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11-AMCP-0075

JAN 26 2011

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Addressees:

SAMPLING AND ANALYSIS PLAN FOR THE WEST LAKE SITE, DOE/RL-2009-121, REVISION 0

This letter transmits the approved Sampling and Analysis Plan for the West Lake Site, DOE/RL-2009-121, Revision 0. The Sampling and Analysis Plan was signed by the U.S. Department of Energy Richland Operations Office on December 2, 2010, and the U.S. Environmental Protection Agency and State of Washington Department of Ecology on December 14, 2010.

If you have any questions, please contact me, or your staff may contact Briant Charboneau, of my staff, on (509) 373-6137.

Sincerely,

Richard A. Holten, Acting Assistant Manager
for the Central Plateau

AMCP:GLS

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cc: See Page 2

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DOE/RL-2009-121
Revision 0

Sampling and Analysis Plan for the West Lake Site

Prepared for the U.S. Department of Energy
Assistant Secretary for Environmental Management

U.S. DEPARTMENT OF ENERGY

Richland Operations Office

P.O. Box 550
Richland, Washington 99352

Approved for Public Release;
Further Dissemination Unlimited

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Approval Page

Title *Sampling and Analysis Plan for the West Lake Site*

Concurrence U.S. Department of Energy, Richland Operations Office

Signature 12-02-10 Date

Concurrence U.S. Environmental Protection Agency

Signature 12-14-10 Date

Concurrence Washington State Department of Ecology

Signature 12-14-10 Date

Contents

1 Introduction 1-1

1.1 Site Description and History 1-1

1.1.1 Contaminant Sources 1-4

1.1.2 October 2009 Aerial Radiological Survey 1-4

1.2 West Lake Environmental Media 1-4

1.3 Contaminants of Potential Concern 1-5

1.4 Data Quality Objectives 1-13

2 Quality Assurance Project Plan 2-1

2.1 Project Management 2-1

2.1.1 Project/Task Organization 2-2

2.1.2 Problem Definition/Background 2-4

2.1.3 Project/Task Description 2-5

2.1.4 Quality Objectives and Criteria 2-5

2.1.5 Special Training Requirements/Certification 2-6

2.1.6 Documents and Records 2-13

2.2 Data Generation and Acquisition 2-23

2.2.1 Sampling Process Design 2-23

2.2.2 Sampling Methods 2-24

2.2.3 Sample Handling and Custody 2-24

2.2.4 Analytical Methods 2-24

2.2.5 Quality Control 2-24

2.2.6 Instrument/Equipment Testing, Inspection, and Maintenance 2-27

2.2.7 Instrument/Equipment Calibration and Frequency 2-27

2.2.8 Inspection/Acceptance of Supplies and Consumables 2-27

2.2.9 Data Acquisition Requirements (Non-Direct Data) 2-27

2.2.10 Data Management 2-28

2.3 Assessment and Oversight 2-29

2.3.1 Assessments and Response Actions 2-29

2.3.2 Reports to Management 2-29

2.4 Data Validation and Usability 2-29

2.4.1 Data Review, Verification, and Validation 2-29

2.4.2 Verification and Validation Methods 2-30

2.4.3 Reconciliation with User Requirements 2-30

3 Field Sampling Plan 3-1

3.1 Sampling Objectives 3-1

3.2 Documentation of Field Activities 3-1

3.3 Sampling Design 3-1
3.4 Calibration of Field Equipment 3-2
3.5 Sample Locations and Frequency 3-2
3.6 Sampling Methods 3-9
3.6.1 Surface Radiation Surveys 3-12
3.6.2 Sample Media Collection Order 3-12
3.6.3 Soil and Salt-Soil Mixture Samples Above the Seasonal Pond Water Level 3-17
3.6.4 Salt, Sediment, and Salt-Soil Mixture Samples Below the Seasonal Pond Water Level 3-17
3.6.5 Hard Substrate Sampling 3-18
3.6.6 Surface Water Sampling 3-18
3.6.7 Subsurface Soil Sampling 3-18
3.6.8 Groundwater and Seep Sampling 3-19
3.6.9 Decontamination of Sampling Equipment 3-19
3.6.10 Preshipment Sample Screening 3-20
3.7 Surveying 3-20
3.8 Waste Management Sampling 3-20
4 Health and Safety 4-1
5 Management of Investigation-Derived Waste 5-1
6 References 6-1

Figures

Figure 1-1. Location Map of West Lake and the 200 Areas on the Hanford Site 1-2
Figure 1-2. Topographic Map of West Lake 1-3
Figure 1-3. October 2009 Aerial Radiological Survey Results 1-6
Figure 1-4. West Lake Environmental Media – Plan View 1-9
Figure 1-5. West Lake Environmental Media – Cross-Section View 1-10
Figure 2-1. Project Organization 2-2
Figure 3-1. Salt and Salt-Soil Mixture Random Sample Locations 3-3
Figure 3-2. Salt and Salt-Soil Mixture Transect and Confirmation Sample Locations 3-4
Figure 3-3. Surface Water and Seep Sample Locations 3-5
Figure 3-4. Groundwater Monitor Well Sample Locations 3-6
Figure 3-5. Soil Boring (SB1 to SB5) Locations 3-7

Tables

Table 1-1. Description of West Lake Environmental Media 1-7
Table 1-2. Presence/Absence of Water in West Lake – March 2006 Through February 2007 1-8

Table 1-3. West Lake COPC List 1-11
Table 2-1. Data Quality Indicators 2-7
Table 2-2. Radionuclide Analytical Performance Requirements – Soil and Sediment 2-10
Table 2-3. Radionuclide Analytical Performance Requirements – Water Matrices 2-12
Table 2-4. Chemical Analytical Performance Requirements – Soil and Sediment 2-15
Table 2-5. Chemical Analytical Performance Requirements – Water Matrices 2-20
Table 2-6. Change Control for Sampling Projects 2-23
Table 2-7. Project Quality Control Sampling Summary 2-25
Table 3-1. Sample Locations and Frequencies and Sampling Methods 3-8
Table 3-2. Sample Preservation, Container, and Holding Times for Soil, Mixed Salt and Soil, Soil, and Sediment Samples 3-9
Table 3-3. Sample Preservation, Container, and Holding Times for Surface Water, Seep, and Groundwater Samples 3-11
Table 3-4. Analytes for Sample Media 3-13

Terms

AEA	alpha energy analysis
ALARA	as low as reasonably achievable
ANSI	American National Standards Institute
ASME	American Society of Mechanical Engineers
ASQC	American Society of Quality Control
ASTM	American Society for Testing and Materials
CERCLA	*Comprehensive Environmental Response, Compensation, and Liability Act of 1980*
CHPRC	CH2M HILL Plateau Remediation Company
CFR	*Code of Federal Regulations*
COPC	constituent of potential concern
CSM	conceptual site model
DOE	U.S. Department of Energy
DQA	data quality assessment
DQI	data quality indicator
DQO	data quality objective
DUP	field duplicates
EB	equipment blank
ECO	environmental compliance officer
Ecology	Washington State Department of Ecology
EPA	U.S. Environmental Protection Agency
FS	feasibility study
FSP	field sampling plan
GE	gamma energy
GPS	global positioning system
GS	gamma spectroscopy
HEIS	Hanford Environmental Information System (database)
HH	human health
HHE	human health and the environment
IC	ion chromatograph
ICP	inductively coupled plasma
IDW	investigation-derived waste

LSC	liquid scintillation counter
MIS	multi-increment sampling
N/A	not applicable
OU	operable unit
PAH	polycyclic aromatic hydrocarbon
PCB	polychlorinated biphenyl
POC	point-of-contact
QA	quality assurance
QAPjP	quality assurance project plan
QC	quality control
RBSL	risk-based screening level
RCRA	*Resource Conservation and Recovery Act of 1976*
RCT	radiological control technician
RI	remedial investigation
ROD	record of decision
RL	DOE Richland Operations Office
SAP	sampling and analysis plan
SVOC	semi-volatile organic compound
TAL	target analyte list
TBD	to be determined
TPA	Tri-Party Agreement
TPH	total petroleum hydrocarbon
VOC	volatile organic compound
WAC	*Washington Administrative Code*
WIDS	Waste Information Data System (database)

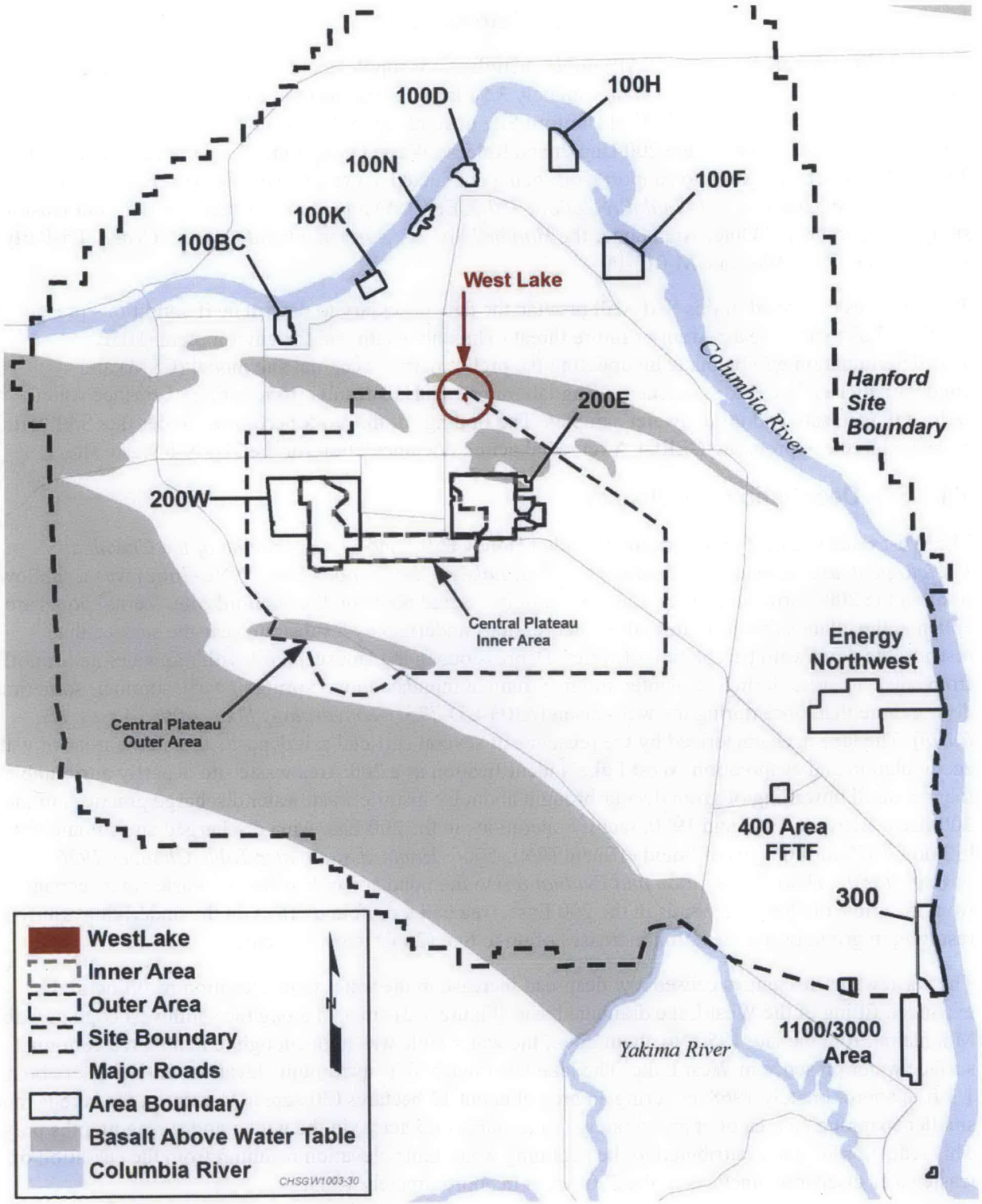


Figure 1-1. Location Map of West Lake and the 200 Areas on the Hanford Site

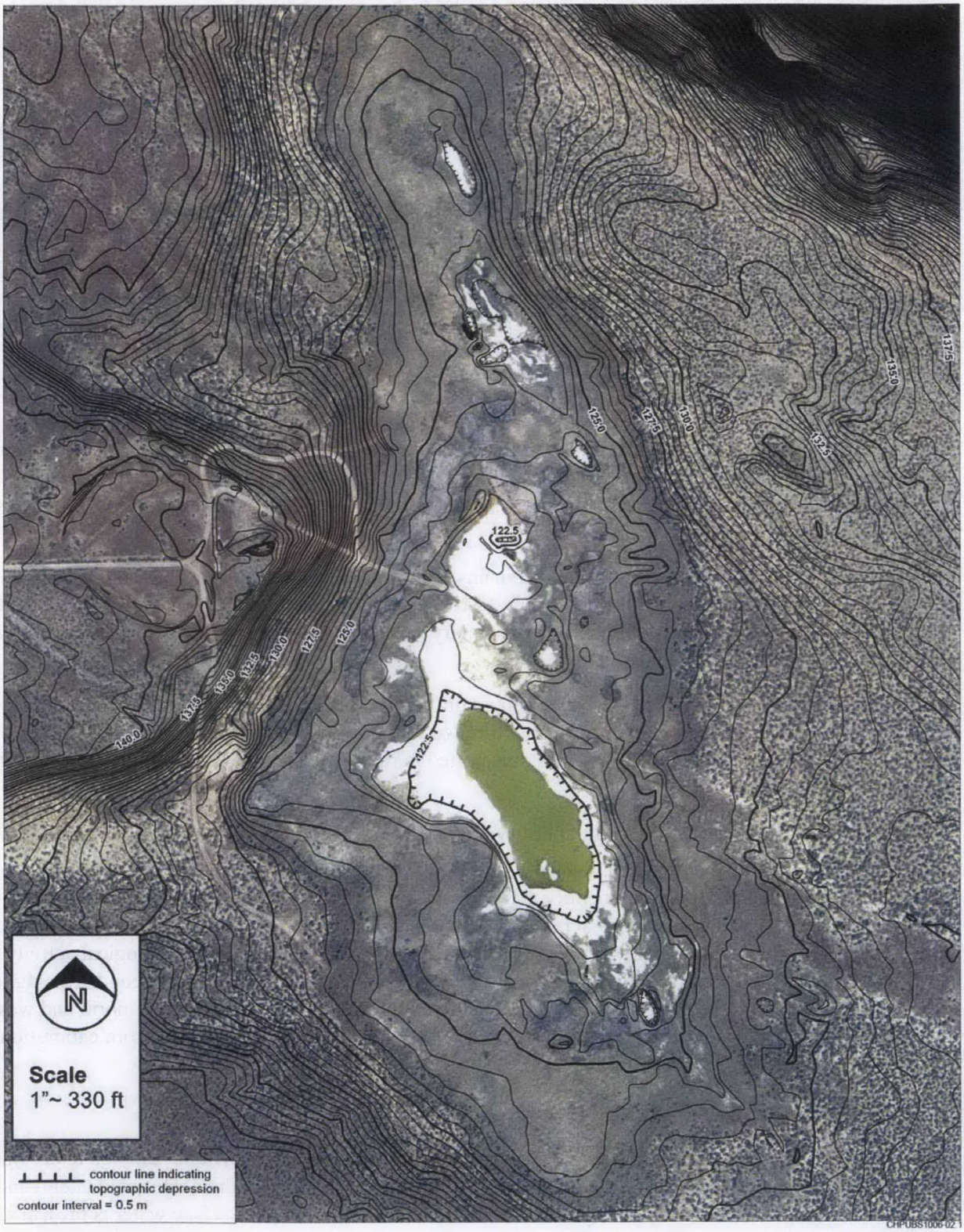


Figure 1-2. Topographic Map of West Lake

1 Introduction

This sampling and analysis plan (SAP) directs activities for supplemental characterization of the West Lake site (216-N-8) located approximately 3.54 km (2.2 mi) north of the 200 East Area at the U.S. Department of Energy's (DOE's) Hanford Site in south-central Washington State (Figure 1-1). The West Lake site is part of the 200 Unplanned Release Waste Group Operable Unit (200-UR-1 OU). This SAP has been prepared to support work being conducted under a *Comprehensive Environmental Response, Compensation, and Liability Act of 1980* (CERCLA) remedial investigation (RI) and feasibility study (FS) for the 200 Outer Area under the *Hanford Facility Agreement and Consent Order*, Tri-Party Agreement (TPA) Milestone M-015-00.

The activities described in this SAP will provide the data necessary to determine if conditions present at the West Lake site pose a current or future threat to human health and the environment (HHE). This determination will be made by updating the preliminary conceptual site model (CSM) and conducting a baseline risk assessment using laboratory analysis results from testing of surface water, sediment, soil, salt, and groundwater samples. The findings of the work performed under this SAP will be presented in the appropriate CERCLA remedial action documentation for the 216-N-8 waste site.

1.1 Site Description and History

The West Lake site (216-N-8) originally called Honey Hill Pond (*An Evaluation of the Chemical, Radiological, and Ecological Conditions of West Lake on the Hanford Site*, PNNL-7662) was a shallow basin in the 200 North Area. West Lake is the only "vernal pool" on the Hanford Site. Vernal pools are ephemeral wetlands that form in shallow depressions underlain by a substrate near the surface that restricts the downward percolation of water. Depressions in the landscape fill with rainwater and runoff from adjacent areas during the winter and may remain inundated until spring or early summer, sometimes drying more than once during the wet season (ARH-CD-775, *Geohydrology Study of the West Lake Basin*). The lake is characterized by the presence of several surficial salt deposits that mark areas of water accumulation and evaporation. West Lake's identification as a 200 Area waste site is partly attributable to the increased upwelling of groundwater brought about by historic wastewater discharge practices in the 200 Area. Between 1943 and 1980, facility operations in the 200 East Area discharged an estimated 365 billion L (829 million gal) of liquid effluent (PNL-5506, *Hanford Site Water Table Changes 1950 through 1980 – Data Observation and Evaluation*) to the pond and crib systems. Wastewater seepage from the cribs, ditches, and ponds in the 200 East Area had a profound effect on the underlying aquifer(s) resulting in groundwater elevation increases of up to 6 m (20 ft) in some areas.

The wastewater discharges caused a widespread increase in the water table elevation resulting in the expanded filling of the West Lake drainage basin (Figure 1-2) situated along the southwest edge of Gable Mountain. From the late 1950s to about 2004, the water table was high enough to maintain a continual surface water presence in West Lake. The lake level reached its maximum elevation and depth of about 1.3 ft in approximately 1968, covering an area of about 12 hectares (30 acres). Currently, the lake is much smaller spanning an area of approximately 0.6 hectares (1.5 acres) in the winter and spring months only. This reduction in size is attributed to the declining water table elevation resulting from the cessation of wastewater discharge practices in the 200 Areas in approximately 1985.

Annual cycles of recharge (natural and enhanced) and evaporation resulted in the formation of several salt deposits within the lake's footprint. During recharge periods, groundwater upwelling transports dissolved minerals into the lake. Water present in the lake also dissolves a portion of the existing salt deposits, further increasing the water's pH and salinity. The salt deposits delineate areas where surface water repeatedly accumulated and then evaporated.

The salt deposits located north of the seasonal pond no longer retain water but mark locations of prior surface water accumulation when recharge volumes were greater. The high alkaline levels (pH ranges from 9.4 to 10) and salinity (total dissolved solids of approximately 15,000 mg/L) present in the seasonal surface water pond are expected to limit its use by humans or animals. Native Americans and some early settlers took advantage of fresh water seeps at West Lake (John Price, Tri-Party Agreement Section Manger, State of Washington, Department of Ecology, Tri-City Herald Newspaper interview, September 2009).

1.1.1 Contaminant Sources

The chemical and radionuclide constituents present in West Lake surface water, sediment, and evaporative salt deposits are the result of natural and anthropogenic sources. As natural groundwater flow passes through alluvium and rock, it dissolves soluble minerals such as sodium, calcium, magnesium, chloride, and to a lesser extent trace metals and other constituents with lower solubility. These dissolved constituents make up the total dissolved solids content of the groundwater which is responsible for its hardness and salinity.

The natural upwelling and evaporation process at West Lake has resulted in the concentration of chemical constituents in surface water, salt, and lake sediments to levels that are higher than those found in natural freshwater bodies and Hanford Site soil. The elevated concentrations for many of these constituents, including naturally occurring uranium isotopes, may be a function of the normal evaporative processes that have taken place for many years.

The West Lake site did not receive effluent from any Hanford Production facilities but may have received discharge via overland flow from the 606 Central Mix cement plant (Drawing H-11-4327). Early Hanford construction camps also reportedly disposed of sanitary sewage in the Honey Hill area lying west of the West Lake site (WIDS, July 2009).

Historic wastewater discharges to the Gable Mountain Pond and B-Pond contained chemical and radionuclide constituents. As this wastewater infiltrated into the underlying aquifer, it mixed with groundwater, and a portion of the water was transported north to West Lake by the regional groundwater flow gradient.

1.1.2 October 2009 Aerial Radiological Survey

An aerial radiological survey was conducted of the West Lake site in early October 2009 to identify surface radiological conditions and identify areas for further investigation. The survey included measurements at over 1,000 locations across a rectangular grid. The survey results, which show measured radiological activity in counts per second, are portrayed on Figure 1-3. Measured radiological activity values ranged from less than -60 counts per second to approximately +81 counts per second. The highest observed values, ranging between 60 and 81 counts per second, were detected along the north and west margins of the lake's primary salt deposit. Negative radiological activity values result from calibration of the detector at a background location with higher activity levels.

1.2 West Lake Environmental Media

The West Lake site contains a number of different environmental media that will be sampled under this SAP. A description of the media is provided in Table 1-1, and maps showing their estimated lateral and vertical distribution are included as Figure 1-4 and Figure 1-5, respectively. Surface water is present and seeps are active during certain times of the year only (Table 1-2). This information will be needed to plan and schedule the activities described in this SAP.

