, 3545, 3550B
8081B	Organochlorine pesticides (water and soil)	3510C, 3520C, 3540C, 3541, 3545,3550B
8082A	PCBs (water and soil)	3510C, 3520C, 3540C, 3541
8141B	Organophosphorus compounds (water and soil)	3510C, 3520C, 3540C, 3541, 3550B
8151A	Chlorinated herbicides (water and soil)	3510C, 3520C, 3540C, 3541, 3550B
8260C	Volatile organics (water and soil)	3585, 5021, 5030B, 5031, 5032, 5035
8270D	Semi-volatile organics (water and soil)	3510C, 3520C, 3540C, 3541, 3545, 3550B
8280B/8290A	Dioxins and furans (water and soil)	see analytical method
8270	PAHs (water and soil)	3510C, 3520C, 3540C, 3541, 3550B
8330A	Explosive residues (water and soil)	3510C, 3520C, 3540C, 3541, 3550B
6010D	Trace metals by ICPES (water and soil)	3005A, 3010A, 3015, 3050B, 3051
6020B	Trace metals by ICP/MS	3005A, 3010A, 3015, 3050B, 3051
314.0	Perchlorate (water and soil)	see analytical method
7041	Antimony (water and soil)	see analytical method, 3005A
7060A	Arsenic (water and soil)	see analytical method, 3050B
7131A	Cadmium (water and soil)	3015, 3020A, 3050B, 3051
7191	Chromium (soil and water)	3015, 3020A, 3050B, 3051
218.6	Hexavalent chromium (water and soil)	3060A, 7199
7421	Lead (soil and water)	3015, 3020A, 3050B, 3051
7470A	Mercury (water)	see analytical method
7471A	Mercury (soil)	see analytical method
7521	Nickel (water and soil)	3015, 3020A, 3050B, 3015
7740	Selenium (water and soil)	see analytical method, 3050B
7841	Thallium (water and soil)	3015, 3020A, 3050B, 3051
7911	Vanadium (water and soil)	3015, 3020A, 3050B, 3051
335.4	Cyanide (water and soil)	see analytical method
314.1 (modified)	Perchlorates (water)	see analytical method (can get as low as 1 ppb in water)
537	PFOS, PFOA (water)	see analytical method
8330	Nitroaromatics	see analytical method
TO-15 (air)	VOCs (SUMMA® canisters)	see analytical method
TO-17 (air)	VOCs (sorbent tubes)	see analytical method

TABLE 2B- CLP SPECIFIC METHODS

Sample Type	Method
Organics	SOMØ2.X
Inorganics	ISMØ2.X
Dioxin/Furan and CBCs	HRSM01.X

TABLE 2C – ANALYTICAL PARAMETERS TABLE

Number of Samples	Matrix	Analytical Parameter	Analytical Method	Container	Preservative	Detection Limit	Maximum Holding Time
6	Solid	TCL VOCs	CLP SOW SOM02.3	Three pre-tared 40-mL VOA vials and one filled with no head space	Ice	CRQL	48 hours to extraction (unpreserved)
6	Solid	TCL SVOCs	CLP SOW SOM02.3	One 8-oz, AWM	Ice	CRQL	7days to extraction, 40 days to analysis

TABLE 2D – ANALYTICAL SCREENING CRITERIA AND PQLS FOR GROUNDWATER AND SOIL SAMPLES**

Analyte VOC	CAS No.	PQLs for Water (µg/L)	PQLs for Soil (µg/Kg)	EPA RSL Residential Soil (mg/Kg)	EPA RSL Industrial Soil (mg/Kg)	EPA RSL Tapwater (ug/L)
1,1,1-Trichloroethane	71-55-6	5	5	8100	36,000	8000
1,1,2,2-Tetrachloroethane	79-34-5	5	5	0.6	2.7	0.076
1,1,2-Trichloro-1,2,2-Trifluoroethane	76-13-1	5	5	40,000	170,000	55,000
1,1,2-Trichloroethane	79-00-5	5	5	1.1	5	0.28

**Achievable detection and quantitation limits are generally not available prior to laboratory selection and submission of samples.

For every project incorporating analysis by GC/MS, there will be a requirement for reporting of Tentatively Identified Compounds (TICs), to be included as a part of the laboratory's reporting package. A qualitative discussion of all the reported TICs may be necessary for inclusion in project reports if high concentrations are found.

C.4 QUALITY CONTROL REQUIREMENTS

QC requirements found in Appendix D will be followed during a BSA and an SI, as the requirements are equivalent.

In general, blank samples are used to identify potential sources of contamination during the sampling, storage, and analytical process. Blanks will be specified as part of each site-specific SAP.

