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Revision 0

Sampling Analysis Instruction for Tribal Plant Sampling in Support of the 100 Area and 300 Area Component of the River Corridor Baseline Risk Assessment

Prepared for the U.S. Department of Energy, Richland Operations Office
Office of Environmental Restoration

Submitted by: Bechtel Hanford, Inc.

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APPROVAL PAGE

Title: Sampling and Analysis Instruction for Tribal Plant Sampling in Support of the 100 Area and 300 Area Component of the River Corridor Baseline Risk Assessment

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3·29·05
Date

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Sampling Analysis Instruction for Tribal Plant Sampling in Support of the 100 Area and 300 Area Component of the River Corridor Baseline Risk Assessment

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ACRONYMS AND ABBREVIATIONS

BHI	Bechtel Hanford, Inc.
CERCLA	*Comprehensive Environmental Response, Compensation, and Liability Act of 1980*
CFR	*Code of Federal Regulations*
COPC	contaminant of potential concern
DOE	U.S. Department of Energy
DQO	data quality objectives
ERC	Environmental Restoration Contractor
ICP	inductively coupled plasma
IDW	investigation-derived waste
PNNL	Pacific Northwest National Laboratory
QC	quality control
RCBRA	River Corridor Baseline Risk Assessment
SAI	sampling and analysis instruction
SAP	sampling and analysis plan

METRIC CONVERSION CHART

Into Metric Units

If You Know	*Multiply By*	*To Get*
Length		
inches	25.4	millimeters
inches	2.54	centimeters
feet	0.305	meters
yards	0.914	meters
miles	1.609	kilometers
Area		
sq. inches	6.452	sq. centimeters
sq. feet	0.093	sq. meters
sq. yards	0.0836	sq. meters
sq. miles	2.6	sq. kilometers
acres	0.405	hectares
Mass (weight)		
ounces	28.35	grams
pounds	0.454	kilograms
ton	0.907	metric ton
Volume		
teaspoons	5	milliliters
tablespoons	15	milliliters
fluid ounces	30	milliliters
cups	0.24	liters
pints	0.47	liters
quarts	0.95	liters
gallons	3.8	liters
cubic feet	0.028	cubic meters
cubic yards	0.765	cubic meters
Temperature		
Fahrenheit	subtract 32, then multiply by 5/9	Celsius
Radioactivity		
picocuries	37	millibecquerel

Out of Metric Units

If You Know	*Multiply By*	*To Get*
Length		
millimeters	0.039	inches
centimeters	0.394	inches
meters	3.281	feet
meters	1.094	yards
kilometers	0.621	miles
Area		
sq. centimeters	0.155	sq. inches
sq. meters	10.76	sq. feet
sq. meters	1.196	sq. yards
sq. kilometers	0.4	sq. miles
hectares	2.47	acres
Mass (weight)		
grams	0.035	ounces
kilograms	2.205	pounds
metric ton	1.102	ton
Volume		
milliliters	0.033	fluid ounces
liters	2.1	pints
liters	1.057	quarts
liters	0.264	gallons
cubic meters	35.315	cubic feet
cubic meters	1.308	cubic yards
Temperature		
Celsius	multiply by 9/5, then add 32	Fahrenheit
Radioactivity		
millibecquerel	0.027	picocuries

1.0 INTRODUCTION

This sampling and analysis instruction (SAI) is intended to provide direction for acquiring samples of plants that are significant to the Tribal use scenarios in support of the 100 Area and 300 Area Component of the River Corridor Baseline Risk Assessment (RCBRA). The sampling results will be used in the Tribal subsistence use scenarios for ingestion, inhalation, and dermal absorption of the contaminants of potential concern (COPCs)[1], as appropriate.

This SAI is generic because the actual plant names, their traditional uses, and their precise locations are proprietary information held by each Tribe. Only the samplers and the Tribal members who assist them in the field will see the plants being collected.

This SAI is not the sampling and analysis plan (SAP) that is to be generated as a result of the RCBRA data quality objectives (DQOs) and ecological risk assessment guidance for the Superfund process being conducted in late 2004 and early 2005. That SAP will be sent for public review in the summer of 2005, which will allow for sampling to begin in October 2005.

The following section provides background information about the RCBRA project and a list of the COPCs to be evaluated.

1.1 BACKGROUND

The *Comprehensive Environmental Response, Compensation, and Liability Act of 1980* (CERCLA), as amended, requires the remediation of hazardous waste sites to protect both human health and the environment. At the Hanford Site, contaminants have been released through operations for more than 50 years, and contamination will remain onsite for thousands of years. The U.S. Department of Energy (DOE) is responsible for evaluating potential risks to human health and the environment from releases of contaminants to the environment at both onsite and offsite locations where contaminants remain or come to be located. The DOE fulfills this responsibility through the risk assessment process.

Through the Risk Assessment/Site Closure Project currently performed by the Environmental Restoration Contractor (ERC), the DOE, Richland Operations Office is conducting a baseline risk assessment that addresses the hazardous substances released from waste sites along the Columbia River Corridor. The purpose of this baseline risk assessment is to characterize the current and potential threats to human health and the environment that may be posed by residual contaminants under current and reasonably anticipated future site conditions. The RCBRA is being performed in compliance with CERCLA and other applicable federal and state risk assessment guidance.

The RCBRA is composed of two main components: (1) the 100 Area and 300 Area Component (including the 100-B/C Pilot Project and the 100-NR-2 assessment), and (2) the Columbia River

[1] Terminology per the U.S. Environmental Protection Agency ecological risk assessment for Superfund process.

Component. The 100 Area and 300 Area Component addresses the 100 Area and 300 Area CERCLA waste sites, including interfaces between the upland zone, riparian zone, and near-shore river zone of the Columbia River located adjacent to the reactor areas. The Columbia River Component will address the risks posed by residual Hanford Site contaminants from the Columbia River beyond the 100 Area and 300 Area near-shore river zone, by extending the study area to the upper elevation of the terrace lying above the floodplain associated with the 1948 flood (Fecht et al. 2004) (Figure 1). The boundaries of the Columbia River Component are defined in the *Columbia River Component of the River Corridor Baseline Risk Assessment: Basis and Assumptions on Project Scope* (DOE-RL 2004). The Columbia River Component is responsible for evaluating the riparian and near-shore river areas not already identified as part of the 100 Area and 300 Area Component, 100-B/C Pilot Project, and 100-NR-2 risk assessments. The results of the 100 Area and 300 Area Component and the Columbia River Component will eventually be combined in a single River Corridor Baseline Risk Assessment report in support of final records of decision for the Hanford Site.

