INFORMATION CLEARANCE FORM

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H. Information Owner/Author/Requestor

J. V. Borghese (E-mail Pg. 3)
(Print and Sign)

Responsible Manager

A. F. Shattuck [signature]
(Print and Sign)

Approval by Direct Report to FH President (Speech/Articles Only)

~~D. L. Foss~~ NA
(Print and Sign)

I. Reviewers	Print	Signature	Public Y/N (If N, complete J)
General Counsel	~~S. J. Bensussen~~ R.T. Swenson	(E-mail Pg. 2)	(Y)/N
Office of External Affairs			Y/N
DOE	B. L. Charboneau	Pg. iii of document	(Y)/N
OUO-SME			Y/N
Clearance	J. D. Aardal	Janis Aardal	(Y)/N
Other			Y/N
Other			Y/N

J. Comments

If Additional comments, Please Attach Separate Sheet 1 of 2

Information Clearance Approval

APPROVED FOR RELEASE
OFFICIAL DOCUMENT
jda
Date 01/29/2009

Borghese, Jane V DOE/RL-2002-11 Rev. 2

From: Swenson, Raymond T
Sent: Tuesday, December 09, 2008 7:51 AM
To: Borghese, Jane V
Cc: Bensussen, Stanley J; Sherwood, Ana R; Swenson, Raymond T; Malek, Debra D
Subject: RE: Approval on Information Clearance Form

Jane: I have read the document and there are no legal objections to its release.

Raymond Takashi Swenson
CHPRC Legal Department
509-376-3511 Office
509-308-7456 BlackBerry
Raymond_T_Swenson@rl.gov

From: Borghese, Jane V
Sent: Monday, December 08, 2008 11:29 AM
To: Swenson, Raymond T
Cc: Bensussen, Stanley J; Borghese, Jane V; Sherwood, Ana R
Subject: FW: Approval on Information Clearance Form

Hi, I have been advised that Mr. Bensussen is out of the office. Can you give your approval to this document electronically?
The document is the 300-FF-5 Sampling and Analysis Plan.

Thanks,
Jane

From: Borghese, Jane V
Sent: Friday, December 05, 2008 3:36 PM
To: Bensussen, Stanley J
Cc: Borghese, Jane V; Sherwood, Ana R
Subject: Approval on Information Clearance Form

Hi,

The attached document is in the final stages of the approval and clearance process. Your review and signature is needed for clearance. Please advise on the best way to seek your approval (email approval or actual signature).

Thanks,
Jane

Jane Borghese
300-FF-5,Soil and Groundwater Remediation Project
CH2M Hill Plateau Remediation Contractor
373 3804 office
528 4892 cell

Aardal, Janis D

From: Borghese, Jane V
Sent: Thursday, January 29, 2009 1:11 PM
To: Schneider, Kathy K; Aardal, Janis D
Subject: RE: FINAL - DOE-RL-2002-11 Rev 2.DOC

Hi Janis,

Please use this email as my concurrence on the clearance form. Thanks, Jane Borghese

---

From: Schneider, Kathy K
Sent: Thursday, January 29, 2009 10:24 AM
To: Borghese, Jane V
Subject: FW: FINAL - DOE-RL-2002-11 Rev 2.DOC
Importance: High

From: Aardal, Janis D
Sent: Thursday, January 29, 2009 10:16 AM
To: Schneider, Kathy K
Subject: RE: FINAL - DOE-RL-2002-11 Rev 2.DOC
Importance: High

Kathy, Jane Borghese also needs to sign the clearance form. I wanted to sign for her per telecon, but didn't get an answer at her office or cell phones. Thanks again, Janis

---

From: Schneider, Kathy K
Sent: Thursday, January 29, 2009 9:59 AM
To: Aardal, Janis D
Subject: FINAL - DOE-RL-2002-11 Rev 2.DOC

Janis, thanks for catching that. I actually didn't work on this document so I'll let the other secretary know to double check page numbers. Thanks again.
Kathy

ADMINISTRATIVE DOCUMENT PROCESSING AND APPROVAL	Page 1 of 26

DOCUMENT TITLE:	**OWNING ORGANIZATION/FACILITY:**
300-FF-5 Operable Unit Sampling and Analysis Plan	CHPRC S&GRP
Document Number: DOE/RL-2002-11	**Revision/Change Number:** 2

DOCUMENT TYPE *(Check Applicable)*

☐ Plan ☒ Report ☐ Study ☐ Description Document ☐ Other

DOCUMENT ACTION ○ New ◉ Revision ○ Cancellation

RESPONSIBLE CONTACTS

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DOCUMENT REVISION SUMMARY

NOTE: Provide a brief description or summary of the changes for the document listed.

REVIEWERS **Others**

Name *(print)*	Organization

APPROVAL SIGNATURES

	Date	RELEASE / ISSUE
Author: [signature]	1/26/09	JAN 29 2009 DATE: HANFORD RELEASE STA: 15 ID: 20
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Name: (Print) A. F. Shattuck		
Other: [signature]	1/26/09	
Name: (Print) A. J. Rossi, Manager		
Other:		
Name: (Print) J. A. Winterhalder, ECO (E-mail Pg. 3)	1/26/09	
Other:		
Name: (Print) W. R. Thackaberry, QA (E-mail Pg. 4)	1/26/09	

ADMINISTRATIVE DOCUMENT PROCESSING AND APPROVAL (continued)	Page 2 of ~~2~~ 6 JdA 1/23
Document Number: DOE/RL-2002-11	**Revision/Change Number:** 2

Other:	
Name: (Print) J. A. Archuleta, Environmental QA (E-mail Pg. 5)	Date 12/08/08
Other:	
Name: (Print) L. C. Tuott, Document Review & Standard. (E-mail Pg. 6)	Date 1/28/09

Dewey, Debra L

From: Winterhalder, John A
Sent: Monday, January 26, 2009 9:30 AM
To: Dewey, Debra L; Rossi, Amadeo J; Thackaberry, W R (Bill)
Subject: RE: DOE-RL-2002-11, Rev 2

Deb,

You may indicate my approval via this e-mail.

Thanks!
John

From: Dewey, Debra L
Sent: Monday, January 26, 2009 9:05 AM
To: Rossi, Amadeo J; Thackaberry, W R (Bill); Winterhalder, John A
Subject: DOE-RL-2002-11, Rev 2

This document was previously circulated and we did have your signatures on the approval pages, however, this page was misplaced. Would you mind sending me an email just stating that you approve this document. I apologize for any inconvenience or confusion. I have attached a link to the document so that it might refresh your memory as to what you approved.

"DOE-RL-2002-11, Rev 2" can be accessed via the following link:
http://idmsweb/idms/livelink.exe/open/141829504

Thanks,
Deb Dewey

Dewey, Debra L

From: Thackaberry, W R (Bill)
Sent: Monday, January 26, 2009 9:18 AM
To: Dewey, Debra L; Rossi, Amadeo J; Winterhalder, John A
Subject: RE: DOE-RL-2002-11, Rev 2

I verified comment incorporation and approved this document on 11/5/2008.
Bill Thackaberry

From: Dewey, Debra L
Sent: Monday, January 26, 2009 9:05 AM
To: Rossi, Amadeo J; Thackaberry, W R (Bill); Winterhalder, John A
Subject: DOE-RL-2002-11, Rev 2

This document was previously circulated and we did have your signatures on the approval pages, however, this page was misplaced. Would you mind sending me an email just stating that you approve this document. I apologize for any inconvenience or confusion. I have attached a link to the document so that it might refresh your memory as to what you approved.

"DOE-RL-2002-11, Rev 2" can be accessed via the following link:
http://idmsweb/idms/livelink.exe/open/141829504

Thanks,
Deb Dewey

Borghese, Jane V

From: Archuleta, Jose A
Sent: Monday, December 08, 2008 12:09 PM
To: Borghese, Jane V
Subject: RE: Approval for DOE/RL-2002-11 Rev 2

Jane

This message serves as my approval for the subject document.

Joe Archuleta
CHPRC, EPA Manager
Jose_A_Archuleta@rl.gov
509.376.0777

From: Borghese, Jane V
Sent: Monday, December 08, 2008 11:25 AM
To: Archuleta, Jose A
Cc: Sherwood, Ana R; Brown, Walter R
Subject: RE: Approval for DOE/RL-2002-11 Rev 2
Importance: High

Joe, Please send your approval electronically. Thanks, Jane

From: Brown, Walter R
Sent: Friday, December 05, 2008 2:02 PM
To: Archuleta, Jose A
Cc: Brown, Walter R; Sherwood, Ana R; Borghese, Jane V
Subject: RE: Approval for DOE/RL-2002-11 Rev 2

Joe: I have reviewed the changes made to the document and they have addressed my comments. I recommend that you sign off on the document at this time. Thanks and have a good weekend. Russ

---

From: Archuleta, Jose A
Sent: Friday, December 05, 2008 12:33 PM
To: Brown, Walter R
Subject: FW: Approval for DOE/RL-2002-11 Rev 2

Russ

Another one. Please let me know if your comments were adequately addressed. If so, then I will approve.

Joe

From: Borghese, Jane V
Sent: Friday, December 05, 2008 11:52 AM
To: Archuleta, Jose A

Cc: Sherwood, Ana R; Borghese, Jane V
Subject: Approval for DOE/RL-2002-11 Rev 2

Hi Joe,

As per the conversation between you and Ana this morning attached is the 300-FF-5 and the DRC form. Please provide your approval of this document or comments.

Thanks,
Jane

Jane Borghese
300-FF-5,Soil and Groundwater Remediation Project
CH2M Hill Plateau Remediation Contractor
373 3804 office
528 4892 cell

Dewey, Debra L

From: Tuott, Lee C
Sent: Wednesday, January 28, 2009 3:28 PM
To: Dewey, Debra L
Subject: RE: DOE-RL-2002-11, Rev 2

Per this email, please sign off for me on this document. My notes identify that this was reviewed by DRS.

Thank you.

Lee Tuott
Manager, Document Review and Standardization
CHPRC
509.376.1045 (office)
208.351.0568 (cell)
email: lee_c_tuott@rl.gov

From: Dewey, Debra L
Sent: Monday, January 26, 2009 3:16 PM
To: Tuott, Lee C
Subject: FW: DOE-RL-2002-11, Rev 2

This document was previously circulated and we did have your signatures on the approval pages, however, this page was misplaced. Would you mind sending me an email just stating that you approve this document. I apologize for any inconvenience or confusion. I have attached a link to the document so that it might refresh your memory as to what you approved.

"DOE-RL-2002-11, Rev 2" can be accessed via the following link:
http://idmsweb/idms/livelink.exe/open/141829504

<< OLE Object: Picture (Device Independent Bitmap) >>

Debbie Dewey
CHPRC, Soil&Groundwater
Technical/EPC
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DOE/RL-2002-11
Revision 2

300-FF-5 Operable Unit Sampling and Analysis Plan

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

United States
Department of Energy
P.O. Box 550
Richland, Washington 99352

DOE/RL-2002-11
Revision 2

300-FF-5 Operable Unit Sampling and Analysis Plan

Date Published
December 2008

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

United States
Department of Energy
P.O. Box 550
Richland, Washington 99352

J. D. Aardal 01/29/2009
Release Approval Date

CONCURRENCE PAGE

Title: 300-FF-5 Operable Unit Sampling and Analysis Plan

Concurrence: B. L. Charboneau
U.S. Department of Energy, Richland Operations Office

_______________________ 12-10-2008
Signature Date

A. Boyd
Environmental Protection Agency

_______________________ Jan 8, 2009
Signature Date

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EXECUTIVE SUMMARY

The 300-FF-5 Operable Unit is one of three operable units identified for the 300 Area National Priorities List Site, which is located in the southeastern portion of the Hanford Site. The operable unit is defined by groundwater that has been affected by releases from waste sites in the 300-FF-1 and 300-FF-2 waste site operable units. As initially defined in 1996, the 300-FF-5 operable unit only included groundwater beneath 300 Area waste sites. In 2000, the operable unit was expanded to include the groundwater impacted by releases from several waste sites outside of the 300 Area. With the addition of the groundwater beneath these waste sites, the 300-FF-5 operable unit also acquired contaminants from sources not associated with 300-FF-1 and 300-FF-2 waste sites, i.e., contaminants that have migrated into the operable unit from regions to the northwest and southwest.

In 1996, the Record of Decision for the 300-FF-5 OU (EPA/ROD/R10-96/143, *Record of Decision for USDOE Hanford 300-FF-1 and 300-FF-5 Operable Units Remedial Actions*) specified continued groundwater monitoring and institutional controls on the use of groundwater during a period of interim action. During this period, extensive remediation of surface waste sites was conducted, along with continued attenuation of groundwater contamination by natural processes. The first five-year review of the decision conducted in 2001 found the remedy still appropriate, but determined a need for additional monitoring and characterization activities. In response to that finding, the Operations and Maintenance plan (DOE/RL-95-73, *Operations and Maintenance Plan for the 300-FF-5 Operable Unit,* Rev. 1) for the 300-FF-5 operable unit was revised and expanded in 2002, along with updating of the sampling and analysis plan (DOE/RL-2002-11, *300-FF-5 Operable Unit Sampling and Analysis Plan*). In 2004, additional characterization of the uranium plume and investigation of potential remedial action technologies were started. The second five-year review of the interim remedy resulted in an action item to complete a feasibility study to provide an improved characterization of uranium contamination in the subsurface at the 300 Area, develop a conceptual model, validate ecological consequences, and evaluate treatment alternatives. A field treatability test involving injection of polyphosphate into the aquifer was also specified. Since 2004, completion or significant progress has been achieved on the elements of this action item.

This revision of the sampling and analysis plan reflects changing information needs, the addition of new monitoring sites, and adjustments based on monitoring results for the last several years. The renewed remedial investigation/feasibility study effort requires more frequent data collection and additional data on general water chemistry. Since the last revision of this sampling and analysis plan, four additional aquifer tube sites will go into service during fiscal year 2008 to complement the existing eight sites along the 300 Area shoreline. Four new wells that resulted from a limited field investigation for uranium are now part of the monitoring network, as are four other new wells installed during fiscal year 2007 as part of investigating the discovery of volatile organic compounds at depth in the unconfined aquifer. Detailed evaluation of trends for contaminants of potential concern has revealed new information that justifies adjustments to the data collection schedules.

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APPENDICES

FIGURES

TABLES

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LIST OF TERMS

ALARA	as low as reasonably achievable
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act of 1980
CHPRC	CH2M Hill Plateau Remediation Company
COC	contaminants of concern
COPC	contaminants of potential concern
DOE	U.S. Department of Energy
DQO	data quality objectives
Ecology	Washington State Department of Ecology
EPA	Environmental Protection Agency
ESD	Explanation of significant difference
FS	feasibility study
FY	fiscal year
HEIS	Hanford Environmental Information System
HGET	Hanford General Employee Training
HRM	Hanford river mile
LED	liquid effluent discharges
LFI	limited field investigation
NPL	National Priorities List
O&M	operations and maintenance
OS&H	Occupational Safety and Health
OU	operable unit
PM	project manager
PNNL	Pacific Northwest National Laboratory
QA	quality assurance
QAPjP	quality assurance project plan
QC	quality control
RCRA	Resource Conservation and Recovery Act of 1976
RI	remedial investigation
RL	U. S. Department of Energy, Richland Operations Office
ROD	record of decision
SAP	sampling and analysis plan
TEDF	Treated Effluent Disposal Facility
Tri-Party Agreement	Hanford Federal Facility Agreement and Consent Order

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1.0 INTRODUCTION

The 300-FF-5 Operable Unit (OU) is located in the southeast portion of the Hanford Site and includes groundwater beneath the 300 Area and in the vicinity of Energy Northwest (Figure 1-1). It is one of three OUs identified for the 300 Area National Priorities List (NPL) Site (Figure 1-2). The extent of the OU is defined by groundwater that has been affected by releases from waste sites in the 300-FF-1 and 300-FF-2 source waste site OUs. As initially defined in the record of decision (ROD) for the 300-FF-1 and 300-FF-5 OUs (EPA/ROD/R10-96/143, *Record of Decision for USDOE Hanford 300-FF-1 and 300-FF-5 Operable Units Remedial Actions*), the 300-FF-5 OU only included groundwater beneath 300 Area waste sites. In 2000, the OU was expanded to include the groundwater impacted by releases from several outlying waste sites, including the 618-11 burial ground, 618-10 burial ground, and 316-4 crib (EPA/ESD/R10-00/524, *Explanation of Significant Difference for the 300-FF-5 Record of Decision*). Groundwater in all sub-regions of the 300-FF-5 OU also contains contaminants from sources not associated with 300-FF-1 and 300-FF-2 waste sites, i.e., contaminants that migrate into the 300-FF-5 OU from 200 East Area sources, and also from sources to the southwest of the 300 Area.

Figure 1-1 General Location Map for the Hanford Site in Southeastern Washington State

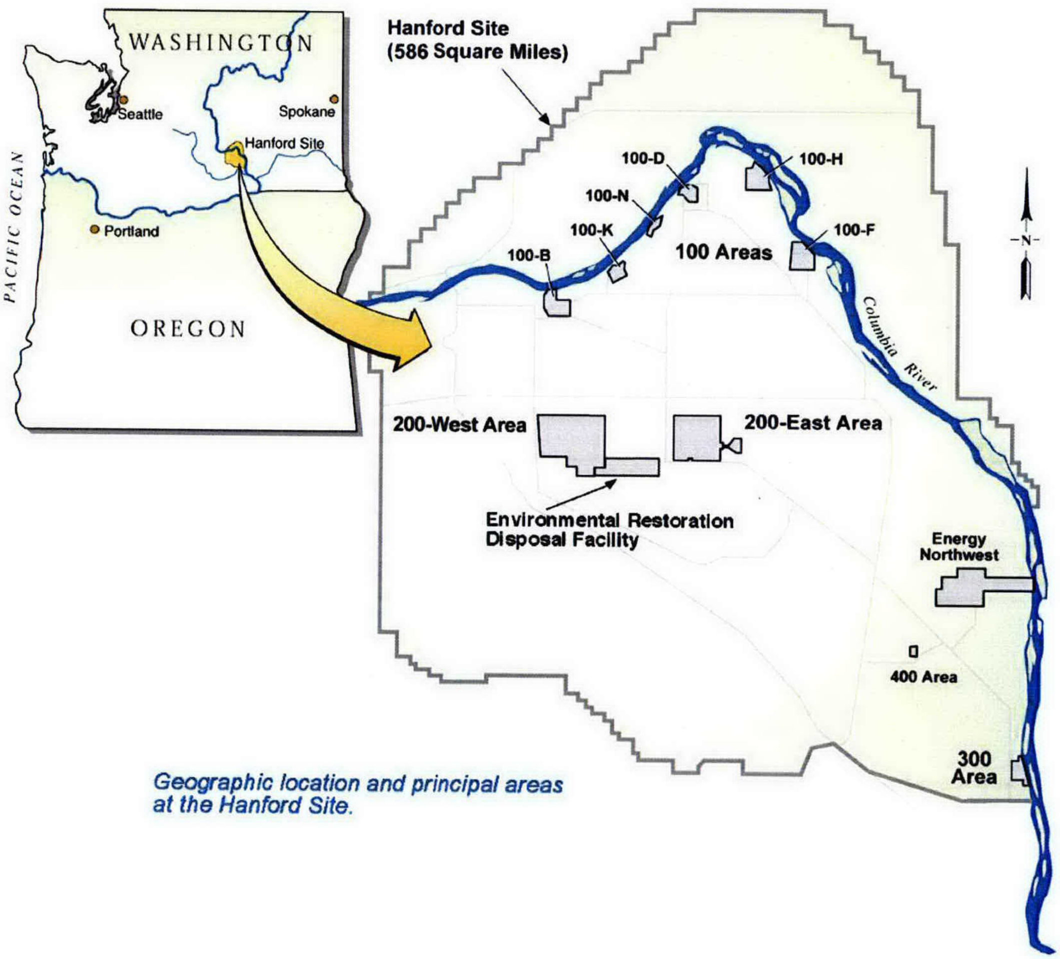
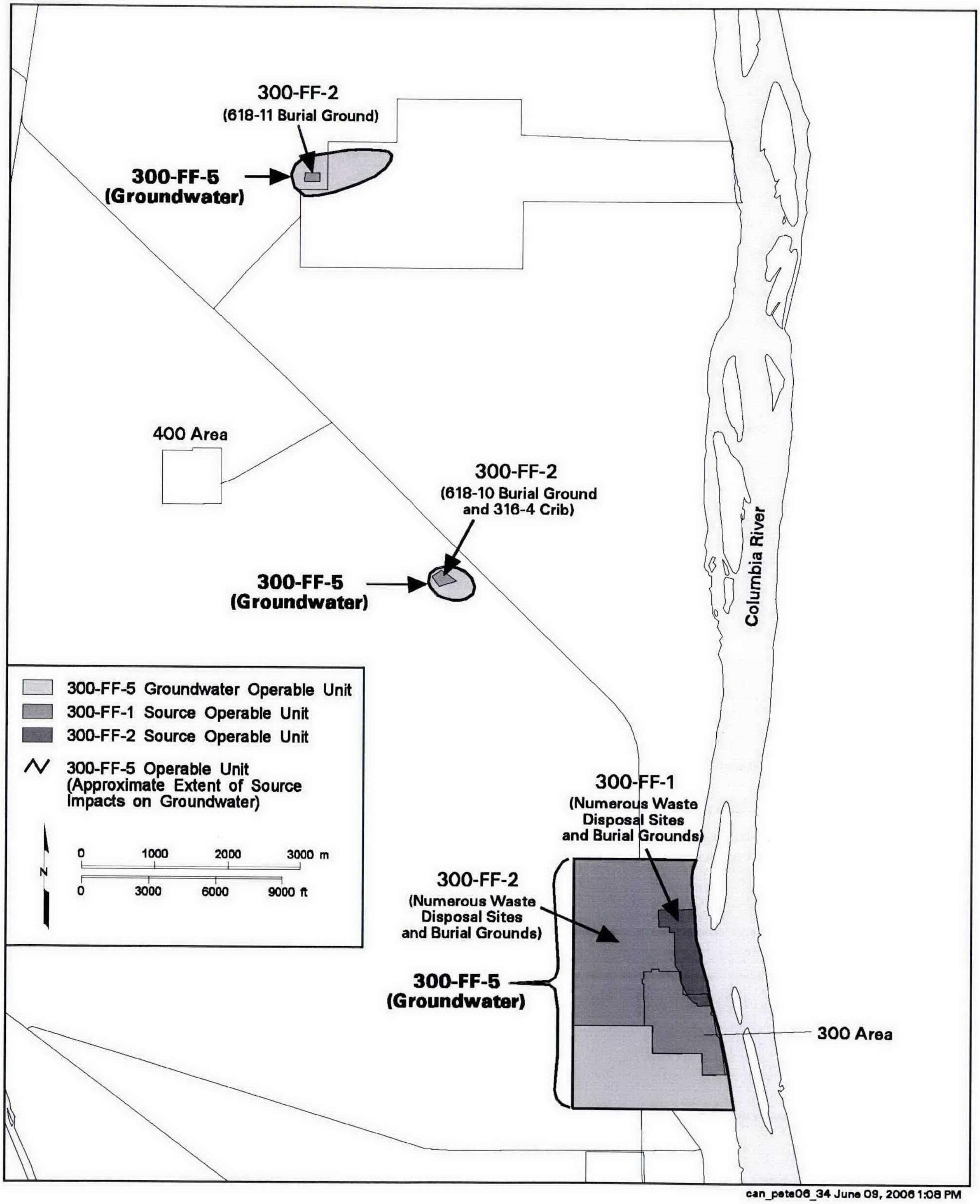


