DOE/ID-10131

U.S. Department of Energy
Idaho Operations Office

HWMA/RCRA POST-CLOSURE PERMIT REAPPLICATION FOR THE IDAHO NUCLEAR TECHNOLOGY AND ENGINEERING CENTER ON THE IDAHO NATIONAL LABORATORY

Volume 21 – Waste Calcine Facility CPP-601/627/640

EPA ID NO. ID4890008952

Revision 1 - September 2013

Book 1 of 1

Idaho Cleanup Project

ATTACHMENT 1

ATTACHMENT 1 FACILITY DESCRIPTION and MAPS of Facility Locations consisting of:

- Introduction of the INTEC Post-Closure Permit Reapplication for the Volume 21 Waste Calcine Facility and CPP-601/627/640

- Part A Permit Application of the INTEC Post-Closure Permit Reapplication for the Volume 21 Waste Calcine Facility and CPP-601/627/640

- Facility Description, Section A of the INTEC Post-Closure Permit Reapplication for the Volume 21 Waste Calcine Facility and CPP-601/627/640

- Facility Location Information, Section F of the INTEC Post-Closure Permit Reapplication for the Volume 21 Waste Calcine Facility and CPP-601/627/640

- Description of Topographic Maps, Section I, and Waste Calcine Facility and CPP-601/627/640 Topographic Map of the INTEC Post-Closure Permit Reapplication for the Volume 21 Waste Calcine Facility and CPP-601/627/640

- Waste Calcine Facility and CPP-601/627/640 Closure Plans of the INTEC Post-Closure Permit Reapplication for the Volume 21 Waste Calcine Facility and CPP-601/627/640

- Required Notices of the INTEC Post-Closure Permit Reapplication for the Volume 21 Waste Calcine Facility and CPP-601/627/640

ATTACHMENT 1 - INTRODUCTION

HWMA/RCRA INTEC POST-CLOSURE PERMIT REAPPLICATION

Volume 21
Waste Calcine Facility and CPP-601/627/640

Attachment 1
Introduction

April 2013

Hazardous Waste Management Act/Resource Conservation and Recovery Act INTEC Post-Closure Permit Reapplication

INTRODUCTION

This Hazardous Waste Management Act/Resource Conservation and Recovery Act Post-Closure Part B Permit Reapplication is for the Waste Calcine Facility and CPP-601/627/640, located at the Idaho Nuclear Technology and Engineering Center (INTEC) of the U.S. Department of Energy's Idaho National Laboratory (INL). The Department of Energy employs a variety of contractors to operate the Idaho National Laboratory's numerous facilities and operations. This permit reapplication consists of the following sections:

Attachment 1

- Introduction
- Part A Permit Application
- Facility Description
- Facility Location Information
- Topographic Map
- Closure Plans:
  - Waste Calcining Facility (INEEL-96/0189, Rev. 2)
  - CPP-601/627/640 Landfill and Phase 1 (DOE/ID-11408, Rev1)
  - CPP-601/627/640 Landfill Phase 2 (DOE/ID-11431, Rev. 2)
  - CPP-601 Deep Tanks System – Phase 1 (DOE/ID-11376, Rev. 2)
- Required Notices for CPP-633 and CPP-601/627/640

Attachment 2

- Security Procedures and Equipment
- Preparedness and Prevention Waiver
- General and Specific Inspection Schedule
- Maintenance Activities
- Examples of Inspection Forms
- Examples of Sampling and Analysis Plan Tables

Attachment 3

Section J Additional Information - Summary of Groundwater Monitoring Data Collected Under Interim Status and:

Appendix J-1. Statistical Analysis of Perched Groundwater Monitoring Data for the Waste Calcining Facility (RPT-1013, Rev. 3 – August 2010)

Appendix J-2. Statistical Analysis of Perched Groundwater Monitoring Data for the CPP-601/627/640 Facility (RPT-2126-33-001, Rev. 0 – April 2012

Geologic and Hydrogeologic Characterization of the INEEL at INTEC

U.S. EPA Region 9 Preliminary Remediation Goals User Guide 2002

Attachment 4

Permit Modification Log and Page Change-Out List

Attachment 5

INTEC Monitoring Wells – Map

INTEC Monitoring Wells – Construction Diagrams

Attachment 6

Monitoring Results

Attachment 7

Certification

BACKGROUND

The Waste Calcine Facility (WCF) is located within the Idaho Nuclear Technology and Engineering Center (INTEC) at the Department of Energy's Idaho National Laboratory (INL) Site. The WCF was used to calcine and evaporate aqueous wastes generated from the reprocessing of spent nuclear fuel (SNF). The WCF calciner operated from 1963 through 1981 and the evaporator system operated from 1983 until 1987. The WCF was closed under an approved Hazardous Waste Management Act (HWMA) closure plan. The WCF was closed with waste in place and covered with a low permeability concrete cap meeting the closure performance standards of Idaho Administrative Procedures Act (IDAPA) 58.01.05.009 [40 Code of Federal Regulations (CFR) §§ 265.111 and

265.310(a)]. The Idaho Department of Environmental Quality (DEQ)[1] approved the closure certification on November 2, 1999.

The CPP-601/627/640 Facility is located at the INTEC on the INL Site. The CPP-601/627/640 facility was part of the spent fuel reprocessing complex at the INTEC, which was used to recover enriched uranium for reuse. The facility included separation, chemical makeup and transfer, and liquid waste receiving processes in the waste collection system. The uranium processing mission for the facility started in mid-1950 and was terminated in 1992.

CPP-601/627/640 was closed under approved HWMA/RCRA closure plans. CPP-601/627/640 was closed with waste in place and covered with a low permeability concrete cap meeting the closure performance standards of IDAPA 58.01.05.008 [40 CFR §§ 264.111 and 264.310]. The DEQ determined that the Deep Tank System Landfill Closure – Phase 1 was completed in accordance with the approved closure plan, and the closure was approved by the DEQ on February 19, 2010. Therefore, the HWMA/RCRA Post-Closure Plan for the CPP-601/627/640 Landfill became effective on February 19, 2010, and groundwater monitoring began in April 2010. The HWMA/RCRA Post-Closure Plan CPP-601/627/640 Landfill – Phase 2 was approved by the DEQ on September 30, 2010.

Regulatory Background

In accordance with IDAPA 58.01.05.012 [40 CFR § 270.1(c)], owners and operators of landfills that certify closure after July 26, 1982, must 1) have post-closure permits, 2) demonstrate closure by removal, or 3) receive enforceable documents in lieu of post-closure permits.

HWMA/RCRA Requirements

The approved HWMA Closure Plan for the Waste Calcine Facility at the Idaho National Laboratory (referred to as the HWMA WCF Closure Plan), dated June 1997, indicated that the post-closure requirements of the WCF would be integrated with the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) post-Record of Decision (ROD) requirements and managed under the CERCLA program. The DEQ approved this provision to eliminate

[1] On July 1, 2000, the Division of Environmental Quality, a division of the Idaho Department of Health and Welfare, was elevated to the Idaho Department of Environmental Quality.

duplication of effort between the HWMA/RCRA and CERCLA programs and to minimize long-term maintenance costs.

In the November 2, 1999, approval of the WCF closure certification, DEQ restated that the HWMA/RCRA post-closure requirements would be addressed as applicable or relevant and appropriate requirements under the post-ROD monitoring plan. The DEQ also required that, in the interim, INL submit a plan addressing the cap maintenance and groundwater monitoring requirements of IDAPA 58.01.05.009 [40 CFR § 265.310(b)]. Between February 1, 2000, and December 8, 2000, INL submitted a revised interim post-closure plan and groundwater monitoring proposal. On February 13, 2001, DEQ rejected the interim WCF post-closure monitoring plan and indicated that allowing INL to address the post-closure monitoring requirements under the pending Federal Facilities Agreement and Consent Order (FFA/CO) actions at INTEC had not yielded the desired results. DEQ then requested submittal of a Part B permit application for post-closure care at the WCF. Therefore, language in the approved HWMA WCF Closure Plan allowing post-closure care under the FFA/CO was superceded and the requirements for post-closure care are performed in accordance with the HWMA/RCRA post-closure permit issued with an effective date of October 16, 2003.

Phase 2 of the HWMA/RCRA closure plan for CPP-601/627/640 is for landfill closure. The landfill results from the closure of the CPP-601 Deep Tanks System and the integration of this tank system closure with the decommissioning of the CPP-601 Fuel Reprocessing Facility, CPP-627 Remote Analytical Facility, and CPP-640 Headend Processing Plant. Phase 1 landfill closure activities were completed and included decontamination and grouting of the CPP-601 Deep Tanks System. Building CPP-627 was decommissioned and removed to grade under a Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) non-time-critical removal action. Buildings CPP-601 and -640 are being decommissioned under a separate non-time-critical removal action. During the Phase 1 post-closure period, under the CPP-601/640 non-time-critical removal action, Buildings CPP-601 and -640 were partially demolished, and grout was being used to fill interior void areas, creating a solid monolith. This, along with the concrete pad created near grade during the CPP-627 decommissioning, created an interim cover for the landfill. Phase 2 of the landfill closure is the installation of a sloped layer of grout over the horizontal surfaces of the CPP-601/640 monolith followed by an earthen weather protection barrier designed to cover the entire CPP-601/627/640 monolith. The final end state for the CPP/601/627/640 landfill is expected to be integrated with the final end state for the surrounding northern Idaho Nuclear Technology and

Engineering Center facilities in approximately 2035 through coordination of the HWMA/RCRA and CERCLA programs.

This permit reapplication demonstrates how the INL complies with the IDAPA 58.01.05.008 (40 CFR § 264) post-closure requirements for permitted facilities. These include maintaining and monitoring the landfill cap, preventing run-on and runoff, protecting and maintaining surveyed benchmarks, identifying a post-closure point of contact, and post-closure certification.

FFA/CO Requirements

In 1991, the U.S. Environmental Protection Agency (EPA) Region 10, the Idaho Department of Health and Welfare, and the U.S. DOE entered into the FFA/CO (EPA et al. 1991). The general purpose of the FFA/CO was multifold:

- Ensure that the environmental impacts associated with releases of hazardous substances at INL were thoroughly investigated and that appropriate response actions were undertaken and completed as necessary to protect the public health, welfare, and the environment
- Establish a procedural framework and schedule for developing, prioritizing, implementing, and monitoring appropriate response actions at INL in accordance with CERCLA, RCRA, and HWMA requirements
- Facilitate cooperation, exchange of information, and participation of the parties in such actions
- Minimize duplication of analyses and documentation
- Expedite the cleanup process to the maximum extent practicable, consistent with protection of human health and the environment
- Supersede the Consent Order and Compliance Agreement, Docket No. 1086-05-16-3008/3013, issued pursuant to Section 3008 of RCRA, 42 U.S.C. § 6928, and executed on July 10, 1987.

The agreement integrated U.S. DOE's CERCLA response obligations and HWMA/RCRA corrective action obligations at the INL as related to releases covered under the agreement. The agreement covered releases that would be subject to corrective action under Sections 3004 (u) and (v) of RCRA, 42 U.S.C. § 6924(u) and (v), for a RCRA permit and CERCLA 42, U.S.C. § 9601 et seq.

The INTEC Waste Area Group (WAG) 3 is one of ten WAGs identified in the FFA/CO. Operable Unit (OU) 3-13, encompassing the entire INTEC facility, was investigated through a comprehensive remedial investigation/feasibility study (RI/FS) to identify potential contaminant releases and exposure pathways (DOE-ID 1997). Those with potential risks (46) were subdivided into groups (1 through 5) based on similar media, contaminant(s) of concern (COC), accessibility, or geographic proximity (DOE-ID 2000a, 2000b). Through the RI/FS, it was found that the footprint of the WCF landfill cap impacted one release site below the WCF building, three release sites existed external to the WCF building, and releases had occurred to the soils around the WCF building. In addition, eight historical release points were identified beneath the CPP-601/627/640 buildings.

In addition to the HWMA/RCRA post-closure activities conducted under this permit reapplication, characterization and monitoring activities occur under the CERCLA Monitoring System Implementation Plans for the perched water in the vadose zone below the INTEC (Group 4). Releases to the WCF and CPP-601/627/640 soils are being managed under “Group 2, Soils Under Buildings and Structures,” and “Group 3, Other Surface Soils,” under the WAG 3, OU 3-13 Record of Decision (DOE-ID 1999). A new OU, 3-14, has been established to specifically address releases at the Tank Farm Facility (TFF).

ATTACHMENT 1 - PART A PERMIT APPLICATION

HWMA/RCRA INTEC POST-CLOSURE PERMIT REAPPLICATION

Volume 21
Waste Calcine Facility and CPP-604/627/640

Attachment 1
Part A Permit Application

April 2013

OMB#: 2050-0024 Expires 12/31/2014

SEND COMPLETED FORM TO: The appropriate State or Regional Office.	United States Environmental Protection Agency **RCRA SUBTITLE C SITE IDENTIFICATION FORM**	
1. Reason for Submittal MARK ALL BOX(ES) THAT APPLY	**Reason for Submittal:** ❑ To provide an Initial Notification (first time submitting site identification information / to obtain an EPA ID number for this location). ❑ To provide Subsequent Notification (to update site identification information for this location). ❑ As a component of a First RCRA Hazardous Waste Part A Permit Application. ☒ As a component of a Revised RCRA Hazardous Waste Part A Permit Application (Amendment#: **Volume 21 HWMA/RCRA INTEC Post-Closure Permit Reapplication - April 2013)** ❑ As a component of the Hazardous Waste Report (If marked, see sub-bullet below)	
	❑ Site was a TSD facility and/or generator of ≥1,000 kg of hazardous waste, >1 kg of acute hazardous waste, or >100 kg of acute hazardous waste spill cleanup in one or more months of the report year (or State equivalent LQG regulations	
2. Site EPA ID Number	**EPA ID Number:** ID4890008952	
3. Site Name	**Name:** IDAHO NATIONAL LABORATORY	
4. Site Location Information	**Street Address:**	
	City, Town, or Village: SCOVILLE	**County:** BUTTE, CLARK, JEFFERSON, BONNEVILLE, BINGHAN
	State: ID	**Country:** USA / **Zip Code:** 83415
5. Site Land Type	❑ Private ❑ County ❑ District ☒ Federal ❑ Tribal ❑ Municipal ❑ State ❑ Other	
6. NAICS Code(s) for the Site (at least 5-digit codes)	**A.** 92411	**B.** 54171
	C. 336992	**D.** Not Applicable
7. Site Mailing Address	**Street or P. O. Box:** 1955 FREMONT AVENUE	
	City, Town, or Village: IDAHO FALLS	
	State: ID	**Country:** USA / **Zip Code:** 83415
8. Site Contact Person	**First Name:** TERESA	**MI:** L / **Last Name:** PERKINS
	Title: DIRECTOR, ENVIRONMENT & SUSTAINABILITY DIVISION	
	Street or P. O. Box: 1955 FREMONT AVENUE	
	City, Town, or Village: IDAHO FALLS	
	State: ID	**Country:** USA / **Zip Code:** 83415
	Email: PERKINTL@ID.DOE.GOV	
	Phone: (208) 526-1483	**Ext.:** N/A / **Fax:** 208-526-1926
9. Legal Owner and Operator of the Site	**A. Name of Site's Legal Owner:** US DEPARTMENT OF ENERGY IDAHO OPERATIONS OFFICE	**Date Became Owner:** 01/01/1952
	Owner Type: ❑ Private ❑ County ❑ District ☒ Federal ❑ Tribal ❑ Municipal ❑ State ❑ Other	
	Street or P. O. Box: 1955 FREMONT AVENUE	
	City, Town, or Village: IDAHO FALLS	**Phone:** (208) 526-1483
	State: ID	**Country:** USA / **Zip Code:** 83415
	B. Name of Sites Operator: CH2M-WG IDAHO, LLC.	**Date Became Operator:** 05/01/2005
	Operator Type: ☒ Private ❑ County ❑ District ❑ Federal ❑ Tribal ❑ Municipal ❑ State ❑ Other	

10. Type of Regulated Waste Activity (at your site)

Mark "Yes" or "No" for all current activities (as of the date submitting the form); complete any additional boxes as instructed.

A. Hazardous Waste Activities; Complete all parts 1-10.

Y ☒ N ❑ 1. Generator of Hazardous Waste

If "Yes" mark only one of the following - a,b, or c

☒ a. LQG: Generates, in any calendar month, 1,000 kg/mo kg/mo (2,200 lbs./mo) or more of hazardous waste; **or** Generates an any calendar month, or accumulates at any time, more than 1 kg/mo (2.2 lbs./mo) of acute hazardous waste **or** Generates, in any calendar month **or** accumulates at any time, more than 100 kg/mo (220 lbs./mo) of acute hazardous spill cleanup material.

❑ b. SQG: 100 to 1,000 kg/mo (220 - 2,200 lbs./mo.) of non-acute hazardous waste.

❑ c. CESQG: Less than 100 kg/mo (220 lbs./mo.) of non-acute hazardous waste

If "Yes" above, indicate other generator activities in 2-4.

Y ❑ N ☒ 2. Short-Term Generator (generate from a short term or one-time event and not from on-going processes). If "Yes", provide an explanation in the Comments section

Y❑ N ☒ 3. United States Importer of Hazardous Waste

Y ☒ N ❑ 4. Mixed Waste (hazardous and radioactive) Generator

Y☒ N ❑ 5. Transporter of Hazardous Waste. If "Yes", mark all that apply.

☒ a. Transporter

❑ b. Transfer Facility (at your site)

Y☒ N ❑ 6. Treater, Storer, or Disposer of Hazardous Waste: Note: A hazardous waste Part B permit is required for these activities.

Y☒ N ❑ 7. Recycler of Hazardous Waste

Y❑ N ☒ 8. Exempt Boiler and/or Industrial Furnace. If "Yes", mark all that apply.

❑ a. Small Quantity On-site Burner Exemption

❑ b. Smelting, Melting, and Refining Furnace Exemption

Y❑ N ☒ 9. Underground Injection Control

Y☒ N ❑ 10. Receives Hazardous Waste from Off-site

B. Universal Waste Activities; Complete all parts 1-2

Y☒ N ❑ 1. 1. Large Quantity Handler of Universal Waste (you accumulate 5,000kg or more)[refer to your State regulations to determine what is regulated]. Indicate types of universal waste managed at your site. If "Yes", mark all that apply.

a. Batteries	☒
b. Pesticides	☒
c. Mercury containing equipment	☒
d. Lamps	☒
e. Other (specify)_____	❑
f. Other (specify)_____	❑
g. Other (specify)_____	❑

Y ☒ N ❑ 2. Destination Facility for Universal Waste

Note: A hazardous waste permit may be required for this activity

C. Used Oil Activities; Complete all parts 1-4.

Y❑ N ☒ 1. Used Oil Transporter

If "Yes", mark all that apply.

❑ a. Transporter

❑ b. Transfer Facility (at your site)

Y❑ N ☒ 2. Used Oil Processor and/or Re-refiner

If "Yes", mark all that apply.

❑ a. Processor

❑ b. Re-refiner

Y❑ N ☒ 3. Off-Specification Used Oil Burner

Y❑ N ☒ 4. Used Oil Fuel Marketer

If "Yes", mark all that apply.

❑ a. Marketer Who Directs Shipment of Off-Specification Used Oil to Off-Specification Used Oil Burner

❑ b. Marketer Who First Claims the Used Oil Meets the Specifications

D. Eligible Academic Entities with Laboratories - Notification for opting into or witdrawing from managing laboratory hazardous wastes pursuant to 40 CFR Part 262 Subpart K.

♦ You can **ONLY** Opt into Subpart K if:

- you are at least one of the following: a college or university; a teaching hospital that is owned by or has a formal affiliation agreement with a college or university; or a non-profit research institute that is owned by or has a formal affiliation agreement with a college or university; AND
- you have checked with your State to determine if 40 CFR Part 262 Subpart K is effective in your state

Y❑ N☒ 1. Opting into or currently operating under 40 CFR Part 262 Subpart K for the management of hazardous wastes in laboratories

See the item-by-item instructions for definitions of types of eligible academic entities. Mark all that apply:

❑a. College or University

❑b. Teaching Hospital that is owned by or has a formal written affilation agreement with a college or university

❑c. Non-profit Institute that is owned by or has a formal written affiliation agreement with a college or university

Y❑ N❑- 2. Withdrawing from 40 CFR Part 262 Subpart K for the management of hazardous wastes in laboratories

11. Description of Hazardous Wastes

A. Waste Codes for Federally Regulated Hazardous Wastes. Please list the waste codes of the Federal hazardous wastes handled at your site. List them in the order they are presented in the regulations (e.g., D001, D003, F007, U112). Use an additional page if more spaces are needed.

See Attached Form OMB#: 2050-0024, Item 9 pageS 5(IAA-1) through 5(IAA-4) of 6

B. Waste Codes for State-Regulated (i.e., non-Federal) Hazardous Wastes. Please List the waste codes of the State-Regulated hazardous wastes handled at your site. List them in the order they are presented in the regulations. Use an additional page if more spaces are needed.

12. Notification of Hazardous Secondary Material (HSM) Activity

Y☐ N ☒ Are you notifying under 40 CFR 260.42 that you will begin managing, are managing or will stop managing hazardous secondary material under 40 CFR 261.2(a)(2)(ii), 40 CFR 261.4(a)(23), (24), or (25)?

If "Yes", you must fill out the Addendum to the Site Identification Form: Notification for Managing Hazardous Secondary Material.

13. Comments

14. Certification. I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fines and imprisonment for knowing violations. For the RCRA Hazardous Waste Part A Permit Application, all owner(s) and operator(s) must sign (se 40 CFR 270.10(b) and 270.11).

Signature of legal owner, operator, or an authorized representative	Name and Official Title (type or print)	Date Signed (mm/dd/yyyy)
	K. W. Daniels, Vice President, CH2M-WG, Idaho, LLC.	
	R. B. Provencher, Manager, Department of Energy Idaho Operations Office	

EPA ID NO: ID4890008952 OMB#: 2050-0024; Expires 12/31/2014

United States Environmental Protection Agency

HAZARDOUS WASTE PERMIT INFORMATION FORM

1. Facility Permit Contact	First Name: **TERESA**	MI: **L**	Last Name: **PERKINS**
	Contact Title: **DIRECTOR, ENVIRONMENT & SUSTAINABILITY DIVISION**		
	Phone: **(208) 526-1483**	Ext.: **N/A**	Email: **PERKINTL@ID.DOE.GOV**
2. Facility Permit Contact Mailing Address	Street or P.O. Box: **1955 FREMONT AVENUE**		
	City, Town, or Village: **IDAHO FALLS**		
	State: **ID**		
	Country: **USA**		Zip Code: **83415**
3. Operator Mailing Address and Telephone Number	Street or P.O. Box: **P.O. BOX 2010**		
	City, Town, or Village: **IDAHO FALLS**		
	State: **ID**		Phone: **(208) 533-3475**
	Country: **USA**		Zip Code: **83403-2010**
4. Facility Existence Date	Facility Existence Date (mm/dd/yyyy): **06/01/1949**		

5. Other Environmental Permits

A. Facility Type *(Enter code)*	B. Permit Number												C. Description
R	I	D	4	8	9	0	0	0	8	9	5	2	Final HWMA Storage & Treatment Permit for the Idaho Nuclear Technology and Engineering Center (INTEC) on the Idaho National Laboratory (INL) (Volume 14)
R	I	D	4	8	9	0	0	0	8	9	5	2	Final HWMA Storage & Treatment Permit for the INTEC and the Accelerated Retrieval Project (ARP) on the INL (Volume 18)
R	I	D	4	8	9	0	0	0	8	9	5	2	HWMA/RCRA Part B Permit Application for the INL - General Information for INL Waste Management Units (Volume 3)
R	I	D	4	8	9	0	0	0	8	9	5	2	HWMA/RCRA Post-Closure Permit for the INTEC Waste Calcine Facility (WCF) and CPP-602/627/640 (Volume 21)
R	I	D	4	8	9	0	0	0	8	9	5	2	HWMA/RCRA Storage Permit for the Calcine Solids Storage Facility (CSSF) at the INTEC on the INL (Volume 22)
R	I	D	4	8	9	0	0	0	8	9	5	2	HWMA/RCRA Storage and Treatment Permit for the Sodium Process Facility (SPF) and Secondary Sodium System (SSS) located at the MFC on the INL (PER-140)
R	I	D	4	8	9	0	0	0	8	9	5	2	HWMA/RCRA Part A Permit Application for the INL (Volume 1) - CH2M-WG Idaho, LLC
P, E, U													See Additional Information Supplement to Item 5 - Other Permits List

6. Nature of Business

The INL was established in 1949, as a center where nuclear power reactors and support facilities could be built, tested, and operated. The INL site covers approximately 890 square miles and is 25 miles west of Idaho Falls, ID. For many years the INL was the site of the largest nuclear power research & development effort in the world. During the 1970's the INL's mission broadened to include such areas as biotechnology, energy and materials research, and conservation and renewable energy. At the end of the Cold War, waste treatment and cleanup of previously contaminated sites became a priority. Today the INL is a science-based, applied engineering national laboratory dedicated to completing its waste cleanup mission and meeting the nation's environmental, energy, nuclear science and technology, and national security needs. Additionally, in 2002, it was announced that the INL will serve as the nation's leading nuclear technology center.

Additional Information
Supplement to Item 5.
Other Environmental Permits

AIR PERMITS

(Permit Type P)

Idaho National Laboratory (INL)

- **Title V Operating Permit -** Permit Number T1-030520
- **Tier I Operating Permit** - Permit Number TI-2009.0148

Idaho Nuclear Technology and Engineering Center (INTEC)

PTC (Permit Number P-2012.0053)
- CPP-606 Distillate Oil-Fired Boilers

PTC (Permit Number p-2008.0199)
- Integrated Waste Treatment Unit at the INL - Idaho Nuclear Technology and Engineering Center

PTC (Permit Number P-2007.0076)
- INTEC PTC for Air Compressor COM-UTI-606

WATER PERMITS

State of Idaho Monitoring Well Permit (IDWR)

(Permit Type U)

INL monitoring well permit applications are sent annually to the IDWR for wells (greater than 18 feet deep) to be constructed in the current calendar year. Permits are authorized by agreement between the DOE-ID and the IDWR.

State of Idaho Water Reuse Permit (WRP)

(Permit Type E)
- INTEC Service Waste System and Sewage Treatment Plant - Permit Number LA-000130-04

Ground Water Rights

(Permit Type E)

INL operations use water guaranteed by both a Federal Reserved Water Right and a water rights agreement with the State of Idaho

7. Process Codes and Design Capacities - Enter information in the Sections on Form Page 3.

A. PROCESS CODE - Enter the code from the list of process codes below that best describes each process to be used at the facility. If more lines are needed, attach a separate sheet of paper with the additional information. For "other" processes (i.e., D99, S99, T04 and X99), describe the process (including its design capacity) in the space proveded in Item 8.

B. PROCESS DESIGN CAPACITY - For each code entered in Item 7.A; enter the capacity of the process, enter the capacity of the process.

1. AMOUNT - Enter the amount. In a case where design capacity is not applicable (such as in a closure/post-closure or enforcement action) enter the total amount of waste for that process.
2. UNIT OF MEASURE - For each amount entered in Section 7.B(1), enter the code in Section 7.B(2) from the list of unit of measure codes below that describes the unit of measure used. Select only from the units of measure in this list.

C. PROCESS TOTAL NUMBER OF UNITS - Enter the total number of units for each corresponding process code.

Process Code	Process	Appropriate Unit of Measure for Process Design Capacity
	Disposal	
D79	Underground Injection Well Disposal	Gallons; Liters; Gallons Per Day; or Liters Per Day
D80	Landfill	Acre-feet; Hectare-meter; Acres; Cubic Meters; Hectares; Cubic Yards
D81	Land Treatment	Acres or Hectares
D82	Ocean Disposal	Gallons Per Day or Liters Per Day
D83	Surface Impoundment Disposal	Gallons; Liters; Cubic Meters; or Cubic Yards
D99	Other Disposal	Any Unit of Measure Listed Below
	Storage	
S01	Container	Gallons; Liters; Cubic Meters; or Cubic Yards
S02	Tank Storage	Gallons; Liters; Cubic Meters; or Cubic Yards
S03	Waste Pile	Cubic Yards or Cubic Meters
S04	Surface Impoundment	Gallons; Liters; Cubic Meters; or Cubic Yards
S05	Drip Pad	Gallons; Liters; Acres; Cubic Meters; Hectares; or Cubic Yards
S06	Containment Building Storage	Cubic Yards or Cubic Meters
S99	Other Storage	Any Unit of Measure Listed Below
	Treatment	
T01	Tank Treatment	Gallons Per Day; Liters Per Day
T02	Surface Impoundment	Gallons Per Day; Liters Per Day
T03	Incinerator	Short Tons Per Hour; Metric Tons Per Hour; Gallons Per Hour; Liters Per Hour; BTUs Per Hour; Pounds Per Hour; Short Tons Per Day; Kilograms Per Hour; Gallons Per Day; Metric Tons Per Hour; or Million BTU Per Hour
T04	Other Treatment	Gallons Per Day; Liters Per Day; Pounds Per Hour; Short Tons Per Hour; Kilograms Per Hour; Metric Tons Per Day; Short Tons Per Day; BTUs Per Hour; Gallons Per Day; Liters Per Hour; or Million BTU Per Hour
T80	Boiler	Gallons; Liters; Gallons Per Hour; Liters Per Hour; BTUs Per Hour; or Million BTU Per Hour

Process Code	PROCESS	APPROPIRATE UNITS OF MEASURE FOR PROCESS DESIGN CAPACITY
	Treatment (continued)	**(for T81 - T94)**
T81	Cement Kiln	Gallons Per Day; Liters Per Day; Pounds Per Hour; Short Tons Per Hour; Kilograms Per Hour; Metric Tons Per Day; Metric Tons Per Hour; Short Tons Per Day; BTU Per Hour; Liters Per Hour; Kilograms Per Hour; or Million BTU Per Hour
T82	Lime Kiln	
T83	Aggregate Kiln	
T84	Phosphate Kiln	
T85	Coke Oven	
T86	Blast Furnace	
T87	Smelting, Melting, or Refining Furnace	
T88	Titanium Dioxide Chloride Oxidation Reactor	
T89	Methane Reforming Furnace	
T90	Pulping Liquor Recovery Furnace	
T91	Combustion Device Used In the Recovery Of Sulfur Values From Spent Sulfuric Acid	
T-92	Halogen Acid Furnaces	
T93	Other Industrial Furnaces Listed In 40 CFR §260.10	
T94	Containment Building - Treatment	Cubic Yards; Cubic Meters; Short Tons Per Hour; Gallons Per Hour; Liters Per Hour; BTU Per Hour; Pounds Per Hour; Short Tons Per Day; Kilograms Per Hour; Metric Tons Per Day; Gallons Per Day; Liters Per Day; Metric Tons Per Hour; or Million BTU Per Hour
	Miscellaneous (Subpart X)	
X01	Open Burning/Open Detonation	Any Unit of Measure in Code Table Below
X02	Mechanical Processing	Short Tons Per Hour; Metric Tons Per Hour;Short Tons Per Day; Metric Tons Per Day; Pounds Per Hour; Kilograms Per Hour; Gallons Per Hour; Liters Per Hour, or Gallons Per Day
X03	Thermal Unit	Gallons Per Day; Liters Per Day; Pounds Per Hour; Short Tons Per Hour; Kilograms Per Hour; Metric tons Per Day; Metric Tons Per Hour; Short Tons Per Day; BTU Per Hour; or Million BTU Per Hour
X04	Geologic Repository	Cubic Yards; Cubic Meters; Acre-feet; Hectare-meter; Gallons; or Liters
X99	Other Subpart X	Any Unit of Measure Listed Below

Unit of Measure	Unit of Measure Code	Unit of Measure	Unit of Measure Code	Unit of Measure	Unit of Measure Code
Gallons	**G**	**Short Tons Per Hour**	**D**	**Cubic Yards**	**Y**
Gallons Per Hour	**E**	**Short Tons Per Day**	**N**	**Cubic Meters**	**C**
Gallons Per Day	**U**	**Metric Tons Per Hour**	**W**	**Acres**	**B**
Liters	**L**	**Metric Tons Per Day**	**S**	**Acre-feet**	**A**
Liters Per Hour	**H**	**Pounds Per Hour**	**J**	**Hectares**	**Q**
Liters Per Day	**V**	**Kilograms Per Hour**	**X**	**Hectare-meter**	**F**
		Million BTU Per Hour	**X**	**BTU Per Hour**	**I**

7. Process Codes and Design Capacities (Continued)

EXAMPLE FOR COMPLETING Item 7 (shown in line number X-1 below): A facility has a storage tank, which can hold 533.788 gallons.

Line Number		A. Process Code (From list above)			B. PROCESS DESIGN CAPACITY (1) Amount (Specify)	B. PROCESS DESIGN CAPACITY (2) Unit of Measure	C. Process Total Number of Units	For Official Use Only
X	1	S	0	2	533.788	G	001	
	1	D	8	0	59	Y	003	
	2	D	8	0	22	Y	003	
	3							
	4							
	5							
	6							
	7							
	8							
	9							
1	0							
1	1							
1	2							
1	3							

NOTE: If you need to list more than 13 process codes, attach an additional sheet(s) with the information in the same format as above. Number the lines sequentially, taking into account any lines that will be used for "other" processes (i.e., D99, S99, T04 and X99) in Item 8.

8. Other Processes (Follow instructions from Item 7 for D99, S99, T04 and X99 process codes)

Line Number (Enter #s in sequence with item 7)		A. Process Code (from list above)			B. PROCESS DESIGN CAPACITY (1) Amount (Specify)	B. PROCESS DESIGN CAPACITY (2) Unit of Measure	C. Process Total Number of Units	For Official Use Only
X	2	T	0	4	100.00	U	001	

ITEM 7. PROCESS CODES AND DESIGN CAPACITIES SUPPLEMENT

LINE NUMBER	PROCESS TYPE UNIT NAME		PROCESS DESIGN CAPACITY
1	**D080- INTEC WCF includes:** • CPP-633 Storage Tanks (WC-100, WC-101, WC-108, WC-119) • CPP-633 WCF HEPA Filter Storage • CPP-633 WCF Evaporator (EVAP-WC-114)		
		Line 1 Total:	**59 cubic yards**
2	**D80 - INTEC CPP-601/627/640 includes:** • CPP-601 • CPP-627 • CPP-640		
		Line 2 Total:	**22 cubic yards**

9. Description of Hazardous Wastes - Enter information in the Sections on Form Page 5.

A. EPA HAZARDOUS WASTE NUMBER - Enter the four-digit number from 40 CFR, Part 261 Subpart D of each listed hazardous waste you will handle. For hazardous wastes which are not listed in 40 CFR, Part 261 Subpart D, enter the four-digit number(s) from 40 CFR Part 261, Subpart C that describes the characteristics and/or the toxic contaminants of those hazardous wastes.

B. ESTIMATED ANNUAL QUANTITY - For each listed waste entered in Item 9.A, estimate the quantity of that waste that will be handled on an annual basis. For each characteristic or toxic contaminant entered in Item 9.A, estimate the total annual quantity of all the non-listed waste(s) that will be handled which possess that characteristic or contaminant.

C. UNIT OF MEASURE - For each quantity entered in Item 9.B, enter the unit of measure code. Units of measure which must be used and the appropriate codes are:

ENGLISH UNIT OF MEASURE	CODE	METRIC UNIT OF MEASURE	CODE
POUNDS	P	KILOGRAMS	K
TONS	T	METRIC TONS	M

If facility records use any other unit of measure for quantity, the units of measure must be converted into one of the required units of measure, taking into account the appropriate density or specific gravity of the waste.

D. PROCESSES

1. PROCESS CODES:

For listed hazardous waste: For each listed hazardous waste entered in Item 9.A, select the code(s) from the list of process codes contained in Items 7.A and 8.A on page 3 to indicate all the processes that will be used to store, treat, and/or dispose of all the listed hazardous wastes.

For non-listed hazardous waste: For each characteristic or toxic contaminant entered in Item 9.A, select the code(s) from the list of process codes contained in Items 7.A and 8.A on page 3 to indicate all the processes that will be used to store, treat, and/or dispose of all the non-listed hazardous wastes that possess that characteristic or toxic contaminant.

NOTE: THREE SPACES ARE PROVIDED FOR ENTERING PROCESS CODES. IF MORE ARE NEEDED:

1. Enter the first two as described above.
2. Enter "000" in the extreme right box of Item 9.D(1).
3. Use additional sheet, enter line number from previous sheet, and enter additional code(s) in Item 9.E.

2. PROCESS DESCRIPTION: If a code is not listed for a process that will be used, describe the process in Item 9.D(2) or in Item 9.E(2).

NOTE: HAZARDOUS WASTES DESCRIBED BY MORE THAN ONE EPA HAZARDOUS WASTE NUMBER - Hazardous wastes that can be described by more than one EPA Hazardous Waste Number shall be described on the form as follows:

1. Select one of the EPA Hazardous Waste Numbers and enter it in Item 9.A. On the same line complete Items 9.B, 9.C, and 9.D by estimating the total annual quantity of the waste and describing all the processes to be used to store, treat, and/or dispose of the waste.

2. In Item 9.A of the next line enter the other EPA Hazardous Waste Number that can be used to describe the waste. In Item 9.D.2 on that line enter "included with above" and make no other entries on that line.

3. Repeat step 2 for each EPA Hazardous Waste Number that can be used to describe the hazardous waste.

EXAMPLE FOR COMPLETING Item 9 (shown in line numbers X-1, X-2, X-3, and X-4 below) - A facility will treat and dispose of an estimated 900 pounds per year of chrome shavings from leather tanning and finishing operations. In addition, the facility will treat and dispose of three non-listed wastes. Two wastes are corrosive only and there will be an estimated 200 pounds per year of each waste. The other waste is corrosive and ignitable and there will be an estimated 100 pounds per year of that waste. Treatment will be in an incinerator and disposal will be in a landfill.

Line Number		A. EPA Hazardous Waste No. (Enter code)				B. Estimated Annual Qty of Waste	C. Unit of Measure (Enter code)	D. PROCESSES									
								(1) PROCESS CODES (Enter code)									(2) PROCESS DESCRIPTION (If code is not entered in 9.D(1))
X	1	K	0	5	4	900	P	T	0	3	D	8	0				
X	2	D	0	0	2	400	P	T	0	3	D	8	0				
X	3	D	0	0	1	100	P	T	0	3	D	8	0				
X	4	D	0	0	2												Included With Above

ITEM 9. DESCRIPTION OF HAZARDOUS WASTE
TABLE OF CONTENTS

TSD UNIT	Page Number
CPP-633 WCF Evaporator	5A of 6
CPP-633 WCF HEPA Filter Storage	5B of 6
CPP-633 WCF Storage Tanks	5C of 6
CPP-601/627/640	5D of 6

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OMB #: 2050-0024 Expires 12/31/2014

9. Description of Hazardous Wastes ***(Continued. Use the additional sheet(s) as necessary; number pages as 5a, etc.)***

Line Number		A. EPA Hazardous Waste No. (Enter code)				B. Estimated Annual Qty of Waste	C. Unit of Measure (Enter code)	D. PROCESSES									
								(1) PROCESS CODES (Enter code)									(2) PROCESS DESCRIPTION (If a code is not entered in 9.D(1))
	1	D	0	0	4	59	Y	D	8	0							CPP-633 WCF EVAPORATOR
	2	D	0	0	5												INCLUDED WITH ABOVE
	3	D	0	0	7												INCLUDED WITH ABOVE
	4	D	0	0	8												INCLUDED WITH ABOVE
	5	D	0	0	9												INCLUDED WITH ABOVE
	6	D	0	1	0												INCLUDED WITH ABOVE
	7	F	0	0	1												INCLUDED WITH ABOVE
	8	F	0	0	2												INCLUDED WITH ABOVE
	9	U	1	3	4												INCLUDED WITH ABOVE
1	0																
1	1																
1	2																
1	3																
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3	6																

EPA ID NO: ID4890008952

OMB #: 2050-0024 Expires 12/31/2014

9. Description of Hazardous Wastes ***(Continued. Use the additional sheet(s) as necessary; number pages as 5a, etc.)***

Line Number		A. EPA Hazardous Waste No. (Enter code)				B. Estimated Annual Qty of Waste	C. Unit of Measure (Enter code)	D. PROCESSES									
								(1) PROCESS CODES (Enter code)									(2) PROCESS DESCRIPTION (If a code is not entered in 9.D(1))
	1	D	0	0	4	59	Y	D	8	0							CPP-633 WCF HEPA FILTER STORAGE
	2	D	0	0	5												INCLUDED WITH ABOVE
	3	D	0	0	7												INCLUDED WITH ABOVE
	4	D	0	0	8												INCLUDED WITH ABOVE
	5	D	0	0	9												INCLUDED WITH ABOVE
	6	D	0	1	0												INCLUDED WITH ABOVE
	7	F	0	0	1												INCLUDED WITH ABOVE
	8	F	0	0	2												INCLUDED WITH ABOVE
	9	U	1	3	4												INCLUDED WITH ABOVE
1	0																
1	1																
1	2																
1	3																
1	4																
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9. Description of Hazardous Wastes ***(Continued. Use the additional sheet(s) as necessary; number pages as 5a, etc.)***

Line Number		A. EPA Hazardous Waste No. (Enter code)				B. Estimated Annual Qty of Waste	C. Unit of Measure (Enter code)	D. PROCESSES									
								(1) PROCESS CODES (Enter code)									(2) PROCESS DESCRIPTION (If a code is not entered in 9.D(1))
	1	D	0	0	4	59	Y	D	8	0							CPP-633 WCF STORAGE TANKS
	2	D	0	0	5												INCLUDED WITH ABOVE
	3	D	0	0	7												INCLUDED WITH ABOVE
	4	D	0	0	8												INCLUDED WITH ABOVE
	5	D	0	0	9												INCLUDED WITH ABOVE
	6	D	0	1	0												INCLUDED WITH ABOVE
	7	F	0	0	1												INCLUDED WITH ABOVE
	8	F	0	0	2												INCLUDED WITH ABOVE
	9	U	1	3	4												INCLUDED WITH ABOVE
1	0																
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EPA ID NO: ID4890008952

OMB #: 2050-0024 Expires 12/31/2014

9. Description of Hazardous Wastes ***(Continued. Use the additional sheet(s) as necessary; number pages as 5a, etc.)***

Line Number		A. EPA Hazardous Waste No. (Enter code)				B. Estimated Annual Qty of Waste	C. Unit of Measure (Enter code)	D. PROCESSES									
								(1) PROCESS CODES (Enter code)									(2) PROCESS DESCRIPTION (If a code is not entered in 9.D(1))
	1	D	0	0	1	22	Y	D	8	0							CPP-601/627/640
	2	D	0	0	2												INCLUDED WITH ABOVE
	3	D	0	0	4												INCLUDED WITH ABOVE
	4	D	0	0	5												INCLUDED WITH ABOVE
	5	D	0	0	6												INCLUDED WITH ABOVE
	6	D	0	0	7												INCLUDED WITH ABOVE
	7	D	0	0	8												INCLUDED WITH ABOVE
	8	D	0	0	9												INCLUDED WITH ABOVE
	9	D	0	1	0												INCLUDED WITH ABOVE
1	0	D	0	1	1												INCLUDED WITH ABOVE
1	1	D	0	1	8												INCLUDED WITH ABOVE
1	2	D	0	1	9												INCLUDED WITH ABOVE
1	3	D	0	2	1												INCLUDED WITH ABOVE
1	4	D	0	2	2												INCLUDED WITH ABOVE
1	5	D	0	2	6												INCLUDED WITH ABOVE
1	6	D	0	2	8												INCLUDED WITH ABOVE
1	7	D	0	3	2												INCLUDED WITH ABOVE
1	8	D	0	3	4												INCLUDED WITH ABOVE
1	9	D	0	3	5												INCLUDED WITH ABOVE
2	0	D	0	3	6												INCLUDED WITH ABOVE
2	1	D	0	3	8												INCLUDED WITH ABOVE
2	2	D	0	3	9												INCLUDED WITH ABOVE
2	3	D	0	4	0												INCLUDED WITH ABOVE
2	4	F	0	0	1												INCLUDED WITH ABOVE
2	5	F	0	0	2												INCLUDED WITH ABOVE
2	6	F	0	0	3												INCLUDED WITH ABOVE
2	7	F	0	0	5												INCLUDED WITH ABOVE
2	8	U	1	3	4												INCLUDED WITH ABOVE
2	9																
3	0																
3	1																
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3	5																
3	6																

10. Map

Attach to this application a topographical map, or other equivalent map, of the area extending to at least one mile beyond property boundaries. The map must show the outline of the facility, the location of each of its existing intake and discharge structures, each of its hazardous waste treatment, storage, or disposal facilities, and each well where it injects fluids underground. Include all springs, rivers and other surface water bodies in this map area. See instructions for precise requirements.

See Attachment 1 - Section I, Volume 21 INTEC Post-Closure Permit Reapplication, Rev. April 2013

11. Facility Drawing

All existing facilities must include a scale drawing of the facility (see instructions for more detail).

See Attachment 1 - Section I, Volume 21 INTEC Post-Closure Permit Reapplication, Rev. April 2013

12. Photographs

All exiting facilities must include photographs (aerial or ground-level) that clearly delineate all existing structures, existing storage, treatment, and disposal areas; and sites of future storage, treatment or disposal areas (see instructions for more detail).

See pages 6a through 6g of the Volume 21 INTEC Post-Closure Permit Reapplication, Part A Permit Application, Rev. April 2013

13. Comments

For a description of hazardous debris categories treated, stored, or disposed of at the facility, as required by IDAPA 58.01.05.012 [40 CFR 270.13(n)], please see attached information titled: "ITEM 13. ADDITIONAL INFORMATION HAZARDOUS DEBRIS CATEGORIES".

ITEM 12. FACILITY PHOTOGRAPHS

WCF - LOOKING EAST AT CONCRETE MONOLITH

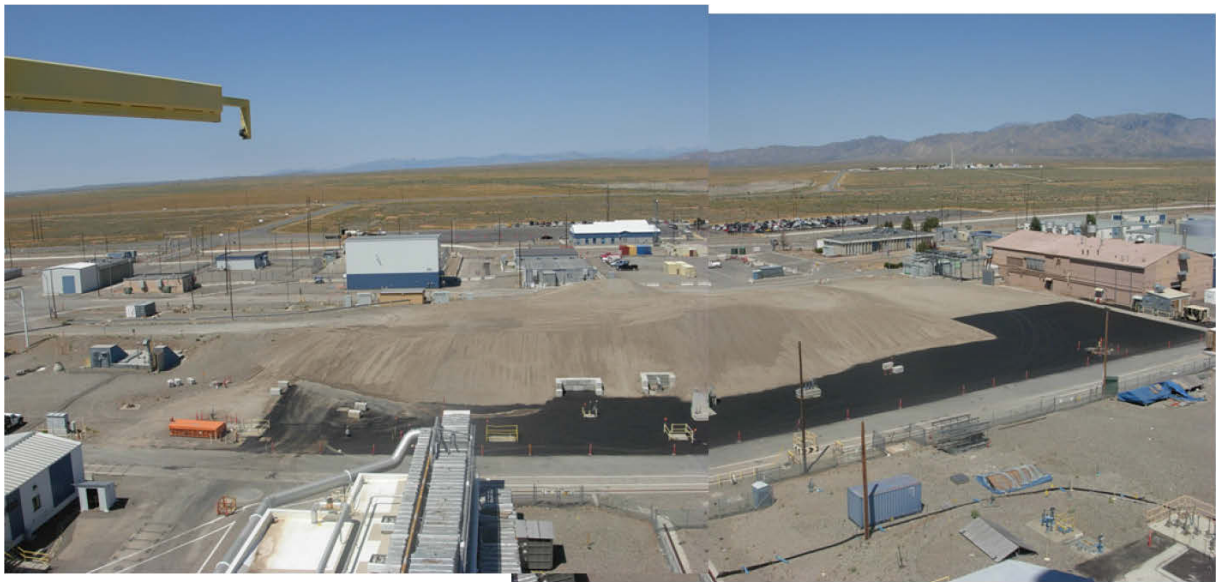
ITEM 12. FACILITY PHOTOGRAPHS

WCF - LOOKING NORTHEAST AT CONCRETE MONOLITH

ITEM 12. FACILITY PHOTOGRAPHS

WCF - LOOKING WEST AT CONCRETE MONOLITH

ITEM 12. FACILITY PHOTOGRAPHS



CPP-601/627/640 EARTHERN COVER LOOKING WEST

ITEM 12. FACILITY PHOTOGRAPHS

CPP-601/627/640 EARTHEN COVER LOOKING SOUTH ALONG EAST SIDE

ITEM 12. FACILITY PHOTOGRAPHS

CPP-601/627/640 EARTHEN COVER LOOKING NE FROM TOP OF EARTHEN COVER

ITEM 12. FACILITY PHOTOGRAPHS

CPP-601/627/640 EARTHEN COVER LOOKING SOUTHEAST FROM TOP OF EARTHEN COVER

ITEM 13. ADDITIONAL INFORMATION
HAZARDOUS WASTE DEBRIS CATEGORIES

IDAPA 58.01.05.012 [40 CFR 270.13 (n)] requires a description of the debris categories treated, stored, or disposed of at a facility to be submitted in the Part A Permit Application. Debris defined by 40 CFR 268.2 means a solid material exceeding a 60 mm particle size that is intended for disposal and that is: a manufactured object; or plant or animal matter; or natural geologic material.

Category I - Manufactured Objects

Glass
Concrete
Masonry and refractory bricks
Paper
Plastic
Rubber
Cloth
Pavement
Metal Debris
- Pipes
- Valves
- Scrap Metal

Other Heterogeneous Debris
- Non-intact containers
- Tanks
- Appliances
- Industrial Equipment

Category II - Plant and Animal Matter

Biological Debris
- Plant Matter

Wood Debris
- Wood
- Plant Stumps

Category III - Natural Geologic Material

Rock
Cobbles
Boulders

ATTACHMENT 1 - FACILITY DESCRIPTION

HWMA/RCRA INTEC POST-CLOSURE PERMIT REAPPLICATION

Volume 21
Waste Calcine Facility and CPP-601/627/640

Attachment 1
Section A, Facility Description

April 2013

A. FACILITY DESCRIPTION

IDAPA 58.01.05.012 [40 CFR 270.14(b)(1)]

The INL site is owned by the DOE. The eastern boundary of the INL site is located 32 mi (52 km) west of Idaho Falls, Idaho. The INL site occupies approximately 890 mi^2 (2,305 km^2) of the northwestern portion of the Eastern Snake River Plain (ESRP) in southeast Idaho. The WCF and CPP-601/627/640 are located within the INTEC facility and is situated approximately 45 mi (72.5 km) from Idaho Falls, Idaho, in the south-central area of the INL site (see Figure A-1). In 1949, the INL site was established, as the National Reactor Testing Station, as a location where the DOE could safely build, test, and operate various types of nuclear reactor facilities. Strict security is maintained for all INL facilities in accordance with the INL's nuclear and defense missions. More detailed facility information on the INL is found in the *HWMA/RCRA Part B Permit Application for the Idaho National Engineering and Environmental Laboratory, Volume 3* (referred to as the *Volume 3 HWMA/RCRA Part B Permit Application*), "General Information for INL Waste Management Units".

A.1 INTEC Description

The INTEC (formerly the Idaho Chemical Processing Plant) occupies an enclosed and secured area of approximately 250 acres (101 ha) that is situated on the south-central portion of the INL site, northeast of the Central Facilities Area (CFA), as shown in Figure A-1. The INTEC was initially constructed in the 1950s to reprocess spent nuclear fuel (SNF) from government naval ship reactors and has undergone continuous additions and improvements since that time. The facility recovered more than $1 billion worth of highly enriched uranium over the years that was returned to the government fuel cycle. In addition, an innovative treatment process known as calcination was developed at INTEC. Calcination was first conducted in the WCF from 1963 until 1981 and then continued in the New Waste Calcining Facility (NWCF) until 1998. Calcination reduced the volume of liquid radioactive waste generated during fuel reprocessing, while placing the waste in a safer, more stable, granular-solid form. Current work at INTEC includes receiving and storing SNF, environmental restoration, decontamination and decommissioning activities, and waste management and technology development. Other HWMA/RCRA-regulated activities at the INTEC include storage in tanks, evaporative treatment, satellite accumulation, container storage, debris treatment, and tank treatment.

Additional information on the INTEC facilities can be found in *Volume 3 HWMA/RCRA Part B Permit Application*.

A.2 WCF Description

The WCF (Building CPP-633), located at the INTEC, calcined and evaporated aqueous wastes generated from reprocessing SNF (see Figure A-2). The interim status units at the WCF included the evaporator tank system (four storage tanks and an evaporator) and a HEPA filter waste pile. The calciner itself operated and closed before being subject to HWMA/RCRA regulations as an operating thermal treatment unit. The calciner began operations in 1963 and solidified over 4 M·gal (15 M·L) of aqueous waste before it was shut down in 1981. Liquid waste containing dissolved metals, radionuclides, and nitrates was transferred through underground pipelines to the WCF. There, the waste was sprayed into a hot fluidized bed of granular solids in the calciner. The calcined solids were then transferred to bin sets. Nine campaigns were conducted at the WCF; however, successive decontamination cycles led to progressive deterioration of the equipment. In 1981, the WCF calciner was replaced by the "new" calciner in the NWCF (Building CPP-659). The WCF evaporator system continued to operate from 1983 until 1987, concentrating high-activity aqueous waste.

In 1988, in anticipation of future system use, the DOE-ID requested and received interim status for the evaporator system. However, the system never operated after receiving interim status. Constructing a new evaporator system at the NWCF made the WCF evaporator system unnecessary and a decision was made to close the WCF units. The units covered by the closure were the evaporator tank system and the HEPA filter waste pile. The WCF was closed by knocking down the aboveground portion of the facility to the below-grade structure; grouting and capping the waste lines; grouting the tanks, cells, and vaults; and constructing a concrete cap over the WCF footprint.

The WCF is closed with mixed waste in place and meets the closure requirements applicable to HWMA/RCRA landfills with an engineered concrete cover (cap) over the grouted vessels, cells, tanks, and superstructure. The design of the WCF concrete cap complies with the performance standards of IDAPA 58.01.05.009 [40 CFR § 265.310(a)]. The cap is constructed of a low-permeability (3.9E-13 in./sec [1E-12 cm/sec]) reinforced concrete, a minimum of 12 in. (0.31 m) thick, with at least 1% slope from the center to the edges of the cap (Keck 1995). The concrete has a

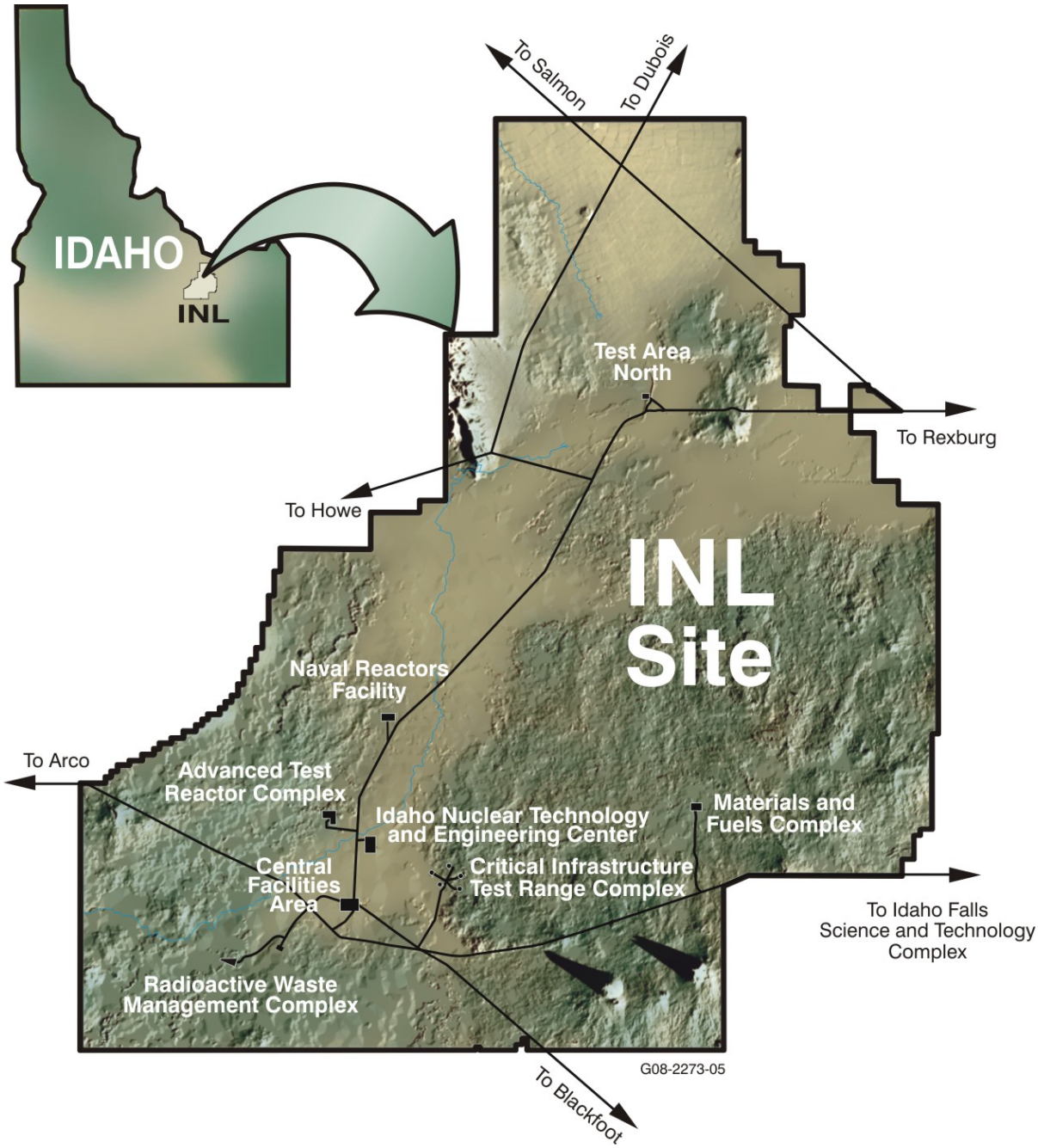


Figure A-1. Location of the INTEC at the INL and the surrounding area.

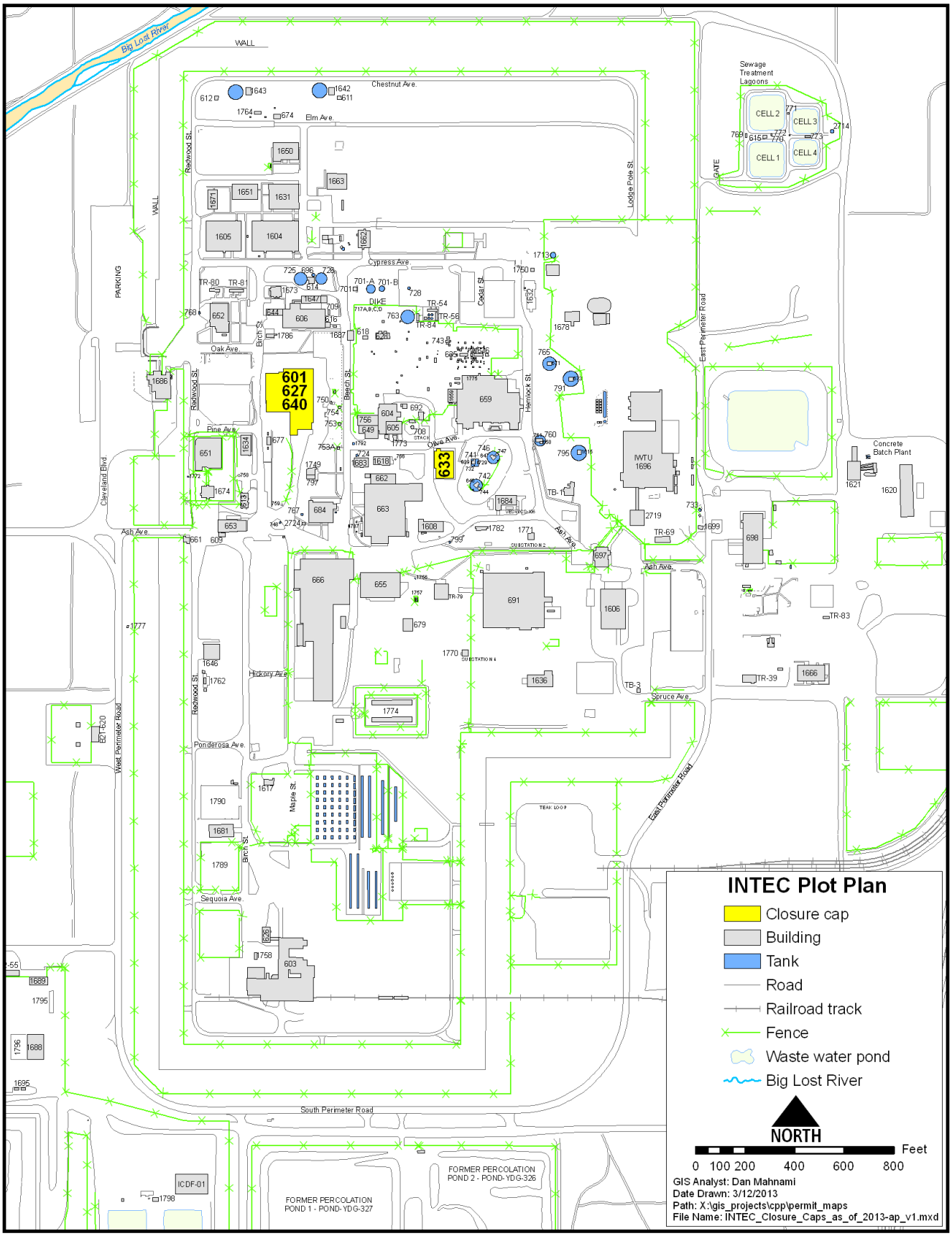


Figure A-2. Waste Calcine Facility (CPP-633) and CPP-601/627/640.

minimum compressive strength of 4,500 psi. The cap extends approximately 5 ft (1.5 m) past the ground-level footprint of the WCF building. The size and configuration of the closure cap is restricted by the proximity of the WCF to other operating facilities at the INTEC. Expansion of the cap to the north, to cover the ancillary waste lines from the WCF to the process equipment waste evaporator (PEWE) and TFF, is limited by the presence of a utility tunnel that runs under Olive Street. The utility tunnel provides access for compressed air, water, steam, and other utilities to the operating facilities in the central portion of the INTEC, including the NWCF. Expansion of the cap to the east is severely limited by the proximity of the berms surrounding and shielding the Calcined Solids Storage Facility (CSSF) bin sets. Radiological controls and seismic criteria associated with the operating envelope for the CSSF prohibit extension of the closure cap to cover the calciner transfer lines.

However, the footprint of the WCF closure extends beyond the concrete cap and include lines PUA-3004 and PLA-101111 that were filled with grout from Valve Boxes B-4 and D-4 respectively.

An attempt was made to fill the calcine transfer line, TAA-3009, to the WCF with grout using an aqueous decontamination solution nipple about 75ft east of the WCF. Subsequently, a 30ft portion of the transfer line was found to be plugged and would not allow the grout to reach the WCF. The transfer line was grouted above the plug toward the calcined solids bin set and below the plug toward the WCF. The 30ft plugged section of pipe was then removed and placed in the WCF for disposal. The footprint of the WCF closure includes approximately 45ft of TAA-3009 from the WCF to where the line was grouted and cut.

The DEQ director will be notified prior to any soil disturbance that will affect lines PUA-3004, PLA-101111, or TAA-3009.

The concrete cap reduces erosion while requiring a minimum of maintenance. The grade of the surface promotes drainage away from the cap. To prevent subsidence and to maintain the integrity of the cap, the belowground voids created by the vessels, tanks and cells were filled with grout. Water that drains off or toward the cap is collected and routed away from the WCF by storm water drains and ditches.

A.3 CPP-601/627/640 FACILITY DESCRIPTION

Buildings CPP-601, -627, and -640 were part of the Fuel Reprocessing Complex at INTEC, which is located in the south-central area of the INL Site. These buildings are described briefly in the following subsections. Detailed descriptions of the buildings and the INL Site are provided in the CPP-601 Phase 1 closure plan (DOE-ID 2009a) and the action memoranda for the CPP-601/640 and CPP-627 NTCRAs (DOE-ID 2008; DOE-NE-ID 2004).

CPP-601 Fuel Reprocessing Facility

The CPP-601 Fuel Reprocessing Facility was a 244 × 102-ft building consisting of six levels, with the primary portion located below ground. The facility was used for reprocessing spent nuclear fuel. Operations included fuel dissolution, separation, chemical makeup and transfer, and liquid waste receiving processes. The top level, constructed of transite panels on post and beam, was above grade and contained an open area that was used for transferring fuel elements to the process equipment and for chemical storage, makeup, and transfer. The lower levels, constructed of steel-reinforced concrete, contained process cells, corridors, and auxiliary cells that housed equipment and controls. The CPP-601 Deep Tanks System was located in the lowest level of Building CPP-601 and consisted of four 4,500-gal stainless steel tanks located in two stainless-steel-lined concrete vaults. This system collected liquid waste generated from separations processes performed in CPP-601. Process systems in CPP-627 and CPP-640, as well as other facilities, also sent waste to these tanks.

Most of the floor, cell walls, and equipment were lined with, or consisted of, stainless steel. The processing equipment, which was designed for remote operations, was generally enclosed in the heavily shielded cells. Often, lead was used as the shielding material. A significant amount of lead shielding also was encased in the concrete structures (floors and walls) (DOE-ID 2009a).

Building CPP-601 was made up of heavily reinforced, 1.5-ft-thick exterior building walls and up to 5-ft-thick interior cell walls and was 80% underground. As part of the CPP-601/640 NTCRA, the interior vessels, large piping, and cells of CPP-601 were filled with grout, which solidified and is contained by the building structure. Because the grout was placed in lifts and allowed to harden, lateral displacement is not a concern. The majority of the facility was founded on approximately 10 ft of compacted engineered subgrade on basalt bedrock. The deep tanks area extended into the basalt about 7 ft. The weight of the building and grout applies a pressure to the subgrade that is less than the underlying bearing capacity. Long-term displacement or subsidence is not expected.

CPP-627 Remote Analytical Facility

The CPP-627 Remote Analytical Facility was a 14,727-ft^2 facility. The building was entirely above ground and was attached to CPP-601. Building CPP-627 was constructed in 1955 of reinforced concrete and masonry block. Waste collection piping in CPP-627 had been inactive since 1989, and the CPP-627 building was last used in 1995. The building housed analytical, experimental, and decontamination facilities, including the Hot Chemistry Laboratory, the Old Shift Laboratory, the Multi-Curie Cell, the Emission Spectroscopy Laboratory, and the Decontamination Development Laboratory. The custom fuel dissolution process was conducted in the Hot Chemistry Laboratory/Multi-Curie Cell until 1991. In 2005, CPP-627 was removed to grade as part of an NTCRA (ICP 2006). Some lines that were part of the drainage system were included in the CPP-601 Deep Tanks System closure because the lines drained to the CPP-601 tanks. These lines remain beneath the CPP-627 pad, and the building footprint is included as part of the CPP-601/627/640 landfill closure.

Building CPP-627 primarily was built as a slab on grade structure. The slab was supported by concrete-filled pipe pillars and, in some areas, deep concrete footings. The building structure was removed essentially to the slab at grade. Subgrade areas, such as the valve pits and Multi-Curie Cell well were filled with concrete. Buried piping was capped at the slab. A concrete pad was poured over the slab area to prevent water infiltration. This pad abuts CPP-601 on the east and CPP-640 on the south. The weight of the existing building floor slab and new concrete pad applies a pressure to the subgrade that is less than the underlying bearing capacity. Long-term displacement or subsidence is not expected.

CPP-640 Headend Processing Plant

The CPP-640 Headend Processing Plant was a 66 × 89-ft structure constructed in 1961 to support research and process development for the uranium reprocessing mission in CPP-601. Fuel processing at CPP-640 ended in June 1984 (DOE-ID 2008).The facility contained two shielded waste-collection tank vaults at the lowest level of the building, five shielded test cells at the mid-level of the building, and an open crane loft with space for chemical makeup equipment and access to the cells through roof hatches at the upper level (DOE-ID 2007a). A major modification in the late 1970s added the shielded mechanical handling cave within the crane loft. The CPP-640 Headend Storage Tank System received decontamination fluids generated in the plant. The tank system comprised two

radiological waste tanks and a nonradiological waste tank. The DEQ approved the certification for the CPP-640 Headend Storage Tank System closure on June 12, 2008 (Monson 2008).

Building CPP-640 was made up of heavily reinforced, 1.5-ft-thick exterior walls and 4.5-ft-thick cell walls and was mostly underground. As part of the CPP-601/640 NTCRA, the interior vessels, large piping, and cells of CPP-640 were filled with grout, which solidified and is contained by the building structure. Because the grout was being placed in lifts and allowed to harden, lateral displacement is not a concern. The majority of the facility was founded on approximately 15 ft of compacted engineered subgrade on basalt bedrock. The weight of the building and grout applies a pressure to the subgrade that is less than the underlying bearing capacity. Long-term displacement or subsidence is not expected.

**ATTACHMENT 1 -
FACILITY LOCATION**

HWMA/RCRA INTEC POST-CLOSURE PERMIT REAPPLICATION

Volume 21
Waste Calcine Facility and CPP-601/627/640

Attachment 1
Section F, Facility Location

April 2013

F. FACILITY LOCATION INFORMATION IDAPA 58.01.05.012 [40 CFR 270.14(b)(11)(i and iii)]

F.1 Seismic Standard

The WCF, CPP-601/627/640, and the entire INTEC are located in Butte County, Idaho, which is not listed in IDAPA 58.01.05.008 (Appendix V to 40 CFR 264) as requiring demonstration of compliance with the seismic standard. Additional seismic information for the INL site is available in the *Volume 3 HWMA/RCRA Part B Permit Application*.

F.2 Floodplain Determination

In January 2006, the DOE-ID provided the contractors with the "Big Lost River Flood Hazard Study, Idaho National Laboratory, Idaho, U.S. Bureau of Reclamation, 2005" by D. A. Ostenna and D. H. O'Connell, to be used for all Big Lost River flood hazard characterization and delineation efforts on the INL. A copy of this study is provided electronically in Appendix IV of the *Volume 3 HWMA/RCRA Part B Permit Application.*

This study will be used for determination of whether or not INTEC units are located within the 100-year floodplain of the Big Lost River. The WCF has been determined to be out of the 100-year floodplain for the Big Lost River. The southwest corner of the CPP-601/627/640 landfill appears to be in contact with the 100-year floodplain of the Big Lost River based on the topographic map (found in Section I of this permit). However, this landfill has no doorways or other openings that would allow floodwaters to enter the landfill. The CPP-601/627/640 landfill sides are sloped to prevent the accumulation of floodwaters and prevent entry of floodwaters into the landfill.

ATTACHMENT 1 - FACILITY TOPOGRAPHIC MAPS

HWMA/RCRA INTEC POST-CLOSURE PERMIT REAPPLICATION

Volume 21
Waste Calcine Facility and CPP-601/627/640

Attachment 1
Section I, Topographic Maps

April 2013

I. TOPOGRAPHIC MAPS

IDAPA 58.01.05.012 [40 CFR 270.14(b)(19)]

This section presents topographic maps and supporting information on prevailing winds; injection, withdrawal, and monitoring wells; surrounding land use; access control; and other structures.

I.1 Topographic Maps

The topographic maps for INL and the INTEC are shown in the *Volume 3 HWMA/RCRA Part B Permit Application*. The topographic map for the INTEC is found in this section of the permit (see Figure I-1).

All of the following maps are found in the *Volume 3 HWMA/RCRA Part B Permit Application*,. Each map includes a date, scale, orientation, and the additional information as identified:

- Map #1—Dubois 1:250,000 (1 in. = 20,833 ft) shows the INL legal boundary and more than 1,000 ft (305 m) around the legal boundary. This map has 200-ft (61-m) contours and shows surface water, surrounding land usage, highways, and legal property boundaries. This map is used in conjunction with Map #2.

- Map #2—Idaho Falls 1:250,000 (1 in. = 20,833 ft) shows the INL legal boundary and more than 1,000 ft (305 m) around the legal boundary. This map has 200-ft (61-m) contours and shows surface water, surrounding land usage, highways, and legal property boundaries. This map is used in conjunction with Map #1.

- Map #3—United States Geological Survey (USGS) topographic map, Circular Butte 3 SW Quadrangle, 1:24,000 (1 in. = 2,000 ft) shows the boundary and more than 1,000 ft (305 m) around the INTEC. This map has 10-ft (3-m) contours and shows surrounding land usage, highways, and legal property boundaries.

The following maps are found in this section of the permit and provide the following information:

- A topographic INTEC map showing a date; map scale; orientation; location of waste management units; runoff control systems; access and entrance roads; lift stations; withdrawal, monitoring, and injection wells; floodplain boundaries, and the facility wind rose (see Figure I-1).

- INTEC map showing the storm and sanitary water systems (see Figures I-2 and I-3).

I.2 Wind Roses

As previously reported, the wind rose data for the INTEC is provided on the INTEC topographic map (see Figure I-1). The diagrams indicate a general southwest to northeast wind direction.

I.3 Injection, Withdrawal, and Monitoring Wells

As previously stated, the locations of injection, withdrawal, and monitoring wells at the INTEC are shown on the INTEC topographic map (see Figure I-1).

I.4 Surrounding Land Use

The federal government, the State of Idaho, and private parties own lands immediately surrounding the INL site. Land uses on federally owned land adjacent to the INL consist of grazing, wildlife management, mineral and energy production, and recreation. State-owned lands are used for grazing, wildlife management, and recreation. Private lands near the INL are used primarily for grazing and farming; irrigated farmlands make up approximately 25% of the land bordering the INL.

Land immediately outside the INL boundaries is used mainly for free-range livestock grazing. Within INL boundaries, approximately 60% of INL land area is open (by permit) to cattle or sheep grazing. Figure I-4 identifies the selected land of the INL and surrounding vicinity. Some irrigation farming occurs in areas near INL boundaries. Large areas of land are irrigated near the Snake River, approximately 20 mi (32 km) southeast of INL, and in the vicinity of Mud Lake.

The small rural communities of Howe, Mud Lake, Atomic City, Butte City, and Arco are scattered around the borders of the INL. The larger communities of Rexburg, Idaho Falls, Blackfoot, and Pocatello are located to the east and southeast of the INL site. The Fort Hall Indian Reservation is located southeast of the INL site.

The INL site and adjacent areas are not likely to experience large-scale residential and commercial development primarily because the INL is remotely located from most developed areas. However, recreation and agricultural uses are expected to increase in the surrounding area in response to greater demand for these types of land uses.

Other uses of the land are severely limited because of the climate, lava flows, and general desert soil characteristics. The only INL land suitable for farming is near the terminations of the Big Lost River, near the town of Howe, and the Little Lost River, approximately 8 mi (13 km) southeast of Howe. Arable land with a moderate irrigation limitation (gravity irrigation) is present on both sides of the Big Lost River and in the remains of the lake bed of prehistoric Lake Terreton (between Mud Lake and Howe). The remainder of the INL, approximately 65% of the surface area, has a low subsurface water-holding capacity, is rocky or covered with basalt, or is classified as having moderate-to-severe limitations for agricultural irrigation.

I.5 Access Control

The INL is a restricted area patrolled by armed security personnel. No unauthorized access is permitted. Access control to the INL is maintained by security personnel stationed in gatehouses on East Portland Avenue, just off U.S. Route 20; on Van Buren Boulevard, just off U.S. Route 20/26; and through an automated gatehouse on Lincoln Boulevard near Test Area North (TAN). Access badges are required to proceed beyond these points.

Access controls in the vicinity of waste management units are described further in Section B of this permit. Details on access controls and specific security features, such as fencing, are discussed in subsequent volumes of this permit as pertinent to specific waste management units.

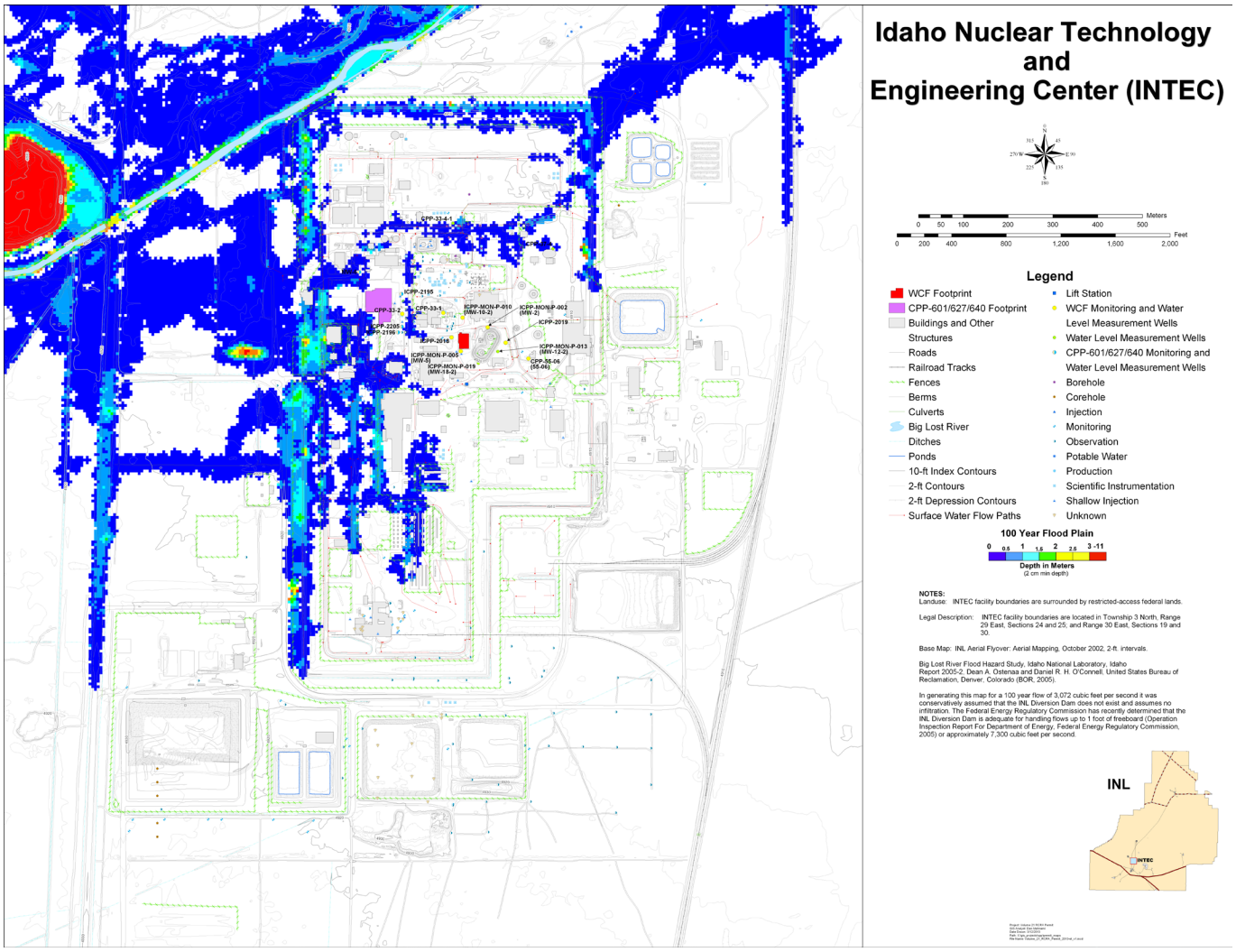


Figure I-1. Topographic map of the INTEC

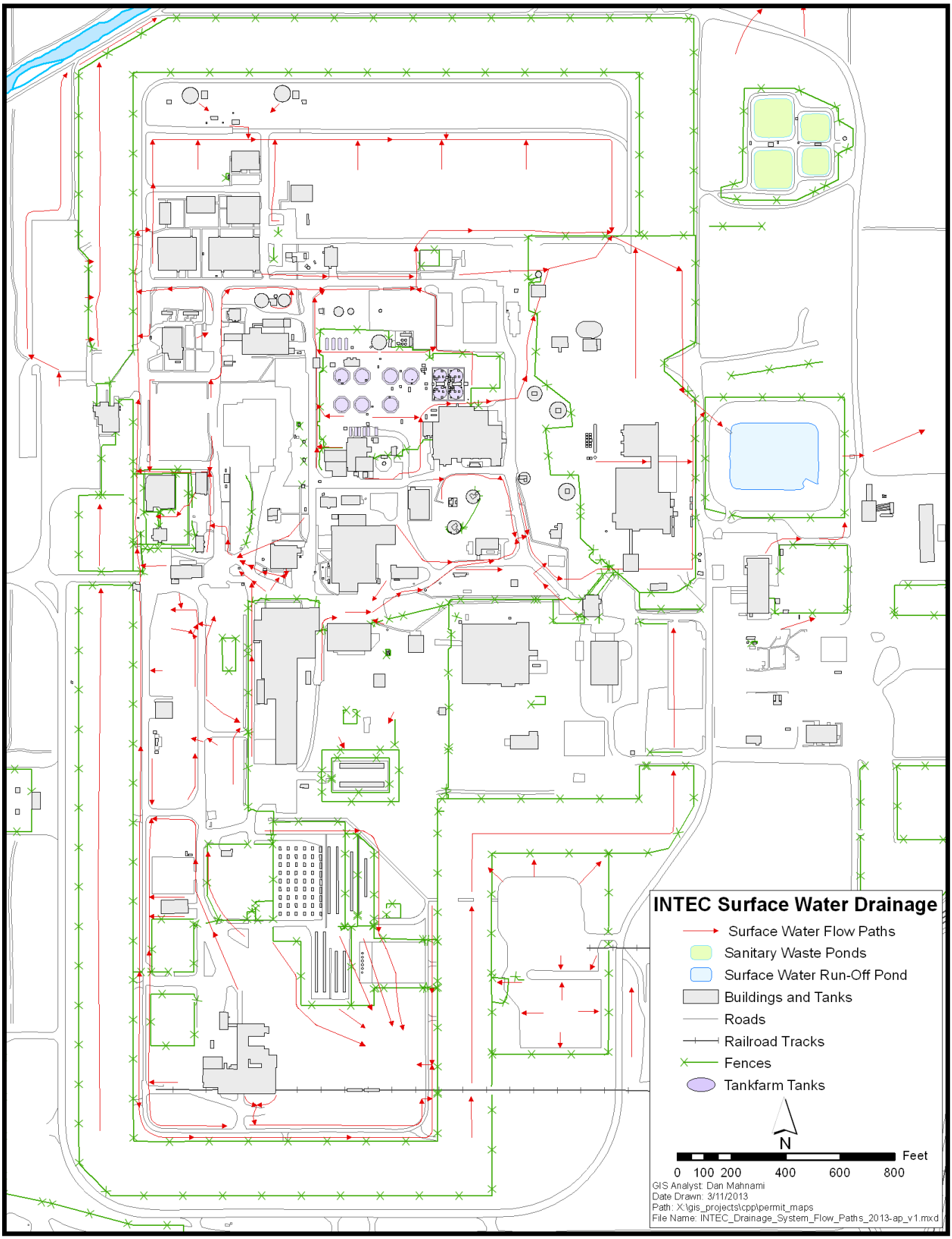


Figure I-2. Plant Drainage System at the INTEC

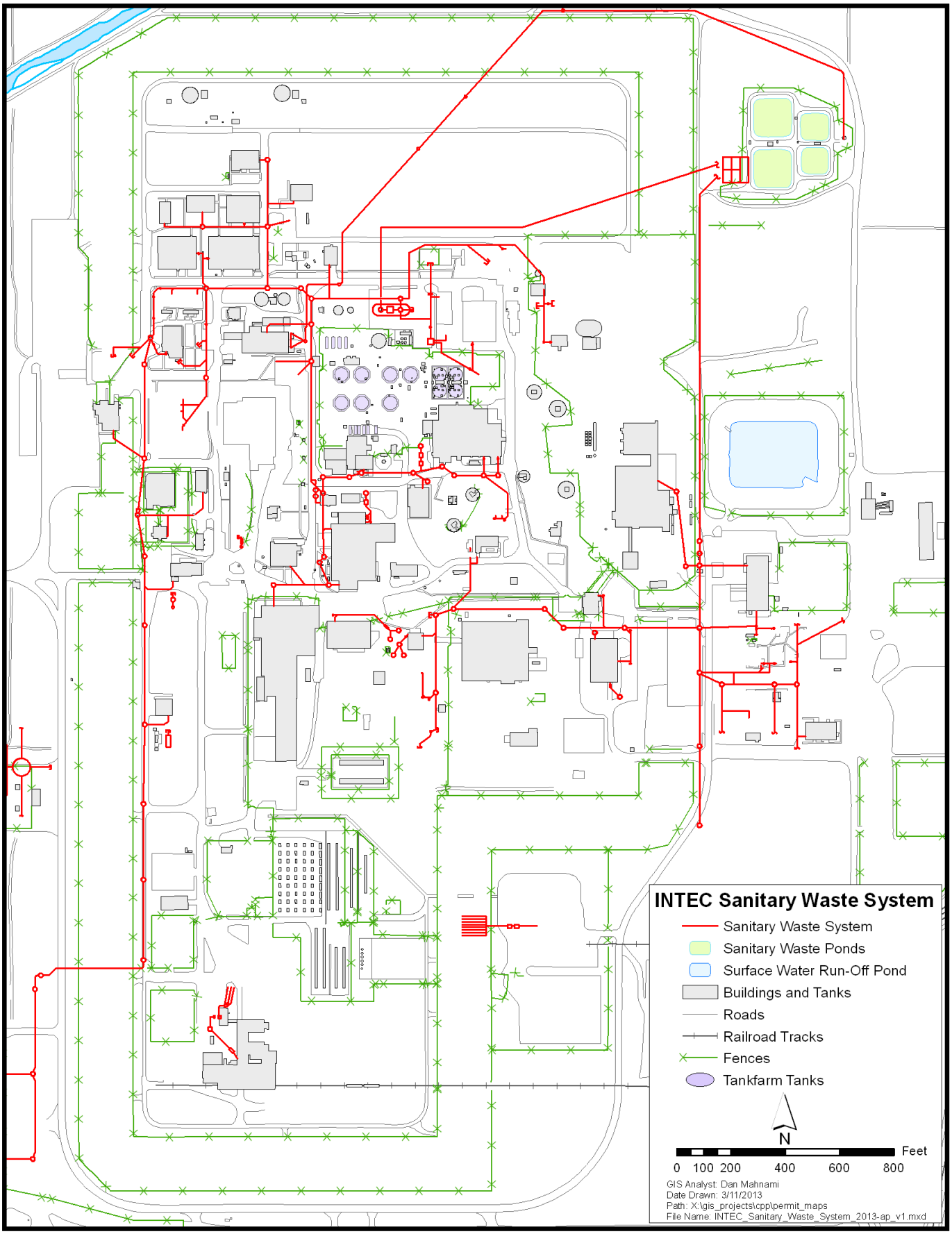


Figure I-3. Plant Sanitary Waste System at the INTEC

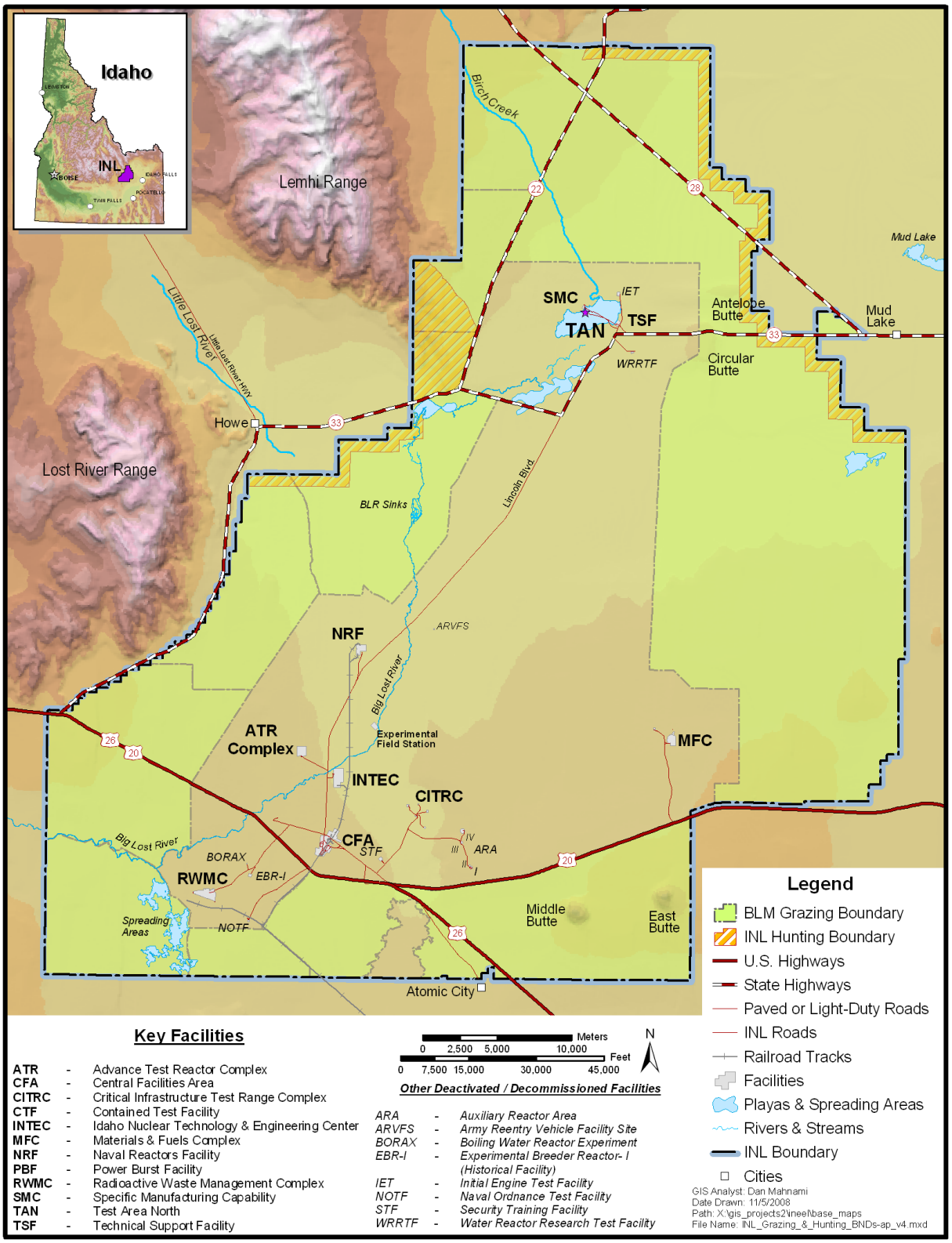


Figure I-4. Selected Land of the INL and Surrounding Vicinity.

I.6 Other Structures

The term "other structures" includes storm and sanitary water systems. These other structures are shown in Figures I-2 and I-3 of this section of the permit. The INL does not have intake or discharge structures.

ATTACHMENT 1
CLOSURE PLANS

HWMA/RCRA INTEC POST-CLOSURE PERMIT REAPPLICATION

Volume 21

Waste Calcine Facility and CPP-601/627/640

Attachment 1

CLOSURE PLANS

HWMA Closure Plan for the Waste Calcining Facility at the INEEL (Rev. 2 – June 1997)

HWMA/RCRA Closure Plan for the CPP-601/627/640 Landfill – Phase 2 (Rev. 2 – September 2010)

HWMA/RCRA Post-Closure Plan for the CPP-601/627/640 Landfill (Rev. 1 – December 2009)

HWMA/RCRA Landfill Closure Plan for the CPP-601 Deep Tanks System – Phase 1 (Rev. 2 – January 2009)

April 2013

Idaho
National
Engineering
Laboratory

INEEL-96/0189
REV 2

June 1997

HWMA Closure Plan for the Waste Calcining Facility at the Idaho National Engineering and Environmental Laboratory

LOCKHEED MARTIN

INEEL-96/0189
REV 2

HWMA Closure Plan for the Waste Calcining Facility at the Idaho National Engineering and Environmental Laboratory

Published June 1997

Idaho National Engineering and Environmental Laboratory
NEPA/Permitting Department
Lockheed Martin Idaho Technologies Company
Idaho Falls, Idaho 83415

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

The Waste Calcining Facility houses a group of Hazardous Waste Management Act/Resource Conservation and Recovery Act Treatment, Storage, and/or Disposal units having interim status. These units processed radioactive and hazardous mixed wastes from 1963 through 1987 and now require closure. The radioactive and hazardous mixed constituents cannot be safely, practically, or cost-effectively removed from the Waste Calcining Facility. Therefore, it will be capped and closed, using the closure standards in Subpart 40 of the Code of Federal Regulations Number 265.111 and the landfill closure and post-closure standards in 40 CFR 265.310, as incorporated by reference in 16.01.05.009 of the Idaho Administrative Procedures Act regulations. The Waste Calcining Facility will be closed by the installation of a concrete cap over the ground floor of the building. The post-closure care management of the Waste Calcining Facility will be assumed by the Comprehensive Environmental Response, Compensation, and Liability Act program at the Idaho Chemical Processing Plant. The footprint of the Waste Calcining Facility cap will impact one CERCLA release site below the Waste Calcining Facility building, three CERCLA release sites external to the building, and the soils around the Waste Calcining Facility. Implementing closure in place is not expected to preclude the final disposition of CERCLA release sites close to the Waste Calcining Facility. Standard construction and excavation practices will be followed at this site if excavation up to or under the cap is determined as the removal response of choice.

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ACRONYMS

ALARA	as low as reasonably achievable
APS	Atmospheric Protection System
ARAR	applicable or relevant, and appropriate requirements
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
CSSF	Calcined Solid Storage Facility
CPP	Chemical Processing Plant
DOE	U.S. Department of Energy
DOE-ID	U.S. Department of Energy, Idaho Operations Office
EA	Environmental Assessment
EPA	U.S. Environmental Protection Agency
FFA/CO	Federal Facility Agreement/Consent Order
HWMA	Hazardous Waste Management Act
HEPA	high-efficiency particulate air
ICPP	Idaho Chemical Processing Plant
IDAPA	Idaho Administrative Procedures Act
IDHW	Idaho Department of Health and Welfare
INEEL	Idaho National Engineering and Environmental Laboratory
LMITCO	Lockheed Martin Idaho Technologies Company
NEPA	National Environmental Policy Act
NWCF	New Waste Calcining Facility
OU	Operable Unit
PEW	Process Equipment Waste

RCRA	Resource Conservation and Recovery Act
RI/FS	remedial investigation/feasibility study
ROD	Record of Decision
WAG	Waste Area Group
WCF	Waste Calcining Facility
WERF	Waste Experimental Reduction Facility

HWMA Closure Plan for the Waste Calcining Facility at the Idaho National Engineering and Environmental Laboratory

1. INTRODUCTION

The Waste Calcining Facility (WCF) calcined and evaporated aqueous wastes generated from the reprocessing of spent nuclear fuel. The calciner operated from 1963 to 1981, primarily processing high-level waste from the first cycle of spent nuclear fuel extraction. Following the calciner shutdown, the evaporator system concentrated high-activity aqueous waste from 1983 until 1987. In 1988, the U.S. Department of Energy Idaho Operations Office (DOE-ID) requested interim status for the evaporator system in anticipation of future system use. The evaporator system has not been operated since it received interim status. At the present time, DOE-ID has completed construction on a new evaporator at the New Waste Calcining Facility (NWCF), and the evaporator at the WCF is not needed. The decision to "not use" the WCF evaporator requires Lockheed Martin Idaho Technologies Company (LMITCO) and DOE-ID to close these units.

The WCF closure alternatives were evaluated and documented in an Environmental Assessment (EA) using the Department of Energy (DOE) National Environmental Policy Act of 1969 (NEPA) process. DOE has determined it is impractical to clean close the WCF units, due to the radiation fields in the cells. Removing the remaining waste, waste residues and contaminated structures and equipment does not meet as low as reasonably achievable (ALARA) worker radiation exposure and health and safety goals. Removing the remaining waste, waste residues and contaminated structures and equipment would generate large quantities of additional radioactive and mixed wastes. The time and cost to reduce the high radiation fields associated with the waste residues in the interim status units, calciner vessel and associated off-gas system, and containment cells are prohibitive. After a detailed evaluation of the closure options in the EA, the preferred and safest option is to close the regulated units by filling voids (grouting vessels, cells and waste piles) and capping the WCF to meet the requirements applicable to the closure of landfills under the Hazardous Waste Management Act (HWMA). This preferred alternative also includes closure of the calciner vessel and off-gas system and other contaminated structures and equipment. A risk assessment prepared to support the EA, using the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) methodologies, indicates closure of the WCF will not pose a significant risk to human health and the environment. CERCLA methodologies for the risk assessment were used to ensure consistency with the Federal Facility Agreement/Consent Order (FFA/CO) (CERCLA Process). The CERCLA process will determine how the WCF post-closure care and monitoring requirements will be implemented.

This closure plan, implements the preferred alternative for the closure of the WCF, including the regulated units, the calciner vessel and off-gas system, and contaminated structures and equipment. The WCF will be covered with a concrete cap that meets the closure standards identified in Idaho Administrative Procedures Act (IDAPA) 16.01.05.009 [40 Code of Federal Regulation (CFR) 265.111 and 265.310].

2. SITE DESCRIPTION

The Idaho National Engineering and Environmental Laboratory (INEEL.) is located approximately 29 miles (mi) west of Idaho Falls, Idaho. The Idaho Chemical Processing Plant (ICPP) is situated on the south-central portion of the INEEL site, as indicated in Figure 1 and occupies an enclosed and secured area of approximately 1 km^2 (250 acres). The WCF [Building Number Chemical Processing Plant (CPP)-633] is located near the center of the ICPP, as shown in Figure 2.

The ICPP primary mission is to safely and cost-effectively manage the radioactive and hazardous waste produced from past spent nuclear fuel processing activities. The WCF contains an evaporator tank system that includes several vessels contained in concrete vaults or cells, and the associated piping, pumps, and floor drains. The calcining process converted high-level radioactive liquid waste into a solid form for dry storage. The WCF converted more than 15.2 million liters (4 million gallons) of high-level liquid waste to less than 2,180 m^3 (77,000 ft^3) of calcine between 1963 and 1981. All of the calcined product was transferred to interim storage at the Calcined Solid Storage Facility (CSSF), pending further treatment and ultimate disposition in a geological repository. The liquid wastes processed in the WCF contained varied amounts of hazardous constituents, and radiological contaminants.

2.1 Description of the WCF

The WCF boundaries encompassed by the closure activities are the outside walls and floors of the underground portion; the aboveground structure; product transfer lines 23 m (77 ft) from the east wall; and the liquid waste, ventilation, and utility piping out to the first valve box, as indicated in Figure 3. The WCF is a heavily reinforced concrete structure with approximately 1600 m^2 (17,250 ft^2) total floor space made up of a ground level and two levels below grade, within a 21 $\times$ 33 m (70 $\times$ 108 ft) footprint, as pictured in Figures 4 through 9. As shown, processing levels are below grade in two banks of cells separated by common operating and access corridors. Nonradiation service areas are located in the aboveground superstructure, erected of concrete block and steel construction. Design and operation of the WCF utilized lead shielding in many of the below-ground cells; pipe corridors; and sample and monitoring stations, to protect workers from high-radiation fields. This shielding is located inside cell walls or in areas heavily contaminated with radioactive constituents.

The interim status regulated units in the WCF are the evaporator tank system and the high-efficiency particulate air (HEPA) filter waste pile, described in Table 1. The evaporator system is comprised of the blend and hold tanks (WC-100 and -101), scrubber tank (WC-108), evaporator (WC-114), and bottoms tank (WC-119), and associated piping. The waste hold tanks, WC-100 and -101 (Process Code S01 - Tank Storage), allowed blending feeds of different composition from the Tank Farm, provided a point for sampling the evaporator feed, and functioned as surge tanks to ensure continuous feed. The quench surge tank, WC-108 (Process Code S01 - Tank Storage), contained the scrubbing solution for quenching (cooling) of the off-gas and removal of the solids from the decomposition gases. The feed evaporator, WC-114 (Process Code T04 - Evaporation), was used to evaporate and concentrate high level waste as a Thermal Treatment Unit with a treatment capacity of 1,440 gallons per day. Vessel WC-119 (Process Code S01 - Tank Storage) is a sump tank located

in the lowest cell of the WCF. WC-119 is currently used to collect steam condensate from building heating and rainwater leaks in the roof that drip on the floor. This moisture is collected through open floor drains. The water collected in WC-119 may contain radionuclides and mercury slightly above 0.2 mg/L and is transferred to the Process Equipment Waste (PEW) facility for treatment. The HEPA filter waste pile (Process Code S03 - Waste Pile Storage) consists of five HEPA filter boxes in the filter cell.

WCF closure activities encompass additional equipment and tanks described in Table 2 that were not included on the INEEL HWMA Part A Application since operation of these tanks and equipment was never intended after promulgation of Resource Conservation and Recovery Act (RCRA) regulation. The calciner and off-gas system include vessels WC-102, -107, -110, -111, -112, -113, -130, -147, -148, and on-line HEPA filters and associated piping, as depicted in Figure 10. Figure 3 depicts the boundary of the closure activity and illustrates the piping that will be grouted from locations external to the WCF building. 3"-PLA-101111 PEW line is ancillary to VES-WC-119, Hot Sump Tank. 3" PLA-101111 will be grouted from valve box #D4 (see Figure 3), located approximately 23 m (129 ft) from the north wall of the WCF. The pipe line beyond #D4 to the PEW is the active discharge line from NWCF to the PEW. 3"-PUA-3004 and 3" PUA-3005, tank farm lines are ancillary to VES-WC-100/101, Waste Hold Tanks. These lines will be grouted from valve box #B4, located approximately 119 m (389 ft) from the north wall of the WCF. The waste line beyond #B4 is the active transfer line from the Tank Farm to the NWCF. The 3"-TAA-3001 and 3"-TAA-3009 product transport lines to the bin sets, are ancillary to VES-WC-102 the Calcine Vessel, a non-interim status hazardous waste unit. These lines will be grouted from an access point used to add decontamination solutions during operations. This access point is located 23 m (77 ft) from the east wall of the WCF. The line beyond the grout addition point is considered ancillary to the CSSF and will be closed when the CSSF is closed. The other lines to the bin sets were not considered for closure at this time because of the inability to prevent the grout from flowing back into the bin sets which would complicate removal of calcine from the bin sets in the future.

All of these lines lie outside the footprint of the closure cap and will be decontaminated by rinsing the hazardous constituents from the pipe back under the cap into their respective tanks or vessels with the grout solution. The highly dilute grout solution is as effective as water as a decontamination solution in the pipes. In addition, the grout offers the benefit of being abrasive in nature and tends to scour waste residue from the interior of the pipes. The closure of the WCF as proposed in this Closure Plan was the subject of a risk assessment prepared to fulfill NEPA requirements. This risk assessment considered the proposed closure configuration of the WCF using a protocol similar to that utilized by CERCLA. The WCF risk assessment will be considered in the CERCLA evaluation of the ICPP and the remedial investigation/feasibility study (RI/FS) to be used for the Waste Area Group (WAG) 3 Record of Decision (ROD).

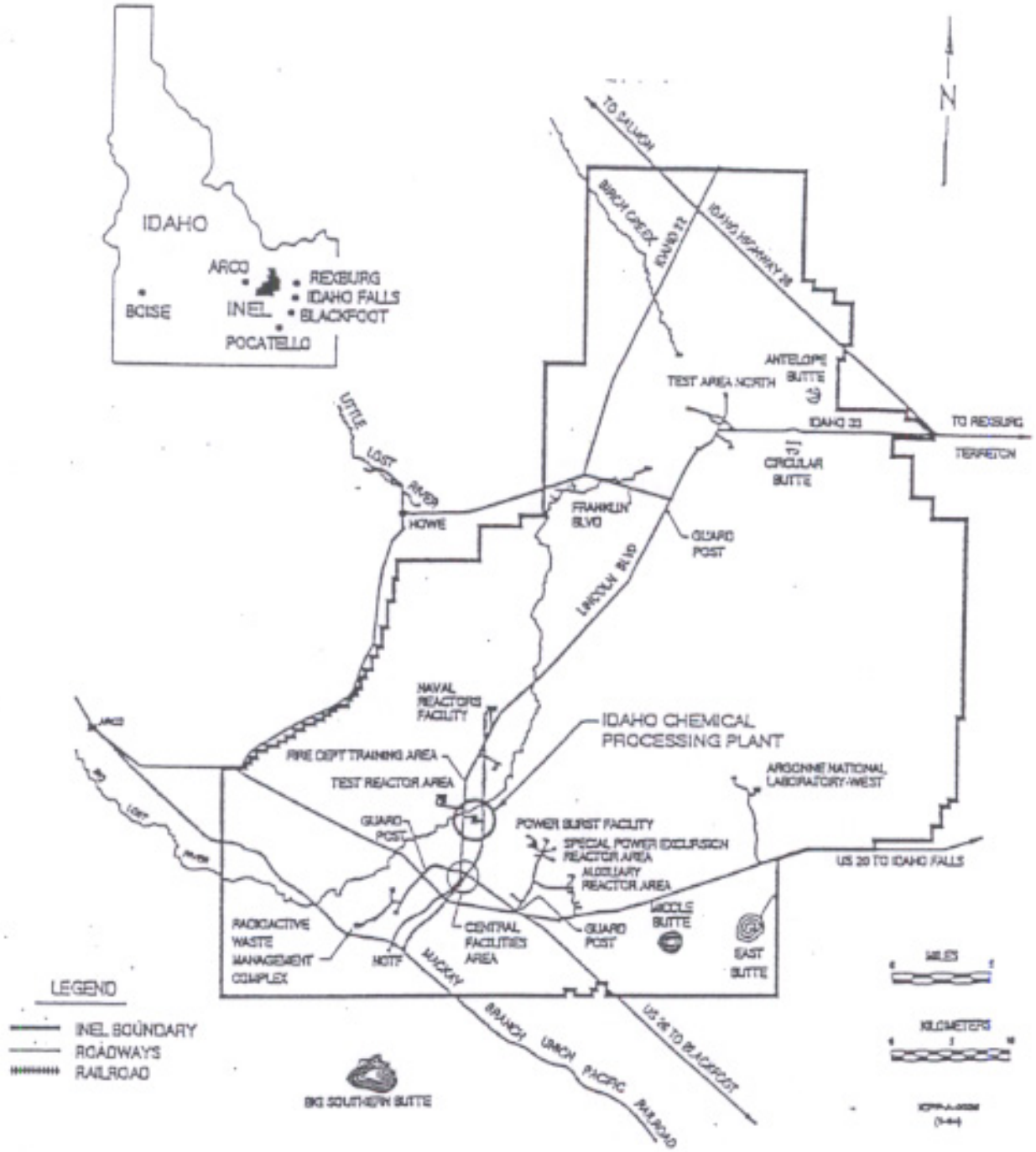


Figure 1. Map of the INEL depicting the location of the ICPP.

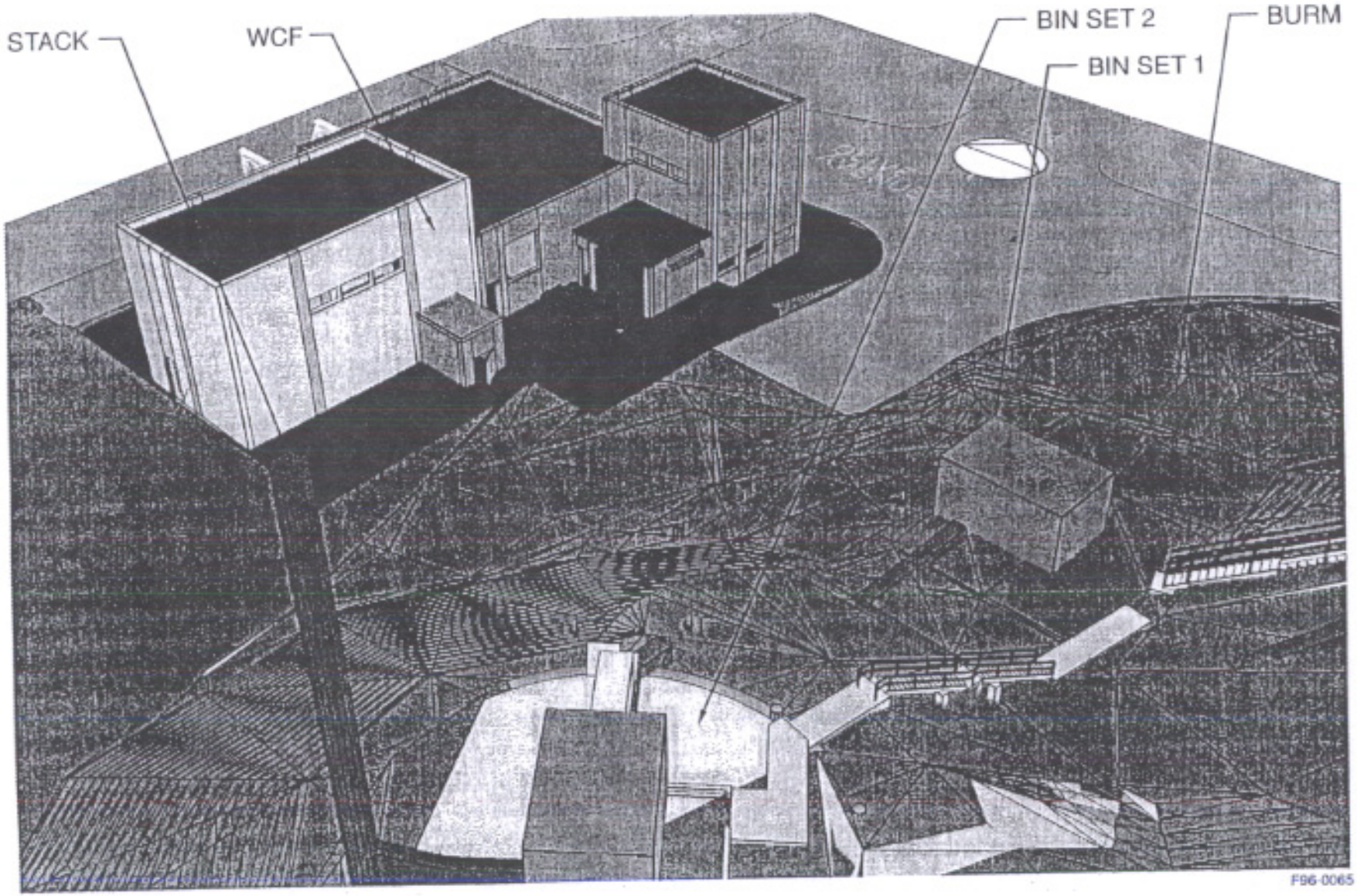
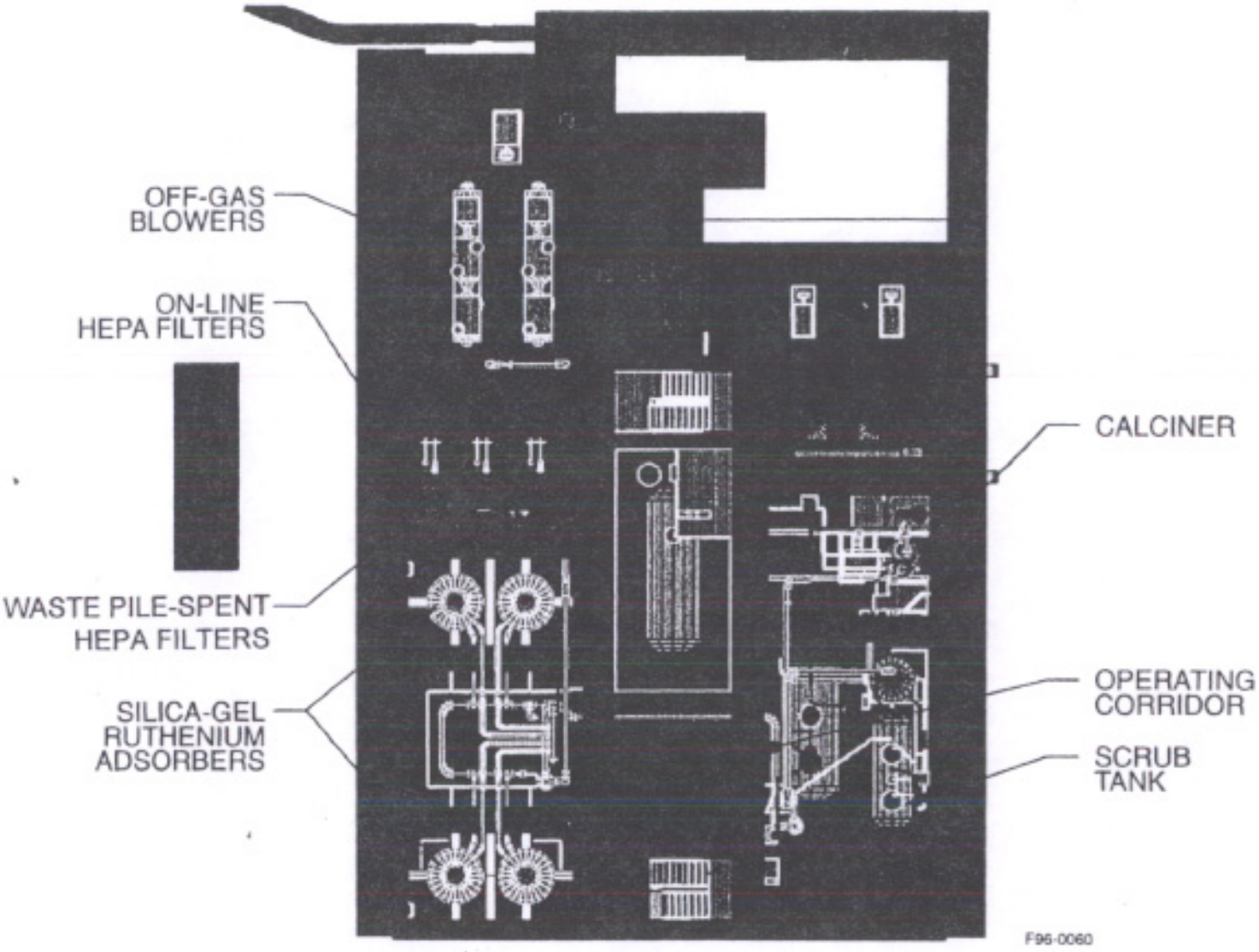


Figure 4. WCF-AS IS.



WASTE CALCINATION FACILITY PLAN

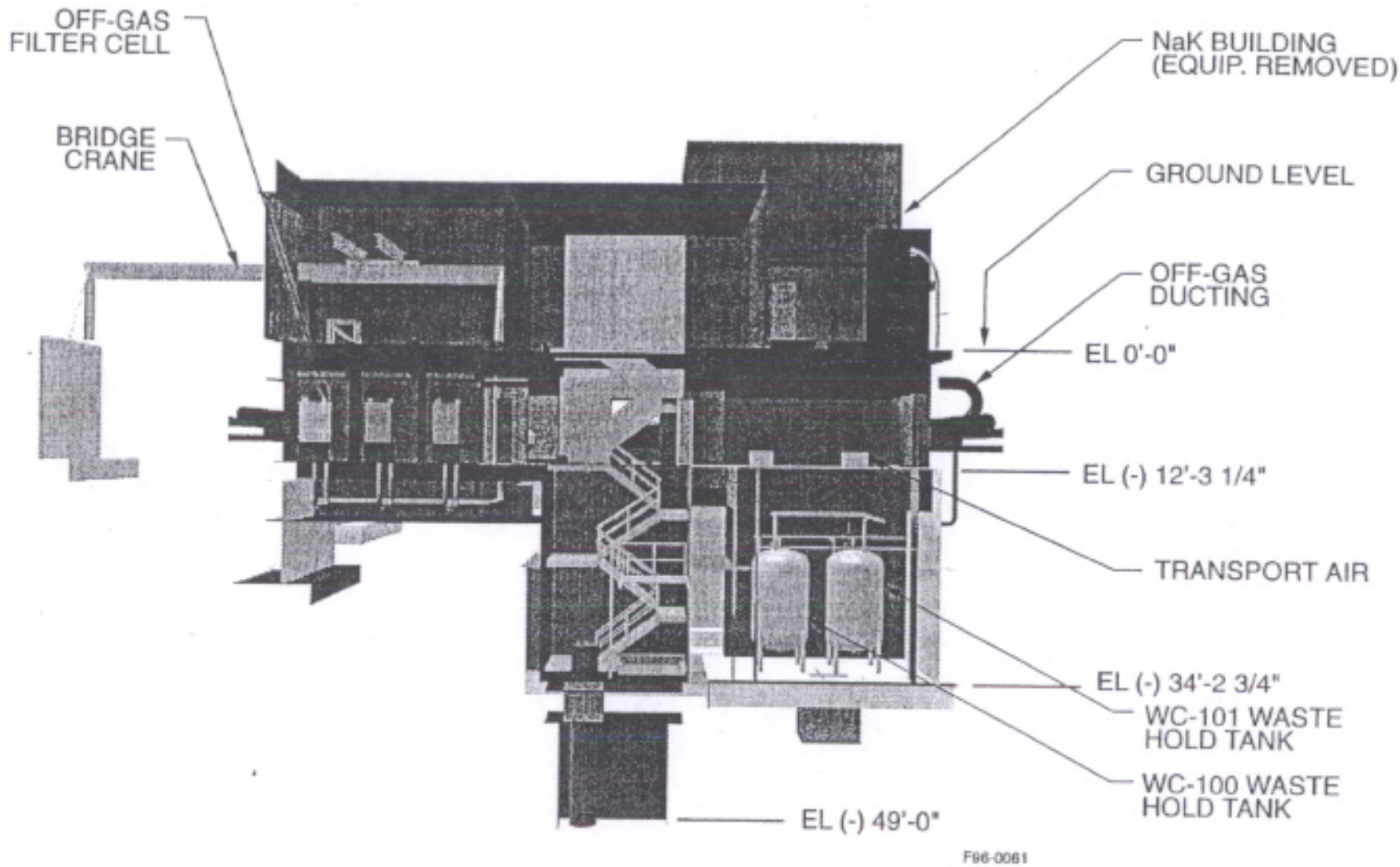


Figure 6. WCF—looking north.

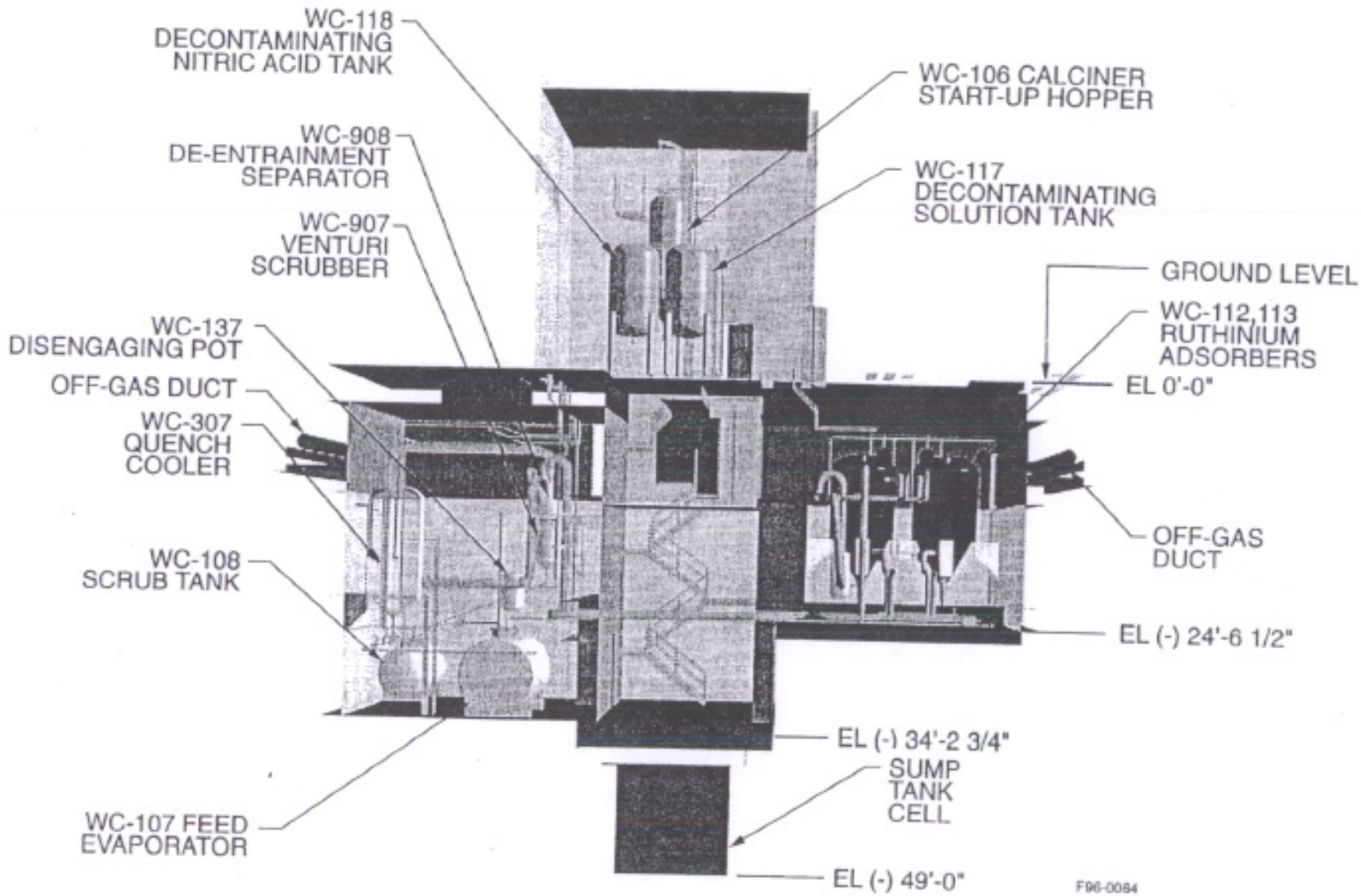


Figure 7. WCF—looking south.

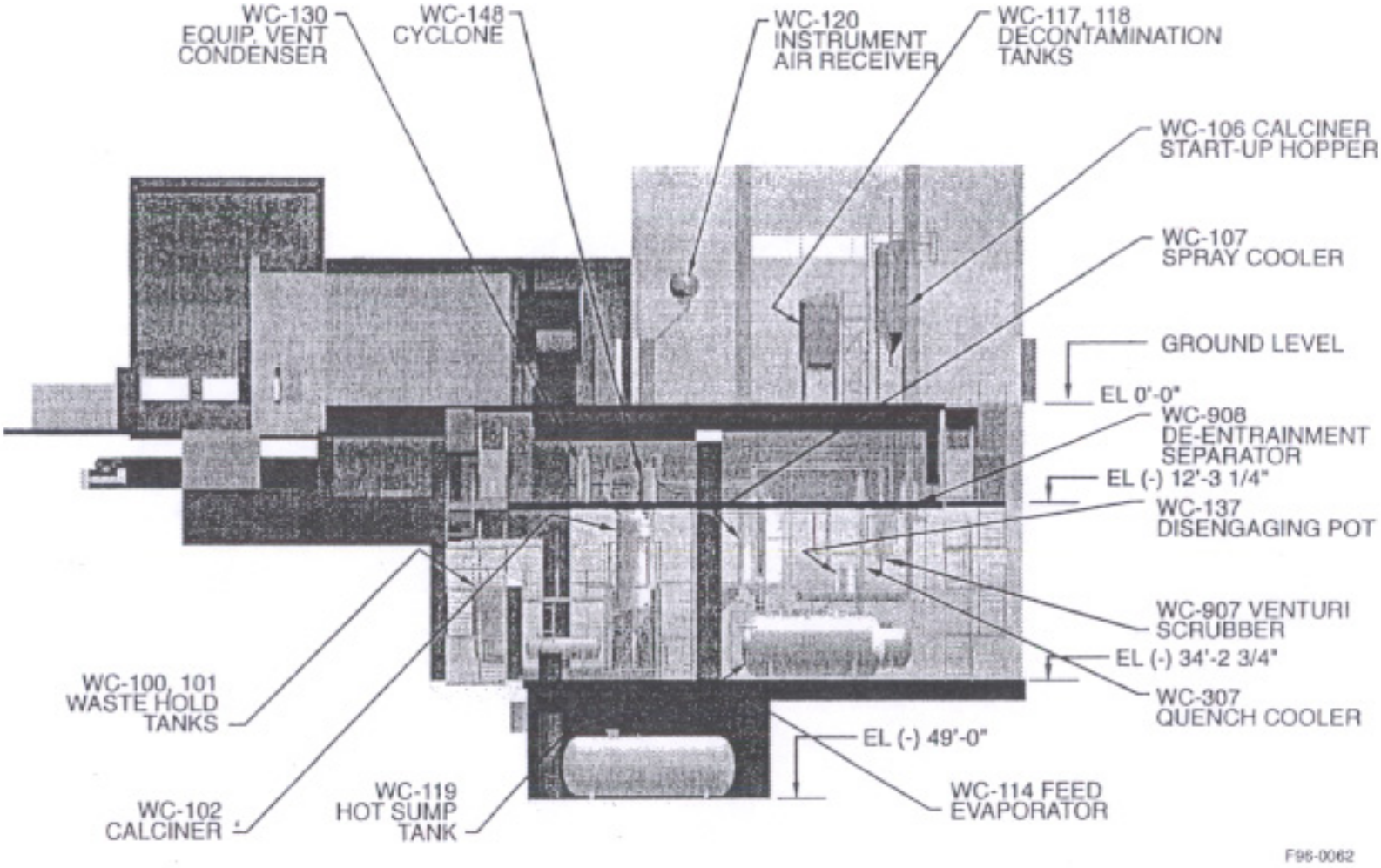


Figure 8. WCF—looking east.

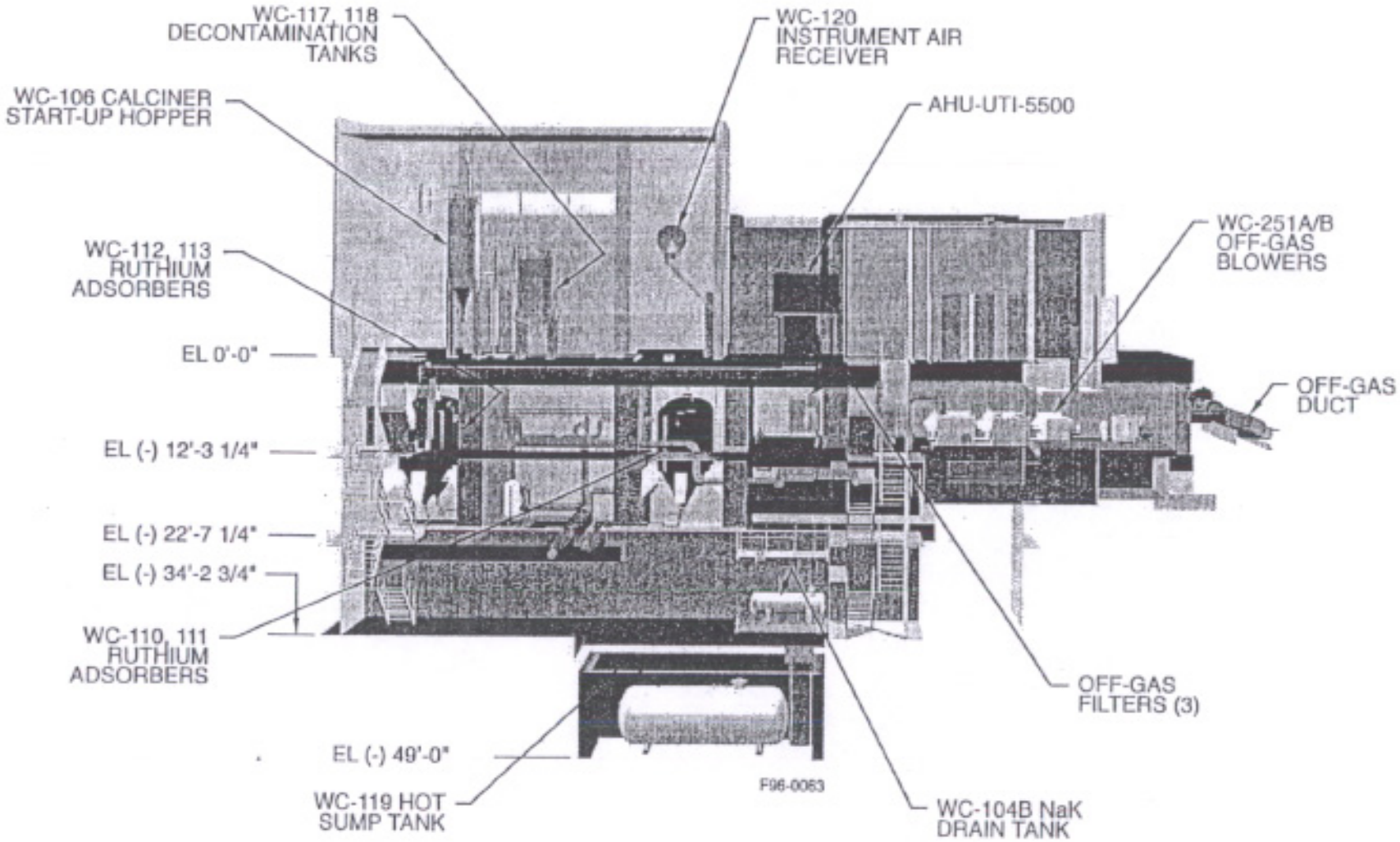


Figure 9. WCF—looking west.

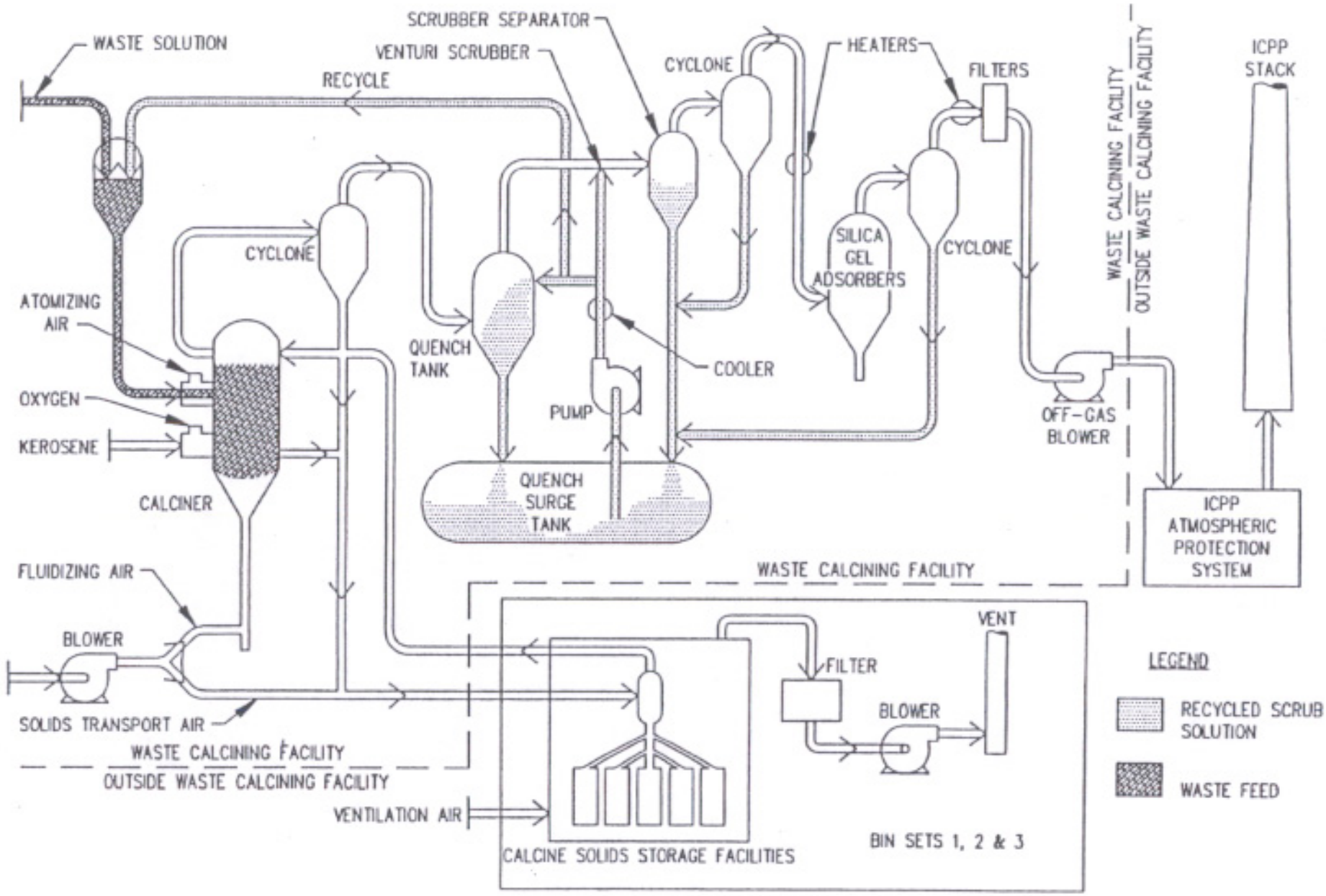


Figure 10. Schematic diagram depicting the calcining process.

The WCF tanks and vessels that will be filled with grout during the closure activities are listed in Table 1 and Table 2. Schematics of the ancillary equipment are included in Appendix B to the Closure Plan. Appendix A, B, and C include the WCF Closure Sequence Chart, the Grouting Schematic Sketches, and the RCRA Closure Room Cell Grouting, Placement Sequence (Table V-1), respectively, from the Comprehensive Work Plan for the Waste Calcining Facility RCRA Closure Project. The Appendices have been added to the Closure Plan to increase the understanding of how building CPP-633 in its entirety will be closed.

Table 1. Interim Status Permitted Hazardous Waste Units

Tank Number and Name	Operational Allowance under Interim Status	Appendix B Schematic Depicting the Unit	Tank Location	Waste Line(s) Ancillary to the Unit	Unit Capacity and Composition
WC-100 Waste Hold Tank	S02 - Tanks Storage	Page 181	Waste Hold Tanks Cell	3" PUA-3004 3" PUA-3005	280 ft^3 (2,090 gal) Stainless Steel
WC-101 Waste Hold Tank	S02 - Tank Storage	Page 185	Waste Hold Tank Cell	3" PUA-3004 3" PUA-3005	280 ft^3 (2,090 gal) Stainless Steel
WC-108 Quench Surge Tank	S02 - Tank Storage	Page 205	Off-gas Cell	No Waste Lines outside of CPP-633	272 ft^3 (2,035 gal) Stainless Steel
WC-114 Feed Evaporator	T04 - Evaporation	Page 186	Off-gas Cell	No Waste Lines outside of CPP-633	726 ft^3 (5,430 gal) Stainless Steel
WC-119 Hot Sump Tank	S02 - Tank Storage	Page 193	Hot Sump Tank Cell	3" PLA-101111	760 ft^3 (5,654 gal) Stainless Steel
HEPA Filter Waste Pile	S03 - Waste Pile Storage	Not Applicable	Filter Cell	Not Applicable	1 m^3 (35.3 ft^3) Stainless Steel

Table 2. Non-Interim Status Permitted Units

Tank Number and Name	Tank Location	Tank Size
WC-110 Ruthenium Adsorber	Adsorber Cell	384 ft^3 (2,870 gal)
WC-111 Ruthenium Adsorber	Adsorber Cell	384 ft^3 (2,870 gal)
WC-112 Ruthenium Adsorber	Adsorber Cell	384 ft^3 (2,870 gal)
WC-113 Ruthenium Adsorber	Adsorber Cell	384 ft^3 (2,870 gal)
WC-107 Quench Tower	Off-gas Cell	252 ft^3 (1,885 gal)
WC-102 Calciner Vessel	Calciner Cell	240 ft^3 (1,800 gal)
WC-908 De-entrainment Separator	Off-gas Cell	33 ft^3 (250 gal)
WC-130 Equipment Vent Condenser	Calciner Cell	30 ft^3 (225 gal)
WC-124/148 Calciner Cyclone	Calciner Cell	20 ft^3 (150 gal)
WC-147 Mist Eliminator	Off-gas Cell	16 ft^3 (118 gal)
WC-149 Vertical Demister	Adsorber Cell	13.4 ft^3 (100 gal)
WC-307 Quench Cooler	Off-gas Cell	10.2 ft^3 (77 gal)
WC-305 Off-Gas Heater	Off-gas Cell	10 ft^3 (75 gal)
WC-105 Calciner Feed Tank	Calciner Cell	8 ft^3 (57 gal)
WC-137 Disengaging Pot	Off-gas Cell	8 ft^3 (57 gal)

Table 3 follows and identifies the listed and characteristic hazardous wastes numbers assigned to the tank farm waste that was subsequently treated in the WCF processes. These hazardous waste numbers have been assigned to the mixed wastes since they are mixed with and/or derived from waste designated with these hazardous waste numbers. The waste that was actually treated in the WCF was comprised primarily of water and nitric acid with small amounts of metal contaminations and trace quantities of the chemical compounds in Table 3.

Table 3. Listed and characteristic wastes determined to have been discharged into the Tank Farm at the ICPP

Constituent	Waste numbers	Constituent	Waste numbers
Arsenic	D004	Chloroform	U044
Barium	D0051,	4-dioxane	U108
Chromium	D007	Isobutyl alcohol	U140, and F005
Lead	D008	Lead acetate	U144
Mercury	D009	Mercury	U151
Selenium	D010	Methylene chloride	U080, and F002
Silver	D011	Methyl ethyl ketone	U159, and F005
Acetonitrile	U030	Methyl iodide	U138
Ammonium vanadate	P119	Phenol	U188
Carbon disulfide	F005	Potassium cyanide	P098
Formaldehyde	U122	Pyridine	U196, and F005
Formic acid	U123	Selenium dioxide	U204
Hydrazine	U133	Silver cyanide	P104
Hydrogen fluoride	U134	Sodium cyanide	P106
2-nitropropane	F005, and U171	Tetrachloroethylene	U210, and F002
Sodium azide	P105	Toluene	U220, and F005
Thiourea	U219	1,1,1-trichloroethane	U226, and F002
Vanadium oxide	P120	1,1,2-trichloroethane	U227, and F002
Aniline	U012	Trichloroethylene	U228, and F002
Benzene	U019, and F005		
Bromoform	U225		
Carbon tetrachloride	U211, and F002		
_____			

a. Documentation identifies these chemicals as being used, but to such a minor extent, that no documentation exists to estimate what the total volumes are.

2.2 Operating History

Nine calcination campaigns were completed at the WCF, beginning in 1963 and ending in 1981, when the WCF was replaced by the NWCF. The calcining process involved using high temperature to evaporate and oxidize the liquid high-level waste in a fluidized bed. Liquid waste was transferred from the ICPP tank farm to the WCF through underground pipelines. The liquid waste, which consisted of metals and nitrates in an aqueous solution, was injected into the calciner vessel, where it was heated. The original heat source was indirectly supplied by liquid sodium; a conversion was later made to in-bed combustion of kerosene and oxygen. As the water evaporated, nitrates were converted to nitrogen oxides (NO_x), and water and the dissolved metals formed oxides and salts at 500°C (932°F). Calcined solids were then pneumatically transferred through underground pipelines to Binsets 1, 2, and 3 in the CSSF.

Process off-gases, NO_x and water vapor, were quenched (cooled) using a nitric acid solution. Depleted quench solution was processed as calciner feed solution or transferred to the tank farm for storage. Cooled off-gas was passed through silica-gel adsorbers to capture radioactive ruthenium, a volatile contaminant. The off-gas also passed through a bank of HEPA filters before being discharged to the ICPP Atmospheric Protection System (APS). The APS has continued to maintain negative pressure on the WCF system since 1981.

2.3 Decontamination Efforts

When the WCF calciner stopped operations in 1981, the system was emptied and the calciner and off-gas cells were cleaned. A review of the WCF operations logbook indicates that when the final calcining campaign was completed on March 16, 1981, the remaining calcined product was transferred to the CSSF for storage, pending further treatment for final disposition in a geological repository. The fluidized bed was removed from the calciner; and the process and transfer lines were "dusted" out with high-pressure, high-volume compressed air on March 20, 1981. Cells containing the process vessels were flushed with fire hoses through the cell hatches on March 23, 1981, to remove waste residues that may have leaked from process line valves in the cells. The calciner vessel was later flushed on December 17, 1984, and the wash water transferred to the PEW for treatment. When the WCF evaporator system was placed on standby in 1987, tanks were drained and the waste was transferred to the PEW for treatment. The steam condensate and rainwater are collected in vessel WC-119 and transferred to the PEW approximately every 1 to 3 months, depending on the time of year.

The out-of-cell operating areas were not decontaminated at the time the facility was shut down. Since 1993, a concerted effort has been made to decontaminate (chemical, radioactive, and asbestos removal) the access areas (aboveground rooms and operating corridors) of the WCF. The cell floors were visually examined, using remote inspection video cameras in 1993 and 1994. The comprehensive inspection did not reveal any accumulation of calcine in the cells.

2.4 Regulatory Status

The WCF contains several interim status waste management units included in the INEEL. HWMA Part A Permit Application, subject to the requirements of IDAPA 16.01.05.009, *Interim*

Status Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities, 16.01.05.009 (40 CFR 265 Subpart J: "Tanks") and IDAPA 16.01.05.009 (40 CFR 265 Subpart L: "Waste Piles"). The tank systems in the WCF do not comply with all requirements for secondary containment in IDAPA 16.01.05.009 (40 CFR 265 Subpart J), thus requiring the preparation and submission of a closure and post-closure plan. The Operating Permits Bureau stated in their letter dated March 27, 1995, if all contaminated system components, structures, and equipment cannot be decontaminated, the tank systems must be closed, in accordance with the closure and post-closure requirements that apply to landfills, IDAPA 16.01.05.009 (40 CFR 265 Subpart N). IDAPA 16.01.05.009 (40 CFR 265 Subpart J) requires that tank units be closed in accordance with the closure and post-closure requirements that apply to landfills, if the operator cannot practicably remove or decontaminate the soils. IDAPA 16.01.05.009 (40 CFR 265 Subpart L) regulations for waste piles also require preparation of closure and post-closure plans, if the operator cannot remove or decontaminate the subsoils.

Since it is not practical to remove all of the waste residues, decontaminate the equipment, and remove the HEPA filters in the waste pile, the WCF will be closed in accordance with the closure and post-closure requirements that apply to landfills. The potential for migration of hazardous waste from the residues in tanks, cells, and the waste pile is low, because they are completely contained within the WCF (Building CPP-633) and will be covered with a concrete cap. The potential for a post-closure release from the WCF as a capped landfill is addressed in the ROD for WAG 3 as part of the FFA/CO. The closure process and cap has been designed to minimize the exposure of workers, the public, and the environment to residual hazardous and radiological constituents remaining in place.

2.4.1 Related Issues—CERCLA

The ICPP includes CERCLA release sites and HWMA interim status and permitted units. In many cases an HWMA unit sits within or over a release site. Typically, an HWMA unit is bound by the building and waste piping to and from the building. The soil around and under the HWMA unit is covered by agreement in the FFA/CO by CERCLA as related to past contaminant releases. Release sites at the ICPP are grouped together and managed as WAG 3. Therefore, when the HWMA units are closed to landfill closure standards, the comprehensive RI/FS for the ICPP would consider any residual risk that may exist for a release from the closed WCF, including waste pipe lines closed outside the footprint of the closure cap (see Figure 3), and at release sites outside the WCF. The WCF is located within the CERCLA WAG 3, with four release sites associated with the cap footprint. These release sites, CPP-36, -48, -85, and -91 (see Figure 11), are part of the remedial investigation at ICPP. The ROD for the Operable Unit (OU) 3-13, WAG 3 Comprehensive RI/FS will address the remedial actions required for these release sites. The WCF closure and post-closure activities are not expected to preclude the selection of remedial actions for the CERCLA release sites in close proximity to the WCF. Since closure activities include grouting the off-gas duct (CPP-85), the CERCLA Program has reviewed this activity. A letter from the INEEL FFA/CO Project Managers approving the action is included as Figure 12.

The design features of the HWMA cap must be considered by OU 3-13 in the evaluation of remedial actions.

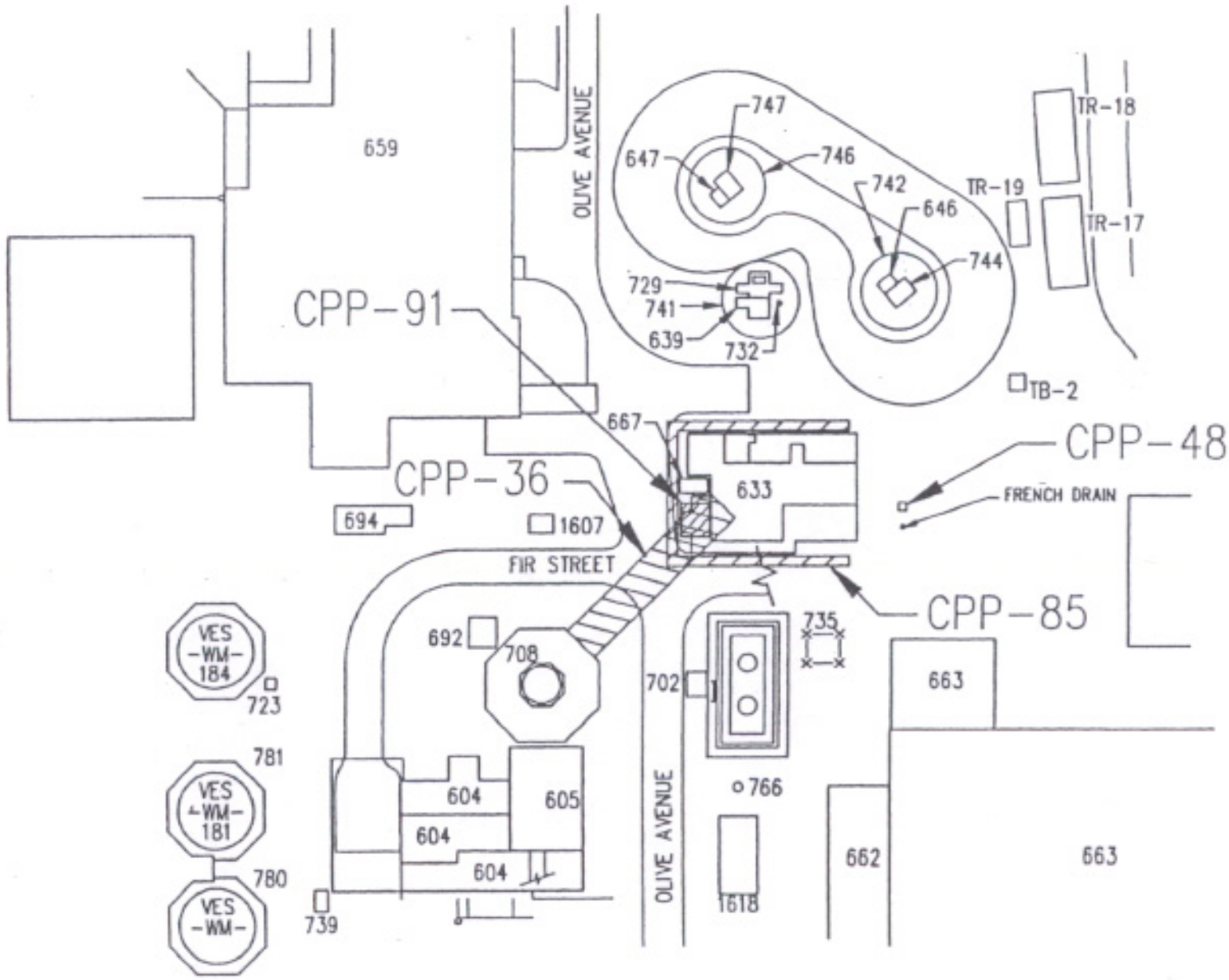


Figure 11. CERCLA release sites.

IDAHO DEPARTMENT
OF HEALTH AND WELFARE

DIVISION OF
ENVIRONMENTAL QUALITY

900 North Skyline, Idaho Falls, ID 83402-1718, (208) 528-2650

Philip E. Batt, Governor

April 3, 1997

Mr. Dave Wessman
DOE-Idaho Operations Office
850 Energy Drive
Idaho Falls, ID 83401

RE: **INCLUSION OF FFA/CO SITE CPP-85 INTO CLOSURE PLAN FOR THE OLD WASTE CALCINE FACILITY**

Dear Mr. Wessman:

Site CPP-85 is a new site that consists of the Waste Calcine Facility (WCF) Blower Corridor, at the Idaho Chemical Processing Plant. The corridor is an 18 to 24 in. vitrified clay pipeline surrounded by a 3 ft by 3.5 ft square concrete envelope. The investigation performed by DOE to support the Comprehensive Remedial Investigation for Waste Area Group 3 indicates that no release to the environment has occurred outside of the pipeline and envelope. DOE has recommended this site to no further action status under the Federal Facility Agreement and Consent Order (FFA/CO). Additionally, DOE has proposed grouting the pipeline during RCRA closure, consistent with the proposed method of closure for other ancillary equipment associated with the WCF.

Concurrence was reached with the IDHW/DEQ, USEPA, and DOE FFA/CO Project Managers on April 3, 1997 that the proposal to grout the pipeline in conjunction with RCRA closure of the WCF would not interfere with potential final remedies under the Waste Area Group 3 Record of Decision. If you should have any questions, please contact us at (208) 528-2650.

Sincerely,

Scott L. Reno

Scott L. Reno
Environmental Scientist
Remediation Bureau

Figure 12. Approval Letter for CPP-85.

Supporting the cap or repairing damage to the cap must be considered when evaluating future source control or removal response actions that include excavation at sites CPP-36 and CPP-91.

If an immediate soil removal action is required, it would be conducted under the FFA/CO, as described in the INEEL Consent Order.

2.5 Hydrology of the ICPP

The Big Lost River, located approximately 0.18 kilometers (km) (0.1 mi) from the northwest corner of the ICPP, is the main surface water feature at the INEEL. Stream flows are often depleted before reaching the INEEL by irrigation diversions and infiltration losses along the river. When flow in the Big Lost River actually reaches the INEEL, it is either diverted at the INEEL Diversion Dam or flows northward across the INEEL in a shallow, gravel-filled channel to the terminus at the Lost River sink, where the flow is lost to evaporation and infiltration.

The Snake River Plain Aquifer is the main body of ground water underlying the INEEL. The depth to the Snake River Plain Aquifer varies from 61 m (200 ft) in the northeast corner of the INEEL, to 270 m (900 ft) in the southeast corner. The depth to the aquifer at the ICPP is approximately 139 m (455 ft). Ground water in the aquifer flows generally to the southwest, although locally, the direction of flow is influenced by recharge from rivers, surface water spreading areas, and heterogeneities in the aquifer. At the ICPP, ground water flow is generally from north-northeast to south-southwest. Tracer studies at the INEEL indicate natural flow rates range from 5 to 20 ft per day (EG&G 1985). Discharges of approximately 8.7×10^6 acre-feet (ac-ft) occur annually through springs in the Hagerman, Idaho area and upstream from the American Falls Reservoir and through irrigation well withdrawals (EG&G 1985).

Perched water bodies originate beneath the Eastern Snake River Plain in areas, where sufficient quantities of water move downward, and sedimentary layers impede further infiltration. Several perched water zones have been identified at the ICPP. The upper and lower zones have been investigated and sampled. An upper perched water zone is located approximately 34 m (110 ft) below land surface, at the contact between surficial alluvium and the uppermost basalt layer. The lower perched zone is located in a sedimentary layer about 115 m (380 ft) deep.

Closure activities planned for the WCF, such as grouting the building in place, permanently blocking all piping (i.e., capping, grouting, or removal) exiting the building, and placement of a final cover over the grouted structure, will reduce the potential for contaminant migration from the WCF and protect the ground water. A water balance for the WCF indicates minimal infiltration rates, due to low precipitation rates, high evapotranspiration rates, and controlled runoff at the site. Characteristics of the unsaturated and saturated zones (e.g., presence of interbeds with lower permeability and higher adsorptive capacity than the basalt), and depth to ground water [142 m (464 ft) measured in WM-18 near the WCF] all indicate minimal adverse impacts to the ground water as a result of WCF closure.

The WCF is located outside the 100-yr floodplain for the Big Lost River. The 100-yr flood for the Big Lost River near Arco, a station 14 mi upstream from the INEEL diversion dam, has an estimated magnitude of approximately 3,700 cfs (Stone et al., 1992). The INEEL diversion dam controls flow onto the Site protecting downstream facilities. Gates placed on two large, corrugated

steel culverts control flow onto the site; less than 900 cfs of flow is permitted through the diversion dam downstream onto the INEEL (Lamke 1969). The INEEL diversion channel is capable of handling flows in excess of 9,000 cfs (Bennett 1986). A 100-yr flood on the Big Lost River would be contained within the natural channel and diversion channel, posing no flood threat to INEEL facilities.

3. WASTE INVENTORY

3.1 Characteristics of Residual Mixed Waste

The high-level mixed waste and the low-level mixed waste (sodium bearing) historically processed through the WCF had the following characteristic hazardous waste numbers: D002 (corrosive), D007 (chromium), D008 (lead), D009 (mercury), D011 (silver), and the listed hazardous waste numbers, as identified in the Listed Waste Determination Report (WINCO 1993) (see Table 3). The chemical compounds listed in Table 3 are unused or off-specification commercial chemical products and decontamination solutions identified in an inventory of ICPP facilities and laboratories as being discarded to the ICPP waste system. The additional hazardous waste numbers identified in the Part A of the INEEL HWMA Permit were a conservative filing to cover chemicals that may have been used, and to allow the future use of the WCF evaporator with waste that may contain these additional constituents. The WCF evaporator has not been used to treat waste containing these additional hazardous waste numbers. The hazardous waste numbers listed in the Listed Waste Determination Report have been concluded to have entered the ICPP waste stream, and applied to all mixed wastes treated in the WCF.

The majority of the listed hazardous waste numbers identified in Table 3 and associated with the WCF are from past practice of transferring off-specification or unused commercial chemical products (reagents) from laboratories and decontamination process solutions to the PEW evaporator and tank farm. These chemicals were primarily used by the laboratory for process control analyses, and were not discarded in large quantities.

These chemical compounds were dispersed from 1963 until 1988 in the 28.4 million liters (7.5 million gallons) of waste. The waste included 15.2 million liters (4 million gallons) processed through the WCF, 5.6 million liters (1.5 million gallons) processed through the NWCF, and 7.6 million liters (2 million gallons) still in storage in the tank farm. Liquid laboratory waste and decontamination wastes were transferred to the PEW evaporator, to remove part of the water, prior to storage in the tank farm. The strong nitric acid solutions and elevated temperatures in the PEW evaporator would have digested the majority of the organics, cyanides, and sulfides. The "listed" metal compounds would have been converted to nitrates and become indistinguishable from the other metal constituents from reprocessing or decontamination procedures. The temperature of the waste during storage in the tank farm also would promote evaporation of the volatile constituents. Organic compounds remaining in the waste would have been destroyed during calcination.

All WCF vessels except WC-119 have been emptied and ventilated since 1987 and are presently dry. Vessel WC-119, the bottoms tank, collects rainwater leaking through the roof and steam condensate from the heating system. The analytical result of the 1994 characterization and for the current liquid waste transfer from WC-119 to the PEW system is found in Appendices D and E, respectively. The calciner and off-gas cells were flushed with water, and the resulting solution was transferred to the PEW. Based on the above discussion, detectable concentrations of these organic constituents in the waste residues found in vessels and piping, or on the cell floors are not expected to be found. Consequently, any remaining residue of these chemicals would present no significant threat to human health or the environment.

3.2 Quantities of Residual Mixed Wastes

An investigation was conducted in 1995, to estimate the quantity of residual mixed waste that will remain in the WCF at closure. Since the radiation fields are too high to allow safe entry for visual inspections or hands-on measurements of the residues in the cells and vessels, a conservative engineering estimate has been made. This conservative estimate is based on a review of the operating records, design specifications, drawings, and safety analysis reports. The investigation identified an estimated quantity of mixed waste residue in WCF vessels, piping, and cells,including the HEPA filter waste pile and ruthenium scrubbers in the WCF, as 45.07 m^3 (58.95 yd^3).

A summary of the assumptions and findings from the 1995 investigation is presented in the following sections of this Closure Plan.

3.2.1 Evaporator and Associated Tanks

The evaporator system vessels were assumed to have a 25.4 mm (1 in.) layer of dry sludge on the bottom, and, due to rinsing, 5% of the original contaminants are still present in this layer. The estimated quantity of mixed waste residue in this system is 0.0005 m^3 (0.0007 yd^3).

3.2.2 HEPA Filters

Four HEPA filters in two filter boxes are stored in the WCF and make up the interim status waste pile. These filters were used during the last calcining run. Six additional HEPA filters stored in three filter boxes, are currently online. These filters were installed after calciner operations were concluded. These six filters contain only radioactive constituents. The estimated quantity of mixed waste, including all ten HEPA filters, is 0.25 m^3 (0.33 yd^3) per filter box, or a total of 1.25 m^3 (1.65 yd^3) mixed hazardous waste in the five filter boxes.

3.2.3 Calciner and Piping

The calciner system vessels, equipment, and piping are conservatively estimated to have a 0.35 mm (0.014 in.) layer of waste residue coating all internal surfaces. This assumption is based on a typical particle of residue having an average size of 0.35 mm (0.014 in.). In addition, it was assumed the process piping around the calciner (10.67 m in length), and the first 6 m (20 ft) of off-gas piping contained a layer of residue, 38.1 mm (1.5 in.) and 25.4 mm (1 in.) thick, respectively. The quantity of mixed waste residue remaining on the internal surfaces of the equipment after the waste was removed in 1981, is estimated at 0.15 m^3 (0.18 yd^3).

3.2.4 Off-Gas System

The pressure drop across the ruthenium adsorbers when the calciner operations were stopped indicated that the adsorbers were at the design pressure drop limit of 356 mm (14 in.) of water. Based on the pressure drop across the adsorbers, the estimated quantity of residual mixed waste in the ruthenium adsorbers, including the inert silica gel contained in the adsorbers, is 43.50 m^3 (56.89 yd^3).

3.2.5 Cell Floors

The cell floors (except absorber cell) were examined using remote inspection videos made in 1993 and 1994. These inspections of the secondary containment for the tanks show an accumulation of dust and rubble in the cells, but no accumulation of calcine. Therefore, it was conservatively assumed that the cells were contaminated with a single, 0.35 mm (0.014 in.) layer of waste residue. The amount of waste residues were adjusted for the following: (1) higher than average radiation fields in the sample blister and adsorber manifold, (2) lower than normal radiation fields in the hot sump and waste hold cells, and (3) documented washing of the calciner and off-gas cells. The estimated quantity of residual mixed waste in the secondary containment cell floors is 0.084 m^3 (0.11 yd^3).

3.2.6 Product Transfer Piping, Valves, and Off-Gas Ducts

Below are the assumptions made concerning the amount of waste residue remaining in the product transfer piping, valves, and off-gas ducts:

- 10.67 m (35 ft) of piping near the calciner has a 38.1 mm (1.5 in.) layer of waste residues on the bottom of the piping
- 11 valves are plugged with waste residues
- 10.67 m (35 ft) of off-gas duct has a 25.4 mm (1 in.) layer of waste residue on the bottom of the duct
- All other piping and ducts are coated with a 3.5 mm layer of waste residue.

Estimated quantity of residual mixed waste in the calciner transfer piping, valves, and ducts is 0.084 m^3 (0.11 yd^3).

3.3 Lead Shielding, Instruments Containing Mercury, and Equipment Oil

An engineering evaluation of other hazardous material that will remain in the WCF has been conducted by reviewing design drawing, equipment specifications, comparison to the NWCF, and personal knowledge of the WCF operation personnel. Based on this review, approximately 15.24 metric tons (15 tons) of lead shielding found structurally in cell walls, pipe corridors, sample blister, and doorways will be left in place. The quantity of mercury contained in the in-cell instruments is conservatively estimated to be 11.8 kg (26 lb). The quantity of oil contained in the in-cell equipment blowers and observation windows is estimated to be 75.7 and 1,022 liters (20 and 270 gallons), respectively. The blowers contain 40 wt. lubrication oil and the observation windows contain mineral oil. Due to the radiation fields and radioactive contamination, the WCF will be closed with these constituents in place.

4. CLOSURE ACTIVITIES

This section is divided into two parts: Section 4.1 discusses the activities necessary to prepare the WCF for closure, and Section 4.2 discusses the closure activities necessary for physical closure of the WCF.

Closure activities in the WCF consist of waste pipe plugging, cell and vessel grouting, and construction of the concrete cap cover over the footprint of the WCF. The WCF will be considered physically closed when these activities have been completed and certified by an independent, registered professional engineer.

Closure activities in the WCF will generate only a limited amount of waste to be disposed of outside the grouted facility. A maximum of 4,700 gallons of water will be transferred from vessel WC-119 to the PEW. The character of this water is low level liquid waste. A maximum of 10 m^3 of radioactively contaminated personal protective equipment may be sent to the Waste Experimental Reduction Facility (WERF) for incineration. All contaminated piping and equipment resulting from grout placement will remain in the WCF to be grouted in-place with the superstructure.

Closure activities will be considered complete upon submittal of Certification of Closure by an independent qualified Idaho-registered professional engineer, LMITCO, and DOE-ID to the director of the Idaho Department of Health and Welfare (IDHW). Certification of Closure will verify that the WCF unit has been closed in accordance with the specifications of the approved closure plan. Copies of the documentation supporting the independent, registered professional engineer's certification will remain at the ICPP in the event this information is requested by the IDHW director.

The WCF Closure Comprehensive Work Plan (Helms et al. 1996) is summarized in the following sections. The Plan includes activities necessary to prepare the WCF for closure and the activities needed to close the facility.

4.1 Activities Necessary to Prepare the WCF for Closure

4.1.1 Reroute Utilities

Utilities to the WCF are associated with other buildings and systems. The utilities will be rerouted to provide continued service to these other buildings and systems. The WCF will be isolated from plant utilities, and temporary service will be provided as required for closure activities. Isolating the WCF from the plant utilities will eliminate sources of water or steam under the cap.

4.1.2 Above grade Equipment Dismantlement and Grouting

Tanks and piping in the chemical makeup room will be dismantled to clear the room to make space for the equipment required for vessel grouting. Equipment currently in the room will be sized, placed on the ground floor, and grouted in place with the superstructure to provide space for grout pumping activities. Equipment in other locations on the ground floor will be dismantled and grouted at grade along with the WCF superstructure (see Section 4.3).

4.1.3 External Utility Pipe Capping

Utility lines will be cut and capped inside and/or outside the WCF. Utility and nonwaste piping will be capped or plugged to prevent water from entering the WCF.

4.2 Closure Activities for the WCF

4.2.1 Grouting (Void Filling)

Cells and operating corridors will be filled with grout to prevent the potential for future cap subsidence. Vessels will be grouted to reduce open voids within the grouted cells. Grouting was selected because it is pumpable, self-leveling, and has the capability to be formulated in a variety of compositions depending on the application, that fits the needs better than sand. Pipes encountered during closure that penetrate the external walls of the WCF will be filled with grout and/or capped to prevent moisture from entering the WCF.

The grout will be delivered to each room, corridor, or cell through a grout pump and hoses on the ground floor, and a delivery pipe extending into each room, corridor, or cell. After a lift has been placed, the delivery piping will be raised 2-4 ft and the upper 2-4 ft section of the pipe will be removed. The delivery piping may come in contact with airborne radiological contamination during grout placement; each section will be monitored for radiological contamination. Sections of radiological contaminated pipe or hoses will be grouted with the dismantled components of the superstructure.

The grouting equipment, other than the delivery piping, will not come in contact with the waste in the waste pile (containers of HEPA filter), mixed waste residues in vessels and piping or hazardous contamination of the floors of the rooms or cells. Therefore, decontamination for hazardous constituents on the grouting equipment will not be required.

Figure 13 shows the proposed grouting sequence for vessels and cells.

4.2.1.1 Capping of the Waste Piping. Waste piping penetrating the exterior walls of the WCF are contained in steel ducting or clay tile casing as illustrated in Figure 3. The annulus between the waste piping and the steel ducting or clay tile casing will be grouted and allowed to setup prior to flushing the waste piping. Waste piping penetrating the exterior walls of the WCF will be flushed by pumping high water content grout through the pipe into tanks in the WCF. The pipe will then be permanently capped. Waste piping will be grouted and capped from the nearest valve box outside the WCF back into a vessel in the WCF. The off-gas duct (CERCLA release site CPP-85) is 2 to 3 m (6.6 to 9.8 ft) below ground level, running around three sides of the WCF perimeter. The duct is constructed of clay pipe, encased in a concrete. The off-gas duct will be filled during cell grouting. The product transfer and return air lines are enclosed in a steel duct surrounded by a concrete encasement. The steel duct will be grouted by pumping grout through holes bored through the encasement and into the steel duct. The product transfer and return air lines will be flushed with grout and then grouted full from a decontamination drop, a point used during operation of the WCF to add aqueous decontamination solutions to the product transfer lines. This access point is located

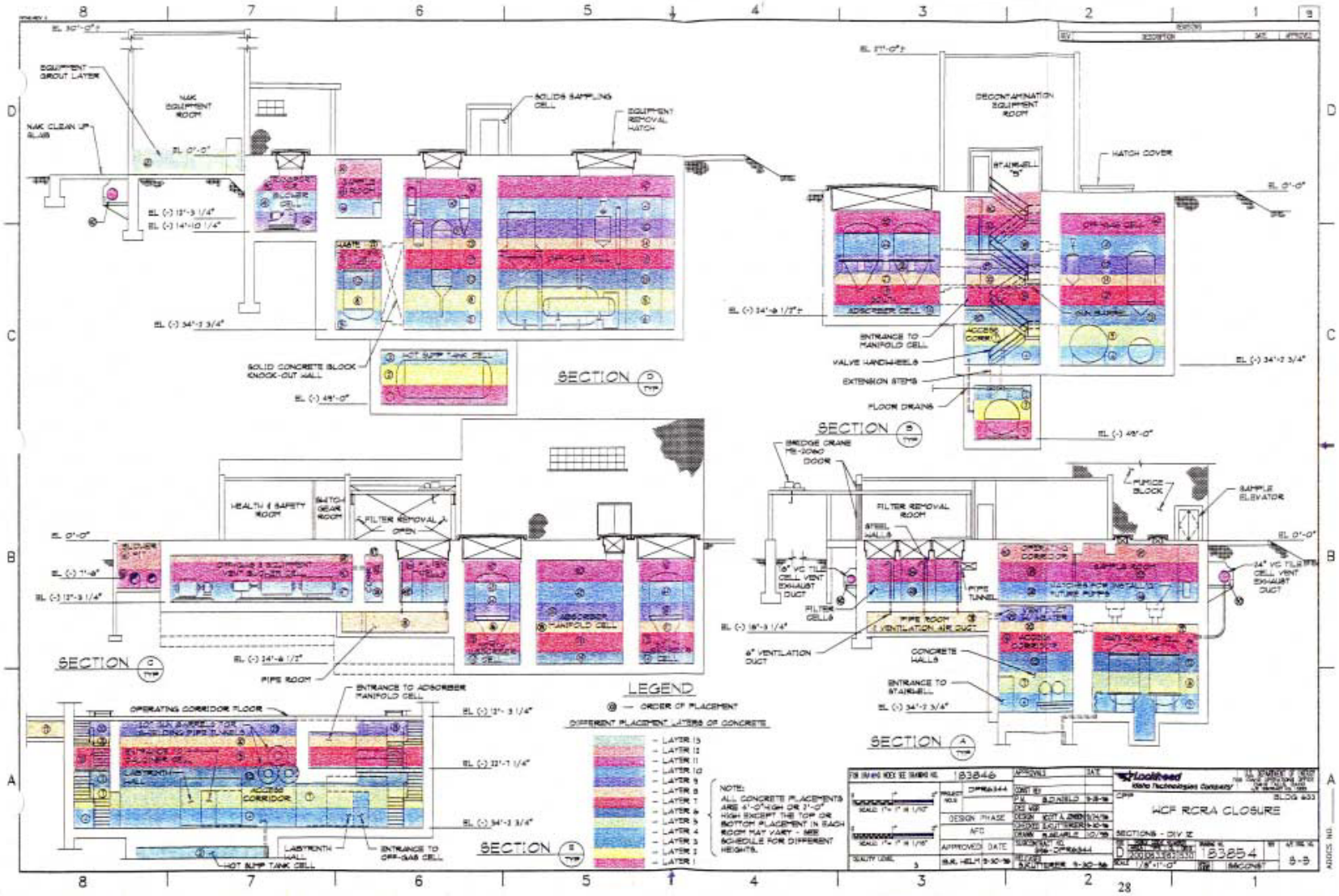


Figure 13. WCF HWMA/RCRA closure concrete placement sequence.

between the WCF and Binset 1, approximately 23 m (75 ft) east of the WCF. This will minimize the potential for additional soil contamination during flushing and grouting of the waste piping not under the cap.

4.2.1.2 Vessel Grouting. Vessels will be grouted to reduce the open voids within the WCF, but grouting is not critical for the structural support of the cap. Therefore, the major vessels (>55 gallons) will be filled with grout as full as is practical, using the existing piping from the chemical makeup area on the ground floor. If a pipe becomes plugged and there is not a backup, it may be necessary to bore a hole into the vessel from the floor above to place the grout. Vessel grouting will start with the vessels in the lower cells and proceed upward (WC-100, -101, and -114 are grouted before WC-119).

The vessels slated for grouting do not currently contain liquids, except vessel WC-119. The liquid content of WC-119 is condensate from the steam heating system in the WCF building, and rain and snow-melt finding its way into the building. This liquid is analyzed prior to treatment at the PEW system. Analytical results indicate it is routinely nonhazardous and only slightly radiologically contaminated. The final transfer of liquid from vessel WC-119 to the PEW will occur just prior initiation of grouting WC-119. The transfer jet in WC-119 is capable of removing all the liquid, except a 280 gallon heel (5% of the tank volume of 760 ft^3) that lies below the jet. This volume of water will be absorbed in an adequate volume of desiccant. Grout mixture will be placed in WC-119 to fill the vessel.

The WCF Closure Sequence Chart indicates VES-WC-119 will be emptied as step T-9 and grouted as step T-19. The WCF Closure Sequence Chart lists the preferred sequence of the activities.

4.2.1.3 Cell Grouting. Cells and operation corridors will be grouted in lifts, as depicted in Figure 12, to allow for curing and heat dissipation between pours. The lift thicknesses will vary, depending on the cell being filled, but typically will be 0.3 to 1.3 m (1 to 4 ft), as indicated in Figure 13. Grout will be pumped into cells and operating corridors through existing piping, where available, or through K-plugs or drill holes bored from the ground floor. Many of the cells and operating corridors will require multiple access points to maintain a level lift when filling. Cells and operating corridors will be considered full when grout becomes visible in the uppermost K-plugs or drill holes being used to fill that cell or corridor. Additionally, the cell or corridor ventilation will stop as the ceiling exhaust ventilation holes located near the top of the cells fill with grout.

The tank and cell closure activities will be conducted from the ground floor of the WCF to minimize the exposure of workers to radioactive contamination. It is not expected that personnel or equipment will be contaminated since the grout placement activities will be accomplished by using remote operations.

NOTE 1: K-plugs are removable access plugs through the roof of the cell.

NOTE 2: The cell roofs are constructed of reinforced concrete, measuring 3 ft thick.

4.2.1.4 Contamination Release Concerns. The potential of spreading contamination from either the radioactive or hazardous constituents to the environment from pipes, vessels, or cells during the placement of grout or concrete has been evaluated. The results are presented in the following sections.

4.2.1.4.1 Cell Filling—The WCF substructure is constructed of heavily reinforced concrete, with walls and floors measuring 2-ft thick. Cells have stainless steel liners covering the floor with a 4-in.-high containment lip at the walls. The calciner cell floor and walls are totally lined with stainless steel. The blend and hold cell does not have a stainless steel liner. During shutdown, several of the cells containing process vessels were washed down, with the flushed residues transported to the PEW system, as described in Section 2.3. Little, if any, free contamination is expected to be present in these areas.

The initial placement of 0.6 to 1.2 m (2 to 4 ft) high concrete lifts will cover and immobilize any contamination that may still be present on the stainless-steel lined floors. Subsequent lifts will lie upon the previous lifts, preventing the migration of liquids downward to the subsurface geology. Any micro cracks in the walls will be quickly filled and plugged by the concrete mixture. Mockup laboratory tests have determined that 1/8 in. diameter holes would plug with a thin slurry grout made up of only flyash and cement at 4.23 kg/cm^2 (60 psi) pressure if not filtered coming out of the delivery pump. The concrete formulation for cells consists of sand and aggregate, much thicker than the slurry grout. This mix will certainly not permeate any cracks to the environment, rather tending to plug and fill any discontinuities and asperities at the inner contact surface. The hydrostatic pressure exerted by a 1.2 m (4 ft) lift of uncured concrete is much lower than the measured 4.23 kg/cm^2 (60 psi) test condition, thus preventing the extrusion of concrete through the walls. The concrete has an initial set time of 2 hours, whereby in the process of hydration, the cement constituents in the concrete formulation will assimilate and tie up the water in the mixture, to complete the exothermic chemical reaction. Free water will not be available to transport any loose contamination to the environment.

4.2.1.4.2 Vessel and Pipe Filling—The facility's stainless-steel drain piping is encased in concrete as it extends from different locations in the facility through soil to the sump tank. All other exterior piping entering the facility is either encased in concrete, or sleeved, or both.

For pipe closure, the lines will either be cut and permanently capped under the footprint of the closure cap or flushed, with the grout being injected through the line back toward the facility. The thin, watery grout will both flush and scour the interior of the piping and ultimately ending up under the closure cap in vessels before it is allowed to cure and solidify. The nature of these tasks makes a release during grouting highly unlikely. Mockup testing of the grout indicates that if a leak were to occur, the grout would solidify when not in motion and quickly be immobilized.

The vessels have been analyzed statically and it has been determined that the supports will maintain integrity following placement of grout. Piping has been evaluated to ensure delivery pressures are within design capacity of specific pipes. In all cases, the capacity far exceeds the expected pressure exerted by the grout.

The following waste and utility pipe lines have been evaluated to determine if they provide a conduit for water to migrate under the cap. All pipe lines that penetrate the outer walls of the WCF are sealed into the wall for radiation shielding and to prohibit water from entering through the pipe penetrations.

Table 4. Waste Transfer Pipe Lines

PIPE LINES	REGULATORY STATUS	DESCRIPTION
3" TAA-3009	Ancillary to WC-102 Waste Calciner, a non-Interim Status Unit	Calcine Line to Bin Sets - Slopes toward the WCF: Line is encased in a 14-in sleeve; concrete was poured around piping at construction; no entry into WCF from exterior of concrete encasement; depth from surface is 9-ft 4-in..
3" TAA-3001	Ancillary to WC-102 Waste Calciner, a non-Interim Status Unit	Calcine Return Air Line From Bin Sets - Slopes toward the WCF; Line is encased in a 14-in sleeve (same sleeve as 3-in TAA-3009); concrete was poured around piping at construction, no entry into WCF from exterior of the concrete encasement; depth from surface is 9-ft 4-in..
1" PUA-3005	Ancillary to WC-100/101 Waste Hold Tanks, Interim Status Units	Drain From Valve Box B6 - Slopes toward the WCF; depth of pipe is 20-ft. Rainwater/snowmelt will not reach this depth. Concrete encased utility lines crossing over the waste lines in the Utility Tunnel are in operation and monitored.
3" PUA-3004	Ancillary to WC-100/101 Waste Hold Tanks, Interim Status Units	Feed Line From Valve Box B6 - Slopes toward the WCF; depth of pipe is 19-ft. Contained in metal sleeve. Rainwater/snowmelt will not reach this depth. Utility lines crossing over the waste lines in Utility Tunnel are in operation and monitored, will be flushed and grouted along with its sleeve.
3" PLA-101111	Ancillary to WC-119, Hot Sump Tank, an Interim Status Unit	Pipe From WCF To PEW - Will be grouted along with its sleeve.

Table 5. Non-waste Transfer Pipe Lines

PIPE LINES	REGULATORY STATUS	DESCRIPTION
3" VGA-3051	Vent line entirely under closure cap	Vent From Transport Air Blower Cell - Fill with grout from excavation, place grout block in line in Transport Air Blower Cell.
1½" DCN-3091	Utility, non-waste line entirely under closure cap	Flushed Nitric Acid Line (reagent) - Fill with grout from the Decon Room .
2" ONA-109721	Utility, non-waste line entirely under closure cap	Oxygen Line- Cut and weld cap on pipe under closure cap footprint from excavation to access cell vent lines.
2" CTN-100242	Utility, non-waste line, slopes away from WCF	Condensate Line - Slopes away from the WCF.
3" HAN-3001	Utility, non-waste line to be filled with grout	Air Line - Fill with grout.
1" HIN-3011	Utility, non-waste line to be capped under the closure cap	Instrument Air Line - Cut and capped line under cap footprint.
3" WRN-3001	Utility, non-waste line to be filled with grout	Cooling Water Line (Service Waste) - Fill with grout from manhole.
6" HSN-3002	Utility, non-waste line to be filled with grout	Steam Line - Fill with grout from manhole.
3" WSN-3011	Utility, non-waste line to be filled with grout	Cooling Water Line - Fill with grout from excavation.
4" WQN-100224	Utility, non-waste line to be filled with grout	Shower Drain Line - Fill with grout from shower drain.
3" SWA-3001	Utility, non-waste line to be filled with grout	Cooling Water Line (Service Waste) - Cut, fill with grout from corner of NaK Room.
¾" PSA-3081	Inactive, non-interim status Bin Set drain line to be filled with grout	Bin Set Vessel Drain Line - Slopes toward the WCF, is encased in 3-in PVA-105527. Depth of pipe is 11-ft. Rainwater/snowmelt will not reach this depth. This pipe is not in service and capped in the Transport Air Blower Cell. It will be encased in grout when filling line 3 inch PUA-105527.
3" PUA-105527	Inactive, non-interim status vent line to be filled with grout	Bin set #1 Vent Line - Slopes toward the WCF. Depth of the pipe is 11-ft. Rainwater/snowmelt will not reach this depth. Fill pipe with grout from an excavation to the WCF transport cell.
1" HIN-3010	Utility, non-waste that slopes away from the WCF	Instrument Air Line - Slopes away from the WCF.
24" CGN-101298	CERCLA Release Site CPP-85	Cell Vent Duct - The cut point and seal will be under the footprint of the cap.
10" PSA-100475	Utility vent line lying under the closure cap	Process Equipment Vent To APS - The cut point and seal will be under the footprint of the cap.

¾" PSA-3081 and 3" PUA-105527 are described in Table 5 above as being at a depth of 11 ft (3.4 m). This is critical because the undisturbed soils at ICPP consist of medium to course textured soils over gravel derived from alluvial deposits of the Big Lost River. Soil samples collected from boreholes drilled at ICPP and analyzed in the laboratory indicate the surface soil/alluvium has a permeability of 2 X 10^{-2} cm/sec. The effective evaporation zone depth for superficial sediments in this area is approximately 1.5 m. Soil moisture movement below this depth is greatly reduced. Infiltration rates in the ICPP area are conservatively estimated at 10 cm/yr. Modelling with the Environmental Protection Agency (EPA) code *Hydrological Evaluation of Landfill Performance* to estimate yearly infiltration of water through the closure cover indicates average annual leakage through a soil cover is 0.3 cm. This flux rate is very low and would not be sufficient to generate leachate. As a result of the semi-arid climate with relatively low annual precipitation (22 cm), high potential annual evapotranspiration (116 cm), and deep water table (137 m), vadose zone soils tend to be relatively dry during most of the year. Precipitation falling on soils around the closure cap would not be expected to penetrate through the evaporation zone depth of approximately 1.5 m.

In summary, the inherent barriers and the nature of the concrete, grout, and the process of delivery of the grout formulations makes the potential of a release of contamination to the environment highly improbable. Measures have been taken in the design to tightly control the procedures and sequence to safely achieve the desired filling of the piping, vessels, and subsurface structures of the WCF, as described in Sections 4.1 and 4.2 of this Closure Plan.

4.2.1.4.3 Waste Pile Grouting—The waste pile consists of four HEPA filters enclosed in two stainless steel HEPA filter housings setting on the floor at the back of the filter room. The currently used six HEPA filters, enclosed in three stainless-steel HEPA filter housings, will be left in place. Approximately, 2-ft of grout will be placed on the floor of the filter room and allowed to set up. The HEPA filter housing and filters weighs approximately 750 lb each, The weight of the housings will prevent the housings from floating on the grout when the first lift is placed in the filter room. Each lift will be allowed to set up before the next lift is placed. Figure 13, Sections A and C identify the lifts by number for the placement of the grout. Lifts 28, 38, 39, 43, 48, 50, 51, 52, 54, 57 and 60 will be used to grout the filter room and adjacent areas. This will completely surround the filter housings with grout.

The filter room and the surfaces of the HEPA filter housings are radiologically contaminated and in a high radiologically contaminated area. Removal of the filters would result in worker exposure to ionizing radiation, which is inconsistent with DOE ALARA goals.

4.2.1.5 Description of the Superstructure Removal and Placement. The superstructure consists of the aboveground portion of the WCF. The WCF above-grade walls are constructed of 12-in. concrete blocks. Following radiation surveys, radioactive "hot spots" will be stabilized with latex paint or an equivalent to control the airborne spread of radiological contamination during demolition. The radioactive hot spots are from airborne contamination, and not from direct contact with the mixed waste processed in the WCF. The roof and walls will be dismantled using a backhoe with a crushing and shear jaw attachment, or similar equipment. The walls and roof structure will then be further sized and placed on the floor over the grouted and cured below-grade structure. Suspension of radioactive or asbestos particles will be controlled by application of water mists, or other dust suppressants during dismantling and sizing processes. Track-mounted equipment, such as

bulldozers, will be used to level and compact the rubble. Grout will be applied to fill empty spaces and voids in the rubble. The entire structure will then be covered by a reinforced concrete cap.

4.2.2 Description of the Cap

The WCF is being closed with mixed waste in place, meeting the closure requirements applicable to landfills, by the construction of an engineered concrete cover or cap over the grouted cells, vessels, and superstructure. The landfill cover or cap requirements for design and construction are listed below. The cover or cap will:

- Minimize migration of liquids through the closed landfill
- Function with minimum maintenance
- Promote drainage and minimize cap erosion or abrasion
- Accommodate settling and subsidence, maintaining the cover's integrity
- Have a permeability less than or equal to the permeability of any bottom liner system or natural subsoils present.

The design of the WCF concrete cap complies with the requirements identified above. The cap will be constructed of a low-permeability reinforced concrete, a minimum of 0.31 m (12 in.) thick, with at least 1% slope from the center to the edges of the cap. The cap will extend approximately 5 ft past the ground level footprint of the WCF building, as indicated in Figures 14 and 15. The size and configuration of the closure cap is restricted by the proximity of the WCF to other operating facilities at the ICPP. Expansion of the cap to the north to cover the ancillary waste lines from the WCF to the PEW (3" PLA-101111) and Tank Farm (3" PUA-3004 and 3" PUA-3005) is limited by the presence of a utility tunnel that runs under Olive Street. The utility tunnel provides access for utilities (compressed air, water, steam, etc.) to the operating facilities in the central portion of the ICPP, including the NWCF. Expansion of the cap to the east is severely limited by the proximity of the berms surrounding and shielding the CSSF bin sets. Radiological controls and seismic criteria associated with the operating envelope for the CSSF prohibit extension of the closure cap to cover the calcine transfer lines (3" TAA-3009 and 3" TAA-3001) any closer to the berms than is currently proposed in the Closure Plan.

Water stops will be installed in the joints on the cap, as presented in Figures 16 and 17. The concrete will have a permeability of approximately 1×10^{-12} cm/sec (3.9×10^{-13} in./sec) (Keck 1995). The concrete will have a minimum compressive strength of 4,500 psi after 28 days (WCF Closure Comprehensive Work Plan 1996). The surface soils have a permeability of 2×10^{-2} to 2×10^{-1} cm/sec (7.8×10^{-3} to 7.8×10^{-2} in./sec). The sedimentary interbed soils have a permeability of 1×10^{-3} to 9×10^{-5} cm/sec (3.9×10^{-4} to 3.5×10^{-5} in./sec) (Keck 1995).

The concrete cap will function with a minimum of maintenance and reduce erosion. The grade of the surface will promote drainage away from the cap. The below ground voids created by the vessels and cells will be filled with a grout, to prevent subsidence and to maintain the integrity of the

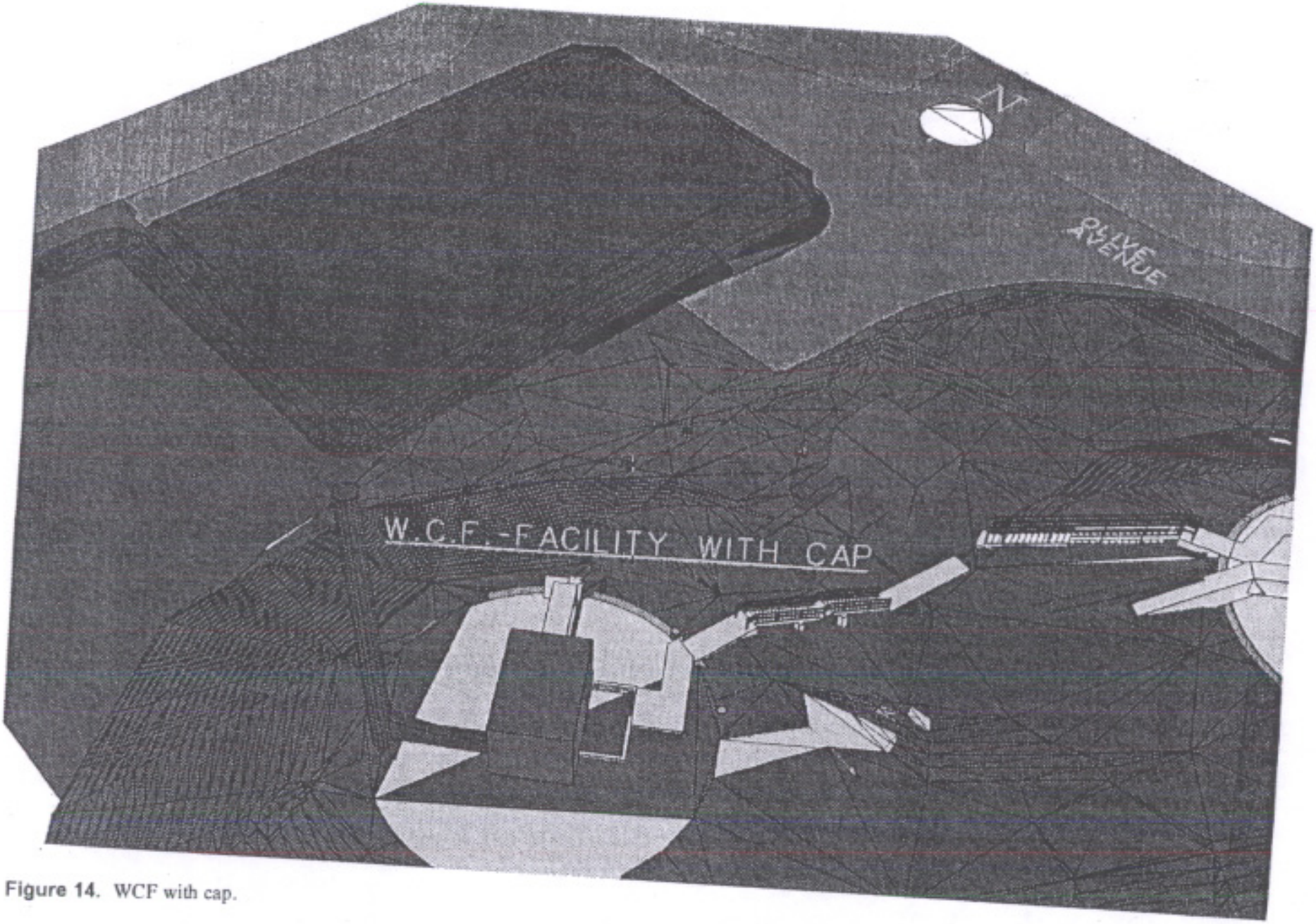


Figure 14. WCF with cap.

