APPENDIX A2
CHARACTERIZATION PHASE WORKPLAN

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PREFACE

The annotated outlines included in this appendix identify potential content for a Characterization Phase Workplan, a Generic Field Sampling Plan (FSP), and a Generic Quality Assurance Project Plan (QAPP). These outlines are not intended to be prescriptive and should be adjusted as appropriate for the site-specific conditions. Some elements of the outlines may apply to your site, while other elements may not. Additional elements than are addressed by these outlines may also be needed. This appendix is for guidance only, and is applicable on a case-by-case basis.

ANNOTATED OUTLINE FOR CHARACTERIZATION PHASE WORKPLAN

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Field Sampling Plan*
Quality Assurance Project Plan*
Site-specific Health and Safety Plan*
Waste Management Plan
[Other appropriate appendices]

**These documents must be prepared to support the field investigation. The documents can either be included as appendices to the workplan or can be referenced by the workplan.*

1.0 INTRODUCTION

Instructions: Provide a general site description. Identify the sites or areas to be investigated. Briefly present the purpose and scope of the investigation. Identify the responsible agency. Outline the project organization.

1.1 SITE LOCATION AND DESCRIPTION
1.2 SITE OR SAMPLING LOCATION DESCRIPTION
1.3 PURPOSE AND SCOPE OF WORK PLAN
1.4 RESPONSIBLE AGENCY
1.5 PROJECT ORGANIZATION

2.0 SITE BACKGROUND

Instructions: The background section should orient the reader to the site. Summarize the site history and operations, as well as any key features relevant to the investigation or conceptual site model. Briefly describe all pertinent details of the topographic and physiographic setting (including the location of rivers, streams, and drainages near the property), the local climate (rainfall, temperature, wind directions, seasonal changes), and local land uses (i.e., residential, industrial, commercial, sensitive land uses). Provide an overview of the site geology and hydrogeology. Identify the depth to groundwater and the water resources in the vicinity of the site. If appropriate, use separate subsections to discuss other relevant topics (e.g., findings of any ecological surveys, whether any cultural resources are present or discuss other environmental media (e.g., surface water).

2.1 SITE HISTORY, OPERATIONS, AND FEATURES
2.2 TOPOGRAPHY, CLIMATE, AND SETTING
2.3 GEOLOGY AND HYDROGEOLOGY
  2.3.1 Geology and Soils
  2.3.2 Groundwater
2.4 [OTHER APPROPRIATE TOPICS]

3.0 PREVIOUS INVESTIGATION AND REMEDIAL ACTIVITIES

Instructions: Discuss and summarize all previous investigations performed at the site. This section should include:

- *A narrative history of previous investigations;*
- *The results of any background studies performed at the site or determined from published sources;*
- *A list of the contaminants of concern that may have been previously determined;*

- *Any remedial measures (such as interim removals or capping) which may have been performed at the site; and*
- *A summary of the investigation results.*

This section should lay the ground work for the investigation objectives and approach described in Section 4 and the sampling design and rationale discussed in Section 5.

3.1 PREVIOUS INVESTIGATIONS
3.2 BACKGROUND CONCENTRATIONS [IF KNOWN]
3.3 CONTAMINANTS OF CONCERN
3.4 PREVIOUS REMEDIAL MEASURES
3.5 SUMMARY OF INVESTIGATION RESULTS

4.0 PROJECT OBJECTIVES/DATA QUALITY OBJECTIVES AND APPROACH

Instructions: Identify the project objectives and data quality objectives (DQOs), including the process used to develop the DQOs. Outline the approach to the investigation (e.g., the PT&R approach is being used, any site-specific adjustments to the PT&R approach, use of TRIAD, how step-out sampling will be addressed if needed. Synthesize the information presented in Sections 2 and 3 to provide a clear and concise presentation of the conceptual site model (CSM). Use the CSM and DQOs to identify the data gaps to be addressed by the investigation.

4.1 PROJECT OBJECTIVES AND DATA QUALITY OBJECTIVES
4.2 PROJECT APPROACH
4.3 CONCEPTUAL SITE MODEL
4.4 DATA GAPS

5.0 SCOPE OF WORK FOR INVESTIGATION

Instructions: This section outlines the scope of work for the investigation. Include separate subsections for each focal point of the investigation. For example, separate subsections should be provided for the activities focused on determining the nature and extent of contamination and those focused on evaluating background concentrations of metals. In addition, data collection activities to support the evaluation and design of the remedy should be addressed in a separate section. If appropriate, include subsections that address other investigation objectives (e.g., sampling of other media).

