

**REMEDIAL INVESTIGATION AND FEASIBILITY STUDY  
FINAL WORK PLAN  
EXTERIOR INDUSTRIAL WASTE DITCH  
NAVAL REACTORS FACILITY  
IDAHO FALLS, IDAHO**

**APPENDIX B  
PART B**

**NRF QUALITY ASSURANCE PROJECT PLAN**

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Prepared for the  
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QUALITY ASSURANCE PROJECT PLAN

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## 1.0 PROJECT DESCRIPTION

### 1.1 Site History and Background

The Idaho National Engineering Laboratory (INEL) is a government-owned reservation managed by the U.S. Department of Energy (DOE), located in southeastern Idaho. The INEL was listed on the National Priorities List (NPL) of the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) in November 1989. In response to this listing, the DOE, the Environmental Protection Agency (EPA), and the State of Idaho negotiated a Federal Facilities Agreement/Consent Order and Action Plan (FFA/CO). This agreement describes the methods by which DOE, EPA, and the Department of Health and Welfare (IDHW) will implement CERCLA and the Resource Conservation and Recovery Act (RCRA) activities at INEL release sites. The INEL has been divided into ten Waste Area Groups (WAGs) to facilitate the remediation process. Each WAG is further divided into Operable Units (OU) which focus on specific concerns.

The Naval Reactors Facility (NRF) has been identified as WAG 8. Historical operations at NRF include prototype reactor plant operations for reactor plant development and training of Naval personnel. NRF also supports research and development efforts on reactor materials by preparation and examination of irradiation test specimens and examination of expended fuel from naval reactors. NRF sites being investigated under the FFA/CO include landfills, old spills, wastewater disposal systems (e.g., ponds, ditches, basins, drains, and drain fields) and storage areas.

WAG 8 is primarily the developed area of the NRF site. However, it also includes waste operations that extended or extend outside the NRF developed area, such as the Industrial Waste Ditch (IWD). All of WAG 8 is within the over all seven square mile NRF site and includes surface and subsurface areas.

This Quality Assurance Project Plan (QAPjP) covers all sample collection and analysis work at NRF related to investigation activities under the FFA/CO. Each individual work plan for remedial investigations and feasibility studies and/or Sample and Analysis Plan (SAP) for Track 2 investigations will reference this QAPjP and will include the description of the specific OU covered by that work plan and/or SAP.

### 1.2 Project Objectives and Scope

The objectives and scope of each OU will be addressed in the Work Plan or SAP for that sampling and analysis effort.

### **1.3 Sample Network Design and Rationale**

The sample network design and rationale for sample locations are described in detail in the work plan or SAP for each OU.

### **1.4 Parameters to be Tested and Frequency**

Sample matrices, analytical parameters and frequencies of sample collection can be found in FSP or SAP for each OU.

### **1.5 Data Quality Objectives**

Data Quality Objectives (DQOs) are qualitative and quantitative statements which specify the quality of the data required to support decisions made during the investigations and studies, and are based on the end uses of the data collected. Different data uses may require different levels of data quality. There are five analytical levels which address various data uses and the Quality Assurance (QA)/Quality Control (QC) effort and methods required to achieve the desired level of quality. The data quality level required for each type of data will be identified in the work plan or SAP for each OU.

#### **1.5.1 Screening (DQO Level I)**

This provides the lowest data quality but the most rapid results. It is often used for health and safety monitoring at the site, preliminary comparison to Applicable or Relevant and Appropriate Requirements (ARARs), initial site characterization to locate areas for subsequent and more accurate analyses, and engineering screening of alternatives (bench-scale tests). These types of data include those generated on-site through the use of photoionization detectors (PID), pH, conductivity, and other real-time monitoring equipment at NRF.

#### **1.5.2 Field Analyses (DQO Level II)**

This provides rapid results and better quality than Level 1. This level may include mobile lab generated data, depending on the level of quality control exercised. NRF plans to conduct testing for geophysical and hydrogeological parameters consisting of remote groundwater level monitoring, electrical resistivity, and microgravity monitoring.

**1.5.3 Engineering (DQO Level III)**

This provides an intermediate level of data quality and is used for site characterization. Engineering analyses may include mobile lab generated data and some analytical lab methods (e.g., laboratory data with quick turnaround used for screening, but without full quality control documentation). Parameters and matrices requiring Level 3 DQO are listed in the FSP and SAP for each OU.

**1.5.4 Confirmational (DQO Level IV)**

This provides the highest level of data quality and is used for purposes of risk assessment, evaluation of remedial alternatives, and Potentially Responsible Party (PRP) determination. These analyses require full Contract Laboratory Program (CLP) analytical and data validation procedures in accordance with recognized protocol.

**1.5.5 Non-Standard (DQO Level V)**

This refers to analyses by non-standard protocols; for example, when exacting detection limits or analysis of an unusual chemical compound is required. These analyses often require method development or adaptation. The level of quality control is usually similar to DQO Level 4 data.

## **2.0 PROJECT ORGANIZATION AND RESPONSIBILITY**

NRF and its subcontractor(s) have overall responsibility for all phases of the Remedial Investigations. NRF and subcontractor personnel will perform the field investigation, and prepare the reports and summaries. Project management will be provided by NRF personnel. An organizational chart and additional organizational details are provided in the work plan and SAP for each OU. The various quality assurance and management responsibilities of key project positions are defined below.

### **2.1 Site Management and Quality Assurance Positions**

#### **2.1.1 Remedial Project Managers**

The Remedial Project Managers (RPM) have the overall responsibility for all phases of the RI/FS. At the present time, the EPA Remedial Project Manager is Mr. Wayne Pierre of the Region 10 in Seattle, Washington. Mr. Pierre will be assisted by Ms. Linda Meyer, WAG-8 Manager. The Remedial Project Managers for the State of Idaho are Mr. Dean Nygard, Project Manager, and Ms. Margie English, WAG-8 Manager. The Remedial Project Manager for the U.S. Department of Energy-Naval Reactors, Idaho Branch Office (IBO) is Mr. Dary Newbry.

#### **2.1.2 NRF Program Manager**

The NRF Program Manager has overall responsibility for ensuring that the project meets objectives and quality standards. In addition, he is responsible for technical quality control and project oversight, and will provide the NRF WAG Manager with access to corporate resources.

#### **2.1.3 NRF Waste Area Group (WAG) Manager**

The NRF WAG Manager (R. W. Nieslanik) is responsible for implementing the project, and has the authority to commit the resources necessary to meet project objectives and requirements. The NRF WAG Manager's primary function is to ensure that technical, financial, and scheduling objectives are achieved. The WAG Manager will be responsible to the EPA Region 10, IDHW, and IBO Remedial Project Managers (RPMs), and will be the major point of contact and control for matters concerning the project. The WAG Manager will:

- Define project objectives and develop a detailed Work Plan schedule
- Establish project policy and procedures to address the specific needs of the project as a whole, as well as the objectives of each task

- Acquire and apply resources as needed to ensure performance within budget and schedule constraints
- Orient all field leaders and support staff concerning the project's special considerations
- Monitor and direct the field leaders
- Develop and meet ongoing project and/or task staffing requirements, including mechanisms to review and evaluate each task product
- Review the work performed on each task to ensure its quality, responsiveness, and timeliness
- Review and analyze overall task performance with respect to planned requirements and authorizations
- Approve all external reports (deliverables) before their submittal to RPMs
- Ultimately be responsible for the preparation and quality of interim and final reports
- Represent the project team at meetings and public hearings

#### **2.1.4 Project Engineers**

The NRF WAG Manager will be supported by NRF project engineers who are responsible for leading and coordinating the day-to-day activities of the various resource specialists under their supervision. The NRF project engineers are experienced environmental professionals and will report directly to the NRF WAG Manager. Specific responsibilities include:

- Provision of day-to-day coordination with the WAG Manager on technical issues in specific areas of expertise
- Development and implementation of field-related workplans, assurance of schedule compliance, and adherence to management-developed study requirements
- Coordination and management of field staff including sampling, drilling, and field laboratory staff
- Implementation of QC for technical data provided by the field staff, including field measurement data

- Adherence to work schedules provided by the WAG Manager
- Authorship, review, and approval of text and graphics required for field team efforts
- Coordination and oversight of technical efforts of subcontractors
- Identification of problems at the field team level, discussion of resolutions with the WAG Manager, and provision of communication between the team and upper management
- Participation in the preparation of the final report

#### **2.1.5 Technical Staff**

The technical staff (team members) for this project will be drawn from NRF and contractor personnel. The technical staff will gather and analyze data and prepare various task reports and support materials.