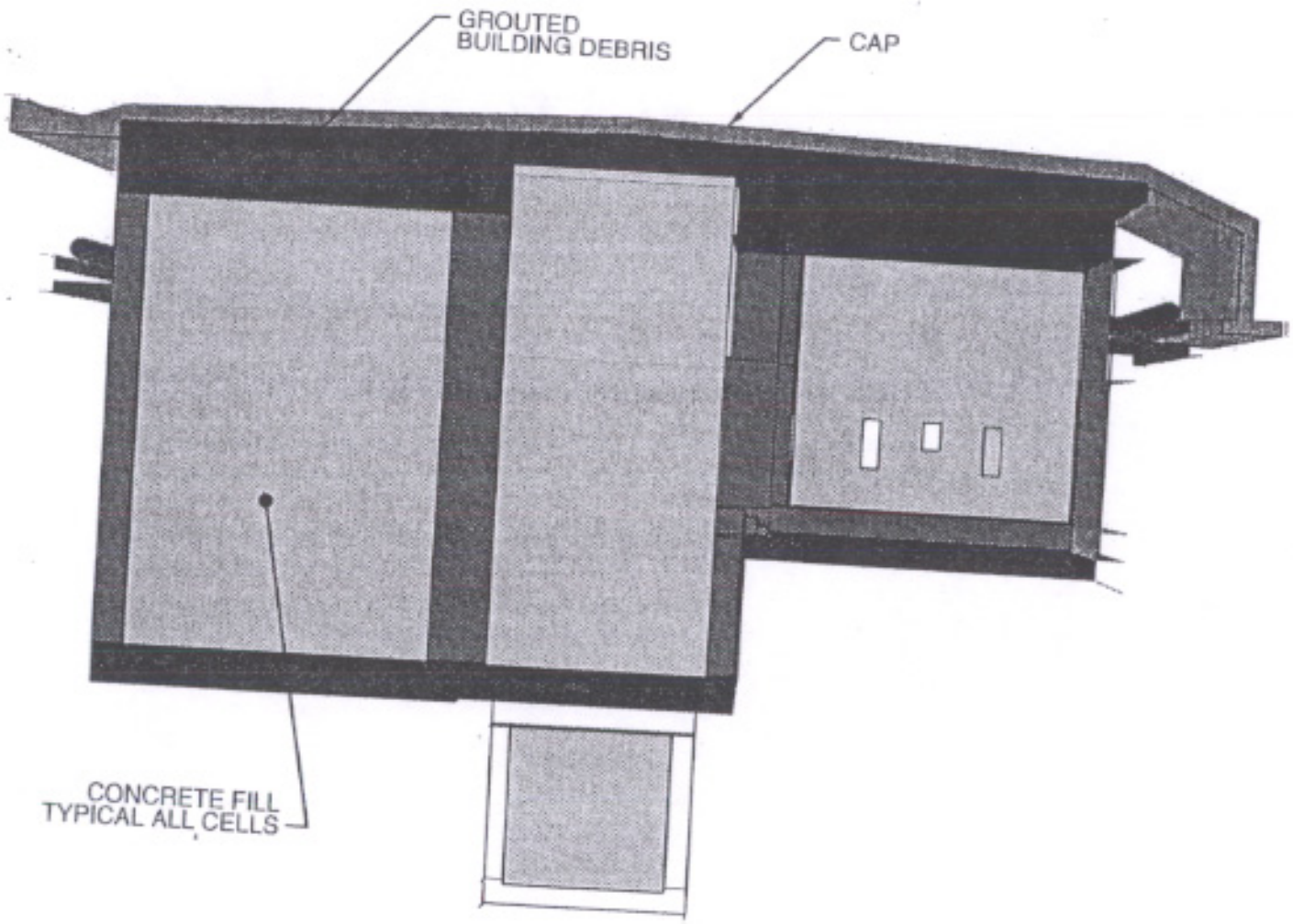


Figure 15. WCF—looking south.

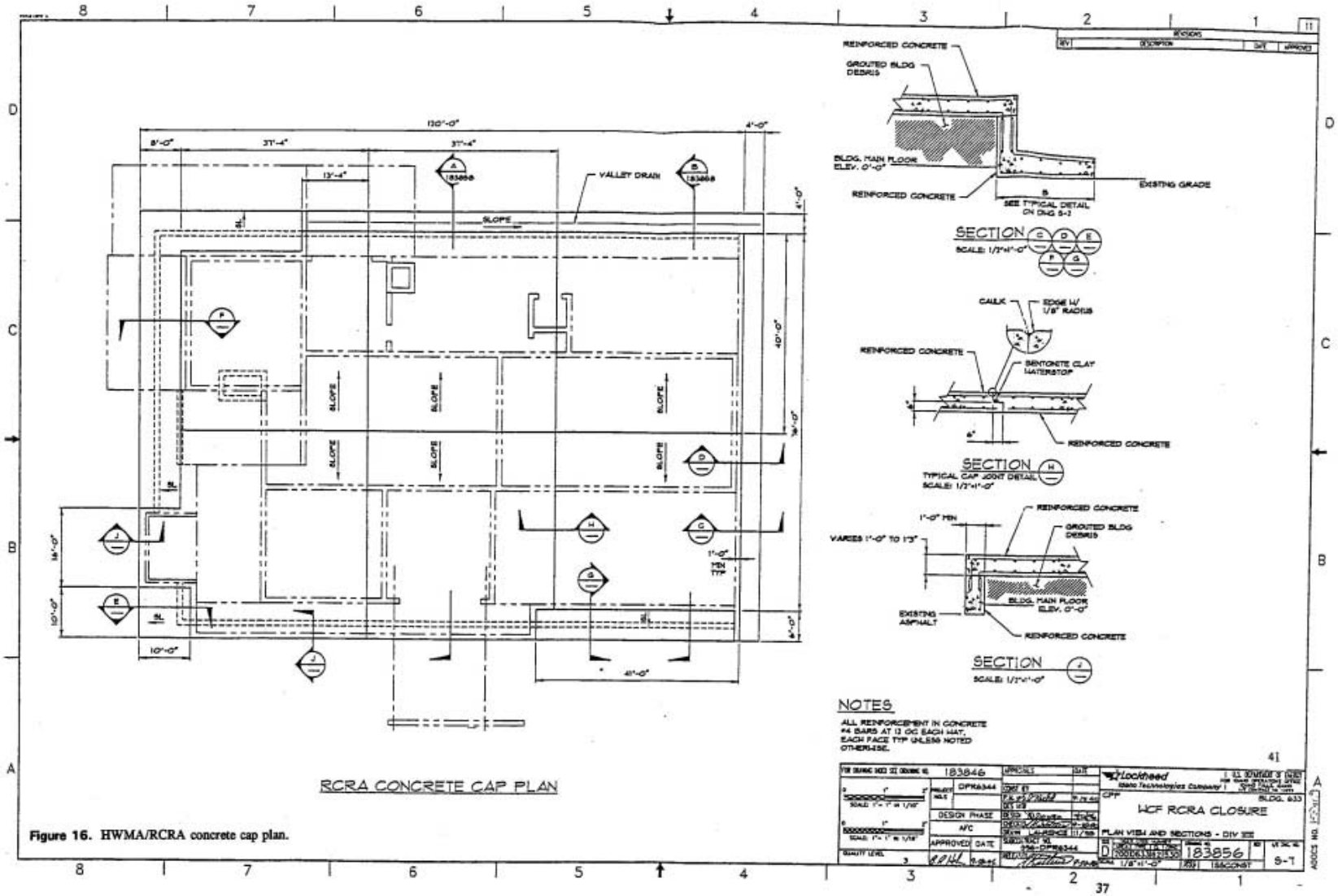


Figure 16. HWMA/RCRA concrete cap plan.

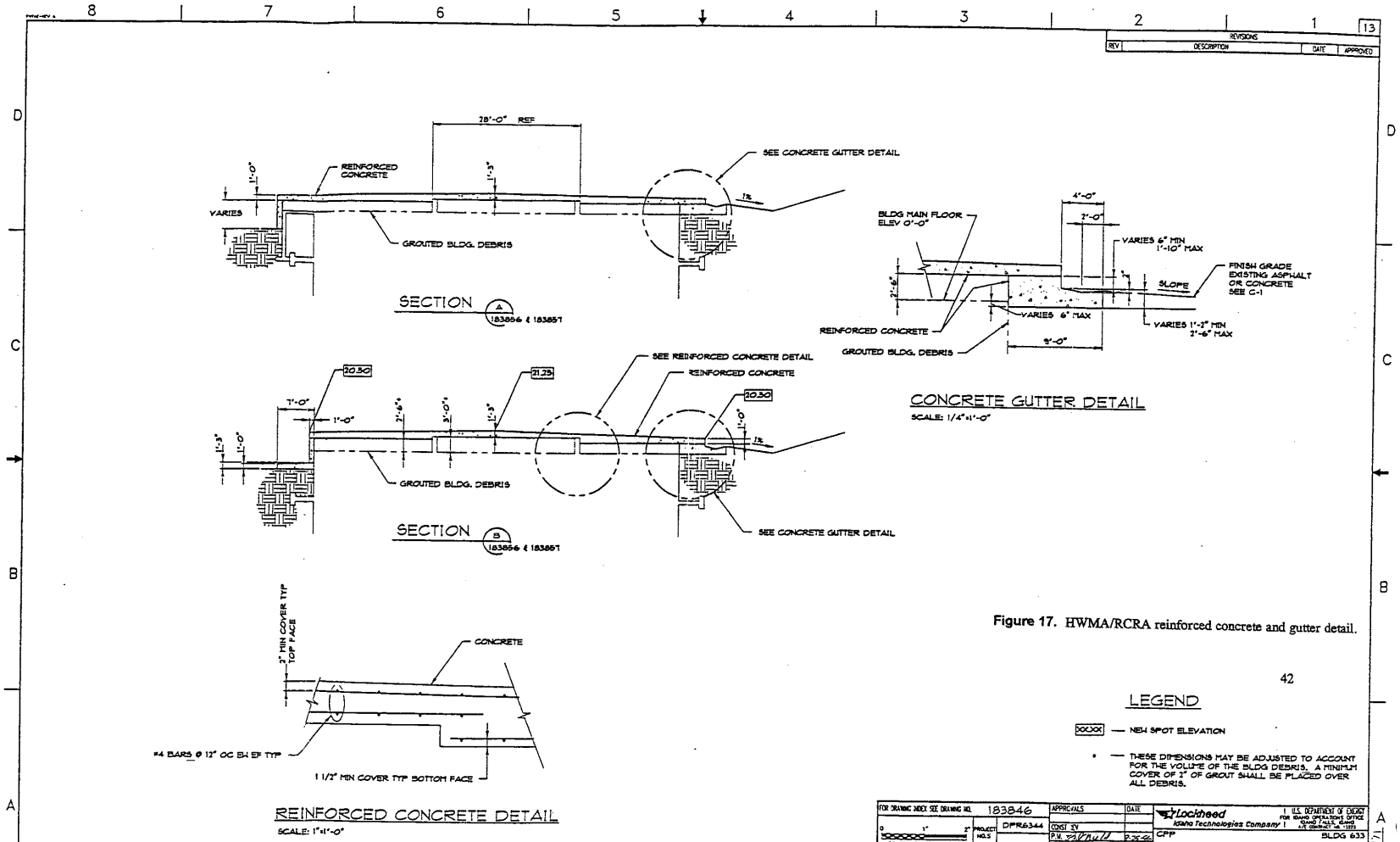


Figure 17. HWMA/RCRA reinforced concrete and gutter detail.

Figure 17. HWMA/RCRA reinforced concrete and gutter detail.

cap. Water that drains off or toward the cap will be collected and routed away from the WCF by the storm water drains and ditches, as shown in Figure 18.

4.2.3 Inspections and Monitoring During Pre-Closure and Closure

HWMA inspection and monitoring of the WCF will be maintained before and during closure activities. As parts of the WCF become inactive or emergency equipment is not needed, the inspection and monitoring requirements for those specific areas or emergency equipment will be terminated. Inspection requirements for vessels, cells, and equipment will be terminated when grouting begins, or when removed from service. Monitoring of the liquid level (steam condensate, rainwater, and snowmelt) in vessel WC-119 will continue as required under the HWMA/RCRA inspection schedule, until the final transfer of liquid to the PEW is accomplished and grouting is initiated. Vessels WC-100, -101, -114, and -108 will also be monitored to confirm no liquids have entered the vessels prior to grouting and are dry at the time of grouting. The waste pile in the filter cell will be monitored for deterioration until filling the cell with grout is started. The date and rationale for termination of the HWMA interim status monitoring and inspection requirements for each area of the WCF will be recorded in the WCF Operating Record. This Record will be maintained throughout HWMA closure. Portable safety showers and eyewash stations will be provided, maintained, and inspected before and during the closure activities. Voice paging, evacuation alarms, and telephones will be maintained and inspected monthly, until the cells are grouted, and building demolition is started. Portable fire extinguishers will be maintained and inspected until the WCF is closed. Spill cabinets will be removed from the WCF when grouting and/or demolition begins. Temporary lighting and emergency lighting will be maintained until building demolition begins. Emergency stretchers will be maintained in the WCF until building demolition begins. Emergency equipment is inspected and maintained by the emergency response organization at the INEEL.

4.3 Demonstration of Closure

4.3.1 Closure Performance Standards

The WCF will be closed in a manner that:

- Minimizes the need for further maintenance, by grouting the vessels and cells to prevent subsidence; and by the construction of a low-permeability concrete cap
- Controls, minimizes, or eliminates release of hazardous constituents
- Protects human health and the environment through the construction of a low-permeability cap and plugging of external pipelines
- Minimizes post-closure escape of hazardous waste, hazardous constituents, leachate, contaminated run-off; hazardous waste decomposition products to the ground or surface waters; or to the atmosphere, by the construction of a low-permeability sloped cap, plugged external piping, and a storm water drainage system to direct run-off away from the cap

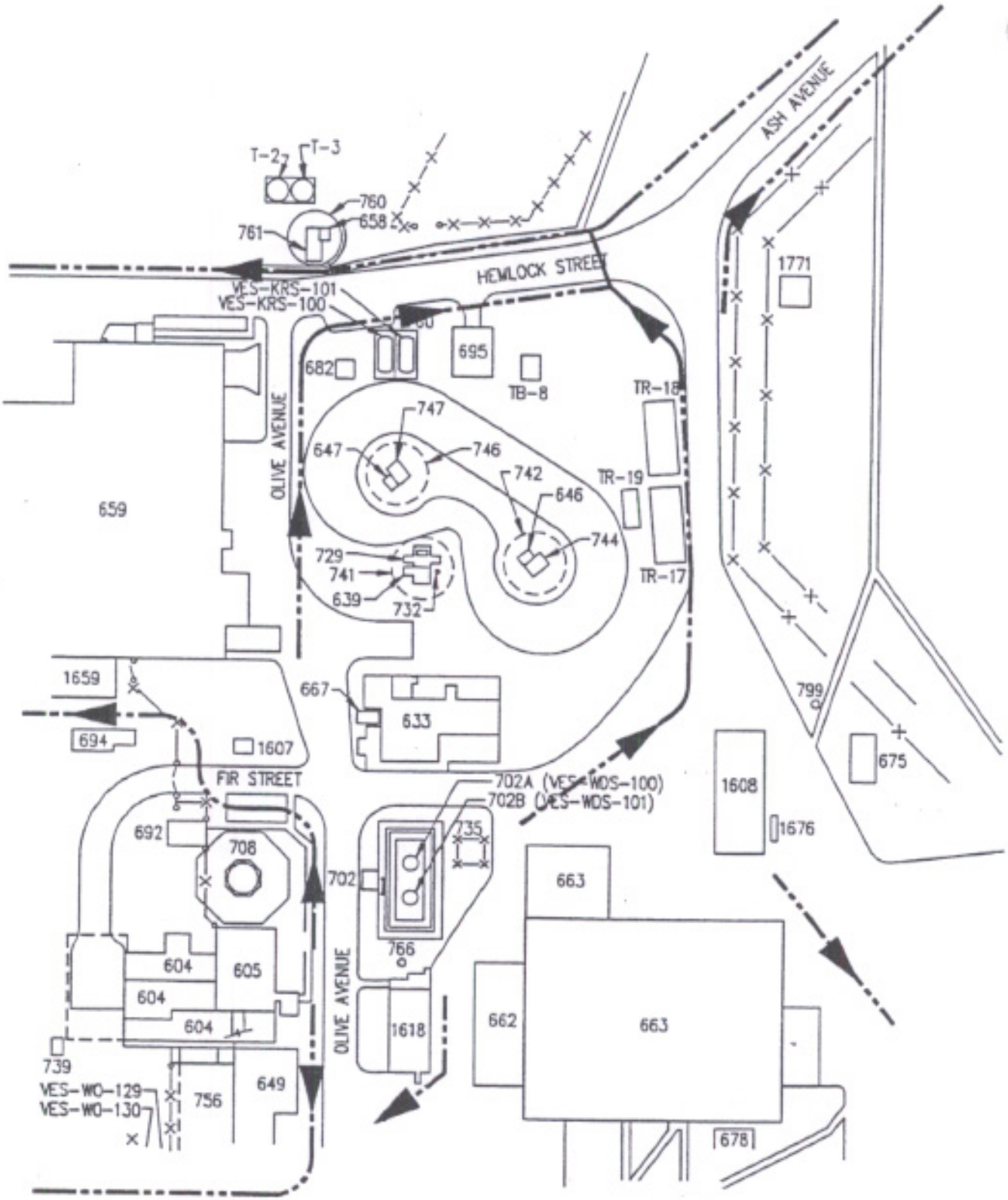


Figure 18. Storm water drains.

- Complies with IDAPA 16.01.05.009 (40 CFR 265.310) closure requirements, in addition to the above, by maintaining the integrity of the cap, ground water monitoring system, and storm water management system.

The closure certification will document the date, amount, and analytical results for the last batch transferred from VES-WC-119 to the PEW system. The certification will also document the volume of liquid in the heel and the placement of an adequate volume of desiccant to absorb this volume of liquid.

4.4 Schedule of Activities

4.4.1 WCF Unit Closure Schedule

Table 4 provides the schedule for WCF unit closure.

Table 6. Schedule for WCF unit closure [a]

Activity	To be completed
Initiate closure activities upon approval of the Closure Plan by HWPB	Month 0
Grout and cap waste piping	Month 13
Cap installation	Month 17
Survey plat	Month 19
Physical closure completed	Month 20
Certification of Closure submitted to the IDHW director	Month 22
Transmit to IDHW and Butte County the "Record of Waste," "Notice in Deed," and "Certification of Notice"	Month 24

a. This schedule assumes approval of the Closure Plan in August 1997. Delays beyond that time will require adjustments in the schedule to preclude completion of certain activities such as demolition of the superstructure and construction of the closure cap during inclement winter weather.

4.4.2 Request for Time Extension

IDAPA 16.01.05.009 (40 CFR 265.113) requires completion of closure activities within 180 days. Health and safety concerns associated with high radiation levels and the complexity of grouting and capping piping, grouting the ducts, and construction of the cap will require a longer timeframe for completion. Thus, an extension is being requested at this time, pursuant to IDAPA 16.01.05.009 (40 CFR 265.113), as it is apparent that closure cannot be completed within the

required timeframe. Subsequent amendments to this Closure Plan may be submitted, if additional time is required to complete closure because of problems encountered in grouting and/or capping the external waste piping and unexpected radioactive contamination.

4.4.3 Amendments to the Closure Plan

The conditions described in IDAPA 16.01.05.012 (40 CFR 270 Subpart D), "Hazardous Waste Permit Program, Changes to Permit" will be followed to implement any changes to this plan that exceed the magnitude of a Class 1 Modification. A written request will be submitted to the IDHW director detailing the proposed changes and the rationale for those changes. Minor changes (i.e., changes made within a work package such as the selection of a particular grout mix or technique) that do not compromise the closure requirements and/or performance standards identified in this plan, may be made without prior notification to the IDHW director. Any minor changes made without approval of the IDHW Director will be noted in documentation supporting the independent professional engineer's certification.

4.5 Certification of Closure

Within 60 days of the completion of physical closure, LMITCO and DOE-ID will submit to the IDHW director, by registered mail, a certification that the WCF, a hazardous waste management unit, has been closed in accordance with specifications in the approved closure plan. Certification of Closure will be provided by an independent Idaho-registered professional engineer, LMITCO, and DOE-ID. Because the WCF will be closed in accordance with requirements applicable to a landfill, a "Notice in Deed" and survey plat will be required in addition to the other requirements under IDAPA 16.01.05.009 (40 CFR 265), *Interim Status Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities*, IDAPA 16.01.05.009 (40 CFR 265 Subpart N: "Landfills").

4.6 Survey Plat and Certification by Professional Land Surveyor

A survey plat of the WCF and cap will be made and certified by a professional land surveyor. The outside wall of the WCF, the concrete closure cap, and location of all waste pipe lines ancillary to the WCF that remain outside of the closure cap footprint will be identified on the survey plat. A benchmark will be installed in the concrete cap and tied to ICPP permanent survey grid. The ICPP survey grid and the WCF benchmark will make it possible to accurately locate the WCF and ancillary waste pipe lines if it becomes necessary in the future. A copy of this plat will be filed at the Butte County Courthouse, a copy will also be kept in the ICPP operation record.

4.7 Notices

4.7.1 Notification of Partial Closure

LMITCO and DOE-ID will notify the IDHW director 60 days prior to the date on which they intend to begin partial closure of the WCF to meet requirements applicable to a landfill.

4.7.2 Record of Wastes

LMITCO and DOE-ID will submit to the IDHW director and Butte County commissioners, no later than 60 days after certification of closure, a record of the type, location, and quantity of hazardous wastes disposed within the WCF.

4.7.3 Notice in Deed

Within 60 days of certification, LMITCO and DOE-ID will, in accordance with Idaho law, file a notation on the deed to the property or other instrument used for title search, that will in perpetuity notify any potential purchaser of the property that:

- The land has been used to manage hazardous wastes
- Its use is restricted under IDAPA 16.01.05.009 (40 CFR Subpart G) regulations
- The survey plat and record of the type, location, and quantity of hazardous wastes disposed within each cell (including location of all waste pipe lines ancillary to the WCF that remain outside of the closure cap footprint) or other hazardous waste disposal unit of the facility as required by IDAPA 16.01.05.009 [40 CFR 265.116 and 265.119(a)] have been filed with Butte County commissioners and the IDHW director.

4.7.4 Certification of Notice

LMITCO and DOE-ID will submit, within 60 days of certification of closure, a signed certification that they have recorded the notation as specified in Section 4.7.3 of this plan and a copy of the document in which the notation has been placed, to the IDHW director.

4.8 Surveying and Record keeping

The following items will be maintained in the operating record for ICPP:

- A map containing the exact location and dimensions, including depth, of each cell and the all waste pipe lines ancillary to the WCF that remain outside of the closure cap footprint with respect to a permanently surveyed benchmark
- The contents of each cell and the approximate location of each hazardous waste type within each cell.

5. POST-CLOSURE CARE PLAN

The Environmental Restoration Department manages the FFA/CO (CERCLA program) at ICPP. The WCF is located approximately in the center of WAG 3. WAG 3 contains several known release sites, which may require maintenance and/or monitoring for many years in the future. Some of the older HWMA units at the INEEL have managed radioactive hazardous waste and may need to be closed with waste in place, which will require post-closure care into the future. In an effort to eliminate duplication of effort and minimize costs associated with the long-term maintenance and/or monitoring, the HWMA post-closure care requirements and the CERCLA post-ROD requirements will be integrated and managed under the CERCLA program.

HWMA surface impoundment, landfill, or land treatment units subject to IDAPA 16.01.05.009 (40 CFR 265.117–120) post-closure care will be managed under the CERCLA program. Prior to CERCLA assuming the post-closure care responsibility for the WCF, the HWMA units will be closed as required by the IDAPA 16.01.05.009 (40 CFR 265.110–116) closure requirements. WCF will be closed when the P.E. certifies that the waste lines have been grouted and capped and the concrete cap was installed as described in this closure plan. The WCF, including the waste pipe lines outside the footprint of the closure cap, will be included as a site in the OU 3-13 WAG 3 Comprehensive RI/FS. The post-closure considerations, required at IDAPA 16.01.05.009 [40 CFR §§ 265.117-120}, will be addressed within the CERCLA process and shall be subject to applicable or relevant, and appropriate requirements (ARAR) procedures under the FFA/CO

The most current schedule prepared for the CERCLA activities at WAG 3 by the DOE-ID ER Program indicates the following:

The current schedule for post-ROD activities indicates the following:

Final Program Plan	1/21/98
End of the Public Comment Period	4/19/98
Draft ROD	5/29/98
Final ROD	9/23/98

Post-ROD Monitoring Package

Develop the monitoring plan	6/1/98
Regulator review	7/14/98
Final version	8/17/98
First round of sampling	8/18-31/98

The latest the monitoring would be implemented would be the result of identifying significant concerns during the public review/comment period. This would potentially delay sampling into the first calendar quarter of 1999.

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DOE/ID-11431
Revision 2

HWMA/RCRA Closure Plan for the CPP-601/627/640 Landfill Phase 2

September 2010

DOE/ID-11431
Revision 2

HWMA/RCRA Closure Plan for the CPP-601/627/640 Landfill Phase 2

September 2010

Prepared for the
U.S. Department of Energy
DOE Idaho Operations Office

ABSTRACT

This Hazardous Waste Management Act/Resource Conservation and Recovery Act (HWMA/RCRA) closure plan has been prepared for Phase 2 of the CPP-601/627/640 landfill closure. The landfill results from the closure of the CPP-601 Deep Tanks System and the integration of this tank system closure with the decommissioning of the CPP-601 Fuel Reprocessing Facility, CPP-627 Remote Analytical Facility, and CPP-640 Headend Processing Plant. Phase 1 landfill closure activities were completed and included decontamination and grouting of the CPP-601 Deep Tanks System. Building CPP-627 was decommissioned and removed to grade under a Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) non-time-critical removal action. Buildings CPP-601 and -640 are being decommissioned under a separate non-time-critical removal action. During the Phase 1 post-closure period, under the CPP-601/640 non-time-critical removal action, Buildings CPP-601 and -640 are being partially demolished, and grout is being used to fill interior void areas, creating a solid monolith. This, along with the concrete pad created near grade during the CPP-627 decommissioning, will be an interim cover for the landfill. Phase 2 of the landfill closure is the installation of a sloped layer of grout over the horizontal surfaces of the CPP-601/640 monolith followed by an earthen weather protection barrier designed to cover the entire CPP-601/627/640 monolith. This plan describes the activities to be conducted for installing the grout layer and earthen weather protection barrier. The final end state for the CPP/601/627/640 landfill is expected to be integrated with the final end state for the surrounding northern Idaho Nuclear Technology and Engineering Center facilities in approximately 2035 through coordination of the HWMA/RCRA and CERCLA programs.

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ACRONYMS

CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
DEQ	Idaho Department of Environmental Quality
DOE	U.S. Department of Energy
HWMA	Hazardous Waste Management Act
IDAPA	Idaho Administrative Procedures Act
INL	Idaho National Laboratory
INTEC	Idaho Nuclear Technology and Engineering Center
NTCRA	non-time-critical removal action
RCRA	Resource Conservation and Recovery Act
USC	United States Code
WCF	Waste Calcining Facility

HWMA/RCRA Closure Plan for the CPP-601/627/640 Landfill Phase 2

1. INTRODUCTION

This closure plan has been prepared for Phase 2 of the CPP-601 Fuel Reprocessing Facility, CPP-627 Remote Analytical Facility, and CPP-640 Headend Processing Plant landfill closure at the Idaho Nuclear Technology and Engineering Center (INTEC) at the Idaho National Laboratory (INL) Site. Phase 1 of the CPP-601/627/640 landfill closure was addressed in the *HWMA/RCRA Landfill Closure Plan for the CPP-601 Deep Tanks System Phase 1* (DOE-ID 2009a). The CPP-601 Deep Tanks System is being closed as a landfill in accordance with Hazardous Waste Management Act (HWMA) (State of Idaho 1983)/Resource Conservation and Recovery Act (RCRA) (42 *United States Code* [USC] 6901 et seq. 1976) regulations of the Idaho Administrative Procedures Act (IDAPA) 58.01.05.008 (40 *Code of Federal Regulations* [CFR] 264, Subparts G and J), which address tank system closure.

The CPP-601 Deep Tanks System is being closed as a landfill because of the presence of abandoned isolated piping runs that could not be flushed, waste remaining in the tank system at closure, and lead that was impracticable to remove. In addition, Buildings CPP-601, -627, and -640, which are part of the Fuel Reprocessing Complex at INTEC, have radionuclide contamination that will not be removed upon decommissioning. Buildings CPP-601 and -640 are being decommissioned in an ongoing Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) (42 USC 9601 et seq. 1980) non-time-critical removal action (NTCRA) (DOE-ID 2008). Building CPP-627 was demolished, and a protective layer of concrete was poured over the building footprint as part of a separate NTCRA (DOE-NE-ID 2004). Therefore, the CPP-601 HWMA/RCRA landfill closure is being integrated with the CPP-601/640 NTCRA and the completed CPP-627 NTCRA, resulting in a single CPP-601/627/640 landfill.

In coordination with the NTCRA, the CPP-601/627/640 HWMA/RCRA landfill closure is being completed in two phases. Activities for Phase 1 of the CPP-601 Deep Tanks System landfill closure were completed in accordance with the Phase 1 closure plan (DOE-ID 2009a), and the Idaho Department of Environmental Quality (DEQ) accepted the closure certification on February 19, 2010 (Monson 2010). Phase 1 post-closure activities are being conducted in accordance with the *HWMA/RCRA Post-Closure Plan for the CPP-601/627/640 Landfill* (DOE-ID 2009b), which became effective upon DEQ's acceptance of the Phase 1 closure certification. During the Phase 1 post-closure period, NTCRA demolition and removal activities are being conducted on Buildings CPP-601 and -640. Grout is being used to fill piping, vessels, and other internal void areas, thus creating a solid monolith. Removing building superstructures during the partial demolition of Buildings CPP-601 and -640 will expose the concrete monolith. This exposed monolith, along with the concrete pad created earlier during the CPP-627 NTCRA, is an interim HWMA/RCRA cover for the CPP-601/627/640 landfill during the Phase 1 post-closure period. The Phase 1 post-closure period extends from DEQ acceptance of the Phase 1 closure certification until DEQ accepts the Phase 2 closure certification.

Phase 2 of the landfill closure is the installation of a layer of grout over the horizontal surfaces of the CPP-601/640 monolith. This grout layer will be sloped as necessary to provide drainage and, along with the CPP-627 pad, will serve as a precipitation-infiltration coating for the horizontal surfaces of the CPP-601/627/640 monolith. The earthen weather protection barrier to be placed over the entire monolith (CPP-601/627/640) after the grout layer is installed will enhance longevity by further promoting precipitation run-off and reducing the impact of freeze/thaw cycles to the monolith. Drainage off of the east side of the monolith will be coordinated with the Operable Unit 3-14 CERCLA program through the

installation of a low-permeability asphalt layer to prevent precipitation infiltration. The final end state for the CPP-601/627/640 landfill is expected to be integrated with final end states for the adjacent northern INTEC facilities in approximately 2035 through coordination of the HWMA/RCRA and CERCLA programs.

The purpose of this plan is to describe the activities to be conducted for installing the Phase 2 grout layer and earthen weather protection barrier over the monolith created in coordination with the CERCLA NTCRAs. Upon DEQ acceptance of Phase 2 closure certification, the HWMA/RCRA post-closure permit for the INTEC Waste Calcining Facility (WCF) (PER-112) will be modified to include the Phase 2 landfill post-closure activities.

2. FACILITY DESCRIPTION

Buildings CPP-601, -627, and -640 are part of the Fuel Reprocessing Complex at INTEC, which is located in the south-central area of the INL Site. These buildings are described briefly in the following subsections. Detailed descriptions of the buildings and the INL Site are provided in the CPP-601 Phase 1 closure plan (DOE-ID 2009a) and the action memoranda for the CPP-601/640 and CPP-627 NTCRAs (DOE-ID 2008; DOE-NE-ID 2004).

2.1 CPP-601 Fuel Reprocessing Facility

The CPP-601 Fuel Reprocessing Facility was a 244 × 102-ft building consisting of six levels, with the primary portion located below ground. The facility was used for reprocessing spent nuclear fuel. Operations included fuel dissolution, separation, chemical makeup and transfer, and liquid waste receiving processes. The top level, constructed of transite panels on post and beam, was above grade and contained an open area that was used for transferring fuel elements to the process equipment and for chemical storage, makeup, and transfer. The lower levels, constructed of steel-reinforced concrete, contained process cells, corridors, and auxiliary cells that housed equipment and controls. The CPP-601 Deep Tanks System was located in the lowest level of Building CPP-601 and consisted of four 4,500-gal stainless steel tanks located in two stainless-steel-lined concrete vaults. This system collected liquid waste generated from separations processes performed in CPP-601. Process systems in CPP-627 and CPP-640, as well as other facilities, also sent waste to these tanks.

Most of the floor, cell walls, and equipment were lined with, or consisted of, stainless steel. The processing equipment, which was designed for remote operations, was generally enclosed in the heavily shielded cells. Often, lead was used as the shielding material. A significant amount of lead shielding also was encased in the concrete structures (floors and walls) (DOE-ID 2009a).

Building CPP-601 was made up of heavily reinforced, 1.5-ft-thick exterior building walls and up to 5-ft-thick interior cell walls and was 80% underground. As part of the CPP-601/640 NTCRA, the interior vessels, large piping, and cells of CPP-601 are being filled with grout, which will solidify and will be contained by the building structure. Because the grout is being placed in lifts and allowed to harden, lateral displacement is not a concern. The majority of the facility was founded on approximately 10 ft of compacted engineered subgrade on basalt bedrock. The deep tanks area extended into the basalt about 7 ft. The weight of the building and grout applies a pressure to the subgrade that is less than the underlying bearing capacity. Long-term displacement or subsidence is not expected.

2.2 CPP-627 Remote Analytical Facility

The CPP-627 Remote Analytical Facility was a 14,727-ft^2 facility. The building was entirely above ground and was attached to CPP-601. Building CPP-627 was constructed in 1955 of reinforced concrete and masonry block. Waste collection piping in CPP-627 had been inactive since 1989, and the CPP-627 building was last used in 1995. The building housed analytical, experimental, and decontamination facilities, including the Hot Chemistry Laboratory, the Old Shift Laboratory, the Multi-Curie Cell, the Emission Spectroscopy Laboratory, and the Decontamination Development Laboratory. The custom fuel dissolution process was conducted in the Hot Chemistry Laboratory/Multi-Curie Cell until 1991. In 2005, CPP-627 was removed to grade as part of an NTCRA (ICP 2006). Some lines that were part of the drainage system were included in the CPP-601 Deep Tanks System closure because the lines drained to the CPP-601 tanks. These lines remain beneath the CPP-627 pad, and the building footprint is included as part of the CPP-601/627/640 landfill closure.

Building CPP-627 primarily was built as a slab on grade structure. The slab was supported by concrete-filled pipe pillars and, in some areas, deep concrete footings. The building structure was removed essentially to the slab at grade. Subgrade areas, such as the valve pits and Multi-Curie Cell well were filled with concrete. Buried piping was capped at the slab. A concrete pad was poured over the slab area to prevent water infiltration. This pad abuts CPP-601 on the east and CPP-640 on the south. The weight of the existing building floor slab and new concrete pad applies a pressure to the subgrade that is less than the underlying bearing capacity. Long-term displacement or subsidence is not expected.

2.3 CPP-640 Headend Processing Plant

The CPP-640 Headend Processing Plant was a 66 × 89-ft structure constructed in 1961 to support research and process development for the uranium reprocessing mission in CPP-601. Fuel processing at CPP-640 ended in June 1984 (DOE-ID 2008).The facility contained two shielded waste-collection tank vaults at the lowest level of the building, five shielded test cells at the mid-level of the building, and an open crane loft with space for chemical makeup equipment and access to the cells through roof hatches at the upper level (DOE-ID 2007a). A major modification in the late 1970s added the shielded mechanical handling cave within the crane loft. The CPP-640 Headend Storage Tank System received decontamination fluids generated in the plant. The tank system comprised two radiological waste tanks and a nonradiological waste tank. The DEQ approved the certification for the CPP-640 Headend Storage Tank System closure on June 12, 2008 (Monson 2008).

Building CPP-640 was made up of heavily reinforced, 1.5-ft-thick exterior walls and 4.5-ft-thick cell walls and was mostly underground. As part of the CPP-601/640 NTCRA, the interior vessels, large piping, and cells of CPP-640 are being filled with grout, which will solidify and will be contained by the building structure. Because the grout is being placed in lifts and allowed to harden, lateral displacement is not a concern. The majority of the facility was founded on approximately 15 ft of compacted engineered subgrade on basalt bedrock. The weight of the building and grout applies a pressure to the subgrade that is less than the underlying bearing capacity. Long-term displacement or subsidence is not expected.

3. LANDFILL CLOSURE APPROACH

The approach for the CPP-601/627/640 landfill closure consists of three steps: Phase 1, the Phase 1 post-closure period, and Phase 2 (DOE-ID 2009a). Upon DEQ acceptance of the Phase 2 closure certification, the WCF HWMA/RCRA post-closure permit (PER-112) will be modified to include the Phase 2 post-closure activities.

Phase 1 landfill closure activities were completed and included the decontamination and grouting of the CPP-601 Deep Tanks System components in accordance with the *HWMA/RCRA Landfill Closure Plan for the CPP-601 Deep Tanks System Phase 1* (DOE-ID 2009a). The DEQ accepted the Phase 1 closure certification on February 19, 2010 (Monson 2010).

The Phase 1 post-closure period of the landfill closure includes the performance of HWMA/RCRA inspection, maintenance, and monitoring activities on the CPP-601/627/640 monolith, which will serve as an interim HWMA/RCRA cover over the landfill. These activities are being performed in accordance with the *HWMA/RCRA Post-Closure Plan for the CPP-601/627/640 Landfill* (DOE-ID 2009b), which became effective upon DEQ's acceptance of the Phase 1 closure certification (Monson 2010). Phase 1 post-closure period activities are being integrated with the CPP-601/640 NTCRA activities. The CPP-601/640 portion of the monolith is being created and exposed as a result of the CPP-601/640 NTCRA activities specified in the *Action Memorandum for Decommissioning CPP-601/640 Fuel Reprocessing Facilities* (DOE-ID 2008). As part of the NTCRA (DOE-ID 2008), the remaining internal void areas of CPP-601 and -640, including vessels and piping, are being grouted to the Process Makeup/Hot Makeup deck level, thus creating the monolith. Building CPP-627 was demolished as part of the NTCRA performed in accordance with the *Action Memorandum for the Decontamination and Decommissioning of Building CPP-627, the Remote Analytical Facility* (DOE-NE-ID 2004). Under the NTCRA, a sloped concrete pad was poured over the CPP-627 building footprint and will become part of the CPP-601/627/640 landfill.

Phase 2 of the landfill closure is the installation of the Phase 2 HWMA/RCRA earthen weather protection barrier system over the concrete monolith. A grout layer will be installed over the horizontal surfaces of the CPP-601/640 monolith to promote drainage, and an earthen weather protection barrier will be placed over the entire monolith to protect the monolith from freeze/thaw cycling. Upon DEQ acceptance of the Phase 2 closure certification, the WCF HWMA/RCRA post-closure permit (PER-112) will be modified to include the Phase 2 landfill post-closure activities. The final end state for the CPP-601/627/640 landfill is expected to be integrated with final end states for the surrounding northern INTEC facilities in approximately 2035 through coordination of the HWMA/RCRA and CERCLA programs. These facilities potentially include the Tank Farm Facility, Calcine Bin Sets, New Waste Calcining Facility, Process Equipment Waste Evaporator, Integrated Waste Treatment Unit, and other miscellaneous facilities.

Table 1 shows the integration of the HWMA/RCRA activities with the CPP-601/640 NTCRA activities and lists the primary activities associated with each step in the phased landfill closure. Descriptions of the landfill closure boundary, Phase 1 closure, CPP-640 HWMA/RCRA closure, CPP-627 NTCRA, CPP-601/640 NTCRA, and Phase 1 post-closure are provided in the following subsections.

Table 1. Primary activities associated with the phased CPP-601/627/640 landfill closure.

Closure Phase	HWMA/RCRA Activities	CERCLA NTCRA Activities
Phase 1 CPP-601 Landfill Closure	*HWMA/RCRA Landfill Closure Plan for the CPP-601 Deep Tanks System Phase 1* (DOE-ID 2009a) • Remove waste to extent practicable • Decontaminate piping and tanks to extent practicable • Sample and analyze rinsate and characterize wastes • Grout tanks for waste stabilization • DEQ Acceptance of Phase 1 landfill closure certification on February 19, 2010 (Monson 2010)	*Action Memorandum for Decommissioning CPP-601/640 Fuel Reprocessing Facilities* (DOE-ID 2008) CPP-601/640 decontamination and decommissioning • Remove accessible bulk lead, asbestos, and other materials that would increase risk • Fill remaining area, including vessels and piping, with grout, creating monolith
Phase 1 Post-Closure Care CPP-601/627/640 Landfill Interim Cover	*HWMA/RCRA Post-Closure Plan for the CPP-601/627/640 Landfill* (DOE-ID 2009b) • Effective upon DEQ acceptance of Phase 1 closure certification on February 19, 2010 (Monson 2010) • Implement inspection, maintenance, and monitoring requirements for CPP-601/627/640 landfill • Install groundwater monitoring wells, and begin groundwater monitoring	*Action Memorandum for Decommissioning CPP-601/640 Fuel Reprocessing Facilities* (DOE-ID 2008) CPP-601/640 demolition • Remove building to the Process Makeup/ Hot Makeup deck level, exposing concrete monolith • Place layer of grout on horizontal surfaces of exposed monolith as appropriate to provide sloping and to serve as a precipitation-infiltration coating over the CPP-601/640 sections of the monolith • Implement institutional controls for monolith maintenance and precipitation run-off control
Phase 2 CPP-601/627/640 Phase 2 Grout Layer and Earthen Weather Protection Barrier Installation	Phase 2 HWMA/RCRA landfill closure plan (this document) • Install grout layer over horizontal surfaces of the CPP-601/640 monolith to provide sloping • Install earthen weather protection barrier over abovegrade sections of CPP-601/627/640 monolith • Continue groundwater monitoring, inspection, and maintenance under the Phase 1 post-closure plan (DOE-ID 2009b) • Certification of Phase 2 closure	
CPP-601/627/640 Permitted Post-Closure Care	• Post-closure permit modification (to be completed) • Continue groundwater monitoring, inspection, and maintenance	

CERCLA—Comprehensive Environmental Response, Compensation, and Liability Act
DEQ—Idaho Department of Environmental Quality
HWMA/RCRA—Hazardous Waste Management Act/Resource Conservation and Recovery Act
NTCRA—non-time-critical removal action

3.1 Landfill Closure Boundary

The boundary for the landfill closure is established in the CPP-601 Deep Tanks System Phase 1 landfill closure plan (DOE-ID 2009a). As stipulated in that plan, the landfill boundary encompasses the CPP-601 Deep Tanks System, as well as the entire footprint of Buildings CPP-601, -627, and -640, which shared common walls and utilities. Also included is the bottom of CPP-602 LC-107 sump, which contains two short sections (3 ft each) of the CPP-602 discharge drain lines. These line segments were replaced with HWMA/RCRA-compliant lines in approximately 1991. The line segments were cut, capped, and covered with grout. A stainless steel sump liner was installed above the lines and new lines installed. These lines extended from the CPP-602 LC-107 sump through the common wall of CPP-601 and CPP-602 into the CPP-601 header. The landfill does not include the rest of the CPP-602 laboratory, which is subject to a separate closure action (DOE-ID 2009a). Figure 1 provides an overview of the landfill boundaries shaded in green.

3.2 CPP-601 Deep Tanks System Phase 1 Landfill Closure

The CPP-601 Deep Tanks System Phase 1 landfill closure activities were completed in accordance with the Phase 1 closure plan (DOE-ID 2009a). Laboratory waste discharge piping from the laboratory hoods, sinks, and drains in CPP-602 and -684 that discharged to CPP-601 were clean-closed by decontamination to the site-specific action levels specified in the closure plan. One line from the Fluorinel Dissolution Process cell in CPP-666 was clean-closed under the Voluntary Consent Order, and a second line from Tanks FA-141 and FA-142 in CPP-666 was clean-closed under a previous RCRA closure activity. The remaining portions of the CPP-601 Deep Tanks System within the landfill closure boundaries of the outer walls of CPP-601/627/640 were flushed to the extent practicable. The CPP-601/627/640 components included in the landfill area were completely isolated from CPP-602, -666, and -684 and the INTEC Liquid Waste Management System waste handling systems (DOE-ID 2009a). The four deep tanks in CPP-601 were filled with grout. DEQ accepted the Phase 1 closure certification on February 19, 2010 (Monson 2010).

3.3 CPP-627 Remote Analytical Facility HWMA/RCRA Piping

The HWMA/RCRA regulated lines in the CPP-627 Remote Analytical Facility were addressed in the CPP-601 Deep Tanks System Phase 1 landfill closure plan (DOE-ID 2009a). DEQ accepted the Phase 1 closure certification covering these lines on February 19, 2010 (Monson 2010).

3.4 CPP-640 Headend Storage Tank System HWMA/RCRA Closure

The CPP-640 Headend Storage Tank System was clean-closed in accordance with HWMA/RCRA requirements. Tank system components, including tanks and ancillary equipment that managed hazardous waste, were decontaminated to the site-specific action levels specified in the *HWMA/RCRA Closure Plan for the CPP-640 Headend Storage Tank System* (DOE-ID 2007a). DEQ accepted the closure certification on June 12, 2008 (Monson 2008).

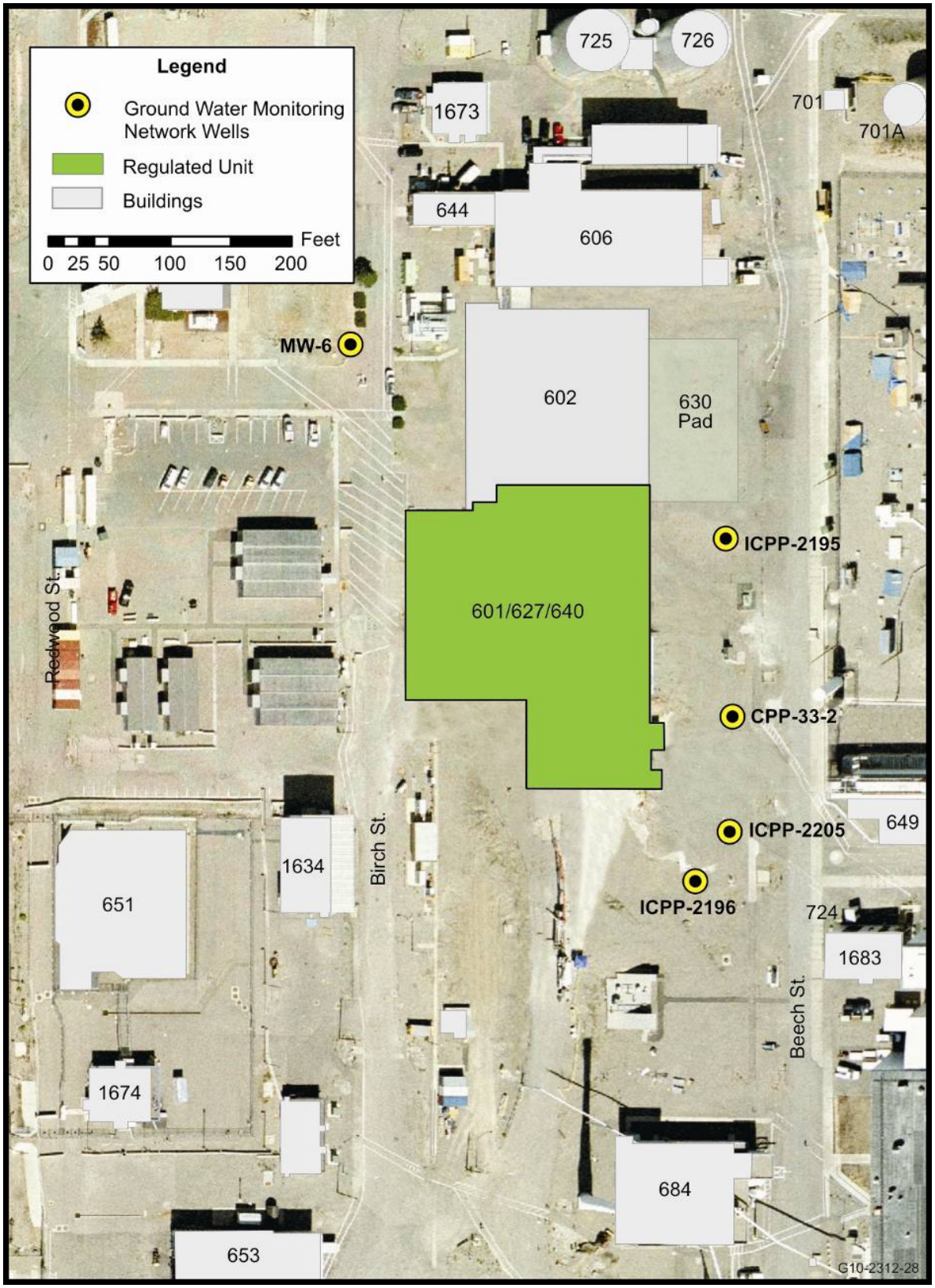

Figure 1. Idaho Nuclear Technology and Engineering Center building layout with landfill footprint shaded in green.

3.5 CPP-627 Non-Time-Critical Removal Action

The CPP-627 Remote Analytical Facility was decommissioned in 2005 (ICP 2006) in an NTCRA as specified in the *Action Memorandum for the Decontamination and Decommissioning of Building CPP-627, the Remote Analytical Facility* (DOE-NE-ID 2004). Abovegrade hazardous waste piping was removed and disposed of, and the CPP-627 facility was removed to grade. The remaining floor slab, which covered the remaining belowgrade inactive/abandoned lines that were inaccessible for decontamination, was washed down to remove loose contamination. A protective layer of concrete was then poured over the entire building footprint to prevent future infiltration of water (ICP 2006). The CPP-627 pad slopes down from approximately 20 in. on the east side adjacent to CPP-601 to approximately 10 in. on the west side (DOE-ID 2008; PWO-05-318).

3.6 CPP-601/640 Non-Time-Critical Removal Action

The CPP-601/640 facilities are being decommissioned in an NTCRA as specified in the *Action Memorandum for Decommissioning CPP-601/640 Fuel Reprocessing Facilities* (DOE-ID 2008). Activities preparatory to this NTCRA have been performed in accordance with the *Action Memorandum for General Decommissioning Activities under the Idaho Cleanup Project* (DOE-ID 2009c). These activities include isolating utilities; removing chemicals, piping, and equipment; and performing routine waste-management practices, such as removing lead, polychlorinated biphenyls, and asbestos (DOE-ID 2009c). Decommissioning activities currently being performed include:

- Waste stabilization through the grouting of larger system piping and vessels, as well as the remaining void spaces within the CPP-601/640 facilities.
- Removal of nonprocess areas, including building components and the upper portion of the mechanical handling cave with processing cells left intact. The top 8 ft of the P, Q, and R cells in CPP-601 and the bottom 2.5 ft of the mechanical handling cave will remain intact and are being grouted. Intact cells were decontaminated to the extent practicable before being grouted.

Grouting of void spaces within the building will effectively encapsulate the vessels and piping left in place. Pipe penetrations through exterior walls are being cut and sealed. Utilities to the building have been isolated. Bulkheads will be built where doors on the outer surface of the monolith have been removed. Openings between CPP-601 and -640 are being sealed by the formation of short wall sections to enclose short passageways that were exposed when the abovegrade nonprocess areas of CPP-640 were removed. Areas behind these bulkheads and new walls will be filled with grout to create a solid monolith.

Figures 2 and 3 show two views of the anticipated configuration of the CPP-601/627/640 monolith (prior to installation of the grout layer on the horizontal surfaces of CPP-601 and -640). The CPP-627 pad, poured at approximately 1 ft above grade, already covers the CPP-627 footprint as shown in the figures.

Figure 2. Anticipated southwest view of the CPP-601/627/640 monolith.

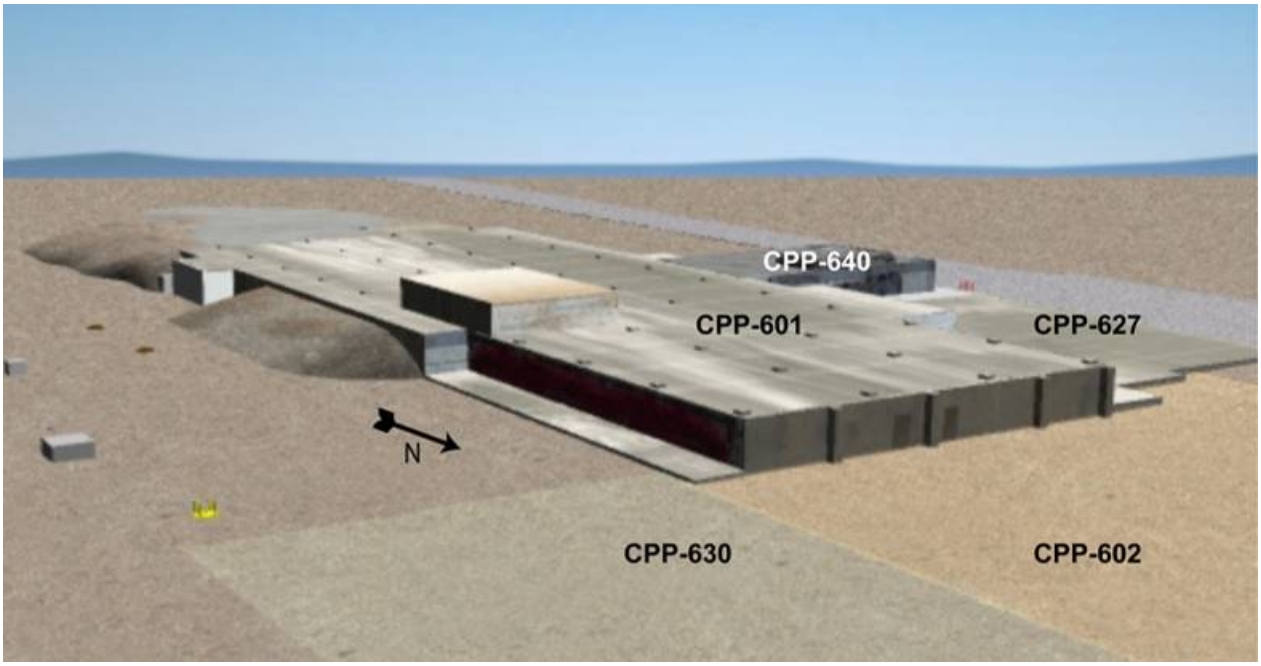

Figure 3. Anticipated northeast view of the CPP-601/627/640 monolith.

Buildings CPP-601 and -640 are being partially demolished to approximately 11 ft above grade in most areas, leaving process cells intact and exposing the concrete monolith in place. Building CPP-640 has been demolished to grade for the non-cell areas, to the Hot Makeup deck level for Cells 1–5, and to approximately 13 ft above grade for the mechanical handling cave. Building CPP-601 is being demolished to the Process Makeup deck level with the exception of the P, Q, and R process cells, which extend approximately 19 ft above grade. Sections of the sample corridor exterior walls on both the east and west sides of CPP-601 were removed to support the removal of lead sample blisters and a lead cave in those areas. Those areas (where sections of the sample corridor walls were removed) are essentially at grade. They will be considered part of the horizontal surfaces and will be covered with a layer of grout similar to the top of the Process Makeup deck. The CPP-601 and CPP-640 structures remaining after

completion of demolition will, along with the CPP-627 pad, form the interim CPP-601/627/640 concrete monolith.

The grout layer to be applied to the horizontal surfaces of that concrete monolith will not be applied to the outer walls (exterior vertical surfaces) of the monolith. Penetrations through these walls will be sealed. However the ends of pipes, conduits, rebar, beams, or other items will remain visible until the earthen weather protection barrier is installed. Wooden barricades were built to seal exterior doorways and other openings created during the demolition process. Some of these wooden barricades will not be removed and will remain visible until the earthen weather protection barrier is installed. The void areas behind these barricades have been filled with grout as part of the NTCRA.

Figures 4 and 5 show examples of the rough exterior of the monolith created under the NTCRA. Figure 4 shows the junction where the south wall of CPP-640 met the west wall of CPP-601. When the nonprocess cell area of CPP-640 was removed to grade, the area where CPP-601 and CPP-604 met was exposed. The barricades in this picture seal those former doorways. The hallways behind these barricades have been filled with grout. Figure 5 shows the north wall of CPP-640 process cells where equipment (lead-encased sample blisters) was removed from that wall. The openings through the 48 in.-thick wall have been sealed.

Figure 4. Junction of CPP-601 and CPP-640.

Figure 5. CPP-640 north wall showing rough exterior of interim monolith.

3.7 CPP-601 Deep Tanks System Phase 1 Landfill Post-Closure

The Phase 1 post-closure activities consist of inspection and maintenance of the CPP-601/627/640 monolith to the extent the monolith has been exposed and groundwater monitoring. The inspection, maintenance, and monitoring programs are being conducted in accordance with the Phase 1 post-closure plan (DOE-ID 2009b). The Phase 1 landfill post-closure activities are being conducted during the interim period from DEQ acceptance of the Phase 1 closure certification until DEQ accepts the Phase 2 closure certification.

During the Phase 1 post-closure period, the monolith is being inspected and maintained in accordance with the provisions of IDAPA 58.01.05.008 (40 CFR 264.15; 40 CFR 264.117). The integrity of the monolith is inspected semiannually on exposed portions of the monolith. The inspections are documented on the CPP-601/627/640 post-closure monitoring form (FRM-1095) and include inspection of the outer surface and surface drainage. Additionally, the following maintenance activities are being performed:

- Maintain the integrity and effectiveness of the interim monolith, including making repairs to the monolith as necessary to correct effects of subsidence, erosion, or other events and including repairs to the groundwater monitoring system and equipment
- Maintain the security of the facility in accordance with IDAPA 58.01.05.008 (40 CFR 264.14)
- Maintain and monitor the groundwater monitoring system, and comply with all other applicable requirements of IDAPA 58.01.05.008 (40 CFR 264, Subpart F)

- Prevent run-on and run-off from eroding or otherwise damaging the monolith.

Groundwater monitoring wells have been established to implement the groundwater monitoring programs. A combination of two existing wells and two new wells will be used to ensure compliance with IDAPA 58.01.05.008 (40 CFR 264, Subpart F). An initial period of quarterly sampling for 2 years will be completed to establish background levels for the four wells planned to be used for monitoring the CPP-601/627/640 monolith. Statistical analyses of the data collected during this period will be used to set background levels and detection monitoring criteria. After the background levels have been established, groundwater monitoring will continue semiannually until the WCF HWMA/RCRA post-closure permit (PER-112) is modified to include CPP-601/627/640.

4. WASTE INVENTORY AND CHARACTERISTICS

The waste remaining in the CPP-601/627/640 facilities has been characterized and quantified and is documented in Engineering Design File (EDF) -9367, "Nonradiological Material Inventory for CPP-601, CPP-627, and CPP-640 Landfill Closure." In addition, in March 2009, the U.S. Department of Energy (DOE) requested concurrence from DEQ and the U.S. Environmental Protection Agency to leave bulk lead in place because the lead had been evaluated and determined to be impracticable to remove. Lead totaling approximately 130 tons in CPP-601 and -640 is integral to the building structure or removal would significantly increase radiological or worker risk (Shaw 2009). DEQ and the Environmental Protection Agency concurred with this request (Monson 2009; Faulk 2009).

Table 2 shows the expected waste inventory remaining in the CPP-601/627/640 facilities of eight of the 19 hazardous constituents listed in the INL WCF post-closure permit (PER-112). These eight constituents are expected to be present in quantities greater than 1 g. The 11 constituents that are not expected to be present, or that are expected to be present in quantities of less than 1 g, are 1,1,1-trichloroethane, benzene, carbon disulfide, carbon tetrachloride, chloroform, methyl ethyl ketone, methylene chloride, pyridine, tetrachloroethene, trichloroethene, and toluene. The 19 constituents listed in PER-112 are considered because the WCF and the CPP-601/627/640 facilities handled similar waste streams generated from fuel processing activities, and they are the constituents being monitored under the WCF post-closure permit. Additional constituents will be added if necessary based on the sampling of chemicals listed in IDAPA 58.01.05.008 (40 CFR 264, Appendix IX) to be completed as a part of the establishment of background levels.

Table 2. Waste inventory expected in CPP-601/627/640 landfill.

Constituent	Total Waste (kg)
Arsenic	3.00E-02
Barium	1.63E+01
Cadmium	5.24E+01
Chromium	1.08E+05
Lead	1.18E+05
Mercury	2.00E-02
Selenium	2.00E-02
Silver	5.60E-01

5. CLOSURE PERFORMANCE STANDARDS

As required by IDAPA 58.01.05.008 (40 CFR 264.197), which addresses closure for tank systems, tank systems to be closed as landfills must meet the closure requirements for landfills specified in IDAPA 58.01.05.008 (40 CFR 264.310). This section describes the performance standards for the CPP-601/627/640 landfill closure under IDAPA 58.01.05.008 (40 CFR 264.111 and 264.310) and the activities that will be conducted to demonstrate that the landfill closure performance standards have been met as established in this closure plan.

5.1 Regulatory Closure Performance Standards

The closure performance standards identified in IDAPA 58.01.05.008 (40 CFR 264.111 and 264.310) applicable to the CPP-601/627/640 landfill closure are:

1. The owner or operator must close the facility in a manner that minimizes the need for further maintenance (IDAPA 58.01.05.008 [40 CFR 264.111(a)])
2. The owner or operator must close the facility in a manner that controls, minimizes, or eliminates, to the extent necessary to protect human health and the environment, post-closure escape of hazardous waste, hazardous constituents, leachate, contaminated run-off, or hazardous waste decomposition products to the ground or surface waters or to the atmosphere (IDAPA 58.01.05.008 [40 CFR 264.111(b)])
3. The owner or operator must close the facility in a manner that complies with the closure requirements of IDAPA 58.01.05.008 (40 CFR 264, Subpart G), including, but not limited to, the requirements of 40 CFR 264.178, 264.197, 264.228, 264.258, 264.280, 264.310, 264.351, 264.601 though 264.603, and 264.1102 (IDAPA 58.01.05.008 [40 CFR 264.111(c)]).

5.2 Required Activities for Achieving Closure Performance Standards

The CPP-601/627/640 Phase 2 landfill closure activities to be conducted under this closure plan are described in detail in Section 6, "Closure Requirements." The following subsections describe the Phase 2 HWMA/RCRA landfill closure activities that will be performed to achieve the closure performance standards listed in Section 5.1. These Phase 2 closure activities will complement the Phase 1 post-closure activities, as well as those activities performed as part of the CPP-601/640 NTCRA. As discussed in the Phase 1 post-closure plan (DOE-ID 2009b), these NTCRA activities will result in an interim monolith that will substantively meet the technical requirements of IDAPA 58.01.05.008 (40 CFR 264.310).

5.2.1 Standard 1

The owner or operator must close the facility in a manner that minimizes the need for further maintenance (IDAPA 58.01.05.008 [40 CFR 264.111(a)]).

This closure performance standard will be achieved by (a) placing a layer of grout over the horizontal surfaces of the CPP-601/640 monolith and (b) placing an earthen weather protection barrier over the entire monolith. The grout layer will provide a low-permeability precipitation-infiltration coating and will be sloped as necessary to promote run-off. The existing sloped pad over the CPP-627 footprint already meets these requirements. The earthen weather protection barrier will reduce the impact of freeze/thaw cycling to the monolith, providing weather protection that will enhance the longevity of the monolith.

5.2.2 Standard 2

The owner or operator must close the facility in a manner that controls, minimizes, or eliminates, to the extent necessary to protect human health and the environment, post-closure escape of hazardous waste, hazardous constituents, leachate, contaminated run-off, or hazardous waste decomposition products to the ground or surface waters or to the atmosphere (IDAPA 58.01.05.008 [40 CFR 264.111(b)]).

This closure performance standard will be achieved by (a) placing a layer of grout over the horizontal surfaces of the CPP-601/640 monolith and (b) placing an earthen weather protection barrier over the entire monolith. The grout layer will provide a low-permeability precipitation-infiltration coating and will be sloped as necessary to promote run-off. The existing sloped pad over the CPP-627 footprint already meets these requirements. The earthen weather protection barrier will reduce the impact of freeze/thaw cycling to the monolith, providing weather protection that will enhance the longevity of the monolith.

5.2.3 Standard 3

At closure of a tank system, if the owner or operator demonstrates that not all contaminated soils can be practicably removed or decontaminated as required in IDAPA 58.01.05.008 [40 CFR 264.197(a)], then the owner or operator must close the tank system and perform post-closure care in accordance with the closure and post-closure care requirements that apply to landfills (IDAPA 58.01.05.008 [40 CFR 264.310]). In addition, for the purposes of closure, post-closure, and financial responsibility, such a tank system is then considered to be a landfill, and the owner or operator must meet all of the requirements for landfills specified in Subparts G and H of 40 CFR 264 (IDAPA 58.01.05.008 [40 CFR 264.197(a) and (b)]).

To meet this closure standard, the CPP-601 Deep Tanks System is being closed as a landfill because of the presence of abandoned isolated piping runs that could not be flushed, waste remaining in the tank system at closure, and lead that was impracticable to remove. In addition, closure of the CPP-601 Deep Tanks System as a landfill is being integrated with the CPP-601/640 NTCRA, which is ongoing, and the CPP-627 NTCRA, which has been completed. These actions will result in a single CPP-601/627/640 landfill, which will be closed in accordance with this closure plan. The soils beneath the CPP-601/627/640 monolith are not addressed in this closure plan because they are being addressed under the CERCLA program as Sites CPP-80, CPP-117, CPP-118, CPP-119, CPP-120, CPP-121, CPP-122, and CPP-123.

6. CLOSURE REQUIREMENTS

This section describes the closure requirements and compliance strategy for Phase 2 of the CPP-601/627/640 landfill closure. The need to close the CPP-601 Deep Tanks System as a landfill and the integration of this tank system closure with the CPP-601/640 and CPP-627 NTCRAs are driven by the closure requirements for tank systems set forth in IDAPA 58.01.05.008 (40 CFR 264.197). These requirements specify that tank systems with waste that cannot be practicably removed or decontaminated as specified in IDAPA 58.01.05.008 [40 CFR 264.197(a)] must be closed in accordance with the closure and post-closure care requirements that apply to landfills (IDAPA 58.01.05.008 [40 CFR 264.310]). The CPP-601 Deep Tanks System, along with Buildings CPP-601, -627, and -640, will be closed as a landfill because of the presence of abandoned isolated piping runs that could not be flushed, waste remaining in the tank system at closure, and lead that was impracticable to remove, all resulting in HWMA/RCRA hazardous constituents left in place.

The concrete monolith for the CPP-601/627/640 landfill that will be created by NTCRA activities will serve as an interim HWMA/RCRA cover pending placement of the grout layer and earthen weather protection barrier for minimization of precipitation infiltration and protection from freeze/thaw cycling. The grout layer and earthen weather protection barrier will constitute the Phase 2 HWMA/RCRA cover. The performance standards are provided in IDAPA 58.01.05.008 (40 CFR 264.111), and the closure requirements are specified in IDAPA 58.01.05.008 (40 CFR 264.310), which addresses landfill closure and post-closure care. Table 3 summarizes these HWMA/RCRA requirements for Phase 2 of the CPP-601/627/640 landfill closure and post-closure and the strategy planned to meet each requirement. This strategy includes the monolith created by the NTCRA, which serves as an interim cover, the activities discussed in this closure plan, as well as post-closure activities. Only those actions specifically described in Section 8 of this document that implement this compliance strategy for Phase II will be subject to certification under this closure plan. Actions taken pursuant solely to either the CPP-627 or CPP-601/640 NTCRAs will not be subject to certification under this closure plan.

Table 3. HWMA/RCRA landfill closure and post-closure requirements and compliance strategy.

IDAPA 58.01.05.008 (40 CFR 264, Subpart G) Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities—Closure and Post-Closure	
Regulatory Requirement Summary	Compliance Strategy
§ 264.111 Closure performance standard.	
(a) Facility must be closed in a manner that minimizes the need for further maintenance	A layer of grout will be placed over the horizontal surfaces of the CPP-601/640 monolith, and an earthen weather protection barrier will be placed over the entire monolith. The grout layer will provide a low-permeability precipitation-infiltration coating and will be sloped as necessary to promote run-off. The earthen weather protection barrier will provide weather protection that will enhance longevity by reducing the impact of freeze/thaw cycles to the monolith from.
(b) Facility must be closed in a manner that controls, minimizes, or eliminates, to the extent necessary to protect human health and the environment, post-closure escape of hazardous waste, hazardous constituents, leachate, contaminated run-off, or hazardous waste decomposition products to the ground or surface waters or to the atmosphere	A layer of grout will be placed over the horizontal surfaces of the CPP-601/640 monolith, and an earthen weather protection barrier will be placed over the entire monolith. The grout layer will provide a low-permeability precipitation-infiltration coating and will be sloped as necessary to promote run-off. The earthen weather protection barrier will provide weather protection that will enhance longevity by reducing the impact of freeze/thaw cycles to the monolith. In addition, the isolation of the waste to be left in place by the placement of grout as part of the CPP-601/640 NTCRA activities will minimize or eliminate the possibility of post-closure escape of hazardous waste or constituents.
(c) Facility must be closed in a manner that complies with the closure requirements of this subpart, including § 264.197 (tank systems) and § 264.310 (landfills)	As stated in § 264.197(b), if not all contaminated wastes can be practicably removed or decontaminated, then the tank system must be closed in accordance with closure and post-closure care requirements that apply to landfills (§ 264.310). The CPP-601 Deep Tanks System, along with Buildings CPP-601/627/640, will be closed as a landfill because of the presence of abandoned isolated piping runs that could not be flushed, waste remaining in the tank system at closure, and lead that was impracticable to remove, all resulting in hazardous constituents left in place. See table entries for § 264.310.

Table 3. (continued).

IDAPA 58.01.05.008 (40 CFR 264, Subpart G) Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities—Closure and Post-Closure	
Regulatory Requirement Summary	Compliance Strategy
§ 264.117 Post-closure care and use of property.	
(a) This section specifies that post-closure care must begin after completion of closure of the unit and continue for 30 years after that date. The post-closure care must include monitoring and reporting in accordance with 40 CFR 264, Subparts F, K, L, M, N, and X. Post-closure care must also include maintenance and monitoring of waste containment systems in accordance with these subparts. The Regional Administrator may shorten or extend the post-closure care period as necessary to protect human health and the environment.	Phase 2 post-closure care activities will begin upon DEQ acceptance of the Phase 2 landfill closure certification. The WCF HWMA/RCRA post-closure permit (PER-112) will be modified to include the Phase 2 landfill post-closure activities.
(b) This section specifies when the Regional Administrator may require that security requirements of § 264.14 must remain in place.	The owner/operator will comply with changes made by the DEQ Director as required.
(c) This section specifies that post-closure use of the property must never be allowed to disturb the integrity of the containment and monitoring systems unless the Regional Administrator allows the disturbance under certain conditions.	Post-closure use of the property will be maintained as required by the post-closure requirements to be specified in the modification to the WCF HWMA/RCRA post-closure permit (PER-112).
(d) All post-closure care activities must be performed in accordance with an approved post-closure plan as specified in § 264.118.	Phase 2 post-closure care activities will be performed in accordance with the post-closure requirements to be specified in the modification to the WCF HWMA/RCRA post-closure permit (PER-112).

Table 3. (continued).

IDAPA 58.01.05.008 (40 CFR 264, Subpart G) Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities—Closure and Post-Closure	
Regulatory Requirement Summary	Compliance Strategy
§ 264.118 Post-closure plan; amendment of plan.	
This section specifies when an owner or operator of a hazardous waste disposal unit must have a written post-closure plan, that the plan must be submitted with the permit application, and that the approved post-closure plan will become a condition of the permit. This section also specifies requirements for the contents of the post-closure plan, including planned monitoring activities and the frequency at which these activities will be performed to comply with Subparts F (Groundwater Monitoring) and N (Landfills). This section also specifies requirements for planned maintenance activities and the frequency at which they will be performed to ensure the integrity of the cap and final cover and the function of the monitoring equipment in accordance with Subparts F (Groundwater Monitoring) and N (Landfills). In addition, this section describes requirements for maintaining the plan, amending the post-closure plan, and modifying the plan and length of the post-closure care period.	Upon DEQ acceptance of the Phase 2 closure certification, the WCF HWMA/RCRA post-closure permit (PER-112) will be modified to include the Phase 2 landfill post-closure activities. The Phase 2 landfill post-closure requirements to be specified in the permit modification will address planned monitoring and maintenance activities, as required. The modified WCF HWMA/RCRA post-closure permit (PER-112) will be maintained as required. Any amendments to the post-closure activities will be made in accordance with requirements for permit modifications.
§ 264.119 Post-closure notices.	
(a) No later than 60 days after certification of closure of each hazardous waste disposal unit, the owner or operator must submit to the local zoning authority, or the authority with jurisdiction over local land use, and to the Regional Administrator a record of the type, location, and quantity of hazardous wastes disposed of within each cell or other disposal unit of the facility.	A record of the type, location, and quantity of hazardous wastes within the CPP-601/627/640 landfill will be submitted to the Butte County commissioners and DEQ within 60 days after closure certification.
(b) This section requires within 60 days of certification of closure	
(1) A notation on the deed to the facility property or other instrument normally examined during title search that will in perpetuity notify any potential purchaser of the property that the land has been used to manage hazardous wastes, the land's use is restricted under 40 CFR 264, Subpart G regulations, and the survey plat and record of wastes required by §§ 264.116 and 264.119(a) have been filed with the local zoning authority or the authority with jurisdiction over local land use and with the Regional Administrator.	Within 60 days of closure certification, the required notation on the deed to the property or other instrument used for title search will be filed in accordance with Idaho law.
(2) Submittal of a certification, signed by the owner or operator, that he has recorded the notation specified in Paragraph (b)(1) of this section, including a copy of the document in which the notation has been placed, to the Regional Administrator.	Within 60 days of closure certification, the required signed certification will be submitted to DEQ.

Table 3. (continued).

IDAPA 58.01.05.008 (40 CFR 264, Subpart G) Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities—Closure and Post-Closure	
Regulatory Requirement Summary	Compliance Strategy
(c) This section specifies requirements for notices when the owner or operator or any subsequent owner or operator of the land upon which a hazardous waste disposal unit is located wishes to remove hazardous wastes and hazardous waste residues, the liner, if any, or contaminated soils.	Not applicable.
§ 264.120 Certification of completion of post-closure care.	
This section specifies that a certification that post-closure care was performed in accordance with the approved post-closure plan must be submitted no later than 60 days following the end of the post-closure care period.	This requirement will be met within 60 days of completion of the Phase 2 post-closure care period.
§ 264.310 Closure and post-closure care.	
(a) At final closure of the landfill, the owner or operator must cover the landfill with a final cover designed and constructed to (1) Provide long-term minimization of migration of liquids through the closed landfill (2) Function with minimum maintenance (3) Promote drainage and minimize erosion or abrasion of the cover (4) Accommodate settling and subsidence so that the cover's integrity is maintained	A grout layer will be placed on horizontal surfaces of the CPP-601/640 monolith and sloped. The existing sloped grout pad on the CPP-627 footprint already meets this requirement. The sloped grout layer will provide long-term minimization of migration of liquids through the closed landfill by providing a low-permeability surface and promoting drainage away from the structure. Approximately 3 ft of soil will be placed over the monolith and sloped to provide adequate drainage at no more than a 3:1 slope. The soil and grout layers will minimize the migration of liquids through the landfill and

Table 3. (continued).

IDAPA 58.01.05.008 (40 CFR 264, Subpart G) Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities—Closure and Post-Closure	
Regulatory Requirement Summary	Compliance Strategy
(5) Have a permeability less than or equal to the permeability of any bottom liner system or natural subsoils present.	will function with minimum maintenance. The earthen weather protection barrier will provide weather protection that will enhance longevity of the monolith by protecting the monolith from any freeze/thaw cycles. The slope will promote further drainage away from the structure and minimize erosion. The interim CPP-601/627/640 monolith is constructed of concrete, grout, and other inert material that fills void spaces in the remaining buildings, including vessels and large piping. As part of the CPP-601/640 NTCRA, drains, pipes, hatches, and other openings on the monolith surface are being sealed. Openings between CPP-601 and -640 are being sealed with short wall sections as necessary. Buildings CPP-601, -627, and -640 were constructed of reinforced walls, with void spaces in CPP-601/640 filled with grout. CPP-627 was demolished to grade, and a sloped concrete pad was placed over the foundation. Drilled piers support grade beams and the former building slab. Soil will be applied over the monolith in lifts as necessary to achieve the desired slope. Therefore, long-term lateral displacement and subsidence are not expected. The monolith's construction, the placement of grout, and the addition of overlying soil will result in permeability less than the soils and bedrock beneath the buildings.
(b) After final closure, the owner or operator must comply with all post-closure requirements contained in §§ 264.117 through 264.120, including maintenance and monitoring throughout the post-closure care period (specified in the permit under § 264.117). The owner or operator must	See table entries for §§ 264.117 through 264.120.
(1) Maintain the integrity and effectiveness of the final cover, including making repairs to the cap as necessary to correct the effects of settling, subsidence, erosion, or other events;	The soil overlying the monolith is to be inspected periodically and resurfaced or have additional fill added as necessary and, to the extent practicable, to correct for the effects of subsidence, erosion, or other events.
(2) Continue to operate the leachate collection and removal system until leachate is no longer detected;	Not applicable.
(3) Maintain and monitor the leak detection system in accordance with §§ 264.301(c)(3)(iv) and (4) and 264.303(c), and comply with all other applicable leak detection system requirements of this part;	Not applicable.
(4) Maintain and monitor the groundwater monitoring system and comply with all other applicable requirements of Subpart F of this part;	The groundwater monitoring system is to be maintained as required by the Phase 1 post-closure plan (DOE-ID 2009b) and will be addressed for the Phase 2 landfill closure in the modification to the WCF HWMA/RCRA post-closure permit (PER-112).

Table 3. (continued).

IDAPA 58.01.05.008 (40 CFR 264, Subpart G) Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities—Closure and Post-Closure	
Regulatory Requirement Summary	Compliance Strategy
(5) Prevent run-on and run-off from eroding or otherwise damaging the final cover; and	The grout layer to be placed on horizontal surfaces of the CPP-601/640 monolith will be sloped to prevent run-on and run-off from eroding or otherwise damaging the monolith. The CPP-627 pad is already sloped. The overlying earthen weather protection barrier also will be sloped away from the landfill to further prevent run-on and run-off from eroding or otherwise damaging that barrier. The overlying earthen weather protection barrier will be inspected for precipitation pooling, erosion, and subsidence; if any of these conditions are found, the soil will be resurfaced and/or additional fill added by appropriate means to the extent practicable. The earthen weather protection barrier overlying and surrounding the monolith will be graded to provide adequate drainage at no more than a 3:1 slope so that the grade slopes away from the CPP-601/627/640 area. The precipitation run-off will be diverted to direct the water away from the monolith and earthen weather protection barrier. Drainage off of the east side will be coordinated with the Operable Unit 3-14 CERCLA program.
(6) Protect and maintain surveyed benchmarks used in complying with § 264.309.	Not applicable.

7. CLOSURE APPROACH

As noted earlier, the CPP-601/627/640 facilities are being closed as a RCRA landfill because clean closure requirements for the HWMA/RCRA tank system were not met and lead was left in place. In contrast with a typical landfill in which wastes are direct-buried, the wastes left in CPP-601/627/640 are encapsulated within a concrete and stainless steel monolith. As the decommissioning of these buildings progressed, void spaces were filled with grout, thereby creating one solid monolith. The monolith is constructed of 42,000 yd^3 of concrete and over 720 tons of stainless steel. This concrete and steel monolith meets the primary requirements for final closure of a landfill as identified in 40 CFR 264.310 though that cover is not expected to be installed for several years (until the final end state for northern INTEC has been determined).

The Operable Unit 3-14 Record of Decision (DOE-ID 2007b) establishes a recharge control zone for the Tank Farm Facility. This recharge control zone is centered over the Tank Farm Facility and extends to the eastern wall of CPP-601. The purpose of this recharge control zone is to collect precipitation to prevent it from recharging the northern INTEC shallow perched water zone. This is accomplished by installing low-permeability pavement over the recharge control zone up to the eastern wall of CPP-601. The low-permeability pavement adjacent to CPP-601 will be beneath the earthen weather protection barrier and will further reduce the potential of precipitation infiltration beneath the monolith.

The monolith with the grout layer on top and the earthen weather protection barrier effectively meet the primary landfill closure requirements of 40 CFR 264.310 (a–e) as described in the following paragraphs.

The concrete and steel layers effectively prevent migration of liquids through the monolith (40 CFR 264.310(a)). Also, adding a sloped grout layer on top of the monolith will effectively prevent pooling on top of the monolith, thereby minimizing the potential for water to move through the monolith. A weather protection barrier (sloped earthen berm) on top of the monolith will further minimize water reaching the monolith, thereby further reducing the potential for water to move through the monolith. The final design of the HWMA/RCRA cover (to be installed when the final end state for northern INTEC has been determined) will specify features that will further prevent migration of the liquids through the monolith. That design could include various barriers (evapotranspiration, capillary, or intrusion) and vegetation.

The existing concrete and steel monolith will function with minimum maintenance (40 CFR 264.310(b)) as is; however, adding the earthen weather protection barrier will further reduce the need for maintenance by minimizing the exposure of the monolith to weather, including freeze/thaw cycling. The only maintenance required will be that necessary to remediate erosion or subsidence issues identified in the semiannual inspections. The design of the final HWMA/RCRA cover also will be required to address the long-term aspects of minimizing maintenance of the final cover.

The concrete construction of the existing monolith promotes drainage away from the waste and minimizes erosion and abrasion (40 CFR 264.310(c)) in comparison to a standard HWMA/RCRA landfill cover. These features are enhanced by the sloped grout layer on top of the monolith that will prevent pooling of water. In addition, the compacted sloped earthen weather protection barrier on top of the monolith promotes drainage away from the monolith and will prevent most precipitation from reaching the monolith, therefore preventing erosion or abrasion of the upper grout layer. Limiting the slope of the earthen weather protection barrier to less than 33% (3:1) limits erosion of the soil until the final cover is

installed. The long-term aspect of drainage away from the monolith and minimizing cover erosion and abrasion will be addressed in the design of the final RCRA/HWMA cover.

The original design and construction of the Buildings CPP-601, -627, and -640 (that are now grouted and comprise the monolith) will minimize settling and subsidence of the earthen layer, thereby maintaining the integrity (40 CFR 264.310(d)) of the weather protection barrier. These buildings were built upon compacted engineered subgrade resting on bedrock or upon drilled concrete-filled pillars and footings. The buildings have been stable for 50 years, and subsidence beneath the buildings is not anticipated based on the foundation construction. The buildings have been filled with grout to form a single, solid monolith. Voids within the buildings with reinforced concrete walls (up to 5 ft thick) are filled with grout, essentially eliminating subsidence concerns within the monolith.

A simplified approach to placement and compaction of the earthen weather protection barrier is proposed based upon INL soil compaction field experience, the nature of the fill material, the earthen weather protection barrier to be installed over the concrete monolith, and the fact that the earthen weather protection barrier will be exposed to approximately 25 years of natural settling forces prior to the final cover being installed.

Various projects at the INL Site were reviewed to determine compaction methods used. Routinely, 95% compaction or better has been achieved with 1-ft lifts and two or more passes with heavy equipment when a reasonable moisture content was present. The soils to be used for backfill for this project are anticipated to come from the Monroe Pit on the INL Site. The Monroe Pit gravels are a mixture of well-graded and poorly graded gravels, with a maximum particle size of 3 to 4 in. This gravel source, like most INL Site alluvial gravel sources, is considered a clean, sandy gravel with few fines. This material readily compacts to 95% or greater. The potential for subsidence is greatly reduced by an earthen weather protection barrier installed over a solid concrete monolith. This solid concrete monolith does not present the potential for waste layer subsidence as would be present in a typical landfill. In the typical landfill, compaction to undisturbed soil densities is extremely important because the base must be stable before the final cover can be installed. However, in this case, where the final cover is not expected to be installed for 25 years, anomalies in the placement of the soils will become evident as subsidence during the semiannual inspection and will be repaired prior to the placement of the final cover. While this subsidence is not expected (because of the reasons delineated previously), the time interval between the installation of the weather protection barrier and the final HWMA/RCRA cover (along with any necessary maintenance activities) will ensure that the final HWMA/RCRA cover will not be subject to subsidence issues.

The simplified earthen weather protection barrier placement plan calls for the fill material to be placed over the monolith in lifts of 1 foot or less and field-compacted to achieve compaction equivalent to undisturbed soil. That field compaction will be done with multiple passes of a sheepsfoot roller. Special precautions for the initial lifts will be take for placement and compaction of fill over existing structures including the paved recharge control zone and portions of Birch Street, as well as over portions of the monolith including CPP-627 pad, CPP-601 and CPP-640. Sufficient moisture content to achieve “field compaction” will be evaluated by routinely taking a handful of fill soil and hand compressing that soil into a lump. If the “soil” lump stays together, then the moisture content is conducive to obtaining “field compaction” soil density. If the “soil” lump falls apart, water will be added to the soil sufficient to meet the requirement. Conversely, if water is expressed from the soil during squeezing, then too much moisture is present, and field activities will not continue until conditions are more conducive to compaction. This simplified approach for evaluating soil moisture content has proven effective over time at the INL Site.

The concrete and steel monolith meets the requirement to have a permeability less than or equal to the permeability of the natural subsoils present (40 CFR 264.310(e)). The contamination left within the

monolith primarily resides within vessels, pipes, or cells with stainless steel liners. The concrete and steel obviously have permeability less than natural subsoils in the area. The grout layer that will be added on top of the monolith will provide an additional layer of low-permeability material. The earthen layer will be compacted to field compaction levels at least equivalent to undisturbed soil. The design of the final HWMA/RCRA cover will ensure that the cover also has permeability equal to or less than the native subsoils.

The earthen weather protection barrier (with a minimum depth of 3 ft) will be sloped at least 2% but not more than 33%. The maximum slope of 33% (3:1) has proven stable using typical INL Site soils. In a few places, the toe of this earthen weather protection barrier could impact active utilities. These include an electrical manhole on the west side and possibly two service waste manholes on the east side. Until these utilities are appropriately abandoned, the toe of the earthen weather protection barrier will not impinge upon the utilities. This will be accomplished by using short barrier walls, or the manholes may be extended above that part of the soil weather protection barrier. The soil in the areas of disturbance would be less than 4 ft deep and would be at least 20 ft away from the monolith. Figure 6 shows the anticipated contours of the earthen weather protection barrier. Upon completion of the installation of this barrier, the landfill will be surveyed and a final contour map prepared documenting that the sloping requirements were achieved and identifying areas of interference as noted previously.

The earthen barrier layer will be inspected semiannually for subsidence or erosion. If erosion channels or subsidence deeper than 3 in. are found, the area will be backfilled and recompacted with several passes of a sheepsfoot roller.

Phase 2 post-closure care activities will begin upon DEQ acceptance of the Phase 2 landfill closure certification. The WCF HWMA/RCRA post-closure permit (PER-112) will be modified to include the Phase 2 landfill post-closure activities. The post-closure activities include:

1. Post-closure use of the property will be controlled to prevent damage to the earthen weather protection barrier and the underlying monolith.
2. A record of the type, location, and quantity of hazardous wastes within the CPP-601/627/640 landfill will be submitted to the Butte County commissioners and DEQ within 60 days after closure certification.
3. Within 60 days of closure certification, the required notation on the deed to the property or other instrument used for title search will be filed in accordance with Idaho law.
4. The earthen weather protection barrier overlying the monolith will be inspected semiannually for precipitation pooling, erosion, and subsidence. As necessary, additional fill material will be added and compacted to the extent practicable. These repairs or maintenance will be necessary when specific areas of subsidence, pooling, or erosion exceed 2 in. in depth with a surface area greater than 10 ft^2.
5. The groundwater monitoring system will be maintained as required by the Phase 1 post-closure plan (DOE-ID 2009b) and will be addressed in the modification to the WCF HWMA/RCRA post-closure permit (PER-112).

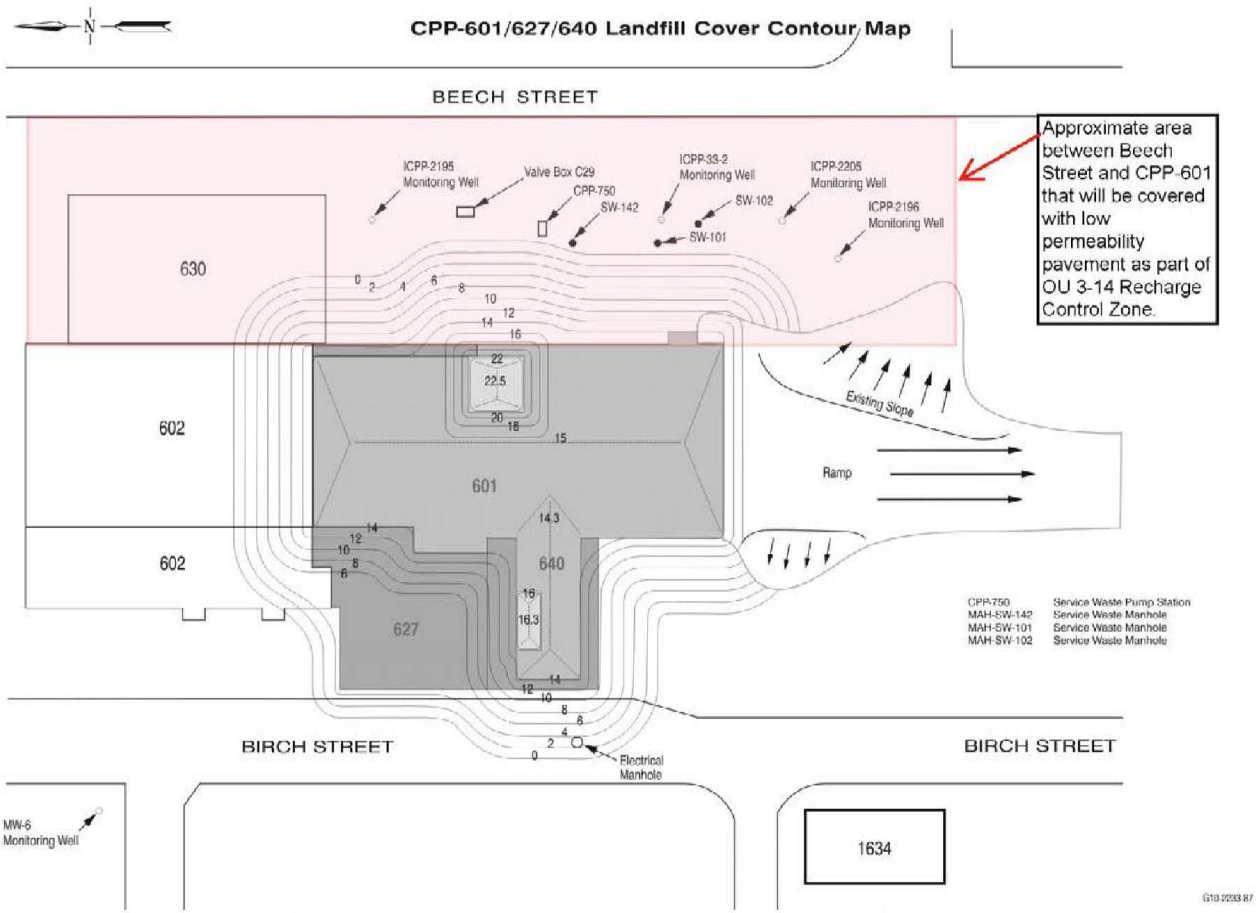

Figure 6. Anticipated contours of CPP-601/627/640 earthen weather protection barrier (area in pink shows Operable Unit 3-14 recharge control zone to be covered with low-permeability pavement at grade).

8. CLOSURE ACTIVITIES

Buildings CPP-601, -640, and -627 are being closed with waste in place and will meet the closure requirements applicable to landfills by the placement of a grout layer over the horizontal surfaces of the CPP-601/640 monolith. The CPP-627 footprint does not require addition of a grout layer because CPP-627 is already covered by an appropriate layer of concrete installed as part of the CPP-627 NTCRA. The addition of the grout layer will be followed by application of an earthen weather protection barrier, providing weather protection over the entire CPP-601/627/640 monolith. The design of the grout layer and soil barrier complies with the requirements identified in Section 6, "Closure Requirements." This section discusses the installation of the grout layer and earthen weather protection barrier and the precipitation infiltration controls for the landfill. The structural stability of the monolith is addressed in Section 3.

8.1 Grout Layer Placement

A grout layer will be applied over the exposed horizontal portions of the CPP-601/640 monolith and sloped to promote drainage off of the monolith. The sloped grout layer will minimize the potential for liquids to migrate through the closed landfill over the long term by preventing pooling and promoting drainage off of the structure. The existing pad over the CPP-627 footprint is sufficiently sloped to meet this requirement.

8.2 Earthen Weather Protection Barrier Placement

After the grout layer is applied, an earthen weather protection barrier will be placed over the entire CPP-601/627/640 monolith. Soil will be applied in lifts of 1 foot or less until an approximate 3-ft-thick earthen weather protection barrier covers all parts of the monolith. The earthen weather protection barrier will be sloped at least 2% from the approximate center to provide adequate drainage off the earthen weather protection barrier and underlying monolith, as well as to prevent pooling. The sides will be sloped at not more than a 3:1 ratio to provide a long-term stable slope, thereby minimizing erosion and subsidence. The earthen weather protection barrier is not intended to be the final cover over the CPP-601/627/640 landfill but rather to reduce the impact to the grouted monolith from freeze/thaw cycles to enhance the longevity of the structure. An artist's rendition of the expected appearance after the earthen weather protection barrier is completed is shown in Figure 7.

After the earthen weather protection barrier is installed, the landfill will be surveyed and a final contour map prepared documenting that the sloping requirements were achieved and identifying areas of interference with active infrastructure.

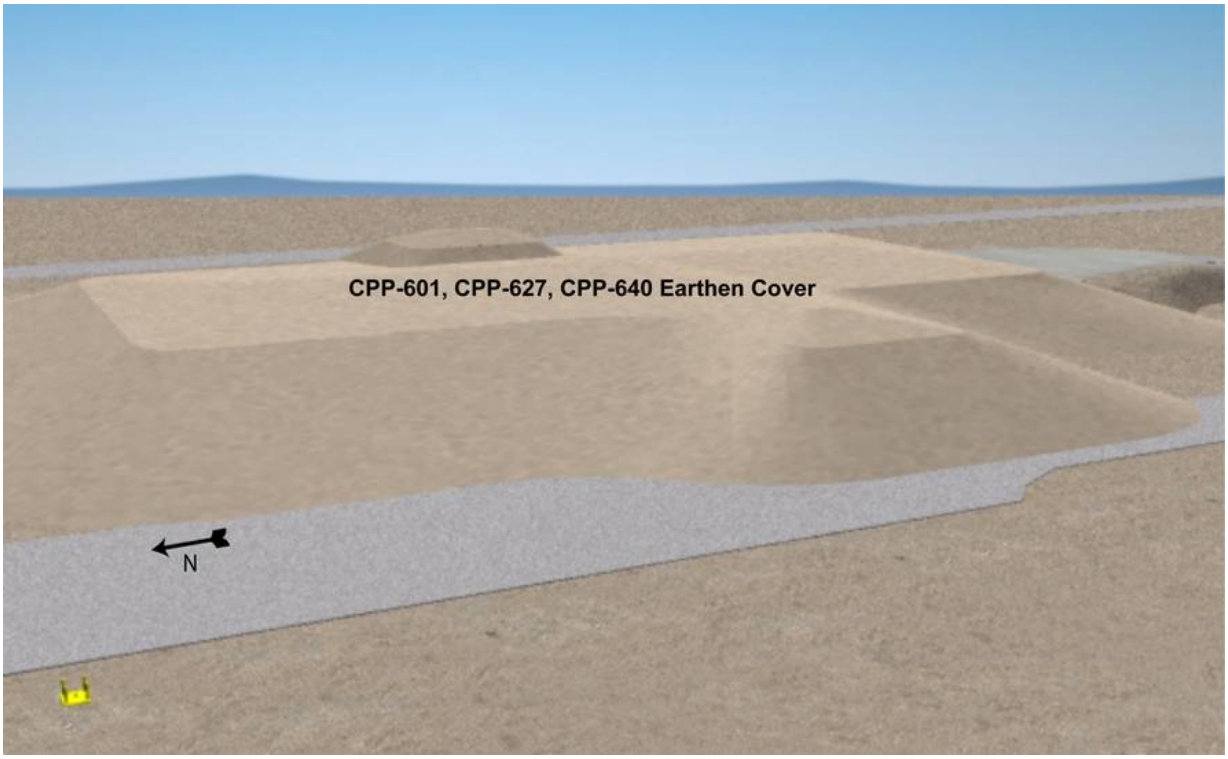

Figure 7. Expected configuration of earthen weather protection barrier overlying the CPP-601/627/640 monolith.

8.3 Run-on and Run-off Control

The grout layer (discussed in Section 8.1) covering the horizontal surfaces of CPP-601 and CPP-640, along with the CPP-627 pad, will promote run-off, prevent pooling of precipitation, and restrict the ability of water to move through the monolith and mobilizing contaminants. In addition the earthen weather protection barrier (discussed in Section 8.2) will be sloped to further reduce precipitation infiltration into the monolith by promoting run-off and eliminating pooling. The earthen weather protection barrier surrounding the monolith will minimize erosion and weather damage of the monolith. The grout layer and the earthen weather protection barrier together will minimize the possibility of precipitation infiltrating the monolith and greatly reduce the transport or migration of potential releases of contamination from the monolith to the environment.

9. EARTHEN WEATHER PROTECTION BARRIER INSPECTION

Until the earthen weather protection barrier is installed, the monolith will continue to be inspected in accordance with the HWMA/RCRA Post-Closure Plan for the CPP-601/627/640 Landfill (DOE/ID 2009b). Those inspections are documented in FRM-1095, "CPP-601/627/640 Landfill Semiannual Inspection of Monolith for Integrity and Drainage" (see Figure 8). Upon installation of the earthen weather protection barrier, the monolith inspections described in the post-closure plan will cease, and the earthen weather protection barrier will be inspected for pooling, subsidence, and erosion using FRM-1203, "CPP-601/627/640 Landfill Berm Semiannual Inspection of Earthen Cover for Pooling, Subsidence, and Erosion" (see Figure 9).

Evidence of pooling, subsidence, or erosion in any specific area on the earthen weather protection barrier greater than 2 in. deep and covering an area greater than 10 ft^2 will be documented on the inspection form and a RCRA remedial opened to ensure that the issue is addressed in a timely manner.

The forms shown in Figures 8 and 9 are the current versions as of August 2010. These forms will be modified as appropriate. However, as specified in IDAPA 58.01.05.008 [40 CFR 264.15(d)], the forms will contain, at a minimum, the following information:

- The date and time of the inspection
- The name of the inspector
- A notation of the observations made, including any and all deficiencies identified
- The date, nature, and status of any needed repairs or other remedial actions (e.g., subsidence area filled September 10, 201X; work order submitted).

Documentation of inspection activities will be maintained at the facility, as required by IDAPA 58.01.05.008 [40 CFR 264.73(b)(5)], for at least 3 years from the inspection date.

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Use with DOE/ID-11408, Chapter 7

CPP-601/627/640 LANDFILL
SEMIANNUAL INSPECTION OF MONOLITH
FOR INTEGRITY AND DRAINAGE

This form is the current version per EDMS.

_____
Signature / Date

Notes:
1: Inspections should be performed in spring and fall of each year.
2: Obtain a functional means of communication prior to performing inspection.
3. Areas with active construction or D&D shall be marked NA with activity description in comment section.

Inspection Date:____/_____/_____ Previous inspection report reviewed:

Approximate Time of Inspection:_____ (Initials_____)

Inspection Items	Inspection Criteria	Issue/ Concern Yes	Issue/ Concern No	Observations/Comments (Location of issue or concern) (Use additional space below as needed)	Nature of Repairs or Remedial Actions Needed	Completion Date for Repairs or Remedial Actions
1. Concrete surface integrity	1a. Surface erosion					
	1b. Cracks (cracks greater than ½" wide need to be repaired)					
	1c. Subsidence					
	1d. Joint seal condition					
	1e. Other concrete surface maintenance issue					
2. Drainage away from monolith	2a. Surface pooling or ponding					
	2b. Run-on or run-off					
	2c. Other drainage maintenance issue					

/ /
Completion Date Time Printed Name of Inspector Inspector's Signature

Further Comments

Comment No.	Inspection Item No.	Remarks

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CPP-601/627/640 LANDFILL
SEMIANNUAL INSPECTION OF MONOLITH
FOR INTEGRITY AND DRAINAGE

CPP-601/627/640 Landfill monolith inspection date: _____/_____/_____

Open RCRA remedial on this form:

Issue No.	Tracking No.	Date Remedial was Identified	Deficiency Description/Comments

Inspector's Name: (Print)_____ Inspector's Signature: _____

Facility Manager's Name: (Print) _____ Facility Manager's Signature: _____

Remedial Actions Completed or Not Required:

Facility Manager's Signature: _____

NOTE: *Inspection criteria based upon* HWMA/RCRA Post-Closure Plan for the CPP-601/627/640 Landfill, *DOE/ID-11408 Revision 1, December 2009, and the inspection criteria from Volume 21 "Hazardous Waste Management Act/Resource Conservation and Recovery Act Post-Closure Permit for the Idaho Nuclear Technology and Engineering Center Waste Calcine Facility," Permit Module IV.C, "Post Closure Care Inspection Plan," and Attachment 2 Section D, "Inspection Schedule," and Section E, "Maintenance Activities."*

Example

Figure 8. FRM-1095, "CPP-601/627/640 Landfill Semiannual Inspection of Monolith for Integrity and Drainage."

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CPP-601/627/640 LANDFILL
SEMIANNUAL INSPECTION OF EARTHEN COVER
FOR POOLING, SUBSIDENCE, AND EROSION

This form is the current version per EDMS.

_____
Signature / Date

Notes:
1: Inspections should be performed in spring and fall of each year.
2: Obtain a functional means of communication prior to performing inspection.
3. Areas with active construction or D&D shall be marked NA with activity description in comment section.

Inspection Date: ____/____/____
Approximate Time of Inspection: _____

Previous inspection report reviewed:
(Initials_____)

Inspection Items	Inspection Criteria	Issue/ Concern Yes	Issue/ Concern No	Observations/Comments (Location of issue or concern) (Use additional space below as needed)	Nature of Repairs or Remedial Actions Needed	Completion Date for Repairs or Remedial Actions
1. Surface Pooling	Pools of standing water greater than 2 inches deep and greater than 10 ft^2					
2. Subsidence	Areas of subsidence greater than 2 inches deep and greater than 10 ft^2					
3. Erosion	Erosion channels or runnels greater than 2 inches deep and greater than 10 ft^2					

____/____/____ Completion Date
_____ Time
_____ Printed Name of Inspector
_____ Inspector's Signature

Further Comments

Comment No.	Inspection Item No.	Remarks

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CPP-601/627/640 LANDFILL
SEMIANNUAL INSPECTION OF EARTHEN COVER
FOR POOLING, SUBSIDENCE, AND EROSION

CPP-601/627/640 Landfill Berm inspection date: ____/____/____

Open RCRA remedial on this form:

Issue No.	Tracking No.	Date Remedial Was Identified	Deficiency Description/Comments

Inspector's Name: (Print)_____ Inspector's Signature: _____

Facility Manager's Name: (Print) _____ Facility Manager's Signature: _____

Remedial Actions Completed or Not Required:

Facility Manager's Signature: _____

NOTE: *Inspection criteria based upon* HWMA/RCRA Closure Plan for the CPP-601/627/640 Landfill Phase 2, *DOE/ID-11431 Revision 1, August 2010.*

EXAMPLE

Figure 9. FRM-1203, "CPP-601/627/640 Landfill Semiannual Inspection of Earthen Cover for Pooling, Subsidence, and Erosion."

10. MAINTENANCE

Upon installation of the earthen weather protection barrier, that barrier will be maintained, as required by IDAPA 58.01.05.008 (40 CFR 264.117) under this closure plan until the post-closure permit is modified. The following maintenance activities will be performed:

- Maintain the integrity and effectiveness of the earthen weather protection barrier as necessary by adding fill material and recontouring
- Maintain the security of the facility in accordance with IDAPA 58.01.05.008 (40 CFR 265.14)
- Maintain and monitor the groundwater monitoring system, and comply with all other applicable requirements of IDAPA 58.01.05.008 (40 CFR 264, Subpart F) in accordance with the post-closure plan
- Prevent run-on and run-off from eroding or otherwise damaging the earthen weather protection barrier.

Documentation of maintenance activities will be maintained at the facility, as required by IDAPA 58.01.05.008 [40 CFR 264.73(b)(5)], for at least 3 years from the inspection date.

11. DOCUMENT MANAGEMENT AND REPORTING

Landfill maintenance and inspection activities to be performed under this closure plan will be properly recorded and maintained. Records may be maintained at INTEC or electronically in a readily retrievable manner. Records may be maintained using a solely electronic format as long as they are readily retrievable to obtain a printed copy.

11.1 Maintenance and Inspection Records

Maintenance and inspections will be recorded on inspection logs and inspection log sheets. At a minimum, the following information will be recorded:

- The date and time of the inspection
- The name of the inspector
- A notation of the observations made, including all deficiencies identified
- The date, nature, and status (e.g., maintenance performed, work order submitted, parts ordered) of any needed repairs or other remedial actions.

Documentation of the inspections and maintenance activities at the landfill will be retained, as required by IDAPA 58.01.05.008 [40 CFR 264.73(b)(5)], for at least 3 years from the inspection date.

11.2 Reporting to the Idaho Department of Environmental Quality

Inspection reports will be submitted to DEQ semiannually until Phase 2 certification or the approval of the Class 3 permit modification for the post-closure permit, whichever occurs last.

12. CLOSURE SCHEDULE

Table 4 shows the closure schedule that will be initiated following DEQ approval of this closure plan. This schedule reflects the time required for conducting closure activities and submitting information to the qualified professional engineer for certification. As specified in IDAPA 58.01.05.008 (40 CFR 264.113), closure is required to be completed within 180 days of the initiation of closure activities. An extension to this period is being requested pursuant to IDAPA 58.01.05.008 (40 CFR 264.113) to protect human health and the environment and to adequately perform closure activities. Closure activities cannot be completed within 180 days because of the need to coordinate closure activities with the CPP-601/640 NTCRA, the complexity of installing the grout layer during cold weather, and the integration with the demolition of the adjacent CPP-602/630 facilities.

Demolition of portions of the CPP-601/640 buildings to reveal the monolith is expected to be completed in Calendar Year 2010. The Phase 1 post-closure period is expected to last from approximately Calendar Year 2009 to 2012. Phase 2 closure activities are expected to be conducted during Calendar Year 2011 to 2012, followed by the permitted Phase 2 post-closure period.

Table 4. Phase 2 landfill closure schedule.

Planned Work Tasks	Day of Completion
DEQ approval of Phase 2 landfill closure plan	Day 0
Complete removal of CPP-601/640 superstructure	Day 365
Complete installation of sloped grout layer on horizontal surfaces of the CPP-601/640 monolith	Day 500
Complete installation of earthen weather protection barrier on CPP-601/627/640	Day 600
Closure activities complete	Day 660
Professional engineer and owner/operator certification submitted to DEQ	Day 720[a,b]

a. If closure activities are completed ahead of the proposed schedule, closure certification will be submitted to DEQ within 60 days of the completion of closure activities.

b. Upon DEQ acceptance of the Phase 2 closure certification, the Waste Calcining Facility HWMA/RCRA post-closure permit (PER-112) will be modified to include the Phase 2 landfill post-closure activities.

DEQ—Idaho Department of Environmental Quality

HWMA/RCRA— Hazardous Waste Management Act/Resource Conservation and Recovery Act

13. CLOSURE PLAN AMENDMENTS

Changes to the DEQ-approved closure plan will be implemented in accordance with IDAPA 58.01.05.008 (40 CFR 264.112). If during closure unexpected events require modification of the approved closure activities or closure schedule, the closure plan will be amended, or DEQ will be otherwise notified within 30 days of the unexpected event. If an amendment is necessary, a written request detailing the proposed changes and the rationale for those changes and a copy of the amended closure plan will be submitted to DEQ for approval. Minor changes to the approved closure plan that are equivalent to, or do not compromise, the closure requirements and performance standards identified in the approved closure plan may be made without prior notification to DEQ. Minor changes will be identified in the documentation supporting the qualified professional engineer certification.

14. CLOSURE CERTIFICATION

In accordance with IDAPA 58.01.05.008 (40 CFR 264.115), a certification of closure of the CPP-601/627/640 landfill will be submitted to DEQ within 60 days of completing the closure activities. This certification, to be signed by a qualified professional engineer and the DOE Idaho Operations Office, will document the completion of closure activities in accordance with the DEQ-approved closure plan and State of Idaho HWMA/RCRA requirements. The closure certification also may identify any minor changes to the closure plan made without prior DEQ approval. Closure of the CPP-601/627/640 landfill will be considered complete upon receipt of written acceptance issued by DEQ.

15. SURVEY PLAT

In accordance with IDAPA 58.01.05.008 (40 CFR 264.116), a survey plat will be filed at the Butte County Courthouse and submitted to DEQ no later than the submission of the closure certification. The survey plat indicating the location and dimensions of the CPP-601/627/640 landfill monolith will be prepared and certified by a professional land surveyor. A benchmark will be installed and tied to the INTEC permanent survey grid. The INTEC survey grid and the CPP-601/627/640 landfill monolith benchmark will allow the monolith to be located in the future, if necessary. The survey plat, filed at the Butte County Courthouse, will contain a prominently displayed note stating the INL's obligation to restrict disturbance of the landfill in accordance with the applicable IDAPA 58.01.05.008 (40 CFR 264, Subpart G) regulations.

16. COST AND LIABILITY REQUIREMENTS

In accordance with IDAPA 58.01.05.008 [40 CFR 264.140(c)], the federal government, as owner of the INL Site, is exempt from the financial requirements of IDAPA 58.01.05.008 (40 CFR Part 264, Subpart H). These provisions include requirements for providing cost estimates, financial assurance, and financial assurance mechanisms for closure; liability; the use of state-required mechanisms; and the state assumption of financial and liability requirements for the closure.

17. NOTICES

In accordance with IDAPA 58.01.05.008 (40 CFR 264.119), a record of wastes, notice in deed, and certification of notice will be submitted as described in the following subsections.

17.1 Record of Wastes

As specified in IDAPA 58.01.05.008 [40 CFR 264.119(a)], a record of the type, location, and quantity of hazardous wastes within the CPP-601/627/640 landfill will be submitted to the Butte County commissioners and DEQ within 60 days of closure certification.

17.2 Notice in Deed

Within 60 days of closure certification, a notation on the deed to the property or other instrument used for title search will be filed in accordance with Idaho law as required by IDAPA 58.01.05.008 [40 CFR 264.119(b)(1)]. The notation will in perpetuity notify any potential purchaser of the property that:

- The land has been used to manage hazardous wastes
- Its use is restricted under IDAPA 58.01.05.008 (40 CFR 264, Subpart G) regulations
- The survey plat and record of the type, location, and quantity of hazardous wastes disposed of within the CPP-601/627/640 landfill required by IDAPA 58.01.05.008 [40 CFR 264.116 and 264.119(a)] have been filed with the Butte County commissioners and DEQ.

17.3 Certification of Notice

As required by IDAPA 58.01.05.008 [40 CFR 264.119(b)(2)], a signed certification that the owner or operator has recorded the notice in deed described in Subsection 17.2 and a copy of the document in which the notice in deed has been placed will be submitted to DEQ within 60 days of closure certification.

18. POST-CLOSURE CARE

Tank systems to be closed as landfills must meet the closure requirements for landfills specified in IDAPA 58.01.05.008 (40 CFR 264.310), which includes compliance with post-closure requirements contained in IDAPA 58.01.05.008 (40 CFR 264.117 through 264.120), as well as groundwater monitoring and other applicable requirements of IDAPA 58.01.05.008 (40 CFR 264, Subpart F).

Upon DEQ acceptance of the Phase 2 closure certification, the WCF HWMA/RCRA post-closure permit (PER-112) will be modified to include landfill closure and post-closure inspection, maintenance, and groundwater monitoring. Phase 2 post-closure activities will include inspection of the earthen weather protection barrier for precipitation pooling, erosion, and subsidence. If any erosion or other penetrations of the overlying soil are observed during inspections, the soil will be resurfaced or additional fill will be added or both, as appropriate and to the extent practicable.

Until the Phase 2 closure certification is accepted, Phase 1 post-closure inspection, monitoring, and maintenance will be performed in accordance with the *HWMA/RCRA Post-Closure Plan for the CPP-601/627/640 Landfill* (DOE-ID 2009b) and this closure plan.

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DOE/ID-11408
Revision 1

HWMA/RCRA Post-Closure Plan for the CPP-601/627/640 Landfill

December 2009

DOE/ID-11408
Revision 1

HWMA/RCRA Post-Closure Plan for the CPP-601/627/640 Landfill

December 2009

Prepared for the
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DOE Idaho Operations Office

ABSTRACT

This Hazardous Waste Management Act/Resource Conservation and Recovery Act post-closure plan has been prepared for the CPP-601/627/640 landfill closure. This closure is being integrated with the decommissioning of the CPP-601 Fuel Reprocessing Facility, CPP-627 Remote Analytical Facility, and CPP-640 Headend Processing Plant. The CPP-627 building has been decommissioned under a Comprehensive Environmental Response, Compensation, and Liability Act non-time-critical removal action. Buildings CPP-601 and -640 are being decommissioned under a separate non-time-critical removal action. In coordination with the action for CPP-601 and -640, the CPP-601/627/640 landfill will be closed in two phases. Phase 1 landfill closure activities have been completed and included the decontamination and grouting of the CPP-601 Deep Tanks System. During the Phase 1 post-closure period, CPP-601/640 will be demolished, and grout will be used to fill remaining void areas, creating a monolith. The monolith will be exposed after portions of the buildings are removed. This, along with the concrete monolith created during the CPP-627 decommissioning, will be an interim cover for the landfill. Phase 2 of the landfill closure will be the installation of the phase 2 cover, which will comprise a concrete layer and a precipitation infiltration coating over the monolith. This post-closure plan describes the inspection, maintenance, and monitoring activities to be conducted during the interim period from the Phase 1 post-closure period until the beginning of the Phase 2 post-closure period.

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ACRONYMS

CAMP	corrective action monitoring program
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
CMP	compliance monitoring program
CY	calendar year
DEQ	State of Idaho Department of Environmental Quality
DML	detection monitoring limits
DMP	detection monitoring program
DOE	U.S. Department of Energy
EPA	U.S. Environmental Protection Agency
EQL	estimated quantitation limit
GPS	groundwater protection standard
HWMA	Hazardous Waste Management Act
IDAPA	Idaho Administrative Procedures Act
INL	Idaho National Laboratory
INTEC	Idaho Nuclear Technology and Engineering Center
NTCRA	non-time-critical removal action
RCRA	Resource Conservation and Recovery Act
WAC	waste acceptance criteria
WCF	Waste Calcining Facility

HWMA/RCRA Post-Closure Plan for the CPP-601/627/640 Landfill

1. INTRODUCTION

This post-closure plan has been prepared for the CPP-601 Fuel Reprocessing Facility, CPP-627 Remote Analytical Facility, and CPP-640 Headend Processing Plant landfill as stipulated in *HWMA/RCRA Landfill Closure Plan for the CPP-601 Deep Tanks System Phase 1* (DOE-ID 2009a). The CPP-601 Deep Tanks System is being closed as a landfill in accordance with Hazardous Waste Management Act (HWMA) (State of Idaho 1983)/Resource Conservation and Recovery Act (RCRA) (42 USC 6901 et seq. 1976) regulations at Idaho Administrative Procedures Act (IDAPA) 58.01.05.008 (40 Code of Federal Regulations [CFR], Subparts G and J), which address tank system closure.

The CPP-601 Deep Tanks System is being closed as a landfill because of the presence of abandoned isolated piping runs that could not be flushed and lead that was impracticable to remove. In addition, Buildings CPP-601, -627, and -640, which are part of the Fuel Reprocessing Complex at the Idaho Nuclear Technology and Engineering Center (INTEC), have contamination that will not be removed upon decommissioning. Buildings CPP-601 and -640 are being decommissioned in an ongoing Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) (42 USC 9601 et seq. 1980) non-time-critical removal action (NTCRA) (DOE-ID 2008). Building CPP-627 has been demolished, and a protective layer of concrete was poured over the building footprint as part of a separate NTCRA. Therefore, the CPP-601 HWMA/RCRA landfill closure is being integrated with the CPP-601/640 NTCRA and the completed CPP-627 NTCRA, resulting in a single CPP-601/627/640 landfill.

In coordination with the NTCRA, the CPP-601/627/640 HWMA/RCRA landfill closure is being completed in two phases. Activities for Phase 1 of the CPP-601 Deep Tanks System landfill closure has been completed in accordance with the closure plan (DOE-ID 2009a) and included decontamination of specific tank system components to site-specific action levels, flushing and isolating portions of the lines and tanks and grouting the tanks. During the Phase 1 post-closure period, NTCRA demolition and removal activities will be conducted on CPP-601/640, and grout and other inert material will be used to fill remaining piping, vessels, and other void areas, thus creating a monolith. This, along with the concrete monolith created earlier during the CPP-627 NTCRA, will serve as an interim HWMA/RCRA cover for the CPP-601/627/640 landfill during the Phase 1 post-closure period. Phase 2 of the landfill closure will be the installation of a layer of concrete over the interim monolith, as necessary, to provide sloping. A precipitation infiltration coating will be applied over the entire CPP-601/627/604 monolith, including the concrete layer placed over the interim monolith. This concrete layer and coating will constitute the Phase 2 HWMA/RCRA covering. The Phase 2 post-closure period will begin after this phase 2 covering is installed.

The purpose of this plan is to describe the inspection, maintenance, and monitoring activities to be conducted during the Phase 1 post-closure period, which will last until the beginning of the Phase 2 post-closure period. The CPP-601 Deep Tanks System is included in the "Partial Permit for HWMA Storage and Treatment for the Liquid Waste Management System at the Idaho Nuclear Technology and Engineering Center on the Idaho National Laboratory" (State of Idaho 2007). Upon approval by the State of Idaho Department of Environmental Quality (DEQ), this post-closure plan will be incorporated as an attachment to the permit via the permit modification process. Phase 2 of the landfill closure is not addressed in this post-closure plan. A separate Phase 2 landfill closure plan will be prepared, and upon Phase 2 closure certification, the appropriate HWMA/RCRA permit will be modified to include the landfill closure and post-closure groundwater monitoring (DOE-ID 2009a).

2. FACILITY DESCRIPTION

Buildings CPP-601, -627, and -640 are part of the Fuel Reprocessing Complex at INTEC, located in the south-central area of the Idaho National Laboratory (INL). The CPP-601 Deep Tanks System is located in the lowest level of Building CPP-601. These buildings are described briefly in the following subsections. Detailed descriptions of the buildings and the INL are provided in the CPP-601 Phase 1 closure plan (DOE-ID 2009a) and the action memoranda for the CPP-601/640 and CPP-627 NTCRAs (DOE-ID 2008; DOE-NE-ID 2004).

2.1 CPP-601 Fuel Reprocessing Facility

The CPP-601 Fuel Reprocessing Facility is a 244- × 102-ft building consisting of five levels with the primary portion located below ground. The facility was used for reprocessing spent nuclear fuel. Operations included separation, chemical makeup and transfer, and liquid waste receiving processes. The top level, constructed of transite panels on post and beam, is above grade and contains an open area that was used for transferring fuel elements to the process equipment and for chemical storage, makeup, and transfer. The lower levels, constructed of steel-reinforced concrete, contain process cells, corridors, and auxiliary cells that house equipment and controls. The CPP-601 Deep Tanks System consists of four 4,500-gal stainless-steel tanks located in two concrete vaults in the lowest level of CPP-601. This system collected liquid waste generated from separations processes performed in CPP-601. Process systems in CPP-627 and -640 could also send waste to these tanks.

Most of the floor, cell walls, and equipment are lined with or consist of stainless steel. The processing equipment, which was designed for remote operations, is generally enclosed in the heavily shielded cells. Often, lead was used as the shielding material. A significant amount of lead shielding also is encased in the concrete structures (floors and walls) (DOE-ID 2009a).

2.2 CPP-627 Remote Analytical Facility

The CPP-627 Remote Analytical Facility was a 14,727-ft^2 facility. The building was entirely above ground and was adjacent and attached to CPP-601. Building CPP-627 was constructed in 1955 of reinforced concrete and masonry block and had been inactive since 1989. The building housed analytical, experimental, and decontamination facilities, including the Hot Chemistry Laboratory, the Old Shift Laboratory, the Multi-Curie Cell, the Emission Spectroscopy Laboratory, and the Decontamination Development Laboratory. In 2005, CPP-627 was removed to grade as part of a NTCRA (ICP 2006). Some lines that were part of the drainage system remain beneath the CPP-627 slab and are included as part of the landfill closure.

2.3 CPP-640 Headend Processing Plant

The CPP-640 Headend Processing Plant is a 66- × 89-ft structure constructed in 1961 to support research and process development for the uranium reprocessing mission in CPP-601. Fuel processing at CPP-640 ended in June 1984 (DOE-ID 2008).The facility contains two shielded waste collection tank vaults at the lowest level of the building, five shielded test cells at the mid-level of the building, and an open crane loft with space for chemical makeup equipment and access to the cells through roof hatches at the upper level (DOE-ID 2007). A major modification in the late 1970s added the shielded mechanical handling cave within the crane loft. The CPP-640 Headend Storage Tank System received decontamination fluids generated in the plant. The tank system comprised two radiological waste tanks and a nonradiological waste tank. The DEQ approved the certification for the CPP-640 Headend Storage Tank System closure on June 12, 2008 (Monson 2008).

3. OVERVIEW OF LANDFILL CLOSURE APPROACH

The approach for the CPP-601/627/640 landfill closure consists of three steps: Phase 1, the Phase 1 post-closure period, and Phase 2 (DOE-ID 2009a). Phase 1 landfill closure activities have been completed and included the decontamination and grouting of the CPP-601 Deep Tanks System components in accordance with *HWMA/RCRA Landfill Closure Plan for the CPP-601 Deep Tanks System Phase 1* (DOE-ID 2009a).

The Phase 1 post-closure period of the landfill closure is the performance of HWMA/RCRA inspection, maintenance, and monitoring activities on the CPP-601/627/640 monolith, which will serve as an interim HWMA/RCRA cover over the landfill. The inspection, maintenance, and monitoring activities will be performed in accordance with this post-closure plan. The CPP-601/640 portion of the monolith will be created and exposed as a result of the CPP-601/640 demolition and grouting activities. Building CPP-627 has been demolished, and the remaining concrete slab will become part of the CPP-601/627/640 landfill. The CPP-601/640 NTCRA activities are specified in *Action Memorandum for Decommissioning CPP-601/640 Fuel Reprocessing Facilities* (DOE-ID 2008). The CPP-627 NTCRA was performed in accordance with *Action Memorandum for the Decontamination and Decommissioning of Building CPP-627, the Remote Analytical Facility* (DOE-NE-ID 2004). Demolition of portions of the CPP-601/640 building to reveal the monolith is expected to be completed in calendar year (CY) 2010. The Phase 1 post-closure period is expected to last from approximately CY 2009 to 2011.

Installation of the phase 2 HWMA/RCRA cover over the monolith will constitute Phase 2 of the landfill closure. A concrete layer and a precipitation infiltration coating is planned to be placed over the interim concrete monolith. This cover will be installed in accordance with a HWMA/RCRA Phase 2 landfill closure plan to be developed. Phase 2 activities are expected to be conducted during CY 2011 to 2012 followed by the permitted Phase 2 post-closure period. Table 1 lists the primary activities associated with each step in the phased landfill closure and the integration with CPP-601/640 NTCRA activities. Descriptions of the landfill closure boundary, Phase 1 closure actions, the CPP-601/640 NTCRA, and the CPP-627 NTCRA are provided in the following subsections.

3.1 Landfill Closure Boundary

The boundary for the landfill closure is established in the CPP-601 Deep Tanks System Phase 1 landfill closure plan (DOE-ID 2009a). As stipulated in that plan, the landfill boundary encompasses the CPP-601 Deep Tanks System as well as the entire footprint of the CPP-601, -627, and -640 buildings, which share common walls and utilities. Also included is a section of a CPP-602 discharge drain line extending from the CPP-601 header into the CPP-602 sump. The line was abandoned and grouted in place, with a stainless-steel liner atop the grouted-in piece of pipe. The landfill does not include the CPP-602 laboratory, which is subject to a separate closure action (DOE-ID 2009a). Figure 1 provides an overview of the landfill boundaries shaded in green.

Table 1. List of primary activities associated with the phased CPP-601/627/640 landfill closure.

Closure Phase	HWMA/RCRA Activities	CERCLA NTCRA Activities
Phase 1 CPP-601 Landfill Closure	*HWMA/RCRA Landfill Closure Plan for the CPP-601 Deep Tanks System Phase 1* (DOE-ID 2009a) • Waste removed to extent practicable • Piping and tanks decontaminated to extent practicable • Rinsate sampled and analyzed and wastes characterized • Tanks grouted for waste stabilization • Phase 1 landfill closure certification	*Action Memorandum for Decommissioning CPP-601/640 Fuel Reprocessing Facilities* (DOE-ID 2008) CPP-601/640 decontamination and decommissioning • Remove accessible bulk lead, asbestos, and other materials that would increase risk • Fill remaining area, including vessels and piping, with grout or other inert material, creating monolith
Phase 1 Post-Closure Care CPP-601/627/640 Landfill Interim Cover	*HWMA/RCRA Post-Closure Plan for the CPP-601/627/640 Landfill* (this document) • Implement inspection, maintenance, and monitoring requirements for CPP-601/627/640 landfill • Install groundwater monitoring wells and begin groundwater monitoring	*Action Memorandum for Decommissioning CPP-601/640 Fuel Reprocessing Facilities* (DOE-ID 2008) CPP-601/640 demolition • Remove building to the Process Makeup/Hot Makeup deck level, exposing concrete monolith • Place layer of concrete on top of exposed monolith as appropriate to provide sloping • Install precipitation infiltration coating over abovegrade sections of CPP-601/627/640 monolith • Implement institutional controls for monolith maintenance and precipitation run-off control
Phase 2 CPP-601/627/640 Phase 2 Cover Installation	Phase 2 HWMA/RCRA landfill closure plan (to be developed) • Install concrete layer as appropriate over interim CPP-601/627/640 monolith to provide sloping • Install precipitation infiltration coating over abovegrade sections of CPP-601/627/640 monolith • Continue groundwater monitoring, inspection, and maintenance • Certification of Phase 2 closure	
CPP-601/627/640 Permitted Post-Closure Care	Post-closure plan and permit modification (to be developed) Continue groundwater monitoring, inspection, and maintenance	

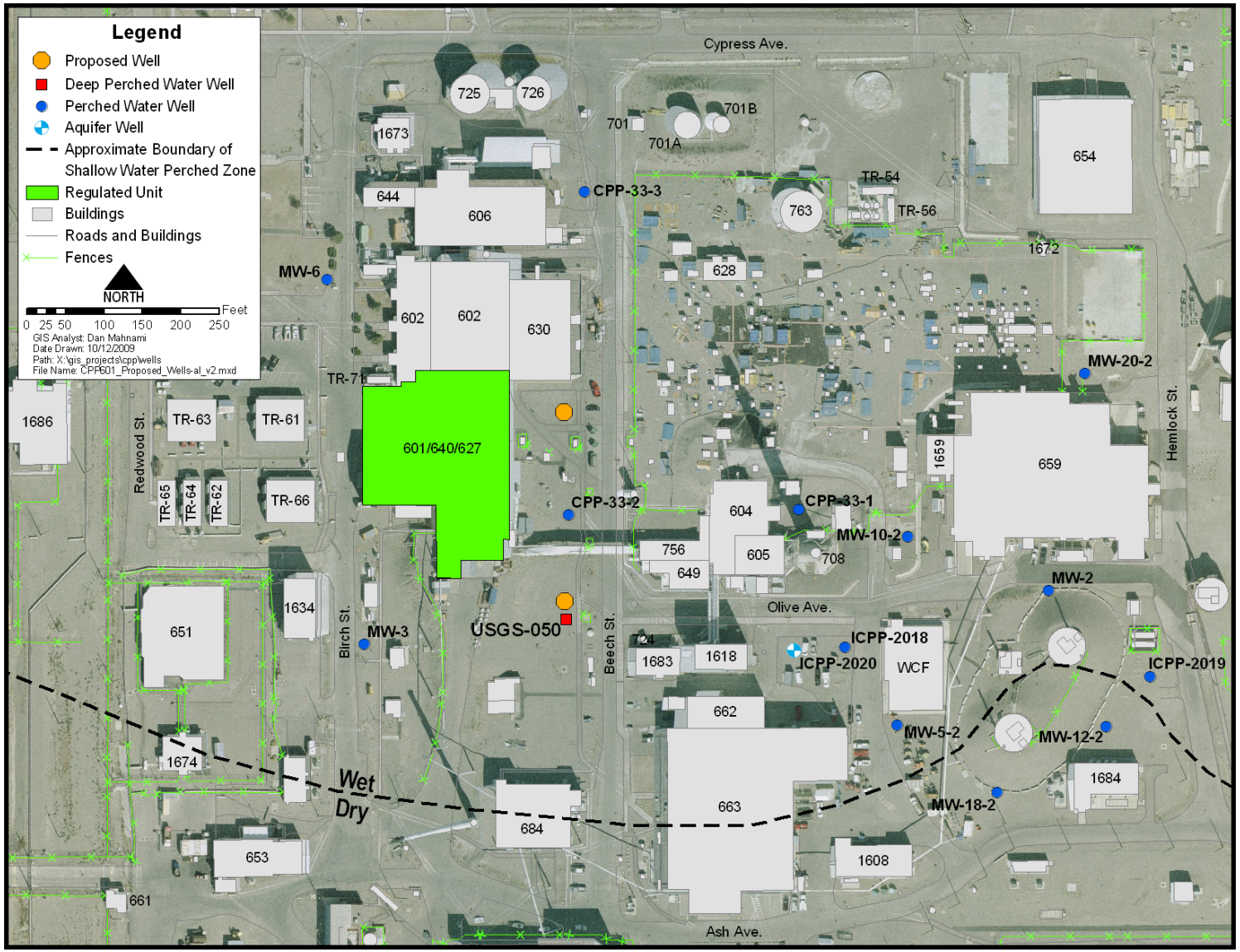

Figure 1. INTEC building layout with landfill footprint shaded in green.

3.2 CPP-601 Deep Tanks System Phase 1 Landfill Closure

The CPP-601 Deep Tanks System Phase 1 landfill closure activities have been completed in accordance with the closure plan (DOE-ID 2009a). Under Phase 1 closure, laboratory waste discharge piping from the laboratory hoods, sinks, and drains in CPP-602 and -684 that discharged to CPP-601 were clean-closed by decontamination to the site-specific action levels specified in the closure plan. The remaining portions of the CPP-601 Deep Tanks System within the landfill closure boundaries of the outer walls of CPP-601/627/640 were flushed to the extent practicable. The CPP-601/627/640 components included in the landfill area were completely isolated from CPP-602, -666, and -684 and the INTEC Liquid Waste Management System waste handling systems (DOE-ID 2009a). The four deep tanks in CPP-601 have been filled with grout. Grouting of piping and the CPP-601 and -640 buildings is in progress and will be completed as part of the CPP-601/640 NTCRA.

3.3 CPP-601/640 NTCRA and CPP-640 Headend Storage Tank System Closure

The CPP-601/640 facilities are being decommissioned in a NTCRA as specified in the *Action Memorandum for Decommissioning CPP-601/640 Fuel Reprocessing Facilities* (DOE-ID 2008). Activities preparatory to this NTCRA have been performed in accordance with the *Action Memorandum for General Decommissioning Activities under the Idaho Cleanup Project* (DOE-ID 2009b). These activities include isolating utilities; removing chemicals, piping, and equipment; and routine waste management practices such as removing lead, polychlorinated biphenyls, and asbestos (DOE-ID 2009b). Decommissioning activities currently being performed include:

- Removal of non-process areas, including building components and the upper portion of the mechanical handling cave with processing cells left intact. The top 8 ft of the P, Q, and R cells in CPP-601 and the bottom 2.5 ft of the mechanical handling cave will remain intact and be grouted. Intact cells will be decontaminated before being grouted.

- Waste stabilization through the grouting of larger system piping and the remaining void spaces within the CPP-601/640 facilities.

In March 2009, the U.S. Department of Energy (DOE) requested concurrence from the DEQ and the U.S. Environmental Protection Agency (EPA) to leave additional bulk lead in place because the lead has been identified as impracticable to remove. Three areas in CPP-601 and -640 have lead totaling approximately 51.9 tons that is integral to the building structure, and removal would significantly increase radiological or worker risk (Shaw 2009). The DEQ and EPA have concurred with this request (Monson 2009; Faulk 2009). Approximately 129 tons of lead from CPP-601 and -640 are expected to remain in place (Shaw 2009).

The CPP-640 Headend Storage Tank System was clean-closed in accordance with HWMA/RCRA requirements as of June 12, 2008 (DOE-ID 2009a). Tank system components, including tanks and ancillary equipment that managed hazardous waste, were decontaminated to the site-specific action levels specified in the *HWMA/RCRA Closure Plan for the CPP-640 Headend Storage Tank System* (DOE-ID 2007). The DEQ approved the closure certification on June 12, 2008 (Monson 2008).

3.4 CPP-627 NTCRA

The CPP-627 Remote Analytical Facility was decommissioned in 2005 in a NTCRA as specified in the *Action Memorandum for the Decontamination and Decommissioning of Building CPP-627, the Remote Analytical Facility* (DOE-NE-ID 2004; ICP 2006). Abovegrade hazardous waste piping was removed and disposed of, and the CPP-627 facility was removed to grade. The remaining concrete slab, which covered the remaining belowgrade inactive/abandoned lines that were inaccessible for decontamination, was washed down to remove loose contamination. A protective layer of concrete was then poured over the entire building footprint to prevent future infiltration of water (ICP 2006).

4. HWMA/RCRA LANDFILL AND POST-CLOSURE REQUIREMENTS

As required by IDAPA 58.01.05.008 (40 CFR 264.197), tank systems to be closed as landfills must meet the closure requirements for landfills specified in IDAPA 58.01.05.008 (40 CFR 264.310). Section 264.310 also requires compliance with post-closure requirements contained in IDAPA 58.01.05.008 (40 CFR 264.117 through 264.120) as well as groundwater monitoring and other applicable requirements of IDAPA 58.01.05.008 (40 CFR 264, Subpart F). The concrete monolith for the CPP-601/627/640 landfill that will be created by NTCRA activities will serve as an interim HWMA/RCRA cover pending placement of the concrete layer for sloping and the application of the precipitation infiltration coating. This concrete layer and coating will constitute the Phase 2 HWMA/RCRA cover. Although the monolith is an interim measure, the technical requirements of IDAPA 58.01.05.008 (40 CFR 264.310) will be substantively met. The primary technical requirements are specified in IDAPA 58.01.05.008 (40 CFR 264.310), which addresses landfill closure and post-closure care, and IDAPA 58.01.05.008 (40 CFR Subpart F §§264.97–264.100), which addresses groundwater monitoring programs. Table 2 summarizes these HWMA/RCRA closure and post-closure technical requirements for Phase 1 of the CPP-601/627/640 landfill closure and post-closure period and the strategy planned to meet each requirement.

Table 2. HWMA/RCRA landfill closure and post-closure technical requirements and compliance strategy.

IDAPA 58.01.05.008 (40 CFR 264, Subpart N) Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities – Landfills	
Regulatory Requirement	Compliance Strategy
§264.310 Closure and post-closure care.	
(a) At final closure of the landfill, the owner or operator must cover the landfill with a final cover designed and constructed to (1) Provide long-term minimization of migration of liquids through the closed landfill (2) Function with minimum maintenance (3) Promote drainage and minimize erosion or abrasion of the cover (4) Accommodate settling and subsidence so that the cover's integrity is maintained (5) Have a permeability less than or equal to the permeability of any bottom liner system or natural subsoils present.	The interim CPP-601/627/640 monolith will be constructed of concrete and other inert material that will fill void spaces in the remaining buildings, including vessels and large piping. Drains, pipes, hatches, and other openings on the monolith surface will be capped and sealed. This construction will minimize migration of liquids through the landfill and function with minimum maintenance until the phase 2 HWMA/RCRA cover is placed. The CPP-627 portion of the monolith is sloped from east to west. The CPP-627 and CPP-601/640 portion will be inspected and maintained for precipitation ponding and pooling. Soil surrounding the monolith will be sloped away from the landfill, so drainage is promoted and erosion minimized. The monolith will be constructed on the footprint of CPP-601/627/640, which are constructed of heavy reinforced walls. Void spaces in CPP-601/640 will be filled with grout in lifts where appropriate. CPP-627 was demolished to grade, and a reinforced, sloping, concrete slab has been placed over the foundation. Drilled piers support grade beams and the former building slab. Therefore, long-term lateral displacement and subsidence are not expected. The monolith's construction results in a permeability less than the soils and bedrock beneath the buildings. If cracks or other penetrations are observed during inspections, repairs will be made as appropriate and to the extent practicable.

Table 2. (continued).

IDAPA 58.01.05.008 (40 CFR 264, Subpart N) Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities – Landfills	
Regulatory Requirement	Compliance Strategy
(b) After final closure, the owner or operator must comply with all post-closure requirements contained in §§264.117 through 264.120, including maintenance and monitoring throughout the post-closure care period (specified in the permit under §264.117). The owner or operator must	Administrative and permit requirements specified in §§264.117 through 264.120 will be addressed during Phase 2 of this landfill closure.
(1) Maintain the integrity and effectiveness of the final cover, including making repairs to the cap as necessary to correct the effects of settling, subsidence, erosion, or other events;	The interim concrete monolith is to be repaired as necessary to correct the effects of subsidence, erosion, or other events.
(2) Continue to operate the leachate collection and removal system until leachate is no longer detected;	Not applicable.
(3) Maintain and monitor the leak detection system in accordance with §§264.301(c)(3)(iv) and (4) and 264.303(c), and comply with all other applicable leak detection system requirements of this part;	Not applicable.
(4) Maintain and monitor the groundwater monitoring system and comply with all other applicable requirements of Subpart F of this part;	The groundwater monitoring system is to be maintained as required. See requirements for Subpart F.
(5) Prevent run-on and run-off from eroding or otherwise damaging the final cover; and	The concrete pad over CPP-627 is sloped from east to west and is designed to prevent run-on and water infiltration at the former CPP-627 footprint. Drains, pipes, hatches, and other openings on the monolith surface will be capped and sealed. The monolith will be inspected for precipitation ponding or pooling; if found, the precipitation will be removed by appropriate means to the extent practicable. Soil surrounding the monolith will be graded so that the ground slopes away from the CPP-601/627/640 area. The precipitation run-off will be diverted to direct the water away from the monolith.
(6) Protect and maintain surveyed benchmarks used in complying with §264.309.	Not applicable.

Table 2. (continued).

IDAPA 58.01.05.008 (40 CFR 264, Subpart F) Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities – Releases from Solid Waste Management Units	
Regulatory Requirement Summary	Compliance Strategy
§264.97 General Groundwater Monitoring Requirements.	
The owner or operator must comply with the following requirements for any groundwater monitoring program developed to satisfy §264.98, §264.99, or §264.100: (a) The groundwater monitoring system must consist of a sufficient number of wells, installed at appropriate locations and depths to yield groundwater samples from the uppermost aquifer that represent the quality of background groundwater that has not been affected by leakage from a regulated unit, represent the quality of groundwater passing the point of compliance, and allow for the detection of contamination when hazardous waste or hazardous constituents have migrated from the waste management area to the uppermost aquifer.	A combination of two existing wells and two new wells will be used with locations as shown in Figure 1. The upgradient background well will be MW-6; well CPP-33-2 will be used as a point-of-compliance monitoring well for both water elevation and constituent monitoring. The two new wells will serve as the second and third point-of-compliance wells.
(b) This section specifies requirements for facilities that contain more than one regulated unit.	Not applicable.
(c) All monitoring wells must be cased in a manner that maintains the integrity of the monitoring-well bore hole.	Well construction detail, where known, is shown in Table 6.
(d) The groundwater monitoring program must include consistent sampling and analysis procedures that are designed to ensure monitoring results that provide a reliable indication of groundwater quality below the waste management area. At a minimum, the program must include procedures and techniques for sample collection sample preservation and shipment, analytical procedures, chain of custody control.	Specific sampling and analysis plan techniques and procedures are included in Attachment 3 of the WCF post-closure permit (PER-112). Laboratory quality assurance/quality control data from each sampling event will be completed within 35 days of receipt of final results from sample analyses, and analytical results will be submitted to DEQ as discussed in Section 9.
(e) The groundwater monitoring program must include sampling and analytical methods that are appropriate for groundwater sampling and that accurately measure hazardous constituents in groundwater samples.	Current SW-846 methods (EPA 2008) for metals, volatile organic compounds, and semi-volatile organic compounds will be used when analyzing groundwater samples collected during implementation of the detection monitoring, compliance monitoring, and corrective action monitoring programs. The specific constituents to be analyzed are listed in Table 5. Equivalent or superior analytical methods may be substituted.
(f) The groundwater monitoring program must include a determination of the groundwater surface elevation each time groundwater is sampled.	Water elevation measurements will be collected semi-annually and used to calculate the semi-annual groundwater flow rate and flow direction for the entire groundwater monitoring network within a 24-hour period. The measurements, flow rate, and direction will be reported as described in Section 9.

Table 2. (continued).

IDAPA 58.01.05.008 (40 CFR 264, Subpart F) Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities – Releases from Solid Waste Management Units	
Regulatory Requirement Summary	Compliance Strategy
(g) In detection monitoring or where appropriate in compliance monitoring, data on each hazardous constituent specified in the permit will be collected from background wells and wells at the compliance point(s). This section also specifies requirements for the number and kinds of samples to be collected, the sample size, the sampling procedure, and the sampling interval.	Monitoring wells will be sampled semi-annually throughout the Phase 1 post-closure period. Quarterly sampling will be performed until DEQ has approved background concentrations. (Compliance monitoring will not be triggered until the background levels have been established even if detection monitoring limits are exceeded.)
(h) This section specifies the statistical methods to be used in evaluating groundwater monitoring data for each hazardous constituent which, upon approval by the Regional Administrator, will be specified in the unit permit.	The following statistical procedures will be used to determine background concentrations. For detected constituents, the Mann-Kendall Test will be used for trend analysis. If no trend is observed, normality and log normality will be assessed using the Shapiro-Wilk Test. Limits will be set using the following methods: • If no trend is present and data are normal – parametric 95% upper tolerance limit using normal data arithmetic mean and standard deviation. • If no trend is present and data are log-normal – parametric tolerance limit using log-normal data arithmetic mean and standard deviation. • If no trend is present and data are non-parametric – non-parametric tolerance limit at certain confidence limit. • If data show a trend – limits must be re-evaluated using the same method provided a statistical steady state (no trend) is established. • If, after additional data are analyzed, the background shows no trend and variability remains similar, then limits will be re-evaluated. When sampling includes non-detects , the following methods will be used: • Less than 15% of samples are non-detects – ½ the estimated quantitation limit (EQL) will be used in place of the non-detect. • Non-detects equate to 15 to 60% of samples collected – non-parametric parametric Wilcoxon Rank-Sum procedure adjusted for ties will be used to compare data collected from upgradient and downgradient monitoring wells. • Non-detects are greater than 60% – Poisson tolerance limits will be used. • All sampling events are non-detects – EQLs will be used as the limit.

Table 2. (continued).

IDAPA 58.01.05.008 (40 CFR 264, Subpart F) Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities – Releases from Solid Waste Management Units	
Regulatory Requirement Summary	Compliance Strategy
(i) This section stipulates requirements for the chosen statistical method.	See (h) above.
(j) Groundwater monitoring data must be maintained in the facility operating record. The Regional Administrator will specify in the permit when the data must be submitted for review.	Data will be maintained in the operating record as required.
§264.98 Detection monitoring program.	
This section specifies the minimum requirements for establishing a detection monitoring program. (a) The owner or operator must monitor for indicator parameters (e.g., specific conductance, total organic carbon, or total organic halogen), waste constituents, or reaction products that provide a reliable indication of the presence of hazardous constituents in groundwater.	The constituents of concern for this post-closure period are listed in Table 5. Samples from each detection monitoring and background well listed in Table 6 will be analyzed for these constituents.
(b) The owner or operator must install a groundwater monitoring system at the compliance point as specified under §264.95.	Well CPP-33-2 and two new wells will be used as point-of-compliance monitoring wells.
(c) The owner or operator must conduct a groundwater monitoring program for each chemical parameter and hazardous constituent specified in the permit and maintain a record of groundwater analytical data as measured and in a form necessary for the determination of statistical significance.	See §264.97
(d) The Regional Administrator will specify the frequencies for collecting samples and conducting statistical tests.	See §264.97
(e) The owner or operator must determine the groundwater flow rate and direction in the uppermost aquifer at least annually.	See §264.97
(f) The owner or operator must determine whether there is statistically significant evidence of contamination for any chemical parameter of hazardous constituent specified in the permit.	Once background levels have been established, data from each detection monitoring sampling event will be compared to the detection monitoring criteria in Table 4. Upon detection of any constituent(s) that exceeds the monitoring criteria, DEQ will be notified in writing within 7 calendar days after completion of data validation. At the INL's discretion, within 15 days, two verification samples from all affected well(s) will be collected, purging the well(s) between samples, and both samples will be analyzed for the constituents listed in Table 5. If the INL demonstrates to the DEQ that a source other than a regulated unit caused the exceedance or that the exceedance resulted from an error in sampling, analysis, or evaluation, DEQ will notify the INL to remain in the

Table 2. (continued).

IDAPA 58.01.05.008 (40 CFR 264, Subpart F) Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities – Releases from Solid Waste Management Units	
Regulatory Requirement Summary	Compliance Strategy
	detection monitoring program. Otherwise, DEQ will instruct the INL to implement the compliance monitoring program. If the verification samples do not confirm the detection of parameter(s) from Table 5 in concentrations that exceed the detection monitoring criteria, the detection monitoring program will be re-established and the DEQ will be notified of the resumption of the detection monitoring program.
(g) If the owner or operator determines that there is statistically significant evidence of contamination for chemical parameters or specified hazardous constituents, then the Regional Administrator must be notified, the groundwater in all monitoring wells must be sampled to determine whether constituents in the 40 CFR 264 Appendix IX are present, and if so, in what concentration. Requirements to establish compliance monitoring are also specified.	If the results from either verification sample confirm the detection of constituents in concentrations that exceed the detection monitoring criteria, the affected well(s) will be sampled within 15 calendar days. Within 60 calendar days of this sampling event, the INL will implement the compliance monitoring program. (The compliance monitoring program addresses Appendix IX constituents.)
(h) If the detection monitoring program no longer satisfies the requirements of this section, an application for a permit modification must be submitted.	For this post-closure period, the post-closure plan would be modified.
§264.99 Compliance monitoring program.	
This section specifies minimum requirements for establishing a compliance monitoring program. (a) The owner or operator must monitor the groundwater to determine whether regulated units are in compliance with the groundwater protection standard under §264.92.	Compliance monitoring wells will be determined by exceedance of detection monitoring criteria in Table 4 after background values have been established.
(b) The owner or operator must install a groundwater monitoring system at the compliance point as specified under §264.95.	Well CPP-33-2 and two new wells will be used as point of compliance monitoring wells.
(c) The Regional Administrator will specify the sampling procedures and statistical methods appropriate for the constituents and the facility. The owner or operator must conduct a sampling program for each specified chemical parameter or hazardous constituent, and the owner or operator must record groundwater analytical data as measured and in a form necessary for the determination of statistical significance.	Samples will be collected as described in Attachment 3 of the WCF post-closure permit (PER-112). The analyte list will include constituents listed in Table 5 and all additional constituents identified from IDAPA 58.01.05.008 (40 CFR 264, Appendix IX) sampling.
(d) The owner or operator must determine whether there is statistically significant evidence of increased contamination for any specified chemical parameter or hazardous constituent at a specified frequency.	Data will be compared to the compliance monitoring criteria in Table 4. If the analytical results for constituent(s) listed in Table 5 are less than or equal to the compliance monitoring criteria in Table 4, sampling will continue until the criteria for transition to the detection monitoring program are met.

Table 2. (continued).

IDAPA 58.01.05.008 (40 CFR 264, Subpart F) Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities – Releases from Solid Waste Management Units	
Regulatory Requirement Summary	Compliance Strategy
(e) The owner or operator must determine the groundwater flow rate and direction in the uppermost aquifer at least annually.	See §264.97
(f) The Regional Administrator will specify the frequencies for collecting samples and conducting statistical tests to determine statistically significant evidence of increased contamination.	See §264.97
(g) Annually, the owner or operator must determine whether additional hazardous constituents from 40 CFR 264 Appendix IX could possibly be present but are not on the detection monitoring list in the permit, are actually present in the uppermost aquifer and, if so, at what concentration.	On an annual basis, any/all monitoring wells will be analyzed for all constituents listed in IDAPA 58.01.05.008 (40 CFR 264, Appendix IX). Any newly identified compounds will be added to the list of analytes in Table 5.
(h) This section specifies actions required if the owner or operator determines that any concentration limits under §264.94 are being exceeded at any monitoring well at the point of compliance.	If analytical results from any well listed in Table 6 exceed the compliance monitoring criteria in Table 4, the corrective action monitoring program (see requirements for §264.100) will be implemented. The DEQ will be notified in writing within 7 calendar days after completion of data validation. Within 15 days of sample validation, two verification samples will be collected from the affected well(s), purging the well(s) between samples, and both samples will be analyzed for all parameters listed in Table 5. If analytical results from either of the verification samples confirm the detection of parameters in concentrations that exceed the groundwater protection standard in Table 5, the INL will notify DEQ in writing within 7 days of making this finding. Within 60 calendar days of sampling, the INL must establish a corrective action monitoring program and submit a revision to this post-closure plan.
(j) If the compliance monitoring program no longer satisfies the requirements of this section, an application for a permit modification must be submitted.	For this post-closure period, the post-closure plan would be modified.
§264.100 Corrective action program.	
This section specifies minimum requirements for establishing a corrective action program. (a) The owner or operator must take corrective action to ensure that regulated units are in compliance with the groundwater protection standard under §264.92. (b) The owner or operator must implement a corrective action program that prevents hazardous constituents from exceeding their respective concentration limits at the compliance point by removing the hazardous waste constituents or treating them in place. The permit will specify the specific measures that will be taken.	A corrective action monitoring program will be implemented if the compliance monitoring criteria in Table 4 are exceeded. The program will remain in effect until the Table 4 compliance monitoring criteria are not exceeded during four consecutive corrective action monitoring program events. At such time, the compliance monitoring program will be reactivated.

Table 2. (continued).

IDAPA 58.01.05.008 (40 CFR 264, Subpart F) Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities – Releases from Solid Waste Management Units	
Regulatory Requirement Summary	Compliance Strategy
(c) The owner or operator must begin corrective action within a reasonable time period after the groundwater protection standard is exceeded. The Regional Administrator will specify that time period in the facility permit. (d) The owner or operator must establish and implement a groundwater monitoring program to demonstrate the effectiveness of the corrective action program. (e) The owner or operator must conduct a corrective action program to remove or treat in place any hazardous constituents under §264.93 that exceed concentration limits under §264.94 in groundwater between the compliance point under §264.95 and the downgradient property boundary, and beyond the facility boundary, where necessary to protect human health and the environment. (f) The owner or operator must continue corrective action measures during the compliance period to the extent necessary to ensure that the groundwater protection standard is not exceeded. (g) The owner or operator must report in writing annually to the Regional Administrator on the effectiveness of the corrective action program. (h) If the corrective action program no longer satisfies the requirements of this section, an application for a permit modification must be submitted.	

5. CONCRETE MONOLITH DESCRIPTION

The interim CPP-601/627/640 concrete monolith will be situated over the footprints of buildings CPP-601, -627, and -640, which share common walls and utilities. The CPP-601/640 portion of the monolith will be created and exposed as a result of the CPP-601/640 demolition and grouting activities. Building CPP-627 has been demolished, and the remaining concrete slab will become part of the CPP-601/627/640 landfill. This section describes the concrete monolith, run-on and run-off controls, and characterization of the waste to be left in place.

The concrete monolith for CPP-601/640 will result from the NTCRA demolition and grouting activities. As part of the NTCRA, buildings CPP-601 and -640 will be partially demolished. To minimize void space to the extent practicable, vessels and larger piping will be filled with grout, and grout will be placed in the buildings' void spaces to encapsulate vessels and piping to be left in place. Where appropriate, the grout will be placed in lifts and allowed to solidify. Grouting for each building will be completed prior to removal of portions of that building. The grouted portions remaining after the buildings are demolished will form the concrete monolith. Thus, the monolith will be exposed as the buildings are removed. Buildings CPP-601 and -640 will be partially demolished to 11 ft above grade in most areas, leaving process cells intact, and exposing the concrete monolith in place as shown in Figure 2. Building CPP-601 will be demolished to the Process Makeup deck level with the exception of the P, Q, and R cells, which will extend approximately 19 ft above grade. Building CPP-640 will be demolished to the Hot Makeup deck level with the exception of the mechanical handling cave (which will extend approximately 14 ft above grade) and the operating area surrounding the process cells (which will extend about 1 ft above grade).

Building CPP-627 was removed to grade, and a reinforced-concrete slab was placed on the foundation footprint to reduce infiltration. The concrete slab slopes down from approximately 20 in. on the east side adjacent to CPP-601 to approximately 10 in. on the west side (DOE-ID 2008; PWO-05-318).

The CPP-601/627/640 interim monolith will be approximately 11 ft above grade in most areas. The monolith dimensions will be approximately 102 × 245 ft over CPP-601 and approximately 90 × 154 ft over the CPP-627 and -640 footprints as shown in Figure 2.

5.1 Structural Stability

Building CPP-601 is made up of heavily reinforced, 1.5-ft exterior building walls and 5-ft-thick cell walls and is 80% underground. The interior vessels, large piping, and cells of CPP-601 will be filled with grout, which will solidify and will be contained by the building structure. Because the grout will be placed in lifts and allowed to harden, lateral displacement is not a concern. The majority of the facility is founded on approximately 10 ft of compacted engineered subgrade on basalt bedrock. The deep tanks area extends into the basalt about 7 ft. The weight of the building and grout applies a pressure to the subgrade that is less than the underlying bearing capacity. Long-term displacement or subsidence is not expected.

Building CPP-640 is made up of heavily reinforced, 1.5-ft exterior walls and 4.5-ft-thick cell walls and is mostly underground. The interior vessels, large piping, and cells of CPP-640 will be filled with grout, which will solidify and will be contained by the building structure. Because the grout will be placed in lifts and allowed to harden, lateral displacement is not a concern. The majority of the facility is founded on approximately 15 ft of compacted engineered subgrade on basalt bedrock. The weight of the building and grout applies a pressure to the subgrade that is less than the underlying bearing capacity. Long-term displacement or subsidence is not expected.

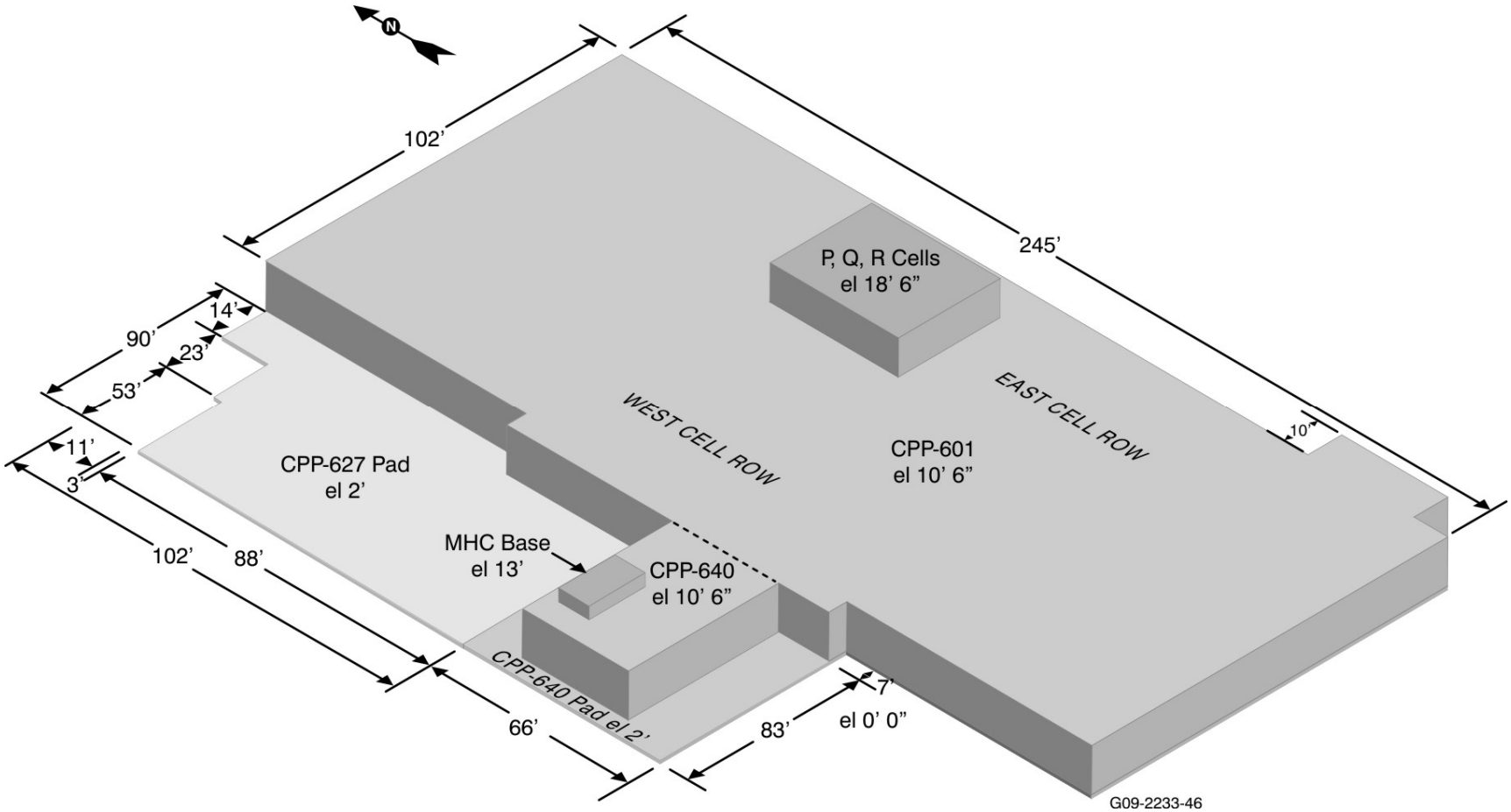

Figure 2. Expected monolith configuration.

Building CPP-627 was demolished to grade, and a reinforced-concrete slab was placed over the remaining foundation in 2005. The underlying foundation is made up of drilled piers supporting grade beams and the former building slab. Some nonstructural cracks have formed on the concrete slab over time, and the seal to adjacent walls of CPP-601 and -640 is sound.

The interim monolith will be inspected and maintained as described in Sections 7 and 8. If cracks or other penetrations are observed, repairs will be made as appropriate to the extent practicable.

5.2 Run-on and Run-off Controls

The interim concrete monolith will be in place to reduce precipitation infiltration into the soil below the building footprints, thereby minimizing potential releases of contamination to the groundwater. The concrete pad over CPP-627 is sloped from east to west at approximately 20 in. above grade next to CPP-601 to approximately 10 in. above grade on the west (PWO-05-318). This sloping was designed to prevent run-on and water infiltration at the former footprint of CPP-627. Before the CPP-601 and -640 buildings are partially demolished and the concrete monolith exposed, drains, pipes, hatches, and any other openings in the concrete will be capped and sealed. The monolith will be inspected as described in Section 7. If precipitation ponding or pooling is observed on the surface, the precipitation will be removed by appropriate means to the extent practicable. The soil surrounding the CPP-601/627/640 monolith will be graded so that the ground slopes away from the CPP-601/627/640 area. The precipitation run-off will be diverted to direct water away from the monolith.

5.3 Waste Characterization Information

The waste remaining in the CPP-601, -627, and -640 facilities has been characterized and quantified in EDF-9367, "Nonradiological Material Inventory for CPP-601, CPP-627, and CPP-640 Landfill Closure." Table 3 shows the expected waste inventory remaining in the CPP-601, -627, and -640 facilities of the 19 hazardous constituents listed in the "INL WCF Post-Closure Permit" (PER-112). Eight of the 19 constituents are expected to be present in quantities greater than 1 g. The 11 constituents that are not expected to be present, or that are expected to be present in quantities of less than 1 g, are 1,1,1-trichloroethane; benzene; carbon disulfide; carbon tetrachloride; chloroform; methyl ethyl ketone; methylene chloride; pyridine; tetrachloroethene; trichloroethene; and toluene. The 19 constituents listed in PER-112 are considered because the Waste Calcining Facility (WCF) and the CPP-601/627/640 facilities handled similar waste streams generated from fuel processing activities, and they are the constituents being monitored under the WCF post-closure permit. Additional constituents will be added if necessary based on the sampling of chemicals listed in IDAPA 58.01.05.008 (40 CFR 264, Appendix IX) to be completed as a part of the establishment of background levels.

Table 3. Waste inventory expected in CPP-601/627/640 landfill.

Constituent	Total Waste (kg)
Arsenic	3.00E-02
Barium	1.63E+01
Cadmium	5.24E+01
Chromium	1.08E+05
Lead	1.18E+05
Mercury	2.00E-02
Selenium	2.00E-02
Silver	5.60E-01

6. POST-CLOSURE MONITORING AND MAINTENANCE

Post-closure monitoring and maintenance will be conducted under this post-closure plan during the period between approval of this post-closure plan and the approval of the post-closure permit for CPP-601/627/640. Monitoring and maintenance of specific landfill components (e.g., monitoring wells) will begin upon installation of the component. A schedule for installation and subsequent post-closure monitoring and maintenance is included in Section 11. Consistent with the waste management approach described in the *Action Memorandum for Decommissioning CPP-601/640 Fuel Reprocessing Facilities* (DOE-ID 2008) and the *HWMA/RCRA Landfill Closure Plan for the CPP-601 Deep Tanks System Phase 1* (DOE-ID 2009a) waste generated in support of the monitoring and maintenance for this facility will be managed as CERCLA waste in compliance with the substantive requirements of IDAPA. These wastes may be disposed of at the Idaho CERCLA Disposal Facility provided they meet the waste acceptance criteria for that facility. Waste that fails to meet the WAC will be sent to a RCRA-permitted treatment, storage, and disposal facility for appropriate treatment or disposal.

6.1 Groundwater Monitoring

Groundwater monitoring will be conducted in accordance with this post-closure plan from completion of installation of the identified monitoring wells until a post-closure permit is in place to address the CPP-601/627/640 landfill.

6.1.1 Groundwater Monitoring Programs

Groundwater monitoring programs will be implemented in accordance with this plan to meet the requirements of IDAPA 58.01.05.008 (40 CFR 264.97, 264.98, 264.99, and 264.100). The groundwater monitoring programs described below are substantively equivalent to those specified in the WCF post-closure permit (PER-112). The groundwater monitoring programs will consist of and be instituted as follows.

An initial period of quarterly sampling for 2 years will be completed to establish background levels for the four wells planned to be used for monitoring the CPP-601/627/640 monolith. Statistical analyses of the data collected during this period will be used to set background levels and detection monitoring criteria.

A detection monitoring program (DMP) will be put into effect upon completion of the monitoring well installation and remain in effect under this post-closure plan until the approval of the post-closure permit for CPP-601/627/640 or the detection monitoring criteria are exceeded as described in Table 4. At the time of the exceedance, a compliance monitoring program (CMP) and/or a corrective action monitoring program (CAMP) will be put into effect. However, the CMP will not be triggered until the background levels have been established even if detection monitoring limits (DMLs) are exceeded.

After the background levels have been established, a CMP will be put into effect when the detection monitoring criteria are demonstrated to have been exceeded as defined in Table 4. The CMP will remain in effect until the detection monitoring criteria have not been exceeded during six consecutive CMP sampling events, at which time the DMP will be re-activated; or the CMP monitoring criteria as defined in Table 4 are exceeded, at which time the CAMP will be put into effect.

A CAMP will be put into effect when the compliance monitoring criteria as defined in Table 4 are exceeded. The CAMP will remain in effect until the Table 4 compliance monitoring criteria are not exceeded during four consecutive CAMP events. At such time, the CMP will be reactivated.

Table 4. Groundwater monitoring criteria for detection, compliance, and corrective action monitoring

Program	Initiation	Monitoring Criteria
Detection Monitoring	Upon completion of monitoring well installation or when compliance monitoring shows DMP criteria have not been exceeded for six consecutive CMP sampling events.	Analytical results for all constituents below the DML as defined in Table 5. Exceedance of DMLs listed in Table 5 will not trigger compliance monitoring until after background values have been established.
Compliance Monitoring	When the detection monitoring criteria are exceeded, or when corrective action monitoring shows CMP criteria have not been exceeded for four consecutive CAMP sampling events.	Analytical results for all constituents below the groundwater protection standard (GPS) but exceed DML for any constituent as defined in Table 5.
Corrective Action Monitoring	When the compliance monitoring criteria are exceeded.	Exceedance of GPS for any constituent as defined in Table 5.

Additional detection monitoring, compliance monitoring, or corrective action wells and/or programs may be added to the detection monitoring, compliance monitoring, or corrective action programs as the need arises, based on future groundwater sampling results.

Detection monitoring limits and groundwater protection standard (GPS) values are provided in Table 5. These limits are typically established as estimated quantitation limits (EQLs) plus established background concentrations. Groundwater protection standards are typically established as the maximum contaminant levels promulgated under the Safe Drinking Water Act plus established background concentrations. Because background concentrations have not yet been established for CPP-601/627/640 landfill post-closure monitoring, initial DMLs and GPSs were taken from the WCF post-closure permit (PER-112). Samples will be collected quarterly for 2 years to establish background levels, which will be calculated using the statistical requirements set out in Subsection 6.1.4.5. Upon establishment of site-specific background values, the DMLs and GPSs included in Table 5 will be modified to account for site-specific background values. During the 2-year period in which background levels are being established, exceedance of a DML will not trigger compliance monitoring, because the exceedence may be a result of a higher background concentration.

Table 5. CPP-601/627/640 post-closure analyte list, quantitation limits, DMLs, and GPSs.[a]

Constituent	EQL (ug/L)	DML (ug/L)	GPS (ug/L)
Arsenic	5	5	20
Barium	20	1,821	4,000
Cadmium	1	1	10
Chromium	10	12	200
Lead	3	3	30
Mercury	0.2	0.7	4
Selenium	20	20	100
Silver	10	10	200
1,1,1-trichloroethane	1	1	400

Table 5. (continued).

Constituent	EQL (ug/L)	DML (ug/L)	GPS (ug/L)
Benzene	1	1	10
Carbon disulfide	1	2	2,000
Carbon tetrachloride	1	1	10
Chloroform	1	1	200
Methyl ethyl ketone	5	5	38,000
Methylene chloride	1	1	86
Pyridine	5	5	720
Tetrachloroethene	1	4.8	10
Trichloroethene	1	2	10
Toluene	1	146	2,000

a. Values taken from the post-closure permit for the INL WCF (PER-112). Upon completion of background sampling, DMLs and GPSs will be corrected to reflect site-specific background levels for the CPP-601/627/640 landfill. Exceedance of DMLs will not trigger compliance monitoring during the background level establishment period.

6.1.2 Groundwater Description

Groundwater beneath CPP-601/627/640 includes a variety of perched water zones and the Snake River Plan Aquifer. A detailed description of the groundwater is included in the WCF post-closure permit (PER-112).

6.1.3 Groundwater Monitoring Wells

A network of monitoring wells will be established to implement the groundwater monitoring programs. A combination of two existing wells and two new wells will be used to ensure compliance with IDAPA 58.01.05.008 (40 CFR 264, Subpart F).

6.1.3.1 Well Location. Well locations are shown on Figure 1. The upgradient background well will be MW-6. Well CPP-33-2 will be used as a point-of-compliance monitoring well for both water-elevation and constituent monitoring. Similarly, two new wells (shown as orange dots) will be installed as second and third point-of-compliance wells.

6.1.3.2 Well Construction. Well construction details, where known, are shown in Table 6.

6.1.3.3 Well Inspection and Maintenance. Monitoring wells identified in Table 6 will be inspected and maintained from the time well installation activities are complete until the post-closure permit for the facility is approved. The need for maintenance will not constitute grounds for missing a sampling event without prior approval from DEQ. Under no circumstances will a well remain out of commission for two consecutive sampling periods.

Examples of possible problems at monitoring wells are:

- Well identification
- Inoperable locks

Table 6. Groundwater monitoring network (elevations are in referenced to NGVD29 datum).

Name	Designation	Type	Monitoring Frequency	Brass Cap Elevation (ft asl)	Measuring Point Elevation (ft asl)	Depth to Screen Top and Bottom (ft bgs)	Elevation Screen Bottom (ft asl)	Well Depth from Measuring Point (ft)
MW-6	Upgradient Background	Water Elevation/ Monitoring	Semi-annually	4,915.73	4,917.31	117-137	4,778.73	139
TBD-01	Point of Compliance	Water Elevation/ Monitoring	Semi-annually	TBD	TBD	TBD	TBD	TBD
CPP-33-2	Point of Compliance	Water Elevation/ Monitoring	Semi-annually	4,913.22	4,915.11	85.8-105.8	4,807.49	107.90
TBD-02	Point of Compliance	Water Elevation/ Monitoring	Semi-annually	TBD	TBD	TBD	TBD	TBD

asl = above sea level
bgs = below ground surface
TBD = to be determined

- Cracked surface casing
- Damaged cement pads
- Compromised impingement protection
- Well head description.

The frequency and location of well maintenance activities are subject to changing well conditions. As a general rule, the overall condition of each well will be inspected visually at each visit to the well. Formal inspection of the wells will be completed and documented on a semi-annual basis.

6.1.4 Groundwater Sampling and Analysis

All monitoring wells listed in Table 6 will be sampled semi-annually throughout the period addressed by this plan. These wells will undergo quarterly sampling until DEQ has approved background concentrations. Specific sampling and analysis plan techniques and procedures are included in Attachment 3 (Section J5) of the WCF post-closure permit (PER-112). These procedures for collecting, preserving, shipping, tracking, controlling, and analyzing groundwater samples will be followed for all sampling conducted under this plan.

Evaluation of the laboratory quality assurance/quality control data from each sampling event will be completed within 35 days of receipt of final results from sample analyses. Analytical results will be submitted to DEQ in accordance with the schedule provided in Section 9.

Current SW-846 (EPA 2008) methods for metals, volatile organic compounds, and semi-volatile organic compounds will be used when analyzing groundwater samples collected during implementation of the DMP, CMP, and CAMP. The specific constituents to be analyzed are listed in Table 5. The analyses must achieve the reporting limits (EQLs) in Table 5. Equivalent or superior analytical methods may be substituted.

The INL will manage purge/development water and returned excess unaltered water samples in a manner protective of human health and the environment as CERCLA waste in compliance with the substantive requirements of IDAPA. This water may be disposed of at the Idaho CERCLA Disposal Facility Evaporation Pond, provided the water meets the waste acceptance criteria (WAC) for that facility. All water associated with the sampling events will be properly stored until the analytical data are received to determine compliance with the above WAC. If the water is found to contain a constituent(s) that exceeds the WAC for that facility, then that water will be sent to a RCRA-permitted treatment, storage, and disposal facility for appropriate treatment or disposal.

6.1.4.1 Groundwater Elevation and Well Depth. Water elevation measurements will be collected semi-annually to be used in calculating the semi-annual groundwater flow rate and flow direction for the entire groundwater monitoring network within a 24-hour period. Semiannual water elevation measurements and the groundwater flow rate and direction will be reported as noted in Section 9. All water elevations will be collected within a 24-hour period.

Prior to initiation of sampling, all groundwater elevations will be measured using an electronic water-level indicator, weighted measuring tape, or continuous recorder method from the reference marker. Measurement of all groundwater levels will be recorded relative to mean sea level and to an accuracy of ± 0.01 ft (0.003 m). The water-level data obtained from the wells in this monitoring program will be combined with water-level measurements obtained from other waste area groups or

U.S. Geological Survey data to determine groundwater flow gradients, determine the direction and rate of annual groundwater flow, and generate potentiometric maps.

6.1.4.2 Detection Monitoring Program. Table 5 indicates the constituents of concern associated with this post-closure plan. Samples from each detection monitoring and background well listed in Table 6 will be collected and analyzed for these constituents. The samples will be collected and analyzed in accordance with Subsection 6.1.4.

The criteria for evaluating data from each detection monitoring sampling event will be to compare the sample analytical results with the detection monitoring criteria in Table 4 of this plan, as follows:

- Upon detection of any constituent(s) that exceeds the detection monitoring criteria specified in Table 4, DEQ will be notified of this finding, in writing, within 7 calendar days after completion of data validation; and (at the discretion of the INL), within 15 calendar days, the INL will collect two verification samples from all affected well(s), purging the well(s) between samples, and reanalyze both samples for all constituents listed in Table 5.

- If analytical results from either verification sample confirm the detection of constituents in concentrations that exceed the detection monitoring criteria given in Table 4, the affected well(s) will be sampled within 15 calendar days and the collected samples must be analyzed for the constituents identified in IDAPA 58.01.05.008 (40 CFR 264, Appendix IX). DEQ will be notified in writing within 7 days of making this finding. Within 60 calendar days of this sampling event, the CMP will be implemented.

However, these actions will not be triggered until the background levels have been established even if detection monitoring criteria are exceeded.

The INL may demonstrate, in accordance with IDAPA 58.01.05.008 [40 CFR 264.98(g)(6)], that a source other than the regulated unit caused the contamination, or that the increased contamination resulted from an error in sampling, analysis, or evaluation. If the INL successfully demonstrates to the DEQ that a source other than a regulated unit caused the exceedance or that the exceedance resulted from an error in sampling, analysis, or evaluation, DEQ will notify the INL to remain in the DMP. Otherwise, the Director of the DEQ will instruct the owner/operator to implement the compliance monitoring program within the timeframe established by the Director. This period will not be less than 45 calendar days.

If analytical results from both verification samples described fail to confirm the detection of parameter(s) from Table 5 in concentrations that exceed the detection monitoring criteria, the detection monitoring program will be re-established and DEQ notified that the DMP has been resumed.

6.1.4.3 Compliance Monitoring Program. Compliance monitoring wells will be determined through exceedance of the detection monitoring criteria in Table 4.

During the CMP, the samples will be collected in accordance with Subsection 6.1.4. The analyte list will include the constituents listed in Table 5 of this plan plus all additional constituents identified from Appendix IX sampling performed during DMP sampling.

On an annual basis, all monitoring wells in the CMP will be analyzed for all constituents listed in IDAPA 58.01.05.008 (40 CFR 264, Appendix IX). As a result of this sampling, any newly identified compounds will be added to the existing list of analytes in Table 5, in accordance with IDAPA 58.01.05.008 [40 CFR 264.99(g)].

The criteria for evaluating data from each compliance monitoring sampling event will be to compare the sample analytical results with the compliance monitoring criteria in Table 4 of this plan, as follows:

- If the analytical results for any constituent(s) listed in Table 5 of this permit are less than or equal to the compliance monitoring criteria in Table 4, sampling under the CMP will continue until the criteria for transition to DMP are met; or if the analytical results from any well listed in Table 6 of this permit exceed the compliance monitoring criteria in Table 4, the CAMP will be implemented.

- If the analytical results of samples taken from any well listed in Table 6 exceed the compliance monitoring criteria in Table 4, the CAMP will be implemented for the monitoring well network and DEQ notified of this finding, in writing, within 7 calendar days after completion of data validation. Within 15 days of sample validation, two verification samples will be collected from all affected well(s), purging the well(s) between samples, and both samples for all parameters listed in Table 5 will be reanalyzed.

- If analytical results from either of the verification samples confirm the detection of parameters in concentrations that exceed the GPS as defined in Table 5, the INL will notify DEQ in writing within 7 days of making this finding. Within 60 calendar days of sampling, the INL will establish a CAMP and submit the CAMP in a revision to this post-closure plan.

6.1.4.4 Data Reporting. While in DMP(s) or CMP(s) after background levels have been established, semi-annual reports will be submitted to the DEQ as described in Section 9. These reports will include, at a minimum:

- A narrative summary of groundwater monitoring data that have been collected to date and a detailed listing of the monitoring and analytical data obtained but not included in the previous report, including laboratory quality assurance/quality control information and all newly identified compounds from any required Appendix IX testing.

- Analytical results from sampling and analysis and a narrative summary of sampling data, including laboratory quality assurance/quality control information.

- A table summary of the groundwater elevation and well depth data collected, the results of groundwater flow rate and direction calculations, and parameters used to calculate groundwater flow velocities and direction for the perched aquifer shall be submitted annually. The table summary will include a summary/statement that either the monitoring well network as described in this plan is still valid for the purpose of satisfying IDAPA 58.01.05.008 [40 CFR 264.97(a)] requirements or an in-depth evaluation of the monitoring well network is warranted. If an in-depth evaluation is needed, a proposal, including a schedule, will be submitted to DEQ within 10 calendar days of the submittal of this summary.

- Field sampling data, including:

  - Sample collection procedures

  - Amount of purge water collected at each well

  - Sample preservation methods

  - Observations of temperature, turbidity, pH, and specific conductance

- Chain-of-custody information
- Any anomalies that may have occurred during sampling and analysis
- Field parameters.

- A summary of maintenance work done on groundwater monitoring equipment.
- A summary of deficiencies identified during the inspections of the monitoring wells' surveyed benchmarks.

6.1.4.5 Data Analysis. The statistical procedures outlined in this section will be used for determining background concentrations. Results of these analyses will be submitted as noted in Section 9.

For detected constituents, the Mann-Kendall Test will be used for trend analysis. If no trend is observed, the Shapiro-Wilk Test will be used to test for normality and log normality.

Limits will be set using the following methods:

- The parametric 95% upper tolerance limit using normal data arithmetic mean and standard deviation will be used if no trend is present and data are normal
- The parametric tolerance limit using log-normal data arithmetic mean and standard deviation will be used if no trend is present and data are log-normal
- The arithmetic mean ($\bar{x}$) and standard deviation(s) for log-normal data will be calculated using the following equations:

$$x_y = \frac{1}{N}\sum_{i=1}^{N} \ln(x_i);\ s_y^2 = \frac{1}{N}\sum_{i=1}^{N}[\ln(x_i) - x_y]^2 \quad (1)$$

$$\bar{x} = \exp(x_y + s_y^2/2);\ s = \sqrt{\exp(2x_y + s_y^2)[\exp(s_y^2) - 1]} \quad (2)$$

- The non-parametric tolerance limit (highest measured value) at certain confidence limit (based on number of data) will be used there is no trend and the data are non-parametric
- If the data show a trend, the limits must be re-evaluated using the same method provided a statistical steady state (no trend) is established
- If, after additional data are analyzed, the background shows no trend and the variability remains similar, then limits will be re-evaluated.

When sampling includes non-detects, the following methods will be used (EPA 1992; Gibbons 1994):

- When less than 15% of samples result in non-detects, –½ the EQL will be used in place of the non-detect.

- When non-detects equate to 15 to 60% of samples collected, the non-parametric parametric Wilcoxon Rank-Sum procedure adjusted for ties (Helsel and Hirsch 1995) will be used for comparison of data collected from upgradient and downgradient monitoring wells. For this procedure to be used, at least three samples worth of data must be collected from downgradient wells.

- When non-detects are greater than 60%, the Poisson tolerance limits will be used.

- The EQLs will be used as the limit whenever all sampling events are nondetects.

The following references will be used for conducting statistical analysis:

- Gibbons, R. D., 1987, "Statistical Models for the Analysis of Volatile Organic Compounds in Waste Disposal Sites," *Groundwater*, Vol. 25, pp. 572–580.

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- EPA, 1992, "Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities: Addendum to Interim Final Guidance," U.S. Environmental Protection Agency, EPA/530-R-93-003.

- Zacks, S., 1970, "Uniformly most accurate upper tolerance limits for monotone likelihood ratio families of discrete distributions," *Journal of the American Statistical Association*, Vol. 65, pp. 307–316.

7. INSPECTION

The monolith will be inspected in accordance with the provisions of IDAPA 58.01.05.008 (40 CFR 264.15). The integrity of the monolith will be inspected on a semi-annual basis on exposed portions of the monolith. The inspections will be documented on the CPP-601/627/640 post-closure monitoring form. The form will be used to document the inspection and the findings of the following:

- Concrete surface (for surface erosion, cracks, spalling, subsidence, joint seal condition)
- Surface drainage (for run-off drainage maintained away from the monolith).

Various surface coatings may be applied for the purposes of testing for weather degradation, adhesion, durability, inspectability, reparability, and other factors. Monolith areas covered by these surface coatings will be inspected by examining the surface coating in a manner similar to the inspection of the bare concrete surface; for example, if cracks or crevices are not visible and the deterioration is not visible, then the area will be determined to meet inspection requirements. The inspection frequency may be modified based on information obtained from the monitoring.

Any deterioration or malfunction discovered by an inspection will be remedied as required by IDAPA 58.01.05.008 [40 CFR 264.15(c)].

Inspections will be recorded on the inspection logs and inspection log sheets, as specified in IDAPA 58.01.05.008 [40 CFR 264.15(d)]. At a minimum, the following information will be recorded:

- The date and time of the inspection
- The name of the inspector
- A notation of the observations made, including any/all deficiencies identified
- The date, nature, and status of any needed repairs or other remedial actions (e.g., lock replaced September 10, 200X, work order submitted – parts ordered).

Documentation of inspection activities will be maintained at the facility as required by IDAPA 58.01.05.008 [40 CFR 264.73(b)(5)] for at least 3 years from the inspection date.

8. MAINTENANCE

The facility will be maintained, as required by IDAPA 58.01.05.008 (40 CFR 264.117) during the post-closure period. The following maintenance activities will be completed:

- Maintain the integrity and effectiveness of the interim monolith, including making repairs to the monolith as necessary to correct the effects of subsidence, erosion, or other events and including repairs to the groundwater monitoring system and equipment

- Maintain the security of the facility in accordance with IDAPA 58.01.05.008 (40 CFR 265.14)

- Maintain and monitor the groundwater monitoring system, and comply with all other applicable requirements of IDAPA 58.01.05.008 (40 CFR 264, Subpart F)

- Prevent run-on and run-off from eroding or otherwise damaging the monolith.

Documentation of maintenance activities will be maintained at the facility, as required by IDAPA 58.01.05.008 [40 CFR 264.73(b)(5)], for at least 3 years from the inspection date.

9. DOCUMENT MANAGEMENT AND REPORTING

Groundwater monitoring and landfill maintenance and inspection activities to be performed under this post-closure plan will be properly recorded and maintained. Records may be maintained at INTEC or electronically in a readily retrievable manner. Records may be maintained using a solely electronic format as long as they are readily retrievable to obtain a printed copy.

9.1 Monitoring Records

A groundwater monitoring checklist will be used to record the routine groundwater monitoring events. Documentation of the groundwater monitoring must be maintained in the operating record until post-closure of the HWMA/RCRA cover is completed and certified, as required by 40 CFR 264.73(b)(6).

9.2 Maintenance and Inspection Records

Maintenance and inspections will be recorded on inspection logs and inspection log sheets. At a minimum, the following information will be recorded:

- The date and time of the inspection
- The name of the inspector
- A notation of the observations made, including all deficiencies identified
- The date, nature, and status (e.g., maintenance performed, work order submitted, parts ordered) of any needed repairs or other remedial actions.

Documentation of the inspections and maintenance activities at the landfill will be retained, as required by IDAPA 58.01.05.008 [40 CFR 264.73(b)(5)] for at least 3 years from the inspection date.

9.3 Reporting to DEQ

Groundwater monitoring reports will be submitted to DEQ on a quarterly basis for the first 2 years and semi-annually thereafter until Phase 2 certification and/or the approval of the Class 3 permit modification for the post-closure permit. Inspection reports will be submitted to DEQ on a semi-annual basis until Phase 2 certification and/or the approval of the Class 3 permit modification for the post-closure permit.

10. AMENDMENTS TO POST-CLOSURE PLAN

The conditions described in IDAPA 58.01.05.008 (40 CFR 264.118), "Post-Closure Plan; Amendment of Plan," will be followed to implement changes to the approved post-closure plan. If unexpected events during the post-closure period require modification of the approved post-closure activities, the post-closure plan will be amended within 60 days of the unexpected event or the DEQ will be otherwise notified. If any amendment becomes necessary, a written request detailing the proposed changes, the rationale for those changes, and a copy of the amended post-closure plan will be submitted to DEQ for approval. Minor changes to the approved post-closure plan, which are equivalent to, or do not compromise, the post-closure requirements and performance standards identified in the approved post-closure plan may be made without prior notification to DEQ.

11. IMPLEMENTATION SCHEDULE

Table 7 identifies the post-closure schedule that will be initiated following DEQ approval of this post-closure plan and certification of Phase 1. This schedule reflects the time required for conducting post-closure activities. For the first 2 years, groundwater monitoring will be conducted quarterly (every 90 days). After 2 years, background levels will be established, and groundwater monitoring will be conducted on a semi-annual basis (every 180 days). Inspection of the landfill will be conducted semi-annually (every 180 days).

Table 7. Post-closure schedule.

Planned Work Tasks	Day of Completion[a]
DEQ approval of post-closure plan	Day 0
Install monitoring wells	End of 2009
Initiate groundwater monitoring	Immediately after installation of wells; every 90 days for the first 2 years; every 180 days thereafter until post-closure permit is approved for CPP-601/627/640
Landfill inspection	Each October and April, starting after this post-closure plan is approved; landfill inspection will be performed and reported every 180 days.
Submittal of Phase 2 closure plan	2010

a. Day of completion for installation of monitoring wells and submittal of closure plan are estimates and may change if new conditions arise or unexpected events occur.

12. CONTACT INFORMATION

The name, address, and telephone number of the person to contact during the post-closure care period, in accordance with IDAPA 58.01.05.008 [40 CFR 264.118(b)(3)], is:

Dave Eaton
INTEC TR-61 104
Phone number: (208) 533-0621

13. REFERENCES

40 CFR 264, "Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities," *Code of Federal Regulations*, Office of the Federal Register, as amended.

