	Cimarron Environmental Response Trust	
environmental properties management, LLC	Cimarron Site Sampling and Analysis Plan	
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Reviews and Approvals	
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QAIP 9.1-1 Chain of Custody Form
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Glossary

Activity Plan: A working level document establishing the elements of a work activity important to quality, and also establishing the sequence of work necessary to successfully complete the work activity.

Assigned Leader: The individual assigned by the Trustee Project Manager with overall responsibility to complete the work described in an Activity Plan.

Cimarron Environmental Response Trust (CERT): The Trust established as having overall responsibility for environmental liabilities at the Cimarron Site in accordance with the January 26, 2011 Settlement Agreement with the Department of Justice (DOJ), the Nuclear Regulatory Commission (NRC) and the State of Oklahoma. The CERT is represented by the CERT Administrator.

Cimarron Site: Refers to the effort to remediate the location of the former Kerr-McGee facility in Crescent, Oklahoma (near Cimarron, Oklahoma), including characterization and remediation of radioactive and chemical contamination, to fulfill requirements for the Cimarron Site established by the NRC and the State of Oklahoma.

Cimarron Site Personnel: Any person performing remediation work or work directly supporting remediation of the Cimarron Site in Crescent, Oklahoma.

Contractor: Any organization or individual contracted directly to the Trustee.

Controlled Document: Any document the Trustee Project Manager or Quality Assurance Coordinator determine should be controlled to assure any user possess the most current revision of the document. This includes the QAPP and all implementing procedures.

Hold Point: A stopping point in a procedure or work plan requiring a signature or initials to verify that data has been recorded or that required actions are verified as complete before proceeding. Hold Points are used as a quality assurance measure in Activity Plans.

Quality Activity: Any activity that supports a decision affecting license termination or site closure, or that is otherwise required by the Trustee Project Manager or Quality

Assurance Coordinator to be subject to the quality assurance program to ensure the success of the Cimarron Site.

Quality Data and Activities: Data and Activities that directly or indirectly support decisions affecting license termination or site closure. Quality data collection and management, and quality activity performance, are subject to the requirements of the Cimarron Site Quality Assurance Program.

Quality Assurance Program Plan (QAPP): The QAPP establishes the structure of the Cimarron Site Quality Assurance Program, including implementing procedures, referenced procedures and plans, and quality requirements directly established in the QAPP's 18 basic criteria descriptions.

Quality Assurance Program (QAP): The Cimarron Site's overall program for quality assurance, as described in the Quality Assurance Program Plan (QAPP).

Quality Assurance Records: Records of site activities or data as prescribed in Section 17.0 of the QAPP.

Station: An observation point where a sample may be collected. Stations are not unique to each sample.

Subcontractor: Any organization or individual contracted with a contractor to the Trustee.

Trustee: Environmental Properties Management (EPM), the Trustee identified in the January 26, 2011 Settlement Agreement with the Department of Justice (DOJ), the Nuclear Regulatory Commission (NRC) and the State of Oklahoma.

Trustee Project Manager: The employee of the Trustee assigned overall responsibility for the administration of work at the Cimarron Site.

1.0 INTRODUCTION

1.1 Scope

This Sampling and Analysis Plan (SAP) governs activities being performed at the former Cimarron Corporation facility in Crescent, Oklahoma. It specifies sample collection requirements for environmental media, and includes sampling requirements for quality assurance quality control (QA/QC) programs. It also specifies sampling equipment decontamination, documentation, sample preparation and shipment, and laboratory analytical methods. Finally, it specifies requirements for groundwater monitoring well installation and abandonment.

This document is to be used by Cimarron Site personnel and contractors who collect samples of environmental media and/or submit samples for analysis. An Activity Plan will be developed for each sampling event. The Trustee Project Manager (PM), QA coordinator and Assigned Leader for each Activity Plan are responsible for ensuring that sampling and requests for analyses are performed in accordance with this SAP. The Trustee PM may authorize departures from this SAP if activity requirements make the provisions of this SAP impractical or inappropriate. Such departures need to be documented and reported to the QA Coordinator (QAC).

1.2 Regulatory Oversight

The Cimarron facility operated as a nuclear fuel production facility under License SNM-928 until the site was closed in 1975. Facility decommissioning began in 1976. The decommissioning of equipment, structures, and soil is complete. The current mission at the Cimarron Site is the remediation of groundwater contaminants to release levels established by the US Nuclear Regulatory Commission (NRC) and the Oklahoma Department of Environmental Quality (ODEQ). As a result of an NRC order dated February 16, 2011 and effective February 14, 2011, the license has been transferred to the Cimarron Environmental Response Trust (CERT), with Environmental Properties Management, LLC (EPM) named as the trustee. The groundwater remediation activity requires planning, data collection and management, and decision-making tasks that are subject to NRC established quality requirements, as well as remediation requirements established by the State of Oklahoma and the ODEQ.

