

QUALITY ASSURANCE PROJECT PLAN

YERINGTON MINE SITE

Revision 5

May 20, 2009

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LIST OF ACRONYMS, ABBREVIATIONS AND SYMBOLS

ARC	Atlantic Richfield Company	QA	Quality Assurance
Anaconda	The Anaconda Company	QAM	Quality Assurance Manager
ASTM	American Society for Testing and Materials	QAPP	Quality Assurance Project Plan
CCV	Continuing Calibration Verification	QC	Quality Control
CFR	Code of Federal Regulations	QCS	Quality Control Sample
CLP	Contract Laboratory Program	RER	Replicate Error Ratio
COC	Chain of Custody	RI	Remedial Investigation
CSM	Conceptual Site Model	RL	Reporting Limit
DOT	Department of Transportation	RPD	Relative Percent Difference
DQI	Data Quality Indicator	SCS	U.S. Soil Conservation Service
DQO	Data Quality Objectives	SLERA	Screening Level Ecological Risk Assessment
EDD	Electronic Data Deliverable	SOP	Standard Operating Procedure
EPA	U.S. Environmental Protection Agency	SOW	Scope of Work
GC/MS	Gas Chromatograph/Mass Spectrometer	SVOC	Semi-Volatile Organic Compounds
GRO	Gasoline Range Organics	TCLP	Toxicity Characteristic Leaching Procedure
HHRA	Human Health Risk Assessment	TDS	Total Dissolved Solids
IATA	International Air Transport Authority	TEMOM	Technically Enhanced Naturally-Occurring Radioactive Materials
ICP	Inductively Coupled Plasma	TOC	Total Organic Content
ICV	Initial Calibration Verification	TPH	Total Petroleum Hydrocarbons
LaMP	Laboratory Management Program	TPU	Total Propagated Uncertainty
LCS	Laboratory Control Sample	TS	Total Solids
LCSD	Laboratory Control Sample Duplicate	TSP	Total Suspended Particulates
LD	Laboratory Duplicate	VOC	Volatile Organic Compound
MDC	Minimum Detectable Concentration		
MDL	Method Detection Limit	α	Alpha
MS	Matrix Spike	β	Beta
MSD	Matrix Spike Duplicate	μg	Microgram
NDEP	Nevada Division of Environmental Protection	mg	Milligram
NIST	National Institute of Standards and Technologies	g	Gram
OUs	Operable Units	gpm	Gallons Per Minute
PCB	Polychlorinated Biphenyl	kg	Kilogram
PID	Photo-Ionization Detector	pCi	Picocurie
PT	Performance Test	L	Liter

SECTION 1.0 INTRODUCTION

This Quality Assurance Project Plan (“QAPP”; Revision 5) has been designed to guide all aspects of environmental field sampling and laboratory analytical activities conducted by the Atlantic Richfield Company (“ARC”) at the Yerington Mine Site (Site”). The location of the Site is shown in Figure 1-1. This QAPP is required under the Scope of Work (“SOW”) attached to the *Administrative Order for Remedial Investigation and Feasibility Study (“RI/FS”) for the Anaconda/Yerington Mine Site (“Order”)*, issued to ARC by the U.S. Environmental Protection Agency – Region 9 (“EPA”) on January 12, 2007 (EPA, 2007). This QAPP will ensure that all field sampling and laboratory analytical activities associated with the RI/FS process can be used by decision makers for the Site, including EPA and ARC project managers and other stakeholders.

This QAPP is consistent with EPA guidance documents such as: 1) *Guidance for Quality Assurance Project Plans* (EPA, 2002a); 2) EPA Document No. RCRA-09-89-0018 (EPA, 1991a); and 3) *EPA Region 9 Requirements for Quality Assurance Program Plans* (EPA Region 9, Draft August 2001). This QAPP is also consistent with *Quality Assurance Project Plan for the Arimetco Heap Leach Pads Remedial Investigation Anaconda Copper Yerington Mine Superfund Site* (CH2M Hill, Final Septemeber 2007). In addition, this QAPP is consistent with ARC’s Laboratory Management Program (“LaMP”). As the fifth revision, this QAPP replaces the November 12, 2008 (Revision 4) document, and is based on the following correspondence:

- April 27, 2009 EPA letter to ARC entitled “Review of *Quality Assurance Project Plan, Yerington Mine Site (Revision 4)*, dated November 12, 2008; Anaconda Copper/Yerington Mine Site (09GU); EPA Administrative Order For Remedial Investigation and Feasibility Study #9-2007-0005.”

This fifth revision of the QAPP addresses the issues discussed in the correspondence listed above including, but not limited to: 1) the replacement of May 2008 regional screening levels with September 2008 regional screening levels and 2) the clear identification of analytes with method detection limits above minimum screening levels.

1.1 QAPP Objectives

QAPP objectives include assurance that: 1) Site investigations achieve complete and accurate environmental data sets that have little bias, high precision, and that meet the project goals; 2) the QA/QC process will allow for comparability of all environmental data sets so that the potential environmental effects associated with the Site can be clearly characterized and assessed; and 3) analytical data can be shown to be representative of actual Site conditions. To ensure that Site data generated are of known and acceptable quality, the QAPP establishes or makes provisions for the following:

- Developing standards for performance related to various elements of the SOW;
- Monitoring actual performance for comparison and compliance with established standards;
- Reporting the monitored performance; and
- Rectifying performance not conforming to the established standards

Quality assurance measures will ensure that all analytical data meet known and appropriate data quality criteria such as accuracy, precision, representativeness, comparability, sensitivity, bias and completeness. Quality control of field data will be achieved through the collection of field QC samples and the calibration of field equipment following EPA-approved SOPs.

1.2 Relationship to SOW Requirements

The Order requires ARC to ‘determine the nature and extent of contamination and any threat to the public health, welfare, or the environment caused by the release or threatened release of hazardous substances, pollutants or contaminants at or from the Site, by conducting a Remedial Investigation’. In accordance with the Order and attached SOW, ARC has prepared this revised QAPP to address the range of anticipated activities described in remedial investigation work plans for the Site, including the following:

- Characterization of chemical releases to the Site.

- Identification of media pathways and assessment of human health and ecological risks.
- Implementation of activities to remediate identified releases.
- Performance of monitoring to assess the effectiveness of the remedial activities.

Pursuant to the Order and attached SOW, field sampling and laboratory analyses of environmental media will be performed at the following operable units (“OUs”) at the Site, as identified by EPA:

- Site-Wide Groundwater (OU-1)
- Pit Lake (OU-2)
- Process Areas (OU-3)
- Evaporation Ponds and Sulfide Tailings (OU-4)
- Waste Rock Areas (OU-5)
- Oxide Tailings Areas (OU-6)
- Wabuska Drain (OU-7)
- Arimetco Facilities (OU-8)

The locations of these OUs are illustrated in Figure 1-2. The SOW requires a remedial investigation work plan (“RI Work Plan”) to be developed for each of the OUs, which will be conducted in accordance with the data quality objectives (“DQOs”) and OU-specific field and laboratory QA/QC procedures developed for each RI Work Plan. Each RI Work Plan may include or modify some or all of the QA/QC procedures, screening levels, number of QC field samples, analytical methods and reporting limits, percentages of data validation reports, etc. presented in this QAPP. Their inclusion or modification would depend on, but not necessarily be limited to the following criteria: 1) the media to be sampled; 2) historic field sampling issues and analytical results for the media to be sampled (i.e., level of confidence in the historic data for specific media); and 3) the development of new sampling techniques or analytical methods that may be applicable to the Site during the RI/FS process.

Environmental media anticipated to be subject to field sampling and laboratory analyses during the RI/FS process, and subsequent Site closure and post-closure monitoring periods, include:

- Air (A)
- Soil (S)
- Sediment (Sed)
- Surface Water (SurW)
- Groundwater (GW)
- Drinking Water (DW)
- Biota (B)

Of these media, the potential sampling and analysis of biota is a new media type relative to the information provided in previous versions of the QAPP. Because specific plant and animal species have not yet been identified for biota sampling and analysis, appropriate sampling and analysis procedures have not yet been determined. Biota sampling specifications will be provided in the individual RI Work Plans as they are developed in consultation with stakeholders (e.g., EPA and Tribal Representatives). These individual RI Work Plans will be provided to stakeholders for review, comment, and approval before they are implemented. As for all RI Work Plan elements, ARC anticipates that the inclusion of the sampling and analysis of biota in a specific RI Work Plan will be subject to the development of DQOs, specifically those related to ecological and human health risk assessment objectives.

Pursuant to the SOW, each RI Work Plan is required to include a human health risk assessment (“HHRA”) work plan for the media and environmental pathways associated with each OU. Screening level ecological risk assessment (“SLERA”) work plans, and associated habitat survey work plans, may also be attached to OU-specific RI Work Plans. The HHRA and ecological risk assessments follow general EPA guidance and, in large part, are based on the *Conceptual Site Model* (Brown and Caldwell and Integral, 2008) submitted to EPA on October 5, 2007.

The Conceptual Site Model (“CSM”) provides an overview of Site conditions including: 1) the physical features of the Site; 2) known and potential sources of mine-related contamination; 3) known and potential chemical migration pathways; and 4) a description of human and ecological populations that may contact mine-related contamination. The revised CSM addresses human health and ecological models separately, recognizing that the two models will share a common

basis (e.g., physical setting, operations history, known and hypothesized chemical release and transport pathways, and current and potential future land uses). The CSM elements related to exposure media, exposure routes, and populations of concern are used to develop exposure scenarios, which are discussed in more detail in the HHRA work plans for each OU. The CSM provides the framework for the RI Work Plans, including each OU-specific field sampling and analysis plan (“FSAP”) to be performed in accordance with the QAPP (i.e., the environmental media to be sampled and the analytical data needed to achieve the DQOs).

This QAPP is also related to the Data Management Plan (“DMP”) for the Site, which was approved by EPA on September 13, 2007. The DMP includes the following elements:

- Maintain data control, consistency, reliability, and reproducibility throughout the life of the project;
- Establish the framework for consistent documentation of the quality and validity of field and laboratory data compiled during all investigations;
- Describe the data management procedures for all Site-related data including groundwater, soil, soil gas, air, and any other Site-specific data collected;
- Describe how new data will be integrated and comprehensively managed with previously collected and historical data;
- Performance of audits to ensure the integrity of the data accumulated for the Site; and
- Include procedures and time lines for sharing data with EPA and other stakeholders, including procedures for providing both electronic and hard copies to specified recipients of each type of data.

1.3 Site Location and History

The Site is located about one-half mile west and northwest of the City of Yerington in Lyon County, Nevada (Figure 1-1). Mining, milling and leaching operations for oxide and sulfide copper ores from the open pit in the southern portion of the Site were conducted between 1953 and 1978 by The Anaconda Company (“Anaconda”). Figure 1-2 depicts the locations of mine units identified on the Site and their OU designations. Waste rock piles were constructed to the south and north of the open pit. Tailings impoundments and process solution evaporation ponds were constructed north of the Yerington Pit and the Process Areas, where the milling of oxide and sulfide ores took place.

Oxide ores were crushed and leached in vats with a dilute sulfuric acid solution that was produced from an on-Site acid plant (Acid Plant). The resulting copper sulfate solution was decanted and the remaining solids were placed in the tailings ponds. The copper sulfate solution was subjected to “iron laundering” in which the copper in solution is exchanged with iron, resulting in a copper precipitate. Residual solutions, containing elevated concentrations of iron and sulfate, were conveyed to evaporation ponds at a rate of about 700 gallons per minute (gpm) (Seitz et al., 1982).

Sulfide ores were finely crushed, and copper sulfides were recovered using a flotation process with the addition of lime to achieve a neutral pH. Residual solids were then placed in the sulfide tailings ponds. During mining and ore processing operations conducted by Anaconda, the tailings deposition areas and associated evaporation ponds and containment ditches were progressively expanded to the north to accommodate the need for increased tailings capacity. Copper concentrates from the milling process were dried and shipped offsite for smelting. Fine-grained tailings were transported to the ponds in slurry form, and the liquid fraction was recycled for use in further milling. Seepage from the northernmost tailings pond was collected in a ditch system, and recycled along with the liquid fraction of the tailings fluid. The mineralogical characteristics of the oxide and sulfide ores and waste rock mined from the Yerington Pit, which contained naturally-occurring radioactive minerals, has resulted in the localized occurrence of technically enhanced naturally-occurring radioactive materials (“TENORM”) on the Site.

Arimetco acquired the property in 1988 from Mr. Don Tibbals, who had previously acquired the property in or about 1982 from Anaconda. Arimetco constructed and operated five lined leach pads located around the Site (Figure 1-2) in the following sequence: Phase I/II (1989-1997); Phase III South (1990-1998); Phase III 4X (1992-1999); Phase IV-Slot (1993-1998); and Phase IV VLT (1995-1998). Some Arimetco leach pads and solution ponds were constructed on pre-existing waste rock and oxide tailings areas. Materials leached by Arimetco include previously deposited waste rock north of the Yerington Pit, VLT materials and ore from the MacArthur Pit, located northwest of the Site.

Arimetco constructed and operated an electro-winning plant with associated solution ponds located south of the former mill area (Figure 1-2). Arimetco ceased mining new ore and leaching operations in November 1998, and continued to recover copper from the heaps until November 1999 (EPA, 2007). Arimetco filed for bankruptcy in 1998 and abandoned the Site in 2000. From 2000 through 2004, the Nevada Division of Environmental Protection (“NDEP”) managed heap process fluids by re-circulation and evaporation. In 2005, ARC was required by EPA to assume responsibility for fluid management operations at the Site pursuant to the Interim Response Actions UAO issued to ARC by EPA (2005).

1.4 Physical Setting of the Site

The Site is located on the west side of Mason Valley and west of the City of Yerington, in west-central Nevada (Figure 1-1). The Walker River flows northerly and northeasterly between the Site and the City of Yerington (Figure 1-2). Site climate conditions are typical of a high desert arid environment. Monthly average temperatures range from 33.3° F in December to 73.7° F in July. Annual average rainfall for the City of Yerington is only 5.3 inches per year, with lowest rainfall occurring between July and September (WRCC, 2007). Wind speed and direction at the Site are variable as a result of natural conditions and variable topographic features created by surface mining operations. Air quality and meteorological monitoring at the Site provide useful information for the air pathway. Air quality and meteorological monitoring were not specified as a Site-wide OU.

Site soils are primarily composed of distal alluvial fan materials originating from the Singatse Range to the west of the Site with lesser amounts of colluvial materials from more local bedrock sources, fluvial materials located in the flood plain of the Walker River. Very minor occurrences of lake sediments from Pleistocene Lake Lahontan also occur at the northern margin of the Site. The U.S. Soil Conservation Service (“SCS”; 1984) soils map for Lyon County, Nevada includes the following major soils types for the alluvial fan materials immediately west of the mine Site: Patna fine sand (511); Rawe gravelly sandy loam (551); and the Rawe-Malpais association (553). In addition, the minor soil types mapped by the SCS (Units 121, 232 and 484) occur beneath the

northern portion of the Site. Based on the distribution of soil types at the Site (SCS, 1984), the majority of Site soils were derived from erosion of bedrock source types in the Singatse Range.

Recharge to bedrock groundwater beneath the Site from the Singatse Range results from the percolation of precipitation and runoff through the fractured bedrock. Recharge to alluvial groundwater beneath the Site occurs as a result of direct percolation of surface and meteoric water. Recharge from direct precipitation on the valley floor is considered negligible. Huxel (1969) estimated the following distribution of recharge to the alluvial aquifers to the Mason Valley hydrographic basin: 3 percent from precipitation that falls on the surrounding mountain ranges; 97 percent from the river and associated agricultural diversions; and less than 0.1 percent from direct precipitation on the valley floor.

Regionally, alluvial groundwater in the Mason Valley flows approximately north (Nork, 1989), more or less parallel to the Walker River. In the vicinity of the Site, the alluvial groundwater flow regime is locally affected by: 1) the Yerington Pit and Pit Lake; 2) bedrock outcrops on the eastern margin of the Site (the Singatse Spur); 3) irrigation and groundwater pumping associated with agricultural activities immediately north of the Site; and 4) groundwater extraction associated with the pumpback well system, which is located on the west and north sides of the Evaporation Ponds. The north-northwest groundwater flow direction beneath the Site primarily results from recharge from the Walker River to the alluvial flow system at the southeast margin of the Site. Groundwater flow north of the Site is greatly influenced by the agricultural operation located immediately north of the Sulfide Tailings (Figure 1-2).

In addition to the air, soil and water media described above, sediments occur at the Site in evaporation ponds, process ponds and in the pit lake. The accumulation of sediments within these various settings is not anticipated to be significant, but will also be subject to the elements described in this QAPP. For the purposes of the information presented below, in Section 1.5, sediments are assumed to contain the same classes of compounds as found in water and soils associated with the Site.

1.5 Compounds of Concern

Based on the information presented in Sections 1.3 and 1.4, Table 1-1 summarizes the classes of compounds, expected media and rationale for inclusion in the revised QAPP. Further discussion of these compounds and associated media are presented in subsequent sections of this document. Note that some compounds are not likely to be found in any, or only some, of the Site-related media.

Table 1-1. Compounds of Concern		
Compound Class	Media	Rationale for Inclusion
Metals	Soil	Multiple metals (e.g., arsenic) are naturally occurring in Site soils. In addition, metals in process solutions and mine wastes may have leaked/spilled into Site soils. Site tailings likely contain mine-related metals.
	Water	Multiple metals (e.g., arsenic) are naturally occurring in groundwater beneath the Site. In addition, mine-related metals in tailings and/or vadose zone soils may leach into groundwater.
	Air	Fugitive dust from Site soils and tailings may contain naturally occurring and/or mine-related metals. Upwind sources may also contribute to metals concentration in air near the Site.
	Biota	Multiple metals (e.g., arsenic) are naturally occurring in Site soils. In addition, metals in process solutions and mine wastes may have leaked/spilled into Site soils. Site tailings likely contain mine-related metals. Plant uptake of metals from Site soils may occur resulting in animals that feed on these plants potentially bioaccumulating these metals.
Radiochemicals	Soil	Some radiochemicals (e.g., uranium) are naturally occurring in Site soils. In addition, radiochemicals in process solutions and mine wastes may have leaked/spilled into Site soils.
	Water	Mine-related radiochemicals in tailings and/or vadose zone soils may leach into groundwater.
	Air	Fugitive dust from Site soils and tailings may contain naturally occurring and/or mine-related radiochemicals. Upwind sources may also contribute to radiochemicals concentration in air near the Site.
Total Petroleum Hydrocarbons	Soil	Petroleum fuels used and stored for mining vehicles/equipment may have leaked/spilled into Site soils.
	Water	Petroleum fuels in tailings and/or vadose zone soils may leach into groundwater.
	Air	Petroleum hydrocarbons are unlikely to be detected in ambient air, but soil vapor intrusion of volatile components into Site buildings may occur.
Volatile Organic Compounds (VOCs)	Soil	Some VOC compounds (e.g., benzene) are components of petroleum fuels used at the Site and may have leaked/spilled into soils. In addition, solvents could have been used for vehicle maintenance at the Site and then spilled/released to soils.
	Water	VOC compounds released to tailings and/or vadose zone soils may leach into groundwater.
	Air	VOCs are unlikely to be detected in ambient air, but soil vapor intrusion into Site buildings may occur.
Semi-Volatile Organic Compounds (SVOCs)	Soil	Some SVOC compounds are components of petroleum fuels/oils/lubricants used at the Site and may have leaked/spilled into soils.
	Water	SVOC compounds released to tailings and/or vadose zone soils may leach into groundwater.
	Air	SVOCs are unlikely to be detected in ambient air, but soil vapor intrusion of the most volatile SVOCs (e.g., naphthalene) into Site buildings may occur.
Polychlorinated Biphenyls (PCBs)	Soil	Transformers exist at the Site and are of the age that could contain PCBs; however, PCBs were detected infrequently in soil samples during the 2004-2005 Process Areas characterization.
	Water	PCBs are not expected to be detected in groundwater due to their infrequent detection in Site soils and low mobility in Site soils.
	Air	PCBs are unlikely to be detected in ambient air due to their infrequent detection in Site soils and high molecular weight.
	Biota	Transformers exist at the Site and are of the age that could contain PCBs; however, PCBs were detected infrequently in soil samples during the 2004-2005 Process Areas characterization. Although PCBs were detected infrequently in soil samples, it is possible that plant uptake of PCBs from Site soils may occur resulting in animals that feed on these plants potentially bioaccumulating these PCBs.

Table 1-1. Compounds of Concern		
Compound Class	Media	Rationale for Inclusion
Pesticides	Soil	Pesticides are unlikely to have been used or stored in significant quantities at the Site. In addition, pesticides were detected infrequently in soil samples during the 2004-2005 Process Areas characterization.
	Water	Pesticides are not expected to be detected in groundwater due to their infrequent detection in Site soils.
	Air	Pesticides are unlikely to be detected in ambient air due to their infrequent detection in Site soils.
Herbicides	Soil	Herbicides are unlikely to have been used or stored in significant quantities at the Site. In addition, herbicides were detected infrequently in soil samples during the 2004-2005 Process Areas characterization.
	Water	Herbicides are not expected to be detected in groundwater due to their infrequent detection in Site soils.
	Air	Herbicides are unlikely to be detected in ambient air due to their infrequent detection in Site soils.
General Chemistry Parameters	Soil	Not applicable.
	Water	General chemistry parameters (e.g., pH, cations, anions) may indicate groundwater impacts from mining-related activity.
	Air	Not applicable
	Biota	General chemistry parameters (e.g., pH, cations, anions) may indicate groundwater impacts from mining-related activity. Plant uptake of anions from Site soils may occur resulting in animals that feed on these plants potentially bioaccumulating these metals.

SECTION 2.0 PROJECT ORGANIZATION AND RESPONSIBILITY

This section describes the organizational structure, lines of authority, and responsibilities of key project individuals. Project activities will be performed within the framework of the organization and functions presented in this section. Emphasis is placed on the organization and entities responsible for implementation and administration of this QAPP. The general organizational structure showing relationships of individuals with key responsibilities for a project is presented in Figure 2-1 (page 19). The organizational structure is designed to provide clear lines of responsibility and authority. This control structure encompasses the following activities:

- Identifying lines of communication and coordination;
- Monitoring project schedules and performance;
- Managing key technical resources;
- Providing periodic progress reports;
- Coordinating support functions such as laboratory analysis and data management; and
- Rectifying deficiencies.

Contractor, subcontractor, and laboratory personnel providing services in support of Site investigations will perform work in strict compliance with the appropriate contract specifications for the activity. In addition to project QA, QA oversight personnel will also:

- Review field and laboratory data;
- Audit field and laboratory activities;
- Ensure that field and laboratory documents are compliant with this QAPP; and
- Identify field and laboratory deficiencies and recommend corrective action, as necessary.

QA personnel will have sufficient authority, organizational freedom, and ability to perform the following tasks:

- Identify QA problems;
- Initiate, recommend, or provide solutions to QA problems through designated channels;

- Ensure that project activities, including processing of information, delivery of deliverables, and installation or use of equipment, are reviewed in accordance with QA objectives;
- Ensure that deficiencies/non-conformances are corrected; and
- Ensure that further processing, delivery, or use of data is controlled until non-conformances, deficiencies, or unsatisfactory conditions have been corrected.

2.1 ARC Project Manager

Responsibilities and duties of the ARC Project Manager include the following: define project objectives and establish project policy and procedures to address the specific needs of the project as a whole, as well as the objectives of each task; review and analyze overall task performance with respect to planned requirements and authorizations; approve reports prior to their submission; and represent ARC at meetings.

2.2 Contractor Responsibilities

Under the direction of ARC, the Contractors are responsible for implementation of work assignments. The Contractors are primarily responsible for the activities encompassing work plans and/or SOP development; sample collection; data processing, interpretation, presentation, and reporting; and the QA procedures and QC measures associated with these activities. The following descriptions of project responsibilities for the functional roles presented below refer to positions within the organizational structure of the Contractors.

2.2.1 Consultant Project Manager

The Consultant Project Manager :1) is responsible for the overall project, including objectives, scope, budget, schedule, and quality of the submittals; 2) will promote continuity of the projects at the Site; and 3) report to management to ensure that the details in this QAPP are followed.

2.2.2 QA Oversight-Quality Assurance Manager (QAM)

The QAM is responsible for the conformance of project activities with this QAPP, applicable work plans and/or SOPs, and applicable EPA guidelines. Areas such as work plans and/or SOP design, sample collection and analysis, data interpretation and reporting, procurement, document control, records, and audits are included in these conformance responsibilities.

The QAM is responsible for initiating audits to ascertain if the project objectives are being achieved and for reviewing and resolving audit findings. The QAM is also responsible for ensuring that appropriate project procedures are developed with the appropriate necessary QA provisions. In addition, the QAM is responsible for reviewing and approving modifications to the QA program. The QAM will oversee and direct on-Site laboratory and field audits including initiation of performance evaluation samples.

2.2.3 Data Validator/Laboratory Auditor

Data validation/verification and laboratory audits will be performed by the QA oversight contractor. The Data Validator is responsible for validating laboratory-produced data and for notifying the QAM and ARC Project Manager of issues relating to the quality or validity of laboratory data and reporting. On-Site laboratory audits will be performed at the direction of the ARC Project Manager. The Laboratory Auditor is responsible for auditing the analytical laboratories and for notifying the QAM and ARC Project Manager of issues relating to quality or validity of the laboratory procedures.

2.2.4 Field Auditor

On-Site field audits will be performed by the QA oversight contractor at the direction of the ARC Project Manager. The Field Auditor is responsible for auditing the field sampling teams and notifying the QAM and ARC Project Manager of issues relating to quality of field procedures.

2.2.5 Field Team Leader

The Field Team Leader is responsible for ensuring that procedures for field activities related to characterization or remediation are executed in the proper manner, that activities are properly documented, that the prescribed scope-of-work is completed, and that communication protocols are performed.