42 USC 6901 et seq., 1976, "Resource Conservation and Recovery Act of 1976," United States Code, as amended.

42 USC 9601 et seq., 1980, "Comprehensive Environmental Response, Compensation, and Liability Act of 1980," as amended. (NOTE: The 1986 amendment is cited as "Superfund Amendments and Reauthorization Act of 1986" [SARA].)

DOE-ID, 2007, *HWMA/RCRA Closure Plan for the CPP-640 Headend Storage Tank System*, DOE/ID-11323, Rev. 1, U.S. Department of Energy, Idaho Operations Office, July 2007.

DOE-ID, 2008, *Action Memorandum for Decommissioning CPP-601/640 Fuel Reprocessing Facilities*, DOE/ID-11360, Rev. 0, U.S. Department of Energy, Idaho Operations Office, August 2008.

DOE-ID, 2009a, *HWMA/RCRA Landfill Closure Plan for the CPP-601 Deep Tanks System Phase 1*, DOE/ID-11376, Rev. 2, U.S. Department of Energy, Idaho Operations Office, January 2009.

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State of Idaho, 1983, "Hazardous Waste Management," Idaho Statute, Title 39, "Health and Safety," Chapter 44, "Hazardous Waste Management" (also known as the Hazardous Waste Management Act of 1983).

State of Idaho, 2007, "Partial Permit for HWMA Storage and Treatment for the Liquid Waste Management System at the Idaho Nuclear Technology and Engineering Center on the Idaho National Laboratory," EPA ID No. ID4890008952, Effective Date: October 18, 2004, Revision Date: December 28, 2007.

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DOE/ID-11376
Revision 2

HWMA/RCRA Landfill Closure Plan for the CPP-601 Deep Tanks System Phase 1

January 2009

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Revision 2

HWMA/RCRA Landfill Closure Plan for the CPP-601 Deep Tanks System Phase 1

January 2009

Prepared for the
U.S. Department of Energy
DOE Idaho Operations Office

ABSTRACT

This Hazardous Waste Management Act/Resource Conservation and Recovery Act landfill closure plan for the CPP-601 Deep Tanks System was developed to meet the tank system closure requirements of IDAPA 58.01.05.008 and 40 CFR 264. Per IDAPA 58.01.05.008 (40 CFR 264.197), for a tank system that does not meet the closure standards in accordance with 40 CFR 264.197(a) through (c), the U.S. Department of Energy must provide to the State of Idaho Department of Environmental Quality a plan for closing the unit as a landfill. Post-closure care will be required as stipulated in 40 CFR 264.310 and 264.117 through 264.120. While the objective of a Hazardous Waste Management Act/ Resource Conservation and Recovery Act closure is to meet clean-closure criteria, meeting the performance standards for clean closure is not expected to be practical due to the presence of abandoned isolated piping runs and bulk lead solids that have been identified in areas where, due to unsafe radiological and industrial hazards for workers, lead is impractical to remove. A landfill closure plan and post-closure plan will be implemented in a three-step approach for CPP-601 and the adjacent CPP-640 and CPP-627 facilities and will be integrated with Comprehensive Environmental Response, Compensation, and Liability Act actions. The first step is the landfill closure for the CPP-601 Deep Tanks System Phase 1, which involves identifying and isolating the CPP-601/627/640 landfill boundaries, and a post-closure plan submittal; step two is the Comprehensive Environmental Response, Compensation, and Liability Act non-time-critical removal action, which includes grouting tank system components, grouting the CPP-601/627/640 facilities, and interim precipitation controls; step three will be the landfill closure for CPP-601/627/640, the CPP-601 Deep Tanks System Closure Plan Phase 2 to include all remaining landfill closure requirements. This document addresses Phase 1 of the landfill closure. The CPP-601 Deep Tanks System (VES-WG-100, VES-WG-101, VES-WH-100, and VES-WH-101) is permitted for tank storage and treatment of hazardous waste in the partial permit for the Idaho Nuclear Technology and Engineering Center Liquid Waste Management System, located at the Idaho Nuclear Technology and Engineering Center, Idaho National Laboratory Site. Portions of this tank system that are immediately adjacent to, but outside the actual CPP-601/627/640 footprint, are addressed in this closure and will be “clean closed” in accordance with the applicable closure performance standards via decontamination or removal of tank system components. As part of Phase 1, the tank system components within the CPP-601/627/640 landfill footprint will be decontaminated to the extent practicable and isolated from all waste discharge systems to meet the landfill requirements in 40 CFR 264.310(a)(1) and (2) until the Comprehensive Environmental Response, Compensation, and Liability Act activities and decontamination and decommissioning of the CPP-601 facility are complete. At that time, Phase 2 of the landfill closure will be implemented in accordance with the final end state selected for these facilities under the Comprehensive Environmental Response, Compensation, and Liability Act.

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Appendix A—Schematics and Line Tables A-1

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ACRONYMS

AL	action level
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
COC	contaminant of concern
D&D	decontamination and decommissioning
DEQ	State of Idaho Department of Environmental Quality
DOE	U.S. Department of Energy
EDF	engineering design file
EE/CA	engineering evaluation/cost analysis
EPA	U.S. Environmental Protection Agency
HWMA	Hazardous Waste Management Act
ILWMS	INTEC Liquid Waste Management System
INL	Idaho National Laboratory
INTEC	Idaho Nuclear Technology and Engineering Center
NTCRA	non-time-critical removal action
OU	operable unit
PEWE	Process Equipment Waste Evaporator
RCRA	Resource Conservation and Recovery Act
ROD	record of decision
TFF	Tank Farm Facility
VCO	Voluntary Consent Order

HWMA/RCRA Landfill Closure Plan for the CPP-601 Deep Tanks System Phase 1

1. INTRODUCTION

This Hazardous Waste Management Act (HWMA) (State of Idaho 1983)/Resource Conservation and Recovery Act (RCRA) (42 USC 6901 et seq. 1976) phased landfill closure plan has been prepared to address closure of the CPP-601 Deep Tanks System located at the Idaho Nuclear Technology and Engineering Center (INTEC), Idaho National Laboratory (INL) Site. The CPP-601 Deep Tanks System includes Tanks VES-WG-100, VES-WG-101, VES-WH-100, and VES-WH-101, and associated ancillary piping and equipment, which is included in the *Partial Permit for HWMA Storage and Treatment for the Liquid Waste Management System at the Idaho Nuclear Technology and Engineering Center on the Idaho National Laboratory* (State of Idaho 2007) for tank storage and treatment of hazardous wastes.

While the objective of a HWMA/RCRA closure is to meet clean-closure criteria, meeting the performance standards for clean closure is not expected to be practical for CPP-601 tank system due to the presence of abandoned isolated piping runs that are no longer connected to the currently active system. In addition, Subsection 2.5.3 of the *Engineering Evaluation/Cost Analysis for Decommissioning of the CPP-601/640 Fuel Reprocessing Facilities* (DOE-ID 2008a) describes bulk lead solids identified in areas where it is expected that it will be impractical to remove due to high levels of radioactive contamination and difficult working conditions. In addition, the removal of this shielding lead would cause radiation levels and subsequent worker exposures to rise significantly. Therefore, this bulk lead has been determined to be impractical to remove and is to be left in place within the building. As such, a landfill closure plan and post-closure plan for the facilities are required. The landfill closure will be implemented in coordination with a Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) (42 USC 9601 et seq. 1980) non-time-critical removal action (NTCRA) in a three-step approach (described below). The first step is the landfill closure for the CPP-601 Deep Tanks System Phase 1, the second step will be the CERCLA NTCRA decontamination and decommissioning (D&D) of the buildings, and the third step will be the final landfill closure for the CPP-601 Deep Tanks System Phase 2.

1. **Step 1 (HWMA/RCRA Closure Phase 1)—**During this phase of the landfill closure, an attempt will be made to clean close portions of the discharge lines from CPP-602 and CPP-684 to CPP-601, and from CPP-601 to a valve box outside the Process Equipment Waste Evaporator in accordance with the tank system closure requirements of IDAPA 58.01.05.008 and 40 CFR 264, Subparts G and J. These lines will be closed via decontamination of tank system components to the site-specific action levels (ALs) specified in this closure plan or removal. The remaining portions of the tank system within the landfill closure boundaries (i.e., the outer walls of CPP-601/627/640) will be flushed and isolated to minimize the potential for release of RCRA contaminants and to meet the requirements in 40 CFR 264.111(a) and (b) by minimizing the liquid waste and waste residues in the remaining tank system and isolating the facility from all waste discharge systems. Upon completion of the activities identified in this plan, closure certification and a post-closure plan will be submitted to DEQ. The Phase 1 landfill closure will be considered complete when the certification is accepted by the State of Idaho Department of Environmental Quality (DEQ).

2. **Step 2 (Integration with CERCLA NTCRA)—**Following the completion of Phase 1 of the landfill closure plan, the CPP-601 facility will continue to be decontaminated and decommissioned in accordance with the NTCRA specified in the *Action Memorandum for General Decommissioning Activities under the Idaho Cleanup Project* (DOE-ID 2006) and, when complete, the *Action Memorandum for Decommissioning CPP-601/640 Fuel Reprocessing Facilities* (DOE-ID 2008b). Decommissioning activities will include waste stabilization through the grouting of the tanks and larger system piping and the general CPP-601/640 facilities, and will provide precipitation infiltration control until the subsequent HWMA/RCRA final landfill closure plan has been completed. Decommissioning activities to be completed under the action memorandum that include CPP-601 tank system landfill closure components will be documented and addressed in the Phase 2 CPP-601 landfill closure and post-closure plan.

3. **Step 3 (RCRA Closure Phase 2)—**Upon completion of the NTCRA, the appropriate HWMA/RCRA permit will be modified to include Phase 2 of the landfill closure, which will include the installation of a RCRA cap over the CPP-601/627/640 monolith (IDAPA 58.01.05.008 [40 CFR 264.310]). Upon certification of the Phase 2 landfill closure plan, the permit will be modified to provide for the post-closure groundwater monitoring (IDAPA 58.01.05.008 [40 CFR 264.118]).

As the tank system being closed is included in the partial permit for the INTEC Liquid Waste Management System (ILWMS) (State of Idaho 2007), upon approval by the DEQ, this landfill closure plan (Phase 1) will be incorporated as an attachment to the permit via the permit modification process.

2. FACILITY DESCRIPTION

2.1 Site Description

The INL Site encompasses approximately 890 mi^2 on the Eastern Snake River Plain in southeastern Idaho, west of Idaho Falls. Within the laboratory complex are eight major applied engineering, interim storage, and research and development facilities. Established in 1949 as the National Reactor Testing Station, the INL continues to allow the U.S. Government to safely build, test, and operate various types of nuclear reactor facilities.

The INTEC facility is situated on the south-central portion of the INL Site (Figure 1) and occupies an enclosed and secured area of approximately 250 acres. Current work at the INTEC includes receiving and storing spent nuclear fuel, environmental restoration, radiological decontamination and decommissioning (D&D) activities, mixed waste treatment, and technology development (DOE-ID 1995).

Figure 1. Map of the INL Site.

2.2 CPP-601 Building Description and Operational History

The CPP-601 facility is rectangular (244 by 102 ft) and consists of five levels with the primary portion located below ground (see Figure 2). The top level is above grade and contains an open area that was utilized for transfer of the fuel elements to the process equipment and for chemical storage, makeup, and transfer. It is constructed of transite panels. The lower levels, constructed of steel-reinforced concrete, contain 25 process cells, corridors, and auxiliary cells that house various equipment and controls. Most of the floor, walls of each cell, and equipment are lined or comprised of stainless steel. Most of the processing equipment in the building, which was designed for remote operations, is enclosed in the heavily shielded cells that often utilized lead as a shielding material. A significant amount of lead shielding is encased in the concrete structures (floors and walls) of CPP-601.

The CPP-601 Fuel Reprocessing Facility at INTEC was used for reprocessing spent nuclear fuel for the purpose of recovering enriched uranium for reuse. The CPP-601 facility included separation, chemical makeup and transfer, and liquid waste receiving processes in the CPP-601 deep tanks waste collection system. The uranium processing mission for CPP-601 started in mid-1950 and was terminated in 1992. After that time, no more uranium was introduced into the processing system.

After the fuel processing ceased, extensive cleanup of the process equipment and cells was conducted. At the end of the last process campaigns (late 1980s and early 1990s), process equipment was flushed with dilute nitric acid and water to recover uranium for purposes of nuclear material accountability. Starting in 1993, process vessels and transfer lines were further flushed, once with nitric acid and three times with water, to remove possible HWMA/RCRA-regulated hazardous material. Starting in 1998, the first-cycle cells (E-, F-, G-, and H-cells, plus U-cell) were subjected to extensive chemical decontamination to lower radiation fields for hands-on maintenance.

Stainless steel was used to line most cell walls (to varying heights) and cell floors. The cell floors were flushed with water and were inspected with black light (ultraviolet illumination provides a very sensitive means of detecting small quantities of uranium by fluorescence) for any residual uranium. Process cell floors were sloped to drain to geometrically safe sumps located at the low point in each cell. The drains in these process cells led to the deep tanks. The drain piping from the process cells to the deep tanks were determined to have contained HWMA/RCRA-hazardous materials and, therefore, are subject to closure under this plan. The equipment and piping in the individual process cells have been determined to be process/product-related equipment and piping that was not a part of the tank waste system, and therefore, are not subject to closure under this plan.

Currently, decommissioning actions at CPP-601 preparatory to the NTCRA are being performed in accordance with *Action Memorandum for General Decommissioning Activities under the Idaho Cleanup Project* (DOE-ID 2006). These decommissioning preparatory activities include isolating utilities; removing chemicals, piping, and equipment; and routine waste management practices such as removing lead, polychlorinated biphenyls, and asbestos.

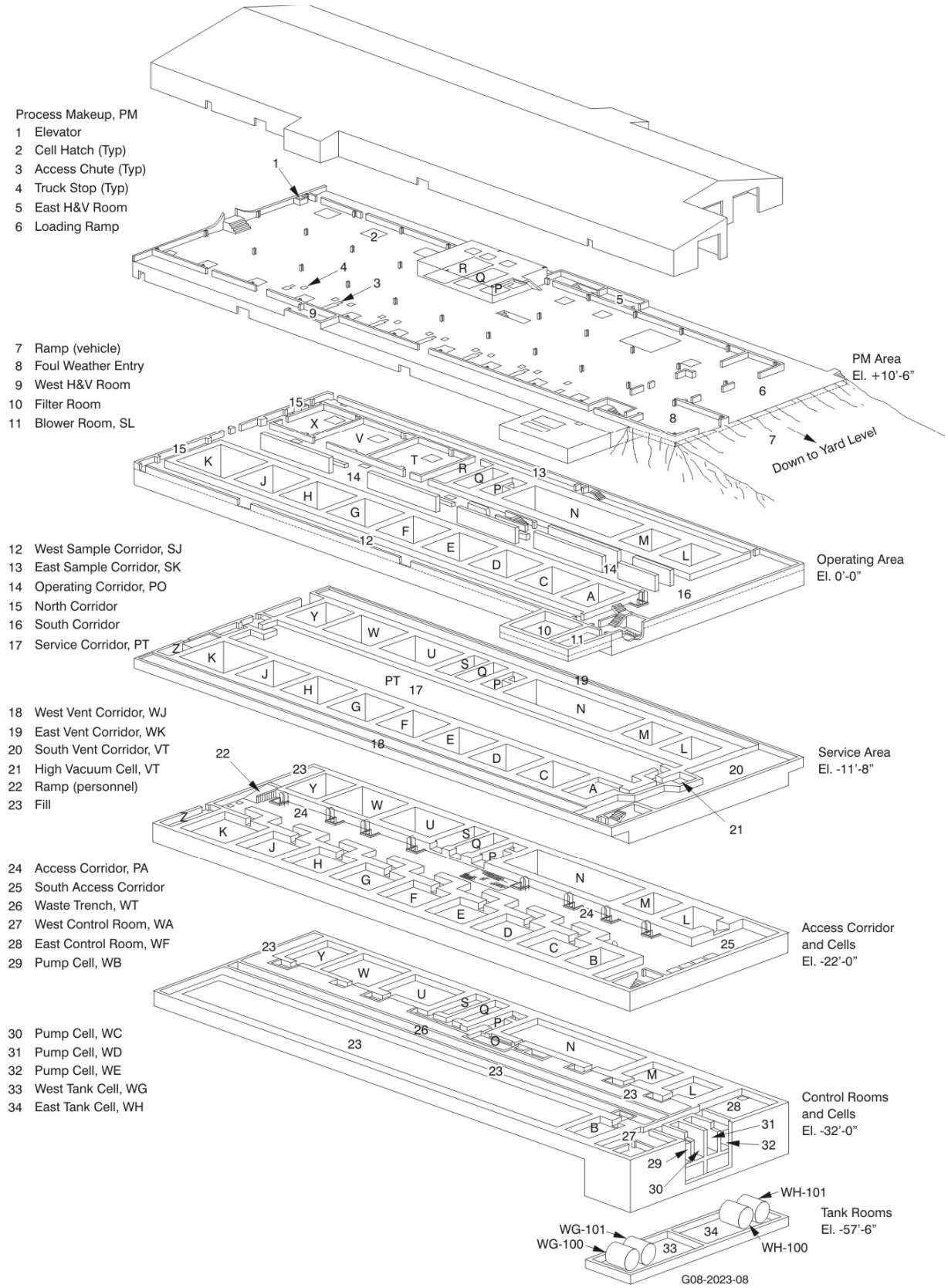

Figure 2. Isometric view of the Fuel Reprocessing Facility (CPP-601).

2.3 CPP-601 Deep Tanks System Description

The CPP-601 Deep Tanks System consists of four 4,500-gal capacity stainless steel tanks (VES-WG-100, VES-WG-101, VES-WH-100, and VES-WH-101), located in two concrete vaults at the lowest level of the building (see Figure 2), ancillary equipment, and piping (see Schematics P-CLOS-CPP-601-1 through -7 and Tables A-1 through -7 in Appendix A). The tanks collected liquid waste generated during fuel reprocessing from the CPP-601 separations processes. The drain piping from the process cells to the deep tanks was determined to have contained HWMA/RCRA-hazardous materials, and therefore, is subject to closure under this plan.

Over the 40 years of fuel reprocessing in CPP-601, modifications were made to the CPP-601 deep tanks waste collection system. The primary modification (1990–1991) was to replace portions of the original piping system, much of which was partially buried under CPP-601, with new piping that met the HWMA/RCRA requirements for a hazardous waste collection system (40 CFR 265.193). In most cases, the original (or pre-HWMA/RCRA) piping was isolated, taken out of service, and abandoned in place. Much of the abandoned CPP-601 deep tanks piping that is buried beneath the CPP-601 concrete structure is inaccessible without demolishing parts of the building structure.

Other sources that sent waste to these tanks included chemistry laboratories in CPP-602, CPP-627, and CPP-684 (see Figure 3). Process systems in CPP-627, CPP-640, and CPP-666 could also send waste to the deep tanks. While waste could be transferred from CPP-640 to CPP-601, no RCRA-regulated wastes were ever transferred through this connection. The line connecting CPP-666 to CPP-601 is being closed under the Voluntary Consent Order (VCO) Program and currently awaits certification. The laboratories and process systems in CPP-602, CPP-640, CPP-666, and CPP-684 have been or will be closed under separate closure actions with the exception of those segments of CPP-602 and CPP-684 discharge lines that directly connect with the CPP-601 system.

The CPP-627 Remote Analytical Facility was removed to grade as part of a NTCRA in 2005 in accordance with the *Action Memorandum for the Decontamination and Decommissioning of Building CPP-627, the Remote Analytical Facility* (DOE-ID 2004). This included removal and disposal of the active RCRA hazardous waste piping. The concrete slab at grade, covering inactive/abandoned lines, was capped with an engineered barrier to reduce infiltration. The inactive/abandoned lines that previously managed RCRA waste are included in the CPP-601/627/640 landfill closure.

The CPP-640 Headend Storage Tanks System has been HWMA/RCRA closed as of June 12, 2008 (Monson 2008). The VCO actions to close the transfer line from the Fluorinel Dissolution Process and Fuel Storage Facility (CPP-666) to CPP-601 and flush and close the raffinate lines from CPP-601 to the Tank Farm Facility (TFF) were completed under the *HWMA/RCRA Closure Plan for the CPP-601 Waste Transfer Lines to the Tank Farm Facility* (DOE-ID 2008c). Closure activities associated with these CPP-601 waste transfer lines will be completed after DEQ acceptance of a certified professional engineer closure certification for the system.

The INTEC analytical laboratory (CPP-602) and remote analytical laboratory (CPP-684) provide a full range of routine analytical capability including inorganic, organic, and radioanalytical analyses in support of process and waste characterization. The CPP-602 and CPP-684 laboratory waste piping from the laboratory hoods, sinks, and drains discharged to the CPP-601 deep tanks. These components were isolated and will be identified in the Volume 14 HWMA/RCRA permit (State of Idaho 2007) via a permit modification for closure at the time of the D&D of each facility.

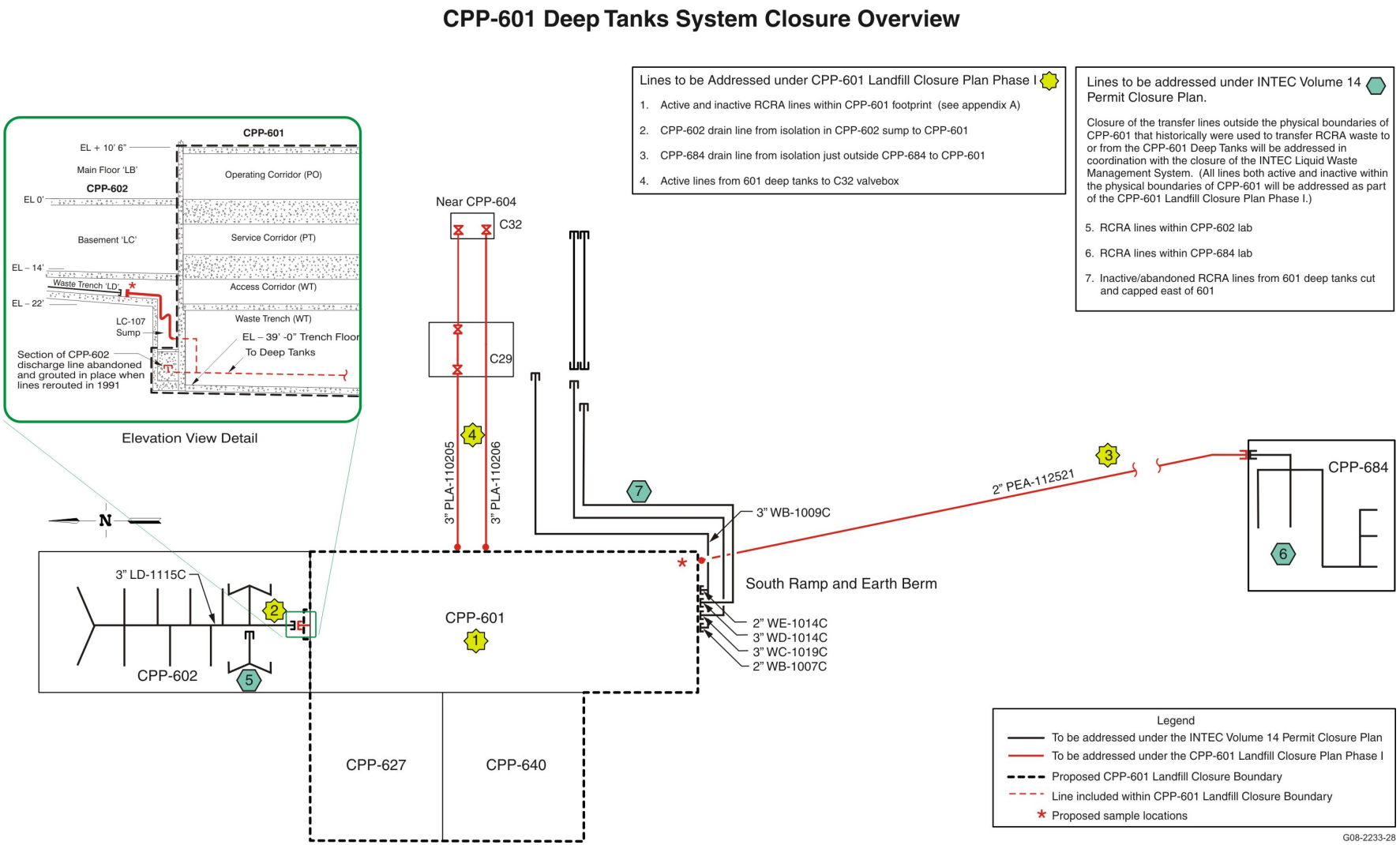

Figure 3. Location of the CPP-601 Deep Tanks System and proposed landfill boundaries.

The CPP-601 Deep Tanks System is included in the *Partial Permit for HWMA Storage and Treatment for the Liquid Waste Management System at the Idaho Nuclear Technology and Engineering Center on the Idaho National Laboratory* (State of Idaho 2007) and is permitted for tank storage and treatment of hazardous wastes. A general description and a detailed process description of the ILWMS (and associated subsystems, including the CPP-601 Deep Tanks System) are included in Attachment 1, Appendixes B and D, respectively, of the partial permit [State of Idaho 2007]).

2.4 RCRA/CERCLA Integration

An engineering evaluation/cost analysis (EE/CA) for decommissioning the Fuel Reprocessing Facilities (DOE-ID 2008a) was prepared to assist the U.S. Department of Energy (DOE) Idaho Operations Office with identifying the most effective approach for the final decommissioning of CPP-601/640, of which the mission has been completed. The process to accomplish this decommissioning and to determine the final end state for CPP-601/640 is to perform a NTCRA under CERCLA (42 USC 9601 et seq. 1980). The approach satisfies environmental review requirements and provides for stakeholder involvement while providing a framework for selecting the appropriate decommissioning alternative. The approach also establishes an administrative record for documentation of the removal action.

The selected NTCRA will place CPP-601/640 in a final configuration that will be protective of human health and the environment. The selected NTCRA will remove non-process areas including building components and the upper portion of the mechanical handling cave leaving the processing cells intact. The intact cells, process vessels, and lines will be decontaminated to remove the radiological and hazardous source terms as necessary to meet the remedial action objectives. Large void spaces without significant piping or vessels may be filled with grout or other inert material. The remaining void spaces within the buildings will be filled with flowable grout to minimize void spaces leaving a grouted monolith approximately 11 ft above grade in most areas, roughly similar to the Waste Calcining Facility. The top surface of the monolith will be sloped to facilitate integration of precipitation control with the operable unit (OU) 3-14 remedial action to the extent practical wherein the collected precipitation will be directed toward lined ditches, which will divert the water to evaporation ponds. The concrete monolith will require routine maintenance, monitoring, and other institutional controls to ensure that future environmental and worker risk remains acceptable until such time as the earthen cap is installed to complete the NTCRA in approximately 2035 when the remaining INTEC facilities have ceased operations.

Decommissioning of the CPP-601/640 facilities is consistent with the joint DOE and U.S. Environmental Protection Agency (EPA) *Policy on Decommissioning of Department of Energy Facilities under the Comprehensive Environmental Response, Compensation, and Liability Act* (DOE and EPA 1995), which establishes the CERCLA NTCRA process as the preferred approach for decommissioning surplus DOE facilities.

Under this policy, a NTCRA may be taken when DOE determines that the action will prevent, minimize, stabilize, or eliminate a risk to human health and/or the environment. When it is determined that a CERCLA NTCRA is necessary, DOE is authorized to evaluate, select, and implement the removal action that DOE determines is most appropriate to address the potential risk posed by the release or threat of release. This action is taken in accordance with applicable authorities and in conjunction with EPA and the State of Idaho pursuant to Subsection 5.3 of the *Federal Facility Agreement and Consent Order for the Idaho National Engineering Laboratory and Action Plan* (DOE-ID 1991).

The CERCLA remedial actions adjacent to CPP-601/627/640 have occurred or will occur in accordance with the records of decision (RODs) (DOE-ID 1999, 2007a) for OUs 3-13 and 3-14. The primary CERCLA remedial action that will interface with the CPP-601/627/640 buildings is the TFF soil and INTEC groundwater remedial action (OU 3-14). The industrial-use area established by the OU 3-14 ROD encompasses the CPP-601/627/640 buildings. Coordination with the OU 3-14 remedial actions will be required to minimize the precipitation infiltration within the recharge control zone (immediately east of CPP-601) that is located within the industrial-use area.

There have been seven release points identified beneath CPP-601, but no releases have been identified beneath CPP-627/640. These releases are described in the Engineering Design File (EDF) -8192, "Nonradiological Material Inventory for CPP-601 and CPP-640," and EDF-8293, "Radioactive Material Inventory for the CPP-601/640 Fuel Reprocessing Complex Engineering Evaluation/Cost Analysis." The releases were mainly acidic liquids primarily contaminated with radionuclides and metals from the dissolution of spent fuel. As part of the CERCLA process, New Site Identification forms were completed and submitted to the CERCLA agencies. The OU 3-13 ROD (DOE-ID 1999) initially determined that release point CPP-80 would be addressed as part of the Group 2 soils. The OU 3-14 ROD (DOE-ID 2007a) dispositioned the other six releases beneath CPP-601 (CPP-118, -119, -120, -121, -122, and -123) to the OU 3-13 Group 2 sites. The OU 3-14 ROD states that the release sites beneath CPP-601 will be addressed under OU 3-13 in accordance with the process identified in the *Operable Unit 3-13 Group 2 Closure Evaluation Criteria and Checklist* (DOE-ID 2000) using the OU 3-14 remediation goals for soil in the industrial use area. The EE/CA for decommissioning the CPP-601/640 fuel reprocessing facilities included these releases in its evaluation of the potential risk and dose to the public from the various NTCRA alternatives. The alternative selected meets the appropriate risk and dose requirements while in addition further reducing the potential risk and dose to the public by placing the buildings in a stable configuration by filling them with grout or other inert material to be followed by the earthen cap as the final action taken under the CERCLA NTCRA in approximately 2035.

3. MAXIMUM WASTE INVENTORIES AND CHARACTERISTICS

3.1 CPP-601 Deep Tanks Waste Inventory

Maximum waste inventory and waste characteristics for the CPP-601 deep tanks (VES-WG-100, VES-WG-101, VES-WH-100, and VES-WH-101), as required per 40 CFR 264.112(b)(3), are provided in the Volume 14 permit (State of Idaho 2007). The maximum waste inventory for the CPP-601 Deep Tanks System (including the gravity-drained discharge piping from CPP-602, CPP-627, CPP-640, CPP-666, and CPP-684) would not have exceeded the capacity of the four deep tanks, which is 18,000 gal.

The CPP-601 tank system is permitted to manage the following wastes and associated EPA hazardous waste numbers:

- Wastes exhibiting the characteristic of ignitability (D001)
- Wastes exhibiting the characteristic of corrosivity (D002)
- Wastes exhibiting the toxicity characteristic for arsenic (D004), barium (D005), cadmium (D006), chromium (D007), lead (D008), mercury (D009), selenium (D010), silver (D011), benzene (D018), carbon tetrachloride (D019), chlorobenzene (D021), chloroform (D022), cresol (D026), 1,2-dichloroethane (D028), hexachlorobenzene (D032), hexachloroethane (D034), methyl ethyl ketone (D035) nitrobenzene (D036), pyridine (D038), tetrachloroethylene (D039), or trichloroethylene (D040)
- Spent halogenated and non-halogenated solvent wastes assigned EPA-listed hazardous waste numbers F001, F002, F003, or F005
- Discarded commercial chemical products, off-specification species, container residues, and spill residues assigned EPA-listed hazardous waste number U134.

3.2 System Boundaries

3.2.1 Tank System Boundaries

The CPP-601 Deep Tanks System includes four tanks (VES-WG-100, VES-WG-101, VES-WH-100, and VES-WH-101) and associated ancillary piping and equipment. The four tanks, ancillary equipment, and piping are located in the CPP-601 tank vaults, pump vault, waste trench, service corridor, vent corridors, and process cells (see Schematics P-CLOS-CPP-601-1 through -8 and Tables A-1 through -8 in Appendix A). Closure boundaries were determined by reviewing the partial permit for the ILWMS (State of Idaho 2007), piping and instrumentation diagrams, and other relevant documents, as well as interviewing cognizant INL personnel.

3.2.2 Equipment Addressed under this Closure Plan

The following tank system components are addressed in Phase 1 of the CPP-601 landfill closure:

- **CPP-601 Deep Tanks, Ancillary Equipment, and Discharge Piping and Secondary Containment.** Tanks, piping, ancillary equipment, and secondary containment structures associated with the CPP-601 tank system included in this closure plan are shown in Schematics P-CLOS-CPP-601-1 through -8 and Tables A-1 through -8 in Appendix A.

3.2.3 Equipment Not Addressed under this Closure Plan

The following tank system components are not addressed in this landfill closure:

- **VCO Components in CPP-601.** The CPP-601 components previously addressed under closure by the VCO Program.

- **CPP-601 Process/Product Equipment.** The vessels, ancillary equipment, and piping in the CPP-601 fuel reprocessing cells are considered process/product components and were emptied using common industrial practices. The materials/liquids processed through the cells were considered product until they were disposed of via the cell sumps and sump discharge lines; therefore, the CPP-601 cell closure boundaries are determined to be the cell sumps and sump discharge lines. Based on historical and process knowledge, two exceptions are the K-cell floor liner and the discharge line from vessels F-107 and F-108 in the F-cell (see Schematic P-CLOS-CPP-601-5 in Appendix A).

- **CPP-602 and CPP-684 Laboratory Drain Lines and Structures.** The CPP-602 and CPP-684 laboratory drain lines will be transferred to an applicable HMWA/RCRA permit and closed when the CPP-602 and CPP-684 buildings undergo D&D.

- **Abandoned Lines Outside the Physical Boundaries of CPP-601/627/640.** Abandoned waste discharge lines to the Process Equipment Waste Evaporator (PEWE) that are outside the CPP-601/627/640 landfill boundary will be included in a future closure plan, or other regulatory actions addressing abandoned and inactive ILWMS lines.

- **Vent, Instrument, Steam, and Air Lines Associated with the Tank System.** These lines did not manage hazardous waste and are not addressed in this closure.

3.2.4 Landfill Boundaries

The CPP-601 and CPP-640 facilities are both included within the landfill boundaries as both facilities are being decommissioned together under one CERCLA NTCRA. These facilities along with CPP-627 will be part of the same concrete monolith, and will be covered by the same earthen cover when the NTCRA is complete. The boundaries of the landfill have been developed to encompass the components of the tank system defined above as well as the entire footprint of the CPP-601, CPP-627, and 640 buildings which share common walls and utilities. The landfill does not include the CPP-602 laboratory, which is adjacent to the CPP-601/627/640 buildings but is subject to separate closure action. The full extent of the landfill boundary is provided on Figure 3. Portions of lines 2” PLA-110205, 2” PLA-110206, 3” LD-1115C, and 2” PEA-112521, while included in this landfill closure plan, are not included within the landfill boundaries because they are outside the physical boundaries of CPP-601/627/640 and will be clean closed.

4. CLOSURE PERFORMANCE STANDARDS

This section describes the performance standards for clean closure of the CPP-601 Deep Tanks System components under IDAPA 58.01.05.008 and 40 CFR 264.111 and 264.197, and the performance standards for landfill closure under IDAPA 58.01.05.008 and 40 CFR 264.111 and 264.310 for the remaining components, and the activities that will be conducted to demonstrate that the closure and landfill closure performance standards have been met as established in this closure plan.

4.1 Regulatory Closure Performance Standards

The closure performance standards identified in IDAPA 58.01.05.008 (40 CFR 264.111 and 264.197) applicable to the CPP-601 Deep Tanks System closure are:

1. The owner or operator must close the facility in a manner that minimizes the need for further maintenance (IDAPA 58.01.05.008 [40 CFR 264.111(a)]).

2. The owner or operator must close the facility in a manner that controls, minimizes, or eliminates to the extent necessary to protect human health and the environment, post-closure escape of hazardous waste, hazardous constituents, leachate, contaminated runoff, or hazardous waste decomposition products to the ground or surface waters or to the atmosphere (IDAPA 58.01.05.008 [40 CFR 264.111(b)]).

3. The owner or operator must close the facility in a manner that complies with the closure requirements of this subpart, including, but not limited to, the requirements of 40 CFR 264.197, 264.228, 264.258, 264.280, 264.310, 264.351, and 264.1102 (IDAPA 58.01.05.008 [40 CFR 264.111(c)]).

4.2 Required Activities for Achieving Closure Performance Standards

The CPP-601 Deep Tanks System closure and waste management activities to be conducted under HWMA/RCRA landfill closure are described in detail in Section 5 of this closure plan. The closure performance standards will be achieved as described in the following subsections.

4.2.1 Standard 1

The owner or operator must close the facility in a manner that minimizes the need for further maintenance (IDAPA 58.01.05.008 [40 CFR 264.111(a)]).

This closure performance standard will be achieved by the following measures:

- Residual hazardous waste inventory will be removed and disposed of to meet RCRA standards

- Tank system components outside the physical boundaries of CPP-601/627/640 undergoing HWMA/RCRA closure will be decontaminated to the site-specific ALs specified in this HWMA/RCRA closure plan or removed

- Isolation of the CPP-601 system will prevent future accumulation of hazardous wastes

- Components within the physical boundaries of CPP-601/627/640 (including both active and inactive systems) will not be clean closed. These components are identified in Schematics P-CLOS-CPP-601-1 through -8 and Tables A-1 through -8 in Appendix A. These components will be rinsed and/or drained to the extent practicable to remove liquid waste and waste residue.

4.2.2 Standard 2

The owner or operator must close the facility in a manner that controls, minimizes, or eliminates to the extent necessary to protect human health and the environment, post-closure escape of hazardous waste, hazardous constituents, leachate, contaminated runoff, or hazardous waste decomposition products to the ground or surface waters or to the atmosphere (IDAPA 58.01.05.008 [40 CFR 264.111(b)]).

This closure performance standard will be achieved by the following measures:

- Residual hazardous waste inventory will be removed and disposed of to meet RCRA standards

- Tank system components outside the physical boundaries of CPP-601/627/640 undergoing HWMA/RCRA closure will be decontaminated to the site-specific ALs specified in this HWMA/RCRA closure plan or removed

- Isolation of the CPP-601 system will prevent future accumulation of hazardous wastes

- Components within the physical boundaries of CPP/601/627/640 (including both active and inactive systems) will not be clean closed. These components are identified in Schematics P-CLOS-CPP-601-1 through -8 and Tables A-1 through -8 in Appendix A. These components will be rinsed and/or drained to the extent practicable to remove liquid waste and waste residue.

4.2.3 Standard 3

At closure of a tank system, the owner or operator must remove or decontaminate all waste residues, contaminated containment system components (liners, etc.), contaminated soils, and structures and equipment contaminated with waste, and manage them as hazardous waste, unless §261.3(d) of this Chapter (CFR Title 40) applies. The closure plan, closure activities, cost estimates for closure, and financial responsibility for the tank systems must meet all of the requirements specified in subparts G and H of this part (IDAPA 58.01.05.008 [40 CFR 264.197(a) and (b)]).

This closure performance standard will be achieved by the following measures:

- Residual hazardous waste inventory will be removed and disposed of to meet RCRA standards.

- Tank system components outside the physical boundaries of CPP-601/627/640 undergoing HWMA/RCRA closure will be decontaminated to the site-specific ALs specified in this HWMA/RCRA closure plan or removed.

- Isolation of the CPP-601 system will prevent future accumulation of hazardous wastes.

- Components within the physical boundaries of CPP-601/627/640 (including both active and inactive systems) will not be clean closed. These components are identified in Schematics P-CLOS-CPP-601-1 through -8 and Tables A-1 through -8 in Appendix A. These components will be rinsed and/or drained to the extent practicable to remove liquid waste and waste residue.

- Contaminated soils associated with CPP-601/627/640 will be addressed as part of the NTCRA/D&D of the buildings. Newly identified sites beneath the building will be addressed under the INL CERCLA program.

5. CLOSURE ACTIVITIES

5.1 Tank System Landfill Closure Phase 1 Activities

This closure plan describes the methods for closing the CPP-601 Deep Tanks System per the tank system closure performance standard requirements of IDAPA 58.01.05.008 (40 CFR 264, Subparts G and J). The approach for clean closure of the CPP-601 Deep Tanks System components outside the physical boundaries of CPP-601/640 will be decontamination to the site-specific ALs specified in Table 1 of this HWMA/RCRA closure plan, or removal and disposal. The approach for closure of the CPP-601 Deep Tanks System components physically located within the CPP-601/627/640 boundaries and included in the CPP-601 landfill will be to flush/drain and isolate the components to minimize the potential for release of RCRA contaminants and to meet the requirements in 40 CFR 264.111(a) and (b) by minimizing the liquid waste and waste residues in the remaining tank system and isolating the facility from all waste discharge systems. The following subsections describe closure activities, waste management activities, and required closure documentation to satisfy the tank system closure and landfill closure performance standards for those units and associated ancillary equipment for which closure activities will be performed, as identified in Subsection 4.2.

5.2 Identification and Removal of Hazardous Waste

No specific waste removal activities are anticipated to be necessary as part of closure activities. If bulk solids are identified, the solids will not be removed, but will be sampled and will be included as part of the CPP-601 landfill. The tanks will be emptied of liquids to the maximum extent practicable by the existing transfer pumps.

Tanks VES-WG-100, VES-WG-101, VES-WH-100, and VES-WH-101 and associated ancillary piping and equipment, and secondary containment structures for which landfill closure activities will be conducted (see Schematics P-CLOS-CPP-601-1 through -8 in Appendix A) will be flushed and/or drained to the extent possible to remove the presence of HWMA/RCRA contaminants. The tank system was designed to manage aqueous solutions and primarily managed aqueous decontamination solutions, aqueous laboratory wastes, and water infiltration; therefore, water is an appropriate flushing/rinsing agent for the tank system. A minimum of three line volumes will be used to flush the ancillary piping. The solutions from flushing efforts will be collected in the deep tanks and sampled to determine the level of HMWA/RCRA constituents and characterization of remaining waste in the CPP-601 system components.

Waste and/or waste residues to be left in place in the landfill, including the CPP-627 abandoned piping, will be characterized as required by 40 CFR 264.309. Samples generated during tank system closure and landfill closure activities will provide characterization data for the waste residuals contained within the system. During decontamination of the tank system under this closure plan, rinsate samples will be collected to demonstrate compliance with the contaminant of concern-specific ALs. The rinsate sample results will be used, where applicable, to document the nature and extent of waste and/or waste residues left in place.

5.3 Decontamination Activities

The CPP-601 waste lines to be closed under HWMA/RCRA by iterative decontamination are lines 2” PLA-110205, 2” PLA-110206, 3” LD-1115C, and 2” PEA-112521, detailed on Schematics P-CLOS-CPP-601-2, -6, and -7 in Appendix A, which are outside the physical boundaries of CPP-601/640. Compliance with the closure performance standards will be demonstrated by sampling the final rinsate solution from the decontamination efforts and comparing the resulting analytical data with

the site-specific ALs provided in Table 1. The final rinsate solutions from decontamination efforts will be collected in accordance with the "Sampling Procedure for HWMA/RCRA Closure of the CPP-601 Deep Tanks System" (SPR-185). In lieu of decontamination, any line subject to decontamination may be removed and disposed of per HMWA/RCRA regulations. If rinsates from a pipe do not meet the site-specific ALs provided in Table 1, and the pipe is not removed, the closure of that pipe will be addressed in appropriate closure plan for either the CPP-602 or CPP-684 laboratory or the ILWMS.

The tank system was designed to manage aqueous solutions and primarily managed aqueous decontamination solutions, aqueous laboratory wastes, and water infiltration; therefore, water is an appropriate decontamination agent for the tank system. The final rinsate solutions from 3" LD-1115C and 2" PEA-112521 which are lines that conveyed waste from CPP-602 and CPP-684 to the CPP-601 will be sampled near where these lines enter CPP-601. Alternative sample locations may be used, in which case the location of the sample event and the system components undergoing decontamination will be recorded and documentation provided for the Phase 1 closure certification.

There is no practical means of safely collecting rinsate samples from the two discharge lines (2" PLA-110205 and 2" PLA-110206), which convey waste from CPP-601 to the Process Equipment Waste Evaporator system. The most convenient location would be the C-32 valve box; however, the C-32 valve box presents a high radiological exposure environment, as well as a cramped work space with minimal access in and around the pipes to be sampled. Meeting the closure performance standards for these lines will be based upon the aqueous nature of the waste that has passed through these lines; the lines 2" PLA-110205, 2" PLA-110206, 3" LD-1115C, and 2" PEA-112521 are all stainless steel lines that discharge similar wastes; that the lines 3" LD-1115C and 2" PEA-112521 can be successfully clean closed by flushing with waste; and that the lines 2" PLA-110205 and 2" PLA-110206 will meet the flushing schedule used to clean close lines 3" LD-1115C and 2" PEA-112521 as well as additional final flushes of a minimum of 20 line volumes of clean water after completing transfers of all other pumpable waste from the system.

The list of contaminants of concern (COCs) was developed based on COCs identified in the closure plan for CPP-641 Westside Waste Holdup Tanks System (DOE-ID 2007b), the closure plan for the CPP-601 waste transfer lines to the TFF (DOE-ID 2008d), *Partial Permit for HWMA Storage and Treatment for the Liquid Waste Management System at the Idaho Nuclear Technology and Engineering Center on the Idaho National Laboratory* (State of Idaho 2007), and COCs identified in *A Regulatory Analysis and Reassessment of U.S. Environmental Protection Agency Listed Hazardous Waste Numbers for Applicability to the INTEC Liquid Waste System* (INEEL 1999).

The ALs were developed by defining the acceptable excess cancer risk and hazard quotient thresholds, and calculating corresponding ALs based upon these risk and hazard thresholds. These ALs were developed to ensure that the units and ancillary equipment, subsequent to completion of closure activities, will be left in a state that is protective of human health and the environment. Because of the wide nature of COCs (metals, semivolatile organic compounds, and volatile organic compounds), final rinsate samples will be analyzed for EPA Contract Laboratory Program metals, semivolatile organic compounds via EPA SW-846 Method 8270C (or equivalent), volatile organic compounds via EPA SW-846 Method 8260B (or equivalent), and hydrogen fluoride via EPA SW-846 Method 9056 (or equivalent) (EPA 2008). If additional HWMA/RCRA COCs are identified during closure, ALs may be revised, as necessary, to account for these additional COCs.

Liquids will be removed to the extent practical using the existing transfer equipment, but some liquids may remain within the CPP-601 Deep Tanks System at the completion of closure. Liquids in the CPP-601 deep tanks will be rendered non-liquid in accordance with this closure plan.

Table 1. Contaminants of concern and corresponding site-specific AL.

COC	Action Level (mg/L rinsate)	COC	Action Level (mg/L rinsate)
Antimony	2.8E+01	Chloromethane	2.8E+01
Arsenic	6.1E–01	Cresol	2.8E+01
Barium	2.8E+01	Cyclohexanone	2.8E+01
Beryllium	2.8E+01	1,2-Dichloroethane	3.0E–01
Cadmium	6.0E–01	Ethyl acetate	2.8E+01
Chromium	3.0E+00	Ethylbenzene	2.8E+01
Lead	3.0E+00	Hexachlorobenzene	7.8E–02
Mercury	1.2E–01	Hexachloroethane	6.1E–01
Nickel	2.8E+01	Hydrogen Fluoride	2.8E+01
Selenium	6.0E–01	Methanol	2.8E+01
Silver	3.0E+00	4-Methyl-2-Pentanone (MIBK)	2.8E+01
Thallium	2.8E+01	Methylene chloride	6.1E–01
Vanadium	2.8E+01	n-nitro-di-n-butylamine	5.8E–02
Zinc	2.8E+01	Nitrobenzene	1.2E+00
Acetone	2.8E+01	Phenol	2.8E+01
Benzene	3.0E–01	Pyridine	3.0E+00
Bis(2-ethylhexyl) phthalate	6.1E–01	Tetrachloroethylene	4.2E–01
Bromomethane	1.3E+01	Toluene	2.8E+01
2-Butanone (MEK)	2.8E+01	1,1,1-Trichloroethane	2.8E+01
Carbon Disulfide	2.8E+01	Trichlorofluoromethane	2.8E+01
Carbon Tetrachloride	3.0E–01	Trichloroethylene	3.0E–01
Chlorobenzene	2.8E+01	Xylenes	2.8E+01
Chloroform	3.6E+00	Aroclor-1260	6.1E–01

5.4 CPP-601 Tank System Isolation

To minimize the need for further maintenance and control the post-closure escape of hazardous waste and/or waste residues, as stipulated by 40 CFR 264.111(a) and (b), respectively, the CPP-601/627/640 deep tanks components included in the landfill area will be completely isolated from CPP-602, CPP-666, and CPP-684, and ILWMS wastewater handling systems before certification of closure as a landfill.

Isolation of the system will include line 2” PEA-112521 from CPP-684 (see Schematic P-CLOS-CPP-601-2), line 1” PE-AF-128433 from CPP-666 (see Schematic P-CLOS-CPP-601-2), line 3” LD-1115C from CPP-602 (see Schematic P-CLOS-CPP-601-6), and lines 3” PLA-110205 and 3” PLA-110206 to CPP-604 (via valve box DVB-WM-PW-C32; see Schematic P-CLOS-CPP-601-7).

5.5 Waste Management

All waste generated within CPP-601/627/640 will be managed as CERCLA waste in accordance with the *Action Memorandum for Decommissioning CPP-601/640 Fuel Reprocessing Facilities CPP-601/640* (DOE/ID 2008d). All closure-derived waste generated during the landfill closure of CPP-601/627/640 will undergo a hazardous waste determination and if hazardous will be managed in substantive compliance with the applicable HWMA/RCRA regulations. As an example, closure-derived hazardous waste will not be subjected to the HWMA/RCRA 90-day storage limit under 40 CFR 262. Closure-derived waste may be subject to generator treatment, debris treatment, or packaging activities. Closure-derived waste determined to be hazardous will be transferred to a RCRA-permitted treatment, storage, and disposal facility for ultimate disposition.

5.6 Closure Documentation

Closure methods and attainment of the closure and landfill closure performance standards for the CPP-601/627/640 landfill closure will be documented by performing the following:

- Closure activities will be monitored and reviewed by a registered professional engineer. Following successful completion of the landfill closure activities, the professional engineer will certify that closure was performed in accordance with the approved closure plan.

- Information related to successful implementation of closure activities, including but not limited to sample collection, analytical data, and management of closure-derived waste will be recorded or documented, and provided to the professional engineer, as requested, to support closure certification.

6. PHASE 1 LANDFILL CLOSURE SCHEDULE

Table 2 identifies the closure schedule that will be initiated following DEQ approval of this closure plan. This schedule reflects the time required for conducting closure activities and submitting information to the registered professional engineer for certification. IDAPA 58.01.05.008 (40 CFR 264.113) requires waste removal activities to be completed 90 days from the approval of the closure plan and closure to be completed within 180 days from the initiation of closure activities. An extension to these time periods is being requested at this time, pursuant to IDAPA 58.01.05.008 (40 CFR 264.113), to ensure that data of adequate quality are collected to show compliance with the closure performance standard. An extension is requested for the 180-day closure period to protect human health and the environment and to adequately perform closure activities. Waste removal, decontamination, and closure activities cannot be completed within these timeframes due to several factors including, but not limited to, the following:

- The need to provide radiological contamination controls to prevent the possible spread of contamination
- All work related to management of radioactive mixed waste requires additional time due to the requirements for care in work planning, including radiological work permits
- Pipe flushing and decontamination activities and other closure activities will require coordination with ongoing CPP-602 and CPP-684 operations, CPP-601 deep tank closure activities, and ILWMS operations
- The time necessary for the analytical laboratories to complete analysis of samples and data validation, receive analytical results, and complete data quality assessment, as specified in the sampling procedure associated with this closure plan (SPR-185), to determine if the closure performance standards have been met.

Table 2. Phase 1 Landfill closure schedule.

Planned Work Tasks	Day of Completion
DEQ approval of phase landfill closure plan	Day 0
Rinse, flush, and drain components to be included in CPP-601/627/640 landfill	Day 180
Complete decontamination and closure certification sampling of external CPP-601/627/640 lines	Day 270
Complete isolate of components to be included in CPP-601/627/640 landfill	Day 360
Closure activities complete	Day 420
Professional engineer and owner/operator certification submitted	Day 480[a,b]

a. If closure activities are completed ahead of the proposed schedule, closure certification will be submitted to DEQ within 60 days of the completion of closure activities.

b. A post-closure plan will be submitted commensurate with the closure certification.

7. CLOSURE PLAN AMENDMENTS

The conditions described in IDAPA 58.01.05.008 (40 CFR 264.112), "Closure Plan; Amendment of Plan," will be followed to implement changes to the approved closure plan. Should unexpected events during the closure period require modification of the approved closure activities, the closure plan will be amended within 30 days of the unexpected event or the DEQ will be otherwise notified. Should decontamination or removal activities for a component outside the landfill boundary but inside the tank system boundary prove impracticable, the closure plan may be amended to revise the system boundaries to exclude the component. Should any amendment become necessary, a written request detailing the proposed changes and the rationale for those changes and a copy of the amended closure plan will be submitted to DEQ for approval. Minor changes to the approved closure plan, which are equivalent to, or do not compromise the closure requirements and performance standards identified in the approved closure plan, may be made without prior notification to DEQ. Minor changes will be identified in the documentation supporting the independent professional engineer's certification.

8. CERTIFICATION OF CLOSURE FOR PHASE 1

Within 60 days of completing the closure activities, a certification of Phase 1 of the CPP-601 landfill closure will be provided to the DEQ, in accordance with IDAPA 58.01.05.008 (40 CFR 264.115), by an Idaho-registered professional engineer. The professional engineer and owner/operator signatures on the closure certification, which is submitted to the DEQ, will document the completion of closure activities in accordance with the approved landfill closure plan and State of Idaho HWMA/RCRA requirements. The closure certification may also identify any minor changes to the closure plan made without prior approval of the DEQ. The Phase 1 closure of these units will be considered complete upon receipt of written acceptance issued by the DEQ. Copies of documentation supporting the closure of the CPP-601 system will remain in the INTEC project files in the event that additional information is requested by DEQ.

9. COST AND LIABILITY REQUIREMENTS

The federal government, as owner of the INL Site, is exempt from the requirements to provide cost estimates for closure, to provide a financial assurance mechanism for closure, and regarding state-required mechanism and state assumption of responsibility per IDAPA 58.01.05.008 [40 CFR 264.140(c)]. The federal government, as owner of the INL Site, is also exempt from liability requirements.

10. REFERENCES

40 CFR 261, "Identification and Listing of Hazardous Waste," *Code of Federal Regulations*, Office of the Federal Register, as amended.

40 CFR 262, "Standards Applicable to Generators of Hazardous Waste," *Code of Federal Regulations*, Office of the Federal Register, as amended.

40 CFR 264, "Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities," *Code of Federal Regulations*, Office of the Federal Register, as amended.

40 CFR 265, "Interim Status Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities," *Code of Federal Regulations*, Office of the Federal Register, as amended.

42 USC 6901 et seq., 1976, "Resource Conservation and Recovery Act of 1976," as amended.

42 USC 9601 et seq., "Comprehensive Environmental Response, Compensation, and Liability Act of 1980," (CERCLA).

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EDF-8293, 2007, "Radioactive Material Inventory for the CPP-601/640 Fuel Reprocessing Complex Engineering Evaluation/Cost Analysis," Rev. 1, Idaho National Laboratory, Idaho Cleanup Project, September 2007.

EPA, 2008, *Test Methods for Evaluating Solid Waste: Physical/Chemical Methods,* SW-846, 3rd Edition, U.S. Environmental Protection Agency, Office of Solid Waste and Emergency Response, http://www.epa.gov/epaoswer/hazwaste/test/main.htm, Web page updated January 7, 2008, Web page visited May 14, 2008.

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Appendix A

Schematics and Line Tables

Appendix A

Schematics and Line Tables

Appendix A includes line tables and schematics identifying the CPP-601 Deep Tanks System components that are included as part of this landfill closure. Tables A-1 through -8 list the system boundaries for the CPP-601 Deep Tanks System and Schematics P-CLOS-CPP-601-1 through -8 are piping diagrams for the CPP-601 Deep Tanks System.

Table A-1. CPP-601 system boundaries for the vent tunnel.

Line Identification Number	Start Point	End Point	Comments
East Vent Header			
3” SK-AR-1076	East Vent North Sample Corridor Drain	3” PE-AR-151880	SHEET 1 (A-2)
1/2” AA-AR-151853	OTA Vent	3” PE-AR-151880	SHEET 1 (A-2)
3” SK-AR-1077	East Vent Middle Sample Corridor Drain	3” PE-AR-151880	SHEET 1 (A-4)
3” SK-AR-1078	East Vent South Sample Corridor Drain	3” PE-AR-151880	SHEET 1 (A-6)
3” PE-AR-151880	Blind Flange ahead of 1/2” AA-AR-151853	3” PW-AR-151713	SHEET 1 (A-2)
1” PVT-11651C	VES-VT-103	3” PW-AR-151713	SHEET 1 (A-7)
1” PWA-202	RCV-VT-1	3” PW-AR-151713	SHEET 1 (A-7)
3” SJ-AR-1070	West Vent South Sample Corridor Drain	3” PE-AR-151890	SHEET 1 (C-6)
3” SJ-AR-1069	West Vent Middle Sample Corridor Drain	3” PE-AR-151890	SHEET 1 (C-4)
3” SJ-AR-1068	West Vent North Sample Corridor Drain	3” PE-AR-151890	SHEET 1 (C-2)
1/2” AA-AR-151852	OTA Vent	3” PE-AR-151890	SHEET 1 (C-2)

Table A-2. CPP-601 system boundaries for the service corridor.

Line Identification Number	Start Point	End Point	Comments
3” PPM-40016C	Standpipe on Roof	3” PE-AR-151787	Sheet 2 (A-2)
3/4” LAA-110218	JV-22	1” LAA-110218	Sheet 2 (A-3)
1” LAA-110218	3/4” LAA-110218	1” LSU-O-4002H	Sheet 2 (B-3)
1” LSU-O-4002H	1” LAA-110218	1 1/2” LSU-O-4001H	Sheet 2 (B-3)
2” LSU-O-4003H	*UVS2-1	1 1/2” LSU-O-4001H	Sheet 2 (B-3)
1/2” LSU-O-4004H	*UVS2-2	1 1/2” LSU-O-4001H	Sheet 2 (B-3)
3/4” LSU-O-4005H	JV-18	1 1/2” LSU-O-4001H	Sheet 2 (B-3)
*ULS2-1	UVV-PO-3	1 1/2” LSU-O-4001H	Sheet 2 (B-4)
1/2” LSU-O-4006H	*UVS2-3	1 1/2” LSU-O-4001H	Sheet 2 (B-4)
1 1/2” LSU-AR-4007	1 1/2” LSU-O-4001H	3” PE-AR-151787	Sheet 2 (B-3)
2” PWA-206	Drip Pan	2” PWA-207	Sheet 2 (A-2)
1” PQ-50311Y	Drip Pan	1” PQ-6081Y	Sheet 2 (A-4)
1” PQ-6081Y	1” PQ-50311Y	1” TQ-6083Y	Sheet 2 (A-4)
1” TQ-6083Y	1” PQ-6081Y	1” TQ-6083Y	Sheet 2 (A-4)
3/4” PQ-60812Y	Loadout Door Drain	1” PS-50813Y	Sheet 2 (A-4)
1” PS-50813Y	Drip Pan	1” PQ-6081Y	Sheet 2 (A-5)
3/4” PP-60914Y	Loadout Door Drain	1” PP-60915Y	Sheet 2 (A-6)
1” PP-60915Y	Drip Pan	1” TP-60917Y	Sheet 2 (A-5)
3/4” PC-2091Y	Hot Sink Drain	2” PL-AR-113573	Sheet 2 (A-7)
2” PL-AR-113573	3/4” PC-2091Y	1 1/2” PE-AR-151820	Sheet 2 (A-7)
1” PE-AR-151802	Sump SU-PT-101	JET-PT-503	Sheet 2 (C-6)
1” PE-AR-151790	JET-PT-503	3” PE-AR-151787	Sheet 2 (C-6)
1” PE-AR-151803	Sump SU-PT-102	JET-PT-504	Sheet 2 (C-4)
1” PE-AR-151794	JET-PT-504	3” PE-AR-151787	Sheet 2 (C-4)
1” PE-AR-151804	Sump SU-PT-103	JET-PT-505	Sheet 2 (C-3)
1” PE-AR-151800	JET-PT-505	3” PE-AR-151787	Sheet 2 (C-3)
3/4” PK-O-11217C	ASV-PA-253-4	Access Corridor Floor Drain	Sheet 2 (D-3)
3/4” PK-O-11216C	Drip Pan	3/4” PK-O-11217C	Sheet 2 (D-3)
1” PE-AR-152505	Drip Pan	1/2” ASA-100148	Sheet 2 (D-6)
2” F1055C	2” PE-AR-151872	VES-WG-101	Sheet 2 (D-4)
3” PE-AR-151787	1 1/2” PE-AR-151900 & 1” PE-AR-151800	3” PW-AR-151713	Sheet 2 (B-2) & (C-3)
1/2” ASA-100148	PEV-PA-240/241-1	Access Corridor Floor Drain	Sheet 2 (D-6)
* Denotes a temporary line or valve number given for the purposes of this closure plan only.			

Table A-3. CPP-601 system boundaries for the sample corridor.

Line Identification Number	Start Point	End Point	Comments
3/4” PY-30218Y	Drip Pan	1” PY-30218Y	Sheet 3 (A-2)
1” PY-30218Y	Drip Pan	1” PY-30219	Sheet 3 (A-2)
1” PY-30219Y	1” PY-30218	1” PY-30221Y	Sheet 3 (A-2)
1” PY-51213	Drip Pan	1” PY-30223Y	Sheet 3 (A-3)
1” PU-40825Y	Drip Pan	1” PU-40826Y	Sheet 3 (A-3)
1” PU-40826Y	1” PU-40825Y	1” PU-40324Y	Sheet 3 (A-3)
1” PE-AR-112682	Cup Sink Drain	OTA Gallery 5 Drip Pan	Sheet 3 (A-4)
3/4” PU-52813Y	Drip Pan	1” PU-52814Y	Sheet 3 (A-5)
1” PU-52814Y	Drip Pan	1” PU-52817Y	Sheet 3 (A-4)
1” PJ-52014Y	Drip Pan	1” PJ-52015Y	Sheet 3 (D-3)
1” PJ-52015Y	1” PJ-52014Y	1” TJ-52017Y	Sheet 3 (D-3)
1” PE-AR-112683	Drip Pan	1” PWA-321	Sheet 3 (D-4)
1/2” PE-AR-108419	Drain	1/2” PE-AR-108420	Sheet 3 (C-5)
1” PC-50616Y	Drip Pan	1” PC-50617Y	Sheet 3 (C-7)
1” PC-50617Y	1” PC-50616Y	1” PC-50612Y	Sheet 3 (C-7)
1” PN-65711Y	Drip Pan	1” PN-65712Y	Sheet 3 (A-6)
1” PQ-51613Y	Drip Pan	1” TQ-51615Y	Sheet 3 (A-6)
1” PK-50613Y	Drip Pan	1” PK-50614Y	Sheet 3 (D-2)
1” PE-AR-108420	1/2” PE-AR-108419	1” PWA-34	Sheet 3 (D-5)
1” PA-51717Y	Drip Pan	3” PE-AR-151787	Sheet 3 (D-6)
1” PC-50612Y	Drip Pan	1” TC-50619Y	Sheet 3 (D-7)

Table A-4. CPP-601 system boundaries for the east cell row.

Line Identification Number	Start Point	End Point	Comments
1 1/2” PE-AR-152457	Hood X-600	1 1/2” PE-AR-151908	Sheet 4 (B-1)
1 1/2” PE-AR-151907	Glove Box Drains	1 1/2” PE-AR-151908	Sheet 4 (A-1)
1 1/2” PE-AR-151908	1 1/2” PE-AR-151907	1 1/2” PE-AR-151904	Sheet 4 (B-2)
1 1/2” PE-AR-151904	1 1/2” PE-AR-151908	VES-Y-119	Sheet 4 (C-2)
1” PE-AR-151901	Sump SU-Y-142	JET-Y-501	Sheet 4 (C-2)
1” PE-AR-151903	JET-Y-501	VES-Y-119	Sheet 4 (C-2)
1” PE-AR-151898	JET-Y-505	VES-Y-119	Sheet 4 (C-2)
3/4” TY-13112Y	JET-Y-508	RCV-Y-23	Sheet 4 (D-2)
1” PE-AR-151897	RCV-Y-23	VES-Y-119	Sheet 4 (D-2)
1 1/2” PE-AR-151900	VES-Y-119	3” PE-AR-151787	Sheet 4 (D-2)
1” PE-AR-151910	Sump SU-U-132	JET-U-512	Sheet 4 (A-3)
1” PE-AR-151911	JET-U-512	3” PE-AR-151787	Sheet 4 (A-3)
1” TW-129	VES-W-129	JET-W-504	Sheet 4 (C-3)
1” PE-AM-151816	JET-W-504	3” PE-AR-151787	Sheet 4 (C-3)
1” PE-AR-151860	Sump SU-W-131	JET-W-507	Sheet 4 (C-3)
1” PE-AR-151858	JET-W-507	3” PE-AR-151787	Sheet 4 (C-3)
3/4” PE-AR-151913	Sump SU-S-113	JET-S-504	Sheet 4 (C-4)
1” PE-AR-151913	JET-S-504	3” PE-AR-151787	Sheet 4 (C-3)
2” PE-AR-113575	VES-L-105	3” PE-AR-151787	Sheet 4 (C-6)
1” PQ-O-2131Y	Sump SU-Q-113	JET-Q-507	Sheet 4 (A-4)
1” PQ-O-2132Y	JET-Q-507	VES-Q-119	Sheet 4 (A-4)
3/4” TQ-2164Y	JET-Q-504	VES-Q-119	Sheet 4 (A-4)
3/4” TQ-3101Y	HE-Q-301	3/4” PQ-2101Y	Sheet 4 (B-4)
3/4” PQ-2101Y	3/4” TQ-3101Y	1 1/2” PE-AR-151843	Sheet 4 (B-4)
1 1/2” PE-AR-151843	VES-Q-119	3” PE-AR-151787	Sheet 4 (B-4)
1” TQ-6083Y	1” TQ-51615Y	VES-Q-119	Sheet 4 (B-4)
1” TQ-51615Y	1” PQ-51613Y	1” TQ-6083Y	Sheet 4 (B-4)
3/4” PP-O-2131Y	Sump SU-P-113	JET-P-505	Sheet 4 (A-5)
3/4” PP-O-2132Y	JET-P-505	VES-P-119	Sheet 4 (A-5)
3/4” TP-1109Y	HE-P-301	1 1/2” PE-AR-151840	Sheet 4 (B-5)
1 1/2” PE-AR-151840	VES-P-119	3” PE-AR-151787	Sheet 4 (B-5)
1” TP-60917Y	1” PP-60915Y	VES-P-119	Sheet 4 (B-5)
1” TN-65713Y	1” PN-65712Y	2” N-1147C	Sheet 4 (B-6)
1” PN-65712Y	1” PN-65711Y	1” TN-65713Y	Sheet 4 (B-6)
2” N-1147C	1” TN-65713Y	2” M-1146C	Sheet 4 (A-6)
3/4” PE-AR-151829	Sump SU-PA-111	JET-PA-501	Sheet 4 (D-7)
3/4” PE-AR-151827	JET-PA-501	6” WT-1165C	Sheet 4 (D-7)

Table A-5. CPP-601 system boundaries for the west cell row.

Line Identification Number	Start Point	End Point	Comments
1/2” PJ-V-2346Y	RCV-J-29	JET-J-535	Sheet 5 (A-1)
1/2” PJ-O-2347Y	JET-J-535	VES-J-119	Sheet 5 (A-1)
1” PJ-2212Y	Sump SU-J-121	JET-J-524	Sheet 5 (A-1)
1” PE-AR-151922	JET-J-524	1” PE-AR-151920	Sheet 5 (A-2)
1/2” PJ-V-2355Y	RCV-J-9	JET-J-525	Sheet 5 (A-2)
1/2” PJ-V-2356Y	JET-J-525	VES-J-119	Sheet 5 (A-2)
3/4” PJ-O-2276Y	RCV-J-19	JET-J-527	Sheet 5 (B-1)
1” PE-AR-151789	JET-J-527	VES-J-119	Sheet 5 (B-1)
1” PE-AR-151799	VES-J-119	1 1/2” PE-AR-151799	Sheet 5 (A-2)
1” PJ-O-2015Y	RCV-J-21	1” PJ-O-2023Y	Sheet 5 (B-2)
1” PJ-O-2023Y	RCV-J-20	1” PE-AR-151799	Sheet 5 (B-2)
1” TJ-52017Y	1” PJ-52015Y	1” PE-AR-151920	Sheet 5 (B-2)
1” PE-AR-151920	1” TJ-52017Y	1 1/2” PE-AR-151799	Sheet 5 (A-2)
1 1/2” PE-AR-151799	1” PE-AR-151920	3” PE-AR-151787	Sheet 5 (A-2)
1” PSA-382	VES-H-108	JET-H-507	Sheet 5 (A-3)
3/4” PWA-301	HE-H-300	1” PE-AR-151866	Sheet 5 (B-2)
1” PE-AR-151866	3/4” PWA-301	1” PWA-320	Sheet 5 (B-3)
1” PWA-320	1” PE-AR-151866	2” PWA-302	Sheet 5 (B-3)
3/4” PWA-302	VES-H-117	RCV-H-6	Sheet 5 (B-3)
2” PWA-302	RCV-H-6	3” PE-AR-151865	Sheet 5 (B-3)
3/4” PSA-577	Sump SU-H-121	JET-H-529	Sheet 5 (B-3)
1” PE-AR-151797	JET-H-529	3” PE-AR-151787	Sheet 5 (A-3)
1” PWA-208	Sump SU-G-117	JET-G-541	Sheet 5 (A-4)
1” PE-AR-151796	JET-G-541	3” PE-AR-151787	Sheet 5 (A-4)
*ULS5-1	VES-G-108	JET-G-520	Sheet 5 (A-4)
2” PWA-308	JET-G-520	2” PWA-310	Sheet 5 (B-4)
*ULS5-2	VES-G-116	JET-G-532	Sheet 5 (A-4)
2” PWA-312	JET-G-532	2” PWA-310	Sheet 5 (A-4)
*ULS5-3	VES-G-115	JET-G-528	Sheet 5 (B-4)
2” PWA-310	JET-G-528	3” PE-AR-151865	Sheet 5 (B-4)
3” PE-AR-151865	2” PWA-302 & 2” PWA-310	6” WT-1165C	Sheet 5 (B-3) & (B-4)
2” PWA-207	2” PWA-206	Drip Pan	Sheet 5 (A-4)
1” PWA-207	Drip Pan	2” PWA-306	Sheet 5 (B-4)
2” PWA-306	1” PWA-207	1” PE-AR-151868	Sheet 5 (B-4)
1” PWA-321	1” PE-AR-112683	1” PE-AR-151868	Sheet 5 (B-4)
1” PE-AR-151868	1” PWA-321	3” PE-AR-151787	Sheet 5 (B-4)
1” PLA-110914	Sump SU-C-112	JET-C-517	Sheet 5 (B-5)

Table A-5. (continued).

Line Identification Number	Start Point	End Point	Comments
1” PLA-110913	JET-C-517	VES-C-103	Sheet 5 (B-5)
1” PE-AR-105604	VES-C-101	JET-C-514	Sheet 5 (B-6)
1” PE-AR-105604	JET-C-514	VES-C-103	Sheet 5 (B-6)
3/4” TC-2091Y	Cap in PM Area	VES-C-103	Sheet 5 (A-5)
1” TC-50619Y	1” PC-50612Y	VES-C-103	Sheet 5 (B-5)
1 1/2” PL-AR-151820	VES-C-103	3” PE-AR-151787	Sheet 5 (A-5)
1” TK-1044Y	EVP-K-104	2” PE-AR-151864	Sheet 5 (C-1)
*ULS5-4	EVP-K-104	JET-K-501	Sheet 5 (C-1)
2” PE-AR-151864	JET-K-501	6” WT-1165C	Sheet 5 (C-1)
1” PK-50614Y	1” PK-50613Y	1” TK-50615Y	Sheet 5 (D-1)
1” TK-50615Y	1” PK-50614Y	2” PE-AR-151864	Sheet 5 (D-1)
*ULS5-5	Sump SU-F-120	JET-F-522	Sheet 5 (C-3)
1” PE-AR-151793	JET-F-522	3” PE-AR-151787	Sheet 5 (C-3)
*ULS5-6	VES-F-105	JET-F-504	Sheet 5 (C-3)
1” PSA-106751	JET-F-504	VES-F-119	Sheet 5 (C-3)
*ULS5-7	VES-F-106	JET-F-515	Sheet 5 (C-3)
1” PSA-106705	JET-F-515	VES-F-119	Sheet 5 (C-3)
1 1/2” PE-AR-151873	VES-F-119	2” PE-AR-151872	Sheet 5 (C-3)
1” PSA-104969	1” PSA-106762	1”PSA-106763	Sheet 5 (D-3)
1” PSA-106762	2” PSAR-108107	2” PE-AR-151872	Sheet 5 (D-3)
1” PSA-106763	2” PSAR-108107	2” PE-AR-151872	Sheet 5 (D-3)
2” PE-AR-151872	1” PSA-106762	2” F1055C	Sheet 5 (D-3)
3/4” PWA-40	Cap by Sump SU-E-111	1” PWA-34	Sheet 5 (C-4)
1” PWA-34	1” PE-AR-108420	6” WT-1067C	Sheet 5 (D-4)
1” PLA-110917	Sump SU-B-108	JET-B-502	Sheet 5 (C-6)
1” PLA-110916	JET-B-502	3” PE-AR-151787	Sheet 5 (C-6)
K-cell liner	K-cell liner	Sump SU-K-107	Sheet 5 (C-2)
1” PK-O-2075Y	Sump SU-K-107	JET-K-505	Sheet 5 (C-2)
1” PE-AR-151923	JET-K-505	2” PE-AR-151864	Sheet 5 (C-2)
* Denotes a temporary line number given for the purposes of this closure plan only.			

Table A-6. CPP-601 system boundaries for the waste trench.

Line Identification Number	Start Point	End Point	Comments
3” PA-1088C	Access Corridor Floor Drain	6” WT-1067C	Sheet 6 (B-5)
3” PA-1087C	Access Corridor Floor Drain	6” WT-1067C	Sheet 6 (B-5)
4” PW-AR-151713	3” PW-AR-151713	6” WT-1067C	Sheet 6 (B-6)
6” WT-1067C	Cap in Waste Trench	VES-WH-120	Sheet 6 (B-4)
3” PA-1116C	Access Corridor Floor Drain	6” WT-1165C	Sheet 6 (C-2)
3” PA-1117C	Access Corridor Floor Drain	6” WT-1165C	Sheet 6 (C-3)
3” PA-1118C	Access Corridor Floor Drain	6” WT-1165C	Sheet 6 (C-4)
3” PA-1119C	Access Corridor Floor Drain	6” WT-1165C	Sheet 6 (C-4)
3” PA-1120C	Access Corridor Floor Drain	6” WT-1165C	Sheet 6 (C-5)
2” M-1146C	2” N-1147C	6” WT-1165C	Sheet 6 (C-5)
6” WT-O-1068C	6” WT-1067C	6” WT-1165C	Sheet 6 (C-6)
6” WT-1165C	Cap in CPP-602 Waste Trench	VES-WG-120	Sheet 6 (C-1)
* ULS6-1	Sump SU-WT-101	JET-WT-501	Sheet 6 (B-6)
* Denotes a temporary line number given for the purposes of this closure plan only.			

Table A-7. CPP-601 system boundaries for the deep tanks vaults.

Line Identification Number	Start Point	End Point	Comments
1/4” TWH1013Y	VES-WH-101	SAM-WH-601	Sheet 7 (D-1)
2 1/2” PWH-1011C	VES-WH-101	P-WE-200	Sheet 7 (D-2)
2” PL-AR-110205	P-WE-200	3” PLA-110205	Sheet 7 (B-3)
3” PLA-110205	2” PL-AR-110205	HV-WM-38	Sheet 7 (A-4)
*ULS7-1	RCV-WE-2	2” PL-AR-110205	Sheet 7 (B-3)
*ULS7-2	RCV-WD-2	2” PL-AR-110211	Sheet 7 (B-3)
3” PLA-110206	2” PL-AR-110205	HV-WM-39	Sheet 7 (A-4)
2” PLA-110207	3” PLA-110206	PLV-YDA-22	Sheet 7 (A-3)
3” PLA-110559	RCV-WM-191	3” PLA-110206	Sheet 7 (A-2)
6” PWH-1019C	VES-WH-120	VES-WH-101	Sheet 7 (C-2)
1 1/2” PWH-2012C	VES-WH-101	JET-WH-501	Sheet 7 (D-2)
1 1/2” PWH-2011C	JET-WH-501	VES-WH-100	Sheet 7 (D-3)
6” PWG-1001C	VES-WH-120	VES-WG-100	Sheet 7 (C-2)
1/4” TWH-2002Y	VES-WH-100	SAM-WH-600	Sheet 7 (D-3)
3/4” PWF-1009C	Drip Pan	1” PWF-1007C	Sheet 7 (B-1)
1” PWF-1007C	Drip Pan	1” PWE-1029C	Sheet 7 (B-1)
1” PWE-1029C	1” PWF-1007C	Pump Pit Floor Drain	Sheet 7 (B-2)
2” PWE-1011C	Pump Pit Floor Drain	2” PW-AR-151608	Sheet 7 (C-3)
2” PW-AR-151608	2” PWE-1011C	VES-WH-100	Sheet 7 (C-3)
2 1/2” PWH-1001C	VES-WH-100	P-WD-200	Sheet 7 (D-3)
2” PL-AR-110211	P-WD-200	2” PL-AR-110205	Sheet 7 (B-4)
6” PWH-1005C	VES-WG-120	VES-WH-100	Sheet 7 (C-3)
1 1/2” PWH-1006C	VES-WH-100	JET-WH-500	Sheet 7 (D-3)
1 1/2” PWH-1007C	JET-WH-500	VES-WG-101	Sheet 7 (D-3)
1 1/2” PWG-2013C	JET-WG-501	VES-WH-100	Sheet 7 (C-5)
1” PWH-1008C	Sump SU-WH-102	JET-WH-502	Sheet 7 (D-4)
1” PWH-1009C	JET-WH-502	VES-WH-100	Sheet 7 (D-4)
1” PWG-2014C	Sump SU-WG-102	JET-WG-502	Sheet 7 (D-5)
1” PWG-2015C	JET-WG-502	VES-WG-101	Sheet 7 (D-5)
1 1/2” PWG-2012C	VES-WG-101	JET-WG-501	Sheet 7 (D-5)
6” PWG-1014C	VES-WG-120	VES-WG-101	Sheet 7 (C-6)
2 1/2” PWG-1016C	VES-WG-101	P-WC-200	Sheet 7 (D-5)
2” PL-AR-110210	P-WC-200	2” PL-AR-110209	Sheet 7 (B-5)
*ULS7-5	DMV-WA-5	Pump Pit Floor Drain	Sheet 7 (B-5)

Table A-7. (continued).

Line Identification Number	Start Point	End Point	Comments
*ULS7-6	DMV-WA-6	Pump Pit Floor Drain	Sheet 7 (B-5)
2” PW-AR-151608	Pump Pit Floor Drain	2” PWE-1011C	Sheet 7 (C-4)
2” PWC-1011C	Pump Pit Floor Drain	2” PWG-1007C	Sheet 7 (C-5)
2” PWG-1007C	2” PWC-1011C	VES-WG-101	Sheet 7 (C-5)
2” PWB-1001C	Pump Pit Floor Drain	2” PWG-1007C	Sheet 7 (C-6)
1/4” TWG-2016Y	VES-WG-101	SAM-WG-601	Sheet 7 (C-6)
1 1/2” PWG-2007C	JET-WG-500	VES-WG-101	Sheet 7 (D-6)
1 1/2” PWG-2006C	VES-WG-100	JET-WG-500	Sheet 7 (D-6)
2 1/2” PWG-1002C	VES-WG-100	P-WB-200	Sheet 7 (D-7)
2” PL-AR-110209	P-WB-200	2” PL-AR-110205	Sheet 7 (B-5)
2” PL-AR-110209 (By-Pass)	2” PL-AR-110209	2” PL-AR-110205	Sheet 7 (B-4)
1” WD-O-1001C	RCV-WE-5	2” PL-AR-110209	Sheet 7 (B-4)
*ULS7-3	RCV-WC-2	2” PL-AR-110210	Sheet 7 (B-5)
*ULS7-4	RCV-WB-2	2” PL-AR-110209	Sheet 7 (B-5)
3/4” PWA-1008C	Drip Pan	1” PWA-1014C	Sheet 7 (C-7)
1” PWA-1014C	Drip Pan	1” PWB-1019C	Sheet 7 (C-7)
1” PWB-1019C	1” PWA-1014C	Pump Pit Floor Drain	Sheet 7 (C-7)
1” WG-2004C	JET-WT-501	2” WG-2004C	Sheet 7 (C-7)
2” WG-2004C	1” WG-2004C	VES-WG-100	Sheet 7 (C-7)
1/4” TWG-1005Y	VES-WG-100	SAM-WG-600	Sheet 7 (C-7)
* Denotes a temporary line number given for the purposes of this closure plan only.			

Table A-8. CPP-627 PEWE Drain System.

Line Identification Number	Start Point	End Point	Comments
3” PWA-204	Capped drains in RAF glove boxes, OSL and HCL	Capped in 601 West Vent Tunnel	Sheet 8 (A-3)
3” WRN-202	Floor drains from RAF, and DDL	Capped in 601 West Vent Tunnel	Sheet 8 (A-3)
2” PE-AR-154109	DDL to PEWE in CPP-601 H-cell. Stainless steel secondary containment.	2005, isolation of CPP-627	Capped at West and east walls of CPP-601 West Vent Tunnel, and at floor level in CPP-627. Flushed during D&D of CPP-627. Sheet 8 (A-5)
2” PE-AR-154097	RAF to PEWE in CPP-601 West Vent Tunnel. Stainless steel secondary containment.	2005, isolation of CPP-627	Capped at west wall of CPP-601 West Vent Tunnel, and floor level in CPP-627. Flushed during D&D of CPP-627. Sheet 8 (A-4)
2” PE-AR-154101	Connects to 2” PE-AR-154097 in floor trench in CPP-627. Stainless steel secondary containment.	2005, isolation of CPP-627	Capped at floor in CPP-627. Flushed during D&D of CPP-627. Sheet 8 (A-4)
2” PE-AR-154073	Connects to 2” PE-AR-154097 in floor trench in CPP-627. Stainless steel secondary containment.	2005, isolation of CPP-627	Capped at floor in CPP-627. Flushed during D&D of CPP-627. Sheet 8 (A-4)
1” PLA-100096	Capped Anteroom Drains	3” PWA-204	Sheet 8 (D-5)

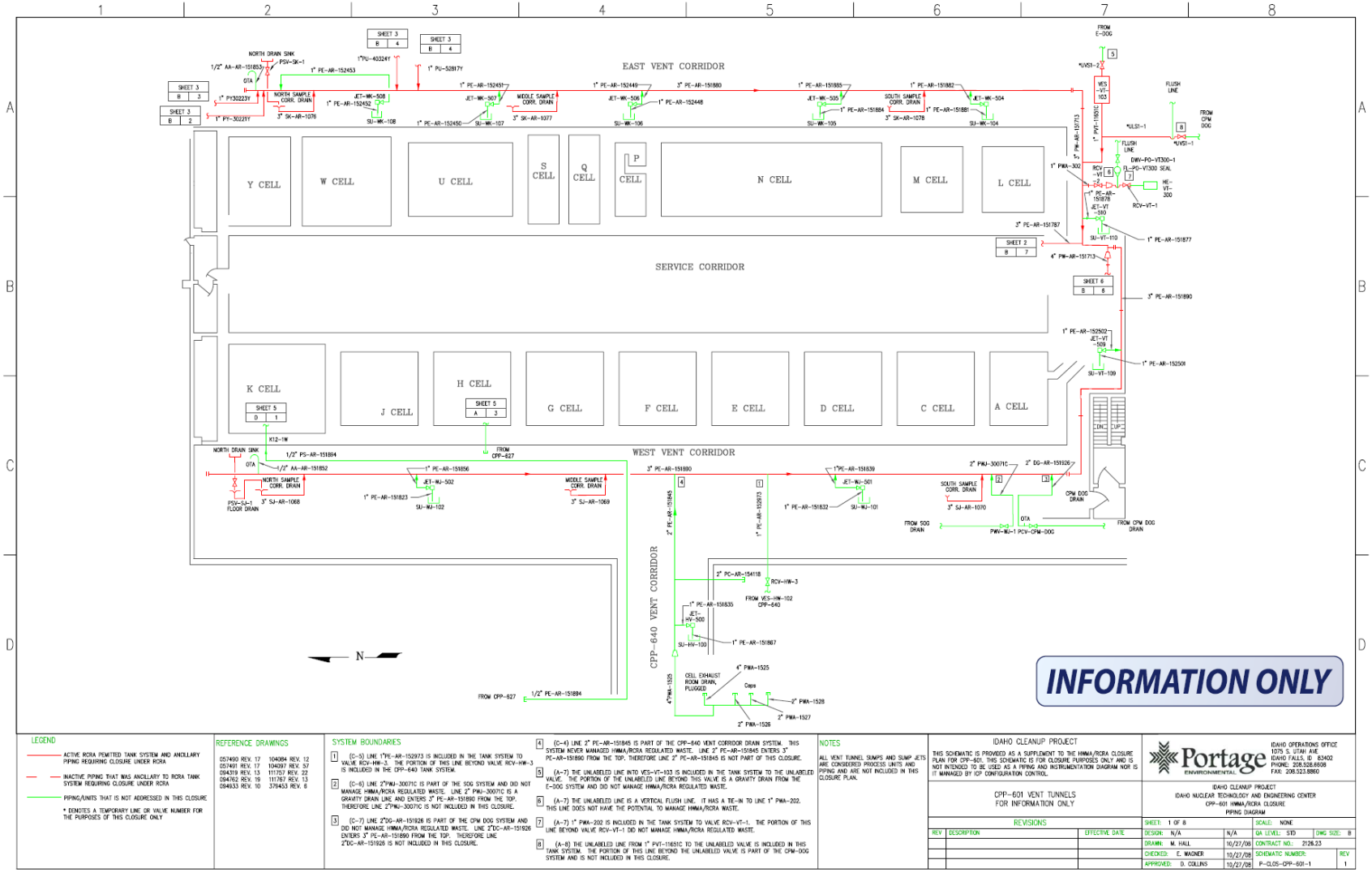


Figure A-1. Schematic P-CLOS-CPP-601-1. CPP-601 HWMA/RCRA closure piping diagram.

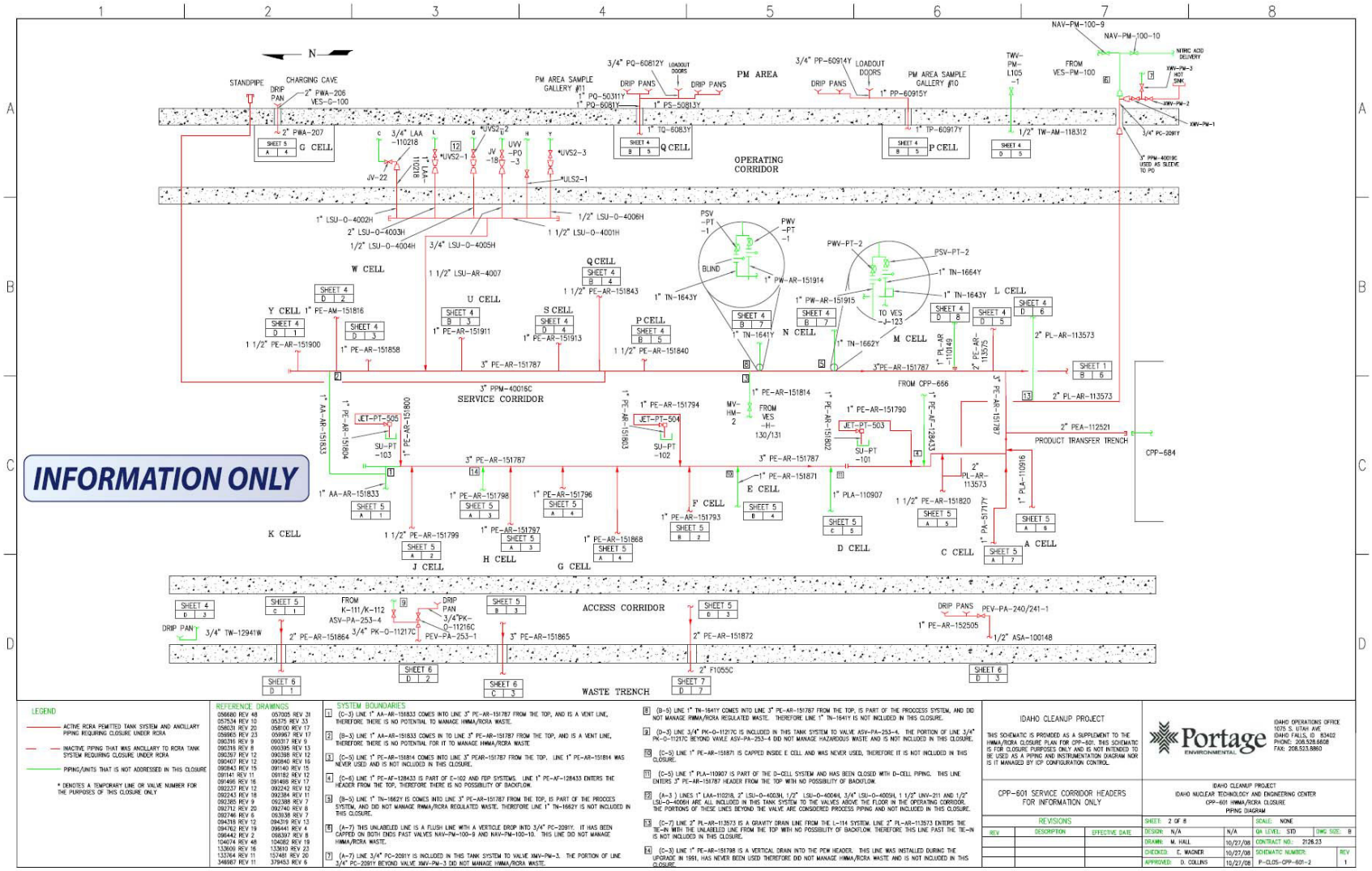


Figure A-2. Schematic P-CLOS-CPP-601-2. CPP-601 HWMA/RCRA closure piping diagram.

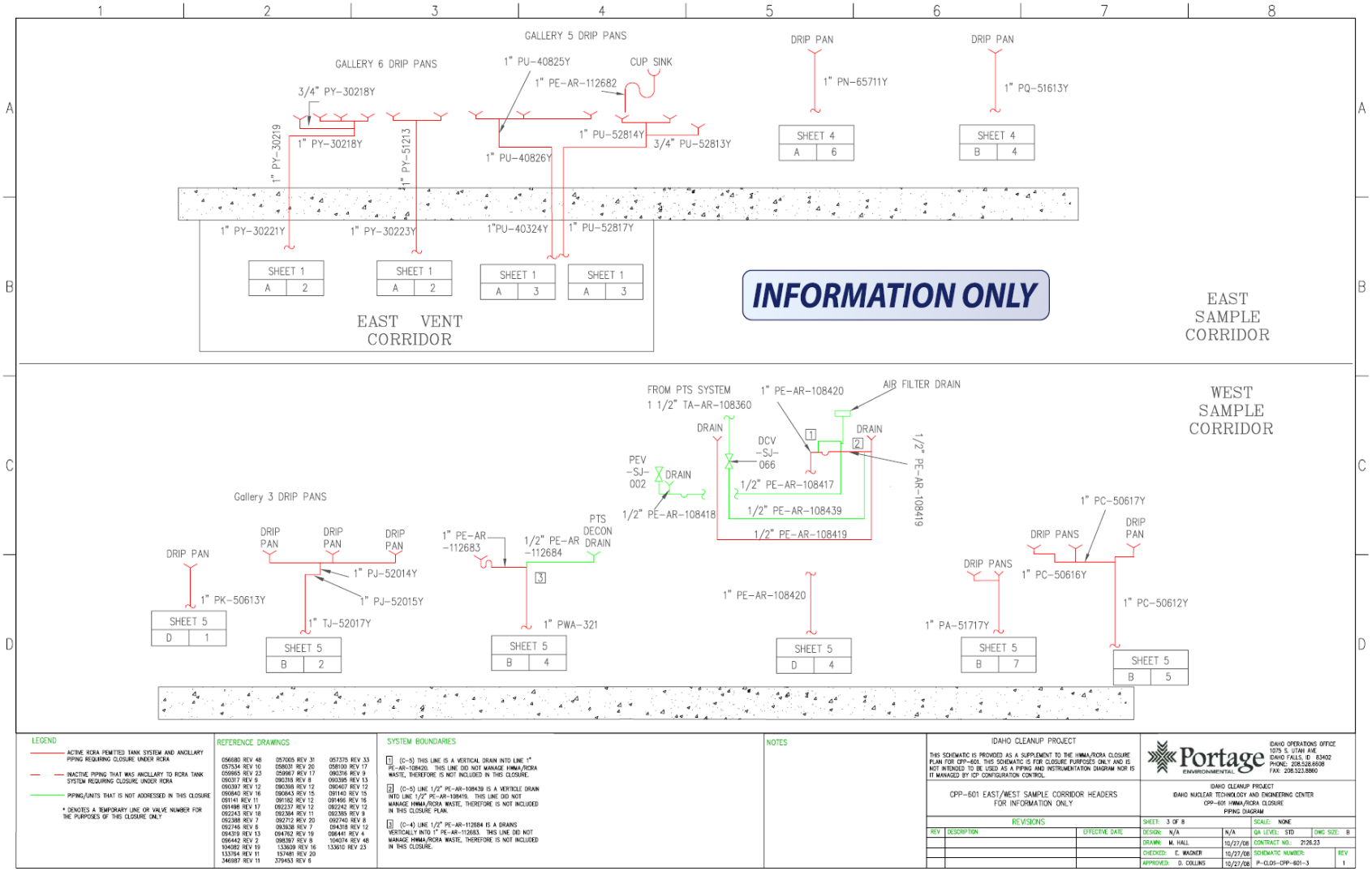


Figure A-3. Schematic P-CLOS-CPP-601-3. CPP-601 HWMA/RCRA closure piping diagram.

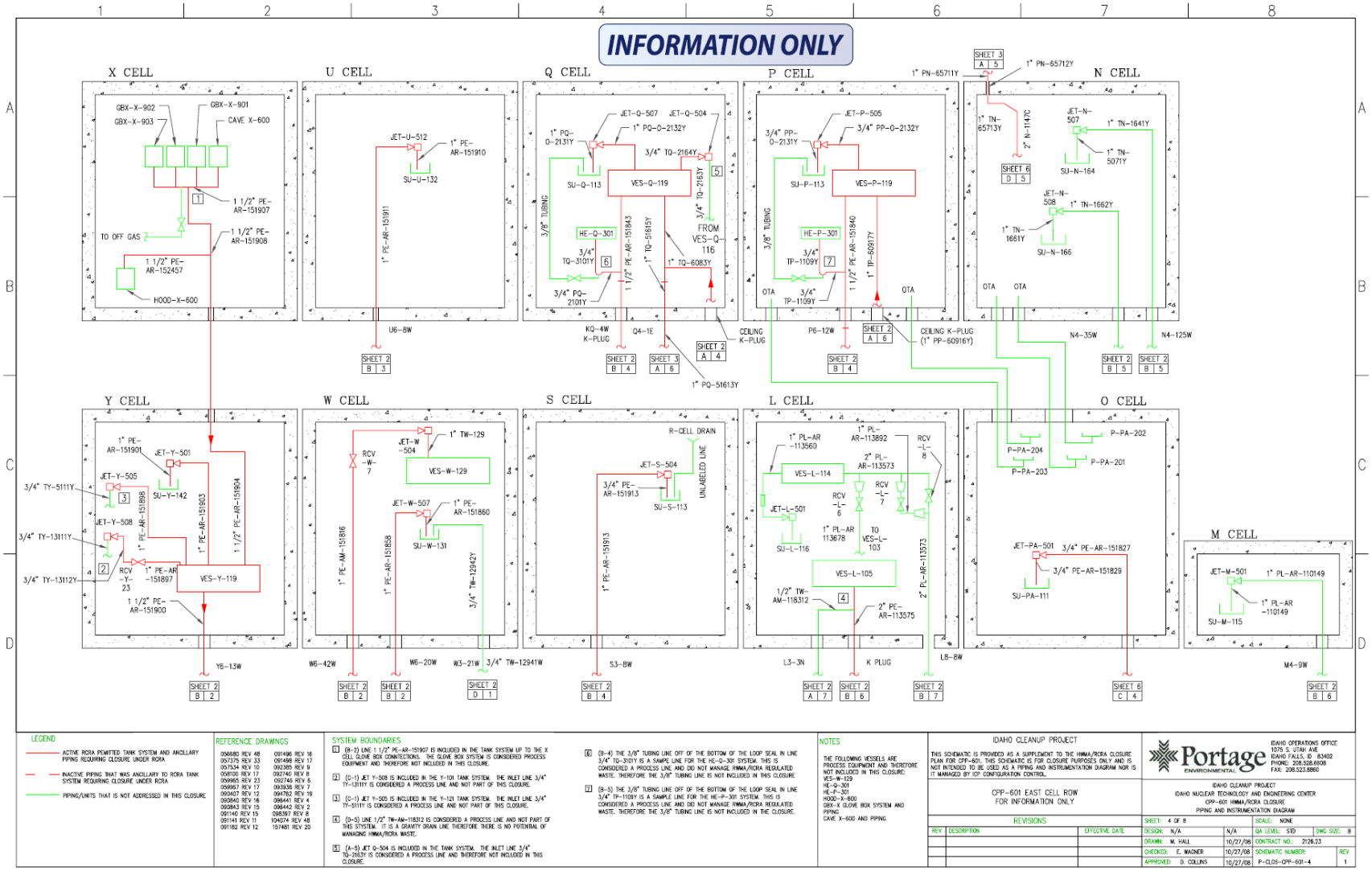


Figure A-4. Schematic P-CLOS-CPP-601-4. CPP-601 HWMA/RCRA closure piping diagram.

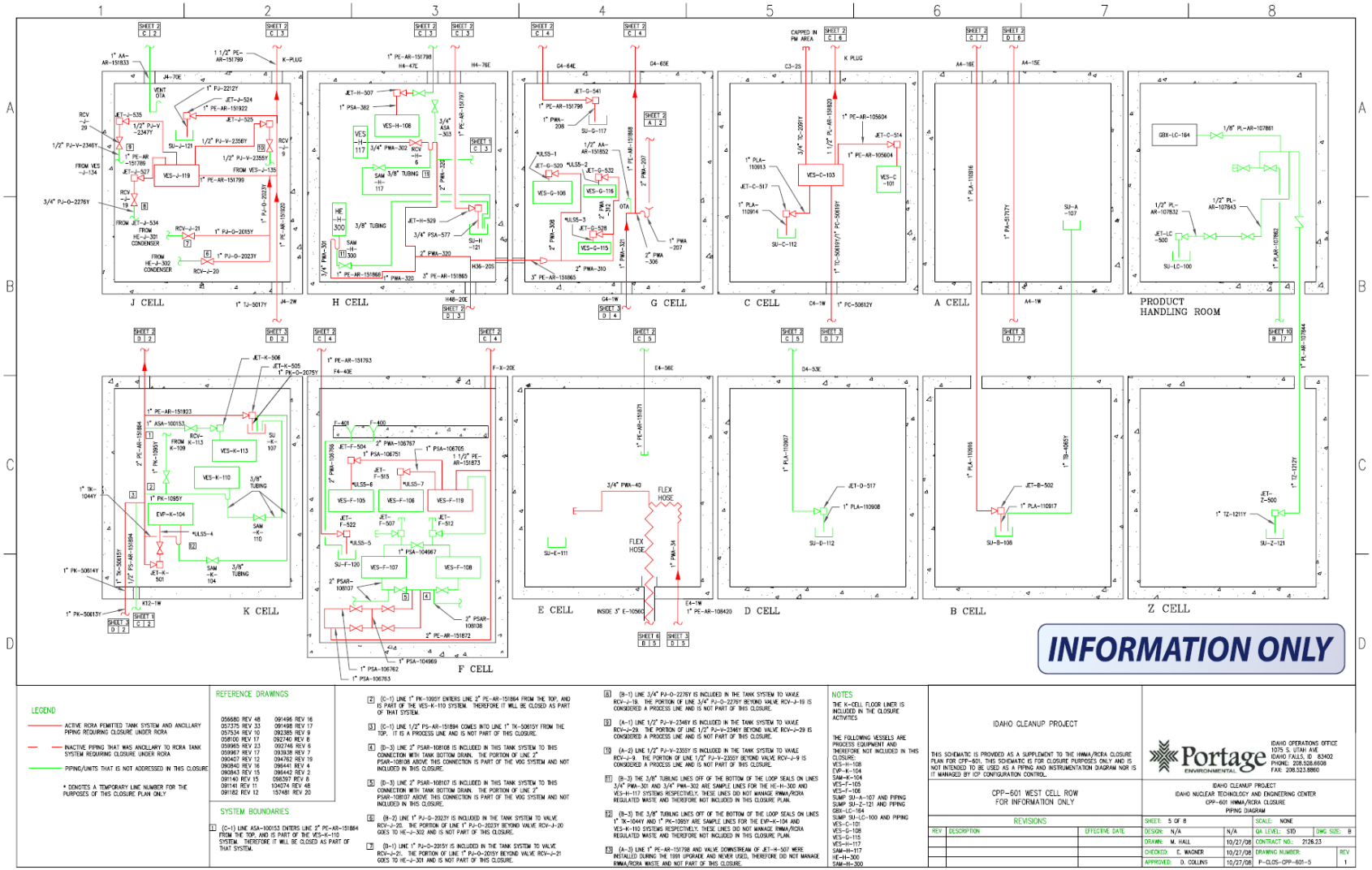


Figure A-5. Schematic P-CLOS-CPP-601-5. CPP-601 HWMA/RCRA closure piping diagram.

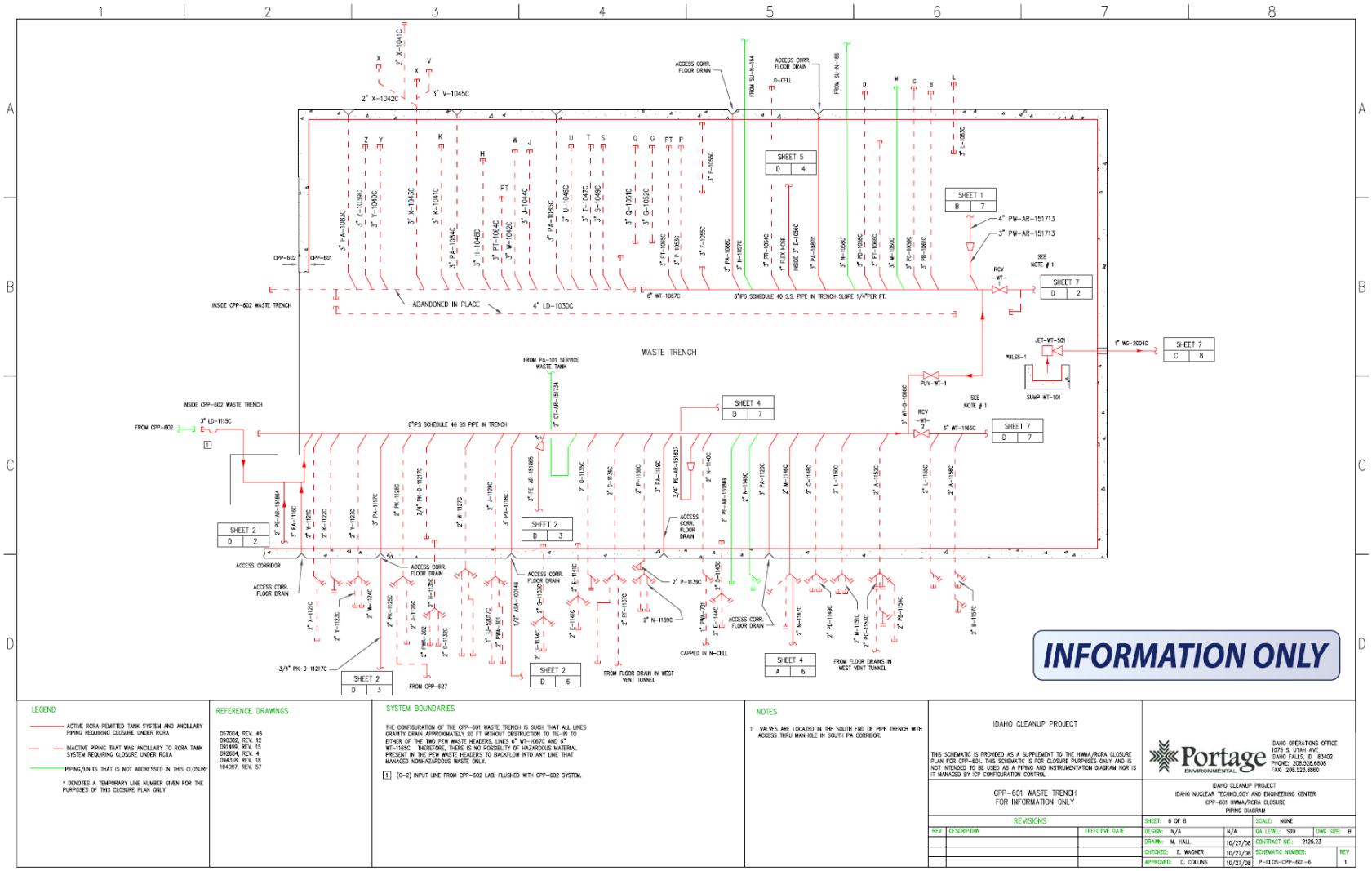


Figure A-6. Schematic P-CLOS-CPP-601-6. CPP-601 HWMA/RCRA closure piping diagram.

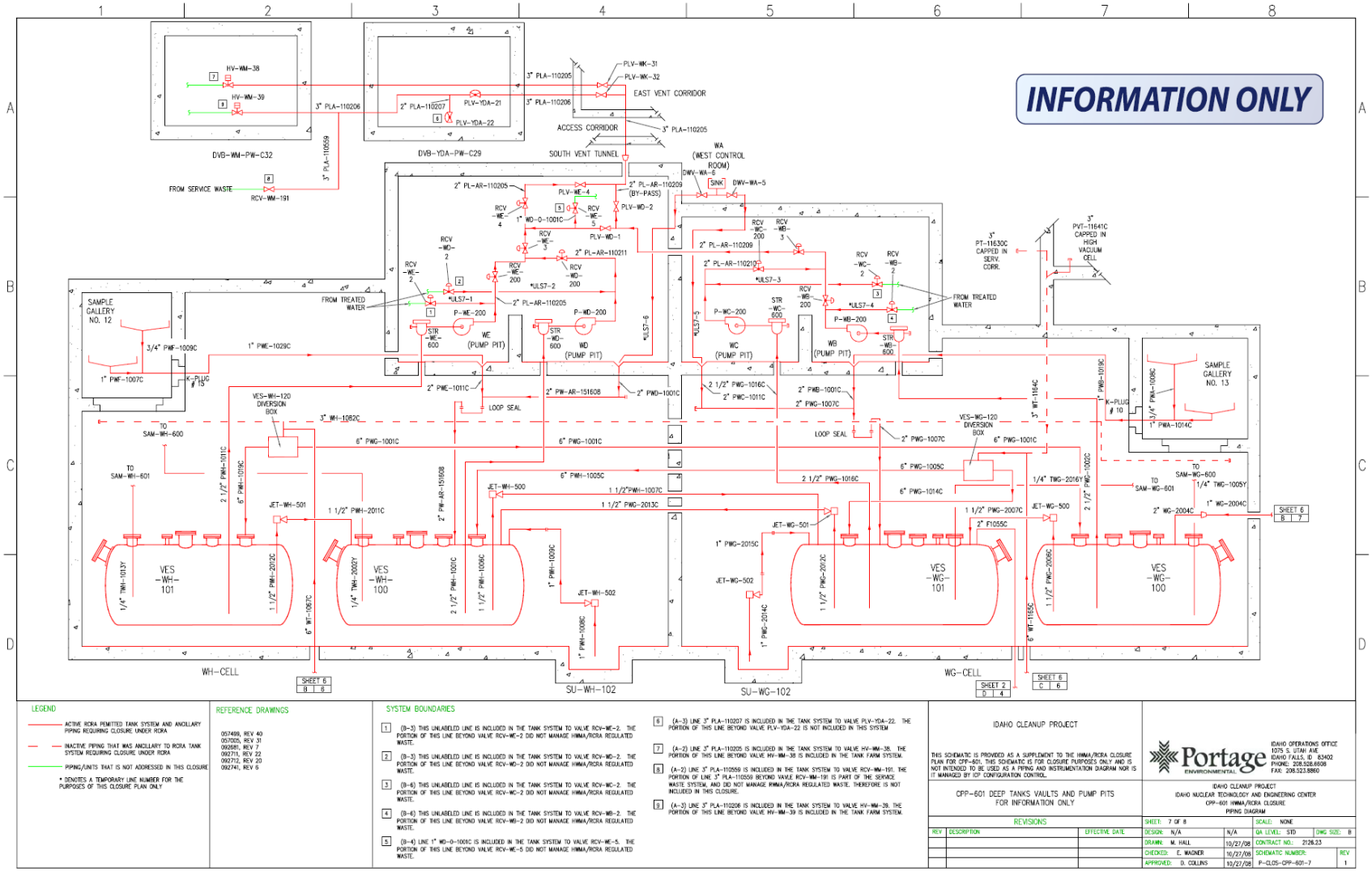


Figure A-7. Schematic P-CLOS-CPP-601-7. CPP-601 HWMA/RCRA closure piping diagram.

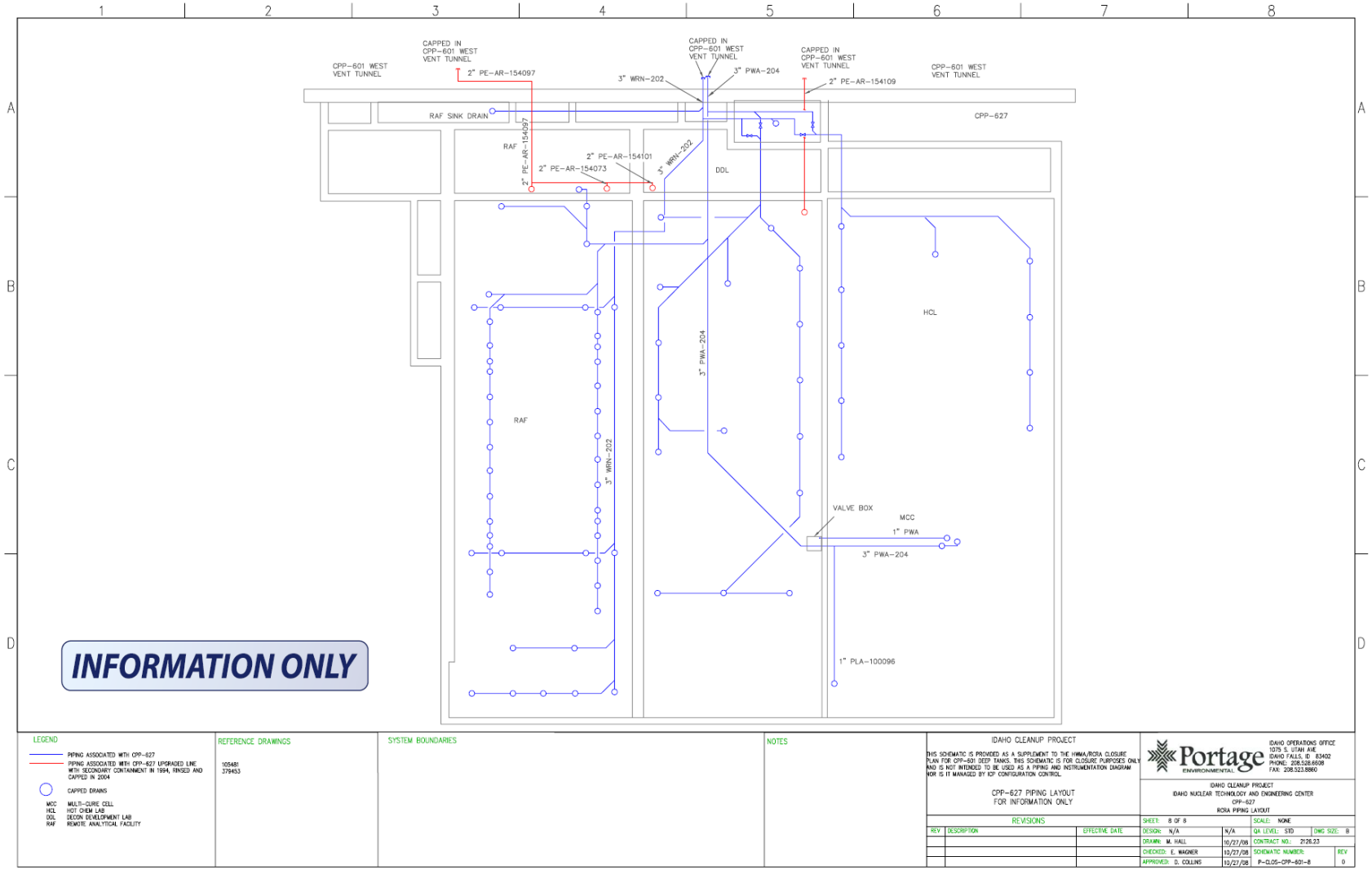


Figure A-8. Schematic P-CLOS-CPP-601-8. CPP-601 HWMA/RCRA closure piping diagram.

ATTACHMENT 1
REQUIRED NOTICES

HWMA/RCRA INTEC POST-CLOSURE PERMIT REAPPLICATION

Volume 21
Waste Calcine Facility and CPP-601/627/640

Attachment 1
Required Notices

April 2013

INEEL
IDAHO NATIONAL ENGINEERING & ENVIRONMENTAL LABORATORY

LOCKHEED MARTIN

Lockheed Martin Idaho Technologies Company
P.O. Box 1625 Idaho Falls, ID 83415

June 10, 1999

Mr. D. L. Wessman
U.S. Department of Energy
Idaho Operations Office
850 Energy Drive, MS 1146
Idaho Falls, ID 83401-1563

WASTE CALCINING FACILITY (CPP-633) CLOSURE PLAT - KM-52-99

Dear Mr. Wessman:

Attached are 4 mylars of the closure plat and record of waste for the Waste Calcining Facility (WCF) for DOE-ID sign-off. The survey plat and record of waste is required to be prepared and filed in accordance with Sections 4.6 and 4.7.2 of the WCF Closure Plan, respectively. The mylars will be managed in the following manner:

1. 1 copy to be transmitted by DOE-ID to the Idaho Division of Health and Welfare (IDHW) Director (Section 4.7.2 of the closure plan).
2. The remaining copies will be submitted to the Butte County Clerk and Recorder for recordation. On behalf of DOE-ID, LMITCO will submit these documents to the Clerk and Recorder. 1 copy will remain in Butte County for permanent record, while the remaining 2 copies, with the County filing information, will be returned to DOE-ID and LMITCO for recording in the closure file.

After these documents are filed with the Clerk and Recorder, the Professional Engineer (PE) will be provided a copy to include in the PE closure certification supporting documents. LMITCO will also provide a copy to the Bureau of Land Management for inclusion in their government land records.

At this time, it is proposed that a "Certification of Notice" to comply with Section 4.7.4 of the WCF Closure Plan will be prepared to identify recordation of the documents with Butte County and the IDHW Director. This notice will be included in the Owner/Operator Certification package.

If additional information or clarification is needed concerning this plat, please feel free to contact Lee Tuott at 526-7990.

Sincerely,

Kliss McNeel, Manager
RCRA/TSCA Policy and Permitting Department

LCT:kd

Attachment:

cc: w/ attachment
K. Davis, Jason Assoc.
M. E. Davis, LMITCO, MS 5218
K. L. Falconer, LMITCO, MS 3940
B. J. Frazee, LMITCO, MS 3921
J. E. Hovinga, LMITCO, MS 5108
J. M. Jackson, LMITCO, MS 3428
K. O. Kingsford, LMITCO, MS 3650
D. A. Love, LMITCO, MS 3899
K. L. Miller, LMITCO, MS 5117
B. D. Nield, LMITCO, MS 5304
J. J. Saye, LMITCO, MS 3428
L. C. Tuott, LMITCO, MS 3428
M. Vorachek, LMITCO, MS 5240
RCRA Closure File
K. McNeel File

Department of Energy
Idaho Operations Office
850 Energy Drive
Idaho Falls, Idaho 83401-1563

July 1, 1999

CERTIFIED MAIL P 298 171 963
RETURN RECEIPT REQUESTED

Regional Administrator
c/o Mr. Brian Monson, Program Manager
Hazardous Waste Program Office
Idaho Division of Environmental Quality
1410 North Hilton
Boise, Idaho 83706-1255

SUBJECT: Owner/Operator Certification, Certification of Notice and the Professional Engineer's Certification of the Waste Calcining Facility (OPE-EP&SA-112-99)

Dear Mr. Monson:

Enclosed are one original and one copy of the Owner/Operator Certification and the Certification of Notice of the Hazardous Waste Management Act closure of the Waste Calcining Facility. Included with the enclosure are the *Supporting Documentation for the HWMA/RCRA Closure Certification of the Waste Calcining Facility*, the Professional Engineer Certification and mylars of the CPP-633 HWMA/RCRA Closure Plats recorded by Butte County.

If you have any questions on this matter, please contact me at (208) 526-0082

Sincerely,

D. L. Wessman

David L Wessman
Environmental Specialist

Enclosures

cc w/encl:
Roberta Hedeen, EPA Region 10, Seattle, Washington

Certification of Notice

The undersigned hereby certify that the notation and information, as specified in Section 4.7.3 of the June, 1997 "*HWMA Closure Plat for the Waste Calcining Facility at the Idaho National Engineering and Environmental Laboratory,*" has been performed. A copy of the recorded plat, entitled the "*CPP-633 HWMA/RCRA Closure Plat, Waste Calcining Facility, INEEL*" and the attached "*Record of Waste*" is provided to the IDHW Director for filing and to document compliance with the requirements of the closure plan.

The information required by Section 4.7.3 is prominently displayed on the face of the plat under the title "*Property Restrictions and Notations.*" This serves to notify any potential purchaser that hazardous wastes remain on the property and identify the restrictions associated with the future use of the property.

On June 21, 1999, the plat was recorded by the Butte County Clerk and Recorder. In accordance with Idaho law, the recording of the plat establishes a permanent document in the land records of Butte County. Prior to the submittal to the Clerk and Recorder, the plat was submitted to the Butte County Commissioners for approval of the plat. The Butte County Attorney determined that the "*Acceptance*" of the plat by the Butte County Commissioners and the "*Treasurer's Certificate*" was not required. Based on this determination, the plat was filed by the Clerk and Recorder with these sections marked "Not Required."

Owner/Operator Signature: Beverly A Cook

Owner/Operator Name: Beverly A. Cook

Title: Manager, DOE Idaho Operations Office

Date: 7/1/99

Co-Operator Signature: William W. Gm

Co-Operator Name: Harold T. Conner, Jr.

Title: Executive Vice President of Operations and Chief Operating Officer, Lockheed Martin Idaho Technologies Company

Date: JULY 1, 1999

Attachment: "*CPP-633 HWMA/RCRA Closure Plat, Waste Calcining Facility, INEEL*" *and includes the "Record of Waste."*

OWNER/OPERATOR CERTIFICATION

Hazardous Waste Management Act (HWMA)/Resource Conservation and Recovery Act (RCRA) Closure Certification of the Waste Calcining Facility (CPP-633) at the Idaho National Engineering and Environmental Laboratory

The undersigned certify as required per IDAPA 16.05.01.012 [40 CFR 270.11 (d) and 270.30 (k)] as follows:

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information including the possibility of fine and imprisonment for knowing violations.

Owner/Operator Signature: Beverly A Cook

Owner/Operator Name: Beverly A. Cook

Title: Manager, DOE Idaho Operations Office

Date: 7/1/99

Co-Operator Signature: William W. Lim

Co-Operator Name: Harold T. Conner, Jr.

Title: Executive Vice President of Operations and Chief Operating Officer, Lockheed Martin Idaho Technologies Company

Date: JULY 1, 1999

Attachments:

- "Supporting Documentation for HWMA/RCRA Closure Certification of the Waste Calcining Facility" June 1999
- "Professional Engineer Certification" June 28, 1999
- "Certification of Notice"

INEEL
IDAHO NATIONAL ENGINEERING & ENVIRONMENTAL LABORATORY

LOCKHEED MARTIN

Lockheed Martin Idaho Technologies Company
P.O. Box 1625 Idaho Falls, ID 83415

July 19, 1999

Mr. Bruce Bass
Bureau of Land Management
1405 Hollipark Dr.
Idaho Falls, Idaho 83401

TRANSMITTAL OF THE RECORDED PLAT FOR THE HAZARDOUS WASTE MANAGEMENT ACT (HWMA)/RESOURCE, CONSERVATION, AND RECOVERY ACT (RCRA) CLOSURE OF THE WASTE CALCINING FACILITY (CPP-633) UNIT - KM-69-99

Dear Mr. Bass:

Attached for the Bureau of Land Management land records is the mylar of the plat and record of waste for the Waste Calcining Facility (CPP-633) closure. The Waste Calcining Facility (WCF) is located at the Idaho Nuclear Technology and Engineering Center (INTEC) at the Idaho National Engineering and Environmental Laboratory (INEEL). The plat and record of waste were filed with Butte County to comply with the requirements identified in the State of Idaho-approved Hazardous Waste Management Act (HWMA)/Resource Conservation and Recovery Act (RCRA) Closure Plan for the Waste Calcining Facility.

These documents support the closure of the WCF to a landfill standard. The plat identifies pertinent information supporting the closure such as the footprint of the building and cap, coordinates of the cap, and restrictions for future use of the property. The record of waste identifies the approximate location and volume of waste that remains in the WCF.

If you have any questions relating to activities associated with this closure action, please contact Lee Tuott at 526-7990.

Sincerely,

JM Jackson for

K. McNeel, Manager
RCRA/TSCA Policy and Permitting

LCT:kd

Attachment

STATE OF IDAHO
DIVISION OF
ENVIRONMENTAL QUALITY

ENV-00229

1410 North Hilton • Boise, Idaho 83706-1255 • (208) 373-0502

Dirk Kempthorne, Governor
C. Stephen Allred, Administrator

November 2, 1999

CERTIFIED MAIL # P 241 839 649

RECEIVED
NOV 04 1999
Office of Program Execution

Dave Wessman
DOE - Idaho Operations Office
850 Energy Drive
Idaho Falls, ID 83401-1563

Dear Mr. Wessman:

Re: June 1999 Closure Certification (Certification) for the 1997 Hazardous Waste Management Act Closure Plan of the Waste Calcine Facility (WCF) at the Idaho National Engineering and Environmental Laboratory, EPA ID No. ID4890008952

DEQ has reviewed the Certification and supporting documents and conducted an inspection of the WCF. Based upon this review and unit inspection, DEQ hereby acknowledges completion of the activities specified in the approved Closure Plan.

In accordance with Section 5 of the approved Closure Plan, the substantive post-closure care requirements of IDAPA 16.01.05.009 [40 CFR §265.310] for the WCF will be addressed under CERCLA as Applicable or Relevant and Appropriate Requirements (ARARs) under the Final Record of Decision and Post-Record of Decision Monitoring Plan for Operable Unit 3-13.

During the preparation of the Post-Record of Decision Monitoring Plan, DEQ requests DOE to preform quarterly monitoring to meet the substantive requirements of IDAPA 16.01.05.009 [40 CFR §265.310(b)]. The Monitoring Plan shall include the following:

- Maintain and monitor the effectiveness of the closure cap.
- Ensure proper run on and runoff of the cover cap.
- Protect and maintain surveyed benchmarks.
- Perform quarterly groundwater monitoring events or adequately describe how a current groundwater monitoring system will sufficiently monitor any contamination from the WCF.

The interim Inspection Schedule shall be submitted within 90 days of receipt of this letter, in accordance with IDAPA 16.01.05.009 [40 CFR §265.118].

If you have any questions or comments, please contact Dinah Little at 208/373-0426.

Sincerely,

Robert E. Bullock
Hazardous Waste Permit Coordinator
State Waste Management & Remediation Program Office

REB/DEL/ra INEEL99\WCFCERT.LTR

cc: Jeff Hunt, EPA Region 10
Rensay Owen, IFRO
INipwc
COF

CH2M•WG Idaho, LLC
P.O. Box 2010
Idaho Falls, Idaho 83403-2010
208-533-0411

September 19, 2011

CCN 312454

Mr. Brian R. Monson
Hazardous Waste Program Manager
Waste Management and Remediation Division
Department of Environmental Quality
1410 North Hilton
Boise, Idaho 83706

SUBJECT: Transmittal of the Certification for the CPP-601/627/640 System Hazardous Waste Management Act/ Resource Conservation and Recovery Act Landfill Closure – Phase 2

Dear Mr. Monson:

This letter transmits the Owner and Operator Certification, Professional Engineer Certification and supporting documentation for the CPP-601/627/640 Hazardous Waste Management Act (HWMA)/Resource Conservation and Recovery Act (RCRA) Landfill Closure –Phase 2 at the Idaho National Laboratory.

CH2M-WG Idaho, LLC and the Department of Energy Idaho Operations Office (DOE) have signed the Owner and Operator certification according to the closure plan approved by the Idaho Department of Environmental Quality (DEQ) as a Class 1 Permit Modification to the Idaho Nuclear Technology and Engineering Center Liquid Waste Management System Hazardous Waste Management Act Storage and Treatment (Volume 14) Permit and the Idaho Administrative Procedures Act 58.01.05.008 (Title 40 Code of Federal Regulations 264.115).

The Owner and Operator Certification and the Professional Engineer Certification and supporting documentation complete Phase 2 of the CPP-601/627/640 HWMA/RCRA landfill closure according to the closure plan.

If you have questions please contact Susan Evans at (208) 521-5657 or (208) 533-0086.

Sincerely,

DP Hutchison

David P. Hutchison, Director
Environmental and Regulatory Services

SKE:caf

Attachment

cc: J. W. Barker, CWI, 9163
H. Brown, CWI, MS 9301
T. J. Dieter, CWI, MS 9101
M. R. Lewis. CWI, MS 9103
M. M. Mitchell, DOE-ID, MS 1221
T. Safford, DOE-ID, MS 1216
D. L. Wessman, DOE-ID, MS 1216

OWNER AND OPERATOR CERTIFICATION

Professional Engineer Certification and Supporting Documentation for the State of Idaho Hazardous Waste Management Act (HWMA)/ Resource Conservation and Recovery Act (RCRA) the CPP-601/627/640 Landfill Closure - Phase 2 at the Idaho National Laboratory

EPA I.D. Number ID4890008952

The undersigned certifies in accordance with IDAPA 58.05.008 [40 CFR 264.115] as follows:

Based on my inquiry of the person or persons who managed the closure activities, or those persons directly responsible for conducting the closure, I certify that to the best of my knowledge and belief, the actions taken to complete the CPP-601/627/640 Landfill Closure - Phase 2 have been performed in accordance with the specifications of the closure plan as approved by the State of Idaho Department of Environmental Quality.

Owner Signature: _____

Owner Name: for Richard B. Provencher

Title: Manager
Department of Energy, Idaho Operations Office

Date: 9-15-2011

The undersigned certifies in accordance with IDAPA 58.05.008 [40 CFR 264.115] as follows:

I certify that the actions taken to complete the CPP-601/627/640 Landfill Closure - Phase 2 have been performed in accordance with the specifications of the closure plan for the tank system as approved by the by the State of Idaho Department of Environmental Quality.

Operator Signature: _____ for KEVIN DANIELS

Operator Name: Kevin W. Daniels

Title: Vice President, ESH &QA
CH2M-WG Idaho, LLC

Date: AUG. 31ST 2011

Attachments:

- "Professional Engineer Certification," August 2011
- *Supporting Documentation for Certification of the CPP-601/627/640 Landfill Closure - Phase 2*, August 2011.

PROFESSIONAL ENGINEER CERTIFICATION

I, Michael L. Vosk, a certified professional engineer, hereby certify, to the best of my knowledge and belief, that I have reviewed the status of the Idaho National Laboratory hazardous waste unit, regulated under the State of Idaho's Hazardous Waste Management Act, entitled

CPP-601/627/640 Landfill Phase 2
Name of Hazardous Waste Unit

I also certify that closure of the aforementioned unit has been performed in accordance with the specifications of the closure plan for the unit approved by the State of Idaho Department of Environmental Quality. The basis of this certification is described in supporting documentation, which has been provided to the Idaho National Laboratory.

Signature

8-30-11
Date

License No. 11911, Idaho
State Professional Engineer License No., Issued by State of

Portage, Inc.
Business

1075 S. Utah Ave., Suite 200
Address

Idaho Falls, Idaho 83402
Address

(208) 528-6608
Telephone Number

PROFESSIONAL ENGINEER LICENSED 11911 STATE OF IDAHO MICHAEL L. VOSK

8-30-11

(Seal)

CH2M • WG Idaho, LLC
P.O. Box 2010
Idaho Falls, Idaho 83403-2010
208-533-0411

December 1, 2011

CCN 312800

Mr. Brian R. Monson
Hazardous Waste Program Manager
Waste Management and Remediation Division
Department of Environmental Quality
1410 North Hilton
Boise, Idaho 83706

SUBJECT: Transmittal of the Survey Plat and Waste Record for the CPP-601/627/640 Landfill at the Idaho Nuclear Technology and Engineering Center on the Idaho National Laboratory

Dear Mr. Monson:

Enclosed is a copy of the recorded survey plat and waste record for the CPP-601/627/640 Landfill at the Idaho Nuclear Technology and Engineering Center (INTEC) on the Idaho National Laboratory (INL). The plat and waste record were filed with Butte County for recording on December 1, 2011 in accordance with the requirements specified in Hazardous Waste Management Act (HWMA)/Resource Conservation and Recovery Act (RCRA) Landfill Closure Plan for CPP-601, CPP-627, and CPP-640 which was approved by the Idaho Department of Environmental Quality.

A copy of the recorded survey plat and waste record has also been submitted to the United States Bureau of Land Management for inclusion in the land records meeting the requirement that a notation on the deed to the property or other instrument used for title search be filed in accordance with Idaho law as required by the Idaho Administrative Procedures Act (IDAPA) 58.01.05.008 [40 Code of Federal Regulations (CFR) 264.119(b)(1)]. The notation will in perpetuity notify any potential purchaser of the property that: 1) The land has been used to manage hazardous wastes; 2) future use is restricted under IDAPA 58.01.05.008 (40 CFR 264, Subpart G) regulations, and 3) the survey plat and record of the type, location, and quantity of hazardous wastes disposed of within the CPP-601/627/640 landfill required by IDAPA 58.01.05.008 [40 CFR 264.116 and 264.119(a)] have been filed with the Butte County commissioners.

The recorded survey plat and waste record support the HWMA/RCRA closure of CPP-601, CPP-627, and CPP-640 as a landfill.

If you have questions related to this landfill closure and the documentation please contact Dave Eaton at (208)-533-0621 or (208)-520-3714 or Susan Evans at (208) 521-5657 or (208) 533-0086.

Sincerely,

D P Hutchison

David P. Hutchison, Director
Environmental and Regulatory Services

SKE:caf

Attachment

cc: J. W. Barker, CWI, 9163
H. Brown, CWI, MS 9301
K. W. Daniels, CWI, MS 9204
T. J. Dieter, CWI, MS 9101
M. R. Lewis. CWI, MS 9103
M. M. Mitchell, DOE-ID, MS 1221
T. Safford, DOE-ID, MS 1216
D. L. Wessman, DOE-ID, MS 1216

CH2M•WG Idaho, LLC
P.O. Box 2010
Idaho Falls, Idaho 83403-2010
208-533-0411

December 1, 2011

CCN 312797

Mr. Joe Kraayenbrink
Idaho Falls District
United States Bureau of Land Management
1405 Hollipark Drive
Idaho Falls, ID. 83401

SUBJECT: Transmittal of the Recorded Survey Plat and Waste Record for the CPP-601/627/640 Landfill Closure at the Idaho Nuclear Technology and Engineering Center on the Idaho National Laboratory

Dear Mr. Kraayenbrink:

Enclosed for the United States Bureau of Land Management land records is a copy of the survey plat and waste record for the CPP-601/627/640 Landfill at the Idaho Nuclear Technology and Engineering Center (INTEC) on the Idaho National Laboratory (INL). The plat and waste record were filed with Butte County in accordance with the requirements specified in Hazardous Waste Management Act (HWMA)/Resource Conservation and Recovery Act (RCRA) Landfill Closure Plan for CPP-601, CPP-627, and CPP-640 which was approved by the Idaho Department of Environmental Quality.

The survey plat and waste record support the HWMA/RCRA closure of CPP-601, CPP-627, and CPP-640 as a landfill. The survey plat, entitled "INTEC CPP-601/627/640 Landfill Earthen Cover–Record of Survey" identifies pertinent information supporting the landfill closure such as the footprint and coordinates of the earthen cover and a statement regarding restricted future use of the property. The waste record, entitled "INTEC CPP-601, CPP-627, and CPP-640 Landfill Constituents Waste Record" lists the remaining mass of waste constituents in the CPP-601/627/640 Landfill.

If you have questions related to this landfill closure and the documentation please contact Dave Eaton at (208)-533-0621 or (208)-520-3714 or Susan Evans at (208) 521-5657 or (208) 533-0086.

Sincerely,

DP Hutchison

David P. Hutchison, Director
Environmental and Regulatory Services

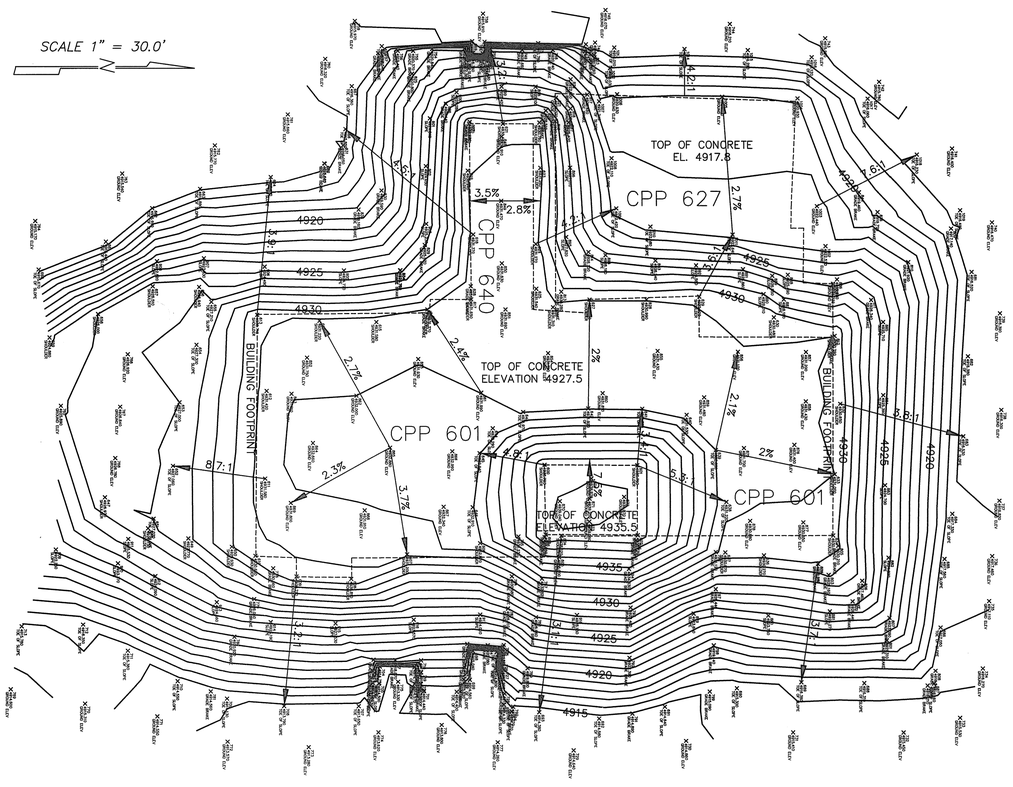
SKE:caf

Enclosure

cc: J. W. Barker, CWI, 9163
H. Brown, CWI, MS 9301 (w/o Enc.)
K. W. Daniels, CWI, MS 9204 (w/o Enc.)
T. J. Dieter, CWI, MS 9101 (w/o Enc.)
M. R. Lewis. CWI, MS 9103 (w/o Enc.)
M. M. Mitchell, DOE-ID, MS 1221 (w/o Enc.)
T. Safford, DOE-ID, MS 1216
D. L. Wessman, DOE-ID, MS 1216

FMT-D1-REV 5.2

REVISIONS	
REV	DESCRIPTION
1	ADDED "SPECIAL INSTRUCTIONS" SEE DRF-334611



CPP-42, PMK MH
N/E OF CPP-606
N=695976.93
E=296673.70
EL=4913.70

N 1°55'38" W
732.07'
BASIS OF BEARINGS – CPP-43 TO CPP-42
INTEC SITE SPECIFIC COORDINATE SYSTEM

CPP-43, PK NAIL
BEECH AND OLIVE STREETS
N=695245.26
E=296698.37
EL=4914.24

PROFESSIONAL LAND SURVEYOR
JEFF L. WILLIAMS
8252
STATE OF IDAHO
2011.11.30
08:42:00 -07'00'

SURVEYOR'S CERTIFICATE

I, JEFF L. WILLIAMS, DO HEREBY CERTIFY THAT I AM A PROFESSIONAL LAND SURVEYOR AND THAT I HOLD CERTIFICATE NUMBER 8252 AS PRESCRIBED BY THE LAWS OF THE STATE OF IDAHO, I FURTHER CERTIFY THAT THE SURVEY SHOWN ON THIS DRAWING IS CORRECTLY REPRESENTED HEREON.

NO. 49168
RECORDED
DEC 01 2011
AT 1:23
COUNTY RECORDER

RECORD OF SURVEY

SPECIAL INSTRUCTIONS:
USE OR DISTURBANCE OF THIS PROPERTY IS RESTRICTED IN ACCORDANCE WITH 40 CFR 264 SUBPART G CLOSURE AND POST CLOSURE REQUIREMENTS

SIGNATURES/DATES APPLY TO CURRENT RELEASE ONLY	SIGN AND DATE
DESIGN: NA	– –
DRAFTER: B. CROUSE	Billie Crouse CWI 2011.11.30 08:50:23 -07'00'
TECHNICAL CHECK: NA	– –
ENG GROUP SUPERVISOR: NA	– –
DESIGN LEAD: NA	– –
DRAFTING CHECK/ EFFECTIVE DATE: B. RHODES	Barry E. Rhodes CWI 2011.11.30 09:33:24 -07'00'
PROJECT NUMBER:	
DRF NUMBER: 334163	

Idaho Cleanup Project CH2M•WG IDAHO, LLC

INTEC
CPP-601/627/640
LANDFILL EARTHEN COVER

RECORD OF SURVEY

SIZE	INDEX CODE NUMBER				DWG-	REV
	AREA	TYPE	CL	ORIG		
D	200	0000	02	136	776142	1

SCALE: 1"=30.0' SHEET 1 OF 1

File: 776142-1.dwg
Path: L:\Y709_INTEC\B. CROUSE\drf-334611 rev 1 on earthen cover
Date: 11/21/11 – 11:43 AM | Layout Name: Layout1
Drawn By: Steve Eaton
ID: CROUBL

FMT-D1-REV 5.2

REVISIONS	
REV	DESCRIPTION

CPP-601/627/640 SUMMARY OF CONTAMINANTS REMAINING AFTER COMPLETION OF LANDFILL CLOSURE.	
CONSTITUENT	REMAINING MASS (KG)
ALUMINUM	1.46
ANTIMONY	1.25
ARSENIC	0.03
BARIUM	16.26
BERYLLIUM	0.01
BORON	907.20
CADMIUM	52.40
CALCIUM	0.46
CHLORIDE	3.61
CHROMIUM	107,783
COBALT	0.04
COPPER	113,437
DI-N-BUTYLPHTHALATE	0.003
FLUORIDE	1.37
HEXONE	276
IRON	36.04
LEAD	117,698
MAGNESIUM	0.05
MANGANESE	0.60
MERCURY	1.33
NICKEL	58,156
NITRATE	1,059
POLYCHLORINATED BIPHENYLS (PCBS)	108.50
POTASSIUM	0.04
SELENIUM	0.02
SILVER	0.56
SODIUM	0.07
SULFATES	2.15
THALLIUM	0.04
TIN	129
URANIUM	1.15
VANADIUM	0.05
ZINC	299.52

NO. 4/9109
RECORDED
DEC 0 1 20
AT 1:30
BY

SIGNATURES/DATES APPLY TO CURRENT RELEASE ONLY	SIGN AND DATE
DESIGN: NA	– –
DRAFTER: B. CROUSE	Billie Crouse CWI 2011.11.30 16:05:22 -07'00'
TECHNICAL CHECK: NA	– –
ENG GROUP SUPERVISOR: NA	– –
DESIGN LEAD: NA	– –
DRAFTING CHECK/ EFFECTIVE DATE: B. RHODES	Barry E. Rhodes CWI 2011.11.30 16:09:48 -07'00'
PROJECT NUMBER: NA	
DRF NUMBER: 335039	

INDEX CODE NUMBER			
AREA	TYPE	CL	ORIG
200	0627	38	136
INDEX CODE NUMBER			
AREA	TYPE	CL	ORIG
200	0640	38	136

Idaho Cleanup Project CH2M•WG IDAHO, LLC

INTEC CPP-601, CPP-627, CPP-640
LANDFILL CONSTITUENTS WASTE RECORD

SIZE	INDEX CODE NUMBER				DWG-	REV
	AREA	TYPE	CL	ORIG		
D	200	0601	38	136	777527	

SCALE: NONE

SHEET 1 OF 1

File: 777527.dwg
Path: L:\FY09_INTEC\B. CROUSE\Dave Eaton\drf-335039
Date: 11/30/11 - 4:01 PM | Layout Name: Layout1 | ID: CROUBL

STATE OF IDAHO
DEPARTMENT OF
ENVIRONMENTAL QUALITY

REC'D JAN 0 3 2012

CCN 312918

1410 North Hilton • Boise, Idaho 83706 • (208) 373-0502

C.L. "Butch" Otter, Governor
Toni Hardesty, Director

December 23, 2011

Ms. Nicole Brooks
DOE NE-ID
1955 Fremont Ave
Idaho Falls, Idaho 83401-1216

Subject: Acceptance of the Survey plat and Waste Record for the CPP-601/627/640 Landfill at the Idaho Nuclear Technology and Engineering Center (INTEC) on the Idaho National Laboratory (INL-EPA ID No. ID4890008952)

Dear Ms. Brooks:

The Department of Environmental Quality (DEQ) has received the survey plat and waste record for the CPP-601/627/640 Landfill at INTEC on the INL. The submittal included documentation that the survey plat has been recorded with Butte County, including notices concerning future land use restrictions.

While the cap is an interim cap rather than the final cover, the documents submitted are consistent with IDAPA 58.01.05.008 [40 CFR Part 264 Subpart G]. Therefore, DEQ accepts the survey plat as an interim document pending final closure of the CPP-601/627/640 site.

If you have any questions on this matter please contact Mr. Brian English at (208) 373-0425.

Sincerely,

Natalie Clough for REB

Robert E. Bullock
Hazardous Waste Permits Manager
Waste Management and Remediation Division

REB:BLE:js CPP601SurveyPlat

cc: R. Hedeen, EPA Region 10
Ann Boehmer, CWI
INipwc
COF

ATTACHMENT 2

ATTACHMENT 2 SECURITY, INSPECTIONS, and MAINTENANCE PLANS consisting of:

- Security Procedures and Equipment, Section B of the INTEC Post-Closure Permit Reapplication for the Volume 21 Waste Calcine Facility and CPP-601/627/640,

- Preparedness and Prevention Waiver, Section C of the INTEC Post-Closure Permit Reapplication for the Volume 21 Waste Calcine Facility and CPP-601/627/640,

- General and Specific Inspection Schedule, Section D of the INTEC Post-Closure Permit Reapplication for the Volume 21 Waste Calcine Facility and CPP-601/627/640,

- Maintenance Activities, Section E of the INTEC Post-Closure Permit Reapplication for the Volume 21 Waste Calcine Facility and CPP-601/627/640,

- Example of Inspection Forms of the INTEC Post-Closure Permit Reapplication for the Volume 21 Waste Calcine Facility and CPP-601/627/640,

- Example of Sampling and Analysis Plan Tables of the INTEC Post-Closure Permit Reapplication for the Volume 21 Waste Calcine Facility and CPP-601/627/640.

ATTACHMENT 2 - SECURITY PROCEDURES & EQUIPMENT

HWMA/RCRA INTEC POST-CLOSURE PERMIT REAPPLICATION

Volume 21

Waste Calcine Facility and CPP-601/627/640

Attachment 2

Section B, Security Procedures and Equipment

April 2013

B. SECURITY PROCEDURES AND EQUIPMENT IDAPA 58.01.05.012 and 008 [40 CFR §§ 270.14(b)(4) and 264.14]

Security

Specific security measures taken for INTEC include fencing, warning signs, keycard access or personnel sign-in, and building locks.

Security Procedures and Equipment [IDAPA 58.01.05.008 and 58.01.05.012; 40 CFR §§ 264.14 and 270.14(b)(4)]

A security system, physical control procedures, and equipment control access to INTEC. A security force operates the security system.

The security force's operations are consistent with DOE-ID directives and orders on access control. The DOE operates a personnel security clearance program to ensure that employees who are required to have a clearance to perform their duties are evaluated and cleared consistently with DOE-ID security policies.

Fencing, guarded gates, and uniformed guards with communication devices are used at INTEC. There are internal communication devices, such as a telephone system in occupied buildings at INTEC. The same communication devices are used for communication outside of the plant. The INTEC also has a plant-wide voice paging system that is used to announce critical information regarding security and safety.

24-Hour Surveillance System [IDAPA 58.01.05.008; 40 CFR § 264.14(b)(1)]

Security at INTEC is provided by trained security guards, who monitor the entry and egress of people and material from the INTEC facility. The main INTEC guard gate at the west side of INTEC is staffed with guards 24 hours a day, seven days a week. There are other gates into INTEC, and they are either locked or staffed with guards. The guards also perform other security functions within the plant premises, including patrolling the perimeter fence and areas throughout INTEC on a 24-hour basis.

Barrier and Means to Control Entry [IDAPA 58.01.05.008; 40 CFR § 264.14(b)(2)(i)]

The treatment, storage, or disposal facilities (TSDFs) at INTEC are enclosed within a fence. All gates into INTEC are either locked or manned with security guards.

Barrier

The INTEC facility is located approximately 42 air miles west of the largest nearby population area, Idaho Falls, Idaho. The entire INTEC facility area is enclosed within a fence. There are gates in the perimeter fences, but only three guarded gates. These gates are identified with the Guard Post (building) where they are located. The Guard Posts are numbered P-501 (CPP-1686), P-507 (CPP-661), and P-521 (CPP-697). The other gates are locked but can be opened by patrols when requested.

Means to Control Entry [IDAPA 58.01.05.008; 40 CFR § 264.14 (b)(ii)]

Employees, sub-contractors, or vendors that have completed required access training and have keycard access are not escorted in the general INTEC interior.

Individuals that have the required access training but do not have keycard access sign an "Employee Log" and are allowed into INTEC without being escorted.

Individuals that do not have the required access training and do not have keycard access are escorted and sign a "Visitors Log" to gain access to INTEC.

ATTACHMENT 2 - PREPAREDNESS & PREVENTION

HWMA/RCRA INTEC POST-CLOSURE PERMIT REAPPLICATION

Volume 21
Waste Calcine Facility and CPP-601/627/640

Attachment 2
Section C, Preparedness and Prevention Waiver

April 2013

C. Preparedness and Prevention IDAPA 58.01.05.008 [40 CFR § 264 Subpart C]

A waiver from these requirements, Preparedness and Prevention, has been approved by the DEQ based on the following:

- The WCF and CPP-601/627/640 were closed as landfills and are concrete monoliths
- The WCF and CPP-601/627/640 landfills are unoccupied and there is no movement of waste into or out of the units
- There is no safety equipment, alarms, communication devices, or fire fighting equipment associated with the WCF or the CPP-601/627/640 landfills
- The WCF and CPP-601/627/640 landfills have no need for adequate aisle space.

None of the requirements described in 40 CFR 264 Subpart C apply to the WCF or the CPP-601/627/640 landfill monoliths.

In addition, as described in Section B, Security Procedures and Equipment, access to the WCF and CPP-601/627/640 monoliths is controlled through physical barriers. These barriers prevent unauthorized personnel from contact with the WCF or CPP-601/627/640 monoliths.

ATTACHMENT 2 - INSPECTION SCHEDULE

HWMA/RCRA INTEC POST-CLOSURE PERMIT REAPPLICATION

Volume 21
Waste Calcine Facility and CPP-601/627/640

Attachment 2
Section D, Inspection Schedule

April 2013

D. GENERAL AND SPECIFIC INSPECTION SCHEDULE IDAPA 58.01.05.012 and 008 [40 CFR 270.14(b)(5) AND 264.15(b)(1)]

The WCF landfill cap and the CPP-601/627/640 earthen cover, storm water drainage system, security system, and groundwater monitoring system are inspected for malfunctions, deterioration, and discharges that may cause, or may lead to, releases of hazardous waste constituents to the environment or a threat to human health. No safety or emergency equipment is associated with the closed WCF and CPP-601/627/640 facilities. Areas subject to inspection under this permit reapplication include:

- WCF landfill cap
- CPP-601/627/640 earthen cover
- INTEC facility security system
- Groundwater monitoring system.

D.1 Integrity of the WCF Landfill Cap and CPP-601/627/640 Earthen Cover

The integrity of the WCF landfill cap and the CPP-601/627/640 earthen cover are inspected on a semi-annual basis. The inspections are documented on the RCRA WCF and CPP-601/627/640 Post-Closure Monitoring forms. The forms are used to document the inspection and the findings of the following:

- Concrete cap (for cap surface erosion, cracks, spalling, subsidence, joint seal condition)
- Earthen cover (for surface pooling, subsidence, erosion, animal intrusion)
- Surface drainage (for runoff drainage maintained away from the cap)
- Brass benchmarks [integrity of brass survey caps]

The inspection frequency may be modified based on information obtained from the monitoring.

D.2 Security System for the INTEC Facility

Security items at the INTEC requiring inspection include:

- Signs and fences for integrity
- Gates and locks for integrity and operability
- Badge readers for integrity and operability

The frequency of inspection for security equipment varies and is based on the manufacturer's maintenance recommendations and equipment history. The inspection of security equipment is developed by Security Systems Maintenance and is specified by the specific building and/or device being inspected.

D.3 Groundwater Monitoring System

The need to inspect the condition of monitoring wells developed as a result of past data collection efforts, site construction work, and natural deterioration. Examples of possible problems at monitoring wells could include:

- Well identification
- Inoperable locks
- Cracked surface casing
- Damaged cement pads
- Compromised impingement protection

The frequency and location of well maintenance activities are subject to changing well conditions. As a general rule, the overall condition of each well will be visually inspected at each visit to the well. Formal inspection of the wells will be completed and documented on a semi-annual basis. As current wells age and future wells are drilled, various problems related to the physical integrity of the well may arise that need to be addressed. Some of these problems include borehole cleanout from formation slough, pump work (trip-in, trip-out, troubleshoot, and repair), pump corrosion, and e-line retrieval repairs are made in accordance to inspection findings.

ATTACHMENT 2 - MAINTENANCE ACTIVITIES

HWMA/RCRA INTEC POST CLOSURE PERMIT REAPPLICATION

Volume 21

Waste Calcine Facility and CPP-601/627/640

Attachment 2

Section E, Maintenance Activities

September 2013

E. Maintenance Activities
IDAPA 58.01.05.008 [264.118(B)(2)]

E.1 Maintenance of Landfill Cap and Final Cover

If, during the semi-annual cap inspections, deficiencies are noted, the following will be performed to maintain the integrity of the containment system:

- Replace soil lost to erosion
- Maintain drainage channels and culverts that direct surface run-on and runoff away from the disposal area and prevent surface water from infiltrating the cover
- Control rodents as necessary to counter infestations (e.g., filling of rodent burrows and applying rodenticide)
- Remove and replace cracked areas with grout or an appropriate concrete patch material, if cracks in the concrete greater than ½ inch (in width) are discovered.

Additional inspections will be conducted following severe storms, and maintenance activities will be completed as necessary. A severe storm is defined as greater than 0.5 inches of precipitation in a 24-hour period as measured at the NOAA mesonet site near INTEC (labeled as GRI).

E.2 Monitoring Well Maintenance

The need to inspect and repair the condition of monitoring wells was identified as a result of past data collection efforts, site construction work, and/or natural deterioration. Examples of possible problems at monitoring wells include inoperable locks, cracked surface casings, and damaged cement pads. As current wells age and future wells are drilled, various problems with regard to the physical integrity of the well may arise that need to be addressed. Some of these include borehole cleanout from formation slough, pump work (trip-in, trip-out, troubleshoot, and repair), pump corrosion, and e-line retrieval. Construction of new monitoring wells shall be performed in accordance with 40 CFR § 264.97(c).

Attempts to analyze field-collected data have also shown the importance of maintaining wells. For example, water-table map construction is complicated with elevation survey

inconsistencies. This occurs when the surface construction of a given well is altered, rendering the measuring point elevation invalid.

The frequency and location of well maintenance activities are subject to changing well conditions. As a general rule, the overall condition of each well will be visually inspected at each visit to the well for ground water sampling purposes. The wells will be inspected semiannually. Maintenance problems encountered at any well location will be addressed as they occur.

E.2.1 Maintenance Implementation

The overall condition of each well in the monitoring well network will be checked in conjunction with the water-level surveys. Observed damage will be noted in the field logbook and the Project Manager (PM) for well services and surveillance notified. Repairs to the damage(s) noted will be made prior to the next water level monitoring or groundwater sampling event.

E.2.2 Maintenance Tracking

The PM, well services and surveillance, directs and tracks well repair activities as they occur. Changes to a well or wellhead, whether or not related to damage observed during an inspection, are recorded in field logbooks and/or well modification logs. Examples of changes that may occur include, but are not limited to, modifying surface casing dimensions, adding/removing the landing plate. If a well modification results in alteration of the current water-level measuring point, a new water-level measuring point will be established.

E.2.3 Corrective Actions

In the event a discrepancy is discovered by field personnel or auditors, the appropriate corrective action will be initiated. The level of action taken is related to the level of the discrepancy. Corrective actions can range from field changes resulting from unforeseen field conditions to DOE reportable incidents.

E.3 Maintenance of Security System

Maintenance of the RCRA barriers and related equipment will be performed by Facility Operations throughout the post-closure period. The need for maintenance shall be identified

through routine inspection. Examples of maintenance that shall be performed include fence repair, and light replacement, as applicable.

Facility Operations Maintenance follows a preventive maintenance schedule approved by Facility Management. The schedule is maintained at the INTEC facility and is developed based on the specific RCRA interest involved. The Preventive Maintenance Procedures outline the equipment to be tested and methods to use to perform the tests. The frequency of inspection is based on the manufacturer recommendations and equipment history. Equipment problems and malfunctions identified during preventive maintenance are tracked through a work control system. The records shall be maintained for at least three years from the date of inspection and repair.

E.4 Name of Contact for Post-Closure IDAPA 58.01.05.008 [264.118 (b)(3)]

The name, address and telephone number of the person to contact during the post-closure period is:

INTEC Plant Shift Manager
P.O. Box 2010
Idaho Falls, ID 83403
Phone number (208) 526-3100.

ATTACHMENT 2 - INSPECTION FORMS

HWMA/RCRA INTEC POST-CLOSURE PERMIT REAPPLICATION

Volume 21
Waste Calcine Facility and CPP-601/627/640

Attachment 2
Examples of Inspection Checklists

September 2013

RCRA WCF and CPP-601/627/640
WELL INSPECTIONS

Previous Inspection Checked (Initial):_____

The Open RCRA Remedials Tracking Book Index for this form has been compared to the previous inspection form, the index has been updated, and the current open RCRA Remedials have been recorded on the tracking table. (Initials):_____

Notes:
1: Inspections should be performed in April and October of each year.

Well Identifier	Location Description	Inspection criteria	Inspection Date/Time: Normal Condition	Off-Spec Condition	Inspection	Comments
MW-2	North side of Bin Set III	Is well identifier in place and legible?	Yes	No	Yes / No	
		Are protective barriers in place?	Yes	No	Yes / No	
		Is the surface casing and cement pad intact?	Yes	No	Yes / No	
		Does well casing extend at least 12 inches above land surface and finished grade? [(a)]	Yes	No	Yes / No	
		Is top of well casing completely covered? [(a)]	Yes	No	Yes / No	
		Is wellhead cover securely attached to the well casing? [(a)]	Yes	No	Yes / No	
ICPP-2019	East side of Bin Set III	Is well identifier in place and legible?	Yes	No	Yes / No	
		Are protective barriers in place?	Yes	No	Yes / No	
		Is the surface casing and cement pad intact?	Yes	No	Yes / No	
		Does well casing extend at least 12 inches above land surface and finished grade? [(a)]	Yes	No	Yes / No	
		Is top of well casing completely covered? [(a)]	Yes	No	Yes / No	
		Is wellhead cover securely attached to the well casing? [(a)]	Yes	No	Yes / No	
MW-12-2	North side of CPP-1684	Is well identifier in place and legible?	Yes	No	Yes / No	
		Are protective barriers in place?	Yes	No	Yes / No	
		Is the surface casing and cement pad intact?	Yes	No	Yes / No	
		Does well casing extend at least 12 inches above land surface and finished grade? [(a)]	Yes	No	Yes / No	
		Is top of well casing completely covered? [(a)]	Yes	No	Yes / No	
		Is wellhead cover securely attached to the well casing? [(a)]	Yes	No	Yes / No	
CPP-55-06	South west corner of TB-1	Is well identifier in place and legible?	Yes	No	Yes / No	
		Are protective barriers in place?	Yes	No	Yes / No	
		Is the surface casing and cement pad intact?	Yes	No	Yes / No	
		Does well casing extend at least 12 inches above land surface and finished grade? [(a)]	Yes	No	Yes / No	
		Is top of well casing completely covered? [(a)]	Yes	No	Yes / No	
		Is wellhead cover securely attached to the well casing? [(a)]	Yes	No	Yes / No	

a) IDAPA 37.03.09.36 Well Construction Standards

RCRA WCF and CPP-601/627/640
WELL INSPECTIONS

Well Identifier	Location Description	Inspection criteria	Inspection Date/Time: Normal Condition	Off-Spec Condition	Inspection	Comments
MW-18-2	South side of Bin Set II	Is well identifier in place and legible?	Yes	No	Yes / No	
		Are protective barriers in place?	Yes	No	Yes / No	
		Is the surface casing and cement pad intact?	Yes	No	Yes / No	
		Does well casing extend at least 12 inches above land surface and finished grade? [(a)]	Yes	No	Yes / No	
		Is top of well casing completely covered? [(a)]	Yes	No	Yes / No	
		Is wellhead cover securely attached to the well casing? [(a)]	Yes	No	Yes / No	
MW-5-2	South side of CPP-633 (WCF cap)	Is well identifier in place and legible?	Yes	No	Yes / No	
		Are protective barriers in place?	Yes	No	Yes / No	
		Is the surface casing and cement pad intact?	Yes	No	Yes / No	
		Does well casing extend at least 12 inches above land surface and finished grade? [(a)]	Yes	No	Yes / No	
		Is top of well casing completely covered? [(a)]	Yes	No	Yes / No	
		Is wellhead cover securely attached to the well casing? [(a)]	Yes	No	Yes / No	
ICPP-2018	West side of CPP-633 (WCF cap)	Is well identifier in place and legible?	Yes	No	Yes / No	
		Are protective barriers in place?	Yes	No	Yes / No	
		Is the surface casing and cement pad intact?	Yes	No	Yes / No	
		Does well casing extend at least 12 inches above land surface and finished grade? [(a)]	Yes	No	Yes / No	
		Is top of well casing completely covered? [(a)]	Yes	No	Yes / No	
		Is wellhead cover securely attached to the well casing? [(a)]	Yes	No	Yes / No	
MW-10-2	West side of CPP-659	Is well identifier in place and legible?	Yes	No	Yes / No	
		Are protective barriers in place?	Yes	No	Yes / No	
		Is the surface casing and cement pad intact?	Yes	No	Yes / No	
		Does well casing extend at least 12 inches above land surface and finished grade? [(a)]	Yes	No	Yes / No	
		Is top of well casing completely covered? [(a)]	Yes	No	Yes / No	
		Is wellhead cover securely attached to the well casing? [(a)]	Yes	No	Yes / No	
CPP-33-1	On Tank Farm, East of CPP-604	Is well identifier in place and legible?	Yes	No	Yes / No	
		Are protective barriers in place?	Yes	No	Yes / No	
		Is the surface casing and cement pad intact?	Yes	No	Yes / No	
		Does well casing extend at least 12 inches above land surface and finished grade? [(a)]	Yes	No	Yes / No	
		Is top of well casing completely covered? [(a)]	Yes	No	Yes / No	
		Is wellhead cover securely attached to the well casing? [(a)]	Yes	No	Yes / No	

RCRA WCF and CPP-601/627/640
WELL INSPECTIONS

Well Identifier	Location Description	Inspection criteria	Inspection Date/Time: Normal Condition	Off-Spec Condition	Inspection	Comments
ICPP-2196	South edge of CPP-601 asphalt pad	Is well identifier in place and legible?	Yes	No	Yes / No	
		Are protective barriers in place?	Yes	No	Yes / No	
		Is the surface casing and cement pad intact?	Yes	No	Yes / No	
		Does well casing extend at least 12 inches above land surface and finished grade? [(a)]	Yes	No	Yes / No	
		Is top of well casing completely covered? [(a)]	Yes	No	Yes / No	
		Is wellhead cover securely attached to the well casing? [(a)]	Yes	No	Yes / No	
ICPP-2205	North west of D-12 Valve Box	Is well identifier in place and legible?	Yes	No	Yes / No	
		Are protective barriers in place?	Yes	No	Yes / No	
		Is the surface casing and cement pad intact?	Yes	No	Yes / No	
		Does well casing extend at least 12 inches above land surface and finished grade? [(a)]	Yes	No	Yes / No	
		Is top of well casing completely covered? [(a)]	Yes	No	Yes / No	
		Is wellhead cover securely attached to the well casing? [(a)]	Yes	No	Yes / No	
CPP-33-2	South side of CPP-750	Is well identifier in place and legible?	Yes	No	Yes / No	
		Are protective barriers in place?	Yes	No	Yes / No	
		Is the surface casing and cement pad intact?	Yes	No	Yes / No	
		Does well casing extend at least 12 inches above land surface and finished grade? [(a)]	Yes	No	Yes / No	
		Is top of well casing completely covered? [(a)]	Yes	No	Yes / No	
		Is wellhead cover securely attached to the well casing? [(a)]	Yes	No	Yes / No	
ICPP-2195	North of CPP-750	Is well identifier in place and legible?	Yes	No	Yes / No	
		Are protective barriers in place?	Yes	No	Yes / No	
		Is the surface casing and cement pad intact?	Yes	No	Yes / No	
		Does well casing extend at least 12 inches above land surface and finished grade? [(a)]	Yes	No	Yes / No	
		Is top of well casing completely covered? [(a)]	Yes	No	Yes / No	
		Is wellhead cover securely attached to the well casing? [(a)]	Yes	No	Yes / No	
MW-6	Northwest corner of Beech St. and Oak Ave.	Is well identifier in place and legible?	Yes	No	Yes / No	
		Are protective barriers in place?	Yes	No	Yes / No	
		Is the surface casing and cement pad intact?	Yes	No	Yes / No	
		Does well casing extend at least 12 inches above land surface and finished grade? [(a)]	Yes	No	Yes / No	
		Is top of well casing completely covered? [(a)]	Yes	No	Yes / No	
		Is wellhead cover securely attached to the well casing? [(a)]	Yes	No	Yes / No	

RCRA WCF and CPP-601/627/640
WELL INSPECTIONS

Well Identifier	Location Description	Inspection criteria	Inspection Date/Time: Normal Condition	Off-Spec Condition	Inspection	Comments
CPP-33-4-1	North of VES-WM-191, North side of Cypress Ave.	Is well identifier in place and legible?	Yes	No	Yes / No	
		Are protective barriers in place?	Yes	No	Yes / No	
		Is the surface casing and cement pad intact?	Yes	No	Yes / No	
		Does well casing extend at least 12 inches above land surface and finished grade? [(a)]	Yes	No	Yes / No	
		Is top of well casing completely covered? [(a)]	Yes	No	Yes / No	
		Is wellhead cover securely attached to the well casing? [(a)]	Yes	No	Yes / No	
CPP-37-4	North east of CPP-1678 (within the IWTU fenced area)	Is well identifier in place and legible?	Yes	No	Yes / No	
		Are protective barriers in place?	Yes	No	Yes / No	
		Is the surface casing and cement pad intact?	Yes	No	Yes / No	
		Does well casing extend at least 12 inches above land surface and finished grade? [(a)]	Yes	No	Yes / No	
		Is top of well casing completely covered? [(a)]	Yes	No	Yes / No	
		Is wellhead cover securely attached to the well casing? [(a)]	Yes	No	Yes / No	

Comments: _____

Open RCRA Remedials on this form:

Footnote Letter	Tracking Number	Date Remedial Was Identified	Deficiency Description/Comments:

Inspector's Name (Print): _____

Inspector's Signature: _____

Inspection Completed; Shift Supervisor's Signature: _____

Remedial Actions Completed or Not Required; Shift Supervisor's Signature: _____

RCRA WCF POST-CLOSURE MONITORING CAP INSPECTION

Previous Inspection Checked (Initials):_____ Date:_____ Time:_____

The Open RCRA Remedials Tracking Book Index for this form has been compared to the previous inspection form, the index has been updated, and the current open RCRA Remedials have been recorded on the tracking table. (Initials): _____

Notes:
1: Inspections should be performed in April and October of each year.

Equip/Area Inspected	Types of Problems/ Inspection Items	Yes	No	Observations	Nature of Repairs or Remedial Actions	Completion Date for Repairs/ Remedial Actions
Concrete Cap	Surface Erosion					
	Cracks (cracks greater than ½" wide need to be repaired)					
	Spalling (spalling to a depth of greater than ½" and an area greater than 1 ft^2 needs to be repaired)					
	Subsidence					
	Joint sealant present					
	Indication of Rodent Infestations					
Surface Drainage	Run-off drainage maintained away from cap					
Brass Benchmarks Inspections	Brass survey caps present					

Comments: _____

_____

_____

_____

Open RCRA Remedial on this form:

Footnote Letter	Tracking Number	Date Remedial was Identified	Deficiency Description/Comments

Inspector's Name: (Print) _____ Inspector's Signature: _____

Inspection Completed; Shift Supervisor's Signature: _____

Remedial Actions Completed or Not Required;

Shift Supervisor's Signature: _____

RCRA CPP-601/627/640 LANDFILL
SEMIANNUAL INSPECTION OF EARTHEN COVER

The Open RCRA Remedials Tracking Book Index for this form has been compared to the previous inspection form, the index has been updated, and the current open RCRA Remedials have been recorded on the tracking table. (Initials): _____

Notes:
1: Inspections should be performed in April and October of each year or following a severe storm, defined as greater than 0.5" of precipitation (i.e., rain or hail) in a 24 hour period as measured at the NOAA INL Weather Center. See last 24 hour precipitation totals for GRI (INTEC) at http://www.noaa.inel.gov/weather/precip.asp.

Inspection Date:____/_____/_____

Approximate Time of Inspection: _____

Previous inspection report reviewed: (Initials_____)

Inspection Items	Inspection Criteria	Issue/ Concern		Observations/Comments (Location of issue or concern) (Use additional space below as needed)	Nature of Repairs or Remedial Actions Needed	Completion Date for Repairs or Remedial Actions
		Yes	No			
1. Surface Pooling	Pools of standing water greater than 2 inches deep and greater than 10 ft^2					
2. Subsidence	Areas of subsidence greater than 2 inches deep and greater than 10 ft^2					
3. Erosion	Erosion channels or runnels greater than 2 inches deep and greater than 10 ft^2					
4. Animal Intrusion	Evidence of animal intrusion such as burrows.					

Further Comments:

Comment No.	Inspection Item No.	Remarks

Open RCRA remedial on this form:

Footnote Letter	Tracking No.	Date Remedial Was Identified	Deficiency Description/Comments

Inspector's Name: (Print) _____ Inspector's Signature: _____

Inspection Completed; Shift Supervisor's Signature: _____

Remedial Actions Completed or Not Required; Shift Supervisor's Signature: _____

ATTACHMENT 2 - SAMPLING & ANALYSIS PLAN TABLES

HWMA/RCRA INTEC POST-CLOSURE PERMIT REAPPLICATION

Volume 21
Waste Calcine Facility and CPP-601/627/640

Attachment 2
Examples of Sampling and Analysis Plan Tables

April 2013

Sampling and Analysis Plan Table for Chemical and Radiological Analysis

SAP Table #: WCF_FEB2013 SAP: PLN-1373 Project Manager: Neil Hutten

Project Name: WCF Spring 2013 Semiannual Ground Water Monitoring February 2013 Sampler: Danielle Millward

SAP Table Date: 12/3/2012 Revision #: SAM POC: Tracy Elder

Event	Media	Col. Type	Planned Date	Location	Type of Location	Location Place	Depth (ft)	AT1	AT2	AT3	AT4	AT5	AT6	AT7	AT8	AT9	AT10	AT11	AT12	AT13	AT14	AT15	AT16	AT17	AT18	AT19	AT20
WCF450	GROUND WATER	GRAB	02/04/2013	MW-5-2	Monitoring Well	INTEC	106.5 - 126.5	1	1	1																	
WCF451	GROUND WATER	GRAB	02/04/2013	CPP-33-1	Monitoring Well	INTEC	89 - 99	1	1	1																	
WCF452	GROUND WATER	GRAB	02/04/2013	MW-2	Monitoring Well	INTEC	102 - 112	1	1	1																	
WCF453	GROUND WATER	GRAB	02/04/2013	ICPP-2018	Monitoring Well	INTEC	97.9 - 117.9	1	1	1																	
WCF454	GROUND WATER	GRAB	02/04/2013	ICPP-2019	Monitoring Well	INTEC	95.2 - 120.2	2	2	2																	
WCF455	GROUND WATER	GRAB	02/04/2013	CPP-55-06	Monitoring Well	INTEC	93.1 - 113.1	2	2 T	2 T																	
WCF456	GROUND WATER	GRAB	02/04/2013	MW-10-2	Monitoring Well	INTEC	141 - 151	1	1	1																	
WCF457	WATER	FB	02/04/2013	INTEC	Field Blank	QC	NA	1	1	1																	
WCF458	WATER	TB	02/04/2013	INTEC	Trip Blank	QC	NA			1																	

AT1: Metals - Filtered
AT2: Semivolatile
AT3: Volatile
AT4:
AT5:
AT6:
AT7:
AT8:
AT9:
AT10:
AT11:
AT12:
AT13:
AT14:
AT15:
AT16:
AT17:
AT18:
AT19:
AT20:

Comments:
Metal - Filtered - Arsenic, Barium, Cadmium, Chromium, Lead, Mercury, Selenium, and Silver

The priority order for collection is Metals, VOCs, SVOCs

Triple volume for lab QC shall only be collected for the field sample and not for its duplicate.

Analysis Suites:

Contingencies:

Sampling and Analysis Plan Table for Chemical and Radiological Analysis

SAP Table #: CPP601-12thQTR SAP: PLN-1373 Project Manager: Neil Hutten

Project Name: CPP-601/627/640 Post-closure Monitoring - 12th Quarter Sampler: Danielle Millward

SAP Table Date: 12/3/2012 Revision #: SAM POC: Tracy Elder

Event	Media	Col. Type	Planned Date	Location	Type of Location	Location Place	Depth (ft)	AT1	AT2	AT3	AT4	AT5	AT6	AT7	AT8	AT9	AT10	AT11	AT12	AT13	AT14	AT15	AT16	AT17	AT18	AT19	AT20
CPP554	GROUND WATER	GRAB	01/28/2013	CPP-33-2	Monitoring Well	INTEC	85.8 - 105.8	1	1	1	1																
CPP555	GROUND WATER	GRAB	01/28/2013	ICPP-2195	Monitoring Well	INTEC	87 - 107	1	1	1	1																
CPP556	GROUND WATER	GRAB	01/28/2013	ICPP-2196	Monitoring Well	INTEC	117 - 142	1	1	1	1																
CPP557	GROUND WATER	GRAB	01/28/2013	ICPP-2205	Monitoring Well	INTEC	121 - 141	1	1	1	1																
CPP558	GROUND WATER	GRAB	01/28/2013	MW-6	Monitoring Well	INTEC	117 - 137	2	2	2 T	2 T																
CPP559	WATER	FB	01/28/2013	INTEC	Field Blank	QC	NA		1	1	1																
CPP560	WATER	TB	01/28/2013	INTEC	Trip Blank	QC	NA				1																

AT1: Gross Alpha/Beta
AT2: Metals - Filtered
AT3: Semivolatile
AT4: Volatile
AT5:
AT6:
AT7:
AT8:
AT9:
AT10:
AT11:
AT12:
AT13:
AT14:
AT15:
AT16:
AT17:
AT18:
AT19:
AT20:

Comments:
If the volume is limited, the order of collection priority is Metals, VOCs, SVOCs

Location MW-6: The triple volume for lab QC shall only be collected for the field sample and not for the duplicate.

Analysis Suites:

Contingencies:

ATTACHMENT 3

ATTACHMENT 3 POST-CLOSURE PLAN, consisting of:

- Section J, Additional Information, of the INTEC Post-Closure Permit Reapplication for the Volume 21 Waste Calcine Facility and CPP-601/627/640 and:

  Appendix J-1. Statistical Analysis of Perched Groundwater Monitoring Data for the Waste Calcining Facility (RPT-1013, Rev. 3 – August 2010)

  Appendix J-2. Statistical Analysis of Perched Groundwater Monitoring Data for the CPP-601/627/640 Facility (RPT-2126.33-001, Rev. 0 – April 2012)

- Geologic and Hydrogeologic Characterization of the INEEL, of the INTEC Post-Closure Permit for the Volume 21 Waste Calcine Facility and CPP-601/627/640,

- U.S. Environmental Protection Agency Region 9 Preliminary Remediation Goals (PRGs) Users Guide, October 2002.

ATTACHMENT 3 - SECTION J ADDITIONAL INFORMATION

HWMA/RCRA INTEC POST-CLOSURE PERMIT REAPPLICATION

Volume 21
Waste Calcine Facility and CPP-601/627/640

Attachment 3
Section J, Additional Information

September 2013

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Appendix J-2. Statistical Analysis of Perched Groundwater Monitoring Data for the CPP-601/627/640 Facility (RPT-2126.33-001, Revision 0 – April 2012)

J. ADDITIONAL INFORMATION IDAPA 58.01.05.012 [40 CFR 270.14(c)]

J.1 Summary of Groundwater Monitoring Data Collected Under Interim Status IDAPA 58.01.05.012 [40 CFR 270.14 (c)(1)]

Groundwater monitoring data were not collected under the provisions of IDAPA 58.01.05.009 (40 CFR 265 Subpart F) during the interim status period. However, groundwater samples were collected from the perched and SRPA groundwater monitoring wells as part of other investigations and well installation projects. During the 1993 to 1994 WAG 3 perched water investigation, samples were collected from the perched groundwater wells and analyzed for organic contaminants. In 1995, under the continuing WAG 3 investigation, the perched and SRPA groundwater monitoring wells were sampled and analyzed for field parameters, inorganics, and radionuclides. Between 1951 and 1998, the USGS sampled numerous SRPA groundwater monitoring wells and analyzed the samples for a variety of organic and inorganic constituents. The locations of the WCF and CPP-601/627/640 perched groundwater monitoring wells at and around the INTEC are shown in Figure J-1. The locations of the SRPA wells at and around the WCF at the INTEC are shown in Figure J-2. A well construction summary of the WCF and CPP-601/627/640 perched groundwater monitoring wells is shown in the Permit, Module III, Tables 2 and 2a.

Eighteen perched groundwater wells were sampled during the 1993 to 1994 WAG 3 investigation. Each sample was analyzed for 35 organic contaminants. Of the 630 reported analytical results (excluding trip blanks), 36 contaminants were reported as detected. However, the analytical data is of unknown quality. Nearly all detections were qualified below the contract laboratory quantification limit, contamination was detected in trip blanks, contaminants were not detected in duplicates with detected contamination, and contaminants were detected in quality control samples. Complicating matters, the original data packages are not available for data validation.

In 1995, under the continuing WAG 3 investigation, the perched groundwater monitoring wells were sampled and analyzed for field parameters, inorganics, and radionuclides. HWMA/RCRA inorganics above the toxicity characteristic leaching procedure levels were not detected in the perched groundwater samples taken below the INTEC.

Between 1951 and 1998, the USGS sampled numerous SRPA monitoring wells. The samples were analyzed for field parameters, inorganics, a variety of organic constituents, and radionuclides. A visual representation of the 1987 through 1998 organic analyses is shown in Figure J-3, Figure J-4, and Figure J-5. As indicated through the analytical results and figures, HWMA/RCRA inorganics above the toxicity characteristic leaching procedure levels, organic, and characteristic contaminants were not detected in the SRPA groundwater samples below the INTEC facility boundaries.

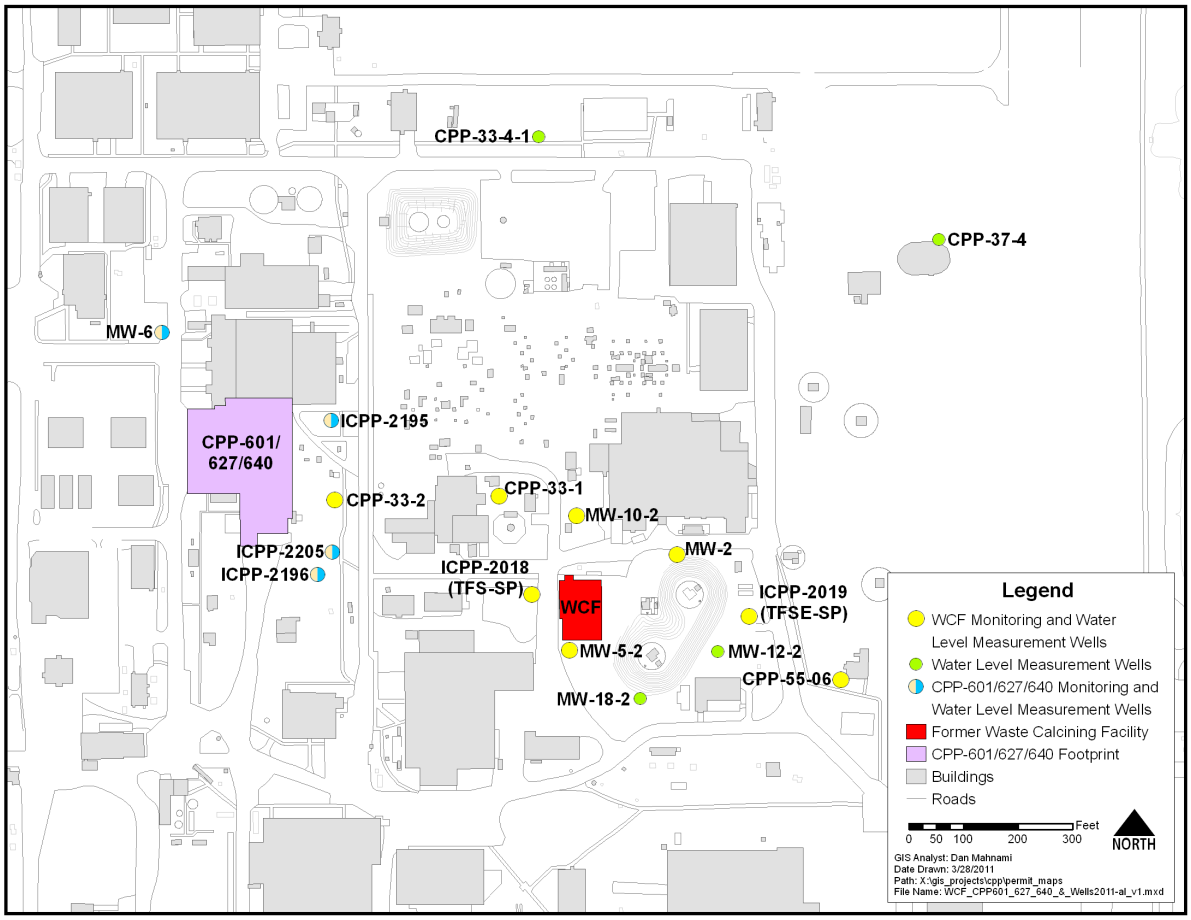


Figure J-1. Perched water wells at and around the WCF and CPP-601/627/640 at the INTEC.

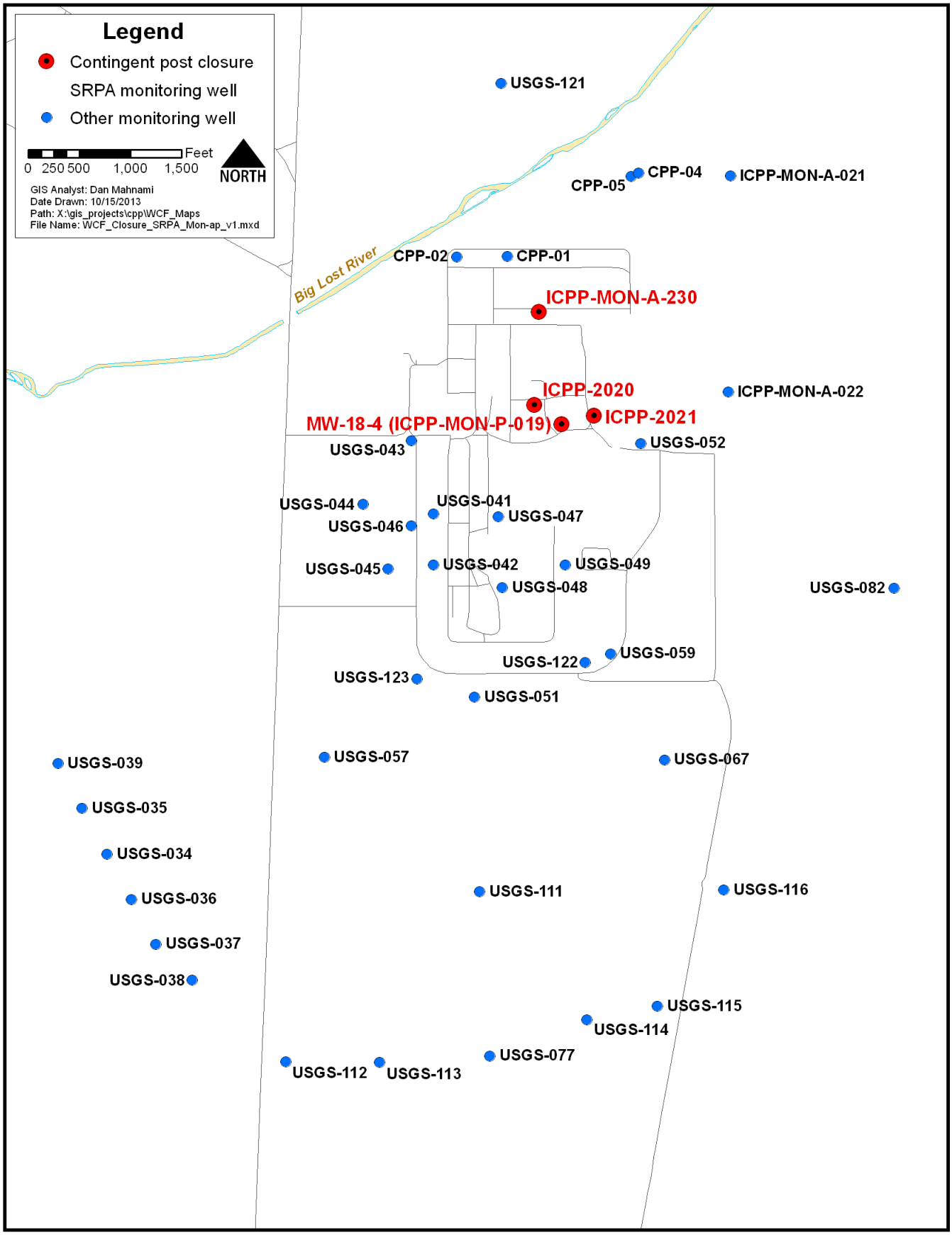


Figure J-2. SRPA wells at and around the INTEC.

In 2001, samples were taken from perched groundwater wells MW-2, MW-5, MW-20, and other wells that are outside the scope of this permit reapplication. The wells were sampled by bailing due to the low water level of the wells. When bailing, the sediment is suspended in the water that is being sampled. The samples were not filtered. Since the samples were not filtered the analysis results included the constituents associated with the sediment not just the water. The analytical results are given in Table J-1.

The following wells were not sampled; therefore, no data is available.

- CPP-55-06
- INTEC-MON-P-019

Table J-1. 2001 Unfiltered sample results from monitoring wells.

Analytes	INTEC-MON-P-002 (MW-2)	INTEC-MON-P-005 (MW-5)	INTEC-MON-P-020 (MW-20)	USGS-050
Arsenic µg/L	16.7	5.0/U	6.1/B	5.0/U
Barium µg/L	295	195/B	357	171/B
Cadmium µg/L	5.0/U	5.0/U	5.0/U	5.0/U
Chromium µg/L	2520	11.3	37.6	11.8
Lead µg/L	14,700	3.0U	7.2	3.0/U
Mercury µg/L	0.04	0.31	.20/U	.20/U
Selenium µg/L	5.0/U	5.0/U	5.0/U	5.0/U
Silver µg/L	5.0/U	5.0/U	5.0/U	5.0/U
Toluene µg/L	5.0U	2.0/J	5.0U	5.0U
Tetrachloroethene µg/L	5.0U	5.0U	2.0J	5.0U

B – Analyte Blank Concentration (laboratory or calibration) ≥ 20% of sample concentration prior to dilution correction.
J – Indicates an estimated value.
U – Analyte was not detected.

In March 2002, wells MW-2, MW-5, and MW-20 were resampled for constituents of concern based on previous sampling/analytical results. The analytical results are presented in Table J-2.

The wells were sampled by bailing due to the low water level of the wells. Once the samples were collected, they were filtered in the field to eliminate the sediment that becomes suspended in the water as a result of the sampling method used. If the samples were not filtered, the analysis results would include the constituents associated with the sediment not just the water. Therefore, filtering allowed the analysis of just the water.

Table J-2. 2002 Filtered sample results from monitoring wells.