1.3 Contaminants of Potential Concern

For the West Lake data quality objective (DQO) process, contaminants of potential concern (COPCs) were identified from WMP-28945, *Data Quality Objectives Summary Report in Support of the 200-BP-5 Groundwater Operable Unit Remedial Investigation/Feasibility Study Process*, WMP-29253 (hereafter referred to as the CP Eco DQO), and DOE/RL-2006-27. These previously developed lists encompass all of the COPCs (Table 1-3) that have been identified as the primary target contaminants needed for assessing soil, sediment and groundwater contaminant distribution, and for assessing potential ecological impacts in the vicinity of the West Lake site.

Several constituents identified in the 200-BP-5 Groundwater OU DQO (i.e., Thorium-234, Neptunium-237, chloroform, methylene chloride, bis(2-ethylhexyl)phthalate, and pentachlorophenol) were eliminated from the COPC list because they are known to have limited distribution in the 200 East Area. Polychlorinated biphenyls (PCBs) were retained as West Lake COPCs per Washington State Department of Ecology (Ecology) request.

The scope of sampling presented in Chapter 3 of this SAP also includes testing for an expanded suite of organic, inorganic, and radionuclide constituents in a subset of the total sample set to provide continuity with the 200 Outer Area ecological risk assessment and to provide confirmation that these constituents are absent. The constituents that are part of this expanded list are identified in Table 1-3 and elsewhere in this SAP by a footnote. Additional information on this supplemental testing is provided in Chapter 3.

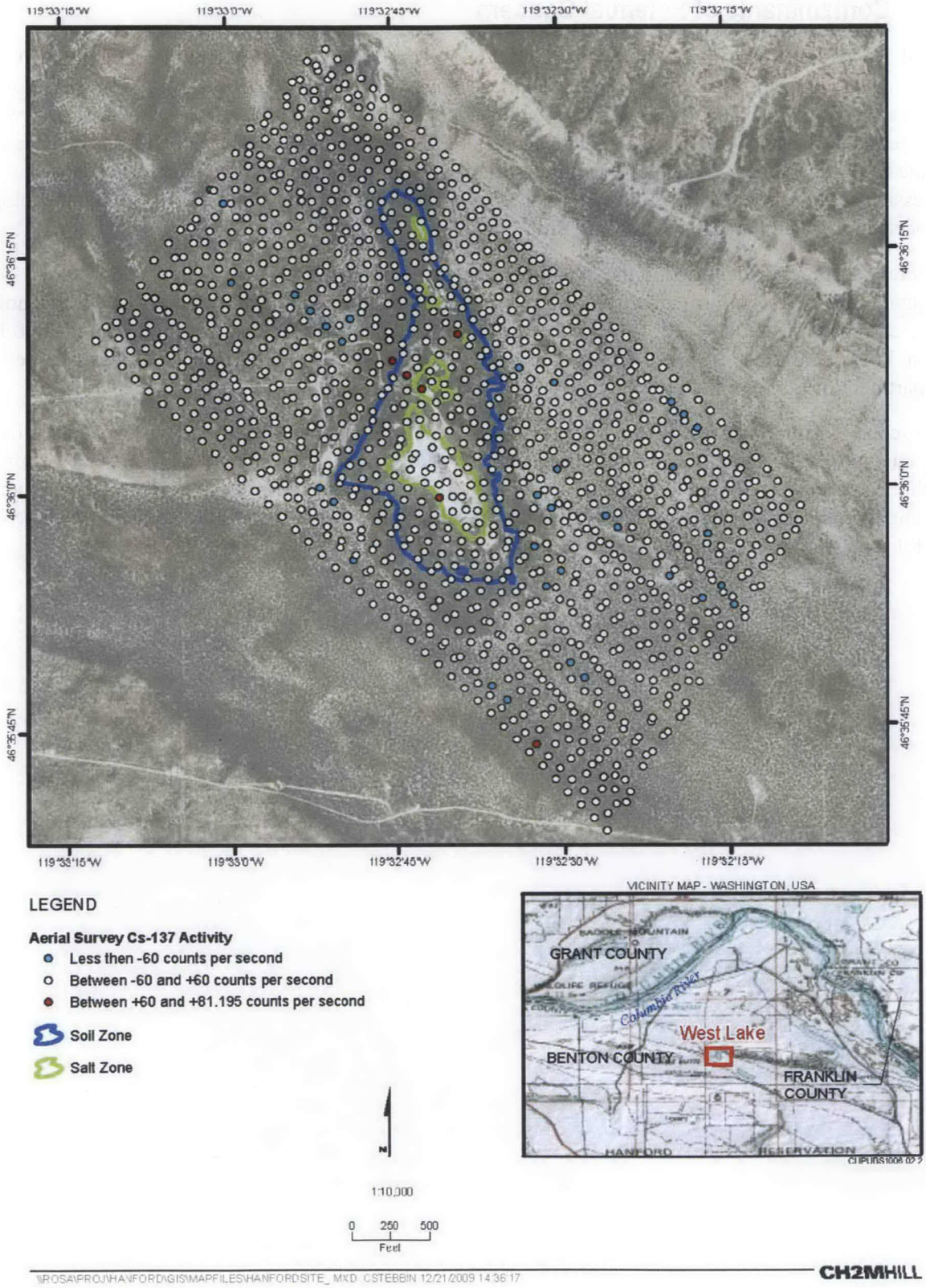


Figure 1-3. October 2009 Aerial Radiological Survey Results

Table 1-1. Description of West Lake Environmental Media

Environmental Media		
Figure 1-4 Designation	**SAP Description**	**Characteristics**
Pond	Seasonal West Lake surface water pond	Saline ephemeral surface water pond defined by the seasonal high water level.
Seeps	Shoreline seeps at the seasonal pond	Local points along the southeast lake margin where groundwater recharges the seasonal pond.
Not Shown	Groundwater underlying West Lake	Groundwater underlies the lake. Depth to groundwater ranges from inches to feet, depending on the local ground surface elevation and time of year. Groundwater is directly connected with surface water at seep locations, and may be connected on a broader–diffuse scale. Groundwater may be in contact with surface soil (0 to 6 inches) at locations where the water table elevation is near the surface or where the capillary fringe ascends into this zone.
Salt Zone #1 to #4	Salt deposits	Evaporation of surface water has formed salt deposits.
Mixed Zone #1 to #3	Mixed salt and soil zone	Consists of a mixture of disseminated salt within soil encompassing the main salt deposits.
Soil Zone #1 and #2	Soil zone	Soil zone surrounding mixed soil and salt zones. When high water periods occurred in the past, the soil zone was submerged. The outer boundary of the soil zone marks the historical maximum extent of surface water at West Lake.
Same as Pond	Sediments	Consist of organic-rich clay to very fine-grained sand underlying the seasonal pond.
	Hard, low-permeability substrate present beneath the lake sediments in the seasonal pond	Very hard (indurated) layer likely composed of calcium carbonate (caliche). Layer expected to act as a barrier potentially affecting diffuse groundwater upwelling into the lake or limiting infiltration of surface water during low groundwater elevation periods.
	Sand and gravel	Hanford formation sand and gravel deposits above water table.
Same as Pond	Benthic Macroinvertebrate Community	Surface water bodies such as West Lake with saline conditions can support macroinvertebrate communities with a diversity and richness that is less developed than other freshwater systems but sufficiently developed to support a complete aquatic food web that includes top level predators including carnivorous wildlife.
Soil Zone #1 and #2	Vegetative Community	Present throughout the footprint of the historic West Lake boundary. Field observations suggest that small mammals reside within the area where vegetation provides cover.
	Terrestrial Invertebrate Community	The terrestrial habitat surrounding West Lake, particularly within the vegetative areas, supports a community of terrestrial invertebrates such as beetles and ants that act as a food source for invertivorous and omnivorous wildlife.
	Small Mammal Population	A population of small burrowing mammals resides within the terrestrial habitat surrounding West Lake, particularly within the vegetation that provides cover.
Not Shown	Subsurface Soil	Media between former Gable Mountain Pond and West Lake that may contain residual contaminants transported by groundwater from Gable Mountain Pond when it was being used.

Table 1-2. Presence/Absence of Water in West Lake – March 2006 Through February 2007

Year	Period	Standing Water	Seeps
2006	March	X	
	April	X	
	May	X	
	June	X	
	July		
	August		
	September		
	October		X (confined)
	November	X	X (confined)
	December	X	X
2007	January	X	X
	February	X	X

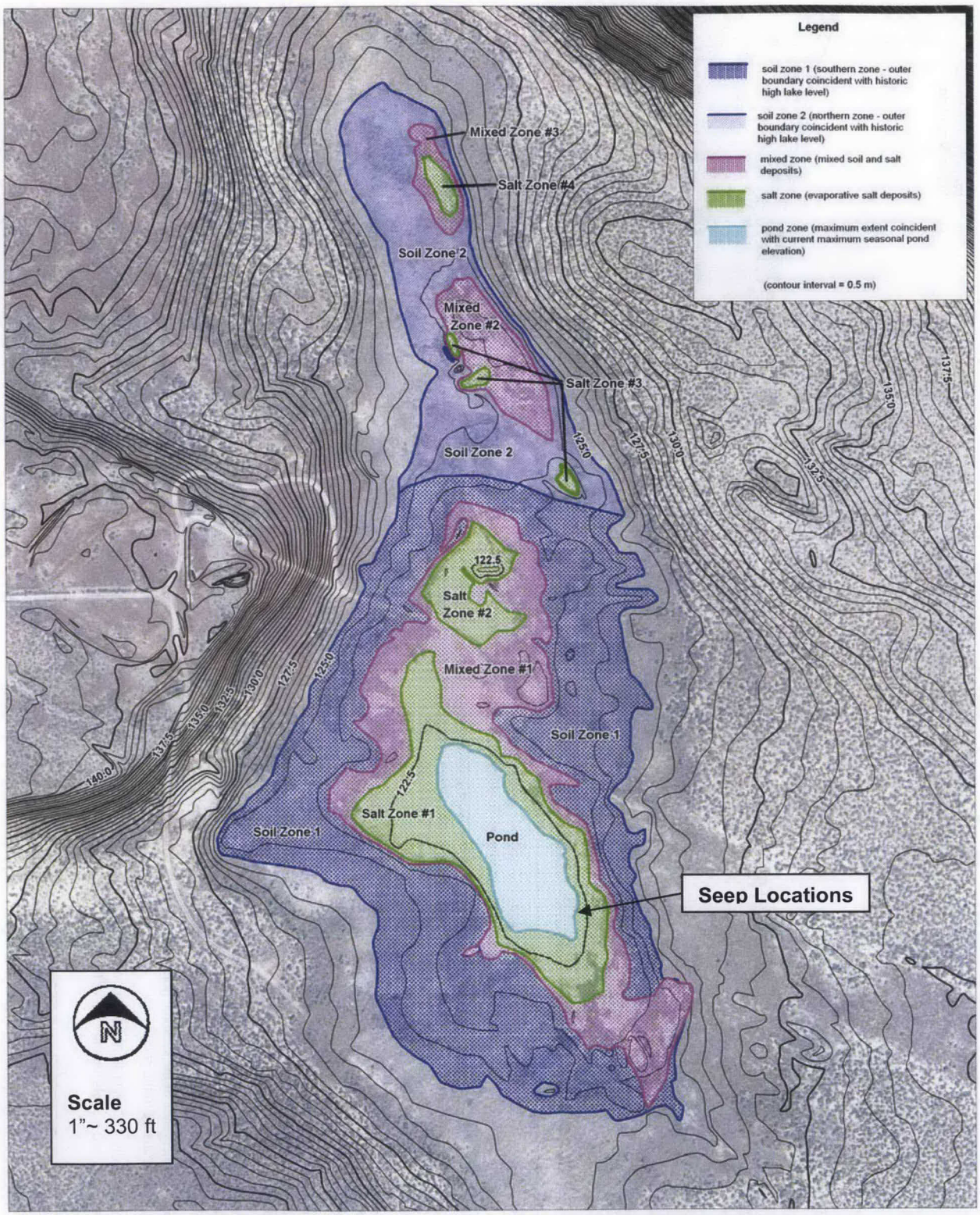
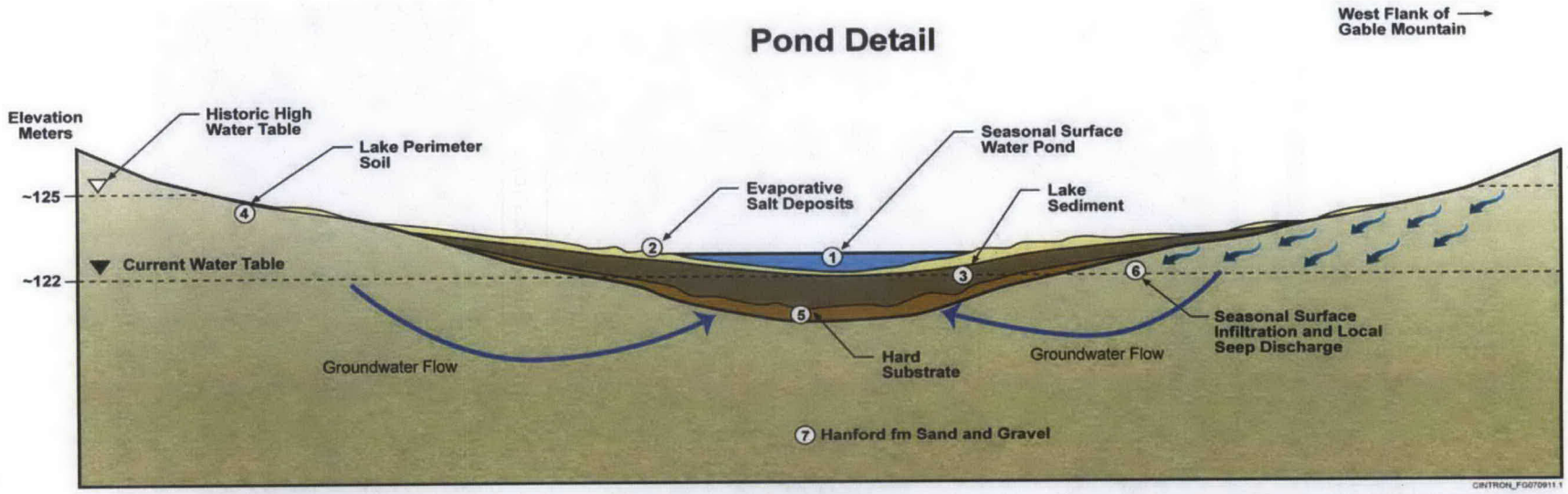


Figure 1-4. West Lake Environmental Media – Plan View



1. The current seasonal pond is highly saline. Soluble constituents occurring in evaporative salts (e.g., metals, uranium isotopes) dissolve back into solution when water recharges the pond. Historically, highly mobile constituents such as tritium and Tc-99, carried by groundwater, migrated from the 200 East Area and have been detected in West Lake surface water.

2. Repetitive seasonal evaporation of surface water in the closed West Lake drainage basin has resulted in the development of salt deposits. These salt deposits are most extensive in the vicinity of the seasonal pond. The process of evaporation has concentrated certain metals (e.g., uranium) and radionuclides (e.g., uranium isotopes) within the saline surface water, and mineral salts have precipitated out of solution. The salt deposits form a crust on the surface as water evaporates. Elevated concentrations of uranium metal as well as uranium isotopes are present in the salt deposits.

3. Dark, organic-rich, clayey to silty lake sediments, several inches to several feet in thickness, occur in the seasonal pond. These sediments can be water saturated or nearly dry, depending on the time of year and water elevation in the pond. Constituents (e.g., arsenic, uranium, and uranium isotopes) may be present as grain coating or within pore water in these sediments.

4. During historical high water conditions, the lake occupied a much larger area, and potentially contaminated water came in contact with surface soils. Residence time of the surface water has been limited in these areas, as indicated by lack of development of evaporate salt deposits. Those constituents that may have come out of solution are assumed to be disseminated in low concentrations in the soil. If present, contamination would be expected to occur at a depth of several inches.

5. A very hard substrate of unknown thickness occurs below the lake sediments in the main pond area. The induration of the substrate is assumed to be the result of mineral precipitation and pore-filling cementation. Based on the level of induration, the mineral cementation is assumed to have occurred before the influx of constituents in to the area; therefore, concentrations of constituents in this substrate are assumed to be low.

6. Seasonal emergence of the seasonal pond at the West Lake waste site is the result of surface runoff, infiltration, and groundwater recharge. Local seeps contribute noncontaminated groundwater recharge to the pond.

7. Approximately 42.7 m (140 ft) of water-saturated sands and gravels of the Hanford formation underlie West Lake. Constituents potentially could be pre sent in the water-saturated Hanford sands and gravels near the top of the water table. Groundwater constituent monitoring and remediation is addressed by the 200-BP-05 Groundwater Operable Unit.

Figure 1-5. West Lake Environmental Media – Cross-Section View

Table 1-3. West Lake COPC List

Radionuclides	
Americium-241	Strontium-90
Carbon-14	Technetium-99
Cesium-137	Thorium-232[a]
Cobalt-60	Tritium
Iodine-129[d]	Uranium-233/234
Plutonium-238	Uranium-235
Plutonium-239/240	Uranium-238
Radium-226[a]	Curium-244[d]
Radium-228[a]	Neptunium-237[d]
Europium-152[d]	Nickel-63[d]
Europium-154[d]	
Europium-155[d]	
Chemicals – Metals	
Aluminum	Manganese[b]
Antimony	Mercury
Arsenic	Molybdenum
Barium	Nickel
Bismuth	Potassium[b]
Boron	Selenium
Cadmium	Silver
Chromium	Sodium[b]
Calcium[b]	Thallium
Copper	Tin
Hexavalent Chromium	Uranium
Iron	Vanadium
Lead	Zinc
Magnesium[b]	Lithium[d]
Beryllium[d]	Cobalt[d]

Table 1-3. West Lake COPC List

Chemicals – General Chemistry	
Bromide	Nitrate/Nitrite
Chloride	Phosphate[b]
Cyanide	Sulfate
Bicarbonate/Carbonate Alkalinity[b]	Sulfides[b]
Fluoride	pH
Ammonium, Ammonia[d]	Iodide[d]
Chemicals – Organics	
Total Organic Carbon	**Semivolatile Organic Compounds[d]**
Volatile Organic Compounds[d]	Acenaphthene
1,1-Dichloroethane	Acenaphthylene
1,1-Dichloroethene	Anthracene
1,1,1-Trichloroethane	Benzo(a)pyrene
1,1,2-Trichloroethane	Benzo(a)anthracene
1,1,2,2-Trichloroethane	Benzo(b)fluoranthene
1,2-Dichlorobenzene	Benzo(ghi)perylene
1,3-Dichlorobenzene	Benzo[k]fluoranthene
2-Butanone (Methyl Ethyl Ketone)	Chrysene
2-Hexanone (Methyl Butyl Ketone)	Dibenz(ah)anthracene
Benzene	Fluoranthene
Butanol	Fluorene
Carbon Tetrachoride	Indeno[1,2,3-cd]pyrene
Chlorobenzene	2-Methylnaphthalene
Chloroform	Naphthalene
Cis-1,2-Dichloroethene	Phenanthrene
Dichloromethane (Methylene Chloride)	Pyrene
Ethylbenzene	Phenol
Methyl Isobutyl Ketone	2-Methylphenol (o-cresol)
n-Butyl Benzene	4-Methylphenol (p-cresol)
Tetrachlorothene	2,4-Dinitrotoluene
Toluene	Bis[2-ethylhexyl]phthalate
trans-1,2-Dichloroethylene	**Petroleum Hydrocarbons[d]**
Trichloroethylene	Gasoline Range Organics

Table 1-3. West Lake COPC List

Xylene	TPH - Diesel
Polychlorinated Biphenyls[c]	TPH - Kerosene
Aroclor-1016	Normal Paraffin Hydrocarbons
Aroclor-1221	
Aroclor-1232	**Pesticides/Herbicides**[d]
Aroclor-1242	Dichloroprop
Aroclor-1248	Aldrin
Aroclor-1254	Beta-1,2,3,4,5,6-Hexachlorocyclohexane
Aroclor-1260	Alpha-Chlordane o
Aroclor-1262	Gamma-Chlordane o
	Dichlorodiphenyldichloroethylene
	Dichlorodiphenyltrichloroethane
	Dieldrin
	Endosulfan I
	Endosulfan II
	Endosulfan Sulfate
	Endrin Aldehyde
	Methoxychlor

a. Radionuclides included for evaluation of decay-chain progeny only.

b. Constituents included for CSM geochemical evaluation only.

c. Added to list as requested by Ecology.

d. Constituent is not a West Lake COPCs but has been included with the West Lake COPC list to provide continuity with the 200 Outer Area ecological risk assessment.

1.4 Data Quality Objectives

The characterization activities described in this SAP are based on implementing the DQO process as documented in SGW-35643.

The West Lake DQO process was initially split with one team addressing site characterization and data requirements necessary to assess threats to human health (HH) and a second team addressing site characterization and data requirements necessary to assess threats to ecological receptors. While very little work has been conducted to date for the former, the latter has culminated in the issuance of several reports that include: DOE/RL-2007-50, *Central Plateau Terrestrial Ecological Risk Assessment Report*, WMP-29253, and DOE/RL 2006-27. The West Lake DQO summary report reviewed all of the information collected to date and unites the balance of the remaining data collection activities into a single SAP.