2.2.6 Field Teams

The Field Teams are responsible for the performance of field activities as required by the individual work plans. Field Teams will document compliance with the work plans and/or SOPs and procedures by recording activities and observations in the field. Field Team structures will be presented in the project-specific SOPs and/or work plans.

2.2.7 Project Chemist

The Project Chemist is responsible for reviewing data validation/verification reports and qualifier codes applied to electronic data deliverables (EDDs) during the data validation/verification process. Based on this information, the Project Chemist relays any data limitation issues to the Consultant Project Manager and Field Team Leader prior to data use.

2.2.8 Database Administrator

The Database Administrator receives EDDs directly from the project laboratories after sample analysis and places them in the proper format prior to sending them to the Data Manager so that they can be used during the validation/verification process. The Database Administrator is also responsible for loading EDDs containing validated/verified data received from the Data Manager into the project database.

2.2.9 Data Manager

The Data Manager receives EDDs from the Database Administrator and is responsible for the application of qualifier codes (determined during the validation/verification process) to the EDDs received. The Data Manager is also responsible for delivering EDDs containing validated/verified data to the Database Administrator for loading into the project database.

2.3 Laboratory Organization and Responsibilities

The functional roles for laboratories are described in this subsection. From the project perspective, the structure is designed to facilitate information exchange among all project parties. This exchange includes planning, technical requirements, schedules, and QA/QC measures. Project information exchange specifically includes sample identification; preservation procedures; sample container requirements; sample collection procedures; decontamination protocols; turn-around-time; and

sample labeling, packing, holding times, and shipping. It is anticipated that the following laboratories will provide analytical support for the Yerington Mine Site project with TestAmerica-Irvine and TestAmerica-Richland providing the majority of the analytical services:

- TestAmerica-Irvine
- TestAmerica-Richland
- TestAmerica-Sacramento
- TestAmerica-St. Louis
- TestAmerica-North Canton
- TestAmerica-Burlington
- TestAmerica-Pittsburgh

The above list of laboratories is subject to change based on future changes in project requirements, and EPA will be notified when there are changes in project laboratories. When new laboratories are added to the project, their applicable SOPs will be sent to EPA for review.

2.3.1 Laboratory Project Manager

The Laboratory Project Manager will primarily schedule project analytical requirements, monitor analytical status/deadlines and turn-around-times, approve laboratory reports, and coordinate data revisions/corrections and resubmittal of packages. The Laboratory Project Manager will provide direction/support for administrative and technical project staff, interface with laboratory project staff on technical issues, and conduct QA oversight of analytical data. The Laboratory Project Manager will ensure that laboratory personnel understand and conform with elements of this QAPP and applicable SOPs and/or work plans as the elements relate to their activities.

2.3.2 Laboratory QA Coordinator

The Laboratory QA Coordinator will ensure conformance with authorized policies, procedures, and sound laboratory practices and will recommend improvements, as necessary. The Laboratory QA Coordinator will inform the Laboratory Program Manager of any nonconformance, introduce control samples into the sampling train, and establish testing lots. In addition, the Laboratory QA Coordinator will approve laboratory data before reporting or committing to permanent storage and

will be responsible for retention of supporting information (e.g., control charts and other performance indicators) to demonstrate that the systems that produced the data were in specification. The Laboratory QA Coordinator will also review results of internal QA audits and recommend corrective actions and time schedules for corrective action implementation.

The responsibilities of the Laboratory QA Coordinator include, but are not limited to, the following:

- Administering the laboratory QA/QC program;
- Implementing QC procedures for each test parameter;
- Reviewing the sampling and analytical methodology employed by laboratory personnel and modifying these protocols, as necessary;
- Coordinating performance auditing;
- Monitoring analytical results, including raw data, calculations, etc.;
- Inspecting laboratory logbooks and the data retrieval system;
- Monitoring proper documentation and maintaining records;
- Identifying and implementing training requirements for laboratory sampling and analytical personnel;
- Overseeing QA/QC implementation at the laboratory on a daily basis;
- Identifying QA/QC problems and recommending appropriate corrective action;
- Preparing status reports, including progress, problems, and recommended solutions; and
- Preparing reports that document completion of corrective actions.

2.3.3 Laboratory Sample Custodian

The Laboratory Sample Custodian will receive samples from the field, sign and date chain-of-custody forms, record the date and time of sample receipt, and record the condition of both shipping containers and sample containers.

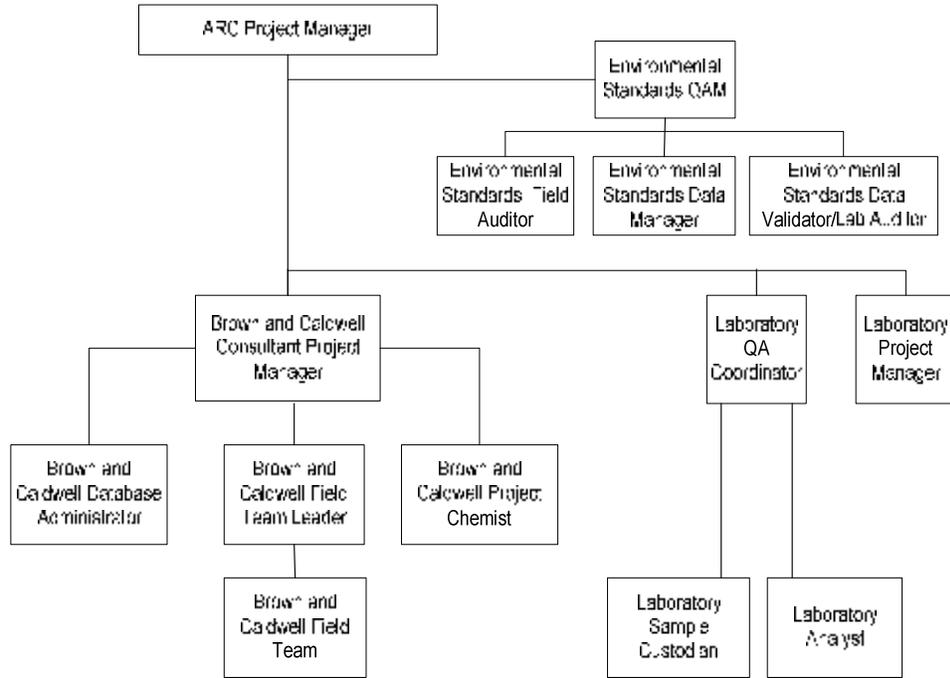
The Laboratory Sample Custodian will verify and record discrepancies or agreement of information on sample documents. If there is a discrepancy, the Laboratory Sample Custodian will record the problems/inconsistencies and will inform the Laboratory Project Manager.

The Laboratory Sample Custodian will also label samples with laboratory sample numbers; place samples, and spent samples into appropriate storage and/or secure areas; and monitor storage conditions.

2.3.4 Laboratory Analyst

The Laboratory Analyst is responsible for preparing and/or analyzing samples in accordance with this document and/or the applicable analytical methods. If there are problems encountered during sample preparation or analysis, the Laboratory Analyst will inform the Laboratory QA Coordinator and Laboratory Project Manager.

FIGURE 2-1
Project Organization



SECTION 3.0

QUALITY ASSURANCE AND QUALITY CONTROL OBJECTIVES

This section describes the data quality objectives (DQOs) and associated precision, bias, accuracy, completeness, representativeness, comparability, and sensitivity parameters used for the project. QA/QC procedures are designed to ensure high quality for all environmental data collected on behalf of ARC.

3.1 Data Quality Objectives

The DQO process is a series of planning steps that is based on a scientific method to ensure that the type, quantity, and quality of environmental data used in decision-making are appropriate for the intended application. In general, DQOs provide a qualitative and quantitative framework around which data collection programs can be designed. The qualitative aspect of DQOs seeks to encourage good planning for field investigations. The quantitative aspect of DQOs involves designing an efficient field investigation that minimizes the possibility of making an incorrect decision. The steps in the DQO process and a brief description of each step (obtained from the *Guidance on Systematic Planning Using the Data Quality Objectives Process EPA QA/G-4 (EPA/240/B-06/001)*) are presented below:

- Problem Statement: Define the problem; identify the members of the planning team; define budget and schedule.
- Decision Statements: State how environmental data will be used to meet the objectives and solve the problem; identify study questions; define alternative outcomes.
- Inputs to the Decision: Identify data and information needed to answer the study question.
- Study Boundaries: Specify the target population and characteristics of interest; define spatial and temporal limits and scales of inference.
- Decision Rules: Present decision rules in terms of “if” statements.
- Acceptance Limits on Decision Errors: Develop performance criteria for newly collected data.
- Optimize the Sampling Design: Summarize Steps 1 through 6 into a SAP that meets the data quality, budget, and schedule objectives.

OU-specific DQOs have been, and will continue to be developed, for each RI Work Plan pursuant to the SOW.

Tables 3-1 through 3-5 of this QAPP present the analytical methods, laboratory reporting limits (reporting limits), and accuracy and precision goals for aqueous samples, soil/sediment samples, air samples, biota samples, and toxicity characterization leaching procedure (TCLP) samples, respectively. While the analyte lists on Tables 3-1 through 3-5 are the comprehensive analyte lists that may be generally applicable for the entire Site, OU-specific work plans will specify focused analyte lists for specific media based on the operational history of the OU. Table 3-6 presents the analytical methods and surrogate recovery goals, and Table 3-7 presents the analytical methods and chemical yield goals. These limits and goals, as well as the precision, bias, accuracy, completeness, representativeness, comparability, and sensitivity parameters described below, serve to limit decision errors. The accuracy and/or precision goals in Tables 3-1 through 3-7 represent the data usability (data validation/verification) goals.

The Data Validator will use these limits to qualify data; however, the laboratory will perform corrective actions based on their internal accuracy and precision goals (see Tables A-22 through A-28 of the QAPP). The laboratory will perform corrective actions by evaluating the Data Quality Indicators (DQIs) based on the accuracy and precision goals in Tables A-22 through A-28. Examples of DQIs that will be evaluated include matrix spike/matrix spike duplicate recoveries and precision results, surrogate recoveries, laboratory control sample recoveries, tracer/carrier recoveries, etc. The laboratory reporting limits on Tables 3-1 through 3-5 represent maximum allowable reporting limits for relatively clean samples without matrix interferences, and the laboratories have been requested to report at or below this limit [eg at the reporting limit or the method detection limit (MDL)]. The actual reporting limits may vary depending upon the laboratory performing the analysis, the sample matrix, and the sample dilution factors. Corrective actions associated with the accuracy and precision goals are presented in Appendix A and Section 10.0.

3.2 Precision, Bias, Accuracy, Completeness, Representativeness, Comparability, and Sensitivity Parameters

Data quality can be assessed using the precision, bias, accuracy, completeness, representativeness, comparability, and sensitivity parameters described below and obtained from EPA *Guidance for Quality Assurance Project* (EPA, 2002a).

3.2.1 Data Precision

Precision is the degree of agreement between repeated, independent measurements. Field measurement precision is determined by replicate sample measurements. The precision of laboratory analyses is determined by replicate sample analyses and/or replicate matrix spike sample analyses. Precision, as relative percent difference (RPD, which is an absolute value), is calculated by dividing the difference of the replicate analytical results by the mean of the replicate analytical results, as shown below.

$$RPD = \frac{X_a - X_b}{X_a + X_b} \times 200$$

Where X_a is the larger of the replicate analytical results and X_b is the smaller of the replicate analytical results. When both replicates are within a factor of five-times the reporting limit (see Tables 3-1 through 3-5 for reporting limits), the calculated precision may not be significant.

For radiological parameters, the precision of replicate sample analyses is better expressed by the replicate error ratio (RER) because the RER factors the uncertainties from the sample and duplicate into the equation. The RER is calculated by dividing the absolute value of the difference of the sample and duplicate activities by the square root of the sum of the sample error squared and duplicate error squared, as shown below.

$$RER = \frac{|A-B|}{\sqrt{S_A^2 + S_B^2}}$$

Where A is the sample activity, B is the duplicate activity, S_A is the sample error, and S_B is the duplicate error.

The precision of radiological laboratory analyses can also be expressed as an RPD value; however, the RER acceptance criteria take precedence over the RPD criteria, when the activity of at least one replicate is less than five times the minimum detectable concentration (MDC).

3.2.2 Data Bias

Data bias is the systematic distortion of a measurement process that causes errors to skew the data in one direction. Data bias is addressed in the field and in the laboratory by calibrating equipment (refer to Section 6.0).

3.2.3 Data Accuracy

Accuracy is the degree to which the sample result agrees with the actual concentration of a parameter. The accuracy of laboratory measurements is determined by analyses of matrix spike samples. Accuracy, as percent recovery, for a matrix spike sample is calculated by subtracting the sample result from the matrix spike sample result and then dividing the outcome by the amount of spike added to the matrix spike sample, as shown below.

$$MSAccuracy = \frac{X_c - X_a}{S} \times 100$$

Where X_a is the sample result, X_c is the matrix spike sample result, and S is the amount of the spike added to the matrix spike sample.

Accuracy, as percent recovery, for a laboratory control sample is calculated by dividing the sample result by the amount of spike added to the laboratory control sample, as shown below.

$$LCSAccuracy = \frac{X_c}{S} \times 100$$

Where X_c is the laboratory control sample result and S is the amount of the spike added to the laboratory control sample.

Accuracy, as percent recovery, for a surrogate is calculated by dividing the sample surrogate result by the amount of surrogate spike added to the sample, as shown below.

$$\text{Surrogate Accuracy} = \frac{X_c}{S} \times 100$$

Where X_c is the surrogate compound result in the sample and S is the amount of the surrogate spike added to the sample.

3.2.4 Data Completeness

Completeness is the degree to which the proposed sampling locations yield usable data (*viz.*, data that was not rejected) of the type requested. Proposed sample collection points may fail to produce usable data for many reasons (e.g., field conditions that prevent collection of samples, sample container breakage, elevated storage temperature, exceeded sample holding time, or data loss). Percent completeness is calculated by dividing the number of usable data points by the number of proposed sample collection points, as shown below.

$$\text{Completeness} = \frac{U}{P} \times 100$$

Where U is the number of usable data points and P is the number of proposed sample collection points. In general, the completeness goal for environmental data is 90 percent. Any changes in the 90 percent completeness goal for specific activities will be identified and defined in the work plan associated with the specific activity.

3.2.5 Data Representativeness

Representativeness expresses the degree to which sample data accurately and precisely represent a characteristic of a population, parameter variations at a sampling point, or an environmental condition. Samples must be representative of the environmental media being sampled. Selection of sample locations and sampling procedures will incorporate consideration of obtaining the most representative sample possible.

Field and laboratory procedures will be performed in such a manner as to ensure, to the degree that is technically possible, that the data derived represents the in-place quantity of the material sampled. Every effort will be made to ensure chemical compounds will not be introduced into the sample via sample containers, handling, and analysis. Decontamination of equipment will be

performed between samples. Laboratory sample containers will be pre-cleaned certified bottleware. Analysis of field blanks, equipment blanks, and method blanks will also be performed to monitor for potential sample contamination from field and laboratory procedures.

The assessment of representativeness also must consider the degree of heterogeneity in the material from which the samples are collected. Sampling heterogeneity will be evaluated through the analysis of field duplicate samples. Consistency in sample collection techniques is critical to the significance of field duplicate sample results in evaluating representativeness. If the samples are not properly collected, results outside of the established controls limits may be indicative of the poor collection technique rather than providing insight into Site conditions. The analytical laboratories will also ensure that the samples are adequately homogenized prior to taking aliquots for analysis. This procedure will ensure the reported results are representative of the sample received, with the exception of samples submitted for the analysis of volatile organic compounds (“VOCs”).

3.2.6 Data Comparability

Data comparability is the confidence with which one data set can be compared to another data set. Data comparability will be achieved by using standard sampling and analytical techniques and by documenting all QA/QC measures and procedures. QA/QC procedures will be considered when comparing data sets.

3.2.7 Data Sensitivity

Data sensitivity is the ability for the analytical method to differentiate between various levels of the measured parameter. The standard reporting limits and method detection limits are presented in Tables 3-1 through 3-5; however, results between the reporting limit and the laboratory method detection limits (sample-specific minimum detectable activity for radiological analyses) will be reported for all analytes (see Section 5.1). This is necessary because the reporting limits for several analytes are above the associated minimum screening values. In many instances, the respective method detection limits are below the minimum screening values; however, there are cases where the method detection limits are above minimum screening values. The aqueous analytes that have method detection limits above minimum screening values are carbon

tetrachloride; chloroform; 1,2-dibromo-3-chloropropane; 1,2-dibromoethane; 1,2-dichloroethane; naphthalene; 1,1,2,2-tetrachloroethane; 1,1,2-trichloroethane; 1,2,3-trichloropropane; vinyl chloride; bis(2-chloroethyl)ether; 3,3'-dichlorobenzene; hexachlorobenzene; *n*-nitroso-di-*n*-propylamine; benzo(a)pyrene; benzo(b)fluoranthene; dibenzo(a,h)anthracene; indeno(1,2,3-cd)pyrene; MCPA; MCPP; arsenic; boron (by Methods 6020 and 200.7); and silver. It should also be noted that aqueous 2,4-dichlorophenol, nitrite, and nitrate/nitrite have method detection limits that are equal to the associated minimum screening value. The soil/sediment analytes that have method detection limits above minimum screening values are *n*-nitroso-di-*n*-propylamine and boron. The air analytes that have method detection limits above minimum screening values are chromium (by Method 6020) and cobalt (by Method 6020).

“Not-detected” results obtained for analytes with method detection limits above the minimum screening level will be addressed in the RI for each specific OU in nature and extent to discuss the potential that the analyte is present given historical use of the OU, whether the minimum screening level is below background concentrations, and appropriate methods to assess potential risk.

Table 3-1. Aqueous Samples Analytical Methods, Reporting Limits, Accuracy, and Precision Goals ^a								
Parameter	Analytical Method	Reporting Limit	Method Detection Limit ^d	MS Accuracy, Percent	Precision, RPD or RER ^b	LCS Accuracy, Percent	Screening Value ^j	Note
Benzene	8260B	0.50 µg/L	0.28 µg/L*	70-130	20	70-130	0.41 µg/L	c
Bromobenzene	8260B	1.0 µg/L	0.27 µg/L	70-130	20	70-130	20 µg/L	i
Bromochloromethane	8260B	1.0 µg/L	0.40 µg/L	70-130	20	70-130	NCA	
Bromodichloromethane	8260B	0.50 µg/L	0.30 µg/L	70-130	20	70-130	1.1 µg/L	c
Bromoform	8260B	0.50 µg/L	0.40 µg/L	70-130	20	70-130	8.5 µg/L	c
Bromomethane	8260B	1.0 µg/L	0.42 µg/L	70-130	20	70-130	8.7 µg/L	c
<i>n</i> -Butylbenzene	8260B	1.0 µg/L	0.37 µg/L	70-130	20	70-130	240 µg/L	i
sec-Butylbenzene	8260B	1.0 µg/L	0.25 µg/L	70-130	20	70-130	240 µg/L	i
<i>tert</i> -Butylbenzene	8260B	1.0 µg/L	0.22 µg/L	70-130	20	70-130	240 µg/L	i
Carbon tetrachloride	8260B	0.50 µg/L	0.28 µg/L>	70-130	20	70-130	0.2 µg/L	c
Chlorobenzene	8260B	0.50 µg/L	0.36 µg/L	70-130	20	70-130	64 µg/L	f
Chloroethane	8260B	0.50 µg/L	0.40 µg/L	70-130	20	70-130	2,100 µg/L	c
2-Chlorotoluene	8260B	1.0 µg/L	0.28 µg/L	70-130	20	70-130	730 µg/L	c
4-Chlorotoluene	8260B	1.0 µg/L	0.29 µg/L	70-130	20	70-130	2600 µg/L	c
Chloroform	8260B	0.50 µg/L	0.33 µg/L>	70-130	20	70-130	0.19 µg/L	c
Chloromethane	8260B	0.50 µg/L	0.40 µg/L	70-130	20	70-130	1.8 µg/L	c
1,2-Dibromo-3-chloropropane	8260B	1.0 µg/L	0.97 µg/L>	70-130	20	70-130	0.00032 µg/L	c
Dibromochloromethane	8260B	0.50 µg/L	0.40 µg/L	70-130	20	70-130	0.80 µg/L	c
1,2-Dibromoethane	8260B	1.0 µg/L	0.40 µg/L>	70-130	20	70-130	0.0065 µg/L	c
Dibromomethane	8260B	1.0 µg/L	0.36 µg/L	70-130	20	70-130	370 µg/L	c
1,3-Dichlorobenzene	8260B	1.0 µg/L	0.35 µg/L	70-130	20	70-130	150 µg/L	e
1,4-Dichlorobenzene	8260B	0.50 µg/L	0.37 µg/L*	70-130	20	70-130	0.43 µg/L	c
Dichlorodifluoromethane	8260B	2.0 µg/L	0.26 µg/L	70-130	20	70-130	390 µg/L	c
1,1-Dichloroethane	8260B	0.50 µg/L	0.40 µg/L	70-130	20	70-130	2.4 µg/L	c
1,2-Dichloroethane	8260B	0.50 µg/L	0.28 µg/L>	70-130	20	70-130	0.15 µg/L	c
1,1-Dichloroethene	8260B	0.50 µg/L	0.42 µg/L	70-130	20	70-130	7 µg/L	k
<i>cis</i> -1,2-Dichloroethene	8260B	0.50 µg/L	0.32 µg/L	70-130	20	70-130	70 µg/L	k
<i>trans</i> -1,2-Dichloroethene	8260B	0.50 µg/L	0.30 µg/L	70-130	20	70-130	100 µg/L	k
Dichlorofluoromethane	8260B	2.5 µg/L	0.90 µg/L	70-130	20	70-130	NCA	

Table 3-1. Aqueous Samples Analytical Methods, Reporting Limits, Accuracy, and Precision Goals ^a								
Parameter	Analytical Method	Reporting Limit	Method Detection Limit ^d	MS Accuracy, Percent	Precision, RPD or RER ^b	LCS Accuracy, Percent	Screening Value ^j	Note
1,2-Dichloropropane	8260B	0.50 µg/L	0.35 µg/L*	70-130	20	70-130	0.39 µg/L	c
1,3-Dichloropropane	8260B	0.50 µg/L	0.32 µg/L	70-130	20	70-130	730 µg/L	c
2,2-Dichloropropane	8260B	1.0 µg/L	0.34 µg/L	70-130	20	70-130	NCA	
1,1-Dichloropropene	8260B	1.0 µg/L	0.28 µg/L	70-130	20	70-130	NCA	
Ethylbenzene	8260B	0.50 µg/L	0.25 µg/L*	70-130	20	70-130	1.5 µg/L	c
Hexachlorobutadiene	8260B	1.0 µg/L	0.38 µg/L*	70-130	20	70-130	0.86 µg/L	c
Isopropylbenzene	8260B	1.0 µg/L	0.25 µg/L	70-130	20	70-130	680 µg/L	c
<i>p</i> -Isopropyltoluene	8260B	1.0 µg/L	0.28 µg/L	70-130	20	70-130	NCA	
Methylene chloride	8260B	1.0 µg/L	0.95 µg/L	70-130	20	70-130	4.8 µg/L	c
Naphthalene	8260B	1.0 µg/L	0.41 µg/L>	70-130	20	70-130	0.14 µg/L	c
<i>n</i> -Propylbenzene	8260B	1.0 µg/L	0.27 µg/L	70-130	20	70-130	240 µg/L	i
Styrene	8260B	0.50 µg/L	0.20 µg/L	70-130	20	70-130	72 µg/L	e
<i>tert</i> -butyl methyl ether	8260B	1.0 µg/L	0.32 µg/L	70-130	20	70-130	12 µg/L	c
1,1,2,2-Tetrachloroethane	8260B	0.50 µg/L	0.30 µg/L>	70-130	20	70-130	0.067 µg/L	c
Tetrachloroethene	8260B	0.50 µg/L	0.32 µg/L>	70-130	20	70-130	0.11 µg/L	c
1,1,1,2-Tetrachloroethane	8260B	1.0 µg/L	0.27 µg/L*	70-130	20	70-130	0.52 µg/L	c
Toluene	8260B	0.50 µg/L	0.36 µg/L	70-130	20	70-130	2.0 µg/L	e
1,2,3-Trichlorobenzene	8260B	1.0 µg/L	0.30 µg/L	70-130	20	70-130	8.0 µg/L	e
1,2,4-Trichlorobenzene	8260B	0.50 µg/L	0.48 µg/L	70-130	20	70-130	8.2 µg/L	c
1,1,1-Trichloroethane	8260B	0.50 µg/L	0.30 µg/L	70-130	20	70-130	11 µg/L	f
1,1,2-Trichloroethane	8260B	0.50 µg/L	0.30 µg/L>	70-130	20	70-130	0.24 µg/L	c
Trichloroethene	8260B	0.50 µg/L	0.26 µg/L	70-130	20	70-130	1.7 µg/L	c
Trichlorofluoromethane	8260B	1.0 µg/L	0.34 µg/L	70-130	20	70-130	1,300 µg/L	c
1,2,3-Trichloropropane	8260B	1.0 µg/L	0.40 µg/L>	70-130	20	70-130	0.0096 µg/L	c
1,2,4-Trimethylbenzene	8260B	1.0 µg/L	0.23 µg/L	70-130	20	70-130	15 µg/L	c
1,3,5-Trimethylbenzene	8260B	1.0 µg/L	0.26 µg/L	70-130	20	70-130	12 µg/L	i
Vinyl chloride	8260B	0.50 µg/L	0.40 µg/L>	70-130	20	70-130	0.016 µg/L	c
Xylene (total)	8260B	1.0 µg/L	0.60 µg/L	70-130	20	70-130	13 µg/L	f
<i>o</i> -Xylene	8260B	1.0 µg/L	0.30 µg/L	70-130	20	70-130	1,400 µg/L	c
<i>m</i> -Xylene	8260B	1.0 µg/L	0.60 µg/L	70-130	20	70-130	1,400 µg/L	c
<i>p</i> -Xylene	8260B	1.0 µg/L	0.60 µg/L	70-130	20	70-130	1,500 µg/L	c