#### **2.1.6 QA Director**

The QA director will be provided by NRF's subcontractor. The QA director will remain independent of direct job involvement and day-to-day operations, and is responsible for auditing the QA program. Specific functions and duties include:

- Provide QA audit of various phases of the field operations
- Ensure compliance with the QAPjP
- Provide QA technical assistance to project staff
- Report on the adequacy, status, and effectiveness of the QA program on a regular basis to the NRF WAG Manager

#### **2.1.7 Region 10 Quality Assurance Officer**

The Region 10 Quality Assurance Officer has the responsibility to review and approve all Quality Assurance Project Plans.

### **2.2 Analytical Laboratory Management and Quality Assurance Positions**

Analytical services will be provided by a subcontractor analytical laboratory. Responsibilities for key personnel are as follows:

### **2.2.1 Analytical Laboratory Project Manager**

- Ensure that all resources of the laboratory are available on an as-required basis
- Perform overview of final analytical reports
- Provide approval of the Laboratory QAPjP

### **2.2.2 Analytical Laboratory Operations Manager**

The Analytical Laboratory Operations Manager is responsible for the following tasks:

- Coordinate laboratory analyses
- Supervise in-house chain-of-custody
- Schedule sample analyses
- Oversee data review
- Oversee preparation of analytical reports
- Approve final analytical reports prior to submission to NRF

### **2.2.3 Analytical Laboratory Quality Assurance Officer**

The Analytical Laboratory Quality Assurance Officer's duties are as follows:

- Perform overview of laboratory quality assurance
- Perform overview of QA/QC documentation
- Conduct detailed data review
- Determine laboratory corrective actions, if required
- Provide technical representation of laboratory QA procedures
- Prepare laboratory Standard Operation Procedures
- Provide approval of the Analytical Laboratory QAPjP

#### **2.2.4 Laboratory Sample Custodian**

The Sample Custodian or his designee performs the following duties:

- Receive and inspect the incoming sample containers
- Record the condition of the incoming sample containers
- Sign appropriate documents
- Verify chain of custody and its correctness
- Notify the Laboratory Manager and Laboratory Supervisor of sample receipt and inspection
- Assign a unique identification number and customer number, and enter each into the sample receiving log
- Initiate transfer of the samples to appropriate lab sections
- Control and monitor access/storage of samples and extracts

### 3.0 QUALITY ASSURANCE OBJECTIVES FOR MEASUREMENT DATA

The overall QA objective is to develop and implement procedures for field sampling, Chain-of-Custody, laboratory analysis, and reporting that will provide data for decision making which are of known and adequate quality, statistically accurate, properly documented, and legally defensible. Specific procedures for sampling, Chain-of-Custody, laboratory instrument calibration, laboratory analysis, reporting of data, internal quality control, audits, preventive maintenance of field equipment, and corrective action are described in other sections of this QAPjP. The purpose of this section is to address the specific objectives for accuracy, precision, completeness, representativeness, and comparability.

#### 3.1 Level of Quality Control Effort

Field blank, trip blank, equipment rinsate, duplicate, and matrix spike samples will be analyzed to assess the quality of the data resulting from the field sampling program. Field and trip blanks consisting of deionized water, will be submitted to the analytical laboratory for the data quality assessment for the field sampling program. Field blank samples are analyzed to check for potential sample contamination at the site. Trip blanks are used to assess the potential for contamination of samples due to contaminant migration during sample shipment and storage, and container cleanliness. Duplicate samples are analyzed to check for sampling and analytical reproducibility. Matrix spikes provide information about the effect of the sample matrix on the digestion and measurement methodology. All matrix spikes are performed in duplicate and will be referred to as Matrix Spike/Matrix Spike Duplicate (MS/MSD) samples. One MS/MSD will be collected for every 20 or fewer investigative samples. MS/MSD samples are designated/collected for organic analyses only.

One field duplicate and one field blank will be analyzed for every 20 or fewer investigative samples. One volatile organic analysis (VOA) trip blank, consisting of deionized ultra pure water will be included with each shipment of VOA samples.

MS/MSD samples are investigative samples. Soil MS/MSD samples require no extra volume for Volatile Organic Compound (VOCs) or extractable organics. However, aqueous MS/MSD samples must be collected at triple the volume for VOCs and double the volume for extractable organics. One MS/MSD sample will be collected/designated for every 20 or fewer investigative samples per sample matrix (i.e., groundwater, soil). The number of duplicate and field blank samples to be collected are listed in the FSP.

The level of QC effort provided by the laboratory will be equivalent to the level of QC effort specified under the CLP program for the Routine Analytical Services (RAS) parameters to be tested. The level of QC effort for testing of inorganics (metals and cyanide) will conform to the most current protocols of Statement of Work (SOW)/ILM01.0. The level of QC effort for testing of Target Compound

List (TCL) organics [Volatiles, Semi-volatiles, and Pesticides/Polychlorinated Biphenyls (PCB)] will conform to the protocols of SOW/OLM01.0, TO-14 and 600. The level of QC effort for testing of TCL organics (Volatiles, Semivolatiles, and Pesticides/PCBs) for drinking water criteria will conform to protocols in 40 CFR Part 136, October 26, 1984, entitled "Guidelines Establishing Test Procedures for the Analysis of Pollutants Under the Clean Water Act."

The QC level for the field measurement of pH consists of pre-measurement calibration and a post-measurement verification using two standard reference solutions each time which are appropriate to the sample pH. This procedure will be performed for each sample tested. The QC effort for field conductivity measurements will include daily calibration of the instrument using standard solutions of known conductivity.

### **3.2 Accuracy, Precision, and Sensitivity of Analysis**

The fundamental QA objective with respect to accuracy, precision, and sensitivity of laboratory analytical data is to achieve the QC acceptance criteria of the analytical protocols.

SOPs for analytical laboratory operations are provided in the laboratory QAPP. These include the required accuracy, precision, and sensitivity of the analyses. The accuracy and precision requirements for geochemical laboratory analyses are included in the geochemical laboratory QAPP.

### **3.3 Completeness, Representativeness, and Comparability**

**Completeness** is a measure of the amount of valid data obtained from a measurement system compared to the amount that was expected to be obtained under normal conditions. The subcontractor analytical laboratory will provide data meeting QC acceptance criteria for 95 percent or more for all samples tested using the RAS in the laboratory QAPP.

**Representativeness** expresses the degree to which data accurately and precisely represent a characteristic of a population, parameter variations at a sampling point, a process condition, or an environmental condition. Representativeness is a qualitative parameter which is dependent upon the proper design of the sampling program and proper laboratory protocol. The sampling network was designed to provide data representative of site conditions. During development of this network, consideration was given to past waste disposal practices, existing analytical data, and the physical setting. The rationale of the sampling network is discussed in detail in the FSP. Representativeness will be satisfied by ensuring that the FSP is followed, proper sampling techniques are used, proper analytical procedures are followed, and holding times of the samples are not exceeded. Representativeness will be assessed by the analysis of field duplicate samples.

**Comparability** expresses the confidence with which one data set can be compared with another. The procedures used to obtain the planned analytical data, as documented in the QAPJP, are expected to provide comparable data.

#### **4.0 SAMPLING PROCEDURES**

The sampling procedures that will be used at each OU are described in detail in the FSP or SAP for each OU. The appropriate SOP's will be identified and included with the FSP or SAP.

## 5.0 SAMPLE CUSTODY

The primary objective of sample custody procedures is to establish a system which will ensure accountability for all samples which are collected and analyzed as part of this project. The sample custody procedures will also ensure that samples can be traced from their collection in the field, transportation from the field to the laboratory, and through laboratory analysis and reporting of results.

### 5.1 Field Chain-of Custody Procedures

The sample packaging and shipment procedures summarized below will ensure that the samples will arrive at the laboratory with the chain of custody intact. The protocol for specific sample numbering and other sample designations are included in the Data Management Plan (DMP) section of the SAP.

#### 5.1.1 Field Procedures

- The field sampler is responsible for the care and custody of the samples until they are transferred or properly dispatched. As few people as possible should handle the samples.
- All bottles will be labeled with sample numbers and locations. NRF sample numbers, labels, and seals will be appropriately affixed to jars, vials, bottles, or shipping containers.
- The RPMs or their designees will review all field activities to determine whether proper custody procedures are being followed during the field work and decide if additional samples are required.

#### 5.1.2 Field Logbooks/Documentation

All data collection activities will be recorded in field logbooks. Entries will be as descriptive as possible so that persons going to the site could reconstruct a particular situation without reliance on memory. Field logbooks will be bound field survey books or notebooks and will be stored in the project files. Each logbook will be identified by the project-specific document number.

Entries into the logbook will contain a variety of information. At the beginning of each entry, the date, start time, weather, names of all sampling team members present, level of personal protection being used, and the signature of the person making the entry will be entered. The names of visitors to the site, field sampling or investigation team personnel, and the purpose of their visit will also be recorded in the field logbook.