2 Quality Assurance Project Plan

The quality assurance project plan (QAPjP) establishes the quality requirements for environmental data collection, including planning, implementation, and assessment of sampling, field measurements, and laboratory analysis. The QAPjP complies with the following requirements:

- DOE O 414.1C, *Quality Assurance*
- 10 CFR 830 Subpart A, "Quality Assurance Requirements"
- EPA/240/B-01/003, *EPA Requirements for Quality Assurance Project Plans for Environmental Data Operations*, as amended

Section 6.5 and Section 7.8 of Ecology, EPA, and DOE, 2003, *Hanford Federal Facility Agreement and Consent Order (Tri-Party Agreement), Attachment 2: Action Plan*, require that the quality assurance (QA)/quality control (QC) and sampling and analysis activities specify the QA Requirements for Treatment, Storage, and Disposal Units as well as for Past Practice Processes. Therefore, the organization of this QAPjP is patterned after the QA elements of EPA/240/B-01/003, *EPA Requirements for Quality Assurance Project Plans*. The QAPjP demonstrates conformance to Part B requirements of American National Standards Institute (ANSI)/American Society of Quality Control (ASQC) E4-1994.

The QAPjP is divided into the following four sections (designated in EPA/240/B-01/003 by a, b, c, and d) which describe the quality requirements and controls applicable to this investigation:

- Project Management (Section 2.1) – This section addresses project management, including the project history and objectives and roles and responsibilities of the participants. These elements ensure that the project has a defined goal, that the participants understand the goal, and that the approach to be used and the planning outputs are documented.

- Data Generation and Acquisition (Section 2.2) – This section addresses all aspects of project design and implementation. Implementation of these elements ensures that appropriate methods for sampling, measurement and analysis, data collection or generation, data handling, and QC activities are employed and properly documented.

- Assessment and Oversight (Section 2.3) – This section addresses the activities for assessing project implementation effectiveness and the associated QA and QC activities. The purpose for the assessment activity is to ensure that the QAPjP is implemented as described.

- Data Validation and Usability (Section 2.4) – This section addresses the QA activities that occur after the data collection or generation phase of the project is completed. Implementation of these elements ensures that the data conform to the specified criteria, thus achieving the project objectives.

2.1 Project Management

The subsections that follow address the basic aspects of project management to ensure that the project has defined goals, that the participants understand the goals, and that the approaches used and the planned outputs are appropriately documented.

2.1.1 Project/Task Organization

The contractor, CH2M HILL Plateau Remediation Company (CHPRC), and its subcontractors are responsible for the planning, preparation, coordination, sampling, packaging, and shipment of all samples collected under this SAP to the laboratory. The project organization, in regard to sampling and characterization, is described in the subsections that follow and is shown graphically in Figure 2-1. The CHPRC Project Manager will maintain a list of individuals or organizations that are the points-of-contact (POCs) for each functional element in the organization chart (Figure 2-1) as these individuals are assigned to the project.

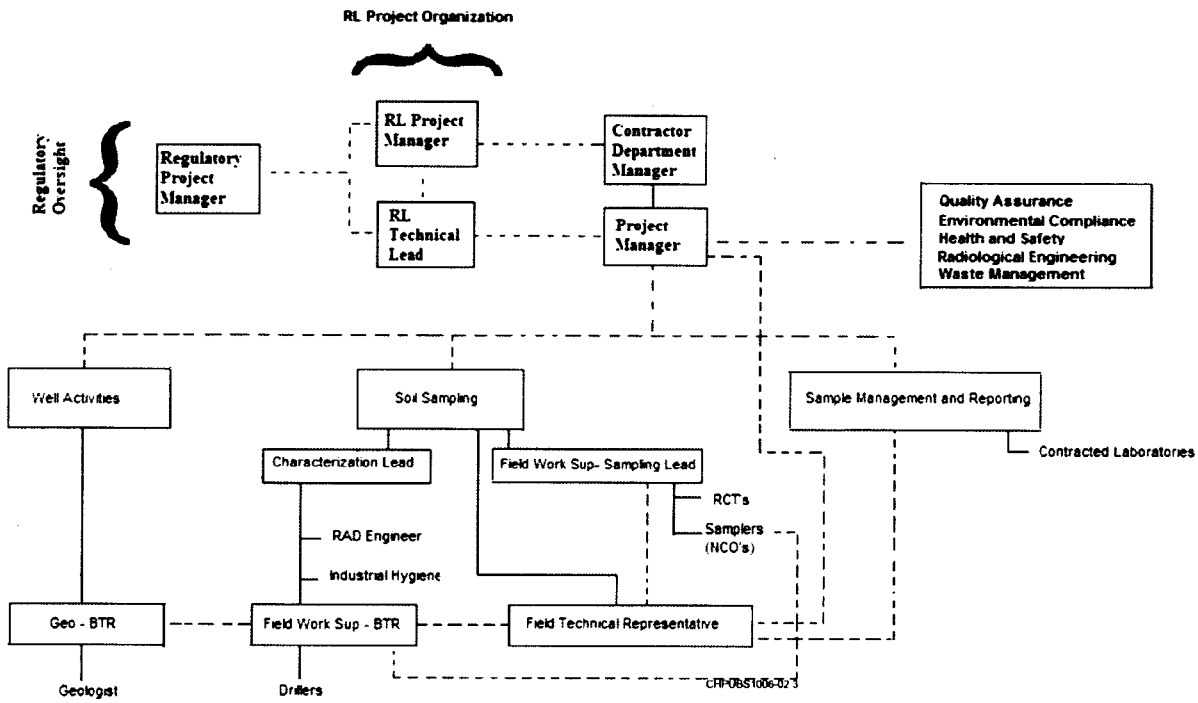


Figure 2-1. Project Organization

2.1.1.1 Regulatory Project Manager

The U.S. Environmental Protection Agency (EPA) and Ecology Project Managers are responsible for oversight of site investigation and remediation activities. EPA or Ecology, as the lead regulatory agency, has approval authority for the work being performed under this SAP. Ecology (or EPA) will work with the DOE Richland Operations Office (RL) to resolve concerns over the work as described in this SAP in accordance with the TPA.

2.1.1.2 RL Project Manager

RL is responsible for the Hanford Site cleanup. The RL Project Manager is responsible for authorizing CHPRC to perform activities under CERCLA, the *Resource Conservation and Recovery Act of 1976* (RCRA), the *Atomic Energy Act of 1954*, and the TPA for the Hanford Site. RL is also responsible to obtain lead regulatory agency approval of the SAP that authorizes field sampling activities.

2.1.1.3 RL Technical Lead

The RL Technical Lead is responsible for day-to-day oversight of CHPRC and subcontractor staff performing the work, coordinating with CHPRC and the regulatory agency project managers or POCs to

identify and resolve technical issues as they arise, and providing technical input to the RL Project Manager.

2.1.1.4 CHPRC Project Manager

The CHPRC Project Manager is responsible for direct management of the project's planning documents and requirements, field activities, and subcontracted tasks and for ensuring that the project file is properly maintained. The Project Manager ensures that the sampling design requirements are converted into field instructions (e.g., work packages) that provide specific direction for field activities. The Project Manager works closely with QA, Health and Safety, the Field Work Supervisor, and the Construction Management Lead as necessary to integrate these and the other lead disciplines in planning and implementing the work. The Project Manager maintains a list of individuals or organizations filling each of the functional elements of the Project Organization (Figure 2-1). In addition, the Project Manager is responsible for version control of the SAP to ensure that personnel are working to the most current job requirements. The Project Manager also coordinates with and reports to RL on all sampling activities. The Project Manager will also support RL in coordinating sampling activities/schedules with the Regulatory Project Manager.

2.1.1.5 Quality Assurance

The QA POC is matrixed to the Project Manager and is responsible for QA issues on the project. Responsibilities include oversight of implementation of the project's QA requirements; review of project documents, including DQO summary reports, SAPs, and the QAPjP; and participation in QA assessments on sample collection and analysis activities, as appropriate. The QA POC must be independent of the unit generating the data.

2.1.1.6 Environmental Compliance Officer

The Environmental Compliance Officer (ECO) provides technical oversight, direction, and acceptance of project and subcontracted environmental work and develops appropriate mitigation measures with a goal of minimizing adverse environmental impacts. The ECO also reviews plans, procedures, and technical documents to ensure that all environmental requirements have been addressed, identifies environmental issues that affect operations, develops cost effective solutions, and responds to environmental/regulatory issues or concerns raised by DOE and/or regulatory agency staff. The ECO may also oversee project implementation for compliance with applicable internal and external environmental requirements.

2.1.1.7 Health and Safety

The Health and Safety organization is responsible for coordination of industrial safety and health support within the project as carried out through health and safety plans, job hazard analyses, and other pertinent safety documents required by federal regulation or by internal primary contractor work requirements. In addition, the Health and Safety organization provides assistance to project personnel in complying with applicable health and safety standards and requirements. The Health and Safety organization coordinates with Radiological Engineering to determine personnel protective clothing requirements.

2.1.1.8 Radiological Engineering

The Radiological Engineering Lead is responsible for radiological/health physics support within the project. Specific responsibilities include conducting as low as reasonably achievable (ALARA) reviews, exposure and release modeling, and radiological controls optimization for all work planning. In addition, the Radiological Engineering Lead identifies radiological hazards and implements appropriate controls to maintain worker exposure ALARA (e.g., requiring personal protective equipment). Also, the Radiological Engineering Lead interfaces with the project health and safety contact and plans and directs support of radiological control technicians (RCTs) for all activities.

2.1.1.9 Sample Management and Reporting Organization

The Sample Management and Reporting Organization coordinates laboratory analytical work ensuring that the laboratories conform to Hanford Site internal laboratory QA requirements, or their equivalent, as approved by DOE, EPA, and Ecology. Sample Management and Reporting receives the analytical data from the laboratories, performs the data entry into the Hanford Environmental Information System (HEIS), and arranges for data validation. Sample Management and Reporting is responsible for informing the CHPRC Project Manager of any issues reported by the analytical laboratory. The Sample Management and Reporting Organization develops and oversees implementation of the letter of instruction to the analytical laboratories, oversees data validation, and works with the CHPRC Project Manager to prepare a field summary or characterization report on the sampling and analysis results.

The Sample Management and Reporting Organization is also responsible for performance of EPA's DQO process, or equivalent, that results in the development of the SAP. Responsibilities include documentation as well as development of the DQOs and the SAP, including sampling design, associated presentations, resolution of technical issues, and any revisions to the SAP.

2.1.1.10 Contract Laboratories

The contract laboratories analyze samples in accordance with established procedures and provide necessary sample reports and explanation of results in support of data validation. The laboratories must meet site specified QA requirements and must have an approved QA plan in place.

2.1.1.11 Waste Management

Waste Management communicates policies and procedures and ensures project compliance for storage, transportation, disposal, and waste tracking of investigation derived waste (IDW) in a safe and cost effective manner. In addition, Waste Management is responsible for identifying waste management sampling/characterization requirements to ensure regulatory compliance, interpreting the characterization data to generate waste designations and profiles, and preparing and maintaining other documents that confirm compliance with waste acceptance criteria.

2.1.1.12 Field Work Supervisor

The Field Work Supervisor is responsible for planning and coordinating field sampling resources. The Field Work Supervisor ensures the availability of trained samplers, equipment and supplies, directs any required training, mock-ups, and practice sessions with field personnel to ensure that the sampling design and equipment use are understood and can be performed as specified.

The Field Work Supervisor directs the samplers who collect the multi-media samples, including field replicates/duplicates, and oversees the preparation of all other field blank samples according to the SAP and corresponding standard procedures and work packages. The samplers also complete the field logbook and chain-of-custody forms, as well as any shipping paperwork, and ensure delivery of the samples to the analytical laboratory.

2.1.2 Problem Definition/Background

The preliminary CSM (Figure 1-5) developed in SGW-35643 identified the presence of chemical and radionuclide constituents (Table 1-3) at concentrations that may pose a potential threat to HHE. To make appropriate risk management decisions for the West Lake site, laboratory analytical data are required to define the current distribution of constituents in surface water, sediment, soil, salt deposits, and groundwater.

Specific uses of the data to be collected under this SAP include:

- Refinement of the CSM. The primary uncertainties with the preliminary CSM are the current distribution of chemical and radionuclide constituents in abiotic media. Sampling performed in 2006-2007 used a multi-increment sampling (MIS) design. Prior to this event, the last comprehensive sampling was conducted in 1989 when the lake footprint was much larger.

- Prepare the West Lake portion of the 200 Outer Area RI/FS HH risk assessment. West Lake is located in a remote part of the Hanford Site where, as site-wide remedial activities reduce the size of Hanford's footprint, it is expected that large portions of the Site will return to the land uses described under DOE/EIS-0222-F, *Final Hanford Comprehensive Land-Use Plan Environmental Impact Statement*, which includes conservation/mining for the West Lake area. The HH risk assessment will determine whether current conditions at the West Lake site are protective of future land uses and, if not, where remedial action may be required.

- Completion of the West Lake portion of the Central Plateau ecological risk assessment. Previous ecological risk screening for West Lake (WMP-20570, WMP-29253, DOE/RL-2007-50, and SGW-35643), conducted using abiotic and biotic media samples, indicates that there is insufficient data to evaluate risks to avian and mammalian wildlife. Several other complete ecological exposure pathways have not been fully or adequately evaluated to date because the West Lake site was evaluated primarily as an aquatic habitat. Prior evaluations did not consider the terrestrial environment within the riparian vegetation surrounding the seasonal pond, nor did they consider the environment between the current pond and historic high water level which is transitioning from an aquatic to desert grassland.

Because of the lake's unique surface water–groundwater hydrologic connection, final remedy selection for the West Lake site will require a comprehensive assessment of the relationship between regional groundwater characteristics and the vadose zone surface water communication that occurs at West Lake.

2.1.3 Project/Task Description

The field activities described in this SAP include sampling of soil, sediment, salt, surface water, and groundwater lying within or in close proximity to the West Lake site. Radiological field measurements will also be performed to screen individual sites prior to sample collection, and to screen samples following collection. Subsurface radiological logging may be performed, if warranted, based on surface radiological measurements. Sampling requirements for waste disposal determinations of IDW will be addressed through a waste designation DQO process before the field characterization activities begin. A separate waste management plan will be prepared by the Waste Management technical lead based on the findings of the DQO process.

At the completion of the field investigation, a field data report will be prepared to summarize the activities performed and information collected in the field. The report will include survey coordinates for all sample locations, the number and types of samples collected and their associated HEIS numbers, laboratory and radiological screening analyses performed, geophysical logging results, and inventory of IDW management containers.

2.1.4 Quality Objectives and Criteria

The QA objective of this plan is to develop implementation guidance that will provide data of known and appropriate quality. Data quality is assessed using DQIs, and by evaluating the data against the DQOs and the work activities identified in this SAP. The applicable QC guidelines, quantitative target limits, and level of effort for assessing data quality are dictated by the intended use of the data and the nature of the

analytical method. The principal DQIs are precision, bias or accuracy, representativeness, comparability, completeness, and sensitivity (Table 2-1). The DQIs are evaluated during the data quality assessment (DQA) process as described further in Section 2.4.3. A target completeness of 95-percent has been established for the West Lake project.

The quality objectives and criteria for soil, sediment, salt, and water measurement data are presented in Table 2-2 through Table 2-5 and are discussed further in the following subsections. The source for the risk-based screening levels (RBSLs) used to select the quality objectives is presented in SGW-35643. Analysis for soil physical properties will be performed according to American Society for Testing and Materials (ASTM) procedures, as applicable.

2.1.5 Special Training Requirements/Certification

A graded approach is used to ensure that workers receive a level of training that is commensurate with their responsibilities and that complies with applicable DOE orders and government regulations. The Field Work Supervisor, in coordination with the CHPRC Project Manager, will ensure that all field personnel meet all special training requirements. Typical training requirements or qualifications have been instituted by the CHPRC management team to meet training requirements imposed by the contract. regulations, DOE orders, DOE contractor requirement documents, the ANSI/American Society of Mechanical Engineers (ASME), and the *Washington Administrative Code* (WAC).

For example, the environmental, safety and health training program provides workers with the knowledge and skills necessary to safely execute assigned duties. Field personnel typically will have completed the following training before starting work:

- Occupational Safety and Health Administration 40-hour hazardous waste worker training and supervised 24-hour hazardous waste site experience
- 8-hour hazardous waste worker refresher training (as required)
- Hanford general employee radiation training
- Hanford general employee training
- Radiological worker training

Project specific safety training, geared specifically to the project and the day's activity, will be provided. Project specific training includes:

- Training requirements or qualifications needed by sampling personnel will be in accordance with QA requirements.
- Samplers are required to have training and/or experience in the type of sampling that is being performed in the field.

Qualification requirements for RCTs are established by the Radiation Protection Program; RCTs assigned to these activities will be qualified through the prescribed training program and will undergo ongoing training and qualification activities.

In addition, pre-job briefings will be performed to evaluate an activity and its hazards by considering the following factors:

- Objective of the activities
- Individual tasks to be performed
- Hazards associated with the planned tasks
- Controls applied to mitigate the hazards
- Environment in which the job will be performed
- Facility where the job will be performed
- Equipment and material required
- Safety procedures applicable to the job
- Training requirements for individuals assigned to perform the work
- Level of management control
- Proximity of emergency contacts

Training records are maintained for each individual in an electronic training record database. The contractor training organization maintains the training records system. Line management will be used to confirm that employee training is appropriate and up-to-date prior to performing any field work.

Table 2-1. Data Quality Indicators

DQI	Definition	Example Determination Methodologies	Project Specific Information	Corrective Actions
Precision	A measure of agreement among repeated measurements of the same property under identical or substantially similar conditions; calculated as either the range or as the standard deviation. May also be expressed as a percentage of the mean of the measurements, such as relative range, relative percent difference or relative standard deviation (coefficient of variation).	Use the same analytical instrument to make repeated analyses on the same sample. Use the same method to make repeated measurements of the same sample within a single laboratory or have two or more laboratories analyze identical samples with the same method. Split a sample in the field and submit both for sample handling, preservation and storage, and analytical measurements. Collect, process, and analyze collocated samples for information on sample acquisition, handling, shipping, storage, preparation, and analytical processes and measurements.	Field precision: at one randomly selected location duplicate samples will be taken. Laboratory precision; analysis of laboratory duplicate or matrix spike duplicate sample.	If duplicate data do not meet objective: -Evaluate apparent cause (e.g., sample heterogeneity). -Request re-analysis or re-measurement. -Qualify the data before use.

Table 2-1. Data Quality Indicators

DQI	Definition	Example Determination Methodologies	Project Specific Information	Corrective Actions
Accuracy	A measure of the overall agreement of a measurement to a known value; includes a combination of random error (precision) and systematic error (bias) components of both sampling and analytical operations.	Analyze a reference material or reanalyze a sample to which a material of known concentration or amount of pollutant has been added (a spiked sample); usually expressed either as percent recovery or as a percent bias.	Laboratory accuracy determination based on matrix spikes and matrix spike duplicates. Note if any of the samples or analyses are more or less critical than the others in determining follow-up actions.	If recovery does not meet objective: -Qualify the data before use. -Request re-analysis or re-measurement.
Representativeness	A qualitative term that expresses "the degree to which data accurately and precisely represent a characteristic of a population, parameter variations at a sampling point, a process condition, or an environmental condition." (ANSI/ASQC 1995)	Evaluate whether measurements are made and physical samples collected in such a manner that the resulting data appropriately reflect the environment or condition being measured or studied.	Samples will be collected as described in the sampling design. Judgmental sampling ensures that areas most likely to be contaminated, based on current information, will be evaluated. Random sampling is based on ensuring all members of the group are equally likely to be chosen and allows probability statements to be made about the quality of estimates derived from the data.	If results are not representative of the system sampled: - Identify the source of the non-representation. - Reject the data, or, if data are otherwise usable, qualify the data for limited use and define the portion of the system that the data represent. - Redefine sampling and measurement requirements and protocols. - Resample and re-analyze.

Table 2-1. Data Quality Indicators

DQI	Definition	Example Determination Methodologies	Project Specific Information	Corrective Actions
Comparability	A qualitative term that expresses the measure of confidence that one data set can be compared to another and can be combined for the decision(s) to be made.	Compare sample collection and handling methods, sample preparation and analytical procedures, holding times, stability issues, and QA protocols.	All sampling personnel will use the same sampling protocols. Samples will be submitted to the same laboratories when possible (based on laboratory contracts) for analysis by the same methods, thus data results will be comparable.	If data are not comparable to other data sets: - Identify appropriate changes to data collection and/or analysis methods. - Identify quantifiable bias, if applicable. - Qualify the data as appropriate. - Resample and/or re-analyze if needed. - Revise sampling/analysis protocols to ensure future comparability.
Completeness	A measure of the amount of valid data needed to be obtained from a measurement program.	Compare number of valid measurements completed (samples collected or samples analyzed) with those established by the project's quality criteria (DQO performance/acceptance criteria).	The percent complete will be determined during data validation. A target completeness of 95% has been established for the West Lake project.	If data set does not meet completeness objective: - Identify appropriate changes to data collection and/or analysis methods. - Identify quantifiable bias, if applicable. - Qualify the data as appropriate. - Resample and/or re-analyze if needed. - Revise sampling/analysis protocols to ensure future comparability.

Table 2-1. Data Quality Indicators

DQI	Definition	Example Determination Methodologies	Project Specific Information	Corrective Actions
Sensitivity	The capability of a method or instrument to discriminate between measurement responses representing different levels of the variable of interest.	Determine the minimum concentration or attribute that can be measured by a method (method detection limit), by an instrument (instrument detection limit), or by a laboratory (quantitation limit). The practical quantitation limit is the lowest level which can be routinely quantified and reported by a laboratory.	Ensure that sensitivity, as measured by detection limits, is appropriate for the action levels.	If sensitivity does not meet objective: - Request re-analysis or re-measurement. - Qualify/Reject the data before use.