Table 3-1. Aqueous Samples Analytical Methods, Reporting Limits, Accuracy, and Precision Goals ^a								
Parameter	Analytical Method	Reporting Limit	Method Detection Limit ^d	MS Accuracy, Percent	Precision, RPD or RER ^b	LCS Accuracy, Percent	Screening Value ^j	Note
Diesel (C12-C23)-TPH	8015B	500 µg/L	100 µg/L	50-130	20	50-130	NCA	
Motor Oil (C23-C40)-TPH	8015B	500 µg/L	100 µg/L	50-130	20	50-130	NCA	
Gasoline (C4-C12)-TPH	8015B	50 µg/L	25 µg/L	70-130	20	70-130	NCA	
2-Chlorophenol	625 LL	1.0 µg/L	0.20 µg/L	50-130	20	50-130	7.0 µg/L	e
4-Chloro-3-methylphenol	625 LL	1.0 µg/L	0.20 µg/L	50-130	20	50-130	NCA	
2,4-Dichlorophenol	625 LL	2.0 µg/L	0.20 µg/L=	50-130	20	50-130	0.20 µg/L	e
2,4-Dimethylphenol	625 LL	2.0 µg/L	0.30 µg/L	50-130	20	50-130	730 µg/L	c
2,4-Dinitrophenol	625 LL	5.0 µg/L	0.90 µg/L	50-130	20	50-130	73 µg/L	c
4,6-Dinitro-o-cresol	625 LL	5.0 µg/L	0.20 µg/L*	50-130	20	50-130	3.7 µg/L	c
2-Methylphenol	625 LL	2.0 µg/L	0.10 µg/L	50-130	20	50-130	13 µg/L	f
3-Methylphenol	625 LL	5.0 µg/L	0.20 µg/L	50-130	20	50-130	1800 µg/L	c
4-Methylphenol	625 LL	5.0 µg/L	0.20 µg/L	50-130	20	50-130	180 µg/L	c
2-Nitrophenol	625 LL	2.0 µg/L	0.10 µg/L	50-130	20	50-130	NCA	
4-Nitrophenol	625 LL	5.0 µg/L	2.5 µg/L	50-130	20	50-130	300 µg/L	f
Pentachlorophenol	625 LL	2.0 µg/L	0.10 µg/L*	50-130	20	50-130	0.56 µg/L	c
Phenol	625 LL	1.0 µg/L	0.30 µg/L	50-130	20	50-130	4.0 µg/L	e
2,4,5-Trichlorophenol	625 LL	2.0 µg/L	0.20 µg/L	50-130	20	50-130	18 µg/L	e
2,4,6-Trichlorophenol	625 LL	1.0 µg/L	0.10 µg/L	50-130	20	50-130	6.1 µg/L	c
Benzoic acid	625 LL	20 µg/L	3.0 µg/L	50-130	20	50-130	42 µg/L	f
4-Bromophenyl phenyl ether	625 LL	1.0 µg/L	0.10 µg/L	50-130	20	50-130	1.5 µg/L	f
Butyl benzyl phthalate	625 LL	5.0 µg/L	0.70 µg/L	50-130	20	50-130	19 µg/L	f
2-Chloronaphthalene	625 LL	0.50 µg/L	0.10 µg/L	50-130	20	50-130	2900 µg/L	c
4-Chloroaniline	625 LL	2.0 µg/L	0.10 µg/L*	50-130	20	50-130	1.2 µg/L	c
Carbazole	625 LL	1.0 µg/L	0.25 µg/L	50-130	20	50-130	3.4 µg/L	i
bis(2-Chloroethoxy)methane	625 LL	0.50 µg/L	0.10 µg/L	50-130	20	50-130	110 µg/L	c
bis(2-Chloroethyl)ether	625 LL	0.50 µg/L	0.10 µg/L>	50-130	20	50-130	0.012 µg/L	c
bis(2-Chloroisopropyl)ether	625 LL	0.50 µg/L	0.10 µg/L*	50-130	20	50-130	0.32 µg/L	c
4-Chlorophenyl phenyl ether	625 LL	0.50 µg/L	0.10 µg/L	50-130	20	50-130	NCA	
2,4-Dinitrotoluene	625 LL	5.0 µg/L	0.20 µg/L	50-130	20	50-130	73 µg/L	c
2,6-Dinitrotoluene	625 LL	5.0 µg/L	0.10 µg/L	50-130	20	50-130	37 µg/L	c
3,3'-Dichlorobenzidine	625 LL	5.0 µg/L	0.40 µg/L>	50-130	20	50-130	0.15 µg/L	c

Table 3-1. Aqueous Samples Analytical Methods, Reporting Limits, Accuracy, and Precision Goals ^a								
Parameter	Analytical Method	Reporting Limit	Method Detection Limit ^d	MS Accuracy, Percent	Precision, RPD or RER ^b	LCS Accuracy, Percent	Screening Value ^j	Note
Dibenzofuran	625 LL	0.50 µg/L	0.10 µg/L	50-130	20	50-130	3.7 µg/L	f
1,2-Dichlorobenzene	625 LL	0.50 µg/L	0.10 µg/L	50-130	20	50-130	0.7 µg/L	e
1,3-Dichlorobenzene	625 LL	0.50 µg/L	0.10 µg/L	50-130	20	50-130	150 µg/L	e
1,4-Dichlorobenzene	625 LL	0.50 µg/L	0.20 µg/L*	50-130	20	50-130	0.43 µg/L	c
di- <i>n</i> -Butyl phthalate	625 LL	2.0 µg/L	0.20 µg/L	50-130	20	50-130	19 µg/L	e
di- <i>n</i> -Octyl phthalate	625 LL	5.0 µg/L	0.10 µg/L	50-130	20	50-130	1,500 µg/L	i
Diethyl phthalate	625 LL	1.0 µg/L	0.10 µg/L	50-130	20	50-130	210 µg/L	f
Dimethyl phthalate	625 LL	0.50 µg/L	0.10 µg/L	50-130	20	50-130	360,000 µg/L	i
bis(2-Ethylhexyl)phthalate	625 LL	5.0 µg/L	1.7 µg/L*	50-130	20	50-130	4.8 µg/L	c
Hexachlorobenzene	625 LL	1.0 µg/L	0.10 µg/L>	50-130	20	50-130	0.042 µg/L	c
Hexachlorobutadiene	625 LL	1.0 µg/L	0.20 µg/L*	50-130	20	50-130	0.86 µg/L	c
Hexachlorocyclopentadiene	625 LL	5.0 µg/L	0.10 µg/L	50-130	20	50-130	50 µg/L	k
Hexachloroethane	625 LL	1.0 µg/L	0.20 µg/L	50-130	20	50-130	4.8 µg/L	c
Isophorone	625 LL	1.0 µg/L	0.10 µg/L	50-130	20	50-130	71 µg/L	c
2-Methylnaphthalene	625 LL	1.0 µg/L	0.10 µg/L	50-130	20	50-130	150 µg/L	c
2-Nitroaniline	625 LL	5.0 µg/L	0.10 µg/L	50-130	20	50-130	110 µg/L	i
3-Nitroaniline	625 LL	5.0 µg/L	0.20 µg/L*	50-130	20	50-130	3.2 µg/L	i
4-Nitroaniline	625 LL	5.0 µg/L	0.50 µg/L*	50-130	20	50-130	3.2 µg/L	c
Nitrobenzene	625 LL	1.0 µg/L	0.10 µg/L	50-130	20	50-130	3.4 µg/L	c
N-Nitroso-di- <i>n</i> -propylamine	625 LL	2.0 µg/L	0.10 µg/L>	50-130	20	50-130	0.0096 µg/L	c
N-Nitrosodiphenylamine	625 LL	1.0 µg/L	0.10 µg/L	50-130	20	50-130	14 µg/L	c
1,2,4-Trichlorobenzene	625 LL	1.0 µg/L	0.10 µg/L	50-130	20	50-130	8.2 µg/L	c
Acenaphthene	8270C SIM	0.50 µg/L	0.05 µg/L	50-130	20	50-130	5.8 µg/L	e
Acenaphthylene	8270C SIM	0.50 µg/L	0.05 µg/L	50-130	20	50-130	NCA	
Anthracene	8270C SIM	0.50 µg/L	0.011 µg/L*	50-130	20	50-130	0.012 µg/L	e
Benzo(a)anthracene	8270C SIM	0.50 µg/L	0.007 µg/L*	50-130	20	50-130	0.018 µg/L	e
Benzo(a)pyrene	8270C SIM	0.50 µg/L	0.009 µg/L>	50-130	20	50-130	0.0029 µg/L	c
Benzo(b)fluoranthene	8270C SIM	0.50 µg/L	0.05 µg/L>	50-130	20	50-130	0.029 µg/L	c
Benzo(g,h,i)perylene	8270C SIM	0.50 µg/L	0.05 µg/L	50-130	20	50-130	NCA	
Benzo(k)fluoranthene	8270C SIM	0.50 µg/L	0.05 µg/L*	50-130	20	50-130	0.29 µg/L	c

Table 3-1. Aqueous Samples Analytical Methods, Reporting Limits, Accuracy, and Precision Goals ^a								
Parameter	Analytical Method	Reporting Limit	Method Detection Limit ^d	MS Accuracy, Percent	Precision, RPD or RER ^b	LCS Accuracy, Percent	Screening Value ^j	Note
Chrysene	8270C SIM	0.50 µg/L	0.05 µg/L	50-130	20	50-130	2.9 µg/L	c
Dibenzo(a,h)anthracene	8270C SIM	0.50 µg/L	0.05 µg/L>	50-130	20	50-130	0.0029 µg/L	c
Fluoranthene	8270C SIM	0.50 µg/L	0.012 µg/L*	50-130	20	50-130	0.04 µg/L	e
Fluorene	8270C SIM	0.50 µg/L	0.05 µg/L	50-130	20	50-130	3.0 µg/L	e
Indeno(1,2,3-cd)pyrene	8270C SIM	0.50 µg/L	0.05 µg/L>	50-130	20	50-130	0.029 µg/L	c
Naphthalene	8270C SIM	0.50 µg/L	0.05 µg/L*	50-130	20	50-130	0.14 µg/L	c
Phenanthrene	8270C SIM	0.50 µg/L	0.05 µg/L*	50-130	20	50-130	0.40 µg/L	e
Pyrene	8270C SIM	0.50 µg/L	0.006 µg/L*	50-130	20	50-130	0.025 µg/L	e
alpha-BHC	8081A LL	0.0013 µg/L	0.000379 µg/L	50-130	20	50-130	0.011 µg/L	c
beta-BHC	8081A LL	0.0013 µg/L	0.000362 µg/L	50-130	20	50-130	0.037 µg/L	c
gamma-BHC (Lindane)	8081A LL	0.0013 µg/L	0.000379 µg/L	50-130	20	50-130	0.061 µg/L	c
delta-BHC	8081A LL	0.0013 µg/L	0.000237 µg/L	50-130	20	50-130	2.2 µg/L	f
Heptachlor	8081A LL	0.0013 µg/L	0.000347 µg/L	50-130	20	50-130	0.0038 µg/L	g
Aldrin	8081A LL	0.0013 µg/L	0.000278 µg/L	50-130	20	50-130	0.0040 µg/L	c
Heptachlor epoxide	8081A LL	0.0013 µg/L	0.000247 µg/L	50-130	20	50-130	0.0038 µg/L	g
Endosulfan I	8081A LL	0.0013 µg/L	0.000185 µg/L	50-130	20	50-130	0.056 µg/L	g
Dieldrin	8081A LL	0.0013 µg/L	0.0002 µg/L	50-130	20	50-130	0.0042 µg/L	c
Endrin aldehyde	8081A LL	0.0013 µg/L	0.000301 µg/L	50-130	20	50-130	NCA	
Endrin	8081A LL	0.0013 µg/L	0.000191 µg/L	50-130	20	50-130	0.036 µg/L	g
Endosulfan II	8081A LL	0.0013 µg/L	0.000377 µg/L	50-130	20	50-130	0.056 µg/L	g
4,4'-DDD	8081A LL	0.0013 µg/L	0.000193 µg/L	50-130	20	50-130	0.011 µg/L	f
Endosulfan sulfate	8081A LL	0.0013 µg/L	0.000398 µg/L	50-130	20	50-130	0.051 µg/L	f
4,4'-DDT	8081A LL	0.0013 µg/L	0.000344 µg/L*	50-130	20	50-130	0.001 µg/L	g
4,4'-DDE	8081A LL	0.0013 µg/L	0.000169 µg/L	50-130	20	50-130	0.20 µg/L	c
Methoxychlor	8081A LL	0.0013 µg/L	0.000458 µg/L	50-130	20	50-130	0.03 µg/L	g
Endrin ketone	8081A LL	0.0013 µg/L	0.000249 µg/L	50-130	20	50-130	NCA	
alpha-Chlordane	8081A LL	0.0013 µg/L	0.000281 µg/L	50-130	20	50-130	NCA	
gamma-Chlordane	8081A LL	0.0013 µg/L	0.000189 µg/L	50-130	20	50-130	NCA	
Toxaphene	8081A LL	0.05 µg/L	0.000378 µg/L*	NA	NA	NA	0.002 µg/L	g
Aroclor-1016	8082 LL	0.01 µg/L	0.002515 µg/L	50-130	20	50-130	0.014 µg/L	g
Aroclor-1221	8082 LL	0.01 µg/L	0.00249 µg/L*	NA	NA	NA	0.0068 µg/L	c

Parameter	Analytical Method	Reporting Limit	Method Detection Limit^d	MS Accuracy, Percent	Precision, RPD or RER^b	LCS Accuracy, Percent	Screening Value^j	Note
Aroclor-1232	8082 LL	0.01 µg/L	0.002931 µg/L*	NA	NA	NA	0.0068 µg/L	c
Aroclor-1242	8082 LL	0.01 µg/L	0.001857 µg/L	NA	NA	NA	0.014 µg/L	g
Aroclor-1248	8082 LL	0.01 µg/L	0.002273 µg/L	NA	NA	NA	0.014 µg/L	g
Aroclor-1254	8082 LL	0.01 µg/L	0.002289 µg/L	NA	NA	NA	0.014 µg/L	g
Aroclor-1260	8082 LL	0.01 µg/L	0.001355 µg/L	50-130	20	50-130	0.014 µg/L	g
2,4,5-T	8151A	1.0 µg/L	0.20 µg/L	50-130	20	50-130	370 µg/L	c
2,4-D	8151A	4.0 µg/L	0.69 µg/L	50-130	20	50-130	4.0 µg/L	e
2,4-DB	8151A	4.0 µg/L	0.27 µg/L	50-130	20	50-130	290 µg/L	c
Dalapon	8151A	2.0 µg/L	0.43 µg/L	50-130	20	50-130	200 µg/L	k
Dichloroprop	8151A	4.0 µg/L	0.40 µg/L	50-130	20	50-130	NCA	
Dicamba	8151A	2.0 µg/L	0.11 µg/L	50-130	20	50-130	1,100 µg/L	c
Dinoseb	8151A	0.60 µg/L	0.24 µg/L	50-130	20	50-130	37 µg/L	c
MCPA	8151A	400 µg/L	64 µg/L>	50-130	20	50-130	18 µg/L	c
MCPP	8151A	400 µg/L	46 µg/L>	50-130	20	50-130	37 µg/L	c
Silvex	8151A	1.0 µg/L	0.25 µg/L	50-130	20	50-130	50 µg/L	k
Aluminum	6010B	0.05 mg/L	0.04 mg/L	75-125	20	80-120	0.087 mg/L	g
Aluminum	200.7	0.05 mg/L	0.04 mg/L	70-130	20	80-120	0.087 mg/L	g
Antimony	6020	2.0 µg/L	0.20 µg/L	75-125	20	80-120	6 µg/L	k
Antimony	200.8	2.0 µg/L	0.20 µg/L	70-130	20	80-120	6 µg/L	k
Arsenic	6020	1.0 µg/L	0.70 µg/L>	75-125	20	80-120	0.045 µg/L	c
Arsenic	200.8	1.0 µg/L	0.70 µg/L>	70-130	20	80-120	0.045 µg/L	c
Barium	6020	1.0 µg/L	0.40 µg/L	75-125	20	80-120	4.0 µg/L	f
Barium	200.8	1.0 µg/L	0.40 µg/L	70-130	20	80-120	4.0 µg/L	f
Beryllium	6020	0.50 µg/L	0.20 µg/L	75-125	20	80-120	0.66 µg/L	f
Beryllium	200.8	0.50 µg/L	0.20 µg/L	70-130	20	80-120	0.66 µg/L	f
Boron	6020	20 µg/L	10 µg/L>	75-125	20	80-120	1.6 µg/L	f
Boron	200.7	50 µg/L	20 µg/L>	70-130	20	80-120	1.6 µg/L	f
Cadmium	6020	1.0 µg/L	0.11 µg/L*	75-125	20	80-120	0.25 µg/L	g
Cadmium	200.8	1.0 µg/L	0.11 µg/L*	70-130	20	80-120	0.25 µg/L	g
Calcium	6010B	0.1 mg/L	0.050 mg/L	75-125	20	80-120	NCA	

Table 3-1. Aqueous Samples Analytical Methods, Reporting Limits, Accuracy, and Precision Goals ^a								
Parameter	Analytical Method	Reporting Limit	Method Detection Limit ^d	MS Accuracy, Percent	Precision, RPD or RER ^b	LCS Accuracy, Percent	Screening Value ^j	Note
Calcium	200.7	0.1 mg/L	0.05 mg/L	70-130	20	80-120	NCA	
Chromium	6020	2.0 µg/L	0.70 µg/L	75-125	20	80-120	74 µg/L	g
Chromium	200.8	2.0 µg/L	0.70 µg/L	70-130	20	80-120	74 µg/L	g
Cobalt	6020	1.0 µg/L	0.15 µg/L	75-125	20	80-120	11 µg/L	c
Cobalt	200.8	1.0 µg/L	0.15 µg/L	70-130	20	80-120	11 µg/L	c
Copper	6020	2.0 µg/L	0.75 µg/L	75-125	20	80-120	9.0 µg/L	g
Copper	200.8	1.0 µg/L	0.75 µg/L	70-130	20	80-120	9.0 µg/L	g
Iron	6010B	0.04 mg/L	0.015 mg/L	75-125	20	80-120	1.0 mg/L	g
Iron	200.7	0.04 mg/L	0.015 mg/L	70-130	20	80-120	1.0 mg/L	g
Lead	6020	1.0 µg/L	0.30 µg/L	75-125	20	80-120	2.5 µg/L	g
Lead	200.8	1.0 µg/L	0.30 µg/L	70-130	20	80-120	2.5 µg/L	g
Lithium	200.8	2.0 µg/L	0.5 µg/L	70-130	20	80-120	14 µg/L	f
Magnesium	6010B	0.02 mg/L	0.012 mg/L	75-125	20	80-120	NCA	
Magnesium	200.7	0.02 mg/L	0.012 mg/L	70-130	20	80-120	NCA	
Manganese	6020	1.0 µg/L	0.75 µg/L	75-125	20	80-120	14 µg/L	f
Manganese	200.8	1.0 µg/L	0.75 µg/L	70-130	20	80-120	14 µg/L	f
Mercury	7470A	0.20 µg/L	0.10 µg/L	75-125	20	80-120	0.77 µg/L	g
Mercury	245.1	0.20 µg/L	0.10 µg/L	75-125	20	80-120	0.77 µg/L	g
Molybdenum	6020	2.0 µg/L	0.20 µg/L	75-125	20	80-120	73 µg/L	e
Molybdenum	200.8	2.0 µg/L	0.20 µg/L	70-130	20	80-120	73 µg/L	e
Nickel	6020	2.0 µg/L	0.90 µg/L	75-125	20	80-120	52 µg/L	g
Nickel	200.8	2.0 µg/L	0.90 µg/L	70-130	20	80-120	52 µg/L	g
Phosphorus	200.7	0.04 mg/L	0.020 mg/L	70-130	20	80-120	NCA	
Potassium	6010B	0.5 mg/L	0.37 mg/L	75-125	20	80-120	NCA	
Potassium	200.7	0.5 mg/L	0.37 mg/L	70-130	20	80-120	NCA	
Selenium	6020	2.0 µg/L	0.30 µg/L	75-125	20	80-120	5.0 µg/L	g
Selenium	200.8	2.0 µg/L	0.30 µg/L	70-130	20	80-120	5.0 µg/L	g
Silicon	200.7	0.05 mg/L	0.013 mg/L	70-130	20	80-120	NCA	
Silver	6020	1.0 µg/L	0.30 µg/L>	75-125	20	80-120	0.1 µg/L	e
Silver	200.8	1.0 µg/L	0.30 µg/L>	70-130	20	80-120	0.1 µg/L	e
Sodium	6010B	0.5 mg/L	0.19 mg/L	75-125	20	80-120	NCA	
Sodium	200.7	0.5 mg/L	0.19 mg/L	70-130	20	80-120	NCA	

Table 3-1. Aqueous Samples Analytical Methods, Reporting Limits, Accuracy, and Precision Goals ^a								
Parameter	Analytical Method	Reporting Limit	Method Detection Limit ^d	MS Accuracy, Percent	Precision, RPD or RER ^b	LCS Accuracy, Percent	Screening Value ^j	Note
Strontium	200.7	0.02 mg/L	0.0050 mg/L	70-130	20	80-120	1.5 mg/L	f
Thallium	6020	1.0 µg/L	0.20 µg/L*	75-125	20	80-120	0.8 µg/L	e
Thallium	200.8	1.0 µg/L	0.20 µg/L	70-130	20	80-120	0.8 µg/L	e
Thorium	200.8	1.0 µg/L	0.5 µg/L	70-130	20	80-120	NCA	
Thorium-232	200.8	1.0 µg/L	0.5 µg/L	70-130	20	80-120	NCA	
Thorium-232 Activity	200.8 (Calculated)	0.1 pCi/L	0.1 pCi/L	NA	NA	NA	NCA	
Tin	200.7	100 µg/L	12 µg/L*	70-130	20	80-120	73 µg/L	f
Titanium	200.7	0.005 mg/L	0.002 mg/L	70-130	20	80-120	150 mg/L	i
Uranium	200.8	1.0 µg/L	0.50 µg/L	70-130	20	80-120	2.6 µg/L	f
Vanadium	6020	2.0 µg/L	0.70 µg/L	75-125	20	80-120	20 µg/L	f
Vanadium	200.8	2.0 µg/L	0.70 µg/L	70-130	20	80-120	20 µg/L	f
Zinc	6020	20 µg/L	2.5 µg/L	75-125	20	80-120	120 µg/L	g
Zinc	200.8	10 µg/L	2.5 µg/L	70-130	20	80-120	120 µg/L	g
Chloride	300.0	0.5 mg/L	0.25 mg/L	75-125	20	80-120	230 mg/L	g
Fluoride	300.0	0.5 mg/L	0.15 mg/L	75-125	20	80-120	2.2 mg/L	c
Nitrate	300.0	0.10 mg/L	0.060 mg/L	75-125	20	80-120	10 mg/L	k
Nitrite	300.0	0.10 mg/L	0.060 mg/L=	75-125	20	80-120	0.06 mg/L	e
Nitrate/Nitrite	300.0	0.10 mg/L	0.060 mg/L=	75-125	20	80-120	0.06 mg/L	e
Sulfate	300.0	0.5 mg/L	0.2 mg/L	75-125	20	80-120	NCA	
Phosphate (ortho)	300.0	0.5 mg/L	0.4 mg/L	75-125	20	80-120	NCA	
Phosphorus, total	365.3	0.15 mg/L	0.05 mg/L	75-125	20	80-120	NCA	
Alkalinity, Total	2320B	2.0 mg/L	2.0 mg/L	NA	20	80-120	20 mg/L	g
Alkalinity, Bicarbonate	2320B	2.0 mg/L	2.0 mg/L	NA	20	80-120	NCA	
Alkalinity, Carbonate	2320B	2.0 mg/L	2.0 mg/L	NA	20	80-120	NCA	
Alkalinity, Hydroxide	2320B	2.0 mg/L	2.0 mg/L	NA	20	80-120	NCA	
pH	150.1	0.10 pH Units	0.10 pH Units	NA	20	80-120	6.5-9 pH Units	g
pH	4500B	0.10 pH Units	0.10 pH Units	NA	20	80-120	6.5-9 pH Units	g
Total Dissolved Solids (TDS)	160.1	10 mg/L	10 mg/L	NA	20	80-120	NCA	

Table 3-1. Aqueous Samples Analytical Methods, Reporting Limits, Accuracy, and Precision Goals ^a								
Parameter	Analytical Method	Reporting Limit	Method Detection Limit ^d	MS Accuracy, Percent	Precision, RPD or RER ^b	LCS Accuracy, Percent	Screening Value ^j	Note
Total Dissolved Solids (TDS)	2540C	10 mg/L	10 mg/L	NA	20	80-120	NCA	
Total Organic Carbon (TOC)	415.1	1.0 mg/L	0.5 mg/L	75-125	20	80-120	NCA	
Total Organic Carbon (TOC)	5310B	1.0 mg/L	0.5 mg/L	75-125	20	80-120	NCA	
Total Solids (TS)	160.3	10 mg/L	10 mg/L	NA	20	80-120	NCA	
Gross α	900.0/00-20	1 pCi/L	1 pCi/L	70-130	RPD<20 or RER< 2	75-125	15 pCi/L	l
Gross β	900.0	1 pCi/L	1 pCi/L	70-130	RPD<20 or RER< 2	75-125	50 pCi/L	l
Radium-226	903.0	1 pCi/L	1 pCi/L	70-130	RPD<20 or RER< 2	75-125	4.08 pCi/L	h
Radium-228	904.0	1 pCi/L	1 pCi/L	70-130	RPD<20 or RER< 2	75-125	3.4 pCi/L	h
Thorium-228	HASL 300	1 pCi/L	1 pCi/L	70-130	RPD<20 or RER< 2	75-125	374 pCi/L	h
Thorium-230	HASL 300	1 pCi/L	1 pCi/L	70-130	RPD<20 or RER< 2	75-125	2570 pCi/L	h
Thorium-232	HASL 300	1 pCi/L	1 pCi/L	70-130	RPD<20 or RER< 2	75-125	304 pCi/L	h
Uranium-234	HASL 300	1 pCi/L	1 pCi/L	70-130	RPD<20 or RER< 2	75-125	202 pCi/L	h
Uranium-235	HASL 300	1 pCi/L	1 pCi/L	70-130	RPD<20 or RER< 2	75-125	217 pCi/L	h
Uranium-238	HASL 300	1 pCi/L	1 pCi/L	70-130	RPD<20 or RER< 2	75-125	223 pCi/L	h
Total Uranium	Calculated	0.1 μ g/L	0.1 μ g/L	NA	NA	NA	NA	

Notes:

NA Not Applicable NCA Not Currently Available

a The goals for accuracy and precision are reflective of the data validation/verification usability limits.

b Precision limit for matrix spike/matrix spike duplicate, laboratory duplicate, or laboratory control sample/ laboratory control sample duplicate analyses.

c EPA Regional Screening Levels (Residential) for Chemical Contaminants at Superfund Sites, September 12, 2008.

d The method detection limits presented are laboratory-derived limits. These limits will periodically be updated; however, the updated limits are not expected to be significantly different than those herein.

e Canadian Council of Ministers of the Environment Water Quality Guidelines, 2007.

f Toxicological Benchmarks for Screening of Potential Contaminants of Concern for Effects on Aquatic Biota on Oak Ridge Reservation, Suter, G.W. II, and C.L. Tsao, 1996.