Figure 1-2 Operable Units Associated with the 300 Area National Priorities List Site



An operations and maintenance (O&M) Plan for the 300-FF-5 operable unit (DOE/RL-95-73, *Operation and Maintenance Plan for the 300-FF-5 Operable Unit*) was prepared in 1996 in response to the initial ROD. An action item resulting from the first five-year review of the ROD (EPA 2001, Action Item 300-4: DOE shall update and expand the O&M Plan for the 300-FF-5 Operable Unit) required that the O&M plan be updated and expanded. The revised O&M plan was to address requirements for (1) monitoring groundwater and riverbank springs, (2) characterizing impacts of contaminated groundwater and riverbank springs discharges, (3) evaluation of groundwater data with respect to the potential effectiveness of a monitored natural attenuation as a remedy, and (4) regulatory reporting for the OU. The revised O&M plan was released in May 2002, along with a new sampling and analysis plan (SAP) (DOE/RL-2002-11, 2002, *300-FF-5 Operable Unit Sampling and Analysis Plan*) for implementing the environmental monitoring requirements contained in the O&M plan. The SAP later underwent revision because of (1) updated interpretations associated with new monitoring results since the original plan, (2) the installation of new monitoring wells at several locations and aquifer tubes along the 300 Area shoreline, and (3) additional information needs associated with the Remedial Investigation (RI)/Phase III Feasibility Study (FS) that began in 2004 (DOE/RL-2005-47, *300-FF-5 Operable Unit Limited Field Investigation Plan*).

As part of the Phase III FS that is focused on uranium contamination in the subsurface at the 300 Area, a limited field investigation (LFI) was conducted that involved detailed characterization of the vadose zone and aquifer at four locations chosen to represent various combinations of proximity to waste sites and the Columbia River (PNNL-16435, *Limited Field Investigation Report for Uranium Contamination in the 300 Area, 300-FF-5 Operable Unit, Hanford Site, Washington*). The four characterization boreholes were completed as monitoring wells. Also, four additional characterization boreholes were drilled in fiscal year (FY) 2007 to investigate volatile organic compounds discovered during the LFI in a fine-grained subunit within the deeper portion of the unconfined aquifer (SGW-32607, *Sampling and Analysis Instructions for TCE Characterization, 300-FF-5 Operable Unit, Fiscal Year 2007*). These additional boreholes were also completed as monitoring wells. Moreover, to further investigate this discovery, four new aquifer tube sites were installed during FY 2008 along the central portion of the 300 Area shoreline.

The second five-year review of the ROD for the 300-FF-5 OU identified an action item to address the persistent uranium plume beneath the 300 Area. The requested action is to complete the Phase III FS, and to a) include better characterization of the uranium contamination, b) develop a conceptual model, c) validate ecological consequences, d) evaluate treatment alternatives, and e) test the injection of polyphosphate into the aquifer as a means to reduce the concentrations of dissolved uranium (DOE/RL-2006-20, 2006, *The Second CERCLA Five-Year Review Report for the Hanford Site*). These actions have either been completed or are in progress during FY 2008. The test injection of polyphosphate was completed in FY 2007. Preliminary results indicate that the hydrogeology may make injection difficult. Because this technology shows promise the Phase III FS is delayed, so that information from further laboratory and field testing can be incorporated into the FS.

To accommodate the newly installed monitoring wells and newly installed aquifer tubes in the groundwater schedule, this revision of the SAP for the 300-FF-5 OU was prepared. The SAP is also being updated with regard to sampling and analysis protocols and quality control (QC)/quality assurance (QA) requirements.

1.1 OBJECTIVES FOR GROUNDWATER MONITORING ACTIVITIES

The interim remedy selected for groundwater in the ROD for the 300-FF-5 OU (and its subsequent explanation of significant difference (ESD) [EPA/ESD/R10-00-524]) involves (a) continued monitoring and characterization of groundwater contamination, and (b) institutional controls on the use of groundwater. The findings of the first and second five-year reviews of the ROD confirmed that these actions are still appropriate as an interim remedy while source remedial actions are still underway.

As described in the Executive Summary for the revised 300-FF-5 OU O&M plan (DOE/RL-95-73), monitoring objectives are to

- verify that natural attenuation reduces groundwater contamination concentrations to drinking water maximum contaminant levels over a reasonable time period,
- confirm that contaminant concentrations in the river seeps (*i.e., riverbank springs—ed.)* do not exceed ambient water quality criteria or established remediation goals, and
- validate contaminant fate and transport conceptual models.

The O&M plan further states that "...these objectives will be achieved by sampling, analyzing, and evaluating plume- and/or area-specific groundwater monitoring wells and near-shore seep water, as well as river water and biota associated with the river seeps."

Lists of sampling sites and analyses to be performed, provided in Chapter 2.0, reflect revisions to the original SAP. These revisions are based on new monitoring data, new monitoring sites, and updated geochemical information acquired since preparation of the SAP in 2002. The groundwater sampling sites include monitoring wells, aquifer tubes installed along the river shoreline, and riverbank springs. Additional sampling associated with the Columbia River and river biota, as required by the O&M plan (DOE/RL-95-73), is currently being conducted under separate projects, most notably, the 100/300 Areas River Corridor Baseline Risk Assessment. The SAP for the 100/300 Areas River Corridor Risk Assessment, which supports the *Comprehensive Environmental Response, Compensation, and Liability Act of 1980* (CERCLA) objectives, is DOE/RL-2005-42, *100 Areas and 300 Area Component of the RCBRA Sampling and Analysis Plan*. The U.S. Department of Energy (DOE)'s Public Safety and Resource Protection Program also conducts environmental monitoring along the 300 Area under its Surface Environmental Surveillance Project, which is conducted by the Pacific Northwest National Laboratory (PNNL). Media sampled under the Surface Environmental Surveillance Project include river water, riverbank springs, sediment, and biota; its schedule calendar year 2008 is presented in PNNL-17282, *Hanford Site Environmental Surveillance Master Sampling Schedule for Calendar Year 2006*. The DOE also supports a field research investigation of the zone of groundwater/river interaction in the 300 Area under the Remedial Action and Closure Science Program. A summary of the sampling activities conducted under these separate programs is provided in Appendix A.

1.2 CONTAMINANTS OF CONCERN OR POTENTIAL CONCERN

Contaminants of concern (COCs) or contaminants of potential concern (COPCs) within the various sub-regions of the 300-FF-5 OU have been characterized regarding historical trends and current levels in an expanded groundwater report for FY 2004 (PNNL-15127, *Contaminants of Potential Concern in the 300-FF-5 Operable Unit: Expanded Annual Groundwater Report for FY2004*). PNNL-15127 includes recommendations as to which constituents should be carried forth as COCs or COPCs, the primary distinction being whether or not to conduct additional investigation of technologies available to address a particular contaminant. Until formal risk assessments for the current conditions are completed, this distinction provides a reasonable basis for planning monitoring activities. The following sections describing the contaminants in each of the sub-regions of the 300-FF-5 OU are extracted from the expanded groundwater report for FY 2004 (PNNL-15127), unless otherwise cited. The summary tables, Table 1-1 and 1-3, for each of the sub-regions show which contamination indicators for the various sub-regions have exceeded the U. S. Environmental Protection Agency (EPA)'s maximum contaminant level for drinking water sources during the period from 2004 through 2007). Appendix B identifies the individual wells and aquifer tubes where standards were exceeded during this period.

1.2.1 300 Area

Groundwater beneath the 300 Area has been contaminated by liquid effluent discharges to a variety of disposal sites during a period of operations that extends from the late 1940s through the mid-1980s. Since the end of fuel fabrication activities, contaminated discharges have largely ceased, although discharges of uncontaminated effluent continued until December 1994, when the 300 Area Treated Effluent Disposal Facility (TEDF) went into operation. Remedial actions have been completed that removed the structures and contaminated soil associated with most of the liquid waste disposal sites. However, residual amounts of some contaminants remain in the underlying vadose zone, and their presence is indicated by groundwater monitoring data.

Some contaminants are currently present at concentrations that exceed the EPA's maximum contaminant level for drinking water sources. The persistence of these contaminants in the face of rapid groundwater movement in the aquifer because of high transmissivity characteristics implies a continuing re-supply. Candidate non-point sources for uranium, the principal COC, include releases from the a) vadose zone beneath former waste sites, b) widely distributed capillary fringe zone near the water table, and/or c) aquifer solids.

COCs in groundwater beneath the 300 Area, as defined by the ROD (EPA/ROD/R10-96/143, pg. ii), are uranium, cis-1,2-dichloroethene, and trichloroethene. Additional COPCs, as identified during the RI (DOE/RL-94-85, *Remedial Investigation/Feasibility Study Report for the 300-FF-5 Operable Unit*) or in *Resource Conservation and Recovery Act* (RCRA) corrective measures monitoring plans (WCH-SD-N-AP-185, *Groundwater Monitoring Plan for the 300 Area Process Trenches*; PNNL-13645, *300 Area Process Trenches Groundwater Plan*), are tetrachloroethene, strontium-90, tritium, and nitrate. A summary of recent concentration data for those contaminants and other contamination indicators is presented in Table 1-1.

1.2.2 618-11 Sub-Region

Groundwater beneath the 618-11 burial ground, the northernmost outlying sub-region of the 300-FF-5 OU, is impacted by release of tritium from materials in the burial ground, which has created a plume of limited extent but of relatively high concentrations that exceed standards. The timing and release mechanism causing the groundwater impact is not fully known. Tritium has presumably impacted groundwater as the result of the out-gassing of tritium from irradiated lithium target material that was disposed to the burial ground (PNNL-13228, 2000, *Evaluation of Elevated Tritium Levels in Groundwater Downgradient from the 618-11 Burial Ground Phase I Investigations*). Several other constituents have exceeded the EPA drinking water standards in groundwater near the 618-11 burial ground or are useful indicators of contamination and are carried as COPC for the OU. Groundwater in this sub-region also contains contaminants associated with the site-wide plume, which originates in the 200 East Area (200-PO-1 Operable Unit). A summary of concentrations for all contamination indicators is presented in Table 1-2.

1.2.3 618-10/316-4 Sub-Region

The second outlying sub-region contains the 618-10 burial ground and 316-4 crib, where the COPCs are uranium and tributyl phosphate. Groundwater was impacted near these waste sites primarily during the early operating years of the 1950s and 1960s, and most impacts were probably associated with discharges to the 316-4 crib. Solvents containing metallic uranium were discharged to these open-bottom crib, thus contaminating the vadose zone and the underlying groundwater. Refurbishment of a monitoring well near the crib in 1995 apparently remobilized some of the vadose zone contamination and caused increases in uranium and volatile organic compounds to appear in the groundwater at that time.

Monitoring to date has not revealed evidence that groundwater beneath the 618-10 burial ground has been affected by tritium releases from buried materials, as has occurred at the 618-11 burial ground to the north. A soil gas survey was conducted in September 2002 along the downgradient perimeter fence to determine if evidence for tritium was present, and to help with positioning two new monitoring wells which would augment the existing well network (PNNL-14320, *Soil Gas Survey and Well Installation at the 618-10 Burial Ground, 300-FF-5 Operable Unit, Hanford Site, Washington*; the newly installed wells were 699-S6-E4L and 699-S6-E4K). High concentrations of helium-3, which would indicate tritium, were not found in the soil gas samples. Groundwater constituents associated with the leading edge of the site-wide plume that originated in the 200 East Area, including relatively low levels of tritium, technetium-99, and nitrate, are present in the vicinity of the 618-10/316-4 waste sites. A summary of concentrations for those contaminants and other contamination indicators is presented in Table 1-3.

1.3 CHANGES FROM THE PREVIOUS PLAN

This SAP has been updated to reflect new monitoring capabilities and information needs, including the following:

- Installation of four additional monitoring wells as part of the volatile organic compounds investigation as found in SGW-32607

- Installation of aquifer tubes at four additional sites along the central portion of the 300 Area shoreline (completed spring 2008)
- Sampling requirements for all aquifer sampling tubes as discussed in the DOE/RL-2000-59, *Sampling and Analysis Plan for Aquifer Sampling Tubes*.
- The need for additional groundwater data to support various information needs associated with the remediation strategy for uranium as discussed in DOE/RL-2005-47, *300-FF-5 Operable Unit Limited Field Investigation Plan.*

Table 1-1 Summary of Concentrations for Contamination Indicators in 300 Area Groundwater (4 Pages)

Contamination Indicator (COCs in bold)	**Filt?**	**Date Range: January 2004 through February 2008**							**MCL[b]**	**No. of Samples Exceeding MCL**	**No. of Wells Where MCL Exceeded**
		No. of Wells Sampled	**No. of Results**	**No. of Detects**	**No. of Excludes[a]**	**Minimum Value**	**Maximum Value**	**Average Value**			
300 Area Wells: Upper Portion of Unconfined Aquifer (TU)											
Dichloroethene (ug/L)[c]	N	41	388	51	0	0	57	5	70		
Gross alpha (pCi/L)	N	31	122	110	0	1	96	26	15	67	23
Gross alpha (pCi/L)	Y	2	4	2	0	13	28	21	15	1	1
Gross beta (pCi/L)	N	28	105	105	0	4	63	22	50	4	4
Nitrate (ug/L)	N	45	268	264	0	49	158,000	31,914	45,000		9
Nitrate (ug/L)	Y	2	4	3	0	44	27,800	12,981	45,000		
Strontium-90 (pCi/L)	N	3	14	7	0	3	3	3	8		
Technetium-99 (pCi/L)	N	1	1	1	0	27	27	27	900		
Tetrachloroethene (ug/L)	N	43	403	26	0	0	10	1	5	1	1
Tetrachloroethene (ug/L)	Y	2	4	0	0	nd	nd	nd	5		
Trichloroethene (ug/L)	N	43	403	242	4	0	5	1	5	1	1
Trichloroethene (ug/L)	Y	2	4	0	0	nd	nd	nd	5		
Tritium (pCi/L)	N	26	113	96	0	13	15,100	3,052	20,000		
Uranium (ug/L)	N	44	379	378	0	0	218	46	30	245	28
Uranium (ug/L)	Y	5	7	7	0	0	70	16	30	2	2

Table 1-1 Summary of Concentrations for Contamination Indicators in 300 Area Groundwater (4 Pages)

Contamination Indicator (COCs in bold)	Filt?	Date Range: January 2004 through February 2008							MCL[b]	No. of Samples Exceeding MCL	No. of Wells Where MCL Exceeded
		No. of Wells Sampled	No. of Results	No. of Detects	No. of Excludes[a]	Minimum Value	Maximum Value	Average Value			
Vinyl chloride (ug/L)	N	43	403	0	0	nd	nd	nd	2		
Vinyl chloride (ug/L)	Y	2	4	0	0	nd	nd	nd	2		
300 Area Wells: Lower Portion of Unconfined Aquifer (LU)											
Dichloroethene (ug/L)	N	7	156	72	0	0	280	80	70	35	1
Gross alpha (pCi/L)	N	5	25	8	0	1	27	12	15	3	2
Gross beta (pCi/L)	N	4	16	13	0	3	22	8	50		
Nitrate (ug/L)	N	8	47	28	0	27	22,800	5,263	45,000		
Strontium-90 (pCi/L)	N	1	2	0	0	nd	nd	nd	8		
Tetrachloroethene (ug/L)	N	8	178	2	0	7	7	7	5	2	1
Trichloroethene (ug/L)	N	8	178	42	0	0	580	30	5	4	1
Tritium (pCi/L)	N	5	20	3	0	11	14	12	20,000		
Uranium (ug/L)	N	8	171	84	1	0	56	7	30	2	2
Vinyl chloride (ug/L)	N	8	178	0	0	nd	nd	nd	2	1	1
300 Area Wells: Uppermost Confined Aquifer c											
Dichloroethene (ug/L)	N	3	3	0	0	nd	nd	nd	70		
Nitrate (ug/L)	N	4	7	2	0	57	374	215	45,000		

Table 1-1 Summary of Concentrations for Contamination Indicators in 300 Area Groundwater (4 Pages)

Contamination Indicator (COCs in bold)	Filt?	Date Range: January 2004 through February 2008							MCL[b]	No. of Samples Exceeding MCL	No. of Wells Where MCL Exceeded
		No. of Wells Sampled	No. of Results	No. of Detects	No. of Excludes[a]	Minimum Value	Maximum Value	Average Value			
Tetrachloroethene (ug/L)	N	3	3	0	0	nd	nd	nd	5		
Trichloroethene (ug/L)	N	3	3	0	0	nd	nd	nd	5		
Tritium (pCi/L)	N	3	10	5	0	6	90	25	20,000		
Uranium (ug/L)	N	4	7	0	0	nd	nd	nd	30		
Vinyl chloride (ug/L)	N	3	3	0	0	nd	nd	nd	2		
300 Area Shoreline--Aquifer Tubes: Upper Portion of Unconfined Aquifer (TU)											
Dichloroethene (ug/L)	N	15	46	6	0	0	4	2	70		
Dichloroethene (ug/L)	Y	1	1	1	0	3	3	3	70		
Gross alpha (pCi/L)	N	8	20	19	0	2	154	53	15	15	5
Gross alpha (pCi/L)	Y	2	2	2	0	29	31	30	15	2	2
Gross beta (pCi/L)	N	8	20	18	0	8	48	20	50		
Gross beta (pCi/L)	Y	2	2	2	0	8	10	9	50		
Nitrate (ug/L)	N	20	115	113	1	3,780	67,300	20,707	45,000		3
Nitrate (ug/L)	Y	2	2	2	0	17,192	18,968	18,080	45,000		
Tetrachloroethene (ug/L)	N	19	68	7	0	0	5	1	5		
Tetrachloroethene (ug/L)	Y	2	2	0	0	nd	nd	nd	5		

Table 1-1 Summary of Concentrations for Contamination Indicators in 300 Area Groundwater (4 Pages)

Contamination Indicator (COCs in bold)	Filt?	Date Range: January 2004 through February 2008							MCL[b]	No. of Samples Exceeding MCL	No. of Wells Where MCL Exceeded
		No. of Wells Sampled	No. of Results	No. of Detects	No. of Excludes[a]	Minimum Value	Maximum Value	Average Value			
Trichloroethene (ug/L)	N	19	68	36	0	0	450	29	5	9	5
Trichloroethene (ug/L)	Y	2	2	1	0	28	28	28	5	1	1
Tritium (pCi/L)	N	15	60	46	1	770	10,500	5,225	20,000		
Uranium (ug/L)	N	20	164	162	1	0	241	67	30	91	16
Uranium (ug/L)	Y	19	40	37	2	5	195	82	30	14	12
Vinyl chloride (ug/L)	N	19	68	0	0	nd	nd	nd	2		
Vinyl chloride (ug/L)	Y	2	2	0	0	nd	nd	nd	2		

a "Excludes" refers to outlier results, i.e., not considered representative of aquifer conditions.
b "MCL" refers to maximum contaminant level, normally the value associated with standard for drinking water sources.
c Form of dichloroethene is cis-1,2-dichloroethene.
"nd" indicates not detected.
Data Source: Hanford Environmental Information System (HEIS), queried for the period January 1, 2004, through February 14, 2008.
Summary statistics prepared using PNNL's Data Visualization and Evaluator (DaVE) interface with HEIS.