2.0 SURFACE SAMPLING

2.1 Introduction

Surface sampling includes any sampling of soil, sediment, waste, surface water or vegetation for geotechnical, chemical, or radiological analysis when such sampling is performed at shallow depths (usually less than one meter in depth).

2.2 Soil Sample Collection

Soil samples will be collected at stations as stipulated in Activity Plans. Surface soil sampling will be performed in accordance with procedure EPM-SAP-101, "Surface Soil Sampling".

2.3 Sediment Sample Collection

Sediment samples will be collected at stations as stipulated in Activity Plans. Sediment sampling will be performed in accordance with procedure EPM-SAP-102, "Sediment Sampling".

2.4 Surface Water Sample Collection

Surface water samples will be collected at stations as stipulated in Activity Plans in accordance with procedure EPM-SAP-103, "Surface Water Sampling". Because of the potential for interference from suspended solids, algae and other biological activity, all surface water samples for off-site radiological analyses are field filtered using a 0.45 micron filter.

If the lab has provided a pre-preserved bottle, the filtered sample is deposited directly to the bottle. If the bottle is not pre-preserved, add a sufficient volume of acid (typically, 2-10 ml per liter of sample) to lower the filtered sample to a pH <2.

The decision to filter surface water samples for all other analyses is dependent upon whether the objective is to analyze for total (unfiltered) or dissolved (filtered) constituents, and must be specified in the Activity Plan.

2.5 Vegetation Sample Collection

Vegetation samples are not anticipated to be collected on this site because of the amount of decommissioning activities that have already occurred. The procedure is included in this SAP for completeness only. If required, vegetation samples will be collected in accordance with procedure EPM-SAP-105 "Vegetation Sampling".

3.0 SUBSURFACE SAMPLING

3.1 Introduction

Subsurface sampling includes any sampling of soil, waste, or impacted soil for geotechnical, chemical, or radiological analysis when such sampling is performed at depths usually greater than one meter. Prior to performing direct push, excavation, or drilling, precautions shall be taken to avoid damaging utilities or pipelines. Clearance for all utilities shall be done prior to performing these tasks by contacting appropriate agencies (Call Okie 1-800-522-OKIE).

3.2 Direct Push

Direct push sampling utilizes a hydraulically powered machine to advance probes into the subsurface. Direct push sampling features minimal setup time and little generated waste. Direct push methods may be used to collect subsurface samples and/or groundwater samples, to screen soil or groundwater, and/or to install temporary piezometers.

When performing direct push sampling for groundwater or geologic/hydrologic investigations and lithologic information is needed, a geologist or hydro-geologist must log the lithology of the boring. Samples taken for other purposes, e.g., radiological characterization, confirmatory samples, etc. need not necessarily be described. When logging is determined to be necessary, lithologic descriptions (in accordance with ASTM D 2488), soil classifications, soil sample locations, field screening measurements, and other observations made in the process of performing the boring should be recorded on the soil boring log (form QAIP 9.1-4 or approved equivalent) as described on the form. Sample collection and/or screening must be performed in accordance with procedure EPM-SAP-106, "Direct Push Soil Sampling". Decontamination of sampling tools must be performed in accordance with Section 7.0, Decontamination, and documented in the field logbook.

3.3 Excavation

Excavating equipment (i.e. backhoes and trackhoes) can be used to examine near surface soils. Excavation is beneficial for determining geologic contacts and identifying the presence of contamination, faulting, and for collecting subsurface samples for geotechnical applications.

When performing excavations for groundwater or geologic/hydrologic investigations and lithologic information is needed, a geologist or hydro-geologist must log the lithology of the trench or pit. (Exception: quarterly surface water sample points sometimes need to be obtained from areas which silt in, requiring that small excavated collection basins be created. Such collection basins do not need to be logged). Lithologic descriptions should be provided on the soil boring log (form QAIP 9.1-4 or approved equivalent) with text, photographs, and

illustrations (in accordance with ASTM D 2488), to document soil classifications, soil sample locations, field screening measurements, and other observations made in the process of performing the excavation. Soil sample collection and/or screening must be performed in accordance with procedure EPM-SAP-108, "Excavation Soil Sampling". Decontamination of sampling tools must be in accordance with Section 7.0, "Decontamination", and documented in the field logbook.

3.4 Drilling

This section covers subsurface investigations that involve the use of a drilling rig or power auger. Groundwater monitoring well installation and abandonment requires drilling methods in all but the shallowest zones.