All measurements made and all samples collected will be recorded. All entries will be made in ink and no erasures will be made. If an incorrect entry is made, the information will be crossed out with a single strike mark and initialed. Whenever a sample is collected, or a measurement is made, a detailed description of the location of the station, including map coordinates, compass and distance measurements, shall be recorded. The number of the photographs taken of the station, if any, will also be noted. All equipment used to make measurements will be identified, along with the date of calibration.

Samples will be collected following the sampling procedures documented in the OU specific SAP. The equipment used to collect samples will be noted, along with the time of sampling, sample description, depth at which the sample was collected, volume, and number of containers. Sample identification numbers will be assigned prior to sample collection. Field duplicate samples, which will receive entirely separate sample identification numbers, will be noted under sample description.

### **5.1.3 Transfer of Custody and Shipment Procedures**

- 5.1.3.1 Samples will be accompanied by a properly completed Chain-of-Custody form. The sample numbers and locations will be listed on the chain-of-custody form. When transferring the possession of samples, the individuals relinquishing and receiving will sign, date, and note the time on the record. This record documents transfer of custody of samples from the sampler to another person, to a mobile laboratory, to the permanent laboratory, or to/from a secure storage area.
- 5.1.3.2 Samples will be properly packaged for shipment and dispatched to the appropriate laboratory for analysis with a separate, signed custody record enclosed in each sample box or cooler. Shipping containers will be locked and secured with strapping tape and custody seals for shipment to the laboratory. The preferred procedure includes use of a custody seal attached to the front right and back left of the cooler. The custody seals are covered with clear plastic tape. The cooler is strapped shut with strapping tape in at least two locations.
- 5.1.3.3 All shipments will be accompanied by the Chain-of-Custody form which identifies the contents. The original form will accompany the shipment, and copies will be retained at NRF.
- 5.1.3.4 If the samples are sent by common carrier, a bill of lading should be used. Receipts of bills of lading will be retained as part of the permanent documentation. The shipment method will be selected to ensure that hold times are not exceeded.

Commercial carriers are not required to sign the custody form as long as the custody forms are sealed inside the sample cooler and the custody seals remain intact. All shipments will adhere to Department of Transportation regulations.

## **5.2 Laboratory Chain-of-Custody Procedures**

Laboratory custody procedures for sample receiving and log-in sample storage tracking during sample preparation and analysis and storage of data are described in the SOP. Laboratory procedures are described in the subcontractor analytical laboratory's QAPP.

## **5.3 Final Data Files Custody Procedures**

The data files for analytical data will be maintained at NRF as part of the project files. The contents of the data files will include all relevant records, reports, correspondence, logs, field logbooks, laboratory sample preparation and analysis logbooks, data packages, pictures, subcontractor's reports, Chain-of-Custody forms, data review reports, etc. The final data file will be under custody of the NRF WAG Manager in a locked, secured area.

## **6.0 CALIBRATION PROCEDURES AND FREQUENCY**

This section describes procedures for maintaining the accuracy of all the instruments and measuring equipment which are used for conducting field tests and laboratory analyses. These instruments and equipment should be calibrated prior to each use in accordance with manufacturer's recommendations.

### **6.1 Field Instruments/Equipment**

Instruments and equipment used to gather, generate, or measure environmental data will be calibrated in accordance with the manufacturer's specifications to maintain the required accuracy and reproducibility of results.

Equipment to be used for field sampling will be examined prior to use to verify that it is in proper operating condition. This includes checking the manufacturer's operating manual and instructions for each instrument to ensure that all maintenance requirements are observed. Field notes from previous sampling trips will be reviewed so that any prior equipment problems are not overlooked, and all necessary repairs have been carried out. A spare electrode will be sent with each pH meter used for field measurements. Two thermometers will be sent to sampling locations where measurement of temperature is required, including those locations where a specific conductance probe/thermometer is required.

Calibration of field instruments will be performed in accordance with the manufacturer's procedures at the intervals specified by the manufacturer for the applicable field analysis method. Field instruments include, but are not limited to, a pH meter, thermometer, nephelometer, specific conductivity meter, portable gas chromatograph, Organic Vapor Analyzer (OVA) or Organic Vapor Photoionization Detector (PID), well installed remote groundwater level monitoring system, microgravity meters, and electrical resistivity meters. In the event that an internally calibrated field instrument fails to meet calibration/check out procedures, it will be returned to a qualified repair facility for service.

### **6.2 Laboratory Instruments**

#### **6.2.1 Analytical Laboratory Calibration Procedures and Frequency**

Calibration of subcontractor analytical laboratory equipment will be in accordance with written procedures approved by the Laboratory Manager. Records of calibration, repairs, or replacement will be filed and maintained by the designated laboratory personnel performing quality control activities. These records will be filed at the location where the work is performed and will be subject to QA audit. Specific instrument calibration procedures and frequency are discussed in the subcontractor laboratory's QAPP.

## 7.0 ANALYTICAL PROCEDURES

All groundwater and soil samples collected during field sampling activities for the NRF will be analyzed by a subcontractor analytical laboratory.

### 7.1 Laboratory Analysis

#### 7.1.1 Routine Analytical Services Laboratory Procedures

Methods published by the EPA will be used as the basis for all analyses whenever possible. For the analysis of TCL parameters by CLP protocols, the laboratory will follow methods detailed in the CLP SOW/OLM01.1 for organic analyses and the CLP (SOW/ILM01.0) for inorganic analyses. Tentatively Identified Compounds (TIC) will require Gas Chromatograph/Mass Spectrometer (GC/MS) methods. Tables 7-1 through 7-5 provide a summary of the analytes, analytical methods, procedures, quantification or detection limits, and QC criteria for anticipated analyses.

If contaminant concentrations are high, or for matrices other than waters and soils, CLP protocols may be inadequate. In this case, sample analysis methodology will follow the SOPs specifically prepared.

All samples for VOA shall be screened as recommended in VOA CLP RAS SOW/OLM01.1. Samples which, as a result of the screening, would normally be quantified using the VOA CLP "Low" level analysis method, shall be analyzed by the SOP for Volatile with the Low Detection Limits. If the result of the screening indicates that the VOA CLP "Medium" level method of analysis should be used, then the sample shall be quantified according to the CLP SOW for Organic Analysis, Multi-media, High Concentration, dated 9/88, revision 4/89. This SOW is also included in the laboratory QAPP.

#### 7.1.2 Non-CLP Procedures

Analytical methods have been selected to provide detection limits in water that are lower than the IDHW drinking water limits for compounds of interest. A specific SOP which meets required detection limits has been prepared by the subcontractor analytical laboratory. SOPs have also been prepared for all non-CLP/RAS methods used for analysis of samples for this project. These SOPs are included in the analytical laboratory QAPP.

Each of these SOPs is based on an analytical method published by the EPA and specifies:

- Procedures for sample preparation

- Instrument start-up and performance check
- Procedures to establish the actual and required detection limits for each parameter
- Initial and continuing calibration check requirements
- Specific methods for each sample matrix type
- Required analyses and QC acceptance limits for method blanks, trip blanks (as appropriate), field blanks, matrix spikes, matrix spike duplicates, and laboratory control samples (EPA or NBS) reference samples or laboratory prepared blank/spikes

The subcontractor analytical laboratory's QAPP summarizes the analyte groups and the respective EPA method from which each SOP is derived for chemical analyses.

## **7.2 Field Screening Analytical Protocols**

The procedures for field measurement of pH, Eh, specific conductivity, and any other parameter are described in the SAP and SOPs for each OU.