Table 1-2 Summary of Concentrations for Contamination Indicators in 618-11 Subregion Groundwater

Contamination Indicator (COCs in bold)	Filt?	Date Range: 2004 through 2007							MCL[b]	No. of Samples Exceeding MCL	No. of Wells Where MCL Exceeded
		No. of Wells Sampled	No. of Results	No. of Detects	No. of Excludes[a]	Minimum Value	Maximum Value	Average Value			
618-11 Subregion Wells: Upper Portion of Unconfined Aquifer (TU)											
Gross alpha (pCi/L)	N	8	83	80	1	1	9	5	15		
Gross beta (pCi/L)	N	8	83	83	0	8	86	28	50	16	1
Iodine-129 (pCi/L)	N	7	18	0	0	nd	nd	nd	1		
Nitrate (ug/L)	N	8	45	44	0	13,300	111,000	52,093	45,000		4
Technetium-99 (pCi/L)	N	4	18	16	0	15	241	104	900		
Tritium (pCi/L)	N	8	86	85	0	1,480	2,320,000	507,788	20,000	81	6
Uranium (ug/L)	N	6	53	53	0	4	11	8	30		

a "Excludes" refers to outlier results, i.e., not considered representative of aquifer conditions.
b "MCL" refers to maximum contaminant level, normally the value associated with standard for drinking water sources.
"nd" indicates not detected.
Data Source: Hanford Environmental Information System (HEIS), queried for the period January 1, 2004 through February 14, 2008.
Summary statistics prepared using PNNL's Data Visualization and Evaluator (DaVE) interface with HEIS.

Table 1-3 Summary of Concentrations for Contamination Indicators in 618-10/316-4 Subregion Groundwater

Contamination Indicator (COCs in bold)	Filt?	Date Range: 2004 through 2007							MCL[b]	No. of Samples Exceeding MCL	No. of Wells Where MCL Exceeded
		No. of Wells Sampled	No. of Results	No. of Detects	No. of Excludes[a]	Minimum Value	Maximum Value	Average Value			
618-10/316-4 Subregion Wells: Upper Portion of Unconfined Aquifer (TU)											
Gross alpha (pCi/L)	N	6	65	62	1	2	26	10	15	9	2
Gross beta (pCi/L)	N	6	65	65	0	9	29	19	50		
Nitrate (ug/L)	N	6	58	58	0	23,500	65,500	35,955	45,000		1
Technetium-99 (pCi/L)	N	4	26	26	0	21	45	29	900		
Tributyl phosphate (ug/L)	N	5	47	14	0	3	160	27	none		
Tritium (pCi/L)	N	6	42	42	0	10,800	16,800	13,531	20,000		
Uranium (ug/L)	N	6	65	65	0	4	42	19	30	24	2

a "Excludes" refers to outlier results, i.e., not considered representative of aquifer conditions.
b "MCL" refers to maximum contaminant level, normally the value associated with standard for drinking water sources.
Data Source: Hanford Environmental Information System (HEIS), queried for the period January 1, 2004 through February 14, 2008.
Summary statistics prepared using PNNL's Data Visualization and Evaluator (DaVE) interface with HEIS.

Some of the 300 Area river shore monitoring called for by the O&M plan for the 300-FF-5 OU is included in this SAP, e.g., shoreline aquifer tubes and riverbank springs. Additional shoreline monitoring and characterization work is being conducted as part of the 100/300 Areas River Corridor Baseline Risk Assessment (DOE/RL-2005-42) and the Surface Environmental Surveillance Project at PNNL (PNNL-17282).

1.4 BACKGROUND INFORMATION—HISTORICAL PERSPECTIVE

The following information is summarized from the expanded groundwater report for FY 2004 (PNNL-15127), unless otherwise cited. Updated information has been provided when available and appropriate.

Facilities in the 300 Area of the Hanford Site were primarily involved with fabrication of nuclear fuel for plutonium production, which included some research and development activities, during the period spanning the startup of Hanford reactors in 1944 through the late 1980s (PNL-7241, *Data Compilation Task Report for the Source Investigations of the 300-FF-1 Operable Unit Phase I Remedial Investigation*; EMO-1026, *Addendum to Data Compilation Task Report for the Source Investigation of the 300-FF-1 Operable Unit Phase I Remedial Investigations*). The range of activities produced a wide variety of waste streams that contained chemical and radiological constituents (WHC,-MR-0388, *Past Practices Technical Characterization Study – 300 Area – Hanford Site*; BHI-00012, 1994, *300-FF-2 Operable Unit Technical Baseline Report*). Since the early 1990s, extensive remediation of liquid waste disposal sites and solid waste burial grounds has taken place. As of March 2004, most liquid waste disposal sites, which are located in the north half of the 300 Area, have been excavated, backfilled, and the ground surface restored (DOE/RL-2004-74, 2004, *300-FF-1 Operable Unit Remedial Action Report*). There is some potential for contamination to remain in the vadose zone beneath the lower extent of the excavation activities. Additional contamination may also remain beneath buildings and facilities in the southern portion of the 300 Area where decontamination and decommissioning activities have not yet been completed, although these activities are continuing during FY 2008.

Groundwater beneath the 300 Area and the two outlying geographic sub-regions (618-11 burial ground and 618-10 burial ground/316-4 crib) contains contaminants from past-practices disposal activities at concentrations that exceed the EPA standards for drinking water sources. The ROD for interim action associated with groundwater and its associated ESD (EPA/ROD/R10-96/143; EPA/ESD/R10-00/524) involves institutional controls on the use of groundwater and continued monitoring to establish trends in the level of contamination.

Uranium is the most prominent waste constituent remaining in the environment. It has persisted in waste sites and groundwater in the 300 Area during the years following the shutdown of most fuel fabrication activities and cessation of liquid effluent disposal to the ground. Figure 1-3 shows the concentration of uranium in groundwater for samples collected between 1988 and 2005. Figure 1-4 shows the tritium and uranium plume in 2007. Uranium in soluble form is of concern for chemical toxicity, as well as for radiological exposure, although the concentrations in groundwater for chemical toxicity are lower than those associated with exceeding radiological dose standards. Specific criteria on the toxicity to freshwater aquatic organisms are not currently established. The EPA's maximum contaminant level in groundwater for drinking water sources is currently 30 μg/L, measured as total uranium in an unfiltered water sample. During the RI in the early 1990s and the development of the initial ROD (EPA/ROD/R10-96/143), the proposed standard for uranium was 20 μg/L. An update to the conceptual model for uranium contamination in the subsurface beneath the 300 Area was recently published in DOE/RL-2008-01, *Hanford Site Groundwater Monitoring for Fiscal Year 2007.*

Additional waste constituents present in groundwater beneath the 300 Area include volatile organic compounds, which resulted from disposal of liquid waste generated in the 300 Area facilities. These constituents include tetrachloroethene and trichloroethene, and cis-1,2-dichloroethene, which may be a degradation product of the other compounds. During the LFI for uranium in 2006 (PNNL-16435), trichloroethene was discovered in a finer-grained interval of Ringold Formation sediment in the unconfined aquifer at concentrations much higher than in the uppermost portion of the aquifer, which includes the water table. A summary of the concentrations for these contaminants as measured in water samples collected during drilling is presented in Table 1-4. Subsequent investigation of this discovery indicates that the contamination is limited to the finer-grained interval and is not widely distributed (DOE/RL-2008-01). The area of concern is to the south and southeast of the former South Process Pond. Because of the very low permeability associated with this sediment, no monitoring wells have been completed in this interval. Tritium, nitrate, technetium-99, and trichloroethene migrate into the 300-FF-5 OU from source areas to the northwest and southwest.

At the outlying 618-11 burial ground waste site, a tritium plume whose source is assumed to be releases from irradiated materials in the burial ground, is being monitored. This plume contains relatively high concentrations but is of relatively small areal extent, and lies within the larger site wide contaminant plume that originates at 200 East Area sources. Figure 1-4 shows the 618-11 burial ground tritium plume for conditions during 2007. At the 618-10/316-4 waste sites, uranium and tributyl phosphate are being monitored. Those two constituents were discharged to the 316-4 crib during the very early operations at 300 Area facilities (i.e., 1950s and 1960s), and residual amounts remain in the vadose zone, as revealed by recent excavation of the 316-4 crib.

During the period of interim remedial action, monitoring and characterization of the various contaminant plumes continues, with one objective being to show how the level of contamination changes with time. The RI (DOE/RL-94-85) found evidence to suggest that levels for uranium would decrease with time (i.e., the plume would attenuate) because of natural processes such as dispersion. A prediction was offered that concentrations of uranium in groundwater would decrease to the proposed drinking water standard or lower in three to 10 years from 1993. This led to anticipating that natural processes would have a role in future decisions regarding remedial action alternatives for groundwater. The phrase "natural attenuation processes" is defined in EPA's guidance for including natural processes when considering remedial action alternatives (EPA Directive 9200.4-17P, *Use of Monitored Natural Attentuation at Superfund, RCRA Corrective Action, and Underground Storage Tank Sites*, pg. 3). The guidance includes the following statements to describe natural attenuation processes

> "...a variety of physical, chemical, or biological processes that, under favorable conditions, act without human intervention to reduce the mass, toxicity, mobility, volume, or concentration of contaminants in soil or groundwater. These in situ processes include biodegradation; dispersion; dilution; sorption; volatilization; radioactive decay; and chemical or biological stabilization, transformation, or destruction of contaminants."

Figure 1-3 Historical Evolution of Uranium Plume in 300 Area Groundwater, 1988 to 2005

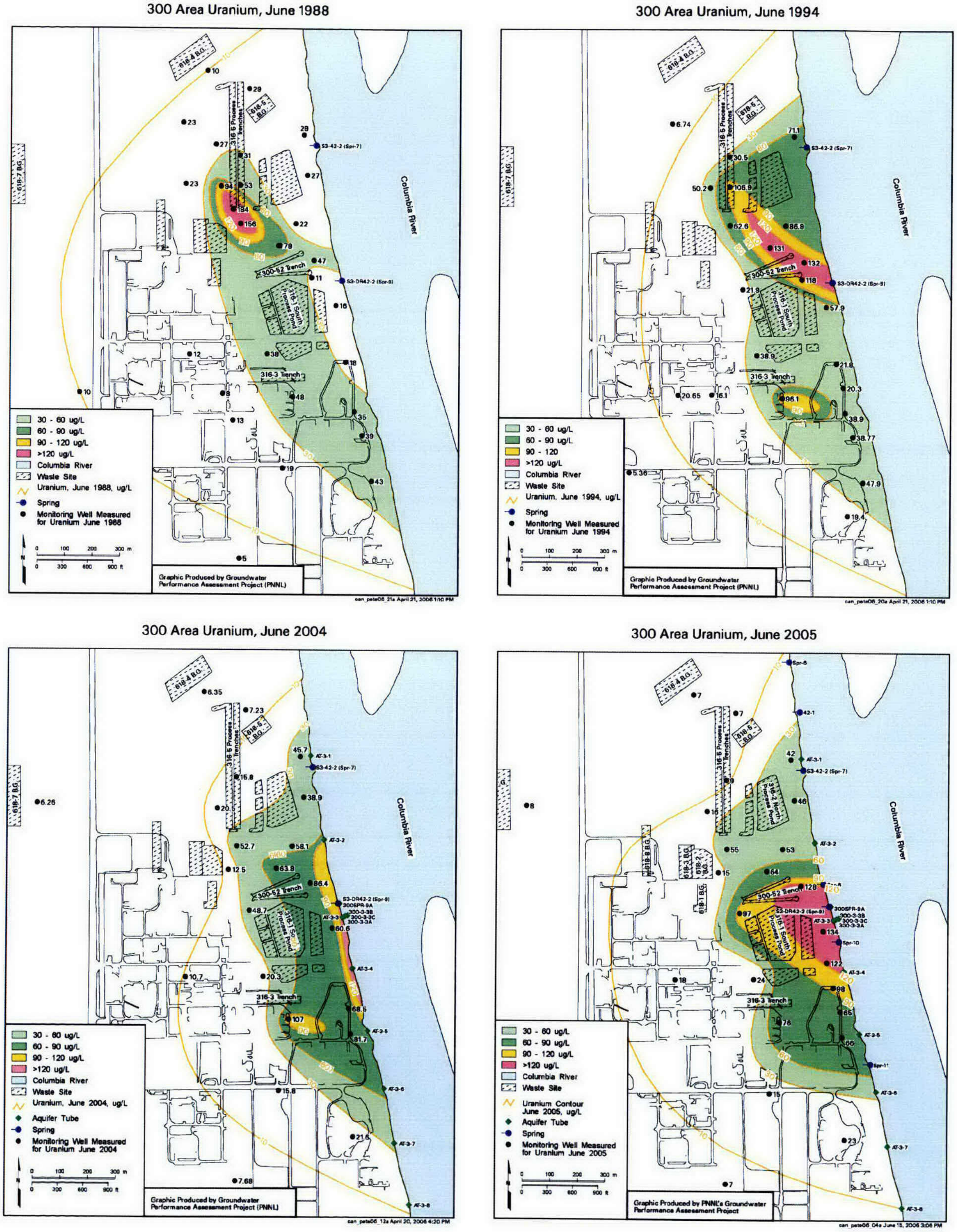


Figure 1-4 Tritium and Uranium Plumes in 300-FF-5 Operable Unit Groundwater During 2007

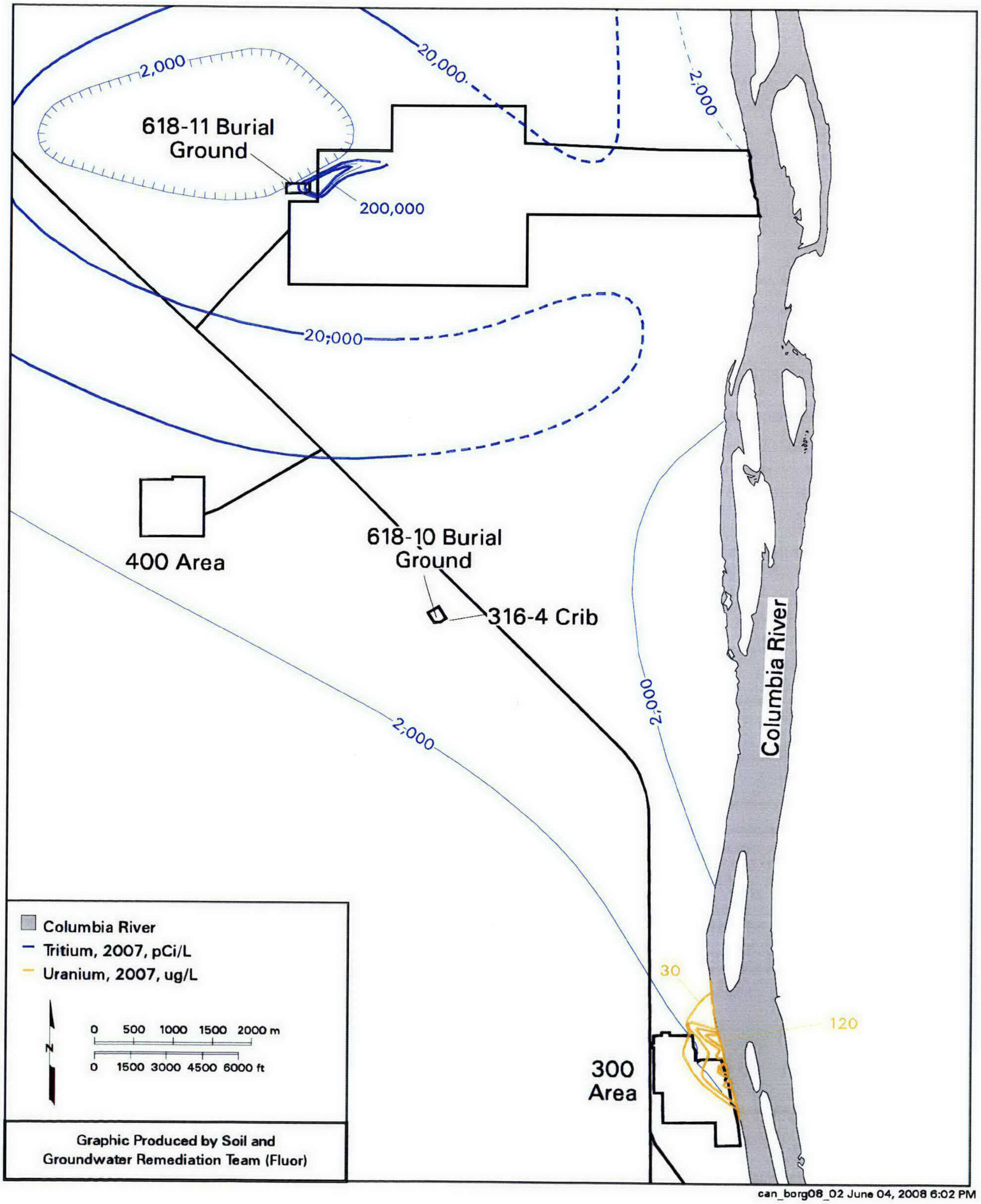


Table 1-4 Summary of Volatile Organic Compounds in Water Samples Collected During Drilling of Characterization Boreholes at the 300 Area

Borehole Location	Investi-gation	Hydro-logic Unit[1]	Sample Collect Date	Trichloro-ethene (µg/L)	Tetrachloro-ethene (µg/L)	cis-1,2-Dichloro-ethene (µg/L)
399-3-18	LFI	R_{sand}	3/14/2006	63.0	1.8	0.7
399-3-18	LFI	R_{sand}	3/15/2006	51.0	0.8	0.7
399-3-18	LFI	R_{sand}	3/16/2006	0.6	U	U
399-3-18	LFI	R_{sand}	3/20/2006	U	U	U
399-1-23	LFI	R_{gravel}	4/5/2006	2.1	0.2	3.0
399-1-23	LFI	R_{gravel}	4/6/2006	2.2	U	15.0
399-1-23	LFI	R_{gravel}	4/7/2006	0.3	U	32.0
399-1-23	LFI	R_{gravel}	4/10/2006	1.1	U	48.0
399-1-23	LFI	R_{gravel}	4/11/2006	2.2	U	51.0
399-1-23	LFI	R_{gravel}	4/17/2006	U	U	57.0
399-1-19	LFI	H_{gravel}	4/28/2006	1.7	U	U
399-1-19	LFI	R_{gravel}	5/3/2006	1.4	U	U
399-3-20	LFI	H_{gravel}	5/15/2006	1.6	U	U
399-3-20	LFI	R_{sand}	5/16/2006	630.0	9.9	6.5
399-3-21	VOC	H_{gravel}	4/17/2007	19.0	U	U[2]
399-3-21	VOC	R_{sand}	4/20/2007	580.0	7.0	12.0[2]
399-3-21	VOC	R_{sand}	4/25/2007	26.0	U	27.0[2]
399-2-5	VOC	H_{gravel}	9/13/2007	U	U	U[2]
399-2-5	VOC	R_{sand}	9/17/2007	U	U	U[2]
399-2-5	VOC	R_{sand}	9/19/2007	U	U	U[2]
399-2-5	VOC	R_{gravel}	9/24/2007	U	U	U[2]
399-2-5	VOC	R_{sand}	9/25/2007	U	U	U[2]
399-4-14	VOC	R_{sand}	10/15/2007	U	U	U[2]
399-4-14	VOC	R_{sand}	10/17/2007	U	U	U[2]
399-3-22	VOC	R_{sand}	11/8/2007	U	U	U[2]
399-3-22	VOC	R_{sand}	11/9/2007	U	U	U[2]

Abbreviations: U = undetected; LFI = limited field investigation, PNNL-16435; VOC = volatile organic compound investigation, PNNL-17666 (DOE/RL-2008-01).
Footnotes: [1] H = Hanford gravels, R = Ringold Unit E; [2] Result is for 1,2-dichloroethene, total
Data Source: PNNL-17666, Tables 2-1 and 2-2 (DOE/RL-2008-01)

Since the RI in the early 1990s, actions and events that may have impacted groundwater in the 300 Area sub-region of the 300-FF-5 OU included a) the expedited response action at the 300 Area process trenches during the early 1990s, b) cessation of liquid discharges to the remaining land disposal facilities with the startup of the TEDF in 1994, c) extensive source remedial actions involving large-scale excavations of liquid waste disposal sites and solid waste burial grounds during the mid-1990s, and d) unusually high and prolonged water-table elevations during 1996 and 1997. The consequences of these actions and events include potential remobilization of contaminants held in the vadose zone, especially beneath former liquid waste disposal sites, and redistribution of contaminants within the groundwater plume, causing variability in concentration patterns.