When drilling for groundwater or geologic/hydrologic investigations and lithologic information is needed, a geologist or hydrogeologist must log the lithology of the boring. Text, photographs, and illustrations may be used to provide detailed lithologic descriptions (in accordance with ASTM D 2488). Soil classifications, blow count information, sample locations, field screening measurements, and other observations made in the process of performing the boring should be recorded on the soil boring log (form QAIP 9.1-4 or approved equivalent) as described on the form. Sample collection and/or screening must be performed in accordance with procedure EPM-SAP-109, "Drilling Subsurface Soil and Bedrock Sampling". Decontamination of sampling tools must be in accordance with Section 7.0, "Decontamination", and documented in the field logbook.

3.4.1 Auger Drilling

Auger drilling does not normally require the use of drilling fluids. Solid augers can be used when precise depth of the sample is not important and when undisturbed samples are not needed. Hollow stem augers can be used when relatively undisturbed samples are needed, and when the depth of a soil sample within a boring is important. Samples can be obtained through hollow stem augers by split-barrel samplers (in accordance with ASTM D 1586), by thin-walled Shelby tubes (in accordance with ASTM D 1587), or by using five-foot split barrel continuous samplers. Monitoring wells can be installed in borings drilled by auger drilling methods.

3.4.2 Rotary Wash Drilling

Rotary wash drilling utilizes a drilling fluid to prevent groundwater and surrounding soil from entering the borehole and to flush the cuttings to the surface. When using a core barrel, undisturbed samples can be collected from relatively precise depth intervals in a boring. Such samples can often be submitted for either physical or chemical testing. Core sampling should

be performed in substantial compliance with ASTM standards related to the type of drilling equipment in use, such as ASTM D 2113 for coding with a diamond bit.

Drilling is typically much faster without a core barrel. Samples can be obtained from boreholes by split-barrel samplers (in accordance with ASTM D 1586), or by thin-walled Shelby tubes (in accordance with ASTM D 1587). Split spoon or Shelby tube samplers collect soil samples by hammering or pushing them in advance of the boring. Monitoring wells can be installed in borings drilled by rotary wash methods. Monitoring well installation and development are critical to successful groundwater sampling when installed in rotary wash borings.

3.4.3 Air Rotary Drilling

Air rotary drilling is similar to rotary wash, but the drilling fluid is air. When using a core barrel, undisturbed samples can be collected from relatively precise depth intervals in such a boring. Such samples can often be submitted for physical or chemical analysis; however, air rotary drilling should not be used if VOC analysis is desired. Core sampling should be performed in substantial compliance with ASTM standards related to the type of drilling equipment in use, such as ASTM D 2113 for coring with a diamond bit.

3.5 Downhole Geophysical Logging

Geophysical logging can provide information about the physical properties of subsurface materials surrounding a borehole without collecting physical samples. Subsurface geologic conditions and engineering characteristics can be derived directly or indirectly from a variety of measured properties. Physical samples can provide ground truth information to calibrate and/or validate geophysical interpretation.

Downhole geophysical surveys may be conducted on selected bore holes. Measurements may include spontaneous potential, natural gamma, gamma-gamma (compensated density), and induction. Geophysical logs generated during downhole surveys may take the place of, or can be combined with, standard soil boring logs.

3.6 Geophysical Surveying

Geophysical surveys provide information that can be correlated with characteristics of subsurface materials without excavating them. The results of the geophysical surveys should be integrated with the results of other surveys, such as Global Positioning System (GPS) surveys.

Geophysical survey methods that are commonly used include:

- Ground-Penetrating Radar
- Electromagnetics
- Resistivity
- Seismic Refraction
- Seismic Reflection
- Magnetics
- Metal Detection

Each type of survey has different capabilities and limitations. Only trained individuals who have demonstrated competence in geophysical investigations may plan, supervise, and evaluate data from geophysical surveys.

4.0 GROUNDWATER SAMPLING

4.1 Piezometer and Monitoring Well Installation

Piezometers may be installed to measure groundwater elevations. Groundwater samples can be obtained from piezometers upon regulatory agency agreement, but they are not primarily intended for this purpose. Groundwater monitoring wells must be installed and developed in order to produce representative samples of the groundwater in the aquifer(s) screened. Piezometers and groundwater monitoring wells must be installed in accordance with procedure EPM-SAP-110, "Piezometer and Monitoring Well Installation and Abandonment". This procedure is intended to provide substantial compliance with EPA's "RCRA Groundwater Monitoring Technical Enforcement Guidance Document" (1986) and "RCRA Groundwater Monitoring: Draft Technical Guidance (1992).

4.2 Well Development

The purpose of monitoring well development is to remove fine particles and residual drilling fluid from the filter pack and the natural formation in the vicinity of the screened interval, and to settle and stabilize the material adjacent to the well screen. On newly installed monitoring wells and piezometers, development must be performed or overseen by a qualified hydrogeologist. A field technician, under the direction of a qualified hydrogeologist can perform the redevelopment of older wells.

