U.S. Department of Energy
Oakland Operations Office, Oakland, California 94612

Lawrence Livermore National Laboratory
University of California, Livermore, California 94550

UCRL-AR-202492

Final Remedial Investigation/Feasibility Study for the Pit 7 Complex at Lawrence Livermore National Laboratory Site 300

Authors:

M. Taffet
L. Ferry
V. Madrid
T. Carlsen
Z. Demir
J. Valett*
M. Dresen*
W. Daily
S. Coleman
V. Dibley

Contributors:

S. Bilir*
S. Chamberlain
B. Esser
B. Hudson
W. McNab
R. Depue
K. Heyward

July 2005

*Weiss Associates, Emeryville, California

Environmental Protection Department
Environmental Restoration Division

This work was performed under the auspices of the U. S. Department of Energy by the University of California, Lawrence Livermore National Laboratory under Contract W-7405-Eng-48.

UCRL-AR-202492

Final Remedial Investigation/Feasibility Study for the Pit 7 Complex at Lawrence Livermore National Laboratory Site 300

Authors:

M. Taffet
L. Ferry
V. Madrid
T. Carlsen
Z. Demir
J. Valett*
M. Dresen*
W. Daily
S. Coleman
V. Dibley

Contributors:

S. Bilir*
S. Chamberlain
B. Esser
B. Hudson
W. McNab
R. Depue
K. Heyward

July 2005

*Weiss Associates, Emeryville, California

Environmental Protection Department

Environmental Restoration Division

Certification

I certify that the work presented in this report was performed under my supervision. To the best of my knowledge, the data contained herein are true and accurate, and the work was performed in accordance with professional standards.

MICHAEL JEFFREY TAFFET
NO. 5616

MICHAEL JEFFREY TAFFET
NO. 129

Michael J Taffet June 30, 2005

Michael J. Taffet PhD. Date
California Registered Geologist
No. 5616
License expires: May 31, 2007
California Certified Hydrogeologist
No. 129
License expires: May 31, 2007

Acknowledgments

The Site 300 Ground Water Project is supported by a number of people who contribute significantly to this effort. The authors and technical editors are pleased to recognize the efforts of the following people and services:

S. Baker, H. Barnes, N. Blankenship, BC Laboratories, Inc., M. Buscheck, D. Burruss, Caltest Analytical Laboratory, B. Clark, R. Davis, K. Ehman, Eberline Laboratories, S. Ezzedine, R. Ferry, R. Foster, B. Goodrich, D. Graves, L. Graves, L. Griffith, J. Johnson, C. Holtzapple, R. Kearns, S. Lambaren, S. Martins, W. McConihe, E. McIlvian, P. McKereghan, G. Metzger, G. Nimz, Norcal Geophysics, S. Orloff, G. Santucci, Sequoia Analytical, E. Walter, and C. Wells.

Table of Contents

List of Figures

List of Tables

Appendices

Executive Summary

Purpose

This Remedial Investigation/Feasibility Study report was prepared for the Pit 7 Complex at the Lawrence Livermore National Laboratory (LLNL) Site 300 experimental test facility. This document is in accordance with the terms of the Site 300 Federal Facility Agreement between the U.S. Department of Energy (DOE), the U.S. Environmental Protection Agency (EPA), the California Department of Toxic Substances Control (DTSC), and the California Regional Water Quality Control Board (RWQCB). The Federal Facility Agreement provides the framework for the conduct of the site cleanup and preparation of necessary regulatory documents. This Remedial Investigation/Feasibility Study is prepared in compliance with the requirements of the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) as amended by the Superfund Amendments and Reauthorization Act of 1986 (SARA). The Remedial Investigation/Feasibility Study forms the basis for evaluating and selecting alternative technologies for remediation of contaminants at the Pit 7 Complex.

The purpose of this Remedial Investigation/Feasibility Study is: (1) to identify the nature and extent of contamination in the Pit 7 Complex and evaluate impacts to human and ecological receptors that could be exposed to contaminated environmental media and (2) to develop and evaluate alternatives for remedial action at the Pit 7 Complex in accordance with CERCLA/SARA.

The Remedial Investigation process described in this report involved:

- Identifying contaminants of concern (COCs) in environmental media at the Pit 7 Complex.
- Identifying the nature and extent of COCs released to soil and ground water.
- Evaluating the potential routes of migration of these chemicals.
- Evaluating potential impacts to human health and the environment as a result of exposure to COCs.

The Feasibility Study process involved:

- Identifying remedial action objectives based on Applicable or Relevant and Appropriate Requirements (ARARs).
- Identifying general response actions.
- Identifying potential remedial technologies and associated process options.
- Screening various technologies and process options based on their applicability, effectiveness, implementability, and cost.
- Assembling the selected technologies into alternatives for contaminant remediation at the Pit 7 Complex.
- Analyzing the alternatives using the U.S. EPA evaluation criteria.

The Remedial Investigation/Feasibility Study process will lead to the selection and subsequent implementation of cost-effective remedial alternatives to protect human health and the environment.

Site Background

LLNL Site 300 is a DOE experimental test facility operated by the University of California. The facility is located in the eastern Altamont Hills about 13 miles southeast of the main Laboratory site in Livermore and 8.5 miles southwest of Tracy. Site 300 is primarily a high-explosives test facility that supports the LLNL weapons program in research, development, and testing associated with weapons components. During past LLNL operations, a number of contaminants were released to the environment.

Prior to August 1990, investigations of potential chemical contamination at Site 300 were conducted under the oversight of the California RWQCB-Central Valley Region. In August 1990, Site 300 was placed on the National Priorities List. Since then, all investigations and remediation have been conducted in accordance with CERCLA under the oversight of the three supervising regulatory agencies: EPA, RWQCB, and DTSC. DOE is the lead agency for all environmental restoration activities and is the sole source of funding.

Site 300 has been divided into eight Operable Units based on the nature and extent of contamination. The Pit 7 Complex is part of the Building 850/Pits 3 and 5 Operable Unit. The Building 850 release site was addressed in the Site-Wide Feasibility Study (Ferry et al., 1999) that presented remedial alternatives for cleanup of this area. An interim remedy was selected for the Building 850 area in the Interim Site-Wide Record of Decision (DOE, 2001). In February 2000, DOE and the regulatory agencies agreed that additional site characterization and evaluation of cleanup options were necessary prior to selecting a remedy for the Pit 7 Complex. Consequently, the Pit 7 Complex was not covered in the Interim Site-Wide Record of Decision. Following the Pit 7 Complex Remedial Investigation/Feasibility Study, a preferred remedy will be presented in a Proposed Plan and at a public meeting. DOE will prepare an amendment to the Interim Site-Wide Record of Decision that will include the selected remedy for the Pit 7 Complex.

Land use surrounding LLNL Site 300 includes private ranch land used primarily for cattle grazing, state-owned land used for recreational motorcycle riding, a state ecological reserve, a fireworks storage facility, and privately-owned land planned for future residential development. The site boundary closest to the Pit 7 Complex is located approximately 2,500 ft north of the landfills and is adjacent to private ranch land.

Remedial Investigation

The Pit 7 Complex is located in the East and West Firing Areas in the northwest portion of Site 300 (Figure EX-1). The majority of activities in the East and West Firing Areas involve testing of conventional explosives that can be used to detonate nuclear devices. No actual fissionable material is used in these hydrodynamic tests. The Pit 7 Complex release site area consists of the Pits 3, 4, 5, and 7 landfills. From the 1958 until 1988, debris from explosive tests conducted within the East and West Firing Areas was disposed in the unlined landfill pits. The waste placed in the pits included wood; plastic; material and debris from tent structures; pea gravel; and exploded test assemblies that frequently contained tritium and depleted uranium. In 1992, LLNL constructed an engineered cap over Pits 4 and 7 in compliance with Resource Conservation and Recovery Act requirements. The cap was designed to prevent precipitation infiltration and leaching of contaminants.

DOE/LLNL have conducted environmental investigations at Site 300 since 1981 to characterize the extent of contamination in soil, bedrock, ground water and surface water. From 1981 to 2000, environmental investigation activities included records searches and interviews; the installation of ground water monitor wells; sampling of soil, bedrock, ground water and surface water; soil vapor surveys; hydraulic testing; evaluating observed water level responses to rainfall events; geologic mapping; ground water transport modeling; geologic and hydrogeologic characterization; and risk assessment.

In February 2000, DOE and the regulatory agencies agreed that additional site characterization and evaluation of cleanup options were necessary prior to selecting a remedy for the Pit 7 Complex. Although this RI/FS briefly discusses the results of these previous investigations, the main emphasis is on investigations conducted since the Site-Wide Feasibility Study data cutoff (October 1999). The investigations conducted since that time included installing additional ground water monitor wells, performing geophysical and helium-3 soil vapor surveys of the pits, conducting a water budget study to refine the hydrogeological conceptual model, and installing a permeable reactive barrier for an *in situ* treatability test for removal of uranium in ground water. The results of the remedial investigations were used to identify contaminant release sites/source areas, evaluate the nature and extent of contamination and to develop a conceptual site model for the Pit 7 Complex area.

A baseline risk assessment was conducted to provide the basis for implementing a remedial action and to identify the potential exposure pathways that need to be addressed by the remedial alternatives. It serves as the baseline to indicate what potential risks might exist if no action were taken at the Pit 7 Complex. Using data compiled during the assessment of the nature and extent of contamination in the Pit 7 Complex area, the environmental fate and transport of contaminants was evaluated to identify actual or potential routes of migration of the source medium to other environmental media of exposure. Public health and ecological risk were estimated based on potential exposure point concentrations. The estimated baseline human health risks and hazards for the Pit 7 Complex were evaluated for adult onsite exposure and residential exposure, as well as additive risk. The results of the risk assessment indicated there was a risk to onsite workers in the Pit 7 Complex area from potential inhalation of tritium evaporating from subsurface soil. In addition, there is a potential for onsite workers to be exposed to the contaminants in the pit waste in the case of unintentional excavation into the pits. In some cases, the preliminary remediation goals (PRGs) for the unrestricted use of ground and surface water were exceeded in the Pit 7 Complex area. However, surface and ground water from the Pit 7 Complex area is not currently used and is not anticipated to be used in the near future. There were no unacceptable hazards to ecological receptors identified. The results of the risk assessment and an evaluation of current and potential future impacts to ground water were used to identify COCs in environmental media at the Pit 7 Complex.

The Remedial Investigation did not indicate any COCs in surface soil. Tritium and uranium were identified as COCs in subsurface soil and bedrock. The Pit 7 Complex is situated in the bottom of a valley. Ground water elevation beneath the Complex is correlated to rainfall. During periods of heavy rainfall, ground water rises into the bottom of the landfills and liberates contaminants in the buried waste. This has resulted in the release of tritium, uranium, volatile organic compounds, perchlorate, and nitrate to ground water. No COCs were identified in surface water (Spring 24), the only perennial natural surface water within the Pit 7 Complex area.

The remedial action objectives and the remedial alternatives were designed to address the risks to onsite workers, as well as restoring water quality to protect beneficial uses of ground water in impacted areas.

Feasibility Study

The purpose of this Feasibility Study is to develop and evaluate alternatives for remedial action at the Pit 7 Complex in accordance with CERCLA/SARA. The Feasibility Study process began with the identification of remedial action objectives based on Applicable or Relevant and Appropriate Requirements (ARARs). General response actions and potential remedial technologies and associated process options were then identified and screened based on their applicability, effectiveness, implementability, and cost. The technologies that were retained from the screening process were assembled into alternatives for contaminant remediation at the Pit 7 Complex. Finally, the alternatives were evaluated against the U.S. EPA evaluation criteria. This Feasibility Study provides the basis for a subsequent Proposed Plan in which a remedy is proposed for regulatory agency and public comment. An Amendment to the Site-Wide Interim Record of Decision, which will specify the selected remedy for the Pit 7 Complex, will follow the Proposed Plan.

ARARs and Remedial Action Objectives

Remedial action objectives are specific goals for protecting human health and the environment. They are developed by evaluating ARARs that protect human health and the environment and the results of remedial investigations, including the human health and ecological risk assessments. The National Contingency Plan specifies that remedial action objectives be developed which address: (1) contaminants of concern, (2) media of concern, (3) potential exposure pathways, and (4) preliminary remediation levels. Cleanup standards for contaminant concentrations in the Final Record of Decision will be between drinking water Maximum Contaminant Levels (MCLs) and background.

The Feasibility Study assembles General Response Actions and technologies into implementable alternatives that will satisfy the following remedial action objectives:

For Human Health Protection:

- Prevent human ingestion of ground water containing contaminant concentrations (single carcinogen) above the State and federal MCLs and any more stringent water quality objectives.
- Prevent human inhalation of tritium volatilizing from subsurface soil to air that pose an excess cancer risk greater than 10^{-6} or hazard index greater than 1, a cumulative excess cancer risk (all carcinogens) in excess of 10^{-4}, or a cumulative hazard index (all noncarcinogens) greater than 1.
- Prevent human exposure to contaminants in media of concern that pose a cumulative excess cancer risk (all carcinogens) greater than 10^{-4} and/or a cumulative hazard index greater than one (all noncarcinogens).

For Environmental Protection:

- Restore water quality, at a minimum, to water quality objectives that are protective of beneficial uses within a reasonable timeframe, and to prevent plume migration. Maintain existing water quality that complies with water quality objectives. This will apply to both individual and multiple constituents that have additive toxicology or carcinogenic effects.

- Ensure existing contaminant conditions do not change so as to threaten wildlife populations and vegetation communities.

There are no remedial action objectives presented for COCs in surface soil or surface water as no human health risk greater than 10^{-6}, hazard index greater than 1, or ecological hazard index greater than 1 has been identified for these contaminants in surface soil or surface water at the Pit 7 Complex.

Identification and Screening of General Response Actions and Remedial Action Technologies

General response actions are general categories of remedial activities and technologies that can potentially achieve the remedial action objectives and can mitigate potential exposure to, control the migration of, and/or remediate COCs at the site. Nine General Response Actions have been identified for the Pit 7 Complex:

1. No Further Action.
2. Risk and Hazard Management.
3. Monitoring.
4. Monitored Natural Attenuation.
5. Source Control /Containment.
6. Plume Control.
7. *In-situ* Treatment.
8. Extraction and *Ex situ* Treatment.
9. Landfill Waste Removal and Disposal.

A general response action category may include several technologies that are applicable to the site conditions. For example, source control/containment can be achieved by excavating pit waste, installing grout curtains, slurry walls, or a drainage diversion system.

In Chapter 3, several general response actions and remedial technologies capable of achieving the remedial action were screened and evaluated based on applicability, effectiveness, implementability, and cost. The various actions and technologies that passed the screening were retained and combined to form the alternative remedies (Table EX-1)

Description of Remedial Alternatives

Chapter 3 presents remedial alternatives that were assembled to address COCs in subsurface soil/rock and ground water in the Pit 7 Complex area. To develop these remedial alternatives, retained technologies and response actions were combined based on applicability, implementability, effectiveness, cost, site- and area-specific requirements, and best professional judgment.

Five remedial alternatives were assembled to meet remedial action objectives by: (1) preventing exposure to contaminants that pose an unacceptable risk (tritium in subsurface soil), (2) controlling or containing the contaminant source area in the pits and underlying vadose zone to prevent further releases to ground water, and (3) addressing COCs already present in ground water at concentrations that impact the beneficial uses of ground water.

The first alternative (no further action) is presented as required by EPA guidance to provide a baseline for comparison to other remedial alternatives and is the postulated basis of the baseline risk assessment. Except for Alternative 1 (No Further Action), all alternatives include a risk and hazard management component to prevent exposure to contaminants posing an unacceptable risk. All alternatives except for Alternative 1 also include a monitoring component to: (1) track changes in plume concentrations and size that results from remediation or natural process, (2) evaluate the effectiveness of the remedial action, (3) determine when cleanup standards are achieved, and (4) detect any future releases of contaminants. A source control or containment component is included in each alternative designed to prevent further releases of contaminants from the landfill pits. The technologies used to control or contain the contaminant source include the excavation and removal of the pit waste (Alternatives 2, 3a, and 3b), installing a hydraulic barrier (Alternative 4b), and hydraulic control through drainage diversion (Alternatives 4a, 5a, and 5b). COCs present in ground water are addressed in each alternative although the general response action/technology differs and includes monitored natural attenuation (Alternatives 2 through 5) and plume migration control through ex situ or in situ treatment of contaminants (Alternatives 3a, 3b, 5a, and 5b). A summary of the alternative components and costs are presented in Table EX-2. The different combinations of response actions and technologies that were retained in the screening process and included as components of the remedial alternatives are summarized in Table EX-3.

Some remediation-specific details are presented in this Remedial Investigation/Feasibility Study for purposes of costing and strategy presentation. The actual site- and technology-specific details will be based on additional data and design criteria presented in the Pit 7 Complex Remedial Design report.

Detailed Analysis of Remedial Alternatives

A detailed analysis of the remedial alternatives was conducted and is presented in Chapter 3. The National Oil and Hazardous Substances Pollution Contingency Plan (NCP) identifies nine criteria to be used in the detailed analysis of alternatives:

1. Overall protection of human health and the environment.
2. Compliance with ARARs.
3. Long-term effectiveness and permanence.
4. Reduction in toxicity, mobility, and volume through treatment.
5. Short-term effectiveness.
6. Implementability.
7. Cost.
8. State acceptance.
9. Community acceptance.

Each alternative was evaluated to how each alternative addresses the first seven EPA criteria specified by the National Contingency Plan (Table 3-12). In addition, a comparative evaluation was conducted of the characteristics of each alternative against other alternatives with respect to these seven criteria (Table 3-13).

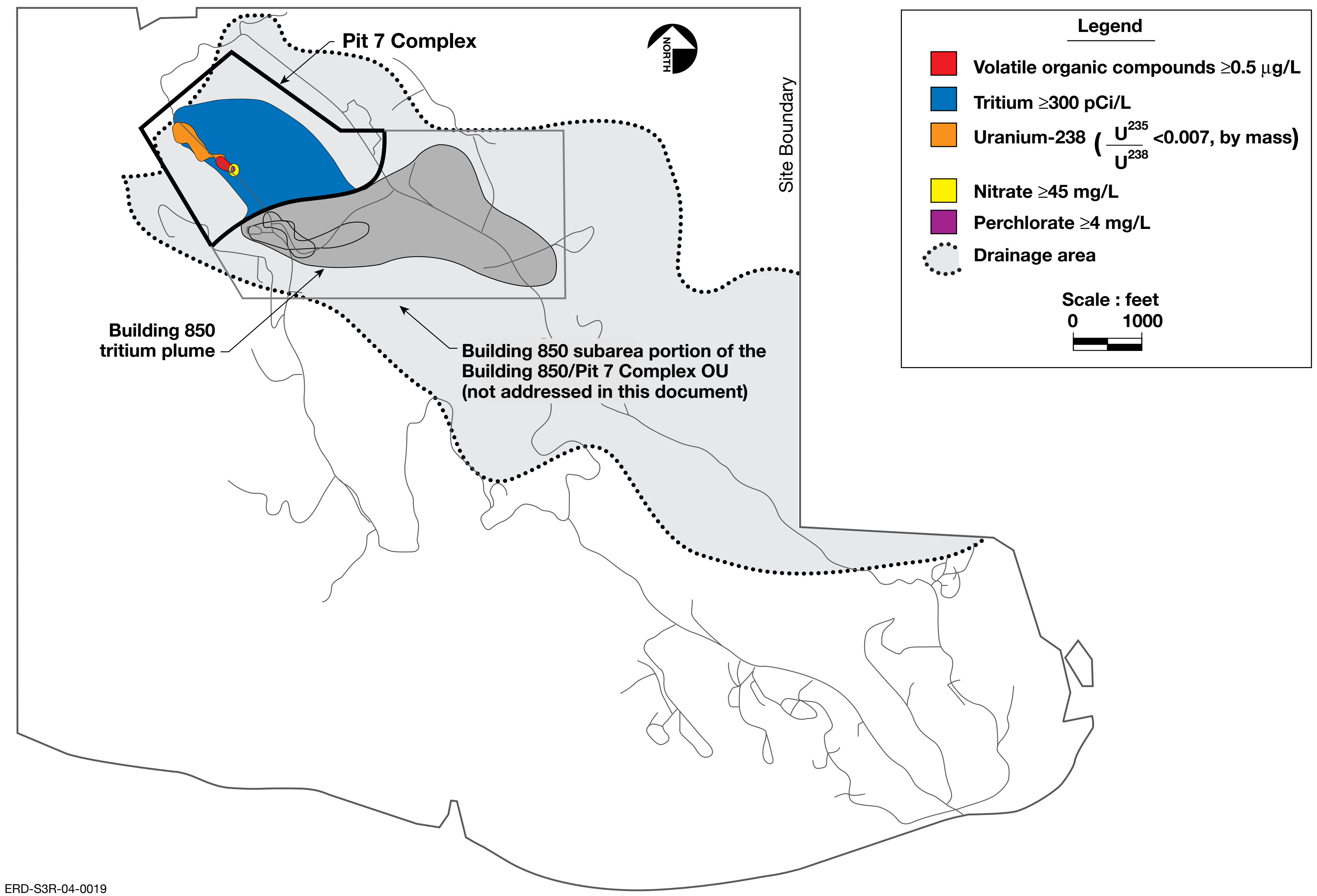
The California Department of Toxic Substances Control and Regional Water Quality Control Board-Central Valley Region will review and comment on this document. Analysis of technical and administrative concerns that these agencies have regarding each of the alternatives will be addressed. The State agencies will participate in the selection of the final remedy and cleanup goals for the Pit 7 Complex that will be codified in the Final Site-Wide Record of Decision.

A Public Workshop will be held after the draft of this document is issued to receive public input on the proposed remedial alternatives for the Pit 7 Complex. A summary of remedial alternatives and the preferred remedy will be published in the Proposed Plan for the remediation of the Pit 7 Complex. A Public Meeting will be held during the 30-day comment period for the Proposed Plan to receive formal comments from the public. Public comments will be considered in the selection of the final remedy for the Pit 7 Complex in the Amendment to the Interim Site-Wide Record of Decision.

Environmental Considerations

Section II.E of the DOE Secretarial Policy Statement on the National Environmental Policy Act (NEPA) requires that when DOE remedial actions under CERCLA of 1980 trigger the procedures set forth in NEPA, the procedural and documentation requirements of NEPA and CERCLA are to be integrated. Integration is to be accomplished by conducting the NEPA and CERCLA environmental planning and review procedures concurrently to avoid duplication, conflicting analysis, and delays in implementing remedial action on procedural grounds. This integration will be accomplished by conducting the NEPA evaluation during the RI/FS process, supplemented as needed to meet the requirements of NEPA.

The NEPA evaluation will provide additional information necessary to evaluate each remedial alternative under NEPA, in compliance with the requirements of the DOE NEPA Implementing Procedures (10 Code of Federal Regulations [CFR] 1021), DOE Order 5400.4 (issued October 6, 1989) and the Council of Environmental Quality Regulations for Implementing the Procedural Provisions of the NEPA (40 CFR 1500–1508, July 1986, as amended). The NEPA evaluation will be issued as a separate report prior to the Draft Proposed Plan for environmental remediation at the Pit 7 Complex.



ERD-S3R-04-0019

Figure EX-1. Site 300 map showing location of the Pit 7 Complex.

Table EX-1. Remedial components for contaminants of concern for environmental media.

Contaminant	Surface soil	Subsurface soil	Ground water	Surface water
Volatile organic compounds	NA	NA	Monitored natural attenuation	NA
Tritium	NA	Risk and hazard management/ exposure control	Risk and hazard management/ exposure control	Monitored natural attenuation[a]
		Source control/ containment	Monitored natural attenuation	Source control/containment[a]
		Removal and disposal	Source control/containment	
Uranium	NA	Source control/ containment	Risk and hazard management/ exposure control	NA
		Removal and disposal	Monitoring	
			Source control/containment	
			Extraction and *ex situ* treatment	
			In situ treatment	
Nitrate	NA	NA	Monitoring	NA
			Source control/containment	
			Extraction and *ex situ* treatment	
			In situ treatment	
Perchlorate	NA	NA	Monitoring	NA
			Extraction and *ex situ* treatment	
			In situ treatment	
			Source control/containment	

Note:

NA = Not applicable; contaminant of concern not detected or does not pose risk/hazard in medium.

[a] Tritium in surface water is addressed through remedial components for tritium in ground water, as the spring is fed by ground water.

Table EX-2. Remedial Alternatives for the Pit 7 Complex.

Remedial Alternatives for the Pit 7 Complex			
Alternative 1	**Alternative 2**	**Alternative 3a**	**Alternative 3b**
No further action for all contaminants and media of concern.	Component A: Monitoring of ground water. Component B: Exposure control through risk and hazard management. Component C: Monitored natural attenuation of tritium in ground water. Component D: Waste excavation of Pits 3 and 5 and disposal.	Component A: Monitoring of ground water. Component B: Exposure control through risk and hazard management. Component C: Monitored natural attenuation of tritium in ground water. Component D: Phased migration control of uranium, nitrate, and perchlorate in ground water using *ex situ* ground water extraction and treatment. Component E: Waste excavation of Pits 3 and 5 and disposal.	Component A: Monitoring of ground water. Component B: Exposure control through risk and hazard management. Component C: Monitored natural attenuation of tritium in ground water. Component D: Phased migration control of uranium, nitrate, and perchlorate in Qal/WBR ground water using *in situ* reactive permeable barrier and extraction and *ex situ* treatment of Tnbs_0 ground water. Component E: Waste excavation of Pits 3 and 5 and disposal.
Previous interim actions: Capped Pits 4 and 7 (and 30% of Pit 3 under RCRA (1992). Total Estimated Cost: $0	Previous interim actions: Capped Pits 4 and 7 (and 30% of Pit 3) under RCRA (1992). Total Estimated Cost: $56,635,000	Previous interim actions: Capped Pits 4 and 7 (and 30% of Pit 3) under RCRA (1992). Total Estimated Cost: $63,741,000 (extraction wells) to $68,326,000 (funnel and sump with extraction and *ex situ* treatment)	Previous interim actions: Capped Pits 4 and 7 (and 30% of Pit 3) under RCRA (1992). Total Estimated Cost: $73,979,000

Table EX-2. Remedial Alternatives for the Pit 7 Complex. (Page 2 of 2)

Remedial Alternatives for the Pit 7 Complex			
Alternative 4a	**Alternative 4b**	**Alternative 5a**	**Alternative 5b**
Component A: Monitoring of ground water. Component B: Exposure control through risk and hazard management. Component C: Monitored natural attenuation of tritium in ground water. Component D Source control by installing hydraulic diversion to prevent water from entering landfills. Previous interim actions: Capped Pits 4 and 7 under RCRA (1992). Total Estimated Cost: $3,738,000	Component A: Monitoring of ground water. Component B: Exposure control through risk and hazard management. Component C: Monitored natural attenuation of tritium in ground water. Component D: Source containment by installing hydraulic barriers (slurry walls) to prevent water from entering landfills. Previous interim actions: Capped Pits 4 and 7 under RCRA (1992). Total Estimated Cost: $4,344,000	Component A: Monitoring of ground water. Component B: Exposure control through risk and hazard management. Component C: Monitored natural attenuation of tritium in ground water. Component D: Source control by installing hydraulic diversion to prevent water from entering landfills. Component E: Phased migration control of uranium, nitrate, and perchlorate in ground water using *ex situ* ground water extraction and treatment. Previous interim actions: Capped Pits 4 and 7 under RCRA (1992). Total Estimated Cost: $10,845,000 (extraction wells) to $15,429,000 (funnel and sump with extraction and *ex situ* treatment)	Component A: Monitoring of ground water. Component B: Exposure control through risk and hazard management. Component C: Monitored natural attenuation of tritium in ground water. Component D: Source control by installing hydraulic diversion to prevent water from entering landfills. Component E: Phased migration control of uranium, nitrate, and perchlorate in Qal/WBR ground water using *in situ* reactive permeable barrier and extraction and *ex situ* treatment of $Tnbs_0$ ground water. Previous interim actions: Capped Pits 4 and 7 under RCRA (1992). Total Estimated Cost: $21,082,000

Table EX-3. Components of remedial alternatives for the Pit 7 Complex.

Alternative remedial component	Alternative 1	Alternative 2	Alternative 3a	Alternative 3b	Alternative 4a	Alternative 4b	Alternative 5a	Alternative 5b
No further action	√							
Monitoring		√	√	√	√	√	√	√
Exposure control		√	√	√	√	√	√	√
Monitored natural attenuation for tritium in ground water		√	√	√	√	√	√	√
Source control: Waste excavation		√	√	√				
Source control: Hydraulic diversion					√		√	√
Source containment: Hydraulic barrier						√		
Phased plume migration control: *Ex situ* treatment of uranium, nitrate, and perchlorate			√				√	
Phased plume migration control: *In situ* treatment of uranium, nitrate, and perchlorate in Qal/WBR ground water with extraction and ex situ treatment of $Tnbs_0$ ground water				√				√

1. Introduction

This Remedial Investigation/Feasibility Study (RI/FS) report was prepared for the Pit 7 Complex at the Lawrence Livermore National Laboratory (LLNL) Site 300 experimental test facility, in accordance with the terms outlined in a Federal Facility Agreement (FFA) (U.S. DOE, 1992). The Site 300 FFA was negotiated between the U.S. Department of Energy (DOE), the U.S. Environmental Protection Agency (EPA), the California Department of Toxic Substances Control (DTSC), and the California Regional Water Quality Control Board (RWQCB). The FFA provides the framework for the conduct of the site cleanup and preparation of necessary regulatory documents. This RI/FS is prepared in compliance with the requirements of the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) as amended by the Superfund Amendments and Reauthorization Act of 1986 (SARA). The RI/FS forms the basis for evaluating and selecting alternative technologies for remediation of contaminants at the Pit 7 Complex.

1.1. Purpose of Report

The purpose of this RI/FS is: (1) to identify the nature and extent of contamination in the Pit 7 Complex and evaluate impacts to human and ecological receptors that could be exposed to contaminated environmental media and (2) to develop and evaluate alternatives for remedial action at the Pit 7 Complex in accordance with CERCLA/SARA.

The Remedial Investigation process described in this report involves:

- Identifying contaminants of concern (COCs) in environmental media at the Pit 7 Complex.
- Identifying the nature and extent of COCs released to soil and ground water.
- Evaluating the potential routes of migration of these chemicals.
- Evaluating potential impacts to human health and the environment as a result of exposure to COCs.

The Feasibility Study process involves:

- Identifying remedial action objectives based on Applicable or Relevant and Appropriate Requirements (ARARs).
- Identifying general response actions.
- Identifying potential remedial technologies and associated process options.
- Screening various technologies and process options based on their applicability, effectiveness, implementability, and cost.
- Assembling the selected technologies into alternatives for contaminant remediation at Site 300.
- Analyzing the alternatives using the U.S. EPA evaluation criteria.

The RI/FS process will lead to the selection and subsequent implementation of cost-effective remedial alternatives to protect human health and the environment.

This chapter provides background information for Site 300 and the Pit 7 Complex. Chapter 2 summarizes the Remedial Investigation conducted at the Pit 7 Complex, including information presented in the Site-Wide Remedial Investigation (SWRI) report (Webster-Scholten, 1994), the Building 850/Pits 3 and 5 SWRI Addendum (Taffet et al., 1996), the Draft Engineering Evaluation/Cost Analysis for the Building 850/Pits 3 and 5 Operable Unit (Taffet et al., 1997), the Ground Water Tritium Plume Characterization Summary Report (Ziagos and Reber-Cox, 1998), the Site-Wide Feasibility Study (Ferry et al., 1999) and subsequent characterization work conducted from 2000 through 2003. Chapter 3 presents the Feasibility Study conducted to develop and evaluate alternatives for remedial action at the Pit 7 Complex including the determination of ARARs and remedial action objectives, an evaluation of technologies, a description of alternatives, and an analysis of alternatives. Chapter 3 also discusses the process that will be followed in addressing environmental considerations to fulfill the requirements of the National Environmental Policy Act (NEPA). Chapters 4 and 5 contain references and acronyms and abbreviations used in this report, respectively.

1.2. Site Background

LLNL Site 300 is a DOE experimental test facility operated by the University of California. The facility is located in the eastern Altamont Hills about 13 miles southeast of the main Laboratory site in Livermore and 8.5 miles southwest of Tracy (Figure 1-1). The site covers 11 square miles (mi^2), most of which is in San Joaquin County. The western one-sixth of the site is located in Alameda County. Site 300 is primarily a high-explosives test facility that supports the LLNL weapons program in research, development, and testing associated with weapons components. During past LLNL operations, a number of contaminants were released to the environment.

Prior to August 1990, investigations of potential chemical contamination at Site 300 were conducted under the oversight of the California RWQCB-Central Valley Region. In August 1990, Site 300 was placed on the National Priorities List. Since then, all investigations and remediation have been conducted in accordance with CERCLA under the oversight of the three supervising regulatory agencies: EPA, RWQCB, and DTSC. DOE is the lead agency for all environmental restoration activities and is the sole source of funding.

Site 300 has been divided into eight Operable Units (OUs) based on the nature and extent of contamination. The Pit 7 Complex, which includes Pits 3, 4, 5, and 7, is part of the Building 850/Pits 3 and 5 OU. The Building 850 release site was addressed in the Site-Wide Feasibility Study (Ferry et al., 1999) that presented remedial alternatives for cleanup of this area. An interim remedy was selected for the Building 850 area in the Interim Site-Wide Record of Decision (ROD) (DOE, 2001). In February 2000, DOE and the regulatory agencies agreed that additional site characterization and evaluation of cleanup options were necessary prior to selecting a remedy for the Pit 7 Complex. Consequently, the Pit 7 Complex was not covered in the Interim Site-Wide ROD. Following the Pit 7 Complex RI/FS, a preferred remedy will be presented in a Proposed Plan and at a public meeting. DOE will prepare an amendment to the Interim ROD that will include the selected remedy for the Pit 7 Complex.

1.2.1. Description of the Pit 7 Complex Area

The Pit 7 Complex is located in the East Firing Area/West Firing Area (EFA/WFA) in the northwest portion of Site 300 (Figure 1-2). The majority of activities in the EFA/WFA involve testing of conventional explosives that can be used to detonate nuclear devices. No actual fissionable material is used in these hydrodynamic tests. The Pit 7 Complex release site area consists of the Pits 3, 4, 5, and 7 landfills. From the late 1950s until 1988, debris from explosive tests conducted within the EFA/WFA was disposed in the landfill pits.

The physiography of the EFA/WFA is dominated by a series of valleys and ridges. The Pit 7 Complex is located within a broad northwest-southeast trending valley. The longitudinal axes of Pits 3, 4, 5, and 7 are parallel to the valley axis. A shallow ephemeral drainage occupies the center of this valley and extends from the Pit 7 Complex to the southeast to a point several hundred feet (ft) east of Building 850 (Figure 1-3). Elevation ranges from about 1,700 ft above means sea level at the ridge top to the west of the Pit 7 Complex to about 1,300 ft above mean sea level in the valley bottom. Seasonal grassland cover predominates in this area. The climate is semiarid and windy with an average annual rainfall of 10.44 inches (in). Average temperatures range from 90 to 100+ degrees Fahrenheit (°F) in July to 51 °F in January with a mean normal temperature of 63 °F. During the winter, westerly cyclonic storms affect the region and are accompanied by southerly or southwesterly winds and short rainy periods. Summers are consistently hot and dry with predominately westerly winds. During the spring and fall, daily temperatures and wind directions are more variable.

Land use surrounding LLNL Site 300 includes private ranch land used primarily for cattle grazing, state-owned land used for recreational motorcycle riding, a state ecological reserve, a fireworks storage facility, and privately owned land planned for future residential development. The site boundary closest to the Pit 7 Complex is located approximately 2,500 ft north of the landfills and is adjacent to private ranch land (Figure 1-4).

1.2.2. History of Waste Disposal Activities at the Pit 7 Complex

From 1958 to 1988, LLNL used Pit 7 Complex landfills to dispose firing table debris and gravel. These pits were constructed by excavating topsoil and alluvial materials to an average depth of 15 to 20 ft (Taffet et al., 1989). LLNL filled the pits incrementally from southeast to northwest with the exception of Pit 5, which was filled from northwest to southeast (Simmons, 1992). The majority of the waste material in the pits came from the firing tables at Buildings 850 and 851, where aboveground detonations are conducted. LLNL typically removed gravel and experimental debris from the firing tables and deposited them in the pits after the gravels became too compacted to deaden the shock produced during detonations. The shock generated by explosives shots pulverizes the gravel into smaller size fractions. The resulting fine-grained material is denser and more compact than the original gravel and poorly attenuates the vibration caused by the explosives test. The waste placed in the pits included wood; plastic; material and debris from tent structures; pea gravel; and exploded test assemblies that frequently contained tritium and depleted uranium.

Tritium was used primarily from 1963 to 1978 with approximately 21,000 curies (Ci) expended at Site 300. After 1978, tritium use was sharply curtained, and the total usage from 1978 to 1988 was approximately 13 Ci, according to the Site 300 programs. About 99 percent of the tritium shipped to Site 300 was used at Buildings 850 (95%) and 851 (4%), so the debris disposed in the Pit 7 Complex contains the majority of tritium residue at Site 300 (Buddemeier, 1985). Metals, including depleted uranium, were also used in explosive tests. Depleted uranium is natural uranium from which most of the uranium-235 (^{235}U) isotope has been removed.

The history of each landfill pit is summarized below:

Pit 3 Landfill

LLNL opened the Pit 3 landfill in 1958 and closed it in 1967 (Taffet et al., 1989). The area and volume of Pit 3 are 6,180 square yards (yd^2) and 26,221 cubic yards (yd^3), respectively (Lindeken and Hieb, 1989).

Pit 4 Landfill

LLNL opened the Pit 4 landfill in 1968 and closed it in 1974 (Taffet et al., 1989). The area and volume of Pit 4 are 855 yd^2 and 2,796 yd^3, respectively (Lindeken and Hieb, 1989).

Pit 5 Landfill

LLNL opened the Pit 5 landfill in 1968 and closed it in 1979 (Taffet et al., 1989). The area and volume of Pit 5 are 9,100 yd^2 and 29,907 yd^3, respectively (Lindeken and Hieb, 1989). The "panhandle" of the southern part of Pit 5 was originally planned as part of the pit, but interviews with Site 300 employees suggest that this section was never actually excavated (Simmons, 1992).

Pit 7 Landfill

In 1978, LLNL opened the Pit 7 landfill and ceased depositing waste in it on November 8, 1988 (Taffet et al., 1989). The area and volume of Pit 7 are approximately 6,250 yd^2 and 31,111 yd^3, respectively (Lindeken and Hieb, 1989). Although most of the waste material in Pit 7 was generated at Buildings 850 and 851, some gravel from firing tables at Buildings 801, 802, 812, and 845 were deposited in Pit 7 in 1988.

Prior to 1988, when waste disposal in the pits was complete, the pits were covered with approximately 3 ft of compacted native soil. In 1992, LLNL constructed an engineered cap over Pits 4 and 7 in compliance with Resource Conservation and Recovery Act (RCRA) requirements. The design included interceptor trenches and drains, a top vegetative layer to prevent erosion and shallow subsurface interflows, a biotic barrier layer to minimize animal burrowing, and a clay layer of very low permeability to prevent precipitation infiltration and leaching of contaminants. The Pits 4 and 7 RCRA cap overlaps Pit 3 by approximately 25–30%. More complete information on the cap design is presented in Volume II, Closure and Post-Closure Plans, Landfill Pits 1 and 7 (Rogers Pacific Corporation, 1990). The original native soil cover on Pit 5 remains intact.

2. Remedial Investigation

DOE/LLNL have conducted environmental investigations at Site 300 since 1981 to characterize the extent of contamination in soil, bedrock, ground water and surface water. The initial investigations were conducted at the request and under the direction of the California RWQCB. Since 1990, when Site 300 was placed on the National Priorities List, additional investigations were conducted in accordance with CERCLA under the direction of the U.S. EPA, RWQCB, and DTSC. This chapter summarizes the results of these investigations

2.1. Summary of Remedial Investigations

2.1.1. Previous Remedial Investigations (1981–2000)

The first hydrogeologic investigation within the Pit 7 Complex area began in 1981 with the Hazardous Waste Assessment Project study of the hydrogeology, geology, and ground water chemistry associated with the Site 300 landfills (Raber et al., 1982).

From 1981 to 2000, environmental investigation activities included records searches and interviews; the installation of ground water monitor wells; sampling of soil, bedrock, ground water and surface water; soil vapor surveys; hydraulic testing; evaluating observed water level responses to rainfall events; geologic mapping; ground water transport modeling; geologic and hydrogeologic characterization; and risk assessment. Summaries of environmental investigations conducted prior to 2000 are presented in the SWRI report (Webster-Scholten, 1994), the Building 850/Pits 3 and 5 SWRI Addendum (Taffet et al., 1996), the Draft Engineering Evaluation/Cost Analysis for the Building 850/Pits 3 and 5 Operable Unit (Taffet et al., 1997), and the Site-Wide Feasibility Study for LLNL Site 300 (Ferry et al., 1999). Although this Chapter briefly discusses the results of these previous investigations, the main emphasis is on investigations conducted since the Site-Wide Feasibility Study (SWFS) data cutoff (October 1999).

2.1.2. Recent Remedial Investigations (2000–2003)

In February 2000, DOE and the regulatory agencies agreed that additional site characterization and evaluation of cleanup options were necessary prior to selecting a remedy for the Pit 7 Complex. From 2000 through 2003, additional site characterization and feasibility study activities included:

- Installing nine additional ground water monitor wells to delineate the extent of tritium originating from the Pit 7 Complex.
- Monitoring ground water from existing and new monitor wells.
- Installing a permeable reactive barrier for an *in situ* treatability test for removal of uranium in ground water.
- Performing a surface geophysical survey to corroborate results of other methods (i.e., borehole logs/cone penetrometer data) and independently define pit bottoms and geometry of alluvium/weathered bedrock.
- Conducting a helium-3 soil vapor survey to corroborate results of other methods (soil moisture and soil vapor tritium data) and independently estimate the number of curies of tritium remaining in the pits and the vadose zone.
- Installing horizontal wells, a shallow drain system, and surface water flow measurement devices to assess whether hydraulic control methods could be used to dewater and prevent recharge from causing water table rises into the Pit 7 Complex landfills.
- Installing monitoring piezometer nests to determine which shallow water-bearing zones may convey water into the valley bottom where the Pit 7 Complex is located.
- Conducting a water budget study to refine the hydrogeological conceptual model for the Pit 7 Complex area, and to support evaluation of remedial alternatives designed to divert water away from the pits.

- Evaluating the Elk Ravine Fault system regarding its potential effects on ground water transport and future plume movement in the vicinity of the Pit 7 Complex.
- Investigating existing and innovative remedial technologies to be evaluated in the Feasibility Study.

The results of this work are presented in Chapters 2 and 3 of this document. Any additional data collected prior to 2000 relevant to the development of the remedial alternatives in Chapter 3 are also summarized in this RI/FS. Post-SWRI soil, ground water, and surface water sample data are contained in Appendix A.

2.2. Physical Description of the Pit 7 Complex

This section describes the physical setting of the Pit 7 Complex area including surface features, surface water hydrology, geology/hydrogeology, demography and land use, and ecology.

2.2.1. Surface Features

The Pit 7 Complex is located within the Elk Ravine drainage area in the northwestern part of Site 300 (Figure 1-2). It covers about 2 square miles and includes the Pit 7 Complex landfill release site and associated soil and ground water contamination. The Elk Ravine drainage area is characterized by a series of native grass-covered linear, northwest-southeast trending ridges and incised valleys. The ridges and valleys in the vicinity of the Pit 7 Complex are bounded to the north and south by valleys (e.g., Doall Ravine) oriented roughly perpendicular (northeast-southwest) to the northwest-trending ridges and valleys. Doall Ravine connects the valley where the Pit 7 Complex is located with the next valley to the east, Elk Ravine, where the Elk Ravine Fault is located. Figure 1-3 is a topographic map showing monitor wells, springs, various cultural features, and the outline of the landfills that comprise the Pit 7 Complex.

2.2.2. Surface Water Hydrology

Due to the semi-arid climate, natural surface water in the Pit 7 Complex area is relatively rare. It has been observed as surface runoff during heavy rainfall events, ponding in surface depressions, and discharges from natural springs. Surface runoff is generally not observed during typical winter storms. Threshold rainfall intensity required to generate surface runoff is discussed in Section 2.2.3.3 along with estimates of infiltration and evapotranspiration. When surface runoff is generated during heavy El Niño-type events, surface water generally flows southeastward toward Doall Ravine in an ephemeral alluvial drainage channel located just east of the Pit 7 Complex. Ephemeral surface water within Doall Ravine flows to the northeast into Elk Ravine and ultimately into Corral Hollow Creek, about 1.5 miles east of Site 300. Corral Hollow Creek discharges to the east into the San Joaquin Valley.

Several man-made drainage channels, including diversion trenches and metal culverts, are located within the Pit 7 Complex area. Runoff diversion ditches and culverts are usually located along roads to reduce erosion potential during peak runoff periods. In addition, as part of the RCRA capping of Pits 4 and 7, concrete drainage channels were installed around these landfills to divert surface runoff away from the landfill caps during heavy rainfall events. The concrete channels are connected to horizontal drains that extend into the hillslope west of Pit 7, and receive flow from two gravel-filled interceptor trenches that run up the center of two prominent depressions on the hillslope. Both concrete channels discharge to the ground surface: one discharges north of Pits 4 and 7 landfills and the other discharges to the south. These features were installed in 1990 when Pits 4 and 7 were covered with a RCRA cap.

Spring 24 is the only perennial natural surface water within the Pit 7 Complex area, located southeast of the landfills, immediately north of where Doall Ravine merges with Elk Ravine (Figure 1-2). Spring 24 is a likely discharge or leak point for confined ground water from a water-bearing silty sandstone along the Elk Ravine Fault.

2.2.3. Geology and Hydrogeology

The geology and hydrogeology of the Pit 7 Complex area are discussed in Chapter 11 of the SWRI report (Webster-Scholten, 1994), the SWRI addendum (Taffet et al., 1996), and the Tritium Plume Characterization Summary Report (Ziagos and Reber-Cox, 1998). This section briefly describes the main aspects of the Pit 7 Complex geology and hydrogeology relevant to this RI/FS report, as well as the water budget study. The stratigraphy, hydrostratigraphy, and hydrogeologic conceptual model have been updated from previous reports.

2.2.3.1. Geology

As shown on the geologic map and cross-sections presented in Figures 2-1, 2-2, and 2-3, the Pit 7 Complex area is underlain by variably weathered and fractured sedimentary rocks of the Neroly Formation. Cross-section A-A′ (Figure 2-2) is oriented southwest-northeast, parallel to the Neroly Formation dip direction, and extends from the hillslope west of the Pit 7 Complex landfills to the Elk Ravine Fault. Cross-section B-B′ (Figure 2-3) is oriented northwest-southeast along an ephemeral drainage channel located adjacent to the pits. The main geologic structures in the area include the northwest-trending shear zones associated with the Elk Ravine Fault zone and a southeast-trending syncline that parallels the Elk Ravine Fault located just west of the fault and directly east of the Pit 7 Complex. The Elk Ravine Fault is a regional right lateral strike-slip fault that extends for several miles northwest of Site 300. The east-west trending, eastward-plunging axis of the Patterson Anticline is located about 1 mile south of the Pit 7 Complex.

A veneer of soil and colluvium covers most northeast-facing slopes in the Pit 7 Complex area, while southwest-facing slopes tend to be steeper, as they are commonly formed by resistant sandstone outcrops of the Neroly Formation. Valley bottoms contain ephemeral drainage channels and associated Quaternary alluvial (Qal) material consisting of fine-grained soil, decomposed bedrock, and colluvium eroded from nearby hillslopes. The ephemeral drainage channel located just east of the Pit 7 Complex landfills extends southeastward to the Building 850 area, where it merges with the northeast-trending drainage channel in Doall Ravine.

The bedrock geology in the Pit 7 Complex area consists primarily of blue-gray to brown, interbedded siltstone, sandstone, conglomerate, and minor claystone of the lower Neroly Formation ($Tnbs_1$), and interbedded siltstone, claystone, and minor sandstone of the $Tnsc_0$ stratigraphic interval. This lower Neroly section generally strikes N20W and dips 5 to 15 degrees northeast. At the base of the $Tnbs_1$ is an 8- to 10-foot thick silty sandstone referred to as the $Tnbs_0$. The $Tnbs_0$ is continuous in the subsurface throughout the area and it can be easily identified and correlated based on its borehole geophysical log signature. The $Tnbs_0$ is overlain by a 2- to 3-foot thick claystone confining layer and underlain by 50 to 100 ft of interbedded siltstone, claystone, and minor sandstone of the $Tnsc_0$ stratigraphic interval. The $Tnsc_0$ overlies gray, quartz-rich sandstone of the Cierbo Formation (Tmss).

2.2.3.2. Hydrogeology

The hydrogeology in the Pit 7 Complex area is similar to other areas of Site 300 such as the General Services Area or the High Explosives Process Area, where a shallow, ephemeral water-bearing zone is in contact with underlying bedrock water-bearing zones. Like these other areas, the spatial and temporal distribution of ground water in the Pit 7 Complex area is influenced by several factors, including: episodic El Niño-type rainfall events, hill slope steepness and ground cover, geologic structures (including bedding orientation, fractures, and faults), and the inclined axes of alluvial drainage channels. During heavy rainfall events, hill slopes and alluvial drainage channels transmit surface and shallow ground water within the Pit 7 Complex area toward Doall Ravine, which discharges to Elk Ravine and ultimately to Corral Hollow Creek.

The interaction between the highly-transmissive alluvial drainage system and the less transmissive, underlying fractured bedrock is important to ground water flow and contaminant transport in the Pit 7 Complex area. Ground water flow and contaminant transport are accelerated during episodic winter rainfall, especially heavy El Niño-type events. It is during these events that shallow ground water rises, inundates the landfill pits, and comes in contact with the pit contents (Figure 2-4). During these periods of high water levels, two nearly orthogonal ground water flow directions exist: one is to the southeast, along the axis of the ephemeral Qal drainage channel, and a second east-northeast flow direction in the underlying bedrock ($Tnbs_0$) water-bearing zone. During the dry season and during drought periods, the alluvial water-bearing zones eventually drain, and become unsaturated and hydraulically disconnected from ground water in the underlying bedrock.

In this RI/FS report, the saturated stratigraphic intervals in the Pit 7 Complex area have been grouped into hydrostratigraphic units (HSUs) (Figure 2-5). An HSU is a water-bearing zone that exhibits similar hydraulic and geochemical properties. The following two HSUs have been identified in the Pit 7 Complex area:

- Quaternary alluvium/weathered bedrock (Qal/WBR).
- Lower Neroly Formation ($Tnbs_0$).

The Qal/WBR HSU is an ephemeral, unconfined, transmissive water-bearing zone. It consists of clay-rich soil, loosely-consolidated sediment, and underlying weathered and fractured bedrock. This HSU exists within the southeast-oriented valley bottom adjacent to the Pit 7 Complex landfills, where it reaches a maximum thickness of about 60 ft. As shown in Figure 2-2, the Qal/WBR HSU cross-sectional shape is asymmetrical toward the western hillslope. As seen in Figure 2-2, the western hillslope is less steep and more extensively weathered than the eastern hillslope. The western hillslope is characterized by rapid infiltration during heavy rainfall events, while the eastern hillslope, which is steeper and composed mainly of bedrock outcrops, tends to shed rain as surface runoff during these events.

Figure 2-6 shows characteristic hydrographs for the Qal/WBR HSU based on monitor well NC7-53 located on the western hillslope and NC7-37 located in the valley adjacent to Pit 3. Note the episodic character of these hydrographs and the rapid response to seasonal rainfall events. During the 1998 El Niño, water levels in Qal/WBR hillslope wells increased by 15 ft between mid-January and late February. In order to monitor recharge on the western hillslope during these types of events, 16 piezometers were installed in 2001. These piezometers were installed in four groupings or clusters; each cluster contains three or more piezometers screened at different depths. Figure 2-7 presents geophysical logs and detailed lithologic descriptions based on data collected from one of these piezometer clusters (W-Pit7-1717, -1718, and -1726) along with the respective hydrographs for two piezometers in the cluster. This cluster was selected because it exhibited the greatest response to rainfall during the period of monitoring. For example, a rapid, large magnitude (4 ft) response was observed in piezometer W-Pit7-1718 during December 2002 rainfall events. This piezometer monitors ground water from 17 to 21 ft deep at the base of the Qal/WBR HSU. The shallow piezometer in this cluster, W-Pit7-1726 (screened from 5.6 to 6.6 ft), remained dry during this period and water in the deepest piezometer, W-Pit7-1718 (screened from 38 to 43 ft), rose about 2 ft.

When saturated, ground water in the Qal/WBR HSU flows to the southeast in the direction of the inclined valley axis. As discussed in Section 2.3, this HSU contains a portion of the tritium and uranium ground water plumes). Ground water flow in this HSU is dominated by preferential flow paths, including soil macro-pores and bedrock fractures. This HSU is also the main source of recharge to the underlying $Tnbs_0$ HSU. Water level data indicate that during extended periods of drought (i.e., 1989 to 1994), most of the wells completed in the Qal/WBR HSU are either dry or have very little water. Any water present mostly occurs in the weathered bedrock zone. The geometry of the Qal/WBR HSU and lack of recharge causes large portions of this aquifer to become unsaturated, therefore significantly slowing the migration of any contaminant in this HSU.

The $Tnbs_0$ HSU is a northeast-dipping silty sandstone water-bearing zone. Ground water in the $Tnbs_0$ HSU flows to the east-northeast. In addition to flow in porous media, this HSU is also influenced by preferential flow paths in the form of bedrock fractures. The $Tnbs_0$ HSU is the main bedrock water-bearing zone that transmits tritium-bearing ground water in the Pit 7 Complex area. It is unconfined in the vicinity of the Pit 7 Complex landfills and confined to the east in the vicinity of Elk Ravine. The confining layer is a 2- to 3-foot thick claystone that overlies the $Tnbs_0$ throughout the area. Several ground water monitor wells have been installed during the past four years in the area east of the Pit 7 Complex in preparation for this RI/FS. Figure 2-6 presents a characteristic hydrograph for the $Tnbs_0$ HSU based on well NC7-25, located about 250 ft northeast of NC7-51. Note that the NC7-25 hydrograph exhibits a slightly delayed, lower magnitude response to significant rainfall events when compared to the Qal/WBR hydrograph. For example, during the 1998 El Niño, the NC7-25 water level reached a peak response of 1.2 ft about 3 months after the Qal/WBR wells reached their peak.

Figure 2-8 presents ground water elevation maps for the Qal/WBR HSU and the $Tnbs_0$ HSU under El Niño or high (March, 1998) and drought or low (March, 1992) water level conditions. These maps clearly show the difference in hydraulic gradient and flow direction between the Qal/WBR HSU and the $Tnbs_0$ HSU. Also note the large difference in saturation extent of the Qal/WBR HSU between drought and El Niño years. Figure 2-9 presents ground water elevation maps for the Qal/WBR HSU and the $Tnbs_0$ HSU based on 2nd quarter 2003 data. Hydraulic conductivity, as calculated from hydraulic tests in wells screened in the Qal/WBR HSU in the Pit 7 Complex area, ranges from 10^{-3} to 10^{-4} centimeters per second (cm/sec)' while $Tnbs_0$ HSU hydraulic conductivity ranges from 10^{-4} to 10^{-5} cm/sec. Assuming a porosity of 0.3, the average ground water velocity ranges from 60 to 150 feet per year in the Qal/WBR HSU and 6 to 12 feet per year in the $Tnbs_0$ HSU. Ground water elevation data for monitor wells in the Pit 7 Complex area are presented in Appendix A, Table A-1.

The Cierbo Formation (Tmss) aquifer underlies the Neroly Formation at Site 300. It is a quartz-rich, medium-grained sandstone aquifer that is unconfined beneath the Pit 7 Complex landfills and is under confined to flowing artesian conditions in the adjacent Building 850 area. The upper part of this sandstone aquifer is unsaturated beneath the Pit 7 Complex. The depth to ground water in the Tmss aquifer beneath the Pit 7 Complex is estimated to be about 100 ft. Well NC7-66, which is screened from 79 to 89 ft in the upper part of the Tmss aquifer, has always been dry since it was installed in 1988. The Tmss aquifer is hydraulically separated from the $Tnbs_0$ HSU by a 30- to 50-foot thick, fine-grained interval ($Tnsc_0$) comprised of interbedded siltstone, claystone, and minor sandstone. Although the Tmss aquifer is monitored by only three wells in the northern part of Site 300, no anthropogenic contaminants have been detected in this aquifer. For example, tritium has never been detected above 50 picocuries per liter (pCi/L) in monitor well NC7-69, which is completed in the Tmss aquifer just south of the Pit 7 Complex area. The lack of Tmss contamination is likely due to the integrity of the overlying $Tnsc_0$ confining layer and the upward hydraulic gradient that exists between the confined portions of this aquifer and overlying water-bearing zones.

2.2.3.3. Water Balance

A water balance was performed to evaluate the relationship between rainfall events and shallow ground water recharge, and to estimate changes in Qal/WBR HSU storage. Understanding how rainfall is partitioned into runoff, infiltration, and evapotranspiration within the Pit 7 Complex watershed is critical to the design and evaluation of remedial alternatives whose objective is to prevent or minimize shallow ground water from rising and inundating the pits during heavy rainfall events.

The water balance is based on the following equation:

Change in storage = rainfall – [evapotranspiration + infiltration + runoff]

The water balance was performed using the Water Erosion Prediction Project (WEPP) model (Flanagan and Nearing, 1995), a process-based, continuous simulation model developed and maintained by Purdue University for the United States Department of Agriculture. WEPP is used primarily to predict soil loss due to erosion from overland flow on hillslopes. In addition, WEPP has a climate component with a stochastic generator to provide daily meteorological data, and a hydrology component based on a modified Green-Ampt infiltration equation and solutions of the kinematic wave equations (WEPP User Summary, 1995). The hydrology component computes a daily water balance.

The main input parameters for WEPP hillslope simulations are: (1) climate data, (2) hillslope profile, (3) soil data, and (4) vegetative cover. At the watershed scale, WEPP can be applied to areas that include ephemeral drainage channels with at least one adjacent hillslope. Figure 2-10 is an air photo of the Pit 7 Complex area with hillslope arrows that define the boundaries of the watershed. As shown in Figure 2-10, the Pit 7 Complex watershed was defined by two hillslopes that flow into a southeast-oriented ephemeral drainage channel. Weather data for the water balance was derived from the WEPP database (Tracy Pumping Station) and the Site 300 Meteorological Tower station. Annual rainfall at Site 300 generally ranges from 8 to 12 inches during typical rainfall years however it can be less than 100 mm during drought years and as high as 18 inches during an El Niño year. The Pit 7 Complex watershed covers an area of about 175 acres. Using an average rainfall of 10 inches, the volume of rain that falls on this watershed during a typical winter is about 170 acre-feet. During El Niño-type events, as much as 285 acre-feet of rain can fall on this watershed.

The other input parameters include soil with an effective hydraulic conductivity of 5 millimeters per hour (mm/h), a thickness of 5 ft, an initial saturation of 75%, and a vegetative cover of native grass. The effective hydraulic conductivity for California soils in the WEPP database ranges from 1 to 10 mm/h.

Based on simulations performed at both the hillslope and watershed scales, evapotranspiration is, by far, the most significant parameter in the water balance equation, ranging from 65 to 75% of annual rainfall (Figure 2-11). This is not surprising given the semi-arid climate at this site. WEPP-simulated infiltration, which was defined as any water that infiltrates below the 5-foot thick soil profile, ranges from 0 to 10% of annual rainfall during typical rainfall years, but can be greater than 25% during El Niño-type events. During a typical winter, WEPP predicts that little or no runoff is generated in this watershed. However, during El Niño-type events, runoff can be as high as 3% of annual rainfall. Figure 2-12 is a plot of rainfall vs. runoff that shows that runoff is generated when rainfall intensity exceeds about 1 inch/day. This magnitude of rainfall intensity generally occurs only during heavy, El Niño-type winters. WEPP watershed–scale simulation results are summarized in Figure 2-13 which presents estimates of each variable in the water balance equation for a typical rainfall year.

In order to compare WEPP-simulations to measured recharge on the hillslope west of the Pit 7 Complex, weather data from the Site 300 Meteorological Tower were used to simulate infiltration from December 1996 to November 2001. This time period covers a range of annual rainfall including typical rainfall seasons during the 1996–1997, 1998–1999, and 1999–2000 winters; the 1997–1998 El Niño winter, and the low rainfall observed during the 2000–2001 winter. As shown in Figure 2-14, there is an excellent correlation between WEPP-simulated infiltration and hillslope recharge as determined from water levels measured in well NC7-53. Note that during the 2000–2001 winter, rainfall did not reach a threshold intensity sufficient to generate infiltration and no water level response was observed at well NC7-53.

WEPP-simulated infiltration was also compared to observed changes in shallow ground water storage at the watershed scale. A surface geophysical survey using the seismic refraction method was conducted to better define the extent of the shallow ground water-bearing Qal/WBR HSU within the watershed (Appendix B). Seismic refraction was used to image the bulk density contrast between the loosely consolidated Qal/WBR HSU and the underlying, more consolidated bedrock. This contact was identified on seismic refraction profiles as an increase in refracted seismic velocity from 2,000-3,000 feet per second to 5,000-6,000 feet per second. This seismic velocity contrast correlates to the base of the Qal/WBR HSU as determined from boreholes located along the seismic refraction profiles.

The seismic refraction data were integrated with surface geologic and borehole data in a three-dimensional (3-D) EarthVision geologic model that was developed for volumetric analysis. Ground water storage volumes for the Qal/WBR HSU for different years compared favorably to infiltration volumes predicted using WEPP. This correlation indicates that changes observed in shallow ground water storage can be attributed primarily to recharge from rain that falls within the watershed and that any contribution from adjacent watersheds is negligible. The amount of recharge water in the Qal/WBR that flows out of the Pit 7 area versus how much recharges the underlying $Tnbs_0$ HSU was also estimated using Darcy's equation (Q = kia) and the same hydraulic conductivity and gradient used in the flow and transport modeling discussed in Section 2.4 and Appendix E. This calculation indicates that about 60% of the water that infiltrates into the Qal/WBR during a typical rainfall year, recharges the $Tnbs_0$, while the remaining 40% flows toward the south in the Qal/WBR drainage channel. Volumetric analysis was also used to estimate the volume of water that would have to be diverted to prevent inundation of the pits during an El Niño-type rainfall event. This analysis was used in Section 3.3 to evaluate the feasibility of remedial alternatives with source control components that involve drainage diversion.

2.2.4. Demography and Land Use

This section discusses the land use and demography in and around Site 300 and the Pit 7 Complex.

2.2.4.1. Land Use

Land use distribution in the vicinity of Site 300 and the Pit 7 Complex is shown in Figure 1-4. Major users of land surround Site 300 include:

- Carnegie State Vehicular Recreation Area, an outdoor recreational facility operated by the California Department of Parks and Recreation for riding and racing private and commercial offroad motorcycles and four-wheel drive vehicles.
- SRI International, a private firm that operates an explosives test site in the hills south of the Carnegie State Vehicular Recreation Area.
- The Gallo and Connolly Ranches that are located south of Site 300 and used primarily for cattle grazing.
- Fireworks America, a private firm that operates a fireworks storage facility adjacent to the eastern border of Site 300.
- California Department of Fish and Game ecological reserve located east of Site 300, which currently has no public access.
- Range land, owned by the Mulqueeny, Yroz, and Vieira families, immediately north and northwest of Site 300. This land and smaller parcels to the west are used primarily for cattle grazing and are generally characterized by absentee ownership.
- Privately owned land northeast of Site 300 where future residential development is planned (Tracy Hills Development).
- Wind turbine generators located north of Site 300.

Land use at Site 300 is designated as a restricted access, federal government industrial (experimental test) facility. The site boundary located closest to the Pit 7 Complex is approximately 2,500 ft north of the landfills and abuts private ranch land.

2.2.4.2. Demography

Site 300 was originally selected as a DOE experimental test site because of the sparsely populated surrounding area. On the basis of residential population, the average density around the perimeter of Site 300 is less than one person per square mile.

Tracy is the closest city to Site 300, located approximately 8 miles northeast. Tracy's location near three interstate freeways (I-580, I-205, and I-5) and railroad lines make it an important warehousing and distribution center. Tracy's population is growing rapidly. In January 1992, the population was 38,000. Commuters moving from the San Francisco and East Bay metropolitan areas in search of affordable housing have nearly doubled Tracy's population to around 70,000 by November of 2003. The population is projected to reach approximately 80,000 by the year 2010. Increased development throughout the Central Valley has become a major concern to area residents, as prime agricultural land is converted to housing, retail, and industrial space. Developers are now locating housing projects in the hilly regions (such as the area surrounding Site 300), to avoid the agricultural versus housing conflict. The Tracy Hills housing project, with a projected population of 28,000 people, is planned for development in 2006. This planned housing project is located on property adjacent to the northeast portion of Site 300.

Approximately 300 employees work at Site 300. This number fluctuates and depends on the number of tests in progress. As the Pit 7 Complex area contains only closed landfills, there are no fulltime workers housed in this area. Occasional workers in this area include environmental restoration staff conducting monitoring, characterization, and remediation activities; Plant Engineering staff performing maintenance on the landfill caps; and LLNL fire department personnel during controlled burns in the area.

2.2.5. Ecology

This section describes the general ecology of the Pit 7 Complex area and the information on which the ecological assessment was based. The ecological assessment, presented in Section 2.5, describes the rare and endangered species with potential to occur in the Pit 7 area, along with the determination of the ecological impact from soil and ground water contamination.

Vegetation habitats and communities at Site 300 were initially sampled and mapped in 1986 (Taylor and Davilla, 1986a). Rare plant surveys were also initially conducted in 1986 (Taylor and Davilla, 1986b). The vegetation types (including wetlands) and rare plants species were updated through additional surveys and mapping conducted in 1991, 1996, 1997, and 2002 (Preston, 2002a and b). For convenience, the vegetation communities at Site 300 can be combined into seven major plant habitats, four upland and three wetland habitats. The four major upland habitats are introduced grassland, native grassland, woodland and scrub. The less extensive wetland habitats are herbaceous wetlands/fresh water seeps (primarily low-flowing springs, the most frequently encountered wetland), very limited northern riparian woodland, and vernal pools/seasonal ponds. These seven major habitats consist of 13 vegetation communities as classified using a list of California natural communities recognized by the Natural Diversity Database. A total of 364 plant species have been identified at Site 300. The Pit 7 Complex area is composed primarily of introduced grassland, with limited areas of native grassland. An herbaceous wetland is found at Spring 24. Two vernal pools/seasonal ponds occur north and west of the complex, and northern riparian woodland is found at Spring 6, east and south of the complex.

Animal surveys were also initially conducted in 1986 (Orloff, 1986) with new surveys conducted in 2002. The new surveys were mesocarnivore surveys (Clark et al., 2002), bat surveys (Rainey, 2003), a small mammal inventory (West, 2002), a breeding raptor and loggerhead shrike status (Bloom, 2002), an avian monitoring program (van Hattem, 2003a), special status reptile surveys (Swaim, 2002), amphibian surveys (van Hattem, 2003b), wet season branchiopod surveys (Weber, 2002), and valley elderberry longhorn beetle surveys

(Arnold, 2002). Fauna with verifiable observations at Site 300 include 22 species of mammals, 23 species of reptiles and amphibians, 111 species of birds and three species of invertebrates (LLNL, 2003). Mammal species observed at the Pit 7 Complex are typical of grassland species, and include mice, hares, squirrels, skunks, foxes, and black-tailed deer. Raptors are frequently observed hunting in the area. Reptiles include various lizards and snakes. Amphibians are known to use Spring 24.

2.3. Nature and Extent of Contamination

The nature and extent of contamination in the Pit 7 Complex area are discussed in Chapter 11, Section 11-4 of the SWRI report (Webster-Scholten, 1994), Chapter 2 of the SWRI Addendum (Taffet et al., 1996), the Ground Water Tritium Plume Characterization Summary report (Ziagos and Reber-Cox, 1998), and Chapter 1 of the SWFS (Ferry et al., 1999). Although the following sections briefly discuss the results of these previous investigations, the main emphasis is on investigations conducted since the SWFS data cutoff (October 1999). These recent studies include:

- Geophysical characterization of Pits 3 and 5 (2002),
- Characterization of residual tritium and uranium sources in Pits 3 and 5 based on samples of pit waste and adjacent soil (1999).
- Characterization of uranium in ground water in the vicinity of the pits (mainly 2002 and 2003 data).
- The extent of tritium in ground water in the $Tnbs_0$ HSU down gradient of the pits (mainly 2003 data).
- Helium-3 soil gas survey to evaluate residual tritium sources in Pits 3 and 5 (2002 and 2003).

Previous studies identified tritium and uranium as major COCs in subsurface soil and ground water. Other COCs identified in ground water include perchlorate, trichloroethylene (TCE), and nitrate. Analyses of chemical data collected after the SWFS data cutoff (October 1999) have not added any new soil or ground water COCs; however, the extent of these contaminants has been revised from previous reports.

2.3.1. Description of Sources of Contamination

Soil and ground water from the Pit 7 Complex area has been analyzed for a broad range of chemicals, including metals, radionuclides (mainly tritium and uranium), explosives compounds, volatile organic compounds (VOCs), and nitrate. In addition, mass spectrometry is used to determine the uranium-235 to uranium-238 ($^{235}U/^{238}U$) mass ratio and estimate the extent of depleted uranium (i.e., $^{235}U/^{238}U$ mass ratio < 0.00711) from anthropogenic sources (Lide, 1991–1992). Uranium-238 comprises 99.3% of the mass of natural uranium and can comprise up to 99.8% of the mass of depleted uranium. Thus, the depleted uranium contamination found in soil and ground water at the Pit 7 Complex is almost exclusively composed of uranium-238. Prior to 1999, environmental investigations at Site 300 used alpha spectrometry to measure the uranium content of environmental media. Because the alpha spectrometry method is relatively insensitive to uranium isotopes other than uranium-238 at the activities observed in Site 300 environmental media, it was often the only uranium isotope reported. In 1999, DOE/LLNL adopted the use of mass spectrometry that provides better detection limits for the uranium isotopes other than uranium-238 and can therefore measure the diagnostic $^{235}U/^{238}U$ mass ratio. Because depleted uranium is composed almost exclusively of uranium-238, this report uses the terms uranium-238 and depleted uranium interchangeably to describe anthropogenic uranium contamination at the Pit 7 Complex.

Characterization data collected to date indicate that the main source of subsurface soil and ground water contamination in this area is the waste in the landfill pits. Tritium and various metals, including depleted uranium, were used in explosives experiments conducted at Site 300. The bulk of the tritium received at Site 300 was used in experiments conducted between 1962 and 1972, when Pits 3 and 5 were actively receiving waste. Nearly all the tritium and depleted uranium-bearing waste generated at the Building 850 firing table, the most active firing table at Site 300, was disposed in Pits 3 and 5. By the time Pit 7 was actively receiving waste between the late 1970s and the late 1980s, tritium use at Site 300 had decreased significantly, although depleted uranium use continued. LLNL only used depleted uranium, not natural uranium, in explosives experiments conducted while the Pit 7 Complex landfills received firing table debris (Wood, 2004; Krauter, 2004). The primary sources of tritium and uranium contamination to both subsurface soil and ground water appear to be Pits 3 and 5. Pit 7 appears to be a source mainly of depleted uranium.

As part of source characterization for this RI/FS report, a surface geophysical survey was conducted by Norcal Geophysical Consultants during the summer of 2002 to more accurately characterize the lateral and vertical extent of the pit waste. This survey utilized several methods including electro-magnetic terrain conductivity, vertical magnetic gradient, and electrical resistivity. These surveys specifically targeted Pits 3 and 5 because the extent of these two pits is less certain than Pit 7 and because Pit 7 has a clay cap and it is difficult to image through clay using these techniques. Geophysical survey results are discussed in detail in Appendix B and briefly summarized below.

The electro-magnetic method, which measures shallow (upper 20 ft) electrical conductivity variations that may be due to buried waste or changes in subsurface materials, was used to determine the approximate boundaries of Pits 3 and 5. However, this method proved to be sensitive to known surface and shallow subsurface features, such as reinforced concrete surface drains and underground utilities, and, therefore, did not add significantly to the characterization of the pits. The vertical magnetic gradient method identified localized magnetic anomalies caused by buried metal (ferrous) objects. This method was also influenced by known surface features such as 55-gallon drums and metal well casing, however, it also detected numerous magnetic anomalies over Pit 3 which most likely represent buried metal objects.

The electrical resistivity method measures the bulk electrical properties of the formation to a depth of 35 to 40 ft and is not influenced by small-scale objects. It proved to be the most useful technique to improve characterization of the pits because it provided continuous information regarding the pit bottom along each electrical resistivity profile. Prior to this survey, the only information regarding pit depth was based on: (1) anecdotal information that the pits were excavated to a depth of about 20 ft; and (2) estimates of the pit bottom based on tip resistance using a cone penetrometer.

Electrical resistivity data were collected along nine profiles in the vicinity of Pits 3 and 5; eight transverse (southwest to northeast) profiles and one longitudinal (northwest to southeast) profile (Appendix B). These profiles indicate that most of the subsurface along the profiles consists of low resistivity (< 20 ohm-meter), materials, while the pits exhibit much higher resistivity (> 90 ohm-meter). The low-resistivity regions on each profile represent native, undisturbed clay-rich soil and weathered bedrock, while the pits contain electrically-resistive firing table gravel and detonation debris. The pit bottom is identified by the steep gradient between the high-resistivity pit contents and the surrounding low resistivity, undisturbed soil or bedrock. As shown on the electrical resistivity profiles in Appendix B, the depths of the pits range from 15 to 20 ft below the present grade.

In addition to the surface geophysics, a soil gas survey was conducted during the summers of 2002 and 2003 to evaluate the distribution of helium-3 in the soil gas overlying the pits and independently corroborate the total tritium activity remaining in the landfills estimated using soil data. Tritium decays to helium-3 gas and thus excess helium-3 in the soil gas overlying the pits is a good indicator of residual tritium sources within the pits. A total of 58 soil gas samples were collected from Pits 3 and 5; 32 samples were collected from Pit 3 and 26 from Pit 5. The helium-3 soil gas results ranged from less than atmospheric background for helium-3 to greater than 10^7 atoms/cm^3. All but six of the samples contained excess helium-3 gas. In general, excess helium-3 gas at Pit 3 was higher than Pit 5. Half of the helium-3 gas samples from Pit 3 were greater than 2×10^7 atoms/cm^3 above background levels; whereas, less than one fourth of the Pit 5 samples were greater than this value. Helium-3 gas sampling methods, data analysis, and a more detailed discussion of results are presented in Appendix C.

All available source characterization data, including surface geophysics, borehole, cone penetrometer, soil gas, and ground water data, indicate that the primary source of tritium, depleted uranium, VOCs, and perchlorate contamination is the pit waste. Residual contamination also exists in the vadose zone beneath the pits due to several releases associated with heavy El Niño rainfall events during the last 30 years. In addition, results of a recent geochemical modeling evaluation indicate that it is possible that some combination of natural and landfill-induced geochemical effects are causing an increase in natural uranium activities in ground water downgradient of the pits. All of the source characterization data were integrated in an Earth Vision contaminant property model to more accurately estimate the extent of tritium and depleted uranium remaining in the pits and underlying vadose zone. These estimates are discussed below in Section 2.3.2. This analysis was also used in Section 3.3 to evaluate remedial alternatives with source control components that involve waste excavation or hydraulic diversion.

2.3.2. Nature and Extent of Contamination in Soil and Rock

Surface (0- to 0.5-ft depth) and subsurface (below 0.5-ft depth) soil and bedrock samples collected in the Pit 7 Complex area have been analyzed for a variety of chemicals and radionuclides, including tritium, uranium, and VOCs. The majority of these samples were analyzed for tritium. Additional data are provided by 14 lysimeter that monitored vadose zone soil moisture in the vicinity of Pits 3 and 5 between 1985 and 1998.

A total of 11 surface (< 0.5 ft) soil samples have been collected in this area for tritium analysis. Three of the 11 surface soil samples contained detectable levels of tritium (> 200 pCi/L). Surface soil samples are generally not reliable indicators of tritium sources since surface soil is subjected to cycles of wetting and drying related to rainfall and evapotranspiration. Nonetheless, the maximum tritium activity in surface soil, 0.72 picocuries per gram (pCi/g)

(18,100 picocuries per liter in soil moisture [pCi/L_{sm}]), was detected near the southeast corner of Pit 3 in borehole B-Pit7-04. Tritium surface soil data are presented in Appendix A, Tables A-2.

Nineteen surface soil samples have been collected and analyzed for uranium-238 in this area. Analytical results for these samples were reported in the SWRI and the Building 850 Addendum reports. The uranium-238 activity detected in these samples ranges from 0.1 to a maximum of 4 pCi/g. The maximum uranium-238 activity was detected in a sample collected from borehole B-Pit7-07 located near the northeast corner of Pit 3.

A total of 397 subsurface (> 0.5 ft depth) soil and rock samples have been collected for tritium analysis and 277 contained detectable levels of tritium. Tritium subsurface soil and rock data collected between July 1995 and June 2003 are presented in Appendix A, Table A-2. Tritium subsurface soil and rock data collected prior to July 1995 are contained in previous reports. About 10% of these samples contained soil moisture tritium in excess of 10^6 pCi/L_{sm}. All the tritium soil moisture results in excess of 10^6 pCi/L_{sm} were collected from Pit 3; either from within the pit (i.e., pit waste) or from adjacent soil or rock. The subsurface soil sample that contained the maximum historical tritium activity (8,090,000 pCi/L_{sm}; 1,180 pCi/g) was collected on November 5, 1984 at a depth of 11.1 ft in the borehole for well NC7-23 located just east of Pit 3. The 2003 decay-corrected value for this sample is 2,740,000 pCi/L_{sm}.

Between 1985 and 1998 tritium soil moisture monitoring was conducted in the Pit 7 Complex area using lysimeters. During this time, 508 soil moisture samples were collected from 14 lysimeters and analyzed for tritium. Tritium lysimeter data are presented in Appendix A, Table A-3. The results range from < 100 pCi/L to a maximum of 7,800,000 pCi/L collected in January 1985 from lysimeter NC7-13. About 10% of the lysimeter samples contained tritium in excess of 10^6 pCi/L. All of the tritium results greater than 10^6 pCi/L were collected from 2 lysimeters, NC7-13 and NC7-32B, located adjacent to the eastern margin of Pit 3. NC7-13, which contains the highest tritium lysimeter result, shows a decreasing trend from 7 to 8 × 10^6 pCi/L during the mid-1980s to 2.5 to 4 × 10^6 pCi/L following the 1998 El Niño.

To further characterize Pits 3 and 5, 16 boreholes were drilled in the vicinity of Pits 3 and 5 to assess the extent of residual tritium and uranium sources in the pit waste and adjacent soil. These data, which were collected in 1999 and are presented in Appendix A, Table A-2 (tritium) and A-4 (uranium isotopes), have not been previously reported. Sixty-eight subsurface soil samples were collected from the 16 boreholes, nine of which were drilled at Pit 3 and seven were drilled at Pit 5. Thirty-nine of the 68 samples were collected from the Pit 3 boreholes and 29 were collected from the Pit 5 boreholes at depths ranging from 3.5 to 29 ft. Thirty-one of the samples were collected within the pits and are representative of pit waste; 37 samples were collected outside the pits from adjacent soil. Twenty-five of the 31 pit waste samples were collected from Pit 3 and 5 were collected from Pit 5. Figure 2-15 is a map showing the location of each borehole and the maximum tritium soil moisture activity in pCi/L_{sm}, the corresponding tritium soil activity in pCi/g, and sample's depth.

As shown in Figure 2-15, the tritium activities in Pit 3 are higher by an order-of-magnitude than those present in Pit 5. The maximum tritium activity in soil at Pit 3 is 1,130 pCi/g (5,960,000 pCi/L_{sm}). This sample was collected at the bottom of the pit at a depth of 22 ft in borehole B-Pit3-08. This sample most likely represents a mixture of pit waste and underlying soil. The maximum tritium detection in soil moisture at Pit 3 is 6,900,000 pCi/L_{sm} (541 pCi/g). This sample was collected within Pit 3 in borehole B-Pit3-11 at a depth of 13.5 ft and is representative of pit waste. The maximum tritium detection outside of Pit 3 is 407 pCi/g (3,090,000 pCi/L_{sm}). This sample was collected at 19 ft in borehole B-Pit3-13, located near the southeast corner of Pit 3.

The maximum tritium activity detected in Pit 5 waste samples is 2.9 pCi/g (58,900 pCi/L_{sm}), from a sample collected at 8.5 ft in borehole B-Pit5-21. The maximum tritium activities detected in soil and soil moisture outside Pit 5 are 143 pCi/g and 595,000 pCi/L_{sm}, respectively, from a sample collected at a depth of 14 ft in borehole B-Pit5-21. This sample was collected outside the pit and represents soil adjacent to Pit 5.

The tritium soil data collected from the Pits 3 and 5 were used in a three-dimensional contaminant property model to characterize the location and magnitude of residual tritium sources with respect to the pit boundaries. Residual tritium mass estimates based on volumetric analysis of these data were presented to the regulatory agencies and the public in 2000. Volumetric analysis of the tritium soil data indicates that approximately 11.7 Ci of tritium remain at Pit 3. However, about 80% (9.3 Ci) of this tritium currently resides in the vadose zone beneath Pit 3 and only 2.4 Ci remain within the pit. The 2.4 Ci estimate of tritium remaining in Pit 3 is consistent with total tritium activity estimates based on the ^{3}He soil gas survey (0.4 to 1.0 Ci; Appendix C). The presence of significant amounts of contamination in the vadose zone beneath the pits has bearing on the feasibility of remedial alternatives with source control components that involve waste excavation.

Soil samples collected from boreholes drilled in the vicinity of Pits 3 and 5 were also analyzed for uranium. These samples were analyzed for uranium-238 in milligrams per kilogram (mg/kg) and uranium isotopes by mass spectrometry. Uranium isotope soil data are presented in Appendix A, Tables A-4. Figure 2-16 shows the maximum uranium-238 in mg/kg, the corresponding total uranium in pCi/g, and the sample's depth. Because uranium-238 is a constituent of both natural and anthropogenic materials, mass spectrometry was used to assess the extent of anthropogenic uranium in the pit waste and nearby soil based on a $^{235}U/^{238}U$ mass ratio that is less than the 0.00711 mass ratio established by the DOE as being the percentage of uranium-235 in natural uranium. Volumetric analysis of the soil uranium property model indicates that 2 of the 3.5 Ci estimated in this region is due to natural sources in the soil and 1.5 Ci is due to depleted uranium of anthropogenic origin. Of the 1.5 Ci of depleted uranium, about 0.5 Ci remains in the pits and about 1 Ci currently resides in the vadose zone underlying the pits. The estimated 1 Ci of depleted uranium that has leached out of the pits does not currently exist as a dissolved phase in the ground water. Rather it exists in: (1) the solid phase on sediment surfaces (e.g., precipitate, sorbed, or colloid), and/or (2) the dissolved phase in soil moisture. Uranium in oxygenated environments, such as within the Pit 7 Complex landfills and adjacent vadose and water-bearing zones, exists in the U^{+6} oxidation state. Equilibrium thermodynamic modeling performed with the Geochemist's Workbench (Bethke, 2003) indicates that in Pit 7 Complex ground waters, dissolved U^{+6} principally occur as soluble uranyl carbonate complexes $(UO_2)\ (CO_3)_2^{-2}$ and $(UO_2)\ (CO_3)_3^{-4}$ species. These uranyl carbonate complexes are dominant in oxidized natural waters that contain bicarbonate as the principal anion. Geochemical modeling also indicates Pit 7 ground water can dissolve a maximum of about 0.17 mg/L of uranium. The maximum dissolved uranium concentrations observed in Pit 7 Complex ground water are in the same order of magnitude. Thus, cycles of inundation and retreat of rising ground water is a sufficient mechanism for the leaching and mobilization of uranium from the pits.

As shown in Figure 2-16, the highest uranium-238 levels in Pit 3 are at the same order-of-magnitude as Pit 5. The uranium-238 activity in these samples ranges from 0.78 to 625 mg/kg and the $^{235}U/^{238}U$ mass ratio ranges from strongly depleted (0.0017) to natural (0.0072). About 25% of the samples collected had natural $^{235}U/^{238}U$ mass ratios while the remainder exhibited varying degrees of uranium-235 depletion. The natural (i.e., background) uranium-238 activity ranges from 0.78 to 10 mg/kg based on the 25% that contain natural $^{235}U/^{238}U$ mass ratios. However, the uranium-238 activities for samples with depleted signatures range from 0.96 mg/kg to a maximum of 626 mg/kg, indicating the highest uranium-238 concentrations correspond to the most depleted uranium.

The maximum total uranium activity in soil in Pit 3 is 234.8 pCi/g was detected in a split from the sample that contained the maximum tritium soil activity of 1,180 pCi/g, collected at the bottom of Pit 3 in borehole B-Pit3-08 at a depth of 22 ft. This sample contained 625.2 mg/kg of uranium-238 and exhibited a depleted $^{235}U/^{238}U$ mass ratio of 0.00172. The maximum total uranium activity detected in Pit 5 is 209.3 pCi/g. This sample was collected at a depth of 4.5 ft in borehole B-Pit5-21. This sample contained a uranium-238 concentration of 546.6 mg/kg and exhibited a depleted $^{235}U/^{238}U$ mass ratio of 0.00202. This sample was collected near the western margin but outside of Pit 5 and was split from the sample that contained the highest soil moisture tritium of the Pit 5 borehole samples. In general, the pit waste samples with the highest total uranium activity indicate the most depletion or most added anthropogenic uranium.

The soil data collected from Pits 3 and 5 and analyzed for total uranium and individual uranium isotopes by mass spectrometry were used in a three-dimensional contaminant property model to characterize the distribution and estimate the magnitude of residual depleted uranium in the pits and underlying vadose zone. Pit 7 is not included in this estimate because it is capped and no soil data exist for this pit. The model used both total uranium activity data (pCi/g) and $^{235}U/^{238}U$ mass ratio data to define the extent of anthropogenic uranium. The model assumed any uranium with a $^{235}U/^{238}U$ mass ratio less than 0.00700 was considered to be depleted, and therefore of anthropogenic origin. Based on volumetric analysis, it was estimated that a total of 3.5 Ci of uranium remains in Pits 3 and 5 and the surrounding vadose zone in the area impacted by depleted uranium.

A total of fourteen soil samples have been collected in the Pit 7 Complex area and analyzed for VOCs. Eleven of the VOC samples were surface samples and three were subsurface samples. The subsurface samples were collected from 6.2 to 26 ft in the borehole for NC7-67 located near the southeast corner of Pit 5. VOCs were not detected in any of the surface or subsurface samples above a 0.0002 mg/kg detection limit. In addition to these soil samples, a passive soil vapor survey was conducted in the vicinity of Pits 3 and 5 to determine whether any residual VOC sources existed in the pit waste. This survey was conducted in 1994 as part of the Building 850/Pit 7 Addendum to the SWRI report. Only trace amounts of TCE were detected in three of the 30 passive soil vapor points. All three detections were located along the margin of Pit 5, indicating a possible minor VOC source within this pit.

In summary, spatial analysis of soil data from within and adjacent to Pits 3 and 5 indicate that a total of 12 Ci of tritium and 1.5 Ci of depleted uranium still exist in this source area. Of the 12 Ci of tritium, 2.4 Ci remain in Pit 3, 0.5 Ci remain in Pit 5, and 9.1 Ci reside in the vadose zone surrounding the pits. Of the 1.5 Ci of depleted uranium remaining, 0.5 Ci remain in the pits and 1.0 Ci remain in the underlying vadose zone. Uranium and tritium sources appear to be co-located in both pits (e.g., the highest tritium activity was detected where the highest depleted uranium activity was detected). The most significant tritium source appears to be located near the bottom of Pit 3 and in the underlying vadose zone. Depleted uranium sources also exist in both pits. The magnitude of the residual uranium sources appears to be comparable in both pits. Based on continued releases of depleted uranium to ground water downgradient as discussed below in Section 2.3.3, Pit 7 is also considered to contain depleted uranium in the buried waste.

2.3.3. Nature and Extent of Contamination in Ground Water

Ground water in the Pit 7 Complex area has been analyzed for a broad range of parameters, including radionuclides, VOCs, metals, perchlorate, and nitrate. Tritium and uranium; VOCs (primarily TCE); perchlorate, and nitrate were identified contaminants in ground water in the Site-Wide Interim Feasibility Study. Ground water data collected in the Pit 7 Complex area are presented in Appendix A as follows:

- Tritium activity data are presented in Table A-5.
- Uranium activity and atom ratio data are presented in Table A-6.
- Uranium isotope activity data are presented in Table A-7.
- Thorium isotope activities are presented in Table A-8.
- Radium isotope activities are presented in Table A-9.
- Nitrate data are presented in Table A-10.
- Perchlorate data are presented in Table A-11.
- Cation data are presented in Table A-12.
- Metal data are presented in Table A-13.
- VOC data are presented in Table A-14.
- Aromatic (fuel) hydrocarbon data are presented in Table A-15.
- Anion, total dissolved solids, specific conductance, and pH data are presented in Table A-16.
- High explosive compound data are presented in Table A-17.
- Polychlorinated biphenyl data are presented in Table A-18.

Analyses of recent data indicate no new contaminants have been detected in ground water since the Site-Wide Interim Feasibility Study.

2.3.3.1. Tritium

Monitoring for tritium activities in ground water in the Pit 7 Complex area began in the mid-1980s and continues today. The number and distribution of monitoring points has increased substantially over time. The current monitoring network covers the lateral and vertical extent of all water-bearing zones upgradient and downgradient of the pits.

Background tritium activity in ground water in the Pit 7 Complex area is estimated to be less than 100 pCi/L. The evaluation of tritium in ground water to determine background levels in ground water is discussed in Appendix D. The historical maximum tritium activity of 2,660,000 pCi/L was detected in a ground water sample collected from well NC7-63 following the 1998 El Niño event. A sample collected from nearby well NC7-51 also contained 1,450,000 pCi/L of tritium following the 1998 El Niño. The maximum tritium activity detected in the Pit 7 Complex during the second quarter 2003 is 469,000 pCi/L in well NC7-25. All of these wells are located downgradient (east-southeast) of Pit 3. As shown in Figure 2-17, tritium ground water activities downgradient from Pit 3 exhibit temporally-varying trends that correlate to episodic rainfall events. For example, the tritium time-series plot for Qal/WBR monitor well NC7-51 shows that tritium activities in ground water increased significantly during the heavy winter rains of 1993, 1996, and 1998. Successive increases in tritium activity in ground water samples collected from well NC7-51 did not occur until water levels exceeded their previous high mark. Well NC7-63 also exhibited a similar trend.

During the second quarter 2003, the distribution of tritium in ground water in the Qal/WBR and $Tnbs_0$ HSUs based on second quarter 2003 data are presented in Figure 2-18. In previous reports, the tritium data from these two HSUs were combined into a single plume map. The distribution of tritium in these two HSUs is now presented separately to be consistent with our revised conceptual hydrogeologic flow model. Another significant revision from previous reports is the extent of tritium in the bedrock $Tnbs_0$ HSU down gradient of the pits. As shown in Figure 2-18, tritium above the 20,000 pCi/L maximum contaminant level (MCL) in this HSU extends further eastward than previously reported. Its revised extent was delineated by a series of monitor wells (W-Pit7-11 through W-Pit7-15) drilled in 1998 and 1999 which are located east of the Pit 7 Complex landfills. These wells range in depth from 180 to 325 ft and are all completed with 5 or 10-foot screens in the $Tnbs_0$ HSU. The distribution of tritium in the $Tnbs_0$ HSU exhibits a pattern that is consistent with two coalescing plumes, one emanating from sources in Pit 3 and a lower activity plume emanating from sources within Pit 5.

Tritium activities in the Qal/WBR HSU are dependent on the temporally varying extent of saturation exhibited by this water-bearing zone during heavy rain events (Figure 2-17). During drought years, this HSU becomes almost entirely desaturated as shallow ground water levels drop; however, during heavy rainfall events its extent increases laterally and vertically and it is the first to be impacted by any releases from the pits. Figure 2-18 shows the current tritium distribution in the Qal/WBR HSU based on second quarter 2003 data and exhibits a pattern that is consistent with two separate sources, one in Pit 3 and another in Pit 5.

In summary, tritium sources still exist in the pits and underlying vadose zone. These residual sources release tritium to shallow ground water during heavy, El Niño-type rainfall events; however, their impact is fairly limited in both space and time. Tritium time-series plots for wells screened in the Qal/WBR HSU and located downgradient of Pit 3, increased by an order-of-magnitude following the heavy rainfall events of 1996 and 1998 (Figure 2-17). However, tritium levels decreased significantly following these events and the second quarter 2003 tritium activity for well NC7-51 has decreased to its pre-1996 level. The impact of these tritium releases to ground water in the $Tnbs_0$ bedrock HSU is shown by the time-series plot for monitor well NC7-25. Tritium levels in this well exhibit a single broad increase from 412,000 pCi/L in December 1997 to a peak of 770,000 pCi/L in October 1999, about 1.5 years after the 1998 Niño. Since that time, tritium in this well has decreased to levels before the 1998 release (469,000 pCi/L in the second quarter of 2003).

2.3.3.2. Uranium

Analytical data from monitor wells in the Pit 7 Complex area since the mid-1990s indicate that both depleted and natural uranium are present in ground water. The nature and extent of both depleted and natural uranium in ground water in the Pit 7 Complex area was evaluated using $^{235}U/^{238}U$ isotope mass ratio data.

Depleted and natural uranium in ground water are differentiated using mass spectrometry to determine the mass ratio of $^{235}U/^{238}U$ isotopes. As discussed in Section 2.3.2, a $^{235}U/^{238}U$ mass ratio less than 0.007 indicates the presence of depleted uranium and a $^{235}U/^{238}U$ mass ratio approximately equal to 0.007 indicates natural uranium.

Depleted uranium was used in open-air explosives experiments conducted on the Buildings 850 and 851 firing tables at Site 300. Disposal of depleted uranium-bearing gravels from these firing tables to the unlined Pit 7 Complex landfills from 1958 to 1988 created a source of depleted uranium to nearby soil and ground water. Depleted uranium does not exist naturally and is the product of a separation process in which the ^{235}U isotope is extracted from natural uranium. The remaining material contains less of the ^{235}U isotope and is called depleted uranium (i.e., depleted in ^{235}U).

LLNL B Division, which conducts the explosives experiments at Site 300, confirmed that no natural or enriched uranium were used in these experiments (Krauter, 2004; Wood, 2004). However, higher activities of natural uranium have been detected in ground water samples from wells downgradient of the Pit 7 Complex than in samples from wells upgradient of the pits. Therefore, natural uranium in ground water was evaluated as part of the Pit 7 Complex Remedial Investigation to: (1) verify the source of natural uranium in ground water, and (2) begin the process of establishing natural uranium background levels in ground water. Based on the evidence DOE/LLNL has gathered and geochemical analysis performed, it is possible that some combination of natural and landfill-induced geochemical effects are responsible for elevated natural uranium activities in ground water downgradient of the pits.

The occurrence and distribution of depleted and natural uranium in ground water in the Pit 7 Complex area are discussed in Sections 2.3.3.2.1 and 2.3.3.2.2, respectively.

2.3.3.2.1. Depleted uranium in ground water

Depleted uranium associated with firing table gravels placed in the pits is released to ground water as the water table rises into the pit waste. The distribution of depleted uranium in Pit 7 Complex ground water in the second quarter of 2003 is shown in Figure 2-19. The extent of deleted uranium is defined by the wells in which ground water samples showed a mass ratio of less than 0.007. The depleted uranium ground water plume is represented in Figure 2-19 by the orange-shaded area near and downgradient from the landfills. The total uranium activities in ground water shown for wells within this orange-shaded area consist of a mixture of both natural and depleted uranium. In Figure 2-19, the symbols for wells screened in the Qal/WBR HSU are designated by a different symbol than those completed in the $Tnbs_0$ HSU to facilitate comparison of the uranium data between the two HSUs. For example, the sample from Qal/WBR well NC7-64, located adjacent to Pit 3, contained a total uranium activity of 116 pCi/L. The $^{235}U/^{238}U$ mass ratio of 0.005 indicates that depleted uranium comprises a portion of the total uranium in the sample from this well. The well symbol indicates that the well is completed in the Qal/WBR HSU.

The distribution and historical activity trends of depleted uranium in the Qal/WBR and $Tnbs_0$ bedrock HSUs are discussed below.

Qal/WBR HSU: The presence of relatively high total uranium activities and low (depleted) mass ratios in ground water samples from Qal/WBR monitor wells located directly adjacent to and downgradient from Pits 3, 5, and 7 indicates that depleted uranium has been released to ground water from these landfills. For example, as shown in Figure 2-19, samples collected from well NC7-64 (located adjacent to Pit 3), well NC7-40 (located near the southeast corner of Pit 5), and well NC7-48 (located adjacent to Pit 7), all contain relatively high total uranium activities and $^{235}U/^{238}U$ mass ratios indicative of depleted uranium. These data indicate that the pits are sources of depleted uranium.

Releases of depleted uranium from the pits correlate with high rainfall and resulting water table rises into the pits. A comparison of historical data from Qal/WBR ground water monitor wells that contained depleted uranium against data from these wells in the second quarter of 2003 show a marked increase in total uranium activities, as well as an increase in the percentage of depleted uranium (as indicated by lower $^{235}U/^{238}U$ mass ratios) during years of extremely high rainfall and high ground water levels (i.e., 1998). During the following years of normal rainfall and lower water levels, the total uranium activity and depleted uranium percentage generally decrease in ground water. For example, the maximum historical total uranium activity detected in ground water affected by depleted uranium in the Pit 7 Complex area was 781 pCi/L. This sample was collected from Qal/WBR monitor well NC7-40, located near the southeast corner of Pit 5, following the 1998 El Niño. This 1998 ground water sample contained a $^{235}U/^{238}U$ mass ratio of 0.002, indicating a highly depleted mass ratio. As shown in Figure 2-19, by the second quarter of 2003, total uranium activities in ground water at well NC7-40 had decreased to 123 pCi/L with an increased 0.003 $^{235}U/^{238}U$ mass ratio, indicating less depleted uranium.

During the second quarter of 2003, total uranium activities in ground water samples from Qal/WBR wells that exhibit a depleted uranium mass ratio ranged from 123 pCi/L in well NC7-40 located adjacent to Pit 5 to 8.63 pCi/L in well K7-07 located downgradient of the landfills. A portion of the total uranium activities detected in Pit 7 Complex ground water are attributed to natural uranium that commingles with the depleted uranium.

The depleted uranium ground water plume in the Qal/WBR HSU is indicated in Figure 2-19 by the orange-shaded area near and downgradient from the landfills and includes all wells in which samples showed a depleted uranium mass ratio of less than 0.007. The plume extended approximately 800 ft downgradient from Pits 3, 5, and 7 source area in the second quarter of 2003. During this time period, the depleted uranium plume had a maximum width of approximately 400 ft in the center of the landfill complex, narrowing to approximately 200 ft in width farther down the alluvial channel.

The extent of depleted uranium in Qal/WBR HSU ground water has changed little since the mid-1990s. Areas of depleted uranium in ground water are bounded by wells that have in the past exhibited ground water isotope mass ratios indicative of natural uranium. This indicates that the depleted uranium plume is not migrating significantly in the short term within the Qal/WBR HSU ground water. Sorption may be responsible for slowing the migration of depleted uranium in ground water compared to conservative contaminants such as tritium.

$Tnbs_0$ Bedrock HSU: Although Figure 2-19 presents uranium data from wells completed in both the Qal/WBR HSU and the $Tnbs_0$ HSU, all ten wells containing depleted uranium in ground water in the Pit 7 Complex (within the orange-shaded area) are screened in the Qal/WBR HSU downgradient of the landfills. Ground water samples from wells screened in the $Tnbs_0$ HSU have not shown a depleted uranium mass ratio, indicating that depleted uranium has not migrated downward into the $Tnbs_0$ HSU. Therefore, further discussion of depleted uranium contamination in this document applies only to ground water in the Qal/WBR HSU.

2.3.3.2.2. Natural uranium in ground water

As natural uranium was not used in experiments at Site 300 that generated the waste placed in the Pit 7 Complex landfills, the sources of natural uranium in ground water in this area are the volcanic-rich Neroly $Tnbs_0$ bedrock and the alluvium/weathered bedrock (Qal/WBR) that are derived from the Neroly Formation. However, DOE/LLNL conducted an evaluation to determine the effects of geochemical processes on the occurrence and distribution of natural uranium in ground water in the Pit 7 Complex area and to identify any potential impacts of the landfills on these processes.

Figure 2-19 shows the 2nd quarter 2003 distribution of natural uranium in ground water at the Pit 7 Complex. Although contours are not presented for natural uranium, its distribution is identified by wells with a $^{235}U/^{238}U$ mass ratio indicative of natural uranium (0.007). The total uranium activity posted for these wells is due solely to natural uranium. For example, the ground water sample collected from well NC7-24 during the second quarter 2003 had a $^{235}U/^{238}U$ mass ratio of 0.007 indicating natural uranium was present at an activity of 5.77 pCi/L.

The occurrence and distribution of natural uranium in the Qal/WBR and $Tnbs_0$ HSUs, as well as the results of the evaluation to determine potential effects of the pits on ground water geochemistry and natural uranium, are discussed below.

Qal/WBR HSU:

During the second quarter of 2003, total uranium activities in ground water samples from Qal/WBR HSU wells that exhibit a natural uranium mass ratio ranged from 0.29 pCi/L in well W-Pit7-02 to 49.6 pCi/L in well NC7-21. Well NC7-21 is the only well completed in the Qal/WBR HSU from which samples have contained total uranium activities exceeding the 20 pCi/L MCL that are entirely composed of natural uranium. Elevated perchlorate and nitrate concentrations have also been detected in ground water samples from this well. As shown in Figure 2-19, both wells NC7-21 and W-Pit7-02 are located downgradient of Pit 5. However, in general, higher activities of natural uranium have been detected in ground water samples from wells completed in the Qal/WBR HSU downgradient of the Pit 7 Complex than in samples from wells in this HSU located upgradient of the pits.

Historical total uranium data show some correlation between increases in natural uranium activities in samples from downgradient Qal/WBR wells with high rainfall years when water levels rose into the pits. For example, the historical maximum natural uranium activity detected in well NC7-21 was 17.5 pCi/L prior to 1998. Following the 1998 El Nino rainfall event, natural uranium activities in this well increased to 48.7 pCi/L.

DOE/LLNL developed a conceptual geochemical model as part of an evaluation to determine the effects of geochemical processes on the occurrence and distribution of natural uranium in Qal/WBR HSU ground water in the Pit 7 Complex area. In this conceptual model, the effects of the physical setting, proximity to the ground water recharge area, chemical composition of the rocks and sediments, ground water geochemistry, residence time, and dilution and mixing along ground water flow paths in the Pit 7 Complex area on the distribution of natural uranium in Qal/WBR ground water were considered. Mass balance constraints, supported by geochemical speciation modeling using PHREEQC (Parkhurst, 1995), were used to identify a possible geochemical explanation for relatively elevated concentrations of natural uranium in ground water samples monitor wells downgradient from the Pit 7 Complex landfills. The geochemical modeling and results are discussed in more detail in Appendix H.

The modeling results and data indicate that there is an increase in dissolved inorganic carbon (occurring primarily as HCO_3^- [bicarbonate]) detected in ground water samples from Qal/WBR HSU wells downgradient of the Pit 7 Complex that cannot be explained solely based on water-rock interactions. This increase in dissolved bicarbonate concentrations in downgradient ground water may be the result of oxidation of carbon-bearing organic matter within the Pit 7 Complex valley due to a combination of: 1) aerobic decomposition of plant material, 2) bacterial action in plant root zones, and/or 3) aerobic decomposition of wood in the pits. Uranium solubility and desorption from mineral surfaces are known to increase as bicarbonate concentrations increase in ground water.

Based on the results of the geochemical analysis and modeling, it is possible that some combination of natural and landfill-induced geochemical effects are causing the distribution of dissolved bicarbonate concentrations that are increasing the capacity for dissolved uranium mobilization in ground water in the Qal/WBR HSU.

$Tnbs_0$ Bedrock HSU:

During the second quarter of 2003, total uranium activities in ground water samples from $Tnbs_0$ HSU wells that exhibit a natural uranium mass ratio ranged from 0.06 pCi/L in well K7-09 to 34.5 pCi/L in well NC7-25. K7-01 and NC7-25 are the only wells completed in the $Tnbs_0$ HSU from which samples have contained total uranium activities exceeding the 20 pCi/L MCL. The uranium in these samples is natural in origin. Samples from these two wells also contained elevated perchlorate and/or nitrate concentrations. As shown in Figure 2-19, K7-01 is located downgradient of Pit 5 and NC7-25 is located downgradient of Pit 3. In general, the highest natural uranium activities have been detected in ground water samples from $Tnbs_0$ wells located downgradient of and in relatively close proximity to the Pit 7 Complex. Natural uranium activities tend to decline in ground water samples from $Tnbs_0$ HSU wells with increasing distance from the pits.

The $Tnbs_0$ HSU was included in the evaluation and modeling to determine the effects of geochemical processes on the occurrence and distribution of natural uranium in ground water in the Pit 7 Complex area. The geochemical modeling and results are discussed in more detail in Appendix H.

Similar to the Qal/WBR HSU, the modeling results and data indicate that there is also an increase in dissolved inorganic carbon (occurring primarily as HCO_3^- [bicarbonate]) in $Tnbs_0$ ground water from wells downgradient of the Pit 7 Complex that cannot be explained solely based on water-rock interactions. The results of the geochemical analysis and modeling indicate that the distribution of dissolved bicarbonate concentrations and natural uranium activities in the $Tnbs_0$ HSU are also due to some combination of natural and landfill-induced geochemical effects.

2.3.3.3. Volatile Organic Compounds (VOCs)

Monitoring for VOCs in ground water began at the Pit 7 Complex in the mid-1980s. The most common VOC detected is TCE. Other VOCs include 1,1-dichloroethylene (DCE), toluene, total xylene isomers, and perchloroethylene (PCE). Table 2-7 lists the frequency of detection for these VOCs, the maximum detected concentrations, and MCLs. To date, TCE has been detected in ground water samples from 19 wells, with six wells that have contained concentrations above the 5 micrograms per liter (μg/L) MCL (Figure 2-20). The 15 μg/L historical maximum TCE concentration was detected in ground water samples from two wells: K7-05 in 1985 and later at NC7-51 in 1995. Based on second quarter, 2003 or most recent data, no wells in the Pit 7 Complex area yield water samples that contain TCE above the 5 μg/L MCL. The second quarter, 2003 maximum TCE concentration is 4.2 μg/L from well K7-03, located just east of Pit 5. Based on historical data and the second quarter, 2003 spatial distribution, it appears that Pit 5 is the likely source of TCE. However, given the decreasing TCE trend to levels below the MCL and the absence of any significant increase in TCE following the 1998 El Niño, it is likely that any remaining VOC sources, if present, are very minor.

2.3.3.4. Metals

Monitoring for metals in ground water began at the Pit 7 Complex area in the early 1980s and continues today. Since 1993, nine surveillance monitor wells (K7-01, K7-03, K7-06, K7-09, K7-10, NC7-25, NC7-26, NC7-47, and NC7-48) located in the Pit 7 Complex area are sampled quarterly for a variety of constituents in ground water including metals, fulfilling the RCRA requirements for the Pit 7 post-closure monitoring plan. Although barium, lead, and vanadium have exceeded concentration limits established for ground water in this area, metals (excluding uranium and arsenic) have never been detected above drinking water MCLs in ground water samples from any wells in the Pit 7 Complex area. While arsenic concentrations have slightly exceeded the 0.01 milligrams per liter (mg/L) MCL for arsenic in several wells in the Pit 7 Complex area, the concentrations are within background levels for arsenic in ground water in this area. Barium, lead, and vanadium are natural constituents of the Neroly Formation rock matrix and probable constituents of the pit waste. Increases in the ground water concentrations for these metals may reflect natural variation and/or may be related to releases from the pit waste. Although barium, lead, and vanadium ground water concentration have exceeded the established concentration limits, the limits for barium (0.09 mg/L) and lead (0.002 mg/L) are more than an order-of-magnitude below their respective MCLs. To date, no MCL has been established for vanadium. Vanadium concentrations in ground water samples from wells in the Pit 7 Complex area have never exceeded EPA's tap water preliminary remediation goal (PRG) of 260 μg/L.

2.3.3.5. Perchlorate

Perchlorate monitoring began at the Pit 7 Complex in 1998 as part of a site-wide effort to characterize the presence and distribution of perchlorate in Site 300 ground water. As of the RI/FS data cutoff date of June 2003, ground water samples from 17 monitor wells have been analyzed for perchlorate in the Pit 7 Complex area. Most of the perchlorate data for this area were derived from RCRA Detection Monitoring that is carried out by LLNL's Water Guidance and Monitoring Group as part of the post-closure requirements for Pit 7. Out of a total of 94 analyses, perchlorate has been detected 17 times above the State Public Health Goal of 6 μg/L. All of these detections occurred in samples collected from three wells (K7-01, K7-03, and NC7-25) that are completed in the $Tnbs_0$ HSU and located near Pits 3 and 5. Only limited sampling of Qal/WBR HSU wells for perchlorate analysis had been performed by the RI/FS data cutoff date. For this reason, samples were collected from 28 wells in the Pit 7 Complex area for perchlorate analysis during 2004 to better define the extent of perchlorate contamination in ground water. These data have been included in Table A-11 and are shown on Figure 2-20.

Since the RI/FS data cutoff date of June 30, 2003, nine Qal/WBR wells and nineteen $Tnbs_0$ wells were sampled and analyzed for perchlorate. Three of the nine Qal/WBR wells sampled (NC7-21, NC7-40, and NC7-64) contained perchlorate at concentrations slightly above the 6 μg/L State Public Health Goal. The maximum perchlorate concentration detected in samples from these Qal/WBR wells was 9.6 μg/L in well NC7-21. Perchlorate was not detected above the 4 μg/L method detection limit in ground water samples from nine other wells screened in the Qal/WBR HSU located downgradient of the Pit 7 Complex.

Three of the nineteen $Tnbs_0$ wells sampled (K7-01, K7-03, and NC7-25) contained perchlorate at concentrations above the 6 μg/L State Public Health Goal. The maximum perchlorate concentration detected in samples from these $Tnbs_0$ wells was 23 μg/L in well K7-01. Perchlorate was not detected above the 4 μg/L method detection limit in ground water samples from fourteen other wells screened in the $Tnbs_0$ HSU located downgradient of the Pit 7 Complex.

Based on the spatial distribution of the perchlorate results to date, it is likely that both Pits 3 and 5 contain low-level perchlorate sources.

2.3.3.6. Nitrate

Nitrate is a natural and anthropogenic constituent of ground water. It has been detected in Site 300 ground water at concentrations above the 45 mg/L MCL for nitrate as NO_3^- in samples from wells that contain other anthropogenic contaminants and in wells that are devoid of anthropogenic contaminants (i.e., "background" wells). For example, anthropogenic contaminants have never been detected in "background" well NC7-47 screened in the $Tnbs_0$ HSU and located about 1,500 ft northeast of Pit 3, yet ground water from this well has consistently contained nitrate (as NO_3^-) in the 40 to 80 mg/L range since 1994. This well is considered a "background" well because monitoring since the mid-1980s has never detected tritium, a "conservative" tracer, above 100 pCi/L or any other anthropogenic contaminants. Ground water samples in downgradient $Tnbs_0$ wells W-865-03, and W-865-1804, and W-865-07 also contain nitrate at concentrations above the MCL but do not contain anthropogenic contaminants, with the exception of W-865-1804 that has contained low levels of tritium. It is likely that the ground water nitrate concentrations in these wells, although clearly elevated above the MCL, are due solely to natural sources in the rock matrix. Although tritium has been detected in ground water samples from well W-865-1804, the elevated nitrate in ground water from this well is also thought to be natural in origin because samples from other $Tnbs_0$ wells located closer to the pit have lower nitrate concentrations than are detected in well W-865-1804, and no other contaminants have been detected in this well.

Although elevated nitrate has been detected in ground water from the Pit 7 Complex area, the spatial distribution of nitrate presented in Figure 2-20 indicates that the landfill pits are not the only source. In fact, some wells (e.g., K7-06) located west and upgradient of the landfill pits contain appreciable concentrations of nitrate (10 to 30 mg/L). The increasing trend of nitrate from 17 mg/L in K7-06 to 85 mg/L in NC7-47 along a ground water flow path in the $Tnbs_0$ HSU, can be explained by the interaction of ground water with a nitrate-bearing rock matrix and increasing residence time along the flow path. Elevated nitrate levels in Qal/WBR ground water in the immediate vicinity of the pits (e.g., NC7-34 at 68 mg/L and NC7-51 at 86 mg/L) indicate that residual nitrate sources may still exist within the pit waste. The nitrate released to ground water from the landfills appears to be restricted to the Qal/WBR HSU with the exception of well K7-01 that is completed across the WBR and $Tnbs_0$. The elevated nitrate detected in well K7-01 is likely derived from the WBR ground water. Some nitrate detected in Qal/WBR ground water may also be the result of dissolution of naturally occurring nitrate from the alluvium and weathered bedrock that is derived from the Neroly Formation. Therefore within the Qal/WBR HSU, concentrations of nitrate in excess of the 45 mg/L MCL may be attributable to a combination of anthropogenic and natural sources.

2.3.4. Nature and Extent of Contamination in Surface Water

Spring 24 is the only perennial surface water in the Pit 7 Complex area. Monitoring of Spring 24 began in 1999 and continues today. Tritium is the only elevated anthropogenic chemical that has been identified in Spring 24 water. To date, all five samples collected from Spring 24 exceed background tritium activities (100 pCi/L) in ground water. The maximum Spring 24 tritium activity, 2,380 pCi/L, was detected in March 2002; the most recent sample, collected in September 2002, contained 2,340 pCi/L. Spring 24 is used to characterize the leading edge of the tritium plume in the $Tnbs_0$ HSU. It is most likely a discharge (or leak) point for confined ground water from the $Tnbs_0$ HSU along the Elk Ravine Fault. A uranium sample collected in 1999 contained 1.24 pCi/L. Although this sample was not analyzed using mass spectrometry, the uranium is probably of natural origin. Surface water data are presented in Appendix A, Tables A-5 through A-18.

2.3.5. Identification of Contaminants of Potential Concern

In the SWRI, compounds detected in soil, rock, ground water and surface water were screened to determine which were contaminants of potential concern. These contaminants of potential concern were then used in the baseline risk assessment to determine risk to human health or the environment presented by the presence of these compounds in environmental media at Site 300. For this RI/FS, new database queries were conducted to ensure that no new contaminants and media of potential concern were overlooked.

2.3.5.1. Evaluation of Contaminants of Potential Concern in the SWRI Report

In the SWRI, contaminants of potential concern were identified for each study area and environmental medium. The principal criterion used to evaluate the exposure potential of substances detected at Site 300 was the frequency with which each substance has been detected. This approach was taken because it reflects the fact that for a substance to have been detected frequently, it must be both persistent in the environment and relatively widespread. The potential for human exposure is directly related to these parameters as well as the tendency of the contaminant to migrate within and between environmental media. The use of 2% frequency of detection as a basic criterion to identify substances of potential concern was stipulated by U.S. EPA, Region IX staff (Seraydarian, 1992).

The Pit 7 Complex was evaluated as part of the EFA/WFA in the SWRI. Sampling data were separated by environmental medium (i.e., ground water, subsurface soil, surface soil, and surface water). The frequency of detection was then determined for ground water and surface soil by dividing the number of times a substance was detected by the number of times for which it was sampled. Those compounds that were detected at greater than 2% frequency of detection in ground water and surface soil were considered to be contaminants of potential concern in the SWRI.

Contaminants of potential concern were then evaluated with respect to available quality control data. Contaminants of potential concern with only poor quality control data (such as evidence that contaminants were laboratory contaminants through their presence in method blanks and not validated with good quality data) were eliminated as contaminants of potential concern. In addition, the ranges of natural background concentration for metals, ions, and radiological parameters in ground water and surface soil were determined as part of the contaminant screening process in the SWRI. Since metals, ions, and radiological constituents occur naturally in environmental media, it is important to distinguish between measured concentrations or activities of these parameters that are representative of background levels and those that indicate contamination. Metals, ions, and radiologic constituents that were detected within the background concentration range established for that constituent at Site 300 were not considered to be contaminants of potential concern. A detailed discussion of the determination of background levels for these constituents in various environmental media at Site 300 is presented in Chapter 4, Sections 4.2.2, 4.4.2, and 4.9.2.4 of the SWRI and Appendix A of the SWFS.

Data on contaminants of potential concern in subsurface soil and rock were not subjected to a frequency-of-detection screening process to identify the most frequently occurring substances. Instead, subsurface soil data were reviewed to determine if VOCs or tritium were present in soil within 12 ft of the surface, since VOCs and tritium above this depth could volatilize and lead to human exposure. The 12 ft depth was established for the SWRI evaluation in conjunction with State and Federal Remedial Program Managers and the EPA toxicologist on the project. In addition, further evaluation of substances detected in subsurface soil was conducted to identify potential contaminants of ecological concern due to ingestion or inhalation risk or hazard to animals. The screening process and criteria, and the evaluation of contaminants of potential concern, is discussed in Chapter 4, Section 4.9 of the SWRI.

In the SWRI, a baseline risk assessment was conducted subsequent to the determination of contaminants of potential concern. Section 2.5 of this RI/FS discusses the risk assessment process used in the SWRI. The SWRI risk assessment was used to determine if contaminants of potential concern presented a risk to human health and the environment. The results of the SWRI risk assessment are used herein to assist in determining actual COCs, as discussed in Section 2.6.

2.3.5.2. Evaluation of Recent Data

New soil and water data have been collected in the Pit 7 Complex area since the SWRI, SWRI Addendum and SWFS reports were issued. Therefore, a new database query was conducted to determine if there were any new contaminants of concern since the SWRI. This re-evaluation is described in more detail in Section 2.5.2. As for the SWRI, contaminants of potential concern with poor quality control data (such as evidence that contaminants were laboratory contaminants through their presence in method blanks and not validated with good quality data) were eliminated as contaminants of potential concern. The results of this query are summarized in Tables 2-2 through 2-4 and discussed in Section 2.5.2.

2.4. Contaminant Fate and Transport

This section summarizes the fate and transport modeling of tritium and uranium migration from sources at the Pit 7 Complex. The purpose of the modeling is to (1) provide exposure point activity levels for the baseline risk assessment calculations for several exposure pathways, and (2) evaluate the fate of tritium and uranium under a variety of scenarios, including natural, non-pumping conditions and active remediation. As part of the SWRI, contaminant release screening and fate analysis for Site 300 was conducted using methods described in the EPA Superfund Exposure Assessment Manual (U.S. EPA, 1988). The contaminant release screening analysis was initiated by identifying each potential contaminant release. The environmental media of concern (ground water, subsurface soil/rock, surface soil, surface water) were then determined by evaluating laboratory analytic data and the transport potential for contaminants of potential concern at the release sites. Each conceptual migration process was conducted in the context of an exposure pathway to define the boundaries of contaminant migration/transport.

On the basis of this evaluation, conceptual models were developed to identify the probable migration processes of the contaminants of potential concern from release sites to selected potential exposure points. These conceptual models provided the basis for selecting the quantitative models used to generate estimates of contaminant migration rates and exposure-point concentrations. Figure 2-21 shows the portions of the conceptual model that are applicable to the Pit 7 Complex.

In the SWRI, the following tasks were conducted to estimate the release rates and exposure point concentrations at the Pit 7 Complex:

- Estimation of the concentration of contaminants bound to resuspended soil particles.
- Modeling of volatilization of tritium-bearing soil moisture.
- Modeling of volatilization of tritium from surface water.
- Vadose zone modeling.
- Ground water flow and transport modeling.

A detailed discussion of the previous modeling conducted for the Pit 7 Complex area is contained in Chapter 5 of the SWRI and the Building 850 SWRI Addendum. New ground water modeling was conducted as part of this RI/FS to estimate tritium and uranium activities in ground water at the site boundary and at Spring 24 based on current data (Appendix E). For volatile constituents in Spring 24, additional modeling was conducted to estimate exposure point concentrations in air for contaminants volatilizing from Spring 24. This modeling is also discussed in Appendix E.

These models generated exposure-point concentrations, which were then used to estimate the magnitude of exposure to contaminants in the baseline public health and ecological assessments presented in Chapter 6 of the SWRI report and summarized in Section 2.5 of this document. The evaluation of the newly developed exposure-point concentrations for Spring 24 is also presented in Section 2.5.

The models were also used to evaluate the fate of the ground water tritium plume under natural attenuation conditions. A sensitivity analysis was conducted to evaluate potential further releases of tritium from the pits due to ground water inundation. This source term was also included when evaluating the fate and transport of tritium in ground water.

Two separate numerical models were developed to evaluate the fate and transport of tritium and uranium in ground water. The first model simulated contaminant migration in the $Tnbs_0$ bedrock to evaluate a hypothetical pathway to the northeastern site boundary and a potential downgradient discharge location at Spring 24. The second model simulated contaminant migration in the Quaternary alluvium and weathered bedrock to evaluate the migration pathway along Doall Ravine and Elk Ravine towards a hypothetical location at the eastern site boundary.

The modeling results indicate that once the source areas are controlled, there will be no impact from tritium or uranium at these three potential exposure points. The models also show that tritium activity in the $Tnbs_0$ bedrock HSU will be reduced below the MCL in 30 to 40 years and that the tritium activity in the Qal/WBR HSU will be reduced below the MCL in 40 to 50 years. The results for uranium simulations indicate that the portions of the ground water systems with activities above the MCL of 20 pCi/L that contain uranium mass ratios will also be reduced below the MCL in 400 to 500 years with a maximum travel distance of less than 1,000 ft in each of the two ground water systems.

2.5. Baseline Risk Assessment Summary

The baseline risk assessment provides the basis for implementing a remedial action and identifies the potential exposure pathways that need to be addressed by the remedial alternatives. It serves as the baseline to indicate what potential risks might exist if no action were taken at the site. This section of the RI/FS summarizes the results of the baseline risk assessment conducted for the Pit 7 Complex. Additional details may be found in Chapter 6 of the Site 300 SWRI report (Webster-Scholten, 1994), the Building 850 SWRI Addendum (Taffet et al., 1996), and the Site 300 SWFS (Ferry et al., 1999).

The baseline risk assessment evaluated potential present and future public health and ecological risks associated with environmental contamination at the Pit 7 Complex, using the assumption that no cleanup or remediation activities would take place at the site. Selection of a specific remediation strategy will be based in part on the extent to which it can reduce potential public health and ecological risks.

The human health baseline risk assessment presented in the SWRI report consists of six components:

- Identification of contaminants of potential concern.
- Identification of the contaminated environmental media and exposure pathways.
- Estimation of potential exposure-point concentrations of contaminants.
- Human exposure and dose assessment.
- Toxicity assessment.
- Risk characterization.

Section 2.5.1 below summarizes the baseline human health risk assessment as presented in the SWRI, the Building 850 SWRI Addendum and the SWFS. Section 2.5.2 re-evaluates the baseline risk assessment for the Pit 7 Complex RI/FS using data collected since the publication of the previous documents and new modeling results.

The ecological assessment presented in the SWRI included the following components:

- Determination of the presence or potential presence of threatened or endangered species.

- Determination of the significant ecological exposure pathways to the ecological contaminants of potential concern.
- Selection of ecological assessment and measurement endpoints.
- Final estimation of ecological impact and hazard on the selected assessment endpoints.

Section 2.5.3 summarizes the baseline ecological assessment.

2.5.1. Baseline Human Health Risk Assessment

Sections 2.3 and 2.4 above summarize the methodology used in the SWRI and previous assessments to identify contaminants of potential concern and estimate potential exposure point concentrations, respectively. This section summarizes the results of the baseline human health risk assessment conducted as part of the SWRI, the Building 850 SWRI Addendum, and the SWFS.

2.5.1.1. Toxicity Assessment

The baseline human health risk assessment identified those contaminants of potential concern that are classified by the U.S. EPA (1992a) or by the State of California EPA (1992) as carcinogens. EPA bases this classification on data from epidemiological studies, animal bioassays, and in vivo and in vitro tests of genotoxicity.

2.5.1.1.1. Cancer Potency Factors. The cancer potency factors used to estimate cancer risk were obtained from values published in either the Integrated Risk Information System (U.S. EPA, 1992b), the Health Effects Assessment Summary Tables (U.S. EPA, 1992a,c), or by the State of California EPA (1992). Cancer potency factors for TCE and perchlorate were also provided by Region IX of the U.S. EPA (1993). All cancer potency factors were derived using versions of the linearized, multistage dose-response model (U.S. EPA, 1989a,b). Generally, the dose- and tumor-incidence data used in the model are from animal bioassays. For contaminants of potential concern at Site 300, the exceptions are cadmium, benzene, and beryllium, where human tumor data are available. The EPA dose-response model calculates the potential increased cancer risk, where increased risk is assumed to be linearly related to dose for low-dose levels typical of environmental exposure. Use of animal bioassay data to predict human tumorigenic response assumes that animals are appropriate models of human carcinogenic response, and that the dose-response relationships observed in high-dose animal bioassays can be extrapolated linearly to the low doses generally associated with human exposure to environmental contaminants. When cancer potency factors were available for a particular contaminant from both a U.S. EPA source and the State of California, the higher potency factors were used. Chapter 6 of the SWRI report lists reference documents for cancer potency factors (slope factors) used to calculate cancer risks.

2.5.1.1.2. Reference Dose. The reference doses used to evaluate potential noncarcinogenic adverse health effects were based, when possible, on long-term (i.e., chronic) exposures and were derived by dividing an experimentally-determined no-observed-adverse-effect-level or lowest-observed-adverse-effect-level (each has units of milligrams per kilogram-day) by one or more uncertainty factors (U.S. EPA, 1992a, b). Each of these uncertainty factors has a value that ranges from 1 to 10 (U.S. EPA, 1992a, b). Pathway-specific reference doses were used, when available (U.S. EPA, 1992a, b; Cal EPA, 1992), to calculate a corresponding hazard quotient. If pathway-specific reference doses were not available, the published reference doses (typically developed for oral exposures) were used to calculate a hazard quotient for all exposure pathways. Reference documents and reference doses used to calculate noncancer hazard indices are listed in Chapter 6 of the SWRI.

2.5.1.2. Risk Characterization

LLNL performed the baseline risk assessment in accordance with Risk Assessment Guidance for Superfund (U.S. EPA, 1989a, b). Carcinogenic risks, an evaluation of potential noncarcinogenic exposure health hazards, and the additivity of response are described below.

2.5.1.2.1. Carcinogenic Risks. For carcinogens, the potential incremental cancer risk associated with long-term exposure to contaminants in surface soil, subsurface soil/rock, and ground water was calculated. For each contaminant at each exposure location, the total risk attributable to that contaminant was estimated by multiplying each pathway-specific intake (e.g., the dose due to ingestion of water or to inhalation of contaminants that volatilize from water to indoor air) by the corresponding pathway-specific cancer potency factors. The products of each pathway-specific intake and pathway-specific cancer potency factors were summed to obtain the potential incremental cancer risk for a specific chemical. Parallel sets of calculations were completed for all contaminants at each exposure location, and then values of chemical-specific risk from all contaminants were summed to yield an estimate of total incremental risk for exposures associated with a given location.

2.5.1.2.2. Evaluation of Hazard from Exposure to Contaminants that Cause Noncancer Health Effects. For contaminants of potential concern that are not classified as carcinogens, and for those carcinogens known to cause adverse health effects other than cancer, the potential for exposure to result in noncarcinogenic adverse health effects was evaluated by comparing the chronic daily intake with an reference dose. When calculated for a single chemical, this comparison yields a hazard quotient. For each chemical at each location, pathway-specific hazard quotients were summed (where applicable) to obtain a hazard quotient estimate for a given chemical. All hazard quotients from all contaminants were then summed to yield a hazard index estimate for exposures associated with a given location.

2.5.1.2.3. Additivity of Response. In every location where cancer risk and noncancer hazard quotients were calculated, chronic daily intakes were estimated for exposures attributable to multiple pathways for each of several contaminants. As noted previously, the total potential cancer risk and/or total hazard index was estimated by summing risk or hazard quotients for all contaminants at a given location, where each chemical-specific estimate of risk or hazard represents an estimated exposure from multiple pathways. Implicit in the summation of risk and hazard is the assumption that the effects of exposure to more than one chemical are additive. This simplifying assumption does not consider similarities or differences in target organ toxicity, mechanism(s) of action, or the possibility of synergistic or antagonistic effects of different contaminants in the mixture.

2.5.1.3. Summary of Human Health Baseline Risks and Hazards Associated with Contaminants

Estimated baseline human health risks and hazards for the Pit 7 Complex were evaluated for adult onsite exposure and residential exposure, as well as additive risk. These are presented in Table 2-1 and described below. Chapter 6 of the SWRI presents detailed discussions of the baseline human health risk and hazard evaluated. Since the completion of the SWRI, LLNL has collected and evaluated additional data to further define human health risk and hazard at Site 300. Details of these additional risk evaluations are contained in the Building 850 SWRI Addendum and the SWFS.

2.5.1.3.1. Adult Onsite Exposures. For the Pit 7 Complex area, the adult onsite exposure scenario addresses health risk attributable to potential exposure to contaminants in surface soil and subsurface soil/rock where an adult is presumed to work in the immediate vicinity of the contamination over a 25-year period of employment at the site.

Potential adult onsite exposure to contamination was evaluated by calculating the associated risk and hazard for two scenarios. The first scenario pertains to potential adult onsite exposure to contaminated surface soil from inhalation of resuspended particulates, dermal absorption of contaminants following direct contact with contaminated soil, and incidental ingestion. The second scenario pertains to potential adult onsite exposure to contaminated subsurface soil/rock through inhalation of tritium from subsurface soil/rock to air.

The estimates of risk and hazard for adults onsite were based on conservative exposure scenarios (e.g., an individual was assumed to be exposed at a single location every working day over their entire 25-year career at LLNL) and health-conservative model parameters were used. Consequently, the risk and hazard associated with adult onsite exposure to environmental contamination at the site was likely overestimated. For example, the evaluation of adult onsite inhalation exposure to tritium volatilizing from contaminated subsurface soil/rock and diffusing into outdoor air assumed that an individual worker would be exposed 8 hrs/day, 5 days/week for 25 years. In reality, workers are not expected to spend their entire career outdoors in a single area. In addition, the current activity of tritium may be much lower than the maximum concentration/activity used to calculate risk and hazard due to natural attenuation or active remediation.

2.5.1.3.2. Additive Risk and Hazards for Adults Onsite. In the previous reports, the risk and hazard to adults working outdoors at Pit 7 that could be exposed simultaneously to contaminants in surface soil (by inhalation of resuspended particulates, and ingestion and dermal absorption of surface soil contaminants) as well as by inhalation of tritium that volatilized from subsurface soil/rock were evaluated. The additional risk posed by inhalation of tritium that had volatilized from the surface of Spring 24 was not previously evaluated in the SWRI baseline risk assessment.

2.5.1.3.3. Residential Exposures. In previous reports, the risk and hazard for potential residential exposure from the Pit 7 area through the use of contaminated water from hypothetical wells located at Site 300 boundaries were evaluated. The residential exposure scenario was developed in consideration of the fact that lands in the vicinity of Site 300 have been subject to encroaching urbanization.

2.5.1.3.4. Uncertainty in the SWRI Baseline Public Health Assessment. Uncertainties are associated with all estimates of potential carcinogenic risk and noncarcinogenic hazard. For example, the exposure parameters recommended by the U.S. EPA (1990; 1991a) are typically obtained from the 90th or 95th percentile of a distribution; they are not necessarily representative of an average individual or of average exposure conditions. Consequently, use of multiple upper-bound parameters may contribute to overly conservative estimates of potential exposure, risk, and hazard.

In addition, the total cancer risk and/or total hazard index was calculated by summing risk of hazard quotients for all contaminants at a given location, where each chemical-specific estimate of risk or hazard represents exposures from multiple pathways. Implicit in the summation of risk and hazard, is the assumption that the effects of exposure to more than one chemical are additive. As stated previously, this simplifying assumption does not consider similarities or differences in target organ toxicity, mechanism(s) of action, or the possibility of synergistic or antagonistic effects of different contaminants in the mixture.

Other uncertainties associated with the estimates of risk and hazard are OU-specific and are related to the generally conservative assumptions made in the modeling conducted to provide exposure-point concentrations, which were subsequently used to calculate risk and hazard. These risk calculations are also predicated on the assumption of continued DOE control over the land at Site 300, hence the use of industrial assumptions for occupancy and exposure. If the lands were to become privately controlled and residential scenarios become appropriate, new assessments would be warranted.

2.5.1.3.5. Evaluation of Data Subsequent to the SWRI Related to Human Health Risk. Subsequent to completion of the SWRI report, LLNL has collected and evaluated additional data to update human health risk based on more recent data. As part of a post-SWRI risk assessment for the Building 850/Pits 3 & 5 OU, calculations of potential exposure, risk, and hazard from metals, uranium, and thorium in surface soil in this OU were made. That risk assessment is discussed in the Building 850/Pit 7 Complex SWRI Addendum (Taffet et al., 1996). Finally, as part of the SWFS, the risk associated with substances in surface soil, subsurface soil/rock and ground water were evaluated through comparisons with EPA PRGs. The results of these post-SWRI risk assessments are included in Table 2-1.

2.5.2. Re-evaluation of the Baseline Risk Assessment

The purpose of this re-evaluation is to update the risk estimates associated with the contaminants of potential concern identified in previous documents, as well as to evaluate the risk associated with contaminants of potential concern identified subsequent to the previous baseline evaluations. Therefore, compounds were examined that were either not detected or not analyzed for since the SWRI data cutoff date (December 31, 1991) through the Pit 7 RI/FS data cutoff date (June 30, 2003), regardless of frequency of detection. The SWRI cutoff date was selected for the evaluation of new data rather than the SWFS as the Pit 7 area was combined with the Building 850 area in the SWFS. New compounds detected in surface soil, subsurface soil, ground water and surface water are presented in Tables 2-2 through 2-4. Substances which described the general mineral chemistry of surface and ground water (such as sulfate, carbonate, etc.) are not included in Tables 2-2 through 2-4.

The substances listed in Tables 2-2 through 2-4 were initially screened to determine if they should be used to update the list of contaminants of potential concern presented in the SWFS. Criteria used for screening is described in detail in Section 2.6 and includes frequency of detection, whether the constituent was detected above background, and whether the substance would be addressed within the remedy for an existing contaminant of concern. Table 2-5 shows the new substances screened out as a result of this process.

The results of the initial screening evaluation were used to update the list of contaminants of potential concern presented in the SWFS. Contaminants of potential concern in surface soil and subsurface soil are presented in Table 2-6 and contaminants of potential concern in ground water and surface water are presented in Table 2-7. The entire data set for the contaminants of potential concern was considered in preparing Tables 2-6 and 2-7. However, the concentration basis for the analysis did not change if current concentrations were lower than the maximum historical values. Current concentrations are discussed in Section 2.3 of this report, where appropriate.