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2.0 FIELD SAMPLING PLAN

This section of the SAP provides the detailed lists of sampling sites (e.g., wells; aquifer tubes and riverbank springs along the 300 Area shoreline), constituents to be monitored, and the frequency of sampling for the three sub-regions associated with the 300-FF-5 OU. Protocols for scheduling, sample data tracking, sample collection, analyses, and related activities are summarized.

2.1 SAMPLING OBJECTIVES

Field activities at monitoring sites are intended to provide samples of groundwater that are representative of conditions in the aquifer and near the Hanford Site's groundwater/Columbia River interface. Laboratory analysis of these samples will produce data that are interpreted for the purpose of meeting the groundwater monitoring objectives stated in the O&M plan (DOE/RL-95-73).

2.2 SAMPLING LOCATIONS, CONSTITUENTS, AND FREQUENCY OF SAMPLING

Tables 2.1 through 2.3 reflect requirements for groundwater sampling and analysis activities in the 300-FF-5 OU. Information in the tables includes the well or site name; the hydrologic unit being sampled; sampling frequency; and the analyses to be performed on the samples.

Minor changes to the schedules presented in these tables may occur because of well maintenance issues, access constraints created by remedial action activities, new information from monitoring results, and special requests for information. Also, sampling at river shore sites is often affected by river conditions and therefore not completely predictable as to schedule. Change control for this SAP is described in Section 4.3.

2.2.1 300 Area Sub-Region

Monitoring wells in the 300 Area cover three different hydrologic horizons: the upper portion of the unconfined aquifer (includes the water table), the lower portion of the unconfined aquifer, and the uppermost confined aquifer, which resides in the basal unit of the Ringold Formation. The majority of monitoring wells have screened or perforated openings in the upper portion of the unconfined aquifer. Contamination is more likely to be found in the upper portion of this hydrologic unit because a) contamination reached the water table by downward migration through the vadose zone, and b) an upward-directed hydraulic gradient exists in the deeper aquifers beneath the 300 Area. Figure 2-1 provides a location map for all available monitoring wells and shoreline monitoring sites. Figure 2-2 is a map showing the uranium plume during June 2007, which is the area of most concern regarding groundwater contamination.

Figure 2-1 Monitoring Site Location Map for the 300 Area Subregion

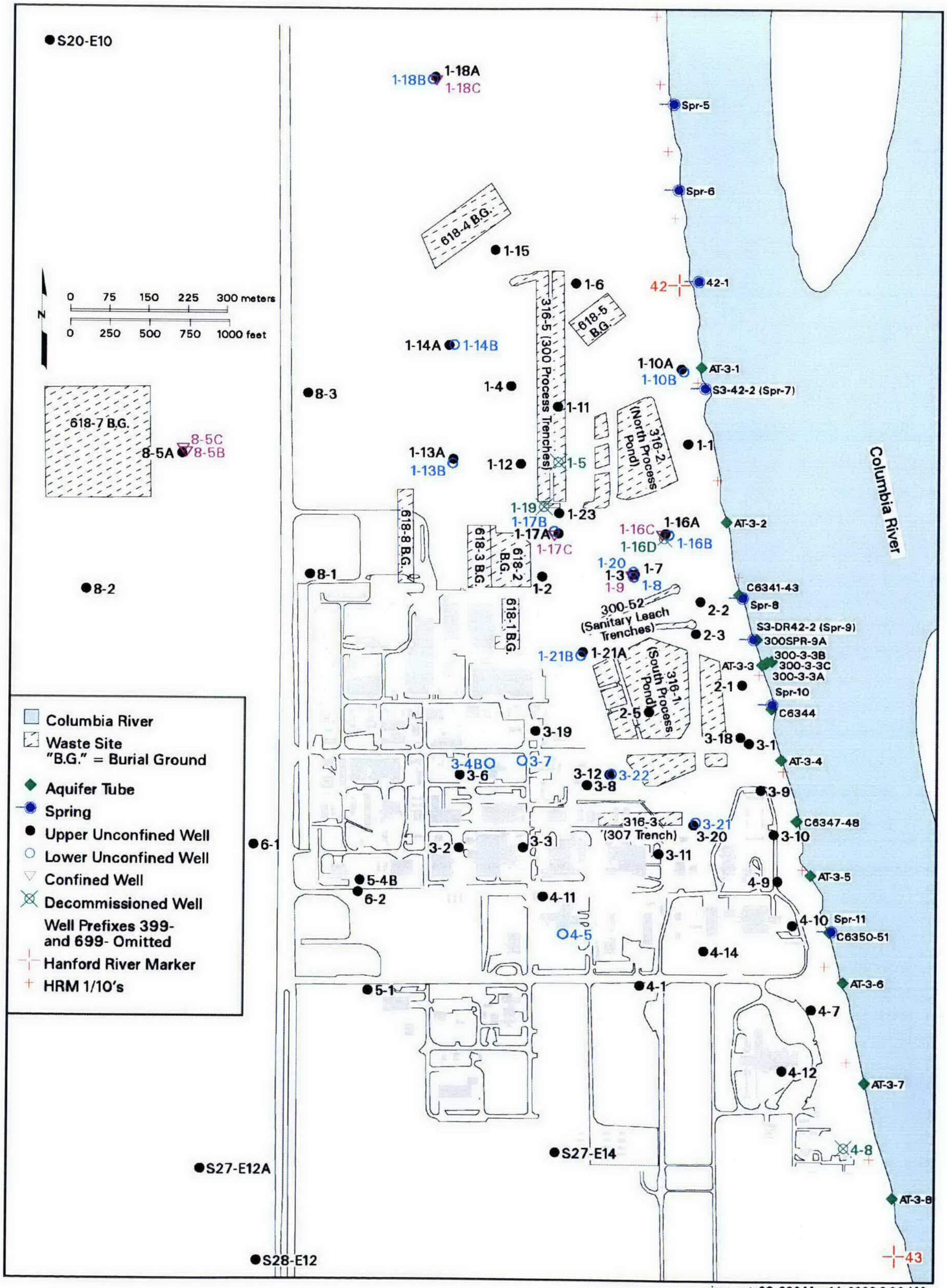

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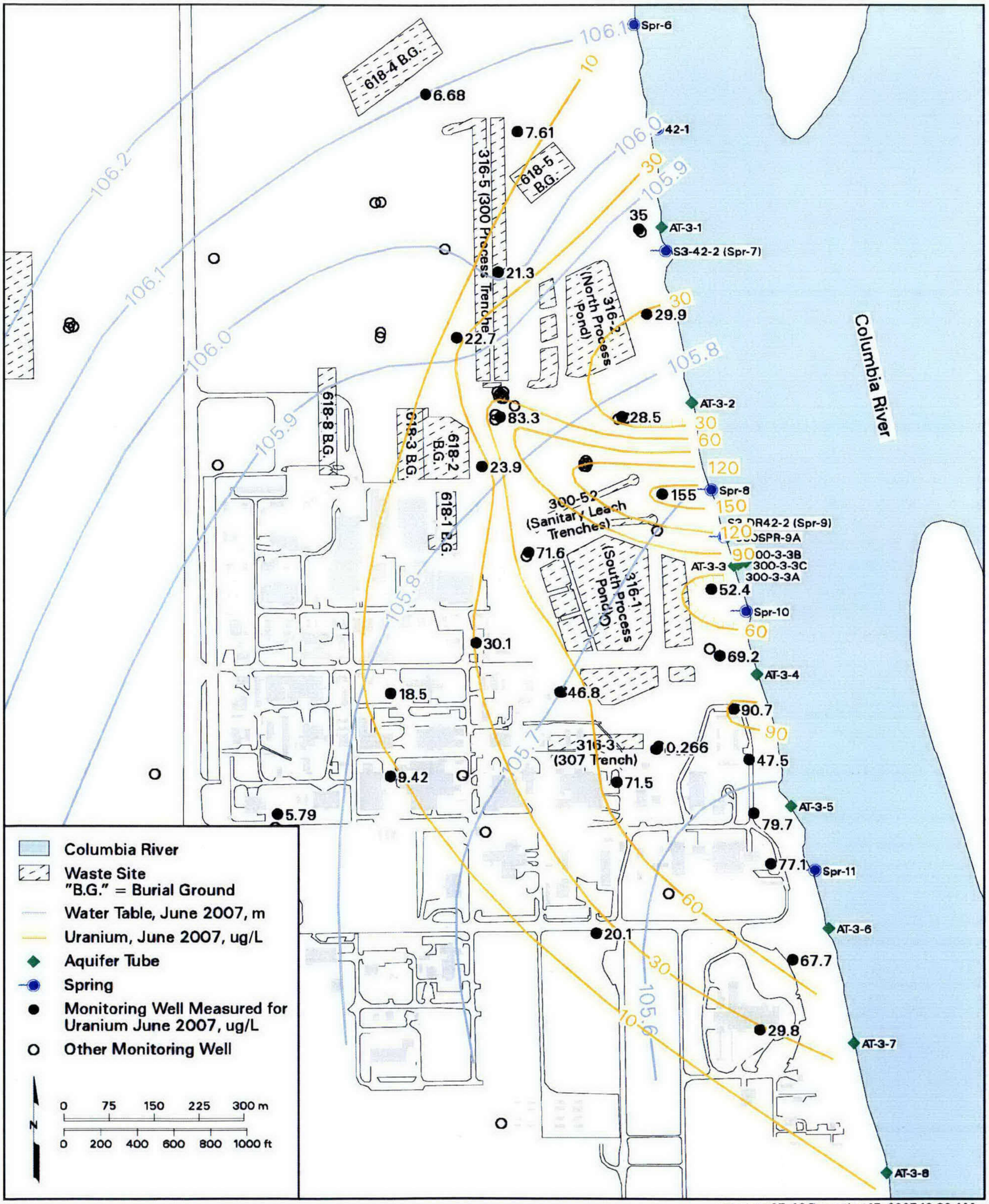
Figure 2-2 300 Area Subregion Uranium Plume in the Upper Portion of the Unconfined Aquifer During June 2007



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Groundwater near the Columbia River at the 300 Area is monitored using near-river wells, and also by collecting samples from aquifer tubes, which are located along the low river-stage shoreline. Figure 2-3 shows the spatial relationship between the screened sampling ports for aquifer tubes and the screened or perforated interval for near-river monitoring wells, along with uranium results for FY 2007 (Note: the horizontal scale in Figure 2-3 refers to the Hanford River Marker [HRM] system shown on the location map in Figure 2-1). Additional samples are collected by other Hanford projects, from riverbank springs (see Figure 2-1) that appear during periods of low river stage; to also help characterize groundwater as it discharges into the river system, their sampling is summarized in Appendix A. Sampling schedules for 300 Area wells are presented in Table 2-1.

2.2.2 618-11 Sub-Region

Monitoring wells in the sub-region surrounding the 618-11 burial ground primarily cover conditions in the uppermost hydrologic unit, i.e., the upper portion of the unconfined aquifer. Figure 2-4 shows the locations of monitoring wells in the sub-region, and Figure 2-5 shows the tritium plume. The sampling and analysis schedule for this sub-region is presented in Table 2-2.

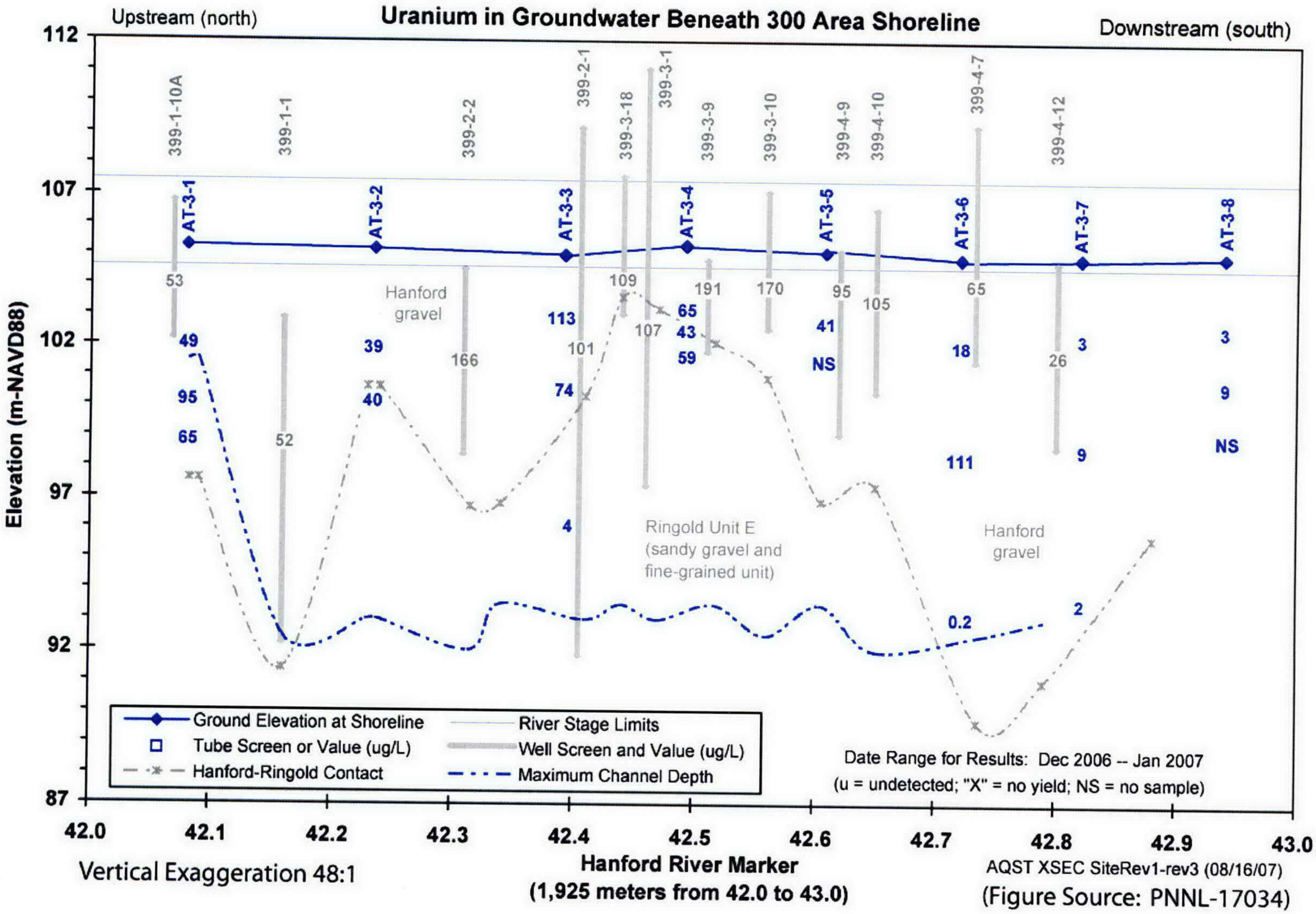
2.2.3 618-10/316-4 Sub-Region

Monitoring wells in the sub-region surrounding the 618-10 burial ground and adjacent to the 316-4 crib also primarily cover conditions in the uppermost hydrologic unit, i.e., the upper portion of the unconfined aquifer. Figure 2-6 shows the locations of monitoring wells in this sub-region; no contaminant plumes are currently mapped as being associated with these two waste sites. However, the leading edge of the site wide plume (200-PO-1 Operable Unit), whose source is the 200 East Area, is present in this sub-region. Also, contaminants observed in groundwater are attributed to releases from these waste sites. The sampling and analysis schedule for this sub-region is presented in Table 2-3.

2.3 WATER-LEVEL MONITORING

The elevation of the water table is monitored on the Hanford Site primarily to help determine the direction and rate of groundwater flow in the uppermost aquifer. This information is used to infer the direction of contaminant plume movement, and also to calibrate computer simulations of groundwater flow, which allow reconstruction of past movement and prediction of future movement. Example lists of wells used, the criteria for their selection, the hydrogeologic units monitored, and a description of the methods used to measure water levels are provided in a water level monitoring plan for the Hanford Site (PNNL-13021, *Water-Level Monitoring Plan for the Hanford Groundwater Monitoring Project*). For the 300 Area, measurements are made three times a year: once in March to support preparation of the site-wide water-table map and again in June and December to support preparation of seasonal water table maps required under the RCRA monitoring task for the former 300 Area Process Trenches (WHC-SD-N-AP-185, *Groundwater Monitoring Plan for the 300 Area Process Trenches*).

Figure 2-3 Cross Section Along Shoreline Showing Relationship between Aquifer Tubes and Near-River Wells



(Note: View is to the east, i.e., from land toward the river.)