All water used for blanks must be deionized lab-pure-water free from the parameter(s) of interest. Field blanks will accompany all sample sets. Commercially available bottled water or tap water is not acceptable for use as blanks. Blanks that are preserved must be prepared with the same stock and same volume of preservative that was used with the samples.

The blank types typically used are as follows:

- Field blank (sample matrix blank)
- Trip blank
- Rinsate blank (equipment blank)
- Temperature blank

One field blank and one rinsate blank should be collected for each 20 field samples and matrix and/or one per day, whichever is more frequent. One trip blank should be included in each cooler containing samples for VOC analysis. One field duplicate and one matrix spike should be collected for every 20 samples.

C.5 Field and Laboratory Instrument/Equipment Maintenance Requirements

All field equipment will be maintained in accordance with each respective instrument manufacturer's operating instructions. All maintenance activities will be recorded in a logbook. All field screening laboratory equipment will be maintained in accordance with each respective manufacturer's operating instructions and MDE-specific Standard Operating Procedures (Appendices G and H).

For field equipment, the equipment log found in Appendix L will be used. When the acceptance criteria are not met, the appropriate corrective action will be implemented. Analytical equipment will be maintained in accordance with procedures recommended by the equipment manufacturer.

C.6 Instrument Calibration and Frequency

All field equipment will be calibrated appropriately. When the acceptance criteria are not met, the appropriate corrective actions will be implemented. Analytical equipment will be calibrated in accordance with the procedures recommended by the equipment manufacturer.

C.7 DATA MANAGEMENT

C.7.1 Sample Documentation

All sample documents will always be legibly written in ink. Any corrections or revisions to sample documentation shall be made by lining through the original entry and initialing any changes. For SIs, this will be done in a manner consistent with Appendix D.

C.7.2 Field Logbook

The field logbook is a descriptive notebook detailing site activities and observations so that an accurate and factual account of field procedures may be reconstructed. The individuals who are making them will sign all entries. All field logbook entries will document the following specifics:

- Site name and project number.
- Contractor name and address.
- Names of personnel on site.
- Dates and times of all entries.
- Descriptions of all site activities, including site entry and exit times.
- Noteworthy events and discussions.
- Weather conditions.
- Site observations.
- Identification and description of samples and locations.
- Subcontractor information and names of on-site personnel.
- Dates and times of sample collections and chain of custody information.
- Records of photographs.
- Site sketches.
- All relevant and appropriate information delineated in field data sheets and sample labels.

C.7.3 Standard Operating Procedures

Often many laboratory and field operations are arranged to form Standard Operating Procedures (SOPs). Whenever SOPs are applicable and available, they will be incorporated into the data collection activities pursuant to any type of investigation. To ensure environmental sample collection efforts are comparable, procedures found in sampling SOPs will be followed. The sampling SOPs are found in Appendix A. Site-specific SAPs will include SOPs for non-EPA approved methods.

C.7.4 Field Data Records

All real-time measurements and observations must always be recorded in project logbooks, field data records or in similar types of record keeping books. Field data records will be organized into standard formats whenever possible and retained in permanent files.

C.7.5 Analytical Data Deliverable Requirements

At a minimum, the analytical data deliverable package for fixed laboratory data will include the following:

- Sample documentation (location, date and time of collection and analysis, etc.)
- Chain of custody.
- Initial and continuing calibration.
- Determination and documentation of detection limits.
- Analyte(s) identification (include chromatograms).
- Analyte(s) quantitation.
- QC blanks.
- Matrix spike recoveries.
- Quality Control sample results.
- Duplicate results.

For an SI, the laboratory will produce an analytical deliverable package consistent with the CLP. For a BSA, the laboratory will produce a CLP-like analytical deliverable package, which is also discussed in MD Cleanup Standards for Soil and Groundwater (Appendix I). Prior to the submission of laboratory data, the laboratory's Quality Assurance Officer will review the data for accuracy, precision and completeness.

C.7.6 Data Management

The LRP does not have a specific laboratory under contract. When a laboratory is selected for the BSA, submittal of the laboratory's QAPP will be required.

D. ASSESSMENT AND OVERSIGHT

D.1 PERFORMANCE AND SYSTEMS AUDITS

Internal and external performance and systems audits will be undertaken to evaluate the capability and performance of the total measurement system. Audits will be utilized to ensure that field and laboratory activities will provide data reflective of the site conditions.

A performance audit is performed to evaluate the accuracy of the total measurement system or component thereof. A systems audit focuses on evaluating the principal components of a measurement system to determine proper selection and use. This oversight activity of field sampling operations is performed to critique the quality control procedures that are to be employed.

EPA Region III employs several tools designed to provide an increased understanding of the components of its quality system, and to provide a basis for improving the system. Internal and external audits are one of the principal tools for determining the effectiveness of QA components. Audits will be conducted in accordance with established procedures and appropriate protocols. Audit frequency and scheduling varies with the type of audit conducted.