- g EPA National Recommended Water Quality Criteria, 2006.
- h DOE Graded Approach for Evaluating Radiation Doses to Aquatic and Terrestrial Biota, 2002 and 2006.
- i EPA Region 9 Tap Water PRG Tables, October 2004.
- j The screening value listed represents the lowest available screening value.
- k EPA National Primary Drinking Water Standards (Maximum Contaminant Levels)
- l EPA Radionuclides Rule, 66 FR 76708-76753, Volume 65, No. 236, December 7, 2000.
- * Method detection limit is used as the required reporting limit in order to meet the screening value.
- > Method detection limit exceeds screening value.
- = Method detection limit equals screening value.

Table 3-2. Soil/Sediment Samples Analytical Methods, Reporting Limits, Accuracy, and Precision Goals ^a								
Parameter	Analytical Method	Reporting Limit	Method Detection Limit ^f	MS Accuracy, Percent	Precision, RPD or RER ^b	LCS Accuracy, Percent	Screening Value ⁿ	Note
Benzene	5035A-8260B	2.0 µg/kg	0.50 µg/kg	70-130	30	70-130	160 µg/kg	h
Bromobenzene	5035A-8260B	5.0 µg/kg	0.84 µg/kg	70-130	30	70-130	94,000 µg/kg	c
Bromochloromethane	5035A-8260B	5.0 µg/kg	0.90 µg/kg	70-130	30	70-130	NCA	
Bromodichloromethane	5035A-8260B	2.0 µg/kg	0.50 µg/kg	70-130	30	70-130	10,000 µg/kg	c
Bromoform	5035A-8260B	5.0 µg/kg	0.80 µg/kg	70-130	30	70-130	61,000 µg/kg	c
Bromomethane	5035A-8260B	5.0 µg/kg	0.92 µg/kg	70-130	30	70-130	7,900 µg/kg	c
<i>n</i> -Butylbenzene	5035A-8260B	5.0 µg/kg	0.72 µg/kg	70-130	30	70-130	240,000 µg/kg	m
<i>sec</i> -Butylbenzene	5035A-8260B	5.0 µg/kg	0.67 µg/kg	70-130	30	70-130	220,000 µg/kg	m
<i>tert</i> -Butylbenzene	5035A-8260B	5.0 µg/kg	0.62 µg/kg	70-130	30	70-130	390,000 µg/kg	m
Carbon tetrachloride	5035A-8260B	5.0 µg/kg	0.50 µg/kg	70-130	30	70-130	47 µg/kg	h
Chlorobenzene	5035A-8260B	2.0 µg/kg	0.52 µg/kg	70-130	30	70-130	410 µg/kg	h
Chloroethane	5035A-8260B	5.0 µg/kg	1.5 µg/kg	70-130	30	70-130	15,000,000 µg/kg	c
2-Chlorotoluene	5035A-8260B	5.0 µg/kg	0.87 µg/kg	70-130	30	70-130	1,600,000 µg/kg	c
4-Chlorotoluene	5035A-8260B	5.0 µg/kg	0.74 µg/kg	70-130	30	70-130	5,500,000 µg/kg	c
Chloroform	5035A-8260B	2.0 µg/kg	0.70 µg/kg	70-130	30	70-130	22 µg/kg	h
Chloromethane	5035A-8260B	5.0 µg/kg	1.0 µg/kg	70-130	30	70-130	1,700 µg/kg	c
1,2-Dibromo-3-chloropropane	5035A-8260B	5.0 µg/kg	1.5 µg/kg	70-130	30	70-130	5.6 µg/kg	c
Dibromochloromethane	5035A-8260B	2.0 µg/kg	0.70 µg/kg	70-130	30	70-130	5,800 µg/kg	c
1,2-Dibromoethane	5035A-8260B	2.0 µg/kg	0.80 µg/kg	70-130	30	70-130	34 µg/kg	c
Dibromomethane	5035A-8260B	2.0 µg/kg	0.90 µg/kg	70-130	30	70-130	780,000 µg/kg	c
1,2-Dichlorobenzene	5035A-8260B	2.0 µg/kg	0.95 µg/kg	70-130	30	70-130	330 µg/kg	h
1,3-Dichlorobenzene	5035A-8260B	2.0 µg/kg	0.84 µg/kg	70-130	30	70-130	1,700 µg/kg	h
1,4-Dichlorobenzene	5035A-8260B	2.0 µg/kg	0.94 µg/kg	70-130	30	70-130	340 µg/kg	h
Dichlorodifluoromethane	5035A-8260B	5.0 µg/kg	1.5 µg/kg	70-130	30	70-130	190,000 µg/kg	c
1,1-Dichloroethane	5035A-8260B	2.0 µg/kg	0.50 µg/kg	70-130	30	70-130	27 µg/kg	h
1,2-Dichloroethane	5035A-8260B	2.0 µg/kg	0.80 µg/kg	70-130	30	70-130	250 µg/kg	h
1,1-Dichloroethene	5035A-8260B	5.0 µg/kg	0.60 µg/kg	70-130	30	70-130	31 µg/kg	h
<i>cis</i> -1,2-Dichloroethene	5035A-8260B	2.0 µg/kg	0.83 µg/kg	70-130	30	70-130	780,000 µg/kg	c
<i>trans</i> -1,2-Dichloroethene	5035A-8260B	2.0 µg/kg	0.70 µg/kg	70-130	30	70-130	110,000 µg/kg	c

Parameter	Analytical Method	Reporting Limit	Method Detection Limit^f	MS Accuracy, Percent	Precision, RPD or RER^b	LCS Accuracy, Percent	Screening Valueⁿ	Note
Dichlorofluoromethane	5035A-8260B	5.0 µg/kg	1.0 µg/kg	70-130	30	70-130	NCA	
1,2-Dichloropropane	5035A-8260B	2.0 µg/kg	0.80 µg/kg	70-130	30	70-130	930 µg/kg	c
1,3-Dichloropropane	5035A-8260B	2.0 µg/kg	0.63 µg/kg	70-130	30	70-130	1,600,000 µg/kg	c
2,2-Dichloropropane	5035A-8260B	2.0 µg/kg	0.60 µg/kg	70-130	30	70-130	NCA	
1,1-Dichloropropene	5035A-8260B	2.0 µg/kg	0.40 µg/kg	70-130	30	70-130	NCA	
Ethylbenzene	5035A-8260B	2.0 µg/kg	0.50 µg/kg	70-130	30	70-130	89µg/kg	h
Hexachlorobutadiene	5035A-8260B	5.0 µg/kg	0.80 µg/kg	70-130	30	70-130	6,200 µg/kg	c
Isopropylbenzene	5035A-8260B	2.0 µg/kg	0.54 µg/kg	70-130	30	70-130	2,200,000 µg/kg	c
<i>p</i> -Isopropyltoluene	5035A-8260B	2.0 µg/kg	0.72 µg/kg	70-130	30	70-130	NCA	
Methylene chloride	5035A-8260B	20 µg/kg	6.5 µg/kg	70-130	30	70-130	370 µg/kg	h
Naphthalene	5035A-8260B	5.0 µg/kg	1.1 µg/kg	70-130	30	70-130	176 µg/kg	j
<i>n</i> -Propylbenzene	5035A-8260B	2.0 µg/kg	0.61 µg/kg	70-130	30	70-130	240,000 µg/kg	m
Styrene	5035A-8260B	2.0 µg/kg	0.58 µg/kg	70-130	30	70-130	6,500,000 µg/kg	c
<i>tert</i> -butyl methyl ether	5035A-8260B	5.0 µg/kg	2.0 µg/kg	70-130	30	70-130	39,000 µg/kg	c
1,1,2,2-Tetrachloroethane	5035A-8260B	2.0 µg/kg	0.86 µg/kg	70-130	30	70-130	590 µg/kg	c
Tetrachloroethene	5035A-8260B	2.0 µg/kg	1.0 µg/kg	70-130	30	70-130	570 µg/kg	c
1,1,1,2-Tetrachloroethane	5035A-8260B	5.0 µg/kg	0.57 µg/kg	70-130	30	70-130	2,000 µg/kg	c
Toluene	5035A-8260B	2.0 µg/kg	0.50 µg/kg	70-130	30	70-130	50 µg/kg	h
1,2,3-Trichlorobenzene	5035A-8260B	5.0 µg/kg	1.0 µg/kg	70-130	30	70-130	20,000 µg/kg	g
1,2,4-Trichlorobenzene	5035A-8260B	5.0 µg/kg	1.0 µg/kg	70-130	30	70-130	9,600 µg/kg	h
1,1,1-Trichloroethane	5035A-8260B	2.0 µg/kg	0.70 µg/kg	70-130	30	70-130	30 µg/kg	h
1,1,2-Trichloroethane	5035A-8260B	2.0 µg/kg	0.87 µg/kg	70-130	30	70-130	1,100 µg/kg	c
Trichloroethene	5035A-8260B	2.0 µg/kg	0.50 µg/kg	70-130	30	70-130	220 µg/kg	h
Trichlorofluoromethane	5035A-8260B	5.0 µg/kg	0.54 µg/kg	70-130	30	70-130	800,000 µg/kg	c
1,2,3-Trichloropropane	5035A-8260B	10 µg/kg	1.0 µg/kg	70-130	30	70-130	91 µg/kg	c
1,2,4-Trimethylbenzene	5035A-8260B	2.0 µg/kg	0.78 µg/kg	70-130	30	70-130	67,000 µg/kg	c
1,3,5-Trimethylbenzene	5035A-8260B	2.0 µg/kg	0.63 µg/kg	70-130	30	70-130	47,000 µg/kg	c
Vinyl chloride	5035A-8260B	5.0 µg/kg	0.91 µg/kg	70-130	30	70-130	60 µg/kg	c
Xylene (total)	5035A-8260B	2.0 µg/kg	0.80 µg/kg	70-130	30	70-130	160 µg/kg	h
<i>o</i> -Xylene	5035A-8260B	2.0 µg/kg	0.50 µg/kg	70-130	30	70-130	5,300,000 µg/kg	c
<i>m</i> -Xylene	5035A-8260B	2.0 µg/kg	0.80 µg/kg	70-130	30	70-130	4,500,000 µg/kg	c

Table 3-2. Soil/Sediment Samples Analytical Methods, Reporting Limits, Accuracy, and Precision Goals ^a								
Parameter	Analytical Method	Reporting Limit	Method Detection Limit ^f	MS Accuracy, Percent	Precision, RPD or RER ^b	LCS Accuracy, Percent	Screening Value ⁿ	Note
<i>p</i> -Xylene	5035A-8260B	2.0 µg/kg	0.80 µg/kg	70-130	30	70-130	4,700,000 µg/kg	c
2-Chlorophenol	8270C	330 µg/kg	70 µg/kg	50-130	35	50-130	390,000 µg/kg	c
4-Chloro-3-methylphenol	8270C	330 µg/kg	70 µg/kg	50-130	35	50-130	NCA	
2,4-Dichlorophenol	8270C	330 µg/kg	60 µg/kg	50-130	35	50-130	180,000 µg/kg	c
2,4-Dimethylphenol	8270C	330 µg/kg	100 µg/kg	50-130	35	50-130	1,200,000 µg/kg	c
2,4-Dinitrophenol	8270C	660 µg/kg	110 µg/kg	50-130	35	50-130	20,000 µg/kg	g
4,6-Dinitro- <i>o</i> -cresol	8270C	420 µg/kg	110 µg/kg	50-130	35	50-130	6,100 µg/kg	c
3-Methylphenol	8270C	330 µg/kg	80 µg/kg	50-130	35	50-130	3,100,000 µg/kg	c
4-Methylphenol	8270C	330 µg/kg	80 µg/kg	50-130	35	50-130	310,000 µg/kg	c
2-Nitrophenol	8270C	330 µg/kg	60 µg/kg	50-130	35	50-130	NCA	
4-Nitrophenol	8270C	830 µg/kg	140 µg/kg	50-130	35	50-130	7,000 µg/kg	g
Pentachlorophenol	8270C	830 µg/kg	150 µg/kg	50-130	35	50-130	2,100 µg/kg	k
2,4,5-Trichlorophenol	8270C	330 µg/kg	130 µg/kg	50-130	35	50-130	9,000 µg/kg	g
2,4,6-Trichlorophenol	8270C	330 µg/kg	75 µg/kg	50-130	35	50-130	10,000 µg/kg	g
Benzoic acid	8270C	830 µg/kg	70 µg/kg	50-130	35	50-130	240,000,000 µg/kg	c
4-Bromophenyl phenyl ether	8270C	330 µg/kg	75 µg/kg	50-130	35	50-130	1,200 µg/kg	h
Butyl benzyl phthalate	8270C	330 µg/kg	80 µg/kg	50-130	35	50-130	11,000 µg/kg	h
2-Chloronaphthalene	8270C	330 µg/kg	65 µg/kg	50-130	35	50-130	6,300,000 µg/kg	c
4-Chloroaniline	8270C	330 µg/kg	80 µg/kg	50-130	35	50-130	9,000 µg/kg	c
Carbazole	8270C	330 µg/kg	50 µg/kg	50-130	35	50-130	24,000 µg/kg	m
<i>bis</i> (2-Chloroethoxy)methane	8270C	330 µg/kg	70 µg/kg	50-130	35	50-130	180,000 µg/kg	c
<i>bis</i> (2-Chloroethyl)ether	8270C	170 µg/kg	60 µg/kg	50-130	35	50-130	190 µg/kg	c
<i>bis</i> (2-Chloroisopropyl)ether	8270C	330 µg/kg	60 µg/kg	50-130	35	50-130	3,500 µg/kg	c
4-Chlorophenyl phenyl ether	8270C	330 µg/kg	85 µg/kg	50-130	35	50-130	NCA	
2,4-Dinitrotoluene	8270C	330 µg/kg	80 µg/kg	50-130	35	50-130	120,000 µg/kg	c
2,6-Dinitrotoluene	8270C	330 µg/kg	95 µg/kg	50-130	35	50-130	61,000 µg/kg	c
3,3'-Dichlorobenzidine	8270C	830 µg/kg	150 µg/kg	50-130	35	50-130	1,100 µg/kg	c
Dibenzofuran	8270C	330 µg/kg	60 µg/kg	50-130	35	50-130	420 µg/kg	h
1,3-Dichlorobenzene	8270C	330 µg/kg	90 µg/kg	50-130	35	50-130	1,700 µg/kg	h
1,4-Dichlorobenzene	8270C	330 µg/kg	65 µg/kg	50-130	35	50-130	340 µg/kg	h
<i>di-n</i> -Butyl phthalate	8270C	330 µg/kg	90 µg/kg	50-130	35	50-130	11,000 µg/kg	h

Table 3-2. Soil/Sediment Samples Analytical Methods, Reporting Limits, Accuracy, and Precision Goals ^a								
Parameter	Analytical Method	Reporting Limit	Method Detection Limit ^f	MS Accuracy, Percent	Precision, RPD or RER ^b	LCS Accuracy, Percent	Screening Value ⁿ	Note
<i>di-n</i> -Octyl phthalate	8270C	330 µg/kg	90 µg/kg	50-130	35	50-130	2,400,000 µg/kg	m
Diethyl phthalate	8270C	330 µg/kg	95 µg/kg	50-130	35	50-130	600 µg/kg	h
Dimethyl phthalate	8270C	330 µg/kg	65 µg/kg	50-130	35	50-130	200,000 µg/kg	g
<i>bis</i> (2-Ethylhexyl)phthalate	8270C	330 µg/kg	90 µg/kg	50-130	35	50-130	35,000 µg/kg	c
Hexachlorobenzene	8270C	330 µg/kg	70 µg/kg*	50-130	35	50-130	300 µg/kg	c
Hexachlorobutadiene	8270C	330 µg/kg	60 µg/kg	50-130	35	50-130	6,200 µg/kg	c
Hexachlorocyclopentadiene	8270C	830 µg/kg	90 µg/kg	50-130	35	50-130	10,000 µg/kg	g
Hexachloroethane	8270C	330 µg/kg	65 µg/kg	50-130	35	50-130	1,000 µg/kg	h
Isophorone	8270C	330 µg/kg	50 µg/kg	50-130	35	50-130	510,000 µg/kg	c
2-Methylnaphthalene	8270C	330 µg/kg	70 µg/kg	50-130	35	50-130	310,000 µg/kg	c
2-Nitroaniline	8270C	330 µg/kg	60 µg/kg	50-130	35	50-130	180,000 µg/kg	m
3-Nitroaniline	8270C	330 µg/kg	75 µg/kg	50-130	35	50-130	18,000 µg/kg	c
4-Nitroaniline	8270C	830 µg/kg	90 µg/kg	50-130	35	50-130	23,000 µg/kg	c
Nitrobenzene	8270C	330 µg/kg	70 µg/kg	50-130	35	50-130	31,000 µg/kg	c
<i>N</i> -Nitroso- <i>di-n</i> -propylamine	8270C	250 µg/kg	70 µg/kg>	50-130	35	50-130	69 µg/kg	c
<i>N</i> -Nitrosodiphenylamine	8270C	330 µg/kg	80 µg/kg	50-130	35	50-130	20,000 µg/kg	g
1,2,4-Trichlorobenzene	8270C	330 µg/kg	50 µg/kg	50-130	35	50-130	9,600 µg/kg	h

Table 3-2. Soil/Sediment Samples Analytical Methods, Reporting Limits, Accuracy, and Precision Goals ^a								
Parameter	Analytical Method	Reporting Limit	Method Detection Limit ^f	MS Accuracy, Percent	Precision, RPD or RER ^b	LCS Accuracy, Percent	Screening Value ⁿ	Note
Phenol	8270C SIM	30 µg/kg	15 µg/kg	50-130	35	50-130	30,000 µg/kg	g
2-Methylphenol	8270C SIM	30 µg/kg	10 µg/kg*	50-130	35	50-130	12 µg/kg	h
Acenaphthene	8270C SIM	30 µg/kg	2.0 µg/kg	50-130	35	50-130	20,000 µg/kg	g
Acenaphthylene	8270C SIM	30 µg/kg	2.0 µg/kg	50-130	35	50-130	NCA	
Anthracene	8270C SIM	30 µg/kg	2.0 µg/kg	50-130	35	50-130	57.2 µg/kg	j
Benzo(a)anthracene	8270C SIM	30 µg/kg	2.0 µg/kg	50-130	35	50-130	108 µg/kg	j
Benzo(a)pyrene	8270C SIM	30 µg/kg	2.0 µg/kg*	50-130	35	50-130	15 µg/kg	c
Benzo(b)fluoranthene	8270C SIM	30 µg/kg	2.0 µg/kg	50-130	35	50-130	150 µg/kg	c
Benzo(g,h,i)perylene	8270C SIM	30 µg/kg	2.0 µg/kg	50-130	35	50-130	NCA	
Benzo(k)fluoranthene	8270C SIM	30 µg/kg	2.0 µg/kg*	50-130	35	50-130	27.2 µg/kg	i
Chrysene	8270C SIM	30 µg/kg	2.0 µg/kg	50-130	35	50-130	166 µg/kg	j
Dibenzo(a,h)anthracene	8270C SIM	30 µg/kg	2.5 µg/kg*	50-130	35	50-130	15 µg/kg	c
Fluoranthene	8270C SIM	30 µg/kg	2.0 µg/kg	50-130	35	50-130	423 µg/kg	j
Fluorene	8270C SIM	30 µg/kg	2.0 µg/kg	50-130	35	50-130	77.4 µg/kg	j
Indeno(1,2,3-cd)pyrene	8270C SIM	30 µg/kg	2.5 µg/kg*	50-130	35	50-130	17.32 µg/kg	i
Naphthalene	8270C SIM	30 µg/kg	3.5 µg/kg	50-130	35	50-130	176 µg/kg	j
Phenanthrene	8270C SIM	30 µg/kg	2.0 µg/kg	50-130	35	50-130	204 µg/kg	j
Pyrene	8270C SIM	30 µg/kg	2.0 µg/kg	50-130	35	50-130	195 µg/kg	j
Diesel (C12-C23)-TPH	8015B	5.0 mg/kg	3.5 mg/kg	50-130	35	50-130	100 mg/kg	d
Motor Oil (C23-C40)-TPH	8015B	5.0 mg/kg	3.5 mg/kg	50-130	35	50-130	100 mg/kg	d
Gasoline (C4-C12)-TPH	5035A-8015B	0.4 mg/kg	0.15 mg/kg	70-130	30	70-130	100 mg/kg	d
<i>alpha</i> -BHC	8081A	5.0 µg/kg	1.5 µg/kg	50-130	35	50-130	77 µg/kg	c
<i>beta</i> -BHC	8081A	5.0 µg/kg	1.5 µg/kg	50-130	35	50-130	120 µg/kg	h
<i>gamma</i> -BHC (Lindane)	8081A	5.0 µg/kg	1.5 µg/kg*	50-130	35	50-130	2.37 µg/kg	j
<i>delta</i> -BHC	8081A	10 µg/kg	1.5 µg/kg	50-130	35	50-130	120 µg/kg	h
Heptachlor	8081A	5.0 µg/kg	2.0 µg/kg	50-130	35	50-130	68 µg/kg	h
Aldrin	8081A	5.0 µg/kg	1.5 µg/kg	50-130	35	50-130	29 µg/kg	c
Heptachlor epoxide	8081A	5.0 µg/kg	2.0 µg/kg*	50-130	35	50-130	2.47 µg/kg	j
Endosulfan I	8081A	5.0 µg/kg	1.5 µg/kg	50-130	35	50-130	5.5 µg/kg	h
Dieldrin	8081A	5.0 µg/kg	1.5 µg/kg*	50-130	35	50-130	1.9 µg/kg	j
Endrin aldehyde	8081A	5.0 µg/kg	1.5 µg/kg	50-130	35	50-130	NCA	

Table 3-2. Soil/Sediment Samples Analytical Methods, Reporting Limits, Accuracy, and Precision Goals ^a								
Parameter	Analytical Method	Reporting Limit	Method Detection Limit ^f	MS Accuracy, Percent	Precision, RPD or RER ^b	LCS Accuracy, Percent	Screening Value ⁿ	Note
Endrin	8081A	5.0 µg/kg	1.5 µg/kg*	50-130	35	50-130	2.22 µg/kg	j
Endosulfan II	8081A	5.0 µg/kg	1.5 µg/kg	50-130	35	50-130	5.5 µg/kg	h
4,4'- DDD	8081A	5.0 µg/kg	1.5 µg/kg*	50-130	35	50-130	4.88 µg/kg	j
Endosulfan sulfate	8081A	10 µg/kg	2.0 µg/kg*	50-130	35	50-130	5.5 µg/kg	h
4,4'-DDT	8081A	5.0 µg/kg	1.5 µg/kg*	50-130	35	50-130	4.16 µg/kg	j
4,4'-DDE	8081A	5.0 µg/kg	1.5 µg/kg*	50-130	35	50-130	3.16 µg/kg	j
Methoxychlor	8081A	5.0 µg/kg	1.5 µg/kg	50-130	35	50-130	19 µg/kg	h
Endrin ketone	8081A	5.0 µg/kg	2.0 µg/kg	50-130	35	50-130	NCA	
<i>alpha</i> -Chlordane	8081A	50 µg/kg	10 µg/kg	50-130	35	50-130	NCA	
<i>gamma</i> -Chlordane	8081A	50 µg/kg	10 µg/kg	50-130	35	50-130	NCA	
Toxaphene	8081A	200 µg/kg	75 µg/kg	NA	NA	NA	440 µg/kg	c
Aroclor-1016	8082	33 µg/kg	8.3 µg/kg*	50-130	35	50-130	31.62 µg/kg	i
Aroclor-1221	8082	33 µg/kg	10.5 µg/kg	NA	NA	NA	120 µg/kg	h
Aroclor-1232	8082	33 µg/kg	8.3 µg/kg	NA	NA	NA	170 µg/kg	c
Aroclor-1242	8082	33 µg/kg	8.3 µg/kg	NA	NA	NA	170 µg/kg	h
Aroclor-1248	8082	33 µg/kg	8.3 µg/kg	NA	NA	NA	220 µg/kg	c
Aroclor-1254	8082	33 µg/kg	8.3 µg/kg	NA	NA	NA	220 µg/kg	c
Aroclor-1260	8082	33 µg/kg	8.3 µg/kg	50-130	35	50-130	220 µg/kg	c
2,4,5-T	8151A	20 µg/kg	3.8 µg/kg	50-130	35	50-130	610,000 µg/kg	c
2,4-D	8151A	80 µg/kg	16 µg/kg	50-130	35	50-130	690,000 µg/kg	c
2,4-DB	8151A	80 µg/kg	13 µg/kg	50-130	35	50-130	490,000 µg/kg	c
Dalapon	8151A	40 µg/kg	5.6 µg/kg	50-130	35	50-130	1,800,000 µg/kg	c
Dichloroprop	8151A	80 µg/kg	17 µg/kg	50-130	35	50-130	NCA	
Dicamba	8151A	40 µg/kg	4.2 µg/kg	50-130	35	50-130	1,800,000 µg/kg	c
Dinoseb	8151A	12 µg/kg	1.9 µg/kg	50-130	35	50-130	61,000 µg/kg	c
MCPA	8151A	8,000 µg/kg	2,524 µg/kg	50-130	35	50-130	31,000 µg/kg	c
MCPP	8151A	8,000 µg/kg	1,580 µg/kg	50-130	35	50-130	61,000 µg/kg	c
Silvex	8151A	20 µg/kg	1.8 µg/kg	50-130	35	50-130	490,000 µg/kg	c
Aluminum	6010B	10 mg/kg	5.0 mg/kg	75-125	35	75-125	77,000 mg/kg	c
Antimony ^e	6020	1000 µg/kg	100 µg/kg*	75-125	35	75-125	270 µg/kg	k