4.3 In-Situ Permeability Testing

The hydraulic conductivity of a formation can be determined by in-situ permeability testing. In-situ permeability tests can be broadly classified as slug tests and pump tests. In slug tests, a "slug" of water or solid, inert material is withdrawn or inserted into a well so as to displace the water column, and the recovery or drawdown of the well is measured over time. In pumping tests, water is continuously pumped from a well for a period of time, and the drawdown and recovery are measured over a much longer period of time, usually in the pumping well and in nearby observation wells. In-situ permeability testing methods vary widely and are dependent upon both the characteristics of the pumping and observation wells and the hydrogeology of the screened interval. Only a qualified, experienced groundwater hydrologist may design in-situ permeability tests. The design must include the methods for performing the test as well as the methods for collecting and evaluating the data.

4.4 Groundwater Sample Collection

Groundwater sampling is performed under the guidance of the site hydrologist according to work plans or work instructions to determine the chemical or radiological characteristics of groundwater in the formation. Typically, the site hydrologist is the activity supervisor for all groundwater sampling events.

To ensure representative samples, groundwater sampling must be performed in accordance with procedure EPM-SAP-104, "Groundwater Sampling". Because of the potential for interference from suspended solids, algae and other biological activity, all groundwater samples for off-site radiological analyses are field filtered using a 0.45 micron filter.

Samples should be preserved using materials provided by the laboratory (sample bottles pre-loaded with acid, or shipped with ampoules). Verification that the pH is less than 2 is performed by the laboratory prior to analysis; it is not a necessary step in onsite sample preparation.

The decision to filter surface water samples for all other analyses is dependent upon whether the objective is to analyze for total (unfiltered) or dissolved (filtered) constituents, and must be specified in the Activity Plan. Section 6 of this document ("Analytical Methods") provides additional guidance on field preservation (e.g. filtering, acidifying, cooling to 4° C) techniques.

5.0 QA/QC SAMPLES

5.1 Introduction

QA/QC samples are collected and analyzed to identify and assess issues associated with sample collection, packaging, transport, laboratory problems, or matrix interferences. The Activity Plan will identify the need to collect QA/QC samples prior to initiating sampling activities. The four categories of QA/QC samples addressed in this SAP are: duplicates, matrix spike/matrix spike duplicates, rinsate blanks, and trip and/or field blanks. Each sampling Activity Plan should be developed with input from the site technical team or personnel with similar expertise, and must specify any required collection of QA/QC samples based on data quality objectives and the intended use of the data.

5.2 Duplicates

Duplicate samples identify the relative precision of multiple analyses of the same material. Duplicates determine the degree to which data generated from repetitive measurements differ from one another, and are requested when the activity supervisor needs to know the potential for error in analyzing a particular media (e.g., soil, groundwater, etc). With regard to the groundwater monitoring program and the long history of site monitoring, duplicates are not always obtained during routine groundwater monitoring events. The site hydrologist is responsible for determining whether duplicate samples may be required for "non-routine" sampling events.

If determined to be necessary, a duplicate sample will be collected at a frequency indicated in the Activity Plan (typically, one duplicate for every ten samples submitted for laboratory analysis Duplicate samples will be collected in such a manner as to minimize the potential for variance between the "sample" and the "duplicate". Duplicates may be identified in such a manner that the laboratory does not know which sample is being duplicated. The correlation will be noted on the facility forms or in a logbook.

5.3 Matrix Spikes/Matrix Spike Duplicates

Laboratories perform matrix spike (MS) and matrix spike duplicates (MSD) analyses on each "batch" of samples analyzed according to their approved methodologies. MS and MSD samples are actual samples that are "spiked" with known concentrations of known compounds. If the "spikes" are not accurately quantified, the sample matrix could have biased the results of that sample for other compounds.

The Cimarron Site does not routinely submit MS/SD samples to the lab for analyses, although methodologies typically require that the lab run an MS/MSD sample at a rate of one per 20

samples. When not specifically submitted by the Cimarron Site, the lab selects which samples to run for MS/MSD. Samples on which MS/MSD are performed are typically samples that exhibit little to no contamination. Samples with a high level of contamination usually exhibit little to no recovery of spiked compound, making such samples useless for QA/QC purposes.

The submittal of MS/MSD samples to the lab by the Cimarron Site is noted on the Chain of Custody Form.

5.4 Equipment Rinsate Blanks

An equipment rinsate blank is a sample of distilled (analyte-free) water run over (or through) the same decontaminated equipment used to collect the sample. Equipment rinsate blanks do not evaluate the material being sampled, but the adequacy of decontamination procedures. Equipment rinsate blanks identify cross contamination of samples due to sampling (or decontamination) methods.