Adults working onsite can be exposed to contaminants in surface soil. PRGs are available that incorporate the inhalation, dermal absorption, and incidental ingestion pathways. These are the same pathways considered in the SWRI evaluation, and incorporate similar default assumptions. Table 2-6 lists the U.S. EPA's Superfund radionuclide PRG, the maximum detected activity of contaminants of potential concern in surface soil, and the 95% Upper Confidence Level (UCL). The PRGs were obtained from the U.S. EPA's Superfund radionuclide PRG download and calculation website (U.S. EPA, 2004). As was done in the SWRI, the 95% UCL was calculated as it integrates the variability in radionuclide activity throughout the Pit 7 area, and thus represents a reasonable exposure activity for adult onsite workers in the area. Since the SWRI evaluation, uranium isotopes have been analyzed using mass spectrometry, rather than the alpha spectrometry used in the SWRI evaluations. However, alpha spectrometry is able to discriminate uranium-238; thus the results of the two analyses were combined. Alpha spectrometry cannot discriminate between uranium-236 and uranium-236. Therefore, only the mass spectrometry data were considered in Table 2-6. The expected cancer risk was calculated by taking the ratio of the maximum concentration to the PRG then multiplying by 10^{-6}. As shown in Table 2-6, the risk associated with each constituent, as well as the cumulative risk, are all below 1×10^{-6}.

Table 2-6 also lists the maximum and 95% UCL activities for contaminants of potential concern in subsurface soil. However, in the absence of inadvertent excavation in the area of the pits, only volatile compounds represent an exposure risk to adults working onsite. Thus, adults working onsite can potentially be exposed to tritium volatilizing from the subsurface. However, there are no PRGs available which represent only the inhalation component of contaminated soil. Therefore, the soil data was reviewed with respect to that used to estimate risk from this pathway in the SWRI (the results of which are summarized in Table 2-1). In the SWRI evaluation, results from samples from selected locations collected from depths between 0.5 and 12 ft were used. This included the maximum activity listed in Table 2-6. Although there is currently no consensus in the scientific community regarding the depth from which volatile compounds in the subsurface can be expected to migrate to the ground surface and into ambient air in any significant concentrations, a depth of 10 ft is typically used for such evaluations. Twelve ft was selected to ensure results from at least two subsurface soil analyses (typically conducted on cores collected from 5 ft depth increments) were available for evaluation. There were no new volatile substances identified in subsurface soil between 0.5 and 12 ft. In addition, in the SWRI baseline risk assessment, data collected from soil vapor points and published in Buddemeier, 1987 were also used to estimate risk from tritium volatilizing from the subsurface. Results from some of these samples exceeded the maximum activity listed in Table 2-6. Of the 82 subsurface soil samples collected between 0.5 and 12 ft, forty-three were collected and analyzed by the SWRI data cutoff date of December 31, 1991. Of these, there were 41 samples that exceeded 1,000 pCi/L (about 0.1 pCi/G), only 6 of these samples were collected after the SWRI cutoff date. Samples with the five highest activities were all collected prior to this date. Therefore, the baseline risk assessment conducted for the SWRI adequately captures the likely risk from tritium, and thus the risk numbers as summarized in Table 2-1 remain valid. The maximum risk values from Table 2-1 have been included in Table 2-6 (4×10^{-6}). In addition, the 95%UCL for samples collected between 0.5 and 12 ft throughout the area have been included.

In addition to substances volatilizing from the subsurface, onsite workers may be potentially exposed to pit waste contents or contaminated subsurface soil should they inadvertently excavate in the area of the pits. Because the pit contents are currently not completely characterized due to safety concerns related to drilling into landfills, it is not possible to quantify this potential risk.

Although PRGs for residential tap water are presented in Table 2-5, they were not used as the sole reason to screen out or include a potential contaminant of concern in ground water and surface water for two reasons. First, ground water underlying the Pit 7 Complex and at Spring 24 is not used for drinking water, and thus this exposure pathway is not complete. Second, cleanup goals for ground water will not be based solely on risk. The concentrations of COCs in ground water will be compared to MCLs, or water quality objectives where applicable, to address the remedial action objectives for human consumption of ground water. MCLs are presented in Table 2-7. Therefore, in addition to PRGs, frequency of detection and comparison to background levels were used to screen contaminants. All contaminants detected in ground water above background levels are considered COCs and remedial alternatives are developed to address all COCs. The only exceptions were those contaminants that were screened out (above or in the SWFS) for which data provide sufficient evidence that the detection of the compound was not related to a release or that the contaminant is no longer present in ground water (see Ferry et al., 1999 and Section 2.6 below for more details).

Background values for tritium in ground water were incorrectly reported in the SWFS. Consequently, two wells (K7-06 and NC7-47) from the Pit 7 Complex area were selected that show no evidence of anthropogenic contamination and are well outside the area of tritium contamination to develop background values for tritium in ground water in this RI/FS. Background levels of tritium in these wells are less than 100 pCi/L.

Modeling of current ground water tritium and uranium activities to the site boundary and Spring 24 was conducted as part of this RI/FS. The results of this modeling are presented in Table 2-8. Modeling of tritium and uranium in ground water to the east and northeast site boundary showed that activities of these radionuclides would not exceed background activities in hypothetical wells at these locations. At Spring 24, modeling indicated that future tritium activities would not exceed the maximum historical tritium activity of 2,380 pCi/L detected in the spring. Modeling also showed that uranium activities at Spring 24 would not exceed background levels.

While Spring 24 is not used as a drinking water source, adults working onsite can be exposed to tritium in Spring 24 through volatilization from surface water. Therefore, the maximum historical concentration and the maximum predicted concentration from the ground water modeling for Spring 24 were used to estimate concentrations of tritium in the air using the model presented in Chapter 5 of the SWRI. This modeling is further described in Appendix E of this RI/FS. Because there is no inhalation PRG for tritium in air, risk was determined using the Pathway Exposure Factors presented in the SWRI and the current slope factor for tritium (see Appendix E for more details). The risk to adults working onsite from tritium volatilizing from Spring 24 into air was estimated to be 1×10^{-9} (Table 2-8a).

Table 2-9 summarizes the results of the PRG evaluations. In this table, the additive risks for outdoor exposure to onsite adults from contaminated surface soil and subsurface soil are presented. These are realistic exposure pathways, and in general are similar to estimates in previous evaluations. As seen in Table 2-9, the risk (4×10^{-6}) is driven by tritium in the subsurface soil. The risk attributed to surface soil/rock in negligible ($<10^{-6}$). The risk associated with the volatilization of tritium from Spring 24 is also presented in Table 2-9. This risk was not added to the risk from surface soil and subsurface soil/rock as the spring is not located in the vicinity of the contaminated soil, but rather on the east side of the ridge dividing the West and East firing areas.

The risk and hazard values presented here were calculated from activities that have not been decay-corrected. Concentrations and activities for many constituents have decreased over time. Therefore, the risk and hazard values presented in Tables 2-6 and 2-8a and summarized in Table 2-9 are conservative.

2.5.3. Summary of the Baseline Ecological Assessment

The baseline ecological assessment is presented in Chapter 6 of the SWRI report. Since its completion, additional data have been collected and evaluated to further define the potential for ecological hazard by contaminants present at Site 300. An evaluation of these data is also presented below.

2.5.3.1. Baseline Ecological Assessment

In the SWRI, a baseline ecological assessment was conducted to determine the potential for ecological impact as a result of contaminant releases to the Site 300 environment. The Pit 7 Complex was evaluated as part of the EFA/WFA. The SWRI assessment includes the following:

- Brief description of the ecological setting.
- Determination of the presence of threatened or endangered species.
- Comprehensive exposure pathway and food web analysis.
- Selection of contaminants of potential concern, and an evaluation of their ecological significance.
- Selection of assessment endpoints.
- Selection of measurement endpoints and estimation of reference doses for each contaminant of potential concern.
- Final estimation of ecological impact and hazard on the selected assessment endpoints.

Assessment endpoints are explicit expressions of the specific environmental values that are to be protected. The assessment endpoints were selected using an exposure pathway/food web analysis; a threatened and endangered species analysis; and an evaluation of contaminants of potential concern. The assessment endpoints selected for the Site 300 baseline ecological assessment that are relevant to the Pit 7 Complex include:

- Changes in species composition in native grassland communities.
- Reduction in the abundance of California ground squirrel populations.
- Reduction in the abundance of black-tailed deer populations.
- Mortality or reduction in reproductive potential of individual San Joaquin kit fox.

Measurement endpoints were selected for each assessment endpoint. Hazard indices were calculated for individual terrestrial animals and plants, species diversity indices were calculated for plant communities, and changes in abundance (both spatially and temporally) were evaluated for the ground squirrel population. A hazard index or toxicity quotient greater than 1 indicates that an elevated ecological hazard potentially exists to individuals of the selected species, although this may not reflect hazard to the overall population. Table 2-10 summarizes risk or hazard to ecological receptors for the Pit 7 Complex from the SWRI.

The results of the measurement endpoints for the native grassland communities indicate a low potential for radionuclides in the EFA/WFA to significantly alter the composition of this community. Species diversity indices calculated for the location containing elevated levels of tritium and uranium are not significantly different than species diversity indices calculated for the reference location. In addition, all calculated hazard indices for the native grassland are well below one.

No unacceptable risks were identified for adult or juvenile ground squirrels, deer or kit fox from radiological substances. Hazard indices for cadmium exceed one for adult ground squirrels based on data collected area wide. However, an evaluation of the percentage of the population thus affected, as well as the distribution of the ground squirrel population (both spatially and temporally), provides evidence that the Site 300 ground squirrel population has not been adversely impacted by cadmium at Site 300.

Hazard indices for individual deer also exceed one for cadmium in the EFA/WFA. Qualitative evidence suggests that the deer population is not at risk from cadmium. A subsequent evaluation of risk to the deer population at Site 300 was conducted in 1994. Section 2.5.3.2 discusses the results of this evaluation.

No unacceptable risk was identified for adult or juvenile kit fox from non-radiological substances.

2.5.3.2. Evaluation of Recent Ecological Data

Additional evaluations of ecological risk posed by cadmium in surface soil were conducted subsequent to the SWRI. These evaluations are described in detail in the Building 850/Pit 7 Complex SWRI Addendum (Taffet et al., 1996).

In 1994, additional soil samples were collected throughout Site 300 to further define areas of elevated cadmium levels. In addition, the location of deer sightings were recorded throughout the year. These observations were made by LLNL Environmental Restoration Division and Site 300 personnel working in the field. The majority of the deer sightings are associated with springs located in the southern half of the site. Areas with deer sightings in general had soil cadmium concentrations below 1 mg/kg, with most of the areas below the 0.1 mg/kg detection limit. Thus, it is reasonable to conclude the localized presence of elevated cadmium levels in the surface soil at Site 300 does not pose a significant threat to the deer populations, as their primary habitat is outside of these areas.

One Swainson’s hawk (*Buteo swainsoni*, threatened) and two peregrine falcons (*Falco mexicanus*, endangered) have been observed at Site 300 since the Environmental Impact Statement/Environmental Impact Report (EIS/EIR) surveys described in the SWRI. The Swainson's hawk was sighted along Corral Hollow Creek in the California Department of Fish and Game Ecological reserve. The Swainson's preferred habitats and distribution occur in the

Central Valley and not the Coastal Range where Site 300 is located. In the winter, these birds migrate to South America (i.e., Argentina). Their preferred diet in the Central Valley includes insects (commonly found in cropland areas) and California voles. In 1989, the entire Central Valley population was estimated at 550 pairs. A female Swainson's Hawk requires a territory of about 2,200 acres and the male a territory four or five times that size.

The peregrine falcon is also a rare visitor at Site 300. There have only been a couple of fly-by sightings and the birds appeared transient. No nesting pairs have been discovered onsite and they are considered unlikely residents. Peregrines hunt bird species (i.e., doves, pigeons, waterfowl). Site 300 landscape features (lack of cliffs) do not provide much suitable habitat for the birds. It has been estimated that there are roughly 130 pairs currently breeding in the entire State.

In conclusion, because of the low probability of these raptors occurring at Site 300 and the Pit 7 Complex, and the nature of their diets, they were not included as a noted species of concern likely to be adversely affected by contamination at the Pit 7 Complex.

As discussed in Section 2.2.6, additional animal surveys have been conducted site-wide for special status species since the completion of the SWFS. Special-status species that have been observed to occur in the Pit 7 Complex include burrowing owls (*Athene cunicularia*) and coast horned lizards (*Phrynosoma coronatum frontale*); both California species of special concern. In addition, the San Joaquin pocket mouse (*Perognathus inornatus*, a federal species of concern) has been observed to the east of the Pit 7 Complex. The burrowing owl is a warm-blooded vertebrate predator that uses ground squirrel burrows for nest sites, somewhat similar to the San Joaquin kit fox. Thus the risk assessment conducted for the kit fox is probably adequate for the burrowing owl, suggesting no adverse impact to the burrowing owl. However, additional natural history information on the burrowing owl will be collected as part of the Ecological Risk and Hazard Management Program that is part of the Site-Wide Compliance Monitoring Program (Ferry et al., 2001; Carlsen et al., 2003). Burrowing owl modeling will be conducted should significant differences be found between the two species. The horned lizard is a cold-blooded reptilian vertebrate that preys on small insects and also lives in burrows. However, it has an outer skin with substantially different properties compared to fur or feathers. Thus, it is questionable as to how representative the kit fox risk assessment is for the horned lizard. Therefore, additional natural history information on the horned lizard will be collected as part of the Ecological Risk and Hazard Management Program and additional modeling for this species will be conducted.

Both the California red-legged frog (*Rana aurora draytonii*, federally listed as threatened) and the California tiger salamander (*Ambystoma californiense*, proposed for federal listing as threatened) are known to occur in the vernal pools/seasonal ponds to the northwest of the Pit 7 Complex as well as in herbaceous wetlands along the road adjacent to Spring 24. This water originally came from cooling tower blow down from the Advanced Test Accelerator facility across the road from Spring 24. However, this facility is no longer active. The wetland is being maintained using water from the Advanced Test Accelerator facility until the existing California red-legged frogs can be relocated to other wetlands. Although low levels of tritium are found in Spring 24, these levels are well below levels shown not to cause ecological impact in the SWRI ecological risk assessment. The dispersal/migration range of both species overlaps with the Pit 7 Complex area proper. The California tiger salamander in particular uses grassland burrows in the summer, and thus it is possible that the species could occur in burrows within the Pit 7

Complex area, although there is currently no evidence this is the case. Should future monitoring show the species to be using the area, additional exposure modeling will be conducted as part of the Ecological Risk and Hazard Management Program.

As described in Section 2.2.6, additional plant surveys have been conducted site-wide for special status species since the completion of the SWFS. Eight special status plant species have been observed at Site 300, five are known to occur in or near the Pit 7 Complex. None are state or federally-listed, but occur on various lists maintained by the California Native Plant Society (CNPS) (Tibor, 2001). List 1B species include those species that meet the definition of threatened or endangered. List 2 includes plants that are rare, threatened, or endangered in California, but more common elsewhere. List 4 includes species of limited distribution that are not considered rare from a statewide perspective, but are uncommon enough that their status should be monitored regularly. The five species are the big tar plant (*Blepharizonia plumosa*, CNPS list 1B), the round-leaved filaree (*Erodium macrophyllum*, CNPS 2), California rock jasmine (*Androsace elongata* ssp. *acuta*, CNPS list 4), stinkbells *(Fritillaria agrestis*, CNPS list 4), and gypsum-loving larkspur (*Delphinium gypsophilum* subsp. *gypsophilum,* CNPS list 4).

None of these plant species occur in the area of the Pit 7 Complex that contains contaminated surface or subsurface soil. A small population of big tarplant does occur on a berm surrounding the Building 850 firing table. Ongoing monitoring and management of all the special status plant species is conducted and reported in annual reports (Carlsen et al., 2002).

2.5.3.3. Evaluation of Contaminants of Potential Concern

The contaminants of potential concern listed in Tables 2-6 and 2-7 were compared to the list of substances for which an ecological risk assessment has been previously conducted in the west firing area. Only surface soil, subsurface soil to 12 ft, and surface water are ecological media of concern. Ecological risk assessments for tritium and uranium in these media using equal or greater activities than those presented in Tables 2-6 and 2-7 were conducted in the SWRI. The radiological substances detected in surface and subsurface soil and surface water are not expected to pose an ecological threat, as comparison of these activities with those evaluated in detail in the SWRI suggest they are far below the levels that could cause an ecological impact.

2.6. Identification of Contaminants of Concern

As part of this RI/FS, a final screening and evaluation process was conducted for the contaminants of potential concern identified in Table 2-6 and 2-7 to complement the screening process that had been conducted in the SWRI, the SWRI Addendum, the SWFS, and above in Section 2.5.2. The objective of this evaluation was to determine which contaminants of potential concern were actual COCs based on the:

- Frequency with which each substance has been detected.
- Concentration of the compound relative to background concentrations.
- Risk or hazard presented by the compound.
- Potential for a compound present in soil or rock to affect ground water.
- Whether the compound will be addressed in the remedy for another compound or media.

The criteria used in this evaluation process were as follows:

1. The frequency with which each substance has been detected. This criterion was selected because it reflects the fact that for a substance to have been detected frequently, it is likely to be both persistent in the environment and relatively widespread. The potential for human exposure is directly related to these parameters as well as to the tendency of the contaminant to migrate within and between environmental media. Contaminants in ground water and surface soil detected at less than 2% frequency of detection were not considered as COCs in the SWRI..
2. Concentration of the constituent relative to background concentrations. If a compound was detected in an environmental media at the Pit 7 Complex but was reported at concentrations within the range of natural background concentrations, it is not considered to be a COC. Appendix A in the SWFS discusses background levels for naturally-occurring substances (i.e., metals, ions and radionuclides). Additional discussion on background levels for radionuclides is found in Appendix D of this document.
3. Risk or hazard presented by the constituent. Constituents in surface and subsurface soil/rock and surface water are not considered COCs if the calculated risk was less than 10^{-6} and the hazard index was less than one. Although PRGs for unrestricted use (i.e., residential tap water) are presented for ground and surface water, this criterion was not used to determine COCs in these media.
4. Potential for a constituent in soil or rock to affect ground water. Constituents in surface soil and subsurface soil or rock are not considered COCs if the constituent does not present a threat to ground water. However, if a constituent in soil or rock did not present a threat to ground water but the calculated risk was greater than 10^{-6} or the hazard index was greater than one, it is still considered a COC. The only contaminants of potential concern in soil and rock were tritium and uranium. These constituents have already impacted ground water, therefore they were automatically considered to be COCs in soil and rock.

Additional screening criteria were used in the SWFS and are detailed in Ferry et al., 1999. These include the use of established background and/or statistical limits as part of either a Pit/Landfill Post-Closure Plan or Waste Discharge Requirements monitoring program, the length of time since as chemical of potential concern had been detected in ground water, and if the presence of the substance could be attributed to a source other than an operable unit release.

COCs for each environmental media were selected based on the following:

- Any constituent detected in surface soil at greater than 2% frequency and above background concentrations is considered to be a contaminant of concern if: (1) a risk above 10^{-6} or hazard quotient above one was calculated for complete exposure pathways for the contaminant and media, and/or (2) the contaminant presents a potential threat to ground water as determined by modeling.
- Any constituent detected in subsurface soil/rock above background concentrations is considered to be a contaminant of concern if: (1) a risk above 10^{-6} or hazard quotient above one was calculated for complete exposure pathways for the contaminant and media, and/or (2) the contaminant presents a potential threat to ground water.
- Any constituent detected in ground water at greater than 2% frequency and above background concentrations is considered to be a contaminant of concern.

- Volatile substances detected in surface water (Spring 24) are considered to be COCs if a risk greater than 10^{-6} or hazard quotient greater than one was calculated for an inhalation pathway. Non-VOC constituents detected at greater than 2% frequency and volatile constituents above background but with no associated risk or hazard were compared to COCs in ground water. Spring 24 is fed by ground water. If a non-VOC constituent (or a VOC constituent above background but with no associated risk or hazard) detected in surface water is present as a COC in ground water, that contaminant will be addressed in ground water remedial alternatives. The contaminant is not considered to be a COC in surface water if either: (1) no complete exposure pathway exists for non-VOC contaminants, or (2) no risk or hazard is associated with the volatile contaminant.

The lists of COCs for each media from the SWRI and SWFS were modified based on the results of the new data evaluation, risk assessment, and vadose zone modeling, and are presented in Tables 2-11 and 2-12. Although the results of this Remedial Investigation did not indicate any contaminants of concern in surface soil, tritium and uranium were identified as contaminants of concern in subsurface soil and bedrock in the Pit 7 Complex area. Ground water contaminants of concern include VOCs, tritium, uranium, nitrate, and perchlorate. No contaminants of concern were identified in surface water (Spring 24).

2.7. Summary of the Remedial Investigation

The main source of contamination in the Pit 7 Complex is the waste in the landfill pits. Statistical analysis of soil and groundwater data confirms tritium and uranium as the primary COCs. Spatial analysis of borehole samples collected in and adjacent the pits indicates that approximately 10 to 12 Ci of tritium and 1.5 Ci of depleted uranium still remain in the pits and underlying vadose zone. These sources are still active and continue to leach tritium and depleted uranium into the ground water. In addition, the results of a recent geochemical modeling evaluation indicate that it is possible that some combination of natural and landfill-induced geochemical effects are causing an increase in natural uranium activities in ground water downgradient of the Pit 7 Complex.

The main contaminant release mechanism is shallow ground water in the Qal/WBR HSU that inundates the landfill pits following heavy El Niño-type rainfall events. The bulk of the water that inundates the pits is shallow recharge water that flows into the pit area following infiltration on the hillslope west of the pits.

During average rainfall years (about 10 inches), approximately 150 to 170 acre-feet of precipitation falls within the Pit 7 Complex catchment. About 20 to 30 acre-ft of this water infiltrates into the subsurface and recharges the Qal/WBR HSU, about 110 to 120 acre-ft is subject to evapotranspiration, and the remaining 20 acre-ft becomes surface runoff. During an El-Niño year, rainfall increases by 50 to 100% (about 300 acre-ft) and the amount of infiltration and runoff increase significantly.

Ground water occurs in two water-bearing zones or HSUs (Qal/WBR and $Tnbs_0$). Ground water in the Qal/WBR HSU flows to the southeast in an ephemeral drainage channel located just east of the landfill pits. Ground water flow in this HSU is highly variable depending on rainfall. Ground water velocities range up to 100 ft/year. It is the main source of recharge to the underlying $Tnbs_0$ HSU. It contains a portion of the tritium plume and all of the depleted uranium. Ground water in the Qal/WBR HSU, that does not recharge the $Tnbs_0$, flows to the southeast toward Building 850 and then to the east in Doall Ravine.

Ground water in the $Tnbs_0$ HSU flows to the east-southeast at a velocity of about 10 to 20 ft/year. Although it contains the bulk of the tritium plume, it does not contain any depleted uranium. Ground water in this HSU flows toward the Elk Ravine Fault and then along the fault to the south. Some of the ground water in the $Tnbs_0$ HSU discharges at Spring 24.

Fate and transport modeling of the $Tnbs_0$ HSU indicates that tritium would not impact a hypothetical water-supply well located at the northern site boundary or Spring 24, even under a scenario where all the estimated tritium remaining in the pits and adjacent soil is released to the ground water. Modeling of the Qal/WBR HSU indicates that tritium or uranium would not impact a hypothetical water-supply well located at the eastern site boundary.

The baseline risk assessment was conducted to provide the basis for implement a remedial action and to identify the potential exposure pathways that need to be addressed by the remedial alternatives. It served as the baseline to indicate what potential risks might exist if no action were taken at the Pit 7 Complex. Using data compiled during the assessment of the nature and extent of contamination in the Pit 7 Complex area, the environmental fate and transport of contaminants was evaluated to identify actual or potential routes of migration of the source medium to other environmental media of exposure. Public health and ecological risk were estimated based on potential exposure point concentrations. The estimated baseline human health risks and hazards for the Pit 7 Complex were evaluated for adult onsite exposure and residential exposure, as well as additive risk. The results of the risk assessment indicated that the only unacceptable risk to human health posed by contaminants in the Pit 7 Complex area was inhalation of tritium evaporating from subsurface soil by onsite workers. The only residential exposure evaluated was from drinking ground water from a hypothetical water-supply well at the eastern site boundary. No impacts of tritium or uranium on this water are indicated. There were no unacceptable hazards to ecological receptors identified. The results of the risk assessment and an evaluation of current and potential future impacts to ground water were used to identify COCs in environmental media at the Pit 7 Complex.

The Remedial Investigation did not indicate any COCs in surface soil. Tritium and uranium were identified as COCs in subsurface soil and bedrock. COCs in ground water included tritium, uranium, VOCs, perchlorate, and nitrate. No COCs were identified in surface water (Spring 24), the only perennial natural surface water within the Pit 7 Complex area.

2.8. Corrective Actions and Facility Upgrades

Concurrent with the remedial investigation of the Pit 7 Complex, LLNL has conducted corrective actions, facility upgrades, and treatability tests to address local environmental contamination. These included landfill covering and capping; well sealing and abandonment; shallow subsurface water diversion and water drainage; and permeable reactive barrier testing, as described below.

From 1959 to 1969, as waste disposal was completed in portions of Pit 3 and 4, the landfills were covered with about 2 ft of compacted native clay loam soil. From 1969 to 1979, Pit 5 was also covered in the same manner, as was Pit 7 from 1979 until 1989, when it stopped receiving waste. These covers are now inspected, maintained, and monitored for subsidence on an annual basis.

In 1988, well K7-07, which was screened across two water-bearing zones, was properly sealed and abandoned by casing perforation and grout injection. The well was replaced by two separate wells, K7-09 and K7-10, which are each screened in one of the water-bearing zones.

In 1992, an 8-ft thick RCRA cap was placed on Pit 7, Pit 4, and about 30% of Pit 3. The RCRA cap included a 2-ft-thick compacted clay layer with a verified vertical permeability of less than 10^{-8} cm/sec. Other layers included an overlying gravel drainage layer, a cobble biotic barrier layer, and a shallow vegetative layer. The cap also includes a shallow interceptor trench along the west side of the cap and two French drains that run up each of two swales on the hillslope west of Pit 7. These water-diversion devices have probably reduced the volume of water recharging ground water, but are not deep enough to prevent water from entering the landfills. The RCRA cap is inspected every April by a licensed Professional Engineer, who issues a report on the integrity of the cap, vegetative cover, and drainage channels. Any deficiencies noted in the report are promptly corrected by the Site 300 Plant Engineering Department.

In 2002, LLNL installed a shallow terrace drain composed of three 20-ft long and 3-ft deep gravel-filled trenches to test the efficacy of this technique for capturing shallow flow on the hillslope west of Pit 7. Removal of such flow would indicate that these devices might effectively divert shallow water away from the landfills. Two horizontal wells were also installed at an angle of two degrees for the same purpose. The outflow points of these devices were fitted with flow meters. During the 2002–2003 season, Site 300 received less rainfall than the annual average, therefore it was not possible to completely evaluate the effectiveness of the pilot system. However, during the installation of these systems valuable information was gained regarding their design details as wells as the optimal locations for installation. If selected as a component of the final remedy, this knowledge will be used to design an effective hydraulic diversion system during the preparation of the remedial design document.

In January 2003, LLNL installed 11 boreholes filled with cow bone char and sand within the alluvial channel fill water-bearing zone that contains uranium emanating from Pit 5. A site-specific finite element flow model was developed and applied to design the optimum borehole geometry and emplaced media grain size to maximize contact time between the ground water and the cow bone char and passive flow into the boreholes. The boreholes were 18 inches in diameter and fully penetrated the water-bearing zone to a depth of 25 ft. Piezometers were installed within and downgradient of the cow bone char emplacement to monitor the effects on hydraulics and ground water chemistry. Uranium activities in the treatment zone have declined from about 189 pCi/L of total uranium to activities as low as 0.3 pCi/L. Concentrations of cow bone char dissolution by-products (bicarbonate, phosphate, and calcium) have not been significant. However, additional boreholes containing a cow bone char-sand mixture of slightly higher porosity may be required, as data suggest that water containing uranium may be flowing around the emplacements.

3. Feasibility Study for the Pit 7 Complex

The purpose of this Feasibility Study is to develop and evaluate alternatives for remedial action at the Pit 7 Complex in accordance with CERCLA/SARA. The Feasibility Study process began with the identification of remedial action objectives based on Applicable or Relevant and Appropriate Requirements (ARARs). General response actions and potential remedial technologies and associated process options were then identified and screened based on their applicability, effectiveness, implementability, and cost. The technologies that were retained from the screening process were assembled into alternatives for contaminant remediation at the Pit 7 Complex. Finally, the alternatives were evaluated against the U.S. EPA evaluation criteria. This Feasibility Study provides the basis for a subsequent Proposed Plan in which a remedy is proposed for regulatory agency and public comment. An Amendment to the Site-Wide Interim ROD, which will specify the selected remedy for the Pit 7 Complex, will follow the Proposed Plan.

3.1. ARARs and Remedial Action Objectives

Remedial action objectives are specific goals for protecting human health and the environment. They are developed by evaluating ARARs that protect human health and the environment and the results of remedial investigations, including the human health and ecological risk assessments. ARARs are discussed below, followed by the remedial action objectives for the Pit 7 Complex.

3.1.1. Identification of Potential Applicable or Relevant and Appropriate Requirements

CERCLA Section 121 (d)(2)(A) requires that remedial actions meet any federal standards, requirements, criteria, or limitations that are determined to be legally applicable or relevant and appropriate. CERCLA Section 121 (d)(2)(A)(ii) requires state ARARs to be met if they are more stringent than federal requirements. In addition, the National Contingency Plan, published in 40 Code of Federal Regulations (CFR) Part 300, requires that local ordinances, unpromulgated criteria, advisories, or guidance that do not meet the definition of ARARs but that may assist in the development of remedial objectives be listed as “to be considered”.

Based on CERCLA guidance, there are three types of ARARs:

- Chemical-specific requirements, which define acceptable exposure concentrations or water quality standards.
- Location-specific requirements, which may restrict remediation activities at sensitive or hazard-prone locations such as active fault zones, wildlife habitat and flood plains.
- Action-specific requirements, which may control activities and/or technology.

Table 3-1 lists the potential ARARs for the Pit 7 Complex. The three types of ARARs are described below.

3.1.2. Chemical-Specific ARARs

3.1.2.1. Risk-Based Requirements

40 CFR 300.430(e)(i)(A)(2) indicates that excess cancer risks greater than one in ten thousand (10^{-4}) are unacceptable, while excess cancer risk between 10^{-4} and one in one million (10^{-6}) may require risk management. The U.S. EPA states that “where the cumulative carcinogenic risk to an individual, based on a reasonable maximum exposure for both current and future land use is less than 10^{-4}, and the non-carcinogenic hazard quotient is less than 1.0, action generally is not warranted unless there are adverse environmental impacts,” unless MCLs are exceeded. EPA uses the general 10^{-4} to 10^{-6} risk range as a “target range” within which risk

management measures are taken as part of the Superfund cleanup (U.S. EPA, 1991b). 40 CFR Part 300 also indicates that “the 10^{-6} risk level shall be used as the point of departure for determining remediation goals for alternatives when ARARs are not available or are not sufficiently protective because of the presence of multiple contaminants at a site or multiple pathways of exposure.” U.S. EPA (1989a) indicates that a hazard index greater than 1.0 may be associated with a noncarcinogenic adverse health effect. Table 2-4 summarizes human health risk greater than 10^{-6} and hazard indices greater than 1.0 at the Pit 7 Complex as identified in the SWRI report (Webster-Scholten, 1994) or in subsequent characterization. Chemicals that were identified as presenting a risk greater than 10^{-6} and hazard index greater than 1.0 in any media for which a complete exposure pathway exists were considered as COCs and addressed in a remedial alternative.

3.1.2.2. Federal and State ARARs

Table 3-2 presents California and federal MCLs for COCs in ground water at the Pit 7 Complex. Although there are no drinking water-supply wells in the Pit 7 Complex area, because ground water at Site 300 is used for drinking water and MCLs apply directly to public drinking water systems with 15 or more service connections, ground water at Site 300 is considered a potential public drinking water source under federal and California law.

The U.S. EPA considers MCLs in setting cleanup standards for contaminated water that is, or may be used for drinking water. Under CERCLA, the most stringent concentration limit is the ARAR for the COC. Under the Safe Drinking Water Act), a state may set more stringent standards for public drinking water systems. As shown in Table 3-2, California has set more stringent MCLs for 1,1-dichloroethylene, toluene, total xylenes, and uranium-238. In addition, the State of California has established an MCL for tritium whereas the U.S. EPA has not.

The California RWQCB-Central Valley Region’s Water Quality Control Plan (Basin Plan) establishes beneficial uses and water quality objectives for ground water and surface waters in the Central Valley region. The RWQCB considers the water quality objectives as a cleanup standard for contaminated water that is, or may be used for, drinking water. A water quality objective (State Public Health Goal) has been included in Table 3-2 for perchlorate for which there is no State MCL.

State Water Resources Control Board (SWRCB) Resolution No. 68-16 reflects the State’s policies for “maintaining high quality of waters in California.” Commonly referred to as the anti-degradation policy, this Resolution applies to discharging waste that might affect the existing quality of the water into which it is discharged and, in turn, affect its beneficial use. The policy requires that waste discharges to existing high quality waters are required to meet best practical treatment or control. Title 23, California Code of Regulations (CCR), Division 3, Chapter 15, also applies to discharges of waste. SWRCB Resolution No. 92-49 establishes policies and procedures for the oversight of investigations and cleanup activities resulting from discharges that affect or threaten water quality. This policy authorizes regional boards to oversee cleanup activities and to require complete cleanup of all waste discharged. These policies are ARARs for the discharge of waste to ground water.

SWRCB Resolution No. 88-63 specifies that all surface and ground waters of the State are considered suitable, or potentially suitable, for municipal or domestic water supply with the following exceptions: (1) those water bodies with yields below 200 gallons per day, (2) total dissolved solids exceeding 3,000 mg/L, or (3) contamination that cannot reasonably be treated for domestic use by either best management practices or best economically achievable treatment practices.

3.1.2.3. Preliminary Remediation Levels

To comply with state and federal ARARs and CERCLA risk-based requirements, actions should be implemented that attempt to protect full beneficial use of ground water beneath the Pit 7 Complex. Because ground water near Site 300 is used for drinking water supply, the preliminary remediation levels for the chemicals of concern are the MCLs, or water quality objectives if applicable, presented in Table 3-2.

SWRCB Resolution 92-49 indicates that background conditions should also be a remedial goal. At this time, however, available site and industry data are insufficient to evaluate whether remediation to background levels is technically or economically feasible. For example, there are currently no cost effective technologies available to treat tritiated ground water. Given the short half-life of tritium (12.3 years), natural decay of tritium should eventually reduce tritium activities to background levels. While technologies are available for treating uranium in ground water, there is uncertainty about the site-specific efficacy of these technologies to remediate uranium to background levels. However, because this is an important policy issue with the State, DOE/LLNL will reevaluate the achievability of this potential long-term goal in the future, as additional monitoring and remediation performance data, and/or new remediation technologies become available.

DOE/LLNL will gather the necessary information to assess the feasibility of different cleanup levels as the Interim Site-Wide ROD is implemented. This information will aid in setting final cleanup levels as part of a Final Site-Wide ROD, such that ground water will be cleaned up to the technically and economically feasible level between MCLs, or any more stringent water quality objectives, and natural background levels.

3.1.3. Location-Specific ARARs

3.1.3.1. Faults

California location standards for permitted hazardous waste transfer, treatment, storage, and disposal facilities (22 CCR 66264.18[a]) prohibit location of new treatment, storage, and disposal facilities, or substantial modification of existing facilities, within 200 ft of a Holocene (active) fault. A right-lateral strike slip Corral Hollow-Carnegie Fault Zone, which traverses the Pit 6 OU, is considered active and capable of generating an earthquake with a magnitude in the range of 6.3 to 7.1 (Carpenter et al., 1992.) However, this fault zone is located in the southwest portion of Site 300, over 4 miles from the Pit 7 Complex.

A potentially active extension of the Midway Fault has been mapped across the northeastern part of Site 300 (Dibblee, 1980). However, this fault, if it actually extends into the northeastern part of Site 300, is not located near the Pit 7 Complex.

The Elk Ravine Fault Zone is located approximately 1/2 mile east of the Pit 7 Complex. Analysis of outcrops, trenches, and engineering studies (Woodward-Clyde, 1979; Hoffman, 1988) indicated no evidence for active or potentially active strands within this fault zone as defined by the State of California.

No other known active or potentially active faults have been identified at Site 300.

3.1.3.2. Wilderness Areas, Wildlife Refuges, and Scenic Rivers

No area within or near Site 300 is designated as a federal wilderness area, wildlife refuge, or scenic river. The California Department of Fish and Game maintains an ecological preserve adjacent to the eastern Site 300 boundary. No remedial action activities will occur within this preserve.

3.1.3.3. Floodplains and Wetlands

22 CCR 66264.18(b)(1) states that treatment, storage, and disposal facilities within a 100-year floodplain must be designed, constructed, operated, and maintained to prevent washout of any hazardous waste by a 100-year flood. However, there are no floodplains within the Pit 7 Complex area. No areas that meet the California and federal definition of wetlands (U.S. DOE, 1992b) have been identified at or near the Pit 7 Complex area.

3.1.3.4. Historical Sites and Archaeological Findings

A discussion of archaeological investigations at Site 300 is presented in the SWRI (Webster-Scholten, 1994). Additional surveys may be conducted prior to remedial activity to ensure that no historical properties will be affected by the activity. Remedial project construction personnel will be advised of the possibility of buried cultural artifacts and be alerted to likely indicators.

3.1.3.5. Rare, Threatened, or Endangered Species

The SWRI and the Site 300 Environmental Impact Statement/Environmental Impact Report (EIS/EIR) (U.S. DOE, 1992) indicate that portions of Site 300 are potential habitat for several species that have been designated by the federal and state governments as threatened or endangered. The federally-listed red-legged frog (threatened) and valley elderberry longhorn beetle (threatened) have been observed at Site 300. Those federally- and state-listed species for which habitat have been identified, but which have not been observed at Site 300, include the San Joaquin kit fox (endangered) and the Alameda whipsnake (threatened).

In addition, the flora species commonly known as the large-flowered fiddleneck (endangered) grows onsite although it has not been found in the Pit 7 Complex area. In an agreement with the U.S. Fish and Wildlife Service, DOE designated 160 acres in the southwest portion of Site 300 as an ecological reserve for the endangered large-flowered fiddle neck. The reserve is located in the southeast corner of Site 300 and will not be impacted by activities in the Pit 7 Complex.

DOE is committed to protecting all potential habitats for these species. Mandatory 60-day advance notification of all ground-breaking activities will initiate an ecological survey by an LLNL biologist to identify the presence of sensitive species and to mitigate any adverse impacts of the project.

3.1.4. Action-Specific ARARs

Most action-specific ARARs address treatment, transportation, and disposal of hazardous waste. Table 3-1 includes descriptions of action-specific ARARs that may be associated with possible remedial actions. Sections 3.3, 3.4, and 3.5 include discussions of ARAR compliance for specific technologies and cleanup activities.

3.1.5. Remedial Action Objectives

The National Contingency Plan specifies that remedial action objectives be developed which address: (1) contaminants of concern, (2) media of concern, (3) potential exposure pathways, and (4) preliminary remediation levels.

The development of these goals involves ARARs and the results of the baseline human and ecological risk assessment in the SWRI and the Pit 7 RI. Cleanup standards for contaminant concentrations in the Final ROD will be between MCLs and background. This Feasibility Study assembles General Response Actions and technologies into implementable alternatives that satisfy these remedial action objectives.

Preliminary remedial action objectives for the Pit 7 Complex Feasibility Study are:

For Human Health Protection:

- Prevent human ingestion of ground water containing contaminant concentrations (single carcinogen) above the State and federal MCLs and any more stringent water quality objectives. The COCs for the Pit 7 Complex, as well as the State and federal MCLs and RWQCB water quality objectives for these COCs are listed in Table 3-2.
- Prevent human inhalation of tritium volatilizing from subsurface soil to air that pose an excess cancer risk greater than 10^{-6} or hazard index greater than 1, a cumulative excess cancer risk (all carcinogens) in excess of 10^{-4}, or a cumulative hazard index (all noncarcinogens) greater than 1.
- Prevent human exposure to contaminants in media of concern that pose a cumulative excess cancer risk (all carcinogens) greater than 10^{-4} and/or a cumulative hazard index greater than one (all noncarcinogens).

For Environmental Protection:

- Restore water quality, at a minimum, to water quality objectives that are protective of beneficial uses within a reasonable timeframe and to prevent plume migration. Maintain existing water quality that complies with water quality objectives. This will apply to both individual and multiple constituents that have additive toxicology or carcinogenic effects.
- Ensure existing contaminant conditions do not change so as to threaten wildlife populations and vegetation communities.

There are no remedial action objectives presented for COCs in surface soil as no human health risk greater than 10^{-6}, hazard index greater than 1 or ecological hazard index greater than 1 has been identified for these contaminants in surface soil at the Pit 7 Complex.

Section 3.3 of this document evaluates a number of alternative remedies to meet these remedial action objectives. The Site-Wide Compliance Monitoring Plan/Contingency Plan (Ferry et al., 2002) addresses the contingent processes and actions to be taken if the originally selected remediation alternatives are unsuccessful in meeting any of the remedial action objectives. Contingent actions may include further evaluations and/or application of new remediation approaches.

3.2. Identification and Screening of General Response Actions and Remedial Action Technologies

3.2.1. Overview and Evaluation of Screening Process

This section evaluates and screens several response actions and remedial technologies capable of achieving the remedial action objectives identified in Section 3.1.5. Section 3.2.2 describes General Response Actions available to address the remedial action objectives. Section 3.2.3 screens remedial technologies and process options that may be included in the General Response Actions based on applicability, effectiveness, implementability, and cost. The various actions and technologies that pass the screening are retained and combined to form the alternative remedies described in Section 3.3. Section 3.2.4 discusses the use of innovative technologies for remediation. The final selection of any innovative technologies will be made after treatability testing or other evaluations. Section 3.3.5 summarizes the technologies retained through this screening process. Technologies evaluated in the screening process are further described in Appendix F.

3.2.2. General Response Actions

General Response Actions are general categories of remedial activities and technologies that can potentially achieve the remedial action objectives described in Section 3.1.5. These actions are intended to: (1) mitigate potential exposure to, (2) control the migration of, and/or (3) remediate COCs identified in Section 2.6. Nine General Response Actions have been identified for the Pit 7 Complex:

1. No Further Action
2. Risk and Hazard Management.
3. Monitoring.
4. Monitored Natural Attenuation.
5. Source Control /Isolation.
6. Plume Control.
7. *In situ* Treatment.
8. Extraction and *Ex situ* Treatment.
9. Landfill Waste Removal and Disposal.

Table 3-3 summarizes the potential response actions that address each remedial action objective for the Pit 7 Complex. Tables 3-4a and 3-4b indicate how these general response actions apply to contaminants in each environmental medium. Additional information on the remedial technologies, and process options are presented in Appendix F.

3.2.2.1. No Further Action

In CERCLA feasibility studies, a no further action alternative provides a basis for comparison with other remedial actions. All ongoing activities would cease under this response. Natural chemical degradation, radioactive decay, dispersion, adsorption, dilution, and volatilization are the only processes that would take place, and will occur regardless of intervention. The no further action alternative will not meet remedial action objectives.

However, the no further action alternative is retained as a baseline for comparison with other general response actions and technologies.

3.2.2.2. Risk and Hazard Management

Risk and hazard management may include institutional and administrative controls, as well as ecological resource surveys, and can be used as a General Response Action to mitigate exposure to contaminated media. This General Response Action is used primarily in areas where risk exceeds 10^{-6}, and may be acceptable as the sole response action when the risk falls in the 10^{-6} to 10^{-4} risk range. Risk and hazard management may also be used when such measures can adequately protect human health or ecological receptors from exposure to hazards that might otherwise exceed a hazard index of one. Risk and hazard management may commonly be employed in conjunction with other actions, such as monitoring or active responses, to assure compliance with all remedial action objectives.

3.2.2.2.1. Institutional/Administrative Controls. Institutional and administrative controls may be used as a means of risk management to restrict some or all access, and thereby mitigate exposure, to hazards in a contaminated area. These controls can involve a range of measures, from simply posting signs and installing fences, to specific restrictions on the use of property. Also included are the use of operational safety procedures, developed for all remedial activities, to ensure worker safety and the proper handling of all hazardous materials. Institutional control measures can have the effect of limiting human activities or access or restricting use of contaminated water. These measures help to mitigate potential exposure pathways.

The human health risks from exposure to tritium in outdoor air from landfill waste and the vadose zone at Pit 3 are in the 10^{-6} to 10^{-4} range. Such exposure can be limited by continuing to restrict access to these areas through institutional controls. This response action is also applicable to contamination in ground water. There were no unacceptable risks or hazards to human or ecological receptors identified for surface soil or surface water (Spring 24).

The following administrative /institutional controls are already in place at the Pit 7 Complex and at Site 300 and will be maintained throughout the cleanup:

- Access is restricted and controlled by fencing and a full time security force.
- Additional controls exist regarding access outside of regular work areas.
- Land use is controlled by Site 300 Management.
- Safety briefings are required of all personnel working at Site 300, which discuss access requirements and areas of contamination.
- There are no drinking water wells in the Pit 7 Complex area, and any new water supply wells at Site 300 are subject to review, with environmental considerations in mind.
- Operational Safety Plans are required for all construction activities, including checks for hazardous materials and sensitive species.
- A wildlife biologist reviews proposals for all land-disturbing activities and recommends ecological protection measures as appropriate.

Institutional/administrative controls can reliably and inexpensively prevent exposure to COCs, however they are effective only while maintained and do not provide a permanent remedy. These management actions do not reduce toxicity, mobility, or volume. However, they were retained for inclusion as components of remedial alternatives.

DOE and LLNL will work with EPA and the State regulatory agencies during the development of the Amendment to the Interim Site-Wide ROD for the Pit 7 Complex to determine the necessary institutional controls. Following the procedures agreed to during the Interim Site-Wide ROD process, the institutional controls that are part of the final selected remedy for the Pit 7 Complex will be incorporated into the Risk and Hazard Management Program contained in the Site-Wide Compliance Monitoring Plan. Compliance Monitoring Reports are submitted to EPA and the State regulatory agencies that describe the Risk and Hazard Management monitoring conducted during the year. In addition, DOE/LLNL will work with LLNL Site 300 Management to incorporate institutional controls into the Site 300 Long Range Plan or other appropriate planning document. DOE intends to hold the Site 300 property in perpetuity. In the unlikely event that the property is transferred in the future, DOE will execute a land use covenant at the time of transfer in compliance with Title 22 California Code of Regulations, Division 4.5, Chapter 39, Section 67391.1.

3.2.2.2.2. Ecological Hazard Controls. Currently, there are no threatened, endangered, or species of special concern that may be potentially exposed to unacceptable levels of contaminants at the Pit 7 Complex. Regardless, an enhancement of LLNL's ongoing ecological resource survey program may be performed to ensure that sensitive species are not negatively impacted by any planned ground-disturbing activities, including actions that will occur as a result of the final remedial actions implemented at the Pit 7 Complex. As currently implemented, any area proposed for an activity that may cause significant surface disturbance (e.g., well installation or facility construction) must be surveyed by a wildlife biologist for the presence of sensitive species. If sensitive species are found, then mitigation measures as defined in the EIS/EIR would be implemented. This program to mitigate impacts to wildlife would be expanded to include monitoring of those areas in which in the future the relevant ecological hazard index exceeds 1.

In addition, biologists will continue to monitor Site 300 for the presence of sensitive species not previously identified at Site 300. The life history of these species will be reviewed to determine the potential for unacceptable exposure to contaminants at the site. Should it be determined that these species do have a potential risk of significant exposure, their presence in areas where hazard indices exceed 1 will be determined. Finally, environmental contaminant data will continue to be evaluated to ensure that site conditions with respect to contamination do not change to such an extent as to threaten any wildlife populations for plant communities.

3.2.2.3. Monitoring

Although not considered a ground water response or remedial technology, monitoring is included in all remedial alternatives except for the baseline no-action case. Monitoring is essential for evaluating the effectiveness of the remedial action and to determine when relevant remedial action objectives are met including MCLs and water quality objectives (Table 3-2). Monitoring is defined as the routine, periodic sampling and analysis of contaminated media not associated with the operation and optimization of remediation systems. Monitoring consists of collecting ground water samples from existing monitor wells and surface water (Spring 24) and measurement of water elevations to:

- Track changes in plume concentrations and size that results from remediation or natural processes.
- Evaluate the effectiveness of the remedial action.

- Determine when cleanup standards are achieved.
- Detect any future releases of contaminants.

Since the delineation of the nature and extent of uranium at the Pit 7 Complex indicates that the areal extent of depleted uranium in ground water has not changed since 1998, monitoring has also been evaluated as a remedial alternative component specifically for uranium. Natural processes, such as sorption, ion exchange, dispersion, and diffusion, may cause a reduction in uranium activity along a ground water flow path. Dissolution and desorption reactions with aquifer rocks may also increase the total uranium activity downgradient of the recharge area. As these natural processes proceed, mass spectrometric analyses of ground water could be used to detect any reduction in the depleted uranium component. A steady decline in the depleted uranium component would be required to verify that attenuation processes are effective. Because further release of uranium from the pits will be eliminated as a part of the final remedy, monitoring of the progress of these processes will only be required for the depleted uranium already present in ground water. A contingency plan would be developed to consider active treatment of uranium. The maximum total uranium activity detected in Pit 7 Complex ground water in 2003 was 122.9 pCi/L in a sample collected from well NC7-40. Of this 122.9 pCi/L, the majority was a result of added depleted uranium.

Fate and transport modeling results based on the current distribution of uranium in ground water predict that the 20 pCi/L contour will not extend more than about 1,000 feet beyond the landfills, and that all uranium activities in the area should diminish to below 20 pCi/L in less than 500 years. More importantly, exposure point uranium concentrations will never exceed background activities. These modeling results do not account for reductions in ground water uranium due to removal by sorption to the aquifer rock matrix surfaces. The sorption of uranium to the aquifer rock matrix surfaces is likely responsible for the fact that depleted uranium has not migrated a significant distance downgradient from Pits 3 and 5.

Mass spectrometric data indicate that ground water at the Pit 7 Complex exceeds the 20 pCi/L MCL purely due to natural uranium sources in the Qal/WBR HSU and the $Tnbs_0$ aquifer materials of the Neroly Formation. A preliminary analysis of local aqueous geochemistry discussed in Section 2.3.3.2 and Appendix H indicate that several wells completed in both the Qal/WBR and bedrock ($Tnbs_0$) HSUs sample ground water containing natural uranium in excess of the MCL, possibly as a result of some combination of natural and landfill-induced geochemical processes. If the landfills are isolated by hydraulic diversion or barriers or if the landfill contents are excavated, monitoring will enable confirmation of a reduction in any landfill-induced geochemical effects and determination of the natural component of these effects on uranium mobility.

Monitoring data would be evaluated regularly to detect any changes in ground water flow and/or the nature and extent of the COCs in ground water, especially mobilization of contaminants from the landfills and adjacent vadose zone to ground water. Monitoring results would be disseminated at Remedial Project Managers' meetings and in monitoring reports. Any changes in ground water conditions would be compared with remedial action objectives and cleanup levels. If conditions required contingency measures, as outlined in the Compliance Monitoring Plan/Contingency Plan (Ferry et al., 2002), these measures would commence in a timely manner. Sampling plans would be prepared and submitted as part of the semi-annual Compliance Monitoring Report.

Monitoring is an essential alternative component to ensure continued protection of human health and the environment, evaluate the effectiveness of remedial actions, determine when cleanup standards are achieved, and to detect future release of contaminants. Therefore, monitoring was retained as a response action and was incorporated in all of the remedial alternatives presented later in this chapter.

3.2.2.4. Monitored Natural Attenuation

Monitored natural attenuation has long been recognized as an option for reducing contaminant toxicity and volume, and has proven effective for certain contaminants (e.g., fuel hydrocarbons and radionuclides with relatively short half-lives such as tritium). In the monitored natural attenuation General Response Action, risk reduction occurs through natural degradation or decay, sorption, volatilization, or evapotranspiration. Attenuation may also occur from dilution and dispersion, although these mechanisms may not be appropriate as the only remediation processes. Monitored natural attenuation is potentially applicable to tritium and may also be applicable to uranium. Attenuation processes for tritium include radioactive decay, volatilization, dilution, and dispersion. Sorption/ion exchange, dilution, dispersion, diffusion, redox change (from oxidizing to reducing conditions), and to a minimal extent, radioactive decay, are processes that can attenuate uranium. Under this response action, monitoring data would be collected and reviewed to determine the natural decline of contaminant concentrations in ground water. Computer modeling with site-specific aquifer parameters and chemical properties would be performed to predict the reduction of subsurface contamination over time. The forecasted contaminant reduction would be confirmed with ground water monitoring.

Monitored natural attenuation would be instituted in conjunction with a specific monitoring plan for upgradient, near-source/interior plume, and guard wells. Monitored natural attenuation requires that there is no threat to environmental media from an active source. Human health must also be protected. Thus, for a monitored natural attenuation remedy to be acceptable for the Pit 7 landfills, an engineered remedy would be implemented to prevent future releases of chemicals from the pits to the environment. Risk and hazard management would also be implemented to prevent exposure until contaminants have attenuated to health-protective levels. DOE has controls already in place to prevent public use or access to Site 300 and has no plans to release lands from their stewardship, and would not do so without full concurrence regarding cleanup. Contingent remedial actions would be implemented if conditions specified in the contingency plan are not met (e.g., contaminant concentrations increase or are not reduced as projected to meet ARARs). DOE submitted a general Site 300 Contingency Plan in 2002, which addresses monitored natural attenuation issues (Ferry et al., 2002). This Contingency Plan may be supplemented to address issues specific to the Pit 7 Complex.

According to EPA policy Directive 9200.4-17, the elements important to establishing a monitored natural attenuation remedy are: (1) contamination does not pose an unacceptable risk, (2) source control, and (3) static or retreating plume contours. Natural attenuation may be demonstrated through a variety of lines of evidence, including static or diminishing plume concentration contours, detection of chemical breakdown products, or detection or formation of geochemical indicators or compounds.

This FS retains monitored natural attenuation as a remedial alternative component where decay, degradation, or other natural attenuation processes can be demonstrated, as is the case for tritium. Maximum tritium activities have declined from 2,660,000 pCi/L in 1998 to

469,000 pCi/L in 2003. The relatively rapid radioactive decay of tritium results in a 50% reduction in mass every 12.3 years. Coupling advection and dispersion with decay, monitored natural attenuation can reduce or limit the advance of tritium in ground water. Monitored natural attenuation was previously accepted as the final remedy for tritium in ground water emanating from Building 850, south of the Pit 7 landfills (Ferry et al., 2000). As stated above, acceptance of monitored natural attenuation for tritium in the Pit 7 Complex area would be contingent on preventing further releases from the landfills. The continued addition of tritium to ground water would thus be curtailed, resulting in an immediate and sustainable reduction in total tritium activity in ground water. Fate and transport modeling of tritium in ground water indicate that even if all the tritium in the landfills is added to the pre-existing ground water plumes, tritium activities would decrease to the drinking water standard of 20,000 pCi/L after a maximum of 45 years without impacting ground water offsite above background activities.

Declining VOC concentrations and extent in ground water indicate that natural processes may be acting to attenuate VOCs in the Pit 7 Complex. However, to date significant concentrations of TCE degradation products, such as 1,2-dichloroethylene, have not been detected.

Monitored natural attenuation was retained as a response action for remediation of the Pit 7 Complex because it can reduce the toxicity, mobility, and volume of tritium without posing a risk to human health or the environment.

3.2.2.5. Source Isolation

The primary mechanism for potential releases of residual contamination from the Pit 7 Complex landfills is the rise of shallow ground water and inundation of the landfills during high rainfall seasons. Containment technologies could be used to physically isolate the buried waste or vadose zone sources or render these impermeable, preventing water from entering the landfill and leaching contaminants. Barrier methods, which include slurry walls, grout curtains, and ground (cryogenic) freezing, could be used to create an impermeable zone around and beneath the landfill waste and vadose zone sources. These barriers would prevent lateral or upward flow of ground water into the landfills. *In situ* stabilization techniques include the injection of a stabilizing agent, such as silica microspheres, directly into the landfill waste and vadose zone to prevent contaminant mobilization.

Slurry walls were retained because they are implementable and cost-effective. Grout curtains were not retained because they would be difficult to install to a depth where they would be effective. Landfill freezing was not retained because it would be expensive to implement and is an unproven technology. Silica injection was not retained because it would be difficult to emplace within coherent bedrock to prevent water table rise into the pits and vadose zone sources and is not a proven technology.

Landfill caps minimize the infiltration of rain water through the waste and subsequent leaching of contaminants to underlying ground water. However, landfill capping is likely to be ineffective in protecting ground water because the primary mechanism for contaminant releases from the Pit 7 Complex landfills is the lateral and upward flow of ground water into the pits, rather than the direct percolation of rain water through the pit waste (Taffet et al., 1996).

Studies of rainfall infiltration adjacent to the pits and modeling of rainfall infiltration through the landfill covers and through landfill waste indicate that even during extreme rainfall years, the wetting front typically would not directly recharge the underlying ground water. Neutron probe monitoring conducted in the alluvial fill adjacent to the pits during the wet winter of 1986-87 showed that wetting fronts did not reach greater than a 6 ft depth (Buddemeier et al., 1987). HELP (Hydrologic Evaluation of Landfill Performance) modeling (U.S Army Corps of Engineers, 1995) of worse-case rainfall volumes falling on the Pit 3 and 5 landfill covers and infiltrating into waste indicated that for the 100 yr rainfall, the wetting front would not reach beyond a depth of several feet (Taffet et al., 1997). Additionally, the water budget analysis conducted for the RI/FS shows that in a typical rainfall year 90% of the rainfall volume is lost to the atmosphere by evapotranspiration and is unavailable for infiltration and percolation to ground water. Also, the installation of an engineered RCRA cap in1992 over Pits 4 and 7 and part of Pit 3, did little to prevent uranium releases from Pit 7 during heavy rainfall events in 1993, 1996, and 1998. During periods of average or below average rainfall when shallow ground water remained below the pit bottoms, monitoring data show no evidence of contaminant releases. Thus, landfill capping would not prevent contaminant releases from the pits. Contaminant releases from the pits are caused from upgradient ground water recharge and lateral flow of rainwater into the pits, both resulting in water entering the landfills and mobilizing contaminants as the water recedes below the pit bottoms.

If a slurry wall were emplaced around the landfills to prevent ground water from entering them, a landfill cap would reduce infiltration. However, because direct percolation through the pits to ground water is generally minor, a landfill cap would not be necessary to prevent the pits from filling with water even if a slurry wall was installed. However, capping would be effective in mitigating risk of tritium volatilization from landfill wastes and the vadose zone to outdoor air at Pit 3. Because landfill capping would be ineffective in preventing further releases from the landfills and vadose zone, it was not retained for further consideration.

3.2.2.6. Source Control

Source control involves hydraulic diversion of surface and shallow subsurface water away from landfill and vadose zone sources during and after extreme rainfall events, thereby preventing further releases to ground water. This would prevent water from entering the landfills laterally or from below as a result of water table rises.

To understand the recharge characteristics of the Pit 7 Complex area, a water balance was performed as described in Section 2.2.3.3. This analysis provided the necessary information required to evaluate the potential effectiveness of source control as one of the general response actions. The hydraulic diversion system could consist of interceptor trenches, french drains, shallow terrace drains, horizontal de-watering wells, surface water drainage ditches, and surface treatment to reduce infiltration. Excess water would be diverted, preventing infiltration into the subsurface and the sudden water table rises currently observed in the Pit 7 Complex during heavy rainfall events. The source control response action would be applicable to control of contaminant sources within the vadose zone and buried waste. In addition, this response action would minimize recharge into the saturated zone, reduce the hydraulic gradient, and effectively slow down migration of contaminants in the saturated zone. Source control by hydraulic diversion may impact hydrologic conditions at the site due to changes in ground water recharge and flow. Any changes to hydrologic conditions would need to be evaluated prior to implementing other remedial technologies at the Pit 7 Complex area.

Source control was retained because it can effectively prevent further releases of COCs in the landfills and vadose zone for an acceptable cost. It also has the added benefit of reducing the migration rate of pre-existing ground water contamination.

3.2.2.7. Hydraulic (Plume) Control

Hydraulic control of the tritium plume by extracting ground water from the downgradient plume and reinjecting upgradient was evaluated. Reinjection rather than the treatment of the extracted ground water was evaluated because there are no implementable technologies available to remove tritium from ground water. The objective of hydraulic control would be to prevent contaminated ground water from further migrating and adversely impacting downgradient ground water by extracting tritium-bearing ground water near the leading edge of the plume and injecting this ground water at upgradient locations to allow more time for radioactive decay to attenuate the tritium. Finite element modeling to evaluate the technical feasibility of the hydraulic plume control approach was conducted separately for the Qal/WBR and Tnbs_0 HSUs. The modeling results indicate that the recirculation process as a remedial measure to hydraulically control the tritium plume poses several problems. The models for both HSUs indicated that, due to the limited storage capacity of these water-bearing zones, the pit contents would be inundated within one to five years and would result in additional releases of contaminants. If the impacts from extraction and injection of tritiated ground water from both the Qal/WBR and Tnbs_0 HSUs are combined, the following adverse impacts all increase significantly:

1) Pit inundation,

2) Additional release of contaminants from the pits,

3) Accelerating migration of the highest activity portions of the tritium plume, and

4) Discharge of contaminated ground water at the surface.

Based on the evaluation of the technical feasibility of hydraulic control by simulating its impact with conservative modeling, DOE/LLNL does not consider this a technically feasible approach. Results of the modeling and additional details on this technology are presented in Appendix F, Section F-1.6.1.

3.2.2.8. In situ Treatment

In situ treatment methods destroy, immobilize, or convert contaminants in ground water to less toxic compounds. A permeable reactive barrier could reduce the mass of uranium in ground water by emplacing sorbents such as cow bone char, or reducing agents such as zero valent iron, in a trench or series of boreholes, in the path of contaminated ground water. Cow bone char is composed primarily of hydroxyapatite ($Ca_5(PO_4)_3(OH,HCO_3)$. The dissolved uranium sorbs to active calcium oxide and phosphate groups on the cow bone char surface. Over time, as the local concentration of the sorbed uranium increases, the uranium converts from a sorbed phase to the uranyl phosphate mineral autunite [$(Ca,H_2)(UO_2)_2(PO_4)_2.10\text{-}12H_2O$]. Appendix F contains a more in-depth discussion of the sequestration process. A detailed discussion of uranium sorption and mineralization is presented in Taffet, 2004 and in Fuller et al., 2002. The reactive material would be installed proximal to the Pit 3 and 5 landfills to treat the highest activity portions of the uranium plume. Because the *in situ* treatment of uranium in ground water is an innovative technology, laboratory experiments and a field pilot-scale treatability test were conducted to determine the long-term effectiveness of the reactive media prior to design and emplacement. In February 2003, cow bone char (apatite) was installed in a series of boreholes within the uranium plume in alluvium and weathered bedrock HSU at Pit 5. Monthly monitoring is being conducted to define chemical and hydraulic effects. Preliminary results indicate that uranium concentrations in ground water within the permeable reactive barrier are being reduced to MCLs or below. A large fraction of the uranium being removed by the barrier is added depleted uranium because the barrier test boreholes are located just downgradient of well NC7-40, where the majority of the 122.8 pCi/L of total uranium is due to depleted uranium.

Preliminary finite element flow modeling was performed to determine how many boreholes of a particular geometry would be required to completely capture the depleted uranium plume in alluvium and weathered bedrock HSU and provide sufficient residence time to allow for uranium removal by cow bone char based on treatability test results.

Treatment media that sorb or destroy nitrate and perchlorate, such as sorptive resins, can also be placed in the subsurface permeable reactive barrier. There are no methods for *in situ* treatment of tritium in ground water.

Because this innovative technology was demonstrated to reduce uranium activities in ground water to very low levels in laboratory and *in situ* treatability studies, nitrate and perchlorate removal by resins is a proven technology, and both appear to be cost-effective, *in situ* treatment was retained for incorporation in one or more remedial alternatives.

3.2.2.9. Extraction and Ex situ Treatment

Removal and treatment of contaminated ground water would involve extraction followed by treatment and discharge of the treated water. Ground water would be extracted at the Pit 7 Complex by pumping from wells, trenches, or sumps.

Ex situ treatment methods separate, destroy, or convert contaminants in extracted ground water. Possible treatment agents for uranium in extracted ground water include ion exchange resins, aerogel/granular activated carbon (GAC) composites, electro-coagulation, apatite (cow bone char or fish bone), and zero valent iron filings. An *ex situ* treatment system uses one or several of these techniques to remove contaminants from extracted ground water. Ion exchange resins are a proven, off-the-shelf technology for uranium, nitrate, and perchlorate. Aerogel/GAC is an innovative technology developed at LLNL that has an extremely high surface area and very high affinity for uranium due to phosphate groups on the aerogel. Electro-coagulation is an innovative technology that utilizes electrically-charged plates to convert dissolved uranium to a filterable solid that can easily be removed from the water. All of these technologies are capable of reducing contaminants concentrations in Pit 7 Complex ground water to levels that satisfy remedial action objectives. There are no commercially-available off-the-shelf technologies for the treatment of tritium. If treatment separates the uranium, nitrate, or perchlorate, such as sorption onto ion exchange resin, the contaminant-bearing resin or other material would be sent to a licensed facility for disposal or further treatment.

The only realistic method for disposing treated ground water at the Pit 7 Complex is reinjection. Treated ground water would likely contain elevated tritium activities and the water would have to be returned to a portion of the aquifer already containing elevated tritium activities in such a way that the reinjected water would not mobilize contaminants or accelerate plume migration. Treated ground water would be discharged to an infiltration gallery or a series of injection wells that would recharge the Qal/WBR HSU. The infiltration gallery or injection wells would be designed and located so that hydrological conditions in this HSU would not be impacted such that further releases of contaminants or plume migration would occur. Preliminary calculations indicate that the volume of water extracted, treated, and returned to the Qal/WBR HSU would not increase water table elevations or hydraulic gradient such that inundation of contaminant sources or enhanced tritium migration would result.

This general response action was retained for incorporation in one or more remedial alternatives because: (1) several innovative *ex situ* treatment technologies were demonstrated to reduce uranium activities in ground water to very low levels in laboratory and *ex situ* treatability studies, (2) removal of nitrate and perchlorate using resins is a proven technology, and (3) these technologies appear to be cost-effective.

3.2.2.10. Source Removal and Disposal

Source removal is applicable to landfill waste and the shallow vadose zone and involves a process of locating, characterizing, excavating, treating, and/or disposing of contaminated waste, soil, rock, and/or debris. A number of tasks must be completed to implement a source removal General Response Action. These tasks may include:

1. Preparing work and safety plans.
2. Constructing temporary waste storage, staging, and decontamination facilities.
3. Excavating source material.
4. Waste characterization.
5. Temporary waste storage.
6. Waste transportation.
7. Offsite or onsite treatment and/or disposal.
8. Protection of the public, workers, and the environment from chemical, radiological, and physical hazards.

Excavation would entail the complete removal of landfill waste in Pits 3 and 5, and a portion of the vadose zone to control contaminant sources and prevent further releases to the environment. The vadose zone below the pits would not be excavated, as these materials are composed of rock and are very deep, requiring special excavation equipment and great expense. Pit 7 and Pit 4 would not be removed as these units have already been capped under RCRA. Additionally, excavation of Pit 7 and Pit 4, comprising an additional 33,907 yd^3 of waste plus capping material, would add great expense to the removal and disposal of Pits 3 and 5, which is already very expensive. Excavation and disposal of Pit 7 and Pit 4 were screened out based on destruction of the RCRA cap and the additional volume of waste and cap material that would require disposal, resulting in extreme costs.

Excavated source material would be transported to an offsite permitted facility (Envirocare-Utah) for treatment and disposal, or could be disposed onsite in a permitted facility. Onsite containment would involve designing and constructing an engineered containment unit with components to prevent releases of contaminants. The excavated material would predominantly be classified as a low-level radioactive or mixed waste and would require disposal as such. Detailed and thorough safety procedures would be required to control airborne dust and to keep wastes dry during excavation and disposal or reburial. Source excavation and replacement with fill may impact hydrological conditions at the site due to changes in ground water recharge and flow. These impacts could affect other remediation strategies that may be implemented at the Pit 7 Complex.

Although offsite disposal was retained for inclusion in a remedial alternative, onsite disposal or containment was screened out for several reasons. As stated in Appendix F, Section F-2.6.2, onsite disposal would require regulatory approvals and permits from several agencies which could be difficult to obtain and would likely require many years to acquire. Community acceptance is also an issue with residential communities planned east of Site 300. Onsite disposal would also require stockpiling of excavated waste, which would increase safety and health concerns. Long-term stewardship of the disposal site would also be required. Additionally, LLNL, Site 300 Management, and DOE would prefer to use offsite disposal options that are available. As is the case for offsite disposal at a permitted facility, onsite disposal of the excavated waste would be expensive. For these reasons, and because offsite disposal would provide equivalent or greater protection of human health and the environment, onsite disposal was screened out.

Because source removal and offsite disposal is an effective and readily implementable technology for curtailing future contaminant releases to ground water, it was retained for inclusion in one or more remedial alternatives.

3.2.3. Evaluation and Screening of Remedial Technologies and Process Options

This section evaluates technologies considered to be potentially viable for each General Response Action. These technologies were evaluated against four criteria: applicability, effectiveness, implementability, and cost.

In the first step of the technology screening process, technologies were evaluated for their applicability to the media and COCs at Site 300. Tables 3-4a and 3-4b list the General Response Actions and technologies by medium and COC at the Pit 7 Complex.

The applicable technologies were evaluated to determine their effectiveness in remediating the media and COCs given the technologies' limitations. The applicable and effective technologies were then assessed for their implementability at the Pit 7 Complex. The technologies considered implementable were retained for cost evaluation.

From the cost evaluation, technologies were retained if considered to be applicable, effective, and implementable, and if costs were estimated to be low to medium. If the estimated cost of a technology was high, but no other available technology exists to remediate the media and COCs at the Pit 7 Complex, the technology was retained. If the cost of a technology was high to very high and other lower cost technologies were available, the technology was not retained for further consideration.

Tables 3-5, 3-6, 3-7, and 3-8 summarize the screening and evaluation of General Response Actions, technology types, and process options available for the remedial alternatives for ground water, vadose zone, surface water, and pit waste, respectively.

The first column of Tables 3-5 through 3-8 lists the General Response Actions. Under each General Response Action are one or more remediation technologies that are considered potentially viable. These tables document the reasons for retaining or eliminating a technology from further consideration, based on the criteria of applicability, effectiveness, implementability, and cost. The last column indicates whether the technology was retained for consideration in the development of the remedial alternatives, which are presented in Section 3.3 of this report. Section 3.2.4 addresses innovative technologies.

3.2.4. Innovative Technologies

Several innovative technologies were evaluated in the screening process. Two of these, cryogenic freezing and silica microsphere injection, are not considered technically feasible for the Pit 7 Complex and were not used in the development of the remedial alternatives. However, several other innovative technologies, such as aerogel/GAC composite, electro-coagulation, and cow bone char apatite for *ex situ* ground water uranium treatment and permeable reactive barriers for *in situ* uranium treatment were retained. The retained innovative technologies were incorporated into one or more remedial alternatives. The final selection of and or decision to utilize these technologies will be based on an evaluation of remedial and cost effectiveness. Furthermore, DOE/LLNL maintain the option of testing, proposing, and/or implementing other innovative technologies for cleanup of the Pit 7 Complex as they are developed. This option is consistent with DOE objectives of conducting environmental remediation projects to allow better, faster, and more cost-effective treatment options to be tested and used in the future. In addition, DOE will continue to review the development of technologies for the treatment of tritium in ground water for which no currently viable treatment technology has been identified.

3.2.5. Summary of Retained Technologies

Through the development and screening of General Response Actions and remedial technologies, numerous actions and technologies have been retained. Table 3-9 summarizes the retained technologies for ground water, vadose zone, surface water, and pit waste contaminants at the Pit 7 Complex. At least one technology from each retained General Response Action or class of response action was incorporated into the alternative remedies assembled in Section 3.3. Retained technologies that were incorporated into the remedial alternatives were chosen based on applicability, implementability, effectiveness, cost, site-specific requirements, and professional experience, and judgment.

3.3. Description of Remedial Alternatives

In this section, remedial alternatives are presented that address COCs in the Pit 7 Complex area. Each of the remedial alternatives was developed from retained technologies and response actions described in Section 3.2.

To develop these remedial alternatives, retained technologies and response actions were combined based on applicability, implementability, effectiveness, cost, site- and area-specific requirements, and best professional judgment.

Some innovative technologies that have been retained for further consideration, i.e., the use of aerogel/GAC for *ex situ* removal of uranium from water, are not included for costing purposes in the remedial alternatives. However, as discussed in Section 3.2, these innovative technologies will continue to be considered for application, after appropriate technical and regulatory reviews, throughout the process of planning and implementing remediation. These technologies may be introduced if technology development and testing indicate a potential for cost-effective and expedited remediation. The final technology or treatment media such as apatite, aerogel/GAC, as well as the rationale for its selection, would be specified in the Remedial Design report for the Pit 7 Complex.

In some cases, it may be appropriate to specify a general remedial strategy for the Pit 7 Complex in this RI/FS but defer selection of specific technologies until the Remedial Design document (EPA, 1996). Some remediation-specific details are presented in this RI/FS for purposes of costing and strategy presentation. The actual site- and technology-specific details will be based on additional data and design criteria presented in the Pit 7 Complex Remedial Design report.

The Pit 7 Complex remedial alternatives consist of a combination of selected technologies and actions, as described above and summarized in Table 3-10, along with their total estimated costs. Detailed cost estimates for alternatives are presented in Appendix G. Consistent with the National Oil and Hazardous Substances Pollution Contingency Plan, DOE/LLNL will reevaluate remediation performance, effectiveness, feasibility, and protectiveness every five years. Based on the outcome of these evaluations, the required level of cleanup, remedial actions, and project life may be redefined.

3.3.1. Remedial Alternatives for the Pit 7 Complex Area

Five remedial alternatives were assembled to meet remedial action objectives and address COCs in subsurface soil/rock and ground water in the Pit 7 Complex area. Tritium and depleted uranium have been identified as COCs in subsurface soil and rock. Tritium, uranium, perchlorate, nitrate, and VOCs have been identified as COCs in ground water. As shown in Table 3-11, the remedial alternatives were formulated to address these contaminants using different combinations of technologies that were retained in the screening process. For example, Alternatives 2, 3a, and 3b all include the same monitoring, exposure control, source control (excavation of pit waste), and tritium plume monitored natural attenuation components, but differ in the technologies used to address uranium, nitrate, and perchlorate contamination in ground water (Alternative 2: natural attenuation, Alternative 3a: phased *ex situ* treatment, Alternative 3b: phased *in situ* treatment). Alternatives 4a and 4b include the same monitoring, exposure control, and tritium and uranium plume components (monitored natural attenuation and monitoring, respectively), but differ in the technologies used to control the contaminant source (Alternative 4a: hydraulic diversion, Alternative 4b: hydraulic barrier). Alternatives 5a and 5b include the same monitoring, exposure control, tritium plume monitored natural attenuation, and source control (hydraulic diversion) components, but differ in the technologies used to address the uranium, nitrate, and perchlorate contamination in ground water (Alternative 5a: phased extraction and *ex situ* treatment, Alternative 5b: phased *in situ* treatment).

In Alternatives 3 and 5, ground water extraction and treatment would be conducted using a phased approach because the design of the systems to treat uranium, nitrate, and perchlorate in ground water cannot be finalized until the effects of pit waste excavation (Alternative 3) or hydraulic diversion (Alternative 5) on local hydrologic conditions have been monitored for a period of time. The locations and depths of the funnel and sump system in Alternatives 3a and 5a, and the details of *in situ* permeable reactive barrier of Alternatives 3b and 5b cannot be properly implemented until a new hydrologic equilibrium is attained. Ground water extraction using existing wells with *ex situ* treatment (Alternatives 3a and 5a) could be implemented simultaneously with pit excavation or hydraulic diversion construction if safety considerations allow.

The cost estimates provided for each alternative are limited to 30 years due to: (1) uncertainty regarding the total time required to achieve at least MCLs, and (2) the difficulty in accurately estimating annual costs in the far future. A 30-year timeframe allows reasonable cost comparisons between remedial alternatives for that time period. An annual cost for activities in Alternatives 2, 3, 4, and 5 that continue for more than 30 years in the future and the duration of those activities are provided in Sections 3.4.2.2.5, 3.4.2.3.5, 3.4.2.4.5, and 3.4.2.5.5, respectively. However, the reliability of these estimates decreases as the duration of the remedy increases.

3.3.1.1. Alternative 1—No Further Action

A no-action alternative is generally required by EPA guidance to provide a baseline for comparison to other remedial alternatives and is the postulated basis of the baseline risk assessment. Under a no-action response, all monitoring and maintenance activities at the Pit 7 Complex would cease. There are no costs associated with the no-action alternative.

3.3.1.2. Alternative 2—Monitoring, Risk and Hazard Management/Exposure Control, Monitored Natural Attenuation of Tritium in Ground Water, and Waste Excavation and Disposal

The primary components of Alternative 2 include:

1. Monitoring ground water for COCs.
2. Risk and hazard management to prevent exposure of humans and ecological receptors to COCs.
3. Monitored natural attenuation of tritium in ground water.
4. Excavation and disposal of waste in Pits 3 and 5.

These components are described in Sections 3.3.1.2.1 through 3.3.1.2.4, below.

The present-worth cost of Alternative 2 for the Pit 7 Complex area is $56,635,000 based on 30 years of monitoring, exposure control, and monitored natural attenuation activities. One-time capital costs for the excavation and disposal of the waste in Pits 3 and 5 are also included. Although Alternative 2 was costed for 30 years, modeling indicates that it could require up to 500 years for uranium to attenuate to the MCL. For Alternative 2, the annual present-worth cost to monitor uranium in ground water is $73,000 in year 31. The annual present-worth monitoring cost for year 31 could be used to estimate longer-term cleanup costs associated with Alternative 2, although the reliability of these estimates decreases as the duration of the remedy increases.

The locations of the components of Alternative 2 are shown on Figure 3-1.

3.3.1.2.1. Monitoring. Sampling and analysis of ground water from monitor wells in the area would continue in order to monitor COCs in the subsurface. Additional monitor wells would be installed, if necessary, to monitor the effectiveness of the remedial action in meeting remedial action objectives and ARARs.

Monitoring would be conducted to:

1. Track changes in concentration and distribution of COCs to ensure there is no impact to downgradient receptors.
2. Evaluate the effectiveness of the overall remedial action.
3. Evaluate the effectiveness of source control measures and the natural attenuation of contaminants in ground water to meet ARARs and cleanup goals.
4. Detect and analyze deviations from expected rates of natural attenuation of contaminants.
5. Verify the attainment of cleanup goals.

Monitoring would focus on COCs in ground water. This monitoring would be conducted to assess potential contaminant migration, changes in ground water concentrations, and assess human or ecological impacts while source control measures prevent further releases. Because active remediation of VOCs, uranium, nitrate, and perchlorate in ground water is not proposed in Alternative 2, monitoring would provide an indication of changes in the nature and extent of these contaminants that could impact human or environmental receptors while source control measures prevent further releases and natural processes reduce COC concentrations in ground water.

Uranium: Uranium has also been detected in ground water in the vicinity of Pits 3 and 5 at a historical maximum of 781 pCi/L in 1998. The maximum total uranium activity detected in ground water in 2003 was 122.9 pCi/L. Uranium activities and isotopic mass ratio data indicate that the extent of depleted uranium in ground water is limited to the area immediately adjacent to the pits as shown in Figure 2-19, and that the extent has not changed appreciably since mass spectrometric analyses began in 1998. Although the uranium activities in ground water exceed the State MCL for total uranium (20 pCi/L), uranium-238 is less toxic than natural uranium**,** which contains a larger fraction of the more radioactive uranium-235 isotope. The dissolution and desorption of natural uranium may have been enhanced by changes in aqueous geochemistry resulting from the landfills. The modeling results discussed in the paragraphs below are based conservatively on the total uranium activities in ground water and thus account for any added natural uranium that arose from landfill influences.

Modeling of uranium fate and transport in ground water in the $Tnbs_0$ HSU estimates that without further releases from the pits, uranium activities in the $Tnbs_0$ HSU will decrease to the 20 pCi/L MCL after 400 to 500 years, with the center of mass 400 ft downgradient from the landfill release sites (Appendix E). Uranium activities in the $Tnbs_0$ HSU would be within background levels when the uranium plume arrives at a hypothetical well at the northeastern Site 300 boundary and also further upgradient at Spring 24. These estimates, and those discussed below, are very conservative in that reduction of uranium activities due to sorption was not considered in the modeling and also because total uranium activities, not the activities arising only from added depleted uranium, were used as input to the models. Modeling of uranium fate and transport in the $Tnbs_0$ HSU is additionally conservative because depleted uranium has not been detected in $Tnbs_0$ ground water. This modeling was performed by using the current distribution of uranium in Qal/WBR HSU ground water as the initial input, as discussed in Appendix E. Results of fate and transport modeling for uranium in ground water from the Pits 3 and 5 area estimate that, without further releases from the pits, uranium activities in the Qal/WBR HSU will decrease to the 20 pCi/L MCL after 400 to 500 years, with the center of mass 1,000 ft from the landfill release sites (Appendix E). Uranium activities in ground water would be at background levels when the uranium plume in the Qal/WBR HSU arrives at a hypothetical well at the eastern Site 300 boundary.

If further releases of uranium are prevented through source control measures, modeling indicates that natural processes would reduce uranium activities in ground water to meet remedial action objectives. Because of the retarded nature of uranium transport relative to tritium, it will take several hundred years for MCLs to be attained everywhere. Modeling also indicates that uranium will never exceed background activities in water that could impact human or ecological receptors. Monitoring data indicate that the distribution of total and depleted uranium in ground water has not increased since detailed monitoring began in 1988. Additionally, there is currently no risk associated with uranium in ground water as there are no existing receptor points.

There are significant geologic and hydrogeologic constraints to the movement of uranium-contaminated ground water in bedrock in the vicinity of and northeast of Pits 3 and 5. A thick low-permeability claystone aquitard ($Tnsc_0$) underlies the $Tnbs_0$ HSU in the vicinity of Pits 3 and 5 and in the northern part of Site 300. As a result, the underlying Cierbo Formation is hydraulically isolated from uranium-contaminated ground water in the overlying $Tnbs_0$ HSU. Ground water in the $Tnbs_0$ sandstone flows to the northeast of the pit area at a low velocity. The $Tnbs_0$ sandstone is unsaturated to the east and northeast of the Site 300 boundary. All Neroly Formation strata, including the $Tnbs_0$ sandstone, and the Cierbo Formation are eroded away in northeastern Site 300 and to the east, and are therefore there is no continuous saturated pathway between the plume and offsite receptors such as the City of Tracy water-supply wells. In addition, significant water level mounding occurs across the Elk Ravine Fault, located east-northeast of the pits. The decreases in water elevation across the fault indicate that the fault significantly retards the flow of ground water in the east-northeast direction. These geologic and hydrogeologic conditions indicate that there is not a complete pathway to existing water-supply wells east or north of Site 300.

Current hydrogeologic studies conducted east of the Pit 7 Complex at the Advanced Testing Accelerator and Pit 1 indicate that northeast of the Elk Ravine Fault, ground water generally flows southeast, parallel to Elk Ravine and towards the southern Site 300 boundary. However, to provide for a most conservative simulation of contaminant fate and transport, uranium migration in bedrock was modeled to hypothetical water-supply wells at the northern boundary of Site 300 despite that fact that this pathway is incomplete. Migration of uranium in alluvium and weathered bedrock was modeled along the more credible southeasterly pathway to hypothetical water-supply wells at the southeastern boundary of Site 300.

Ground water in the alluvium flows to the southeast. Although ground water in the Qal/WBR HSU travels at a higher velocity than in the $Tnbs_0$ bedrock HSU, the flow pathway distance for alluvial ground water to hypothetical receptors at the southeast site boundary is much greater than in bedrock (over 15,000 ft). In addition, despite the higher velocities for ground water flow in the Qal/WBR HSU that were calculated from hydraulic tests, the movement of ground water in this HSU is correlated to rainfall recharge. Therefore, the movement of uranium in the Qal/WBR HSU slows greatly following wet seasons because the HSU becomes desaturated. This is demonstrated by a flattening of the hydraulic gradient during dry months and the relative stability of the extent of the uranium plume. As discussed above, the modeling of uranium in ground water indicates that without further releases from the pit, uranium will reach background activities without impacting ground water offsite.

The Site 300 Contingency Plan would be modified to include actions to be implemented in the event that unanticipated migration of the uranium plume occurs.

VOCs: The maximum TCE concentrations in ground water in the Pit 7 Complex are declining, from an historical maximum of 15 μg/L in 1995 to 2.8 μg/L (below the 5 μg/L MCL) in 2003. VOC concentrations are below MCLs with decreasing concentration trends and no significant concentration increases following the 1998 El Niño. These data indicate that any remaining VOC sources, if present, are very minor. VOCs in ground water would be monitored to ensure that concentrations continue to decrease and remain below MCLs.

Nitrate: The nitrate released from the landfills appears to be restricted to the Qal/WBR HSU with the exception of well K7-01 that is screened across the WBR and $Tnbs_0$ HSUs. The elevated nitrate detected in well K7-01 is likely derived from the WBR ground water. Within the Qal/WBR HSU, concentrations of nitrate in excess of the 45 mg/L MCL may be attributed to a combination of anthropogenic and natural sources. The majority of the nitrate in Qal/WBR ground water is collocated with the extent of depleted uranium. Monitoring would be conducted to ensure that the concentrations or extent of nitrate in ground water do not increase and pose a threat to human health or the environment.

Perchlorate: In 2004, perchlorate was detected in ground water at a maximum concentration of 21 μg/L (above the Public Health Goal of 6 μg/L). The historical maximum perchlorate concentration is 19 μg/L. Additional monitoring would be implemented to continue tracking of perchlorate concentrations and distribution in ground water downgradient of Pits 3 and 5.

Monitoring Plan: The ground water monitoring plan for the Pit 7 Complex will be presented in the semi-annual Site 300 Site-Wide Compliance Monitoring Report that is consistent with the provisions of the Site-Wide Compliance Monitoring Plan (Ferry et al., 2002). Specific monitoring information such as the total number of wells sampled, well names and sampling frequency, specific analytes, and the purpose and location of each well will be added to the semi-annual sampling plans.

The ground water data obtained as part of the Alternative 2 monitoring program would be reviewed regularly. If data indicate that contaminant concentrations, ground water flow direction, and/or velocity have changed, the monitoring program would be reevaluated.

Costs: Monitoring costs include water level measurements, ground water sampling and analysis, well maintenance, QA/QC, database management, and data evaluation. The costs for monitoring under Alternative 2 were estimated assuming that samples will be collected and analyzed for COCs and that ground water elevations will be measured in all monitor wells in the Pit 7 Complex on a quarterly basis for 30 years.

3.3.1.2.2. Risk and Hazard Management/Exposure Control. As part of Alternative 2, institutional and/or administrative controls and a risk and hazard management program will be implemented to:

1. Ensure remedial action objectives are achieved.
2. Manage risk and/or hazard by preventing exposure to contaminated media.

These controls provide a degree of protection to human health by restricting access to or activities in areas of contamination, thereby preventing exposure to contaminants.

In the current baseline risk assessment, an inhalation risk of 4×10^{-6} to adult onsite workers was identified for tritiated water evaporating from subsurface soil to the ambient air in the vicinity of the Pit 3 Landfill. There are currently no active facilities located in the vicinity and the landfill was closed and covered with native soil fill in 1967. Since there are no manned facilities in this area, there are no receptors for tritium volatilizing from subsurface soil into air. In addition, in 1992, a RCRA cap was installed on Pit 7, Pit 4, and approximately 30% of Pit 3. Exposure control measures would be implemented in the area to prevent inhalation risk if land use changes occur in the vicinity of Pit 3 that would result in exposure to onsite workers.

The risk and hazard management program would include: (1) implementing restrictions for construction in the Pit 7 complex area, (2) sampling outdoor air annually (or until two successive years indicate no risk) for tritium at Pit 3, (3) reviewing exposure pathway-related conditions, such as facility and land use, (4) refining risk and hazard models using current data, and (5) reporting the results to the stakeholders.

There is no unacceptable risk of exposure to contaminants in any media in the vicinity of the Pit 7 complex to individual adult or juvenile ground squirrels, deer, or kit fox. While specific exposure control measures for ecological receptors are not needed, the current LLNL program of conducting ecological resource surveys for sensitive species prior to the initiation of any ground-disturbing activities will continue. The need for detailed ecological resource surveys would be evaluated every five years.

The Site 300 Contingency Plan would be modified, as necessary, include actions to be implemented in the event that exposure control measures do not achieve remedial action objectives or comply with ARARs. For example, the Site 300 Contingency Plan would be amended to also address situations where existing access restrictions are removed or relaxed.

3.3.1.2.3. Monitored Natural Attenuation of Tritium in Ground Water. Alternative 2 includes monitored natural attenuation to reduce tritium activities in ground water to meet remedial action objectives and ARARs.

EPA's OSWER Directive 9200.4-17 (1997) states that monitored natural attenuation may be appropriate as a remedial approach where it can be demonstrated to be capable of achieving a site's remedial objectives within a time frame that is reasonable compared to that offered by other methods and given the particular circumstances of the site. According to this directive, the elements that are important to establish a monitored natural attenuation remedy are: (1) the contamination is not currently posing an unacceptable risk, (2) source control measures have been implemented or the data show that the source is no longer releasing contaminants to the environment, and (3) static or reduction in areal extent of plume contours. Natural attenuation may be demonstrated through a variety of lines of evidence, including static or reduced areal extent of plume concentration contours, the presence of contaminant breakdown products, or the formation or depletion of geochemical indicator compounds.

Historical data indicate periodic slug releases of tritium as illustrated by spikes in tritium activities in ground water following periods of elevated rainfall such as during the El Niño in the winter of 1998. During these periods of increased precipitation, water levels rise and inundate the bottom of Pits 3 and 5, releasing tritium to ground water. For example, the maximum historical tritium activities (2,660,000 pCi/L) in ground water near Pits 3 and 5 were detected in

1998 indicating continued releases of tritium from these pits. Although the maximum tritium activity detected in ground water in 2003 has decreased to 469,000 pCi/L, source control measures may be needed to prevent further releases during high rainfall years.

Tritium fate and transport modeling for Pits 3 and 5 (Appendix E) estimates that without further releases from the pits, tritium activities in the $Tnbs_0$ HSU will decrease to the 20,000 pCi/L MCL after 33 years with the center of mass of the plumes 720 ft downgradient from the landfills. Assuming there was a continuous pathway in the $Tnbs_0$ HSU to the northeastern Site 300 boundary (the extent of saturation is limited in that direction), tritium activities in ground water would not exceed background levels at the northeast site boundary. If all of the residual tritium in the landfills and vadose zone were added to the tritium already in ground water, tritium activities in the $Tnbs_0$ HSU would decrease to the MCL after 35 years at a distance of 800 ft from the landfill release sites, and tritium activities would be within the range of background activities at the northeastern Site 300 boundary.

The maximum tritium activity of 2,380 pCi/L was detected in Spring 24 water in 2003 (Appendix E). Modeling, which accounted for both the existing tritium in ground water and additional releases of tritium from landfill and vadose zone sources, estimated that tritium activities in Spring 24 water would never exceed this activity in the future.

Tritium fate and transport modeling results for Pits 3 and 5 estimate that without further releases from the pits, tritium activities in the Qal/WBR HSU will decrease to the MCL after 41 years, with the center of mass 500 ft from the landfill release sites (Appendix E). Ground water tritium activities would be at background activities when the current tritium plumes arrive at a hypothetical well at the southeastern Site 300 boundary, even if additional tritium mass from sources within the pits and vadose zone are added to ground water. If all of the residual tritium in the landfills and vadose zone were added to the tritium already in ground water, tritium activities in Qal/WBR HSU ground water would decrease to the MCL in 45 years, at which time the center of mass of the tritium plumes would be a distance of 550 ft downgradient from the pits.

The modeling results indicate that even if the tritium source was not controlled, monitored natural attenuation would reduce tritium activities in ground water to meet remedial objectives within a reasonable time frame. A monitored natural attenuation remedy for tritium will also avoid risks associated with extracting tritiated ground water and bringing it to the surface for disposal. As discussed in Section 3.2 and Appendix F, there are currently no effective or reasonable technologies available to remediate tritiated ground water.

There are significant geologic and hydrogeologic constraints to the movement of tritium-contaminated ground water in bedrock in the vicinity of and northeast of Pits 3 and 5. A thick low-permeability claystone aquitard ($Tnsc_0$) underlies the $Tnbs_0$ HSU in the vicinity of Pits 3 and 5 and in the northern part of Site 300. As a result, the underlying Cierbo Formation is hydraulically isolated from tritium-contaminated ground water in the overlying $Tnbs_0$ HSU. Ground water in the $Tnbs_0$ sandstone flows to the northeast of the pit area at a low velocity. The $Tnbs_0$ sandstone is unsaturated to the east and northeast of the Site 300 boundary. All Neroly Formation strata, including the $Tnbs_0$ sandstone, and the Cierbo Formation are eroded away in northeastern Site 300 and to the east, and are therefore there is no continuous saturated pathway between the plume and offsite receptors such as the City of Tracy water-supply wells. In addition, significant water level mounding occurs across the Elk Ravine Fault, located east-northeast of the pits. The decreases in water elevation across the fault indicate that the fault significantly retards the flow of ground water in the east-northeast direction. These geologic and hydrogeologic conditions indicate that there is not a complete pathway to existing water-supply wells east or north of Site 300.

Current hydrogeologic studies conducted east of the Pit 7 Complex at the Advanced Testing Accelerator and Pit 1 indicate that northeast of the Elk Ravine Fault, ground water generally flows southeast, parallel to Elk Ravine and towards the southern Site 300 boundary. However, to provide for a most conservative simulation of contaminant fate and transport, tritium migration in bedrock was modeled to hypothetical water-supply wells at the northern boundary of Site 300 despite that fact that this pathway is incomplete. Migration of tritium in alluvium and weathered bedrock was modeled along the more credible southeasterly pathway to hypothetical water-supply wells at the southeastern boundary of Site 300.

Ground water in the alluvium flows to the southeast. Although ground water in the Qal/WBR HSU travels at a higher velocity than in the Tnbs_0 bedrock HSU, the flow pathway distance for alluvial ground water to hypothetical receptors at the southeast site boundary is much greater than in bedrock (over 15,000 ft). In addition, despite the higher velocities for ground water flow in the Qal/WBR HSU that were calculated from hydraulic tests, the movement of ground water in this HSU is very episodic in response to rainfall recharge. Therefore, the movement of the tritium in the Qal/WBR HSU slows greatly following wet seasons because the HSU becomes desaturated. This is demonstrated by a flattening of the hydraulic gradient during dry months and the relative stability of the extent of the tritium plumes. As discussed above, the modeling of tritium in ground water indicates that without further releases from the pit, tritium will decay to background activities without impacting ground water offsite.

The following activities would be conducted to monitor the effectiveness of monitored natural attenuation and detect any changes in activities or plume size that could result in impacts to human or ecological receptors:

- Measure ground water levels.
- Sample and analyze ground water for tritium.
- Manage, analyze, and present data.
- Perform fate and transport modeling to predict the spatial distribution of tritium and uranium over time and to demonstrate the efficacy of monitored natural attenuation in meeting remedial action objectives and ARARs.
- Conduct risk assessments, as necessary, to re-evaluate risk and hazard posed to human and ecological receptors based on newer data and modeling results.
- Install additional monitoring wells, if required.

The Site 300 Contingency Plan would be modified to include actions to be implemented in the event that monitored natural attenuation of tritium in ground water does not achieve remedial action objectives or comply with ARARs. If such a situation arose, the remedy would be changed and documented in the final ROD or a ROD amendment.

3.3.1.2.4. Waste Excavation of Pits 3 and 5 and Disposal. As part of Alternative 2, the waste in the Pits 3 and 5 Landfills would be excavated. These landfills continue to be sources of tritium and depleted uranium to ground water. Although past investigations have not confirmed that VOCs and perchlorate were components of the pit waste, the landfills are the likely sources for these contaminants. Although some nitrate detected in ground water may be attributable to sources in the Pit 7 Complex, data indicate there are also natural sources of nitrate in the bedrock in this area. As discussed in Chapter 2, Section 2.3.2, high activities of both tritium and uranium have been detected in the pit waste and vadose zone rock underlying Pits 3 and 5. A comparison of tritium activities in ground water at Pits 3 and 5 with precipitation and water level data indicates that during years of significant rainfall, such as the winters of 1997–1998 and 1998–1999, the water table rises significantly, inundating the bottom of Pits 3 and 5. Elevated tritium and generally depleted uranium activities in ground water are contemporaneous with these water levels rises, indicating continued releases from these pits as a result of inundation.

The excavation and disposal component of Alternative 2 for the Pit 7 Complex is designed to eliminate the potential for continued releases of contaminants from the pits and entails removing 26,200 yd^3 volume of waste from Pit 3 and 29,000 yd^3 of waste from Pit 5. Some vadose zone material outside the landfills would also be removed. However, material beneath and some material to the sides of the landfills, some with elevated activities of tritium and depleted uranium, would remain as would all of Pits 4 and 7, which are beneath the RCRA cap. As a result, there would be the potential for additional releases of tritium and uranium from deeper bedrock in the vadose zone underlying the Pits 3, 4, 5, and 7, even after excavation of the pit contents and shallow vadose zone.

The Pit 7 RCRA cap covers about 30% of Pit 3. However, this portion of the cap does not include the 2-ft thick impermeable clay layer and thus the excavation of Pit 3 would not breach the clay layer. A berm of fill gravel and soil comprise the portion of the Pit 7 RCRA cap that overlies Pit 3. This berm would be excavated, segregated prior to excavation of Pit 3, and reconstructed after excavating and filling the pit with clean soil.

Material would be excavated by backhoes and front loaders to depths in excess of 20 ft below grade to remove all landfill waste and some adjacent vadose zone soil. Excavated low-level mixed waste would be transported to an offsite permitted facility for treatment, destruction, and/or disposal. The resulting depression created from the removal of the waste would be filled with compacted native soil from the surrounding area. This component includes health and safety plan development, dust control, temporary storage measures, and other actions designed to protect human health and ecological receptors during excavation and disposal.

3.3.1.3. Alternative 3—Monitoring, Risk and Hazard Management/Exposure Prevention, Monitored Natural Attenuation of Tritium in Ground Water, Waste Excavation and Disposal, and Treatment of Uranium, Nitrate, and Perchlorate in Ground Water

Alternative 3 includes the following elements of Alternative 2 as described in Sections 3.3.1.2.1, 3.3.1.2.2, 3.3.1.2.3 (for tritium only), and 3.3.1.2.4:

1. Monitoring of ground water for COCs.
2. Risk and hazard management to prevent exposure of COCs to humans and ecological receptors.
3. Monitored natural attenuation of tritium in ground water.
4. Waste excavation and disposal.

VOC concentrations are below MCLs with decreasing concentration trends and no significant concentration increases following the 1998 El Niño. These data indicate that any remaining VOC sources, if present, are very minor. VOCs in ground water would be monitored to ensure that concentrations continue to decrease and remain below MCLs.

Additionally, Alternative 3 provides for treatment of uranium, nitrate, and perchlorate in Qal/WBR and $Tnbs_0$ ground water through the use of *ex situ* treatment of ground water (Alternative 3a) or *in situ* treatment of Qal/WBR ground water coupled with extraction and *ex situ* treatment of $Tnbs_0$ ground water (Alternative 3b). Because active remediation of uranium, nitrate, and perchlorate in ground water is a component of Alternative 3, monitoring would provide an indication of changes in the nature and extent of these contaminants that could impact human or environmental receptors while source control measures and active remediation reduce COC concentrations in ground water.

The present-worth cost of Alternative 3a for the Pit 7 Complex area ranges from $63,741,000 to $68,326,000 for 30 years of monitoring, exposure control, monitored natural attenuation, *ex situ* ground water treatment activities, and one-time costs for waste excavation and disposal. The lower end of the cost range includes ground water extraction from Qal/WBR and $Tnbs_0$ wells and *ex situ* treatment and the higher end cost includes Qal/WBR ground water extraction using a funnel and sump combined with $Tnbs_0$ ground water extraction using wells with *ex situ* treatment. The present-worth cost of Alternative 3b for the Pit 7 Complex area is $73,979,000 for 30 years of monitoring, exposure control, monitored natural attenuation, *in situ* treatment of Qal/WBR ground water combined with extraction and *ex situ* treatment of $Tnbs_0$ ground water, and one-time capital costs for waste excavation and disposal. Although Alternative 3a and 3b were both costed for 30 years, modeling indicates that it could require up to 150 years for uranium activities to be reduced below the MCL under Alternative 3a and up to 500 years for Alternative 3b. The present-worth costs for Alternative 3a in year 31 range from $137,000 (extraction wells) to $301,000 (funnel and sump with $Tnbs_0$ extraction wells) and are $454,000 for Alternative 3b in year 31. The annual present-worth costs for year 31 could be used to estimate longer-term cleanup costs associated with Alternative 3a and b, although the reliability of these estimates decreases as the duration of the remedy increases.

The locations of the components of Alternatives 3a and 3b are shown on Figure 3-2.

3.3.1.3.1. Treatment of Uranium, Nitrate, and Perchlorate in Ground Water. As stated previously, uranium, nitrate, and perchlorate have been identified in ground water downgradient of Pits 3, 5, and 7. The extent of uranium in ground water in the Pit 7 Complex area is shown in Figure 2-19. There are two areas of high uranium activities, one located adjacent to and downgradient from Pit 3, and a second area located adjacent to and downgradient from Pit 5. Depleted uranium is present only in ground water in the Qal/WBR HSU and has not been detected in the $Tnbs_0$ HSU. Natural uranium has been detected in ground water samples from Qal/WBR well NC7-21 and $Tnbs_0$ wells K7-01 and NC7-25 at activities that exceed the 20 pCi/L MCL. The ground water extraction system will be designed to remove depleted uranium from the Qal/WBR HSU and natural uranium at activities that exceed the MCLs from both the Qal/WBR and $Tnbs_0$ HSUs.

Nitrate and perchlorate concentrations in ground water in the Pit 7 Complex area are shown in Figure 2-20. The highest concentrations of nitrate and perchlorate in ground water are generally located in the same areas as the highest uranium activities. Nitrate and perchlorate have been detected in ground water in both the Qal/WBR and $Tnbs_0$ HSUs. Alternative 3 will address nitrate and perchlorate contamination in ground water in both the Qal/WBR and $Tnbs_0$ HSUs. In Alternative 3a, the ground water extraction system using wells would be designed to include extraction of perchlorate and nitrate from wells completed in the Qal/WBR and $Tnbs_0$ HSUs. The funnel and sump system in Alternative 3a and permeable reactive barrier in Alternative 3b would be located downgradient of the pits to capture Qal/WBR ground water containing uranium, nitrate, and perchlorate in excess of MCLs or the Public Health Goal. Both the funnel and sump system and the permeable reactive barrier would be supplemented with extraction from wells K7-01 and NC7-25 to remove natural uranium, perchlorate, and nitrate-contaminated ground water from the $Tnbs_0$ HSU.

Sections 3.3.1.3.1.1 and 3.3.1.3.1.2 below describe how *ex situ* and *in situ* removal of uranium, nitrate, and perchlorate would be conducted as a component of Alternatives 3a and 3b, respectively. Alternative 3a includes two methods for extracting ground water and returning treated water to the subsurface: (1) a funnel and sump system to remove ground water with an infiltration trench, and (2) extraction and reinjection wells. The *in situ* treatment of contaminants of concern in ground water in Alternative 3b would be accomplished using a permeable reactive barrier.

The goal of both the extraction and *ex situ* treatment component of Alternative 3a and *in situ* treatment component of Alternative 3b is to reduce uranium activities, and concentrations of anthropogenic nitrate and perchlorate in ground water to meet RAOs. The performance of both *ex situ* and *in situ* treatment toward meeting this goal could be measured by: (1) the percentage of total uranium activities attributable to depleted uranium as determined by the mass ratio, (2) total uranium activities in ground water, and (3) nitrate and perchlorate concentrations in ground water.

In Alternatives 3a and 3b, ground water treatment would be conducted using a phased approach because design of the systems to treat uranium, nitrate, and perchlorate in ground water cannot be finalized until the effects of pit waste excavation on local hydrologic conditions have stabilized. The excavation of the pit waste and subsequent backfilling may alter recharge patterns in the Pit 7 Complex area, causing changes to the hydrologic conditions adjacent to and downgradient of the landfills. These changes in hydrologic conditions will have the greatest impact on the design and placement of the *in situ* treatment system (permeable reactive barrier), less on the funnel and sump with an *ex situ* treatment system, and least on the extraction well, *ex situ* treatment, and reinjection system. For example, monitoring the effects of pit excavation and backfilling on hydrologic conditions may be necessary to ensure that an *in situ* permeable reactive barrier was designed and strategically located for maximum effectiveness in contaminant removal. The funnel and sump system may also require some time to determine the proper depth and width of funnel and sump to address the range of cross-sectional areas and discharge volumes of ground water within the Qal/WBR HSU. Ground water extraction using existing wells with *ex situ* treatment could be implemented simultaneously with pit excavation if safety considerations allow. The initial design of this extraction and *ex situ* treatment system would be based on historic ground water elevations in the Qal/WBR HSU. Modifications to the extraction wellfield could be implemented as needed, based on changes to local ground water conditions in response to the pit excavation and backfilling.

3.3.1.3.1.1. (Alternative 3a) *Ex situ* Treatment of Uranium, Nitrate, and Perchlorate in Ground Water. In Remedial Alternative 3a, uranium-, nitrate-, and perchlorate-contaminated ground water would be extracted from either a funnel and sump system or extraction wells immediately downgradient of Pits 3 and 5. The same type of treatment system would be used under either extraction scenario.

Ground water extraction using a funnel and sump system: If a funnel and sump system were used to extract ground water, it would be keyed into the coherent bedrock and designed to completely capture the full width of ground water in the alluvial channel as it flows southeast along the valley axis. The uranium plume within the Qal/WBR HSU is as much as 250 ft wide. A 600-ft long and 3- to 5-ft thick V-shaped (in plan-view) trench would be constructed and filled with gravel (Figure 3-2). The trench would be excavated to a depth of about 40 ft to completely penetrate the Qal/WBR HSU. Ground water would be pumped from a 4-ft diameter casing within the sump and into an *ex situ* treatment system.

As contaminant sources would largely be eliminated by the excavation and removal of landfill wastes, extraction of ground water from the funnel and sump system would continue until ground water containing uranium, nitrate and perchlorate had traversed the Qal/WBR channel cross-section captured by the funnel and sump system. Because the migration of uranium is retarded relative to nitrate and perchlorate, these latter two contaminants would be treated before the trailing edge of the depleted uranium plume reached the funnel and sump. It is anticipated that the funnel and sump system would be located southeast of well NC7-21, immediately downgradient of the portion of the Qal/WBR HSU that contains total uranium activities, and nitrate, and perchlorate at concentrations that exceed the MCL or Public Health Goal (Figure 3-2). In 2003, ground water samples collected from well NC7-21 contained total uranium, nitrate, and perchlorate at concentrations of 49.2 pCi/L, 73 mg/L, and 9.6 µg/L, respectively. Ground water samples collected from downgradient well K7-07 in 2003 contained depleted uranium. However, the maximum total uranium activity (8.63 pCi/L) and nitrate concentration (28 mg/L) in ground water samples collected from this well in 2003 were well below the MCL. For this reason, the funnel and sump system was located upgradient of well K7-07 in the FS preliminary design. The preliminary design of the funnel and sump presented in this RI/FS was prepared for costing purposes. Because details of depth, width, and thickness require knowledge of changes in saturated thickness and other hydrologic conditions that may change after landfill excavation, the final design of the funnel and sump system would be determined following several years of monitoring of the effects of pit excavation on local hydraulic conditions to optimize contaminant removal efficiency. The final remedial design would be presented in the Remedial Design report for the Pit 7 Complex.

In addition to the funnel and sump system, ground water would be extracted from two Tnbs_0 wells (K7-01 and NC7-25) that contain perchlorate at concentrations above the Public Health Goal, and/or nitrate above the MCL. The locations of these extraction wells are shown on Figure 3-2. Ground water from the Tnbs_0 extraction wells would likely be processed in a separate treatment unit and returned to the Tnbs_0 HSU via reinjection wells to prevent the introduction of water with high tritium activities in downgradient areas of lower tritium activities in ground water. Ground water from Tnbs_0 wells NC7-47, W-865-03, W-865-1804, and W-865-07 located far downgradient that contain nitrate in excess of the MCL would not be extracted and treated. As discussed in Section 2.3.3.6, this nitrate appears to be natural in origin. Ground water from well K7-03, screened in the WBR and Tnbs_0 units, contains perchlorate at concentrations above the Public Health Goal but will not be extracted and treated. Ground water samples from K7-03 do not contain uranium or nitrate above the MCL. It is anticipated that once the source control measures are implemented and pumping of nearby Qal/WBR and $Tnbs_0$ wells is initiated, that perchlorate concentrations in ground water in K7-03 will decrease. DOE/LLNL will continue monitoring of this well for perchlorate to determine if these remedial actions are effective in achieving water quality goals in this well. Pumping of well K7-03 will be considered in the future if perchlorate concentrations do not decrease as anticipated.

If a funnel and sump system was installed, an infiltration gallery would be used to return the treated water to the subsurface. The specific location of the infiltration gallery would be selected and discussed with the regulatory agencies as part of the remedial design. The efficacy of this remedial strategy would depend on the volume of water and tritium activities to be reinjected, as well as the location of the infiltration gallery. Modeling was conducted for the preliminary design to ensure that a steady-state water balance is maintained during extraction and reinjection so that further mobilization of tritium is avoided.

Modeling was conducted to estimate the period of time necessary for the funnel and sump with *ex situ* treatment to reduce uranium activities in ground water to below the MCL. The modeling results indicate that once the source of uranium is isolated, it may take up to 500 years for the uranium plume to reach a single downgradient funnel and sump system (Figure 3-2). However, installing multiple funnel and sump systems strategically located near the areas of highest uranium activities can reduce the time to cleanup (Figure 3-2). The detailed design for the uranium remediation system would be prepared once the effect of pit waste excavation on local hydraulic conditions is determined.

Ground water extraction using wells: If extraction wells were used to remove ground water from the subsurface, the wells would be placed within the areas of high depleted uranium activities in Qal/WBR ground water adjacent to and downgradient of Pits 3 and 5. Wells NC7-21, -40, -51, -64, and W-Pit7-03 are likely Qal/WBR extraction well candidates due to relatively high concentrations of depleted uranium, nitrate, and perchlorate. In addition, natural uranium would be extracted and treated from the three wells from which recent samples contained natural uranium activities in excess of the 20 pCi/L MCL for total uranium. Ground water samples from these wells include NC7-21 screened in the Qal/WBR HSU, K7-01 screened across the WBR and $Tnbs_0$ bedrock, and the $Tnbs_0$ bedrock well NC7-25. These wells also contain elevated concentrations of perchlorate and nitrate. Wells K7-01 and NC7-25 would only be pumped when ground water elevations in overlying Qal/WBR HSU are sufficiently low to avoid pulling depleted uranium and other contaminants from the Qal/WBR HSU into the $Tnbs_0$ HSU during extraction of ground water from the $Tnbs_0$ HSU. As discussed in the funnel and sump section, ground water from $Tnbs_0$ wells NC7-47, W-865-03, W-865-1804, and W-865-07, located far downgradient of the Pit 7 Complex, that contain nitrate in excess of the MCL would not be extracted and treated because the nitrate detected in these wells is believed to be of natural origin. In addition, ground water from well K7-03, screened in the WBR and $Tnbs_0$ units, contains perchlorate at concentrations above the Public Health Goal but will not be extracted and treated. Ground water samples from K7-03 do not contain uranium or nitrate above the MCL. It is anticipated that once the source control measures are implemented and pumping of nearby Qal/WBR and $Tnbs_0$ wells is initiated, that perchlorate concentrations in ground water in K7-03 will decrease. DOE/LLNL will continue monitoring of this well for perchlorate to determine if these remedial actions are effective in achieving water quality goals in this well. Pumping of well K7-03 will be considered in the future if perchlorate concentrations do not decrease as anticipated.

The final extraction well configuration would be determined during the Remedial Design process based on contaminant concentrations and well yield. If in the future, natural uranium is detected in ground water samples from other wells at activities in excess of the 20 pCi/L MCL for total uranium, DOE/LLNL and the regulatory agencies will determine the need from ground water extraction on a well-by-well basis. Ground water would be also extracted from wells completed in the Qal/WBR and $Tnbs_0$ HSUs that contain nitrate and perchlorate at concentrations above the MCL or Public Health Goal.

Ground water extracted from the wells would be treated in an *ex situ* treatment system and the treated water would then be reinjected into wells located downgradient of the extraction wells. A conceptual design for the extraction and reinjection wellfield is shown in Figure 3-2. The effects of extraction and *ex situ* treatment would be evaluated. Pumping could be adjusted spatially and temporally to enhance treatment as necessary. The use of an extraction wellfield may require a shorter timeframe for implementation than a funnel and sump system. Pre-existing monitor wells and historic water elevation data could be used for implementation and design, respectively, of a wellfield for extraction of contaminated ground water. The specific location of the injection wells would be selected and discussed with the regulatory agencies as part of the remedial design. The efficacy of this remedial strategy would depend on the volume of water and tritium activities to be reinjected, as well as the location of the injection wells. Modeling was conducted for the preliminary design to ensure that a steady-state water balance is maintained during extraction and reinjection so that further mobilization of tritium is avoided.

Modeling was conducted to estimate the period of time necessary for the extraction wellfield with *ex situ* treatment to reduce uranium activities in ground water to below the MCL. The modeling results indicate that once the source of uranium is isolated, it may take up to 150 years to reduce total uranium activities to below MCLs using extraction wells. The detailed design for the uranium remediation system would be prepared once the effect of pit waste excavation on local hydraulic conditions is determined.

Ground water treatment: Because the contaminants to be treated are the same under both the funnel and sump and extraction well scenarios, the same type of treatment system would be used. The *ex situ* treatment unit would use ion exchange resins to remove uranium. Because uranium in local ground water occurs as anionic complexes $[(UO_2)\ (CO_3)_2^{-2}]$ and $[(UO_2)\ (CO_3)_3^{-4}]$, the same ion exchange resin may also be effective in removing nitrate, perchlorate, and uranium from extracted ground water. If the same ion exchange resin is not capable of removing nitrate, perchlorate, and uranium from ground water, several ion exchange resins would be employed in series.

In the cost estimates presented in Sections 3.3.1.3.1 and 3.4, and in Appendix G, ion exchange resins were specified as the removal medium for uranium, nitrate, and perchlorate in ground water. However, other innovative technologies have been retained for further consideration for the treatment of uranium-contaminated ground water including aerogel/GAC, cow bone char (hydroxyapatite), or electro-coagulation. The final treatment media, as well as the rationale for its selection, would be specified in the Remedial Design report for the Pit 7 Complex. Depending on the treatment media selected, regeneration and/or disposal of spent treatment media and/or rinseate as radioactive or mixed waste may be required.

Because there is currently no viable technology available for the treatment of tritiated ground water, the treated water containing only tritium would be reintroduced to the subsurface through infiltration trenches or reinjection wells. Safety precautions would be implemented to prevent exposure to tritium during the extraction and infiltration/reinjection process. If VOCs are detected above MCLs in extracted ground water, additional treatment may be necessary prior to reinfiltration or reinjection.

3.3.1.3.1.2. (Alternative 3b) *In Situ* Treatment of Uranium, Nitrate, and Perchlorate in Ground Water. In Remedial Alternative 3b, plume migration control for uranium, nitrate, and perchlorate in ground water would be provided by installing an *in situ* permeable reactive barrier downgradient of the Pit 5 Landfill within the Qal/WBR HSU coupled with extraction of ground water from two wells screened in the $Tnbs_0$ HSU. To completely capture uranium, nitrate, and perchlorate in the Qal/WBR HSU ground water, the permeable reactive barrier would consist of sixty-three 36-in. diameter boreholes filled with a treatment medium and inert sand from 10 to 40 ft below grade. These boreholes would be installed immediately south of the area where 11 cow bone char-filled treatment boreholes were installed in 2003 as an *in situ* treatability test. Cow bone char (hydroxyapatite) is currently the proposed medium for emplacement within the permeable reactive barrier and was used as the treatment media for costing calculations presented in Sections 3.3.1.3.1 and 3.4, and Appendix H. Other potential candidate media include zero-valent iron filings, other forms of hydroxyapatite (fish bone), zeolites, aerogel/GAC, and sol gel resin beads. The final treatment media, as well as the rationale for its selection, would be specified in the Remedial Design report for the Pit 7 Complex.

Finite element flow modeling and laboratory and field treatability test results were used to determine that 63 cow bone char-filled boreholes of 36-in. diameter would be sufficient to achieve ground water capture and residence time within the treatment media to reduce uranium to low parts per billion activities. More specific finite element modeling would be conducted as part of the remedial design to determine the distribution and geometry of the treatment boreholes. Optimum ground water uranium removal requires at least one to two days of ground water residence time within the barrier. This requirement can be met at even the highest estimated flow velocities. Additional wells would be installed up- and downgradient of the reactive barrier to monitor uranium activities, water elevations, and other indicator parameters.

Based on treatability studies conducted at LLNL, it is anticipated that the cow bone char would effectively sorb uranium and remain permeable for at least 10 years. Approximately every ten years, the apatite-bearing boreholes would be drilled out and the spent reactive material, likely a low-level mixed waste, would be excavated, transported, and disposed at an offsite disposal facility permitted to accept it. Fresh treatment material would be emplaced in the same configuration, unless monitoring and additional modeling results dictated a change in emplacement geometry. Alternatively, LLNL is evaluating a potential *in situ* regeneration technique whereby alkaline and phosphatic fluids would be flushed into an injection well at one end of the permeable reactive barrier and removed via an extraction well to remove and concentrate the uranium. The resulting concentrate would be disposed of offsite as low level waste. This technology could substantially reduce the costs of the permeable reactive barrier by regenerating the reactive media *in situ* and avoiding disposing large volumes of uranium-saturated cow bone char.

The permeable reactive barrier would be designed to retard the migration of uranium downgradient of its source in Pit 3 and 5 and remove uranium from Qal/WBR ground water. Nitrate and perchlorate that exist as co-contaminants within the Qal/WBR HSU could also be treated by adding resins capable of sorbing these constituents to the cow bone char. Tritium would be unaffected by the barrier. VOCs would be unaffected by the barrier unless an agent that sorbs or degrades these chemicals were mixed with the cow bone char.

In situ treatment would target areas where total uranium activities, and nitrate and perchlorate concentrations in Qal/WBR ground water exceed the MCL. To promote the objective of this component, it is anticipated that the permeable reactive barrier would be located southeast of well NC7-21, immediately downgradient of the portion of the Qal/WBR HSU that contains total uranium activities, and nitrate, and perchlorate at concentrations that exceed the MCL or Public Health Goal (Figure 3-2). Ground water samples from well NC7-21 contained uranium at an activity of 49.2 pCi/L in 2003. Ground water samples collected from downgradient well K7-07 in 2003 contained depleted uranium and nitrate. However, the total uranium activity (8.63 pCi/L) and nitrate concentration (28 mg/L) in ground water samples collected from this well in 2003 were below the MCL. For this reason, the permeable reactive barrier was located upgradient of well K7-07 in the FS preliminary design. The preliminary design of the permeable reactive barrier presented in this RI/FS was prepared for costing purposes. However, the final design of the *in situ* treatment system would be determined following several years of monitoring of the effects of pit excavation on local hydraulic conditions to optimize contaminant removal efficiency. The final remedial design would be presented in the Remedial Design report for the Pit 7 Complex.

In addition to the permeable reactive barrier, ground water would be extracted from two $Tnbs_0$ wells (K7-01 and NC7-25) that contain perchlorate at concentrations above the Public Health Goal, and/or uranium and nitrate above the MCL. The locations of extraction and injection wells are shown schematically on Figure 3-2. An *ex situ* treatment unit would use ion exchange resins to remove uranium. Because uranium in local ground water occurs as anionic complexes $[(UO_2)\ (CO_3)_2^{-2}]$ and $[(UO_2)\ (CO_3)_3^{-4}]$, the same ion exchange resin may also be effective in removing nitrate, perchlorate, and uranium from extracted ground water. If the same ion exchange resin is not capable of removing nitrate, perchlorate, and uranium from ground water, several ion exchange resins would be employed in series. The use of other innovative technologies have been retained for further consideration for the treatment of uranium-contaminated ground water including aerogel/GAC, cow bone char (hydroxyapatite), or electro-coagulation. The final treatment media, as well as the rationale for its selection, would be specified in the Remedial Design report for the Pit 7 Complex. Depending on the treatment media selected, regeneration and/or disposal of spent treatment media and/or rinseate as radioactive or mixed waste may be required.

Because there is currently no viable technology available for the treatment of tritiated ground water, the treated water containing only tritium would be reintroduced to the subsurface through reinjection wells. Safety precautions would be implemented to prevent exposure to tritium during the extraction and infiltration/reinjection process.

Ground water would not be extracted from $Tnbs_0$ wells NC7-47, W-865-03, W-865-1804, and W-865-07, located far downgradient from the Pit 7 Complex, that contain nitrate in excess of the MCL. As discussed in Section 2.3.3.6, this nitrate appears to be natural in origin. Ground water from well K7-03, that is screened in the WBR and $Tnbs_0$ units, contains perchlorate at concentrations above the Public Health Goal but will not be extracted and treated. Ground water samples from K7-03 do not contain uranium or nitrate above the MCL. It is anticipated that once the source control measures are implemented and pumping of nearby Qal/WBR and $Tnbs_0$ wells is initiated, that perchlorate concentrations in ground water in K7-03 will decrease. DOE/LLNL will continue monitoring of this well for perchlorate to determine if these remedial actions are effective in achieving water quality goals in this well. Pumping of well K7-03 will be considered in the future if perchlorate concentrations do not decrease as anticipated.

Ground water fate and transport modeling indicates that once the source of depleted uranium and any landfill contents that enhance natural uranium mobility are isolated, it may take up to 500 years for all the elevated uranium in Qal/WBR ground water to pass through the *in situ* treatment zone or for total uranium levels to be reduced below MCLs. Because the migration of uranium is retarded relative to nitrate and perchlorate, these latter two contaminants would be treated before the trailing edge of the depleted uranium plume reached the permeable reactive barrier. However, the time to cleanup could be reduced by installing multiple permeable reactive barriers strategically located near the areas of highest depleted uranium activities in ground water.

3.3.1.4. Alternative 4—Monitoring, Risk and Hazard Management/Exposure Prevention, Monitored Natural Attenuation of Tritium in Ground Water, and Source Control/Isolation

Alternative 4 includes the following elements of Alternative 2 as described in Sections 3.3.1.2.1, 3.3.1.2.2, and 3.3.1.2.3:

1. Monitoring ground water for COCs. The contingency plan would contain measures to be implemented if the remedy does not proceed as anticipated.
2. Risk and hazard management to prevent exposure of humans and ecological receptors to COCs.
3. Monitored natural attenuation of tritium in ground water.

Because active remediation of VOCs, uranium, nitrate, and perchlorate in ground water is not proposed in Alternative 4, monitoring would provide an indication of changes in the nature and extent of these contaminants that could impact human or environmental receptors while source control measures prevent further releases and natural processes reduce COC concentrations in ground water. For example, VOC concentrations are below MCLs with decreasing concentration trends and no significant concentration increases following the 1998 El Niño. These data indicate that any remaining VOC sources, if present, are very minor. VOCs in ground water would be monitored to ensure that concentrations continue to decrease and remain below MCLs.

To prevent future releases of COCs from the landfills, Alternative 4 includes two sub-alternatives that each can isolate the landfills from ground water to prevent future release of contaminants from the pits. Alternative 4a includes source control in the form of hydraulic diversion to prevent lateral and upward flow of ground water into the pits. Alternative 4b includes source isolation by installing a hydraulic barrier designed to isolate the pits from ground water contact.

The present-worth cost of Alternative 4a for 30 years of monitoring, exposure control, monitored natural attenuation, and hydraulic diversion at the Pit 7 Complex is $3,738,000. The present-worth cost of Alternative 4b for 30 years of monitoring, exposure control, monitored natural attenuation, and hydraulic barrier containment at the Pit 7 Complex is $4,344,000. Although Alternative 4a and 4b were both costed for 30 years, modeling indicates that it could require up to 500 years for uranium to attenuate to the MCL. For Alternative 4a and b, the annual present-worth cost to monitor depleted uranium in ground water range from $78,000

(Alternative 4a) to $79,000 (Alternative 4b) in year 31. The annual present-worth monitoring cost for year 31 could be used to estimate longer-term cleanup costs associated with Alternatives 4a and b, although the reliability of these estimates decreases as the duration of the remedy increases.

The locations of the components of Alternative 4a and 4b are shown on Figure 3-3.

3.3.1.4.1. (Alternative 4a) Source Control: Hydraulic Diversion. To prevent water from entering the landfills during and after high rainfall periods that could cause lateral flows or upwelling of ground water, Alternative 4a incorporates a series of engineered water diversion structures to prevent or reduce infiltration of recharge and subsequent inundation of Pits 3, 4, 5, and 7 by ground water. This approach isolates the contaminant source zones from subsurface water, effectively preventing further releases from the pits and vadose zone. The water balance discussed in Section 2.2.3.3 indicated that 10% of average rainfall infiltrates in the Pit 7 Complex Area. Under these average annual recharge conditions, the sources are isolated from shallow ground water and potential releases are not likely. When the recharge rate increases to 25% of rainfall during El Niño years, the pits are inundated and residual contamination comes into contact with shallow subsurface water. The hydraulic diversion structures will target the excess water during these heavy rainfall events and will be engineered to a capacity to handle the excess water.

LLNL has installed a series of nested hill-slope wells on the west side of the valley. Ground water elevations have been monitored in these wells since 2001. This data was used to identify subsurface horizons that play a significant role in ground water recharge on this slope. In addition, there are already existing drainage ditches constructed during the capping of Pit 7 that will also be incorporated into the diversion system. Two interceptor trenches with sub-components comprised of french drains, horizontal wells, shallow terrace drains would be constructed on the western slope of the valley where most of the infiltration is expected to occur due to the presence of thick colluvium and weathered bedrock. The northern trench will slope to the north and will be connected to the existing lined drainage ditches to divert water north of the Pit 7 Complex watershed. The second trench will convey the intercepted water to the existing lined drainage ditches that discharge downgradient and south of the landfills. The eastern slope of the valley mainly consists of unweathered bedrock with minimal infiltration capacity. Therefore, an interceptor trench sloping to the south will be constructed to divert potential recharge away from this area.

Hydraulic diversion systems are commonly used by the California Department of Transportation and in many construction sites throughout the state. There are well-established guidance and best management practices for dealing with storm water and non-storm water diversion projects. Many of these projects are operational and have proven effective for long-term applications with minimal maintenance. LLNL will follow existing guidance and best management practices for the design and implementation of the hydraulic diversion system at the Pit 7 Complex.

The hydraulic diversion system proposed in Alternative 4a, would be designed to divert surface runoff and shallow ground water from the hill slopes west and east of the pits in order to minimize rapid water table rises and pit inundation. To be effective, the proposed system would need to divert a significant amount of water, about 20 to 30 acre-feet, during intense, El Niño-type rainfall events to prevent pit inundation. The amount of water that would be diverted and discharged to the watershed north of the Pit 7 watershed by the proposed alternative would likely be about 5 to 10 acre-ft. Because this water would be diverted prior to entering the pits, it would be devoid of contaminants and therefore would not adversely impact the water quality for downstream users, springs, or wetlands. The diversion system would be designed to minimize the creation of wetlands and would not significantly alter the regional recharge conditions in the Pit 7 Complex or the overall ground water basin. As discussed in Sections 2.2.3.2 and 2.2.3.3, releases from the pits are directly related with the rainfall intensity and the following ground water elevation response. The hydraulic diversion system will be designed to alter this relation, divert the excess storm water, and prevent ground water rises into source areas.

The specific design details of hydraulic diversion structure would be presented in the Remedial Design report for the Pit 7 Complex. The system will be comprised of several components that can be expanded or modified as the system's performance is monitored. The hydraulic diversion system is not intended for capturing 100% of the rainfall. Rather, it will be designed to ensure that the residual contamination in the source areas will not come in contact with shallow ground water. This will effectively control the sources allowing tritium and uranium to decay in place, while preventing the migration of uranium, nitrate, and perchlorate.

3.3.1.4.2. (Alternative 4b) Source Isolation: Barrier. Alternative 4b includes a hydraulic barrier system to prevent water from entering the pits from the sides or below. Under this alternative, a continuous slurry wall would be installed around landfill Pits 3, 4, 5, and 7 by drilling or trenching and high-pressure pumping of a slurry to create a continuous layer of low permeability material that would enclose the landfills. The bottom of the slurry wall would key into bedrock to prevent water from building up pressure and upwelling beneath the barrier. The wall would be approximately 2,500 ft in perimeter length, 2 ft wide, and 30 ft deep. The 30-foot depth is the approximate transition from decomposed to coherent bedrock. Special engineering measures might be required to install trenches to the depths necessary to ensure that the slurry wall extends beneath the saturated zone to prevent ground water mounding under pressure that could compromise its integrity. A series of finite element model simulations also would be conducted to help ensure that the slurry wall would effectively prevent water from flowing beneath it and upwelling into the landfills during 100-year storm events. Although this alternative includes the cost for a slurry wall emplacement, a similar technology could be employed if one is found that is more cost-effective.

In summary, Alternatives 4a and 4b provide for source control or isolation of the landfills by hydraulic diversion or barriers to prevent lateral and upward flow of ground water into the pits and contaminant releases to ground water. With the landfill sources isolated, this alternative uses monitored natural attenuation and monitoring, respectively, to reduce tritium and uranium activities in ground water to meet remedial action objectives through radioactive decay of tritium and sorption of uranium. Tritium and uranium would continue to be restricted to onsite ground water that is not used for domestic or industrial supply. The ground water monitoring component will ensure and verify that COCs in ground water do not threaten human or ecological receptors and that the remedial measures reduce contaminant concentrations to meet cleanup standards. Risk and hazard management would assure that human and ecological receptors are not exposed to harmful levels of COCs.

3.3.1.5. Alternative 5—Monitoring, Risk and Hazard Management/Exposure Prevention, Monitored Natural Attenuation of Tritium in Ground Water, Source Control, and Treatment of Uranium, Nitrate, and Perchlorate in Ground Water

Alternative 5 includes the following elements of Alternative 4 as described in Sections 3.3.1.2.1, 3.3.1.2.2, 3.3.1.2.3, (for tritium only) of Alternative 2, and 3.3.1.3.1 of Alternative 3:

1. Monitoring ground water for COCs.
2. Risk and hazard management to prevent exposure of humans and ecological receptors to COCs.
3. Monitored natural attenuation of tritium in ground water.
4. Source control through hydraulic diversion.
5. Phased *ex situ* or *in situ* treatment of uranium, nitrate, and perchlorate in ground water.

The ground water monitoring component of Alternative 5 will ensure and verify that other COCs in ground water do not threaten human or ecological receptors and that the remedial measures reduce contaminant concentrations to meet cleanup standards. VOC concentrations are below MCLs with decreasing concentration trends and no significant concentration increases following the 1998 El Niño. These data indicate that any remaining VOC sources, if present, are very minor. VOCs in ground water would be monitored to ensure that concentrations continue to decrease and remain below MCLs. Because active remediation of uranium, nitrate, and perchlorate in ground water is a component of Alternative 5, monitoring would provide an indication of changes in the nature and extent of these contaminants that could impact human or environmental receptors while source control measures and active remediation reduce COC concentrations in ground water. Risk and hazard management would assure that human and ecological receptors are not exposed to harmful levels of COCs.

Alternative 5 provides for source control of the landfills by hydraulic diversion to prevent shallow ground water from contacting residual contamination that could result in releases to ground water. In addition to source control, the hydraulic diversion component of this alternative plays a secondary role that is important for designing *ex situ* or *in situ* treatment alternatives for depleted uranium, nitrate, and perchlorate contamination in ground water. The hydraulic diversion system will reduce recharge to the shallow ground water in the Pit 7 Complex area, effectively reducing the hydraulic gradient and total amount of subsurface flow in the area. This allows for favorable design parameters for the *ex situ* or *in situ* treatment systems by reducing the necessary design capacity and residence time requirements. It also reduces the total recharge into the $Tnbs_0$ bedrock HSU slowing the migration of the tritium plume and allowing for natural attenuation (decay) in place.

With the landfill sources controlled, the alternative uses monitored natural attenuation to reduce tritium activities in ground water to meet remedial action objectives through radioactive decay of tritium. Tritium would continue to be restricted to onsite ground water that is not used for domestic or industrial supply.

Alternative 5 provides for treatment of uranium, nitrate, and perchlorate in ground water by one of two potential approaches, as discussed for Alternative 3. Alternative 5a includes *ex situ* treatment of uranium, nitrate, and perchlorate in the Qal/WBR and $Tnbs_0$ ground water.

Alternative 5b includes *in situ* treatment of uranium, nitrate, and perchlorate in Qal/WBR ground water coupled with extraction and *ex situ* treatment of contaminants in $Tnbs_0$ ground water. The detailed discussion of *ex situ* and *in situ* contaminant treatment discussed for Alternatives 3a and 3b in Sections 3.3.1.3.1.1, and 3.3.1.3.1.2, respectively would be the same under Alternatives 5a and b. Locations of the *in situ* and *ex situ* treatment components of Alternatives 5a and 5b are shown on Figure 3-4. Either of these techniques for the treatment of uranium, nitrate, and perchlorate could be implemented in a phased approach.

Ground water treatment would be conducted using a phased approach because design of the systems to treat uranium, nitrate, and perchlorate in ground water cannot be finalized until the effects of the hydraulic diversion system on local hydrologic conditions have stabilized. The drainage diversion system used for source control will alter recharge patterns in the Pit 7 Complex area, causing changes to the hydrologic conditions adjacent to and downgradient of the landfills. As a result of recharge diversion, the volume of ground water and extent of saturation may be reduced in the Qal/WBR HSU near the pits and in the areas of highest depleted uranium activities in ground water. These changes in hydrologic conditions will have the greatest impact on the design and placement of the *in situ* treatment system (permeable reactive barrier), less on the funnel and sump with an *ex situ* treatment system, and least on the extraction well, *ex situ* treatment, and reinjection system. For example, several years of monitoring the effects of the hydraulic diversion system on hydrologic conditions may be necessary to ensure that an *in situ* permeable reactive barrier was designed and strategically located for maximum effectiveness in contaminant removal. The funnel and sump system may also require several years to determine the proper depth and width of funnel and sump to address the range of cross-sectional areas and discharge volumes of ground water within the Qal/WBR HSU. Ground water extraction using existing wells with *ex situ* treatment could be implemented simultaneously with construction of the hydraulic diversion system if safety considerations allow. The initial design of this extraction and *ex situ* treatment system would be based on historic ground water elevations in the Qal/WBR HSU. Modifications to the extraction wellfield could be implemented as needed, based on changes to local ground water conditions in response to the drainage diversion system installation during future rainfall events.

The goal of phased *ex situ* or *in situ* treatment is to reduce uranium activities, and nitrate and perchlorate concentrations to satisfy remedial action objectives and ARARs. The performance of both *ex situ* and *in situ* treatment toward meeting this goal could be measured by: (1) the percentage of total uranium activities attributable to depleted uranium as determined by the mass ratio, (2) total uranium activities, and (3) nitrate and perchlorate concentrations in ground water.