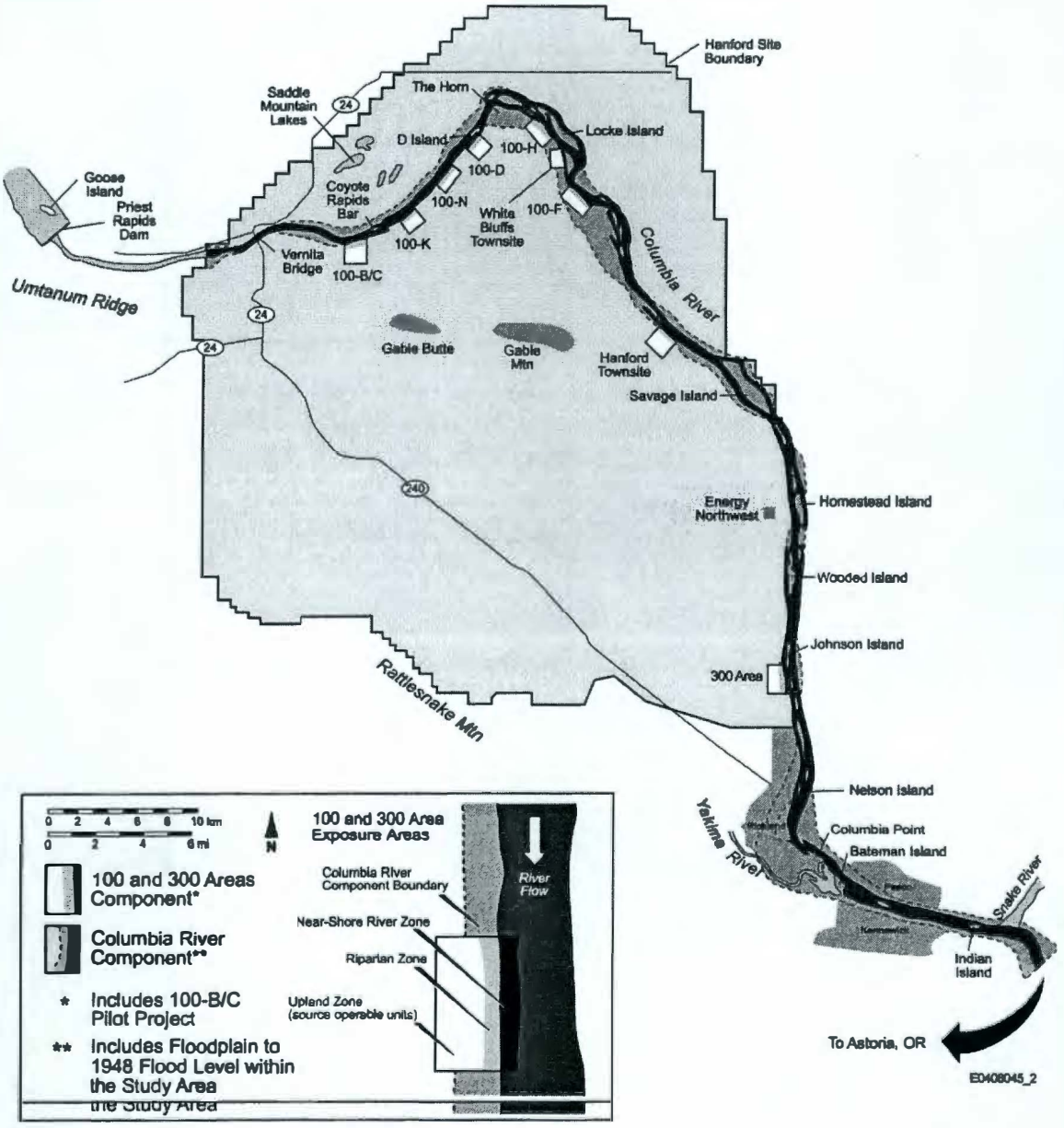
Key documentation is being developed as the risk assessment progresses. One of the first documents produced as part of the risk assessment process is a SAP, which is built on the results of the DQO process. The SAP explains the basis for the sampling design and techniques used for data collection for the risk assessment. The SAP also addresses data gaps and is used to document what cost-effective, defensible, high-quality data need to be collected for use in exposure estimation and risk calculations. The SAP for the 100 Area and 300 Area Component will be written in 2005, after the DQO process is completed. Because the plants used in the Tribal risk assessment scenarios are not subject to discussion through the DQO process or elaboration in a SAP, their collection is discussed in this SAI, which will also allow early collection of some plants (sample collection under the SAP will not begin until fiscal year 2006).

1.2 PREVIOUS INVESTIGATIONS

In 2004, the 100-B/C Pilot Project collected plants of Tribal interest as part of the overall risk assessment sampling effort. One Tribe participated in sample collection. The COPCs analyzed for in these plants were strontium-90, technetium-99 (a 100-B/C Area-specific COPC), gamma emitters (through gamma energy analysis), and metals. For each plant, the surrounding soil was also collected. To collect enough mass for each sample, several individuals of the same species of plant were composited. Plant roots and shoots were analyzed separately as indicated by the Tribal members for the use of the plant.

Figure 1. Overview of the Geographic Scope of the River Corridor Baseline Risk Assessment.

(The operable unit sizes and shapes vary from what is shown, and the actual extent of the riparian and near-shore river zones of the 100 Area and 300 Area Component reflect the 100 and 300 Area groundwater operable units.)



1.3 CONTAMINANTS OF POTENTIAL CONCERN

The COPCs to be investigated include radionuclides and metals because they are typical contaminants associated with most 100 Area and 300 Area waste sites and are primary risk drivers. The COPCs listed in Table 1, which also includes polychlorinated biphenyls/pesticides and semi-VOAs, are a result of the initial COPC screening for the DQO process that was conducted for the 100 Area and 300 Area Component of the RCBRA for uplands soils. Volatile organics were excluded during the DQO, based on the 100 Area and 300 Area component of RCBRA DQO data evaluation, which indicated that because they do not persist in the environment, they are not present at concentrations that could pose a threat. The COPCs are listed in Table 1. Appendix A lists all of the analytes included in each analytical suite.

Table 1. Contaminants of Potential Concern for Tribal Plant Sampling.

Radionuclides	Metals	Other
Suite of GEA radionuclides, to include, but not be limited to: Americium-241 Cesium-137 Cobalt-60 Europium-152 Europium-154 Europium-155 Radium-226 Radium-228 Thorium-228 **Other radionuclide analytes:** Strontium-90 Isotopic uranium: Uranium-233/234 Uranium-235 Uranium-238	**Suite of metals, to include, but not be limited to:** Antimony Arsenic Barium Beryllium Boron Cadmium Chromium (total) Cobalt Copper Lead Manganese Molybdenum Nickel Selenium Silver Uranium (total) Vanadium Zinc Mercury Hexavalent chromium (for soils)	**Suite of PCB/pesticides, to include, but not be limited to:** Aroclor-1254 Aroclor-1260 Aroclor-1016 Aroclor-1221 Aroclor-1232 Aroclor-1242 **SVOC suite:** A comprehensive list of analytes (see Appendix A for list of analytes included)

NOTE: Per the data quality objective workshops, the entire suite of analytes under these categories will be reported. Only the specific contaminants identified in the preliminary evaluation are listed here.
GEA = gamma energy analysis
PCB = polychlorinated biphenyl
SVOC = semivolatile organic compound

1.4 PROBLEM DEFINITION

The 100 Area and 300 Area Component of the RCBRA includes the evaluation of a range of human use scenarios, including Tribal use. Part of any future Tribal use will likely include traditional subsistence use, such as the use of noncultivated plants for food subsistence,

medicinal, and spiritual purposes. To evaluate the potential risk from these plants, the levels of exposure to COPCs in concentrations of radionuclides and nonradionuclides in representative samples must be determined for inclusion in the risk calculations.