Such blanks are typically analyzed for the same parameters as the collected water samples. With the extended site history on sample collection and no evidence that decontamination has been a problem in the past, equipment rinsate blanks are not normally collected. If equipment rinsate blanks are determined to be needed based on the data quality objectives and intended use of the data, the activity supervisor will specify the frequency at which they will be obtained.

5.5 Trip and Field Blanks

Trip blanks are prepared by the laboratory and accompany sample containers transported to the site. Trip blanks remain on site un-opened during sampling activities. Trip blanks are used to identify problems associated with sample handling, packaging and delivery. One trip blank will be submitted for each cooler that contains sample containers shipped overnight to the laboratory.

Field blanks are prepared by site personnel and accompany sample containers transported to the laboratory. Field blanks are similar to trip blanks in that they identify problems associated with sample handling, packaging, and delivery. Field blanks are samples of distilled water poured into sample containers by sampling personnel. The Activity Plan may specify the use of field blanks when sample bottles are taken from site inventory (ordinarily the contract lab supplies sample bottles and rarely would field blanks be obtained). When taken, one field blank will typically be submitted to the laboratory each day sampling is performed.

6.0 ANALYTICAL METHODS

6.1 Introduction

Soil, sediment, water, waste, and vegetation samples will be packaged and preserved in accordance with Tables 6-1 and 6-2. Chain of Custody forms must be filled out in accordance with procedure EPM-SAP-111, "Sample Identification and Control".

Surface water and groundwater samples for off-site radiological analyses are preserved in the field by first filtering through a 0.45 micron filter before being preserved with sufficient volume of nitric acid to lower the sample to pH <2. For all other analyses, depending upon whether the objective is for dissolved or total constituents, filtration with a 0.45 micron filter may or may not be performed. Samples must be filtered prior to preservation with acid or other additives. Table 6-1 gives guidance on filtering, acidifying and preserving samples with ice. These guidelines may be modified per sampling event, depending on the data quality objectives (DQO's), work plan, activity plan or work instructions.

6.2 Chemical/Radiological Analyses

Table 6-3 lists acceptable analytical methods for radiological and non-radiological parameters for water and soil (including waste) samples.

6.3 Geotechnical Analyses

Geotechnical analyses will be performed in accordance with applicable ASTM standard methods. Examples include, but are not limited to:

Nuclear Density	D 2922	Density - Sand Replacement	D 4914
Balloon Density	D 2167	Moisture Content (microwave)	D 4643
Moisture Content (oven)	D 2216	Core Permeability (constant head)	D 2434
Core Permeability (falling head)	D 5084	Compaction by Standard Proctor	D 698
Compaction by Modified Proctor	D 1557	Soil Classification	D 2488
Atterberg Limits	D 4318	Field Soil pH Determination	D 4972

Specific ASTM standard methods should be identified for geotechnical testing prior to submitting samples for analysis. If ASTM methods are not available or are not appropriate, other generally accepted methods should be specified or procedures should be developed for such analyses.

TABLE 6-1
Typical Sample Containers, Preparation, Preservatives and Holding Times for Surface Water and Groundwater