Each subsection should identify the sampling objectives, provide the technical basis for the proposed sampling, and identify the sampling locations and depths. Support each subsection with appropriate figures which accurately depict the locations of proposed samples.

5.1 NATURE AND EXTENT OF CONTAMINATION
- 5.1.1 Objectives
- 5.1.2 Sampling Design and Rationale
- 5.1.3 Sample Locations and Depths

5.2 BACKGROUND CONCENTRATIONS OF METALS [IF NECESSARY]
- 5.2.1 Objectives
- 5.2.2 Sampling Design and Rationale
- 5.2.3 Sample Locations and Depths

5.3 REMEDY EVALUATION AND DESIGN
- 5.3.1 Objectives
- 5.3.2 Sampling Design and Rationale
- 5.3.3 Sample Locations and Depths

5.4 [OTHER INVESTIGATION ELEMENTS]

6.0 SAMPLING AND ANALYSIS

Instructions: Outline the general sample collection and preservation procedures and methods, a complete discussion of the analytical methods to be applied to the samples, and a quality assurance/quality control program for the field aspect of the investigation (which includes provisions for duplicate samples, blanks, and equipment blanks). Reference the FSP, QAPP, and site-specific health and safety plan (HASP). Also, reference any additional appendices that support the investigation activities (e.g., waste management plan).

6.1 GENERAL SAMPLE COLLECTION PROCEDURES AND PRESERVATION METHODS

6.2 LABORATORY ANALYTICAL METHODS

6.3 QUALITY ASSURANCE AND QUALITY CONTROL

7.0 DATA MANAGEMENT, EVALUATION, AND REPORTING

Instructions: Describe how the data generated by the investigation will be managed, evaluated, and reported. The data evaluation section should address any statistical methods that will be used to evaluate the data or to compare data to background concentrations, screening levels, or another threshold value. The reporting section should indicate whether/how information will be conveyed to stakeholders during the investigation (e.g., regulatory input on step-out sampling) and should outline the content of the investigation report.

7.1 DATA MANAGEMENT

7.2 DATA EVALUATION
- 7.2.1 General Data Evaluation
- 7.2.2 Statistical Methods

7.3 REPORTING

8.0 PROJECT SCHEDULE

Instructions: If appropriate, a project schedule may be included as a separate section.

9.0 REFERENCES

Instructions: Include all references to documents cited in the workplan.

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ANNOTATED OUTLINE FOR GENERIC FIELD SAMPLING PLAN (FSP)

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  - 5.2.2 Trench/Test Pit Excavations
    - 5.2.2.1 General Excavation Procedures, Methods
    - 5.2.2.2 Sampling and Logging
    - 5.2.2.3 Trench/Test Pit Decommissioning
  - 5.2.3 Surface Sampling
    - 5.2.3.1 Hand Auger Method
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5.7 Field Measurements
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  - 5.7.4.3 Portable X-ray Fluorescence Method

6.0 RECORD KEEPING
- 6.1 Chain of Custody Form
- 6.2 Field Notes, Photograph Log
- 6.3 Field Variances
- 6.4 Field Sampling Team Compliance Form

7.0 FIELD HEALTH AND SAFETY PROCEDURES

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1.0 INTRODUCTION

Instructions: Indicate what the FSP presents and how it relates to the associated workplan and QAPP.

This Field Sampling Plan (FSP) presents, in specific terms, the requirements and procedures for conducting field operations and investigations. The FSP presents project specific elements to ensure (1) the data quality objectives (DQOs) specified to this project are met, (2) the field sampling protocols are documented and reviewed in a consistent manner, and (3) the data collected are scientifically valid and suitable for risk management decision making. The FSP together with the project specific Quality Assurance Project Plan (QAPP) shall constitute, by definition, a Sampling and Analysis Plan (SAP).

This FSP is required reading for all staff participating in field work on this project. The FSP shall be in the possession of the field teams during the collection of samples. All personnel are required to be familiar with the components of the FSP and each team member is required to sign the Field Sampling Team Compliance Form (Section 5.4) before each sampling event stating that he/she has read and understands the current version of the SAP.

2.0 PROJECT BACKGROUND

2.1 SCOPE AND PURPOSE

Instructions: Briefly describe the purpose of this FSP.

2.2 PROJECT SITE DESCRIPTION

Instructions: Provide a brief description of the project including the general location, current land use, proposed future land use (if known), problem to be investigated, types of analyses that will be performed, and regulatory oversight.