Modeling indicates that it make take up to 500 years for the funnel and sump extraction and treatment system to reduce total uranium activities in ground water to below the MCLs. Modeling also indicates that about 150 years may be required for the wellfield extraction and treatment system to reduce total uranium activities to below MCLs.

The present-worth cost of Alternative 5a for 30 years of monitoring, exposure control, monitoring, monitored natural attenuation of tritium, *ex situ* treatment of uranium, nitrate, and perchlorate in ground water, and source control by hydraulic diversion at the Pit 7 Complex ranges from \$10,845,000 to \$15,429,000. The lower end of the cost range includes ground water extraction from Qal/WBR and $Tnbs_0$ wells and *ex situ* treatment and the higher end includes Qal/WBR ground water extraction from a funnel and sump combined with $Tnbs_0$ ground water extraction using wells, and *ex situ* treatment. The present-worth cost of Alternative 5b for

30 years of monitoring, exposure control, monitored natural attenuation of tritium, and *in situ* treatment of uranium, nitrate, and perchlorate in Qal/WBR ground water combined with extraction and *ex situ* treatment of Tnbs_0 ground water, and source control by hydraulic diversion at the Pit 7 Complex is $21,082,000. Although Alternative 5a and 5b were both costed for 30 years, modeling indicates that it could require up to 150 years for uranium activities to be reduced below the MCL under Alternative 5a and up to 500 years for Alternative 5b. The present-worth costs for Alternative 5a in year 31 range from $142,000 (extraction wells) to $306,000 (funnel and sump with Tnbs_0 extraction wells) and are $459,000 for Alternative 5b in year 31. The annual present-worth costs for year 31 could be used to estimate longer-term cleanup costs associated with Alternative 5, although the reliability of these estimates decreases as the duration of the remedy increases.

3.4. Detailed Evaluation of Remedial Alternatives

3.4.1. Criteria and Evaluation Process

This section presents a detailed analysis and comparison of the remedial alternatives developed in Section 3.3 for the Pit 7 Complex. The National Oil and Hazardous Substances Pollution Contingency Plan identifies nine criteria to be used in the detailed analysis of remedial alternatives:

1. Overall protection of human health and the environment.
2. Compliance with ARARs.
3. Long-term effectiveness and permanence.
4. Reduction of toxicity, mobility, and volume.
5. Short-term effectiveness.
6. Implementability.
7. Cost.
8. State acceptance.
9. Community acceptance.

The first two criteria, called threshold criteria, are the most important since alternatives that do not meet them are not considered viable. Criteria 3 through 7 are called balancing criteria and are used to evaluate trade-offs among the alternatives. The last two criteria, called modifying criteria, are to be considered in the remedy selection and are evaluated after State of California and community comments are received on the subsequent Proposed Plan for the Pit 7 Complex. Each of these criteria is discussed below.

3.4.1.1. Overall Protection of Human Health and the Environment

This criterion addresses whether the alternative achieves and maintains protection of human health and the environment during implementation and after remediation objectives are achieved.

3.4.1.2. Compliance with ARARs

Unless a waiver is obtained, the alternative or combination of alternatives that are finally selected must comply with all location-, action-, and chemical-specific ARARs.

3.4.1.3. Long-Term Effectiveness and Permanence

This criterion evaluates how each alternative maintains protection of human health and the environment. This includes evaluating residual risk and management obligations after meeting the remedial action objectives.

3.4.1.4. Reduction of Toxicity, Mobility, and Volume

This criterion is used to evaluate if and how well each alternative reduces the toxicity, mobility, and/or volume of contaminants through treatment. It also addresses the amount of contaminants remaining on site after completion of remedial measures.

3.4.1.5. Short-Term Effectiveness

This criterion addresses the effectiveness of each alternative to protect human health and the environment during construction and implementation of each remedial action. This includes the safety of workers and the public, disruption of site and surrounding land uses, and time necessary to achieve protective measures.

3.4.1.6. Implementability

This criterion addresses the technical and administrative feasibility of each alternative including:

- Availability of goods and services.
- Flexibility of each alternative to allow additional modified remedial actions.
- Effectiveness of monitoring.
- Generation and disposal of hazardous waste.
- Substantive permitting requirements.

3.4.1.7. Cost

Capital, operation and maintenance, monitoring, and contingency costs are estimated for each alternative and are presented as 2004 present-worth costs using a 5% discount rate. Total costs for all alternatives were estimated within an accuracy of +50% and –30% in accordance with EPA guidance (2000) and are presented in Table 3-10. Detailed costs for each alternative are presented in Appendix G.

The cost estimates provided for each alternative are limited to 30 years due to: (1) uncertainty regarding the total time required to achieve MCLs, and (2) the difficulty in accurately estimating annual costs in the far future. A 30-year timeframe allows reasonable cost comparisons between remedial alternatives for that time period. An annual cost for activities in Alternatives 2, 3, 4, and 5 that continue for more than 30 years in the future and the duration of those activities are provided in Sections 3.4.2.2.5, 3.4.2.3.5, 3.4.2.4.5, and 3.4.2.5.5, respectively. However, the reliability of these estimates decreases as the duration of the remedy increases.

3.4.1.8. State Acceptance

The California DTSC and RWQCB-Central Valley Region will review and comment on this document. Analysis of technical and administrative concerns that these agencies may have regarding each of the alternatives will be addressed. The State agencies will participate in the selection of the remedy for the Amendment to the Interim ROD. The State agencies will also participate in the selection of cleanup goals for the Pit 7 Complex that will be codified in the Final ROD for Site 300.

3.4.1.9. Community Acceptance

A Public Workshop will be held after the Draft Pit 7 Complex RI/FS is published to present and receive public input on the proposed remedial alternatives. A summary of the remedial alternatives and the preferred remedies will be published in the Proposed Plan for the Remediation of the Pit 7 Complex. A Public Meeting will be held during the 30-day comment period for the Proposed Plan to received formal comments from the public. Public comments will be considered in the selection of the remedy for the Amendment to Site-Wide ROD for the Pit 7 Complex. Public comments made during the Public Meeting and 30-day comment period will be addressed in writing in the Responsiveness Summary of the ROD Amendment.

3.4.2. Detailed Analysis of Remedial Alternatives

This section evaluates how each alternative addresses the first seven EPA criteria specified by the National Contingency Plan. Evaluations of State and community acceptance will be addressed in the ROD Amendment following comments on this document and the subsequent Proposed Plan. Table 3-12 presents a detailed analysis of the remedial alternatives in meeting the evaluation criteria.

3.4.2.1. Evaluation of Alternative 1—No Action

Alternative 1 is intended to provide a baseline to compare to other alternatives. Under a no-action response, all activities in the Pit 7 Complex, including monitoring, would cease.

3.4.2.1.1. Protection of Human Health and the Environment and Compliance with ARARs. Alternative 1 may not protect human health or the environment because without monitoring of the COCs in ground water, there would be no means of determining changes in plume size and location that could impact downgradient receptors. No water-supply wells are currently pumping ground water contaminated with tritium, uranium, VOCs, nitrate, or perchlorate originating at the Pit 7 Complex, or are located near plumes in this area.

Alternative 1 does not meet the remedial action objective to prevent potential inhalation of tritium by onsite workers above health-based concentrations in the vicinity of Pit 3. Fencing and full-time security patrols are in place to prevent public access to the plume and source areas. There was no unacceptable risk or hazard to ecological receptors in the Pit 7 Complex identified in the baseline risk assessment.

Without source control for Pits 3 and 5, contaminant concentrations may remain above MCLs, which would not meet the requirements of the Basin Plan or SWRCB Resolutions 68-16 and 92-49.

3.4.2.1.2. Long-Term Effectiveness and Reduction in Toxicity, Mobility, and Volume. The long-term effectiveness and permanence of this alternative relies solely on natural attenuation to reduce contaminant concentrations and to restrict the mobility and reduce the toxicity and volume of tritium, uranium, TCE, perchlorate, and nitrate in ground water. It is possible that without source control measures for Pits 3 and 5, this may not be achieved in a reasonable timeframe.

3.4.2.1.3. Short-Term Effectiveness. Since there would be no remediation-related construction occurring under Alternative 1, there would be no impact to human or ecological receptors and therefore it would be effective in the short-term.

3.4.2.1.4. Implementability. This alternative is readily implementable.

3.4.2.1.5. Cost. There are no costs associated with this alternative.

3.4.2.2. Evaluation of Alternative 2—Monitoring, Risk and Hazard Management/Exposure Control, Monitored Natural Attenuation of Tritium in Ground Water, and Waste Excavation and Disposal

The objectives of Alternative 2 are to:

1. Provide risk and hazard management measures to prevent exposure of humans and ecological receptors in the short-term.
2. Monitor COCs in ground water to: (a) track changes in plume concentrations/activities to evaluate the effectiveness of source control measures and the natural attenuation of tritium and depleted uranium in ground water to health- and environmentally protective levels, (b) ensure that depleted uranium activities and VOC, nitrate, and perchlorate concentrations continue to decrease, (c) ensure there is no impact to downgradient receptors, and (d) ensure that State and Federal chemical-specific ARARs are met within a reasonable timeframe.
3. Provide for active source control measures by excavating and disposing of waste in Pits 3 and 5 to prevent further releases of contaminants from the pits and to mitigate inhalation risk to onsite workers.

This section evaluates how Alternative 2 addresses the first seven EPA criteria.

3.4.2.2.1. Protection of Human Health and the Environment and Compliance with ARARs. No risk or hazard associated with COCs in surface soil in the Pit 7 Complex has been identified. An inhalation risk of 4×10^{-6} to adult onsite workers was identified for tritium evaporating from subsurface soil/rock to ambient air in the vicinity of the Pit 3 Landfill. There are currently no active facilities located in the vicinity and the landfill was closed to use in 1967. Since there are no manned facilities in this area, there are no receptors for tritium volatilizing from subsurface soil/rock. In addition, in 1992, a landfill cover was installed on Pit 7 that is adjacent to Pit 3. Approximately 40% of the Pit 3 landfill was covered during the capping of Pi 7. Exposure control measures would be implemented in the area in the short term to prevent inhalation risk in the event that land usage changes occur in the vicinity of Pit 3 that would result in exposure to onsite workers. Excavation of the pit waste would partially mitigate inhalation risk by removing the tritium source in the Pit 3 Landfill. No risk or hazard to ecological receptors has been identified in the Pit 7 Complex area.

Concentrations of TCE in ground water in the Pit 7 Complex area have steadily decreased below the MCL and continue to decline. Monitoring of VOCs in ground water would continue to detect any changes that could impact human health or the environment. Nitrate has been detected at concentrations that exceed the MCL of 45 mg/L in ground water from one well located downgradient of Pit 3 (NC7-51) and seven wells downgradient of Pit 5 (NC7-16, NC7-20, NC7-21, NC7-34, NC7-37, NC7-40, and K7-01). All but one of these wells (K7-01) are completed in the Qal/WBR HSU. Ground water from $Tnbs_0$ wells NC7-47, W-865-03, W-865-1804, and W-865-07, located far downgradient from the Pit 7 Complex, contain nitrate concentrations in ground water that exceed the MCL. For example, well NC7-47 has consistently contained elevated nitrate concentrations since monitoring began in 1995. This well contains no evidence of anthropogenic contaminants and it did not contain tritium above a detection limit of 2.5 pCi/L indicating pre-"bomb pulse" (i.e., pre-1960s) water. Maximum concentrations of perchlorate are currently above the 6 μ/L State Public Health Goal in both the Qal/WBR and $Tnbs_0$ ground water. While waste excavation would prevent further releases of perchlorate to ground water, Alternative 2 does not include measures to actively remediate the perchlorate and nitrate that is already present in ground water. Monitoring will continue to track any changes in concentrations and the extent of these contaminants in ground water that could impact human health or the environment.

Given the short half-life of tritium, once the tritium source has been largely removed by excavating the contents of Pits 3 and 5, monitored natural attenuation would reduce tritium activities in ground and surface water to meet remedial action objectives and achieve State and Federal chemical-specific ARARs within a reasonable timeframe as discussed in Section 3.3.1.2.3. Ground water in this area is not used as a drinking water supply. Modeling of tritium fate and transport in ground water from the Pits 3 and 5 area estimated that even with further releases from the pits, tritium activities would decrease to the 20,000 pCi/L MCL after a maximum of 45 years without impacting ground water offsite above background activities. Monitored natural attenuation for tritium would also prevent incurring risks associated with extracting tritiated ground water and bringing it to the surface for treatment. As discussed in Section 3.2 and Appendix F, there are currently no efficient or cost effective technologies available to remediate tritiated ground water.

If further releases of uranium are reduced or eliminated by landfill excavation and disposal, natural processes would reduce depleted uranium activities in ground water. Although uranium has an extremely long half-life, it sorbs readily to subsurface material, reducing its mobility. An analysis of depleted uranium in ground water indicates it is moving even slower than that estimated by modeling. There is currently no risk associated with uranium in ground water, as there are no existing receptors. Fate and transport modeling of uranium in ground water indicates that uranium would not reach the site boundary at activities greater than background.

Monitoring and continued modeling of tritium and uranium in ground water would help to determine how and if any changes in tritium or uranium activities or plume size may impact human health and potentially warrant more active remedial measures.

The remedial measures presented in Alternative 2 should provide adequate protection of human health and the environment by preventing exposure to contaminants. Landfill excavation and disposal measures would partially reduce future impacts to the environment. Because Alternative 2 does not provide for removal of contamination in bedrock underlying the landfills, this alternative may not be completely effective in meeting ARARs as there is the potential for additional contaminants to be released if the vadose zone in inundated. The natural attenuation of tritium and the attenuation processes of sorption, dispersion, and diffusion of uranium would reduce their activities in ground water to health-protective levels. Monitoring would be used to detect changes that could impact human health and the environment and demonstrate the effectiveness of the remedial measures in reducing contaminant levels to meet State and Federal chemical-specific ARARs.

While ground water MCLs for uranium may not be achieved for up to 500 years, human health would be protected because the plume would not significantly migrate once the source is controlled and the ground water in this area is not suitable for potable uses due to naturally high total dissolved solids concentrations in ground water. Also, there are no complete pathways for this ground water to reach human or ecological receptors. Therefore, DOE/LLNL believes that since human health and the environment will be protected during the period of time necessary to reach MCLs for uranium, Alternative 2 is capable of achieving RAOs and ARARs without impacting human health or the environment. However, EPA and the State regulatory agencies do not agree that 500 years is an acceptable timeframe for achieving MCLs or other RAOs for uranium.

If necessary, modifications to the Site 300 Contingency Plan will include actions to be implemented in the event that these measures do not achieve remedial action objectives or compliance with ARARs.

3.4.2.2.2. Long-Term Effectiveness and Reduction in Toxicity, Mobility, and Volume. Natural attenuation of tritium in ground water would achieve a long-term and permanent reduction in its toxicity, mobility, and volume in the subsurface. The sorption of depleted and natural uranium to aquifer rocks would reduce their mobility, but not their toxicity or volume in the subsurface. The excavation component of Alternatives 2 would permanently reduce the mobility of the contaminants in the pit waste by removing any waste constituting a significant source, thus preventing further significant leaching of contaminants to the subsurface. It would not reduce the toxicity or volume of the contaminants as the waste would be redeposited at a different location. Because the waste excavation proposed in Alternative 2 does not include removal of bedrock containing residual contamination, this alternative would not reduce the toxicity, mobility, or volume of contaminants remaining in the vadose zone. Source control measures have already been implemented at Pits 4 and 7 through installation of a pit cap and drainage diversion system in 1992. Monitoring would be continued after State and Federal chemical-specific ARARs are achieved to ensure long-term effectiveness and permanence.

3.4.2.2.3. Short-Term Effectiveness. Exposure controls would prevent exposure of onsite workers and ecological receptors in the short-term. There would be minimal impact to onsite workers during monitoring activities and workers would follow Site 300 operational safety procedures to mitigate potential risks that may be posed during these activities. A much higher level of exposure control would be necessary to prevent short-term exposure of onsite workers and ecological receptors during excavation. Buried waste and associated contamination would be brought to the surface, handled, transported, and disposed at an offsite low level mixed waste landfill. This would likely increase the number of exposure pathways, as well as disrupt habitat, increasing the potential for short-term exposure and impacts to the environment. Disposal offsite would entail transportation on public highways, and the associated risks. DOE/LLNL would employ its radioactive and hazardous waste transportation procedures to mitigate those risks.

A health and safety plan would be developed prior to excavation of the pit waste to protect the health of onsite workers. In addition, workers would follow Site 300 operation procedures, and use personal protective equipment and clothing to mitigate potential risks during pit excavation. Biological resource surveys would be conducted prior to any ground disturbing activities to ensure there are no impacts to ecological receptors.

While ground water MCLs for uranium may not be achieved for up to 500 years, human health would be protected because the plume would not significantly migrate once the source is controlled and the ground water in this area is not suitable for potable uses due to naturally high total dissolved solids concentrations in ground water. Also, there are no complete pathways for this ground water to reach human or ecological receptors. Therefore, DOE/LLNL believes that since human health and the environment will be protected during the period of time necessary to reach MCLs for uranium, Alternative 2 provides short-term effectiveness without impacting human health or the environment. However, EPA and the State regulatory agencies do not agree that 500 years is an acceptable timeframe for achieving MCLs or other RAOs for uranium.

3.4.2.2.4. Implementability. All of the remedial components for Alternative 2 can be implemented at the Pit 7 Complex. Many of the exposure control methods are already in place. Monitoring can be implemented easily, although the installation of additional monitor wells may be necessary. Monitored natural attenuation is implementable. Excavation of landfill waste would require extensive provisions to prevent exposure and protect the safety of onsite workers, transport personnel, and the public during transport of the waste. It would also require locating a facility permitted and willing to accept low-level mixed waste at a reasonable cost.

3.4.2.2.5. Cost. The estimated present worth cost of the landfill waste excavation, 30 years of exposure control, MNA of tritium and ground water monitoring presented in Alternative 2 is $56,635,000. The costs of the components to implement Alternative 2 are summarized in Table 3-10. The detailed costs of the components used to assemble Alternative 2 are presented in Appendix G.

Modeling indicates that it could require up to 500 years for uranium to attenuate to the MCL. Because of the extremely conservative assumptions used in the modeling in which the cleanup times were estimated, it is possible that MCLs will be achieved more rapidly. The cost estimate is limited to 30 years due to: (1) uncertainty regarding the time required to achieve MCLs, and (2) the difficulty in accurately estimating annual costs in the far future. For Alternative 2, the annual cost to monitor depleted uranium in ground water is $73,000 in year 31. This annual cost could be used to estimate monitoring costs past 30 years associated with Alternative 2 (i.e., monitoring cost × number of years), but the reliability of these estimates decreases as the duration of the remedy increases.

3.4.2.3. Evaluation of Alternative 3—Monitoring, Risk and Hazard Management/Exposure Prevention, Monitored Natural Attenuation of Tritium in Ground Water, Waste Excavation and Disposal, and Treatment of Uranium, Nitrate, and Perchlorate in Ground Water

The objectives of Alternative 3 are to:

1. Provide risk and hazard management measures to prevent exposure of humans and ecological receptors in the short-term.
2. Monitor COCs in ground water to: (a) track changes in plume concentrations/activities to evaluate the effectiveness of source control measures ant the natural attenuation of tritium in ground water to health- and environmentally protective levels, (b) ensure that VOC concentrations continue to decrease, (c) ensure there is no impact to downgradient receptors, and (d) ensure that State and Federal chemical-specific ARARs are met within a reasonable timeframe.

3. Reduce the concentrations/activities of depleted uranium, nitrate, and perchlorate to levels protective of human health and the environment and prevent further migration of the uranium plume in ground water by either: (a) extracting and treating ground water, or (b) installing an *in situ* permeable reactive barrier that removes uranium, nitrate, and perchlorate with cow bone char or other reactive materials from Qal/WBR ground water coupled with extraction and treatment of Tnbs_0 ground water.
4. Provide for active source control measures by excavating and disposing of waste in Pits 3 and 5 to prevent further releases of contaminants from the pits and mitigate inhalation risk to onsite workers.

This section evaluates how Alternative 3 addresses the first seven EPA criteria. Because Alternative 3 consists of two possible methods for treating uranium, nitrate, and perchlorate in ground water (*in situ* and *ex situ* treatment under Alternatives 3a and 3b, respectively), any differences in how these two treatment methods affect the evaluation are highlighted in the following discussion. All other components of this alternative including risk and hazard management, monitoring, monitored natural attenuation of tritium in ground water, and source control are the same for both Alternative 3a and 3b and therefore are evaluated together

3.4.2.3.1. Protection of Human Health and the Environment and Compliance with ARARs. No risk or hazard associated with COCs in surface soil in the Pit 7 Complex has been identified. An inhalation risk of 4×10^{-6} to adult onsite workers was identified for tritium evaporating from subsurface soil/rock to ambient air in the vicinity of the Pit 3 Landfill. There are currently no active facilities located in the vicinity and the landfill was closed to use in 1967. Since there are no manned facilities in this area, there are no receptors for tritium volatilizing from subsurface soil/rock. In addition, in 1992, a landfill cover was installed on Pit 7 that is adjacent to Pit 3. Approximately 40% of the Pit 3 Landfill was covered during the capping of Pit 7. Exposure control measures would be implemented in the area in the short term to prevent inhalation risk in the event that land usage changes occur in the vicinity of Pit 3 that would result in exposure to onsite workers. Excavation of the pit waste would partially mitigate inhalation risk by removing the tritium source in the Pit 3 Landfill. No risk or hazard to ecological receptors has been identified in the Pit 7 Complex area.

Concentrations of TCE in ground water in the Pit 7 Complex area have steadily decreased below the MCL and continue to decline. Monitoring of VOCs in ground water would continue to detect any changes that could impact human health or the environment. The nitrate released from the landfills appears to be restricted primarily to the Qal/WBR HSU. Nitrate has been detected at concentrations above the MCL in ground water samples from one Tnbs_0 well, K7-01, located immediately downgradient of the Pit 5 landfill. Within the Qal/WBR HSU and Tnbs_0 well K7-01, concentrations of nitrate in excess of the 45 mg/L MCL may be attributable to a combination of anthropogenic and natural sources. The majority of the nitrate in Qal/WBR ground water is collocated with the extent of depleted uranium in ground water, although nitrate concentrations exceed the MCL in samples from one well (NC7-20) downgradient of the depleted uranium plume. Ground water from Tnbs_0 wells NC7-47, W-865-03, W-865-1804, and W-865-07, located far downgradient from the Pit 7 Complex, contains nitrate in excess of the MCL that is natural in origin. Maximum concentrations of perchlorate in ground water are currently above the 6 mg/L State Public Health Goal in ground water in both the Qal/WBR and Tnbs_0 HSUs. Monitoring will continue to track any changes in concentrations and the extent of perchlorate in ground water. The *ex situ* treatment system (Alternative 3a) or *in situ* treatment system (Alternative 3b) will include a treatment media to remove nitrate and perchlorate contamination from ground water. Treatment media, such as resins, would be added in series to the aboveground treatment system of Alternative 3a or would be emplaced with cow bone char or other reactive media in the subsurface *in situ* treatment system of Alternative 3b.

Given the short half-life of tritium, once the tritium source has been largely removed by excavating the contents of Pits 3 and 5, monitored natural attenuation would reduce tritium activities in ground and surface water to meet remedial action objectives and achieve State and Federal chemical-specific ARARs within a reasonable timeframe as discussed in Section 3.3.1.2.3. Ground water in this area is not used as a drinking water supply. Modeling of tritium fate and transport in ground water from the Pits 3 and 5 area estimated that even with further releases from the pits, tritium activities would decrease to the 20,000 pCi/L MCL after a maximum of 45 years without impacting ground water offsite above background activities. Monitored natural attenuation for tritium would also prevent incurring risks associated with extracting tritiated ground water and bringing it to the surface for treatment. As discussed in Section 3.2 and Appendix F, there are currently no efficient or cost effective technologies available to remediate tritiated ground water. The monitoring and continued modeling of tritium in ground water would help to determine any changes in tritium activities or plume size that could impact human health and warrant more active remedial measures.

If further releases of uranium, nitrate, and perchlorate are reduced or eliminated by landfill excavation and disposal, active *ex situ* or *in situ* treatment of ground water would reduce concentrations and activities of these contaminants in ground water to meet ARARs. Ground water treatment would be conducted using a phased approach because design of the systems to treat uranium, nitrate, and perchlorate in ground water cannot be finalized until the effects of pit waste excavation on local hydrologic conditions have stabilized. These changes in hydrologic conditions will have the greatest impact on the design and placement of the *in situ* treatment system (permeable reactive barrier), less on the funnel and sump with an *ex situ* treatment system, and least on the extraction well, *ex situ* treatment, and reinjection system. The locations and depths of the funnel and sump system in Alternative 3a and the details of *in situ* permeable reactive barrier of Alternative 3b cannot be properly implemented until a new hydrologic equilibrium is attained. Ground water extraction using existing wells with *ex situ* treatment could be implemented simultaneously with pit excavation if safety considerations allow.

Modeling results indicate that it may take up to 500 years for the funnel and sump extraction and treatment system (Alternative 3a) and the permeable reactive barrier (Alternative 3b) to reduce total uranium activities to below MCLs. Modeling results indicate that it may take up to 150 years to reduce total uranium activities to below MCLs using an extraction wellfield and *ex situ* treatment system (Alternative 3a). However, since total uranium activities were used in the model, the time to reduce depleted uranium activities to below MCLs may be less.

Alternative 3 (a and b) should adequately protect human health and the environment by preventing exposure to contaminants. Landfill excavation and disposal measures would partially reduce future impacts to the environment. Because Alternatives 3 (a and b) do not provide for removal of contamination in bedrock underlying the landfills, these alternatives may not be completely effective in meeting ARARs as there is the potential for additional contaminants to be released if the vadose zone in inundated. The natural attenuation of tritium and extraction and *ex situ* or *in situ* treatment of depleted uranium, nitrate, and perchlorate reduces concentrations/activities in ground water to health-protective and ARAR-compliant levels.

Monitoring would be used to demonstrate the effectiveness of the remedial measures in reducing contaminant levels to meet State and Federal chemical-specific ARARs in a reasonable timeframe. If necessary, modifications to the Site 300 Contingency Plan would include actions to be implemented in the event that these measures do not achieve remedial action objectives or compliance with ARARs.

3.4.2.3.2. Long-Term Effectiveness and Reduction in Toxicity, Mobility, and Volume. The irreversible decay of tritium in all environmental media would achieve a long-term and permanent reduction in toxicity, mobility, and volume of tritium in the subsurface. The extraction and treatment of ground water under Alternative 3a would reduce the volume and mobility of uranium, nitrate, perchlorate, and any extracted VOCs in ground water. Because the uranium collected in the resins used for ion exchange is not destroyed, radioactive decay would be relied upon to reduce the toxicity and volume of the uranium removed from ground water. Under Alternative 3b, the *in situ* reactive barrier would limit the migration of uranium and other contaminants for which treatment media are emplaced. The *in situ* treatment component of Alternative 3b would also allow for the removal of contaminants collected in the barrier treatment media when removed from the subsurface. *In situ* treatment of contaminants in Qal/WBR ground water, coupled with the extraction and *ex situ* treatment of contaminants in $Tnbs_0$ ground water, would also reduce the toxicity and volume of uranium, nitrate, and perchlorate in ground water at the Pit 7 Complex. Natural attenuation processes (i.e., radioactive decay) would have to be relied upon to permanently reduce the toxicity and volume of the contaminants sorbed to the treatment media.

The excavation component of Alternative 3 (a and b) would reduce contaminant mobility by removing any waste constituting a significant source, thus preventing further leaching of contaminants from the pit waste to the subsurface. It would not reduce the toxicity or volume of the contaminants as the waste would be redeposited at a different location. Because the waste excavation proposed in Alternatives 3a and 3b does not include removal of bedrock containing residual contamination, this alternative would not reduce the toxicity, mobility, or volume of contaminants remaining in the vadose zone. Source control measures have already been implemented at Pits 4 and 7 through the installation of a pit cap and drainage diversion system in 1992. Monitoring would be continued after ARARs are achieved to ensure long-term effectiveness and permanence.

3.4.2.3.3. Short-Term Effectiveness. Exposure controls would prevent exposure of onsite workers and ecological receptors in the short-term. There would be minimal impact to onsite workers during monitoring activities and workers would follow Site 300 operational safety procedures to mitigate potential risks that may be posed during these activities. Workers would use appropriate protective procedures, clothing, and equipment to prevent the possibility of exposure during installation of either the extraction and treatment system in Alternative 3a or the *in situ* reactive barrier in Alternative 3b, and while performing system operation and maintenance, or drilling. Both Alternatives 3a and 3b pose additional short-term, and possibly long-term exposure risks in the handling and storage or disposal of uranium-contaminated ion exchange resin or cow bone char, respectively. This is due to the fact that uranium is removed and concentrated in ion exchange resins or cow bone char as part of the treatment process. Exposure control measures would be needed to prevent exposure until uranium activities decayed to health-protective levels. Under Alternatives 3a and 3b, short-term exposure risk would also increase if tritiated ground waters were brought to the surface during ground water extraction.

A much higher level of exposure control would be necessary to prevent short-term exposure of onsite workers and ecological receptors during excavation. Buried waste and associated contamination would be brought to the surface, handled, transported, and disposed at an offsite low level mixed waste landfill. This would likely increase the number of exposure pathways, as well as disrupt habitat, increasing the potential for short-term exposure and impacts to the environment. Disposal offsite would entail transportation on public highways, and the associated risks. DOE/LLNL would employ its radioactive and hazardous waste transportation procedures to mitigate those risks.

Prior to excavation of the pit waste, a health and safety plan would be developed to protect the health of restoration workers who will enter the exclusion zone or be nearby during the excavation. In addition, workers would follow Site 300 standard operating procedures, and use personal protective equipment and clothing to mitigate potential risks during pit excavation.

Modeling indicates that it may take up to 150 to 500 years to reduce uranium activities to below MCLs using extraction wells and a funnel and sump system, respectively, with *ex situ* treatment. However, human health would be protected because the remediation system would prevent plume migration once the source is controlled and the ground water in this area is not suitable for potable uses due to naturally high total dissolved solids concentrations in ground water. Also, there are no complete pathways for this ground water to reach human or ecological receptors. Therefore, DOE/LLNL believes that because human health and the environment will be protected during the period of time necessary to reach MCLs for uranium, Alternative 3 provides short-term effectiveness without impacting human health or the environment.

3.4.2.3.4. Implementability. All of the remedial components for Alternative 3 can be implemented at the Pit 7 Complex. Many of the exposure control methods are already in place. Monitoring can be implemented easily, although the installation of additional monitor wells may be necessary. Monitored natural attenuation is implementable. Excavation of landfill waste is implementable but would require extensive provisions to prevent exposure and protect the safety of onsite workers, transport personnel, and the public during transport of the waste. It would also require locating a facility permitted and willing to accept low-level mixed waste at a reasonable cost.

The ground water treatment portion options for Alternative 3a and 3b are both implementable. The operation of the *ex situ* ground water treatment system in Alternatives 3a and 3b would require reinjection of the treated effluent due to the presence of tritium. The reinjection of treated water would need to be done in such a way as to prevent enhanced migration of COCs in ground water or the contamination of pristine ground water. The implementability of the *in situ* reactive barrier component of Alternative 3b is limited by issues associated with the removal and replacement of spent treatment materials in the subsurface barrier.

3.4.2.3.5. Cost. The estimated present worth cost of landfill waste excavation, 30 years of exposure control, MNA of tritium, and *in situ* and *ex situ* uranium, nitrate, and perchlorate treatment and ground water monitoring presented in Alternative 3 ranges from \$63,741,000 (extraction wells only) to \$68,326,000 (funnel and sump with Tnbs_0 extraction wells) for Alternative 3a and is \$73,979,000 for Alternative 3b depending on whether *ex situ* or *in situ* ground water treatment is implemented. The costs to implement Alternatives 3a and 3b are summarized in Table 3-10.

Although Alternative 3a and 3b were both costed for 30 years, modeling indicates that it could require up to 150 years for uranium activities to be reduced below the MCL under Alternative 3a and up to 500 years for Alternative 3b.

Because of the extremely conservative assumptions used in the modeling in which the cleanup times were estimated, it is possible that cleanup will be achieved more rapidly. The cost estimate for Alternative 3a and 3b is limited to 30 years due to: (1) uncertainty regarding the time required to achieve MCLs, and (2) the difficulty in accurately estimating annual costs in the far future. For Alternative 3a, the annual cost to maintain and operate the extraction and *ex situ* treatment system ranges from $137,000 (extraction wells only) to $301,000 (funnel and sump with $Tnbs_0$ extraction wells) in year 31. For Alternative 3b, the annual cost to maintain and operate the *in situ* permeable reactive barrier system and well extraction and *ex situ* treatment system is $454,000 in year 31. These annual costs could be used to estimate longer-term cleanup costs associated with Alternative 3 (i.e., annual O&M cost × number of years).

3.4.2.4. Evaluation of Alternative 4—Monitoring, Risk and Hazard Management/Exposure Prevention, Monitored Natural Attenuation of Tritium in Ground Water, and Source Control/Isolation

The objectives of Alternative 4 are to:

1. Provide risk and hazard management measures to prevent exposure of humans and ecological receptors in the short-term.
2. Monitor COCs in ground water to: (a) track changes in plume concentrations/activities to evaluate the effectiveness of source control measures and the natural attenuation of tritium in ground water to health- and environmentally protective levels, (b) ensure that depleted uranium activities and VOC, perchlorate, and nitrate concentrations continue to decrease, (c) ensure there is no impact to downgradient receptors, and (d) ensure that State and Federal chemical-specific ARARs are met within a reasonable timeframe.
3. Providing for active source control by hydraulic diversion or source isolation by hydraulic barrier for Pits 3 and 5 to prevent further releases of contaminants from the pits.

This section evaluates how Alternative 4 addresses the first seven EPA criteria.

3.4.2.4.1. Protection of Human Health and the Environment and Compliance with ARARs. No risk or hazard associated with COCs in surface soil in the Pit 7 Complex has been identified. An inhalation risk of 4×10^{-6} to adult onsite workers was identified for tritium evaporating from subsurface soil/rock to ambient air in the vicinity of the Pit 3 Landfill. There are currently no active facilities located in the vicinity and the landfill was closed to use in 1967. Since there are no manned facilities in this area, there are no receptors for tritium volatilizing from subsurface soil/rock. In addition, in 1992, a landfill cover was installed on Pit 7 that is adjacent to Pit 3. Approximately 40% of the Pit 3 landfill was covered during the capping of Pit 7. Exposure control measures would be implemented in the area in the short term to prevent inhalation risk in the event that land usage changes occur in the vicinity of Pit 3 that would result in exposure to onsite workers. No risk or hazard to ecological receptors has been identified in the Pit 7 Complex area.

Concentrations of TCE in ground water in the Pit 7 Complex area have steadily decreased below the MCL and continue to decline. Monitoring of VOCs in ground water would continue to detect any changes that could impact human health or the environment. Nitrate is only detected above the MCL in water samples from one well located downgradient of Pit 3 (NC7-51) and in seven wells downgradient of Pit 5 (NC7-16, NC7-20, NC7-21, NC7-34, NC7-37, NC7-40, and K7-01). Ground water from $Tnbs_0$ wells NC7-47, W-865-03, W-865-1804, and W-865-07, located far downgradient from the Pit 7 Complex, contain nitrate in excess of the MCL. The nitrate detected in ground water in these downgradient wells could not be due to landfill release because, with the exception of well W-865-1804, tritium has not been detected above background activities and tritium travels with the velocity of ground water, while nitrate migrates more slowly. As discussed in Section 2.3.3.6, nitrate detected in ground water from these wells is believed to be natural in origin. Maximum concentrations of perchlorate in ground water are currently above the 6 mg/L State Public Health Goal, in ground water in both the Qal/WBR and $Tnbs_0$ HSUs. While source control or isolation measures (hydraulic diversion or barriers) would prevent further releases of perchlorate to ground water, Alternative 4 does not include measures to actively remediate the perchlorate and nitrate that is already present in ground water. Once perchlorate and nitrate sources are isolated by hydraulic diversion or barriers, perchlorate and nitrate concentrations in local ground water will decline by natural attenuation processes. LLNL has not yet evaluated the time necessary for perchlorate and nitrate in ground water to reach MCLs or WQOs by natural processes. However, under this alternative, active remediation would be implemented if perchlorate and nitrate concentrations did not decrease to meet MCLs or WQOs in a reasonable timeframe. Monitoring will continue to track any changes in concentrations and the extent of these contaminants in ground water that could impact human health or the environment.

Given the short half-life of tritium, once the tritium source in Pits 3 and 5 has been contained or controlled through the use of hydraulic diversion or barriers, monitored natural attenuation would reduce tritium activities in ground and surface water to meet remedial action objectives and achieve State and Federal chemical-specific ARARs within a reasonable timeframe as discussed in Section 3.3.1.2.3. Ground water in this area is not used as a drinking water supply. Modeling of tritium fate and transport in ground water from the Pits 3 and 5 area estimated that even with further releases from the pits, tritium activities would decrease to the 20,000 pCi/L MCL after a maximum of 45 years without impacting ground water offsite above background activities. Monitored natural attenuation for tritium would also prevent incurring risks associated with extracting tritiated ground water and bringing it to the surface for treatment. As discussed in Section 3.2 and Appendix F, there are currently no efficient or cost effective technologies available to remediate tritiated ground water.

If further releases of uranium are contained or controlled through the use of hydraulic diversion or barriers, natural processes would reduce depleted uranium activities in ground water. Although uranium has an extremely long half-life, it sorbs readily to subsurface material, reducing its mobility. An analysis of depleted uranium in ground water indicates it is moving even slower than that estimated by modeling, and that the plumes are not expanding. There is currently no risk associated with uranium in ground water, as there are no existing receptors. Fate and transport modeling estimates that uranium in ground water would not reach the site boundary at activities greater than background.

Monitoring and continued modeling of tritium and uranium in ground water would help to determine how and if any changes in tritium or uranium activities or plume size may impact human health and potentially warrant more active remedial measures.

Alternative 4 should provide adequately protect human health and the environment by preventing exposure to contaminants. Source control or isolation measures would reduce future impacts to the environment, and natural attenuation of tritium and sorption, dispersion, and diffusion of uranium would reduce their activities in ground water to health-protective levels. Monitoring would be used to detect changes that could impact human health and the environment and demonstrate the effectiveness of the remedial measures in reducing contaminant levels to meet State and Federal chemical-specific ARARs.

While ground water MCLs for uranium may not be achieved for up to 500 years, human health would be protected because the plume would not significantly migrate once the source is controlled. Also, there are no complete pathways for this ground water to reach human or ecological receptors and this ground water is not suitable for potable uses due to naturally high total dissolved solid concentrations. Therefore, DOE/LLNL believes that since human health will be protected during the period of time necessary to reach MCLs for uranium, Alternative 4 is capable of achieving RAOs and ARARs without impacting human health or the environment. However, EPA and the State regulatory agencies do not agree that 500 years is an acceptable timeframe for achieving MCLs or other RAOs for uranium.

If necessary, modifications to the Site 300 Contingency Plan will include actions to be implemented in the event that these measures do not achieve remedial action objectives or compliance with ARARs.

3.4.2.4.2. Long-Term Effectiveness and Reduction in Toxicity, Mobility, and Volume. Natural attenuation of tritium in ground water would achieve a long-term and permanent reduction in its toxicity, mobility, and volume in the subsurface. The sorption of depleted and natural uranium to aquifer rocks will reduce their mobility, but not their toxicity or volume in the subsurface. The source control or isolation component of Alternatives 4 would permanently reduce the mobility of contaminants in the pit waste or shallow vadose zone by preventing further releases of contaminants to the subsurface. These techniques would not reduce the toxicity or volume of the contaminants as the contaminated waste would remain in place and chemically unchanged in the landfills. Some source control measures have already been implemented at Pits 4 and 7 through installation of a pit cap and drainage diversion system in 1992. Monitoring would be continued after State and Federal chemical-specific ARARs are achieved to ensure long-term effectiveness and permanence.

3.4.2.4.3. Short-Term Effectiveness. Exposure controls would prevent exposure of onsite workers and ecological receptors in the short-term. There would be minimal impact to onsite workers during monitoring activities and workers would follow Site 300 operational safety procedures to mitigate potential risks that may be posed during these activities. If necessary, workers would use appropriate protective procedures, clothing, and equipment to prevent the possibility of exposure during installation of the hydraulic diversion system or barrier. However, since construction of these systems would primarily occur outside the main area of contamination, the need for exposure control measures will likely be limited. Biological resource surveys would be conducted prior to any ground disturbing activities to ensure there are no impacts to ecological receptors.

While ground water MCLs for uranium may not be achieved for up to 500 years, human health would be protected because the plume would not significantly migrate once the source is controlled and the ground water in this area is not suitable for potable uses due to naturally high total dissolved solids concentrations in ground water. Also, there are no complete pathways for this ground water to reach human or ecological receptors. Therefore, DOE/LLNL believes that since human health and the environment will be protected during the period of time necessary to reach MCLs for uranium, Alternative 4 provides short-term effectiveness without impacting human health or the environment. However, EPA and the State regulatory agencies do not agree that 500 years is an acceptable timeframe for achieving MCLs or other RAOs for uranium.

3.4.2.4.4. Implementability. All of the remedial components for Alternative 4 can be implemented at the Pit 7 Complex. Many of the exposure control methods are already in place. Monitoring and monitored natural attenuation can be implemented easily as an extensive monitor well system is already in place. Both source control through hydraulic diversion or source isolation using a hydraulic barrier are implementable. Special engineering considerations may be necessary to ensure that a hydraulic barrier system extends beneath the saturated zone to prevent ground water mounding under pressure that could compromise its integrity.

3.4.2.4.5. Cost. The estimated present worth cost of 30 years of exposure control, MNA of tritium, hydraulic diversion or hydraulic barriers, and ground water monitoring in Alternative 4 ranges from $3,738,000 to $4,344,000 depending on whether a hydraulic diversion system or a hydraulic barrier is installed (Alternative 4a or 4b). The costs to implement Alternative 4 are summarized in Table 3-10.

Modeling indicates that it could require up to 500 years for uranium to attenuate to the MCL. Because of the extremely conservative assumptions used in the modeling in which the cleanup times were estimated, it is possible that MCLs will be achieved more rapidly. The cost estimate is limited to 30 years due to: (1) uncertainty regarding the time required to achieve MCLs, and (2) the difficulty in accurately estimating annual costs in the far future. For Alternative 4, the annual cost to monitor depleted uranium in ground water and to perform operate and maintain the hydraulic barrier or diversion system is $78,000 to $79,000 in year 31. This annual cost could be used to estimate monitoring costs past 30 years associated with Alternative 4 (i.e., monitoring cost × number of years), but the reliability of these estimates decreases as the duration of the remedy increases.

3.4.2.5. Evaluation of Alternative 5—Monitoring, Risk and Hazard Management/Exposure Prevention, Monitored Natural Attenuation of Tritium in Ground Water, Source Control, and Treatment of Uranium, Nitrate, and Perchlorate in Ground Water

The objective of Alternative 5 is to:

1. Provide risk and hazard management measures to prevent exposure of humans and ecological receptors in the short-term.
2. Monitor COCs in ground water to: (a) track changes in plume concentrations/activities to evaluate the effectiveness of source control measures and the natural attenuation of tritium in ground water to health- and environmentally protective levels, (b) ensure that VOCs concentrations continue to decrease, (c) ensure there is no impact to downgradient

receptors, and (d) ensure that State and Federal chemical-specific ARARs are met within a reasonable timeframe.

3. Reduce the activities/concentrations of depleted uranium (and perchlorate) to levels protective of human health and the environment and prevent further migration of the uranium plume in ground water by either of two phased approaches: (a) extracting and treating ground water, or (b) installing an *in situ* permeable reactive barrier coupled with extraction and *ex situ* treatment of Tnbs_0 ground water to remove uranium, nitrate, and perchlorate.
4. Provide for active source control by hydraulic diversion to prevent further releases of contaminants from Pits 3 and 5.

This section evaluates how Alternative 5 addresses the first seven EPA criteria. Because Alternative 5 consists of two possible methods for treating uranium, nitrate, and perchlorate in ground water (*in situ* and *ex situ* treatment under Alternatives 5a and 5b, respectively), any differences in how these two treatment methods affect the evaluation are highlighted in the following discussion. All other components of this alternative including risk and hazard management, monitoring, monitored natural attenuation of tritium in ground water, and source control are the same for both Alternative 5a and 5b and therefore are evaluated together.

3.4.2.5.1. Protection of Human Health and the Environment and Compliance with ARARs. No risk or hazard associated with COCs in surface soil in the Pit 7 Complex has been identified. An inhalation risk of 4×10^{-6} to adult onsite workers was identified for tritium evaporating from subsurface soil/rock to ambient air in the vicinity of the Pit 3 Landfill. There are currently no active facilities located in the vicinity and the landfill was closed to use in 1967. Since there are no manned facilities in this area, there are no receptors for tritium volatilizing from subsurface soil/rock. In addition, in 1992, a landfill cover was installed on Pit 7 that is adjacent to Pit 3. Approximately 40% of the Pit 3 landfill was covered during the capping of Pit 7. Exposure control measures would be implemented in the area in the short term to prevent inhalation risk in the event that land usage changes occur in the vicinity of Pit 3 that would result in exposure to onsite workers. No risk or hazard to ecological receptors has been identified in the Pit 7 Complex area.

Concentrations of TCE in ground water in the Pit 7 Complex area have steadily decreased below the MCL and continue to decline. Monitoring of VOCs in ground water would continue to detect any changes that could impact human health or the environment. The nitrate released from the landfills appears to be restricted primarily to the Qal/WBR HSU. Nitrate has been detected at concentrations above the MCL in ground water samples from one Tnbs_0 well, K7-01, located immediately downgradient of the Pit 5 landfill. Within the Qal/WBR HSU and Tnbs_0 well K7-01, concentrations of nitrate in excess of the 45 mg/L MCL may be attributable to a combination of anthropogenic and natural sources. The majority of the nitrate in Qal/WBR ground water is collocated with the extent of depleted uranium in ground water, although nitrate concentrations exceed the MCL in one well (NC7-20) downgradient of the depleted uranium. Ground water from Tnbs_0 wells NC7-47, W-865-03, W-865-1804, and W-865-07, located far downgradient from the Pit 7 Complex, contains nitrate in excess of the MCL that is natural in origin. Maximum concentrations of perchlorate in ground water are currently above the 6 mg/L State Public Health Goal in ground water in both the Qal/WBR and Tnbs_0 HSUs. While source control or hydraulic diversion would prevent further releases of nitrate and perchlorate to ground water, the *ex situ* treatment system (Alternative 5a) or *in situ* treatment system (Alternative 5b) would include a treatment media to remove nitrate and perchlorate contamination in ground water. Treatment media, such as resins, would be added in series to the aboveground treatment system of Alternative 5a or would be emplaced with cow bone char in the subsurface *in situ* treatment system of Alternative 5b. Monitoring will continue to track any changes in concentrations and the extent of these contaminants in ground water that could impact human health or the environment.

Given the short half-life of tritium, once the tritium source in Pits 3 and 5 has been contained or controlled through the use of hydraulic diversion, monitored natural attenuation would reduce tritium activities in ground and surface water to meet remedial action objectives and achieve State and Federal chemical-specific ARARs within a reasonable timeframe as discussed in Section 3.3.1.2.3. Ground water in this area is not used as a drinking water supply. Modeling of tritium fate and transport in ground water from the Pits 3 and 5 area estimated that even with further releases from the pits, tritium activities would decrease to the 20,000 pCi/L MCL after a maximum of 45 years without impacting ground water offsite above background activities. Monitored natural attenuation for tritium would also prevent incurring risks associated with extracting tritiated ground water and bringing it to the surface for treatment. As discussed in Section 3.2 and Appendix F, there are currently no efficient or cost-effective technologies available to remediate tritiated ground water. Monitoring and continued modeling of tritium in ground water would help to determine how and if any changes in tritium activities or plume size may impact human health and potentially warrant more active remedial measures.

If further releases of uranium, nitrate, and perchlorate are reduced or eliminated by source control through hydraulic diversion, active *ex situ* or *in situ* phased treatment of these contaminants in ground water would reduce their concentrations or activities in ground water to meet ARARs. Ground water treatment would be conducted using a phased approach because design of the systems to treat uranium, nitrate, and perchlorate in ground water cannot be finalized until the effects of the hydraulic diversion system on local hydrologic conditions stabilized. These changes in hydrologic conditions will have the greatest impact on the design and placement of the *in situ* treatment system (permeable reactive barrier), less on the funnel and sump with an *ex situ* treatment system, and least on the extraction well, *ex situ* treatment, and reinjection system. The locations and depths of the funnel and sump system in Alternative 5a and the details of *in situ* permeable reactive barrier of Alternative 5b cannot be properly implemented until a new hydrologic equilibrium is attained. Ground water extraction using existing wells with *ex situ* treatment (Alternative 5a) could be implemented simultaneously with construction of the hydraulic diversion system if safety considerations allow.

Modeling results indicate that it may take up to 500 years for the funnel and sump extraction and treatment system (Alternative 5a) and the permeable reactive barrier (Alternative 5b) to reduce total uranium activities to below MCLs. Modeling results indicate that it may take up to 150 years to reduce total uranium activities to below MCLs using an extraction wellfield and *ex situ* treatment system (Alternative 5a). However, since total uranium activities were used in the model, the time to reduce depleted uranium activities to below MCLs may be less.

Alternative 5 (a and b) should adequately protect human health and the environment by preventing exposure to contaminants while the natural attenuation of tritium and extraction and *ex situ* treatment (Alternative 5a) or *in situ* treatment (Alternative 5b) of depleted uranium, nitrate, and perchlorate reduces activities/concentrations in ground water to health-protective and

ARAR-compliant levels. Monitoring would be used to demonstrate the effectiveness of the remedial measures in reducing contaminant levels to meet State and Federal chemical-specific ARARs in a reasonable timeframe. If necessary, modifications to the Site 300 Contingency Plan would include actions to be implemented in the event that these measures do not achieve remedial action objectives or compliance with ARARs.

3.4.2.5.2. Long-Term Effectiveness and Reduction in Toxicity, Mobility, and Volume. The irreversible decay of tritium in all environmental media, including ground water, would achieve a long-term and permanent reduction in toxicity, mobility, and volume of tritium in the subsurface. The extraction and treatment of ground water under Alternative 5a would reduce the volume and mobility of uranium, nitrate, perchlorate, and VOCs in ground water. Because the uranium collected in the resins used for ion exchange is not destroyed, radioactive decay would be relied upon to reduce the toxicity and volume of the uranium removed from ground water. Under Alternative 5b, the *in situ* reactive barrier would limit the migration of uranium, nitrate, and perchlorate in ground water. The *in situ* treatment component of Alternative 5b would also allow for the removal of contaminants collected in the excavated barrier treatment media when removed from the subsurface. *In situ* treatment of contaminants in Qal/WBR ground water, coupled with the extraction and *ex situ* treatment of contaminants in $Tnbs_0$ ground water, would also reduce the toxicity and volume of uranium, nitrate, and perchlorate in ground water at the Pit 7 Complex. Natural attenuation processes (i.e., radioactive decay) would be relied upon to permanently reduce the toxicity and volume of the contaminants sorbed to the treatment media.

The source control component of Alternatives 5 (a and b) would permanently reduce the mobility of contaminants in the pit waste or shallow vadose zone by preventing further releases of contaminants to the subsurface. It would not reduce the toxicity or volume of the contaminants as the contaminated waste would remain in place and chemically unchanged in the landfills. Some source control measures have already been implemented at Pits 4 and 7 through installation of a pit cap and drainage diversion system in 1992. Monitoring would be continued after State and Federal chemical-specific ARARs are achieved to ensure long-term effectiveness and permanence.

3.4.2.5.3. Short-Term Effectiveness. Exposure controls would prevent exposure of onsite workers and ecological receptors in the short-term. There would be minimal impact to onsite workers during monitoring activities and workers would follow Site 300 operational safety procedures to mitigate potential risks that may be posed during these activities. Workers would use appropriate protective procedures, clothing, and equipment to prevent the possibility of exposure during installation of either the extraction and treatment system of Alternative 5a or the *in situ* reactive barrier in Alternative 5b, and while performing system operation and maintenance, or drilling. Both Alternatives 5a and 5b pose additional short-term, and possibly long-term exposure risks in the handling and storage or disposal of uranium-contaminated ion exchange resin or cow bone char, respectively. This is due to the fact that uranium is removed and concentrated in ion exchange resins or cow bone char as part of the treatment process. Exposure control measures would be needed to prevent exposure to uranium. Under Alternative 5a, short-term exposure risk would also increase if tritiated ground waters were brought to the surface during ground water extraction.

If necessary, workers would use appropriate protective procedures, clothing, and equipment to prevent the possibility of exposure during installation of the hydraulic diversion system. However, since construction of this system would primarily occur outside the main area of contamination, the need for exposure control measures will likely be limited. Biological resource surveys would be conducted prior to any ground disturbing activities to ensure there are no impacts to ecological receptors.

Modeling indicates that it may take up to 150 to 500 years to reduce uranium activities to below MCLs using extraction wells and a funnel and sump system, respectively with *ex situ* treatment. However, human health would be protected because the remediation system would prevent plume migration once the source is controlled and the ground water in this area is not suitable for potable uses due to naturally high total dissolved solids concentrations in ground water. Also, there are no complete pathways for this ground water to reach human or ecological receptors. Therefore, DOE/LLNL believes that because human health and the environment will be protected during the period of time necessary to reach MCLs for uranium, Alternative 5 provides short-term effectiveness without impacting human health or the environment.

3.4.2.5.4. Implementability. All of the remedial components for Alternative 5 can be implemented at the Pit 7 Complex. Many of the exposure control methods are already in place. Monitoring and monitored natural attenuation can be implemented easily as an extensive monitor well system is already in place. Source control through hydraulic diversion is implementable.

The ground water treatment portion options for Alternatives 5a and 5b are both implementable. The operation of the *ex situ* ground water treatment system in Alternative 5a would require reinjection of the treated effluent due to the presence of tritium. The reinjection of treated water would need to be done in such a way as to prevent enhanced migration of COCs in ground water or the contamination of pristine ground water. The implementability of the *in situ* reactive barrier component of Alternative 5b is limited by issues associated with the removal and replacement of spent treatment materials in the subsurface barrier.

3.4.2.5.5. Cost. The estimated present worth costs of 30 years of exposure control, MNA of tritium, and hydraulic diversion, and *in situ* or *ex situ* treatment of nitrate, perchlorate, and uranium, and ground water monitoring in Alternative 5 ranges from $10,845,000 (extraction wells only) to $15,429,000 (funnel and sump with Tnbs_0 extraction wells) for Alternative 5a and is $21,082,000 for Alternative 5b depending on whether phased *ex situ* or *in situ* ground water treatment is implemented. The costs to implement Alternatives 5a and 5b are summarized in Table 3-10.

Although Alternative 5a and 5b were both costed for 30 years, modeling indicates that it could require up to 150 years for uranium activities to be reduced below the MCL under Alternative 5a and up to 500 years for Alternative 5b.

Because of the extremely conservative assumptions used in the modeling in which the cleanup times were estimated, it is possible that cleanup will be achieved more rapidly. The cost estimate for Alternative 5a and 5b is limited to 30 years due to: (1) uncertainty regarding the time required to achieve MCLs, and (2) the difficulty in accurately estimating annual costs in the far future. For Alternative 5a, the annual cost to maintain and operate the extraction and *ex situ* treatment system ranges from $142,000 (extraction wells only) to $306,000 (funnel and sump with Tnbs_0 extraction wells) in year 31. For Alternative 5b, the annual cost to maintain and operate the *in situ* Qal/WBR permeable reactive barrier system and Tnbs_0 well extraction and *ex situ* treatment system is $459,000 in year 31. These annual costs could be used to estimate longer-term cleanup costs associated with Alternative 5 (i.e., annual O&M cost x number of years).

3.4.3. Comparative Evaluation of Remedial Alternatives for the Pit 7 Complex

This section and Table 3-13 present a comparative evaluation of the characteristics of each alternative against the other alternatives for the Pit 7 Complex with respect to the first seven EPA criteria.

3.4.3.1. Overall Protection of Human Health and the Environment

Alternative 1 (no action) may not be protective of human health or the environment because without monitoring COCs in ground water, there would be no means of determining changes in plume size and location that could impact downgradient receptors. No water-supply wells are currently contaminated with VOCs, tritium, uranium, nitrate, or perchlorate originating from the Pit 7 Complex, or are located near plumes in this area.

Alternative 1 does not met the remedial action objectives to prevent potential inhalation of tritium by onsite workers above health-based concentrations in the vicinity of Pit 3. Fencing and full-time security patrols are in place to prevent public access to the plume and source areas, but there are currently no controls in-place to prevent exposure to onsite workers. There was no unacceptable risk or hazard to ecological receptors in the Pit 7 complex identified in the baseline risk assessment.

Alternatives 2, 3 (a and b), 4 (a and b), and 5 (a and b) address risk to human health from potential ingestion of contaminated ground water and inhalation of tritium fluxing from subsurface soil/rock. These alternatives include the same measures to prevent exposure of human and ecological receptors to contamination while contaminant concentrations/activities are being reduced, such as administrative controls to prevent access to contaminated ground water.

Alternatives 2, 3 (a and b), 4 (a and b), and 5 (a and b) include measures to reduce contaminant concentrations and mass in ground water and monitor for changes that could impact human health and the environment. The monitored natural attenuation and monitoring components of Alternatives 2, 3 (a and b), 4 (a and b), and 5 (a and b) include monitoring and modeling of contaminant fate and transport in ground water that would help to determine any changes in contaminant activities or plume size that could impact human health and warrant more active remedial measures. While it may take up to 500 years to reduce uranium activities and mass to meet MCLs under Alternatives 2 and 4 (a and b), human health would be protected because the plume would not significantly migrate once the source is controlled and the ground water in this area is not suitable for potable uses due to naturally high total dissolved solid concentrations in ground water. Also, there are no complete pathways for this ground water to reach human or ecological receptors. Therefore, DOE/LLNL believes that Alternatives 2 and 4 (a and b) can protect human health and the environment during the time period necessary to reduce uranium mass to meet MCLs. However, EPA and the State regulatory agencies do not agree that 500 years is an acceptable timeframe for achieving MCLs or other RAOs for uranium. Under Alternatives 2 and 4 (a and b), nitrate and perchlorate concentrations in ground water would be reduced to meet regulatory standards by natural processes well in advance of depleted uranium.

The *ex situ* or *in situ* treatment of depleted uranium, nitrate, and perchlorate in Alternatives 3 (a and b)and 5 (a and b) would reduce activities/concentrations of these contaminants to levels that are protective of human health and the environment. Thus, all these alternatives would provide long-term and effective protection of human health and the environment.

The excavation component of Alternatives 2 and 3 (a and b) would provide additional long-term protection for human health and the environment by removing the contaminant source thereby mitigating tritium inhalation risk and reducing the chances of further releases to ground water. Exposure potential for workers will increase during excavation and disposal. Offsite disposal would entail risks associated with transport of potentially hazardous materials on public roads. The hydraulic diversion component of Alternatives 4a and 5 (a and b) and the hydraulic barrier component of Alternative 4b would provide long-term protection for human health and the environment by preventing ground water contact with contaminant sources thereby preventing further releases to ground water. In addition, as discussed above DOE/LLNL believe that Alternatives 2 and 4 (a and b) can protect human health and the environment during the time period necessary to reach MCLs for uranium. However, EPA and the State regulatory agencies do not agree that 500 years is an acceptable timeframe for achieving MCLs or other RAOs for uranium. In summary, all of the remedial alternatives, except for Alternative 1, protect human health and the environment. However, several of the alternatives increase risk to workers by bringing contaminated media to the surface such as during the excavation of landfill wastes (Alternatives 2 and 3a and b), *ex situ* treatment of uranium-contaminated ground water (Alternatives 3a and 5a), and the excavation and disposal of spent *in situ* treatment media (Alternatives 3b and 5b).

3.4.3.2. Compliance with ARARs

A comparative evaluation of the remedial alternatives against action- and location-specific ARARS is presented in Table 3-14. The comparative evaluation of the alternatives against chemical-specific ARARs is discussed in this section.

Alternative 1 (no action) may not comply with ARARs. Natural attenuation, primarily the radioactive decay of tritium and uranium, would act to reduce contaminant concentrations. However, there are no provisions in this alternative to monitor for the attainment of ARARs and the timeframe to reduce concentrations to MCLs or lower may not be reasonable without source control or source isolation measures to prevent further releases.

Alternatives 2, 3 (a and b), 4 (a and b), and 5 (a and b) include measures to meet State and Federal ground water chemical-specific ARARs by reducing contaminant concentrations/activities to MCLs, water quality objectives, or below. These alternatives provide for source control or source isolation measures to prevent further releases of contaminants to the subsurface. Alternatives 2 and 3 (a and b) include waste excavation and Alternatives 4 (a and b) and 5 (a and b) either hydraulic diversion or barriers to prevent contaminant releases to ground water. Because the waste excavation proposed in Alternatives 2 and 3 (a and b) would not include removal of bedrock containing residual contamination, these alternatives may not be as effective in meeting ARARs as Alternatives 4 (a and b) and 5 (a and b), which employ hydraulic diversion or barriers to prevent water contact with waste and any future degradation of water quality. These alternatives all rely on monitored natural attenuation to reduce tritium activities in ground water to meet State and Federal chemical-specific ARARs. Monitoring and modeling data indicate that tritium should meet ARARs in a reasonable timeframe whether or not source control or source isolation measures are implemented.

Alternatives 2 and 4 (a and b) rely on sorption, dispersion, and diffusion to reduce uranium activities, and nitrate and perchlorate concentrations in ground water. While it may take up to 500 years to reduce uranium activities and mass to meet MCLs, human health would be protected because the plume would not significantly migrate once the source is controlled and the ground water in this area is not suitable for potable uses due to naturally high total dissolved solid concentrations in ground water. Also, there are no complete pathways for this ground water to reach human or ecological receptors. Therefore, DOE/LLNL believes that since human health and the environment will be protected during the time period necessary to reach MCLs for uranium, Alternatives 2 and 4 (a and b) are capable of achieving RAOs and ARARs without impacting human health or the environment. This timeframe should also be adequate to reduce perchlorate and nitrate concentrations to below WQOs. However, EPA and the State regulatory agencies do not agree that 500 years is an acceptable timeframe for achieving MCLs or other RAOs for uranium.

Alternatives 3 (a and b) and 5 (a and b) provide measures to actively reduce the activities/concentrations and mass of depleted uranium, nitrate, and perchlorate in ground water to meet ARARs. Modeling results indicate that it may take up to 500 years for the funnel and sump extraction and treatment system in Alternatives 3a and 5a and the permeable reactive barrier in Alternatives 3b and 5b to reduce total uranium activities to below MCLs. Modeling results indicate that it may take up to 150 years to reduce total uranium activities to below MCLs using an extraction wellfield and *ex situ* treatment system (Alternatives 3a and 5a). However, since total uranium activities were used in the model, the time to reduce depleted uranium activities to below MCLs may be less.

In summary, all the alternatives, except for Alternative 1, would prevent future releases of COCs to ground water and employ monitored natural attenuation to reduce pre-existing ground water tritium contamination to meet ARARs. *In situ* or *ex situ* treatment provided under Alternatives 3 (a and b) and 5 (a and b) can reduce uranium activities in ground water faster to meet ARARs than monitoring (Alternatives 2 and 4a and b) alone.

3.4.3.3. Long-Term Effectiveness and Permanence

Alternative 1 (no action) may provide some long-term effectiveness in meeting ARARs or permanently reducing contaminant concentrations. The radioactive decay of tritium and uranium is irreversible and hence effective in the long term and permanent.

Alternatives 2, 3 (a and b), 4 (a and b), and 5 (a and b) provide long-term effectiveness through the control or containment of contaminant sources, and the natural attenuation of contaminants in ground water.

The excavation component of Alternatives 2 and 3 (a and b) provides the most permanent, long-term solution for the Pit 7 Complex, though the contaminated waste would be transferred to another disposal site.

The *ex situ* or *in situ* treatment components of Alternatives 3 (a and b) and 5 (a and b) would permanently remove uranium, nitrate, and perchlorate from the subsurface and control the migration of contaminants more rapidly than by natural attenuation only. Once the landfill sources are isolated, the treatment of uranium, nitrate, and perchlorate would only be required until these pre-existing anthropogenic contaminants in ground water are removed. Thus, the ground water treatment technologies proposed would be effective in the long term.

The source control (hydraulic diversion) and containment (hydraulic barrier) components of Alternatives 4 (a and b) and 5 (a and b) would isolate contaminant sources in the vadose zone outside the landfill, that would not be controlled or contained under other alternatives.

The excavation component of Alternatives 2 and 3 (a and b) would provide for the most effective and permanent prevention of future contaminant releases from the landfills to ground water, but would not prevent future releases from the contaminated vadose zone. The drainage diversion and barrier components of Alternatives 4 (a and b) and 5 (a and b) would be effective and permanent in preventing future chemical releases from all source areas but might require some maintenance and repair in the future. The *ex situ* or *in situ* treatment components of Alternatives 3 (a and b) and 5 (a and b) would permanently remove uranium, nitrate, and perchlorate from the subsurface and control the migration of these contaminants more rapidly than by natural attenuation (Alternatives 2 and 4 a and b) only.

3.4.3.4. Reduction of Toxicity, Mobility, and Volume

While Alternative 1 does not remove COCs from the subsurface, the natural attenuation of contaminants may result in the long-term reduction of toxicity, mobility, and volume of contaminants if further releases do not occur.

Alternatives 2, 3 (a and b), 4 (a and b), and 5 (a and b) all rely on the monitored natural attenuation of tritium in ground water to achieve a long-term reduction in toxicity, mobility, and volume of tritium in the subsurface. Alternatives 2 and 4 (a and b) rely on sorption to reduce the mobility of depleted uranium in ground water, however the toxicity and volume would not be reduced. If the uranium plume does not behave as anticipated, contingency actions could be implemented.

The excavation component of Alternatives 2 and 3 (a and b) would reduce the mobility of the contaminants in the pit waste by removing any waste that constitutes a significant source, thus preventing further leaching of contaminants to the subsurface. It would not reduce the toxicity or volume of the contaminants as the waste would be redeposited at a new location. Because the waste excavation proposed in Alternatives 2 and 3 (a and b) does not include removal of bedrock containing residual contamination, these alternatives would not reduce the toxicity, mobility, or volume of contaminants remaining in the vadose zone compared to Alternatives 4 and 5.

The extraction and *ex situ* treatment component of Alternatives 3a and 5a would reduce the volume and mobility of uranium, nitrate, and perchlorate, and some VOCs in ground water. Because the uranium collected in the treatment media is not destroyed, radioactive decay would be relied upon to reduce the toxicity and volume of the uranium removed from ground water.

Alternatives 3b and 5b employ *in situ* reactive barriers to limit the mobility of uranium, nitrate, and perchlorate by sorption onto reactive materials within the barrier. Removal of the spent barrier materials would reduce the volume of uranium in the subsurface. Because the uranium collected on the ion exchange resins and cow bone char is not destroyed, radioactive decay would be relied upon to reduce the toxicity and volume of the uranium removed from ground water.

The source control component of Alternatives 4a and 5 (a and b) and the source isolation component of Alternatives 4b would reduce the mobility of contaminants in the pit waste or shallow vadose zone by preventing further releases of contaminants to the subsurface. These techniques would not reduce toxicity or volume of the contaminants, as the contaminated waste would remain in place.

In summary, only the natural attenuation of tritium (Alternative 1) or monitored natural attenuation of tritium (Alternatives 2, 3 (a and b), 4 (a and b), and 5 (a and b) will quickly reduce the toxicity of this contaminant in the Pit 7 Complex.

The mobility of contaminants will be curtailed by all of the alternatives, though excavation (Alternatives 2 and 3 [a and b]) will only prevent migration from landfill wastes, as vadose zone contaminant sources will remain. Drainage diversion (Alternatives 4a and 5 [a and b]) is superior to excavation in that vadose zone releases will also be prevented and local ground water gradients will be reduced, effectively slowing pre-existing tritium and uranium plume migration. The barrier containment proposed in Alternative 4b will prevent further releases of contaminants to ground water but may not reduce plume migration as effectively as the drainage diversion alternatives.

The proposed *ex situ* (Alternatives 3a and 5a) and *in situ* (Alternatives 3b and 5b) treatment technologies will reduce mobility of uranium, nitrate and perchlorate more than the monitoring proposed under Alternatives 2 and 4 (a and b). The *ex-situ* technique will remove the uranium, nitrate, and perchlorate from the aquifer as the contaminated water is pumped from the subsurface and treated. The *in situ* technique will concentrate the waste on the treatment media in the ground until removal and replacement at approximately ten-year intervals. Both techniques should be equally effective in reducing contaminant mobility, although pumping contaminated water from the funnel and sump system proposed for *ex situ* treatment provides for somewhat more complete capture than passive capture from the reactive borehole array proposed for *in situ* treatment. The installation of the *in situ* barrier would require careful emplacement and flow modeling to assure adequate residence time and flow into the reactive media.

Only the radioactive decay of tritium will reduce the volume of contamination within a reasonable timeframe. This decay will occur under all the alternatives. Excavation as proposed under Alternatives 2 and 3 (a and b) will remove contaminants from the subsurface, but will not reduce the volume as the excavated waste will be disposed at a different location.

3.4.3.5. Short-Term Effectiveness

Since there would be no remediation-related construction occurring in Alternative 1, there would be no short-term impact to human or ecological receptors.

Exposure control components of Alternatives 2, 3 (a and b), 3 (a and b), 4 (a and b) and 5 (a and b) would all protect human and ecological receptors from exposure to contamination in the short-term. There would be minimal impact to onsite workers for the monitoring component of these alternatives, as workers would follow Site 300 operational safety procedures to mitigate potential risks that may be posed during monitoring activities.

The monitored natural attenuation of tritium and monitoring of depleted uranium components of Alternatives 2, 3 (a and b), 3 (a and b), 4 (a and b) and 5 (a and b) would also protect human and ecological receptors from exposure to contamination in the short-term. Allowing tritium to naturally attenuate and depleted uranium to disperse, sorb, diffuse, and to a lesser extent, radioactively decay below the ground surface would prevent exposure of onsite workers to these contaminants that would occur in bringing ground water to the surface for *ex situ* treatment.

Alternatives 2 and 3 (a and b) have the potential for short-term exposure for onsite workers during waste excavation and disposal. This is likely to increase the number of exposure pathways, as well as disrupt habitat, increasing the potential for short-term exposure and impacts to the environment. A much higher level of exposure control would be necessary to prevent short-term exposure of onsite workers and ecological receptors during excavation. Offsite disposal would require measures to prevent exposure during the transport of potentially hazardous materials over public roads.

The *ex situ* treatment component of Alternatives 3a and 5a pose short-term and possibly long-term exposure risk to onsite workers as contaminants, including tritium, depleted uranium, perchlorate, and VOCs, would be brought to the surface. Workers could be exposed during the installation, operation and maintenance of the treatment systems and the handling and storage of uranium-contaminated resin. This is due to the fact that uranium is removed and concentrated in ion exchange resins as part of the treatment process. Exposure control measures would be needed to prevent exposure until the uranium is safely disposed.

Alternatives 3b and 5b slightly increase the short-term exposure risk for workers while installing the *in situ* permeable reactive barrier and removing contaminated barrier materials at ten-year intervals. Operational safety procedures would minimize risk to prevent exposure to materials containing uranium until they are safely disposed. Such exposure protection should not be an issue as the uranium is principally an ingestion hazard.

The source control/hydraulic diversion component of Alternatives 4a and 5 (a and b) and the source isolation/hydraulic barrier component of Alternative 4b may slightly increase the short-term exposure risks for workers while installing the diversion or barrier system. However, since the construction of these systems would primarily occur outside the main area of contamination, the need for short-term exposure control measures would likely be limited. If necessary, workers would use appropriate protective procedures, clothing, and equipment to prevent the possibility of exposure during the installation these systems.

Alternative 1 would be the least effective in terms of the time to cleanup compared to the other alternatives because without source control, contaminant releases would continue. Modeling indicates that it may take up to 500 years to reduce uranium activities to below MCLs under Alternatives 2 and 4, and between 150 to 500 years for Alternatives 3 and 5. However, human health would be protected in all alternatives because the plume would not significantly migrate once the source is controlled and the ground water in this area is not suitable for potable uses due to naturally high total dissolved solids concentrations in ground water. Also, there are no complete pathways for this ground water to reach human or ecological receptors. Therefore, DOE/LLNL believes that because human health and the environment will be protected during the period of time necessary to reach MCLs for uranium, all alternatives provide short-term effectiveness without impacting human health or the environment. MCLs would be achieved more rapidly using Alternatives 3 and 5 than using Alternatives 2 and 4 due to active remediation of uranium in ground water.

In summary, the greatest short-term exposure to workers could occur during excavation and disposal of landfill wastes as proposed under Alternatives 2 and 3 (a and b). The *ex situ* and *in situ* treatment of uranium (Alternatives 3 [a and b] and 5 [a and b]) pose lesser potential short-term and long-term exposures as contaminated ground water and spent reactive materials are brought to the surface and disposed of. There may be an effective trade-off with the increase in exposure risk posed by extracting and treating uranium-contaminated ground water (Alternatives 3a and 5a), which would also contain tritium, or removing exhausted *in situ* reactive media (Alternatives 3b and 5b) to the surface, thereby increasing the number of exposure pathways and the need for controls. Cleanup of uranium to meet MCLs would be achieved more rapidly using Alternatives 3 and 5 than using Alternatives 1, 2, and 4.

3.4.3.6. Implementability

No actions would be necessary to implement Alternative 1.

The monitoring components of Alternatives 2, 3 (a and b), 4 (a and b) and 5 (a and b) can be implemented easily. Most of the monitoring network is already in-place, although the installation of additional monitor wells may be necessary.

Many of the exposure control measures in Alternatives 2, 3a and b, 4a and b, and 5a and b are also already in-place but additional exposure controls would need to be evaluated and implemented, as necessary.

The monitored natural attenuation component of Alternatives 2, 3 (a and b), 4 (a and b) and 5 (a and b) can also be implemented easily.

The excavation of landfill waste under Alternatives 2 and 3 (a and b) is implementable but would require extensive provisions to prevent exposure and protect the safety of onsite workers, transport personnel, and the public during transport of the waste, as well as resolution of potential disposal issues. It would also require locating a facility permitted and willing to accept low-level mixed waste at a reasonable cost.

The *ex situ* ground water treatment portion of Alternatives 3a and 5a is implementable but is limited by the likelihood of extracting tritium along with the other contaminants. The operation of the *ex situ* ground water treatment system would require reinjection of the treated effluent in such a way as to prevent enhance migration of COCs in ground water or the contamination of pristine ground water.

The *in situ* ground water treatment (reactive barrier) component of Alternatives 3b and 5b is implementable but is limited by issues associated with the removal and replacement of spent materials in the subsurface barriers and permitting requirements for the long-term storage of uranium-contaminated materials. The *in situ* reactive barrier may require Waste Discharge Requirements to ensure that residual materials or byproducts protect beneficial uses of ground water.

The source control/hydraulic diversion component of Alternatives 4a and 5 (a and b) and the source isolation/hydraulic barrier component of Alternative 4b are implementable. The implementability of the hydraulic barrier may be limited by special engineering considerations necessary to prevent ground water mounding under pressure that would compromise the integrity of the slurry wall barrier.

In summary, monitoring, exposure controls, and monitored natural attenuation can all be implemented easily. The other remedial measures presented are all implementable, but would require special engineered measures or controls to: (1) protect worker safety and dispose of landfill wastes during excavation (Alternatives 2 and 3[a and b]), (2) prevent enhanced migration of contaminants during *ex-situ* uranium treatment in Alternatives 3a and 5a, (3) replace and dispose of reactive materials generated by *in situ* uranium treatment in Alternatives 3b and 5b, and (4) install the hydraulic barrier component of Alternative 4b.

3.4.3.7. Cost

The estimated present worth of the life-cycle costs for the Pit 7 Complex alternatives ranges from no cost for Alternative 1 to $69,287,000 for Alternative 3b. Costs are summarized in Table 3-10. Significant differences in the costs of the alternatives are due to the following differences in the alternatives listed below. Compared to the other alternatives:

- Alternative 1 has no cost as no remedial action would occur.
- The estimated present-worth cost of the landfill waste excavation and disposal, 30 years of exposure control, monitored natural attenuation of tritium, and ground water monitoring in Alternative 2 is $56,635,000.

  Although Alternative 2 was costed for 30 years, modeling indicates that it could require up to 500 years for uranium to attenuate to the MCL. For Alternative 2, the annual present-worth cost to monitor depleted uranium in ground water is $73,000 in year 31. The annual present-worth monitoring cost for year 31 could be used to estimate longer-term cleanup costs associated with Alternative 2, although the reliability of these estimates decreases as the duration of the remedy increases.
- The estimated present-worth cost of landfill waste excavation and disposal, and 30 years of exposure control, monitored natural attenuation of tritium, extraction and *ex situ* treatment of uranium, nitrate, and perchlorate, and ground water monitoring in Alternative 3a ranges from $63,741,000 to $68,326,000. The lower end of the cost range includes Qal/WBR and $Tnbs_0$ ground water extraction from wells and *ex situ* treatment followed by reinjection to wells and the higher end cost includes ground water extraction using a funnel and sump system combined with $Tnbs_0$ ground water extraction using wells with *ex situ* treatment followed by reinjection.

  Although Alternative 3a was costed for 30 years, modeling indicates that it could require up to 150 years for uranium activities to be reduced below the MCL using extraction wells, *ex situ* treatment of uranium, and reinjection of treated water. Modeling results show that it could take up to 500 years if a single funnel and sump extraction system is used. For Alternative 3a, the annual cost range to maintain and operate the extraction and *ex situ* treatment systems is $137,000 (extraction wells) to $301,000 (funnel and sump with $Tnbs_0$ extraction wells) in year 31. The annual present-worth monitoring costs for year 31 could be used to estimate longer-term cleanup costs associated with Alternative 3a, although the reliability of these estimates decreases as the duration of the remedy increases.
- The estimated present-worth cost of landfill waste excavation and disposal, and 30 years of exposure control, monitored natural attenuation of tritium, *in situ* treatment of uranium, nitrate, and perchlorate, and ground water monitoring presented in Alternative 3b is $73, 979,000.

  Although Alternative 3b was costed for 30 years, modeling indicates that it could require up to 500 years for uranium activities to be reduced below the MCL using *in situ* treatment of uranium. For Alternative 3b, the annual cost to maintain and operate the *in situ* Qal/WBR permeable reactive barrier system and $Tnbs_0$ ground water extraction and *ex situ* treatment system is $454,000 in year 31. The annual present-worth monitoring cost for year 31 could be used to estimate longer-term cleanup costs associated with Alternative 3b, although the reliability of these estimates decreases as the duration of the remedy increases.

- The present-worth cost of Alternative 4a for 30 years of monitoring, exposure control, monitored natural attenuation of tritium, and source control by hydraulic diversion is $3,738,000.

  Although Alternative 4a was costed for 30 years, modeling indicates that it could require up to 500 years for uranium to attenuate to the MCL. For Alternative 4a, the annual present-worth cost to monitor depleted uranium in ground water and provide operation and maintenance of the hydraulic diversion system is $78,000 in year 31. The annual present-worth monitoring cost for year 31 could be used to estimate longer-term cleanup costs associated with Alternative 4a, although the reliability of these estimates decreases as the duration of the remedy increases.

- The present-worth cost of Alternative 4b for 30 years of monitoring, exposure control, monitored natural attenuation of tritium, and source control using hydraulic barriers is $4,344,000.

  Although Alternative 4b was costed for 30 years, modeling indicates that it could require up to 500 years for uranium to attenuate to the MCL. For Alternative 4b, the annual present-worth cost to monitor depleted uranium in ground water and operate and maintain the hydraulic barrier is $79,000 in year 31. The annual present-worth monitoring cost for year 31 could be used to estimate longer-term cleanup costs associated with Alternative 4b, although the reliability of these estimates decreases as the duration of the remedy increases.

- The estimated present worth costs of 30 years of exposure control, monitored natural attenuation of tritium, hydraulic diversion, extraction and *ex situ* treatment of nitrate, perchlorate, and uranium, and ground water monitoring in Alternative 5a ranges from $10,845,000 to $15,429,000. The lower end of the cost range includes ground water extraction from Qal/WBR and $Tnbs_0$ wells and *ex situ* treatment followed by reinjection to wells and the higher end cost includes Qal/WBR ground water extraction using a funnel and sump system coupled with $Tnbs_0$ ground water extraction using wells with *ex situ* treatment and reinjection.

  Although Alternative 5a was costed for 30 years, modeling indicates that it could require up to 150 years for uranium activities to be reduced below the MCL using extraction wells, *ex situ* treatment of uranium, and reinjection of treated water. Modeling results show that it could take up to 500 years if a single funnel and sump extraction system is used. For Alternative 5a, the annual cost range to maintain and operate the extraction and *ex situ* treatment systems is $142,000 (extraction wells only) to $306,000 (funnel and sump with $Tnbs_0$ extraction wells) in year 31. The annual present-worth monitoring cost for year 31 could be used to estimate longer-term cleanup costs associated with Alternative 5a, although the reliability of these estimates decreases as the duration of the remedy increases.

- The estimated present worth costs of 30 years of exposure control, monitored natural attenuation of tritium, hydraulic diversion, extraction and *in situ* treatment of nitrate, perchlorate, and uranium, and ground water monitoring in Alternative 5b is $21,082,000.

  Although Alternative 5b was costed for 30 years, modeling indicates that it could require up to 500 years for uranium activities to be reduced below the MCL using *in situ* treatment of uranium. For Alternative 5b, the annual cost to maintain and operate the *in situ* Qal/WBR permeable reactive barrier system coupled with Tnbs_0 extraction wells with *ex situ* treatment is $459,000 in year 31. The annual present-worth monitoring cost for year 31 could be used to estimate longer-term cleanup costs associated with Alternative 5b, although the reliability of these estimates decreases as the duration of the remedy increases.

3.5. Environmental Considerations

The Record of Decision, issued on January 21, 1993, for the August 1992 Final EIS/EIR for Continued Operation of Lawrence Livermore National Laboratory and Sandia National Laboratory, Livermore, California (U.S. DOE, 1992) published DOE's decision to continue operation of LLNL, including near-term proposed projects. One of the proposed actions described in the 1992 Environmental Impact Statement/Environmental Impact Report (EIS/EIR) is the remediation of soil and ground water contamination at Site 300.

Section II.E of the DOE Secretarial Policy Statement on the National Environmental Policy Act (NEPA) requires that when DOE remedial actions under CERCLA of 1980 trigger the procedures set forth in NEPA, the procedural and documentation requirements of NEPA and CERCLA are to be integrated. Integration is to be accomplished by conducting the NEPA and CERCLA environmental planning and review procedures concurrently to avoid duplication, conflicting analysis, and delays in implementing remedial action on procedural grounds. This integration will be accomplished by conducting the NEPA evaluation during the RI/FS process, supplemented as needed to meet the requirements of NEPA.

In accordance with 10 Code of Federal Regulations (CFR) 1021.300, DOE shall determine, under the procedures in the Council of Environmental Quality (CEQ) regulations, whether any DOE proposal requires preparation of an EIS, Environmental Assessment (EA), or is categorically excluded from preparation of an EIS or an EA. It is expected that the preferred remedy for the remediation of Pit 7, once selected, would either require preparation of an EA or be categorically excluded. To determine if the project is categorically excluded, DOE would determine whether the preferred remedy fits within a class of actions listed in Appendix A or B of 10 CFR 1021 Subpart D. If the preferred remedy does fall within the class of actions listed, further review would be done to ensure that the project: (1) does not violate any existing regulation or requirement, (2) does not require siting or construction of a waste facility, (3) would not release existing contaminants to the environment, and does not adversely affect environmentally sensitive resources. If the preferred remedy fits within these guidelines the project would be categorically excluded from preparing an EA. If the preferred remedy does not fit within these guidelines then an EA would be prepared. The EA would include discussion on the relationship of the proposed project to other activities at LLNL, the environmental setting and potentially affected environment, potential environmental impacts and accidents, and cumulative impacts.

4. References

Arnold, R.A. (2002), *Report on the Threatened Valley Elderberry Longhorn Beetle and its Elderberry Food Plant at the Lawrence Livermore National Laboratory–Site 300.* Entomological Consulting Services, Ltd. Pleasant Hill, Calif.

Bethke, G. (2003), The Geochemist's Workbench, Geochemical Modeling Package, Rockware Inc. and the University of Illinois.

Bloom, P.H. (2002), *Breeding Raptor and Loggerhead Shrike Status and Management Recommendations for Site 300, Lawrence Livermore National Laboratory*, Livermore, Calif.

Buddemeier, R.W. (1985), *Investigation of Tritium in Ground Water at Site 300*, Lawrence Livermore National Laboratory, Livermore, Calif. (UCID-20600).

Buddemeier, R.W., M.R. Ruggieri, and J.A. Oberdorfer (1987), *Tritium in Ground Water at Site 300*, Lawrence Livermore National Laboratory, Livermore, Calif. (UCID-21031).

California Environmental Protection Agency (Cal-EPA) (1992), Memorandum from Standards and Criteria Work Group to California EPA Departments, Boards, and Offices regarding California Cancer Potency Factors, dated June 18, 1992.

Carlsen, T.M., E. Espeland, and A. Smith (2002), *Rare Plant Restoration and Monitoring at Lawrence Livermore National Laboratory Site 300 Project Progress Report, Fiscal Year 2001, October 2000–September 2001,* Lawrence Livermore National Laboratory, Livermore, Calif. (UCRL-AR-142408-01).

Carlsen, T., V. Dibley, S. Gregory, V. Madrid, M. Taffet, and J. Valett (September 30, 2003), *First Semester 2003 Compliance Report for Lawrence Livermore National Laboratory Site 300*, Lawrence Livermore National Laboratory, Livermore, Calif.

Carpenter, D.W., J.R. Copland, A.L. Lamarre, R.S. Mateik, M.J. Taffet, and W.M. Wade (1992), *Investigation of Holocene Faulting Near Closed Landfill Pit 6, Lawrence Livermore National Laboratory Site 300*, Lawrence Livermore National Laboratory, Livermore, Calif. (UCRL-ID-106316).

Clark, H.O., D.A. Smith, B.L. Cypher, and P.A. Kelly (2002), *Mesocarnivore surveys on Lawrence Livermore National Laboratory, Site 300*, California State University, Stanislaus, Endangered Species Recovery Program, Fresno, Calif.

Dibblee, T.W., Jr. (1980), Preliminary Geologic Map of the Midway Quadrangle, Alameda and San Joaquin Counties, California, USGS Open-File Report 80-535.

Ferry, L., R. Ferry, W. Isherwood, R. Woodward, T. Carlsen, Z. Demir, R. Qadir, and M. Dresen (1999), *Final Site-Wide Feasibility Study for Lawrence Livermore National Laboratory Site 300*, Lawrence Livermore National Laboratory, Livermore, Calif. (UCRL-AR-132609).

Ferry, R., L. Ferry, M. Dresen, and T. Carlsen (2002), *Compliance Monitoring Plan/Contingency Plan for Interim Remedies at Lawrence Livermore National Laboratory Site 300*, Lawrence Livermore National Laboratory, Livermore, Calif. (UCRL-AR-147570).

Flanagan, D.C., and M.A. Nearing (1995), *Status of the WEPP Computer Code as of July 1995.* Appendix in "WEPP Technical Documentation". National Soil Erosion Research Laboratory, NSERL Report No. 10.

Fuller, C.C., J.R. Bargar, and J.A. Davis (2003), "Molecular- Scale Characterization of Uranium Sorption by Bone Apatite Minerals for a Permeable Reactive Barrier Demonstration," *Environ. Sci. and Technol.* **37**, 4642–4649.

Hoffman, F. (1988), "Fault Investigation at Pit 1," LLNL Site 300 letter to Michael L. Higgins, Regional Water Quality Control Board-Central Valley Region, December 15, 1988.

Krauter, G. (2004), Lawrence Livermore National Laboratory, B Division, Livermore, Calif., memorandum to Michael Taffet, LLNL, Environmental Restoration Division, Livermore, Calif., June 21, 2004, "Use of Natural Uranium in Explosives Experiments at Site 300 Firing Bunkers."

Lawrence Livermore National Laboratory (LLNL) (2003), Lawrence Livermore National Laboratory Environmental Report 2002, August 29, 2003, Lawrence Livermore National Laboratory, Livermore, Calif. (UCRL-50027-02).

Lide, D.R. (Ed.) (1991–1992) Handbook of Chemistry and Physics, 72nd ed., CRC Press.

Lindeken, C.L. and D.A. Hieb (1989), *Past and Present Uses, Storage and Disposal of Hazardous Materials at the Lawrence Livermore National Laboratory's Site 300*, Lawrence Livermore National Laboratory, Livermore, Calif.

Orloff, S. (1986), *Wildlife Studies at Site 300, Emphasizing Rare and Endangered Species, Lawrence Livermore National Laboratory, San Joaquin County, California*, *November, 1986*, Biosystems Analysis, Inc., Santa Cruz, CA. Prepared for Science Applications International Corporation, Pleasanton, Calif.

Parkhurst, D.L. (1995) *User's Guide to PHREEQC-A Computer Program for Speciation, Reaction-Path, Advective-Transport, and Inverse Geochemical Calculations*, United States Geological Survey Water Resources Investigations Report 95-4227, Lakewood, Colorado.

Preston, R.E. (2002a), *Special-status Plant Species Surveys and Vegetation Mapping at Lawrence Livermore National Laboratory*, Jones and Stokes, Sacramento, Calif.

Preston, R.E. (2002b), *Delineation of Waters of the United States for Lawrence Livermore National Laboratory, Site 300*, Jones and Stokes, Sacramento, Calif.

Raber, E., D. Helm, D. Carpenter, D. Pfeifer, and J. Sweeney (1982), *Site 300 Hazardous Waste Assessment Project, Interim Report: November 1981, Preliminary Site Reconnaissance and Project Work Plan*, Lawrence Livermore National Laboratory, Livermore, Calif. (UCID-19315).

Rainey, B. (2003), Personal communication with Lisa Paterson, LLNL Operations and Regulatory Affairs Division, July 2003.

Rogers/Pacific Corporation (1990), *Closure and Post-Closure Plans Volume II, Landfill Pits 1 and 7*, prepared for Lawrence Livermore National Laboratory, Livermore, Calif. (EPA ID No. 2890090002).

Seraydarian, R. (1992), Remedial Project Manager, U.S. EPA, Region IX, San Francisco, Calif., personal communication to L.C. Hall, Environmental Scientist, Environmental Sciences Division, LLNL, regarding use of a 2% frequency of detection criterion for the inclusion or exclusion of contaminants of potential concern in certain environmental media at Lawrence Livermore National Laboratory Site 300, Livermore, Calif., January 27, 1992.

Simmons, L. (1992), personal communications with Michael Wade, Laurene Green, Jack Gardner, and Gwen Caviness, Weiss Associates, and Dave Carpenter, Michael Taffet, and Neil Crow, LLNL.

Swaim, K. (2002), *Results of Surveys for Special Status Reptiles at the Site 300 facilities of Lawrence Livermore National Laboratory*, Swaim Biological Consulting, Livermore, Calif.

Taffet, M.J., and A.L. Lamarre (1989), *Remedial Investigation of Landfill Pit 9 Lawrence Livermore National Laboratory Site 300*, Lawrence Livermore National Laboratory, Livermore, Calif. (UCID-21764).

Taffet, M.J., L.K. Green-Horner, L.C. Hall, T.M. Carlsen, and J.A. Oberdorfer (1996), *Addendum to the Site-Wide Remedial Investigation Report*, *Lawrence Livermore National Laboratory Site 300*, *Building 850/Pit 7 Complex Operable Unit*, Lawrence Livermore National Laboratory, Livermore, Calif. (UCRl-AR108131 Add. 1).

Taffet, M.J., L.K. Green-Horner, R.J. Woodward, and J.A. Oberdorfer (1997), *Draft Engineering Evaluation/Cost Analysis for the Building 850/Pits 3 and 5 Operable Unit, Lawrence Livermore National Laboratory Site 300*, Lawrence Livermore National Laboratory, Livermore, Calif. (UCRL-AR-126386DR).

Taffet, M.J., (2004), *Study of the Chemical Reactions Controlling the Mobility of Uranium in Ground and Surface Water Systems in Contact with Apatite*, Lawrence Livermore National Laboratory, Livermore, Calif. (UCRL-TR-203891).

Tayor, D.W. and W. Davilla (1986a), *A rare plant survey of Site 300, Lawrence Livermore National Laboratory, San Joaquin County, California, July 18, 1986*, Biosystems Analysis, Inc., Santa Cruz, CA. Prepared for Science Applications International Corporation, Pleasanton, Calif.

Tayor, D.W., and W. Davilla (1986b), *Vegetation of Site 300, Lawrence Livermore National Laboratory, San Joaquin County, California, November, 1986*, Biosystems Analysis, Inc., Santa Cruz, CA. Prepared for Science Applications International Corporation, Pleasanton, Calif.

Tibor, D.P. (Ed.) (2001), *California Native Plant Society's Inventory of Rare and Endangered Plants of California, 6th edition*. California Native Plant Society, Sacramento, Calif.

U.S. Army Corps of Engineers (1995), *Hydrologic Evaluation of Landfill Performance (HELP) Model*, U.S. Army Corps of Engineers, Washington, D.C.

U.S. Department of Energy (DOEa) (1992), *Lawrence Livermore National Laboratory Site 300 Federal Facility Agreement Under CERCLA Section 120*, Lawrence Livermore National Laboratory. Livermore, Calif.

U.S. Department of Energy (DOE) (1992b), *Environmental Impact Statement and Environmental Impact Report for Continued Operation of Lawrence Livermore National Laboratory and Sandia National Laboratories*, *Livermore, California*, U.S. Department of Energy, Washington, D.C. (DOE/EIS-0157).

U.S. DOE (2001), *Interim Site-Wide Record of Decision for Lawrence Livermore National Laboratory Site 300,* Lawrence Livermore National Laboratory, Livermore, Calif. (UCRL-AR-138470).

U.S. EPA (1988), *Superfund Exposure Assessment Manual*, EPA/540/1-88/001, OSWER Directive 9355.3-01, U.S. Environmental Protection Agency, Office of Remedial Response, Washington, D.C.

U.S. EPA (1989a), *Risk Assessment Guidance for Superfund, Vol. I: Human Health Evaluation Manual, Interim Final,* Office of Emergency and Remedial Response, U.S. Environmental Protection Agency, Washington, D.C. (EPA/540/1-89/002).

U.S. EPA (1989b), *Risk Assessment Guidance for Superfund, Vol. II: Human Health Evaluation Manual, Interim Final,* Office of Emergency and Remedial Response, U.S. Environmental Protection Agency, Washington, D.C. (EPA/540/1-89/001).

U.S. EPA (1990), *Exposure Factors Handbook*, Office of Health and Environmental Assessment, U.S. Environmental Protection Agency, Washington, D.C. (EPA 600-8-89-043).

U.S. EPA (1991a), *Risk Assessment Guidance for Superfund, Vol. I: Human Health Evaluation Manual, Supplemental Guidance—"Standard Default Exposure Factors,"* Interim Final, Office of Emergency and Remedial Response, Toxics Integration Branch, U.S. Environmental Protection Agency, Washington, D.C. (OSWER Directive: 9285.6–03).

U.S. EPA (1991b), Memorandum issued on the "Role of the Baseline Risk Assessment in Superfund Remedy Selection Decisions," OSWER Directive 9355.0-30.

U.S. EPA (1992a), *Health Effects Summary Tables*, Supplement No. 2 to the March 1992 Annual Update, Office of Research and Development, Office of Emergency and Remedial Response, U.S. Environmental Protection Agency, Washington, D.C. (OERR 9200.6-303 [92-3]).

U.S. EPA (1992b), *Integrated Risk Information System (IRIS),* an electronic database maintained by the U.S. Environmental Protection Agency, Office of Research and Development, Environmental Criteria and Assessment Office, Cincinnati, Ohio.

U.S. EPA (1992c), *Health Effects Assessment Summary Tables*, *FY-1992 Annual*, Office of Research and Development, Office of Emergency and Remedial Response, U.S. Environmental Protection Agency, Washington, D.C. (OHEA ECAO-CIN-821).

U.S. EPA (1993), Memorandum from D. Stralka, Ph.D., U.S. Environmental Protection Agency Region IX, to L. Tan, Remedial Project Manager, U.S. Environmental Protection Agency Region IX, regarding a "Technical request from Linda Hall at Lawrence Livermore National Laboratory" for toxicity values for PCE, TCE, and tetrahydrofuran, dated February 25, 1993.

U.S. EPA (1996), *Presumptive Response Strategy and Ex Situ Treatment Technologies for Contaminated Ground Water at CERCLA Sites, Final Guidance*, Office of Solid Waste and Emergency Response Directive 9283.1-12, Washington, D.C. (EPA 540/R-96/023).

U.S. EPA (1997), *Use of Monitored Natural Attenuation at Superfund, RCRA Corrective Action, and Underground Storage Tank Sites*, Office of Solid Waste and Emergency Response (OSWER), Directive 9200.4-17.

U.S. Environmental Protection Agency (EPA) (2000), *A Guide to Developing and Documenting Cost Estimates During the Feasibility Study*, Office of Emergency and Remedial Response, Washington, D.C. (EPA 540-R-00-002) OSWER 9355.0-75.

U.S. EPA (2004), Region 9 PRG Table 2004 Update, October 1, 2004. Obtained from http://www.epa.gov/region09/waste/sfund/prg/index.htm on October 28, 2004.

U.S. EPA (2003), Radionuclide Toxicity and Preliminary Remediation Goals for Superfund, April 12, 2003. Obtained from http://epa-prgs.ornl.gov/radionuclides/ on October 28, 2003.

USGS (1992),"*WATSTORE" a computerized database of ground water quality data, selected data obtained for the Central Valley of California*, United States Geological Survey, Water Resources Division, Sacramento, Calif.

Van Hattem, M. (2003a), *The Current and Historical Distribution of Special Status Amphibians at the Livermore Site and Site 300*, Lawrence Livermore National Laboratory, Livermore, Calif.

Van Hattem, M. (2003b), *LLNL Avian Monitoring Program Variable Circular Plot Point Count and Constant Mist Netting,* Lawrence Livermore National Laboratory, Livermore, Calif.

Weber, W. (2002), *2001-2002 Wet Season Branchiopod Survey Report, University of California Lawrence Livermore National Laboratory, Site 300*, Alameda and San Joaquin Counties. Condor Country Consulting, Hayward, Calif.

WEPP User Summary (1995), NSERL Report No. 11, USDA-AR-MWA, July 1995.

West, E. (2002), *Small Mammal Inventory at Lawrence Livermore National Laboratory, Site 300*, Jones and Stokes, Sacramento, Calif.

Webster-Scholten, C.P., Ed. (1994), *Final Site-Wide Remedial Investigation Report*, *Lawrence Livermore National Laboratory Site 300*, Lawrence Livermore National Laboratory, Livermore, Calif. (UCRL-AR-108131).

Wood, C. (2004), Lawrence Livermore National Laboratory, B Division, Livermore, Calif., memorandum to Michael Taffet, LLNL, Environmental Restoration, Livermore, Calif., June 15, 2004, "Site 300 Depleted Uranium."

Woodward-Clyde Consultants (1979), "Geotechnical Investigation Advanced Test Accelerator, Lawrence Livermore National Laboratory, unpublished consultants report."

Ziagos, J., and E. Reber-Cox (1998), *Ground Water Tritium Plume Characterization Summary Report for the Building 850/Pits 3&5 Operable Unit, Lawrence Livermore National Laboratory Site 300*, Lawrence Livermore National Laboratory, Livermore, Calif.

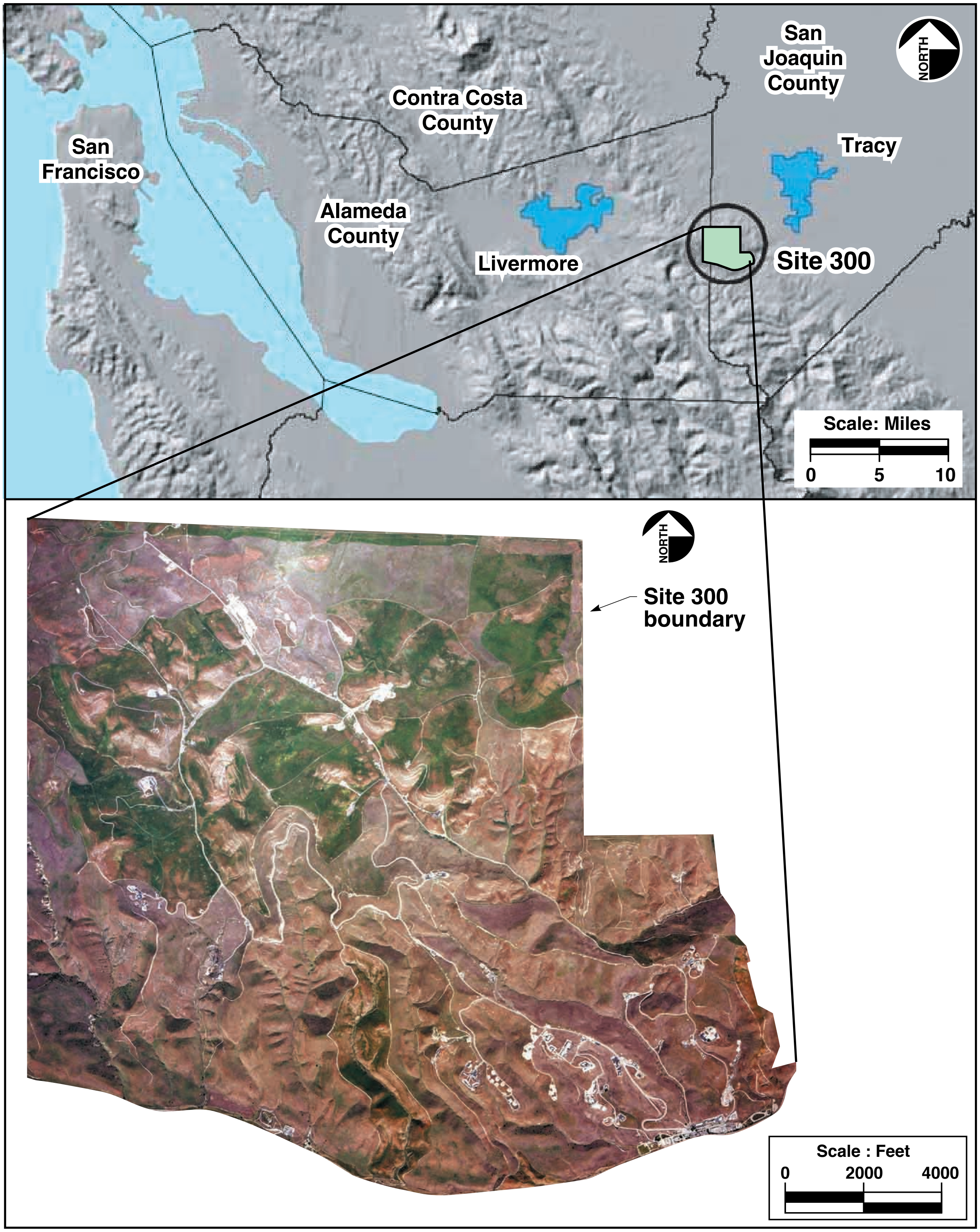
5. Acronyms and Abbreviations

AOC	Area of concern
ARARs	Applicable or Relevant and Appropriate Requirements
CAMU	Corrective action management unit
CCR	California Code of Regulations
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
Ci	Curies
cm	centimeters
cm^3	cubic centimeters
cm/sec	centimeters per second
CNPS	California Native Plant Society
COC	Contaminants of Concern
DCE	Dichloroethylene

DOE	Department of Energy
DTSC	(California) Department of Toxic Substances Control
EFA/WFA	East Firing Area/West Firing Area
EIS/EIR	Environmental Impact Statement /Environmental Impact Report
EPA	Environmental Protection Agency
FFA	Federal Facility Agreement
ft	feet
ft^2	square feet
ft/day	feet per day
ft/ft	feet per feet
ft/sec	feet per second
GAC	Granular activated carbon
^3H	Tritium
^3He	Helium-3
^4He	Helium-4
HSU	Hydrostratigraphic unit
in.	inch
in./yr	inches per year
LLNL	Lawrence Livermore National Laboratory
m^2	Square meters
mCi	milliCuries
MCL	Maximum Contaminant Level
mg/kg	milligrams per kilogram
mg/L	milligrams per liter
mi^2	square miles
mm	millimeters
mm/day	millimeters per day
mm/hr	millimeters per hour
m/sec	meters per second
m/yr	meters per year
MNA	Monitored Natural Attenuation
NEPA	National Environmental Policy Act
OU	Operable Unit
PCE	Perchloroethylene
pCi/g	Picocuries per gram
pCi/L	Picocuries per liter
pCi/L_{sm}	Picocuries per liter in soil moisture
pCi/m^3	Picocuries per cubic meter
pCi/yr	Picocuries per year
pg/g	Picograms per gram

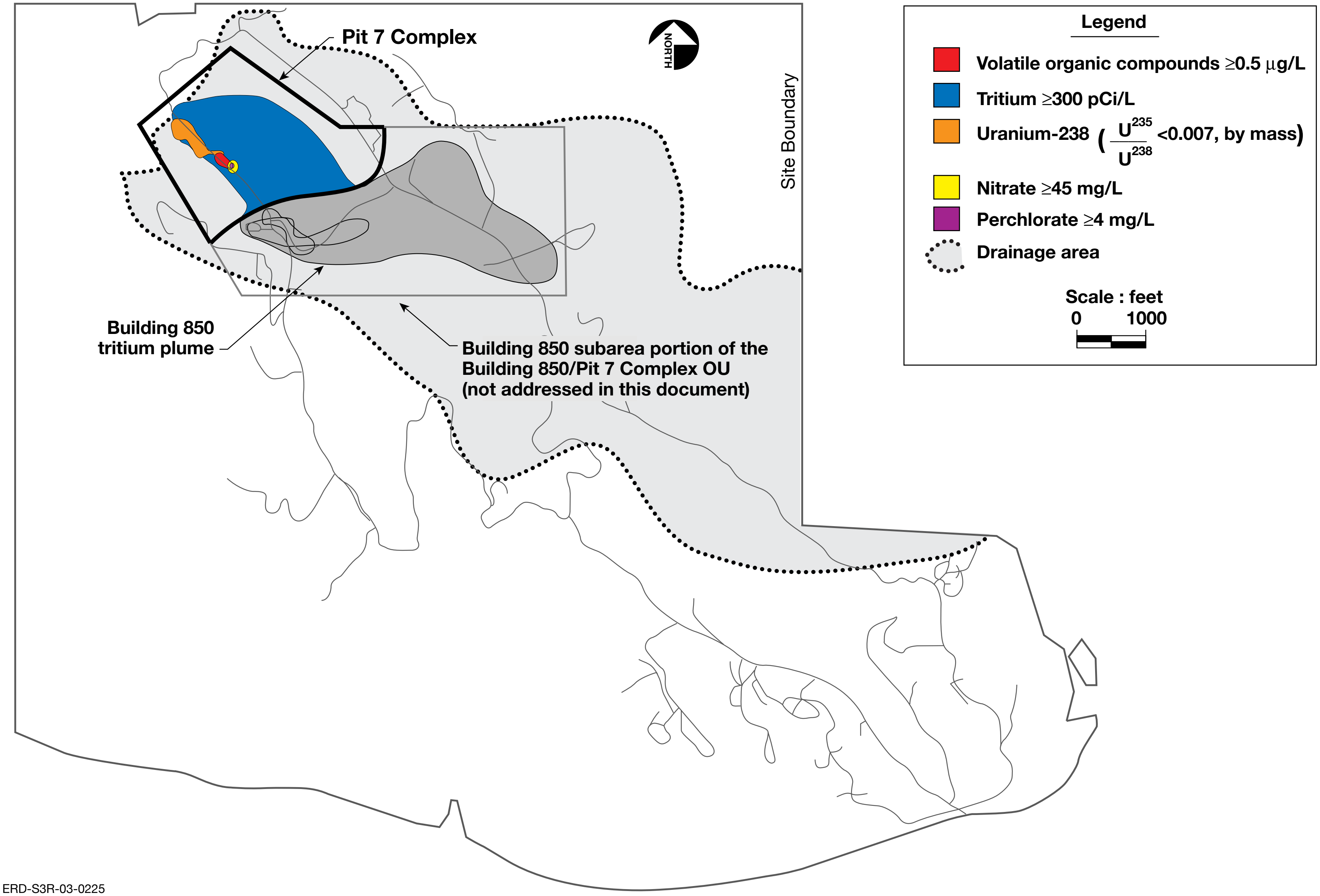
PRG	Preliminary Remediation Goal (EPA Region IX)
Qal	Quaternary alluvium
^{226}Ra	Radium-226
^{228}Ra	Radium-228
RAOs	Remedial Action Objectives
RCRA	Resource Conservation and Recovery Act
RI	Remedial Investigation
RI/FS	Remedial Investigation/Feasibility Study
ROD	Record of Decision
RWQCB	(California) Regional Water Quality Control Board
SARA	Superfund Amendments and Reauthorization Act
SWFS	Site-Wide Feasibility Study
SWRCB	(California) State Water Resources Control Board
SWRI	Site-Wide Remedial Investigation
TCE	Trichloroethylene
Th	Thorium
^{228}Th	Thorium-228
^{230}Th	Thorium-230
^{232}Th	Thorium-232
Tmss	Tertiary Cierbo Formation
$Tnbs_0$	Tertiary Neroly basal sandstone
$Tnbs_1$	Tertiary Neroly lower blue sandstone
$Tnsc_0$	Tertiary Neroly basal siltstone/claystone
TMV	Toxicity, mobility, and volume
U	Uranium
^{234}U	Uranium-234
^{235}U	Uranium-235
^{236}U	Uranium-236
^{238}U	Uranium-238
UCRL	University of California Radiation Laboratory
VOCs	volatile organic compounds
WBR	Weathered bedrock
WEPP	Water Erosion Prediction Project
yd^2	square yards
yd^3	cubic yards
μg/L	micrograms per liter
°C	degrees Celsius
°F	degrees Fahrenheit

Figures



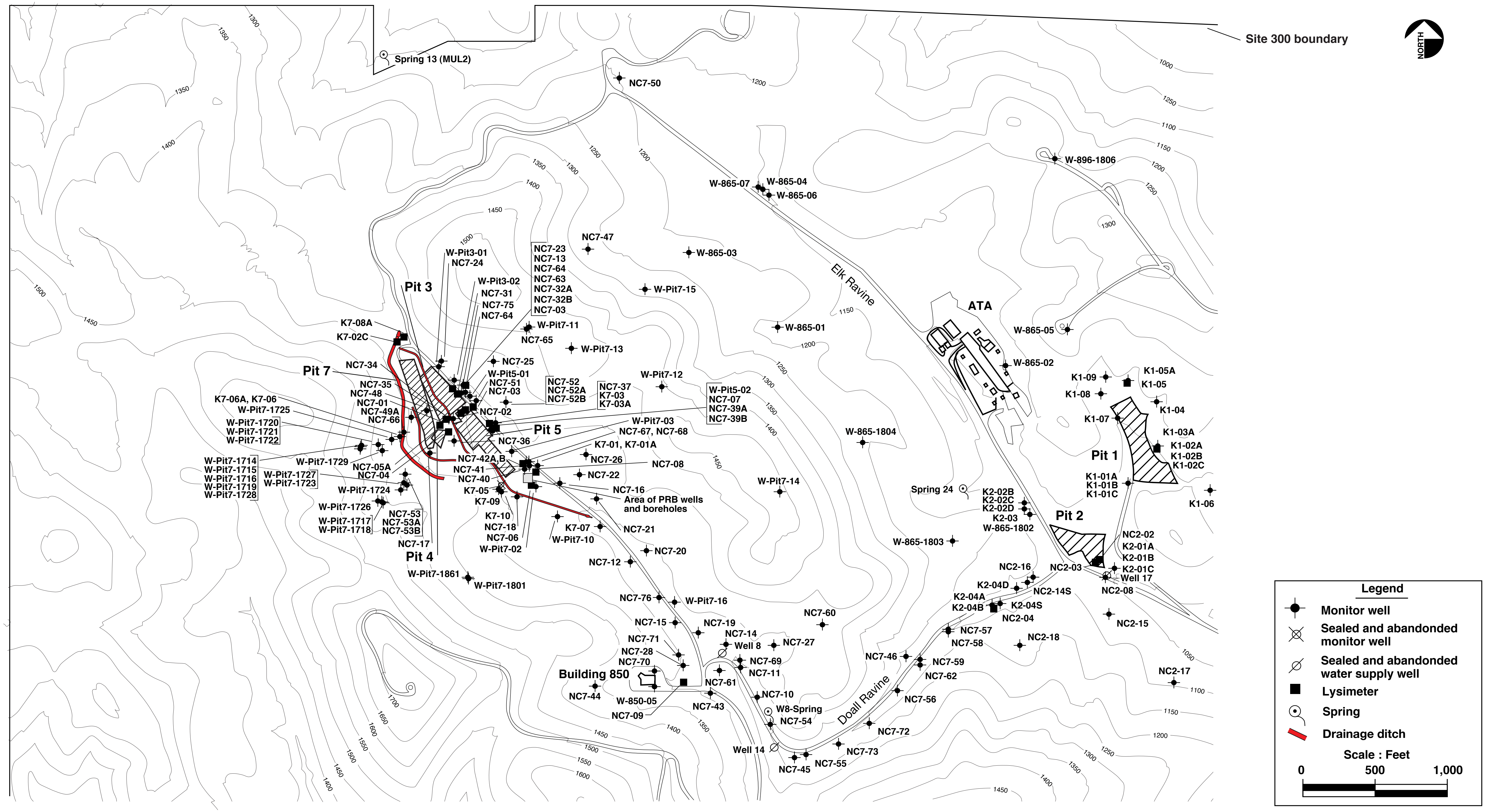
ERD-S3R-03-0218

Figure 1-1. Location of LLNL Site 300.



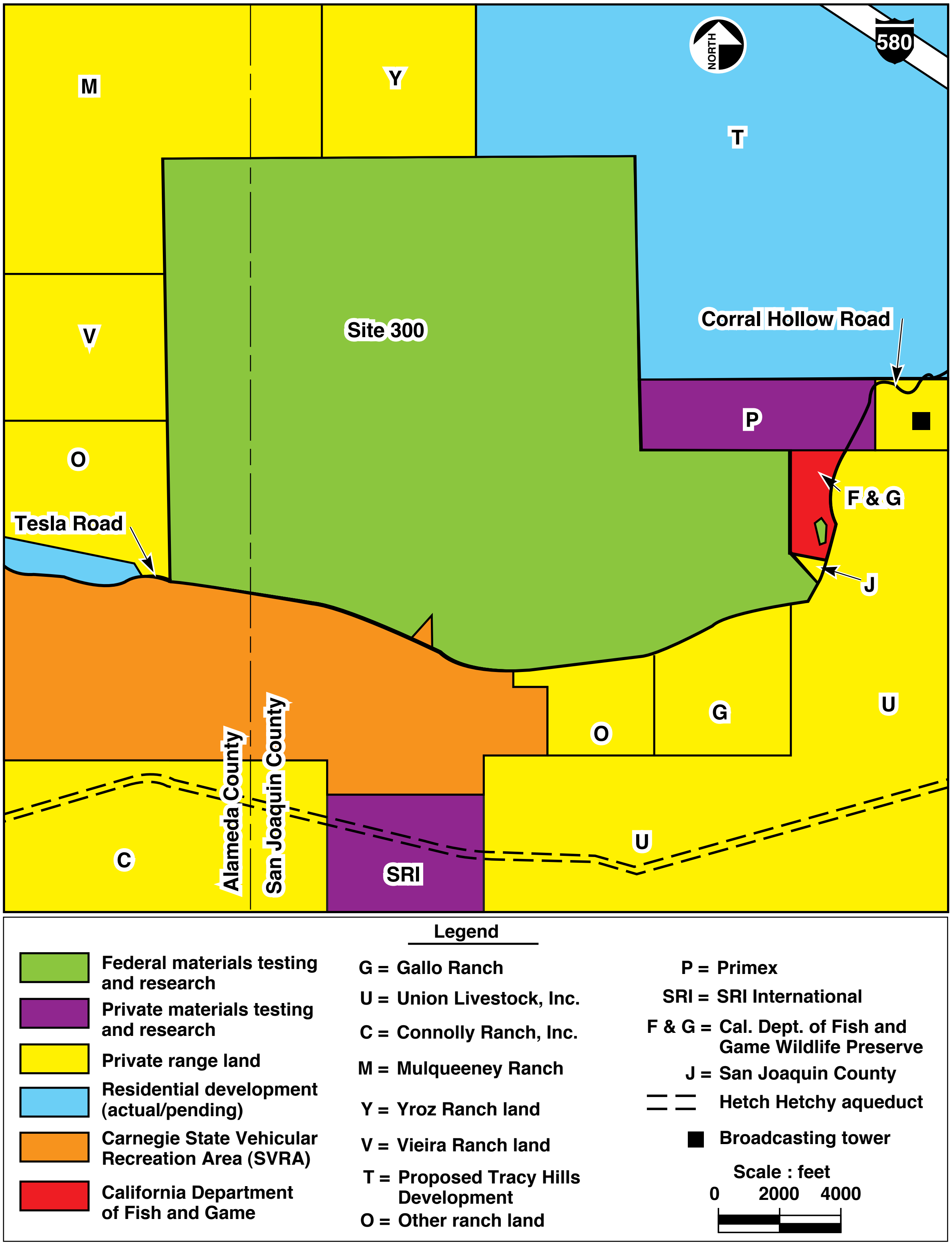
ERD-S3R-03-0225

Figure 1-2. Site 300 map showing location of the Pit 7 Complex.



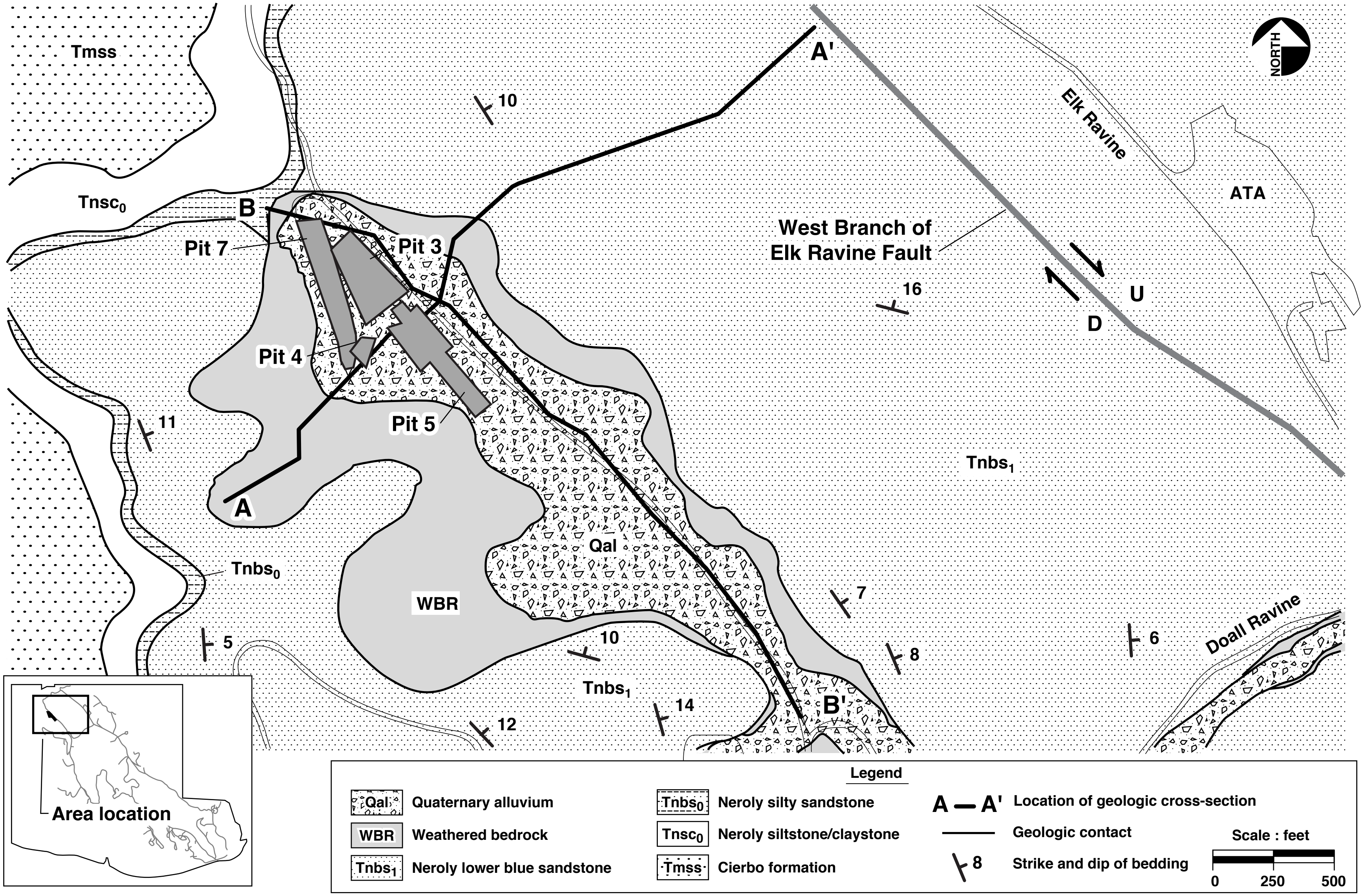
ERD-S3R-03-0228

Figure 1-3. Pit 7 Complex Area map showing topography, roads, buildings, wells, lysimeters, springs, pits, and drainage ditches.



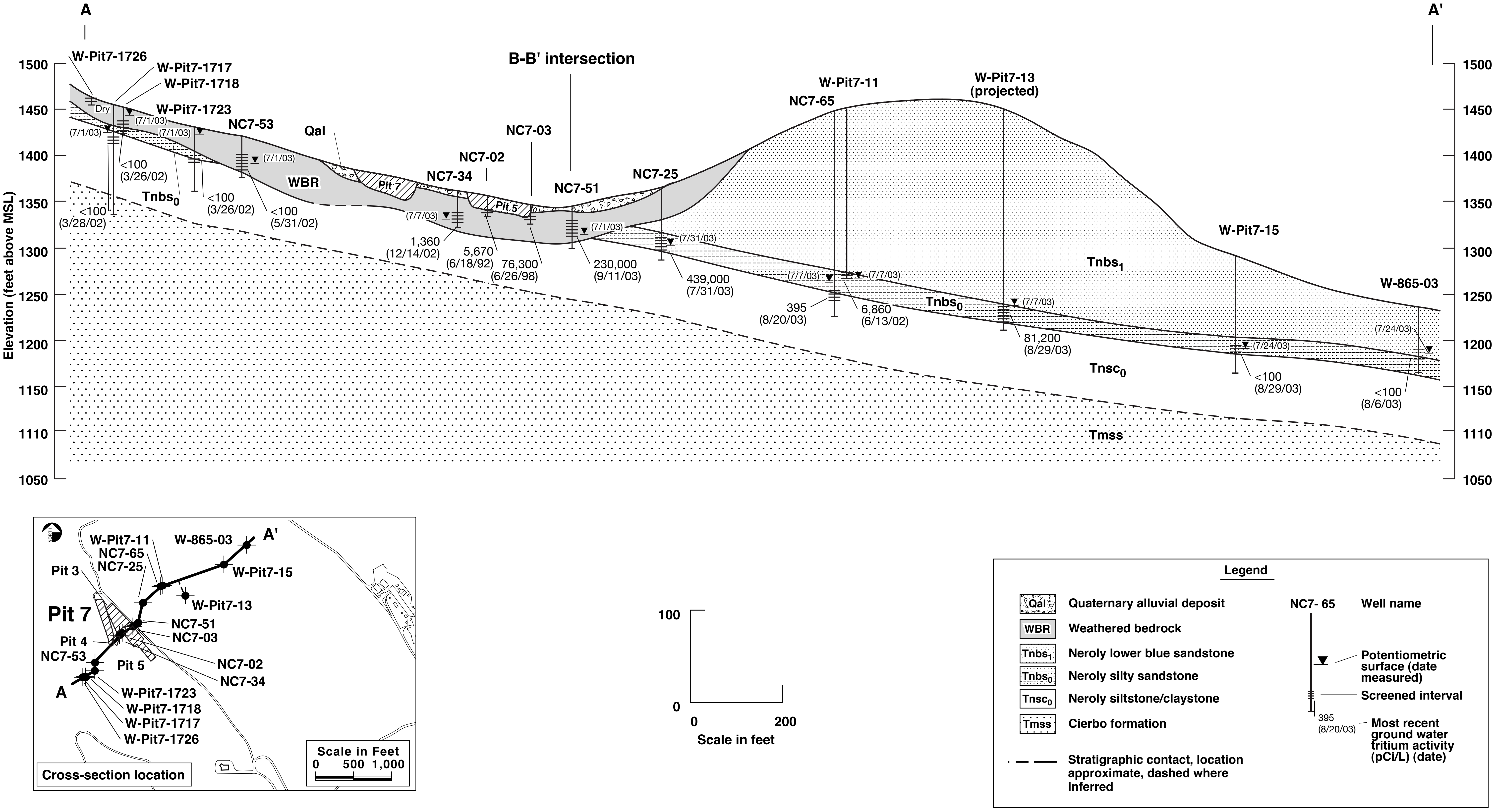
ERD-S3R-03-0231

Figure 1-4. Land use in the vicinity of the Site 300.



ERD-S3R-03-0221

Figure 2-1. Geologic map of the Pit 7 Complex Area.



ERD-S3R-03-0213

Figure 2-2. Hydrogeologic cross-section A-A', Pit 7 Complex Area, LLNL Site 300.

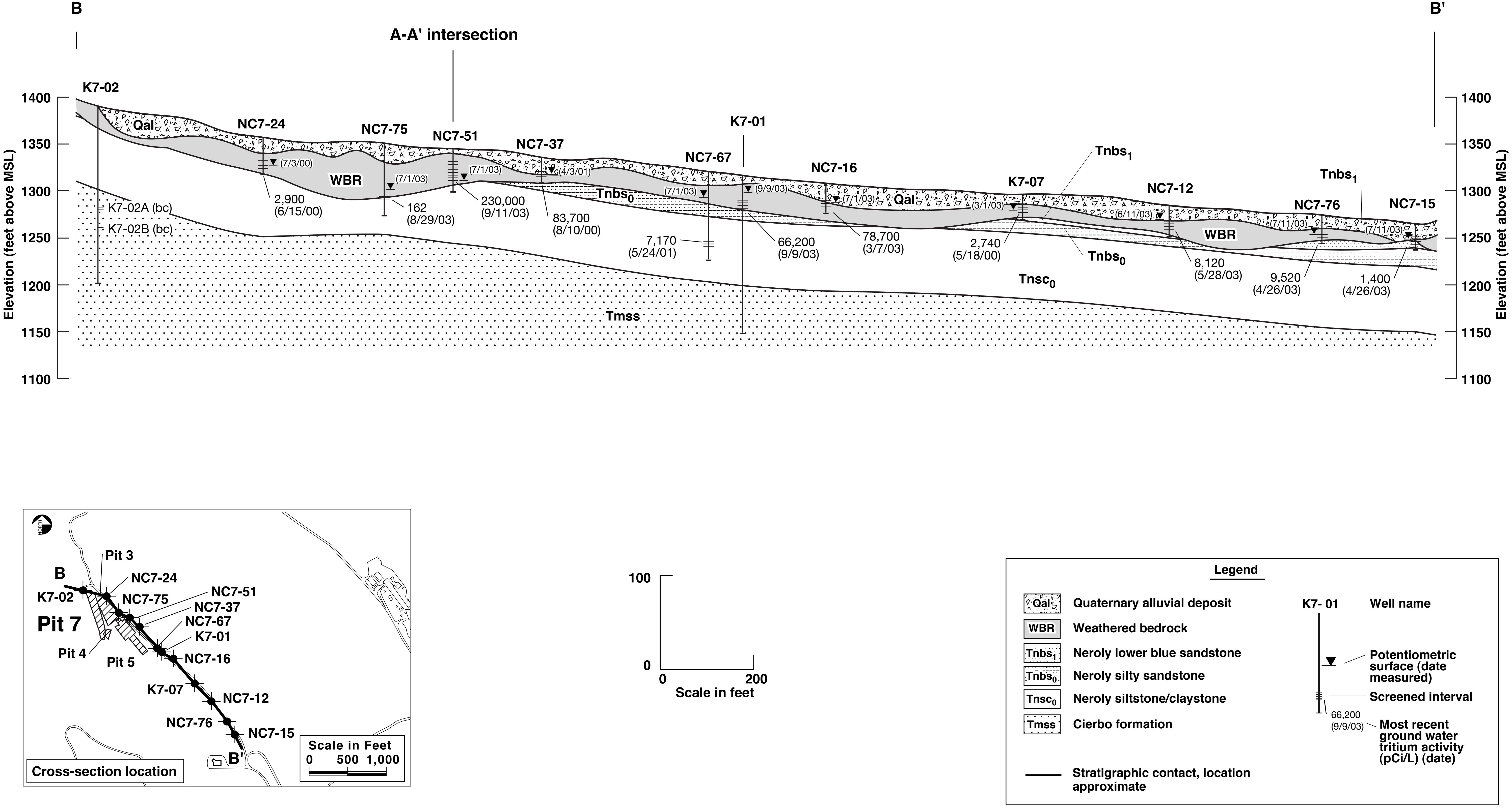
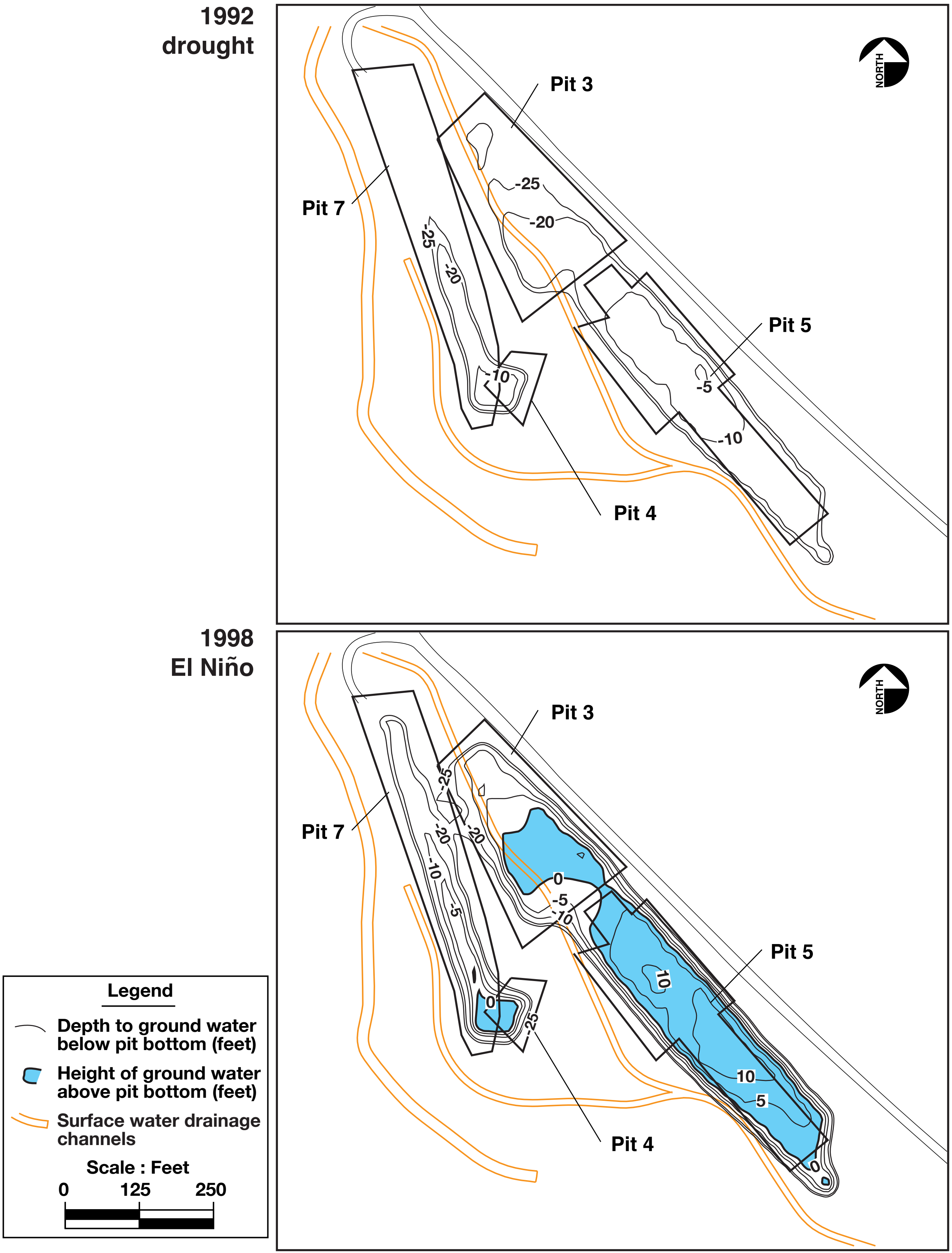


Figure 2-3. Hydrogeologic cross-section B-B', Pit 7 Complex Area, LLNL Site 300.



ERD-S3R-04-0049

Figure 2-4. Ground water depth in relation to pit bottom at the Pit 7 Complex in 1992 (drought) and 1998 (El Niño).