Analytes	INTEC-MON-P-002 (MW-2)	INTEC-MON-P-005 (MW-5)	INTEC-MON-P-020 (MW-20)
Arsenic µg/L	2.6/B	No Data	No Data
Cadmium µg/L	0.60/U	No Data	No Data
Chromium µg/L	115	No Data	No Data
Lead µg/L	2.8/U	No Data	No Data
Toluene µg/L	No Data	5.0/U	5.0/U
Tetrachloroethene µg/L	No Data	5.0/U	3.0/J

B – Analyte Blank Concentration (laboratory or calibration) ≥ 20% of sample concentration prior to dilution correction.
J – Indicates an estimated value.
U – Analyte was not detected.
Analysis was not performed for the constituents listed as "No Data"

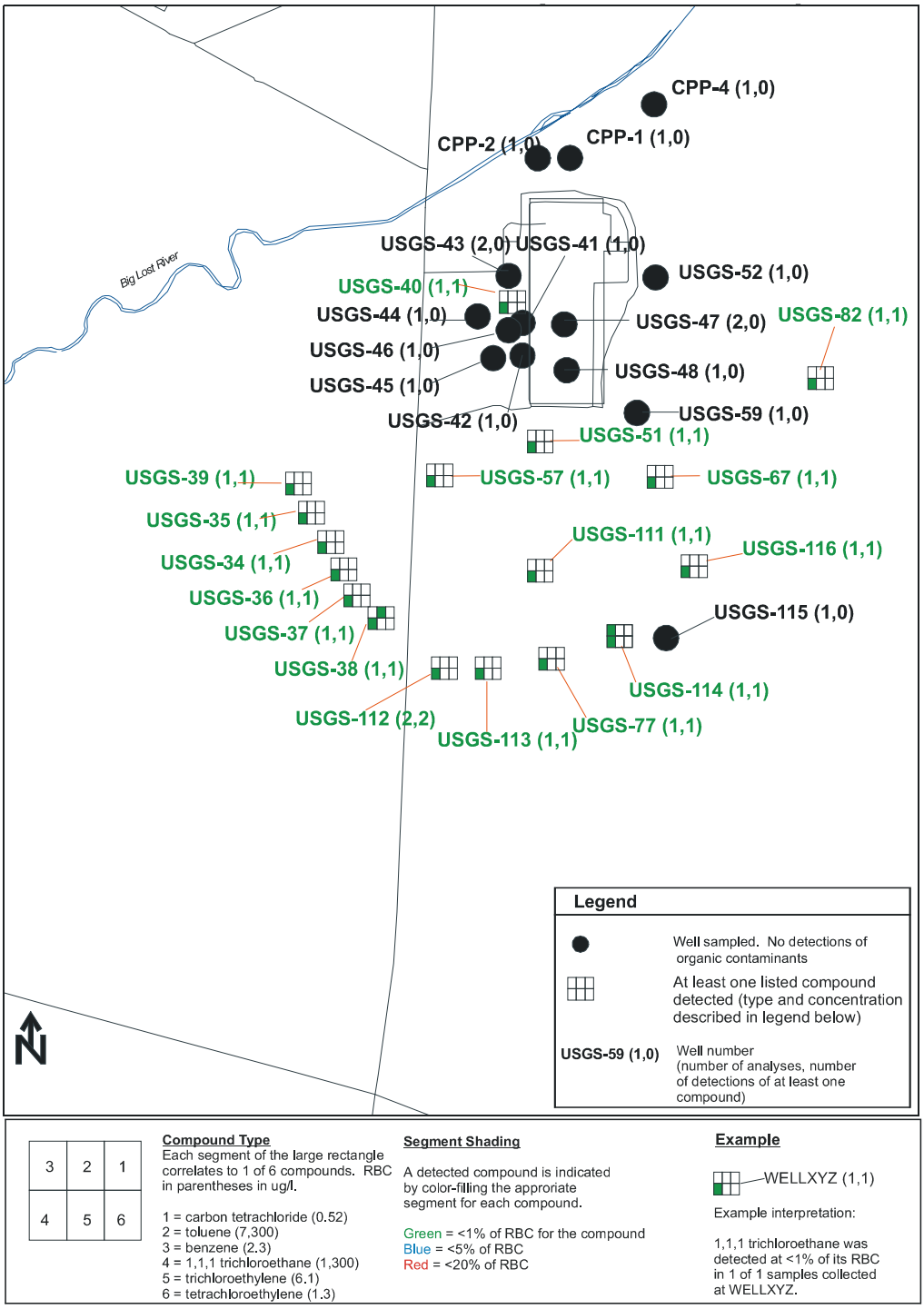


Figure J-3. Results of sampling for HWMA/RCRA-listed constituents in the SRPA monitoring wells from 1987 to 1990.

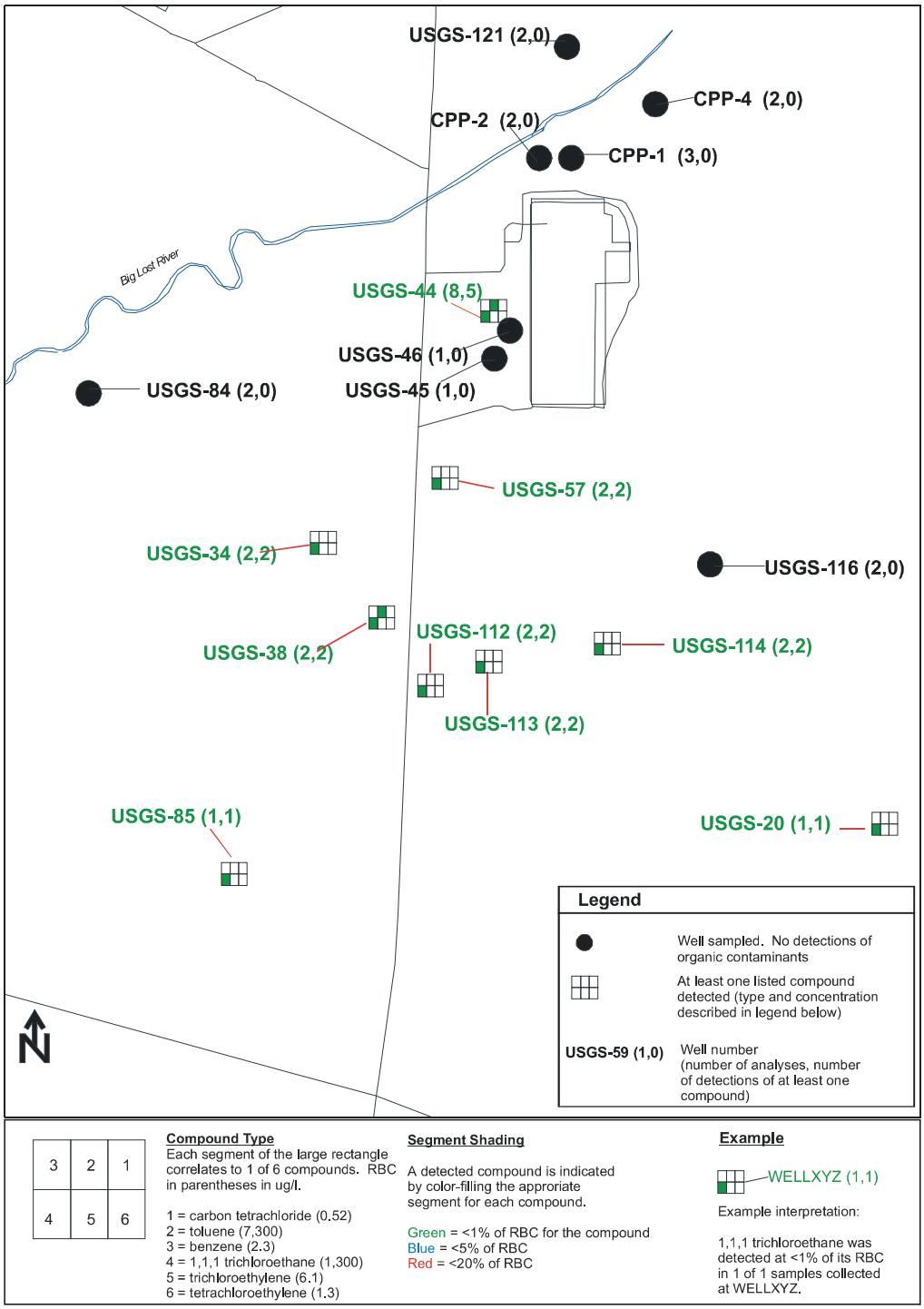


Figure J-4. Results of sampling for HWMA/RCRA-listed constituents in the SRPA monitoring wells from 1991 to 1995.

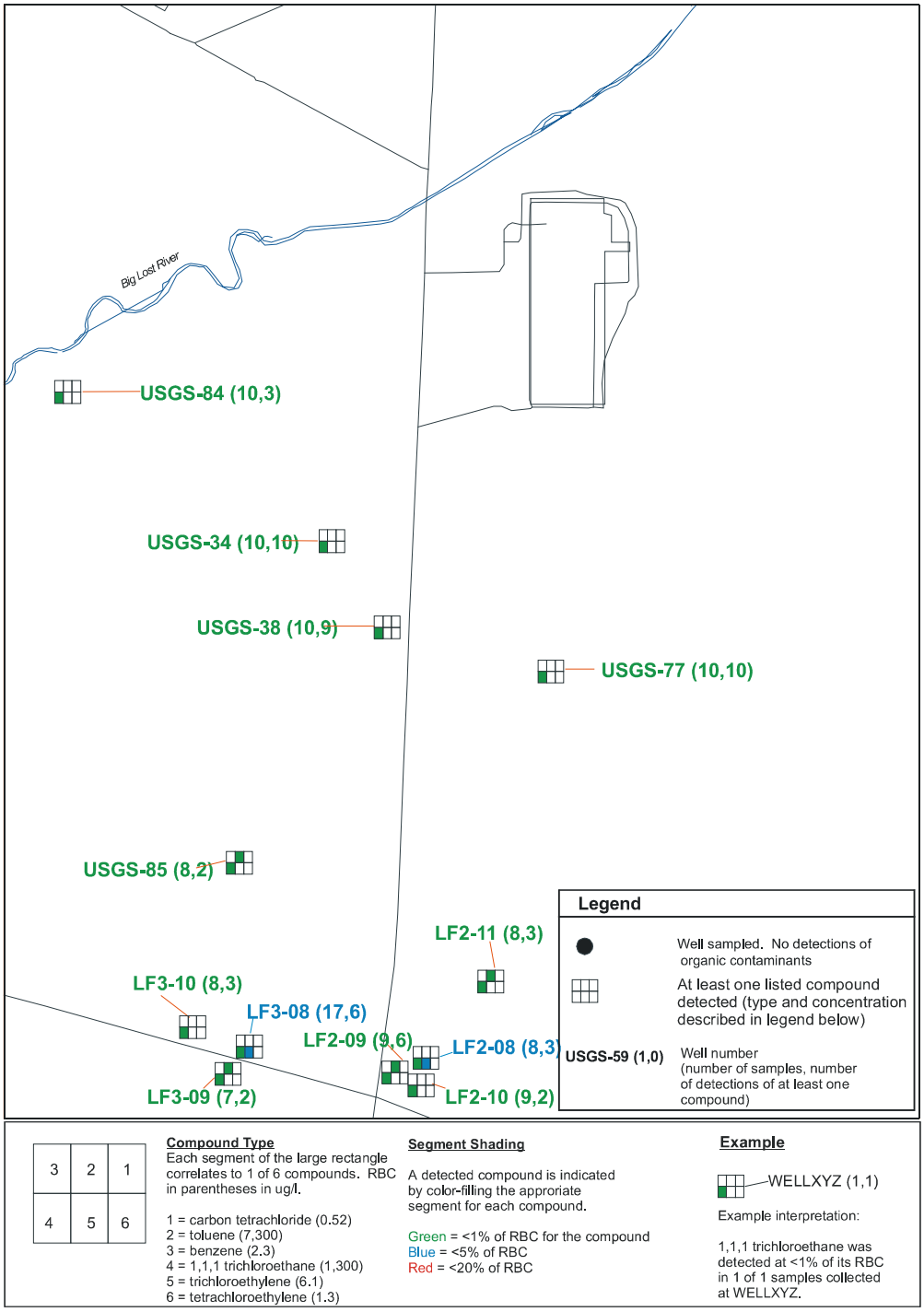


Figure J-5. Results of sampling for HWMA/RCRA-listed constituents in the SRPA monitoring wells from 1995 to 1999.

J.2 Geology, Hydrology, Identification of the Perched Zone, Groundwater Flow Direction, and Rate IDAPA 58.01.05.012 [40 CFR 270.14(c)(2)]

J.2.1 Area Description

The INL is located in the Mud Lake–Lost River Basin (also known as the Pioneer Basin.) This closed drainage basin includes three main streams: the Big and Little Lost Rivers and Birch Creek. These three streams drain the mountain areas to the north and west of the INL, although most flow is diverted before it reaches the INL boundaries. Flow that reaches the INL infiltrates the ground surface along the length of the stream beds, in the spreading areas at the southern end of the INL, and, if the stream flow is sufficient, in the ponding areas (playas or sinks) in the northern portion of the INL. During dry years, there is little to no surface water flow on the INL. Because the Mud Lake–Lost River Basin is a closed drainage basin, water either infiltrates the ground surface to recharge the aquifer or is lost to evapotranspiration.

The Big Lost River flows southeast from Mackay Dam, past Arco, and onto the ESRP. Near the southwestern boundary of the INL, a diversion dam prevents flooding of downstream areas during periods of heavy runoff by diverting water to a series of natural depressions or spreading areas (DOE 1995). During periods of high flow or low irrigation demand, the Big Lost River continues northeastward past the diversion dam, passes within 200 ft (61 m) of the INTEC, and ends in a series of playas 15 to 20 mi (24 to 32 km) northeast of the INTEC, where water infiltrates the ground surface. Flow from Birch Creek and the Little Lost River infrequently reaches the INL, as this water is diverted for irrigation upstream of the INL in the summer months. During periods of unusually high precipitation or rapid snow melt, water from Birch Creek and the Little Lost River may enter INL from the northwest and infiltrate the ground. As with much of the Big Lost River on the INL, the channel is typically dry at the INTEC; however, it should be noted that the Big Lost River flowed during most of 1997 and 1998.

The principal surface materials at the INL are basalt, alluvium, lake bed or lacustrine sediments, slope wash sediments, talus, silicic volcanic rocks, and sedimentary rocks. The INTEC is located on an alluvial plain approximately 200 ft (61 m) from the Big Lost River channel near the point the channel intersects with Lincoln Boulevard on the INL. The INTEC is surrounded by a storm water drainage ditch system (DOE-ID 1998). Storm-water runoff from most areas of INTEC flows through ditches to an abandoned gravel pit on the northeast side of the INTEC. From the gravel pit, the runoff infiltrates the ground. The system is designed to handle a 25-yr, 24-hr storm event. Because

the land is relatively flat (slopes of generally less than 1%) and annual precipitation is low, storm water runoff volumes are small and are generally spread over large areas where they evaporate or infiltrate the ground surface.

J.2.2 Site Geology

The INL is located on the west-central part of the ESRP, a northeast-trending structural basin about 220 mi (322 km) long and 50 to 70 mi (80.5 to 113 km) wide. The INL is underlain by a sequence of Tertiary and Quaternary volcanic rocks and sedimentary interbeds that are more than 10,000 ft (3,050 m) thick (Whitehead 1992). The volcanic rocks consist mainly of basalt flows in the upper part of the sequence and rhyolitic ash-flow tuffs in the lower part.

Hundreds of basalt flows[1], basalt-flow groups, and sedimentary interbeds underlie the INL. Basalt makes up about 85% of the volume of deposits in most areas. A basalt flow group consists of one or more distinct basalt flows deposited during a single, brief eruptive event. All basalt flows of a group erupted from the same vent or several nearby vents; represent the accumulation of one or more lava fields from the same magma; and have similar geologic ages, paleomagnetic properties, potassium contents, and natural-gamma emissions (Anderson and Bartolomy 1995). The basalt flows consist mainly of medium- to dark-gray vesicular to dense olivine basalt. Individual flows generally range from 10 to 50 ft (3 to 15 m) thick and are locally interbedded with scoria and thin layers of sediment. Sedimentary interbeds are as thick as 50 ft (15 m) and consist of well to poorly sorted deposits of clay, silt, sand, and gravel. In places, the interbeds consist mainly of scoria and basalt rubble. Sedimentary interbeds accumulated on the land surface for hundreds to several hundred-thousand years during periods of volcanic quiescence and are thickest between basalt-flow groups.

At least 178 basalt-flow groups and 103 sedimentary interbeds underlie the INL above the effective base of the aquifer (Anderson et al. 1996, 1997). Basalt-flow groups and sedimentary interbeds are informally referred to as A through S5. Basalt-flow groups LM through L and related sediments range in age from about 200,000 to 800,000 years and make up the unsaturated zone and the uppermost areas of the INL. Most wells in the southern and eastern part of the INL are completed in basalt-flow groups AB through I and related sediments. These flow groups and related sediments range in age from about 200,000 to 640,000 years and make up a stratigraphic section characterized by horizontal to slightly inclined layers. Anderson et al (1997) estimated the geologic ages and accumulation rates of basalts and sediments in the unsaturated zone and the SRPA from about

[1] A basalt flow is a solidified body of rock formed by the surficial outpouring of molten lava from a vent or fissure (Bates and Jackson 1980).

200,000 to 1.8 M·yr and average accumulation rates are reflective of the subsidence rate of 164 ft (50 m)/100,000 years.

The nomenclature for the stratigraphy underlying the INTEC facility and the surrounding area is based on work presented by Anderson (1991). At land surface, as much as 60 ft (18.2 m) of surficial alluvium is composed of gravelly, medium- to coarse-grained sediment. This alluviual material overlies a series of basalt/sediment units where the basalt is very transmissive, and the sediment units are relatively thin, much less transmissive, and laterally discontinuous as shown in Figure J-6. The stratigraphy of the aquifer at and near the INTEC is dominated by thick, massive, basalt flows of Flow Group I and thin, overlying flows of Flow Groups B through H. The basalt flows, as interpreted, appear to be relatively uniform in thickness beneath the INTEC.

Significant changes in the flow thickness are often related to changes in the lithology of the flow or are caused by the flow margins in which the flow appears as a lobe of basalt. The lithologic changes that may cause a change in the flow thickness are either the existence of pyroclastic deposits on or within a flow or a flow being very vesicular, and thus, more susceptible to the effects of erosion. Based on Anderson (1991) geologic cross section, there are 19 basalt flow groups, 11 sedimentary interbeds, and the surficial alluvium that make up the unsaturated zone and upper aquifer underlying the INTEC facility. The sediments, as interpreted, appear to be primarily made up of sands and silts with some small clay lenses. The majority of the sediments are 1 to 5-ft (thick) (0.3 to 1.5-m) layers of silt between the major basalt flows. Sediments were most likely deposited in eolian or fluvial type environment. Two major sediment sequences are shown on the cross sections: the upper sequence associated with the CD, the thick D, and DE2 sands and silts and the lower sediments associated with the DE6, DE7, and DE8 stratigraphic units.

The cross sections show a thick sequence of sediments, particularly in the northern end of the south-north section, which are stratigraphically shown as the CD, D, and DE2 units. These sediments appear to be made up of thick layers of sands overlain by silts and clays. The sediments associated with the DE6, DE7, and DE8 stratigraphic units appear to be made up of gravels, silts, and clays. These sediments were most likely deposited in a fluvial environment and may indicate a braided stream deposit. This is the last major sediment deposit above the SRPA.

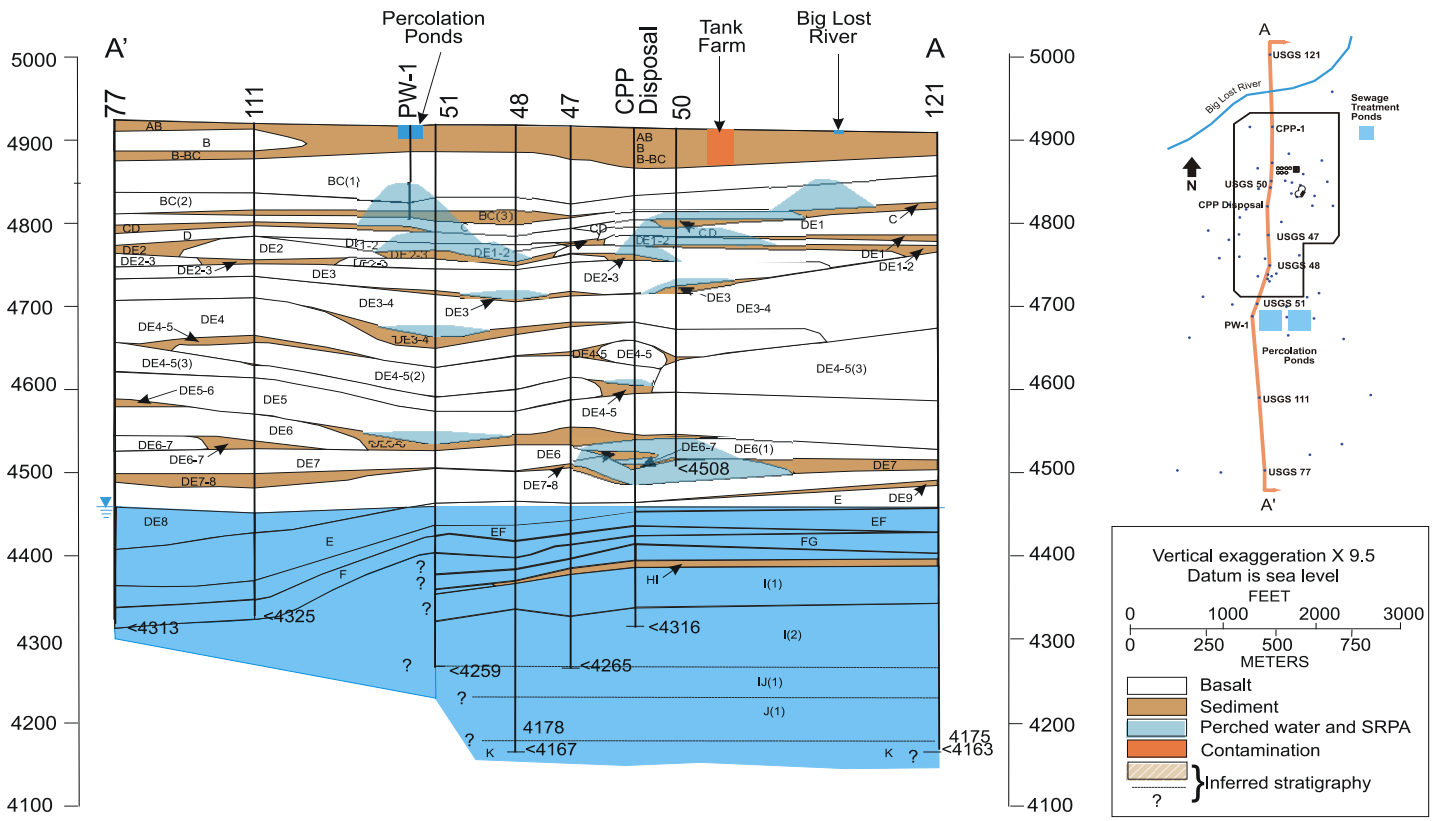


Figure J-6. North to south cross section through INTEC subsurface, illustrating the perched water bodies, lithologies, and water table of the SRPA.

Holocene surficial geology and archaeology suggest that fluvial and eolian deposition and tectonic subsidence in the INL area have been in approximate net balance for at least the past 10,000 years. A reversal of the long-term, regional pattern of ESRP subsidence, sedimentation, and volcanism into an erosional rather than a depositional regime would require major changes from the Holocene tectonic or climatic configuration of the ESRP. Worldwide geologic evidence indicates that the Quaternary epoch (approximately the past 2 M yr) has been a time of major climatic fluctuations. During colder and wetter periods, glaciers occupied high-elevation areas, and lowland areas such as the ESRP, received thick, widespread loess blankets. Lowland areas were also periodically impacted by local catastrophes such as the large, late-Pleistocene, glacial outburst flood that traveled down the Big Lost River valley, eroded upland surfaces on the ESRP, and deposited sediment in the INTEC area. Additional geologic characterization of the INTEC is provided in Attachment 3 of this permit reapplication.

J.2.3 Site Hydrology

J.2.3.1 Surface Water.

Most of the INL and all of the INTEC is located in the Pioneer Basin, which is a closed topographic depression on the ESRP that receives intermittent runoff from the Big Lost River, Little Lost River, and Birch Creek Drainage. The Pioneer Basin is not crossed by any perennial streams because of the permeability of alluvium and underlying rock that causes the water to infiltrate the ground. In addition, much of the water from the tributary drainage basins is diverted for irrigation upstream of the INL. The largest stream, the Big Lost River, enters the INL near the southern end from the west and, during exceptionally wet years, flows in a large arc north to the foot of the Lemhi Mountain Range where it ends in a series of playas (sinks). Birch Creek enters INL from the north and the Little Lost River approaches the INL from the northwest, through Howe. As indicated in Subsection J.2.1, flow from these streams infrequently reaches the INL.

The Big Lost River is the most important natural element affecting the surface water hydrology of the INL and INTEC. The Big Lost River discharges an average of 211,000 acre·ft/yr (260.2E+06 m^3/y) below Mackay Dam, 30 mi (48 km) northwest of Arco. The largest recorded annual flow of the Big Lost River for the entire period of record occurred in 1984 and amounted to 476,000 acre·ft/yr (587.1E+06 m^3/yr), which was measured below Mackay Dam. The second largest annual flow occurred in 1965 and amounted to roughly three-quarters of the 1984 record.

Except for evapotranspiration, most of the water in the Big Lost River, Little Lost River, and Birch Creek is recharged to the ground through irrigation or infiltration. Water from the Big Lost River infiltrates into the material beneath the river and into the SRPA. The volume of this infiltration

is significant during wet years. However, the historical record indicated that there are several years in which no flow occurs in the Big Lost River near the INTEC facility. During these years, recharge to the perched zones and ultimately the SRPA is negligible and results in significant changes in the thickness and extent of the perched water zones. Perched water zones have been identified along the Big Lost River when it contains water; however, the extent and volume of these perched water zones is not completely known.

Other than these intermittent streams, playas, and the manmade percolation, infiltration, and evaporation ponds, there is little surface water at the INL site. Surface water that reaches the INL is not used for consumptive purposes (e.g., irrigation, manufacturing, or drinking). The Bureau of Land Management has a small water right on INL for stock watering.

J.2.3.2 Perched Water below INTEC.

Stratigraphy controls the hydrogeologic characteristics of the subsurface at the INTEC, particularly in the formation and movement of perched groundwater. The formation of perched groundwater may be attributed to lithologic features contributing to contrasts in the vertical hydraulic conductivity of basalt layers and sedimentary interbeds in the unsaturated zone. Cecil et al. (1991) attributed four lithologic features to the formation of perched groundwater at the INTEC. Perched groundwater can form in an area, for example, where (a) there is sedimentary interbed with a reduced vertical hydraulic conductivity underlying a more conductive basalt layer, (b) there are altered baked zones between two basalt flows that reduce hydraulic conductivity, (c) there is a presence of dense unfractured basalt that has low vertical hydraulic conductivity, and (d) where sedimentary and chemical filling of fractures near the upper contact of a basalt flow reduced vertical hydraulic conductivity.

Several sources of water contribute to moisture movement and the development of perched water in the INTEC subsurface (DOE-ID 2000a). The two major recharge sources are the historic percolation ponds and the Big Lost River. Historic Service waste percolation pond (SWP-1) was 412 by 480 ft and 16 ft deep (126 by 146 m and 4.8 m deep). The pit was excavated in gravelly alluvium that is approximately 20 to 35 ft thick and underlain with basalt rock. The pond was designed to accommodate continuous disposal of 1.5 M·gal (5.7 M·L) of water each day based on 10 gal/day/ft^2 of area. Service waste percolation pond (SWP-2) was located immediately to the west of SWP-1. It was 498 ft^2 and 12 to 14 ft deep (46 m^2 by 3.6 to 4.3 m deep). The pit was excavated in gravelly alluvium, 20 to 35 ft thick and underlain with basalt rock. The pond was designed to accommodate

continuous disposal of 3 M·gal (11 M·L) of water each day based on the observed percolation pond rates of SWP-1. Both ponds are fenced to exclude large wildlife. An average of 1.16 M·gal (4.39 M·L) of wastewater was discharged to the historic percolation ponds each day. Prior to August 26, 2006, this wastewater was discharged to the Old (existing) Percolation Ponds Numbers 1 or 2, located directly south of the INTEC. On August 26, 2002, discharge of the service wastewater to the existing Percolation Ponds ceased and was transferred to the New Percolation Ponds (CPP-1791), located approximately two miles to the southwest of the INTEC.

Depending on the depth of the snowpack and volume of precipitation that occurs in a particular year, the Big Lost River may flow all year or cease to flow entirely for several months or years. The mean annual flow in the Big Lost River at a point near the INTEC site is 34,429 acre·ft/mo (42,467,544 m^3/mo). Together, these two sources are thought to supply over 98% of the recharge. The wastewater treatment lagoons operational activities, and precipitation account for the remaining recharge. Average annual discharge to the wastewater treatment lagoons is 13.9 M·gal/yr (52.6 M·L/yr). Operational losses are variable and not well quantified. The mean annual precipitation at the INL is approximately 8.5 in./yr (21.5 cm/yr). Usually, less than one-half of this amount occurs as snowfall. The collection of precipitation in local basins can supply substantial amounts of focused infiltration (DOE-ID 2000a).

Water movement in the basalt units located in the unsaturated zone is poorly understood. These perched water bodies are significant because they increase the opportunity for contaminants to move both laterally and vertically in the vadose zone. This lateral water and contaminant movement in the vadose zone results in vertical migration rates that are spatially nonuniform beneath the INTEC. Infiltration from the surface is assumed to move vertically through the basalt to an interbed. The water and contaminants migrate along the interbed and accumulate at interbed low points because the interbeds are sloped. This results in greater than average vertical water and contaminant fluxes in water accumulation areas and less than average vertical water and contaminant fluxes in the elevated portions of the interbed. The extent to which water moves horizontally while vertically transiting the fractured basalts is uncertain. Water has been shown to move laterally several miles in the subsurface when sufficient water was available to support long lateral spread. Eventually, water infiltrating at the surface of the INTEC will reach the underlying SRPA. Additional information on perched water below the INTEC is provided in Attachment 3 of this permit reapplication.

J.2.3.3 Perched Water in Surficial Alluvium.

In places with a concentrated source of surface recharge, a perched water zone can develop in the surficial alluvium on top of the first basalt flow. Perched water has been identified in the alluvium at the INTEC beneath surface disposal ponds (the historic Percolation Ponds and the sewage treatment pond). Historically, a small perched water table in alluvium was encountered west of CPP-603. The source for the perched water was assumed to be wastewater that was discharged to a shallow seepage pit (Robertson et al. 1974). The seepage pit was taken out of service in 1966 and it was assumed that the water body dissipated.

Perched water in the surficial alluvium requires a concentrated source of recharge that exceeds the normal recharge provided by precipitation. Perched water has not been widely measured at the sediment-basalt interface.

J.2.3.4 Northern Upper Perched Water.

Two perched groundwater bodies have been identified in the northern INTEC. The upper perched groundwater body (also divided into upper shallow and lower shallow) is present above the CD and D interbeds, respectively, and the lower perched groundwater body has been identified on the DE3 interbed. According to the lithology, the CD interbed occurs at depths between 113 and 119 ft (34 and 36 m) BGL, the D interbed occurs at depths between 128 and 135 ft (39 and 41m) BGL, and the DE3 interbed occurs at depths between 163 and 170 ft (50 and 52m) BGL. Based on available information, it appears that the perched groundwater between the CD and D interbeds is continuous over much of the northern portion of the INTEC as these interbeds are only separated by 9 ft (3 m).

Water-level elevations range from 4,797.3 to 4,845.3 ft (1,462.2 to 1,476.8 m) above mean sea level (AMSL) and represent the average water-table level throughout the monitoring period. Perched groundwater is not known to occur above the CD and D interbeds outside the areas illustrated on Figure J-6. The perched water bodies overlap (i.e., in the vicinity of Wells CPP-33-4-1, CPP-33-4-2, CPP-33-1, and MW-5), the entire region between the CD and D interbeds is likely to be saturated. Otherwise, perched groundwater is only present above the associated interbed.

Based on the water-table configuration, it appears that multiple water sources are providing recharge to the upper perched water body in the northern portion of the INTEC. These sources may include recharge from the Big Lost River, the wastewater treatment lagoons, and operational releases. The wastewater treatment lagoons, located northeast of the facility, provide approximately 1.25E+6

gal (4.73E+6 L) per month of recharge to the eastern side of this perched water body. This recharge has resulted in a water-table elevation of approximately 4,845 ft (1,477 m) AMSL in the well (ICPP-MON-A-022) completed near the sewage treatment ponds. In the western portion of the perched water body and beneath the main portion of the facility, recharge from an unknown source has produced a water-table elevation of 4,815.2 ft (1,467.7 m) AMSL in Well CPP-33-2. Between the eastern and western portions of the upper perched water body, the groundwater elevation is 4,808.8 ft (1,465.7 m) AMSL in Well CPP-37-4. This water-table configuration indicates that separate sources of water are providing recharge to the eastern and western portions of the perched water body and that the sewage treatment ponds have minimal, if any, impact upon the western portion of this perched water body. Fluctuations in water levels in the upper perched water zone that are observed in response to flow in the river indicate a connection between the northern upper perched water and the river (DOE-ID 2000a).

J.2.3.4.1 Contamination in the Northern Upper Perched Zone—The highest perched water radioactive contamination occurs beneath the northern portion of the INTEC and is particularly associated with Wells MW-2, MW-5, and CPP 55-06 (see Figure J-1). The maximum gross alpha and gross beta activities measured in the upper perched groundwater were 1,140 ± 220 pCi/L and 589,000 ± 2,600 pCi/L, respectively, in Well MW-2. At a depth of approximately 140 ft (42 m), the maximum gross alpha and gross beta concentrations measured in the perched water were 137 ± 9 pCi/L and 65,300 ± 600 pCi/L in Wells MW-10 and MW-20. These two wells are completed in water-bearing zones at depths of approximately 140 ft (42 m). Again, only radioactive contamination has been detected in the lower water bearing zones. The maximum concentrations for ^{3}H, ^{90}Sr, and ^{99}Tc from these wells are 38,000 ± 50 pCi/L, 25,800 ± 30 pCi/L, and 127 ± 2 pCi/L, respectively.

J.2.3.5 Southern Upper Perched Water.

Perched water has been identified beneath two areas of the southern portion of the INTEC. The largest perched water body is the result of discharge to the percolation ponds and is monitored by Wells PW-1 through PW-6 (Figure J-1). Six wells (MW-7, MW-9, and MW-13 through MW-16) were installed to monitor perched water on the upper interbed that is present between 110 and 130 ft (33.5 and 39.6 m) BGL. One triple completion well (MW-17) was installed to monitor for perched water on a deeper interbed occurring approximately 190 ft (57.9 m) BGL.

Wells PW-1 through PW-6 were installed adjacent to the historic percolation ponds to monitor the perched groundwater beneath the ponds. The hydrographs for these wells show a similar fluctuation in the water level as observed in Wells PW-1, PW-3, and PW-6 indicating these wells are effective in monitoring infiltration from the western percolation ponds. The water-level fluctuation in Well PW-4 is opposite to the response observed in Wells PW-1, PW-3, and PW-6, indicating this well monitors infiltration from the eastern percolation pond. The water-level fluctuations in Wells PW-2 and PW-5 are fairly consistent and indicate that these wells are influenced by discharge to either pond.

The water elevations in the southern perched water zone range between 4,732.4 to 4,790.2 ft (1,442.4 to 1,460.0 m) AMSL north of the percolation ponds and between 4,796.2 to 4,848.9 ft (1,461.9 to 1,477.9 m) AMSL near the percolation ponds. Only two upper perched water wells are located between the northern and southern perched water bodies (Wells MW-11 and MW-14) and neither indicates perched water in these areas.

J.2.3.5.1 Contamination in the Southern Upper Perched Zone—Wells that monitor the perched water quality in the upper southern perched water zone include Wells MW-7, MW-9, MW-13, MW-14, MW-15, MW-16, and MW-17. As previously indicated, there is no verifiable evidence of HWMA/RCRA-regulated contamination below the INTEC in the southern perched water bodies. From the inorganic analysis, only nitrate/nitrite was detected at a concentration exceeding the maximum contaminate level (MCL) at Well MW-15 (14.7 mg/L). The radionuclides detected in the perched water include ^{3}H (3,360 ± 176 to 25,700 ± 400 pCi/L) and ^{99}Tc (6.4 ± 0.6 to 23.7 ± 0.6 pCi/L). In addition, ^{90}Sr and ^{234}U were detected in Well MW-15 at concentrations of 17,200 ± 200 pCi/L and 11.8 ± 1.0 pCi/L, respectively (DOE-ID 2000a).

The six wells (PW-1 through PW-6) that monitor the perched water body associated with wastewater discharge to the percolation ponds have been monitored by the USGS since 1987. Wells PW-1, PW-2, PW-4, and PW-5 have been sampled for radionuclides on a quarterly basis as part of the INTEC groundwater monitoring program since 1991.

Most of the historical radioactivity present in the PW-series wells is from ^{3}H, with ^{90}Sr providing a secondary activity contribution. According to the USGS monitoring, activities from both ^{3}H and ^{90}Sr have remained relatively stable with the exception of an increased ^{3}H activity period in mid-1988. Average ^{3}H concentrations range from 1,334 ± 421 to 4,681 ± 567 pCi/L with ^{90}Sr concentrations averaging 3.7 ± 3.4 pCi/L (DOE-ID 2000a).

J.2.3.6 Hydraulic Conductivities in the Upper Perched Zones.

Field aquifer tests were performed to determine the hydraulic conductivities for both basalt and sedimentary interbeds. Hydraulic conductivities determined in the field were fairly consistent, varying only over two orders of magnitude. Field hydraulic conductivities ranged from 3.9E-5 to 2.9E-3 cm/s with an average of 1.2E-3 cm/s. Significant differences in hydraulic conductivities were not observed between tests performed on the basalt versus tests performed on the sedimentary interbeds (i.e., interbeds CD, D, and DE2). The depths are approximately 110, 140, and 230 ft (33.5, 42.7, and 70.1 m) BGL.

The range of hydraulic conductivities determined from the field aquifer tests is within the range of hydraulic conductivities measured in the laboratory. The average hydraulic conductivity determined from the field tests is 3.3 ft/d (1.2E-3 cm/s) compared to an average of 1.96 ft/d (6.9E-4 cm/s) determined from the laboratory tests. Some of the difference between the two hydraulic conductivities may be attributed to the fact that the field tests measured horizontal hydraulic conductivity whereas the laboratory tests measured vertical hydraulic conductivity. Typically, horizontal hydraulic conductivities are greater than the corresponding vertical hydraulic conductivities.

Hydraulic conductivities obtained from both field and laboratory measurements of the boreholes were compared. Results showed that, from the same zone in Well MW-4, the average hydraulic conductivity determined in the laboratory was 0.1 ft/day (3.8E-5 m/s) compared to the field determined value of 0.11 ft/day (3.9E-5 m/s). Similarly in Well MW-6, the hydraulic conductivity determined in the laboratory was 6.2 ft/d (2.2E-3 cm/s) compared to the field determined value of 3.7 ft/day (1.3E-3 cm/s). These two wells are the only locations where both field and laboratory measurements were performed.

J.2.3.7 Lower Perched Water Zone.

A lower perched water zone has been identified in the basalt between 320 and 420 ft (98 and 128 m) BGL. This zone was first discovered in 1956 when perched groundwater was encountered at a depth of 348 ft (106 m) while drilling Well USGS-40 (Robertson et al. 1974). Since then, perched water has been encountered in this zone during the drilling of Wells MW-1, MW-17, and MW-18 (Figure J-1), USGS-41, USGS-43, USGS-44, USGS-50, USGS-52 (Figure J-2). Borehole neutron logs run from Wells USGS-40, USGS-43, USGS-46, USGS-51, and USGS-52 indicate that in 1993 perched water may still have been present in this zone.

New well sets have been installed to support post-ROD monitoring of the vadose zone. Prior to these installations, only four wells were completed in the lower perched water zone. Wells MW-1, MW-18, and USGS-50 were completed in the northern portion of the facility, and water has been encountered at approximately 322, 407, and 383 ft (98.1, 124, and 117 m) BGL, respectively. In the southern portion of the INTEC facility, only Well MW-17D was completed in the lower perched water zone in which water is encountered at a depth of approximately 364 ft (111 m) BGL.

Similar to the upper perched water zone, it is thought that the lower perched water zone is formed by decreased permeability associated with sedimentary interbed layers. It appears that the lower perched water has formed primarily on the DE7 interbed (see Figure J-6). The top of this interbed occurs beneath the INTEC at depths ranging from 383 to 426 ft (101 to 112.5 m) BGL in the western portion of the INTEC facility. However, the DE6 interbed is responsible for creating perched water associated with Wells USGS-40 and USGS-43. The lower perched water zone is not continuous beneath the entire facility and may actually consist of several individual perched water bodies. Recharge to the southern perched water body is from service wastewater discharged to the historic percolation ponds. The source of recharge to the western portion of the northern perched water body is unknown, though the Big Lost River and facility water leaks are likely contributors.

Water levels in the lower perched water zone have been monitored since the early 1960s in Well USGS-50. The water level in this well has been fairly consistent, ranging between 4,530 to 4,540 ft (1,381 to 1,384 m) AMSL. In the late 1960s and early 1970s, however, the water level increased by approximately 90 ft (27.4 m) in response to failure of the INTEC injection well, CPP-23. During this period, wastewater was discharged directly to the vadose zone from the INTEC injection well at a reported depth of 226 ft (69 m) BGL (Fromm et al. 1994). Measurements made in 1966 showed that the well was intact. Therefore, most of the collapse took place in 1967 or early 1968. The period when the INTEC injection well was plugged and discharged directly into the vadose zone has resulted in a thick zone of contamination underlying the INTEC. This zone serves as a possible source of contamination to the lower perched water zone and complicates any interpretation of contamination in the subsurface.

In September 1970, a drilling contractor began to redrill and reline the injection well to its original depth. By October, deepening had progressed to about 500 ft (152.4 m) and the water level in the well had resumed its normal depth at about 455 ft (138.7 m). During the well repair, wastewater was disposed to Well USGS-50. The injection well collapsed again and had to be reopened to the water table in late 1982. At this time, a high-density polyethylene liner 10 in. (25.4 cm) in diameter

was placed in the well from ground level to the bottom of the well. The liner was perforated from 450 ft (137 m) BGL (approximately 8 ft [2.4 m] above the water table) to the bottom of the well. On February 7, 1984, the injection well was taken out of routine service, and wastewater was pumped to the historic Percolation Ponds.

J.2.3.8 Lower Perched Water Contamination.

Contamination in the lower portion of the vadose zone is different in composition from the upper perched zone. The lower vadose zone perched water contamination results from the two INTEC injection well (CPP-23) collapses where service wastewater was released into the vadose zone above the lower sediment and the migration of upper perched water toward the SRPA. Lower perched water is monitored at the INTEC by Wells MW-1, MW-17, MW-18, and USGS-50 that are completed in water-bearing zones occurring at depths between 326 to 336 ft (99.4 to 102.4 m), 360 to 381 ft (110 to 116 m), 394 to 414 ft (120 to 126 m), and 360 to 405 ft (110 to 123 m), respectively.

Historically, two rounds of perched water samples have been collected from Well MW-1, one round of perched water samples has been collected from Wells MW-17 and MW-18, and a substantial database concerning radioactive contaminants is available about the water quality from Well USGS-50. As previously indicated, there is no verifiable evidence of HWMA/RCRA-regulated contamination below the INTEC in the lower perched water bodies. However, radionuclides have been detected. The radionuclides detected in water samples from Well MW-1 include ^{90}Sr (4.5 ± 0.4 pCi/L) and ^{3}H (24,700 ± 400 pCi/L). Of these contaminants, only ^{3}H was measured above the federal primary MCL of 20,000 pCi/L. As ^{3}H concentrations in the lower perched water zone are higher than the ^{3}H concentrations in the overlying perched water bodies, the source of this contamination is either a historical release where the contaminants have moved through the system, or wastewater disposal to the INTEC injection well.

Well MW-18 is completed in the deeper perched water zone near the eastern boundary of the INTEC. From sampling conducted during June 1995, only nitrate/nitrite concentration at 34.4 mg/L exceeded either a federal primary or secondary MCL. The radionuclides detected in the lower perched groundwater at this location include ^{3}H (73,000 ± 700 pCi/L), ^{90}Sr (207 ± 2 pCi/L), and ^{99}Tc (736 ± 6J[2] pCi/L). The ^{3}H and ^{99}Tc concentrations from this well are some of the highest concentrations measured in the perched water beneath the INTEC.

[2] Results for ^{99}Tc were labeled with a "J" during data validation, which indicates that an intervening factor (or factors) make it probable that the level of uncertainty in the reported value is greater than the uncertainty listed.

Well USGS-50 was originally intended to be completed in the SRPA, but was ultimately drilled to a total depth of 405 ft (123 m) to monitor a lower perched water zone. This well is located in the north-central portion of the facility. The highest concentrations of ^{3}H and ^{90}Sr occurred in 1969 and 1970. These elevated concentrations were attributed to the failure of the INTEC disposal well, where the wastewater was injected to the vadose zone rather than directly to the aquifer.

From the May 1995 water sampling of Well USGS-50, the concentrations of all chemical contaminants except nitrate/nitrite were below federal primary or secondary MCLs. Nitrate/nitrite concentration was measured at 31.3 mg/L compared to the federal primary MCL of 10 mg/L. Radionuclides in the perched water that were detected include ^{3}H (61,900 ± 700 pCi/L), ^{90}Sr (151 ± 2 pCi/L), and ^{99}Tc (63 ± 1J pCi/L). The concentrations for ^{3}H and ^{90}Sr are within the expected values based on the historical sampling conducted by the USGS.

Well MW-17 is the only lower perched water monitoring well located in the southern portion of the INTEC. This well has been constructed to monitor three perched water bodies: an upper zone from 181.7 to 191.7 ft (55.4 to 58.4 m) BGL, a middle zone from 263.8 to 273.8 ft (80.4 to 83.5 m) BGL, and a lower zone from 360 to 381 ft (110 to 116 m) BGL. During the May 1995 sample collection, water was only present in the upper and lower zones. None of the chemical constituents detected in the perched water exceeded either a federal primary or secondary MCL. Only two radionuclides (^{3}H and ^{99}Tc) were detected in perched water samples collected from Well MW-17. The concentrations of these two radionuclides were similar between the upper and lower perched water zones. Concentrations of ^{3}H varied from 25,100 ± 400 to 25,700 ± 400 pCi/L and ^{99}Tc concentrations varied from 5.9 ± 0.6 to 6.4 ± 0.6 pCi/L.

J.2.4 Snake River Plain Aquifer

The SRPA has been designated by the EPA as a sole-source aquifer for the region. The SRPA is about 200 mi (322 km) long and varies between 55 to 70 mi (89 to 113 km) wide. It extends from Ashton, Idaho, and the Big Bend Ridge on the northeast to Hagerman, Idaho, on the southwest and covers about 10,000 mi^2 (25,900 km^2). The aquifer consists of a series of basalt flows with interbedded sedimentary deposits and pyroclastic materials. The boundaries are formed by the contacts of the aquifer with less permeable rock at the margins of the plain (Mundorff et al. 1964). Robertson et al. (1974) estimated that as much as 2 billion acre·ft of water may be in storage in the aquifer, of which about 500 M acre·ft are recoverable (DOE-ID 2000b).

Groundwater in the SRPA generally occurs under unconfined conditions, but locally may be quasi-artesian or artesian (Nace et al. 1959). The quasi-artesian or artesian conditions are caused by layers of dense, massive basalt or sediments with relatively low permeability. Nace et al. (1959) described quasi-artesian as the situation in which the groundwater level is first recognized in a borehole during drilling at a depth below the regional water table, and then the level rises significantly (5 to 50 ft [1.5 to 15.2 m]) to the level of the water table. This rise of the water level simulates artesian pressure, but the conditions are not truly artesian. Nace et al. (1959) also noted water levels in some wells in the SRPA respond to fluctuations in barometric pressure similar to wells in confined aquifers, indicating that tight zones in the basalt may impede pressure equalization. True artesian or flowing artesian conditions in the SRPA were identified at Rupert, Idaho, in parts of the Mud Lake Basin, and north of the American Falls Reservoir (Nace et al. 1959).

Recharge to the aquifer is primarily by valley underflow from the mountains to the north and northeast of the plain and from infiltration of irrigation water. A small amount of recharge occurs directly from precipitation. Recharge to the aquifer within INL boundaries is primarily by underflow from the northeastern part of the plain and the Big Lost River (Bennett 1990). Significant amounts of recharge from the Big Lost River have caused water levels in some wells at the INL to rise as much as 6 ft (1.8 m) within in a few days after high flows in the river (Barraclough et al. 1982). Locally, the direction of groundwater flow is temporarily changed by recharge from the Big Lost River (Bennett 1990).

Estimates of the effective thickness of the SRPA at the INL vary. A 10,365-ft (3,159-m) deep geothermal test well (INEL-1) was drilled about 4.5 mi (7.2 km) north of the INTEC in 1979. Subsurface geologic information from INEL-1 indicates at least 2,000 ft (610 m) of basalt underlie the INL (Prestwich and Bowman 1980). Hydrological data from INEL-1 were interpreted by Mann (1986) to indicate that the effective base of the aquifer is located 850 to 1,220 ft (259 to 372 m) BGL. The depth to water at INEL-1 is about 400 ft (122 m) BGL, which suggests an effective aquifer thickness of 450 to 820 ft (137 to 250 m). In earlier studies by Robertson et al. (1974), the effective portion of the SRPA at the Test Reactor Area was assumed to be the upper 250 ft (76 m) of the saturated zone based on lithology and water quality. The aquifer thickness varies at different areas, and the aquifer becomes less productive with depth because of decreasing hydraulic conductivity (Hull 1989). Hydraulic conductivity of the basalt in the upper 800 ft (244 m) of the aquifer generally is 1.0 to 100 ft/d (0.3 to 30.5 m/d); whereas, the hydraulic conductivity of underlying rocks is several orders of magnitude smaller (Orr and Cecil 1991). Fracture filling from sediments and secondary mineralization are the principal reasons for the decreased hydraulic conductivity. Additional INL and

INTEC geologic and hydrogeologic characterization is found in Attachment 3 of this permit reapplication.

The water-table elevations range from 4,590 ft (1,399 m) AMSL in the northern part of INL to about 4,420 ft (1,347 m) AMSL south of the INL; the depth to the water table varies from about 200 ft (61.0 m) BGL in the northern part of INL to about 900 ft (274 m) BGL in the southern part. The general direction of groundwater flow is to the south-southwest, and the average gradient is about 4 ft/mi (0.8 m/km) (Orr and Cecil 1991). Locally, however, the hydraulic gradient varies significantly and ranges from about 1.0 ft/mi (0.2 m/km) in the northern part of INL to a maximum of 15 ft/mi (2.8 m/km).

The elevation of the water table and direction of groundwater flow are affected by recharge, groundwater withdrawal, and variations in aquifer transmissivity. The effects of groundwater withdrawal are often localized in contrast to recharge and transmissivity variations that have regional impacts. From July 1985 to July 1988, Orr and Cecil (1991) reported water-level changes in INL wells ranging from a 26-ft (7.9-m) decline near the Radioactive Waste Management Complex to a 4-ft (1.2-m) rise north of TAN. Water levels generally declined in the southern two-thirds of the INL during that time and rose in the northern one-third.

J.2.4.1 Hydraulic Conductivity in the SRPA.

Hydraulic properties of the SRPA have been determined by pumping tests. The effective hydraulic conductivity of the basalts and interbedded sediments that make up the SRPA at and near the INL ranges from 3E-3 to 1E+4 m/d. This six-orders of magnitude range was estimated from single-well aquifer tests in 114 wells, and is mainly attributed to basalt flows and dikes (Anderson et al. 1999). By calculating the geometric mean of transmissivity values, Hull (1989) estimated regional aquifer transmissivity for the southern INL to be 2.94E+5 ft^2/d (2.7E+5 m^2/d). Estimates of the storage coefficients range from 0.01 to 0.06 and effective porosity from 5 to 15%, with 10% being historically the most accepted value (Robertson et al. 1974), although more recent information indicates that a lower value may be appropriate.

J.2.4.2 Hydraulic Conductivity of the SRPA in the Vicinity of the INTEC.

The hydraulic conductivity of the SRPA in the vicinity of INTEC was estimated using the transmissivity values reported by Ackerman (1991) and the saturated thickness of the open interval of the well . The estimation of hydraulic conductivity assumes the wells fully penetrate the saturated

thickness of the aquifer. Hydraulic conductivities range five-orders of magnitude with a maximum hydraulic conductivity of 1E+4 ft/d (3E+3 m/d) at Well CPP-3 and a minimum hydraulic conductivity of 1E-1 ft/d (3E-2 m/d) at Well USGS-114. The average hydraulic conductivity within the immediate vicinity of the INTEC is 1.3E+3 ± 2.6E+3 ft/d (4E+2 ± 7.9E+2 m/d). Using the average hydraulic conductivity, a hydraulic gradient of 6.3 ft/mi (1.2 m/km) (Orr and Cecil 1991), and an effective porosity of 10%, the calculated seepage velocity in the vicinity of the INTEC is approximately 10 ft/d (3 m/d) (DOE-ID 2000a). Additional information on hydraulic conductivity of the INTEC is provided in Attachment 3 of this permit reapplication.

J.2.4.3 Contamination in the SRPA.

There is no verifiable evidence of HWMA/RCRA contamination below the INTEC in the SRPA. However, the water quality in the SRPA at and downgradient from the INTEC has been adversely impacted from past facility operations. The SRPA (Group 5) is identified under the CERCLA program as containing low-level threat wastes. The COCs identified in the OU 3-13 baseline risk assessment are primarily radionuclides and include ^{90}Sr, tritium, ^{137}Cs, ^{129}I, plutonium isotopes ($^{238, 239, 240, \text{ and } 241}$Pu), uranium isotopes ($^{234, 235, \text{ and } 238}$U), ^{237}Np, ^{241}Am, and ^{99}Tc. In addition, mercury was identified through modeling as a COC.

Water-level elevations indicate two separate sources of local recharge to the SRPA. One source for recharge is apparently from the historic percolation ponds as indicated by elevated water levels measured in Wells USGS-51, USGS -112, USGS-113, USGS-114, USGS-115, and USGS-116. Water-level response to recharge from these ponds is indicated by a 2-ft (0.6-m) rise in Well USGS-113 and a 1.0-ft (0.3-m) rise in Well USGS-51. The water table in the SRPA downgradient from the historic percolation ponds indicates a preferred flow direction toward the southwest with a secondary flow component to the southeast.

Directly south of the historic percolation ponds, water levels in Wells USGS-77 and USGS-111 are significantly lower than what would be expected based on the water levels in the adjacent wells. The primary reason suspected for this anomaly is the local variation in the water-bearing characteristics of the SRPA. A second possible source of recharge to the SRPA may be indicated by unusually high water levels measured in Well USGS-47. These levels are consistently 1 to 2 ft (0.3 to 0.6 m) higher than corresponding water levels measured from the surrounding wells. The possible causes of this situation include local recharge, local pumping, vertical hydraulic gradient (i.e., increasing hydraulic head with depth), and well completion characteristics.

Groundwater directly beneath the INTEC generally flows to the southwest and southeast, with a minor flow component to the south. The local flow pattern likely results from local recharge (i.e., percolation ponds and sewage ponds) that creates the mounding in the water table, and possibly from pumping the production wells. As the groundwater progresses beyond the influence of INTEC, it flows toward the southwest. The local hydraulic gradient is low, only 1.2 ft/mi (0.2 m/km) compared to the regional gradient of 4 ft/mi (0.8 m/km). Additional hydrogeologic characterization of the INTEC is provided in Attachment 3.

J.2.4.4 Local Flow Velocity in the SRPA.

Tritium from INTEC wastes has been used extensively in tracing groundwater flow velocities and directions (Morris et al. 1964; Hawkins and Schmalz 1965; Barraclough et al. 1967). Peaks of high tritium discharge to the disposal well have been particularly useful in determining the local flow characteristics in the SRPA. One of the most studied peak discharges of tritium occurred in December 1961, because it was preceded and followed by relatively long periods of low tritium discharge.

The concentration of the tritium peak as it passed each observation well provides an indication of the amount of dispersion the tritium discharge has undergone. The tritium concentration distribution indicates two preferred flow paths from the disposal well probably exist: the predominant path to the southwest and a less clearly defined path to the southeast. Some of the explanation for this phenomenon is provided in the plot of the transmissivity values for the INTEC, where a zone of low transmissivity is located directly to the south. This zone of low transmissivity to the south apparently acts as a barrier and impedes the local groundwater flow. The high degree of anisotropy associated with fractured aquifers is another reason for the large amount of dispersion that occurs in the SRPA. Additional characterization of local flow velocity at the INTEC is provided in Attachment 3.

J.2.4.5 Groundwater Pumping Effects on the SRPA.

The INTEC facility uses approximately 2.1 M·gal (7.9 M·L) of water each day. This water is supplied by two raw water wells (CPP-1 and CPP-2) and two potable water wells (CPP-4 and ICPP-POT-012) located in the northern portion of the facility. As part of the WAG 3 remedial investigation, the effect of pumping groundwater from these wells upon the local water table was investigated during July and August 1995. This investigation involved continuous water-level monitoring of several aquifer wells completed in the northern section of the INTEC while metering the pump usage in Production Well CPP-2.

Water-level fluctuations in six aquifer wells (MW-18, USGS-40, USGS-43, USGS-47, USGS-52, and USGS -121) were monitored at 5-minute intervals using pressure transducers and data loggers. The National Oceanic and Atmospheric Administration recorded barometric pressure changes at 5-minute intervals at the CFA weather station, which is located approximately 3 mi (5 km) from the INTEC. Pump usage for Well CPP-2 was continuously monitored based on amperage requirements. During the 11 days of the test, the production well pump turned on 17 times with each pump cycle lasting for approximately 9 hours.

The water levels in all aquifer wells exhibited a similar response. Daily fluctuations, generally less than 1 in. (3 cm), were observed in all aquifer wells corresponding with pump usage of the production well. In almost all pump cycles, the corresponding water levels in the aquifer wells decreased by an average of 0.75 in. (1.9 cm). Only Pump Cycle No. 11 demonstrated an increase in water levels throughout the pump duration for all wells except Well USGS-40. This water-level increase during this pump cycle may be the result of a local or regional trend and is not related to pumping groundwater. Other than Pump Cycle No. 11, the water levels decreased during the pump cycle in Wells MW-18, USGS-40, USGS-43, and USGS-52 throughout the test.

As shown by this test, water levels in the SRPA are affected by pumping groundwater from the production well. Minimal responses (< 1.0 in. [< 2.5 cm]) were observed in these six monitoring wells; however, the wells are located approximately 2,000 ft (610 m) from the production well. Increased drawdown would be expected closer to the production well that could affect the local groundwater flow direction in the northern sections of the INTEC. Additional information on the effects of pumping groundwater at the INTEC is provided in Attachment 3.

J.3 Topographic Map Showing Groundwater Monitoring Wells IDAPA 58.01.05.012 [40 CFR 270.14(c)(3)]

The topographic map showing the waste management areas and the groundwater monitoring wells selected for groundwater monitoring is provided in Attachment 1.

J.4 Description of any Plume Contaminants from a Regulated Unit IDAPA 58.01.05.012 [40 CFR 270.14(c)(4)]

As previously stated, there is no verifiable evidence of HWMA/RCRA constituents originating from the WCF or CPP-601/627/640 in the perched groundwater.

J.5 Proposed Groundwater Monitoring System IDAPA 58.01.05.012 and 008 [40 CFR 270.14(c)(5) and 40 CFR 264.97]

Groundwater monitoring of perched water will be conducted to determine (1) whether hazardous waste or hazardous waste constituents associated with the WCF or CPP-601/627/640 have entered the groundwater, (2) the rate and extent of migration of hazardous waste or hazardous waste constituents in the groundwater, and (3) the concentrations of hazardous waste or hazardous waste constituents in the groundwater. If summary statistics determine that significant evidence of contamination is detected above established background levels a PMR would be submitted to the DEQ to include SRPA monitoring.

Correlating contaminants, or contaminant concentrations, that may be observed in the perched water to a release from the closed INTEC landfills is extremely complicated because of three significant factors. First, the waste streams that were processed at the WCF and CPP-601/627/640 are not unique to these facilities. The same waste streams were processed at several other major facilities all located in relatively close proximity. These include the Fluorinel Dissolution Process and Fuel Storage Area (Building CPP-666),, the HLLW TFF, the PEWE (Building CPP-604/605), and the NWCF (Building CPP-659). In the WAG 3, OU 3-13 ROD, ten release sites were identified at the TFF alone (DOE-ID 1999). Second, approximately 450 ft of vadose zone is present between the land surface and SRPA. The vadose zone beneath the INTEC comprises a highly heterogeneous layering of fractured basalt flows and sedimentary interbeds. Significant sources of groundwater recharge act on the vadose zone, including surface water infiltration due to snowmelt and precipitation over the INTEC facility and anthropogenic sources from leaks in the INTEC water systems. Recharge from these water sources combine to create perched water bodies in the vadose zone and a flow system that mixes contaminants from the numerous surface release sites. Given the layering of the system, where horizontal permeabilities can be several orders of magnitude greater than vertical permeabilities, significant lateral movement of the perched water and associated contaminant may occur, further

complicating the ability to track contaminants from land surface to the aquifer. Third, past disposal of service water (including a component from the PEWE) through the former INTEC injection well and the identified presence of soil contamination from old releases under and around the WCF make identification of new releases difficult.

J.5.1 Perched Groundwater Monitoring Wells

The WCF monitoring system will consist of wells within the upper perched water zones and lower perched water zones. The perched water zones are noncontiguous bodies of water that are subject to directional change from recharge influences from the Big Lost River, sewage treatment lagoons, and the historic percolation ponds. Within the perched water zones, these factors make it difficult to establish unaffected, hydraulically upgradient background wells for use in detection monitoring. Therefore, perched water monitoring wells have been spatially selected to account for changes in groundwater flow direction, and statistical methods have been proposed to examine significant changes within individual wells and within the entire monitoring well network as a system.

To assess contamination from the WCF, perched water samples were collected from five perched groundwater wells. The wells originally selected for detection monitoring are CPP-55-06, ICPP-MON-P-002 (MW-2), ICPP-MON-P-005 (MW-5), ICPP-MON-P-019 (MW-18), and ICPP-MON-P-020 (MW-20) (see Topographic Map in Attachment 1). Well construction details for the perched water monitoring wells are given in Permit Module III, Table 2.

As required by Permit Condition III.H.3.a., a Monitoring Well Network Compliance Statement was provided in the fall 2004 semiannual report. The compliance statement assessed whether the monitoring network, as described in the WCF post-closure permit has satisfied the requirements of IDAPA 58.01.05.008 [40 CFR 264.97(a)]. Because monitoring wells MW-12-2, MW-18-2, and CPP-33-1 had not consistently yielded a sufficient volume of water for sampling, the compliance statement proposed revising the monitoring network by adding MW-10-2 and CPP-55-06 for quarterly sampling to provide supplemental information.

As required by previous Permit Condition III.I.2., the construction of two additional wells was completed (April 5, 2005). The two wells, identified as ICPP-2018 (alias TFS-SP for tank farm south-shallow perched) and ICPP-2019 (alias TFSE-SP for tank farm southeast-shallow perched), were first sampled during the May 10-12, 2005 sampling event.

A HWMA/RCRA Class 2 permit modification request (PMR) to modify the WCF monitoring well network, approved by the DEQ on January 17, 2006, revised the permit to: add wells ICPP-2018, ICPP-2019, and MW-10-2 as monitoring wells; change well CPP-55-06 from a water elevation well to a monitoring well; remove well MW-4-2 as a water elevation well; and change groundwater sampling and analysis procedures and monitoring schedule.

Sample results from wells CPP-55-06 and MW-10-2 had been reported as supplemental wells, as proposed in the response to the Comprehensive Ground Water Monitoring Evaluation (CME) for the Waste Calcine Facility. As a result of the HWMA/RCRA Class 2 PMR to modify the WCF monitoring well network, approved by the DEQ on January 17, 2006, wells CPP-55-06 and MW-10-2 were no longer considered as supplemental wells but are considered to be part of the permit reapplication monitoring network and are considered monitoring wells, not supplemental wells during the 2006 WCF quarterly sampling events.

The addition of these wells provided a total of thirteen wells in the WCF monitoring network, three of which were background wells and six of which were point-of-compliance wells. Two of the point-of-compliance wells (MW-12-2 and MW-18-2) have been consistently dry and were changed from water monitoring to water elevation only wells via the Class 3 PMR. Water level well MW-8 has been consistently dry, and therefore MW-8 was removed from the WCF network via the Class 3 PMR. The current WCF monitoring network is expected to continue to satisfy the requirements of IDAPA 58.01.05.008 [40 CFR 264.97(a)].

Because of the noncontiguous nature of the perched zones, the water levels in the wells were monitored on a bi-monthly basis for three years to evaluate flow directions in the perched water zones. The five wells were selected to account for possible shifts in flow direction. The interim point of compliance (POC) wells were ICPP-55-06, ICPP-MON-P-002 (MW-2), and ICPP-MON-P-005 (MW-5). The direction and rate of flow in the uppermost perched aquifer have been determined as required by Permit Condition III.B.2. This information has been reported in the Fall 2004, 2005, and 2006 semiannual reports.

The CPP-601/627/640 monitoring well system will consist of five wells: MW-6, CPP-33-2, ICPP-2195, ICPP-2196, and ICPP-2205. Note that the proposed monitoring network initially included only four wells, however during drilling, well ICPP-2196 was dry. Therefore, with DEQ concurrence, well ICPP-2205 was completed to replace well ICPP-2196. The well construction details for these wells are provided in Permit Module III, Table 2a. These wells will be sampled and the data

statistically evaluated to determine background levels. The sampling and analysis protocols and compliance requirements are the same as for the WCF sampling.

The stated WAG 3 remedial action objective for the INTEC is to eliminate perched water by removing the sources. To accomplish this, the historic service water percolation ponds were moved to a new area west of the INTEC. Other anthropogenic sources of water are being addressed on a case by case basis. The necessity or ability to monitor perched water will be evaluated each year. If a perched water well is dry at the time of sampling, perched water samples will not be collected during that sampling event. All perched monitoring wells proposed for abandonment due to the elimination of perched water must be approved by the Director prior to abandonment and will require a permit modification in accordance with 40 CFR § 270.42.

As the water levels in the existing well network for the WCF and CPP-601/627/640 continue to decline, wells located between WCF and CPP-601/627/640 may be used as dual purpose wells (i.e., as both downgradient/point of compliance wells for CPP-601/627/640 and upgradient wells for WCF). The dual purpose use of these wells will provide adequate monitoring for the detection of releases from either unit. As monitoring continues and water levels decline, the well network will continue to be modified to ensure a regulatory compliant network is in place to monitor the post-closure units. Preference will be given to existing wells at INTEC, over installation of new wells, as necessary to support monitoring.

J.5.2 Sampling and Analysis Procedures

Field measurements, sample collection and preservation, and quality assurance/quality control (QA/QC) criteria are defined below for the post-closure sample collection activities.

J.5.2.1 Groundwater Elevations.

Prior to initiation of sampling, all groundwater elevations will be measured using an electronic water-level indicator, weighted measuring tape, or continuous recorder method from the reference marker. Measurement of all groundwater levels will be recorded relative to mean sea level and to an accuracy of ± 0.01 ft (0.003 m).

The water-level data obtained from the wells in this monitoring program will be combined with water-level measurements obtained from other WAGs or USGS data to determine groundwater flow gradients, direction and rate of annual groundwater flow, and to generate potentiometric maps.

Table J-3. Summary of perched groundwater monitoring wells.

Monitored Zone	Well Designation
Upper Perched Groundwater	CPP-33-1, CPP-33-2, CPP-33-4-1, CPP-37-4, CPP-55-06, ICPP-MON-P-002 (MW-2), ICPP-MON-P-005 (MW-5), ICPP-MON-P-020 (MW-20), MW-10-2, MW-12-2, MW-18-2, ICPP-2018 (TFS), ICPP-2019 (TFSE), MW-6, CPP-33-2, ICPP-2195, ICPP-2196, ICPP-2205

J.5.2.2 Perched Groundwater Purging.

All perched water wells will be purged prior to sample collection in an effort to obtain a representative sample from the perched water zone. Prior to purging, the static water level in each well scheduled for sampling is measured and a static well casing volume is calculated. Wells that contain one foot of water column, or less, will be considered to have insufficient water for sampling. Wells are purged using low-flows at 0.5 to 2 Liters/min to minimize draw down and formation disruption while obtaining a representative sample from the perched water zone. During purging, measurements will be made to determine specific conductance and pH. These parameters may be measured either with probes located downhole or at the ground surface. Purging consists of removing one to three well volumes while measuring these parameters. Samples for water quality analysis can be collected after a minimum of one well casing volume of water has been purged from the well, and as soon as two consecutive measurements of pH and specific conductance fall within the following limits:

- pH ± 0.2 standard units
- Specific conductance ± 5 % of reading

If pH and specific conductance fail to stabilize within the above limits, purging will continue until a maximum of three well casing volumes of water have been purged from the well, at which point sampling will begin regardless of parameter stabilization. Water temperature and turbidity will be measured/recorded during well purging. Stabilization of temperature or turbidity is influenced by the volume of water in the well and the rate of recharge, thus are not appropriate stability parameters for these low yielding wells. Stable pH and specific conductance parameters will be used as criterion for sampling. Purged water from wells completed within the perched water zones will be collected and managed in accordance with the appropriate HWMA/RCRA and radiological requirements.

J.5.2.3 Perched Groundwater Sample Collection.

When purging a well, if insufficient water is available to complete the purging, as described above, the well should be purged to dryness and sampled the next working day at which point, no additional purging or stable parameters are required at the well and the samplers will collect the available water for analysis. Sampling at the well will then be considered complete. The following is the preferred order for sample collection:

1. Metals (filtered)
2. Volatile organic compounds (VOCs)
3. Semivolatile organic compounds.

Sample bottles are protected from contamination by the sampler using clean, waterproof gloves. The identification label is placed on the bottle with the appropriate information such as sample ID number, name of project area/well, type of analysis, date, sampler, preservative and collection time. Sufficient water from the well is collected to fill the required number of bottles. The water is transferred from the sampling equipment directly to the sample bottle. The bottle is filled to the neck or for samples that require volatile organic analysis, the bottle is filled until no air bubbles or headspace is left.

Following sampling, all non-dedicated equipment that came in contact with the well water will be decontaminated using deionized water. Since the media sampled is suspected of containing RCRA listed hazardous waste, the solution used to decontaminate the equipment is contained, managed, and disposed of in accordance with appropriate HWMA/RCRA and radiological requirements.

J.5.2.4 QA/QC Samples.

For perched groundwater monitoring and sampling, collection of QA/QC samples is required. Equipment rinsate samples are required when the same sampling equipment is used to collect samples from multiple wells. Equipment rinsate samples provide an indication of the effectiveness of equipment decontamination between well sampling locations. Equipment rinsate samples are not required for wells that have a dedicated pump or when sampling equipment is limited to sampling of a single well (e.g., disposable bailers that are used to sample one well and then disposed instead of reused to sample a second well).

Quality control requirements will be satisfied by collecting QA/QC samples (duplicates, field blanks, and equipment rinsate) during the perched groundwater sampling according to the schedule presented in Table J-4.

J.5.2.5 Sample Preservation.

Sample preservation is required for many of the chemical constituents and physiochemical parameters that are not chemically stable but are measured or evaluated in a perched groundwater sampling program. Methods of sample preservation are generally intended to retard biological action, retard hydrolysis, and reduce sorption effects. Preservation methods usually include pH control, chemical addition, refrigeration, and protection from light. Appropriate preservation methods will be used.

J.5.2.6 Chain-of-Custody Procedures.

The purpose of the chain-of-custody procedures is to ensure the possession and handling of samples are traceable at all times. A sample is considered in custody if it falls under one of the following descriptions:

- In one's possession
- In one's view after being in one's physical possession
- In one's physical possession and then locked up to prevent someone from tampering with the sample
- Kept in a secured area and restricted to authorized and accountable personnel only. A secured area is an area that is locked, such as a room, cooler, or refrigerator. If the area cannot be locked, a current revision of custody seal will be used to secure the area.

The following recommended information is recorded as appropriate:

- Signature of the person maintaining custody
- Project name or title
- Sample identification number
- Sampling date

- Sampling time
- Type of sample (e.g., grab or composite)
- Physical state of sample (e.g., aqueous or solid)
- Preservation used
- Sample location
- Analysis to be performed
- Number of sample containers

J.5.2.7 Transportation of Samples.

Samples will be shipped in accordance with the regulations issued by the U.S. Department of Transportation (DOT) (49 CFR 171 through 178) and EPA sample handling, packaging, and shipping methods (40 CFR 262).

J.5.2.8 Custody Seals.

Custody seals will be placed on all shipping containers in such a way as to ensure that tampering or unauthorized opening does not compromise sample integrity. Clear plastic tape will be placed over the seals to ensure that the seals are not damaged during shipment.

Table J-4. The QA/QC samples for perched groundwater sampling.

Activity	Type	Comment
Perched Groundwater sampling	Duplicate	Field duplicates will be collected at a frequency of 1 per 20 samples per sampling event or 1 per 4 sampling days, whichever is more frequent.
	Field blank	Field blanks will be collected at a frequency of 1 per 20 samples per sampling event or 1 per 4 sampling days, whichever is more frequent.
	Trip blanks	Trip blanks will be collected when VOC samples are taken to include one in every cooler shipped.
	Equipment rinsate	Equipment rinsate samples will be collected if the same sampling equipment is used to sample more than one well. A minimum of 1 rinsate sample will be collected per sampling event, or 1 per 20 samples per sampling event, or 1 per 4 sampling days, whichever is more frequent.

VOC = volatile organic compound

J.5.2.9 On-Site and Off-Site Shipping.

An on-Site shipment is any transfer of material within the perimeter of the INL. Site-specific requirements for transporting samples within INL boundaries and those required by the shipping and receiving department will be followed. Shipment within the INL boundaries will conform to DOT requirements as stated in 49 CFR Parts 171–178. Off-Site shipment will be coordinated with INL packaging and transportation personnel, as necessary, and will conform to all applicable DOT requirements.

J.5.2.10 Sample Identification Code.

The following lists the sample label information to be used for perched groundwater sampling as applicable:

- Project name
- The site/sample identification
- The analysis to be performed on the sample
- The date the sample was collected
- The time the sample was collected
- The preservative used (if any)
- Name of sampler

The Sampling and Analysis Plan (SAP) tables will be used to record all pertinent information (well designation, media, date, etc.) associated with each sample ID code.

J.5.2.11 Sample Designation.

The SAP table format was developed to simplify the presentation of the sampling scheme for project personnel. Examples of SAP tables are presented in Attachment 2.

J.6 Quality Criteria for Measurement Data

J.6.1 Evaluation of Initial Characterization Data

There is no verifiable evidence of HWMA/RCRA constituents that have originated from the WCF or CPP-601/627/640 in the perched groundwater (INEEL 2002). Groundwater data were not collected under the provisions of IDAPA 58.01.05.009 (40 CFR 265 Subpart F) during the interim status period at the WCF nor were groundwater data collected for CPP-601/627/640 under either interim status or the HWMA/RCRA permit. However, groundwater samples were collected from the perched and SRPA groundwater monitoring wells as part of other investigations during this period. During the 1993 to 1994 WAG 3, perched water investigation, the perched and SRPA groundwater monitoring wells were sampled and analyzed for field parameters, inorganics, and radionuclides.

During the 1993 to 1994 WAG 3 investigation, 18 perched groundwater wells were sampled for 35 organic contaminants. Of the 630 reported analytical results (excluding trip blanks), 36 contaminants were reported as detected. These data are of an unknown quality. Nearly all detections were qualified below the contract laboratory quantification limit, contamination was detected in trip blanks, constituents were not detected in duplicate samples where the same constituent was detected in the duplicate pair, and contaminants were detected in quality control samples. Additionally, the original data packages are not available for data validation.

Under a continuing WAG 3 investigation in 1995, the perched and SRPA groundwater monitoring wells were sampled and analyzed for field parameters, inorganics, and radionuclides. HWMA/RCRA inorganics above the toxicity characteristic leaching procedure were not detected in the perched or SRPA groundwater samples taken below INTEC.

The USGS sampled numerous SRPA monitoring wells between 1951 and 1998 for a variety of organic and inorganic constituents. HWMA/RCRA organic and characteristic contaminants were not detected in the SRPA groundwater samples taken from below INTEC facility boundaries.

Samples were taken from the perched groundwater wells MW-2, MW-5, MW-20, USGS-050, and other wells in 2001 and 2002. The 2001 samples were not filtered and results included analytes associated with the water and soil/sediment fractions of the samples. The 2002 samples were filtered prior to analysis, and results include only those analytes associated with the water fraction of the samples. No HWMA/RCRA constituents were detected in the filtered samples.

J.6.2 Quality Assurance/Quality Control

QA/QC objectives specify what measurement criteria must be met to produce acceptable data for a project. The technical and statistical qualities of these measurements must be properly documented. Precision, accuracy, and completeness are quantitative parameters that must be specified for physical/chemical measurements. Comparability and representativeness are qualitative parameters.

QA/QC objectives for this project will be met through a combination of field and laboratory checks. Field checks will consist of collecting field duplicates, equipment blanks, and field blanks. Laboratory checks consist of initial and continuing calibration samples, laboratory control samples, matrix spikes, and matrix spike duplicates.

J.6.3.1 Field Precision.

Field precision is a measure of the variability not due to laboratory or analytical methods. The three types of field variability or heterogeneity are spatially within the data population, between individual samples, and within an individual sample. Although the heterogeneity between and within samples can be evaluated using duplicate and sample splits, overall field precision will be calculated as the relative percent difference between two measurements, or relative standard deviation among three or more measurements. The relative percent difference or relative standard deviation will be calculated during the data validation process or by the laboratory as a requirement of the analytical method used.

Duplicate samples to assess precision will be co-located and collected by field personnel at a minimum frequency of one duplicate for at least one of the wells sampled each event. Examples of sample identifications for the duplicate samples are provided in the SAP table presented in Attachment 2. The location for duplicate samples will be rotated over the project life to ensure that at least one duplicate sample will be collected from each well if sufficient water exists.

J.6.3.2 Field Accuracy.

Cross-contamination of the samples during collection or shipping could yield incorrect analytical results. To assess the occurrence of any cross-contamination events, equipment and field blanks will be collected to evaluate any potential impacts. The goal of the sampling program is to eliminate any cross-contamination associated with sample collection or shipping.

Field personnel will collect equipment rinsate blanks and field blanks during the course of the project. Trip blanks will be collected whenever samples for volatile organic compound analysis are scheduled for collection. The equipment rinsate blanks and field blanks will be collected at a frequency listed in Table J-4. Examples of sample identifications for the blanks are provided in the SAP table presented in Attachment 2.

J.6.3.3 Field Completeness.

Field completeness will be assessed by comparing the number of samples collected to the number of planned samples. Field sampling completeness is affected by such factors as equipment and instrument malfunctions, and insufficient sample recovery. Completeness can be assessed following data validation and reduction. The completeness goal for this project is 95%.

J.6.3.4 Comparability.

Comparability is a qualitative measure of the confidence with which one data set can be compared to another. These data sets include data generated by different laboratories performing analysis, data generated by laboratories in previous studies, data generated by the same laboratory over a period of several years, or data obtained using different sampling techniques or analytical protocols. Throughout the background concentration determination phase of this project, the same analytical procedures will be used and the same laboratory will analyze the samples in an effort to ensure data comparability. For field aspects of this program, data comparability will be achieved using standard methods of sample collection and handling.

J.6.3.5 Representativeness.

Representativeness is evaluated by assessing the accuracy and precision of the sampling program and expressing the degree to which samples represent actual site conditions. In essence, representativeness is a qualitative parameter that addresses whether the sampling program was properly designed to meet the requirements specified. The representativeness criterion is best satisfied by confirming that sampling locations are selected properly, sample collection procedures are consistently followed, and a sufficient number of samples are collected to meet the requirements stated in the final SAP table.

J.7 Establishment of a Detection Monitoring Program IDAPA 58.01.05.012 and .008 [40 CFR 270.14(c)(6)and 40 CFR 264.98]

The WCF and CPP-601/627/640 are closed units located among several identified contaminant release sites currently being managed under the FFA/CO through the CERCLA program. As emphasized earlier, correlating contaminants or contaminant concentrations that may be observed in the perched water to a new release from the WCF will be complicated.

J.7.1 Detection Monitoring Indicator Parameters for WCF

Calcination was conducted in the WCF from 1963 until 1981, and then continued in the NWCF until 1998. The *HWMA WCF Closure Plan* provided a list of HWMA/RCRA hazardous waste numbers associated with the WCF. This list was based on an inventory of commercial chemical products that were used at the INTEC and represented a conservative over-filing to allow for potential future operations. A more recent list of HWMA/RCRA hazardous waste numbers that actually entered the calciner systems (via the INTEC liquid waste system) was presented in the February 1999 *A Regulatory Analysis and Reassessment of U.S. Environmental Protection Agency Listed Hazardous Waste Numbers for Applicability to the INTEC Liquid Waste System* (INEEL 1999). Characteristic hazardous waste numbers associated with the WCF were taken from INL's Part A permit application.

The hazardous waste numbers applicable to the WCF and CPP-601/627/640 are shown in Table J-5. The selected indicator parameters for the detection monitoring program are based upon the HWMA/RCRA-listed and characteristic waste constituents as found in the current WCF and CPP-601/627/640 Part A Permit Application (see Attachment 1). These parameters are shown in Table 3a and 3c in Module III of the permit. The organic parameters will provide an indication of whether listed hazardous constituents associated with the WCF and CPP-601/627/640 are present in the groundwater. The characteristic parameters will indicate whether the groundwater exhibits a characteristic of hazardous waste.

The approved closure plan for the WCF characteristic and listed hazardous constituents list was based on information in Revision 0 and 1 of the *Regulatory Analysis of INTEC Liquid Waste Stream U.S. Environmental Protection Agency Hazardous Waste Numbers*. The report was based on operational information up to and including 1993. This resulted in a lengthy list of constituents in the WCF approved closure plan. Changes incorporated in Revision 2 of the regulatory analysis were a result of operational information acquired after 1993 up to July 1998. The assessment document, *A*

Regulatory Analysis and Reassessment of U.S. Environmental Protection Agency Listed Hazardous Waste Numbers for Applicability to the INTEC Liquid Waste System, Revision 1, provides the applicable hazardous waste numbers as a result of reevaluation of operational information as of February 1999. Between the 1993 list and the 1999 list the number of constituents was greatly reduced as appropriate with supporting data.

Table J-5. EPA hazardous waste numbers associated with the WCF and CPP-601/627/640.

EPA Hazardous Waste Numbers	Chemical Characteristic/Name
D004	Arsenic
D005	Barium
D006**	Cadmium
D007	Chromium
D008	Lead
D009	Mercury
D010	Selenium
D011	Silver
F001	1,1,1-Trichloroethane, Carbon tetrachloride, Trichloroethylene
F002	1,1,1-Trichloroethane, Carbon tetrachloride, Trichloroethylene, Tetrachloroethylene, Methylene chloride, 1,1,2-Trichloroethane
U134	Hydrogen fluoride*

* These constituents are not listed in 40 CFR264 Appendix IX - Groundwater Monitoring List. Therefore, analysis will not be performed for these constituents.

**This EPA hazardous waste number is only associated with CPP-601/627/640 (not applicable to the WCF)

J.7.2 Background Values for Detection Monitoring Parameters for WCF.

Background values were not established during the interim status period for use in the detection monitoring program. In preamble language to the July 26, 1982, "Hazardous Waste Management System; Permitting Requirements for Land Disposal Facilities" (Federal Register 1982), the EPA stated,

> "*Under the detection monitoring program, the owner or operator determines whether contaminants from a regulated unit have entered ground water by comparing levels of constituents at the compliance point to background values for those constituents. The first step in the process, then, is to establish a background value for each monitoring well*."

For newly regulated units, EPA allowed background concentrations to be established from the results of quarterly groundwater sampling conducted during the first year. However, in the case where insufficient data existed to establish background at the time of permit issuance, EPA stated,

> "*The Regional Administrator may, however, specify in the permit the procedures to be used in calculating background and indicate that whatever value results from the calculation shall automatically become part of the permit. For example, the owner may have only assembled 6 months of background data at the time the permit is ready to be issued. Rather than wait for another 6 months until the rest of the one year of background data has been assembled, the Regional Administrator may simply specify how the additional background data will be used to calculate the value."* (Federal Register 1982)

Because the WCF is located among several identified contaminant release sites, and the perched water is subject to recharge fluctuation, establishing background conditions and accounting for the seasonal, temporal, and recharge fluctuation within the groundwater monitoring system is critical.

A statistical analysis of all data collected to date to establish background concentrations pursuant to Permit Condition III.D.1. was submitted to DEQ on December 11, 2006 and was approved on January 29, 2007. An updated statistical analysis of WCF data was completed in August 2010 (see Appendix J-1.) to support revision of the WCF DMLs in Table 3b in Permit Module III.

J.7.3 Groundwater Monitoring for CPP-601/627/640.

Ground water monitoring programs for CPP-601/627/640 have been implemented to meet the requirements of IDAPA 58.01.05.008 (40 CFR 264.97, 264.98, 264.99, and 264.100). A detection monitoring program (DMP) was put into effect upon completion of the monitoring well installation. Detection monitoring limits and groundwater protection standard (GPS) values for CPP-601/627/640 are provided in Table 3c in Module III of the permit. These limits are typically established as estimated quantitation limits (EQLs) plus established background concentrations. Groundwater protection standards are typically established as the maximum contaminant levels promulgated under the Safe Drinking Water Act plus established background concentrations. Because background concentrations had not yet been established for CPP-601/627/640 landfill post-closure monitoring, initial DMLs and GPSs were matched to the WCF DMLs that were in effect at the time of the CPP-601/627/640 post-closure plan approval. Samples were collected quarterly for 2 years to establish background levels, which were calculated using the statistical requirements set out in Permit Condition III.J. The statistical analysis report was submitted to the DEQ on December 12, 2012 as part of a permit modification request to revise the DMLs for CPP-601/627/640 in Table 3c, and add Table 3d for DMLs that differ among wells for CPP-601/627/640. The DEQ approved the permit modification request on February 25, 2013.

J.7.4 Contingent Groundwater Monitoring Plan for the Snake River Plain Aquifer

The following contingent monitoring plan was developed to address sampling of the Snake River Plain Aquifer in the event that perched water levels continue to decline. An ongoing CERCLA remedial objective has been to remove sources of recharge and dry up the perched water zones beneath INTEC. Water level declines in the upper perched zone indicate that this remedial objective has been at least partially successful. It is expected that perched water levels will continue to decline, and there may soon be insufficient water for monitoring the perched zones. There are five wells in the CPP-601/627/640 monitoring network and seven wells in the WCF monitoring network that are sampled semiannually when there is sufficient water (greater than one foot) in the wells. The wells in these two sampling networks were combined in a Class 2 permit modification request that was approved by DEQ on February 25, 2013, to operate as a combined dual purpose sampling network to address the potential lack of water in some of the CPP-601/627/640 wells.

Table J-6 identifies the Snake River Plain Aquifer wells that will be sampled in this contingent monitoring plan. Table J-7 lists the existing analytical data for the contaminants of concern from these wells. Figures J-7, J-8, J-9, and J-10 are the well construction diagrams for these aquifer wells. This contingent monitoring plan will be implemented when there is no longer at least one up-

gradient perched water well and three down-gradient (point of compliance) perched water wells that have at least one foot each of water available for sampling for two consecutive semi-annual sampling events. When this occurs, samples will be collected from the perched wells that contain sufficient water for sampling and from the four Snake River Plain Aquifer wells listed in Table J-6 during the next semiannual sampling event. The constituents to be analyzed and the reporting limits (EQLs) are those listed in Table 3a and 3b. Sampling the Snake River Plain Aquifer will then continue semiannually and will be reported semiannually per permit condition I.P.8.

Aquifer well purging will be similar to purging performed for the perched water wells and will be calculated as the water column within the screened interval. Samples for water quality analysis can be collected after a minimum of one water column has been purged from the well, and as soon as two consecutive measurements of pH and specific conductance are within the limits listed in Section J.5.2.2. Purged water from the aquifer wells will be collected and managed in accordance with the appropriate HWMA/RCRA and radiological requirements. Procedures for the collection of QA/QC samples, sample preservation, chain-of-custody, and transportation of samples will follow those described in Section J.5

Table J-6. Completion details for Post Closure Snake River Plain Aquifer monitoring wells.

Monitoring Well Name	Well Designation	Year Installed	Casing Diam. (in.)	Total Depth Drilled (ft bgs)	Well Screen Material	Screened Interval (ft bgs)
ICPP-MON-A-230	Upgradient Background	2001	6	503	SS	443 to 483
ICPP-MON-P 019 (MW-18-4)	Point of Compliance	1994	4	492	PVC	458 to 478
ICPP-2020	Point of Compliance	2005	6	506	SS	455 to 495
ICPP-2021	Point of Compliance	2005	6	507	SS	453 to 493
Well Screen Material: SS = Stainless Steel PVC = polyvinyl chloride						

Table J-7. Existing analytical data for contaminants of concern from Snake River Plain Aquifer Wells

Official Well Name	Date Collected	Constituent	Concentration (µg/L)	Lab Qualifier	Validation Qualifier
ICPP-2020	4/18/2005	1,1,1-Trichloroethane	1	U	
ICPP-2020	4/18/2005	2-Butanone	5	U	
ICPP-2020	4/18/2005	Arsenic	6.8	B	
ICPP-2020	4/18/2005	Arsenic	6	U	
ICPP-2020	4/18/2005	Barium	111		
ICPP-2020	4/18/2005	Barium	110		
ICPP-2020	4/18/2005	Benzene	1	U	
ICPP-2020	4/18/2005	Cadmium	1	U	
ICPP-2020	4/18/2005	Cadmium	1	U	
ICPP-2020	4/18/2005	Carbon disulfide	5	U	
ICPP-2020	4/18/2005	Carbon tetrachloride	1	U	
ICPP-2020	4/18/2005	Chloroform	1	U	
ICPP-2020	4/18/2005	Chromium	3.9	B	U
ICPP-2020	4/18/2005	Chromium	2.8	B	U
ICPP-2020	4/18/2005	Lead	2.5	U	
ICPP-2020	4/18/2005	Lead	2.5	U	
ICPP-2020	4/18/2005	Mercury	0.05	U	
ICPP-2020	4/18/2005	Mercury	0.05	U	
ICPP-2020	4/18/2005	Mercury	0.05	U	
ICPP-2020	4/18/2005	Methylene chloride	5	U	
ICPP-2020	4/18/2005	Selenium	6	U	
ICPP-2020	4/18/2005	Selenium	6	U	
ICPP-2020	4/18/2005	Silver	1	U	
ICPP-2020	4/18/2005	Silver	1	U	
ICPP-2020	4/18/2005	Tetrachloroethene	1	U	
ICPP-2020	4/18/2005	Toluene	38		
ICPP-2020	4/18/2005	Trichloroethene	1	U	
ICPP-2020	3/8/2006	Arsenic	6	U	
ICPP-2020	3/8/2006	Barium	112		
ICPP-2020	3/8/2006	Cadmium	1	U	
ICPP-2020	3/8/2006	Chromium	6.3	B	
ICPP-2020	3/8/2006	Lead	2.5	U	
ICPP-2020	3/8/2006	Mercury	0.065	B	
ICPP-2020	3/8/2006	Selenium	10.7	B	U
ICPP-2020	3/8/2006	Silver	1	U	
ICPP-2020	4/11/2007	Arsenic	6	U	

Table J-7 (continued)

Official Well Name	Date Collected	Constituent	Concentration (µg/L)	Lab Qualifier	Validation Qualifier
ICPP-2020	4/11/2007	Barium	104		
ICPP-2020	4/11/2007	Cadmium	1	U	
ICPP-2020	4/11/2007	Chromium	2.7	B	U
ICPP-2020	4/11/2007	Lead	2.5	U	
ICPP-2020	4/11/2007	Mercury	0.06	U	
ICPP-2020	4/11/2007	Selenium	6	U	
ICPP-2020	4/11/2007	Silver	1.8	B	U
ICPP-2020	4/7/2009	Benzene	1	U	
ICPP-2020	4/7/2009	Benzene	1	U	
ICPP-2020	4/7/2009	Toluene	1	U	
ICPP-2020	4/7/2009	Toluene	1	U	
ICPP-2020	10/29/2009	Benzene	1	U	
ICPP-2020	10/29/2009	Toluene	1	U	
ICPP-2020	12/16/2009	Benzene	1	U	
ICPP-2020	12/16/2009	Benzene	1	U	
ICPP-2020	12/16/2009	Toluene	1	U	
ICPP-2020	12/16/2009	Toluene	1	U	
ICPP-2020	4/13/2010	Benzene	1	U	
ICPP-2020	4/13/2010	Toluene	1	U	
ICPP-2021	4/18/2005	1,1,1-Trichloroethane	1	U	
ICPP-2021	4/18/2005	1,1,1-Trichloroethane	1	U	
ICPP-2021	4/18/2005	2-Butanone	5	U	
ICPP-2021	4/18/2005	2-Butanone	5	U	
ICPP-2021	4/18/2005	Arsenic	6	U	
ICPP-2021	4/18/2005	Arsenic	6	U	
ICPP-2021	4/18/2005	Arsenic	6	U	
ICPP-2021	4/18/2005	Arsenic	6	U	
ICPP-2021	4/18/2005	Barium	139		
ICPP-2021	4/18/2005	Barium	146		
ICPP-2021	4/18/2005	Barium	141		
ICPP-2021	4/18/2005	Barium	143		
ICPP-2021	4/18/2005	Benzene	1	U	
ICPP-2021	4/18/2005	Benzene	1	U	
ICPP-2021	4/18/2005	Cadmium	1	U	
ICPP-2021	4/18/2005	Cadmium	1	U	
ICPP-2021	4/18/2005	Cadmium	1	U	
ICPP-2021	4/18/2005	Cadmium	1	U	
ICPP-2021	4/18/2005	Carbon disulfide	5	U	

Table J-7 (continued)

Official Well Name	Date Collected	Constituent	Concentration (µg/L)	Lab Qualifier	Validation Qualifier
ICPP-2021	4/18/2005	Carbon disulfide	5	U	
ICPP-2021	4/18/2005	Carbon tetrachloride	1	U	
ICPP-2021	4/18/2005	Carbon tetrachloride	1	U	
ICPP-2021	4/18/2005	Chloroform	1	U	
ICPP-2021	4/18/2005	Chloroform	1	U	
ICPP-2021	4/18/2005	Chromium	6.4	B	U
ICPP-2021	4/18/2005	Chromium	8.1	B	U
ICPP-2021	4/18/2005	Chromium	6.2	B	U
ICPP-2021	4/18/2005	Chromium	7	B	U
ICPP-2021	4/18/2005	Lead	2.5	U	
ICPP-2021	4/18/2005	Lead	2.5	U	
ICPP-2021	4/18/2005	Lead	2.5	U	
ICPP-2021	4/18/2005	Lead	2.5	U	
ICPP-2021	4/18/2005	Mercury	0.05	U	
ICPP-2021	4/18/2005	Mercury	0.05	U	
ICPP-2021	4/18/2005	Mercury	0.05	U	
ICPP-2021	4/18/2005	Mercury	0.05	U	
ICPP-2021	4/18/2005	Mercury	0.05	U	
ICPP-2021	4/18/2005	Methylene chloride	5	U	
ICPP-2021	4/18/2005	Methylene chloride	5	U	
ICPP-2021	4/18/2005	Selenium	6	U	
ICPP-2021	4/18/2005	Selenium	6	U	
ICPP-2021	4/18/2005	Selenium	6	U	
ICPP-2021	4/18/2005	Selenium	6	U	
ICPP-2021	4/18/2005	Silver	1	U	
ICPP-2021	4/18/2005	Silver	1	U	
ICPP-2021	4/18/2005	Silver	1	U	
ICPP-2021	4/18/2005	Silver	1	U	
ICPP-2021	4/18/2005	Tetrachloroethene	1	U	
ICPP-2021	4/18/2005	Tetrachloroethene	1	U	
ICPP-2021	4/18/2005	Toluene	22.2		
ICPP-2021	4/18/2005	Toluene	16.4		
ICPP-2021	4/18/2005	Trichloroethene	1	U	
ICPP-2021	4/18/2005	Trichloroethene	1	U	
ICPP-2021	3/8/2006	Arsenic	6	U	
ICPP-2021	3/8/2006	Barium	146		
ICPP-2021	3/8/2006	Cadmium	1	U	

Table J-7 (continued)

Official Well Name	Date Collected	Constituent	Concentration (µg/L)	Lab Qualifier	Validation Qualifier
ICPP-2021	3/8/2006	Chromium	9.2	B	
ICPP-2021	3/8/2006	Lead	2.5	U	
ICPP-2021	3/8/2006	Mercury	0.05	U	
ICPP-2021	3/8/2006	Selenium	8.9	B	U
ICPP-2021	3/8/2006	Silver	1	U	
ICPP-2021	4/11/2006	Arsenic	2	U	
ICPP-2021	4/11/2006	Arsenic	2	U	
ICPP-2021	4/11/2006	Barium	150		
ICPP-2021	4/11/2006	Barium	145		
ICPP-2021	4/11/2006	Cadmium	0.057	U	
ICPP-2021	4/11/2006	Cadmium	0.057	U	
ICPP-2021	4/11/2006	Chromium	10.4		
ICPP-2021	4/11/2006	Chromium	9.8	B	U
ICPP-2021	4/11/2006	Lead	0.93	B	
ICPP-2021	4/11/2006	Lead	0.49	U	
ICPP-2021	4/11/2006	Mercury	0.093	U	
ICPP-2021	4/11/2006	Mercury	0.093	U	
ICPP-2021	4/11/2006	Selenium	1.4	B	
ICPP-2021	4/11/2006	Selenium	1.3	B	
ICPP-2021	4/11/2006	Silver	0.2	U	
ICPP-2021	4/11/2006	Silver	0.2	U	
ICPP-2021	4/10/2007	Arsenic	6	U	
ICPP-2021	4/10/2007	Barium	148		
ICPP-2021	4/10/2007	Cadmium	1	U	
ICPP-2021	4/10/2007	Chromium	8.4	B	U
ICPP-2021	4/10/2007	Lead	2.5	U	
ICPP-2021	4/10/2007	Mercury	0.06	U	
ICPP-2021	4/10/2007	Selenium	6	U	
ICPP-2021	4/10/2007	Silver	1	U	
ICPP-2021	9/1/2009	Benzene	1	U	
ICPP-2021	9/1/2009	Toluene	32.6		
ICPP-2021	10/29/2009	Benzene	1	U	
ICPP-2021	10/29/2009	Benzene	1	U	
ICPP-2021	10/29/2009	Toluene	3		
ICPP-2021	10/29/2009	Toluene	3.1		
ICPP-2021	4/12/2010	Benzene	1	U	
ICPP-2021	4/12/2010	Benzene	1	U	
ICPP-2021	4/12/2010	Toluene	1	U	
ICPP-2021	4/12/2010	Toluene	1	U	
ICPP-MON-A-230	5/13/2003	Arsenic	3.31	U	

Table J-7 (continued)

Official Well Name	Date Collected	Constituent	Concentration (µg/L)	Lab Qualifier	Validation Qualifier
ICPP-MON-A-230	5/13/2003	Arsenic	3.31	U	
ICPP-MON-A-230	5/13/2003	Barium	123	B	
ICPP-MON-A-230	5/13/2003	Barium	125	B	
ICPP-MON-A-230	5/13/2003	Cadmium	0.66	U	
ICPP-MON-A-230	5/13/2003	Cadmium	0.66	U	
ICPP-MON-A-230	5/13/2003	Chromium	11.3		
ICPP-MON-A-230	5/13/2003	Chromium	12.7		
ICPP-MON-A-230	5/13/2003	Lead	2.4	U	
ICPP-MON-A-230	5/13/2003	Lead	2.4	U	
ICPP-MON-A-230	5/13/2003	Mercury	0.095	U	
ICPP-MON-A-230	5/13/2003	Mercury	0.095	U	
ICPP-MON-A-230	5/13/2003	Mercury	0.095	U	
ICPP-MON-A-230	5/13/2003	Selenium	3.39	U	
ICPP-MON-A-230	5/13/2003	Selenium	3.39	U	
ICPP-MON-A-230	5/13/2003	Silver	1.7	U	
ICPP-MON-A-230	5/13/2003	Silver	1.7	U	
ICPP-MON-A-230	10/13/2003	1,1,1-Trichloroethane	1	U	
ICPP-MON-A-230	10/13/2003	1,1,1-Trichloroethane	1	U	
ICPP-MON-A-230	10/13/2003	1,1,1-Trichloroethane	1	U	
ICPP-MON-A-230	10/13/2003	2-Butanone	10	U	R
ICPP-MON-A-230	10/13/2003	2-Butanone	10	U	R
ICPP-MON-A-230	10/13/2003	2-Butanone	10	U	R
ICPP-MON-A-230	10/13/2003	Benzene	1	U	
ICPP-MON-A-230	10/13/2003	Benzene	1	U	
ICPP-MON-A-230	10/13/2003	Benzene	1	U	
ICPP-MON-A-230	10/13/2003	Carbon disulfide	1	U	
ICPP-MON-A-230	10/13/2003	Carbon disulfide	1	U	
ICPP-MON-A-230	10/13/2003	Carbon disulfide	1	U	
ICPP-MON-A-230	10/13/2003	Carbon tetrachloride	1	U	
ICPP-MON-A-230	10/13/2003	Carbon tetrachloride	1	U	
ICPP-MON-A-230	10/13/2003	Carbon tetrachloride	1	U	
ICPP-MON-A-230	10/13/2003	Chloroform	1	U	
ICPP-MON-A-230	10/13/2003	Chloroform	1	U	
ICPP-MON-A-230	10/13/2003	Chloroform	1	U	
ICPP-MON-A-230	10/13/2003	Mercury	0.033	U	

Table J-7 (continued)

Official Well Name	Date Collected	Constituent	Concentration (µg/L)	Lab Qualifier	Validation Qualifier
ICPP-MON-A-230	10/13/2003	Mercury	0.033	U	
ICPP-MON-A-230	10/13/2003	Methylene chloride	1	U	UJ
ICPP-MON-A-230	10/13/2003	Methylene chloride	1	U	UJ
ICPP-MON-A-230	10/13/2003	Methylene chloride	1	U	UJ
ICPP-MON-A-230	10/13/2003	Pyridine	10	U	
ICPP-MON-A-230	10/13/2003	Pyridine	10	U	
ICPP-MON-A-230	10/13/2003	Pyridine	10	U	
ICPP-MON-A-230	10/13/2003	Tetrachloroethene	1	U	
ICPP-MON-A-230	10/13/2003	Tetrachloroethene	1	U	
ICPP-MON-A-230	10/13/2003	Tetrachloroethene	1	U	
ICPP-MON-A-230	10/13/2003	Toluene	1	U	
ICPP-MON-A-230	10/13/2003	Toluene	1	U	
ICPP-MON-A-230	10/13/2003	Toluene	1	U	
ICPP-MON-A-230	10/13/2003	Trichloroethene	1	U	
ICPP-MON-A-230	10/13/2003	Trichloroethene	1	U	
ICPP-MON-A-230	10/13/2003	Trichloroethene	1	U	
ICPP-MON-A-230	4/14/2004	Arsenic	2.62	B	
ICPP-MON-A-230	4/14/2004	Barium	141		
ICPP-MON-A-230	4/14/2004	Cadmium	0.313	U	
ICPP-MON-A-230	4/14/2004	Chromium	4.89	B	
ICPP-MON-A-230	4/14/2004	Lead	1.72	U	UJ
ICPP-MON-A-230	4/14/2004	Mercury	0.047	U	
ICPP-MON-A-230	4/14/2004	Selenium	4.53	B	
ICPP-MON-A-230	4/14/2004	Silver	0.835	U	
ICPP-MON-A-230	4/13/2005	Mercury	0.05	U	
ICPP-MON-A-230	4/13/2005	Mercury	0.05	U	
ICPP-MON-A-230	2/28/2006	Arsenic	6	U	
ICPP-MON-A-230	2/28/2006	Arsenic	6	U	
ICPP-MON-A-230	2/28/2006	Barium	152		
ICPP-MON-A-230	2/28/2006	Barium	153		
ICPP-MON-A-230	2/28/2006	Cadmium	1	U	
ICPP-MON-A-230	2/28/2006	Cadmium	1	U	
ICPP-MON-A-230	2/28/2006	Chromium	7.7	B	
ICPP-MON-A-230	2/28/2006	Chromium	7.8	B	
ICPP-MON-A-230	2/28/2006	Lead	2.5	U	
ICPP-MON-A-230	2/28/2006	Lead	2.5	U	
ICPP-MON-A-230	2/28/2006	Mercury	0.05	U	
ICPP-MON-A-230	2/28/2006	Mercury	0.05	U	

Table J-7 (continued)

Official Well Name	Date Collected	Constituent	Concentration (µg/L)	Lab Qualifier	Validation Qualifier
ICPP-MON-A-230	2/28/2006	Selenium	16.9	B	U
ICPP-MON-A-230	2/28/2006	Selenium	14.2	B	U
ICPP-MON-A-230	2/28/2006	Silver	1	U	
ICPP-MON-A-230	2/28/2006	Silver	1	U	
ICPP-MON-A-230	4/10/2007	Arsenic	6	U	
ICPP-MON-A-230	4/10/2007	Arsenic	6	U	
ICPP-MON-A-230	4/10/2007	Barium	148		
ICPP-MON-A-230	4/10/2007	Barium	148		
ICPP-MON-A-230	4/10/2007	Cadmium	1	U	
ICPP-MON-A-230	4/10/2007	Cadmium	1	U	
ICPP-MON-A-230	4/10/2007	Chromium	7.1	B	U
ICPP-MON-A-230	4/10/2007	Chromium	6.1	B	U
ICPP-MON-A-230	4/10/2007	Lead	2.5	U	
ICPP-MON-A-230	4/10/2007	Lead	2.5	U	
ICPP-MON-A-230	4/10/2007	Mercury	0.06	U	
ICPP-MON-A-230	4/10/2007	Mercury	0.06	U	
ICPP-MON-A-230	4/10/2007	Selenium	6	U	
ICPP-MON-A-230	4/10/2007	Selenium	6	U	
ICPP-MON-A-230	4/10/2007	Silver	2.2	B	U
ICPP-MON-A-230	4/10/2007	Silver	1	U	
ICPP-MON-A-230	4/8/2009	Benzene	1	U	
ICPP-MON-A-230	4/8/2009	Toluene	1	U	
ICPP-MON-A-230	10/29/2009	Benzene	1	U	
ICPP-MON-A-230	10/29/2009	Toluene	9.7		
ICPP-MON-A-230	4/12/2010	Benzene	1	U	
ICPP-MON-A-230	4/12/2010	Toluene	1	U	
ICPP-MON-P-019	5/13/2003	Mercury	0.095	U	
ICPP-MON-P-019	4/20/2004	Arsenic	2.24	U	
ICPP-MON-P-019	4/20/2004	Barium	130		
ICPP-MON-P-019	4/20/2004	Cadmium	0.313	U	
ICPP-MON-P-019	4/20/2004	Chromium	8	B	
ICPP-MON-P-019	4/20/2004	Lead	1.72	U	
ICPP-MON-P-019	4/20/2004	Mercury	0.047	U	
ICPP-MON-P-019	4/20/2004	Selenium	2.81	U	
ICPP-MON-P-019	4/20/2004	Silver	0.835	U	
ICPP-MON-P-019	4/15/2005	Mercury	0.05	U	
ICPP-MON-P-019	4/15/2005	Mercury	0.05	U	
ICPP-MON-P-019	2/28/2006	Arsenic	6	U	
ICPP-MON-P-019	2/28/2006	Arsenic	6	U	
ICPP-MON-P-019	2/28/2006	Barium	127		

Table J-7 (continued)

Official Well Name	Date Collected	Constituent	Concentration (µg/L)	Lab Qualifier	Validation Qualifier
ICPP-MON-P-019	2/28/2006	Barium	126		
ICPP-MON-P-019	2/28/2006	Cadmium	1	U	
ICPP-MON-P-019	2/28/2006	Cadmium	1	U	
ICPP-MON-P-019	2/28/2006	Chromium	7.3	B	
ICPP-MON-P-019	2/28/2006	Chromium	7.2	B	
ICPP-MON-P-019	2/28/2006	Lead	2.5	U	
ICPP-MON-P-019	2/28/2006	Lead	2.5	U	
ICPP-MON-P-019	2/28/2006	Mercury	0.05	U	
ICPP-MON-P-019	2/28/2006	Mercury	0.05	U	
ICPP-MON-P-019	2/28/2006	Selenium	13.2	B	U
ICPP-MON-P-019	2/28/2006	Selenium	8	B	U
ICPP-MON-P-019	2/28/2006	Silver	1	U	
ICPP-MON-P-019	2/28/2006	Silver	1	U	
ICPP-MON-P-019	4/10/2007	Arsenic	6	U	
ICPP-MON-P-019	4/10/2007	Arsenic	6	U	
ICPP-MON-P-019	4/10/2007	Barium	120		
ICPP-MON-P-019	4/10/2007	Barium	122		
ICPP-MON-P-019	4/10/2007	Cadmium	1	U	
ICPP-MON-P-019	4/10/2007	Cadmium	1	U	
ICPP-MON-P-019	4/10/2007	Chromium	6.5	B	U
ICPP-MON-P-019	4/10/2007	Chromium	6.2	B	U
ICPP-MON-P-019	4/10/2007	Lead	2.5	U	
ICPP-MON-P-019	4/10/2007	Lead	2.5	U	
ICPP-MON-P-019	4/10/2007	Mercury	0.06	U	
ICPP-MON-P-019	4/10/2007	Mercury	0.06	U	
ICPP-MON-P-019	4/10/2007	Selenium	6	U	
ICPP-MON-P-019	4/10/2007	Selenium	6	U	
ICPP-MON-P-019	4/10/2007	Silver	1.3	B	U
ICPP-MON-P-019	4/10/2007	Silver	1	U	
ICPP-MON-P-019	9/1/2009	Benzene	1	U	
ICPP-MON-P-019	9/1/2009	Toluene	1	U	
ICPP-MON-P-019	10/29/2009	Benzene	1	U	
ICPP-MON-P-019	10/29/2009	Toluene	1	U	
ICPP-MON-P-019	4/8/2010	Benzene	1	U	
ICPP-MON-P-019	4/8/2010	Toluene	1	U	

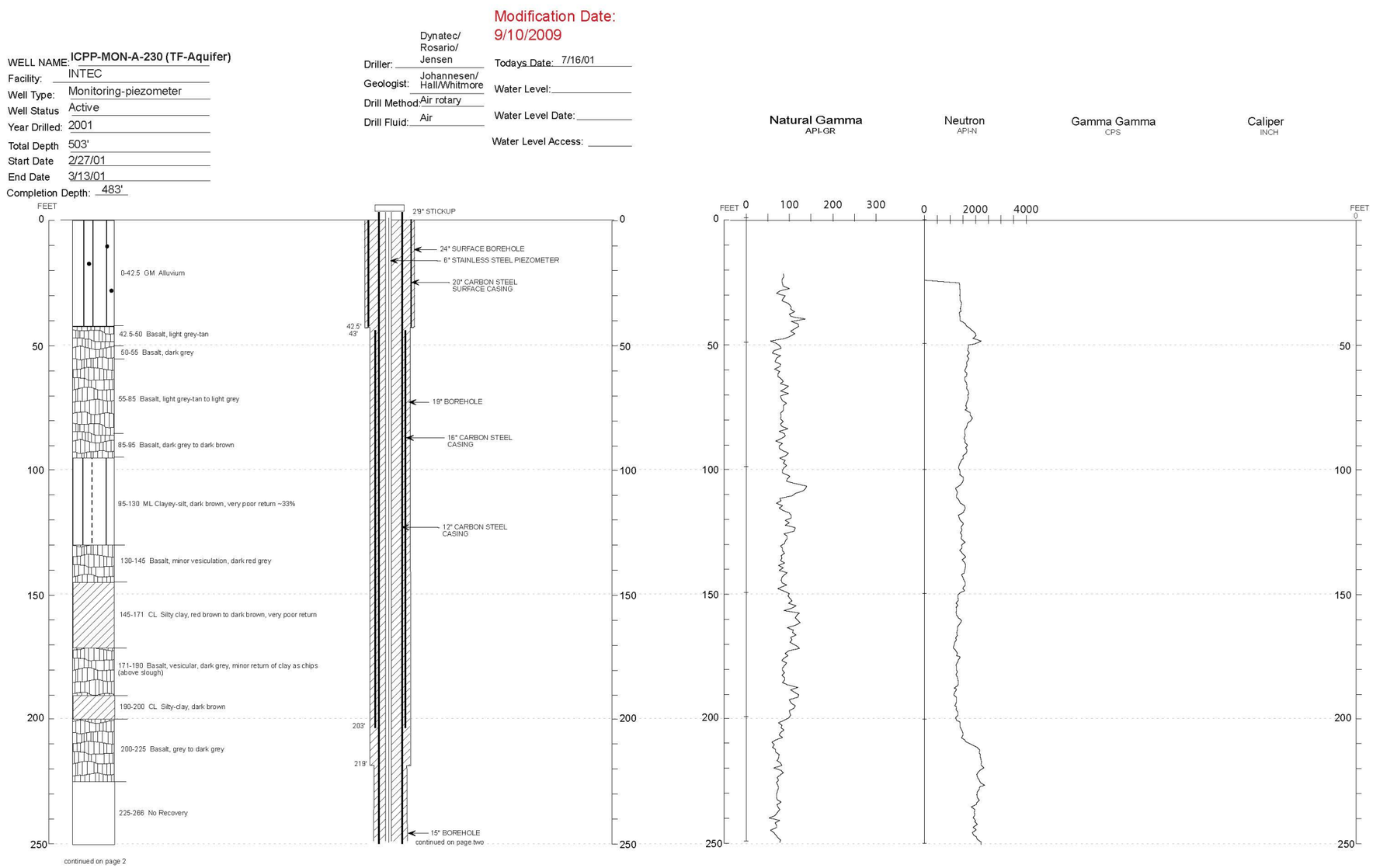


Figure J-7. Well construction diagram for ICPP-MON-A-230 (page 1 of 2).

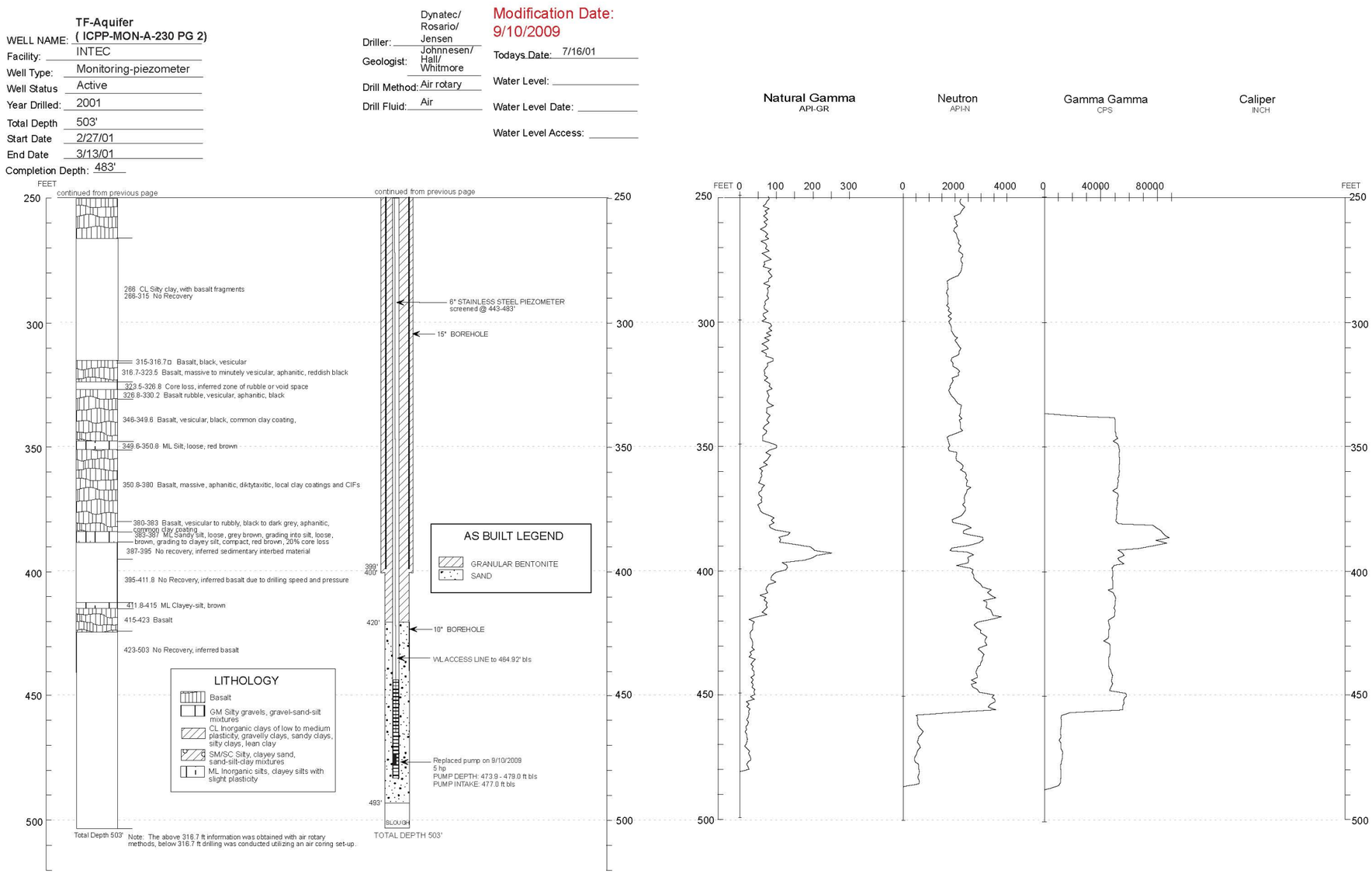


Figure J-7. Well construction diagram for ICPP-MON-A-230 (page 2 of 2).

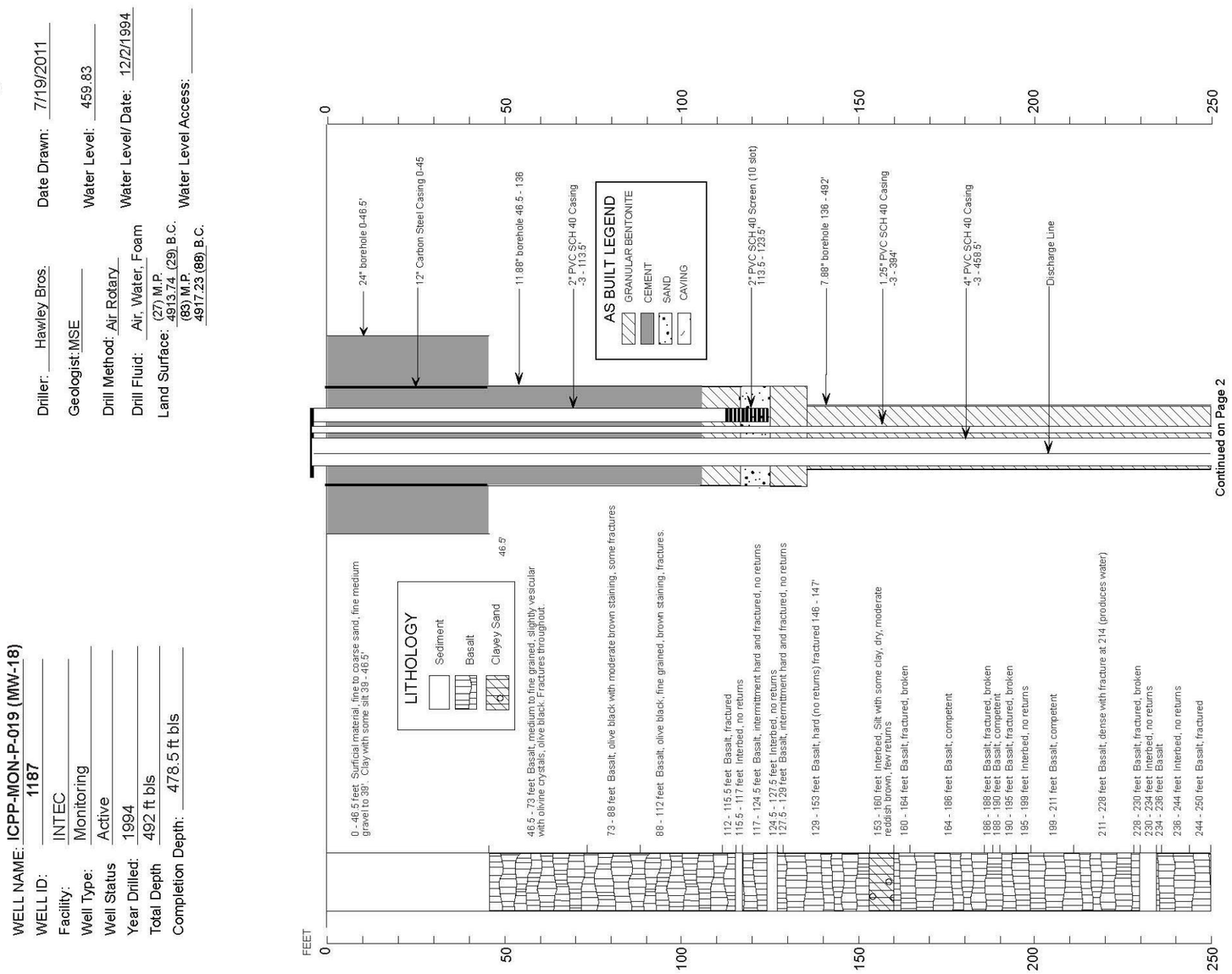


Figure J-8. Well construction diagram for ICPP-MON-P-019 (page 1 of 2).

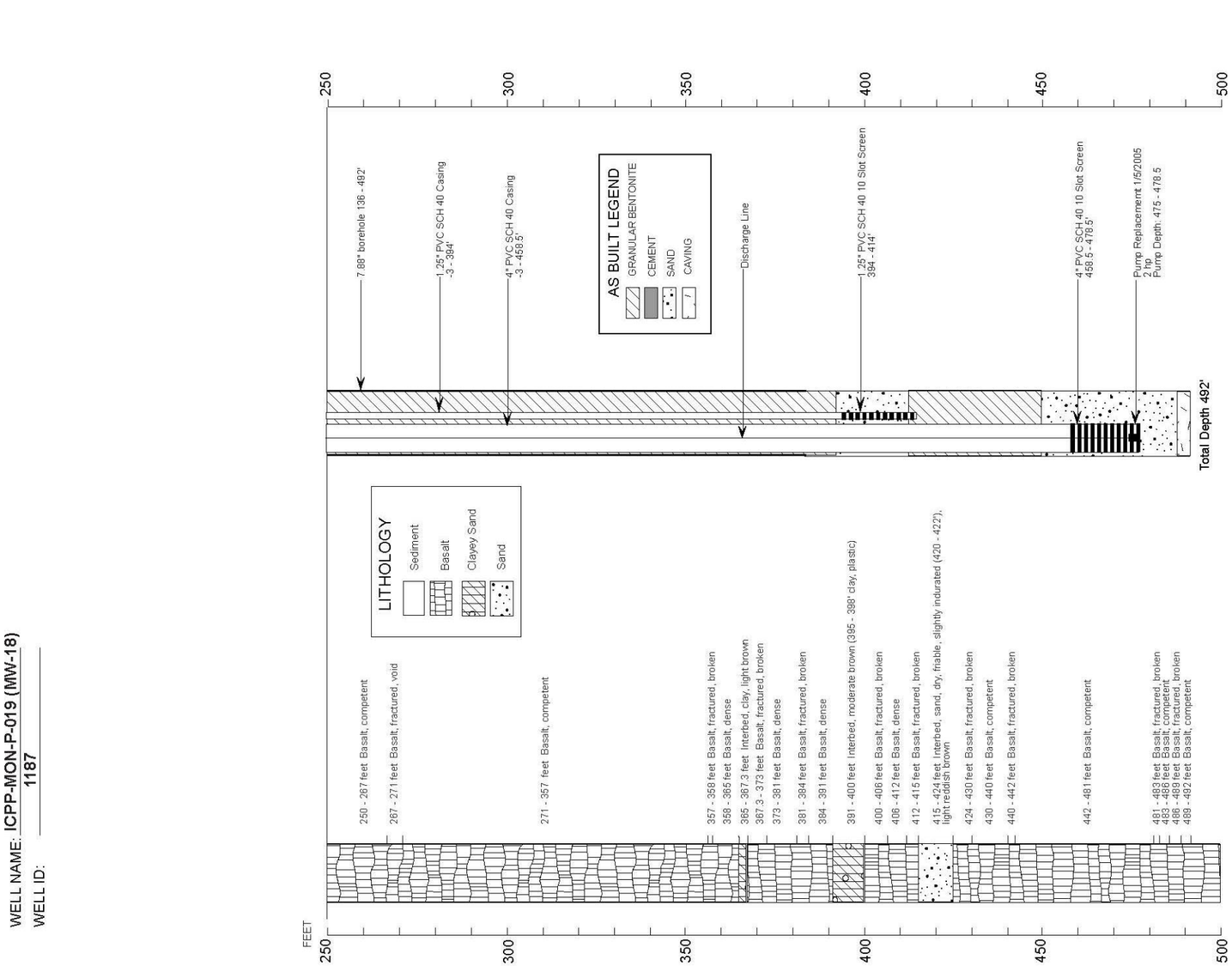


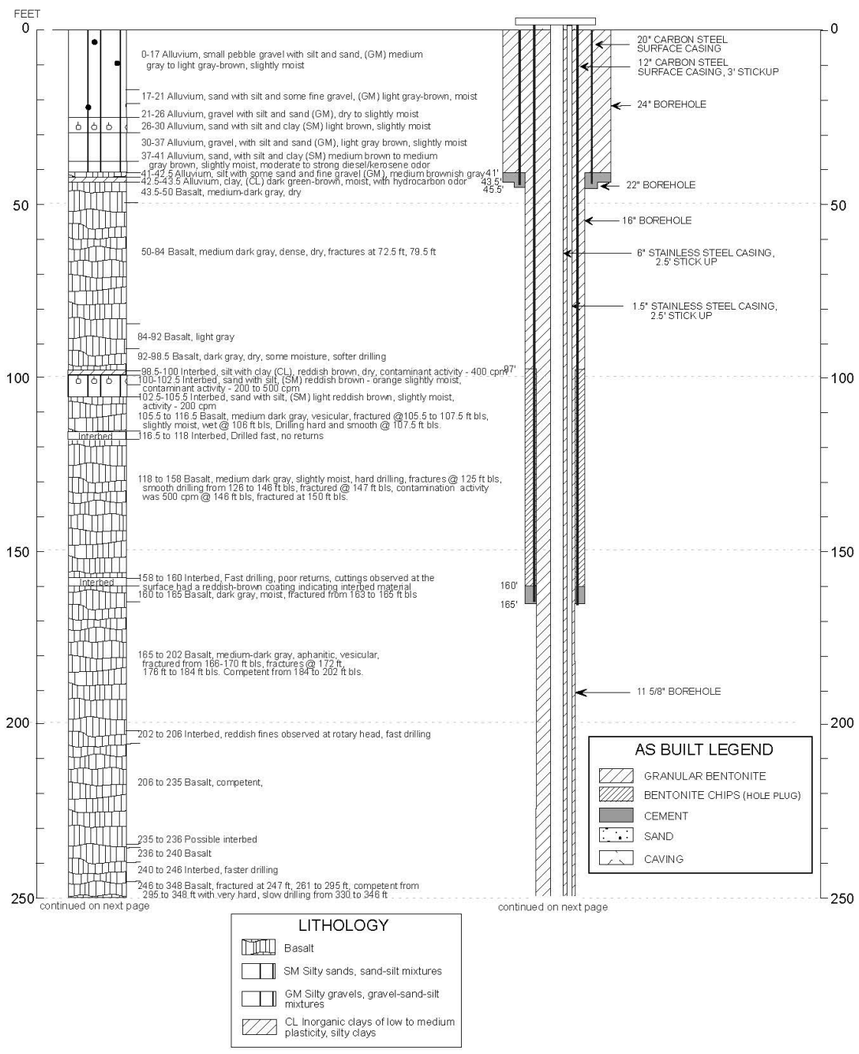
Figure J-8. Well construction diagram for ICPP-MON-P-019 (page 2 of 2).

Modification Date: 1/20/2010 Page 1 of 2

WELL NAME: ICPP-2020
Facility: INTEC
Well Type: Monitoring
Well Status: Active
Year Drilled: 2005
Total Depth: 506'
Drilling Start Date: 2/15/05 End Date: 3/4/05
Completion Start Date: 3/28/05 End Date: 3/29/05
Completion Depth: 495'

Driller: Dynatec/Rosario, Jensen
Geologist: Manchester, Oberhansley, Myers
Drill Method: Vacuum Rotary/ Air Rotary
Drill Fluid: Air/Foam/Water
Elevation: 4914.36 (29 BC) 4916.92 (29 MP) 4917.85 (88 BC) 4920.41 (88MP)

Todays Date: 5/23/05
Water Level: 462' BLS
Water Level Date: 3/5/05
Water Level Access: 1" SS pipe +2.2 to 450.5'



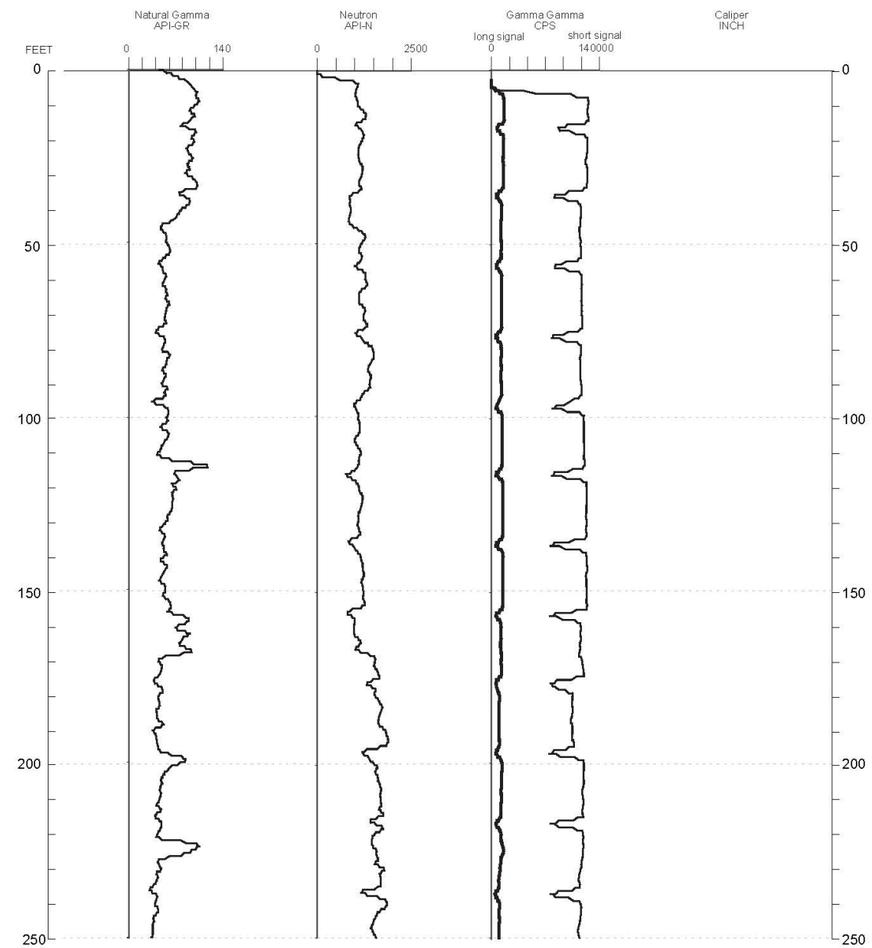
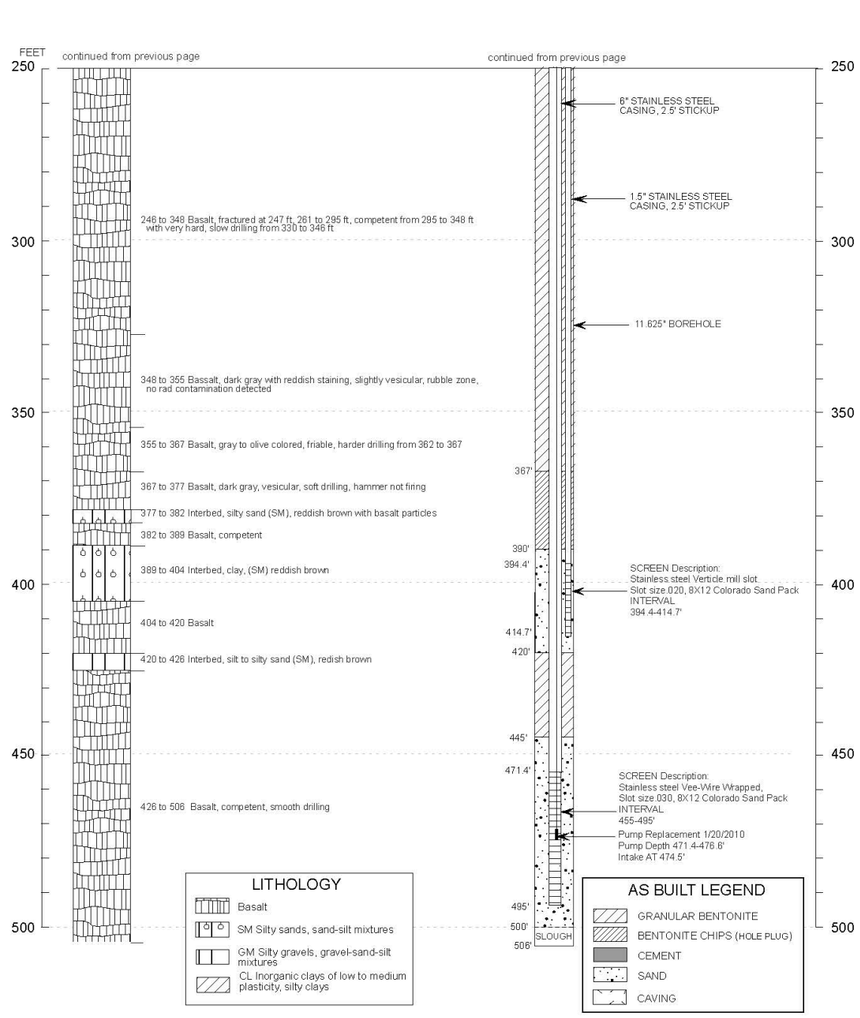


Figure J-9. Well construction diagram for ICPP-2020 (page 1 of 2).

WELL NAME: ICPP-2020

Modification Date: 1/20/2010

Page 2 of 2



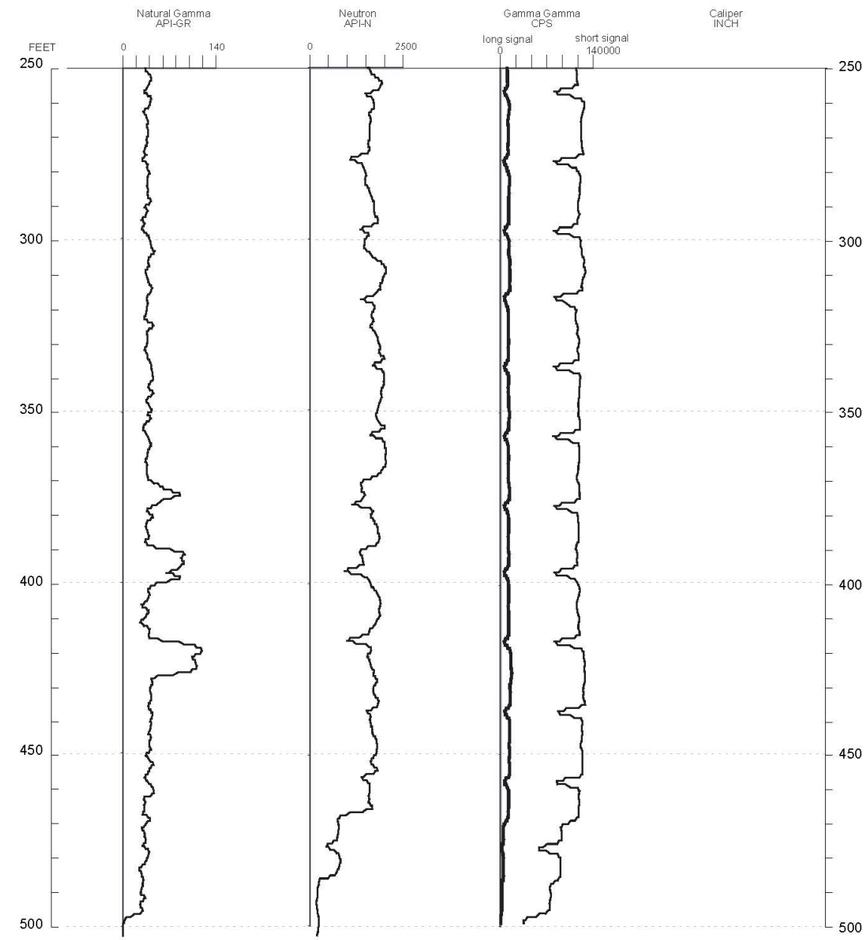


Figure J-9. Well construction diagram for ICPP-2020 (page 2 of 2).

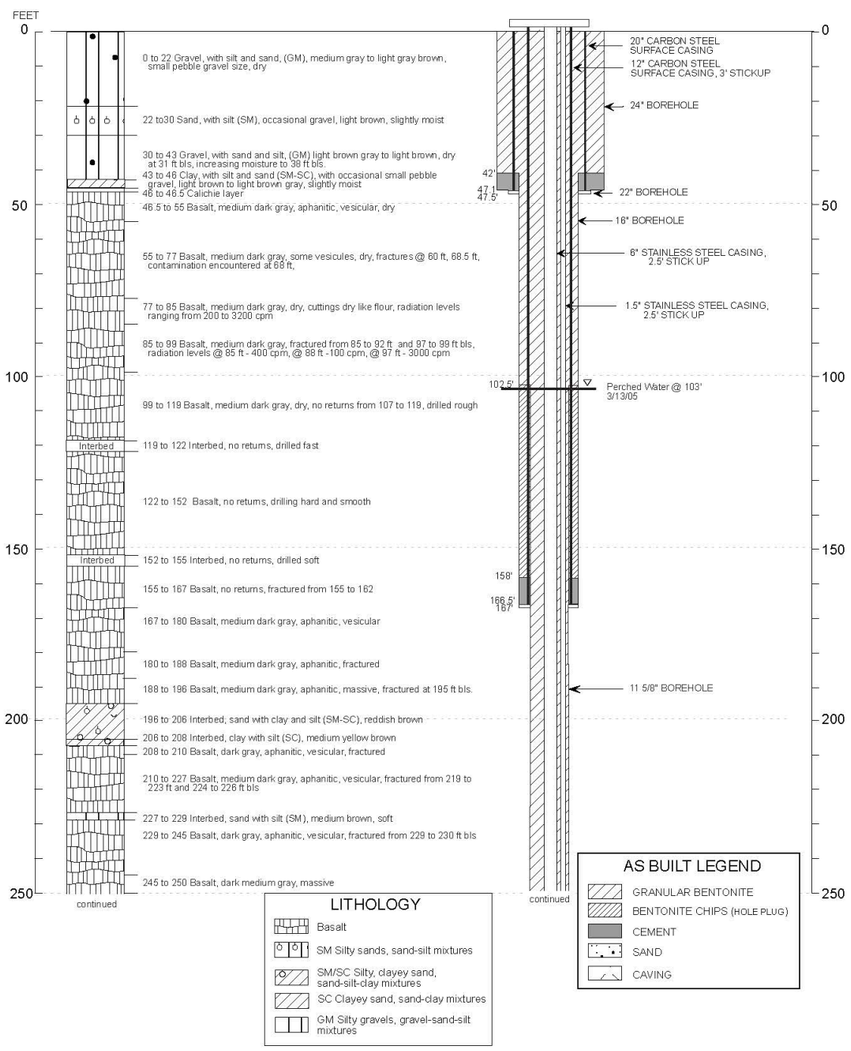
Modification Date: 8/18/2009

Page 1 of 2

WELL NAME: ICPP-2021
Facility: INTEC
Well Type: Monitoring
Well Status: Active
Year Drilled: 2005
Total Depth: 507'
Drilling Start Date: 3/5/05 End Date: 3/18/05
Completion Start Date: 3/23/05 End Date: 3/24/05
Completion Depth: 493.4'

Driller: Dynatec/Rosario, Jensen
Geologist: Manchester, Oberhansley, Myers
Drill Method: Vacuum Rotary/ Air Rotary
Drill Fluid: Air/Foam/Water
Elevation: 4912.14 (29 BC) 4914.70 (29 MP) 4915.63 (88 BC) 4918.19 (88MP)

Todays Date: 6/9/05
Water Level: Perched 103' 3/13/05 ~462' BLS
Water Level Date: 3/21/05
Water Level Access: 1" SS pipe +2.2 to 450.5'



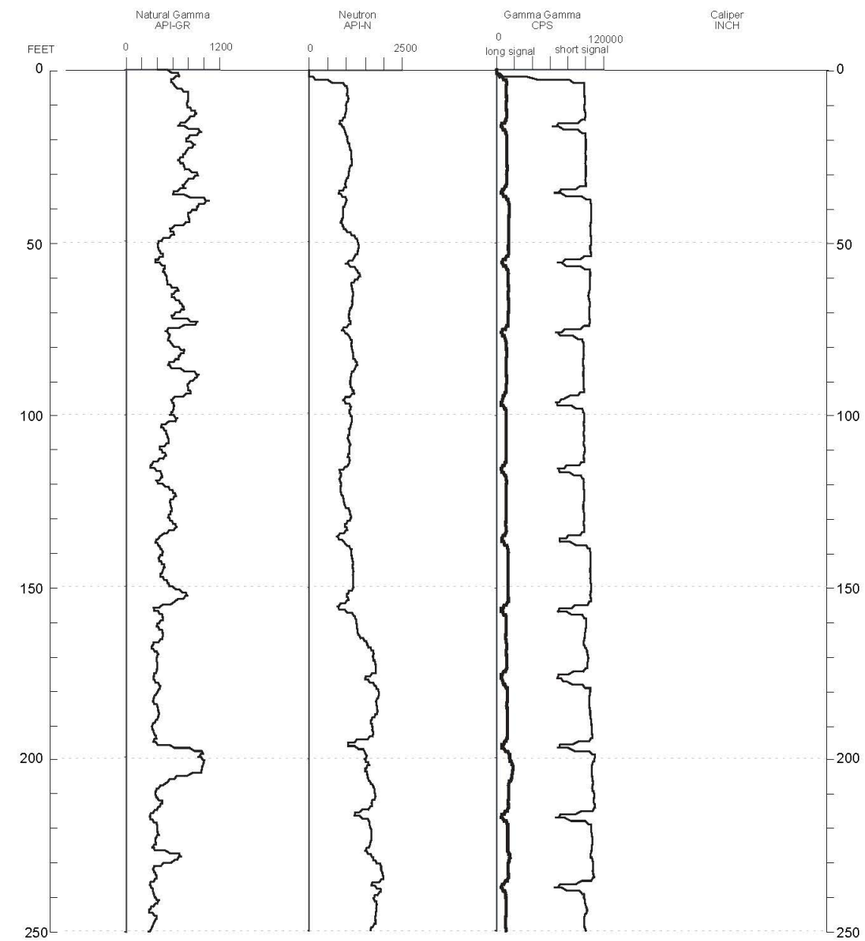
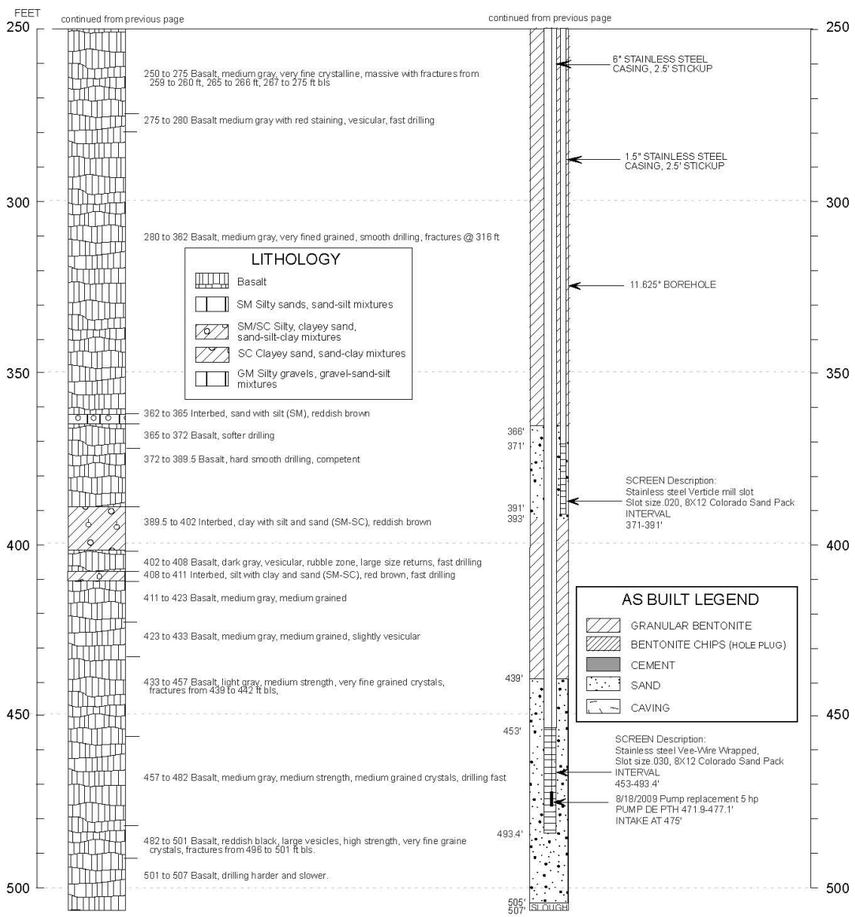


Figure J-10. Well construction diagram for ICPP-2021 (page 1 of 2).

Modification Date: 8/18/2009

WELL NAME: ICPP-2021

Page 2 of 2



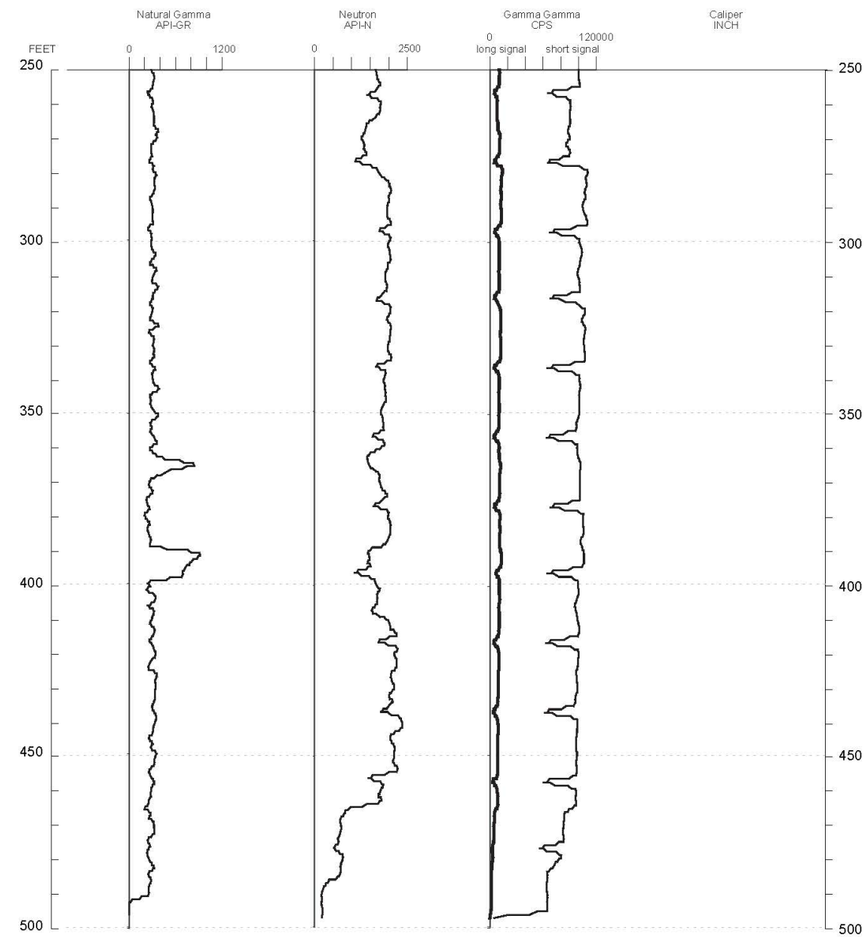


Figure J-10. Well construction diagram for ICPP-2021 (page 2 of 2).

APPENDIX J-1. Statistical Analysis of Perched Groundwater Monitoring Data for the Waste Calcining Facility

(RPT-1013, Rev. 3- August 2010)

RPT-1013
Revision 3

Statistical Analysis of Perched Groundwater Monitoring Data for the Waste Calcining Facility

August 2010

Portage

RPT-1013
Revision 3

Statistical Analysis of Perched Groundwater Monitoring Data for the Waste Calcining Facility

August 2010

Portage, Inc.
1075 S. Utah Avenue, Suite 200
Idaho Falls, ID 83402

Prepared for
CH2M-WG Idaho, LLC
Contract BMC 500116, Release 30
Portage Project No. 2126.30

ABSTRACT

The Waste Calcining Facility is located at the Idaho Nuclear Technology and Engineering Center. In 1999, the Waste Calcining Facility was closed under an approved Hazardous Waste Management Act/Resource Conservation and Recovery Act (HWMA/RCRA) Closure Plan. Vessels and spaces were grouted and then covered with a concrete cap. The Idaho Department of Environmental Quality issued a final HWMA/RCRA post-closure permit on September 15, 2003, with an effective date of October 16, 2003. This permit sets forth procedural requirements for groundwater characterization and monitoring, maintenance, and inspections of the Waste Calcining Facility to ensure continued protection of human health and the environment.

Detection monitoring limits were determined in the November 2006 document, *Statistical Analysis of Perched Water Monitoring Data for the Waste Calcining Facility* (Medema 2006). Data obtained from recent sampling events indicate that background concentrations of several constituents have increased in the last few years. These data were analyzed and the results were used to compute new detection monitoring limits to more accurately reflect the current background conditions.

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ACRONYMS

DEQ	Department of Environmental Quality
DML	detection monitoring limit
DOE-ID	Department of Energy, Idaho Operations Office
EPA	Environmental Protection Agency
EQL	estimated quantitation limit
GPS	groundwater protection standard
HWMA	Hazardous Waste Management Act
ICP	Idaho Cleanup Project
INTEC	Idaho Nuclear Technology and Engineering Center
RCRA	Resource Conservation and Recovery Act
UTL	upper tolerance limit
WCF	Waste Calcining Facility

Statistical Analysis of Perched Groundwater Monitoring Data for the Waste Calcining Facility

August 2010

1. INTRODUCTION

Shallow perched groundwater beneath and adjacent to the Waste Calcining Facility (WCF) cap at the Idaho Nuclear Technology and Engineering Center (INTEC) is routinely monitored through a detection monitoring program as outlined in the Resource Conservation and Recovery Act (RCRA) post-closure permit (DEQ 2007). Recent perched groundwater sampling has detected the presence of some constituents in some wells at levels that are higher than the current permit-required detection monitoring limits (DMLs). WCF Permit Condition III.F.4.a.2. requires that when DMLs are exceeded, two verification samples or RCRA Appendix IX samples be collected from each of the affected wells unless the detections can be shown to be due to a source other than the regulated unit (the WCF itself).

The Idaho Cleanup Project (ICP) has investigated these detections above DMLs and believes, with Department of Environmental Quality (DEQ) concurrence, that these detections have resulted from a source or sources other than the WCF. In addition, ICP believes that the recent detections above DMLs are an indication that the perched water in the vicinity of the WCF has changed from the background conditions established by the statistical analysis that was performed in 2006 (Medema 2006). ICP has proposed to DEQ that it may be worthwhile to perform a statistical analysis of all WCF perched groundwater quality data collected to date. Such an analysis would include considerable data collected since the previous statistical analysis was performed, which set the DMLs and was accepted by DEQ. DEQ has encouraged the proposed statistical analysis of all WCF water quality data for the purpose of updating the WCF information (Bullock 2009).

Current WCF DMLs were established as a result of a permit-required statistical analysis of all data collected during twelve quarterly sampling events through August 2006, approved by DEQ on January 29, 2007 (Bullock 2007). The results of the current statistical analysis are intended to document the changes in the perched water in the vicinity of the WCF, will supersede the results of the previous statistical analysis, and will establish new detection monitoring limits upon DEQ approval. The statistical methods used in this analysis to determine DMLs are specified in the WCF post-closure permit (DEQ 2007).

2. METHODS

The methods for development of background levels used for DMLs were in accordance with the WCF Post-Closure Permit. The DMLs were either set at the estimated quantitation limit (EQL) or calculated as the upper tolerance limit (UTL). These methods are summarized and additional analyses are described below.

For hypothesis tests, a significance level (α) of 0.05 was used. For UTLs, 95% confidence and 95% coverage were used (i.e., a 95% confidence limit on the 95th percentile). The analyses were performed for each constituent independently. Analyses were performed for each well separately only when significant differences among wells were identified.

The outline below follows the process prescribed in the Permit augmented by additional analyses:

1. Test for differences among wells using the non-parametric Kruskal-Wallis Rand test.

    a. Performed for constituents with at least one detectable result greater than the EQL.

    b. Constituents with all results less than the EQL were assumed to not differ among wells.

    c. All following analyses were performed for results combined across wells unless the Kruskal-Wallis test was significant.

2. Test for trend using the Mann-Kendall Test.

    a. Performed for constituents in at least 20% of the data and one annual detectable result greater than the EQL.

    b. All results less than EQL, detect or nondetect, were replaced with the EQL.

    c. If a trend existed, another five years of monitoring data would be required before limits could be determined. This would be a stopping point in these analyses for the constituent.

3. Test for normality and log normality using the Shapiro-Wilk Test.

    a. Performed for constituents detected in at least 85% of the data. Otherwise nonparametric methods as were mandated in the Permit were performed.

    b. One-half of the EQL was used in place of undetected values for constituents detected in at least 85% of the data overall.

4. Determine UTLs for constituents with at least 85% detects.

    a. If data are normal (Step 3), use standard normal theory procedures.

    b. If data are lognormal (Step 3), use the equations in the Permit (established lognormal estimates, see Gibbons [1994] or Gilbert [1987]).

    c. If data are neither normal nor lognormal, use nonparametric tolerance limits.

5. Determine UTLs for constituents with less than 85% detects.

    a. Use Poisson tolerance limits for constituents with at least one detectable result greater than the EQL.

    b. The DML is set to the EQL for constituents with all values not detected or below the EQL.

The details of the hypothesis tests (Kruskal-Wallis, Mann-Kendall and Shapiro-Wilk) are not presented here; the Kruskal-Wallis and Mann-Kendall tests were performed using R software (R Development Core Team 2009). Shapiro-Wilk tests were performed using Analyse-it software (Analyse-it 2008). The UTL methods are described briefly.

The parametric 95% UTL for the 95th percentile, assuming normally distributed data, is $\bar{x} + Ks$, where $\bar{x}$ is the sample mean, s is the sample standard deviation, and K is a constant that depends on the sample size, coverage (percentile), and confidence. K values are tabulated in selected statistical texts (e.g., Gilbert 1987).

The parametric 95% UTL for the 95th percentile, assuming lognormally distributed data, can be calculated using the above formula after calculation of mean and variance of the transformed data and then back transformation, as directed by the Permit:

Calculation of transformed data: $\bar{y} = \frac{1}{n}\sum_{i=1}^{n} \ln(x_i)$ $\quad s_y^2 = \frac{1}{n}\sum_{i=1}^{n}[ln(x_i) - \bar{y}]^2$

Back transformation: $\bar{x} = exp\left(\bar{y} + {s_y^2}/{2}\right)$ $\quad s = \sqrt{exp(2\bar{y} + s_y^2) \times [exp(s_y^2) - 1]}$

The Poisson UTL assumes data are comprised of undetected results and a generally few detected values. The limit is calculated in three steps.

1. Calculate $T_n = \frac{1}{2}EQL \times NumND + \sum_{detects} x_i$

where NumND is the number of nondetects and detects less than the EQL and the summation is over all detects greater than the EQL.

2. Calculate $\lambda_{T_n} = \frac{1}{2n}\chi^2_{0.05}[2T_n + 2]$

where $\chi^2_{0.05}[2T + 2]$ is the 95th percentile of the Chi-square distribution with $[2T + 2]$ degrees of freedom.

3. Find $\chi^2_{0.05}[2k + 2] \geq 2\lambda_{T_n}$

and solve for *k*, which will be set as the UTL.

3. DATA

The WCF Post-Closure Permit monitoring network at one time consisted of nine wells that were sampled for water quality. These wells are CPP-33-1, CPP-55-06, MW-2, MW-5-2, MW-10-2, MW-12-2, MW-18-2, ICPP-2018, and ICPP-2019. Wells MW-12-2 and MW-18-2 had been consistently dry since the effective date of the Permit so these two wells were changed from water quality sampling to water level measurements only via a RCRA Class 3 permit modification request approved by DEQ on June 26, 2007. Thus, there are currently seven wells from which samples are collected for analyses. The seven wells' completion midpoints range from 94-ft bgs to 141 ft bgs. These completions are assumed to occur within one perched water body, allowing combination of sample results. Figure 1 shows the locations of the wells with the size of the point relative to the completion depth midpoint. Well MW-10-2 is the deepest well and is nearest the shallowest well, CPP-33-1. The depth range for well MW-10-2 does not overlap the depth range for any other well. The depth range for well CPP-33-1 overlaps three of the other wells.

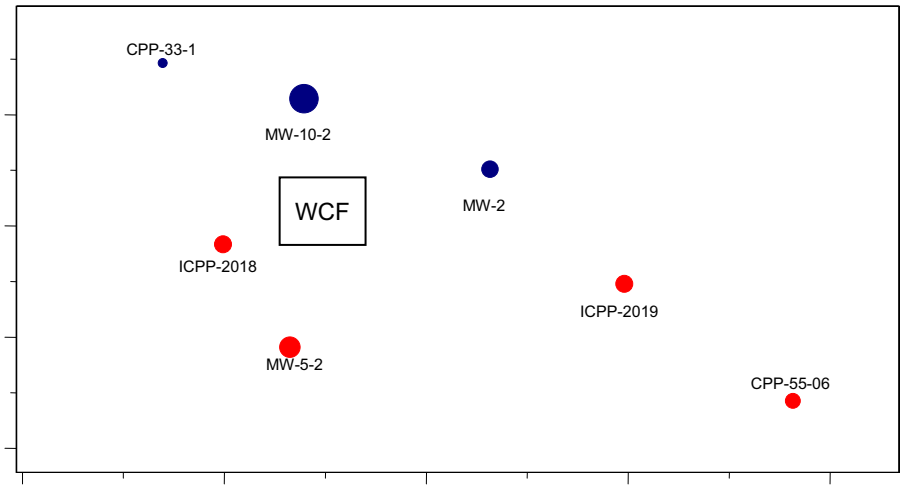


Figure 1. WCF perched water monitoring wells. Upgradient wells are blue and downgradient are red. Increasing size of symbol represents increasing depth of monitoring well sample location.

The upgradient and downgradient wells (Figure 1) were selected from existing wells. Wells ICPP-2018 and MW-5-2 are directly downgradient from the facility while wells ICPP-2019 and CPP-55-06 are farther downgradient.

The number of permit-required constituents to be analyzed from each well has changed through the years that the WCF Post-Closure Permit has been in effect. Thirty-three permit-required constituents for each well (Table 1) were outlined in the original permit (DEQ 2004). However, the list of permit required constituents was reduced to 19 after the 2006 Statistical Report (Medema 2006) via the RCRA Class 3 permit modification request that was approved by DEQ on June 26, 2007 (Monson 2007). Only these 19 permit-required constituents are addressed in this report. The amount of water available from each well has varied occasionally because some monitoring wells have dried up. When this has occurred, less well water was available for sampling, and data from fewer constituents were generated for some wells. An example of this is well MW-10-2. As the water level in this well changed, the entire sample volume could not be collected so some of the constituents could not be analyzed (see footnotes to Table 1). Monitoring wells CPP-55-06 and MW-10-2 were added to the monitoring network via a RCRA Class 2 permit modification request (approved on January 17, 2006), increasing the total number of wells. Thus, the total number of results per constituent has increased due to the increase in the number of wells. Table 1 shows the number of constituents analyzed for each permit prescribed sampling event. Although the data for the October and December 2008 verification and Appendix IX sampling were used to compute the DMLs, these two events are not included in Table 1.

Table 1. Number of constituents analyzed at each well for the 20 sampling events. Thirty-three constituents were required by the WCF Permit prior to August 2007. After August 2007 only 19 constituents were required.

Well	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
CPP-33-1	0	0	0	0	33	0	33	33	33	33	33	33	33	0	0	0	0	0	0	19
CPP-55-06	0	0	0	0	0	33	33	33	33	33	33	33	33	33	33	19	19	19	19	19
ICPP-2018	0	0	0	0	0	0	33	33	33	33	33	33	33	33	33	19	19	19	19	19
ICPP-2019	0	0	0	0	0	0	33	33	33	33	33	33	33	33	33	19	19	19	19	19
MW-2	0	33	33	33	33	33	33	33	33	33	33	33	33	33	33	19	19	19	19	19
MW-5-2	33	33	33	33	33	33	33	33	33	33	33	24[c]	9[b]	0	28[i]	0	0	19	0	19
MW-10-2	0	0	0	0	0	27[a]	9[b]	24[c]	30[d]	20[e]	23[f]	27[a]	30[g]	25[h]	26[j]	19	19	19	19	19

a. Samples not analyzed for 1,4-dioxane, aniline, cyanide, formaldehyde, phenol, or pyridine

b. Only metals were analyzed.

c. Samples not analyzed for metals

d. Samples not analyzed for 1,4-dioxane, cyanide, or formaldehyde.

e. Samples not analyzed for metals, 1,4-dioxane, cyanide, formaldehyde, and isobutyl alcohol.

f. Sample was not analyzed for metals and cyanide.

g. Sample was not analyzed for 1,4-dioxane, formaldehyde, and hydrazine.

h. Sample was not analyzed for 1,4-dioxane, aniline, cyanide, formaldehyde, hydrazine, isobutyl alcohol, phenol, and pyridine.

i. Samples not analyzed for 1,4-dioxane, cyanide, formaldehyde, hydrazine, and isobutyl alcohol.

j. Sample was not analyzed for 1,4-dioxane, aniline, cyanide, formaldehyde, isobutyl alcohol, phenol, and pyridine.

4. ANALYSIS RESULTS AND DETECTION MONITORING LIMITS

The data were pared down to, at most, one observation per well per sampling event. Many duplicates were taken for quality assurance purposes. For each well and sampling event, the primary sample result was retained for data analyses unless only a duplicate value was available. The number of final results used in analyses is provided in Table 2 along with the number of detectable quantities and the number of results exceeding the EQL. Data included in this report were collected from November 2003 through August 2009.

Eleven constituents had detectable results, although only 10 of these constituents have detectable results greater than the EQL (Table 2). Few of the constituents showed a time trend based on the results of the Mann-Kendall test. Figure 2 contains plots of measured concentrations with respect to time for each of the 11 detected constituents.

The 10 constituents with detected results above the EQL were tested for differences among wells using the Kruskal-Wallis non-parametric test (Table 3). Arsenic, barium, chromium, tetrachloroethene, toluene, and 2-butanone (methyl ethyl ketone) concentrations significantly differed among the wells. Lead, mercury, trichloroethene, and carbon disulfide did not significantly differ among wells. The EQLs for the remaining 9 constituents were set as the DMLs.

The Mann-Kendall test was performed on constituents with at least 20% of the results detectable and greater than the EQL. The test was performed by well if the Kruskal-Wallis test was significant for that constituent. The Mann-Kendall test was performed on arsenic (well ICPP-2018), barium for each well, chromium (wells CPP-33-1 and CPP-55-06), tetrachloroethene (well MW-10-2), and toluene (wells CPP-55-06 and MW-10-2). The Mann-Kendall test was significant for barium in well MW-10-2, chromium in well CPP-55-06, and toluene in well CPP-55-06. This means that these analytes in these wells have increased over the past several sampling events. No trends were detected using the Mann-Kendall test in the 2006 statistical analysis (Medema 2006).

The Shapiro-Wilk test for normality was performed on barium for all wells, chromium (wells CPP-33-1, CPP-55-06, ICPP-2019, and MW-2), and tetrachloroethene for well MW-10-2. These were the only constituents with no more than 15% nondetects and with results greater than the EQL. The Shapiro-Wilk test indicated that all of these analytes were normally distributed with the exception of barium for wells ICPP-2018 and MW-5-2, and chromium for wells CPP-55-06, ICPP-2019, and MW-2. Barium was shown to be lognormally distributed in well MW-5-2, as was chromium in well ICPP-2019.

DMLs were determined based on the above results and on permit requirements and are listed in Table 6. Of the 19 constituents, 9 had their DML set as the EQL because all of the values were less than or equal to the EQL. Poisson UTLs were computed for carbon disulfide, lead, mercury, and trichloroethene across all wells (Table 4). Six constituents (arsenic, barium, chromium, tetrachloroethene, toluene, and 2-butanone) required well-specific DMLs. Various statistical methods were employed to generate these DMLs (see Table 5).

Table 2. Summary of monitoring results by constituent and well. The first value in each cell is the number of results. In parentheses are the number of detects followed by the number of detect results greater than the EQL. If none of the data are detected, only a zero is listed in parentheses. The 10 constituents that have at least one detection that exceeds the EQL are in **bold**.

Constituent	CPP-33-1	CPP-55-06	ICPP-2018	ICPP-2019	MW-10-2	MW-2	MW-5-2
1,1,1-Trichloroethane	9 (0)	21 (0)	17 (0)	17 (0)	16 (0)	22 (0)	23 (0)
2-Butanone	9 (0)	21 (0)	**17 (1,1)**	17 (0)	16 (0)	22 (0)	**23 (3,3)**
Arsenic	**9 (3,1)**	19 (0)	**20 (8,8)**	15 (0)	12 (0)	22 (2,0)	**21 (2,1)**
Barium	**9 (9,9)**	**19 (19,19)**	**20 (18,18)**	**15 (15,15)**	**12 (12,12)**	**22 (22,22)**	**21 (21,21)**
Benzene	9 (0)	21 (0)	17 (0)	17 (0)	16 (0)	22 (0)	23 (0)
Cadmium	9 (0)	19 (0)	20 (0)	15 (0)	12 (0)	22 (0)	21 (0)
Carbon Disulfide	**9 (1,1)**	21 (0)	17 (0)	17 (0)	16 (0)	20 (0)	**21 (1,1)**
Carbon Tetrachloride	9 (0)	21 (0)	17 (0)	17 (0)	16 (0)	22 (0)	23 (0)
Chloroform	9 (0)	21 (0)	17 (0)	17 (0)	16 (0)	22 (0)	23 (0)
Chromium	**9 (9,5)**	**19 (19,19)**	20 (4,0)	**15 (15,1)**	12 (0)	**22 (19,4)**	**21 (13,2)**
Lead	9 (0)	19 (1,0)	20 (0)	15 (0)	12 (0)	**22 (1,1)**	21 (0)
Mercury	9 (0)	19 (0)	20 (2,0)	15 (0)	12 (0)	**22 (2,1)**	**21 (2,1)**
Methylene Chloride	9 (0)	21 (0)	17 (0)	17 (0)	16 (0)	22 (0)	23 (0)
Pyridine	10 (0)	20 (0)	19 (0)	17 (0)	10 (0)	23 (0)	23 (0)
Selenium	9 (4,0)	19 (0)	20 (0)	15 (0)	12 (0)	22 (2,0)	21 (2,0)
Silver	9 (0)	19 (0)	20 (0)	15 (0)	12 (0)	22 (0)	21 (0)
Tetrachloroethene	9 (0)	21 (0)	17 (0)	17 (0)	**16 (15,15)**	20 (1,0)	21 (0)
Toluene	9 (0)	**21 (6,6)**	17 (0)	17 (0)	**16 (7,7)**	**22 (1,1)**	**23 (1,1)**
Trichlorethene	**9 (1,1)**	21 (0)	17 (0)	17 (0)	16 (0)	**22 (1,1)**	**23 (1,1)**

Table 3. Kruskal-Wallis test results for differences among wells for constituents with at least one detection exceeding the EQL. If at least 85% of results were detected, then Shapiro-Wilk Test p-value (lognormal p-value in parentheses if non-normal) is given either overall or by well.

Constituent	Kruskal-Wallis Test p-Value	Over All Wells	CPP-33-1	CPP-55-06	ICPP-2018	ICPP-2019	MW-10-2	MW-2	MW-5-2
Arsenic	0.0184	-[a]	>15% NDs[b]	<EQL[c]	>15% NDs[b]	<EQL[c]	<EQL[c]	<EQL[c]	>15% NDs[b]
Barium	<0.0001	-[a]	0.902	0.066	0.001 (<0.01)	0.622	0.164	0.455	<0.001 (0.067)
Chromium	<0.0001	-[a]	0.552	<0.01 (0.004)	<EQL[c]	0.021 (0.146)	<EQL[c]	<0.001 (0.0002)	>15% NDs[b]
Lead	0.3692	>15% NDs[b]	-[a]	-[a]	-[a]	-[a]	-[a]	-[a]	-[a]
Mercury	0.3478	>15% NDs[b]	-[a]	-[a]	-[a]	-[a]	-[a]	-[a]	-[a]
Trichloroethene	0.4977	>15% NDs[b]	-[a]	-[a]	-[a]	-[a]	-[a]	-[a]	-[a]
Tetrachloroethene	<0.0001	-[a]	<EQL[c]	<EQL[c]	<EQL[c]	<EQL[c]	0.196	<EQL[c]	<EQL[c]
Carbon Disulfide	0.2770	>15% NDs[b]	-[a]	-[a]	-[a]	-[a]	-[a]	-[a]	-[a]
Toluene	0.0005	-[a]	<EQL[c]	>15% NDs[b]	<EQL[c]	<EQL[c]	>15% NDs[b]	>15% NDs[b]	>15% NDs[b]
2-Butanone	<0.0001	-[a]	<EQL[c]	<EQL[c]	>15% NDs[b]	<EQL[c]	<EQL[c]	<EQL[c]	>15% NDs[b]

a. Shapiro-Wilk test not performed for the category (either over all wells or by well) based on results of the Kruskal-Wallis test.

b. No test for distribution was performed for constituents with more than 15% nondetects (NDs).

c. No test for distribution was performed for constituents with all results less than the EQL.

Table 4. Detection monitoring limits for constituents that do not differ among wells and method for determination.

Constituent	Overall DML (µg/L)	Method	Constituent	Overall DML (µg/L)	Method
1,1,1-Trichloroethane	1	EQL	Mercury	1	P
Benzene	1	EQL	Pyridine	5	EQL
Cadmium	1	EQL	Selenium	20	EQL
Carbon Disulfide	2.5	P	Silver	10	EQL
Carbon Tetrachloride	1	EQL	Trichloroethene	2.5	P
Chloroform	1	EQL	Methylene Chloride	1	EQL
Lead	3	P			

P = Poisson upper tolerance limit

EQL = estimated quantitation limit

Table 5. Detection monitoring limits (µg/L) for constituents that differ among wells and method for determination.

	CPP-33-1		CPP-55-06		ICPP-2018		ICPP-2019		MW-10-2		MW-2		MW-5-2	
Arsenic	7.5	P	5	EQL	9	P	5	EQL	5	EQL	5	EQL	6	P
Barium	244	N	269	N	477	NP	237	N	282	N	370	N	778	LN
Chromium	22.3	N	14.7	NP	10	EQL	10[a]	EQL	10	EQL	41.9	NP	11.5	P
Tetrachloroethene	1	EQL	1	EQL	1	EQL	1	EQL	5.91	N	1	EQL	1	EQL
Toluene	1	EQL	24	P	1	EQL	1	EQL	62	P	2.3	P	2.5	P
2-Butanone	5	EQL	5	EQL	6	P	5	EQL	5	EQL	5	EQL	5.5	P

P = Poisson upper tolerance limit

N = normal upper tolerance limit

LN = lognormal upper tolerance limit

EQL = estimated quantitation limit

NP = nonparametric upper tolerance limit

a. Distributional tests indicated that the DML should be computed using lognormal methods. Therefore, the lognormal DML was less than the EQL so the EQL is used as the DML.

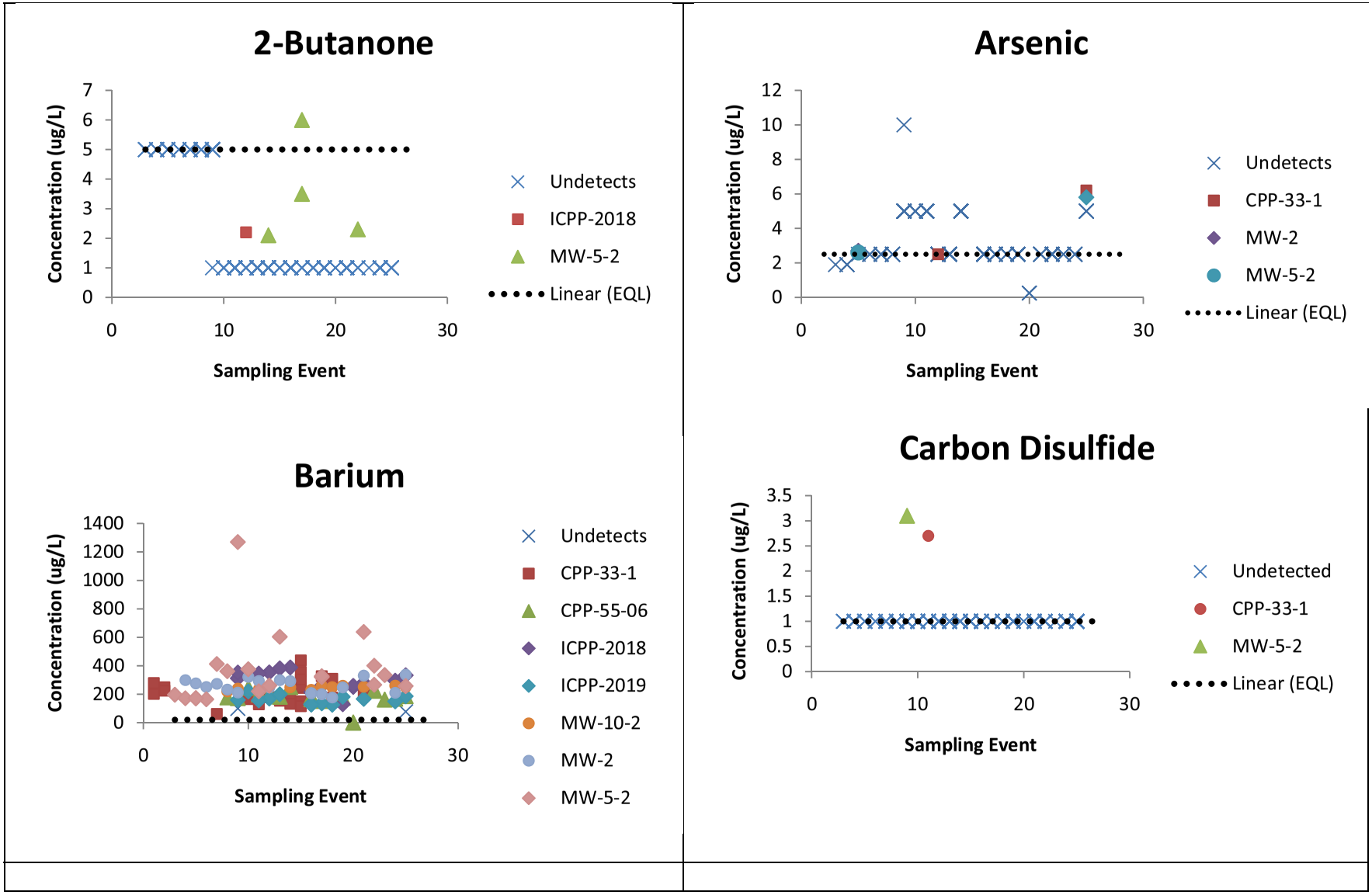


Figure 2. Concentrations by sampling event number for constituents with at least one detected result (even if less than the EQL).

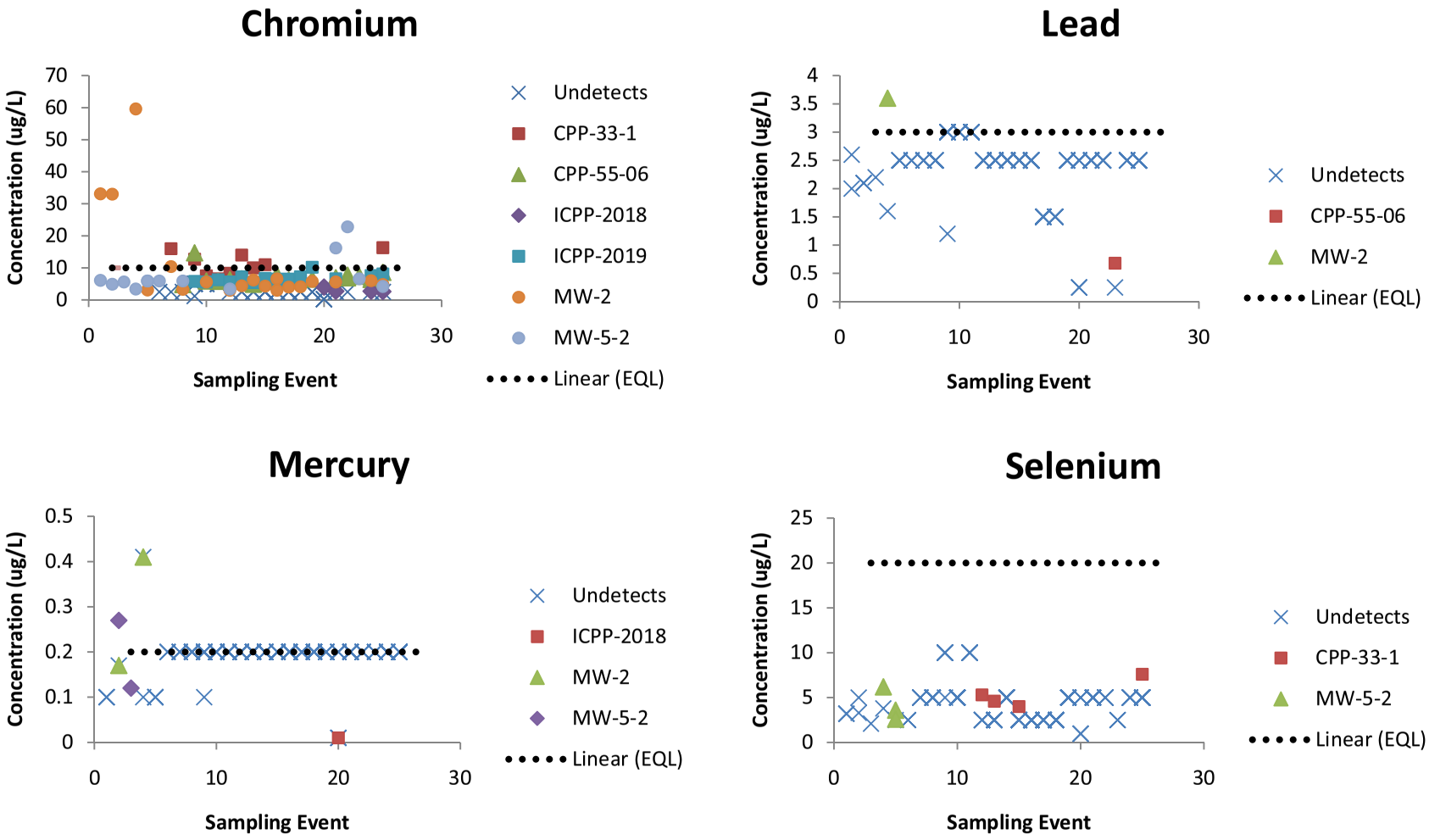
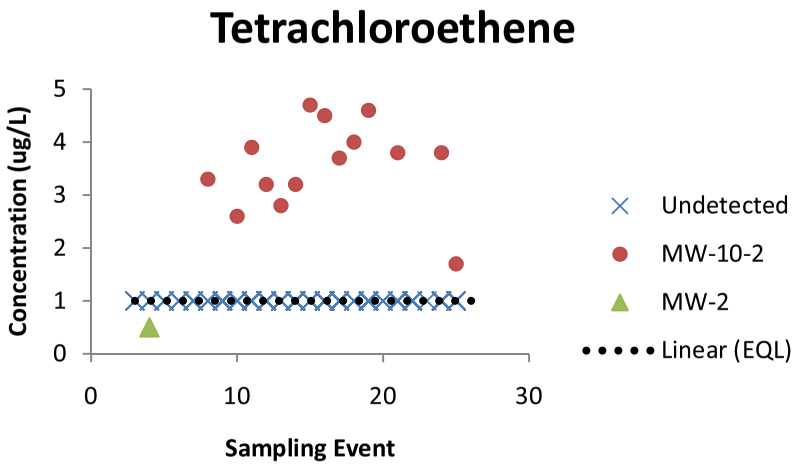
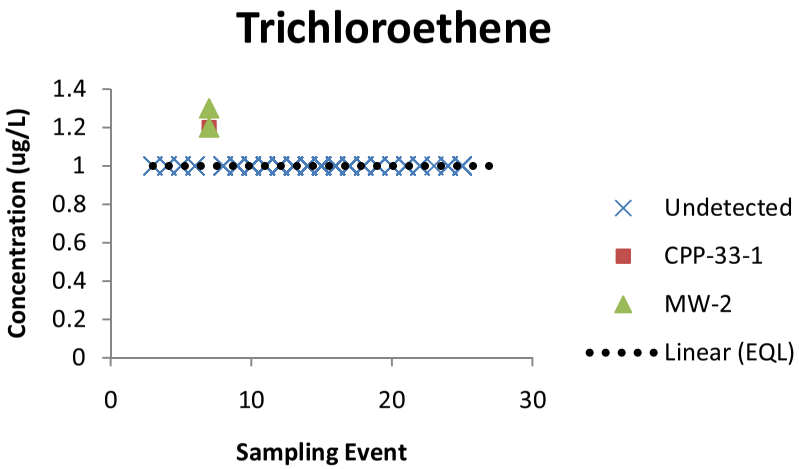


Figure 2 (cont.). Concentrations by sampling event for constituents with at least one detected result (even if less than the EQL).





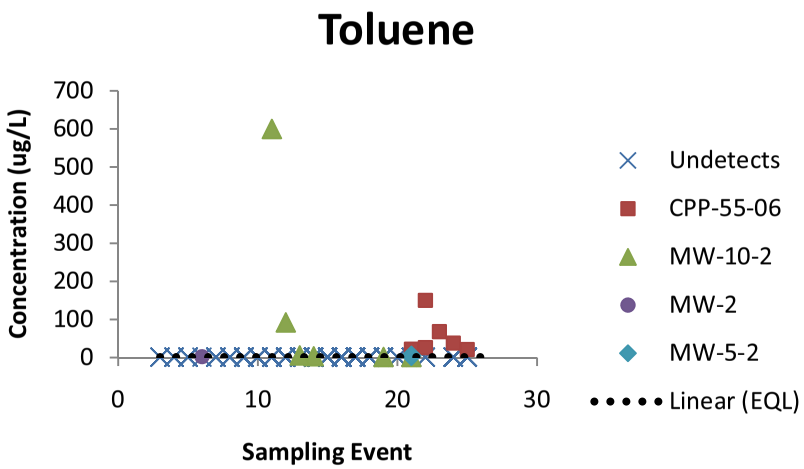


Figure 2 (cont). Concentrations by sampling event for constituents with at least one detected result (even if less than the EQL).

5. DISCUSSION

DMLs were calculated according to Permit requirements. Of the 19 constituents that are required by Permit, 9 have DMLs set at the EQL. Four of the constituents (carbon disulfide, lead, mercury, and trichloroethene) had at least one value detected above the EQL that had a DML computed across all wells. Six constituents (arsenic, barium, chromium, tetrachloroethene, toluene, and 2-butanone) had at least one result above the EQL that had well-specific DMLs calculated.

Three distributions (normal, lognormal, and non-parametric) were used to describe the distribution of the data and to determine the appropriate UTL for each constituent. Barium results are lognormally distributed in well MW-5-2 and are non-parametric in well ICPP-2018. The barium data in all other wells are normally distributed. Chromium data from well CPP-33-1 are normally distributed, chromium data from wells CPP-55-06 and MW-2 are non-parametric, and chromium data from well ICPP-2019 are lognormally distributed. Tetrachloroethene data from well MW-10-2 are normally distributed. Because the normal distribution is symmetric without long flat tails, the UTL will be close to the maximum observed values. The lognormal distribution is skewed toward larger concentrations; it has a long flat tail to the right. This long tail dictates the UTL. Determined distributions were used to determine the correct UTL as outlined in Section 2.

Poisson UTLs were computed for constituents with less than 85% detected values. The Poisson distribution describes rare occurrences; results with positive detections are rare occurrences for many constituents. The UTL is based on the number of nondetect values and the results for the positive detections. For constituents with mostly nondetects or few very large detects, the UTL can be considerably less than the maximum observed results. For toluene in well MW-10-2 the maximum result is 600 µg/L but the calculated DML is 58 µg/L. The reason for the difference is that the maximum concentration is 600 times the EQL of 1 µg/L. Four of the six detected values (68, 150, 26, and 38 µg/L) for the toluene data in well CPP-55-06 exceed the DML listed in Table 5 of 23.5 µg/L. The reason that the computed DML is so much smaller than the maximum is that the 15 nondetects overwhelm the few detected values that are just over the DML.

The DMLs are set to represent the background status of the perched water from the start of sampling in November of 2003 until the present. Although the Poisson distribution is appropriate for constituents with many nondetects, having a DML that is exceeded by the background data is troublesome because it is likely that the DML will often be exceeded when there is no release. An alternative would be to set the DML to the maximum of the calculated DML, using methods from the Permit and the maximum observed result. For this report, the DML for constituents whose maximum values are considerably larger than the computed UTL, the DML is changed to the maximum value. Final proposed DMLs are listed in Table 6.

Increased background concentrations of arsenic, chromium, and toluene prompted the development of new DMLs. Comparison of the previous DMLs (Medema 2006) to the newly computed DMLs shows that the new DMLs for arsenic, chromium, toluene, and 2-butanone have increased. The previous DML for arsenic was set at the EQL. Current calculations indicate that arsenic concentrations differ between wells and the DMLs for wells CPP-33-1, ICPP-2018, and MW-5-2 are greater than the EQL. New data also indicate that chromium concentrations differ between wells. DMLs for chromium have increased in wells CPP-33-1, CPP-55-06, and MW-2. Toluene DMLs were previously specified by well, and statistical analysis indicates that this is still appropriate. The previous DML for 2-butanone was set as the EQL for all wells. The current analysis shows that the data differ between wells. The DML was still set as the EQL for all of the wells except for well MW-5-2 which was computed using a Poisson UTL. DMLs for toluene increased in wells CPP-55-06, MW-10-2, and MW-5-2. These increases indicate that background concentrations of arsenic, chromium, toluene, and 2-butanone have indeed increased in some wells.

6. PRESENTATION OF FINAL DETECTION MONITORING LIMITS

Tables 4 and 5 list the DMLs computed using the methods outlined in Section 2. However, several of the maximum reported values far exceeded the DMLs. It was determined that the maximum reported value should be set as the DML when this occurred to ensure DMLs are not regularly exceeded as a result of natural fluctuations in constituent concentration. Table 6 lists the DMLs that should be used for groundwater monitoring.