TABLE B-7-1 VOLATILE ORGANICS (VOCs) SAMPLE PARAMETERS

SW-846 METHOD 8240

| Analyte                    | CAS Number | Calibration and QC Acceptance Criteria (2) |                   |           |        |            |                  |
|----------------------------|------------|--|-------------------|-----------|--------|------------|------------------|
|                            |            | Practical Quantification Limits(1)         |                   | Range     | Limit  | Range      | Range            |
|                            |            | Ground Water                               | Low Soil/Sediment | for Q     | for s  | for x      | p,p <sub>s</sub> |
|                            |            | ug/L                                       | ug/kg             | (ug/L)    | (ug/L) | (ug/L)     | (%)              |
| Chloroform                 | 67-66-3    | 5  | 5                 | 13.5-26.5 | 6.1    | 13.7-24.2  | 51-138           |
| Tetrachloroethylene        | 127-18-4   | 5  | 5                 | 14.7-25.3 | 5.0    | 17.0-26.6  | 64-148           |
| 1,1,1-Trichloroethane      | 71-55-6    | 5  | 5                 | 15.0-25.0 | 4.6    | 13.7-30.1  | 52-162           |
| Trichloroethylene          | 79-01-6    | 5  | 5                 | 13.3-26.7 | 6.6    | 18.5-27.6  | 71-157           |
| Trans-1,2-Dichloroethylene | 156-60-5   | 5  | 5                 | 13.9-26.1 | 5.7    | 13.6-28.4  | 54-156           |
| Chloromethane              | 74-87-3    | 10   | 10                | D-40.8    | 19.8   | D-45.9     | D-273            |
| 1,1-Dichloroethane         | 75-34-3    | 5  | 5                 | 14.5-25.5 | 5.1    | 14.2-28.4  | 59-155           |
| Bromoform                  | 75-25-2    | 5  | 5                 | 14.2-25.8 | 5.4    | 11.4-31.1  | 45-169           |
| 1,1,2,2-Tetrachloroethane  | 79-34-5    | 5  | 5                 | 12.1-27.9 | 7.4    | 13.5-27.2  | 46-157           |
| Chlorobenzene              | 108-90-7   | 5  | 5                 | 13.2-26.8 | 6.3    | 16.4-27.4  | 37-160           |
| 1,2-Dichloroethylene       | 75-35-4    | 5  | 5                 | 10.1-29.9 | 9.1    | 3.7-42.3   | D-234            |
| 1,2-Dichloropropane        | 78-87-5    | 5  | 5                 | 6.8-33.2  | 13.8   | 3.8-36.2   | D-210            |
| Toluene                    | 108-88-3   | 5  | 5                 | 14.9-25.1 | 4.8    | 16.6-26.7  | 47-150           |
| Ethylbenzene               | 100-41-4   | 5  | 5                 | 11.8-28.2 | 7.5    | 17.4-26.7  | 37-162           |
| Vinyl Chloride             | 75-01-4    | 10   | 10                | 0.8-39.2  | 20.0   | D-43.5     | D-251            |
| Benzene                    | 71-43-2    | 5  | 5                 | 12.8-27.2 | 6.9    | 15.2-26.0  | 37-151           |
| Methylene chloride         | 75-09-2    | 5  | 5                 | 12.1-27.9 | 7.4    | D-41.0     | D-221            |
| Bromodichloromethane       | 75-27-4    | 5  | 5                 | 13.1-26.9 | 6.4    | 10.1-28.90 | 35-155           |
| Chlorodibromomethane       | 124-48-1   | 5  | 5                 | 13.5-26.5 | 6.1    | 13.8-26.6  | 53-149           |

- (1) Practical Quantification Limits (PQL's) are highly matrix-dependent. The PQLs listed above are provided for guidance and may not always be achievable. PQL's will be higher for sample extracts and samples that require dilution or reduced sample size to avoid saturation of the detector.
- (2) Calibration and QC acceptance criteria are based on reference samples containing 20 ug/L of the attribute.  
 Q = Concentration measured in QC Check Sample.  
 S = Standard deviation of four recovery measurements, in ug/L.  
 X = Average recovery of four recovery measurements, in ug/L.  
 p,p<sub>s</sub> = Observed percent recoveries.  
 D = detected; result must be greater than zero.

TABLE B-7-2 PESTICIDES AND PCB'S SAMPLE PARAMETERS

SW-846 METHOD 8080

| Analyte            | Practical Quantification Limits (1) |                         | QC Acceptance Criteria (2) |        |           |        |
|--------------------|-------------------------------------|-------------------------|----------------------------|--------|-----------|--------|
|                    | Water                               | Low Level Soil/Sediment | Test                       | Limit  | Range     | Range  |
|                    | (ug/L)                              | (ug/Kg)                 | conc.                      | for s  | for x     | p,p.   |
|                    | (ug/L)                              | (ug/Kg)                 | (ug/L)                     | (ug/L) | (ug/L)    | (%)    |
| Aldrin             | 0.05                                | 8                       | 2.0                        | 0.42   | 1.08-2.24 | 42-122 |
| $\alpha$ -BHC      | 0.05                                | 8                       | 2.0                        | 0.48   | 0.98-2.44 | 37-134 |
| $\beta$ -BHC       | 0.05                                | 8                       | 2.0                        | 0.64   | 0.78-2.60 | 17-147 |
| $\delta$ -BHC      | 0.05                                | 8                       | 2.0                        | 0.72   | 1.01-2.37 | 19-130 |
| Lindane            | 0.05                                | 8                       | 2.0                        | 0.46   | 0.86-2.32 | 32-127 |
| Chlordane          | 0.05                                | 80                      | 50                         | 10.0   | 27.6-54.3 | 45-119 |
| 4,4' -DDD          | 0.1                                 | 16                      | 10                         | 2.8    | 4.8-12.6  | 31-141 |
| 4,4' -DDE          | 0.1                                 | 16                      | 2.0                        | 0.55   | 1.08-2.60 | 30-145 |
| 4,4' -DDT          | 0.1                                 | 16                      | 10                         | 3.6    | 4.6-13.7  | 25-160 |
| Dieldrin           | 0.1                                 | 16                      | 2.0                        | 0.76   | 1.15-2.49 | 36-146 |
| Endosulfan I       | 0.05                                | 8                       | 2.0                        | 0.49   | 1.14-2.82 | 45-153 |
| Endosulfan II      | 0.1                                 | 16                      | 10                         | 6.1    | 2.2-17.2  | D-202  |
| Endosulfan Sulfate | 0.1                                 | 16                      | 10                         | 2.7    | 3.8-13.2  | 26-144 |
| Endrin             | 0.1                                 | 16                      | 10                         | 3.7    | 5.1-12.6  | 30-147 |
| Endrin Aldehyde    | 0.1                                 | 16                      |                            |        |           |        |
| Heptachlor         | 0.05                                | 8                       | 2.0                        | 0.40   | 0.86-2.00 | 34-111 |
| Heptachlor Epoxide | 0.05                                | 8                       | 2.0                        | 0.41   | 1.13-2.63 | 37-142 |
| Methoxychlor       |                                     |                         | 0.5                        | 80     |           |        |
| Toxaphene          | 1                                   | 160                     | 50                         | 12.7   | 27.8-55.6 | 41-126 |
| PCB-1016           | 0.5                                 | 80                      | 50                         | 10.0   | 30.5-51.5 | 50-114 |
| PCB-1221           | 0.5                                 | 80                      | 50                         | 24.4   | 22.1-75.2 | 15-178 |
| PCB-1232           | 0.5                                 | 80                      | 50                         | 17.9   | 14.0-98.5 | 10-215 |
| PCB-1242           | 0.5                                 | 80                      | 50                         | 12.2   | 24.8-69.6 | 39-150 |
| PCB-1248           | 0.5                                 | 80                      | 50                         | 15.9   | 29.0-70.2 | 38-158 |
| PCB-1254           | 1                                   | 160                     | 50                         | 13.8   | 22.2-57.9 | 29-131 |
| PCB-1260           | 1                                   | 160                     | 50                         | 10.4   | 18.7-54.9 | 8-127  |
| PCB-1262           | 1                                   | 160                     |                            |        |           |        |

- (1) Practical Quantification Limits (PQL's) are highly matrix-dependent. The PQL's listed above are provided for guidance and may not always be achievable. Actual PQL's for different matrices may be estimated by multiplying the PQL's in Table 7.2 by the following factors: Ground Water (10); low-level soil by sonication with Gel Permeation Chromatography (GPC) cleanup (670); high-level soil and sludges by sonication (10,000); non-water miscible waste (100,000).
- (2) Calibration and QC acceptance criteria are based on reference samples containing test concentrations as indicated.  
 S = Standard deviation of four recovery measurements, in ug/L.  
 X = Average recovery of four recovery measurements, in ug/L.  
 o.p. = Observed percent recoveries.