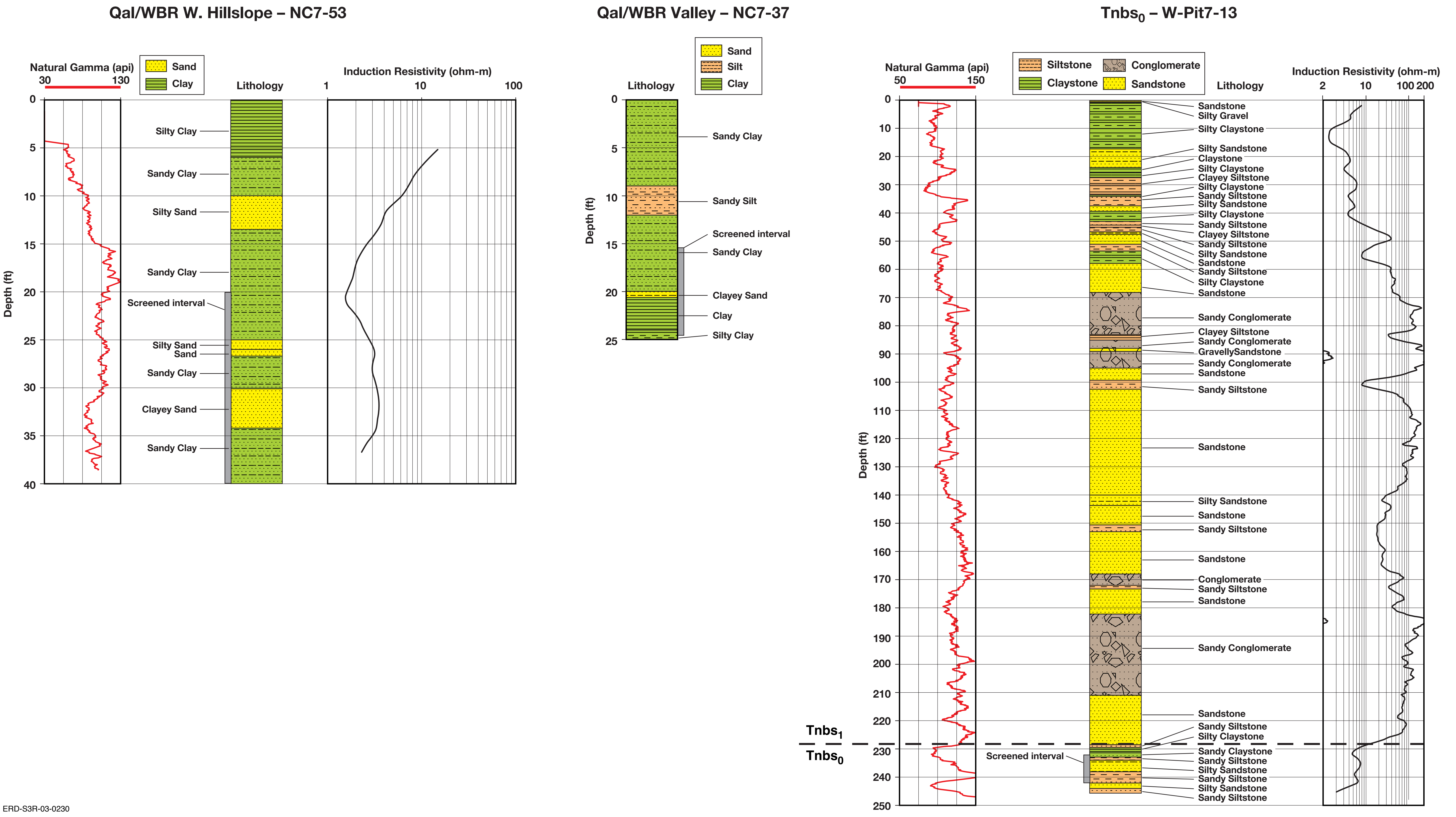
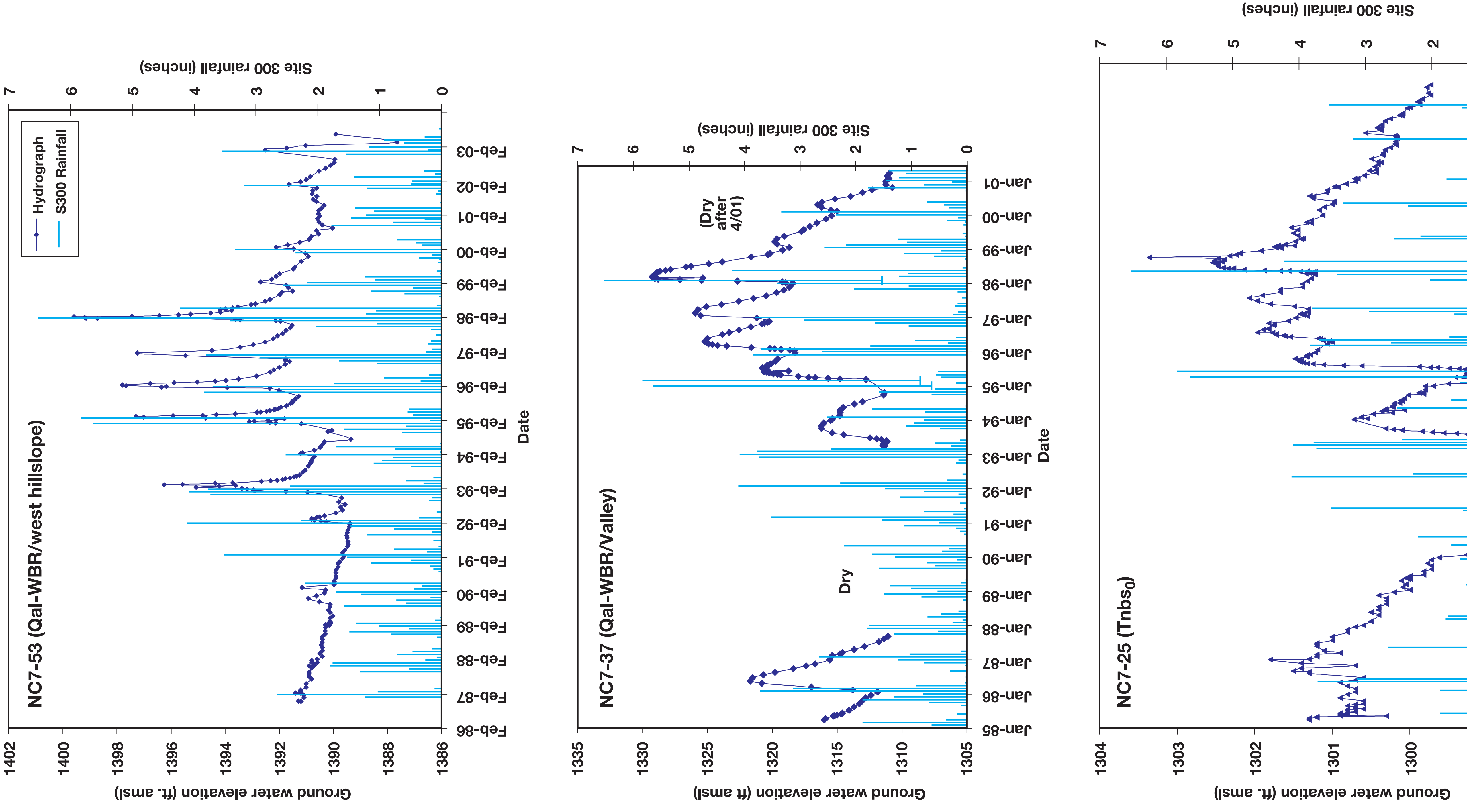


Figure 2-5. Type stratigraphic/geophysical logs of Qal/WBR Valley (NC7-37), Qal/WBR W. Hillslope (NC7-53), and Tnbs$_0$ (W-Pit7-13).



ERD-S3R-03-0216

Figure 2-6. Type hydrographs for wells NC7-53, NC7-37, and NC7-25 showing rainfall, Pit 7 Complex Area, LLNL Site 300.

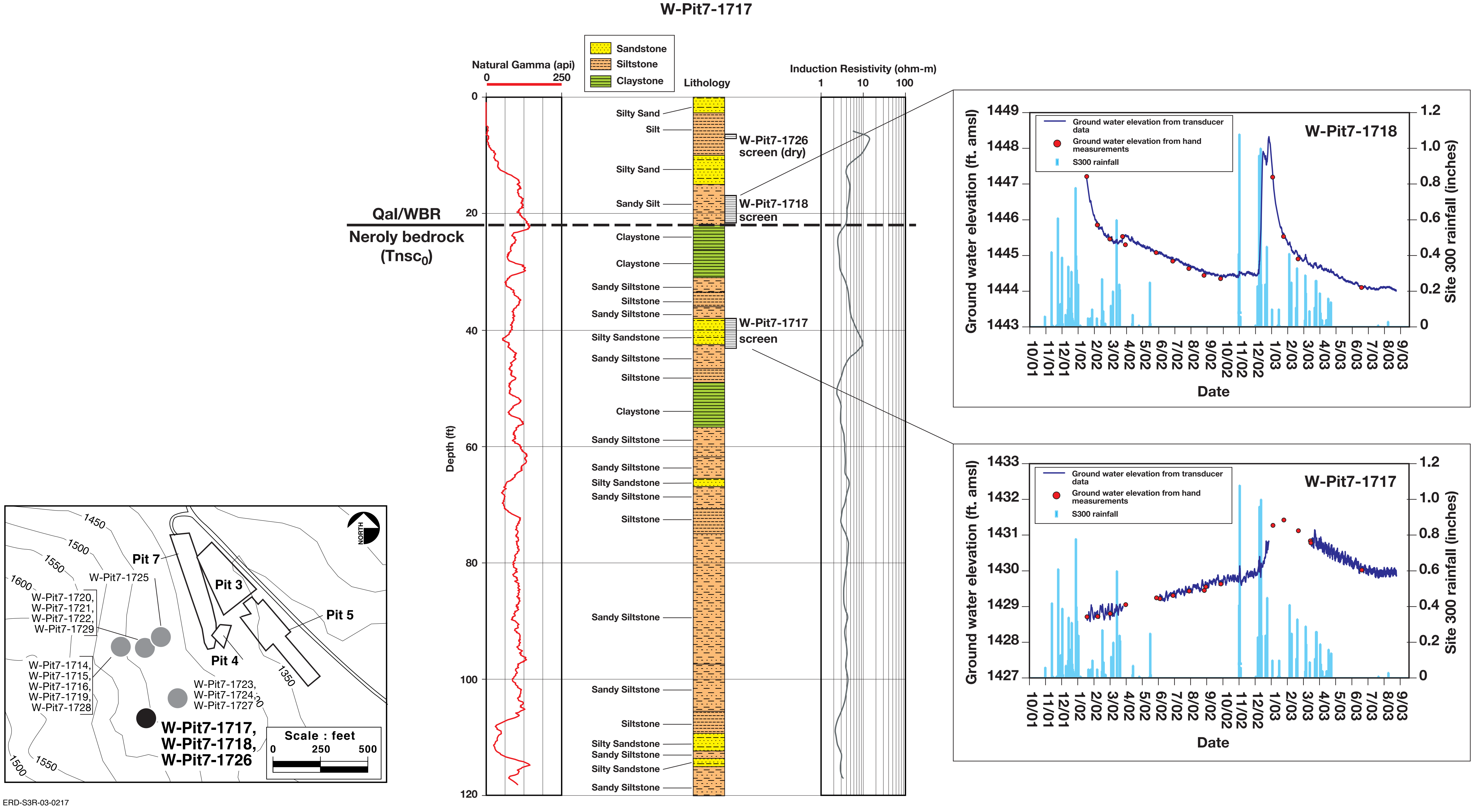
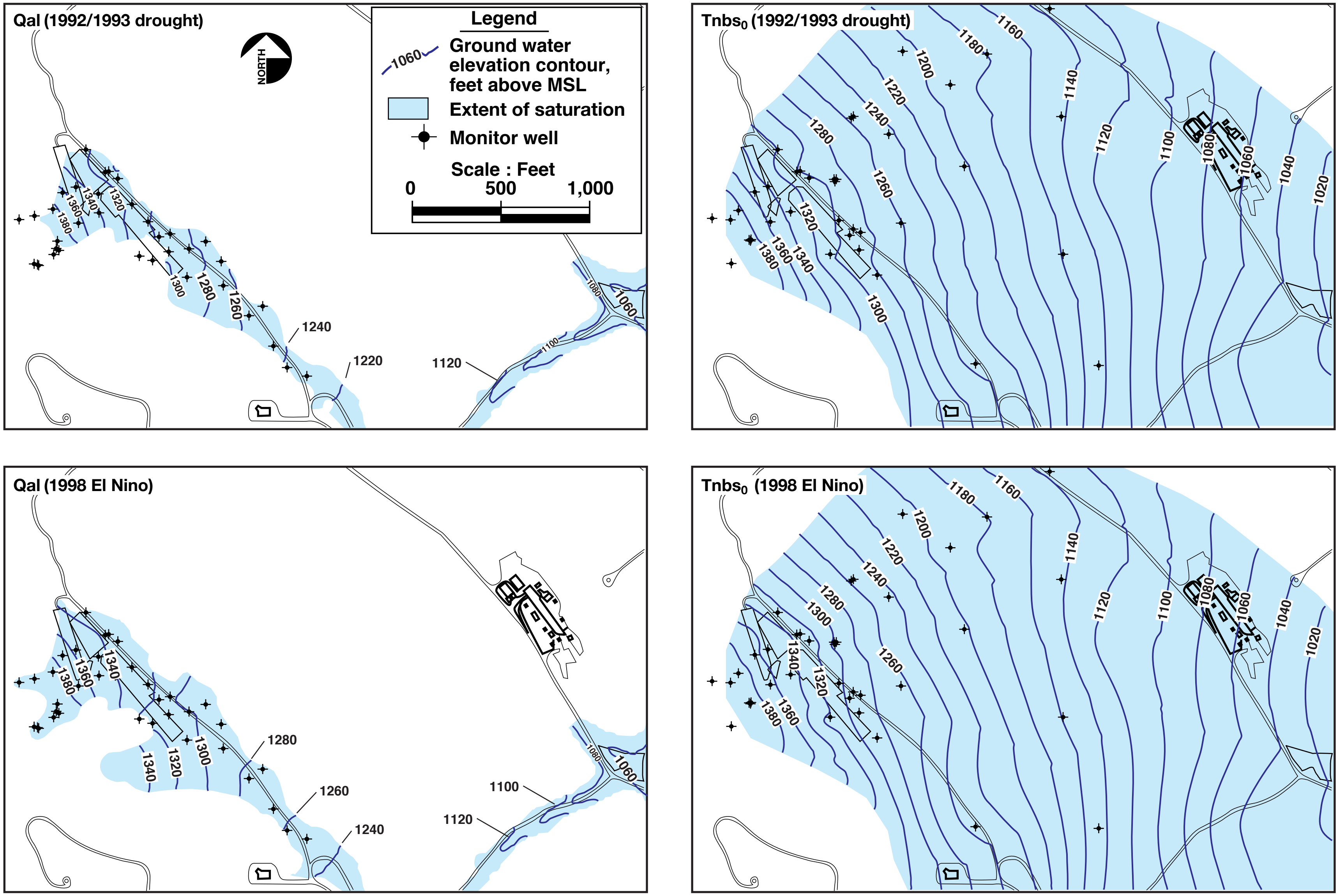


Figure 2-7. Stratigraphic/geophysical column of well W-Pit7-1717 showing screens and hydrographs of W-Pit7-1717 and W-Pit7-1718.


Qal (1992/1993 drought)

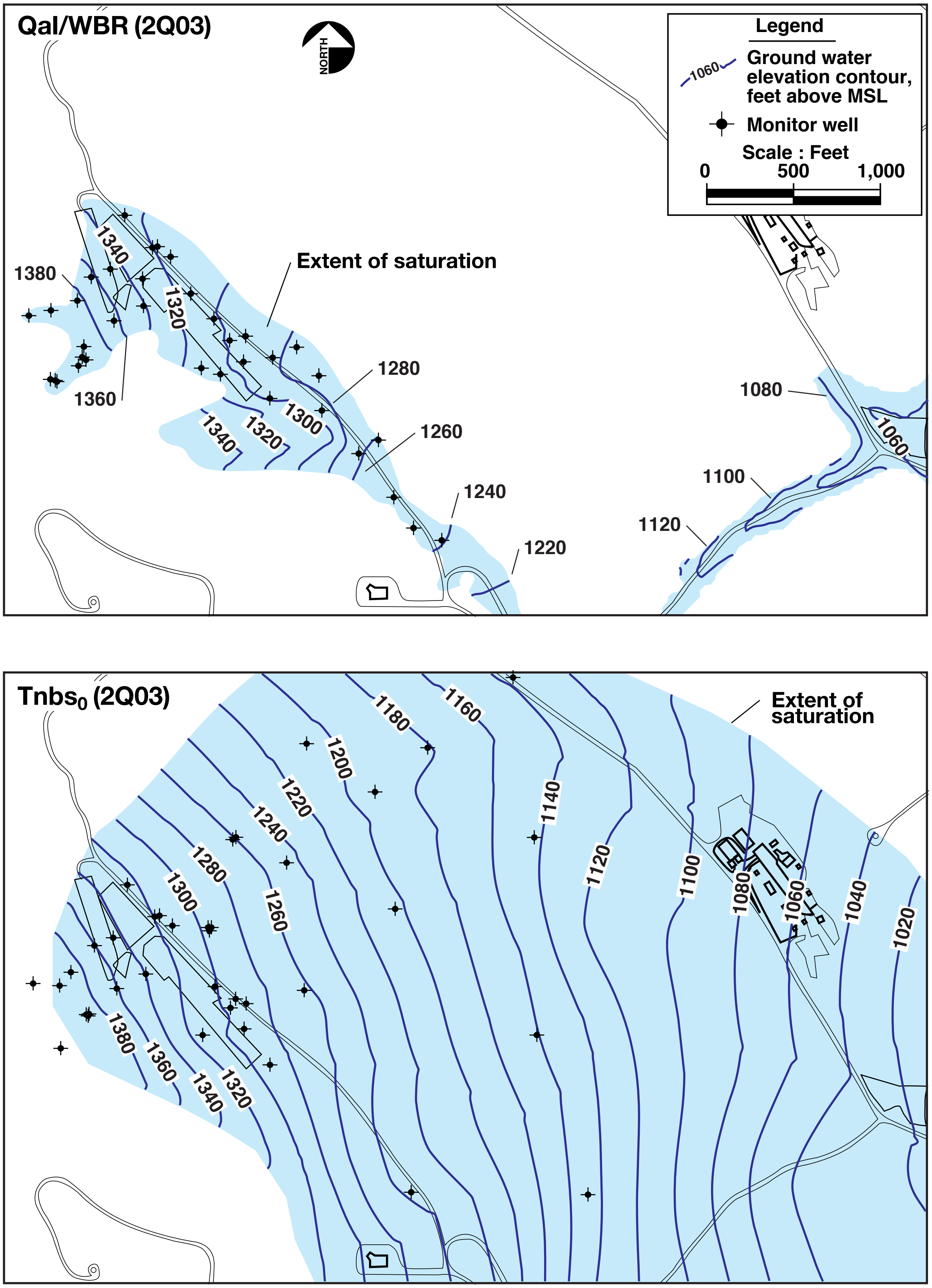
Tnbs$_0$ (1992/1993 drought)

Qal (1998 El Nino)

Tnbs$_0$ (1998 El Nino)

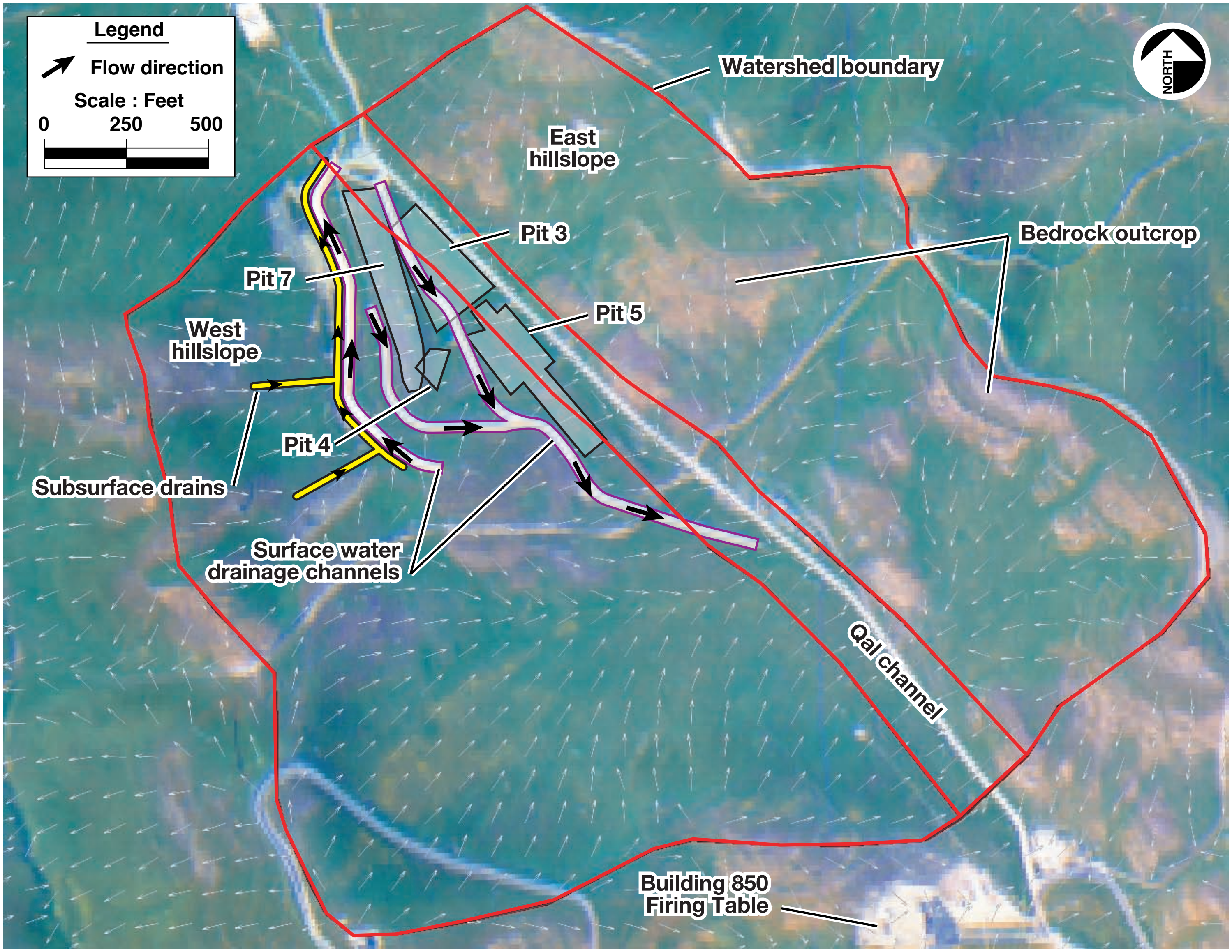
ERD-S3R-03-0229

Figure 2-8. Ground water elevation contour maps with extent of saturation for Qal (1992/1993 drought), Qal (1998 El Nino), Tnbs$_0$ (1992/1993 drought), and Tnbs$_0$ (1998 El Nino).



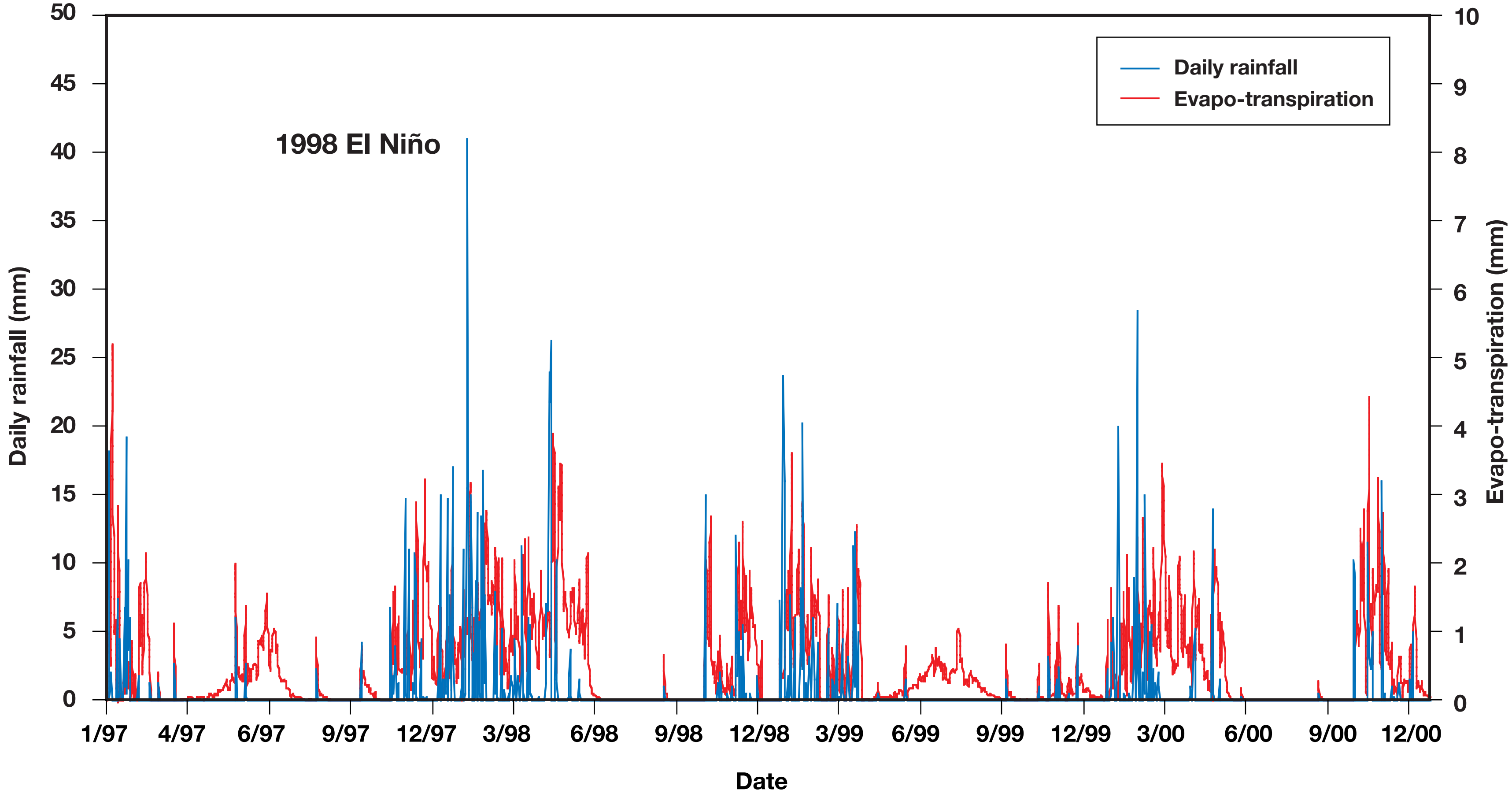
ERD-S3R-03-0227

Figure 2-9. Second quarter 2003 ground water elevation contour maps for the Qal/WBR and Tnbs$_0$ HSUs.



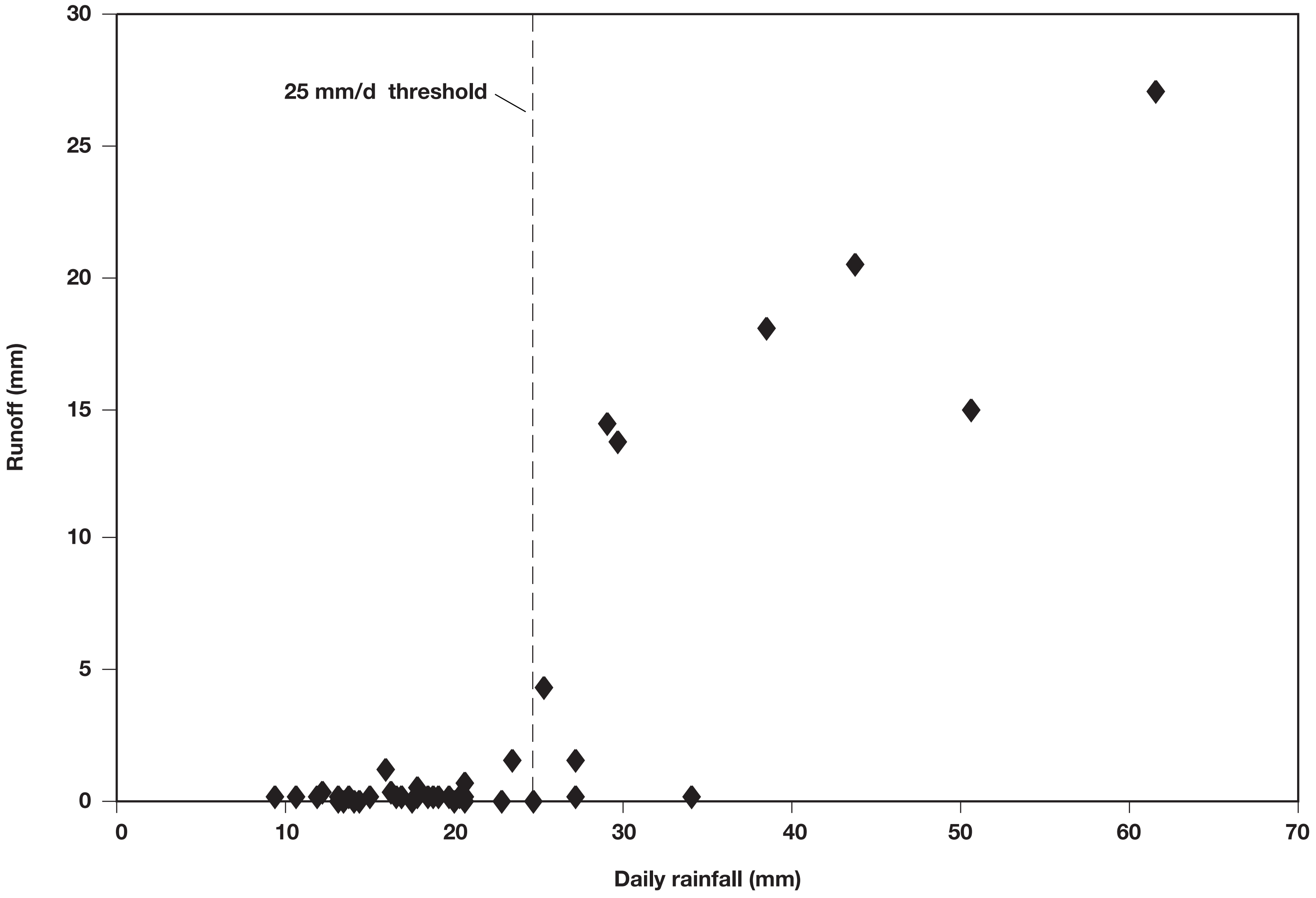
ERD-S3R-03-0242

Figure 2-10. Air photo of the Pit 7 Complex Area watershed with slope arrows.



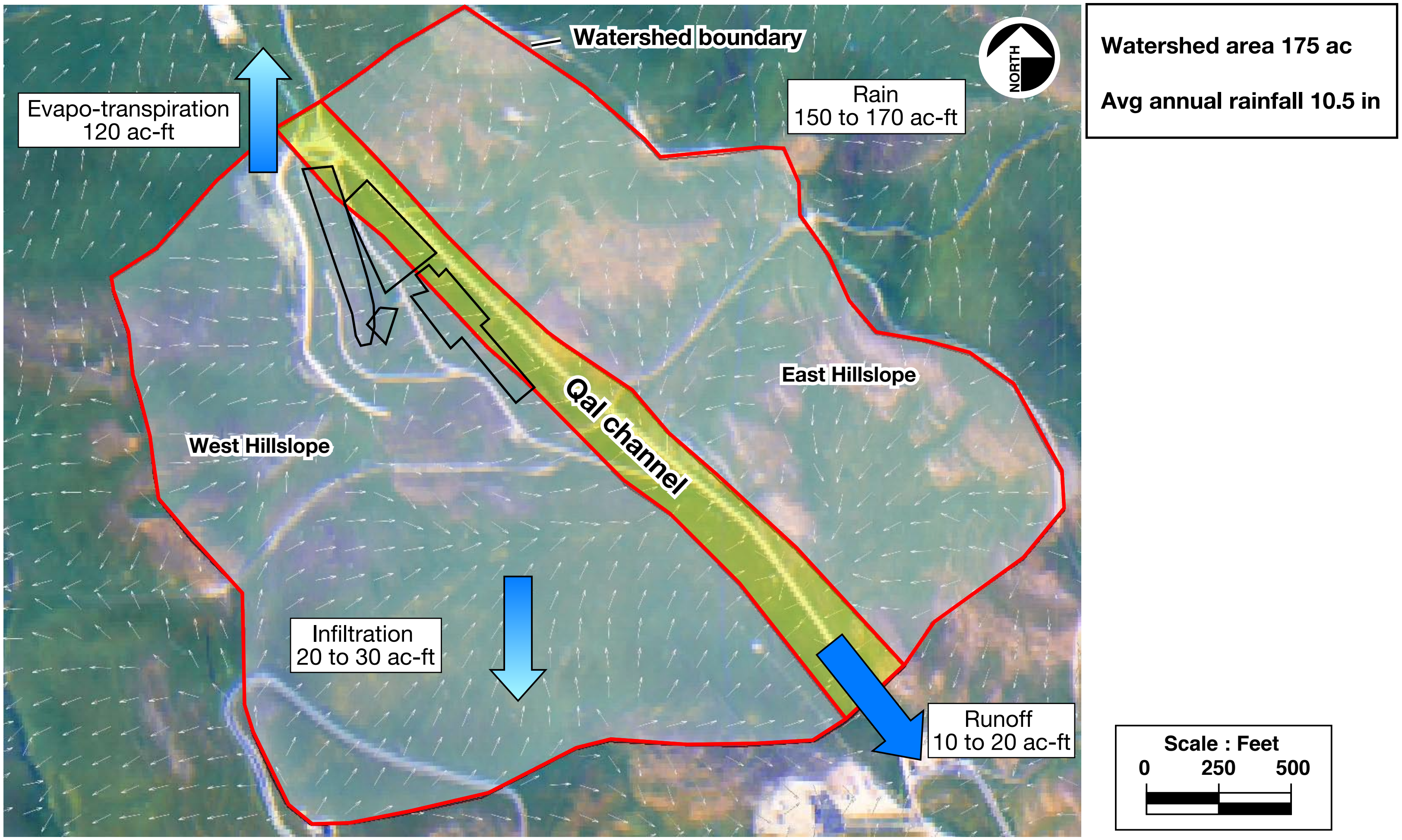
ERD-S3R-03-0235

Figure 2-11. Plot of Site 300 rainfall and WEPP simulated evapo-transpiration.



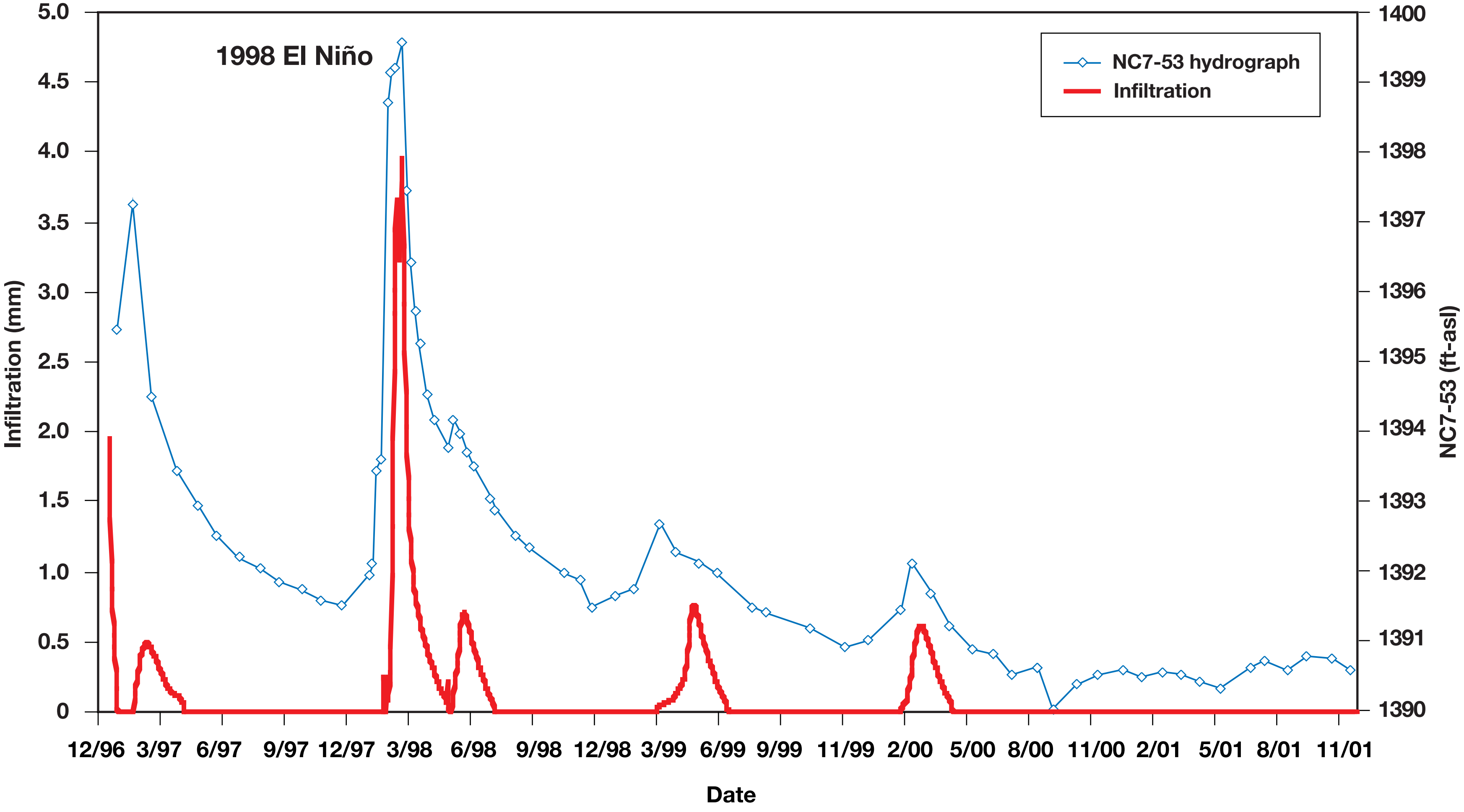
ERD-S3R-03-0240

Figure 2-12. Plot of daily rainfall vs WEPP-simulated runoff.



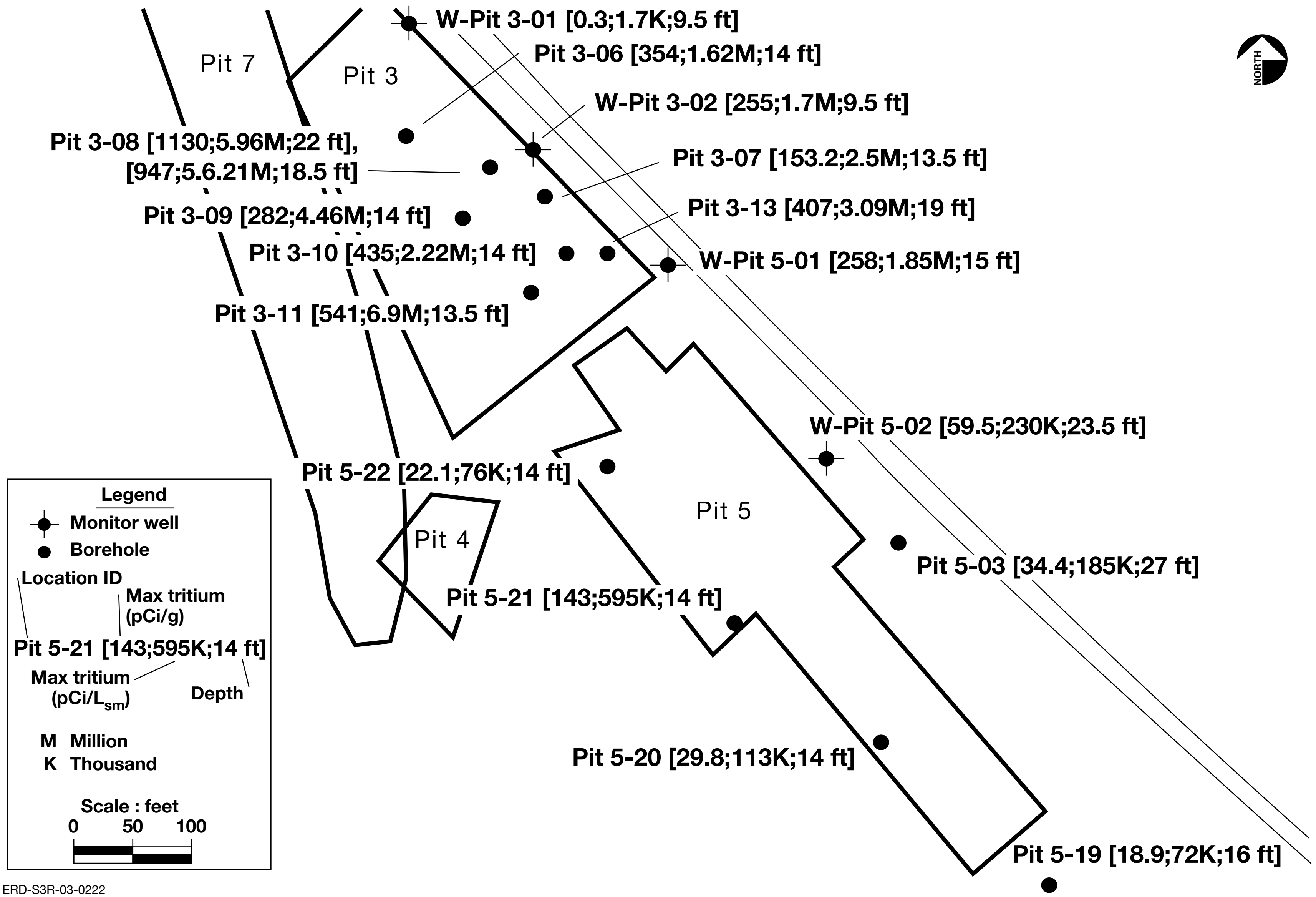
ERD-S3R-03-0243

Figure 2-13. Map showing Pit 7 Complex watershed with water balance results for a typical rainfall year.



ERD-S3R-03-0241

Figure 2-14. NC7-53 hydrograph with WEPP-simulated infiltration.



ERD-S3R-03-0222

Figure 2-15. Maximum tritium activities in soil at Pits 3 and 5.

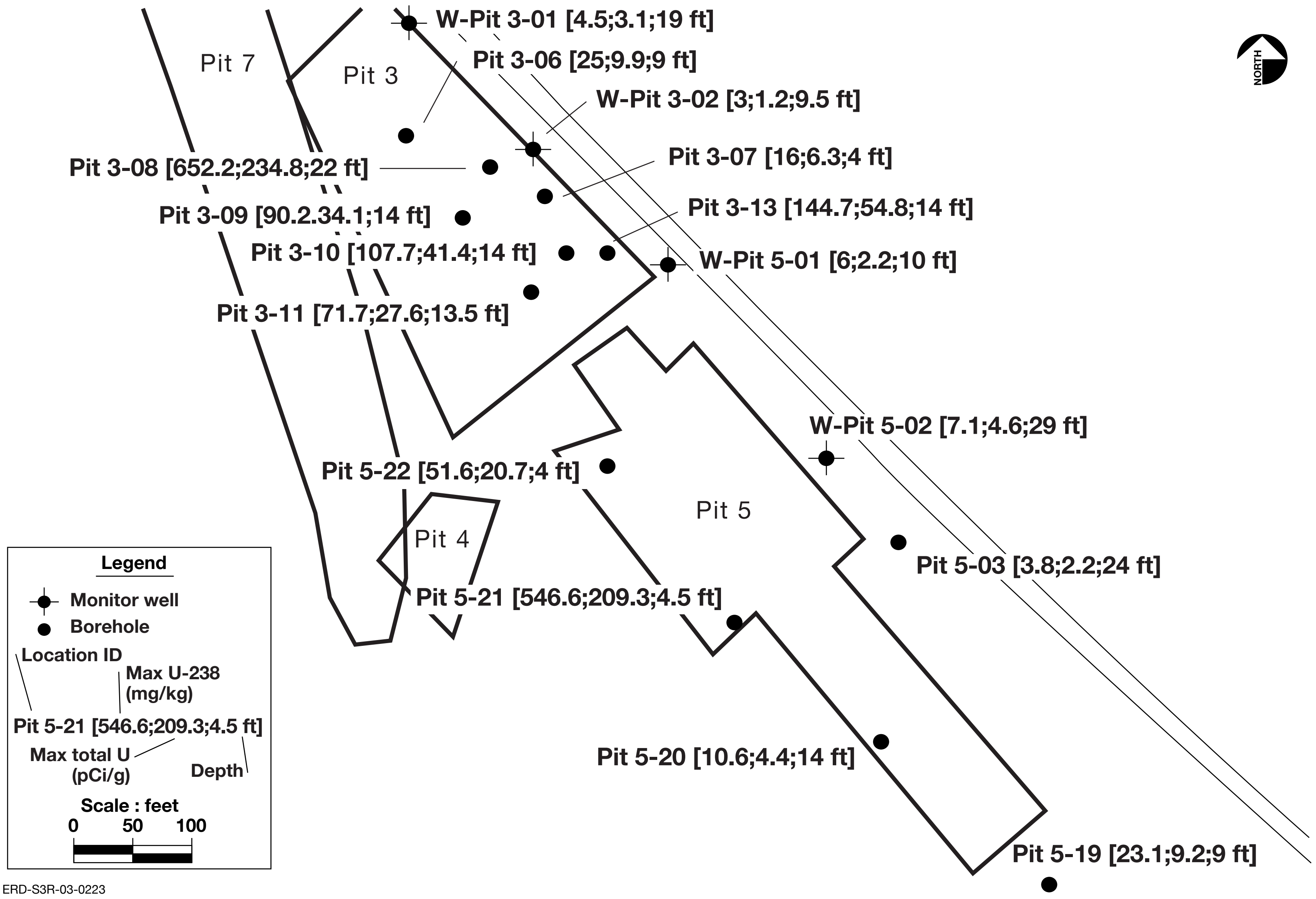
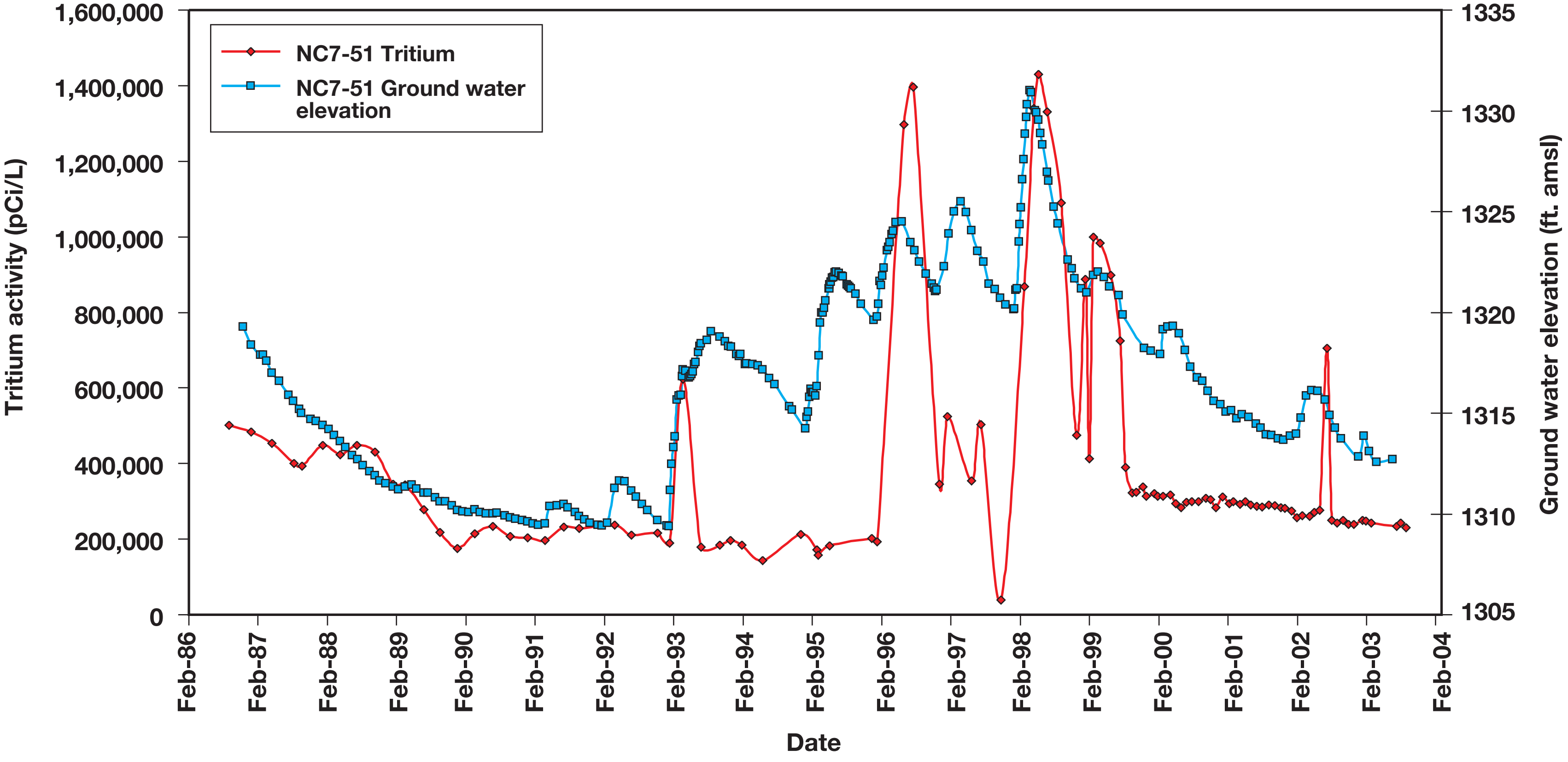
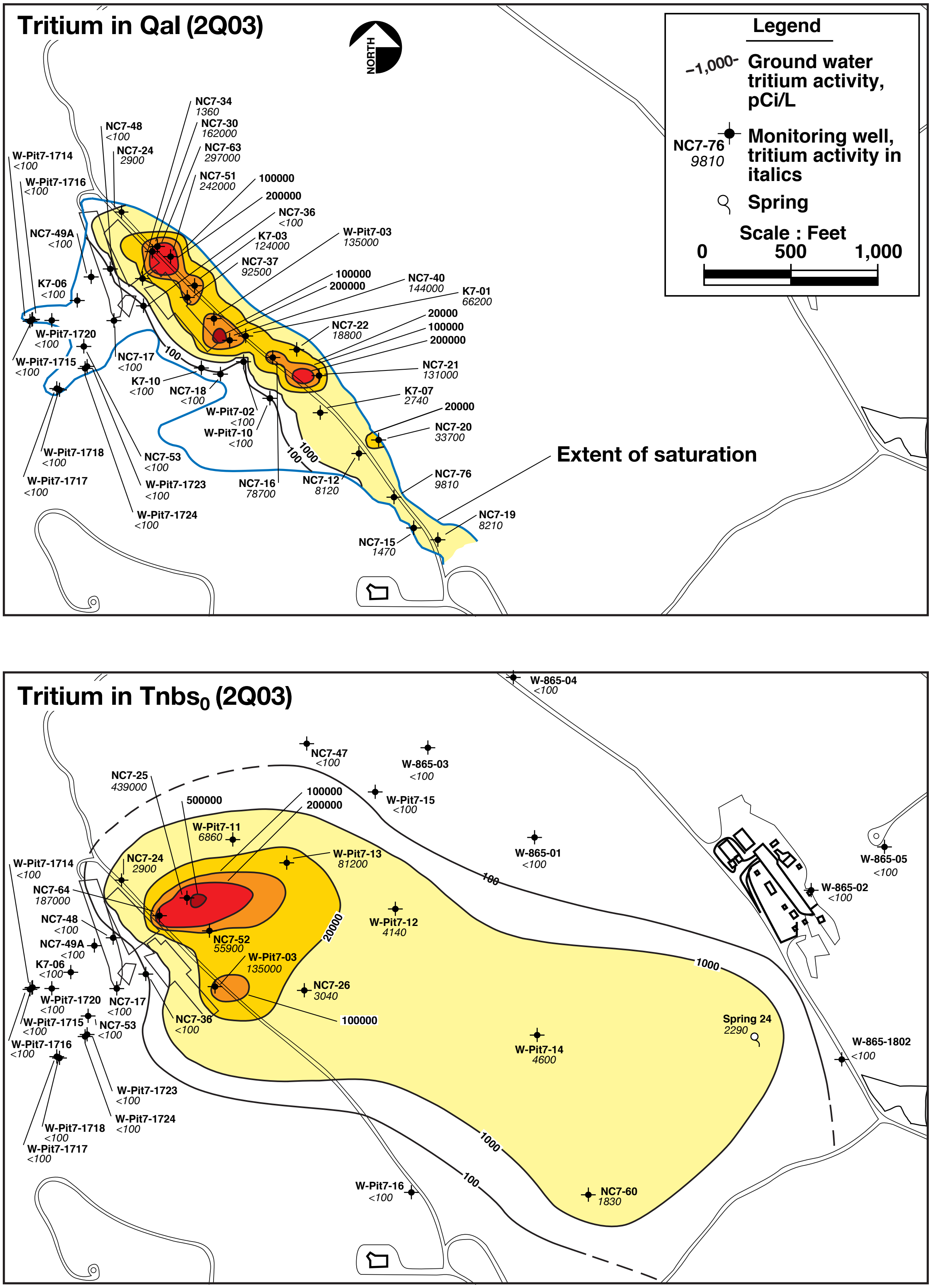


Figure 2-16. Maximum uranium activities in soil at Pits 3 and 5.



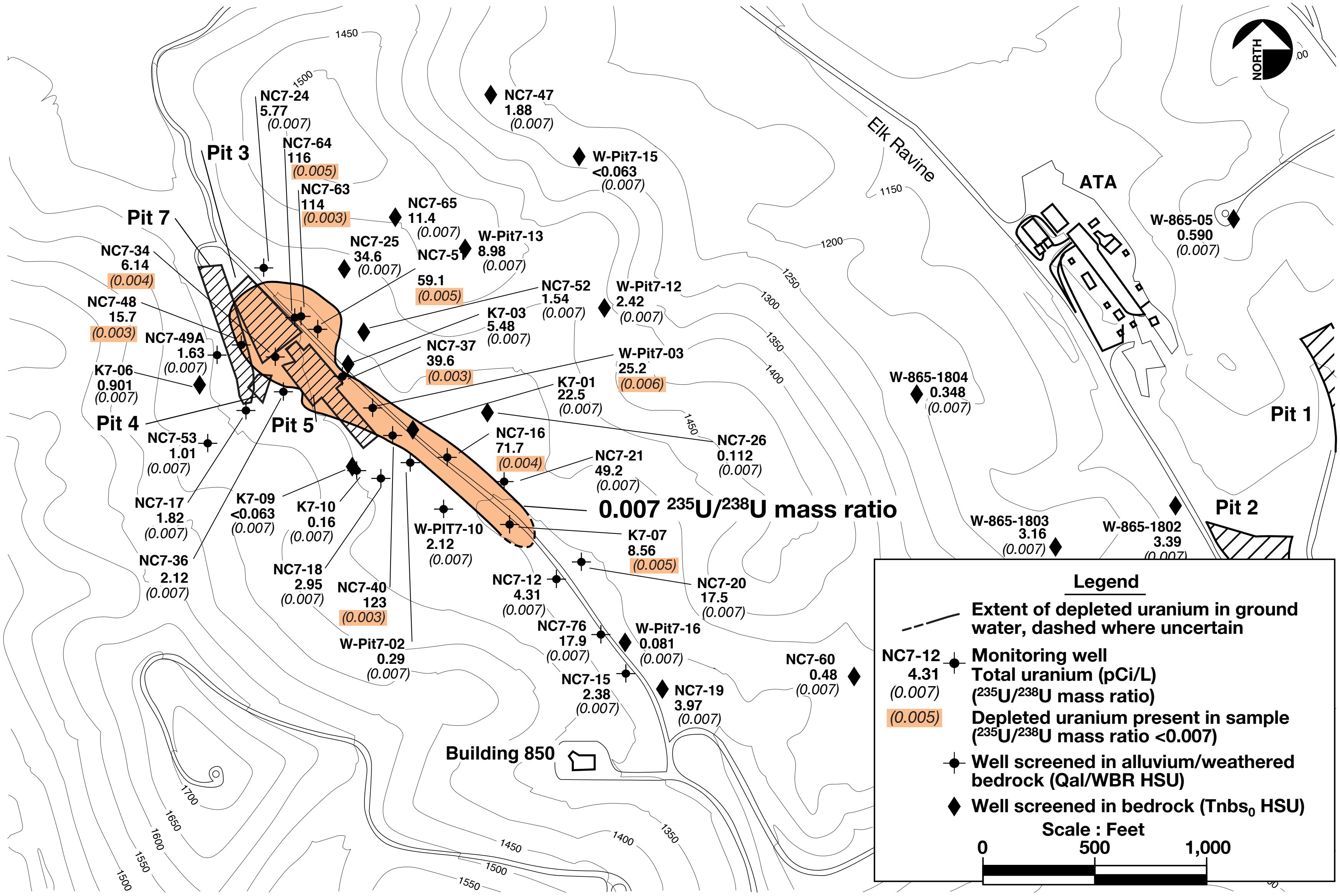
ERD-S3R-03-0219

Figure 2-17. NC7-51 time-series graph of tritium in ground water with hydrograph.



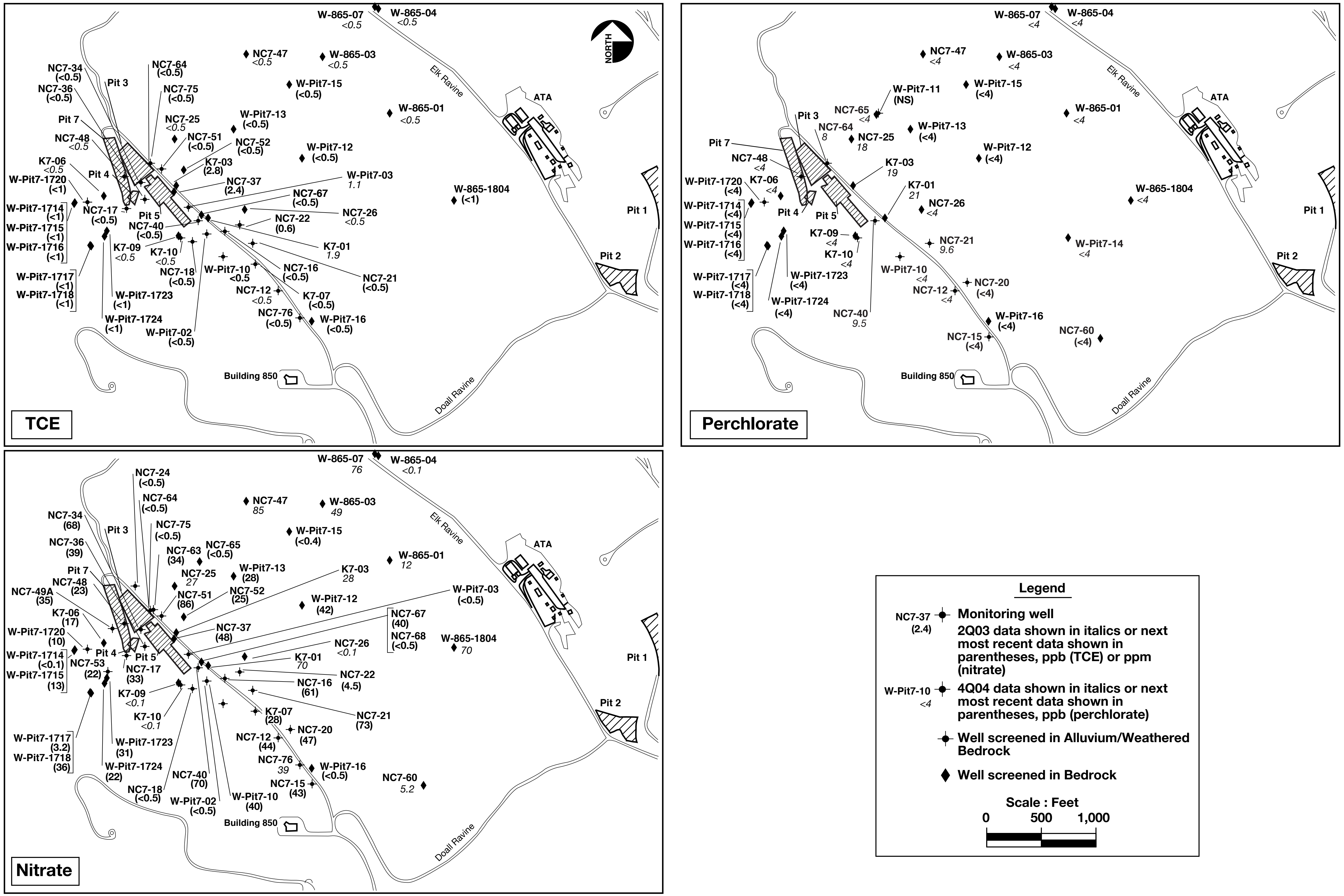
ERD-S3R-03-0244

Figure 2-18. Second quarter 2003 tritium plume in the Qal and $Tnbs_0$ HSUs.



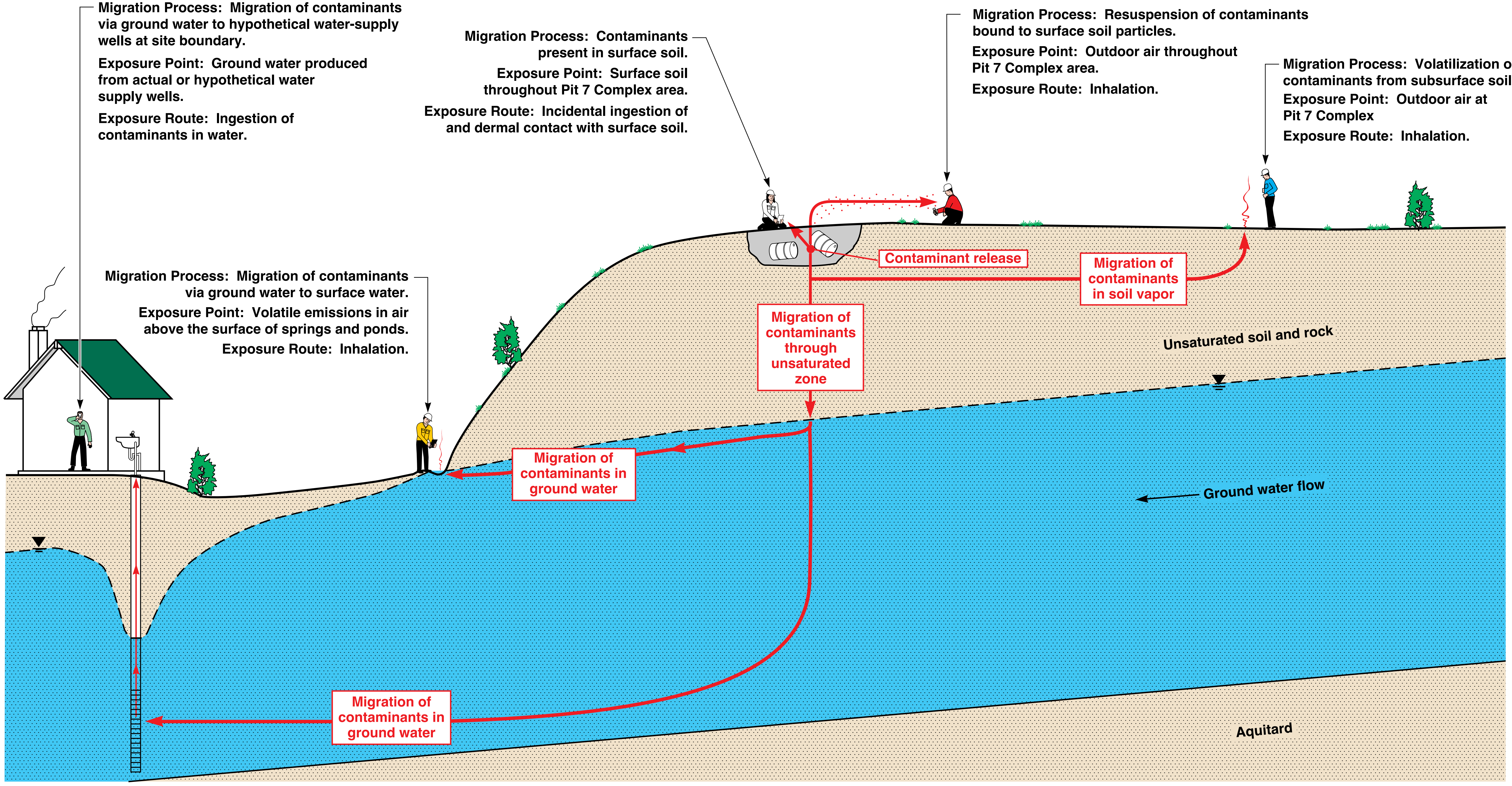
ERD-S3R-03-0245

Figure 2-19. Extent of depleted uranium mass ratio in ground water (second quarter 2003, or most recent data).



ERD-S3R-03-0253

Figure 2-20. TCE, perchlorate, and nitrate concentrations in ground water.



Migration Process: Migration of contaminants via ground water to hypothetical water-supply wells at site boundary.

Exposure Point: Ground water produced from actual or hypothetical water supply wells.

Exposure Route: Ingestion of contaminants in water.

Migration Process: Contaminants present in surface soil.

Exposure Point: Surface soil throughout Pit 7 Complex area.

Exposure Route: Incidental ingestion of and dermal contact with surface soil.

Migration Process: Resuspension of contaminants bound to surface soil particles.

Exposure Point: Outdoor air throughout Pit 7 Complex area.

Exposure Route: Inhalation.

Migration Process: Volatilization of contaminants from subsurface soil.

Exposure Point: Outdoor air at Pit 7 Complex

Exposure Route: Inhalation.

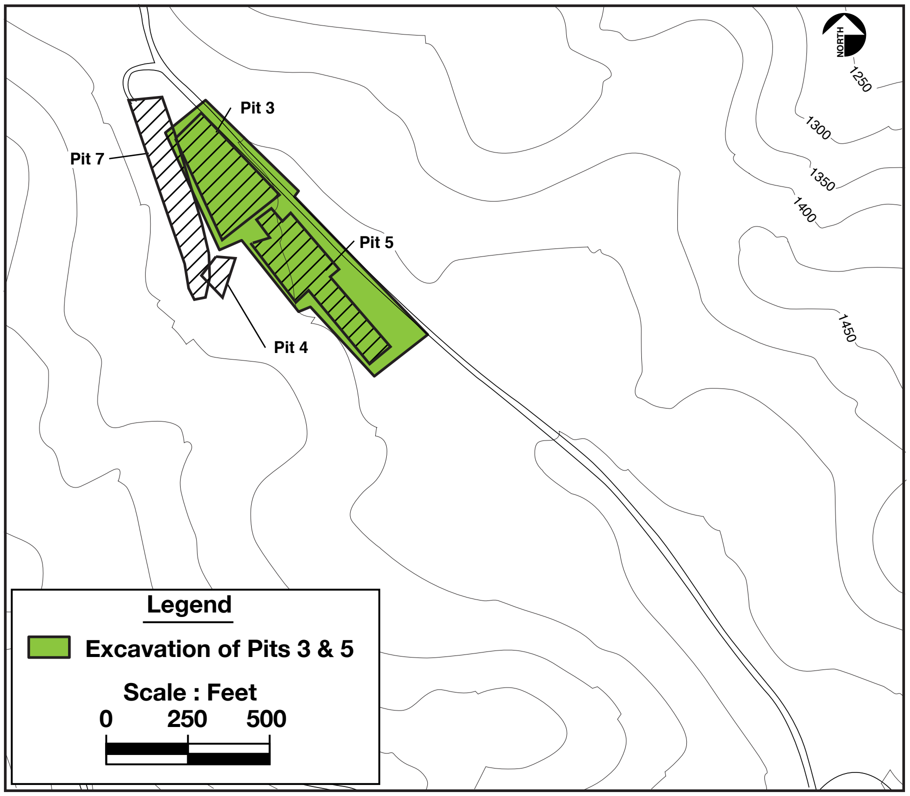
Migration Process: Migration of contaminants via ground water to surface water.

Exposure Point: Volatile emissions in air above the surface of springs and ponds.

Exposure Route: Inhalation.

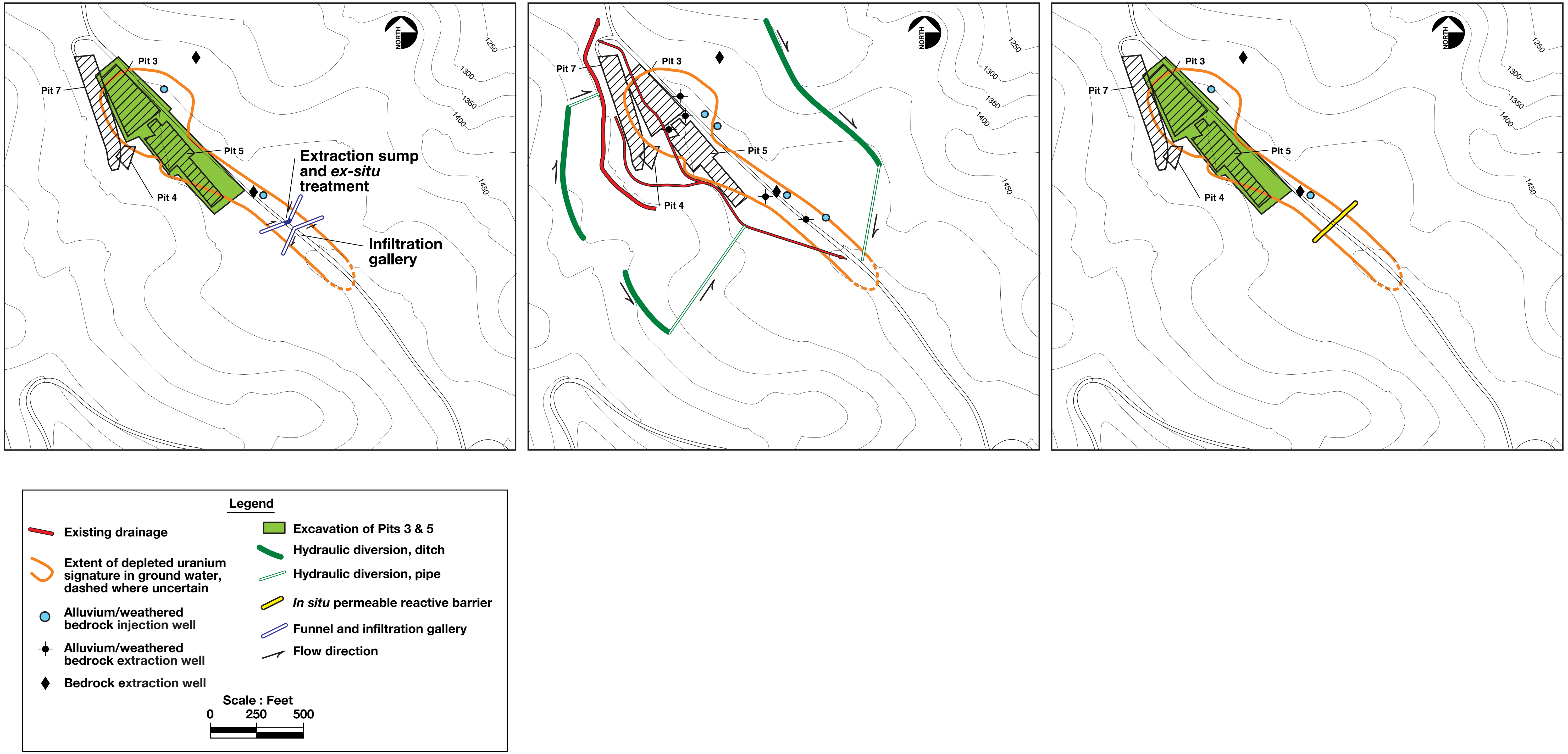
ERD-S3R-03-0232

Figure 2-21. Conceptual human exposure scenarios for Pit 7 Complex.



ERD-S3R-03-0236

Figure 3-1. Location map for the components of Remedial Alternative 2 at the Pit 7 Complex.



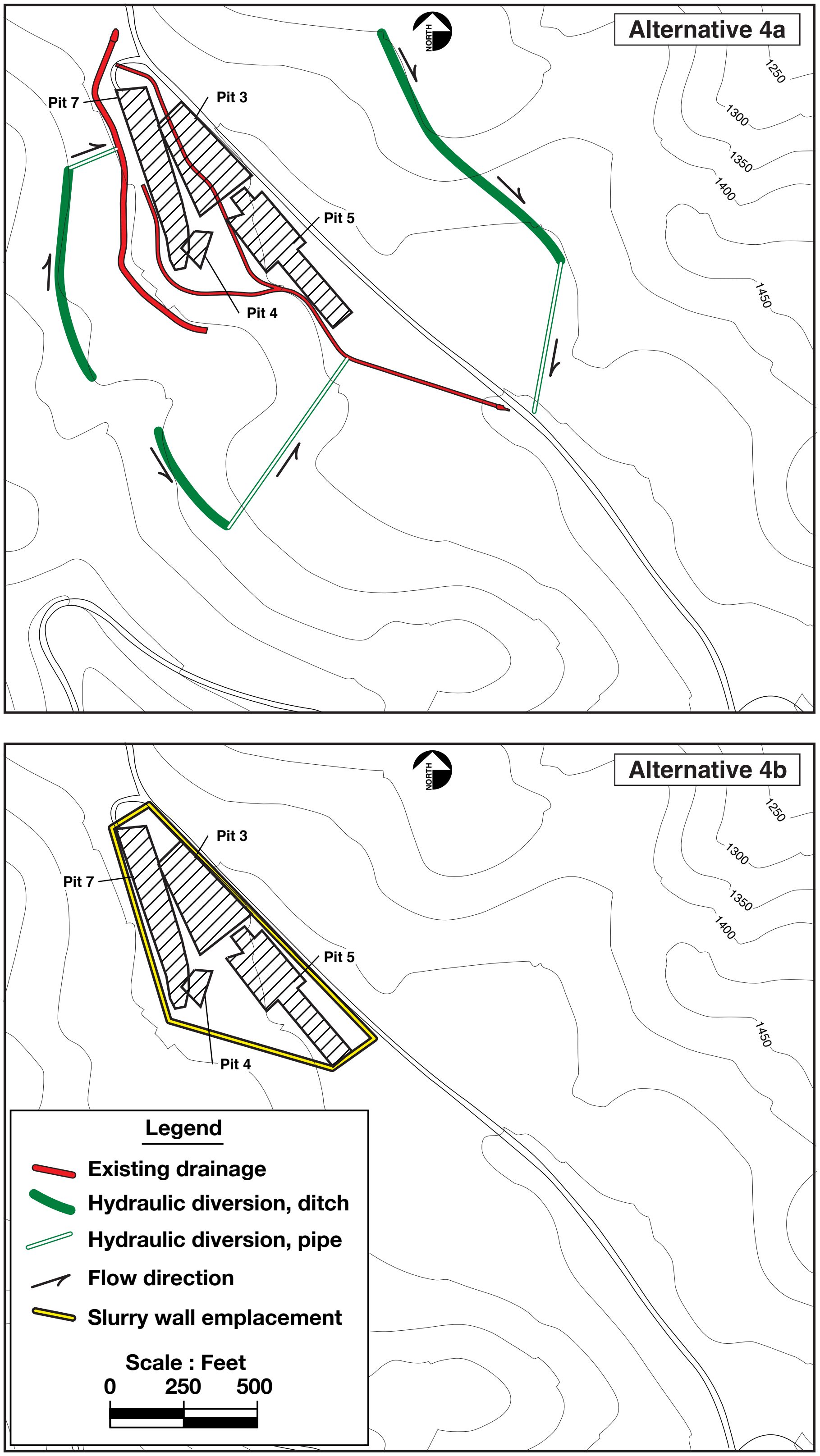
Alternative 3a – Funnel and sump and extraction wells with *ex situ* treatment (Option 1)

Alternative 3a – Extraction wells with *ex situ* treatment (Option 2)

Alternative 3b – Permeable reactive barrier and extraction wells with *ex situ* treatment

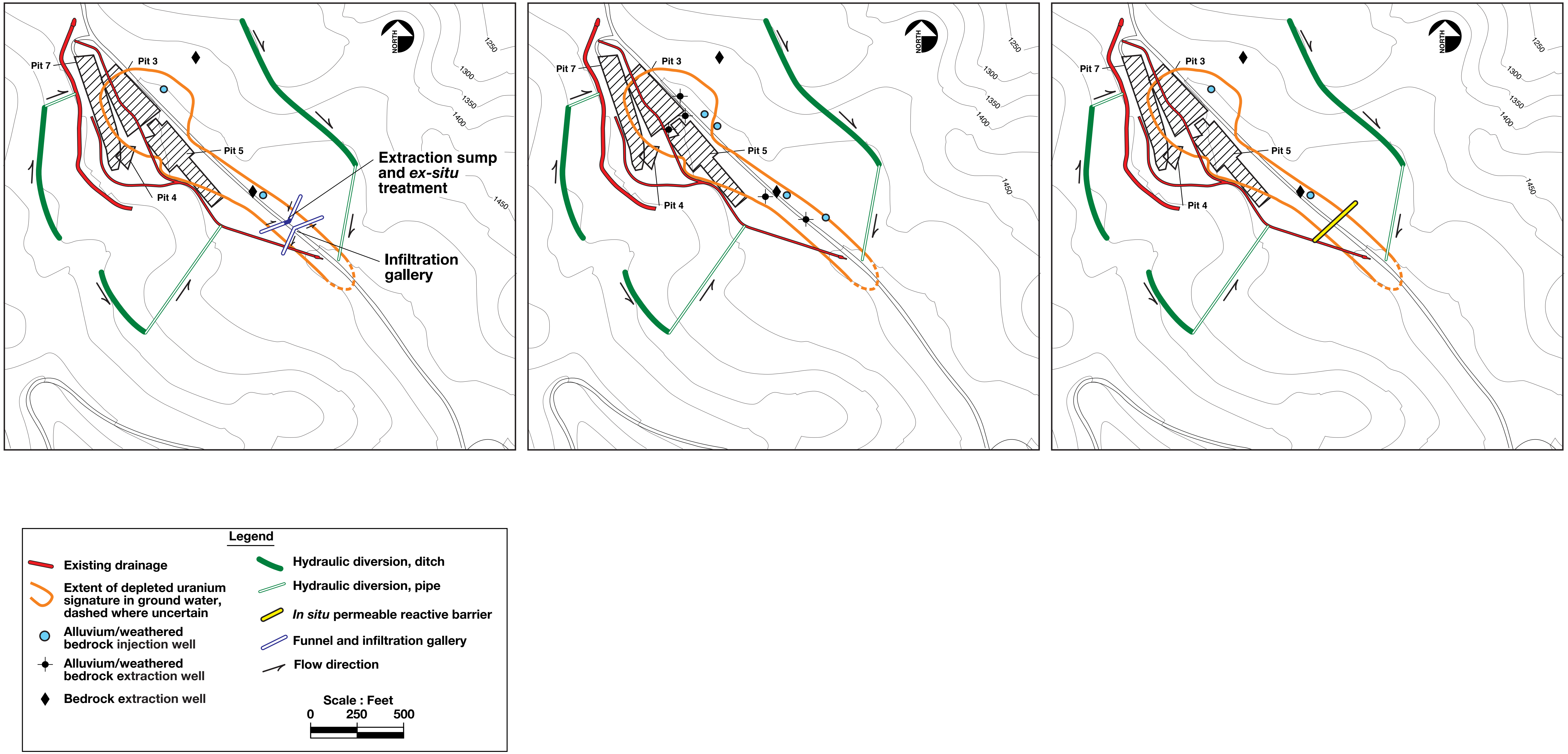
ERD-S3R-04-0119

Figure 3-2. Location map for the components of Remedial Alternatives 3a and 3b (employing either a funnel and sump, permeable reactive barrier and/or extraction and injection wells for ground water treatment) at the Pit 7 Complex.



ERD-S3R-03-0238

Figure 3-3. Location map for the components of Remedial Alternatives 4a and 4b at the Pit 7 Complex.



Alternative 5a – Funnel and sump and extraction wells with *ex situ* treatment (Option 1)

Alternative 5a – Extraction wells with *ex situ* treatment (Option 2)

Alternative 5b – Permeable reactive barrier and extraction wells with *ex situ* treatment

ERD-S3R-04-0118

Figure 3-4. Location map for the components of Remedial Alternatives 5a and 5b (employing either a funnel and sump, permeable reactive barrier and/or extraction and injection wells for ground water treatment) at the Pit 7 Complex.

Tables

Table 2-1. Baseline human health risk assessment summary for the Pit 7 Complex (from previous reports)[a].

		Human health risk assessment		
Risk assessment conducted/document	**Exposure pathway evaluated**	**Contaminant of potential concern evaluated**	**Individual lifetime cancer risk**	**Hazard quotient**
SWRI Chapter 6 and 11, Building 850 SWRI Addendum	**Inhalation of fugitive (airborne) dust; contaminants bound to resuspended soil particles throughout the Building 850/Pit 7 Complex (adult onsite exposure) (Building 850 SWRI Addendum)**	**Thorium–232**	**1×10^{-8}**	**NA**
		Uranium–235	**7×10^{-10}**	**3×10^{-8}**
		Uranium–238	**2×10^{-8}**	**9×10^{-6}**
			Total Risk = 3.1×10^{-8}	**HI = 9×10^{-6}**
	Incidental ingestion and direct dermal contact with contaminants in surface soil throughout the Building 850/Pit 7 Complex (adult onsite exposure) (Building 850 SWRI Addendum)	**Thorium–232**	**4×10^{-9}**	**NA**
		Uranium–235	**4×10^{-10}**	**5×10^{-6}**
		Uranium–238	**2×10^{-8}**	**1×10^{-3}**
			Total Risk = 2.4×10^{-8}	**HI = 1×10^{-3}**
	Inhalation of tritium evaporating from subsurface soil to the atmosphere in the vicinity of: (adult onsite exposure) (SWRI Chapter 11):			
	– Pit 3	**Tritium**	**4×10^{-6}**	**Not calculated**
	– Pit 5	**Tritium**	**4×10^{-8}**	**Not calculated**
			Total Risk = 4×10^{-6}	
	Residential use of ground water contaminated with uranium–238 at the boundary of Site 300 (Building 850 SWRI Addendum):			
	– Pit 7	**Uranium–238**	**1×10^{-7}**	**1×10^{-2}**
	– Pit 5	**Uranium–238**	**6×10^{-7}**	**5×10^{-2}**
	– Building 850 and Pit 5	**Uranium–238**	**4×10^{-7}**	**3×10^{-2}**
			Total Risk = 1×10^{-6}	**HI = 9×10^{-2}**
	Residential use of contaminated ground water from Pit 5 at a hypothetical well located at the northeast Site 300 boundary (SWRI Chapter 11)	**Acetone**	**Not carcinogenic**	**3×10^{-5}**
		Carbon disulfide	**Not carcinogenic**	**5×10^{-5}**
		Chloroform	**2×10^{-6}**	**7×10^{-3}**
		1,2–DCA	**1×10^{-8}**	**NA**
		1,1–DCE	**6×10^{-7}**	**2×10^{-4}**
		Freon 113	**Not carcinogenic**	**3×10^{-6}**
		Phenolics	**Not carcinogenic**	**5×10^{-3}**
		PCE	**1×10^{-8}**	**5×10^{-5}**
		Toluene	**Not carcinogenic**	**5×10^{-6}**
		TCE	**4×10^{-8}**	**1×10^{-3}**
		Total xylenes	**Not carcinogenic**	**2×10^{-6}**
			Total Risk = 2.7×10^{-6}	**HI = 1×10^{-2}**
	Total risk attributable to residential use of tritium–contaminated ground water from (SWRI Chapter 11):			
	– Pit 3	**Tritium**	**2×10^{-9}**	**Not calculated**
	– Pit 5	**Tritium**	**3×10^{-8}**	**Not calculated**
			Total Risk = 3×10^{-8}	

Table 2-1. Baseline human health risk assessment summary for the Pit 7 Complex (from previous reports)[a]. (Cont. page 2 of 2)

	Human health risk assessment			
Risk assessment conducted/document	**Exposure pathway evaluated**	**Contaminant of potential concern evaluated**	**Individual lifetime cancer risk**	**Hazard quotient**
SWRI Chapter 6 and 11, Building 850 SWRI Addendum (cont.)	**Residential use of ground water contaminated with Uranium–238 at a hypothetical well located at the Site 300 boundary (Building 850 SWRI Addendum):**			
	– Pit 7	**Uranium–238**	1×10^{-7}	1×10^{-2}
	– Pit 5	**Uranium–238**	6×10^{-7}	5×10^{-2}
	– Building 850 and Pit 5	**Uranium–238**	$\underline{4 \times 10^{-7}}$	$\underline{3 \times 10^{-2}}$
			Total Risk = 1×10^{-6}	**HI =** 9×10^{-2}
Site-Wide Feasibility Study	**Surface soil (outdoor adult onsite exposure from inhalation of resuspended particulates, dermal absorption, and incidental ingestion)**	**HMX**	**NA**	4×10^{-5}
		Tritium	2×10^{-11}	**NA**
		Uranium 233 and 234	5×10^{-8}	**NA**
		Uranium–235 and 236	9×10^{-7}	**NA**
		Uranium–238	$\underline{3 \times 10^{-7}}$	**<u>NA</u>**
			Total Risk = 1×10^{-6}	**HI =** 4×10^{-5}
	Subsurface soil (outdoor adult onsite exposure from inhalation, dermal absorption, and incidental ingestion of tritium volatilized from subsurface soil to air)	**Tritium**	3×10^{-8}	**NA**
	Ground water (theoretical adult onsite exposure from use of ground water as a water supply)	**Other[b]**	**NA**	1×10^{0}
		Nitrate	**NA**	2×10^{1}
		VOCs	3×10^{-4}	9×10^{-1}
		Tritium	4×10^{-3}	**NA**
		Uranium 233 and 234	6×10^{-5}	**NA**
		Uranium–235 and 236	5×10^{-6}	**NA**
		Uranium–238	$\underline{2 \times 10^{-4}}$	**<u>NA</u>**
			Total Risk = 1×10^{-2}	**HI =** 2×10^{1}

Notes:

DCA = Dichloroethane.
DCE = Dichoroethylene.
HI = Hazard index.
HMX = High melting explosive.
NA = Slope factor or RfD not available.
PCE = Tetrachloroethylene.
RfD = Reference dose.
SWRI = Site–Wide Remedial Investigation.
TCE = Trichloroethylene.
VOCs = Volatile organic compounds.

[a] The baseline risk assessment data presented in this table was compiled from the SWRI report (Webster–Scholten, 1994), the Building 850 SWRI Addendum (Taffet et al., 1996), and the Site–Wide Feasibility Study.

[b] Other includes carbon disulfide, nitrite, perchlorate, phenolics, and silver.

Table 2-2. New substances reported in surface soil (0 to 0.5 ft) and subsurface soil (all depths below 0.5 ft) after the SWRI data cutoff (December 31, 1991).

Constituent	Number of detections	Number of samples	Percent detections	Maximum result	Units
Surface Soil					
Uranium 235[a]	13	13	100	0.346	pCi/g
Uranium 238[a]	13	13	100	24	pCi/g
Subsurface Soil					
Uranium	73	73	100	235	pCi/g
Uranium 234[a]	73	73	100	22.65	pCi/g
Uranium 235[a]	103	103	100	2.38	pCi/g
Uranium 236[a]	36	73	49.3	1.67	pCi/g
Uranium 238[a]	103	103	100	210	pCi/g

[a] Analyzed by mass spectrometry.

Table 2-3. New substances reported in ground water after the SWRI cutoff (December 31, 1991).

Constituent	Number of detections	Number of samples	Percent detections	Maximum result	Units
Acetone	1	85	1.2	23	μg/L
Bismuth	21	22	95.5	0.0006	mg/L
HMX	1	649	0.2	2	μg/L
Lead 210	1	1	100	54	pCi/L
Lead 214	1	3	33.3	20.4	pCi/L
Nitrate (as NO3)	459	558	82.3	363	mg/L
Nitrite (as N)	31	188	16.5	1.5	mg/L
PCB 1254	1	108	0.9	61	μg/L
Perchlorate	27	94	28.7	19	μg/L
RDX	1	648	0.2	1	μg/L
Radium 228	16	36	44.4	14.2	pCi/L
Silver	14	470	3.0	0.013	mg/L
Thorium	13	23	56.5	0.0012	mg/L
Thorium 230	169	483	35.0	39.5	pCi/L
Uranium	354	359	98.6	741	pCi/L
Uranium 234[a]	413	459	90.0	144	pCi/L
Uranium 235[a]	466	478	97.5	11.06	pCi/L
Uranium 236[a]	227	422	53.8	4.7	pCi/L
Uranium 238[a]	473	477	99.2	726	pCi/L

[a] Analyzed by mass spectrometry.

Table 2-4. New substances reported in surface water (Spring 24) since the SWRI cutoff (December 31, 1991).

Constituent	Number of detections	Number of samples	Percent detections	Maximum result	Units
Aluminum	1	3	33.3	33	mg/L
Arsenic	1	1	100	0.014	mg/L
Barium	1	1	100	0.029	mg/L
Copper	1	3	33.3	0.16	mg/L
Fluoride	3	3	100	0.49	mg/L
Iron	1	3	33.3	44	mg/L
Magnesium	3	3	100	23	mg/L
Manganese	2	3	66.7	0.89	mg/L
Nitrate (as NO_3)	3	3	100	55	mg/L
Tritium	5	5	100	2380	pCi/L
Uranium 234/233	1	1	100	125	pCi/L
Uranium 238	1	1	100	0.535	pCi/L
Zinc	2	3	66.7	0.16	mg/L

Table 2-5. Screening out new substances detected since SWRI as contaminants of potential concern.

Constituent	No. of detections/ No. of samples	Maximum concentration	Preliminary Remediation Goal (PRGs)	Rationale for screening out contaminant
Subsurface soil				
Uranium 234	73 of 73	22.6 pCi/g	32.4 pCi/g[a, g]	No complete exposure pathway. Maximum activities are below the PRG.
Uranium 235	103 of 103	2.38 pCi/g	0.41 pCi/g[a, g]	No complete exposure pathway. Where associated with anthropogenic contamination will be addressed by remedy for depleted uranium.
Uranium 236	36 of 73	1.67 pCi/g	34.8 pCi/g[a, g]	No complete exposure pathway. Maximum activities are below the PRG.
Ground Water				
Acetone	1 of 85	23 μg/L	5,500 μg/L[b, f]	A single detection (detection frequency 1.2%) in NC7-47 on May 19. 1993, not detected since. Maximum concentrations are below the PRG. A common laboratory contaminant. No evidence of widespread contamination.
Bismuth	21 of 22	0.0006 mg/L	No available PRG	All samples collected between May and June 1994. Maximum detected in NC7-16 on June 1, 1994. No available PRG. Screened out in SWFS.
HMX	1 of 649	2 μg/L	1,800 μg/L[b, f]	A single detection (detection frequency of 0.3%) in NC7-48 on May 4 1999. The same sample reported the only detection of RDX. Maximum concentrations are below the PRG. No evidence of widespread contamination.
Lead 210	1 of 1	54 pCi/L	0.0541 pCi/L[c, g]	Detected in K7-06 on December 1, 1994. Insufficient data to establish background. Limited data provides no evidence of widespread contamination.
Lead 214	1 of 3	20.4 pCi/L	138 pCi/L[c, g]	Detected in K7-01 on March 17, 1995. Maximum concentrations are below the PRG. Insufficient data to establish background. Limited data provides no evidence of widespread contamination.

Table 2-5. Screening out new substances detected since SWRI as contaminants of potential concern. (Cont. Page 2 of 5)

Constituent	No. of detections/ No. of samples	Maximum concentration	Preliminary Remediation Goals (PRGs)	Rationale for screening out contaminant
Nitrite (as N)	31 of 188	1.5 mg/L	No available PRG	Maximum detected in W-Pit7-1917 on March 4, 2004. Exceeds the background concentration established in the SWFS (0.01 mg/L). Nitrate can be converted to nitrite under anoxic conditions. Will be addressed by the remedy for nitrate.
PCB 1254	1 of 108	61 μg/L	0.034 μg/L[b, g]	Single detection (detection frequency 1.9%) in NC7-75 on May 27, 1997. No evidence of widespread contamination.
RDX	1 of 648	61 μg/L	0.61 μg/L[b, g]	Single detection (detection frequency 0.3%) in NC7-48 on May 4, 1999. The same sample reported the only detection of HMX. No evidence of widespread contamination.
Radium 228	16 of 36	14.2 pCi/L	0.0458 pCi/L[c, g]	Naturally occurring decay product of Th-232. A routine sample from upgradient well K7-06 contained 14.2 pCi/L. The duplicate sample collected on the same day (7/21/98) contained 1.0 pCi/L. Not a constituent of concern in the Compliance Monitoring Program. Believed to be of natural origin. Additional information on background found in Appendix D.
Silver	14 of 470	0.013 mg/L	0.18 mg/L[b, f]	Detected at a frequency of 3.0%. Maximum concentrations are below the PRG. All detections occurred in 13 wells between April and July 1995 and exceeded the SWFS background of 0.0004 mg/L. Maximum detected in NC7-48 on April 25, 1995. Has not been detected since 1995. Monitored as part of Waste Discharge Requirements (WDR) 96-248.
Thorium	13 of 23	0.0012 mg/L	No available PRG	Maximum detected in NC7-36 on May 25, 1994. Information on background found in Appendix D.

Table 2-5. Screening out new substances detected since SWRI as contaminants of potential concern. (Cont. Page 3 of 5)

Constituent	No. of detections/ No. of samples	Maximum concentration	Preliminary Remediation Goals (PRGs)	Rationale for screening out contaminant
Thorium 230	266 of 483	39.5 pCi/L	0.523 pCi/L[c, g]	Maximum detected in NC7-47 on May 25, 1994. Part of the Uranium 234 decay series. Detected in far downgradient well NC7-47 at 39.5 pCi/L. Not a constituent of concern in the Compliance Monitoring program. Additional information on background found in Appendix D.
Uranium	359 of 359	781 pCi/L	No applicable PRG[d]	Maximum detected in NC7-40 on April 29, 1998. Will be addressed by the remedy for depleted uranium.
Uranium 234	444 of 459	144 pCi/L	0.674 pCi/L[c, g]	Maximum detected in NC7-40 on April 29, 1998. Where associated with anthropogenic contamination, will be addressed by the remedy for depleted uranium.
Uranium 235	470 of 478	11.1 pCi/L	0.684 pCi/L[c, g]	Maximum detected in NC7-40 on April 29, 1998. Where associated with anthropogenic contamination, will be addressed by the remedy for depleted uranium.
Uranium 236	336 of 422	4.7 pCi/L	0.711 pCi/L[c, g]	Maximum detected in NC7-40 on April 29, 1998. Where associated with anthropogenic contamination, will be addressed by the remedy for depleted uranium.
Surface Water (Spring 24)				
Aluminum	1 of 3	33 mg/L	37 mg/L[b, f]	Exceeds background range cited in SWFS (from 1.2 to 1.3 mg/L). Maximum concentrations are below the PRG. Limited data provides no evidence of widespread contamination in ground water.
Arsenic	1 of 1	14 μg/L	0.0071 μg/L[b, g, h]	Within background range cited in SWFS (2 to 220 μg/L).
Barium	1 of 1	0.029 mg/L	2.6 mg/L[b, f]	Within background range cited in SWFS (0.004 to 29 mg/L) and maximum concentrations are below the PRG.

Table 2-5. Screening out new substances detected since SWRI as contaminants of potential concern. (Cont. Page 4 of 5)

Constituent	No. of detections/ No. of samples	Maximum concentration	Preliminary Remediation Goals (PRGs)	Rationale for screening out contaminant
Copper	1 of 3	0.16 mg/L	1.5 mg/L[b, f]	Maximum exceeds background of 0.001 mg/L cited in SWFS. Maximum concentrations are below the PRG. Limited data provides no evidence of widespread contamination in ground water.
Fluoride	3 of 3	0.49 mg/L	2.2 mg/L[b, f]	Within background range cited in SWFS (0.28 to 0.76 mg/L). Maximum concentrations are below the PRG.
Iron	1 of 3	44 mg/L	11 mg/L[b, f]	Exceeds background range cited in SWFS (from 0.3 to 3.8 mg/L) and the PRG. Limited data provides no evidence of widespread contamination in ground water.
Magnesium	3 of 3	23 mg/L	No available PRG	Within background range cited in SWFS (0.26 to 102 mg/L).
Manganese	2 of 3	0.89 mg/L	0.88 mg/L[b, f]	Near the upper limit of the background range cited in SWFS (from 0.01 to 0.77 mg/L). Limited data provides no evidence of widespread contamination in ground water.
Nitrate (as NO_3)	3 of 3	55 mg/L	No available PRG	Will be addressed by the remedy for nitrate in ground water.
Uranium 234 and 233	1 of 1	1.25 pCi/L	0.674 pCi/L[c, e, g]	Within background ranges from 0.25 to 13 pCi/L (SWFS). Additional information on background found in Appendix D.
Uranium 238	1 of 1	0.535 pCi/L	0.744 pCi/L[c, g]	Within background range cited in SWFS (0.12 to 9.38 mg/L) and maximum concentrations are below the PRG. Additional information on background found in Appendix D.
Zinc	2 of 3	0.16 mg/L	11 mg/L[b, f]	Near the upper limit of the background range cited in SWFS (from 0.01 to 0.12 mg/L). Maximum concentrations are below the PRG. No evidence of widespread contamination in ground water.

Footnotes appear on following page.

Table 2-5. Screening out new substances detected since SWRI as contaminants of potential concern. (Cont. Page 5 of 5)

[a] Outdoor worker PRGs from U.S. EPA (2004) Radionuclide Toxicity and Preliminary Remediation Goals for Superfund, August 4, 2004.

[b] Residential tap water PRGs from U.S. EPA (2004), Region 9 PRG Table 2004 Update, October 20, 2004.

[c] Tap water PRGs from U.S. EPA (2004) Radionuclide Toxicity and Preliminary Remediation Goals for Superfund, October 20, 2004.

[d] Chemical toxicity only PRG is 7.3 μg/L from from U.S. EPA (2004), Region 9 PRG Table 2004 Update, October 20, 2004. Conversion from mass to activity dependent upon known ratios, therefore isotope-specific PRGs more applicable.

[e] PRG for Uranium 234

[f] Chronic Hazard

[g] Cancer Risk

[h] CAL-Modified PRG

Table 2-6. Contaminants of potential concern in surface soil (0 to 0.5 ft), subsurface soil (at all depths below 0.5 ft), preliminary remediation goals (PRGs), baseline cancer risk, and noncancer hazard.

Constituent	Number of detections	Number of samples	Percent detections	Maximum result (pCi/g)	95% UCL (pCi/g)	Cancer PRG[a]	Risk
Surface Soil							
Tritium	4	15	26.7	7.24E-01[b]	1.49E-01	1.42 E+00	1E-07[c]
Uranium 235[d]	13	13	100	3.46E-01	1.32E-01	4.17 E-01	3E-07[c]
Uranium 238[e]	19	19	100	2.40E+01	6.64E+00	3.48 E+01	2E-07[c]
						Risk total =	6 E-07
Subsurface Soil							
Tritium	206	314	65.6	1.18E+03[f,g]	9.10E+01[h]	NA	4E-06[i]
Uranium 238[e]	112	112	100	2.10E+02[j,k]	1.72E+01[h]	**	**

Notes:

NA = No PRG available for inhalation pathway only.

** = No complete exposure pathway.

UCL = Upper Confidence Level.

PRG = Preliminary Remediation Goal.

[a] US EPA outdoor worker soil cancer PRG; cancer PRG activity equates to a 10^{-6} cancer risk; PRG and result in similar units.

[b] The results of this sample were reported as 18,100 pCi/L in soil moisture, with a soil moisture content by weight of 4%. Results were converted to pCi/g.

[c] 95% UCL used to calculate risk.

[d] Only measurements by mass spectrometry used.

[e] Combined measurements by mass spectrometry and alpha spectrometry.

[f] Maximum result was detected between 0.5 and 12 ft (11.1 ft) on November 5, 1984, prior to the SWRI data cutoff date of December 31, 1991.

[g] The results of this sample were reported as 8,089,000 pCi/L in soil moisture, with a soil moisture content by weight of 14.6%. Results were converted to pCi/g.

[h] Samples collected between 0.5 and 12 ft were used to calculate subsurface soil 95%UCL.

[i] Risk value reported as for Pit 3 from the SWRI (summarized in Table 2-1).

[j] The sample results are equivalent to 652.2 mg/kg.

[k] Maximum result detected at 22 ft on November 8, 1999.

Table 2-7. Contaminants of potential concern in ground water and Spring 24.

Constituent	Number of detections	Number of samples	Percent detections	Maximum result	Maximum Contaminant Level	Units
Ground water						
1,1-Dichloro-ethene	131	1,321	9.9	6.20E+00	7.0E+00[b] 6.0E+00[c]	μg/L
Nitrate (as NO_3)	381	476	80	3.63E+05	4.5E+04[b, c]	μg/L
Perchlorate	20	73	27.4	1.90E+01	6.0E+00[d]	μg/L
Toluene	7	137	5.1	5.10E+00	1.0E+03[b] 1.5E+02[c]	μg/L
Total xylene isomers	8	82	9.8	1.00E+01	1.0E+04[b] 1.7E+03[c]	μg/L
Trichloroethene	338	1,311	25.8	1.50E+01	5.0E+00[b, c]	μg/L
Tritium	2,059	3,068	67.1	2.66E+06	2.0E+04[b,c]	pCi/L
Uranium[a]	1,210	1,285	94.2	7.26E+02	3.0E+01[b] 2.0E+01[c]	μg/L pCi/L
Spring 24						
Tritium	5	5	100	2.38E+03	2.0E+04[b,c]	pCi/L

Note:

[a] **Combined measurements by mass spectrometry and alpha spectrometry.**

[b] **Federal Maximum Contaminant Level.**

[c] **State of California Maximum Contaminant Level.**

[d] **State of California Public Health Goal.**

Table 2-8. Contaminants of potential concern in ground water modeled to the site boundary and to Spring 24.

Constituent	Maximum modeled activity	Units	Date of maximum activity	Background pCi/L[a]
East Site Boundary 1				
Tritium	No impact	–	–	<100
Total Uranium	No impact	–	–	10.1–41.8
Northeast Site Boundary 2				
Tritium	No impact	–	–	<100
Total Uranium	No impact	–	–	10.1–41.8
Spring 24				
Tritium	2380[b]	pCi/L	2nd quarter 2003	<100
Total Uranium	No impact	–	–	10.1–41.8

[a] Background values obtained from wells NC7-25 (total uranium) and K7-06 (tritium).

[b] Second quarter 2003.

Table 2-8a. Risk to adults working onsite associated with tritium volatilizing from Spring 24 into air.

	Activity in water (pCi/L)	Estimated activity in air (pCi/m_3)	PEF (m_3)	Risk
Historic maximum	2,380	1.54E-01	1.25E+05	1E-09
Predicted maximum	*	*	*	*

Note:

* = The modeled maximum activity of tritium at Spring 24 does not exceed the historic maximum.

Table 2-9. Summary of re-evaluation of baseline human health effects at the Pit 7 Complex.

Media (Exposure pathways)	Contaminant of potential concern	Baseline risk
Surface soil (outdoor adult onsite exposure from inhalation of resuspended particulates, dermal absorption, and incidental ingestion)	**Tritium**	**1×10^{-7a}**
	Uranium 235	**3×10^{-7a}**
	Uranium 238	**2×10^{-7a}**
	Total Risk (surface soil)	**6×10^{-7}**
Subsurface soil (outdoor adult onsite exposure from inhalation of tritium volatilized from subsurface soil to air)	**Tritium**	**4×10^{-6b}**
	Total Risk (surface and subsurface soil)	**4×10^{-6}**
Surface water (outdoor adult onsite exposure from inhalation of tritium volatilized from Spring 24 to air)	**Tritium**	**1×10^{-9c}**

Notes:

PRG = Preliminary remediation goal.

[a] Risk number was derived from comparison to the appropriate cancer PRG. The 95%UCL of each contaminant was divided by the contaminant-specific PRG and multiplied times 10^{-6} to derive the risk number.

[b] Risk number from SWRI, as summarized in Table 2-1.

[c] Risk number as presented in Table 2-8a.

Table 2-10. Baseline Ecological Risk Assessment Summary for Pit 7 Complex.

	Ecological risk assessment		
Risk assessment done/document	Exposure pathway evaluated	Contaminant of potential concern evaluated	Impacts
Yes: SWRI Chapters 6 and 11	• Inhalation of tritium vapor that diffuses into the air of subsurface burrows (Pits 3 and 5) • Inhalation of tritium vapor from subsurface soil to atmosphere (Pits 3 and 5) • Inhalation of contaminated, resuspended particles (area wide) • Inhalation of uranium-238 contaminated, resuspended soil particles in subsurface burrows (Pits 3 and 5) • Incidental ingestion of contaminants in surface and subsurface soil (area wide) • Radiological impacts to vegetation (B850) • Inhalation of tritium water vapor evaporating from spring water into air (B850: Well 8 Spring, Spring 6) • Direct ingestion of contaminants of surface water (B850: Well 8 Spring, Spring 6)	Tritium, beryllium, cadmium, copper, zinc, uranium-238, freon 11, freon 113, RDX	• No unacceptable risk from radiological exposure to adult or juvenile ground squirrels, deer, or kit fox. • HI for combined oral and inhalation risk for individual adult squirrels, and for individual adult and juvenile deer exceeds 1 for cadmium, and for the sum of VOCs, metals, and HE. However, there is no unacceptable risk to the ground squirrel and deer populations (Webster-Scholten, 1994, and Sections 2.5.3.1 and 2.5.3.2, respectively). • No unacceptable risk from individual VOCs to adult or juvenile ground squirrels, deer, or kit fox. • Except for cadmium, no unacceptable risk from individual metals to adult or juvenile squirrels or deer. • No unacceptable risk from any metals to adult or juvenile kit fox. • No unacceptable risk from HE to adult or juvenile ground squirrels, deer, or kit fox. • The HI from tritium or uranium-238 is less than 1 for native perennial bunch grasses. • The TQ for tritium and uranium-238 is below 1 for Well Spring 8 and Spring 6.

Notes:

B850 = Building 850.
HE = High explosive.
HI = Hazard index.
RDX = Research Department Explosive.
SWRI = Site-Wide Remedial Investigation.
TQ = Toxicity Quotient.
VOCs = Volatile organic compounds.

Table 2-11. Contaminants of concern in surface soil and subsurface soil and rock for the Pit 7 Complex.

Media	Contaminant of concern	Historical maximum concentration	Recent maximum
Surface soil	**No surface soil contaminants of concern. No associated cancer risk or hazard associated with individual compounds. Primary threat to ground water from subsurface soil/rock**	**NA**	**NA**
Subsurface soil and rock (all depths)	**Tritium**	**1180 pCi/g (8,089,000 pCi/L in soil moisture, 1984)**	**947 pCi/g (6,210,000 pCi/L in soil moisture, 1999)**
	Uranium-238	**210 pCi/g (652.2 mg/kg) (1999)**	**210 pCi/g (652.2 mg/kg) (1999)**

Notes:

NA = Not applicable.

pCi/g = Picocuries per gram.

pCi/L = Picocuries per liter.

Table 2-12. Contaminants of concern in surface and ground water for the Pit 7 Complex.

Media	Contaminant of concern	Historic maximum concentration	Maximum concentration in 2003
Surface Water			
Spring 24	No surface water contaminants of concern. No inhalation risk or hazard associated with volatile contaminants (tritium). All contaminants with activities greater than background are addressed in ground water.	NA	NA
Ground Water	<u>VOCs</u>		
	1,1-DCE	6.2 μg/L[c] (1985)	1.0 μg/L
	TCE	15 μg/L (1995)	2.8 μg/L
	Toluene[a]	5.1 μg/L (1993)	No analyses
	Total xylenes[a]	10 μg/L (1984)	No analyses
	<u>Radionuclides</u>		
	Tritium	2,660,000 pCi/L (1998)	469,000 pCi/L
	Uranium-238[b]	726 pCi/L (1998)	78.6 pCi/L
	<u>Other</u>		
	Nitrate (as NO_3)	363 mg/L (2003)	363 mg/L
	Perchlorate	19 μg/L (2003)	19 μg/L

Notes:

DCE = Dichloroethylene.
mg/L = Milligrams per liter.
NA = Not applicable.
pCi/L = Picocuries per liter.
TCE = Trichloroethylene.
VOCs = Volatile organic compounds.
μg/L = Microgram per liter.

[a] Contaminant not reported in last 2 years, but sampling history not yet adequate to rule out as a COC.

[b] Total uranium maximum activity for NC7-40 is 122.9 pCi/L for 2003.

[c] 1,1-DCE at a concentration of 11 g/L in K7-01 (1985) was not used due to being flagged by the QC program as an outlier.

Table 3-1. Potential ARARs for the Pit 7 Complex.

Action(s)	Source	Description	Application
Ground water: monitored natural attenuation, ground water extraction, *in situ* treatment, containment, and hydraulic control	*State:* State Water Resources Control Board (SWRCB) Resolution 92-49, Paragraph IIIG[a] (Applicable, chemical-specific)	Establishes requirements for investigation and cleanup and abatement of discharges.	All cleanup activities associated with the implementation of remedial actions will be conducted under the supervision of the Central Valley Regional Water Quality Control Board (CVRWQCB). DOE/LLNL will evaluate compliance with SWRCB Resolution 92-49 in the Evaluation Summary Report for the final ROD.
	Chapter 15, California Code of Regulations (CCR), Title 23, Sections 2550.7, 2550.10 (Relevant and appropriate, action-specific)	Requires monitoring of the effectiveness of the remedial actions.	Contaminant concentrations in *in situ* ground water will be measured.
	CCR, Title 27, Sections 20390, 20395, 20400, 20405, and 20420 CCR, Title 23, Sections 2550.2, 2550.3, 2550.4, 2550.5, and 2550.8 (Relevant and appropriate, action-specific)	Requires establishment of a water quality protection standard consisting of a list of constituents of concern, concentration limits, compliance monitoring points, all monitoring points, detection monitoring, and identification of the point of compliance, hydraulically down gradient from the area where waste was discharged to land.	Applies to landfills if waste is left in place.

Table 3-1. Potential ARARs for the Pit 7 Complex. (Cont. Page 2 of 6)

Action(s)	Source	Description	Application
Ground water: monitored natural attenuation, ground water extraction, *in situ* treatment, containment, and hydraulic control (cont.)	**CCR, Title 27, Section 20410** **CCR, Title 23, Section 2550.6** **(Relevant and appropriate, chemical-specific)**	**Requires monitoring for compliance with remedial action objectives for three years from the date of achieving cleanup standards.**	**Applies to ground water and soil remedial actions.**
Surface discharge of treated ground water	*State:* **SWRCB Resolution 68-16 (anti-degradation policy) (Applicable, chemical-specific)**	**Requires that high quality surface and ground water be maintained to the maximum extent possible.**	**Ground water treatment system effluent will be monitored to ensure that surface and ground water quality will be maintained to the maximum extent possible.**
	State: **Water Quality Control Plan (Basin Plan) for CVRWCB (Applicable, chemical-specific)**	**Establishes beneficial uses and water quality objectives for ground water and surface waters in the Central Valley Region as well as implementation plans to meet water quality objectives and protect beneficial uses.**	**Any activity, including but not limited to, the discharge of contaminated waters will be precluded from resulting in actual water quality exceeding water quality objectives.** **Any new discharge to surface water shall be subject to either an NPDES permit adopted by the CVRWQCB or substantive requirements with concurrence of the CVRWQCB. Any NPDES permit or substantive requirement must include applicable state requirements under the Water Code including the antidegradation policy.**

Table 3-1. Potential ARARs for the Pit 7 Complex. (Cont. Page 3 of 6)

Action(s)	Source	Description	Application
Treated ground water reinjection	*Federal:*		
	Safe Drinking Water Act Underground Injection Control Program (40 CFR 144.26-144.27) (Applicable, action-specific)	Requires monitoring for reinjection of treated water.	Treated ground water will be analyzed to verify complete removal of contaminants to regulatory treatment standards, prior to reinjection.
	State:		
	SWRCB Resolution 68-16 (anti-degradation policy) (Applicable, chemical-specific)	Requires that high quality ground water be maintained to the maximum extent possible.	Treated ground water will be analyzed to verify complete removal of contaminants to regulatory treatment standards, prior to reinjection.
	Water Quality Control Plan (Basin Plan) for CVRWCB (Applicable, chemical-specific)	Establishes beneficial uses and water quality objectives for ground water and surface waters in the Central Valley Region as well as implementation plans to meet water quality objectives and protect beneficial uses.	Monitoring will be conducted to preclude any activity, including, but not limited to, the discharge of contaminated waters that result in actual water quality exceeding water quality objectives.
Capping/On-site consolidation	*State:*		
	CCR, Title 27, Section 21090 (Applicable, action-specific)	Requires a final cover constructed in accordance with specific prescriptive standards, to be maintained as long as wastes pose a threat to ground water.	Applies to wastes contained or left in place at the end of remedial actions that could affect water quality. Includes closure of landfills and other areas where waste has been disposed to land.
	CCR, Title 22, Division 4.5, Chapter 14, Article 14 (Relevant and appropriate, action-specific)	Provides requirements for constructing and maintaining an onsite consolidation unit and for capping of existing pits.	Potentially applies to landfill pits under consideration for either on-site consolidation or capping (Pits 3 and 5).

Table 3-1. Potential ARARs for the Pit 7 Complex. (Cont. Page 4 of 6)

Action(s)	Source	Description	Application
Capping/Onsite consolidation (cont.)	CCR, Title 27, Sections 20950, 22207 (a), 22212 (a), and 22222 CCR, Title 23, Sections 2550.0 (b), 2580, 2580 (f) Applicable, action-specific)	General closure requirements, including continued maintenance of waste containment, drainage controls, and ground water monitoring throughout the closure and post-closure maintenance periods.	Applies to the landfill pits.
Disposition of waste	*State:*		
	California Health and Safety Code, Division 20, Chapter 6.5, CCR, Title 22, Division 4.5, Chapters 11 and 12: Minimum Standards for Management of Hazardous and Extremely Hazardous Wastes (Applicable, action-specific)	Controls hazardous wastes from point of generation through accumulation, transportation, treatment, storage, and ultimate disposal.	Applies to the spent resin vessels and to excavated contaminated soil or waste.
	State:		
	California Health and Safety Code, Division 20, Chapter 6.5, CCR, Title 22, Division 4.5, Chapter 14, Article 14 (Relevant and appropriate, action-specific)	Requirements for constructing and maintaining an onsite consolidation unit and for capping of existing pits.	Potentially applies to all landfill pits under consideration for either onsite consolidation or capping.
	CCR, Title 23, Division 3, Chapter 15 (Applicable, action-specific)	Establishes waste and siting classification systems and minimum waste management standards for discharges of waste to land for treatment, storage, and disposal. Engineered alternatives that are consistent with Title 23 performance goals may be considered. Also establishes corrective action requirements for responding to leaks and other unauthorized discharges.	Applies to *ex situ* treatment, storage, and disposal of any remediation-derived hazardous solid wastes.

Table 3-1. Potential ARARs for the Pit 7 Complex. (Cont. Page 5 of 6)

Action(s)	Source	Description	Application
Disposition of waste (cont.)	*State:*		
	CCR, Title 27, Division 2, Subdivision 1 (Applicable, action-specific)	Regulates hazardous wastes that are discharged to land.	Waste and site classifications and waste management requirements will be applied for solid waste storage or disposal on land.
Storm water controls	*Federal:*		
	40 CFR Parts 122, 123, 124, National Pollution Discharge Elimination System, implemented by California Storm Water Permit for Industrial Activities, State Water Resources Control Board Order No. 97-03-DWQ. (Applicable, action-specific)	Regulates pollutants in discharges of storm water associated with hazardous waste treatment, storage, and disposal facilities, wastewater treatment plants, landfills, land application sites, and open dumps. Includes requirements to ensure storm water discharges do not contribute to a violation of surface water quality standards.	Applies to storm water discharges from industrial areas. Includes measures to minimize and/or eliminate pollutants in storm water discharges and monitoring to demonstrate compliance.
	Federal:		
	40 CFR Parts 122, 123, 124, National Pollution Discharge Elimination System, implemented by State Water Resources Control Board Order No. 92-08 DWQ (Applicable, action-specific)	Regulates pollutants in discharges of storm water associated with construction activity (clearing, grading, or excavation) involving the disturbance of 5 acres or more. Includes requirements to ensure storm water discharges do not contribute to a violation of surface water quality standards.	Applies to construction areas over 5 acres in size. Includes measures to minimize and/or eliminate pollutants in storm water discharges and monitoring to demonstrate compliance.

Table 3-1. Potential ARARs for the Pit 7 Complex. (Cont. Page 6 of 6)

Action(s)	Source	Description	Application
Protection of endangered species	*Federal:* Endangered Species Act of 1973, 16 USC Section 1531 et seq. 50 CFR Part 200, 50 CFR Part 402 [40 CFR 257.3-2] (Applicable, location-specific) *State:* California Endangered Species Act, California Department of Fish and Game Sections 2050-2068 (Applicable, location-specific)	Requires that facilities or practices not cause or contribute to the taking of any endangered or threatened species of plants, fish, or wildlife. NEPA implementation requirements may apply.	Prior to any well installation, facility construction, or similar potentially disruptive activities, wildlife surveys will be conducted and mitigation measures implemented if required.

[a] ARARs pertaining to clean-up standards will be selected at the time of the Final ROD.

Table 3-2. MCLs and WQOs for COCs in ground water at the Pit 7 Complex.

Chemical of concern	Federal MCL (μg/L)[a]	State MCL or WQO (μg/L)[a]	Release site
Halogenated VOCs			
1,1-DCE	7	MCL: 6	Pit 5
TCE	5	MCL: 5	Pit 5
Aromatic VOCs			
Toluene	1,000	MCL: 150	Pit 5
Total xylenes	10,000	MCL: 1,750	Pit 5
Radionuclides			
Tritium	20,000 pCi/L	MCL: 20,000 pCi/L	Pits 3 & 5
Uranium	30	MCL: 20 pCi/L	Pits 3 & 5
Other:			
Nitrate (as NO_3)	45,000	MCL: 45,000	Pits 3 & 5
Perchlorate	None[b]	Public health goal: 6	Pits 3 & 5

Notes:

COCs = Contaminants of concern.
DCE = Dichloroethylene.
MCL = Maximum contaminant level.
TCE = Trichloroethylene.
VOC = Volatile organic compound.
WQO = Water quality objective.

[a] Units in μg/L except where otherwise indicated.

[b] Perchlorate is on EPA's Contaminant Candidate List that contains contaminants not currently subject to any proposed or promulgated national primary drinking water regulation, are known or anticipated to occur in public water systems, and may require regulations under the Safe Drinking Water Act.

Table 3-3. Potential general response actions to achieve remedial action objectives at the Pit 7 Complex subarea.

Remedial Action Objective	Potential General Response Actions
For Human Health Protection:	
1. Prevent human ingestion of ground water containing contaminant concentrations (single carcinogen) above the State and federal maximum contaminant levels (MCLs) and any more stringent water quality objectives (WQOs). The contaminants of concern (COCs) for the Pit 7 Complex, as well as the State and Federal MCLs and Regional Water Quality Control Board WQOs for these COCs are listed in Table 3-2.	– No further action – Risk and hazard management – Monitoring – Monitored natural attenuation – Ground water *in situ* treatment – Ground water extraction and *ex situ* treatment – Hydraulic control – Source control/containment – Removal and disposal
2. Prevent human inhalation of tritium volatilizing from subsurface soil to air that pose an excess cancer risk greater than 10^{-6} or hazard index (HI) greater than 1, a cumulative excess cancer risk (all carcinogens) in excess of 10^{-4}, or a cumulative HI (all noncarcinogens) greater than 1.	– No further action – Risk and hazard management – Vapor extraction and *ex situ* treatment – Source control/containment – Removal and disposal
3. Prevent human inhalation of contaminants (tritium) volatilizing from surface water at Spring 24 to air that pose an excess cancer risk greater than 10^{-6} or HI greater than 1, a cumulative excess cancer risk (all carcinogens) in excess of 10^{-4}, or a cumulative HI (all noncarcinogens) greater than 1.	– No further action – Risk and hazard management – Containment
4. Prevent human exposure to contaminants in media of concern that pose a cumulative excess cancer risk (all carcinogens) greater than 10^{-4} and/or a cumulative HI greater than one (all noncarcinogens).	– No further action – Risk and hazard management – Monitoring – Monitored natural attenuation – Ground water *in situ* treatment – Ground water extraction and *ex situ* treatment – Vapor extraction and ex situ treatment – Hydraulic control – Source control/containment – Removal and disposal

Table 3-3. Potential general response actions to achieve remedial action objectives at the Pit 7 Complex subarea. (Cont. Page 2 of 2)

Remedial Action Objective	Potential General Response Actions
For Environmental Protection:	
1. Restore water quality, at a minimum, to water quality objectives that are protective of beneficial uses within a reasonable timeframe and prevent plume migration. Maintain existing water quality that complies with water quality objectives. This will apply to both individual and multiple constituents that have additive toxicology or carcinogenic effects.	– No further action – Risk and hazard management – Monitoring – Monitored natural attenuation – Ground water *in situ* treatment – Ground water extraction and *ex situ* treatment – Hydraulic control – Source control/containment – Removal and disposal
2. Ensure ecological receptors important at the individual level of ecological organization (listed threatened or endangered, State of California species of special concern) do not reside in areas where relevant hazard indices exceed 1.	– No further action – Risk and hazard management
3. Ensure existing contaminant conditions do not change so as to threaten wildlife populations and vegetation communities.	– No further action – Risk and hazard management

Notes:

COCs = Contaminants of concern.
HI = Hazard index.
MCL = Maximum contaminant level.
WQO = Water quality objective.

Table 3-4a. Potential general response actions and technologies by contaminant and media.

	Ground water		Vadose zone		Surface soil		Surface water	
Contaminant	General response action	Technology	General response action	Technology	General response action	Technology	General response action	Technology
VOCs	No further action:	– None	NA	– NA	NA	– NA	NA	– NA
	Monitored natural attenuation:	– Ground water sampling and analysis; water level measurements; modeling						
Tritium	No further action:	– None	No further action:	– None	NA	– NA	No further action:	– None
	Risk and hazard management:	– Institutional controls	Risk and hazard management:	– Institutional controls (i.e., fencing, land use restrictions) – Ecological hazards control			Risk and hazard management:	– Institutional/engineered controls (i.e., fencing, land use restrictions) – Ecological hazards control
	Monitored natural attenuation:	– Ground water sampling and analysis; water level measurements; modeling	Extraction and *ex situ* treatment of tritiated water vapor:	– No safe, proven technologies available			Containment:	– Collection and disposal
	Hydraulic plume control:	– Funnel and sump – Extraction with reinjection	Source control/ containment:					
	Source control/ Containment:	See vadose zone and pit waste for source control/containment	Capping	– Engineered cap				
			In situ stabilization	– Silica gel injection				
			Hydraulic barrier	– Slurry wall – Grout curtain – Cryogenic freezing				
			Hydraulic diversion	– Surface and subsurface flow interceptor system				
			Removal and disposal:	– Soil/rock removal – Offsite or onsite soil/rock disposal				
Uranium	No further action:	– None	No further action:	– None	NA	– NA	NA	–NA
	Risk and hazard management:	– Institutional controls	Risk and hazard management:	– Institutional controls				

Table 3-4a. Potential general response actions and technologies by contaminant and environmental media. (Cont. Page 2 of 3)

	Ground water		Vadose zone		Surface soil		Surface water	
Contaminant	General response action	Technology	General response action	Technology	General response action	Technology	General response action	Technology
Uranium (cont.)	Monitoring:	– Ground water sampling and analysis; water level measurements; modeling	Source control/ containment:					
	In situ treatment:	– Permeable reactive barrier	*In situ* stabilization	– Silica gel injection				
	Extraction with *ex situ* treatment:		Hydraulic barrier	– Slurry wall – Grout curtain – Cryogenic freezing				
	Ground water extraction:	– Funnel and sump – Ground water pumping from wells	Hydraulic diversion	– Surface and subsurface flow interceptor system				
	Ex situ treatment:	– Ion exchange – Aerogel/GAC – Electrocoagulation – Apatite	Removal and disposal:	– Soil/rock removal – Offsite or onsite soil/rock disposal				
	Disposal of treated water:	– Onsite surface discharge – Reinjection using infiltration trench or injection wells – Onsite recycling or reuse – Air misting						
	Disposal of treatment waste:	– Offsite disposal/ regeneration of ion exchange resin – Offsite disposal of spent GAC/Aerogel – Offsite disposal of spent apatite						
	Hydraulic control:	– Funnel and sump – Extraction with reinjection						
	Source control/ containment:	See vadose zone and pit waste for source control/containment						

Table 3-4a. Potential general response actions and technologies by contaminant and environmental media. (Cont. Page 3 of 3)

	Ground water		Vadose zone		Surface soil		Surface water	
Contaminant	General response action	Technology	General response action	Technology	General response action	Technology	General response action	Technology
Nitrate	No further action:	– None			NA	– NA	NA	– NA
	Monitoring:	– Ground water sampling and analysis; water level measurement						
Nitrate (Cont.)	*In situ* treatment:	– Permeable reactive barrier						
	Extraction with *ex situ* treatment:							
	Ground water extraction:	– Funnel and sump – Ground water pumping from wells						
	Ex situ treatment:	– Ion exchange						
	Disposal of treated water:	– Offsite disposal/regeneration of ion exchange resin						
	Disposal of treatment waste:	– Offsite disposal/regeneration of ion exchange resin						
Perchlorate	No further action:	– None			NA	– NA	NA	– NA
	Monitoring:	– Ground water sampling and analysis; water level measurement						
	In situ treatment:	– Permeable reactive barrier						
	Extraction with *ex situ* treatment:							
	Ground water extraction:	– Funnel and sump – Ground water pumping from wells						
	Ex situ treatment:	– Ion exchange						
	Disposal of treated water:	– Reinjection using infiltration trench or injection wells						
	Disposal of treatment waste:	– Offsite disposal/regeneration of ion exchange resin						
	Hydraulic control:	– Funnel and sump – Extraction with reinjection						

Notes:
GAC = Granular activated carbon.
NA = Not applicable; contaminant not present in media.
SVE = Soil vapor extraction.

Table 3-4b. Potential general response actions and technologies for the pit waste at the Pit 7 Complex by contaminant.

	Pit waste	
Contaminant	**General response action**	**Technology**
VOCs	**No further action:**	**– None**
	Risk and hazard management:	**– Institutional controls**
	Monitored natural attenuation:	**– Ground water sampling and analysis; water level measurements; modeling**
	Source containment:	**– Capping**
	***In situ* stabilization**	**– Silica gel injection**
	Hydraulic barrier	**– Slurry wall** **– Grout curtain** **– Cryogenic freezing**
	Source control:	
	Hydraulic diversion	**– Surface and subsurface flow interceptor system**
	Removal and disposal:	**– Excavation** **– Offsite or onsite waste disposal**
Tritium	**No further action:**	**– None**
	Risk and hazard management:	**– Institutional controls**
	Monitored natural attenuation:	**– Ground water sampling and analysis; water level measurements; modeling**
	Source containment:	
	Capping	**– Engineered cap**
	***In situ* stabilization**	**– Silica gel injection**
	Hydraulic barrier	**– Slurry wall** **– Grout curtain** **– Cryogenic freezing**
	Source control:	
	Hydraulic diversion	**– Surface and subsurface flow interceptor system**
	Removal and disposal:	**– Excavation** **– Offsite or onsite waste disposal**
Uranium	**No further action:**	**– None**
	Risk and hazard management:	**– Institutional controls**

Table 3-4b. Potential general response actions and technologies for the pit waste at the Pit 7 Complex by contaminant. (Cont. Page 2 of 2)

	Pit waste	
Contaminant	**General response action**	**Technology**
	Monitoring:	– Ground water sampling and analysis; water level measurements
	Source containment:	
	Capping	– Engineered cap
	***In situ* stabilization**	– Silica gel injection
	Hydraulic barrier	– Slurry wells – Grout curtain – Cryogenic freezing
	Source control:	
	Hydraulic diversion	– Surface and subsurface flow interceptor system
	Removal and disposal	– Excavation – Offsite or onsite waste disposal
Nitrate	**No further action:**	– None
	Monitoring:	– Ground water sampling and analysis; water level measurement
	Source containment:	– Engineered cap
	Removal and disposal:	– Excavation – Offsite or onsite waste disposal
Perchlorate	**No further action:**	– None
	Monitoring:	– Ground water sampling and analysis; water level measurement
	Source containment:	
	Capping	– Engineered cap
	***In situ* stabilization**	– Silica gel injection
	Hydraulic barrier	– Slurry wells – Grout curtain – Cryogenic freezing
	Removal and disposal:	– Excavation – Offsite or onsite waste disposal

Table 3-5. Preliminary response action and technology screening and evaluation for ground water at the Pit 7 Complex.

General Response Action	Remediation technology type	Technology (process options)	Screening comments	Effectiveness	Implementability	Cost	Retained?
No further action	None	Natural decay, degradation, dispersion, adsorption, dilution, and volatilization	Applicable.	Limited effectiveness.	Implementable.	No cost	For comparison only
Risk and hazard manage-ment	Institutional controls: limit access to ground water	Access controls	Applicable.	Effective onsite.	Implementable.	Very low	Yes
Monitoring	Ground water sampling and analysis; water level measurement	Natural decay, degradation, dispersion, adsorption, dilution, and volatilization	Applicable.	Effective for contaminants that naturally attenuate (i.e., VOCs, uranium, nitrate, and perchlorate).[a]	Implementable.	Low	Yes
Monitored natural attenuation	Ground water sampling and analysis; water level measurement; modeling	Natural decay, degradation, dispersion, adsorption, dilution, and volatilization	Applicable.	Effective for contaminants that naturally attenuate within a reasonable timeframe (i.e., VOCs and tritium).	Implementable.	Low	Yes

Table 3-5. Preliminary response action and technology screening and evaluation for ground water at the Pit 7 Complex. (Cont. Page 2 of 8)

General Response Action	Remediation technology type	Technology (process options)	Screening comments	Effectiveness	Implementability	Cost	Retained
In Situ Treatment (uranium, nitrate, and perchlorate)	*In situ* ground water treatment (uranium, nitrate, and perchlorate)	Permeable reactive barrier	Applicable. Innovative technology: Install barrier trench with reactive material in the path of the contaminant plume that mineralizes and/or sorbs uranium, nitrate, and perchlorate as contaminated ground water passes through the reactive barrier.	Effectively controls the migration of uranium, nitrate, and perchlorate in ground water by mineralization and/or sorbing contaminants to reactive material. Not effective in controlling tritium. May increase short-term exposure risk to workers during removal/ replacement of spent reactive material.	Implementability is limited by: 1) difficulties associated w/ removal and replacement of spent materials in the subsurface barrier, and 2) designing the system to ensure residual materials or by-products protect beneficial ground water uses.	Medium	Yes
Extraction and *ex situ* treatment	Ground water extraction (uranium, nitrate, and perchlorate)	Ground water pumping from funnel and sump	Applicable. Effectively captures upgradient uranium, nitrate, and perchlorate plumes.	Effective for uranium. Permanently removes uranium, nitrate, and perchlorate from the subsurface. Not effective in controlling tritium.	Implementable. Some challenges in excavation and installation of funnel and sump. Would need to reinject tritiated water into subsurface following uranium/nitrate/perchlorate treatment.	Low	Yes
		Ground water pumping from wells	Applicable. Effectively captures upgradient uranium, nitrate, and perchlorate plumes.	Effective for uranium, nitrate, and perchlorate. Permanently removes uranium, nitrate, and perchlorate from the subsurface. Not effective for controlling tritium.	Extensive wellfield would be required to capture uranium, nitrate, and perchlorate. Would need to reinject tritiated water into subsurface following uranium/nitrate/perchlorate treatment.	Medium	Yes[b]

Table 3-5. Preliminary response action and technology screening and evaluation for ground water at the Pit 7 Complex. (Cont. Page 3 of 8)

General Response Action	Remediation technology type	Technology (process options)	Screening comments	Effectiveness	Implementability	Cost	Retained
Extraction and *ex situ* treatment (cont.)	***Ex situ* ground water treatment**	**Ion-exchange resin (uranium, nitrate, and perchlorate)**	**Applicable.**	**Effective for uranium, nitrate, and perchlorate.** **Not effective in treating tritium.** **Increases short-term exposure risk to workers as tritiated and uranium contaminated water is brought to the surface.**	**Would need to reinject tritiated water into subsurface following uranium/nitrate/perchlorate treatment.**	**Low to medium**	**Yes**
		Aerogel /GAC Composite (Uranium)	**Applicable.** **Innovative technology.**	**Some research and development testing of the technology has been conducted.** **Not effective for treating tritium.** **Increases short-term exposure risk to workers as tritiated and uranium contaminated water is brought to the surface.**	**Requires field testing of the technology to determine implementability.** **Would need to reinject tritiated water into subsurface following uranium/nitrate/perchlorate treatment.**	**Low to medium**	**Yes**[b]
		Electrocoagulation (Uranium)	**Applicable.** **Innovative technology.**	**Some research and development testing of the technology has been conducted.** **Not effective for treating tritium.** **Increases short-term exposure risk to workers as tritiated and uranium contaminated water is brought to the surface.**	**Requires field testing of the technology to determine implementability.** **Would need to reinject tritiated water into subsurface following uranium/nitrate/perchlorate treatment.**	**Low**	**Yes**[b]

Table 3-5. Preliminary response action and technology screening and evaluation for ground water at the Pit 7 Complex. (Cont. Page 4 of 8)

General Response Action	Remediation technology type	Technology (process options)	Screening comments	Effectiveness	Implementability	Cost	Retained
Extraction and *ex situ* treatment (cont.)		Apatite (Uranium)	Applicable. Innovative technology.	Some research and development testing of the technology has been conducted. Not effective for treating tritium. Increases short-term exposure risk to workers as tritiated and uranium contaminated water is brought to the surface.	Requires field testing of the technology to determine implementability. Would need to reinject tritiated water into subsurface following uranium/nitrate/ perchlorate treatment.	Low to medium	Yes[b]
Disposal	Treated ground water disposal	Onsite surface discharge	Not applicable due to tritium in treated ground water.	NCF	NCF	NCF	No
		Reinjection using infiltration gallery	Applicable.	Effective.	Implementable.	Low	Yes

Table 3-5. Preliminary response action and technology screening and evaluation for ground water at the Pit 7 Complex. (Cont. Page 5 of 8)

General Response Action	Remediation technology type	Technology (process options)	Screening comments	Effectiveness	Implementability	Cost	Retained
Disposal (cont.)		Reinjection using injection wells	Applicable.	Injection wells not effective due to localized ground water mounding.	Implementable. Would need to locate reinjection well(s) outside source and plume area to avoid accelerated mobilization of contaminants from the pits. Injection wells require maintenance. Would not be consistent with State ARARs to reinject tritiated water into pristine ground water.	NCF	No
		Onsite reuse and recycling	Not applicable due to tritium in treated ground water.	NCF	NCF	NCF	No
		Air misting	Not applicable due to tritium in treated ground water.	NCF	NCF	NCF	No
		Offsite uses	Not applicable due to tritium in treated ground water.	NCF	NCF	NCF	No

Table 3-5. Preliminary response action and technology screening and evaluation for ground water at the Pit 7 Complex. (Cont. Page 6 of 8)

General Response Action	Remediation technology type	Technology (process options)	Screening comments	Effectiveness	Implementability	Cost	Retained
Disposal (cont.)	Disposal of treatment waste	Offsite disposal/ regeneration of spent ion-exchange resin	Applicable.	Effective.	Implementable.	Low	Yes
		Offsite disposal of spent Aerogel/ GAC	Applicable.	Effective.	Implementable.	Low	Yes[b]
		Offsite disposal of spent apatite	Applicable.	Effective.	Implementable.	Low	Yes[b]
Hydraulic control	Collection and reinjection	Funnel and sump	Applicable.	May be effective in controlling tritium, uranium, nitrate, and perchlorate migration. However reinjection could increase the hydraulic gradient and result in additional contaminant releases. Increases short-term exposure risk to workers if tritiated water, and possibly water containing uranium is brought to the surface.	Implementable but may result in additional releases and/or an increase in the volume of contaminated ground water if reinjection occurs near the pits. Reinjection of extracted ground water is severely limited by inadequate storage capacity of bedrock. If reinjection occurs away from the pits, it may be restricted by SWRCB Resolution 92-49 which prohibits degrading pristine waters of the state.	NCF	No

Table 3-5. Preliminary response action and technology screening and evaluation for ground water at the Pit 7 Complex. (Cont. Page 7 of 8)

General Response Action	Remediation technology type	Technology (process options)	Screening comments	Effectiveness	Implementability	Cost	Retained
Hydraulic control (cont.)		Extraction w/ reinjection	Applicable.	May be effective in controlling tritium, uranium, nitrate, and perchlorate plume migration. However reinjection could increase the hydraulic gradient and result in additional contaminant releases. Increases short-term exposure risk to workers if tritiated water, and possibly water containing uranium is brought to the surface.	Implementable but may result in additional releases and/or an increase in the volume of contaminated ground water if reinjection occurs near the pits. Reinjection of extracted ground water is severely limited by inadequate storage capacity of bedrock. Without a technology available to remove the tritium from the extracted ground water before it is reinjected, the pumping rate would need to be continually increased as more water entered the extraction/injection zone. Thus, controlling the leading edge of the tritium plume would be offset by the resulting latent spreading of the plume. If reinjection occurs away from the pits, it may be restricted by SWRCB Resolution 92-49 which prohibits degrading pristine waters of the state.	NCF	No

Notes and footnotes appear on following page.