Table 6. Proposed constituent analyte list, associated estimated quantitation limits, groundwater protection standards, and WCF detection monitoring limits.

Constituent	EQL (*u*g/L)	GPS (*u*g/L)	DML (*u*g/L)
Arsenic	5	20	*note
Barium	20	4000	*note
Cadmium	1	10	1
Chromium	10	200	*note
Lead	3	30	3
Mercury	0.2	4	1
Selenium	20	100	20
Silver	10	200	10
1,1,1-Trichloroethane	1	400	1
Carbon Tetrachloride	1	10	1
Trichloroethene	1	10	2.5
Tetrachloroethene	1	10	*note
Carbon Disulfide	1	2000	2.5
Toluene	1	2000	*note
Pyridine	5	720	5
2-Butanone (methyl ethyl ketone)	5	38000	*note
Benzene	1	10	1
Chloroform	1	200	1
Methylene Chloride	1	86	1

*Note – Constituent was analyzed by well, and DMLs (µg/L) are listed in the columns below.

Table 6 (cont.)

	CPP-33-1	CPP-55-06	ICPP-2018	ICPP-2019	MW-10-2	MW-2	MW-5-2
Arsenic	7.5	5	9	5	5	5	6
Barium	244	269	477	237	282	370	778
Chromium	22.3	14.7	10	10	10	59.6	22.8
Tetrachloroethene	1	1	1	1	5.91	1	1
Toluene	1	150[a]	1	1	600[a]	2.3	4.5[a]
2-Butanone	5	5	6	5	5	5	5.5

a. DML is the maximum detected value.

7. CONCLUSIONS

The statistical analysis of 20 quarterly and semi-annual sampling events and 2 Appendix IX sampling events of WCF monitoring data combined with an evaluation of constituents present in the INTEC liquid waste management system results in 19 constituents and associated updated detection monitoring limits (Table 6) for which ICP proposes continued monitoring semi-annually.

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APPENDIX J-2. Statistical Analysis of Perched Groundwater Monitoring Data for the CPP-601/627/640 Facility

(RPT-2126.33-001, Revision 0 – April 2012)

RPT-2126.33-001
Revision 0

Statistical Analysis of Perched Groundwater Monitoring Data for the CPP-601/627/640 Facility

April 2012

RPT-2126.33-001
Revision 0

Statistical Analysis of Perched Groundwater Monitoring Data for the CPP-601/627/640 Facility

April 2012

Portage, Inc.
1075 S. Utah Avenue, Suite 200
Idaho Falls, ID 83402

Prepared for
CH2M-WG Idaho, LLC
Contract BMC 500116, Release 33
Portage Project No. 2126.33

ABSTRACT

In 1999, the Waste Calcining Facility, located at the Idaho Nuclear Technology and Engineering Center, was closed under an approved Hazardous Waste Management Act/Resource Conservation and Recovery Act (HWMA/RCRA) closure plan. The Idaho Department of Environmental Quality issued a final HWMA/RCRA post-closure permit on September 15, 2003, with an effective date of October 16, 2003. This permit sets forth procedural requirements for groundwater characterization and monitoring, maintenance, and inspections of the Waste Calcining Facility to ensure continued protection of human health and the environment. On July 26, 2011, a RCRA Class 2 permit modification request was approved by the Idaho Department of Environmental Quality. As a result, the post-closure permit was modified to consolidate the CPP-601/627/640 and Waste Calcining Facility post-closure care units, monitoring program, and monitoring frequency under the post-closure permit.

This report provides statistical analysis of the results from eight quarterly sampling events of the CPP-601/627/640 monitoring wells. These sampling events were performed from April 2010 through February 2012. Data collected from eight quarterly sampling events were used in this statistical analysis to determine background concentrations of the monitored constituents and establish detection monitoring limits for the CPP-601/627/640 Landfill.

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ACRONYMS

DEQ	Department of Environmental Quality
DML	detection monitoring limit
EQL	estimated quantitation limit
GPS	groundwater protection standard
HWMA	Hazardous Waste Management Act
INTEC	Idaho Nuclear Technology and Engineering Center
LN	lognormal
ND	nondetect
RCRA	Resource Conservation and Recovery Act
UTL	upper tolerance limit

Statistical Analysis of Perched Groundwater Monitoring Data for the CPP-601/627/640 Facility

1. INTRODUCTION

Shallow perched groundwater in the vicinity of the CPP-601/627/640 facility at the Idaho Nuclear Technology and Engineering Center (INTEC) is routinely monitored through a detection monitoring program, as outlined in the *HWMA/RCRA Post-Closure Permit for the Idaho Nuclear Technology and Engineering Center Waste Calcining Facility and CPP-601/627/640 at the Idaho National Laboratory* (DEQ 2011). On July 26, 2011, a Resource Conservation and Recovery Act Class 2 permit modification request was approved by the Idaho Department of Environmental Quality (DEQ), with an effective date of August 25, 2011. As a result, the post-closure permit was modified to consolidate the CPP-601/627/640 and Waste Calcining Facility post-closure care units, monitoring program, and monitoring frequency. The CPP-601/627/640 monitoring well network consists of five wells in the vicinity of the CPP-601/627/640 Landfill. The five wells are monitored for water levels and sampled for 19 constituents listed in Table 3c of the post-closure permit. Perched groundwater samples have been collected from these five wells for laboratory analyses on a quarterly basis since the first quarterly sampling event in April 2010. Samples have been collected and analyzed from eight quarterly sampling events, and results from these sampling events were used in this statistical analysis to determine background concentrations of the monitored constituents and to establish detection monitoring limits for the CPP-601/627/640 Landfill monitoring wells.

During certain periods of the quarterly sampling events performed to date, some of the monitoring wells had insufficient water for sampling. Consequently, during those dry periods, concentrations of the 19 permit-required constituents are unavailable for some of the monitoring wells (see Table 1). The post-closure permit (DEQ 2011) requires that the permittee complete the calculation of background data using the statistical methods in Permit Condition III.J after validation of the analytical data for eight quarterly sampling events or after sufficient samples are obtained to determine concentrations with the DEQ Director's approval. Therefore, this report will determine whether the data available after eight quarterly sampling events are sufficient to perform valid statistical analyses as outlined in the post-closure permit.

Table 1. Number of constituents analyzed at each well for the eight sampling events.[a]

Well	1	2	3	4	5	6	7	8
CPP-33-2	19	19	19	0[b]	19	19	19	19
ICCP-2195	19	19	19	0[b]	0[b]	19	0[b]	0[b]
ICCP-2196	19	19	19	19	19	19	19	19
ICCP-2205	19	19	0[a]	0[b]	0[b]	0[b]	0[b]	0[b]
MW-6	19	19	19	19	19	19	19	19

a. Post-closure permit requires analysis for 19 constituents in samples obtained at each well.
b. Well was dry during sampling event; no samples could be collected.

2. METHODS

The methods for development of background levels used for detection monitoring limits (DMLs) were in accordance with the INTEC post-closure permit (DEQ 2011). The DMLs were either set at the

estimated quantitation limit (EQL) or calculated as the upper tolerance limit (UTL). These methods are summarized, and additional analyses are described below.

A significance level (α) of 0.05 was used for hypothesis tests. A 95% confidence and 95% coverage were used (i.e., a 95% confidence limit on the 95th percentile) for the UTLs. The analyses were performed for each constituent independently. Analyses were performed for each well separately only when significant differences among wells were identified.

The outline below follows the process prescribed in the permit augmented by additional analyses:

1. Test for differences among wells using the non-parametric Kruskal-Wallis Rand test.

    a. This test was performed for constituents with at least one detectable result greater than the EQL.

    b. Constituents with all results less than the EQL were assumed to not differ among wells.

    c. All following analyses were performed for results combined across wells unless the Kruskal-Wallis test was significant.

2. Test for time trend using the Mann-Kendall test.

    a. This test was performed for constituents in at least 20% of the data and one annual detectable result greater than the EQL.

    b. All results less than EQL, detect or nondetect, were replaced with the EQL.

    c. If a trend existed, another 5 years of monitoring data would be required before limits could be determined. This would be a stopping point in these analyses for the constituent.

3. Test for normality and log normality using the Shapiro-Wilk test.

    a. This test was performed for constituents detected in at least 85% of the data. Otherwise, nonparametric methods as mandated in the permit were performed.

    b. One-half of the EQL was used in place of undetected values for constituents detected in at least 85% of the data overall.

4. Determine UTLs for constituents with at least 85% detects.

    a. If data were normal (Step 3), standard normal theory procedures were used.

    b. If data were lognormal (Step 3), the equations in the permit (established lognormal estimates; see Gibbons [1994] or Gilbert [1987]) were used.

    c. If data were neither normal nor lognormal, nonparametric tolerance limits were used.

5. Determine UTLs for constituents with less than 85% detects.

    a. Poisson tolerance limits were used for constituents with at least one detectable result greater than the EQL.

b. The DML was set to the EQL for constituents with all values not detected or below the EQL.

The details of the hypothesis tests (Kruskal-Wallis, Mann-Kendall, and Shapiro-Wilk) are not presented here; the Kruskal-Wallis, Mann-Kendall, and Shapiro-Wilk tests were performed using R software (R Development Core Team [2011]). The UTL methods are described briefly.

The parametric 95% UTL for the 95th percentile, assuming normally distributed data, is

$$\bar{x} + Ks \tag{1}$$

where

$\bar{x}$ = sample mean

s = sample standard deviation

K = constant that depends on the sample size, coverage (percentile), and confidence (K values are tabulated in selected statistical texts, e.g., Gilbert [1987]).

The parametric 95% UTL for the 95th percentile, assuming lognormally distributed data, can be calculated using the above formula after calculation of mean and variance of the transformed data and then back transformation, as directed by the permit.

Calculation of transformed data:

$$x_y = \frac{1}{n}\sum_{i=1}^{n} \ln(x_i) \qquad s_y^2 = \frac{1}{n}\sum_{i=1}^{n}[\ln(x_i) - x_y]^2 \tag{2}$$

Back transformation:

$$\bar{x} = exp\left(x_y + {s_y^2}/{2}\right) \qquad s = \sqrt{exp(2x_y + s_y^2) \times [exp(s_y^2) - 1]} \tag{3}$$

The Poisson UTL assumes data are composed of undetected results and generally a few detected values. The limit is calculated in three steps:

1. Calculate $$T_n = \frac{1}{2}EQL \times NumND + \sum_{detects} x_i \tag{4}$$

where

NumND = number of nondetects and detects less than the EQL and the summation is over all detects greater than the EQL.

2. Calculate $$\lambda_{T_n} = \frac{1}{2n}\chi^2_{0.05}[2T_n + 2] \tag{5}$$

where

$\chi^2_{0.95}[2T+2]$ = 95th percentile of the Chi-square distribution with $[2T+2]$ degrees of freedom.

3. Find $\chi^2_{0.95}[2k+2] \geq 2\lambda_{T_n}$ (6)

and solve for *k*, which will be set as the UTL.

3. DATA

The CPP-601/627/640 monitoring well network consists of five wells in the vicinity of the CPP-601/627/640 Landfill that were sampled for water quality. These wells are CPP-33-2, ICPP-2195, ICPP-2196, ICPP-2205, and MW-6. Well ICPP-2205 has been consistently dry since the third quarterly sampling event in October of 2010. Well CPP-33-2 was dry during the fourth quarterly sampling event in January/February 2011 but was sampled during the remaining quarterly sampling events. Well ICPP-2195 was dry in the fourth, fifth, seventh, and eighth quarterly sampling events. The five wells' completion midpoints range from 95.8 to 131 ft below ground surface. These completions are assumed to occur within one perched water body, allowing combination of sample results. Figure 1 shows the locations of the wells. Well ICPP-2205 has the deepest well completion midpoint, and Well CPP-33-22 has the shallowest well completion midpoint. The depth range for well ICPP-2205 overlaps the depth range for wells MW-6 and ICPP-2196. The depth range for well CPP-33-2 overlaps well ICPP-2195.

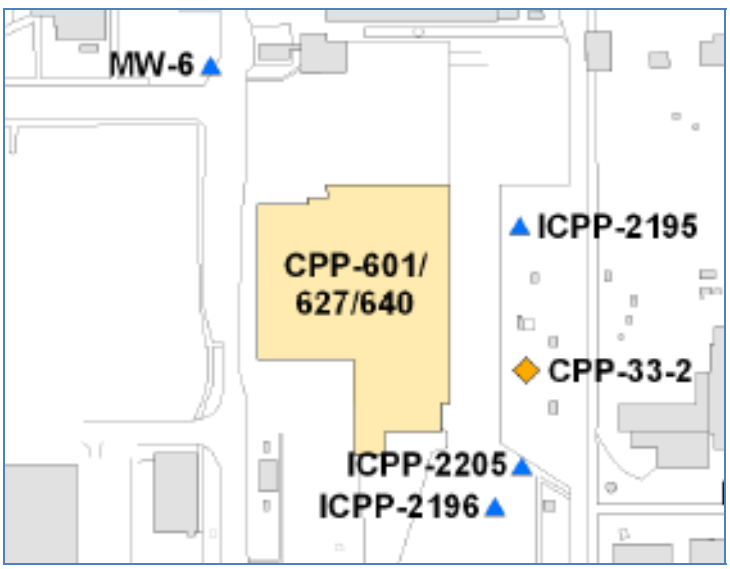


Figure 1. CPP-601/627/640 perched water monitoring wells. Wells identified by a blue triangle are both monitoring and water-level wells. Well CPP-33-2, identified by an orange diamond, is used as a monitoring and water-level well for CPP-601/627/640 and as a water level well for the Waste Calcining Facility.

The upgradient well (MW-6) and one of the downgradient wells (CPP-33-2) were selected from existing wells. Wells ICPP-2195 and ICPP-2196 were drilled to facilitate monitoring of the CPP-601/627/640 facility. Well ICPP-2196 was dry during drilling, so well ICPP-2205 was drilled to monitor the same area. However, well ICPP-2205 was dry for every sampling event after the second quarter, and well ICPP-2196 had sufficient water for sampling for all eight sampling events. Therefore,

well ICPP-2205 was not used to develop DMLs and is not included in the analysis presented in this report. All four downgradient wells are immediately adjacent to the CPP-601/627/640 Landfill.

Although samples were not obtained from Well ICPP-2195 during all eight sampling events, it appears that concentrations of the 19 measured constituents are either remaining constant or decreasing. Also, since the well had sufficient water for the first three sampling events but contained only enough for one of the later five events, it is unlikely that sufficient water will exist to allow future sampling. Therefore, the maximum detected value is a conservative estimate of the DML for this well despite the small number of samples.

4. ANALYSIS RESULTS AND DETECTION MONITORING LIMITS

The data were pared down to, at most, one observation per well per sampling event. Many duplicates were taken for quality assurance purposes. For each well and sampling event, the maximum detectable result was retained for data analyses. The number of final results used in the analyses is provided in Table 2 along with the number of detectable quantities and the number of results exceeding the EQL. Data included in this report were collected from April 2010 through February 2012.

Seven constituents had detectable results, although only five of these constituents have detectable results greater than the EQL (Table 2). The five constituents with detected results above the EQL were tested for differences among wells using the Kruskal-Wallis non-parametric test (Table 3). Barium, chromium, and toluene concentrations significantly differed among the wells. Tetrachloroethene and chloroform did not significantly differ among wells. The Kruskal-Wallis test was not performed on benzene or selenium, because none of the detected values for those two analytes were greater than their respective EQLs. The EQLs for the remaining 14 constituents were set as the DMLs.

The Mann-Kendall test was performed on constituents with at least 20% of the results detectable and greater than the EQL. The test was performed by well if the Kruskal-Wallis test was significant for that constituent. The Mann-Kendall test was performed on barium for each well, chromium (well CPP-33-2), and toluene (well MW-6). The Mann-Kendall test was not significant for any of these wells. The Mann-Kendall test was not performed on the ICPP-2195 data for any constituents because of the small number of samples collected from the well. However, visual inspection of the time plots indicates that concentrations of chromium and toluene may have decreased in the well but have stabilized, and barium does not appear to have a time trend. Figure 2 contains plots of measured concentrations with respect to time for each of the seven detected constituents.

The Shapiro-Wilk test for normality was performed on barium and chromium for all wells. These were the only constituents that had results greater than the EQL, with 85% of the data detected. Both requirements are necessary to test for normality. The Shapiro-Wilk test indicated that both barium and chromium were normally distributed in all wells, with the exception of chromium for Well CPP-33-2. The chromium data for Well CPP-33-2 was lognormally distributed.

DMLs were determined based on the above results and on permit requirements. Of the 19 constituents, 14 had their DML set as the EQL, because all of the values were less than or equal to the EQL. Poisson UTLs were computed for tetrachloroethene and chloroform across all wells (Table 4). Three constituents (barium, chromium, and toluene) required well-specific DMLs. Various statistical methods were employed to generate these DMLs (Table 5).

Table 2. Summary of monitoring results by constituent and well.

Constituent	MW-6	CPP-33-2	ICPP-2195	ICPP-2196
1,1,1-Trichloroethane	8 (0)	7 (0)	4 (0)	8 (0)
2-Butanone	8 (0)	7 (0)	4 (0)	8 (0)
Arsenic	8 (0)	7 (0)	4 (0)	8 (0)
Barium	**8 (8,8)**	**7 (7,7)**	**4 (4,4)**	**8 (8,8)**
Benzene	8 (1,0)	7 (0)	4 (0)	8 (0)
Cadmium	8 (0)	7 (0)	4 (0)	8 (0)
Carbon disulfide	8 (0)	7 (0)	4 (0)	8 (0)
Carbon tetrachloride	8 (0)	7 (0)	4 (0)	8 (0)
Chloroform	**8 (1,1)**	7 (0)	4 (0)	8 (0)
Chromium	8 (8,0)	**7 (7,7)**	**4 (4,1)**	8 (8,0)
Lead	8 (0)	7 (0)	4 (0)	8 (0)
Mercury	8 (0)	7 (0)	4 (0)	8 (0)
Methylene chloride	8 (0)	7 (0)	4 (0)	8 (0)
Pyridine	8 (0)	7 (0)	4 (0)	8 (0)
Selenium	8 (0)	7 (1,0)	4 (0)	8 (1,0)
Silver	8 (0)	7 (0)	4 (0)	8 (0)
Tetrachloroethene	8 (0)	7 (0)	4 (0)	**8 (3,3)**
Toluene	**8 (6,6)**	7 (0)	**4 (1,1)**	8 (0)
Trichloroethene	8 (0)	7 (0)	4 (0)	8 (0)

NOTE: The first value in each cell is the number of results from the specified well. In parentheses are the number of detects followed by the number of detect results greater than the EQL. If none of the data are detected, only a zero is listed in parentheses. The five constituents that have at least one detection that exceeds the EQL are in bold.

Table 3. Kruskal-Wallis and Shapiro-Wilk test results for constituents with at least one detection exceeding the EQL.

Constituent	Kruskal-Wallis Test p-Value	Over All of the Wells	MW-6	CPP-33-2	ICPP-2195	ICPP-2196
Barium	0.0001	–[a]	0.4450	0.4431	0.1837	0.4085
Chromium	0.01177	–[a]	0.8899	0.0454 (0.1587)	0.0035 (0.0376)[b]	0.4066
Tetrachloroethene	0.0528	>15% NDs[c]	–[a]	–[a]	–[a]	–[a]
Toluene	0.0025	–[a]	>15% NDs[c]	>15% NDs[c]	>15% NDs[c]	>15% NDs[c]
Chloroform	0.4983	>15% NDs[c]	–[a]	–[a]	–[a]	–[a]

a. Shapiro-Wilk test not performed for the category based on results of the Kruskal-Wallis test.
b. The p-value for the Shapiro-Wilk test for lognormality is in parentheses.
c. No test for distribution was performed for constituents with more than 15% nondetects (NDs).

Table 4. Calculated detection monitoring limits for constituents that do not differ among wells.

Constituent	Overall DML (µg/L)	Method
Selenium	20	EQL
Tetrachloroethene	2	P
Benzene	1	EQL
Chloroform	2	P

EQL = Estimated quantitation limit.
P = Poisson upper tolerance limit.

Table 5. Calculated detection monitoring limits (µg/L) for constituents that differ among wells and method for determination.

	MW-6		CPP-33-2		ICPP-2195		ICPP-2196	
Barium	401	N	380	N	85	NP	165	N
Chromium	10	EQL	101	LN	10	EQL	13.1	N
Toluene	3	P	1	EQL	2	P	1	EQL

EQL = Estimated quantitation limit.
LN =Lognormal upper tolerance limit.
N = Normal upper tolerance limit.
NP = Nonparametric upper tolerance limit.
P = Poisson upper tolerance limit.

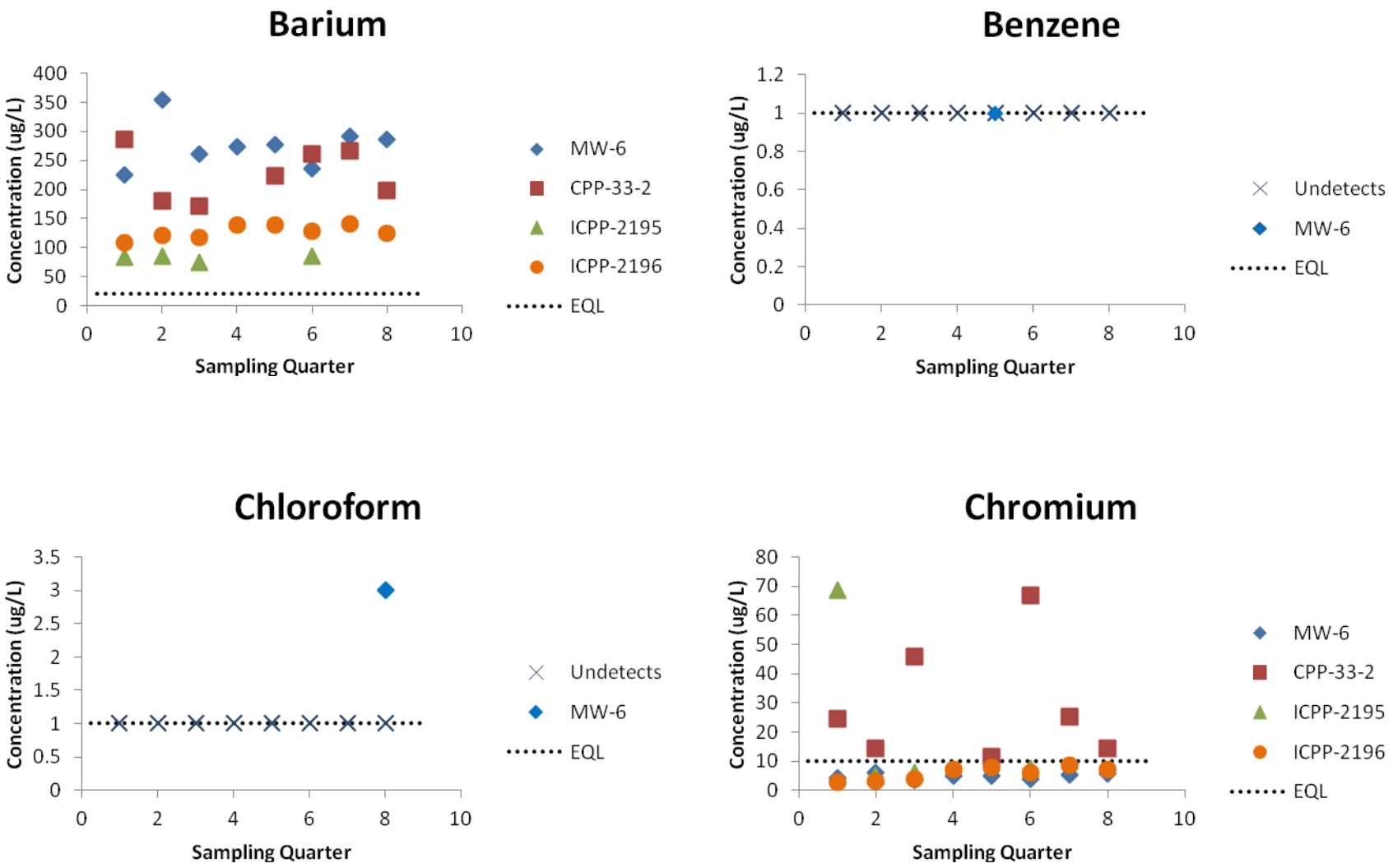
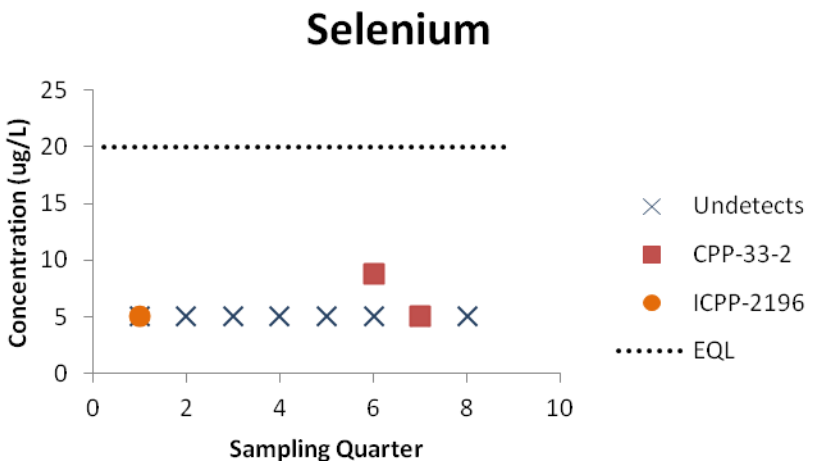
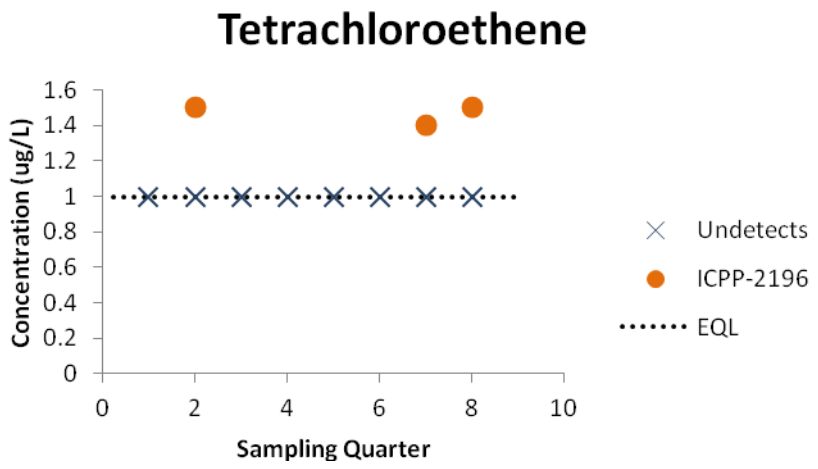


Figure 2. Concentrations by sampling event number for constituents with at least one detected result.





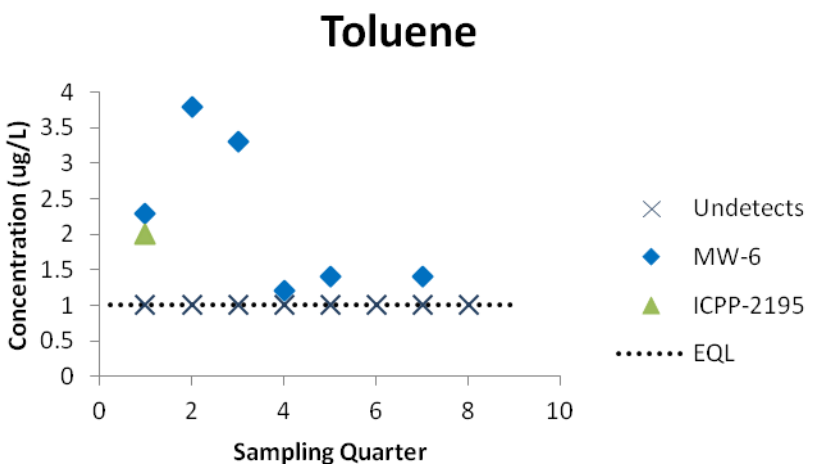


Figure 2. (continued).

5. CONCLUSIONS

DMLs were determined based on the above results and on permit requirements. Table 6 lists the DMLs for each of the 19 constituents outlined in the permit (DEQ 2011), the corresponding EQL, and the groundwater protection standard (GPS). Of the 19 constituents, 14 had their DML set as the EQL, because all of the values were less than or equal to the EQL. DMLs for Well ICPP-2195 were set either as the EQL or the maximum detected value, because of the small number of samples obtained from the well due to insufficient water. However, because the measured concentrations of all 19 constituents appear to be undetected or decreasing, the maximum detected value provides a conservative value for the DML. UTLs were computed for tetrachloroethene and chloroform across all wells. Three constituents (barium, chromium, and toluene) required well-specific DMLs. Various statistical methods were employed to generate these DMLs as outlined in the permit (see Tables 4 and 5).

Table 6. Detection monitoring limits for CPP-601/627/640.

Constituent	EQL (*u*g/L)	GPS (*u*g/L)	DML (*u*g/L)
Arsenic	5	20	5
Barium	20	4,000	*
Cadmium	1	10[a]	1
Chromium	10	200	*
Lead	3	30	3
Mercury	0.2	4	0.2
Selenium	20	100	20
Silver	10	200	10
1,1,1-Trichloroethane	1	400	1
Carbon tetrachloride	1	10	1
Trichloroethene	1	10	1
Tetrachloroethene	1	10	2
Carbon disulfide	1	2,000	1
Toluene	1	2,000	*
Pyridine	5	720	5
2-Butanone (methyl ethyl ketone)	5	38,000	5
Benzene	1	10	1
Chloroform	1	200	2
Methylene chloride	1	86	1

*Constituent was analyzed by well, and DMLs (µg/L) are listed in the columns below.
[a]Typographical error corrected – the value was changed from 1 to 10 by A. M. Boehmer

Constituent	MW-6 (*u*g/L)	CPP-33-2 (*u*g/L)	ICPP-2195 (*u*g/L)	ICPP-2196 (*u*g/L)
Barium	401	380	84.6	165
Chromium	10	101	10	13.1
Toluene	3	1	2	1

6. REFERENCES

DEQ, 2011, *HWMA/RCRA Post-Closure Permit for the Idaho Nuclear Technology and Engineering Center Waste Calcining Facility and CPP-601/627/640 at the Idaho National Laboratory*, EPA ID No. ID4890008952, Idaho Department of Environmental Quality, as modified August 25, 2011.

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ATTACHMENT 3
GEOLOGIC AND HYDROGEOLOGIC INFORMATION

HWMA/RCRA INTEC POST-CLOSURE PERMIT REAPPLICATION

Volume 21

Waste Calcine Facility and CPP-601/627/640

Attachment 3

Geologic and Hydrogeologic Characterization of the INEEL and INTEC

April 2013

Geologic and Hydrogeologic Characterization of the INEEL and INTEC

The characterization provided in this appendix is from the *Comprehensive RI/FS for the Idaho Chemical Processing Plant OU 3-13 at the INEEL – Part A, RI/BRA Report*, DOE/ID-10534, U.S. Department of Energy Idaho Operations Office, Idaho Falls, Idaho, November 1997.

2. ENVIRONMENTAL SETTING OF THE ICPP

The INEEL occupies 2,305 km^2 (890 mi^2) on the northern portion of the Eastern Snake River Plain (ESRP) in southeastern Idaho (Figure 1-1). The eastern boundary of the INEEL is located approximately 51 km (32 mi) west of Idaho Falls. The INEEL is bounded on the northwest by the Lost River, Lemhi, and Beaverhead mountain ranges. The remainder of the INEEL is bounded by the ESRP.

The INEEL is located in a topographically closed drainage basin. Three intermittent streams, the Big Lost River, Little Lost River, and Birch Creek flow onto the INEEL. These streams originate in local mountain drainages and much of the water is diverted or stored upstream of the INEEL for use in irrigation. The Big Lost River is the principal surface water feature on the INEEL. Several storage and diversion systems exist on the Big Lost River. The Mackay Reservoir is located about 48-km (30-mi) upstream from Arco, Idaho, and has a storage capacity of 44,500 acre-ft (Van Haaften et al., 1984). A flood diversion system was constructed on the INEEL in 1958 to protect INEEL facilities from potential flooding of the Big Lost River. The system uses a low dam to divert river flow into a series of spreading areas located in the southwestern portion of the INEEL. The capacity of the diversion system was expanded in 1984, and the system is capable of accommodating flows of up to 263 m^3/sec (9,300 ft^3/sec) (Bennett, 1986).

Except for evapotranspiration, most of the water in the Big Lost River, Little Lost River, and Birch Creek is recharged to the ground through irrigation or infiltration. Water from the Big Lost River infiltrates into the material beneath the river and into the SRPA. The volume of this infiltration is significant during wet years. Zones of perched water have been identified along the Big Lost River when it contains water. The extent and volume of these perched water zones is not completely known.

The Snake River Plain Aquifer (SRPA) underlies the INEEL and is a valuable regional resource in southeastern Idaho, extending approximately 320 km (200 mi) from Ashton, Idaho, in the northeast to Hagerman, Idaho, on the southwest. The aquifer consists of a series of basalt flows with interbedded sedimentary deposits and pyroclastic materials. INEEL-wide water-level data compiled in July 1985 indicated the general direction of groundwater flow across the INEEL was toward the south-southwest at an average gradient of about 0.8 m/km (4 ft/mi)(Bartholomay et al., 1997). Horizontal groundwater flow rates in the SRPA have been estimated to vary from 0.3 to 7.6 m/day (1 to 25 ft/day) (Kaminsky et al., 1994; Robertson et al., 1974). The SRPA was designated as a sole source aquifer by the EPA (56 FR 50634, October 7, 1991) because it is the only viable source of drinking water for many communities on the ESRP. The aquifer is the source of all water used at the INEEL.

2.1 Surface Features

The land surface of the INEEL is characterized as rolling to broken, typical of basalt terrain. The predominant relief on the INEEL is the result of volcanic buttes and unevenly surfaced and fissured basalt flows. Elevations on the INEEL range from 1,585 m (5,200 ft) in the northeast to 1,448 m (4,750 ft) in the southwest with the average being approximately 1,520 m (5,000 ft). A broad ridge on the ESRP extends through the Big Southern, Middle, and East Buttes on the southern portion of the INEEL, effectively separating drainage from the mountains in the north from that of the Snake River to the south. The Big Lost River flows onto the INEEL in the southwest and turns north, culminating in a series of playa lakes where it infiltrates, recharging the SRPA. The majority of the land within the boundaries of the INEEL is relatively undisturbed and covered with sagebrush. Three public highways traverse the INEEL.

The ICPP is located in the south-central portion of the INEEL. Elevation at the ICPP is 1,498 m (4,917 ft), and the facility's northwest corner is actually truncated by the current channel of the Big Lost River. Gravelly, medium-to-coarse textured soils derived from alluvial deposits occur in the vicinity of the ICPP. The underlying basalt is covered with as much as 18.2 m (60 ft) of these soils and the land surface is flat and covered with sagebrush.

2.2 Demographic and Land Use

2.2.1 Demography (On-Site and Off-Site Populations)

The nearest INEEL boundaries are 51 km (32 mi) west of Idaho Falls, 37-km (23-mi) northwest of Blackfoot, 71 km (44 mi) northwest of Pocatello, and 11 km (7 mi) east of Arco, Idaho. With a population of approximately 1100, Arco is the largest boundary community in the area surrounding the Site. Approximately 121,500 people reside within a radius of 80 km (50 mi) of the Site's operational center, which is the TRA-ICPP area. There are no residents within 16 km (10 mi) of that center with Atomic City (population 25) being the closest boundary community.

2.2.2 Land Use (Current and Future)

As with virtually all of the sites in the DOE complex, the INEEL is making major changes in the use of its land. Until recent years, land use planning was driven by nuclear energy research and defense-related projects. Presently, however, the shutdown of facilities and environmental restoration of the land play important roles in land use planning.

The primary use of INEEL lands is to support facility operations and act as buffer and safety zones around the facilities. Virtually all of the work at the INEEL is performed within the site's primary facility areas [i.e., Central Facilities Area (CFA), Test Reactor Area (TRA), ICPP]. These areas, however, occupy only about 2% of the total INEEL land area. Other land uses include environmental research, ecological preservation, and socio-cultural preservation. INEEL land is also used for grazing, recreation, and connecting infrastructure, with the remaining land being essentially undisturbed.

Currently the ICPP has a total land area of 200 acres and 106,070 m^2 (1,141,711 ft^2) of facilities. Land at ICPP is used to store spent nuclear fuels and radioactive wastes for the DOE. Other uses include a coal-fired generating plant, Tank Farm waste storage facility, and wastewater treatment/disposal facilities. Before April 1992, spent nuclear fuels were reprocessed at the plant. With the DOE's decision to cease reprocessing operations, however, the need to store greater quantities of these fuels increased.

As the shutdown of INEEL facilities and the environmental restoration of INEEL land play greater roles, environmental studies are increasingly important elements in land use planning. These studies provide INEEL scientists, engineers, and planners with information about how nuclear reactor research has affected the environment and the extent of remediation necessary to restore the land.

To facilitate decisions about environmental restoration activities at the INEEL, DOE-ID conducted analyses in 1994 to project reasonable land use scenarios at the INEEL for the next 100 years. These analyses, conducted with extensive public involvement, resulted in the development of specific issues, assumptions, and constraints that guided the generation of facility and land use scenarios for the next 25, 50,

75, and 100 years, as published in the *Long-Term Land Use Future Scenarios for the Idaho National Engineering Laboratory* (DOE-ID, 1995). Refer to that document for a listing of participating individuals/organizations, comments received, and an explanation of the process for producing future land use scenarios. The INEEL Site Specific Advisory Board reviewed and provided input to the creation of the future use scenarios. EPA and IDHW did not review or comment on the document.

The planning assumptions for the future use scenarios include:

- The INEEL will remain under DOE management and control for at least the next 100 years.

- Advances in DOE and private-sector research will result in the obsolescence of existing facilities. It is further assumed that new facilities will need to be constructed in response to the need to provide state-of-the-art research facilities. Other programs, however, will be discontinued after the facilities become obsolete.

- New construction may include structures in existing facility areas; other new construction may require the development of new facility areas.

- As facilities become obsolete, decontamination and decommissioning will likely be required. Similarly, contaminated areas will require remediation.

- To the extent practical, new development will be encouraged in developed facility areas to take advantage of existing physical and service infrastructures. Such redevelopment will reduce environmental degradation associated with construction activities in previously undeveloped areas.

- The CFA will remain the focal area for support and infrastructure activities.

- The life expectancy of current and new facilities is expected to range between 30 and 50 years. The decontamination and decommissioning process will commence after closure of a facility, assuming no new missions for a facility are articulated.

- Environmental restoration and waste management activities will continue. Cleanup of hazardous, mixed, and low-level waste sites is expected to be completed within 10 years after completion of a record of decision for the activities mandated under Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA).

- Research and development facilities will be expanded to accommodate "new frontier research" such as fusion, transportation, space exploration, nuclear propulsion, alternative fuels, and advanced cleanup technologies.

- Research at the INEEL will focus increasingly on advances in nuclear medical research and the production of isotopes used in medicine, research, and industry. In addition, other specific research initiatives (i.e., alternative fuels, advanced environmental restoration and waste management technology, transportation) will gain importance at the INEEL. To support such efforts, cooperative partnerships between the public and private sectors will be developed to

achieve mutual goals. This could result in the reuse of INEEL facilities by private sector interests, supplemented with technology support by INEEL personnel.

- The INEEL will continually be prepared to support defense-related operations (i.e., manufacturing, testing, support) in response to the ever-changing military climate throughout the world. Although the INEEL will continue to be used for defense-related research, other nuclear research will receive an increasing emphasis in years to come.

- Regional development trends will be closely related to activities at the INEEL. For example, new housing development will be generated by increases in onsite employment because the INEEL is a major regional employer. Conversely, a major decrease in onsite employment will hamper the regional housing market.

- No residential development (i.e., housing) will occur within INEEL boundaries; however, grazing will be allowed to continue in the buffer area.

- No new, major, private developments (residential or nonresidential) are expected in areas adjacent to the INEEL site. There is uncertainty about the applicability of this assumption to privately held land. Beyond 25 to 50 years, there is less certainty about this assumption.

- An 890 mi^2 site dedicated to nuclear research, development, testing, and evaluation is irreplaceable. It was therefore assumed that it is extremely unlikely that a similar DOE facility could be sited at any other location.

The ICPP was one of the facilities that had a future use scenario projected. The scenarios are broken down into the present situation, as well as for the next 25, 50, 75, and 100 years.

Present:	Interim storage of SNFs; disposition of fuels; managing waste and improving waste and water management techniques.
25-Year:	Continue use as industrial area; planned new waste treatment facility.
50-Year:	Approaching end of useful life if no new mission identified; D&D with all or selected areas for restricted industrial use.
75-Year:	Standby mode for restricted industrial use; reuse permitted, but no new development outside existing fence line.
100-Year:	Continuation as a restricted industrial area.

These planning assumptions and the constraints just described were used to project the most likely INEEL configuration. Over time, the planning assumptions and resulting long-term scenarios may need to be revised due to unforeseen developments.

2.3 Surface Water Recharge

Surface water recharge to the groundwater beneath the ICPP is provided through natural precipitation, human made sources (i.e., surface percolation ponds, lawn watering, steam injection wells, leaking water pipes), and occasionally during wet years from the Big Lost River. These water sources have resulted in the formation of several perched water zones beneath the ICPP at depths ranging from 12.2 to 115 m (40 to 377 ft) (Thomas, 1988; Chipman, 1989).

2.3.1 Climatology and Meteorology

The INEEL is located on the Snake River Plain, which is a large flat valley surrounded by mountains. Air masses cross this mountain barrier before entering the Snake River Plain. Most of the moisture is lost in crossing the mountain barrier; thus, the INEEL has little annual rainfall and is classified as semiarid.

The arid climate permits intense solar heating of the ground surface during the day and rapid cooling at night, especially during the summer months. In general, the INEEL has a large diurnal variation in temperature at ground level.

Mountain ranges to the north block many of the shallow, intensely cold, air masses moving out of Canada in the winter months. The climate in eastern Idaho is a more moderate climate than the climate in areas at similar latitudes east of the continental divide. The mountains can also serve as a barrier and cold air masses that do enter the valley are frequently held in place for a week or longer.

The surrounding mountains tend to channel the winds in the region. The prevailing winds on the Snake River Plain are from the southwest and windspeeds are frequently greater than 8 km/hr (5 mi/hr). The second most frequent winds are from the northeast.

Meteorological data have been collected at over 40 locations on or near the INEEL since 1949. The weather station at the CFA was the first onsite station and appears on National Climatic Center records as Idaho Falls 46 W. There are 27 active meteorological stations in operation on or near the INEEL. Most of the meteorological monitoring within 80 km (50 mi) of the INEEL is conducted by the National Oceanic and Atmospheric Administration (NOAA) Air Resources Laboratories. A large database has been compiled and analyzed by NOAA (Clawson et al., 1989).

An overview of climatological data is available from summaries of temperatures, precipitation, snowfall and snow depth, windspeed and direction, and moisture content of the air. Much of the summary information comes from the monitoring station at CFA, which is located approximately 5 km (3 mi) south of the ICPP. Differences in climate between the facilities would be small local variations.

Temperatures at the INEEL vary widely over the course of the year. Records for CFA indicate that the highest daily maximum temperature occurring between 1950 and 1988 was 38°C (101°F) and the lowest temperature recorded at CFA was -44°C (-47°F). The highest daily average temperature over the course of a month was 28°C (83°F) and the lowest daily average was -33°C (-28°F). Temperatures also vary greatly over the course of the day and, on average, span a 17°C (30°F) range. The maximum temperature range in 1 day at CFA spanned 50°C (90°F).

Average annual precipitation at the CFA (1950 to 1988 inclusive) is 22.1 cm (8.7 in.). The highest annual precipitation was 36.6 cm (14.4 in.) and the lowest was 11.4 cm (4.5 in.). Over the years, the wettest months have been May and June. However, recorded precipitation amounts of less than 0.3 cm (0.1 in.) have occurred in all months. Individual months have had as much as 11.2 cm (4.4 in.) of precipitation or as little as no precipitation. The greatest amount of precipitation at the CFA in a 1-hr period or a 24-hr period, is 1.3 cm (0.5 in.) and 4.1 cm (1.6 in.), respectively, occurred in June. The monthly precipitation totals for CFA from March 1950 through November, 1995 are provided in Table 2-1.

From 1950 to 1988, the CFA averaged 70.1 cm (27.6 in.) of snow per year. The maximum snowfall in a year was 151.6 cm (59.7 in.). Maximum snowfall occurs in December and January. Little snow falls from May through October. June, July, and August are the only months with no recorded snowfall between 1950 and 1988. The maximum snowfall in a 24-hr period was 21.8 cm (8.6 in.), which occurred in March. A snowfall of 21.6 cm (8.5 in.) in a 24-hr period is recorded for January. The lowest annual snowfall at the CFA was 17.3 cm (6.8 in.). All months have gone without snowfall in at least 1 year during the recording period.

January and February have the highest average maximum snow depth at 10.4 cm (4.1 in.). The highest recorded maximum snow depth was 51 cm (20 in.) and occurred in March. December, January, and February also have had snow depths greater than 28 cm (11 in.).

Average relative humidities at the CFA range from 30 to 70%. Relative humidities typically are higher during the colder months (November through March). The relationship between relative humidity and temperature makes high relative humidities possible from small amounts of moisture when the temperature is low. Consequently, winter months may have high relative humidities from very low moisture contents. Relative humidities on summer afternoons are frequently lower than 15% and can be lower than 5%. Maximum absolute humidities reach 100% in all months except July Average minimum absolute humidities are below 16% in all months and below 10% from April through October.

From 1955 through 1961, the average air temperature in January (the coldest month) was -8.6°C (16.5°F) and the average dewpoint was -13.7°C (7.4°F). During July, the warmest month, the temperature averaged 20.6°C (69.0°F) and the dewpoint averaged 0.8°C (33.5°F). The annual average temperature was 5.9°C (42.6°F) and the dewpoint was -6.4°C (20.4°F). Low dewpoints and relative humidities indicate the environment at the INEEL is quite arid.

The most frequent winds at the ICPP are southwesterly. Other significant components are westerly and northeasterly. Most windspeeds are less than 5.0 m/sec (11 mph). The peak wind gust at the CFA [6.1 m (20 ft) level] was 126 km/hr (78 mph), which occurred in January. All months have seen wind gusts of 97 km/hr (60 mph) or greater. At 76.2 m (250 ft), the peak wind gust at CFA was 135 km/hr (84 mph) and occurred in March.

Severe weather on the INEEL consists of thunderstorms, tornadoes, and funnel clouds. On the average, two to three thunderstorms occur during each of the summer months. Small hail may accompany the thunderstorms but hail damage has not been reported at the INEEL. Occasionally, rain in excess of the average monthly total precipitation may be recorded at a monitoring station on the INEEL as a result of a single thunderstorm. Nevertheless, precipitation from thunderstorms on the INEEL is generally light and may evaporate before reaching the ground.

Table 2-1. CFA precipitation totals for March 1950 through November 1995 (NOAA database).

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1950	—	—	1.05	0.14	0.28	0.98	0.10	1.08	0.28	0.16	0.30	0.55	(4.92)
1951	0.76	0.58	0.60	0.30	0.56	0.15	0.58	2.17	0.00	0.69	0.33	0.72	7.44
1952	0.61	1.04	0.41	0.03	0.80	0.91	0.38	0.29	0.12	0.00	0.37	0.67	5.63
1953	0.45	0.25	0.40	0.64	1.78	0.80	0.00	0.18	0.01	0.41	0.08	0.25	5.25
1954	0.51	0.87	0.55	0.46	0.45	2.74	0.16	0.39	0.15	0.07	0.65	0.40	7.40
1955	0.47	0.21	0.20	0.49	0.81	1.03	0.65	0.19	0.21	0.20	0.24	2.06	6.76
1956	0.80	0.31	0.27	0.35	1.63	0.02	0.17	0.02	0.28	1.53	0.28	0.15	5.81
1957	1.15	1.12	0.82	1.43	4.42	0.83	0.47	0.11	0.06	1.03	0.39	0.47	12.30
1958	0.85	0.87	0.93	1.45	0.79	0.48	0.45	0.20	0.66	0.00	0.43	0.23	7.34
1959	0.52	0.49	0.16	0.04	1.82	1.45	0.05	1.52	0.74	0.05	0.00	1.13	7.97
1960	0.66	1.33	0.71	0.45	0.70	1.38	0.07	1.20	0.29	0.23	1.02	0.12	8.16
1961	0.00	0.80	0.12	0.54	1.55	0.54	0.20	0.96	3.52	0.96	0.31	0.54	10.04
1962	0.80	2.40	0.58	0.23	1.91	1.77	0.72	0.03	1.21	0.29	0.11	0.25	10.30
1963	1.04	0.84	0.74	2.50	2.30	2.84	0.00	0.89	1.39	0.36	0.98	0.52	14.40
1964	0.47	0.22	0.81	1.17	1.05	2.23	0.49	0.26	0.00	0.74	1.53	3.43	12.40
1965	1.56	0.15	0.07	1.54	1.32	1.86	0.07	0.54	0.20	0.03	1.25	0.36	8.95
1966	0.14	0.63	0.24	0.30	0.84	0.12	0.25	0.11	0.47	0.23	0.29	0.88	4.50
1967	1.39	0.01	0.54	0.86	0.69	2.58	0.56	0.18	0.03	0.52	0.37	0.63	8.36
1968	0.55	0.20	0.33	0.11	1.49	3.89	0.05	3.27	0.85	0.34	0.94	1.23	13.25
1969	2.56	0.93	0.08	0.08	0.07	2.39	0.02	0.00	0.29	0.20	1.02	0.50	8.14
1970	0.62	0.05	0.83	1.26	1.28	0.96	0.51	0.50	0.53	0.35	1.53	0.97	9.39
1971	0.56	0.71	0.70	0.43	1.48	1.05	0.11	0.43	2.08	1.07	0.78	1.54	10.94
1972	0.48	0.09	0.25	0.35	0.66	1.41	0.34	0.78	0.48	0.75	0.76	1.08	7.43
1973	0.69	0.76	0.75	0.41	0.50	1.04	1.70	0.15	1.09	0.62	1.30	1.18	10.19
1974	0.66	0.36	1.44	0.35	0.72	0.49	0.03	0.71	0.01	1.34	0.42	1.19	7.72
1975	0.76	0.94	1.20	1.99	0.98	0.89	0.61	0.14	0.00	1.16	0.50	0.16	9.33
1976	0.45	0.88	0.50	1.66	1.00	0.79	0.18	0.82	0.96	0.51	0.00	0.05	7.80
1977	0.60	0.16	0.32	0.00	1.55	1.07	0.45	0.25	0.31	0.00	0.70	0.97	6.38
1978	1.00	1.05	0.66	1.32	0.74	0.26	0.31	0.17	0.96	0.09	0.48	0.44	7.48
1979	0.92	0.80	0.79	0.06	1.41	0.39	1.33	0.90	0.06	0.65	0.60	0.18	8.09

Table 2-1. (continued).

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1980	0.91	0.84	0.24	0.48	2.24	1.26	0.59	0.35	1.52	0.52	0.20	0.73	9.88
1981	0.61	0.69	0.94	1.83	1.81	0.25	0.17	0.07	0.14	0.93	1.34	0.67	9.45
1982	0.53	0.28	1.25	0.42	1.03	0.71	0.51	0.76	0.92	0.95	0.66	1.88	9.90
1983	0.20	0.19	1.08	0.42	0.40	1.75	1.31	0.88	1.07	1.67	1.18	0.81	10.96
1984	0.03	0.58	0.75	1.45	0.71	2.86	2.09	0.43	0.25	0.44	1.43	0.26	11.28
1985	0.98	0.50	0.76	0.06	0.91	0.40	2.29	0.02	1.67	0.28	1.07	0.63	9.57
1986	0.31	2.36	1.22	1.25	1.46	0.74	0.48	1.11	1.50	0.67	0.17	0.02	11.29
1987	0.65	0.38	0.18	0.40	1.96	0.76	2.16	0.21	0.00	0.11	0.72	0.42	7.95
1988	0.50	0.00	0.08	1.28	0.56	0.13	0.04	0.04	0.23	0.01	1.74	0.80	5.41
1989	0.31	0.38	0.62	0.31	0.75	1.21	0.32	0.41	1.86	0.29	0.45	0.04	6.95
1990	1.05	0.15	0.19	0.97	1.28	0.86	0.59	0.68	0.05	0.25	0.18	0.23	6.48
1991	0.05	0.00	1.18	0.51	2.03	1.15	0.53	0.78	1.08	0.51	0.73	0.00	8.55
1992	0.01	0.45	0.28	0.06	0.31	1.53	0.25	0.07	0.58	0.33	0.47	1.16	5.50
1993	1.15	1.44	0.57	1.20	1.99	2.73	0.08	0.73	0.12	0.92	0.48	0.21	11.62
1994	0.17	0.72	0.00	1.00	0.80	0.00	0.06	0.33	1.11	0.44	0.69	0.85	6.17
1995	1.03	0.28	2.03	0.72	2.34	4.64	0.59	0.05	0.52	0.07	0.22	—	(12.49)

( )—indicates incomplete record.

Since 1949, three small tornadoes, which caused no damage, have occurred within the boundaries of the INEEL. Additionally, 10 confirmed and three unconfirmed funnel clouds have been observed since 1954 (NOAA and Morrison Knudsen, 1983). NOAA records indicate a total of five funnel clouds and no tornadoes on the INEEL since 1950 (Clawson et al., 1989). Discrepancies in these records may be related to different methods of reporting and confirming tornadoes. No INEEL facilities have ever been damaged by a tornado.

Dust devils are also common in the region and can entrain dust and pebbles and transport them over short distances. Dust devils usually occur on warm sunny days with little or no wind. The dust cloud may be several hundred meters (yards) in diameter and extend several hundred meters (feet) in the air.

Vertical temperature and humidity profiles in the atmosphere determine atmospheric stability. Stable atmospheres are characterized by low levels of turbulence and less vertical mixing. Stability parameters at the INEEL range from stable to unstable. Stable conditions occur mostly at night during strong radiational cooling. Unstable conditions can occur during the day when there is strong solar heating of the surface layer or whenever a synoptic scale disturbance passes over the region.

2.3.1.1 Air Quality Monitoring. Air quality monitoring at the INEEL consists of two networks of stations designed to monitor atmospheric transport of radionuclides on particulate matter and ambient concentrations of total suspended particulates. Although the air quality monitoring networks are designed to monitor emissions from the entire INEEL, select low-volume particulate samplers in the vicinity of the ICPP provide detailed data on ambient concentrations of radionuclides and particulates.

Historically, one network has been operated by the contractor and the other network has been operated independently by the DOE. The contractor network consists of low-volume air samplers that operate at 0.14 m^3/min (5 ft^3/min). Particulate matter is collected on a membrane filter. The air filters are collected and analyzed every 2 weeks for gross alpha and gross beta activity. Filters are also analyzed monthly for selected gamma-emitting radionuclides. Gross beta analyses of the air filters are evaluated to determine if any increases in the sample radioactivity may require more immediate and/or more in-depth analysis by gamma spectrometry or radiochemistry.

The DOE network consists of 23 monitoring stations on and around the INEEL. Each low-volume air sampler contains two filters: a membrane prefilter and charcoal-impregnated paper filter. Filters are collected and analyzed weekly. Gross beta activity for each filter is determined weekly as a screening technique to give timely information in the event of site releases. If unusually high gross beta activity is detected on the filters, gamma spectrometry is conducted to obtain more detailed information. Composites of the membrane prefilters for each location are analyzed for specific radionuclides on a quarterly basis.

2.3.2 Humanmade Surface Water Features

Human made surface water features in the vicinity of the ICPP consist of two percolation ponds used for disposal of water in the service waste system (formerly injected into the aquifer via the ICPP injection well) and sewage treatment lagoons for treated water. In addition, several landscaped areas at the ICPP have historically been watered during the summer months and a network of ditches are used to channel runoff from the plant after precipitation events. Historically, precipitation runoff has been channeled to an old gravel pit (Site CPP-37-1) and both this pit and the unlined ditches may contribute recharge to the perched water bodies at the ICPP. Perched water bodies are known to exist beneath the percolation ponds and the sewage

treatment ponds. In addition, perched water bodies are known to exist beneath the ICPP plant facilities, including the high-level liquid waste (HLLW) Tank Farm and the CPP-603 facility.

The presence of the perched water bodies with no identifiable surface water source, and discrepancies between the reported volume of water pumped from the SRPA and the volume of water disposed at the ICPP, suggest water is being lost from the plant water distribution system and/or the liquid waste collection system. Leaks in municipal water systems are not unusual; however, concerns that this water source could leach and transport contaminants that have been released over the years at the ICPP led to a Water Inventory Study (Richards, 1994).

2.3.2.1 ICPP Water Inventory Study. The Water Inventory Study (Richards, 1994) was undertaken to determine if water was leaking from plant water supply systems and wastewater systems in sufficient quantities to account for seepage into the Tank Farm vaults and support the perched water beneath the plant (which have no readily apparent source, such as the surface infiltration ponds). The study involved a number of tasks and was designed to:

- Evaluate water budget measurements and calculations for plant water systems
- Upgrade plant water metering as necessary to quantify the plant water budget
- Leak-test the plant water supply and wastewater systems in the northern portion of the ICPP
- Estimate natural recharge
- Identify sources of water seeping into the Tank Farm vaults.

The ICPP uses approximately 7.9M L (2.1M gal) of water per day. Water is supplied by two raw water wells and one potable water well. The water is used for process cooling, equipment cooling, steam production, process solutions, decontamination, fuel storage basin makeup, chemical laboratory use, regeneration of ion exchange units, fire protection, and human uses. Piping systems external to facility buildings are either buried or enclosed in utility tunnels. The ICPP water systems that were considered relevant to the water inventory study included the raw water, fire water, treated (softened) water, demineralized water, steam condensate, landscape watering, potable water, service waste (industrial wastewater), and sanitary waste systems. Criteria of low volume, secondary containment, distinct radiological or chemical signature, and close monitoring or visibility were used to eliminate the steam distribution system, HLLW process lines, and pipes used to distribute cooling water to the HLLW storage tanks in the Tank Farm from leak testing during the Water Inventory Study.

The primary water systems at the ICPP include the raw water system, fire water system, water softeners (treated water system), and demineralizer (demineralized water system). The raw water system piping has an approximate length of 1,905 m (6,250 ft) and an average flow of 1,473 L/min (389 gal/min). Raw water is pumped from the aquifer from two production wells to the fire water storage tanks. The raw water feed tanks supply water to three distribution pumps. The fire water piping system has a length of 8.0 km (5 mi), with an average flow of 170 L/min (45 gal/min). This flow in the system is water used for watering lawns, safety showers, cooling of waste tanks and sump pump bearings, and flushing radiation monitor bowls. The treated (softened) water system has a length of 1,219 m (4,000 ft) and an average flow of 3,407 L/min (900 gal/min). Treated water is used for chemical process makeup and in heat exchangers. The

demineralized water system has a length of 1,280 m (4,200 ft) and an average flow of 5.7 L/min (1.5 gal/min). Demineralized water is used for process cooling, steam, and in fuel storage basins.

The steam condensate piping system has a length of 1,280 m (4,200 ft) and an average flow of 280 L/min (74 gal/min) between September and April. Primary steam use occurs between the months of September and March due to seasonal demands such as heating and freeze protection. Most of the steam is condensed and recycled or routed to the service waste system. Approximately 10% of the steam is either released to the atmosphere or discharged to the ground.

The potable water system has a length of 3.2 km (2 mi) with an average flow of 231 L/min (61 gal/min) (Figure 2-1). Potable water is supplied from two wells completed in the SRPA. Water is pumped to a storage tank, and three distribution pumps in building CPP-606 are used to supply potable water to ICPP facilities. The potable water system includes a chlorination system.

The service waste piping system has a length of 3.9 km (2.4 mi) and an average flow of 4,997 L/min (1,320 gal/min) (Figure 2-2). Raw water, treated water, demineralized water, and steam condensate are discharged to the service waste system. Waste streams that might be contaminated with radioactive materials are monitored before discharge to the service waste system, and the water is diverted to a holding tank for processing in the process equipment waste (PEW) Evaporator if contamination is detected. Water in the service waste system is discharged to two percolation ponds located on the south end of the facility.

The sanitary sewer piping system is 2.4 km (1.5 mi) long and has an average flow rate of 110 L/min (29 gal/min) (Figure 2-3). Potable water and sanitary waste from ICPP facilities are discharged to the sanitary sewer system and gravity drained to lift stations, where the waste is pumped to the ICPP Sewage Treatment Plant (STP). The waste is transferred to a series of treatment lagoons located at the northeast corner of the ICPP.

The seven landscape watering systems are all located in the northern ICPP and historically covered a total area of 1.5 acres (Figure 2-4). Approximately 75,710 L/day (20,000 gal/day) from the raw water, fire water, and potable water systems has been used to maintain lawns and landscaping at the ICPP during the summer months. A total volume of 8.90M L (2.35M gal) was used to water ICPP lawns each year. Consumptive use was calculated to require 2,967,760 L (784,000 gal) per growing season. Subtracting the consumption and evapotranspiration from the supplied water yields a net volume of 5.94M L (1.57M gal) available for infiltration and recharge of the perched water bodies.

2.3.2.1.1 Leak Testing—Leak testing was performed as part of the Water Inventory Study and indicated the fire water and potable water systems were leaking. The fire water system was found to have a year-round leak of 15.1 L/min (4 gal/min) and an additional leak of 45.4 L/min (12 gal/min) in a branch connection that is only used periodically. The potential loss from the fire water system was determined to be 14.8M L/yr (3.9M gal/yr). The potable water system was found to have a small leak of 0.57 L/min (0.15 gal/min), which would provide 299,050 L/yr (79,000 gal/yr) of potential recharge. These leaks have been repaired, but have historically provided nearly 15.1M L/yr (4M gal/yr) of potential recharge to the perched water bodies below the ICPP facilities and Tank Farm.

2.3.2.1.2 Tank Farm Vaults—Another purpose of the water inventory study (Richards, 1994) was identification of the source of water infiltrating into the Tank Farm vaults. Seepage into the vaults is a concern because the water could be leaching contaminants released to the soil in the vicinity of the Tank Farm

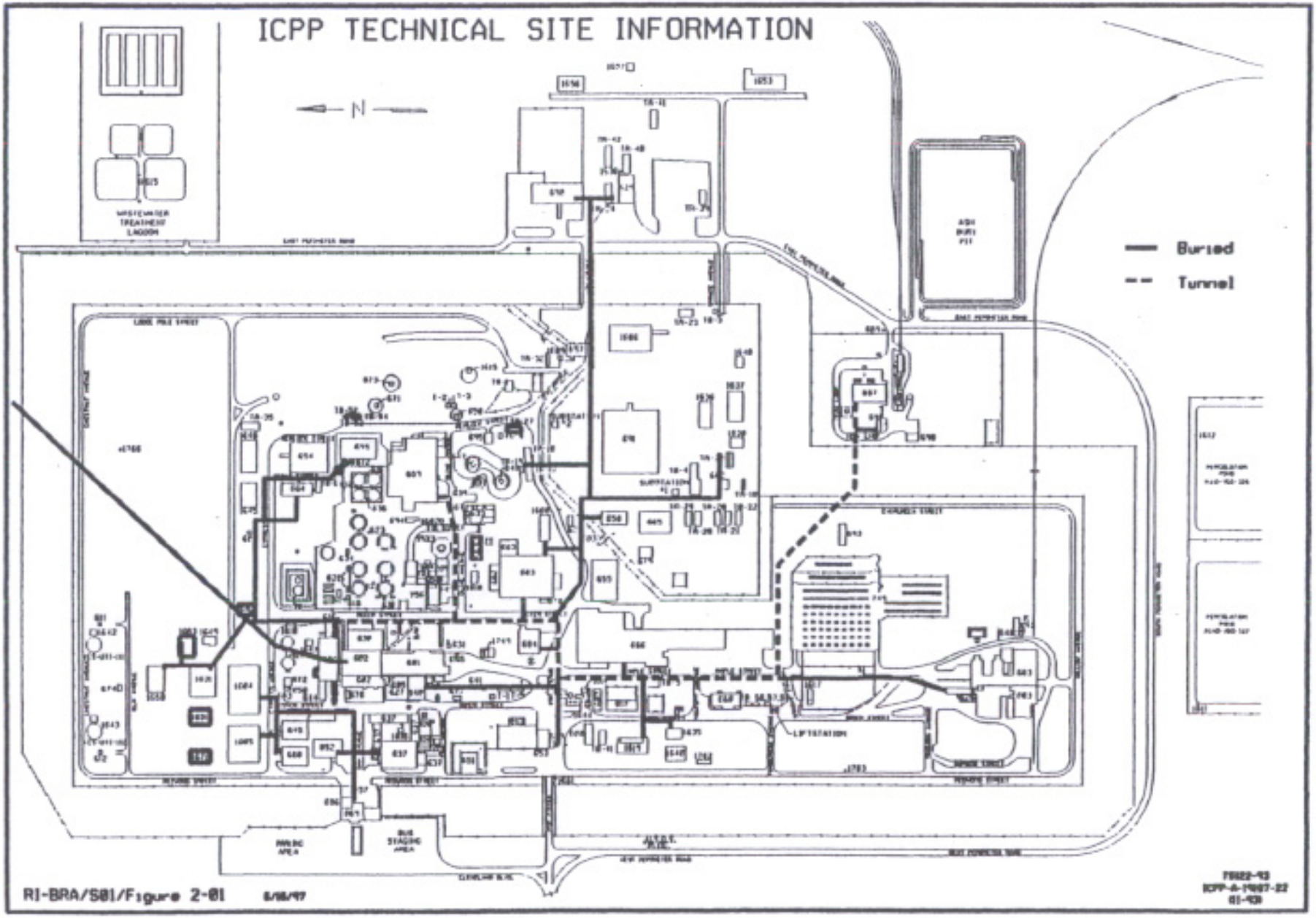


Figure 2-1. Potable water piping system.

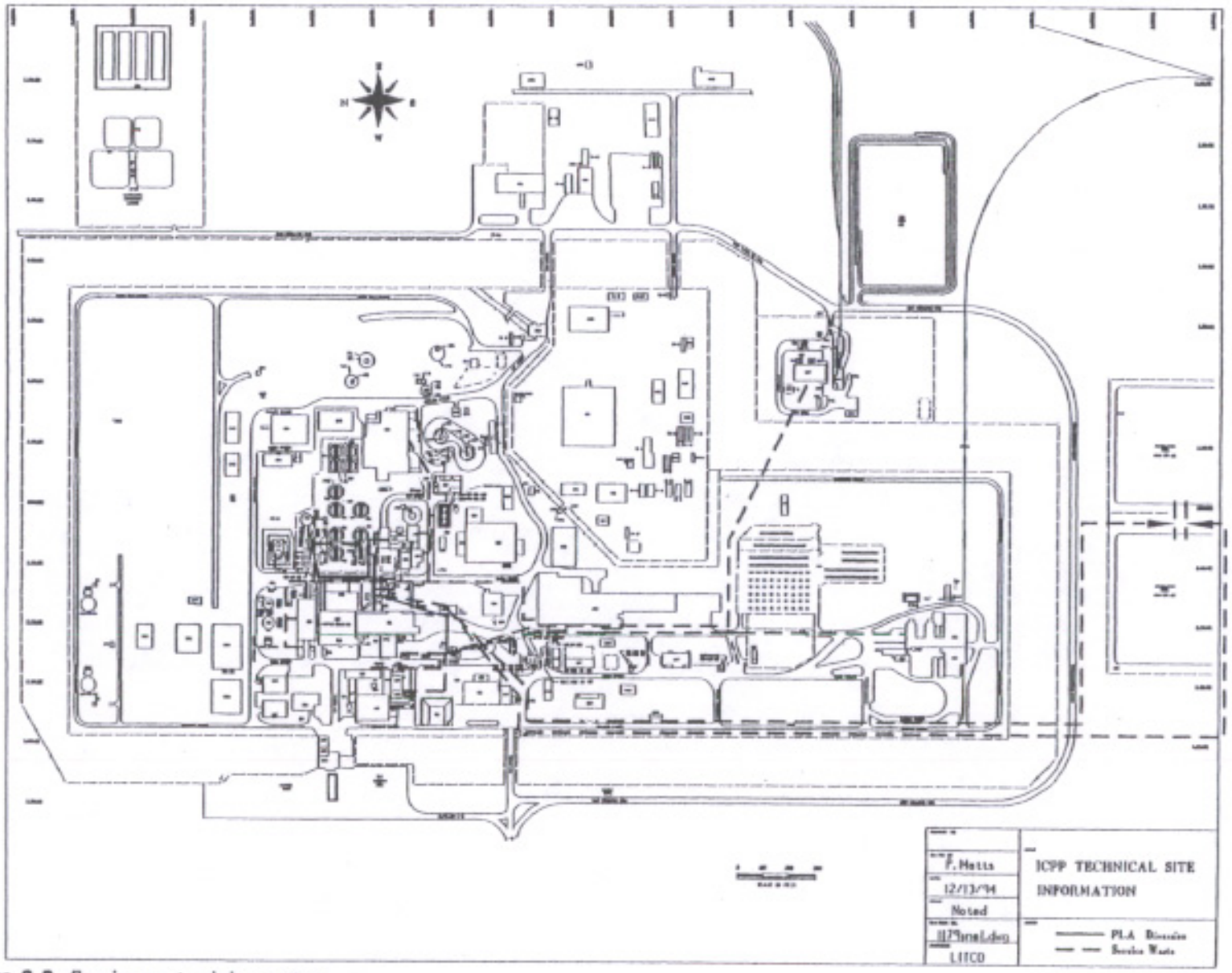


Figure 2-2. Service waste piping system.

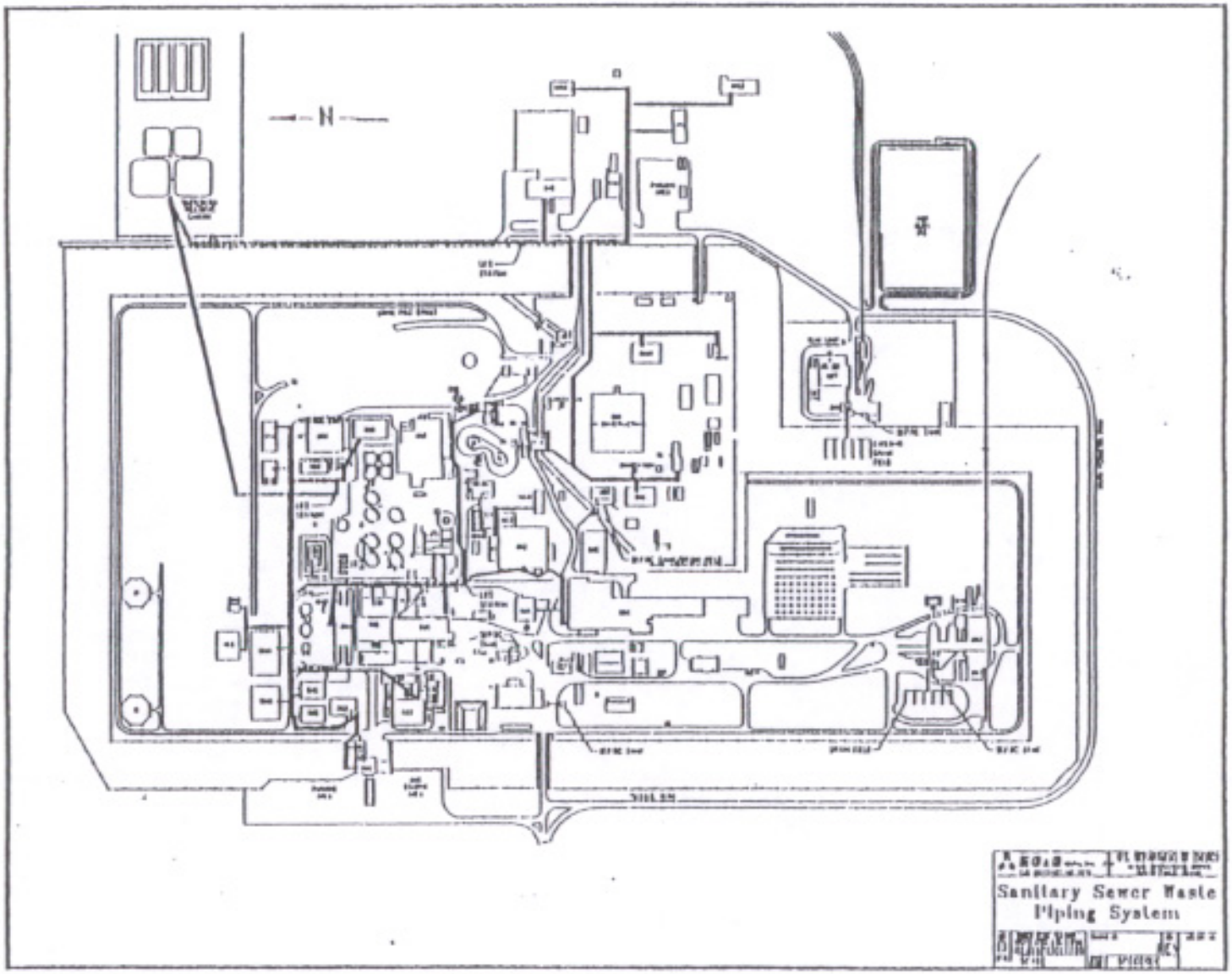


Figure 2-3. Sanitary sewer piping system.

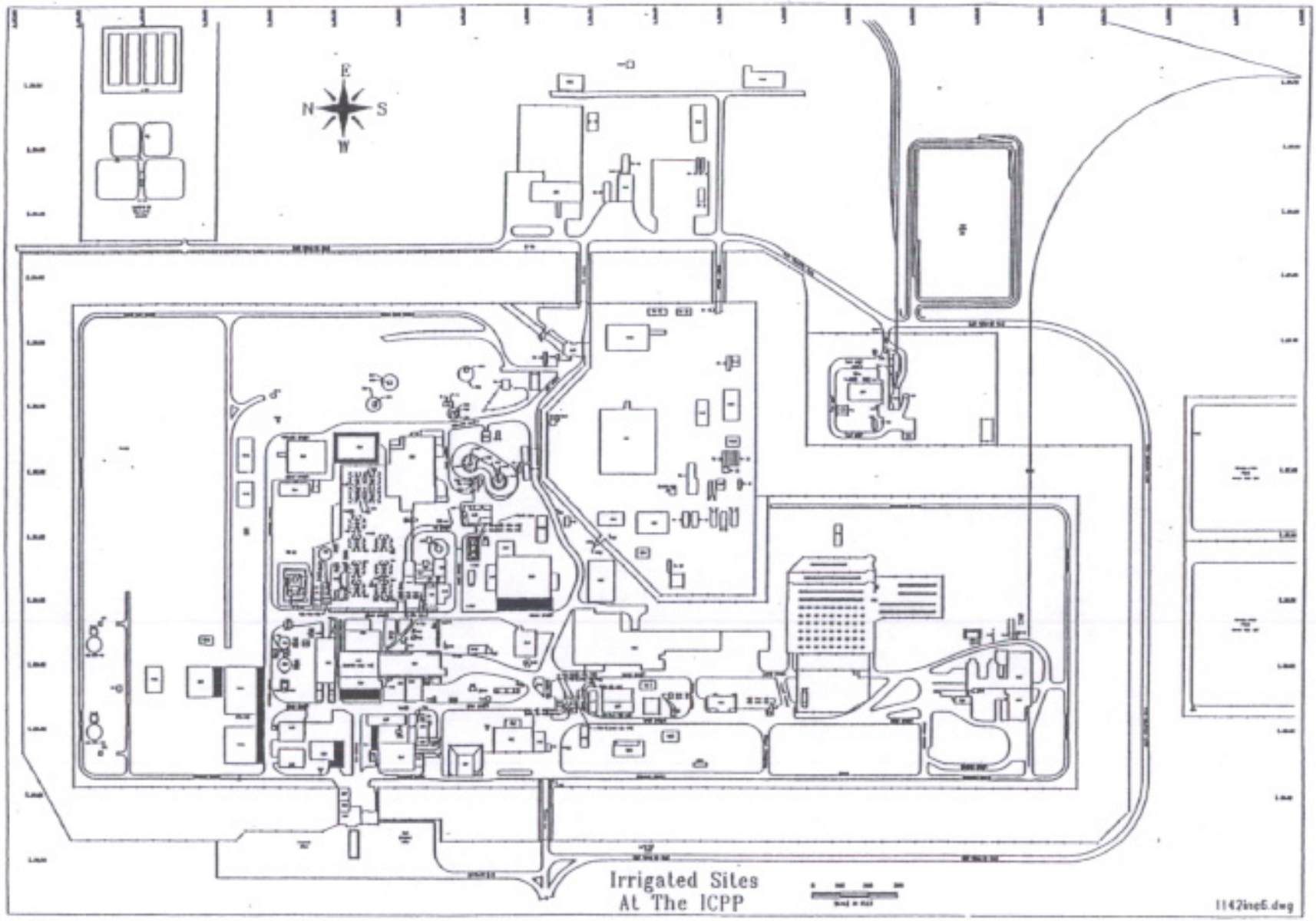


Figure 2-4. Historically irrigated sites at the ICPP.

and transporting those contaminants to the aquifer. The rate of seepage into the vaults is approximately 109,780 L/yr (29,000 gal/yr). Sources of this water were evaluated based on the pattern (constant, precipitation related, seasonal, or random) of seepage, chemistry of the water, location of the sources, and volume of water available for seepage from a particular source. The two most important sources of water for seepage were determined to be infiltration of precipitation and watering the lawn to the west of building CPP-699.

Infiltration of precipitation is a source of seepage for every vault except 781, which showed no seepage during the study period. The volume of water falling on the Tank Farm as precipitation is more than sufficient to provide the necessary volume of water, and the most likely pathway for the water to enter the vaults is seepage through the existing membrane at perforations made for pipes, risers, and valve boxes. Approximately 41% of the water seeping into the vaults comes from this source. The second most important source of seepage for the Tank Farm is watering the lawn. The volume of water from this source is slightly greater than that from precipitation, providing 47% of the seepage. However, this water only affects Vault 713. The pathway for movement of this water was not clearly identified by Richards (1994) because 9.1 to 12.2 m (30 to 40 ft) of lateral movement with only 0.9 to 1.2 m (3 to 4 ft) of vertical movement would be required. Movement of this landscape irrigation water along pipe encasements and drain lines is possible. The remaining 12% of seepage, or 13,476 L/yr (3,560 gal/yr), is from miscellaneous sources, such as leaky steam valves or leaks from valve seals in waste transfer lines. These small sources are not major contributors, but do contribute to seepage periodically.

2.3.2.2 ICPP Steam Condensate System. Subsequent to the Water Inventory Study, a perched groundwater investigation was undertaken in fiscal year (FY)-94. This study was intended to provide additional information about the northern perched groundwater system, including water chemistry and temperature, dissolved contaminant concentrations, depth, and saturated thickness. Temperature measurements in the perched groundwater ranged from 22.2°C (72.1°F) in Well MW-5 to 10.8°C (51.5°F) in Well MW-4. The elevated temperatures in the perched groundwater suggest that hot water sources may be contributing to the perched water system in some areas at the ICPP. Steam condensate drains located throughout the facility (Figure 2-5) are one of the major sources of hot water at the ICPP.

The ICPP steam system consists of two boiler plants (CPP-606 and -687), which supply steam to various buildings and installations throughout the ICPP. Steam condensate traps are located at low portions of the steam lines and these traps allow condensate water to exit the system. The volume of condensate at each trap depends on the length of the steam line the vent services and the heat loss in the steam line. A large portion of this steam distribution system is located in a utility tunnel housing a 30.5-cm (12-in.) steam line connecting CPP-606 to the coal powered generating plant (CPP-687). A total of 48 steam vent condensate drains are located in the utility tunnel. Condensate water drains to the subsurface. Generally, the steam is used in steam heater units, which are used to heat a majority of the buildings onsite. Steam usage is greatest during the heating season beginning in September and ending in April when an average flow rate of 280 L/min (74 gal/min) occurs in the system. Volumes of condensate water generated in the system depend on the heat load of the system, and estimates of the volume of condensate originating at steam heater units were based on 150 days at an ambient temperature of -7°C (20°F). The main steam line in the utility tunnel is active all year and condensate calculations for the steam condensate traps along this line were adjusted to reflect 365 days/yr of operation.

The volume of condensate from the steam heater units and the steam traps were estimated (Table 2-2). The largest contributors of waste steam condensate water to the ground are the steam heater units located in

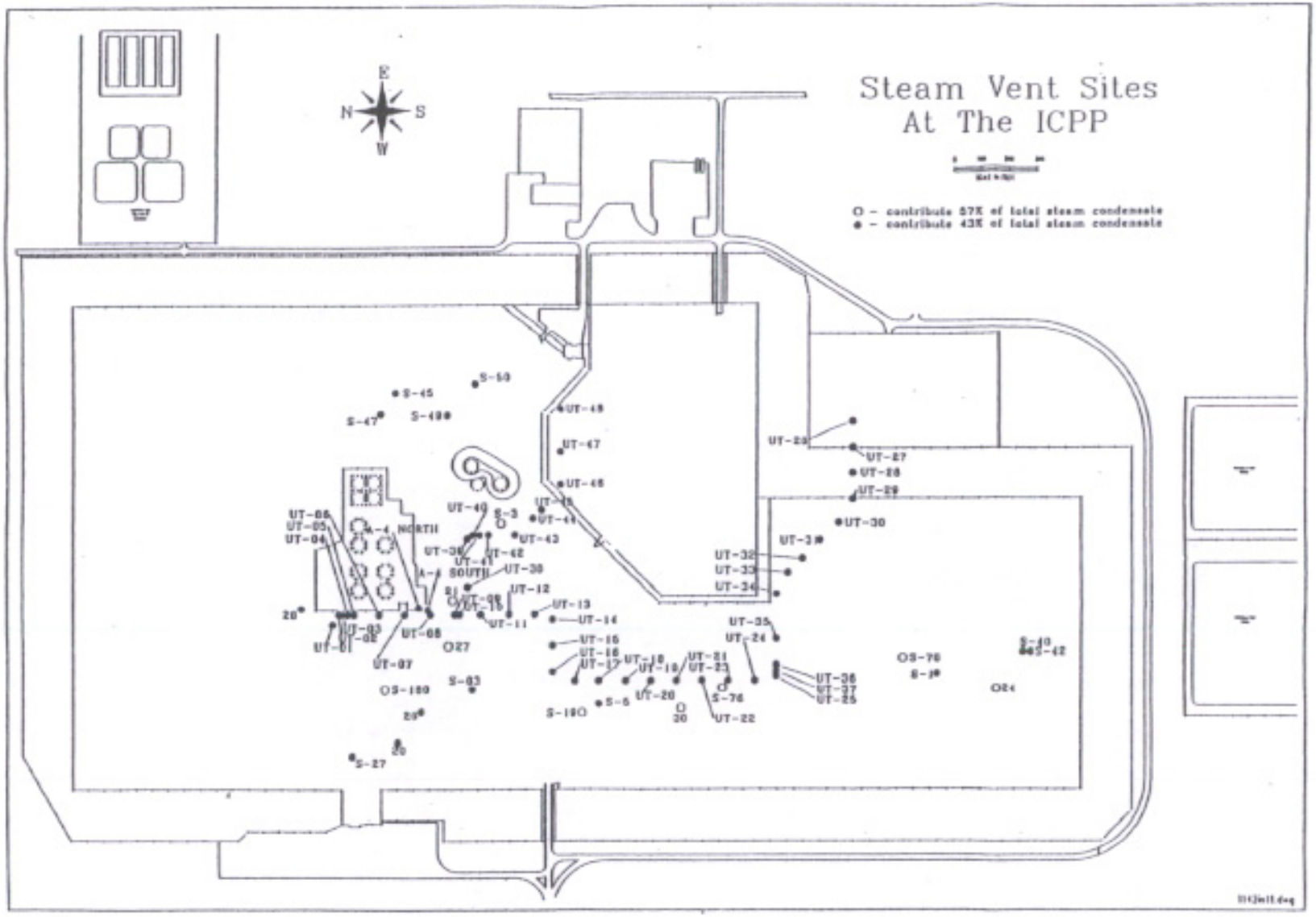


Figure 2-5. Steam condensate drains at the ICPP.

Table 2-2. Approximate discharge from the ICPP condensate drains.

STEAM VENT IDENTIFICATION	NORTHING COORDINATE	EASTING COORDINATE	VOLUME OF WATER IN GALLONS PER DAY	YEARLY VOLUME IN GALLONS
S-1	693405	296474	6	900
S-3	695098	297063	2160	324000
S-5	694707	296359	0	0
S-19	694774	296325	1344	201600
S-27	695682	296160	0	0
S-40	693067	296557	28	4200
S-42	693037	296557	5	750
S-45	695511	297568	8	1200
S-47	695568	297487	8	1200
S-49	695308	297482	8	1200
S-51	695200	297600	8	1200
S-63	695209	296416	15	2250
S-76	694229	296419	288	43200
S-78	693537	296533	144	21600
S-180	695551	296416	432	64800
20	695502	296213	28	4200
21	695286	296761	144	21600
24	693170	296417	1008	151200
26	695411	296330	28	4200
27	695302	296383	144	21600
28	695877	296728	28	4200
30	694389	296342	432	64800
A-4 NORTH	695419	296731	0	0
A-4 SOUTH	695385	296722	0	0
UT-01	695757	296665	35	12775
UT-02	695733	296704	23	8395
UT-03	695723	296704	8	2920
UT-04	695699	296704	10	3650
UT-05	695674	296704	26	9490
UT-06	695574.5	296704	43	15695
UT-07	695474	296704	43	15695
UT-08	695373	296704	42	15330
UT-09	695277.5	296704	25	9125
UT-10	695259	296704	43	15695
UT-11	695178.5	296704	42	15330
UT-12	695066	296704	46	16790
TU-13	694966	296704	42	15330
UT-14	694895	296683	42	15330
UT-15	694895	296584	43	15695
UT-16	694895	296484	47	17155
UT-17	694804	296448	46	16790
UT-18	694708	296448	43	15695
UT-19	694604	296448	44	16060
UT-20	694506	296448	45	16425
UT-21	694406.5	296448	45	16425
UT-22	694307	296448	43	15695
UT-23	694207	296448	43	15695
UT-24	694107	296448	44	16060
UT-25	694025	296466	30	10950
UT-26	693729	297452	52	18980
UT-27	693729	297352	43	15695
UT-28	693729	297252	43	15695
UT-29	693729	297152	43	15695
UT-30	693781	297061	43	15695
UT-31	693854	296992	43	15695
UT-32	693924	296921	39	14235
UT-33	693981	296865	39	14235

Table 2-2. (continued).

STEAM VENT IDENTIFICATION	NORTHING COORDINATE	EASTING COORDINATE	VOLUME OF WATER IN GALLONS PER DAY	YEARLY VOLUME IN GALLONS
UT-34	694025	296782	59	21535
UT-35	694025	296608	59	21535
UT-36	694025	296508	43	15695
UT-37	694025	296485	30	10950
UT-38	695229	296813	51	18615
UT-39	695229	297004	51	18615
UT-40	695208	297017.5	58	21170
UT-41	695181.5	297017.5	16	5840
UT-42	695148	297017.5	33	12045
UT-43	695042.5	297017.5	44	16060
UT-44	694973	297082	31	11315
UT-45	694938	297115	32	11680
UT-46	694863	297212	53	19345
UT-47	694863	297341	61	22265
UT-48	694863	297504	104	37960
TOTALS:			8279	1674645

some of the buildings around the site. These units produce a 3.8-L/min (1-gal/min) flow of condensate water for every 600,000 British thermal units (BTUs) of heat energy generated. The amount of condensate water generated at each steam condensate trap along the line in the utility tunnel is relatively low compared to the volumes generated by the steam heater units, but the number of these traps and drains make this a significant source of steam condensate that is discharged to the subsurface. The total annual volume of steam condensate discharged to the ground was estimated to be 6.32M L (1.67M gal). Of this volume, approximately 4.92M L (1.3M gal) are discharged in an area where the condensate could contribute to the northern perched water body.

2.3.2.3 CPP-603 Basins. CPP-603 consists of three reinforced concrete fuel storage basins connected by a transfer channel. The walls of the basins are 0.6-m (2-ft) thick and the floor is 1.5-m (5-ft) thick. The pools are 6.1-m (20-ft) deep and the water inventory is maintained at approximately 5.7M L (1.5M gal). The basin water treatment system consists of sand filters, a selective cation exchange system, and an ultraviolet sterilizer. Demineralized makeup water is provided from a reverse osmosis unit. The basin water contains a variety of soluble radionuclides and stable constituents. The radionuclides are removed by the basin water treatment system and the primary nonradioactive soluble ions that have accumulated in the basin water are sodium, calcium, chloride, and nitrate. Inspection of the accessible walls and floor of the basin do not indicate any cracking or other physical damage. The basin is unlined and several studies have been undertaken to estimate the quantity of water that may be leaking from the basin. These studies have estimated losses due to evaporation and have evaluated the basin water inventory.

Various methods of estimating water loss from the basin were evaluated. Measurement of the dilution of dissolved solids was used to estimate the basin water inventory because the method is direct and reasonably reliable. This method involves measurement of the dilution of a dissolved solid in the basin water as water is added to the basin to maintain the water level. The dissolved solid selected for measurement must not be removed by the basin ion exchanges system, the filter, or by contact with the basin walls and piping. Chloride was selected as the best candidate dissolved solid for monitoring. Cation concentrations can be affected by the basin ion exchange system and are not useful for determining the basin leak rate. Nitrate is also not useful because the ion is a known nutrient for basin microorganisms. Chloride is not a nutrient and is not affected by the basin water treatment systems. However, small amounts of chloride may be lost from corrosion of aluminum. The sludges on the basin floor are also known to contain undissolved chloride, but chloride in the sludges is likely to be in equilibrium with the water.

Dilution of chloride has been used in two basin water inventory studies. The first study was conducted from July 28, 1986, through August 3, 1987. In this study, the chloride concentration in the makeup water was assumed to be 10 parts per million (ppm) based on measurements of the concentration in ICPP well water. A loss rate of 379 L/day (100 gal/day) in excess of measured losses was estimated. The estimate was determined to have an error of approximately 100%. The second study calculated basin water inventory based on dilution of chloride during the period from May 3, 1993 to October 3, 1993. In this inventory, the total loss rate from the basin was determined to be 874 L/day (231 gal/day). Measured losses were determined to be 363 L/day (96 gal/day), leaving a discrepancy of 511 L/ day (135 gal/day) (estimated error has not been calculated). The evaporation rate from the pond was estimated to be 1,173 L/day (310 gal/day), which is consistent with a previous laboratory study estimate of 1,211 L/day (320 gal/day). The 511 L/day (135 gal/day) loss rate can be attributed to permeation through microcracks along the basin surface. Based on the two studies the best estimate for the loss rate is between 500–700 L/day. This loss rate is very small for a simple concrete structure as large as CPP-603 and is an indication the basin surfaces are in excellent condition.

2.3.2.4 Sewage Treatment and Percolation Ponds. The ICPP STP treats sanitary sewage from 31 permanent facilities at the ICPP, primarily consisting of wastewater from restrooms and cafeterias. All sanitary waste from the 31 permanent facilities is collected by gravity-flow lines and piped via lift stations to the STP for treatment. In addition, sanitary waste from nine ICPP buildings is collected and treated separately from the main STP.

The STP facility is located to the northeast of the enclosed ICPP plant area. It consists of two aerated lagoons, two quiescent facultative stabilization lagoons, four infiltration/percolation (I/P) trenches, and six weir boxes. The aerated lagoons are arranged in series and drain into facultative lagoons, which then overflow into the I/P trenches. The weir boxes route the wastewater through the lagoons and trenches. Maximum plant capacity is 454,200 L/day (120,000 gal/day), with an average flow of 159,000 L/day (42,000 gal/day). From 1984 to present, the monthly discharge to the sewage treatment ponds is provided in Table 2-3.

The service waste system collects, monitors, and samples nonradioactive, nonhazardous wastewater used in various plant activities and transfers it to one of the two percolation ponds located south of the ICPP for disposal. Percolation Ponds 1 and 2 are located outside the ICPP southern security fence, southeast of CPP-603. The percolation ponds are unlined ponds that were excavated from the surficial alluvium in 1982 and 1985. Percolation Pond 1 began receiving flow in 1984, but an inadequate percolation rate made it necessary to build Pond 2. The two ponds have been used alternately since then, receiving approximately [5.7 to 9.5M L/day (1.5 to 2.5M gal/day)] of service wastewater. From 1984 to present, the monthly discharge to the percolation ponds is provided in Table 2-4.

2.3.3 Big Lost River

The Big Lost River flows southeast from the Mackay Dam, through the Big Lost River Basin, past Arco, Idaho, and onto the Snake River Plain. The river flows onto the INEEL near the southwest boundary, curves to the northeast, and flows northward to its termination in the Big Lost River playas (Figure 1-1).

The Big Lost River basin includes parts of Custer and Butte Counties in south-central Idaho (Bennett, 1990). The drainage area of the river upstream of the INEEL is approximately 3,626 km^2 (1,400 mi^2). Of the 2,305 km^2 (890 mi^2) within the boundaries of the INEEL, only 181 to 207 km^2 (70 to 80 mi^2) contribute surface runoff of any significance to the Big Lost River. Noncontributing areas of the Big Lost River basin within the INEEL consist of small topographically closed basins 2.6 to 26 km^2 (1 to 10 mi^2) in area. Land surface altitudes of the drainage area range from 1,457 m (4,780 ft) above sea level at the terminal playas to 3,858 m (12,656 ft) at Borah Peak in the Lost River Range. The channel of the Big Lost River is incised about 18.3 m (60 ft) into the basalt of the Snake River Plain at a point 1.6 to 3.2 km (1 to 2 mi) downstream from the gauging station near Arco. After reaching the western boundary of the INEEL, the river emerges from the narrow, 61- to 91-m (200- to 300-ft) wide, canyon into a broad plain where it is incised less than 6.1 m (20 ft). The river is incised less than 3 m (10 ft) near Highway 20 and downstream from the highway, the river enters a broad floodplain that ranges in width from 1.6 to 6.4 km (1 to 4 mi). This floodplain is characterized by remnants of old meander channels. Ultimately, the main channel branches into many small channels and flow spreads across several ponding areas, or playas, known as the Big Lost River Sinks. Playas 1 and 2 have an elevation of 1,459 m (4,788 ft) and surface areas of about 350 and 110 acres, respectively. Playas 3 and 4 are at an altitude of 1,457 m (4,780 ft) and have surface areas of 1,000 and 1,350 acres, respectively.

Table 2-3. Monthly discharge of the sewage treatment ponds (RWMIS database).

	Jan.	Feb.	March	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.	Total
1984	0.7	0.6	0.5	0.6	0.7	0.5	0.6	0.6	0.6	0.5	0.6	0.6	7.1
1985	0.6	0.6	0.7	0.6	0.6	0.6	0.6	0.5	0.6	0.6	0.6	0.1	6.5
1986	0.8	0.8	0.9	0.9	0.8	0.7	0.9	0.8	0.8	0.7	0.8	0.8	9.6
1987	0.8	0.8	0.8	0.8	0.8	0.7	0.7	0.7	0.6	0.7	0.8	0.8	9.0
1988	0.9	0.8	0.8	0.8	0.8	0.7	0.7	0.7	0.8	0.7	0.7	0.8	9.2
1989	0.8	0.9	0.9	0.8	0.8	0.8	0.7	0.7	0.7	0.9	0.8	0.9	9.7
1990	0.8	1.0	0.9	0.8	0.9	0.9	1.0	1.1	1.1	0.9	0.9	0.9	11.3
1991	1.2	1.1	0.8	0.9	0.8	0.8	0.9	0.7	0.8	0.7	0.9	1.2	10.8
1992	0.9	1.5	1.6	1.5	1.5	1.3	1.3	1.6	1.7	2.0	2.2	1.7	18.7
1993	1.1	1.2	1.1	1.2	1.1	1.2	1.4	0.6	0.8	1.2	1.2	1.1	13.1
1994	3.1	1.4	ND	1.9	4.4	5.9	3.2	2.0	1.4	1.0	1.6	2.0	(27.92)
1995	2.5	1.3	2.3	2.2	3.1	1.3	0.1	1.8	1.3	ND	ND	ND	(15.75)

( ) - indicates incomplete record.
Discharge in millions of gallons.

Table 2-4. Monthly discharge to percolation ponds (RWMIS database).

	Jan.	Feb.	March	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
1984	ND	ND	42.1	45.4	52.5	53.1	45.0	47.2	41.8	41.3	37.6	38.9	(444.9)
1985	29.9	36.7	36.4	0.6	31.5	41.9	39.3	43.4	60.0	58.5	17.4	57.6	453.23
1986	54.1	46.7	40.8	50.1	45.0	47.3	50.2	50.6	43.7	49.7	49.3	48.1	575.56
1987	51.9	50.7	47.9	50.4	51.8	52.1	51.4	50.8	49.5	49.7	46.6	47.1	599.90
1988	53.3	49.4	47.1	51.4	47.4	50.3	48.2	48.3	42.5	44.9	41.2	41.5	565.50
1989	36.2	40.2	39.0	36.9	29.8	35.9	33.0	33.2	37.9	36.7	37.6	43.4	439.80
1990	46.7	45.1	38.7	51.5	59.9	62.4	57.3	55.7	62.5	50.9	47.4	44.3	622.40
1991	45.6	44.4	38.0	44.6	45.6	44.0	49.3	48.1	52.7	48.6	49.2	46.3	556.43
1992	55.5	58.7	52.6	57.5	48.1	43.6	47.5	54.2	57.8	54.6	58.8	53.6	642.50
1993	58.2	57.1	62.9	60.2	56.1	59.2	53.1	53.9	50.9	48.6	49.8	54.8	664.80
1994	55.5	40.8	54.9	49.6	48.7	40.0	35.2	37.8	40.2	37.3	40.1	39.1	519.20
1995	39.5	40.8	38.0	58.0	46.1	35.9	35.6	45.3	3.8	ND	ND	ND	(342.98)

() - indicates incomplete records.

Discharge in millions of gallons.

Storage and diversion systems on the Big Lost River include the Mackay Dam, several irrigation diversions, and the INEEL flood diversion dam. The Mackay Dam is a 435.9-m (1,430-ft) long, 24.1-m (79-ft) high earthfill dam built for the Big Lost River Irrigation District. The dam was completed in 1918 and is located 6.4-km (4-mi) northwest of the town Mackay. The dam has a storage capacity of 5.49 $\times 10^7$ m^3 (4.45×10^4 acre-ft) of water. The dam is used to impound water for irrigation in the Big Lost River Irrigation District. Water from the Big Lost River is used to irrigate about 57,500 acres of land downstream from the Mackay Reservoir and another 10,200 acres of land are subirrigated upstream from the reservoir (Harenberg et al., 1987).

The INEEL flood diversion system, located approximately 10.5-km (6.5-mi) downstream from the western INEEL boundary, was built in 1958 to divert high flows on the Big Lost River away from INEEL facilities. During the winter months, most of the flow in the river is diverted to avoid accumulation of ice in the channel, thus reducing the possibility of flooding at downstream INEEL facilities. The system consists of a small earthen diversion dam and headgate that diverts water from the main channel, through a connecting channel, and into a series of four natural depressions, called spreading areas. The capacity of the spreading areas is about 7.2×10^7 m^3 (5.8×10^4 acre-ft) at an elevation of 1,539 m (5,050 ft) mean sea level. An overflow weir in Spreading Area D allows water to drain southwest off the INEEL. Runoff from the Big Lost River has never been sufficient to exceed the capacity of the areas and overflow the weir.

Carrigan (1972) modeled the capacity of the INEEL flood diversion system as it existed in 1972 and concluded the system was inadequate for long period floods. The diversion system was upgraded in 1984 in response to a flood risk that occurred in late 1983 and early 1984 (McKinney, 1985). The present diversion system has a total diversion channel capacity of up to 263.3 m^3/s (9,300 ft^3/s). The existing diversion channel can carry 203.9 m^3/s (7,200 ft^3/s). The ICPP area has not been flooded since construction of the diversion system.

Gauging stations are located upstream and downstream of the Mackay Reservoir to monitor discharge. Additional stream gauging stations are maintained on the Big Lost River by the U.S. Geologic Survey (USGS), including a station where the river is crossed by Lincoln Boulevard on the INEEL. Flow in the river is highly variable with peak flows occurring in June and July due to snowmelt (Table 2-5). Generally, there is no flow in the river during the winter months.

The Big Lost River flow is perennial upstream from a point a few miles southeast of Arco. Downstream, the flow is lost by infiltration through the river bottom, and the point where flow ceases depends on discharge and the infiltration conditions of the channel. Infiltration rates are greatest when the channel is initially wetted and the hydraulic head is at a maximum. Flow in the river may not reach the western boundary of the INEEL or may continue as far north as Playa 4. Losses in streamflow also result from evaporation and transpiration. These losses are small by comparison to losses due to infiltration. The intermittent flow of the river does not encourage growth of vegetation along the periphery, which minimizes transpiration. Annual net evaporation from large water surfaces in the ESRP is 84 cm/yr (33 in./yr) (Stearns et al., 1938). Using this evaporation rate, Harenberg et al. (1987) calculated the maximum possible evaporation for the 71-km (44-mi) stretch from Arco to the playas would be less than 900 acre-ft/yr. The river is also generally dry during periods of peak evaporation so actual losses are lower. During the period from 1965 to 1987, losses due to evapotranspiration and infiltration in the 18-km (11-mi) stretch between the INEEL diversion dam and Lincoln Boulevard averaged 9,820 acre-ft/yr. During this period there was no flow 28% of the time at the diversion dam and 49% of the time at Lincoln Boulevard. Since 1987, the Big Lost

Table 2-5. Monthly discharge of the Big Lost River at Lincoln Boulevard near the ICPP (acre-feet).

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
1965[a]	0	0	2,380	10,300	15,400	29,600	31,100	16,900	10,900	0	0	0	116,580
1966	0	0	0	3,660	981	0	0	0	0	0	0	0	4,641
1967	0	0	0	0	2,030	20,180	18,376	4,400	9,050	8,740	0	0	62,776
1968	0	0	2,280	3,390	16	524	0	1,053	1,130	3,290	4,500	0	16,183
1969	0	0	0	3,960	33,000	33,500	21,800	4,780	9,840	6,710	3,290	0	116,880
1970	0	0	501	1,650	793	13,800	17,700	1,510	6,080	5,280	4,750	8	52,072
1971	0	0	0	10,600	12,300	17,200	20,800	7,760	13,400	14,400	13,100	0	109,560
1972	0	0	1,540	4,920	504	1,710	861	84	2,990	3,520	3,099	0	19,228
1973	0	0	0	2,830	405	0	0	0	0	0	0	0	3,235
1974	0	0	3,240	5,520	6,940	16,200	9,390	1,170	1,160	3,760	4,200	0	51,580
1975	0	0	0	3,180	12,000	12,100	18,700	3,560	6,520	8,210	7,990	0	72,260
1976	0	0	333	1,450	1,660	1,120	0	0	300	620	1,100	76	6,659
1977	0	0	0	0	0	0	0	0	0	0	0	0	0
1978	0	0	0	0	0	0	0	0	0	0	0	0	0
1979	0	0	0	0	0	0	0	0	0	0	0	0	0
1980	0	0	0	0	0	0	1,140	0	0	0	0	0	1,140
1981	0	0	0	1,300	5,092	7,560	0	0	0	0	0	0	13,952
1982	0	0	0	5,930	17,200	13,400	15,100	4,820	8,190	10,500	5,740	600	81,480
1983	600	600	900	12,800	15,800	18,900	18,200	9,780	7,320	6,200	5,660	1,200	97,960
1984	1,200	1,200	1,200	2,200	2,320	4,550	3,950	5,790	5,140	5,980	8,710	2,120	44,360
1985	3	0	0	7,170	6,430	0	0	0	9,950	10,707	1,275	0	35,535
1986	0	96	537	8,370	14,825	20,315	2,900	1,016	14,753	8,220	1,190	2	72,224
1987	0	0	531	491	0	0	0	0	0	0	0	0	1,022
1988[b]	0	0	0	0	0	0	0	0	0	0	0	0	0
1989	0	0	0	0	0	0	0	0	0	0	0	0	0
1990	0	0	0	0	0	0	0	0	0	0	0	0	0
1991	0	0	0	0	0	0	0	0	0	0	0	0	0

Table 2-5. (continued).

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
1992	0	0	0	0	0	0	0	0	0	0	0	0	0
1993	0	0	0	0	0	5,116	0	0	0	0	0	0	5,116
1994	0	0	0	0	0	0	0	0	0	0	0	0	0
1995	0	11	0	0	0	16,010	22,310	955	0	NA	NA	NA	—

a. Monthly discharge volume for 1965 to 1988 from Bennett 1990, Streamflow Losses and Ground Water Level Changes Along the Big Lost River at the Idaho National Engineering Laboratory, Idaho. USGS Water-Resources Investigations Report 90-4067.

b. Monthly discharge data for 1988 to 1994 from the USGS.

NA—Not available.

River has been dry on the INEEL with the exception of brief periods in 1993, 1995, and 1996. Flows have reached Playa 1 in 24 of the 77 years since the construction of the Mackay Reservoir in 1917.

The ICPP is located on the alluvial plain approximately 61.0 m (200 ft) from the Big Lost River channel near the point where the channel intersects with Lincoln Boulevard on the INEEL. The elevation of the Big Lost River channel immediately northwest of the ICPP is 1,495 m (4,908 ft), and the elevation of the river bank or berm is 1,497.1 m (4,912 ft). The average elevation of the ICPP is 1,498.7 m (4,917 ft).

The INEEL diversion system diverts water from the Big Lost River during periods of high flow. The diversion dam across the Big Lost River permits the passage of less than 900 cubic feet per second during floods (Bennett, 1986), and the river channel near ICPP can accommodate this flow. The maximum diversion capacity of the INEEL diversion system is up to 9,300 cubic feet per second, well above the 100-year flood stage (Bennett, 1986). The Big Lost River poses no flood threat to the ICPP as it flows northeast to its termination in the playas.

2.3.3.1 Aquifer Recharge from the Big Lost River. In 1985, flow in the SRPA at the INEEL was to the southwest and the gradient was about 0.8 m/km (4 ft/mi) (Bartholomay et al., 1997). The direction of flow is locally affected by recharge and discharge. Recharge at the INEEL is primarily the result of underflow from the northeastern part of the plain and the Big Lost River. During periods of high flow, local groundwater levels and the direction of groundwater flow can be temporarily altered by recharge from the river. In periods of low flow in the Big Lost River, local gradients reflect regional flow directions.

The altitude of water levels and configuration of the water table in the SRPA vary in response to changes in the volume and source of recharge. Water levels peaked in the early 1970s during a prolonged period of above average precipitation and high flows in the Big Lost River beginning in 1965. Water levels subsequently declined during a period of average or below average precipitation and stream flow beginning in 1976 and continuing through the early 1980s. No flows were recorded at Lincoln Boulevard on the INEEL during the period from 1977 through 1979 and small flows were recorded in 1 month of 1980 and 3 months of 1981. Measured water levels in USGS monitoring wells rose during the period from 1981 through 1985, corresponding with a period of flow in the Big Lost River Channel.

During the period from 1972 to 1978, water levels declined as much as 3.0 m (10 ft) near the Radioactive Waste Management Complex (RWMC) spreading areas and north of the Naval Reactors Facility (NRF). During the same period, water levels in the eastern part of the INEEL, where water levels are probably influenced least by flows in the Big Lost River and other surface water recharge sources, declined about 1.5 m (5 ft). The net increase in the regional water table during the period from 1981 to 1985 reflected a change in the volume of water available for recharge during a comparatively wet period following 3 years of no flow in the river. The water table in the vicinity of the RWMC rose as much as 4.9 m (16 ft) in response to recharge from water diverted to the spreading areas. Water levels rose as much as 3.7 m (12 ft) in the vicinity of the NRF and about 1.5 m (5 ft) in the eastern INEEL. Water levels at the Test Area North (TAN) declined less than 0.3 m (1 ft) during the first period, but rose as much as 1.2 m (4 ft) during the period of high flow. Between the period 1989 to 1991, water levels declined because there was no stream flow in the Big Lost River below Arco and because of a general decline in recharge to the aquifer. From 1991 to 1995, water levels generally decline throughout the INEEL because of drought conditions that began in 1987. Water level declines ranged from about 8.5 ft in wells in the west-central part of the INEEL to about 2.5 ft. in wells in the southern part. The water level decline in the west-central part of the INEEL is attributed to lack of recharge from the Big Lost River.

Changes in water levels in wells in the vicinity of the Big Lost River sinks correlate with flows that were recorded at the gauging station at Lincoln Boulevard. Groundwater levels rose rapidly during periods of high stream flow and declined during periods of decreased or no flow. Groundwater levels in the areas southwest of the RWMC and north of the NRF are significantly affected by recharge from the Big Lost River. These areas correspond with the spreading areas and sinks.

From 1964 through 1994, water levels in USGS monitoring wells near the ICPP rose in response to periods of flow on the Big Lost River (Figure 2-6). Periods of high flow on the river correspond to periods of rising water levels in the monitoring wells. Peak water levels in the wells occurred approximately 1 year after each period of high flow in the river. Although infiltration of precipitation would contribute to water levels in the wells and river flows would be expected to be greater in years with higher precipitation, infiltration of water from the Big Lost River channel appears to be the major cause of increased water table elevation along the channel during periods of high flow.

2.3.4 Summary of Surface Water Recharge

The ICPP uses approximately 7.9M L (2.1M gal) of water per day. Water is supplied by two raw water wells and two potable water wells located in the northern portion of the facility. The primary water systems at the ICPP include raw water, fire water, treated (softened) water, demineralized water, steam condensate, landscape watering, potable water, service waste (industrial wastewater), and sanitary waste systems (Table 2-6). Piping systems external to facility buildings are either buried or enclosed in utility tunnels. Based on the primary water systems, approximately 2.9B L (767M gal) of water are distributed throughout 23 km (14 mi) of piping annually at the ICPP.

A Water Inventory Study (Richards, 1994) was performed at the ICPP to determine whether water was leaking from the plant's water supply and wastewater systems in sufficient quantities to support the perched water bodies beneath the plant (which have no readily apparent source). A thorough evaluation of the primary piping systems was performed and leaks were discovered on the fire water and potable water systems. The fire water system was found to have a year-round leak of 15 L/min (4 gal/min) and an additional leak of 45.4 L/min (12 gal/min) in a branch connection that was only used periodically. The potential loss from the fire water systems was determined to be 14.8M L/yr (3.9M gal/yr). The potable water system was found to have a small leak of 0.57 L/min (0.15 gal/min), which would provide approximately 299,000 L/yr (79,000 gal/yr) of potential recharge to the perched water systems. These leaks have been repaired, but historically provided nearly 15.1M L/yr (4M gal/yr) of potential recharge to the perched water bodies. A potential exists that other unknown leaks are present in the 23 km (14 mi) of piping. For example, even if the metering could measure the flow throughout the plant to a 5% accuracy, an annual loss of 145M L (38.4M gal) could go undetected.

Another source of recharge to the perched water bodies is the subsurface injection of waste steam condensate. The steam condensate piping system has a length of 1,280 m (4,200 ft) and an average flow of 280 L/min (74 gal/min.) between September and April. Primary steam use occurs between these months due to seasonal demands such as heating and freeze protection. The total annual volume of steam condensate discharged to the ground was estimated to be 6.4M L (1.7M gal). Of this volume, it is estimated that 4.9M L (1.3M gal) are discharged in an area where the condensate could contribute to the northern perched water body.

The seven landscape watering systems are all located in the northern ICPP and cover a total area of approximately 1.5 acres. It is estimated 75,710 L/day (20,000 gal/day) of water are used to maintain lawns

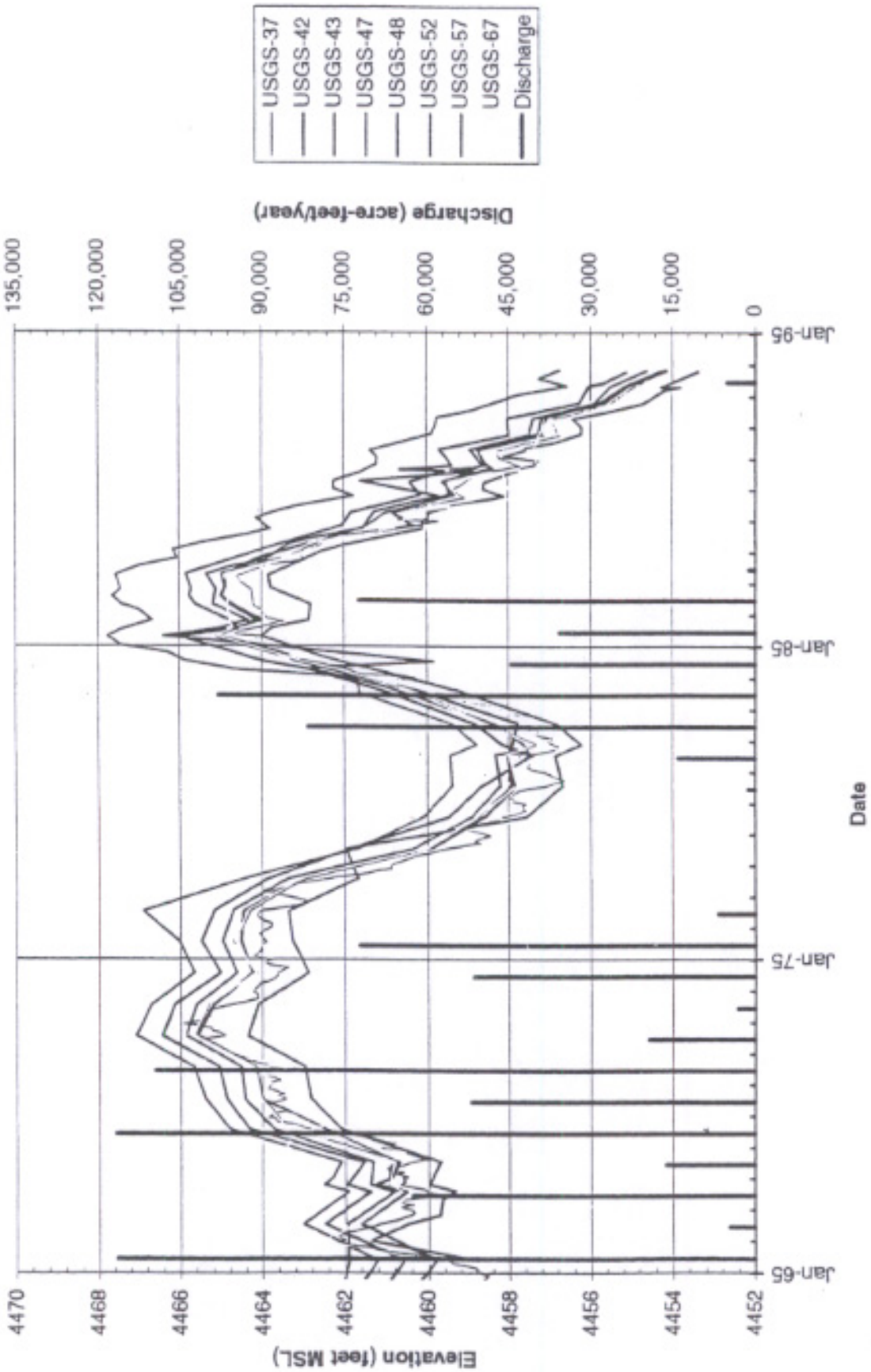

USGS-37
USGS-42
USGS-43
USGS-47
USGS-48
USGS-52
USGS-57
USGS-67
Discharge
Discharge (acre-feet/year)
135,000
120,000
105,000
90,000
75,000
60,000
45,000
30,000
15,000
0
Elevation (feet MSL)
4470
4468
4466
4464
4462
4460
4458
4456
4454
4452
Jan-65
Jan-75
Jan-85
Jan-95
Date

Table 2-6. Primary water systems at ICPP.

System	Estimated annual flow (gallons)	Length of piping
Raw	200,000,000	1,905 m (6,250 ft)
Fire	24,000,000	8,049 m (26,400 ft)
Treated (softened)	470,000,000	1,219 m (4,000 ft)
Demineralized	790,000	1,280 m (4,200 ft)
Steam condensate	39,000,000	1,280 m (4,200 ft)
Potable	32,000,000	3,220 m (10,560 ft)
Service	690,000,000	3,863 m (12,670 ft)
Sanitary	15,000,000	2,415 m (7,920 ft)
Total	1,470,000,000[a]	20,132 m (76,200 ft) (14.4 mi)

a. Annual flow is approximately twice the estimated 7.9M L (2.1M gal) of water used daily because the annual flow is based on both the process end and the waste disposal (i.e., service and sanitary wastewater).

and landscaping at the ICPP during the summer months. Annually, a total volume of 8.9M L (2.35M gal) is used to water ICPP lawns. Consumptive use was calculated to require 2,967,760 L/growing season (784,000 gal/growing season). Subtracting the consumption and evapotranspiration from the supplied water yields a net volume of approximately 5.94M L (1.57M gal) available for infiltration and recharge of the perched water bodies.

Natural recharge from precipitation is also available to support perched water bodies. Long-term average annual precipitation at the INEEL is 22.1 cm (8.7 in.) and pan evaporation is on the order of 109 cm/yr (43 in./yr). Nevertheless, water from snowmelt or heavy rains may infiltrate to a depth where it cannot be evaporated. Furthermore, many areas within the ICPP are impervious and precipitation runs off to drainage ditches. The ditches are unlined and a significant fraction of infiltration is likely to occur along the ditches. Estimates of net recharge from precipitation range from 2.5 to 10.2 cm (1 to 4 in.) (Miller et al., 1990), with 4.1 cm/yr (1.6 in./yr) being considered to be the best estimate for net infiltration to be used at the ICPP. Infiltration may actually be greater due to the impervious areas, drainage ditches, and infiltration ponds used to collect runoff. Using a net infiltration rate of 4.1 cm/yr (1.6 in./yr) and assuming the recharge area for the entire ICPP to be approximately 184 acres provides an estimate of 30M L (8M gal) of water available for recharge from natural precipitation. For the northern perched water bodies, approximately 14.3M L (3.8M gal) of recharge is available due to precipitation using an area of 87 acres. Approximately 15M gal/yr are discharged into the infiltration galleries of the new sewage treatment plant in the northeastern corner of the facility. Finally, the largest source of recharge to the southern portion of the facility is due to approximately 690M gal/yr of service waste water discharge to the 2 service waste percolation ponds.

A summary of the amount of water available to recharge the perched water bodies at the ICPP is provided in Table 2-7. Historically, approximately 2.73 billion L/yr (720M gal/yr) are known to be providing recharge at the ICPP. This does not include an additional 145M L (38.4M gal) that could be leaking through the facility piping and go undetected by the current metering system.

Table 2-7. Estimated volume of water recharging the perched water bodies at ICPP.

	Northern ICPP		Facility-wide	
Source	Volume (gal/yr)	Percent	Volume (gal/yr)	Percent
Service wastewater	None	0	690,000,000	95.8
Sewage treatment ponds	15,000,000	58	15,000,000	2.1
Water system leaks[a]	3,980,000	16	3,980,000	0.6
Landscape irrigation[a]	1,568,000	6	1,568,000	0.2
Precipitation infiltration	3,800,000	15	8,000,000	1.1
Steam condensate	1,300,000	5	1,700,000	0.2
CPP-603 Basins	None 0.00	0.0	49,275	<0.1
Total	25,648,000	100	720,297,275	100

a. Estimate based on past leaks and irrigation practices. Actual loss from piping leaks is unknown.

2.4 Geology

The following geologic description is summarized from *Lithology and Stratigraphy at the Idaho Chemical Processing Plant* [Attachment 2 of LITCO (1995)]. This technical memorandum includes the data used for the interpretation, an explanation of interpretive methods, and lithologic descriptions of each geologic unit.

2.4.1 Regional Geology

The INEEL is located in south-central Idaho on the Snake River Plain. The Snake River Plain is commonly divided into two regions: a western region, which is a northwest trending depositional basin, and an eastern region, which is a northeast trending volcanic plain (Malde, 1991). The INEEL is located in the eastern region of the Snake River Plain. This volcanic plain is comprised of approximately 914 m (3,000 ft) of layered late Cenozoic basalt flows over a rhyolitic basement that is approximately 3,048 m (10,000 ft) deep (Malde, 1991).

The ESRP is approximately 322-km (200-mi) long and ranges between 80 and 113 km (50 and 70 mi) in width (Anderson, 1991). It is bounded on the west by the north flowing reach of the Snake River through the Hagerman Valley and on the east by the Island Park rhyolite deposits. The northern and southern boundaries consist of the basin and range mountains of south central Idaho (Malde, 1991).

2.4.1.1 Origin of the Snake River Plain Volcanics. The crustal structure of the Snake River Plain volcanics, although not completely understood, is believed to include the entire thickness of the crust (Malde, 1991). It is believed the crust beneath the plain was modified by a hotspot (Malde, 1991). This theory is supported by numerous geophysical studies (Malde, 1991).

The geophysical studies suggest the crust beneath the plain is approximately 3.1-km (1.9-mi) thick as opposed to the crust surrounding the plain, which is approximately 20.0 km (12.4-mi) thick (Malde, 1991). There is geophysical evidence that a shallow source of heat exists at approximately 12.1 km (7.5 mi) below the surface (Malde, 1991). Heat flow measurements and volcanic activity suggest either the hotspot has progressed in a northeast direction or the crust has moved in a southwest direction resulting in the hotspot being presently associated with Yellowstone National Park (Malde, 1991). The absence of Paleozoic rocks within the ESRP is explained by Malde (1991), who suggests the hotspot produced mafic intrusions causing the granitic crust to melt from below, which resulted in a thinning of the crust and the formation of silicic magma bodies. These silicic magma bodies would have resulted in the formation of granitic batholiths, which would effectively displace any Paleozoic rock, leaving only the silicic magma and the underlying mafic intrusion as the only source materials for the formation of the ESRP. As the silicic magma erupted to the surface, the rhyolitic rocks found beneath the basalt were deposited. The violent silicic eruptions would have opened passage ways for the mafic magma to move through, eventually resulting in the basalt flows that now make up the ESRP.

2.4.1.2 Basalt Flow Structure. Greeley (1982) proposed the term "basalt plain" to describe the basaltic region of the ESRP. According to Greeley, a basalt plain combines elements of shield volcanoes and flood basalt plateaus.

The ESRP is composed of multiple thin flows erupted from vents aligned on volcanic rift zones. Two types of basalt are commonly erupted on the ESRP: a form known as *pahoehoe*, which is a very fluid, low-viscosity magma that produces thin tongues and lobes, and *aa*, which is a high-viscosity magma that results in blocky angular flows. A third "hybrid" type of basalt is also found among the lava flows of the ESRP. It is suggested it was formed by magma interacting with crustal rocks at depths of about 31 km (19 mi) (Malde, 1991).

As suggested by Greeley (1982), pahoehoe is the dominant type of basalt that erupted on the Snake River Plain, which forms the long, low angle flanks of the low shield volcanoes. The eruption of an aa lava produces the higher angle slopes surrounding the vents. As the eruption of the basalt continued over time, several low shield volcanoes formed, their flanks overlapping, to produce the complex stratigraphy found within the Snake River Plain.

2.4.1.3 Flows, Flow Units, Flow Groups. A lava flow is generally defined as a solidified body of rock that has been extruded out horizontally across the earth's surface from a fissure or vent. A lava flow may be described as a flow, which refers to the overall body of rock; a lava flow may also be described as a flow unit that is defined as a separate distinct lobe that issues out from a flow, or a lava flow may be described as a flow group, which is a sequence of petrographically similar flows that erupted from the same magma chamber (Anderson and Lewis, 1989). Between lava flows there is a contact that represents a cooling surface between flows. The cooling surface is typically marked by an increase in the number of vesicles and fractures in the rock as well as a significant amount of oxidation. There may also be a layer of sediments between flows. Commonly these sediments are referred to as interbeds.

The sediment or interbed sources may be other volcanic activity or alluvial, lacustrine, and eolian types of sediments. The sediment thickness depends on the location of the deposition, time between eruptions, and type of sediments.

2.4.1.4 Volcanic Features Near the INEEL. Several volcanic features exist on the Snake River Plain in the vicinity of the INEEL; these features make up a series of volcanic rift zones. To the west of the INEEL is the Arco Volcanic Rift Zone, to the south is an arc of volcanic vents and rhyolitic domes, the largest of which is Big Southern Butte, which is dated at about 300,000 years ago (Spear and King, 1982). This arc of volcanic features is called the Axial Volcanic Zone. To the east of the INEEL is the Hells Half Acre Rift Zone, which trends northwest to southeast. These volcanic zones are thought to be the sources of much of the basalt that has flowed out onto the Snake River Plain.

2.4.1.5 Surficial Sediments. A summary of Kuntz et al. (1990) of the surficial sediments deposited on the surface of the Snake River Plain follows:

> "The surficial sediments deposited on the surface of the plain in the vicinity of the INEEL are composed of alluvial, lacustrine, and eolian deposits. During the Pleistocene times, streams originating in the mountains north of the plain carried large volumes of sediments and deposited them in the mouths of the stream valleys as huge alluvial fans. Some sediments were carried out into the basins below the mountain ranges to form broad gravel plains. In addition to the sediments deposited by the regular workings of the mountain streams, some sediments were distributed through large floods that moved across the plain. There was also a large lake that formed during the Pleistocene time that covered much of the northeast portion of the INEEL. The lake has been named Lake Terreton. Sediment was also carried out over the plain by strong winds which deposited fine grained sands and silts."

2.4.2 Subsurface Geology of the ICPP

The subsurface of the ICPP has been extensively drilled and sampled by the USGS in an effort to understand and monitor the movement of groundwater and contaminants beneath the ICPP. The geologic data acquired during the drilling of the wells at the ICPP were used to make the geologic interpretation of the subsurface at the ICPP.

To date, 41 wells have been drilled at and around the ICPP to depths that exceed the upper limits of the SRPA (36 USGS monitoring wells, four production wells, and ICPP monitoring well); 32 wells have been drilled and are completed in the various perched water bodies beneath the ICPP; and numerous holes have been drilled at the ICPP in the surficial sediments to the top of the basalt. Two of the deep aquifer wells and 11 of the shallow perched wells were cored. A significant number of the wells completed in the perched groundwater and SRPA have geophysical logs including natural-gamma, neutron, gamma-gamma, and caliper. In addition, borehole video logs are available for each well. Figure 2-7 is a map of the ICPP showing well locations.

The subsurface geologic interpretation is divided into a section in which the lithology of the basalt flows is discussed and a section in which the basalt flow stratigraphy is discussed. The reason the geologic interpretation is being presented in this manner is because the complex lithology (i.e., fracturing, vesicles, and weathering surfaces) is not continuous within a single flow unit and, therefore, the lithology cannot be correlated between boreholes. However, the stratigraphic relationship of the basalt flows can be correlated

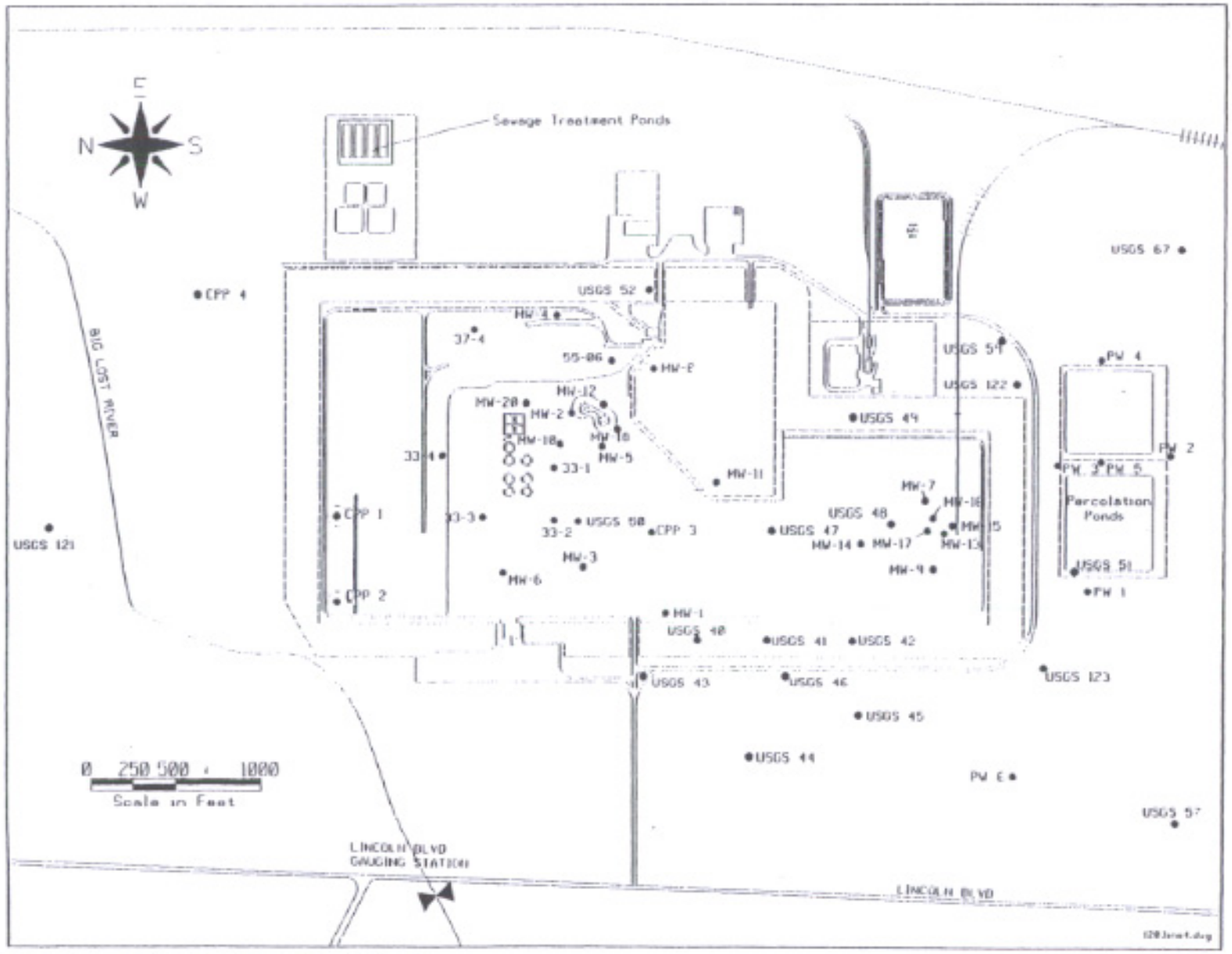


Figure 2-7. Locations of the ICPP monitoring wells.

between boreholes using the stratigraphic position of the flows as indicated by similar geophysical responses measured within the boreholes. This correlation is difficult due to the high degree of similarity between basalt flows.

2.4.2.1 Lithology. Figure 2-8 is a generalized lithologic column showing the basalt flows and sedimentary interbeds beneath the ICPP and the geophysical response associated with each different geologic material as determined by careful examination of core from the ICPP.

The generalized lithologic column (Figure 2-8) shows three typical lithologic sequences found in basalt flows beneath the ICPP. The upper portion of the column indicates a massive dry basalt grading downward into a moist vesicular basalt. The base of the flow rests on a saturated layer of sediments. The sediments cover a weathered fractured vesicular basalt in which the vesicles and fractures have been filled to some extent with sediments from above. A set of horizontal sediment-filled fractures are shown below the upper weathered zone. These horizontal fractures overlay a dry massive basalt, which grades into a saturated basalt vesicular basalt. The bottom of this flow unit overlies a tight, moist sediment layer. The sediments then overlay a moist to dry layer of vesicular fractured basalt, which grades to a massive dry basalt. Below the massive basalt is a basalt vesicular zone followed by a fractured weathered vesicular zone. This is typical of a contact between two flows in which there are no sediments present. There may be some measurable amount of moisture due to the fracturing and vesicular nature of the basalt near the edge of flows. The basalt then grades to a massive dry basalt.

The geophysical logs provided on the generalized column show typical responses to the different lithologies. The gamma log shows a typical low gamma radiation count for the massive portions of the basalt with increasing gamma counts related to zones of increased sediment percentages. The largest gamma counts correspond to those portions of the lithologic column that are entirely sediment. The sediment-filled horizontal fracture produces a small gamma anomaly. The actual gamma count from the sediment may be equal to that of the thicker sediment layer above, but because the fracture is very small, the radiation is attenuated causing a smaller response.

The neutron log indicates a response to moisture in the formation. The dry basalt causes very limited neutron thermalization and, therefore, the neutron count for these zones is much higher than the zones where moisture is present. Zones of either limited porosity or moisture tend to produce a moderate number of neutron collisions, thereby causing the neutron count to decrease slightly. Saturated zones produce the most neutron collisions, which is reflected by the low neutron counts.

The generalized natural-gamma and neutron logs show perching units versus nonperching units and zones where groundwater occurs. A perching unit will have a neutron low above it and exhibit a neutron high. If the perching layer is composed of sediments, there will be a natural-gamma anomaly associated with it. Fractures and other zones of water are indicated by low neutron counts.

2.4.2.2 Lithology of Corehole USGS-121. The lithologic column for Corehole USGS-121 was selected to show the lithology from the ground surface to the SRPA. This corehole penetrates lithology that is typical of the ICPP subsurface, however, the lithology may vary significantly between boreholes at the ICPP.

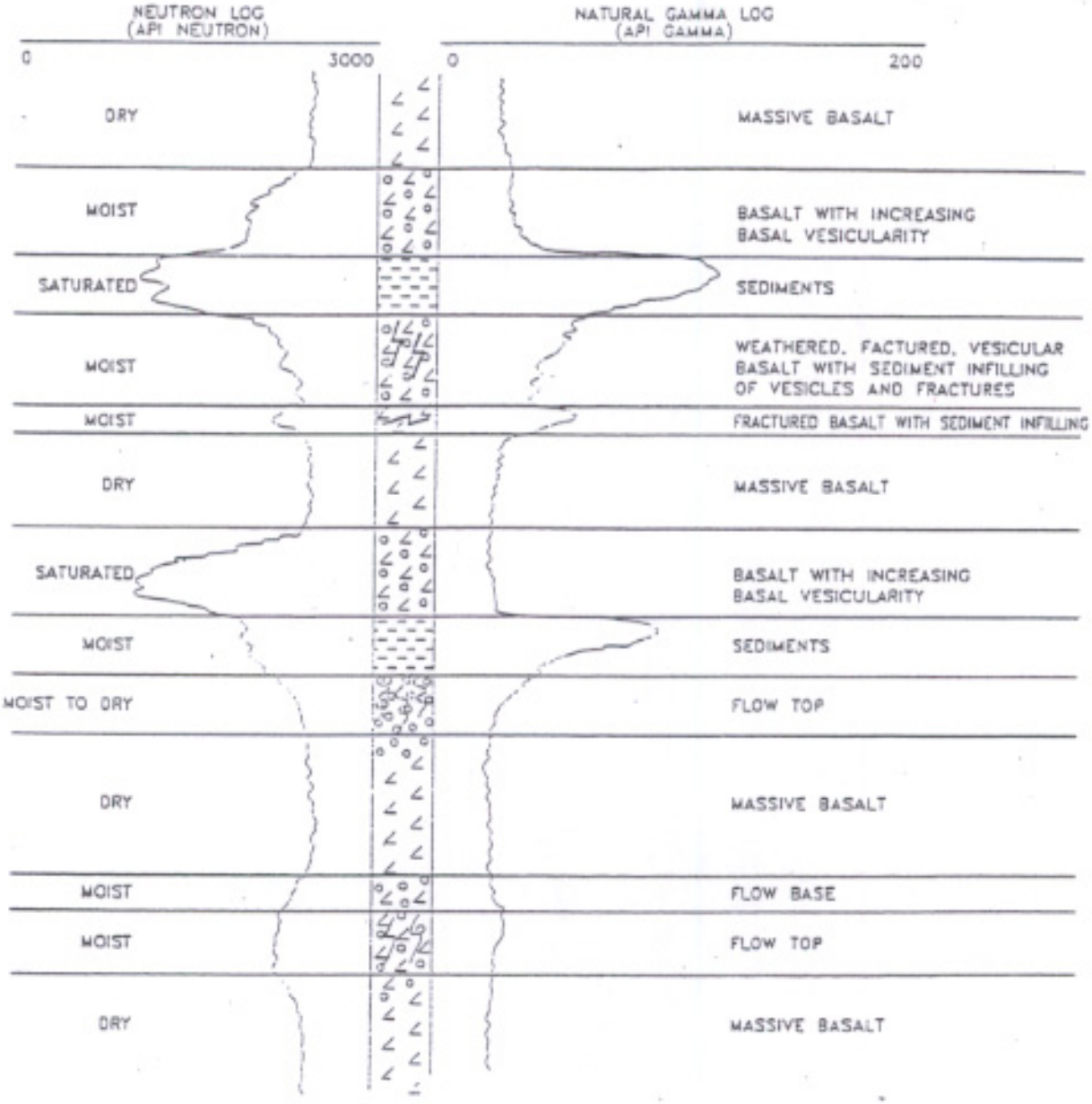


Figure 2-8. Generalized lithologic column and associated geophysical response.

Corehole USGS-121 is located north of the ICPP (Figure 2-7); the total depth of the corehole is 227 m (745.8 ft) below ground surface (bgs). The corehole was drilled in 1989 and 1990 as a monitoring well. Static water level in the SRPA is approximately 139 m (455 ft) bgs. The hole was overreamed to 30.18 cm (11.88 in.) and cased to 131.7 m (432 ft) bgs with a 20-cm (8-in.) carbon steel casing. Stainless steel casing was hung from 125.8 to 136 m (412.6 to 449 ft) bgs having 7.9 m (26 ft) of 0.02 slot stainless screen and an additional 1.5 m (5 ft) of stainless steel casing to a depth of 146 m (480 ft) bgs. A silica sand pack was placed from 146 to 148 m (480 to 485 ft) bgs over a Volclay bentonite plug, which was installed from 148 to 151 m (485 to 495 ft) bgs.

Digital natural-gamma and neutron logs were recorded for Corehole USGS-121 in June, 1993 to a depth of 146 m (480 ft) bgs, which is the top of the silica sand pack. Before the 1993 logging effort, the hole was geophysically logged using an analog natural-gamma, neutron, and gamma-gamma logging system in 1989 and again in 1990. For the lithologic evaluation of the hole, the digital log recorded in 1993 was used. The effects of well construction and the static water level on the neutron log are seen in the interval from 131 to 140 m (430 to 460 ft) bgs.

A detailed lithologic column for Corehole USGS-121 was derived from the core log description and geophysical logs contained in Attachment 2 of LITCO (1995). Top and bottom depths of the lithologic units and descriptions of the lithologic units are also provided in LITCO (1995). Significant lithologic sequences penetrated by Corehole USGS-121 are described as follows:

- The base of the surficial sediments at 10.4 m (34 ft) bgs are indicated by a sharp decrease in the natural gamma count. The neutron log does not show a significant change until the basalt becomes more competent and less fractured and/or vesicular. This delay in the neutron log response was confirmed by inspection of the core.

- A basalt sequence of an unusually high natural gamma radiation is found between 35.4 and 39.6 m (116 and 130 ft) bgs. This was confirmed as a basalt from inspection of the core. It appears to be a single unit with a thin sediment layer above and below, as indicated by the neutron log. The neutron log shows a significant decrease between 34.7 and 35.4 m (114 and 116 ft) bgs and again at 39.6 and 40.5 m (130 and 133 ft) bgs. Core loss in these zones prevented a detailed description of the materials from these intervals, but silty sediments were found on the core above and below these intervals.

- Moist silt is possibly indicated by the natural gamma and neutron logs between 42.7 and 44.2 m (140 and 145 ft) bgs. Inspection of the core from above and below this interval revealed traces of silt, thus supporting the interpretation of the geophysical logs.

- The interval between 79.2 and 85.3 m (260 and 280 ft) bgs is a slightly weathered to fresh dusky red basalt that is highly fractured, as indicated by the neutron log. It overlies a 9.8-m (32-ft) thick interval [85.3 to 95.1 m (280 to 312 ft) bgs] of fresh, minutely vesicular basalt that is relatively unfractured. This interval is characterized by a higher neutron log count than the overlying basalt, while the natural gamma log remains essentially the same. Below this interval is a highly weathered vesicular basalt, which is possibly a pyroclastic flow [97.8 to 98.4 m (321 to 323 ft) bgs]. The neutron log shows a significant decrease in the count rate between 95.7 and 97.5 m (314 and 320 ft) bgs, whereas, the natural gamma log does not show any significant change between this interval and the one above.

- The interval from 122.2 to 125.3 m (401 to 411 ft) bgs is a series of sands, silts, and clays. The sediment descriptions were obtained by inspection of the core. The geophysical responses of the sediments are used to confirm the intervals in which the sediments exist and aid in the identification of the type of sediments.

  The sediments between 122.2 and 122.5 m (401 and 402 ft) bgs are described in the core log as silt with basalt gravel. The natural gamma count is beginning to increase in this interval and the neutron log shows a significant low.

  From 122.5 to 123.4 m (402 to 405 ft) bgs a reddish brown, massive silty clay is described. The natural gamma count has significantly increased from the interval above and the neutron log also increased in this interval, indicating a decrease in the moisture content in these sediments.

  From 123.4 to 124.7 m (405 to 409 ft) bgs there was a significant amount of core loss, but no indication the lithology changed from sediments to basalt. The geophysical data suggest a sand. This is based on the low natural gamma count combined with a decrease in the neutron count indicating the clay mineral content of the sediments decreased and the porosity increased, which is typical of a sand.

  From 124.7 to 125.0 m (409 to 410 ft) bgs a pale yellow brown moist silt is described in the core log. This geologic material type is accompanied by a high natural gamma count and an increase in the neutron count.

  Based on the above observations, it appears water may be perching on the fine clay like sediments from 122.5 to 123.4 m (402 to 405 ft) bgs. The sediments above this zone may contain some water based on the neutron response while the sediments below appear to be relatively dry.

2.4.2.3 Stratigraphy. Several stratigraphic units based on similar lithology and stratigraphic position have been identified beneath the ICPP. A generalized stratigraphic column is presented in LITCO (1995). This figure shows the stratigraphic units and gives a general description of the units. The unit thicknesses provided on the stratigraphic column are average thicknesses from the wells used to make the stratigraphic interpretation. A complete table of the unit thicknesses are provided in *Lithology and Stratigraphy at the Idaho Chemical Processing Plant* [Attachment 2 of LITCO (1995)]. The names given the stratigraphic units are based on the nomenclature used by Anderson (1991). An attempt was made to stratigraphically associate the sediments found between the basalt flows and as a result, the names of the sediment units are based on their stratigraphic association (i.e., "DE2" Basalt and "DE2" Sands).

South-north and west-east cross sections have been prepared from the available data. A complete description of these cross sections is presented in *Lithology and Stratigraphy at the Idaho Chemical Processing Plant* [Attachment 2 of LITCO (1995)]. The cross sections extend from the ground surface [approximately 1,494 m (4,900 ft) above median sea level (amsl)] to 1,341 m (4,400 ft) amsl. The top of the SRPA is approximately 1,356 m (4,450 ft) amsl in the vicinity of the ICPP. Figure 2-9 shows the location of the east-west cross section and the wells used for correlation. The east-west cross section of the ICPP may be found in Section 2.6.1.2.1 of this report, and additional cross sections are provided in Plate 3 of the Final Work Plan. The wells used for the west-east section include USGS-043, MW-001, CPP-03 (Injection Well), MW-018 (the location of MW-018 is approximate; it was not surveyed in at the time of this Work Plan), MW-008, and USGS-052. MW-001, MW-008, and MW-018 were drilled using an air rotary drill rig with a

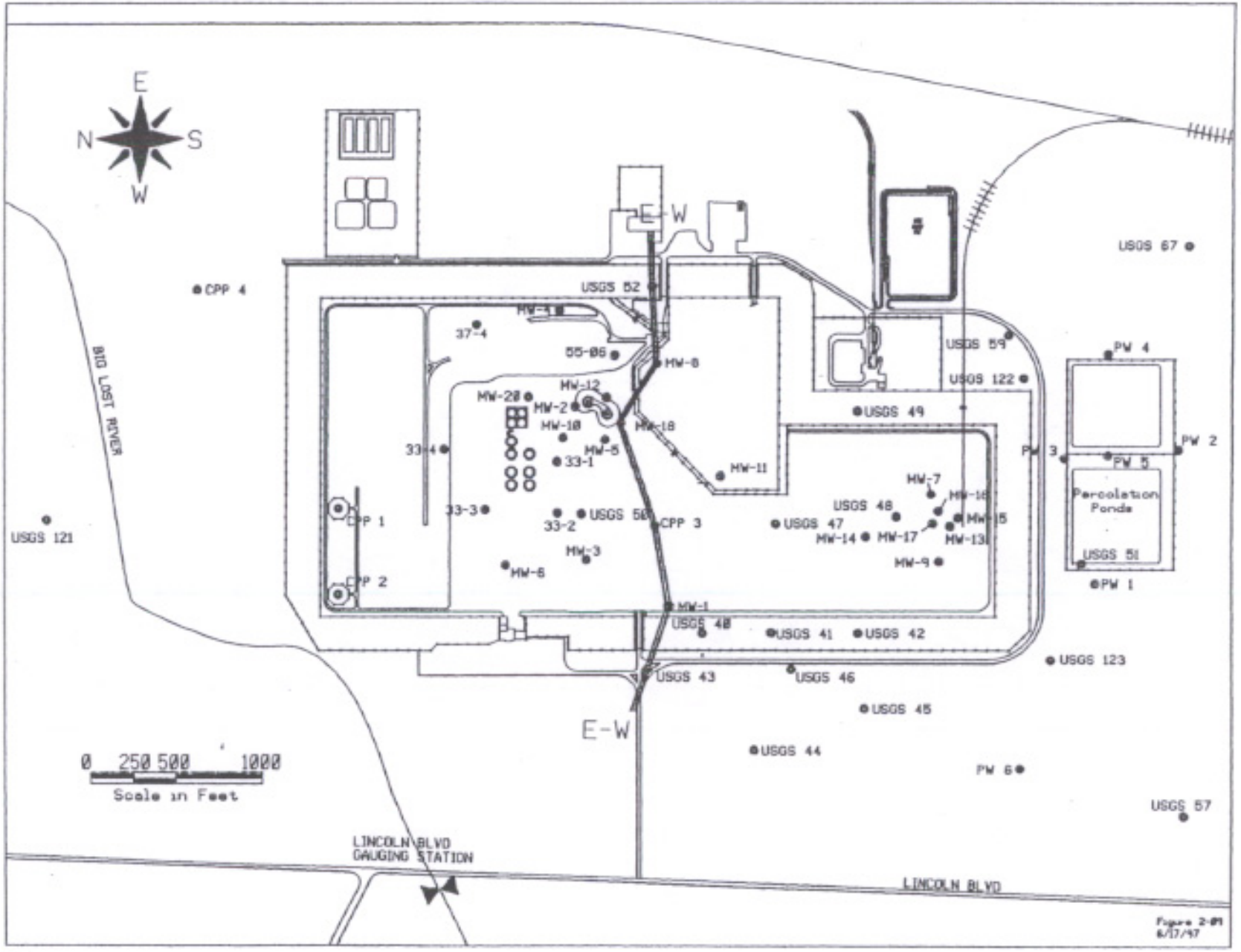


Figure 2-9. Map showing locations of the east-west section lines.

tri-cone bit between 1992 and 1994. The remaining wells were drilled using a cable tool rig in the early 1950s and 1960s.

The USGS wells were drilled as monitoring wells for the SRPA. The MW series of wells were drilled to monitor the perched water zones beneath the ICPP. Well CPP-3 was drilled as a deep injection well for the ICPP (it has since been abandoned), and Well CPP-2 was drilled as a production well for the ICPP water supply.

The stratigraphic relations shown on the cross section depict the typical subsurface stratigraphy beneath the ICPP. The basalt flows are characterized as overlapping lobes of basalt intermixed with larger basalt flows of relatively uniform thickness beneath the ICPP. The sediments found between the basalt flows are often discontinuous and characterized by sequences of sands, silt, and clays. These changes in the sediment lithology are distinguished by the geologist records from drilling and/or the responses of the sediments on the geophysical logs.

The basalt flows, as interpreted, appear to be relatively uniform in thickness beneath the ICPP. Significant changes in the flow thickness are often related to changes in the lithology of the flow or are caused by the flow margins in which the flow appears as a lobe of basalt. The lithologic changes that may cause a change in the flow thickness are the existence of pyroclastic deposits on or within a flow, or a flow being very vesicular, and thus, more susceptible to the effects of erosion.

Stratigraphically significant basalt flows beneath the ICPP include the "CD" flow, "DE3" flow, and "DE4" and "DE5" flows. The "CD" flow appears to be a very hard, nonporous flow that is not continuous over the entire ICPP. This could potentially affect the movement of groundwater in the vadose zone. The "DE3" flow is typically uniform in thickness and appears to be relatively flat lying; it is most likely a porous to semiporous basalt. It provides a lower boundary for the thick sediments associated with the "D" and "DE2" stratigraphic units. The "DE4" and "DE5" basalt flow units are often characterized as massive and unfractured, however, portions of the flows are described as pyroclastic cinder-type deposits in which the basalt is highly vesicular and fractured. The boundary between these flows is not clearly defined; there does not appear to be any major sedimentary units separating these basalt flows.

The sediments, as interpreted, appear to be primarily made up of sands and silts with some small clay lenses. The majority of the sediments are thin [0.3- to 1.5-m (1- to 5-ft) thick] layers of silt between the major basalt flows. Sediments were most likely deposited in eolian or fluvial type environments. Two major sediment sequences are shown on the cross sections: the upper sequence associated with the "CD," the thick "D" and "DE2" sands and silts; and the lower sediments associated with the "DE6," "DE7," and "DE8" stratigraphic units.

The cross sections show a very thick sequence of sediments, particularly in the northern end of the south-north section, which are stratigraphically shown as the "CD", "D," and "DE2" units. These sediments appear to be a thick sequence of sands over and underlain by silts and clays. Structure contour maps of the top of the "CD" and "D" interbeds are provided in Figures 2-10 and 2-11, respectively.

The sediments associated with the "DE6," "DE7," and "DE8"stratigraphic units appear to be made up of gravels, silts, and clays. These sediments were most likely deposited in a fluvial environment and may indicate a braided stream deposit. This is the last major sediment deposit above the SRPA. Structure contour map of the top of the "DE8" interbed is provided in Figure 2-12.

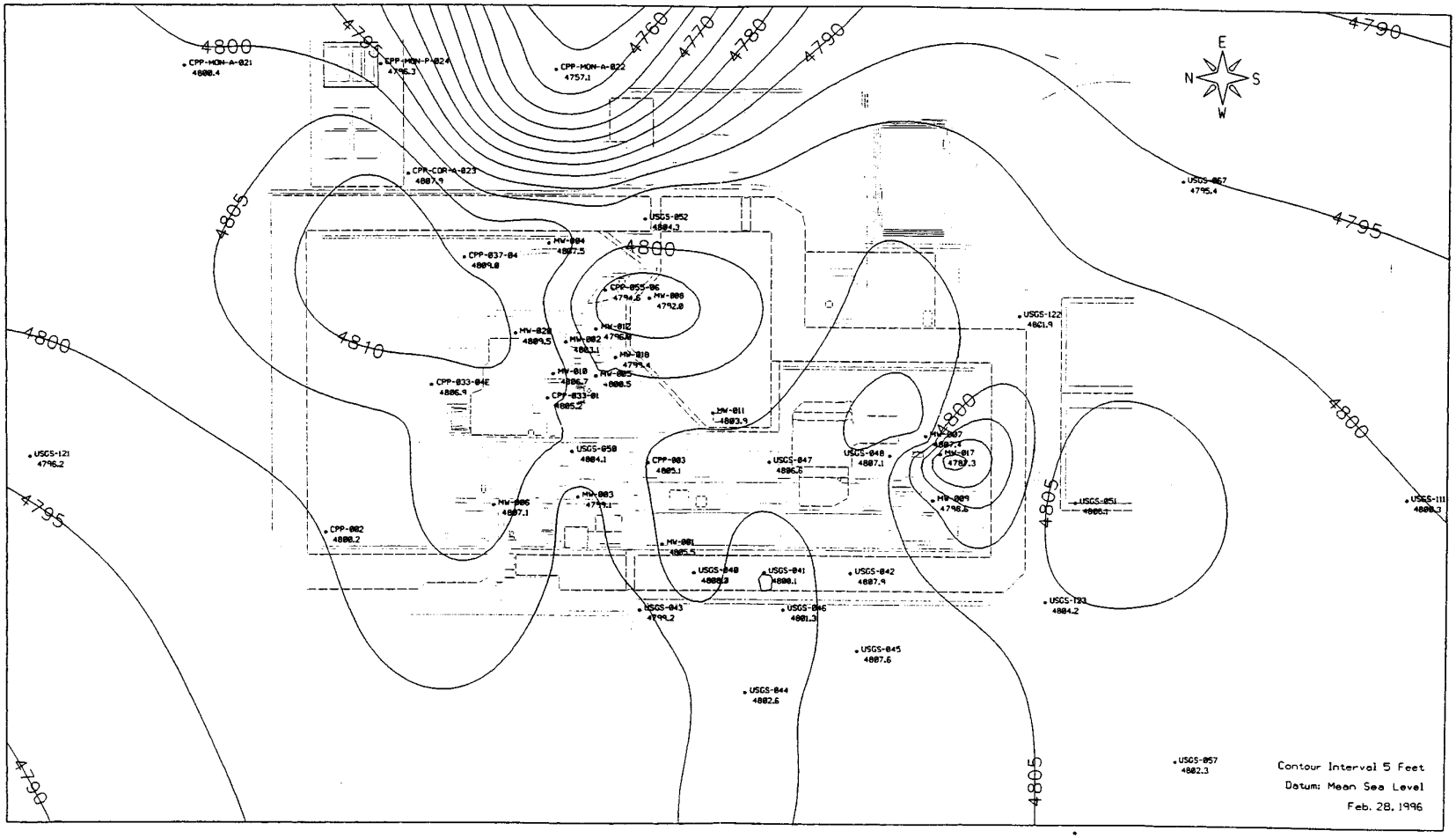


Figure 2-10. Structure contour map of the top of the "CD" interbed.

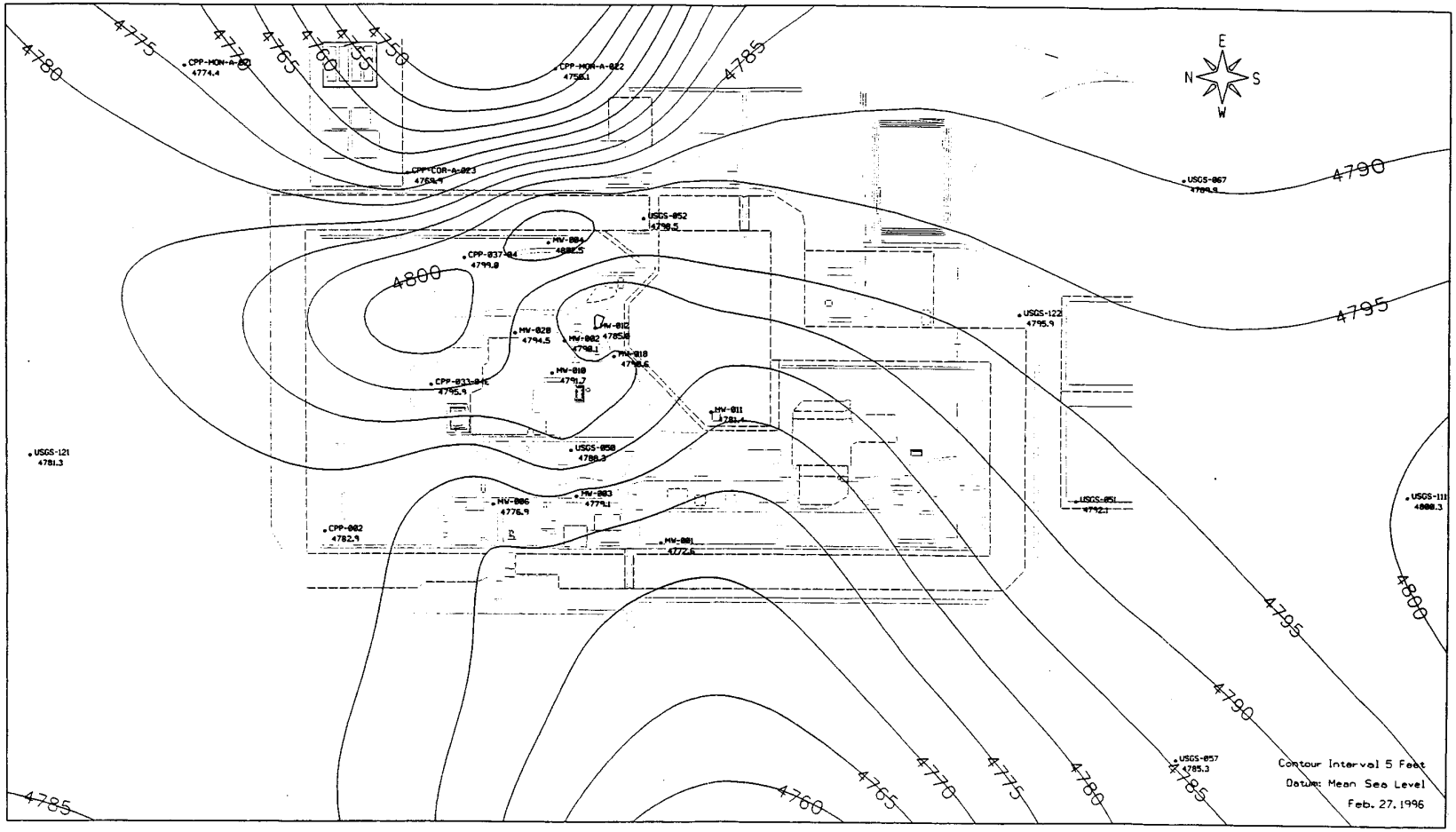


Figure 2-11. Structure contour map of the top of the "D" interbed.

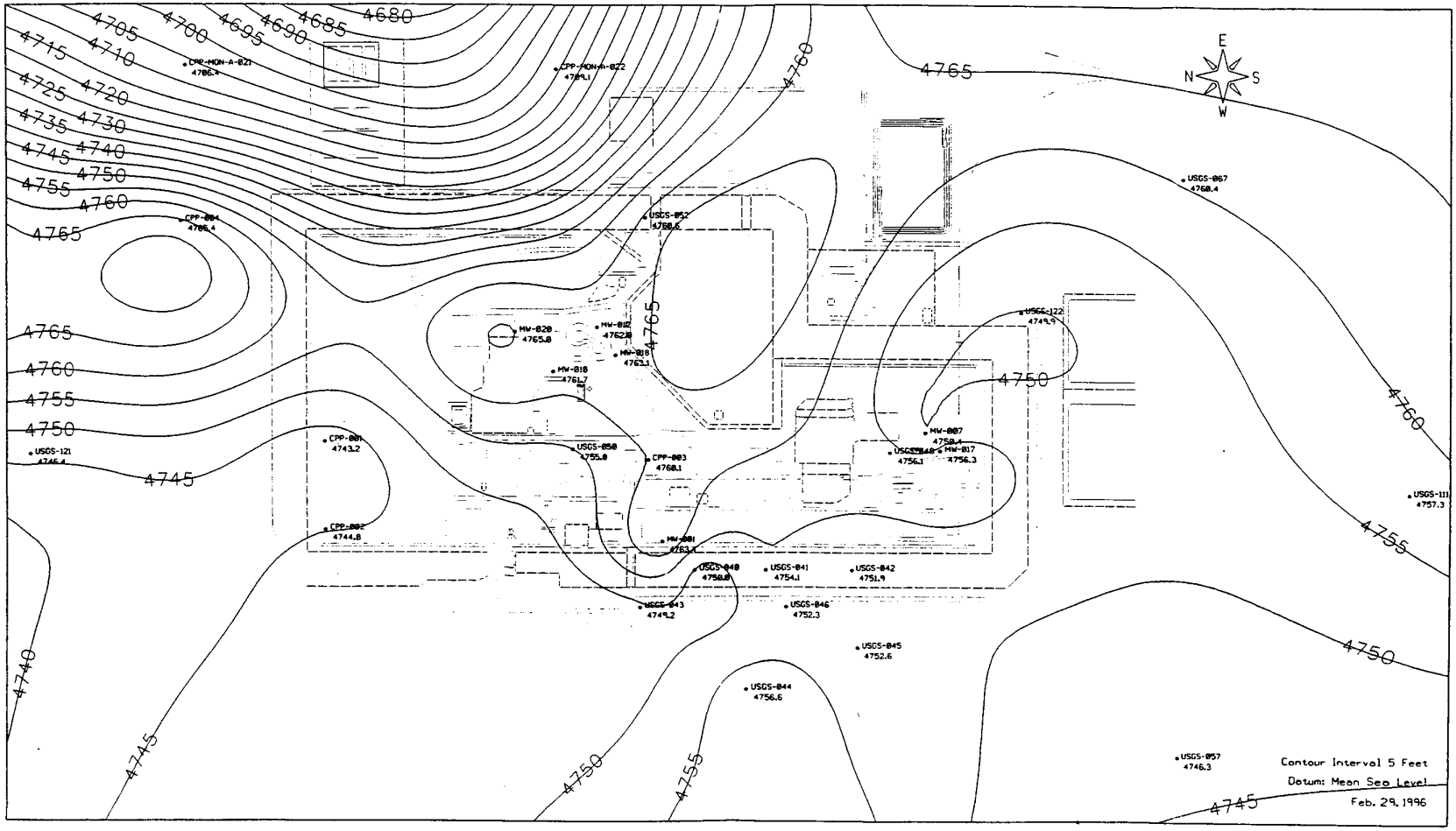


Figure 2-12. Structure contour map of the top of the "DE8" interbed.

2.5 Regional Hydrogeology

The SRPA flows beneath the INEEL and is about 322 km (200 mi) long and 89- to 113-km (55- to 70-mi) wide. It extends from Ashton and the Big Bend Ridge on the northeast to Hagerman on the southwest (Figure 2-13) and covers about 25,900 km^2 (10,000 mi^2). The aquifer consists of a series of basalt flows with interbedded sedimentary deposits and pyroclastic materials. The boundaries are formed by the contacts of the aquifer with less permeable rock at the margins of the plain (Mundorff et al., 1964). Robertson et al. (1974) estimated as much as 2B acre-ft of water may be in storage in the aquifer, of which about 500M acre-ft are recoverable.

Groundwater in the SRPA generally occurs under unconfined conditions, but locally may be quasi-artesian or artesian (Nace et al., 1959). The quasi-artesian or artesian conditions are caused by layers of dense, massive basalt or sediments with relatively low permeability. Nace et al. (1959) described quasi-artesian as the situation in which the groundwater level is first recognized in a borehole during drilling at a depth below the regional water table, and then the level rises significantly [1.5 to 15.2 m (5 to 50 ft)] to the level of the water table. This rise of the water level simulates artesian pressure, but the conditions are not truly artesian. Nace et al. (1959) also noted water levels in some wells in the SRPA respond to fluctuations in barometric pressure similar to wells in confined aquifers, indicating tight zones in the basalt may impede pressure equalization. True artesian or flowing artesian conditions in the SRPA were identified at Rupert, in parts of the Mud Lake Basin, and north of the American Falls Reservoir (Nace et al., 1959).

Recharge to the aquifer is primarily by valley underflow from the mountains to the north and northeast of the plain and from infiltration of irrigation water. A small amount of recharge occurs directly from precipitation. Recharge to the aquifer within INEEL boundaries is primarily by underflow from the northeastern part of the plain and the Big Lost River (Bennett, 1990). Significant amounts of recharge from the Big Lost River have caused water levels in some wells at the INEEL to rise as much as 1.8 m (6 ft) in a few months after high flows in the river (Barraclough et al., 1982). Locally, the direction of groundwater flow is temporarily changed by recharge from the Big Lost River (Bennett, 1990).

Estimates of the effective thickness of the SRPA at the INEEL are variable. A 3,159-m (10,365-ft) deep geothermal test well (INEL-1) was drilled about 7.2-km (4.5-mi) north of the ICPP in 1979. Subsurface geologic information from INEL-1 indicates at least 610 m (2,000 ft) of basalt underlie the INEEL (Prestwich and Bowman, 1980). Hydrological data from INEL-1 were interpreted by Mann (1986) to indicate the effective base of the aquifer is 259 to 372 m (850 to 1,220 ft) bgs. The depth to water at INEL-1 is about 122 m (400 ft) bgs, which suggests an effective aquifer thickness of 137 to 250 m (450 to 820 ft). In earlier studies by Robertson et al. (1974), the effective portion of the SRPA at the Test Reactor Area (TRA) was assumed to be the upper 76 m (250 ft) of the saturated zone based on lithology and water quality. The aquifer's thickness varies at different areas, and the aquifer becomes less productive with depth due to decreasing hydraulic conductivity (Hull, 1989). Hydraulic conductivity of the basalt in the upper 244 m (800 ft) of the aquifer generally is 0.3 to 30.5 m/day (1 to 100 ft/day); whereas, the hydraulic conductivity of underlying rocks is several orders of magnitude smaller (Orr and Cecil, 1991). Fracture filling from sediments and secondary mineralization are the principal reasons for the decreased hydraulic conductivity.

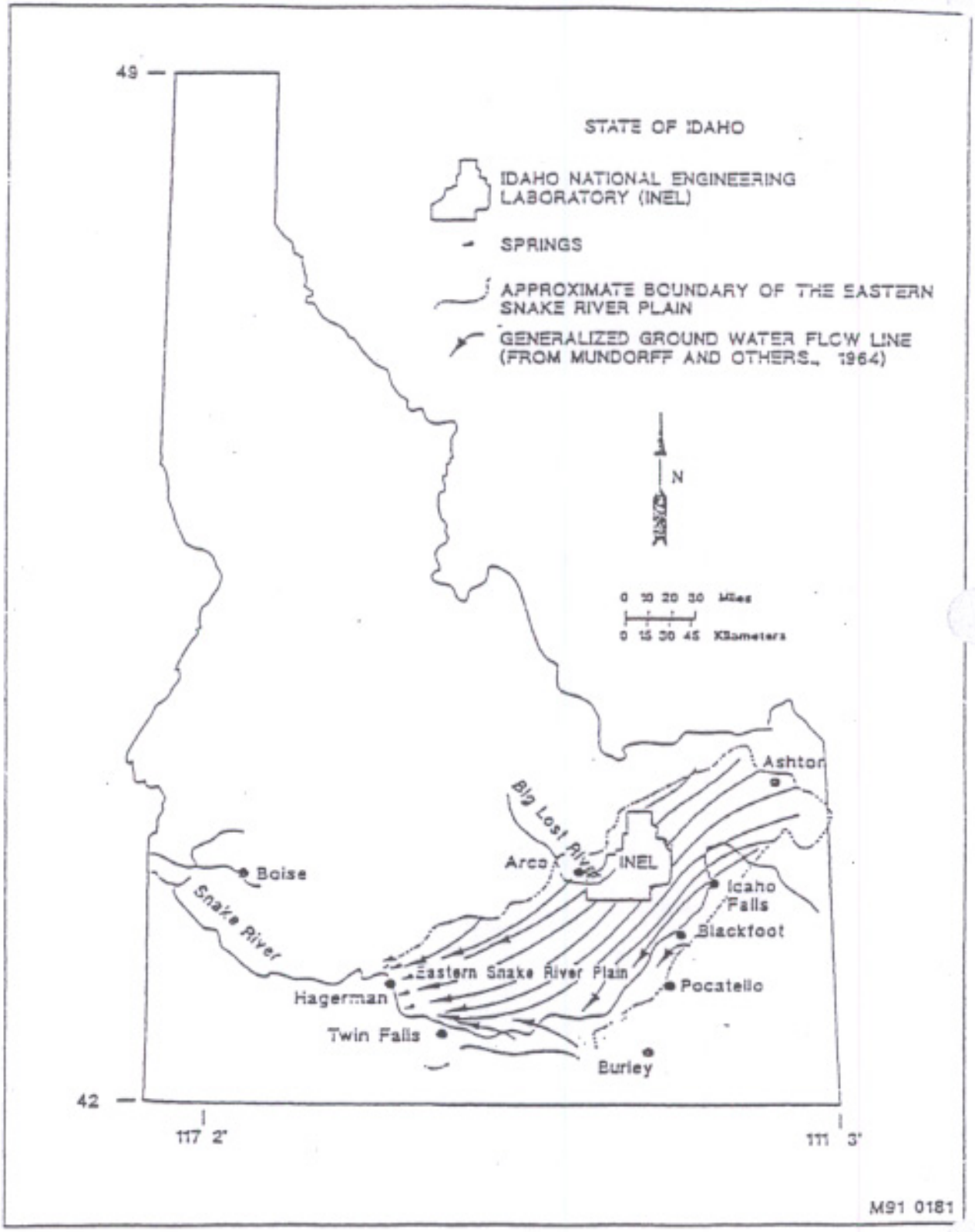


Figure 2-13. Map of Idaho showing location of the INEEL, Snake River Plain, and generalized groundwater flow of the SRPA (Hull, 1989).

Perched groundwater zones occur when downward flow to the aquifer is impeded by fine sediments or dense basalt flows with relatively low permeability. At the INEEL, perched groundwater has been documented beneath the Big Lost River system, and at the NRF, TRA, and ICPP (Morris et al., 1965; Robertson et al. 1974; and Pittman et al., 1988). The occurrence of perched groundwater at the ICPP will be discussed later in this section.

2.5.1 Depth to Water and Groundwater Flow

The water table contour map shows the configuration of the water table and general lateral direction of groundwater flow across the INEEL in July, 1988 (Figure 2-14). The water level elevations ranged from 1,399 m (4,590 ft) amsl in the northern part of the INEEL to about 1,347 m (4,420 ft) amsl south of the INEEL; the depth to the water table varied from about 61.0 m (200 ft) bgs in the northern part of the INEEL to about 274-m (900-ft) bgs in the southern part. The general direction of groundwater flow was to the south-southwest, and the average gradient was about 0.8 m/km (4 ft/mi) (Orr and Cecil, 1991). Locally, however, the hydraulic gradient varies significantly and ranges from about 0.2 m/km (1 ft/mi) in the northern part of the INEEL to a maximum of 2.8 m/km (15 ft/mi).

The elevation of the water table and direction of groundwater flow are affected by recharge and groundwater withdrawal. From July 1985 to July 1988, Orr and Cecil (1991) reported water level changes in INEEL wells ranging from a 7.9-m (26-ft) decline near the RWMC to a 1.2-m (4-ft) rise north of TAN. Water levels generally declined in the southern two-thirds of the INEEL during that time and rose in the northern one-third.

The Big Lost River flows intermittently on the INEEL. When flowing, the water infiltrates from the river and percolates downward toward the SRPA. Layers of sediment and massive basalt in the vadose zone having relatively low permeability may impede the downward percolation of water and sometimes form perched water bodies beneath the river. A hydrograph of Well USGS-78 located west of the ICPP and corresponding discharge measurements from the Big Lost River at the Lincoln Boulevard Bridge near the ICPP are shown in Figure 2-15. Well USGS-78 is 71.6 m (235 ft) from the river and 61.9 m (203 ft) deep, and is completed approximately 79.2 m (260 ft) above the SRPA.

The water level in Well USGS-78 begins an abrupt rise about 4½ days after flow starts in the Big Lost River. The water level may rise as much as 30.5 m (100 ft) within a few months. The water level in the well is very sensitive to river stage, and as stream flow declines or ceases, the perched water level declines abruptly. Declines of 18.3 to 27.4 m (60 to 90 ft) have been measured within 3 or 4 months (Barraclough and Jensen, 1976). Well USGS-78 is an open borehole from 20.1 to 61.9 m (66- to 203-ft) bgs, and as a result, the transmissive zone cannot be determined to provide an estimate for the vertical flow velocity. The horizontal groundwater velocity from the Big Lost River to Well USGS-78 appears to be as high as 0.9 m/hr (3 ft/hr).

2.5.2 Aquifer Properties

Aquifer permeability is controlled primarily by fractures, fissures, and voids along the upper and lower contacts of basalt flows, interstitial large voids, and intergranular pore spaces. Vesicles contribute little to permeability because most are isolated and do not transmit much water. Locally, the direction of groundwater flow may vary due to the variability of the hydraulic characteristics of the aquifer within a small area.

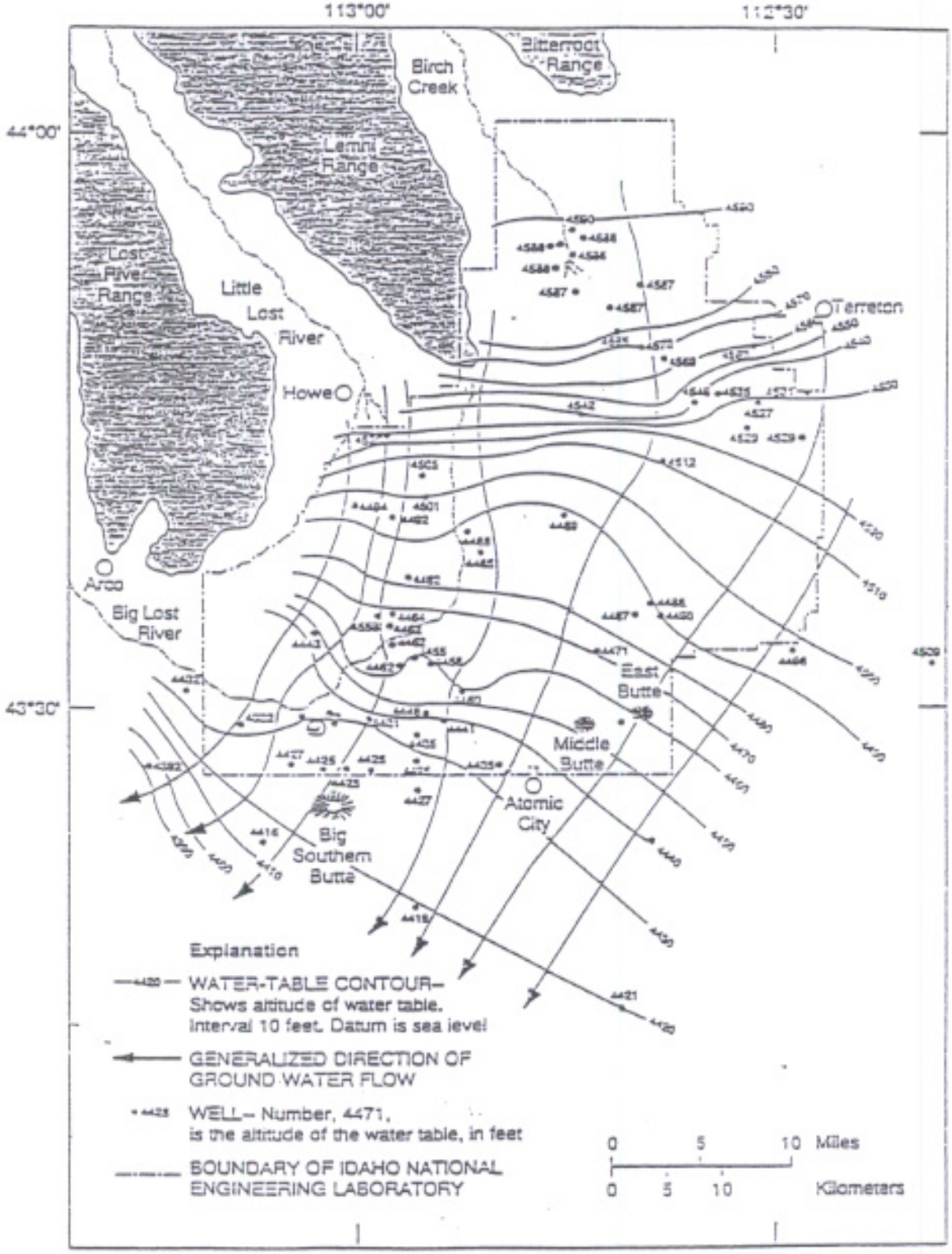


Figure 2-14. Water table elevation and generalized direction of groundwater flow for the SRPA, July 1988 (Orr and Cecil, 1991).

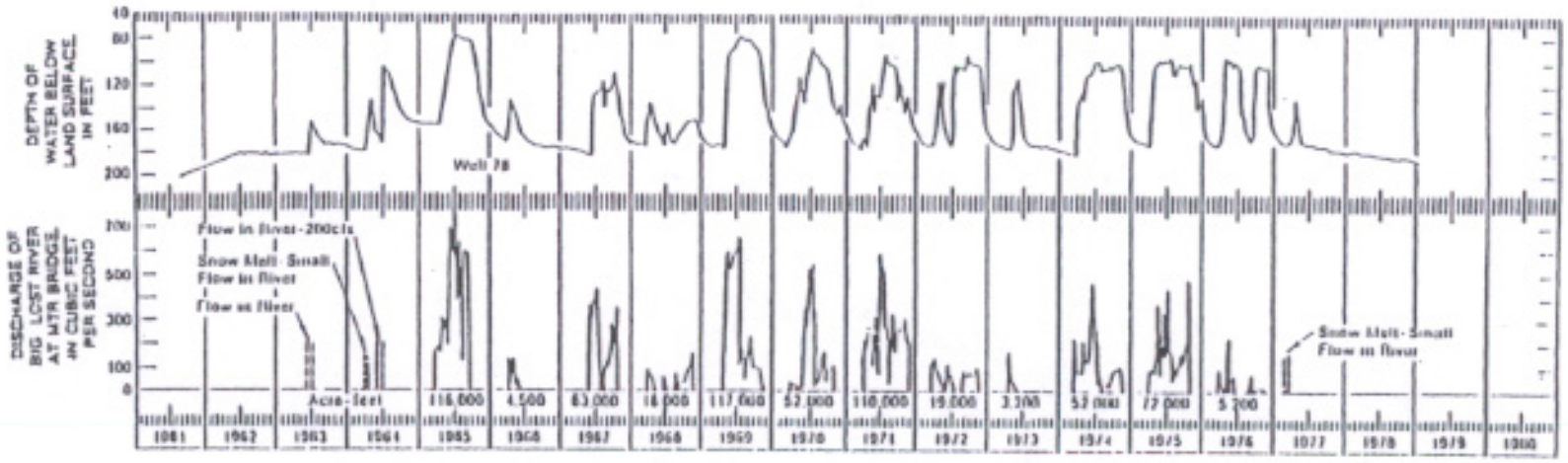


Figure 2-15. USGS-78 water level response vs. Big Lost River discharge at Lincoln Boulevard (Barraclough et al., 1982).

Hydraulic properties of the SRPA have been determined by pumping tests. According to Robertson et al. (1974), transmissivities range from 1.24×10^4 to 1.24×10^6 m^2/day (1.34×10^5 to 1.3×10^7 ft^2/day) with 6.2×10^4 m^2/day (6.7×10^5 ft^2/day) considered normal. Table 2-8 summarizes transmissivity and storage coefficients calculated from tests conducted at the INEEL. Transmissivities range from 3.7×10^2 to 2.2×10^4 m^2/day (4.0×10^4 to 2.4×10^6 ft^2/day), with the lowest at TAN and highest at TRA. By calculating the geometric mean of transmissivity values, Hull (1989) estimated regional aquifer transmissivity for the southern INEEL to be 27,000 m^2/day (294,000 ft^2/day). Estimates of the storage coefficients range from 0.01 to 0.06 and effective porosity from 5 to 15%, with 10% being historically the most accepted value (Robertson et al., 1974), though more recent information indicates that a lower value may be appropriate.

2.6 ICPP Hydrogeology

Sixty-eight wells have been installed at the ICPP to monitor perched water bodies and the SRPA. This monitoring well network consists of 32 wells completed in the perched water zones and 36 wells completed in the SRPA. Several of the perched water monitoring wells are completed in multiple water bearing zones. The location of the wells completed in the perched water zones are shown in Figure 2-16, with the construction specifications provided in Table 2-9.

2.6.1 Perched Water Zones

The uppermost perched water zone identified at the ICPP occurred within the Big Lost River alluvium above the basalt. This shallow perched water was first investigated near the fuel element cutting and storage facility (CPP-603) in the early 1960's. The perched water was primarily attributed to the discharges of wastewater to the shallow seepage pit (CPP-2) located on the west side of the building. This shallow perched water body was investigated by installing 27 observation wells in the alluvium above the basalt. A small zone of perched water was encountered at a depth of 6.7-m (22-ft) bgs, and a larger zone was encountered directly on the basalt surface at a depth of 9.8-m (32-ft) bgs. This perched water body has not been monitored since 1970 and is believed to have dissipated since the construction of the Irradiated Fuel Storage Facility (IFSF) on the western portion of CPP-603 over the seepage pit in the early 1970's. Other than the shallow perched water bodies beneath surface discharge ponds, no other extensive alluvial perched water bodies have been identified at the ICPP.

The upper basalt perched water zone was initially discovered in the late 1950s where Wells USGS-50 and USGS-52 encountered perched water at 38.4 and 53.0 m (126 and 174 ft) bgs, respectively. The occurrence of this perched water was attributed to operational practices based on the presence of radioactive and chemical contaminants. Since then, numerous monitoring wells have been installed in the upper perched water zone to identify the source of recharge, delineate the perched water bodies, and determine the nature and extent of contamination. A discussion of this perched water zone is provided in Section 2.6.1.2.

A lower perched water zone was also identified in the basalt at depths between 104 and 122 m (340 and 400 ft) bgs (Robertson et al., 1974). This water was first discovered in 1956 while drilling Well USGS-40 where perched water was encountered at a depth of 106 m (348 ft). An analysis of this perched water

Table 2-8. Results of aquifer tests conducted to determine transmissivity and storage properties of the SRPA (Walton, 1958 and Walker, 1960).

Well number	Test date	Transmissivity (ft^2/day)	Storage coefficient	Penetration of well below water table (ft)
CFA-2	27-FEB-51	2.1×10^4	—	209
TRA-1	22-JUL-57	1.9×10^6	0.02	114
MTR-TEST	07-JUN-57	2.4×10^6	0.06	134
Fire Station Well	03-NOV-58	4.1×10^5	—	96
SPERT	11-JAN-56	1.6×10^4	—	196
GCRE	20-MAY-59	3.9×10^5	—	747
4N 30E 7ad	29-AUG-50	2.3×10^5	—	367
CPP-1	11-NOV-51	4.4×10^5	0.06	136
STR-1	17-NOV-50	2.0×10^5	—	172
NRF-1	12-NOV-53	1.1×10^4	0.03	157
STR-2	03-AUG-50	4.9×10^5	—	163
NRF-2	19-FEB-57	5.7×10^5	—	
ALW	24-AUG-56	1.5×10^5	—	180
NRF-3	25-MAR-57	6.4×10^4	—	
ANP-1	16-APR-53	9.4×10^4	0.01	157
ANP-2	30-APR-53	1.3×10^4	—	133
ANP-3	20-JUL-53	8.6×10^4	—	112
FET Prod 1	17-APR-58	4.4×10^4	—	139
FET Prod 2	03-MAY-58	9.1×10^4	—	259
LPTF Disposal	20-JUN-57	4.0×10^3	—	109

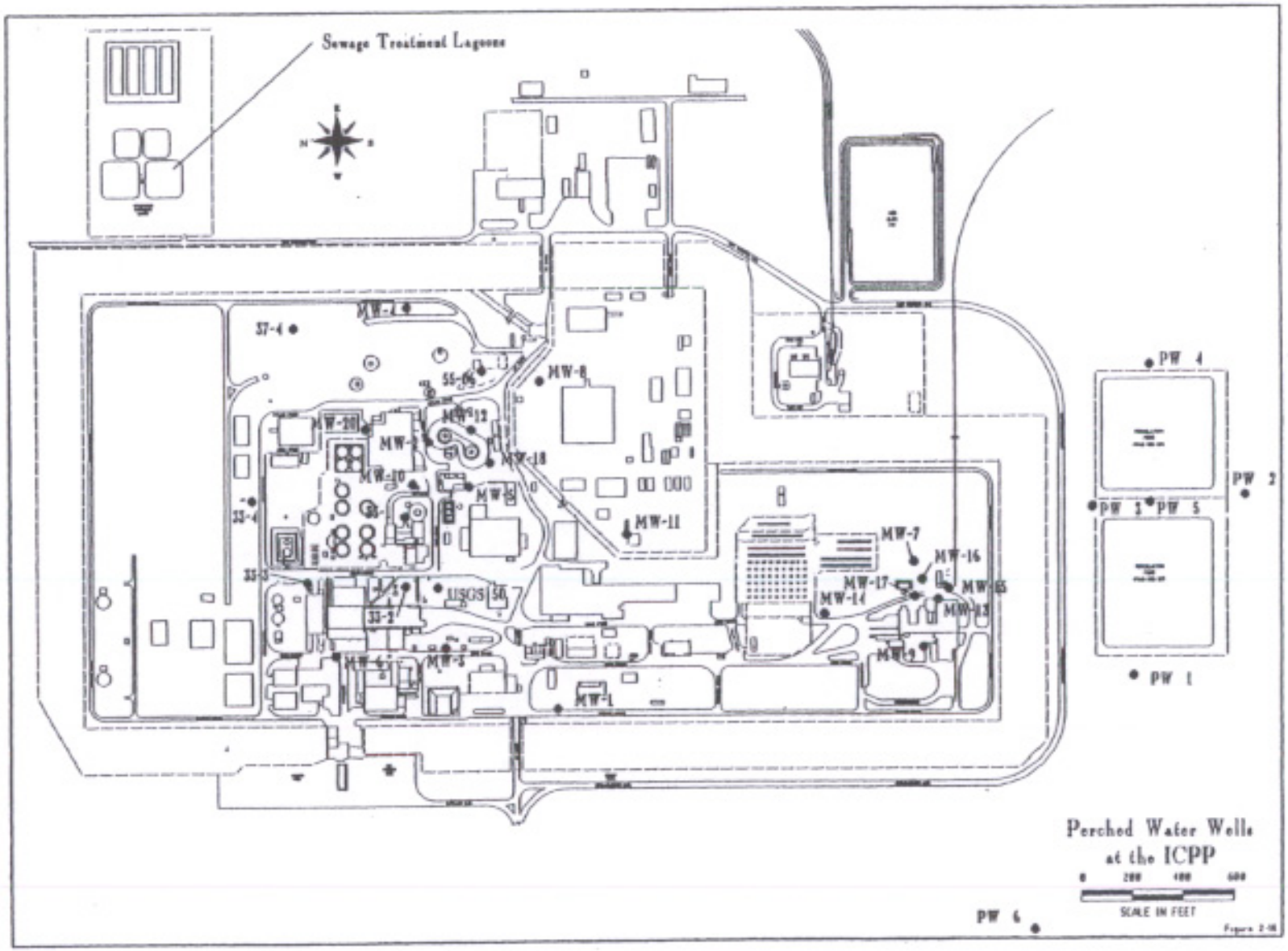


Figure 2-16. Locations of the perched water wells as the ICPP.

Table 2-9. Specifications of the perched water wells.