Table 3-2. Soil/Sediment Samples Analytical Methods, Reporting Limits, Accuracy, and Precision Goals ^a								
Parameter	Analytical Method	Reporting Limit	Method Detection Limit ^f	MS Accuracy, Percent	Precision, RPD or RER ^b	LCS Accuracy, Percent	Screening Value ⁿ	Note
Arsenic	6020	500 µg/kg	350 µg/kg*	75-125	35	75-125	390 µg/kg	c
Barium	6020	500 µg/kg	200 µg/kg	75-125	35	75-125	330,000 µg/kg	k
Beryllium	6020	300 µg/kg	100 µg/kg	75-125	35	75-125	21,000 µg/kg	k
Boron	6010B	5.0 mg/kg	2.1 mg/kg>	75-125	35	75-125	0.50 mg/kg	g
Cadmium	6020	500 µg/kg	60 µg/kg*	75-125	35	75-125	360 µg/kg	k
Calcium	6010B	15 mg/kg	6.2 mg/kg	75-125	35	75-125	NCA	
Chromium	6020	1,000 µg/kg	350 µg/kg	75-125	35	75-125	26,000 µg/kg	k
Cobalt	6020	500 µg/kg	80 µg/kg	75-125	35	75-125	13,000 µg/kg	k
Copper	6020	1,000 µg/kg	380 µg/kg	75-125	35	75-125	28,000 µg/kg	k
Iron	6010B	5.0 mg/kg	1.5 mg/kg	75-125	35	75-125	55,000 mg/kg	c
Lead	6020	500 µg/kg	150 µg/kg	75-125	35	75-125	11,000 µg/kg	k
Magnesium	6010B	10 mg/kg	1.0 mg/kg	75-125	35	75-125	NCA	
Manganese	6020	500 µg/kg	380 µg/kg	75-125	35	75-125	220,000 µg/kg	k
Mercury	1631	1.0 µg/kg	0.24 µg/kg	70-130	35	75-125	10 µg/kg	g
Molybdenum	6020	1,000 µg/kg	100 µg/kg	75-125	35	75-125	2,000 µg/kg	g
Nickel	6020	1,000 µg/kg	450 µg/kg	75-125	35	75-125	22,700 µg/kg	k
Potassium	6010B	50 mg/kg	19 mg/kg	75-125	35	75-125	NCA	
Selenium	6020	1,000 µg/kg	450 µg/kg*	75-125	35	75-125	520 µg/kg	k
Silver	6010B	1,000 µg/kg	800 µg/kg	75-125	35	75-125	4,200 µg/kg	k
Silver	6020	500 µg/kg	150 µg/kg	75-125	35	75-125	4,200 µg/kg	k
Sodium	6010B	50 mg/kg	24 mg/kg	75-125	35	75-125	NCA	
Thallium	6020	500 µg/kg	100 µg/kg	75-125	35	75-125	1,000 µg/kg	g
Thorium	6020	0.20 mg/kg	0.042mg/kg	75-125	35	75-125	NCA	
Uranium	6020	0.10 mg/kg	0.020mg/kg	75-125	35	75-125	230 mg/kg	c
Vanadium	6020	1,000 µg/kg	350 µg/kg	75-125	35	75-125	7,800 µg/kg	k
Zinc	6020	10,000 µg/kg	1,300 µg/kg	75-125	35	75-125	46,000 µg/kg	k
Gross α	9310	1.0 pCi/g	1.0 pCi/g	NA	RPD<30 or RER< 2	75-125	NCA	
Gross β	9310	1.0 pCi/g	1.0 pCi/g	NA	RPD<30 or RER< 2	75-125	NCA	

Parameter	Analytical Method	Reporting Limit	Method Detection Limit^f	MS Accuracy, Percent	Precision, RPD or RER^b	LCS Accuracy, Percent	Screening Valueⁿ	Note
Radium-226	HASL 300 (Section 4.5.2.3)	1.0 pCi/g	1.0 pCi/g	70-130	RPD<30 or RER< 2	75-125	50.6 pCi/g	1
Radium-228	HASL 300 (Section 4.5.2.3)	1.0 pCi/g	1.0 pCi/g	70-130	RPD<30 or RER< 2	75-125	43.9 pCi/g	1
Thorium-228	HASL 300	1.0 pCi/g	1.0 pCi/g	70-130	RPD<30 or RER< 2	75-125	530 pCi/g	1
Thorium-230	HASL 300	1.0 pCi/g	1.0 pCi/g	70-130	RPD<30 or RER< 2	75-125	9980 pCi/g	1
Thorium-232	HASL 300	1.0 pCi/g	1.0 pCi/g	70-130	RPD<30 or RER< 2	75-125	1300 pCi/g	1
Uranium-234	HASL 300	1.0 pCi/g	1.0 pCi/g	70-130	RPD<30 or RER< 2	75-125	5130 pCi/g	1
Uranium-235	HASL 300	1.0 pCi/g	1.0 pCi/g	70-130	RPD<30 or RER< 2	75-125	2770 pCi/g	1
Uranium-238	HASL 300	1.0 pCi/g	1.0 pCi/g	70-130	RPD<30 or RER< 2	75-125	1580 pCi/g	1
TS	160.3	0.05%	0.05%	NA	35	NA	NA	
TS	2540G	0.05%	0.05%	NA	35	NA	NA	

Notes:

- NA Not Applicable NCA Not Currently Available
- a The goals for accuracy and precision are reflective of the data validation/verification usability limits.
- b Precision limit for matrix spike/matrix spike duplicate, laboratory duplicate, or laboratory control sample/ laboratory control sample duplicate analyses.
- c EPA Regional Screening Levels (Residential) for Chemical Contaminants at Superfund Sites, September 12, 2008.
- d Nevada DEP Corrective Action Level as defined by Nevada Administrative Code 445A.2272.
- e Antimony will be digested using SW-836 Method 3050B (aqua-regia), which is a modification of Method 3050B shown to improve the recovery of antimony matrix spikes.
- f The method detection limits presented are laboratory-derived limits. These limits will periodically be updated; however, the updated limits are not expected to be significantly different than those herein.
- g Toxicological Benchmarks for Screening of Potential Contaminants of Concern for Effects on Soil and Litter Invertebrates and Heterotrophic Process, Efroymson, R. A., M. E. Will, and G. W. Suter II, 1997b.
- h Toxicological Benchmarks for Screening Potential Contaminants of Concern for Effects on Sediment-Associated Biota, Jones, D.S., G.W. Suter, and R.N. Hull, 1997.
- i NOAA Screening Quick Reference Tables, 1999.
- j Development and Evaluation of Consensus-Based Sediment Quality Guidelines for Freshwater Ecosystems, MacDonald, D.D., C.G. Ingersoll, and T.A. Berger, 2000.
- k EPA Interim Final Ecological Soil Screening Levels, 2007.

- l DOE Graded Approach for Evaluating Radiation Doses to Aquatic and Terrestrial Biota, 2002 and 2006.
- m EPA Region 9 PRG Tables, October 2004.
- n The screening value listed represents the lowest available screening value.
- * Method detection limit is used as the required reporting limit in order to meet the screening value.
- > Method detection limit exceeds screening value.

Table 3-3. Air Samples Analytical Methods, Reporting Limits, Accuracy, and Precision Goals ^a								
Parameter	Analytical Method	Reporting Limit ^d	Method Detection Limit ^e	MS Accuracy, Percent	Precision, RPD or RER ^b	LCS Accuracy, Percent	Screening Value ⁱ	Note
Aluminum	6010B	0.15 µg/m ³	0.025 µg/m ³	NA	20	75-125	5.2 µg/m ³	c
Aluminum	IO3.3	0.00017 µg/m ³	0.00017 µg/m ³	NA	20	75-125	5.2 µg/m ³	c
Arsenic	6020	0.0022 µg/m ³	0.00054 µg/m ³ *	NA	20	75-125	0.00057 µg/m ³	c
Arsenic	IO3.3	0.000055 µg/m ³	0.000055 µg/m ³	NA	20	75-125	0.00057 µg/m ³	c
Barium	6020	0.074 µg/m ³	0.0053 µg/m ³	NA	20	75-125	0.52 µg/m ³	c
Beryllium	6020	0.00074 µg/m ³	0.000065 µg/m ³	NA	20	75-125	0.001 µg/m ³	c
Cadmium	6020	0.00074 µg/m ³	0.000017 µg/m ³	NA	20	75-125	0.0014 µg/m ³	c
Cadmium	IO3.3	0.000090 µg/m ³	0.000090 µg/m ³	NA	20	75-125	0.0014 µg/m ³	c
Calcium	6010B	1.8 µg/m ³	0.55 µg/m ³	NA	20	75-125	NCA	
Chromium	6020	0.0074 µg/m ³	0.0014 µg/m ³ >	NA	20	75-125	0.00016 µg/m ³	h
Chromium	IO3.3	0.000015 µg/m ³	0.000015 µg/m ³	NA	20	75-125	0.00016 µg/m ³	h
Cobalt	6020	0.0074 µg/m ³	0.0014 µg/m ³ >	NA	20	75-125	0.00027 µg/m ³	c
Cobalt	IO3.3	0.000012 µg/m ³	0.000012 µg/m ³	NA	20	75-125	0.00027 µg/m ³	c
Copper	6020	0.0037 µg/m ³	0.00081 µg/m ³	NA	20	75-125	NCA	
Copper	IO3.3	0.000017 µg/m ³	0.000017 µg/m ³	NA	20	75-125	NCA	
Iron	6010B	0.074 µg/m ³	0.0088 µg/m ³	NA	20	75-125	NCA	
Lead	6020	0.00074 µg/m ³	0.00014 µg/m ³	NA	20	75-125	NCA	
Magnesium	6010B	0.37 µg/m ³	0.060 µg/m ³	NA	20	75-125	NCA	

Parameter	Analytical Method	Reporting Limit^d	Method Detection Limit^e	MS Accuracy, Percent	Precision, RPD or RER^b	LCS Accuracy, Percent	Screening Valueⁱ	Note
Manganese	6020	0.0037 µg/m ³	0.0013 µg/m ³	NA	20	75-125	0.052 µg/m ³	c
Manganese	IO3.3	0.000050 µg/m ³	0.000050 µg/m ³	NA	20	75-125	0.052 µg/m ³	c
Mercury	7471A	0.000074 µg/m ³	0.00000037 µg/m ³	NA	20	75-125	0.31 µg/m ³	c
Molybdenum	6020	0.0037 µg/m ³	0.00065 µg/m ³	NA	20	75-125	NCA	
Nickel	6020	0.0037 µg/m ³	0.00073 µg/m ³	NA	20	75-125	0.01 µg/m ³	c
Nickel	IO3.3	0.000013 µg/m ³	0.000013 µg/m ³	NA	20	75-125	0.01 µg/m ³	c
Selenium	6020	0.0022 µg/m ³	0.00018 µg/m ³	NA	20	75-125	NCA	
Silver	6020	0.00074 µg/m ³	0.000011 µg/m ³	NA	20	75-125	NCA	
Sodium	6010B	3.7 µg/m ³	1.2 µg/m ³	NA	20	75-125	NCA	
Vanadium	6020	0.0074 µg/m ³	0.0018 µg/m ³	NA	20	75-125	NCA	
Zinc	6020	0.015 µg/m ³	0.0031 µg/m ³	NA	20	75-125	NCA	
Sulfate	9056	0.000025 mg/m ³	0.0000025 mg/m ³	NA	20	80-120	NCA	
Gross α	900.0	0.012 pCi/m ³	0.012 pCi/m ³	NA	RPD<30 or RER< 2	75-125	NCA	
Gross β	900.0	0.0031 pCi/m ³	0.0031 pCi/m ³	NA	RPD<30 or RER< 2	75-125	NCA	
Radium-226	903.1	0.00061 pCi/m ³	0.00061 pCi/m ³	NA	RPD<30 or RER< 2	75-125	NCA	
Radium-228	904.0	0.0019 pCi/m ³	0.0019 pCi/m ³	NA	RPD<30 or RER< 2	75-125	NCA	
Radium, Total	IO3.3	0.000061 µg/m ³	0.000061 µg/m ³	NA	NA	75-125	NCA	

Parameter	Analytical Method	Reporting Limit^d	Method Detection Limit^g	MS Accuracy, Percent	Precision, RPD or RER^b	LCS Accuracy, Percent	Screening Valueⁱ	Note
Thorium-228	HASL 300	0.00061 pCi/m ³	0.00061 pCi/m ³	NA	RPD<30 or RER< 2	75-125	NCA	
Thorium-230	HASL 300	0.00061 pCi/m ³	0.00061 pCi/m ³	NA	RPD<30 or RER< 2	75-125	NCA	
Thorium-232	HASL 300	0.00061 pCi/m ³	0.00061 pCi/m ³	NA	RPD<30 or RER< 2	75-125	NCA	
Thorium, Total	IO3.3	0.000061 µg/m ³	0.000061 µg/m ³	NA	NA	75-125	NCA	
Uranium-234	HASL 300	0.00061 pCi/m ³	0.00061 pCi/m ³	NA	RPD<30 or RER< 2	75-125	NCA	
Uranium-235	HASL 300	0.00061 pCi/m ³	0.00061 pCi/m ³	NA	RPD<30 or RER< 2	75-125	NCA	
Uranium-238	HASL 300	0.00061 pCi/m ³	0.00061 pCi/m ³	NA	RPD<30 or RER< 2	75-125	NCA	
Uranium, Total	IO3.3	0.000061 µg/m ³	0.000061 µg/m ³	NA	NA	75-125	NCA	
TSP	40 CFR Appendix B	0.061 µg/m ³	NA	NA	NA	NA	75 µg/m ³ /260 µg/m ³	e
PM-10	40 CFR Appendix J	0.061 µg/m ³	NA	NA	NA	NA	50 µg/m ³ /150 µg/m ³	f

Notes:

NA Not Applicable NCA Not Currently Available

a The goals for accuracy and precision are reflective of the data validation/verification usability limits.

b Precision limit for laboratory duplicate or laboratory control sample/ laboratory control sample duplicate analyses.

c EPA Regional Screening Levels (Residential) for Chemical Contaminants at Superfund Sites, September 12, 2008.

d The laboratory reporting limits were based on an assumed target air volume of 1630 m³.

e NAAQS for particulate matter based on TSP was discontinued by EPA in 1987. Annual and 24-hour averages were set at 75 ug/m³ and 260 ug/m³, respectively.

f NAAQS for particulate matter currently based on PM10 annual average of 50 ug/m³ and 24-hour average of 150 ug/m³.

g The method detection limits presented are laboratory-derived limits. These limits will periodically be updated; however, the updated limits are not expected to be significantly different than those herein.

h EPA Region 9 PRG Tables, October, 2004.

i The screening value listed represents the lowest available screening value.

* Method detection limit is used as the required reporting limit in order to meet the screening value.

> Method detection limit exceeds screening value.

Table 3-4. Biota Samples Analytical Methods, Reporting Limits, Accuracy, and Precision Goals ^a								
Parameter	Analytical Method	Reporting Limit	Method Detection Limit ^c	MS Accuracy, Percent	Precision, RPD or RER ^b	LCS Accuracy, Percent	Screening Value ^c	Note
Aluminum	6010B	20 mg/kg	6.0 mg/kg*	70-130	35	75-125	8.2 mg/kg	d
Antimony	6020	2.0 mg/kg	0.012 mg/kg*	70-130	35	75-125	0.34 mg/kg	d
Arsenic	6020	0.20 mg/kg	0.020 mg/kg	70-130	35	75-125	2.7 mg/kg	d
Barium	6020	10 mg/kg	0.11 mg/kg	70-130	35	75-125	104 mg/kg	d
Beryllium	6020	0.20 mg/kg	0.013 mg/kg	70-130	35	75-125	5.0 mg/kg	d
Boron	6020	4.0 mg/kg	0.33 mg/kg	70-130	35	75-125	220 mg/kg	d
Cadmium	6020	0.20 mg/kg	0.0034 mg/kg	70-130	35	75-125	3.5 mg/kg	d
Calcium	6010B	500 mg/kg	5.1 mg/kg	70-130	35	75-125	NCA	
Chromium	6020	0.40 mg/kg	0.090 mg/kg	70-130	35	75-125	10 mg/kg	d
Cobalt	6020	1.0 mg/kg	0.010 mg/kg	70-130	35	75-125	6.9 mg/kg	d
Copper	6020	2.0 mg/kg	0.070 mg/kg	70-130	35	75-125	14 mg/kg	d
Iron	6010B	20 mg/kg	2.2 mg/kg	70-130	35	75-125	NCA	
Lead	6020	0.20 mg/kg	0.012 mg/kg	70-130	35	75-125	4.7 mg/kg	d
Magnesium	6010B	500 mg/kg	7.9 mg/kg	70-130	35	75-125	NCA	
Manganese	6020	0.40 mg/kg	0.018 mg/kg	70-130	35	75-125	113 mg/kg	d
Mercury	7471A	0.033 mg/kg	0.0070 mg/kg	70-130	35	75-125	0.30 mg/kg	d
Molybdenum	6020	2.0 mg/kg	0.070 mg/kg*	70-130	35	75-125	1.1 mg/kg	d
Nickel	6020	2.0 mg/kg	0.068 mg/kg	70-130	35	75-125	10 mg/kg	d
Potassium	6010B	500 mg/kg	30 mg/kg	70-130	35	75-125	NCA	
Selenium	6020	0.20 mg/kg	0.027 mg/kg	70-130	35	75-125	0.54 mg/kg	d
Silver	6010B	1.0 mg/kg	0.18 mg/kg	70-130	35	75-125	1.3 mg/kg	d
Sodium	6010B	500 mg/kg	9.4 mg/kg	70-130	35	75-125	NCA	
Strontium	6010B	2.0 mg/kg	0.013 mg/kg	70-130	35	75-125	2063 mg/kg	d
Thallium	6020	0.20 mg/kg	0.0037 mg/kg	70-130	35	75-125	5.3 mg/kg	d
Thorium	6020	0.20 mg/kg	0.075 mg/kg	70-130	35	75-125	NCA	
Tungsten	6020	0.20 mg/kg	0.030 mg/kg	70-130	35	75-125	5.5 mg/kg	d
Uranium	6020	0.20 mg/kg	0.050 mg/kg	70-130	35	75-125	13 mg/kg	d
Vanadium	6020	0.40 mg/kg	0.014 mg/kg*	70-130	35	75-125	0.21 mg/kg	d
Zinc	6020	2.0 mg/kg	0.14 mg/kg	70-130	35	75-125	103 mg/kg	d
Fluoride	340.2	1.0 mg/kg	0.14 mg/kg	70-130	35	75-125	74 mg/kg	d
Aroclor-1016	8082	0.017 mg/kg	0.0032 mg/kg	50-130	35	50-130	0.86 mg/kg	d
Aroclor-1221	8082	0.017 mg/kg	0.0023 mg/kg	NA	NA	NA	0.86 mg/kg	d

Parameter	Analytical Method	Reporting Limit	Method Detection Limit^c	MS Accuracy, Percent	Precision, RPD or RER^b	LCS Accuracy, Percent	Screening Value^e	Note
Aroclor-1232	8082	0.017 mg/kg	0.0023 mg/kg	NA	NA	NA	0.86 mg/kg	d
Aroclor-1242	8082	0.017 mg/kg	0.0033 mg/kg	NA	NA	NA	0.86 mg/kg	d
Aroclor-1248	8082	0.017 mg/kg	0.0054 mg/kg	NA	NA	NA	0.86 mg/kg	d
Aroclor-1254	8082	0.017 mg/kg	0.0019 mg/kg	NA	NA	NA	0.86 mg/kg	d
Aroclor-1260	8082	0.017 mg/kg	0.0026 mg/kg	50-130	35	50-130	0.86 mg/kg	d

Notes:

NA Not Applicable NCA Not Currently Available

a The goals for accuracy and precision are reflective of the data validation/verification usability limits.

b Precision limit for laboratory duplicate or laboratory control sample/ laboratory control sample duplicate analyses.

c The method detection limits presented are laboratory-derived limits. These limits will periodically be updated; however, the updated limits are not expected to be significantly different than those herein.

d Screening Level Values and Target Detection Limits for Chemicals in Plant and Animal Tissue for the Yerington Site, Intergral Consulting, Inc. (Technical Memorandum, May 2, 2008)

e The screening value listed represents the lowest available screening value.

* Method detection limit is used as the required reporting limit in order to meet the screening value.

Table 3-5. TCLP Samples Analytical Methods, Reporting Limits, Accuracy, and Precision Goals ^a							
Parameter	Analytical Method	Reporting Limit	Method Detection Limit ^d	MS Accuracy, Percent	Precision, RPD ^b	LCS Accuracy, Percent	Screening Level: RCRA ^c
Vinyl chloride	1311 8260B	0.050 mg/L	0.0040 mg/L	70-130	30	70-130	0.2 mg/L
1,1-Dichloroethene	1311 8260B	0.050 mg/L	0.0042 mg/L	70-130	30	70-130	0.7 mg/L
Chloroform	1311 8260B	0.020 mg/L	0.0033 mg/L	70-130	30	70-130	6.0 mg/L
1,2-Dichloroethane	1311 8260B	0.020 mg/L	0.0028 mg/L	70-130	30	70-130	0.5 mg/L
2-Butanone	1311 8260B	0.10 mg/L	0.047 mg/L	70-130	30	70-130	200 mg/L
Carbon tetrachloride	1311 8260B	0.050 mg/L	0.0028 mg/L	70-130	30	70-130	0.5 mg/L
Trichloroethene	1311 8260B	0.020 mg/L	0.0026 mg/L	70-130	30	70-130	0.5 mg/L
Benzene	1311 8260B	0.020 mg/L	0.0028 mg/L	70-130	30	70-130	0.5 mg/L
Tetrachloroethene	1311 8260B	0.020 mg/L	0.0032 mg/L	70-130	30	70-130	0.7 mg/L
Chlorobenzene	1311 8260B	0.020 mg/L	0.0036 mg/L	70-130	30	70-130	0.5 mg/L
1,4-Dichlorobenzene	1311 8260B	0.020 mg/L	0.0037 mg/L	70-130	30	70-130	7.5 mg/L
2,4-Dinitrotoluene	1311 8270C	0.050 mg/L	0.018 mg/L	50-130	35	50-130	0.13 mg/L
Hexachlorobenzene	1311 8270C	0.050 mg/L	0.015 mg/L	50-130	35	50-130	0.13 mg/L
Hexachlorobutadiene	1311 8270C	0.050 mg/L	0.020 mg/L	50-130	35	50-130	0.5 mg/L
Hexachloroethane	1311 8270C	0.050 mg/L	0.018 mg/L	50-130	35	50-130	3.0 mg/L
2-Methylphenol	1311 8270C	0.050 mg/L	0.015 mg/L	NA	NA	NA	200 mg/L
3&4-Methylphenol	1311 8270C	0.10 mg/L	0.028 mg/L	NA	NA	NA	200 mg/L
Nitrobenzene	1311 8270C	0.20 mg/L	0.013 mg/L	50-130	35	50-130	2.0 mg/L
Pentachlorophenol	1311 8270C	0.20 mg/L	0.018 mg/L	50-130	35	50-130	100 mg/L
Pyridine	1311 8270C	0.050 mg/L	0.013 mg/L	50-130	35	50-130	5.0 mg/L
2,4,5-Trichlorophenol	1311 8270C	0.10 mg/L	0.015 mg/L	50-130	35	50-130	400 mg/L
2,4,6-Trichlorophenol	1311 8270C	0.10 mg/L	0.023 mg/L	50-130	35	50-130	2.0 mg/L
2,4-D	1311 8151A	0.20 mg/L	0.0018 mg/L	50-130	35	50-130	10 mg/L
2,4,5-TP	1311 8151A	0.20 mg/L	0.0025 mg/L	50-130	35	50-130	1.0 mg/L
<i>gamma</i> -BHC (Lindane)	1311 8081A	0.00050 mg/L	0.00015 mg/L	50-130	35	50-130	0.4 mg/L
Chlordane	1311 8081A	0.010 mg/L	0.0010 mg/L	50-130	35	50-130	0.03 mg/L
Endrin	1311 8081A	0.00050 mg/L	0.00015 mg/L	50-130	35	50-130	0.02 mg/L
Heptachlor	1311 8081A	0.00050 mg/L	0.00015 mg/L	50-130	35	50-130	0.008 mg/L

Parameter	Analytical Method	Reporting Limit	Method Detection Limit^d	MS Accuracy, Percent	Precision, RPD^b	LCS Accuracy, Percent	Screening Level: RCRA^c
Heptachlor epoxide	1311 8081A	0.00050 mg/L	0.00015 mg/L	50-130	35	50-130	0.008 mg/L
Methoxychlor	1311 8081A	0.00050 mg/L	0.00020 mg/L	50-130	35	50-130	10 mg/L
Toxaphene	1311 8081A	0.020 mg/L	0.0080 mg/L	50-130	35	50-130	0.5 mg/L
Arsenic	1311 6010B	0.20 mg/L	0.070 mg/L	75-125	30	80-120	5.0 mg/L
Barium	1311 6010B	0.20 mg/L	0.060 mg/L	75-125	30	80-120	100 mg/L
Cadmium	1311 6010B	0.10 mg/L	0.020 mg/L	75-125	30	80-120	1.0 mg/L
Chromium	1311 6010B	0.10 mg/L	0.020 mg/L	75-125	30	80-120	5.0 mg/L
Lead	1311 6010B	0.10 mg/L	0.030 mg/L	75-125	30	80-120	5.0 mg/L
Selenium	1311 6010B	0.10 mg/L	0.080 mg/L	75-125	30	80-120	1.0 mg/L
Silver	1311 6010B	0.20 mg/L	0.060 mg/L	75-125	30	80-120	5.0 mg/L
Mercury	1311 7470A	0.0020 mg/L	0.0010 mg/L	75-125	30	80-120	0.2 mg/L

Notes:

NA Not Applicable

a The goals for accuracy and precision are reflective of the data validation/verification usability limits.

b Precision limit for matrix spike/matrix spike duplicate, laboratory duplicate, or laboratory control sample/ laboratory control sample duplicate analyses.

c Resource Conservation and Recovery Act ("RCRA")

d The method detection limits presented are laboratory-derived limits. These limits will periodically be updated; however, the updated limits are not expected to be significantly different than those herein.