Table 3-5. Preliminary response action and technology screening and evaluation for ground water at the Pit 7 Complex. (Cont. Page 8 of 8)

Notes:

ARARs = Applicable, relevant, and appropriate requirements.
GAC = Granular activated carbon.
NCF = Not considered further.
SWRCB = State Water Resources Control Board.
VOCs = Volatile organic compounds.

[a] DOE believes that a monitoring response action, when coupled with source control measures, is effective for uranium in ground water because human health and the environment will be protected during the time period necessary to reach MCLs for uranium in ground water. However, EPA and the State regulatory agencies do not agree that 500 years for achieving MCLs for uranium is a reasonable timeframe and therefore feel that a monitoring response action is not effective for uranium.

[b] Retained for future consideration.

Table 3-6. Preliminary response action and technology screening and evaluation for the vadose zone at the Pit 7 Complex.

General Response Action	Remediation technology type	Technology (process options)	Screening comments	Effectiveness	Implementability	Cost	Retained?
No further action	None	Natural decay, degradation, dispersion, adsorption, dilution, and volatilization	Applicable.	Limited effectiveness.	Implementable.	No cost	For comparison only
Risk and hazard manage-ment	Institutional controls: Restrict access and use	Fencing and signs	Applicable.	Effective.	Currently implemented onsite.	Very low	Yes
		Security guards and patrols	Applicable.	Effective.	Currently implemented onsite.	Low-medium	Yes
		Land use restrictions	Applicable.	Effective.	Currently implemented onsite.	Low	Yes
	Ecological hazards control	Ecological surveys	Applicable.	Effective.	Currently implemented onsite.	Low-medium	Yes
Extraction and *ex situ* treatment (Tritiated water vapor)	Tritiated water vapor extraction and treatment	No viable technologies are available to treat tritiated water vapor	NCF	NCF	NCF	NCF	No
Source control/ contain-ment	Capping	Engineered cap	Applicable.	Prevents venting of tritiated vapors and retards leaching from the vadose zone. By itself, does not prevent contaminant releases that result from water level rises into the vadose zone and pits.	Implementable.	High	No

Table 3-6. Preliminary response action and technology screening and evaluation for the vadose zone at the Pit 7 Complex. (Cont. Page 2 of 5)

General Response Action	Remediation technology type	Technology (process options)	Screening comments	Effectiveness	Implementability	Cost	Retained
Source control/ contain-ment (cont.)	*In situ* stabilization	Silica gel injection	Applicable. Innovative technology: Uses viscosity-sensitive barrier liquids which, when set in porous media, causes the media to exhibit very low permeability. The viscous liquid, when injected into a permeable medium, solidifies at a controlled rate to isolate the enclosed material.	Field testing conducted at Los Banos, Savannah River Complex, and Brookhaven National Laboratory has demonstrated that this technology may not be effective in reducing porosity in bedrock. Potential exists for fracturing to occur if the barrier liquid is injected into low permeability bedrock. Non-reversible.	NCF	NCF	No
	Hydraulic barrier	Slurry wall	Applicable.	Effective for source control to prevent horizontal migration of contaminants into unconsolidated material. Not effective for controlling releases of contaminants to bedrock due to construction constraints. May not be effective in preventing inundation of pits and vadose zone from water table rises.	May be difficult to install due to accessibility difficulties for equipment in uneven terrain. Installation depth will be limited to the alluvium due to constraints installing in bedrock.	Low	Yes

Table 3-6. Preliminary response action and technology screening and evaluation for the vadose zone at the Pit 7 Complex. (Cont. Page 3 of 5)

General Response Action	Remediation technology type	Technology (process options)	Screening comments	Effectiveness	Implementability	Cost	Retained
Source control/ containment (cont.)	Hydraulic barrier	Grout curtain	Applicable.	Effective for source control to prevent horizontal migration of contaminants into unconsolidated material. Not effective for controlling releases of contaminants to bedrock due to construction constraints. May not be effective in preventing inundation of pits and vadose zone from water table rises.	Unable to install in stiff low permeability soil and coherent bedrock.	NCF	No
		Cryogenic freezing	Applicable. Innovative technology: Could create a low permeable barrier underneath and along side the pits. As the water table rises, it freezes when it comes into contact with the freezing mechanism (requires additional energy/resources). Those areas where ground water does not rise remain partially saturated and frozen.	May be effective in immobilizing both tritium and uranium in the pit waste and adjacent vadose zone, thereby preventing releases. May not be effective for long-term control of uranium in pit waste. Minimizes human exposure to contaminants. Minimally intrusive. Reversible (by thawing). Effectiveness can be verified through sampling, modeling, and geophysical techniques.	Has been implemented at Oak Ridge National Laboratory as a field test although not on a large scale.	Medium for 30-year baseline cost. High to very high for long-term containment of uranium source.	No

Table 3-6. Preliminary response action and technology screening and evaluation for the vadose zone at the Pit 7 Complex. (Cont. Page 4 of 5)

General Response Action	Remediation technology type	Technology (process options)	Screening comments	Effectiveness	Implementability	Cost	Retained
Source control/ contain- ment (cont.)	Hydraulic drainage diversion	Surface and subsurface flow interceptor system	Applicable. Captures upgradient surface and shallow subsurface flow upgradient of the pits to prevent water level rises and inundation of the contaminated vadose zone underlying the pits.	Effective for tritium and uranium.	Implementable. Must be designed to prevent inundation that occurs as a result of a general rise in ground water levels in the landfill area, not just from upgradient flow.	Low	Yes
Removal and disposal	Excavation	Soil/rock removal	Applicable for small, shallow volumes only.	Effective if coupled with removal of the pit waste. Removes contaminant sources in the vadose zone. Does not reduce the toxicity or volume of waste as the waste would be re-deposited at a different location.	Impractical because it would require excavation of bedrock over a large area to an approximate 30 ft depth. Excavation would require extensive provisions to prevent exposure and protect the safety of workers, transport personnel and public during low-level mixed waste transport.	Very high	No
	Contaminated soil/rock disposal	Offsite disposal	Applicable.	Effective. Increases short-term exposure risk to workers during removal, transport and disposal of waste.	Implementable.	Very high	No

Table 3-6. Preliminary response action and technology screening and evaluation for the vadose zone at the Pit 7 Complex. (Cont. Page 5 of 5)

General Response Action	Remediation technology type	Technology (process options)	Screening comments	Effectiveness	Implementability	Cost	Retained
Removal and disposal (cont.)	Contaminated soil/rock disposal	Onsite disposal	Applicable.	Effective. Increases short-term exposure risk to workers during removal, transport and disposal of waste.	Implementable. May be limited by high cost, hydrogeological, biological, and topographical considerations, DOE regulations, and institutional concerns. Disposal in onsite containment unit would require long permitting process, siting, design, and approval with stakeholder input, which could stop process and impact time, resources, and cost to implement.	Very high	No

Notes:

DOE = U.S. Department of Energy.
NCF = Not considered further.

Table 3-7. Preliminary response action and technology screening and evaluation for surface water at the Pit 7 Complex.

General Response Action	Remediation technology type	Technology (process options)	Screening comments	Effectiveness	Implementability	Cost	Retained?
No further action	None	Natural decay, degradation, dispersion, adsorption, dilution, and volatilization	Applicable.	Limited. May not protect human health.	Implementable.	No cost	For comparison only
Risk and hazard management	Institutional controls: Restrict access and use	Fencing and signs	Applicable.	Effective.	Currently implemented onsite.	Low	Yes
		Security guards and patrols	Applicable.	Effective.	Currently implemented onsite.	Low	Yes
		Land use restrictions	Applicable.	Effective.	Currently implemented onsite.	Low	Yes
	Ecological hazards control	Ecological surveys	Applicable.	Effective.	Currently implemented onsite.	Low	Yes
Containment	Collection and treatment of surface water	No viable technologies are currently available for the treatment of tritiated water.	NCF	NCF	NCF	NCF	No

Note:

NCF = Not considered further.

Table 3-8. Preliminary response action and technology screening and evaluation for the pit waste at the Pit 7 Complex.

General Response Action	Remediation technology type	Technology (process options)	Screening comments	Effectiveness	Implementability	Cost	Retained?
No further action	None	Natural decay, degradation, dispersion, adsorption, dilution, and volatilization	Applicable.	Effective. No risk or hazard associated with contaminants in surface soil.	Implementable.	None	Yes
Risk and hazard management	Institutional controls: Restrict access and use	Fencing and signs	Applicable.	Effective	Currently implemented onsite.	Very low	Yes
		Security guards and patrols	Applicable.	Effective	Currently implemented onsite.	Low to medium	Yes
		Land use restrictions	Applicable.	Effective	Currently implemented onsite.	Low	Yes
Monitoring (Detection)	Ground water sampling and analysis; water level measurement	Leak detection monitoring	Applicable.	Effective for detection of further releases of contaminants from the pit waste.	Implementable.	Low	Yes
Monitored natural attenuation	Ground water sampling and analysis; water level measurement	Natural decay, degradation, adsorption, and volatilization	Applicable.	Effective for contaminants that naturally attenuate within a reasonable timeframe (i.e., VOCs and tritium).	Implementable.	Low	Yes

Table 3-8. Preliminary response action and technology screening and evaluation for the pit waste at the Pit 7 Complex. (Cont. Page 2 of 6)

General Response Action	Remediation technology type	Technology (process options)	Screening comments	Effectiveness	Implementability	Cost	Retained
Source isolation	Capping	Engineered cap	Applicable.	Effective. Retards leaching from pit waste but does not address primary contaminant release mechanism of ground water inundation of the pits. Direct percolation through pits to ground water is a relatively insignificant recharge pathway. Installation of a cap would not prevent future contaminant releases.	Implementable.	High	No
	In situ stabilization	Silica gel injection	Applicable. Innovative technology: Uses viscosity sensitive barrier liquids which, when set in porous media, causes the media to exhibit very low permeability. The viscous liquid, when injected into a permeable medium, solidifies at a controlled rate to isolate the enclosed material.	Field testing conducted at Los Banos, Savannah River Complex, and Brookhaven National Laboratory has demonstrated significant uncertainties to the effectiveness of this technology in waste material. Does not address contaminants already released to vadose zone. May not effectively reduce porosity in bedrock. Potential for fracturing to occur if the barrier liquid is injected into low permeability bedrock. Non-reversible.	NCF	NCF	No

Table 3-8. Preliminary response action and technology screening and evaluation for the pit waste at the Pit 7 Complex. (Cont. Page 3 of 6)

General Response Action	Remediation technology type	Technology (process options)	Screening comments	Effectiveness	Implementability	Cost	Retained
Source isolation (Cont.)	Hydraulic barrier	Slurry wall	Applicable.	Effective for source control to prevent horizontal migration of contaminants into unconsolidated material. Not effective for controlling releases of contaminants to bedrock due to construction constraints. May not be effective in preventing inundation of pits from water table rises.	May be difficult to install due to accessibility difficulties for equipment in uneven terrain. Installation depth will be limited to the alluvium due to constraints installing in bedrock.	Low	Yes
		Grout curtain	Applicable.	Effective for source control to prevent horizontal migration of contaminants into unconsolidated material. Not effective for controlling releases of contaminants to bedrock due to construction constraints. May not be effective in preventing inundation of pits from water table rises.	Unable to install in stiff low permeability soils and coherent bedrock.	NCF	No

Table 3-8. Preliminary response action and technology screening and evaluation for the pit waste at the Pit 7 Complex. (Cont. Page 4 of 6)

General Response Action	Remediation technology type	Technology (process options)	Screening comments	Effectiveness	Implementability	Cost	Retained
Source isolation (Cont.)		Cryogenic freezing	Applicable. Innovative technology: Create a low permeable barrier underneath and along side the pits. As the water table rises, it freezes when it comes into contact with the freezing mechanism (requiring additional energy/resources). Those areas where ground water does not rise remain partially saturated and frozen.	May be effective in immobilizing both tritium and uranium in the pit waste and adjacent vadose zone, thereby preventing releases. May not be effective for long-term control of uranium in pit waste. Minimizes human exposure to contaminants. Minimally intrusive. Reversible (by thawing). Effectiveness can be verified through sampling, modeling, and geophysical techniques.	Has been implemented at Oak Ridge National Laboratory as a field test, although not on a large scale.	Medium for 30-year baseline cost. High to very high for long-term containment of uranium source.	No
Source control	Hydraulic drainage diversion	Surface and subsurface flow interceptor system	Applicable. Captures upgradient surface and shallow subsurface water in bedrock upgradient of the pits to prevent water level rises and inundation of the pits.	Effective for tritium and uranium.	Implementable. Must be designed to prevent inundation that occurs as a result of a general rise in ground water levels in the landfill area, not just from upgradient flow.	Low	Yes

Table 3-8. Preliminary response action and technology screening and evaluation for the pit waste at the Pit 7 Complex. (Cont. Page 5 of 6)

General Response Action	Remediation technology type	Technology (process options)	Screening comments	Effectiveness	Implementability	Cost	Retained
Removal and disposal	Excavation	Excavate and remove contaminated waste from Pits 3 and 5 only.	Applicable.	Effective. Removes source materials but does not address contamination already released to the vadose zone. Not a permanent solution. Materials would be land disposed or treated elsewhere. Significantly increases short-term exposure risk to workers during excavation of waste.	Implementable. Need to protect excavation workers from increased risk to exposure. Need to locate disposal facility to accept waste for treatment and/or disposal.	Very high	Yes
		Excavate and remove contaminated waste from Pits 3, 4, 5, and 7.	Applicable	Effective. Removes source materials but does not address contamination already released to the vadose zone. Not a permanent solution. Materials would be land disposed or treated elsewhere. Significantly increases short-term exposure risk to workers during excavation of waste.	Implementable. Need to protect excavation workers from increased risk to exposure. Need to locate disposal facility to accept waste for treatment and/or disposal. Excavation of Pits 7 and 4 would require destruction of Pit 7 cap. Would require excavation of an additional 33,907 yd^3 of waste cap resulting in extremely high costs.	Very high	No
	Contaminated waste and soil disposal	Offsite treatment and/or disposal	Applicable.	Effective. Increases short-term exposure risk to workers during transport and disposal of waste.	Implementable.	Very high	Yes

Table 3-8. Preliminary response action and technology screening and evaluation for the pit waste at the Pit 7 Complex. (Cont. Page 6 of 6)

General Response Action	Remediation technology type	Technology (process options)	Screening comments	Effectiveness	Implementability	Cost	Retained
Removal and disposal (Cont.)	Contaminated waste and soil disposal	Onsite treatment and/or disposal	Applicable.	Effective. Increases short-term exposure risk to workers during transport and disposal of waste	Implementable. Limited by high cost; hydrological, biological, and topographical consideration; DOE regulations; and institutional concerns. Disposal in onsite contaminant unit would require long permitting process, siting, design, and approval with stakeholder input, which could stop process and impact time, resources, and cost to implement.	Very High	No

Notes:

DOE = Department of Energy.

NCF = Not considered further.

VOCs = Volatile organic compounds.

Table 3-9. Retained general response actions and remedial technologies.

General Response Action/Technology	Applicability to COCs
Ground water	
Risk and hazard management:	
Institutional controls:	
Access control[a]	All COCs[b]
Monitoring:	
Ground water sampling/analysis and water levels	Uranium, VOCs, nitrate, and perchlorate
Monitored natural attenuation:	
Ground water sampling/analysis and water levels; modeling	VOCs and tritium
In situ treatment:	
Permeable reactive barrier	Uranium, nitrate, and perchlorate
Extraction with *ex situ* treatment:	
Extraction:	
Extraction via funnel and sump	Uranium, nitrate, and perchlorate
Extraction via ground water pumping	Uranium, nitrate, and perchlorate
Treatment:	
Ion exchange (resin sorption)	Uranium, nitrate, and perchlorate
Aerogel/GAC sorption—aqueous phase[c]	Uranium
Electrocoagulation[c]	Uranium
Apatite[c]	Uranium
Disposal of treated water:	
Reinjection using infiltration gallery	Uranium
Disposal of treatment waste:	
Off-site disposal/regeneration spent resin and brine	Uranium, nitrate, and perchlorate
Off-site disposal of spent GAC/Aerogel[c]	Uranium
Off-site disposal of spent apatite[c]	Uranium
Vadose zone	
Risk and hazard management:	
Institutional controls:	
Fencing and signs	Tritium
Security guards/patrols	Tritium
Land use restrictions	Uranium and tritium
Ecological hazard control	Tritium

Table 3-9. Retained general response actions and remedial technologies. (Cont. Page 2 of 2)

General Response Action/Technology	Applicability to COCs
<u>Source control/containment:</u>	
Hydraulic barrier:	
Slurry wall	Uranium and tritium
Hydraulic drainage diversion:	
Surface and subsurface flow interceptor system	Uranium and tritium
Surface Water	
<u>Risk and hazard management:</u>	
Institutional controls:	
Fencing and signs	Tritium
Security guards/patrols	Tritium
Land use restrictions	Tritium
Ecological hazard control	Tritium
Pit Waste	
<u>No further action:</u> (No sampling or analysis)	All COCs
<u>Risk and hazard management:</u>	
Institutional controls:	
Fencing and signs	Tritium
Security guards/patrols	Tritium
Land use restrictions	Tritium
<u>Monitoring:</u>	
Ground water sampling/analysis and water levels	All COCs
<u>Monitored natural attenuation:</u>	
Ground water sampling/analysis and water levels; modeling	VOCs and tritium
<u>Source Control/Containment:</u>	
Hydraulic barrier:	
Slurry wall	All COCs
Hydraulic drainage diversion:	
Surface and subsurface flow interceptor system	All COCs
<u>Removal and disposal:</u>	
Excavation	TBC for all COCs in pit waste
Onsite contaminated waste disposal	TBC for all COCs in pit waste
Offsite contaminated waste disposal	TBC for all COCs in pit waste

Notes:

COC = Contaminant of concern.

TBC = To be considered.

VOC = Volatile organic compound.

[a] Control private well drilling and use of ground water.

[b] COCs in ground water include VOCs, uranium, tritium, nitrate, and perchlorate.

[c] Retained for future consideration.

Table 3-10. Remedial Alternatives for the Pit 7 Complex.

Remedial Alternatives for the Pit 7 Complex			
Alternative 1	**Alternative 2**	**Alternative 3a**	**Alternative 3b**
No further action for all contaminants and media of concern.	Component A: Monitoring of ground water.	Component A: Monitoring of ground water.	Component A: Monitoring of ground water.
	Component B: Exposure control through risk and hazard management.	Component B: Exposure control through risk and hazard management.	Component B: Exposure control through risk and hazard management.
	Component C: Monitored natural attenuation of tritium in ground water.	Component C: Monitored natural attenuation of tritium in ground water.	Component C: Monitored natural attenuation of tritium in ground water.
	Component D: Waste excavation of Pits 3 and 5 and disposal.	Component D: Control migration of uranium, nitrate, and perchlorate in ground water using *ex situ* ground water extraction and treatment.	Component D: Control migration of uranium, nitrate, and perchlorate in Qal/WBR ground water using *in situ* reactive permeable barrier and extraction and *ex situ* treatment of Tnbs$_0$ ground water.
		Component E: Waste excavation of Pits 3 and 5 and disposal.	Component E: Waste excavation of Pits 3 and 5 and disposal.
Previous interim actions: Capped Pits 4 and 7 (and 30% of Pit 3 under RCRA (1992).	Previous interim actions: Capped Pits 4 and 7 (and 30% of Pit 3) under RCRA (1992).	Previous interim actions: Capped Pits 4 and 7 (and 30% of Pit 3) under RCRA (1992).	Previous interim actions: Capped Pits 4 and 7 (and 30% of Pit 3) under RCRA (1992).
Total Estimated Cost: $0	Total Estimated Cost: $56,635,000	Total Estimated Cost: $63,741,000 (extraction wells) to $68,326,000 (funnel and sump with extraction and *ex situ* treatment)	Total Estimated Cost: $73,979,000

Table 3-10. Remedial Alternatives for the Pit 7 Complex. (Page 2 of 2)

Remedial Alternatives for the Pit 7 Complex			
Alternative 4a	**Alternative 4b**	**Alternative 5a**	**Alternative 5b**
Component A: **Monitoring of ground water.** **Component B:** **Exposure control through risk and hazard management.** **Component C:** **Monitored natural attenuation of tritium in ground water.** **Component D** **Source control by installing hydraulic diversion to prevent water from entering landfills.** **Previous interim actions:** **Capped Pits 4 and 7 under RCRA (1992).** **Total Estimated Cost:** **$3,738,000**	**Component A:** **Monitoring of ground water.** **Component B:** **Exposure control through risk and hazard management.** **Component C:** **Monitored natural attenuation of tritium in ground water.** **Component D:** **Source containment by installing hydraulic barriers (slurry walls) to prevent water from entering landfills.** **Previous interim actions:** **Capped Pits 4 and 7 under RCRA (1992).** **Total Estimated Cost:** **$4,344,000**	**Component A:** **Monitoring of ground water.** **Component B:** **Exposure control through risk and hazard management.** **Component C:** **Monitored natural attenuation of tritium in ground water.** **Component D:** **Source control by installing hydraulic diversion to prevent water from entering landfills.** **Component E:** **Phased migration control of uranium, nitrate, and perchlorate in ground water using *ex situ* ground water extraction and treatment.** **Previous interim actions:** **Capped Pits 4 and 7 under RCRA (1992).** **Total Estimated Cost:** **$10,845,000 (extraction wells) to $15,429,000 (funnel and sump with extraction and *ex situ* treatment).**	**Component A:** **Monitoring of ground water.** **Component B:** **Exposure control through risk and hazard management.** **Component C:** **Monitored natural attenuation of tritium in ground water.** **Component D:** **Source control by installing hydraulic diversion to prevent water from entering landfills.** **Component E:** **Phased migration control of uranium, nitrate, and perchlorate in Qal/WBR ground water using *in situ* reactive permeable barrier and extraction and *ex situ* treatment of Tnbs$_0$ ground water.** **Previous interim actions:** **Capped Pits 4 and 7 under RCRA (1992).** **Total Estimated Cost:** **$21,082,000**

Table 3-11. Components of remedial alternatives for the Pit 7 Complex.

Alternative remedial component	Alternative 1	Alternative 2	Alternative 3a	Alternative 3b	Alternative 4a	Alternative 4b	Alternative 5a	Alternative 5b
No further action	√							
Monitoring		√	√	√	√	√	√	√
Exposure control		√	√	√	√	√	√	√
Monitored natural attenuation for tritium in ground water		√	√	√	√	√	√	√
Source control: Waste excavation		√	√	√				
Source control: Hydraulic diversion					√		√	√
Source containment: Hydraulic barrier						√		
Phased plume migration control: *Ex situ* treatment of uranium, nitrate, and perchlorate			√				√	
Phased plume migration control: *In situ* treatment of uranium, nitrate, and perchlorate in Qal/WBR ground water with extraction and ex situ treatment of $Tnbs_0$ ground water				√				√

Table 3-12. Detailed analysis of remedial alternatives for the Pit 7 Complex.

Alternative number	Alternative components	Overall protection of human health and the environment	Compliance with ARARs	Long-term effectiveness and permanence	Reduction in toxicity, mobility, and volume (TMV)	Short-term effectiveness	Implementability	Net present worth cost, $K
1.	No Further Action	No	No	No	No	No	NA	None
2.	Monitoring of ground water	Yes. Ground water in the Pit 7 Complex area is not used for drinking water and will not migrate to offsite exposure points at uranium activities that pose a risk.	Uranium: Although uranium has a much longer half-life than tritium, it sorbs readily to subsurface material preventing significant migration, and would not impact offsite water supply wells. Because human health and the environment will be protected during the time period necessary to reach MCLs for uranium, Alternative 2 is capable of achieving RAOs and ARARs without impacting human health or the environment. However, EPA and the State regulatory agencies do not agree that 500 years is an acceptable timeframe for achieving MCLs or other RAOs for uranium. Perchlorate and nitrate: Alternative 2 does not comply with ARARs for perchlorate and nitrate, and there is no basis for an ARAR waiver.	Uranium: Dispersion, sorption, diffusion, and to a lesser extent, radioactive decay would provide long-term and permanent reduction in uranium activities in ground water. Monitoring of uranium, VOCs, perchlorate, and nitrate will assure long-term effectiveness by providing an indication of whether the remedy is satisfying WQOs.	Uranium sorbs readily to subsurface material which reduces its mobility in the subsurface. Although the monitoring of uranium, VOCs, perchlorate, and nitrate will not reduce the toxicity, mobility, and volume of these contaminants in the subsurface, it will provide an indication of whether the remedy is satisfying WQOs.	Yes. Uranium-contaminated ground water remains in the subsurface, short-term exposure/risk to workers would be prevented. Monitoring of uranium, VOCs, perchlorate, and nitrate will assure short-term effectiveness by providing an indication of whether the remedy is satisfying WQOs. Because human health would be protected during time period (up to 500 years) to reach MCLs for uranium, Alternative 2 provides short-term effectiveness without impacting human health or the environment. However, EPA and the State regulatory agencies do not agree that 500 years is an acceptable timeframe to achieve MCLs or other RAOs for uranium.	Implementable-monitoring network already in place.	
	Risk and hazard management	Yes–Used in conjunction with active remedies.	Used in conjunction with active remedies.	Effective in conjunction with active remedies. Must be actively maintained.	Not by itself. Relies on MNA and waste excavation to reduce TMV.	Effective in preventing exposure.	Implementable-Site controls in place to prevent accidental exposure	

Table 3-12. Detailed analysis of remedial alternatives for the Pit 7 Complex. (Cont. Page 2 of 6)

Alternative number	Alternative components	Overall protection of human health and the environment	Compliance with ARARs	Long-term effectiveness and permanence	Reduction in toxicity, mobility, and volume (TMV)	Short-term effectiveness	Implementability	Net present worth cost, $K
2. (Cont.)	Monitored natural attenuation (MNA) of tritium in ground water	Yes. Ground water in the Pit 7 Complex area is not used for drinking water and will not migrate to offsite exposure points at tritium activities that pose a risk.	Tritium: Given the short half-life of tritium, once the source is controlled, MNA would reduce tritium activities in ground and surface water to meet ARARs within a reasonable timeframe.	Tritium: Irreversible decay would provide long-term and permanent reduction of tritium and uranium activities in ground water.	Irreversible decay would reduce the TMV of tritium and in the subsurface.	Yes. As tritiated water remains in the subsurface, short-term exposure/risk to workers would be prevented.	Implementable-monitoring network already in place.	
	Source control: waste excavation and disposal (Pits 3&5)	Excavation of the Pit 3 waste would mitigate inhalation risk by removing the tritium source.	Would prevent further releases of contaminants of concern (COCs) from waste in Pits 3&5. May not meet ground water ARARs, as it would not prevent further releases of COCs present in vadose zone underlying the pits.	Would be effective in permanently removing COCs in waste. Would not prevent further releases of COCs present in vadose zone underlying the pits.	Would reduce mobility by removing contaminant source in pit waste. Will not reduce the toxicity or volume of contaminants as the waste would be redeposited at a different location. Because the waste excavation does not include removal of bedrock containing residual contamination, this alternative would not reduce the TMV of contaminants remaining in the vadose zone.	Increased potential for onsite workers and impact to ecological receptors during excavation as contaminated waste would be brought to the surface, handled, and transported to a disposal location. Higher level of exposure control needed to prevent short-term exposure.	Implementable. Would require extensive provisions to prevent exposure of workers during excavation, transport personnel, and public during waste transport.	
								$56,635,000
3a.	Monitoring of ground water	Used in conjunction with active remedies. Monitoring of uranium, VOCs, perchlorate, and nitrate will assure protection of human health and the environment by providing an indication of whether the remedy is achieving RAOs.	Used in conjunction with active remedies. Monitoring of uranium, VOCs, perchlorate, and nitrate will assure compliance with ARARs by providing an indication of whether the remedy is achieving RAOs.	Used in conjunction with active remedies. Monitoring of uranium, VOCs, perchlorate, and nitrate will assure long- term effectiveness by providing an indication of whether the remedy is achieving RAOs.	Used in conjunction with active remedies Monitoring of uranium, VOCs, perchlorate, and nitrate will assure reduction in toxicity, mobility, and volume by providing an indication of whether the remedy is achieving RAOs.	Used in conjunction with active remedies. Monitoring of uranium, VOCs, perchlorate, and nitrate will assure short-term effectiveness by providing an indication of whether the remedy is achieving RAOs.	Same as Alternative 2.	
	Risk and hazard management	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	Not by itself. Relies on MNA of tritium, active uranium treatment, and waste excavation to reduce TMV.	Same as Alternative 2.	Same as Alternative 2.	

Table 3-12. Detailed analysis of remedial alternatives for the Pit 7 Complex. (Cont. Page 3 of 6)

Alternative number	Alternative components	Overall protection of human health and the environment	Compliance with ARARs	Long-term effectiveness and permanence	Reduction in toxicity, mobility, and volume (TMV)	Short-term effectiveness	Implementability	Net present worth cost, $K
3a. (Cont.)	MNA of tritium in ground water	Yes. Ground water in the Pit 7 Complex area is not used for drinking water and will not migrate to offsite exposure points at activities that pose a risk.	Yes. Given the short half-life of tritium, once the source is controlled, MNA would reduce tritium activities in ground and surface water to meet ARARs within a reasonable timeframe.	Irreversible decay would provide long-term and permanent reduction of tritium activities in ground water	Irreversible decay of tritium would reduce the TMV of tritium in the subsurface.	Yes. As tritiated water remains in the subsurface, short-term exposure/risk to workers would be prevented.	Implementable-monitoring network already in place.	
	Plume migration control: *Ex situ* treatment of uranium, nitrate, and perchlorate	Risk to human health and the environment limited by safety procedures. Negligible risk to onsite workers and public from system exposure. No toxic air emissions.	With uranium, nitrate, and perchlorate source controlled, will reduce uranium activities, and nitrate and perchlorate concentrations in ground water to meet ARARs. Uranium, nitrate, and perchlorate will be treated using *ex situ* treatment to meet ground water cleanup standards to be agreed upon in the final Site-Wide ROD.	Would provide long-term permanent reduction of uranium, nitrate, and perchlorate in ground water.	Would reduce the volume and mobility of uranium, nitrate, and perchlorate in the ground water. Because the treatment media does not destroy uranium, nitrate, or perchlorate, decay degradation, and/or treatment would be relied upon to reduce the toxicity and volume of these contaminants in the media (i.e., ion exchange resin).	Short-term exposure risk posed by bringing tritiated and uranium-contaminated ground water to the surface for treatment and handling, storage, and disposal of uranium-contaminated treatment media. Exposure control measures would be needed to prevent exposure until uranium activities decay to health-protective levels. Because human health would be protected during time period (150 to 500 years) to reach MCLs for uranium, Alternative 3a provides short-term effectiveness without impacting human health or the environment.	Implementable. Would require reinjection of treated water due to the presence of tritium in a manner so as to prevent enhanced migration of tritium in ground water or contamination of pristine waters.	
	Source control: waste excavation and disposal (Pits 3&5)	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	$63,741,000 (extraction wells) to $68,326,000 (funnel and sump with extraction and *ex situ* treatment.
3b.	Monitoring of ground water	Same as Alternative 3a.	Same as Alternative 3a.	Same as Alternative 3a.	Same as Alternative 3a.	Same as Alternative 3a.	Same as Alternative 2.	
	Risk and hazard management	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	Not by itself. Relies on MNA of tritium, active uranium, nitrate, and perchlorate treatment, and waste excavation to reduce TMV.	Same as Alternative 2.	Same as Alternative 2.	

Table 3-12. Detailed analysis of remedial alternatives for the Pit 7 Complex. (Cont. Page 4 of 6)

Alternative number	Alternative components	Overall protection of human health and the environment	Compliance with ARARs	Long-term effectiveness and permanence	Reduction in toxicity, mobility, and volume (TMV)	Short-term effectiveness	Implementability	Net present worth cost, $K
3b. (Cont.)	MNA of tritium in ground water	Same as Alternative 3a.	Same as Alternative 3a.	Same as Alternative 3a.	Same as Alternative 3a.	Same as Alternative 3a.	Same as Alternative 3a.	
	Plume migration control: *In situ* treatment of uranium, nitrate, and perchlorate in Qal/WBR ground water with extraction and *ex situ* treatment of Tnbs$_0$ ground water.	Risk to human health and the environment is limited by safety procedures. There is a negligible risk to onsite workers and the public during the removal and replacement of spent treatment media.	With uranium, nitrate, and perchlorate source controlled, will reduce uranium activities, and perchlorate and nitrate concentrations in ground water to meet ARARs. Uranium, nitrate, and perchlorate will be treated using a combination of *in situ* and *ex situ* treatment to meet ground water cleanup standards to be agreed upon in the final Site-Wide Record of Decision (ROD).	Would provide long-term permanent reduction of uranium, nitrate, and perchlorate in ground water.	Would reduce the volume and mobility of uranium, nitrate, and perchlorate in the ground water. Because the treatment media does not destroy uranium, decay would be relied upon to reduce the toxicity and volume of uranium in the media (i.e., apatite).	Lower short-term exposure risk as contaminated ground water is not brought to the surface for treatment. Because human health would be protected during time period (up to 500 years) to reach MCLs for uranium, Alternative 3b provides short-term effectiveness without impacting human health or the environment.	Implementable. Would not need to reinject tritiated ground water as with *ex situ* treatment. Would require replacement of reactive media periodically (approximately every 10 years).	
	Source control: waste excavation and disposal (Pits 3&5)	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	
								$69,287,000
4a.	Monitoring of ground water	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	
	Risk and hazard management	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	Not by itself. Relies on MNA of tritium and source control through hydraulic diversion to reduce TMV.	Same as Alternative 2.	Same as Alternative 2.	
	MNA of tritium in ground water	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	
	Source control: hydraulic diversion	Would reduce further impacts to ground water by preventing inundation of contaminant sources in the pit waste and underlying vadose zone; preventing further releases.	Would meet ARARs prevent further releases of COCs from waste in Pits 3, 5, and 7 and from the underlying vadose zone.	Would be effective in permanently eliminating the COC release mechanism of inundation of the pit waste and underlying vadose zone.	Would reduce mobility by eliminating the COC release mechanism of inundation of the pit waste and underlying vadose zone. Will not reduce the toxicity or volume of contaminants in the source area.	No short-term exposure risk as contaminated waste remains in place.	Implementable. Trenches do not need to be installed to depths required for hydraulic barriers.	
								$3,738,000

Table 3-12. Detailed analysis of remedial alternatives for the Pit 7 Complex. (Cont. Page 5 of 6)

Alternative number	Alternative components	Overall protection of human health and the environment	Compliance with ARARs	Long-term effectiveness and permanence	Reduction in toxicity, mobility, and volume (TMV)	Short-term effectiveness	Implementability	Net present worth cost, $K
4b.	Monitoring of ground water	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	
	Risk and hazard management	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	Not by itself. Relies on MNA of tritium and source control using a hydraulic barrier to reduce TMV.	Same as Alternative 2.	Same as Alternative 2.	
	Monitored natural attenuation of tritium in ground water	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	
	Source control: hydraulic barrier	Would reduce further impacts to ground water by preventing inundation of contaminant sources in the pit waste and underlying vadose zone; preventing further releases.	Would meet ARARs prevent further releases of COCs from waste in Pits 3, 5, and 7 and from the underlying vadose zone.	Would be effective in permanently eliminating the COC release mechanism of inundation of the pit waste and underlying vadose zone.	Would reduce mobility by eliminating the COC release mechanism of inundation of the pit waste and underlying vadose zone. Will not reduce the toxicity or volume of contaminants in the source area.	No short-term exposure risk as contaminated waste remains in place.	Implementable. Requires installation of barrier to depths of 30 ft (deeper than is required for hydraulic diversion).	
								$4,344,000
5a.	Monitoring of ground water	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	
	Risk and hazard management	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	Not by itself. Relies on MNA of tritium, active uranium, nitrate, and perchlorate treatment, and source control through hydraulic diversion to reduce TMV.	Same as Alternative 2.	Same as Alternative 2.	
	Monitored natural attenuation of tritium in ground water	Same as Alternative 3a.	Same as Alternative 3a.	Same as Alternative 3a.	Same as Alternative 3a.	Same as Alternative 3a.	Same as Alternative 3a.	
	Phased plume migration control: *Ex situ* treatment of uranium, nitrate, and perchlorate in ground water	Same as Alternative 3a.	Same as Alternative 3a.	Same as Alternative 3a.	Same as Alternative 3a.	Same as Alternative 3a.	Same as Alternative 3a.	

Table 3-12. Detailed analysis of remedial alternatives for the Pit 7 Complex. (Cont. Page 6 of 6)

Alternative number	Alternative components	Overall protection of human health and the environment	Compliance with ARARs	Long-term effectiveness and permanence	Reduction in toxicity, mobility, and volume (TMV)	Short-term effectiveness	Implementability	Net present worth cost, $K
5a. (Cont.)	Source control: hydraulic diversion	Same as Alternative 4a.	Same as Alternative 4a.	Same as Alternative 4a.	Same as Alternative 4a.	Same as Alternative 4a.	Same as Alternative 4a.	$10,845,000 (extraction wells) to $15,429,000 (funnel and sump with extraction and *ex situ* treatment.
5b.	Monitoring of ground water	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	$21,082,000
	Risk and hazard management	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	Not by itself. Relies on MNA of tritium, active uranium treatment, and source control through hydraulic diversion to reduce TMV.	Same as Alternative 2.	Same as Alternative 2.	
	Monitored natural attenuation of tritium in ground water	Same as Alternative 3a.	Same as Alternative 3a.	Same as Alternative 3a.	Same as Alternative 3a.	Same as Alternative 3a.	Same as Alternative 3a.	
	Phased plume migration control: *In situ* treatment of uranium, nitrate, and perchlorate in Qal/WBR ground water with extraction and *ex situ* treatment of Tnbs$_0$ ground water.	Same as Alternative 3b.	Same as Alternative 3b.	Same as Alternative 3b.	Same as Alternative 3b.	Same as Alternative 3b.	Same as Alternative 3b.	
	Source control: hydraulic diversion	Same as Alternative 4a.	Same as Alternative 4a.	Same as Alternative 4a.	Same as Alternative 4a.	Same as Alternative 4a.	Same as Alternative 4a.	

Notes:

ARARs = Applicable or relevant and appropriate requirements.
MCLs = Maximum Contaminant Levels.
MNA = Monitored Natural Attenuation.
RAOs = Remedial action objectives.
TMV = Toxicity, mobility, and volume.
VOCs = Volatile organic compounds.
WQOs = Water quality objectives.

Table 3-13. Comparative evaluation of remedial alternatives for the Pit 7 Complex.

Alternative number	Alternative components	Overall protection of human health and the environment	Compliance with Applicable or relevant and appropriate requirements (ARARs)	Long-term effectiveness and permanence	Reduction in toxicity, mobility, and volume (TMV)	Short-term effectiveness	Implementability	Net present worth cost
1.	No Further Action	○	○	○	○	◒	●	$0
		Least protective of human health or the environment compared to the other alternatives. Changes to plume size and location that could impact downgradient receptors cannot be determined without monitoring contaminants of concern (COCs).	Least compliant with remedial action objectives (RAOs) compared to the other alternatives. Potential inhalation of tritium vapors by onsite workers cannot be prevented without exposure control measures.	Least effective for the long-term without source control due to continued release of contaminants compared to the other alternatives.	Least effective for TMV compared to the other alternatives. Without source control and relying solely on natural attenuation, TMV may not be reduced in a reasonable timeframe due to continued release of contaminants.	The most effective alternative for the short-term protection of onsite workers since there would be no remediation-related construction occurring. There would be no short-term impact to human or ecological receptors. Least effective in terms of time to cleanup compared to the other alternatives as without source control, contaminant releases would continue.	This alternative is the easiest to implement.	This alternative is the least expensive to implement.
2.	Monitoring, exposure control, Monitored Natural Attenuation (MNA) for tritium source control through waste excavation	●	▨*	◔	◔	◔	◔	$56,635,000
		Addresses risk to human health (ground water ingestion and inhalation of tritium); controls source; and utilizes MNA to reduce tritium and other processes to reduce uranium activities in ground water.	Includes measures to meet State and Federal ARARs in ground water. Monitoring of the effects of dispersion, sorption, diffusion, and to a lesser extent, radioactive decay of uranium will take longer than more active remedies in Alternatives 3a, 3b, 5a, and 5b*. Because human health and the environment will be protected during the time period necessary to reach MCLs for uranium, Alternative 2 is capable of achieving RAOs and ARARs without impacting human health or the environment. However, EPA and the State regulatory agencies do not agree	Provides a more effective long-term, permanent solution for contaminant source in the pit waste through excavation, compared to Alternatives 4a, 4b, 5a, and 5b. However, the contaminant source in the vadose zone is not addressed.	Effectively and permanently reduces the mobility of the contaminants by removing the pit waste source. It would not reduce the toxicity or volume of the contaminants as the waste would be redeposited at a different location. The TMV of contaminants in the vadose zone bedrock would not be reduced. The mobility of uranium in ground water would be reduced through sorption to aquifer rocks, but its toxicity, and volume would not be reduced. The TMV of VOCs, nitrate, and perchlorate in ground water would not be reduced.	Not as effective as 1, 4a, 4b, 5a, and 5b for short term onsite worker protection. A high level of exposure control would be necessary to prevent short-term exposure of onsite workers and ecological receptors during excavation. Compares equally to Alternatives 3a and 3b. Because human health would be protected during time period (up to 500 years) to reach MCLs for uranium, Alternative 2 provides short-term effectiveness without impacting human health or the environment. However, EPA and the State regulatory agencies do not agree that 500 years is an acceptable timeframe to achieve	This alternative is not as implementable as Alternatives 1, 4a, 4b, 5a, and 5b. Implementability is contingent on locating a facility permitted and willing to accept low-level mixed waste at a reasonable cost. Compares equally to Alternatives 3a and 3b.	Cost of this alternative is very high compared to Alternatives 4a, 4b, 5a, and 5b.

Table 3-13. Comparative evaluation of remedial alternatives for the Pit 7 Complex. (Cont. Page 2 of 6)

Alternative number	Alternative components	Overall protection of human health and the environment	Compliance with Applicable or relevant and appropriate requirements (ARARs)	Long-term effectiveness and permanence	Reduction in toxicity, mobility, and volume (TMV)	Short-term effectiveness	Implementability	Net present worth cost
2. (Cont.)			that 500 years is an acceptable timeframe for achieving MCLs or other RAOs for uranium. Alternative 2 may not be as effective in meeting ARARs as Alternatives 4 (a and b) and 5 (a and b) because contamination remaining in the vadose zone that could degrade water quality. Alternative 2 does not comply with ARARs for perchlorate and nitrate, and there is no basis for an ARAR waiver.			MCLs or other RAOs for uranium.		
3a.	Monitoring, exposure control, MNA for tritium, source control through waste excavation, uranium, nitrate, and perchlorate plume migration control by *ex situ* treatment	●	◕	◕	◒	◔	◔	$63,741,000 (extraction wells) to $68,326,000 (funnel and sump with extraction and *ex situ* treatment
	Monitoring, exposure control, MNA for tritium, source control through waste excavation, uranium, nitrate, and perchlorate plume migration control by *ex situ* treatment	Addresses risk to human health (ground water ingestion and inhalation of tritium); controls source; and utilizes MNA to reduce tritium and *ex situ* treatment to reduce uranium, nitrate, and perchlorate in ground water.	Includes measures to meet State and Federal ARARs in ground water. Uranium, nitrate, and perchlorate will be treated using *ex situ* treatment to meet ground water cleanup standards to be agreed upon in the final Site-Wide ROD. Alternatives 3a may not be as effective in meeting ARARs as Alternatives 4 (a and b) and 5 (a and b) because contamination remaining in the vadose zone that could degrade water quality.	Provides a more effective long-term, permanent solution for contaminant source in the pit waste through excavation, compared to Alternatives 4a, 4b, 5a, and 5b. However the contaminant source in the vadose zone is not addressed.	Effectively and permanently reduces the mobility of the contaminants by removing the pit waste source. It would not reduce the toxicity or volume of the contaminants as the waste would be redeposited at a different location. The TMV of contaminants in the bedrock may not be reduced. The ground water contaminants TMV would be reduced using active uranium remediation, therefore this alternative would more rapidly reduce TMV than Alternatives 1, 2, 4a, and 4b that use MNA.	Not as effective as 1, 4a, 4b, 5a, and 5b for short-term onsite worker protection. A high level of exposure control would be necessary to prevent short-term exposure of onsite workers and ecological receptors during excavation. Compares equally to Alternatives 2 and 3b. Because human health would be protected during time period (150 to 500 years) to reach MCLs for uranium, Alternative 3a provides short-term effectiveness without impacting human health or the environment.	This alternative is not as implementable as Alternatives 1, 4a, 4b, 5a, and 5b. Implementability is contingent on locating a facility permitted and willing to accept low-level mixed waste at a reasonable cost. Compares equally to Alternatives 2 and 3b.	Cost of this alternative is very high compared to Alternatives 4a, 4b, 5a, and 5b.

Table 3-13. Comparative evaluation of remedial alternatives for the Pit 7 Complex. (Cont. Page 3 of 6)

Alternative number	Alternative components	Overall protection of human health and the environment	Compliance with Applicable or relevant and appropriate requirements (ARARs)	Long-term effectiveness and permanence	Reduction in toxicity, mobility, and volume (TMV)	Short-term effectiveness	Implementability	Net present worth cost
3b.	**Monitoring, exposure control, MNA for tritium, source control through waste excavation, uranium, nitrate, and perchlorate plume migration control by *in situ* treatment of Qal/WBR ground water and extraction and *ex situ* treatment of Tnbs$_0$ ground water.**	●	◕	◕	◒	◔	◔	73,979,000
		Addresses risk to human health (ground water ingestion and inhalation of tritium); controls source; and utilizes MNA to reduce tritium and *in situ* treatment to reduce uranium, nitrate, and perchlorate in ground water.	Includes measures to meet State and Federal ARARs in ground water. Uranium, nitrate, and perchlorate will be treated using a combination of *in situ* and *ex situ* treatment to meet ground water cleanup standards to be agreed upon in the final Site-Wide ROD. Alternative 3b may not be as effective in meeting ARARs as Alternatives 4 (a and b) and 5 (a and b) because contamination remaining in the vadose zone that could degrade water quality.	Provides a more effective long-term, permanent solution for contaminant source in the pit waste through excavation, compared to Alternatives 4a, 4b, 5a, and 5b. However the contaminant source in the vadose zone is not addressed.	Effectively and permanently reduces the mobility of the contaminants by removing the pit waste source. It would not reduce the toxicity or volume of the contaminants as the waste would be redeposited at a different location. The TMV of contaminants in the bedrock may not be reduced. The TMV of uranium, nitrate, and perchlorate in ground water would be reduced using active remediation, therefore this alternative would more rapidly reduce TMV than Alternatives 1, 2, 4a, and 4b that use MNA.	Not as effective as 1, 4a, 4b, 5a, and 5b for short-term worker protection. A high level of exposure control would be necessary to prevent short-term exposure of onsite workers and ecological receptors during excavation. Compares equally to Alternatives 2 and 3a. Because human health would be protected during time period (up to 500 years) to reach MCLs for uranium, Alternative 3b provides short-term effectiveness without impacting human health or the environment.	This alternative is not as implementable as Alternatives 1, 4a, 4b, 5a, and 5b. Implementability is contingent on locating a facility permitted and willing to accept low-level mixed waste at a reasonable cost. Compares equally to Alternatives 2 and 3a.	Cost of this alternative is very high compared to Alternatives 4a, 4b, 5a, and 5b.
4a.	**Monitoring, exposure control, MNA for tritium and source control through hydraulic diversion**	●	◍*	◒	◔	◒	◕	$3,738,000
		Addresses risk to human health (ground water ingestion and inhalation of tritium); controls source; and utilizes MNA to reduce tritium and other processes to reduce uranium activities in ground water.	Includes measures to meet State and Federal ARARs in ground water. Monitoring the effects of dispersion, sorption, diffusion, and to a lesser extent, radioactive decay of uranium will take longer than more active remedies in Alternatives 3a, 3b, 5a, and 5b*. Because human health and the environment will be protected during the time period necessary to reach MCLs for	Effectively and permanently controls releases from the contaminant source in the pit waste and vadose zone by hydraulic diversion. Because the waste remains in place, it is not as effective as removing the source (Alternative 2, 3a, 3b). However, it is more effective in addressing the vadose zone contamination. Would require long-term maintenance of the hydraulic diversion.	Effectively and permanently reduces the mobility of contaminants in the pit waste and shallow vadose zone by preventing further releases. Would not reduce the toxicity or volume of the contaminants as the contaminated waste would remain in place. The mobility of uranium in ground water would be reduced through sorption to aquifer rocks, but its toxicity and volume would not be reduced.	More effective than Alternatives 2, 3a, 3b, 5a, and 5b for short-term onsite worker protection. Minimal impact to onsite workers during monitoring and hydraulic diversion construction activities. Compares equally to Alternative 4b. Because human health would be protected during time period (up to 500 years) to reach MCLs for uranium, Alternative 4a provides short-term	This alternative is more implementable than Alternatives 2, 3a, 3b, 4b, 5a, and 5b. Monitoring and MNA can be implemented easily. The hydraulic diversion implementation requires special design considerations.	Alternative cost is implementable.

Table 3-13. Comparative evaluation of remedial alternatives for the Pit 7 Complex. (Cont. Page 4 of 6)

Alternative number	Alternative components	Overall protection of human health and the environment	Compliance with Applicable or relevant and appropriate requirements (ARARs)	Long-term effectiveness and permanence	Reduction in toxicity, mobility, and volume (TMV)	Short-term effectiveness	Implementability	Net present worth cost
4a. (Cont.)			uranium, Alternative 4a is capable of achieving RAOs and ARARs without impacting human health or the environment. However, EPA and the State regulatory agencies do not agree that 500 years is an acceptable timeframe for achieving MCLs or other RAOs for uranium.		The TMV of VOCs, nitrate, and perchlorate in ground water would not be reduced.	effectiveness without impacting human health or the environment. However, EPA and the State regulatory agencies do not agree that 500 years is an acceptable timeframe to achieve MCLs or other RAOs for uranium.		
4b.	Monitoring, exposure control, MNA for tritium and source control through hydraulic barrier	●	◍*	◒	◔	◒	◕	$4,344,000
		Addresses risk to human health (ground water ingestion and inhalation of tritium); controls source; and utilizes MNA to reduce tritium in ground water.	Includes measures to meet State and Federal ARARs in ground water. Monitoring the effects of dispersion, sorption, diffusion, and to a lesser extent, radioactive decay of uranium will take longer than more active remedies in Alternatives 3a, 3b, 5a, and 5b*. Because human health and the environment will be protected during the time period necessary to reach MCLs for uranium, Alternative 4b is capable of achieving RAOs and ARARs without impacting human health or the environment. However, EPA and the State regulatory agencies do not agree that 500 years is an acceptable timeframe for achieving MCLs or other RAOs for uranium.	Effectively and permanently controls releases from the contaminant source in the pit waste and vadose zone by hydraulic barrier. Because the waste remains in place, it is not as effective as removing the source (Alternative 2, 3a, 3b). However, it is more effective in addressing the vadose zone contamination. Would require long-term maintenance of the hydraulic barrier.	Effectively and permanently reduces the mobility of contaminants in the pit waste and shallow vadose zone by preventing further releases. Would not reduce the toxicity or volume of the contaminants as the contaminated waste would remain in place. The mobility of uranium in ground water would be reduced through sorption to aquifer rocks, but its toxicity and volume would not be reduced. The TMV of VOCs, nitrate, and perchlorate in ground water would not be reduced.	More effective than Alternatives 2, 3a, 3b, 5a, and 5b for short-term onsite worker protection. Minimal impact to onsite workers during monitoring and hydraulic barrier construction activities. Compares equally to Alternative 4a. Because human health would be protected during time period (up to 500 years) to reach MCLs for uranium, Alternative 4b provides short-term effectiveness without impacting human health or the environment. However, EPA and the State regulatory agencies do not agree that 500 years is an acceptable timeframe to achieve MCLs or other RAOs for uranium.	This alternative is more implementable than Alternatives 2, 3a, 3b, 5a, and 5b. Monitoring and MNA can be implemented easily. The hydraulic barrier implementation requires special design considerations.	Alternative cost is implementable.

Table 3-13. Comparative evaluation of remedial alternatives for the Pit 7 Complex. (Cont. Page 5 of 6)

Alternative number	Alternative components	Overall protection of human health and the environment	Compliance with Applicable or relevant and appropriate requirements (ARARs)	Long-term effectiveness and permanence	Reduction in toxicity, mobility, and volume (TMV)	Short-term effectiveness	Implementability	Net present worth cost
5a.	Monitoring, exposure control, MNA for tritium, source control through hydraulic diversion, and phased uranium, nitrate, and perchlorate plume migration control by *ex situ* treatment	●	●	◒	◒	●	◕	$10,845,000 (extraction wells) to $15,429,000 (funnel and sump with extraction and ex situ treatment.
		Addresses risk to human health (ground water ingestion and inhalation of tritium); controls source; and utilizes MNA to reduce tritium and ex situ treatment to reduce uranium, nitrate, and perchlorate in ground water.	Includes measures to meet State and Federal ARARs in ground water. Uranium, nitrate, and perchlorate will be treated using ex situ treatment to meet ground water cleanup standards to be agreed upon in the final Site-Wide ROD.	Effectively and permanently controls releases from the contaminant source in the pit waste and vadose zone by hydraulic diversion. Because the waste remains in place, it is not as effective as removing the source (Alternative 2, 3a, 3b). However, it is more effective in addressing the vadose zone contamination. Would require long-term maintenance of the hydraulic diversion.	Effectively and permanently reduces the mobility of contaminants in the pit waste and shallow vadose zone by preventing further releases. Would not reduce the toxicity or volume of the contaminants as the contaminated waste would remain in place. The ground water contaminants TMV would be reduced using active uranium remediation, therefore this alternative would more rapidly reduce TMV than Alternatives 1, 2, 4a, and 4b that use MNA.	More effective than Alternatives 2, 3a, and 3b. Minimal impact to onsite workers during monitoring, uranium treatment and hydraulic diversion construction activities. Additional exposure controls may be necessary due to the re-injection of tritiated water from ex situ uranium treatment. Because human health would be protected during time period (150 to 500 years) to reach MCLs for uranium, Alternative 5a provides short-term effectiveness without impacting human health or the environment.	This alternative is more implementable than Alternatives 2, 3a, and 3b. Monitoring and MNA can be implemented easily. The implementation of the hydraulic diversion and re-injection of tritiated water from ex situ uranium treatment requires special design considerations.	Costs are higher compared to Alternatives 4a and 4b. A faster timeframe for uranium remediation is achieved for the additional costs.
5b.	Monitoring, exposure control, MNA for tritium, source control through hydraulic diversion, and phased uranium, nitrate, and perchlorate plume migration control by in situ treatment of Qal/WBR ground water and extraction and ex situ treatment of $Tnbs_0$ ground water.	●	●	◒	◒	◕	◕	$21,082,000
		Addresses risk to human health (ground water ingestion and inhalation of tritium); controls source; and utilizes MNA to reduce tritium and in situ treatment to reduce uranium, nitrate, and perchlorate in ground water.	Includes measures to meet State and Federal ARARs in ground water. Uranium, nitrate, and perchlorate will be treated using a combination of in situ and ex situ treatment to meet ground water cleanup standards to be agreed upon in the final Site-Wide ROD.	Effectively and permanently controls releases from the contaminant source in the pit waste and vadose zone by hydraulic diversion. Because the waste remains in place, it is not as effective as removing the source (Alternative 2, 3a, 3b). However, it is more effective in addressing the vadose zone contamination.	Effectively and permanently reduces the mobility of contaminants in the pit waste and shallow vadose zone by preventing further releases. Would not reduce the toxicity or volume of the contaminants as the contaminated waste would remain in place. The ground water contaminants TMV	More effective than Alternatives 2, 3a, 3b, and 5a. Minimal impact to onsite workers during monitoring and hydraulic diversion construction activities. Because human health would be protected during time period (up to 500 years) to reach MCLs for uranium, Alternative 5b provides	This alternative is more implementable than Alternatives 2, 3a, and 3b. Monitoring and MNA can be implemented easily. The hydraulic diversion implementation requires special design consideration.	Costs are higher compared to Alternatives 4a and 4b. A faster timeframe for uranium remediation is achieved for the additional costs.

Table 3-13. Comparative evaluation of remedial alternatives for the Pit 7 Complex. (Cont. Page 6 of 6)

Alternative number	Alternative components	Overall protection of human health and the environment	Compliance with Applicable or relevant and appropriate requirements (ARARs)	Long-term effectiveness and permanence	Reduction in toxicity, mobility, and volume (TMV)	Short-term effectiveness	Implementability	Net present worth cost
5b. (Cont.)				Would require long-term maintenance of the hydraulic diversion.	would be reduced using active uranium remediation, therefore this alternative would more rapidly reduce TMV than Alternatives 1, 2, 4a, and 4b that use MNA.	short-term effectiveness without impacting human health or the environment.		

Key:

○ = Alternative fails to satisfy criterion.

● = Alternative fully satisfies criterion.

▨* = DOE and the regulatory agencies do not agree on the degree to which the alternative satisfies criterion.

Notes:

ARARs = Applicable or relevant and appropriate requirements.
COCs = Contaminants of concern.
MCLs = Maximum Contaminant Levels.
MNA = Monitored Natural Attenuation.
Qal/WBR = Quaternary alluvium/Weathered bedrock.
RAOs = Remedial action objectives.
TMV = Toxicity, mobility, and volume.

Table 3-14. Comparative evaluation of remedial alternatives for compliance with action- and location-specific ARARs.

Action	Potential ARAR	Application	Alternatives							
			1	2	3a	3b	4a	4b	5a	5b
Ground water: MNA, extraction, *in situ* treatment, containment, and hydraulic control	Chapter 15, California Code of Regulations (CCR), Title 23, Sections 2550.7, 2550.10 (action-specific)	Contaminant concentrations in *in situ* ground water will be monitored to determine the effectiveness of the remedial action.	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	CCR, Title 27, Sections 20390, 20395, 20400, 20405, 20420 (action-specific)	Applies to landfills if waste is left in place.	No	NA	NA	NA	Yes	Yes	Yes	Yes
	CCR, Title 23, Sections 2550.2, 2550.3, 2550.4, 2550.5, 2550.8 (action-specific)	Applies to landfills if waste is left in place.	No	NA	NA	NA	Yes	Yes	Yes	Yes
Treated ground water reinjection	Safe Drinking Water Act Underground Injection Control Program (40 CFR 144.26-144.27) (action-specific)	Treated ground water will be analyzed to verify complete removal of contaminants to regulatory treatment standards prior to reinjection.	NA	NA	Yes	NA	NA	NA	Yes	NA
Capping/onsite consolidation	CCR, Title 27, Section 21090 (action-specific)	Final cover construction standards.[a]	NA	NA	NA	NA	NA	NA	NA	NA
	CCR, Title 22, Div. 4.5, Chapter 14, Article 14 (action-specific)	Potentially applies to landfill pits under consideration for either on-site consolidation or capping (Pits 3 and 5).[a]	NA	NA	NA	NA	NA	NA	NA	NA
	CCR, Title 27, Sections 20950, 22207(a), 22212(a) and 22222 (action-specific)	Continued maintenance of drainage controls and ground water monitoring following landfill closure.	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	CCR, Title 23, Sections 2550.0 (b), 2580(f) (action-specific)	Continued maintenance of drainage controls and ground water monitoring following landfill closure.	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Disposition of waste	California Health and Safety Code, Division 20, Chapter 6.5, CCR, Title 22, Division 4.5, Chapters 11 and 12: Minimum Standards for Management of Hazardous and Extremely Hazardous Wastes (action-specific)	Applies to the spent resin vessels and to excavated contaminated waste	NA	Yes	Yes	Yes	NA	NA	Yes	Yes

Table 3-14. Comparative evaluation of remedial alternatives for compliance with action- and location-specific ARARs. (Cont. Page 2 of 2)

Action	Potential ARAR	Application	Alternatives							
			1	2	3a	3b	4a	4b	5a	5b
Disposition of waste (Cont.)	California Health and Safety Code, Division 20, Chapter 6.5, CCR, Title 22, Division 4.5, Chapter 14, Article 14 (action-specific)	Potentially applies to onsite consolidation or capping of landfills	NA	NA	NA	NA	NA	NA	NA	NA
	CCR, Title 23, Div. 3, Chapter 15 (action-specific)	Waste management standards for remediation derived hazardous solid wastes	NA	Yes	Yes	Yes	NA	NA	Yes	Yes
	CCR, Title 27, Div. 2, Subdiv. 1 (action-specific)	Waste management standards will be applied for solid hazardous waste storage or disposal on land	NA	Yes	Yes	Yes	NA	NA	Yes	Yes
Storm water controls	40 CFR Parts 122, 123, 124, NPDES [b] (action-specific)	Applies to storm water discharges including measures to minimize or eliminate pollutants in storm water discharges	NA	NA	NA	Yes	Yes	NA	Yes	Yes
	40 CFR Parts 122, 123, 124, NPDES[b] (action-specific)	Applies to construction areas over 5 acres in size and includes measures to minimize or eliminate pollutants in storm water discharges and monitoring to demonstrate compliance.	NA	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Protection of endangered species	Endangered Species Act of 1973, 16 USC Section 1531, 50 CFR Part 200, 50 CFR Part 402 [40 CFR 257.3-2] (location-specific)	Prior to any well installation, facility construction or potentially disruptive activities, wildlife surveys will be conducted and mitigation measures implemented if required.	NA	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	California Endangered Species Act, Calif. Dept. of Fish and Game Section 2050-2068 (location-specific	Prior to any well installation, facility construction or potentially disruptive activities, wildlife surveys will be conducted and mitigation measures implemented if required.	NA	Yes	Yes	Yes	Yes	Yes	Yes	Yes

[a] Action screened but not retained in remedial alternatives.

[b] Implemented by California Storm Water Permit for Industrial Activities, State Water Resources Control Board Order No. 97-03-DWQ.

Notes:

No = Alternative does not comply with ARAR.
Yes = Alternative complies with ARAR.
ARAR = Applicable, relevant, and appropriate requirements.
CCR = California Code of Regulations.
CFR= Code of Federal Regulations.
NA = Not applicable.
NPDES = National Pollutant Discharge Elimination System.
MNA = Monitored natural attenuation.
RWQCB = California Regional Water Quality Control Board.
WDR = Waste Discharge Requirements.

Appendix A

Analytical Data Tables

List of Analytical Data Tables

Table A-1. Ground Water Elevations measured for monitor wells in the Pit 7 Complex measured between July 1, 1995 and June 30, 2003.
Current Date: December 19, 2003
Current Time: 17:19:11

Table A-1. Ground Water Elevations for Monitor Wells in the Pit 7 Complex, measured between July 1, 1995, and June 30, 2003.

Location	Date of Measurement	Depth to Water (ft)	Water Elevation (ft/MSL)	Notes
K7-01				
	07/07/95	23.20	1295.82	
	07/14/95	23.30	1295.72	PS
	07/21/95	23.32	1295.70	
	07/26/95	23.40	1295.62	PS
	07/28/95	23.38	1295.64	
	08/18/95	23.59	1295.43	
	08/25/95	23.64	1295.38	
	09/01/95	23.67	1295.35	
	09/08/95	23.70	1295.32	
	10/04/95	23.82	1295.20	
	11/01/95	23.95	1295.07	
	01/05/96	24.02	1295.00	
	01/26/96	24.08	1294.94	
	02/02/96	24.07	1294.95	
	02/07/96	24.70	1294.32	
	02/09/96	22.50	1296.52	
	02/16/96	22.25	1296.77	
	02/23/96	21.40	1297.62	
	03/01/96	20.35	1298.67	
	03/18/96	18.62	1300.40	
	03/25/96	18.36	1300.66	
	04/02/96	18.23	1300.79	
	04/11/96	18.32	1300.70	
	04/19/96	18.45	1300.57	
	04/24/96	18.57	1300.45	PS
	05/03/96	18.60	1300.42	
	06/04/96	19.56	1299.46	
	07/18/96	20.55	1298.47	
	07/25/96	20.84	1298.18	PS
	08/08/96	19.84	1299.18	
	09/04/96	20.20	1298.82	
	10/07/96	20.43	1298.59	
	10/18/96	20.65	1298.37	PS
	11/08/96	20.82	1298.20	
	11/14/96	21.00	1298.02	PS
	11/18/96	20.82	1298.20	
	11/25/96	20.87	1298.15	
	11/25/96	21.00	1298.02	PS
	12/05/96	20.84	1298.18	
	01/10/97	20.87	1298.15	
	02/05/97	20.36	1298.66	
	03/04/97	17.87	1301.15	
	04/08/97	18.17	1300.85	
	05/08/97	18.79	1300.23	
	06/03/97	19.75	1299.27	
	07/08/97	20.60	1298.42	
	08/07/97	20.68	1298.34	
	09/03/97	20.88	1298.14	
	10/06/97	20.89	1298.13	
	11/04/97	20.92	1298.10	
	12/02/97	20.94	1298.08	
	01/14/98	21.00	1298.02	
	01/14/98	21.00	1298.02	PS
	01/16/98	20.91	1298.11	
	01/23/98	20.88	1298.14	
	01/30/98	20.89	1298.13	
	02/09/98	20.90	1298.12	0.01 FT RISE
	02/13/98	20.82	1298.20	
	02/20/98	20.61	1298.41	
	02/27/98	20.31	1298.71	
	03/06/98	20.16	1298.86	
	03/13/98	20.00	1299.02	
	03/20/98	19.81	1299.21	
	03/26/98	19.54	1299.48	
	04/07/98	18.97	1300.05	
K7-01 (continued)				
	04/16/98	18.67	1300.35	
	04/20/98	18.63	1300.39	PS
	05/07/98	18.27	1300.75	
	05/14/98	18.17	1300.85	
	05/22/98	18.07	1300.95	
	06/02/98	17.95	1301.07	
	06/05/98	17.97	1301.05	PS
	06/12/98	18.00	1301.02	PS
	06/12/98	17.85	1301.17	
	07/07/98	17.74	1301.28	
	07/14/98	17.68	1301.34	
	07/21/98	17.80	1301.22	PS
	08/11/98	17.70	1301.32	
	09/01/98	17.81	1301.21	
	10/19/98	18.40	1300.62	PS
	10/24/98	18.34	1300.68	
	11/16/98	18.59	1300.43	
	12/01/98	18.65	1300.37	
	01/04/99	18.72	1300.30	
	01/19/99	18.68	1300.34	PS
	02/01/99	18.77	1300.25	
	03/09/99	18.62	1300.40	
	04/02/99	18.63	1300.39	
	04/22/99	18.83	1300.19	PS
	05/04/99	18.72	1300.30	
	06/01/99	18.74	1300.28	
	07/20/99	18.92	1300.10	PS
	07/22/99	18.82	1300.20	
	08/12/99	18.79	1300.23	
	09/13/99	18.86	1300.16	
	09/15/99	19.00	1300.02	PS
	09/22/99	18.99	1300.03	PS
	10/07/99	19.00	1300.02	PS
	10/13/99	18.74	1300.28	
	12/02/99	19.11	1299.91	
	01/06/00	18.93	1300.09	
	02/11/00	19.29	1299.73	PS
	02/23/00	19.22	1299.80	
	03/09/00	19.23	1299.79	
	04/04/00	19.15	1299.87	
	04/25/00	19.34	1299.68	PS
	05/01/00	19.16	1299.86	
	06/01/00	19.23	1299.79	
	07/03/00	19.18	1299.84	
	07/24/00	19.28	1299.74	PS
	08/01/00	19.43	1299.59	
	09/07/00	19.79	1299.23	
	09/07/00	19.79	1299.23	
	10/02/00	19.23	1299.79	
	10/30/00	19.49	1299.53	PS
	11/02/00	19.62	1299.40	
	12/04/00	19.58	1299.44	
	01/08/01	19.58	1299.44	
	01/23/01	19.65	1299.37	PS
	02/05/01	19.68	1299.34	
	03/06/01	19.70	1299.32	
	04/03/01	19.79	1299.23	
	04/24/01	19.86	1299.16	PS
	05/01/01	19.73	1299.29	
	06/05/01	19.68	1299.34	
	07/12/01	19.87	1299.15	
	07/17/01	19.90	1299.12	ps
	08/02/01	19.83	1299.19	
	09/07/01	19.94	1299.08	
	10/02/01	19.97	1299.05	

Table A-1. Ground Water Elevations for Monitor Wells in the Pit 7 Complex, measured between July 1, 1995, and June 30, 2003.

Location	Date of Measurement	Depth to Water (ft)	Water Elevation (ft/MSL)	Notes
K7-01 (continued)				
	10/24/01	20.10	1298.92	PS
	11/05/01	20.22	1298.80	
	12/05/01	20.27	1298.75	
	01/09/02	20.37	1298.65	
	01/23/02	20.50	1298.52	PS
	02/04/02	20.45	1298.57	
	03/05/02	20.54	1298.48	
	04/03/02	20.58	1298.44	
	04/22/02	20.65	1298.37	PS
	05/01/02	20.61	1298.41	
	06/01/02	20.67	1298.35	
	07/10/02	20.76	1298.26	
	08/06/02	20.75	1298.27	
	09/01/02	20.78	1298.24	
	09/13/02	20.88	1298.14	PS
	10/03/02	20.78	1298.24	
	11/27/02	20.86	1298.16	PS
	01/04/03	20.73	1298.29	
	02/01/03	20.73	1298.29	
	02/10/03	20.81	1298.21	PS
	03/01/03	20.72	1298.30	
	04/10/03	20.75	1298.27	
	05/01/03	20.78	1298.24	PS
K7-03				
	07/07/95	22.85	1316.24	
	07/14/95	22.90	1316.19	PS
	07/21/95	22.87	1316.22	
	07/26/95	22.90	1316.19	PS
	07/28/95	22.85	1316.24	
	08/18/95	23.07	1316.02	
	08/25/95	23.11	1315.98	
	09/01/95	23.10	1315.99	
	09/08/95	23.15	1315.94	
	10/04/95	23.49	1315.60	
	11/01/95	23.75	1315.34	
	01/05/96	24.16	1314.93	
	01/26/96	23.80	1315.29	
	02/02/96	22.45	1316.64	
	02/07/96	21.85	1314.39	
	02/09/96	21.65	1317.44	
	02/16/96	22.16	1316.93	
	02/23/96	21.21	1317.88	
	03/01/96	21.17	1317.92	
	03/18/96	20.65	1318.44	
	03/25/96	20.77	1318.32	
	04/02/96	20.77	1318.32	
	04/11/96	20.63	1318.46	
	04/19/96	20.60	1318.49	
	04/24/96	20.46	1318.63	PS
	05/03/96	20.21	1318.88	
	06/04/96	20.06	1319.03	
	07/18/96	20.80	1318.29	
	07/25/96	20.78	1318.31	PS
	08/08/96	21.10	1317.99	
	09/04/96	21.59	1317.50	
	10/08/96	22.24	1316.85	
	10/18/96	22.50	1316.59	PS
	10/29/96	22.60	1316.49	PS
	11/08/96	22.81	1316.28	
	11/18/96	22.90	1316.19	
	11/25/96	23.13	1315.96	
	12/05/96	23.05	1316.04	
	01/10/97	21.40	1317.69	
K7-03 (continued)				
	02/05/97	20.01	1319.08	
	03/04/97	19.57	1319.52	
	04/08/97	21.42	1317.67	
	05/08/97	19.58	1319.51	
	06/03/97	20.28	1318.81	
	07/08/97	21.20	1317.89	
	08/07/97	22.01	1317.08	
	09/03/97	22.80	1316.29	
	10/06/97	23.22	1315.87	
	11/04/97	23.65	1315.44	
	12/02/97	23.90	1315.19	
	01/14/98	23.75	1315.34	
	01/15/98	23.57	1315.52	PS
	01/16/98	23.09	1316.00	Transducer d
	01/23/98	22.10	1316.99	
	01/30/98	22.39	1316.70	
	02/09/98	19.57	1319.52	2.82 FT RISE
	02/11/98	19.45	1319.64	PS
	02/13/98	19.14	1319.95	
	02/18/98	19.00	1320.09	PS
	02/20/98	18.56	1320.53	
	02/27/98	17.55	1321.54	
	03/06/98	17.17	1321.92	
	03/13/98	16.92	1322.17	
	03/20/98	16.76	1322.33	
	03/26/98	16.70	1322.39	
	04/07/98	16.71	1322.38	
	04/16/98	16.68	1322.41	
	04/21/98	16.70	1322.39	PS
	05/07/98	16.57	1322.52	
	05/14/98	16.49	1322.60	
	05/22/98	16.56	1322.53	
	06/02/98	16.87	1322.22	
	06/12/98	17.12	1321.97	
	07/07/98	17.75	1321.34	
	07/14/98	18.08	1321.01	
	07/27/98	18.57	1320.52	PS
	08/11/98	18.84	1320.25	
	09/01/98	19.59	1319.50	
	10/19/98	21.35	1317.74	PS
	10/24/98	21.40	1317.69	
	11/16/98	21.93	1317.16	
	12/01/98	22.54	1316.55	
	01/04/99	23.07	1316.02	
	01/19/99	23.21	1315.88	PS
	02/01/99	23.50	1315.59	
	03/04/99	22.17	1316.92	PS
	03/09/99	22.16	1316.93	
	03/23/99	22.57	1316.52	PS
	03/30/99	22.56	1316.53	PS
	04/02/99	22.33	1316.76	
	04/22/99	22.20	1316.89	PS
	05/04/99	22.52	1316.57	
	06/01/99	22.90	1316.19	
	07/19/99	23.85	1315.24	PS
	07/22/99	23.77	1315.32	
	08/01/99			NM/NETTLES
	09/01/99			NM/NETTLES
	09/15/99	24.40	1314.69	PS
	09/22/99	24.46	1314.63	PS
	10/07/99	24.67	1314.42	PS
	10/20/99	24.53	1314.56	
	12/02/99	24.89	1314.20	
	01/06/00	24.94	1314.15	
	02/11/00	26.25	1312.84	PS

Table A-1. Ground Water Elevations for Monitor Wells in the Pit 7 Complex, measured between July 1, 1995, and June 30, 2003.

Location	Date of Measurement	Depth to Water (ft)	Water Elevation (ft/MSL)	Notes
K7-03 (continued)				
	02/23/00	24.51	1314.58	
	03/09/00	23.67	1315.42	
	04/04/00	24.16	1314.93	
	04/25/00	24.29	1314.80	PS
	05/01/00	24.34	1314.75	
	06/01/00	24.46	1314.63	
	07/03/00	24.92	1314.17	
	07/24/00	25.27	1313.82	PS
	08/01/00	25.45	1313.64	
	09/07/00	25.77	1313.32	
	09/07/00	25.77	1313.32	
	09/11/00	25.89	1313.20	PS
	09/18/00	25.90	1313.19	PS
	10/02/00	26.77	1312.32	
	10/30/00	26.40	1312.69	PS
	11/02/00	26.45	1312.64	
	12/04/00	26.82	1312.27	
	01/08/01	26.94	1312.15	
	01/23/01	26.95	1312.14	PS
	02/05/01	27.15	1311.94	
	03/06/01	27.36	1311.73	
	04/03/01	27.59	1311.50	
	04/17/01	27.60	1311.49	PS
	05/01/01	27.63	1311.46	
	06/05/01	27.76	1311.33	
	06/10/01	27.75	1311.34	PS
	06/18/01	27.75	1311.34	PS
	07/12/01	27.83	1311.26	
	07/17/01	27.85	1311.24	ps
	08/07/01	27.96	1311.13	
	08/23/01	48.30	1290.79	ps
	08/30/01	28.03	1311.06	ps
	09/07/01	28.18	1310.91	
	10/02/01	28.42	1310.67	
	10/24/01	28.60	1310.49	PS
	11/05/01	28.48	1310.61	
	12/05/01	28.57	1310.52	
	01/09/02	27.92	1311.17	
	01/23/02	28.30	1310.79	PS
	02/04/02	28.16	1310.93	
	03/05/02	27.91	1311.18	
	04/03/02	27.34	1311.75	
	04/22/02	27.15	1311.94	PS
	05/01/02	26.93	1312.16	
	06/02/02	26.84	1312.25	
	07/03/02	27.03	1312.06	
	08/06/02	27.51	1311.58	
	09/01/02	27.84	1311.25	
	09/06/02	28.05	1311.04	PS
	10/03/02	27.42	1311.67	
	11/27/02	28.95	1310.14	PS
	01/04/03	27.69	1311.40	
	02/01/03	27.25	1311.84	
	02/07/03	27.68	1311.41	PS
	03/01/03	28.35	1310.74	
	04/10/03	28.97	1310.12	
	05/01/03	29.18	1309.91	PS
K7-06				
	07/07/95	24.50	1389.45	
	07/14/95	24.50	1389.45	PS
	07/21/95	24.53	1389.42	
	07/26/95	24.50	1389.45	PS
	07/28/95	24.54	1389.41	
K7-06 (continued)				
	08/18/95	24.70	1389.25	
	08/25/95	24.82	1389.13	
	09/01/95	24.76	1389.19	
	09/08/95	24.80	1389.15	
	10/04/95	24.83	1389.12	
	11/01/95	24.90	1389.05	
	01/05/96	24.29	1389.66	
	01/26/96	23.46	1390.49	
	02/02/96	21.27	1392.68	
	02/09/96	20.79	1393.16	
	02/12/96	21.20	1392.75	
	02/16/96	21.35	1392.60	
	02/23/96	20.75	1393.20	
	03/01/96	21.00	1392.95	
	03/18/96	21.40	1392.55	
	03/25/96	21.75	1392.20	
	04/02/96	21.90	1392.05	
	04/11/96	22.33	1391.62	
	04/19/96	22.65	1391.30	
	04/24/96	22.88	1391.07	PS
	05/03/96	23.11	1390.84	
	06/04/96	23.69	1390.26	
	07/19/96	24.02	1389.93	
	07/24/96	24.04	1389.91	PS
	08/08/96	24.03	1389.92	
	09/05/96	24.20	1389.75	
	10/08/96	24.35	1389.60	
	10/18/96	24.55	1389.40	PS
	11/06/96	24.44	1389.51	
	11/18/96	24.29	1389.66	
	11/25/96	24.24	1389.71	
	12/05/96	24.30	1389.65	
	01/10/97	21.63	1392.32	
	02/05/97	21.11	1392.84	
	03/04/97	22.25	1391.70	
	04/08/97	23.15	1390.80	
	05/08/97	23.45	1390.50	
	06/03/97	23.72	1390.23	
	07/08/97	23.94	1390.01	
	08/07/97	24.02	1389.93	
	09/03/97	24.18	1389.77	
	10/06/97	24.24	1389.71	
	11/04/97	24.40	1389.55	
	12/02/97	24.19	1389.76	
	01/14/98	23.58	1390.37	PS
	01/14/98	23.49	1390.46	TRANSDUCER
	01/16/98	23.52	1390.43	
	01/23/98	21.85	1392.10	
	01/30/98	22.29	1391.66	
	02/09/98	19.87	1394.08	2.42 FT RISE
	02/13/98	20.16	1393.79	
	02/20/98	20.43	1393.52	
	02/27/98	20.50	1393.45	
	03/06/98	21.00	1392.95	
	03/13/98	21.30	1392.65	
	03/20/98	21.57	1392.38	
	03/26/98	21.72	1392.23	
	04/07/98	22.00	1391.95	
	04/16/98	22.17	1391.78	
	04/21/98	22.35	1391.60	PS
	05/07/98	22.00	1391.95	
	05/14/98	21.90	1392.05	
	05/22/98	22.10	1391.85	
	06/02/98	22.33	1391.62	
	06/12/98	22.50	1391.45	

Table A-1. Ground Water Elevations for Monitor Wells in the Pit 7 Complex, measured between July 1, 1995, and June 30, 2003.

Location	Date of Measurement	Depth to Water (ft)	Water Elevation (ft/MSL)	Notes
K7-06 (continued)				
	07/07/98	22.85	1391.10	
	07/14/98	22.96	1390.99	
	07/21/98	23.10	1390.85	PS
	08/11/98	23.05	1390.90	
	09/01/98	23.44	1390.51	
	10/19/98	23.67	1390.28	PS
	10/23/98	23.48	1390.47	
	11/16/98	23.79	1390.16	
	12/01/98	23.61	1390.34	
	01/04/99	23.77	1390.18	
	01/19/99	23.81	1390.14	PS
	02/01/99	23.42	1390.53	
	03/09/99	23.18	1390.77	
	04/02/99	23.42	1390.53	
	04/23/99	23.60	1390.35	PS
	05/04/99	23.66	1390.29	
	06/01/99	23.79	1390.16	
	07/19/99	24.48	1389.47	PS
	07/22/99	24.19	1389.76	
	08/12/99	24.38	1389.57	
	09/12/99			NM
	10/12/99	24.87	1389.08	PS
	10/13/99	24.66	1389.29	
	12/02/99	24.90	1389.05	
	01/06/00	24.79	1389.16	
	02/11/00	24.73	1389.22	PS
	02/22/00	23.49	1390.46	
	03/09/00	23.55	1390.40	
	04/04/00	24.21	1389.74	
	04/25/00	24.65	1389.30	PS
	05/01/00	24.72	1389.23	
	06/05/00	25.65	1388.30	
	07/05/00	25.74	1388.21	
	07/24/00	25.71	1388.24	PS
	08/01/00	25.79	1388.16	
	09/07/00	25.48	1388.47	
	09/07/00	25.48	1388.47	
	10/09/00	25.63	1388.32	
	11/01/00	25.62	1388.33	PS
	11/02/00	25.68	1388.27	
	12/05/00	28.60	1385.35	
	01/08/01	25.58	1388.37	
	02/05/01	25.47	1388.48	
	03/06/01	24.65	1389.30	
	04/03/01	25.70	1388.25	
	05/01/01	26.02	1387.93	
	06/05/01	26.45	1387.50	
	06/06/01	26.50	1387.45	PS
	07/12/01	24.66	1389.29	
	07/19/01	24.55	1389.40	ps
	08/03/01	24.36	1389.59	
	09/05/01	24.17	1389.78	
	10/03/01	24.18	1389.77	
	10/29/01	24.20	1389.75	PS
	11/05/01	24.34	1389.61	
	12/05/01	24.20	1389.75	
	01/11/02	23.22	1390.73	
	01/23/02	24.30	1389.65	PS
	02/08/02	24.45	1389.50	
	03/04/02	24.64	1389.31	
	04/03/02	24.75	1389.20	
	04/29/02	25.15	1388.80	PS
	05/01/02			NM
	06/01/02	25.34	1388.61	
	07/03/02	25.71	1388.24	
K7-06 (continued)				
	08/03/02	25.91	1388.04	
	08/29/02	25.98	1387.97	PS
	09/01/02	26.07	1387.88	
	10/09/02	26.19	1387.76	
	12/03/02	23.61	1390.34	PS
	01/10/03	23.62	1390.33	
	02/01/03	24.80	1389.15	
	02/07/03	25.93	1388.02	PS
	03/10/03	25.39	1388.56	
	04/17/03	25.94	1388.01	
	05/06/03	26.13	1387.82	PS
K7-07				
	07/07/95	20.48	1277.54	
	07/21/95	20.68	1277.34	
	07/28/95	20.77	1277.25	
	08/18/95	21.05	1276.97	
	08/25/95	21.14	1276.88	
	09/01/95	21.23	1276.79	
	09/08/95	21.31	1276.71	
	10/04/95	21.62	1276.40	
	11/01/95	21.91	1276.11	
	01/05/96	21.45	1276.57	
	01/26/96	21.13	1276.89	
	02/02/96	20.20	1277.82	
	02/09/96	19.14	1278.88	
	02/16/96	18.72	1279.30	
	02/23/96	18.17	1279.85	
	03/01/96	17.58	1280.44	
	03/18/96	16.40	1281.62	
	03/25/96	15.98	1282.04	
	04/02/96	15.57	1282.45	
	04/11/96	15.24	1282.78	
	04/19/96	15.05	1282.97	
	05/03/96	14.90	1283.12	
	05/20/96	15.12	1282.90	PS
	06/04/96	15.46	1282.56	
	07/18/96	16.82	1281.20	
	08/08/96	17.46	1280.56	
	09/05/96	18.28	1279.74	
	09/13/96	18.49	1279.53	PS
	10/08/96	19.17	1278.85	
	11/08/96	19.91	1278.11	
	11/18/96	19.98	1278.04	
	11/19/96	20.00	1278.02	PS
	11/25/96	20.03	1277.99	
	12/05/96	20.26	1277.76	
	01/10/97	18.11	1279.91	
	02/05/97	16.40	1281.62	
	03/04/97	15.18	1282.84	
	04/08/97	14.75	1283.27	
	05/08/97	15.28	1282.74	
	06/03/97	16.20	1281.82	
	07/08/97	17.25	1280.77	
	08/07/97	18.19	1279.83	
	09/03/97	19.02	1279.00	
	10/06/97	19.79	1278.23	
	11/04/97	20.33	1277.69	
	12/02/97	20.56	1277.46	
	01/14/98	20.78	1277.24	
	01/16/98	20.61	1277.41	
	01/23/98	19.65	1278.37	
	01/30/98	19.03	1278.99	
	02/09/98	16.39	1281.63	2.64 FT RISE

Table A-1. Ground Water Elevations for Monitor Wells in the Pit 7 Complex, measured between July 1, 1995, and June 30, 2003.

Location	Date of Measurement	Depth to Water (ft)	Water Elevation (ft/MSL)	Notes
K7-07 (continued)				
	02/13/98	15.50	1282.52	
	02/20/98	14.15	1283.87	
	02/27/98	12.66	1285.36	
	03/06/98	11.61	1286.41	
	03/13/98	10.93	1287.09	
	03/20/98	10.40	1287.62	
	03/26/98	10.08	1287.94	
	04/07/98	9.67	1288.35	
	04/16/98	9.62	1288.40	
	05/07/98	8.67	1289.35	
	05/14/98	9.21	1288.81	
	05/22/98	9.63	1288.39	
	06/02/98	10.10	1287.92	
	06/02/98	10.13	1287.89	PS
	06/12/98	10.56	1287.46	
	07/07/98	11.82	1286.20	
	07/14/98	12.23	1285.79	
	08/11/98	13.52	1284.50	
	09/01/98	14.46	1283.56	
	10/23/98	16.48	1281.54	
	11/16/98	17.26	1280.76	
	11/30/98	17.70	1280.32	PS
	12/01/98	17.79	1280.23	
	01/04/99	18.72	1279.30	
	02/01/99	18.86	1279.16	
	03/09/99	17.35	1280.67	
	04/02/99	18.13	1279.89	
	05/04/99	18.78	1279.24	
	05/26/99	18.23	1279.79	PS
	06/01/99	19.26	1278.76	
	07/22/99	19.91	1278.11	
	08/12/99	20.08	1277.94	
	09/13/99	20.35	1277.67	BAILER IN WE
	10/13/99	20.57	1277.45	
	12/02/99	20.99	1277.03	
	01/06/00	20.91	1277.11	
	02/23/00	19.77	1278.25	
	03/09/00	18.80	1279.22	
	04/04/00	19.59	1278.43	
	05/01/00	20.57	1277.45	
	05/18/00	20.80	1277.22	PS
	06/05/00	20.20	1277.82	
	07/03/00	21.34	1276.68	
	08/01/00	21.80	1276.22	
	09/07/00	21.96	1276.06	
	09/07/00	21.96	1276.06	
	10/09/00	22.25	1275.77	
	11/02/00	22.23	1275.79	
	12/04/00	22.45	1275.57	
	01/08/01	22.57	1275.45	
	02/05/01	22.62	1275.40	
	03/06/01	22.41	1275.61	
	04/03/01	22.65	1275.37	
	05/01/01	22.81	1275.21	
	06/05/01	22.90	1275.12	
	07/12/01			DRY
	08/03/01			DRY
	09/05/01			DRY
	10/02/01			DRY
	11/05/01			DRY
	12/05/01			DRY
	01/09/02	22.33	1275.69	DRY
	02/04/02	22.72	1275.30	
	03/05/02			DRY
	04/03/02			DRY
K7-07 (continued)				
	05/01/02			DRY
	06/01/02			DRY
	07/10/02			DRY
	08/06/02			DRY
	09/01/02			DRY
	10/03/02			DRY
	01/04/03			DRY
	02/01/03			DRY
	03/01/03	22.90	1275.12	
	04/10/03			DRY
K7-09				
	07/11/95	46.90	1297.87	
	07/17/95	46.90	1297.87	PS
	09/11/95	46.90	1297.87	PS
	02/07/96	46.20	1298.57	
	04/26/96	68.40	1277.20	PS
	05/02/96	45.26	1299.51	
	06/04/96	44.94	1299.83	
	07/19/96	45.19	1299.58	
	07/24/96	45.16	1300.44	PS
	08/08/96	45.18	1299.59	
	09/04/96	45.18	1300.42	
	10/07/96	45.38	1300.22	
	10/23/96	45.60	1300.00	PS
	11/06/96	45.42	1300.18	
	12/05/96	45.48	1300.12	
	01/10/97	45.09	1300.51	
	02/05/97	43.98	1301.62	
	03/04/97	43.85	1301.75	
	04/08/97	43.87	1301.73	
	05/08/97	43.71	1301.89	
	06/03/97	43.87	1301.73	
	07/08/97	44.05	1301.55	
	08/07/97	44.40	1301.20	
	09/03/97	53.28	1292.32	
	10/06/97	44.64	1300.96	
	11/04/97	44.91	1300.69	
	12/02/97	44.84	1300.76	
	01/14/98	45.19	1300.41	
	01/21/98	45.15	1300.45	PS
	02/06/98	43.92	1301.68	
	02/11/98	43.85	1301.75	PS
	02/20/98	43.23	1302.37	PS
	03/05/98	42.35	1303.25	
	04/03/98	41.54	1304.06	
	04/22/98	41.65	1303.95	PS
	05/06/98	41.59	1304.01	
	06/05/98	41.72	1303.88	
	07/14/98	42.16	1303.44	
	07/27/98	42.40	1303.20	PS
	08/11/98	42.08	1303.52	
	09/01/98	42.05	1303.55	
	09/14/98	42.00	1303.60	PS
	10/20/98	42.15	1303.45	PS
	10/23/98	44.15	1301.45	
	11/16/98	42.04	1303.56	
	12/01/98	42.05	1303.55	
	01/04/99	43.87	1301.73	
	01/25/99	42.30	1303.30	PS
	02/01/99	42.88	1302.72	
	03/09/99	41.33	1304.27	
	04/02/99	41.60	1304.00	
	04/23/99	41.93	1303.67	PS

Table A-1. Ground Water Elevations for Monitor Wells in the Pit 7 Complex, measured between July 1, 1995, and June 30, 2003.

Location	Date of Measurement	Depth to Water (ft)	Water Elevation (ft/MSL)	Notes
K7-09 (continued)				
	05/04/99	43.22	1302.38	
	06/01/99	43.11	1302.49	
	06/18/99	43.61	1301.99	PS
	06/28/99	43.89	1301.71	PS
	07/15/99	43.88	1301.72	PS
	07/22/99	44.60	1301.00	
	08/12/99	43.85	1301.75	
	09/13/99	44.21	1301.39	
	10/11/99	44.74	1300.86	PS
	10/13/99	49.68	1295.92	ME
	12/02/99	45.00	1300.60	
	12/07/99	44.97	1300.63	PS
	12/15/99	45.29	1300.31	PS
	01/06/00	44.99	1300.61	
	02/16/00	45.31	1300.29	PS
	02/23/00	45.85	1299.75	
	03/09/00	44.53	1301.07	
	04/04/00	44.17	1301.43	
	04/25/00	44.75	1300.85	PS
	05/01/00	45.58	1300.02	
	06/02/00	45.12	1300.48	
	07/05/00	45.41	1300.19	
	08/01/00	45.77	1299.83	
	08/09/00	45.68	1299.92	PS
	09/07/00	45.91	1299.69	
	09/07/00	45.91	1299.69	
	10/09/00	46.11	1299.49	
	11/01/00	46.38	1298.92	PS
	11/02/00	56.36	1288.94	MEASURED TWI
	12/05/00	46.47	1298.83	MEASURED TWI
	12/14/00	46.40	1298.90	ps
	12/21/00	46.40	1298.90	ps
	01/08/01	46.59	1298.71	
	01/23/01	46.75	1298.55	PS
	02/05/01	46.89	1298.41	
	02/15/01	46.78	1298.52	ps
	02/22/01	46.80	1298.50	ps
	03/06/01	46.77	1298.53	
	04/03/01	46.94	1298.36	
	04/24/01	47.00	1298.30	PS
	05/01/01	47.00	1298.30	
	06/05/01	47.14	1298.16	
	07/12/01	47.34	1297.96	
	07/17/01	47.35	1297.95	ps
	08/03/01	47.33	1297.97	
	09/05/01	47.47	1297.83	
	10/03/01	47.62	1297.68	
	10/24/01	47.75	1297.55	PS
	11/07/01	47.93	1297.37	
	12/05/01	47.85	1297.45	
	01/11/02	47.92	1297.38	
	01/23/02	47.40	1297.90	PS
	02/04/02	47.33	1297.97	
	03/05/02	47.20	1298.10	
	04/03/02	47.38	1297.92	
	04/23/02	47.65	1297.65	PS
	05/01/02			NM
	06/02/02	47.52	1297.78	
	07/10/02	47.81	1297.49	OILY RESIDUE
	08/01/02	48.37	1296.93	
	09/01/02	48.04	1297.26	
	09/06/02	48.40	1296.90	PS
	10/03/02	48.28	1297.02	
	11/29/02	48.41	1296.89	PS
	01/04/03	48.56	1296.74	

Location	Date of Measurement	Depth to Water (ft)	Water Elevation (ft/MSL)	Notes
K7-09 (continued)				
	02/01/03	47.60	1297.70	
	02/07/03	47.93	1297.37	PS
	03/10/03	47.79	1297.51	OILY RESIDUE
	03/20/03	47.84	1297.46	PS
	03/27/03	48.83	1296.47	PS
	04/10/03	48.35	1296.95	
	05/01/03	48.55	1296.75	PS
K7-10				
	07/07/95	35.94	1307.37	
	07/18/95	35.85	1307.46	PS
	07/18/95	35.85	1307.46	
	07/28/95	35.90	1307.41	
	08/18/95	36.03	1307.28	
	08/25/95	35.93	1307.38	
	09/01/95	35.94	1307.37	
	09/08/95	35.90	1307.41	
	10/04/95	35.99	1307.32	
	11/01/95	36.02	1307.29	
	01/05/96	34.17	1309.14	
	01/26/96	32.84	1310.47	
	02/02/96	31.83	1311.48	
	02/09/96	31.50	1311.81	
	02/12/96	32.00	1311.31	
	02/16/96	32.49	1310.82	
	02/23/96	32.19	1311.12	
	03/01/96	32.27	1311.04	
	03/18/96	32.40	1310.91	
	03/25/96	33.00	1310.31	
	04/02/96	33.31	1310.00	
	04/11/96	33.70	1309.61	
	04/19/96	33.95	1309.36	
	04/26/96	68.40	1274.91	PS
	05/03/96	33.90	1309.41	
	06/04/96	34.20	1309.11	
	07/16/96	34.49	1308.82	
	07/24/96	34.43	1308.88	PS
	08/08/96	34.46	1308.85	
	09/04/96	34.49	1308.82	
	10/07/96	34.61	1308.70	
	10/24/96	34.60	1308.71	PS
	11/06/96	34.82	1308.49	
	11/18/96	34.66	1308.65	
	11/25/96	34.90	1308.41	
	12/05/96	34.69	1308.62	
	01/10/97	31.56	1311.75	
	02/05/97	30.99	1312.32	
	03/04/97	32.75	1310.56	
	04/08/97	33.07	1310.24	
	05/08/97	33.24	1310.07	
	06/03/97	33.39	1309.92	
	07/08/97	33.61	1309.70	
	08/07/97	33.72	1309.59	
	09/03/97	36.18	1307.13	
	10/06/97	33.94	1309.37	
	11/04/97	34.14	1309.17	
	12/02/97	34.19	1309.12	
	01/14/98	33.90	1309.41	
	01/16/98	33.45	1309.86	
	01/21/98	31.20	1312.11	PS
	01/23/98	31.97	1311.34	
	01/30/98	30.95	1312.36	
	02/09/98	30.00	1313.31	0.95 FT RISE
	02/13/98	29.73	1313.58	

Table A-1. Ground Water Elevations for Monitor Wells in the Pit 7 Complex, measured between July 1, 1995, and June 30, 2003.

Location	Date of Measurement	Depth to Water (ft)	Water Elevation (ft/MSL)	Notes
K7-10 (continued)				
	02/20/98	29.62	1313.69	
	02/27/98	29.51	1313.80	
	03/06/98	29.93	1313.38	
	03/13/98	30.34	1312.97	
	03/20/98	30.69	1312.62	
	03/26/98	30.83	1312.48	
	04/07/98	31.29	1312.02	
	04/16/98	31.60	1311.71	
	04/28/98	31.67	1311.64	PS
	05/07/98	31.70	1311.61	
	05/14/98	30.95	1312.36	
	05/22/98	30.60	1312.71	
	06/02/98	31.24	1312.07	
	06/05/98	31.40	1311.91	PS
	06/12/98	31.43	1311.88	PS
	06/12/98	31.43	1311.88	
	07/07/98	31.89	1311.42	
	07/14/98	31.95	1311.36	
	07/31/98	32.10	1311.21	PS
	08/11/98	32.09	1311.22	
	09/01/98	32.11	1311.20	
	09/18/98	32.45	1310.86	PS
	09/23/98	32.52	1310.79	PS
	10/23/98	32.60	1310.71	
	10/26/98	32.61	1310.70	PS
	11/04/98	32.70	1310.61	PS
	11/16/98	32.62	1310.69	
	12/01/98	32.87	1310.44	
	01/04/99	33.29	1310.02	
	01/25/99	32.98	1310.33	PS
	02/01/99	33.17	1310.14	
	03/09/99	30.52	1312.79	
	04/01/99	31.66	1311.65	PS
	04/02/99	33.78	1309.53	
	04/19/99	31.57	1311.74	PS
	04/26/99	31.83	1311.48	PS
	05/04/99	31.99	1311.32	
	06/01/99	32.33	1310.98	
	06/18/99	32.80	1310.51	PS
	07/15/99	32.98	1310.33	PS
	07/22/99	33.15	1310.16	
	08/12/99	33.21	1310.10	
	09/13/99	33.14	1310.17	
	10/11/99	33.55	1309.76	PS
	10/13/99	35.33	1307.98	
	12/02/99	33.95	1309.36	
	01/06/00	34.02	1309.29	
	01/20/00	34.25	1309.06	PS
	02/23/00	33.27	1310.04	
	03/09/00	31.03	1312.28	
	04/04/00	32.29	1311.02	
	04/26/00	33.15	1310.16	PS
	05/01/00	33.22	1310.09	
	06/02/00	33.71	1309.60	
	07/05/00	33.72	1309.59	
	08/01/00	34.13		PS
	08/01/00	34.11	1309.20	
	08/08/00	34.15	1309.16	PS
	09/07/00	34.26	1309.05	
	09/07/00	34.26	1309.05	
	09/11/00	34.38	1308.93	PS
	09/18/00	34.40	1308.91	PS
	10/09/00	34.61	1308.70	
	11/01/00	34.85	1308.46	PS
	11/02/00	35.84	1307.47	
K7-10 (continued)				
	12/05/00	35.01	1308.30	
	01/08/01	35.02	1308.29	
	01/23/01	35.20	1308.11	PS
	02/05/01	35.49	1307.82	
	03/06/01	35.40	1307.91	
	04/03/01	35.33	1307.98	
	04/24/01	35.50	1307.81	PS
	05/01/01	35.69	1307.62	
	05/02/01	35.88	1307.43	PS
	06/05/01	35.65	1307.66	
	07/12/01	35.84	1307.47	
	07/17/01	35.85	1307.46	ps
	08/03/01	35.97	1307.34	
	09/05/01	36.03	1307.28	
	10/03/01	36.10	1307.21	
	10/24/01	36.30	1307.01	PS
	11/07/01	36.38	1306.93	
	12/05/01	36.45	1306.86	
	01/11/02	34.25	1309.06	
	01/24/02	34.15	1309.16	PS
	02/04/02	34.33	1308.98	
	03/05/02	35.03	1308.28	
	04/03/02	35.48	1307.83	
	04/23/02	35.60	1307.71	PS
	05/01/02			NM
	06/02/02	35.84	1307.47	
	07/10/02	36.08	1307.23	
	08/03/02	36.14	1307.17	
	08/28/02	36.34	1306.97	PS
	09/01/02	36.91	1306.40	
	10/04/02	36.43	1306.88	
	11/29/02	36.39	1306.92	PS
	01/04/03	34.90	1308.41	
	02/01/03	34.00	1309.31	
	02/07/03	34.27	1309.04	PS
	03/10/03	35.33	1307.98	
	04/10/03	35.62	1307.69	
	05/05/03	35.91	1307.40	PS
NC7-12				
	07/07/95	18.29	1267.40	
	07/21/95	18.45	1267.24	
	07/28/95	18.51	1267.18	
	08/18/95	18.82	1266.87	
	08/25/95	18.92	1266.77	
	09/01/95	19.02	1266.67	
	09/08/95	19.12	1266.57	
	10/03/95	19.50	1266.19	
	11/01/95	19.85	1265.84	
	01/05/96	19.27	1266.42	
	01/26/96	18.60	1267.09	
	02/02/96	15.90	1269.79	
	02/09/96	14.04	1271.65	
	02/16/96	14.20	1271.49	
	02/23/96	13.00	1272.69	
	03/01/96	12.36	1273.33	
	03/18/96	11.90	1273.79	
	03/25/96	12.35	1273.34	
	04/02/96	12.74	1272.95	
	04/11/96	13.07	1272.62	
	04/19/96	13.40	1272.29	
	05/03/96	14.00	1271.69	
	06/04/96	14.82	1270.87	
	07/18/96	16.00	1269.69	

Table A-1. Ground Water Elevations for Monitor Wells in the Pit 7 Complex, measured between July 1, 1995, and June 30, 2003.

Location	Date of Measurement	Depth to Water (ft)	Water Elevation (ft/MSL)	Notes
NC7-12 (continued)				
	08/08/96	16.46	1269.23	
	09/05/96	17.03	1268.66	
	10/07/96	17.62	1268.07	
	11/08/96	18.18	1267.51	
	11/18/96	17.44	1268.25	
	11/25/96	17.89	1267.80	
	12/05/96	18.28	1267.41	
	01/10/97	14.36	1271.33	
	02/05/97	12.65	1273.04	
	03/04/97	13.98	1271.71	
	04/08/97	14.82	1270.87	
	05/08/97	15.32	1270.37	
	06/03/97	15.96	1269.73	
	07/11/97	16.70	1268.99	
	08/07/97	17.19	1268.50	
	09/03/97	17.70	1267.99	
	10/06/97	18.30	1267.39	
	11/04/97	18.81	1266.88	
	12/02/97	18.78	1266.91	
	01/14/98	18.51	1267.18	
	01/16/98	17.94	1267.75	
	01/23/98	15.73	1269.96	
	01/30/98	16.22	1269.47	
	02/09/98	14.03	1271.66	2.19 FT RISE
	02/13/98	13.23	1272.46	
	02/20/98	12.21	1273.48	
	02/27/98	10.86	1274.83	
	03/06/98	9.95	1275.74	
	03/13/98	9.62	1276.07	
	03/20/98	9.57	1276.12	
	03/26/98	9.65	1276.04	
	04/07/98	9.84	1275.85	
	04/16/98	10.05	1275.64	
	05/07/98	9.73	1275.96	
	05/14/98	10.10	1275.59	
	05/22/98	10.34	1275.35	
	06/02/98	10.78	1274.91	
	06/12/98	11.13	1274.56	
	07/07/98	12.19	1273.50	
	07/14/98	12.51	1273.18	
	08/11/98	13.71	1271.98	
	09/01/98	14.58	1271.11	
	10/23/98	16.13	1269.56	
	11/16/98	16.63	1269.06	
	12/01/98	17.07	1268.62	
	01/04/99	17.56	1268.13	
	02/01/99	17.60	1268.09	
	03/09/99	16.61	1269.08	
	04/02/99	17.23	1268.46	
	05/04/99	17.64	1268.05	
	06/01/99	17.99	1267.70	
	07/22/99	18.70	1266.99	
	08/12/99	18.76	1266.93	
	09/13/99	19.01	1266.68	
	10/13/99	19.32	1266.37	
	12/02/99	19.70	1265.99	
	01/06/00	19.76	1265.93	
	02/23/00	18.87	1266.82	
	03/09/00	17.88	1267.81	
	04/04/00	18.28	1267.41	
	05/01/00	18.91	1266.78	
	06/01/00	19.74	1265.95	
	07/03/00	20.03	1265.66	
	08/01/00	20.44	1265.25	
	09/07/00	20.58	1265.11	
NC7-12 (continued)				
	09/07/00	20.58	1265.11	
	10/02/00	20.70	1264.99	
	11/02/00	20.96	1264.73	
	12/04/00	21.02	1264.67	
	01/05/01	21.33	1264.36	
	02/05/01	21.32	1264.37	
	03/06/01	20.71	1264.98	
	04/03/01	21.02	1264.67	
	05/01/01	21.20	1264.49	
	06/05/01	21.43	1264.26	
	07/12/01	21.74	1263.95	
	08/03/01	21.82	1263.87	
	09/05/01	21.98	1263.71	
	10/02/01	22.00	1263.69	
	11/05/01	22.00	1263.69	
	12/04/01	22.04	1263.65	
	01/09/02	20.81	1264.88	
	02/04/02	21.00	1264.69	
	03/05/02	21.49	1264.20	
	04/03/02	21.34	1264.35	
	05/01/02	21.90	1263.79	
	06/01/02	22.09	1263.60	
	07/10/02	22.22	1263.47	
	08/06/02	22.32	1263.37	
	09/07/02	22.42	1263.27	
	10/03/02	22.39	1263.30	
	01/04/03	21.98	1263.71	
	02/01/03	21.54	1264.15	
	03/01/03	21.71	1263.98	
	04/10/03	21.98	1263.71	
NC7-15				
	07/07/95	19.30	1250.11	
	07/21/95	19.61	1249.80	
	07/28/95	19.72	1249.69	
	08/18/95	20.00	1249.41	
	08/25/95	20.05	1249.36	
	09/01/95	20.12	1249.29	
	09/08/95	20.19	1249.22	
	10/03/95	20.42	1248.99	
	11/01/95	20.51	1248.90	
	01/05/96	20.08	1249.33	
	01/26/96	19.69	1249.72	
	02/02/96	18.93	1250.48	
	02/09/96	17.10	1252.31	
	02/16/96	17.52	1251.89	
	02/23/96	16.03	1253.38	
	03/01/96	15.04	1254.37	
	03/18/96	13.80	1255.61	
	03/25/96	13.48	1255.93	
	04/02/96	13.57	1255.84	
	04/11/96	13.95	1255.46	
	04/19/96	14.35	1255.06	
	05/03/96	15.00	1254.41	
	06/04/96	16.29	1253.12	
	07/18/96	17.45	1251.96	
	08/08/96	17.89	1251.52	
	09/05/96	18.37	1251.04	
	10/07/96	18.79	1250.62	
	11/08/96	19.11	1250.30	
	11/18/96	19.13	1250.28	
	11/25/96	18.97	1250.44	
	12/05/96	19.11	1250.30	
	01/10/97	16.74	1252.67	

Table A-1. Ground Water Elevations for Monitor Wells in the Pit 7 Complex, measured between July 1, 1995, and June 30, 2003.

Location	Date of Measurement	Depth to Water (ft)	Water Elevation (ft/MSL)	Notes
NC7-15 (continued)				
	02/05/97	14.32	1255.09	
	03/04/97	14.47	1254.94	
	04/08/97	15.91	1253.50	
	05/08/97	16.63	1252.78	
	06/03/97	17.34	1252.07	
	07/11/97	18.03	1251.38	
	08/07/97	18.42	1250.99	
	09/03/97	18.72	1250.69	
	10/06/97	19.04	1250.37	
	11/04/97	19.32	1250.09	
	12/02/97	19.43	1249.98	
	01/14/98	19.44	1249.97	
	01/16/98	19.32	1250.09	
	01/23/98	18.45	1250.96	
	01/30/98	18.15	1251.26	
	02/09/98	15.74	1253.67	2.41 FT RISE
	02/13/98	14.22	1255.19	
	02/20/98	12.62	1256.79	
	02/27/98	10.63	1258.78	
	03/06/98	9.87	1259.54	
	03/13/98	9.78	1259.63	
	03/20/98	10.18	1259.23	
	03/26/98	10.40	1259.01	
	04/07/98	11.10	1258.31	
	04/16/98	11.57	1257.84	
	05/07/98	11.96	1257.45	
	05/14/98	11.86	1257.55	
	05/22/98	12.03	1257.38	
	06/02/98	12.37	1257.04	
	06/12/98	12.63	1256.78	
	07/07/98	13.34	1256.07	
	07/14/98	13.60	1255.81	
	08/11/98	14.40	1255.01	
	09/01/98	15.12	1254.29	
	10/23/98	17.12	1252.29	
	11/16/98	17.80	1251.61	
	12/01/98	18.05	1251.36	
	01/04/99	18.42	1250.99	
	02/01/99	18.39	1251.02	
	03/09/99	17.60	1251.81	
	04/02/99	18.10	1251.31	
	05/04/99	18.44	1250.97	
	06/01/99	18.68	1250.73	
	07/22/99	19.11	1250.30	
	08/12/99	19.18	1250.23	
	09/13/99	18.34	1251.07	
	10/13/99	19.52	1249.89	
	12/02/99	20.10	1249.31	
	01/20/00	19.67	1249.74	
	02/23/00	18.15	1251.26	
	03/09/00	18.89	1250.52	
	04/04/00	18.99	1250.42	
	05/01/00	19.62	1249.79	
	06/01/00	19.82	1249.59	
	07/03/00	20.01	1249.40	
	08/01/00	20.36	1249.05	
	09/07/00	20.48	1248.93	
	09/07/00	20.48	1248.93	
	10/02/00	20.47	1248.94	
	11/01/00	20.71	1248.70	
	12/04/00	20.76	1248.65	
	01/05/01	20.84	1248.57	
	02/05/01	20.95	1248.46	
	03/06/01	20.70	1248.71	
	04/03/01	20.69	1248.72	
NC7-15 (continued)				
	05/01/01	20.86	1248.55	
	06/01/01	20.94	1248.47	
	07/12/01	21.10	1248.31	
	08/03/01	21.15	1248.26	
	09/05/01	21.27	1248.14	
	10/02/01	21.24	1248.17	
	11/05/01	21.29	1248.12	
	12/04/01	21.31	1248.10	
	01/09/02	20.65	1248.76	
	02/04/02	20.72	1248.69	
	03/05/02	20.97	1248.44	
	04/03/02	21.00	1248.41	
	05/01/02			NM
	06/01/02	21.32	1248.09	
	07/10/02	21.45	1247.96	
	08/06/02	21.49	1247.92	
	09/07/02	21.54	1247.87	
	10/09/02	21.59	1247.82	
	01/04/03	21.20	1248.21	
	02/01/03	21.15	1248.26	
	03/01/03	21.22	1248.19	
	04/10/03	21.32	1248.09	
NC7-16				
	07/07/95	21.98	1289.06	
	07/21/95	22.26	1288.78	
	07/28/95	22.35	1288.69	
	08/18/95	22.64	1288.40	
	08/25/95	22.72	1288.32	
	09/01/95	22.77	1288.27	
	09/08/95	22.81	1288.23	
	10/04/95	23.05	1287.99	
	11/01/95	23.29	1287.75	
	01/05/96	23.58	1287.46	
	01/26/96	23.33	1287.71	
	02/02/96	22.22	1288.82	
	02/09/96	21.09	1289.95	
	02/16/96	20.58	1290.46	
	02/23/96	19.55	1291.49	
	03/01/96	18.45	1292.59	
	03/18/96	16.70	1294.34	
	03/25/96	16.35	1294.69	
	04/02/96	16.34	1294.70	
	04/11/96	16.50	1294.54	
	04/19/96	16.73	1294.31	
	05/03/96	17.10	1293.94	
	06/04/96	17.94	1293.10	PS
	07/18/96	19.05	1291.99	
	08/08/96	19.44	1291.60	
	09/05/96	20.00	1291.04	
	10/07/96	20.57	1290.47	
	11/08/96	21.14	1289.90	
	11/18/96	21.29	1289.75	
	11/25/96	21.39	1289.65	
	12/05/96	21.48	1289.56	
	01/10/97	20.26	1290.78	
	02/05/97	17.45	1293.59	
	03/04/97	16.31	1294.73	
	04/08/97	16.80	1294.24	
	05/08/97	17.37	1293.67	
	06/03/97	18.28	1292.76	
	07/08/97	19.29	1291.75	
	08/07/97	20.12	1290.92	
	09/03/97	20.82	1290.22	

Table A-1. Ground Water Elevations for Monitor Wells in the Pit 7 Complex, measured between July 1, 1995, and June 30, 2003.

Location	Date of Measurement	Depth to Water (ft)	Water Elevation (ft/MSL)	Notes
NC7-16 (continued)				
	10/06/97	21.50	1289.54	
	11/04/97	22.22	1288.82	
	12/02/97	22.75	1288.29	
	01/14/98	23.12	1287.92	
	01/16/98	22.97	1288.07	
	01/23/98	22.17	1288.87	
	01/30/98	22.03	1289.01	
	02/09/98	19.85	1291.19	2.18 FT RISE
	02/13/98	18.46	1292.58	
	02/20/98	15.97	1295.07	
	02/27/98	12.34	1298.70	
	03/06/98	11.00	1300.04	
	03/13/98	10.59	1300.45	
	03/20/98	10.65	1300.39	
	03/26/98	10.83	1300.21	
	04/07/98	11.24	1299.80	
	04/16/98	11.57	1299.47	
	05/07/98	12.14	1298.90	
	05/14/98	12.00	1299.04	
	05/22/98	12.15	1298.89	
	06/02/98	12.55	1298.49	
	06/12/98	12.97	1298.07	
	07/07/98	14.24	1296.80	
	07/14/98	14.63	1296.41	
	08/11/98	15.91	1295.13	
	09/01/98	16.88	1294.16	
	10/23/98	19.11	1291.93	
	11/16/98	19.92	1291.12	
	12/01/98	20.38	1290.66	
	01/04/99	21.20	1289.84	
	02/01/99	21.73	1289.31	
	03/09/99	20.97	1290.07	
	04/02/99	20.98	1290.06	
	05/04/99	21.32	1289.72	
	06/01/99	21.57	1289.47	
	07/22/99	22.25	1288.79	
	08/12/99	22.65	1288.39	
	09/13/99	23.26	1287.78	
	10/13/99	23.66	1287.38	
	12/02/99	29.11	1281.93	ME
	01/06/00	24.68	1286.36	
	02/22/00	24.43	1286.61	
	03/09/00	23.48	1287.56	
	04/04/00	23.58	1287.46	
	05/01/00	24.21	1286.83	
	06/01/00	24.63	1286.41	
	07/03/00	25.01	1286.03	
	08/01/00	25.48	1285.56	
	09/07/00	25.68	1285.36	
	09/07/00	25.68	1285.36	
	10/02/00	25.79	1285.25	
	11/01/00	26.18	1284.86	
	12/04/00	26.48	1284.56	
	01/05/01	26.62	1284.42	
	02/05/01	26.80	1284.24	
	03/06/01	26.65	1284.39	
	04/03/01	26.88	1284.16	
	05/01/01	20.05	1290.99	
	06/05/01	27.16	1283.88	
	07/12/01	27.41	1283.63	
	08/07/01	27.61	1283.43	
	09/05/01			DRY
	10/02/01			DRY
	11/05/01			DRY
	12/04/01			DRY
NC7-16 (continued)				
	01/11/02	26.25	1284.79	
	02/04/02			DRY
	03/05/02			DRY
	04/04/02	27.46	1283.58	
	05/01/02	27.67	1283.37	
	06/02/02	27.77	1283.27	
	07/10/02	27.89	1283.15	
	08/06/02	28.11	1282.93	
	09/01/02	28.19	1282.85	
	10/03/02	28.23	1282.81	
	01/04/03	26.95	1284.09	
	02/01/03	26.70	1284.34	
	03/01/03	27.30	1283.74	
	04/10/03	27.51	1283.53	
NC7-17				
	07/07/95	26.64	1362.86	
	07/21/95	26.90	1362.60	
	07/28/95	26.97	1362.53	
	08/18/95	27.20	1362.30	
	08/25/95	27.24	1362.26	
	09/01/95	27.20	1362.30	
	09/08/95	27.20	1362.30	
	10/04/95	27.53	1361.97	
	11/01/95	27.88	1361.62	
	01/05/96	27.26	1362.24	
	01/26/96	26.91	1362.59	
	02/02/96	26.63	1362.87	
	02/09/96	25.94	1363.56	
	02/16/96	25.50	1364.00	
	02/23/96	25.07	1364.43	
	03/01/96	24.57	1364.93	
	03/18/96	24.11	1365.39	
	03/25/96	24.08	1365.42	
	04/02/96	24.32	1365.18	
	04/11/96	24.59	1364.91	
	04/19/96	24.84	1364.66	
	05/03/96	25.00	1364.50	
	06/04/96	25.52	1363.98	PS
	07/19/96	26.36	1363.14	
	08/08/96	26.53	1362.97	
	09/05/96	26.67	1362.83	
	10/08/96	26.84	1362.66	
	11/06/96	27.21	1362.29	
	11/18/96	27.23	1362.27	
	11/25/96	27.19	1362.31	
	12/05/96	27.02	1362.48	
	01/10/97	25.65	1363.85	
	02/05/97	24.13	1365.37	
	03/04/97	24.55	1364.95	
	04/08/97	25.19	1364.31	
	05/08/97	25.68	1363.82	
	06/03/97	26.18	1363.32	
	07/08/97	26.53	1362.97	
	08/07/97	26.70	1362.80	
	09/03/97	26.86	1362.64	
	10/06/97	27.00	1362.50	
	11/04/97	27.28	1362.22	
	12/02/97			
	01/14/98	27.08	1362.42	
	01/16/98	27.11	1362.39	
	01/23/98	26.69	1362.81	
	01/30/98	26.31	1363.19	
	02/09/98	24.04	1365.46	2.27 FT RISE

Table A-1. Ground Water Elevations for Monitor Wells in the Pit 7 Complex, measured between July 1, 1995, and June 30, 2003.

Location	Date of Measurement	Depth to Water (ft)	Water Elevation (ft/MSL)	Notes
NC7-17 (continued)				
	02/13/98	23.43	1366.07	
	02/20/98	22.38	1367.12	
	02/27/98	20.90	1368.60	
	03/06/98	21.65	1367.85	
	03/13/98	22.61	1366.89	
	03/20/98	23.22	1366.28	
	03/26/98	23.63	1365.87	
	04/07/98	24.20	1365.30	
	04/16/98	24.61	1364.89	
	05/07/98	24.93	1364.57	
	05/14/98	24.98	1364.52	
	05/22/98	24.83	1364.67	
	06/02/98	24.82	1364.68	
	06/12/98	24.90	1364.60	
	07/07/98	25.35	1364.15	
	07/14/98	25.54	1363.96	
	08/11/98	25.96	1363.54	
	09/01/98	26.17	1363.33	
	10/23/98	26.68	1362.82	
	11/16/98	26.81	1362.69	
	12/01/98	26.95	1362.55	
	01/04/99	27.07	1362.43	
	02/01/99	27.21	1362.29	
	03/09/99	26.49	1363.01	
	04/02/99	26.46	1363.04	
	05/04/99	26.59	1362.91	
	06/01/99	26.62	1362.88	
	07/22/99	27.22	1362.28	
	08/12/99	27.35	1362.15	
	09/13/99			NM
	10/22/99			DATA LOGGER
	12/02/99	28.42	1361.08	
	01/20/00	28.29	1361.21	
	02/23/00	27.91	1361.59	
	03/09/00	27.04	1362.46	
	04/04/00	26.85	1362.65	
	05/01/00	27.54	1361.96	
	06/05/00	28.34	1361.16	
	07/05/00	28.81	1360.69	
	08/01/00	29.12	1360.38	
	09/07/00	29.41	1360.09	
	09/07/00	29.41	1360.09	
	10/02/00	29.40	1360.10	
	11/02/00	29.32	1360.18	
	12/05/00	29.25	1360.25	
	01/08/01	29.33	1360.17	
	02/05/01	29.48	1360.02	
	03/06/01	29.26	1360.24	
	04/03/01	28.80	1360.70	
	05/01/01	29.54	1359.96	
	06/05/01	29.80	1359.70	
	07/12/01	29.66	1359.84	
	08/03/01	29.31	1360.19	
	09/05/01	29.03	1360.47	
	10/03/01	28.98	1360.52	
	11/07/01	29.32	1360.18	
	12/05/01	29.48	1360.02	
	01/11/02	28.38	1361.12	
	02/08/02	27.53	1361.97	
	03/05/02	27.89	1361.61	
	04/03/02	28.94	1360.56	
	05/01/02			NM
	06/02/02	29.76	1359.74	
	07/10/02	30.04	1359.46	
	08/03/02	30.11	1359.39	
NC7-17 (continued)				
	09/01/02	30.19	1359.31	
	10/03/02	30.39	1359.11	
	01/04/03	28.97	1360.53	
	02/01/03	27.63	1361.87	
	03/01/03	27.85	1361.65	
	04/16/03	29.20	1360.30	
NC7-18				
	07/07/95	20.32	1311.94	
	07/21/95	20.58	1311.68	
	07/28/95	20.65	1311.61	
	08/18/95	20.91	1311.35	
	08/25/95	20.96	1311.30	
	09/01/95	21.00	1311.26	
	09/08/95	21.05	1311.21	
	10/04/95	21.23	1311.03	
	11/01/95	21.45	1310.81	
	01/05/96	18.89	1313.37	
	01/26/96	16.59	1315.67	
	02/02/96	12.45	1319.81	
	02/09/96	10.23	1322.03	
	02/16/96	12.00	1320.26	
	02/23/96	9.65	1322.61	
	03/01/96	11.34	1320.92	
	03/18/96	13.56	1318.70	
	03/25/96	15.44	1316.82	
	04/02/96	16.62	1315.64	
	04/11/96	17.35	1314.91	
	04/19/96	17.80	1314.46	
	05/03/96	18.26	1314.00	
	06/04/96	19.03	1313.23	PS
	07/19/96	19.96	1312.30	
	08/08/96	20.12	1312.14	
	09/04/96	20.30	1311.96	
	10/07/96	20.55	1311.71	
	11/06/96	20.82	1311.44	
	11/18/96	20.82	1311.44	
	11/25/96	20.95	1311.31	
	12/05/96	20.91	1311.35	
	01/10/97	13.44	1318.82	
	02/05/97	11.90	1320.36	
	03/04/97	17.46	1314.80	
	04/08/97	18.85	1313.41	
	05/08/97	19.65	1312.61	
	06/03/97	20.10	1312.16	
	07/08/97	20.40	1311.86	
	08/07/97	20.68	1311.58	LID HARD TO
	09/03/97	20.84	1311.42	LID HARD TO
	10/06/97	21.91	1310.35	
	11/04/97	21.20	1311.06	
	12/02/97	21.33	1310.93	
	01/14/98	20.52	1311.74	TRANSDUCER
	01/16/98	19.50	1312.76	Transducer d
	01/23/98	14.65	1317.61	
	01/30/98	14.29	1317.97	
	02/09/98	7.26	1325.00	7.03 FT RISE
	02/13/98	7.36	1324.90	
	02/20/98	7.22	1325.04	
	02/27/98	8.51	1323.75	
	03/06/98	11.16	1321.10	
	03/13/98	13.24	1319.02	
	03/20/98	14.87	1317.39	
	03/26/98	15.83	1316.43	
	04/07/98	16.93	1315.33	

Table A-1. Ground Water Elevations for Monitor Wells in the Pit 7 Complex, measured between July 1, 1995, and June 30, 2003.

Location	Date of Measurement	Depth to Water (ft)	Water Elevation (ft/MSL)	Notes
NC7-18 (continued)				
	04/16/98	17.50	1314.76	
	05/07/98	17.59	1314.67	
	05/14/98	15.60	1316.66	
	05/22/98	15.43	1316.83	
	06/02/98	17.33	1314.93	
	06/12/98	18.03	1314.23	
	07/07/98	18.86	1313.40	
	07/14/98	18.98	1313.28	
	08/11/98	19.51	1312.75	
	09/01/98	19.72	1312.54	
	10/23/98	20.31	1311.95	
	11/16/98	20.51	1311.75	
	12/01/98	20.62	1311.64	
	01/04/99	20.92	1311.34	
	02/01/99	20.92	1311.34	
	03/09/99	16.20	1316.06	
	04/02/99	18.11	1314.15	
	05/04/99	19.04	1313.22	
	06/01/99	20.12	1312.14	
	07/22/99	20.73	1311.53	
	08/12/99	20.81	1311.45	
	09/13/99	20.99	1311.27	
	10/13/99	21.10	1311.16	
	12/02/99	22.67	1309.59	
	01/06/00	21.58	1310.68	
	02/23/00	20.22	1312.04	
	03/09/00	17.24	1315.02	
	04/04/00	18.64	1313.62	
	05/01/00	20.48	1311.78	
	06/02/00	21.35	1310.91	
	07/05/00	21.65	1310.61	
	08/01/00	21.92	1310.34	
	09/07/00	22.10	1310.16	
	09/07/00	22.10	1310.16	
	10/02/00	22.18	1310.08	
	11/02/00	22.33	1309.93	
	12/05/00	22.57	1309.69	
	01/08/01	22.75	1309.51	
	02/05/01	23.20	1309.06	
	03/06/01	23.45	1308.81	
	04/03/01	23.46	1308.80	
	05/01/01	23.76	1308.50	
	06/05/01	24.10	1308.16	
	07/12/01	24.49	1307.77	
	08/03/01	24.48	1307.78	
	09/05/01	24.45	1307.81	
	10/03/01	24.45	1307.81	
	11/07/01	24.52	1307.74	
	12/05/01	24.59	1307.67	
	01/11/02	22.21	1310.05	
	02/04/02	20.43	1311.83	
	03/05/02	21.63	1310.63	
	04/03/02	22.34	1309.92	
	05/01/02			NM
	06/02/02	23.92	1308.34	
	07/10/02	24.19	1308.07	
	08/03/02	24.42	1307.84	
	09/01/02	24.57	1307.69	
	10/03/02	24.60	1307.66	
	01/04/03	21.42	1310.84	
	02/01/03	18.80	1313.46	
	03/10/03	21.30	1310.96	
	04/10/03	22.23	1310.03	

Location	Date of Measurement	Depth to Water (ft)	Water Elevation (ft/MSL)	Notes
NC7-20				
	07/07/95	34.05	1261.34	
	07/21/95	34.34	1261.05	
	07/28/95	34.40	1260.99	
	08/18/95	34.77	1260.62	
	08/25/95	34.85	1260.54	
	09/01/95	34.93	1260.46	
	09/08/95	34.99	1260.40	
	10/04/95	35.32	1260.07	
	11/01/95	35.67	1259.72	
	01/05/96	35.47	1259.92	
	01/26/96	35.27	1260.12	
	02/02/96	33.95	1261.44	
	02/09/96	32.10	1263.29	
	02/16/96	31.84	1263.55	
	02/23/96	31.29	1264.10	
	03/01/96	30.86	1264.53	
	03/18/96	30.05	1265.34	
	03/25/96	29.98	1265.41	
	04/02/96	30.05	1265.34	
	04/11/96	30.11	1265.28	
	04/19/96	30.35	1265.04	
	05/03/96	30.67	1264.72	
	06/04/96	31.33	1264.06	
	07/19/96	32.37	1263.02	
	08/08/96	32.69	1262.70	
	09/05/96	33.18	1262.21	
	10/07/96	33.64	1261.75	
	11/06/96	34.10	1261.29	
	11/18/96	34.05	1261.34	
	11/25/96	34.00	1261.39	
	12/05/96	34.15	1261.24	
	01/10/97	31.55	1263.84	
	02/05/97	30.45	1264.94	
	03/04/97	30.39	1265.00	
	04/08/97	31.14	1264.25	
	05/08/97	31.55	1263.84	
	06/03/97	32.16	1263.23	
	07/11/97	32.78	1262.61	
	08/07/97	33.18	1262.21	
	09/03/97	33.63	1261.76	
	10/06/97	34.09	1261.30	
	11/04/97	34.65	1260.74	
	12/02/97	34.98	1260.41	
	01/14/98	34.99	1260.40	
	01/16/98	34.76	1260.63	
	01/23/98	33.19	1262.20	
	01/30/98	33.00	1262.39	
	02/09/98	31.81	1263.58	1.19 FT RISE
	02/13/98	31.14	1264.25	
	02/20/98	30.35	1265.04	
	02/27/98	29.20	1266.19	
	03/06/98	28.60	1266.79	
	03/13/98	28.52	1266.87	
	03/20/98	28.52	1266.87	
	03/26/98	28.61	1266.78	
	04/07/98	28.69	1266.70	
	04/16/98	28.75	1266.64	
	05/07/98	28.78	1266.61	
	05/14/98	28.80	1266.59	
	05/22/98	28.77	1266.62	
	06/02/98	28.88	1266.51	
	06/12/98	29.00	1266.39	
	07/07/98	29.40	1265.99	
	07/14/98	29.61	1265.78	
	08/11/98	30.18	1265.21	

Table A-1. Ground Water Elevations for Monitor Wells in the Pit 7 Complex, measured between July 1, 1995, and June 30, 2003.

Location	Date of Measurement	Depth to Water (ft)	Water Elevation (ft/MSL)	Notes
NC7-20 (continued)				
	09/01/98	30.71	1264.68	
	10/23/98	32.05	1263.34	
	11/16/98	32.34	1263.05	
	12/01/98	32.86	1262.53	
	01/04/99	33.21	1262.18	
	02/01/99	33.67	1261.72	
	03/09/99	32.57	1262.82	
	04/02/99	33.12	1262.27	
	05/04/99	33.38	1262.01	
	06/01/99	33.73	1261.66	
	07/22/99	34.33	1261.06	
	08/12/99	34.59	1260.80	
	09/13/99	34.88	1260.51	
	10/13/99	35.00	1260.39	
	12/02/99	35.67	1259.72	
	01/07/00	35.58	1259.81	
	02/22/00	35.50	1259.89	
	03/09/00	34.35	1261.04	
	04/04/00	34.32	1261.07	
	05/01/00	35.26	1260.13	
	06/01/00	35.68	1259.71	
	07/03/00	36.10	1259.29	
	08/01/00	36.38	1259.01	
	09/07/00	36.51	1258.88	
	09/07/00	36.51	1258.88	
	10/09/00	36.81	1258.58	
	11/01/00	36.70	1258.69	
	12/04/00	37.01	1258.38	
	01/05/01	37.10	1258.29	
	02/05/01	37.18	1258.21	
	03/07/01	36.94	1258.45	
	04/03/01	36.99	1258.40	
	05/01/01	37.18	1258.21	
	06/01/01	37.20	1258.19	
	07/12/01	37.44	1257.95	
	08/07/01	37.51	1257.88	
	09/05/01	37.55	1257.84	
	10/03/01	37.61	1257.78	
	11/05/01	37.67	1257.72	
	12/04/01	37.63	1257.76	
	01/09/02	37.30	1258.09	
	02/04/02	36.96	1258.43	
	03/05/02	37.31	1258.08	
	04/04/02	37.38	1258.01	
	05/01/02			NM
	06/02/02	37.74	1257.65	
	07/12/02	37.81	1257.58	
	08/06/02	37.86	1257.53	
	09/07/02	37.90	1257.49	
	10/03/02	37.92	1257.47	
	01/04/03	37.80	1257.59	
	02/01/03	37.48	1257.91	
	03/01/03	37.50	1257.89	
	04/10/03	37.65	1257.74	
NC7-21				
	07/07/95	24.35	1279.79	
	07/21/95	24.25	1279.89	
	07/28/95	24.55	1279.59	
	08/18/95	24.85	1279.29	
	08/25/95	24.89	1279.25	
	09/01/95	24.92	1279.22	
	09/08/95	24.95	1279.19	
	10/04/95	25.25	1278.89	
NC7-21 (continued)				
	11/01/95	25.46	1278.68	
	01/05/96	25.41	1278.73	
	01/26/96	25.25	1278.89	
	02/02/96	24.85	1279.29	
	02/09/96	23.92	1280.22	
	02/16/96	23.67	1280.47	
	02/23/96	23.33	1280.81	
	03/01/96	22.79	1281.35	
	03/18/96	21.43	1282.71	
	03/25/96	21.02	1283.12	
	04/02/96	20.73	1283.41	
	04/11/96	20.41	1283.73	
	04/19/96	20.28	1283.86	
	05/03/96	20.03	1284.11	
	06/04/96	20.16	1283.98	
	07/19/96	21.20	1282.94	
	08/08/96	21.58	1282.56	
	09/05/96	22.22	1281.92	
	10/07/96	22.86	1281.28	
	11/06/96	23.42	1280.72	
	11/18/96	23.58	1280.56	
	11/25/96	23.68	1280.46	
	12/05/96	23.61	1280.53	
	01/10/97	22.42	1281.72	
	02/05/97	21.15	1282.99	
	03/04/97	19.98	1284.16	
	04/08/97	19.47	1284.67	
	05/08/97	19.75	1284.39	
	06/03/97	20.46	1283.68	
	07/08/97	21.23	1282.91	
	08/07/97	21.96	1282.18	
	09/03/97	22.74	1281.40	
	10/06/97	23.29	1280.85	
	11/04/97	23.81	1280.33	
	12/02/97	24.21	1279.93	
	01/14/98	24.45	1279.69	
	01/16/98	24.50	1279.64	
	01/23/98	23.80	1280.34	
	01/30/98	23.62	1280.52	
	02/09/98	21.84	1282.30	1.78 FT RISE
	02/13/98	20.89	1283.25	
	02/20/98	19.96	1284.18	
	02/27/98	18.66	1285.48	
	03/06/98	17.71	1286.43	
	03/13/98	17.08	1287.06	
	03/20/98	16.64	1287.50	
	03/26/98	16.48	1287.66	
	04/07/98	16.14	1288.00	
	04/16/98	16.04	1288.10	
	05/07/98	15.80	1288.34	
	05/14/98	15.64	1288.50	
	05/22/98	15.75	1288.39	
	06/02/98	15.95	1288.19	
	06/12/98	16.23	1287.91	
	07/07/98	17.05	1287.09	
	07/14/98	17.41	1286.73	
	08/11/98	18.34	1285.80	
	09/01/98	18.96	1285.18	
	10/23/98	20.64	1283.50	
	11/16/98	21.17	1282.97	
	12/01/98	21.82	1282.32	
	01/04/99	22.98	1281.16	
	02/01/99	23.06	1281.08	
	03/09/99	21.88	1282.26	
	04/02/99	22.28	1281.86	

Table A-1. Ground Water Elevations for Monitor Wells in the Pit 7 Complex, measured between July 1, 1995, and June 30, 2003.