Table 2-1 Sampling Locations, Constituents, and Frequency for the 300 Area Subregion, FY2008 Update (6 Pages)

Monitoring Site Name	Hydrologic Unit Monitored	COC			COPC				Supporting Measurements					
		cis-1,2-Dichloroethene	**Trichloroethene**	**Uranium-total**	**Tetrachloroethene**	**Strontium-90**	**Tritium**	**Nitrate**	**Anions (IC)**	**Alkalinity**	**Metals (ICP)-unfiltered and filtered**	**Volatile Organic Compounds**	**Gross Alpha/Beta**	**Uranium-isotopic**
Near-River Well Grouping														
399-1-10A	TU	SA	SA	Q	SA		A	Q	Q	Q	SA	SA	SA	A
399-1-1	TU	SA	SA	SA	SA			SA	SA	SA	SA	SA	SA	
399-1-16A	TU	SA	SA	Q	SA		A	Q	Q	Q[a]	SA	SA	SA	A
399-2-2	TU	SA	SA	SA	SA			SA	SA	SA	SA	SA	SA	
399-2-3 (2-2 alt)	TU													
399-2-1	TU	SA	SA	Q	SA		A	Q	Q	Q	SA	SA	SA	A
399-3-18	TU	SA	SA	Q	SA		A	Q	Q	Q	SA	SA	SA	A
399-3-1	TU	SA	SA	SA	SA			SA	SA	SA	SA	SA	SA	
399-3-9	TU	SA	SA	SA	SA			SA	SA	SA	SA	SA	SA	
399-3-10	TU	SA	SA	Q	SA		A	Q	Q	Q	SA	SA	SA	A
399-4-9	TU	SA	SA	SA	SA			SA	SA	SA	SA	SA	SA	
399-4-10	TU	SA	SA	SA	SA			SA	SA	SA	SA	SA	SA	
399-4-7	TU	SA	SA	SA	SA			SA	SA	SA	SA	SA	SA	
399-1-10B	LU	SA	SA	SA	SA			SA	SA	SA	SA	SA		
399-1-16B	LU	SA	SA	SA	SA			SA	SA	SA	SA	SA		
399-1-16C	C	A	A	A	A			A	A	A	A	A		

Table 2-1 Sampling Locations, Constituents, and Frequency for the 300 Area Subregion, FY2008 Update (6 Pages)

Monitoring Site Name	Hydrologic Unit Monitored	COC			COPC				Supporting Measurements					
		cis-1,2-Dichloroethene	Trichloroethene	Uranium-total	Tetrachloroethene	Strontium-90	Tritium	Nitrate	Anions (IC)	Alkalinity	Metals (ICP)-unfiltered and filtered	Volatile Organic Compounds	Gross Alpha/Beta	Uranium-isotopic
Central Region--Uranium Plume Transport Corridor Well Grouping														
399-1-6	TU	SA	SA	SA	SA			SA	SA	SA	SA	SA	SA	
399-1-4 (1-6 alt)	TU													
399-1-11	TU	SA	SA	SA	SA			SA	SA	SA	SA	SA	SA	
399-1-12	TU	SA	SA	SA	SA			SA	SA	SA	SA	SA	SA	
399-1-23	TU	SA	SA	Q	SA		A	Q	Q	Q	SA	SA	SA	A
399-1-17A[a]	TU	SA	SA	Q[a]	SA		A	Q	Q[a]	Q[a]	SA	SA	SA	A
399-1-2	TU	SA	SA	SA	SA			SA	SA	SA	SA	SA	SA	
399-1-7	TU	SA	SA	SA	SA			SA	SA	SA	SA	SA	SA	
399-1-3 (1-7 alt)	TU													
399-1-21A	TU	SA	SA	Q	SA		A	Q	Q	Q	SA	SA	SA	A
399-2-5	TU	Q	Q	Q	Q		A	Q	Q	Q	Q	Q	Q	A
399-3-12	TU	SA	SA	SA	SA			SA	SA	SA	SA	SA		
399-3-8 (3-12 alt)	TU													
399-3-20	TU	SA	SA	Q	SA	A	A	Q	Q	Q	SA	SA	SA	A
399-3-11	TU	SA	SA	Q	SA	A	A	Q	Q	Q	SA	SA	SA	A
399-1-17B	LU	SA	SA	SA	SA			SA	SA	SA	SA	SA	SA	
399-1-8	LU	SA	SA	SA	SA			SA	SA	SA	SA	SA	SA	
399-1-21B	LU	SA	SA	SA	SA			SA	SA	SA	SA	SA	SA	
399-3-21	LU	Q	Q	Q	Q		A	Q	Q	Q	Q	Q	Q	

Table 2-1 Sampling Locations, Constituents, and Frequency for the 300 Area Subregion, FY2008 Update (6 Pages)

Monitoring Site Name	Hydrologic Unit Monitored	COC			COPC				Supporting Measurements					
		cis-1,2-Dichloroethene	Trichloroethene	Uranium-total	Tetrachloroethene	Strontium-90	Tritium	Nitrate	Anions (IC)	Alkalinity	Metals (ICP)-unfiltered and filtered	Volatile Organic Compounds	Gross Alpha/Beta	Uranium-isotopic
399-3-22	LU	Q	Q	Q	Q		A	Q	Q	Q	Q	Q	Q	
399-1-17C	C	A	A	A	A			A	A	A	A	A		
399-1-9	C	A	A	A	A			A	A	A	A	A		
Northwest Region--Upgradient Conditions Well Group														
699-S20-E10	TU			SA			SA	SA	SA	SA	SA			
399-1-18A	TU			SA			SA	SA	SA	SA	SA			
399-1-15	TU	SA	SA	SA	SA			SA	SA	SA	SA	SA	SA	
399-1-14A (1-15 alt)	TU													
399-8-3 (8-5A alt)	TU													
399-8-5A	TU	SA	SA	SA	SA			SA	SA	SA	SA	SA	SA	
399-1-13A (1-12 alt)	TU													
399-8-1 (8-5A alt)	TU													
399-8-2 (8-5A alt)	TU													
399-1-18B	LU			SA			SA	SA	SA	SA	SA			
399-1-14B (1-18B alt)	LU													
399-1-13B (1-18B alt)	LU													
399-1-18C	C			A				A	A	A	A			
399-8-5B (1-18C alt)	C													
399-8-5C (1-18C alt)	C													

Table 2-1 Sampling Locations, Constituents, and Frequency for the 300 Area Subregion, FY2008 Update (6 Pages)

Monitoring Site Name	Hydrologic Unit Monitored	COC			COPC				Supporting Measurements					
		cis-1,2-Dichloroethene	**Trichloroethene**	**Uranium-total**	**Tetrachloroethene**	**Strontium-90**	**Tritium**	**Nitrate**	**Anions (IC)**	**Alkalinity**	**Metals (ICP)-unfiltered and filtered**	**Volatile Organic Compounds**	**Gross Alpha/Beta**	**Uranium-isotopic**
Southwest Region--Upgradient Conditions Well Group														
399-3-19	TU	SA	SA	Q	SA		A	Q	Q	Q	SA	SA	SA	A
399-3-6	TU	SA	SA	SA	SA			SA	SA	SA	SA	SA		
399-6-1 (5-4B alt)	TU													
399-3-2	TU	SA	SA	SA	SA			SA	SA	SA	SA	SA		
399-3-3 (3-2 alt)	TU													
399-5-4B	TU	SA	SA	SA	SA			SA	SA	SA	SA	SA		
399-6-2 (5-4B alt)	TU													
399-4-11 (3-2 alt)	TU													
399-5-1 (5-4B alt)	TU													
399-4-1	TU	SA	SA	SA	SA			SA	SA	SA	SA	SA		
399-4-12	TU	SA	SA	SA	SA			SA	SA	SA	SA	SA		
399-4-14	TU	Q	Q	Q	Q		A	Q	Q	Q	Q	Q	Q	
699-S27-E14	TU	A	A	A	A			A	A	A	A	A		

Abbreviations: Q = quarterly; SA = semi-annually; and A = annually. IC = ion chromatography; ICP = inductively coupled plasma analysis for metals. Hydrologic Units: TU = upper portion of unconfined aquifer; LU = lower portion of unconfined aquifer; and C = uppermost confined aquifer.

Group Methods: Anions (IC) = To include: chloride, fluoride, nitrate, nitrite, and sulfate. Metals (ICP) = To include: barium, beryllium, cadmium, chromium, copper, iron, manganese, silver, and zinc. Volatile Organic Compounds include cis-1,2-dichloroethene, tetrachloroethene, trichloroethene, and vinyl chloride.

Monthly sampling at these wells will be conducted under *Comprehensive Environmental Response, Compensation, and Liability Act of 1980* during April, May, October, and November to supplement the 300 Area Process Trenches RCRA schedule, thus providing a full year of monthly results (FY2008/2009 only).

Note: Field parameters pH, temperature, specific conductance, turbidity, dissolved oxygen, oxidation-reduction potential (redox), and depth-to-water are measured at the sampling site during each sampling event. All analyses are performed on unfiltered samples, except for metals (ICP) where both filtered and unfiltered analyses are performed.

Figure 2-4 Monitoring Well Location for the 618-11 Area Subregion

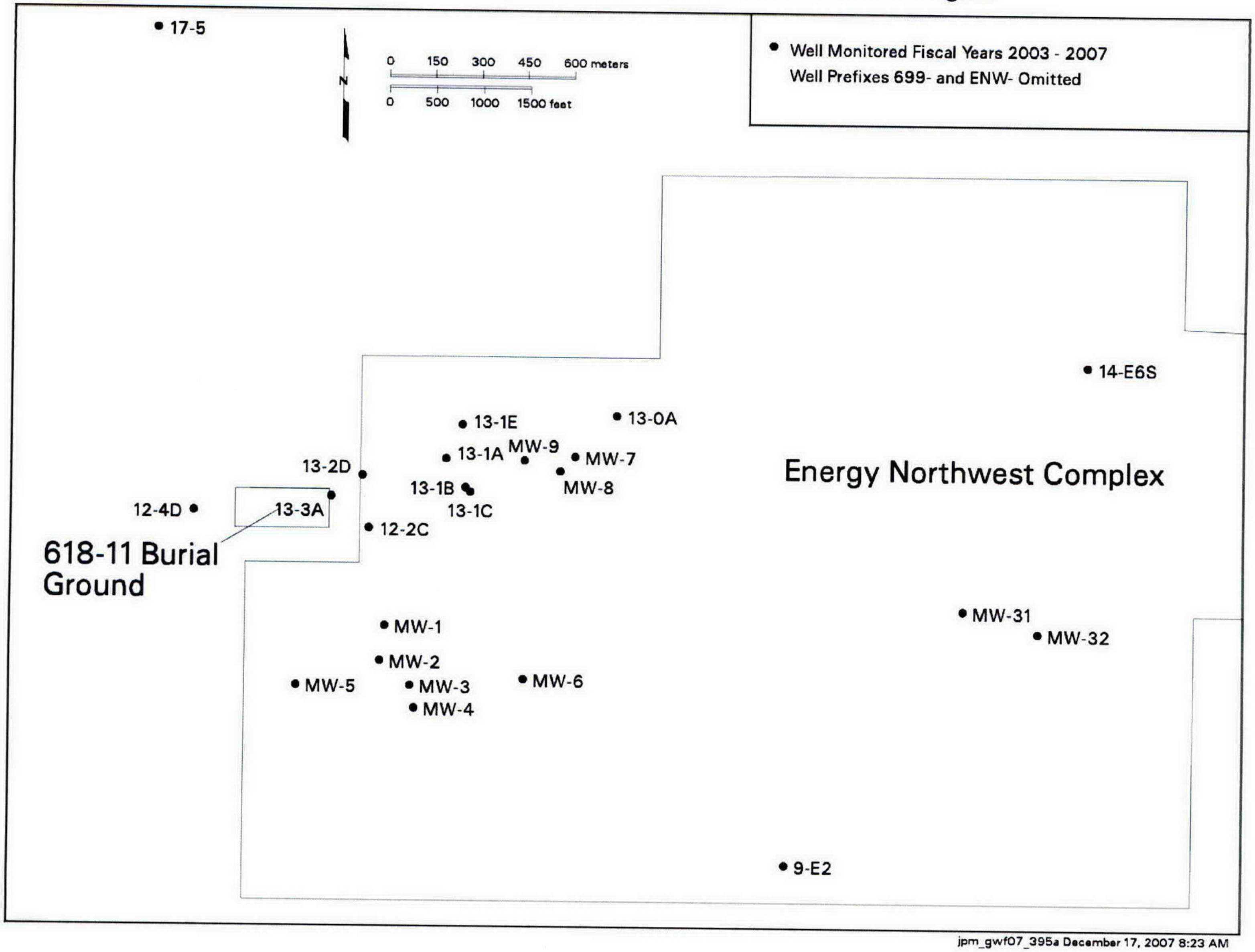


Figure 2-5 Tritium Plume Map for the 618-11 Area Subregion

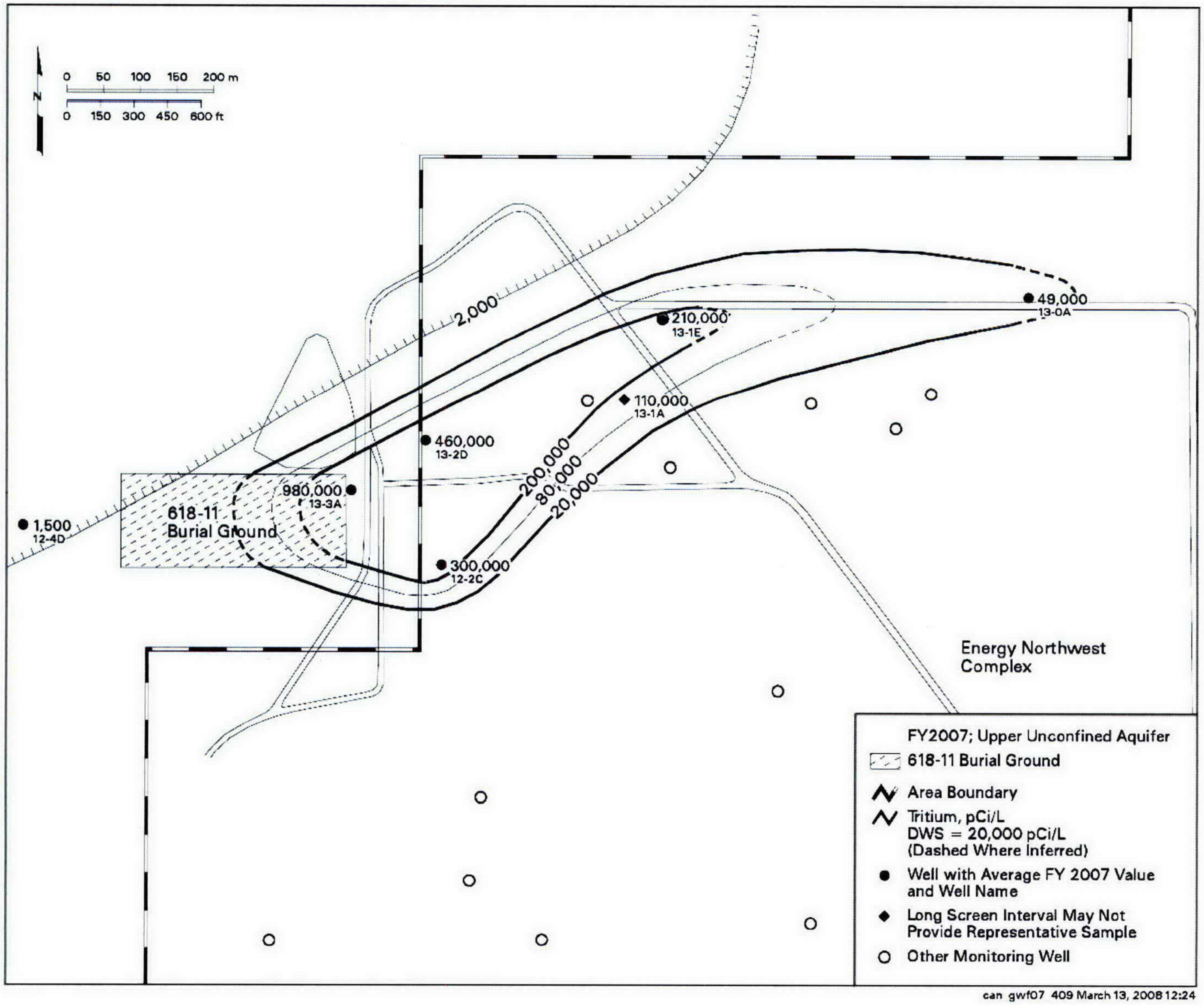


Table 2-2 Sampling Locations, Constituents, and Frequency for the 618-11 Subregion, FY2008 Update

Monitoring Site Name	Hydrologic Unit Monitored	COPC						Supporting Measurements		
		Tritium	**Gross Beta**	**Uranium**	**Technetium-99**	**Gross Alpha**	**Nitrate**	**Anions (IC)**	**Alkalinity**	**Metals (ICP)-unfiltered and filtered**
Downgradient of 618-11 Burial Ground (Near-Field)										
699-13-3A	TU	Q	Q	SA	SA	Q	SA	SA	SA	SA
699-13-2D	TU	Q	Q	SA	SA	Q	SA	SA	SA	SA
699-12-2C	TU	Q	Q	SA	SA	Q	SA	SA	SA	SA
Upgradient Conditions (Near-Field)										
699-12-4D	TU	A	A	A	A	A	A	A	A	A
Downgradient of 618-11 Burial Ground (Far-Field)										
699-13-1E	TU	SA	SA			SA	SA	SA	SA	SA
699-13-0A	TU	SA	SA			SA	SA	SA	SA	SA

Abbreviations: Q = quarterly; SA = semi-annually; and A = annually. IC = ion chromatography; ICP = inductively coupled plasma analysis for metals.
Hydrologic Units: TU = top of unconfined aquifer.
Group Methods: Anions (IC) = To include: chloride, fluoride, nitrate, nitrite, and sulfate. Metals (ICP) = To include: barium, beryllium, cadmium, chromium, copper, iron, manganese, silver, and zinc.
Note: Field parameters pH, temperature, specific conductance, turbidity, dissolved oxygen, oxidation-reduction potential (redox), and depth-to-water are measured at the sampling site during each sampling event. All analyses are performed on unfiltered samples, except for metals (ICP) where both filtered and unfiltered analyses are performed

Figure 2-6 Monitoring Well Location Map for the 618-10/316-4 Area Subregion

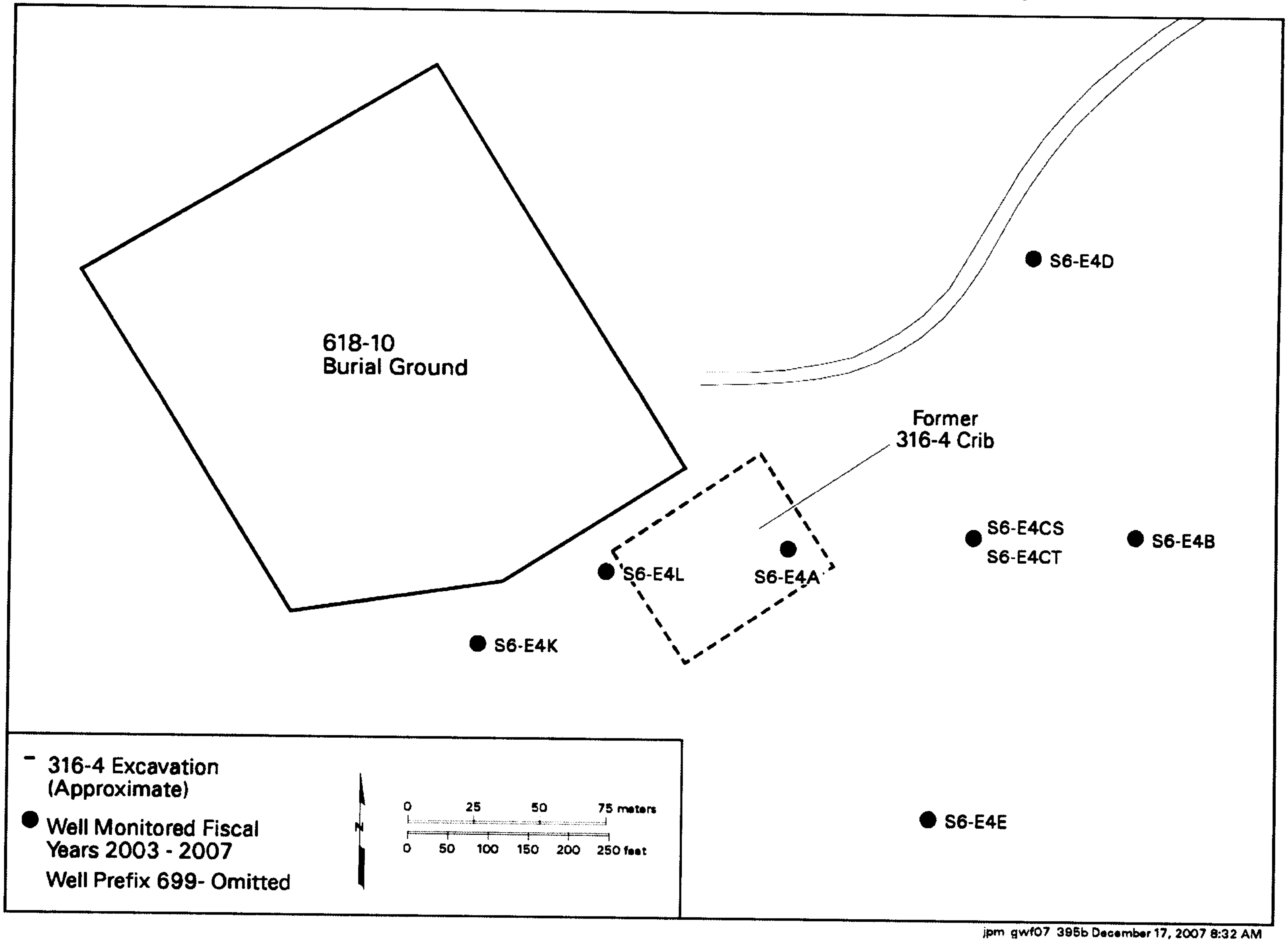


Table 2-3 Sampling Locations, Constituents, and Frequency for the 618-10 Subregion, FY2008 Update

Monitoring Site Name	Hydrologic Unit Monitored	COPC					Supporting Measurements					
		Uranium-total	Tributyl Phosphate	Gross Alpha	Gross Beta	Nitrate	Alkalinity	Metals (ICP)-unfiltered and filtered	Volatile Organic Compounds	Tritium	Technetium-99	Uranium-isotopic
Downgradient of 618-10 Burial Ground (Near-Field)												
699-S6-E4L	TU	Q	SA	Q	Q	Q	SA	SA	SA	SA	SA	A
699-S6-E4K	TU	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	A
Downgradient of 618-10 Burial Ground; Within 316-4 Crib Footprint (Near-Field)												
699-S6-E4A	TU	Q	SA	Q	Q	Q	SA	SA	SA	SA	SA	A
Background: 618-10 Burial Ground/316-4 Crib												
699-S6-E4D	TU	A		A	A	A	A	A		A	A	
Downgradient of 618-10 Burial Ground/316-4 Crib												
699-S6-E4B	TU	SA		SA	SA	SA	SA	SA		SA		
699-S6-E4E	TU	SA		SA	SA	SA	SA	SA		SA		

Abbreviations: Q = quarterly; SA = semi-annually; and A = annually. IC = ion chromatography; ICP = inductively coupled plasma analysis for metals.
Hydrologic Units: TU = top of unconfined aquifer.
Group Methods: Anions (IC) = To include: chloride, fluoride, nitrate, nitrite, and sulfate. Metals (ICP) = To include: barium, beryllium, cadmium, chromium, copper, iron, manganese, silver, and zinc. Volatile Organic Compounds include cis-1,2,-dichloroethene, tetrachloroethene, trichloroethene, and vinyl chloride.
Note: Field parameters pH, temperature, specific conductance, turbidity, dissolved oxygen, oxidation-reduction potential (redox), and depth-to-water are measured at the sampling site during each sampling event. All analysis are performed on unfiltered samples, except for metals (ICP) where both filtered and unfiltered analyses are performed.