Table 3-6. Analytical Methods and Surrogate Recovery Goals			
Matrix	Method	Surrogate Compound^a	Recovery Limits (Percent)^b
Aqueous	8260B	4-Bromofluorobenzene	80-120
Aqueous	8260B	Dibromofluoromethane	80-120
Aqueous	8260B	Toluene-d ₈	80-120
TCLP	1311 8260B	4-Bromofluorobenzene	80-120
TCLP	1311 8260B	Dibromofluoromethane	80-120
TCLP	1311 8260B	Toluene-d ₈	80-120
Aqueous	625 LL	2,4,6-Tribromophenol	40-120
Aqueous	625 LL	2-Fluorobiphenyl	40-120
Aqueous	625 LL	2-Fluorophenol	40-120
Aqueous	625 LL	Nitrobenzene-d ₅	40-120
Aqueous	625 LL	Phenol-d ₆	40-120
Aqueous	625 LL	Terphenyl-d ₁₄	40-120
Aqueous	8270C SIM	2-Fluorobiphenyl	40-120
Aqueous	8270C SIM	Nitrobenzene-d ₅	40-120
Aqueous	8270C SIM	Terphenyl-d ₁₄	40-120
TCLP	1311 8270C	2,4,6-Tribromophenol	40-120
TCLP	1311 8270C	2-Fluorobiphenyl	40-120
TCLP	1311 8270C	2-Fluorophenol	40-120
TCLP	1311 8270C	Nitrobenzene-d ₅	40-120
TCLP	1311 8270C	Phenol-d ₆	40-120
TCLP	1311 8270C	Terphenyl-d ₁₄	40-120
Aqueous	8015B-Diesel/Motor Oil	<i>n</i> -Octacosane	40-120
Aqueous	8015B-Gasoline	4-Bromofluorobenzene	70-120
Aqueous	8151A	2,4-DCAA	40-120
TCLP	1311 8151A	2,4-DCAA	40-120
Aqueous	8081A LL	Decachlorobiphenyl	40-120
Aqueous	8081A LL	Tetrachloro- <i>m</i> -xylene	40-120
TCLP	1311 8081A	Decachlorobiphenyl	40-120
TCLP	1311 8081A	Tetrachloro- <i>m</i> -xylene	40-120
Aqueous	8082 LL	Decachlorobiphenyl	40-120
Aqueous	8082 LL	Tetrachloro- <i>m</i> -xylene	40-120
Soil	8260B	4-Bromofluorobenzene	75-125
Soil	8260B	Dibromofluoromethane	75-125

Table 3-6. Analytical Methods and Surrogate Recovery Goals			
Matrix	Method	Surrogate Compound^a	Recovery Limits (Percent)^b
Soil	8260B	Toluene-d ₈	75-125
Soil	8270C	2,4,6-Tribromophenol	35-125
Soil	8270C	2-Fluorobiphenyl	35-125
Soil	8270C	2-Fluorophenol	35-125
Soil	8270C	Nitrobenzene-d ₅	35-125
Soil	8270C	Phenol-d ₆	35-125
Soil	8270C	Terphenyl-d ₁₄	35-125
Soil	8270C SIM	2-Fluorobiphenyl	35-125
Soil	8270C SIM	Nitrobenzene-d ₅	35-125
Soil	8270C SIM	Terphenyl-d ₁₄	35-125
Soil	8015B-Diesel/Motor Oil	<i>n</i> -Octacosane	35-125
Soil	5035A-8015B	4-Bromofluorobenzene	70-130
Soil	8081A	Decachlorobiphenyl	35-125
Soil	8081A	Tetrachloro- <i>m</i> -xylene	35-125
Soil	8082	Decachlorobiphenyl	35-125
Soil	8082	Tetrachloro- <i>m</i> -xylene	35-125
Soil	8151A	2,4-DCAA	35-125
Biota	8082	Decachlorobiphenyl	40-125
Biota	8082	Tetrachloro- <i>m</i> -xylene	40-125

Notes:

- a The specific surrogate compounds utilized for an analytical method may change due to method updates or other factors.
- b The goals for recovery are reflective of the data validation/verification usability limits.

Table 3-7. Analytical Methods and Chemical Yield Goals			
Matrix	Method	Tracer/Carrier^a	Recovery Limits (Percent)^b
Aqueous	903.0	Ba-133/Y	40-115
Aqueous	904.0	Ba-133/Y	40-115
Aqueous	HASL 300	Th-234	25-115
Aqueous	HASL 300	U-232	25-115
Soil	Ra-226/HASL 300	NA	NA
Soil	Ra-228/HASL 300	NA	NA
Soil	HASL 300	Th-229	25-115
Soil	HASL 300	U-232	25-115
Air	HASL 300	Th-229	25-115
Air	903.1	Ba-133/Y	25-115
Air	904.0	Ba-133/Y	25-115
Air	HASL 300	U-232	25-115

Notes:

NA Not Applicable

a The specific tracers/carriers utilized for an analytical method may change due to method updates or other factors.

b The goals for recovery are reflective of the data validation/verification usability limits.

3.3 Field and Laboratory Quality Control Samples

The quality of data will be controlled, monitored, and verified by maintaining logs, by documenting field activities, and by collecting and analyzing QC samples concurrently with investigative samples. Field and laboratory QC samples will be used to assess accuracy and precision to gauge both field and laboratory activities. QC samples will be collected and analyzed in conjunction with samples designated for laboratory analysis.

Standard analytical QC checks that may be instituted by field and laboratory personnel include, but are not limited to, the following:

- Equipment Rinsate Blanks;
- Field Blanks;
- Ambient Air Blanks;
- Trip Blanks;
- Filter Blanks;
- Field Duplicate Samples;
- Co-Located Samples;
- Matrix Spike (“MS”) Samples;
- Matrix Spike Duplicate (“MSD”) Samples;
- Surrogate and Tracer/Carrier Spiking;
- Method Blanks;
- Laboratory Control Samples (“LCSs”);
- Laboratory Duplicate (“LD”) Samples; and
- Temperature Blanks.

These above-cited QC checks are discussed in the following subsections. Field and laboratory QC samples may not be applicable to all sample matrices. Table 3-8 provides a summary of the QC checks associated with each sample matrix. Field QC samples will be submitted to the laboratory using the same information as that submitted for the associated investigative samples. All field QC samples, (e.g., field and equipment blanks, field duplicate sample, etc.) are submitted “blind” to the project laboratories.

Table 3-8. Field QC Sample Summary								
QC Check	Matrix							Frequency
	A	S	Sed	SurW	GW	DW	B	
Equipment Rinsate Blanks	No	Yes	Yes	Yes	Yes	Yes	Yes	every 20 samples (or less) each day samples are collected
Field Blanks	Yes	Yes	Yes	Yes	Yes	Yes	Yes	every 20 samples
Trip Blanks	No	Yes	Yes	Yes	Yes	Yes	No	one per sample cooler (during volatile organic sampling)
Filter Blanks (Air)	Yes	No	No	No	No	No	No	every 20 samples
Filter Blanks (Aqueous)	No	No	No	No	Yes	No	No	one per each filter lot per sampling round
Field Duplicate Samples	No	Yes	Yes	Yes	Yes	Yes	No	every 10 samples per sample matrix
Co-Located Samples	Yes (applies to high-volume air samplers only)	Yes	Yes	No	No	No	Yes	every 10 samples per sample matrix
Matrix Spike	No	Yes	Yes	Yes	Yes	Yes	Yes	each batch of samples for every 20 (or less) samples received
Matrix Spike Duplicate	No	Yes	Yes	Yes	Yes	Yes	Yes	each batch of samples for every 20 (or less) samples received
Surrogate Spiking	No	Yes	Yes	Yes	Yes	Yes	Yes	added to all project and QC samples
Tracer/Carrier Spiking	Yes	Yes	Yes	Yes	Yes	Yes	No	added to all project and QC samples
Method Blanks	Yes	Yes	Yes	Yes	Yes	Yes	Yes	each batch of samples for every 20 (or less) samples received
Laboratory Control Samples	Yes	Yes	Yes	Yes	Yes	Yes	Yes	each batch of samples for every 20 (or less) samples received
Laboratory Duplicate	Yes	Yes	Yes	Yes	Yes	Yes	Yes	each batch of samples for every 20 (or less) samples received
Temperature Blanks	Yes	Yes	Yes	Yes	Yes	Yes	Yes	one per sample cooler

3.3.1 Equipment Rinsate Blanks

Analyses of equipment rinsate blanks are used to assess the efficiency of field equipment decontamination procedures in preventing cross-contamination between samples. Certified analyte-free reagent water shipped from the laboratory to the field team will be poured into/through/over clean (decontaminated) sampling equipment used in the collection of investigative samples and subsequently collected in prepared sample bottles. Preservatives or additives will be added as required for the analysis. The rinsate blank will then be shipped with the associated investigative samples. For each matrix, a rinsate blank will be collected and analyzed for every 20 samples (or less) each day samples are collected. Aqueous rinsate blank results will be applied to the associated

solid sample results following the appropriate unit conversions. For volatile organics, three vials for aqueous samples or three tared with 10 mL of reagent water will be prepared. The rinsate blanks will be analyzed for the same parameters as the investigative samples. Rinsate blanks will also be collected from pre-cleaned disposable/one-use equipment (i.e., disposable bailers/brass stainless steel sleeves) each time a new lot is used to demonstrate cleanliness for the lot of equipment. Rinsate blanks need not be collected when dedicated equipment is used for sampling.

3.3.2 Field Blanks

Analyses of field blanks are used to assess the contamination of samples during sample collection. Field blanks are samples that are prepared using certified analyte-free water. For the air sampling, a field blank consists of a clean filter that is placed onto the high volume air sampler and then taken off without running the sampler. A field blank will be collected and analyzed for every 20 samples. The field blanks will be analyzed for the same parameters as the investigative samples.

3.3.3 Trip Blanks

Trip blanks are volatile organic samples that are prepared in the laboratory using analyte-free water. Trip blanks should be kept by the field team for a maximum of 10 days, and if not used, they should be replaced with fresh trip blanks. The trip blanks must be inspected for air bubbles by both the laboratory (prior to shipping trip blanks to the field team) and by the field team (prior to shipping trip blanks back to the laboratory with associated investigative samples). Any vials containing air bubbles must be discarded. The trip blanks are analyzed to assess the contamination of samples during transport to the Site, during sample collection, and during transport to the laboratory. Trip blank containers will be the same type of sample container as that used for VOC samples. One trip blank sample (three vials for aqueous or three tared vials with 10 mL of reagent water for soils) will be included for each cooler of samples collected for analysis of VOCs. At no time after their preparation and before arrival at the laboratory will the trip blanks be opened.

3.3.4 Air Filter Blanks

Analyses of air filter blanks are used to assess the contamination of samples from the native presence of target analytes in the filters used for air sample collection. An air filter blank consists of a clean filter that is transported with associated investigative samples, but is never taken out of its

protective sleeve. An air filter blank will be collected at a minimum of every 20 samples. The air filter blank will be analyzed for the same parameters as the investigative samples and will also be from the same filter lot as the associated investigative samples.

3.3.5 Aqueous Filter Blanks

Analyses of aqueous filter blanks are used to assess the contamination of samples from the native presence of target analytes in the filters used for the filtering of samples collected for dissolved metals analysis. Certified analyte-free reagent water shipped from the laboratory to the field team will be filtered using one of the filters from the same lot of filters used to filter the associated investigative samples for dissolved metals analysis and subsequently collected in prepared sample bottles. An aqueous filter blank will be collected at a minimum of one per each filter lot per sampling round. The aqueous filter blank will be analyzed for the same parameters as the investigative samples.

3.3.6 Field Duplicate Samples

Field duplicate samples are used to check for sampling and analytical error, reproducibility, and homogeneity. One duplicate sample will be collected per 10 samples per sample matrix. For soil/sediment samples, the duplicate will be obtained by collecting a sample from an area adjacent to the routine sample or by collecting a separate aliquot of soil from within the same core, whichever is more appropriate for the type of sample/sampling technique (i.e., surface or subsurface soil sample). The samples, with the exception of the samples collected for volatile organic analysis, are then thoroughly homogenized and split. Duplicates will be analyzed for the same parameters specified for the associated investigative samples.

The DQO for S and Sed field duplicates is as follows: if the sample result for each sample is equal to or greater than five-times the reporting limit, the RPD between sample results should be less than or equal to 40 percent. If at least one of the sample results is less than five-times the reporting limit, the absolute difference between the results should be less than or equal to twice the higher of the reporting limits.

The DQO for SurW, GW, and DW field duplicates is as follows: if the sample result for each sample is equal to or greater than five-times the reporting limit, the RPD between sample results should be less than or equal to 20 percent. If at least one of the sample results is less than five-times the reporting limit, the absolute difference between the results should be less than or equal to the higher of the reporting limits. The DQO for all field duplicates analyzed for radiological parameters is as follows: the replicate error ratio (“RER”) will be <2.

3.3.7 Co-Located Samples

Co-located samples (collected for air analyses, biota analyses, and for volatile organic soil and sediment analyses) are used to check for sampling and analytical error, reproducibility, and homogeneity. One co-located sample will be collected per 10 samples per sample matrix. The co-located sample will be obtained by collecting a sample from an area adjacent to the routine sample. Co-located samples will be analyzed for the same parameters specified for the associated investigative samples.

The DQO for A, S, B, and Sed co-located samples is as follows: if the sample result for each sample is equal to or greater than five-times the reporting limit, the RPD between sample results should be less than or equal to 40 percent. If at least one of the sample results is less than five-times the reporting limit, the absolute difference between the results should be less than or equal to twice the higher of the reporting limits.

The DQO for all co-located samples analyzed for radiological parameters is as follows: the replicate error ratio (RER) will be <2. The RER is calculated by dividing the absolute value of the difference of the sample and duplicate activities by the square root of the sum of the sample error squared and duplicate error squared, as shown below.

$$RER = \frac{|A-B|}{\sqrt{S_A^2 + S_B^2}}$$

Where A is the sample activity, B is the duplicate activity, S_A is the sample error, and S_B is the duplicate error.

3.3.8 Matrix Spike/Matrix Spike Duplicate (MS/MSD) Samples

MS/MSD samples are investigative samples to which known amounts of analytes are added in the laboratory before extraction/preparation and analysis. The recoveries for spiked compounds can be used to assess how well the method used for analysis recovers target compounds in the Site-specific sample matrices. For each matrix type, with the exception of air samples, at least one set of MS/MSD samples will be analyzed for each batch of samples for every 20 (or less) samples received. For general chemistry analyses, a matrix spike and a laboratory duplicate (described below) are specified for analysis.

3.3.9 Surrogate and Tracer/Carrier Spiking

Surrogate and Tracer/Carrier spiking consists of adding reference compounds to samples before sample preparation for analysis. Surrogate compounds are used for organic analyses and tracers or carriers are used for radiological analyses. Surrogate compound and tracer/carrier recovery can be used to assess method accuracy on a sample-specific basis. Surrogate compounds and tracers/carriers will be added to investigative and QA/QC sample analyses as appropriate to the analytical method. Table 3-6 provides the recovery limits for the surrogate compounds and Table 3-7 provides the recovery limits for the tracers/carriers.

3.3.10 Laboratory Method Blanks

Method blanks consist of analyte-free materials (e.g., reagent water) that are prepared in the same manner as the associated samples (i.e., digested, extracted, distilled, etc.) and that are analyzed and reported in the same manner as the associated investigative samples.

For the method blank analysis to be considered acceptable, the following conditions must be met: concentration of target analyte in the method blank is less than the reporting limit of the analyte; the associated sample concentration is $\geq 10 \times$ blank concentration; or samples display “not-detected” results for the analyte.

3.3.11 Laboratory Control Samples (LCSs)

Laboratory control samples consist of laboratory-certified reagent-grade water fortified (spiked) with the analytes of interest or a certified reference material that is prepared and analyzed. LCS data are used to monitor analytical accuracy and laboratory performance.

3.3.12 Laboratory Duplicate Samples

Duplicate samples are obtained by splitting a field sample into two separate aliquots and performing separate preparation and analysis on the respective aliquots. The analysis of laboratory duplicate samples monitors precision; however, precision may be affected by sample heterogeneity, particularly in the case of non-aqueous samples. Laboratory duplicates will be analyzed and reported for inorganic analyses only, with the exception of air filter analyses. A laboratory duplicate will be analyzed with every batch of 20 (or less) field samples.

3.3.13 Temperature Blanks

Temperature blanks are aliquots of analyte-free water used by the laboratory to record the cooler temperature upon receipt at the laboratory. Each cooler containing samples that require temperature preservation will contain a temperature blank.

SECTION 4.0 SAMPLING PROCEDURES

This section includes the sampling rationale, documentation methods, and sampling procedures including, sample labeling, sample preservation and holding times, sample custody tracking, and decontamination.

4.1 Sampling Rationale

Characterization requirements of specific environmental media are set forth in the Scope of Work, Appendix A of the Administrative Order (Docket No. 9-2007-0005). Samples may be collected for one or more of the following media:

- Air (A);
- Soil (S);
- Sediment (Sed);
- Surface Water (SurW);
- Groundwater (GW); and
- Drinking Water (DW).
- Biota (B)

Field investigation and sampling procedures will be conducted so that samples are representative of the media sampled and the resultant data can be compared to other data sets. If a statistical analysis of data is planned, the location and number of samples to be collected will be adequate to permit statistical treatment of the data generated. The RI Work Plans and SOPs should provide a statistically meaningful number of field sampling points. Where chemical levels may vary with location, enough samples should be collected to characterize the area. The RI Work Plans and SOPs will be employed to implement the field investigation and sampling methods, including equipment requirements and decontamination procedures required for each project.

The overall investigative rationale and specific sampling and analytical program are addressed in the RI Work Plans and/or SOPs (Work Plans and/or SOPs are required for all sample collection activities). The details and content of the RI Work Plans and/or SOPs should reflect the complexity of the sample collection task.

4.2 Sample Containers, Preservation, and Holding Times

Samples for chemical analyses will be containerized and preserved in accordance with appropriate EPA specifications. For each parameter, the required type of container, volume of sample, sample temperature, type and concentration of preservative, and extraction and analytical holding times are specified on Tables 4-1, 4-2, 4-3, and 4-4. Sampling containers and preservatives will be provided by the laboratory designated to perform the analyses. Sample containers provided will be new, pre-cleaned I-Chem Series 300 or equivalent. Samples will be placed in individual pre-cleaned containers for shipment to the laboratory.

Sample containers provided by the laboratory will be shipped with a packing list that details the number and type of bottles shipped, the bottle lot numbers, chemical preservatives, custody seals, and the packer's signature. The chain-of-custody records will be completed by field sampling personnel and returned to the laboratory with the samples. After the cooler is sealed, sampling personnel will attach two signed/dated custody seals to the outside of the cooler. One seal will be placed on the right front of the cooler and the second seal will be placed on the rear left side of the cooler.

Tables 4-1, 4-2, 4-3, and 4-4 provide recommended sample volumes, containers, preservation, and holding times for each analysis. The specific sample containers, preservatives, and analytical holding times for chemical analyses that are not included on Tables 4-1, 4-2, 4-3, and 4-4 will be identified in the RI Work Plans and/or SOPs, as necessary.

Applicable samples will be kept chilled from the time of collection until the time of analysis by the laboratory. Field personnel will keep samples cold using ice and coolers, in which samples will be

stored until delivery to the analytical laboratory personnel. After receipt of the samples, it is the laboratory's responsibility to store the applicable samples (see Tables 4-1 through 4-4) at $\leq 6^{\circ}\text{C}$ until preparation and analysis has been initiated.

Samples have a finite holding time (the time between sample collection, sample extraction, and sample analysis) to limit the potential for degradation of the analytes. Sample holding times specified on Tables 4-1 through 4-4 must be met unless otherwise dictated by the analytical method. The holding times for required analyses are measured from the verified time of sample collection. Whenever possible, samples will be shipped by overnight carrier or delivered by same-day carrier to minimize the time between collection and laboratory receipt.

Upon sample receipt at the laboratory, the condition of the custody seals, sample collection dates, and sample temperature will be noted by the Laboratory Sample Custodian (if applicable). The required date for completion of analysis (or extraction) will be noted and keyed to the holding time. Analyses that have holding times of 48 hours or less will be identified by the Laboratory Sample Custodian, and the appropriate Laboratory Project Manager and analyst will be notified upon sample arrival at the laboratory. The Laboratory Project Manager will be responsible for ensuring proper execution of required analyses.

Table 4-1. Aqueous Samples - Containers, Preservation, and Holding Times					
Parameter	EPA Method(s)	Suggested Volume ¹	Container	Preservative ^a	Holding Time from Collection
Alkalinity, Bicarbonate Alkalinity, and Carbonate Alkalinity	2320B	200 mL	P or G	≤6°C	14 days
Chloride, Fluoride, Total Nitrate/Nitrite, and Sulfate	300.0	200 mL	P or G	≤6°C	28 days
Nitrate, Nitrite, and Ortho-phosphate	300.0	200 mL	P or G	≤6°C	48 hours
Herbicides	8151A	2 x 1 L	AG	≤6°	7/40 days ^c
Mercury (total)	7470A and 245.1	200 mL	P	HNO ₃ to pH<2	28 days
Mercury (dissolved)	7470A and 245.1	200 mL	P	HNO ₃ to pH<2	28 days
Metals (total)	6010B, 200.7, 6020, and 200.8	500 mL	P	HNO ₃ to pH<2	6 months
Metals (dissolved)	6010B, 200.7, 6020, and 200.8	500 mL	P	Field Filtered and then HNO ₃ to pH<2	6 months
PCBs	8082	2 x 1 L	AG	≤6°C	7/40 days ^c
pH	150.1 and 4500B/H	200 mL	P or G	≤6°C	24 hours
Phosphorus, total	365.3	200 mL	P or G	≤6°C, H ₂ SO ₄ to pH<2	28 days
Radionuclides	900.0, 903.0, 904.0, and 907.0	4 L	P	HNO ₃ to pH<2	6 months
Semivolatile Organics	625 LL	2 x 1 L	AG	≤6°C	7/40 days ^c
PAHs	8270C SIM	2 x 1 L	AG	≤6°C	7/40 days ^c
TDS	160.1 and 2540C	200 mL	P or G	≤6°C	7 days
TS	160.3	200 mL	P or G	≤6°C	7 days
TOC	415.1 and 5310B	200 mL	G/T	≤6°C, H ₃ PO ₄ to pH<2	28 days
Pesticides	8081A	2 x 1 L	AG	≤6°	7/40 days ^c
Diesel (C12-C23)-TPH	8015B	2 x 1 L	G/T	≤6°C, HCl to pH<2 ^d	7/40 days ^c
Motor Oil (C23-C40)-TPH	8015B	2 x 1 L	G/T	≤6°C, HCl to pH<2 ^d	7/40 days ^c
Gasoline (C4-C12)-TPH	8015B	3 x 40 mL	G/T	≤6°C, HCl to pH<2, no headspace ^b	14 days
Volatile (organic)	8260B	3 x 40 mL	G/T	≤6°C, HCl to pH<2, no headspace ^b	14 days

Notes:

¹ Extra volume must be provided for matrix QC samples (MS, MSD, and/or laboratory duplicate samples).

^a Preservation should be done immediately upon sample collection (within 15 minutes).

^b No preservation is necessary if the sample is analyzed within 7 days of collection.

^c Extract sample within 7 days. Analyze extract within 40 days after extraction.

^d Acid preservation acceptable, but not required.

AG Amber glass container with Teflon[®]-lined cap.

G Glass container with Teflon[®]-lined cap.

P Plastic container (polyethylene container used for metals).