Table 2-2. Radionuclide Analytical Performance Requirements – Soil and Sediment

Chemical Abstracts Service No. or Constituent Identifier No.	Analyte	Survey or Analytical Method[a]	Soil Background or Lowest Overall RBSL[b] (pCi/g)	Soil Target Detection Limits (pCi/g)	Soil Precision Required (%)[c]	Soil Accuracy Required (%)[c]
14596-10-2	Americium-241	Am-241 AEA	2.5	2.5	≤30	70-130
14762-75-5	Carbon-14	C-14 – liquid scintillation	0.13	0.13	≤30	70-130
10045-97-3	Cesium-137	Gamma GS	1.1	1.1	≤30	70-130
10198-40-0	Cobalt-60	Gamma GS	0.009	0.009	≤30	70-130
13981-15-2	Curium-244[d]	GE	4.4	4.4	≤30	70-130
14683-23-9	Europium-152[d]	GE	0.021	0.021	≤30	70-130
15585-10-1	Europium-154[d]	GE	0.034	0.034	≤30	70-130
14391-16-3	Europium-155[d]	GE	0.9	0.90	≤30	70-130
13994-20-2	Neptunium-237[d]	AEA	0.09	0.09	≤30	70-130
13981-37-8	Nickel-63[d]	Chemical separation liquid scintillation	30	30	≤30	70-130
15046-84-1	Iodine-129[d]	Chemical separation low-energy spectroscopy	0.0046	0.0046	≤30	70-130
13981-16-3	Plutonium-238	AEA	1.6	1.6	≤30	70-130
15117-48-3/ 14119-33-6	Plutonium-239/240	AEA	1.6	1.6	≤30	70-130

Table 2-2. Radionuclide Analytical Performance Requirements – Soil and Sediment

Chemical Abstracts Service No. or Constituent Identifier No.	Analyte	Survey or Analytical Method[a]	Soil Background or Lowest Overall RBSL[b] (pCi/g)	Soil Target Detection Limits (pCi/g)	Soil Precision Required (%)[c]	Soil Accuracy Required (%)[c]
13982-63-3	Radium-226	Lucas cell alpha scintillation (EPA Method 903.1)	0.82	0.82	≤30	70-130
1526-20-1	Radium-228	Beta gas-proportional counting (EPA Method 904.0)	1.32	1.32	≤30	70-130
Radium-Strontium	Strontium-90	Strontium-89, 90-Total strontium gas proportional counting	0.18	0.18	≤30	70-130
14133-76-7	Technetium-99	Technetium-99 LSC (low level)	0.07	0.1	≤30	70-130
7440-29-1	Thorium-232	Isotopic Thorium AEA	3.4	3.4	≤30	70-130
10028-17-8	Tritium	Tritium-H_3 LSC (mid level)	4.5	4.5	≤30	70-130
13966-29-5	Uranium-233/234	Isotopic Uranium AEA	1.1	1.1	≤30	70-130
15117-96-1	Uranium-235		0.21	0.21	≤30	70-130
7440-61-1	Uranium-238		1.1	1.1	≤30	70-130
N/A	Gross Cesium-137 Counts	Portable sodium – iodide detector	3.9	3.9	N/A	N/A

a. EPA Methods 903.1 and 904.0 are found in EPA-600/4-80-032, 1980, Prescribed Procedures for Measurement of Radioactivity in Drinking Water.

b. Human health and ecological RBSL. For some constituents, human health screening levels may be lower than ecological based screening levels.

c. Accuracy criteria for associated batch laboratory control sample percent recoveries. With the exception of gamma energy analysis, additional analysis-specific evaluations were also performed for matrix spikes, tracers, and carriers, as appropriate to the method. Precision criteria are based on batch laboratory replicate sample analyses.

d. Constituent is not a West Lake COPC but is included with the West Lake COPC list to provide continuity with the 200 Outer Area ecological risk assessment.

Table 2-3. Radionuclide Analytical Performance Requirements – Water Matrices

Chemical Abstracts Service No. or Constituent Identifier No.	Analyte	Survey or Analytical Method[a]	Water Lowest Overall RBSL[b] (pCi/L)	Water Target Detection Limits (pCi/L)	Water Precision Required (%)[c]	Water Accuracy Required (%)[c]
14596-10-2	Americium-241	Am-241 AEA	15	15	≤20	80-120
14762-75-5	Carbon-14	C-14 – liquid scintillation	609	609	≤20	80-120
10045-97-3	Cesium-137	Gamma GS	43	43	≤20	80-120
10198-40-0	Cobalt-60	Gamma GS	100	100	≤20	80-120
13981-15-2	Curium-244[e]	GE	15	15	≤20	80-120
14683-23-9	Europium-152[e]	GE	200	200	≤20	80-120
15585-10-1	Europium-154[e]	GE	60	60	≤20	80-120
14391-16-3	Europium-155[e]	GE	600	600	≤20	80-120
13994-20-2	Neptunium-237[e]	AEA	15	15	≤20	80-120
13981-37-8	Nickel-63[e]	Chemical separation liquid scintillation	50	50	≤20	80-120
15046-84-1	Iodine-129[e]	Chemical separation low-energy spectroscopy	1	1	≤20	80-120
13981-16-3	Plutonium-238	AEA	15	15	≤20	80-120
15117-48-3/14119-33-6	Plutonium-239/240	AEA	15	15	≤20	80-120
13982-63-3	Radium-226	Lucas cell alpha scintillation (EPA Method 903.1)	4	4	≤20	80-120
1526-20-1	Radium-228	Beta gas-proportional counting (EPA Method 904.0)	3	3	≤20	80-120
Rad-Sr	Strontium-90	Strontium-89, 90 – Total strontium gas proportional counting	8	8	≤20	80-120
14133-76-7	Technetium-99	Technetium-99 LSC (low level)	900	900	≤20	80-120
7440-29-1	Thorium-232	Isotopic	15	15	≤20	80-120

Table 2-3. Radionuclide Analytical Performance Requirements – Water Matrices

Chemical Abstracts Service No. or Constituent Identifier No.	Analyte	Survey or Analytical Method[a]	Water Lowest Overall RBSL[b] (pCi/L)	Water Target Detection Limits (pCi/L)	Water Precision Required (%)[c]	Water Accuracy Required (%)[c]
		Thorium AEA				
10028-17-8	Tritium	Tritium - LSC (mid level)	20,000	20,000	≤20	80-120
13966-29-5	Uranium-233/ 234	Isotopic Uranium AEA	None (20)[d]	None (20)[d]	≤20	80-120
15117-96-1	Uranium-235		None (24)[d]	None (24)[d]	≤20	80-120
7440-61-1	Uranium-238		None (24)[d]	None (24)[d]	≤20	80-120
N/A	Gross cesium-137 counts	Portable sodium-iodide detector	N/A	N/A	N/A	N/A

a. EPA Methods 903.1 and 904.0 are found in EPA-600/4-80-032, 1980, Prescribed Procedures for Measurement of Radioactivity in Drinking Water.

b. Human health and ecological RBSL. For some constituents, human health screening levels may be lower than ecological based screening levels.

c. Accuracy criteria for associated batch laboratory control sample percent recoveries. With the exception of gamma energy analysis, additional analysis-specific evaluations were also performed for matrix spikes, tracers, and carriers, as appropriate to the method. Precision criteria are based on batch laboratory replicate sample analyses.

d. No existing maximum contaminant levels for uranium isotopes. Values shown in parentheses are concentrations in water that would produce an effective dose equivalent of 4 mrem/yr if consumed at average annual rates (from Table 1.0-6, DOE/RL-2008-01, Hanford Site Groundwater Monitoring Report for Fiscal Year 2007).

e. Constituent is not a West Lake COPC but is included with the West Lake COPC list to provide continuity with the 200 Outer Area ecological risk assessment.

2.1.6 Documents and Records

The CHPRC Project Manager is responsible for distributing copies of the SAP and any addendums to field sampling personnel. Version control is maintained by the administrative document control process. Significant changes to the SAP that affect the DQOs will be reviewed and approved by DOE and the regulatory agency prior to implementation. Table 2-6 defines the types of changes that may be made to the sampling design and the appropriate documentation requirements.

The Field Work Supervisor is responsible for ensuring that field instructions are maintained, up to date, and aligned with any revisions to the SAP. The Field Work Supervisor will ensure that all deviations from the SAP or problems encountered in the field are documented appropriately (e.g., in the field logbook or on nonconformance report forms) in accordance with internal corrective action procedures.

The CHPRC Project Manager, Field Work Supervisor, or designee, will be responsible for communicating field corrective action requirements, ensuring that immediate corrective actions are applied to field activities when necessary, and determining the effectiveness of any corrective actions that are taken.

Logbooks are required for field activities. The logbook must be identified with a unique project name and number. Individuals responsible for logbooks shall be identified in the front of the notebook, and only

authorized persons may make entries in logbooks. Logbooks will be signed by the field manager, supervisor, or other assigned field personnel. Logbooks shall have the following characteristics:

- Permanently bound
- Waterproof
- Ruled with sequentially numbered pages

Pages shall not be removed from logbooks for any reason. Entries shall be made in indelible ink. Corrections shall be made by marking through the erroneous data with a single line, entering the correct data, and initialing and dating the change.

The CHPRC Project Manager is responsible for ensuring that a project file is properly maintained. The project file will include the following items, as appropriate:

- Field logbooks or operational records
- Data forms
- Global positioning system (GPS) data
- Chain-of-custody forms
- Sample receipt records
- Inspection or assessment reports and corrective action reports
- Interim progress reports
- Final reports

The project file will contain the records or references to their storage locations.
The laboratory is responsible for maintaining, and having available upon request, the following:

- Analytical logbooks
- Raw data and QC sample records
- Standard reference material and/or proficiency test sample data
- Instrument calibration information

Table 2-4. Chemical Analytical Performance Requirements – Soil and Sediment

Chemical Abstracts Service No. or Constituent Identifier No.	Analyte	Survey or Analytical Method[a]	Soil Background or Lowest Overall RBSL (mg/kg)	Soil Target Detection Limits[b] (mg/kg)	Soil Precision Required (%)[c]	Soil Accuracy Required (%)[c]
		Metals				
7429-90-5	Aluminum	EPA Methods 6010 (trace), 6020, or 200.8 (trace)	11,800	11,800	≤30	70-130
7440-36-0	Antimony	EPA Methods 6010 (trace), 6020, or 200.8 (trace)	5.0	5.0	≤30	70-130
7440-38-2	Arsenic	EPA Methods 6010 (trace), 6020, 7062, or 200.8	6.8	6.8	≤30	70-130
7440-39-3	Barium	EPA Methods 6010, 6020, or 200.8	132	132	≤30	70-130
7440-41-7	Beryllium[i]	EPA Methods 6010, 6020, or 200.8	2.5	2.5	≤30	70-130
7440-69-9	Bismuth	EPA Methods 6010, 6020, or 200.8	--	1	≤30	70-130
7440-42-8	Boron	EPA Method 6010	0.5	0.5	≤30	70-130
7440-43-9	Cadmium	EPA Methods 6010, 6020, or 200.8	0.81	0.81	≤30	70-130
7440-70-2	Calcium	EPA Method 6010	--	100	≤30	70-130
7440-47-3	Chromium (III)/Chromium (Total)	EPA Methods 6010, 6020, or 200.8	19	19	≤30	70-130
7440-48-4	Cobalt[i]		16	16	≤30	70-130
7440-50-8	Copper	EPA Methods 6010, 6020, or 200.8	22	22	≤30	70-130
18540-29-9	Hexavalent Chromium	EPA Method 7196	0.34[d]	0.34	≤30	70-130
7439-89-6	Iron	EPA Method 6010	151	151	≤30	70-130
7439-92-1	Lead	EPA Methods 6010, 6020, or 200.8	11	11	≤30	70-130
7439-93-2	Lithium[i]	EPA Methods 6010, 6020, or 200.8	2.0	2.0	≤30	70-130
7439-95-4	Magnesium[h]	EPA Method 6010	--	100	≤30	70-130
7439-96-5	Manganese	EPA Methods 6010, 6020, or 200.8	512	512	≤30	70-130
7439-97-6	Mercury	EPA Methods 7470, 7471, 6020, or 200.8	0.33	0.33	≤30	70-130
7439-98-7	Molybdenum	EPA Methods 6010, 6020, or 200.8	6.0	6.0	≤30	70-130
7440-02-0	Nickel	EPA Methods 6010, 6020, or 200.8	19	19	≤30	70-130
7440-09-7	Potassium[h]	EPA Methods 6010, 6020, or 200.8	--	100	≤30	70-130
7782-49-2	Selenium	EPA Methods 6010 (trace), 6020, or 200.8	0.78[i]	0.78[i]	≤30	70-130
7440-22-4	Silver	EPA Methods 6010, 6020, or 200.8	2.0	2.0	≤30	70-130
7440-23-5	Sodium[h]	EPA Method 6010	690	690	≤30	70-130
7440-24-6	Strontium	EPA Methods 6010, 6020, or 200.8	96	96	≤30	70-130
7440-28-0	Thallium	EPA Methods 6010 (trace), 6020, or 200.8	0.032	0.032	≤30	70-130
7440-31-5	Tin	EPA Methods 6010, 6020, or 200.8	50	50	≤30	70-130
7440-61-1	Uranium (Total)	Kinetic phosphorescence analysis, or EPA Method 200.8	5.0	5.0	≤30	70-130

Table 2-4. Chemical Analytical Performance Requirements – Soil and Sediment

Chemical Abstracts Service No. or Constituent Identifier No.	Analyte	Survey or Analytical Method[a]	Soil Background or Lowest Overall RBSL (mg/kg)	Soil Target Detection Limits[b] (mg/kg)	Soil Precision Required (%)[c]	Soil Accuracy Required (%)[c]
7440-62-2	Vanadium	EPA Methods 6010, 6020, or 200.8	85	85	≤30	70-130
7440-66-6	Zinc	EPA Methods 6010, 6020, or 200.8	68	68	≤30	70-130
		General Chemistry				
7664-41-7	Ammonia[i]	EPA 350.1	9.2	9.2	≤30	70-130
14798-03-9	Ammonium[i]	EPA 350.1	-	5	≤30	70-130
16887-00-6	Chloride	IC, EPA Methods 300.0 or 9056	100	100	≤30	70-130
57-12-5	Cyanide	EPA Methods 9010 total cyanide or 335	0.1	0.1	≤30	70-130
16984-48-8	Fluoride	IC, EPA Methods 300.0 or 9056	31	31	≤30	70-130
20461-54-5	Iodide[i]	IC, EPA Methods 300.0 or 9056	4	4	≤30	70-130
14797-55-8	Nitrate	IC, EPA Methods 300.0 or 9056	52[e] or 40[f]	52[e] or 40[f]	≤30	70-130
14797-65-0	Nitrite	IC, EPA Methods 300.0 or 9056	4[g]	4.0	≤30	70-130
14265-44-2	Phosphorous in Phosphate[h]	IC, EPA Methods 300.0 or 9056	0.79	0.79	≤30	70-130
14808-79-8	Sulfate	IC, EPA Methods 300.0 or 9056	237	237	≤30	70-130
18496-25-8	Sulfide	EPA Method 9030	--	5	≤30	70-130
3812-32-6/14280-30-9	Total Carbonate/Hydroxide Titrations	Titration for carbonate and hydroxide	--	N/A	N/A	N/A
Alkalinity	Alkalinity	Method 310.1/310.2	--	100	≤30	70-130
pH	pH	Method 9040	N/A	N/A	N/A	N/A
Hardness	Total Hardness	Method 2340 (calculate from Ca + Mg)	N/A	N/A	N/A	N/A
TDS	Total Dissolved Solids	Method 160.1	N/A	N/A	N/A	N/A
		PCBs[j]				
12674-11-2	Aroclor-1016	PCBs, EPA Method 8082	0.65	0.65	±50	70-130
11104-28-2	Aroclor-1221	PCBs, EPA Method 8082	0.0075	0.0075	±50	70-130
11141-16-5	Aroclor-1232	PCBs, EPA Method 8082	0.0075	0.0075	±50	70-130
53469-21-9	Aroclor-1242	PCBs, EPA Method 8082	0.041	0.041	±50	70-130
12672-29-6	Aroclor-1248	PCBs, EPA Method 8082	0.0072	0.0072	±50	70-130
11097-69-1	Aroclor-1254	PCBs, EPA Method 8082	0.041	0.041	±50	70-130
11096-82-5	Aroclor-1260	PCBs, EPA Method 8082	0.14	0.145	±50	70-130
37324-23-5	Aroclor-1262	PCBs, EPA Method 8082	0.14	0.14	±50	70-130
		Volatile Organic Compounds[i]				
75-34-3	1,1-Dichloroethane	SW-846, Method 8260	8.7	8.7	≤30	70-130

Table 2-4. Chemical Analytical Performance Requirements – Soil and Sediment

Chemical Abstracts Service No. or Constituent Identifier No.	Analyte	Survey or Analytical Method[a]	Soil Background or Lowest Overall RBSL (mg/kg)	Soil Target Detection Limits[b] (mg/kg)	Soil Precision Required (%)[c]	Soil Accuracy Required (%)[c]
75-35-4	1,1-Dichloroethene	SW-846, Method 8260	0.050	0.050	≤30	70-130
71-55-6	1,1,1-Trichloroethane	SW-846, Method 8260	1.6	1.6	≤30	70-130
79-00-5	1,1,2-Trichloroethane	SW-846, Method 8260	0.0043	0.0043	≤30	70-130
79-34-5	1,1,2,2-Tetrachloroethane	SW-846, Method 8260	0.0012	0.0012	≤30	70-130
95-50-01	1,2-Dichlorobenzene	SW-846, Method 8260	7.0	7.0	≤30	70-130
107-06-2	1,2-Dichloroethane	SW-846, Method 8260	0.0023	0.0023	≤30	70-130
541-73-1	1,3-Dichlorobenzene	SW-846, Method 8260	0.88	0.88	≤30	70-130
78-93-3	2-Butanone (Methyl Ethyl Ketone)	SW-846, Method 8015C	20	20	≤30	70-130
591-78-6	2-Hexanone	SW-846, Method 8015C	20	20	≤30	70-130
71-43-2	Benzene	SW-846, Method 8260	0.34	0.34	≤30	70-130
71-36-3	Butanol	SW-846, Method 8260	0.0045	0.0045	≤30	70-130
56-23-5	Carbon Tetrachloride	SW-846, Method 8260	3.3	3.3	≤30	70-130
108-90-7	Chlorobenzene	SW-846, Method 8260	0.0031	0.0031	≤30	70-130
67-66-3	Chloroform	SW-846, Method 8260	0.0075	0.0075	≤30	70-130
156-59-2	*cis*-1,2-Dichloroethylene	SW-846, Method 8260	0.35	0.35	≤30	70-130
75-09-2	Dichloromethane (Methylene Chloride)	SW-846, Method 8260	0.019	0.019	≤30	70-130
100-41-4	Ethyl Benzene	SW-846, Method 8260	0.034	0.034	≤30	70-130
108-10-1	Methyl Isobutyl Ketone	SW-846, Method 8260	2.7	2.7	≤30	70-130
104-51-8	*n*-Butyl Benzene	SW-846, Method 8260	--	--	≤30	70-130
127-18-4	Tetrachloroethylene	SW-846, Method 8260	8.67E-04	8.67E-04	≤30	70-130
108-88-3	Toluene	SW-846, Method 8260	4.7	4.7	≤30	70-130
156-60-5	*trans*-1,2-Dichloroethylene	SW-846, Method 8260	0.54	0.54	≤30	70-130
79-01-6	Trichloroethylene	SW-846, Method 8260	0.0030	0.0030	≤30	70-130
1330-20-795-47-6	Xylene- o, Xylene- m, p	SW-846, Method 8260	1.4	1.4	≤30	70-130
		Semivolatile Organic Compounds[i]				
83-32-9	Acenaphthene	SW-846, Method 8270	0.25	0.25	≤30	70-130
208-96-8	Acenaphthylene	SW-846, Method 8270	29	29	≤30	70-130
120-12-7	Anthracene	SW-846, Method 8270	6.8	6.8	≤30	70-130
50-32-8	Benzo(a)pyrene	SW-846, Method 8270	0.14	0.14	≤30	70-130
56-55-3	Benzo(a)anthracene	SW-846, Method 8270	0.86	0.86	≤30	70-130

Table 2-4. Chemical Analytical Performance Requirements – Soil and Sediment

Chemical Abstracts Service No. or Constituent Identifier No.	Analyte	Survey or Analytical Method[a]	Soil Background or Lowest Overall RBSL (mg/kg)	Soil Target Detection Limits[b] (mg/kg)	Soil Precision Required (%)[c]	Soil Accuracy Required (%)[c]
205-99-2	Benzo(b)fluoranthene	SW-846, Method 8270	1.1	1.1	≤30	70-130
191-24-2	Benzo(ghi)perylene	SW-846, Method 8270	1.1	1.1	≤30	70-130
207-08-9	Benzo[k]fluoranthene	SW-846, Method 8270	1.1	1.1	≤30	70-130
218-01-9	Chrysene	SW-846, Method 8270	1.1	1.1	≤30	70-130
53-70-3	Dibenz(ah)anthracene	SW-846, Method 8270	1.1	1.1	≤30	70-130
206-44-0	Fluoranthene	SW-846, Method 8270	1.1	1.1	≤30	70-130
86-73-7	Fluorene	SW-846, Method 8270	3.7	3.7	≤30	70-130
193-39-5	Indeno[1,2,3-cd]pyrene	SW-846, Method 8270	1.1	1.1	≤30	70-130
91-57-6	2-Methylnaphthalene	SW-846, Method 8270	2.5	2.5	≤30	70-130
91-20-3	Naphthalene	SW-846, Method 8270	1.0	1.0	≤30	70-130
85-01-8	Phenanthrene	SW-846, Method 8270	5.5	5.5	≤30	70-130
12900-0	Pyrene	SW-846, Method 8270	1.1	1.1	≤30	70-130
		Petroleum Hydrocarbons[i]				
NA	Gasoline Range Organics	SW-846, Method 8015C	100	100	≤30	70-130
NA	TPH - Diesel	SW-846, Method 8015C	200	200	≤30	70-130
NA	TPH - Kerosene	SW-846, Method 8015C	2,000	2,000	≤30	70-130
NA	Normal Paraffin Hydrocarbons	SW-846, Method 8015C	-	100	≤30	70-130
		Pesticides/Herbicides[i]				
120-36-5	Dichloroprop	SW-846, SW8081/SW8151A	--	--	≤30	70-130
309-00-2	Aldrin	SW-846, SW8081/SW8151A	0.0025	0.0025	≤30	70-130
319-85-7	Beta-1,2,3,4,5,6-Hexachlorocyclohexane (beta HCH)	SW-846, SW8081/SW8151A	0.0025	0.0025	≤30	70-130
5103-71-9	Alpha-Chlordane o	SW-846, SW8081/SW8151A	0.17	0.17	≤30	70-130
5103-74-2	Gamma-Chlordane o	SW-846, SW8081/SW8151A	0.17	0.17	≤30	70-130
143-50-0	Dichlorodiphenyldichloroethylene	SW-846, SW8081/SW8151A	0.021	0.021	≤30	70-130
50-29-3	Dichlorodiphenyltrichloroethane	SW-846, SW8081/SW8151A	0.021	0.021	≤30	70-130
60-57-1	Dieldrin	SW-846, SW8081/SW8151A	0.0029	0.0029	≤30	70-130
959-98-8	Endosulfan I	SW-846, SW8081/SW8151A	0.64	0.64	≤30	70-130
33213-65-9	Endosulfan II	SW-846, SW8081/SW8151A	0.64	0.64	≤30	70-130
1031-07-8	Endosulfan Sulfate	SW-846, SW8081/SW8151A	0.64	0.64	≤30	70-130
7421-93-4	Endrin Aldehyde	SW-846, SW8081/SW8151A	0.0014	0.0014	≤30	70-130