Prior to sampling any well used in the 300-FF-5 monitoring task under this SAP, depth-to-water is measured with a minimum of two consistent measurements being taken to confirm precision of the measurement. The depth-to-groundwater is subtracted from the elevation of a reference point (usually top of casing) to obtain the water-level elevation. Depth-to-water data, and their conversion to elevation data, are stored in the PNNL's HydroDat database, which is frequently uploaded into the Hanford Site Environmental Information System (HEIS).

2.4 PROTOCOLS ASSOCIATED WITH SAMPLING AND ANALYSIS

Groundwater sampling and analysis for the 300-FF-5 OU is conducted as part of CH2M Hill Plateau Remediation Company (CHPRC)'s Soil and Groundwater Remediation Project (groundwater project) and follows that project's QA project plan (HNF-20635, *Soil & Groundwater Remediation Project Quality Assurance Project Plan [GRP-QA-001]*), (QAPjP) which is compliant with the EPA's Requirements for Quality Assurance Project Plans (EPA/240/B-01/003 *EPA Requirements for Quality Assurance Project Plans QA/R-5*). Groundwater sampling and analysis activities under this SAP will follow the requirements of the most recent revision of the QAPjP.

Following laboratory analysis of the samples, the performing laboratory reports results back to the groundwater project via electronic and hard-copy media. The data are then loaded into the HEIS and become available for use.

2.4.1 Scheduling For Field Activities

The groundwater project has the responsibility for scheduling collection of samples from wells, aquifer tubes, and some riverbank springs. Many Hanford Site wells are sampled to meet multiple objectives and requirements. Overlapping use of a well by multiple projects is managed by the groundwater project scheduling staff, to avoid unnecessary well trips, redundant sample collection, and duplicative analytical work.

2.4.2 Chain of Custody

Chain-of-custody procedures and documentation that are consistent with EPA/240/B-01/003 are used for sample collection. Use of these protocols documents the integrity of groundwater samples from the time of collection through data reporting. The forms required by the procedure are generated during scheduling and managed by the samplers. Information on the forms includes the following:

- Sampler's name(s)
- Method of shipment and destination
- Collection date and time
- Sample identification numbers
- Analysis methods
- Preservation methods.

When samples are transferred from one custodian to another (e.g., from sampler to shipper or shipper to analytical laboratory), the receiving custodian inspects the form and samples and notes any deficiencies. Each transfer of custody is documented by the printed names and signatures of the custodian relinquishing the samples and the custodian receiving the samples, and the time and date of transfer are recorded.

2.4.3 Sample Collection

In brief, prior to collecting a sample, the well is purged by typically removing three times the volume of water in the submerged portion of the casing. This purge is generally sufficient to remove potentially stagnant water from the casing and pump piping. A sufficient purge is indicated by stability in field parameters, as monitored during the purge. A similar procedure is followed for collecting samples from aquifer tubes and riverbank springs.

Level I EPA pre-cleaned sample containers will be used for samples. When sample preservatives are required for a specific constituent, the preservatives are normally added to the collection bottles before their use in the field. Samples to be analyzed for metals are typically filtered in the field so that results represent primarily the dissolved form of the metal. For samples being collected to show compliance with drinking water standards, an unfiltered sample is analyzed for some constituents such as metals, such that the analytical result represents all forms of a metal, i.e., dissolved and particulate. For all water samples collected, the sample bottles are stored in a secure container while field sampling is still underway, and chilled with ice if required by the handling requirements. Evidence tape is wrapped around the sample bottle label prior to transferring custody and/or shipping to the analytical lab.

2.4.4 Analytical Protocols

Analytical parameters and methods are addressed in Table 2-4. Laboratory specific standard operating procedures for analytical methods are described in the Hanford Site internal laboratory QA requirements. Errors reported by the laboratories are communicated to the sample and data management project coordinator, who initiates a sample disposition record in accordance with CHPRC procedures. This process is used to document analytical errors and to establish resolution with the sampling lead. Errors or difficulties encountered during field analysis will be reported to the project task lead. Field instruments are used to collect key parameters during sampling. The identity of each field instrument used during a sampling event is tracked on field documentation, as is its standardization and calibration, which is conducted per the instrument manufacturer's instructions.

2.4.5 Waste Management

Waste generated in the field during sample collection activities will be managed according to the waste management plan for the 300-FF-5 OU (DOE/RL-2000-56, 2000, *Waste Management Plan for the 300-FF-5 Operable Unit*). Typical waste materials include purge water from monitoring wells and aquifer tubes; rubber gloves, sample tubing, and inline filters; and unused sample material.

Table 2-4 Analytical Parameters and Methods

Analyte	Analysis Method	Required Quantitation Limit (μg/L or pCi/L)	Precision	Accuracy
Fluoride	Anions by Ion Chromatography EPA Method 300.0	500	±20%	80% to 120%
Chloride		200		
Nitrite		250		
Nitrate		250		
Sulfate		500		
Alkalinity	EPA Method 2320	5000	±20%	80% to 120%
Barium	Elements by ICP or ICP-MS EPA Method 6010, 6020 or 200.8	20	±20%	80% to 120%
Beryllium		5		
Cadmium		5		
Chromium		10		
Copper		10		
Iron		50		
Manganese		5		
Silver		10		
Zinc		10		
cis-1,2-Dichloroethene	EPA SW-846 Method 8260	5	±20%	80% to 120%
Trichloroethene		5		
Tetrachloroethene		5		
Vinyl Chloride		10		
Gross Alpha	EPA Method 9310	3	±30%	70% to 130%
Gross Beta		4		
Tritium	Liquid scintillation	400	±30%	70% to 130%
Stronium-90	Gas proportional counting	2	±30%	70% to 130%
Technetium-99	Liquid scintillation	15	±30%	70% to 130%
Uranium-isotopic	AEA	1	±30%	70% to 130%
Uranium-total (unfiltered)	EPA 200.8 or laser phosphorimetry	1	±20%	80% to 120%

NOTE: 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 performed for matrix spikes and surrogates as appropriate to the method. Precision criteria for batch laboratory replicate matrix spike sample analyses.
EPA = U.S. Environmental Protection Agency

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3.0 QUALITY ASSURANCE

The QAPjP establishes the quality requirements for environmental data collection, including sampling, field measurements, and laboratory analysis. The QAPjP complies with the requirements of the following:

- DOE O 414.1C, *Quality Assurance*
- 10 CFR 830.121, "Quality Assurance Program (QAP)"
- EPA/240/B-01/003, *EPA Requirements for Quality Assurance Project Plans EPA QA/R-5*.

The following subsections describe the quality requirements and controls that apply to all groundwater monitoring networks in the groundwater project, including the 300-FF-5 OU. Correlation between EPA QA/R-5 requirements and the information in this section are provided in Table 3-1.

Quality assurance requirements are implemented in accordance with CHPRC's Environmental Quality Assurance Program Plan. The QA program document describes how CHPRC implements the QA requirements conveyed in DOE O 414.1C and 10 CFR 830.120, "Nuclear Safety Management" and how the *Hanford Federal Facility Agreement and Consent Order* (Ecology et al. 1989) (Tri-Party Agreement) and Hanford Site internal laboratory QA requirements apply to CHPRC environmental QA program plans.

All work performed under this SAP will be performed in compliance with the CHPRC QA program plan, the CHPRC Groundwater Remediation Project plan, or subsequent and equivalent CHPRC quality program plans. Field sample collection and documentation activities will be performed in accordance with applicable CHPRC procedures, except as modified for certain non-routine procedures documented herein.

Table 3-1 Correlation between EPA QA/R-5 Requirements and the Sampling and Analysis Plan

EPA QA/R-5 Criteria	EPA QA/R-5 Title	Reference Section
Project Management	Project/Task Organization	3.1
	Problem Definition/Background	1.0
	Project/Task Description	2.0
	Quality Objectives and Criteria	3.2
	Special Training/Certification	3.3
	Documents and Records	3.4
Data Generation and Acquisition	Sampling Process Design	2.2, 3.5
	Sampling Methods	2.4.3, 3.5.1
	Sample Handling and Custody	2.4.2, 3.5.3
	Analytical Methods	2.4.4, 3.5.5
	Quality Control	3.5.6
	Instrument/Equipment Testing, Inspection, and Maintenance	3.5.7
	Instrument/Equipment Calibration and Frequency	3.5.8
	Inspection/Acceptance of Supplies and Consumables	3.5.9
	Non-direct Measurements	3.5.10
	Data Management	3.5.11
Assessment and Oversight	Assessments and Response Actions	3.6.1
	Reports to Management	3.6.2
Data Validation and Usability	Data Review, Verification, and Validation	3.7
	Verification and Validation Methods	3.7.1, 3.7.2
	Reconciliation with User Requirements	3.7.2

Note: EPA QA/R-5 Criteria can be found in EPA/240/B-01/003, *EPA Requirements for Quality Assurance Project Plans QA/R-5*, U.S. Environmental Protection Agency, Washington, D.C.

3.1 TASK ORGANIZATION

The project organization is described in the subsections that follow and is shown in Figure 3-1.

3.1.1 Groundwater 300 Area Project Manager

The Groundwater 300 Area project manager (PM) provides oversight for all activities and coordinates with U.S. Department of Energy, Richland Operations Office (RL) and the regulators in support of sampling activities.

3.1.2 Sampling Lead

The sampling lead is responsible for direct management of sampling documents and requirements, as well as field activities. The sampling lead ensures that the field team leader, samplers, and others responsible for implementation of this SAP are provided with current copies of this document and any revisions thereto. The sampling lead works closely with QA, Health and Safety, and the field team leaders to integrate these and the other lead disciplines in planning and implementing work.

3.1.3 Quality Assurance Engineer

The QA Engineer is responsible for QA issues on the project. Responsibilities include overseeing the implementation of project QA requirements, reviewing project documents (including SAPs [and the QAPjP]), and participating in QA assessments on sample collection and analysis activities, as appropriate. The QA Engineer reports to the CHPRC Quality Assurance Organization to maintain independence and is matrixed to the Soil and Groundwater Remediation Project.

3.1.4 Environmental Compliance Officer

The Environmental Compliance Officer works directly with the project manager to ensure that regulations and agreements are followed.

Other responsibilities include assistance in identifying and implementing the regulatory requirements.

3.1.5 Waste Management

The waste management lead communicates waste-handling policies and procedures and ensures project compliance for safe and effective storage, transportation, disposal, and tracking of waste.

Other responsibilities include identifying waste management sampling/characterization requirements to ensure regulatory compliance interpretation with WAC-173-303, "Dangerous Waste Regulations" and the applicable waste control plan.

3.1.6 Field Team Leader

The field team leader has the overall responsibility for the planning, coordination, and execution of field characterization activities. Specific responsibilities include converting the sampling design requirements into field task instructions that provide specific direction for field activities. Responsibilities also include directing training and practice sessions with field personnel to ensure that the sampling design is understood and can be performed as specified. The field team leader communicates with the sampling lead to identify field constraints that could affect the sampling design. In addition, the field team leader directs the procurement and installation of materials and equipment needed to support fieldwork.

The field team leader oversees field-sampling activities that include sample collection, packaging, provision of certified clean sampling bottles/containers, documentation of sampling activities in controlled logbooks, chain-of-custody documentation, and packaging and transportation of samples to the laboratory or shipping center.

The field team leader, field geologists, samplers, and others responsible for implementation of this SAP and the QAPjP will be provided with current copies of this document and any revisions thereto.

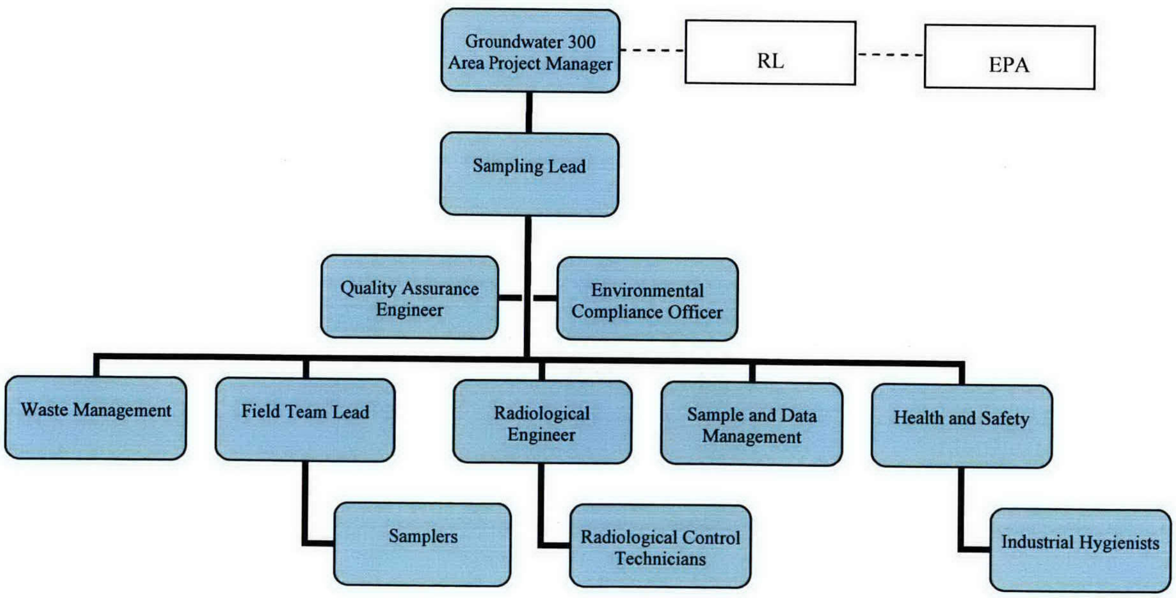
3.1.7 Radiological Engineering

The Radiological Engineering lead is responsible for the radiological engineering and health physics support within the project. Specific responsibilities include conducting as low as reasonably achievable reviews, conducting exposure and release modeling, and optimizing radiological controls for all planned work. In addition, radiological hazards are identified and appropriate controls are implemented to minimize worker exposure to radiological hazards. Radiological Engineering interfaces with the project Health and Safety representative and plans and directs radiological control technician support for all activities.

3.1.8 Sample and Data Management

The Sample and Data Management organization selects the laboratories that perform the analyses. This organization also ensures that the laboratories conform to Hanford Site internal laboratory QA requirements (or their equivalent), as approved by RL, EPA, and the Washington State Department of Ecology (Ecology). Sample and Data Management receives analytical data from the laboratories and enters the data into the HEIS database.

Figure 3-1 Task Organization



3.1.9 Health and Safety

The responsibilities of the Health and Safety organization include coordinating industrial safety and health support within the project as carried out through safety and health plans, job hazard analyses, and other pertinent safety documents required by Federal regulations or by internal CHPRC work requirements. In addition, assistance is provided to project personnel in complying with applicable health and safety standards and requirements. Personnel protective clothing requirements are coordinated with Radiological Engineering.

3.2 QUALITY OBJECTIVES AND CRITERIA FOR MEASUREMENT DATA

Laboratory analytical detection limits and the precision and accuracy requirements for each laboratory analysis to be performed are summarized in Section 2.4.4. A Data Quality Objectives (DQO) Summary Report is contained within the Operation and Maintenance Plan for the 300-FF-5 OU (DOE/RL-95-73).

3.3 SPECIAL TRAINING REQUIREMENTS AND CERTIFICATIONS

Training or certification requirements for sampling personnel shall be in accordance with the requirements specified in the Hanford Site internal laboratory QA requirements.

Field personnel will typically have completed the following training before starting work:

- Occupational Safety and Health (OS&H) Administration 40-Hour Hazardous Waste Worker Training
- Training Program (29 CFR 1910.120)
- 8-Hour Hazardous Waste Worker Refresher Training (as required)
- Hanford General Employee Training (HGET).

3.4 DOCUMENTATION AND RECORDS

The project task lead is responsible for ensuring that the field team leader, samplers, and others responsible for implementation of this SAP are provided with current copies of this document and any revisions thereto.

Field sampling and well site activity documentation will be performed in accordance with CHPRC procedures pertaining to the following:

- Notebooks and logbooks
- Groundwater sampling
- Calibration of field equipment
- Sampling documentation
- Chain-of-custody/sample analysis requests
- Sample packaging and shipping.

Laboratory analytical documentation will be in accordance with applicable Laboratory Statements of Work for sampling. Overall project documentation will be in accordance with the CHPRC procedures standards-based management system.

Analysis of the data will be published in the Hanford Site Annual Groundwater Report.

3.5 DATA AND MEASUREMENT ACQUISITION

The following subsections present the requirements for sampling methods, sample handling and custody, analytical methods, and field and laboratory QC. The requirements for instrument calibration and maintenance, supply inspections, and data management are also addressed.

3.5.1 Sampling Methods Requirements

Sampling associated with this SAP will be performed in accordance with established sampling practices and requirements pertaining to sample collection, collection equipment, and sample handling. The procedures to be implemented in the field shall be in accordance with those outlined in Hanford Site internal laboratory QA requirements and applicable CHPRC procedures for the sampling and documentation activities listed in Section 3.4 of this SAP.

The field team leader is responsible for ensuring that all field procedures are followed completely and that field personnel are adequately trained. The field team leader must document situations that may impair the usability of the samples and/or data in the field logbook or nonconformance report forms in accordance with internal corrective action procedures, as appropriate. The field team leader will note any deviations from the standard procedures for sample collection, COPCs, sample transport, or monitoring that occur.

3.5.2 Sample Identification

A sample and data-tracking database will be used to track the samples from the point of collection through the laboratory analysis process. The HEIS database is the repository for laboratory analytical results. The HEIS sample numbers will be issued to the sampling organization for this project, and the HEIS numbers are to be carried through the laboratory data-tracking system.

3.5.3 Sample Handling, Shipment, and Custody

All sample handling, labeling, shipping, and custody requirements will be performed in accordance the applicable CHPRC procedures pertaining to sample packaging and shipping and chain-of-custody/sample analysis requests. Sample custody will be maintained in accordance with existing Hanford Site protocols to ensure the maintenance of sample integrity throughout the analytical process. The custody of samples will be maintained from the time the samples are collected until the ultimate disposal of the samples, as appropriate. A chain-of-custody record will be initiated in the field at the time of sampling and will accompany each set of samples shipped to any laboratory. Shipping requirements will determine how sample shipping containers are prepared for shipment. The analyses requested for each sample will be indicated on the accompanying chain-of-custody form. Chain-of-custody procedures will be followed throughout sample collection, transfer, analysis, and disposal to ensure that sample integrity is maintained. Each time the responsibility changes for the custody of the sample the new and previous custodians will sign the record and note the date and time.