Well	Type	Northing	Easting	Land Surface Elevation	Measuring Point Elevation	Total Depth Drilled Footage	Total Depth Drilled Elevation	Well Screen (footage) Top	Well Screen (footage) Bottom	Well Screen (elevation) Top	Well Screen (elevation) Bottom
CPP 33-1	2-in. SS Well	695392	296939	4915.2	4917.38	113.6	4801.6	89.0	99.0	4826.2	4816.2
CPP 33-2	2-in. SS Well	695385	296639	4914.2	4915.42	114.7	4799.5	85.8	105.8	4828.4	4808.4
CPP 33-3	2-in. SS Well	695806	296659	4913.7	4916.23	126.4	4787.3	111.8	121.8	4801.9	4791.9
CPP 33-4	2-in. SS Well	696049	297011	4911.9	4914.01	124.0	4787.9	98.2	118.2	4813.7	4793.7
CPP 37-4	2-in. SS Well	695861	297743	4911.0	4912.66	129.3	4781.7	99.9	109.9	4811.1	4801.1
CPP 55-06	2-in. SS Well	695057	297563	4911.6	4913.21	122.9	4788.7	93.1	113.1	4818.5	4798.5
PW-1	6-in. Steel Well	692270	296234	4917.8	4919.13	120.0	4797.8	100.0	120.0	4817.8	4797.8
PW-2	6-in. Steel Well	691791	297010	4917.0	4918.54	131.0	4786.0	111.0	131.0	4806.0	4786.0
PW-3	6-in. Steel Well	692447	296961	4916.7	4918.12	123.0	4793.7	103.0	123.0	4813.7	4793.7
PW-4	6-in. Steel Well	692197	297572	4914.8	4916.30	150.0	4764.8	110.0	150.0	4804.8	4764.8
PW-5	6-in. Steel Well	692196	296978	4916.4	4918.40	131.0	4785.4	109.0	129.0	4807.4	4787.4
PW-6	6-in. Steel Well	692696	295150	4920.5	4922.34	135.0	4785.5	105.0	125.0	4815.5	4795.5
MW-1	4-in. PVC Well	694731	296099	4916.5	4919.25	395.0	4521.5	326.0	336.0	4590.5	4580.5
MW-1	1-in. PVC Piezo.	694731	296099	4916.5	4919.00	395.0	4521.5	359.0	369.0	4557.5	4547.5
MW-2	2-in. PVC Well	695285	297262	4913.1	4916.09	127.0	4786.1	102.0	112.0	4811.1	4801.1
MW-3	2-in. PVC Well	695215	296369	4916.0	4918.50	151.3	4764.7	128.0	138.0	4788.0	4778.0
MW-3	1-in. PVC Piezo.	695215	296369	4916.0	4918.50	151.3	4764.7	116.3	118.0	4799.7	4798.0
MW-4	2-in. PVC Well	695376	297828	4911.4	4914.21	131.0	4780.4	100.6	110.6	4810.8	4800.8
MW-4	1-in. PVC Piezo.	695376	297828	4911.4	4913.77	131.0	4780.4	128.0	129.7	4783.4	4781.7
MW-5	2-in. PVC Well	695110	297064	4916.4	4919.27	141.0	4775.4	106.5	126.5	4809.9	4789.9
MW-6	2-in. PVC Well	695690	296320	4916.5	4919.26	161.0	4755.5	117.0	137.0	4799.5	4779.5
MW-7	2-in. PVC Well	693209	296726	4917.4	4920.13	177.0	4740.4	132.0	142.0	4785.4	4775.4
MW-7	1-in. PVC Piezo.	693209	296726	4917.4	4920.13	177.0	4740.4	102.3	104.0	4815.1	4813.4
MW-8	2-in. PVC Well	694806	297514	4911.7	4914.37	141.0	4770.7	115.0	125.0	4796.7	4786.7
MW-9	2-in. PVC Well	693168	296357	4919.6	4922.33	158.0	4761.6	120.0	130.0	4799.6	4789.6
MW-9	1-in. PVC Piezo.	693168	296357	4919.6	4922.33	158.0	4761.6	104.2	105.7	4815.4	4813.9
MW-10	2-in. PVC Well	695356	297078	4914.7	4917.41	181.0	4733.7	141.0	151.0	4773.7	4763.7
MW-10	1-in. PVC Piezo.	695356	297078	4914.7	4917.41	181.0	4733.7	76.5	78.0	4838.2	4836.7
MW-11	2-in. PVC Well	694435	296854	4914.9	4917.72	150.5	4764.4	131.0	136.0	4783.9	4778.9
MW-11	1-in. PVC Piezo.	694435	296854	4914.9	4917.72	150.5	4764.4	112.0	113.5	4802.9	4801.4
MW-12	2-in. PVC Well	695107	297336	4913.0	4915.99	153.0	4760.0	109.0	119.0	4804.0	4794.0
MW-12	1-in. PVC Piezo.	695107	297336	4913.0	4915.99	153.0	4760.0	148.6	150.3	4764.4	4762.7

Table 2-9. (continued).

Well	Type	Northing	Easting	Land Surface Elevation	Measuring Point Elevation	Total Depth Drilled Footage	Total Depth Drilled Elevation	Well Screen (footage) Top	Well Screen (footage) Bottom	Well Screen (elevation) Top	Well Screen (elevation) Bottom
MW-13	2-in. PVC Well	693106	296561	4919.9	4921.99	128.0	4791.9	100.0	105.0	4819.9	4814.9
MW-14	2-in. PVC Well	693594	296503	4919.1	4921.60	138.0	4781.1	94.0	104.0	4825.1	4815.1
MW-15	2-in. PVC Well	693059	296608	4918.9	4921.25	143.0	4775.9	111.3	131.3	4807.6	4787.6
MW-16	2-in. PVC Well	693173	296648	4919.1	4921.65	126.0	4793.1	97.0	107.0	4822.1	4812.1
MW-17	2-in. PVC Well	693129	296622	4918.3	4921.11	381.0	4537.3	181.7	191.7	4736.6	4726.6
MW-17	1-in. PVC Piezo.	693129	296622	4918.3	4921.11	381.0	4537.3	263.8	273.8	4654.5	4644.5
MW-17	4-in. Steel Well	693129	296622	4918.3	4921.11	381.0	4537.3	360.0	381.0	4558.3	4537.3
MW-18	2-in. PVC Well	695020	297193	4914.0	4917.33	494.0	4420.0	113.5	123.5	4800.5	4790.5
MW-18	1-in. PVC Well	695020	297193	4914.0	4917.33	494.0	4420.0	394.0	414.0	4520.0	4500.0
MW-18	4-in. PVC Well	695020	297193	4914.0	4917.31	494.0	4420.0	458.5	478.5	4455.5	4435.5
MW-20	2-in. PVC Well	695568	297309	4915.0	4918.00	151.5	4763.5	133.2	148.4	4781.8	4766.6
MW-20	1-in. PVC Piezo.	695568	297309	4915.0	4918.00	151.5	4763.5	96.0	106.0	4819.0	4809.0
USGS-50	4-in. Steel Well	695247	296633	4913.5	4918.31	405.0	4508.5	356.0	405.0	4557.5	4508.5

Notes: SS = stainless steel
Piezo. = piezometer.

detected abnormally high total dissolved solids (303 mg/L), sodium (25 mg/L), and chloride (81 mg/L) indicating the water is of waste origin (Olmsted, 1962). According to Robertson et al. (1974), this was a reasonable level for the perched groundwater due to the presence of a clay bed "aquitard" at 113 m (370 ft) bgs.

In the late 1950s, only wells drilled in the northern ICPP encountered the lower perched groundwater zone. Since 1984, a lower perched groundwater zone has also formed in the southern ICPP due to disposal of process waste through the percolation ponds. The location of this lower perched water zone is indicated by Well MW-17 and borehole neutron logs from Well USGS-51. A discussion of the lower basalt perched water zone is described in Section 2.6.1.3.

2.6.1.1 Alluvium Perched Water. The only extensive perched water identified in the alluvium at the ICPP, other than beneath surface disposal ponds (i.e., percolation pond and sewage treatment pond), was encountered west of CPP-603. The source for the perched water was thought to be wastewater discharged to the shallow seepage pit (CPP-02). This disposal pit was in operation from 1952 to 1966 (Robertson et al., 1974). In 1963, 27 observation wells were installed in the alluvium to monitor this perched water body.

From 1962 to 1963, the volume of liquid wastes discharged to the pit averaged 37,850 L/day (10,000 gal/day). Morris et al. (1965) calculated that approximately 37,850 L (10,000 gal) of liquid waste were contained in the alluvium near the pit. Therefore, the shallow perched water body contained approximately 1 day's discharge of waste. Under these conditions, the perched water should quickly reflect short-term variations in the discharge rates or compositions. A comparison of the Sr-90 concentrations on the discharge to the Sr-90 concentration in the perched water confirms the short-term variations in the water quality (Morris et al., 1965).

If the source of recharge to the shallow alluvium perched water was solely due to the discharge pit, cessation in discharge to the pit should result in a dramatic decrease in the shallow perched water. Use of the pit was discontinued in October 1966, however, the shallow perched water body had not reflected the corresponding response by 1970 (Robertson et al., 1974). The configuration of the post-1966 perched water body is very similar to that of the pre-1966 period (Figure 2-17).

Robertson et al. (1974) made a comparison of the Sr-90 and H-3 concentrations in the shallow perched groundwater for 1963 and 1970 (Figure 2-18). The high Sr-90 concentrations in the 1963 perched water were the result of large Sr-90 releases to the disposal pit when more than 33 Ci were discharged. The 1970 concentrations in the perched water were attributed to either continued minor discharges or desorption from sediments of previously discharged and sorbed Sr-90. Tritium concentrations in the perched water indicate a significant decrease during the period from 1963 to 1970. The high concentrations in 1963 reflect the relatively high volumes of waste discharged to the pit during 1962 and 1963. The decline in H-3 concentrations from 1963 to 1970 is too great to be caused solely by radioactive decay. This information, combined with an increase in water levels from 1966 to 1970, indicates a nonradioactive source may have been percolating down and recharging the shallow perched water body, thus diluting the H-3 concentrations.

According to Morris et al. (1965), sewage wastes (nonradioactive) from CPP-603 were discharged to the pit from a nearby septic tank. It is unknown how the volume of sewage discharge compared to the volume

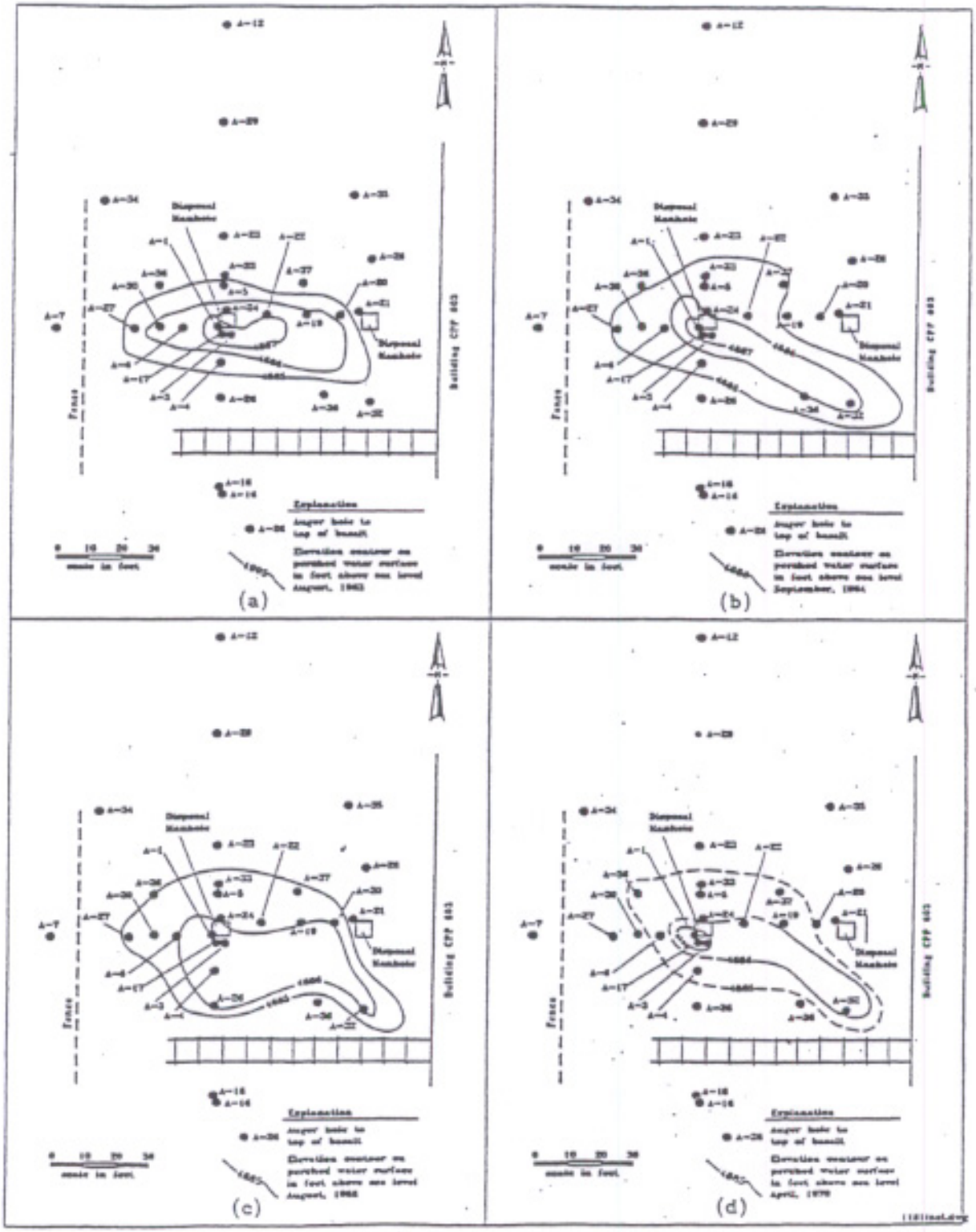


Figure 2-17. Water level contours on the alluvial perched water at the ICPP for 1963, 1966, 1968, and 1970 (Robertson et al., 1974).

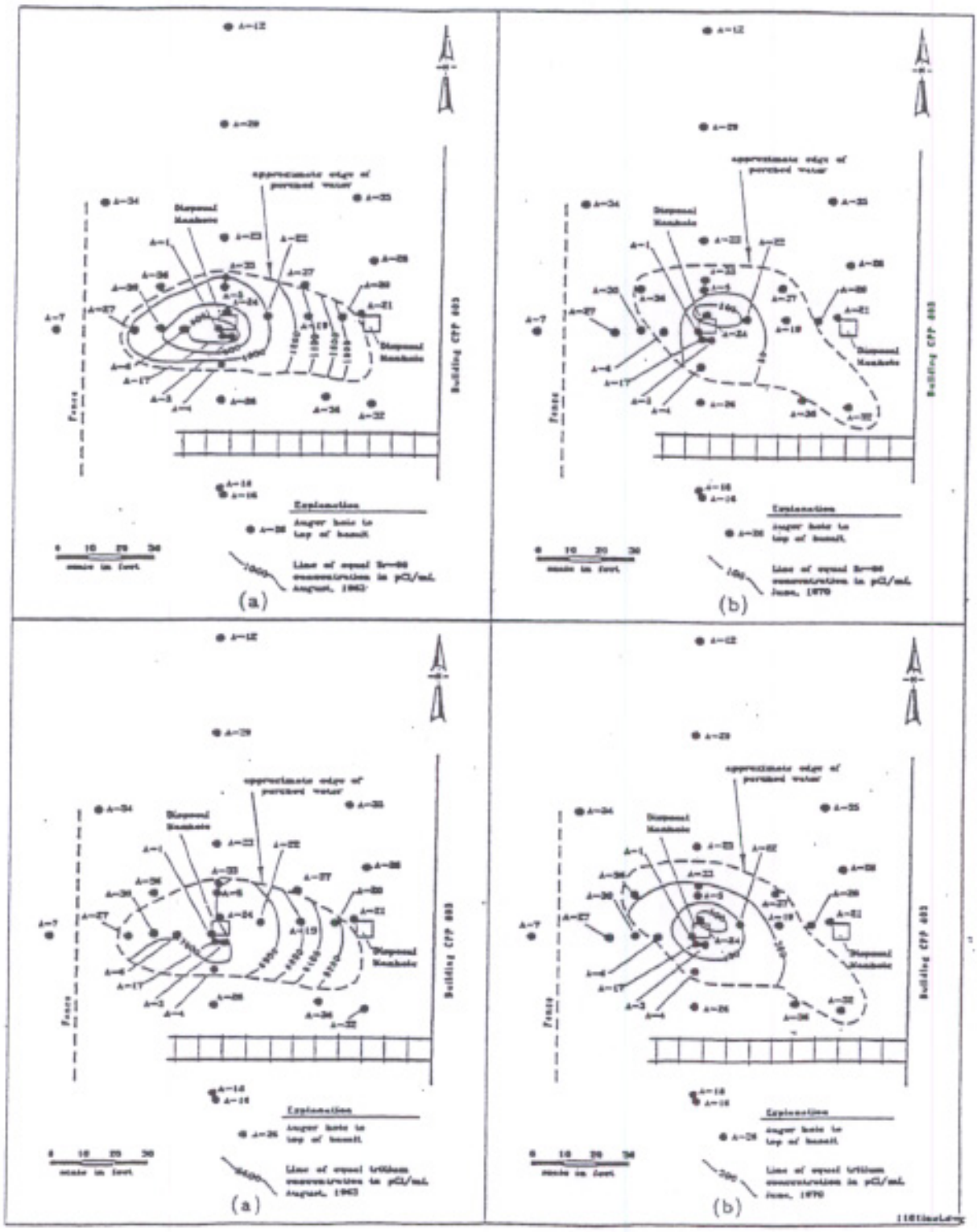


Figure 2-18. Distribution of Sr-90 and H-3 in the alluvial perched groundwater for 1963 and 1970 (Robertson et al., 1974).

of radioactive wastes discharged to the seepage pit. It was postulated that the sewage discharge may be at least partially responsible for the existence of the shallow perched water body in 1970. It was also speculated that piping leaks of nonradioactive water may also be contributing to the perched water body in 1970. Since the construction of the IRFS in 1973, the shallow perched water body has not been monitored and is believed to have dissipated. From the soil borings and monitoring wells installed during 1993 and 1994, only Well MW-13 encountered perched water in the alluvium. The water encountered by Well MW-13 is not believed to be related to the historical perched water body because (a) the well is located to the east of the facility and the historical perched water body was to the west and (b) discharge from the disposal pit ceased in 1966.

2.6.1.2 Upper Basalt Perched Water Zone. Stratigraphy controls the hydrogeologic characteristics of the subsurface at the ICPP, particularly in the formation and movement of perched groundwater. The formation of perched groundwater can be attributed to lithologic features contributing to contrasts in the vertical hydraulic conductivity of basalt layers and sedimentary interbeds in the unsaturated zone. Cecil et al. (1991) attributed four lithologic features to the formation of perched groundwater at the ICPP. Perched groundwater can form where (a) a sedimentary interbed with a reduced vertical hydraulic conductivity underlies a more conductive basalt layer, (b) altered baked zones between two basalt flows reduce the hydraulic conductivity, (c) the presence of dense unfractured basalt having low vertical hydraulic conductivity, and (d) sedimentary and chemical filling of fractures near the upper contact of a basalt flow reduce the vertical hydraulic conductivity.

Based on the perched water data, it appears the upper perched groundwater bodies are formed by the relatively low vertical hydraulic conductivity in the sedimentary interbeds. Of particular importance to the formation of perched groundwater are the "CD," "D," and "DE3" interbeds. Figure 2-19 shows the location of the upper basalt perched water zone that occurs between depths of 30.5 and 58 m (100 to 190 ft).

2.6.1.2.1 Northern ICPP—Twenty-three monitoring wells (including multiple completion wells) have been installed in the northern ICPP to monitor the upper perched groundwater (i.e., groundwater that occurs less than 58 m (190 ft) bgs. Two perched groundwater bodies have been identified in the northern ICPP. The upper perched groundwater body is present above the "CD" and "D" interbeds and the lower perched groundwater body has been identified on the "DE3" interbed. According to the lithology, the "CD" interbed occurs at depths between 34 and 36 m (113- and 119-ft) bgs, the "D" interbed occurs at depths between 39 and 41 m (128- and 135-ft) bgs, and the "DE3" interbed occurs at depths between 50 and 52 m (163- and 170-ft) bgs. Based on available information, it appears that the perched groundwater between the "CD" and "D" interbeds is continuous over much of the northern ICPP since these interbeds are only separated by 9 ft. The perched water body and monitoring well completed above the associated interbed are as follows:

"CD" Interbed	"D" Interbed	"DE3" Interbed
CPP-33-1	CPP-33-3	MW-10 (2-in.)
CPP-33-2	CPP-33-4	MW-12 (1-in.)
CPP-37-4	CPP-37-4	MW-20 (2-in.)
CPP-55-06	MW-3 (2-in.)	
MW-2 (2-in.)	MW-4 (2-in.)	
MW-3 (1-in.)	MW-5 (2-in.)	
MW-8 (2-in.)	MW-6 (2-in.)	
MW-11 (1-in.)	MW-11 (2-in.)	
MW-12 (2-in.)	MW-18 (1-in.)	
MW-20 (1-in.)		

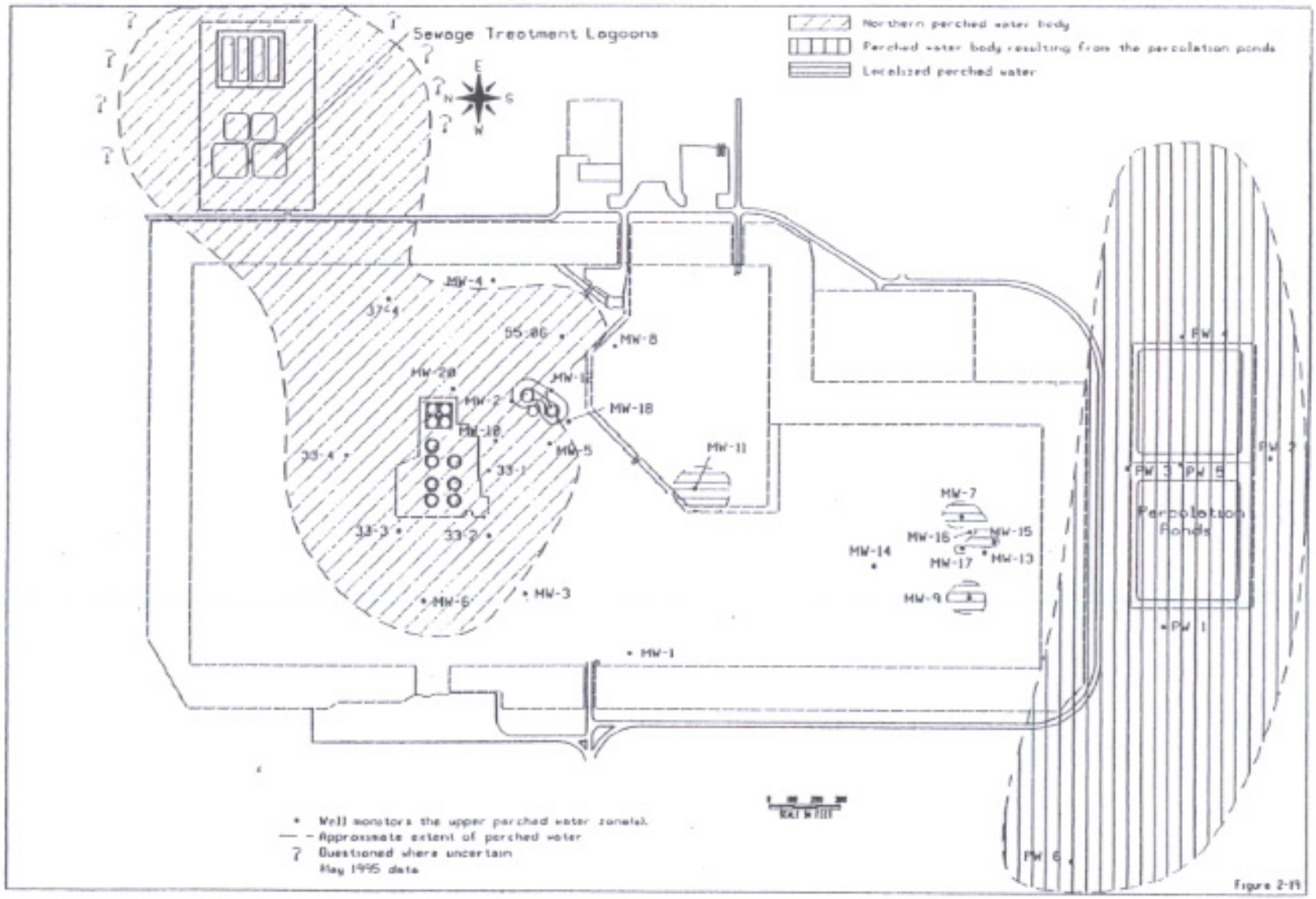


Figure 2-19. Approximate extent of the upper basalt perched water bodies at the ICPP.

In addition to these wells, well MW-4 (1 in.) is completed at the bottom of the "D" interbed and Well MW-10 (1 in.) is completed in a fracture zone associated with the "BC" interbed. Historically, both of these wells have been dry.

The extent of the upper basalt perched groundwater body is provided in Figure 2-19. These elevations range from 1,462.2 to 1,476.8 m (4,797.3 to 4,845.3 ft) and represent the average water table level throughout the monitoring period as discussed in Section 2.6.1.4. The extent of the perched water above the "CD" and "D" interbeds are illustrated in this figure. Perched groundwater is not known to occur above these interbeds outside the areas illustrated on the map. Where the perched water bodies overlap (i.e., in the vicinity of wells CPP-33-4, CPP-33-1, MW-5), the entire region between the "CD" and "D" interbeds is likely to be saturated. Otherwise, perched groundwater is only present above the associated interbed. The height of the perched groundwater above the "CD" and "D" interbeds is provided in Figures 2-20 and 2-21, respectively. Based upon the input parameters used in the Tetrad groundwater model, and assuming 100% water saturation, it is estimated that the upper perched water zone contains 25.7×10^9 L (6.8×10^9 gal) of water.

An east-west cross section is provided in Figure 2-22 to illustrate the occurrence of the interbeds and the associated perched groundwater. In the eastern part of the section (i.e., in the vicinity of wells MW-4 and CPP 55-06), the "CD" and "D" interbeds form a single stratigraphic unit because the "CD" basalt flow is not present. These interbeds separate toward the west forming two layers to impede the downward migration of water. The average separation between these two interbed is approximately 2.7 m (9 ft).

Based on the water table configuration, it appears that multiple water sources are providing recharge to the upper basalt perched water body in the northern ICPP. The sewage treatment ponds, located east of the facility, provide approximately 4.73×10^6 L (1.25×10^6 gal) per month of re harge to this perched water body. This recharge has resulted in a water table elevation of 1,476.8 m (4,845 ft) in the well (CPP-MON-P-024) completed near the sewage treatment ponds. In the western portion of the perched water body and beneath the main portion of the facility, recharge from an unknown source(s) has produced a maximum water table elevation of 1,468.4 m (4,817.5 ft) in well CPP-33-2. Between the eastern and western portions of the upper perched water body, the average groundwater elevation is 1,465.8 m (4,809.2) ft in Well CPP-37-4. This water table configuration indicates separate sources of water providing recharge to the eastern and western portions of the upper-most perched water body and that the sewage treatment ponds have minimal, if any, impact upon the western portion of this perched water body.

Occurring beneath the upper perched groundwater body, a deeper perched groundwater body has been identified at a depth of approximately 140 ft bgs. This groundwater appears to be the result of the "DE3" interbed, which occurs between 163 and 169 ft bgs in the northern ICPP. Only three wells [MW-10 (2-in.), MW-12 (1-in.), and MW-20 (2-in.)] are completed in this perched groundwater body. Based upon monitoring data, the water table elevation within this perched water zone varies from 1,453.6 to 1,456.6 m (4,769 to 4,779 ft). The estimated extent and water table elevation for this perched water body is provided in Figure 2-23. Based on the input parameters for the Tetrad groundwater model, and assuming 100% water saturation, it is estimated that the middle perched water zone contains 14.8×10^9 L (3.9×10^9 gal) of water.

2.6.1.2.2 Southern ICPP—The upper perched water bodies identified in the southern ICPP are shown in Figure 2-19. The largest perched water body is the result of discharge to the percolation ponds and monitored by wells PW-1 through PW-6. In the vicinity of CPP-603, six wells (MW-7, MW-9, and MW-13

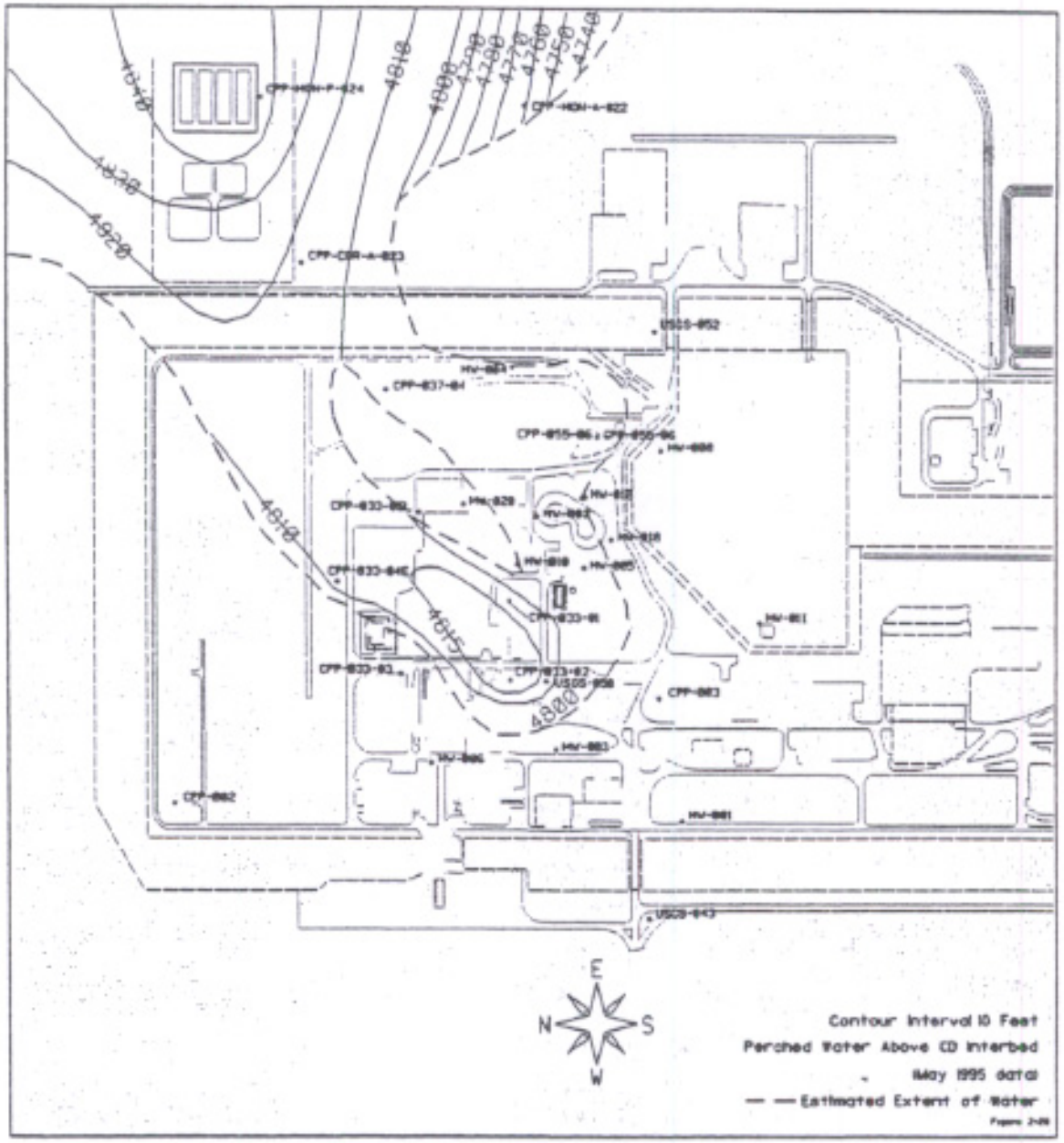


Figure 2-20. Elevation of water above the "CD" interbed in the northern ICPP.

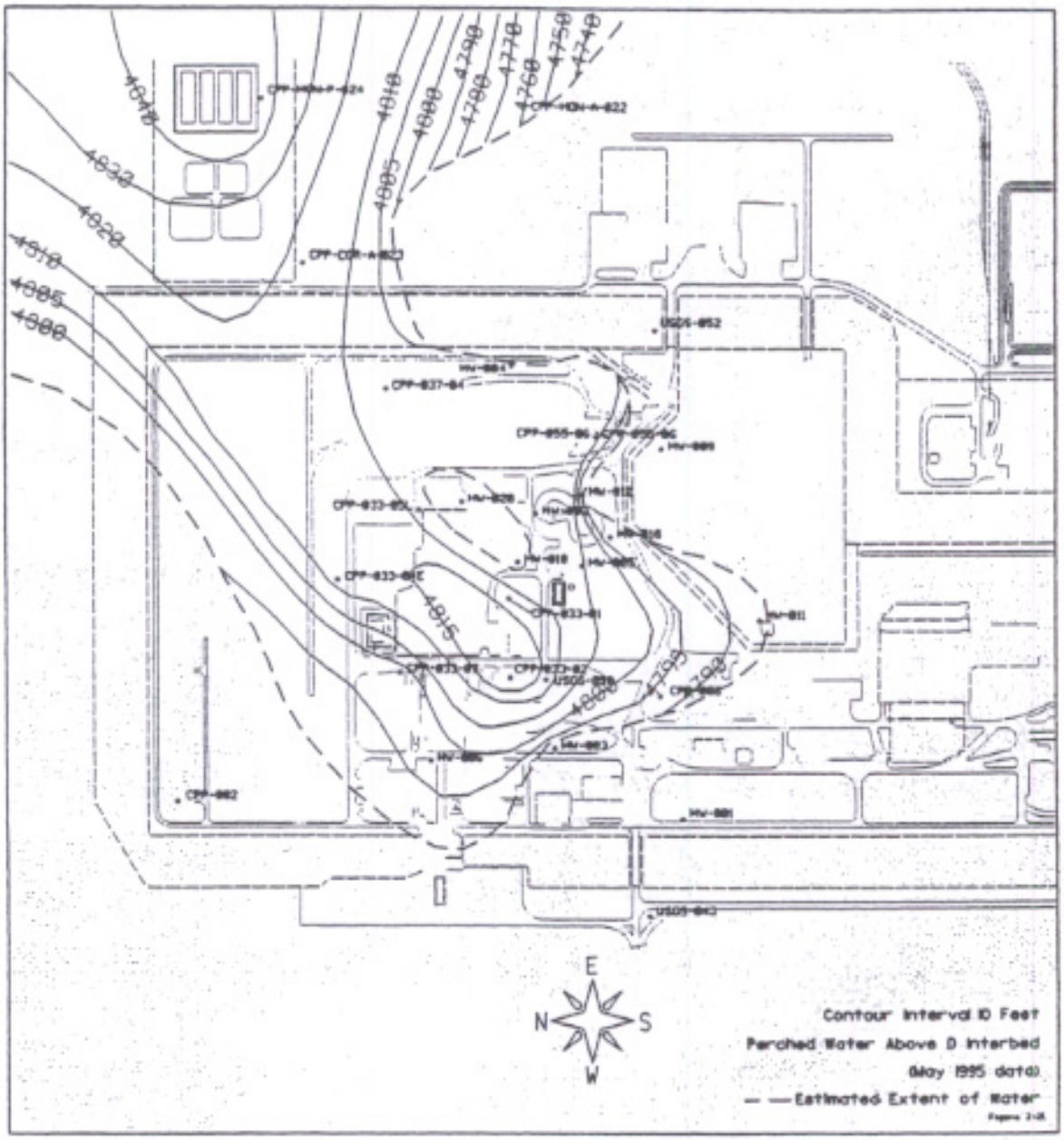


Figure 2-21. Elevation of water above the "D" interbed in the northern ICPP.

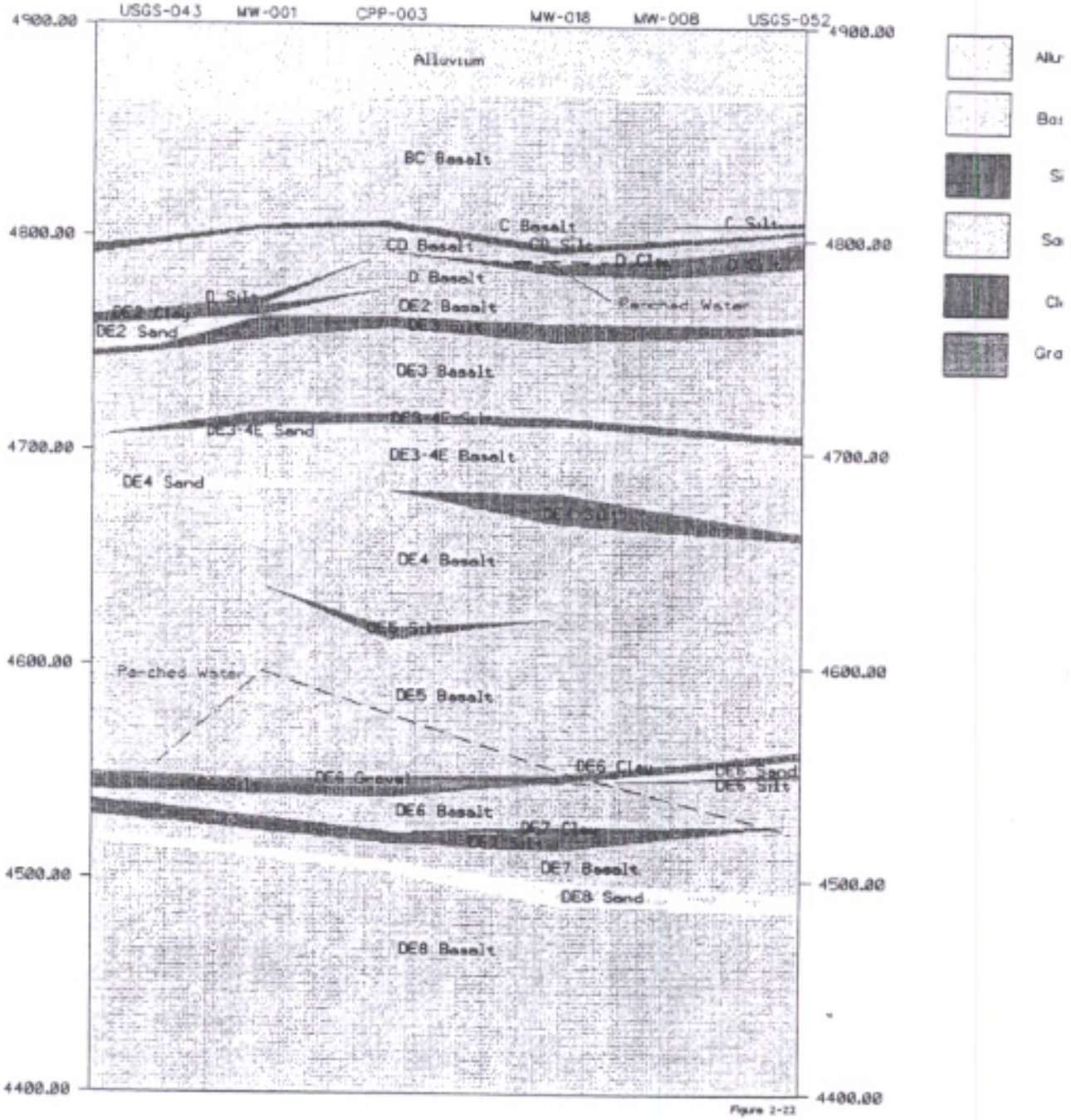


Figure 2-22. East-west cross section of the upper basalt perched water zone in the northern ICPP.

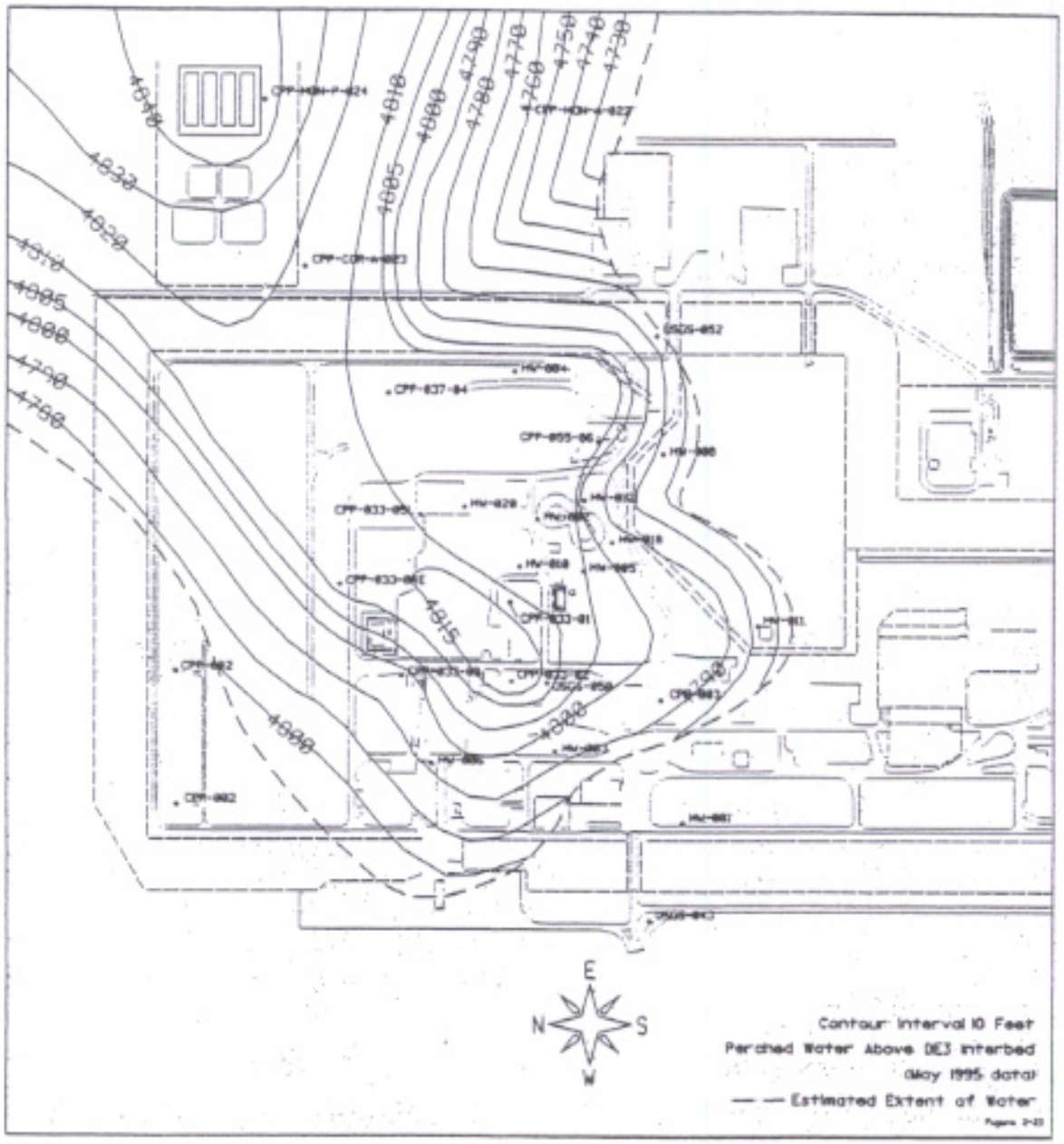


Figure 2-23. Approximate extent of the perched groundwater above the "DE3" interbed.

through MW-16) were installed to monitor perched water on the upper interbed that is present between 33.5- and 39.6-m (110- and 130-ft) bgs. One triple completion well (MW-17) was installed to monitor for perched water on a deeper interbed occurring approximately 57.9 m (190 ft) bgs.

An extensive perched water body on the upper interbed has not been identified in the vicinity of CPP-603. Only three wells (MW-7, MW-9, and MW-15) have detected water on the upper interbed, and the remaining three wells (MW-13, MW-14, and MW-16) are dry. Other than MW-15, only minimal water has been encountered with the height of water above the interbed less than 1.2 m (4 ft) during every measuring event.

Wells PW-1 through PW-6 were installed adjacent to the percolation ponds to monitor the perched groundwater beneath the ponds. Figure 2-24 provides the hydrographs for these wells during the period from September 1986 through early 1994. As shown in this figure, a similar fluctuation in the water level is observed for Wells PW-1, PW-3, and PW-6 indicating these wells are effective in monitoring infiltration from the western percolation pond. The water level fluctuation in Well PW-4 is opposite to the response observed in Wells PW-1, PW-3, and PW-6, indicating this well monitors infiltration from the eastern percolation pond. The water level fluctuations in Wells PW-2 and PW-5 are fairly consistent indicating these wells are influenced by discharge to either pond.

2.6.1.3 Lower Basalt Perched Water Zone. A lower perched groundwater zone has been identified to occur in the basalt between 97.5- and 128-m (320- and 420-ft) bgs. This water was first discovered in 1956 while drilling Well USGS-40 where perched groundwater was encountered at a depth of 106 m (348 ft) (Robertson et al., 1974). Since then, groundwater has been encountered in this zone during the drilling of Wells USGS-41, USGS-43, USGS-44, USGS-50, USGS-52, MW-1, MW-17, and MW-18. Table 2-10 summarizes the available data from the USGS wells concerning the deep perched groundwater zone. Borehole neutron logs ran in 1993 indicate perched water may still be present in this zone from Wells USGS-40, USGS-43, USGS-46, USGS-51, and USGS-52.

Only four wells are completed in the lower perched water zone that presently monitor water level changes. Wells MW-1, MW-18, and USGS-50 are completed in the northern portion of the facility having encountered water at approximately 85, 107.5, and 101 m (322, 407, and 383-ft) bgs, respectively. In the southern portion of the facility, only Well MW-17 is completed in the lower perched water zone where water is encountered at a depth of approximately 96-m (364-ft) bgs. Based upon water quality information, the deep perched groundwater encountered by Well MW-17 is the result of discharge to the percolation ponds.

Similar to the upper basalt perched water zone, the lower perched water zone is thought to be formed by decreased permeability associated with sedimentary interbed layers. It appears that the lower perched groundwater has formed primarily on the "DE8" interbed. The top of this interbed occurs beneath the ICPP at depths ranging from 101 to 112.5 m (383 to 426 ft) bgs. In the western portion of the facility, however, the "DE6' interbed is responsible for creating perched groundwater associated with Wells USGS-40 and USGS-43. Table 2-11 provides a summary of the perching layer, depth to water, and water table elevation for the wells that encountered lower perched groundwater. The extent of the lower perched groundwater and approximate elevation of the water table is shown in Figure 2-25. It should be noted that these data contain a high degree of uncertainty since they consist of a combination of original drillers logs (some dating back 40 years), geophysical borehole logs, and monitoring wells that are completed in this zone.

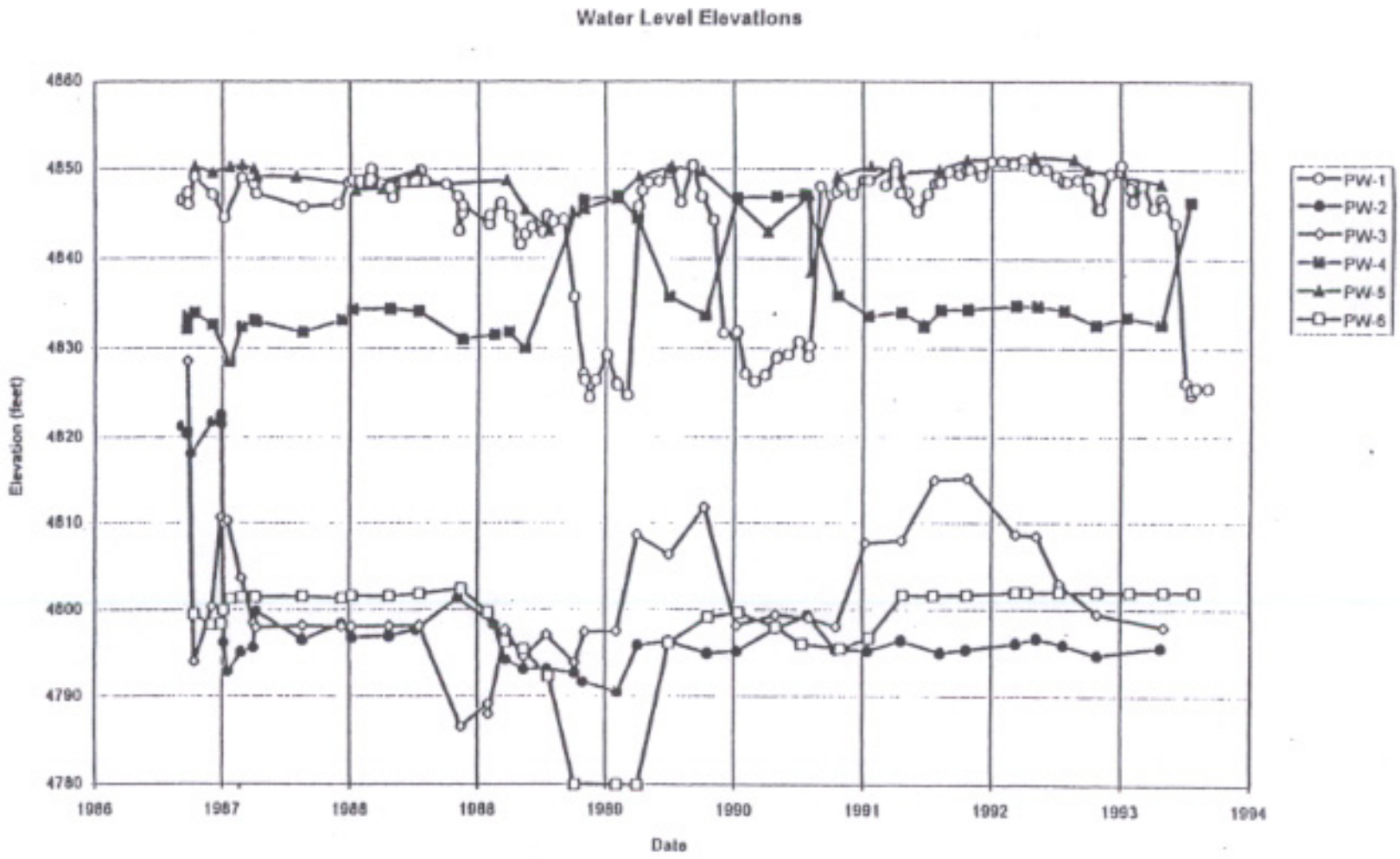


Figure 2-24. Hydrographs for the PW-series wells.

Table 2-10. Depth of perched water zones encountered during the drilling of wells around the ICPP (Robertson et al., 1974).

Well number	Date drilled	Depths to perched water (ft)	Characteristics of the water	Depth of perching clay layer (ft)
USGS-40	September, 1956	348 (rose to 340)	high Na^+, Cl^-	370
USGS-41	December, 1956	396 (rose to 384)	high Cl^-	Unknown
USGS-43	March, 1957	367 (rose to 362)	background groundwater composition	370
USGS-44	September, 1957	385	background groundwater composition	Unknown
USGS-50	September, 1959	84		110 ?
		126	high sodium, β activity, Ru-106, Rh-106 present	135
	Deepened to 405 ft October, 1962	390	high H-3	392
USGS-52	December, 1959	174	slightly high Na^+, high β and γ activity, I-131, Ru-106, Rh-106 present	195
	Deepened to 650 ft October, 1960	320		345
		385	slightly high Na^+, high β activity, Ru-106 present	410

Table 2-11. Perched layer, depth to water, and water table elevation for the wells encountering water in the lower perched water zone.

	Water Level		Perching Layer		Water Table Elevation
Well	ft bls	Year	Interbed	Depth	(ft AMSL)
USGS-40	340	1956	DE6	368-383	4,576
USGS-41	384	1956	DE8	406-430	4,533
USGS-43	362	1957	DE6	368-376	4,554
USGS-44	385	1957	DE8	410	4,534
USGS-50	383	1995	DE8	396-405	4,535
USGS-51	270	1986	DE6	384-400	4,686
USGS-52	385	1960	DE8	416-425	4,525
MW-1	322	1995	Unknown	Unknown	4,597
MW-17	364	1995	DE8	>381	4,557
MW-18	407	1995	DE8	412.7-423.2	4,553

As shown in Figure 2-25, the lower perched water zone is probably not continuous beneath the entire facility, and may actually consist of several individual perched water bodies. The north-south separation of the lower perched water bodies is based on the lack of perched groundwater (either through drilling or subsequent neutron logging) identified in Wells USGS-42, -45, -47, -48, and -49. Based on input parameters used in the Tetrad groundwater model, and assuming 100% water saturation, it is estimated that the deep perched water zone contains 20.4×10^9 L (5.4×10^9 gal) of water. Recharge to the southern perched water body is from wastewater discharged to the percolation ponds. The source of recharge to the western portion of the northern perched water body is unknown.

Water levels in this lower perched water zone have been monitored since the early 1960's in Well USGS-50 (Figure 2-26). Other than during the late 1960's and early 1970's, the water level in this well has been fairly consistent. The water level during this period generally ranged between 1,381 and 1,384 m (4,530 and 4,540 ft) amsl. In the late 1960's/early 1970's; however, the water level increased by approximately 27.4 m (90 ft) in response to failure of the ICPP injection well. During this period, wastewater was discharged directly to the vadose zone from the ICPP injection well at a reported depth of 68.9 m (226 ft) bgs.

The presence of a deep perched groundwater zone beneath the percolation ponds is indicated by the borehole neutron response from Wells USGS-51 and MW-17. Figure 2-27 shows the natural gamma log, stratigraphy, and epithermal neutron logs ran in 1984, 1985, and 1986 for Well USGS-51. Deflections of the neutron log to the left indicate increases in moisture content. As shown in this figure, two zones illustrate significantly increasing moisture content since the percolation ponds were placed into service on February 1984. These two zones occur from 44.2 to 54.3 m (145 to 178 ft) and 83.5 to 101 m (274- to 332-ft) bgs. The upper perched water zone is currently being monitored by the PW-series wells. Well MW-17 (4-in.) is completed in the lower perched water zone.

2.6.1.4 Water Level Fluctuation. Thirty-two wells have been installed to monitor the water level fluctuations in the perched groundwater beneath the ICPP. Several piezometers have been completed in conjunction with the perched water wells, resulting in 44 different monitoring intervals. If water was present in the well following completion, the well was usually equipped with a pressure transducer and data logger to automatically monitor changes in the water level. Table 2-12 describes the well, monitoring period, number of measurements, and general statistics concerning the water level elevation for the wells being monitored. Concurrent with the automatic monitoring of selected wells, complete rounds of water level measurements have been recorded for all the perched water wells. A summary of the water level data from these measuring events is provided in Table 2-13.

Hydrographs for the nine perched water wells completed in the northern ICPP are provided in Figure 2-28. Figure 2-29 shows the same well hydrographs grouped according to similar water level patterns. Data presented in these hydrographs were collected between January 1993 and October 1995 and represent the majority of perched water monitoring at the ICPP. Individual hydrographs for each of these wells are presented in Appendix B. Several water-level fluctuation patterns are shown in the hydrographs presented in Figure 2-29 and are discussed below:

- Wells CPP-33-4, CPP-37-4, and MW-4 show similar water-level fluctuation patterns. During 1994, water level elevations were highest in March, and decreased during the summer and remained relatively constant for the remainder of the year. Well CPP-33-4 showed a rise in water level during the November and December of 1994. Water levels increased from January 1995 to

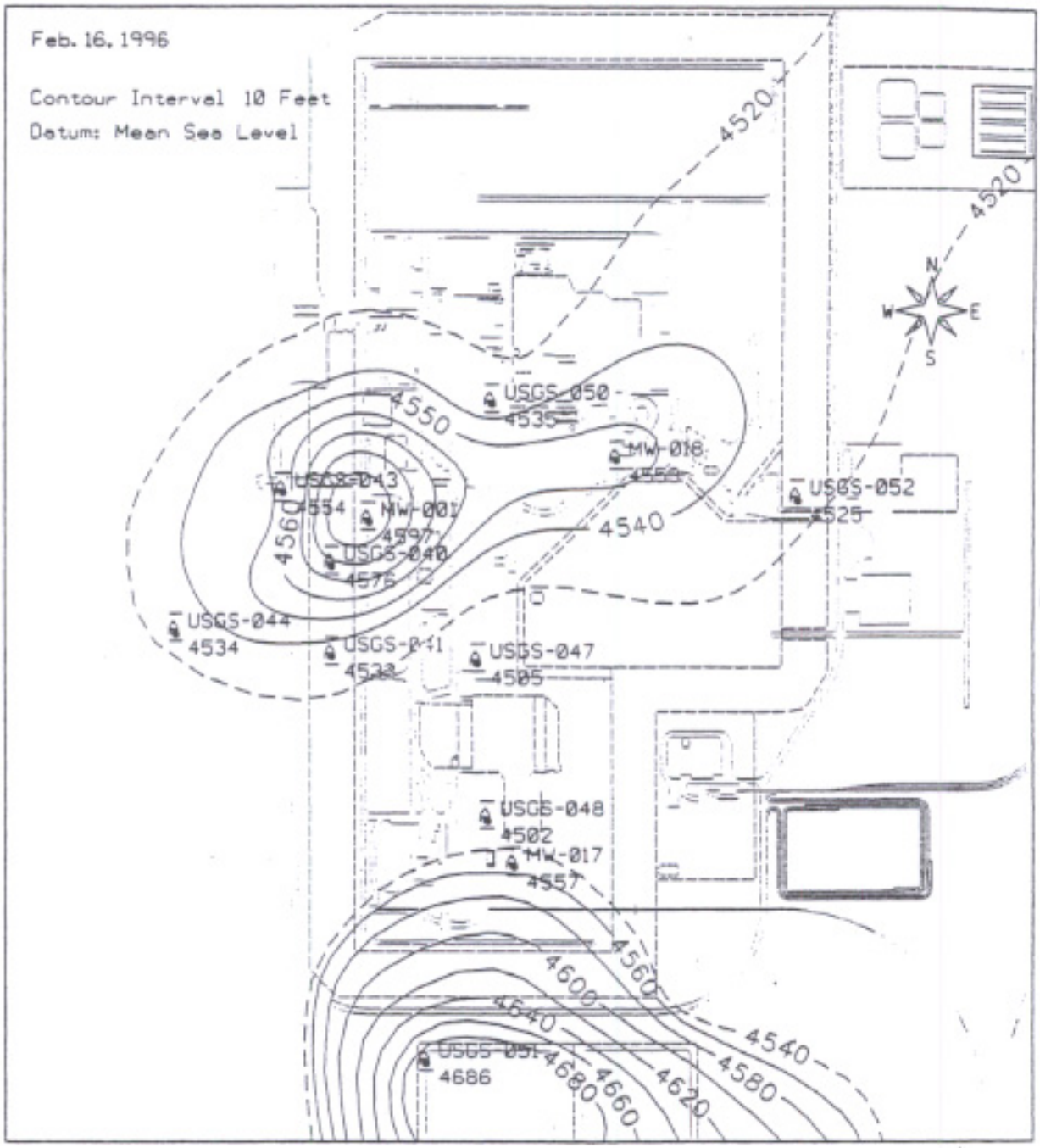


Figure 2-25. Approximate extent of the lower perched groundwater zone.

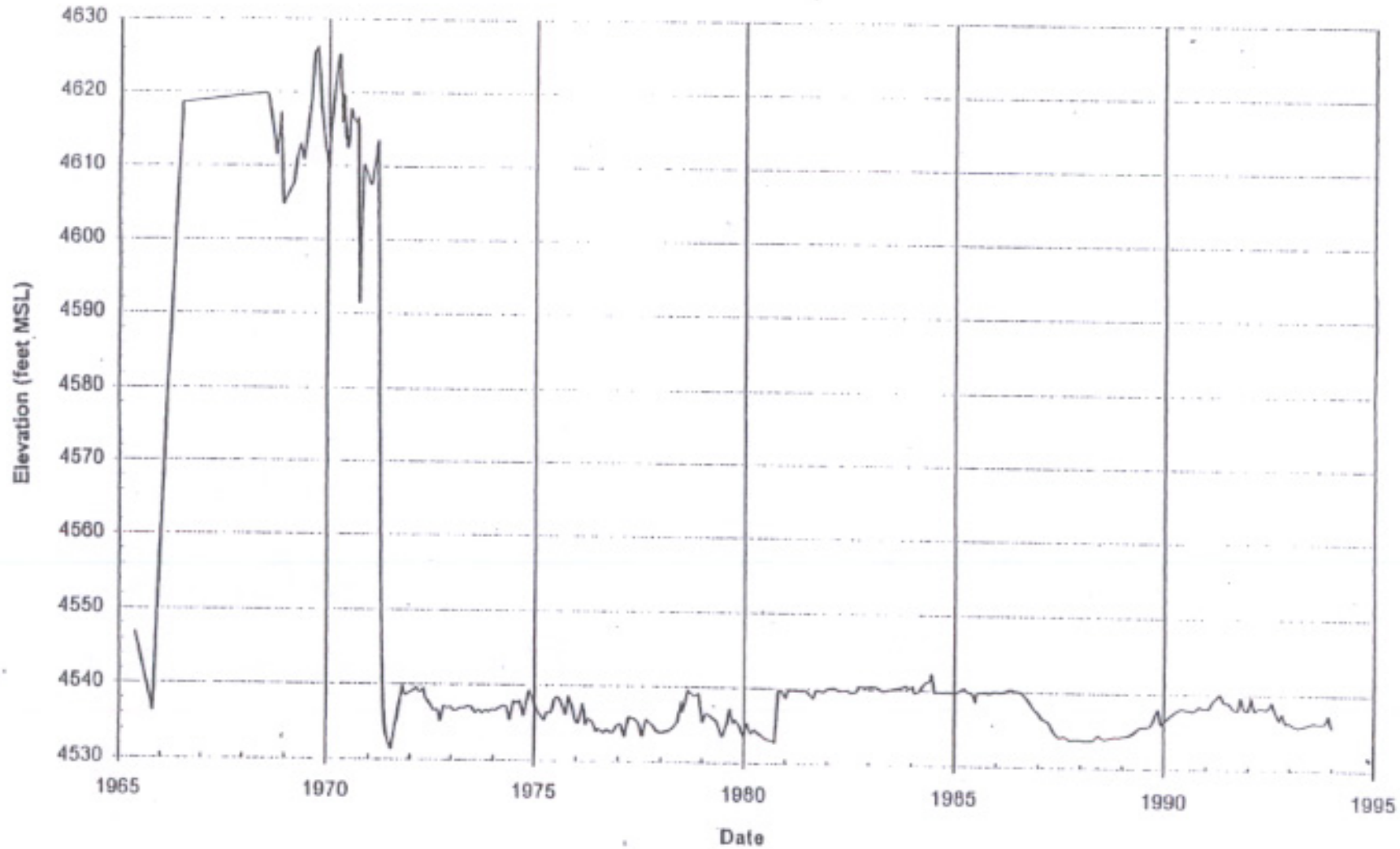


Figure 2-26. Hydrograph for Well USGS-50 (USGS records).

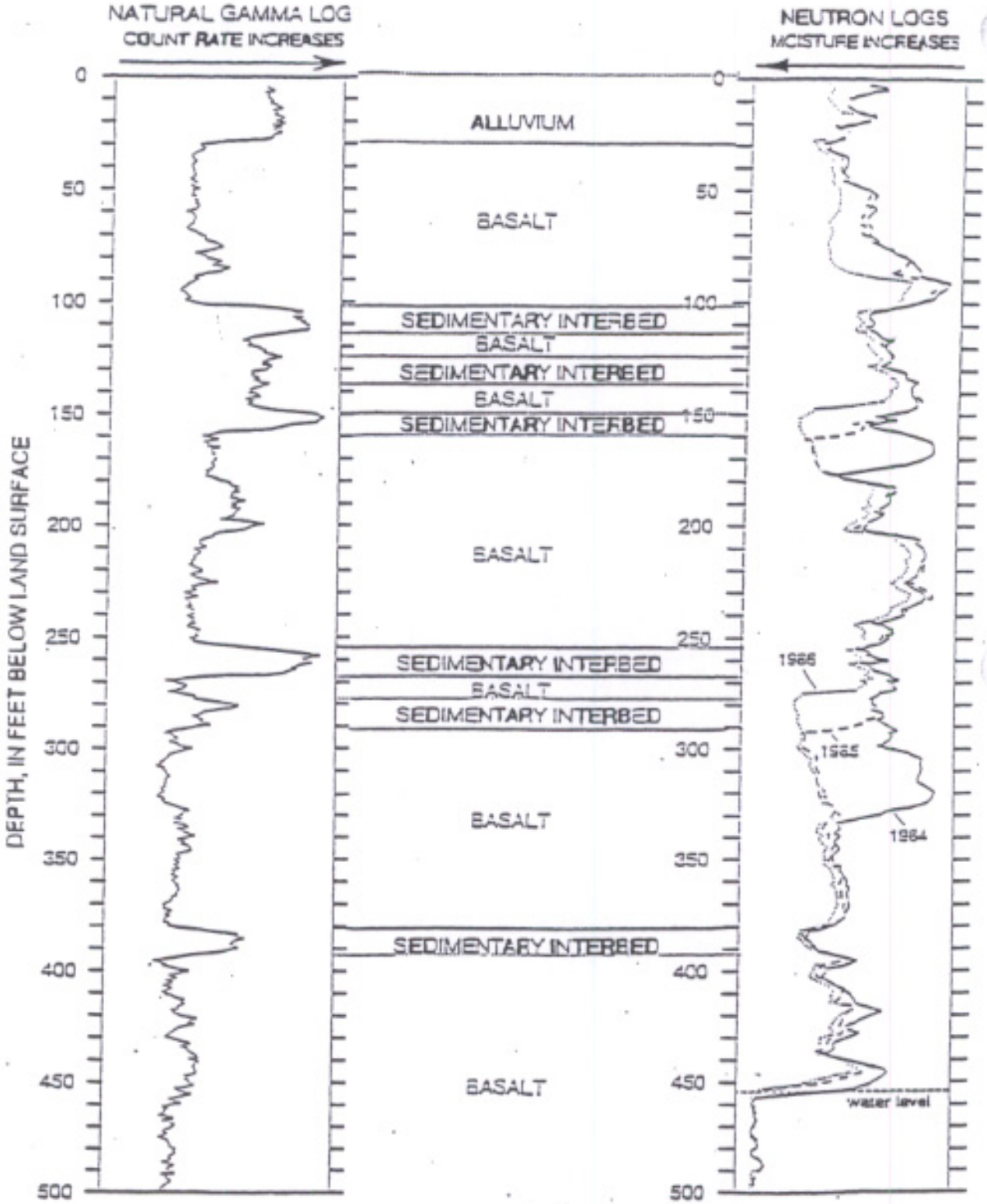


Figure 2-27. Natural gamma log, stratigraphy, and neutron logs for Well USGS-51 (Cecil et al., 1991).

Table 2-12. Summary of the water level monitoring data from the perched water wells equipped with data loggers.

Well	Period of record	Number of measurements	Minimum water level (ft amsl)	Maximum water level (ft amsl)	Average water level (ft amsl)
CPP 33-2	12/92–10/95	973	4,811.14	4,820.68	4,817.53
CPP 33-3	1/93–10/95	962	4,794.02	4,802.25	4,799.05
CPP 33-4	1/93–10/95	672	4,800.11	4,815.51	4,810.83
CPP 37-4	9/92–10/95	481	4,806.52	4,812.82	4,809.21
CPP 55-06	10/92–10/95	1,000	4,802.10	4,810.52	4,806.61
MW-1	6/95–11/95	942	4,595.07	4,602.89	4,598.97
MW-2	2/94–10/95	588	4,804.72	4,809.85	4,807.14
MW-4	2/94–10/95	606	4,804.64	4,810.04	4,806.65
MW-5	3/94–9/95	559	4,803.34	4,808.98	4,805.61
MW-6	2/94–10/95	608	4,792.14	4,804.79	4,797.32
MW-20	6/95–9/95	539	4,779.56	4,781.44	4,780.53
USGS-50	6/95–11/95	943	4,524.02	4,534.80	4,533.05

Table 2-13. Summary of water level data from the perched water wells.

		January 1994			May 1994			August 1994			Sept 1994 - Jan 1995			May 1995		
Designation	Construction	Ft bls	Elevation	Ft in Well	Ft bls	Elevation	Ft in Well	Ft bls	Elevation	Ft in Well	Ft bls	Elevation	Ft in Well	Ft bls	Elevation	Ft in Well
CPP 33-1	2-in. SS Well	Dry(1)	NA	NA	Dry(1)	NA	NA	Dry(1)	NA	NA	Dry	NA	NA	99.91	4817.47	1.27
CPP 33-2	2-in. SS Well	101.55	4813.87	5.47	98.90	4816.52	8.12	98.67	4816.75	8.35	98.85	4816.57	8.17	97.50	4817.92	9.52
CPP 33-3	2-in. SS Well	117.95	4798.28	6.38	117.92	4798.31	6.41	117.85	4798.38	6.48	115.11	4801.12	9.22	118.33	4797.90	6.00
CPP 33-4	2-in. SS Well	104.88	4809.13	15.43	102.56	4811.45	17.75	106.60	4807.41	13.71	106.83	4807.18	13.48	102.85	4811.16	17.46
CPP 37-4	2-in. SS Well	104.66	4808.00	6.90	105.60	4807.06	5.96	106.21	4806.45	5.35	106.60	4806.06	4.96	103.80	4808.86	7.76
CPP 55-06	2-in. SS Well	106.42	4806.79	8.29	108.58	4804.63	6.13	110.48	4802.73	4.23	106.93	4806.28	7.78	106.25	4806.96	8.46
MW-1	4-in. PVC Well	318.12	4601.13	20.63	322.00	4597.25	16.75	324.23	4595.02	14.52	323.25	4596.00	15.50	322.28	4596.97	16.47
MW-1	1-in. PVC Piezo.	NR	NA	NA	Dry	NA	NA	Dry	NA	NA	Dry	NA	NA	Dry	NA	NA
MW-2	2-in. PVC Well	107.87	4808.22	7.12	109.88	4806.21	5.11	Dry	NA	NA	107.70	4808.39	7.29	107.49	4808.60	7.50
MW-3	2-in. PVC Well	Dry	NA	NA	Dry	NA	NA	Dry	NA	NA	Dry	NA	NA	Dry	NA	NA
MW-3	1-in. PVC Piezo.	NR	NA	NA	Dry	NA	NA	Dry	NA	NA	Dry	NA	NA	Dry	NA	NA
MW-4	2-in. PVC Well	Dry	NA	NA	Dry	NA	NA	Dry	NA	NA	Dry	NA	NA	105.85	4808.36	7.56
MW-4	1-in. PVC Piezo.	NR	NA	NA	NR	NA	NA	Dry	NA	NA	Dry	NA	NA	131.10	4782.67	0.97
MW-5	2-in. PVC Well	111.92	4807.35	17.45	113.25	4806.02	16.12	115.12	4804.15	14.25	115.36	4803.91	14.01	112.30	4806.97	17.07
MW-6	2-in. PVC Well	126.34	4792.92	13.42	127.25	4792.01	12.51	116.77	4802.49	22.99	116.60	4802.66	23.16	122.70	4796.56	17.06
MW-7	2-in. PVC Well	141.85	4778.28	2.88	140.75	4779.38	3.98	140.75	4779.38	3.98	134.31	4785.82	10.42	Dry	NA	NA
MW-7	1-in. PVC Piezo.	NR	NA	NA	NR	NA	NA	Dry(1)	NA	NA	Dry	NA	NA	Dry	NA	NA
MW-8	2-in. PVC Well	Dry	NA	NA	Dry	NA	NA	Dry	NA	NA	Dry	NA	NA	Dry	NA	NA
MW-9	2-in. PVC Well	129.81	4792.52	2.92	Dry(1)	NA	NA	132.35	4789.98	0.38	131.87	4790.46	0.86	Dry	NA	NA
MW-9	1-in. PVC Piezo.	NR	NA	NA	NR	NA	NA	Dry	NA	NA	Dry	NA	NA	Dry	NA	NA
MW-10	2-in. PVC Well	Dry	NA	NA	NA	NA	NA	147.29	4770.12	6.42	141.47	4775.94	12.24	148.12	4769.29	5.59
MW-10	1-in. PVC Piezo.	NR	NR	NR	NR	NA	NA	Dry	NA	NA	Dry	NA	NA	79.12	4838.29	1.59
MW-11	2-in. PVC Well	138.46	4779.44	0.54	137.72	4780.18	1.28	138.62	4779.28	0.38	Dry	NA	NA	Dry	NA	NA
MW-11	1-in. PVC Piezo.	NR	NR	NR	NR	NA	NA	Dry	NA	NA	Dry	NA	NA	Dry	NA	NA
MW-12	2-in. PVC Well	Dry	NA	NA	Dry	NA	NA	Dry	NA	NA	Dry	NA	NA	Dry	NA	NA
MW-12	1-in. PVC Piezo.	NR	NR	NR	NR	NA	NA	Dry	NA	NA	Dry	NA	NA	153.00	4762.99	0.29
MW-13	2-in. PVC Well	NR	NR	NR	NR	NR	NR	NR	NR	NR	Dry	NA	NA	Dry	NA	NA
MW-14	2-in. PVC Well	NR	NR	NR	NR	NR	NR	NR	NR	NR	Dry	NA	NA	Dry	NA	NA
MW-15	2-in. PVC Well	NR	NR	NR	NR	NR	NR	NR	NR	NR	122.50	4798.75	11.15	122.85	4798.40	10.80
MW-16	2-in. PVC Well	NR	NR	NR	NR	NR	NR	NR	NR	NR	Dry	NA	NA	Dry	NA	NA
MW-17	2-in. PVC Well	NR	NR	NR	NR	NR	NR	NR	NR	NR	190.50	4730.61	4.01	190.37	4730.74	4.14
MW-17	1-in. PVC Piezo.	NR	NR	NR	NR	NR	NR	NR	NR	NR	Dry	NA	NA	Dry	NA	NA
MW-17	4-in. Steel Well	NR	NR	NR	NR	NR	NR	NR	NR	NR	364.30	4556.81	19.51	364.80	4556.31	19.01
MW-18	2-in. PVC Well	NR	NR	NR	NR	NR	NR	NR	NR	NR	Dry	NA	NA	124.35	4792.97	2.47
MW-18	1-in. PVC Well										407.25	4510.08	10.08	407.63	4509.70	9.70
MW-18	4-in. PVC Well	NR	NR	NR	NR	NR	NR	NR	NR	NR	462.95	4454.36	18.86	464.19	4453.12	17.62
MW-20	2-in. PVC Well	NR	NR	NR	NR	NR	NR	NR	NR	NR	139.60	4778.40	11.80	137.33	4780.67	14.07
MW-20	1-in. PVC Piezo.	NR	NR	NR	NR	NR	NR	NR	NR	NR	Dry	NA	NA	109.34	4808.66	0.00

NR - not reported.
NA - not available.

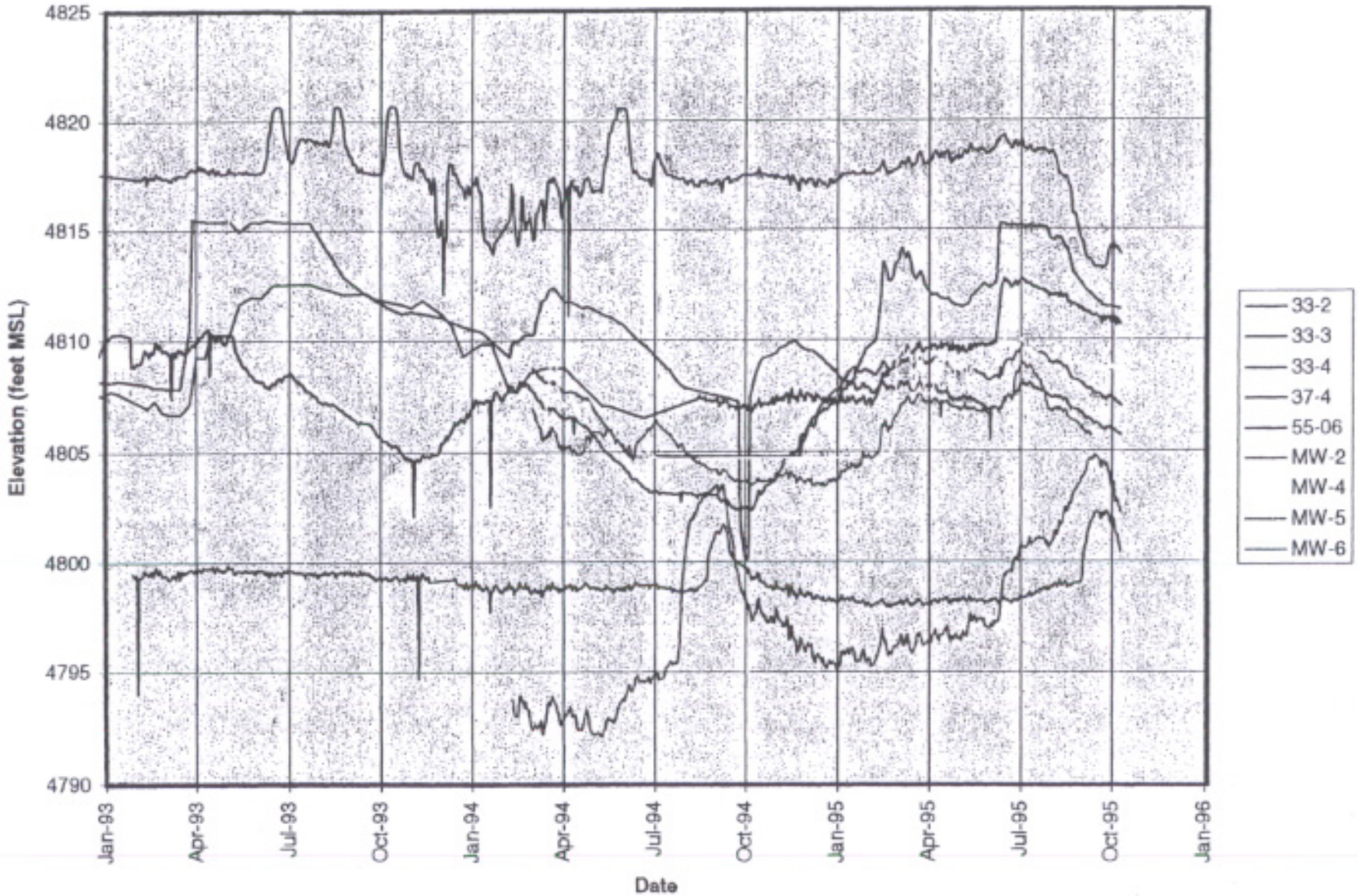


Figure 2-28. Hydrographs for the perched water wells equipped with data loggers

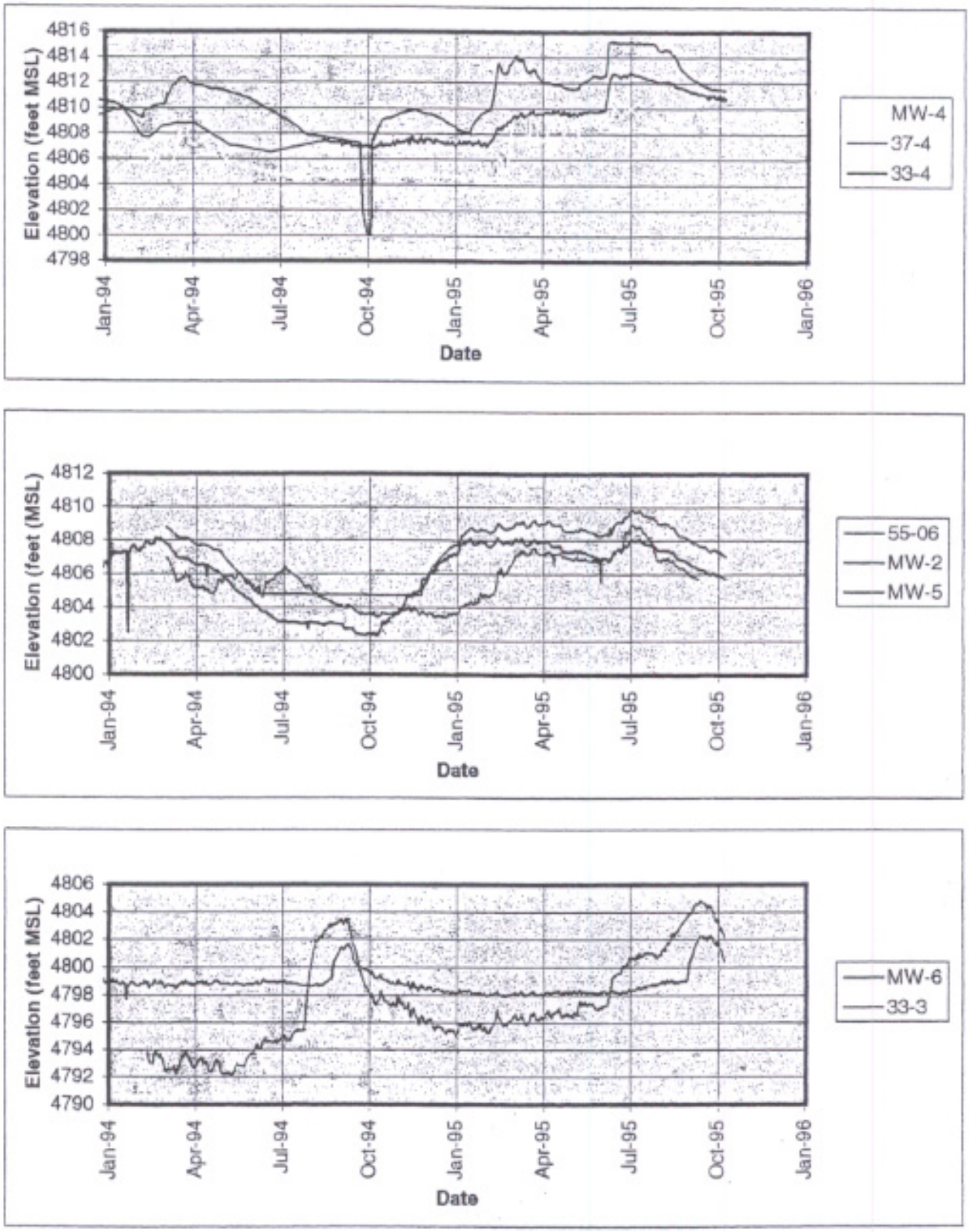


Figure 2-29. Hydrographs for perched water wells from 1994 to October 1995.

the highest level during May 1995. The water level fluctuations at these wells appear to be caused by recharge from both spring snowmelt and increased runoff in the Big Lost River as indicated by the June water level increases. The hydrograph for well MW-2 shows the water-level elevation of about 4805 ft msl between July 1994 and February 1995, which was caused by the water level falling below the transducer.

- Similar water-level responses are shown by wells 55-06, MW-2, and MW-5. Water levels generally are lower during the summer months and increase during the fall, winter, and spring months. These water-level patterns are largely attributed to the steam injection vents, where excess steam is discharged to the subsurface. The hydrograph for well MW-2 shows the water-level elevation of 4,805 ft msl between May and November 1994 which was caused by the water level falling below the transducer.

- Wells MW-6 and CPP-33-3 also exhibit similar water-level fluctuations. Both wells show an apparent seasonal water-level increase and decrease between July and October for each of the years monitored. The water level increase during this period is about 8 feet for well MW-6 and 3 feet for well 33-3. These apparent seasonal responses can not be attributed to any known plant operations. The water-level fluctuations may suggest a local lag in groundwater recharge, resulting from spring snowmelt, to the area where these wells are completed. The permeability of the C interbed at well MW-6 is about two orders of magnitude less than the C-interbed at the adjacent well MW-3 which might account for the apparent lag.

- Water-levels in well CPP 33-2 are not similar to most of the other perched water wells. This well exhibits relatively rapid responses to recharge events as shown in the hydrograph presented in Figure 2-28. The hydrograph presented in Appendix B is difficult to evaluate but appears to show a general pattern of higher water levels during the spring and lower or more constant water levels during the winter. The highest water levels occurred during late spring and summer of 1993 which was a much wetter period than average. About 6 inches of precipitation (Table 2-1) occurred between April and June 1993. The lowest measured water levels occurred during late September 1995, which was also during a period of much lower than average precipitation.

Correlation between pairs of water level data was also performed using the Pearson product-moment test. This procedure is used to calculate the strength of a linear relationship between two variables on a scale of -1 to +1. These coefficients correspond to a perfect negative correlation for -1 and a perfect positive correlation for +1. A coefficient near 0 indicates no linear relationship between the variables. The equation used to calculate the coefficients is as follows:

$$r = \frac{S_{xy}}{\sqrt{S_{xx} * S_{yy}}} \qquad (2\text{-}1)$$

where

r = correlation coefficient

x = variable 1

y = variable 2

S_{xy} = sum of column x multiplied by the sum of column y squared

S_{xx} = sum of column x multiplied by the sum of column x squared

S_{yy} = sum of column y multiplied by the sum of column y squared.

The results of the Pearson product-moment correlation for the perched water wells in the northern ICPP is provided in Table 2-14. The best positive correlation is observed between Wells CPP 55-06 and MW-2 (0.96), followed by Wells CPP 37-4 and MW-4 (0.93). Good positive correlation is also observed between Wells CPP 37-4 and MW-5 (0.88), Wells CPP 33-4 and CPP 37-4 (0.84), Wells CPP 33-4 and MW-4 (0.81), and Wells CPP 33-4 and MW-5 (0.80). These wells are located in the northeastern portion of the facility indicating a similar source of recharge to these wells. Poor correlation is observed from the wells located in the western portion of the facility (CPP 33-2, CPP 33-3, and MW-6) to the wells located to the east. This variation in the water level response indicates two separate sources of recharge to the northern perched water body: one water source providing recharge to the western portion (i.e., in the vicinity of Wells CPP 33-2, CPP 33-3, and MW-6) and the other source providing recharge to the eastern portion (i.e., in the vicinity of Wells CPP 33-4, CPP 37-4, CPP 55-06, MW-2, MW-4, and MW-6).

2.6.1.4.1 Barometric Pressure Effects—Barometric efficiency, which is the response in water level change to change in barometric pressure, was examined in the perched water monitoring wells at ICPP. Barometric efficiency may be as high as 80% (*Ground Water Manual*), and is estimated using the relationship B=dH/dpA, where B is the barometric efficiency, dH is the change in water elevation in a monitoring well, and dpA is the change in air pressure expressed as equivalent feet of water. Daily water level and barometric pressure readings in April 1994 were used because the general trend for water levels in each perched water monitoring well was relatively uneventful and appeared to be less affected by influences other than barometric pressure.

Water level fluctuations in several of the wells exhibited good correlation with changes in barometric pressure, while other wells were either insensitive to air pressure variation or the response was masked by other influences. Well CPP 33-3 exhibited an excellent correlation between water fluid level and barometric pressure, indicating local confinement in this area. Water level fluctuations from Well MW-5 displayed good correlation with barometric changes throughout the first several weeks of April, implying some local confinement for the perched water in this area. There was a significant rise in water level during the fourth week of April in Well MW-5 in excess of that due to barometric pressure alone. Well CPP 55-06 also had good correlation during the first several weeks of April, whereas the last 2 weeks of water level fluctuations were not as correlatable to barometric pressure. Wells CPP 33-2 and MW-6 demonstrated significant changes in water levels, frequently in excess of 100% efficiency, indicating something other than barometric pressure may be influencing the local fluid level behavior. Wells CPP 33-4 and MW-2 exhibited considerably lower barometric efficiency than did Wells CPP 33-3 and MW-5, however, the data are in the range normally observed in confined water aquifer systems, suggesting confinement of perched water may also be occurring in the vicinity of these wells.

Figures 2 through 8 in Appendix B display water levels in perched water wells and also barometric pressure expressed in equivalent feet of head. Table 2-15 provides a summary of the estimates of barometric efficiency for the perched water monitoring wells.

Table 2-14. Pearson correlation coefficient for the perched water wells.

	33-2	33-3	33-4	37-4	55-06	MW-2	MW-4	MW-5	MW-6
33-2	X	-0.65	0.15	0.02	0.07	0.08	0.02	0.36	-0.35
33-3	-0.65	X	-0.25	0.04	-0.42	-0.34	0.000	-0.34	0.60
33-4	0.15	-0.25	X	0.84	0.71	0.74	0.81	0.80	0.07
37-4	0.02	0.04	0.84	X	0.54	0.69	0.93	0.88	0.46
55-06	0.07	-0.42	0.71	0.54	X	0.96	0.64	0.57	-0.10
MW-2	0.08	-0.34	0.74	0.69	0.96	X	0.75	0.70	0.02
MW-4	0.02	0.00	0.81	0.93	0.64	0.75	X	0.84	0.32
MW-5	0.36	-0.34	0.80	0.88	0.57	0.70	0.84	X	0.10
MW-6	-0.35	0.60	0.07	0.46	-0.10	0.02	0.32	0.10	X

2.6.1.5 Big Lost River Effects. The Big Lost River is located directly to the north of the ICPP. Surface water flow from the Big Lost River is monitored near the ICPP at the Lincoln Boulevard gauging station located adjacent to the bridge. Typically, no flow is observed in the Big Lost River near the ICPP. During the past 5 years, however, flow was observed at the Lincoln Boulevard gauging station twice. The first time occurred during June, 1993 where flow in the Big Lost River lasted for approximately 3 weeks. No response was observed in any of the upper basalt perched water wells resulting from the 1993 stream flow in the Big Lost River (Figure 2-30).

Flow in the Big Lost River was again observed at the Lincoln Boulevard gauging station from June 6 to August 9, 1995, which is a span of 64 days. During this period flows were 16,010 acre/ft (June), 22,310 acre/ft (July) and 955 acre/ft (August). An evaluation of the water level response in the perched groundwater to the Big Lost River flow is therefore based on the duration of flow rather than the flow measurements at the gauging station. Figure 2-31 provides hydrographs for wells completed in the upper perched water zone and flow duration for the Big Lost River at the Lincoln Boulevard gauging station.

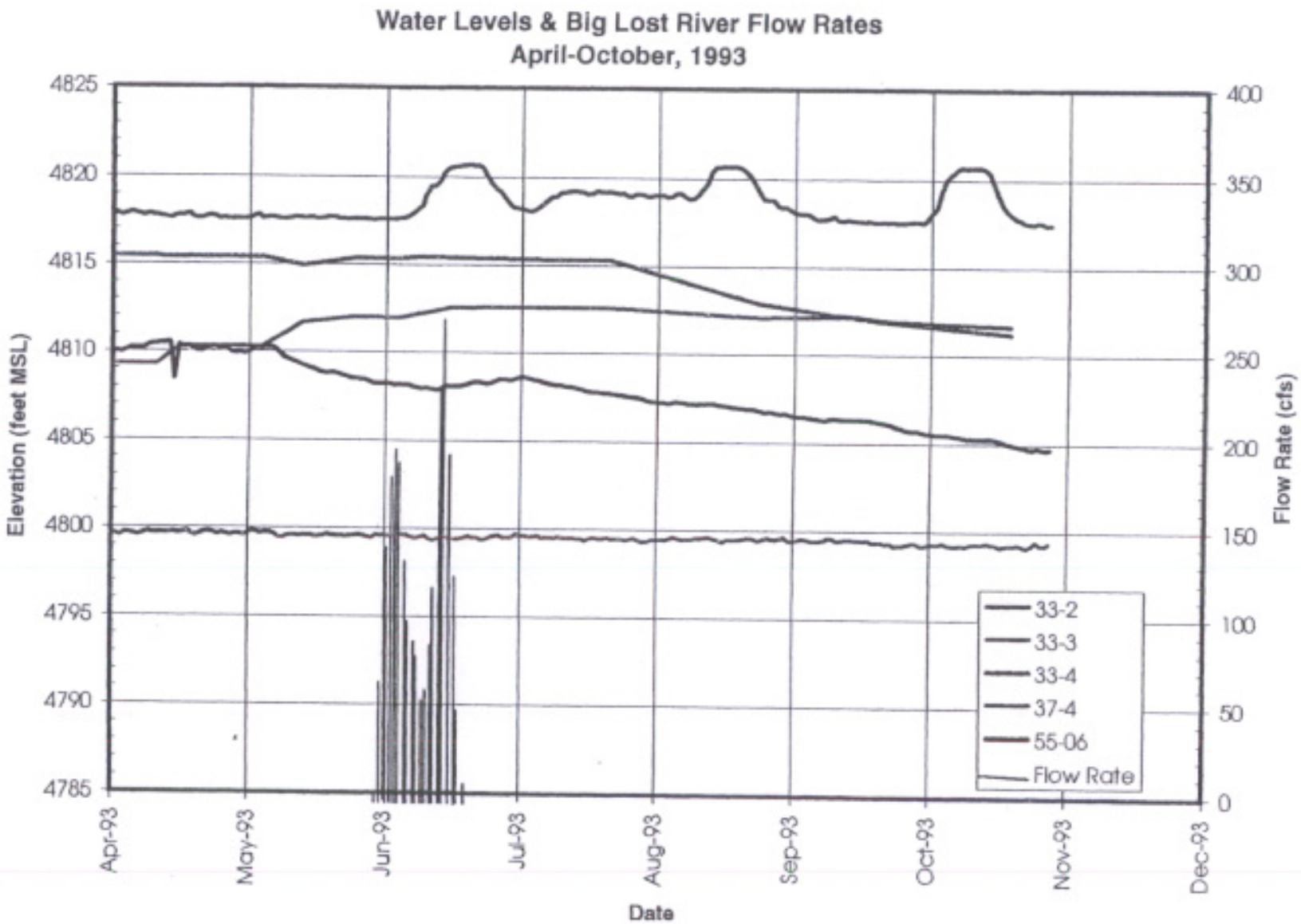
Of the nine wells completed in the upper perched groundwater zone in the northern ICPP, response to flows in the Big Lost River was observed in seven wells (CPP 33-4, CPP 37-4, CPP 55-06, MW-2, MW-4, MW-5, and MW-6). According to the monitoring data, changes in water level were observed to occur between 3 and 9 days following flow in Big Lost River. The average response time was 5.2 days. The maximum increase in water level was observed in Well CPP 33-4 at 0.6 m (2.4 ft). An average increase in the water level for all wells was 0.3 m (1.2 ft). An estimated travel time for the water to move from the Big Lost River to the upper perched groundwater was calculated based upon the distance between the well and the river and the amount of time elapsed until a response was observed in the well. The estimated travel time from the Big Lost River to the upper perched water zone varied between 64.5 to 220 m/day (244 to 834 ft/day) with an average of 121 m/day (459 ft/day). Table 2-16 provides a summary of the water level response attributed to the Big Lost River.

The effects of the Big Lost River were monitored in the lower perched groundwater zone as shown in Figure 2-32. Wells MW-1 and USGS-50 are completed in lower perched groundwater zones at depths of approximately 85 and 100 m (322 and 380 ft), respectively. The water level increased throughout the

Table 2-15. Barometric efficiency estimates for selected perched water monitoring wells at the ICPP.

Change in barometric pressure			Change in water level (ft)						
Interval	dpA, Hg (in.)	dpA, H_2O (ft)	Well 55-06 dH	Well 33-2 dH	Well 33-3 dH	Well 33-4 dH	Well MW-2 dH	Well MW-5 dH	Well MW-6 dH
A-B	0.280	0.317	0.027	0.157	0.202	0.037	0.007	0.178	0.398
B-C	0.110	0.125	0.034	0.532	0.088	0.026	0.013	0.112	0.031
C-D	0.240	0.272	0.101	0.309	0.180	0.000	0.043	0.140	0.360
D-E	0.420	0.476	0.080	0.389	0.272	0.003	0.074	0.295	0.448
E-F	0.280	0.317	0.021	0.469	0.203	0.060	0.009	0.120	0.121
F-G	0.350	0.397	0.132	0.361	0.254	0.067	0.125	0.241	0.585
G-H	0.620	0.703	0.221	0.842	0.367	0.159	0.137	0.834	0.790
H-I	0.480	0.544	0.269	0.393	0.269	0.006	0.223	0.265	0.844
			Barometric efficiency						
			Well 55-06 B	Well 33-2 B	Well 33-3 B	Well 33-4 B	Well MW-2 B	Well MW-5 B	Well MW-6 B
A-B			8.51%	49.46%	63.63%	11.66%	2.21%	56.07%	125.37%[a]
B-C			27.26%	426.57%[a]	70.56%	20.85%	10.42%	89.80%	24.86%
C-D			37.12%	113.56%	66.15%	0.00%	15.80%	51.45%	132.30%[a]
D-E			16.80%	81.69%	57.12%	0.63%	15.54%	61.95%	94.08%
E-F			6.61%	147.74%	63.94%	18.90%	2.84%	37.80%	38.12%
F-G			33.26%	90.97%[a]	64.01%	16.88%	31.50%	60.73%	147.42%[a]
G-H			31.44%	119.78%	52.21%	22.62%	19.49%	118.64%	112.38%
H-I			49.43%	72.21%	49.43%	1.10%	40.98%	48.69%	155.09%[a]
	Average		26.3%	87.9%	60.9%	11.6%	17.4%	66.0%	67.4%
	Std Dev		13.8%	26.3%	6.8%	9.0%	12.5%	26.0%	42.4%

a. If the barometric efficiency was greater than 120%, it was not included in Average and Standard Deviation calculations.


Water Levels & Big Lost River Flow Rates
April-October, 1993
Elevation (feet MSL)
4825
4820
4815
4810
4805
4800
4795
4790
4785
Flow Rate (cfs)
400
350
300
250
200
150
100
50
0
Apr-93
May-93
Jun-93
Jul-93
Aug-93
Sep-93
Oct-93
Nov-93
Dec-93
Date
33-2
33-3
33-4
37-4
55-06
Flow Rate

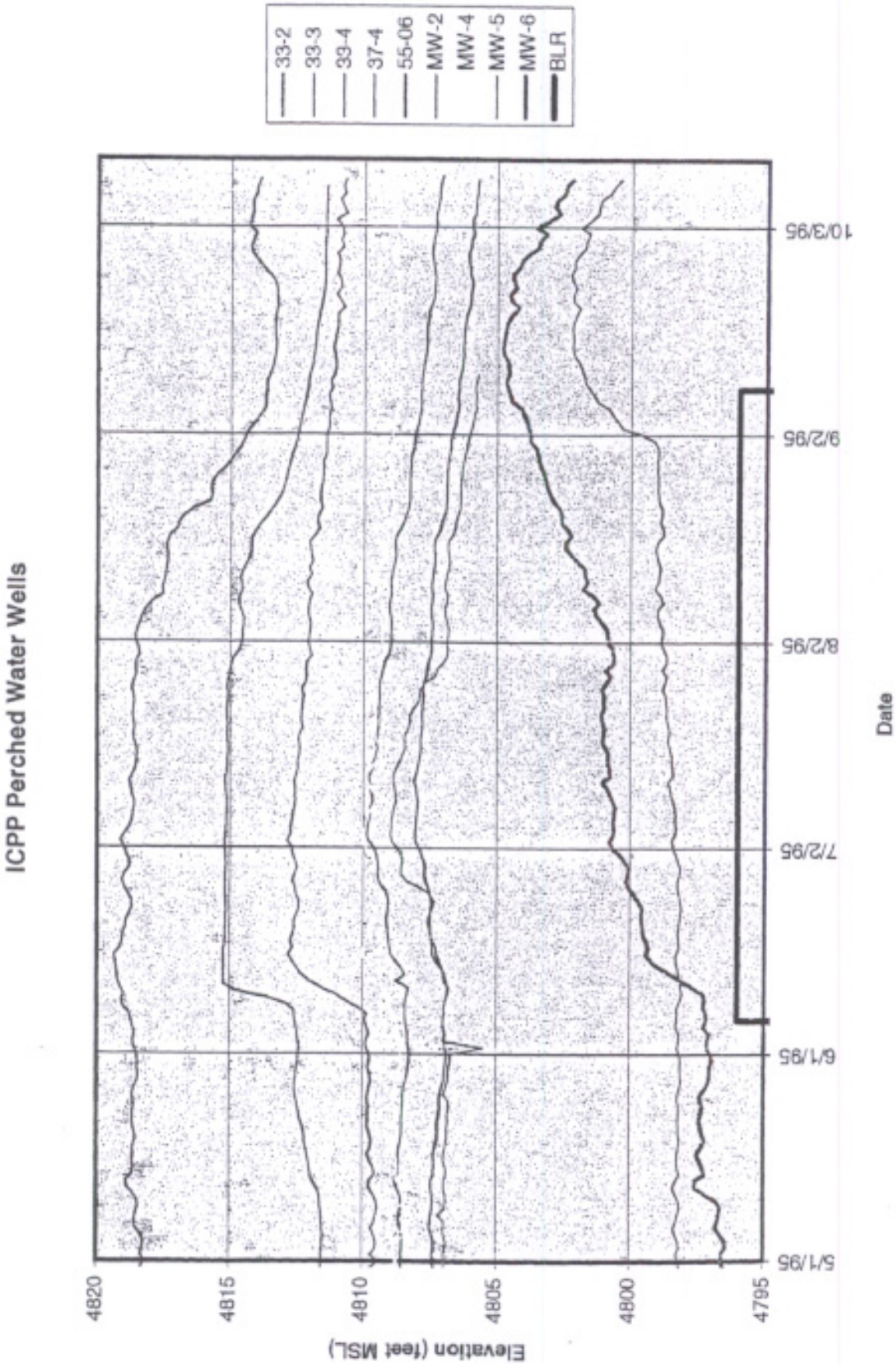

ICPP Perched Water Wells
33-2
33-3
33-4
37-4
55-06
MW-2
MW-4
MW-5
MW-6
BLR
4820
4815
4810
4805
4800
4795
Elevation (feet MSL)
5/1/95
6/1/95
7/2/95
8/2/95
9/2/95
10/3/95
Date

Table 2-16. Summary of upper perched groundwater level response to discharge in the Big Lost River.

Well	Well distance to BLR (feet)	Depth to water (ft bgs)	Water level increase (feet)	Water level response (days)	Estimated travel[a] (ft/day)
CPP 33-4	1,429	99	2.4	3	477
CPP 37-4	2,286	101	2.3	3	763
CPP 55-06	2,500	104	0.3	9	278
MW-2	2,143	104	0.4	6	358
MW-4	2,500	102	0.9	3	834
MW-5	2,071	109	0.5	8	259
MW-6	1,214	119	1.9	5	244
Average					459

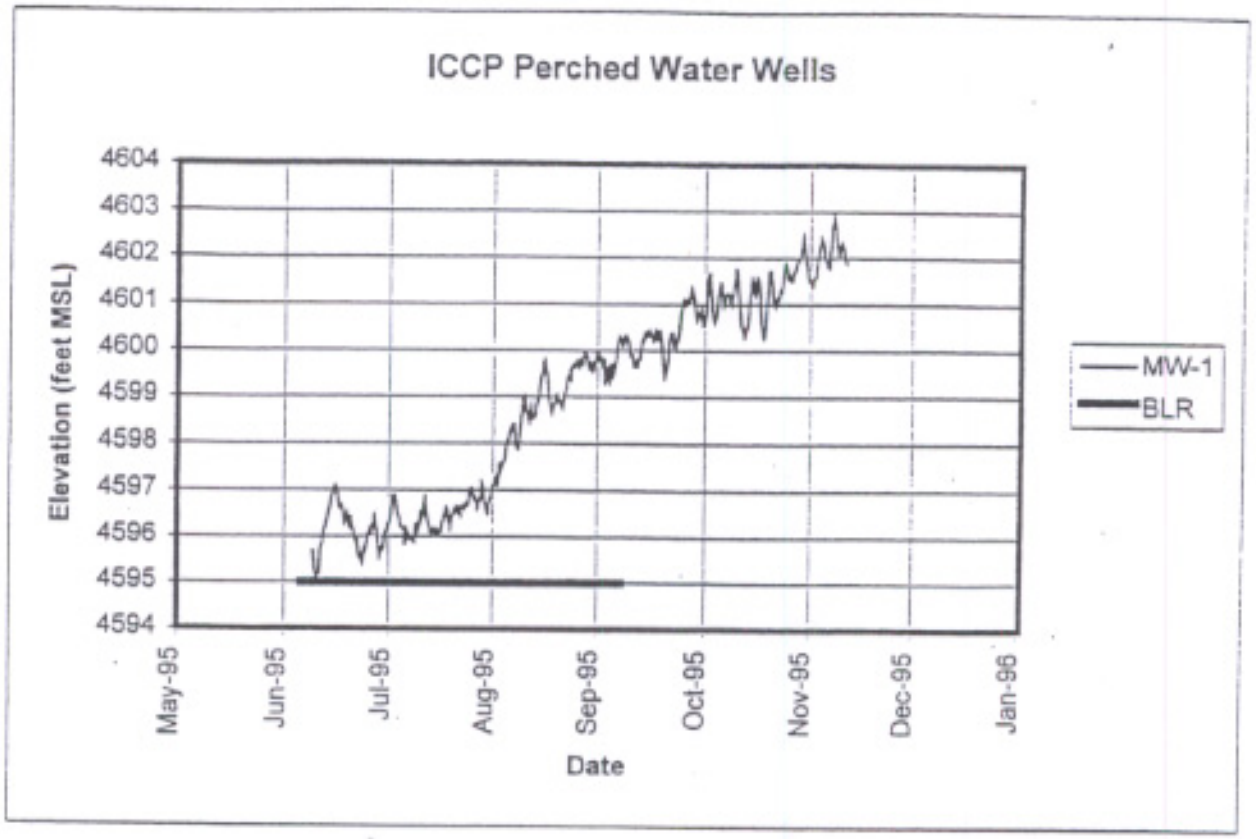
a. Rate assuming straight line.

monitoring period for both of these wells. Since historical data are not available, it is uncertain whether this increase in water level is attributable to the Big Lost River or some other factor.

2.6.1.6 Physical and Hydrologic Properties (Perched Water Zone). Aquifer tests have been performed on nine wells completed in the upper perched water zone. Single well pumping tests using the drawdown and recovery data were performed on Wells CPP 33-2, CPP 33-3, CPP 33-4, and CPP 55-06. Saturated zone hydraulic conductivities were calculated using the Cooper-Jacob analytical technique (Hubbell, 1992 and Bishop, 1992). Slug tests were performed on Wells MW-1, MW-2, MW-4, MW-5, and MW-6. These data were also evaluated using the Cooper-Jacob analytical technique to determine the saturated zone hydraulic conductivities. A 22-hr pumping test was also performed on Well MW-5 to determine the saturated zone hydraulic conductivity and the response from surrounding wells completed in the upper perched groundwater zone.

Field aquifer tests were performed to determine the hydraulic conductivities for both basalts and sedimentary interbeds (Table 2-17). Hydraulic conductivities determined in the field were fairly consistent, varying only over two orders of magnitude. Field hydraulic conductivities ranged from 3.9×10^{-5} to 2.9×10^{-3} cm/s (0.11 to 8.3 ft/day) with an average of 1.2×10^{-3} cm/s (3.3 ft/day). As shown in Table 2-17, significant differences in hydraulic conductivities were not observed between tests performed on basalts versus tests performed on sedimentary interbeds.

Laboratory testing of the interbed samples was performed to determine the physical properties of the various interbeds. During the drilling operation, interbed samples were obtained from Wells MW-3, MW-4, MW-5, MW-6, MW-7, MW-8, MW-9, and MW-10 (Table 2-18). This table presents a summary of the field data and laboratory results including depth, soil type (from logbooks), moisture content, density, porosity, and saturated hydraulic conductivity. Additionally, this information is grouped by depth into three different



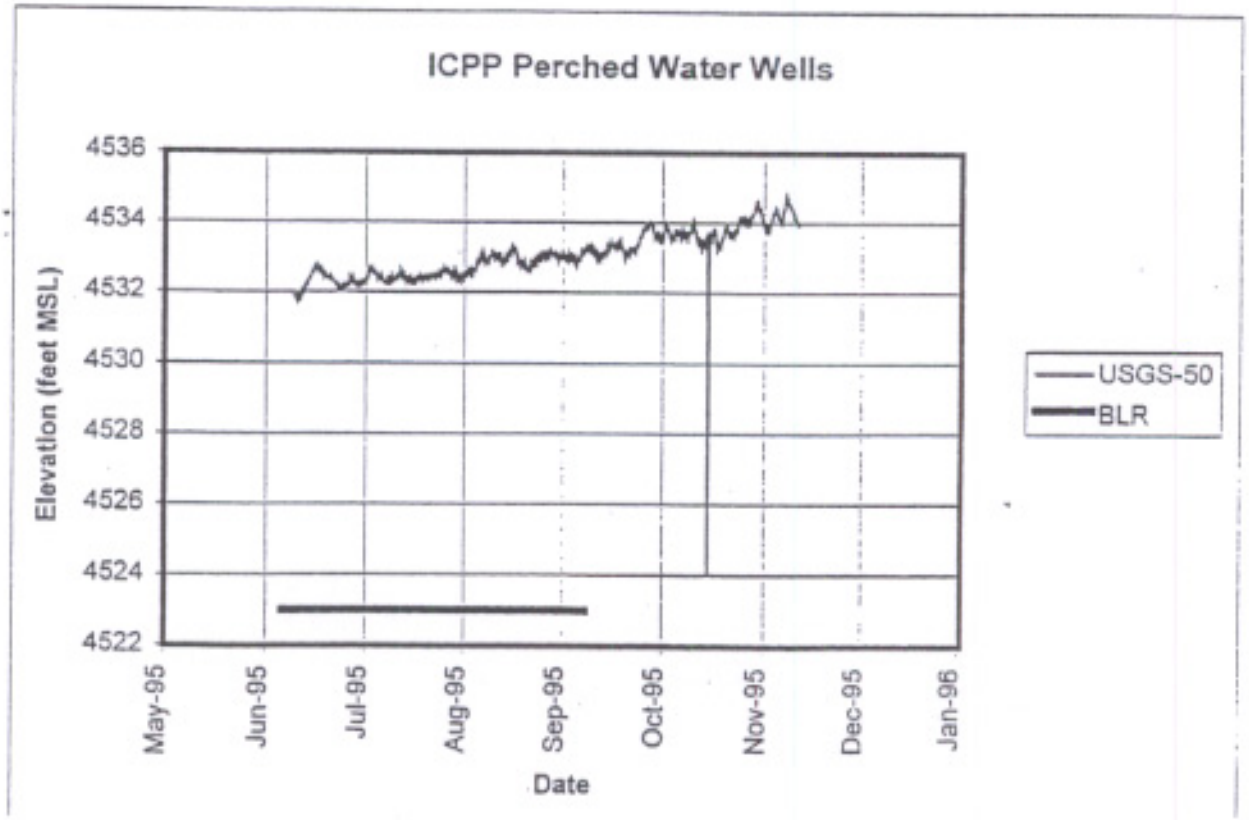


Figure 2-32. Big Lost River discharge vs. lower perched groundwater levels (1995).

Table 2-17. Results of perched water aquifer tests at the ICPP.

Well	Test zone (ft bgs)	Test type	Material	Hydraulic conductivity cm/sec	Hydraulic conductivity ft/day
CPP 33-2	97.8–105.8	Pumping/Recovery	Basalt	1.3×10^{-3}	5.0
CPP 33-3	111.2–121.8	Pumping/Recovery	Basalt	9.5×10^{-4}	2.7
CPP 33-4	103.7–118.2	Pumping/Recovery	Basalt	2.9×10^{-3} (average)	6.9 (average)
CPP 55-06	105.2–113.1	Pumping/Recovery	Basalt	4.2×10^{-4}	1.2
MW-1	326–336	Slug	Basalt	2×10^{-4}	0.57
MW-2	107.9–112	Slug	Sandy clay interbed	1.8×10^{-3} (average)	5.1 (average)
MW-4	104.6–110.6	Slug	Silty sand and gravel interbed	3.9×10^{-5}	0.11
MW-5	115–126.5	Slug	Basalt with small sandy clay interbeds	1.1×10^{-3}	3.1
MW-5	110.8–126.5	22-hr Pumping Test	Basalt with small sandy clay interbeds	1.3×10^{-3}	3.6
MW-6	140–151	Slug	Silty sand, fine grained interbed	1.3×10^{-3} (average)	3.7 (average)
			Average (basalts)[a]	1.2×10^{-3}	3.5
			Average (interbeds)[b]	1.0×10^{-3}	3.0
			Average (all tests)	1.3×10^{-3}	3.3

a. Average is based on Wells CPP 33-2, CPP 33-3, CPP 33-4, CPP 55-06, MW-1, and MW-5.

b. Average is based on Wells MW-2, MW-4, and MW-6.

Table 2-18. Laboratory testing results for the ICPP interbed samples.

Well	Depth (feet)	Interbed	Soil type (logbooks)	Initial moisture content Gravimetric (%,g/g)	Initial moisture content Volumetric (%,cc/cc)	Dry bulk density (g/cc)	Calculated porosity (%)	Ksat (cm/sec)
MW-3	117-119.3	CD	silty clay	32.8	42.5	1.29	52.5	8.9E-05
MW-4	108 -109.3	CD	silty sand and gravel	35.9	49.2	1.37	50.2	1.6E-05
MW-7	113.5-114.5	CD	silt with fine gravel	22.7	32.5	1.44	47.0	1.3E-03
MW-8	122.3-123.7	CD	clay with silt	28.0	42.2	1.51	45.0	1.1E-05
MW-10	110.3-111	CD	sandy silt	39.5	50.2	1.27	54.0	1.0E-05
MW-11	113.7-115.3	CD	silty sand	29.5	43.7	1.48	45.9	1.2E-05
MW-4	105.1-105.6	CD	silt	43.8	51.4	1.18	57.6	3.2E-05
MW-4	105.6-106.8	CD	silt	50.8	56.8	1.12	60.9	6.7E-05
MW-6	110-111	CD	clay	33.4	48.3	1.45	47.8	3.0E-07
MW-9	111.6-112.5	CD	clay with silt	28.8	30.1	1.05	61.4	21.E-03
	Average			34.5	44.7	1.33	50.9	3.6E-04
MW-11	135.4-136	D	clay	18.1	33.2	1.83	33.6	5.2E-08
MW-3	138-139	D	silty clay	21.6	30.9	1.43	47.2	8.3E-04
MW-6	142-143	D	silty clay	22.4	30.6	1.36	49.5	2.2E-03
MW-9	148.7-149.4	DE 2	silt with clay	9.5	12.7	1.34	50.3	3.4E-03
	Average			17.9	26.9	1.48	44.6	1.6E-03
MW-1	231.7-232.3	DE 4	sand with silt	15.7	24.8	1.59	41.3	3.3E-04

classes (i.e., interbeds "CD," "D," and "DE2"). The depths are approximately 33.5, 42.7, and 70.1 m (110-, 140-, and 230-ft) bgs. A complete discussion of the sample collection and laboratory data package is described in *Interim Data Results From the FY 93/94 Perched Ground Water Investigation* (February 18, 1994).

The range of hydraulic conductivities determined from the field aquifer tests are within the range of hydraulic conductivities measured in the laboratory. The average hydraulic conductivity determined from the field tests is 1.2×10^{-3} cm/s (3.3 ft/day) compared to an average of 6.9×10^{-4} cm/s (1.96 ft/day) determined from the laboratory tests. Some of the difference between the two hydraulic conductivities may be attributed to the fact that the field tests measured horizontal hydraulic conductivity whereas the laboratory tests measured vertical hydraulic conductivity. Typically, horizontal hydraulic conductivities are higher than the corresponding vertical hydraulic conductivities.

Good correlation in the hydraulic conductivity values occurred from the boreholes where both field and laboratory measurements were performed. From the same zone in Well MW-4, the average hydraulic conductivity determined in the laboratory was 3.81×10^{-5} cm/s (0.1 ft/day) compared to the field determined value of 3.9×10^{-5} cm/s (0.11 ft/day). Similarly in Well MW-6, the hydraulic conductivity determined in the laboratory was 2.2×10^{-3} cm/s (6.2 ft/day) compared to the field determined value of 1.3×10^{-3} cm/s (3.7 ft/day). These two wells are the only locations where both field and laboratory measurements were performed.

The physical property data collected from the interbeds at the ICPP were compared to similar data collected at other INEEL facilities (Table 2-19). This table provides minimum, maximum, and average values of saturated hydraulic conductivity, density, porosity, and Van Genuchten parameters for the three ICPP interbeds and interbeds at the TRA and RWMC. A significant range of values is apparent in this table, however, the physical properties data collected on the ICPP interbeds are in good agreement with the data collected at other INEEL facilities.

2.6.1.6.1 MW-5 Pumping Test Results—A constant rate pumping test was performed on Well MW-5, which is completed in the upper perched groundwater zone. The well was pumped at a rate of 11.4 L/min (3 gpm) for 22 hr after which, the pump was turned off and the water level recovery data monitored. Figure 2-33 provides the drawdown and recovery data for the test. In addition to monitoring the pumping well, water levels in wells MW-2, MW-4, MW-6, CPP 33-2, CPP 33-3, CPP 33-4, CPP 37-4, and CPP 55-06 were recorded at 1-min intervals throughout the duration of the test.

For the first 400 min into the test, drawdown in Well MW-5 was similar to an expected "Theis-type" curve where the rate of drawdown decreases exponentially. An increase in drawdown was noted for the next 100 minutes where a maximum drawdown of approximately 3 m (10 ft) was recorded at 500 min into the test. The additional 2 feet of drawdown observed at approximately 500 minutes into the test probably represents a local boundary condition caused by a much lower permeability stratum of interbed material which could not provide sufficient recharge to the well at the constant discharge rate. Water levels in Well MW-5 increased for the next 100 minutes to a drawdown of 2.4 m (8 ft). This level corresponds to the level that would have been expected if the water level response were to follow a "Theis-type" response. Drawdown in the latter portion of the test (600 to 1,300 min) increased more that what would be expected assuming a "Theis-type" response. The increased drawdown in the middle portion of the test may be the result of local boundary effects caused by heterogenous sedimentary interbed material. The well recovered to approximately 0.2 m (0.5 ft) of the prepumping levels and maintained the constant level for several days.

Table 2-19. Comparison of the physical properties data for the interbeds from ICPP, TRA, and RWMC.

Interbed or INEEL facility	Approx depth (ft)	Ksat (cm/sec)	Dry bulk density (g/cc)	Porosity	Van Genuchten Parameters				
					Sat. water content	Res. water content	alpha	n	r-squared
"CD" interbed (range of values)	110	3.7E-05 (3.0E-07 to 1.3E-03)	1.33 (1.05 to 1.51)	50.9 (45.0 to 61.4)	0.50 (0.43 to 0.64)	0.0 0 0.00	0.0025 (0.00012 to 0.25)	1.43 (1.12 to 2.70)	0.96 (0.88 to 1.00)
D interbed (range of values)	140	1.3E-04 (5.2E-08 to 3.4E-03)	1.48 (1.34 to 1.83)	44.6 (33.6 to 50.3)	0.46 (0.36 to 0.55)	0.0036 (0.00 to 0.82)	0.24 (0.0021 to 0.078)	1.63 (1.20 to 2.71)	0.97 (0.95 to 0.99)
deep interbed (range of values)	230	3.3E-04 —	1.59 —	41.3 —	0.43 —	0.041 —	0.052 —	1.29 —	0.99 —
TRA (range of values)	—[a]	1.4E-06 (1.7E-08 to 1.4E-03)	1.66 (1.24 to 2.13)	38.4 (20.4 to 54.8)	0.42 (0.31 to 0.57)	— —	— —	— —	— —
RWMC (range of values)	—	7.6E-05 —	— —	— —	— —	— —	— —	— —	— —

a. — = no value.

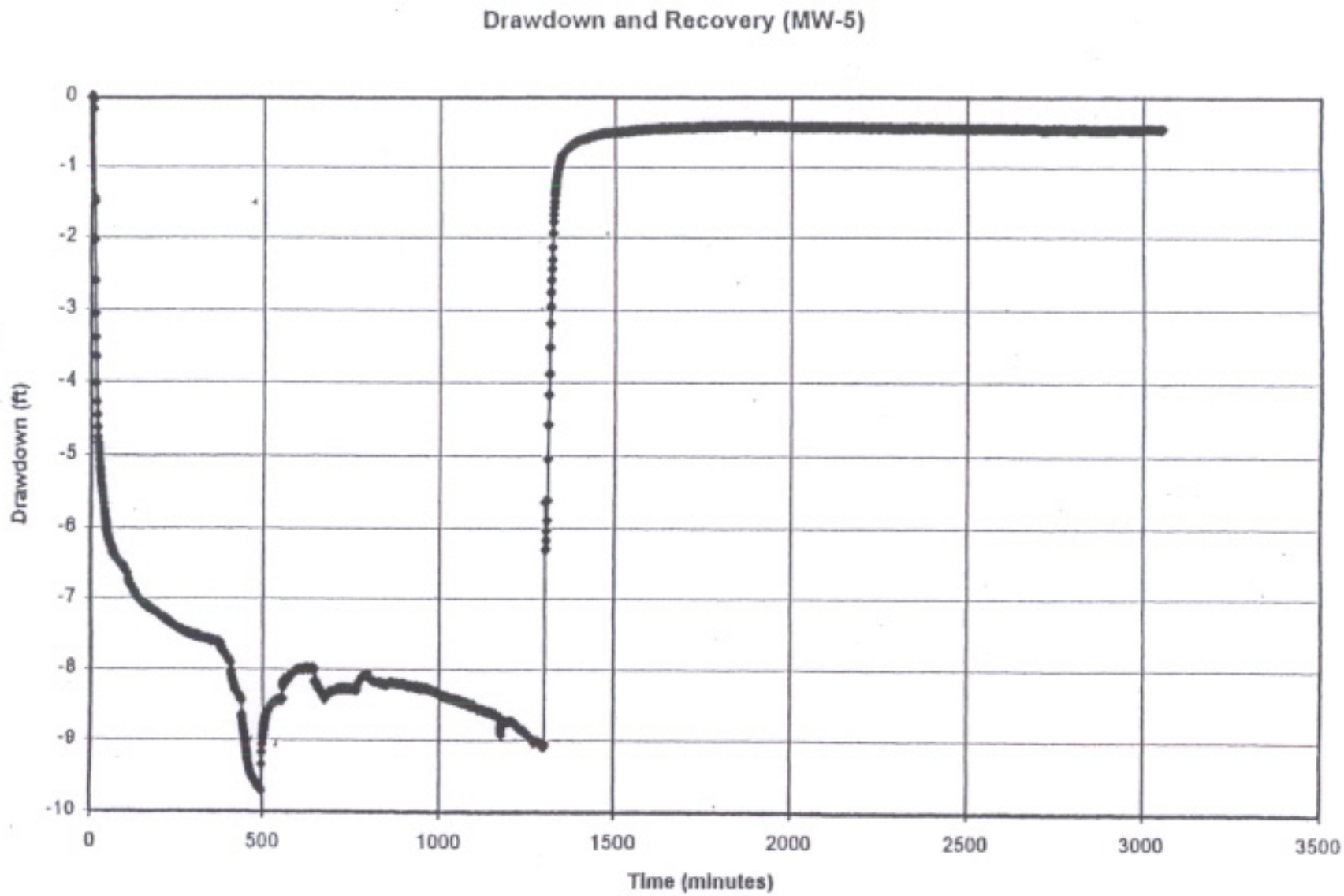


Figure 2-33. Drawdown and recovery data for the Well MW-5 pumping test.

As stated earlier, the water level in eight wells completed in the upper perched groundwater were monitored at 1-minute intervals throughout the duration of the test. The groundwater elevations in these observation wells did not respond to discharge from Well MW-5 as shown in Figure 2-34. Overall, water elevations in the observation wells increased (i.e., negative drawdown) during the first half of the test and then decreased for the remainder of the monitoring period with no correlation to the pumping test.

The drawdown data from the pumping well (MW-5) was evaluated using the Jacob straight line method (Figure 2-35) (Fetter, 1980). The early time data (i.e., under 10 min) were not used in the calculation because of water stored in the casing. Schafer (1978) suggests that in many instances the early pumping test data may not fit Jacob's modification of the nonequilibrium theory, and that calculations based on the early drawdown data will be erroneous. When pumping begins, water in the casing is removed first. As the water level in the casing falls, water begins to enter the well from the surrounding formation. Gradually, a greater percentage of the well's yield will be from the aquifer. Based on the height of water in the well at the time of the test, approximately 79 L (21 gal) of water is contained in the well casing and surrounding sand pack. It would take approximately 7 min to purge this volume of water from the well using a pumping rate of 11.4 L/min (3 gpm). Therefore, it is reasonable to ignore the early time data from this test and base the transmissivity calculation solely on the late-time data.

Transmissivity and hydraulic conductivity were calculated using the following equations:

$$T = \frac{264Q}{\Delta s} \tag{2-2}$$

$$K = T/b \tag{2-3}$$

where

T = transmissivity (gpd/ft)

Q = discharge (gpm)

s = drawdown (ft)

K = hydraulic conductivity (gpd/ft^2)

b = saturated thickness (ft).

Based on these equations and a saturated thickness of 4.8 m (15.7 ft), the transmissivity and hydraulic conductivity are 419.6 gpd/ft and 1.3×10^{-3} cm/s (3.6 ft/day), respectively. The hydraulic conductivity determined from the pumping test correlates very well with the hydraulic conductivity of 1.1×10^{-3} cm/s (3.1 ft/day) determined from the slug test.

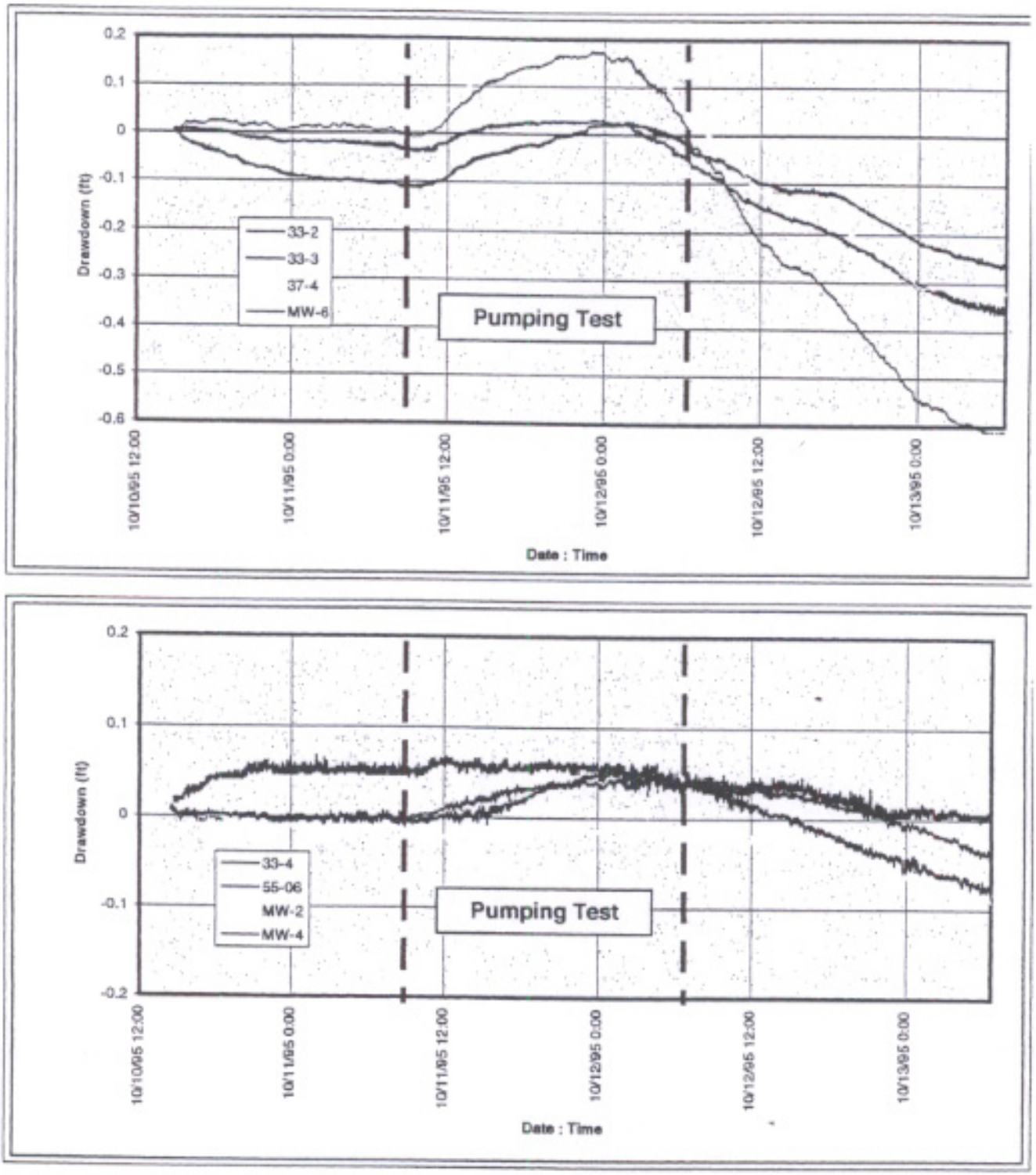


Figure 2-34. Water level response in the perched water wells monitored during the pumping test.

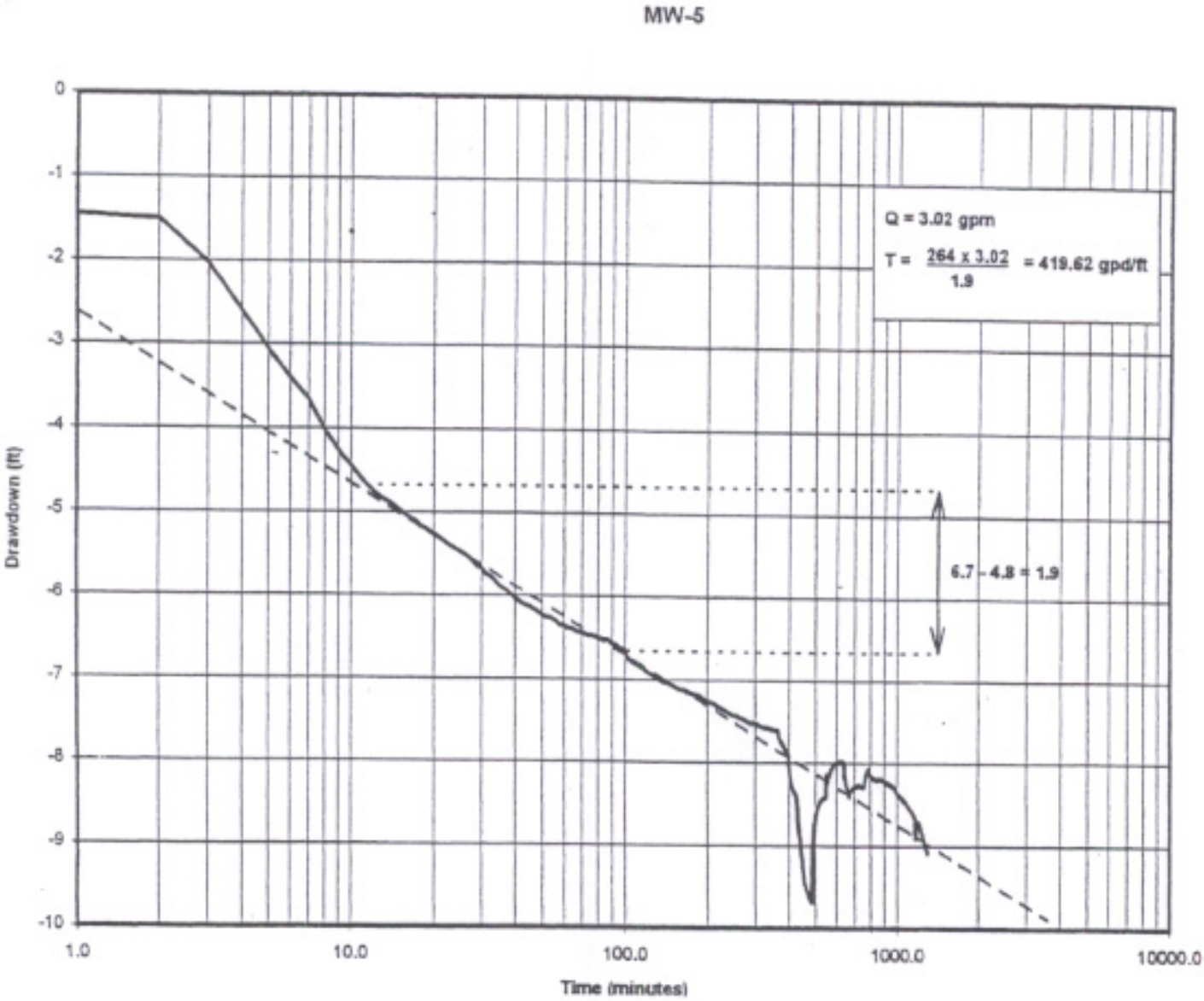


Figure 2-35. Drawdown data from the Well MW-5 pumping test.

2.6.2 Snake River Plain Aquifer

Thirty-three monitoring wells have been installed by the USGS around the ICPP to characterize the occurrence, movement, and quality of water in the SRPA. The monitoring well network was designed to determine hydraulic-gradient changes that influence the rate and direction of groundwater and waste-constituent movement in the SRPA, identify sources of recharge to the aquifer, and measure the effect of recharge (Orr and Cecil, 1991). The location of the observation wells, frequency of water-level measurements, and frequency of water sample collection are shown in Figure 2-36.

2.6.2.1 Groundwater Flow. As part of the WAG 3 RI, a complete round of water level measurements was recorded for the wells completed in the SRPA (Table 2-20). This table includes the measured water depth, borehole deviation information (if available), and a corrected depth to water based upon the borehole deviation. Subsequently, the water level elevations listed in Table 2-20 are corrected for borehole deviation and use the most recent INEEL well survey data. Based on these measurements, the groundwater flow down gradient of the ICPP during May, 1995 is shown in Figure 2-37. Overall, the local groundwater flow is to the south-southwest, consistent with the regional groundwater flow as discussed in Section 2.5.1.

The water level elevations indicate two separate sources of local recharge to the SRPA. One source for recharge is apparently from the percolation ponds as indicated by elevated water levels measured in Wells USGS-51, -112, -113, -114, -115, and -116. Water level response to recharge from these ponds is indicated by a 0.6 m (2 ft) increase in Well USGS-113 and a 0.3 m (1 ft) increase in Well USGS-51. The water table in the SRPA down gradient from the percolation ponds has a bimodal shape, indicating a preferred flow direction toward the southwest with a secondary flow component to the southeast. Directly south of the ponds, water levels in Wells USGS-77 and USGS-111 are significantly lower than what would be expected based on the water levels in the adjacent wells. The reason(s) for the anomalously low water levels in these two wells is not attributed to erroneous wellhead elevations or borehole deviation, but rather to local variations in the water-bearing characteristics of the SRPA (see Section 2.6.2.2, Hydraulic Characteristics).

A second possible source of recharge to the SRPA may be indicated by anomalously high water levels measured in Well USGS-47. The water levels measured in Well USGS-47 are consistently 0.3 to 0.6 m (1 to 2 ft) higher than corresponding water levels measured from the surrounding wells. The possible causes of the anomalously high water levels include local recharge, local pumping, vertical hydraulic gradient (i.e., increasing hydraulic head with depth), and/or well completion characteristics.

The local groundwater flow appears complex and is apparently affected by local recharge, variations in hydraulic conductivity, local pumping, and possibly vertical hydraulic gradients. Groundwater directly beneath the ICPP generally flows to the southwest and southeast, with a minor flow component to the south. The local flow pattern likely results from local recharge (i.e., percolation ponds and sewage ponds) that creates the mounding in the water table and possibly from pumpage of the production wells. As the groundwater progresses beyond the influence of the ICPP, it flows toward the southwest. The local hydraulic gradient is low, only 0.2 m/km (1.2 ft/mi) compared to the regional gradient of 0.8 m/km (4 ft/mi).

2.6.2.2 Hydraulic Characteristics. Hydraulic characteristics of the SRPA have been determined from 16 aquifer tests conducted in the vicinity of the ICPP (Ackerman, 1991). Transmissivity is the rate at which water is transmitted through a unit width of an aquifer under a unit gradient. Since transmissivity is the rate

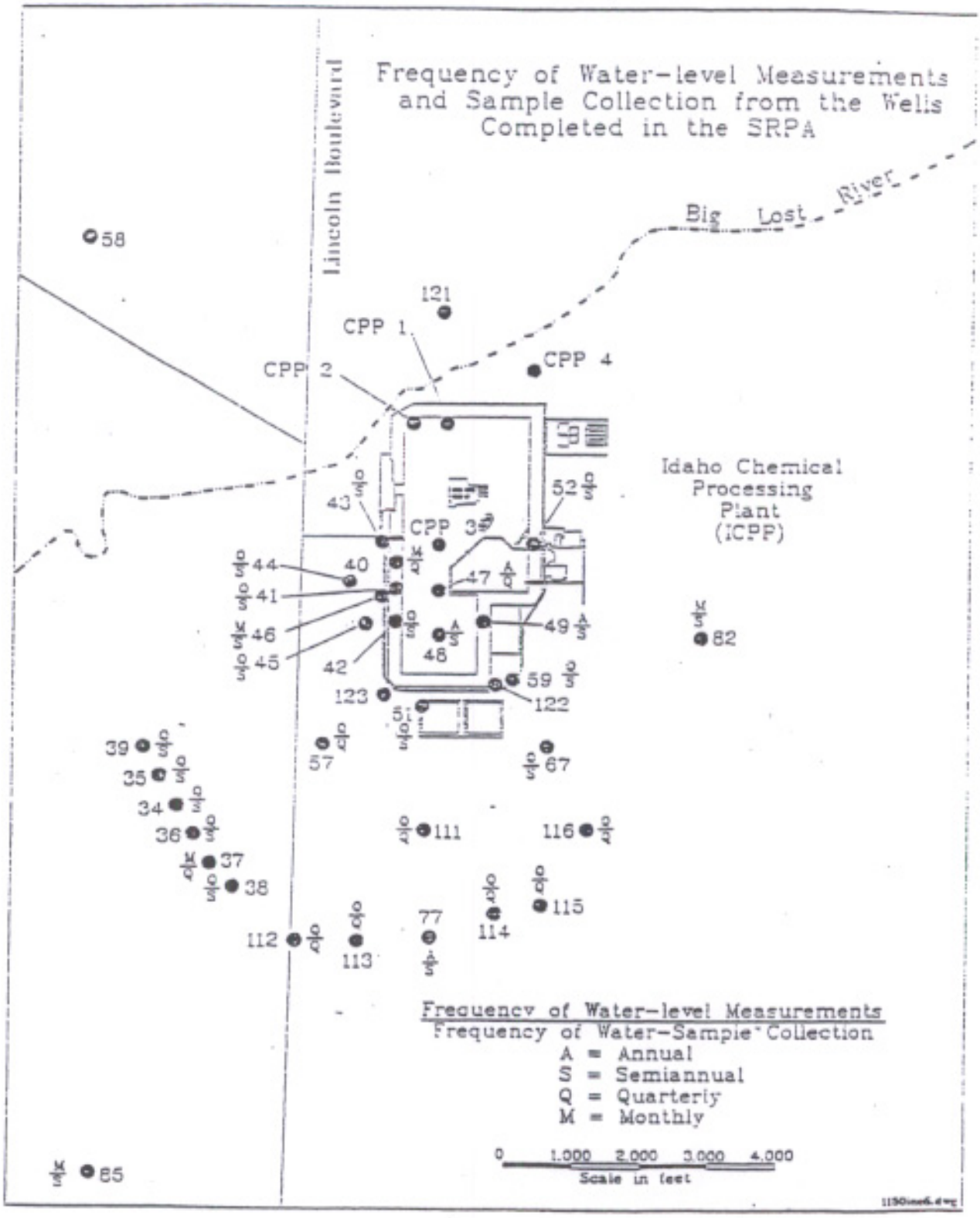


Figure 2-36. Location and frequency of water level measurements, and frequency of water sample collection for the wells completed in the SRPA (USGS).

Table 2-20. Water level measurements in the SRPA (May 1995).

Well	Drilled Depth (ft)	Actual Vertical Depth - Well (ft)	Measured Vertical Depth - Well (ft)	Measured Water Depth (ft)	Actual Water Depth (ft)	Water Level Elevation (ft)
MW-18	479.0	471.96	472.4	464.19	463.75	4453.56
USGS 34	700.0	564.90	565.0	477.33	477.25	4453.02
USGS 35	578.5	479.71	480.0	477.76	477.47	4453.73
USGS 36	567.1	539.94	540.0	477.48	477.42	4453.01
USGS 37	573.0	550.00	550.0	477.61	477.54	4453.07
USGS 38	729.0	599.94	600.0	478.03	477.98	4453.08
USGS 39	571.9	479.89	480.0	479.16	479.05	4453.13
USGS 40	679.0	No borehole deviation survey.		463.58	463.58	4453.67
USGS 41	674.4	No borehole deviation survey.		464.53	464.53	4453.87
USGS 42	678.5	No borehole deviation survey.		464.83	464.83	4453.89
USGS 43	676.0	No borehole deviation survey.		465.58	465.58	4451.25
USGS 44	650.0	No borehole deviation survey.		465.58	465.58	4453.79
USGS 45	651.2	No borehole deviation survey.		467.41	467.41	4452.40
USGS 46	650.9	No borehole deviation survey.		468.10	468.10	4449.53
USGS 47	652.0	Deviation noted as insignificant.		461.34	461.34	4455.11
USGS 48	750.0	No borehole deviation survey.		464.16	464.16	4453.99
USGS 49	656.0	No borehole deviation survey.		NA	NA	NA
USGS 51	659.0	No borehole deviation survey.		466.77	466.77	4454.10
USGS 52	650.0	No borehole deviation survey.		457.75	457.75	4453.92
USGS 57	732.0	No borehole deviation survey.		471.80	471.80	4452.64
USGS 59	657.0	No borehole deviation survey.		461.44	461.44	4453.45
USGS 67	698.0	No borehole deviation survey.		462.34	462.34	4453.42
USGS 77	610.0	No borehole deviation survey.		471.26	471.26	4452.75
USGS 82	700.0	No borehole deviation survey.		454.94	454.94	445 .66
USGS 84	505.0	No borehole deviation survey.		486.56	486.56	4453.03
USGS 85	637.0	No borehole deviation survey.		489.07	489.07	4452.45
USGS 111	595.0	512.75	520.0	475.98	469.35	4453.40
USGS 112	563.0	546.04	550.0	479.67	476.22	4453.91
USGS 113	564.0	541.39	550.0	480.31	472.79	4454.88
USGS 114	562.0	533.70	540.0	474.02	468.49	4453.85
USGS 115	581.0	546.33	550.0	470.27	467.13	4454.00
USGS 116	580.0	559.47	560.0	464.71	464.27	4454.33
USGS 121	745.8	456.49	458.0	459.12	457.61	4453.86
USGS 122	482.8	478.79	479.3	462.62	462.13	4453.57
USGS 123	744.2	480.10	480.2	468.39	468.29	4453.02
LF2-08	495.0	477.04	480.0	485.79	482.80	4450.34
LF2-09	497.0	479.12	485.0	486.30	480.40	4453.06
LF2-10	765.0	707.52	710.0	484.74	483.05	4450.59
LF2-11	499.0	484.90	485.0	477.60	477.50	4452.67
LF2-12	483.0	474.89	475.0	481.85	481.73	4452.53
LF3-08	510.0	489.96	495.0	494.16	489.13	4452.45
LF3-09	500.0	489.87	490.0	490.59	490.46	4452.31
LF3-10	501.0	489.99	490.0	492.14	492.13	4452.49
LF3-11	492.2	479.97	480.0	NA	NA	NA

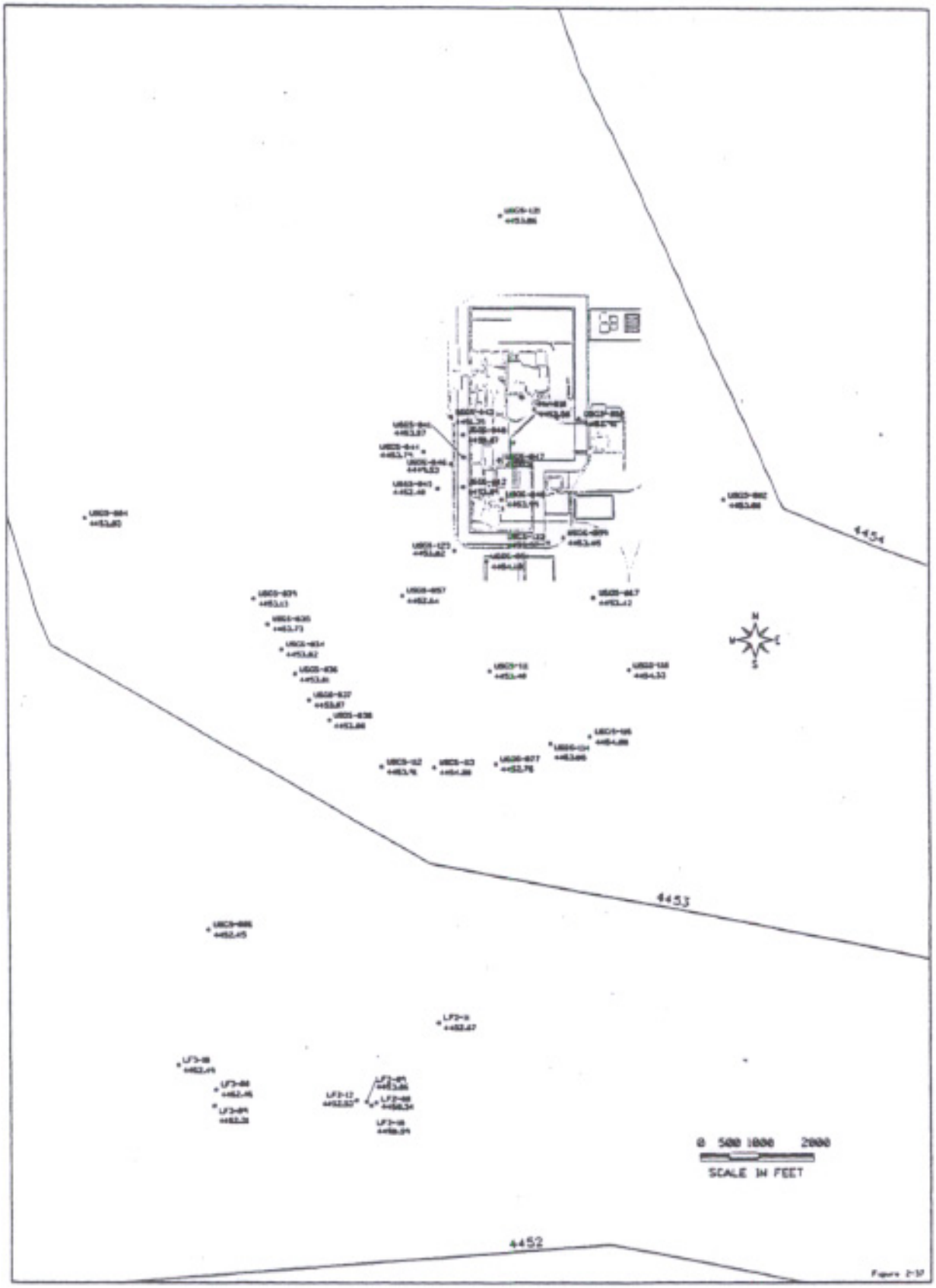


Figure 2-37. Groundwater flow in the SRPA (May 1995).

at which water will be transmitted through a unit width of an aquifer under a unit hydraulic gradient, the values are directly comparable from well to well. The transmissivity values at the ICPP range five orders of magnitude with a maximum transmissivity of 7.0×10^4 m^2/day (7.5×10^5 ft^2/day) at well CPP-3 and a minimum transmissivity of 0.93 m^2/day (10 ft^2/day) at well USGS-114 (Table 2-21). The average transmissivity for the SRPA in the vicinity of the ICPP is $8.8 \times 10^3 \pm 1.8 \times 10^4$ m^2/day ($9.5 \times 10^4 \pm 1.9 \times 10^5$ ft^2/day).

A plot of the SRPA transmissivities at the ICPP is shown in Figure 2-38. This figure indicates two zones of higher transmissivity extend to the southwest and east-southeast of the ICPP Disposal Well. Directly to the south of the ICPP is a region of relative low transmissivities [<93 m^2/day (<1,000 ft^2/day)], indicating lower flow rates through this area. This transmissivity pattern apparently has a big impact on the groundwater flow direction from the ICPP as shown in contaminant distribution maps.

Hydraulic conductivity describes the rate at which water can move through permeable medium. Aquifer hydraulic conductivity is estimated by including the aquifer thickness using the following relationship:

$$K = T/b \tag{2-4}$$

where

K = hydraulic conductivity (ft/day)

T = transmissivity (ft^2/day)

b = aquifer thickness (ft).

One problem with estimating hydraulic conductivity by dividing the transmissivity by aquifer thickness for a well in fractured rock aquifers is the hydraulic conductivity could range over several orders of magnitude depending on whether a 0.3-m (1-ft) zone is highly fractured to dense and unfractured. At local scales, the velocity of groundwater movement or the movement of a pollutant is governed by the maximum hydraulic conductivity that would be representative of a fracture or set of fractures in a zone open to a well. Therefore, a calculated velocity using an average hydraulic conductivity can be misleading.

The hydraulic conductivity of the SRPA in the vicinity of the ICPP was estimated using the transmissivity values reported by Ackerman (1991) and the saturated thickness of the open interval of the well (Table 2-21). The estimation of hydraulic conductivity assumes the wells fully penetrate the saturated thickness of the aquifer. Hydraulic conductivities range five orders of magnitude with a maximum hydraulic conductivity of 3.0×10^3 m/day (1.0×10^4 ft/day) at Well CPP-3 and a minimum hydraulic conductivity of 3.0×10^{-2} m/day (1.0×10^{-1} ft/day) at Well USGS-114. The average hydraulic conductivity within the immediate vicinity of the ICPP is $4.0 \times 10^2 \pm 7.9 \times 10^2$ m/day ($1.3 \times 10^3 \pm 2.6 \times 10^3$ ft/day). Using the average hydraulic conductivity, a hydraulic gradient of 1.2 m/km (6.3 ft/mi) (Orr and Cecil, 1991), and an effective porosity of 10%, the calculated seepage velocity in the vicinity of the ICPP is approximately 3 m/day (10 ft/day).

2.6.2.3 Local Flow Velocity. Tritium from the ICPP wastes has been used extensively in tracing groundwater flow velocities and directions (Morris et al., 1964; Hawkins and Schmalz, 1965; and

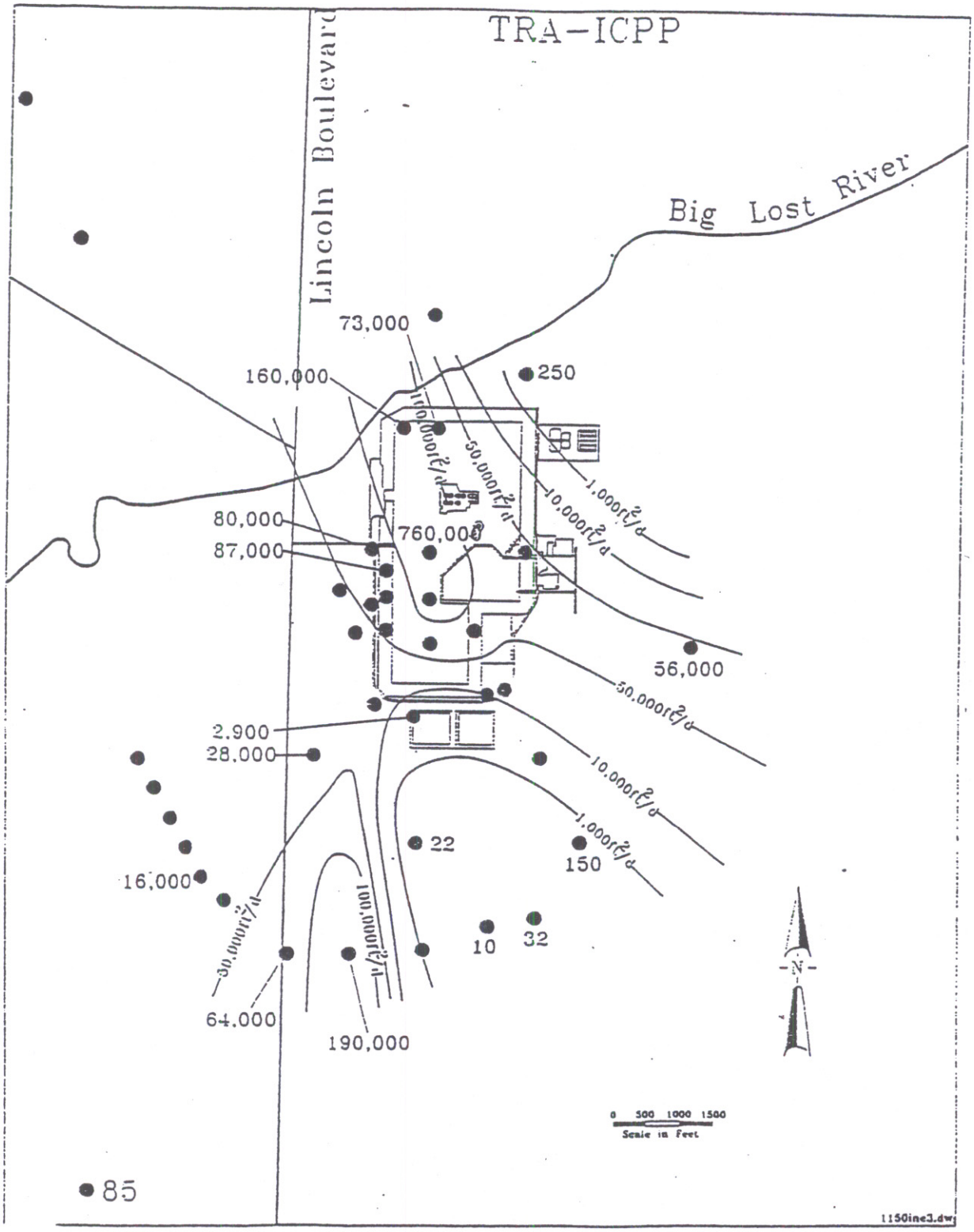


Figure 2-38. Plot of transmissivities in the SRPA near the ICPP.

Table 2-21. Transmissivities in the SRPA near the ICPP (Ackerman, 1991) and estimates of hydraulic conductivity.

Well identifier	Transmissivity (ft^2/day)	Saturated thickness (ft)[a]	Hydraulic conductivity (ft/day)
CPP-1	7.3×10^4	150	4.9×10^2
CPP-2	1.6×10^5	75	2.1×10^3
CPP-3	7.6×10^5	74	1.0×10^4
CPP-4	2.5×10^2	255	9.8×10^{-1}
USGS-37	1.6×10^4	65	2.5×10^2
USGS-40	8.7×10^4	27	3.2×10^3
USGS-43	8.0×10^4	225	3.6×10^2
USGS-51	2.9×10^3	184	1.6×10^1
USGS-57	2.8×10^4	255	1.1×10^2
USGS-82	5.6×10^4	100	5.6×10^2
USGS-111	2.2×10^1	137	1.6×10^{-1}
USGS-112	6.4×10^4	96	6.7×10^2
USGS-113	1.9×10^5	97	2.0×10^3
USGS-114	1.0×10^1	100	1.0×10^{-1}
USGS-115	3.2×10^1	123	2.6×10^{-1}
USGS-116	1.5×10^2	127	1.2×10^0
Maximum	7.6×10^5		1.0×10^4
Minimum	1.0×10^1		1.0×10^{-1}
Average±standard deviation (SD)	9.5×10^4 $\pm 1.9 \times 10^5$		1.3×10^3 $\pm 2.6 \times 10^3$

a. Saturated thickness values are the total saturated portion of the open well intervals.

Barraclough et al., 1967). Peaks of high H-3 discharge to the disposal well have been particularly useful in determining the local flow characteristics in the SRPA. One of the most studied "peak" discharges of H-3 occurred in December 1961 because it was preceded and followed by relatively long periods of low H-3 discharge.

The concentration of the H-3 peak as it passed each observation well provides an indication of the amount of dispersion the slug has undergone. Wells along the most direct line of flow should show the least attenuation in peak concentration. This effect is illustrated in Figure 2-39 where the maximum concentration of the peak from the December, 1961 release was plotted and contoured (Barraclough et al., 1967). The most prominent features are the zones of least attenuation to the southwest (Wells USGS-42, USGS-57, USGS-38, and USGS-85) and a second lobe of higher peak concentrations to the southeast. These lobes indicate two preferred flow paths from the disposal well probably exist; the predominant one to the southwest and a less clearly defined path to the southeast. Some of the explanation for this phenomenon is provided in the plot of the transmissivity values for the ICPP where a zone of low transmissivity is located directly to the south. This zone of low transmissivity to the south apparently acts as a barrier to impede the local groundwater flow.

According to Figure 2-39, the most prominent flow path from the disposal well is to the southwest along Wells USGS-42, USGS-57, USGS-38, and USGS-85. Barraclough et al. (1967) studied the movement of the December 1961 peak down this line of wells and calculated the groundwater flow velocity from the ICPP. Figure 2-40 shows the H-3 concentration with time for these wells. The December 1961 peak is apparent through Well USGS-57, but becomes obscured in Wells USGS-38 and USGS-85. The arrow on the figure indicates the time of arrival for the December 1961 peak (Barraclough et al., 1967).

The behavior of the peak is shown in the following tabulation (Barraclough et al., 1967):

Well	Distance from disposal well (ft)	Groundwater velocity (ft/day)
47	705	25
42	1,340	11.5
48	1,400	12.5
57	3,500	20
38	6,300	12
85	10,400	10

The anomously high value for Well USGS-57 apparently indicates very rapid flow from Wells USGS-42 and USGS-48. The groundwater velocity between Well USGS-47 and Well USGS-42 or USGS-48 would have to be approximately 2.3 m/day (7.5 ft/day), while the average groundwater flow velocity between Well USGS-42 or USGS-48 and Well USGS-57 would have to be approximately 18.3 m/day (60 ft/day). One possible explanation for the extremely high groundwater flow velocity is Wells USGS-42 and USGS-48 are not in the most direct flow path from the disposal well. In this case, the preferred groundwater flow path from the disposal well would occur as a thin band between these two wells.

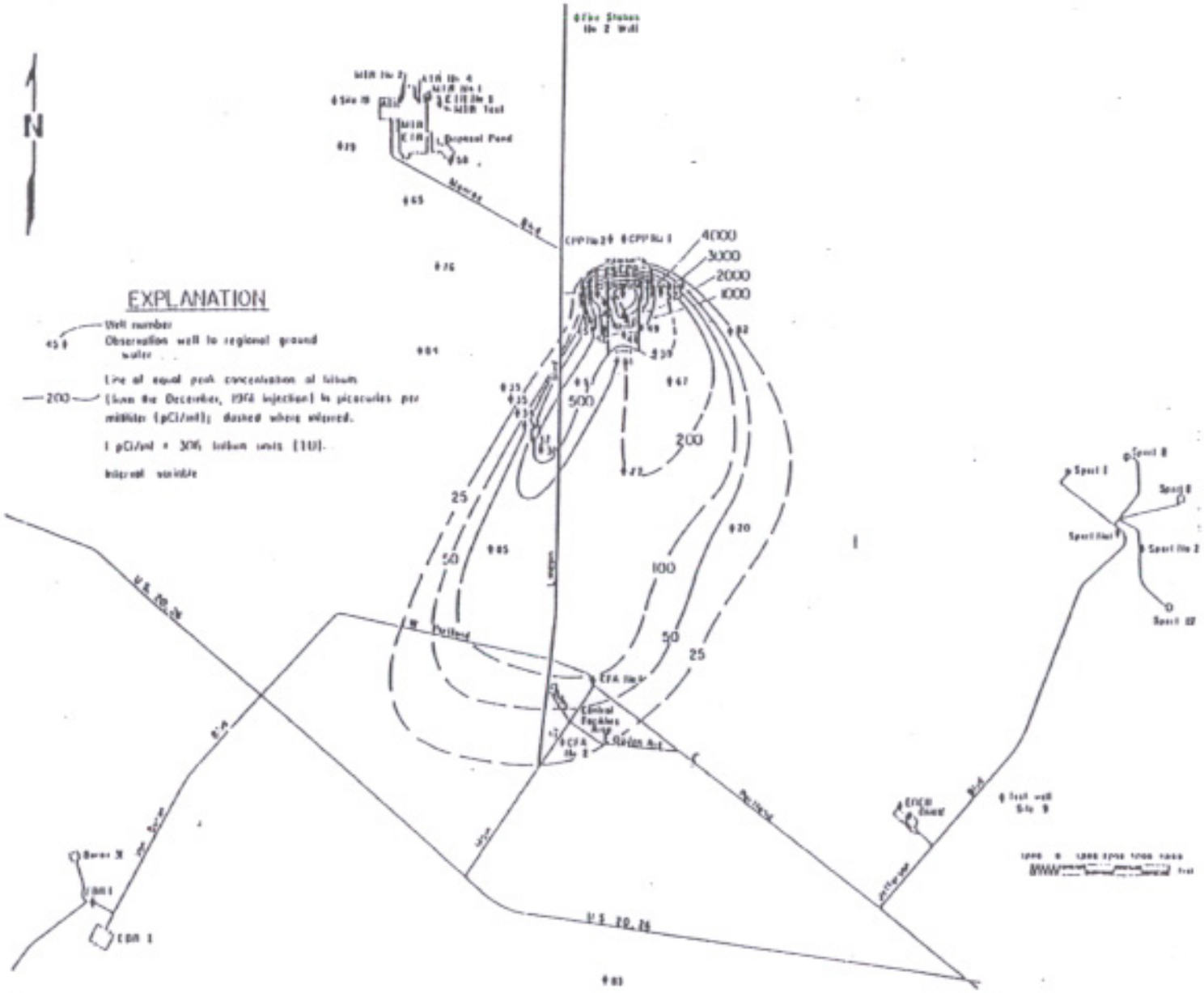


Figure 2-39. Maximum tritium concentrations in the SRPA from the December 1961 release (Barraclough et al., 1967).

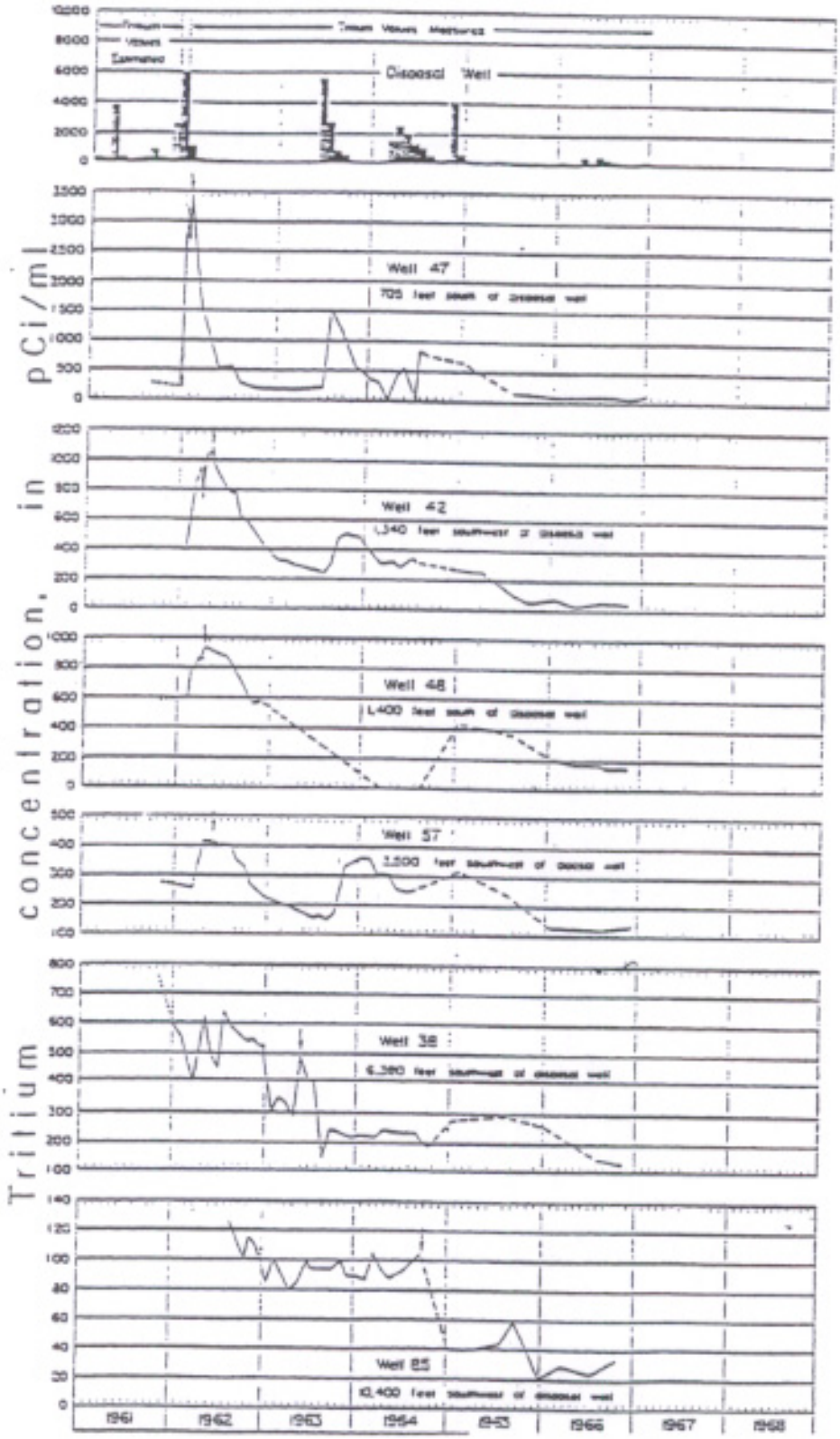


Figure 2-40. Graphs of tritium concentrations in the SRPA Wells USGS-47, -42, -57, -38, and -85 from 1961 through 1966 (Barraclough et al., 1967).

The relatively poor response of Well USGS-38 to the December 1961 peak is probably due to either the well not being located on the most direct flow path or the well being completed in a different portion of the aquifer than the other wells along the line. Most of the other wells are perforated in the upper 76.2 m (250 ft) of the aquifer, whereas, Well USGS-38 is completed in a 15.5-m (51-ft) wide zone between 64 and 79 m (210 and 260 ft) below the water table. This may indicate the majority of the H-3 is being transported in the upper 61 m (200 ft) of the aquifer.

Well USGS-85 also shows a poor response to the December 1961 H-3 peak. It was postulated by Barraclough et al. (1967) that this poor response may be a result of the well not being in the direct flow path and also due to its greater distance from the disposal well.

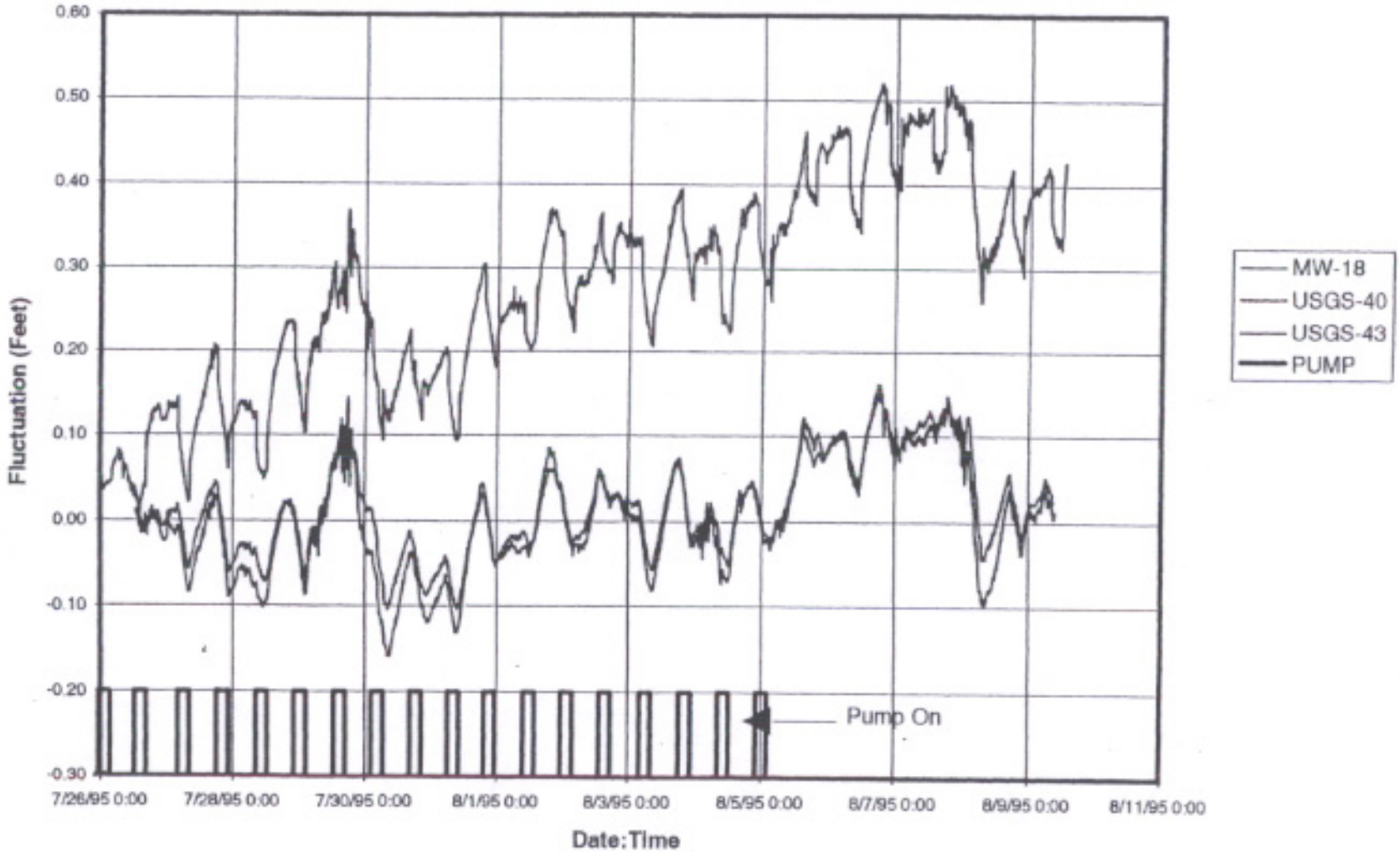
2.6.2.4 Pumping Effects. The ICPP uses approximately 7.9M L (2.1M gal) of water per day. This water is supplied by two raw water wells (CPP-1 and CPP-2) and two potable water wells (CPP-4 and new well) located in the northern portion of the facility. As part of the WAG 3 RI, the effect of groundwater pumpage from these wells upon the local water table was investigated during July and August 1995. This investigation involved continuous water level monitoring of several aquifer wells completed in the northern ICPP while metering the pump usage in Production Well CPP-2.

Water level fluctuations in six aquifer wells (MW-18, USGS-40, -43, -47, -52, and -121) were monitored at 5-min intervals using pressure transducers and data loggers. Barometric pressure changes were recorded at 5-min intervals by NOAA at the CFA weather station, which is located approximately 5 km (3 mi) from the test site. Pump usage for Well CPP-2 was continuously monitored based on amperage requirements. Plots of the water level fluctuation versus pump usage for this test are provided in Figures 2-41 and 2-42. During the 11 days of the test, the production well pump turned on 17 times with each pump cycle lasting for approximately 9 hr.

The water levels in all aquifer wells exhibited a similar response. Daily fluctuations, generally less than 3 cm (1 in.), were observed in all aquifer wells corresponding with pump usage of the production well. The change in water level for each pump cycle is provided in Table 2-22. In almost all pump cycles, the corresponding water levels in the aquifer wells decreased by an average of 1.9 cm (0.75 in.). Only Pump Cycle #11 demonstrated an increase in water levels throughout the pump duration for all wells except Well USGS-40. This water level increase during this pump cycle may be the result of a local or regional trend and not related to groundwater pumpage. Other than Pump Cycle #11, the water levels decreased during the pump cycle in Wells MW-18, USGS-40, -43, and -52 throughout the test.

The SRPA has been described as "quasi-artesian" by Nace et al. (1959) and therefore, the water levels may be affected by changes in barometric pressure. Plots of the change in barometric pressure versus change in water level (standardized to feet of water) for the six aquifer wells are provided in Figure 2-43. The barometric pressure efficiency for each well was then calculated based upon the linear regression line shown in the figure. The barometric pressure efficiency for Wells MW-18, USGS-40, -47, and -121 were calculated to be 54, 77, 66, and 48%, respectively. For two of the wells (USGS-43 and -52), the linear regression line did not intercept the 0-0 point and as a result, the barometric pressure efficiency could not be calculated for these wells.

Water Level Fluctuation & Pump Operation



Water Level Fluctuation & Pump Operation

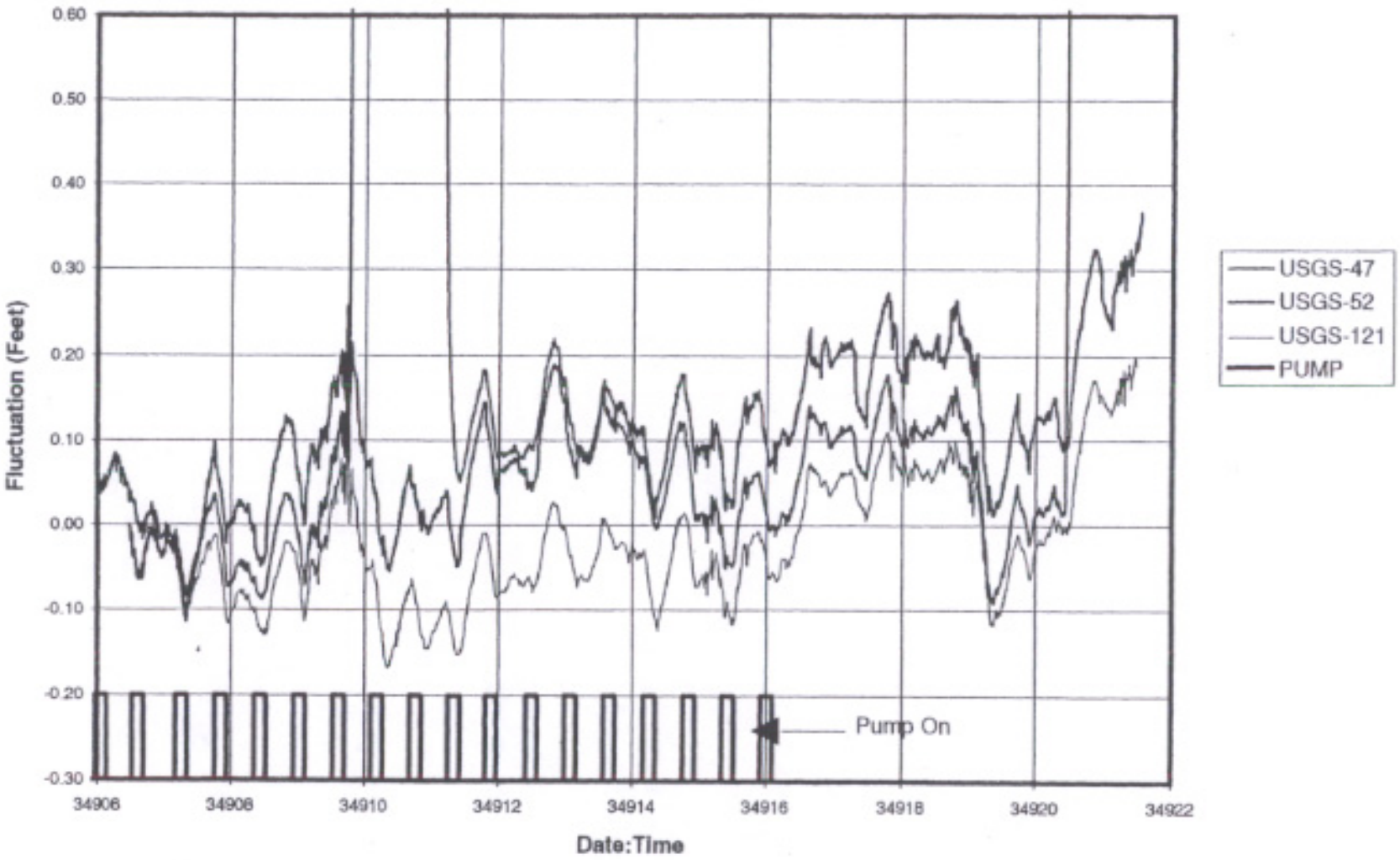
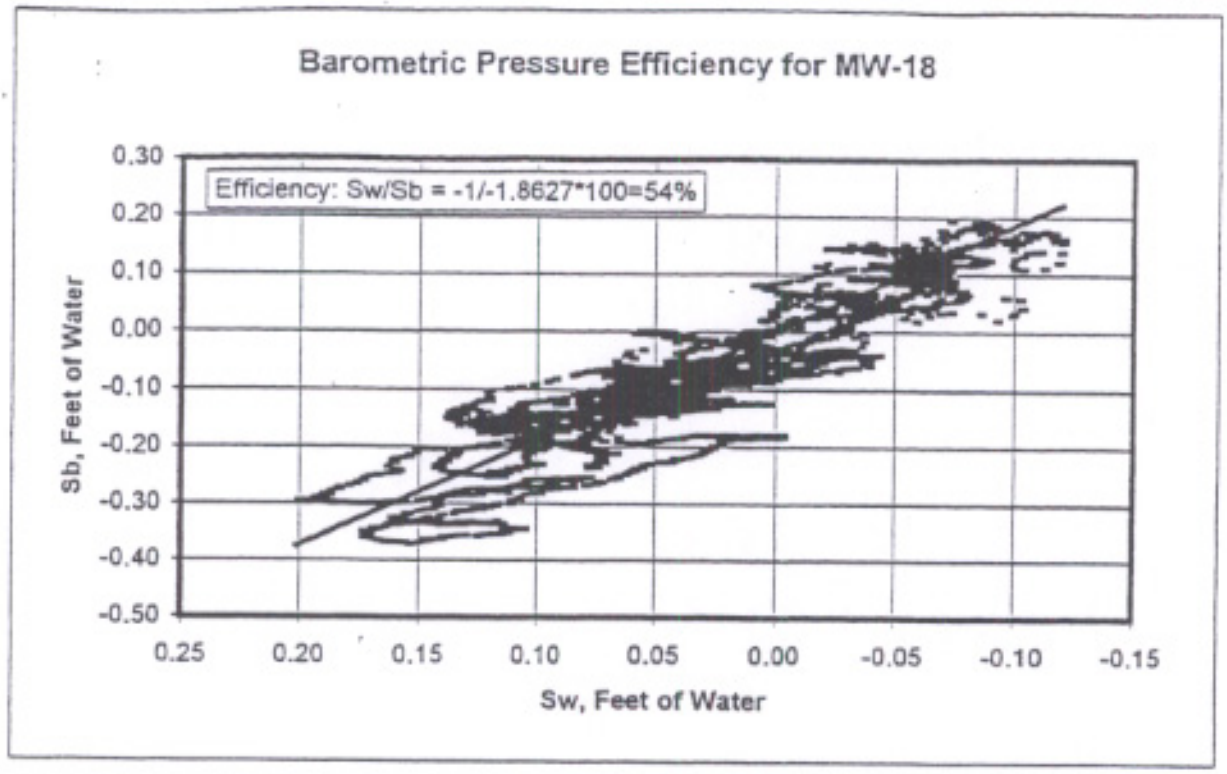


Table 2-22. Summary of water level fluctuation for each pump cycle.

	Water Level Fluctuation (including barometric pressure effects)					
Pump Cycle	MW-18	USGS-40	USGS-43	USGS-47	USGS-52	USGS-121
1	-0.02	NA	NA	-0.27	NA	NA
2	-0.08	-0.07	-0.12	-0.07	-0.07	-0.08
3	-0.12	-0.10	-0.11	-0.11	-0.10	-0.10
4	-0.02	-0.03	-0.06	-0.01	-0.01	0.01
5	-0.09	-0.08	-0.08	-0.08	-0.09	-0.08
6	0.00	-0.01	-0.05	0.00	-0.02	0.00
7	-0.10	-0.09	-0.08	-0.14	-0.08	-0.09
8	-0.06	-0.06	-0.11	0.00	-0.05	-0.06
9	-0.05	-0.05	-0.05	-0.15	-0.03	-0.05
10	-0.09	-0.08	-0.01	-0.10	-0.11	-0.08
11	0.01	-0.01	0.00	0.04	0.02	0.01
12	-0.07	-0.07	-0.11	-0.08	-0.06	-0.06
13	-0.03	-0.04	-0.08	-0.05	-0.02	-0.03
14	-0.09	-0.08	-0.12	-0.08	-0.06	-0.08
15	-0.10	-0.07	-0.13	-0.11	-0.09	-0.08
16	-0.03	-0.04	-0.05	-0.02	0.00	-0.04
17	-0.05	-0.05	-0.09	-0.05	-0.06	-0.04
Maximum	0.01	-0.01	0.00	0.04	0.02	0.01
Minimum	-0.12	-0.10	-0.13	-0.27	-0.11	-0.10
Average	-0.06	-0.06	-0.08	-0.08	-0.05	-0.05

	Water Level Fluctuation (without barometric pressure effects)					
Pump Cycle	MW-18	USGS-40	USGS-43	USGS-47	USGS-52	USGS-121
1	-0.02	0.00	NA	-0.27	NA	0.00
2	-0.10	-0.10	NA	-0.10	NA	-0.10
3	-0.15	-0.16	NA	-0.15	NA	-0.13
4	0.00	0.00	NA	0.02	NA	0.01
5	-0.09	-0.08	NA	-0.08	NA	-0.80
6	-0.07	-0.10	NA	-0.08	NA	-0.05
7	-0.15	-0.17	NA	-0.21	NA	-0.14
8	0.06	0.11	NA	0.15	NA	0.05
9	-0.04	-0.04	NA	-0.14	NA	-0.37
10	-0.10	-0.09	NA	-0.10	NA	-0.08
11	0.06	0.06	NA	0.09	NA	0.05
12	-0.08	-0.82	NA	-0.09	NA	-0.08
13	-0.01	-0.02	NA	-0.03	NA	-0.02
14	-0.11	-0.12	NA	-0.11	NA	-0.10
15	-0.13	-0.11	NA	-0.14	NA	-0.10
16	0.00	0.00	NA	0.17	NA	-0.01
17	-0.05	-0.05	NA	-0.05	NA	-0.04
Maximum	0.06	0.11	NA	0.17	NA	0.05
Minimum	-0.15	-0.82	NA	-0.27	NA	-0.80
Average	-0.06	-0.10	NA	-0.07	NA	-0.11

NA denotes not available



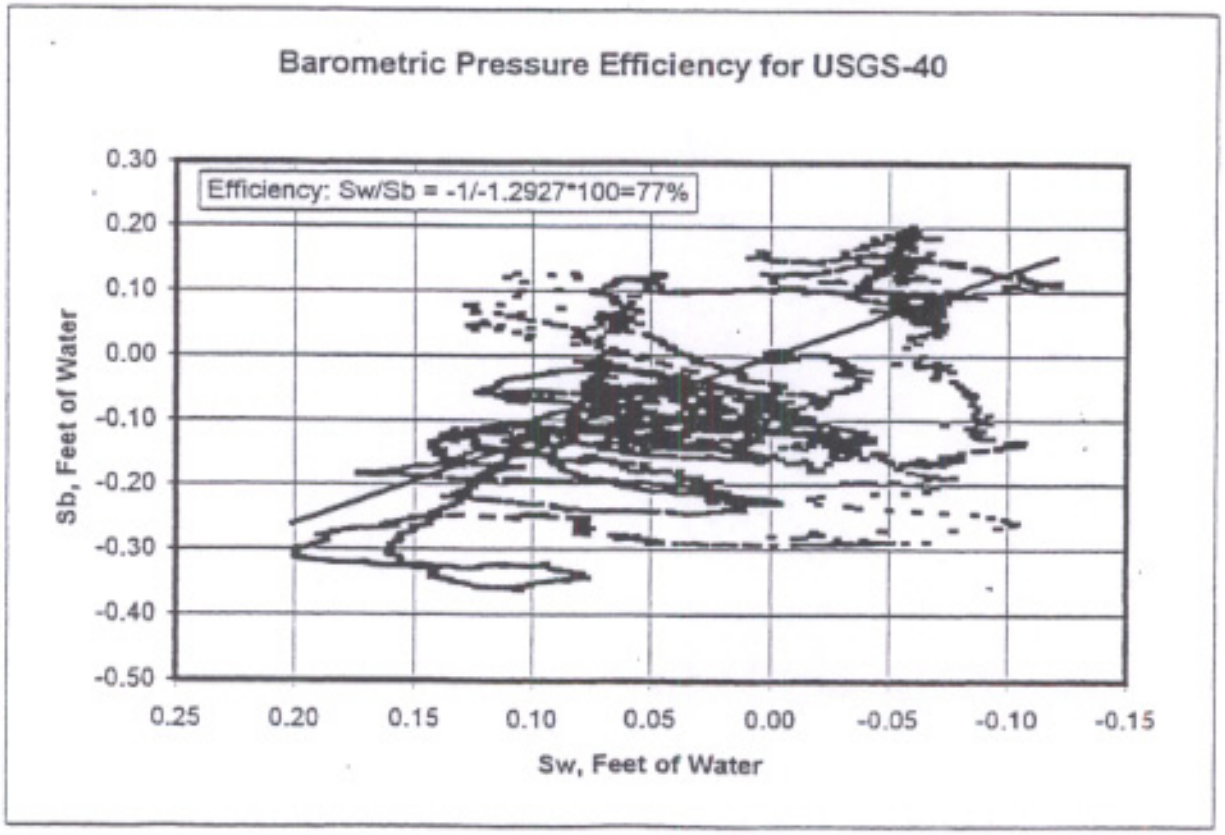
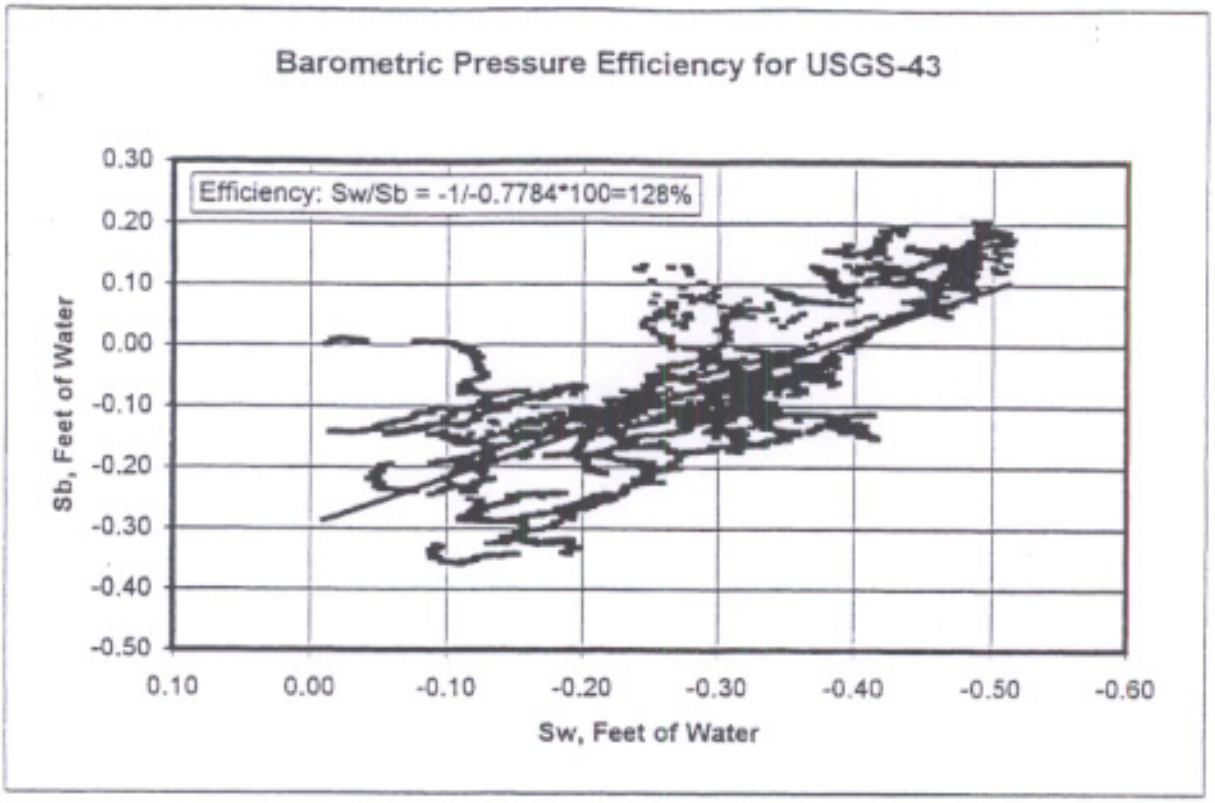


Figure 2-43. Barometric pressure vs. water level fluctuation for Wells MW-18, USGS-40, -43, -47, -52, and -121.