1.5 DECISION POINTS

The following subsections enumerate the input and decisions required to resolve the problem identified in Section 1.4 and the input needed to resolve the decision.

1.5.1 Decision Statements

Determine the levels of COPCs in representative plants used for food subsistence, medicinal, or other cultural purposes by local Tribes.

1.5.2 Required Inputs for Decision Making

1. In order to determine the contaminant concentrations in selected plant species, plant samples will be collected in locations specified by the Tribes. The plants will be identified in the field by Tribal members, or a person designated by a tribe, and will likely be the same species as previously collected at the 100-B/C Area for the 100-B/C Pilot Project.

2. The plants will be identified only as "Species X, use" (e.g., "species x, food"; "species y, inhalation"; "species z, external use"). Each species will also be noted as "shallow rooted" (majority of root systems with 30 cm [12 in.] of soil surface) or "deep rooted." The location information in the Hanford Environmental Information System will be limited to the ecological zone (i.e., near-shore river, riparian, or upland) and the operational area (e.g., 300 Area, 100-H, 100-K). The actual Geographic Information System locations sampled will be recorded only in the field logbooks to allow any particular location to be revisited (e.g., if significantly elevated concentrations of any COPCs are detected).

3. The soil under the plants, in the main rooting zone (relative to the species sampled), will also be collected in multi-increment samples and homogenized for analysis to help in correlating the levels of COPCs in the soil with uptake by the plants.

4. The plant samples and surrounding soil will be analyzed for the analytical suites listed in Table 1. Results from laboratory analyses will be evaluated to provide input to the risk calculations for one or more Tribal scenarios.

2.0 PROJECT MANAGEMENT

This section identifies the individuals or organizations that are participating in the project and discusses specific roles and responsibilities of the individuals/organizations. The quality objectives for measurement data and the training requirements for the staff performing the work are also discussed.

2.1 PROJECT/TASK ORGANIZATION

The project shall be managed through the Risk Assessment/Site Closure Project, with an assigned project manager and project environmental lead. The ERC Field Analytical Services and Sample Management group shall be responsible for sample collection (performed in coordination with Pacific Northwest National Laboratory [PNNL] personnel), field screening, sample packaging, shipping, and arranging for analytical services. The ERC Waste Management organization (or similar appropriate organization for work not performed by ERC personnel) shall provide support for management and disposition of field investigation-related waste. The staff of the Risk Assessment/Site Closure Project will perform the data evaluation and interpretation in coordination with subcontracted scientific staff supporting the baseline risk assessment. The ERC Safety and Health group (or similar appropriate organization for work not performed by ERC personnel) shall provide radiological control and safety support as required, and the ERC Quality Assurance and Services group shall be responsible for performing independent quality assurance activities.

2.2 QUALITY OBJECTIVES AND CRITERIA FOR MEASUREMENT DATA

The sensitivities of the field and laboratory analytical methods were evaluated to ensure that the methods were of sufficient sensitivity to support decision-making. The required method sensitivities for the field and laboratory methods to be performed are summarized in Table 2.

Table 2. Required Method Sensitivities for Field and Laboratory Methods for Plants and Soil. (2 Pages)

Analytical Suite	Analytes	Reporting Detection Limit[a]	Precision (% RPD)	Accuracy (% Recovery)
Radionuclides				
GEA	Americium-241	0.3 pCi/g	±30%[a]	70 to 130[a]
	Cesium-137	0.1 pCi/g	±30%	70 to 130
	Cobalt-60	0.05 pCi/g	±30%	70 to 130
	Europium-152	0.1 pCi/g	±30%	70 to 130
	Europium-154	0.1 pCi/g	±30%	70 to 130
	Europium-155	0.1 pCi/g	±30%	70 to 130
	Radium-226	0.1 pCi/g	±30%	70 to 130
	Radium-228	0.2 pCi/g	±30%	70 to 130
	Thorium-228	0.2 pCi/g	±30%	70 to 130
Radioactive strontium (total)	Strontium-90	1 pCi/g	±30%	70 to 130
Isotopic uranium HPGe	Uranium-233/234	1 PCI/G	±30%[e]	70 to 130[e]
	Uranium-235			
	Uranium-238			
Metals				
ICP metals (SW-846, Method 6010)[b]	Antimony	0.6 mg/kg[c]	±30%[d]	70 to 130[d]
	Arsenic	1 mg/kg[c]	±30%	70 to 130
	Barium	0.5 mg/kg[c]	±30%	70 to 130
	Beryllium	0.2 mg/kg[c]	±30%	70 to 130
	Boron	2 mg/kg	±30%	70 to 130
	Cadmium	0.2 mg/kg[c]	±30%	70 to 130
	Chromium (total)	0.2 mg/kg[c]	±30%	70 to 130
	Cobalt	2 mg/kg	±30%	70 to 130
	Copper	1 mg/kg	±30%	70 to 130
	Lead	0.5 mg/kg[c]	±30%	70 to 130
	Manganese	5 mg/kg	±30%	70 to 130
	Molybdenum	2 mg/kg	±30%	70 to 130
	Nickel	4 mg/kg	±30%	70 to 130
	Selenium	1 mg/kg[c]	±30%	70 to 130
	Silver	0.2 mg/kg[c]	±30%	70 to 130
	Uranium	5 mg/kg[c]	±30%	70 to 130
	Vanadium	2.5 mg/kg	±30%	70 to 130
	Zinc	1 mg/kg	±30%	70 to 130
Mercury (SW-846, Method 7471)[b]	Mercury	0.2 mg/kg	±30%[d]	70 to 130[d]
Hexavalent chromium (SW-846, Method 7196)[b]	Hexavalent chromium	0.5 mg/kg	±30%[d]	70 to 130[d]

Table 2. Required Method Sensitivities for Field and Laboratory Methods for Plants and Soil. (2 Pages)

Analytical Suite	Analytes	Reporting Detection Limit[a]	Precision (% RPD)	Accuracy (% Recovery)
Isotopic uranium HPGe	Uranium-233 Uranium-235 Uranium-238	1 pCi/g	±30%[e]	70 to 130[e]
PCBs 8082	Aroclor-1254 Aroclor-1260	0.0165 µg/kg	±30%[f]	50 to 150[f]
SVOCs 8270-GCMS	Acenaphthene Benzo(a)pyrene Chrysene Dibenz[a,h]anthracene Fluoranthene Phenanthrene Pyrene	0.33[h]	±30%[f]	50 to 150[f]
Pesticides 8081		0.005[g]	±30%[f]	50 to 150[f]