3.5.4 Sample Preservation, Containers, and Holding Times

Sample preservation, container, and holding-time requirements will be prepared for specific sample events as specified on the sampling authorization forms and chain-of-custody forms in accordance with the requirements specified in laboratory statement of work and the specific analytical method.

3.5.5 Analytical Method Requirements

Laboratory-specific standard operating procedures for analytical methods are described in the Hanford Site internal laboratory QA requirements. Table 2-4 lists the precision and accuracy requirements for the analysis methods. If the laboratory uses a nonstandard 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.

3.5.6 Quality Control Requirements

The QC procedures described in the Hanford Site internal laboratory QA requirements must be followed in the field and laboratory to ensure that reliable data are obtained. When performing the field sampling effort, care should be taken to prevent the cross-contamination of sampling equipment, sample bottles, and other equipment that could compromise sample integrity.

Samples including a duplicate, a split, and a daily field blank (where volatile organic analytes are collected) will be per batch of 20 samples. 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. Laboratory sample duplicates and/or matrix spike duplicates will be analyzed. The laboratory method blanks, laboratory control sample/blank spike, and matrix spike are defined in Chapter 1.0 of SW-846, *Test Methods for the Evaluation of Solid Waste: Physical/Chemical Methods*, and will be run at the frequency specified in that reference.

3.5.7 Instrument/Equipment Testing, Inspection, and Maintenance

All onsite environmental instruments shall be tested, inspected, and maintained in accordance with the manufacturer's specifications and CHPRC procedures pertaining to control and calibration of laboratory and field and monitoring instruments. The results from all testing, inspection, and maintenance activities shall be recorded in accordance with applicable CHPRC procedures. Evaluated and approved off site laboratories test, inspect and maintain instrumentation in accordance with their evaluated internal plans and procedures.

3.5.8 Instrument Calibration and Frequency

All onsite environmental instruments, laboratory and field, shall be calibrated in accordance with the manufacturer's specifications and CHPRC procedures pertaining to the following:

- Calibration requirements of field measurement equipment
- Control of monitoring instruments.

The results from all testing, inspection, and maintenance activities shall be recorded in accordance with applicable CHPRC procedures.

All instruments shall be calibrated with certified equipment or standards with a known valid relationship to a nationally recognized standard.

3.5.9 Inspection/Acceptance Requirements for Supplies and Consumables

Supplies and consumables procured by CHPRC that are used in support of sampling and analysis activities are procured in accordance with internal work requirements and processes that describe the CHPRC acquisition system and the responsibilities and interfaces necessary to ensure that structures, systems, and components, or other items and services procured/acquired for CHPRC meet the specific technical and quality requirements. The procurement process ensures that purchased items and services 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 laboratory's QA plan.

3.5.10 Non-Direct Measurements

Non-direct measurement sources such as computer databases, programs, and literature files were used during preparation of this report to assist with analytes for analysis.

3.5.11 Data Management

Data resulting from the implementation of this SAP shall be managed and stored in accordance with applicable programmatic requirements governing data management procedures. At the direction of the sampling lead, all analytical data packages shall be subject to final technical review by qualified personnel before the results are submitted to the regulatory agencies or before inclusion in reports. Electronic data access, when appropriate, shall be via a database (e.g., HEIS). Where electronic data are not available, hard copies shall be provided in accordance with Section 9.6 of the Tri-Party Agreement (Ecology et al. (1989).

Planning for sample collection and analysis shall be in accordance with the programmatic requirements governing fixed laboratory sample collection activities, as discussed in the sampling procedures. In the event that specific procedures do not exist for a particular task, or if additional guidance to complete certain tasks is needed, a work package will be developed to adequately control the activities. Examples of the sample teams' 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 and checklists
- Sample packaging and shipping Requirements associated with preparing and transporting regulated material.

Logbooks undergo routine independent review that is documented in the logbook.

Approved work control packages and procedures will be used to document radiological measurements when implementing this SAP. Examples of the types of documentation for field radiological data include the following:

- Instructions regarding the minimum requirements for documenting radiological controls information in accordance with 10 CFR 835, "Occupational Radiation Protection"
- Instructions for managing the identification, creation, review, approval, storage, transfer, and retrieval of Hanford Site 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 survey/sample plans

Data will be cross-referenced between laboratory analytical data and radiation measurements to facilitate interpretation of the investigation results.

3.6 ASSESSMENT AND OVERSIGHT

3.6.1 Assessments and Response Actions

The CHPRC Environmental Quality Assurance group 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.

Deficiencies identified during these assessments shall be reported to the project task lead. Appropriate, corrective actions will be taken by the project task lead in accordance with Hanford Site internal laboratory QA requirements to minimize recurrence.

3.6.2 Reports to Management

Management shall be made aware of all deficiencies identified by self-assessments and QA surveillance. Identified deficiencies shall be reported to the Groundwater 300 Area PM.

3.7 DATA REVIEW, VERIFICATION, AND USABILITY REQUIREMENTS

3.7.1 Data Verification and Usability Methods

Data review and verification are performed by the CHPRC Soil and Groundwater Remediation Project. Sample and Data Management organization to confirm that sampling and chain-of-custody documentation are complete. This review shall include tying sample numbers to specific sampling location, reviewing sample collection dates and sample preparation and analysis dates to assess whether or not holding times have been met, and reviewing QC data to determine whether analyses met the data quality requirements specified in this SAP.

All data verification and usability assessments shall be performed in accordance with Hanford Site internal laboratory QA requirements. These data will be accepted, rejected, or qualified.

3.7.2 Data Quality Assessment

The data quality assessment process compares completed field sampling activities to those proposed in corresponding sampling documents 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 project DQOs. The EPA data quality assessment process (Data Quality Assessment: A Reviewer's Guide EPA QA/G-9R [EPA/240/B-06/002], Data Quality Assessment: Statistical Methods for Practitioners EPA QA/G-9S [EPA/240/B-06/003]) identifies five steps for evaluating data generated from this project, as summarized below:

- Step 1 – Review the project objectives and sampling design: This step requires a comprehensive review of the sampling and analytical requirements outlined in the project-specific DQO workbook and SAP.
- Step 2 – Conduct a preliminary data review: In this step, a comparison is made between the actual QA/QC achieved (e.g., detection limits, precision, and accuracy) and the requirements determined during the DQO process. Any significant deviations will be documented. Basic statistics will be calculated from the analytical data at this point, as appropriate to the data set, including an evaluation of the distribution of the data and in accordance with the DQOs.
- Step 3 – Select the statistical test: Using the data evaluated in step 2, an appropriate statistical hypothesis test is selected and justified.
- Step 4 – Verify the assumptions: In this step, the validity of the data analyses is assessed by determining if the data support the underlying assumptions necessary for the analyses or if the data set must be modified (e.g., transposed or augmented with additional data) before further analysis. If one or more assumptions are questioned, step 3 is repeated.
- Step 5 – Draw conclusions from the data: The statistical test is applied in this step, and the results either reject the null hypothesis or fail to reject the null hypothesis. If the latter is true, the data should be analyzed further. If the null hypothesis is rejected, the overall performance of the sampling design should be evaluated by performing a statistical power calculation to assess the adequacy of the sampling design.

4.0 DATA INTERPRETATION AND REPORTING

This section describes how analytical results from sampling activities are interpreted relative to environmental conditions. Reporting activities are also described.

4.1 DATA INTERPRETATION

After analytical results are validated and verified, the data are used by project scientists to interpret groundwater conditions at the site or geographic interest area. Interpretive techniques include

- Hydrographs – graphs showing water levels as a function of time. Hydrographs are used to illustrate changes related to natural (e.g., seasonality) and/or human activity-related fluctuations in groundwater levels.
- Water-table elevation maps – maps showing contour lines of constant elevation that outline the shape of the water table surface. Because groundwater flow is generally directed perpendicular to the contour lines, the pattern of movement can be inferred from these maps.
- Concentration trend plots – graphs showing the concentrations of constituents as a function of time. Trend plots reveal changes in contaminant characteristics with time that may be related to waste disposal or cleanup activities; movement of groundwater; and seasonal changes in groundwater flow. Knowledge of concentration trends is needed to assess the reduction in contamination levels because of natural features and processes (natural attenuation).
- Plume maps – maps showing the concentrations of chemical or radiological constituents, either as values plotted at wells and/or as contour lines of constant concentration. Plume maps are used to illustrate areas where groundwater quality does not meet regulatory standards; how the level and extent of contamination are changing with time; and where contamination may be in proximity to sensitive habitat or resource use.
- Contaminant ratios – the ratios of various contamination indicators or other groundwater constituents can sometimes be used to distinguish between different sources for the contamination.

4.2 REPORTING

An internal record of each biweekly review is maintained by the project for the groundwater interest area. The status of key issues for each interest area is presented at monthly unit managers meetings. (Note: The level of detail presented at a unit managers meeting is per the preference of the managers for the particular OU.) Unusual or out of trend results for the 300-FF-5 OU will be summarized in informal reports to RL, which may be forwarded to the appropriate regulatory agency (e.g., reports via e-mail or presented at unit manager's meetings). A formal, interpretive groundwater report for the entire Hanford Site is prepared annually and publicly available by March of each year.

The most recent annual report for the 300-FF-5 OU is presented in DOE/RL-2008-01, which covers FY 2007 (October 2006 through September 2007). An additional expanded description of groundwater conditions for the 300-FF-5 OU was prepared during FY 2004 (PNNL-15127). This report was prepared to provide detailed information for use in the second five-year review of the 300-FF-5 ROD, and for the Phase III FS.

4.3 CHANGE CONTROL

Changes to sampling and analysis activities associated with the 300-FF-5 OU are documented according to the criteria shown in Table 4-1.

Table 4-1 Change Control for Groundwater Monitoring in the 300-FF-5 Operable Unit

Type of Change	Action	Documentation
Temporarily (≤1 year) adding constituents, wells, or increasing sampling frequency	Project management approval; notify regulator if appropriate	Project's schedule tracking system.
Permanently (>1 year) adding constituents, wells, or increasing sampling frequency	Revise SAP	Letter report documenting changes or revised plan.
Deleting constituents or wells; decreasing frequency	Obtain regulatory approval prior to change.	Initial approval may be verbal or e-mail. Formal approval via letter or signed meeting minutes.
Unavoidable changes (e.g., dry wells; delayed samples, one-time missed samples due to broken pump, lost bottle, etc.)	Notify regulator	Project's schedule tracking system; notification via letter, report, e-mail or meeting minutes.
Revision to SAP	Revise plan; obtain regulatory approval; distribute plan.	Revised plan.

5.0 HEALTH AND SAFETY

All personnel working at the sites addressed by this SAP will have completed, at a minimum, the following:

- OS&H Administration 40-Hour Hazardous Waste Worker Training
- Training Program (29 CFR 1910.120)
- 8-Hour Hazardous Waste Worker Refresher Training (as required)
- HGET

Work will be performed in accordance with the following policies, specifications, or procedures:

- Site-specific plans, as applicable
  - Health and safety plans
  - Radiological work permit, as applicable
  - Automated job hazard analysis
  - Site-specific waste packaging instruction
- Hanford nuclear facility implementing procedures
- Soil and Groundwater Remedial Project radiological control procedures
- CHPRC environmental procedures.

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6.0 REFERENCES

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APPENDIX A

SUMMARY OF GROUNDWATER/RIVER INTERFACE AND BIOTA MONITORING ALONG THE 300 AREA SHORELINE

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APPENDIX A

SUMMARY OF GROUNDWATER/RIVER INTERFACE AND BIOTA MONITORING ALONG THE 300 AREA SHORELINE

A.1 SOURCE AND GROUNDWATER COMPONENT OF THE RIVER CORRIDOR BASELINE RISK ASSESSMENT PROGRAM

The purpose for the Source and Groundwater Component (formerly the 100 Areas and 300 Area Component) of the River Corridor Baseline Risk Assessment (RCBRA) is to (a) fill data gaps associated with completing baseline human health and ecological risk assessments that represent the conditions subsequent to the implementation of the interim remedial actions in the River Corridor of the Hanford Site, and (b) use results to support risk management decision making for developing final records of decision (DOE/RL-2005-42, *100 Areas and 300 Area Component of the RCBRA Sampling and Analysis Plan*, pg. 1-1).

A detailed plan for collecting environmental data from the 300 Area shoreline is presented in DOE/RL-2005-42 and was developed using the U.S. Environmental Protection Agency (EPA)'s data quality objectives process (EPA/600/R-96/055, *Guidance for the Data Quality Objectives Process EPA QA/G-4*). Participants in the planning included the U.S. Department of Energy (DOE), EPA, Washington State Department of Ecology (Ecology), the Hanford Site Natural Resources Trustee Council, Native American Tribes, Hanford Site contractors, and other interested Stakeholders.

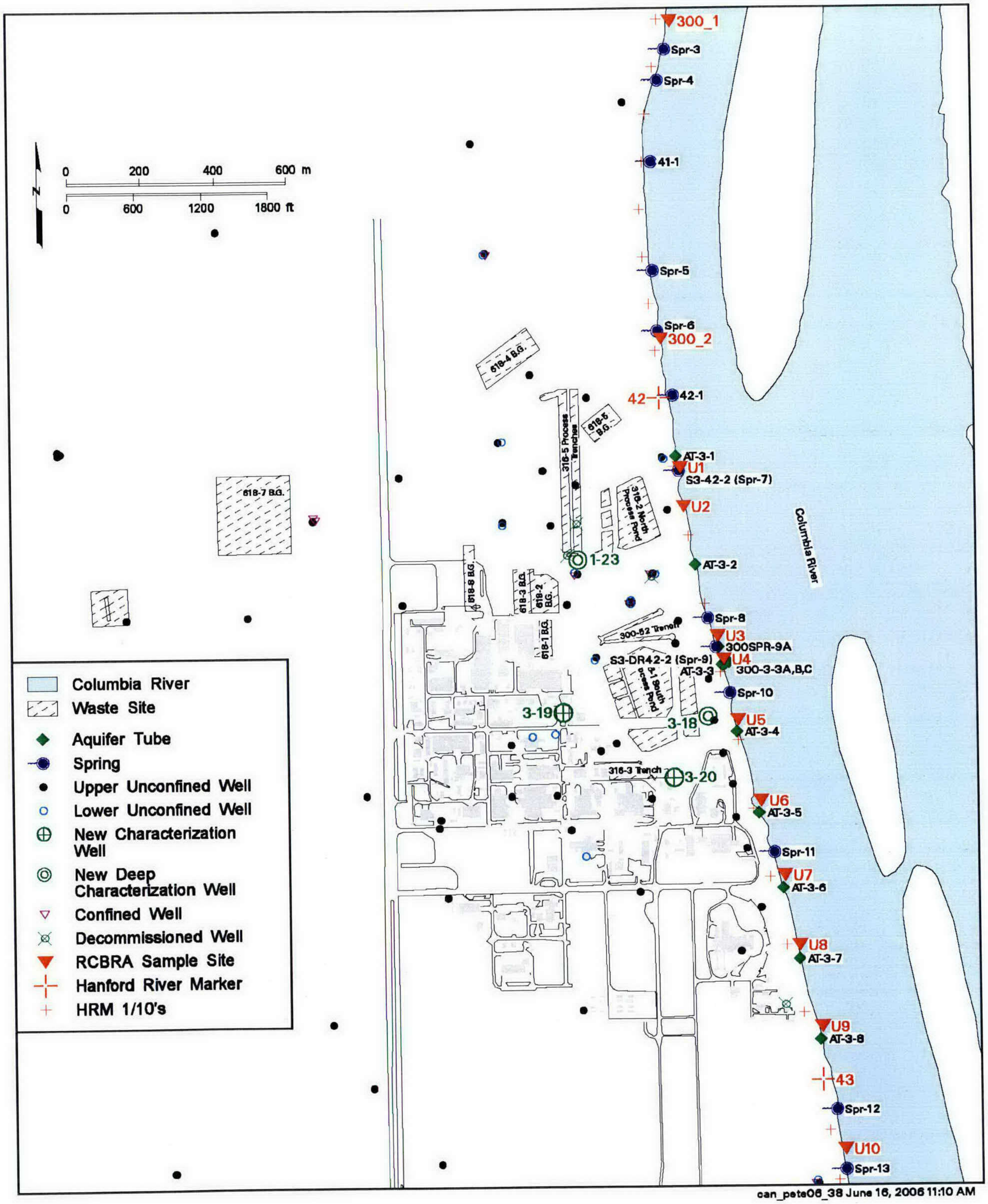
The portion of the RCBRA sampling and analysis plan that addresses the 300 Area shoreline is more comprehensive than the efforts described in the 300-FF-5 O&M Plan (DOE/RL-95-73, *Operation and Maintenance Plan for the 300-FF-5 Operable Unit*, pp. 5-5 to 5-7).

Two geographic zones containing sampling/study sites are defined for the shoreline (DOE/RL-2005-42, *100 Areas and 300 Area Component of the RCBRA Sampling and Analysis Plan)*:

- "Riparian Sites" are located along the river shoreline where various media (riverbank springs, groundwater, or soil) have the potential for exposing receptors to contaminants. This zone supports vegetation along the shoreline and is only occasionally submerged, i.e., during periods of high river stage. Sampling for soil and biota were conducted within this zone.
- "Near-shore Aquatic Sites" are located in the zone containing the frequently submerged sediment and cobble beach area, and the riverbed beyond the "green line" to a distance offshore where the water depth does not exceed ~1.8 meters. The green line is where periphyton remains green all year long; it represents a low-river stage reference marker. Sampling for sediment, pore water, surface water, and biota were conducted within this zone.

At the 300 Area, ten near-shore aquatic sites were characterized; two upstream reference near-shore aquatic sites were characterized; and one riparian site was characterized (Figure A-1).

Figure A-1 300 Area Sampling Sites Associated with the River Corridor Baseline Risk Assessment



(Note: U1 through U10 are Aquatic Sites; U3 is also Riparian Site #6; and 300_1 and 300_2 are Reference Locations.)

Detailed descriptions of the media that were sampled, which included water, sediment, and various biota are provided in the summary reports generated following completion of each sampling season in support of the RCBRA Source and Groundwater Component (WCH-085, *100 Area and 300 Area Component of the RCBRA Fall 2005 Data Compilation*; WCH-139, *100 Area and 300 Area Component of the River Corridor Baseline Risk Assessment Spring 2006 Data Compilation*, WCH-274, *Inter-Areas Component of the River Corridor Baseline Risk Assessment Sampling Summary*). Analytical information for the RCBRA sampling activities is detailed in the RCBRA SAP (DOE/RL-2005-42).

The scheduled sampling activities for the RCBRA Source and Groundwater Component concluded in 2007.

A.2 PUBLIC SAFETY AND RESOURCE PROTECTION PROGRAM, SURFACE ENVIRONMENTAL SURVEILLANCE PROJECT

Monitoring under this program is conducted to evaluate levels of radioactive and non-radioactive pollutants in the Hanford Site environment, as required by DOE O 450.1, *Environmental Protection Program*. The sampling design is described in the Hanford Site's DOE/RL-91-50, *Environmental Monitoring Plan*. Extensive co-sampling by the Washington State Department of Health is conducted.

The sampling and analysis schedule for each planning year is described in PNNL-17282, *Hanford Site Environmental Surveillance Master Sampling Schedule for Calendar Year 2006*. The results of sampling and analysis are published in the annual "Hanford Site Environmental Report" (PNNL-16623, *Hanford Site Environmental Report for Calendar Year 2006*).

Along the 300 Area for 2008, the Surface Environmental Surveillance Project (SESP) collects samples of (a) river water along the shore and at a transect that crosses the river, (b) riverbank springs, (c) sediment associated with springs, and (d) various biota. (Note: Locations of sampling sites can be estimated using Figure A.1, by reference to the Hanford River Marker [HRM] system.)

River water sampling is conducted according to the following guidelines:

- Annually, along a transect that crosses the river just downstream of the 300 Area, at HRM 43.1
  - For tritium (low level), strontium-90, uranium, major anions, and metals (filtered and unfiltered samples).
- Near-shore samples along the 300 Area shoreline at HRM's 41.5, 42.1, 42.4, 42.8, and 42.9.
  - (Same list of analyses as for cross-river transect).

Riverbank spring water and sediment sampling is conducted according to the following guidelines:

- Annually in the late summer/early fall, at four riverbank spring locations (HRM's 41.9, 42.1, 42.4, and 42.7). Note: spring water frequently is a mixture of groundwater and river water that has infiltrated the riverbank.

  - Water: For gross alpha/beta, tritium, strontium-90, uranium, iodine-129, gamma scan, major anions, major metals (filtered and unfiltered, including mercury), and volatile organic compounds.
  - Sediment: For gamma scan, strontium-90, uranium, and major metals, including mercury.