2.3 SITE HISTORY

Instructions: Describe the history of activity at the project location (site) including activities that led to contamination and previous investigations (if any) to determine the nature and extent of contamination.

3.0 SCOPE AND OBJECTIVES

3.1 OBJECTIVES

Instructions: Discuss the project: DQOs, data quality indicators (DQIs), data review and validation, data management, and assessment oversight—which collectively describe the procedures used to implement the quality assurance program (QA). The FSP should discuss how project-specific decision rules were derived from the DQO process and define data quality categories (e.g., screening data vs. definitive data). Reference the project QAPP.

3.2 SAMPLING RATIONALE

Instructions: Justify the number and location of samples, types of samples, types of analytical analyses, and field activities needed. Justify the location of any proposed background or ambient condition samples (e.g., collected from similar lithology to the site, but free from impacts of site-related activity).

3.3 SAMPLE ANALYSIS SUMMARY

Instructions: For each analytical method, list the (1) number of analyses, (2) total number of environmental samples for all matrices, (3) number of background or ambient condition samples and their location, (4) the number of equipment blanks, (5) the number of field duplicate samples, and (6) the number of screening samples to be confirmed (if screening samples are taken).

3.4 FIELD ACTIVITIES

Instructions: Provide a general overview of the soil sampling event. Present a rationale for choosing each sampling location and depth at the site. If sampling decisions are to be made in the field, provide details concerning the criteria that will be used. List the compounds of concern at each location and provide a rationale for why the specific compound was chosen.

4.0 PROJECT ORGANIZATION AND RESPONSIBILITY

Instructions: List the names, addresses, e-mail address and, telephone numbers for the project organization and key personnel responsibilities on the project. At a minimum list the: Project Manager, Regulatory Oversight Contact, Field Staff, Quality Assurance Manager, and all contractors with their staff. The Quality Assurance Manager is responsible for the implementation of the SAP and QA plan, and specifies if quality control (QC) procedures are being followed.

5.0 FIELD OPERATIONS

5.1 SITE RECONNAISSANCE AND PREPARATION

Instructions: Describe the results of site reconnaissance including preparation for determining the presence of underground utilities at any location designated for intrusive investigation. Vehicle and field staff access should be determined and provide maps of all access roads, trails, or other access features. Central decontamination areas should be designated and locations provided to store investigation derived wastes.

5.2 SAMPLING METAL-IMPACTED MATERIALS

Instructions: Describe the materials to be sampled and the methods to be employed. Given the methods selected chose all applicable subsections as follows.

5.2.1 Borehole Drilling

Instructions: Describe the general drilling activities to be used including methods of drilling, sampling (e.g. split spoon or direct push), frequency of sampling, logging methods, and borehole decommissioning. Indicate that all drilling activities will conform to state and local requirements and will be supervised by a licensed geologist or engineer. Indicate that permits, applications, and other documentation will be acquired prior to field deployment. Describe all decontamination procedures.

5.2.2 Trench/Test Pit Excavations

Instructions: Describe the general excavation activities to be used including methods used , sampling method, frequency of sampling, logging methods, and excavation decommissioning. Describe all decontamination procedures.

5.2.3 Surface Sampling

Instructions: Describe the results of site reconnaissance including preparation for determining the presence of underground utilities at any location designated for intrusive investigation. Vehicle and field staff access should be determined and provide maps of all access roads, trails, or other access features. Central decontamination areas should be designated and locations provided to store investigation derived wastes.

5.3 SURVEYING

Instructions: Describe the methods to survey the location of all investigations on the site and provide the licensed surveyor or other method used.

5.4 EQUIPMENT DECONTAMINATION

Instructions: Specify the decontamination procedures that will be followed for all non-dedicated/non-disposable sampling equipment.

5.5 WASTE HANDLING

Instructions: Specify all investigation-derived waste handling procedures including storage methods, storage containers, storage locations, handling procedures, waste manifest and categorization, and disposal options.

5.6 SAMPLE HANDLING

Instructions: For each type of analysis, specify sample containers to be used, sample volume, and the preservation methods. Specify the sample identification (numbering and labeling), sample packaging and shipping, field quality control procedures (ambient blank samples, equipment blanks, field duplicates and field replicates), sample custody procedures including forms, and methods for determining background samples.