Table 2-4. Chemical Analytical Performance Requirements – Soil and Sediment

Chemical Abstracts Service No. or Constituent Identifier No.	Analyte	Survey or Analytical Method[a]	Soil Background or Lowest Overall RBSL (mg/kg)	Soil Target Detection Limits[b] (mg/kg)	Soil Precision Required (%)[c]	Soil Accuracy Required (%)[c]
72-43-5	Methoxychlor	SW-846, SW8081/SW8151A	5	5	≤30	70-130

a. For 4-digit EPA methods, see SW-846, *Test Methods for Evaluating Solid Waste: Physical/Chemical Methods*, Third Edition; Final Update III-B, as amended. For EPA Methods 300.0, 335, and 353, see EPA-600/4-79-020, *Methods of Chemical Analysis of Water and Wastes*. For EPA Method 200.8, see EPA-600/R-94-111, *Methods for the Determination of Metals in Environmental Samples, Supplement 1*.

b. Detection limits are based on optimal conditions in a standard fixed laboratory. Interferences and matrix effects may degrade the values shown.

c. Accuracy criteria are the minimum for associated batch laboratory control sample percent recoveries. Laboratories must meet statistically based control if more stringent. Additional analyte-specific evaluations also are performed for matrix spikes and surrogates, as appropriate to the method. Precision criteria are based on batch laboratory replicate matrix spike analyses.

d. Target detection limit is less than the human health inhalation limit of 2 mg/kg.

e. Value applies to analytical results when the measured nitrogen content has been calculated and reported as the anion nitrate.

f. Value applies when analytical results are reported for nitrate as N.

g. Value applies when analytical results are reported for nitrite as N.

h. Not a COPC but retained for analysis per other DS data needs.

i. Constituent is not a West Lake COPC but is included with the West Lake COPC list to provide continuity with the 200 Outer Area ecological risk assessment.

j. Added to the list as requested by Ecology.

-- No information available.

Table 2-5. Chemical Analytical Performance Requirements – Water Matrices

Chemical Abstracts Service No. or Constituent Identifier No.	Analyte	Survey or Analytical Method[a]	Water Lowest Overall RBSL (µg/L)	Water Target Detection Limits[b] (µg/L)	Water Precision Required (%)[c]	Water Accuracy Required (%)[c]
7429-90-5	Aluminum	EPA Methods 6010 (trace), 6020, or 200.8 (trace)	50	50	≤20	80-120
7440-36-0	Antimony	EPA Methods 6010 (trace), 6020, or 200.8 (trace)	6.0	6.0	≤20	80-120
7440-38-2	Arsenic	EPA Methods 6010 (trace), 6020, 7062, or 200.8	0.058	0.058	≤20	80-120
7440-39-3	Barium	EPA Methods 6010, 6020, or 200.8	4	4	≤20	80-120
7440-41-7	Beryllium[j]	EPA Methods 6010, 6020, or 200.8	0.66	0.66	≤20	80-120
7440-69-9	Bismuth	EPA Methods 6010, 6020, or 200.8	--	5.0	≤20	80-120
7440-42-8	Boron	EPA Method 6010	1.6	1.6	≤20	±20
7440-43-9	Cadmium	EPA Methods 6010, 6020, or 200.8	0.25	0.25	≤20	80-120
7440-70-2	Calcium	EPA Method 6010	--	1,000	≤20	80-120
7440-47-3	Chromium (III)/Chromium (Total)	EPA Methods 6010, 6020, or 200.8	74	74	≤20	80-120
7440-48-4	Cobalt[j]		4.8	4.8	≤20	80-120
7440-50-8	Copper	EPA Methods 6010, 6020, or 200.8	9.0	9.0	≤20	80-120
18540-29-9	Hexavalent Chromium	EPA Method 7196	11	11	≤20	80-120
7439-89-6	Iron	EPA Method 6010	300	300	≤20	80-120
7439-92-1	Lead	EPA Methods 6010, 6020, or 200.8	2.5	2.5	≤20	80-120
7439-93-2	Lithium[j]	EPA Methods 6010, 6020, or 200.8	14	14	≤20	80-120
7439-95-4	Magnesium[h]	EPA Method 6010	--	1,000	≤20	80-120
7439-96-5	Manganese	EPA Methods 6010, 6020, or 200.8	50	50	≤20	80-120
7439-97-6	Mercury	EPA Methods 7470, 7471, 6020, or 200.8	0.77	0.77	≤20	80-120
7439-98-7	Molybdenum	EPA Methods 6010, 6020, or 200.8	80	80	≤20	80-120
7440-02-0	Nickel	EPA Methods 6010, 6020, or 200.8	52	52	≤20	80-120
7440-09-7	Potassium[h]	EPA Methods 6010, 6020, or 200.8	--	100	≤20	80-120
7782-49-2	Selenium	EPA Methods 6010 (trace), 6020, or 200.8	5.0	5.0	≤20	80-120
7440-22-4	Silver	EPA Methods 6010, 6020, or 200.8	0.36	0.36	≤20	80-120
7440-23-5	Sodium[h]	EPA Method 6010	--	1,000	≤20	80-120
7440-24-6	Strontium	EPA Methods 6010, 6020, or 200.8	620	620	≤20	80-120
7440-28-0	Thallium	EPA Methods 6010 (trace), 6020, or 200.8	2.0	2.0	≤20	80-120
7440-31-5	Tin	EPA Methods 6010, 6020, or 200.8	73	73	≤20	80-120
7440-61-1	Uranium (total)	Kinetic Phosphorescence Analysis, or EPA Method 200.8	0.5	0.5	≤20	80-120

Table 2-5. Chemical Analytical Performance Requirements – Water Matrices

Chemical Abstracts Service No. or Constituent Identifier No.	Analyte	Survey or Analytical Method[a]	Water Lowest Overall RBSL (µg/L)	Water Target Detection Limits[b] (µg/L)	Water Precision Required (%)[c]	Water Accuracy Required (%)[c]
7440-62-2	Vanadium	EPA Methods 6010, 6020, or 200.8	20	20	≤20	80-120
7440-66-6	Zinc	EPA Methods 6010, 6020, or 200.8	120	120	≤20	80-120
General Chemistry						
7664-41-7	Ammonia[j]	EPA 350.1	-	10	≤20	80-120
14798-03-9	Ammonium[j]	EPA 350.1	-	10	≤20	80-120
16887-00-6	Chloride	IC, EPA Methods 300.0 or 9056	230,000	230,000	≤20	80-120
57-12-5	Cyanide	EPA Methods 9010 Total Cyanide or 335	5.2	5.2	≤20	80-120
16984-48-8	Fluoride	IC, EPA Methods 300.0 or 9056	200	200	≤20	80-120
20461-54-5	Iodide[j]	IC, EPA Methods 300.0 or 9056	-	100	≤20	80-120
14797-55-8	Nitrate	IC, EPA Methods 300.0 or 9056	1,600	1,600	≤20	80-120
14797-65-0	Nitrite	IC, EPA Methods 300.0 or 9056	40	40	≤20	80-120
14265-44-2	Phosphorous in Phosphate[h]	IC, EPA Methods 300.0 or 9056	0.10	0.10	≤20	80-120
14808-79-8	Sulfate	IC, EPA Methods 300.0 or 9056	70,000	70,000	≤20	80-120
18496-25-8	Sulfide	EPA Method 9030	--	500	≤20	80-120
3812-32-6/ 14280-30-9	Total Carbonate/Hydroxide Titrations	Titration for Carbonate and Hydroxide	--	100	≤20	80-120
Alkalinity	Alkalinity	Method 310.1/310.2	--	5,000	≤20	80-120
pH	pH	Method 9040	--	0.1	+/-0.1 pH units	+/-0.1 pH units
Hardness	Total Hardness	Method 2340 (Calculate from Ca + Mg)	N/A	N/A	N/A	N/A
TDS	Total Dissolved Solids	Method 160.1	500,000	500,000	≤20	80-120

a. For 4-digit EPA methods, see SW-846, *Test Methods for Evaluating Solid Waste: Physical/Chemical Methods*, Third Edition; Final Update III-B, as amended. For EPA Methods 300.0, 335, and 353, see EPA-600/4-79-020, *Methods of Chemical Analysis of Water and Wastes*. For EPA Method 200.8, see EPA-600/R-94-111, *Methods for the Determination of Metals in Environmental Samples*, Supplement 1.

b. Detection limits are based on optimal conditions in a standard fixed laboratory. Interferences and matrix effects may degrade the values shown.

c. Accuracy criteria are the minimum for associated batch laboratory control sample percent recoveries. Laboratories must meet statistically based control if more stringent. Additional analyte-specific evaluations also are performed for matrix spikes and surrogates, as appropriate to the method. Precision criteria are based on batch laboratory replicate matrix spike analyses.

d. Target detection limit is less than the inhalation limit of 2 mg/kg.

e. Value applies to analytical results when the measured nitrogen content has been calculated and reported as the anion nitrate.

f. Value applies when analytical results are reported for nitrate as N.

g. Value applies when analytical results are reported for nitrite as N.

h. Not a COPC but retained for analysis per other DS data needs.

i. Value from Figure 47 of Ecology Publication 94-115, *Natural Background Soil Metals Concentrations in Washington State*.

j. Constituent is not a West Lake COPC but is included with the West Lake COPC list to provide continuity with the 200 Outer Area ecological risk assessment.

-- No information available.

Table 2-6. Change Control for Sampling Projects

Type of Change	Action	Documentation
Temporary (≤1 event) adding constituents, locations, or increasing sampling frequency.	Project management approval; notify regulatory agency POC if appropriate.	Project's schedule tracking system.
Permanent (>1 event or year) adding constituents, locations, or increasing sampling frequency.	Revise SAP; obtain regulatory approval; distribute plan.	Letter report documenting changes or revised plan.

Records may be stored in either electronic or hard copy format. Documentation and records, regardless of medium or format, are controlled in accordance with internal work requirements and processes that ensure accuracy and retrievability of stored records. Records required by the TPA will be managed in accordance with TPA requirements.

2.2 Data Generation and Acquisition

The following subsections address data generation and acquisition to ensure that project methods for sampling, measurement and analysis, data collection and generation, data handling, and QC activities are appropriate and documented.

2.2.1 Sampling Process Design

The sample design presented in Chapter 3 of this SAP uses both a stratified random sampling and a systematic grid sampling approach. The random sampling design locates samples where the data will be used to calculate a statistically based exposure point concentration for quantitative HH risk evaluation, and for assessing ecological risk based on a weight of evidence approach. The grid sampling design locates samples that will be used for refinement of the preliminary CSM. The integrated sampling design identifies the number of samples to be collected from each media and sample zone, their location, and associated analytical requirements. The sample frequency will consist of one event only. Sample locations are presented in Chapter 3 of this SAP.

The field team will note in the daily field sampling log any instance where samples cannot be collected at the designated location because of field conditions. These events will be discussed in the follow-on CERCLA documentation (e.g., field summary report, RI, or FS). Sample locations may be adjusted based on access constraints, or field observations identifying an alternate sample location that better serves the DQOs. Depending on the time of year that the sampling is conducted, field location adjustments will likely occur due to access constraints. These adjustments will most likely occur at sample locations sited within the seasonal pond. Additional samples (locations and depths) may be added based on the judgment of field personnel and Field Work Supervisor. Minor changes in sample locations can be made and documented in the field. More significant changes (reduction or elimination of sample locations) that impact DQOs require notification of the CHPRC Project Manager, and approval by the RL and Regulatory Project Manager.

Sample locations will be marked in the field using GPS coordinates (latitude and longitude) provided in this SAP before sample collection activities commence. Because conditions at the West Lake site are subject to change, the sample location marking event will provide an early opportunity for the CHPRC Project Manager and Field Work Supervisor to observe actual site conditions to determine how best to

access each of the sample locations. Based on conditions observed during this event, the Field Work Supervisor may propose adjustments to the sampling locations.

2.2.2 Sampling Methods

Sampling methods are described in Chapter 3 and are based on previously approved operating procedures developed for similar field characterization activities conducted at the Hanford Site. The sampling procedures are available for RL, EPA, and Ecology review and reference.

2.2.3 Sample Handling and Custody

A sample and data tracking database is used to track the samples from the point of collection through the laboratory analysis process. Laboratory analytical results are entered and maintained in the HEIS database. HEIS sample numbers are issued to the sampling organization for the project. Each chemical, radiological, and physical property sample is identified and labeled with a unique HEIS sample number.

Laboratory sample custody is addressed in the applicable laboratory standard operating procedures. Laboratory custody procedures will ensure that sample integrity and identification are maintained throughout the analytical process. Storage of samples at the laboratory will be consistent with laboratory instructions prepared by the Data and Sample Management organization.

2.2.4 Analytical Methods

Information on the analytical methods to be used under this SAP is provided in Table 2-2 and Table 2-3. These analytical methods are controlled in accordance with the laboratory's QA Plan and the requirements of this QAPjP. CHPRC participates in oversight of off-site analytical laboratories to qualify them for performing Hanford Site analytical work. If the laboratory uses a non-standard or unapproved method, then the laboratory must provide method validation data to confirm that the method is adequate for the intended use of the data. This includes information such as determination of detection limits, quantitation limits, typical recoveries, and analytical precision and bias. Deviations from the analytical methods noted in Table 2-2 and Table 2-3 must be approved by the Sample and Data Management Organization in consultation with the CHPRC Project Manager.

Laboratories providing analytical services in support of this SAP will have in place a corrective action program that addresses analytical system failures and documents on the effectiveness of any corrective actions. Issues that may affect analytical results are to be resolved by the Sample and Data Management Organization in coordination with the CHPRC Project Manager.

2.2.5 Quality Control

QC procedures must be followed in the field and laboratory to ensure that reliable data are obtained. Field QC samples will be collected to evaluate the potential for cross-contamination and to provide information pertinent to field variability. Field QC for sampling will require the collection of field replicates (duplicates), trip or field blanks, and equipment blanks. Laboratory QC samples estimate the precision and bias of the analytical data. Field and laboratory QC sampling frequency is summarized in Table 2-7, and the sample types described further in the following subsections.

2.2.5.1 Field Quality Control Samples

Field QC samples for this SAP will include equipment blanks (EB) and field duplicates (DUP).

Equipment Blanks – or equipment rinsate blanks are samples in which high purity reagent water is passed through the sample collection tool or put in contact with the sampling surfaces of the equipment and the water collected and transferred into the appropriate containers. EB samples need only be collected from equipment that undergoes decontamination and is used for repeated sample collection. The EB

sample bottles are placed in the same storage containers with the samples from the associated sampling event. EB samples are analyzed for the same constituents as the samples from the associated sampling event. EBs are used to evaluate the effectiveness of the cleaning process to ensure samples are not cross contaminated from previous sampling events or locations.

High purity water is Type II ASTM organic-free water if samples for PCB, inorganic, and radionuclides analysis are being collected that day, or certified deionized water if samples for only inorganic and radionuclide constituents are being collected.

For EB type samples, laboratory results greater than twice the method detection limit may indicate the presence of cross-contamination. However, for common laboratory constituents such as acetone, methylene chloride, 2-butanone, toluene, and phthalate esters, the threshold is five times the method detection limit. For radiological analytical data, blank results are flagged if they are greater than two times the total minimum detectable activity.

Field Duplicates – are two samples that are collected as close as possible to the same time and same location and are intended to be identical. DUP should be collected generally from an area that is expected to have some contamination, so that valid comparisons between the samples can be made. DUP for soil are collected by homogenizing the sample in a decontaminated stainless-steel bowl before dividing it into two separate samples in the field. DUP for water are collected by filling similar analyte containers from the same sampling tool. DUP are stored and transported together and are analyzed for the same constituents. The DUP are used to determine precision for both sampling and laboratory measurements.

Field duplicate results must have precision within 20 percent, as measured by the relative percent difference, for water samples and within 30 percent for soil/sediment and salt matrices. Only DUP with at least one result greater than five times the method detection limit or minimum detectable activity are evaluated.

Table 2-7. Project Quality Control Sampling Summary

QC Sample Type	Purpose	Frequency
	Field QC	
Field Duplicates	Estimate precision, including sampling and analytical variability	Minimum of one sample for each sample media type or 1 per 20 sample locations, whichever is greater.
Equipment Rinsate	Verify adequacy of sampling equipment decontamination	Solids: Minimum of one per each sample train or 1 per 10 locations, whichever is greater. Water: Minimum of one for each sample train or 1 per 10 locations, whichever is greater. If disposable equipment is used, then an equipment rinsate blank is not required.
	Laboratory QC*	
Method Blank	Assess response of an entire laboratory analytical system	One per batch,* 20 samples maximum, of each matrix type, or as required by laboratory contract.
Matrix Spike	Identify analytical (preparation + analysis) Bias; possible matrix affect on the analytical method used	One per batch,* 20 samples maximum, of each matrix type, or as required by laboratory contract.

Table 2-7. Project Quality Control Sampling Summary

QC Sample Type	Purpose	Frequency
Matrix Duplicate or Matrix Spike Duplicate	Estimate analytical Bias and Precision	One per batch,* 20 samples maximum, of each matrix type, or as required by laboratory contract.
Laboratory Control Samples	Assess method accuracy	One per batch,* 20 samples maximum, of each matrix type, or as required by laboratory contract.
Surrogates	Estimate recovery/yield	As required by laboratory contract.

* Batching across projects is allowed for similar matrices.

2.2.5.2 *Laboratory Quality Control*

Laboratory QC samples (e.g., method blanks, laboratory control sample/blank spike, and matrix spike) are defined in Chapter 1 of SW-846, *Test Methods for Evaluating Solid Waste: Physical/Chemical Methods, Third Edition; Final Update III A*, as amended, and will be run at the frequency specified in that reference unless superseded by agreement. QC checks outside of control limits will be identified in the data validation process and during the DQA as described in Section 2.4. Laboratory QC samples include method blanks, matrix spike/matrix spike duplicate, control and surrogates.

Method Blanks – assess response of an entire laboratory analytical system. One sample is routinely processed per batch (20 samples maximum) by the laboratory for each matrix type, or as required by laboratory contract, or project specific requirements.

Matrix Spike and Matrix Spike Duplicate – identify analytical (preparation + analysis) bias; possible matrix affect on the analytical method used. One sample per batch, 20 samples maximum, of each matrix type or as required by laboratory contract. This type of sample requires that triple the normal volume of sample be collected in the field. The need for this sample type will be defined on the Sample Authorization Form.

Laboratory Control Samples – assess method accuracy. One sample is routinely processed per batch (20 samples maximum) by the laboratory for each matrix type, or as required by laboratory contract, or project specific requirements.

Surrogates – estimate recovery/yield. Frequency is specified by laboratory contract.

For chemical analyses, the acceptance criteria for laboratory duplicates, matrix spikes, matrix spike duplicates, surrogates, and laboratory control samples are generally derived from historical data at the laboratories in accordance with SW-846. Typical acceptance limits are within 25 percent of the expected values, although the limits may vary considerably with the method and analyte. For radiological analyses, the acceptance limits for laboratory QC samples are specified in the laboratory contract.

Holding time is the elapsed time period between sample collection and analysis. Exceeding required holding times could result in changes in constituent concentrations due to volatilization, decomposition, decay or other physical/chemical alterations. Recommended holding times depend on the analytical method, as specified in SW-846 or EPA/600/4-79/020, *Methods of Chemical Analysis of Water and Wastes*. Holding times are specified in laboratory contracts. Data associated with exceeded holding times are flagged with an "H" in HEIS, and data will not be used for decision-making purposes unless approved by Ecology.

Additional QC measures include laboratory audits and participation in nationally based performance evaluation studies. The contract laboratories participate in national studies such as the EPA-sanctioned Water Pollution and Water Supply Performance Evaluation studies. The groundwater project periodically audits the analytical laboratories to identify and solve quality problems or to prevent such problems. Audit results are used to improve performance. Summaries of audit results and performance evaluation studies are presented in the annual groundwater monitoring report.

Failure of QC will be determined and evaluated during data validation and DQA process. Data will be qualified as appropriate.

2.2.6 Instrument/Equipment Testing, Inspection, and Maintenance

Equipment used for collection, measurement, and testing, should meet the applicable standards (e.g., ASTM) or have been evaluated as acceptable and valid in accordance with the procedures, requirements, and specifications. The Field Work Supervisor, Field Technical Representative, or equivalent will ensure that the data generated from instructions using a software system are backed up and/or downloaded on a regular basis. Any software configuration will be acceptance tested prior to use in the field.