Location	Date of Measurement	Depth to Water (ft)	Water Elevation (ft/MSL)	Notes
NC7-21 (continued)				
	05/04/99	22.83	1281.31	
	06/01/99	22.98	1281.16	
	07/22/99	23.65	1280.49	
	08/12/99	23.89	1280.25	
	09/13/99	24.34	1279.80	
	10/13/99	24.47	1279.67	
	12/02/99	25.19	1278.95	
	01/07/00	24.63	1279.51	
	02/22/00	24.86	1279.28	
	03/09/00	24.11	1280.03	
	04/04/00	24.28	1279.86	
	05/02/00	24.86	1279.28	
	06/05/00	25.48	1278.66	
	07/03/00	25.62	1278.52	
	08/01/00	25.89	1278.25	
	09/07/00	26.01	1278.13	
	09/07/00	26.01	1278.13	
	10/09/00	26.45	1277.69	
	11/01/00	26.42	1277.72	
	12/05/00	26.75	1277.39	
	01/05/01	26.85	1277.29	
	02/05/01	26.97	1277.17	
	03/07/01	26.97	1277.17	
	04/03/01	27.13	1277.01	
	05/01/01	27.21	1276.93	
	06/01/01	27.34	1276.80	
	07/12/01	27.50	1276.64	
	08/07/01	27.59	1276.55	
	09/05/01	28.03	1276.14	3.0 STOVE PI
	10/03/01	28.03	1276.14	
	11/07/01	28.24	1275.93	
	12/05/01	28.32	1275.85	
	01/11/02	27.36	1276.81	
	02/04/02	27.47	1276.70	
	03/05/02	27.84	1276.33	
	04/04/02	28.07	1276.10	
	05/01/02	28.02	1276.15	
	06/01/02	28.35	1275.82	
	07/12/02	28.52	1275.65	
	08/06/02	28.55	1275.62	
	09/07/02	28.63	1275.54	
	10/03/02	28.68	1275.49	
	01/10/03	27.55	1276.62	
	02/01/03	27.60	1276.57	
	03/01/03	27.98	1276.19	
	04/10/03	28.13	1276.04	
NC7-22				
	07/12/95	35.02	1276.95	
	10/04/95	36.08	1275.89	
	01/05/96	36.83	1275.14	
	04/09/96	30.31	1281.66	
	07/19/96	31.11	1280.86	
	10/07/96	32.73	1279.24	
	01/10/97	33.12	1278.85	
	04/08/97	29.64	1282.33	
	07/08/97	31.19	1280.78	
	10/06/97	33.38	1278.59	
	01/14/98	35.72	1276.25	
	04/03/98	27.16	1284.81	
	07/14/98	28.32	1283.65	
	10/23/98	31.03	1280.94	
	01/04/99	32.99	1278.98	
	04/02/99	32.98	1278.99	

Location	Date of Measurement	Depth to Water (ft)	Water Elevation (ft/MSL)	Notes
NC7-22 (continued)				
	07/22/99	34.84	1277.13	
	10/13/99	35.93	1276.04	
	01/07/00	36.73	1275.24	
	04/04/00	35.96	1276.01	
	07/03/00	37.11	1274.86	
	10/09/00			DRY
	01/05/01			DRY
	04/03/01			DRY
	07/12/01			DRY
	10/02/01			DRY
	01/11/02			DRY
	04/04/02			DRY
	07/12/02			DRY
	10/03/02			DRY
	01/04/03			DRY
	04/10/03			DRY
NC7-24				
	07/11/95	35.18	1324.65	
	09/06/95	35.84	1323.99	
	10/03/95	36.05	1323.78	
	11/01/95	36.30	1323.53	
	01/05/96	36.70	1323.13	
	02/02/96	36.52	1323.31	
	03/01/96	35.82	1324.01	
	04/05/96	33.92	1325.91	
	05/02/96	33.63	1326.20	
	06/04/96	33.99	1325.84	
	07/18/96	34.78	1325.05	
	08/08/96	35.06	1324.77	
	09/04/96	35.38	1324.45	
	10/08/96	35.67	1324.16	
	11/06/96	35.95	1323.88	
	12/05/96	36.01	1323.82	
	01/10/97	35.80	1324.03	
	02/05/97	34.45	1325.38	
	03/04/97	33.28	1326.55	
	04/08/97	33.48	1326.35	
	05/08/97	33.85	1325.98	
	06/03/97	34.30	1325.53	
	07/08/97	34.90	1324.93	
	08/07/97	35.33	1324.50	
	09/03/97	35.70	1324.13	
	10/06/97	35.83	1324.00	
	11/04/97	36.07	1323.76	
	12/02/97	36.22	1323.61	
	01/14/98	36.23	1323.60	
	02/06/98	35.64	1324.19	
	03/05/98	31.25	1328.58	
	04/03/98	31.28	1328.55	
	05/06/98	32.49	1327.34	
	06/05/98	32.57	1327.26	
	07/14/98	33.33	1326.50	
	08/11/98	33.80	1326.03	
	09/01/98	33.87	1325.96	
	10/23/98	34.59	1325.24	
	11/16/98	34.72	1325.11	
	12/01/98	34.97	1324.86	
	01/04/99	34.99	1324.84	
	02/01/99	35.27	1324.56	
	03/09/99	33.92	1325.91	
	04/02/99	43.88	1315.95	
	05/04/99	34.26	1325.57	
	06/01/99	34.86	1324.97	

Table A-1. Ground Water Elevations for Monitor Wells in the Pit 7 Complex, measured between July 1, 1995, and June 30, 2003.

Location	Date of Measurement	Depth to Water (ft)	Water Elevation (ft/MSL)	Notes
NC7-24 (continued)				
	07/22/99	36.11	1323.72	
	08/12/99	36.43	1323.40	
	09/12/99			NM
	10/13/99	36.86	1322.97	
	12/02/99	37.56	1322.27	
	01/06/00			DRY
	02/22/00	37.60	1322.23	
	03/09/00	37.04	1322.79	
	04/04/00	36.00	1323.83	
	05/01/00	36.25	1323.58	
	06/01/00	36.85	1322.98	
	07/03/00	37.35	1322.48	
	08/01/00			DRY
	09/07/00			DRY
	09/07/00			DRY
	10/09/00			DRY
	11/01/00			DRY
	12/04/00			DRY
	01/08/01			DRY
	02/05/01			DRY
	03/06/01			DRY
	04/03/01			DRY
	05/01/01			DRY
	06/01/01			DRY
	07/12/01			DRY
	08/03/01			DRY
	09/05/01			DRY
	10/02/01			DRY
	11/05/01			DRY
	12/04/01			DRY
	01/09/02			DRY
	02/04/02			DRY
	03/05/02			DRY
	04/03/02			DRY
	05/01/02			DRY
	06/01/02			DRY
	07/10/02			DRY
	08/03/02			DRY
	09/01/02			DRY
	10/03/02			DRY
	01/04/03			DRY
	02/01/03			DRY
	03/01/03			DRY
	04/10/03			DRY
NC7-25				
	07/07/95	65.42	1301.40	
	07/18/95	65.40	1301.42	PS
	07/18/95	65.40	1301.42	
	07/28/95	65.34	1301.48	
	08/18/95	65.49	1301.33	
	08/25/95	65.50	1301.32	
	09/01/95	65.49	1301.33	
	09/06/95	65.54	1301.28	
	09/08/95	65.50	1301.32	
	10/04/95	65.60	1301.22	
	11/01/95	65.63	1301.19	
	01/04/96	65.76	1301.06	
	01/26/96	65.82	1301.00	
	02/02/96	65.78	1301.04	
	02/09/96	65.71	1301.11	
	02/12/96	65.70	1301.12	
	02/16/96	65.70	1301.12	
	02/23/96	65.66	1301.16	
NC7-25 (continued)				
	03/01/96	65.64	1301.18	
	03/18/96	65.28	1301.54	
	03/25/96	65.22	1301.60	
	04/02/96	65.19	1301.63	
	04/11/96	65.10	1301.72	
	04/19/96	65.10	1301.72	
	04/29/96	65.05	1301.77	PS
	05/03/96	64.86	1301.96	
	06/04/96	64.93	1301.89	
	06/07/96	65.00	1301.82	PS
	06/17/96	65.00	1301.82	PS
	07/19/96	65.06	1301.76	
	07/29/96	65.07	1301.75	PS
	08/08/96	65.00	1301.82	
	09/04/96	65.25	1301.57	
	10/08/96	65.35	1301.47	
	10/24/96	65.50	1301.32	PS
	11/06/96	65.45	1301.37	
	11/18/96	65.41	1301.41	
	11/25/96	65.46	1301.36	
	12/05/96	65.51	1301.31	
	01/10/97	65.51	1301.31	
	02/05/97	65.33	1301.49	
	03/04/97	65.02	1301.80	
	04/08/97	64.85	1301.97	
	05/08/97	64.75	1302.07	
	06/03/97	64.92	1301.90	
	07/08/97	65.15	1301.67	
	08/07/97	65.15	1301.67	
	09/03/97	65.44	1301.38	
	10/06/97	65.44	1301.38	
	11/04/97	65.50	1301.32	
	12/02/97	65.55	1301.27	
	01/14/98	65.60	1301.22	
	01/16/98	65.59	1301.23	
	01/22/98	65.60	1301.22	PS
	01/23/98	65.48	1301.34	
	01/30/98	65.52	1301.30	
	02/09/98	65.57	1301.25	0.03 FT RISE
	02/11/98	65.60	1301.22	PS
	02/13/98	65.41	1301.41	
	02/18/98	65.50	1301.32	PS
	02/20/98	65.26	1301.56	
	02/23/98	65.15	1301.67	PS
	02/27/98	64.94	1301.88	
	03/06/98	64.68	1302.14	
	03/13/98	64.55	1302.27	
	03/20/98	64.48	1302.34	
	03/23/98	64.55	1302.27	PS
	03/26/98	64.41	1302.41	
	04/07/98	64.35	1302.47	
	04/16/98	64.35	1302.47	
	04/28/98	64.35	1302.47	PS
	05/07/98	64.32	1302.50	
	05/14/98	64.35	1302.47	
	05/22/98	64.28	1302.54	
	05/27/98	64.40	1302.42	PS
	06/02/98	64.30	1302.52	
	06/12/98	64.30	1302.52	
	06/25/98	64.43	1302.39	PS
	07/07/98	64.35	1302.47	
	07/14/98	63.46	1303.36	
	07/31/98	64.50	1302.32	PS
	08/11/98	64.58	1302.24	
	08/24/98	64.63	1302.19	PS

Table A-1. Ground Water Elevations for Monitor Wells in the Pit 7 Complex, measured between July 1, 1995, and June 30, 2003.

Location Date of Measurement	Depth to Water (ft)	Water Elevation (ft/MSL)	Notes
NC7-25 (continued)			
09/01/98	64.64	1302.18	
09/23/98	64.90	1301.92	PS
10/23/98	65.16	1301.66	
10/26/98	65.10	1301.72	PS
11/04/98	65.08	1301.74	PS
11/16/98	65.33	1301.49	
11/23/98	65.13	1301.69	PS
12/01/98	65.21	1301.61	
01/04/99	65.34	1301.48	
01/27/99	65.42	1301.40	PS
02/01/99	65.45	1301.37	
03/09/99	65.38	1301.44	
04/02/99	65.32	1301.50	
05/04/99	68.84	1297.98	
05/04/99	65.38	1301.44	PS
06/01/99	65.29	1301.53	
07/14/99	65.55	1301.27	PS
07/22/99	65.49	1301.33	
08/12/99	65.55	1301.27	
09/12/99			NM
10/07/99	65.70	1301.12	PS
10/22/99			DATA LOGGER
12/02/99	65.65	1301.17	
01/06/00	65.72	1301.10	
02/04/00	65.82	1301.00	PS
02/22/00	65.85	1300.97	
03/09/00	65.85	1300.97	
04/04/00	65.57	1301.25	
04/26/00	65.58	1301.24	PS
05/01/00	65.53	1301.29	
06/05/00	65.75	1301.07	
07/05/00	65.76	1301.06	
08/01/00	65.90	1300.92	
08/09/00	65.85	1300.97	PS
09/07/00	66.00	1300.82	
09/07/00	66.00	1300.82	
10/02/00	66.12	1300.70	
11/01/00	66.11	1300.71	PS
11/02/00	66.15	1300.67	
12/05/00	66.23	1300.59	
01/05/01	66.39	1300.43	
01/25/01	66.30	1300.52	PS
02/05/01	66.39	1300.43	
03/07/01	66.37	1300.45	
04/03/01	66.41	1300.41	
04/26/01	66.45	1300.37	PS
05/01/01	66.41	1300.41	
06/01/01	66.33	1300.49	
07/13/01	66.47	1300.35	
07/18/01	66.48	1300.34	ps
08/03/01	66.48	1300.34	
09/05/01	66.50	1300.32	
10/03/01	66.57	1300.25	
10/25/01	66.65	1300.17	PS
11/07/01	66.63	1300.19	
12/05/01	66.64	1300.18	
01/11/02	66.66	1300.16	
01/24/02	66.65	1300.17	PS
02/04/02	66.63	1300.19	
03/05/02	66.25	1300.57	
04/03/02	66.45	1300.37	
04/29/02	66.45	1300.37	PS
05/01/02	66.40	1300.42	
06/02/02	66.46	1300.36	
07/12/02	66.50	1300.32	

Location Date of Measurement	Depth to Water (ft)	Water Elevation (ft/MSL)	Notes
NC7-25 (continued)			
08/06/02	66.57	1300.25	
09/07/02	66.72	1300.10	
09/11/02	66.69	1300.13	PS
10/03/02	66.73	1300.09	
11/27/02	66.79	1300.03	PS
11/29/02	66.83	1299.99	PS
01/04/03	66.95	1299.87	
02/01/03	66.92	1299.90	
02/11/03	66.94	1299.88	PS
03/01/03	66.98	1299.84	
04/16/03	67.09	1299.73	
05/05/03	67.06	1299.76	PS
NC7-26			
07/12/95	69.58	1259.09	
07/17/95	69.60	1259.07	PS
02/08/96	70.40	1258.27	
04/26/96	68.40	1260.27	PS
07/25/96	68.69	1259.98	PS
10/07/96	69.02	1259.65	
10/23/96	69.30	1259.37	PS
01/10/97	69.22	1259.45	
04/08/97	68.38	1260.29	
07/08/97	68.69	1259.98	
10/06/97	69.12	1259.55	
01/14/98	69.78	1258.89	
01/21/98	69.82	1258.85	PS
02/11/98	69.72	1258.95	PS
02/20/98	69.25	1259.42	PS
04/03/98	67.64	1261.03	
04/22/98	67.60	1261.07	PS
06/22/98	67.90	1260.77	PS
06/29/98	67.90	1260.77	PS
07/14/98	67.91	1260.76	
07/27/98	68.00	1260.67	PS
10/20/98	68.58	1260.09	PS
10/23/98	68.70	1259.97	
01/04/99	69.23	1259.44	
01/25/99	69.03	1259.64	PS
03/30/99	69.29	1259.38	PS
04/02/99	68.99	1259.68	
04/07/99	69.22	1259.45	PS
05/04/99	69.32	1259.35	PS
06/16/99	69.51	1259.16	PS
06/28/99	69.40	1259.27	PS
07/14/99	69.55	1259.12	PS
07/22/99	69.38	1259.29	
10/11/99	70.00	1258.67	PS
10/13/99	69.91	1258.76	
01/07/00	70.45	1258.22	
02/16/00	71.63	1257.04	PS
04/04/00	70.06	1258.61	
04/26/00	70.34	1258.33	PS
07/05/00	70.64	1258.03	
08/09/00	64.95	1263.72	PS
10/09/00	70.95	1257.72	
11/02/00	72.01	1256.66	PS
01/05/01	71.16	1257.51	
01/25/01	71.25	1257.42	PS
04/03/01	71.30	1257.37	PS
04/26/01	71.38	1257.29	PS
07/12/01	71.38	1257.29	
07/18/01	71.40	1257.27	ps
08/23/01	71.40	1257.27	ps

Table A-1. Ground Water Elevations for Monitor Wells in the Pit 7 Complex, measured between July 1, 1995, and June 30, 2003.

Location	Date of Measurement	Depth to Water (ft)	Water Elevation (ft/MSL)	Notes
NC7-26 (continued)				
	08/30/01	71.45	1257.22	ps
	10/03/01	71.45	1257.22	
	10/25/01	71.50	1257.17	PS
	01/11/02	71.58	1257.09	
	01/24/02	71.60	1257.07	PS
	04/04/02	71.75	1256.92	
	04/22/02	71.80	1256.87	PS
	07/12/02	71.54	1257.13	
	09/13/02	70.61	1258.06	PS
	10/03/02	71.52	1257.15	
	11/29/02	71.59	1257.08	PS
	01/04/03	71.68	1256.99	
	02/12/03	71.54	1257.13	PS
	04/10/03	71.56	1257.11	
	05/06/03	71.55	1257.12	PS
NC7-34				
	07/07/95	22.53	1341.80	
	07/21/95	22.84	1341.49	
	07/28/95	22.89	1341.44	
	08/18/95	23.11	1341.22	
	08/25/95	23.16	1341.17	
	09/01/95	23.18	1341.15	
	09/08/95	23.17	1341.16	
	10/04/95	23.32	1341.01	
	11/01/95	23.59	1340.74	
	01/05/96	23.23	1341.10	
	01/26/96	22.75	1341.58	
	02/02/96	22.53	1341.80	
	02/09/96	22.17	1342.16	
	02/16/96	21.82	1342.51	
	02/20/96	21.49	1342.84	
	03/01/96	20.84	1343.49	
	03/18/96	19.57	1344.76	
	03/25/96	19.29	1345.04	
	04/02/96	19.34	1344.99	
	04/11/96	19.67	1344.66	
	04/19/96	20.05	1344.28	
	05/03/96	20.64	1343.69	
	06/04/96	21.83	1342.50	PS
	07/19/96	22.71	1341.62	
	08/08/96	22.85	1341.48	
	09/05/96	22.99	1341.34	
	10/08/96	23.09	1341.24	
	11/06/96	23.32	1341.01	
	11/18/96	23.30	1341.03	
	11/25/96	23.33	1341.00	
	12/05/96	23.08	1341.25	
	01/10/97	21.83	1342.50	
	02/05/97	19.09	1345.24	
	03/04/97	19.50	1344.83	
	04/08/97	21.22	1343.11	
	05/08/97	22.08	1342.25	
	06/03/97	22.60	1341.73	
	07/08/97	22.94	1341.39	
	08/07/97	23.12	1341.21	
	09/03/97	23.28	1341.05	
	10/06/97	23.33	1341.00	
	11/04/97	23.61	1340.72	
	12/02/97	23.80	1340.53	
	01/14/98	23.38	1340.95	
	01/16/98	23.35	1340.98	
	01/23/98	23.10	1341.23	
	01/30/98	22.75	1341.58	
NC7-34 (continued)				
	02/09/98	20.23	1344.10	2.52 FT RISE
	02/13/98	18.45	1345.88	
	02/20/98	16.91	1347.42	
	02/27/98	15.66	1348.67	
	03/06/98	15.89	1348.44	
	03/13/98	16.28	1348.05	
	03/20/98	16.76	1347.57	
	03/26/98	17.30	1347.03	
	04/07/98	18.39	1345.94	
	04/16/98	19.13	1345.20	
	05/07/98	20.45	1343.88	
	05/14/98	20.70	1343.63	
	05/22/98	20.95	1343.38	
	06/02/98	21.14	1343.19	
	06/12/98	21.40	1342.93	
	07/07/98	22.05	1342.28	
	07/14/98	22.28	1342.05	
	08/10/98	21.96	1342.37	
	09/01/98	22.97	1341.36	
	10/23/98	23.44	1340.89	
	11/16/98	23.46	1340.87	
	12/01/98	23.55	1340.78	
	01/04/99	23.67	1340.66	
	02/01/99	23.67	1340.66	
	03/09/99	22.58	1341.75	
	04/02/99	22.97	1341.36	
	05/04/99	23.42	1340.91	
	06/01/99	23.72	1340.61	
	07/22/99	24.46	1339.87	
	08/12/99	24.68	1339.65	
	09/12/99			NM
	10/22/99			DATA LOGGER
	12/02/99	26.44	1337.89	
	01/06/00	26.55	1337.78	
	02/23/00	25.70	1338.63	
	03/09/00	24.43	1339.90	
	04/04/00	23.15	1341.18	
	05/02/00	24.21	1340.12	
	06/02/00	25.92	1338.41	
	07/05/00	27.74	1336.59	
	08/01/00	27.92	1336.41	
	09/07/00	28.40	1335.93	
	09/07/00	28.40	1335.93	
	10/02/00	28.71	1335.62	
	11/02/00	28.67	1335.66	
	12/05/00	28.42	1335.91	
	01/08/01	28.31	1336.02	
	02/05/01	28.56	1335.77	
	03/06/01	28.42	1335.91	
	04/03/01	27.20	1337.13	
	05/01/01	27.67	1336.66	
	06/05/01	28.93	1335.40	
	07/12/01	29.80	1334.53	
	08/03/01	29.57	1334.76	
	09/05/01	28.97	1335.36	
	10/03/01	27.91	1336.42	
	11/07/01	26.76	1337.57	
	12/05/01	26.75	1337.58	
	01/11/02	26.09	1338.24	
	02/04/02	24.13	1340.20	
	03/05/02	23.40	1340.93	
	04/10/02	24.37	1339.96	
	05/01/02			NM
	06/02/02	27.05	1337.28	
	07/10/02	29.07	1335.26	

Table A-1. Ground Water Elevations for Monitor Wells in the Pit 7 Complex, measured between July 1, 1995, and June 30, 2003.

Location	Date of Measurement	Depth to Water (ft)	Water Elevation (ft/MSL)	Notes
NC7-34 (continued)				
	08/03/02	30.27	1334.06	
	09/01/02	31.41	1332.92	
	10/03/02	32.21	1332.12	
	01/04/03	32.58	1331.75	
	02/01/03	27.78	1336.55	
	03/01/03	27.79	1336.54	
	04/05/03	25.22	1339.11	
NC7-36				
	07/07/95	20.34	1341.60	
	07/21/95	20.56	1341.38	
	07/28/95	20.60	1341.34	
	08/18/95	20.86	1341.08	
	08/25/95	20.88	1341.06	
	09/01/95	20.90	1341.04	
	09/08/95	20.87	1341.07	
	10/04/95	21.07	1340.87	
	11/01/95	21.30	1340.64	
	01/05/96	21.36	1340.58	
	01/26/96	20.94	1341.00	
	02/02/96	20.30	1341.64	
	02/09/96	18.65	1343.29	
	02/15/96	18.72	1343.22	
	02/23/96	17.97	1343.97	
	03/01/96	17.30	1344.64	
	03/18/96	15.94	1346.00	
	03/25/96	15.97	1345.97	
	04/02/96	16.29	1345.65	
	04/11/96	16.86	1345.08	
	04/19/96	17.40	1344.54	
	05/03/96	18.09	1343.85	
	06/04/96	19.31	1342.63	PS
	07/19/96	20.36	1341.58	
	08/08/96	20.41	1341.53	
	09/05/96	20.56	1341.38	
	10/08/96	20.66	1341.28	
	11/06/96	20.91	1341.03	
	11/18/96	20.96	1340.98	
	11/25/96	20.98	1340.96	
	12/05/96	20.79	1341.15	
	01/10/97	19.47	1342.47	
	02/05/97	15.77	1346.17	
	03/04/97	16.98	1344.96	
	04/08/97	18.88	1343.06	
	05/08/97	19.74	1342.20	
	06/03/97	20.24	1341.70	
	07/08/97	20.50	1341.44	
	08/07/97	20.59	1341.35	
	09/03/97	20.77	1341.17	
	10/06/97	20.76	1341.18	
	11/04/97	20.98	1340.96	
	12/02/97	21.17	1340.77	
	01/14/98	20.93	1341.01	
	01/16/98	20.93	1341.01	
	01/23/98	20.46	1341.48	
	01/30/98	20.23	1341.71	
	02/09/98	17.66	1344.28	2.57 FT RISE
	02/13/98	15.45	1346.49	
	02/20/98	13.39	1348.55	
	02/27/98	12.47	1349.47	
	03/06/98	12.90	1349.04	
	03/13/98	9.52	1352.42	
	03/20/98	14.05	1347.89	
	03/26/98	14.73	1347.21	
NC7-36 (continued)				
	04/07/98	15.92	1346.02	
	04/16/98	16.85	1345.09	
	05/07/98	18.20	1343.74	
	05/14/98	18.35	1343.59	
	05/22/98	18.38	1343.56	
	06/02/98	18.75	1343.19	
	06/12/98	19.06	1342.88	
	07/07/98	19.72	1342.22	
	07/14/98	19.90	1342.04	
	08/10/98	20.26	1341.68	
	09/01/98	20.77	1341.17	
	10/23/98	20.83	1341.11	
	11/16/98			WASPS
	12/01/98	21.07	1340.87	
	01/04/99	21.11	1340.83	
	02/01/99	20.94	1341.00	
	03/09/99	20.20	1341.74	
	04/02/99	20.46	1341.48	
	05/04/99	20.76	1341.18	
	06/01/99	20.84	1341.10	
	07/22/99	21.28	1340.66	
	08/12/99	21.45	1340.49	
	09/12/99			NM
	10/22/99			DATA LOGGER
	12/02/99	22.57	1339.37	
	01/06/00	22.72	1339.22	
	02/23/00	22.28	1339.66	
	03/09/00	21.36	1340.58	
	04/04/00	20.49	1341.45	
	05/02/00	21.09	1340.85	
	06/02/00	22.10	1339.84	
	07/05/00	23.22	1338.72	
	08/01/00	23.71	1338.23	
	09/07/00	24.11	1337.83	
	09/07/00	24.11	1337.83	
	10/02/00	24.34	1337.60	
	11/02/00	24.28	1337.66	
	12/05/00	24.15	1337.79	
	01/08/01	24.34	1337.60	
	02/05/01	24.43	1337.51	
	03/06/01	24.41	1337.53	
	04/03/01	23.87	1338.07	
	05/01/01	24.18	1337.76	
	06/01/01	24.65	1337.29	
	07/12/01	25.13	1336.81	
	08/03/01	24.85	1337.09	
	09/05/01	24.34	1337.60	
	10/03/01	23.84	1338.10	
	11/07/01	23.63	1338.31	
	12/05/01	23.83	1338.11	
	01/11/02	23.22	1338.72	
	02/04/02	21.97	1339.97	
	03/05/02	21.38	1340.56	
	04/04/02	21.75	1340.19	
	05/01/02			NM
	06/02/02	23.78	1338.16	
	07/10/02	24.98	1336.96	
	08/03/02	25.40	1336.54	
	09/01/02	25.78	1336.16	
	10/03/02	26.00	1335.94	
	01/04/03	25.67	1336.27	
	02/01/03	23.43	1338.51	
	03/01/03	22.00	1339.94	
	04/05/03	22.70	1339.24	

Table A-1. Ground Water Elevations for Monitor Wells in the Pit 7 Complex, measured between July 1, 1995, and June 30, 2003.

Location	Date of Measurement	Depth to Water (ft)	Water Elevation (ft/MSL)	Notes
NC7-37				
	07/07/95	18.31	1320.41	
	07/21/95	17.95	1320.77	
	07/28/95	17.97	1320.75	
	08/18/95	18.30	1320.42	
	08/25/95	18.40	1320.32	
	09/01/95	18.50	1320.22	
	09/08/95	18.60	1320.12	
	10/04/95	18.94	1319.78	
	11/01/95	19.14	1319.58	
	01/05/96	20.48	1318.24	
	01/26/96	20.40	1318.32	
	02/02/96	20.06	1318.66	
	02/09/96	19.39	1319.33	
	02/16/96	18.90	1319.82	
	02/20/96	18.53	1320.19	
	03/01/96	17.09	1321.63	
	03/18/96	15.20	1323.52	
	03/25/96	14.49	1324.23	
	04/02/96	14.10	1324.62	
	04/11/96	13.80	1324.92	
	04/19/96	13.70	1325.02	
	05/03/96	13.51	1325.21	
	06/04/96	13.71	1325.01	
	07/18/96	14.86	1323.86	
	08/08/96	15.40	1323.32	
	09/04/96	16.14	1322.58	
	10/08/96	17.07	1321.65	
	11/06/96	17.90	1320.82	
	11/18/96	18.10	1320.62	
	11/25/96	18.34	1320.38	
	12/05/96	18.48	1320.24	
	01/10/97	17.52	1321.20	
	02/05/97	13.19	1325.53	
	03/04/97	12.79	1325.93	
	04/08/97	12.98	1325.74	
	05/08/97	13.63	1325.09	
	06/03/97	14.78	1323.94	
	07/08/97	16.13	1322.59	
	08/07/97	17.26	1321.46	
	09/03/97	18.25	1320.47	
	10/06/97	19.04	1319.68	
	11/04/97	19.61	1319.11	
	12/02/97	20.01	1318.71	
	01/14/98	20.31	1318.41	
	01/16/98	20.26	1318.46	
	01/23/98	19.75	1318.97	
	01/30/98	19.47	1319.25	
	02/09/98	16.03	1322.69	3.44 FT RISE
	02/13/98	13.28	1325.44	
	02/20/98	11.60	1327.12	
	02/27/98	9.92	1328.80	
	03/06/98	9.67	1329.05	
	03/13/98	13.37	1325.35	
	03/20/98	9.44	1329.28	
	03/26/98	9.45	1329.27	
	04/07/98	9.54	1329.18	
	04/16/98	9.67	1329.05	
	05/07/98	9.81	1328.91	
	05/14/98	9.84	1328.88	
	05/22/98	10.05	1328.67	
	06/02/98	10.48	1328.24	
	06/12/98	10.88	1327.84	
	07/07/98	12.05	1326.67	
	07/14/98	12.45	1326.27	
	08/11/98	13.82	1324.90	
NC7-37 (continued)				
	09/01/98	14.86	1323.86	
	10/23/98	17.10	1321.62	
	11/16/98	18.36	1320.36	
	12/01/98	18.55	1320.17	
	01/04/99	19.50	1319.22	
	02/01/99	20.02	1318.70	
	03/09/99	19.10	1319.62	
	04/02/99	18.90	1319.82	
	05/04/99	19.07	1319.65	
	06/01/99	19.63	1319.09	
	07/22/99	20.95	1317.77	
	08/12/99	21.16	1317.56	
	09/13/99	21.62	1317.10	
	10/20/99	22.14	1316.58	
	12/02/99	22.86	1315.86	
	01/06/00	23.28	1315.44	
	02/23/00	23.70	1315.02	
	03/09/00	23.24	1315.48	
	04/04/00	22.53	1316.19	
	05/01/00	22.22	1316.50	
	06/01/00	22.56	1316.16	
	07/03/00	23.55	1315.17	
	08/01/00	24.75	1313.97	
	09/07/00	25.67	1313.05	
	09/07/00	25.67	1313.05	
	10/09/00	26.43	1312.29	
	11/02/00	27.96	1310.76	
	12/04/00	27.46	1311.26	
	01/08/01	27.45	1311.27	
	02/05/01	27.69	1311.03	
	03/06/01	27.57	1311.15	
	04/03/01	27.75	1310.97	
	05/01/01			DRY
	06/05/01			DRY
	07/12/01			DRY
	08/03/01			DRY
	09/05/01			DRY
	10/02/01			DRY
	11/05/01			DRY
	12/04/01			DRY
	01/09/02			DRY
	02/04/02			DRY
	03/05/02			DRY
	04/03/02			DRY
	05/01/02			NM
	06/02/02			DRY
	07/03/02			DRY
	08/06/02			DRY
	09/01/02			DRY
	10/03/02			DRY
	01/04/03			DRY
	02/01/03			DRY
	03/01/03			DRY
	04/10/03			DRY
NC7-40				
	07/07/95	18.12	1301.66	
	07/21/95	18.16	1301.62	
	07/28/95	18.16	1301.62	
	08/18/95	18.18	1301.60	
	08/25/95	18.18	1301.60	
	09/01/95	18.20	1301.58	
	09/08/95	18.20	1301.58	
	10/04/95	18.30	1301.48	

Table A-1. Ground Water Elevations for Monitor Wells in the Pit 7 Complex, measured between July 1, 1995, and June 30, 2003.

Location Date of Measurement	Depth to Water (ft)	Water Elevation (ft/MSL)	Notes
NC7-40 (continued)			
11/01/95	18.50	1301.28	
01/05/96	18.89	1300.89	
01/26/96	18.44	1301.34	
02/02/96	17.55	1302.23	
02/09/96	16.70	1303.08	
02/16/96	16.60	1303.18	
02/20/96	16.26	1303.52	
03/01/96	14.30	1305.48	
03/18/96	12.40	1307.38	
03/25/96	12.15	1307.63	
04/02/96	12.33	1307.45	
04/11/96	12.71	1307.07	
04/19/96	13.05	1306.73	
05/03/96	13.64	1306.14	
06/04/96	14.73	1305.05	
07/18/96	15.72	1304.06	
08/08/96	16.09	1303.69	
09/04/96	16.57	1303.21	
10/07/96	17.11	1302.67	
11/06/96	17.66	1302.12	
11/18/96	17.55	1302.23	
11/25/96	17.79	1301.99	
12/05/96	17.97	1301.81	
01/10/97	16.38	1303.40	
02/05/97	11.75	1308.03	
03/04/97	11.18	1308.60	
04/08/97	12.44	1307.34	
05/08/97	13.46	1306.32	
06/03/97	14.85	1304.93	
07/08/97	16.05	1303.73	
08/07/97	16.86	1302.92	
09/03/97	17.44	1302.34	
10/06/97	18.06	1301.72	
11/04/97	18.54	1301.24	
12/02/97	18.85	1300.93	
01/14/98	18.72	1301.06	
01/16/98	18.35	1301.43	
01/23/98	17.75	1302.03	
01/30/98	17.57	1302.21	
02/09/98	14.53	1305.25	3.04 FT RISE
02/13/98	12.11	1307.67	
02/20/98	7.40	1312.38	
02/27/98	4.46	1315.32	
03/06/98	4.12	1315.66	
03/13/98	4.21	1315.57	
03/20/98	4.67	1315.11	
03/26/98	5.11	1314.67	
04/07/98	5.85	1313.93	
04/16/98	6.51	1313.27	
05/07/98	7.27	1312.51	
05/14/98	7.61	1312.17	
05/22/98	7.93	1311.85	
06/02/98	8.64	1311.14	
06/12/98	9.28	1310.50	
07/07/98	10.73	1309.05	
07/14/98	11.15	1308.63	
08/11/98	12.90	1306.88	
09/01/98	14.25	1305.53	
10/24/98	16.56	1303.22	
11/16/98	17.08	1302.70	
12/01/98	17.35	1302.43	
01/04/99	17.86	1301.92	
02/01/99	18.23	1301.55	
03/09/99	17.53	1302.25	
04/02/99	17.49	1302.29	
NC7-40 (continued)			
05/04/99	17.64	1302.14	
06/01/99	17.83	1301.95	
07/22/99	18.54	1301.24	
08/12/99	18.76	1301.02	
09/12/99			NM
10/13/99	19.52	1300.26	
12/02/99	19.30	1300.48	
01/06/00	20.00	1299.78	
02/23/00	19.55	1300.23	
03/09/00	19.40	1300.38	
04/04/00	19.34	1300.44	
05/01/00	19.81	1299.97	
06/01/00	20.05	1299.73	
07/03/00	20.23	1299.55	
08/01/00	20.63	1299.15	
09/07/00	20.95	1298.83	
09/07/00	20.95	1298.83	
10/02/00	20.94	1298.84	
11/02/00	21.34	1298.44	
12/04/00	21.47	1298.31	
01/08/01	21.75	1298.03	
02/05/01	21.80	1297.98	
03/06/01	21.55	1298.23	
04/03/01	21.92	1297.86	
05/01/01	22.01	1297.77	
06/05/01	22.04	1297.74	
07/12/01	22.26	1297.52	
08/03/01	22.30	1297.48	
09/05/01	22.45	1297.33	
10/02/01	22.52	1297.26	
11/05/01	22.65	1297.13	
12/04/01	22.61	1297.17	
01/09/02	21.22	1298.56	
02/04/02	21.84	1297.94	
03/06/02	21.94	1297.84	
04/03/02	21.93	1297.85	
05/01/02			NM
06/02/02	22.21	1297.57	
07/10/02	22.40	1297.38	
08/06/02	22.51	1297.27	
09/01/02	22.63	1297.15	
10/03/02	22.68	1297.10	
01/04/03	20.93	1298.85	
02/01/03	21.83	1297.95	
03/01/03	22.02	1297.76	
04/10/03	22.44	1297.34	
NC7-47			
07/14/95	63.08	1205.43	
07/18/95	63.00	1205.51	PS
02/13/96	63.30	1205.21	
04/29/96	65.05	1203.46	PS
05/02/96	63.13	1205.38	
06/06/96	63.02	1205.49	
07/18/96	63.06	1205.45	
07/29/96	63.03	1205.48	PS
08/08/96	63.01	1205.50	
09/04/96	63.03	1205.48	
10/08/96	63.00	1205.51	
10/24/96	63.15	1205.36	PS
11/18/96	62.95	1205.56	
12/11/96	63.04	1205.47	
01/13/97	63.02	1205.49	
02/05/97	63.02	1205.49	

Table A-1. Ground Water Elevations for Monitor Wells in the Pit 7 Complex, measured between July 1, 1995, and June 30, 2003.

Location	Date of Measurement	Depth to Water (ft)	Water Elevation (ft/MSL)	Notes
NC7-47 (continued)				
	03/05/97	63.00	1205.51	
	04/16/97	64.12	1204.39	
	05/16/97	62.97	1205.54	
	06/05/97	63.87	1204.64	
	07/10/97	62.91	1205.60	
	08/04/97	62.89	1205.62	
	09/04/97	62.86	1205.65	
	10/07/97	62.87	1205.64	
	11/04/97	62.82	1205.69	
	12/02/97	62.85	1205.66	
	01/16/98	62.76	1205.75	
	01/27/98	62.80	1205.71	PS
	02/09/98	62.83	1205.68	
	03/06/98	62.75	1205.76	
	04/06/98	62.74	1205.77	
	04/29/98	62.72	1205.79	PS
	05/07/98	62.70	1205.81	
	06/05/98	62.58	1205.93	
	07/22/98	62.56	1205.95	
	07/29/98	62.35	1206.16	PS
	08/11/98	62.32	1206.19	
	09/01/98	62.22	1206.29	
	09/14/98	62.15	1206.36	PS
	09/21/98	62.20	1206.31	PS
	10/21/98	62.17	1206.34	PS
	10/23/98	62.21	1206.30	
	11/16/98	62.14	1206.37	
	12/01/98	62.26	1206.25	
	01/04/99	62.29	1206.22	
	01/27/99	62.39	1206.12	PS
	02/01/99	62.38	1206.13	
	02/04/99	62.31	1206.20	PS
	03/09/99			TOO WET
	03/29/99	62.43	1206.08	PS
	04/02/99	62.38	1206.13	
	04/07/99	62.35	1206.16	PS
	05/04/99	62.42	1206.09	
	05/04/99	62.50	1206.01	PS
	06/01/99	62.46	1206.05	
	07/15/99	62.55	1205.96	PS
	07/22/99	62.48	1206.03	
	08/12/99	62.52	1205.99	
	09/12/99			NM
	10/11/99	62.70	1205.81	PS
	10/12/99	62.55	1205.96	
	12/03/99	62.65	1205.86	
	01/20/00	62.38	1206.13	
	01/27/00	62.76	1205.75	PS
	02/18/00	62.74	1205.77	
	03/09/00	62.75	1205.76	
	04/03/00	62.33	1206.18	
	05/01/00	62.65	1205.86	
	05/01/00	62.68	1205.83	PS
	06/05/00	62.79	1205.72	
	07/07/00	62.67	1205.84	
	08/02/00	62.70	1205.81	
	08/09/00	62.72	1205.79	PS
	09/05/00	62.80	1205.71	
	10/02/00	62.72	1205.79	
	11/01/00	62.75	1205.76	
	11/02/00	62.65	1205.86	PS
	12/04/00	62.81	1205.70	
	01/04/01	62.91	1205.60	
	01/25/01	62.70	1205.81	PS
	02/07/01	62.88	1205.63	
NC7-47 (continued)				
	03/07/01	62.77	1205.74	
	04/05/01	62.71	1205.80	
	04/27/01	62.75	1205.76	PS
	05/02/01	62.75	1205.76	
	06/01/01	62.82	1205.69	
	07/13/01	62.64	1205.87	
	07/19/01	62.65	1205.86	ps
	08/02/01	62.76	1205.75	
	09/07/01	62.77	1205.74	
	10/04/01	62.75	1205.76	
	10/29/01	62.75	1205.76	PS
	11/07/01	62.82	1205.69	
	12/05/01	62.78	1205.73	
	01/11/02	62.81	1205.70	
	01/23/02	62.85	1205.66	PS
	02/04/02	62.71	1205.80	
	03/06/02	62.73	1205.78	
	04/11/02	62.47	1206.04	
	04/30/02	62.80	1205.71	PS
	05/01/02			NM
	06/02/02	62.47	1206.04	
	07/19/02	62.85	1205.66	
	08/07/02	62.69	1205.82	
	08/29/02	62.77	1205.74	PS
	09/07/02	62.73	1205.78	
	10/03/02	62.67	1205.84	
	12/03/02	62.71	1205.80	ps
	01/08/03	62.76	1205.75	
	02/01/03	62.80	1205.71	
	02/12/03	62.77	1205.74	PS
	03/01/03	62.80	1205.71	
	04/12/03	62.81	1205.70	
	05/06/03	62.75	1205.76	PS
NC7-48				
	07/07/95	45.11	1348.29	BS
	07/19/95	45.30	1348.10	PS
	07/21/95	45.60	1347.80	BS
	07/25/95	45.35	1348.05	PS
	07/28/95	45.40	1348.00	BS
	08/18/95	45.49	1347.91	BS
	08/25/95	45.53	1347.87	BS
	09/01/95	45.55	1347.85	
	09/08/95	45.60	1347.80	
	10/04/95	45.65	1347.75	
	11/01/95	45.76	1347.64	
	01/05/96	43.89	1349.51	
	01/26/96	44.14	1349.26	
	02/02/96	43.28	1350.12	
	02/09/96	42.04	1351.36	
	02/15/96	41.40	1352.00	
	02/15/96	41.40	1352.00	
	02/23/96	40.90	1352.50	
	03/01/96	40.05	1353.35	
	03/18/96	39.65	1353.75	
	03/25/96	39.84	1353.56	
	04/02/96	40.35	1353.05	
	04/11/96	41.05	1352.35	
	04/19/96	41.70	1351.70	
	04/30/96	42.50	1350.90	PS
	05/03/96	42.71	1350.69	
	06/04/96	43.88	1349.52	
	07/19/96	44.55	1348.85	
	07/30/96	44.65	1348.75	PS

Table A-1. Ground Water Elevations for Monitor Wells in the Pit 7 Complex, measured between July 1, 1995, and June 30, 2003.

Location Date of Measurement	Depth to Water (ft)	Water Elevation (ft/MSL)	Notes
NC7-48 (continued)			
08/08/96	44.67	1348.73	
09/05/96	44.81	1348.59	
10/08/96	44.99	1348.41	
10/25/96	45.20	1348.20	PS
11/06/96	45.14	1348.26	
11/18/96	45.09	1348.31	
11/25/96	44.67	1348.73	
12/05/96	44.39	1349.01	
01/10/97	41.42	1351.98	
02/05/97	38.92	1354.48	
03/04/97	40.50	1352.90	
04/08/97	43.10	1350.30	
05/08/97	43.85	1349.55	
06/03/97	44.41	1348.99	
07/08/97	44.80	1348.60	
08/07/97	45.09	1348.31	
09/03/97	45.10	1348.30	
10/06/97	45.15	1348.25	
11/04/97	45.40	1348.00	
12/02/97	45.30	1348.10	
01/14/98	44.54	1348.86	
01/16/98	44.39	1349.01	
01/22/98	43.40	1350.00	PS
01/22/98	44.01	1349.39	
01/30/98	42.42	1350.98	
02/09/98	40.86	1352.54	1.56 FT RISE
02/13/98	38.28	1355.12	
02/20/98	36.43	1356.97	
02/23/98	35.90	1357.50	PS
02/27/98	35.21	1358.19	
03/06/98	35.35	1358.05	
03/13/98	36.25	1357.15	
03/20/98	37.45	1355.95	
03/23/98	38.00	1355.40	PS
03/26/98	38.40	1355.00	
04/07/98	39.54	1353.86	
04/16/98	40.10	1353.30	
04/28/98	40.80	1352.60	PS
05/07/98	41.08	1352.32	
05/14/98	40.33	1353.07	
05/22/98	40.22	1353.18	
05/27/98	40.50	1352.90	PS
06/02/98	40.65	1352.75	
06/12/98	41.11	1352.29	
06/25/98	41.93	1351.47	PS
07/07/98	42.42	1350.98	
07/14/98	42.80	1350.60	
07/31/98	43.34	1350.06	PS
08/11/98	43.78	1349.62	
08/24/98	44.00	1349.40	PS
09/01/98	44.17	1349.23	
09/23/98	44.45	1348.95	PS
10/23/98	44.44	1348.96	
10/26/98	44.40	1349.00	PS
11/04/98	44.43	1348.97	PS
11/16/98	44.46	1348.94	
11/23/98	44.44	1348.96	PS
12/01/98	44.46	1348.94	
01/04/99	44.52	1348.88	
01/28/99	43.69	1349.71	PS
02/01/99	43.47	1349.93	
03/09/99	42.02	1351.38	
04/02/99	43.51	1349.89	
05/04/99	44.70	1348.70	PS
05/04/99	44.68	1348.72	

Location Date of Measurement	Depth to Water (ft)	Water Elevation (ft/MSL)	Notes
NC7-48 (continued)			
06/01/99	44.94	1348.46	
07/19/99	45.88	1347.52	PS
07/22/99	45.90	1347.50	
08/12/99	45.91	1347.49	
09/12/99			NM
10/12/99	36.37	1357.03	PS
10/22/99			DATA LOGGER
12/02/99	46.17	1347.23	
01/07/00	45.88	1347.52	
01/20/00	45.95	1347.45	PS
02/23/00	43.95	1349.45	
03/09/00	42.86	1350.54	
04/04/00	43.84	1349.56	
05/01/00	45.51	1347.89	PS
05/01/00	45.44	1347.96	
06/05/00	46.62	1346.78	
07/05/00	47.17	1346.23	
08/01/00	47.22	1346.18	
08/10/00	47.29	1346.11	PS
08/18/00	47.29	1346.11	PS
09/07/00	47.39	1346.01	
09/07/00	47.39	1346.01	
10/02/00	47.23	1346.17	
11/02/00	47.18	1346.22	PS
11/02/00	47.43	1345.97	
12/05/00	46.89	1346.51	
01/08/01	46.80	1346.60	
01/25/01	46.60	1346.80	PS
02/05/01	46.62	1346.78	
03/06/01	46.14	1347.26	
04/03/01	45.68	1347.72	
04/26/01	45.97	1347.43	PS
05/01/01	46.73	1346.67	
06/05/01	47.47	1345.93	
07/12/01	47.57	1345.83	
07/18/01	47.60	1345.80	ps
08/03/01	47.02	1346.38	
09/05/01	46.61	1346.79	
10/03/01	46.33	1347.07	
10/25/01	46.40	1347.00	PS
11/07/01	46.39	1347.01	
12/05/01	46.49	1346.91	
01/11/02	44.19	1349.21	
01/23/02	44.23	1349.17	PS
02/08/02	44.95	1348.45	
03/05/02	45.70	1347.70	
04/04/02	46.19	1347.21	
04/30/02	46.80	1346.60	PS
05/01/02			NM
06/02/02	47.25	1346.15	
07/10/02	47.61	1345.79	
08/03/02	47.76	1345.64	
09/01/02	47.91	1345.49	
09/12/02	47.95	1345.45	PS
10/03/02	48.00	1345.40	
11/29/02	47.94	1345.46	PS
01/04/03	44.69	1348.71	
02/01/03	44.50	1348.90	
02/11/03	45.04	1348.36	PS
03/01/03	45.70	1347.70	
04/05/03	47.42	1345.98	
05/06/03	47.06	1346.34	PS

Table A-1. Ground Water Elevations for Monitor Wells in the Pit 7 Complex, measured between July 1, 1995, and June 30, 2003.

Location	Date of Measurement	Depth to Water (ft)	Water Elevation (ft/MSL)	Notes
NC7-49A				
	07/07/95	29.97	1363.75	
	07/21/95	30.20	1363.52	
	07/28/95	30.24	1363.48	
	08/18/95	30.51	1363.21	
	08/25/95	30.52	1363.20	
	09/01/95	30.55	1363.17	
	09/08/95	30.55	1363.17	
	10/03/95	30.58	1363.14	
	11/01/95	30.70	1363.02	
	01/05/96	28.16	1365.56	
	01/26/96	27.70	1366.02	
	02/02/96	26.42	1367.30	
	02/09/96	26.13	1367.59	
	02/16/96	27.06	1366.66	
	02/23/96	26.15	1367.57	
	03/01/96	26.34	1367.38	
	03/18/96	26.50	1367.22	
	03/25/96	27.03	1366.69	
	04/02/96	27.39	1366.33	
	04/11/96	27.61	1366.11	
	04/19/96	27.85	1365.87	
	05/03/96	28.21	1365.51	
	06/04/96	28.56	1365.16	
	07/19/96	29.21	1364.51	
	08/08/96	29.32	1364.40	
	09/05/96	29.41	1364.32	
	10/08/96	29.35	1364.38	
	11/06/96	29.30	1364.43	
	11/18/96	29.00	1364.73	
	11/25/96	28.15	1365.58	
	12/05/96	28.54	1365.19	
	01/10/97	26.80	1366.93	
	02/05/97	25.75	1367.98	
	03/04/97	27.58	1366.15	
	04/10/97	28.45	1365.28	
	05/10/97	28.62	1365.11	
	06/03/97	29.04	1364.69	
	07/08/97	29.49	1364.24	
	08/07/97	29.78	1363.95	
	09/03/97	29.78	1363.95	
	10/06/97	29.68	1364.05	
	11/04/97	29.77	1363.96	
	12/02/97	28.63	1365.10	
	01/14/98	28.16	1365.57	
	01/16/98	27.63	1366.01	
	01/23/98	26.44	1367.29	
	01/30/98	27.43	1366.30	
	02/09/98	22.88	1370.85	4.55 FT RISE
	02/13/98	22.89	1370.84	
	02/20/98	23.39	1370.34	
	02/27/98	23.20	1370.53	
	03/06/98	25.30	1368.43	
	03/13/98	26.30	1367.43	
	03/20/98	26.90	1366.83	
	03/26/98	27.12	1366.61	
	04/07/98	27.46	1366.27	
	04/16/98	27.62	1366.11	
	05/07/98	26.95	1366.78	
	05/14/98	26.79	1366.94	
	05/22/98	27.32	1366.41	
	06/02/98	27.51	1366.22	
	06/12/98	27.74	1365.99	
	07/07/98	28.25	1365.48	
	07/22/98	28.68	1365.05	
	08/11/98	28.98	1364.75	
NC7-49A (continued)				
	09/01/98	29.13	1364.60	
	10/23/98	28.62	1365.11	
	11/16/98	28.42	1365.31	
	12/01/98	28.42	1365.31	
	01/04/99	28.83	1364.90	
	02/01/99	27.67	1366.06	
	03/09/99	28.22	1365.51	
	04/02/99	28.55	1365.18	
	05/04/99	29.13	1364.60	
	06/01/99	29.69	1364.04	
	07/22/99	31.20	1362.53	
	08/12/99	31.38	1362.35	
	09/12/99			NM
	10/22/99			DATA LOGGER
	12/03/99	31.31	1362.42	
	01/20/00	30.66	1363.07	
	02/23/00	27.33	1366.40	
	03/09/00	27.97	1365.76	
	04/04/00	29.57	1364.16	
	05/01/00	31.06	1362.67	
	06/05/00	32.31	1361.42	
	07/05/00	32.74	1360.99	
	08/01/00	32.77	1360.96	
	09/07/00	32.92	1360.81	
	09/07/00	32.92	1360.81	
	10/02/00	32.65	1361.08	
	11/02/00	32.32	1361.41	
	12/05/00	31.85	1361.88	
	01/08/01	31.96	1361.77	
	02/05/01	31.04	1362.69	
	03/06/01	29.92	1363.81	
	04/03/01	31.11	1362.62	
	05/01/01	32.40	1361.33	
	06/01/01	33.02	1360.71	
	07/12/01	33.11	1360.62	
	08/03/01	32.12	1361.61	
	09/05/01	31.87	1361.86	
	10/03/01	31.72	1362.01	
	11/07/01	32.04	1361.69	
	12/05/01	31.65	1362.08	
	01/11/02	27.69	1366.04	
	02/04/02	29.73	1364.00	
	03/05/02	31.26	1362.47	
	04/11/02	31.32	1362.41	
	05/01/02			NM
	06/02/02	32.93	1360.80	
	07/10/02	33.36	1360.37	
	08/03/02	33.51	1360.22	
	09/01/02	33.69	1360.04	
	10/04/02	33.53	1360.20	
	01/11/03	27.97	1365.76	
	02/01/03	29.55	1364.18	
	03/10/03	31.65	1362.08	
	04/16/03	31.67	1362.06	
NC7-50				
	10/04/95			DRY
	01/08/96			DRY
	04/09/96			DRY
	07/18/96			DRY
	10/08/96			DRY
	01/13/97			DRY
	04/10/97			DRY
	07/10/97			DRY

Table A-1. Ground Water Elevations for Monitor Wells in the Pit 7 Complex, measured between July 1, 1995, and June 30, 2003.

Location Date of Measurement	Depth to Water (ft)	Water Elevation (ft/MSL)	Notes
NC7-50 (continued)			
10/07/97			DRY
01/16/98			DRY
04/06/98	87.72	1112.00	
07/22/98	75.47	1124.25	
10/23/98	71.86	1127.86	
01/04/99	71.96	1127.76	
04/02/99	70.96	1128.76	
07/22/99	69.53	1130.19	
10/12/99	69.00	1130.72	
01/10/00	69.15	1130.57	
04/03/00	69.39	1130.33	
07/07/00	70.00	1129.72	
10/02/00	69.90	1129.82	
01/04/01	70.91	1128.81	
04/10/01	70.75	1128.97	
07/13/01	71.35	1128.37	
10/04/01	71.71	1128.01	
01/02/02	72.29	1127.43	
04/11/02	72.58	1127.14	
07/19/02	71.97	1127.75	
10/03/02	72.06	1127.66	
01/08/03	72.27	1127.45	
04/12/03	72.67	1127.05	
NC7-51			
07/07/95	26.17	1321.96	
07/21/95	26.33	1321.80	
07/28/95	26.35	1321.78	
08/18/95	26.75	1321.38	
08/25/95	26.82	1321.31	
09/01/95	26.88	1321.25	
09/08/95	26.95	1321.18	
10/04/95	27.22	1320.91	
11/01/95	27.70	1320.43	
01/05/96	28.50	1319.63	
01/26/96	28.35	1319.78	
02/02/96	27.70	1320.43	
02/09/96	26.60	1321.53	
02/16/96	26.78	1321.35	
02/23/96	26.31	1321.82	
03/01/96	25.93	1322.20	
03/18/96	25.05	1323.08	
03/25/96	24.88	1323.25	
04/02/96	24.65	1323.48	
04/11/96	24.27	1323.86	
04/19/96	24.08	1324.05	
05/03/96	23.65	1324.48	
06/04/96	23.62	1324.51	
07/18/96	24.67	1323.46	
08/08/96	25.05	1323.08	
09/04/96	25.61	1322.52	
10/08/96	26.21	1321.92	
11/08/96	26.72	1321.41	
11/18/96	26.91	1321.22	
11/25/96	27.10	1321.03	
12/05/96	27.03	1321.10	
01/10/97	25.85	1322.28	
02/05/97	24.24	1323.89	
03/04/97	23.12	1325.01	
04/08/97	22.64	1325.49	
05/08/97	23.15	1324.98	
06/03/97	24.05	1324.08	
07/08/97	25.09	1323.04	
08/07/97	25.61	1322.52	

Location Date of Measurement	Depth to Water (ft)	Water Elevation (ft/MSL)	Notes
NC7-51 (continued)			
09/03/97	26.72	1321.41	
10/06/97	27.00	1321.13	
11/04/97	27.43	1320.70	
12/02/97	27.76	1320.37	
01/14/98	27.99	1320.14	
01/16/98	27.95	1320.18	
01/23/98	27.03	1321.10	
01/30/98	26.96	1321.17	
02/09/98	24.63	1323.50	2.33 FT RISE
02/13/98	23.76	1324.37	
02/20/98	22.92	1325.21	
02/27/98	21.54	1326.59	
03/06/98	20.55	1327.58	
03/13/98	19.28	1328.85	
03/20/98	18.43	1329.70	
03/26/98	17.81	1330.32	
04/07/98	17.11	1331.02	
04/16/98	17.20	1330.93	
05/07/98	18.10	1330.03	
05/14/98	18.20	1329.93	
05/22/98	18.59	1329.54	
06/02/98	19.25	1328.88	
06/12/98	19.80	1328.33	
07/07/98	21.17	1326.96	
07/14/98	21.61	1326.52	
08/11/98	22.91	1325.22	
09/01/98	23.73	1324.40	
10/24/98	25.53	1322.60	
11/16/98	25.94	1322.19	
12/01/98	26.46	1321.67	
01/04/99	26.96	1321.17	
02/01/99	27.15	1320.98	
03/09/99	26.28	1321.85	
04/02/99	26.12	1322.01	
05/04/99	26.39	1321.74	
06/01/99	26.85	1321.28	
07/22/99	27.28	1320.85	
08/12/99	28.26	1319.87	
09/12/99			NM
10/22/99			DATA LOGGER
12/02/99	29.92	1318.21	
01/07/00	30.05	1318.08	
02/23/00	30.20	1317.93	
03/08/00	28.97	1319.16	
04/04/00	28.84	1319.29	
05/01/00	28.81	1319.32	
06/01/00	29.16	1318.97	
07/03/00	30.02	1318.11	
08/01/00	30.83	1317.30	
09/07/00	31.37	1316.76	
09/07/00	31.37	1316.76	
10/02/00	31.52	1316.61	
11/02/00	32.03	1316.10	
12/04/00	32.53	1315.60	
01/08/01	32.71	1315.42	
02/05/01	33.05	1315.08	
03/06/01	32.99	1315.14	
04/03/01	33.39	1314.74	
05/01/01	33.18	1314.95	
06/05/01	33.33	1314.80	
07/12/01	33.67	1314.46	
08/07/01	33.87	1314.26	
09/05/01	34.19	1313.94	
10/02/01	34.23	1313.90	
11/05/01	34.39	1313.74	

Table A-1. Ground Water Elevations for Monitor Wells in the Pit 7 Complex, measured between July 1, 1995, and June 30, 2003.

Location	Date of Measurement	Depth to Water (ft)	Water Elevation (ft/MSL)	Notes
NC7-51 (continued)				
	12/04/01	34.47	1313.66	
	01/09/02	34.27	1313.86	
	02/08/02	34.16	1313.97	
	03/05/02	33.36	1314.77	
	04/03/02	32.26	1315.87	
	05/01/02	32.00	1316.13	
	06/02/02	32.04	1316.09	
	07/12/02	32.47	1315.66	
	08/06/02	33.22	1314.91	
	09/01/02	33.85	1314.28	
	10/03/02	34.40	1313.73	
	01/04/03	35.29	1312.84	
	02/01/03	34.25	1313.88	
	03/01/03	35.02	1313.11	
	04/10/03	35.56	1312.57	
NC7-52				
	07/11/95	76.05	1292.30	
	10/04/95	75.98	1292.37	
	01/04/96	76.05	1292.30	
	04/09/96	75.69	1292.66	
	07/19/96	75.57	1292.78	
	10/08/96	75.74	1292.61	
	01/10/97	75.54	1292.81	
	04/08/97	74.75	1293.60	
	07/08/97	75.24	1293.11	
	10/06/97	75.37	1292.98	
	01/14/98	75.64	1292.71	
	04/03/98	73.72	1294.63	
	07/14/98	74.41	1293.94	
	10/23/98	74.87	1293.48	
	01/04/99	75.22	1293.13	
	03/09/99	74.68	1293.67	
	04/02/99	74.71	1293.64	
	05/04/99	74.87	1293.48	
	06/01/99	74.81	1293.54	
	07/22/99	74.97	1293.38	
	08/12/99	75.16	1293.19	
	09/12/99			NM
	10/13/99	75.02	1293.33	
	12/02/99	75.00	1293.35	
	01/07/00	74.99	1293.36	
	02/22/00	75.28	1293.07	
	03/09/00	75.22	1293.13	
	04/04/00	74.83	1293.52	
	05/01/00	74.78	1293.57	
	06/05/00	75.01	1293.34	
	07/05/00	75.09	1293.26	
	08/01/00	75.32	1293.03	
	09/07/00	75.24	1293.11	
	09/07/00	75.24	1293.11	
	10/09/00	75.35	1293.00	
	11/02/00	75.44	1292.91	
	12/05/00	75.40	1292.95	
	01/05/01	75.23	1293.12	
	02/05/01	75.41	1292.94	
	03/06/01	75.38	1292.97	
	04/03/01	75.40	1292.95	
	05/01/01	75.34	1293.01	
	06/01/01	75.47	1292.88	
	07/12/01	75.43	1292.92	
	08/03/01	75.38	1292.97	
	09/05/01	75.34	1293.01	
	10/03/01	75.16	1293.19	
NC7-52 (continued)				
	11/07/01	75.32	1293.03	
	12/05/01	75.51	1292.84	
	01/11/02	75.38	1292.97	
	02/04/02	75.38	1292.97	
	03/05/02	75.32	1293.03	
	04/03/02	75.29	1293.06	
	05/01/02	75.28	1293.07	
	06/02/02	75.27	1293.08	
	07/12/02	75.14	1293.21	
	08/06/02	75.17	1293.18	
	09/07/02	75.13	1293.22	
	10/03/02	75.27	1293.08	
	01/04/03	75.22	1293.13	
	02/01/03	75.02	1293.33	
	03/01/03	75.12	1293.23	
	04/10/03	75.04	1293.31	
NC7-52A				
	07/11/95	77.31	1291.85	
	10/04/95	77.29	1291.87	
	01/04/96	77.24	1291.92	
	04/09/96	76.78	1292.38	
	07/19/96	76.57	1292.59	
	10/08/96	76.76	1292.40	
	01/10/97	76.59	1292.57	
	04/08/97	75.78	1293.38	
	07/08/97	76.16	1293.00	
	10/06/97	76.29	1292.87	
	01/14/98	76.54	1292.62	
	04/03/98	74.93	1294.23	
	07/14/98	75.28	1293.88	
	10/23/98	75.77	1293.39	
	01/04/99	75.87	1293.29	
	04/02/99	75.54	1293.62	
	07/22/99	75.81	1293.35	
	10/13/99	75.77	1293.39	
	01/07/00	75.83	1293.33	
	04/04/00	75.49	1293.67	
	07/05/00	76.21	1292.95	
	10/09/00	76.40	1292.76	
	01/05/01	76.23	1292.93	
	04/03/01	76.33	1292.83	
	07/13/01	76.37	1292.79	
	10/03/01	76.14	1293.02	
	01/11/02	76.36	1292.80	
	02/04/02	74.04	1295.12	
	04/03/02	76.26	1292.90	
	07/12/02	76.04	1293.12	
	10/03/02	76.23	1292.93	
	01/04/03	76.20	1292.96	
	04/10/03	76.05	1293.11	
NC7-52B				
	07/11/95	75.12	1291.85	
	10/04/95	75.12	1291.85	
	01/04/96	75.08	1291.89	
	04/09/96	74.62	1292.35	
	07/19/96	74.41	1292.56	
	10/08/96	74.58	1292.39	
	01/10/97	74.32	1292.65	
	04/08/97	73.58	1293.39	
	07/08/97	74.01	1292.96	
	10/06/97	74.06	1292.91	

Table A-1. Ground Water Elevations for Monitor Wells in the Pit 7 Complex, measured between July 1, 1995, and June 30, 2003.

Location	Date of Measurement	Depth to Water (ft)	Water Elevation (ft/MSL)	Notes
NC7-52B (continued)				
	01/14/98	74.31	1292.66	
	04/03/98	72.53	1294.44	
	07/14/98	73.17	1293.80	
	10/23/98	73.58	1293.39	
	01/04/99	73.89	1293.08	
	04/02/99	73.37	1293.60	
	07/22/99	73.71	1293.26	
	10/13/99	73.49	1293.48	
	01/07/00	73.63	1293.34	
	04/04/00	73.22	1293.75	
	07/05/00	73.82	1293.15	
	10/09/00	73.96	1293.01	
	01/05/01	74.02	1292.95	
	04/03/01	74.03	1292.94	
	07/13/01	74.11	1292.86	
	10/03/01	73.94	1293.03	
	01/11/02	74.09	1292.88	
	02/04/02	76.32	1290.65	
	04/03/02	74.04	1292.93	
	07/12/02	73.75	1293.22	
	10/03/02	74.00	1292.97	
	01/04/03	73.95	1293.02	
	04/10/03	73.77	1293.20	
NC7-53				
	07/07/95	31.38	1391.94	
	07/21/95	31.58	1391.74	
	07/28/95	31.60	1391.72	
	08/18/95	31.75	1391.57	
	08/25/95	31.80	1391.52	
	09/01/95	31.80	1391.52	
	09/08/95	31.80	1391.52	
	10/04/95	31.93	1391.39	
	11/01/95	32.05	1391.27	
	01/05/96	31.31	1392.01	
	01/26/96	30.97	1392.35	
	02/02/96	29.40	1393.92	
	02/09/96	26.97	1396.35	
	02/16/96	27.15	1396.17	
	02/23/96	25.66	1397.66	
	03/01/96	25.53	1397.79	
	03/18/96	26.55	1396.77	
	03/25/96	27.43	1395.89	
	04/02/96	28.29	1395.03	
	04/11/96	28.95	1394.37	
	04/19/96	29.35	1393.97	
	05/03/96	29.82	1393.50	
	06/04/96	30.48	1392.84	PS
	07/19/96	30.99	1392.33	
	08/08/96	31.13	1392.19	
	09/05/96	31.33	1391.99	
	10/08/96	31.55	1391.77	
	11/06/96	31.70	1391.62	
	11/18/96	31.55	1391.77	
	11/25/96	31.55	1391.77	
	12/05/96	31.57	1391.75	
	01/10/97	27.86	1395.46	
	02/05/97	26.08	1397.24	
	03/04/97	28.83	1394.49	
	04/08/97	29.88	1393.44	
	05/08/97	30.36	1392.96	
	06/03/97	30.80	1392.52	
	07/08/97	31.10	1392.22	
	08/07/97	31.26	1392.06	
NC7-53 (continued)				
	09/03/97	31.45	1391.87	
	10/06/97	31.57	1391.75	
	11/04/97	31.74	1391.58	
	12/02/97	31.80	1391.52	
	01/14/98	31.37	1391.95	TRANSDUCER
	01/16/98	31.19	1392.13	Transducer d
	01/23/98	29.88	1393.44	
	01/30/98	29.70	1393.62	
	02/09/98	24.60	1398.72	5.1 FT RISE.
	02/13/98	24.18	1399.14	
	02/20/98	24.13	1399.19	
	02/27/98	23.74	1399.58	
	03/06/98	25.88	1397.44	
	03/13/98	26.89	1396.43	
	03/20/98	27.60	1395.72	
	03/26/98	28.05	1395.27	
	04/07/98	28.79	1394.53	
	04/16/98	29.14	1394.18	
	05/07/98	29.56	1393.76	
	05/14/98	29.14	1394.18	
	05/22/98	29.33	1393.99	
	06/02/98	29.60	1393.72	
	06/12/98	29.80	1393.52	
	07/07/98	30.28	1393.04	
	07/14/98	30.44	1392.88	
	08/11/98	30.80	1392.52	
	09/01/98	30.98	1392.34	
	10/23/98	31.34	1391.98	
	11/16/98	31.42	1391.90	
	12/01/98	31.82	1391.50	
	01/04/99	31.67	1391.65	
	02/01/99	31.58	1391.74	
	03/09/99	30.63	1392.69	
	04/02/99	31.04	1392.28	
	05/04/99	31.20	1392.12	
	06/01/99	31.34	1391.98	
	07/22/99	31.84	1391.48	
	08/12/99	31.90	1391.42	
	09/12/99			NM
	10/13/99	32.14	1391.18	
	12/02/99	32.40	1390.92	
	01/06/00	32.29	1391.03	
	02/22/00	31.86	1391.46	
	03/09/00	31.20	1392.12	
	04/04/00	31.64	1391.68	
	05/01/00	32.09	1391.23	
	06/05/00	32.43	1390.89	
	07/05/00	32.50	1390.82	
	08/01/00	32.78	1390.54	
	09/07/00	32.69	1390.63	
	09/07/00	32.69	1390.63	
	10/02/00	33.29	1390.03	
	11/02/00	32.91	1390.41	
	12/05/00	32.79	1390.53	
	01/08/01	32.74	1390.58	
	02/05/01	32.82	1390.50	
	03/06/01	32.76	1390.56	
	04/03/01	32.78	1390.54	
	05/01/01	32.89	1390.43	
	06/01/01	32.98	1390.34	
	07/12/01	32.70	1390.62	
	08/03/01	32.58	1390.74	
	09/05/01	32.71	1390.61	
	10/03/01	32.54	1390.78	
	11/07/01	32.56	1390.76	

Table A-1. Ground Water Elevations for Monitor Wells in the Pit 7 Complex, measured between July 1, 1995, and June 30, 2003.

Location Date of Measurement	Depth to Water (ft)	Water Elevation (ft/MSL)	Notes
NC7-53 (continued)			
12/05/01	32.71	1390.61	
01/11/02	31.68	1391.64	
02/08/02	32.11	1391.21	
03/04/02	32.32	1391.00	
04/04/02	32.47	1390.85	
05/01/02			NM
06/01/02	32.79	1390.53	
07/03/02	33.04	1390.28	
08/03/02	33.22	1390.10	
09/01/02	33.35	1389.97	
10/03/02	33.37	1389.95	
01/11/03	30.80	1392.52	
02/01/03	31.60	1391.72	
03/01/03	32.30	1391.02	
04/05/03	35.68	1387.64	
NC7-53A			
07/11/95	31.89	1391.15	
10/04/95	32.29	1390.75	
01/05/96	31.64	1391.40	
04/09/96	29.62	1393.42	
07/19/96	31.42	1391.62	
10/08/96	31.82	1391.22	
01/10/97	28.74	1394.30	
04/08/97	30.47	1392.57	
07/08/97	31.50	1391.54	
10/06/97	31.89	1391.15	
01/14/98	31.62	1391.42	
04/03/98	29.23	1393.81	
07/14/98	30.86	1392.18	
10/23/98	31.56	1391.48	
01/04/99	31.99	1391.05	
04/02/99	31.41	1391.63	
07/22/99	32.07	1390.97	
10/13/99	32.25	1390.79	
01/06/00	32.51	1390.53	
04/04/00	31.82	1391.22	
07/05/00	32.76	1390.28	
10/09/00	32.95	1390.09	
01/08/01	33.10	1389.94	
04/03/01	32.91	1390.13	
07/12/01	32.81	1390.23	
10/03/01	32.73	1390.31	
01/11/02	31.87	1391.17	
02/04/02	32.22	1390.82	
04/04/02	32.66	1390.38	
07/03/02	33.17	1389.87	
10/03/02	33.46	1389.58	
01/11/03	30.95	1392.09	
04/05/03	33.86	1389.18	
NC7-53B			
07/11/95	31.21	1392.87	
10/04/95	31.81	1392.27	
01/05/96	30.81	1393.27	
04/09/96	28.11	1395.97	
07/19/96	30.51	1393.57	
10/08/96	31.16	1392.92	
01/10/97	26.43	1397.65	
04/08/97	29.02	1395.06	
07/08/97	30.60	1393.48	
10/06/97	31.25	1392.83	
01/14/98	31.08	1393.00	

Location Date of Measurement	Depth to Water (ft)	Water Elevation (ft/MSL)	Notes
NC7-53B (continued)			
04/03/98	27.51	1396.57	
07/14/98	29.60	1394.48	
10/23/98	30.71	1393.37	
01/04/99	31.23	1392.85	
04/02/99	30.08	1394.00	
07/22/99	31.40	1392.68	
10/13/99	31.90	1392.18	
01/06/00	32.38	1391.70	
04/04/00	30.77	1393.31	
07/05/00	32.61	1391.47	
10/09/00	33.34	1390.74	
01/08/01	33.14	1390.94	
04/03/01	33.13	1390.95	
07/12/01	32.75	1391.33	
10/03/01	32.49	1391.59	
01/11/02	31.45	1392.63	
02/04/02	31.81	1392.27	
04/04/02	32.62	1391.46	
07/03/02	33.42	1390.66	
10/03/02	33.03	1391.05	
01/11/03	29.30	1394.78	
04/05/03	33.97	1390.11	
NC7-60			
07/12/95	155.54	1172.08	
10/03/95	156.54	1171.08	
01/04/96	157.23	1170.39	
04/10/96	156.16	1171.46	
07/18/96	156.72	1170.90	
10/07/96	157.05	1170.57	
01/10/97	157.11	1170.51	
04/10/97	155.94	1171.68	
07/11/97	156.75	1170.87	
10/06/97	155.94	1171.68	
01/13/98	156.76	1170.86	
04/03/98	155.59	1172.03	
07/14/98	144.76	1182.86	
10/23/98	156.08	1171.54	
01/04/99	156.46	1171.16	
04/02/99	156.04	1171.58	
07/22/99	156.68	1170.94	
10/13/99	156.62	1171.00	
01/07/00	156.95	1170.67	
04/04/00	158.32	1169.30	
07/10/00	158.82	1168.80	
10/09/00	158.11	1169.51	
01/05/01	158.29	1169.33	
04/10/01	158.40	1169.22	
07/12/01	158.75	1168.87	
10/03/01	158.31	1169.31	
01/11/02	158.42	1169.20	
02/05/02	158.95	1168.67	
04/04/02	158.24	1169.38	
07/12/02	158.68	1168.94	
10/03/02	158.37	1169.25	
01/11/03	158.45	1169.17	
04/16/03	158.59	1169.03	
NC7-63			
07/11/95	27.00	1322.37	
10/04/95	27.96	1321.41	
01/05/96	28.73	1320.64	
04/05/96	26.06	1323.31	

Table A-1. Ground Water Elevations for Monitor Wells in the Pit 7 Complex, measured between July 1, 1995, and June 30, 2003.

Location	Date of Measurement	Depth to Water (ft)	Water Elevation (ft/MSL)	Notes
NC7-63 (continued)				
	07/18/96	25.25	1324.12	
	10/08/96	27.09	1322.28	
	01/10/97	27.59	1321.78	
	04/08/97	20.96	1328.41	
	07/08/97	26.00	1323.37	
	10/06/97	27.58	1321.79	
	01/14/98	28.40	1320.97	
	03/20/98	17.72	1331.65	
	03/26/98	16.65	1332.72	
	04/07/98	15.70	1333.67	
	04/16/98	15.54	1333.83	
	05/07/98	16.07	1333.30	
	05/12/98	16.28	1333.09	
	05/22/98	16.40	1332.97	
	06/02/98	16.65	1332.72	
	06/12/98	16.95	1332.42	
	07/07/98	18.09	1331.28	
	07/14/98	18.57	1330.80	
	10/24/98	25.92	1323.45	
	01/04/99	27.09	1322.28	
	04/02/99	26.49	1322.88	
	07/22/99	27.87	1321.50	
	08/12/99	28.13	1321.24	
	09/12/99			NM
	10/20/99	28.72	1320.65	
	12/02/99	29.15	1320.22	
	01/07/00	29.20	1320.17	
	02/23/00	29.39	1319.98	
	03/09/00	29.26	1320.11	
	04/04/00	28.53	1320.84	
	05/01/00	27.38	1321.99	
	06/01/00	29.05	1320.32	
	07/03/00	29.43	1319.94	
	08/01/00	30.11	1319.26	
	09/07/00	30.57	1318.80	
	09/07/00	30.57	1318.80	
	10/09/00	30.99	1318.38	
	11/02/00	31.38	1317.99	
	12/04/00	31.65	1317.72	
	01/08/01	31.93	1317.44	
	02/05/01	32.10	1317.27	
	03/06/01	31.99	1317.38	
	04/03/01	32.28	1317.09	
	05/01/01	32.04	1317.33	
	06/05/01	32.18	1317.19	
	07/12/01	32.62	1316.75	
	08/07/01	32.88	1316.49	
	09/05/01	33.04	1316.33	
	10/02/01	32.15	1317.22	
	11/05/01	33.10	1316.27	
	12/04/01	33.11	1316.26	
	01/09/02	32.98	1316.39	
	02/04/02	32.79	1316.58	
	03/05/02	31.31	1318.06	
	04/03/02	30.35	1319.02	
	05/01/02			NM
	06/02/02	30.75	1318.62	
	07/12/02	30.68	1318.69	
	08/03/02	32.24	1317.13	
	09/01/02	32.88	1316.49	
	10/03/02	33.21	1316.16	
	01/04/03	33.81	1315.56	
	02/01/03	33.92	1315.45	
	03/01/03	33.93	1315.44	
	04/10/03	33.57	1315.80	

Location	Date of Measurement	Depth to Water (ft)	Water Elevation (ft/MSL)	Notes
NC7-64				
	07/07/95	20.35	1328.53	
	07/21/95	20.88	1328.00	
	07/28/95	21.07	1327.81	
	08/18/95	21.79	1327.09	
	08/25/95	21.97	1326.91	
	09/01/95	22.15	1326.73	
	09/08/95	22.32	1326.56	
	10/04/95	22.87	1326.01	
	11/01/95	23.52	1325.36	
	01/05/96	24.52	1324.36	
	01/26/96	24.14	1324.74	
	02/02/96	23.89	1324.99	
	02/09/96	23.48	1325.40	
	02/16/96	23.00	1325.88	
	02/20/96	22.44	1326.44	
	03/01/96	21.25	1327.63	
	03/18/96	18.90	1329.98	
	03/25/96	18.20	1330.68	
	04/02/96	17.70	1331.18	
	04/11/96	17.30	1331.58	
	04/19/96	17.15	1331.73	
	05/03/96	17.05	1331.83	
	06/04/96	17.84	1331.04	
	07/18/96	19.31	1329.57	
	08/08/96	20.06	1328.82	
	09/04/96	20.90	1327.98	
	10/08/96	21.62	1327.26	
	11/08/96	22.43	1326.45	
	11/18/96	22.60	1326.28	
	11/25/96	22.77	1326.11	
	12/05/96	22.82	1326.06	
	01/10/97	21.87	1327.01	
	02/05/97	18.74	1330.14	
	03/04/97	16.71	1332.17	
	04/08/97	16.81	1332.07	
	05/08/97	17.72	1331.16	
	06/03/97	19.32	1329.56	
	07/08/97	20.49	1328.39	
	08/07/97	21.63	1327.25	
	09/03/97	22.44	1326.44	
	10/06/97	22.99	1325.89	
	11/04/97	23.57	1325.31	
	12/02/97	23.97	1324.91	
	01/14/98	23.96	1324.92	
	01/16/98	23.88	1325.00	
	01/23/98	23.70	1325.18	
	01/30/98	23.39	1325.49	
	02/09/98	21.86	1327.02	1.53 FT RISE
	02/13/98	20.09	1328.79	
	02/20/98	18.20	1330.68	
	02/27/98	15.72	1333.16	
	03/06/98	14.25	1334.63	
	03/13/98	13.65	1335.23	
	03/20/98	13.33	1335.55	
	03/26/98	13.21	1335.67	
	04/07/98	13.54	1335.34	
	04/16/98	13.75	1335.13	
	05/07/98	14.46	1334.42	
	05/14/98	14.69	1334.19	
	05/22/98	15.15	1333.73	
	06/02/98	15.46	1333.42	
	06/12/98	15.78	1333.10	
	07/07/98	16.82	1332.06	
	07/14/98	18.06	1330.82	
	08/11/98	18.67	1330.21	

Table A-1. Ground Water Elevations for Monitor Wells in the Pit 7 Complex, measured between July 1, 1995, and June 30, 2003.

Location	Date of Measurement	Depth to Water (ft)	Water Elevation (ft/MSL)	Notes
NC7-64 (continued)				
	09/01/98	19.63	1329.25	
	10/24/98	21.43	1327.45	
	11/16/98	21.70	1327.18	
	12/01/98	21.93	1326.95	
	01/04/99	22.15	1326.73	
	02/01/99	22.76	1326.12	
	03/09/99	21.53	1327.35	
	04/02/99	21.21	1327.67	
	05/04/99	21.66	1327.22	
	06/01/99	22.52	1326.36	
	07/22/99	24.26	1324.62	
	08/12/99	24.85	1324.03	
	09/12/99			NM
	10/20/99	26.39	1322.49	
	12/02/99	37.38	1311.50	ME
	01/07/00	27.37	1321.51	
	02/23/00	27.83	1321.05	
	03/09/00	27.25	1321.63	
	04/04/00	25.35	1323.53	
	05/01/00	25.16	1323.72	
	06/01/00	26.15	1322.73	
	07/03/00	27.74	1321.14	
	08/02/00	28.82	1320.06	
	09/07/00	29.59	1319.29	
	09/07/00	29.59	1319.29	
	10/02/00	30.09	1318.79	
	11/02/00	30.57	1318.31	
	12/04/00	30.83	1318.05	
	01/08/01	31.02	1317.86	
	02/05/01	31.29	1317.59	
	03/06/01	31.34	1317.54	
	04/03/01	31.24	1317.64	
	05/01/01	30.94	1317.94	
	06/01/01	30.97	1317.91	
	07/12/01	31.67	1317.21	
	08/07/01	31.92	1316.96	
	09/05/01	32.15	1316.73	
	10/02/01	32.27	1316.61	
	11/05/01	32.34	1316.54	
	12/04/01	32.22	1316.66	
	01/09/02	32.05	1316.83	
	02/04/02	31.53	1317.35	
	03/05/02	29.06	1319.82	
	04/03/02	28.10	1320.78	
	05/01/02			NM
	06/02/02	29.13	1319.75	
	07/12/02	30.46	1318.42	
	08/03/02	31.22	1317.66	
	09/01/02	32.11	1316.77	
	10/03/02	32.60	1316.28	
	01/04/03	33.47	1315.41	
	02/01/03	33.55	1315.33	
	03/01/03	33.54	1315.34	
	04/10/03	32.75	1316.13	
NC7-65				
	07/11/95	189.83	1261.45	
	10/03/95	189.57	1261.71	
	01/04/96	189.87	1261.41	
	04/10/96	190.36	1260.92	
	07/19/96	190.06	1261.22	
	10/08/96	190.18	1261.10	
	01/10/97	189.42	1261.86	
	04/10/97	188.78	1262.50	
NC7-65 (continued)				
	07/08/97	188.87	1262.41	
	10/06/97	188.88	1262.40	
	01/14/98	189.12	1262.16	
	04/06/98	188.43	1262.85	
	07/14/98	188.48	1262.80	
	10/23/98	188.91	1262.37	
	01/04/99	189.04	1262.24	
	04/02/99	188.62	1262.66	
	07/22/99	186.57	1264.71	
	10/13/99	187.38	1263.90	
	01/06/00	187.75	1263.53	
	04/04/00	187.43	1263.85	
	07/07/00	186.67	1264.61	
	10/09/00	186.54	1264.74	
	01/05/01	186.28	1265.00	
	04/03/01	186.42	1264.86	
	07/13/01	186.45	1264.83	
	10/03/01	186.54	1264.74	
	01/11/02	186.68	1264.60	
	04/03/02	186.67	1264.61	
	07/12/02	186.68	1264.60	
	10/03/02	187.00	1264.28	
	01/11/03	187.10	1264.18	
NC7-67				
	07/11/95	29.00	1293.92	
	10/04/95	29.75	1293.17	
	01/05/96	29.99	1292.93	
	04/05/96	25.59	1297.33	
	07/18/96	27.54	1295.38	
	10/07/96	28.43	1294.49	
	01/10/97	28.42	1294.50	
	04/08/97	25.45	1297.47	
	07/08/97	27.31	1295.61	
	10/06/97	28.21	1294.71	
	01/14/98	29.17	1293.75	
	04/06/98	20.09	1302.83	
	07/14/98	24.77	1298.15	
	10/24/98	26.26	1296.66	
	01/04/99	26.99	1295.93	
	04/02/99	26.20	1296.72	
	07/01/99	26.96	1295.96	
	10/13/99	27.58	1295.34	
	01/06/00	28.00	1294.92	
	04/04/00	27.73	1295.19	
	07/10/00	28.24	1294.68	
	10/09/00	28.74	1294.18	
	01/08/01	29.43	1293.49	
	04/03/01	29.65	1293.27	
	07/12/01	29.58	1293.34	
	10/02/01	29.78	1293.14	
	01/09/02	30.09	1292.83	
	04/10/02	30.58	1292.34	
	07/10/02	30.78	1292.14	
	10/09/02	30.99	1291.93	
	01/04/03	30.95	1291.97	
	04/10/03	30.74	1292.18	
NC7-68				
	07/11/95	28.79	1294.11	
	10/03/95	29.36	1293.54	
	01/05/96	29.85	1293.05	
	04/10/96	25.21	1297.69	

Table A-1. Ground Water Elevations for Monitor Wells in the Pit 7 Complex, measured between July 1, 1995, and June 30, 2003.

Location	Date of Measurement	Depth to Water (ft)	Water Elevation (ft/MSL)	Notes
NC7-68 (continued)				
	07/18/96	27.34	1295.56	
	10/07/96	28.13	1294.77	
	01/10/97	28.17	1294.73	
	04/08/97	25.18	1297.72	
	07/08/97	27.11	1295.79	
	10/06/97	27.93	1294.97	
	01/14/98	28.84	1294.06	
	04/03/98	19.59	1303.31	
	07/14/98	24.64	1298.26	
	10/24/98	26.10	1296.80	
	01/04/99	26.68	1296.22	
	04/02/99	25.85	1297.05	
	07/22/99	26.85	1296.05	
	10/13/99	27.13	1295.77	
	01/06/00	27.50	1295.40	
	04/04/00	27.14	1295.76	
	07/03/00	27.81	1295.09	
	10/02/00	28.71	1294.19	
	01/08/01	28.98	1293.92	
	04/03/01	28.99	1293.91	
	07/12/01	29.36	1293.54	
	10/02/01	29.69	1293.21	
	01/09/02	29.75	1293.15	
	04/03/02	29.84	1293.06	
	07/10/02	30.36	1292.54	
	10/09/02	30.50	1292.40	
	01/04/03	30.54	1292.36	
	04/10/03	30.28	1292.62	
NC7-75				
	07/07/95	47.15	1305.07	
	07/21/95	47.12	1305.10	
	07/28/95	46.97	1305.25	
	08/18/95	47.00	1305.22	
	08/25/95	46.95	1305.27	
	09/01/95	46.92	1305.30	
	09/08/95	46.90	1305.32	
	10/04/95	46.97	1305.25	
	11/01/95	46.98	1305.24	
	01/05/96	47.21	1305.01	
	01/26/96	47.18	1305.04	
	02/02/96	46.95	1305.27	
	02/09/96	46.90	1305.32	
	02/15/96	46.94	1305.28	
	02/23/96	46.89	1305.33	
	03/01/96	46.87	1305.35	
	03/18/96	46.30	1305.92	
	03/25/96	46.10	1306.12	
	04/02/96	45.89	1306.33	
	04/11/96	45.78	1306.44	
	04/19/96	45.75	1306.47	
	05/03/96	45.36	1306.86	
	06/04/96	45.26	1306.96	
	07/18/96	45.24	1306.98	
	08/08/96	45.24	1306.98	
	09/04/96	45.21	1307.01	
	10/08/96	45.52	1306.70	
	11/08/96	45.81	1306.41	
	11/18/96	45.58	1306.64	
	11/25/96	45.80	1306.42	
	12/05/96	45.70	1306.52	
	01/10/97	45.73	1306.49	
	02/05/97	45.22	1307.00	
	03/04/97	44.76	1307.46	
NC7-75 (continued)				
	04/08/97	44.46	1307.76	
	05/08/97	44.39	1307.83	
	06/03/97	44.64	1307.58	
	07/08/97	44.78	1307.44	
	08/07/97	44.90	1307.32	
	09/03/97	45.04	1307.18	
	10/06/97	44.95	1307.27	
	11/04/97	45.31	1306.91	
	12/02/97	45.06	1307.16	
	01/14/98	45.19	1307.03	
	01/16/98	45.15	1307.07	
	01/23/98	45.08	1307.14	
	01/30/98	44.98	1307.24	
	02/09/98	44.85	1307.37	0.13 FT RISE
	02/13/98	44.63	1307.59	
	02/20/98	44.42	1307.80	
	02/27/98	43.93	1308.29	
	03/06/98	43.43	1308.79	
	03/13/98	43.17	1309.05	
	03/20/98	42.91	1309.31	
	03/26/98	42.67	1309.55	
	04/07/98	42.56	1309.66	
	04/16/98	42.55	1309.67	
	05/07/98	42.24	1309.98	
	05/14/98	42.30	1309.92	
	05/22/98	42.37	1309.85	
	06/02/98	43.31	1308.91	
	06/12/98	42.42	1309.80	
	07/07/98	42.52	1309.70	
	07/14/98	42.53	1309.69	
	08/11/98	42.68	1309.54	
	09/01/98	42.76	1309.46	
	10/24/98	43.34	1308.88	
	11/16/98	43.56	1308.66	
	12/01/98	43.48	1308.74	
	01/04/99	43.85	1308.37	
	02/01/99	44.03	1308.19	
	03/09/99	43.50	1308.72	
	04/02/99	43.45	1308.77	
	05/04/99	43.51	1308.71	
	06/01/99	43.65	1308.57	
	07/22/99	43.97	1308.25	
	08/12/99	44.13	1308.09	
	09/12/99			NM
	10/20/99	44.61	1307.61	
	12/02/99	44.93	1307.29	
	01/07/00	44.97	1307.25	
	02/23/00	45.11	1307.11	
	03/09/00	45.19	1307.03	
	04/04/00	45.11	1307.11	
	05/01/00	45.00	1307.22	
	06/01/00	45.13	1307.09	
	07/03/00	45.37	1306.85	
	08/01/00	45.68	1306.54	
	09/07/00	45.92	1306.30	
	09/07/00	45.92	1306.30	
	10/09/00	46.15	1306.07	
	11/02/00	46.32	1305.90	
	12/04/00	46.49	1305.73	
	01/08/01	46.64	1305.58	
	02/05/01	46.82	1305.40	
	03/06/01	46.73	1305.49	
	04/03/01	46.82	1305.40	
	05/01/01	47.05	1305.17	
	06/01/01	46.92	1305.30	

Table A-1. Ground Water Elevations for Monitor Wells in the Pit 7 Complex, measured between July 1, 1995, and June 30, 2003.

Location	Date of Measurement	Depth to Water (ft)	Water Elevation (ft/MSL)	Notes
NC7-75 (continued)				
	07/12/01	47.22	1305.00	
	08/03/01	47.33	1304.89	
	09/05/01	47.20	1305.02	
	10/02/01	47.44	1304.78	
	11/05/01	47.62	1304.60	
	12/04/01	47.73	1304.49	
	01/09/02	47.67	1304.55	
	02/04/02	47.70	1304.52	
	03/05/02	47.45	1304.77	
	04/03/02	47.45	1304.77	
	05/01/02	47.03	1305.19	
	06/02/02	47.28	1304.94	
	07/10/02	47.30	1304.92	
	08/03/02	47.48	1304.74	
	09/01/02	47.69	1304.53	
	10/03/02	47.90	1304.32	
	01/04/03	48.59	1303.63	
	02/01/03	48.62	1303.60	
	03/01/03	48.59	1303.63	
	04/10/03	48.47	1303.75	
NC7-76				
	07/12/95	20.04	1256.84	
	10/04/95	20.90	1255.98	
	01/05/96	20.45	1256.43	
	04/05/96	15.09	1261.79	
	07/18/96	18.48	1258.40	
	10/07/96	19.37	1257.51	
	01/10/97	16.85	1260.03	
	04/08/97	17.45	1259.43	
	07/08/97	18.85	1258.03	
	10/06/97	19.73	1257.15	
	01/14/98	20.06	1256.82	
	04/03/98	12.47	1264.41	
	07/14/98	15.60	1261.28	
	10/23/98	18.57	1258.31	
	01/04/99	19.37	1257.51	
	04/02/99	19.18	1257.70	
	07/22/99	19.98	1256.90	
	08/12/99	20.09	1256.79	
	09/13/99	20.26	1256.62	
	10/13/99	20.42	1256.46	
	12/02/99	20.78	1256.10	
	01/07/00	20.77	1256.11	
	02/23/00	20.32	1256.56	
	03/09/00	19.64	1257.24	
	04/04/00	19.85	1257.03	
	05/01/00	20.51	1256.37	
	06/01/00	20.78	1256.10	
	07/03/00	20.97	1255.91	
	08/01/00	21.24	1255.64	
	09/07/00	21.41	1255.47	
	09/07/00	21.41	1255.47	
	10/09/00	21.63	1255.25	
	11/02/00	21.72	1255.16	
	12/04/00	21.85	1255.03	
	01/05/01	21.91	1254.97	
	02/05/01	21.98	1254.90	
	03/06/01	21.67	1255.21	
	04/03/01	21.77	1255.11	
	05/01/01	21.86	1255.02	
	06/01/01	22.01	1254.87	
	07/12/01	22.26	1254.62	
	08/03/01	22.27	1254.61	

Location	Date of Measurement	Depth to Water (ft)	Water Elevation (ft/MSL)	Notes
NC7-76 (continued)				
	09/05/01	22.33	1254.55	
	10/02/01	22.45	1254.43	
	11/05/01	22.53	1254.35	
	12/04/01	22.58	1254.30	
	01/09/02	21.81	1255.07	
	01/24/02	71.60	1205.28	PS
	02/04/02	21.74	1255.14	
	03/05/02	22.09	1254.79	
	04/04/02	22.15	1254.73	
	05/01/02			NM
	06/01/02	22.55	1254.33	
	07/10/02	22.73	1254.15	
	08/06/02	22.85	1254.03	
	09/07/02	22.88	1254.00	
	10/03/02	22.86	1254.02	
	01/04/03	22.62	1254.26	
	02/01/03	22.35	1254.53	
	03/01/03	22.40	1254.48	
	04/10/03	22.51	1254.37	
W-PIT3-01				
	04/04/00			DRY
	05/01/00			DRY
	06/01/00			DRY
	07/04/00			DRY
	08/01/00			DRY
	09/07/00			DRY
	09/07/00			DRY
	10/02/00			DRY
	11/01/00			DRY
	12/04/00			DRY
	01/08/01			DRY
	02/01/01			DRY
	03/05/01			DRY
	04/03/01			DRY
	05/01/01			DRY
	06/04/01			DRY
	07/12/01			DRY
	08/03/01			DRY
	09/05/01			DRY
	10/02/01			DRY
	11/05/01			DRY
	12/04/01			DRY
	01/11/02			DRY
	02/04/02			DRY
	03/05/02			DRY
	04/03/02			DRY
	05/01/02			DRY
	06/02/02			DRY
	07/10/02			DRY
	08/03/02			DRY
	09/01/02			DRY
	10/03/02			DRY
	01/04/03			DRY
	02/01/03			DRY
	03/01/03			DRY
	04/12/03			DRY
W-PIT3-02				
	04/04/00			DRY
	05/01/00			DRY
	06/01/00			DRY
	07/04/00			DRY

Table A-1. Ground Water Elevations for Monitor Wells in the Pit 7 Complex, measured between July 1, 1995, and June 30, 2003.

Location	Date of Measurement	Depth to Water (ft)	Water Elevation (ft/MSL)	Notes
W-PIT3-02 (continued)				
	08/01/00			DRY
	09/07/00			DRY
	09/07/00			DRY
	10/02/00			DRY
	11/01/00			DRY
	12/04/00			DRY
	01/08/01			DRY
	02/01/01			DRY
	03/05/01			DRY
	04/03/01			DRY
	05/01/01			DRY
	06/04/01			DRY
	07/12/01			DRY
	08/03/01			DRY
	09/05/01			DRY
	10/02/01			DRY
	11/05/01			DRY
	12/04/01			DRY
	01/09/02			DRY
	02/04/02			DRY
	03/05/02			DRY
	04/03/02			DRY
	05/01/02			DRY
	06/02/02			DRY
	07/10/02			DRY
	08/03/02			DRY
	09/01/02			DRY
	10/03/02			DRY
	01/04/03			DRY
	02/01/03			DRY
	03/01/03			DRY
	04/12/03			DRY
W-PIT5-01				
	04/04/00			DRY
	05/01/00			DRY
	06/01/00			DRY
	07/04/00			DRY
	08/01/00			DRY
	09/07/00			DRY
	09/07/00			DRY
	10/02/00			DRY
	11/01/00			DRY
	12/04/00			DRY
	01/08/01			DRY
	02/01/01			DRY
	03/05/01			DRY
	04/03/01			DRY
	05/01/01			DRY
	06/04/01			DRY
	07/12/01			DRY
	08/03/01			DRY
	09/05/01			DRY
	10/02/01			DRY
	11/05/01			DRY
	12/04/01			DRY
	01/09/02			DRY
	02/04/02			DRY
	03/05/02			DRY
	04/03/02			DRY
	05/01/02			DRY
	06/02/02			DRY
	07/10/02			DRY
	08/06/02			DRY
W-PIT5-01 (continued)				
	09/01/02			DRY
	10/03/02			DRY
	01/04/03			DRY
	02/01/03			DRY
	03/01/03			DRY
	04/10/03			DRY
W-PIT5-02				
	04/04/00			DRY
	05/01/00			DRY
	06/01/00			DRY
	07/04/00			DRY
	08/01/00			DRY
	09/07/00			DRY
	09/07/00			DRY
	10/02/00			DRY
	11/01/00			DRY
	12/04/00			DRY
	01/08/01			DRY
	02/01/01			DRY
	03/05/01			DRY
	04/03/01			DRY
	05/01/01			DRY
	06/04/01			DRY
	07/12/01			DRY
	08/03/01			DRY
	09/05/01			DRY
	10/02/01			DRY
	11/05/01			DRY
	12/04/01			DRY
	01/09/02			DRY
	02/04/02			DRY
	03/05/02			DRY
	04/03/02			DRY
	05/01/02			NM
	06/02/02			DRY
	07/03/02			DRY
	08/05/02			DRY
	09/01/02			DRY
	10/03/02			DRY
	01/04/03			DRY
	02/01/03			DRY
	03/01/03			DRY
	04/10/03			DRY
W-PIT7-02				
	07/07/95	19.00	1298.97	
	07/21/95	19.20	1298.77	
	07/28/95	19.51	1298.46	
	08/18/95	19.44	1298.53	
	08/25/95	19.47	1298.50	
	09/01/95	19.53	1298.44	
	09/08/95	19.58	1298.39	
	10/04/95	19.80	1298.17	
	11/01/95	19.98	1297.99	
	01/05/96	19.95	1298.02	
	01/26/96	19.60	1298.37	
	02/02/96	18.80	1299.17	
	02/09/96	17.12	1300.85	
	02/16/96	16.28	1301.69	
	02/23/96	15.59	1302.38	
	03/01/96	14.50	1303.47	
	03/18/96	14.20	1303.77	

Table A-1. Ground Water Elevations for Monitor Wells in the Pit 7 Complex, measured between July 1, 1995, and June 30, 2003.

Location	Date of Measurement	Depth to Water (ft)	Water Elevation (ft/MSL)	Notes
W-PIT7-02 (continued)				
	03/25/96	14.05	1303.92	
	04/02/96	14.38	1303.59	
	04/11/96	14.88	1303.09	
	04/19/96	15.21	1302.76	
	05/03/96	15.71	1302.26	
	06/04/96	16.79	1301.18	
	07/19/96	17.71	1300.26	
	08/08/96	18.03	1299.94	
	09/04/96	18.26	1299.71	
	10/07/96	18.68	1299.29	
	11/08/96	19.10	1298.87	
	11/18/96	19.00	1298.97	
	11/25/96	19.19	1298.78	
	12/05/96	19.27	1298.70	
	01/10/97	17.25	1300.72	
	02/05/97	13.75	1304.22	
	03/04/97	14.32	1303.65	
	04/08/97	15.42	1302.55	
	05/08/97	16.26	1301.71	
	06/03/97	17.19	1300.78	
	07/08/97	17.85	1300.12	
	08/07/97	18.34	1299.63	
	09/03/97	18.72	1299.25	
	10/06/97	19.10	1298.87	
	11/04/97	19.41	1298.56	
	12/02/97	19.62	1298.35	
	01/14/98	19.86	1298.11	
	01/16/98	19.79	1298.18	
	01/23/98	19.08	1298.89	
	01/30/98	18.20	1299.77	
	02/09/98	15.56	1302.41	2.64 FT RISE
	02/13/98	13.78	1304.19	
	02/20/98	11.70	1306.27	
	02/27/98	9.53	1308.44	
	03/06/98	9.04	1308.93	
	03/13/98	9.04	1308.93	
	03/20/98	9.36	1308.61	
	03/26/98	9.67	1308.30	
	04/07/98	10.49	1307.48	
	04/16/98	11.10	1306.87	
	05/07/98	12.11	1305.86	
	05/14/98	12.15	1305.82	
	05/22/98	12.35	1305.62	
	06/02/98	12.86	1305.11	
	06/12/98	13.33	1304.64	
	07/07/98	14.45	1303.52	
	07/14/98	14.75	1303.22	
	08/11/98	15.74	1302.23	
	09/01/98	16.38	1301.59	
	10/23/98	17.77	1300.20	
	11/16/98	18.09	1299.88	
	12/01/98	18.18	1299.79	
	01/04/99	18.72	1299.25	
	02/01/99	18.99	1298.98	
	03/09/99	17.08	1300.89	
	04/02/99	17.38	1300.59	
	05/04/99	17.88	1300.09	
	06/01/99	18.38	1299.59	
	07/22/99	18.93	1299.04	
	08/12/99	19.11	1298.86	
	09/13/99	19.34	1298.63	
	10/13/99	19.56	1298.41	
	12/02/99	20.00	1297.97	
	01/06/00	20.13	1297.84	
	02/23/00	20.09	1297.88	
W-PIT7-02 (continued)				
	03/09/00	19.19	1298.78	
	04/04/00	18.60	1299.37	
	05/01/00	19.26	1298.71	
	06/02/00	19.76	1298.21	
	07/05/00	20.01	1297.96	
	08/01/00	20.45	1297.52	
	09/07/00	20.71	1297.26	
	09/07/00	20.71	1297.26	
	10/09/00	21.02	1296.95	
	11/02/00	21.13	1296.84	
	12/05/00	21.29	1296.68	
	01/08/01	21.55	1296.42	
	02/05/01	21.77	1296.20	
	03/07/01	21.74	1296.23	
	04/03/01	21.98	1295.99	
	05/01/01	22.13	1295.84	
	06/05/01	22.22	1295.75	
	07/12/01	22.35	1295.62	
	08/03/01	22.38	1295.59	
	09/05/01	22.52	1295.45	
	10/03/01	22.60	1295.37	
	11/07/01	22.69	1295.28	
	12/04/01	22.77	1295.20	
	01/11/02	22.22	1295.75	
	02/04/02	22.13	1295.84	
	03/05/02	22.15	1295.82	
	04/03/02	22.29	1295.68	
	05/01/02			NM
	06/02/02	22.69	1295.28	
	07/10/02	22.91	1295.06	
	08/06/02	23.08	1294.89	
	09/01/02	23.20	1294.77	
	10/03/02	23.22	1294.75	
	01/04/03	22.61	1295.36	
	02/01/03	22.15	1295.82	
	03/01/03	22.00	1295.97	
	04/10/03	22.47	1295.50	
W-PIT7-03				
	07/07/95	19.97	1309.55	
	07/21/95	19.93	1309.59	
	07/28/95	19.89	1309.63	
	08/18/95	19.95	1309.57	
	08/25/95	18.97	1310.55	
	09/01/95	20.02	1309.50	
	09/08/95	20.06	1309.46	
	10/04/95	20.36	1309.16	
	11/01/95	20.77	1308.75	
	01/05/96	21.71	1307.81	
	01/26/96	21.80	1307.72	
	02/02/96	21.24	1308.28	
	02/09/96	20.29	1309.23	
	02/16/96	19.89	1309.63	
	02/23/96	19.35	1310.17	
	03/01/96	18.25	1311.27	
	03/18/96	16.05	1313.47	
	03/25/96	15.33	1314.19	
	04/02/96	14.95	1314.57	
	04/11/96	14.80	1314.72	
	04/19/96	14.80	1314.72	
	05/03/96	14.73	1314.79	
	06/04/96	14.91	1314.61	
	07/18/96	16.04	1313.48	
	08/08/96	16.62	1312.90	

Table A-1. Ground Water Elevations for Monitor Wells in the Pit 7 Complex, measured between July 1, 1995, and June 30, 2003.

Location Date of Measurement	Depth to Water (ft)	Water Elevation (ft/MSL)	Notes
W-PIT7-03 (continued)			
09/04/96	17.42	1312.10	
10/08/96	18.40	1311.12	
11/08/96	19.28	1310.24	
11/18/96	19.44	1310.08	
11/25/96	19.64	1309.88	
12/05/96	19.91	1309.61	
01/10/97	18.80	1310.72	
02/05/97	13.64	1315.88	
03/04/97	12.56	1316.96	
04/08/97	13.17	1316.35	
05/08/97	14.01	1315.51	
06/03/97	15.51	1314.01	
07/08/97	17.03	1312.49	
08/07/97	18.32	1311.20	
09/03/97	19.34	1310.18	
10/06/97	20.40	1309.12	
11/04/97	21.08	1308.44	
12/02/97	21.55	1307.97	
01/14/98	21.78	1307.74	
01/16/98	21.70	1307.82	
01/23/98	21.00	1308.52	
01/30/98	20.59	1308.93	
02/09/98	17.79	1311.73	2.80 FT RISE
02/13/98	14.60	1314.92	
02/20/98	9.95	1319.57	
02/27/98	6.90	1322.62	
03/06/98	6.30	1323.22	
03/13/98	6.11	1323.41	
03/20/98	6.25	1323.27	
03/26/98	6.45	1323.07	
04/07/98	6.84	1322.68	
04/16/98	7.27	1322.25	
05/07/98	7.74	1321.78	
05/14/98	8.00	1321.52	
05/22/98	8.21	1321.31	
06/02/98	8.75	1320.77	
06/12/98	9.36	1320.16	
07/07/98	10.97	1318.55	
07/14/98	11.46	1318.06	
08/11/98	13.39	1316.13	
09/01/98	14.91	1314.61	
10/24/98	17.94	1311.58	
11/16/98	18.77	1310.75	
12/01/98	19.23	1310.29	
01/04/99	20.07	1309.45	
02/01/99	20.74	1308.78	
03/09/99	20.03	1309.49	
04/02/99	19.88	1309.64	
05/04/99	20.02	1309.50	
06/01/99	20.29	1309.23	
07/01/99	20.86	1308.66	
08/12/99	21.66	1307.86	
09/12/99			NM
10/20/99	22.62	1306.90	
12/02/99	23.23	1306.29	
01/06/00	23.24	1306.28	
02/23/00	23.45	1306.07	
03/09/00	22.90	1306.62	
04/04/00	22.59	1306.93	
05/01/00	22.78	1306.74	
06/05/00	22.96	1306.56	
07/03/00	23.35	1306.17	
08/01/00	23.86	1305.66	
09/07/00	24.44	1305.08	
09/07/00	24.44	1305.08	
W-PIT7-03 (continued)			
10/09/00	24.94	1304.58	
11/02/00	25.29	1304.23	
12/04/00	25.55	1303.97	
01/08/01	25.80	1303.72	
02/05/01	26.12	1303.40	
03/06/01	26.11	1303.41	
04/03/01	26.46	1303.06	
05/01/01	26.63	1302.89	
06/05/01	26.74	1302.78	
07/12/01	26.91	1302.61	
08/03/01	27.04	1302.48	
09/05/01	27.21	1302.31	
10/02/01	27.44	1302.08	
11/05/01	27.59	1301.93	
12/04/01	27.68	1301.84	
01/09/02	26.78	1302.74	
02/04/02	27.02	1302.50	
03/05/02	27.03	1302.49	
04/03/02	26.90	1302.62	
05/01/02	26.88	1302.64	
06/02/02	26.90	1302.62	
07/01/02	27.10	1302.42	
08/06/02	27.33	1302.19	
09/01/02	27.62	1301.90	
10/03/02	27.73	1301.79	
01/04/03	27.59	1301.93	
02/01/03	27.64	1301.88	
03/01/03	27.85	1301.67	
04/10/03	28.27	1301.25	
W-PIT7-10			
07/07/95	23.75	1294.68	
07/21/95	23.88	1294.55	
07/28/95	23.90	1294.53	
08/18/95	24.15	1294.28	
08/25/95	24.20	1294.23	
09/01/95	24.20	1294.23	
09/08/95	24.22	1294.21	
10/04/95	24.49	1293.94	
11/01/95	24.67	1293.76	
01/05/96	25.00	1293.43	
01/26/96	25.04	1293.39	
02/02/96	24.89	1293.54	
02/09/96	24.40	1294.03	
02/15/96	24.00	1294.43	
02/23/96	23.50	1294.93	
03/01/96	22.78	1295.65	
03/18/96	20.77	1297.66	
03/25/96	20.28	1298.15	
04/02/96	19.94	1298.49	
04/11/96	19.80	1298.63	
04/19/96	19.92	1298.51	
05/03/96	20.13	1298.30	
06/04/96	21.16	1297.27	
07/19/96	22.28	1296.15	
08/08/96	22.54	1295.89	
09/04/96	22.26	1296.17	
10/17/96	23.33	1295.10	
11/08/96	23.50	1294.93	
11/18/96	23.54	1294.89	
11/25/96	23.70	1294.73	
12/05/96	23.52	1294.91	
01/10/97	23.15	1295.28	
02/05/97	21.23	1297.20	

Table A-1. Ground Water Elevations for Monitor Wells in the Pit 7 Complex, measured between July 1, 1995, and June 30, 2003.

Location	Date of Measurement	Depth to Water (ft)	Water Elevation (ft/MSL)	Notes
W-PIT7-10 (continued)				
	03/04/97	19.50	1298.93	
	04/08/97	20.00	1298.43	
	05/08/97	20.76	1297.67	
	06/03/97	21.59	1296.84	
	07/08/97	22.20	1296.23	
	08/07/97	22.54	1295.89	
	09/03/97	22.95	1295.48	
	10/06/97	23.06	1295.37	
	11/04/97	23.34	1295.09	
	12/02/97	23.50	1294.93	
	01/14/98	23.74	1294.69	
	01/16/98	23.81	1294.62	
	01/23/98	23.68	1294.75	
	01/30/98	23.53	1294.90	
	02/09/98	22.85	1295.58	0.68 FT RISE
	02/13/98	21.87	1296.56	
	02/20/98	20.32	1298.11	
	02/27/98	18.15	1300.28	
	03/06/98	15.92	1302.51	
	03/13/98	14.58	1303.85	
	03/20/98	13.90	1304.53	
	03/26/98	13.73	1304.70	
	04/07/98	14.22	1304.21	
	04/16/98	14.89	1303.54	
	05/07/98	16.43	1302.00	
	05/14/98	16.96	1301.47	
	05/22/98	17.34	1301.09	
	06/02/98	17.87	1300.56	
	06/12/98	18.31	1300.12	
	07/07/98	19.37	1299.06	
	07/14/98	19.55	1298.88	
	08/11/98	20.22	1298.21	
	09/01/98	20.48	1297.95	
	10/23/98	21.35	1297.08	
	11/16/98	21.26	1297.17	
	12/01/98	21.71	1296.72	
	01/04/99	21.85	1296.58	
	02/01/99	22.12	1296.31	
	03/09/99	21.18	1297.25	
	04/02/99	20.90	1297.53	
	05/04/99	21.27	1297.16	
	06/01/99	21.46	1296.97	
	07/22/99	22.02	1296.41	
	08/12/99	22.12	1296.31	
	09/13/99	22.16	1296.27	
	10/13/99	22.42	1296.01	
	12/02/99	22.55	1295.88	
	01/06/00	22.68	1295.75	
	02/23/00	22.84	1295.59	
	03/09/00	22.80	1295.63	
	04/04/00	22.23	1296.20	
	05/02/00	22.42	1296.01	
	06/02/00	22.84	1295.59	
	07/05/00	23.11	1295.32	
	08/02/00	23.31	1295.12	
	09/08/00	23.47	1294.96	
	09/08/00	23.47	1294.96	
	10/09/00	23.61	1294.82	
	11/02/00	23.80	1294.63	
	12/05/00	24.01	1294.42	
	01/08/01	23.91	1294.52	
	02/05/01	24.00	1294.43	
	03/07/01	24.21	1294.22	
	04/03/01	24.17	1294.26	
	05/01/01	24.31	1294.12	
W-PIT7-10 (continued)				
	06/01/01	24.32	1294.11	
	07/12/01	24.61	1293.82	
	08/03/01	24.64	1293.79	
	09/07/01	24.74	1293.69	
	10/03/01	24.76	1293.67	
	11/02/01	24.88	1293.55	
	12/05/01	24.79	1293.64	
	01/11/02	25.05	1293.38	
	02/04/02	24.92	1293.51	
	03/05/02	24.93	1293.50	
	04/03/02	24.98	1293.45	
	05/01/02			NM
	06/02/02	25.23	1293.20	
	07/03/02	25.40	1293.03	
	08/06/02	25.51	1292.92	
	09/01/02	25.61	1292.82	
	10/03/02	25.65	1292.78	
	01/04/03	25.83	1292.60	
	02/01/03	25.35	1293.08	
	03/01/03	25.39	1293.04	
	04/10/03	25.34	1293.09	
W-PIT7-11				
	10/13/99	189.82		CASING 4.7'
	12/02/99	190.29		
	01/06/00	190.33		
	02/22/00	190.46		
	03/09/00	190.70		
	04/04/00	187.74		
	05/01/00	187.27		
	06/05/00	187.03		
	07/07/00	187.02		
	08/01/00	186.95		
	09/08/00	186.80	1265.14	
	09/08/00	186.80	1265.14	
	10/09/00	186.97	1264.97	
	11/02/00	186.87	1265.07	
	12/05/00	186.84	1265.10	
	01/05/01	186.74	1265.20	
	02/08/01	186.63	1265.31	
	03/06/01	186.77	1265.17	
	04/03/01	186.75	1265.19	
	05/01/01	186.96	1264.98	
	06/04/01	186.79	1265.15	
	07/13/01	186.92	1265.02	
	08/03/01	186.83	1265.11	
	09/05/01	186.85	1265.09	
	10/03/01	186.91	1265.03	
	11/07/01	187.01	1264.93	
	12/05/01	187.09	1264.85	
	01/11/02	187.13	1264.81	
	02/05/02	187.07	1264.87	
	03/05/02	187.03	1264.91	
	04/03/02	186.99	1264.95	
	05/01/02			NM
	06/02/02	187.02	1264.92	
	07/12/02	187.09	1264.85	
	08/06/02	187.22	1264.72	
	09/07/02	187.27	1264.67	
	10/03/02	187.45	1264.49	
	01/11/03	187.55	1264.39	
	02/01/03	187.56	1264.38	
	03/01/03	187.11	1264.83	
	04/10/03	187.57	1264.37	

Table A-1. Ground Water Elevations for Monitor Wells in the Pit 7 Complex, measured between July 1, 1995, and June 30, 2003.

Location	Date of Measurement	Depth to Water (ft)	Water Elevation (ft/MSL)	Notes
W-PIT7-12				
	04/02/99	210.13		POM=3.03
	05/04/99	210.22		
	06/01/99	210.08		
	07/22/99	210.17		
	08/12/99	210.27		
	09/12/99			NM
	10/13/99	210.26		
	12/02/99	210.50		
	01/06/00	210.59		
	02/22/00	210.84		
	03/09/00	211.04		
	04/04/00	209.73		
	05/01/00	209.85		
	06/05/00	209.93		
	07/07/00	209.92		
	08/01/00	209.91		
	09/08/00	209.89	1206.66	
	09/08/00	209.89	1206.66	
	10/09/00	210.00	1206.55	
	11/02/00	210.17	1206.38	
	12/05/00	210.22	1206.33	
	01/05/01	210.18	1206.37	
	02/08/01	210.08	1206.47	
	03/06/01	210.14	1206.41	
	04/03/01	210.23	1206.32	
	05/01/01	210.37	1206.18	
	06/04/01	210.20	1206.35	
	07/13/01	210.41	1206.14	
	08/03/01	210.42	1206.13	
	09/05/01	210.48	1206.07	
	10/03/01	210.49	1206.06	
	11/02/01	210.59	1205.96	
	12/05/01	210.67	1205.88	
	01/11/02	210.74	1205.81	
	02/05/02	210.84	1205.71	
	03/05/02	210.60	1205.95	
	04/03/02	210.65	1205.90	
	05/01/02			NM
	06/02/02	210.73	1205.82	
	07/12/02	210.81	1205.74	
	08/06/02	210.88	1205.67	
	09/07/02	210.91	1205.64	
	10/03/02	210.94	1205.61	
	01/11/03	211.12	1205.43	
	02/01/03	211.00	1205.55	
	03/01/03	211.13	1205.42	
	04/10/03	211.19	1205.36	
W-PIT7-13				
	10/13/99	230.28		CASING 6.0'
	12/02/99	230.68		
	01/06/00	230.97		
	02/22/00	231.00		
	03/09/00	231.25		
	04/04/00	228.63		
	05/01/00	228.72		
	06/05/00	228.99		
	07/07/00	229.01		
	08/01/00	229.23		
	09/08/00	229.04	1253.50	
	09/08/00	229.04	1253.50	
	10/02/00	229.28	1253.26	
	11/02/00	229.60	1252.94	
	12/05/00	229.72	1252.82	
W-PIT7-13 (continued)				
	01/05/01	229.89	1252.65	
	02/08/01	229.80	1252.74	
	03/06/01	229.93	1252.61	
	04/03/01	229.92	1252.62	
	05/01/01	229.72	1252.82	
	06/04/01	229.48	1253.06	
	07/13/01	230.00	1252.54	
	08/03/01	230.03	1252.51	
	09/05/01	229.89	1252.65	
	10/03/01	230.03	1252.51	
	11/02/01	230.17	1252.37	
	12/05/01	230.29	1252.25	
	01/11/02	230.45	1252.09	
	02/05/02	230.41	1252.13	
	03/05/02	230.41	1252.13	
	04/03/02	229.73	1252.81	
	05/01/02			NM
	06/02/02	230.01	1252.53	
	07/12/02	230.09	1252.45	
	08/06/02	230.21	1252.33	
	09/07/02	230.37	1252.17	
	10/03/02	229.68	1252.86	
	01/11/03	230.35	1252.19	
	02/01/03	230.45	1252.09	
	03/01/03	230.32	1252.22	
	04/10/03	230.58	1251.96	
W-PIT7-14				
	03/09/00			NM/MUDDY
	04/04/00	296.24		
	05/01/00	296.56		
	06/01/00			NA
	07/07/00	296.56		
	08/01/00	297.61		
	09/08/00	298.53	1164.71	
	09/08/00	298.53	1164.71	
	10/09/00	299.89	1163.35	
	11/02/00	299.40	1163.84	
	12/05/00	299.58	1163.66	
	01/05/01	299.47	1163.77	
	02/08/01	299.33	1163.91	
	03/06/01	299.62	1163.62	
	04/03/01	299.49	1163.75	
	05/01/01	299.55	1163.69	
	06/04/01	299.48	1163.76	
	07/13/01	299.54	1163.70	
	08/03/01	299.48	1163.76	
	09/07/01	299.39	1163.85	
	10/03/01	299.44	1163.80	
	11/07/01	299.63	1163.61	
	12/05/01	299.77	1163.47	
	01/11/02	299.60	1163.64	
	02/05/02	298.38	1164.86	
	03/05/02	299.52	1163.72	
	04/04/02	299.63	1163.61	
	05/01/02			NM
	06/02/02	298.25	1164.99	
	07/12/02	298.78	1164.46	
	08/06/02	299.98	1163.26	
	09/07/02	299.36	1163.88	
	10/03/02	300.03	1163.21	
	01/11/03	300.10	1163.14	
	02/01/03	300.13	1163.11	
	03/01/03	300.05	1163.19	

Table A-1. Ground Water Elevations for Monitor Wells in the Pit 7 Complex, measured between July 1, 1995, and June 30, 2003.

Location	Date of Measurement	Depth to Water (ft)	Water Elevation (ft/MSL)	Notes
W-PIT7-14 (continued)				
	04/10/03	300.02	1163.22	
W-PIT7-15				
	04/03/00	103.43		
	05/01/00	102.31		
	06/05/00	102.35		POM2.00
	07/07/00	102.51		
	08/02/00	102.10		
	09/08/00	102.11	1192.71	
	09/08/00	102.11	1192.71	
	10/02/00	102.43	1192.39	
	11/01/00	102.53	1192.29	
	12/04/00	102.35	1192.47	
	01/04/01	102.37	1192.45	
	02/07/01	102.03	1192.79	
	03/07/01	102.32	1192.50	
	04/05/01	102.16	1192.66	
	05/02/01	102.11	1192.71	
	06/01/01	102.05	1192.77	
	07/13/01	102.36	1192.46	
	08/02/01	102.45	1192.37	
	09/05/01	102.36	1192.46	
	10/04/01	102.40	1192.42	
	11/02/01	102.92	1191.90	
	12/05/01	102.72	1192.10	
	01/10/02	102.76	1192.06	
	02/05/02	102.47	1192.35	
	03/06/02	102.33	1192.49	
	04/04/02	102.45	1192.37	
	05/01/02			NM
	06/02/02	102.62	1192.20	
	07/19/02	102.80	1192.02	
	08/07/02	102.74	1192.08	
	09/07/02	102.69	1192.13	
	10/03/02	102.80	1192.02	
	01/08/03	102.64	1192.18	
	02/01/03	102.65	1192.17	
	03/01/03	102.90	1191.92	
	04/12/03	102.68	1192.14	
W-PIT7-16				
	04/04/00	17.64		
	06/01/00	18.99		
	07/03/00	19.03		
	08/01/00	19.22		
	09/08/00	19.34	1251.66	
	09/08/00	19.34	1251.66	
	10/09/00	19.50	1251.50	
	11/02/00	19.45	1251.55	
	12/04/00	19.72	1251.28	
	01/05/01	19.78	1251.22	
	02/05/01	19.85	1251.15	
	03/06/01	19.60	1251.40	
	04/03/01	19.77	1251.23	
	05/04/01	20.05	1250.95	
	06/05/01	20.02	1250.98	
	07/12/01	20.04	1250.96	
	08/03/01	20.04	1250.96	
	09/05/01	20.21	1250.79	
	10/02/01	20.25	1250.75	
	11/02/01	20.33	1250.67	
	12/04/01	20.30	1250.70	
	01/09/02	20.24	1250.76	
W-PIT7-16 (continued)				
	02/04/02	20.23	1250.77	
	03/05/02	20.28	1250.72	
	04/03/02	20.28	1250.72	
	05/01/02			NM
	06/01/02	20.45	1250.55	
	07/10/02	20.53	1250.47	
	08/06/02	20.64	1250.36	
	09/07/02	20.64	1250.36	
	10/03/02	20.76	1250.24	
	01/04/03	20.74	1250.26	
	02/01/03	20.70	1250.30	
	03/01/03	20.65	1250.35	
	04/01/03	20.70	1250.30	
W-PIT7-1714				
	06/29/01			
	08/03/01	97.43	1367.09	
	09/05/01	97.92	1366.60	
	10/03/01	97.81	1366.71	
	11/07/01	97.89	1366.63	
	12/05/01	98.02	1366.50	
	01/11/02	97.80	1366.72	
	02/04/02	97.75	1374.38	
	03/04/02	97.69	1374.44	
	04/03/02	97.58	1374.55	
	05/01/02			NM
	06/01/02	97.38	1374.75	
	07/03/02	97.56	1374.57	
	08/03/02	97.61	1374.52	
	09/01/02	97.77	1374.36	
	10/03/02	97.79	1374.34	
	01/11/03	97.70	1374.43	
	02/01/03	97.83	1374.30	
	03/01/03	97.73	1374.40	
W-PIT7-1715				
	12/05/01	47.08	1415.92	
	01/11/02	47.24	1415.76	
	02/08/02	47.67	1424.31	
	03/04/02	47.61	1424.37	
	04/03/02	48.10	1423.88	
	05/01/02			NM
	06/01/02	48.49	1423.49	
	07/03/02	49.09	1422.89	
	08/03/02	49.26	1422.72	
	09/01/02	49.29	1422.69	
	10/03/02	49.45	1422.53	
	01/11/03	49.02	1422.96	
	02/01/03	48.80	1423.18	
	03/01/03	48.88	1423.10	
W-PIT7-1716				
	12/05/01	31.68	1430.32	
	01/11/02	32.26	1429.74	
	02/08/02	32.63	1438.88	
	03/04/02	33.18	1438.33	
	04/03/02	33.51	1438.00	
	05/01/02			NM
	06/01/02	34.39	1437.12	
	07/03/02	34.94	1436.57	
	08/03/02	35.29	1436.22	
	09/01/02	35.61	1435.90	

Table A-1. Ground Water Elevations for Monitor Wells in the Pit 7 Complex, measured between July 1, 1995, and June 30, 2003.

Location	Date of Measurement	Depth to Water (ft)	Water Elevation (ft/MSL)	Notes
W-PIT7-1716 (continued)				
	10/03/02	35.87	1435.64	
	01/11/03	36.17	1435.34	
	02/01/03	36.33	1435.18	
	03/01/03	36.40	1435.11	
W-PIT7-1717				
	06/29/01			
	08/03/01	34.91	1432.29	
	09/05/01	35.60	1431.60	
	10/03/01	35.54	1431.66	
	11/07/01	35.60	1431.60	
	12/05/01	35.42	1431.78	
	01/11/02	34.17	1433.03	
	02/08/02	33.80	1428.72	
	03/04/02	33.72	1428.80	
	04/03/02	33.47	1429.05	
	05/01/02			NM
	06/01/02	33.28	1429.24	
	07/03/02	33.21	1429.31	
	08/03/02	33.09	1429.43	
	09/01/02	33.07	1429.45	
	10/03/02	32.89	1429.63	
	01/11/03	31.25	1431.27	
	02/01/03	31.10	1431.42	
	03/01/03	31.40	1431.12	
W-PIT7-1718				
	06/29/01			
	08/03/01	16.21	1450.89	
	09/05/01	16.58	1450.52	
	10/03/01	16.59	1450.51	
	11/07/01	16.73	1450.37	
	12/05/01	16.77	1450.33	
	01/11/02	14.14	1452.96	
	02/08/02	16.30	1445.85	
	03/04/02	16.69	1445.46	
	04/03/02	16.85	1445.30	
	05/01/02			NM
	06/01/02	17.07	1445.08	
	07/03/02	17.31	1444.84	
	08/03/02	17.52	1444.63	
	09/01/02	17.71	1444.44	
	10/03/02	17.80	1444.35	
	01/11/03	14.96	1447.19	
	02/01/03	16.62	1445.53	
	03/01/03	17.25	1444.90	
W-PIT7-1720				
	06/29/01			
	08/03/01	30.88	1406.18	
	09/05/01	30.70	1406.36	
	10/03/01	30.75	1406.31	
	11/07/01	30.94	1406.12	
	12/05/01	31.07	1405.99	
	01/11/02	31.01	1406.05	
	02/08/02	31.32	1413.91	
	03/04/02	31.62	1413.61	
	04/03/02	31.80	1413.43	
	05/01/02			NM
	06/01/02	32.35	1412.88	
	07/03/02	32.65	1412.58	
	08/03/02	32.66	1412.57	
W-PIT7-1720 (continued)				
	09/01/02	32.81	1412.42	
	10/03/02	32.88	1412.35	
	01/11/03	32.30	1412.93	
	02/01/03	32.26	1412.97	
	03/01/03	32.50	1412.73	
	04/05/03	33.84	1411.39	
W-PIT7-1723				
	06/29/01			
	08/03/01	2.19	1430.13	
	09/05/01	2.79	1429.53	
	10/03/01	2.94	1429.38	
	11/07/01	3.15	1429.17	
	12/05/01	3.36	1428.96	
	01/11/02	2.66	1429.66	
	02/08/02	2.72	1425.24	
	03/04/02	2.89	1425.07	
	04/03/02	3.30	1424.66	
	05/01/02			NM
	06/01/02	3.61	1424.25	
	07/03/02	3.84	1424.02	
	08/03/02	3.89	1423.97	
	09/01/02	4.13	1423.73	
	10/03/02	4.21	1423.65	
	01/11/03	3.41	1424.45	
	02/01/03	3.20	1424.66	
	03/01/03	3.68	1424.18	
	04/05/03	5.16	1422.70	
W-PIT7-1724				
	06/29/01			
	08/03/01	15.43	1416.95	
	09/05/01	15.71	1416.67	
	10/03/01	15.74	1416.64	
	11/07/01	15.81	1416.57	
	12/05/01	15.82	1416.56	
	01/11/02	15.01	1417.37	
	02/08/02	15.35	1413.11	
	03/04/02	15.45	1413.01	
	04/03/02	15.60	1412.86	
	05/01/02			NM
	06/01/02	15.62	1412.84	
	07/03/02	15.98	1412.48	
	08/07/02	16.07	1412.39	
	09/01/02	16.09	1412.37	
	10/03/02	16.03	1412.43	
	01/11/03	14.80	1413.66	
	02/01/03	15.20	1413.26	
	03/01/03	15.37	1413.09	
	04/05/03	16.55	1411.91	
W-PIT7-1725				
	12/05/01	120.00	1302.00	
	01/11/02	120.35	1301.65	
	02/04/02	120.53	1299.52	
	03/04/02	120.62	1299.43	
	04/04/02	120.01	1300.04	
	05/01/02			NM
	06/01/02	120.02	1300.03	
	07/03/02	120.17	1299.88	
	08/03/02	120.25	1299.80	
	09/01/02	120.22	1299.83	

Table A-1. Ground Water Elevations for Monitor Wells in the Pit 7 Complex, measured between July 1, 1995, and June 30, 2003.

Location Date of Measurement	Depth to Water (ft)	Water Elevation (ft/MSL)	Notes
W-PIT7-1725 (continued)			
10/03/02	120.45	1299.60	
01/11/03	120.60	1299.45	
02/01/03	120.66	1299.39	
03/01/03	120.68	1299.37	
04/05/03	121.17	1298.88	
W-PIT7-1903			
04/10/03	21.44	1293.56	
W-PIT7-1904			
04/10/03	22.06	1292.94	
W-PIT7-1905			
04/10/03	21.55	1293.45	
W-PIT7-1907			
04/10/03	21.34	1293.66	
W-PIT7-1915			
04/10/03	21.64	1293.36	
W-PIT7-1916			
04/10/03	21.91	1293.09	
W-PIT7-1917			
04/10/03	22.79	1292.21	
W-PIT7-1918			
04/10/03	21.46	1293.54	
W-PIT7-1919			
04/10/03	21.69	1293.31	
W-865-01			
04/02/99	32.89		POM=2.79
05/04/99	33.05		
06/01/99	33.12		
07/22/99	33.50		
08/12/99	33.74		
09/12/99			NM
10/13/99			NM
12/03/99	34.40		
01/20/00	34.17		
02/18/00	34.18		
03/16/00	34.05		
04/03/00	33.00		
05/01/00	33.46		
06/05/00	33.42	1154.24	
07/07/00	33.47	1154.19	
08/02/00	33.30	1154.36	
09/05/00	33.33	1154.33	
10/02/00	33.31	1154.35	
11/01/00	33.42	1154.24	
12/04/00	33.41	1154.25	
01/04/01	33.50	1154.16	
W-865-01 (continued)			
02/08/01	33.34	1154.32	
03/07/01	33.26	1154.40	
04/05/01	33.47	1154.19	
05/02/01	33.47	1154.19	
06/05/01	33.53	1154.13	
07/13/01	33.46	1154.20	
08/02/01	33.52	1154.14	
09/07/01	33.50	1154.16	
10/04/01	33.52	1154.14	
11/02/01	33.61	1154.05	
12/05/01	33.65	1154.01	
01/10/02	33.50	1154.16	
02/04/02	33.60	1154.06	
03/06/02	33.60	1154.06	
04/11/02	34.11	1153.55	
05/01/02			NM
06/02/02	34.03	1153.63	
07/22/02	34.06	1153.60	
08/03/02	34.08	1153.58	
09/07/02	34.09	1153.57	
10/04/02	34.04	1153.62	
01/08/03	33.48	1154.18	
02/01/03	33.85	1153.81	
03/01/03	34.10	1153.56	
04/12/03	34.02	1153.64	
W-865-03			
04/03/00	51.93		
05/01/00	50.58		
06/05/00	50.79	1185.19	POM2.00
07/07/00	50.98	1185.00	
08/02/00	50.67	1185.31	
09/05/00	50.83	1185.15	
10/02/00	50.85	1185.13	
11/01/00	51.14	1184.84	
12/04/00	51.29	1184.69	
01/04/01	51.20	1184.78	
02/07/01	51.30	1184.68	
03/07/01	51.47	1184.51	
04/05/01	51.42	1184.56	
05/02/01	51.42	1184.56	
06/01/01	51.50	1184.48	
07/13/01	51.69	1184.29	
08/02/01	51.79	1184.19	
09/07/01	51.82	1184.16	
10/04/01	51.93	1184.05	
11/02/01	51.80	1184.18	
12/05/01	52.04	1183.94	
01/10/02	52.17	1183.81	
02/04/02	52.15	1183.83	
03/06/02	52.16	1183.82	
04/11/02	52.37	1183.61	
05/01/02			NM
06/02/02	52.49	1183.49	
07/19/02	52.73	1183.25	
08/03/02	52.69	1183.29	
09/07/02	52.69	1183.29	
10/03/02	52.68	1183.30	
01/08/03	52.83	1183.15	
02/01/03	52.95	1183.03	
03/01/03	53.00	1182.98	
04/12/03	53.06	1182.92	

Table A-1. Ground Water Elevations for Monitor Wells in the Pit 7 Complex, measured between July 1, 1995, and June 30, 2003.