T Teflon[®]-lined cap/septum.

Parameter	EPA Method(s)	Suggested Volume ¹	Container	Preservative ^a	Holding Time from Collection
Herbicides	8151A	100 g	WM	≤6°C	14/40 days ^b
Mercury	1631	50 g	WM	≤6°C	28 days
Metals	6010B and 6020	50 g	WM	None	6 months
PCB	8082	100 g	WM	≤6°C	14/40 days ^b
Pesticides	8081A	100 g	WM	≤6°C	14/40 days ^b
Semivolatile Organic	8270C	100 g	WM	≤6°C	14/40 days ^b
Phenol, 2-Methylphenol, and PAHs	8270C SIM	100 g	WM	≤6°C	14/40 days ^b
Diesel (C12-C23)-TPH	8015B	100 g	WM	≤6°C	14/40 days ^b
Motor Oil (C23-C40)-TPH	8015B	100 g	WM	≤6°C	14/40 days ^b
Gasoline (C4-C12)-TPH	5035-8015B	5 g/ container	3 – En Core [®] or Tared vials	≤6°C	48 hours/ 14 days ^{c,d}
TS	160.3 and 2540G	50 g	WM	≤6°C	7 days
Volatile (organic)	5035-8260B	5 g/ container	3 – En Core [®] or Tared vials	≤6°C	48 hours/ 14 days ^{c,d}
Radionuclides	9310, HASL 300 (Section 4.5.2.3), and HASL 300	750 g	WM	None	6 months
TCLP Volatiles	1311-8260B	50 g	WM	≤6°C	14 days till TCLP leachate generation; 14 days from leachate generation date to analyze TCLP leachate
TCLP Semivolatiles	1311-8270C	200 g	WM	≤6°C	14 days till TCLP leachate generation; 14 days till extraction/ 40 days to inject extract
TCLP Organochlorine Pesticides	1311-8081A	200 g	WM	≤6°C	14 days till TCLP leachate generation; 14 days till extraction/ 40 days to inject extract
TCLP Herbicides	1311-8151A	200 g	WM	≤6°C	14 days till TCLP leachate generation; 14 days till extraction/ 40 days to inject extract
TCLP Metals	1311-6010B, -6020, and -7471A	200 g	WM	≤6°C	180 days (28 days for mercury) till TCLP leachate generation; 180 days (28 days for mercury) till analysis

Notes:

- ¹ Extra volume must be provided for matrix QC samples (MS, MSD, and/or laboratory duplicate samples).
 - ^a Preservation should be done immediately upon sample collection (within 15 minutes).
 - ^b Extract sample within 14 days. Analyze extract within 40 days after extraction.
 - ^c If collecting En Core[®] samples, samples must be preserved with methanol and ≤6°C, sodium bisulfate and ≤6°C, or reagent water and ≤-10°C within 48 hours of collection and analyzed within 14 days of collection. En Core[®] samples can also be stored ≤-10°C and analyzed within 7 days of collection.
 - ^d If collecting samples in En Core[®] samplers, an additional aliquot sample must be collected and submitted to the laboratory for percent solids analysis.
- WM Wide-mouth glass jar with Teflon[®]-lined cap.

Parameter	EPA Method(s)	Suggested Volume	Container	Preservative	Holding Time from Collection
Mercury	7471A	8 × 10 Quartz Fiber Filter	P	≤6°C	28 days
Metals	6010B and 6020	8 × 10 Quartz Fiber Filter	P	None	6 months
Metals	IO3.3	47-mm Teflon Filter	P	None	6 months
Sulfate	9056	8 × 10 Quartz Fiber Filter	P	≤6°C	28 days
Radionuclides	900.0, 903.1, 904.0, 908, and IsoTh	8 × 10 Quartz Fiber Filter	P	None	6 months
TSP	40 CFR Appendix B	8 × 10 Quartz Fiber Filter	P	None	6 months
PM-10	40 CFR Appendix J	8 × 10 Quartz Fiber Filter	P	None	6 months

Notes:
P = Protective sleeve in plastic bag (or equivalent).

Parameter	EPA Method(s)	Suggested Volume	Container	Preservative	Holding Time from Collection
Metals	6010B and 6020	50 g	WM	≤6°C	6 months
Mercury	7471A	50 g	WM	≤6°C	28 days
Fluoride	340.2	50 g	WM	≤6°C	28 days
PCBs	8082	100 g	WM	≤6°C	1 year (if kept frozen)

Notes:
WM Wide-mouth glass jar with Teflon®-lined cap.

4.3 Decontamination

Tools and equipment decontamination procedures are implemented to prevent cross-contamination of samples and to control potential inadvertent transport of hazardous constituents. Personnel decontamination procedures are designed to prevent personnel exposure to chemicals. Proper tool and equipment decontamination procedures are documented in the RI Work Plans and/or SOPs.

4.4 Sample Identification, Documentation, and Custody

Field sampling personnel are responsible for the collection, description, documentation, labeling, packaging, storage, handling, and shipping samples obtained in the field. Appropriate practices are necessary to ensure sample integrity from collection through laboratory analysis and data reporting.

4.4.1 Sample Identification

Sample labeling and identity establishment are of critical importance in the collection of samples. Data for a sample will be keyed to the sample's unique sample designation. This sample designation, which will be used on sample containers and associated field data forms, will be used for data recall from the database system.

Each sample container will be clearly labeled, as soon as possible, after collection. At a minimum, the following information will be written, using permanent ink, on a waterproof sample label:

- A unique sample identification number;
- Time and date of collection;
- Company name;
- Project number;
- Chain-of-custody number;
- Any preservatives added; and
- Required analyses.

4.4.2 Sample Custody

Chain-of-custody ("COC") procedures will be used to ensure proper handling of samples during sampling and analysis and to provide sample tracking. Samples and sample documentation will be maintained in the physical possession of authorized personnel or under control in a secure area. The purpose of sample custody procedures is to document the history of samples (and sample extracts or digestates) from the time of sample collection through shipment, analysis, and disposal. A sample is considered to be in one's custody if one or more of the following conditions apply:

- The sample is in an individual's actual possession;
- The sample is in view after being in an individual's physical possession; and
- The sample is locked up so that no one can tamper with it after having been in an individual's physical possession.

4.4.3 Sample Custody in the Field

A chain-of-custody form will be filled out upon sample collection. At a minimum, the following information will be written on the COC form:

- Sample identification number;
- Time and date of collection;
- Field sampler's name;
- Sample matrix;
- Type, quantity, and volume of sample containers;
- Project number;
- Any preservatives added;
- Required analyses;
- Requested analytical turn-around-time; and
- Any additional information the laboratory must know to perform the requested analysis, such as holding time, filtering require, etc.

The following chain-of-custody procedures will be followed for samples submitted to the laboratory for chemical or physical properties analyses.

- Each individual field sampler is responsible for the care and custody of samples he/she collects until the samples are properly transferred to temporary storage or are shipped to the laboratory.
- A chain-of-custody form will be completed by the sampler for samples collected and submitted to the laboratory.
- If temperature preservation of the samples required, each cooler will contain a temperature blank used by the laboratory to record the cooler temperature upon receipt at the laboratory.
- After the cooler is sealed, two custody tape seals will be affixed to the cooler as described in Section 4.2 prior to delivery pickup by the overnight courier.
- Each time the samples are transferred, the signatures of the person relinquishing and the person receiving the samples, as well as the date and time of transfer, will be documented.

- A copy of any carrier airbill will be retained as part of the permanent Chain-of-Custody documentation.
- The laboratory will record the condition of the sample containers and the temperature (if applicable) upon receipt.
- Changes or corrections to the information documented by the chain-of-custody form (including, but not limited to, field sample ID or requested analyses) must be dated and initialed by the person making the change. If the request for change is by the Consultant Project Manager or Field Team Leader, a copy of the chain-of-custody form will be revised, initialed, and forwarded to the laboratory and will supercede the original chain-of-custody form.
- A copy of the original chain-of-custody form and any documented changes to the original will be included as part of the final analytical report. This record will be used to document sample custody transfer from the sampler to the laboratory and will become a permanent part of the project file.

4.4.4 Sample Packaging and Shipment

Samples will be packed and shipped in accordance with applicable and current US Department of Transportation (“DOT”) regulations, field consultant guidelines, and International Air Transport Association (“IATA”) standards (as detailed in the most current edition of *IATA Dangerous Goods Regulations* for hazardous materials shipments).

4.4.5 Sample Custody in the Laboratory

The following subsections describe the chain-of-custody procedures associated with sample receipt, storage, tracking, and documentation by the laboratory.

4.4.5.1 Sample Receipt

The Laboratory Sample Custodian will be responsible for samples received at the laboratory. The Laboratory Sample Custodian will be familiar with custody requirements and the potential hazards associated with environmental samples. In addition to receiving samples, the Laboratory Sample Custodian will also be responsible for documenting sample receipt, storage before and after sample analysis, and the proper disposal of samples. Upon sample receipt, the Laboratory Sample Custodian will accomplish the following tasks.

- Inspect the sample containers for integrity and ensure that custody seals are intact on the shipping coolers. The temperature of the samples upon receipt and presence of leaking or broken containers will be noted on the chain-of-custody/sample analysis request forms. The preservation of the samples will be checked and recorded (unless it is checked in the appropriate laboratory area, i.e. volatile aqueous samples).
- Sign (with date and time of receipt) the chain-of-custody/sample analysis request forms, thereby assuming custody of the samples, and assign the laboratory sample identification numbers
- Compare the information of the chain-of-custody/sample analysis request forms with the sample labels to verify sample identity. Any inconsistencies will be resolved with a field sampling representative before sample analysis proceeds.
- Store samples in accordance with Subsection 4.4.5.2.
- Alert appropriate laboratory managers and analysts of any analysis requiring immediate attention because of short holding times specified in analytical protocols
- Send a sample receipt confirmation report to the Field Team Leader
- Alert Laboratory Project Manager of any sample preservation issues, sample discrepancies, or other problems so that this information can immediately (within 24 hours) be relayed to the Field Team Leader (as required by the Technical Requirements for Environmental Laboratory Analytical Services BP Laboratory Management Program (LaMP) [Section 2.9], see Appendix C).

4.4.5.2 Sample Storage

Analytical samples will be stored in a locked secure storage area. Samples that require temperature preservation will be stored in a locked refrigerator maintained at $\leq 6^{\circ}\text{C}$. Samples that do not require temperature preservation will be stored in a locked and secured storage area. The temperature will be monitored and recorded daily, at a minimum, and archived as a bound logbook by laboratory personnel. Samples will be removed from the locked storage area/refrigerator by dedicated personnel only. Each time the samples are transferred within the laboratory, the signatures of the persons relinquishing and receiving the samples, as well as the date and time of transfer, will be documented. Internal (laboratory) Chain-of-Custody Records will be maintained for all samples.

4.4.5.3 Sample Tracking

Each sample will receive a unique laboratory sample identification number at the laboratory when the sample is logged into the laboratory computer system. For samples that require extraction or digestion prior to analysis, a sample extraction or digestion record will be prepared. Laboratory

data will be entered on the sample extraction form and permanently recorded in a laboratory logbook. The laboratory will maintain a sample tracking system that documents the following:

- Organization/individual who performed sample analyses;
- Date of sample receipt, extraction (if applicable), and analysis;
- Sample holding times;
- Names of analysts;
- Sample preparation procedures;
- Analytical methods used to analyze the samples;
- Calibration and maintenance of instruments;
- Deviations from established analytical procedures, if applicable;
- QC procedures used to ensure that analyses were in control during data generation (instrument calibration, precision checks, method standards, method blanks, etc.);
- Procedures used for the calculation of precision, accuracy, and MDLs for the reported data; and
- Statement of quality of analytical results.

4.5 Sample Documentation and Records

After sample collection and before proceeding to the next sampling point, field sampling personnel will complete the chain-of-custody record and all appropriate forms and/or logbook entries. A field logbook will be maintained at the Site by the Field Team Leader or other designated field team member to record information pertinent to daily activities, the field sampling program, and the equipment preparation efforts. Field logbooks will be bound, with pages sequentially numbered. Entries will be made in permanent, waterproof ink. The Field Team Leader will review field log entries daily and will initial each page of entries. Field logbooks will be transferred to the project files at the end of field activities to provide a record of sampling. The following sections describe the documentation of field records.

4.5.1 Field Logbook and/or Field Forms

A separate entry will be made for each sample collected. At a minimum, the following information will be recorded in a field logbook or on the appropriate sampling forms using indelible ink:

- Sample identification number;
- Time and date of collection;
- Sample matrix;
- Number of sample bottles;
- Project number;
- Any preservatives added;
- Required analyses;
- Odors or visual observations;
- Any deviations from SOP and/or work plans;
- Sample location;
- Method of sample collection;
- Analyses performed in the field;
- General comments (e.g., weather conditions);
- Names and signatures of all sampling personnel;
- Condition of the well head, if appropriate; and
- Any deviations from established protocols or work instructions during sample collection.

4.5.2 Corrections to Documentation

Corrections to the Field Logbook will be made by drawing a single line through the incorrect entry and writing the correct entry. The person making the correction will date and initial the correction. There will be no erasures or obliterated entries in the field logs.

4.5.3 Equipment Calibration Log

An equipment calibration log will be maintained by the Field Team Leader to record the calibration measurements and frequencies of calibration of equipment. This log may be incorporated into the Field Logbook notes for a specific location/task and date of activity.

4.5.4 Project Files

4.5.4.1 Laboratory Files

Data related to sample preparation and analysis, as well as observations by laboratory analysts, will be permanently recorded and archived as bound laboratory notebooks. Laboratory notebook page will be signed and dated by laboratory analysts on the date of the entry. Corrections to notebook entries will be made by drawing a single line through the erroneous entry and writing the correct entry next to the crossed-out entry. Corrections will be initialed and dated by the analyst.

4.5.4.2 Field Contractor Files

A project file containing the complete documentation of Site activities will be maintained for the duration of the activities at field consultant's field offices. The project file will contain all records of field activities in the forms listed above, COC records, calibration logs, analytical data packages, QC documentation, references, cited literature, reports, permits, audits, corrective action, and correspondence.

SECTION 5.0 ANALYTICAL PROCEDURES

Routine analytical services are performed using standard EPA-approved methodology. In some cases, modification of standard methods may be necessary to provide accurate analyses of particularly complex matrices. When modifications to standard analytical methods are performed, the specific deviations, as well as the reason for the deviations, will be documented in the laboratory analytical SOPs or will be reported with the analytical results.

Tables 3-1 through 3-5 present the analytical methods, reporting limits, accuracy and precision goals for aqueous samples, soil/sediment samples, air samples, biota samples, and toxicity characterization leaching procedure (“TCLP”) samples, respectively. The reporting limits in Tables 3-1 through 3-5 are presented for reference only and represent approximate reporting limits for relatively clean samples without matrix interferences. Individual sample reporting limits may vary from the laboratory’s routinely reported limits; this variance may be a result of dilution requirements, sample weight or volume used to perform the analysis, dry-weight adjustment for solid samples, the presence of analytical background contaminants, or other sample-related or analysis-related conditions.

Most of the methods listed in Tables 3-1 through 3-5 are contained in the most current versions of *Methods for Chemical Analysis of Water and Wastes* (EPA, 1983), *Test Methods for Evaluating Solid Waste* (SW-846), and *Standard Methods for the Examination of Water and Wastewater*. Leaching tests used for characterizing remediation wastes for disposal purposes will use the SW-846 RCRA TCLP. It should be noted that TCLP characterization will be performed on any solid, semi-solid, or liquid waste materials in which analysis is needed solely to determine whether the waste materials should be handled as hazardous wastes. TCLP characterization will not solely be used for determining the proper disposal of waste generated at the Site that is “CERLCA waste.”

5.1 Laboratory Analysis

The laboratory will perform a soil moisture test on each soil sample in accordance with EPA SW-846 procedures for determining dry sample weight; accordingly, the analytical data will be reported on a dry-weight basis. If requested, the laboratory may perform soil moisture tests in accordance with ASTM D2216-71 *Laboratory Determination of Moisture Content of Soil*.

Results between the reporting limit and the laboratory MDL (sample-specific minimum detectable activity [or concentration] for radiological analyses) will be reported for all analytes. When the project laboratories report results between the MDL and reporting limit (“RL”), those results will be reported as estimated values.

As part of the characterization and assessment programs, various media, including soil, sediment, air, water, and biota will be analyzed for constituents of concern. Samples collected as part of these studies may be analyzed for the constituents included on listed on Tables 3-1 through 3-5. Dissolved metals analysis of groundwater shall be performed on field filtered (0.45- μ m filter) water samples. Analytical results will be reported with guidance provided in *Laboratory Documentation Required for Data Evaluation* (EPA Region 9, August 2001).

5.2 Common Laboratory Contaminants

Certain VOCs such as methylene chloride, acetone, and 2-butanone, and semi-volatile organic compounds (“SVOCs”) such as phthalates are commonly detected as laboratory contaminants. To ensure that the data reported are not biased by potential laboratory contamination, certain QA procedures, including reagent blank analysis, will be performed.

For the analysis of VOCs, a method blank analysis will be performed every 12 hours for gas chromatograph/mass spectrometer (“GC/MS”) analysis and every 10 samples for GC analysis. For the analysis of SVOCs, a method blank will be prepared and analyzed every extraction batch up to 20 samples of similar matrix.

5.3 Field Screening For Radiochemicals

Field screening for radiochemicals during sampling may be conducted as part of health and safety monitoring and Site characterization activities. Instruments to be used for field screening during intrusive activities may include a Geiger Counter or gamma radiation detector. These instruments are to be used for screening purposes only and, therefore, there are no specific DQOs. These instruments will be calibrated according to the manufacturer recommendation, or at a minimum, at the start of each day's field use.

SECTION 6.0 CALIBRATION PROCEDURES

This section provides the requirements for calibration of measuring and test equipment/instruments used in field sampling and laboratory analysis. The calibration procedures stipulated in this QAPP are designed to ensure that field equipment and instrumentation are calibrated to operate within manufacturer specifications and that the required traceability, sensitivity, and precision of the equipment/instruments are maintained. Measurements that affect the quality of an item or activity will be taken only with instruments, tools, gauges, or other measuring devices that are accurate, controlled, calibrated, adjusted, and maintained at predetermined intervals to ensure the specified level of precision and accuracy. All calibration measurements and maintenance records are documented so that data may be verified and validated during an audit. All documentation will be maintained for the duration of activities associated with the orders.

6.1 Field Equipment Calibration and Procedures

Field instruments that may be used during characterization and response activities include, but are not limited to, the following:

- Photo-Ionization Detector (“PID”);
- Specific Conductance Meter/Temperature Probe;
- Geiger Counter;
- Gamma radiation detector;
- pH Meter;
- Turbidimeter;
- Oxidation Reduction Potential;
- Dissolved Oxygen; and
- Particulate Meter.

Field instruments will be calibrated according to the manufacturer recommendation, or at a minimum, at the start of each day's field use. Calibration records will contain the following information:

- Instrument name and identification number;
- Name of person performing the calibration;
- Date of calibration;
- Calibration points;
- Results of the calibration;
- Manufacturer lot number of the calibration standards; and
- Expiration dates for the calibration standards, where applicable.

Field equipment will be properly inspected, charged, and in good working condition prior to the beginning of each working day. Prior to the start of each working day, the Field Team Leader will inspect equipment to ensure its proper working condition. Field equipment and instruments will be properly protected against inclement weather conditions during the field work. At the end of each working day, field equipment and instruments will be properly decontaminated, taken out of the field, and appropriately placed for overnight storage and/or charging.

Calibration checks may suggest the need for maintenance or calibration by the manufacturer. Field instruments that do not meet the calibration requirements will be taken out-of-service until acceptable performance can be verified. Maintenance should be performed when the instrument will not adequately calibrate. Maintenance of field equipment should be noted in an instrument logbook or field notebook.

6.2 Laboratory Equipment Calibration

Before any instrument is used as a measuring device, the instrument's response to known reference materials must be determined. The manner in which various instruments are calibrated is dependent on the particular type of instrument and its intended use. Preparation of reference materials used for calibration will be documented in a laboratory notebook.

The two types of laboratory instrument calibration are initial calibration and continuing calibration. Initial calibration procedures establish the calibration range of the instrument and determine instrument response over that range. Typically, three to five analyte concentrations are used to establish instrument response over a concentration range. The instrument response over that range is expressed as a correlation coefficient. This is not entirely applicable to radiological analytical methods.

Calibration verification typically measures the instrument's response to fewer calibration standards and requires instrument response to fall within certain limits (e.g., 10 percent) of the initial measured instrument response. Calibration verification may be used within an analytical sequence to verify stable calibration throughout the sequence and/or to demonstrate that instrument response did not drift during a period of non-use of the instrument. This is not entirely applicable to radiological analytical methods.

The procedures contained in the analytical method and this QAPP (Appendices A and C) will be used for calibration. If an analytical method is not addressed in the QAPP, the calibration procedure outlined in the analytical method will be utilized. In addition, the following procedures will be used for the calibration of balances and thermometers.

6.2.1 Balances

Laboratory balances will be calibrated and serviced annually by a certified external contractor. In addition, the analyst will check the balance daily before use. Calibration should include weights that bracket the approximate weights of the samples or reagents to be measured. A record of calibrations and daily checks will be maintained in the balance log.

6.2.2 Thermometers

Oven and refrigerator thermometers will be calibrated annually against a National Institute of Standards and Technologies (NIST)-certified thermometer in the range of interest. Annual calibrations will be recorded in a calibration notebook. Daily oven and refrigerator readings will be recorded in a notebook or captured by an electronic log if the oven or refrigerator is monitored electronically.

6.3 Records

Records will be maintained as evidence of required calibration frequencies, and equipment will be marked suitably to indicate calibration status. If marking on the equipment is not possible, records traceable to the equipment will be readily available for reference.

SECTION 7.0 PREVENTIVE MAINTENANCE

7.1 Field Equipment

As discussed in Section 6.0 of this QAPP, contractor field equipment will be properly calibrated, charged, and in good general working condition prior to the beginning of each working day. Maintenance and calibration of equipment prior to field use will be a prerequisite. As appropriate, field instruments will be maintained in accordance with manufacturer specifications. When used, field test-kits will be inspected and associated monitoring equipment will be maintained in accordance with manufacturer specifications.

Field instruments and field test-kits will be properly protected against inclement weather conditions during the field investigation. Each instrument is specially designed to maintain its operating integrity during variable temperature ranges that are representative of the ranges that will be encountered during cold-weather working conditions. At the end of each working day, field equipment will be taken out of the field and appropriately stored overnight. Field instrumentation and equipment maintenance, repair, and calibration procedures will be in accordance with manufacturer specifications.

7.2 Laboratory Equipment

The ability to generate valid analytical data requires that analytical instrumentation be properly maintained. The laboratory will be responsible for appropriate maintenance for major instruments. The following three elements of an effective maintenance program are identified and discussed in the following subsections:

- Instrument maintenance logbooks;
- Instrument calibration and maintenance; and
- Available spare parts.

7.2.1 Instrument Maintenance Logbooks

Each analytical instrument will be assigned an instrument logbook. Maintenance activities will be recorded in the instrument logbook and the information entered will include:

- Date of service;
- Person performing service;
- Type of service performed and reason for service;
- Replacement parts installed (if appropriate); and
- Miscellaneous information.

If service is performed by the manufacturer, a copy of the service record will be taped into the page facing the logbook page where the above information-cited has been entered.

7.2.2 Instrument Calibration and Maintenance

The routine calibration procedures used for analytical instrumentation are described in Section 6.0. Preventive maintenance and calibration by manufacturer service representatives will be provided on a routine basis.

Procedures for maintenance will be in accordance with manufacturer specifications. The laboratory and field teams should have a preventive maintenance schedule for all instrumentation.

7.2.3 Spare Parts

The laboratory will be responsible for maintaining inventories of routinely required spare parts (e.g., vacuum pumps and filaments for mass spectrometer sources; and spare torches and burner heads for ICP). The Laboratory QA Manager has the responsibility to ensure that an acceptable inventory of spare parts is maintained.

SECTION 8.0

DATA REDUCTION, VALIDATION AND REPORTING

Data validation is a process used to determine if data are accurate, complete, or meet specified criteria (ANSI, 1995). Data validation objectives are as follows:

- Produce data with values that are validated and of a known quality;
- Evaluate the internal, spatial, temporal, and physical consistency of the data; and
- Intercompare data to identify errors, biases, or outliers. (EPA, 2003)

The data validation process will consist of data generation, reduction, and review of both field data and laboratory analytical data. The results of the validation will be included with the original hardcopies of the data and will be maintained in the project file. The data will be recorded in the Site database.

8.1 Field and Technical Data

The field and technical (non-laboratory) data that will be collected during the field effort can generally be characterized as either “objective” or “subjective” data. Objective data (e.g., field test-kit results) include direct measurements of field data such as field screening/analytical parameters and water-level measurements. Subjective data include descriptions and observations such as descriptions of sampling locations and conditions and physical descriptions of auger samples.

Field data collected during the field activities will be evaluated for usability by conducting a QA review that consists of checking the procedures used and comparing the data to previous measurements. Field QC samples will be evaluated to ensure that field measurements and sampling protocols have been observed and followed. Checks will include, but may not be limited to, the following:

- Calibration method and frequency;
- QC lot number;
- Date and time sampled;
- Preservation;
- Samplers;
- Laboratory;
- Chain-of-Custody forms; and
- Date shipped.

Validity of data will be determined by checking calibration procedures used in the field and by comparing the data to previous measurements, if any, at the specific location. Large variations (greater than 50 percent) will be examined for possible re-collection of data or assignment to a lower level of validity.

If geologic data are generated, geologic logging data will be subject to field QC checks and a subsequent technical review after entry into a geologic logging and data management system. Subjective data will be filed as hardcopies for subsequent review and incorporation into technical reports, as appropriate.