5.7 FIELD MEASUREMENTS

Instructions: When field measurements are obtained, the parameters to be obtained should be listed by the technique used (e.g., mobile laboratory, field assay kit, X-ray fluorescence) and describe equipment handling and calibration, quality control measures (replicate samples sent to analytical laboratories), equipment maintenance, adequate field staff training on the instrument to be used, and decontamination procedures.

6.0 RECORD KEEPING

Instructions: Describe how the project will keep adequate field records and provide copies of the forms to be used including chain-of-custody form, field notes and photograph logs, field variances from the SAP recorded, and the field sampling compliance form (stating that the individual field staff understands and knows the latest version of the SAP attested to by signature before field activities commence.

7.0 FIELD HEALTH AND SAFETY PROCEDURES

Instructions: Reference, or attach a copy of, the field health and safety plan prepared by a qualified industrial hygienist.

ANNOTATED OUTLINE FOR GENERIC QUALITY ASSURANCE PROJECT PLAN (QAPP)

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- 3.1 Assessments and Response Actions
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4.0 DATA VALIDATION AND USABILITY
- 4.1 Data Review, Verification, and Validation
- 4.2 Verification and Validation Methods
- 4.3 Reconciliation with User Requirements

5.0 REFERENCES

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**Include all standard operating procedures (SOPs) referenced in the QAPP.*

1.0 PROJECT MANAGEMENT

Instructions: Identify the purpose of the Quality Assurance Project Plan (QAPP) (e.g., document the results of technical planning process, providing in one document a clear, concise, and complete plan for environmental data acquisition, respective data quality objectives, and related key project personnel). Outline the content of the QAPP (e.g., defines and describes how the environmental data will be used, the project's goals, the decisions that will be made from the information obtained, how the data will be obtained, the possible problems that may occur during data collection, the quantity and quality of data to be collected, how data will be evaluated for suitability for decision making, and how the data will be reported.) Briefly describe the project, its background, location, history of operation, previous environmental work (if any), and associated reports including Sampling and Analysis Plan (SAP), Work Plan, Field Sampling Plan (FSP), etc.

1.1 DISTRIBUTION LIST

Instructions: List the names of key project personnel that will be provided with copies of the current version of the QAPP including: project manager, laboratory manager, field team leader, data processor or statistician, modeler, quality assurance (QA) officer, data reviewers, and prime contractors and subcontractor personnel.

1.2 PROJECT/TASK ORGANIZATION

Instructions: List the individuals and organizations involved with the project identifying roles and responsibilities, including those that will use the data such as the principal data user and decision maker or regulator; and the information producers such as QA managers and field staff. Provide an organizational chart showing the relationships and lines of communication among project personnel.

1.3 PROBLEM DEFINITION

Instructions: State the specific problem to be solved, decision to be made, or outcome to be achieved. More complex projects will require more extensive information in this section.

1.4 PROJECT/TASK DESCRIPTION

Instructions: Summarize the work to be performed and data to be developed. Provide the project schedule and maps, tables, etc. showing geographic locations.

1.5 QUALITY OBJECTIVES AND CRITERIA

Instructions: Define the project data quality objectives (DQOs) and data quality indicators (DQIs). Example DQIs are shown in Table 1. Describe the criteria for measuring data performance and acceptance. These relate the quality of data needed to the established limits on the chance of making a decision error.

Table 1. Data Quality Indicators (DQIs)

DQI	Definition	Methodologies
Precision	A measure of agreement among repeated measurements, can be expressed as a range or standard deviation.	Use the same instrument to make repeated analyses on the same sample. Use split samples.
Bias	Systematic or persistent distortion of measurements.	Use reference materials or analyze spiked samples.
Accuracy	A measure of the overall agreement of a known value.	Analyze reference materials or reanalyze known concentrations.
Representativeness	Qualitatively expresses the accuracy and precision of a parameter.	Evaluate measurements and sample collection methods to appropriately reflect the environment.
Comparability	A qualitative term expressing the confidence of data comparison.	Compare sample collecting and handling methods, holding times, QA, etc.
Completeness	A measure of the amount of valid data needed for a measurement system.	Compare the number of valid data with those established by the DQOs.
Sensitivity	The ability to discriminate between different levels of the variable of interest.	Determine the minimum concentration that can be measured (method detection limit), by an instrument (instrument detection limit), or by a laboratory (quantitation limit).

1.6 SPECIAL TRAINING/CERTIFICATIONS

Instructions: Identify special training/certifications needed by personnel. Provide documentation of this training.

1.7 DOCUMENTATION AND RECORDS

Instructions: Describe how the most current approved QAPP will be distributed to project staff. List records to be included in the data report package, list any other project documents to be produced, and provide disposition of records including location and retention schedule.