[a] The detection limit requirements shown are based on obtaining the full volumes of samples as identified in Tables 3 and 4. The inability to obtain full volumes will likely affect achievable detection limits. Specific detection limit requirements will be determined on a case-by-case basis when full volume samples cannot be obtained.
[b] *Test Methods for Evaluating Solid Waste: Physical/Chemical Methods* (EPA 1997).
[c] Required detection limit is provided by ICP trace metal analysis.
[d] The accuracy criteria specified is for calculated percent recoveries for associated analytical batch matrix spike samples. Additional accuracy evaluation, based on statistical control limits for analytical batch laboratory control samples, is also performed. The precision criteria shown is for batch laboratory replicate matrix spike or replicate sample relative percent differences (RPDs).
[e] The accuracy criteria shown is for associated batch laboratory control sample percent recoveries. Except for GEA, additional accuracy criteria accuracy criteria include analysis-specific evaluations performed for matrix spike, tracer, and/or carrier recoveries as appropriate to the method. The precision criteria shown is for batch laboratory replicate sample RPDs.
[f] The accuracy criteria shown is the minimum for associated for associated batch laboratory control sample percent recoveries. Laboratories must meet statistically based control if more stringent. Additional accuracy criteria include analyte-specific evaluations performed for matrix spike, and surrogate recoveries as appropriate to the method. The precision criteria shown are for batch laboratory replicate matrix spike analysis RPDs.
[g] Maximum detection limit for pesticides except for chlordane, methoxychlor, and toxaphene. Chlordane and methoxychlor limits are 5X value shown; toxaphene is 50X value shown.
[h] SVOA detection limits shown are "nominal" maximums. Most analytes will achieve this or a lower detection limit. A limited will have higher detection limits. Analytes having higher detection limits will be documented with the laboratory prior to analysis.
GEA = gamma energy analysis
HPGe = high-purity germanium (detector)
ICP = inductively coupled plasma
RPD = relative percent difference

2.3 ADDITIONAL PROJECT REQUIREMENTS

Training or certification requirements needed by personnel shall be in accordance with the requirements of *Hanford Analytical Services Quality Assurance Requirements Document*, Vol. 1, "Administrative Requirements" (DOE-RL 1998). Field personnel will typically have completed the following training before starting work:

- Occupational Safety and Health Administration 40-Hour Hazardous Waste Worker Training

- Radiation Worker Training
- Hanford General Employee Training.

In addition, sampling personnel shall review this SAI and the applicable sampling procedures identified.

3.0 MEASUREMENT/DATA ACQUISITION

This section presents the sampling process design and the requirements for sampling methods, laboratory analysis, sample handling, custody, preservation, containers, and holding times. The requirements for laboratory quality control (QC), instrument calibration and maintenance, and field documentation are also discussed. The applicable requirements of the 100 Area remedial action SAP/quality assurance project plan (DOE/RL-96-22, Rev. 3) will be followed.

3.1 PLANT SAMPLING

Plant samples will be collected and analyzed to determine the concentrations of COPCs. The surrounding soils will also be sampled to allow for an evaluation of plant uptake of the COPCs. The results will be used as input to the risk assessment for one or more of the Tribal use scenarios. For this effort, plants will be collected in the upland and riparian zones associated with the operable units, and at remediated waste sites as plants are available. No plants will be collected on unremediated CERCLA waste sites.

3.1.1 Sample Collections

Depending on the use of the plant species, either (1) the shoots and the soil in which the plant is growing; or (2) the shoots, roots, and soil in which the plant is growing will be collected.

If enough mass is available from one plant, the species will not be composited. However, to get an adequate sample size, several individual specimens of a smaller species in a local area may need to be composited and homogenized. If that is the case, the soil associated with each plant will also be composited and homogenized. This compositing of smaller plants will likely accurately represent the contaminant levels (and bioaccumulation levels) that a person collecting and using the plants would be exposed to.

Three species of plants will be collected in each of three operations area. Five samples of each plant species (five shoot samples, five soil samples, and five root samples, if relevant), if sufficient biomass is present, will be collected from each area. Approximately 180 samples total will be taken (3 species x 3 parts [shoots, roots, soil] x 5 samples x 4 areas = 180 samples). In some plants, only one tissue type may be sampled as applicable and directed by Tribal representatives.

As stated previously, several individual specimens of each species may be required for each sample to meet analytical sample mass requirements. For each sample, the approximate area over which the sample was collected will be recorded (square feet).

Because the 100-B/C Pilot Project completed a similar sampling effort in 2004, using upriver reference locations near the Vernita Bridge and traditional harvesting areas, this sampling effort will rely on those results for reference values. However, if additional plant species are collected in 2005, the same species will also be collected upriver from the Hanford Site, which will increase the total number of samples collected.

3.1.2 Sample Depths

Sampling depth will be representative of the greatest rooting density for the plant species sampled. For many plants this is the 0- to 0.3-m (0- to 1-ft) interval.

3.2 SAMPLING METHODS AND REQUIREMENTS

The procedures to be implemented in the field should be consistent with those outlined in BHI-EE-01, *Environmental Investigations Procedures*, including the following:

- Procedure 4.0, "Soil and Sediment Sampling"
- Procedure 4.5, "Sample Compositing."

Pre-cleaned, disposable sampling equipment may be used to collect soil samples, eliminating the need to perform equipment decontamination. If stainless steel sampling equipment is used, it will be pre-cleaned or cleaned prior to use in accordance with *Sampling Services Procedure Manual*, Procedure 2.5, "Laboratory Cleaning of Sampling Equipment" (WMFS 1998).

3.3 ANALYTICAL METHODS

Analytical methods for this investigation were selected to achieve the project performance requirement of evaluating radionuclide and metals concentrations in the 100 Areas. The methods that will be used are specified in Table 2.

3.4 SAMPLE HANDLING, SHIPPING, AND CUSTODY REQUIREMENTS

All sample handling, shipping, and custody should be performed in a accordance with BHI-EE-01, Procedure 3.1, "Sample Packaging and Shipping"; Procedure 3.0, "Chain of Custody"; and Procedure 4.2, "Sample Storage and Shipping Facility."

3.5 SAMPLE PRESERVATION, CONTAINER, AND HOLDING TIME REQUIREMENTS

The sample preservation, container, and holding time requirements for the analyses to be performed for soil samples are summarized in Table 3 and for plant samples in Table 4. The final requirements shall be specified on the sample authorization form in accordance with BHI-EE-01, Procedure 2.0, "Sample Event Coordination." Project-specific requirements for biota sampling will be arranged with the Sample Management organization at the time biota is identified for potential field sample collection.

Table 3. Sample Containers, Volumes, Preservatives, and Holding Times for Soil.