Measurement and testing equipment used in the field or in the laboratory that directly affects the quality of analytical data will be subject to preventive maintenance measures to ensure minimization of measurement system downtime. Laboratories and onsite measurement organizations must maintain and calibrate their equipment. Maintenance requirements (such as documentation of routine maintenance) will be included in the individual laboratory and the onsite organization QA plan or operating procedures (as appropriate). Maintenance of laboratory instruments will be performed in a manner consistent with SW-846, *Test Methods for Evaluating Solid Waste: Physical/Chemical Methods*, as amended, or with auditable DOE/RL-96-68, *Hanford Analytical Services Quality Assurance Requirements Documents* and contractual requirements. Consumables, supplies, and reagents will be reviewed per SW-846 requirements and will be appropriate for their use.

2.2.7 Instrument/Equipment Calibration and Frequency

Specific field equipment calibration information is provided in Section 3.4 of this SAP. Analytical laboratory instruments and measuring equipment are calibrated in accordance with the laboratory QA plan.

2.2.8 Inspection/Acceptance of Supplies and Consumables

Supplies and consumables that are used in support of sampling and analysis activities are procured in accordance with internal work requirements and processes that describe the contractor acquisition system and the responsibilities and interfaces necessary to ensure that items procured/acquired for contractor meet the specific technical and quality requirements. The procurement system ensures that purchased items comply with applicable procurement specifications. Supplies and consumables are checked and accepted by users prior to use.

Supplies and consumables procured by the analytical laboratories are procured, checked, and used in accordance with the laboratories' QA plans.

2.2.9 Data Acquisition Requirements (Non-Direct Data)

Other information sources that may be used for the West Lake project include existing historical data, and chemical analysis information for other alkaline lakes that may be similar to West Lake.

Existing historical data for the West Lake site obtained through 1989 were reviewed while preparing SGW-35643. These data are usable for assessing historic concentration trends and estimating constituent distribution in environmental media. Existing MIS data obtained in 2006 and 2007 may be used for comparison purposes only. Literature information for other alkaline lakes, will be used for comparison purposes only. Existing historical data cannot be used for risk assessment purposes.

2.2.10 Data Management

The Sample Management and Reporting Organization, in coordination with the CHPRC Project Manager, is responsible for ensuring that analytical data is appropriately reviewed, managed and stored in accordance with the applicable programmatic requirements governing data management procedures. Electronic data access, when appropriate, will be via a database (e.g., HEIS or a project-specific database). Where electronic data are not available, hard copies will be provided in accordance with Section 9.6 of the TPA Action Plan (Ecology et al. 2003).

Planning for sample collection and analysis will be in accordance with the programmatic requirements governing fixed laboratory sample collection activities, as discussed in the sample team's procedures. In the event that specific procedures do not exist for a particular work evolution, or it is determined that additional guidance to complete certain tasks is needed, a work package will be developed to adequately control the activities, as appropriate. Examples of the sample team's requirements include activities associated with the following:

- Chain of custody/sample analysis requests
- Project and sample identification for sampling services
- Control of certificates of analysis
- Logbooks
- Checklists
- Sample packaging and shipping

Approved work control packages and procedures will be used to document field activities, including radiological measurements when this SAP is implemented. All field activities will be recorded in the field logbook. Examples of the types of documentation for field radiological data include the following:

- Instructions regarding the minimum requirements for documenting radiological controls information as per 10 CFR 835, "Occupational Radiation Protection."
- Instructions for managing the identification, creation, review, approval, storage, transfer, and retrieval of primary contractor radiological records.
- The minimum standards and practices necessary for preparing, performing, and retaining radiological-related records.
- The indoctrination of personnel on the development and implementation of sample plans.
- The requirements associated with preparing and transporting regulated material.
- Daily reports of radiological surveys and measurements collected during conduct of field investigation activities. Data will be cross-referenced between laboratory analytical data and radiation measurements to facilitate interpreting the investigation results.

Laboratory errors are reported to the Sample Management and Reporting Organization on a routine basis. For reported laboratory errors a sample disposition record will be initiated in accordance with contractor

procedures. This process is used to document analytical errors and to establish their resolution with the Project Manager. The sample disposition records become a permanent part of the analytical data package for future reference and for records management.

2.3 Assessment and Oversight

This section describes the methods to be used for assessing the effectiveness of project implementation and associated QA and QC activities. The purpose of assessment is to ensure that the QAPjP is implemented as prescribed.

2.3.1 Assessments and Response Actions

CHPRC management, regulatory compliance, quality and/or health and safety representatives may conduct random surveillance and assessments to verify compliance with the requirements outlined in this SAP, project work packages, the project quality management plan, procedures, and regulatory requirements. The CHPRC Project Manager will determine if a DQA will be performed for the activities identified in this SAP. The results of the DQA will be provided to the CHPRC Project Manager.

If circumstances should arise in the field that would dictate the need for additional assessment activities, as determined by the CHPRC Project Manager or Field Work Supervisor, then they would be performed and recorded. Deficiencies identified by these assessments will be reported in accordance with existing programmatic requirements. CHPRC management representatives shall coordinate the corrective actions/deficiencies in accordance with the CHPRC QA program, the corrective action management program, and associated procedures that implant these programs.

Oversight activities in the analytical laboratories, including corrective action management, are conducted in accordance with the laboratories' QA plans. The primary contractor conducts oversight of off-site analytical laboratories to qualify them for performing Hanford Site analytical work.

2.3.2 Reports to Management

Reports to management on data quality issues will be made if and when these issues are identified. Issues reported by the laboratories are communicated to the Sample and Data Management Organization, and documented in a sample disposition record. This process is used to document analytical or sample issues and to establish resolution with the CHPRC Project Manager.

Depending on the type, significance, and visibility of the project, a DQA report may be prepared to determine if the type, quality, and quantity of the collected data met the quality objectives described in this SAP.

2.4 Data Validation and Usability

This section describes the QA activities that occur after the data collection phase of the project is completed. Implementation of these elements determines whether or not the data conform to the specified acceptance criteria.

2.4.1 Data Review, Verification, and Validation

The criteria for verification may include review for: completeness (all samples were analyzed as requested), use of the correct analytical method/procedure, transcription errors, correct application of dilution factors, appropriate reporting of dry weight versus wet weight, correct application of conversion factors. Laboratory personnel may perform data verification.

Data validation will be performed to ensure that the data quality goals established during the planning phase have been achieved. As recommended in EPA guidance (Bleyler 1988a, *Laboratory Data Validation Functional Guidelines for Evaluating Inorganics Analyses*; Bleyler 1988b, *Laboratory Data Validation Functional Guidelines for Evaluating Organics Analyses*) the criteria for data validation are based on a graded approach. Based on contract requirements, five levels of validation, A–E, have been defined. Level A is the lowest level and is the same as verification. Level E is a 100 percent review of all data (e.g., calibration data; calculations of representative samples from the data set).

Validation will be performed to Level C. Level C validation is a review of the QC data and specifically requires verification of deliverables and requested versus reported analyses and qualification of the results based on: analytical holding times; method blank results; matrix spike/matrix spike duplicate; surrogate recoveries; duplicates; and analytical method blanks. Level C validation will be performed on at least 5 percent of the data by matrix and analyte group. Analyte group refers to categories, such as radionuclides, PCBs, metals, anions, etc. The goal is to cover the various analyte groups and matrices during the validation.

Relative to analytical data in sample media, physical data and/or field screening results are of lesser importance. Field QA/QC will be reviewed to ensure that physical property data and/or field screening results are consistent with expectations and useable.

2.4.2 Verification and Validation Methods

Validation activities will be based on EPA functional guidelines (Bleyler 1988a, Bleyler 1988b). Data validation may be performed by the Sample and Data Management Organization or by a party independent of both the data collector and the data user.

When outliers or questionable results are identified, additional data validation will be performed. The additional validation will be performed for up to five percent of the statistical outliers and/or questionable data. The additional validation will begin with Level C and may increase to Levels D and E as needed to ensure that the data are usable. Note that Level C validation is a review of the QC data, while Levels D and E include review of calibration data and calculations of representative samples from the data set. All data validation will be documented in data validation reports, which will placed in the project file.

2.4.3 Reconciliation with User Requirements

The DQA process (EPA QA/G-9R, *Data Quality Assessment: A Reviewer's Guide* and EPA QA/G-9S, *Data Quality Assessment: Statistical Methods for Practitioners*) compares completed field sampling activities to those described in the SAP and provides an evaluation of the resulting data. The purpose of the data evaluation is to determine if quantitative data are of the correct type and are of adequate quality and quantity to meet the DQOs. The CHPRC Project Manager is responsible for determining if a DQA is necessary and ensuring that, if required, one is performed. The results of the DQA will be used in interpreting the data and determining if the objectives have been met. The type of DQA performed may vary depending on whether the sample design was statistical or not. DQA activities typical of a statistical based sample design may include the steps described below.

Step 1. Review DQOs and Sampling Design. This step requires a comprehensive review of the sampling and analytical requirements outlined in the project-specific DQO summary report and SAP. As appropriate:

- Verify that the hypothesis or estimate chosen is consistent with the project's objective and meets the project's performance and acceptance criteria.
- Translate study objectives into statistical terms.
- List any deviations from the planned sampling design.
- Determine the potential effect of any deviations.

Step 2. Conduct a Preliminary Data Review. Compare the actual QA/QC achieved (e.g., precision, accuracy, completeness) with the requirements identified in the SAP. Document in the final DQA report any significant deviations. Calculate the basic statistics from the analytical data and include an evaluation of the distribution of the data. As appropriate, determine:

- Central tendency of the data (e.g., mean, median, and mode)
- Relative standing of individual datum (e.g., percentiles and quantiles)
- Dispersion of the data (e.g., range, variance, and standard deviation)
- Association, i.e. relationship between two or more variables, of the data (e.g., correlation coefficients)

If appropriate, this information can be determined and/or displayed graphically.

Step 3. Select the Data Analyses. Select the appropriate statistical hypothesis test(s) or graphical data analyses and justify this selection. As appropriate, determine:

- The null hypothesis
- Alternative hypothesis
- Statistic test (t-test)
- Critical value (regulatory threshold)
- Conclusion

Step 4. Verify the Assumptions. Assess the validity of the data analyses (Step 3) by determining if the data support the underlying assumptions necessary for the analyses or if the data set must be modified (e.g., transposed, augmented with additional data) before further analysis. This step is necessary because the validity of the selected method depends on the validity of key assumptions underlying the test. As appropriate, determine:

- Assumptions required for data analyses test (e.g., independent data, approximate normal distribution)
- If data meet the assumptions

Assumptions might be determined qualitatively by reviewing the sampling plan, qualitatively inspecting the shape of a histogram, and quantitatively applying an appropriate test for distributions assumptions. If it is determined that one or more of the assumptions is not met, then an alternate plan is needed (selection of a different statistical method or collection of additional data).

Step 5. Draw Conclusions from the Data. Apply the statistical method selected in Step 3. Clearly document any calculations used. As appropriate, determine:

- If the data reject the null hypothesis
- If the data fail to reject the null hypothesis
- Confidence interval (qualitatively or quantitatively)
- Tolerance interval

3 Field Sampling Plan

3.1 Sampling Objectives

The objective for the field sampling plan (FSP) is to clearly identify project sampling and analysis activities. The FSP implements the sampling design developed through the DQO process and presents the design using figures and tables to identify sampling locations, the total number of samples to be collected, sampling procedures to be implemented, sample container requirements and the analyses to be performed.

3.2 Documentation of Field Activities

Logbooks or data forms are required for field activities. Requirements for the logbook are described in Section 2.1.6. Data forms may be used to record field information, however they must follow the same requirements for logbooks and must be referenced in the logbooks.

Information to be recorded in logbooks or data forms shall include:

- Purpose of activity
- Day, date, time, weather conditions
- Names, titles, organizations of personnel present
- Deviations from the QAPjP or procedures
- All site activities, including field tests
- Materials quality documentation (e.g., certifications)
- Details of samples collected (preparation, splits, duplicates, matrix spikes, equipment blanks)
- Location and types of samples
- Field observations for media sampled – absence or presence of microorganisms; presence of animal tracks of droppings
- Chain-of-custody details and variances relating to chain-of-custody
- Field measurements
- Field calibrations and surveys, and equipment identification numbers as applicable
- Equipment decontaminated, number of decontaminations, and variations to any decontamination procedures
- Equipment failures or breakdowns and descriptions of any corrective actions
- Telephone calls relating to field activities

3.3 Sampling Design

The sample design uses a stratified random and a systematic grid (transects) sampling approach to collect soil, sediment and salt samples. Subsurface soil, surface water, seep, and groundwater samples will be collected using a directed approach at designated locations where access or existing well infrastructure exists.

During the field sample collection planning stage, the CHPRC Project Manager and Field Work Supervisor shall visit the West Lake site and use hand-held GPS equipment to identify each location using the geographic coordinates shown on the sample location figures (Section 3.5). Sample locations shall be marked with survey stakes. Depending on the time of the year that samples are collected, access to sample locations within the seasonal pond and underlying salt and sediment media may be limited. The CHPRC Project Manager and the Field Work Supervisor will make a determination as to whether the surface water, salt and sediment locations shall be offset closer to the shoreline or whether the sites can be accessed with available equipment or an alternate sampling method. The field team will note in the daily field sampling log any instance where samples cannot be collected at the designated location because of field conditions.

3.4 Calibration of Field Equipment

The Field Work Supervisor, or designated personnel, is responsible to ensure that all field equipment is calibrated appropriately. All on-site environmental instruments are calibrated in accordance with the manufacturer's operating instructions, internal work requirements and processes, and/or work packages that provide direction for equipment calibration or verification of accuracy by analytical methods. The results from all instrument calibration activities are recorded in logbooks and/or work packages; either hard copy or electronic are acceptable. Calibrations must be performed as follows:

- Prior to initial use of a field analytical measurement system
- At the frequency recommended by the manufacturer or procedure, or as required by regulations
- Upon failure to meet specified QC criteria

Field instrumentation, calibration, and QA checks will be performed in accordance with the following:

- Calibration of radiological field instruments on the Hanford Site is performed under contract by Pacific Northwest National Laboratory, as specified in their program documentation.
- Daily calibration checks will be performed and documented for each instrument used to characterize areas that are under investigation or to measure physical-chemical properties. These checks will be made on standard materials that are sufficiently like the matrix under consideration so that direct comparison of the data can be made. Analysis times will be sufficient to establish detection efficiency and resolution.
- Standards used for calibration will be traceable to a nationally or internationally recognized standard agency source or measurement system, if available.

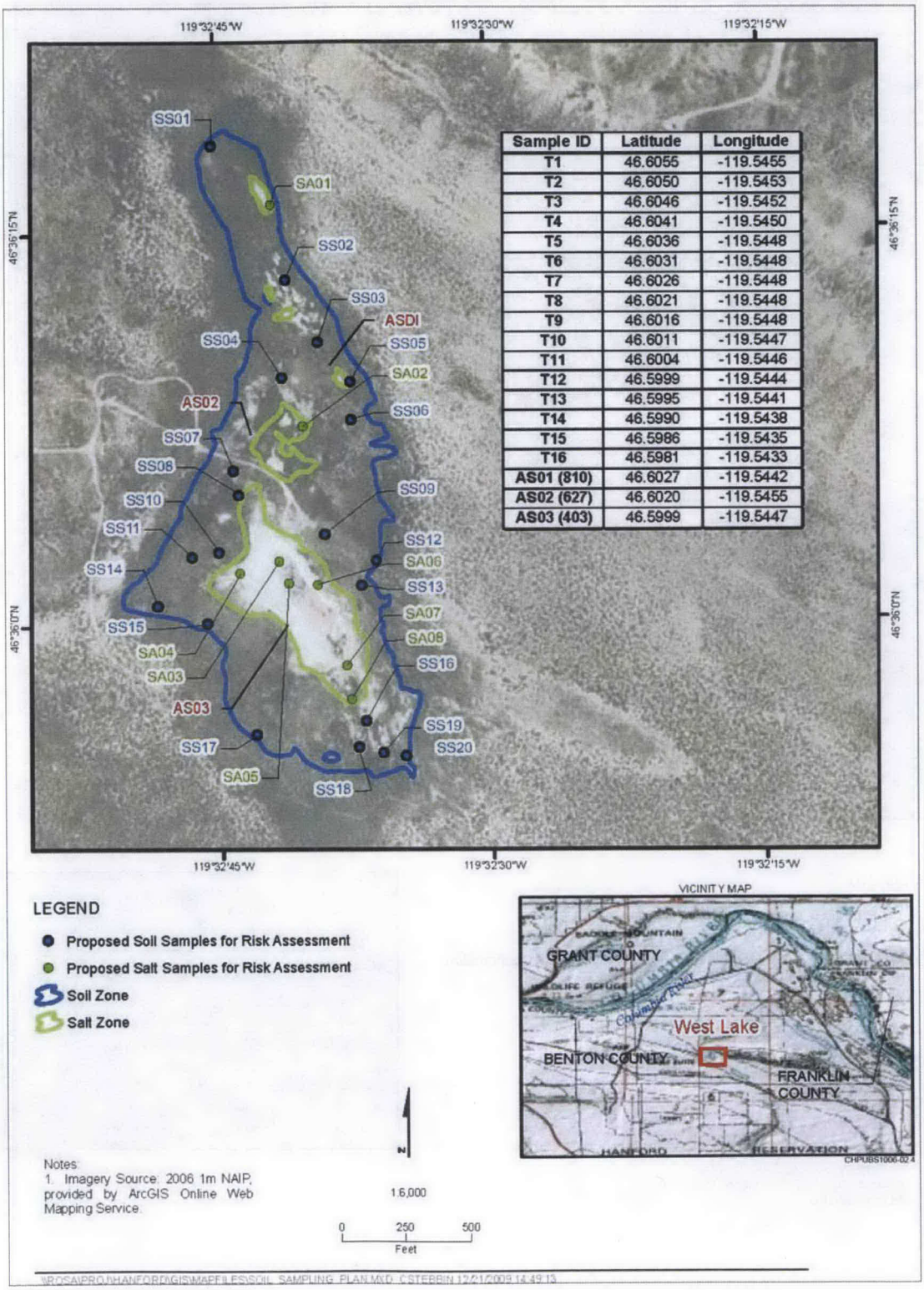
Non-radiological equipment requiring field calibration includes water quality meters (pH, temperature, specific conductance – salinity, and dissolved oxygen). Selection of the pH buffers and other standards shall account for the alkaline and salinity levels present at West Lake.

The elevated salinity levels present in West Lake surface water may require preparation of field dilutions for the aliquots used to measure specific conductance – salinity. Certified deionized water and a graduated 1,000 milliliter cylinder shall be used to prepare the field dilutions.

3.5 Sample Locations and Frequency

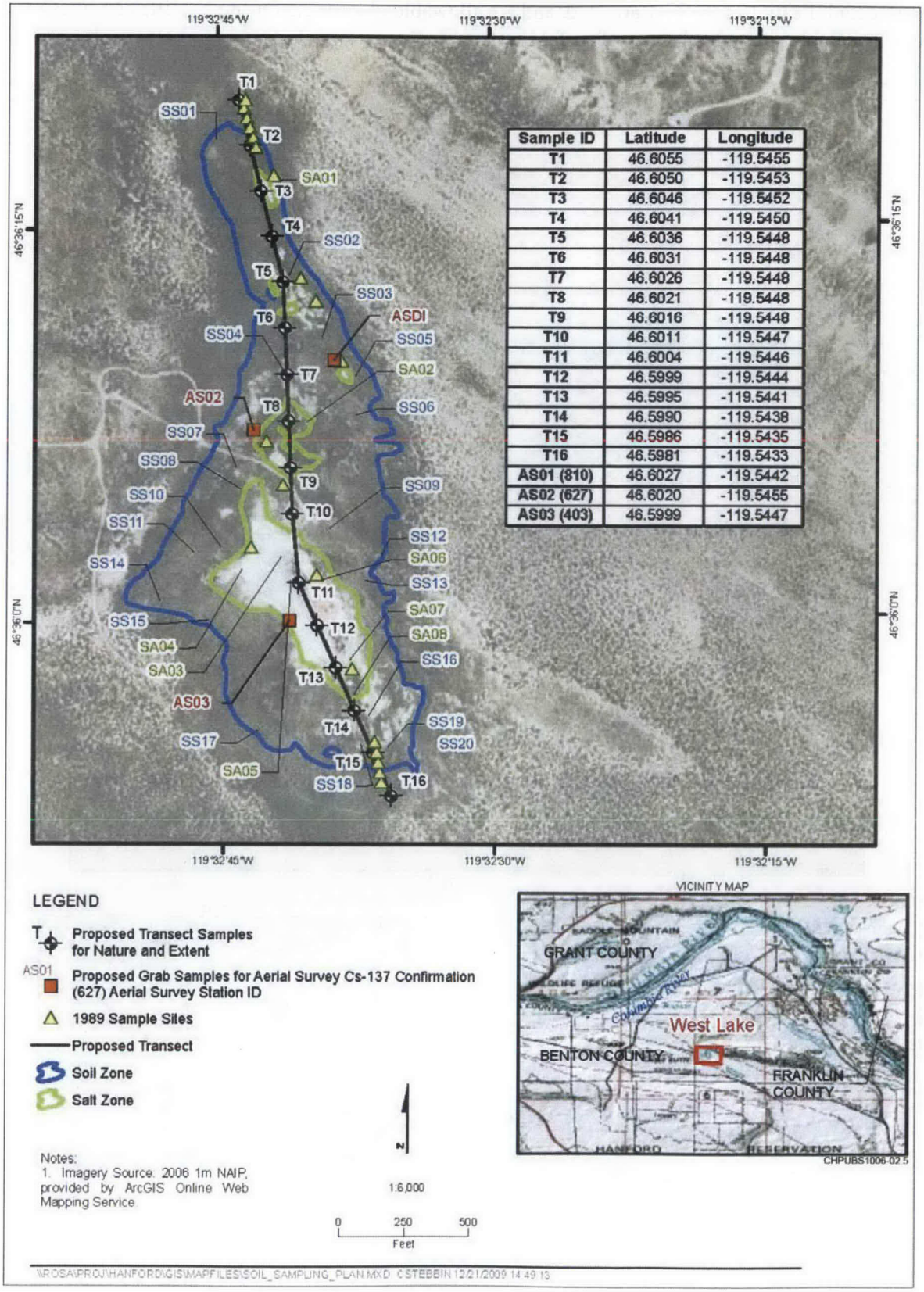
Sample locations are shown on Figure 3-1 (random samples), Figure 3-2 (transect and confirmation samples), Figure 3-3 (surface water and seeps), Figure 3-4 (groundwater), and Figure 3-5 (soil borings). Additional sample collection information is provided in Table 3-1. The sample design includes a one-time event with all samples collected during a single mobilization spanning a multi-day period. However,

separate mobilizations may be warranted, and are allowable, depending on site-specific conditions (i.e. access to sample sites and absence of surface water).