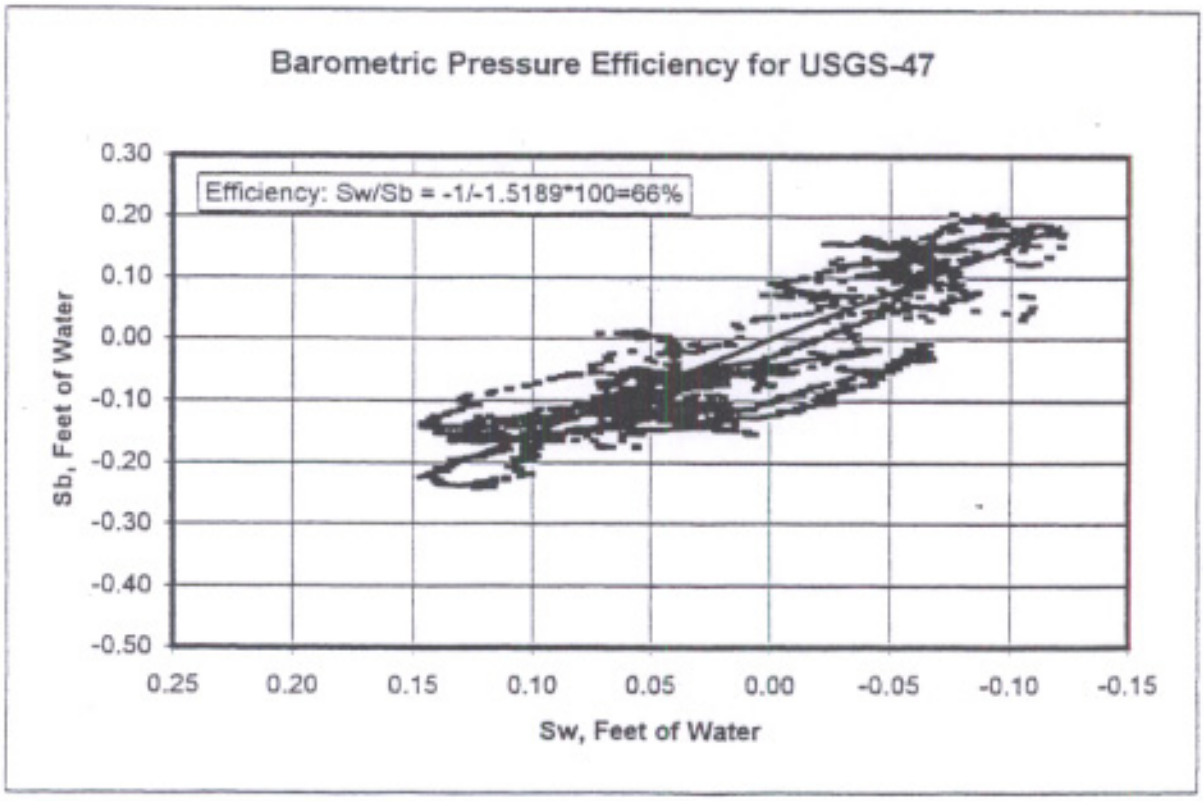
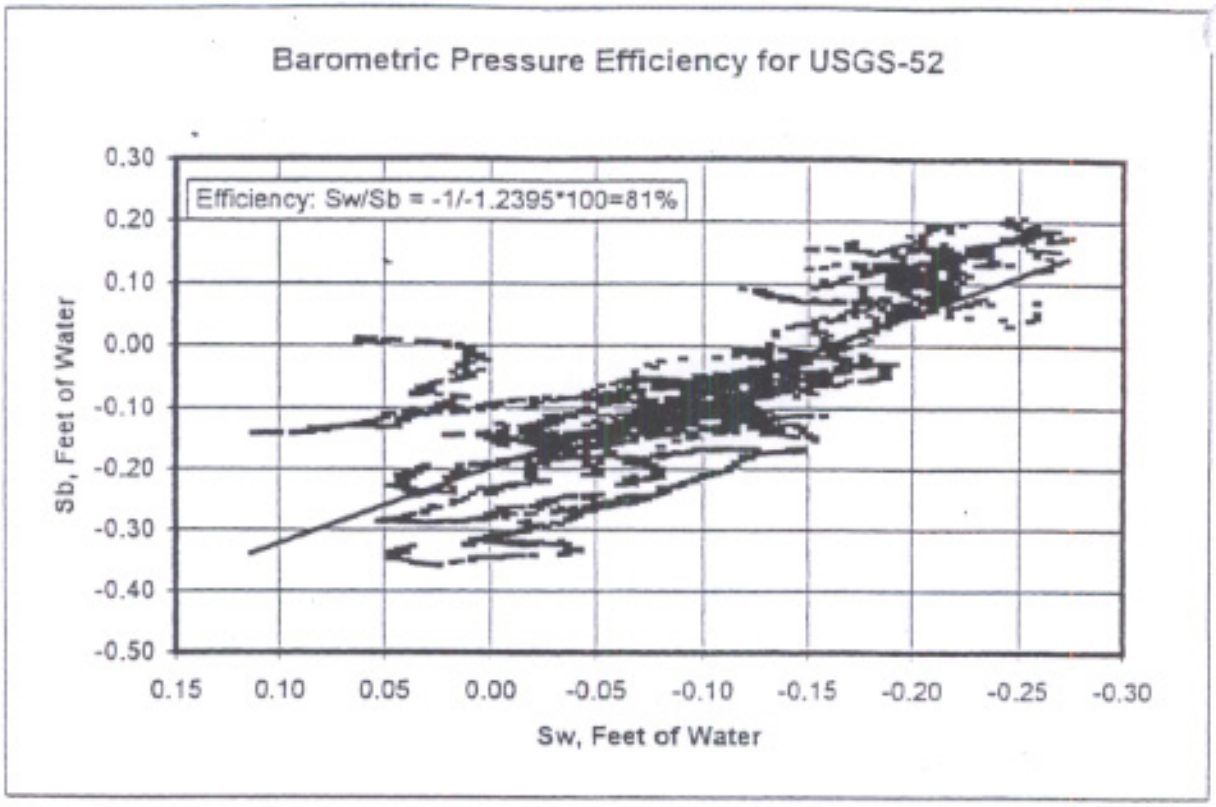


Figure 2-43. (continued).



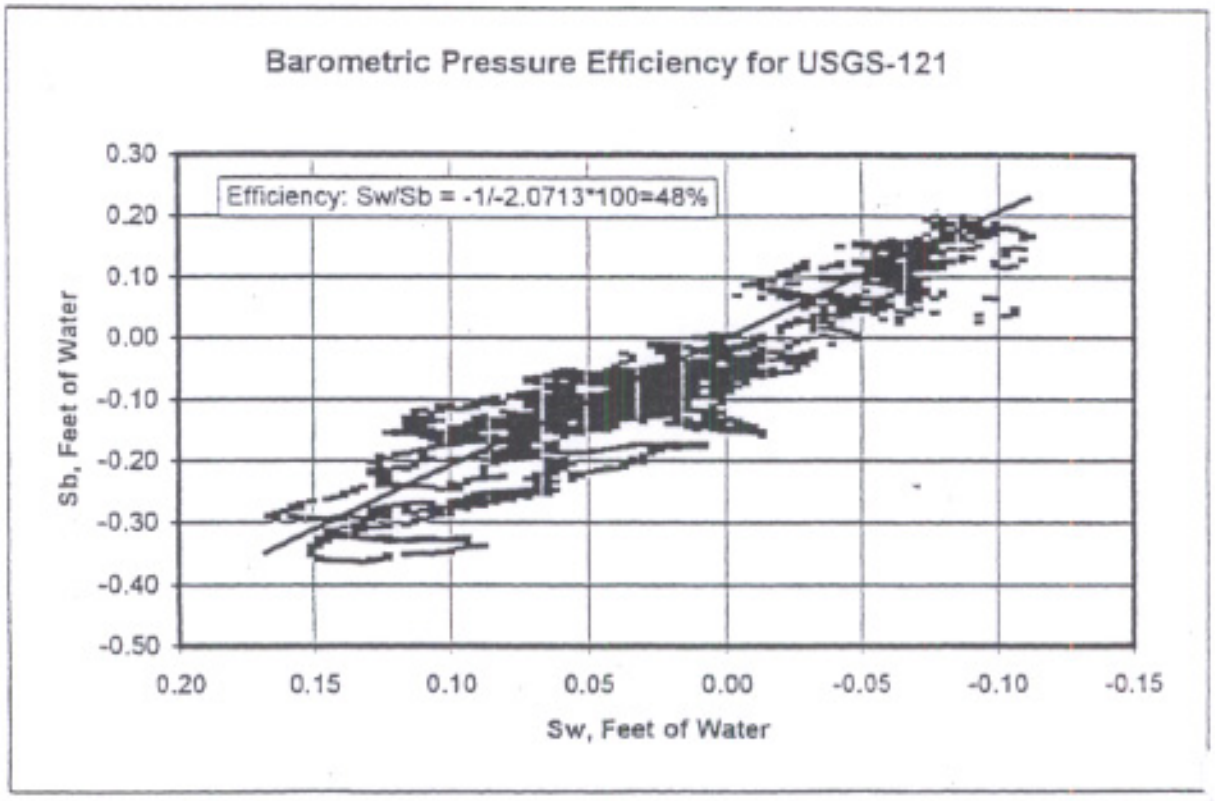


Figure 2-43. (continued).

The effects of barometric pressure upon the water level were eliminated by combining the barometric pressure change during the pump cycle with the barometric pressure efficiency calculated in Figure 2-43. The water level fluctuations without barometric pressure effects for each pump cycle are also provided in Table 2-22. By eliminating barometric pressure effects, water levels in the SRPA decreased during 13 pump cycles, increased during three pump cycles, and demonstrated a mixed response in one pump cycle. Overall, the water level in the SRPA decreased an average of 2.5 cm (1 in.) during each pump cycle.

As shown by this test, water levels in the SRPA are affected by groundwater pumpage from the production well. Minimal responses [<2.5 cm (<1 in.)] were observed in these six monitoring wells, however, the wells are located approximately 610 m (2,000 ft) from the production well. Increased drawdown would be expected closer to the production well that could affect the local groundwater flow direction in the northern ICPP.

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4. NATURE AND EXTENT OF CONTAMINATION

During more than 40 years of operations, radioactive and hazardous materials have been released to the environment at the ICPP. Releases, which are not unusual at industrial facilities, have occurred as the result of spills, leaks in waste transfer lines, and through previous waste management practices. To date, 94 potentially contaminated sites have been identified. Most of these sites were identified before finalization of the FFA/CO and are grouped in OUs based on similar waste streams or conditions. Some release sites were cleaned up at the time of the release and most have been sampled and characterized. The objective of this section is to describe the major sources of contamination that have led to adverse soil and groundwater impacts and subsequently describe the extent of contamination to groundwater. This section will also discuss efforts taken to verify the completeness of the data collected.

To this end, Section 4.1 will describe the nature of contamination in terms of the major sources and Sections 4.2 and 4.3 will describe the resulting extent of contamination in the perched water and aquifer. It should be noted that Section 4.1.3 briefly discusses soil contamination however, the nature and extent of soil contamination will be described in detail on a site basis in Sections 8 through 26. The completeness of the field investigations in terms of the inventory of radioactive contaminants expected given the spent nuclear fuel reprocessing mission of the ICPP is discussed in Section 4.4.

4.1 Sources and Source Inventory

Based on a review of the generation process and existing artifacts, the primary sources of contamination at the ICPP include (a) historical waste discharge to the ICPP disposal well (Section 4.1.1), (b) leakage from the concrete holding tanks in building CPP-603 (Section 4.1.2), and (c) accidental releases to the environment as identified in the FFA/CO. For all sources except the CPP-603 concrete holding tanks, the release of contamination to the environment is from historical events. Wastewater is currently being discharged to two active surface impoundments, the percolation ponds and sewage treatment ponds. According to existing characterization data on the ponds sediments and the quality of the waste stream, these two sources do not contribute significantly to the groundwater contamination. However, water movement from these ponds may affect the migration of contaminants in other areas of the ICPP such as the tank farm. Depending upon the location of the water source with respect to the contaminated areas, this discharge may contribute to contaminant migration in the subsurface.

4.1.1 ICPP Injection Well, CPP-23

Since 1952, ICPP processes have generated large volumes of plant cooling waters and condensates. These service waste waters contained small quantities of radioactive and inorganic contaminants. The ICPP injection well (MEH-FE-PL-304), located north of building CPP-666, was used to discharge these low-level radioactive and chemical wastes to the aquifer from 1952 to February 1984. The ICPP injection well was drilled in 1950 to a depth of 64.6 m (212 ft) and deepened in 1951 to 182 m (597 ft). A 61-cm (24-in.) diameter borehole was drilled and cased using 41-cm (16-in.) nominal diameter carbon steel casing. The annular space between the borehole and casing was filled with gravel. The well casing was perforated from 125.6 to 137.8 m (412- to 452-ft) and 149.4- to 180.7-m (490- to 593-ft) bls. The average discharge to the well during this period was about 1.4B L/yr (363M gal./yr) or about 3.8 ML/day (1M gal/day). Figure 4-1

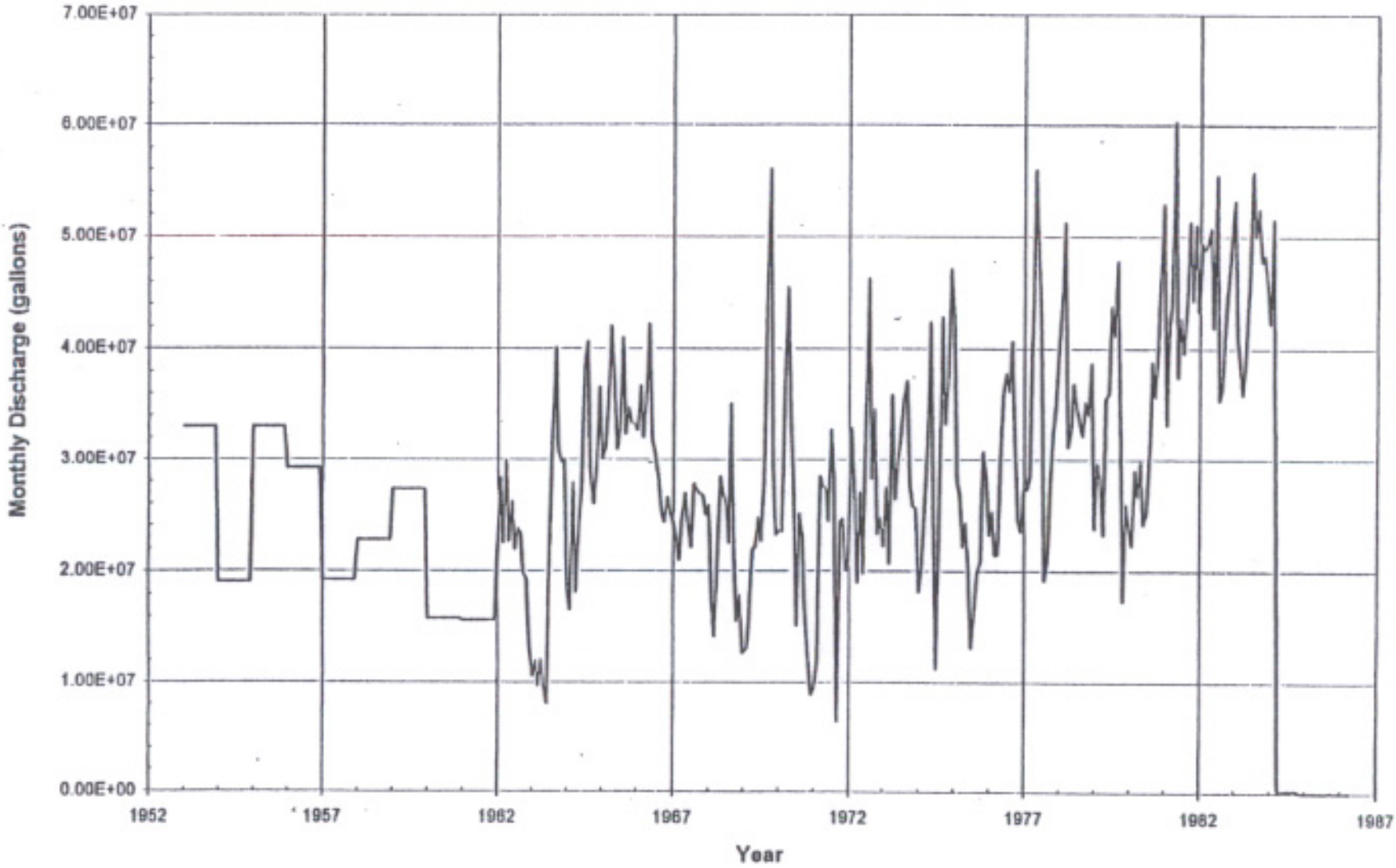


Figure 4-1. Monthly waste water discharge to the ICPP injection well (RWMIS records).

presents the monthly volume of wastewater discharged to the ICPP injection well. The available data for 1953 to 1961 are yearly totals and are plotted by assuming equal volumes discharged every month.

In June 1970, an attempt was made to replace a defective measuring line in the disposal well. It was discovered the well had collapsed and was plugged at a depth of 68.9 m (226 ft). Consequently, waste water was being injected into the unsaturated zone above 68.9 m (226 ft) (WINCO, 1990). The waste water discharged to the disposal well was warm (65° to 70°F) and salty (chloride content averaging approximately 200 to 250 mg/L). The salty, aerated waste water apparently corroded the casing until it collapsed, allowing the gravel pack and intruding sediment to fill the well up to the 68.9-m (226-ft) depth. Only fragmentary corroded pieces of the original 41-cm (16-in.) casing were left as indicated by caliper logs and first attempts at cleaning the well. Measurements made in 1966 showed the well was still intact. Therefore, most of the collapse took place in 1967 or early 1968. Additional evidence supporting this time frame are levels of H-3 and Sr-90 in USGS-50 which occurred in 1969 and 1990 (see Section 4.2.4).

In September 1970, a drilling contractor began to redrill and reline the injection well to its original depth. By October, deepening had progressed to about 152.4 m (500 ft) and the water level in the well had resumed its normal depth at about 138.7 m (455 ft). During this period of well rehabilitation, waste water was disposed to USGS-50. It is assumed during or after these well rehabilitation operations, the well collapsed again and was reopened to the water table in late 1982. At this time, a 2.5-cm (1-in.) thick high-density polyethylene line was placed in the well from ground level to the bottom of the well. The liner was perforated from 137 m (450 ft) bls [approximately 2.4 m (8 ft) above the water table] to the bottom of the well (WINCO Installation Assessment Report, 1986).

On February 7, 1984, the injection well was taken out of routine service and waste water has been pumped from two parallel collection vaults to Percolation Ponds 1 and 2. Disposal of waste water decreased in 1985 and 1986. The injection well also served as an emergency overflow protection for buildings CPP-709, -734, and -797, which contain the vaults from which the service waste water is monitored and pumped. The overflow protection was only required on a temporary basis if the operating and standby pumps from one of the parallel streams failed simultaneously. All the lines have been plugged and can no longer be used to route service waste water overflow from the vaults in the buildings.

In 1986, modifications were made to the injection well entry, which further decreased use of the well resulting in a decrease to approximately 12,200 L (3,220 gal.) to the injection well in 1986. No releases have occurred to the well since 1986.

In October and November 1989, the injection well was sealed by perforating the casing throughout and pumping in cement. The well was sealed from the basalt silt layer [145 m (475 ft) bls] to land surface to prevent hydraulic communication between the land surface, perched water, and SRPA.

4.1.1.1 Waste Disposal. From 1952 to 1984, the injection well was used for the disposal of waste water. According to the RWMIS database, it is estimated a total of 22,200 Ci (approximately 96% consisting of H-3) have been released in 4.2×10^{10} L (1.1×10^{10} gal.) of water. This database provides a qualitative estimate of the activity and volume of waste water discharged to the injection well. Table 4-1 presents a summary of the total curies discharged to the injection well for each radionuclide and includes the curies remaining after radioactive decay. Based on drinking water standards, the major radionuclides of concern

Table 4-1. Activity of radionuclides discharged to the ICPP injection well (RWMIS Database).

Radionuclide	Half Life (years)	Total Activity Injected (Ci)	Total Activity Remaining* (Ci)	Percent of the Injected Activity Remaining (after decay)	Percent of the Current Activity
Ag-110m	6.80E-01	8.36E-05	1.34E-12	0.0	0.00
Am-241	4.32E+02	3.17E-04	3.08E-04	97.2	0.00
Ba-140	3.49E-02	5.05E-04	8.86E-156	0.0	0.00
C-14	5.73E+03	1.27E-01	1.27E-01	99.8	0.00
Ce-141	8.90E-02	1.68E-04	3.19E-61	0.0	0.00
Ce-141/144	7.80E-01	1.16E-01	2.42E-14	0.0	0.00
Ce-144	7.80E-01	1.75E+01	2.07E-06	0.0	0.00
Co-57	7.40E-01	6.54E-03	8.91E-09	0.0	0.00
Co-60	5.27E+00	1.49E-01	8.77E-03	5.9	0.00
Cr-51	7.59E-02	5.37E-03	2.91E-67	0.0	0.00
Cs-134	2.06E+00	1.50E+00	2.03E-03	0.1	0.00
Cs-137	3.02E+01	2.05E+01	1.19E+01	57.8	0.30
Cs-138	6.10E-05	2.50E-01	0.00E+00	0.0	0.00
Eu-152	1.36E+01	8.12E-02	4.36E-02	53.7	0.00
Eu-154	8.80E+00	8.38E-02	2.95E-02	35.2	0.00
Eu-155	4.96E+00	2.22E-02	3.43E-03	15.5	0.00
H-3	1.23E+01	2.13E+04	3.89E+03	18.2	99.44
Hg-203	1.28E-01	7.33E-05	3.10E-42	0.0	0.00
I-129	1.57E+07	2.78E-01	2.78E-01	100.0	0.01
I-130	2.21E-02	2.98E+01	4.38E-152	0.0	0.00
K-40	1.28E+09	2.81E-12	2.81E-12	100.0	0.00
La-140	4.60E-03	6.22E-04	0.00E+00	0.0	0.00
Mn-54	8.30E-01	6.55E-03	7.02E-08	0.0	0.00
Nb-95	9.58E-02	4.63E-01	4.17E-35	0.0	0.00
Np-237	2.14E+06	5.48E-03	5.48E-03	100.0	0.00
Pr-144	3.29E-05	4.47E-01	0.00E+00	0.0	0.00
Pu-238	8.78E+01	1.32E-01	1.15E-01	87.1	0.00
Pu-239	2.44E+04	1.05E-02	1.04E-02	99.9	0.00
Pu-239/240	2.44E+04	3.74E-02	3.74E-02	99.9	0.00
Pu-240	6.57E+03	1.14E-03	1.14E-03	99.8	0.00
Rb-106	9.48E-07	4.81E+00	0.00E+00	0.0	0.00
Ru-103	1.10E-01	1.45E-01	4.59E-37	0.0	0.00
Ru-106	1.00E+00	1.70E+01	6.85E-04	0.0	0.00
Sb-124	1.65E-01	2.41E-04	5.02E-36	0.0	0.00
Sb-125	2.77E+00	1.86E+00	1.22E-02	0.7	0.00
Sr-85	1.78E-01	9.14E-05	1.78E-23	0.0	0.00
Sr-89	1.40E-01	5.59E+00	4.51E-27	0.0	0.00
Sr-89/90	2.86E+01	1.31E+00	6.40E-01	48.8	0.02
Sr-90	2.86E+01	1.60E+01	8.75E+00	54.8	0.22
U-234	2.45E+05	2.28E-02	2.25E-02	100.0	0.00
U-235	7.04E+08	1.94E-03	1.94E-03	100.0	0.00
U-236	2.34E+07	4.09E-04	4.09E-04	100.0	0.00
U-238	4.47E+09	6.81E-03	6.81E-03	100.0	0.00
Y-90	7.32E-03	1.32E+00	0.00E+00	0.0	0.00
Zn-65	6.68E-01	4.65E-04	1.39E-11	0.0	0.00
Zr-95	1.78E-01	2.34E-01	2.53E-23	0.0	0.00
Zr/Nb-95	1.78E-01	2.06E+01	1.38E-43	0.0	0.00
Unidentified Alpha	–	6.36E-01	–	–	–
Unidentified Beta-Gamma	–	5.82E+01	–	–	–
Others**		6.33E+02	–	–	–
	Total	2.22E+04	3.92E+03	–	100.0

* Decayed to January 1, 1995

** Estimate of radionuclides other than H-3 from 1957 to 1962 (assuming 95.5% of the total curies is H-3, Barraclough (1966))

disposed to the injection well were H-3 and Sr-90 with Cs-137 exhibiting the second highest remaining activity. Figures 4-2 and 4-3 provides plots of the disposal history of H-3 and Sr-90 to the ICPP injection well, respectively. The waste water also contained low concentrations of various chemicals. Since well closure in February 7, 1984, the well was used only for emergencies such as loss of pump power and overflow protection for buildings CPP-709, -734, and -797, which contain vaults from which service waste water was monitored and pumped.

Since the percolation ponds were placed in service, the volumes of service waste effluents transferred to the injection well during emergencies decreased to about 2.96×10^8 L (7.8×10^7 gal.) in 1984, 185,490 L (49,000 gal.) in 1985, and 12,190 L (3,220 gal.) in 1986. Emergency releases to the injection well decreased from 1984 to 1986 because the percolation ponds were placed in service and volumes of service waste effluents transferred to the injection well decreased. No discharges to the injection well occurred after 1986.

During the ICPP operational life, known accidental discharges to the injection well occurred and are described below (WINCO, 1992).

1. July 1953: The contents of a tank discharged to the waste water flowing to the well. A post discharge analysis showed that 51 mCi of radioactive contaminants were released in 923,640 L (244,000 gal.) of water.

2. December 1958: About 29 Ci of radioactive contaminants, including 7 Ci of Sr-90 were released to the well.

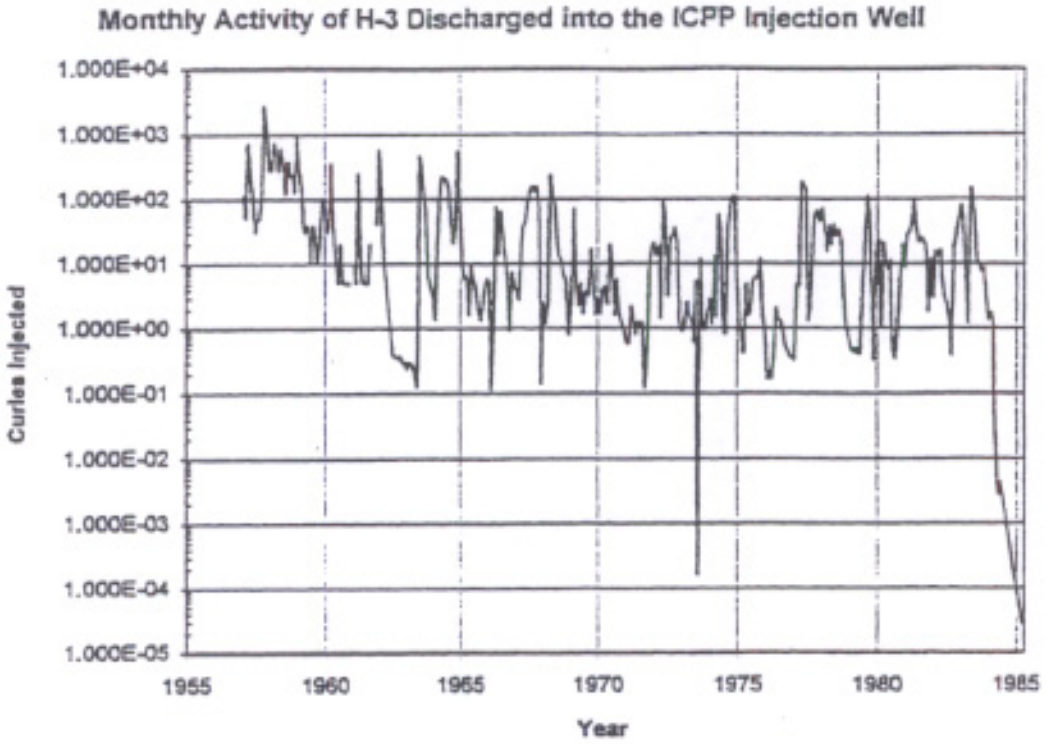
3. September 1969: Twc separate releases resulted in 19 Ci of fission products released to the well. Releases included Cs-137, Cs-134, cerium (Ce)-144, and antimony (Sb)-125 in 12.4×10^6 L (3.28×10^6) of waste water.

4. December 1969: Two releases occurred in which the quantity of Sr-90 released was higher than expected. About 1 Ci, including 30% Sr-90 was released.

5. March 1981: mercury was detected during routine monitoring of the ICPP Service Waste System. Mercury in the form of mercuric nitrate was released from CPP-601, through the ICPP Service Waste System to the ICPP injection well. An estimated 0.207 mg/L of mercury was detected in service waste (RCRA EP Toxicity limit for mercury is 0.2 mg/L).

   Soluble mercury, as mercuric nitrate, is used as a catalyst in certain ICPP fuel dissolution processes. These operations are the only ones in which significant quantities of soluble mercury have been used at the ICPP. In March 1981, a batch of catalyst was mixed, then found to contain solids. The solution was discarded and it is assumed it was drained to the waste system. Assuming the worst case scenario of draining one batch of catalyst, the maximum catalyst lost would be 250 L (66.0 gal) of solution containing 15 kg of mercury. This is the only contaminant release to the well identified as a RCRA concern.

4.1.1.2 Monitoring. Eight monitoring wells within 0.40 km (0.25 mi) and downgradient of the injection well have been established by the USGS. Although there is typical dispersion of waste plumes laterally and



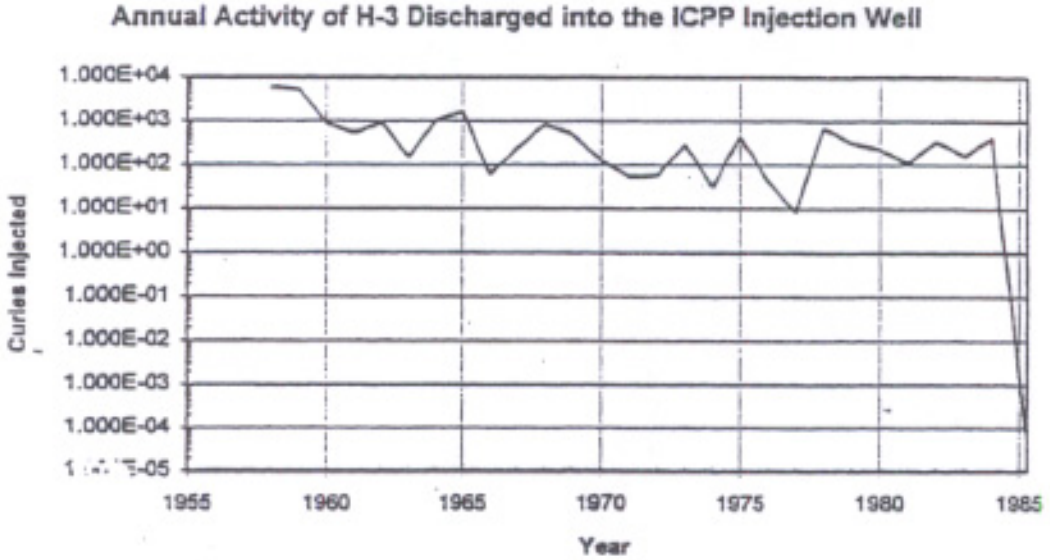
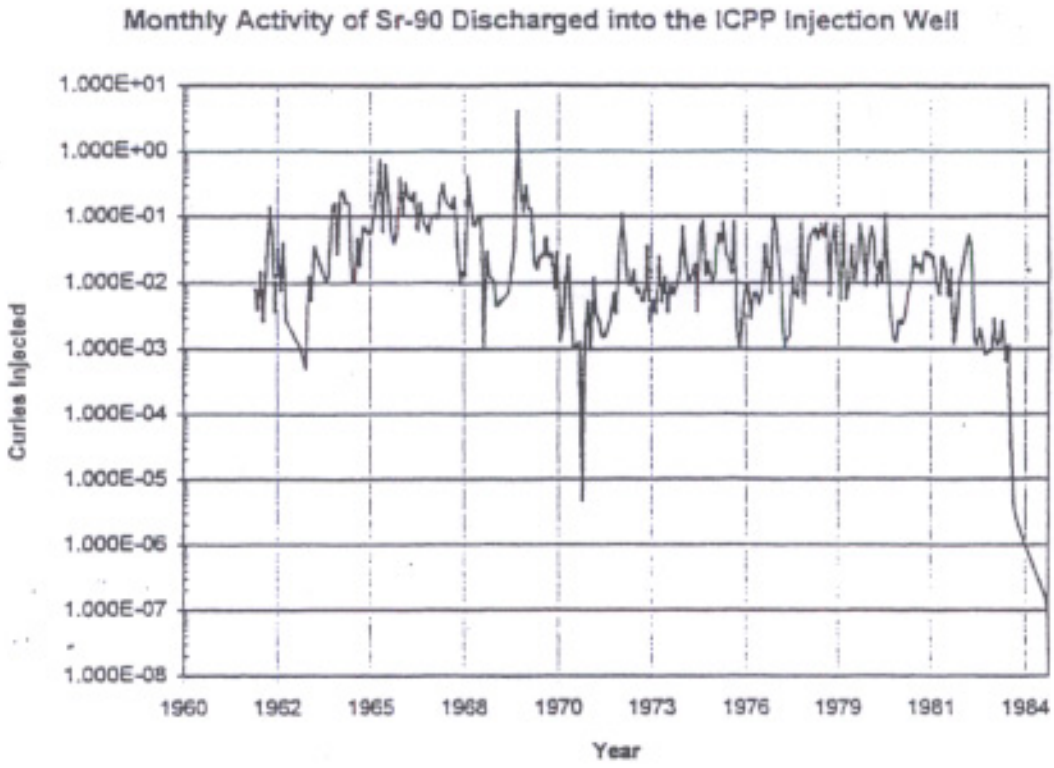


Figure 4-2. Monthly and annual activity of H-3 discharged to the ICPP injection well (RWMIS Records).



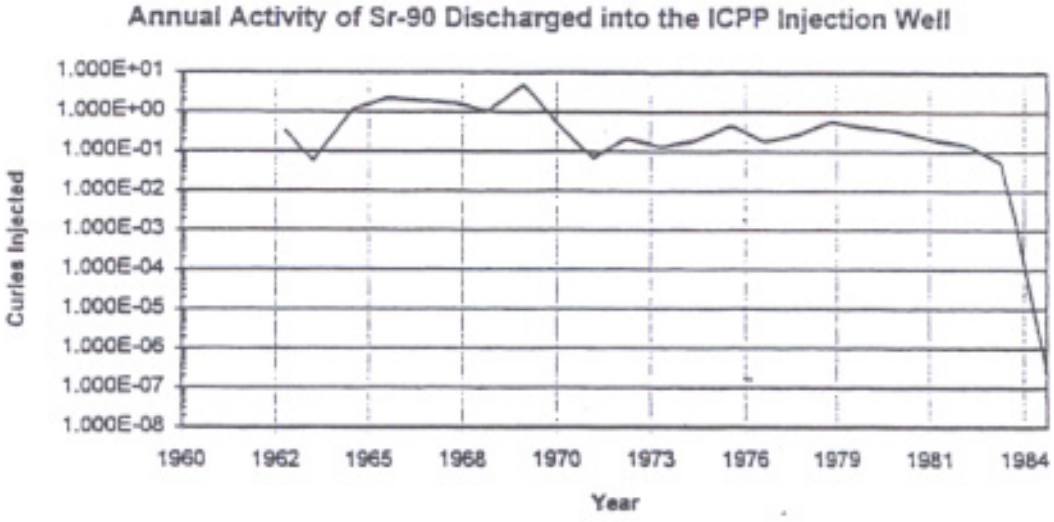


Figure 4-3. Monthly and annual activity of Sr-90 discharged to the ICPP injection well (RWMIS Records).

longitudinally, there appears to be little vertically because of relatively low vertical permeability and apparent lower permeability at depths greater than about 76.2 m (250 ft) below the water table. Analyses of water samples collected from the USGS wells downgradient of the ICPP indicated detectable mercury concentrations (0.2 µg/L) in three USGS wells (36, 37, and 41). Because heavy metal analysis is not conducted by the USGS on a regular frequency, it is not certain if these analyses indicate detectable mercury because of the March 1981 injection well release.

A sample of the sediment within the injection well was collected on August 31, 1989. PCB 1260 (Arochlor) was the only organic compound detected above method detection limit (MDL) in this sediment sample; however, the sample was collected from the top of the sediment column in the injection well and may not be representative of contaminants and concentrations at deeper intervals of the column. Arochlor was detected at a concentration of 10 µg/kg; the minimum detectable limit is 8.3 µg/kg. Downgradient monitoring wells were sampled and PCB was not indicated. Radionuclide analyses of sediments taken from the injection well measured indicate beta activity at 150 pCi/g and three radionuclides: Cs-137 at 100 pCi/g; Eu-152 at 3.8 pCi/g; and Eu-154 at 2.5 pCi/g.

4.1.2 CPP-603 Basins

CPP-603 fuel storage basin has been operational since 1952 and is utilized to store spent fuel assemblies until such time a sufficient amount of fuel was accumulated for a processing run. CPP-603 consists of three reinforced concrete fuel storage basins connected by a transfer channel. The basins are 6.1 m (20 ft) thick and the water inventory is maintained at approximately 5.7M L (1.5M/gal). Based on two studies performed in 1986/87 and 1993 the estimated loss rates from the basins are between 500–700 L/day.

Limited basin water quality data collected by plant operations is available over the period from 1976 to 1996. Water quality parameters analyzed for during this period included pH, chlorides, conductivity, nitrate, and total activity. During this period pH has ranged from 7.2 and 8.3 (1977–1996 data), chlorides 382 mg/L (1977 data) to 35 mg/L (1995 data), conductivity 592.5 to 511 uS/cm (1995–1996 data), and nitrate 682 mg/L (1981 data) to 149 mg/L (1995 data). The total activity for the period 1976 to 1996 has ranged from 0.12 uCi/mL (1976 data) to 3.3 E-05 uCi/mL (1987 data). The major contributor to total activity over this period was Cs-137.

4.1.3 Soil Contamination

Based on the WAG 3 RI/FS Work Plan (INEL-95/0056, Rev. 2), 73 different contaminants have been identified at the ICPP including 13 metals, 25 organic compounds, 32 radionuclides, and 3 other (fluoride, nitrate, and oil and grease) contaminants. Results from the Track 1 and Track 2 investigations indicate that radionuclides are the most significant contaminants at the ICPP. Most if not all field investigations to define the nature of contamination within the soil release areas and groundwater were scoped during the Track 1 and 2 process. Of course, the more recent investigations in 1995 were scoped during the RI Report work plan phase. The sampling programs were designed with the use of process history to the extent that it was available and therefore, the analysis suite was in large part defined by what was known to have been released at a particular site. For example, the soil samples taken within the releases associated with the operation of the HLW tank farm were analyzed for contaminants known to be present in the HLW inside the 11 tanks.

The soil sample results are located in Appendix G and are summarized on a site by site basis in Sections 8 through 26 of this document.

4.2 Perched Groundwater

Perched groundwater zones have been identified to occur in the basalts beneath the ICPP at depths ranging from 30.5 to 42.7 m (100 to 140 ft) bls and 110 to 128 m (360 to 420 ft) bls. Within the upper perched water zone, one perched water body is being monitored beneath the sewage treatment pond, two perched water bodies are being monitored beneath the Tank Farm, one perched water body is being monitored in the vicinity of building CPP-603, and one perched water body is being monitored beneath the percolation ponds. The extent of the lower perched water body(s) is less well defined, being monitored by only three wells in the northern portion of the plant and only one well in the southern portion.

As part of the WAG 3 RI, a complete round of groundwater samples were collected during May and June 1995 from all perched water wells having sufficient water for sample collection. The results from this sampling effort are provided in Table 4-2 and described in the following subsections. The results from previous groundwater sampling efforts have been described in the WAG 3 RI/FS Work Plan (INEL-95/0056, Rev. 2).

4.2.1 Northern Perched Groundwater

Wells that monitor the groundwater quality in the upper perched water zone in the northern ICPP include CPP 33-2, CPP 33-3, CPP 33-4, CPP 37-4, CPP 55-06, MW-2, MW-3, MW-4, MW-5, MW-6, MW-8, MW-10, MW-11, MW-12, MW-18, and MW-20. In addition, well ICPP-Mon-A-024 was installed to monitor the perched water beneath the sewage treatment plan. In addition, well ICPP-Mon-A-024 was installed to monitor the perched water beneath the sewage treatment plant. During the WAG 3 RI, sufficient water was available for the collection of groundwater samples for analysis in all wells except MW-3, MW-8, MW-11, MW-12, and in the 113.5 to 123.5-ft completion zone of MW-18.

4.2.1.1 Chemical Contaminants. The only chemical constituent in the upper perched groundwater zone that was detected above either a Federal primary or secondary maximum contaminant level (MCL) was nitrate. Nitrate/nitrite was detected above the Federal primary MCL of 10 mg/L in wells CPP 33-4, CPP 37-4, CPP 55-06, MW-2, MW-4, MW-5, MW-10, and MW-20 (Figure 4-4). The highest nitrate/nitrite concentrations (35.4 mg/L in well CPP 55-06 and 26.8 mg/L in well MW-10) were measured in the southeastern portion of the perched groundwater body. As shown in Figure 4-4, Nitrate/nitrite concentrations decrease toward the northeastern portion of the perched water body.

4.2.1.2 Radionuclides. The distribution of radionuclide contamination in the upper perched water zones is illustrated by plots of gross alpha and gross beta concentrations (Figures 4-5 and 4-6, respectively). These plots indicate the highest radioactive contamination occurs within the southeastern portion of the perched water body, particularly associated with wells MW-2, MW-5, and CPP 55-06. The maximum gross alpha and gross beta activity measured in the upper perched groundwater were 1,140±220 pCi/L and 589,000±2,600 pCi/L, respectively, in well MW-2. At a depth of approximately 42 m (140 ft), the maximum gross alpha and gross beta concentrations measured in the perched groundwater were 137±9 pCi/L and 65,300±600 pCi/L in wells MW-10 and MW-20.

Table 4-2. Water quality results from the perched water wells (May–June 1995).

Well		MW-17	MW-17	MW-18	MW-20	USGS-50	MW-5	MW-5	MW-5	MW-5	USGS-10	CPP 33-4
Date		May-95	May-95	Jun-95	Jun-95	May-95	Oct-95	Oct-95	Oct-95	Oct-95	Duplicate	Duplicate
Sample Depth		190.18 to 195.2	364.8 to 381	407.63 to 414	137.33 to 148.4	384-405	START	MIDDLE	END	MIDDLE	384-405	102.85 to 118.2
Sample ID	Units	31323101	31323301	31323501	31323601	31323801	31323901	31324001	31324101	31324201	31324301	31324401
Field Parameters												
Temperature	(celsius)	17.85	19.96	18.4	15.68	N/A	N/A	N/A	N/A	N/A	N/A	N/A
pH		7.77	9.05	8.81	7.72	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Conductivity	(mmomos)	0.434	0.615	0.53	0.747	N/A	N/A	N/A	N/A	N/A	N.A	N/A
Misc. Inorganics												
Alkalinity	(mg/L)	152	61.2	143	284	129	ND	ND	ND	ND	150	216
Bic Alkaline	(mg/L)	152	55.9	143	284	129	ND	ND	ND	ND	150	216
Carbonate	(mg/L)	2 U	5.4	2 U	2 U	2 U	ND	ND	ND	ND	2 U	2 U
Chloride	(mg/L)	21.5	125	78.6	28.3	66	ND	ND	ND	ND	65.6	81.3
Fluoride	(mg/L)	0.3	0.28	0.21	0.23	0.36	ND	ND	ND	ND	0.35	0.15
Sulfate	(mg/L)	28.1	33.5	58.6	49.3	44.8	ND	ND	ND	ND	44.5	60.1
TKN	(mg/L)	0.1	0.22	1.5 J	0.1 UJ	0.11	ND	ND	ND	ND	0.1 U	0.1 U
Ammonia-N	(mg/L)	0.1	0.1 U	0.1 U	0.1 U	0.1	ND	ND	ND	ND	0.1 U	0.1 U
NO3/NO2-N	(mg-N/L)	4.9	4.6	34.4	12.1	31.3	ND	ND	ND	ND	33.2	12.7
TAL Inorganics												
Aluminum	(ug/L)	68.9 BU	26.8 U	69.7 BU	26.8 U	26.8 U	ND	ND	ND	ND	32.1 BU	26.8 U
Antimony	(ug/L)	1.9 U	6.4 B	2.7 U	1.9 U	1.9 U	ND	ND	ND	ND	1.9 U	1.9 U
Arsenic	(ug/L)	4 U	4 U	3.4 B	4 U	4 U	ND	ND	ND	ND	4 U	4 U
Barium	(ug/L)	72.1 B	136 B	86.8 B	194 B	183 B	ND	ND	ND	ND	165 BU	284
Beryllium	(ug/L)	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	ND	ND	ND	ND	0.1 U	0.1 U
Cadmium	(ug/L)	0.4 U	0.4 U	0.3 U	0.4 U	0.4 U	ND	ND	ND	ND	0.4 U	0.4 U
Calcium	(ug/L)	40600	22100	49100	87700	73300	ND	ND	ND	ND	67100	103000
Chromium	(ug/L)	4.1 U	4.1 U	11.1	4.1 U	4.3 B	ND	ND	ND	ND	5.2 B	4.1 U
Cobalt	(ug/L)	0.5 U	0.5 U	0.94 B	0.5 U	0.5 U	ND	ND	ND	ND	1.2 B	0.52 B
Copper	(ug/L)	2.7 BJ	14.9 B	2.2 U	2.1 B	2.6 B	ND	ND	ND	ND	7.4 B	1.3 UJ
Iron	(ug/L)	173	21.5 U	30 B	21.5 U	21.5 U	ND	ND	ND	ND	21.5 U	21.5 U
Lead	(ug/L)	2 U	2 U	2 U	2 U	2 U	ND	ND	ND	ND	2 U	2 U
Magnesium	(ug/L)	10400	9250	18900	23400	20000	ND	ND	ND	ND	18450	27000
Manganese	(ug/L)	51.7	3.7 B	1.3 BU	0.8 U	1.8 B	ND	ND	ND	ND	1.2 B	0.8 U
Mercury	(ug/L)	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	ND	ND	ND	ND	0.28	0.1 U
Nickel	(ug/L)	3.4 U	3.4 U	2.5 B	3.4 U	3.4 U	ND	ND	ND	ND	3.8 B	3.4 U
Potassium	(ug/L)	5160 EJ	24300	8060 EJ	5318	6350	ND	ND	ND	ND	5750	3930 BEJ
Selenium	(ug/L)	3.2 BU	2.7 U	2.8 U	2.7 U	2.7 U	ND	ND	ND	ND	3.4 B	5.4 BU
Silver	(ug/L)	0.6 NUJ	0.6 U	1.4 B	0.6 U	0.6 U	ND	ND	ND	ND	0.6 U	0.6 NUJ
Sodium	(ug/L)	33300	75600	75200 EJ	47200	66200	ND	ND	ND	ND	59400	30300
Thallium	(ug/L)	4.6 U	4.6 U	3.2 U	4.6 U	4.6 U	ND	ND	ND	ND	4.6 U	4.6 U
Vanadium	(ug/L)	1.5 BJ	6.7 B	3.4 BU	3.3 BU	6.5 B	ND	ND	ND	ND	6 B	1.1 BJ
Zinc	(ug/L)	3.4 BU	4.2 BU	27.1 EJ	12.6 BU	10.8 BU	ND	ND	ND	ND	10.8 BU	13.7 B
Zirconium	(ug/L)	ND	31.2 U	ND	31.2 U	31.2 U	ND	ND	ND	ND	31.2 U	ND
Radionuclides												
Gross Alpha	(pCi/L)	2.3±1	0±1.1 U	3.2±1.7 U	16±19 U	0.3±1.7 U	ND	ND	ND	ND	2.6±1.8 U	8.4±2.6
Gross Beta	(pCi/L)	11±1	45±2	756±7	65300±600	456±6	ND	ND	ND	ND	475±6	491±7
Tritium	(pCi/L)	25700±400	25100±400	73000±700	1150±180	61900±700	ND	ND	ND	ND	62800±700	971±143
Sr-90	(pCi/L)	1.6±1.4 U	0.7±0.4 U	207±2	25800±30	151±2	76700±400	98400±500	104000±500	101000±500	135±2	173±1
Pu-238	(pCi/L)	ND	ND	ND	0±0.12 U	ND	ND	ND	ND	ND	ND	0.06±0.07 U
Pu-239/240	(pCi/L)	ND	ND	ND	0.07±0.08 U	ND	ND	ND	ND	ND	ND	0±0.07 U
Am-241	(pCi/L)	ND	ND	ND	0±0.06 U	ND	ND	ND	ND	ND	ND	0±0.04 U
Np-237	(pCi/L)	ND	ND	ND	0.02±0.14 U	ND	ND	ND	ND	ND	ND	0±0.11 U
I-129	(pCi/L)	0±0.4 U	0±0.3 U	0±0.3 U	0±0.3 U	0±0.3 U	ND	ND	ND	ND	0±0.2 U	0±0.3 U
Tc-99	(pCi/L)	6.4±0.6	5.9±0.6	736±6 J	18.3±0.5	63±1 J	ND	ND	ND	ND	75±1	0.5±0.5 U
U-234	(pCi/L)	ND	ND	ND	3.3±0.5 J	ND	ND	ND	ND	ND	ND	3.2±0.6
U-235	(pCi/L)	ND	ND	ND	0±0.2 U	ND	ND	ND	ND	ND	ND	0±0.2 U
U-238	(pCi/L)	ND	ND	ND	2.7±0.5 J	ND	ND	ND	ND	ND	ND	2.8±0.5

NA - not analyzed.
ND - not detected.
NS - not sampled.
U - analyzed, not detected.
B - contaminant in associated blank.
R - concentration reported is unusable.
J - estimated concentration.

Table 4-2. (Continued).

Well		CPP 33-2	CPP 33-4	CPP 37-4	CPP 55-06	MW-1	MW-2	MW-4	MW-5	MW-6	MW-10	MW-15
Date		May-95	May-95	May-95	Jun-95	May-95	Jun-95	Jun-95	Jun-95	May-95	Jun-95	Jun-95
Sample Depth		97.5 to 105.8	102.85 to 118.2	103.8 to 109.9	106.25 to 113.1	312.28 to 336	107.49 to 112	105.85 to 110.6	112.5 to 126.5	122.7 to 137	148.12 to 151	122.85 to 131.3
Sample ID	Units	31320201	31320401	31320501	31320601	31320701	31320901	31321201	31321401	31321501	31322101	31322901
Field Parameters												
Temperature	(celsius)	19.07	14.11	16.02	16.4	15.24	19.9	10.9	24.8	18.69	18.4	21.3
pH		7.15	7.19	7.72	7.85	7.59	7.5	7.92	7.57	7.19	7.95	7.84
Conductivity	(mmhos)	0.44	0.766	0.692	1.28	0.993	1.11	0.91	1	0.572	0.9	0.83
Misc. Inorganics												
Alkalinity	(mg/L)	168	217	214	229	165	223	246	293	180	217	178
Bic Alkalinc	(mg/L)	168	217	214	229	165	223	246	293	180	217	178
Carbonate	(mg/L)	2 U	2	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U
Chloride	(mg/L)	27.4	81.2	32.6	52.5	63.4	83.7	45.8	37.6	55.7	54.4	24.1
Fluoride	(mg/L)	0.29	0.16	0.27	0.21	0.22	0.24	0.25	0.28	0.21	0.24	0.26
Sulfate	(mg/L)	27.7	61.8	48.9	39.8	26.4	35.5	42.6	27.9	26.2	61.4	31.9
TKN	(mg/L)	0.1	0.1 U	0.1 U	0.1 U	0.1 UJ	0.1 U	0.1 U	0.1 U	0.1 U	0.1 UJ	0.1 U
Ammonia-N	(mg/L)	0.1 U	0.1 U	0.1 U	0.1 U	0.1 UJ	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
NO2/NO2-N	(mg-N/L)	3.3	13	17.7	35.4	69.6	15.7	10.9	19	4.6	26.8	14.7
TAL Inorganics												
Aluminum	(ug/L)	26.8 U	26.8 U	45.7 BU	50.5 BU	26.8 U	47 BU	58.2 BU	65.9 BU	79.6 BU	44.8 BU	45.8 BU
Antimony	(ug/L)	1.9 U	1.9 U	2.8 B	2 B	3.4 B	1.9 U	1.9 U	3.4 B	1.9 U	2.7 U	1.9 U
Arsenic	(ug/L)	4 U	4 U	4 U	4.9 B	4 U	4 U	4.2 B	4 U	4 U	2.4 U	5.1 BU
Barium	(ug/L)	139 B	138 B	220	289	253	328	227	394	230	165 B	71.4 B
Beryllium	(ug/L)	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.12	0.1 U
Cadmium	(ug/L)	0.4 U	0.4 U	0.4 U	0.4 U	0.4 U	0.4 U	0.4 U	0.4 U	0.4 U	0.3 U	0.4 U
Calcium	(ug/L)	56200	51000	72200	94100	114000	84400	85700	94900	75800	97100	62700
Chromium	(ug/L)	5.7 B	4.1 U	4.1 U	5 B	4.1 U	4.8 B	5.4 B	4.1 U	4.1 U	1.6 U	4.1 U
Cobalt	(ug/L)	0.5 U	0.5 U	1.3 B	0.9 B	0.6 B	0.63 B	0.66 B	0.64 B	0.57 B	0.6 U	0.5 U
Copper	(ug/L)	1.3 U	1.3 U	1.3 B	1.3 U	2 B	1.3 U	2.7 B	1.7 B	1.3 UJ	2.2 U	1.3 U
Iron	(ug/L)	21.5 U	21.5 U	21.5 U	21.5 U	21.5 U	21.5 U	33.8 B	62.7 B	21.5 U	5.3 BU	21.5 U
Lead	(ug/L)	2 U	2 U	2 U	2 UJ	2 U	2 UJ	2 UJ	2 UJ	2 U	2 U	2 BJ
Magnesium	(ug/L)	14500	13700	23800	27700	34000	22900	24300	29200	17900	27900	15200
Manganese	(ug/L)	1.5 B	0.85 B	2.2 B	2.2 B	18.9	0.8 U	1.4	186	1.2 B	1.1 B	1.7 B
Mercury	(ug/L)	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
Nickel	(ug/L)	3.4 U	3.4 U	3.9 B	7.5 B	3.4 U	3.4 U	3.4 U	3.4 U	3.4 U	3 BU	3.4 U
Potassium	(ug/L)	2910 BEJ	1910 BEJ	3960 B	5240	6220 B	5340	4490 B	5300	3380 BEJ	6510 EJ	3900 B
Selenium	(ug/L)	2.7 U	2.7 U	4 B	2.7 U	2.7 U	2.7 U	2.7 U	2.7 U	2.7 U	3 B	3 B
Silver	(ug/L)	0.6 UN	0.77 BNU	0.6 U	0.6 U	0.6 U	0.6 U	0.6 U	0.6 U	0.6 NUJ	0.8 UN	0.6 U
Sodium	(ug/L)	21900	14300	48200	48000	35400	59000	38500	41700	19680	44400 EJ	37900
Thallium	(ug/L)	5 B	4.6 U	4.6 U	4.6 U	4.6 U	4.6 U	4.6 U	4.6 U	4.6 U	3.3 B	4.6 U
Vanadium	(ug/L)	3 BU	1.4 BU	4.1 B	2.6 B	2.2 BU	2.8 B	2.7 B	2.8 B	2.4 BJ	1.9 B	5.2 B
Zinc	(ug/L)	69.3 EJ	7.6 BEUJ	7.9 BU	2.6 B	29.5	3 B	30.2	4.1 B	16.7 B	28.1 EJ	4.3 B
Zirconium	(ug/L)	31.3 U	31.3 U	31.2 U	31.2 U	31.2 U	31.2 U	31.2 U	31.2 U	ND	11.6 U	31.2 U
Radionuclides												
Gross Alpha	(pCi/L)	3±1.4	2.1±1.8 U	3.8±1.6	92±9	3±2.1 U	1140±220	23±4	265±108	0.3±1.4 U	137±9 J	25±4
Gross Beta	(pCi/L)	317±4	505±6	37±2	139000±200	26±3	589000±2600	23400±40	207000±1600	5.2±1.7	48000±100	44700±180
Tritium	(pCi/L)	2540±170	839±134	1680±190	621±113	24700±480	6380±260	382±106 U	15300±400	197±123 U	38000±500	3630±176
Sr-90	(pCi/L)	102±1	191±2	5±0.5	66300±600	4.5±0.4	320000±3000	11900±200	104000±1000	0.7±0.3	17200±200	22100±200
Pu-238	(pCi/L)	ND	ND	ND	0.17±0.11 U	ND	0±0.4	0.07±0.08 U	0±0.01	ND	0.05±0.06 U	0.03±0.07 U
Pu-239/240	(pCi/L)	ND	ND	ND	0.02±0.06 U	ND	0±0.5	0±0.04 U	0±0.5	ND	0±0.04 U	0.01±0.08 U
Am-241	(pCi/L)	ND	ND	ND	0±0.06 U	ND	0.16±0.1	0±0.06 U	0.03±0.08	ND	ND	0.11±0.1 U
Np-237	(pCi/L)	ND	ND	ND	0±0.14 U	ND	0±0.9 U	0±0.09 U	0±0.14 U	ND	0±0.14 U	0±0.13 U
I-129	(pCi/L)	0±0.5 U	0±0.3	0±0.2 U	0±1.2 U	0±0.3 U	0.5±0.3 U	0±1.3 U	0.5±0.3 U	0±0.3 U	0±0.6 U	0±1.4 U
Tc-99	(pCi/L)	3.1±0.7	0.4±0.6	3.3±0.6	73±1 J	0.3±0.3 UJ	77±2 J	12.9±0.7	105±2 J	0±0.5 U	127±2	23.7±0.6 J
U-234	(pCi/L)	ND	ND	ND	3.5±0.6 J	ND	3.7±0.6 J	4.1±0.6 J	1.9±0.4 J	ND	4.6±0.7	11.8±1
U-235	(pCi/L)	ND	ND	ND	0±0.2 U	ND	0±0.2 U	0.1±0.2 U	0±0.2 U	ND	0±0.2 U	0.2±0.3 U
U-238	(pCi/L)	ND	ND	ND	2.1±0.5 J	ND	1.6±0.4 J	1.9±0.4 J	0.8±0.3 J	ND	2.2±0.5	2.3±0.5 J

NA - not analyzed.
ND - not detected.
NS - not sampled.
U - analyzed, not detected.
B - contaminant in associated blank.
R - concentration reported is unusable.
J - estimated concentration.

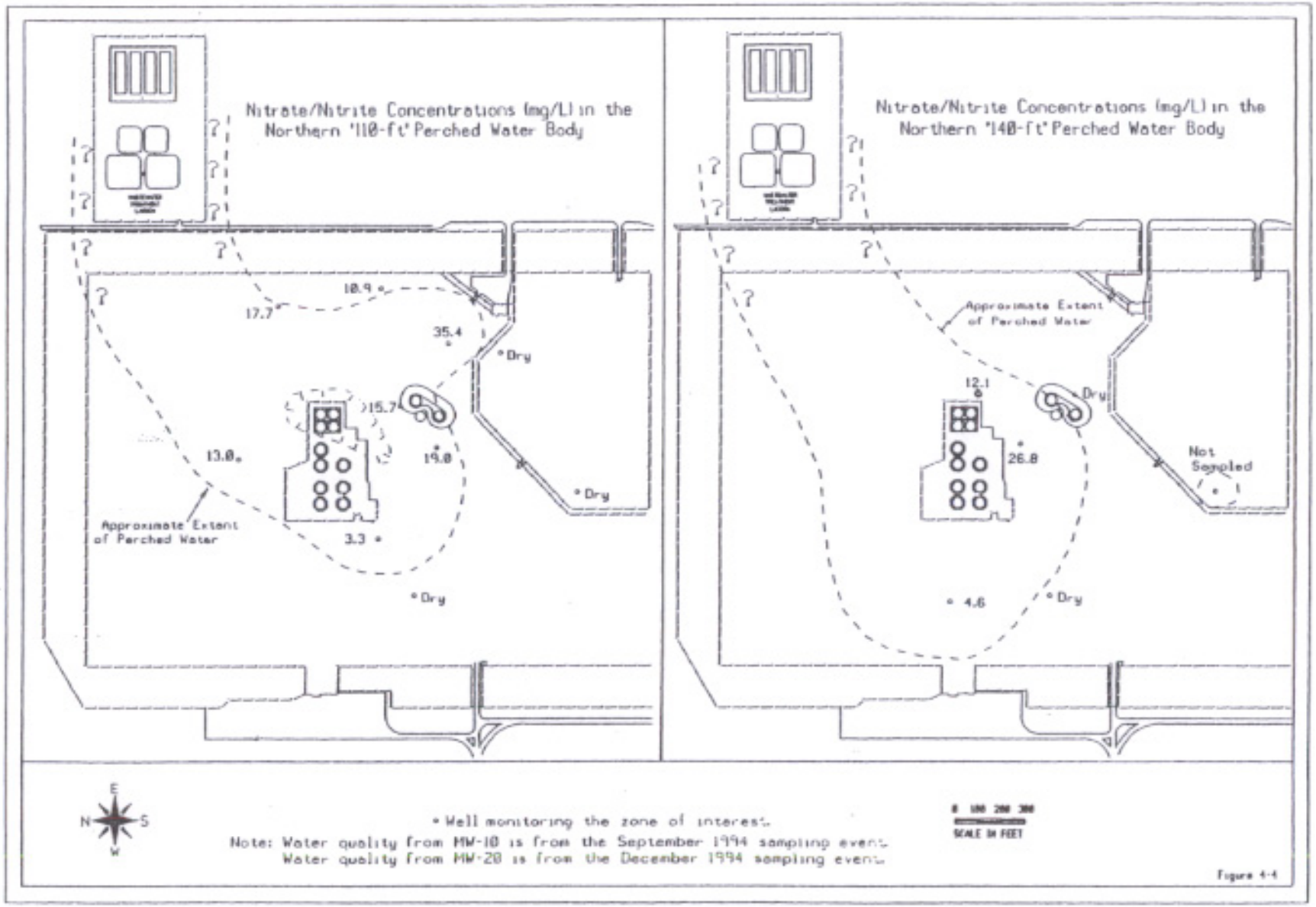


Figure 4-4. Nitrate/Nitrite concentrations in the upper perched water body (May–June 1995).

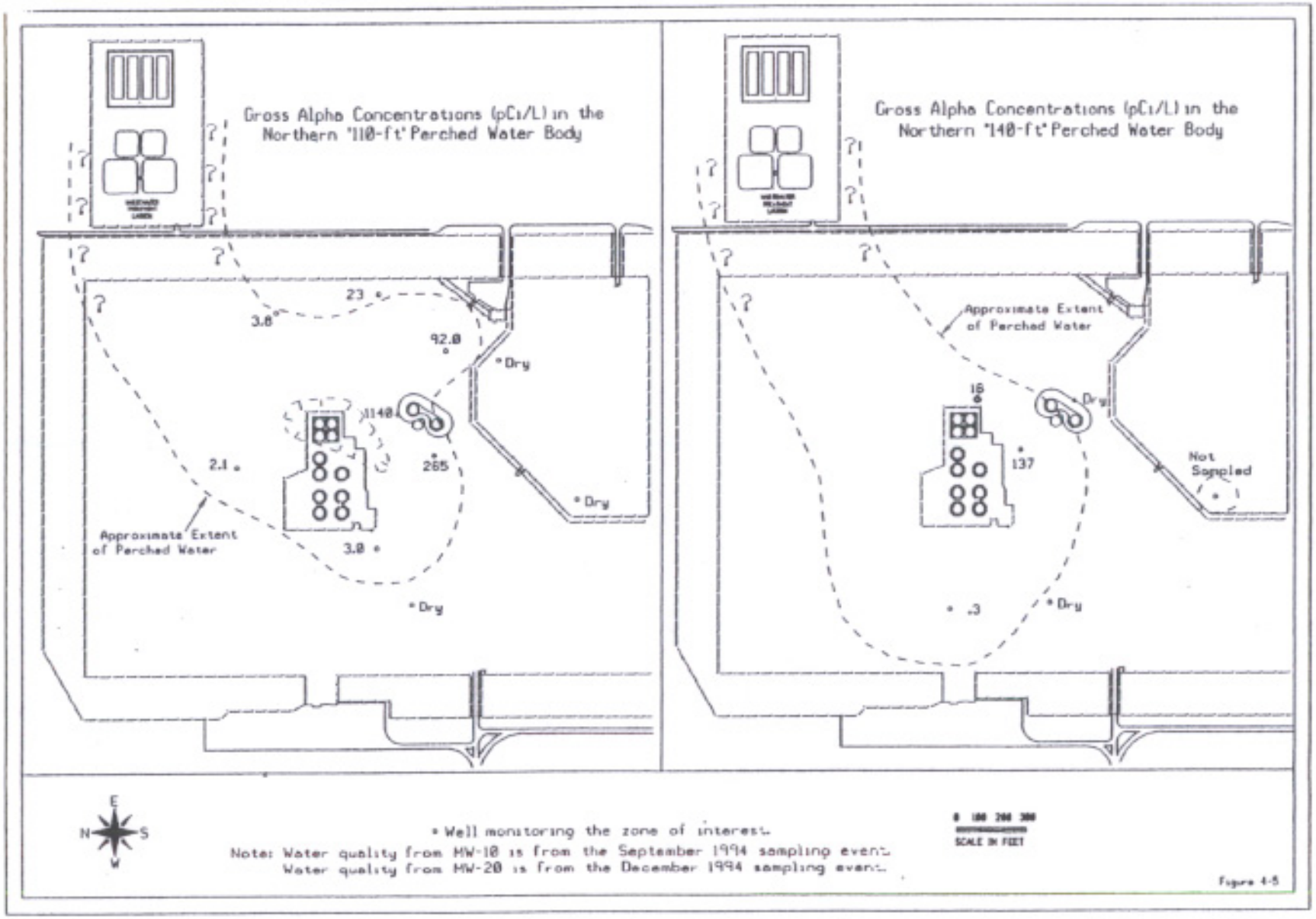


Figure 4-5. Gross alpha activities in the upper perched groundwater (May–June 1995).

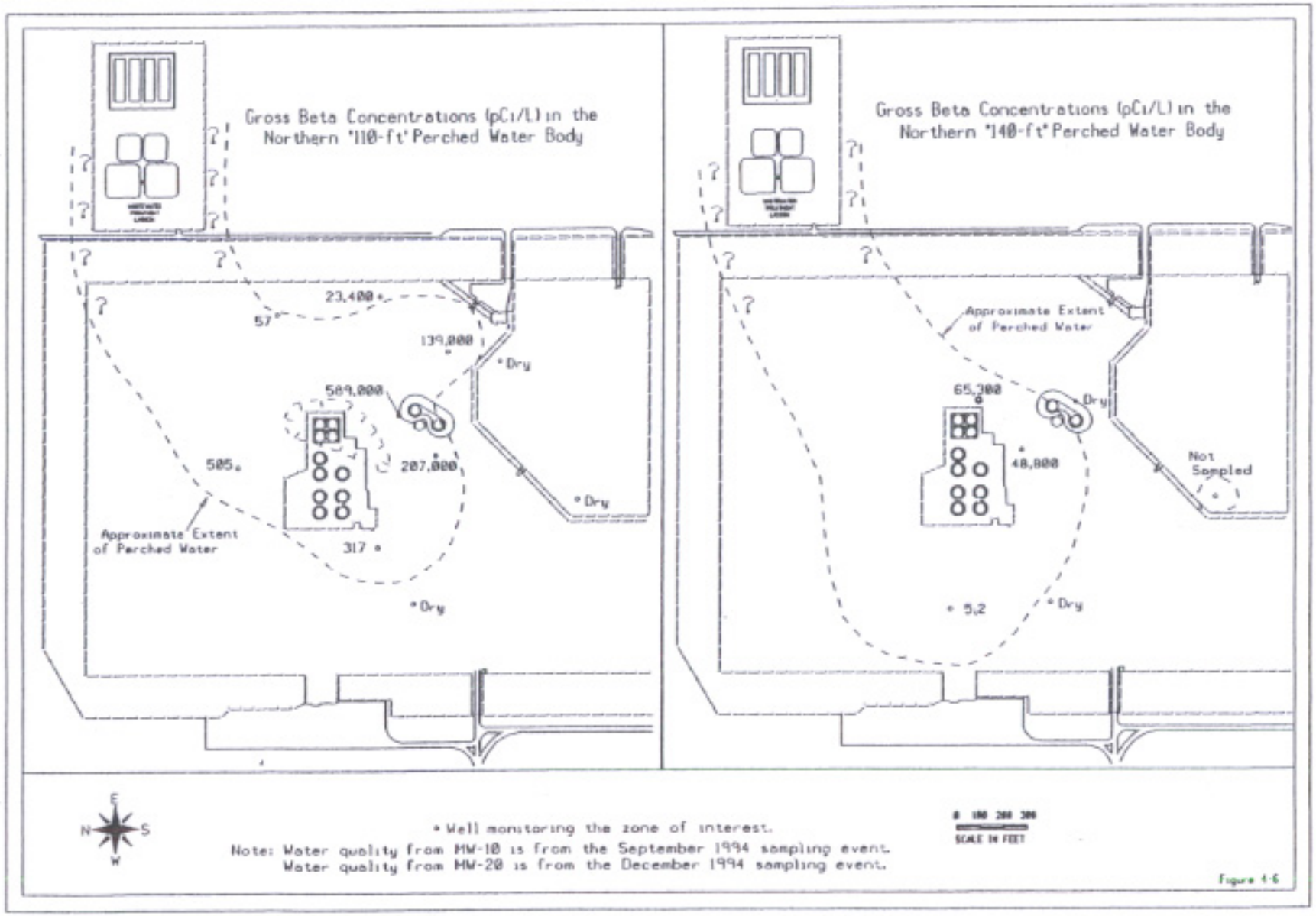


Figure 4-6. Gross beta activities in the upper perched groundwater (May–June 1995).

The most significant radionuclides in the upper perched water body are Sr-90 and Tc-99. Low levels of H-3 were also detected in the upper perched water zone, however, none of the water samples exceeded the Federal primary MCL of 20,000 pCi/L. The low H-3 concentrations in the upper perched water zone significantly contrast the waste stream that was directed to the ICPP disposal well where the vast majority of the associated radioactivity consisted of H-3.

Radioactivity from fission products is due almost equally from Sr-90 and two Cs isotopes (Cs-134 and Cs-137) with minor contributions from several other intermediate term radionuclides. Cesium isotopes have not been detected in the groundwater, probably as a result of the high sorption capacity of Cs, which makes it relatively immobile in the environment. Strontium-90 was detected in all wells completed in the upper perched water zone with the distribution shown in Figure 4-7. The maximum Sr-90 concentration detected in the upper perched water zone was 320,000±3,000 pCi/L (well MW-2) followed by 104,000±1,000 pCi/L (well MW-5) and 66,300±600 pCi/L (well CPP 55-06).

The only other fission product detected in the upper perched groundwater is Tc-99. This radionuclide has been detected in all wells except CPP 33-4 and MW-6 with the distribution provided in Figure 4-8. The maximum Tc-99 concentration detected in the upper perched groundwater zone was 105±2 pCi/L in well MW-5.

Two wells (MW-10 and MW-20) are completed in water-bearing zones at depths of approximately 42 m (140 ft). The maximum concentrations for H-3, Sr-90, and Tc-99 from these wells are 38,000±50 pCi/L, 25,800±30 pCi/L, and 127±2 pCi/L, respectively. A comparison of the water quality from the wells completed in the upper perched groundwater body [i.e., at approximately 33 m (110 ft)] to this deeper zone indicates an increase in both H-3 and Tc-99 concentrations and a decrease in the Sr-90 concentrations.

4.2.2 Southern Perched Groundwater

Two perched water bodies have been identified in the southern ICPP. A small perched water body has been identified in the vicinity of building CPP-603 and a larger perched water body has developed from the discharge of waste water to the percolation ponds.

Wells that monitor the groundwater quality in the upper perched groundwater zone around CPP-603 include MW-7, MW-9, MW-13, MW-14, MW-15, MW-16, and MW-17. Of these seven wells, wells MW-7, MW-9, MW-15, and MW-17 have historically had sufficient water for sample collection. During the WAG 3 RI, sufficient water was only available in wells MW-15 and MW-17.

Water samples were collected from wells MW-15 and MW-17 and analyzed for miscellaneous inorganics, target analyte list (TAL) inorganics, and radionuclides. From the inorganic analysis, only nitrate/nitrite was detected at a concentration exceeding either a Federal primary or secondary MCL. The nitrate/nitrite concentration in well MW-15 was 14.7 mg/L, compared to the Federal primary MCL of 10 mg/L. The nitrate/nitrite concentration in well MW-17 was 4.9 mg/L.

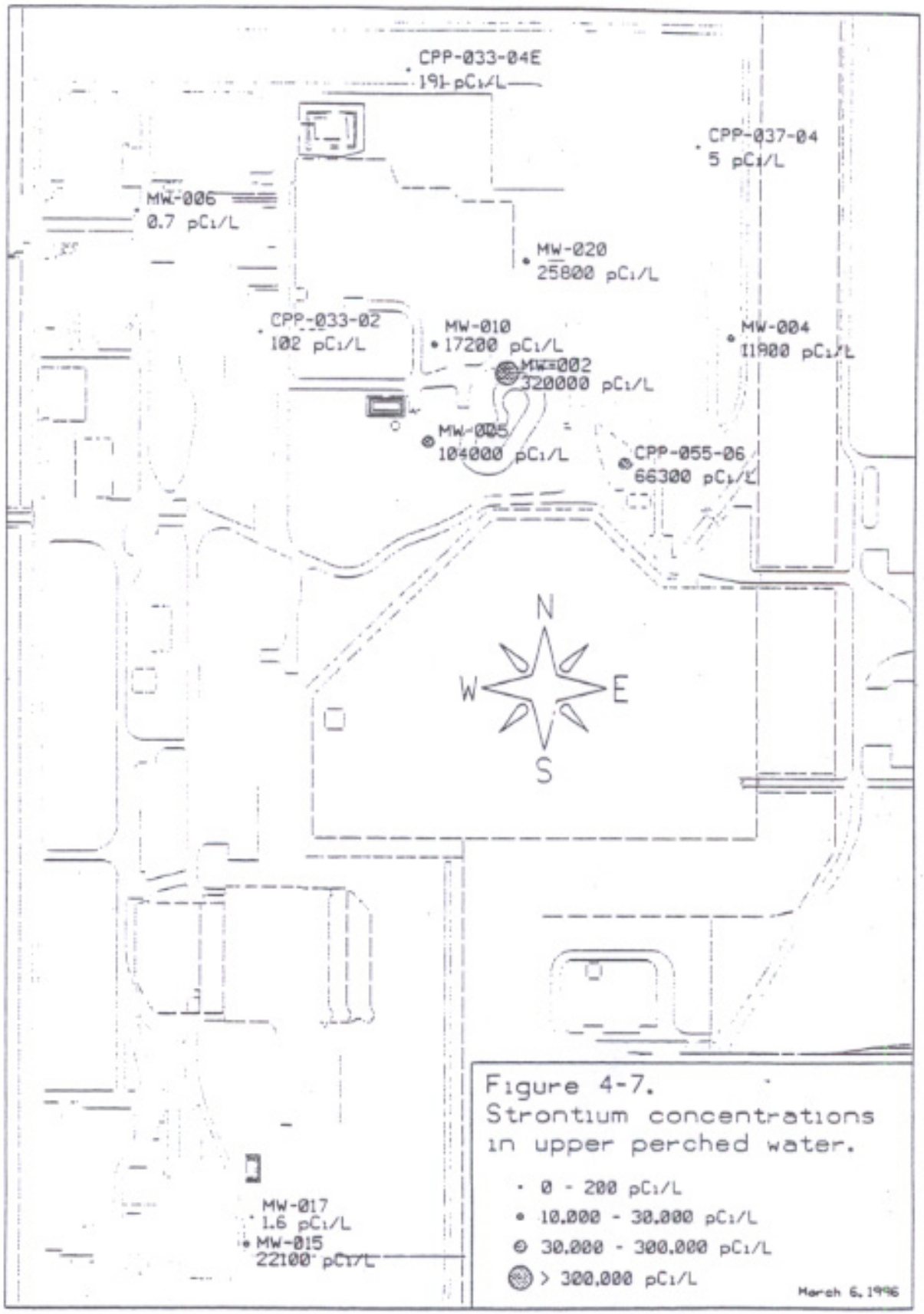


Figure 4-7. Sr-90 concentrations in the upper perched groundwater (May–June 1995).

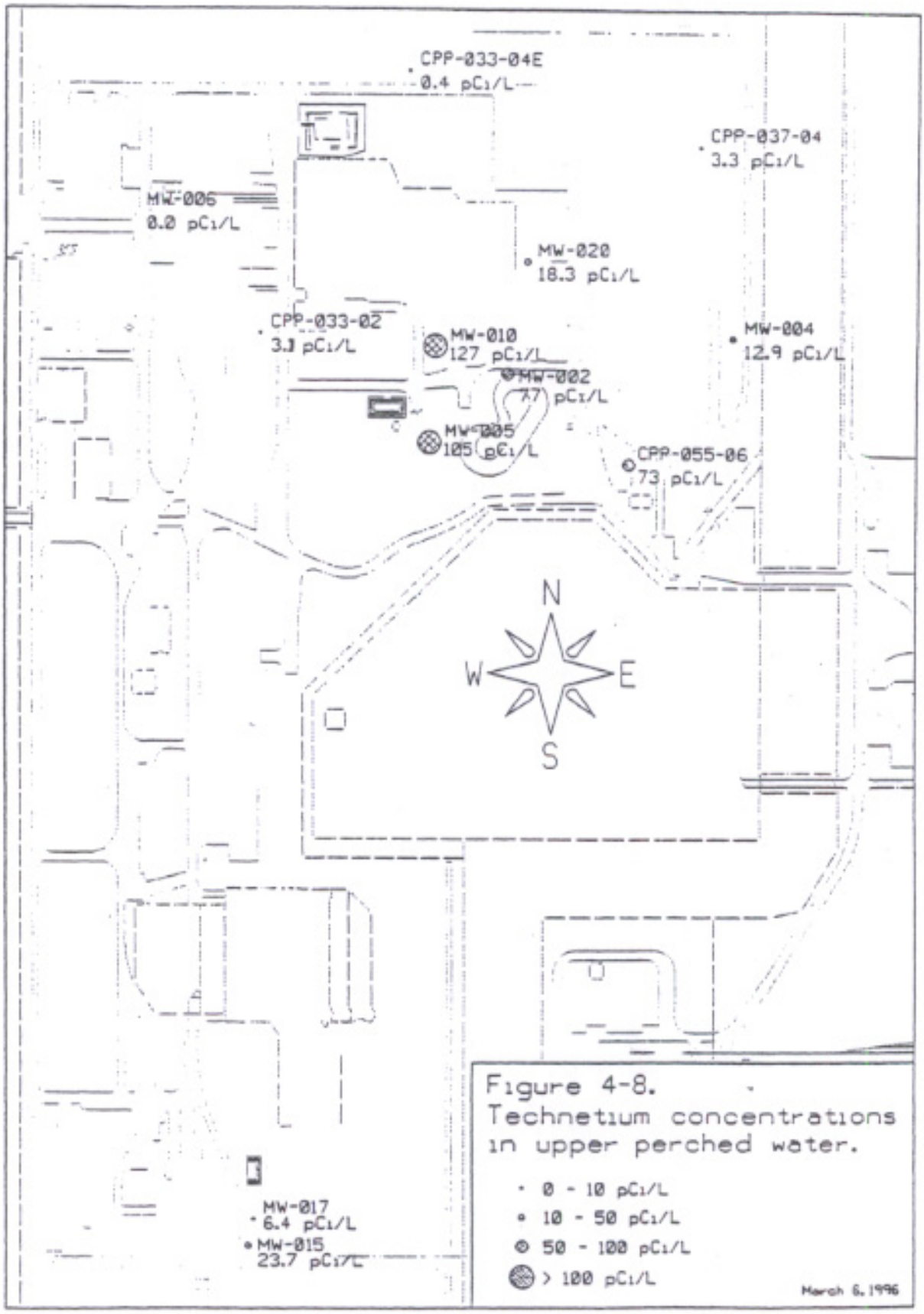


Figure 4-8. Tc-99 concentrations in the upper perched groundwater (May–June 1995).

The radionuclides detected in the groundwater from both wells include H-3 (3,360±176 to 25,700±400 pCi/L) and Tc-99 (6.4±0.6 to 23.7±0.6 pCi/L). In addition, Sr-90 and U-234 were detected in MW-15 at concentrations of 17,200±200 pCi/L and 11.8±1 pCi/L, respectively.

4.2.3 Percolation Pond Perched Groundwater

Six wells, designated as PW-1 through PW-6, were installed in 1986 to monitor the upper-most perched groundwater body associated with waste water discharge to the percolation ponds. These wells have been monitored by the USGS since 1987. Wells PW-1, PW-2, PW-4, and PW-5 have been sampled on a quarterly basis as part of the ICPP groundwater monitoring program since 1991 (INEL-95/0056, Rev. 2). They were not sampled however, as part of the OU 3-13 RI.

Since the waste stream to the percolation ponds is virtually the same as the waste stream formerly sent to the disposal well (with somewhat better contaminant removal than in the past), the contamination in these wells should not differ significantly from that observed downgradient from the disposal well. As would be expected, most of the historical radioactivity present in the PW-series wells is from H-3, with Sr-90 providing a secondary activity contribution. According to the USGS monitoring, activities from both H-3 and Sr-90 have remained relatively stable with the exception of an increased H-3 activity period in mid-1988 (Figure 4-9).

According to the results from the ICPP groundwater monitoring program, the constituents detected in the upper perched water zone that exceeded either a Federal primary or secondary MCL include chloride, nitrate, manganese, iron, and Sr-90. Chloride concentrations generally exceeded the Federal secondary MCL of 250 mg/L in all wells. Nitrate concentrations exceeded the Federal primary MCL of 10 mg/L in a single sample collected from well PW-4 (14.1J mg/L from the October 1993 sample). Manganese concentrations exceeded the Federal secondary MCL of 50 μg/L in two samples collected from well PW-2 (165 μg/L from the October 1991 sample and 60.2 μg/L from the August 1993 sample). Iron concentrations exceeded the Federal secondary MCL of 300 μg/L in one sample collected from PW-1 (324J μg/L from the April 1993 sample) and the first three samples collected from PW-2 (i.e., prior to September 1992). Strontium-90 concentrations exceeded the Federal primary MCL of 8 pCi/L in samples collected from PW-1, PW-4, and PW-5 with the maximum concentration measured during October 1991 sampling event at PW-1 (15.7 pCi/L).

4.2.4 Deep Perched Groundwater

Four wells at the ICPP monitor deeper perched groundwater zones. These wells include MW-1, MW-17, MW-18, and USGS-50 that are completed in water-bearing zones occurring at depths between 99.4 to 102.4 m (326 to 336 ft), 109.7 to 116.1 m (360 to 381 ft), 120.1 to 126.2 m (394 to 414 ft), and 109.7 to 123.4 m (360 to 405 ft), respectively. Historically, two rounds of groundwater samples have been collected from MW-1, one round of groundwater samples have been collected from MW-17 and MW-18, and a substantial database concerning radioactive contaminants is available for the water quality from USGS-50. Results from these water sampling events are described in the WAG 3 RI/FS Work Plan (INEL-95/0056, Rev. 2).

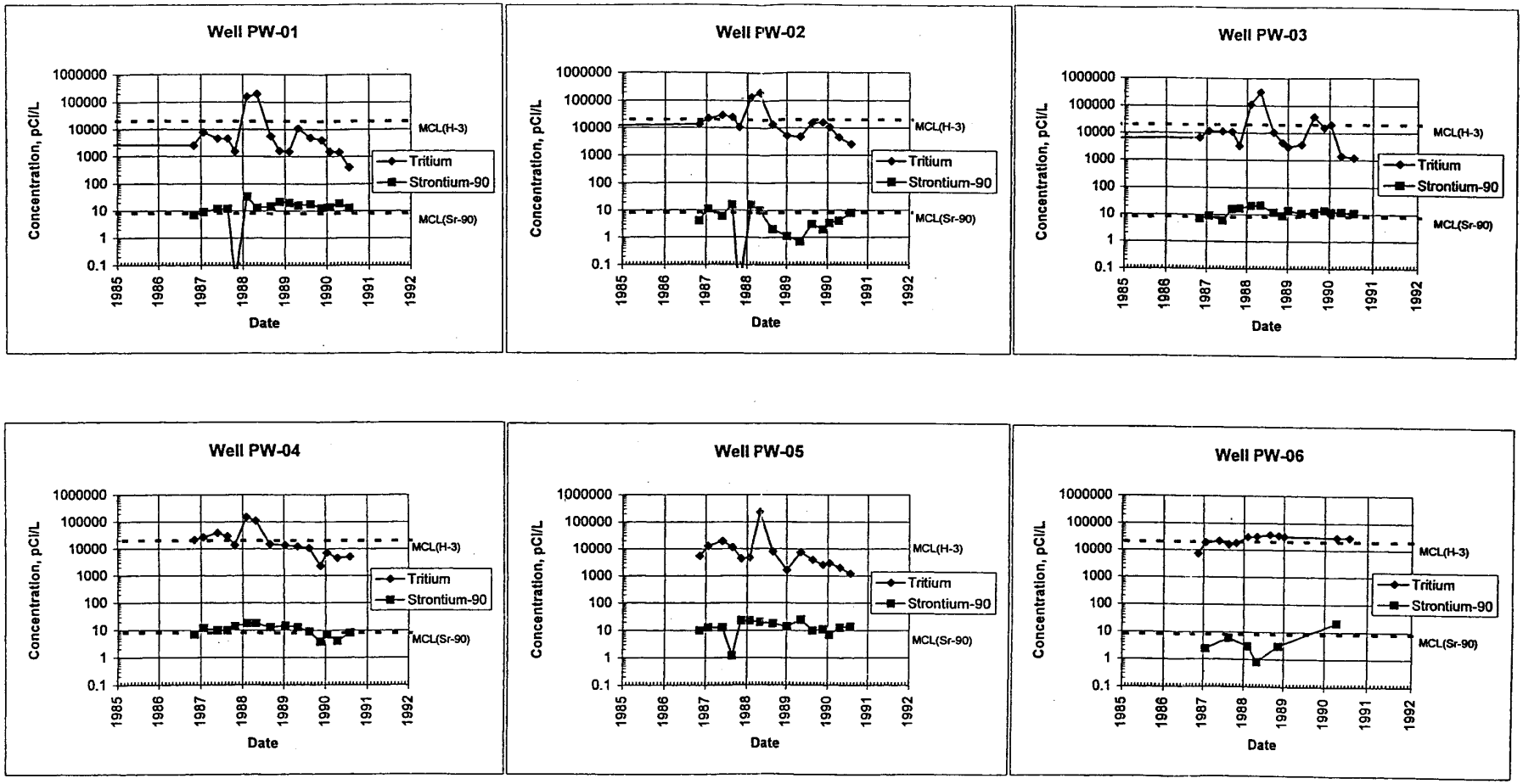


Figure 4-9. Historical H-3 and Sr-90 concentrations in the PW-series wells (USGS records).

Well MW-1 is located in the northern ICPP along the southwestern edge of the deeper perched water body. The only chemical contaminant to exceed either a Federal primary or secondary MCL was nitrate/nitrite. Nitrate/nitrite was detected above the Federal primary MCL of 10 mg/L at a concentration of 69.6 mg/L. The radionuclides detected in water samples from well MW-1 include Sr-90 (4.5±0.4 pCi/L) and H-3 (24,700±400 pCi/L). Of these contaminants, only H-3 was measured above the Federal primary MCL of 20,000 pCi/L. Since H-3 concentrations in the deep perched water zone are higher than the H-3 concentrations in the overlying perched water bodies, the source of this contamination is either from a historical release where the contaminants have moved through the system or waste water disposal to the ICPP injection well.

Well MW-18 is completed in the deeper perched water zone near the eastern boundary of the ICPP. From the June 1995 sampling event, only nitrate/nitrite concentration at 34.4 mg/L exceeded either a Federal primary or secondary MCL. The radionuclides detected in the deep perched groundwater at this location include H-3 (73,000±700 pCi/L), Sr-90 (207±2 pCi/L), and Tc-99 (736±6J pCi/L). The H-3 and Tc-99 concentrations from this well are some of the highest concentrations measured in the perched groundwater beneath the ICPP.

USGS-50 was originally intended to be completed in the aquifer, but was ultimately drilled to a total depth of 123 m (405 ft) to monitor a deep perched water zone. This well is located in the north central portion of the facility, to the south of the northern perched water zone and upgradient from the former ICPP disposal well. According to the historical water quality, the highest concentrations of H-3 and Sr-90 occurred in 1969 and 1970 (Figure 4-10). These elevated concentrations were attributed to the failure of the ICPP disposal well where the waste water was injected into the vadose zone rather than directly to the aquifer. The relationship between the ICPP disposal well discharge and the water level and H-3 concentrations in well USGS-50 is shown in Figure 4-11. Based on the response observed in well USGS-50 and the ICPP disposal well records, it appears the well failed in mid-1967 and allowed approximately 3.41×10^9 L (9.0×10^8 gal.) of waste water to be injected into the basalt above the 69-m (226-ft) plug (Robertson et al., 1974). The ICPP disposal well was repaired by early 1971. It again failed in the 1970s and was repaired in 1982.

Since 1970, H-3 and Sr-90 concentrations have varied little between sampling events, indicating an overall slight decrease with time. Two periods of slight increase are noted with the first period occurring from the late 1970s until 1982 and the second period from late 1986 to early 1988. The first period of increase (from approximately 1978 to 1982) was probably the result of the ICPP disposal well failing and injecting waste water directly into the vadose zone. It is uncertain exactly when the ICPP disposal well failed the second time, however, it was reportedly repaired by 1982. The second period of increase, from late 1986 to early 1988, is after the ICPP disposal well was taken out of service. The increase in Sr-90 concentrations during this period suggests either (1) a local, post-disposal well source or (2) a delay in the migration of contamination from a near surface source. It should also be noted water from overlying perched water has been observed leaking into the wellbore though the annular space. This mixing of water from two perched water zones places additional uncertainty on the representativeness of the water quality from USGS-50. The leaky borehole annulus was repaired during the FY-94 field season.

From the May 1995 water sampling of USGS-50, the concentrations of all chemical contaminants except nitrate/nitrite were below Federal primary or secondary MCLs. Nitrate/nitrite concentration was measured at 31.3 mg/L, compared to the Federal primary MCL of 10 mg/L. Radionuclides in the

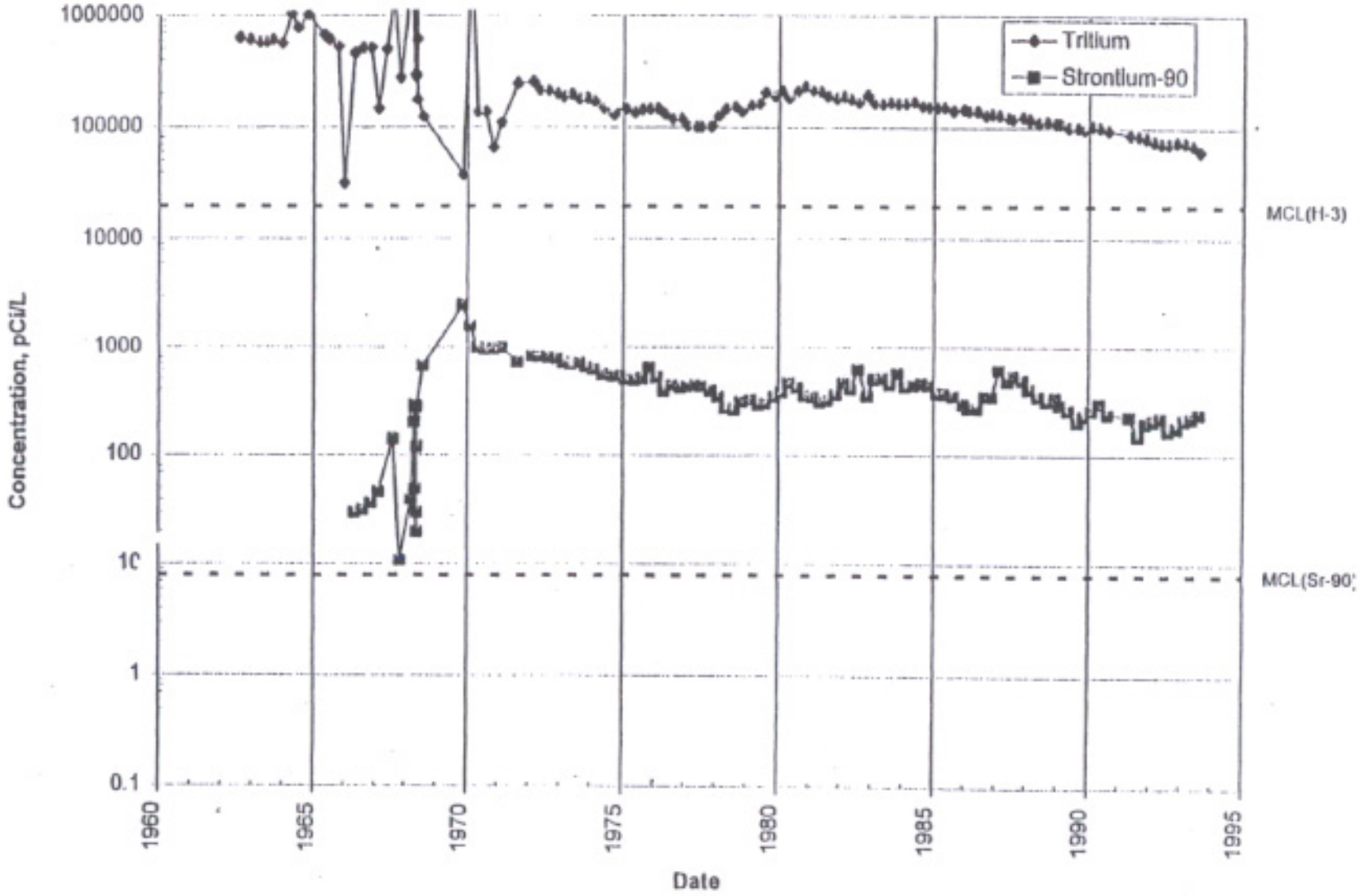


Figure 4-10. Historical H-3 and Sr-90 concentrations in well USGS-50 (USGS records).

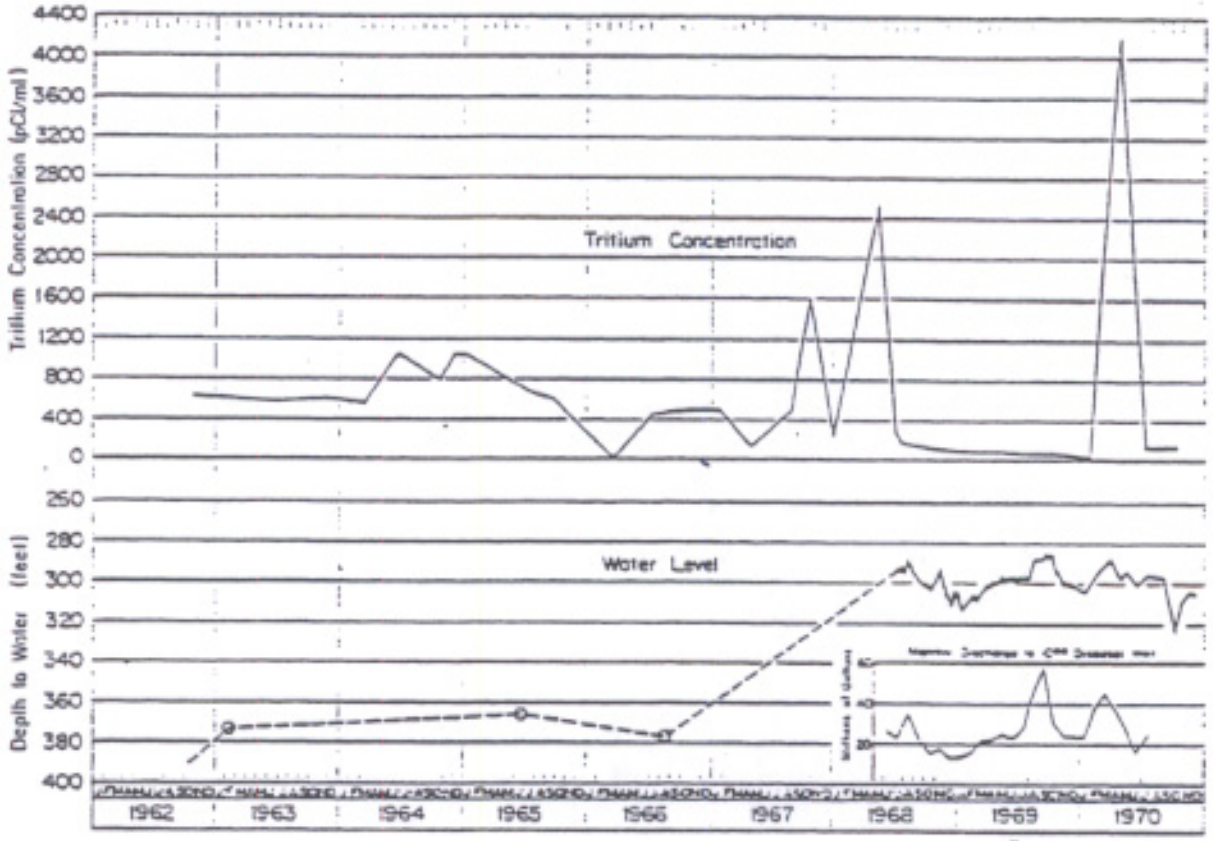


Figure 4-11. Relationship between discharge to the ICPP injection well and water level and H-3 concentrations in USGS-50 (Robertson et al., 1974).

groundwater that were detected include H-3 (61,900±700 pCi/L), Sr-90 (151±2 pCi/L), and Tc-99 (63±1J pCi/L). The concentrations for H-3 and Sr-90 are within the expected values based on the historical sampling conducted by the USGS.

Well MW-17 is the only deep perched water monitoring well located in the southern portion of the ICPP. This well has been constructed to monitor three perched water bodies: an upper zone from 55.4 to 58.4 m (181.7 to 191.7 ft) bls, a middle zone from 80.4 to 83.5 m (263.8 to 273.8 ft) bls, and a lower zone from 110 to 116 m (360 to 381 ft) bls. During the May 1995 sampling event, water was only present in the upper and lower zones. None of the chemical constituents detected in the groundwater exceeded either a Federal primary or secondary MCL. Only two radionuclides (H-3 and Tc-99) were detected in groundwater samples collected from MW-17. The concentrations of these two radionuclides were similar between the upper and lower perched water zones. H-3 concentrations varied from 25,100±400 to 25,700±400 pCi/L and Tc-99 concentrations varied from 5.9±0.6 to 6.4±0.6 pCi/L.

4.2.5 Sedimentary Interbed Results

Twelve perched water wells were drilled and installed in 1993 and 1994 during the perched water investigation at the ICPP. Sedimentary interbed samples were collected and analyzed. The results of this analysis are summarized in Table 4-3. A review of the data indicates a large presence of gross beta activity at the MW-2 location, most of which is due to Sr-90. This confirms that Sr-90 has migrated to the 110 ft interbed from a number of possible sources that include the release areas within the tank farm or possibly from the old calcine bin storage located next to MW-2.

4.3 Snake River Plain Aquifer

The water quality in the SRPA at and downgradient from the ICPP has been adversely impacted due to past facility operations, primarily related to the disposal of wastes through the ICPP injection well. This well was the primary source for waste disposal from 1952 through February 1984 and used intermittently for emergency situations until 1986. It has been estimated a total of 22,000 Ci of radioactive contaminants have been released in 4.2×10^{10} L (1.1×10^{10} gal.) of water (WINCO, 1994). The vast majority of radioactivity is being attributed to H-3 (approximately 96%) with minor components of Am-241, Tc-99, Sr-90, Cs-137, Co-60, iodine (I)-129, and Pu. During the last 2 yrs of operation (1984 to 1986) when it was only used for emergency situations, the injection well discharged 0.002 Ci in 15.2×10^6 L (4×10^6 gal.) of water. A discussion of the waste discharge to the ICPP injection well is provided in Section 4.1.1.

Since the 1950's, the USGS has installed 33 monitoring wells around the ICPP to characterize the occurrence, movement, and quality of the water in the SRPA. The radioactive and chemical character of the water in the SRPA is determined from analyses of water samples collected as part of a comprehensive sampling program to identify contaminant concentrations and define the pattern of waste migration in the aquifer (Orr and Cecil, 1991). This sampling program has been in place since the early 1960s and provides an excellent database to evaluate the impact of facility operations on the SRPA. The location of the wells completed in the SRPA and the frequency of groundwater sample collection by the USGS are provided in Figure 4-12.

Table 4-3. Summary of radiological results from sedimentary interbed samples at the ICPP (pCi/g).

Sample Number	Well	Depth(ft)	Gross Alpha	Gross Beta	Am-241	Ce-144	Co-60	Cs-134	Cs-137	Eu-154	EU-155
3PG10101BG	MW-1	231-232.5	13 ± 3	23 ± 2	ND	ND	ND	ND	ND	ND	ND
3PG10201BG	MW-1	375-378.1	13 ± 3	26 ± 3	ND	ND	ND	ND	ND	ND	ND
3PG10501BG	MW-2	111.6-112	140 ± 10	76000 ± 100	.09 ± .07	ND	ND	ND	ND	ND	ND
3PG10301BG	MW-2	94.2-94.5	26 ± 4	4300 ± 20	.06 ± .06	ND	ND	ND	ND	ND	ND
3PG10401BG	MW-2	109-110.5	520 ± 15	74000 ± 100	.06 ± .06	ND	ND	ND	ND	ND	ND
3PG10701BG	MW-3	118-118.3	15 ± 3	27 ± 3	ND	ND	ND	ND	ND	ND	ND
3PG10801BG	MW-3	138-139	16 ± 3	28 ± 3	ND	ND	ND	ND	ND	ND	ND
3PG11001BG	MW-4	106.8-108	16 ± 3	75 ± 3	ND	ND	ND	ND	ND	ND	ND
3PG11301BG	MW-5	119.5-120	8.1 ± 2.4	520 ± 5	ND	ND	ND	ND	ND	ND	ND
3PG11601BG	MW-6	106.2-106.8	8 ± 2.4	15 ± 2	ND	ND	ND	ND	ND	ND	ND
3PG11701BG	MW-6	141-141.5	19 ± 3	30 ± 3	0 ± .02	ND	ND	ND	ND	ND	ND
3PG11901BG	MW-7	103.6-104	9.5 ± 2.4	25 ± 2	ND	ND	ND	ND	ND	ND	ND
3PG12201BG	MW-8	123.7-124	17 ± 3	36 ± 3	0 ± .02	ND	ND	ND	ND	ND	ND
3PG12601BG	MW-9	145.6-148.4	11 ± 3	23 ± 3	0 ± .02	ND	ND	ND	ND	ND	ND
3PG12501BG	MW-9	105.8-106.1	24 ± 4	1390 ± 10	ND	ND	ND	ND	ND	ND	ND
3PG12801BG	MW-10	109-109.5	18 ± 3	87 ± 3	ND	ND	ND	ND	ND	ND	ND
3PG12901BG	MW-10	154.0-154.3	12 ± 3	75 ± 3	ND	ND	ND	ND	ND	ND	.2 ± .05
3PG13101BG	MW-11	113.7-115.3	18 ± 3	25 ± 3	.11 ± .05	ND	ND	ND	ND	ND	ND
3PG13201BG	MW-11	134.135.4	13 ± 3	22 ± 2	ND	ND	ND	ND	ND	ND	ND
3PG13301BG	MW-12	117.8-118.1	9.5 ± 2.4	61 ± 3	ND	ND	ND	ND	ND	ND	ND
3PG13401BG	MW-12	152.0-152.5	20 ± 3	28 ± 3	.08 ± .03	ND	ND	ND	ND	ND	.21 ± .05
31311101E9	MW-17	208-210.5	14 ± 4	14 ± 2	.03 ± .03	ND	ND	ND	ND	ND	ND
31310101E9	MW-18	196-196.5	9.4 ± 1.7	544 ± 6	ND	ND	ND	ND	ND	ND	ND
31310201E9	MW-18	397.6-398	12 ± 2	23 ± 2	ND	ND	ND	ND	ND	ND	ND
31311601E9	MW-18	397.6-398	11 ± 2	27 ± 2	ND	ND	ND	ND	ND	ND	ND
31310301E9	MW-18	420.75-421	17 ± 2	33 ± 2	ND	ND	ND	ND	ND	ND	ND
31311501E9	MW-20	108	29 ± 5	30 ± 3	.03 ± .03	ND	ND	ND	ND	ND	ND

ND = Not Detected.

Table 4-3. (continued).

Sample Number	Well	Depth(ft)	Nb-95	Pu-238	Pu-239/240	Ru-103	Ru-106	Sb-125	Sr-90	U-234	U-235	U-238
3PG10101BG	MW-1	231-232.5	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
3PG10201BG	MW-1	375-378.1	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
3PG10501BG	MW-2	111.6-112	ND	0 ± .03	0 ± .04	ND	ND	ND	40400 ± 10	1 ± .10	0 ± .10	.9 ± .10
3PG10301BG	MW-2	94.2-94.5	ND	0 ± .03	0 ± .05	ND	ND	ND	38900 ± 10	.9 ± .10	0 ± .10	.9 ± .10
3PG10401BG	MW-2	109-110.5	ND	0 ± .03	.04 ± .06	ND	ND	ND	2390 ± 3	.8 ± .10	0 ± .10	.8 ± .10
3PG10701BG	MW-3	118-118.3	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
3PG10801BG	MW-3	138-139	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
3PG11001BG	MW-4	106.8-108	ND	ND	ND	ND	ND	ND	32.8 ± .50	ND	ND	ND
3PG11301BG	MW-5	119.5-120	ND	ND	ND	ND	ND	ND	321 ± 2	ND	ND	ND
3PG11601BG	MW-6	106.2-106.8	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
3PG11701BG	MW-6	141-141.5	ND	0 ± .02	0 ± .03	ND	ND	ND	3.7 ± .5	.9 ± .10	0 ± .10	.9 ± .10
3PG11901BG	MW-7	103.6-104	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
3PG12201BG	MW-8	123.7-124	ND	0 ± .02	0 ± .03	ND	ND	ND	4 ± .20	1.1 ± .10	0 ± .10	1.1 ± .10
3PG12601BG	MW-9	145.6-148.4	ND	0 ± .02	0 ± .02	ND	ND	ND	819 ± 2	1.3 ± .10	0 ± .10	1.4 ± .10
3PG12501BG	MW-9	105.8-106.1	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
3PG12801BG	MW-10	109-109.5	ND	ND	ND	ND	ND	ND	32.2 ± .50	ND	ND	ND
3PG12901BG	MW-10	154.0-154.3	ND	ND	ND	ND	ND	ND	24.5 ± .70	ND	ND	ND
3PG13101BG	MW-11	113.7-115.3	ND	0 ± .02	.03 ± .04	ND	ND	ND	ND	1 ± .10	0 ± .10	1.1 ± .10
3PG13201BG	MW-11	134.135.4	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
3PG13301BG	MW-12	117.8-118.1	ND	ND	ND	ND	ND	ND	29 ± 1.00	ND	ND	ND
3PG13401BG	MW-12	152.0-152.5	ND	0 ± .01	0 ± .02	ND	ND	ND	ND	1.6 ± .10	.06 ± .05	1.4 ± .10
31311101E9	MW-17	208-210.5	ND	.01 ± .02	0 ± .02	ND	ND	ND	0 ± .20	.67 ± .06	.01 ± .05	.68 ± .06
31310101E9	MW-18	196-196.5	ND	ND	ND	ND	ND	ND	321 ± 200	ND	ND	ND
31310201E9	MW-18	397.6-398	ND	ND	ND	ND	ND	ND	.6 ± .20	ND	ND	ND
31311601E9	MW-18	397.6-398	ND	ND	ND	ND	ND	ND	.3 ± .10	ND	ND	ND
31310301E9	MW-18	420.75-421	ND	ND	ND	ND	ND	ND	.3 ± .20	ND	ND	ND
31311501E9	MW-20	108	ND	0 ± .01	0 ± .02	ND	ND	ND	0 ± .40	.74 ± .07	.02 ± .05	.74 ± .07

ND = Not Detected.

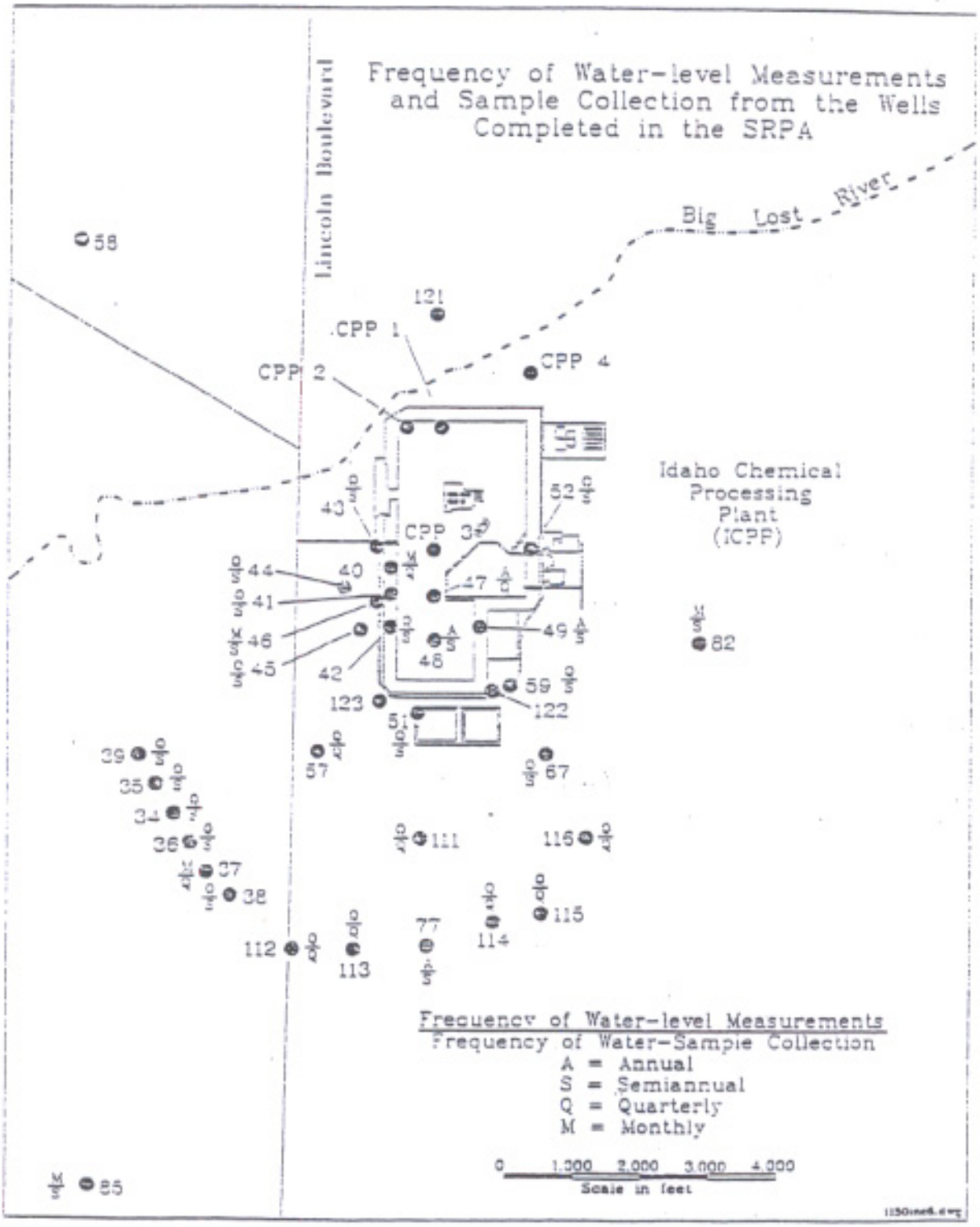


Figure 4-12. Locations of wells completed in the SRPA.

According to the latest USGS report describing SRPA water quality (Bartholomay, 1997), detectable concentrations of H-3, Sr-90, Co-60, Cs-137, Pu-238, Pu-239/-240 (undivided), and americium (Am)-241 from samples taken from wells in the SRPA at INEEL decreased or remained constant during 1992–1995. Decreased concentrations are attributed to reduced rates of radioactive-waste disposal, sorption processes, radioactive decay, and changes in waste disposal practices. Chemical constituents detected in SRPA at the INEEL include total chromium, sodium, chloride, and nitrate. Purgeable organic compounds were detected in samples from wells at the INEEL. This report provides information concerning the distribution of chemical and radionuclide constituents in the SRPA and covers the period from 1992 to 1995. Of the 14 purgeable organic compounds detected at the INEEL, only 1,1,1-trichloroethane was detected in the vicinity of the ICPP at concentrations well below the federal drinking water standard (MCL) of 200 μg/L.

The ICPP has a groundwater sampling program of selected SRPA wells to satisfy the groundwater monitoring requirements for the RCRA and DOE Order 5400.1. This sampling program, implemented in October 1991, uses selected USGS wells and collects samples on a quarterly basis to be analyzed for the RCRA groundwater contamination parameters, RCRA drinking water parameters, RCRA groundwater quality parameters, and selected radionuclides. The results from this sampling program are provided in the WAG 3 RI/FS Work Plan (INEL-95/0056, Rev. 2). Also, wells ICPP-Mon-A-021 and -022 were installed to monitor the SRPA water quality beneath the sewage treatment plant.

In May and June 1995, a complete round of groundwater samples were collected from the aquifer wells located near and downgradient from the ICPP (see Figure 4-12). The results from this sampling effort are provided in Table 4-4, and described in the following subsections.

4.3.1 Contaminant Distribution

4.3.1.1 Cesium-137. According to Bartholomay (1997), Cs-137 has been detected above reporting levels through 1985 in wells USGS-40 and USGS-47 at the ICPP due to liquid-waste discharge to the ICPP injection well. During 1982 to 1985, maximum concentrations in wells USGS-40 and USGS-47 were 237±45 and 200±50 pCi/L, respectively. During 1986 to 1988, Cs-137 was not detected in these wells (Orr and Cecil, 1991). Since 1988, cesium-137 was detected in one sample from well USGS-40 (70±30 pCi/L on January 15, 1990) and one sample from well USGS-47 (70±30 pCi/L on April 29, 1992). Cs-137 was not detected in any of the aquifer wells sampled during the WAG 3 RI. The half-life for Cs-137 is 30.17 yrs.

4.3.1.2 Plutonium. Monitoring the quantities of Pu-238 and Pu-239/-240 (undivided) discharged to the ICPP disposal well began in 1974. Prior to that time, alpha activity from plutonium disintegration was not separable from the monitored, undifferentiated alpha activity. During 1974 through 1985, about 0.15 Ci of Pu-238 and 0.05 Ci of Pu-239/-240 (undivided) were discharged to the ICPP injection well. During the period from 1986 to 1988, approximately 0.06 Ci of plutonium isotopes were discharged to the infiltration ponds at the ICPP. The half-lives of Pu-238, -239, and -240 are 87.7, 24 100, and 6,560 years, respectively.

According to Orr and Cecil (1991), plutonium has been detected in the SRPA near the ICPP in wells USGS-40 and USGS-47. Both of these wells are located near the ICPP injection well. In well USGS-40, Pu-238 and Pu-239/-240 (undivided) were last detected in January 1987 at concentrations of 0.47±0.16 pCi/L and 5.5±0.4 pCi/L, respectively. In well USGS-47, Pu-238 was last detected in October 1983 at a concentration of 0.5±0.06 pCi/L. Since the 1986 to 1988 period reported by Orr and Cecil (1991),

Table 4-4. Water quality from the wells completed in the SRPA (May–June 1995).

Well		MW-18	USGS 34	USGS 35	USGS 36
Date		Jun-95	May-95	May-95	May-95
Sample Depth		464.19 to 479	477.33 to 700	477.76 to 580.5	477.48 to 567.1
Sample ID	Units	31330101	31330201	31330301	31330401
Field Parameters					
Temperature	(celsius)	18.2	12.31	12.08	12.75
pH		7.88	7.67	7.73	7.81
Conductivity	(msiemen)	0.73	0.468	0.454	0.486
T.A.L. Inorganics					
Aluminum	(ug/L)	26.8 U	49.9 BU	53.4 BU	26.8 U
Antimony	(ug/L)	1.9 U	42.2 U	42.2 U	1.9 U
Arsenic	(ug/L)	4 U	1.8 U	1.8 U	4 U
Barium	(ug/L)	122 B	95.1 B	98.1 B	109 B
Beryllium	(ug/L)	0.1 U	0.1 U	0.1 U	0.1 U
Cadmium	(ug/L)	0.4 U	2.9 U	2.9 U	0.4 U
Calcium	(ug/L)	62300	57000	57400	57200
Chromium	(ug/L)	4.1 U	21.6	29.2	13.5
Cobalt	(ug/L)	0.5 U	4.9 U	4.9 U	0.5 U
Copper	(ug/L)	2.8 B	7.1 U	7.1 U	2 BU
Iron	(ug/L)	21.5 U	7.1 U	20.3 B	21.5 U
Lead	(ug/L)	2 U	2.3 BWJ	1.5 UW	2 U
Magnesium	(ug/L)	18700	14300	14900	14700
Manganese	(ug/L)	2 B	1.2 U	1.2 U	0.8 U
Mercury	(ug/L)	0.1 U	0.1 U	0.1 U	0.1 U
Nickel	(ug/L)	3.4 U	12.4 U	12.4 U	3.4 U
Potassium	(ug/L)	4650 B	2640 B	3110 B	2770 BEJ
Selenium	(ug/L)	2.7 U	1.2 U	1.2 U	2.7 U
Silver	(ug/L)	0.6 U	5.2 BNR	6.5 BNR	0.6 UN
Sodium	(ug/L)	30800	10100	9950	16600
Thallium	(ug/L)	4.6 U	2.3 UW	2.3 UW	4.6 U
Vanadium	(ug/L)	3.2 B	6.9 B	4 U	3.7 BU
Zinc	(ug/L)	14.2 BU	2.6 B	3.5 B	2 BEUJ
Zirconium	(ug/L)	31.2 U	31.3 U	31.3 U	31.3 U
Radionuclides					
Gross Alpha	(pCi/L)	10±2	2±1.2 U	2.4±1.2	4.4±1.4
Gross Beta	(pCi/L)	469±6	13±1	14±1	32±2
Tritium	(pCi/L)	26400±400	4530±217	6680±250	6560±240
Sr-90	(pCi/L)	84±1	2.4±0.3	2.6±0.3	9±0.5
Pu-238	(pCi/L)	0±0.07 U	ND	ND	ND
Pu-239/240	(pCi/L)	0.03±0.05 U	ND	ND	ND
Am-241	(pCi/L)	0.05±0.07 U	ND	ND	ND
Np-237	(pCi/L)	3.1±0.3 U	ND	ND	ND
I-129	(pCi/L)	0±0.3 U	0±0.3 U	0±0.3 U	0±0.3 U
Tc-99	(pCi/L)	448±4 J	0.9±0.6 U	0.9±0.8 U	4.1±0.5
U-234	(pCi/L)	0.7±0.3	ND	ND	ND
U-235	(pCi/L)	0±0.2 U	ND	ND	ND
U-238	(pCi/L)	0.9±0.3	ND	ND	ND

NA - not analyzed.
ND - not detected.
NS - not sampled.
U - analyzed, not detected.
B - contaminant in blank.
R - concentration is unusable.
J - estimated concentration.

Table 4-4. (continued).

Well		USGS 37	USGS 38	USGS 39	USGS 40
Date		May-95	May-95	May-95	May-95
Sample Depth		477.61 to 573	478.03 to 729	479.16 to 573.9	463.58 to 679
Sample ID	Units	31330501	31330601	31330701	31330801
Field Parameters					
Temperature	(celsius)	13.46	14.41	12.1	14.31
pH		7.76	7.69	7.73	7.46
Conductivity	(mmemen)	0.751	0.737	0.436	0.524
TAL Inorganics					
Aluminum	(ug/L)	26.8 U	26.8 U	42.9 U	26.8 U
Antimony	(ug/L)	1.9 U	1.9 U	42.2 U	1.9 U
Arsenic	(ug/L)	4 U	4 U	1.8 U	4 U
Barium	(ug/L)	170 B	197 B	104 B	98.3 B
Beryllium	(ug/L)	0.1 U	0.1 U	0.1 U	0.1 U
Cadmium	(ug/L)	0.4 U	0.4 U	3 B	0.4 U
Calcium	(ug/L)	71200	66900	58000	62100
Chromium	(ug/L)	7.1 B	5.6 B	38.8	5.3 B
Cobalt	(ug/L)	0.5 U	0.5 U	4.9 U	0.5 U
Copper	(ug/L)	1.3 U	1.3 U	7.1 U	1.3 U
Iron	(ug/L)	21.5 U	21.5 U	9.4 B	21.5 U
Lead	(ug/L)	3.9 B	2 U	1.5 UW	2 U
Magnesium	(ug/L)	18900	18300	15700	17000
Manganese	(ug/L)	0.8 U	0.84 B	1.4 BU	0.8 U
Mercury	(ug/L)	0.1 U	0.1 U	0.1 U	0.1 U
Nickel	(ug/L)	3.4 U	3.4 U	12.4 U	3.4 U
Potassium	(ug/L)	4220 BEJ	4500 BEJ	2250 B	2510 BEJ
Selenium	(ug/L)	2.7 U	2.7 U	1.2 U	2.7 U
Silver	(ug/L)	0.6 UN	0.6 UN	5.1 UN	0.6 UN
Sodium	(ug/L)	41900	52000	8460	16100
Thallium	(ug/L)	4.6 U	4.6 U	2.3 UW	4.6 U
Vanadium	(ug/L)	3.8 BU	3.8 BU	6.3 B	3.5 BU
Zinc	(ug/L)	179 EJ	18.6 BEJ	3.9 B	216 EJ
Zirconium	(ug/L)	31.3 U	31.3 U	31.3 U	31.3 U
Radionuclides					
Gross Alpha	(pCi/L)	1.7±1.6 U	4.9±2	1.6±1 U	3±1.3
Gross Beta	(pCi/L)	38±2	63±3	3.2±1.2	81±2
Tritium	(pCi/L)	17700±400	17300±400	7620±260	9850±280
Sr-90	(pCi/L)	7.6±0.5	19±0.7	0±0.3	17.4±0.6 J
Pu-238	(pCi/L)	ND	ND	ND	ND
Pu-239/240	(pCi/L)	ND	ND	ND	ND
Am-241	(pCi/L)	ND	ND	ND	ND
Np-237	(pCi/L)	ND	ND	ND	ND
I-129	(pCi/L)	0±0.3 U	0±0.3 U	0±0.4	0±0.4 U
Tc-99	(pCi/L)	7.3±0.5	14±1	39±1	3.9±0.5
U-234	(pCi/L)	ND	ND	ND	ND
U-235	(pCi/L)	ND	ND	ND	ND
U-238	(pCi/L)	ND	ND	ND	ND

NA - not analyzed.
ND - not detected.
NS - not sampled.
U - analyzed, not detected.
B - contaminant in blank.
R - concentration is unusable.
J - estimated concentration.

Table 4-4. (continued).

Well		USGS 41	USGS 42	USGS 44	USGS 45
Date		May-95	May-95	May-95	May-95
Sample Depth		646.53 to 674.4	464.83 to 678.5	465.58 to 650	467.41 to 651.2
Sample ID	Units	31330901	31334301	31331101	31331201
Field Parameters					
Temperature	(celsius)	13.05	13.29	12.18	12.55
pH		7.41	7.37	7.69	7.56
Conductivity	(mmemen)	0.484	0.468	0.397	0.441
TAL Inorganics					
Aluminum	(ug/L)	26.8 U	26.8 U	42.9 U	27.2 BU
Antimony	(ug/L)	1.9 U	1.9 U	42.2 U	1.9 U
Arsenic	(ug/L)	4 U	4 U	1.8 U	4 U
Barium	(ug/L)	94.2 B	91.8 B	89.9 B	82 B
Beryllium	(ug/L)	0.1 U	0.1 U	0.1 U	0.1 U
Cadmium	(ug/L)	0.4 U	0.4 U	2.9 U	0.4 U
Calcium	(ug/L)	60800	58800	56300	54400
Chromium	(ug/L)	5.3 B	5.4 B	5.5 U	5.1 B
Cobalt	(ug/L)	0.5 U	0.5 U	4.9 U	0.5 U
Copper	(ug/L)	1.3 U	1.8 BU	7.1 U	1.3 UJ
Iron	(ug/L)	21.5 U	21.5 U	7.1 U	21.5 U
Lead	(ug/L)	2 U	2 U	1.5 UW	2 U
Magnesium	(ug/L)	16700	16200	14600	14700
Manganese	(ug/L)	0.8 U	0.8 U	1.2 BU	0.8 U
Mercury	(ug/L)	0.1 B	0.1 U	0.1 U	0.1 U
Nickel	(ug/L)	3.4 U	3.4 U	12.4 U	3.4 U
Potassium	(ug/L)	2410 BEJ	2350 BEJ	2550 B	2510 BEJ
Selenium	(ug/L)	2.7 U	2.7 U	1.2 U	2.7 U
Silver	(ug/L)	0.6 UN	0.6 UN	5.1 UN	0.6 NUJ
Sodium	(ug/L)	13200	10500	8560	10300
Thallium	(ug/L)	4.6 U	4.6 U	2.3 U	4.6 U
Vanadium	(ug/L)	4.1 BU	4.1 BU	4.2 B	3.5 BJ
Zinc	(ug/L)	10.8 BEUJ	11.1 BEUJ	3.2 B	4.5 BU
Zirconium	(ug/L)	31.3 U	31.3 U	31.3 U	ND
Radionuclides					
Gross Alpha	(pCi/L)	4.1±1.4	2.6±1.2	3.6±1.3	2.3±1.2 U
Gross Beta	(pCi/L)	52.4±2.2	33±2	14±1	14±1
Tritium	(pCi/L)	7770±250	3880±200	581±138	2540±180
Sr-90	(pCi/L)	15.8±0.6	9.7±0.6	3.6±0.3	3.8±0.4
Pu-238	(pCi/L)	ND	0.03±0.04 U	ND	ND
Pu-239/240	(pCi/L)	ND	0±0.03 U	ND	ND
Am-241	(pCi/L)	ND	0.54±0.14	ND	ND
Np-237	(pCi/L)	ND	0±0.11 U	ND	ND
I-129	(pCi/L)	0±0.3 U	0±0.3 U	0±0.3 U	0±0.3 U
Tc-99	(pCi/L)	8.2±0.6	8±0.8	0.4±0.6 U	0.4±0.5 U
U-234	(pCi/L)	ND	1.8±0.4	ND	ND
U-235	(pCi/L)	ND	0±0.2 U	ND	ND
U-238	(pCi/L)	ND	0.9±0.3	ND	ND

NA - not analyzed.
ND - not detected.
NS - not sampled.
U - analyzed, not detected.
B - contaminant in blank.
R - concentration is unusable.
J - estimated concentration.

Table 4-4. (continued).

Well		USGS 46	USGS 47	USGS 48	USGS 51
Date		May-95	Jun-95	May-95	May-95
Sample Depth		468.1 to 654.9	460.35 to 652	464.16 to 752	466.77 to 659
Sample ID	Units	31331301	31334401	31331401	31331601
Field Parameters					
Temperature	(celsius)	13.52	16.2	14.77	13.73
pH		7.55	7.75	7.42	7.69
Conductivity	(msiemen)	0.61	0.54	0.59	0.623
TAL Inorganics					
Aluminum	(ug/L)	120 BU	25.2 BU	47.5 BU	26.8 U
Antimony	(ug/L)	1.9 U	2.7 U	42.2 U	1.9 U
Arsenic	(ug/L)	4 U	2.4 U	1.8 U	4 U
Barium	(ug/L)	107 B	98.3 B	85 B	101 B
Beryllium	(ug/L)	0.1 U	0.1 U	0.1 U	0.1 U
Cadmium	(ug/L)	0.4 U	0.3 U	2.9 U	0.4 U
Calcium	(ug/L)	64500	64800	57400	59400
Chromium	(ug/L)	4.7 B	6.7 B	5.5 U	8.9 B
Cobalt	(ug/L)	0.93 B	0.6 U	4.9 U	0.5 U
Copper	(ug/L)	1.3 U	2.2 U	7.1 U	1.6 BU
Iron	(ug/L)	119	3 B	7.1 U	21.5 U
Lead	(ug/L)	2 U	2 U	1.5 UW	2.9 B
Magnesium	(ug/L)	17100	17200	15700	20000
Manganese	(ug/L)	1.3 B	0.8 U	1.7 BU	0.8 U
Mercury	(ug/L)	0.1 U	0.32	0.11 B	0.1 U
Nickel	(ug/L)	3.4 U	1.8 U	12.4 U	3.4 U
Potassium	(ug/L)	2740 B	2290 B	2550 B	5000 EJ
Selenium	(ug/L)	2.7 U	2.8 B	1.5 B	2.7 U
Silver	(ug/L)	0.6 U	0.8 UN	5.5 BNR	0.6 UN
Sodium	(ug/L)	16000	20000	14500	23700
Thallium	(ug/L)	4.6 U	3.2 U	2.3 U	4.6 U
Vanadium	(ug/L)	4 B	3.8 B	4.1 B	5.7 BU
Zinc	(ug/L)	7.6 BU	380	5.5 B	166 EJ
Zirconium	(ug/L)	31.2 U	11.6 U	31.3 U	31.3 U
Radionuclides					
Gross Alpha	(pCi/L)	2.8±1.3 J	3.8±1.5 U	2.3±1.2 U	0.2±1.2 U
Gross Beta	(pCi/L)	140±3 J	233±3	81±2	5.7±1.4
Tritium	(pCi/L)	10200±300	15800±400 U	6820±252	23900±400
Sr-90	(pCi/L)	23.4±0.8	67±1 J	18.4±0.5	0.4±0.3 U
Pu-238	(pCi/L)	ND	ND	0±0.03 U	ND
Pu-239/240	(pCi/L)	ND	ND	0±0.04 U	ND
Am-241	(pCi/L)	ND	ND	0±0.05 U	ND
Np-237	(pCi/L)	ND	ND	0±0.11 U	ND
I-129	(pCi/L)	0±0.4 U	0.1±0.3 U	0±0.3 U	0±0.4 U
Tc-99	(pCi/L)	9.7±0.7	174±2	2±0.7	0.8±0.5 U
U-234	(pCi/L)	ND	2.6±0.8	1.9±0.4	ND
U-235	(pCi/L)	ND	0±0.3 U	0±0.2 U	ND
U-238	(pCi/L)	ND	0.4±0.5 U	0.8±0.3	ND

NA - not analyzed.
ND - not detected.
NS - not sampled.
U - analyzed, not detected.
B - contaminant in blank.
R - concentration is unusable.
J - estimated concentration.

Table 4-4. (continued).

Well		USGS 52	USGS 57	USGS 59	USGS 67
Date		May-95	May-95	May-95	May-95
Sample Depth		457.75 to 650	471.8 to 732	470 to 657	462 to 699
Sample ID	Units	31331701	31331801	31331901	31332001
Field Parameters					
Temperature	(celsius)	13.69	13.77	14.89	14.03
pH		7.48	7.7	7.51	7.48
Conductivity	(msiemen)	0.475	0.811	0.897	0.875
TAL Inorganics					
Aluminum	(ug/L)	26.8 U	26.8 U	36.4 BU	56.7 BU
Antimony	(ug/L)	1.9 U	1.9 U	3.1 B	1.9 U
Arsenic	(ug/L)	4 U	4 U	10.8 B	4 U
Barium	(ug/L)	99.5 B	90.9 B	188 B	185 B
Beryllium	(ug/L)	0.1 U	0.1 U	0.1 U	0.1 U
Cadmium	(ug/L)	0.4 U	0.4 U	0.4 U	0.4 U
Calcium	(ug/L)	48700	30000	62500	77200
Chromium	(ug/L)	6.2 B	4.1 U	5.8 B	5.6 B
Cobalt	(ug/L)	0.5 U	0.5 U	0.5 U	0.5 U
Copper	(ug/L)	1.7 BU	1.3 U	1.6 BJ	1.3 UJ
Iron	(ug/L)	21.5 U	21.5 U	21.5 U	21.5 U
Lead	(ug/L)	2 U	2 U	2 U	5 BU
Magnesium	(ug/L)	14100	8250	16800	21700
Manganese	(ug/L)	0.8 U	0.8 U	0.8 U	0.8 U
Mercury	(ug/L)	0.1 U	0.18 B	0.1 U	0.1 U
Nickel	(ug/L)	3.4 U	3.4 U	3.4 U	3.4 U
Potassium	(ug/L)	3280 BEJ	1960 BEJ	5140 EJ	5340 EJ
Selenium	(ug/L)	2.7 U	2.7 U	4.5 BU	5 BU
Silver	(ug/L)	0.6 UN	0.6 UN	0.6 NUJ	0.6 NUJ
Sodium	(ug/L)	22400	24400	76700	44700
Thallium	(ug/L)	4.6 U	4.6 U	4.6 U	4.6 U
Vanadium	(ug/L)	4.9 BU	1.8 BU	3.1 BJ	3.1 BJ
Zinc	(ug/L)	5.9 BEUJ	4.4 BEUJ	296	329
Zirconium	(ug/L)	31.3 U	31.3 U	ND	ND
Radionuclides					
Gross Alpha	(pCi/L)	2.8±1.3 U	2±1.8 U	1±1.7 U	1.6±1.6 U
Gross Beta	(pCi/L)	183±3	83±3	43±3	45±3
Tritium	(pCi/L)	10700±300	18400±400	17900±400	21200±400
Sr-90	(pCi/L)	12.1±0.6	22.7±0.7	12±0.5	10.3±0.5
Pu-238	(pCi/L)	ND	0±0.07 U	ND	ND
Pu-239/240	(pCi/L)	ND	0±0.02 U	ND	ND
Am-241	(pCi/L)	ND	0.09±0.07 U	ND	ND
Np-237	(pCi/L)	ND	0±0.14 U	ND	ND
I-129	(pCi/L)	0±0.3 U	0.1±0.3 U	0±0.3 U	1±0.3
Tc-99	(pCi/L)	235±3	28±1	20±1	13±1
U-234	(pCi/L)	ND	2±0.4	ND	ND
U-235	(pCi/L)	ND	0±0.2 U	ND	ND
U-238	(pCi/L)	ND	0.9±0.3 U	ND	ND

NA - not analyzed.
ND - not detected.
NS - not sampled.
U - analyzed, not detected.
B - contaminant in blank.
R - concentration is unusable.
J - estimated concentration.

Table 4-4. (continued).

Well		USGS 77	USGS 82	USGS 84	USGS 85
Date		May-95	May-95	May-95	May-95
Sample Depth		471.26 to 610	454.94 to 700	486.56 to 505	489.07 to 637
Sample ID	Units	31332101	31332201	31334201	31332301
Field Parameters					
Temperature	(celsius)	13.05	12.48	12.28	12.7
pH		7.7	7.78	7.91	7.54
Conductivity	(mmomen)	0.704	0.31	0.454	0.508
TAL Inorganics					
Aluminum	(ug/L)	26.8 U	43.4 BU	26.8 U	38.4 BU
Antimony	(ug/L)	1.9 U	42.2 U	1.9 U	1.9 U
Arsenic	(ug/L)	4 U	3.1 B	4 U	4 U
Barium	(ug/L)	147 B	50 B	92.6 B	127 B
Beryllium	(ug/L)	0.1 U	0.1 U	0.1 U	0.1 U
Cadmium	(ug/L)	0.4 U	2.9 U	0.4 U	0.4 U
Calcium	(ug/L)	68000	35300	55500	63400
Chromium	(ug/L)	11.4	5.5 U	19.9	16.2
Cobalt	(ug/L)	0.5 U	4.9 U	0.5 U	0.55 B
Copper	(ug/L)	2.3 BU	7.1 U	5.7 BU	1.3 UJ
Iron	(ug/L)	21.5 U	8.8 B	29.1 B	21.5 U
Lead	(ug/L)	2 U	1.5 UW	17.5 B	2 U
Magnesium	(ug/L)	20000	13000	17700	16200
Manganese	(ug/L)	0.8 U	1.4 BU	0.8 U	1.9 B
Mercury	(ug/L)	0.1 U	0.1 U	0.1 U	0.1 U
Nickel	(ug/L)	3.4 U	12.4 U	3.4 U	3.4 U
Potassium	(ug/L)	4430 BEJ	3460 B	2030 BEJ	3530 BEJ
Selenium	(ug/L)	2.7 U	1.2 U	2.7 U	2.7 U
Silver	(ug/L)	0.73 BNJ	5.8 BNR	0.6 UN	0.63 BNJ
Sodium	(ug/L)	30800	10400	8980	25600
Thallium	(ug/L)	4.6 U	2.3 U	4.6 U	4.6 U
Vanadium	(ug/L)	3.7 BU	9.9 B	3.2 BU	3.2 BJ
Zinc	(ug/L)	5.3 BEUJ	106	428 EJ	8.6 B
Zirconium	(ug/L)	31.3 U	31.3 U	31.3 U	ND
Radionuclides					
Gross Alpha	(pCi/L)	4.6±1.7	2.9±1.1	1±1.2 U	3±1.4
Gross Beta	(pCi/L)	13±2	4.1±1.3	2.4±1.2	16±2
Tritium	(pCi/L)	30700±500	67±122 U	4790±210	11800±300
Sr-90	(pCi/L)	1.3±0.3	0.1±0.3 U	0±0.3 U	4±0.4
Pu-238	(pCi/L)	ND	ND	ND	ND
Pu-239/240	(pCi/L)	ND	ND	ND	ND
Am-241	(pCi/L)	ND	ND	ND	ND
Np-237	(pCi/L)	ND	ND	ND	ND
I-129	(pCi/L)	0±0.3 U	0±0.3 U	0±0.3 U	0±0.3 U
Tc-99	(pCi/L)	7.5±0.7	0.1±0.6 U	0.8±0.6 U	6.4±0.6
U-234	(pCi/L)	ND	ND	ND	ND
U-235	(pCi/L)	ND	ND	ND	ND
U-238	(pCi/L)	ND	ND	ND	ND

NA - not analyzed.
ND - not detected.
NS - not sampled.
U - analyzed, not detected.
B - contaminant in blank.
R - concentration is unusable.
J - estimated concentration.

Table 4-4. (continued).

Well		USGS 111	USGS 112	USGS 113	USGS 114
Date		May-95	May-95	May-95	May-95
Sample Depth		475.98 to 597	479.67 to 563	480.31 to 564	474.02 to 564
Sample ID	Units	31332401	31332501	31332601	31332701
Field Parameters					
Temperature	(celsius)	13.46	13.94	13.37	13.55
pH		9.02	7.6	7.71	7.72
Conductivity	(mmemen)	0.608	0.18	0.945	0.531
TAL Inorganics					
Aluminum	(ug/L)	57.6 BU	44.1 BU	26.8 U	26.8 U
Antimony	(ug/L)	42.2 U	1.9 U	1.9 U	1.9 U
Arsenic	(ug/L)	1.8 U	4 U	4 U	4 U
Barium	(ug/L)	105 B	205	107 B	102 B
Beryllium	(ug/L)	0.1 U	0.1 U	0.1 U	0.1 U
Cadmium	(ug/L)	2.9 U	0.4 U	0.4 U	0.4 U
Calcium	(ug/L)	58100	71500	32000	55600
Chromium	(ug/L)	29.6	6 B	4.1 U	9.3 B
Cobalt	(ug/L)	4.9 U	0.5 U	0.5 U	0.5 U
Copper	(ug/L)	7.1 U	1.3 UJ	1.7 BU	3.9 BU
Iron	(ug/L)	86.8 B	21.5 U	21.5 U	21.5 U
Lead	(ug/L)	1.5 UW	2 U	2 U	2 U
Magnesium	(ug/L)	16900	19000	9060	17700
Manganese	(ug/L)	1.2 U	0.8 U	0.8 U	0.8 U
Mercury	(ug/L)	0.1 U	0.1 B	0.1 U	0.1 U
Nickel	(ug/L)	12.4 U	3.4 U	3.4 U	3.4 U
Potassium	(ug/L)	3600 B	4920 BEJ	2520 BEJ	3850 BEJ
Selenium	(ug/L)	1.4 B	2.7 U	2.7 U	2.7 U
Silver	(ug/L)	5.1 UN	0.6 NUJ	0.88 BNJ	0.6 UN
Sodium	(ug/L)	23700	57000	33500	19800
Thallium	(ug/L)	2.3 WUJ	4.6 U	4.6 U	4.6 U
Vanadium	(ug/L)	6.1 B	3.6 BJ	1.9 BU	3.6 BU
Zinc	(ug/L)	200	169	90.7 EJ	261 EJ
Zirconium	(ug/L)	31.3 U	ND	31.3 U	31.3 U
Radionuclides					
Gross Alpha	(pCi/L)	0.2±1.2 U	2.3±1.7 U	0±1.8 U	0.4±1.1 U
Gross Beta	(pCi/L)	3.5±1.3	78±3	38±3	11±1
Tritium	(pCi/L)	10900±300	17900±400	15500±300	27000±400
Sr-90	(pCi/L)	0.2±0.3 U	21.5±0.7	12±0.5	0.1±0.4 U
Pu-238	(pCi/L)	ND	0±0.02 U	ND	ND
Pu-239/240	(pCi/L)	ND	0±0.04 U	ND	ND
Am-241	(pCi/L)	ND	0.09±0.07 U	ND	ND
Np-237	(pCi/L)	ND	0.02±0.14 U	ND	ND
I-129	(pCi/L)	0±0.3 U	0.1±0.4 U	0.1±0.3 U	0±0.3 U
Tc-99	(pCi/L)	1.5±0.8 U	18±1	9.6±0.7	12.6±0.9
U-234	(pCi/L)	ND	1.3±0.4	ND	ND
U-235	(pCi/L)	ND	0±0.2 U	ND	ND
U-238	(pCi/L)	ND	0.6±0.3 U	ND	ND

NA - not analyzed.
ND - not detected.
NS - not sampled.
U - analyzed, not detected.
B - contaminant in blank.
R - concentration is unusable.
J - estimated concentration.

Table 4-4. (continued).

Well		USGS 115	USGS 116	USGS 121	USGS 122
Date		May-95	May-95	May-95	May-95
Sample Depth		470.27 to 581	464.71 to 580	459.12 to 475	465 to 476
Sample ID	Units	31332801	31332901	31333001	31333101
Field Parameters					
Temperature	(celsius)	13.31	12.99	12.6	15.39
pH		7.85	7.71	7.58	7.65
Conductivity	(mmemen)	0.385	0.69	0.424	0.59
TAL Inorganics					
Aluminum	(ug/L)	26.8 U	26.8 U	36.6 BU	26.8 U
Antimony	(ug/L)	1.9 U	1.9 U	1.9 B	1.9 U
Arsenic	(ug/L)	4 U	4 U	7.5 B	4 U
Barium	(ug/L)	57.6 B	137 B	88.6 B	114 B
Beryllium	(ug/L)	0.1 U	0.1 U	0.1 U	0.1 U
Cadmium	(ug/L)	0.4 U	0.4 U	0.4 U	0.4 U
Calcium	(ug/L)	40100	59000	52800	46000
Chromium	(ug/L)	7.7 B	7.8 B	4.2 B	4.1 U
Cobalt	(ug/L)	0.5 U	0.5 U	0.5 U	0.5 U
Copper	(ug/L)	1.7 BU	2 BU	1.3 UJ	1.3 U
Iron	(ug/L)	21.5 U	21.5 U	21.5 U	21.5 U
Lead	(ug/L)	3 B	2.9 B	2 U	2 U
Magnesium	(ug/L)	12600	17000	14100	11900
Manganese	(ug/L)	0.8 U	0.8 U	0.8 U	44
Mercury	(ug/L)	0.1 U	0.1 U	0.1 U	0.1 U
Nickel	(ug/L)	3.4 U	3.4 U	3.4 U	4.3 B
Potassium	(ug/L)	3300 BEJ	4950 BEJ	2350 BEJ	6800
Selenium	(ug/L)	2.7 U	2.7 U	3 BU	2.7 U
Silver	(ug/L)	0.6 UN	0.6 UN	0.6 NUJ	0.6 U
Sodium	(ug/L)	13100	32200	7340	30600
Thallium	(ug/L)	4.6 U	4.6 U	4.6 U	4.6 U
Vanadium	(ug/L)	4.1 BU	4.4 BU	3.4 BJ	3.2 B
Zinc	(ug/L)	454 EJ	197 EJ	6.8 BU	46.8
Zirconium	(ug/L)	31.3 U	31.3 U	ND	31.2 U
Radionuclides					
Gross Alpha	(pCi/L)	2.3±1	3.5±1.6	2.6±1.1	1.6±1.1 U
Gross Beta	(pCi/L)	8.4±1.3	5.8±1.6	2.7±1.1	13±1
Tritium	(pCi/L)	5340±220	8020±260	168±123 U	19300±300
Sr-90	(pCi/L)	0.6±0.3 U	0.8±0.3	0.3±0.3 U	2.2±0.3
Pu-238	(pCi/L)	ND	ND	ND	ND
Pu-239/240	(pCi/L)	ND	ND	ND	ND
Am-241	(pCi/L)	ND	ND	ND	ND
Np-237	(pCi/L)	ND	ND	ND	ND
I-129	(pCi/L)	0±0.4 U	0±0.3 U	0±0.4 U	0±0.2 U
Tc-99	(pCi/L)	4±0.7	3.4±0.6	0.1±0.5 U	2±0.5 J
U-234	(pCi/L)	ND	ND	ND	ND
U-235	(pCi/L)	ND	ND	ND	ND
U-238	(pCi/L)	ND	ND	ND	ND

NA - not analyzed.
ND - not detected.
NS - not sampled.
U - analyzed, not detected.
B - contaminant in blank.
R - concentration is unusable.
J - estimated concentration.

Table 4-4. (continued).

Well		USGS 123	CPP-1	CPP-2	LF2-08
Date		May-95	Jun-95	May-95	May-95
Sample Depth		468.39 to 475	595	595	495
Sample ID	Units	31333201	31334501	31334601	31333301
Field Parameters					
Temperature	(celsius)	14.61	16.6	15.2	12.84
pH		8.26	7	7.7	7.87
Conductivity	(msiemen)	0.662	0.547	0.534	0.748
T.A.L. Inorganics					
Aluminum	(ug/L)	69.1 BU	26.8 U	43.9 BU	26.8 U
Antimony	(ug/L)	1.9 U	1.9 U	1.9 U	1.9 U
Arsenic	(ug/L)	4 U	4 U	4 U	4 U
Barium	(ug/L)	173 B	96.2 B	186 B	159 B
Beryllium	(ug/L)	0.1 U	0.1 U	0.1 U	0.1 U
Cadmium	(ug/L)	0.4 U	0.4 U	0.4 U	2.1 B
Calcium	(ug/L)	70400	58100	77500	74900
Chromium	(ug/L)	8.6 B	4.1 U	5.9 B	9.1 B
Cobalt	(ug/L)	0.79 B	0.5 U	0.5 U	0.5 U
Copper	(ug/L)	1.8 B	1.3 U	1.3 UJ	2.1 B
Iron	(ug/L)	129	21.5 U	21.5 U	21.5 U
Lead	(ug/L)	2 U	2 U	2.1 BU	37.7
Magnesium	(ug/L)	18900	17000	21600	20400
Manganese	(ug/L)	3 B	0.8 U	0.8 U	0.8 U
Mercury	(ug/L)	0.14 B	0.1 U	0.1 U	0.1 U
Nickel	(ug/L)	4.7 B	3.4 U	3.4 U	3.4 U
Potassium	(ug/L)	4570 B	2980 B	5330 EJ	6100
Selenium	(ug/L)	2.7 U	2.7 U	2.7 U	2.7 U
Silver	(ug/L)	0.6 U	0.6 U	0.6 NUJ	0.6 U
Sodium	(ug/L)	46100	9110	44500	40600
Thallium	(ug/L)	4.6 U	4.6 U	4.6 U	4.6 U
Vanadium	(ug/L)	3.9 B	4.9 B	3.4 BJ	3.1 B
Zinc	(ug/L)	7.3 BU	1.3 BU	339	5.7 BU
Zirconium	(ug/L)	31.2 U	31.2 U	ND	31.2 U
Radionuclides					
Gross Alpha	(pCi/L)	1.7±1.5 U	1.9±1.1 U	ND	2±1.6 U
Gross Beta	(pCi/L)	123±3	25±2	ND	38±2
Tritium	(pCi/L)	25900±400	754±173	ND	21000±400
Sr-90	(pCi/L)	30±1	0.9±0.3 U	ND	0.6±0.3 U
Pu-238	(pCi/L)	0.08±0.06 U	ND	ND	ND
Pu-239/240	(pCi/L)	0±0.03 U	ND	ND	ND
Am-241	(pCi/L)	0.03±0.06 U	ND	ND	ND
Np-237	(pCi/L)	0±0.12 U	ND	ND	ND
I-129	(pCi/L)	0±0.2 U	0±0.3 U	ND	0.4±0.4 U
Tc-99	(pCi/L)	48±1	31±1 J	ND	4.7±0.4
U-234	(pCi/L)	1.3±0.4	ND	ND	ND
U-235	(pCi/L)	0±0.2 U	ND	ND	ND
U-238	(pCi/L)	1.1±0.4	ND	ND	ND

NA - not analyzed.
ND - not detected.
NS - not sampled.
U - analyzed, not detected.
B - contaminant in blank.
R - concentration is unusable.
J - estimated concentration.

Table 4-4. (continued).

Well		LF2-10	LF2-11	LF2-12	LF3-08
Date		May-95	Aug-95	Jun-95	May-95
Sample Depth		765	499	489	510
Sample ID	Units	31333501	31333601	31333701	31333801
Field Parameters					
Temperature	(celsius)	12.79	12.77	13.73	12.85
pH		8.58	8.11	7.59	7.79
Conductivity	(mmemen)	0.515	1.035	0.724	0.705
TAL Inorganics					
Aluminum	(ug/L)	26.8 U	76.3 BU	26.8 U	26.8 U
Antimony	(ug/L)	1.9 U	4.6 B	1.9 U	1.9 U
Arsenic	(ug/L)	4 U	2.4 U	4 U	4 U
Barium	(ug/L)	92.1 B	127 B	177 B	139 B
Beryllium	(ug/L)	0.1 U	0.1 U	0.1 U	0.1 U
Cadmium	(ug/L)	0.4 U	1 BU	2.7 B	0.4 U
Calcium	(ug/L)	64800	66200	77000	69900
Chromium	(ug/L)	8.9 B	1.8 B	4.1 U	4.1 U
Cobalt	(ug/L)	0.5 U	1.4 B	0.74 B	1 B
Copper	(ug/L)	1.8 B	18.5 BU	1.3 U	3.2 B
Iron	(ug/L)	21.5 U	6.3 BU	21.5 U	21.5 U
Lead	(ug/L)	2 U	2 U	12.2	2 U
Magnesium	(ug/L)	18100	19600	20300	20100
Manganese	(ug/L)	0.8 U	62.8	6.7 B	0.8 U
Mercury	(ug/L)	0.1 UJ	0.1 U	0.44	0.1 U
Nickel	(ug/L)	3.4 U	206	23.3 B	3.4 U
Potassium	(ug/L)	2840 B	1490 EJ	5340	5950
Selenium	(ug/L)	2.7 U	3.7 B	2.7 B	2.8 B
Silver	(ug/L)	0.6 U	0.8 U	0.6 U	0.6 U
Sodium	(ug/L)	11700	54500	46700	42700
Thallium	(ug/L)	4.6 U	3.4 BU	4.6 U	4.6 U
Vanadium	(ug/L)	4 B	0.7 U	2.3 B	3.7 B
Zinc	(ug/L)	18.3 BU	11.2 BEUJ	30.8	46
Zirconium	(ug/L)	31.2 U	11.6 U	31.2 U	31.2 U
Radionuclides					
Gross Alpha	(pCi/L)	2.5±1.3 U	0±1.7 U	2.6±1.6 U	4±1.8
Gross Beta	(pCi/L)	3.4±1.3	18±2	12±2	17±2
Tritium	(pCi/L)	7700±300	24000±400	25200±400	25200±400
Sr-90	(pCi/L)	0.7±0.3	0.4±0.3 U	0.3±0.3 U	0.2±0.3 U
Pu-238	(pCi/L)	ND	ND	ND	ND
Pu-239/240	(pCi/L)	ND	ND	ND	ND
Am-241	(pCi/L)	ND	ND	ND	ND
Np-237	(pCi/L)	ND	ND	ND	ND
I-129	(pCi/L)	0±0.3 U	0.3±0.3 U	1.2±0.3	0.3±0.3 U
Tc-99	(pCi/L)	0.6±0.5 U	3.1±0.5	8.5±0.6	9.4±0.6
U-234	(pCi/L)	ND	ND	ND	ND
U-235	(pCi/L)	ND	ND	ND	ND
U-238	(pCi/L)	ND	ND	ND	ND

NA - not analyzed.
ND - not detected.
NS - not sampled.
U - analyzed, not detected.
B - contaminant in blank.
R - concentration is unusable.
J - estimated concentration.

Table 4-4. (continued).

Well		LF3-09	LF3-10	USGS 36	USGS 67
Date		May-95	Aug-95	Duplicate	Duplicate
Sample Depth		500	501	477.48 to 567.1	462.34 to 698
Sample ID	Units	31333901	31334001	31334801	31335001
Field Parameters					
Temperature	(celsius)	12.83	12.96	12.75	14.03
pH		7.6	8.33	7.81	7.48
Conductivity	(msiemen)	0.681	0.771	0.486	0.875
TAL Inorganics					
Aluminum	(ug/L)	26.8 U	96.4 BU	26.8 U	NA
Antimony	(ug/L)	1.9 U	2.7 U	1.9 U	NA
Arsenic	(ug/L)	4 U	2.4 U	4 U	NA
Barium	(ug/L)	132 B	152 B	108 B	NA
Beryllium	(ug/L)	0.1 U	0.1 U	0.1 U	NA
Cadmium	(ug/L)	0.48 B	0.94 BU	0.4 U	NA
Calcium	(ug/L)	68500	65700	56000	NA
Chromium	(ug/L)	4.1 U	5.1 B	12.9	NA
Cobalt	(ug/L)	0.52 B	0.69 B	0.5 U	NA
Copper	(ug/L)	1.8 B	16.2 BU	1.8 BU	NA
Iron	(ug/L)	36.6 B	6.3 BU	21.5 U	NA
Lead	(ug/L)	13.9	2.6 B	2 U	NA
Magnesium	(ug/L)	20300	18700	14500	NA
Manganese	(ug/L)	1.8 B	10.4 B	0.8 U	NA
Mercury	(ug/L)	0.1 U	0.1 U	0.1 U	NA
Nickel	(ug/L)	24.7 B	7 B	3.4 U	NA
Potassium	(ug/L)	5030	4810 BEJ	2810 BEJ	NA
Selenium	(ug/L)	2.7 U	3.2 B	2.7 U	NA
Silver	(ug/L)	0.6 U	0.8 U	0.6 UN	NA
Sodium	(ug/L)	36500	40800	16200	NA
Thallium	(ug/L)	4.6 U	7.6 BU	4.6 U	NA
Vanadium	(ug/L)	3 B	2.5 BU	3.3 BU	NA
Zinc	(ug/L)	168	109 EJ	6.2 BEUJ	NA
Zirconium	(ug/L)	31.2 U	11.6 U	31.3 U	NA
Radionuclides					
Gross Alpha	(pCi/L)	1.8±1.4 U	2.3±1.6 U	2.9±1.3	0±1.5 U
Gross Beta	(pCi/L)	31±2	13±2	31±2	47±3
Tritium	(pCi/L)	26900±400	17600±400	6110±230	21000±400
Sr-90	(pCi/L)	0.2±0.3 U	0.7±0.3	8.6±0.5	12.8±0.5
Pu-238	(pCi/L)	ND	ND	ND	ND
Pu-239/240	(pCi/L)	ND	ND	ND	ND
Am-241	(pCi/L)	ND	ND	ND	ND
Np-237	(pCi/L)	ND	ND	ND	ND
I-129	(pCi/L)	0.9±0.3	0.2±0.3 U	0±0.3 U	0±0.3 U
Tc-99	(pCi/L)	9.4±0.6	1.8±0.5	4.8±0.8	12±1
U-234	(pCi/L)	ND	ND	ND	ND
U-235	(pCi/L)	ND	ND	ND	ND
U-238	(pCi/L)	ND	ND	ND	ND

NA - not analyzed.
ND - not detected.
NS - not sampled.
U - analyzed, not detected.
B - contaminant in blank.
R - concentration is unusable.
J - estimated concentration.

Table 4-4. (continued).

Well		USGS 121	CPP-2	USGS 47	USGS 47
Date		Duplicate	Duplicate	Jun-95	Jun-95
Sample Depth		459.12 to 475	595	462 to 470.8	483 to 491.8
Sample ID	Units	31334901	31334601	31340601	31340701
Field Parameters					
Temperature	(celsius)	12.6	15.2	16.2	16.2
pH		7.58	7.7	7.75	7.75
Conductivity	(mmemen)	0.424	0.534	0.54	0.54
TAL Inorganics					
Aluminum	(ug/L)	38.7 BU	26.8 U	NA	NA
Antimony	(ug/L)	1.9 U	1.9 U	NA	NA
Arsenic	(ug/L)	4 U	4 U	NA	NA
Barium	(ug/L)	90.7 B	96.6 B	NA	NA
Beryllium	(ug/L)	0.1 U	0.1 U	NA	NA
Cadmium	(ug/L)	0.4 U	0.4 U	NA	NA
Calcium	(ug/L)	53900	55100	NA	NA
Chromium	(ug/L)	5.1 B	4.1 U	NA	NA
Cobalt	(ug/L)	0.5 U	0.5 U	NA	NA
Copper	(ug/L)	1.3 UJ	13.5 B	NA	NA
Iron	(ug/L)	21.5 U	21.5 U	NA	NA
Lead	(ug/L)	2 U	2 U	NA	NA
Magnesium	(ug/L)	14300	16300	NA	NA
Manganese	(ug/L)	0.8 U	0.8 U	NA	NA
Mercury	(ug/L)	0.1 U	0.1 U	NA	NA
Nickel	(ug/L)	3.4 U	3.4 U	NA	NA
Potassium	(ug/L)	2380 BEJ	2890 B	NA	NA
Selenium	(ug/L)	5.5 BU	2.7 U	NA	NA
Silver	(ug/L)	0.6 NUJ	0.6 U	NA	NA
Sodium	(ug/L)	7480	8180	NA	NA
Thallium	(ug/L)	4.6 U	4.6 U	NA	NA
Vanadium	(ug/L)	3.8 BJ	4.9 B	NA	NA
Zinc	(ug/L)	9.5 B	3.6 BU	NA	NA
Zirconium	(ug/L)	ND	31.2 U	NA	NA
Radionuclides					
Gross Alpha	(pCi/L)	4.7±1.2	1.6±1 U	1.4±0.8 U	4.3±1.6
Gross Beta	(pCi/L)	3.8±1.2	3.8±1.2	105±2	267±4
Tritium	(pCi/L)	240±123 U	136±156 U	10300±300	15600±400
Sr-90	(pCi/L)	0±0.4 U	0.7±0.3 U	31±1	44±1 U
Pu-238	(pCi/L)	ND	ND	ND	ND
Pu-239/240	(pCi/L)	ND	ND	ND	ND
Am-241	(pCi/L)	ND	ND	ND	ND
Np-237	(pCi/L)	ND	ND	ND	ND
I-129	(pCi/L)	0±0.3 U	0±0.3 U	0±0.3 U	0.2±0.3 U
Tc-99	(pCi/L)	0.1±0.5 U	1.1±0.5	119±2	17±1
U-234	(pCi/L)	ND	ND	ND	ND
U-235	(pCi/L)	ND	ND	ND	ND
U-238	(pCi/L)	ND	ND	ND	ND

NA - not analyzed.
ND - not detected.
NS - not sampled.
U - analyzed, not detected.
B - contaminant in blank.
R - concentration is unusable.
J - estimated concentration.

Table 4-4. (continued).

Well		USGS 47	USGS 47	USGS 47	USGS 47
Date		Jun-95	Jun-95	Jun-95	Jun-95
Sample Depth		511.5 to 520.8	558 to 566.8	576 to 584.8	483 to 491.8
Sample ID	Units	31340801	31340901	31341001	31341101
Field Parameters					
Temperature	(celsius)	16.2	16.2	16.2	16.2
pH		7.75	7.75	7.75	7.75
Conductivity	(mmemen)	0.54	0.54	0.54	0.54
TAL Inorganics					
Aluminum	(ug/L)	NA	NA	NA	NA
Antimony	(ug/L)	NA	NA	NA	NA
Arsenic	(ug/L)	NA	NA	NA	NA
Barium	(ug/L)	NA	NA	NA	NA
Beryllium	(ug/L)	NA	NA	NA	NA
Cadmium	(ug/L)	NA	NA	NA	NA
Calcium	(ug/L)	NA	NA	NA	NA
Chromium	(ug/L)	NA	NA	NA	NA
Cobalt	(ug/L)	NA	NA	NA	NA
Copper	(ug/L)	NA	NA	NA	NA
Iron	(ug/L)	NA	NA	NA	NA
Lead	(ug/L)	NA	NA	NA	NA
Magnesium	(ug/L)	NA	NA	NA	NA
Manganese	(ug/L)	NA	NA	NA	NA
Mercury	(ug/L)	NA	NA	NA	NA
Nickel	(ug/L)	NA	NA	NA	NA
Potassium	(ug/L)	NA	NA	NA	NA
Selenium	(ug/L)	NA	NA	NA	NA
Silver	(ug/L)	NA	NA	NA	NA
Sodium	(ug/L)	NA	NA	NA	NA
Thallium	(ug/L)	NA	NA	NA	NA
Vanadium	(ug/L)	NA	NA	NA	NA
Zinc	(ug/L)	NA	NA	NA	NA
Zirconium	(ug/L)	NA	NA	NA	NA
Radionuclides					
Gross Alpha	(pCi/L)	2.3±1.2 J	2.5±1.2	4.6±1.4	1.4±1.3 U
Gross Beta	(pCi/L)	148±3	158±3	151±3	268±4
Tritium	(pCi/L)	5310±260	6130±270	7570±280	15800±400
Sr-90	(pCi/L)	40±1	41±1	42±1	44±1 U
Pu-238	(pCi/L)	ND	ND	ND	ND
Pu-239/240	(pCi/L)	ND	ND	ND	ND
Am-241	(pCi/L)	ND	ND	ND	ND
Np-237	(pCi/L)	ND	ND	ND	ND
I-129	(pCi/L)	0±0.3 U	0±0.3 U	0±0.3 U	0.8±0.3
Tc-99	(pCi/L)	62±1	23±1	63±1	18±1
U-234	(pCi/L)	ND	ND	ND	ND
U-235	(pCi/L)	ND	ND	ND	ND
U-238	(pCi/L)	ND	ND	ND	ND

NA - not analyzed.
ND - not detected.
NS - not sampled.
U - analyzed, not detected.
B - contaminant in blank.
R - concentration is unusable.
J - estimated concentration.

Table 4-4. (continued).

Well		USGS 47
Date		Jun-95
Sample Depth		596 to 604.8
Sample ID	Units	31341401
Field Parameters		
Temperature	(celsius)	N/A
pH		N/A
Conductivity	(msiemen)	N/A
TAL Inorganics		
Aluminum	(ug/L)	NA
Antimony	(ug/L)	NA
Arsenic	(ug/L)	NA
Barium	(ug/L)	NA
Beryllium	(ug/L)	NA
Cadmium	(ug/L)	NA
Calcium	(ug/L)	NA
Chromium	(ug/L)	NA
Cobalt	(ug/L)	NA
Copper	(ug/L)	NA
Iron	(ug/L)	NA
Lead	(ug/L)	NA
Magnesium	(ug/L)	NA
Manganese	(ug/L)	NA
Mercury	(ug/L)	NA
Nickel	(ug/L)	NA
Potassium	(ug/L)	NA
Selenium	(ug/L)	NA
Silver	(ug/L)	NA
Sodium	(ug/L)	NA
Thallium	(ug/L)	NA
Vanadium	(ug/L)	NA
Zinc	(ug/L)	NA
Zirconium	(ug/L)	NA
Radionuclides		
Gross Alpha	(pCi/L)	4±1.3 U
Gross Beta	(pCi/L)	80±2
Tritium	(pCi/L)	3280±220
Sr-90	(pCi/L)	29±1
Pu-238	(pCi/L)	ND
Pu-239/240	(pCi/L)	ND
Am-241	(pCi/L)	ND
Np-237	(pCi/L)	ND
I-129	(pCi/L)	0±0.3 U
Tc-99	(pCi/L)	34±1
U-234	(pCi/L)	ND
U-235	(pCi/L)	ND
U-238	(pCi/L)	ND

NA - not analyzed.
ND - not detected.
NS - not sampled.
U - analyzed, not detected.
B - contaminant in blank.
R - concentration is unusable.
J - estimated concentration.

Pu-238 was only detected in a single water sample collected from well USGS-48. The sample was collected in October 1990 and had a concentration near the MDL at 0.05±0.02 pCi/L. During 1992–1995, all plutonium measurements at the INEEL were below the reporting level (Bartholomay, 1997). Plutonium was not detected in any of the aquifer wells sampled during the WAG 3 RI field investigation of 1995.

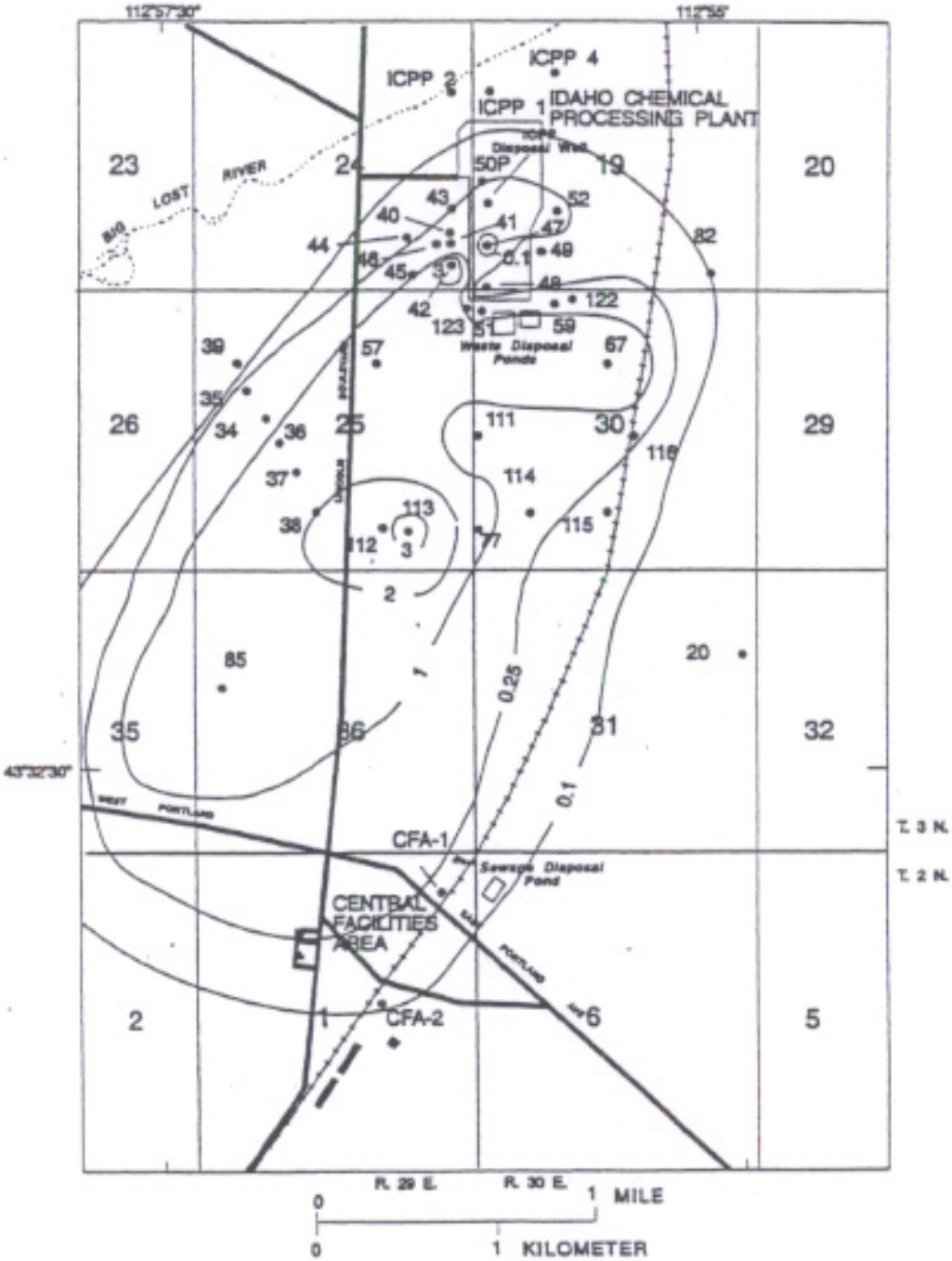
4.3.1.3 Americium-241. Americium-241 is a decay product of Pu-241 and has a half-life of 432.7 years. According to Orr and Cecil (1991), Am-241 has only been detected in the SRPA near the RWMC and TAN. Since 1988, however, Am-241 was detected in well USGS-44 during July 1992 at concentrations of 0.07±0.03 and 0.08±0.03 pCi/L, in well USGS-37 during October 1992 at a concentration of 0.09±0.03 pCi/L, and in well USGS-85 during June 1991 at concentrations of 0.08±0.03 pCi/L. During 1992–1995, all other plutonium measurements were below the reporting level (Bartholomay, 1997). During the WAG 3 RI field investigation in 1995, Am-241 was detected in well USGS-42 at a concentration of 0.54±0.14 pCi/L.

4.3.1.4 Iodine-129. From 1953 to 1983, an estimated 0.01 to 0.136 Ci/yr (0.56 to 1.18 Ci) of I-129 were contained in the waste water discharged to the disposal well (Mann et al., 1988). For 1984 to 1986, the annual amount of I-129 in the waste water discharged to the ICPP percolation ponds ranged from 0.0064 to 0.039 Ci.

Four rounds of groundwater samples (1977, 1981, 1986, and 1990–1991) have been collected by the USGS from the SRPA at the ICPP (Mann and Beasley, 1994). During 1990 through 1991, samples were collected from 50 aquifer wells. Figure 4-13 displays approximate areal extent of groundwater containing greater than 0.1 pCi/L I-129 based on the 1990–1991 sampling results. According to Mann and Beasley (1994), "In 1990–1991 concentrations of I-129 in water samples from wells that obtain water from the Snake River Plain aquifer ranged from 0.0000006±0.0000002 to 3.82±0.19 picocuries per liter (pCi/L). The mean concentration in water from 18 wells was 0.81±0.19 as compared to 1.3±0.26 in 1986." Mann et al. (1988) reported a similar decrease in I-129 groundwater concentrations between the 1981 and 1986 sampling events. Decreases in the I-129 concentration in groundwater at the ICPP are attributed to (1) the decrease in the amount of I-129 disposed annually, (2) a change in the disposal techniques from the disposal well to the percolation ponds, and (3) dilution by infiltration of stream flow from the Big Lost River.

During the WAG 3 RI, I-129 was detected in wells USGS-67, LF2-12, and LF3-08 at concentrations of 1±0.3 pCi/L, 1.2±0.3 pCi/L, and 0.9±0.3 pCi/L, respectively. Two of these wells are located several miles downgradient from the ICPP indicating the contamination is from a historical release rather than an on-going source. The limited amount of I-129 contamination in the aquifer is consistent with the observations made by Mann et al. (1988) where decreasing I-129 concentrations were attributed to decreasing I-129 disposal and the change in disposal techniques. The half-life of I-129 is 1.57E+07 years.

4.3.1.5 Tritium. A H-3 plume has developed in the SRPA since the 1950s from disposal of liquid wastes at the INEL. The principle sources of H-3 in the aquifer have been through injection of liquid wastes through the disposal well at the ICPP and discharge of waste water to the infiltration ponds at the ICPP and the TRA. It is estimated approximately 30,900 Ci of H-3 have been discharged to the SRPA at the ICPP since 1952 (Orr and Cecil, 1991). Of this amount, approximately 22,200 Ci were discharged via the disposal well at the ICPP. The remainder of the H-3 was discharged to the aquifer via the ICPP percolation ponds.



EXPLANATION

—1— LINE OF EQUAL IODINE-129 CONCENTRATION–Interval, in picocuries per liter, is variable

57 • WELL FROM WHICH WATER SAMPLE FOR IODINE-129 WAS COLLECTED IN 1990-91–Number, 57, is local well identifier; P indicates well obtains water from a perched ground-water zone. See table 2 for iodine-129 concentrations in specific wells

Figure 4-13. I-129 distribution in the SRPA during 1990–1991 (taken from Mann and Beasely, 1994).

According to Orr and Cecil (page 30, 1991), "Tritium concentrations in water from the Snake River Plain aquifer decreased by as much as 39,000 pCi/L during 1986–88. By October 1988, tritium concentrations ranged from 700±200 pCi/L to 61,600±1,100 pCi/L and the tritium plume extended southwestward in the general direction of ground-water flow. The size of the plume in which tritium concentrations exceeded 0.5 pCi/mL decreased from about 51 mi^2 in October 1985 to about 45 mi^2 in October 1988. The area of the plume containing tritium concentrations in excess of the maximum contaminant level (MCL) of 20,000 pCi/L (EPA 1989, p. 551) decreased from 4.4 to 2.8 mi^2." They attributed the reduced concentrations of H-3 and decreased size of the plume to radioactive decay processes, overall reduction in H-3 disposal rates, dilution from recharge, and changes in the disposal methods. Long term radioactive decay processes and an overall decrease in tritium disposal rates have contributed to decreased concentrations and a decrease in the area of the tritium plume at the INEEL during 1992–1995 (Figure 4-14).

The distribution of H-3 in the SRPA for May 1995 is shown in Figure 4-15. The size of the plume that exceeds the federal drinking water standard of 20,000 pCi/L is approximately 3.3 km^2 (1.3 mi^2), significantly smaller than the 7.3 km^2 (2.8 mi^2) reported in October 1988. Using these areas, the distribution of H-3 in May 1995, an aquifer thickness of 76.2 m (250 ft), and an effective porosity of 10% yields approximately 706 Ci of H-3 currently present in the SRPA. This is a rough approximation of high uncertainty due to the assumptions that were necessary for this estimate. Of the 44 aquifer monitoring wells sampled during the WAG 3 RI, water samples from 11 wells exceeded the federal MCL for H-3 of 20,000 pCi/L. H-3 concentrations from these 11 wells was a maximum of 30,700 pCi/L in well USGS-77. Historical H-3 concentrations for the USGS and CPP aquifer wells were provided in the WAG 3 RI/FS Work Plan (INEL-95/0056, Rev. 2).

4.3.1.6 Strontium-90. A plume of Sr-90 has formed downgradient from the ICPP primarily in response to the ICPP disposal well. According to Orr and Cecil (page 32, 1991), "in October 1985, the size of the strontium-90 plume where concentration exceeded 6 pCi/L was about 2 mi^2 (Pittman et al., 1988, p. 53); the concentrations of strontium-90 in wells 57 and 47 were 74±5 and 63±5 pCi/L, respectively. Strontium concentrations decreased as much as 33 pCi/L during 1986-88. By October 1988, strontium-90 concentrations ranged from 8±2 to 48±3 pCi/L, and the area of the strontium-90 plume had decreased to approximately 0.8 mi^2. The strontium-90 concentrations in wells 57 and 47, both within the plume, decreased to 41±3 and 48±3 pCi/L, respectively." They attributed the reduced areal extent and concentration of Sr-90 to the diversion of liquid radioactive wastes from the disposal well to the infiltration ponds in addition to radioactive decay, diffusion, dispersion, and dilution from natural recharge. Since 1989, concentrations of Sr-90 in water samples from most wells have remained relatively constant. Figure 4-17 depicts the plume extent for 2, 8, 40 ad 70 pCi/L based on the most recent data.

The distribution of Sr-90 in the SRPA for May 1995 is provided in Figure 4-17. The areal extent of the Sr-90 plume has decreased between October 1988 and May 1995, consistent with the previous years' trend. The size of the plume exceeding the federal drinking water standard is approximately 1.6 km^2 (0.6 mi^2). Using the distribution of Sr-90 in May 1995, an aquifer thickness of 76.2 m (250 ft), and an effective porosity of 10% yields approximately 0.27 Ci of Sr-90 currently present in the SRPA. This is a rough approximately of high uncertainty due to the assumptions that were necessary for this estimate. Of the 44 aquifer monitoring wells, water samples from 16 wells exceeded the federal drinking water standard during May 1995 of 8 pCi/L. The maximum Sr-90 concentration detected in the aquifer was 84 pCi/L in well

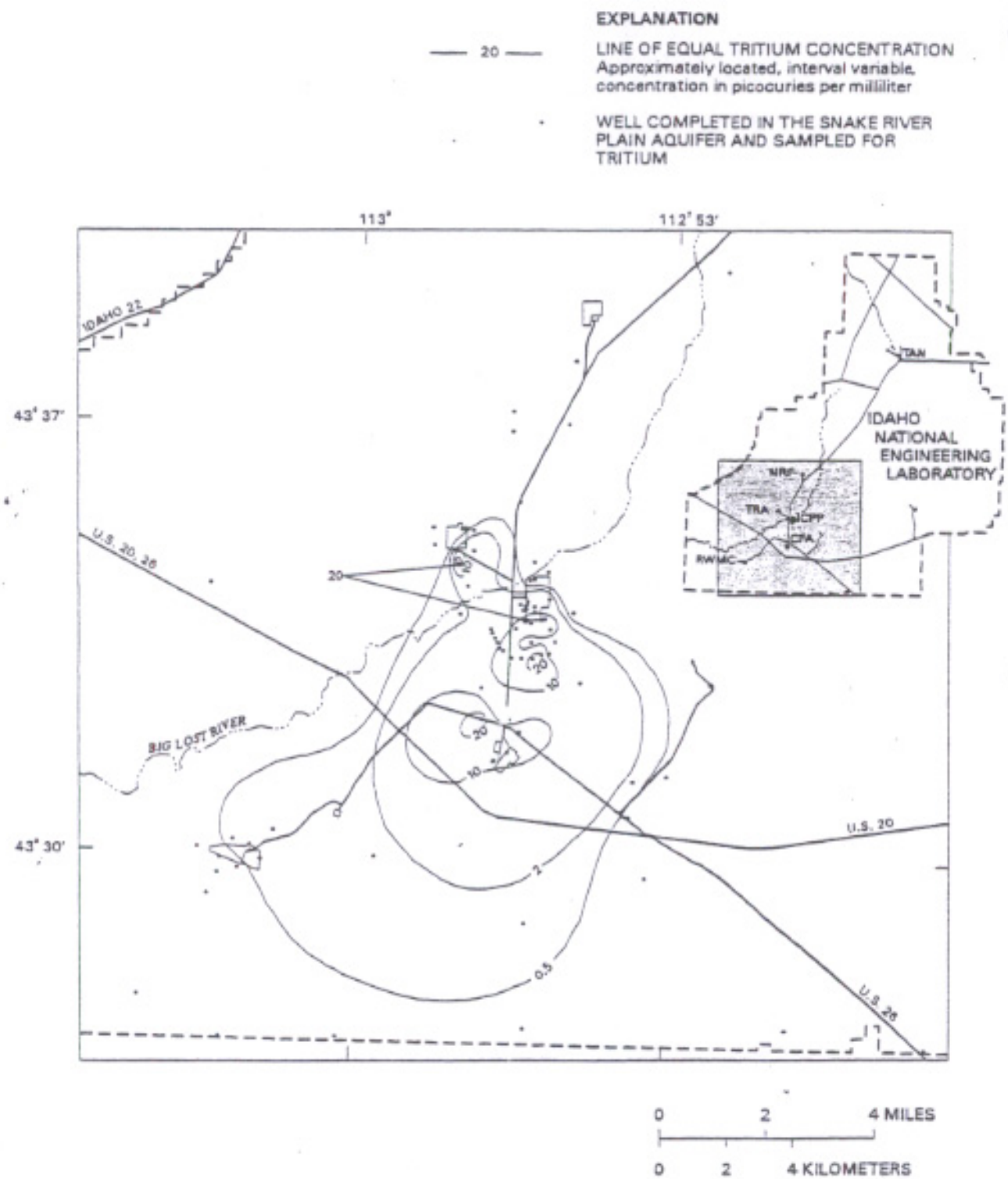


Figure 4-14. H-3 distribution in the SRPA during October 1995 (Bartholomay, 1997).

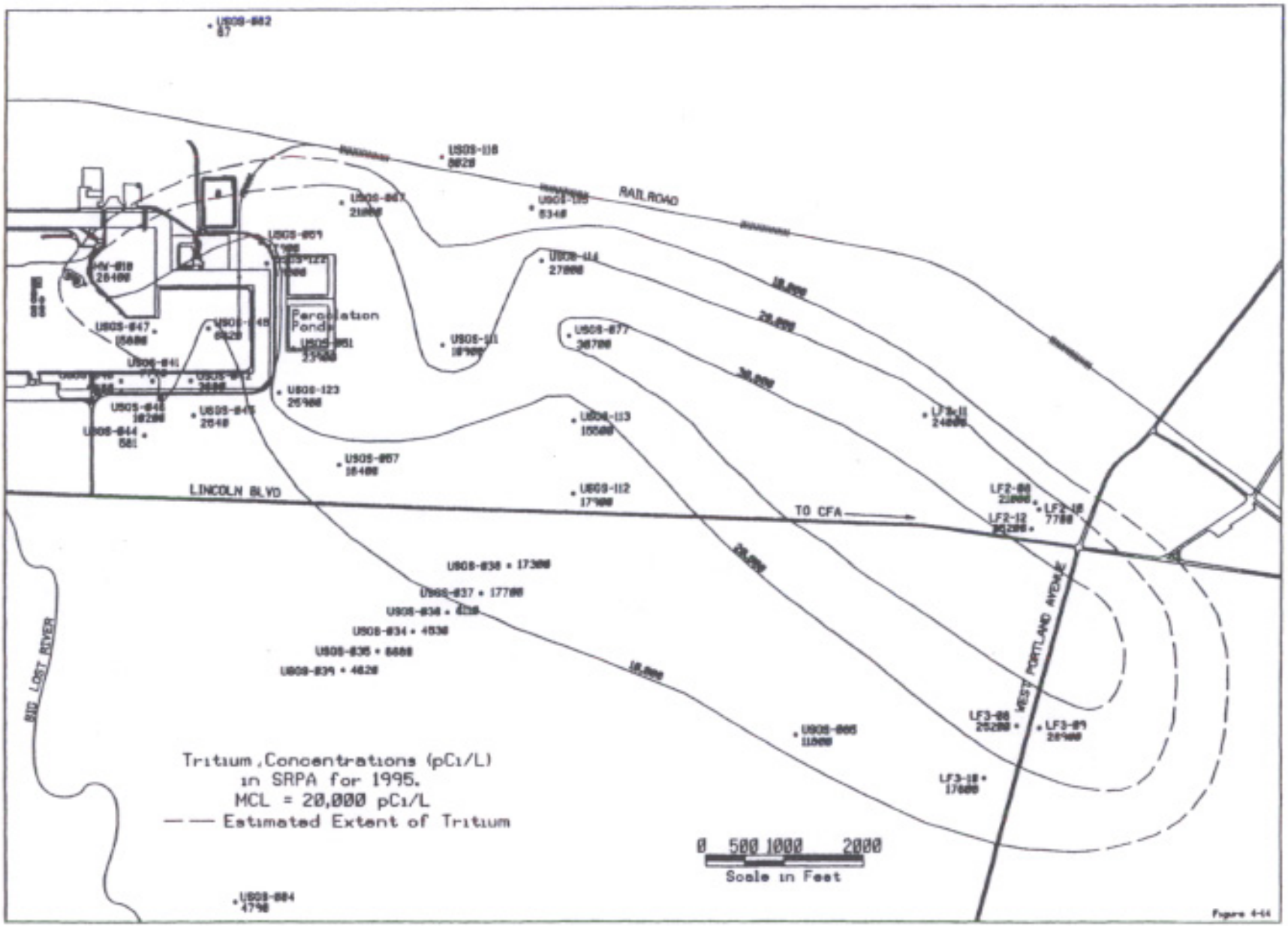


Figure 4-15. H-3 distribution in the SRPA (May 1995).