Analytical Method	Container	Volume	Preservative	Holding Time
ICP metals (SW-846, Method 6010) Mercury (SW-846, Method 7471)	Amber glass	500 mL	Cool 4°C	6 months
Hexavalent chromium (SW-846, Method 7196)	Glass/plastic	15 g	Cool 4°C	30 days
Gamma spectroscopy	Glass/plastic	500 g	None	6 months
Strontium-90 (total)	Glass/plastic	10 g	None	6 months
Isotopic uranium HPGe	Glass/plastic	10 g	None	6 months
PCBs and pesticides 8081 and 8082	Amber glass	120 g	Cool 4°C	14/40 days (extraction/ analysis)
SVOCs 8270	Amber glass	250 g	Cool 4°C	14/40 days

HPGe = high-purity germanium (detector)
ICP = inductively coupled plasma
PCB = polychlorinated biphenyl
SVOC = semivolatile organic compound

Table 4. Sample Containers, Volumes, Preservatives, and Holding Times for Plants. (2 Pages)

Analytical Method	Container	Volume[a]	Preservative	Holding Time
ICP metals (SW-846, Method 6010) Mercury (SW-846, Method 7471)	Amber glass	15 g	Cool 4°C	6 months
Gamma spectroscopy	Glass/plastic	60 g	None	6 months
Strontium-90 (total)	Glass/plastic	4 g	None	6 months
Isotopic uranium	Glass/plastic	4 g	None	6 months

Table 4. Sample Containers, Volumes, Preservatives, and Holding Times for Plants. (2 Pages)

Analytical Method	Container	Volume[a]	Preservative	Holding Time
PCBs and pesticides 8081 and 8082	Amber glass	50 g	Cool 4°C	14/40 days
SVOCs 8270	Amber glass	50 g	Cool 4°C	14/40 days

[a] Volume shown based on "dry weight" of sample material. Historical values range from 25% to 75% dry solids.
ICP = inductively coupled plasma
PCB = polychorinated biphenyl
SVOC = semivolatile organic compound

3.6 QUALITY CONTROL REQUIREMENTS

QC procedures must be followed in the field and in the laboratory to ensure that reliable data are obtained. All sampling and analysis will follow the criteria in accordance with the *Hanford Analytical Services Quality Assurance Requirements Document*, Vol. 1, Section 4.0 (DOE-RL 1996) and the 100 Area remedial action SAP (DOE-RL 2001). Sample collection QC will be performed in accordance with BHI-QA-03, *ERC Quality Assurance Program Plans*, Plan No. 5.1, "Field Sampling Quality Assurance Program Plan." Field analysis will be performed in accordance with BHI-QA-03, Plan No. 5.2, "Onsite Measurements Quality Assurance Program Plan."

When performing this field sampling effort, care shall be taken to prevent the cross-contamination of sampling equipment, sample bottles, and other equipment, which could compromise sample integrity.

3.6.1 Field Quality Control

Field QC requirements are used to monitor and ensure the quality of the field results. Field QC samples will be collected during field work to monitor the performance of soil sample collections and measure the effects of sampling bias or variability. No field QC samples will be collected for plant samples because there will be limited media available for sample collection.

Field QC requirements will consist of the following:

- **Equipment blanks:** Equipment blanks are not required if pre-cleaned disposable sampling equipment is used. Several years of experience using this equipment and performing equipment blanks has demonstrated the cleanliness of this equipment for soil sampling activities where metals and radionuclides are COPCs.

  If stainless steel sampling equipment is used to collect soil samples, one equipment blank consisting of clean silica sand will be collected and submitted for offsite analysis of gamma-emitting radionuclides, strontium-90, inductively coupled plasma (ICP) metals, mercury, and hexavalent chromium. The equipment blank will be collected by pouring silica

sand over the surfaces of a set of soil sampling equipment prior to use and collecting the blank media in clean sample jars for analyses. The sample results will be used to evaluate the cleanliness of the sampling equipment and the decontamination procedure.

- **Field duplicate samples:** One field duplicate sample will be collected during sampling at each of the operations areas where sampling is conducted and analyzed for gamma-emmitting radionuclides, strontium-90, ICP metals, mercury, and hexavalent chromium. The duplicate sample will be collected from the same soil as the primary sample and will be uniquely numbered. The field duplicate sample provides information concerning the homogeneity of the soil media and may also provide an evaluation of the precision of the analysis process.

3.6.2 Laboratory Quality Control

Laboratory QC requirements will be performed as specified in the analytical services statement of work for the selected laboratory and will consist of a laboratory method blank, laboratory control sample, matrix spike, and laboratory duplicate or matrix spike duplicate.

3.7 FIELD DOCUMENTATION

Field documentation shall be kept in accordance with BHI-EE-01, Procedure 1.5, "Field Logbooks," and Procedure 3.0, "Chain of Custody."

4.0 ASSESSMENTS AND RESPONSE ACTIONS

The Compliance and Quality Programs group may conduct random surveillance and assessments in accordance with BHI-MA-02, *ERC Project Procedures*, Procedure 2.7, "Self-Assessment," to verify compliance with the requirements outlined in this SAI, project work packages, the BHI quality management plan, BHI procedures, and regulatory requirements.

Deficiencies identified by one of these assessments shall be reported in accordance with BHI-MA-02, Procedure 2.7. When appropriate, corrective actions will be taken by the project engineer in accordance with the *Hanford Analytical Services Quality Assurance Requirements Document*, Vol. 1, Section 4.0 (DOE-RL 1996), to minimize recurrence.

5.0 DATA VERIFICATION AND ASSESSMENT REQUIREMENTS

Data verification is performed on the analytical data sets to confirm that sampling and chain-of-custody documentation is complete, sample numbers can be tied to specific sampling locations,

analysis was performed within specified turnaround times, and that all requested data have been provided.

A data assessment will be performed to compare the sampling approach and resulting analytical data with the sampling and data quality requirements specified by the project objectives and performance specifications. The assessment involves the evaluation of the data to determine if they are of the right type, quality, and quantity to support their intended use. The results of the assessment will be documented.

6.0 WASTE MANAGEMENT

All waste generated by sampling activities will be managed as investigation-derived waste (IDW) in accordance with BHI-EE-10, *Waste Management Plan*; the project site-specific waste management instruction; and the project-specific waste control plan (BHI 2005). This investigation is part of a CERCLA remedial investigation and risk assessment.

All managed IDW will be containerized and stored at the 1330-N CERCLA Management Area or at another storage location specified in the approved waste control plan until analytical data are evaluated for proper waste designation. While in storage, IDW will be managed in accordance with the approved plan.

Upon receiving the analytical results, the IDW will be designated and profiled. IDW that meets the *Environmental Restoration Disposal Facility Waste Acceptance Criteria* (BHI 2002) and, if applicable, meets the land disposal restriction standards (40 *Code of Federal Regulations* [CFR] 268) for underlying hazardous constituents will be disposed of at the Environmental Restoration Disposal Facility. If analyses indicate that the IDW is not a dangerous, radioactive, or mixed waste, it will be dispositioned at an appropriate solid waste disposal facility.

Unused samples and associated fixed laboratory waste for the analysis will be dispositioned in accordance with the laboratory contract and agreements for return to the Hanford Site. Pursuant to 40 CFR 300.440, Remedial Project Manager approval is required before returning unused samples or waste from offsite laboratories. In addition, as a best management practice, Remedial Project Manager approval will be obtained before shipping sample waste from Hanford onsite laboratories back to the waste site of origination.

7.0 HEALTH AND SAFETY

All field operations will be performed in accordance with BHI health and safety requirements, which are outlined in BHI-SH-01, *ERC Safety and Health Program*, and BHI-RC-01, *Radiation Protection Program Manual*. The sampling procedures and associated activities will consider

exposure reduction and contamination control techniques that will minimize exposure to the sampling team as required by BHI-SH-01 and BHI-QA-01, *ERC Quality Program*.

Where necessary, a work planning package will be prepared that will further control site operations. The work planning package will include, as appropriate, a job hazard analysis and/or a site-specific health and safety plan and applicable radiological work permits.