Sample ID	Latitude	Longitude
T1	46.6055	-119.5455
T2	46.6050	-119.5453
T3	46.6046	-119.5452
T4	46.6041	-119.5450
T5	46.6036	-119.5448
T6	46.6031	-119.5448
T7	46.6026	-119.5448
T8	46.6021	-119.5448
T9	46.6016	-119.5448
T10	46.6011	-119.5447
T11	46.6004	-119.5446
T12	46.5999	-119.5444
T13	46.5995	-119.5441
T14	46.5990	-119.5438
T15	46.5986	-119.5435
T16	46.5981	-119.5433
AS01 (810)	46.6027	-119.5442
AS02 (627)	46.6020	-119.5455
AS03 (403)	46.5999	-119.5447

Figure 3-1. Salt and Salt-Soil Mixture Random Sample Locations



Sample ID	Latitude	Longitude
T1	46.6055	-119.5455
T2	46.6050	-119.5453
T3	46.6046	-119.5452
T4	46.6041	-119.5450
T5	46.6036	-119.5448
T6	46.6031	-119.5448
T7	46.6026	-119.5448
T8	46.6021	-119.5448
T9	46.6016	-119.5448
T10	46.6011	-119.5447
T11	46.6004	-119.5446
T12	46.5999	-119.5444
T13	46.5995	-119.5441
T14	46.5990	-119.5438
T15	46.5986	-119.5435
T16	46.5981	-119.5433
AS01 (810)	46.6027	-119.5442
AS02 (627)	46.6020	-119.5455
AS03 (403)	46.5999	-119.5447

Figure 3-2. Salt and Salt-Soil Mixture Transect and Confirmation Sample Locations

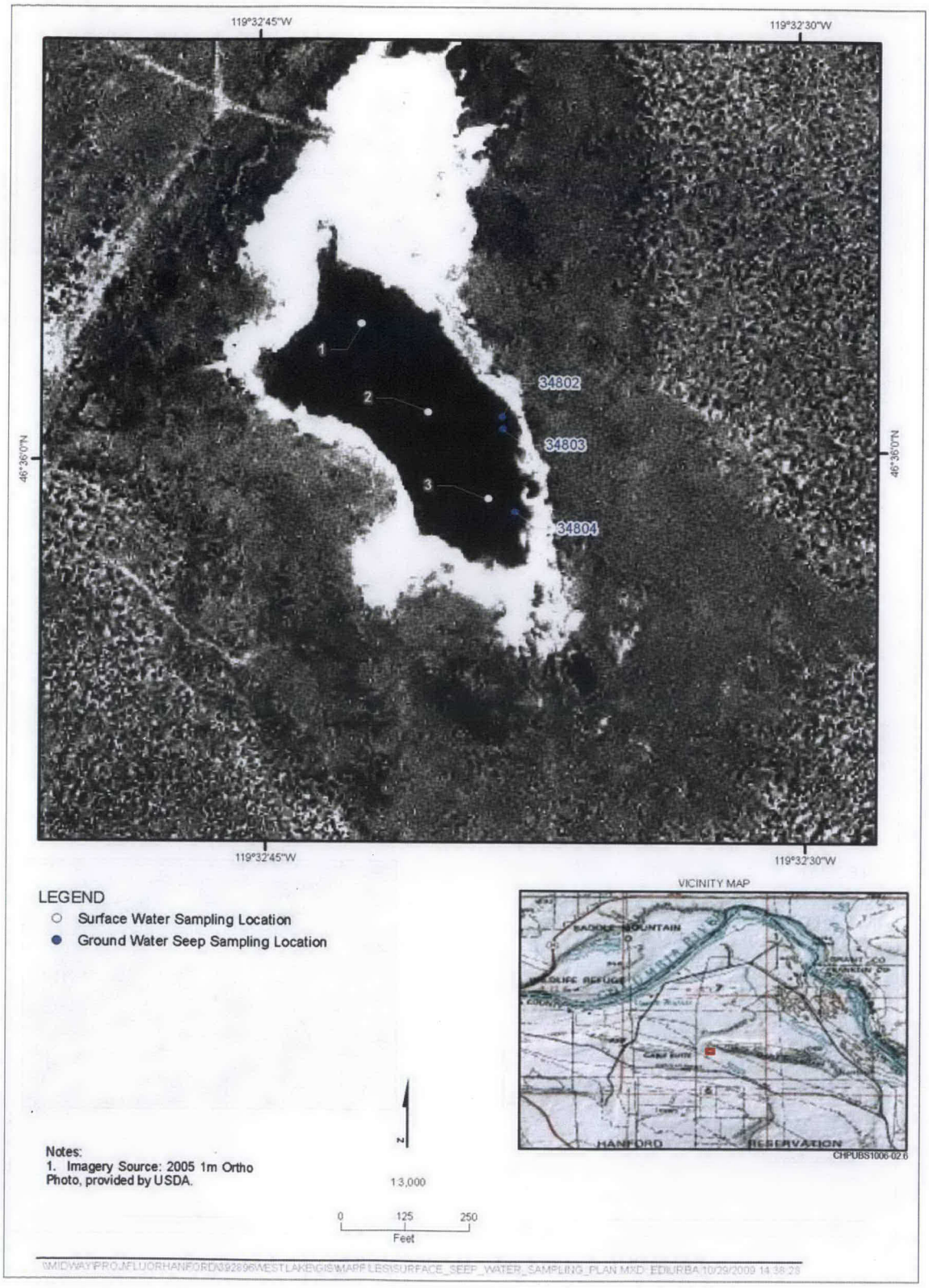


Figure 3-3. Surface Water and Seep Sample Locations

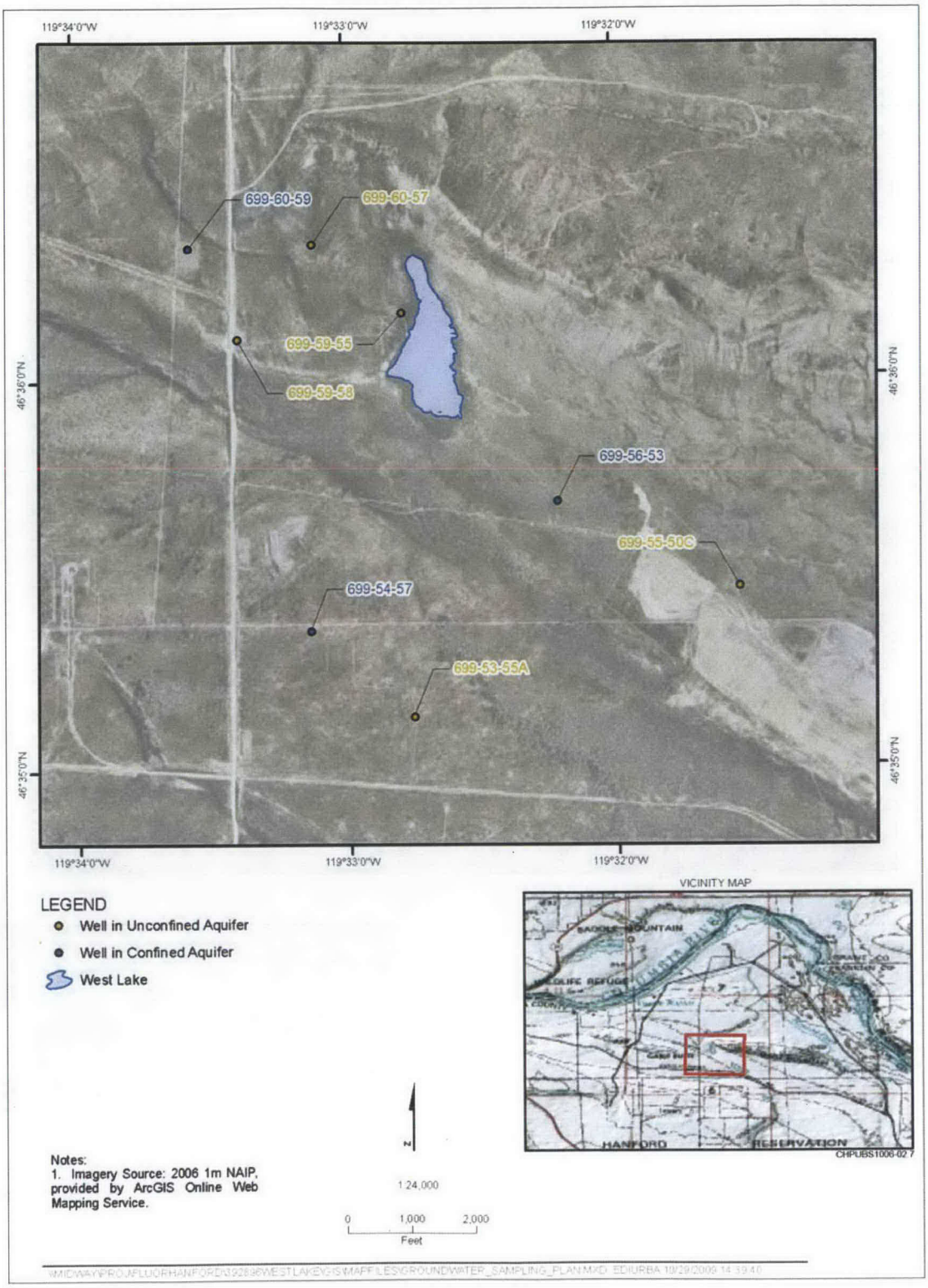


Figure 3-4. Groundwater Monitor Well Sample Locations

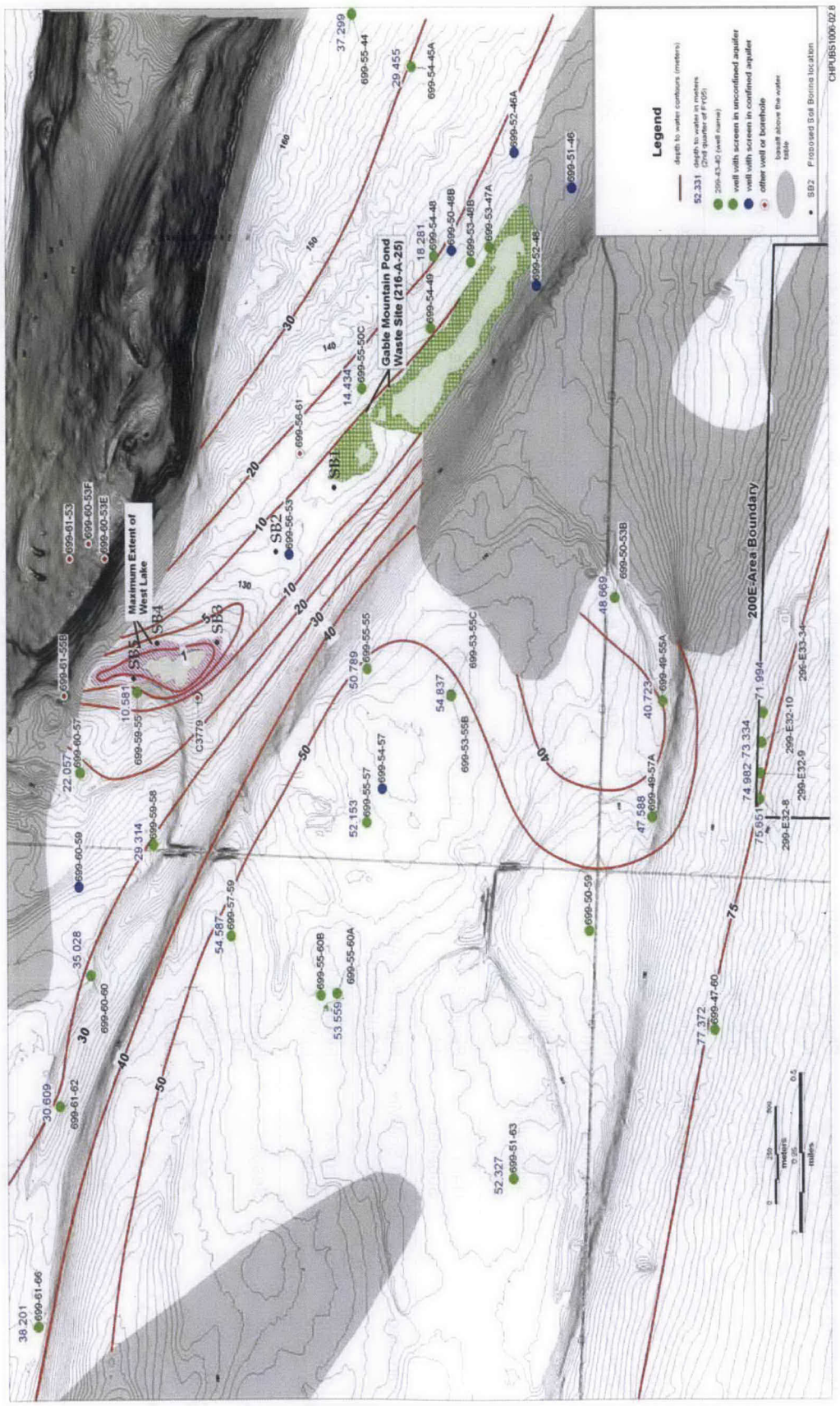


Figure 3-5. Soil Boring (SB1 to SB5) Locations

Table 3-1. Sample Locations and Frequencies and Sampling Methods

Sampling Design	Sample Matrix	Sample Locations	Allowable Variation in Location (ft)	Number of Samples & Depth	Number of QA Samples	Sampling Procedure	Sampling Frequency
Random Sampling	Salt	Figure 3-1. SA01 to SA08	25 ft	8 – crust only	1 – DUP 1 – EB	GRP-FS-04-G-029	Once
	Sediment	Figure 3-1. SA01 to SA08	25 ft	8 – below the crust to 0.5 ft depth	1 – DUP 1 – EB	GRP-FS-04-G-029	Once
	Salt-Soil Mix	Figure 3-1. SS01 to SS20	10 ft	20 – 0 to 1 ft	1 – DUP 1 – EB	GRP-FS-04-G-029	Once
Transect Sampling	North Salt/Soil	Figure 3-2. 1 to 10	10 ft	10 – 0 to 1 ft	1 – DUP	GRP-FS-04-G-029	Once
	South – Soil, Salt-Soil Mix, Salt	Figure 3-2. 11 to 16	10 ft	6 – 0 to 1 ft	1 – DUP	GRP-FS-04-G-029	Once
	Hard Substrate	Figure 3-2. 7, 10, 14	10 ft	3 – location specific	1 – DUP	See Section 3.6	Once
Directed	Salt-Soil Mix	Figure 3-2, AS01, AS02, AS03	10 ft	3 – 0 to 1 ft	1 – DUP	GRP-FS-04-G-029	Once
	Surface Water	Figure 3-3. SW-1 to SW-3	25 ft	3 – surface	1 – DUP 1 – EB	See Section 3.6	Once
	Seeps	Figure 3-3. 34802, 34803, 34804	0 ft	3 – from 10 inch PVC casing sumps	1 – DUP	GRP-FS-04-G-028	Once
	Groundwater	Figure 3-4. Existing monitor wells	0 ft	8 – from existing monitor wells	1 – DUP	GRP-FS-04-G-028	Once
	Soil Borings	Figure 3-5	25 ft	15 – (SB1 to SB5 at 5, 10, 15 ft)	2 – DUP 1 – EB	Direct Push Core Sampling or Split - Spoon	Once

3.6 Sampling Methods

The sampling performed under this SAP includes sediment, salt, salt-soil mixtures, hard substrate, seeps and groundwater. Sample collection methods for each media are described in the following subsections. Sample container requirements are shown in Table 3-2 and Table 3-3. Chemical preservatives will be added to the sample containers beforehand by laboratory staff. Analysis requirements for each sample are listed in Table 3-4.

As described in Section 3.3, a reconnaissance survey and field marking of sample locations will be performed 2-3 weeks in advance of the sample collection effort. During this effort, the Field Work Supervisor shall test the methodology proposed for collection of the salt, salt-soil mixture, sediment and hard substrate media to ensure the methods are workable for the conditions present at the West Lake site. Based on this initial trial, sample collection methods may have to be adjusted.

Table 3-2. Sample Preservation, Container, and Holding Times for Soil, Mixed Salt and Soil, Soil, and Sediment Samples[a,b]

Analyte or Analyte Groups	Container		Estimated Sample Volume[c]	Preservation	Packing Requirements	Holding Time to Analysis
	Number	Type				
Radionuclides[c]						
Gamma Spectroscopy (Cesium-137, Cobalt-60)	1	Plastic	10-1,500 g	Cool 4°C	None	N/A
Carbon-14	1	Plastic	10-1,500 g	Cool 4°C	None	N/A
Strontium-90	1	Plastic	10-1,500 g	Cool 4°C	None	N/A
Isotopic Americium	1	Plastic	10-1,500 g	Cool 4°C	None	N/A
Isotopic Plutonium	1	Plastic	10-1,500 g	Cool 4°C	None	N/A
Isotopic Uranium	1	Plastic	10-1,500 g	Cool 4°C	None	N/A
Iodine-129[e]	1	Plastic	10-1,500 g	Cool 4°C	None	N/A
Radium-226/Radium-228	1	Plastic	10-1,500 g	Cool 4°C	None	N/A
Technetium-99	1	Plastic	10-1,500 g	Cool 4°C	None	N/A
Thorium-232	1	Plastic	10-1,500 g	Cool 4°C	None	N/A
Tritium	1	Plastic	10-1,500 g	Cool 4°C	None	N/A
Curium-244, Europium-152/154/155, Nickel-63, Neptunium-237[e]	1 to 3	Plastic	10-1,500 g	Cool 4°C	None	N/A
Inorganics[c]						
ICP Metals[d]	1	Plastic	10-1,500 g	Cool 4°C	None	6 months
Hexavalent Chromium	1	Plastic	10-1,500 g	Cool 4°C	None	24 hours
Mercury	1	Plastic	10-1,500 g	Cool 4°C	Cool 4°C	28 days
Uranium (Total)	1	Plastic	10-1,500 g	Cool 4°C	Cool 4°C	28 days

Table 3-2. Sample Preservation, Container, and Holding Times for Soil, Mixed Salt and Soil, Soil, and Sediment Samples[a,b]

Analyte or Analyte Groups	Container		Estimated Sample Volume[c]	Preservation	Packing Requirements	Holding Time to Analysis
	Number	Type				
Alkalinity	1	Plastic	10-1,500 g	Cool 4°C	Cool 4°C	14 days
Anions	1	Plastic	10-1,500 g	Cool 4°C	Cool 4°C	28 days/ 48 hours
Acid Volatile Sulfide	1	Plastic	10-1,500 g	Cool 4°C	None	7 days
Total Sulfides	1	Plastic	10-1,500 g	Cool 4°C	None	7 days
Beryllium, Cobalt, Lithium[e]	1	Plastic	10-1,500 g	Cool 4°C	None	6 months
Organics[c]						
PCBs Aroclors[e, f]	1	Glass	8 ounce	Cool 4°C	Cool 4°C	7 days to extraction, 40 days after extraction
Volatile Organic Compounds[e]	1	Glass	4 ounce	Cool 4°C	Cool 4°C	14 days
Semivolatile Organic Compounds[e]	1	Glass	8 ounce	Cool 4°C	Cool 4°C	7 days to extraction, 40 days after extraction
Petroleum Hydrocarbons[e]	1	Glass	4 ounce	Cool 4°C	Cool 4°C	14 days
Pesticides/Herbicides[e]	1	Glass	8 ounce	Cool 4°C	Cool 4°C	7 days to extraction, 40 days after extraction

a. The pond hard substrate will be cored. If the core material can be broken into small enough fragments, it will be containerized. The cored material may require shipment to the laboratory for further sample preparation.

b. Refer to Table 2-2 through Table 2-5 for specific constituents requiring analyses for each media. Refer to Table 2-4 and Table 2-5 for specified analytical methods.

c. Final sample container types, use of shared containers for multiple analyses, and sample volumes will be defined on the Sampling Authorization Form.

d. Includes: aluminum, antimony, arsenic, barium, bismuth, boron, cadmium, chromium, copper, iron, lead, manganese, molybdenum, nickel, selenium, silver, strontium, thallium, tin, vanadium, and zinc.

e. Constituent(s) is not a West Lake COPC but is included with the West Lake COPC list to provide continuity with the 200 Outer Area ecological risk assessment.

f. Constituent group requested by Ecology.