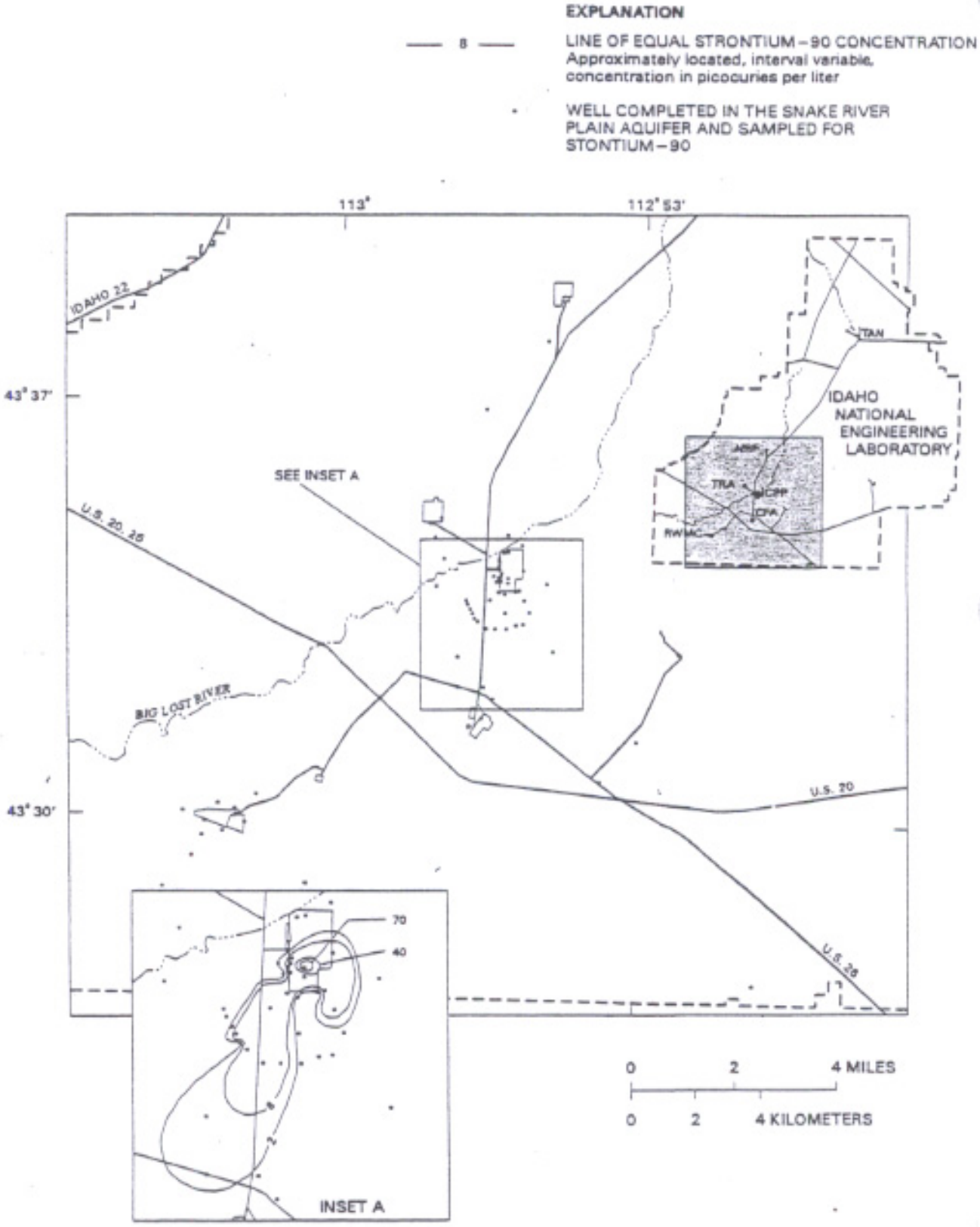


Figure 4-16. Sr-90 distribution in the SRPA during October 1995 (Bartholomay, 1997).

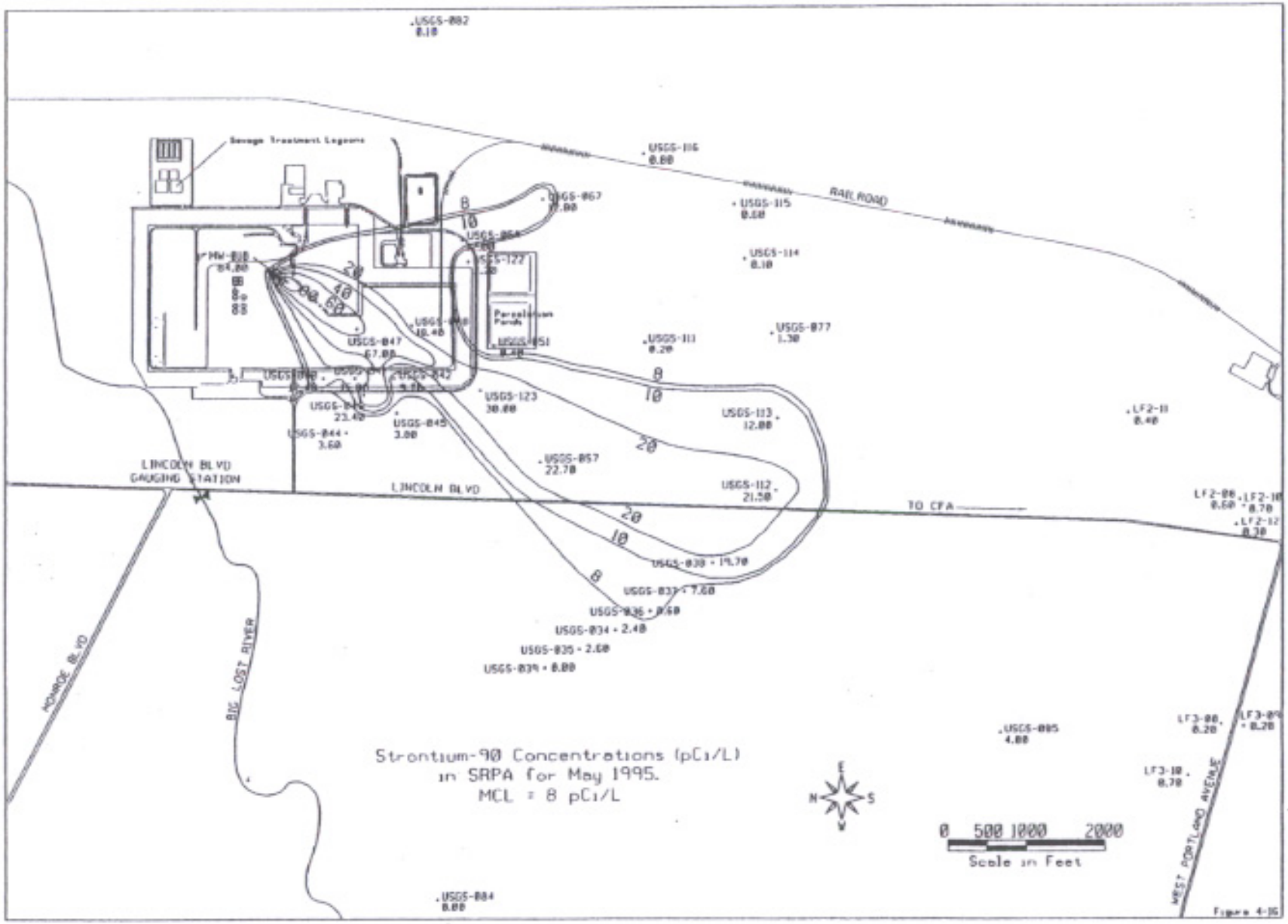


Figure 4-17. Sr-90 distribution in the SRPA (May 1995).

MW-18. Historical Sr-90 concentrations for the USGS and CPP aquifer wells were provided in the WAG 3 RI/FS Work Plan (INEL-95/0056, Rev. 2).

4.3.1.7 Technetium-99. Tc-99 was identified in 32 of the 44 wells sampled during the WAG 3 RI (Figure 4-18). The highest concentration of Tc-99 were identified in the north central portion of the ICPP in wells MW-18, USGS-47, and USGS-52 having concentrations of 448±4 pCi/L, 235±3 pCi/L, and 174±2 pCi/L, respectively. The Tc-99 plume extends to the southwest of the ICPP and includes wells USGS-123, USGS-57, and USGS-39. The maximum Tc-99 concentration outside the ICPP security perimeter fence is 49 pCi/L in well USGS-123.

4.3.1.8 Inorganics. During the WAG 3 RI, water samples were collected from all aquifer wells and analyzed for CLP metals plus zirconium. From the 44 wells tested, only the water sample from well LF2-11 exceeded a federal primary or secondary MCL. The magnesium concentration in LF2-11 was measured at 62.8 μg/L, compared to a federal secondary MCL of 50 μg/L. This well is located approximately three miles downgradient from ICPP and since magnesium was not measured in other wells above the federal secondary MCL, this contamination is not likely associated with the ICPP.

4.3.2 Background Concentrations and Regulatory Limits

The established Federal Primary and Secondary Maximum contaminant Levels (MCLs) and back ground water quality for the SRPA are included in Table 4-5 for inorganic, organic and radionuclides. The background inorganic concentration reported by the USGS in Orr et al. (1991) are for filtered groundwater samples. The Primary MCLs are the maximum permissible levels of contaminants in water delivered from a public water system. The EPA uses MCLs under the Safe Drinking Water Act as reference points for water resource protection efforts when groundwater in question is a potential source of drinking water. The Secondary MCLs control contaminants in drinking water that primarily affect the aesthetic qualities. The Secondary regulations are not Federally enforceable, but are intended as guidelines for the States.

A report by Orr et al. (1991) describes the background concentrations of selected radionuclides, organic compounds, and inorganic chemical constituents in the groundwater from the SRPA in the vicinity of INEL. This report statistically presents the median and mean concentrations for various constituents in the groundwater. This statistical interpretation is based only on sample analyses having reportable concentrations based on the instrument/method detection level. Any analyses that resulted in non-detects for a given constituent were not used for the determination of background concentrations.

4.4 Verification of Source Inventory

At the time of this writing, a number of issues were raised regarding the inventory of contaminants considered in this RI/BRA Report. Specifically, the concern focused on radioactive contaminants that, given the nature of the former reprocessing mission at the ICPP, should be present in areas where HLW solutions have been released to the soil. The presumption is that raffinates produced by the reprocessing of spent U.S. Navy nuclear fuel contains more actinides and activation and fission products than have actually been measured during recent and past field investigations. To help address this concern, the computer code

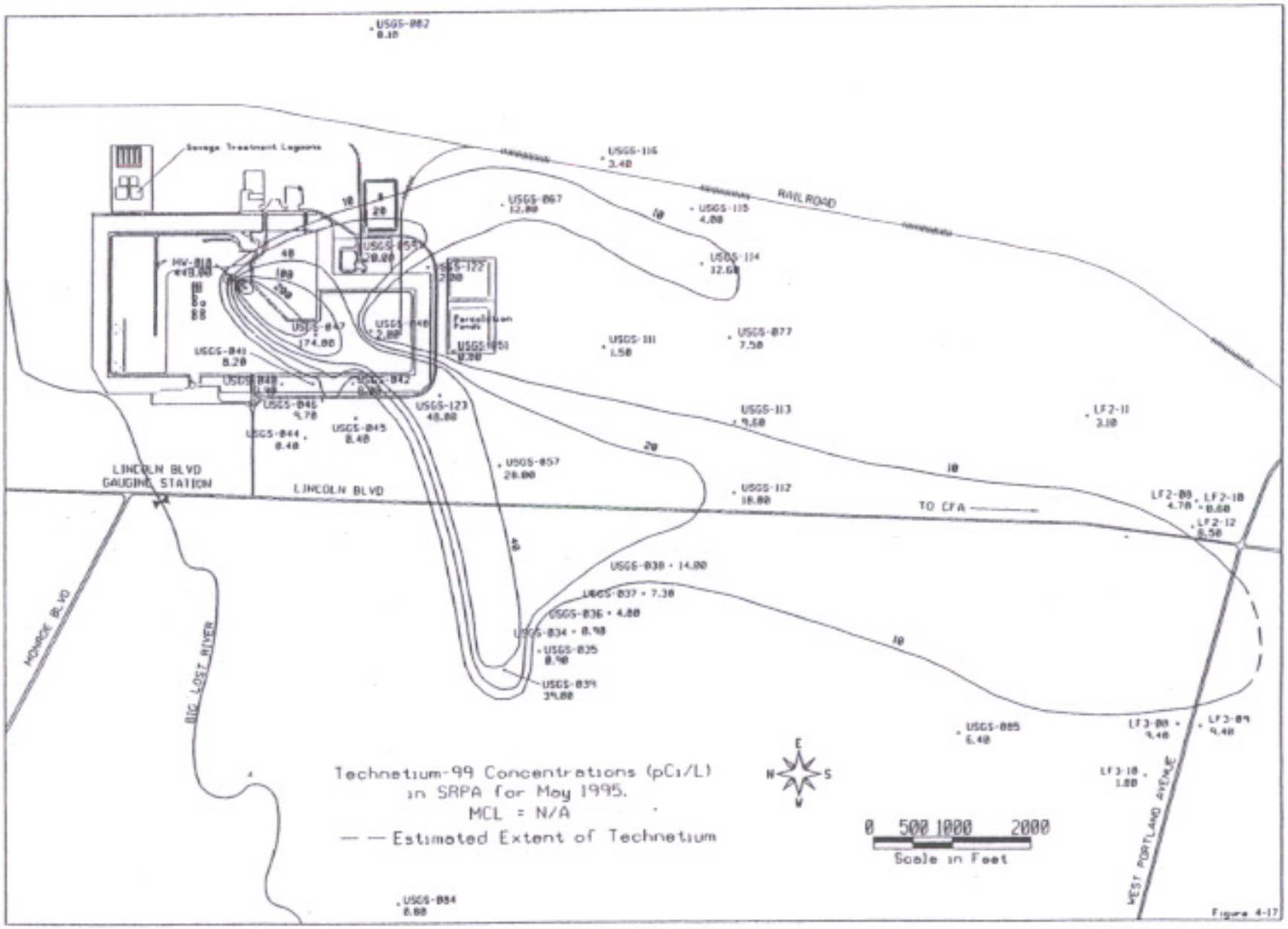


Figure 4-18. Tc-99 distribution in the SRPA (May 1995).

Table 4-5. Federal drinking water standards and background concentrations for inorganic constituents, organic constituents, and radionuclides.

Inorganic	Federal Primary Drinking Water Standard 40 CFR 141.11 (μg\L)	Federal Secondary Drinking Water Standard 40 CFR 143.3 (μg\L)	Background[a] (μg\L)
Arsenic	50	—	2–3
Barium	1,000	—	50–70
Beryllium	2,000	—	—
Cadmium	10	—	<1
Chromium	50	—	2–3
Chloride	—	250,000	—
Copper	—	1,000	—
Fluoride	4,000	2,000	400–500
Iron	—	300	—
Lead	50	—	<5
Manganese	—	50	—
Mercury	2	—	<0.1
Nitrate	10,000	—	<1,400
pH	—	6.5–8.5	—
Selenium	5	—	<1
Silver	—	—	<1
Sulfate	—	250,000	—
TDS	—	500,000	—
Thallium	200	—	—
Zinc	—	5,000	—

a. Background for Snake River Plain Aquifer in the vicinity of INEL. (From Orr et al., 1991)

Table 4-5. (continued).

Organic	Federal Primary Drinking Water Standard 40 CFR 141.12 40 CFR 141.61 (μg\L)	Background[a] (μg\L)
Volatile Organic		
Benzene	5	<0.2
Carbon Tetrachloride	5	<0.2
1,1-Dichloroethylene	7	<0.2
1,2-Dichloroethylene	5	<0.2
para-Dichlorobenzene	75	<0.2
Total trihalomethanes	100[b]	<0.2
1,1,1-Trichloroethane	200	<0.2
Trichloroethylene	5	<0.2
Vinyl chloride	2	<0.2
Pesticides/Herbicides		
Endrin	0.2	<0.01
Lindane	4	<0.01
Methoxychlor	100	<0.01
Toxaphene	5	<1
2,4-D	100	<0.01
2,4,5-TP Silvex	10	<0.01

a. Background for Snake River Plain Aquifer in the vicinity of INEL (Orr et al., 1991).

b. Sum of the concentrations of bromodichloromethane, Dibromochloromethane, bromoform, and chloroform.

Table 4-5. (continued).

Radionuclide	Federal Primary Drinking Water Standard 40 CFR 141.15 40 CFR 141.16 (pCi/mL)	Background[a] (pCi/mL)
Total Uranium[b]	—	0–0.009
Radium 226 & 228	0.005	<0.005
Radon 222	—	0–0.25
Plutonium 238	—	0
Plutonium 239,240	—	0
Americium 241	—	0
Tritium	20	0.75–0.15
Strontium 90	0.008	0
Iodine 129	—	0–0.00005
Gross alpha[c]	0.015	0–0.005
Man-made beta	Concentration causing 4 mrem/yr total body or organ dose	0–0.008
Cesium 137	—	0
Cobalt 60	—	0

a. Background for Snake River Plain Aquifer in the vicinity of INEL (Orr et al., 1991).

b. Total uranium is the sum of U-234, U-235, and U-238.

c. Gross alpha particle activity excluding radon and uranium.

ORIGEN was used to evaluate the inventory of radioactive contaminants that could be expected in the waste solutions released within several areas at the ICPP. The computer code simulates the activation, actinide, and fission product yields for the fissioning of U-235. Ideally, the composition of the nuclear fuel, cladding material, reactor time, and other information about the Navy spent fuel would need to be known to estimate the inventory and quantities of radionuclides present in the spent fuel. However, this information is sensitive and could not be obtained. The approach used to help address the issue of missing contaminants was to compare the screened results of the ORIGEN code against soil contaminant field measurements and/or assumptions used to estimate sources for use in the groundwater model. As a result, any contaminants identified as potentially missing from source estimates can be explained as uncertainty and the impact it could have on the results of the RI/BRA.

Results from two ORIGEN runs were used to provide a benchmark of the radionuclides that could be present in areas where these waste solutions were released. One of the ORIGEN runs was based on a high enrichment fuel configuration used by Oak Ridge National Laboratory (ORNL) to conduct irradiation and material studies. This ORIGEN run was already available and was developed with assumptions of 93% U-235 fuel enrichment (i.e., 285 grams of U-235 per element), aluminum cladding, 49% fissional yield (or U-235 "burn-up"), a fissionable period of 234 days, followed by a decay period of 10.8 years. The other ORIGEN run was prepared by personnel familiar with the reprocessing history at the ICPP, especially during the November 1972 release of HLW during a transfer between tanks WM-181 and WM-180, now known as site CPP-31. The assumptions for this run are described in Appendix N of the RI/BRA but include the type of fuel and extraction chemistry being used at that time.

The raw results from both ORIGEN runs each included over 150 different radionuclides. These were reduced to a more manageable number by separately placing the results of each ORIGEN run through a screening step. The technique used is that recommended by EPA in the Risk Assessment Guidance that consists of a toxicity-concentration screen whereby risk factors are calculated for each contaminant, and those having a factor of less than 0.01 can be screened out from further consideration. Since site risks are expected to be high, the factor used in this screen was lowered to 0.0001 or 0.01%. Approximately 25 radionuclides did not have health criteria and could not be evaluated. Normally, these would not screen out; however, their activity relative abundance were very small, ranging between 0.001 to 1E-10% and are not expected to contribute significantly. The contaminants contributing to a relative risk of 99.99% for both ORIGEN runs are shown on Table 4-6. Many of these radioactive contaminants have a half-life of 5 years or less and will decay by a factor of about 1E+06 or more by the year 2095. These are flagged in Table 4-6. Based on the screened results of both ORIGEN runs, the most significant radionuclides at the ICPP would be Sr-90, Cs-137, Eu-154, Am-241, Pu-238, Pu-239, Pu-240, and Pu-241.

The next step in the use of these results was to compare this inventory against what has been measured in the soil, perched water, aquifer, and the source estimates used for the tank farm releases. The purpose of this comparison is to help identify potential data gaps. The results are shown in Table 4-7. For the perched water and SRPA, they indicate that the sampling programs have included those contaminants shown by the screened ORIGEN runs to be of concern. The results of the comparisons with regard to the soil measurements at each site are further discussed in each site-specific section of this document.

Table 4-6. Summary of the results for both ORIGEN simulations.

Simulated Radionuclide Having Risk Factor > 0.01%	Half-Life (years)	Potential Problem	Reason
		ORNL Fuel	
Sr-90+D	29.1	Y	
Cs-137+D	30.0	Y	
Cs-134	2.06	N	Half-Life < 5 years
Eu-154	8.6	Y	
Eu-155	4.96	N	Half-Life < 5 years
Ce-144+D	0.8	N	Half-Life < 5 years
Ru-106+D	1.01	N	Half-Life < 5 years
Sb-125+D	2.77	N	Half-Life < 5 years
Pm-147	2.62	N	Half-Life < 5 years
Am-241	432	Y	
Pu-238	87.8	Y	
Pu-239	24,100	Y	
Pu-240	6,570	Y	
Pu-241	14.4	Y	
		CPP-31 Release	
Co-60	5.27	N	Half life is within 5% of the screening criteria.
Cs-134	2.06	N	Half-Life < 5 years
Cs-137	30.0	Y	
Eu-154	8.6	Y	
Sb-125+D	2.77	N	Half-Life < 5 years
Sr-90+D	29.1	Y	
Pm-147	2.62	N	Half-Life < 5 years
Am-241	432	Y	
Pu-238	87.8	Y	
Pu-239	24,100	Y	
Pu-240	6,570	Y	
Pu-241	14.4	Y	

Table 4-7. Summary of which nuclides were sampled for in the aquifer, perched water, and contaminated soil sites.

Site	Am-241	Cs-137	Eu-154	Pu-238	Pu-239	Pu-240	Pu-241	Sr-90
Aquifer	X	X	X	X	X	X	X	X
Perched Water	X	X	X	X	X	X	X	X
Soil Sites								
Tank Farm								
CPP-20/-25	X	X	X	X	X	X		X
CPP-26	X	X	X	X	X			X
CPP-28*		X	X		X	X	X	X
CPP-31*	X	X	X		X	X	X	X
CPP-32E/W		X	X					X
CPP-79		X	X		X	X	X	X
Tank Farm South								
CPP-15 - zone 1W	X	X	X	X	X	X		
CPP-15 - zone 1E								
CPP-15 - zone 2								
CPP-27/-33	X	X	X	X	X	X		X
CPP-58E/W	X	X	X	X	X	X		X
WCF								
CPP-35	X	X	X	X	X	X		X
CPP-36/-91 - zone 1	X	X	X	X	X	X		X
CPP-36/-91 - zone 2								
CPP-85		X	X					X
Old Storage Pool								
CPP-01/-04/-05	X	X	X		X	X		X
CPP-08/09		X	X					X
CPP-10		X	X					X
CPP-11	X	X	X	X	X	X		X
Storage Yard East								
CPP-03		X						X
CPP-17A		X	X					X
CPP-17B		X						

Table 4-7. (continued).

Site	Am-241	Cs-137	Eu-154	Pu-238	Pu-239	Pu-240	Pu-241	Sr-90
WAG 3 individual sites								
CPP-06		X						X
CPP-13		X	X					X
CPP-14 Imhoff	X	X		X	X	X		X
CPP-14 Plant	X	X		X	X	X		X
CPP-14 Drain	X	X		X	X	X		X
CPP-19	X	X	X		X	X		X
CPP-22		X	X					X
CPP-34		X		X				X
CPP-37A	X	X		X				X
CPP-37B	X	X		X				X
CPP-67	X	X		X	X	X		X
CPP-89	X	X		X	X	X		X
CPP-90		X	X					X

Notes: "X's" indicate radioactive contaminants that were analyzed for in the various environmental medium. Spaces are blank in this table to indicate radioactive contaminants that have not been part of the sampling program.

a. The CPP-28 (and CPP-79) release estimate for groundwater modeling use was based on release history and not soil data therefore the "X" denotes contaminants included in the gw release. This estimate did not include Am-241 or Pu-238. See Section 9 of Appendix F for a discussion of uncertainty and/or impacts to the simulations from not including these COCs. The same comment applies to only Pu-238 at CPP-31.

4.5 References

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ATTACHMENT 3 - PRELIMINARY REMEDIATION GOALS USERS GUIDE

HWMA/RCRA INTEC POST-CLOSURE PERMIT REAPPLICATION

Volume 21
Waste Calcine Facility and CPP-601/627/640

Attachment 3
U.S. EPA Region 9
Preliminary Remediation Goals Users Guide
October 2002

April 2013

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION IX
75 Hawthorne Street
San Francisco, CA 94105

October 1, 2002

Subject: Region 9 PRGs Table 2002 Update

From: Stanford J. Smucker, Ph.D.
Regional Toxicologist (SFD-8-B)
Technical Support Team

To: PRGs Table Users

With this cover letter, we announce the update to the Region 9 PRGs table for 2002. The PRGs table contains over 600 preliminary remediation goals (PRGs) for contaminants in soil, air, and tap water. Region 9 PRGs are risk-based concentrations that are intended to assist risk assessors and others in initial screening-level evaluations of environmental measurements.

As their name implies, Region 9 PRGs may also be viewed as preliminary cleanup goals for an individual chemical, but in this context, they are best viewed as dynamic and subject to change because they are generic and based on direct contact exposures which may not address site-specific conditions and/or indirect exposure pathways at sites (See Exhibit 1-1 in "Region 9 PRGs Table Users Guide/Technical Background Document"). Also for planning purposes, these human health based PRGs should always be considered in conjunction with ARAR-based PRGs (e.g. MCLs), ecological benchmarks, and "background" conditions before establishing a final cleanup level for a particular site.

You can find the PRGs 2002 table, InterCalc tables, "Region 9 PRGs Table Users Guide/Technical Background Document", and additional helpful toxicological and risk assessment information at:

http://www.epa.gov/region09/waste/sfund/prg/ .

We view risk-based PRGs as "evergreen". Ongoing changes to the PRGs reflect continuing improvements in our scientific knowledge base and state-of-the-art approaches to risk assessment. In the new *Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites* (Supplemental SSL Guidance, EPA 2001a), two different soil ingestion rates are assumed for non-construction workers: 100 mg/day is assumed for outdoor workers whereas 50 mg/day is assumed for indoor workers. The default value of 100 mg/day for outdoor workers is also recommended by EPA's Technical Review Workgroup for Lead (TRW), and it reflects increased exposures to soils for outdoor workers relative to their indoor counterparts. For more on this, please see Section 4.1 of the "Region 9 PRGs Table Users Guide/Technical Background Document" or refer to the Supplemental SSL Guidance available at the following website:

http://www.epa.gov/superfund/resources/soil/index.htm

Because the Region 9 PRGs are generic and intended for screening sites early in the investigation process (often before site-specific information is available), we have chosen to use the 100 mg/day soil ingestion (i.e. outdoor worker) assumption to calculate industrial soil PRGs. Please note that previous issues of the Region 9 PRGs table assumed 50 mg/day soil ingestion rate for workers. This change in soil ingestion rates is reflected in a somewhat lower (more stringent) industrial soils PRG for many contaminants. The appropriateness of this assumption for a particular site may be evaluated when additional information becomes available regarding site conditions or site development.

In addition to changes in exposure factor assumptions, several chemicals have new or revised toxicity values that results in changes to the PRG calculations. To facilitate the users review, chemicals with new and revised toxicological criteria are presented in bold in the 2002 table and also listed here for convenience: **acetonitrile, benzyl chloride, boron, bromate, 1,3-butadiene, 1-butanol, butylbenzenes, cacodylic acid, cadmium (California State value), chloroform, chloronitrobenzenes, chrysene (California State value), cobalt, 1,2-dibromo-3-chloropropane (California State value), 1,1-dichloroethylene, diethylene glycol ethers, diethylformamide, dinitrobenzenes, di-n-octyl phthalate, diphenyl sulfone, ethylbenzene, HCH, hexachlorocyclopentadiene, kepone, lead (California State value), MTBE, 2-nitroaniline, carcinogenic PAHs, perchlorate, polychlorinated terphenyls, benzo(k)fluoranthene (California State value), propylbenzene, propylene glycol, quinoline, tetrachloroethylene, tetrahydrofuran, thiocyanate, 1,1,1-trichloroethane, trichloroethylene, 2,4,6-trichlorophenol, 1,2,3-trichloropropane, triphenylphosphine oxide, tris(2-chloroethyl) phosphate, vinyl chloride, and xylene.**

Also in this update to the "Region 9 PRGs Table User's Guide/Technical Background Document", we have added a brief discussion of special case chemicals for which an alternate approach was applied in the derivation of the Region 9 PRGs (Section 2.3). Increasingly, chemical-specific approaches are being used that do not lend themselves to a single PRG model. Special case chemicals that are discussed include: cadmium, chromium 6, lead, manganese, nitrate/nitrite, thallium, and vinyl chloride.

Finally it should be recognized by all that use the PRGs table that not all PRG values in the table are "created equal". For some chemicals, a robust data set exists upon which the toxicological criteria are based whereas for others, there may be relatively few studies that form the basis of the PRG calculation. Also, PRGs for some chemicals are based on withdrawn toxicity values or route-extrapolated values. Withdrawn and route-extrapolated numbers are shown in the table because we still need to deal with these contaminants during the long delays before replacement numbers are ready. Please consult with your toxicologist or agency risk assessor to best address potential uncertainties associated with chemical-specific PRGs, especially if the chemical is a risk driver at your site.

As with any risk-based tool, there exists the potential for misuse. We try to highlight potential problems in Section 3.8. However, it should be noted that the use of PRGs at a particular site becomes the responsibility of the user. It is recommended that the user verify the numbers with an agency toxicologist or risk assessor because the toxicity / exposure information in the table may contain errors or default assumptions that need to be refined based on further evaluation. If you find an error please send me a note via email at smucker.stan@epa.gov.

DISCLAIMER

Preliminary remediation goals (PRGs) focus on common exposure pathways and may not consider all exposure pathways encountered at CERCLA / RCRA sites (Exhibit 1-1). PRGs do not consider impact to groundwater or address ecological concerns. The PRG table is specifically not intended as a (1) stand-alone decision-making tool, (2) as a substitute for EPA guidance for preparing baseline risk assessments, (3) a rule to determine if a waste is hazardous under RCRA, or (4) set of final cleanup or action levels to be applied at contaminated sites.

The guidance set out in this document is not final Agency action. It is not intended, nor can it be relied upon to create any rights enforceable by any party in litigation with the United States. EPA officials may decide to follow the guidance provided herein, or act at variance with the guidance, based on an analysis of specific circumstances. The Agency also reserves the right to change this guidance at any time without public notice.

1.0 INTRODUCTION

Region 9 Preliminary Remediation Goals (PRGs) are risk-based tools for evaluating and cleaning up contaminated sites. They are being used to streamline and standardize all stages of the risk decision-making process.

The Region 9 PRG table combines current EPA toxicity values with "standard" exposure factors to estimate contaminant concentrations in environmental media (soil, air, and water) that the agency considers protective of humans (including sensitive groups), over a lifetime. Chemical concentrations above these levels would not automatically designate a site as "dirty" or trigger a response action. However, exceeding a PRG suggests that further evaluation of the potential risks that may be posed by site contaminants is appropriate. Further evaluation may include additional sampling, consideration of ambient levels in the environment, or a reassessment of the assumptions contained in these screening-level estimates (e.g. appropriateness of route-to-route extrapolations, appropriateness of using chronic toxicity values to evaluate childhood exposures, appropriateness of generic exposure factors for a specific site etc.).

The PRG concentrations presented in the table can be used to screen pollutants in environmental media, trigger further investigation, and provide an initial cleanup goal if applicable. When considering PRGs as cleanup goals, residential concentrations should be used for maximum beneficial uses of a property. Industrial concentrations are included in the table as an alternative cleanup goal for soils. **In general, it recommended that industrial PRGs not be used for screening sites unless they are used in conjunction with residential values.**

Before applying PRGs as screening tools or initial goals, the user of the table should consider whether the exposure pathways and exposure scenarios at the site are fully accounted for in the PRG calculations. Region 9 PRG concentrations are based on direct contact pathways for which generally accepted methods, models, and assumptions have been developed (i.e. ingestion, dermal contact, and inhalation) for specific land-use conditions and do not consider impact to groundwater or ecological receptors (see Developing a Conceptual Site Model below).

EXHIBIT 1-1
TYPICAL EXPOSURE PATHWAYS BY MEDIUM
FOR RESIDENTIAL AND INDUSTRIAL LAND USES[a]

EXPOSURE PATHWAYS, ASSUMING:		
MEDIUM	RESIDENTIAL LAND USE	INDUSTRIAL LAND USE
Ground Water	***Ingestion from drinking***	Ingestion from drinking
	Inhalation of volatiles	Inhalation of volatiles
	Dermal absorption from bathing	Dermal absorption
Surface Water	***Ingestion from drinking***	Ingestion from drinking
	Inhalation of volatiles	Inhalation of volatiles
	Dermal absorption from bathing	Dermal absorption
	Ingestion during swimming	
	Ingestion of contaminated fish	
Soil	***Ingestion***	***Ingestion***
	Inhalation of particulates	***Inhalation of particulates***
	Inhalation of volatiles	***Inhalation of volatiles***
	Exposure to indoor air from soil gas	Exposure to indoor air from soil gas
	Exposure to ground water contaminated by soil leachate	Exposure to ground water contaminated by soil leachate
	Ingestion via plant, meat, or dairy products	Inhalation of particulates from trucks and heavy equipment
	Dermal absorption	***Dermal absorption***

Footnote:
[a]Exposure pathways considered in the PRG calculations are indicated in boldface italics.

2.0 READING THE PRG TABLE

2.1 General Considerations

With the exceptions described below, PRGs are chemical concentrations that correspond to fixed levels of risk (i.e. either a one-in-one million [10^{-6}] cancer risk or a noncarcinogenic hazard quotient of 1) in soil, air, and water. In most cases, where a substance causes both cancer and noncancer (systemic) effects, the 10^{-6} cancer risk will result in a more stringent criteria and consequently this value is presented in the printed copy of the table. PRG concentrations that equate to a 10^{-6} cancer risk are indicated by "ca". PRG concentrations that equate to a hazard quotient of 1 for noncarcinogenic concerns are indicated by "nc".

If the risk-based concentrations are to be used for site screening, it is recommended that both cancer and noncancer-based PRGs be used. Both carcinogenic and noncarcinogenic values may be obtained at the Region 9 PRG homepage at:

http://www.epa.gov/region09/waste/sfund/prg/

It has come to my attention that some users have been multiplying the cancer PRG concentrations by 10 or 100 to set "action levels" for triggering remediation or to set less stringent cleanup levels for a specific site after considering non-risk-based factors such as ambient levels, detection limits, or technological feasibility. This risk management practice recognizes that there may be a range of values that may be "acceptable" for carcinogenic risk (EPA's risk management range is one-in-a-million [10^{-6}] to one-in-ten thousand [10^{-4}]). However, this practice could lead one to overlook serious noncancer health threats and it is strongly recommended that the user consult with a toxicologist or regional risk assessor before doing this. For carcinogens, I have indicated by asterisk ("ca*") in the PRG table where the noncancer PRGs would be exceeded if the cancer value that is displayed is multiplied by 100. Two stars ("ca**") indicate that the noncancer values would be exceeded if the cancer PRG were multiplied by 10. There is no range of "acceptable" noncarcinogenic "risk" so that under no circumstances should noncancer PRGs be multiplied by 10 or 100, when setting final cleanup criteria. In the rare case where noncancer PRGs are more stringent than cancer PRGs set at one-in-one-million risk, a similar approach has been applied (e.g. “nc**”).

In general, PRG concentrations in the printed table are risk-based but for soil there are two important exceptions: (1) for several volatile chemicals, PRGs are based on the soil saturation equation ("sat") and (2) for relatively less toxic inorganic and semivolatile contaminants, a non-risk based "ceiling limit" concentration is given as 10^{+5} mg/kg ("max"). At the Region 9 PRG website, the risk-based calculations for these same chemicals are also available in the “InterCalc Tables” if the user wants to view the risk-based concentrations prior to the application of “sat” or “max”. For more information on why the “sat” value and not a risk-based value is presented for several volatile chemicals in the PRGs table, please see the discussion in Section 4.5.

With respect to applying a “ceiling limit” for chemicals other than volatiles, it is recognized that this is not a universally accepted approach. Some within the agency argue that all values should be risk-based to allow for scaling (for example, if the risk-based PRG is set at a hazard quotient = 1.0, and the user would like to set the hazard quotient to 0.1 to take into account multiple chemicals, then this is as simple as multiplying the risk-based PRG by 1/10th). If scaling is necessary, PRG users can do

this simply by referring to the "InterCalc Tables" at our website where risk-based soil concentrations are presented for all chemicals (see soil calculations, "combined" pathways column).
In spite of the fact that applying a ceiling limit is not a universally accepted approach, we have opted to continue applying a "max"soil concentration to the PRGs table for the following reasons:

- Risk-based PRGs for some chemicals in soil exceed unity (>1,000,000 mg/kg) which is not possible.

- The ceiling limit of 10^{+5} mg/kg is equivalent to a chemical representing 10% by weight of the soil sample. At this contaminant concentration (and higher), the assumptions for soil contact may be violated (for example, soil adherence and windborne dispersion assumptions) due to the presence of the foreign substance itself.
- PRGs currently do not address short-term exposures (e.g. pica children and construction workers). Although extremely high soil PRGs are likely to represent relatively non-toxic chemicals, such high values may not be justified if in fact more toxicological data were available for evaluating short-term and/or acute exposures.

In addition to Region 9 PRG values, the PRGs table also includes California EPA PRGs ("CAL-Modified PRGs") for specific chemicals where CAL-EPA screening values may be "significantly" more restrictive than the federal values (see Section 2.4) and EPA OSWER soil screening levels (SSLs) for protection of groundwater (see Section 2.5).

2.2 Toxicity Values

Hierarchy of Toxicity Values

EPA toxicity values, known as noncarcinogenic reference doses (RfD) and carcinogenic slope factors (SF) were obtained from IRIS, NCEA through September 2002, and HEAST (1997). The priority among sources of toxicological constants in order of preference is as follows: (1) IRIS (indicated by "i"), (2) NCEA ("n"), (3) HEAST ("h"), (4) withdrawn from IRIS or HEAST and under review ("x") or obtained from other EPA documents ("o"). This hierarchy is subject to change once the HEAST tables are updated.

Inhalation Conversion Factors

As of January 1991, IRIS and NCEA databases no longer present RfDs or SFs for the inhalation route. These criteria have been replaced with reference concentrations (RfC) for noncarcinogenic effects and unit risk factors (URF) for carcinogenic effects. However, for purposes of estimating risk and calculating risk-based concentrations, inhalation reference doses (RfDi) and inhalation slope factors (SFi) are preferred. This is not a problem for most chemicals because the inhalation toxicity criteria are easily converted. To calculate an RfDi from an RfC, the following equation and assumptions may be used for most chemicals:

$$RfDi\ \frac{mg}{(kg\text{-}day)} = RfC\ (mg/m^3) \times \frac{20m^3}{day} \times \frac{1}{70kg}$$

Likewise, to calculate an SFi from an inhalation URF, the following equation and assumptions may be used:

$$SFi\ \frac{(kg\text{-}day)}{(mg)} = URF(m^3/ug) \times \frac{day}{20m^3} \times 70kg \times \frac{10^3\ ug}{mg}$$

Substances with New or Withdrawn Toxicity Values

To help users rapidly identify substances with new or revised toxicity values, these chemicals are listed in boldface type in the PRGs table. This issue of the table contains new or revised toxicity values for: **acetonitrile, benzyl chloride, boron, bromate, 1,3-butadiene, 1-butanol, butylbenzenes, cacodylic acid, cadmium (California State value), chloroform, chloronitrobenzenes, chrysene (California State value), cobalt, 1,2-dibromo-3-chloropropane (California State value), 1,1-dichloroethylene, diethylene glycol ethers, diethylformamide, dinitrobenzenes, di-n-octyl phthalate, diphenyl sulfone, ethylbenzene, HCH, hexachlorocyclopentadiene, kepone, lead (California State value), MTBE, 2-nitroaniline, carcinogenic PAHs, perchlorate, polychlorinated terphenyls, benzo(k)fluoranthene (California State value), propylbenzene, propylene glycol, quinoline, tetrachloroethylene, tetrahydrofuran, thiocyanate, 1,1,1-trichloroethane, trichloroethylene, 2,4,6-trichlorophenol, 1,2,3-trichloropropane, triphenylphosphine oxide, tris(2-chloroethyl) phosphate, vinyl chloride, and xylene.**

Chemicals that have been delisted because they are outdated, undocumented, or derived from a data base other than IRIS, HEAST or NCEA include: acifluorfen, 4-bromophenyl phenyl ether, chloroacetaldehyde, 2-chloroethyl vinyl ether, hexachlorodibenzo-p-dioxin mixture (HxCDD), maneb, methyl chlorocarbonate, nitrapyrin, nitric oxide, and 4-nitrophenol.

Route-to-Route Methods

Route-to-route extrapolations ("r") were frequently used when there were no toxicity values available for a given route of exposure. Oral cancer slope factors ("SFo") and reference doses ("RfDo") were used for both oral and inhaled exposures for organic compounds lacking inhalation values. Inhalation slope factors ("SFi") and inhalation reference doses ("RfDi") were used for both inhaled and oral exposures for organic compounds lacking oral values. Route extrapolations were not performed for inorganics due to portal of entry effects and known differences in absorption efficiency for the two routes of exposure.

An additional route extrapolation is the use of oral toxicity values for evaluating dermal exposures. For many chemicals, a scientifically defensible data base does not exist for making an adjustment to the oral slope factor/RfD to estimate a dermal toxicity value. Based on the current guidance (USEPA 2001b), the only chemical for which an adjustment is recommended is cadmium. An oral absorption efficiency of 5% is assumed for cadmium which leads to an estimated dermal reference dose (RfDd) of 2.5E-05 that was used in the soil PRG calculations for cadmium.

Although route-to-route methods may be a useful screening procedure, the appropriateness of these default assumptions for specific contaminants should be verified by a toxicologist or regional risk assessor. Please note that whenever route-extrapolated values are used to calculate risk-based PRGs, additional uncertainties are introduced in the calculation.

2.3 Region 9 PRGs Derived with Special Considerations

Most of the Region 9 PRGs are readily derived by referring to Equations 4-1 thru 4-8 contained in this "User's Guide/Technical Background Document" to the Region 9 PRGs. However, there are some chemicals for which the standard equations do no apply and/or adjustments to the toxicity values are recommended. These special case chemicals are discussed below.

Cadmium The PRGs for Cadmium are based on the oral RfD for water which is slightly more conservative (by a factor of 2) than the RfD for food. Because the PRGs are considered screening values, we elected to use the more conservative RfD for cadmium. However, reasonable arguments could be made for applying an RfD for food (instead of the oral RfD for water) for some media such as soils.

The water RfD for cadmium assumes a 5% oral absorption factor. The assumption of an oral absorption efficiency of 5% for Cadmium leads to an estimated dermal RfD of 2.5E-05. The PRG calculations incorporate these adjustments per recent guidance (USEPA 2001b).

Chromium 6 For Chromium 6 (Cr6), IRIS shows an air unit risk of 1.2E-2 per (ug/cu.m) or expressed as an inhalation cancer slope factor (adjusting for inhalation/body weight) of 42 $(mg/kg\text{-}day)^{-1}$. However, the supporting documentation in the IRIS file states that these toxicity values are based on an assumed 1:6 ratio of Cr6:Cr3. Because of this assumption, we in Region 9 prefer to present PRGs based on these cancer toxicity values as "total chromium" numbers.

In the PRG tables, we also include a Cr6 specific value (assuming 100% Cr6) that is derived by multiplying the "total chromium" value by 7, yielding a cancer potency factor of 290 $(mg/kg\text{-}day)^{-1}$. This is considered to be an overly conservative assumption by some within the Agency. However, this calculation is also consistent with the State of California's interpretation of the Mancuso study that forms the basis of Cr6's toxicity values.

If you are working on a project outside of California (and outside of Region 9), you may want to contact the appropriate regulatory officials to determine what their position is on this issue. As mentioned, Region 9 also includes PRGs for "total chromium" which is based on the same ratio (1:6 ratio Cr6:Cr3) that forms the basis of the cancer slope factor of 42 $(mg/kg\text{-}day)^{-1}$ presented in IRIS.

Lead Residential PRGs for Lead (Region 9 EPA and California EPA) are derived based on pharmacokinetic models. Both EPA's Integrated Exposure Uptake Biokinetic (IEUBK) Model and California's LeadSpread model are designed to predict the probable blood lead concentrations for children between six months and seven years of age who have been exposed to lead through various sources (air, water, soil, dust, diet and *in utero* contributions from the mother). Run in the reverse, these models also allow the user to calculate lead PRGs that are considered "acceptable" by EPA or the State of California.

The California LeadSpread model can also estimate PRGs for non-residential exposures (e.g. worker) whereas EPA uses a second Adult Lead Model to estimate PRGs for an industrial setting.

For more information on EPA' Lead models used to estimate residential and industrial PRGs, please refer to the following website:

http://www.epa.gov/oerrpage/superfund/programs/lead/

For more information on California's LeadSpread Model and Cal-Modified PRGs for lead, please go to:
http://www.dtsc.ca.gov/ScienceTechnology/ledspred.html

Manganese The IRIS RfD (0.14 mg/kg-day) includes manganese from all sources, including diet. The author of the IRIS assessment for manganese recommends that the dietary contribution from the normal U.S. diet (an upper limit of 5 mg/day) be subtracted when evaluating non-food (e.g. drinking water or soil) exposures to manganese, leading to a RfD of 0.071 mg/kg-day for non-food items. The explanatory text in IRIS further recommends using a modifying factor of 3 when calculating risks associated with non-food sources due to a number of uncertainties that are discussed in the IRIS file for manganese, leading to a RfD of 0.024 mg/kg-day. This modified RfD is applied in the derivation of the Region 9 PRGs for soil and water. For more information regarding the Manganese RfD, you may want to contact Dr. Bob Benson at (303) 312-7070.

Nitrates/Nitrates Tap water PRGs for Nitrates/Nitrites are based on the MCL as there is no available RfD for these compounds. For more information, please see IRIS at:
http://www.epa.gov/iriswebp/iris/index.html

Thallium IRIS has many values for the different salts of thallium. However, our analytical data packages typically report "thallium". Therefore, as a practical matter it makes more sense to report a PRG for plain thallium. We have done this by making the adjustment contained in the IRIS file for thallium sulfate based on the molecular weight of the thallium in the thallium salt. The adjusted oral RfD for plain thallium is 6.6 E-05 mg/kg-day which we use to calculate a thallium PRG.

Vinyl Chloride In EPA's recent reassessment of vinyl chloride toxicity, IRIS presents two cancer slope factors for vinyl chloride (VC): one that is intended to be applied towards evaluating adult risks and a second more protective slope factor that takes into account the unique susceptibility of developing infants and young children. For residential PRGs, the Region 9 PRGs table applies the more conservative cancer potency factor that addresses exposures to both children and adults whereas for the industrial soils PRG, the adult only cancer slope factor is applied.

Because of the age-dependent vulnerability associated with vinyl chloride exposures, and due to the method that is applied in deriving the cancer slope factor for VC, an assumption of a 70 year exposure over the lifetime is assumed, consistent with the way that the toxicity value for VC was derived. Therefore, instead of the usual exposure assumption of 6 years as a child and 24 years as an adult that is assumed for carcinogenic substances, we have revised the exposure assumption for VC to 6 years as a child and 64 years as adult. Since most of the cancer risk is associated with the first 30 years of exposure to VC, there is actually little difference between a 30 year exposure assumption (typically assumed for Superfund risk assessments) and the 70 year exposure assumption that is assumed in calculating the PRG for VC.

2.4 "Cal-Modified PRGs"

When EPA Region 9 first came out with a Draft of the PRGs table in 1992, there was concern expressed by California EPA's Department of Toxic Substances and Control (DTSC) that for some chemicals the risk-based concentrations calculated using Cal-EPA toxicity values were "significantly" more protective than the risk-based PRGs calculated by Region 9. At an interagency meeting

comprised of mostly toxicologists, it was agreed that PRG values are at best order-of-magnitude estimates, so that if we assume a logarithmic scale, then a difference greater than 3.3 (½ log above or below) would be considered a significant difference. Therefore, for individual chemicals where California PRG values are significantly more protective than Region 9 EPA PRGs, Cal-Modified PRGs are included in the Region 9 PRGs table. For more information on Cal-Modified PRGs, the reader may want to contact Dr. Michael Wade in Cal-EPA's Department of Toxic Substances (DTSC) at (916) 255-6653.

Please note that in the State of California, Cal-Modified PRGs should be used as screening levels for contaminated sites because they are more stringent than the Federal numbers.

2.5 Soil Screening Levels

Generic, soil screening levels (SSLs) for the protection of groundwater have been included in the PRG table for 100 of the most common contaminants at Superfund sites. Generic SSLs are derived using default values in standardized equations presented in EPA OSWER's *Soil Screening Guidance* series, available on the web at http://www.epa.gov/superfund/resources/soil/index.htm .

The SSLs were developed using a default dilution-attenuation factor (DAF) of 20 to account for natural processes that reduce contaminant concentrations in the subsurface. Also included are generic SSLs that assume no dilution or attenuation between the source and the receptor well (i.e., a DAF of 1). These values can be used at sites where little or no dilution or attenuation of soil leachate concentrations is expected at a site (e.g., sites with shallow water tables, fractured media, karst topography, or source size greater than 30 acres).

In general, if an SSL is not exceeded for the migration to groundwater pathway, the user may eliminate this pathway from further investigation.

It should be noted that in the State of California, the California Regional Water Quality Control Board has derived "California SSLs" for a number of pathways including migration to groundwater. These are not included in the Region 9 PRGs table, but may be accessed at the following website:

http://www.swrcb.ca.gov/rwqcb2/rbsl.htm

Or, for more information on the "California SSLs", please contact Dr Roger Brewer at: (510) 622-2374.

2.6 Miscellaneous

Volatile organic compounds (VOCs) are indicated by "1" in the VOC column of the table and in general, are defined as those chemicals having a Henry's Law constant greater than 10^{-5} (atm-m^3/mol) and a molecular weight less than 200 g/mole). Three borderline chemicals (dibromochloromethane, 1,2-dibromochloropropane, and pyrene) which do not strictly meet these criteria of volatility have also been included based upon discussions with other state and federal agencies and after a consideration of vapor pressure characteristics etc. Volatile organic chemicals are evaluated for potential volatilization from soil/water to air using volatilization factors (see Section 4.1).

Chemical-specific dermal absorption values for contaminants in soil and dust are presented for arsenic, cadmium, chlordane, 2,4-D, DDT, lindane, TCDD, PAHs, PCBs, and pentachlorophenols as recommended in the "Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment) Interim Guidance" (USEPA 2001b). Otherwise, default skin absorption fractions are assumed to be 0.10 for nonvolatile organics. Please note that previous defaults of 0.01 and 0.10 for inorganics and VOCs respectively, have been withdrawn per new guidance.

3.0 USING THE PRG TABLE

The decision to use PRGs at a site will be driven by the potential benefits of having generic risk-based concentrations in the absence of site-specific risk assessments. The original intended use of PRGs was to provide initial cleanup goals for individual chemicals given specific medium and land-use combinations (see RAGS Part B, 1991), however risk-based concentrations have several applications. They can also be used for:

- Setting health-based detection limits for chemicals of potential concern
- Screening sites to determine whether further evaluation is appropriate
- Calculating cumulative risks associated with multiple contaminants

A few basic procedures are recommended for using PRGs properly. These are briefly described below. Potential problems with the use of PRGs are also identified.

3.1 Developing a Conceptual Site Model

The primary condition for use of PRGs is that exposure pathways of concern and conditions at the site match those taken into account by the PRG framework. Thus, it is always necessary to develop a conceptual site model (CSM) to identify likely contaminant source areas, exposure pathways, and potential receptors. This information can be used to determine the applicability of PRGs at the site and the need for additional information. For those pathways not covered by PRGs, a risk assessment specific to these additional pathways may be necessary. Nonetheless, the PRG lookup values will still be useful in such situations for focusing further investigative efforts on the exposure pathways not addressed.

To develop a site-specific CSM, perform an extensive records search and compile existing data (e.g. available site sampling data, historical records, aerial photographs, and hydrogeologic information). Once this information is obtained, CSM worksheets such as those provided in ASTM's *Standard Guide for Risk-Based Corrective Action Applied at Petroleum Release Sites* (1995) can be used to tailor the generic worksheet model to a site-specific CSM. The final CSM diagram represents linkages among contaminant sources, release mechanisms, exposure pathways and routes and receptors. It summarizes our understanding of the contamination problem.

As a final check, the CSM should answer the following questions:

- Are there potential ecological concerns?
- Is there potential for land use other than those covered by the PRGs (that is, residential and industrial)?

- Are there other likely human exposure pathways that were not considered in development of the PRGs (e.g. impact to groundwater, local fish consumption, raising beef, dairy, or other livestock)?

- Are there unusual site conditions (e.g. large areas of contamination, high fugitive dust levels, potential for indoor air contamination)?

If any of these four conditions exist, the PRG may need to be adjusted to reflect this new information. Suggested websites for the evaluation of pathways not currently addressed by Region 9 PRG's are presented in Exhibit 3-1.

EXHIBIT 3-1
SUGGESTED WEBSITES FOR EVALUATING EXPOSURE PATHWAYS NOT CURRENTLY ADDRESSED BY REGION 9 PRGs

EXPOSURE PATHWAY	WEBSITE
Migration of contaminants to an underlying potable aquifer	EPA Soil Screening Guidance: http://www.epa.gov/superfund/resources/soil/index.htm California Water Board Guidance: http://www.swrcb.ca.gov/rwqcb2/rbsl.htm
Ingestion via plant uptake	EPA Soil Screening Guidance: http://www.epa.gov/superfund/resources/soil/index.htm EPA Fertilizer Risk Assessment: http://www.epa.gov/epaoswer/hazwaste/recycle/fertiliz/risk/
Ingestion via meat, dairy products, human milk	EPA Protocol for Combustion Facilities: http://www.epa.gov/epaoswer/hazwaste/combust/riskvol.htm#volume1 California "Hot Spots" Risk Guidelines: http://www.oehha.ca.gov/air/hot_spots/HRSguide.html
Inhalation of volatiles that have migrated into basements or other enclosed spaces.	EPA's Version of Johnson & Ettinger Model: http://www.epa.gov/oerrpage/superfund/programs/risk/airmodel/johnson_ettinger.htm
Ecological pathways	EPA Ecological Soil Screening Guidance: http://www.epa.gov/superfund/programs/risk/ecorisk/ecossl.htm NOAA Sediment Screening Table: http://response.restoration.noaa.gov/cpr/sediment/squirt/squirt.html

3.2 Background Levels Evaluation

A necessary step in determining the applicability of Region 9 risk-based PRGs is the consideration of background contaminant concentrations. There is new EPA guidance on determining background at sites. *Guidance for Characterizing Background Chemicals in Soil at Superfund Sites* (USEPA 2001c) is available on the web at: http://www.epa.gov/superfund/programs/risk/background.pdf .

EPA may be concerned with two types of background at sites: naturally occurring and anthropogenic. Natural background is usually limited to metals whereas anthropogenic (i.e. human-made) "background" includes both organic and inorganic contaminants. Before embarking on an extensive sampling and analysis program to determine local background concentrations in the area, one should first compile existing data on the subject. Far too often there is pertinent information in the literature that gets ignored, resulting in needless expenditures of time and money.

Generally EPA does not clean up below natural background. In some cases, the predictive risk-based models generate PRG levels that lie within or even below typical background. If natural background concentrations are higher than the risk-based PRGs, an adjustment of the PRG is probably needed. Exhibit 3-2 presents summary statistics for selected elements in soils that have background levels that may exceed risk-based PRGs. An illustrative example of this is naturally occurring arsenic in soils which frequently is higher than the risk-based concentration set at a one-in-one-million cancer risk (the PRG for residential soils is 0.39 mg/kg). After considering background concentrations in a local area, EPA Region 9 has at times used the non-cancer PRG (22 mg/kg) to evaluate sites recognizing that this value tends to be above background levels yet still falls within the range of soil concentrations (0.39-39 mg/kg) that equates to EPA's "acceptable" cancer risk range of 10E-6 to 10E-4.

Where anthropogenic "background" levels exceed PRGs and EPA has determined that a response action is necessary and feasible, EPA's goal will be to develop a comprehensive response to the widespread contamination. This will often require coordination with different authorities that have jurisdiction over the sources of contamination in the area.

EXHIBIT 3-2
BACKGROUND CONCENTRATIONS OF SELECTED ELEMENTS IN SOILS

TRACE	U.S. STUDY DATA[1]			CALIFORNIA DATA[2]		
ELEMENT	Range	GeoMean	ArMean	Range	GeoMean	ArMean
Arsenic	<.1-97	5.2 mg/kg	7.2 mg/kg	0.59-11	2.75 mg/kg	3.54 mg/kg
Beryllium	<1-15	0.63 "	0.92 "	0.10-2.7	1.14 "	1.28 "
Cadmium	<1-10	--	<1	0.05-1.7	0.26	0.36
Chromium	1-2000	37	54	23-1579	76.25	122.08
Nickel	<5-700	13	19	9.0-509	35.75	56.60

[1]Shacklette and Hansford, "Element Concentrations in Soils and Other Surficial Materials of the Conterminous United States",USGS Professional Paper 1270, 1984.

[2]Bradford et. al, "Background Concentrations of Trace and Major Elements in California Soils", Kearney Foundation Special Report, UC-Riverside and CAL-EPA DTSC, March 1996.

3.3 Screening Sites with Multiple Pollutants

A suggested stepwise approach for PRG-screening of sites with multiple pollutants is as follows:

- Perform an extensive records search and compile existing data.

- Identify site contaminants in the PRG table. Record the PRG concentrations for various media and note whether PRG is based on cancer risk (indicated by "ca") or noncancer hazard (indicated by "nc"). Segregate cancer PRGs from non-cancer PRGs and exclude (but don't eliminate) non-risk based PRGs ("sat" or "max").

- For cancer risk estimates, take the site-specific concentration (maximum or 95 UCL) and divide by the PRG concentrations that are designated for cancer evaluation ("ca"). Multiply this ratio by 10^{-6} to estimate chemical-specific risk for a reasonable maximum exposure (RME). For multiple pollutants, simply add the risk for each chemical:

$$Risk = \left[\left(\frac{conc_x}{PRG_x}\right) + \left(\frac{conc_y}{PRG_y}\right) + \left(\frac{conc_z}{PRG_z}\right)\right] x\ 10^{-6}$$

- For non-cancer hazard estimates. Divide the concentration term by its respective non-cancer PRG designated as "nc" and sum the ratios for multiple contaminants. The cumulative ratio represents a non-carcinogenic hazard index (HI). A hazard index of 1 or less is generally considered “safe”. A ratio greater than 1 suggests further evaluation. **[Note that carcinogens may also have an associated non-cancer PRG that is not listed in the printed copy of the table sent to folks on the mailing list. To obtain these values, the user should view or download the PRG table at our website and display the appropriate sections.]**

$$Hazard\ Index = \left[\left(\frac{conc_x}{PRG_x}\right) + \left(\frac{conc_y}{PRG_y}\right) + \left(\frac{conc_z}{PRG_z}\right)\right]$$

For more information on screening site risks, the reader should contact EPA Region 9's Technical Support Team.

3. 4 Potential Problems

As with any risk-based tool, the potential exists for misapplication. In most cases the root cause will be a lack of understanding of the intended use of Region 9 PRGs. In order to prevent misuse of PRGs, the following should be avoided:

- Applying PRGs to a site without adequately developing a conceptual site model that identifies relevant exposure pathways and exposure scenarios,

- Not considering background concentrations when choosing PRGs as cleanup goals,

- Use of PRGs as cleanup levels without the nine-criteria analysis specified in the

National Contingency Plan (or, comparable analysis for programs outside of Superfund),

- Use of PRGs as cleanup levels without verifying numbers with a toxicologist or regional risk assessor,

Use of antiquated PRG tables that have been superseded by more recent publications,

- Not considering the effects of additivity when screening multiple chemicals, and

- Adjusting PRGs upward by factors of 10 or 100 without consulting a toxicologist or regional risk assessor.

4.0 TECHNICAL SUPPORT DOCUMENTATION

Region 9 PRGs consider human exposure hazards to chemicals from contact with contaminated soils, air, and water. The emphasis of the PRG equations and technical discussion are aimed at developing screening criteria for soils, since this is an area where few standards exist. For air and water, additional reference concentrations or standards are available for many chemicals (e.g. MCLs, non-zero MCLGs, AWQC, and NAAQS) and consequently the discussion of these media are brief.

4.1 Soils - Direct Ingestion

Calculation of risk-based PRGs for direct ingestion of soil is based on methods presented in RAGS HHEM, Part B (USEPA 1991a) and *Soil Screening Guidance* (USEPA 1996a,b, USEPA 2001a). Briefly, these methods backcalculate a soil concentration level from a target risk (for carcinogens) or hazard quotient (for noncarcinogens).

<u>Residential Soil PRGs</u>

A number of studies have shown that inadvertent ingestion of soil is common among children 6 years old and younger (Calabrese et al. 1989, Davis et al. 1990, Van Wijnen et al. 1990). To take into account the higher soil intake rate for children, two different approaches are used to estimate PRGs, depending on whether the adverse health effect is cancer or some effect other than cancer.

For carcinogens, the method for calculating PRGs uses an age-adjusted soil ingestion factor that takes into account the difference in daily soil ingestion rates, body weights, and exposure duration for children from 1 to 6 years old and others from 7 to 31 years old. This health-protective approach is chosen to take into account the higher daily rates of soil ingestion in children as well as the longer duration of exposure that is anticipated for a long-term resident. For more on this method, see USEPA RAGs Part B (1991a).

For noncarcinogenic concerns, the more protective method of calculating a soil PRG is to evaluate childhood exposures separately from adult exposures. In other words, an age-adjustment factor is not applied as was done for carcinogens. This approach is considered conservative because it combines the higher 6-year exposure for children with chronic toxicity criteria. In their analysis of the method, the Science Advisory Board (SAB) indicated that, for most chemicals, the approach may be overly

protective. However, they noted that there are specific instances when the chronic RfD may be based on endpoints of toxicity that are specific to children (e.g. fluoride and nitrates) or when the dose-response is steep (i.e., the dosage difference between the no-observed-adverse-effects level [NOAEL] and an adverse effects level is small). Thus, for the purposes of screening, EPA Region 9 has adopted this approach for calculating soil PRGs for noncarcinogenic health concerns.

Industrial Soil PRGs

In the new *Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites* (Supplemental SSL Guidance, EPA 2001a), two different soil ingestion rates are assumed for non-construction workers: 100 mg/day is assumed for outdoor workers whereas 50 mg/day is assumed for indoor workers. The default value of 100 mg/day for outdoor workers is also recommended by EPA's Technical Review Workgroup for Lead (TRW), and it reflects increased exposures to soils for outdoor workers relative to their indoor counterparts. For more on this, please see the Supplemental SSL Guidance available at the following website:

http://www.epa.gov/superfund/resources/soil/index.htm

Because the Region 9 PRGs are generic and intended for screening sites early in the investigation process (often before site-specific information is available), we have chosen to use the 100 mg/day soil ingestion (i.e. outdoor worker) assumption to calculate industrial soil PRGs. Please note that previous issues of the Region 9 PRGs table assumed 50 mg/day soil ingestion rate for workers. This change in soil ingestion rates is reflected in a somewhat lower (more stringent) industrial soils PRG for many contaminants. The appropriateness of this assumption for a particular site may be evaluated when additional information becomes available regarding site conditions or site development.

4.2 Soils - Vapor and Particulate Inhalation

Agency toxicity criteria indicate that risks from exposure to some chemicals via inhalation far outweigh the risk via ingestion; therefore soil PRGs have been designed to address this pathway as well. The models used to calculate PRGs for inhalation of volatiles/particulates are updates of risk assessment methods presented in RAGS Part B (USEPA 1991a) and are identical to the *Soil Screening Guidance: User's Guide and Technical Background Document* (USEPA 1996a,b).

It should be noted that the soil-to-air pathway that is evaluated in the PRGs calculations is based on direct inhalation exposures that result from the volatilization or particulate emissions of chemicals from soil to outdoor air. The soil PRG calculations currently do not evaluate potential for volatile contaminants in soil to migrate indoors. For this evaluation, a site-specific assessment is required because the applicable model, the Johnson and Ettinger model, is extremely sensitive to a number of model parameters that do not lend themselves to standardization on a national basis. For more information on the indoor air model and/or to download a copy, please go to:

http://www.epa.gov/oerrpage/superfund/programs/risk/airmodel/johnson_ettinger.htm

To address the soil-to-outdoor air pathways, the PRG calculations incorporate volatilization factors (VF_s) for volatile contaminants and particulate emission factors (PEF) for nonvolatile contaminants. These factors relate soil contaminant concentrations to air contaminant concentrations that may be inhaled on-site. The VF_s and PEF equations can be broken into two separate models: an emission model to estimate emissions of the contaminant from the soil and a dispersion model to simulate the dispersion of the contaminant in the atmosphere.

The box model in RAGS Part B has been replaced with a dispersion term (Q/C) derived from a modeling exercise using meteorological data from 29 locations across the United States because the box model may not be applicable to a broad range of site types and meteorology and does not utilize state-of-the-art techniques developed for regulatory dispersion modeling. The dispersion model for both volatiles and particulates is the AREA-ST, an updated version of the Office of Air Quality Planning and Standards, Industrial Source Complex Model, ISC2. However, different Q/C terms are used in the VF and PEF equations. Los Angeles was selected as the 90th percentile data set for volatiles and Minneapolis was selected as the 90th percentile data set for fugitive dusts (USEPA1996 a,b). A default source size of 0.5 acres was chosen for the PRG calculations. This is consistent with the default exposure area over which Region 9 typically averages contaminant concentrations in soils. If unusual site conditions exist such that the area source is substantially larger than the default source size assumed here, an alternative Q/C could be applied (see USEPA 1996a,b).

Volatilization Factor for Soils

Volatile chemicals, defined as those chemicals having a Henry's Law constant greater than 10^{-5} (atm-m^3/mol) and a molecular weight less than 200 g/mole, were screened for inhalation exposures using a volatilization factor for soils (VF_s). Please note that VF_s's are available at our website.

The emission terms used in the VF_s are chemical-specific and were calculated from physical-chemical information obtained from several sources. The priority of these sources were as follows: *Soil Screening Guidance* (USEPA 1996a,b), *Superfund Chemical Data Matrix* (USEPA 1996c), *Fate and Exposure Data* (Howard 1991), *Subsurface Contamination Reference Guide* (EPA 1990a), and *Superfund Exposure Assessment Manual* (SEAM, EPA 1988). When there was a choice between a measured or a modeled value (e.g. Koc), we went with modeled values. In those cases where Diffusivity Coefficients (Di) were not provided in existing literature, Di's were calculated using Fuller's Method described in SEAM. A surrogate term was required for some chemicals that lacked physico-chemical information. In these cases, a proxy chemical of similar structure was used that may over- or under-estimate the PRG for soils.

Equation 4-9 forms the basis for deriving generic soil PRGs for the inhalation pathway. The following parameters in the standardized equation can be replaced with specific site data to develop a simple site-specific PRG

- Source area
- Average soil moisture content
- Average fraction organic carbon content
- Dry soil bulk density

The basic principle of the VF_s model (Henry's law) is applicable only if the soil contaminant concentration is at or below soil saturation "sat". Above the soil saturation limit, the model cannot predict an accurate VF-based PRG. How these particular cases are handled, depends on whether the contaminant is liquid or solid at ambient soil temperatures (see Section 4.5).

Particulate Emission Factor for Soils

Inhalation of chemicals adsorbed to respirable particles (PM_{10}) were assessed using a default PEF equal to 1. 316 x 10^9 m^3/kg that relates the contaminant concentration in soil with the concentration of respirable particles in the air due to fugitive dust emissions from contaminated soils. The generic PEF was derived using default values in Equation 4-11, which corresponds to a receptor point concentration of approximately 0.76 ug/m^3. The relationship is derived by Cowherd (1985) for a rapid assessment procedure applicable to a typical hazardous waste site where the surface contamination provides a relatively continuous and constant potential for emission over an extended period of time (e.g. years). This represents an annual average emission rate based on wind erosion that should be compared with chronic health criteria; it is not appropriate for evaluating the potential for more acute exposures.

The impact of the PEF on the resultant PRG concentration (that combines soil exposure pathways for ingestion, skin contact, and inhalation) can be assessed by accessing the Region 9 PRG website and viewing the pathway-specific soil concentrations. Equation 4-11 forms the basis for deriving a generic PEF for the inhalation pathway. For more details regarding specific parameters used in the PEF model, the reader is referred to *Soil Screening Guidance: Technical Background Document* (USEPA 1996a).

Note: the generic PEF evaluates windborne emissions and does not consider dust emissions from traffic or other forms of mechanical disturbance that could lead to greater emissions than assumed here.

4.3 Soils - Dermal Exposure

Dermal Contact Assumptions

Exposure factors for dermal contact with soil are based on recommendations in "Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment) Interim Guidance" (USEPA 2001b). Recommended RME (reasonable maximum exposure) defaults for adult workers' skin surface areas (3300 cm^2/day) and soil adherence factors (0.2 mg/cm^2) now differ from the defaults recommended for adult residents (5700 cm^2/day, 0.07 mg/cm^2) as noted in Exhibit 4-1. This is due to differences in the range of activities experienced by workers versus residents.

Dermal Absorption

Chemical-specific skin absorption values recommended by the Superfund Dermal Workgroup were applied when available. Chemical-specific values are included for the following chemicals: arsenic, cadmium, chlordane, 2,4-D, DDT, lindane, TCDD, PAHs, PCBs, and pentachlorophenols.

The "Supplemental Guidance for Dermal Risk Assessment" (USEPA 2001b) recommends a default dermal absorption factor for semivolatile organic compounds of 10% as a screening method for the majority of SVOCs without dermal absorption factors. Default dermal absorption values for other chemicals (VOCs and inorganics) are not recommended in this new guidance. Therefore, the assumption of 1% for inorganics and 10% for volatiles is no longer included in the Region 9 PRG table. This change has minimal impact on the final risk-based calculations because human exposure to VOCs and inorganics in soils is generally driven by other pathways of exposure.

4.4 Soils - Migration to Groundwater

The methodology for calculating SSLs for the migration to groundwater was developed to identify chemical concentrations in soil that have the potential to contaminate groundwater. Migration of contaminants from soil to groundwater can be envisioned as a two-stage process: (1) release of contaminant in soil leachate and (2) transport of the contaminant through the underlying soil and aquifer to a receptor well. The SSL methodology considers both of these fate and transport mechanisms.

SSLs are backcalculated from acceptable ground water concentrations (i.e. nonzero MCLGs, MCLs, or risk-based PRGs). First, the acceptable groundwater concentration is multiplied by a dilution factor to obtain a target leachate concentration. For example, if the dilution factor is 10 and the acceptable ground water concentration is 0.05 mg/L, the target soil leachate concentration would be 0.5 mg/L. The partition equation (presented in the *Soil Screening Guidance* document) is then used to calculate the total soil concentration (i.e. SSL) corresponding to this soil leachate concentration.

The SSL methodology was designed for use during the early stages of a site evaluation when information about subsurface conditions may be limited. Because of this constraint, the methodology is based on conservative, simplifying assumptions about the release and transport of contaminants in the subsurface. For more on SSLs, and how to calculate site-specific SSLs versus generic SSLs presented in the PRG table, the reader is referred to the *Soil Screening Guidance* document (USEPA 1996a,b).

4.5 Soil Saturation Limit

The soil saturation concentration "sat" corresponds to the contaminant concentration in soil at which the absorptive limits of the soil particles, the solubility limits of the soil pore water, and saturation of soil pore air have been reached. Above this concentration, the soil contaminant may be present in free phase, i.e., nonaqueous phase liquids (NAPLs) for contaminants that are liquid at ambient soil temperatures and pure solid phases for compounds that are solid at ambient soil temperatures.

Equation 4-10 is used to calculate "sat" for each volatile contaminant. As an update to RAGS HHEM, Part B (USEPA 1991a), this equation takes into account the amount of contaminant that is in the vapor phase in soil in addition to the amount dissolved in the soil's pore water and sorbed to soil particles.

Chemical-specific "sat" concentrations must be compared with each VF-based PRG because a basic principle of the PRG volatilization model is not applicable when free-phase contaminants are present. How these cases are handled depends on whether the contaminant is liquid or solid at ambient

temperatures. Liquid contaminant that have a VF-based PRG that exceeds the "sat" concentration are set equal to "sat" whereas for solids (e.g., PAHs), soil screening decisions are based on the appropriate PRGs for other pathways of concern at the site (e.g., ingestion).

4.6 Tap Water - Ingestion and Inhalation

Calculation of PRGs for ingestion and inhalation of contaminants in domestic water is based on the methodology presented in RAGS HHEM, Part B (USEPA 1991a). Ingestion of drinking water is an appropriate pathway for all chemicals. For the purposes of this guidance, however, inhalation of volatile chemicals from water is considered routinely only for chemicals with a Henry's Law constant of 1×10^{-5} atm-m^3/mole or greater <u>and</u> with a molecular weight of less than 200 g/mole.

For volatile chemicals, an upperbound volatilization constant (VF_w) is used that is based on all uses of household water (e.g showering, laundering, and dish washing). Certain assumptions were made. For example, it is assumed that the volume of water used in a residence for a family of four is 720 L/day, the volume of the dwelling is 150,000 L and the air exchange rate is 0.25 air changes/hour (Andelman in RAGS Part B). Furthermore, it is assumed that the average transfer efficiency weighted by water use is 50 percent (i.e. half of the concentration of each chemical in water will be transferred into air by all water uses). Note: the range of transfer efficiencies extends from 30% for toilets to 90% for dishwashers.

4.7 Default Exposure Factors

Default exposure factors were obtained primarily from RAGS Supplemental Guidance Standard Default *Exposure Factors* (OSWER Directive, 9285.6-03) dated March 25, 1991 and more recent information from U.S. EPA's Office of Solid Waste and Emergency Response, U.S. EPA's Office of Research and Development, and California EPA's Department of Toxic Substances Control (see Exhibit 4-1).

Because contact rates may be different for children and adults, carcinogenic risks during the first 30 years of life were calculated using age-adjusted factors ("adj"). Use of age-adjusted factors are especially important for soil ingestion exposures, which are higher during childhood and decrease with age. However, for purposes of combining exposures across pathways, additional age-adjusted factors are used for inhalation and dermal exposures. These factors approximate the integrated exposure from birth until age 30 combining contact rates, body weights, and exposure durations for two age groups - small children and adults. Age-adjusted factors were obtained from RAGS PART B or developed by analogy (see derivations next page).

For soils only, noncarcinogenic contaminants are evaluated in children separately from adults. No age-adjustment factor is used in this case. The focus on children is considered protective of the higher daily intake rates of soil by children and their lower body weight. For maintaining consistency when evaluating soils, dermal and inhalation exposures are also based on childhood contact rates.

(1) ingestion([mg-yr]/[kg-d]:

$$IFS_{adj} = \frac{ED_c \ x \ IRS_c}{BW_c} + \frac{(ED_r - ED_c) \ x \ IRS_a}{BW_a}$$

(2) skin contact([mg-yr]/[kg-d]:

$$SFS_{adj} = \frac{ED_c \ x \ AF \ x \ SA_c}{BW_c} + \frac{(ED_r - ED_c) \ x \ AF \ x \ SA_a}{BW_a}$$

(3) inhalation ([m^3-yr]/[kg-d]):

$$InhF_{adj} = \frac{ED_c \ x \ IRA_c}{BW_c} + \frac{(ED_r - ED_c) \ x \ IRA_a}{BW_a}$$

EXHIBIT 4-1
STANDARD DEFAULT FACTORS

Symbol	Definition (units)	Default	Reference
CSFo	Cancer slope factor oral (mg/kg-d)-1	--	IRIS, HEAST, or NCEA
CSFi	Cancer slope factor inhaled (mg/kg-d)-1	--	IRIS, HEAST, or NCEA
RfDo	Reference dose oral (mg/kg-d)	--	IRIS, HEAST, or NCEA
RfDi	Reference dose inhaled (mg/kg-d)	--	IRIS, HEAST, or NCEA
TR	Target cancer risk	10^{-6}	--
THQ	Target hazard quotient	1	--
BWa	Body weight, adult (kg)	70	RAGS (Part A), EPA 1989 (EPA/540/1-89/002)
BWc	Body weight, child (kg)	15	Exposure Factors, EPA 1991 (OSWER No. 9285.6-03)
ATc	Averaging time - carcinogens (days)	25550	RAGS(Part A), EPA 1989 (EPA/540/1-89/002)
ATn	Averaging time - noncarcinogens (days)	ED*365	
SAa	Exposed surface area for soil/dust (cm^2/day)		Dermal Assessment, EPA 2000 (EPA/540/R-99/005)
	– adult resident	5700	
	– adult worker	3300	
SAc	Exposed surface area, child in soil (cm^2/day)	2800	Dermal Assessment, EPA 2000 (EPA/540/R-99/005)
AFa	Adherence factor, soils (mg/cm^2)		Dermal Assessment, EPA 2000 (EPA/540/R-99/005)
	– adult resident	0.07	
	– adult worker	0.2	
AFc	Adherence factor, child (mg/cm^2)	0.2	Dermal Assessment, EPA 2000 (EPA/540/R-99/005)
ABS	Skin absorption defaults (unitless):		
	– semi-volatile organics	0.1	Dermal Assessment, EPA 2000 (EPA/540/R-99/005)
	– volatile organics	--	Dermal Assessment, EPA 2000 (EPA/540/R-99/005)
	– inorganics	--	Dermal Assessment, EPA 2000 (EPA/540/R-99/005)
IRAa	Inhalation rate - adult (m^3/day)	20	Exposure Factors, EPA 1991 (OSWER No. 9285.6-03)
IRAc	Inhalation rate - child (m^3/day)	10	Exposure Factors, EPA 1997 (EPA/600/P-95/002Fa)
IRWa	Drinking water ingestion - adult (L/day	2	RAGS(Part A), EPA 1989 (EPA/540/1-89/002)
IRWc	Drinking water ingestion - child (L/day)	1	PEA, Cal-EPA (DTSC, 1994)
IRSa	Soil ingestion - adult (mg/day)	100	Exposure Factors, EPA 1991 (OSWER No. 9285.6-03)
IRSc	Soil ingestion - child (mg/day),	200	Exposure Factors, EPA 1991 (OSWER No. 9285.6-03)
IRSo	Soil ingestion - occupational (mg/day)	100	Soil Screening Guidance (EPA 2001a)
EFr	Exposure frequency - residential (d/y)	350	Exposure Factors, EPA 1991 (OSWER No. 9285.6-03)
EFo	Exposure frequency - occupational (d/y)	250	Exposure Factors, EPA 1991 (OSWER No. 9285.6-03)
EDr	Exposure duration - residential (years)	30[a]	Exposure Factors, EPA 1991 (OSWER No. 9285.6-03)
EDc	Exposure duration - child (years)	6	Exposure Factors, EPA 1991 (OSWER No. 9285.6-03)
EDo	Exposure duration - occupational (years)	25	Exposure Factors, EPA 1991 (OSWER No. 9285.6-03)
	Age-adjusted factors for carcinogens:		
IFSadj	Ingestion factor, soils ([mg-yr]/[kg-d])	114	RAGS(Part B), EPA 1991 (OSWER No. 9285.7-01B)
SFSadj	Dermal factor, soils ([mg-yr]/[kg-d])	361	By analogy to RAGS (Part B)
InhFadj	Inhalation factor, air ([m^3-yr]/[kg-d])	11	By analogy to RAGS (Part B)
IFWadj	Ingestion factor, water ([L-yr]/[kg-d])	1.1	By analogy to RAGS (Part B)
VFw	Volatilization factor for water (L/m^3)	0.5	RAGS(Part B), EPA 1991 (OSWER No. 9285.7-01B)
PEF	Particulate emission factor (m^3/kg)	See below	Soil Screening Guidance (EPA 1996a,b)
VFs	Volatilization factor for soil (m^3/kg)	See below	Soil Screening Guidance (EPA 1996a,b)
sat	Soil saturation concentration (mg/kg)	See below	Soil Screening Guidance (EPA 1996a,b)

Footnote:
[a]Exposure duration for lifetime residents is assumed to be 30 years total. For carcinogens, exposures are combined for children (6 years) and adults (24 years) .

4.8 Standardized Equations

The equations used to calculate the PRGs for carcinogenic and noncarcinogenic contaminants are presented in Equations 4-1 through 4-8. The PRG equations update RAGS Part B equations. The methodology backcalculates a soil, air, or water concentration level from a target risk (for carcinogens) or hazard quotient (for noncarcinogens). For completeness, the soil equations combine risks from ingestion, skin contact, and inhalation simultaneously. **Note: the electronic version of the table also includes pathway-specific PRGs, should the user decide against combining specific exposure pathways; or, the user wants to identify the relative contribution of each pathway to exposure.**

To calculate PRGs for volatile chemicals in soil, a chemical-specific volatilization factor is calculated per Equation 4-9. Because of its reliance on Henry's law, the VF_s model is applicable only when the contaminant concentration in soil is at or below saturation (i.e. there is no free-phase contaminant present). Soil saturation ("sat") corresponds to the contaminant concentration in soil at which the adsorptive limits of the soil particles and the solubility limits of the available soil moisture have been reached. Above this point, pure liquid-phase contaminant is expected in the soil. If the PRG calculated using VF_s was greater than the calculated sat, the PRG was set equal to sat, in accordance with *Soil Screening Guidance* (USEPA 1996 a,b). The equation for deriving sat is presented in Equation 4-10.

PRG EQUATIONS

Soil Equations: For soils, equations were based on three exposure routes (ingestion, skin contact, and inhalation).

Equation 4-1: Combined Exposures to Carcinogenic Contaminants in Residential Soil

$$C(mg/kg) = \frac{TR \times AT_c}{EF_r \left[\left(\frac{IFS_{adj} \times CSF_o}{10^6 mg/kg} \right) + \left(\frac{SFS_{adj} \times ABS \times CSF_o}{10^6 mg/kg} \right) + \left(\frac{InhF_{adj} \times CSF_i}{VF_s^a} \right) \right]}$$

Equation 4-2: Combined Exposures to Noncarcinogenic Contaminants in Residential Soil

$$C(mg/kg) = \frac{THQ \times BW_c \times AT_n}{EF_r \times ED_c \left[\left(\frac{1}{RfD_o} \times \frac{IRS_c}{10^6 mg/kg} \right) + \left(\frac{1}{RfD_o} \times \frac{SA_c \times AF \times ABS}{10^6 mg/kg} \right) + \left(\frac{1}{RfD_i} \times \frac{IRA_c}{VF_s^a} \right) \right]}$$

Equation 4-3: Combined Exposures to Carcinogenic Contaminants in Industrial Soil

$$C(mg/kg) = \frac{TR \times BW_a \times AT_c}{EF_o \times ED_o \left[\left(\frac{IRS_o \times CSF_o}{10^6 mg/kg} \right) + \left(\frac{SA_a \times AF \times ABS \times CSF_o}{10^6 mg/kg} \right) + \left(\frac{IRA_a \times CSF_i}{VF_s^a} \right) \right]}$$

Footnote:
[a]Use VF_s for volatile chemicals (defined as having a Henry's Law Constant [atm-m^3/mol] greater than 10^{-5} and a molecular weight less than 200 grams/mol) or PEF for non-volatile chemicals.

Equation 4-4: Combined Exposures to Noncarcinogenic Contaminants in Industrial Soil

$$C(mg/kg) = \frac{THQ \times BW_a \times AT_n}{EF_o \times ED_o[(\frac{1}{RfD_o} \times \frac{IRS_o}{10^6 mg/kg}) + (\frac{1}{RfD_o} \times \frac{SA_a \times AF \times ABS}{10^6 mg/kg}) + (\frac{1}{RfD_i} \times \frac{IRA_a}{VF_s^a})]}$$

<u>Tap Water Equations:</u>

Equation 4-5: Ingestion and Inhalation Exposures to Carcinogenic Contaminants in Water

$$C(ug/L) = \frac{TR \times AT_c \times 1000 ug/mg}{EF_r\ [(IFW_{adj} \times CSF_o) + (VF_w \times InhF_{adj} \times CSF_i)]}$$

Equation 4-6: Ingestion and Inhalation Exposures to Noncarcinogenic Contaminants in Water

$$C(ug/L) = \frac{THQ \times BW_a \times AT_n \times 1000 ug/mg}{EF_r \times ED_r\ [(\frac{IRW_a}{RfD_o}) + (\frac{VF_w \times IRA_a}{RfD_i})]}$$

<u>Air Equations</u>:

Equation 4-7: Inhalation Exposures to Carcinogenic Contaminants in Air

$$C(ug/m^3) = \frac{TR \times AT_c \times 1000 ug/mg}{EF_r \times InhF_{adj} \times CSF_i}$$

Equation 4-8: Inhalation Exposures to Noncarcinogenic Contaminants in Air

$$C(ug/m^3) = \frac{THQ \times RfD_i \times BW_a \times AT_n \times 1000 ug/mg}{EF_r \times ED_r \times IRA_a}$$

Footnote:

[a]Use VF_s for volatile chemicals (defined as having a Henry's Law Constant [atm-m^3/mol] greater than 10^{-5} and a molecular weight less than 200 grams/mol) or PEF for non-volatile chemicals.

SOIL-TO-AIR VOLATILIZATION FACTOR (VF_s)

Equation 4-9: Derivation of the Volatilization Factor

$$VF_s(m^3/kg) = (Q/C) \ x \ \frac{(3.14 \ x \ D_A \ x \ T)^{1/2}}{(2 \ x \ \rho_b \ x \ D_A)} \ x \ 10^{-4}(m^2/cm^2)$$

where:

$$D_A = \frac{[(\Theta_a^{10/3} D_i H' + \Theta_w^{10/3} D_w)/n^2]}{\rho_B K_d + \Theta_w + \Theta_a H'}$$

Parameter	Definition (units)	Default
VF_s	Volatilization factor (m^3/kg)	--
D_A	Apparent diffusivity (cm^2/s)	--
Q/C	Inverse of the mean conc. at the center of a 0.5-acre square source ($g/^{M2}$-s per kg/m^3)	68.81
T	Exposure interval (s)	9.5×10^8
ρ_b	Dry soil bulk density (g/cm^3)	1.5
Θ_a	Air filled soil porosity (L_{air}/L_{soil})	0.28 or n-Θ_w
n	Total soil porosity (L_{pore}/L_{soil})	0.43 or 1 - (ρ_b/ρ_s)
Θ_w	Water-filled soil porosity (L_{water}/L_{soil})	0.15
ρ_s	Soil particle density (g/cm^3)	2.65
Di	Diffusivity in air (cm^2/s)	Chemical-specific
H	Henry's Law constant (atm-m^3/mol)	Chemical-specific
H'	Dimensionless Henry's Law constant	Calculated from H by multiplying by 41 (USEPA 1991a)
D_w	Diffusivity in water (cm^2/s)	Chemical-specific
K_d	Soil-water partition coefficient (cm^3/g) = $K_{oc}f_{oc}$	Chemical-specific
K_{oc}	Soil organic carbon-water partition coefficient (cm^3/g)	Chemical-specific
f_{oc}	Fraction organic carbon in soil (g/g)	0.006 (0.6%)

SOIL SATURATION CONCENTRATION (sat)

Equation 4-10: Derivation of the Soil Saturation Limit

$$sat = \frac{S}{\rho_b} \left(K_d \rho_b + \Theta_w + H' \Theta_a \right)$$

Parameter	Definition (units)	Default
sat	Soil saturation concentration (mg/kg)	--
S	Solubility in water (mg/L-water)	Chemical-specific
ρ_b	Dry soil bulk density (kg/L)	1.5
n	Total soil porosity (L_{pore}/L_{soil})	0.43 or 1 - (ρ_b/ρ_s)
ρ_s	Soil particle density (kg/L)	2.65
K_d	Soil-water partition coefficient (L/kg)	K_{oc} x f_{oc} (chemical-specific)
k_{oc}	Soil organic carbon/water partition coefficient (L/kg)	Chemical-specific
f_{oc}	Fraction organic carbon content of soil (g/g)	0.006 or site-specific
Θ_w	Water-filled soil porosity (L_{water}/L_{soil})	0.15
Θ_a	Air filled soil porosity (L_{air}/L_{soil})	0.28 or n-Θ_w
w	Average soil moisture content (kg_{water}/kg_{soil} or L_{water}/kg_{soil})	0.1
H	Henry's Law constant (atm-m^3/mol)	Chemical-specific
H'	Dimensionless Henry's Law constant	H x 41, where 41 is a units conversion factor

SOIL-TO-AIR PARTICULATE EMISSION FACTOR (PEF)

Equation 4-11: Derivation of the Particulate Emission Factor

$$PEF(m^3/kg) = Q/C \times \frac{3600 s/h}{0.036 \times (1-V) \times (U_m/U_t)^3 \times F(x)}$$

Parameter	Definition (units)	Default
PEF	Particulate emission factor (m^3/kg)	1.316×10^9
Q/C	Inverse of the mean concentration at the center of a 0.5-acre-square source (g/^{M2}-s per kg/m^3)	90.80
V	Fraction of vegetative cover (unitless)	0.5
U_m	Mean annual windspeed (m/s)	4.69
U_t	Equivalent threshold value of windspeed at 7 m (m/s)	11.32
F(x)	Function dependent on U_m/U_t derived using Cowherd (1985) (unitless)	0.194

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ATTACHMENT 4

ATTACHMENT 4 PERMIT MODIFICATION LOG and PAGE CHANGE OUT LIST, consisting of:

- Attachment 4 shall be used to track the current revision of the permit/permit reapplication, including attachments. The permit modification log shall record each permit modification, the portion of the permit affected, the date the modification was posted to the permit, and either a reference to a page change-out sheet, or if fewer than three pages of an attachment are revised a list of the page changes.

ATTACHMENT 4 - PERMIT MODIFICATION LOG

HWMA/RCRA INTEC POST-CLOSURE PERMIT REAPPLICATION

Volume 21
Waste Calcine Facility and CPP-601/627/640

Attachment 4
Permit Modification Log

April 2013

PERMIT MODIFICATION TRACKING LOG

PERMIT MODIFICATION REQUEST (PMR) NUMBER	DATE PMR SUBMITTED TO DEQ	DATE PMR APPROVED BY DEQ	PMR CLASS	SUMMARY OF CHANGES REQUESTED IN THE PMR	PORTION OF THE PERMIT &/OR ATTACHMENTS AFFECTED BY THE PMR
1	10/30/2003	11/7/2003	1*	- Changing the methods of analyses for hydrazine and formaldehyde	- Permit Module III, page 30 of 42
				- Changing the detection limits for hydrazine	- Permit Module III, page 31 of 42
				- Deleting redundant language on the wording for purge water disposition	- Permit Module III, page 30 of 42
				- Updating the Inspection Form for Facilities Stormwater Pollution Prevention Plan for Industrial Activities	- Attachment II, Inspection Forms: Inspection Form for Facilities Storm Waste Pollution Prevention Plan for Industrial Activities, Form 450.24, 1/30/2003, Rev. 04.
				N/A	- Permit – List of Attachments, Page 7 of 42, revised to reflect informational changes as approved in the PMR.

PERMIT MODIFICATION TRACKING LOG

PERMIT MODIFICATION REQUEST (PMR) NUMBER	DATE PMR SUBMITTED TO DEQ	DATE PMR APPROVED BY DEQ	PMR CLASS	SUMMARY OF CHANGES REQUESTED IN THE PMR	PORTION OF THE PERMIT &/OR ATTACHMENTS AFFECTED BY THE PMR
2	5/21/2004	6/10/2004	1*	- Revising Table 2 in Permit Module III to reflect correct nomenclature of existing monitoring wells - Clarifying Permit Condition III.E.2. to reflect that annual monitoring well depths will not be required for wells that have dedicated downhole equipment - Revising Table 3 of Permit Module III for the Estimated Quantitation Limit for formaldehyde - Deleting Storm Water Information that is no longer applicable to the Permitted Facility - Revising the wording to accurately reflect the field inspection conditions for Maintenance Implementation and Tracking	- Permit Module III, Table 2, page 28 of 42 - Permit Module III, Permit Condition III.E.2., page 30 of 42 - Permit Module III, Table 3, page 31 of 42 - Attachment 2, Sections D.3 Storm Water Drainage System, E.2 Maintenance of the Storm Water System and Appendix 2 Inspections Forms - Attachment 2, Section E.3.1 Maintenance and Implementation and Section E.3.2 Maintenance Tracking

PERMIT MODIFICATION TRACKING LOG

PERMIT MODIFICATION REQUEST (PMR) NUMBER	DATE PMR SUBMITTED TO DEQ	DATE PMR APPROVED BY DEQ	PMR CLASS	SUMMARY OF CHANGES REQUESTED IN THE PMR	PORTION OF THE PERMIT &/OR ATTACHMENTS AFFECTED BY THE PMR
2 (continued)	5/21/2004	6/10/2004	1*	- Revising the wording to reflect the correct purging and sampling operations - Revising the wording to clarify when equipment rinsate samples will be collected for perched groundwater monitoring sampling events. - Other editorial/informational changes	- Attachment 3, Section J.5.2.3 Perched Groundwater Sample Collection - Attachment 3, Section J.5.2.4 QA/QC Samples and Table J-5 QA/QC Samples for Perched Groundwater Sampling - Permit Condition III.H.6, page 35 of 42, Permit Condition IV.C.3 page 39 of 42, and Permit Condition V.A., page 42 of 42 - WCF HWMA/RCRA Well Inspection Checklist Form

PERMIT MODIFICATION TRACKING LOG

PERMIT MODIFICATION REQUEST (PMR) NUMBER	DATE PMR SUBMITTED TO DEQ	DATE PMR APPROVED BY DEQ	PMR CLASS	SUMMARY OF CHANGES REQUESTED IN THE PMR	PORTION OF THE PERMIT &/OR ATTACHMENTS AFFECTED BY THE PMR
3	4/19/2005	4/26/2005	1*	- Transfer of Operational Control from Bechtel BWXT Idaho, LLC. to CH2M-WG Idaho, LLC. with an effective transfer date of May 1, 2005.	- Permit – List of Attachments; pages 6, 7, and 9 of 42 - Attachment 1 – Part A Permit Application for Volume 21 Post-Closure Permit; pages 1 through 6 of EPA Form 8700-23 (OMB #: 2050-0034) and pages 1 through 3 of EPA Form 8700-23 (OMB #: 2050-0175)
4	11/14/2005	1/17/2006	2	- Revising Table 2 in Permit Module III to add wells ICPP-2018, ICPP-2019, and MW-10-2 as monitoring wells. - Changing well CPP-55-06 from a water elevation well to a monitoring well. - Removing well MW-4-2 as a water elevation well. - Revising Map 1 in Attachment 1 to show the locations of the wells.	- Permit Module III, Table 2, page 28 of 41 - Permit Module III, Table 2, page 28 of 41 - Permit Module III, Table 2, page 28 of 41 - Attachment 1, Section I. Topographic Map

PERMIT MODIFICATION TRACKING LOG

PERMIT MODIFICATION REQUEST (PMR) NUMBER	DATE PMR SUBMITTED TO DEQ	DATE PMR APPROVED BY DEQ	PMR CLASS	SUMMARY OF CHANGES REQUESTED IN THE PMR	PORTION OF THE PERMIT &/OR ATTACHMENTS AFFECTED BY THE PMR
4 (continued)	11/14/2005	1/17/2006	2	- Changing groundwater sampling and analysis procedures and monitoring schedule to allow quarterly monitoring of the groundwater network, including these new wells to continue longer than the initial two-year period specified in the permit.	- Permit Module III, page 29 of 41
				- Removing Permit Conditions II.H., III.B.1., III.F.1., III.I.1., III.I.2., and III.I.3. that were applicable during the first two years after permit issuance, have been fulfilled, and are no longer applicable.	- Permit Modules II and III, pages 24, 27, 30, and 35 of 41
				- Making other information and administrative changes:	
				- Permit Condition I.P.4. was updated with new INTEC WCF point of contact information.	- Permit Conditions I.P.4., page 17 of 41

PERMIT MODIFICATION TRACKING LOG

PERMIT MODIFICATION REQUEST (PMR) NUMBER	DATE PMR SUBMITTED TO DEQ	DATE PMR APPROVED BY DEQ	PMR CLASS	SUMMARY OF CHANGES REQUESTED IN THE PMR	PORTION OF THE PERMIT &/OR ATTACHMENTS AFFECTED BY THE PMR
4 (continued)	11/14/2005	1/17/2006	2	- Permit Condition I.Z. submittal of the biennial report to the DEQ occurs by March 1 of each even numbered year, not March 31.	- Permit Condition I.Z., page 21 of 41
				- Permit Condition III.D.6. was changed to state that the current versions of the specified analytical methods will be used.	- Permit Condition III.D.6., page 29 of 41
				- The identification number of the Waste Acceptance Criteria for the ICDF Evaporation Pond referenced in Permit Condition III.D.8. was changed from DOE/ID 10866 to DOE/ID 10881 to reflect an update of this document.	- Permit Condition III.D.8., page 30 of 41
				- Permit Condition III.F.1. was changed to identify that Table 3 lists the constituents of concern.	- Permit Condition III.F.1., page 30 of 41
				- Change from INEEL to INL and repagination of permit.	- Pages 1 through 41 of permit and pages 1 through 5 of Attachment 4

PERMIT MODIFICATION TRACKING LOG

PERMIT MODIFICATION REQUEST (PMR) NUMBER	DATE PMR SUBMITTED TO DEQ	DATE PMR APPROVED BY DEQ	PMR CLASS	SUMMARY OF CHANGES REQUESTED IN THE PMR	PORTION OF THE PERMIT &/OR ATTACHMENTS AFFECTED BY THE PMR
5	March 1, 2007	June 26, 2007	3	- Modification of the EQL and/or GPS concentrations found in Table 3 of the Permit after background concentrations have been established and approved by the DEQ	- Entire permit/attachments revised as applicable and reformatted to reflect approved revisions
				- Reduce the number of analytes that are sample/analyzed and establish DMLs for the remaining constituents found in Table 3 of the Permit	- Entire permit/attachments revised as applicable and reformatted to reflect approved revisions
				- Revise Table 2 of the Permit to reduce the number of monitoring wells that are sampled/analyzed	- Entire permit/attachments revised as applicable and reformatted to reflect approved revisions
				- Revise the permit to incorporate DEQs approval of the calculation of WCF water quality background data, submitted to the DEQ on December 11, 2006 and approved by the DEQ on January 29, 2007.	- Entire permit/attachments revised as applicable and reformatted to reflect approved revisions

PERMIT MODIFICATION TRACKING LOG

PERMIT MODIFICATION REQUEST (PMR) NUMBER	DATE PMR SUBMITTED TO DEQ	DATE PMR APPROVED BY DEQ	PMR CLASS	SUMMARY OF CHANGES REQUESTED IN THE PMR	PORTION OF THE PERMIT &/OR ATTACHMENTS AFFECTED BY THE PMR
5 (continued)	March 1, 2007	June 26, 2007	3	- Revise the permit reflect SW-846 Methods to be used to analyze groundwater samples required by this permit.	- Entire permit/attachments revised as applicable and reformatted to reflect approved revisions
				- Provide reporting requirement clarification	- Entire permit/attachments revised as applicable and reformatted to reflect approved revisions
				- Revise the permit to remove permit conditions that have been completed and approved by the Director.	- Entire permit/attachments revised as applicable and reformatted to reflect approved revisions
				- Revise/update the permit attachments to reflect current figures, forms, maps, and facility information	- Entire permit/attachments revised as applicable and reformatted to reflect approved revisions
				- Revise the permit to provide new Floodplain information	- Entire permit/attachments revised as applicable and reformatted to reflect approved revisions

PERMIT MODIFICATION TRACKING LOG

PERMIT MODIFICATION REQUEST (PMR) NUMBER	DATE PMR SUBMITTED TO DEQ	DATE PMR APPROVED BY DEQ	PMR CLASS	SUMMARY OF CHANGES REQUESTED IN THE PMR	PORTION OF THE PERMIT &/OR ATTACHMENTS AFFECTED BY THE PMR
5 (continued)	March 1, 2007	June 26, 2007	3	- Update security information to reflect current operations at the INL and to be consistent with other INTEC HWMA/RCRA permits - Update Groundwater Monitoring Data to reflect current information on groundwater monitoring wells, etc. at the INTEC - Provide other informational/ administrative changes as necessary and reformat and repaginate the entire Volume 21 Permit.	- Entire permit/attachments revised as applicable and reformatted to reflect approved revisions - Entire permit/attachments revised as applicable and reformatted to reflect approved revisions - Entire permit/attachments revised as applicable and reformatted to reflect approved revisions

PERMIT MODIFICATION TRACKING LOG

PERMIT MODIFICATION REQUEST (PMR) NUMBER	DATE PMR SUBMITTED TO DEQ	DATE PMR APPROVED BY DEQ	PMR CLASS	SUMMARY OF CHANGES REQUESTED IN THE PMR	PORTION OF THE PERMIT &/OR ATTACHMENTS AFFECTED BY THE PMR
6	May 31, 2011	August 25, 2011	2	- Addition of the CPP-601/627/640 Landfill unit, currently operating under an approved Post-Closure Plan, to this post-closure permit - Update the Detection Monitoring Limits in Table 3b for the WCF based on additional statistical analyses completed in August 2010 - Revise/update the permit attachments to reflect current figures, forms, maps, and facility information - Update Groundwater Monitoring Wells and Data to reflect current information on groundwater monitoring wells, etc. at the INTEC - Addition of Attachment 5. Attachment 5 presents the INTEC Monitoring Well Map and the INTEC Monitoring Well Construction Diagrams - Provide other informational/administrative changes as necessary and reformat and repaginate the entire Volume 21 Permit.	- Entire permit/attachments revised as applicable and reformatted to reflect approved revisions - Entire permit/attachments revised as applicable and reformatted to reflect approved revisions - Entire permit/attachments revised as applicable and reformatted to reflect approved revisions - Entire permit/attachments revised as applicable and reformatted to reflect approved revisions - Permit – List of Attachments and Attachment 5. - Entire permit/attachments revised as applicable and reformatted to reflect approved revisions

PERMIT MODIFICATION TRACKING LOG

PERMIT MODIFICATION REQUEST (PMR) NUMBER	DATE PMR SUBMITTED TO DEQ	DATE PMR APPROVED BY DEQ	PMR CLASS	SUMMARY OF CHANGES REQUESTED IN THE PMR	PORTION OF THE PERMIT &/OR ATTACHMENTS AFFECTED BY THE PMR
7	December 12, 2012	February 25, 2013	2	- Table 2 – Well depth from MP was revised for well MW-5-2, reflecting measurements taken August 2011. - Table 2a – Brass Cap and Measuring Point Elevations for Wells ICPP-2195 and ICPP-2196 were revised. Additionally, the well depths from the measuring point for wells ICPP-2195, ICPP-2196, and ICPP-2205 were revised and are now based on depth to screen bottoms instead of drilled depths. The physical changes are the result of repair work in November 2011 and surveying work which was completed in April 2012. - Update the Detection Monitoring Limits (DMLs) in Table 3c for the CPP-601/627/640 landfilll unit based on additional statistical analyses completed in April 2012	- Page 28 of the Permit, Table 2. WCF Ground water Monitoring Network, was revised to reflect correct elevations - Page 29 of the Permit, Table 2a. CPP-602/627/640 Ground Water Monitoring Network, was revised to reflect correct elevations - Page 33 of the Permit, Table 3c. CPP-601/627/640 Post-Closure Analyte List, Estimated Quantitation Limits (EQL), Ground Water Protection Standards (GPS), and Detection Monitoring Limits, was revised to reflect new DMLs.

PERMIT MODIFICATION TRACKING LOG

PERMIT MODIFICATION REQUEST (PMR) NUMBER	DATE PMR SUBMITTED TO DEQ	DATE PMR APPROVED BY DEQ	PMR CLASS	SUMMARY OF CHANGES REQUESTED IN THE PMR	PORTION OF THE PERMIT &/OR ATTACHMENTS AFFECTED BY THE PMR
7 (continued)	December 12, 2012	February 25, 2013	2	- Add Table 3d for the CPP-601/627/640 landfill unit DMLs for constituents that differ among wells. - Update the Part A Permit Application to incorporate the use of Part A Forms revised by the EPA in December 2011 - Add information regarding a combined network/dual purpose wells was added to address the potential lack of water in some of the CPP-601/627/640 landfill unit wells - Add Appendix J-2. Statistical Analysis of Perched Groundwater Monitoring Data for the CPP-601/627;640 Facility (RPT-2126.33-00 Rev. 0, April 2012) - Attachment 4 – Revision Log updated to incorporate changes requested/approved in Class 2 PMR	- Page 33 of the Permit, Table 3d. CPP-601/627/640 Detection Monitoring Limits (µg/L) for Constituents That Differ Among Wells, was added to the Permit - Entire Part A was updated and added to Attachment 1 – Part A Permit Application - Attachment 3 – Section J – Additional Information, Section J.5.1,l page J-31 - Attachment 3 – Section J - Additional Information, Appendix J-2 - Attachment 4 – Revision Log, Revised to reflect Class 2 PMR

PERMIT MODIFICATION TRACKING LOG					
PERMIT MODIFICATION REQUEST (PMR) NUMBER	**DATE PMR SUBMITTED TO DEQ**	**DATE PMR APPROVED BY DEQ**	**PMR CLASS**	**SUMMARY OF CHANGES REQUESTED IN THE PMR**	**PORTION OF THE PERMIT &/OR ATTACHMENTS AFFECTED BY THE PMR**
Volume 21 Permit Reapplication	April 2013	TBD	N/A	- Attachment 1 – Section A, Facility Description Figure A-1 was revised to reflect the current conditions at the INTEC - Attachment I – Section I, Figure I-1 INTEC topographic map was revised to reflect current conditions at the INTEC, Figure I-2 was revised to reflect the current surface drainage at INTEC, and Figure I-3 was revised to reflect the current INTEC sanitary waste system - Attachment 1 - Required Notices was updated to include applicable CPP-601/627/640 information/ notices. - Attachment 2 - Updated examples of inspection forms were included to reflect current information/ forms - Attachment 2 – Updated examples of Sampling and Analysis Plan Tables were included to reflect current SAP tables/information	

PERMIT MODIFICATION TRACKING LOG					
PERMIT MODIFICATION REQUEST (PMR) NUMBER	**DATE PMR SUBMITTED TO DEQ**	**DATE PMR APPROVED BY DEQ**	**PMR CLASS**	**SUMMARY OF CHANGES REQUESTED IN THE PMR**	**PORTION OF THE PERMIT &/OR ATTACHMENTS AFFECTED BY THE PMR**
Volume 21 Permit Reapplication (continued)	April 2013	TBD	N/A	- Administrative/editorial information such as the Document Title, Attachment Cover Pages, Document Headers, etc. were revised to reflect that the information being submitted is a "Permit Reapplication" as required by Permit Condition I.G and IDAPA 58.01.05.012 and 40 CFR 270.10(h) and 270.30(b). Additionally, IDAPA citations were revised/corrected as necessary	

ATTACHMENT 5

ATTACHMENT 5 Well Information consisting of:

- INTEC Monitoring Wells - Map
- INTEC Monitoring Wells - Construction Diagrams

ATTACHMENT 5 - INTEC MONITORING WELLS - MAP

HWMA/RCRA INTEC POST-CLOSURE PERMIT REAPPLICATION

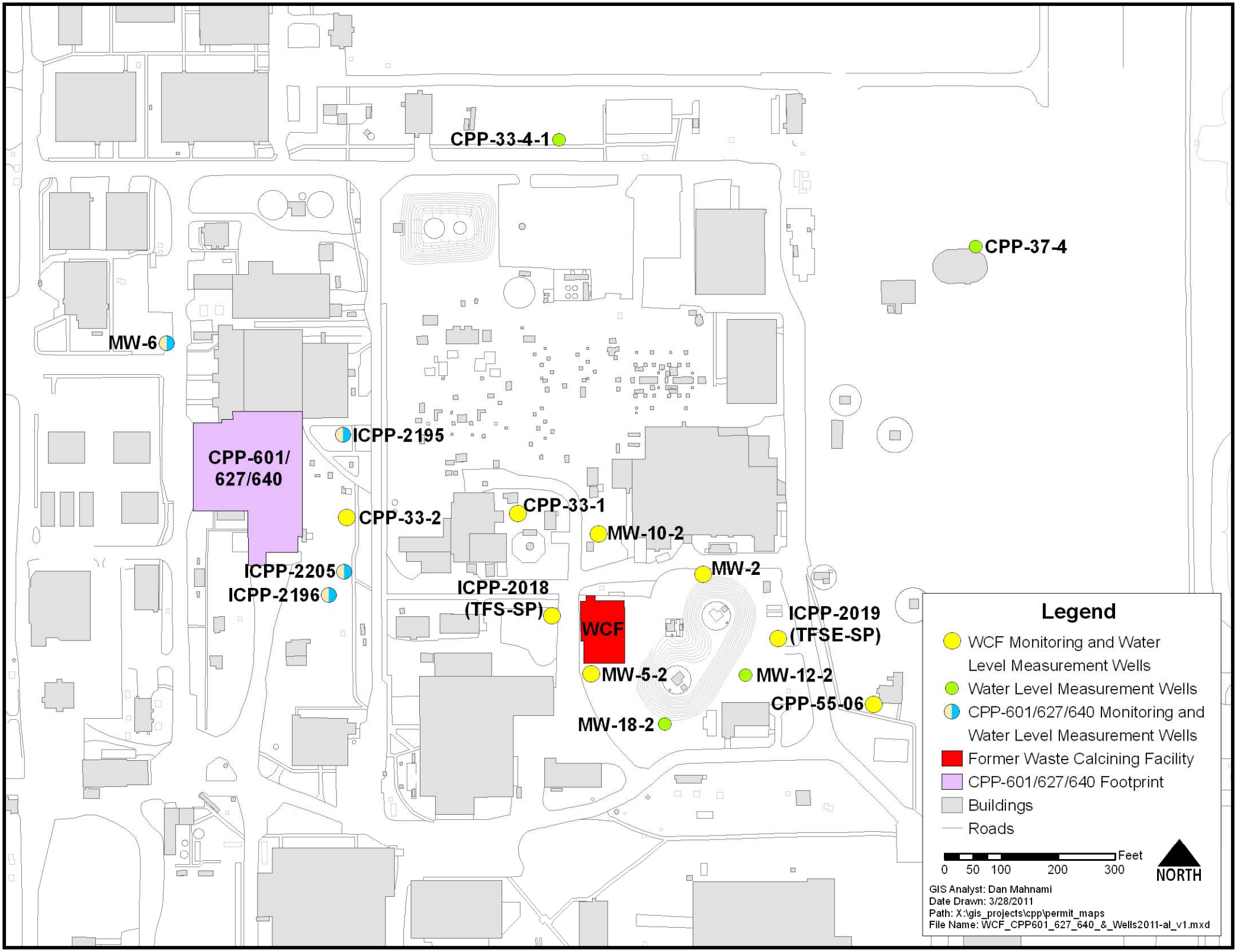
Volume 21

Waste Calcine Facility and CPP-601/627/640

Attachment 5

INTEC Monitoring Wells - Map

April 2013


CPP-33-4-1
CPP-37-4
MW-6
CPP-601/
627/640
ICPP-2195
CPP-33-2
CPP-33-1
MW-10-2
MW-2
ICPP-2205
ICPP-2196
ICPP-2018
(TFS-SP)
WCF
ICPP-2019
(TFSE-SP)
MW-5-2
MW-12-2
CPP-55-06
MW-18-2
Legend
WCF Monitoring and Water Level Measurement Wells
Water Level Measurement Wells
CPP-601/627/640 Monitoring and Water Level Measurement Wells
Former Waste Calcining Facility
CPP-601/627/640 Footprint
Buildings
Roads
Feet
0 50 100 200 300
NORTH
GIS Analyst: Dan Mahnami
Date Drawn: 3/28/2011
Path: X:\gis_projects\cpp\permit_maps
File Name: WCF_CPP601_627_640_&_Wells2011-al_v1.mxd

ATTACHMENT 5 - MONITORING WELLS CONSTRUCTION DIAGRAMS

HWMA/RCRA INTEC POST-CLOSURE PERMIT REAPPLICATION

Volume 21

Waste Calcine Facility and CPP-601/627/640

Attachment 5
INTEC Monitoring Wells - Construction Diagrams

April 2013

Land Surface: 4914.33(29)BC
4917.82(88)BC
(29)MP
(88)MP

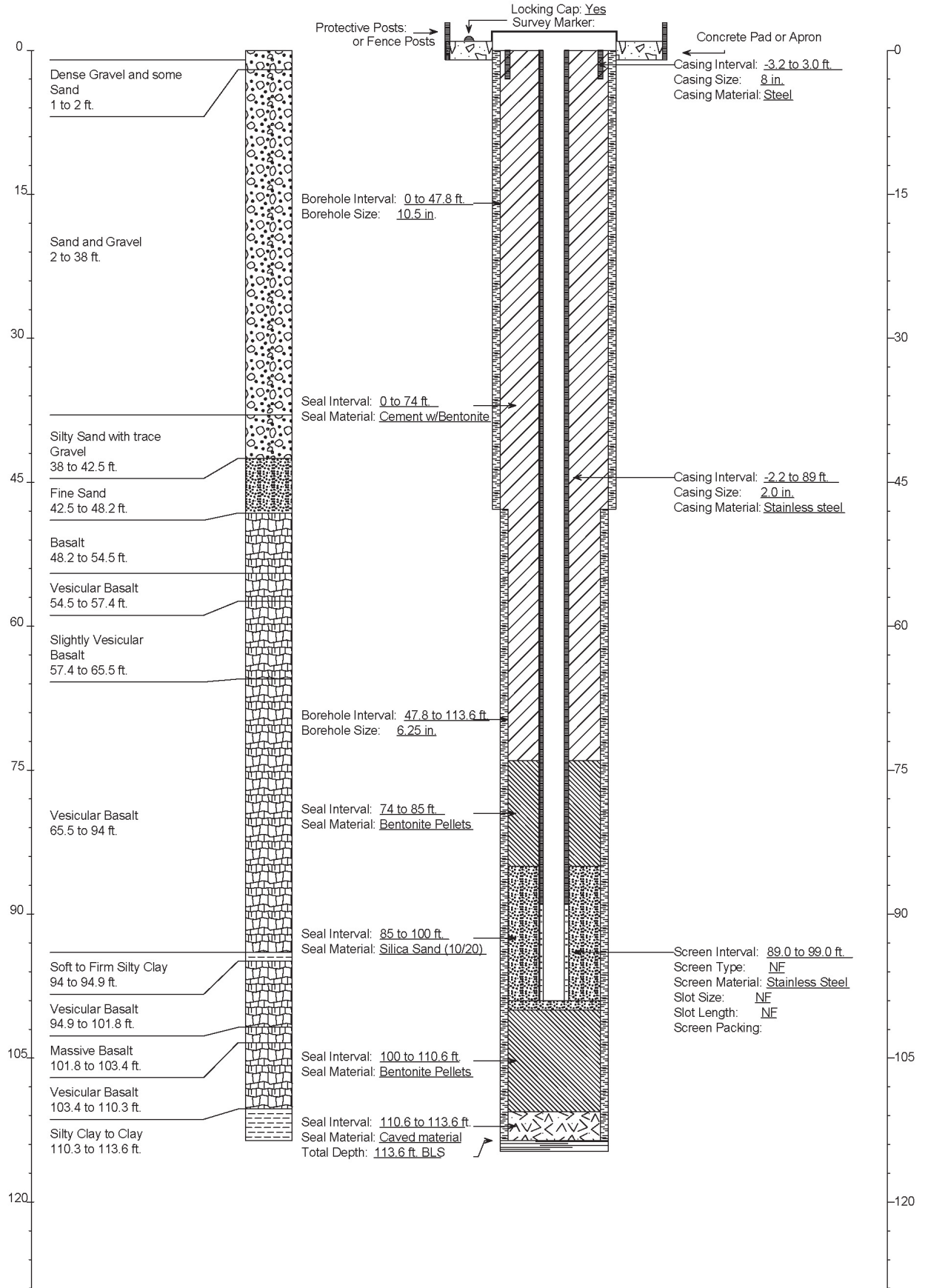
WellName: CPP-33-1

08/24/1993

Facility: ICPP
Well Type: Observation Well
Well Status: Active
Year Drilled: 1991
Total Depth: 113.6
Completion Depth: 100

Driller: Hawley Bros.
Geologist: Brandenberger,Norton
Drilling Method: HSA and Core
Drilling Fluid: Air

Water Level: NF
Water Level Date: NF
Water Level Access: NF



Land Surface: 4913.29(29)BC
4916.78(88)BC
(29)MP
(88)MP

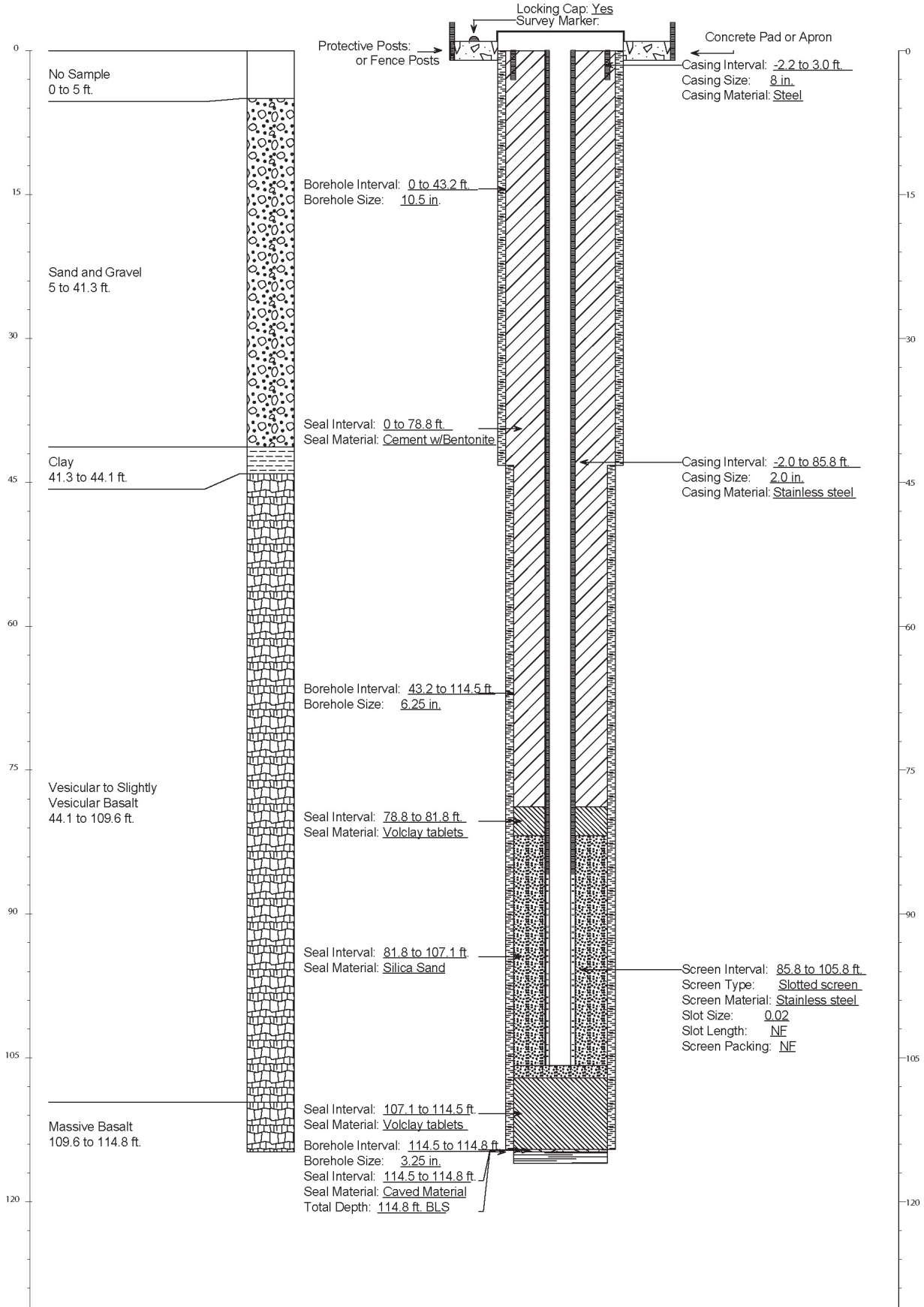
WellName: CPP-33-2

Facility: ICPP
Well Type: Observation Well
Well Status: Active
Year Drilled: 1990
Total Depth: 114.8
Completion Depth: 107.1

08/19/1993

Driller: Hawley Bros.
Geologist: B Smith
Drilling Method: HSA and Core
Drilling Fluid: Air

Water Level: NF
Water Level Date: NF
Water Level Access: NF



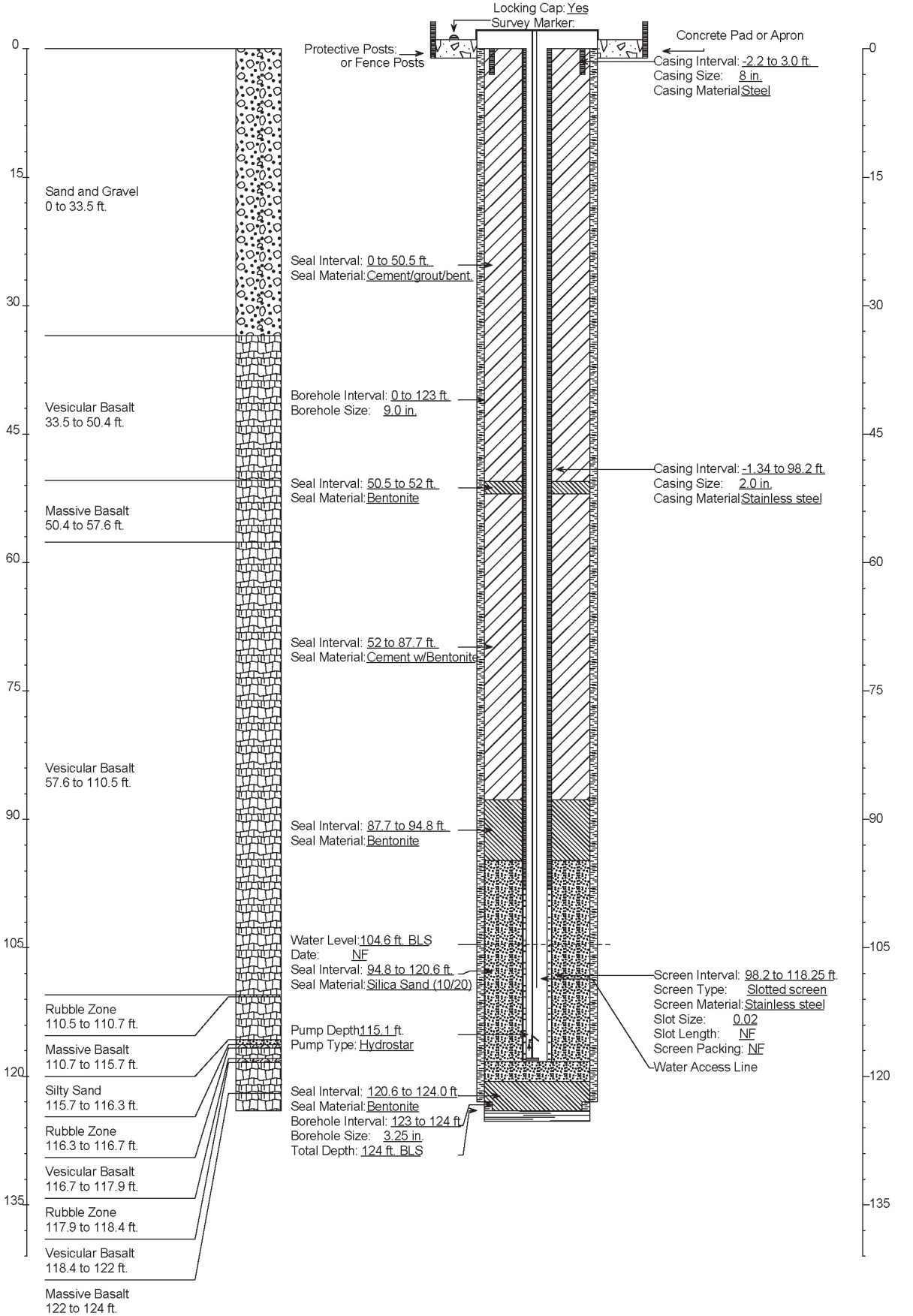
WellName: CPP-33-4-1

Facility: ICPP
Well Type: Observation Well
Well Status: Active
Year Drilled: 1990
Total Depth: 124
Completion Depth: 120.6

08/24/1993

Driller: Hawley Bros.
Geologist: Smith, Norton
Drilling Method: Hollow Stem Augers
Drilling Fluid: NF

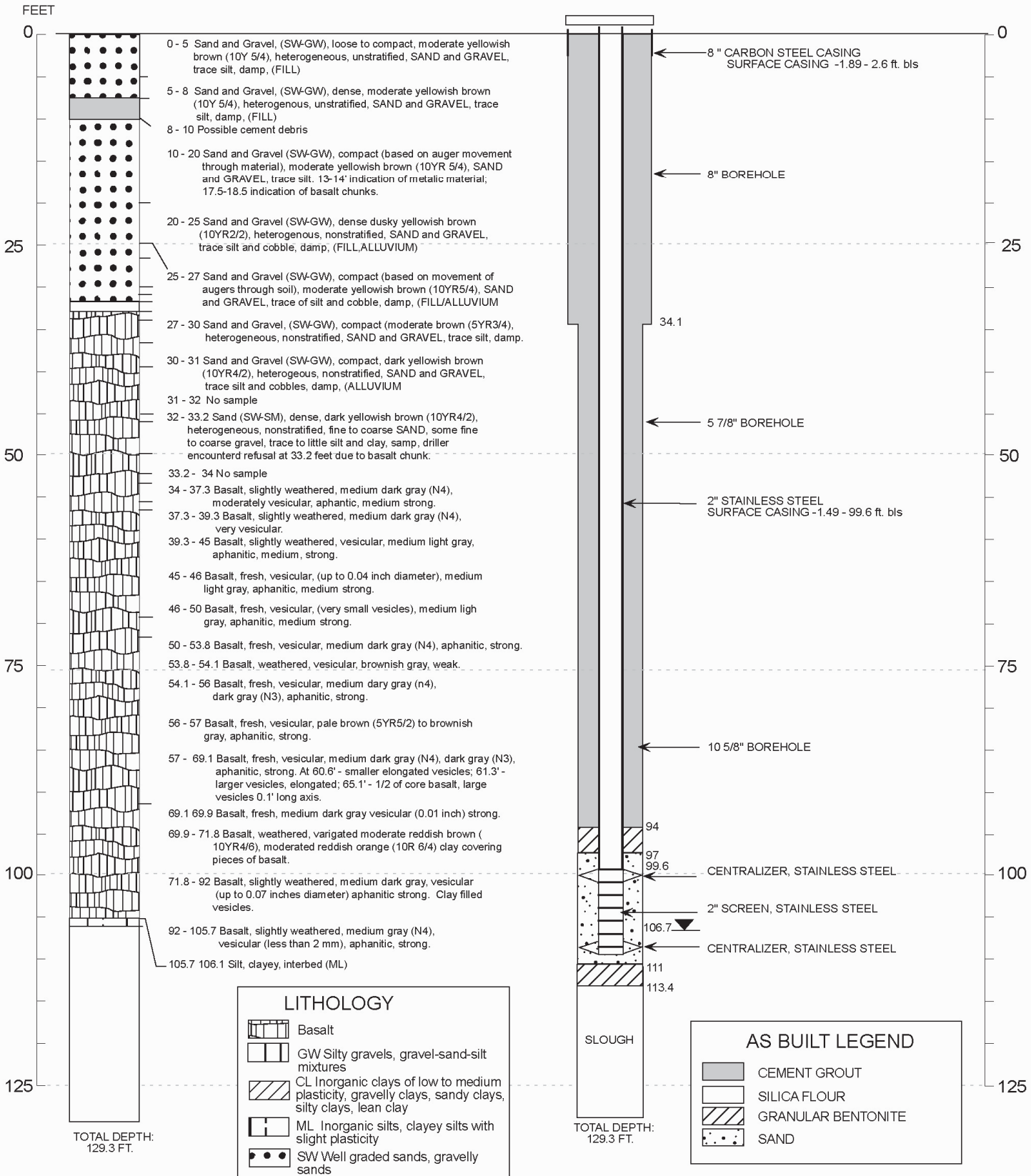
Water Level: 104.6
Water Level Date: NF
Water Level Access: Line



WELL NAME: CPP-37-4
Facility: INTEC
Well Type: Observation
Well Status N/A
Year Drilled: 1991
Total Depth 129.3 ft.
Start Date August, 1991
End Date August, 1991
Completion Depth: 110 ft.

Driller: J. Wozniewicz; K.E. Pilgrim
Geologist: D. Hawley
Drill Method: Hollow Stem Auger/ HxB core/Tri core
Drill Fluid: Air
Land Surface:

Todays Date: 4/28/2004
Water Level: 106.7 ft
Water Level/ Date: 8/28/1991
Water Level Access:



Land Surface: 4911.61(29)BC
4915.10(88)BC
(29)MP
(88)MP

Modification Date: 12/17/2008

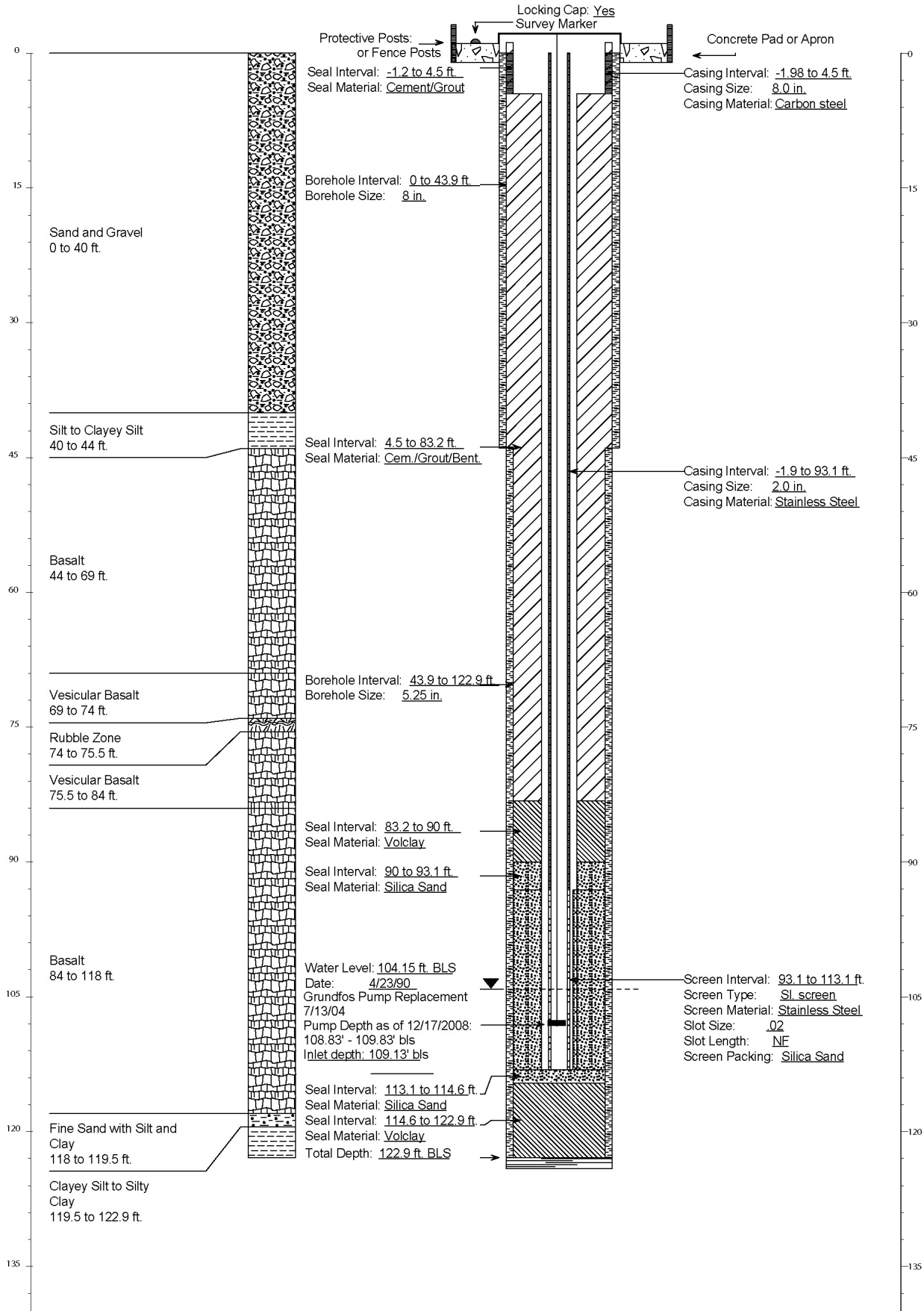
WellName: CPP-55-06

09/11/1993

Facility: ICPP
Well Type: Observation Well
Well Status: Active
Year Drilled: 1990
Total Depth: 122.9
Completion Depth: 114.6

Driller: Hawley
Geologist: SJB
Drilling Method: Core
Drilling Fluid: NF

Water Level: 104.15
Water Level Date: 4/23/90
Water Level Access: NF

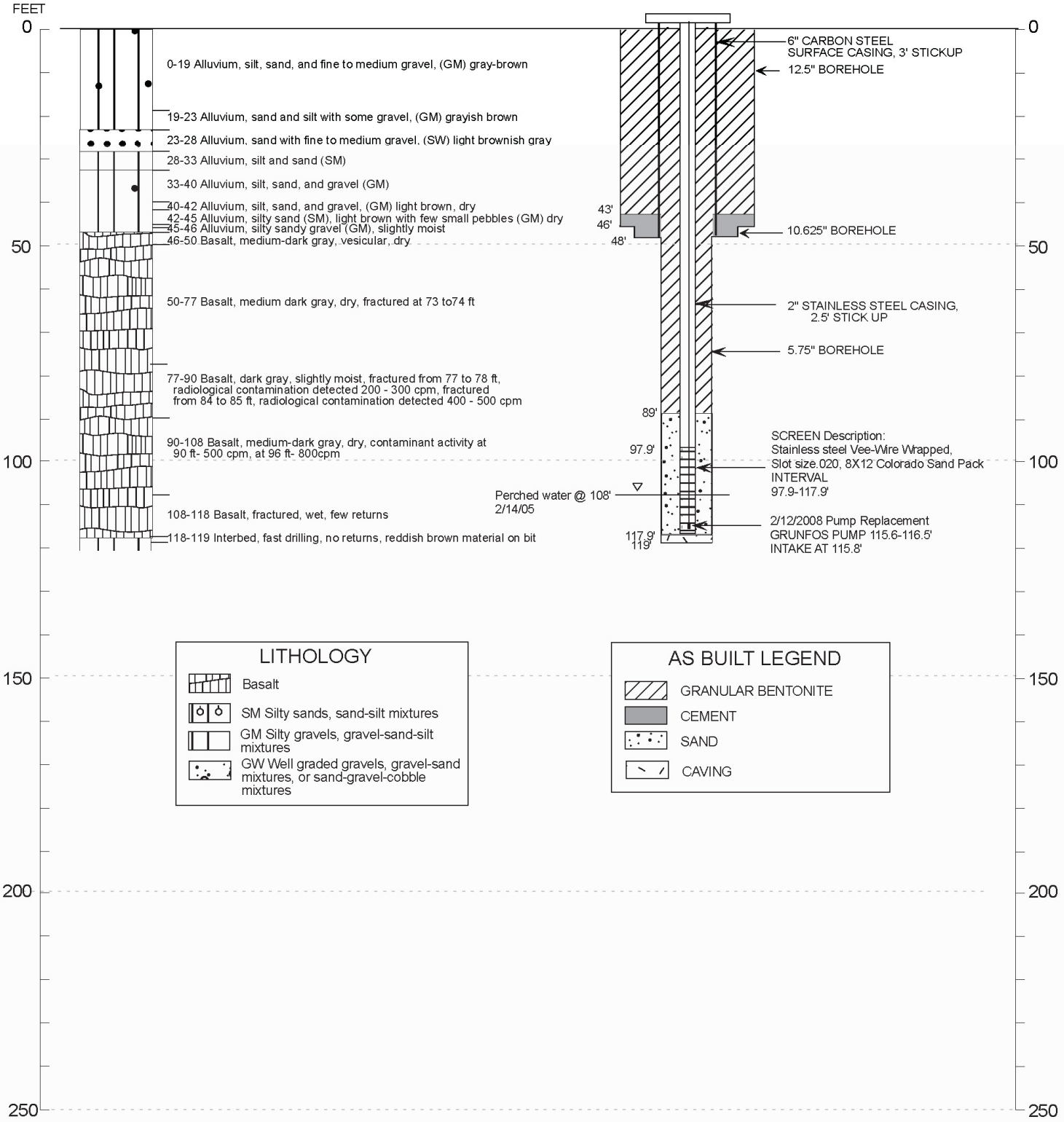


Modification Date:
2/12/2008

WELL NAME: **ICPP-2018**
Facility: INTEC
Well Type: Monitoring
Well Status: Active
Year Drilled: 2005
Total Depth: 119'
Drilling Start Date: 2/10/05 End Date: 2/14/05
Completion Start Date: 2/17/05 End Date: 2/18/05
Completion Depth: 117.9'

Driller: Dynatec/Rosario, Jensen
Geologist: Manchester, Oberhansley, Myers
Drill Method: Vacuum Rotary/ Air Rotary
Drill Fluid: Air/Water
Elevation: 4913.26 (29 BC) 4915.85 (29 MP) 4916.75 (88 BC) 4919.34 (88MP)

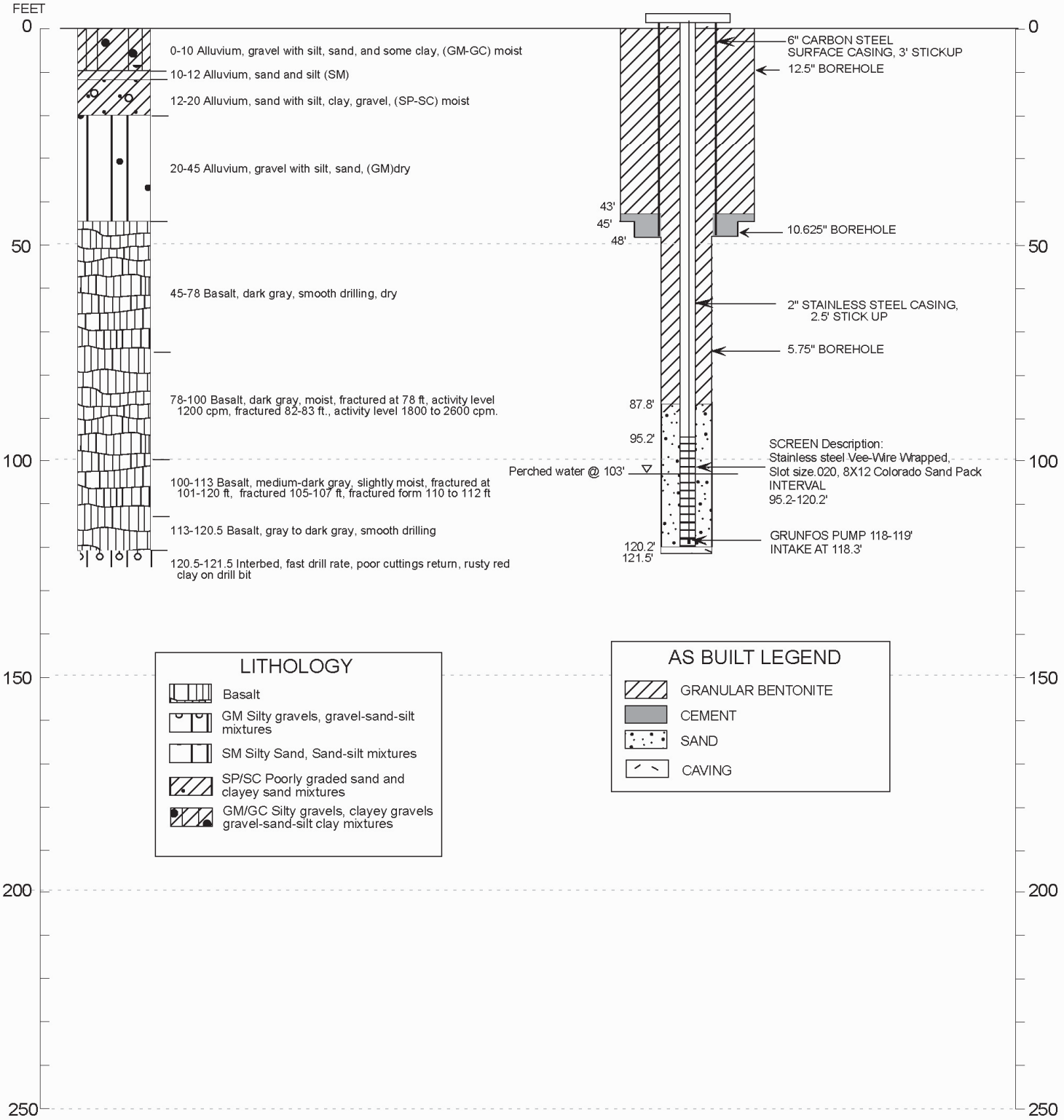
Todays Date: 5/18/05
Water Level: 108' BLS
Water Level Date: 2/14/05
Water Level Access: 2" well casing



WELL NAME: **ICPP-2019**
Facility: INTEC
Well Type: Monitoring
Well Status: Active
Year Drilled: 2005
Total Depth: 121.5'
Drilling Start Date: 2/4/05 End Date: 2/9/05
Completion Start Date: 2/19/05 End Date: 2/19/05
Completion Depth: 120.2'

Driller: Dynatec/Rosario, Jensen
Geologist: Manchester, Oberhansley, Myers
Drill Method: Vacuum Rotary/ Air Rotary
Drill Fluid: Air/Water
Elevation: 4912.06 (29 BC) 4914.65 (29 MP) 4915.55 (88 BC) 4918.14 (88MP)

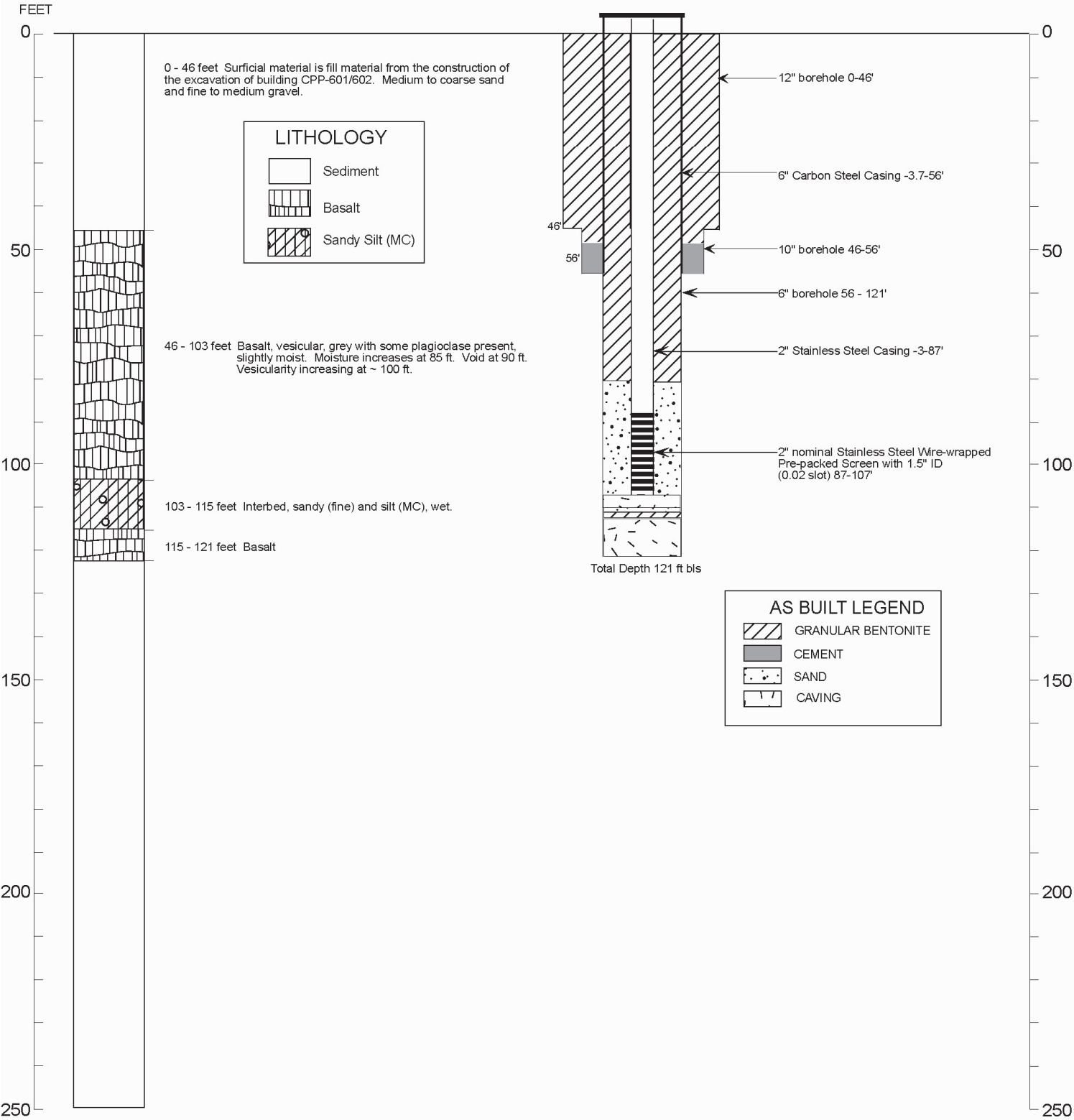
Todays Date: 5/23/05
Water Level: 103' BLS
Water Level Date: 2/9/05
Water Level Access: 2" well casing



WELL NAME: **ICPP-2195**
WELL ID: **2195**
Facility: INTEC
Well Type: Monitoring
Well Status: Active
Year Drilled: 2010
Total Depth: 121 ft bls
Drilling Start Date 2/16/2010 Drilling End Date 2/25/2010
Completion Depth: 107 ft bls

Driller: Major Drilling
Geologist: W. Jolley
Drill Method: Conventional Rotary
Drill Fluid: Air
Land Surface: (27) M.P. 4914.23 (29) B.C. (83) M.P. 4917.72 (88) B.C.

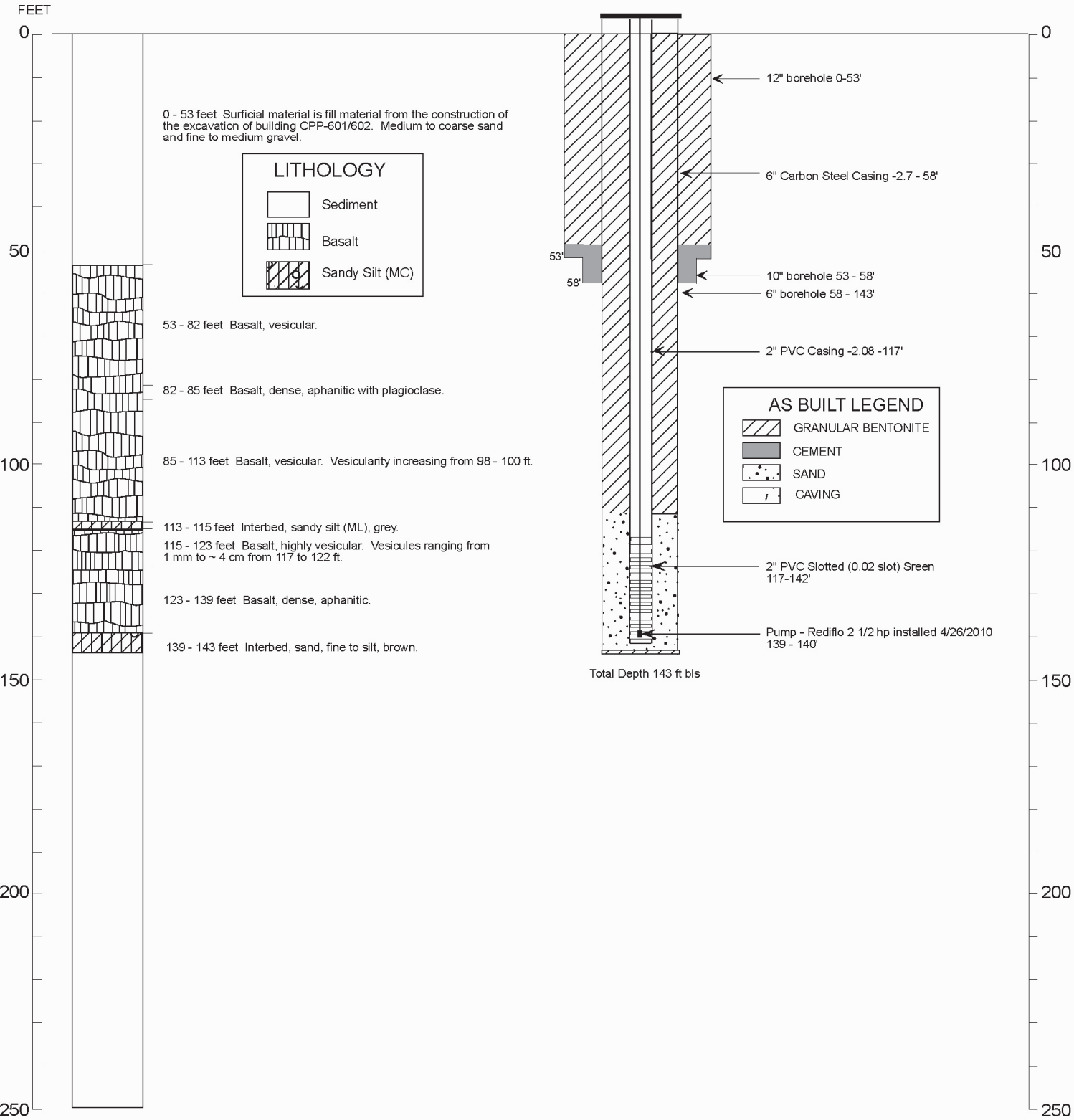
Date Drawn: 5/6/2010
Water Level: 102.0 ft bls
Water Level/ Date: 2/25/2010
Water Level Access: Hole



WELL NAME: **ICPP-2196**
WELL ID: **2196**
Facility: INTEC
Well Type: Monitoring
Well Status: Active
Year Drilled: 2010
Total Depth: 143 ft bls
Drilling Start Date 3/01/2010 Drilling End Date 3/22/2010
Completion Depth: 142 ft bls

Driller: Major Drilling
Geologist: W. Jolley
Drill Method: Conventional Rotary
Drill Fluid: Air
Land Surface: (27) M.P. 4914.40 (29) B.C. (83) M.P. 4917.89 (88) B.C.

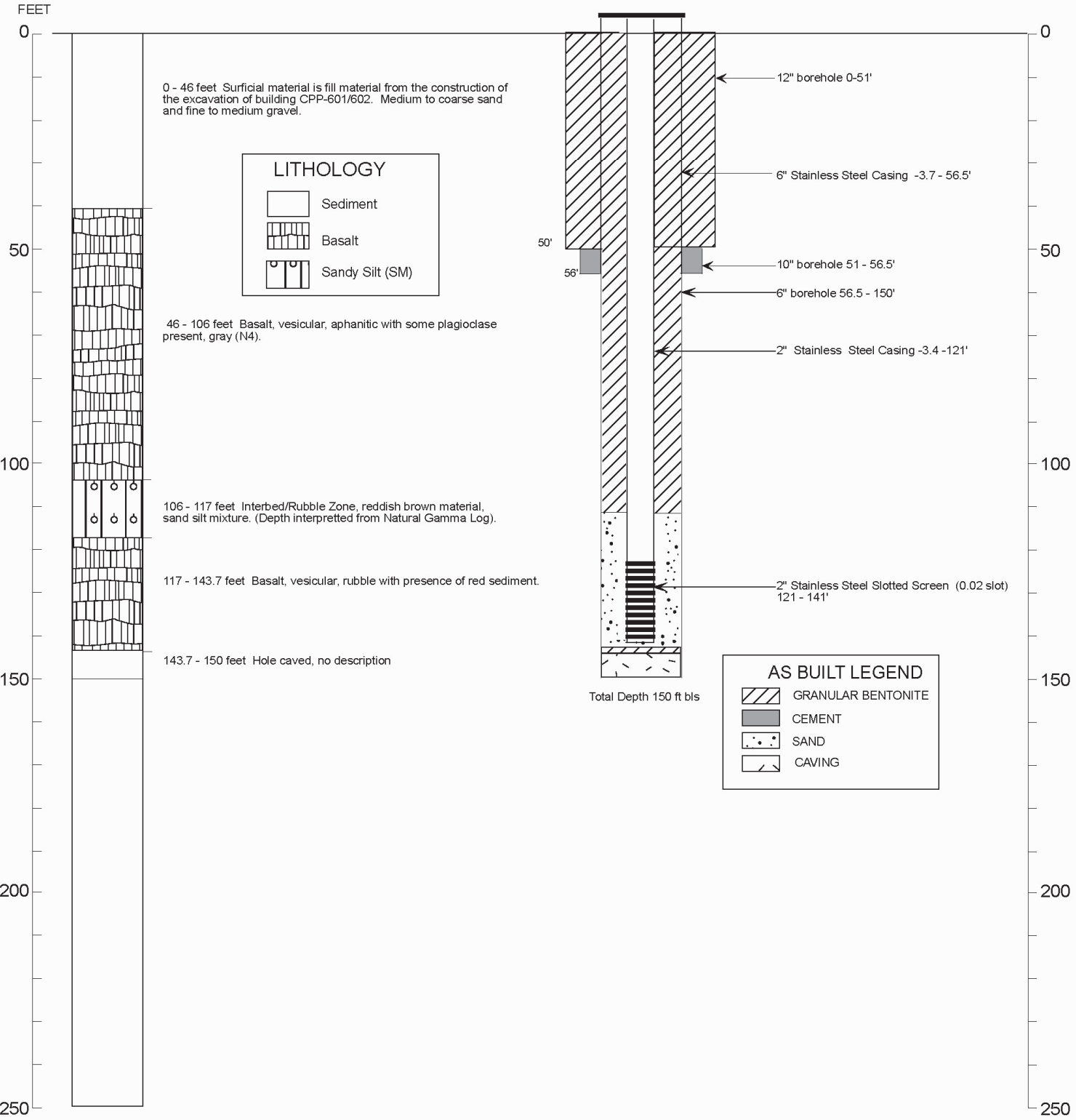
Date Drawn: 5/10/2010
Water Level: Dry
Water Level/ Date:
Water Level Access:



WELL NAME: **ICPP-2205**
WELL ID: **2205**
Facility: INTEC
Well Type: Monitoring
Well Status: Active
Year Drilled: 2010
Total Depth: 150 ft bls
Drilling Start Date 3/23/2010 Drilling End Date 3/29/2010
Completion Depth: 141 ft bls

Driller: Major Drilling
Geologist: D. Smith
Drill Method: Conventional Rotary
Drill Fluid: Air
Land Surface: (27) M.P. 4913.47 (29) B.C. (83) M.P. 4916.96 (88) B.C.

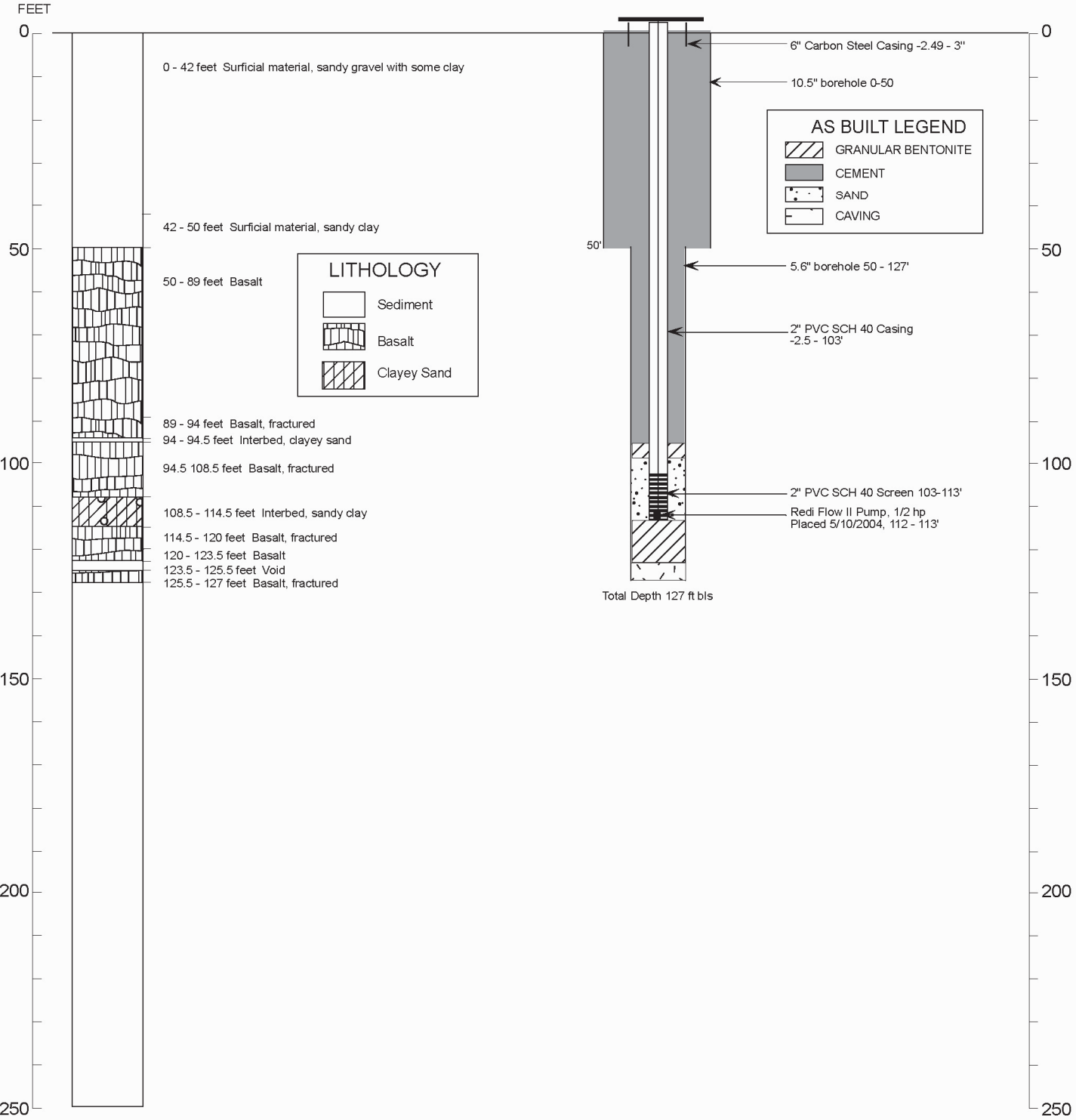
Date Drawn: 5/11/2010
Water Level: 126.16 ft bls
Water Level/ Date: 3/24/2010
Water Level Access: Hole



WELL NAME: ICPP-MON-P-002 (MW-2)
WELL ID: 1058
Facility: INTEC
Well Type: Monitoring
Well Status: Active
Year Drilled: 1994
Total Depth: 127 ft bls
Completion Depth: 113.2 ft bls

Driller: Hawley Bros.
Geologist: MSE
Drill Method: Air Rotary
Drill Fluid: Air, Water, Foam
Land Surface: (27) M.P. 4912.3 (29) B.C. (83) M.P. 4915.79 (88) B.C.

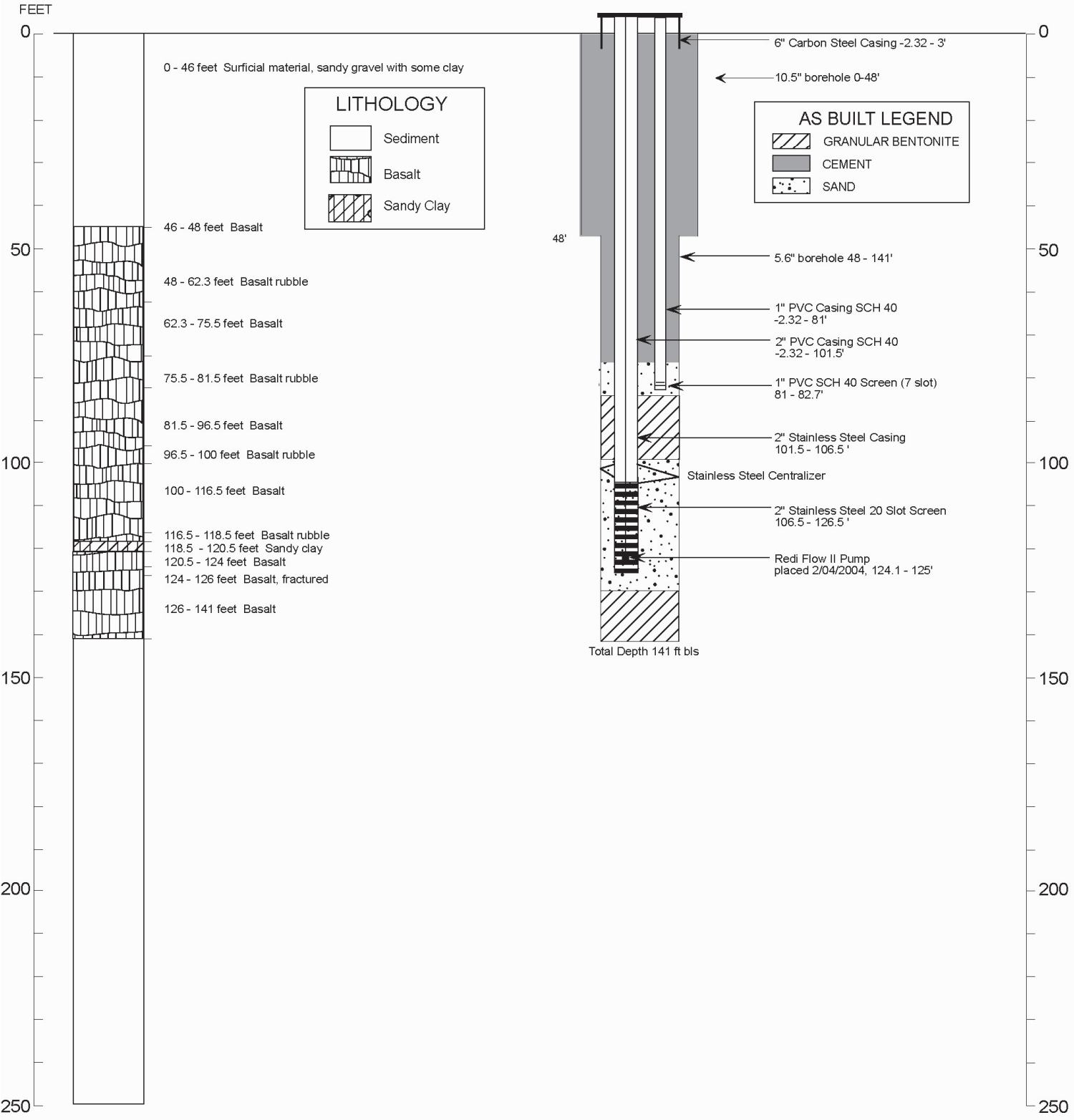
Date Drawn: 7/07/2011
Water Level: 105.77
Water Level/ Date: 1/20/1994
Water Level Access:



WELL NAME: **ICPP-MON-P-005 (MW-5)**
WELL ID: **1061**
Facility: INTEC
Well Type: Monitoring
Well Status: Active
Year Drilled: 1993
Total Depth: 141 ft bls
Completion Depth: 126.5 ft bls

Driller: Hawley Bros.
Geologist: MSE
Drill Method: Air Rotary
Drill Fluid: Air
Land Surface: (27) M.P. 4915.59 (29) B.C. (83) M.P. 4919.08 (88) B.C.

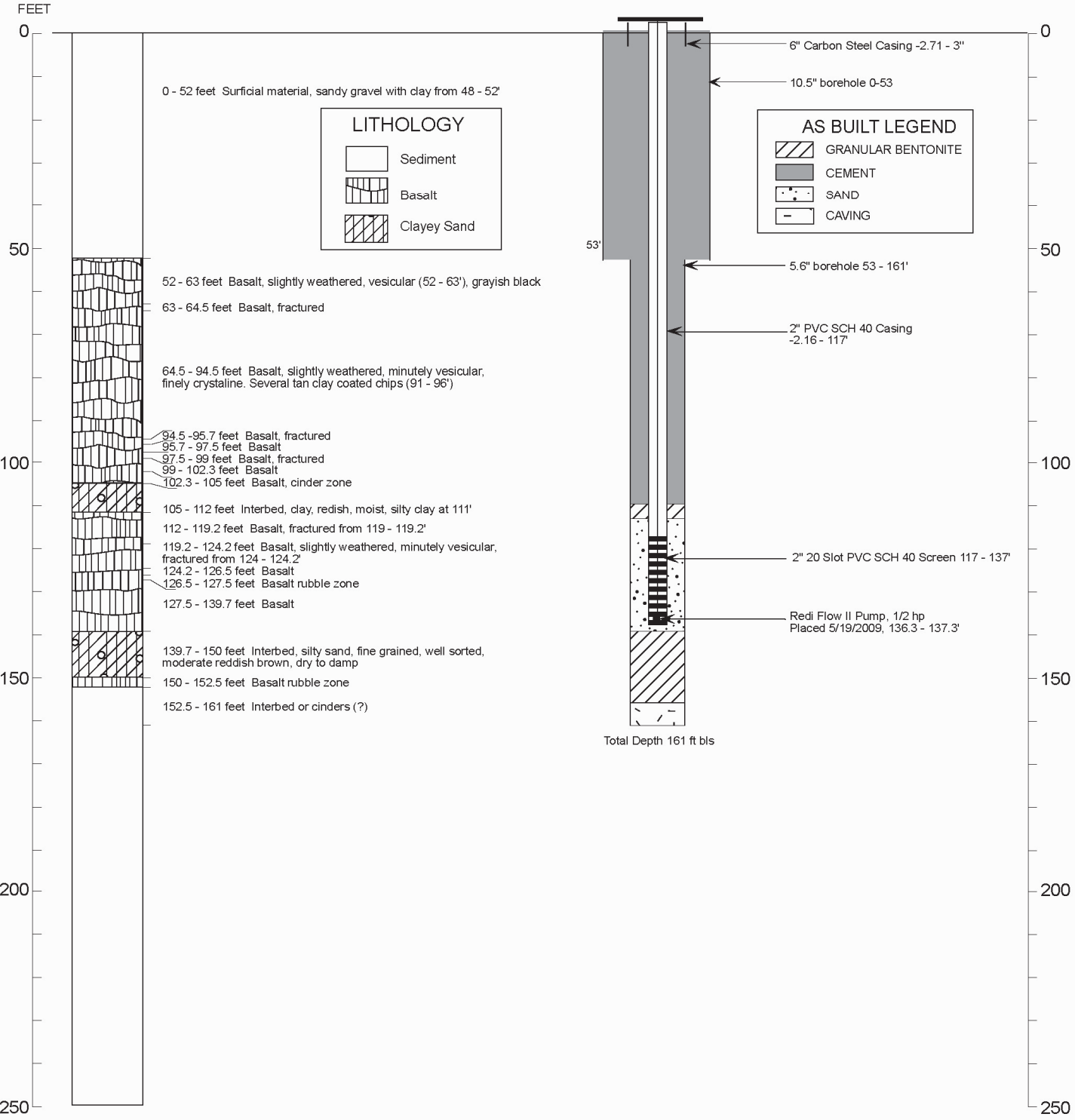
Date Drawn: 7/12/2011
Water Level: 109.98
Water Level/ Date: 1/20/1994
Water Level Access: 2 " PVC



WELL NAME: ICPP-MON-P-006 (MW-6)
WELL ID: 1062
Facility: INTEC
Well Type: Monitoring
Well Status: Active
Year Drilled: 1993
Total Depth: 161 ft bls
Completion Depth: 137 ft bls

Driller: Hawley Bros.
Geologist: MSE
Drill Method: Air Rotary
Drill Fluid: Air
Land Surface: (27) M.P. 4915.73 (29) B.C. (83) M.P. 4919.22 (88) B.C.

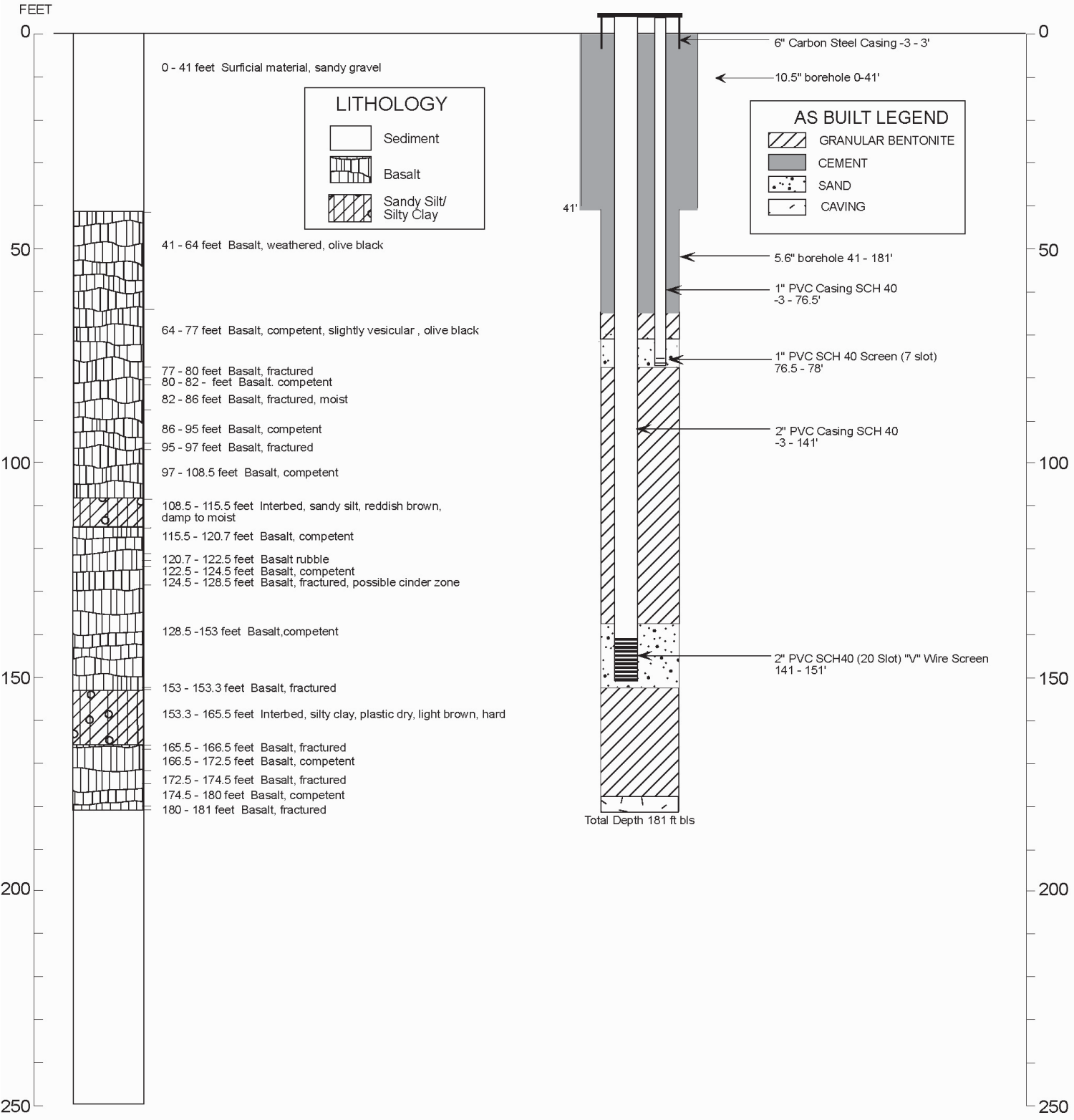
Date Drawn: 7/26/2011
Water Level: 124.55 ft
Water Level/ Date: 01/20/1994
Water Level Access: PVC



WELL NAME: **ICPP-MON-P-010 (MW-10)**
WELL ID: **1066**
Facility: INTEC
Well Type: Monitoring
Well Status: Active
Year Drilled: 1993
Total Depth: 181 ft bls
Completion Depth: 151 ft bls

Driller: Hawley Bros.
Geologist: MSE
Drill Method: Air Rotary
Drill Fluid: Air
Land Surface: (27) M.P. 4913.88 (29) B.C. (83) M.P. 4917.37 (88) B.C.

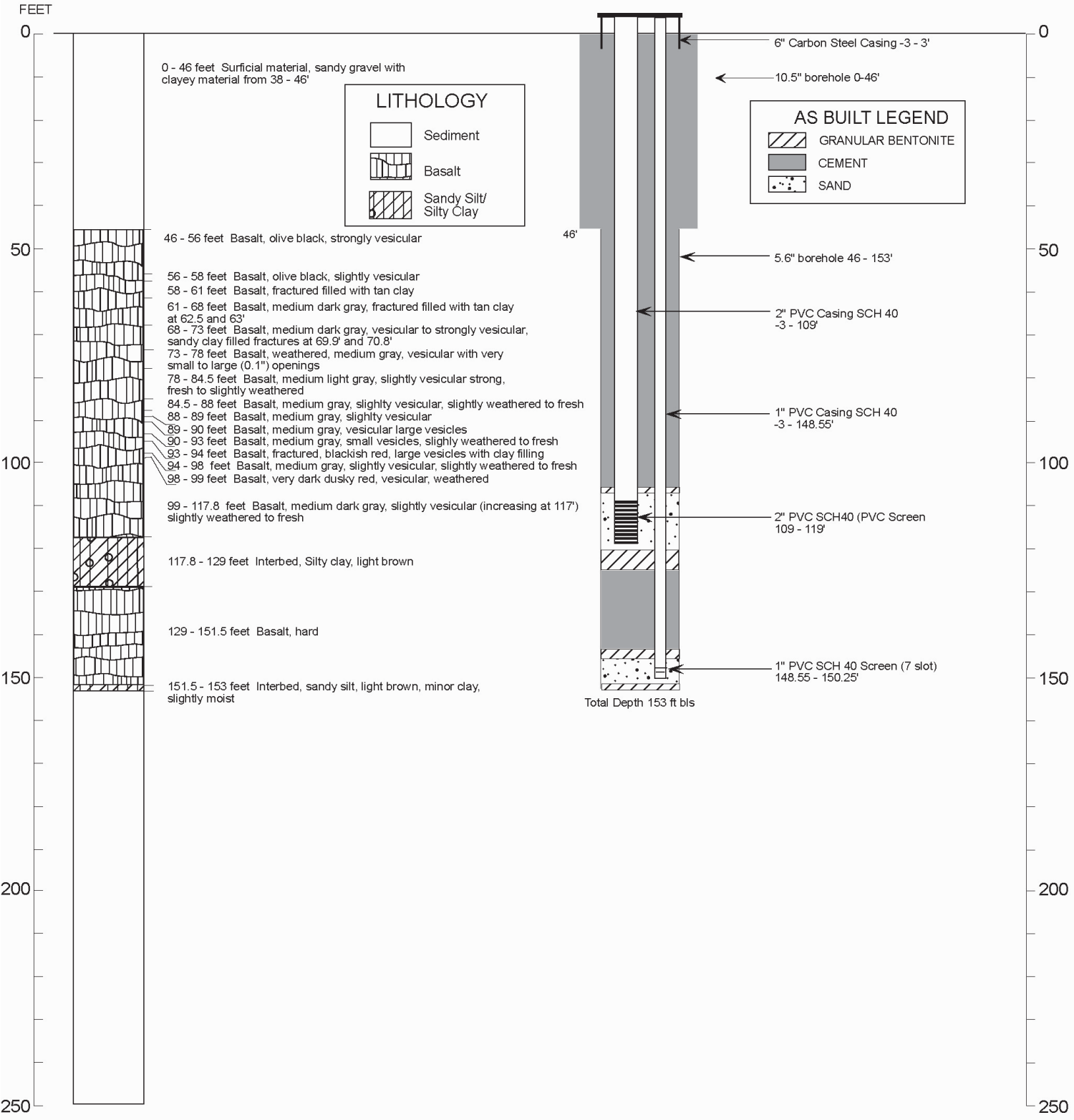
Date Drawn: 7/12/2011
Water Level:
Water Level/ Date:
Water Level Access:



WELL NAME: ICPP-MON-P-013 (MW-12)
WELL ID: 1068
Facility: INTEC
Well Type: Monitoring
Well Status: Active
Year Drilled: 1994
Total Depth: 153 ft bls
Completion Depth: 150.25 ft bls

Driller: Hawley Bros.
Geologist: MSE
Drill Method: Air Rotary
Drill Fluid: Air
Land Surface: (27) M.P. 4912.14 (29) B.C. (83) M.P. 4915.63 (88) B.C.

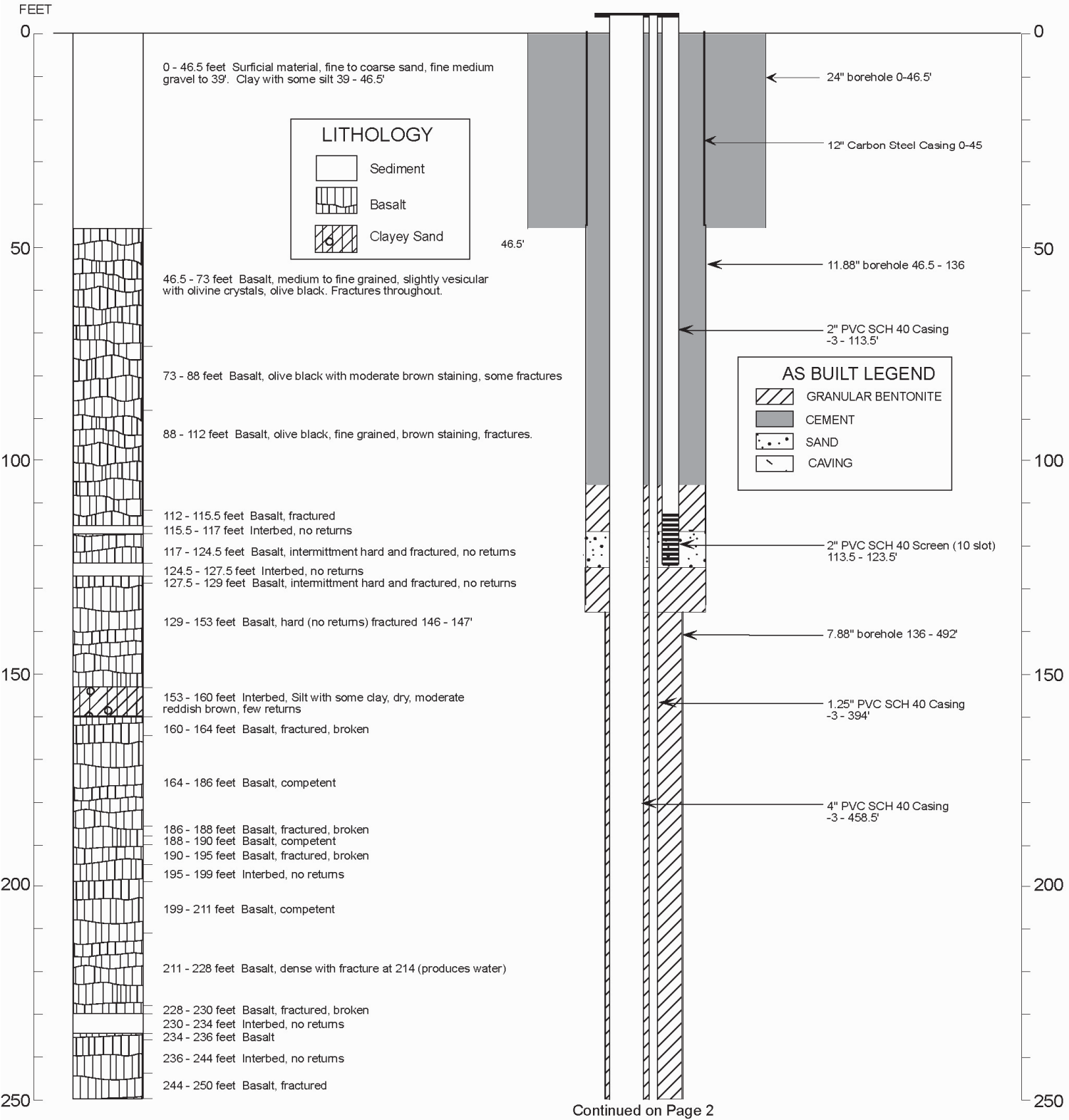
Date Drawn: 7/19/2011
Water Level:
Water Level/ Date:
Water Level Access:



WELL NAME: ICPP-MON-P-019 (MW-18)
WELL ID: 1187
Facility: INTEC
Well Type: Monitoring
Well Status: Active
Year Drilled: 1994
Total Depth: 492 ft bls
Completion Depth: 478.5 ft bls

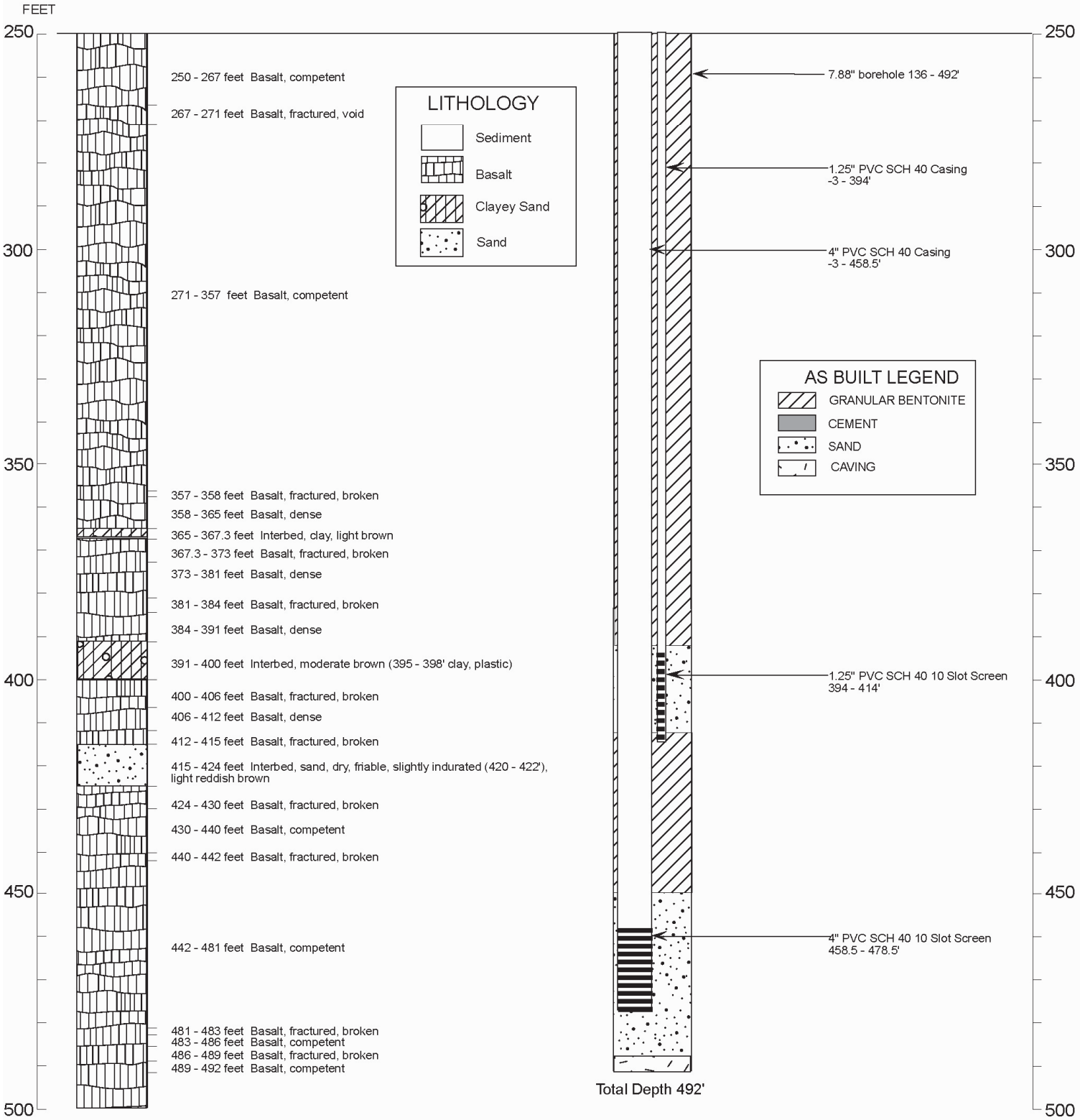
Driller: Hawley Bros.
Geologist: MSE
Drill Method: Air Rotary
Drill Fluid: Air, Water, Foam
Land Surface: (27) M.P. 4913.74 (29) B.C. (83) M.P. 4917.23 (88) B.C.

Date Drawn: 7/19/2011
Water Level: 459.83
Water Level/ Date: 12/2/1994
Water Level Access:



Continued on Page 2

WELL NAME: ICPP-MON-P-019 (MW-18)
WELL ID: 1187



ATTACHMENT 6 - MONITORING RESULTS

HWMA/RCRA INTEC POST-CLOSURE PERMIT REAPPLICATION

Volume 21
Waste Calcine Facility and CPP-601/627/640

Attachment 6
Monitoring Results

April 2013

Monitoring Results

Perched Groundwater Monitoring Results and Snake River Plain Aquifer Monitoring Results were previously submitted to the DEQ as part of the original INTEC Post- Closure Permit Application (respectively Appendix VI and VII of the Volume 21 Permit Application – Revision 2, September 2002) and are part of the administrative record for this Post-Closure Permit and are therefore not being included in this permit reapplication.

ATTACHMENT 7 - CERTIFICATION

REGULATORY CERTIFICATION [IDAPA 58.01.05.012; 40 CFR 270.11(d) and 270.30(k)]

Volume 21 – INTEC HWMA/RCRA Post-Closure Permit Reapplication

April 2013

The undersigned certifies as required per 40 CFR 270.11(d) and 270.30(k) as follows:

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision according to a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

Operator Signature

3/18/2013

Kevin W. Daniels, Vice President ESH&Q
CH2M WG Idaho, LLC.

Date

12. Notification of Hazardous Secondary Material (HSM) Activity

Y☐ N ☒ Are you notifying under 40 CFR 260.42 that you will begin managing, are managing or will stop managing hazardous secondary material under 40 CFR 261.2(a)(2)(ii), 40 CFR 261.4(a)(23), (24), or (25)?

If "Yes", you must fill out the Addendum to the Site Identification Form: Notification for Managing Hazardous Secondary Material.

13. Comments

14. Certification. I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fines and imprisonment for knowing violations. For the RCRA Hazardous Waste Part A Permit Application, all owner(s) and operator(s) must sign (se 40 CFR 270.10(b) and 270.11).

Signature of legal owner, operator, or an authorized representative	Name and Official Title (type or print)	Date Signed (mm/dd/yyyy)
	K. W. Daniels, Vice President, CH2M-WG, Idaho, LLC.	03/18/2013
	R. B. Provencher, Manager, Department of Energy Idaho Operations Office	4/12/13

REGULATORY CERTIFICATION [IDAPA 58.01.05.012; 40 CFR 270.11(d) and 270.30(k)]

Volume 21 – INTEC HWMA/RCRA Post-Closure Permit Reapplication

April 2013

The undersigned certifies as required per 40 CFR 270.11(d) and 270.30(k) as follows:

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision according to a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

Owner Signature

Richard B. Provencher, Manager
Department of Energy Idaho Operations Office

4/12/13
Date

REGULATORY CERTIFICATION [IDAPA 58.01.05.012; 40 CFR 270.11(d) and 270.30(k)]

Volume 21 – INTEC HWMA/RCRA Post-Closure Permit Reapplication Notice of Deficiency Response

September 2013

The undersigned certifies as required per 40 CFR 270.11(d) and 270.30(k) as follows:

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision according to a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

Operator Signature

9/10/2013

Kevin W. Daniels, Vice President ESH&Q
CH2M WG Idaho, LLC.

Date

REGULATORY CERTIFICATION [IDAPA 58.01.05.012; 40 CFR 270.11(d) and 270.30(k)]

Volume 21 – INTEC HWMA/RCRA Post-Closure Permit Reapplication
Notice of Deficiency Response

September 2013

The undersigned certifies as required per 40 CFR 270.11(d) and 270.30(k) as follows:

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision according to a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

Owner Signature

9/19/13

Richard B. Provencher, Manager
Department of Energy Idaho Operations Office

Date