8.0 REFERENCES

40 CFR 268, "Land Disposal Restrictions," *Code of Federal Regulations*, as amended.

40 CFR 300, "National Oil and Hazardous Substances Pollution Contingency Plan," *Code of Federal Regulations*, as amended.

BHI-EE-01, *Environmental Investigations Procedures*, Bechtel Hanford, Inc., Richland, Washington.

BHI-EE-10, *Waste Management Plan*, Bechtel Hanford, Inc., Richland, Washington.

BHI-MA-02, *ERC Project Procedures*, Bechtel Hanford, Inc., Richland, Washington.

BHI-QA-01, *ERC Quality Program*, Bechtel Hanford, Inc., Richland, Washington.

BHI-QA-03, *ERC Quality Assurance Program Plans*, Bechtel Hanford, Inc., Richland, Washington.

BHI-RC-01, *Radiation Protection Program Manual*, Bechtel Hanford, Inc., Richland, Washington.

BHI-SH-01, *ERC Safety and Health Program*, Bechtel Hanford, Inc., Richland, Washington.

BHI, 2002, *Environmental Restoration Disposal Facility Waste Acceptance Criteria,* BHI-00139, Rev. 4, Bechtel Hanford, Inc., Richland Washington.

Comprehensive Environmental Response, Compensation, and Liability Act of 1980, 42 U.S.C. 9601, et seq.

DOE-RL, 1996, *Hanford Analytical Services Quality Assurance Requirements Document*, DOE/RL-96-68, Rev. 0, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

DOE-RL, 1998, *Hanford Analytical Services Quality Assurance Requirements Document*, DOE/RL-96-68, Rev. 2, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

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DOE-RL, 2004, *Columbia River Component of the River Corridor Baseline Risk Assessment: Basis and Assumptions on Project Scope*, DOE/RL-2004-49, Rev. 0, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

EPA, 1997, *Test Methods for Evaluating Solid Waste: Physical/Chemical Methods*, SW-846, 3rd ed., as amended, U.S. Environmental Protection Agency, Washington, D.C.

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WMFS, 1998, *Sampling Services Procedures Manual*, ES-SSPM-001, Waste Management Federal Services, Inc., Northwest Operations, Richland, Washington.

APPENDIX A

LIST OF ANALYTES ASSOCIATED WITH EACH SUITE

APPENDIX A

LIST OF ANALYTES ASSOCIATED WITH EACH SUITE

Analytical Suite & Method	Constituent ID	Constituent Long Name
ICP Metals – 6010 (Client List)	7429-90-5	Aluminum
ICP Metals – 6010 (Client List)	7440-36-0	Antimony
ICP Metals – 6010 (Client List)	7440-38-2	Arsenic
ICP Metals – 6010 (Client List)	7440-39-3	Barium
ICP Metals – 6010 (Client List)	7440-41-7	Beryllium
ICP Metals – 6010 (Client List)	7440-69-9	Bismuth
ICP Metals – 6010 (Client List)	7440-42-8	Boron
ICP Metals – 6010 (Client List)	7440-43-9	Cadmium
ICP Metals – 6010 (Client List)	7440-70-2	Calcium
ICP Metals – 6010 (Client List)	7440-47-3	Chromium
ICP Metals – 6010 (Client List)	7440-48-4	Cobalt
ICP Metals – 6010 (Client List)	7440-50-8	Copper
ICP Metals – 6010 (Client List)	7439-89-6	Iron
ICP Metals – 6010 (Client List)	7439-92-1	Lead
ICP Metals – 6010 (Client List)	7439-93-2	Lithium
ICP Metals – 6010 (Client List)	7439-95-4	Magnesium
ICP Metals – 6010 (Client List)	7439-96-5	Manganese
ICP Metals – 6010 (Client List)	7439-98-7	Molybdenum
ICP Metals – 6010 (Client List)	7440-02-0	Nickel
ICP Metals – 6010 (Client List)	7723-14-0	Phosphorus
ICP Metals – 6010 (Client List)	7440-09-7	Potassium
ICP Metals – 6010 (Client List)	7782-49-2	Selenium
ICP Metals – 6010 (Client List)	7440-21-3	Silicon
ICP Metals – 6010 (Client List)	7440-22-4	Silver
ICP Metals – 6010 (Client List)	7440-23-5	Sodium
ICP Metals – 6010 (Client List)	7440-24-6	Strontium
ICP Metals – 6010 (Client List)	7440-28-0	Thallium
ICP Metals – 6010 (Client List)	7440-31-5	Tin
ICP Metals – 6010 (Client List)	7440-61-1	Uranium

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Analytical Suite & Method	Constituent ID	Constituent Long Name
ICP Metals – 6010 (Client List)	7440-62-2	Vanadium
ICP Metals – 6010 (Client List)	7440-66-6	Zinc
Mercury – 7471 – (CV)	7439-97-6	Mercury
Hexavalent Chromium – 7196A	18540-29-9	Hexavalent Chromium
Semi-VOA – 8270A (App IX)	95-94-3	1,2,4,5-Tetrachlorobenzene
Semi-VOA – 8270A (App IX)	120-82-1	1,2,4-Trichlorobenzene
Semi-VOA – 8270A (App IX)	95-50-1	1,2-Dichlorobenzene
Semi-VOA – 8270A (App IX)	541-73-1	1,3-Dichlorobenzene
Semi-VOA – 8270A (App IX)	106-46-7	1,4-Dichlorobenzene
Semi-VOA – 8270A (App IX)	123-91-1	1,4-Dioxane
Semi-VOA – 8270A (App IX)	130-15-4	1,4-Naphthoquinone
Semi-VOA – 8270A (App IX)	134-32-7	1-Naphthylamine
Semi-VOA – 8270A (App IX)	58-90-2	2,3,4,6-Tetrachlorophenol
Semi-VOA – 8270A (App IX)	95-95-4	2,4,5-Trichlorophenol
Semi-VOA – 8270A (App IX)	88-06-2	2,4,6-Trichlorophenol
Semi-VOA – 8270A (App IX)	120-83-2	2,4-Dichlorophenol
Semi-VOA – 8270A (App IX)	105-67-9	2,4-Dimethylphenol
Semi-VOA – 8270A (App IX)	51-28-5	2,4-Dinitrophenol
Semi-VOA – 8270A (App IX)	121-14-2	2,4-Dinitrotoluene
Semi-VOA – 8270A (App IX)	87-65-0	2,6-Dichlorophenol
Semi-VOA – 8270A (App IX)	606-20-2	2,6-Dinitrotoluene
Semi-VOA – 8270A (App IX)	53-96-3	2-Acetylaminofluorene
Semi-VOA – 8270A (App IX)	91-58-7	2-Chloronaphthalene
Semi-VOA – 8270A (App IX)	95-57-8	2-Chlorophenol
Semi-VOA – 8270A (App IX)	91-57-6	2-Methylnaphthalene
Semi-VOA – 8270A (App IX)	95-48-7	2-Methylphenol (cresol, o-)
Semi-VOA – 8270A (App IX)	91-59-8	2-Naphthylamine
Semi-VOA – 8270A (App IX)	88-74-4	2-Nitroaniline
Semi-VOA – 8270A (App IX)	88-75-5	2-Nitrophenol
Semi-VOA – 8270A (App IX)	109-06-8	2-Picoline
Semi-VOA – 8270A (App IX)	88-85-7	2-secButyl-4,6-dinitrophenol(DNBP)
Semi-VOA – 8270A (App IX)	65794-96-9	3+4 Methylphenol (cresol, m+p)
Semi-VOA – 8270A (App IX)	91-94-1	3,3'-Dichlorobenzidine