Location Date of Measurement	Depth to Water (ft)	Water Elevation (ft/MSL)	Notes
W-865-04			
04/04/00	16.71		
05/01/00	15.65		
06/02/00	15.96		
07/07/00	16.37		
08/02/00	16.79		
09/05/00	16.93	1139.24	
10/02/00	17.03	1139.14	
11/01/00	17.18	1138.99	
12/01/00	17.44	1138.73	
01/04/01	17.65	1138.52	
02/01/01	17.56	1138.61	
03/07/01	17.58	1138.59	
04/05/01	17.68	1138.49	
05/02/01	17.71	1138.46	
06/01/01	17.76	1138.41	
07/13/01	17.82	1138.35	
08/02/01	17.91	1138.26	
09/07/01	17.92	1138.25	
10/04/01	17.98	1138.19	
11/02/01	18.03	1138.14	
12/04/01	18.15	1138.02	
01/02/02	18.01	1138.16	
02/04/02	17.66	1138.51	
03/06/02	17.90	1138.27	
04/11/02	18.24	1137.93	
05/01/02			NM
06/02/02	18.49	1137.68	
07/19/02	18.85	1137.32	
08/03/02	18.89	1137.28	
09/07/02	19.00	1137.17	
10/03/02	19.12	1137.05	
01/08/03	18.75	1137.42	
02/01/03	18.76	1137.41	
03/01/03	19.00	1137.17	
04/12/03	19.31	1136.86	
W-865-06			
03/09/00	95.65		
04/03/00	94.11		
05/01/00	92.21		
06/02/00	91.35		
07/07/00	91.27		
08/02/00	90.82		
09/05/00	90.82	1063.79	
10/02/00	90.67	1063.94	
11/01/00	90.82	1063.79	
12/01/00	90.68	1063.93	
01/04/01	90.75	1063.86	
02/01/01	90.79	1063.82	
03/07/01	90.36	1064.25	
04/05/01	90.49	1064.12	
05/04/01	90.41	1064.20	
06/01/01	90.26	1064.35	
07/13/01	90.57	1064.04	
08/02/01	90.56	1064.05	
09/07/01	90.52	1064.09	
10/04/01	90.60	1064.01	
11/02/01	90.76	1063.85	
12/04/01	90.75	1063.86	
01/02/02	90.76	1063.85	
02/04/02	90.92	1063.69	
03/06/02	90.95	1063.66	
04/11/02	90.97	1063.64	
05/01/02			NM
W-865-06 (continued)			
06/02/02	90.82	1063.79	
07/19/02	91.20	1063.41	
08/03/02	91.09	1063.52	
09/07/02	91.17	1063.44	
10/03/02	91.20	1063.41	
01/08/03	91.32	1063.29	
02/01/03	91.47	1063.14	
03/01/03	91.37	1063.24	
04/12/03	91.52	1063.09	
W-865-07			
03/09/00	15.44		
04/03/00	15.17		
05/01/00	15.48		
06/02/00	16.19		
07/07/00	16.55		
08/02/00	16.68		
09/05/00	17.13	1139.78	
10/02/00	17.23	1139.68	
11/01/00	17.50	1139.41	
12/01/00	17.64	1139.27	
01/04/01	17.92	1138.99	
02/01/01	17.88	1139.03	
03/07/01	18.02	1138.89	
04/05/01	18.04	1138.87	
05/02/01	18.13	1138.78	
06/01/01	18.24	1138.67	
07/13/01	18.57	1138.34	
08/01/01	18.63	1138.28	
09/07/01	18.68	1138.23	
10/04/01	18.85	1138.06	
11/02/01	18.84	1138.07	
12/04/01	19.17	1137.74	
01/02/02	18.71	1138.20	
02/04/02	18.47	1138.44	
03/06/02	18.75	1138.16	
04/11/02	19.18	1137.73	
05/01/02			NM
06/02/02	19.41	1137.50	
07/19/02	19.75	1137.16	
08/03/02	19.80	1137.11	
09/07/02	19.94	1136.97	
10/03/02	20.10	1136.81	
01/08/03	19.17	1137.74	
02/01/03	19.40	1137.51	
03/01/03	19.80	1137.11	
04/12/03	20.03	1136.88	

Table A-1. Ground Water Elevations for Monitor Wells in the Pit 7 Complex, measured between July 1, 1995, and June 30, 2003.

Location	Date of Measurement	Depth to Water (ft)	Water Elevation (ft/MSL)	Notes	Location	Date of Measurement	Depth to Water (ft)	Water Elevation (ft/MSL)	Notes

Notes:

ABD	Abandoned well.
AD	Drilling of adjacent new wells disturbed water level.
BS	Water detected below bottom of screened interval.
DRY	Well dry at time of time of measurement.
ME	Measuring error suspected.
NM	Not measured.
PD	Predevelopment measurement.
PS	Measurement taken just before sampling.
PT	Pump test interfered with measurement.
WE	Well equilibrium suspect.
WR	Well recovery.

Table A-2. Surface/subsurface soil and rock moisture analyses for tritium (pCi/Lsm) in samples collected from the Pit 7 Complex between July 1, 1995 and June 30, 2003. Results recorded by December 4, 2003.

Tritium in Soil, Site 300
December 9, 2003
gemini2

s3tritso.09dec2003

Min Sample Date
July 1, 1995
Max Sample Date
June 30, 2003

Table A-2. Surface/subsurface soil and rock moisture analyses for tritium (pCi/Lsm) in samples collected from the Pit 7 Complex between July 1, 1995 and June 30, 2003. Results recorded by December 4, 2003.

Location Date	Lab	Note	Val.	Depth (ft)	Tritium (pCi/L)	Moisture by Weight (percent)
PIT3-06						
10-nov-1999	ME	a	V	4.0	-	10.16
10-nov-1999	ME	a	V	4.0	5560 +/- 5710	-
10-nov-1999	ME	a	V	9.0	-	16.05
10-nov-1999	ME	a	V	9.0	291000 +/- 37500	-
10-nov-1999	ME	a	V	14.0	-	17.94
10-nov-1999	ME	a	V	14.0	1.62e+06 +/- 88700	-
PIT3-07						
05-nov-1999	ME	a	V	4.0	-	4.93
05-nov-1999	ME	a	V	4.0	120000 +/- 25600	-
05-nov-1999	ME	a	V	9.0	-	6.04
05-nov-1999	ME	a	V	9.0	859000 +/- 67600	-
05-nov-1999	ME	a	V	13.5	-	5.76
05-nov-1999	ME	a	V	13.5	2.5e+06 +/- 116000	-
PIT3-08						
08-nov-1999	ME	a	V	4.0	-	7.77
08-nov-1999	ME	a	V	4.0	117000 +/- 24300	-
08-nov-1999	ME	a	V	4.5	-	9.01
08-nov-1999	ME	a	V	4.5	68400 +/- 18300	-
08-nov-1999	ME	a	V	10.0	-	3.24
08-nov-1999	ME	a	V	10.0	1.1e+06 +/- 74100	-
08-nov-1999	ME	a	V	18.5	-	13.23
08-nov-1999	ME	a	V	18.5	6.21e+06 +/- 174000	-
08-nov-1999	ME	a	V	22.0	-	15.91
08-nov-1999	ME	a	V	22.0	5.96e+06 +/- 170000	-
PIT3-09						
11-nov-1999	ME	a	V	4.0	-	6.42
11-nov-1999	ME	a	V	4.0	157000 +/- 27800	-
11-nov-1999	ME	a	V	9.0	-	22.88
11-nov-1999	ME	a	V	9.0	2.97e+06 +/- 120000	-
11-nov-1999	ME	a	V	14.0	-	5.94
11-nov-1999	ME	a	V	14.0	4.46e+06 +/- 14800	-
11-nov-1999	ME	a	V	19.5	-	27.89
11-nov-1999	ME	a	V	19.5	622000 +/- 5510	-
11-nov-1999	ME	a	V	24.0	-	22.38
11-nov-1999	ME	a	V	24.0	470000 +/- 47900	-
PIT3-10						
01-nov-1999	ME	a	V	4.0	-	13.34
01-nov-1999	ME	a	V	4.0	35800 +/- 14300	-
01-nov-1999	ME	a	V	9.5	-	5.78
01-nov-1999	ME	a	V	9.5	303000 +/- 40200	-
01-nov-1999	ME	a	V	14.0	-	16.41
01-nov-1999	ME	a	V	14.0	2.22e+06 +/- 109000	-
01-nov-1999	ME	a	V	18.5	-	6.52
01-nov-1999	ME	a	V	18.5	2.13e+06 +/- 107000	-
01-nov-1999	ME	a	V	24.0	-	12.36
01-nov-1999	ME	a	V	24.0	2.14e+06 +/- 107000	-
01-nov-1999	ME	a	V	29.0	-	15.75
01-nov-1999	ME	a	V	29.0	1.45e+06 +/- 88200	-

Table A-2. Surface/subsurface soil and rock moisture analyses for tritium (pCi/Lsm) in samples collected from the Pit 7 Complex between July 1, 1995 and June 30, 2003. Results recorded by December 4, 2003.

Location Date	Lab	Note	Val.	Depth (ft)	Tritium (pCi/L)	Moisture by Weight (percent)
PIT3-11						
05-nov-1999	ME	a	V	4.0	-	4.55
05-nov-1999	ME	a	V	4.0	54900 +/- 17500	-
05-nov-1999	ME	a	V	9.0	-	4.22
05-nov-1999	ME	a	V	9.0	235000 +/- 35700	-
05-nov-1999	ME	a	V	13.5	-	7.27
05-nov-1999	ME	a	V	13.5	6.9e+06 +/- 192000	-
05-nov-1999	ME	a	V	18.5	-	15.97
05-nov-1999	ME	a	V	18.5	3.67e+06 +/- 140000	-
05-nov-1999	ME	a	V	23.5	-	19.88
05-nov-1999	ME	a	V	23.5	284000 +/- 38900	-
PIT3-13						
03-nov-1999	ME	a	V	4.5	-	14.05
03-nov-1999	ME	a	V	4.5	83400 +/- 21500	-
03-nov-1999	ME	a	V	14.0	-	16.72
03-nov-1999	ME	a	V	14.0	2.64e+06 +/- 119000	-
03-nov-1999	ME	a	V	19.0	-	11.65
03-nov-1999	ME	a	V	19.0	3.09e+06 +/- 129000	-
03-nov-1999	ME	a	V	24.0	-	14.98
03-nov-1999	ME	a	V	24.0	2.91e+06 +/- 125000	-
03-nov-1999	ME	a	V	28.5	-	14.51
03-nov-1999	ME	a	V	28.5	2.51e+06 +/- 116000	-
PIT5-03						
23-nov-1999	ME	a	V	3.5	-	16.54
23-nov-1999	ME	a	V	3.5	1200 +/- 2130	-
23-nov-1999	ME	a	V	9.5	-	17.83
23-nov-1999	ME	a	V	9.5	8150 +/- 4630	-
23-nov-1999	ME	a	V	14.5	-	18.84
23-nov-1999	ME	a	V	14.5	70300 +/- 13200	-
23-nov-1999	ME	a	V	19.0	-	18.84
23-nov-1999	ME	a	V	19.0	106000 +/- 16600	-
23-nov-1999	ME	a	V	24.0	-	19.16
23-nov-1999	ME	a	V	24.0	160000 +/- 19800	-
23-nov-1999	ME	a	V	27.0	-	15.64
23-nov-1999	ME	a	V	27.0	185000 +/- 21300	-
PIT5-19						
01-dec-1999	ME	a	V	5.0	-	12.02
01-dec-1999	ME	a	V	5.0	3300 +/- 3120	-
01-dec-1999	ME	a	V	9.0	-	19.41
01-dec-1999	ME	a	V	9.0	32700 +/- 9030	-
01-dec-1999	ME	a	V	13.5	-	18.35
01-dec-1999	ME	a	V	13.5	27000 +/- 8180	-
01-dec-1999	ME	a	V	16.0	-	20.7
01-dec-1999	ME	a	V	16.0	72200 +/- 13300	-
PIT5-20						
02-dec-1999	ME	a	V	5.0	-	20.47
02-dec-1999	ME	a	V	5.0	738 +/- 1860	-
02-dec-1999	ME	a	V	9.0	-	14.92
02-dec-1999	ME	a	V	9.0	45700 +/- 10600	-
02-dec-1999	ME	a	V	14.0	-	20.89

Table A-2. Surface/subsurface soil and rock moisture analyses for tritium (pCi/Lsm) in samples collected from the Pit 7 Complex between July 1, 1995 and June 30, 2003. Results recorded by December 4, 2

Location Date	Lab	Note	Val.	Depth (ft)	Tritium (pCi/L)	Moisture by Weight (percent)
PIT5-20 (continued)						
02-dec-1999	ME	a	V	14.0	113000 +/- 16600	-
PIT5-21						
02-dec-1999	ME	a	V	4.5	-	2.66
02-dec-1999	ME	a	V	4.5	5380 +/- 3830	-
02-dec-1999	ME	a	V	8.5	-	4.68
02-dec-1999	ME	a	V	8.5	58900 +/- 12100	-
02-dec-1999	ME	a	V	14.0	-	19.33
02-dec-1999	ME	a	V	14.0	595000 +/- 38100	-
PIT5-22						
06-dec-1999	ME	a	V	4.0	-	10.48
06-dec-1999	ME	a	V	4.0	1410 +/- 2250	-
06-dec-1999	ME	a	V	9.0	-	2.63
06-dec-1999	ME	a	V	9.0	6760 +/- 4270	-
06-dec-1999	ME	a	V	14.0	-	22.51
06-dec-1999	ME	a	V	14.0	76200 +/- 13600	-
W-PIT3-01						
15-nov-1999	ME	a	V	4.5	-	17.31
15-nov-1999	ME	a	V	4.5	<296 +/- 2310U	-
15-nov-1999	ME	a	V	9.5	-	17.76
15-nov-1999	ME	a	V	9.5	1760 +/- 3680	-
15-nov-1999	ME	a	V	14.5	-	18.1
15-nov-1999	ME	a	V	14.5	1250 +/- 3310	-
15-nov-1999	ME	a	V	19.0	-	21.43
15-nov-1999	ME	a	V	19.0	718 +/- 2910	-
W-PIT3-02						
16-nov-1999	ME	a	V	4.5	-	13.18
16-nov-1999	ME	a	V	4.5	359000 +/- 41800	-
16-nov-1999	ME	a	V	9.5	-	12.45
16-nov-1999	ME	a	V	9.5	1.79e+06 +/- 93800	-
16-nov-1999	ME	a	V	14.0	-	9.66
16-nov-1999	ME	a	V	14.0	1.49e+06 +/- 85500	-
W-PIT5-01						
17-nov-1999	ME	a	V	5.0	-	12.29
17-nov-1999	ME	a	V	5.0	129000 +/- 25200	-
17-nov-1999	ME	a	V	10.0	-	14.17
17-nov-1999	ME	a	V	10.0	1.42e+06 +/- 83100	-
17-nov-1999	ME	a	V	15.0	-	12.24
17-nov-1999	ME	a	V	15.0	1.85e+06 +/- 95100	-
17-nov-1999	ME	a	V	19.0	-	16.35
17-nov-1999	ME	a	V	19.0	670000 +/- 57300	-
W-PIT5-02						
22-nov-1999	ME	a	V	5.0	-	14
22-nov-1999	ME	a	V	5.0	5540 +/- 3980	-

Table A-2. Surface/subsurface soil and rock moisture analyses for tritium (pCi/Lsm) in samples collected from the Pit 7 Complex between July 1, 1995 and June 30, 2003. Results recorded by December 4, 2003.

Location Date	Lab	Note	Val.	Depth (ft)	Tritium (pCi/L)	Moisture by Weight (percent)
W-PIT5-02 (continued)						
22-nov-1999	ME	a	V	9.0	-	15.75
22-nov-1999	ME	a	V	9.0	39600 +/- 9920	-
22-nov-1999	ME	a	V	14.5	-	16.67
22-nov-1999	ME	a	V	14.5	43400 +/- 10400	-
22-nov-1999	ME	a	V	18.5	-	24.88
22-nov-1999	ME	a	V	18.5	157000 +/- 19700	-
22-nov-1999	ME	a	V	23.5	-	20.56
22-nov-1999	ME	a	V	23.5	230000 +/- 23800	-
22-nov-1999	ME	a	V	29.0	-	31.35
22-nov-1999	ME	a	V	29.0	117000 +/- 17000	-
W-PIT7-11						
04-jun-1999	TN	a	V	182.7	3590 +/- 470	-
04-jun-1999	TN	ag	V	184.7	1960 +/- 360	-
04-jun-1999	TN	a	V	186.4	3430 +/- 440	-
W-PIT7-12						
12-nov-1998	GE	aj	V	140.0	-	21.3
12-nov-1998	GE	aj	V	145.2	-	18
12-nov-1998	GE	aj	V	150.0	-	15.9
12-nov-1998	GE	aj	V	155.0	-	15.2
12-nov-1998	GE	aj	V	160.2	-	15
12-nov-1998	GE	aj	V	165.0	-	14.2
12-nov-1998	GE	aj	V	170.0	-	6.4
12-nov-1998	GE	aj	V	175.0	-	13.4
12-nov-1998	GE	aj	V	180.0	-	12.8
12-nov-1998	GE	aj	V	185.1	-	15
16-nov-1998	ME	a	N	195.0	<49.2 +/- 37.2U	-
16-nov-1998	ME	a	N	205.0	<48.9 +/- 37.9U	-
16-nov-1998	ME	a	N	210.0	175 +/- 47.6	-
17-nov-1998	ME	a	N	215.0	1830 +/- 10	-
17-nov-1998	ME	a	N	220.0	1790 +/- 98.2	-
17-nov-1998	ME	a	N	225.0	925 +/- 75.4	-
17-nov-1998	ME	a	N	230.0	<48.5 +/- 36.7U	-
W-PIT7-13						
11-may-1999	TN	a	V	222.5	<200 +/- 95LOU	-
12-may-1999	TN	a	V	228.0	2580 +/- 290LO	-
12-may-1999	TN	a	V	235.4	54400 +/- 5500LO	-
12-may-1999	TN	a	V	237.4	18200 +/- 1800LO	-
12-may-1999	TN	a	V	239.7	2160 +/- 250LO	-
12-may-1999	TN	a	V	242.7	<200 +/- 85LOU	-
12-may-1999	TN	a	V	244.1	<200 +/- 77LOU	-
W-PIT7-14						
03-aug-1999	TN	a	N	299.4	<200 +/- 340LU	-
03-aug-1999	TN	a	N	303.3	<200 +/- 300LU	-
03-aug-1999	TN	a	N	318.8	<200 +/- 300LU	-
03-aug-1999	TN	a	N	325.3	<200 +/- 310LU	-

Table A-2. Surface/subsurface soil and rock moisture analyses for tritium (pCi/Lsm) in samples collected from the Pit 7 Complex between July 1, 1995 and June 30, 2003. Results recorded by December 4, 2003.

Location Date	Lab	Note	Val.	Depth (ft)	Tritium (pCi/L)	Moisture by Weight (percent)
W-PIT7-15						
07-dec-1999	TN	a	V	100.3	<200 +/- 120U	–
07-dec-1999	TN	a	V	105.0	<200 +/- 120U	–
08-dec-1999	TN	a	V	110.0	<200 +/- 130U	–
08-dec-1999	TN	a	V	115.0	<200 +/- 120U	–
08-dec-1999	TN	a	V	120.0	<200 +/- 120U	–
08-dec-1999	TN	a	V	125.0	<200 +/- 110U	–
W-PIT7-16						
28-dec-1999	TN	a	V	20.2	<200 +/- 110U	–
05-jan-2000	TN	a	V	25.5	<200 +/- 120U	–
05-jan-2000	TN	a	V	27.7	<200 +/- 120U	–
10-jan-2000	TN	a	V	30.1	<200 +/- 87U	–
10-jan-2000	TN	a	V	40.5	<200 +/- 110U	–
11-jan-2000	TN	a	V	49.3	<200 +/- 100U	–
11-jan-2000	TN	a	V	60.0	<200 +/- 97U	–
11-jan-2000	TN	a	V	70.0	<200 +/- 91U	–
12-jan-2000	GE	ah	V	81.5	15.4 +/- 109	–
12-jan-2000	TN	a	V	81.7	<200 +/- 100U	–
12-jan-2000	TN	a	V	90.0	<200 +/- 100U	–
12-jan-2000	TN	a	V	98.1	<200 +/- 97U	–
18-jan-2000	TN	a	V	120.0	<200 +/- 110U	–
18-jan-2000	TN	a	V	130.0	<200 +/- 120U	–
18-jan-2000	TN	a	V	139.8	<200 +/- 120U	–
19-jan-2000	TN	a	V	149.0	<200 +/- 100U	–
19-jan-2000	TN	a	V	159.6	<200 +/- 140U	–
W-865-03						
10-feb-2000	TN	a	V	55.0	<200 +/- 180U	–
10-feb-2000	TN	a	V	61.0	<200 +/- 100U	–
W-865-04						
03-jan-2000	ME	a	V	100.0	–	19.83
03-jan-2000	ME	a	V	100.0	<172 +/- 130U	–
03-jan-2000	ME	a	V	110.0	–	21.07
03-jan-2000	ME	a	V	110.0	<170 +/- 129U	–
03-jan-2000	ME	a	V	118.0	–	25.57
03-jan-2000	ME	a	V	118.0	<169 +/- 123U	–
04-jan-2000	ME	a	V	124.5	–	17.35
04-jan-2000	ME	a	V	124.5	<170 +/- 122U	–
04-jan-2000	ME	a	V	152.0	–	16.31
04-jan-2000	ME	a	V	152.0	<169 +/- 124U	–
W-865-06						
18-jan-2000	TN	a	V	120.0	<200 +/- 120U	–
19-jan-2000	TN	a	V	139.0	<200 +/- 120U	–
19-jan-2000	TN	a	V	161.0	<200 +/- 110U	–
20-jan-2000	TN	a	V	180.0	<200 +/- 100U	–
20-jan-2000	TN	a	V	200.0	<200 +/- 110U	–

Table A-2. Surface/subsurface soil and rock moisture analyses for tritium (pCi/Lsm) in samples collected from the Pit 7 Complex between July 1, 1995 and June 30, 2003. Results recorded by December 4, 2003.

Location Date	Lab	Note	Val.	Depth (ft)	Tritium (pCi/L)	Moisture by Weight (percent)
W-865-07						
31-jan-2000	TN	a	N	25.0	<200 +/- 110U	-
31-jan-2000	TN	a	N	30.0	<200 +/- 100U	-
31-jan-2000	TN	a	N	35.0	<200 +/- 110U	-
31-jan-2000	TN	a	N	40.0	<200 +/- 120U	-

See following page for notes

Table A-2. Surface/subsurface soil and rock moisture analyses for tritium (pCi/Lsm) in samples collected from the Pit 7 Complex between July 1, 1995 and June 30, 2003. Results recorded by December 4, 2003.

Notes:

- Indicates no analysis performed for this compound

Val. = Validation code

Footnotes:

a	ERD data
b	ORAD WGMG data
c	Analytical results for this sample are suspect
d	Sample collected during hydraulic testing
e	Blind sample, sent to lab without location identity
f	Sample dilution necessary for analysis; detection limits increased
g	Interlaboratory collocated sample
h	Intralaboratory collocated sample
i	Sample collected as part of pilot study
j	Note field may contain important information regarding this sample
k	Pre-development sample
l	Norm month, norm quarter or norm year inconsistent with sample date
m	Confirmation sample
n	Sample analyzed after standard holding time
o	Sample comprised of partial composite
p	Alpha spectroscopy analysis of uranium isotopes
q	Gamma spectroscopy analysis of uranium isotopes
r	Tritium data represents non-detect with activity calc'd for 100 percent error.

Lab Codes:

GE	General Engineering Laboratori	PO 30712, Charleston, SC 29417
ME	LLNL C&MS Environmental Servic	LLNL
TN	Eberline Services	2030 Wright Ave, Richmond, CA 94804

Validation Codes:

V	Validated
N	Not validated (default value)
U	Undeclared
H	Historical comparison only

CLP flags: (follow result)

B	Analyte found in method blank
D	Analysis performed at a secondary dilution or concentration (i.e., vapor samples)
E	The analyte was detected below the LLNL reporting limit, but above the analytical laboratory minimum detection limit.
F	Analyte found in field blank, trip blank, or equipment blank
G	Quantitated using fuel calibration, but does not match typical fuel fingerprint (fuel maybe gasoline, diesel, motor oil etc.).
H	Sample analyzed outside of holding time, sample results should be evaluated
J	Analyte was postively identified; the associated numerical value is the approximate concentration of the analyte in the sample.
L	Spike accuracy not within control limits
O	Duplicate spike or sample precision not within control limits
P	Indicates that the absence of a data qualifier flag does not mean that the data does not need qualification, but that the implementation of electronic data qualifier flags was not yet established
R	Sample results are rejected due to serious deficiencies in the ability to analyze the sample and meet QC criteria. The presence or absence of the analyte cannot be verified
S	Analytical results for this sample are suspect
T	Analyte is tentatively identified compound; result is approximate
U	Compound was analyzed for, but not detected above detection limit

Table A-3. Lysimeter soil moisture analyses for tritium (pCi/L) in samples collected from the Pit 7 Complex between July 1, 1995 and June 30, 2003. Results recorded by December 4, 2003.

Lysimeter soil moisture tritiums
December 8, 2003
gemini2

S3tritLY.08dec2003

Min Sample Date
July 1, 1995
Max Sample Date
June 30, 2003

Table A-3. Lysimeter soil moisture analyses for tritium (pCi/L) in samples collected from the Pit 7 Complex between July 1, 1995 and June 30, 2003. Results recorded by December 4, 2003.

Location Date	Lab	Note	Val.	Depth (ft)	Tritium Activity
K7-08A					
07-sep-1995	IT	a	V	0.0	<92.6 +/- 27.7U
22-mar-1996	LH	a	V	0.0	<88 +/- 71U
16-may-1997	LH	a	V	0.0	<87 +/- 50U
25-mar-1998	QU	a	V	0.0	<141 +/- 80.5U
26-jun-1998	QU	a	V	0.0	<139 +/- 83.1U
11-sep-1998	QU	a	V	0.0	<120 +/- 70.3U
23-dec-1998	QU	a	V	0.0	118 +/- 72
NC7-01					
22-mar-1996	LH	a	V	0.0	6810 +/- 320
06-mar-1997	LH	a	V	0.0	7100 +/- 460JO
16-may-1997	LH	a	V	0.0	5990 +/- 390B
05-sep-1997	LH	a	V	0.0	6070 +/- 490
31-dec-1997	FG	a	V	0.0	6600 +/- 200H
25-mar-1998	QU	a	V	0.0	4910 +/- 509
26-jun-1998	QU	a	V	0.0	7470 +/- 757
11-sep-1998	QU	a	V	0.0	7590 +/- 796
23-dec-1998	QU	a	V	0.0	7130 +/- 718
NC7-03					
22-mar-1996	LH	a	V	0.0	39700 +/- 1500
06-mar-1997	LH	a	V	0.0	27900 +/- 1800J
16-may-1997	LH	a	V	0.0	24100 +/- 1500
25-mar-1998	QU	a	V	0.0	21900 +/- 2200
26-jun-1998	QU	a	V	0.0	76300 +/- 7630
NC7-04					
22-mar-1996	LH	a	V	0.0	184 +/- 78
06-mar-1997	LH	a	V	0.0	271 +/- 75JO
25-mar-1998	QU	a	V	0.0	<142 +/- 83U
NC7-05A					
22-mar-1996	LH	a	V	0.0	250 +/- 81
NC7-06					
07-sep-1995	IT	a	V	0.0	41700 +/- 138
08-dec-1995	IT	a	V	0.0	39600 +/- 412
22-mar-1996	LH	a	V	0.0	41100 +/- 1500
08-aug-1996	LH	a	V	0.0	40400 +/- 2600O
14-nov-1996	LH	a	V	0.0	40000 +/- 2500
06-mar-1997	LH	a	V	0.0	37300 +/- 2300J
NC7-07					
07-sep-1995	IT	a	V	0.0	76000 +/- 232
22-mar-1996	LH	a	V	0.0	77200 +/- 2800
08-aug-1996	LH	a	V	0.0	57400 +/- 3200O
14-nov-1996	LH	a	V	0.0	26200 +/- 1700
06-mar-1997	LH	a	V	0.0	23100 +/- 1500JO
25-mar-1998	QU	a	V	0.0	42600 +/- 4260
NC7-13					
06-mar-1997	LH	a	V	0.0	3.56e+06 +/- 180000J
16-may-1997	ME	a h	V	0.0	3.27e+06 +/- 0.1%
16-may-1997	ME	ah	V	0.0	3.26e+06 +/- 0.1%
25-mar-1998	QU	a	V	0.0	2.7e+06 +/- 270000
NC7-39A					
07-sep-1995	IT	a	V	0.0	2230 +/- 43
08-dec-1995	IT	a	V	0.0	2870 +/- 48
22-mar-1996	LH	a	V	0.0	130 +/- 76
08-aug-1996	LH	a	V	0.0	170 +/- 69O
26-jun-1998	QU	a	V	0.0	<142 +/- 85.4U
NC7-39B					
22-mar-1996	LH	a	V	0.0	26900 +/- 1000
08-aug-1996	LH	a	V	0.0	28600 +/- 1800O

Table A-3. Lysimeter soil moisture analyses for tritium (pCi/L) in samples collected from the Pit 7 Complex between July 1, 1995 and June 30, 2003. Results recorded by December 4, 2003.

Location Date	Lab	Note	Val.	Depth (ft)	Tritium Activity
NC7-39B (continued)					
06-mar-1997	LH	a	V	0.0	22700 +/- 1500JO
16-may-1997	LH	a	V	0.0	23800 +/- 1500
25-mar-1998	QU	a	V	0.0	21700 +/- 2170
26-jun-1998	QU	a	V	0.0	32700 +/- 3270
11-sep-1998	QU	a	V	0.0	38300 +/- 3830

See following page for notes

Table A-3. Lysimeter soil moisture analyses for tritium (pCi/L) in samples collected from the Pit 7 Complex between July 1, 1995 and June 30, 2003. Results recorded by December 4, 2003.

Notes:

\- Indicates no analysis performed for this compound

Val. = Validation code

Footnotes:

a	ERD data
b	ORAD WGMG data
c	Analytical results for this sample are suspect
d	Sample collected during hydraulic testing
e	Blind sample, sent to lab without location identity
f	Sample dilution necessary for analysis; detection limits increased
g	Interlaboratory collocated sample
h	Intralaboratory collocated sample
i	Sample collected as part of pilot study
j	Note field may contain important information regarding this sample
k	Pre-development sample
l	Norm month, norm quarter or norm year inconsistent with sample date
m	Confirmation sample
n	Sample analyzed after standard holding time
o	Sample comprised of partial composite
p	Alpha spectroscopy analysis of uranium isotopes
q	Gamma spectroscopy analysis of uranium isotopes
r	Tritium data represents non-detect with activity calc'd for 100 percent error.

Lab Codes:

FG	Fruit Growers Laboratory, Inc.	853 Corporation St. Santa Paula, Ca 93061-0272
IT	International Technology Corp.	IS was used for short time.
LH	LAS-formerly Lockheed<1jan97	975 Kelly Johnson Las Vegas NV 89119
ME	LLNL C&MS Environmental Servic	LLNL
QU	Quanterra Env. Serv.,St.Louis	13715 Rider Trail North, Earth City, MO 63045

Validation Codes:

V	Validated
N	Not validated (default value)
U	Undeclared
H	Historical comparison only

CLP flags: (follow result)

B	Analyte found in method blank
D	Analysis performed at a secondary dilution or concentration (i.e., vapor samples)
E	The analyte was detected below the LLNL reporting limit, but above the analytical laboratory minimum detection limit.
F	Analyte found in field blank, trip blank, or equipment blank
G	Quantitated using fuel calibration, but does not match typical fuel fingerprint (fuel maybe gasoline, diesel, motor oil etc.).
H	Sample analyzed outside of holding time, sample results should be evaluated
J	Analyte was postively identified; the associated numerical value is the approximate concentration of the analyte in the sample.
L	Spike accuracy not within control limits
O	Duplicate spike or sample precision not within control limits
P	Indicates that the absence of a data qualifier flag does not mean that the data does not need qualification, but that the implementation of electronic data qualifier flags was not yet established
R	Sample results are rejected due to serious deficiencies in the ability to analyze the sample and meet QC criteria. The presence or absence of the analyte cannot be verified
S	Analytical results for this sample are suspect
T	Analyte is tentatively identified compound; result is approximate
U	Compound was analyzed for, but not detected above detection limit

Table A-4. Surface/subsurface soil and rock mass spectrometric analyses for uranium isotopes (pCi/g) and U235/U238 atom ratio, Pit 7 Complex, between July 1, 1995 and June 30, 2003. Results recorded by February 3, 2004.

SO Uranium by mass spec and ratio, Site 300
February 4, 2004
gemini1

s3umassspecsoL.04feb2004
s3umassspecsoR.04feb2004

Min Sample Date
July 1, 1995
Max Sample Date
June 30, 2004

Table A-4. Surface/subsurface soil and rock mass spectrometric analyses for uranium isotopes

Location Date	Lab	Val. Note	Depth (ft)	Total Uranium by mass measurement	Uranium 234 by mass measurement	Uranium 235 by mass measurement
PIT3-06						
10-nov-1999	IC a	N	4.0	2.171 +/- 0.011	0.479 +/- 0.004	0.034 +/- 0.0002
10-nov-1999	IC a	N	9.0	9.909 +/- 0.052	1.28 +/- 0.011	0.1106 +/- 0.0007
10-nov-1999	IC a	N	14.0	3.983 +/- 0.017	1.686 +/- 0.011	0.0895 +/- 0.0006
PIT3-07						
05-nov-1999	IC a	N	4.0	6.325 +/- 0.025	0.841 +/- 0.006	0.0722 +/- 0.0003
05-nov-1999	IC a	N	9.0	4.444 +/- 0.018	0.622 +/- 0.005	0.0523 +/- 0.0002
05-nov-1999	IC a	N	13.5	5.751 +/- 0.023	0.724 +/- 0.006	0.0645 +/- 0.0003
PIT3-08						
08-nov-1999	IC a	N	4.0	8.907 +/- 0.037	1.199 +/- 0.01	0.1013 +/- 0.0005
08-nov-1999	IC a	N	4.5	24.818 +/- 0.138	2.663 +/- 0.026	0.268 +/- 0.0018
08-nov-1999	IC a	N	10.0	17.365 +/- 0.094	1.757 +/- 0.018	0.173 +/- 0.0011
08-nov-1999	IC a	N	18.5	24.441 +/- 0.131	2.782 +/- 0.023	0.2504 +/- 0.0016
08-nov-1999	IC a	N	22.0	234.827 +/- 1.292	20.782 +/- 0.173	2.3219 +/- 0.0149
PIT3-09						
11-nov-1999	IC a	N	4.0	2.009 +/- 0.01	0.35 +/- 0.003	0.0267 +/- 0.0002
11-nov-1999	IC a	N	9.0	14.562 +/- 0.078	1.618 +/- 0.014	0.1612 +/- 0.001
11-nov-1999	IC a	N	14.0	34.182 +/- 0.186	3.335 +/- 0.028	0.3474 +/- 0.0022
11-nov-1999	IC a	N	19.5	3.648 +/- 0.016	1.278 +/- 0.009	0.073 +/- 0.0005
11-nov-1999	IC a	N	24.0	1.793 +/- 0.008	0.71 +/- 0.005	0.0438 +/- 0.0003
PIT3-10						
01-nov-1999	IC a	N	4.0	6.815 +/- 0.027	1.077 +/- 0.008	0.0814 +/- 0.0004
01-nov-1999	IC a	N	9.5	6.15 +/- 0.024	0.852 +/- 0.008	0.0695 +/- 0.0003
01-nov-1999	IC a	N	14.0	41.491 +/- 0.164	4.709 +/- 0.032	0.4474 +/- 0.002
01-nov-1999	IC a	N	18.5	36.104 +/- 0.152	4.024 +/- 0.031	0.3868 +/- 0.0019
01-nov-1999	IC a	N	24.0	3.725 +/- 0.014	0.58 +/- 0.004	0.0453 +/- 0.0002
01-nov-1999	IC a	N	29.0	2.964 +/- 0.01	0.99 +/- 0.006	0.0567 +/- 0.0003
PIT3-11						
05-nov-1999	IC a	N	4.0	2.318 +/- 0.009	0.361 +/- 0.003	0.0282 +/- 0.0001
05-nov-1999	IC a	N	9.0	22.888 +/- 0.098	2.64 +/- 0.022	0.2478 +/- 0.0012
05-nov-1999	IC a	N	13.5	27.673 +/- 0.112	3.112 +/- 0.03	0.3013 +/- 0.0014
05-nov-1999	IC a	N	18.5	1.932 +/- 0.007	0.44 +/- 0.003	0.0281 +/- 0.0001
05-nov-1999	IC a	N	23.5	1.129 +/- 0.004	0.468 +/- 0.003	0.0276 +/- 0.0001
PIT3-13						
03-nov-1999	IC a	N	4.5	1.043 +/- 0.004	0.477 +/- 0.003	0.0235 +/- 0.0001
03-nov-1999	IC a	N	14.0	54.897 +/- 0.229	5.381 +/- 0.055	0.5537 +/- 0.0025
03-nov-1999	IC a	N	19.0	2.503 +/- 0.011	0.453 +/- 0.006	0.0325 +/- 0.0002
03-nov-1999	IC a	N	24.0	3.161 +/- 0.012	0.528 +/- 0.004	0.04 +/- 0.0002
03-nov-1999	IC a	N	28.5	2.769 +/- 0.01	0.754 +/- 0.005	0.0465 +/- 0.0002
PIT5-03						
23-nov-1999	IC a	N	3.5	0.935 +/- 0.006	0.456 +/- 0.005	0.0213 +/- 0.0001
23-nov-1999	IC a	N	9.5	1.479 +/- 0.007	0.764 +/- 0.006	0.0318 +/- 0.0002
23-nov-1999	IC a	N	14.5	1.194 +/- 0.005	0.589 +/- 0.004	0.0263 +/- 0.0002
23-nov-1999	IC a	N	19.0	0.597 +/- 0.004	0.261 +/- 0.003	0.0143 +/- 0.0001
23-nov-1999	IC a	N	24.0	2.235 +/- 0.01	0.887 +/- 0.006	0.0593 +/- 0.0004
23-nov-1999	IC a	N	27.0	1.557 +/- 0.007	0.584 +/- 0.004	0.043 +/- 0.0003
PIT5-19						
01-dec-1999	IC a	N	5.0	1.451 +/- 0.007	0.691 +/- 0.005	0.0337 +/- 0.0002
01-dec-1999	IC a	N	9.0	9.27 +/- 0.049	1.34 +/- 0.011	0.1178 +/- 0.0008
01-dec-1999	IC a	N	13.5	4.192 +/- 0.021	0.801 +/- 0.007	0.0576 +/- 0.0004
01-dec-1999	IC a	N	16.0	0.768 +/- 0.005	0.375 +/- 0.004	0.0174 +/- 0.0001
PIT5-20						
02-dec-1999	IC a	N	5.0	1.186 +/- 0.006	0.587 +/- 0.005	0.0254 +/- 0.0001
02-dec-1999	IC a	N	9.0	4.3 +/- 0.025	0.778 +/- 0.01	0.0556 +/- 0.0004
02-dec-1999	IC a	N	14.0	4.482 +/- 0.02	0.844 +/- 0.008	0.0588 +/- 0.0003

(pCi/g) and U235/U238 atom ratio, Pit 7 Complex, between July 1, 1995 and June 30, 2003.
Results recorded by February 3, 2004.

Uranium 236 by mass measurement	Uranium 238 by mass measurement	Uranium 235/238 (atom ratio)	Location Date
			PIT3-06
0.0081 +/- 0.0002	1.65 +/- 0.01	0.003204 +/- 7e-06	10-nov-1999
0.0592 +/- 0.0012	8.46 +/- 0.051	0.002032 +/- 4e-06	10-nov-1999
<0.007 +/- 0.0001U	2.205 +/- 0.013	0.00631 +/- 1.2e-05	10-nov-1999
			PIT3-07
0.0346 +/- 0.0008	5.377 +/- 0.024	0.002089 +/- 1e-06	05-nov-1999
0.0227 +/- 0.0005	3.747 +/- 0.017	0.00217 +/- 1e-06	05-nov-1999
0.0307 +/- 0.0007	4.932 +/- 0.022	0.002034 +/- 1e-06	05-nov-1999
			PIT3-08
0.0505 +/- 0.0014	7.556 +/- 0.035	0.002086 +/- 1e-06	08-nov-1999
0.1543 +/- 0.0026	21.733 +/- 0.135	0.001918 +/- 4e-06	08-nov-1999
0.1193 +/- 0.002	15.316 +/- 0.093	0.001757 +/- 3e-06	08-nov-1999
0.1603 +/- 0.0028	21.248 +/- 0.129	0.001832 +/- 4e-06	08-nov-1999
1.6735 +/- 0.0238	210.05 +/- 1.28	0.001719 +/- 3e-06	08-nov-1999
			PIT3-09
0.0096 +/- 0.0002	1.623 +/- 0.01	0.002558 +/- 5e-06	11-nov-1999
0.0911 +/- 0.0016	12.692 +/- 0.077	0.001975 +/- 4e-06	11-nov-1999
0.1936 +/- 0.0035	30.306 +/- 0.184	0.001783 +/- 4e-06	11-nov-1999
<0.007 +/- 0.0002U	2.29 +/- 0.014	0.004953 +/- 1e-05	11-nov-1999
<0.007 +/- 0.0001U	1.039 +/- 0.006	0.006555 +/- 1.3e-05	11-nov-1999
			PIT3-10
0.038 +/- 0.0009	5.619 +/- 0.026	0.002253 +/- 1e-06	01-nov-1999
0.0324 +/- 0.0008	5.196 +/- 0.023	0.00208 +/- 1e-06	01-nov-1999
0.2456 +/- 0.0053	36.089 +/- 0.161	0.001928 +/- 1e-06	01-nov-1999
0.2041 +/- 0.005	31.489 +/- 0.149	0.00191 +/- 1e-06	01-nov-1999
0.0189 +/- 0.0005	3.08 +/- 0.014	0.002285 +/- 1e-06	01-nov-1999
<0.007 +/- 0.0003U	1.911 +/- 0.008	0.004614 +/- 1e-06	01-nov-1999
			PIT3-11
0.0113 +/- 0.0003	1.917 +/- 0.009	0.00229 +/- 1e-06	05-nov-1999
0.1318 +/- 0.0034	19.868 +/- 0.095	0.00194 +/- 1e-06	05-nov-1999
0.1638 +/- 0.0039	24.096 +/- 0.108	0.001944 +/- 1e-06	05-nov-1999
0.0079 +/- 0.0002	1.456 +/- 0.007	0.002996 +/- 1e-06	05-nov-1999
<0.007 +/- 0.0002U	0.633 +/- 0.03	0.006777 +/- 3e-06	05-nov-1999
			PIT3-13
<0.007 +/- 0.0002U	0.542 +/- 0.003	0.006744 +/- 4e-06	03-nov-1999
0.3374 +/- 0.0079	48.625 +/- 0.222	0.001771 +/- 1e-06	03-nov-1999
0.0119 +/- 0.0003	2.006 +/- 0.009	0.002519 +/- 1e-06	03-nov-1999
0.0154 +/- 0.0004	2.578 +/- 0.012	0.002411 +/- 1e-06	03-nov-1999
0.0084 +/- 0.0003	1.96 +/- 0.009	0.003688 +/- 2e-06	03-nov-1999
			PIT5-03
<0.007 +/- 0.0006U	0.458 +/- 0.003	0.007239 +/- 1.5e-05	23-nov-1999
<0.007 +/- 0.0009U	0.683 +/- 0.004	0.007249 +/- 1.5e-05	23-nov-1999
<0.007 +/- 0.0005U	0.579 +/- 0.003	0.007048 +/- 1.5e-05	23-nov-1999
<0.007 +/- 0.0002U	0.322 +/- 0.002	0.006927 +/- 1.5e-05	23-nov-1999
<0.007 +/- 0.0002U	1.289 +/- 0.008	0.007161 +/- 1.5e-05	23-nov-1999
<0.007 +/- 0.0002U	0.93 +/- 0.006	0.007196 +/- 1.5e-05	23-nov-1999
			PIT5-19
<0.007 +/- 0.0002U	0.727 +/- 0.004	0.007214 +/- 1.5e-05	01-dec-1999
0.0449 +/- 0.0011	7.768 +/- 0.048	0.002359 +/- 5e-06	01-dec-1999
0.0202 +/- 0.0005	3.313 +/- 0.02	0.002701 +/- 6e-06	01-dec-1999
<0.007 +/- 0.0006U	0.376 +/- 0.002	0.007212 +/- 1.6e-05	01-dec-1999
			PIT5-20
<0.007 +/- 0.0001U	0.573 +/- 0.003	0.006885 +/- 6e-06	02-dec-1999
0.0184 +/- 0.0007	3.448 +/- 0.022	0.002508 +/- 6e-06	02-dec-1999
0.0184 +/- 0.0007	3.561 +/- 0.018	0.00257 +/- 3e-06	02-dec-1999

Table A-4. Surface/subsurface soil and rock mass spectrometric analyses for uranium isotopes

Location Date	Lab	Val. Note	Depth (ft)	Total Uranium by mass measurement	Uranium 234 by mass measurement	Uranium 235 by mass measurement
PIT5-21						
02-dec-1999	IC a	N	4.5	209.39 +/- 0.98	22.65 +/- 0.25	2.3795 +/- 0.0125
02-dec-1999	IC a	N	8.5	3.711 +/- 0.016	0.681 +/- 0.006	0.0507 +/- 0.0003
02-dec-1999	IC a	N	14.0	7.588 +/- 0.032	1.344 +/- 0.011	0.0974 +/- 0.0005
PIT5-22						
06-dec-1999	IC a	N	4.0	20.705 +/- 0.089	3.017 +/- 0.023	0.2426 +/- 0.0012
06-dec-1999	IC a	N	9.0	8.745 +/- 0.049	1.302 +/- 0.031	0.0975 +/- 0.0005
06-dec-1999	IC a	N	14.0	1.383 +/- 0.006	0.628 +/- 0.005	0.0321 +/- 0.0002
W-PIT3-01						
15-nov-1999	IC a	N	4.5	0.791 +/- 0.003	0.342 +/- 0.002	0.0198 +/- 0.0001
15-nov-1999	IC a	N	9.5	1.112 +/- 0.005	0.506 +/- 0.003	0.0271 +/- 0.0002
15-nov-1999	IC a	N	14.5	1.463 +/- 0.009	0.686 +/- 0.007	0.0343 +/- 0.0003
15-nov-1999	IC a	N	19.0	3.108 +/- 0.014	1.514 +/- 0.01	0.0705 +/- 0.0005
W-PIT3-02						
16-nov-1999	IC a	N	4.5	0.877 +/- 0.004	0.398 +/- 0.003	0.0204 +/- 0.0001
16-nov-1999	IC a	N	9.5	1.53 +/- 0.007	0.483 +/- 0.003	0.0271 +/- 0.0002
16-nov-1999	IC a	N	14.0	1.245 +/- 0.006	0.439 +/- 0.003	0.0239 +/- 0.0002
W-PIT5-01						
17-nov-1999	IC a	N	5.0	1.426 +/- 0.007	0.43 +/- 0.004	0.0233 +/- 0.0002
17-nov-1999	IC a	N	10.0	2.285 +/- 0.013	0.218 +/- 0.005	0.0346 +/- 0.0002
17-nov-1999	IC a	N	15.0	0.585 +/- 0.005	0.102 +/- 0.004	0.0142 +/- 0.0001
17-nov-1999	IC a	N	19.0	1.479 +/- 0.009	0.568 +/- 0.007	0.0354 +/- 0.0002
W-PIT5-02						
22-nov-1999	IC a	N	5.0	1.164 +/- 0.012	0.433 +/- 0.011	0.023 +/- 0.0002
22-nov-1999	IC a	N	9.0	0.796 +/- 0.004	0.263 +/- 0.003	0.0184 +/- 0.0001
22-nov-1999	IC a	N	14.5	0.436 +/- 0.003	0.16 +/- 0.003	0.0121 +/- 0.0001
22-nov-1999	IC a	N	18.5	2.339 +/- 0.011	0.827 +/- 0.007	0.0431 +/- 0.0003
22-nov-1999	IC a	N	23.5	2.433 +/- 0.012	0.905 +/- 0.008	0.0602 +/- 0.0004
22-nov-1999	IC a	N	29.0	4.625 +/- 0.028	2.141 +/- 0.021	0.1102 +/- 0.0009
W-865-04						
03-jan-2000	IC a	N	100.0	2.713 +/- 0.009	1.354 +/- 0.007	0.0606 +/- 0.0003
03-jan-2000	IC a	N	110.0	2.733 +/- 0.011	1.289 +/- 0.009	0.0641 +/- 0.0003
03-jan-2000	IC a	N	118.0	1.515 +/- 0.007	0.761 +/- 0.006	0.0336 +/- 0.0002
04-jan-2000	IC a	N	124.5	1.743 +/- 0.006	0.892 +/- 0.005	0.0377 +/- 0.0002
04-jan-2000	IC a	N	152.0	2.072 +/- 0.008	1.013 +/- 0.006	0.0471 +/- 0.0002

(pCi/g) and U235/U238 atom ratio, Pit 7 Complex, between July 1, 1995 and June 30, 2003. Results recorded by February 3, 2004.

m

Uranium 236 by mass measurement	Uranium 238 by mass measurement	Uranium 235/238 (atom ratio)	Location Date
			PIT5-21
0.7254 +/- 0.0283	183.635 +/- 0.947	0.002015 +/- 2e-06	02-dec-1999
0.0149 +/- 0.0005	2.964 +/- 0.015	0.00266 +/- 3e-06	02-dec-1999
0.0327 +/- 0.0009	6.114 +/- 0.031	0.002477 +/- 2e-06	02-dec-1999
			PIT5-22
0.1005 +/- 0.0022	17.345 +/- 0.086	0.002175 +/- 2e-06	06-dec-1999
0.0453 +/- 0.0015	7.3 +/- 0.038	0.002078 +/- 2e-06	06-dec-1999
<0.007 +/- 0.0002U	0.723 +/- 0.004	0.006913 +/- 7e-06	06-dec-1999
			W-PIT3-01
<0.007 +/- 0.0001U	0.429 +/- 0.003	0.007162 +/- 1.4e-05	15-nov-1999
<0.007 +/- 0.0001U	0.579 +/- 0.003	0.007272 +/- 1.4e-05	15-nov-1999
<0.007 +/- 0.0001U	0.743 +/- 0.005	0.007168 +/- 2.3e-05	15-nov-1999
<0.007 +/- 0.0001U	1.523 +/- 0.009	0.007195 +/- 1.5e-05	15-nov-1999
			W-PIT3-02
<0.007 +/- 0.0001U	0.458 +/- 0.003	0.00692 +/- 1.4e-05	16-nov-1999
<0.007 +/- 0.0001U	1.016 +/- 0.006	0.004152 +/- 8e-06	16-nov-1999
<0.007 +/- 0.0001U	0.78 +/- 0.005	0.00477 +/- 9e-06	16-nov-1999
			W-PIT5-01
<0.007 +/- 0.0001U	0.968 +/- 0.006	0.003745 +/- 8e-06	17-nov-1999
0.0102 +/- 0.0005	2.023 +/- 0.013	0.00266 +/- 6e-06	17-nov-1999
<0.007 +/- 0.0003U	0.468 +/- 0.003	0.004718 +/- 1.1e-05	17-nov-1999
<0.007 +/- 0.0005U	0.876 +/- 0.005	0.00629 +/- 1.3e-05	17-nov-1999
			W-PIT5-02
<0.007 +/- 0.0002U	0.705 +/- 0.004	0.005079 +/- 1.1e-05	22-nov-1999
<0.007 +/- 0.0002U	0.514 +/- 0.003	0.005564 +/- 1.2e-05	22-nov-1999
<0.007 +/- 0.0003U	0.264 +/- 0.002	0.007153 +/- 1.6e-05	22-nov-1999
<0.007 +/- 0.0002U	1.465 +/- 0.009	0.00458 +/- 1e-05	22-nov-1999
<0.007 +/- 0.0006U	1.467 +/- 0.009	0.006374 +/- 1.5e-05	22-nov-1999
<0.007 +/- 0.0004U	2.374 +/- 0.018	0.00722 +/- 1.9e-05	22-nov-1999
			W-865-04
<0.007 +/- 0.0005U	1.299 +/- 0.006	0.007249 +/- 6e-06	03-jan-2000
<0.007 +/- 0.0003U	1.38 +/- 0.007	0.007221 +/- 7e-06	03-jan-2000
<0.007 +/- 0.0003U	0.721 +/- 0.004	0.007247 +/- 6e-06	03-jan-2000
<0.007 +/- 0.0004U	0.813 +/- 0.004	0.007218 +/- 7e-06	04-jan-2000
<0.007 +/- 0.0003U	1.012 +/- 0.005	0.007243 +/- 7e-06	04-jan-2000

See following page for notes

Table A-4. Surface/subsurface soil and rock mass spectrometric analyses for uranium isotopes (pCi/g) and U235/U238 atom ratio, Pit 7 Complex, between July 1, 1995 and June 30, 2003. Results recorded by February 3, 2004.

Notes:

- Indicates no analysis performed for this compound

Val. = Validation code

Footnotes:

a	ERD data
b	ORAD WGMG data
c	Analytical results for this sample are suspect
d	Sample collected during hydraulic testing
e	Blind sample, sent to lab without location identity
f	Sample dilution necessary for analysis; detection limits increased
g	Interlaboratory collocated sample
h	Intralaboratory collocated sample
i	Sample collected as part of pilot study
j	Note field may contain important information regarding this sample
k	Pre-development sample
l	Norm month, norm quarter or norm year inconsistent with sample date
m	Confirmation sample
n	Sample analyzed after standard holding time
o	Sample comprised of partial composite
p	Alpha spectroscopy analysis of uranium isotopes
q	Gamma spectroscopy analysis of uranium isotopes
r	Tritium data represents non-detect with activity calc'd for 100 percent error.

Lab Codes:

IC	ICP MS Facility

Validation Codes:

V	Validated
N	Not validated (default value)
U	Undeclared
H	Historical comparison only

CLP flags: (follow result)

B	Analyte found in method blank
D	Analysis performed at a secondary dilution or concentration (i.e., vapor samples)
E	The analyte was detected below the LLNL reporting limit, but above the analytical laboratory minimum detection limit.
F	Analyte found in field blank, trip blank, or equipment blank
G	Quantitated using fuel calibration, but does not match typical fuel fingerprint (fuel maybe gasoline, diesel, motor oil etc.).
H	Sample analyzed outside of holding time, sample results should be evaluated
J	Analyte was postively identified; the associated numerical value is the approximate concentration of the analyte in the sample.
L	Spike accuracy not within control limits
O	Duplicate spike or sample precision not within control limits
P	Indicates that the absence of a data qualifier flag does not mean that the data does not need qualification, but that the implementation of electronic data qualifier flags was not yet established
R	Sample results are rejected due to serious deficiencies in the ability to analyze the sample and meet QC criteria. The presence or absence of the analyte cannot be verified
S	Analytical results for this sample are suspect
T	Analyte is tentatively identified compound; result is approximate
U	Compound was analyzed for, but not detected above detection limit

Table A-5. Ground and surface water analyses for tritium (pCi/L) in samples collected from the Pit 7 Complex between July 1, 1995 and June 30, 2003. Results recorded by December 18, 2003.

Tritium in Ground Water, Site 300
December 19, 2003
gemini2

s3trit.19dec2003

Min Sample Date
July 1, 1995
Max Sample Date
June 30, 2003

Table A-5. Ground and surface water analyses for tritium (pCi/L) in samples collected from the Pit 7 Complex between July 1, 1995 and June 30, 2003. Results recorded by December 18, 2003.

Location Date	Lab	Note	Val.	Tritium Activity
MUL2				
06-sep-1996	ME	a	V	<57.1 +/- 100% U
08-sep-1997	ME	a	V	<31.9 +/- 100% U
16-sep-1998	ME	a	V	<82.3 +/- 65.9U
08-sep-1999	ME	ah	V	<68.8 +/- 56.1U
08-sep-1999	ME	aeh	V	<69.2 +/- 53.1U
06-sep-2000	ME	a	V	<54.6 +/- 43LU
05-sep-2001	TN	ah	V	<100 +/- 58U
05-sep-2001	TN	aeh	V	<102 +/- 59U
17-sep-2002	TN	ah	V	<100 +/- 56U
17-sep-2002	TN	aeh	V	<100 +/- 58U
K7-01				
14-jul-1995	ME	a	V	29500 +/- 1.1%
17-oct-1995	ME	ah	V	25400 +/- 1.3%
17-oct-1995	ME	aeh	V	25600 +/- 1.3%
07-feb-1996	ME	a	V	24500 +/- 1.3%
24-apr-1996	ME	a	V	28700 +/- 1.1%
25-jul-1996	ME	ah	V	28800 +/- 1.2%
25-jul-1996	ME	aeh	V	29000 +/- 1.2%
18-oct-1996	ME	a	V	28600 +/- 1.2%
22-jan-1997	ME	ah	V	31000 +/- 1.3%
22-jan-1997	ME	aeh	V	31100 +/- 1.3%
08-apr-1997	ME	a	V	35600 +/- 0.9%
23-jul-1997	ME	a	V	43000 +/- 0.8%
21-oct-1997	ME	ah	V	42600 +/- 0.8%
21-oct-1997	ME	aeh	V	43200 +/- 0.8%
14-jan-1998	ME	a	V	43700 +/- 350
20-apr-1998	ME	a	V	60800 +/- 426
21-jul-1998	ME	a	V	61800 +/- 433
19-oct-1998	ME	ah	N	66600 +/- 622
19-oct-1998	ME	aeh	N	67300 +/- 623
19-jan-1999	ME	ah	N	64300 +/- 606
19-jan-1999	ME	aeh	N	64300 +/- 608
22-apr-1999	ME	a	N	62400 +/- 588
20-jul-1999	ME	a	N	67000 +/- 554
07-oct-1999	ME	ah	V	72900 +/- 629
07-oct-1999	ME	aeh	V	70500 +/- 618
11-feb-2000	ME	a	V	64300 +/- 561
25-apr-2000	ME	ah	V	66800 +/- 548
25-apr-2000	ME	aeh	V	65700 +/- 543
24-jul-2000	ME	a	V	66800 +/- 563
30-oct-2000	TN	ah	V	62100 +/- 6900
30-oct-2000	TN	aeh	V	62300 +/- 7000
23-jan-2001	TN	a	V	63800 +/- 6400
24-apr-2001	TN	a	V	63700 +/- 6400
17-jul-2001	TN	ah	V	64400 +/- 6500
17-jul-2001	TN	aeh	V	65400 +/- 6600
24-oct-2001	TN	a	N	64800 +/- 6500
23-jan-2002	TN	a	V	67500 +/- 6800
22-apr-2002	TN	aeh	V	63700 +/- 6400
22-apr-2002	TN	ah	V	64100 +/- 6400
13-sep-2002	TN	a	V	64600 +/- 6500
27-nov-2002	TN	ah	V	63100 +/- 6300
27-nov-2002	TN	ah	V	65600 +/- 6600
10-feb-2003	TN	a	N	67200 +/- 6800
01-may-2003	TN	ah	V	66600 +/- 6700
01-may-2003	TN	aeh	V	65200 +/- 6600
K7-03				
14-jul-1995	ME	ah	V	118000 +/- 0.6%
14-jul-1995	ME	aeh	V	143000 +/- 0.5%
18-oct-1995	NC	a	V	138000 +/- 0.5%
07-feb-1996	ME	a	V	151000 +/- 0.5%
24-apr-1996	ME	ah	V	160000 +/- 0.5%
24-apr-1996	ME	aeh	V	159000 +/- 0.5%
25-jul-1996	ME	a	V	159000 +/- 0.5%

Table A-5. Ground and surface water analyses for tritium (pCi/L) in samples collected from the Pit 7 Complex between July 1, 1995 and June 30, 2003. Results recorded by December 18, 2003.

Location Date	Lab	Note	Val.	Tritium Activity
K7-03 (continued)				
18-oct-1996	ME	a	V	170000 +/- 0.5%
23-jan-1997	ME	a	V	168000 +/- 4.4%
08-apr-1997	ME	ah	V	158000 +/- 0.4%
08-apr-1997	ME	aeh	V	154000 +/- 0.4%
23-jul-1997	ME	a	V	156000 +/- 0.4%
21-oct-1997	ME	a	V	149000 +/- 0.4%
15-jan-1998	ME	ah	V	139000 +/- 556
15-jan-1998	ME	aeh	V	137000 +/- 548
21-apr-1998	ME	a	V	141000 +/- 564
27-jul-1998	ME	a	V	143000 +/- 572F
19-oct-1998	ME	a	N	152000 +/- 940
19-jan-1999	ME	a	N	149000 +/- 923
22-apr-1999	ME	ah	N	118000 +/- 805
22-apr-1999	ME	aeh	N	112000 +/- 788
19-jul-1999	ME	a	N	127000 +/- 830
07-oct-1999	ME	a	V	114000 +/- 788
11-feb-2000	ME	a	V	109000 +/- 727
25-apr-2000	ME	a	V	111000 +/- 705
24-jul-2000	ME	ah	V	108000 +/- 717
24-jul-2000	ME	aeh	V	108000 +/- 715
30-oct-2000	TN	a	V	86000 +/- 9600
23-jan-2001	TN	a	V	109000 +/- 11000
17-apr-2001	TN	ah	V	119000 +/- 12000
17-apr-2001	TN	aeh	V	110000 +/- 11000
17-jul-2001	TN	a	V	121000 +/- 12000
24-oct-2001	TN	a	N	117000 +/- 12000
23-jan-2002	TN	aeh	V	125000 +/- 13000
23-jan-2002	TN	ah	V	130000 +/- 13000
22-apr-2002	TN	a	V	119000 +/- 12000
06-sep-2002	TN	ah	V	110000 +/- 11000
06-sep-2002	TN	aeh	V	110000 +/- 11000
27-nov-2002	TN	a	V	132000 +/- 13000
07-feb-2003	TN	ah	N	126000 +/- 13000
07-feb-2003	TN	aeh	N	125000 +/- 13000
01-may-2003	TN	a	V	121000 +/- 12000
K7-06				
14-jul-1995	ME	a	V	<53.1 +/- 100% U
17-oct-1995	ME	a	V	71 +/- 84.5%
12-feb-1996	ME	ah	V	<56.3 +/- 100% U
12-feb-1996	ME	aeh	V	<53.3 +/- 100% U
24-apr-1996	ME	a	V	<48.2 +/- 100% U
24-jul-1996	ME	a	V	<71.6 +/- 100% U
18-oct-1996	ME	a	V	<63.5 +/- 100% U
22-jan-1997	ME	a	V	<67.6 +/- 100% U
08-apr-1997	ME	a	V	<30 +/- 100% U
23-jul-1997	ME	a	V	<34.1 +/- 100% U
21-oct-1997	ME	a	V	<39.8 +/- 100% U
14-jan-1998	ME	a	V	<34.5 +/- 34.5U
21-apr-1998	ME	ah	V	<32.5 +/- 32.5U
21-apr-1998	ME	aeh	V	<32.4 +/- 32.4U
21-jul-1998	ME	ah	V	<34 +/- 34U
21-jul-1998	ME	aeh	V	<35.7 +/- 35.7U
19-oct-1998	ME	a	N	<86.6 +/- 69U
19-jan-1999	ME	a	N	<98.2 +/- 77.4 U
23-apr-1999	ME	a	N	<61.1 +/- 48.9U
19-jul-1999	ME	ah	N	<73.6 +/- 58.4U
19-jul-1999	ME	aeh	N	<73.2 +/- 57.7U
12-oct-1999	ME	a	V	<89.1 +/- 71.6U
11-feb-2000	ME	a	V	<69 +/- 53.3U
25-apr-2000	ME	a	V	<44.3 +/- 33.8U
24-jul-2000	ME	a	V	<71.9 +/- 59.7U
01-nov-2000	TN	a	V	<108 +/- 64U
06-jun-2001	TN	a	V	<100 +/- 56U
19-jul-2001	TN	a	V	<100 +/- 57U
29-oct-2001	TN	a	N	<102 +/- 60U
30-jan-2002	TN	a	V	<100 +/- 59U

Table A-5. Ground and surface water analyses for tritium (pCi/L) in samples collected from the Pit 7 Complex between July 1, 1995 and June 30, 2003. Results recorded by December 18, 2003.

Location Date	Lab	Note	Val.	Tritium Activity
K7-06 (continued)				
29-apr-2002	TN	a	V	<100 +/- 56U
29-aug-2002	TN	a	V	<100 +/- 53U
03-dec-2002	TN	a	V	<100 +/- 45U
07-feb-2003	TN	a	V	<100 +/- 64U
06-may-2003	TN	a	V	<100 +/- 56U
K7-07				
07-aug-1995	ME	ah	V	26000 +/- 1.2%
07-aug-1995	ME	aeh	V	26300 +/- 1.2%
30-oct-1995	ME	a	V	22500 +/- 1.4%
23-jan-1996	IT	a	V	18400 +/- 197
20-may-1996	ME	a	V	6430 +/- 2.5%
19-nov-1996	ME	a	V	3760 +/- 2.7% F
22-jan-1997	LH	a	V	8080 +/- 520BL
13-may-1997	ME	a	V	4010 +/- 2.8%
18-nov-1997	ME	a	V	7680 +/- 154
02-jun-1998	ME	ah	V	2220 +/- 82.1
02-jun-1998	ME	aeh	V	2110 +/- 82.3
30-nov-1998	ME	a	V	15700 +/- 307
26-may-1999	ME	a	N	6940 +/- 209
18-may-2000	ME	a	V	2740 +/- 117
K7-09				
17-jul-1995	ME	a	V	<53.1 +/- 100% U
18-oct-1995	NC	ah	V	<56.8 +/- 100% U
07-feb-1996	ME	a	V	<55.8 +/- 100% U
26-apr-1996	ME	a	V	<48 +/- 100% U
24-jul-1996	ME	a	V	<72 +/- 100% U
23-oct-1996	ME	a	V	<63.3 +/- 100% U
23-jan-1997	ME	a	V	<28.9 +/- 100% U
10-apr-1997	ME	a	V	<30.3 +/- 100% U
17-jul-1997	ME	a	V	<32.5 +/- 100% U
22-oct-1997	ME	a	V	<39.4 +/- 100% U
21-jan-1998	ME	a	V	<34.2 +/- 34.2U
22-apr-1998	ME	a	V	<31.4 +/- 31.4U
27-jul-1998	ME	a	V	<34.4 +/- 34.4U
20-oct-1998	ME	a	N	<87.6 +/- 69.7U
25-jan-1999	ME	a	N	<82.1 +/- 56.4U
23-apr-1999	ME	a	N	<61.1 +/- 48U
15-jul-1999	ME	a	N	<73.1 +/- 57.4U
11-oct-1999	ME	a	V	<88.6 +/- 70.5U
16-feb-2000	ME	a	V	<66.8 +/- 52.5U
25-apr-2000	ME	a	V	<44.2 +/- 33U
09-aug-2000	ME	a	N	<74.2 +/- 57.50U
01-nov-2000	TN	a	V	<109 +/- 64U
23-jan-2001	TN	a	V	<100 +/- 53U
24-apr-2001	TN	a	V	<100 +/- 54U
17-jul-2001	TN	a	V	<100 +/- 56U
24-oct-2001	TN	a	N	<100 +/- 56U
23-jan-2002	TN	a	V	<100 +/- 56U
23-apr-2002	TN	a	V	<100 +/- 58U
06-sep-2002	TN	a	V	<100 +/- 55U
29-nov-2002	TN	a	V	<100 +/- 59U
07-feb-2003	TN	a	V	<100 +/- 61U
01-may-2003	TN	a	V	<100 +/- 57U
K7-10				
18-jul-1995	ME	a	V	<48.6 +/- 100% U
19-oct-1995	NC	a	V	<56.8 +/- 100% U
12-feb-1996	ME	a	V	<56.3 +/- 100% U
26-apr-1996	ME	a	V	<47.8 +/- 100% U
24-jul-1996	ME	a	V	<72.4 +/- 100% U
24-oct-1996	ME	a	V	<65.5 +/- 100% U
28-jan-1997	ME	a	V	<67.2 +/- 100% U
15-apr-1997	ME	a	V	<30.2 +/- 100% U
17-jul-1997	ME	a	V	<32.7 +/- 100% U
27-oct-1997	ME	a	V	<39.4 +/- 100% U

Table A-5. Ground and surface water analyses for tritium (pCi/L) in samples collected from the Pit 7 Complex between July 1, 1995 and June 30, 2003. Results recorded by December 18, 2003.

Location Date	Lab	Note	Val.	Tritium Activity
K7-10 (continued)				
21-jan-1998	ME	a	V	<33.9 +/- 33.9U
28-apr-1998	ME	a	V	<32.6 +/- 32.6U
31-jul-1998	ME	a	V	<32.4 +/- 32.4U
26-oct-1998	ME	a	N	<65.1 +/- 51.9U
25-jan-1999	ME	a	N	<82 +/- 58.4U
26-apr-1999	ME	a	N	<61 +/- 48.9U
15-jul-1999	ME	a	N	<73.1 +/- 58.4U
11-oct-1999	ME	a	V	<88.2 +/- 72.1U
27-jan-2000	ME	a	V	<48.2 +/- 37.6U
26-apr-2000	ME	a	V	<45.1 +/- 37U
01-aug-2000	ME	a	V	<71.8 +/- 58.9U
01-nov-2000	TN	a	V	<108 +/- 65U
23-jan-2001	TN	a	V	<100 +/- 54U
24-apr-2001	TN	a	V	<100 +/- 55U
17-jul-2001	TN	a	V	<100 +/- 56U
24-oct-2001	TN	a	N	<100 +/- 56U
24-jan-2002	TN	a	V	231 +/- 65
25-mar-2002	TN	a	V	<100 +/- 59U
03-apr-2002	TN	a	V	<100 +/- 55U
23-apr-2002	TN	a	V	<100 +/- 58U
28-aug-2002	TN	a	V	<100 +/- 52U
29-nov-2002	TN	a	V	<100 +/- 59U
07-feb-2003	TN	a	V	<100 +/- 59U
05-may-2003	TN	a	V	<100 +/- 56U
NC7-12				
03-oct-1995	IT	a	V	9300 +/- 68
02-apr-1996	LH	a	V	8100 +/- 360
20-nov-1996	LH	a	V	11590 +/- 740L
23-may-1997	LH	a	V	18100 +/- 1300
14-may-1998	QU	a	V	10200 +/- 1030
26-may-1999	TN	a	V	37200 +/- 4200
13-jun-2000	TN	a	V	12500 +/- 1300
14-may-2001	TN	ah	V	8860 +/- 900
14-may-2001	TN	aeh	V	8770 +/- 890
22-may-2002	TN	a	V	9340 +/- 950
28-may-2003	TN	a	V	8120 +/- 820
NC7-15				
03-oct-1995	IT	a	V	1200 +/- 36
02-apr-1996	LH	a	V	662 +/- 98
20-nov-1996	CX	ag	V	1056 +/- 17
20-nov-1996	LH	ag	V	441 +/- 82L
30-may-1997	FG	a	V	700 +/- 200
30-may-1997	LH	a	V	1780 +/- 320
07-nov-1997	LH	a	V	583 +/- 87
12-may-1998	FG	ag	V	1000 +/- 200
12-may-1998	QU	ag	V	564 +/- 107
23-nov-1998	GE	agj	V	<100 +/- 266U
23-nov-1998	QU	ag	V	223 +/- 76
26-may-1999	TN	a	V	549 +/- 81
03-dec-1999	TN	a	V	651 +/- 93L
05-jun-2000	TN	a	N	572 +/- 83
30-oct-2000	TN	a	V	621 +/- 88
22-may-2001	TN	a	V	492 +/- 90
15-nov-2001	TN	a	V	937 +/- 120
22-may-2002	TN	a	V	1010 +/- 130
14-dec-2002	TN	a	V	1470 +/- 180
26-apr-2003	GE	ah	V	1470 +/- 180
26-apr-2003	GE	aeh	V	1400 +/- 175
NC7-16				
14-nov-1995	IT	a	V	98000 +/- 993
05-jun-1996	LH	a	V	131500 +/- 8300O
18-dec-1996	LH	a	V	140700 +/- 7600O
28-jan-1997	LH	a	V	130700 +/- 7100
12-may-1997	LH	a	V	144400 +/- 7600

Table A-5. Ground and surface water analyses for tritium (pCi/L) in samples collected from the Pit 7 Complex between July 1, 1995 and June 30, 2003. Results recorded by December 18, 2003.

Location Date	Lab	Note	Val.	Tritium Activity
NC7-16 (continued)				
24-jul-1997	LH	a	V	155400 +/- 8100
07-nov-1997	LH	a	V	148600 +/- 7500
30-jan-1998	FG	a	V	126000 +/- 700
29-apr-1998	QU	a	V	141000 +/- 14100
17-aug-1998	QU	a	V	153000 +/- 15300
23-nov-1998	QU	a	V	155000 +/- 15500
26-jan-1999	QU	a	V	140000 +/- 14000J
27-may-1999	TN	a	V	147000 +/- 16000
26-aug-1999	TN	a	V	151000 +/- 15000
07-dec-1999	TN	a	V	148000 +/- 15000L
25-feb-2000	TN	a	V	152000 +/- 15000
14-jun-2000	TN	a	V	149000 +/- 15000
25-jul-2000	TN	a	V	147000 +/- 15000
30-oct-2000	TN	a	V	140000 +/- 14000
13-feb-2001	TN	ag	V	130000 +/- 13000
22-may-2001	TN	a	V	115000 +/- 12000
30-jul-2002	TN	a	V	82100 +/- 8300
07-mar-2003	TN	a	N	78700 +/- 7900
NC7-17				
21-nov-1995	IT	ah	V	<85.1 +/- 25.5U
21-nov-1995	IT	aeh	V	<88.3 +/- 26.6U
05-jun-1996	LH	a	V	<94 +/- 52UO
27-aug-1996	LH	a	V	<100 +/- 55OU
17-dec-1996	LH	a	V	<90 +/- 54U
19-may-1997	LH	a	V	<87 +/- 50LU
18-may-1998	QU	a	V	<118 +/- 68.9U
21-may-1999	TN	a	V	<200 +/- 40U
23-may-2000	TN	a	V	<100 +/- 51U
16-may-2001	TN	a	V	<110 +/- 66U
30-may-2002	TN	a	V	<100 +/- 58U
NC7-18				
29-nov-1995	IT	a	V	<100 +/- 30U
05-jun-1996	LH	a	V	<93 +/- 54UO
13-dec-1996	LH	a	V	<97 +/- 57U
13-may-1997	LH	aj	V	163 +/- 58
09-jun-1997	LH	a	V	<86 +/- 48U
18-may-1998	QU	a	V	<118 +/- 68.4U
21-may-1999	TN	a	V	<200 +/- 41U
26-may-2000	TN	a	N	<100 +/- 51U
16-may-2001	TN	a	V	<108 +/- 66U
30-may-2002	TN	a	V	<100 +/- 57U
NC7-20				
17-nov-1995	IT	a	V	39500 +/- 408
15-may-1996	LH	a	V	33900 +/- 1800LO
20-dec-1996	LH	a	V	29300 +/- 1900
05-jun-1997	LH	a	V	23700 +/- 1400
16-oct-1997	LH	a	V	23600 +/- 1500
14-may-1998	QU	a	V	25600 +/- 2560
23-nov-1998	QU	a	V	22100 +/- 2220
28-may-1999	TN	a	N	22700 +/- 2300
07-dec-1999	TN	a	V	24600 +/- 2500L
14-jun-2000	TN	a	V	31000 +/- 3100
30-oct-2000	TN	a	V	31100 +/- 3100
31-may-2001	TN	a	N	32400 +/- 3300
15-nov-2001	TN	ah	V	32800 +/- 3300
15-nov-2001	TN	aeh	V	33400 +/- 3400
22-may-2002	TN	a	V	33700 +/- 3400
07-dec-2002	TN	a	V	33700 +/- 3400
NC7-21				
14-nov-1995	IT	a	V	100000 +/- 1020
05-jun-1996	LH	a	V	92700 +/- 5900O
26-dec-1996	LH	a	V	100900 +/- 5600O
29-may-1997	LH	a	V	96000 +/- 5200L

Table A-5. Ground and surface water analyses for tritium (pCi/L) in samples collected from the Pit 7 Complex between July 1, 1995 and June 30, 2003. Results recorded by December 18, 2003.

Location Date	Lab	Note	Val.	Tritium Activity
NC7-21 (continued)				
30-oct-1997	LH	a	V	115400 +/- 6100
20-may-1998	QU	a	V	98900 +/- 9890
23-nov-1998	QU	a	V	116000 +/- 11600
28-may-1999	TN	a	N	126000 +/- 13000
07-dec-1999	TN	a	V	125000 +/- 13000L
15-jun-2000	TN	a	V	132000 +/- 13000
30-oct-2000	TN	a	V	132000 +/- 13000
22-may-2001	TN	a	V	132000 +/- 13000
15-nov-2001	TN	a	V	132000 +/- 13000
23-may-2002	TN	a	V	131000 +/- 13000
NC7-22				
15-nov-1995	IT	a	V	10900 +/- 122
05-jun-1996	LH	a	V	3740 +/- 260O
18-dec-1996	LH	a	V	11780 +/- 750O
29-may-1997	LH	a	V	9280 +/- 600L
29-oct-1997	FG	a	V	14600 +/- 200
29-oct-1997	LH	a	V	12590 +/- 780
20-may-1998	QU	a	V	9590 +/- 965
23-nov-1998	QU	a	V	23500 +/- 2350
28-may-1999	TN	a	N	1870 +/- 190
07-dec-1999	TN	a	V	16600 +/- 1700L
15-jun-2000	TN	a	V	18800 +/- 1900
NC7-24				
03-oct-1995	IT	a	V	1850 +/- 40
28-may-1996	LH	a	V	5090 +/- 290LO
17-sep-1996	LH	a	V	3990 +/- 290O
11-dec-1996	LH	a	V	3190 +/- 230
28-jan-1997	LH	a	V	4770 +/- 320
29-may-1997	LH	a	V	3660 +/- 250L
29-jul-1997	LH	a	V	2960 +/- 240
17-nov-1997	LH	a	V	3080 +/- 220
09-mar-1998	QU	a	V	1840 +/- 209
20-may-1998	QU	a	V	2530 +/- 281
17-aug-1998	QU	a	V	2530 +/- 281
24-nov-1998	QU	a	V	2000 +/- 226
07-jun-1999	TN	a	N	703 +/- 94
26-aug-1999	TN	a	V	958 +/- 120
15-jun-2000	TN	a	V	2900 +/- 310
NC7-25				
18-jul-1995	ME	a	V	266000 +/- 0.4%
20-oct-1995	ME	a	V	270000 +/- 0.5%
12-feb-1996	ME	a	V	273000 +/- 0.4%
15-mar-1996	FG	ag	N	292000 +/- 2000
15-mar-1996	LH	ag	V	299000 +/- 11000
15-mar-1996	MA	ag	V	314568 +/- 1573
29-apr-1996	ME	a	V	320000 +/- 0.3%
30-jul-1996	ME	a	V	377000 +/- 0.3%
24-oct-1996	ME	a	V	348000 +/- 0.3% F
28-jan-1997	ME	a	V	444000 +/- 5%
16-apr-1997	ME	a	V	458000 +/- 0.3%
12-may-1997	ME	a	V	471000 +/- 0.3%
20-may-1997	ME	a	V	481000 +/- 0.2%
30-jul-1997	ME	a	V	493000 +/- 0.3%
27-oct-1997	ME	a	V	536000 +/- 0.2%
13-nov-1997	ME	a	V	527000 +/- 5.1%
22-dec-1997	ME	a	V	412000 +/- 1240
22-jan-1998	ME	a	V	537000 +/- 1070
23-feb-1998	ME	a	V	<550000 +/- 7150U
23-mar-1998	ME	a	V	558000 +/- 1120
28-apr-1998	ME	a	V	545000 +/- 1090
27-may-1998	ME	a	V	559000 +/- 1120
25-jun-1998	ME	a	V	586000 +/- 1760
31-jul-1998	ME	a	V	583000 +/- 1750
24-aug-1998	ME	a	V	591000 +/- 1180

Table A-5. Ground and surface water analyses for tritium (pCi/L) in samples collected from the Pit 7 Complex between July 1, 1995 and June 30, 2003. Results recorded by December 18, 2003.

Location Date	Lab	Note	Val.	Tritium Activity
NC7-25 (continued)				
23-sep-1998	ME	a	V	580000 +/- 2010
26-oct-1998	ME	a	N	651000 +/- 1910
23-nov-1998	ME	a	N	663000 +/- 1930
17-may-1999	ME	a	N	715000 +/- 1790
15-jul-1999	ME	a	N	759000 +/- 2030
07-oct-1999	ME	a	V	770000 +/- 2040
04-feb-2000	ME	ah	V	653000 +/- 1690
04-feb-2000	ME	aeh	V	659000 +/- 1700
26-apr-2000	ME	a	V	674000 +/- 1740
09-aug-2000	ME	a	N	656000 +/- 17800
01-nov-2000	TN	a	V	551000 +/- 62000
25-jan-2001	TN	a	V	532000 +/- 53000
26-apr-2001	TN	a	V	574000 +/- 58000
18-jul-2001	TN	a	V	539000 +/- 54000
25-oct-2001	TN	ah	N	522000 +/- 52000
25-oct-2001	TN	aeh	N	514000 +/- 52000
24-jan-2002	TN	a	V	532000 +/- 53000
29-apr-2002	TN	a	V	492000 +/- 49000
11-sep-2002	TN	a	V	465000 +/- 47000
27-nov-2002	TN	a	V	458000 +/- 46000
11-feb-2003	TN	a	N	469000 +/- 47000
05-may-2003	TN	a	V	451000 +/- 45000
NC7-26				
17-jul-1995	ME	a	V	1960 +/- 5.1%
18-oct-1995	NC	a	V	1800 +/- 5.7%
08-feb-1996	ME	a	V	2060 +/- 5.1%
26-apr-1996	ME	a	V	3070 +/- 3.7%
25-jul-1996	ME	a	V	6710 +/- 2.6%
23-oct-1996	ME	a	V	3300 +/- 4.1%
23-jan-1997	ME	a	V	3570 +/- 2.7%
10-apr-1997	ME	a	V	5030 +/- 2.5%
24-jul-1997	ME	a	V	3890 +/- 2.9%
22-oct-1997	ME	a	V	4500 +/- 2.6%
21-jan-1998	ME	a	V	4000 +/- 108
22-apr-1998	ME	a	V	3480 +/- 108
27-jul-1998	ME	a	V	10700 +/- 171F
20-oct-1998	ME	a	N	6940 +/- 212
25-jan-1999	ME	a	N	15500 +/- 301
04-may-1999	ME	a	N	30000 +/- 367
14-jul-1999	ME	a	N	28500 +/- 378
11-oct-1999	ME	a	V	14300 +/- 288
16-feb-2000	ME	a	V	6760 +/- 189
26-apr-2000	ME	a	V	3520 +/- 130
09-aug-2000	ME	a	N	3160 +/- 1360
02-nov-2000	TN	a	V	2990 +/- 350
25-jan-2001	TN	a	V	2850 +/- 300
26-apr-2001	TN	a	V	2820 +/- 300
18-jul-2001	TN	a	V	2850 +/- 310
25-oct-2001	TN	a	N	2980 +/- 310
24-jan-2002	TN	a	V	3000 +/- 320
22-apr-2002	TN	a	V	2960 +/- 320
13-sep-2002	TN	a	V	2960 +/- 320
28-nov-2002	TN	a	V	2930 +/- 310
12-feb-2003	TN	a	N	3010 +/- 320
06-may-2003	TN	a	V	3150 +/- 330
NC7-34				
15-nov-1995	IT	a	V	5160 +/- 64
21-feb-1996	IT	a	V	5250 +/- 51
05-jun-1996	LH	a	V	8700 +/- 5600
17-sep-1996	LH	a	V	4370 +/- 3100
20-dec-1996	LH	a	V	2620 +/- 200
29-may-1997	LH	a	V	6700 +/- 430L
30-oct-1997	LH	a	V	5740 +/- 360
20-may-1998	FG	ag	V	25600 +/- 300
20-may-1998	QU	ag	V	25900 +/- 2590

Table A-5. Ground and surface water analyses for tritium (pCi/L) in samples collected from the Pit 7 Complex between July 1, 1995 and June 30, 2003. Results recorded by December 18, 2003.

Location Date	Lab	Note	Val.	Tritium Activity
NC7-34 (continued)				
24-nov-1998	QU	a	V	6940 +/- 699
07-jun-1999	TN	a	N	3860 +/- 400
06-dec-1999	TN	a	V	1200 +/- 140
09-mar-2000	TN	a	V	1170 +/- 140
14-jun-2000	TN	a	V	1360 +/- 150
09-aug-2000	TN	a	V	1010 +/- 140L
20-nov-2000	TN	a	V	744 +/- 110
15-feb-2001	TN	a	V	496 +/- 87
12-jun-2001	TN	a	V	507 +/- 86
27-aug-2001	TN	a	V	477 +/- 81
30-nov-2001	TN	a	V	425 +/- 79
14-feb-2002	TN	a	V	428 +/- 79
04-jun-2002	TN	a	V	825 +/- 110
16-aug-2002	TN	a	V	635 +/- 96
14-dec-2002	TN	a	V	1360 +/- 160
NC7-36				
15-nov-1995	IT	a	V	<88.8 +/- 26.9U
15-feb-1996	IT	a	V	<86 +/- 25U
05-jun-1996	LH	a	V	<93 +/- 54UO
27-aug-1996	LH	a	V	<100 +/- 59OU
13-dec-1996	LH	a	V	120 +/- 63
13-may-1997	LH	a	V	<86 +/- 54U
30-oct-1997	LH	a	V	<68 +/- 38U
20-may-1998	QU	a	V	<143 +/- 84.5U
23-nov-1998	GE	agj	V	<100 +/- 251U
23-nov-1998	QU	ag	V	<114 +/- 67.6U
16-jun-1999	TN	a	V	<100 +/- 54U
29-nov-1999	TN	a	V	<100 +/- 58LOU
19-jun-2000	GE	ag	V	<100 +/- 48.4U
19-jun-2000	TN	ag	V	<100 +/- 56U
14-nov-2000	TN	a	V	<105 +/- 64U
25-may-2001	TN	a	N	<101 +/- 62U
19-nov-2001	TN	a	V	<100 +/- 59U
31-may-2002	TN	a	V	<100 +/- 59U
14-dec-2002	TN	a	V	<113 +/- 67U
NC7-37				
28-dec-1995	IT	a	V	21200 +/- 224
20-feb-1996	IT	a	V	21700 +/- 90
28-may-1996	LH	a	V	27500 +/- 1500LO
16-sep-1996	LH	a	V	22900 +/- 1500O
18-dec-1996	LH	a	V	29800 +/- 1900O
28-jan-1997	LH	a	V	35000 +/- 2200
27-may-1997	LH	ah	V	27700 +/- 1800L
27-may-1997	LH	aeh	V	27100 +/- 1700L
25-jul-1997	LH	a	V	32400 +/- 1900
16-oct-1997	LH	a	V	56000 +/- 3600
30-jan-1998	FG	a	V	70200 +/- 600
29-apr-1998	QU	a	V	41300 +/- 4130
25-aug-1998	QU	a	V	65000 +/- 6500
30-nov-1998	QU	a	V	111000 +/- 11100
16-feb-1999	QU	a	V	141000 +/- 14100
16-jun-1999	TN	a	V	117000 +/- 12000
01-sep-1999	TN	a	V	108000 +/- 11000
29-nov-1999	TN	a	V	114000 +/- 11000LO
14-jun-2000	TN	a	V	102000 +/- 10000
10-aug-2000	GE	ag	V	92500 +/- 1850O
10-aug-2000	TN	ag	V	83700 +/- 9400
NC7-40				
14-nov-1995	IT	a	V	114000 +/- 1160
21-feb-1996	IT	a	V	98500 +/- 298
30-may-1996	LH	a	V	134100 +/- 5400LO
12-sep-1996	LH	a	V	145100 +/- 9200O
18-dec-1996	LH	a	V	170000 +/- 9000O
28-jan-1997	LH	a	V	184100 +/- 9700

Table A-5. Ground and surface water analyses for tritium (pCi/L) in samples collected from the Pit 7 Complex between July 1, 1995 and June 30, 2003. Results recorded by December 18, 2003.

Location Date	Lab	Note	Val.	Tritium Activity
NC7-40 (continued)				
27-may-1997	FG	ag	V	177000 +/- 700
27-may-1997	LH	ag	V	178200 +/- 9300L
29-jul-1997	LH	a	V	218000 +/- 11000
31-oct-1997	LH	a	V	157100 +/- 8200
27-jan-1998	FG	a	V	137000 +/- 800
29-apr-1998	QU	a	V	267000 +/- 26600
25-aug-1998	QU	a	V	201000 +/- 20000
24-nov-1998	QU	a	V	199000 +/- 19900
27-jan-1999	QU	a	V	168000 +/- 16800J
07-jun-1999	TN	a	N	162000 +/- 16000
26-aug-1999	TN	a	V	137000 +/- 14000
29-nov-1999	TN	a	V	134000 +/- 13000LO
09-mar-2000	TN	a	V	134000 +/- 13000
13-jun-2000	TN	a	V	131000 +/- 13000
25-jul-2000	TN	a	V	133000 +/- 13000
20-nov-2000	TN	a	V	134000 +/- 15000
13-feb-2001	TN	a	V	137000 +/- 14000
12-jun-2001	TN	a	V	134000 +/- 13000
23-aug-2001	TN	a	V	130000 +/- 13000
19-nov-2001	TN	a	V	138000 +/- 14000
14-feb-2002	TN	a	V	133000 +/- 13000
29-may-2002	TN	a	V	132000 +/- 13000
11-sep-2002	TN	a	V	139000 +/- 14000
21-dec-2002	TN	a	V	140000 +/- 14000
NC7-47				
18-jul-1995	ME	a	V	<50.7 +/- 100% U
20-oct-1995	NC	a	V	64 +/- 93.3%
13-feb-1996	ME	a	V	<57.1 +/- 100% U
30-apr-1996	ME	a	V	<42 +/- 100% U
30-jul-1996	ME	a	V	<44.9 +/- 100% U
25-oct-1996	ME	a	V	<63.4 +/- 100% U
03-feb-1997	ME	a	V	<63.6 +/- 100% U
16-apr-1997	ME	a	V	<30.9 +/- 100% U
30-jul-1997	ME	a	V	<39.6 +/- 100% U
27-oct-1997	ME	a	V	<39.3 +/- 100% U
02-jan-1998	ME	ag	V	51.3 +/- 33.8
29-apr-1998	ME	a	V	<28.6 +/- 28.6U
29-jul-1998	ME	a	V	<32.8 +/- 32.8U
21-oct-1998	ME	a	N	<65.9 +/- 50.1U
27-jan-1999	ME	a	N	<76.8 +/- 54.5U
04-may-1999	ME	a	N	<51.9 +/- 38.9 U
15-jul-1999	ME	a	N	<73.5 +/- 56.6U
11-oct-1999	ME	a	V	<89.2 +/- 70.7U
27-jan-2000	ME	a	V	<48.2 +/- 38U
21-apr-2000	WE	ah	N	<2.6 +/- 1.9U
01-may-2000	ME	a	V	<81.9 +/- 65.2U
09-aug-2000	ME	a	N	<74.9 +/- 60.1OU
02-nov-2000	TN	a	V	<107 +/- 64U
25-jan-2001	TN	a	V	<100 +/- 53U
27-apr-2001	TN	a	V	<100 +/- 56U
19-jul-2001	TN	a	V	<100 +/- 56U
29-oct-2001	TN	a	N	<100 +/- 58U
30-jan-2002	TN	a	V	<100 +/- 58U
30-apr-2002	TN	a	V	<100 +/- 57U
29-aug-2002	TN	a	V	<100 +/- 53U
03-dec-2002	TN	a	V	<100 +/- 46U
12-feb-2003	TN	a	N	<100 +/- 59U
07-may-2003	TN	a	V	<100 +/- 57U
NC7-48				
19-jul-1995	ME	a	V	301 +/- 20.8%
19-oct-1995	NC	a	V	220 +/- 29.4%
15-feb-1996	ME	ah	V	98.4 +/- 59.9%
30-apr-1996	ME	a	V	303 +/- 18%
30-jul-1996	ME	a	V	302 +/- 18.8%
25-oct-1996	ME	ah	V	236 +/- 30.3%

Table A-5. Ground and surface water analyses for tritium (pCi/L) in samples collected from the Pit 7 Complex between July 1, 1995 and June 30, 2003. Results recorded by December 18, 2003.

Location Date	Lab	Note	Val.	Tritium Activity
NC7-48 (continued)				
25-oct-1996	ME	aeh	V	211 +/- 33.5%
28-jan-1997	ME	a	V	198 +/- 37.3%
16-apr-1997	ME	ah	V	379 +/- 12%
30-jul-1997	ME	ah	V	166 +/- 27.5%
30-jul-1997	ME	aeh	V	192 +/- 24.5%
28-oct-1997	ME	a	V	112 +/- 30.7%
13-nov-1997	ME	a	V	140 +/- 25.6%
22-dec-1997	ME	a	V	50.3 +/- 37
22-jan-1998	ME	a	V	79.5 +/- 36.9
23-feb-1998	ME	a	V	<213 +/- 37.1U
23-mar-1998	ME	a	V	161 +/- 35.1
28-apr-1998	ME	a	V	180 +/- 38.9
27-may-1998	ME	a	V	320 +/- 45.1
25-jun-1998	ME	a	V	324 +/- 44.4
31-jul-1998	ME	a	V	297 +/- 43.7
24-aug-1998	ME	a	V	311 +/- 40.4
23-sep-1998	ME	a	V	237 +/- 60.7
26-oct-1998	ME	a	N	193 +/- 61.1
23-nov-1998	ME	a	N	265 +/- 61.9
17-may-1999	ME	a	N	87.3 +/- 44.1
19-jul-1999	ME	a	N	<72.9 +/- 60.8U
12-oct-1999	ME	a	V	<89.4 +/- 72.9U
27-jan-2000	ME	a	V	<48.2 +/- 39.6U
01-may-2000	ME	a	V	<81.3 +/- 67.7U
10-aug-2000	ME	a	N	<74.8 +/- 62.2U
02-nov-2000	TN	a	V	<108 +/- 64U
25-jan-2001	TN	a	V	<100 +/- 54U
26-apr-2001	TN	a	V	<100 +/- 56U
18-jul-2001	TN	a	V	<100 +/- 57U
25-oct-2001	TN	a	N	<100 +/- 56U
30-jan-2002	TN	a	V	<100 +/- 58U
30-apr-2002	TN	a	V	<100 +/- 58U
12-sep-2002	TN	a	V	<100 +/- 57U
29-nov-2002	TN	a	V	<102 +/- 60U
11-feb-2003	TN	a	N	<100 +/- 59U
06-may-2003	TN	a	V	<100 +/- 60U
NC7-49A				
03-oct-1995	IT	a	V	<91.5 +/- 27.4U
02-apr-1996	LH	a	V	<89 +/- 73U
13-dec-1996	LH	a	V	<94 +/- 55U
13-may-1997	LH	a	V	<87 +/- 50U
18-may-1998	QU	a	V	<127 +/- 73.4U
21-may-1999	TN	a	V	<200 +/- 41U
26-may-2000	TN	a	N	<100 +/- 51U
21-may-2001	TN	a	V	<113 +/- 67U
04-jun-2002	TN	a	V	<100 +/- 59U
NC7-50				
14-may-1998	QU	a	V	<148 +/- 84.6U
16-jun-1999	TN	a	V	<100 +/- 54U
07-mar-2000	TN	a	V	<100 +/- 54U
21-apr-2000	WE	ah	N	<2.6 +/- 1.9U
31-may-2000	TN	a	N	<100 +/- 50U
30-jan-2001	TN	a	V	<107 +/- 64U
25-apr-2001	TN	a	V	<100 +/- 56U
13-aug-2001	TN	a	V	<100 +/- 57U
18-oct-2001	TN	ah	V	<100 +/- 56U
18-oct-2001	TN	aeh	V	<100 +/- 57U
19-feb-2002	TN	a	V	<100 +/- 57U
28-may-2002	TN	a	V	<100 +/- 57U
30-jul-2002	TN	a	V	<113 +/- 66U
21-dec-2002	TN	a	V	<108 +/- 65U
25-jan-2003	TN	a	V	<106 +/- 64U

Table A-5. Ground and surface water analyses for tritium (pCi/L) in samples collected from the Pit 7 Complex between July 1, 1995 and June 30, 2003. Results recorded by December 18, 2003.

Location Date	Lab	Note	Val.	Tritium Activity
NC7-51				
28-dec-1995	IT	ah	V	172000 +/- 1730
28-dec-1995	IT	aeh	V	202000 +/- 2030
23-jan-1996	IT	a	V	194000 +/- 1950
12-jun-1996	CX	ag	V	1.2963e+06 +/- 6480
12-jun-1996	LH	ag	V	1.188e+06 +/- 60000
02-aug-1996	LH	a	V	1.325e+06 +/- 67000O
02-aug-1996	LH	a	V	1.396e+06 +/- 70000
18-dec-1996	CX	ag	V	321585 +/- 643BL
18-dec-1996	LH	ag	V	346000 +/- 18000O
18-dec-1996	ME	ag	V	321000 +/- 1.7%
28-jan-1997	LH	a	V	525000 +/- 27000
05-jun-1997	LH	a	V	354000 +/- 18000L
25-jul-1997	LH	a	V	503000 +/- 25000
07-nov-1997	LH	a	V	39200 +/- 2000
09-mar-1998	QU	a	V	869000 +/- 86800
29-apr-1998	QU	a	V	1.34e+06 +/- 134000
22-may-1998	QU	a	V	1.43e+06 +/- 143000
07-jul-1998	QU	a	V	1.33e+06 +/- 133000
21-sep-1998	QU	a	V	1.09e+06 +/- 109000
10-dec-1998	QU	a	V	474000 +/- 47300
27-jan-1999	QU	a	V	888000 +/- 88800
16-feb-1999	QU	a	V	412000 +/- 41200
10-mar-1999	QU	a	N	999000 +/- 99800
14-apr-1999	TN	a	V	984000 +/- 10000L
09-jun-1999	TN	a	V	898000 +/- 90000
29-jul-1999	TN	a	N	724000 +/- 73000
25-aug-1999	TN	a	N	389000 +/- 39000
29-sep-1999	TN	a	V	322000 +/- 32000
21-oct-1999	TN	a	V	325000 +/- 33000
24-nov-1999	TN	a	V	338000 +/- 34000
14-dec-1999	TN	a	V	314000 +/- 32000
25-jan-2000	TN	a	V	321000 +/- 32000
11-feb-2000	TN	a	V	314000 +/- 32000
08-mar-2000	TN	a	V	314000 +/- 32000
17-apr-2000	TN	a	V	318000 +/- 32000
15-may-2000	TN	a	V	295000 +/- 30000
14-jun-2000	TN	a	N	283000 +/- 28000
12-jul-2000	TN	a	V	297000 +/- 30000
09-aug-2000	TN	a	V	300000 +/- 33000L
13-sep-2000	TN	a	V	299000 +/- 30000L
20-oct-2000	TN	a	V	308000 +/- 31000
15-nov-2000	TN	a	V	304000 +/- 31000
13-dec-2000	TN	a	V	284000 +/- 29000
17-jan-2001	TN	a	V	312000 +/- 31000
21-feb-2001	TN	a	V	294000 +/- 30000L
14-mar-2001	TN	a	V	299000 +/- 30000
18-apr-2001	TN	a	V	293000 +/- 29000
17-may-2001	TN	a	V	300000 +/- 30000
13-jun-2001	TN	a	V	290000 +/- 29000
18-jul-2001	TN	a	V	287000 +/- 29000
15-aug-2001	TN	a	V	285000 +/- 29000
18-sep-2001	TN	a	V	290000 +/- 29000
18-oct-2001	TN	a	V	288000 +/- 29000
19-nov-2001	TN	a	V	283000 +/- 28000
12-dec-2001	TN	a	V	281000 +/- 28000
16-jan-2002	TN	a	V	274000 +/- 28000
14-feb-2002	TN	a	V	257000 +/- 26000
14-mar-2002	TN	a	V	262000 +/- 26000
22-apr-2002	TN	a	V	260000 +/- 26000
15-may-2002	TN	a	V	271000 +/- 27000
13-jun-2002	TN	a	V	276000 +/- 28000
23-jul-2002	TN	a	V	706000 +/- 71000
16-aug-2002	TN	a	V	250000 +/- 25000
11-sep-2002	TN	a	V	243000 +/- 24000
15-oct-2002	TN	a	V	250000 +/- 25000O
13-nov-2002	TN	a	V	240000 +/- 24000
11-dec-2002	TN	a	N	239000 +/- 24000

Table A-5. Ground and surface water analyses for tritium (pCi/L) in samples collected from the Pit 7 Complex between July 1, 1995 and June 30, 2003. Results recorded by December 18, 2003.

Location Date	Lab	Note	Val.	Tritium Activity
NC7-51 (continued)				
25-jan-2003	TN	a	V	249000 +/- 25000
12-feb-2003	TN	a	V	248000 +/- 25000
12-mar-2003	TN	a	N	243000 +/- 24000
NC7-52				
29-nov-1995	IT	a	V	2080 +/- 44
16-jan-1996	IT	a	V	26000 +/- 273
19-jun-1996	LH	a	V	25900 +/- 1600LO
12-aug-1996	LH	a	V	52400 +/- 2900O
17-dec-1996	LH	a	V	10120 +/- 650
21-jan-1997	LH	a	V	77700 +/- 4300BL
15-may-1997	LH	a	V	14080 +/- 900
22-jul-1997	LH	a	V	80300 +/- 4300
28-oct-1997	LH	a	V	39900 +/- 2300
28-jan-1998	FG	a	V	30900 +/- 400
18-may-1998	QU	a	V	20200 +/- 2030
25-aug-1998	QU	a	V	110000 +/- 11000
20-nov-1998	QU	a	V	124000 +/- 12400
16-feb-1999	QU	a	V	79500 +/- 7950
07-jun-1999	TN	a	N	128000 +/- 13000
26-aug-1999	GE	ag	V	113000 +/- 978L
26-aug-1999	TN	a	V	121000 +/- 12000
29-nov-1999	TN	a	V	94900 +/- 9500LO
10-mar-2000	TN	a	V	62500 +/- 6300
15-jun-2000	TN	a	V	85300 +/- 8600
09-aug-2000	TN	a	V	43400 +/- 4900L
14-nov-2000	TN	a	V	96600 +/- 11000
30-jan-2001	TN	a	V	68400 +/- 6900
23-may-2001	TN	a	V	37600 +/- 3800
17-aug-2001	TN	a	V	67000 +/- 6700
19-nov-2001	TN	a	V	54700 +/- 5500
25-feb-2002	TN	a	V	59300 +/- 6000
31-may-2002	TN	a	V	66900 +/- 6700
16-aug-2002	TN	a	V	71000 +/- 7100
07-dec-2002	TN	a	V	85700 +/- 8600
25-jan-2003	TN	a	V	59600 +/- 6000
NC7-53				
18-jul-1995	IT	ap	V	<90.9 +/- 26.9U
20-nov-1995	IT	a	V	<88.3 +/- 26.4U
12-feb-1996	IT	a	V	<86 +/- 25U
05-jun-1996	LH	a	V	<93 +/- 54UO
27-aug-1996	CX	ag	V	536.04 +/- 9.54BLO
27-aug-1996	LH	ag	V	<100 +/- 60OU
16-dec-1996	LH	a	V	<100 +/- 58U
13-may-1997	LH	a	V	<90 +/- 53U
18-may-1998	QU	a	V	<145 +/- 83.7U
21-may-1999	TN	a	V	<200 +/- 40U
23-may-2000	TN	a	V	<100 +/- 51U
21-may-2001	TN	a	V	<112 +/- 66U
31-may-2002	TN	a	V	<100 +/- 56U
NC7-60				
03-oct-1995	IT	a	V	3690 +/- 48
10-apr-1996	LH	a	V	3630 +/- 200
20-dec-1996	LH	a	V	2840 +/- 210
09-jun-1997	LH	a	V	2540 +/- 190
30-oct-1997	LH	a	V	3790 +/- 250
09-sep-1998	QU	a	V	3330 +/- 390
24-nov-1998	QU	a	V	3150 +/- 329
09-jun-1999	TN	a	V	2990 +/- 310
26-aug-1999	TN	a	V	2780 +/- 290
06-dec-1999	TN	a	V	2700 +/- 290
27-mar-2000	QR	ag	N	2400 +/- 169
27-mar-2000	TN	ag	V	2590 +/- 280
05-jun-2000	TN	a	N	2460 +/- 260
10-aug-2000	TN	a	V	2400 +/- 290

Table A-5. Ground and surface water analyses for tritium (pCi/L) in samples collected from the Pit 7 Complex between July 1, 1995 and June 30, 2003. Results recorded by December 18, 2003.

Location Date	Lab	Note	Val.	Tritium Activity
NC7-60 (continued)				
14-nov-2000	TN	a	V	2390 +/- 290
15-feb-2001	TN	a	V	2220 +/- 240
23-may-2001	TN	a	V	2220 +/- 240
17-aug-2001	TN	a	V	2050 +/- 220
12-dec-2001	TN	a	V	2110 +/- 230
25-feb-2002	TN	a	V	2080 +/- 230
29-may-2002	TN	a	V	1980 +/- 220
30-jul-2002	TN	a	V	1910 +/- 210
19-apr-2003	TN	a	V	1830 +/- 200
NC7-63				
14-feb-1997	LH	a	V	271000 +/- 14000BJ
21-may-1997	LH	a	V	1.361e+06 +/- 68000BL
25-jul-1997	LH	a	V	324000 +/- 17000
27-oct-1997	LH	a	V	321000 +/- 16000
27-jan-1998	FG	aeh	V	347000 +/- 1200
27-jan-1998	FG	ah	V	317000 +/- 1100
07-apr-1998	QU	a	V	1.45e+06 +/- 145000
12-may-1998	QU	a	V	1.55e+06 +/- 155000
22-may-1998	QU	a	V	1.72e+06 +/- 172000
07-jul-1998	QU	a	V	2.66e+06 +/- 266000
09-sep-1998	QU	a	V	2.5e+06 +/- 250000
10-dec-1998	QU	a	V	370000 +/- 37000
27-jan-1999	QU	a	V	376000 +/- 37600
16-feb-1999	QU	a	V	377000 +/- 37700
10-mar-1999	QU	a	N	387000 +/- 38700
14-apr-1999	TN	a	V	374000 +/- 3800L
09-jun-1999	TN	a	V	357000 +/- 36000
29-jul-1999	TN	a	N	372000 +/- 37000
25-aug-1999	TN	a	N	381000 +/- 38000
29-sep-1999	TN	a	V	391000 +/- 39000
21-oct-1999	TN	a	V	404000 +/- 41000
24-nov-1999	TN	a	V	419000 +/- 42000
14-dec-1999	TN	a	V	396000 +/- 40000
25-jan-2000	TN	a	V	377000 +/- 38000
10-feb-2000	TN	a	V	388000 +/- 39000
08-mar-2000	TN	a	V	384000 +/- 39000
17-apr-2000	TN	a	V	367000 +/- 37000
15-may-2000	TN	a	V	357000 +/- 36000
14-jun-2000	TN	a	N	344000 +/- 35000
12-jul-2000	TN	a	V	359000 +/- 36000
09-aug-2000	TN	a	V	351000 +/- 39000L
13-sep-2000	TN	a	V	366000 +/- 37000L
20-oct-2000	TN	a	V	400000 +/- 40000
15-nov-2000	TN	a	V	384000 +/- 39000
13-dec-2000	TN	a	V	347000 +/- 35000
17-jan-2001	TN	a	V	355000 +/- 36000
21-feb-2001	TN	a	V	353000 +/- 35000L
14-mar-2001	TN	a	V	344000 +/- 35000
18-apr-2001	TN	a	V	348000 +/- 35000
17-may-2001	TN	a	V	331000 +/- 33000
13-jun-2001	TN	a	V	341000 +/- 34000
18-jul-2001	TN	a	V	348000 +/- 35000
15-aug-2001	TN	a	V	290000 +/- 29000
18-sep-2001	TN	a	V	342000 +/- 34000
18-oct-2001	TN	a	V	339000 +/- 34000
19-nov-2001	TN	a	V	338000 +/- 34000
12-dec-2001	TN	a	V	337000 +/- 34000
16-jan-2002	TN	a	V	329000 +/- 33000
14-feb-2002	TN	a	V	322000 +/- 32000
14-mar-2002	TN	a	V	319000 +/- 32000
22-apr-2002	TN	a	V	314000 +/- 32000
16-may-2002	TN	a	V	318000 +/- 32000
13-jun-2002	TN	a	V	315000 +/- 32000
23-jul-2002	TN	a	V	682000 +/- 69000
16-aug-2002	TN	a	V	306000 +/- 31000
11-sep-2002	TN	a	V	285000 +/- 29000

Table A-5. Ground and surface water analyses for tritium (pCi/L) in samples collected from the Pit 7 Complex between July 1, 1995 and June 30, 2003. Results recorded by December 18, 2003.

Location Date	Lab	Note	Val.	Tritium Activity
NC7-63 (continued)				
15-oct-2002	TN	a	V	298000 +/- 30000O
03-nov-2002	TN	a	V	303000 +/- 30000
11-dec-2002	TN	a	N	302000 +/- 30000
NC7-64				
29-nov-1995	IT	a	V	185000 +/- 1870
21-feb-1996	IT	a	V	147000 +/- 442
19-jun-1996	LH	a	V	223000 +/- 12000LO
13-sep-1996	LH	a	V	228000 +/- 14000LO
26-dec-1996	LH	a	V	250000 +/- 13000O
22-jan-1997	FG	ag	V	207000 +/- 800
22-jan-1997	LH	ag	V	229000 +/- 12000BL
29-may-1997	LH	a	V	268000 +/- 14000L
24-jul-1997	LH	a	V	263000 +/- 13000
31-oct-1997	LH	a	V	307000 +/- 16000
27-jan-1998	FG	a	V	249000 +/- 1000
14-may-1998	QU	a	V	491000 +/- 49100
09-sep-1998	QU	a	V	329000 +/- 32900
30-nov-1998	QU	a	V	378000 +/- 37800
27-jan-1999	GE	a	V	349000 +/- 3090
27-jan-1999	QU	a	V	376000 +/- 37600J
28-jun-1999	TN	a	V	348000 +/- 35000
26-aug-1999	TN	a	N	351000 +/- 35000
29-nov-1999	TN	a	V	337000 +/- 34000LO
10-mar-2000	TN	a	V	326000 +/- 33000
15-jun-2000	TN	a	V	304000 +/- 31000
10-aug-2000	TN	a	V	295000 +/- 33000
20-nov-2000	TN	a	V	281000 +/- 31000
23-feb-2001	TN	a	V	278000 +/- 28000L
23-may-2001	TN	a	V	262000 +/- 26000
27-aug-2001	TN	a	V	231000 +/- 23000
30-nov-2001	TN	a	V	238000 +/- 24000
19-feb-2002	TN	a	V	236000 +/- 24000
13-jun-2002	TN	a	V	224000 +/- 23000
11-sep-2002	TN	a	V	206000 +/- 21000
07-dec-2002	TN	a	V	194000 +/- 19000
25-jan-2003	TN	a	V	201000 +/- 20000
NC7-65				
03-oct-1995	IT	a	V	105 +/- 28
10-apr-1996	LH	a	V	84 +/- 68
17-dec-1996	LH	a	V	115 +/- 59
19-may-1997	LH	a	V	148 +/- 58BL
09-sep-1998	QU	a	V	<212 +/- 128U
21-may-1999	TN	a	V	221 +/- 50
28-mar-2000	TN	a	V	<100 +/- 56U
26-may-2000	TN	a	N	<100 +/- 51U
09-aug-2000	TN	a	V	<104 +/- 65LU
14-nov-2000	TN	a	V	649 +/- 100
30-jan-2001	TN	a	V	933 +/- 120
14-jun-2001	TN	a	V	1410 +/- 160
17-aug-2001	TN	a	V	1640 +/- 180
12-dec-2001	TN	a	V	2340 +/- 250
25-feb-2002	TN	a	V	2930 +/- 310
31-may-2002	TN	a	V	3240 +/- 340
28-sep-2002	TN	a	V	2430 +/- 260
25-jan-2003	TN	a	V	1500 +/- 170
NC7-67				
28-dec-1995	IT	a	V	6320 +/- 75
11-jun-1996	LH	a	V	3840 +/- 250
19-dec-1996	LH	a	V	8360 +/- 5400
12-may-1997	LH	ah	V	8570 +/- 550
12-may-1997	LH	aeh	V	8560 +/- 550
20-may-1998	FG	ag	V	11700 +/- 200
20-may-1998	QU	ag	V	11200 +/- 1120
01-jul-1999	TN	ah	V	4300 +/- 440

Table A-5. Ground and surface water analyses for tritium (pCi/L) in samples collected from the Pit 7 Complex between July 1, 1995 and June 30, 2003. Results recorded by December 18, 2003.

Location Date	Lab	Note	Val.	Tritium Activity
NC7-67 (continued)				
01-jul-1999	TN	aeh	V	4140 +/- 430
01-jun-2000	GE	ag	V	2850 +/- 101
01-jun-2000	TN	ag	N	2280 +/- 240
24-may-2001	TN	a	V	7170 +/- 730
NC7-68				
03-oct-1995	IT	a	V	507 +/- 31
10-apr-1996	LH	a	V	634 +/- 89
12-dec-1996	LH	a	V	716 +/- 94
21-may-1999	TN	a	V	26400 +/- 2700
NC7-75				
09-nov-1995	IT	a	V	12100 +/- 1330
15-feb-1996	IT	a	V	5170 +/- 65
30-may-1996	LH	a	V	2840 +/- 190LO
12-sep-1996	LH	a	V	970 +/- 120O
16-dec-1996	LH	a	V	3180 +/- 230
24-jan-1997	LH	a	V	15500 +/- 1000B
27-may-1997	LH	a	V	9660 +/- 620L
24-jul-1997	LH	a	V	3970 +/- 300
31-oct-1997	LH	a	V	4510 +/- 290
28-jan-1998	FG	a	V	9300 +/- 200
01-jun-1998	QU	a	V	5500 +/- 591
09-sep-1998	GE	ag	V	3590 +/- 449
09-sep-1998	QU	ag	V	1280 +/- 204
09-dec-1998	QU	a	V	6340 +/- 640
27-jan-1999	QU	a	V	8330 +/- 850J
16-jun-1999	TN	a	V	5400 +/- 560
01-sep-1999	TN	a	V	5210 +/- 530
10-mar-2000	TN	a	V	173 +/- 58
05-jun-2000	TN	a	N	316 +/- 63
09-aug-2000	TN	a	V	277 +/- 75L
27-nov-2000	TN	a	V	362 +/- 79
24-may-2001	TN	a	V	243 +/- 66
29-aug-2001	TN	a	V	224 +/- 66
27-nov-2001	TN	a	V	267 +/- 68
25-feb-2002	GE	ag	V	217 +/- 106
25-feb-2002	TN	ag	V	190 +/- 64
31-may-2002	TN	a	V	111 +/- 61
14-sep-2002	TN	a	V	159 +/- 61
14-dec-2002	TN	a	V	<111 +/- 67U
NC7-76				
30-nov-1995	IT	a	V	3110 +/- 48
15-may-1996	LH	a	V	2410 +/- 210LO
19-dec-1996	LH	a	V	165 +/- 63O
22-jan-1997	LH	a	V	1640 +/- 150LO
06-may-1997	LH	a	V	1920 +/- 160
23-jul-1997	FG	ag	V	2400 +/- 200
23-jul-1997	LH	ag	V	2560 +/- 190
16-oct-1997	LH	a	V	2040 +/- 160
27-jan-1998	FG	a	V	2700 +/- 200
06-may-1998	QU	a	V	2780 +/- 305
09-sep-1998	QU	a	V	3020 +/- 359
30-nov-1998	QU	a	V	1720 +/- 194
16-jun-1999	TN	a	V	2240 +/- 240
01-sep-1999	TN	a	V	2540 +/- 270
03-dec-1999	TN	a	V	2860 +/- 300L
10-mar-2000	TN	a	V	2760 +/- 290
26-may-2000	TN	a	N	3040 +/- 320
09-aug-2000	TN	a	V	3380 +/- 400L
17-nov-2000	GE	a	V	4790 +/- 286
17-nov-2000	TN	ag	V	4280 +/- 440
22-feb-2001	TN	a	V	5360 +/- 550L
31-may-2001	TN	a	N	6480 +/- 660
24-aug-2001	TN	a	V	7080 +/- 720
27-nov-2001	TN	a	V	8350 +/- 850

Table A-5. Ground and surface water analyses for tritium (pCi/L) in samples collected from the Pit 7 Complex between July 1, 1995 and June 30, 2003. Results recorded by December 18, 2003.

Location Date	Lab	Note	Val.	Tritium Activity
NC7-76 (continued)				
19-feb-2002	GE	ag	V	8830 +/- 332
19-feb-2002	TN	ag	V	8980 +/- 910
23-may-2002	TN	a	V	8890 +/- 900
14-sep-2002	TN	a	V	9470 +/- 960
07-dec-2002	TN	a	V	9250 +/- 940
26-apr-2003	GE	ah	V	9810 +/- 363
26-apr-2003	GE	aeh	V	9520 +/- 359L
W-PIT7-02				
26-jul-1995	IT	a	V	102 +/- 30
21-nov-1995	IT	a	V	<85.1 +/- 25.6U
15-feb-1996	IT	a	V	<86 +/- 25U
18-jun-1996	LH	a	V	155 +/- 56J
28-aug-1996	LH	a	V	<100 +/- 57OU
20-dec-1996	LH	a	V	<97 +/- 54U
21-jan-1997	LH	a	V	659 +/- 95LO
15-may-1997	LH	a	V	<88 +/- 53U
22-jul-1997	LH	a	V	<84 +/- 49U
16-oct-1997	LH	a	V	116 +/- 59
27-jan-1998	FG	a	V	1500 +/- 200
30-apr-1998	QU	a	V	<142 +/- 84.1U
09-sep-1998	QU	a	V	<212 +/- 127U
20-nov-1998	QU	a	V	<111 +/- 64.2U
16-jun-1999	TN	a	V	<100 +/- 53U
01-sep-1999	GE	ag	V	<100 +/- 51.2LU
01-sep-1999	TN	ag	V	<100 +/- 53U
29-nov-1999	TN	a	V	<100 +/- 56LOU
27-mar-2000	TN	a	V	<100 +/- 57U
16-jun-2000	TN	a	V	<100 +/- 55U
15-aug-2000	TN	a	V	<103 +/- 61U
27-nov-2000	GE	ag	V	<123 +/- 66.8U
27-nov-2000	TN	ag	V	<104 +/- 63U
27-feb-2001	TN	a	V	<100 +/- 59LU
14-jun-2001	TN	a	V	<100 +/- 56U
23-aug-2001	TN	a	V	<100 +/- 53U
26-nov-2001	TN	aeh	V	<100 U
26-nov-2001	TN	ah	V	<100 +/- 55U
07-mar-2002	GE	ag	V	<200 +/- 95.2U
07-mar-2002	TN	ag	V	<100 +/- 56U
23-may-2002	TN	a	V	<100 +/- 60U
28-sep-2002	TN	a	V	<100 +/- 60U
21-dec-2002	TN	a	V	<112 +/- 67U
25-jan-2003	GE	ah	V	<200 +/- 107LU
W-PIT7-03				
26-jul-1995	IT	a	V	157000 +/- 477
21-nov-1995	IT	a	V	133000 +/- 1340
16-feb-1996	IT	a	V	112000 +/- 1140
28-may-1996	LH	a	V	167100 +/- 6500LO
18-sep-1996	LH	a	V	163000 +/- 10000O
20-dec-1996	CX	ag	V	156198 +/- 437BL
20-dec-1996	LH	ag	V	143100 +/- 7700
22-jan-1997	LH	a	V	157000 +/- 8300BL
30-may-1997	FG	a	V	120000 +/- 600
30-may-1997	LH	a	V	137300 +/- 7300
22-jul-1997	LH	a	V	122500 +/- 6400
31-oct-1997	LH	a	V	131700 +/- 6900
27-jan-1998	FG	a	V	134000 +/- 700
30-apr-1998	QU	a	V	140000 +/- 14000
09-sep-1998	GE	ag	V	105000 +/- 2090
09-sep-1998	QU	ag	V	111000 +/- 11100
23-nov-1998	QU	a	V	105000 +/- 10500
09-feb-1999	QU	a	V	106000 +/- 10600
01-jul-1999	TN	a	V	127000 +/- 13000
29-sep-1999	TN	a	V	141000 +/- 14000
29-nov-1999	TN	a	V	154000 +/- 15000LO
27-mar-2000	TN	a	V	163000 +/- 16000

Table A-5. Ground and surface water analyses for tritium (pCi/L) in samples collected from the Pit 7 Complex between July 1, 1995 and June 30, 2003. Results recorded by December 18, 2003.

Location Date	Lab	Note	Val.	Tritium Activity
W-PIT7-03 (continued)				
19-jun-2000	GE	ag	V	172000 +/- 1510
19-jun-2000	TN	ag	V	176000 +/- 18000
15-aug-2000	TN	a	V	178000 +/- 20000
27-nov-2000	TN	a	V	168000 +/- 19000
27-feb-2001	TN	a	V	171000 +/- 17000L
18-jun-2001	TN	a	V	162000 +/- 16000
29-aug-2001	TN	a	V	152000 +/- 15000
26-nov-2001	TN	a	V	161000 +/- 16000
07-mar-2002	TN	a	V	158000 +/- 16000
01-jul-2002	TN	a	V	168000 +/- 17000
14-sep-2002	TN	a	V	165000 +/- 17000
21-dec-2002	TN	a	V	146000 +/- 15000
W-PIT7-10				
26-jul-1995	IT	a	V	<94.9 +/- 28.7U
21-nov-1995	IT	a	V	<79.5 +/- 23.4U
15-feb-1996	IT	a	V	<86 +/- 25U
18-sep-1996	LH	a	V	<100 +/- 56OU
20-dec-1996	LH	a	V	<99 +/- 58U
21-jan-1997	LH	a	V	<97 +/- 55LOU
15-may-1997	LH	a	V	<88 +/- 49U
22-jul-1997	LH	a	V	<84 +/- 47U
16-oct-1997	LH	a	V	<86 +/- 47U
28-jan-1998	FG	a	V	700 +/- 200
30-apr-1998	QU	a	V	<143 +/- 82.1U
09-sep-1998	QU	a	V	<213 +/- 124U
20-nov-1998	QU	a	V	<111 +/- 65.1U
24-may-1999	TN	a	V	<200 +/- 42U
26-aug-1999	TN	a	N	<100 +/- 54U
06-dec-1999	TN	a	V	<100 +/- 53U
23-may-2000	TN	a	V	<100 +/- 51U
15-aug-2000	TN	a	V	<103 +/- 60U
17-nov-2000	TN	a	V	<100 +/- 54U
27-feb-2001	TN	a	V	<100 +/- 59LU
21-may-2001	TN	a	V	<111 +/- 66U
17-aug-2001	TN	a	V	<100 +/- 53U
26-oct-2001	TN	a	V	<100 +/- 57U
07-mar-2002	TN	a	V	<100 +/- 56U
03-jun-2002	TN	a	V	<102 +/- 60U
28-sep-2002	TN	a	V	<100 +/- 56U
07-dec-2002	TN	a	V	<102 +/- 62U
21-feb-2003	TN	a	N	<100 +/- 62U
W-PIT7-11				
08-sep-2000	TN	a	V	3140 +/- 330L
13-jun-2002	TN	a	V	6860 +/- 700
W-PIT7-12				
18-mar-1999	QU	a	N	6770 +/- 681
25-may-1999	TN	a	V	7100 +/- 720
28-mar-2000	TN	a	V	6000 +/- 610
15-aug-2000	TN	a	V	6050 +/- 690
08-sep-2000	TN	a	V	5830 +/- 600L
17-nov-2000	TN	a	V	5630 +/- 580
30-jan-2001	TN	a	V	5300 +/- 540
11-jun-2001	TN	a	V	5200 +/- 540
23-aug-2001	TN	a	V	5000 +/- 510
26-oct-2001	TN	a	V	4950 +/- 510
29-oct-2001	GE	a	V	4950 +/- 260
25-mar-2002	TN	aeh	V	4860 +/- 500
25-mar-2002	TN	ah	V	4880 +/- 500
03-jun-2002	TN	a	V	4880 +/- 500
14-sep-2002	TN	a	V	4780 +/- 490
W-PIT7-13				
08-sep-2000	TN	a	V	87400 +/- 8800L
30-mar-2001	TN	a	V	69200 +/- 7000L

Table A-5. Ground and surface water analyses for tritium (pCi/L) in samples collected from the Pit 7 Complex between July 1, 1995 and June 30, 2003. Results recorded by December 18, 2003.

Location Date	Lab	Note	Val.	Tritium Activity
W-PIT7-13 (continued)				
14-jun-2001	TN	a	V	61800 +/- 6200
23-aug-2001	TN	a	V	77000 +/- 7700
26-oct-2001	TN	a	V	102000 +/- 10000
14-mar-2002	TN	a	V	82700 +/- 8300
31-may-2002	TN	a	V	91000 +/- 9100
14-sep-2002	TN	a	V	91100 +/- 9200
01-feb-2003	TN	a	N	72900 +/- 7300
W-PIT7-14				
08-sep-2000	TN	a	V	804 +/- 110L
13-jun-2002	TN	a	V	330 +/- 76
W-PIT7-15				
08-sep-2000	TN	a	V	<100 +/- 52LU
20-mar-2001	TN	a	V	<100 +/- 54LOU
25-apr-2001	TN	a	V	<100 +/- 53U
13-aug-2001	TN	a	V	<100 +/- 56U
30-oct-2001	TN	a	N	<100 +/- 56U
28-mar-2002	TN	a	V	<100 +/- 57U
04-jun-2002	TN	a	V	<100 +/- 58U
28-sep-2002	TN	a	V	<100 +/- 58U
W-PIT7-16				
08-sep-2000	TN	a	V	<100 +/- 52LU
28-mar-2001	TN	a	V	<100 +/- 58U
11-jun-2001	TN	a	V	<100 +/- 54U
23-aug-2001	TN	a	V	<100 +/- 53U
26-oct-2001	TN	a	V	<100 +/- 59U
07-mar-2002	TN	a	V	<100 +/- 56U
23-may-2002	TN	a	V	<104 +/- 63U
14-sep-2002	TN	a	V	<100 +/- 56U
14-dec-2002	TN	a	N	<102 +/- 61U
03-may-2003	TN	a	V	<100 +/- 55U
W-PIT7-1714				
27-mar-2002	TN	a	V	<100 +/- 57U
W-PIT7-1715				
27-mar-2002	TN	a	V	<100 +/- 60U
W-PIT7-1716				
27-mar-2002	TN	a	V	<100 +/- 57U
W-PIT7-1717				
28-mar-2002	TN	a	V	<100 +/- 56U
W-PIT7-1718				
26-mar-2002	TN	a	V	<100 +/- 57U
W-PIT7-1720				
27-mar-2002	TN	a	V	<100 +/- 56U
W-PIT7-1723				
26-mar-2002	TN	a	V	<100 +/- 58U
W-PIT7-1724				
26-mar-2002	TN	a	V	<100 +/- 56U
W-865-01				
30-mar-1999	GE	a	V	<100 +/- 63.2U
24-may-1999	GE	ag	V	<100 +/- 50.2LU
24-may-1999	TN	ag	V	<200 +/- 41U
25-aug-1999	TN	a	N	<100 +/- 56U
09-dec-1999	TN	a	V	<100 +/- 55U
07-mar-2000	TN	a	V	<100 +/- 54U
21-jul-2000	TN	a	V	<100 +/- 54U
16-nov-2000	TN	a	V	<100 +/- 51U

Table A-5. Ground and surface water analyses for tritium (pCi/L) in samples collected from the Pit 7 Complex between July 1, 1995 and June 30, 2003. Results recorded by December 18, 2003.

Location Date	Lab	Note	Val.	Tritium Activity
W-865-01 (continued)				
26-jan-2001	TN	a	V	<100 +/- 57U
25-apr-2001	TN	a	V	<100 +/- 55U
14-aug-2001	TN	a	V	<100 +/- 56U
31-oct-2001	TN	a	N	<100 +/- 58U
31-jan-2002	TN	a	V	<100 +/- 57U
30-may-2002	TN	a	V	<100 +/- 57U
31-jul-2002	TN	a	V	<100 +/- 55U
19-feb-2003	TN	a	N	<103 +/- 61U
29-may-2003	TN	a	V	<100 +/- 55U
W-865-03				
10-apr-2000	TN	a	V	<137 +/- 82U
29-sep-2000	TN	a	V	<100 +/- 53U
16-nov-2000	TN	a	V	<100 +/- 52U
30-jan-2001	TN	a	V	<105 +/- 62U
25-apr-2001	TN	a	V	<100 +/- 55U
14-aug-2001	TN	a	V	<100 +/- 56U
30-oct-2001	TN	a	N	<100 +/- 57U
31-jan-2002	TN	a	V	<100 +/- 58U
30-may-2002	TN	a	V	<101 +/- 59U
31-jul-2002	TN	a	V	<100 +/- 56U
19-feb-2003	TN	a	N	<100 +/- 60U
29-may-2003	TN	a	V	<100 +/- 56U
W-865-04				
10-apr-2000	TN	a	V	<136 +/- 82U
28-sep-2000	TN	a	V	<100 +/- 51U
16-nov-2000	TN	a	V	<100 +/- 52U
26-jan-2001	TN	a	V	<100 +/- 57U
25-apr-2001	TN	a	V	<100 +/- 54U
14-aug-2001	TN	a	V	<100 +/- 59U
30-oct-2001	TN	a	N	<100 +/- 56U
31-jan-2002	TN	a	V	<100 +/- 59U
23-may-2002	TN	a	V	<100 +/- 58U
31-jul-2002	TN	a	V	<100 +/- 55U
19-feb-2003	TN	a	N	<100 +/- 59U
29-may-2003	TN	a	V	<100 +/- 56U
W-865-06				
10-apr-2000	TN	a	V	<137 +/- 82U
W-865-07				
10-apr-2000	TN	a	V	<138 +/- 83U
29-sep-2000	TN	a	V	<100 +/- 52U
16-nov-2000	TN	a	V	<100 +/- 52U
26-jan-2001	TN	a	V	<100 +/- 56U
25-apr-2001	TN	a	V	<100 +/- 55U
14-aug-2001	TN	a	V	<100 +/- 56U
30-oct-2001	TN	a	N	<100 +/- 57U
31-jan-2002	TN	a	V	<103 +/- 61U
23-may-2002	TN	a	V	<100 +/- 58U
31-jul-2002	TN	a	V	<100 +/- 56U
19-feb-2003	TN	a	N	<100 +/- 58U
29-may-2003	TN	a	V	<100 +/- 55U
W-865-1804				
31-jul-2002	TN	a	V	1710 +/- 190
23-jun-2003	TN	a	V	141 +/- 56
SPRING13				
06-nov-1995	IT	a	V	<85.8 +/- 25.5U
SPRING24				
22-oct-1999	TN	a	V	1190 +/- 140
27-aug-2001	TN	a	V	1910 +/- 210
13-dec-2001	TN	a	V	2180 +/- 240
25-mar-2002	TN	a	V	2380 +/- 260

Table A-5. Ground and surface water analyses for tritium (pCi/L) in samples collected from the Pit 7 Complex between July 1, 1995 and June 30, 2003. Results recorded by December 18, 2003.

Location Date	Lab	Note	Val.	Tritium Activity
SPRING24 (continued)				
28-sep-2002	TN	a	V	2340 +/- 250

See following page for notes

Table A-5. Ground and surface water analyses for tritium (pCi/L) in samples col between July 1, 1995 and June 30, 2003. Results recorded by December 18, 2003.

Notes:

- Indicates no analysis performed for this compound

Val. = Validation code

Footnotes:

a	ERD data
b	ORAD WGMG data
c	Analytical results for this sample are suspect
d	Sample collected during hydraulic testing
e	Blind sample, sent to lab without location identity
f	Sample dilution necessary for analysis; detection limits increased
g	Interlaboratory collocated sample
h	Intralaboratory collocated sample
i	Sample collected as part of pilot study
j	Note field may contain important information regarding this sample
k	Pre-development sample
l	Norm month, norm quarter or norm year inconsistent with sample date
m	Confirmation sample
n	Sample analyzed after standard holding time
o	Sample comprised of partial composite
p	Alpha spectroscopy analysis of uranium isotopes
q	Gamma spectroscopy analysis of uranium isotopes
r	Tritium data represents non-detect with activity calc'd for 100 percent error.

Lab Codes:

CX	Ceimic(replaced Maxwell Jul96)	8808 Balboa Avenue, San Diego CA 92123
FG	Fruit Growers Laboratory, Inc.	853 Corporation St. Santa Paula, Ca 93061-0272
GE	General Engineering Laboratori	PO 30712, Charleston, SC 29417
IT	International Technology Corp.	IS was used for short time.
LH	LAS-formerly Lockheed<1jan97	975 Kelly Johnson Las Vegas NV 89119
MA	Maxwell Laboratories, Inc.	S-Cubed Div., 8808 Balboa Ave. San Diego CA 92123
ME	LLNL C&MS Environmental Servic	LLNL
NC	Nuclear Chemistry LLNL Lab	
QR	Quanterra Env. Serv.,Richland	2800 George Washington Way, Richland,WA 99352
QU	Quanterra Env. Serv.,St.Louis	13715 Rider Trail North, Earth City, MO 63045
TN	Eberline Services	2030 Wright Ave, Richmond, CA 94804
WE	Univ/Waterloo EnvirIsotope Lab	Univ. of Waterloo, Waterloo, ONT CANADA N2L3G1

Validation Codes:

V	Validated
N	Not validated (default value)
U	Undeclared
H	Historical comparison only

CLP flags: (follow result)

B	Analyte found in method blank
D	Analysis performed at a secondary dilution or concentration (i.e., vapor samples)
E	The analyte was detected below the LLNL reporting limit, but above the analytical laboratory minimum detection limit.
F	Analyte found in field blank, trip blank, or equipment blank
G	Quantitated using fuel calibration, but does not match typical fuel fingerprint (fuel maybe gasoline, diesel, motor oil etc.).
H	Sample analyzed outside of holding time, sample results should be evaluated
J	Analyte was postively identified; the associated numerical value is the approximate concentration of the analyte in the sample.
L	Spike accuracy not within control limits
O	Duplicate spike or sample precision not within control limits
P	Indicates that the absence of a data qualifier flag does not mean that the data does not need qualification, but that the implementation of electronic data qualifier flags was not yet established
R	Sample results are rejected due to serious deficiencies in the ability to analyze the sample and meet QC criteria. The presence or absence of the analyte cannot be verified
S	Analytical results for this sample are suspect
T	Analyte is tentatively identified compound; result is approximate
U	Compound was analyzed for, but not detected above detection limit

Table A-6. Ground/surface water mass spectrometric analyses for uranium isotopes (pCi/L) and U235/U238 atom ratio collected from the Pit 7 Complex between July 1, 1995 and June 30, 2003. Results recorded by February 17, 2004.