TABLE B-7-3 GROUND WATER QUALITY PARAMETERS

| Analyte               | QC Acceptance Criteria (3) |            |   |                     |                  |                     |
|-----------------------|----------------------------|------------|---|---------------------|------------------|---------------------|
|                       | Procedure(1)               |            | Method<br>Detection<br>Limit(2)<br>(ug/L) | Precision<br>(%RSD) | Accuracy<br>(%R) | Completeness<br>(%) |
|                       | Reference                  | Procedure  |   |                     |                  |                     |
| Arsenic               | a/b                        | 7060/206.2 | 10  | 34                  | 55-123           | 95                  |
| Barium                | a/b                        | 6010/200.7 | 200                                       | 14                  | 90-106           | 95                  |
| Cadmium               | a/b                        | 6010/213.2 | 1   | 20                  | 75-125           | 95                  |
| Chromium              | a/b                        | 6010/218.2 | 5   | 20                  | 75-125           | 95                  |
| Lead                  | a/b                        | 8010/239.2 | 5   | 20                  | 75-125           | 95                  |
| Mercury               | a/b                        | 7470/245.1 | 0.2                                       | 27                  | 67-142           | 95                  |
| Selenium              | a/b                        | 7740/270.2 | 5   | 30                  | 28-121           | 95                  |
| Silver                | a/b                        | 6010/272.2 | 5   | 20                  | 79-118           | 95                  |
| Nitrate-N             | a/b                        | 9200/353.2 | 100                                       | 7                   | 67-118           | 95                  |
| Fluoride              | b                          | 340.2      | 100                                       | 20                  | 77-131           | 95                  |
| Chloride              | a                          | 9252       | 2000                                      | 8                   | 94-119           | 95                  |
| Vanadium              | a                          | 6010       | 100                                       | 18                  | 65-115           | 95                  |
| Manganese             | a                          | 6010       | 150                                       | 24                  | 62-121           | 95                  |
| Sodium                | a                          | 6010       | 5000                                      | 30                  | 65-123           | 95                  |
| Phenol                | a                          | 9066       | 5   | 16                  | 14-113           | 95                  |
| Sulfate               | a                          | 9035       | 5000                                      | 15                  | 77-117           | 95                  |
| Total Organic Carbon  | a                          | 9060       | 1000                                      | 14                  | 78-123           | 95                  |
| Total Organic Halogen | a                          | 9020       | 10  | 40                  | 50-117           | 95                  |
| Antimony              | a                          | 6010       | 60  | 15                  | 24-124           | 95                  |
| Beryllium             | a                          | 6010       | 5   | 12                  | 68-107           | 95                  |
| Copper                | a                          | 6010       | 25  | 17                  | 75-104           | 95                  |
| Nickel                | a                          | 6010       | 40  | 11                  | 70-107           | 95                  |
| Thallium              | a                          | 7841       | 10  | 20                  | 75-125           | 95                  |
| Zinc                  | a                          | 6010       | 20  | 21                  | 63-113           | 95                  |
| Cyanide               | a                          | 9010       | 5   | 33                  | 48-116           | 95                  |
| Sulfide               | a                          | 9030       | 1000                                      | 14                  | 46-117           | 95                  |

(1) References:

- a - SW-846; "Test Methods for Evaluating Solid Wastes"
- b - EPA-600/4; "Methods for Chemical Analysis of Water and Wastes"
- c - EPA-600/4-80-005; "Interim Method for Determining Asbestos in Water"

(2) Method Detection Limits (MDL's) are highly matrix-dependent. The MDL's listed above are provided for guidance and may not always be achievable.

(3) These criteria are defined in Section 12.

**TABLE B-7-4 MISCELLANEOUS SOIL AND SOLIDS SAMPLE PARAMETERS  
 INCLUDING TCLP PROCEDURE (METHOD 1311)**

| Analyte  | Procedure (1)<br>References | Procedure | Method<br>Detection<br>Limit(2)<br>(mg/l) | QC Acceptance Criteria (3) |                  |                     |
|----------|-----------------------------|-----------|---|----------------------------|------------------|---------------------|
|          |                             |           |   | Precision<br>(% RSD)       | Accuracy<br>(%R) | Completeness<br>(%) |
| Arsenic  | a                           | 7060      | 0.5                                       | 34                         | 38-140           | 95                  |
| Barium   | a                           | 6010      | 10  | 14                         | 51-128           | 95                  |
| Cadmium  | a                           | 6010      | 0.1                                       | 9                          | 66-108           | 95                  |
| Chromium | a                           | 6010      | 0.5                                       | 18                         | 67-111           | 95                  |
| Lead     | a                           | 6010      | 0.5                                       | 15                         | 52-124           | 95                  |
| Mercury  | a                           | 7470      | 0.02                                      | 27                         | 50-161           | 95                  |
| Selenium | a                           | 7740      | 0.1                                       | 30                         | 28-121           | 95                  |
| Silver   | a                           | 6010      | 0.5                                       | 26                         | 61-108           | 95                  |

- (1) References:  
 a. Test Methods for Evaluating Solid Wastes (SW 846).
- (2) Method Detection Limits (MDL's) are highly matrix-dependent. The MDL's listed above are provided for guidance and may not always be achievable.
- (3) These criteria are defined in Section 12.

TABLE B-7-5 TOTAL METALS ANALYSIS AND OTHERS

| Analyte   | Procedure(1)<br>References | Procedure | Method<br>Detection<br>Limit(2)<br>mg/kg | QC Acceptance Criteria (3) |                   |                     |
|-----------|----------------------------|-----------|--|----------------------------|-------------------|---------------------|
|           |                            |           |  | Precision<br>(% RSD)       | Accuracy<br>(% R) | Completeness<br>(%) |
| Arsenic   | a                          | 7060      | 0.5                                      | 34                         | 38-140            | 95                  |
| Barium    | a                          | 6010      | 10                                       | 14                         | 63-115            | 95                  |
| Cadmium   | a                          | 6010      | 0.25                                     | 9                          | 73-110            | 95                  |
| Chromium  | a                          | 6010      | 0.05                                     | 18                         | 75-104            | 95                  |
| Lead      | a                          | 7421      | 0.5                                      | 20                         | 75-125            | 95                  |
| Mercury   | a                          | 7470      | 0.25                                     | 27                         | 50-161            | 95                  |
| Selenium  | a                          | 7740      | 0.5                                      | 30                         | 28-121            | 95                  |
| Silver    | a                          | 6010      | 0.5                                      | 26                         | 61-108            | 95                  |
| Antimony  | a                          | 6010      | 3  | 15                         | 24-124            | 95                  |
| Beryllium | a                          | 6010      | 0.25                                     | 12                         | 68-107            | 95                  |
| Copper    | a                          | 6010      | 1.25                                     | 17                         | 75-104            | 95                  |
| Nickel    | a                          | 6010      | 2  | 11                         | 70-107            | 95                  |
| Thallium  | a                          | 6010      | 5  | 13                         | 68-108            | 95                  |
| Zinc      | a                          | 6010      | 1  | 21                         | 63-113            | 95                  |
| Cyanide   | a                          | 9010,9012 | 0.5                                      | 33                         | 48-116            | 95                  |
| Sulfide   | a                          | 9030      | 50                                       | 14                         | 46-117            | 95                  |

- (1) References:  
 a. Test Methods for Evaluating Solid Wastes (SW 846)
- (2) Method Detection Limits (MDL's) are highly matrix-dependent. The MDL's listed above are provided for guidance and may not always be achievable.
- (3) These criteria are defined in Section 12.