Biota sampling is conducted according to the following guidelines:

- Carp from the 300 Area shoreline are collected once every two years during spring/early summer (2008 is a collection year); bass are collected once every three years (2009 is the next planned sampling); samples of fillet, carcass, and liver are analyzed for contamination.
  - For gamma scan, strontium-90, uranium, and major metals, including mercury
- Canada geese are collected once every two years, with samples of muscle, bone, and liver analyzed for contamination.
  - For gamma scan, strontium-90, and major metals, including mercury.
- Soil samples are collected from locations north and south of the 300 Area every 3 to 5 years, with the next sampling scheduled for 2009.
  - For gamma scan, strontium-90, uranium, and plutonium.
- Vegetation from the 300 Area shoreline is collected and analyzed every three to five years, with the next sampling scheduled for 2007.
  - For gamma scan, strontium-90, uranium, and plutonium.

A.3 OTHER ACTIVITIES IN PROGRESS ALONG THE 300 AREA SHORELINE

The DOE's Remedial Action and Closure Science program has supported a detailed field investigation of the groundwater/river interface (hyporheic zone) at a 300 Area shoreline site since 2004, and that project was concluded in 2007 (PNNL-16805, *Investigation of the Hyporheic Zone at the 300 Area, Hanford Site*). Objectives included;

- evaluating the effects of river stage on groundwater chemistry in the zone of groundwater/river interaction,
- developing estimates for the extent of contaminant discharge across the groundwater river/interface and estimates for mass flux (uranium is the focus),
- developing methods to characterize the dilution of contamination in groundwater as a consequence of infiltrating river water, and
- obtaining data for improving the characterization of aquifer hydraulic properties, in support of computer simulation of groundwater flow and contaminant transport.

Methods employed during this investigation include installation of water sampling devices of various designs that are intended to produce representative samples from the zone of interaction; high frequency sampling to define the variability created by river stage fluctuations; and developing new techniques to estimate groundwater discharge across the interface.

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APPENDIX B

WELLS AND AQUIFER TUBE SITES WHERE MAXIMUM CONTAMINANT LEVEL STANDARDS ARE EXCEEDED DURING 2004 THROUGH 2007 (HEIS QUERY DATE RANGE JANUARY 1, 2004, TO FEBRUARY 14, 2008)

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Table B-1 300 Area Locations Where Maximum Contaminant Levels in Groundwater are Exceeded

Well/Tube Name	Contamination Indicator (COCs in bold)	Filt?	Date Range: January 2004 through February 2008						MCL[b]	No. of Samples Exceeding MCL
			No. of Results	No. of Detects	No. of Excludes[a]	Minimum Value	Maximum Value	Average Value		
300 Area Wells: Upper Portion of Unconfined Aquifer (TU)										
399-1-1	Gross alpha (pCi/L)	N	3	3	0	15	28	22	15	2
399-1-2	Gross alpha (pCi/L)	N	6	5	0	2	24	8	15	1
399-1-7	Gross alpha (pCi/L)	N	1	1	0	55	55	55	15	1
399-1-10A	Gross alpha (pCi/L)	N	3	3	0	16	21	18	15	3
399-1-12	Gross alpha (pCi/L)	N	2	2	0	11	18	14	15	1
399-1-16A	Gross alpha (pCi/L)	N	4	4	0	4	45	24	15	2
399-1-17A	Gross alpha (pCi/L)	N	7	7	0	10	74	36	15	6
399-1-21A	Gross alpha (pCi/L)	N	4	4	0	12	24	15	15	1
399-1-23	Gross alpha (pCi/L)	N	5	5	0	12	48	31	15	4
399-2-1	Gross alpha (pCi/L)	N	3	3	0	31	60	45	15	3
399-2-2	Gross alpha (pCi/L)	N	2	2	0	79	83	81	15	2
399-2-5	Gross alpha (pCi/L)	N	7	2	0	15	17	16	15	2
399-2-5	Gross alpha (pCi/L)	Y	1	1	0	28	28	28	15	1
399-3-1	Gross alpha (pCi/L)	N	2	2	0	24	61	43	15	2
399-3-9	Gross alpha (pCi/L)	N	2	2	0	44	96	70	15	2
399-3-10	Gross alpha (pCi/L)	N	2	2	0	24	87	56	15	2
399-3-11	Gross alpha (pCi/L)	N	8	8	0	22	66	38	15	8
399-3-18	Gross alpha (pCi/L)	N	5	5	0	20	80	41	15	5
399-3-19	Gross alpha (pCi/L)	N	6	6	0	6	42	18	15	4
399-3-20	Gross alpha (pCi/L)	N	7	7	0	31	67	44	15	7
399-4-7	Gross alpha (pCi/L)	N	2	2	0	28	43	35	15	2
399-4-9	Gross alpha (pCi/L)	N	2	2	0	43	44	44	15	2
399-4-10	Gross alpha (pCi/L)	N	2	2	0	44	45	44	15	2

Table B-1 300 Area Locations Where Maximum Contaminant Levels in Groundwater are Exceeded

Well/Tube Name	Contamination Indicator (COCs in bold)	Filt?	Date Range: January 2004 through February 2008						MCL[b]	No. of Samples Exceeding MCL
			No. of Results	No. of Detects	No. of Excludes[a]	Minimum Value	Maximum Value	Average Value		
399-4-14	Gross alpha (pCi/L)	N	6	4	0	14	31	26	15	3
399-1-17A	Gross beta (pCi/L)	N	7	7	0	23	50	30	50	1
399-2-2	Gross beta (pCi/L)	N	2	2	0	49	61	55	50	1
399-3-10	Gross beta (pCi/L)	N	2	2	0	17	63	40	50	1
399-3-18	Gross beta (pCi/L)	N	5	5	0	11	51	30	50	1
399-5-1	Nitrate (ug/L)	N	2	2	0	99,200	133,000	116,100	45,000	2
399-5-4B	Nitrate (ug/L)	N	3	3	0	31,900	67,700	55,767	45,000	2
699-S27-E12A	Nitrate (ug/L)	N	4	4	0	129,000	158,000	138,500	45,000	4
699-S27-E14	Nitrate (ug/L)	N	9	9	0	62,400	94,700	74,944	45,000	9
699-S28-E13A	Nitrate (ug/L)	N	5	5	0	85,400	107,000	97,520	45,000	5
699-S29-E12	Nitrate (ug/L)	N	3	3	0	89,400	117,000	99,033	45,000	3
699-S29-E13A	Nitrate (ug/L)	N	4	4	0	76,100	101,000	85,225	45,000	4
699-S29-E16A	Nitrate (ug/L)	N	4	4	0	66,000	82,300	72,700	45,000	4
699-S30-E15A	Nitrate (ug/L)	N	3	3	0	72,600	80,600	76,433	45,000	3
399-3-20	**Tetrachloroethene (ug/L)**	N	11	1	0	10	10	10	5	1
399-1-7	**Trichloroethene (ug/L)**	N	9	9	0	0	5	2	5	1
399-1-1	**Uranium (ug/L)**	N	7	7	0	14	66	41	20	6
399-1-2	**Uranium (ug/L)**	N	7	7	0	8	57	20	20	2
399-1-7	**Uranium (ug/L)**	N	9	9	0	46	111	69	20	9
399-1-10A	**Uranium (ug/L)**	N	34	34	0	17	70	47	20	33
399-1-11	**Uranium (ug/L)**	N	10	10	0	8	60	17	20	2
399-1-12	**Uranium (ug/L)**	N	7	7	0	14	37	22	20	4
399-1-16A	**Uranium (ug/L)**	N	34	34	0	12	88	61	20	33
399-1-17A	**Uranium (ug/L)**	N	36	36	0	31	155	66	20	36

Table B-1 300 Area Locations Where Maximum Contaminant Levels in Groundwater are Exceeded

Well/Tube Name	Contamination Indicator (COCs in bold)	Filt?	Date Range: January 2004 through February 2008						MCL[b]	No. of Samples Exceeding MCL
			No. of Results	No. of Detects	No. of Excludes[a]	Minimum Value	Maximum Value	Average Value		
399-1-21A	**Uranium (ug/L)**	N	11	11	0	18	97	44	20	10
399-1-23	**Uranium (ug/L)**	N	5	5	0	18	111	68	20	4
399-2-1	**Uranium (ug/L)**	N	9	9	0	21	152	86	20	9
399-2-2	**Uranium (ug/L)**	N	7	7	0	24	166	107	20	7
399-2-5	**Uranium (ug/L)**	N	7	6	0	0	40	14	20	2
399-2-5	**Uranium (ug/L)**	Y	1	1	0	70	70	70	20	1
399-3-1	**Uranium (ug/L)**	N	6	6	0	27	134	97	20	6
399-3-6	**Uranium (ug/L)**	N	8	8	0	11	43	20	20	2
399-3-9	**Uranium (ug/L)**	N	5	5	0	46	191	114	20	5
399-3-10	**Uranium (ug/L)**	N	9	9	0	37	218	105	20	9
399-3-11	**Uranium (ug/L)**	N	11	11	0	27	121	77	20	11
399-3-12	**Uranium (ug/L)**	N	7	7	0	16	97	36	20	6
399-3-18	**Uranium (ug/L)**	N	8	8	0	43	145	108	20	8
399-3-19	**Uranium (ug/L)**	N	6	6	0	11	79	35	20	4
399-3-20	**Uranium (ug/L)**	N	7	7	0	64	148	89	20	7
399-4-1	**Uranium (ug/L)**	N	7	7	0	15	29	19	20	2
399-4-7	**Uranium (ug/L)**	N	3	3	0	65	68	66	20	3
399-4-9	**Uranium (ug/L)**	N	7	7	0	33	95	73	20	7
399-4-10	**Uranium (ug/L)**	N	6	6	0	77	105	89	20	6
399-4-12	**Uranium (ug/L)**	N	13	13	0	12	30	22	20	8
399-4-14	**Uranium (ug/L)**	N	6	6	0	0	57	30	20	4
399-4-14	**Uranium (ug/L)**	Y	3	3	0	0	24	8	20	1
300 Area Wells: Lower Portion of Unconfined Aquifer (LU)										
399-1-16B	**Dichloroethene (ug/L)[c]**	N	35	35	0	95	280	162	70	35

Table B-1 300 Area Locations Where Maximum Contaminant Levels in Groundwater are Exceeded

Well/Tube Name	Contamination Indicator (COCs in bold)	Filt?	Date Range: January 2004 through February 2008						MCL[b]	No. of Samples Exceeding MCL
			No. of Results	No. of Detects	No. of Excludes[a]	Minimum Value	Maximum Value	Average Value		
399-1-8	Gross alpha (pCi/L)	N	2	2	0	1	25	13	15	1
399-3-21	Gross alpha (pCi/L)	N	9	2	0	21	27	24	15	2
399-3-21	Tetrachloroethene (ug/L)	N	9	2	0	7	7	7	5	2
399-3-21	**Trichloroethene (ug/L)**	N	9	4	0	19	580	294	5	4
399-1-8	**Uranium (ug/L)**	N	9	9	0	0	53	12	20	1
399-3-21	**Uranium (ug/L)**	N	7	7	0	0	56	8	20	1
300 Area Wells: Uppermost Confined Aquifer (C)--No exceedances in wells that monitor this aquifer										
300 Area Shoreline–Aquifer Tubes: Upper Portion of Unconfined Aquifer (TU)										
AT-3-1-M	Gross alpha (pCi/L)	N	1	1	0	31	31	31	15	1
AT-3-2-M	Gross alpha (pCi/L)	N	1	1	0	20	20	20	15	1
AT-3-3-M	Gross alpha (pCi/L)	N	7	7	0	26	114	67	15	7
AT-3-3-S	Gross alpha (pCi/L)	N	5	5	0	26	154	87	15	5
AT-3-4-D	Gross alpha (pCi/L)	Y	1	1	0	31	31	31	15	1
AT-3-5-S	Gross alpha (pCi/L)	Y	1	1	0	29	29	29	15	1
AT-3-6-M	Gross alpha (pCi/L)	N	1	1	0	48	48	48	15	1
AT-3-7-M	Nitrate (ug/L)	N	6	6	0	20,400	54,000	37,417	45,000	3
AT-3-8-M	Nitrate (ug/L)	N	2	2	0	30,100	52,200	41,150	45,000	1
AT-3-8-S	Nitrate (ug/L)	N	4	4	0	31,100	67,300	46,175	45,000	2
AT-3-3-D	**Trichloroethene (ug/L)**	N	3	3	0	96	450	279	5	3
AT-3-3-M	**Trichloroethene (ug/L)**	N	8	5	0	1	7	3	5	1
AT-3-4-D	**Trichloroethene (ug/L)**	N	4	4	0	4	9	6	5	2
AT-3-4-M	**Trichloroethene (ug/L)**	N	1	1	0	8	8	8	5	1
AT-3-4-M	**Trichloroethene (ug/L)**	Y	1	1	0	28	28	28	5	1
AT-3-7-D	**Trichloroethene (ug/L)**	N	2	2	0	57	96	77	5	2

Table B-1 300 Area Locations Where Maximum Contaminant Levels in Groundwater are Exceeded

Well/Tube Name	Contamination Indicator (COCs in bold)	Filt?	Date Range: January 2004 through February 2008						MCL[b]	No. of Samples Exceeding MCL
			No. of Results	No. of Detects	No. of Excludes[a]	Minimum Value	Maximum Value	Average Value		
AT-3-1-D(1)	**Uranium (ug/L)**	N	9	9	0	56	93	70	20	9
AT-3-1-D(1)	**Uranium (ug/L)**	Y	1	1	0	82	82	82	20	1
AT-3-1-M	**Uranium (ug/L)**	N	11	11	0	59	100	80	20	11
AT-3-1-M	**Uranium (ug/L)**	Y	2	2	0	64	77	70	20	2
AT-3-1-S	**Uranium (ug/L)**	N	10	10	0	49	87	64	20	10
AT-3-1-S	**Uranium (ug/L)**	Y	1	1	0	60	60	60	20	1
AT-3-2-M	**Uranium (ug/L)**	N	8	8	0	38	95	67	20	8
AT-3-2-M	**Uranium (ug/L)**	Y	2	2	0	39	76	58	20	2
AT-3-2-S	**Uranium (ug/L)**	N	7	7	0	36	97	58	20	7
AT-3-2-S	**Uranium (ug/L)**	Y	1	1	0	58	58	58	20	1
AT-3-3-M	**Uranium (ug/L)**	N	14	14	0	51	177	126	20	14
AT-3-3-M	**Uranium (ug/L)**	Y	7	7	0	70	183	137	20	7
AT-3-3-S	**Uranium (ug/L)**	N	11	10	1	42	180	126	20	10
AT-3-3-S	**Uranium (ug/L)**	Y	6	6	0	88	195	142	20	6
AT-3-4-D	**Uranium (ug/L)**	N	9	9	0	59	157	106	20	9
AT-3-4-D	**Uranium (ug/L)**	Y	2	2	0	55	126	90	20	2
AT-3-4-M	**Uranium (ug/L)**	N	7	7	0	3	126	68	20	6
AT-3-4-S	**Uranium (ug/L)**	N	10	10	0	65	241	144	20	10
AT-3-4-S	**Uranium (ug/L)**	Y	3	3	0	42	161	109	20	3
AT-3-5-S	**Uranium (ug/L)**	N	9	9	0	28	88	49	20	9
AT-3-5-S	**Uranium (ug/L)**	Y	1	1	0	42	42	42	20	1
AT-3-6-M	**Uranium (ug/L)**	N	6	6	0	63	111	89	20	6
AT-3-6-M	**Uranium (ug/L)**	Y	1	1	0	80	80	80	20	1
AT-3-6-S	**Uranium (ug/L)**	N	7	7	0	18	85	57	20	6

Table B-1 300 Area Locations Where Maximum Contaminant Levels in Groundwater are Exceeded

Well/Tube Name	Contamination Indicator (COCs in bold)	Filt?	Date Range: January 2004 through February 2008						MCL[b]	No. of Samples Exceeding MCL
			No. of Results	No. of Detects	No. of Excludes[a]	Minimum Value	Maximum Value	Average Value		
AT-3-6-S	**Uranium (ug/L)**	Y	1	1	0	56	56	56	20	1
AT-3-7-M	**Uranium (ug/L)**	N	9	9	0	9	21	17	20	2
AT-3-7-S	**Uranium (ug/L)**	N	5	5	0	3	23	10	20	1
AT-3-8-M	**Uranium (ug/L)**	N	5	5	0	9	21	15	20	1

(a) "Excludes" refers to outlier results, i.e., not considered representative of aquifer conditions.
(b) "MCL" refers to maximum contaminant level, normally the value associated with standard for drinking water sources.
(c) Form of dichloroethene is cis-1,2-dichloroethene.
Data Source: Hanford Environmental Information System (HEIS), queried for the period January 1, 2004 through February 14, 2008.
Summary statistics prepared using PNNL's Data Visualization and Evaluator (DaVE) interface with HEIS.

Table B-2 618-11 Subregion Locations Where Maximum Contaminant Levels in Groundwater are Exceeded

Well/Tube Name	Contamination Indicator (COCs in bold)	Filt?	Date Range: January 2004 through February 2008						MCL[b]	No. of Samples Exceeding MCL
			No. of Results	No. of Detects	No. of Excludes[a]	Minimum Value	Maximum Value	Average Value		
618-11 Subregion Wells: Upper Portion of Unconfined Aquifer (TU)										
699-12-2C	Gross beta (pCi/L)	N	16	16	0	55	86	67	50	16
699-12-2C	Nitrate (ug/L)	N	8	8	0	53,600	111,000	79,400	45,000	8
699-13-1E	Nitrate (ug/L)	N	7	7	0	46,500	59,800	50,729	45,000	7
699-13-2D	Nitrate (ug/L)	N	8	8	0	46,500	63,700	51,500	45,000	8
699-13-3A	Nitrate (ug/L)	N	8	8	0	65,100	101,000	78,263	45,000	8
699-12-2C	**Tritium (pCi/L)**	N	16	16	0	240,000	409,000	347,313	20,000	16
699-13-0A	**Tritium (pCi/L)**	N	15	15	0	26,700	54,600	41,960	20,000	15
699-13-1A	**Tritium (pCi/L)**	N	2	2	0	110,000	139,000	124,500	20,000	2
699-13-1E	**Tritium (pCi/L)**	N	15	15	0	152,000	306,000	210,800	20,000	15
699-13-2D	**Tritium (pCi/L)**	N	16	16	0	408,000	677,000	515,125	20,000	16
699-13-3A	**Tritium (pCi/L)**	N	17	17	0	850,000	2,320,000	1,489,176	20,000	17

(a) "Excludes" refers to outlier results, i.e., not considered representative of aquifer conditions.
(b) "MCL" refers to maximum contaminant level, normally the value associated with standard for drinking water sources.
Data Source: Hanford Environmental Information System (HEIS), queried for the period January 1, 2004 through February 14, 2008.
Summary statistics prepared using PNNL's Data Visualization and Evaluator (DaVE) interface with HEIS.

Table B-3. 618-10/316-4 Subregion Locations Where Maximum Contaminant Levels in Groundwater are Exceeded.

Well/Tube Name	Contamination Indicator (COCs in bold)	Filt?	Date Range: January 2004 through February 2008						MCL[b]	No. of Samples Exceeding MCL
			No. of Results	No. of Detects	No. of Excludes[a]	Minimum Value	Maximum Value	Average Value		
618-10/316-4 Subregion Wells: Upper Portion of Unconfined Aquifer (TU)										
699-S6-E4A	Gross alpha (pCi/L)	N	19	19	0	3	26	10	15	2
699-S6-E4L	Gross alpha (pCi/L)	N	22	21	1	2	25	14	15	7
699-S6-E4L	Nitrate (ug/L)	N	22	22	0	41,600	65,500	46,986	45,000	12
699-S6-E4A	**Uranium (ug/L)**	N	19	19	0	11	42	23	20	7
699-S6-E4L	**Uranium (ug/L)**	N	22	22	0	18	36	29	20	17

(a) "Excludes" refers to outlier results, i.e., not considered representative of aquifer conditions.
(b) "MCL" refers to maximum contaminant level, normally the value associated with standard for drinking water sources.
Data Source: Hanford Environmental Information System (HEIS), queried for the period January 1, 2004 through February 14, 2008.
Summary statistics prepared using PNNL's Data Visualization and Evaluator (DaVE) interface with HEIS.

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