Parameter	Sample Containers	Sample Preservation	Holding Times
Indicator Parameters			
Total Organic Carbon (TOC)	(1) 250 ml glass bottle	Cool to 0≤6^{0}C, H_2SO_4 to pH<2	28 days
Total Organic Halogen (TOX)	(1) 500 ml amber glass bottle	Cool to 0≤6^{0}C, $H_2SO_4$to pH<2	28 days
Specific Conductivity	(1) 500 ml plastic bottle	Cool to 0≤6^{0}C	28 days
pH	(1) 250 ml plastic bottle	Cool to 0≤6^{0}C	24 hours
Chemical Oxygen Demand (COD)	(1) 250 ml amber glass or plastic bottles	Cool to 0≤6^{0}C, HCI or H_2SO_4 to pH <2	28 days
Biological Oxygen Demand (BOD)	(1) 1 liter plastic bottle	Cool to 0≤6^{0}C	48 hours
Total Dissolved Solids (TDS)	(1) 500 ml plastic bottle	Cool to 0≤6^{0}C	7 days
Total Suspended Solids (TSS)	(1) 1 liter plastic bottle	Cool to 0≤6^{0}C	7 days
Sulfates	(1) 250 ml plastic bottle	Cool to 0≤6^{0}C	28 days
Nitrate/nitrite	(1) 500 ml plastic bottle	Cool to 0≤6^{0}C, H_2SO_4 to pH<2	28 days
Fluoride and chloride	(1) 250 ml plastic bottle	Cool to 0≤6^{0}C	28 days
Bicarbonate/carbonate alkalinity	(1) 125 ml plastic bottle	Cool to 0≤6^{0}C	14 days
Oil and Grease	(2) 1 liter amber glass bottle	Cool to 0≤6^{0}C, HCI or H_2SO_4 to pH <2	28 days
Organic Parameters			
Total Petroleum Hydrocarbon (TPH) by GC/FID	(2) 1 liter amber glass bottle	Cool to 0≤6^{0}C	7 days for extraction, 40 days for analysis
Total Extractable Petroleum Hydrocarbons (TEPH)	(2) 1 liter amber glass bottle	Cool to 0≤6^{0}C	7 days for extraction, 40 days for analysis
Total Volatile Petroleum Hydrocarbons (TVPH)	(3) 40 ml VOA vials	Cool to 0≤6^{0}C, HCI to pH <2	14 days
Volatile Organics	(3) 40 ml VOA vials	Cool to 0≤6^{0}C, HCl to pH<2	14 days
Semivolatile Organics	(2) 1 liter amber glass bottle	Cool to 0≤6^{0}C	7 days for extraction, 40 days for analysis
Metal Parameters			
Metals (except Cr VI and Hg)	(1) 500 ml plastic bottle	Cool to 0≤6^{0}C, HNO_3 to pH<2	180 days
Major Cations (Ca, Na, K etc)	(1) 500 ml plastic bottle	Cool to 0≤6^{0}C, HNO_3 to pH <2	180 days
Chromium VI	(1) 500 ml plastic bottle	Cool to 0≤6^{0}C	24 hours
Mercury	(1) 500 ml plastic bottle	Cool to 0≤6^{0}C, HNO_3 to pH<2	28 days
Radiological Parameters			
Uranium 234,235,238,alpha spec	(1) gal plastic cubitainer or similar	Filtered; HNO_3 to pH <2	180 days
Uranium by ICP/MS	(1) 500 ml plastic bottle	Filtered; HNO3 to pH <2	180 days
Iso Uranium (233/234, 235/236, 238)	(1) 500 ml plastic bottle	Filtered; HNO3 to pH <2	180 days
Total Uranium by KPA	(1) 500 ml plastic bottle	Filtered; HNO3 to pH <2	180 days
Thorium 228,230,232 alpha spec	(1) 1 gal plastic cubitainer or similar	Filtered; HNO_3 to pH <2	180 days
Radium 226,228	(1) 1 gal plastic cubitainer or similar	Filtered; HNO_3 to pH <2	180 days
Technetium-99	(1) 500 ml plastic bottle	Filtered; HNO_3 to pH <2	180 days
Gross Alpha	(1) 500 ml plastic bottle	Filtered; HNO_3 to pH <2	180 days
Gross Beta	(1) 500 ml plastic bottle	Filtered; HNO_3 to pH <2	180 days

TABLE 6-2

Typical Sample Containers, Preparation, Preservatives and Holding Times for Soils and Solid Wastes

Parameter	Sample Containers	Sample Preservation	Holding Times
Indicator Parameters			
Total Organic Carbon (TOC)	(1) 250 ml amber glass bottle	Cool to 0≤6 °C	28 days
Total Organic Halogen (TOX)	(1) 250 ml glass bottle	Cool to 0≤6 °C	28 days
pH	(1) 250 ml plastic bottle	Cool to 0≤6 °C	48 hours
Organic Parameters			
Total Petroleum Hydrocarbon (TPH) by GC/FID	(1) 250 ml glass bottle	Cool to 0≤6 °C	28 days
Total Petroleum Hydrocarbon (TPH) by IR	(1) 250 ml glass bottle	Cool to 0≤6 °C	28 days
Total Extractable Petroleum Hydrocarbons (TEPH)	(1) 125 ml wide mouth glass jar w/ Teflon lined lid	Cool to 0≤6 °C	14 days for extraction, 40 days for analysis
Total Volatile Petroleum Hydrocarbons (TVPH)	(1) 125 ml wide mouth glass jar w/ Teflon lined lid	Cool to 0≤6 °C	14 days
Volatile Organics	(1) 125 ml glass bottle or Encore or similar	Cool to 0≤6 °C	14 days
Semivolatile Organics	(1) 250 ml glass bottle	Cool to 0≤6 °C	14 days for extraction, 40 days for analysis
Metal Parameters			
Metals (total - except Hg)	(1) 250 ml plastic bottle	Cool to 0≤6 °C	180 days
RCRA Characteristics			
TCLP Metals (except Hg)	(1) 500 ml glass or plastic bottle	Cool to 0≤6 °C	180 days to leach, 180 days for analysis
TCLP Volatile Organics	(1) 250 ml glass bottle	Cool to 0≤6 °C	14 days to leach, 14 days for analysis
TCLP Semivolatile Organics	(1) 500 ml glass bottle	Cool to 0≤6 °C	14 days to leach, 7 days to extract, 40 days for analysis
Ignitability	(1) 250 ml glass or plastic bottle	Cool to 0≤6 °C	14 days
Corrosivity	(1) 250 ml glass or plastic bottle	Cool to 0≤6 °C	48 hours
Reactivity	(1) 250 ml glass or plastic bottle	Cool to 0≤6 °C	7 days
Radiological Parameters			
Uranium 235,238, Thorium 232, Radium 226	(1) 500 ml plastic bottle	None	180 days