Appendix A – List of Analytes Associated with Each Suite

Analytical Suite & Method	Constituent ID	Constituent Long Name
Semi-VOA – 8270A (App IX)	119-93-7	3,3'-Dimethylbenzidine
Semi-VOA – 8270A (App IX)	56-49-5	3-Methylcholanthrene
Semi-VOA – 8270A (App IX)	99-09-2	3-Nitroaniline
Semi-VOA – 8270A (App IX)	534-52-1	4,6-Dinitro-2-methylphenol
Semi-VOA – 8270A (App IX)	92-67-1	4-Aminobiphenyl
Semi-VOA – 8270A (App IX)	101-55-3	4-Bromophenylphenyl ether
Semi-VOA – 8270A (App IX)	59-50-7	4-Chloro-3-methylphenol
Semi-VOA – 8270A (App IX)	106-47-8	4-Chloroaniline
Semi-VOA – 8270A (App IX)	7005-72-3	4-Chlorophenylphenyl ether
Semi-VOA – 8270A (App IX)	100-01-6	4-Nitroaniline
Semi-VOA – 8270A (App IX)	100-02-7	4-Nitrophenol
Semi-VOA – 8270A (App IX)	56-57-5	4-Nitroquinoline-1-oxide
Semi-VOA – 8270A (App IX)	99-55-8	5-Nitro-o-toluidine
Semi-VOA – 8270A (App IX)	57-97-6	7,12-Dimethylbenz[a]anthracene
Semi-VOA – 8270A (App IX)	83-32-9	Acenaphthene
Semi-VOA – 8270A (App IX)	208-96-8	Acenaphthylene
Semi-VOA – 8270A (App IX)	98-86-2	Acetophenone
Semi-VOA – 8270A (App IX)	62-53-3	Aniline
Semi-VOA – 8270A (App IX)	120-12-7	Anthracene
Semi-VOA – 8270A (App IX)	140-57-8	Aramite
Semi-VOA – 8270A (App IX)	56-55-3	Benzo(a)anthracene
Semi-VOA – 8270A (App IX)	50-32-8	Benzo(a)pyrene
Semi-VOA – 8270A (App IX)	205-99-2	Benzo(b)fluoranthene
Semi-VOA – 8270A (App IX)	191-24-2	Benzo(ghi)perylene
Semi-VOA – 8270A (App IX)	207-08-9	Benzo(k)fluoranthene
Semi-VOA – 8270A (App IX)	100-51-6	Benzyl alcohol
Semi-VOA – 8270A (App IX)	111-91-1	Bis(2-Chloroethoxy)methane
Semi-VOA – 8270A (App IX)	108-60-1	Bis(2-chloro-1-methylethyl)ether
Semi-VOA – 8270A (App IX)	111-44-4	Bis(2-chloroethyl) ether
Semi-VOA – 8270A (App IX)	117-81-7	Bis(2-ethylhexyl) phthalate
Semi-VOA – 8270A (App IX)	85-68-7	Butylbenzylphthalate
Semi-VOA – 8270A (App IX)	510-15-6	Chlorobenzilate
Semi-VOA – 8270A (App IX)	218-01-9	Chrysene

Appendix A – List of Analytes Associated with Each Suite

Analytical Suite & Method	Constituent ID	Constituent Long Name
Semi-VOA – 8270A (App IX)	84-74-2	Di-n-butylphthalate
Semi-VOA – 8270A (App IX)	117-84-0	Di-n-octylphthalate
Semi-VOA – 8270A (App IX)	2303-16-4	Diallate
Semi-VOA – 8270A (App IX)	53-70-3	Dibenz[a,h]anthracene
Semi-VOA – 8270A (App IX)	132-64-9	Dibenzofuran
Semi-VOA – 8270A (App IX)	84-66-2	Diethylphthalate
Semi-VOA – 8270A (App IX)	60-51-5	Dimethoate
Semi-VOA – 8270A (App IX)	131-11-3	Dimethyl phthalate
Semi-VOA – 8270A (App IX)	122-39-4	Diphenylamine
Semi-VOA – 8270A (App IX)	298-04-4	Disulfoton
Semi-VOA – 8270A (App IX)	97-63-2	Ethyl methacrylate
Semi-VOA – 8270A (App IX)	62-50-0	Ethyl methanesulfonate
Semi-VOA – 8270A (App IX)	52-85-7	Famphur
Semi-VOA – 8270A (App IX)	206-44-0	Fluoranthene
Semi-VOA – 8270A (App IX)	86-73-7	Fluorene
Semi-VOA – 8270A (App IX)	118-74-1	Hexachlorobenzene
Semi-VOA – 8270A (App IX)	87-68-3	Hexachlorobutadiene
Semi-VOA – 8270A (App IX)	77-47-4	Hexachlorocyclopentadiene
Semi-VOA – 8270A (App IX)	67-72-1	Hexachloroethane
Semi-VOA – 8270A (App IX)	70-30-4	Hexachlorophene
Semi-VOA – 8270A (App IX)	1888-71-7	Hexachloropropene
Semi-VOA – 8270A (App IX)	193-39-5	Indeno(1,2,3-cd)pyrene
Semi-VOA – 8270A (App IX)	465-73-6	Isodrin
Semi-VOA – 8270A (App IX)	78-59-1	Isophorone
Semi-VOA – 8270A (App IX)	120-58-1	Isosafrole
Semi-VOA – 8270A (App IX)	143-50-0	Kepone
Semi-VOA – 8270A (App IX)	91-80-5	Methapyrilene
Semi-VOA – 8270A (App IX)	80-62-6	Methyl methacrylate
Semi-VOA – 8270A (App IX)	66-27-3	Methyl methanesulfonate
Semi-VOA – 8270A (App IX)	298-00-0	Methyl parathion
Semi-VOA – 8270A (App IX)	621-64-7	N-Nitroso-di-n-dipropylamine
Semi-VOA – 8270A (App IX)	924-16-3	N-Nitrosodi-n-butylamine
Semi-VOA – 8270A (App IX)	55-18-5	N-Nitrosodiethylamine