2.0 DATA GENERATION AND ACQUISITION

2.1 SAMPLING PROCESS DESIGN

Instructions: Define representative sampling (e.g., selection of a portion of a larger target population, universe, or body, with the characteristics of that sample being inferred as applicable to the target population). Discuss types of sampling strategies (e.g., probability-based, judgmental) and how the strategies affect the conclusions that can be drawn from the data. Provide the current sampling protocol and the basis for sampling design. Include the number of samples, sampling locations, number of samples at each location, the number of composite samples (if any), and the number of QA samples (field replicates, etc.).

2.2 SAMPLING METHODS

Instructions: Describe what constitutes a sample, the required volume, the description of sample/data collection procedures. List the equipment needed; identify performance requirements, and describe corrective actions to be taken if problems arise.

2.3 SAMPLE HANDLING AND CUSTODY

Instructions: Describe the procedures to ensure the integrity of the samples: preservation methods, holding times, chain of custody, field notes to be made, custody seals, and packing procedures. Provide examples of chain of custody forms, custody seals, etc.

2.4 ANALYTICAL METHODS

Instructions: Describe the analytical methods to be used. Identify performance criteria and describe corrective actions to be taken if problems arise.

2.5 QUALITY CONTROL

Instructions: List the QC activities needed for sampling, analytical, or measurement techniques, along with their frequency. Provide control limits for each QC activity and give corrective action measures when they are exceeded. Identify any applicable statistical methods to be used.

2.6 INSTRUMENT/EQUIPMENT TESTING, INSPECTION, AND MAINTENANCE

Instructions: List the equipment and/or systems needing periodic maintenance, testing, or inspection, and provide the schedule. Describe how these procedures will be performed and how they will be documented. Discuss how critical spare parts will be provided and stocked. Describe how re-inspections will be performed and the effectiveness of corrective actions taken.

2.7 INSTRUMENT/EQUIPMENT CALIBRATION AND FREQUENCY

Instructions: List all project tools, gages, instruments, sampling, and testing equipment to be used in the project. Describe specific calibration methods and frequency. Provide copies of calibration and certification forms and how records will be maintained.

2.7.1 Calibration Record Form
2.7.2 Technician Certification

2.8 INSPECTION/ACCEPTANCE OF SUPPLIES AND CONSUMABLES

Instructions: List project supplies and consumables that may directly or indirectly affect the quality of the data. Identify acceptable criteria and identify the staff responsible.

2.9 NON-DIRECT MEASUREMENTS

Instructions: Identify any existing data that will be obtained from non-measurement sources such as literature files and historic databases. Describe acceptance criteria and how the data will be used.

2.10 DATA MANAGEMENT

Instructions: Discuss the project data management process giving record-keeping procedures, data handling equipment, error identification and correction. Provide examples of forms or checklists to be used. Identify computer hardware/software to be used. Include provisions to evaluate the effectiveness of the data management processes.

3.0 ASSESSMENT AND OVERSIGHT

Instructions: Indicate that assessments and evaluations are conducted to determine whether the QAPP is being implemented as approved and to evaluate the effectiveness of project implementation.

3.1 ASSESSMENTS AND RESPONSE ACTIONS

Instructions: Provide a description of the project assessments planned and the information to be collected. Give the schedule for these assessments and work deliverables. Provide for both self- and independent-assessments.

3.2 REPORTS TO MANAGEMENT

Instructions: Indicate how the assessment report will be distributed, who will prepare the report, etc.

4.0 DATA VALIDATION AND USABILITY

Instructions: Indicate that the content of this section addresses the final project checks to determine if the data conforms to the project objectives and to assess the effect of any deviations.

4.1 DATA REVIEW, VERIFICATION, AND VALIDATION

Instructions: State the criteria for accepting, rejecting, or qualifying project data in an objective and consistent manner.

4.2 VERIFICATION AND VALIDATION METHODS

Instructions: Describe how data will be verified and validated. Provide how issues will be resolved and who has authority for resolution. Describe how data results will be released to users. Describe how verification issues differ from validation issues. Provide examples of any forms or checklists used in this process.

4.3 RECONCILIATION WITH USER REQUIREMENTS

Instructions: Indicate how project results will be reconciled with the data requirements and how data user's needs will be met. Analyze and determine possible anomalies or departures from assumptions made when the project was planned.

5.0 REFERENCES

List the references cited in the QAPP.