TABLE B-7-6 SEMI-VOLATILE ORGANICS (SVOCs) SAMPLE PARAMETERS  
SW-846 METHOD 8270

| Analyte                           | CAS Number | Practical Quantification Limits(1) |       | QC Acceptance Criteria (2) |                   |                          |
|-----------------------------------|------------|------------------------------------|-------|----------------------------|-------------------|--------------------------|
|                                   |            | Matrix: Soil                       |       | Precision<br>(% RSD)       | Accuracy<br>(% R) | Com-<br>pleteness<br>(%) |
|                                   |            | ug/L                               | ug/kg |                            |                   |                          |
| Phenol                            | 108-95-2   | 10                                 | 330   | 16                         | 14-113            | 95                       |
| bis(2-Chloroethyl) ether          | 111-44-4   | 10                                 | 330   | 24                         | 12-158            | 95                       |
| 2-Chlorophenol                    | 95-57-8    | 10                                 | 330   | 14                         | 16-100            | 95                       |
| 1,3-Dichlorobenzene               | 541-73-1   | 10                                 | 330   | 29                         | D-172             | 95                       |
| 1,4-Dichlorobenzene               | 106-46-7   | 10                                 | 330   | 13                         | 14-94             | 95                       |
| 1,2-Dichlorobenzene               | 95-50-1    | 10                                 | 330   | 16                         | 32-129            | 95                       |
| 2-Methylphenol                    | 95-48-7    | 10                                 | 330   | 30                         | 50-150            | 95                       |
| 2,2'-oxybis<br>(1-Chloropropane)# | 108-60-1   | 10                                 | 330   | -                          | -                 | 95                       |
| 4-Methylphenol                    | 106-44-5   | 10                                 | 330   | 30                         | 50-150            | 95                       |
| N-Nitroso-di-n-dipropylamine      | 621-64-7   | 10                                 | 330   | 12                         | 31-102            | 95                       |
| Hexachloroethane                  | 67-72-1    | 10                                 | 330   | 12                         | 40-113            | 95                       |
| Nitrobenzene                      | 98-95-3    | 10                                 | 330   | 26                         | 25-80             | 95                       |
| Isophorone                        | 78-59-1    | 10                                 | 330   | 29                         | 21-196            | 95                       |
| 2-Nitrophenol                     | 88-75-5    | 10                                 | 330   | 26                         | 29-182            | 95                       |
| 2,4-Dimethylphenol                | 105-67-9   | 10                                 | 330   | 14                         | 32-119            | 95                       |
| bis(2-Chloroethoxy) methane       | 111-91-1   | 10                                 | 330   | 25                         | 33-184            | 95                       |
| 2,4-Dichlorophenol                | 120-83-2   | 10                                 | 330   | 16                         | 39-135            | 95                       |
| 1,2,4-Trichlorobenzene            | 120-82-1   | 10                                 | 330   | 12                         | 23-95             | 95                       |
| Naphthalene                       | 91-20-3    | 10                                 | 330   | 19                         | 21-133            | 95                       |
| 4-Chloroaniline                   | 106-47-8   | 10                                 | 330   | -                          | -                 | 95                       |
| Hexachlorobutadiene               | 87-68-3    | 10                                 | 330   | 15                         | 24-116            | 95                       |
| 4-Chloro-3-methylphenol           | 59-50-7    | 10                                 | 330   | 28                         | D-160             | 95                       |
| 2-Methylnaphthalene               | 91-57-6    | 10                                 | 330   | 30                         | 50-150            | 95                       |
| Hexachlorocyclopentadiene         | 77-47-4    | 10                                 | 330   | 36                         | D-37              | 95                       |
| 2,4,6-Trichlorophenol             | 88-06-2    | 10                                 | 330   | 18                         | 37-144            | 95                       |
| 2,4,5-Trichlorophenol             | 95-95-4    | 50                                 | 1700  | 30                         | 50-150            | 95                       |
| 2-Chloronaphthalene               | 91-58-7    | 10                                 | 330   | 10                         | 60-118            | 95                       |
| 2-Nitroaniline                    | 88-74-4    | 50                                 | 1700  | 30                         | 50-150            | 95                       |
| Dimethylphthalate                 | 131-11-3   | 10                                 | 330   | 50                         | D-112             | 95                       |
| Acenaphthylene                    | 208-96-8   | 10                                 | 330   | 19                         | 33-145            | 95                       |
| 2,6-Dinitrotoluene                | 606-20-2   | 10                                 | 330   | 18                         | 50-158            | 95                       |
| 3-Nitroaniline                    | 99-09-2    | 50                                 | 1700  | 30                         | 50-150            | 95                       |

TABLE B-7-6 SEMI-VOLATILE ORGANICS (SVOCs) SAMPLE PARAMETERS  
SW-846 METHOD 8270 (Continued)

| Analyte                     | CAS Number | Practical Quantification Limits(1) |       | QC Acceptance Criteria (2) |                   |                     |
|-----------------------------|------------|------------------------------------|-------|----------------------------|-------------------|---------------------|
|                             |            | Matrix: Soil                       |       | Precision<br>(% RSD)       | Accuracy<br>(% R) | Completeness<br>(%) |
|                             |            | ug/L                               | ug/kg |                            |                   |                     |
| Acenaphthene                | 83-32-9    | 10                                 | 330   | 12                         | 35-109            | 95                  |
| 2,4-Dinitrophenol           | 51-28-5    | 50                                 | 1700  | 17                         | 19-123            | 95                  |
| 4-Nitrophenol               | 100-02-7   | 50                                 | 1700  | 23                         | D-135             | 95                  |
| Dibenzofuran                | 132-64-9   | 10                                 | 330   | -                          | -                 | 95                  |
| 2,4-Dinitrotoluene          | 121-14-2   | 10                                 | 330   | 17                         | 19-123            | 95                  |
| Diethylphthalate            | 84-66-2    | 10                                 | 330   | 50                         | D-114             | 95                  |
| 4-Chlorophenyl-phenyl ether | 7005-72-3  | 10                                 | 330   | 22                         | 25-158            | 95                  |
| Fluorene                    | 86-73-7    | 10                                 | 330   | 10                         | 59-121            | 95                  |
| 4-Nitroaniline              | 100-01-6   | 50                                 | 1700  | 30                         | 50-150            | 95                  |
| 4,6-Dinitro-2-methylphenol  | 534-52-1   | 50                                 | 1700  | 30                         | D-181             | 95                  |
| N-nitrosodiphenylamine      | 86-30-62   | 10                                 | 330   | 23                         | 22-124            | 95                  |
| 4-Bromophenyl-phenylether   | 101-55-3   | 10                                 | 330   | 12                         | 53-127            | 95                  |
| Hexachlorobenzene           | 118-74-1   | 10                                 | 330   | 25                         | D-152             | 95                  |
| Pentachlorophenol           | 87-86-5    | 50                                 | 1700  | 25                         | 4-153             | 95                  |
| Phenanthrene                | 85-01-8    | 10                                 | 330   | 11                         | 54-120            | 95                  |
| Anthracene                  | 120-12-7   | 10                                 | 330   | 18                         | 27-133            | 95                  |
| Garbazole                   | 86-74-8    | 10                                 | 330   | -                          | -                 | 95                  |
| Di-n-butylphthalate         | 84-74-2    | 10                                 | 330   | 20                         | 1-118             | 95                  |
| Fluoranthene                | 206-44-0   | 10                                 | 330   | 18                         | 26-137            | 95                  |
| Pyrene                      | 129-00-0   | 10                                 | 330   | 27                         | 9-172             | 95                  |
| Butylbenzylphthalate        | 85-68-7    | 10                                 | 330   | 50                         | D-152             | 95                  |
| 3,3'-Dichlorobenzidine      | 91-94-1    | 10                                 | 330   | 44                         | D-262             | 95                  |
| Benzo(a)anthracene          | 56-55-3    | 10                                 | 330   | 18                         | 33-143            | 95                  |
| Chrysene                    | 218-01-9   | 10                                 | 330   | 25                         | 17-168            | 95                  |
| bis(2-Ethylhexyl)phthalate  | 117-81-7   | 10                                 | 330   | 25                         | 8-158             | 95                  |
| Di-n-octylphthalate         | 117-84-0   | 10                                 | 330   | 24                         | 4-146             | 95                  |
| Benzo(b)fluoranthene        | 205-99-2   | 10                                 | 330   | 23                         | 24-159            | 95                  |
| Benzo(k)fluoranthene        | 207-08-9   | 10                                 | 330   | 25                         | 11-162            | 95                  |
| Benzo(a)pyrene              | 50-32-8    | 10                                 | 330   | 24                         | 17-163            | 95                  |
| Indeno(1,2,3-cd)pyrene      | 193-39-5   | 10                                 | 330   | 29                         | 21-196            | 95                  |
| Dibenz(a,h)anthracene       | 53-70-3    | 10                                 | 330   | 38                         | D-227             | 95                  |
| Benzo(g,h,i)perylene        | 191-24-2   | 10                                 | 330   | 36                         | D-219             | 95                  |

(1) Practical Quantification Limits (PQL's) are highly matrix-dependent. The PQLs listed above are provided for guidance and may not always be achievable. PQL's will be higher for sample extracts and samples that require dilution or reduced sample size to avoid saturation of the detector.  
(2) These criteria are defined in Section 12.

## **8.0 INTERNAL QUALITY CONTROL CHECKS**

### **8.1 Field Sample Collection**

The assessment of field sampling precision and accuracy will be made through collection of field duplicates and field blanks in accordance with the OU specific SAP.

### **8.2 Field Measurement**

QC checks for field measurements are limited to checking the reproducibility of the measurement by obtaining multiple readings on a single sample or standard, and by calibrating the instruments.

### **8.3 Laboratory Analysis**

Two types of quality assurance (QA) that will be used by the subcontractor analytical laboratory to ensure the production of analytical data of known and documented quality are quality assurance (QA) programs and QC checks.

#### **8.3.1 QA Program**

The subcontractor analytical laboratory has a written Quality Assurance/Quality Control program which provides rules and guidelines to ensure the reliability and validity of work conducted at the laboratory. Compliance with the QA/QC program is coordinated and monitored by the laboratory's Quality Assurance Unit (QAU), which is independent of the operating departments.

The objectives of the Laboratory QA/QC Program are:

- Ensure that all procedures are documented, including any changes in administrative and/or technical procedures
- Ensure that all analytical procedures are conducted according to sound scientific principles and have been validated
- Monitor the performance of the laboratory by a systemic inspection program and provide for corrective actions as necessary
- Collaborate with other laboratories in establishing quality levels
- Ensure that all data are properly recorded and archived

All laboratory procedures are documented in writing as either SOP or Method Procedures (MP), which are edited and controlled by the QAU. Internal quality control procedures for analytical services will be conducted by the subcontractor laboratory in accordance with SOPs and the individual method requirements in a manner consistent with appropriate SOWs- (OLM01.1 for organics and ILM01.0 for inorganic), and NIOSH analytical methods.