Appendix A – List of Analytes Associated with Each Suite

Analytical Suite & Method	Constituent ID	Constituent Long Name
Semi-VOA – 8270A (App IX)	62-75-9	N-Nitrosodimethylamine
Semi-VOA – 8270A (App IX)	86-30-6	N-Nitrosodiphenylamine
Semi-VOA – 8270A (App IX)	10595-95-6	N-Nitrosomethylethylamine
Semi-VOA – 8270A (App IX)	59-89-2	N-Nitrosomorpholine
Semi-VOA – 8270A (App IX)	100-75-4	N-Nitrosopiperidine
Semi-VOA – 8270A (App IX)	91-20-3	Naphthalene
Semi-VOA – 8270A (App IX)	98-95-3	Nitrobenzene
Semi-VOA – 8270A (App IX)	930-55-2	Nitrosopyrrolidine
Semi-VOA – 8270A (App IX)	126-68-1	O,O,O-Triethyl phosphorothioate
Semi-VOA – 8270A (App IX)	297-97-2	O,O-Diethyl O-2-pyrazinyl phosphorothioate
Semi-VOA – 8270A (App IX)	56-38-2	Parathion
Semi-VOA – 8270A (App IX)	608-93-5	Pentachlorobenzene
Semi-VOA – 8270A (App IX)	76-01-7	Pentachloroethane
Semi-VOA – 8270A (App IX)	82-68-8	Pentachloronitrobenzene (PCNB)
Semi-VOA – 8270A (App IX)	87-86-5	Pentachlorophenol
Semi-VOA – 8270A (App IX)	62-44-2	Phenacetin
Semi-VOA – 8270A (App IX)	85-01-8	Phenanthrene
Semi-VOA – 8270A (App IX)	108-95-2	Phenol
Semi-VOA – 8270A (App IX)	298-02-2	Phorate
Semi-VOA – 8270A (App IX)	23950-58-5	Pronamide
Semi-VOA – 8270A (App IX)	129-00-0	Pyrene
Semi-VOA – 8270A (App IX)	110-86-1	Pyridine
Semi-VOA – 8270A (App IX)	94-59-7	Safrol
Semi-VOA – 8270A (App IX)	3689-24-5	Tetraethyl dithiopyrophosphate
Semi-VOA – 8270A (App IX)	122-09-8	alpha,alpha-Dimethylphenethylamine
Semi-VOA – 8270A (App IX)	99-65-0	m-Dinitrobenzene
Semi-VOA – 8270A (App IX)	95-53-4	o-Toluidine
Semi-VOA – 8270A (App IX)	60-11-7	p-Dimethylaminoazobenzene
Semi-VOA – 8270A (App IX)	106-50-3	p-Phenylenediamine
Semi-VOA – 8270A (App IX)	99-35-4	sym-Trinitrobenzene
Semi-VOA – 8270A (App IX Add-On)	126-73-8	Tributyl phosphate
Pesticides – 8081	309-00-2	Aldrin
Pesticides – 8081	319-84-6	Alpha-BHC

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Analytical Suite & Method	Constituent ID	Constituent Long Name
Pesticides – 8081	319-86-8	Delta-BHC
Pesticides – 8081	72-54-8	Dichlorodiphenyldichloroethane
Pesticides – 8081	72-55-9	Dichlorodiphenyldichloroethylene
Pesticides – 8081	50-29-3	Dichlorodiphenyltrichloroethane
Pesticides – 8081	60-57-1	Dieldrin
Pesticides – 8081	959-98-8	Endosulfan I
Pesticides – 8081	33213-65-9	Endosulfan II
Pesticides – 8081	1031-07-8	Endosulfan sulfate
Pesticides – 8081	72-20-8	Endrin
Pesticides – 8081	7421-93-4	Endrin aldehyde
Pesticides – 8081	58-89-9	Gamma-BHC (Lindane)
Pesticides – 8081	76-44-8	Heptachlor
Pesticides – 8081	1024-57-3	Heptachlor epoxide
Pesticides – 8081	72-43-5	Methoxychlor
Pesticides – 8081	8001-35-2	Toxaphene
Pesticides – 8081	5103-71-9	alpha-Chlordane
Pesticides – 8081	319-85-7	beta-1,2,3,4,5,6-Hexachlorocyclohexane
Pesticides – 8081	5103-74-2	gamma-Chlordane
PCBs – 8082	12674-11-2	Aroclor-1016
PCBs – 8082	11104-28-2	Aroclor-1221
PCBs – 8082	11141-16-5	Aroclor-1232
PCBs – 8082	53469-21-9	Aroclor-1242
PCBs – 8082	12672-29-6	Aroclor-1248
PCBs – 8082	11097-69-1	Aroclor-1254
PCBs – 8082	11096-82-5	Aroclor-1260
TPH-Diesel Range – WTPH-D (8015M)	TPHDIESEL	Total petroleum hydrocarbons – diesel range
Gamma Spec – Complete	14596-10-2	Americium-241
Gamma Spec – Complete	14234-35-6	Antimony-125
Gamma Spec – Complete	13981-41-4	Barium-133
Gamma Spec – Complete	13966-02-4	Beryllium-7
Gamma Spec – Complete	13967-74-3	Cerium-141
Gamma Spec – Complete	CE/PR-144	Cerium/Praseodymium-144
Gamma Spec – Complete	13967-70-9	Cesium-134

Appendix A – List of Analytes Associated with Each Suite

Analytical Suite & Method	Constituent ID	Constituent Long Name
Gamma Spec – Complete	10045-97-3	Cesium-137
Gamma Spec – Complete	13981-43-6	Chlorine-36
Gamma Spec – Complete	13981-50-5	Cobalt-57
Gamma Spec – Complete	13981-38-9	Cobalt-58
Gamma Spec – Complete	10198-40-0	Cobalt-60
Gamma Spec – Complete	14683-23-9	Europium-152
Gamma Spec – Complete	15585-10-1	Europium-154
Gamma Spec – Complete	14391-16-3	Europium-155
Gamma Spec – Complete	14596-12-4	Iron-59
Gamma Spec – Complete	13966-31-9	Manganese-54
Gamma Spec – Complete	14681-63-1	Niobium-94
Gamma Spec – Complete	13966-00-2	Potassium-40
Gamma Spec – Complete	13982-63-3	Radium-226
Gamma Spec – Complete	15262-20-1	Radium-228
Gamma Spec – Complete	13968-53-1	Ruthenium-103
Gamma Spec – Complete	13967-48-1	Ruthenium-106
Gamma Spec – Complete	14391-65-2	Silver-108 metastable
Gamma Spec – Complete	13966-32-0	Sodium-22
Gamma Spec – Complete	14274-82-9	Thorium-228
Gamma Spec – Complete	TH-232	Thorium-232
Gamma Spec – Complete	13966-06-8	Tin-113
Gamma Spec – Complete	15117-96-1	Uranium-235
Gamma Spec – Complete	U-238	Uranium-238
Gamma Spec – Complete	13982-39-3	Zinc-65
Isotopic Plutonium	13981-16-3	Plutonium-238
Isotopic Plutonium	PU-239/240	Plutonium-239/240
Total Uranium	7440-61-1	Uranium
Isotopic Uranium	U-233/234	Uranium-233/234
Isotopic Uranium	15117-96-1	Uranium-235
Isotopic Uranium	U-238	Uranium-238
Strontium-89,90 – Total Sr	SR-RAD	Total beta radiostrontium

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Analytical Suite & Method	Constituent ID	Constituent Long Name
Carbon-14	14762-75-5	Carbon-14
Tritium- H3[a]	10028-17-8	Tritium

[a] Tritium is a Human Health COPC; other Human Health COPCs will be listed in the SAP.
ICP = inductively coupled plasma
PCB = polychlorinated biphenyl
VOA = volatile organic analysis

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