A technical systems audit (TSA) is conducted to assess the sampling and analytical quality control procedures used to generate environmental data. Region III will use TSAs to evaluate laboratory and field procedures used by EPA and state personnel, contractors and grantees. TSAs may entail a comprehensive, on-site evaluation of facilities, equipment calibration, personnel qualifications and training, record keeping procedures, data validation, data management and reporting of field and laboratory activities. Both laboratory and field TSAs may be performed.

D.2 REPORTS TO MANAGEMENT

MDE prepares semiannual reports for the cooperative agreements with the EPA. The following information is included in the semiannual report, as well as other pertinent information.

- Status of projects
- Changes (i.e., additions and deletions) to the cooperative agreement
- Changes to QAPP

E. DATA VALIDATION AND USABILITY

E.1 REVIEW OF FIELD DATA

The criteria used to review field data for accuracy and precision includes but is not limited to calibration results, site location information, etc. This will be done in a manner consistent with the CLP for an SI, and in a manner consistent with the National Functional Guidelines 2020 (Appendix J) for a Site Assessment.

E.2 DATA VERIFICATION AND VALIDATION

Data verification by the various staff involved in the project, will be conducted to ensure that appropriate outputs are being produced and shall continue through the life of the project. Data verification will occur in the field and in the laboratory, as information is being passed from one level to the next. For example, while in the field, the field sample custodian will verify that all field documents (chain-of-custody logs, shipping documents, etc.) are present and complete (with the correct sample numbers, sample tags, sample dates, sampler signatures, etc.) and when the samples are received at the lab, laboratory personnel will ensure that all reporting forms in the laboratory data package are present (analytical services requests, internal laboratory receipt forms, internal laboratory chain-of-custody forms, etc.) and complete.

To ensure that measurement data generated when performing a BSA or an SI are of an appropriate quality, 100 % of all fixed laboratory data will be validated. Data validation is a systematic procedure of 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. It requires that the techniques utilized be applied to the body of the data in a systemic and uniform manner. The process of data validation must be done by an independent third party, and not the laboratory performing the analysis, and according to the 2020 National Functional Guidelines. The third party doing the validation will be named prior to sampling. A complete raw data package is generated as a laboratory deliverable requirement for this review.

The goals of data validation are to evaluate whether the data quality goals established during the planning phase have been achieved, to ensure that all project requirements are met, to determine the impact on data quality of those that were not met, and to document the results of the data validation. The main focus of data validation is determining data quality in terms of accomplishment of measurement quality objectives. In the process of data validation, the laboratory will use proper and adequate QA/QC in analyzing the samples and producing the data; the data produced will meet all quality control standards prescribed in the method; proper data quality flags will be applied to the data; measurement performance criteria from the QAPP will be compared to the actual data collected; and data validation will be performed independently of the data generator by a third party. The ultimate purpose of following this procedure is to produce definitive and/or legally defensible data that follows the 2020 National Functional Guidelines.

E.3 RECONCILIATION WITH USER REQUIREMENTS

E.3.1 Accuracy

Accuracy will be assessed through the analysis of quality control samples. The analytical accuracy will be expressed as the percent recovery (%R) of an analyte that has been added to the environmental sample at a known concentration before analysis and is calculated according to the following equation.

$$\%R = 100\frac{S - U}{C_{sa}}$$

Where: %R = percent recovery

S = measured concentration in spiked aliquot
U = measured concentration in unspiked aliquot
C_{sa} = actual concentration of spike added

The following formula should be used for measurements where a standard reference material is used.

$$\%R = 10\frac{C_m}{C_a}$$

Where: %R = percent recovery
C_m = measured concentration of standard reference material
C_a = actual concentration of standard reference material

E.3.2 Precision

Precision will be determined using field duplicates, matrix spike/matrix spike duplicates, and duplicate quality control samples. The Relative Percent Difference (RPD) between the two results will be calculated and used as an indication of the precision of the analyses performed.

The following formula should be used to calculate precision:

$$RPD = \frac{(C_1 - C_2)}{(C_1 + C_2)/2} \times 100$$

Where: RPD = relative percent difference

C_1 = larger of the two observed values
C_2 = smaller of the two observed values

E.3.3 Completeness

Completeness is defined as 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. Data completeness will be expressed as the percentage of valid data obtained from the measurement system. For data to be considered valid, it must meet all the acceptable criteria including accuracy and precision, as well as any other criteria required by the prescribed analytical method.

The following formula should be used to calculate completeness:

$$\%C = 100\frac{\mathrm{V}}{\mathrm{n}}$$

Where: %C = percent completeness
V = number of measurements judged valid
n = total number of measurements necessary to achieve a specified statistical level of confidence in decision making.