### **8.3.2 Quality Control Checks**

QC checks will be performed by the subcontractor analytical laboratory as described in the laboratory QAPP. The subcontractor analytical laboratory will document, in each data package provided, that both initial and ongoing instrument and analytical QC functions have been met. Any samples analyzed in non-conformance with the QC criteria will be reanalyzed by the subcontractor analytical laboratory.

## 9.0 DATA REDUCTION, VALIDATION AND REPORTING

### 9.1 General

Data reduction, validation, and reporting practices will be followed to ensure that raw and reduced data are not inadvertently altered during transfers of data, that data are accurately reduced to their final results, and that raw and reduced data are properly reported.

### 9.2 Data Reduction

Data reduction is the process of converting raw laboratory data and field data into a form usable by engineers and scientists. This form is generally an expression of the concentration of the constituent being analyzed (i.e., analyte) in the sample medium. Concentrations are determined through the use of mathematical formulae that utilize the raw laboratory data as input.

#### 9.2.1 Units for Determinations

Analytical data obtained during the course of the investigation for ground water and surface water will be reported in units of  $\mu\text{g/l}$  for organics and inorganics. Analytical data for solid (soil and sediment) samples will be reported on a dry weight basis in units of mg/kg for organic and inorganic determinations. Reporting units for field measurements will be appropriate to the analysis performed, such as pH measurements (pH units), specific conductance ( $\mu\text{mhos}$ ), flow rate (gpm), or temperature ( $^{\circ}\text{C}$ ), etc.

#### 9.2.2 Equations and Procedures Used for Data Reduction

##### 9.2.2.1 Onsite Data Reduction

Data reduction performed by the subcontractor for this investigation will be minimal and will consist primarily of performing data evaluations of the analytical laboratory sample analysis results within the data base software package discussed in the DMP. The data reduction equations and statistical evaluation equations used will be installed in the database software package discussed in the DMP.

After all of the data packages received from the analytical laboratory are validated by the NRF or the subcontractor, all data reductions and transfers will be reviewed prior to entry of the data into sample database.

#### 9.2.2.2 Analytical Laboratory Data Reduction

The data reduction equations and procedures utilized by the analytical laboratory to reduce the data acquired from analyses on the samples are discussed in the Data Reduction, Validation, and Reporting section of the analytical laboratory's QAPP. The equations used for data reduction are provided in the specific SOPs for each analysis.

#### 9.2.3 Procedures for Transfers of Data

In order to control the transfer of data, all copies of raw data from the field logbooks and the data received from the analytical laboratory will be entered into the project files. The project files will serve as the ultimate archive for all information and data generated. The project files will be maintained as discussed in the DMP.

#### 9.2.4 Procedures for Checking Data Reduction and Transfers

All involved personnel will be responsible for the proper transfer of data from one data source (e.g., field logbooks, analytical laboratory result sheets, etc.) to another (e.g., computer database, reports, etc.). All transfers of data will be validated by the subcontractor Field or Data Manager, as appropriate, and at least 10% of the transfers will be reviewed by the NRF WAG Manager.

### 9.3 Data Validation

Data validation is the overall process of determining whether or not field or analytical laboratory data meet the quality control requirements and are useable. The procedures to validate data can be found in a series of EPA documents generally titled "Laboratory Data Validation Functions Guidelines". These documents provide thorough discussions of the validation process and were used in developing the NRF SOP for data validation.

#### 9.3.1 Objectives and Scope of Data Validation

The objective of data validation is to ensure that all data transfers are accurate, that all data is appropriate to meet the objectives of the OU specific SAP, and that all data reductions and reporting are performed in accordance with the requirements specified in this QAPjP. If these objectives are met, they will permit a meaningful evaluation of the data and valid conclusions.

### **9.3.2 Techniques Used for Data Validation**

#### **9.3.2.1 Field Data**

All the field data, such as those generated during field measurements, observations, and field instrument calibrations, will be entered directly into a field logbook. Each involved project member will be responsible for all data transfers made. Data entered into the field logbooks will be reviewed by the subcontractor Field Manager. The Field Manager will document all reviews by signing and dating the logbook pages. At least 10% of all data reviewed by the Field Manager will be over-checked by the NRF WAG Manager or his designee.

#### **9.3.2.2 Subcontractor Analytical Data**

Upon receipt of the sample analysis data packages from the analytical laboratory, the laboratory data will be validated by the subcontractor in accordance with the NRF SOP for data validation. At least 10% of the validated data will be over-checked by NRF personnel.

Sample or field measurement data that fails the QC requirements specified above will be flagged. However, all data will be documented (with flags) regardless of whether or not they pass QC requirements. Data that cannot be validated may still be useful in making some judgements about the site, and give project personnel some insight when planning follow-up sampling programs. Where data does not meet the objectives for precision, accuracy, completeness, and repeatability, discussions will be provided to indicate whether the data is still considered adequate to meet the overall project objectives.

### **9.4 Reporting**

Data will be available for controlled access by the WAG Manager and authorized personnel using a site-specific code. Validated data will be summarized and provided to EPA and IDHW RPMs in accordance with the INEL FFA/CO. The complete data set will be incorporated into the final report for each OU.

## 10.0 PERFORMANCE AND SYSTEM AUDITS

### 10.1 Onsite Audits

Onsite system audits will be performed quarterly to review all field related quality assurance activities associated with sample collection and field measurements. During the performance of the field related audits, all activities which are associated with information collection in the field activities will also be reviewed for the quality assurance measures discussed in the QAPjP.

The audits will be conducted by the Subcontractor Quality Assurance Director. The acceptance criteria for the audits will be adherence to the protocols presented throughout the QAPjP. Deficiencies found during the audits will be brought to the attention of the responsible individuals, the WAG Manager, and the Subcontractor Project Manager, and corrective action per Section 13 of the QAPjP will be initiated. Copies of the audits will be distributed to the Project Manager, NRF WAG Manager, Project Engineers, Subcontractor Project Manager, and QA Director. Summaries of any problems identified during audits, corrective actions planned, and subsequent completion of planned corrective actions will be provided to EPA and IDHW in the monthly progress reports.

#### 10.1.1 Field-Related Audits

Specific elements of the onsite field-related audits include the verification of the following:

- Completeness and accuracy of sample Chain-of-Custody forms, including documentation of times, dates, transaction descriptions, and signatures
- Completeness and accuracy of sample identification labels, including identification of the sample code number, and the notation of time, date, location, type of sample, and person collecting the sample
- Completeness and accuracy of field logbooks, including documentation of times, dates, drillers' names, sampling method used, sampling locations, number of samples taken, name of person collecting samples, types of samples, results of measurements, soil logs, and any problems encountered during sampling
- Adherence to health and safety guidelines outlined in the Site Health and Safety Plan, including wearing of proper protective clothing
- Adherence to the calibration procedures and calibration frequency identified in Section 6 of the QAPjP

- Adherence to equipment decontamination SOPs
- Adherence to sample collection, preparation, preservation, and storage requirements as specified in the SOPs and the analytical laboratory QAPP

#### **10.1.2 Audits of Other Activities**

Specific elements of the audits of other activities include the verification of the following:

- Adherence to the responsibilities identified in Section 2 of the QAPjP
- Adherence to the QA objectives for measurement data in terms of precision, accuracy, completeness, repeatability, and comparability identified in the QAPjP and the laboratory QAPP, and the specific routine procedures used to assess them identified in Section 12 of the QAPjP
- Adherence to the data reduction, validation, and reporting identified in Section 9 of the QAPjP, including the use of the proper equations and the documentation of all actions
- Adherence to the sample and field measurement code number assignment procedures and proper maintenance of the code number logbook identified in the DMP
- Adherence to the schedules for reports outlined in the DMP
- Adherence to the preventive maintenance measures identified in Section 11 of the QAPjP
- Institution of and effectiveness of corrective measures for identified problems
- Completeness, accuracy, and documentation of all data reviews performed, including reviews for log and field books, reviews of transfers of data from log and field books to other data sources such as a computer database, and reviews of data reduction performed on-site and by the vendor analytical laboratory
- Completeness of the information and data maintained in the project files and adherence to the requirements identified in the DMP

## 10.2 Analytical Laboratory Audits

### 10.2.1 Internal Laboratory Audits

The analytical laboratory performs regular system and performance audits as described in laboratory QAPP.

### 10.2.2 External Laboratory Audits

#### 10.2.2.1 NRF and Subcontractor Audits

Annually, but at least once during the subcontracted analytical laboratory analysis of NRF samples, NRF and the subcontractor will perform an audit of the analytical laboratory. The audits will be conducted by the WAG Manager or his designee. The acceptance criteria for the audits will be adherence to the protocols presented in SW-846, other EPA approved procedures, and the analytical laboratory's QAPP. Deficiencies found during the audits will be brought to the attention of the responsible individuals in the analytical laboratory and the NRF Project Manager, and corrective action will be initiated. Copies of the audits will be distributed to appropriate Project management personnel and the management of the analytical laboratory. Summaries of any problems identified during audits, corrective actions planned, and subsequent completion of planned corrective actions will be provided to the EPA with the progress reports discussed in the DMP.