The subjective data will be formatted into a usable medium, such as a computer database program. The database will allow for the generation of summary tables, graphs, and figures while maintaining the integrity and accountability of the original data.

The QA review for usability of objective field and technical data will be performed at two levels. For the first level, data will be reviewed at the time of collection by following standard procedures and QC checks. For the second level, after data reduction to table format or arrays, the data will be reviewed for anomalous values. Any inconsistencies or anomalies identified by this review will be immediately resolved, if possible, by seeking clarification from the field personnel responsible for collecting the data. Inconsistencies and anomalies will be documented during the validation process.

Subjective field and technical data will be approved for use by review of field reports for reasonableness and completeness. In addition, random checks of sampling and field conditions will be made to check recorded data at that time to confirm the recorded observations. Whenever possible, peer review also will be incorporated into the data QA review process, particularly for subjective data, to maximize consistency among field personnel. For example, during drilling activities, scheduled periodic reviews of archived lithologic samples will be performed to ensure that field personnel are consistently applying the appropriate lithologic descriptions and codes.

8.2 Laboratory Data Documentation

The laboratory will retain records of the analytical data and project files for a minimum of 5 years, or longer in order to meet the requirements stipulated in the Order, from the date of the report.

8.2.1 Data Reduction

Data reduction is performed by the individual analysts and consists of calculating concentrations in samples from the raw data obtained from the measuring instruments. The complexity of the data reduction will be dependent upon the specific analytical method and the number of discrete operations (i.e., extractions, dilutions, and levels/concentrations) involved in obtaining a sample that can be measured.

For those methods using a calibration curve, sample response will be applied to the linear regression line to obtain an initial raw result, which will then be factored into equations to obtain the estimate of the concentration in the original sample. Rounding will not be performed until after the final result has been obtained to minimize rounding errors; results will not normally be expressed in more than three significant figures. Copies of raw data and calculations used to generate the final results will be retained on file to allow reconstruction of the data reduction process at a later date.

8.2.2 Laboratory Data Review

System reviews are performed at all levels. The individual analyst constantly reviews the quality of data through calibration checks, QC sample results, and performance evaluation samples. These reviews are performed prior to submission to the Laboratory Project Manager.

Criteria for analytical data review/verification include checks for internal consistency, transmittal errors, laboratory protocol, and laboratory QC. QC sample results and information documented in field notes will be used to interpret and evaluate laboratory data. The laboratory QA personnel will independently conduct a complete review of selected reports to confirm analytical results.

The laboratory will complete standard validation procedures, including:

- Verifying analyses requested were analyses performed
- Preliminary data proofing for anomalies - investigation and corrections, where possible
- Reviewing laboratory data sheets for detection limits, holding times, surrogate recovery performance, and spike recovery performance
- Double-checking computerized data entry, if applicable

The Laboratory Project Manager will review data for consistency and reasonableness with other generated data and determine whether program requirements have been satisfied. Selected hardcopy output of data (chromatograms, spectra, etc.) will be reviewed to ensure that results are interpreted correctly. Unusual or unexpected results will be reviewed, and a determination will be made as to whether the analyses should be repeated. In addition, the Laboratory Project Manager may recalculate selected results to verify the calculation procedure.

Prior to final review/signoff by the Laboratory Project Manager, the Data Reporting Department will verify that the report deliverable is complete and in proper format, screen the report for compliance to laboratory and client QA/QC requirements, and ensure that the Case Narrative addresses any noted deficiencies. The Laboratory Project Manager will perform the final

laboratory review prior to reporting the results to the QAM and Consultant Project Manager. The Consultant Project Manager will perform a final completeness check before submitting the data report to the ARC Project Manager.

The Laboratory QA Coordinator will independently conduct a complete review of selected projects to determine whether laboratory and client QA/QC requirements have been met. Discrepancies will be reported to the Laboratory Project Manager for communication to the Contractor QAM.

8.2.3 Data Reporting/Deliverable Package

The data will be reported in the data package format specified in Appendix B. The laboratory will be responsible for providing a Brown and Caldwell approved electronic data deliverable (“EDD”) to the QA oversight consultant within 21 days of sample receipt, as well as analytical data packages in a scanned image format (i.e., pdf) and hardcopy of the Level IV data packages. Longer time for data deliverables may be necessary for certain analytical fractions and matrices (i.e. air samples, biota samples). If resubmittals are required from the laboratory, they will be provided to the QA oversight consultant within seven days from the day of request.

The deliverable package will contain final results (uncorrected for blanks and recoveries), analytical methods, detection limits, surrogate recovery data, method blank data, and results of QC samples (where applicable). In addition, special analytical problems and/or any modifications of referenced methods will be noted. The number of significant figures reported will be consistent with the limits of uncertainty inherent in the analytical method. Data are normally reported in units commonly used for the analyses performed. Concentration units are specified on Tables 3-1 through 3-5.

QC results reported will include method blanks, LCSs, MS/MSD samples, laboratory duplicate samples, and field QC samples. Sample data results (including QC sample results) will also be entered into the program data management system. The laboratory is responsible for reviewing the electronic data to ensure that these data are consistent with the hardcopy reports.

8.3 Data Review and Verification/Validation

The purpose of analytical data verification/validation is to qualify data due to data quality limitations and to identify data reduction errors. In addition to the laboratory QA review, the fully documented data packages will be evaluated by the Data Validator for the following:

- Compliance with requested testing
- Completeness
- Confirmation of receipt of requested items

Selected data will be independently validated by the Data Validator, who will validate the data with guidance from the in *EPA Contract Laboratory Program National Functional Guidelines for Organic Data Review* (EPA, October 1999); *EPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review* (EPA, February 1994); and *Region 9 Superfund Data Evaluation/Validation Guidance* (EPA Region 9, December 2001). EPA Functional Guidelines, which were developed for the validation of data generated in accordance with the Contract Laboratory Program (“CLP”), are not completely applicable to the type of analyses/protocols associated with the analyses for this Site. The Data Validator will perform the validation by applying the EPA guidelines as appropriate; by assessing the data relative to method QC protocols, DQOs in this QAPP; and by using professional judgment.

Under the direction of the QA Oversight Contractor, the Data Validator will perform complete data validation (including raw data evaluation) on 20 percent of the air, soil, sediment, surface water, groundwater, drinking water, and biota samples collected. As described in individual RI Work Plans, ARC may request this percentage to be reduced for specific media based on historic analytical results, technical rationale, and other factors (e.g., the use of ‘routine’ analytical methods or sampling procedures, etc. in the OU-specific field and sampling plan). Rationale for proposing a reduction in data validation from 20 percent includes, but is not limited to, the following:

- Analytes/analyte lists that are not compounds of concern (e.g., water quality parameters).
- Data that will not be for risk assessment of remedial decision-making.

- A robust database of previously collected samples (e.g., select ground water locations)
- A statistical assessment of long term data sets yielding similar data qualification/rejection between data verification and data validation.
- The production of adequate results from a project laboratory over a defined period of time.

Written approval by EPA for the reduction of the data validation percentage to some value less than 20 percent in any work plan would be required for ARC to implement that reduction.

Under the direction of the QA Oversight Contractor, the Data Validator will perform data verification on approximately 80 percent of the data for samples collected. The specific measures evaluated during verification and the associated criteria are addressed in this QAPP (Tables 3-1 through 3-7) and include the measures specified below:

- Holding times;
- Accuracy (by evaluating MS/MSD and LCS recovery);
- Precision (by evaluating field and laboratory duplicate results);
- Blank contamination (laboratory method blanks and field-generated blanks);
- Surrogate compound recoveries;
- Tracer/Carrier recoveries;
- Percent solids for solid matrices;
- Chain-of-Custody; and
- Case Narrative.

Instrument calibration and raw data for the field and QC samples are not evaluated during the data verification process.

The full data validation includes the review of the QC measures reviewed during the data verification but also includes the review of the summary forms for all quality control procedures and all sample and quality control raw data (including instrument calibration) to support the results reported.

The Data Validator will use the following data validation qualifiers.

- U The analyte was analyzed for, but was not detected above the level of the reported sample detection limit.
- J The analyte was positively identified but the result is an estimated quantity. The associated numerical value is the approximate concentration of the analyte in the sample.
- UJ The analyte was analyzed for, but was not detected above the level of the reported sample detection limit. The reported detection limit is approximate and may be inaccurate or imprecise.
- R The data are unusable. The sample results are rejected due to serious deficiencies in the ability to analyze the sample and meet quality control criteria. The analyte may or may not be present in the sample.
- UR The analyte was analyzed for, but was not detected above the level of the reported sample detection limit; however, the data are unusable. The sample results are rejected due to serious deficiencies in the ability to analyze the sample and meet quality control criteria. The analyte may or may not be present in the sample.
- N The analysis indicates the presence of an analyte for which there is presumptive evidence to make a “tentative identification”.
- NJ The analysis indicates the presence of an analyte that has been “tentatively identified” and the associated numerical value represents its approximate concentration.

In conjunction with the aforementioned data validation qualifiers, the Data Validator will also use the following “Valid Reason Codes” to further describe data qualifications/limitations.

- 1 Holding time violation
- 2 Method blank contamination
- 3 Surrogate recovery
- 4 Matrix spike/matrix spike duplicate recovery
- 5 Matrix spike/matrix spike duplicate precision outside limits
- 6 Laboratory control sample recovery
- 7 Field blank contamination
- 8 Field duplicate precision outside limits
- 9 Other deficiencies (including cooler temperature)
- A Absence of supporting QC
- S ICV, CCV or column performance check problem
- Y Initial and continuing calibration blank problem

- M Interference check samples problem
- O Post-digestion spike outside of 85-115 percent
- F MSA correlation coefficient <0.995, or MSA not done
- G Serial dilution problem
- K DFTPP or BFB tuning problem
- Q Initial calibration problem
- X Internal standard recovery problem
- V Second source standard calibration verification problem
- L Low bias
- Z Retention time problem
- N Counting time error (radiochemical chemistry)
- W Detector instability (radiochemical chemistry)
- C Co-elution of compounds
- E Value exceeds linear calibration range
- I Interferences present during analysis
- T Trace level compound, poor quantitation
- P 1C/2C precision outside of limits
- B LCS/LCSD precision outside limits
- D Lab Dup/Rep precision outside limits
- H High bias

8.4 Data Management

A copy of the chain-of-custody will be delivered to the Consultant Project Manager for inclusion in project files. Upon receipt and log-in of the samples at the laboratory, the remaining sections of the field chain-of-custody will be noted on the field chain-of-custody. These sections include description of the sample condition at the time of receipt, assigned laboratory batch number, laboratory identification number, and any special conditions. The laboratory will document discrepancies, and the Consultant Project Manager will be notified. The field chain-of-custody information will be initially keyed into and maintained in the laboratory's database.

A copy of the laboratory's chain-of-custody information, referred to as a sample receipt confirmation, will be sent to the Consultant Project Manager following sample log-in for verification of properly entered handwritten chain-of-custody requests and information such as sample identification numbers, analyses requested, and the quantity of samples. In cases of discrepancies between the field chain-of-custody and the sample receipt confirmation, the appropriate revisions will be communicated to the laboratory for the chain-of-custody corrections. Corrected information on the field chain-of-custody will be recorded into the project database.

The samples received by the laboratory will be analyzed following internal laboratory QC procedures. Following sample analysis, the laboratory will deliver the EDD to the field consultant where it will be uploaded into the project database. The EDD will then be delivered to the Data Validator to be used in the data validation/verification process. If any required information is missing or if database fields are inappropriately filled, the laboratory and field consultant will be notified and the laboratory will provide a corrected EDD.

8.5 Data Archival

Applicable electronic field and laboratory data collected from Site investigations will be archived electronically for a minimum period of 5 years, or longer in order to meet the requirements stipulated in the Order. Backup tapes containing databases and programs or software utilities will be maintained in a secure location.

8.6 Contractor Data Assessment

An assessment of the data quality will be made by the QAM and/or Data Validator receiving the analytical laboratory report. The assessment should be included with the report in which the data are first presented. During the assessment, the data reviewer may evaluate:

- Whether appropriate sample collection equipment, sampling procedures, and decontamination procedures were used;
- For groundwater data, whether groundwater quality indicator parameters either stabilized during purging or the well was purged to dryness;

- Whether proper sample containers and preservatives were used;
- The completeness of Chain-of-Custody documentation;
- The sample condition upon laboratory receipt;
- Whether analytical holding times were exceeded;
- Any contamination suggested by laboratory method, or by field, trip, and equipment blanks;
- The accuracy as indicated by surrogate, LCS, and matrix spike recoveries compared to the QAPP DQO;
- The precision as indicated by field duplicates, laboratory duplicates, and laboratory matrix spike duplicates compared to the QAPP DQO;
- The completeness as indicated by the degree the planned sampling locations yielded usable data compared to the QAPP DQO;
- Other laboratory QA issues noted by the analytical laboratory report such as laboratory calibration or internal standard problems, or quantification of analytes outside the calibration range;
- The data reduction calculations; and
- The historical data for that location (for example, whether a data point from a groundwater well sample is consistent with past data from that well).

Each data validation report will include a section that provides an assessment of project data. Sensitivity will be evaluated on a sample by sample basis and cases where project reporting limits for specific analytes could not be met by the laboratory (e.g., sample dilutions or matrix interference) will be detailed in this section. Depending on the intended data use, it may be determined that additional sample cleanups and/or resampling and reanalysis by a different analytical technique be performed in cases where project reporting limits for specific analytes could not be met by the laboratory.

8.7 Standard Plans and Reports

Project reports (e.g., characterization reports) will include a section (or appendix) on QA review. This review will summarize field documentation, field audits, field screening, sample collection and method analysis, duplicate sample precision, field blanks, trip blanks, sample holding times, MS/MSD recoveries and precision, LCS recoveries, surrogate recoveries, and laboratory method blank results. Any corrective actions taken will also be identified.

8.8 Use of QC Sample Results

Quality control samples (e.g. duplicates, splits, blanks) will be used in evaluating the quality of the original field samples by identifying possible laboratory or field sampling quality issues such as contamination or laboratory recovery. If sample quality issues are identified, then the samples will be reanalyzed by the labs or recollected if required. The QC samples will not be used in data analysis including summary tables, graphs or maps. Where duplicate samples are collected along side normal field samples, only the results of the normal field sample will be used.

SECTION 9.0 PERFORMANCE AND SYSTEM AUDITS

The primary objective of performance and system audits is to ensure that the established QA/QC procedures are properly implemented. Audit documentation will be maintained in the project file.

9.1 Performance Audits

Performance audits are quantitative evaluations of data quality produced by a particular activity or function. At the direction of the ARC Project Manager, and at a minimum of once per year, performance audits of the laboratories will be conducted through the submission and analysis of single- or double-blind performance evaluation samples. The QAM will coordinate the manufacture and submission of performance audit samples to the laboratories. An EPA-approved performance test (“PT”) provider will obtain the performance evaluation samples.

9.2 System Audits

A systems audit entails an on-Site evaluation of the laboratories and/or on-Site evaluation of the field sampling activities of the field teams for compliance with the QAPP, SOPs, and/or RI Work Plans. At the direction of the ARC Project Manager, and at a minimum of once per year, system audits of the field and laboratory activities will be conducted. Prior to conducting an on-Site audit, the auditor should review the findings of previous audits and examine procedures and records. These on-Site audits will also include verification of effectiveness of implemented corrective actions. On-Site audits will be performed by the Laboratory Auditors or Field Auditors under the direction of the QAM.

The system audits will address both field and laboratory activities, including a review of personnel qualifications, equipment, documentation, sampling techniques, analytical methods, and adherence to QA/QC procedures. Because laboratories have their own Quality Assurance

Plans the laboratory audit activities under this project QAPP will entail a general review of laboratory quality assurance practices. The Field Auditor will witness field operations during an audit (witnessing laboratory operations on specific field samples is not required).

9.3 Audit Report

Audit findings will be submitted, in writing, to the ARC Project Manager for review. Each audit report should summarize scope and results of the audit. In the event that inadequacies are identified, corrective actions will be undertaken as outlined in Section 10.

SECTION 10.0 FEEDBACK AND CORRECTIVE ACTIONS

10.1 Feedback Mechanism

There are mechanisms within the project structure that allow for the identification, feedback, and control of any nonconformances or deficiencies. In general, the technical personnel involved with the project are responsible for reporting suspected technical nonconformances through standard communication channels established by the organizational structure. In the same manner, project personnel are responsible for reporting suspected QA nonconformances.

10.2 Corrective Action

Corrective action may be initiated under several situations. Table 10-1 lists several possible problems and example corrective actions. The form that will be used for all project corrective actions is included in Appendix D. All personnel involved in the environmental project are responsible for identifying the need for corrective actions. The person who identifies the problem will immediately notify the person who is responsible for the activity.

Before re-sampling is done to correct a problem, the data user should evaluate the project completeness goals. If the goals are met and a sufficient number of data was obtained, then re-sampling may not be necessary and improper/inconsistent data may be rejected.

When a problem is not quickly resolved or has a cost effect, the ARC Project Manager, Consultant Project Manager, and QAM should be notified. Data quality problems that cannot be resolved may need to be reported with qualifying statements.

During performance and systems audits, the Laboratory or Field Auditor may find deficiencies in personnel qualifications, instrumentation, or documentation. Problems with existing procedures may be identified through audits or field observations. The Laboratory or Field Auditor should

review documented QA problems and verify that corrective actions were completed. Existing deficiencies will be documented by the auditor and resolved by the personnel responsible for the activity.

Table 10-1. Potential Corrective Actions		
Problem	Action Identified By	Example Corrective Actions
An instrument malfunctions.	Analyst	The instrument is taken out-of-service until the malfunction can be remedied. Instrument operation and calibration are checked. Calibration standards are checked and new standards prepared as necessary. The instrument is repaired, as needed.
Review of field or laboratory data suggests that calculations are in error.	Reviewer	The results are re-calculated.
Review of field or laboratory data suggests that an improper technique was used.	Reviewer	The task is repeated using the proper technique.
An insufficient number of data points were obtained.	Reviewer	If data completeness goals are not met, re-sample and analyze to generate missing data points. Additional samples are collected.
Historical data suggest that a data point is inconsistent.	Reviewer	The data point is re-sampled and analyzed. If the problem persists or is critical in nature, a different sampler repeats the sample collection or a different analyst reanalyzes the sample.
Review of electronic COC Records suggests that information recorded by the field personnel is in error.	Reviewer	The error(s) are documented. Amended electronic COC Records are issued by the field personnel.
A performance and systems audit suggests a deficiency.	Auditor	The deficiency is evaluated and, if indicated, corrected. Corrective action is documented.

10.2.1 Field Activities

Field personnel have the initial responsibility to monitor the quality of field measurements and observations. The Field Team Leader is responsible for verifying that QC procedures are followed. This responsibility requires the Field Team Leader to assess the correctness of field methods and the ability to meet QA objectives. If a problem occurs that might jeopardize the integrity of the project or that might cause a specific QA objective to not be met, the Field Team Leader will notify the Consultant Project Manager and the QAM. An appropriate corrective action will then be determined and implemented.

The Field Team Leader will document the problem, the corrective action, and the results. Copies of the documentation form will be provided to the Consultant Project Manager, QAM, and ARC Project Manager.

10.2.2 Laboratory Corrective Action

The laboratory has the responsibility to monitor the quality of the analytical system. The laboratory will verify that QC procedures are followed and that the results of QC analyses samples are within the acceptance criteria. This verification requires that the laboratory assess the correctness of the following items, including but not limited to:

- Sample preparation procedure;
- Initial calibration;
- Calibration verification;
- Instrument tuning;
- Method blank result;
- Laboratory control samples;
- Laboratory duplicate analysis;
- Fortified sample result;
- Surrogate recoveries;
- Chemical Yields; and
- Internal standard performance.

If the assessment reveals that the QC acceptance criteria are not met, the laboratory must immediately evaluate the analytical system and correct the problem. The analyst will notify the Laboratory QA Coordinator of the problem and, if possible, will identify potential causes and suggest corrective action. Figure 10-1 (page 102) presents the pathway for corrective actions.

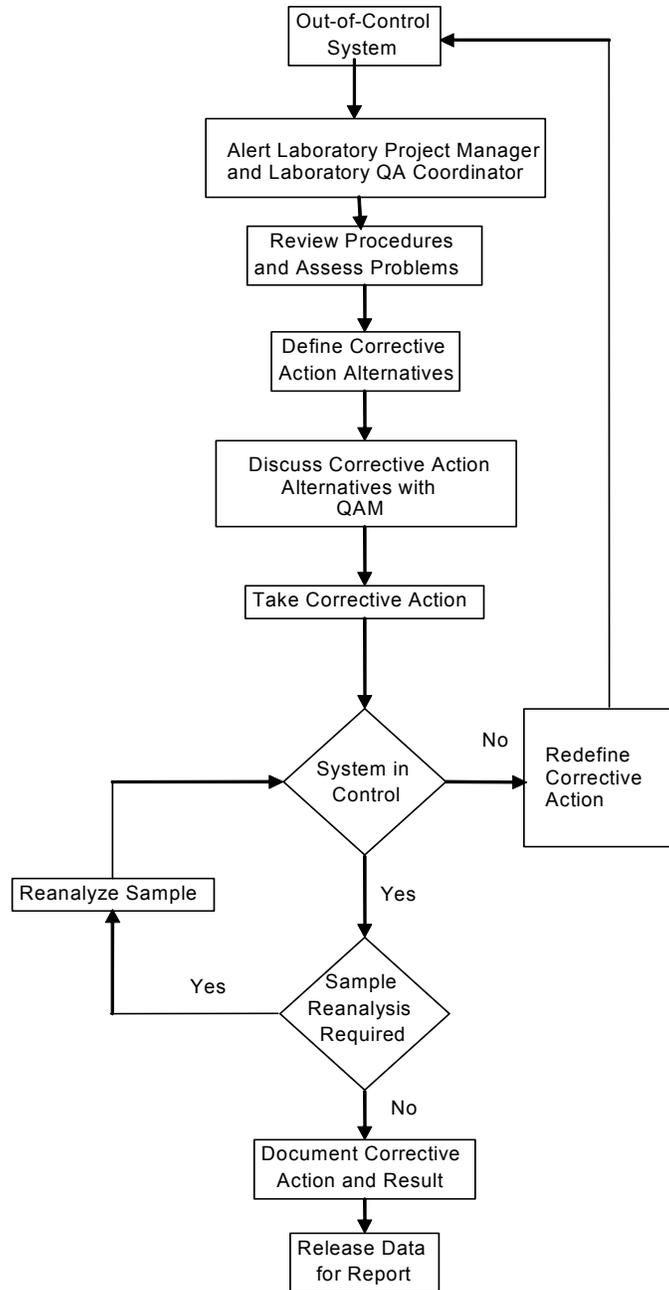
The nature of the corrective action obviously depends on the nature of the problem. For example, if a calibration process is determined to be out-of-control, the corrective action may require recalibration of the analytical system and reanalysis of all samples analyzed since the last acceptable continuing calibration standard.

When the appropriate corrective action measures have been defined and the analytical system is determined to be “in control,” the analyst will document the problem, the corrective action, and the data demonstrating that the analytical system is in control. Copies of the documentation will be provided to the Laboratory QA Coordinator.

Data generated concurrently with an out-of-control system will be evaluated for usability relative to the nature of the deficiency. If the deficiency does not impair the usability of the results, data will be reported and the deficiency will be addressed in the case narrative. If sample results are impaired, the Laboratory Project Manager will be notified and appropriate corrective action (e.g., reanalysis) will be taken.

The specific approach to corrective action procedures for laboratory instruments will be those contained in Appendix A, in the analytical method, or the procedures specified in the laboratory quality assurance plan.

FIGURE 10-1
Critical Path For Laboratory Corrective Action



SECTION 11.0

QUALITY ASSURANCE REPORTS TO MANAGEMENT

Communication among ARC, laboratory, field consultant, and QA oversight consultant personnel is important to ensure that problems are remedied and that solutions are documented in an informed and timely manner.

At least once a year, the QAM should assess and prepare a QA report to the ARC Project Manager. This QA report will include significant unresolved QA problems and recommended solutions. The report should also discuss resolved problems and the corrective actions taken since the last management report. The ARC Project Manager is responsible for ensuring that QA problems, identified in the QA reports, are resolved.

Within 45 days after the completion of a performance and systems audit, the QAM will submit an audit report to the ARC Project Manager. This audit report should include a list of observed field activities, a list of reviewed documents, and any observed deficiencies. The ARC Project Manager and QAM will meet with the laboratory and/or Consultant Project Managers of any area with observed deficiencies to review the audit findings, confirm the observations, and to resolve misunderstandings. In the event that inadequacies are identified, corrective actions will be undertaken as outlined in Section 10.0.

11.1 Field QA Reports

The Field Team Leader will provide the Consultant Project Manager with daily field progress reports and with weekly compiled field data sets. The Consultant Project Manager will immediately notify the QAM and ARC Project Manager about field QA situations that require corrective action.

11.2 Laboratory QA Reports

The Laboratory QA Coordinator will provide periodic, routine summary reports specific to the project to the ARC Project Manager. These reports will summarize QA activities for the reporting period, including results of performance audits (external and internal), results of system audits (external and internal), summaries of corrective action to remedy out-of-control situations, and recommendations for revisions of laboratory procedures to improve the analytical systems. The Laboratory Project Manager will notify the QAM and ARC Project Manager about laboratory QA situations that appear to systematically impact data quality.

11.3 Data Submittals

The electronic data deliverable and complete data packages (scanned images onto a pdf) will summarize the deviations from approved protocols and significant data findings in the Case Narratives. Analytical reports will be submitted to the Consultant Project Manager and QAM as separate documents and will be transmitted in electronic formats (pdf for data package and in the database required file format). The QAM or the Consultant Project Manager may request a hardcopy of the data package for selected samples.

Electronic data will be archived for a minimum period of five years, or longer in order to meet the requirements stipulated in the Order.

SECTION 12.0
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