Table 3-3. Sample Preservation, Container, and Holding Times for Surface Water, Seep, and Groundwater Samples[a]

Analytes[b]	Container		Estimated Sample Volume[b]	Preservation	Packing Requirements	Holding Time to Analysis
	Number	Type				
Radionuclides						
Gamma Spectroscopy (Cesium-137, Cobalt-60)	1	Plastic	1 L	None	None	N/A
Carbon-14	1	Plastic	10-1,500 g	Cool 4°C	None	N/A
Strontium-90	1	Plastic	1 L	None	None	N/A
Iodine-129[d]	1	Plastic	10-1,500 g	Cool 4°C	None	N/A
Radium-226/Radium-228	1	Plastic	10-1,500 g	Cool 4°C	None	N/A
Strontium-90	1	Plastic	10-1,500 g	Cool 4°C	None	N/A
Technetium-99	1	Plastic	10-1,500 g	Cool 4°C	None	N/A
Thorium-232	1	Plastic	10-1,500 g	Cool 4°C	None	N/A
Tritium	1	Plastic	10-1,500 g	Cool 4°C	None	N/A
Isotopic Americium	1	Plastic	1 L	None	None	N/A
Isotopic Plutonium	1	Plastic	1 L	None	None	N/A
Isotopic Rranium	1	Plastic	1 L	None	None	N/A
Curium-244, Europium-152/154/155, Nickel-63, Neptunium-237[d]	1 to 3	Plastic	10-1,500 g	Cool 4°C	None	N/A
Inorganics						
ICP Metals – 6010A (Total and Dissolved)	1	Plastic	1 L	HNO3 pH <2	None	N/A
Mercury (Total and Dissolved)	1	Plastic	0.5 L	HNO3 pH <2	Cool 4°C	N/A
Hexavalent Chromium	1	Plastic	10-1,500 g	Cool 4 °C	None	24 hours
Uranium (Total)	1	Plastic	10-1,500 g	Cool 4 °C	Cool 4°C	28 days
Beryllium, Cobalt, Lithium[d]	1	Plastic	10-1,500 g	Cool 4 °C	None	6 months
General Chemistry						
Alkalinity (Total)	1	Plastic	0.5 L	None	Cool 4°C	N/A
Anions (Total) – Chloride, Fluoride, Iodide[d], Sulfate	1	Plastic	0.5 L	None	Cool 4°C	28 Days
Nitrate/Nitrite	1	Plastic	0.5 L	pH <2 with H_2SO_4	Cool 4°C	28 days

Table 3-3. Sample Preservation, Container, and Holding Times for Surface Water, Seep, and Groundwater Samples[a]

Analytes[b]	Container		Estimated Sample Volume[b]	Preservation	Packing Requirements	Holding Time to Analysis
	Number	Type				
Phosphorous (Total)	1	Plastic	0.5 L	pH <2 with H_2SO_4	Cool 4°C	28 days
Cyanide	1	Plastic	0.5 L	pH >12 with NaoH	Cool 4°C	14 days
Acid Volatile Sulfide (Total)	1	Plastic	1 L	None	None	N/A
Total Sulfides (Total)	1	Plastic	1 L	None	None	N/A
Ammonia/Ammonium[d]	1	Plastic	0.5 L	pH <2 with H_2SO_4	Cool 4°C	14 days

a. Refer to Table 2-2 through Table 2-5 for specific constituents requiring analyses for each media. Refer to Table 2-4 and Table 2-5 for specified analytical methods.

b. Minimum sample volume will be defined on the Sampling Authorization Form.

c. Includes: aluminum, antimony, arsenic, barium, bismuth, boron, cadmium, chromium, copper, iron, lead, manganese, molybdenum, nickel, selenium, silver, strontium, thallium, tin, vanadium, and zinc.

d. Constituent is not a West Lake COPC but is included with the West Lake COPC list to provide continuity with the 200 Outer Area ecological risk assessment.

3.6.1 Surface Radiation Surveys

Three soil or salt-soil mixture samples will be collected for correlation with the October 2009 aerial radiological survey. Prior to collecting the samples, the Radiological Engineering Lead will conduct a surface radiation survey of an approximate 400 m^2 (4300 ft^2) sized area around each of the three sample sites (Figure 3-2) to identify the location with the highest activity. The samples shall be collected from each of the three survey areas at the location with the highest observed activity. Each surface radiation survey area corresponds to the geographical precision (0.0001 degree lat/long) of the aerial survey.

The surveys shall be conducted using a hand-held 2-in. by 2-in. sodium iodide detector. Survey readings will be recorded via an integrated system consisting of a portable radiological survey meter, a GPS, and a data logger that records instrument response and location coordinates.

Radiological control technicians will perform the surface radiation surveys in accordance with applicable health and safety procedures. Instrument measurements and data recording operations will be performed according to radiological survey task instructions generated by the Radiological Control organization. A survey report will be prepared that documents the procedures, deviations, instrument raw count rate values, survey location coordinates, and calculated Cs-137 activities.

Before the survey begins, a local area background reading will be taken with the field instrument at a location to be selected in the field per established procedures.

3.6.2 Sample Media Collection Order

Environmental media samples shall be collected in the following order:

- Soil, salt, and salt-soil mixture samples located above the West Lake surface water elevation
- Surface water, seep (from sumps) and groundwater samples

Table 3-4. Analytes for Sample Media

Analyte List	Sample Units and Media of Interest							
	Pond Surface Water	Pond Zone Hard Substrate	Pond Zone Sediments	Salt	Soil and Mixed Soil	Subsurface Soil (Soil Borings)	Groundwater Seeps	Groundwater (Monitor Wells)
Radionuclide Analyte List								
Americium-241	X	X	X	X	X	X	X	X
Carbon-14	X	X	X	X	X	X	X	X
Cesium-137	X	X	X	X	X	X	X	X
Cobalt-60	X	X	X	X	X	X	X	X
Iodine-129	X	X	X	X	X	X	X	X
Plutonium-238	X	X	X	X	X	X	X	X
Plutonium-239/240	X	X	X	X	X	X	X	X
Radium-226[a]	X	X	X	X	X	X	X	X
Radium-228[a]	X	X	X	X	X	X	X	X
Strontium-90	X	X	X	X	X	X	X	X
Technetium-99	X	X	X	X	X	X	X	X
Thorium-232[a]	X	X	X	X	X	X	X	X
Tritium	X	X	X	X	X	X	X	X
Uranium-233	X	X	X	X	X	X	X	X
Uranium-234	X	X	X	X	X	X	X	X
Uranium-235	X	X	X	X	X	X	X	X
Uranium-238	X	X	X	X	X	X	X	X
Supplemental Testing – Curium-244, Europium-152/154/155, Nickel-63, Neptunium-237				AS-03 only	SS-09, SS-10, SS-16			
Metals Analyte List (total with dissolved at water sites)								
Aluminum	X	X	X	X	X	X	X	X
Antimony	X	X	X	X	X	X	X	X
Arsenic	X	X	X	X	X	X	X	X
Barium	X	X	X	X	X	X	X	X
Bismuth	X	X	X	X	X	X	X	X
Boron	X	X	X	X	X	X	X	X
Cadmium	X	X	X	X	X	X	X	X
Calcium[b]	X	X	X	X	X	X	X	X

Table 3-4. Analytes for Sample Media

Analyte List	Sample Units and Media of Interest							
	Pond Surface Water	Pond Zone Hard Substrate	Pond Zone Sediments	Salt	Soil and Mixed Soil	Subsurface Soil (Soil Borings)	Groundwater Seeps	Groundwater (Monitor Wells)
Chromium	X	X	X	X	X	X	X	X
Copper	X	X	X	X	X	X	X	X
Hexavalent Chromium	X	X	X	X	X	X	X	X
Iron	X	X	X	X	X	X	X	X
Lead	X	X	X	X	X	X	X	X
Magnesium[b]	X	X	X	X	X	X	X	X
Manganese[b]	X	X	X	X	X	X	X	X
Mercury	X	X	X	X	X	X	X	X
Molybdenum	X	X	X	X	X	X	X	X
Nickel	X	X	X	X	X	X	X	X
Potassium[b]	X	X	X	X	X	X	X	X
Selenium	X	X	X	X	X	X	X	X
Silver	X	X	X	X	X	X	X	X
Sodium[b]	X	X	X	X	X	X	X	X
Strontium	X	X	X	X	X	X	X	X
Thallium	X	X	X	X	X	X	X	X
Tin	X	X	X	X	X	X	X	X
Uranium	X	X	X	X	X	X	X	X
Vanadium	X	X	X	X	X	X	X	X
Zinc	X	X	X	X	X	X	X	X
Supplemental Testing – Beryllium, Cobalt, Lithium				AS-03 only	SS-09, SS-10, SS-16			
General Chemistry List (total)								
Bromide	X	X	X	X	X	X	X	X
Chloride	X	X	X	X	X	X	X	X
Cyanide	X	X	X	X	X	X	X	X
Carbonate[b]	X	X	X	X	X	X	X	X
Fluoride	X	X	X	X	X	X	X	X
Iodide		X	X	X	X	X	X	X
Nitrate/Nitrite	X	X	X	X	X	X	X	X

Table 3-4. Analytes for Sample Media

Analyte List	Sample Units and Media of Interest							
	Pond Surface Water	Pond Zone Hard Substrate	Pond Zone Sediments	Salt	Soil and Mixed Soil	Subsurface Soil (Soil Borings)	Groundwater Seeps	Groundwater (Monitor Wells)
Phosphorous[b]	X	X	X	X	X	X	X	X
Sulfate	X	X	X	X	X	X	X	X
Sulfides[b]	X	X	X	X	X	X	X	X
Hardness[b]	X						X	X
Organics Analyte List								
Polychlorinated Biphenyl Arochlors: 1016, 1221, 1232, 1242, 1246, 1254, 1260			X	X	X			
Supplemental Testing – VOCs[c]					SS-09, SS-10, SS-16			
Supplemental Testing – SVOCs[d]					SS-09, SS-10, SS-16			
Supplemental Testing – Petroleum Hydrocarbons[e]					SS-09, SS-10, SS-16			
Supplemental Testing – Pesticides/Herbicides[f]					SS-09, SS-10, SS-16			

a. Radionuclides included for evaluation of decay-chain progeny only.

b. Constituents included for geochemical evaluation only.

c. Includes: 1,1-dichloroethane, 1,1-dichloroethene, 1,1,1-trichloroethane, 1,1,2-trichloroethane, 1,1,2,2-tetrachloroethane, 1,2-dichlorobenzene, 1,2-dichloroethane, 1,3-dichlorobenzene, 2-butanone, 2-hexanone, benzene, butanol, carbon tetrachloride, chlorobenzene, chloroform, *cis*-1,2-dichloroethene, methylene chloride, ethylbenzene, methyl isobutyl ketone, *n*-butyl benzene, tetrachloroethene, toluenen, *trans*-1,2-dichloroethene, trichloroethene, and xylene.

d. Includes: acenaphthene, acenaphthylene, anthracene, benzo(a)pyrene, benzo(a)anthracene, benzo(b)fluoranthene, benzo(ghi)perylene, benzo(k)fluoranthene, chrysene, dibenzo(ah)anthracene, fluoranthene, fluorine, indeno(1,2,3-cd)pyrene, 2-methylnaphthalene, naphthalene, phenanthrene, pyrene, phenol, o-creosol, p-creosol, 2,4-dinitrotoluene, bis(2-ethylhexyl)phthalate.

e. Includes: gasoline range, diesel range, kerosene, and normal paraffin hydrocarbons.

f. Includes: dichlorprop, aldrin, beta-1,2,3,4,5,6-hexachlorocyclohexane, alph-chlorodane, gamma-chlorodane, dichlorodiphenyldichloroethylene, dichlorodiphenyltrichloroethane, dieldrin, endosulfan I, endosulfan II, endosulfan sulfate, endrin aldehyde, and methoxychlor.

- Salt, salt-soil mixture, and sediment samples located below the West Lake surface water elevation

To further reduce cross-contamination potential, media samples located below the surface water elevation shall be collected in an order that prevents adjacent samples from being sampled consecutively.

3.6.3 Soil and Salt-Soil Mixture Samples Above the Seasonal Pond Water Level

The soil and salt-soil mixture samples (random samples SS01 to SS20 on Figure 3-1, and transect samples 1 to 14 on Figure 3-2) that lie above the seasonal pond water level shall be collected using the following general procedure:

- Samples will be collected from the 0 to 30 cm (1 ft) depth interval.
- The sample will be collected using a disposable or decontaminated scoop, trowel, or core sampler.
- The sample media will be placed in a decontaminated, stainless steel mixing bowl, homogenized, then placed in the appropriate sample containers per the specified sampling procedure (Table 3-1).
- The IDW generated during this activity will be handled according to the procedures listed in Chapter 5 and the waste control plan (to be prepared/approved before the start of field activities).
- Field personnel shall label the soil sample containers. Radiological control technicians will use standard radiological field instrumentation to measure gross contamination levels within each sample for radiological safety/job control purposes, and to establish activity levels for each sample.
- Samples shall be stored in iced coolers under chain-of-custody until submitted for laboratory analysis.

3.6.4 Salt, Sediment, and Salt-Soil Mixture Samples Below the Seasonal Pond Water Level

Salt and sediment samples (random samples SA01 to SA08), and any salt-soil mixture samples that lie below the seasonal pond water level, will be collected using the following general procedure:

- Samples shall be collected using a split-barrel, hand-driven core or auger style sampler (an AMS, Inc. multi-stage, split-barrel sampler or equivalent).
- At locations SA01 to SA08, the sampler shall be advanced to a depth of 0.2 m (0.5 ft), and gently extracted after rotating the sampler 360 degrees. The salt portion of the sample shall be manually removed and placed in a stainless steel bowl. The sediment fraction present between the salt crust and a depth of 0.15 m (0.5 ft) shall be extracted and placed in a separate bowl. Several cores may have to be advanced to collect enough material.
- At any salt-soil mixture locations, the sampler shall be advanced to a depth of 0.3 m (1 ft).
- Sample material shall be homogenized, visible organic debris removed, and the material transferred to the appropriate sample container as described in the sampling procedure (Table 3-1).
- The IDW generated during this activity will be handled according to the procedures listed in Chapter 5 and the waste control plan (to be prepared/approved before the start of field activities).
- Field personnel shall label the soil samples. Radiological control technicians will use standard radiological field instrumentation to measure gross contamination levels directly within the soil samples for radiological safety/job control purposes and to measure the contamination levels associated with each sample.

- The samples will be stored in iced coolers under chain-of-custody until submitted to the laboratory for analyses.

Additional information on core sampling of submerged, unconsolidated sediments is described in ASTM D4823-95, *Standard Guide for Core Sampling Submerged, Unconsolidated Sediments*.

3.6.4.1 Salt Samples – Additional Considerations

The salt samples have high levels of sodium that may interfere with trace metal analysis. Salt samples collected in 2006 were mixed with deionized water by the laboratory and the water tested. Sample Management and Organization representatives will coordinate with the laboratory selected to conduct the analyses to determine sample preparation requirements.

3.6.5 Hard Substrate Sampling

Three samples of the hard substrate that lies beneath the pond sediments will be collected using a core sampler equipped with a cutting tip. This will require that the surface material above the hard substrate be removed with a shovel. Once this has been done, the coring tool shall be advanced 0.2 to 0.3 m (0.5 to 1 ft) into the substrate and the sample collected as done with the other media. This material is reportedly indurated and may be very difficult to sample. Sample locations may have to be adjusted towards or away from the seasonal pond to allow for ease of collection. All excess sample material shall be containerized and managed in accordance with Section 3.8.

3.6.6 Surface Water Sampling

The seasonal pond at the time of sampling will be shallow (less than 0.3 m [1 ft]); therefore, no significant density or thermal stratification is expected.

Surface water samples will be collected using a dipper sampling device (i.e. beaker with a pour spout) attached to an extension pole (up to 6 m [18 ft) handle). The dipper shall be constructed of a non-reactive material (for example, glass, stainless steel, polypropylene, or Teflon). Care should be taken to not stir up or collect any sediment with the water by ensuring that the dipper is filled at the air-water interface. Do not submerge the dipper below the water surface.

The liquid will be transferred to a stainless steel bowl and when sufficient volume has been collected, the liquid in the bowl shall be placed in the designated sample containers. Total and dissolved samples for metals analysis will be collected.[1] The sample for dissolved metals will be field-filtered though a hand operated 0.45 micron filter prior to placing the water in the sample container. The dissolved sample shall be collected immediately after taking the sample for total metals.

As the water is being placed in the bowl, an aliquot shall be drawn for water quality parameter measurements to include pH, temperature, specific conductance–salinity, and dissolved oxygen. Measurements will be recorded in the field logbook or on the data form.

3.6.7 Subsurface Soil Sampling

Fifteen subsurface soil samples will be collected from five boreholes (SB1 to SB5) to be drilled to depths of 15 ft each (Table 3-1). Drilling will be conducted using direct push, a cable-tool rig, or a similar type of rig that allows control of contaminated cuttings, and provides adequate soil return to support sample volume requirements. At each of the boring locations, the water table may be encountered. Sample depths

[1] Total and dissolved are terms associated with the collection of samples for metals analysis. Total refers to the collection of an unfiltered sample, dissolved to collection of a sample field-filtered through a disposable 0.45 micron filter. The filter element is either a hand operated unit used for surface water sampling, or an inline unit for seep and groundwater samples collected with a peristaltic pump.

will not be varied to account for the water table. Once the total depth has been reached and all samples have been collected, the borehole will be decommissioned.

Sampling will be performed using a split-spoon sampler equipped with stainless steel liners. Site personnel will not overdrive the sampling device. When a split-spoon sample is obtained and removed from the borehole, sampling personnel will visually inspects the interior of the split-spoon sampler to verify that the sample was collected. The split-spoon sampler will also be checked for damage. The sampler will then be placed on a sample table and opened. Sampling personnel will visually inspect the core to determine if the minimum volume has been obtained. If the sample volume appears low, then an additional sample push shall be taken to obtain more material. Once an adequate volume has been obtained, the contents of the split-spoon sampler(s) shall be transferred to a pre-cleaned, stainless steel mixing bowl, the material homogenized, and then placed into the appropriate sample containers.

3.6.8 Groundwater and Seep Sampling

Groundwater samples shall be collected from the three existing seep sumps and eight existing monitor wells. Depth to water measurements will be collected before sampling begins.

The three seep sumps and eight monitor wells shall be purged using standard procedures and water quality parameters (pH, temperature, specific conductance, dissolved oxygen and salinity) measured during the purging step. Samples are generally collected after three casing volumes of water have been purged or after field parameters (pH, temperature, specific conductance–salinity, and turbidity) have stabilized in accordance with the criteria described in the standard procedure. Field parameters are measured in a flow-through chamber.

Following the purging step, seep samples shall be collected with a dipper sampler and monitor well groundwater samples collected using a disposable bailer. Total and dissolved samples for metals analysis will be collected. The sample for dissolved metals will be field-filtered though a hand operated or inline 0.45 micron unit placed on the peristaltic pump suction tubing prior to placing the water in the sample container.

All purge water shall be containerized and managed as described in Section 3.8.

3.6.9 Decontamination of Sampling Equipment

Sampling equipment will be decontaminated in accordance with the sampling equipment decontamination procedure. To prevent contamination of the samples, care should be taken to use clean equipment for each sampling activity. Special care should be taken to avoid the following common ways in which cross-contamination or background contamination may compromise the samples:

- Improperly storing or transporting sampling equipment and sample containers.
- Contaminating the equipment or sample container by setting the equipment/sample container on or near potential contamination sources (e.g., uncovered ground).
- Handling bottles or equipment with dirty hands or gloves.
- Improperly decontaminating equipment before sampling or between sampling events. Field decontamination (e.g., field washing methods) are not rigorous enough or do not use the appropriate equipment (stiff brushes or pressure washer) for the sampling equipment being used.

All spent decontamination solutions shall be containerized and managed as described in Section 3.8.

3.6.10 Preshipment Sample Screening

A representative portion of each sample, retained from leftover media, will be shipped to the Waste Sampling and Characterization Facility or other suitable onsite laboratory for total activity analysis. Total radiological activities or other analysis as required will be used for sample-shipping characterization. Samples that slightly exceed the offsite laboratory criterion may be reduced in volume to reduce total activity and allow offsite shipment. Onsite and offsite laboratories will be identified before field activities are initiated and will be mutually acceptable to the CHPRC Sample and Data Management Organization and the Field Work Supervisor.

3.7 Surveying

The final location of all soil sampling locations will be surveyed during sampling. Data will be recorded in NAVD88, *North American Vertical Datum of 1988*, and the Washington State Plane (South Zone) NAD83, *North American Datum of 1983*, with the 1991 adjustment for horizontal coordinates. All survey data will be recorded in meters and feet. GPS survey instrumentation will be used.

3.8 Waste Management Sampling

A waste designation DQO process will be performed immediately before the characterization activities, to ensure that the proper information is collected during the field sampling to support the designation of all project IDW. Any additional sampling requirements or analytes needed to support waste designation activities will be identified and implemented through the waste designation DQO summary report that will be prepared at that time.

Based on existing information, it is expected that all IDW water (decontamination solutions and purge water) can be transported to the Effluent Treatment Facility for disposal.

4 Health and Safety

All field operations will be performed in accordance with health and safety requirements and procedures. In addition, documentation will be prepared that will further control site operations. This documentation will consist of an activity hazard analysis, a site-specific health and safety plan, and applicable work permits. Work will be performed in accordance with these site-specific health and safety plans and applicable work permits. The sampling procedures and associated activities will take into consideration exposure reduction and contamination control techniques that will minimize the sampling team's exposure.

5 Management of Investigation-Derived Waste

The IDW generated by characterization activities will be managed in accordance with existing approved CHPRC waste management documents that identify the requirements and responsibilities for containment, labeling, and tracking of IDW. IDW will be managed in accordance with the applicable waste control plan, waste DQO document, and waste packaging and labeling instruction sheet provided by the Waste Management Representative.

Unused samples and associated laboratory waste from offsite laboratory analysis will be dispositioned in accordance with the laboratory contract, which in most cases will allow the laboratory to dispose of this material. Unused sample material from onsite laboratories will be returned to the project for disposal.

A waste designation DQO process will be completed before characterization activities are initiated, to ensure that information necessary to support designation of all project IDW is collected during the field activities. During the IDW DQO activities, any listed waste issues will be resolved. Additional sampling or analysis required to support designation activities will be identified in the waste designation DQO summary report.

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