Specific elements of the analytical laboratory audits include the verification of the following:

- Adherence to the analytical procedures, including all protocols
- Completeness and accuracy of the analytical laboratory sample identification labels, including identification of the laboratory's sample code number
- Completeness and accuracy of the analytical laboratory logbooks and notebooks, including sample receipt logbooks and analysis notebooks
- Adherence to the calibration procedures and calibration frequency identified in the analytical laboratory's QAPP
- Adherence to the sample storage procedures outlined in the analytical laboratory's QAPP

- Adherence to the data reduction, validation, and reporting procedures identified in the analytical laboratory's QAPP, including the use of the proper equations and the documentation of all actions
- Adherence to the preventive maintenance measures identified in the analytical laboratory's QAPP
- Institution of corrective measures for problems identified which are consistent with those specified in the analytical laboratories QAPP
- Completeness, accuracy, and documentation of all data reviews performed by the analytical laboratory, including reviews of logbooks, reviews of transfers of data from logbooks to other data sources such as a computer database, and reviews of data reduction performed by the analytical laboratory
- Performance in inter-laboratory studies conducted by the EPA or IDHW agencies as part of laboratory certification programs

### **10.3 Tracking Resolution of Corrective Actions**

In order to ensure the resolution of all deficiencies identified during the performance of audits, all audit findings requiring resolution will be entered into a computer database. The database will include the audit findings, the planned corrective actions, and a schedule for the completion of the corrective actions. Any additional corrective actions established to resolve deficiencies identified independently of audits will also be entered into this database. Reports will be prepared every two weeks from the database to track progress on the scheduled corrective actions. This database will be maintained by the subcontractor Project Manager and the periodic reports will be provided to the NRF Project Manager and the NRF WAG Manager. Additional discussion of corrective actions, including the use of a corrective action form, is provided in Section 13 of the QAPjP.

## 11.0 PREVENTIVE MAINTENANCE PROCEDURES

### 11.1 Field Equipment/Instruments

Specific preventive maintenance procedures for field equipment are those recommended by the manufacturer.

Routine maintenance items for equipment will include:

- Thorough cleaning and drying of sample collection equipment following use
- Secure, inside storage of all field equipment
- Inspections and calibrations prior to use
- Equipment with rechargeable batteries on a continuous charge

In addition to the routine maintenance and calibration of the field equipment, an inventory of spare equipment and parts is maintained to ensure continual support for the field operations. This inventory includes:

- Batteries of the appropriate sizes
- Sample collection equipment, such as shovels, bowls, containers, preservatives, labels, markers, seals, tape, coolers, and packing material
- OVA supplies such as igniters, filters, gas, and battery charger
- Additional health and safety equipment, including gloves, boots, respirators, cartridges, safety glasses, safety labels, and coats
- Foul weather gear, including gloves, parkas, ponchos, and boots

## 11.2 Laboratory Instruments

As part of their QA/QC Program, a routine preventive maintenance program is conducted by the subcontractor analytical laboratory to minimize the occurrence of instrument failure and other system malfunctions. The subcontractor analytical laboratory has an internal group to perform routine scheduled maintenance, and to repair or to coordinate with the vendor for the repair of all instruments. All laboratory instruments are maintained in accordance with manufacturer's specifications and the requirements of the specific method employed. This maintenance is carried out on a regular, scheduled basis, and is documented in the laboratory instrument service logbook for each instrument. Emergency repair or scheduled manufacturer's maintenance is provided under a repair and maintenance contract with factory representatives. Routine, preventive maintenance schedules are found in the laboratory QAPP.

**12.0 SPECIFIC ROUTINE PROCEDURES TO ASSESS DATA PRECISION, ACCURACY, AND COMPLETENESS**

**12.1 Field Measurements**

Field data will be assessed for compliance with the established QC criteria that are specified in the QAPjP and FSP. Accuracy of the field measurements will be assessed using daily instrument calibration, calibration check, and analysis of blanks. Precision will be assessed on the basis of reproducibility by multiple readings of a single sample.

**12.2 Laboratory Data**

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

**12.2.1 Precision**

Precision of laboratory analysis will be assessed by comparing the analytical results between matrix spike/matrix spike duplicate (MS/MSD) for organic analysis, and laboratory duplicate analyses for inorganic analysis. The relative percent difference (%RPD) will be calculated for each pair of duplicate analysis using the Equation 12-1.

$$\%RPD = \frac{S - D}{(S + D)/2} \times 100 \quad \text{Equation 12-1}$$

Where: S = First sample value (original or MS value)

D = Second sample value (duplicate or MSD value)

### 12.2.2 Accuracy

Accuracy of laboratory results will be assessed for compliance with the established QC criteria that are described in the laboratory QAPP using the analytical results of method blanks, reagent/preparation blank, matrix spike/matrix spike duplicate samples, field blank, and bottle blanks. The percent recovery (%R) of matrix spike samples will be calculated using Equation 12-2.

$$\%R = \frac{A - B}{C} \times 100 \quad \text{Equation 12-2}$$

Where:

A = The spiked sample analytical result

B = The background level determined by a separate analysis of the unspiked sample

C = The known concentration of the spike added

### 12.2.3 Completeness

The data completeness of laboratory analyses results will be assessed for compliance with the amount of data required for decision making. The completeness is calculated using Equation 12-3.

$$\text{Completeness} = \frac{\text{Valid Data Obtained}}{\text{Total Data Collected}} \times 100 \quad \text{Equation 12-3}$$

### 12.2.4 Sensitivity

The achievement of method detection limits depend on instrument sensitivity and matrix effects. Therefore, it is important to monitor the instrument sensitivity to ensure data quality through constant instrument performance. The instrument sensitivity will be monitored through the analysis of method blanks, calibration check sample and laboratory control samples.

### 13.0 CORRECTIVE ACTION

Corrective action is required for any lack of compliance with the requirements of the QAPjP. A more detailed discussion of corrective actions associated with the analytical laboratory is provided in the laboratory's QAPP.

All significant quality assurance corrective actions will be documented. The documentation of such actions associated with the analytical laboratory will be processed via an NRF engineer specifically assigned to act as coordinator with the analytical laboratory. Other corrective actions will be documented in reports resulting from the specific routine procedures found in the QAPjP and including: data reduction, validation, and reporting; internal quality control checks; and performance and system audits. Section 10 of the QAPjP also discusses a follow system to be used for performance and system audit corrective actions. The remaining corrective actions will be documented using the form shown in Figure B-13-1, or its equivalent. The Subcontractor Project Manager is responsible for ensuring that the corrective actions adequately address root causes and are implemented in a responsible manner. The Subcontractor Project Manager is also responsible for confirming that corrective actions have been effective.

**FIGURE B-13-1 Corrective Action Form (CAF)**

CAF# \_\_\_\_\_

Date: \_\_\_\_\_ Location of Observation: \_\_\_\_\_

Responsible Organization: \_\_\_\_\_

Individual(s) Contacted: \_\_\_\_\_

Observation(s):

Recommendation(s):

Observation By (Signature): \_\_\_\_\_

-----  
Root Cause(s):

Corrective Action(s) Taken by Cognizant Management:

Cognizant Management Signature: \_\_\_\_\_ Date: \_\_\_\_\_

#### **14.0 QUALITY ASSURANCE REPORTS**

In addition to the audit reports submitted to the WAG Manager in accordance with QAPjP Section 12.0, a monthly progress report identified in the FFA/CO will be submitted to the EPA and IDHW. Quality Assurance issues will be addressed in this monthly report. The final report for each OU will contain QA sections that summarize data quality information collected during the project.

## 15.0 REFERENCES

40 CFR Part 136, October 26, 1984, entitled "Guidelines Establishing Test Procedures for the Analysis of Pollutants Under the Clean Water Act."

USEPA (1990) Contract Laboratory Program Statement of Work for Inorganic Analysis, Multi-Media, Multi-Concentration, Document Number ILMO1.0.

USEPA (1990) Contract Laboratory Program Statement of Work for Organic Analysis, Multi-Media, Multi-Concentration, Document Number OLMO1.0.

USEPA (1984) Methods for Organic Chemical Analysis of Municipal and Industrial Waste (EPA 600 Methods) as presented in 40 CFR Part 136, Guidelines Establishing Test Procedures for the Analysis of Pollutants under the Clean Water Act.

USEPA (1986) Test Methods for Evaluating Solid Waste (SW846): Physical/Chemical Methods. Third Edition: Office of Solid Waste.