Table 6-3
Analytical Methods for Soil, Solid Wastes and Water

Parameter	Soil / Waste Method	Water Method
Total Organic Carbon (TOC)	SW-846 9060	SW-846 9060
Total Organic Halogen (TOX)	SW-846 9023	SW-846 9020
Specific Conductivity	EPA 120.1	SW-846 9050 or EPA 120.1
Total Dissolved Solids (TDS)		160.1
Total suspended Solids (TSS)		160.2
Ph	SW-846 9045C	SW-846 9040B or EPA 150.1
Chloride	SW-846 9056	SW-846 9056 or EPA 300.0
Iron	SW-846 6010B	SW-846 6010B or EPA 200.8
Manganese	SW-846 6010B	SW-846 6010B or EPA 200.8
Magnesium		SW-846 6010B or EPA 200.8
Sodium	SW-846 6010B	SW-846 6010B or EPA 200.8
Sulfate	SW-846 9056	SW-846 9056 or EPA 300.0
Aluminum		SW-846 6010B or EPA 200.8
Ammonia		350.1
Barium	SW-846 6010B	SW-846 6010B or EPA 200.8
Cadmium	SW-846 6010B	SW-846 6010B or EPA 200.8
Calcium		SW-846 6010B or EPA 200.8
Carbonate Bicarbonate		SM2320B
Fluoride	SW-846 9056	EPA 300.0
Nitrate/nitrite		EPA 353.2
Nitrate	SW-846 9056	SW-846 9056 or EPA 300.0
Nitrite	SW-846 9056	SW-846 9056 or EPA 300.0
Mercury	SW-846 7471A	SW 846 7470A
Phosphate, total		EPA 365.4
Phosphate, ortho		EPA 300.0
Potassium		EPA 200.8
Selenium	SW-846 6010B	EPA 200.8
Silver	SW-846 6010B	EPA 200.8
Arsenic	SW-846 6010B	EPA 200.8
Chromium	SW-846 6010B	EPA 200.8
Lead	SW-846 6010B	EPA 200.8
Cyanides	SW-846 6010B	EPA 200.8
Metals	SW-846 6010B	EPA 200.8
Acid/Base/Neutral Extractable	SW-846 8270C	SW-846 8270C
Volatile Organics	SW-846 8260B	SW-846 8260B
TCLP metals (except Hg)	SW-846 1311/6010B	
TCLP – Hg	SW-846 1311/74711A	
TPH (Gravimetric)	SW-846 9071A	
TEPH (GC/FID)	SW-846 8015M	SW-846 8015M
TVPH (GC/FID)	SW-846 8015M	SW-846 8015M
Ignitability	SW-846 1010	
Corrosivity	SW-846 9045C	
Reactivity, sulfide	Ch SW 7.3.4.2	
Reactivity, cyanide	Ch SW 7.3.4.2	
Uranium by ICP/MS		EPA 200.8
Total Uranium by KPA		ASTM-D5174
Iso Uranium (233/234, 235/236, 238)		DOE HASL-300
γ spec Uranium	DOE HASL-300	DOE HASL-300
γ spec Thorium	DOE HASL-300	DOE HASL-300
γ spec Radium	DOE HASL-300	DOE HASL-300
α spec Uranium	DOE HASL 1900	DOE HASL-300
α spec Thorium	DOE HASL 1900	DOE HASL-300
α spec Radium		
Gross α		EPA Method 900.0
Gross β		EPA Method 900.0
Radium-226	EPA Method 903.10	EPA Method 903.10
Radium-228		EPA Method 904.00
Technetium-99		DOE HASL-300

7.0 DECONTAMINATION

Except when dedicated equipment is used, sampling equipment must be decontaminated between samples to prevent contamination of succeeding samples. Equipment rinsate blanks aid in determining the adequacy of decontamination procedures, but only provide information "after the fact". The following questions should provide the basis for developing appropriate decontamination methods:

1. For what purposes are the samples being collected and how important is the data?
2. Could some degree of cross-contamination of samples be a problem?
3. What decontamination methods will prevent what degree of cross-contamination?

As a general rule, decontamination of sampling equipment for radiological analyses requires only physical cleaning of sampling equipment between samples (e.g. wipes or pressure washing with clean water). When using sampling equipment for chemical analyses, decontamination generally requires scrubbing with a detergent and triple rinsing with distilled or deionized water.

ASTM Standard D 5088, "Standard Practice for Decontamination of Field Equipment Used at Nonradioactive Waste Sites", and ASTM Standard D 5608, "Standard Practice for Decontamination of Field Equipment Used at Low Level Radioactive Waste Sites" may be used as guidance for developing appropriate decontamination methods. In lieu of other specific decontamination procedures, sampling personnel will follow procedure EPM-SAP-107, "Sampling Equipment Decontamination".

NOTE: The requirements of this section pertain to decontamination requirements to prevent cross-contamination of samples. Additional requirements may apply for radiological decontamination of equipment in accordance with the requirements of the Radiation Protection Plan and as directed by the Radiation Safety Officer (RSO) or designee.

8.0 DOCUMENTATION

8.1 Field and Facility Sample Logbook/Field Parameter Forms

It is important to develop thorough, narrative descriptions of collected samples as well as the conditions surrounding the sampling event. Should the relevance or adequacy of the data come into question in the future, notes recorded in field or facility logbooks and field parameter forms may provide the needed information to justify or disqualify data both for its intended use and other purposes for which its adequacy may be in question. Field or facility (sample) logbooks and field parameter forms also provide verification that work plans were followed and station names were appropriately assigned.

The individuals collecting the samples shall enter information in both a field and facility (sample) logbook or field parameter forms. Sampling personnel maintain field logbooks and field parameter forms, whereas facility personnel maintain facility (sample) logbooks at the site. The facility logbook consists of a 3-ring binder in which field notes are kept. Alternatively, complete records of the sampling event may be maintained with the Activity Plan. The logbooks contain sufficient information such that sampling conditions and activities can be reconstructed without reliance upon memory. Logbook entries are written on a per-sample or per-event basis based on the type of information. For instance, if numerous groundwater samples are collected for the same set of analyses on the same day, analytical parameters could be listed one time for the sampling event, but well-specific information would be listed per sample. Information that might be included in the logbooks includes, but is not limited to:

- Date and time of sample collection
- Sample station name
- Interval and depth of sample, if applicable
- Field measurements (e.g., pH, conductivity, temperature, dissolved oxygen, oxidation/reduction potential, etc) or observations
- Variances from the work plan for the sampling event
- Water level and total depth measurements, if applicable
- Well purging volume and technique, if applicable

All entries are made in indelible ink, signed, and dated. If an incorrect entry is made, the information is crossed out with a single strike mark initialed and dated by the recorder. The site hydrologist or assigned project manager must approve all variances from the work plan.

8.2 Chain of Custody

The Chain of Custody (COC) provides physical evidence of sample custody. Field personnel will initiate a COC, and subsequent persons receiving and relinquishing the samples will sign, date, and note the time of transfer on the COC (commercial shippers such as FedEx and Airborne will not sign Chain of Custody Forms, so shipping containers are sealed prior to their pick up). The COC remains with the samples in the sealed shipping container during handling by the shipping company. Chain of Custody forms will be filled, out and used in accordance with procedure EPM-SAP-111, "Sample Identification and Control".

9.0 SAMPLE PACKAGING AND SHIPPING

Sample packaging and shipping procedures should comply with USEPA specifications and US Department of Transportation regulations. Samples should be packaged and shipped within 24 hours of collection in accordance with procedure EPM-SAP-112, "Sample Packaging and Shipping”.

SAMPLING AND ANALYSIS PLAN STANDARD OPERATING PROCEDURES

Procedure	Issued	Revision No.
EPM-SAP-101 - Surface Soil Sampling	April 7, 2011	Revision 0
EPM-SAP-102 - Sediment Sampling	April 7, 2011	Revision0
EPM-SAP-103 - Surface Water Sampling	April 7, 2011	Revision 0
EPM-SAP-104 - Groundwater Sampling	April 7, 2011	Revision 0
EPM-SAP-105 - Vegetation Sampling	April 7, 2011	Revision 0
EPM-SAP-106 - Direct Push Soil Sampling	April 7, 2011	Revision 0
EPM-SAP-107 - Sampling Equipment Decontamination	April 7, 2011	Revision 0
EPM-SAP-108 - Excavation Soil Sampling	April 7, 2011	Revision 0
EPM-SAP-109 - Drilling - Subsurface Soil and Bedrock Sampling	April 7, 2011	Revision 0
EPM-SAP-110 - Piezometer and Monitoring Well Installation And Abandonment	April 7, 2011	Revision 0
EPM-SAP-111 - Sample Identification and Control	April 7, 2011	Revision 0
EPM-SAP-112 - Sample Packaging and Shipping	April 7, 2011	Revision 0