Uranium mass spec in ground water
February 18, 2004
gemini1

s3uraniummsL.18feb2004
s3uraniummsR.18feb2004

Min Sample Date
July 1, 1995
Max Sample Date
June 30, 2003

Table A-6. Ground/surface water mass spectrometric analyses for uranium isotopes (pCi/L) and

Location Date	Lab	Note	Val.	Total Uranium by mass measurement	Uranium 234 by mass measurement	Uranium 235 by mass measurement
MUL2						
05-dec-2002	IC	a	N	0.86549 +/- 0.05342	0.439 +/- 0.053	0.01899 +/- 0.00037
K7-01						
22-jan-1997	IC	agh	V	11.8 +/- 0.6	7.1 +/- 0.6	0.211 +/- 0.003
22-jan-1997	IC	aeh	V	10.4 +/- 0.6	5.7 +/- 0.6	0.211 +/- 0.003
11-feb-2000	IC	a	N	20.5 +/- 0.2	11.2 +/- 0.2	0.413 +/- 0.004
25-apr-2000	IC	ah	N	21.64 +/- 0.43	11.7617 +/- 0.4225	0.43987 +/- 0.00321
25-apr-2000	IC	aeh	N	19.17 +/- 0.34	10.2 +/- 0.3	0.402 +/- 0.003
24-jul-2000	IC	a	N	23.0376 +/- 0.489457	12.8347 +/- 0.479622	0.462155 +/- 0.00653586
30-oct-2000	IC	ah	N	22.8167 +/- 0.548283	12.416 +/- 0.539168	0.466801 +/- 0.00660157
30-oct-2000	IC	aeh	N	22.4279 +/- 0.88503	12.65 +/- 0.88	0.43795 +/- 0.00622
23-jan-2001	IC	a	N	24.64 +/- 0.56	13.0186 +/- 0.5518	0.5168 +/- 0.00731
24-apr-2001	IC	a	N	22.4435 +/- 0.552714	11.96 +/- 0.543516	0.463163 +/- 0.00655011
17-jul-2001	IC	ah	N	23.8555 +/- 0.949536	12.8957 +/- 0.943718	0.48683 +/- 0.00688482
17-jul-2001	IC	aeh	N	21.0707 +/- 0.38181	11.2 +/- 0.37	0.44075 +/- 0.00682
24-oct-2001	IC	a	N	22.9909 +/- 0.378286	12.2403 +/- 0.364008	0.47794 +/- 0.00675909
23-jan-2002	IC	a	N	22.2479 +/- 0.573096	11.9002 +/- 0.564461	0.458333 +/- 0.0064818
22-apr-2002	IC	aeh	N	21.5487 +/- 1.55623	11.859 +/- 1.553	0.42968 +/- 0.00646
22-apr-2002	IC	ah	N	22.789 +/- 0.794965	12.2461 +/- 0.788526	0.467261 +/- 0.00660807
13-sep-2002	IC	a	N	21.2 +/- 0.4	11.5 +/- 0.4	0.429 +/- 0.003
27-nov-2002	IC	ah	N	23.6 +/- 0.5	12.8 +/- 0.5	0.485 +/- 0.004
27-nov-2002	IC	aeh	N	21.7569 +/- 0.53831	12.05 +/- 0.53	0.4309 +/- 0.00665
10-feb-2003	IC	a	N	24.3 +/- 1	13.6 +/- 1	0.478 +/- 0.004
01-may-2003	IC	ah	N	21.9736 +/- 0.89597	12.01 +/- 0.891	0.44557 +/- 0.00627
01-may-2003	IC	aeh	N	22.5134 +/- 1.11452	12.138 +/- 1.11	0.46543 +/- 0.00664
K7-03						
23-jan-1997	IC	a	V	3.1 +/- 0.11	1.72 +/- 0.1	0.062 +/- 0.0009
11-feb-2000	IC	a	N	3.7697 +/- 0.0661745	1.96192 +/- 0.0632278	0.0809771 +/- 0.00122105
25-apr-2000	IC	a	N	4.32308 +/- 0.51831	2.379 +/- 0.518	0.08608 +/- 0.00125
24-jul-2000	IC	a	N	5.17421 +/- 0.49849	3.019 +/- 0.498	0.09521 +/- 0.00138
30-oct-2000	IC	a	N	3.82323 +/- 0.0701	2.002 +/- 0.068	0.08123 +/- 0.00115
23-jan-2001	IC	a	N	5.1542 +/- 0.05639	2.678 +/- 0.051	0.1112 +/- 0.00157
17-apr-2001	IC	ah	N	5.38 +/- 0.08	2.76 +/- 0.08	0.1172 +/- 0.0007
17-apr-2001	IC	aeh	N	5.81 +/- 0.08	2.92 +/- 0.08	0.1286 +/- 0.0009
17-jul-2001	IC	a	N	5.69719 +/- 0.06267	2.983 +/- 0.057	0.12119 +/- 0.00172
24-oct-2001	IC	a	N	9.02283 +/- 0.8006	5.79 +/- 0.8	0.14483 +/- 0.00252
23-jan-2002	IC	aeh	N	5.88811 +/- 0.1094	3.035 +/- 0.106	0.12711 +/- 0.0018
23-jan-2002	IC	ah	N	6.38871 +/- 0.07029	3.319 +/- 0.064	0.13771 +/- 0.00194
22-apr-2002	IC	a	N	6.08402 +/- 0.07069	3.161 +/- 0.063	0.13102 +/- 0.002
06-sep-2002	IC	ah	N	6.64547 +/- 0.12371	3.48 +/- 0.12	0.14147 +/- 0.002
06-sep-2002	IC	aeh	N	7.26854 +/- 0.242	4 +/- 0.24	0.14554 +/- 0.00205
27-nov-2002	IC	a	N	6.02019 +/- 0.16034	3.2 +/- 0.156	0.12619 +/- 0.00214
07-feb-2003	IC	ah	N	8.23642 +/- 0.33175	4.59 +/- 0.33	0.16242 +/- 0.0023
07-feb-2003	IC	aeh	N	6.26996 +/- 0.341	3.56 +/- 0.34	0.12096 +/- 0.00194
01-may-2003	IC	a	N	5.48121 +/- 0.18909	2.913 +/- 0.186	0.11521 +/- 0.00195
K7-06						
22-jan-1997	IC	a	V	1.14 +/- 0.07	0.67 +/- 0.07	0.0209 +/- 0.0003
08-jun-2001	IC	a	N	11.5616 +/- 0.45743	6.486 +/- 0.455	0.22058 +/- 0.00308
29-apr-2002	IC	a	N	0.75347 +/- 0.02423	0.425 +/- 0.024	0.01467 +/- 0.00021
06-may-2003	IC	a	N	0.90094 +/- 0.02824	0.508 +/- 0.028	0.01764 +/- 0.00025
K7-07						
02-jun-1998	IC	a	N	8.63 +/- 0.11H	3.6 +/- 0.1H	0.156 +/- 0.002H
18-may-2000	IC	a	N	8.56989 +/- 0.399618	4.61016 +/- 0.397773	0.12363 +/- 0.00191127
K7-09						
23-jan-1997	IC	a	V	<0.063 +/- 0.0001U	<0.062 U	2.2e-05 +/- 2e-05
01-may-2003	IC	a	N	<0.062725 +/- 0.0031EU	<0.062 +/- 2.369U	<2.2e-05 +/- 6.47597U
K7-10						
28-jan-1997	IC	a	V	0.37 +/- 0.04	0.23 +/- 0.04	0.00605 +/- 0.0001
05-may-2003	IC	a	N	0.16	<0.062 +/- 0.49	0.00728 +/- 0.00024

U235/U238 atom ratio collected from the Pit 7 Complex between July 1, 1995 and June 30, 2003.
Results recorded by February 17, 2004.

Uranium 236 by mass measurement	Uranium 238 by mass measurement	Uranium 235/238 (atom ratio)	Location Date
			MUL2
<0.0007 +/- 0.00117U	0.4075 +/- 0.0067	0.007248 +/- 7.2e-05	05-dec-2002
			K7-01
<0.0007 U	4.51 +/- 0.05	0.00729 +/- 7e-05	22-jan-1997
<0.0007 U	4.42 +/- 0.05	0.00741 +/- 7e-05	22-jan-1997
<0.007 +/- 0.0013U	8.9 +/- 0.05	0.00721 +/- 5e-05	11-feb-2000
<0.00222 +/- 0.00222 U	9.43424 +/- 0.0582059	-	25-apr-2000
<0.007 +/- 0.0012U	8.61 +/- 0.06	0.00725 +/- 3e-05	25-apr-2000
<0.00287178 +/- 0.00287178U	9.74072 +/- 0.0974072	-	24-jul-2000
<0.00361949 +/- 0.00361949U	9.93394 +/- 0.0993394	-	30-oct-2000
<0.0007 +/- 0.00896U	9.34 +/- 0.094	0.007292 +/- 7.3e-05	30-oct-2000
<0.00302 +/- 0.00302 U	11.1014 +/- 0.111014	-	23-jan-2001
<0.00586842 +/- 0.00586842U	10.0204 +/- 0.100204	-	24-apr-2001
<0.00474125 +/- 0.00474125U	10.4729 +/- 0.104729	-	17-jul-2001
<0.0007 +/- 0.00181U	9.43 +/- 0.094	0.007268 +/- 8.6e-05	17-jul-2001
<0.00103976 +/- 0.00103976U	10.2727 +/- 0.102727	-	24-oct-2001
<0.00226165 +/- 0.00226165U	9.88935 +/- 0.0988935	-	23-jan-2002
<0.0007 +/- 0.01777U	9.26 +/- 0.1	0.007214 +/- 7.2e-05	22-apr-2002
<0.00257925 +/- 0.00257925U	10.0757 +/- 0.100757	-	22-apr-2002
<0.007 +/- 0.0022U	9.29 +/- 0.05	0.00717 +/- 2e-05	13-sep-2002
<0.007 +/- 0.004U	10.37 +/- 0.04	0.00728 +/- 5e-05	27-nov-2002
<0.0007 +/- 0.0089U	9.276 +/- 0.094	0.007224 +/- 8.4e-05	27-nov-2002
<0.007 +/- 0.0109U	10.3 +/- 0.06	0.00721 +/- 4e-05	10-feb-2003
<0.0007 +/- 0.0073U	9.518 +/- 0.094	0.00728 +/- 7.3e-05	01-may-2003
<0.0007 +/- 0.01331U	9.91 +/- 0.1	0.007303 +/- 7.3e-05	01-may-2003
			K7-03
<0.0007 U	1.323 +/- 0.013	0.00729 +/- 7e-05	23-jan-1997
<0.00013505 +/- 0.00013505U	1.72679 +/- 0.0194888	-	11-feb-2000
<0.0007 +/- 0.0082U	1.858 +/- 0.018	0.007204 +/- 7.6e-05	25-apr-2000
<0.0007 +/- 0.00751U	2.06 +/- 0.022	0.007188 +/- 7.2e-05	24-jul-2000
<0.0007 +/- 0.00067U	1.74 +/- 0.017	0.00726 +/- 7.3e-05	30-oct-2000
<0.0007 +/- 0.00045U	2.365 +/- 0.024	0.00731 +/- 7.3e-05	23-jan-2001
<0.007 +/- 0.0013U	2.502 +/- 0.009	0.00728 +/- 4e-05	17-apr-2001
<0.007 +/- 0.0004U	2.757 +/- 0.013	0.00725 +/- 4e-05	17-apr-2001
<0.0007 +/- 0.00149U	2.593 +/- 0.026	0.007269 +/- 7.3e-05	17-jul-2001
<0.0007 +/- 0.01362U	3.088 +/- 0.031	0.007293 +/- 0.000104	24-oct-2001
<0.0007 +/- 0.00052U	2.726 +/- 0.027	0.007252 +/- 7.3e-05	23-jan-2002
<0.0007 +/- 0.00056U	2.932 +/- 0.029	0.007304 +/- 7.3e-05	23-jan-2002
<0.0007 +/- 0.00107U	2.792 +/- 0.032	0.007296 +/- 7.3e-05	22-apr-2002
<0.0007 +/- 0.00116U	3.024 +/- 0.03	0.007276 +/- 7.3e-05	06-sep-2002
<0.0007 +/- 0.0024U	3.123 +/- 0.031	0.007247 +/- 7.2e-05	06-sep-2002
<0.0007 +/- 0.00207U	2.694 +/- 0.037	0.007283 +/- 7.3e-05	27-nov-2002
<0.0007 +/- 0.00401U	3.484 +/- 0.034	0.00725 +/- 7.5e-05	07-feb-2003
<0.0007 +/- 0.00397U	2.589 +/- 0.026	0.007265 +/- 9.1e-05	07-feb-2003
<0.0007 +/- 0.00235U	2.453 +/- 0.034	0.007305 +/- 7.3e-05	01-may-2003
			K7-06
<0.0007 U	0.451 +/- 0.003	0.0072 +/- 8e-05	22-jan-1997
<0.0007 +/- 0.01024U	4.855 +/- 0.047	0.007066 +/- 7.1e-05	08-jun-2001
<0.0007 +/- 0.00012U	0.3138 +/- 0.0033	0.007273 +/- 7.3e-05	29-apr-2002
<0.0007 +/- 0.00029U	0.3753 +/- 0.0037	0.007308 +/- 7.3e-05	06-may-2003
			K7-07
0.0139 +/- 0.0006H	4.87 +/- 0.06H	0.00499 +/- 2e-05	02-jun-1998
0.0099163 +/- 0.00190879	3.82619 +/- 0.0382619	-	18-may-2000
			K7-09
<0.0007 U	0.0085 +/- 0.0001	0.00724 +/- 0.00031	23-jan-1997
<0.0007 +/- 0.03024U	0.0289 +/- 0.0031	<0.012079 U	01-may-2003
			K7-10
<0.0007 U	0.136 +/- 0.0007	0.00691 +/- 0.00011	28-jan-1997
<0.0007 +/- 0.00216U	0.1548 +/- 0.0041	0.007313 +/- 0.000138	05-may-2003

Table A-6. Ground/surface water mass spectrometric analyses for uranium isotopes (pCi/L) and

Location Date	Lab	Note	Val.	Total Uranium by mass measurement	Uranium 234 by mass measurement	Uranium 235 by mass measurement
NC7-12						
14-may-2001	IC	ah	N	4.63176 +/- 0.08369	2.464 +/- 0.081	0.09276 +/- 0.00132
14-may-2001	IC	aeh	N	5.53567 +/- 0.211994	2.96431 +/- 0.210551	0.106751 +/- 0.00165623
22-may-2002	IC	a	N	4.43403 +/- 0.04835	2.287 +/- 0.044	0.09303 +/- 0.00131
28-may-2003	IC	a	N	4.30741 +/- 0.2836	2.34 +/- 0.282	0.08541 +/- 0.00161
NC7-15						
22-may-2002	IC	a	N	2.10094 +/- 0.05383	1.133 +/- 0.053	0.04304 +/- 0.00061
28-may-2003	IC	a	N	2.37614 +/- 0.1685	1.333 +/- 0.168	0.04614 +/- 0.00076
NC7-16						
14-nov-1995	IC	a	V	28.4 +/- 2	12.7 +/- 1.7	0.049 +/- 0.009
05-jun-1996	IC	a	V	40 +/- 2	16.3 +/- 1.7	0.68 +/- 0.01
18-dec-1996	IC	a	V	55.24 +/- 7.63	16.88 +/- 4.96	1.068 +/- 0.077
29-apr-1998	IC	a	N	52.8 +/- 1.1H	9.9 +/- 0.6H	0.681 +/- 0.016H
23-nov-1998	IC	a	N	226 +/- 1.2H	54.9 +/- 1.1H	2.93 +/- 0.02H
07-dec-1999	IC	a	N	145 +/- 4	56.6 +/- 4.3	1.74 +/- 0.03
14-jun-2000	IC	a	N	94.83 +/- 2.55	37.8132 +/- 2.5395	1.30299 +/- 0.01131
30-oct-2000	IC	a	N	71.663 +/- 2.15483	33.6183 +/- 2.12274	0.915773 +/- 0.012951
NC7-17						
05-jun-1996	IC	a	V	1.45 +/- 0.09	0.75 +/- 0.09	0.0309 +/- 0.0003
17-dec-1996	LH	a	V	-	<6200 U	<0.22 U
16-may-2001	IC	a	N	1.98357 +/- 0.06177	1.145 +/- 0.061	0.03727 +/- 0.00059
30-may-2002	IC	a	N	1.81919 +/- 0.05649	1.044 +/- 0.056	0.03469 +/- 0.00049
NC7-18						
29-nov-1995	IC	a	V	3.56 +/- 0.26	1.77 +/- 0.24	0.08 +/- 0.002
05-jun-1996	IC	a	V	1.77 +/- 0.05	0.94 +/- 0.05	0.0377 +/- 0.0007
16-dec-1996	IC	a	V	3.27 +/- 0.18	1.71 +/- 0.17	0.067 +/- 0.001
26-may-2000	IC	a	N	2.95 +/- 0.04	1.475 +/- 0.037	0.0655 +/- 0.0007
16-may-2001	IC	a	N	3.59114 +/- 0.06598	1.866 +/- 0.064	0.07714 +/- 0.00109
30-may-2002	IC	a	N	2.95402 +/- 0.07612	1.57 +/- 0.075	0.06202 +/- 0.00087
NC7-20						
17-nov-1995	IC	a	V	8.12 +/- 0.33	4.38 +/- 0.31	0.166 +/- 0.003
15-may-1996	IC	a	V	6.2 +/- 0.2	3.3 +/- 0.2	0.1272 +/- 0.0013
30-dec-1996	IC	a	V	5.15 +/- 0.21	2.53 +/- 0.19	0.113 +/- 0.002
14-jun-2000	IC	a	N	16.9701 +/- 1.47753	10.065 +/- 1.476	0.29007 +/- 0.00413
31-may-2001	IC	a	N	17.5489 +/- 0.251466	9.47461 +/- 0.239263	0.34858 +/- 0.00535604
NC7-21						
14-nov-1995	IC	a	V	17.5 +/- 1.2	9.58 +/- 1.04	0.36 +/- 0.012
05-jun-1996	IC	a	V	12.5 +/- 0.6	6.5 +/- 0.6	0.265 +/- 0.005
26-dec-1996	IC	a	V	14.5 +/- 1.1	7.6 +/- 0.98	0.311 +/- 0.007
15-jun-2000	IC	a	N	48.7 +/- 0.65	25.3651 +/- 0.6339	0.94531 +/- 0.00789
22-may-2001	IC	a	N	49.63 +/- 0.79	25.7918 +/- 0.7519	1.04478 +/- 0.02627
NC7-24						
28-may-1996	IC	a	V	5.7 +/- 0.1	3.36 +/- 0.14	0.1093 +/- 0.002
17-sep-1996	LH	a	V	-	<6200 U	<0.22 U
11-dec-1996	IC	a	V	5.77 +/- 0.27	3.45 +/- 0.25	0.1 +/- 0.002
NC7-25						
20-oct-1995	IC	a	V	23 +/- 0.85	12.59 +/- 0.74	0.468 +/- 0.009
29-apr-1996	IC	a	V	19.7 +/- 0.6	10.3 +/- 0.6	0.4228 +/- 0.0084
28-jan-1997	IC	a	V	20.8 +/- 1.3	10.4 +/- 1.1	0.465 +/- 0.01
22-dec-1997	IC	a	N	28.3 +/- 1.1	15.3 +/- 1.1	0.571 +/- 0.005
28-apr-1998	IC	a	N	27.8 +/- 0.3H	15.2 +/- 0.2H	0.57 +/- 0.006H
31-jul-1998	IC	a	N	34 +/- 0.5H	18.8 +/- 0.5H	0.68 +/- 0.006H
26-oct-1998	IC	a	N	29.8 +/- 0.2H	16.1 +/- 0.2H	0.606 +/- 0.004H
27-jan-1999	IC	a	N	35 +/- 3H	19 +/- 2H	0.704 +/- 0.091H
04-feb-2000	IC	a	N	38.5 +/- 0.66	21.6744 +/- 0.6475	0.75078 +/- 0.00578
26-apr-2000	IC	a	N	37.95 +/- 0.49	21.2157 +/- 0.4818	0.74673 +/- 0.00333
09-aug-2000	IC	a	N	38.8373 +/- 0.778466	21.8484 +/- 0.76129	0.762744 +/- 0.0107868
01-nov-2000	IC	a	N	38.1692 +/- 1.05193	21.4888 +/- 1.03975	0.752794 +/- 0.0106461
25-jan-2001	IC	a	N	41.77 +/- 0.69	23.3555 +/- 0.6631	0.82271 +/- 0.01163
26-apr-2001	IC	a	N	37.5081 +/- 0.897461	20.9463 +/- 0.883329	0.731876 +/- 0.0103503

U235/U238 atom ratio collected from the Pit 7 Complex between July 1, 1995 and June 30, 2003.
Results recorded by February 17, 2004.

Uranium 236 by mass measurement	Uranium 238 by mass measurement	Uranium 235/238 (atom ratio)	Locations Date
			NC7-12
<0.0007 +/- 0.00159U	2.075 +/- 0.021	0.006952 +/- 7e-05	14-may-2001
0.00224165 +/- 0.000762516	2.46237 +/- 0.0246237	-	14-may-2001
<0.0007 +/- 0.00118U	2.054 +/- 0.02	0.007042 +/- 7e-05	22-may-2002
<0.0007 +/- 0.00397U	1.882 +/- 0.03	0.007057 +/- 7.1e-05	28-may-2003
			NC7-15
<0.0007 +/- 0.00071U	0.9249 +/- 0.0094	0.007237 +/- 7.2e-05	22-may-2002
<0.0007 +/- 0.0023U	0.997 +/- 0.013	0.007193 +/- 7.2e-05	28-may-2003
			NC7-16
0.05 +/- 0.009	15.19 +/- 0.24	0.00502 +/- 3e-05	14-nov-1995
0.07 +/- 0.01	23.2 +/- 0.4	0.00459 +/- 3e-05	05-jun-1996
0.1921 +/- 0.0447	37.1 +/- 2.6	0.00448 +/- 0.0001	18-dec-1996
0.226 +/- 0.009H	41.9 +/- 0.9H	0.00253 +/- 2e-05	29-apr-1998
0.65 +/- 0.02H	167.5 +/- 0.5H	0.00272 +/- 1e-05	23-nov-1998
0.78 +/- 0.15U	85.5 +/- 0.4	0.00316 +/- 4e-05	07-dec-1999
0.23808 +/- 0.02214	55.4743 +/- 0.261293	-	14-jun-2000
0.159188 +/- 0.0203762	36.9697 +/- 0.369697	-	30-oct-2000
			NC7-17
<0.0007 U	0.664 +/- 0.003	0.00724 +/- 7e-05	05-jun-1996
<65 U	0.73	-	17-dec-1996
<0.0007 +/- 0.00077U	0.8013 +/- 0.0097	0.007233 +/- 7.2e-05	16-may-2001
<0.0007 +/- 0.00085U	0.7405 +/- 0.0074	0.007286 +/- 7.3e-05	30-may-2002
			NC7-18
<0.0007 U	1.71 +/- 0.02	0.00725 +/- 9e-05	29-nov-1995
<0.0007 U	0.791 +/- 0.006	0.00741 +/- 0.00012	05-jun-1996
<0.0007 U	1.5 +/- 0.02	0.0069 +/- 7e-05	16-dec-1996
<0.007 +/- 0.0003U	1.413 +/- 0.012	0.00721 +/- 5e-05	26-may-2000
<0.0007 +/- 0.00063U	1.648 +/- 0.016	0.007278 +/- 7.3e-05	16-may-2001
<0.0007 +/- 0.00076U	1.322 +/- 0.013	0.007296 +/- 7.3e-05	30-may-2002
			NC7-20
<0.0007 U	3.57 +/- 0.02	0.0072 +/- 6e-05	17-nov-1995
<0.0007 U	2.72 +/- 0.02	0.00727 +/- 6e-05	15-may-1996
<0.0007 U	2.51 +/- 0.03	0.00698 +/- 7e-05	30-dec-1996
<0.0007 +/- 0.01903U	6.615 +/- 0.067	0.006819 +/- 6.8e-05	14-jun-2000
0.00663691 +/- 0.00108832	7.71906 +/- 0.0771906	-	31-may-2001
			NC7-21
-	7.59 +/- 0.17	0.00738 +/- 6e-05	14-nov-1995
<0.0007 U	5.7 +/- 0.1	0.00719 +/- 5e-05	05-jun-1996
<0.0007 U	6.56 +/- 0.13	0.00738 +/- 0.0001	26-dec-1996
0.02063 +/- 0.00397	22.3721 +/- 0.160291	-	15-jun-2000
0.02458 +/- 0.00189	22.7707 +/- 0.227707	-	22-may-2001
			NC7-24
<0.0007 U	2.26 +/- 0.02	0.00752 +/- 0.00012	28-may-1996
<65 U	2.5	-	17-sep-1996
<0.0007 U	2.22 +/- 0.02	0.00703 +/- 8e-05	11-dec-1996
			NC7-25
<0.0007 U	9.98 +/- 0.1	0.00729 +/- 5e-05	20-oct-1995
<0.0007 U	9 +/- 0.1	0.00733 +/- 0.0001	29-apr-1996
<0.0007 U	10 +/- 0.2	0.00724 +/- 0.0001	28-jan-1997
<0.0096 +/- 0.0096U	12.48 +/- 0.08	0.00712 +/- 4e-05	22-dec-1997
<0.0018 HU	12.11 +/- 0.12H	0.00732 +/- 2e-05	28-apr-1998
<0.03 HU	14.52 +/- 0.11H	0.00728 +/- 3e-05	31-jul-1998
<0.02 HU	13.07 +/- 0.06H	0.00721 +/- 4e-05	26-oct-1998
<0.013 HU	15.1 +/- 1.9H	0.00723 +/- 3e-05	27-jan-1999
<0.00148 +/- 0.00148 U	16.0765 +/- 0.110918	-	04-feb-2000
<0.00216 +/- 0.00216 U	15.9877 +/- 0.059395	-	26-apr-2000
<0.004 +/- 0.00371788U	16.2262 +/- 0.162262	-	09-aug-2000
<0.005 +/- 0.00489834U	15.9276 +/- 0.159276	-	01-nov-2000
<0.00199 +/- 0.00199 U	17.5899 +/- 0.175899	-	25-jan-2001
<0.006 +/- 0.00570681U	15.8299 +/- 0.158299	0.00723 +/- 1.4e-05	26-apr-2001

Table A-6. Ground/surface water mass spectrometric analyses for uranium isotopes (pCi/L) and

Location Date	Lab	Note	Val.	Total Uranium by mass measurement	Uranium 234 by mass measurement	Uranium 235 by mass measurement
NC7-25 (continued)						
26-apr-2001	IC	a	N	34.5919 +/- 0.81223	19.4 +/- 0.81	0.67493 +/- 0.0031
18-jul-2001	IC	a	N	37.1523 +/- 0.679891	20.6577 +/- 0.661295	0.736339 +/- 0.0104134
25-oct-2001	IC	ah	N	36.6007 +/- 0.803182	19.885 +/- 0.78707	0.743158 +/- 0.0105098
25-oct-2001	IC	aeh	N	35.1712 +/- 0.59917	19.72 +/- 0.58	0.69117 +/- 0.01014
24-jan-2002	IC	a	N	37.6115 +/- 0.792593	20.9657 +/- 0.776393	0.736877 +/- 0.010421
29-apr-2002	IC	a	N	36.0861 +/- 0.645481	19.5768 +/- 0.625818	0.732851 +/- 0.0103641
12-sep-2002	IC	a	N	32.9 +/- 0.4	18.3 +/- 0.3	0.646 +/- 0.004
29-nov-2002	IC	a	N	38 +/- 0.5	21.1 +/- 0.5	0.756 +/- 0.007
12-feb-2003	IC	a	N	35.3 +/- 0.9	19.1 +/- 0.9	0.721 +/- 0.006
06-may-2003	IC	a	N	34.5749 +/- 1.38916	19.14 +/- 1.381	0.69493 +/- 0.00982
NC7-26						
18-oct-1995	IC	a	V	0.1	<0.062 U	0.004 +/- 0.001
26-apr-1996	IC	a	V	0.19 +/- 0.02	0.12 +/- 0.02	0.0027 +/- 0.0001
19-jun-1996	IC	a	V	0.38 +/- 0.04	0.24 +/- 0.04	0.0064 +/- 0.0001
20-dec-1996	IC	a	V	0.26 +/- 0.03	0.17 +/- 0.03	0.0044 +/- 0.0002
23-jan-1997	IC	a	V	0.26 +/- 0.02	0.16 +/- 0.02	0.00456 +/- 0.00012
26-apr-2000	IC	a	N	0.370235 +/- 0.00863939	0.221482+/-0.00851407	0.0066595 +/- 9.56e-05
26-apr-2001	IC	a	N	0.1145 +/- 0.0012	<0.062 +/- 0.3U	0.00513 +/- 9e-05
22-apr-2002	IC	a	N	0.29613 +/- 0.02004	0.197 +/- 0.02	0.00443 +/- 7e-05
06-may-2003	IC	a	N	0.11185 +/- 0.0011	<0.062 +/- 0.386U	0.00505 +/- 8e-05
NC7-34						
15-nov-1995	IC	a	V	21.96 +/- 1.03	7.02 +/- 0.88	0.327 +/- 0.006
21-feb-1996	IC	a	V	27.8 +/- 1.32	9.12 +/- 1.1	0.374 +/- 0.007
05-jun-1996	IC	ah	V	27.3 +/- 0.7	8.2 +/- 0.7	0.42 +/- 0.007
05-jun-1996	IC	ah	V	28 +/- 1	8.4 +/- 1.3	0.429 +/- 0.009
17-sep-1996	LH	a	V	-	<6200 U	0.33
30-dec-1996	IC	a	V	15.6 +/- 1.6	5.59 +/- 1.27	0.24 +/- 0.01
09-mar-2000	IC	a	N	17.37 +/- 0.52	7.4 +/- 0.5	0.234 +/- 0.002
14-jun-2000	IC	a	N	20.96 +/- 0.43	9.8466 +/- 0.4223	0.26321 +/- 0.00295
09-aug-2000	IC	a	N	21.3338 +/- 0.436361	10.1491 +/- 0.422575	0.278598 +/- 0.00393997
20-nov-2000	IC	a	N	16.9468 +/- 0.813809	8.4523 +/- 0.809485	0.232396 +/- 0.0144602
15-feb-2001	IC	a	N	15.14 +/- 0.64	6.8851 +/- 0.635	0.21529 +/- 0.00332
12-jun-2001	IC	a	N	12.7869 +/- 0.458784	5.6395 +/- 0.453467	0.180866 +/- 0.00255783
27-aug-2001	IC	a	N	12.2857 +/- 0.587216	5.68281 +/- 0.583308	0.171623 +/- 0.0024921
30-nov-2001	IC	a	N	12.4248 +/- 0.159908	5.54512 +/- 0.145256	0.175096 +/- 0.00247623
14-feb-2002	IC	a	N	11.6239 +/- 0.372975	5.02985 +/- 0.36743	0.171574 +/- 0.00242642
16-aug-2002	IC	a	N	5.66 +/- 0.05	<0.062 +/- 7.8U	0.1495 +/- 0.0022
14-dec-2002	IC	a	N	12.05 +/- 0.55	5.7 +/- 0.6	0.1604 +/- 0.0013
25-jan-2003	IC	a	N	6.14 +/- 0.05	<0.062 +/- 6.2U	0.162 +/- 0.0016
NC7-36						
15-nov-1995	IC	a	V	2 +/- 0.1	1.07 +/- 0.09	0.041 +/- 0.001
15-feb-1996	IC	ah	V	3.02 +/- 0.27	1.73 +/- 0.24	0.058 +/- 0.003
15-feb-1996	IC	ah	V	2.57 +/- 0.37	1.44 +/- 0.34	0.051 +/- 0.003
05-jun-1996	IC	a	V	2.7 +/- 0.2	1.44 +/- 0.17	0.0569 +/- 0.0009
13-dec-1996	IC	a	V	4.19 +/- 0.3	2.09 +/- 0.26	0.093 +/- 0.002
16-jun-1999	IC	a	N	3.2 +/- 0.05H	1.75 +/- 0.05H	0.0633 +/- 0.0006H
19-jun-2000	IC	a	N	2.09747 +/- 0.15921	1.284 +/- 0.159	0.03607 +/- 0.00052
31-may-2002	IC	a	N	2.12129 +/- 0.06657	1.211 +/- 0.066	0.04019 +/- 0.00057
NC7-37						
28-dec-1995	IC	a	V	78.7 +/- 5.6	26.46 +/- 4.99	1.061 +/- 0.027
28-may-1996	IC	a	V	36.2 +/- 1.5	8.3 +/- 1.5	0.5225 +/- 0.011
29-apr-1998	IC	a	N	37.3 +/- 1.1H	6.8 +/- 0.5H	0.52 +/- 0.02H
30-nov-1998	IC	a	N	59.6 +/- 0.5H	13.3 +/- 0.4H	0.756 +/- 0.006H
14-jun-2000	IC	a	N	39.56 +/- 1.07	13.3999 +/- 1.0638	0.48373 +/- 0.00364
NC7-40						
21-feb-1996	IC	a	V	111.8 +/- 6.48	33.8 +/- 5.6	1.74 +/- 0.03
30-may-1996	IC	a	V	104 +/- 3	30.7 +/- 2.3	1.66 +/- 0.05
12-sep-1996	LH	a	V	-	<6200 U	2.3
29-apr-1998	IC	ah	N	781 +/- 26H	144 +/- 9H	9.5 +/- 0.4H
29-apr-1998	IC	ah	N	741 +/- 3H	<190 HU	11.06 +/- 0.15H
24-nov-1998	IC	a	N	238 +/- 3H	70 +/- 3H	3.1 +/- 0.03H
29-nov-1999	IC	a	N	103 +/- 3	31.6 +/- 3.4	1.32 +/- 0.03

U235/U238 atom ratio collected from the Pit 7 Complex between July 1, 1995 and June 30, 2003.
Results recorded by February 17, 2004.

Uranium 236 by mass measurement	Uranium 238 by mass measurement	Uranium 235/238 (atom ratio)	Location Date
			(continued) NC7-25
<0.0007 +/- 0.00278U	14.517 +/- 0.06	-	26-apr-2001
<0.001 +/- 0.00132066U	15.7582 +/- 0.157582	-	18-jul-2001
<0.005 +/- 0.0054617U	15.9725 +/- 0.159725	-	25-oct-2001
<0.0007 +/- 0.00566U	14.76 +/- 0.15	0.007281 +/- 7.8e-05	25-oct-2001
<0.002 +/- 0.00242855U	15.9089 +/- 0.159089	-	24-jan-2002
<0.005 +/- 0.00472396U	15.7764 +/- 0.157764	-	29-apr-2002
<0.007 +/- 0.0026U	13.97 +/- 0.08	0.0072 +/- 2e-05	12-sep-2002
<0.007 +/- 0.0043U	16.08 +/- 0.12	0.00731 +/- 4e-05	29-nov-2002
<0.007 +/- 0.0075U	15.44 +/- 0.08	0.00726 +/- 4e-05	12-feb-2003
<0.0007 +/- 0.01413U	14.74 +/- 0.15	0.007334 +/- 7.3e-05	06-may-2003
			NC7-26
<0.0007 U	0.096 +/- 0.001	0.0073 +/- 0.0002	18-oct-1995
<0.0007 U	0.0592 +/- 0.0004	0.00707 +/- 0.00013	26-apr-1996
<0.0007 U	0.1341 +/- 0.0009	0.0074 +/- 7e-05	19-jun-1996
<0.0007 U	0.093 +/- 0.001	0.00736 +/- 0.00026	20-dec-1996
<0.0007 U	0.0964 +/- 0.0007	0.00736 +/- 0.00018	23-jan-1997
<9e-05 +/- 9e-05U	0.142093 +/- 0.00146307	-	26-apr-2000
<0.007 +/- 0.0005U	0.1094 +/- 0.0012	0.00729 +/- 9e-05	26-apr-2001
<0.0007 +/- 0.0002U	0.0947 +/- 0.0012	0.007271 +/- 7.9e-05	22-apr-2002
<0.0007 +/- 0.00117U	0.1068 +/- 0.0011	0.007353 +/- 9.2e-05	06-may-2003
			NC7-34
0.064 +/- 0.008	14.5 +/- 0.1	0.0035 +/- 4e-05	15-nov-1995
0.094 +/- 0.014	18.2 +/- 0.2	0.00319 +/- 3e-05	21-feb-1996
0.092 +/- 0.007	18.5 +/- 0.2	0.00353 +/- 5e-05	05-jun-1996
0.08 +/- 0.01	18.9 +/- 0.2	0.00353 +/- 6e-05	05-jun-1996
<65 U	14	-	17-sep-1996
0.0372 +/- 0.0112	9.69 +/- 0.35	0.00385 +/- 8e-05	30-dec-1996
0.043 +/- 0.005	9.68 +/- 0.05	0.00376 +/- 3e-05	09-mar-2000
0.04488 +/- 0.00568	10.8051 +/- 0.0652303	-	14-jun-2000
0.0453993 +/- 0.00548313	10.8607 +/- 0.108607	-	09-aug-2000
0.0332271 +/- 0.00623267	8.22891 +/- 0.0822891	-	20-nov-2000
0.03057 +/- 0.00438	8.00809 +/- 0.0800809	-	15-feb-2001
0.024537 +/- 0.00495544	6.94198 +/- 0.0694198	-	12-jun-2001
0.0253251 +/- 0.00443689	6.4059 +/- 0.0674453	-	27-aug-2001
0.0246243 +/- 0.00172802	6.67993 +/- 0.0667993	-	30-nov-2001
0.0245221 +/- 0.00243812	6.39799 +/- 0.0639799	-	14-feb-2002
<0.007 +/- 0.0344U	5.51 +/- 0.05	0.00422 +/- 5e-05	16-aug-2002
0.024 +/- 0.004	6.2 +/- 0.04	0.00402 +/- 2e-05	14-dec-2002
0.02 +/- 0.005	5.96 +/- 0.05	0.00423 +/- 3e-05	25-jan-2003
			NC7-36
<0.0007 U	0.9 +/- 0.01	0.00709 +/- 8e-05	15-nov-1995
<0.0007 U	1.24 +/- 0.02	0.00725 +/- 0.00024	15-feb-1996
<0.0007 U	1.08 +/- 0.03	0.00729 +/- 0.00018	15-feb-1996
<0.0007 U	1.231 +/- 0.009	0.00719 +/- 0.0001	05-jun-1996
<0.0007 U	2.01 +/- 0.04	0.00717 +/- 8e-05	13-dec-1996
<0.0007 +/- 0.003HU	1.391 +/- 0.007H	0.00708 +/- 6e-05H	16-jun-1999
<0.0007 +/- 0.00224U	0.7774 +/- 0.0081	0.007215 +/- 7.2e-05	19-jun-2000
<0.0007 +/- 0.00083U	0.8701 +/- 0.0087	0.007182 +/- 7.2e-05	31-may-2002
			NC7-37
0.254 +/- 0.042	50.9 +/- 0.54	0.00324 +/- 5e-05	28-dec-1995
0.11 +/- 0.01	27.2 +/- 0.2	0.00299 +/- 6e-05	28-may-1996
0.137 +/- 0.006H	29.8 +/- 1H	0.00273 +/- 2e-05	29-apr-1998
0.214 +/- 0.005H	45.3 +/- 0.2H	0.00259 +/- 2e-05	30-nov-1998
0.1367 +/- 0.00518	25.5367 +/- 0.0847054	-	14-jun-2000
			NC7-40
0.393 +/- 0.044	75.9 +/- 0.81	0.00356 +/- 3e-05	21-feb-1996
0.25 +/- 0.04	72 +/- 1	0.00359 +/- 8e-05	30-may-1996
<65 U	100	-	12-sep-1996
3.69 +/- 0.12H	625 +/- 25H	0.00236 +/- 1e-05	29-apr-1998
4.7 +/- 0.3H	726 +/- 3H	0.00237 +/- 3e-05	29-apr-1998
0.9 +/- 0.04H	164.1 +/- 0.8H	0.00294 +/- 2e-05	24-nov-1998
<0.0007 +/- 0.4U	70.5 +/- 0.5	0.0029 +/- 5e-06	29-nov-1999

Table A-6. Ground/surface water mass spectrometric analyses for uranium isotopes (pCi/L) and

Location Date	Lab	Note	Val.	Total Uranium by mass measurement	Uranium 234 by mass measurement	Uranium 235 by mass measurement
NC7-40 (continued)						
13-jun-2000	IC	a	N	129.55 +/- 2.09	41.3787 +/- 2.0443	1.76515 +/- 0.01284
20-nov-2000	IC	a	N	120.98 +/- 2.65914	39.6273 +/- 2.53805	1.66371 +/- 0.0235284
12-jun-2001	IC	a	N	117.419 +/- 4.32765	37.3196 +/- 4.2563	1.54956 +/- 0.0219141
19-nov-2001	IC	a	N	106.925 +/- 1.77537	32.6597 +/- 1.62061	1.45469 +/- 0.0205724
21-dec-2002	IC	a	N	118 +/- 2	37.2 +/- 2	1.588 +/- 0.011
06-jun-2003	IC	a	N	122.881 +/- 10.2421	42.3 +/- 10.22	1.60911 +/- 0.02123
NC7-47						
03-feb-1997	IC	a	V	2.1 +/- 0.3	1.5 +/- 0.3	0.0271 +/- 0.0006
01-may-2000	IC	a	N	1.85189 +/- 0.0327908	1.21638 +/- 0.0321143	0.0282117 +/- 0.000417108
27-apr-2001	IC	a	N	2.06 +/- 0.06	1.376 +/- 0.059	0.03047 +/- 0.00032
30-apr-2002	IC	a	N	1.90001 +/- 0.0365	1.271 +/- 0.036	0.02831 +/- 0.00041
07-may-2003	IC	a	N	1.87617 +/- 0.07829	1.255 +/- 0.078	0.02787 +/- 0.00042
NC7-48						
25-jul-1995	IC	a	V	18.5 +/- 0.9	5.09 +/- 0.8	0.26 +/- 0.007
19-oct-1995	IC	a	V	14.2 +/- 0.5	4.03 +/- 0.4	0.208 +/- 0.004
15-feb-1996	IC	a	V	14.3 +/- 0.71	3.38 +/- 0.6	0.196 +/- 0.004
30-apr-1996	IC	a	V	21.5 +/- 1.3	4 +/- 1.2	0.2993 +/- 0.0084
19-jun-1996	IC	a	V	17 +/- 0.6	4 +/- 0.6	0.233 +/- 0.005
28-jan-1997	IC	a	V	19.1 +/- 1.7	1.6 +/- 1	0.293 +/- 0.013
28-oct-1997	IC	a	N	12.7 +/- 0.7	3.1 +/- 0.5	0.167 +/- 0.002
13-nov-1997	IC	a	N	11 +/- 0.7	2.4 +/- 0.5	0.1488 +/- 0.0014
22-dec-1997	IC	a	N	10.1 +/- 0.6	2.5 +/- 0.3	0.1282 +/- 0.0011
22-jan-1998	IC	a	N	12.7 +/- 0.4	3 +/- 0.4	0.159 +/- 0.003
23-jan-1998	IC	a	N	9.6 +/- 0.3	1.9 +/- 0.3	0.13 +/- 0.0012
23-feb-1998	IC	a	N	0.439 +/- 0.002	<0.062 +/- 0.8U	0.0082 +/- 0.0002
23-feb-1998	IC	a	N	-	<0.062 +/- 22U	1.451 +/- 0.048
23-mar-1998	IC	aj	N	13.3 +/- 0.4	2.4 +/- 0.4	0.169 +/- 0.002
23-mar-1998	IC	a	N	-	20.1 +/- 2	1.251 +/- 0.023
28-apr-1998	IC	ah	N	51 +/- 2H	8.5 +/- 0.6H	0.69 +/- 0.04H
28-apr-1998	IC	ah	N	93 +/- 2H	27.5 +/- 1.2H	1.54 +/- 0.04H
28-apr-1998	IC	ah	N	68.7 +/- 0.7H	16.2 +/- 0.6H	0.843 +/- 0.01H
28-apr-1998	IC	ah	N	68.3 +/- 0.4H	13.6 +/- 0.4H	0.884 +/- 0.008H
27-may-1998	IC	a	N	47.8 +/- 0.8H	10.5 +/- 0.4H	0.612 +/- 0.012H
27-may-1998	IC	a	N	59.6 +/- 1H	13 +/- 0.5H	0.759 +/- 0.016H
25-jun-1998	IC	ah	N	41.9 +/- 1H	8.4 +/- 0.7H	0.546 +/- 0.013H
25-jun-1998	IC	ah	N	51.5 +/- 0.6H	10.9 +/- 0.4H	0.666 +/- 0.009H
31-jul-1998	IC	ah	N	46.9 +/- 0.5H	11.5 +/- 0.5H	0.597 +/- 0.005H
31-jul-1998	IC	ah	N	45.4 +/- 0.4H	10.6 +/- 0.4H	0.583 +/- 0.003H
24-aug-1998	IC	ah	N	38.6 +/- 0.4H	9.7 +/- 0.3H	0.49 +/- 0.004H
24-aug-1998	IC	ah	N	38.9 +/- 0.5H	9.7 +/- 0.4H	0.494 +/- 0.005H
23-sep-1998	IC	ah	N	30.8 +/- 0.4H	7.3 +/- 0.3H	0.392 +/- 0.003H
23-sep-1998	IC	ah	N	32.2 +/- 0.3H	8.6 +/- 0.3H	0.403 +/- 0.002H
26-oct-1998	IC	ah	N	27.3 +/- 0.4H	7.6 +/- 0.4H	0.339 +/- 0.002H
26-oct-1998	IC	ah	N	27.7 +/- 0.3H	8 +/- 0.3H	0.336 +/- 0.003H
23-nov-1998	IC	ah	N	24.8 +/- 0.3H	7.4 +/- 0.2H	0.303 +/- 0.003H
23-nov-1998	IC	ah	N	24.6 +/- 0.2H	7.2 +/- 0.2H	0.297 +/- 0.002H
27-jan-2000	IC	a	N	12.68 +/- 0.3	4.1128 +/- 0.2984	0.1472 +/- 0.00115
01-may-2000	IC	a	N	17.74 +/- 0.24	5.2615 +/- 0.2359	0.21179 +/- 0.00128
10-aug-2000	IC	a	N	12.0536 +/- 0.515528	4.11068 +/- 0.509629	0.14172 +/- 0.00200423
02-nov-2000	IC	a	N	12.7713 +/- 0.584945	4.9526 +/- 0.579936	0.166702 +/- 0.00459507
25-jan-2001	IC	a	N	13.4 +/- 0.27	3.6328 +/- 0.2568	0.16996 +/- 0.00249
26-apr-2001	IC	a	N	13.1768 +/- 0.405723	4.03161 +/- 0.395711	0.158019 +/- 0.00253396
18-jul-2001	IC	a	N	11.4631 +/- 0.285423	3.86425 +/- 0.275579	0.135361 +/- 0.00191429
25-oct-2001	IC	a	N	14.7455 +/- 0.533732	4.87766 +/- 0.524904	0.169293 +/- 0.00239417
30-jan-2002	IC	a	N	18.1445 +/- 0.413706	4.97243 +/- 0.393087	0.220687 +/- 0.00312098
30-apr-2002	IC	a	N	13.455 +/- 0.460108	4.16692 +/- 0.451009	0.162805 +/- 0.00230242
12-sep-2002	IC	a	N	9.67 +/- 0.22	3.3 +/- 0.2	0.1139 +/- 0.0007
29-nov-2002	IC	a	N	11.28 +/- 0.27	3.8 +/- 0.3	0.136 +/- 0.0015
11-feb-2003	IC	a	N	14.07 +/- 0.08	<0.062 +/- 7.6U	0.242 +/- 0.003
06-may-2003	IC	a	N	15.7267 +/- 1.15439	5.171 +/- 1.15	0.18815 +/- 0.00266
NC7-49A						
26-may-2000	IC	a	N	1.532 +/- 0.014	0.887 +/- 0.013	0.02854 +/- 0.0003
04-jun-2002	IC	a	N	1.63108 +/- 0.04639	0.994 +/- 0.046	0.02828 +/- 0.0004

U235/U238 atom ratio collected from the Pit 7 Complex between July 1, 1995 and June 30, 2003.
Results recorded by February 17, 2004.

Uranium 236 by mass measurement	Uranium 238 by mass measurement	Uranium 235/238 (atom ratio)	Location Date
			(continued) NC7-40
0.43138 +/- 0.0138	85.9704 +/- 0.410637	-	13-jun-2000
0.405975 +/- 0.0126544	79.2829 +/- 0.792829	-	20-nov-2000
0.36922 +/- 0.0276327	78.1808 +/- 0.781808	-	12-jun-2001
0.353069 +/- 0.011957	72.4575 +/- 0.724575	-	19-nov-2001
0.38 +/- 0.03	79.2 +/- 0.3	0.00312 +/- 2e-05	21-dec-2002
0.36188 +/- 0.04534	78.61 +/- 0.67	0.003183 +/- 3.2e-05	06-jun-2003
			NC7-47
<0.0007 U	0.605 +/- 0.01	0.00696 +/- 0.00012	03-feb-1997
<0.00010711 +/- 0.00010711U	0.607299 +/- 0.00661356	-	01-may-2000
<0.007 +/- 0.0006U	0.654 +/- 0.002	0.00725 +/- 7e-05	27-apr-2001
<0.0007 +/- 0.00023U	0.6007 +/- 0.006	0.007329 +/- 7.5e-05	30-apr-2002
<0.0007 +/- 0.00102U	0.5933 +/- 0.0067	0.007305 +/- 7.3e-05	07-may-2003
			NC7-48
0.05 +/- 0.01	13.1 +/- 0.1	0.00309 +/- 5e-05	25-jul-1995
0.053 +/- 0.006	9.88 +/- 0.08	0.00327 +/- 3e-05	19-oct-1995
0.056 +/- 0.007	10.7 +/- 0.1	0.00285 +/- 2e-05	15-feb-1996
0.092 +/- 0.005	17.1 +/- 0.3	0.00272 +/- 6e-05	30-apr-1996
0.076 +/- 0.009	12.7 +/- 0.2	0.00285 +/- 5e-05	19-jun-1996
0.11 +/- 0.02	17.1 +/- 0.7	0.00267 +/- 4e-05	28-jan-1997
0.0343 +/- 0.005	9.4 +/- 0.05	0.00277 +/- 2e-05	28-oct-1997
0.044 +/- 0.005	8.49 +/- 0.05	0.00273 +/- 2e-05	13-nov-1997
0.0342 +/- 0.003	7.43 +/- 0.04	0.00268 +/- 2e-05	22-dec-1997
0.046 +/- 0.004	9.5 +/- 0.04	0.0026 +/- 4e-05	22-jan-1998
0.03 +/- 0.003	7.49 +/- 0.04	0.0027 +/- 2e-05	23-jan-1998
<0.0007 +/- 0.012U	0.431 +/- 0.002	0.00295 +/- 6e-05	23-feb-1998
<0.0007 +/- 0.315U	96.5 +/- 2.9	0.00234 +/- 3e-05	23-feb-1998
0.045 +/- 0.004	10.73 +/- 0.05	0.00244 +/- 3e-05	23-mar-1998
0.526 +/- 0.016	83.12 +/- 0.55	0.00234 +/- 4e-05	23-mar-1998
0.206 +/- 0.006H	41.3 +/- 2.1H	0.00258 +/- 3e-05	28-apr-1998
0.26 +/- 0.013H	64.1 +/- 1.8H	0.00373 +/- 2e-05	28-apr-1998
0.249 +/- 0.01H	51.4 +/- 0.3H	0.00255 +/- 3e-05	28-apr-1998
0.243 +/- 0.007H	53.5 +/- 0.2H	0.00257 +/- 2e-05	28-apr-1998
0.181 +/- 0.008H	36.6 +/- 0.7H	0.0026 +/- 2e-05	27-may-1998
0.231 +/- 0.01H	45.6 +/- 0.8H	0.00259 +/- 3e-05	27-may-1998
0.168 +/- 0.008H	32.8 +/- 0.7H	0.00259 +/- 3e-05	25-jun-1998
0.189 +/- 0.01H	39.7 +/- 0.4H	0.00261 +/- 3e-05	25-jun-1998
0.17 +/- 0.003H	34.6 +/- 0.2H	0.00268 +/- 2e-05	31-jul-1998
0.171 +/- 0.004H	34.12 +/- 0.12H	0.00266 +/- 1e-05	31-jul-1998
0.134 +/- 0.005H	28.3 +/- 0.2H	0.0027 +/- 1e-05	24-aug-1998
0.142 +/- 0.004H	28.6 +/- 0.2H	0.00269 +/- 2e-05	24-aug-1998
0.108 +/- 0.003H	22.93 +/- 0.12H	0.00266 +/- 1e-05	23-sep-1998
0.11 +/- 0.005H	23.1 +/- 0.09H	0.00271 +/- 1e-05	23-sep-1998
0.091 +/- 0.003H	19.18 +/- 0.06H	0.00275 +/- 2e-05	26-oct-1998
0.09 +/- 0.002H	19.24 +/- 0.09H	0.00272 +/- 2e-05	26-oct-1998
0.081 +/- 0.004H	17.04 +/- 0.08H	0.00276 +/- 3e-05	23-nov-1998
0.072 +/- 0.004H	17.09 +/- 0.1H	0.0027 +/- 2e-05	23-nov-1998
0.04134 +/- 0.00306	8.37882 +/- 0.048915	-	27-jan-2000
0.06023 +/- 0.00346	12.2094 +/- 0.0558883	-	01-may-2000
0.0399214 +/- 0.00443541	7.76131 +/- 0.0776131	-	10-aug-2000
0.0380505 +/- 0.00403449	7.6139 +/- 0.076139	-	02-nov-2000
0.0485 +/- 0.00208	9.55287 +/- 0.0955287	-	25-jan-2001
0.0423925 +/- 0.00402377	8.94476 +/- 0.0894476	-	26-apr-2001
0.0366596 +/- 0.00167801	7.42679 +/- 0.0742679	-	18-jul-2001
0.0484154 +/- 0.00516311	9.65013 +/- 0.0965013	-	25-oct-2001
0.0635014 +/- 0.00402952	12.8879 +/- 0.128879	-	30-jan-2002
0.0403981 +/- 0.00556105	9.08487 +/- 0.0908487	-	30-apr-2002
0.029 +/- 0.002	6.26 +/- 0.02	0.00283 +/- 1e-05	12-sep-2002
0.034 +/- 0.004	7.35 +/- 0.04	0.00288 +/- 3e-05	29-nov-2002
0.075 +/- 0.008	13.75 +/- 0.08	0.00274 +/- 3e-05	11-feb-2003
0.04751 +/- 0.00991	10.32 +/- 0.1	0.002835 +/- 2.8e-05	06-may-2003
			NC7-49A
<0.007 +/- 0.00012U	0.616 +/- 0.004	0.0072 +/- 6e-05	26-may-2000
<0.0007 +/- 0.00082U	0.6088 +/- 0.006	0.007225 +/- 7.2e-05	04-jun-2002

Table A-6. Ground/surface water mass spectrometric analyses for uranium isotopes (pCi/L) and

Location Date	Lab	Note	Val.	Total Uranium by mass measurement	Uranium 234 by mass measurement	Uranium 235 by mass measurement
NC7-51						
29-apr-1998	IC	a	N	198.3 +/- 9.3H	34.9 +/- 2.7H	2.55 +/- 0.14H
21-sep-1998	IC	a	N	187 +/- 2H	40 +/- 2H	2.4 +/- 0.024H
16-feb-1999	IC	a	N	114 +/- 2H	46 +/- 2H	1.599 +/- 0.016H
25-aug-1999	IC	a	N	132 +/- 4H	63.9 +/- 4.2H	1.95 +/- 0.03H
24-nov-1999	IC	a	N	132.3 +/- 1.1	65.2 +/- 1.1	2.03 +/- 0.11
11-feb-2000	IC	a	N	111.38 +/- 1.44	48.7789 +/- 1.4057	1.86839 +/- 0.01039
15-may-2000	IC	a	N	113 +/- 1.85	51.9355 +/- 1.8386	1.84783 +/- 0.00992
09-aug-2000	IC	a	N	110.775 +/- 2.83487	51.1391 +/- 2.77546	1.80243 +/- 0.0254903
15-nov-2000	IC	a	N	109.587 +/- 3.06889	50.371 +/- 3.01489	1.78437 +/- 0.0252348
21-feb-2001	IC	a	N	113.4 +/- 1.76	48.0646 +/- 1.6469	1.87687 +/- 0.02654
17-may-2001	IC	a	N	3.84372 +/- 0.18683	1.927 +/- 0.18	0.05632 +/- 0.00163
18-jul-2001	IC	a	N	105.85 +/- 2.6018	46.6255 +/- 2.53767	1.68372 +/- 0.0238114
19-nov-2001	IC	a	N	104.219 +/- 2.66095	45.9782 +/- 2.60033	1.66411 +/- 0.0311281
14-feb-2002	IC	a	N	101.304 +/- 1.8944	43.5417 +/- 1.80968	1.63215 +/- 0.0230821
15-may-2002	IC	a	N	100.807 +/- 3.72311	43.7952 +/- 3.68184	1.6286 +/- 0.0230318
20-nov-2002	IC	a	N	101 +/- 3	44.7 +/- 2.6	1.602 +/- 0.01
12-feb-2003	IC	a	N	59.1 +/- 0.4	<0.062 +/- 53U	1.693 +/- 0.018
NC7-52						
29-nov-1995	IC	a	V	1.69 +/- 0.15	0.83 +/- 0.14	0.038 +/- 0.001
19-jun-1996	IC	a	V	1.76 +/- 0.07	1.11 +/- 0.07	0.0287 +/- 0.0004
17-dec-1996	LH	a	V	-	<6200 U	<0.22 U
15-jun-2000	IC	a	N	0.27571 +/- 0.00501	<0.062 +/- 0.831U	0.01231 +/- 0.00029
31-may-2002	IC	a	N	1.5406 +/- 0.09327	0.889 +/- 0.093	0.0291 +/- 0.00046
NC7-53						
05-jun-1996	IC	a	V	0.303	<0.062 U	0.0133 +/- 0.0003
16-dec-1996	IC	a	V	0.93 +/- 0.08	0.54 +/- 0.08	0.0171 +/- 0.0003
21-may-1999	IC	a	N	0.96 +/- 0.03H	0.57 +/- 0.03H	0.0175 +/- 0.0003H
23-may-2000	IC	a	N	0.43125 +/- 0.00604	<0.062 +/- 4.357U	0.01935 +/- 0.00065
31-may-2002	IC	a	N	1.01397 +/- 0.0493	0.554 +/- 0.049	0.02057 +/- 0.00033
NC7-60						
05-jun-2000	IC	a	N	2.99627 +/- 0.17024	2.05 +/- 0.17	0.04217 +/- 0.0006
23-may-2001	IC	a	N	2.73 +/- 0.11	1.7786 +/- 0.106	0.0423 +/- 0.00078
29-may-2002	IC	a	N	0.62742 +/- 0.00602	<0.062 +/- 3.07U	0.02802 +/- 0.00051
16-jun-2003	IC	a	N	0.4818 +/- 0.00471	<0.062 +/- 1.83U	0.0215 +/- 0.00033
NC7-63						
10-feb-2000	IC	a	N	198.79 +/- 1.49	64.0058 +/- 1.35	2.79205 +/- 0.01477
15-may-2000	IC	a	N	206.99 +/- 2.92	76.976 +/- 2.878	2.79645 +/- 0.01757
09-aug-2000	IC	a	N	195.883 +/- 3.14943	67.454 +/- 2.88995	2.66577 +/- 0.0376996
15-nov-2000	IC	a	N	196.955 +/- 4.14916	65.5658 +/- 3.94612	2.60969 +/- 0.0369066
21-feb-2001	IC	a	N	199.2 +/- 2.74	64.5387 +/- 2.407	2.8057 +/- 0.03968
17-may-2001	IC	a	N	198.126 +/- 16.5115	84.35 +/- 16.48	2.36551 +/- 0.03629
18-jul-2001	IC	a	N	191.144 +/- 3.93676	62.9335 +/- 3.73302	2.76647 +/- 0.0391239
16-may-2002	IC	a	N	114 +/- 1	<0.062 +/- 75U	2.43 +/- 0.04
NC7-64						
29-nov-1995	IC	a	V	109 +/- 5.7	52.5 +/- 4.8	2.08 +/- 0.05
21-feb-1996	IC	a	V	106 +/- 7.37	51 +/- 6.4	1.95 +/- 0.03
19-jun-1996	IC	a	V	118 +/- 5	52 +/- 4	2.2 +/- 0.1
13-sep-1996	LH	a	V	-	<6200 U	2.6
26-dec-1996	IC	a	V	126 +/- 12	57.67 +/- 8.84	2.4 +/- 0.1
10-mar-2000	IC	a	N	138 +/- 2	58.8 +/- 2.4	2.18 +/- 0.02
15-jun-2000	IC	a	N	149.13 +/- 3.18	64.775 +/- 3.1487	2.36694 +/- 0.01629
10-aug-2000	IC	a	N	149.17 +/- 4.05627	68.3305 +/- 3.9798	2.29194 +/- 0.0324129
20-nov-2000	IC	a	N	146.69 +/- 3.91715	65.2481 +/- 3.83669	2.30813 +/- 0.0326418
23-feb-2001	IC	a	N	151.76 +/- 3.16	65.4873 +/- 3.0454	2.43829 +/- 0.03448
23-may-2001	IC	a	N	134.517 +/- 5.28823	58.9792 +/- 5.23714	2.15132 +/- 0.0382884
27-aug-2001	IC	a	N	130.569 +/- 4.04187	56.4269 +/- 3.97746	2.14928 +/- 0.0303954
30-nov-2001	IC	a	N	121.021 +/- 1.98705	51.7743 +/- 1.87049	2.0356 +/- 0.0287878
19-feb-2002	IC	a	N	115.639 +/- 2.21157	49.6734 +/- 2.11732	1.95886 +/- 0.0277024
13-jun-2002	IC	a	N	98.2 +/- 3.8	42.9 +/- 3.7	1.626 +/- 0.017
07-dec-2002	IC	a	N	113 +/- 2	51.9 +/- 2.2	1.925 +/- 0.014
25-jan-2003	IC	a	N	116 +/- 3	53.5 +/- 3.2	1.954 +/- 0.017

U235/U238 atom ratio collected from the Pit 7 Complex between July 1, 1995 and June 30, 2003.
Results recorded by February 17, 2004.

Uranium 236 by mass measurement	Uranium 238 by mass measurement	Uranium 235/238 (atom ratio)	Location Date
			NC7-51
0.99 +/- 0.03H	160 +/- 9H	0.00248 +/- 2e-05	29-apr-1998
0.83 +/- 0.02H	143.4 +/- 0.7H	0.0026 +/- 2e-05	21-sep-1998
0.35 +/- 0.015H	66.3 +/- 0.3H	0.00375 +/- 3e-05	16-feb-1999
<0.0007 +/- 0.4HU	66.602 +/- 0.304H	0.00456 +/- 7e-05H	25-aug-1999
<0.0007 +/- 0.4U	65.1 +/- 0.2	0.00486 +/- 0.00026	24-nov-1999
0.19146 +/- 0.00617	60.5387 +/- 0.305227	-	11-feb-2000
0.18493 +/- 0.01594	59.0323 +/- 0.223224	-	15-may-2000
0.189064 +/- 0.0186946	57.6442 +/- 0.576442	-	09-aug-2000
0.210611 +/- 0.0215485	57.2212 +/- 0.572212	-	15-nov-2000
0.22376 +/- 0.01269	63.2393 +/- 0.632393	-	21-feb-2001
0.0064 +/- 0.00143	1.854 +/- 0.05	0.004723 +/- 4.7e-05	17-may-2001
0.207701 +/- 0.0170618	57.3332 +/- 0.573332	-	18-jul-2001
0.203156 +/- 0.0130608	56.373 +/- 0.56373	-	19-nov-2001
0.18771 +/- 0.0173332	55.9421 +/- 0.559421	-	14-feb-2002
0.192143 +/- 0.0216696	55.1913 +/- 0.551913	-	15-may-2002
0.192 +/- 0.03	54.4 +/- 0.2	0.00458 +/- 3e-05	20-nov-2002
0.2 +/- 0.04	57.2 +/- 0.4	0.0046 +/- 4e-05	12-feb-2003
			NC7-52
<0.0007 U	0.82 +/- 0.01	0.00725 +/- 7e-05	29-nov-1995
<0.0007 U	0.624 +/- 0.004	0.00716 +/- 8e-05	19-jun-1996
<65 U	0.6	-	17-dec-1996
<0.0007 +/- 0.00248U	0.2634 +/- 0.005	0.00727 +/- 0.0001	15-jun-2000
<0.0007 +/- 0.00107U	0.6225 +/- 0.0071	0.00727 +/- 8e-05	31-may-2002
			NC7-53
<0.0007 U	0.289 +/- 0.004	0.00715 +/- 0.00015	05-jun-1996
<0.0007 U	0.372 +/- 0.004	0.00715 +/- 8e-05	16-dec-1996
<0.0007 +/- 0.005HU	0.375 +/- 0.004H	0.00726 +/- 0.00011H	21-may-1999
<0.0007 +/- 0.02109U	0.4119 +/- 0.006	0.007307 +/- 0.00022	23-may-2000
<0.0007 +/- 0.00051U	0.4394 +/- 0.0054	0.00728 +/- 7.3e-05	31-may-2002
			NC7-60
<0.0007 +/- 0.00243U	0.9041 +/- 0.0091	0.007254 +/- 7.3e-05	05-jun-2000
<0.00122 +/- 0.00122 U	0.911462 +/- 0.00911462	-	23-may-2001
<0.0007 +/- 0.01U	0.5994 +/- 0.006	0.007271 +/- 0.00011	29-may-2002
<0.0007 +/- 0.00609U	0.4603 +/- 0.0047	0.007264 +/- 8.4e-05	16-jun-2003
			NC7-63
0.68806 +/- 0.02897	131.301 +/- 0.618444	-	10-feb-2000
0.64995 +/- 0.03531	126.567 +/- 0.52058	-	15-may-2000
0.661859 +/- 0.024996	125.102 +/- 1.25102	-	09-aug-2000
0.71067 +/- 0.0462483	128.069 +/- 1.28069	-	15-nov-2000
0.68073 +/- 0.02876	131.176 +/- 1.31176	-	21-feb-2001
0.51035 +/- 0.19144	110.9 +/- 1	0.003318 +/- 4.1e-05	17-may-2001
0.604472 +/- 0.0519604	124.839 +/- 1.24839	-	18-jul-2001
0.59 +/- 0.07	110.6 +/- 1.4	0.00341 +/- 3e-05	16-may-2002
			NC7-64
0.1 +/- 0.04	54.4 +/- 0.8	0.00594 +/- 5e-05	29-nov-1995
0.112 +/- 0.031	52.9 +/- 0.91	0.00574 +/- 4e-05	21-feb-1996
0.16 +/- 0.02	63 +/- 3	0.0055 +/- 3e-05	19-jun-1996
<65 U	75	-	13-sep-1996
0.1509 +/- 0.0382	65.6 +/- 2.7	0.0057 +/- 6e-05	26-dec-1996
0.28 +/- 0.03	76.4 +/- 0.4	0.00444 +/- 2e-05	10-mar-2000
0.29458 +/- 0.01674	81.6907 +/- 0.411872	-	15-jun-2000
0.286162 +/- 0.0315166	78.2617 +/- 0.782617	-	10-aug-2000
0.256614 +/- 0.0256458	78.8775 +/- 0.788775	-	20-nov-2000
0.30724 +/- 0.02435	83.5263 +/- 0.835263	-	23-feb-2001
0.224984 +/- 0.0329648	73.1611 +/- 0.731611	-	23-may-2001
0.218642 +/- 0.0200575	71.7739 +/- 0.717739	-	27-aug-2001
0.227807 +/- 0.0122759	66.9837 +/- 0.669837	-	30-nov-2001
0.211329 +/- 0.0159438	63.7951 +/- 0.637951	-	19-feb-2002
0.183 +/- 0.038	53.5 +/- 0.4	0.00473 +/- 3e-05	13-jun-2002
0.184 +/- 0.021	59 +/- 0.3	0.00507 +/- 3e-05	07-dec-2002
0.191 +/- 0.025	60.5 +/- 0.3	0.00502 +/- 4e-05	25-jan-2003

Table A-6. Ground/surface water mass spectrometric analyses for uranium isotopes (pCi/L) and

Location Date	Lab	Note	Val.	Total Uranium by mass measurement	Uranium 234 by mass measurement	Uranium 235 by mass measurement
NC7-65						
21-may-1999	IC	a	N	1.045 +/- 0.014H	0.612 +/- 0.014H	0.0191 +/- 0.0002H
26-may-2000	IC	a	N	0.775 +/- 0.014	0.44 +/- 0.014	0.01491 +/- 0.00015
14-jun-2001	IC	a	N	9.17949 +/- 0.82063	5.89 +/- 0.82	0.14749 +/- 0.00265
31-may-2002	IC	a	N	11.423 +/- 0.16505	6.365 +/- 0.142	0.22697 +/- 0.00455
NC7-67						
01-jul-1999	IC	ah	N	12.9 +/- 0.4H	5.4 +/- 0.4H	0.161 +/- 0.003H
01-jul-1999	IC	aeh	N	<0.062725 +/- 0.0006HU	<0.062 +/- 1.8HU	<2.2e-05 +/- 0.0002HU
01-jun-2000	IC	aeh	N	<0.062725 +/- 0.00034EU	<0.062 +/- 0.189U	<2.2e-05 +/- 3.12252U
01-jun-2000	IC	ah	N	0.09412 +/- 0.00202	0.067 +/- 0.002	0.00122 +/- 2e-05
24-may-2001	IC	a	N	1.96774 +/- 0.62702	1.929 +/- 0.627	<2.2e-05 +/- 0.00206U
NC7-75						
09-nov-1995	IC	a	V	0.14	<0.062 U	0.006 +/- 0.001
15-feb-1996	IC	a	V	0.2 +/- 0.05	0.12 +/- 0.05	0.004 +/- 0.001
30-may-1996	IC	a	V	0.472 +/- 0.055	0.33 +/- 0.05	0.0056 +/- 0.0002
12-sep-1996	LH	a	V	-	<6200 U	<0.22 U
16-dec-1996	IC	a	V	0.17 +/- 0.02	0.08 +/- 0.01	0.0034 +/- 0.0001
14-dec-2002	IC	a	N	0.25055 +/- 0.01803	0.147 +/- 0.018	0.00435 +/- 7e-05
NC7-76						
15-may-1996	IC	a	V	3.3 +/- 0.2	1.7 +/- 0.17	0.0711 +/- 0.001
10-jun-2003	IC	a	N	17.9264 +/- 0.3405	<0.062 +/- 35.61U	0.79638 +/- 0.01844
W-PIT7-02						
26-jul-1995	IC	a	V	1.48 +/- 0.166	0.8 +/- 0.16	0.03 +/- 0.001
21-nov-1995	IC	a	V	0.87 +/- 0.07	0.46 +/- 0.06	0.019 +/- 0.001
15-feb-1996	IC	agh	V	0.63 +/- 0.12	0.42 +/- 0.12	0.01 +/- 0.001
15-mar-1996	IC	agh	V	0.46 +/- 0.06	0.23 +/- 0.05	0.01 +/- 0.001
15-mar-1996	LH	ag	V	-	-	-
15-mar-1996	FG	ag	N	-	<0.01 U	0.001
15-mar-1996	LH	ag	V	-	<6200 U	<0.043 U
15-mar-1996	MA	ag	V	-	-	<215
18-jun-1996	IC	a	V	0.52 +/- 0.02	0.32 +/- 0.02	0.0086 +/- 0.0001
30-dec-1996	IC	a	V	1.33 +/- 0.08	0.73 +/- 0.07	0.0254 +/- 0.0004
06-may-1998	IC	a	N	1.285 +/- 0.013H	0.638 +/- 0.013H	0.0291 +/- 0.0002H
16-jun-2000	IC	a	N	0.11626 +/- 0.0017	<0.062 +/- 0.486U	0.00516 +/- 0.0001
14-jun-2001	IC	a	N	10.7422 +/- 0.84269	7.104 +/- 0.842	0.15719 +/- 0.00231
23-may-2002	IC	a	N	0.29155 +/- 0.01803	0.191 +/- 0.018	0.0044 +/- 6e-05
W-PIT7-03						
26-jul-1995	IC	a	V	24.78 +/- 1.99	12.69 +/- 1.84	0.505 +/- 0.011
21-nov-1995	IC	a	V	24.7 +/- 1.1	13.13 +/- 1.02	0.5 +/- 0.009
16-feb-1996	IC	a	V	22.4 +/- 1.68	11.89 +/- 1.43	0.461 +/- 0.014
28-may-1996	IC	a	V	26.3 +/- 5.7	14 +/- 6	0.5193 +/- 0.0099
18-sep-1996	LH	a	V	-	<6200 U	<0.22 U
30-dec-1996	IC	a	V	31.2 +/- 3.1	15.82 +/- 2.77	0.607 +/- 0.016
06-may-1998	IC	a	N	32.45 +/- 0.49H	15.6 +/- 0.5H	0.756 +/- 0.008H
01-jul-1999	IC	a	N	35.7 +/- 0.2H	19.42 +/- 0.15H	0.607 +/- 0.005H
23-may-2000	IC	a	N	2.31169 +/- 0.18732	1.356 +/- 0.187	0.04269 +/- 0.0007
19-jun-2000	IC	a	N	27.26 +/- 0.73	14.3091 +/- 0.7311	0.49956 +/- 0.00391
19-jun-2000	IC	ah	N	27.2112 +/- 0.548511	13.8554 +/- 0.533231	0.509688 +/- 0.00720807
18-jun-2001	IC	a	N	28.1662 +/- 0.661058	14.6415 +/- 0.648136	0.532923 +/- 0.00753667
01-jul-2002	IC	a	N	25.2 +/- 0.8	13.6 +/- 0.8	0.455 +/- 0.004
W-PIT7-10						
26-jul-1995	IC	a	V	2.28 +/- 0.3	1.22 +/- 0.29	0.046 +/- 0.001
21-nov-1995	IC	a	V	2.08 +/- 0.16	1.03 +/- 0.14	0.047 +/- 0.009
15-feb-1996	IC	agh	V	1.88 +/- 0.2	0.99 +/- 0.18	0.04 +/- 0.002
15-mar-1996	IC	agh	V	1.95 +/- 0.24	1.05 +/- 0.21	0.041 +/- 0.002
15-mar-1996	LH	ag	V	-	-	-
15-mar-1996	FG	ag	N	-	0.02	0.009
15-mar-1996	LH	ag	V	-	<6200 U	0.045
18-jun-1996	IC	a	V	2.1 +/- 0.1	1.2 +/- 0.1	0.0402 +/- 0.0005
18-sep-1996	LH	a	V	-	<6200 U	<0.22 U
30-dec-1996	IC	a	V	2.02 +/- 0.12	1.15 +/- 0.11	0.038 +/- 0.001
06-may-1998	IC	a	N	2.26 +/- 0.03H	1.29 +/- 0.03H	0.044 +/- 0.0005H

U235/U238 atom ratio collected from the Pit 7 Complex between July 1, 1995 and June 30, 2003. Results recorded by February 17, 2004.

Uranium 236 by mass measurement	Uranium 238 by mass measurement	Uranium 235/238 (atom ratio)	Location Date
			NC7-65
<0.0007 +/- 0.0012HU	0.4142 +/- 0.0014H	0.00718 +/- 6e-05H	21-may-1999
<0.007 +/- 6e-05U	0.32 +/- 0.002	0.00725 +/- 6e-05	26-may-2000
<0.0007 +/- 0.01145U	3.142 +/- 0.032	0.0073 +/- 0.000109	14-jun-2001
<0.0007 +/- 0.00185U	4.831 +/- 0.084	0.007306 +/- 7.3e-05	31-may-2002
			NC7-67
0.046 +/- 0.002H	7.27 +/- 0.05H	0.00344 +/- 5e-05H	01-jul-1999
<0.0007 +/- 0.03HU	0.0414 +/- 0.0006H	<0.00725 HU	01-jul-1999
<0.0007 +/- 0.00164U	0.02079 +/- 0.00034	<0.008093 U	01-jun-2000
<0.0007 +/- 1e-05U	0.0259 +/- 0.00026	0.007302 +/- 9.5e-05	01-jun-2000
<0.007 +/- 0.00765U	0.03874 +/- 0.0045	<0.008255 U	24-may-2001
			NC7-75
<0.0007 U	0.133 +/- 0.001	0.0071 +/- 0.00017	09-nov-1995
<0.0007 U	0.082 +/- 0.002	0.00735 +/- 0.00021	15-feb-1996
<0.0007 U	0.138 +/- 0.001	0.00629 +/- 0.00018	30-may-1996
<65 U	<0.34 U	-	12-sep-1996
<0.0007 U	0.077 +/- 0.001	0.00691 +/- 0.00015	16-dec-1996
<0.0007 +/- 0.00034U	0.0992 +/- 0.001	0.006812 +/- 8.1e-05	14-dec-2002
			NC7-76
<0.0007 U	1.51 +/- 0.01	0.00735 +/- 9e-05	15-may-1996
<0.0007 +/- 0.13474U	17.13 +/- 0.34	0.007228 +/- 8.9e-05	10-jun-2003
			W-PIT7-02
<0.0007 U	0.652 +/- 0.005	0.0072 +/- 0.00015	26-jul-1995
<0.0007 U	0.4 +/- 0.01	0.00733 +/- 0.0001	21-nov-1995
<0.0007 U	0.204 +/- 0.003	0.0075 +/- 0.0004	15-feb-1996
<0.0007 U	0.214 +/- 0.004	0.00727 +/- 0.00028	15-mar-1996
<65 U	-	-	15-mar-1996
-	<0.0005 U	-	15-mar-1996
-	<0.34 U	-	15-mar-1996
-	16.8	-	15-mar-1996
<0.0007 U	0.19 +/- 0.001	0.00703 +/- 8e-05	18-jun-1996
<0.0007 U	0.57 +/- 0.01	0.00698 +/- 7e-05	30-dec-1996
<0.021 HU	0.618 +/- 0.003H	0.00731 +/- 3e-05	06-may-1998
<0.0007 +/- 0.00128U	0.1111 +/- 0.0017	0.007219 +/- 9.4e-05	16-jun-2000
<0.0007 +/- 0.01202U	3.481 +/- 0.034	0.007023 +/- 7.8e-05	14-jun-2001
<0.0007 +/- 0.0005U	0.09615 +/- 0.00097	0.007123 +/- 7.1e-05	23-may-2002
			W-PIT7-03
<0.0007 U	11.59 +/- 0.13	0.00677 +/- 9e-05	26-jul-1995
<0.0007 U	11.1 +/- 0.1	0.00704 +/- 6e-05	21-nov-1995
<0.0007 U	10 +/- 0.24	0.00716 +/- 4e-05	16-feb-1996
<0.0007 U	11.9 +/- 0.1	0.00681 +/- 0.0001	28-may-1996
<65 U	<0.34 U	-	18-sep-1996
0.0198 +/- 0.0113	14.77 +/- 0.35	0.00639 +/- 7e-05	30-dec-1996
<0.009 HU	16.08 +/- 0.16H	0.00731 +/- 3e-05	06-may-1998
<0.0007 +/- 0.07HU	15.681 +/- 0.102H	0.00602 +/- 3e-05H	01-jul-1999
<0.0007 +/- 0.00315U	0.913 +/- 0.011	0.007267 +/- 8.4e-05	23-may-2000
0.0168 +/- 0.00276	12.4372 +/- 0.0684821	-	19-jun-2000
0.013413 +/- 0.00303447	12.8327 +/- 0.128327	-	19-jun-2000
0.0115407 +/- 0.00352592	12.9802 +/- 0.129802	-	18-jun-2001
0.018 +/- 0.006	11.14 +/- 0.06	0.00635 +/- 4e-05	01-jul-2002
			W-PIT7-10
<0.0007 U	1.01 +/- 0.01	0.00707 +/- 0.00016	26-jul-1995
<0.0007 U	1 +/- 0.01	0.00733 +/- 6e-05	21-nov-1995
<0.0007 U	0.847 +/- 0.02	0.00741 +/- 0.00016	15-feb-1996
<0.0007 U	0.86 +/- 0.027	0.00744 +/- 0.00013	15-mar-1996
<65 U	-	-	15-mar-1996
-	0.0025	-	15-mar-1996
-	0.91	-	15-mar-1996
<0.0007 U	0.876 +/- 0.006	0.00714 +/- 8e-05	18-jun-1996
<65 U	<0.34 U	-	18-sep-1996
<0.0007 U	0.83 +/- 0.01	0.00708 +/- 8e-05	30-dec-1996
<0.0005 HU	0.935 +/- 0.01H	0.00732 +/- 3e-05	06-may-1998

Table A-6. Ground/surface water mass spectrometric analyses for uranium isotopes (pCi/L) and

Location Date	Lab	Note	Val.	Total Uranium by mass measurement	Uranium 234 by mass measurement	Uranium 235 by mass measurement
W-PIT7-10 (continued)						
03-jun-2002	IC	a	N	2.1211 +/- 0.09839	1.204 +/- 0.098	0.0406 +/- 0.00057
W-PIT7-12						
11-jun-2001	IC	a	N	2.92 +/- 0.08	1.892 +/- 0.079	0.0457 +/- 0.0005
03-jun-2002	IC	a	N	2.41735 +/- 0.07963	1.551 +/- 0.079	0.03835 +/- 0.0006
W-PIT7-13						
30-mar-2001	IC	a	N	5.48 +/- 0.24	3.5164 +/- 0.2404	0.08717 +/- 0.00141
14-jun-2001	IC	a	N	9.86 +/- 0.34	6.2181 +/- 0.3391	0.16436 +/- 0.00246
31-may-2002	IC	a	N	8.98334 +/- 1.03441	5.92 +/- 1.034	0.13634 +/- 0.00192
W-PIT7-15						
20-mar-2001	IC	a	N	0.0367 +/- 0.0004	<1.089 +/- 1.08887U	<0.005 +/- 0.0046893U
25-apr-2001	IC	a	N	0.12525 +/- 0.01101	0.09 +/- 0.011	0.00155 +/- 3e-05
04-jun-2002	IC	a	N	<0.062725 +/- 0.00028EU	<0.062 +/- 0.087U	0.0013 +/- 2e-05
W-PIT7-16						
28-mar-2001	IC	a	N	0.204629 +/- 0.00200829	<1.223 +/- 1.2234U	0.00889865 +/- 0.000449686
11-jun-2001	IC	a	N	0.33882 +/- 0.01704	0.223 +/- 0.017	0.00472 +/- 8e-05
23-may-2002	IC	a	N	0.33274 +/- 0.02702	0.226 +/- 0.027	0.00454 +/- 7e-05
17-jun-2003	IC	a	N	0.08072 +/- 0.002	<0.062 +/- 0.31U	0.00352 +/- 0.00012
W-PIT7-1903						
11-apr-2003	IC	a	N	28.5 +/- 0.2	<0.062 +/- 21U	0.641 +/- 0.008
02-may-2003	IC	a	N	53.9 +/- 0.4	<0.062 +/- 33U	1.037 +/- 0.013
06-jun-2003	IC	a	N	77.4778 +/- 5.76948	24.8 +/- 5.73	1.03129 +/- 0.01714
W-PIT7-1904						
11-apr-2003	IC	a	N	69.6 +/- 2.3	27.8 +/- 2.2	1.053 +/- 0.013
02-may-2003	IC	a	N	45.1 +/- 0.4	<0.062 +/- 35U	1.112 +/- 0.016
06-jun-2003	IC	a	N	82.8809 +/- 4.64906	32.07 +/- 4.6	1.20299 +/- 0.02034
W-PIT7-1905						
11-apr-2003	IC	a	N	10.86 +/- 0.09	<0.062 +/- 8.7U	0.238 +/- 0.003
02-may-2003	IC	a	N	12.36 +/- 0.1	<0.062 +/- 9U	0.267 +/- 0.004
06-jun-2003	IC	a	N	21.9099 +/- 1.66689	6.63 +/- 1.66	0.32706 +/- 0.00474
W-PIT7-1907						
11-apr-2003	IC	a	N	0.337 +/- 0.014	0.14 +/- 0.014	0.00538 +/- 9e-05
02-may-2003	IC	a	N	0.562 +/- 0.021	0.217 +/- 0.021	0.00918 +/- 0.00012
06-jun-2003	IC	a	N	0.20718 +/- 0.0044	<0.062 +/- 0.23U	0.00558 +/- 0.00013
W-PIT7-1915						
11-apr-2003	IC	a	N	0.0698 +/- 0.0003	<0.062 +/- 0.07U	0.00204 +/- 3e-05
02-may-2003	IC	a	N	0.0971 +/- 0.0012	<0.062 +/- 0.11U	0.00275 +/- 4e-05
06-jun-2003	IC	a	N	<0.062725 +/- 0.00091EU	<0.062 +/- 0.14U	0.00155 +/- 5e-05
W-PIT7-1916						
11-apr-2003	IC	a	N	82.509 +/- 1.12945	24.261 +/- 10.67	1.14231 +/- 0.01206
02-may-2003	IC	a	N	96.1 +/- 3.2	32.3 +/- 3.2	1.291 +/- 0.016
06-jun-2003	IC	a	N	92.5439 +/- 5.80891	28.83 +/- 5.77	1.28975 +/- 0.01892
W-PIT7-1917						
11-apr-2003	IC	a	N	46 +/- 1.8	17.8 +/- 1.8	0.674 +/- 0.009
02-may-2003	IC	a	N	34 +/- 0.3	<0.062 +/- 22U	0.833 +/- 0.011
06-jun-2003	IC	a	N	54.7827 +/- 2.50209	20.43 +/- 2.48	0.86107 +/- 0.01214
W-PIT7-1918						
11-apr-2003	IC	a	N	39.2 +/- 1.3	15.3 +/- 1.3	0.642 +/- 0.009
02-may-2003	IC	a	N	26.8 +/- 0.2	<0.062 +/- 22U	0.71 +/- 0.008
06-jun-2003	IC	a	N	47.1677 +/- 1.99859	19.74 +/- 1.98	0.73572 +/- 0.01051
W-PIT7-1919						
11-apr-2003	IC	a	N	39.5 +/- 0.3	<0.062 +/- 27U	0.872 +/- 0.011
02-may-2003	IC	a	N	59.9 +/- 2.1	20.4 +/- 2	0.873 +/- 0.012
06-jun-2003	IC	a	N	65.1547 +/- 1.44007	26.102 +/- 1.42	0.87424 +/- 0.00735

U235/U238 atom ratio collected from the Pit 7 Complex between July 1, 1995 and June 30, 2003.
Results recorded by February 17, 2004.

Uranium 236 by mass measurement	Uranium 238 by mass measurement	Uranium 235/238 (atom ratio)	Location Date
			(continued) W-PIT7-10
<0.0007 +/- 0.00134U	0.8765 +/- 0.0087	0.007203 +/- 7.2e-05	03-jun-2002
			W-PIT7-12
<0.007 +/- 0.0009U	0.981 +/- 0.007	0.00725 +/- 5e-05	11-jun-2001
<0.0007 +/- 0.00127U	0.828 +/- 0.01	0.007205 +/- 7.2e-05	03-jun-2002
			W-PIT7-13
<0.00178 +/- 0.00178 U	1.87403 +/- 0.0187403	-	30-mar-2001
<0.00294 +/- 0.00294 U	3.48101 +/- 0.0348101	-	14-jun-2001
<0.0007 +/- 0.0146U	2.927 +/- 0.029	0.007244 +/- 7.2e-05	31-may-2002
			W-PIT7-15
<0.002 +/- 0.002U	0.0366945 +/- 0.000366945	-	20-mar-2001
<0.0007 +/- 0.00022U	0.0337 +/- 0.00034	0.007159 +/- 0.000114	25-apr-2001
<0.0007 +/- 0.00023U	0.02778 +/- 0.00028	0.007258 +/- 0.000117	04-jun-2002
			W-PIT7-16
<0.00203944 +/- 0.00203944U	0.19573 +/- 0.0019573	-	28-mar-2001
<0.0007 +/- 0.00019U	0.1111 +/- 0.0011	0.006603 +/- 8.7e-05	11-jun-2001
<0.0007 +/- 0.00035U	0.1022 +/- 0.0011	0.006906 +/- 6.9e-05	23-may-2002
<0.0007 +/- 0.00312U	0.0772 +/- 0.002	0.007087 +/- 0.000147	17-jun-2003
			W-PIT7-1903
0.133 +/- 0.024	27.7 +/- 0.2	0.00359 +/- 3e-05	11-apr-2003
0.3 +/- 0.03	52.5 +/- 0.4	0.00307 +/- 3e-05	02-may-2003
0.24648 +/- 0.06909	51.4 +/- 0.67	0.00312 +/- 3.2e-05	06-jun-2003
			W-PIT7-1904
0.198 +/- 0.024	40.5 +/- 0.3	0.00404 +/- 4e-05	11-apr-2003
0.186 +/- 0.038	43.8 +/- 0.4	0.00395 +/- 5e-05	02-may-2003
0.21786 +/- 0.06637	49.39 +/- 0.67	0.003788 +/- 3.8e-05	06-jun-2003
			W-PIT7-1905
0.06 +/- 0.015	10.57 +/- 0.09	0.0035 +/- 4e-05	11-apr-2003
0.059 +/- 0.009	12.03 +/- 0.1	0.00345 +/- 5e-05	02-may-2003
0.06284 +/- 0.02	14.89 +/- 0.15	0.003415 +/- 3.6e-05	06-jun-2003
			W-PIT7-1907
<0.007 +/- 0.0002U	0.191 +/- 0.002	0.00438 +/- 5e-05	11-apr-2003
<0.007 +/- 0.0002U	0.334 +/- 0.003	0.00427 +/- 4e-05	02-may-2003
<0.0007 +/- 0.00116U	0.2016 +/- 0.0044	0.004301 +/- 4.3e-05	06-jun-2003
			W-PIT7-1915
<0.007 +/- 0.0003U	0.0678 +/- 0.0003	0.00467 +/- 6e-05	11-apr-2003
<0.007 +/- 0.0007U	0.0943 +/- 0.0012	0.00453 +/- 4e-05	02-may-2003
<0.0007 +/- 0.00063U	0.05631 +/- 0.00091	0.00429 +/- 0.000105	06-jun-2003
			W-PIT7-1916
0.26167 +/- 0.01103	56.844 +/- 0.37	0.003125 +/- 2.6e-05	11-apr-2003
0.32 +/- 0.03	62.1 +/- 0.6	0.00323 +/- 3e-05	02-may-2003
0.27418 +/- 0.03589	62.15 +/- 0.67	0.003227 +/- 3.2e-05	06-jun-2003
			W-PIT7-1917
0.125 +/- 0.018	27.4 +/- 0.3	0.00382 +/- 3e-05	11-apr-2003
0.152 +/- 0.017	33 +/- 0.3	0.00393 +/- 4e-05	02-may-2003
0.1216 +/- 0.03202	33.37 +/- 0.33	0.004013 +/- 4e-05	06-jun-2003
			W-PIT7-1918
0.091 +/- 0.019	23.2 +/- 0.2	0.00431 +/- 4e-05	11-apr-2003
0.106 +/- 0.015	25.9 +/- 0.2	0.00426 +/- 4e-05	02-may-2003
0.10202 +/- 0.03062	26.59 +/- 0.27	0.004302 +/- 4.4e-05	06-jun-2003
			W-PIT7-1919
0.191 +/- 0.032	38.4 +/- 0.3	0.00353 +/- 3e-05	11-apr-2003
0.19 +/- 0.024	38.5 +/- 0.3	0.00353 +/- 4e-05	02-may-2003
0.16042 +/- 0.01462	38.018 +/- 0.239	0.003576 +/- 2e-05	06-jun-2003

Table A-6. Ground/surface water mass spectrometric analyses for uranium isotopes (pCi/L) and

Location Date	Lab	Note	Val.	Total Uranium by mass measurement	Uranium 234 by mass measurement	Uranium 235 by mass measurement
W-865-1804						
23-jun-2003	IC	a	N	0.34795 +/- 0.00711	<0.062 +/- 1.06U	0.01535 +/- 0.00038

U235/U238 atom ratio collected from the Pit 7 Complex between July 1, 1995 and June 30, 2003.
Results recorded by February 17, 2004.

Uranium 236 by mass measurement	Uranium 238 by mass measurement	Uranium 235/238 (atom ratio)	Location Date
<0.0007 +/- 0.0037U	0.3326 +/- 0.0071	0.007177 +/- 9.3e-05	W-865-1804 23-jun-2003

See following page for notes

Table A-6. Ground/surface water mass spectrometric analyses for uranium isotopes (pCi/L) and U235/U238 atom ratio collected from the Pit 7 Complex between July 1, 1995 and June 30, 2003. Results recorded by February 17, 2004.

Notes:

- Indicates no analysis performed for this compound

Val. = Validation code

Footnotes:

a	ERD data
b	ORAD WGMG data
c	Analytical results for this sample are suspect
d	Sample collected during hydraulic testing
e	Blind sample, sent to lab without location identity
f	Sample dilution necessary for analysis; detection limits increased
g	Interlaboratory collocated sample
h	Intralaboratory collocated sample
i	Sample collected as part of pilot study
j	Note field may contain important information regarding this sample
k	Pre-development sample
l	Norm month, norm quarter or norm year inconsistent with sample date
m	Confirmation sample
n	Sample analyzed after standard holding time
o	Sample comprised of partial composite
p	Alpha spectroscopy analysis of uranium isotopes
q	Gamma spectroscopy analysis of uranium isotopes
r	Tritium data represents non-detect with activity calc'd for 100 percent error.

Lab Codes:

FG	Fruit Growers Laboratory, Inc.	853 Corporation St. Santa Paula, Ca 93061-0272
IC	ICP MS Facility	
LH	LAS-formerly Lockheed<1jan97	975 Kelly Johnson Las Vegas NV 89119
MA	Maxwell Laboratories, Inc.	S-Cubed Div., 8808 Balboa Ave. San Diego CA 92123

Validation Codes:

V	Validated
N	Not validated (default value)
U	Undeclared
H	Historical comparison only

CLP flags: (follow result)

B	Analyte found in method blank
D	Analysis performed at a secondary dilution or concentration (i.e., vapor samples)
E	The analyte was detected below the LLNL reporting limit, but above the analytical laboratory minimum detection limit.
F	Analyte found in field blank, trip blank, or equipment blank
G	Quantitated using fuel calibration, but does not match typical fuel fingerprint (fuel maybe gasoline, diesel, motor oil etc.).
H	Sample analyzed outside of holding time, sample results should be evaluated
J	Analyte was postively identified; the associated numerical value is the approximate concentration of the analyte in the sample.
L	Spike accuracy not within control limits
O	Duplicate spike or sample precision not within control limits
P	Indicates that the absence of a data qualifier flag does not mean that the data does not need qualification, but that the implementation of electronic data qualifier flags was not yet established
R	Sample results are rejected due to serious deficiencies in the ability to analyze the sample and meet QC criteria. The presence or absence of the analyte cannot be verified
S	Analytical results for this sample are suspect
T	Analyte is tentatively identified compound; result is approximate
U	Compound was analyzed for, but not detected above detection limit

Table A-7. Ground/surface water alpha spectrometric analyses for uranium isotopes (pCi/L) in samples collected from the Pit 7 Complex between July 1, 1995 and June 30, 2003. Results recorded by December 18, 2003.

Uranium alpha spec in ground water
December 19, 2003
gemini2

s3uraniumalpha.19dec2003

Min Sample Date
July 1, 1995
Max Sample Date
June 30, 2003

Table A-7. Ground/surface water alpha spectrometric analyses for uranium isotopes (pCi/L) in samples collected from the Pit 7 Complex between July 1, 1995 and June 30, 2003. Results recorded by December 18, 2003.

Location Date	Lab	Note	Val.	Uranium 233+234	Uranium 235+236	Uranium 238
MUL2						
06-sep-1996	LH	a	V	0.551 +/- 0.099BLO	0.057 +/- 0.032LOB	0.445 +/- 0.088BLO
08-sep-1997	LH	a	V	0.355 +/- 0.078B	0.028 +/- 0.021B	0.335 +/- 0.074B
16-sep-1998	QR	a	V	<1 +/- 0.169U	<1 +/- 0.0413U	<1 +/- 0.17U
08-sep-1999	TN	ah	V	0.465 +/- 0.084	<0.1 +/- 0.022UE	0.426 +/- 0.079
08-sep-1999	TN	aeh	V	0.516 +/- 0.099	<0.1 +/- 0.023UE	0.436 +/- 0.089
06-sep-2000	TN	a	V	1.51 +/- 0.24	0.153 +/- 0.061	1.09 +/- 0.19
05-sep-2001	TN	ah	V	0.445 +/- 0.077	<0.1 +/- 0.011U	0.474 +/- 0.083
05-sep-2001	TN	aeh	V	0.519 +/- 0.087	<0.1 +/- 0.021EU	0.504 +/- 0.086
17-sep-2002	TN	ah	V	0.442 +/- 0.079	<0.1 +/- 0.022EU	0.412 +/- 0.074
17-sep-2002	TN	aeh	V	0.399 +/- 0.074	<0.1 +/- 0.017EU	0.402 +/- 0.074
K7-01						
14-jul-1995	LH	ap	V	4.31 +/- 0.5	0.31 +/- 0.13	3.96 +/- 0.48O
17-oct-1995	LH	ah	V	5.37 +/- 0.56B	0.29 +/- 0.12B	5.05 +/- 0.54B
17-oct-1995	LH	aeh	V	4.98 +/- 0.52B	0.32 +/- 0.12B	4.58 +/- 0.49B
07-feb-1996	LH	a	V	4.82 +/- 0.57BF	0.32 +/- 0.14BF	4.6 +/- 0.56BF
24-apr-1996	LH	a	V	4.76 +/- 0.34B	0.315 +/- 0.068	4.7 +/- 0.34
25-jul-1996	LH	aeh	V	5.67 +/- 0.42	0.355 +/- 0.079	5.22 +/- 0.39
25-jul-1996	LH	ah	V	5.46 +/- 0.38	0.392 +/- 0.075	5.19 +/- 0.37
18-oct-1996	LH	a	V	5.57 +/- 0.42	0.319 +/- 0.076	5.01 +/- 0.39
08-apr-1997	LH	a	V	5.96 +/- 0.4	0.256 +/- 0.056	5.94 +/- 0.39
23-jul-1997	LH	a	V	7.15 +/- 0.52	0.299 +/- 0.079	7.23 +/- 0.52
21-oct-1997	LH	ah	V	8.13 +/- 0.54H	0.43 +/- 0.086H	7.28 +/- 0.5H
21-oct-1997	LH	aeh	V	7.35 +/- 0.49H	0.321 +/- 0.069H	7.33 +/- 0.49H
14-jan-1998	FG	a	V	7.18 +/- 0.61B	0.27 +/- 0.1	6.54 +/- 0.56
20-apr-1998	QU	a	V	8.36 +/- 2.28BJ	0.54 +/- 0.37	7.66 +/- 2.11
21-jul-1998	QU	a	V	8.17 +/- 2.01B	<0.36 +/- 0.24U	8 +/- 1.97
19-oct-1998	QU	ah	V	8.1 +/- 2.2B	1.43 +/- 0.64	7.68 +/- 2.1B
19-oct-1998	QU	aeh	V	6.11 +/- 1.69B	0.49 +/- 0.33	6.33 +/- 1.74B
19-jan-1999	QU	ah	V	8.18 +/- 1.68B	0.52 +/- 0.14	7.98 +/- 1.64B
19-jan-1999	QU	aeh	V	7.39 +/- 1.49B	0.4 +/- 0.11	7.1 +/- 1.43B
22-apr-1999	TN	a	V	9.4 +/- 0.42	0.582 +/- 0.082	8.72 +/- 0.4
20-jul-1999	TN	a	V	9.78 +/- 1.1	0.521 +/- 0.094	9.26 +/- 1
07-oct-1999	TN	ah	V	8.37 +/- 0.94	0.426 +/- 0.086	7.65 +/- 0.86
07-oct-1999	TN	aeh	V	7.65 +/- 0.83	0.438 +/- 0.078	7.09 +/- 0.78
11-feb-2000	TN	a	V	9.17 +/- 1	0.582 +/- 0.11	8.33 +/- 0.94
25-apr-2000	TN	ah	V	8.54 +/- 1	0.442 +/- 0.13	7.89 +/- 0.98
25-apr-2000	TN	aeh	V	8.5 +/- 0.97	0.499 +/- 0.1	8.04 +/- 0.92
24-jul-2000	TN	a	V	9.34 +/- 1	0.522 +/- 0.087	8.76 +/- 0.94
30-oct-2000	TN	ah	V	9.4 +/- 1.2	0.599 +/- 0.18	8.89 +/- 1.2
30-oct-2000	TN	aeh	V	9.87 +/- 1.3	0.546 +/- 0.19	8.82 +/- 1.2
23-jan-2001	TN	a	V	8.94 +/- 0.96	0.545 +/- 0.088	8.32 +/- 0.9
24-apr-2001	TN	a	V	9.89 +/- 1.1	0.6 +/- 0.11	9.23 +/- 1
17-jul-2001	TN	ah	V	10.2 +/- 1.1	0.543 +/- 0.093	9.44 +/- 1
17-jul-2001	TN	aeh	V	9.98 +/- 1.1	0.477 +/- 0.098	9.2 +/- 1
24-oct-2001	TN	a	N	9.98 +/- 1.1	0.464 +/- 0.086	9.08 +/- 0.99
23-jan-2002	TN	a	V	9.69 +/- 1	0.629 +/- 0.1	8.95 +/- 0.97
22-apr-2002	TN	aeh	V	9.36 +/- 1	0.634 +/- 0.097	8.78 +/- 0.94
22-apr-2002	TN	ah	V	9.89 +/- 1.1	0.473 +/- 0.081	9.04 +/- 0.97
13-sep-2002	TN	a	V	9.68 +/- 1.1	0.61 +/- 0.11	8.89 +/- 0.97
27-nov-2002	TN	ah	V	9.86 +/- 1.3	0.392 +/- 0.16	8.59 +/- 1.2
27-nov-2002	TN	ah	V	9.93 +/- 1.1	0.476 +/- 0.1	8.94 +/- 0.97
10-feb-2003	TN	a	N	9.45 +/- 1	0.409 +/- 0.077	8.81 +/- 0.93
01-may-2003	TN	ah	V	10.4 +/- 1.1	0.477 +/- 0.085	9.62 +/- 1
01-may-2003	TN	aeh	V	8.81 +/- 0.94	0.458 +/- 0.087	8.26 +/- 0.89
K7-03						
14-jul-1995	LH	ahp	V	1.43 +/- 0.23	0.044 +/- 0.039	1.51 +/- 0.24O
14-jul-1995	LH	aehp	V	1.92 +/- 0.48	0.24 +/- 0.16	2.01 +/- 0.48O
18-oct-1995	LH	a	V	2.21 +/- 0.36B	0.3 +/- 0.13B	2.21 +/- 0.35BF
07-feb-1996	LH	a	V	2.04 +/- 0.35BF	0.042 +/- 0.047BF	1.68 +/- 0.31BF
24-apr-1996	LH	ah	V	1.82 +/- 0.19B	0.137 +/- 0.046	1.69 +/- 0.18
24-apr-1996	LH	aeh	V	1.88 +/- 0.19B	0.133 +/- 0.044B	1.75 +/- 0.18
25-jul-1996	LH	a	V	1.85 +/- 0.18	0.083 +/- 0.033	1.71 +/- 0.17
18-oct-1996	LH	a	V	1.85 +/- 0.2	0.09 +/- 0.04	1.73 +/- 0.19
08-apr-1997	LH	aeh	V	1.6 +/- 0.17	0.13 +/- 0.045	1.53 +/- 0.16

Table A-7. Ground/surface water alpha spectrometric analyses for uranium isotopes (pCi/L) in samples collected from the Pit 7 Complex between July 1, 1995 and June 30, 2003. Results recorded by December 18, 2003.

Location Date	Lab	Note	Val.	Uranium 233+234	Uranium 235+236	Uranium 238
K7-03 (continued)						
08-apr-1997	LH	ah	V	1.59 +/- 0.15B	0.07 +/- 0.027	1.54 +/- 0.15
23-jul-1997	LH	a	V	1.52 +/- 0.16	0.097 +/- 0.038	1.49 +/- 0.16
21-oct-1997	LH	a	V	1.96 +/- 0.19H	0.096 +/- 0.038H	1.65 +/- 0.18H
15-jan-1998	FG	ah	V	1.7 +/- 0.28B	<0.08 +/- 0.05U	1.61 +/- 0.26
15-jan-1998	FG	aeh	V	1.62 +/- 0.05	<0.16 +/- 0.09U	1.74 +/- 0.25
21-apr-1998	QU	a	V	2.01 +/- 0.72BJ	<0.29 +/- 0.14U	1.67 +/- 0.63
27-jul-1998	QU	a	V	1.8 +/- 0.65B	<0.24 +/- 0.15U	1.62 +/- 0.6
19-oct-1998	QU	a	V	1.64 +/- 0.56B	<0.32 +/- 0.17U	1.43 +/- 0.51B
19-jan-1999	QU	a	V	1.6 +/- 0.34B	0.088 +/- 0.044	1.64 +/- 0.35B
22-apr-1999	TN	ah	V	1.42 +/- 0.14	<0.1 +/- 0.033U	1.17 +/- 0.12
22-apr-1999	TN	aeh	V	1.57 +/- 0.13	0.108 +/- 0.035	1.51 +/- 0.13
19-jul-1999	TN	a	V	1.96 +/- 0.27	0.154 +/- 0.05	1.63 +/- 0.23
07-oct-1999	TN	a	V	1.4 +/- 0.18	<0.1 +/- 0.029EU	1.24 +/- 0.17
11-feb-2000	TN	a	V	1.9 +/- 0.25	0.143 +/- 0.046	1.62 +/- 0.22
25-apr-2000	TN	a	V	2.13 +/- 0.29	0.147 +/- 0.056	1.77 +/- 0.25
24-jul-2000	TN	ah	V	1.6 +/- 0.19	<0.1 +/- 0.031EU	1.49 +/- 0.19
24-jul-2000	TN	aeh	V	2.23 +/- 0.27	0.143 +/- 0.039	2.11 +/- 0.25
30-oct-2000	TN	a	V	2.32 +/- 0.28	0.155 +/- 0.041	2.23 +/- 0.27
23-jan-2001	TN	a	V	2.24 +/- 0.26	0.117 +/- 0.036	1.98 +/- 0.24
17-apr-2001	TN	ah	V	2.39 +/- 0.29	0.161 +/- 0.049	2.26 +/- 0.28
17-apr-2001	TN	aeh	V	2.47 +/- 0.3	0.205 +/- 0.051	2.18 +/- 0.27
17-jul-2001	TN	a	V	2.7 +/- 0.32	0.132 +/- 0.039	2.36 +/- 0.29
24-oct-2001	TN	a	N	3.1 +/- 0.36	0.176 +/- 0.046	3.04 +/- 0.36
23-jan-2002	TN	aeh	V	2.67 +/- 0.32	0.191 +/- 0.048	2.63 +/- 0.31
23-jan-2002	TN	ah	V	3.04 +/- 0.35	0.222 +/- 0.051	2.85 +/- 0.34
22-apr-2002	TN	a	V	2.91 +/- 0.35	0.132 +/- 0.042	2.71 +/- 0.33
06-sep-2002	TN	ah	V	3.03 +/- 0.32	0.167 +/- 0.029	2.85 +/- 0.3
06-sep-2002	TN	aeh	V	3.15 +/- 0.4	0.134 +/- 0.049	2.82 +/- 0.36
27-nov-2002	TN	a	V	3.44 +/- 0.4	0.156 +/- 0.055	3.18 +/- 0.38
07-feb-2003	TN	ah	N	2.01 +/- 0.28	<0.1 +/- 0.048UE	2.05 +/- 0.28
07-feb-2003	TN	aeh	N	2.09 +/- 0.28	0.114 +/- 0.056	2.23 +/- 0.29
01-may-2003	TN	a	V	3.15 +/- 0.37	0.124 +/- 0.042	3 +/- 0.35
K7-06						
14-jul-1995	LH	ap	V	1.07 +/- 0.22	0.093 +/- 0.065	0.51 +/- 0.15O
17-oct-1995	LH	a	V	0.73 +/- 0.19B	<0.061 +/- 0.025UB	0.6 +/- 0.17B
12-feb-1996	LH	ah	V	0.69 +/- 0.2BF	0.106 +/- 0.079BF	0.51 +/- 0.16BF
12-feb-1996	LH	aeh	V	0.76 +/- 0.2BF	0.146 +/- 0.088BF	0.51 +/- 0.17BF
24-apr-1996	LH	a	V	0.73 +/- 0.11B	0.054 +/- 0.032	0.502 +/- 0.087
24-jul-1996	LH	a	V	0.77 +/- 0.11	0.037 +/- 0.022	0.718 +/- 0.1
18-oct-1996	LH	a	V	0.85 +/- 0.14	0.069 +/- 0.036	0.64 +/- 0.12
08-apr-1997	LH	a	V	0.73 +/- 0.096	0.023 +/- 0.018	0.649 +/- 0.089
23-jul-1997	LH	a	V	1.17 +/- 0.14	0.086 +/- 0.035	0.704 +/- 0.1
21-oct-1997	LH	a	V	0.81 +/- 0.11H	0.035 +/- 0.022H	0.684 +/- 0.1H
14-jan-1998	FG	a	V	0.75 +/- 0.15B	<0.08 +/- 0.05U	0.62 +/- 0.14
21-apr-1998	QU	ah	V	0.72 +/- 0.35BJ	<0.25 +/- 0.087U	0.27 +/- 0.2
21-apr-1998	QU	aeh	V	1.19 +/- 0.53BJ	<0.45 +/- 0.17U	0.4 +/- 0.27
21-jul-1998	QU	ah	V	0.58 +/- 0.28B	<0.18 +/- 0.066U	0.53 +/- 0.26
21-jul-1998	QU	aeh	V	0.97 +/- 0.42B	<0.31 +/- 0.088U	0.57 +/- 0.32
19-oct-1998	QU	a	V	0.74 +/- 0.33B	<0.23 +/- 0.16U	0.42 +/- 0.24B
19-jan-1999	QU	a	V	0.72 +/- 0.17B	<0.025 +/- 0.019U	0.53 +/- 0.13B
23-apr-1999	TN	a	V	0.789 +/- 0.094	<0.1 +/- 0.024U	0.606 +/- 0.082
19-jul-1999	TN	ah	V	0.931 +/- 0.14	<0.1 +/- 0.018UE	0.617 +/- 0.1
19-jul-1999	TN	aeh	V	0.73 +/- 0.12	<0.1 +/- 0.024U	0.625 +/- 0.11
12-oct-1999	TN	a	V	0.644 +/- 0.098	<0.1 +/- 0.024EU	0.502 +/- 0.083
11-feb-2000	TN	a	V	0.733 +/- 0.12	<0.1 +/- 0.029EU	0.494 +/- 0.089
25-apr-2000	TN	a	V	0.539 +/- 0.09	<0.1 +/- 0.021EU	0.458 +/- 0.081
24-jul-2000	TN	a	V	0.481 +/- 0.087	<0.1 +/- 0.017U	0.427 +/- 0.079
01-nov-2000	TN	a	V	0.65 +/- 0.13	<0.1 +/- 0.033EU	0.483 +/- 0.11
06-jun-2001	TN	a	V	0.49 +/- 0.081	<0.1 +/- 0.018EU	0.36 +/- 0.064
19-jul-2001	TN	a	V	0.472 +/- 0.089	<0.1 +/- 0.014U	0.365 +/- 0.074
29-oct-2001	TN	a	N	0.453 +/- 0.078	<0.1 +/- 0.015U	0.386 +/- 0.071
30-jan-2002	TN	a	V	0.763 +/- 0.12	<0.1 +/- 0.018EU	0.361 +/- 0.072
29-apr-2002	TN	a	V	0.401 +/- 0.076	<0.1 +/- 0.022U	0.35 +/- 0.069
29-aug-2002	TN	a	V	0.474 +/- 0.082	<0.1 +/- 0.02EU	0.397 +/- 0.07
03-dec-2002	TN	a	V	0.392 +/- 0.083	<0.1 +/- 0.022U	0.343 +/- 0.075
07-feb-2003	TN	a	V	0.295 +/- 0.071	<0.1 +/- 0.016U	0.266 +/- 0.065

Table A-7. Ground/surface water alpha spectrometric analyses for uranium isotopes (pCi/L) in samples collected from the Pit 7 Complex between July 1, 1995 and June 30, 2003. Results recorded by December 18, 2003.

Location Date	Lab	Note	Val.	Uranium 233+234	Uranium 235+236	Uranium 238
K7-06 (continued)						
06-may-2003	TN	a	V	0.544 +/- 0.093	<0.1 +/- 0.017U	0.376 +/- 0.071
K7-07						
13-may-1997	LH	a	V	3.17 +/- 0.25B	0.144 +/- 0.044B	4.11 +/- 0.31B
18-nov-1997	LH	a	V	3.11 +/- 0.26	0.198 +/- 0.054	4.33 +/- 0.33
30-nov-1998	QU	a	V	7.82 +/- 1.61B	0.32 +/- 0.11	6.04 +/- 1.25B
26-may-1999	TN	a	V	3.64 +/- 0.43	0.3 +/- 0.064	6.31 +/- 0.7
18-may-2000	TN	a	V	2.31 +/- 0.29	0.164 +/- 0.051	3.22 +/- 0.39
K7-09						
17-jul-1995	LH	ap	V	0.37 +/- 0.24	<0.19 +/- 0.13U	<0.3 +/- 0.21O
18-oct-1995	LH	a	V	0.37 +/- 0.14B	<0.078 +/- 0.065UB	0.28 +/- 0.13BF
07-feb-1996	LH	a	V	0.29 +/- 0.14BF	0.104 +/- 0.084BF	0.114 +/- 0.096BF
26-apr-1996	LH	a	V	0.259 +/- 0.078FB	0.084 +/- 0.041F	0.155 +/- 0.061F
24-jul-1996	LH	a	V	0.183 +/- 0.056	<0.035 +/- 0.021U	0.141 +/- 0.048
23-oct-1996	LH	a	V	0.079 +/- 0.042	<0.026 +/- 0.02U	0.036 +/- 0.029
10-apr-1997	LH	a	V	0.055 +/- 0.029JB	<0.021 +/- 0.015U	0.052 +/- 0.026JB
17-jul-1997	LH	a	V	0.117 +/- 0.037B	0.017 +/- 0.014B	0.053 +/- 0.025B
22-oct-1997	LH	a	V	0.142 +/- 0.052H	<0.03 +/- 0.024UH	0.075 +/- 0.037H
21-jan-1998	FG	a	V	<0.07 U	<0.02 +/- 0.01U	<0.04 +/- 0.03U
22-apr-1998	QU	a	V	0.27 +/- 0.17B	<0.18 +/- 0.1U	0.24 +/- 0.17B
27-jul-1998	QU	a	V	0.15 +/- 0.15B	<0.22 +/- 0.094U	<0.18 +/- 0.11U
25-jan-1999	QU	a	V	0.055 +/- 0.027B	0.02 +/- 0.017	0.038 +/- 0.022B
23-apr-1999	TN	a	V	<0.1 +/- 0.025U	<0.1 +/- 0.015U	<0.1 +/- 0.012U
15-jul-1999	TN	a	V	0.176 +/- 0.057	<0.1 +/- 0.008U	<0.1 +/- 0.028UE
11-oct-1999	TN	a	V	<0.1 +/- 0.032EU	<0.1 +/- 0.011U	<0.1 +/- 0.023EU
16-feb-2000	TN	a	V	0.15 +/- 0.046	<0.1 +/- 0.013U	<0.1 +/- 0.033EU
25-apr-2000	TN	a	V	<0.1 +/- 0.028EU	<0.1 +/- 0.016U	<0.1 +/- 0.018EU
09-aug-2000	TN	a	V	0.126 +/- 0.039	<0.1 +/- 0.017U	<0.1 +/- 0.024EU
01-nov-2000	TN	a	V	<0.1 +/- 0.032EU	<0.1 +/- 0.013U	<0.1 +/- 0.032U
23-jan-2001	TN	a	V	<0.1 +/- 0.014U	<0.1 +/- 0.009U	<0.1 +/- 0.011U
24-apr-2001	TN	a	V	<0.1 +/- 0.017EU	<0.1 +/- 0.007U	<0.1 +/- 0.017U
17-jul-2001	TN	a	V	<0.1 +/- 0.024U	<0.1 +/- 0.014U	<0.1 +/- 0.024U
24-oct-2001	TN	a	N	<0.1 +/- 0.021EU	<0.1 +/- 0.006U	<0.1 +/- 0.01U
23-jan-2002	TN	a	V	<0.1 +/- 0.019EU	<0.1 +/- 0.011U	<0.1 +/- 0.009U
23-apr-2002	TN	a	V	<0.1 +/- 0.017EU	<0.1 +/- 0.014U	<0.1 +/- 0.011U
06-sep-2002	TN	a	V	<0.1 +/- 0.018U	<0.1 +/- 0.006U	<0.1 +/- 0.009U
29-nov-2002	TN	a	V	<0.1 +/- 0.015U	<0.1 +/- 0.009U	<0.1 +/- 0.013U
07-feb-2003	TN	a	V	<0.1 +/- 0.023U	<0.1 +/- 0.009U	<0.1 +/- 0.015U
01-may-2003	TN	a	V	<0.1 +/- 0.025UE	<0.1 +/- 0.012U	<0.1 +/- 0.02UE
K7-10						
18-jul-1995	LH	ap	V	1.14 +/- 0.42	0.28 +/- 0.19	1 +/- 0.37O
19-oct-1995	LH	a	V	0.66 +/- 0.17B	0.128 +/- 0.081B	0.41 +/- 0.13B
12-feb-1996	LH	a	V	0.56 +/- 0.19BF	0.1 +/- 0.086BF	0.23 +/- 0.12BF
26-apr-1996	LH	a	V	0.427 +/- 0.081FB	0.052 +/- 0.027F	0.225 +/- 0.058F
24-jul-1996	LH	a	V	0.292 +/- 0.064	0.03 +/- 0.022	0.204 +/- 0.052
24-oct-1996	LH	a	V	0.338 +/- 0.079	0.058 +/- 0.034	0.334 +/- 0.077
15-apr-1997	LH	a	V	0.286 +/- 0.061JB	<0.019 +/- 0.0074UO	0.238 +/- 0.054JB
17-jul-1997	LH	a	V	0.386 +/- 0.067B	0.029 +/- 0.019B	0.206 +/- 0.049B
27-oct-1997	LH	a	V	0.377 +/- 0.076FH	0.038 +/- 0.025H	0.241 +/- 0.061FH
21-jan-1998	FG	a	V	<0.09 U	<0.06 U	<0.07 +/- 0.04U
28-apr-1998	QU	a	V	0.74 +/- 0.31B	<0.22 +/- 0.1U	0.43 +/- 0.22B
31-jul-1998	QU	a	V	1.29 +/- 0.56B	0.34 +/- 0.29	1.13 +/- 0.52B
26-oct-1998	QU	a	V	35.1 +/- 6.96	0.5 +/- 0.14	5.4 +/- 1.1
04-nov-1998	QU	a	V	0.3 +/- 0.18B	0.12 +/- 0.1B	0.3 +/- 0.13B
25-jan-1999	QU	a	V	0.27 +/- 0.08B	<0.031 +/- 0.021U	0.19 +/- 0.06B
26-apr-1999	TN	a	V	0.212 +/- 0.05	<0.1 +/- 0.02U	0.165 +/- 0.044
15-jul-1999	TN	a	V	0.272 +/- 0.065	<0.1 +/- 0.021U	0.206 +/- 0.051
11-oct-1999	TN	a	V	0.212 +/- 0.056	<0.1 +/- 0.017U	0.157 +/- 0.041
27-jan-2000	TN	a	V	0.222 +/- 0.065	<0.1 +/- 0.015U	0.183 +/- 0.052
26-apr-2000	TN	a	V	0.145 +/- 0.043	<0.1 +/- 0.012U	<0.1 +/- 0.031EU
01-aug-2000	TN	a	V	<0.1 +/- 0.034EU	<0.1 +/- 0.017U	<0.1 +/- 0.03EU
01-nov-2000	TN	a	V	0.18 +/- 0.05	<0.1 +/- 0.012U	0.136 +/- 0.038
23-jan-2001	TN	a	V	0.217 +/- 0.046	<0.1 +/- 0.013U	0.133 +/- 0.035
24-apr-2001	TN	a	V	0.22 +/- 0.056	<0.1 +/- 0.007U	0.136 +/- 0.041
17-jul-2001	TN	a	V	0.141 +/- 0.043	<0.1 +/- 0.007U	0.115 +/- 0.037

Table A-7. Ground/surface water alpha spectrometric analyses for uranium isotopes (pCi/L) in samples collected from the Pit 7 Complex between July 1, 1995 and June 30, 2003. Results recorded by December 18, 2003.

Location Date	Lab	Note	Val.	Uranium 233+234	Uranium 235+236	Uranium 238
K7-10 (continued)						
24-oct-2001	TN	a	N	0.279 +/- 0.062	<0.1 +/- 0.011U	0.245 +/- 0.052
24-jan-2002	TN	a	V	0.26 +/- 0.056	<0.1 +/- 0.011U	0.216 +/- 0.05
23-apr-2002	TN	a	V	0.154 +/- 0.037	<0.1 +/- 0.009U	0.112 +/- 0.032
28-aug-2002	TN	a	V	0.195 +/- 0.047	<0.1 +/- 0.011U	0.115 +/- 0.035
29-nov-2002	TN	a	V	0.149 +/- 0.044	<0.1 +/- 0.011U	0.162 +/- 0.044
07-feb-2003	TN	a	V	0.222 +/- 0.067	<0.1 +/- 0.009U	0.133 +/- 0.049
05-may-2003	TN	a	V	0.144 +/- 0.077	<0.1 +/- 0.018U	0.152 +/- 0.078
NC7-12						
23-may-1997	LH	a	V	4.13 +/- 0.27B	0.293 +/- 0.047B	4.73 +/- 0.3
14-may-1998	QU	a	V	3.92 +/- 0.99B	<0.33 +/- 0.2U	5.07 +/- 1.23B
26-may-1999	TN	a	V	11.3 +/- 1.2	0.813 +/- 0.13	16.4 +/- 1.8
13-jun-2000	TN	a	V	3.49 +/- 0.55	0.153 +/- 0.11	4.17 +/- 0.64
NC7-15						
30-may-1997	FG	a	V	1.627 +/- 0.2397	<0.17 +/- 0.0896U	1.128 +/- 0.2014
30-may-1997	LH	a	V	1.5 +/- 0.12B	0.071 +/- 0.024B	1.39 +/- 0.12B
07-nov-1997	LH	a	V	1.5 +/- 0.17B	0.127 +/- 0.044B	1.41 +/- 0.16B
12-may-1998	FG	ag	V	1.87 +/- 0.23	0.11 +/- 0.05	1.63 +/- 0.21
12-may-1998	QU	ag	V	1.84 +/- 0.59B	<0.083 U	1.64 +/- 0.54B
23-nov-1998	GE	agj	V	2.14 +/- 0.272	<0.1 +/- 0.0422UE	2.01 +/- 0.258
23-nov-1998	QU	ag	V	3.25 +/- 0.66B	0.24 +/- 0.07B	2.15 +/- 0.44
03-dec-1999	TN	a	V	1.08 +/- 0.15L	<0.1 +/- 0.038EU	0.908 +/- 0.14L
05-jun-2000	TN	a	N	0.692 +/- 0.11	<0.1 +/- 0.018OU	0.587 +/- 0.1O
30-oct-2000	TN	a	V	1.08 +/- 0.2	<0.1 +/- 0.029U	0.925 +/- 0.18
NC7-16						
12-may-1997	LH	a	V	29.6 +/- 1.8	1.8 +/- 0.26	61.6 +/- 3.4
07-nov-1997	LH	a	V	30.7 +/- 3B	2.35 +/- 0.71B	51.5 +/- 4.2B
NC7-17						
21-nov-1995	IT	ah	V	1.09 +/- 0.2B	0.06 +/- 0.037B	0.73 +/- 0.15B
21-nov-1995	IT	aeh	V	1.07 +/- 0.19B	0.059 +/- 0.033B	0.92 +/- 0.17B
27-aug-1996	LH	a	V	1.07 +/- 0.21B	0.103 +/- 0.062B	1.03 +/- 0.2B
19-may-1997	LH	a	V	1.11 +/- 0.15BO	0.034 +/- 0.027	0.75 +/- 0.12
18-may-1998	QU	a	V	2.42 +/- 0.61B	0.17 +/- 0.13B	0.98 +/- 0.3B
NC7-18						
14-may-1997	LH	a	V	0.78 +/- 0.14BO	0.038 +/- 0.034	0.88 +/- 0.15
18-may-1998	QU	a	V	1.01 +/- 0.36B	<0.18 +/- 0.15U	0.62 +/- 0.26B
NC7-20						
05-jun-1997	LH	a	V	3.96 +/- 0.24B	0.144 +/- 0.027B	3.25 +/- 0.2B
14-may-1998	QU	a	V	4.01 +/- 1.02B	0.21 +/- 0.16B	3.43 +/- 0.89B
NC7-21						
29-may-1997	LH	a	V	9.63 +/- 0.55B	0.562 +/- 0.072	9.59 +/- 0.55
30-oct-1997	LH	a	V	11.62 +/- 0.74O	0.68 +/- 0.12O	11.31 +/- 0.72
20-may-1998	QU	a	V	8.47 +/- 2.05B	<0.36 +/- 0.25U	7.84 +/- 1.91B
23-nov-1998	QU	a	V	23.7 +/- 4.7B	2.36 +/- 0.56B	13 +/- 2.6
07-dec-1999	TN	a	V	20.8 +/- 2.2L	0.945 +/- 0.14	20.9 +/- 2.2L
NC7-22						
29-may-1997	LH	a	V	3.54 +/- 0.23B	0.236 +/- 0.041	3.46 +/- 0.23
29-oct-1997	FG	a	V	1.4 +/- 0.22O	<0.11 +/- 0.06U	0.99 +/- 0.18
29-oct-1997	LH	a	V	1.27 +/- 0.15O	0.072 +/- 0.032O	1.05 +/- 0.13
20-may-1998	QU	a	V	4.3 +/- 1.12B	0.59 +/- 0.3	3.52 +/- 0.95B
23-nov-1998	QU	a	V	27.6 +/- 5.4B	0.39 +/- 0.12B	3.2 +/- 0.66
NC7-24						
28-jan-1997	LH	a	V	3.59 +/- 0.32BLO	0.174 +/- 0.058BLO	2.51 +/- 0.25LO
29-may-1997	LH	a	V	4.36 +/- 0.28B	0.293 +/- 0.05	5.63 +/- 0.35
30-jul-1997	LH	a	V	4.68 +/- 0.75O	0.37 +/- 0.2	3.22 +/- 0.61
20-nov-1997	LH	a	V	4.48 +/- 0.33	0.167 +/- 0.048	3.32 +/- 0.27
09-mar-1998	QU	a	V	6.59 +/- 1.8	<0.31 +/- 0.23U	4.26 +/- 1.25
20-may-1998	QU	a	V	4.14 +/- 1.15B	0.21 +/- 0.18	2.5 +/- 0.77B
17-aug-1998	QU	a	V	104 +/- 23S	12 +/- 3.5S	685 +/- 147S

Table A-7. Ground/surface water alpha spectrometric analyses for uranium isotopes (pCi/L) in samples collected from the Pit 7 Complex between July 1, 1995 and June 30, 2003. Results recorded by December 18, 2003.

Location Date	Lab	Note	Val.	Uranium 233+234	Uranium 235+236	Uranium 238
NC7-24 (continued)						
24-nov-1998	QU	a	V	7.98 +/- 1.6B	0.26 +/- 0.09B	4.46 +/- 0.91
27-jan-1999	QU	a	V	6.18 +/- 1.25B	0.23 +/- 0.08	4.01 +/- 0.83B
NC7-25						
18-jul-1995	LH	ap	V	10.4 +/- 0.85	0.52 +/- 0.15	8.89 +/- 0.76O
20-oct-1995	LH	a	V	11.34 +/- 0.98B	0.44 +/- 0.16B	9.71 +/- 0.88B
12-feb-1996	LH	a	V	10.81 +/- 0.94BF	0.54 +/- 0.18BF	10.27 +/- 0.91BF
15-mar-1996	FG	ag	N	10.16 +/- 0.63	0.39 +/- 0.08	8.71 +/- 0.55
15-mar-1996	LH	ag	V	11.79 +/- 0.72	0.639 +/- 0.1	10.05 +/- 0.63
15-mar-1996	MA	ag	V	11.61 +/- 0.86J	0.14 +/- 0.77	10.09 +/- 0.04J
29-apr-1996	LH	a	V	10.56 +/- 0.66B	0.72 +/- 0.11	9.63 +/- 0.61
30-jul-1996	LH	a	V	13.29 +/- 0.8FB	0.69 +/- 0.11F	11.84 +/- 0.73FB
24-oct-1996	LH	a	V	13.07 +/- 0.8	0.555 +/- 0.1	11.18 +/- 0.7
16-apr-1997	LH	a	V	14.11 +/- 0.84JB	0.641 +/- 0.1OB	12.2 +/- 0.74JB
30-jul-1997	LH	a	V	15.19 +/- 0.9O	0.91 +/- 0.13	13.39 +/- 0.81
27-oct-1997	LH	a	V	17.4 +/- 1FH	0.98 +/- 0.15H	14.99 +/- 0.92FH
22-jan-1998	FG	a	V	16.92 +/- 1.54	0.57 +/- 0.2	14.37 +/- 1.35
28-apr-1998	QU	a	V	12.3 +/- 2.8B	0.53 +/- 0.29	9.41 +/- 2.22B
31-jul-1998	QU	a	V	17.7 +/- 4.45	1.32 +/- 0.63	15.7 +/- 3.98
26-oct-1998	QU	a	V	35.6 +/- 7.4B	1.15 +/- 0.43	14.7 +/- 3.2
04-nov-1998	QU	a	V	17.7 +/- 3.7B	0.92 +/- 0.42B	14.9 +/- 3.1B
27-jan-1999	QU	a	V	17.6 +/- 3.6B	1 +/- 0.25	15.4 +/- 3.1
04-may-1999	TN	a	V	17.7 +/- 1.1	0.961 +/- 0.18	14.8 +/- 0.94
15-jul-1999	TN	a	V	17.6 +/- 2	0.993 +/- 0.16	14.9 +/- 1.7
07-oct-1999	TN	a	V	14.8 +/- 1.6	0.806 +/- 0.14	12 +/- 1.3
04-feb-2000	TN	ah	V	17.5 +/- 1.9	1.09 +/- 0.16	14.4 +/- 1.6
04-feb-2000	TN	aeh	V	17.9 +/- 1.9	0.911 +/- 0.14	14.6 +/- 1.6
26-apr-2000	TN	a	V	17 +/- 1.8	0.865 +/- 0.13	14.3 +/- 1.5
09-aug-2000	TN	a	V	16.9 +/- 1.8	1.02 +/- 0.15	14.2 +/- 1.5
01-nov-2000	TN	a	V	17.6 +/- 2	0.902 +/- 0.18	14.2 +/- 1.6
25-jan-2001	TN	a	V	15.3 +/- 1.6	0.842 +/- 0.12	12.8 +/- 1.4
26-apr-2001	TN	a	V	16.9 +/- 1.8	1.04 +/- 0.16	13.6 +/- 1.5
18-jul-2001	TN	a	V	16.7 +/- 1.8	1.09 +/- 0.17	13.7 +/- 1.5
25-oct-2001	TN	ah	N	16.8 +/- 1.8	0.855 +/- 0.13	14 +/- 1.5
25-oct-2001	TN	aeh	N	15.9 +/- 1.7	1.25 +/- 0.17	13.1 +/- 1.4
24-jan-2002	TN	a	V	18.1 +/- 2.7	0.574 +/- 0.25	14.7 +/- 2.2
29-apr-2002	TN	a	V	16.5 +/- 1.8	0.976 +/- 0.15	13.6 +/- 1.5
11-sep-2002	TN	a	V	15.2 +/- 1.7	0.834 +/- 0.15	12.4 +/- 1.4
12-sep-2002	TN	a	V	16.8 +/- 1.8	0.82 +/- 0.13	13.8 +/- 1.5
27-nov-2002	TN	a	V	16.4 +/- 1.7	0.749 +/- 0.12	13.5 +/- 1.4
11-feb-2003	TN	a	N	16 +/- 1.7	0.656 +/- 0.1	13.1 +/- 1.4
05-may-2003	TN	a	V	18.6 +/- 1.9	0.798 +/- 0.13	16.2 +/- 1.7
NC7-26						
17-jul-1995	LH	ap	V	0.28 +/- 0.12	0.072 +/- 0.058	0.27 +/- 0.11O
18-oct-1995	LH	a	V	0.32 +/- 0.14B	0.124 +/- 0.083B	0.146 +/- 0.097BF
08-feb-1996	LH	a	V	0.185 +/- 0.1BF	<0.068 +/- 0.038U	0.151 +/- 0.095BF
26-apr-1996	LH	a	V	0.278 +/- 0.065FB	0.045 +/- 0.025F	0.166 +/- 0.049F
25-jul-1996	LH	a	V	0.453 +/- 0.078	0.067 +/- 0.029	0.274 +/- 0.059
23-oct-1996	LH	a	V	0.239 +/- 0.066	0.013 +/- 0.015	0.12 +/- 0.048
10-apr-1997	LH	a	V	0.387 +/- 0.069B	<0.014 +/- 0.011U	0.222 +/- 0.051JB
24-jul-1997	LH	a	V	0.432 +/- 0.077OB	0.039 +/- 0.023	0.294 +/- 0.063
22-oct-1997	LH	a	V	0.352 +/- 0.073H	0.072 +/- 0.034H	0.228 +/- 0.058H
21-jan-1998	FG	a	V	0.15 +/- 0.07F	<0.07 +/- 0.04U	0.09 +/- 0.05F
22-apr-1998	QU	a	V	3.76 +/- 1.22B	<0.51 +/- 0.24U	1.03 +/- 0.53B
22-jun-1998	QU	a	V	<0.72 +/- 0.47JU	<0.38 +/- 0.28JU	<0.54 +/- 0.33JU
29-jun-1998	QU	a	V	0.27 +/- 0.17	<0.074 +/- 0.078U	0.32 +/- 0.18
27-jul-1998	QU	a	V	0.57 +/- 0.37	<0.45 +/- 0.12U	<0.51 +/- 0.31U
20-oct-1998	QU	a	V	0.52 +/- 0.15B	<0.13 +/- 0.061BU	0.29 +/- 0.1B
25-jan-1999	QU	a	V	0.62 +/- 0.15B	<0.025 +/- 0.015U	0.41 +/- 0.1B
04-may-1999	TN	a	V	0.79 +/- 0.94	<0.1 +/- 0.029UE	0.519 +/- 0.073
14-jul-1999	TN	a	V	0.796 +/- 0.14	<0.1 +/- 0.023UE	0.459 +/- 0.091
11-oct-1999	TN	a	V	0.358 +/- 0.069	<0.1 +/- 0.022EU	0.244 +/- 0.056
16-feb-2000	TN	a	V	0.367 +/- 0.13	<0.1 +/- 0.062U	0.12 +/- 0.07
26-apr-2000	TN	a	V	0.205 +/- 0.056	<0.1 +/- 0.019U	0.133 +/- 0.038
09-aug-2000	TN	a	V	0.154 +/- 0.057	<0.1 +/- 0.017U	0.12 +/- 0.043
02-nov-2000	TN	a	V	0.142 +/- 0.061	<0.1 +/- 0.024U	<0.1 +/- 0.04EU

Table A-7. Ground/surface water alpha spectrometric analyses for uranium isotopes (pCi/L) in samples collected from the Pit 7 Complex between July 1, 1995 and June 30, 2003. Results recorded by December 18, 2003.

Location Date	Lab	Note	Val.	Uranium 233+234	Uranium 235+236	Uranium 238
NC7-26 (continued)						
25-jan-2001	TN	a	V	0.133 +/- 0.037	<0.1 +/- 0.01U	<0.1 +/- 0.026EU
26-apr-2001	TN	a	V	0.144 +/- 0.041	<0.1 +/- 0.011U	0.109 +/- 0.035
18-jul-2001	TN	a	V	0.117 +/- 0.044	<0.1 +/- 0.015U	<0.1 +/- 0.031EU
25-oct-2001	TN	a	N	0.141 +/- 0.04	<0.1 +/- 0.011U	0.134 +/- 0.039
24-jan-2002	TN	a	V	0.169 +/- 0.045	<0.1 +/- 0.011U	0.104 +/- 0.034
22-apr-2002	TN	a	V	0.15 +/- 0.036	<0.1 +/- 0.009U	<0.1 +/- 0.027EU
13-sep-2002	TN	a	V	0.143 +/- 0.041	<0.1 +/- 0.012U	<0.1 +/- 0.03EU
28-nov-2002	TN	a	V	0.129 +/- 0.04	<0.1 +/- 0.011U	<0.1 +/- 0.034EU
13-feb-2003	TN	a	N	0.108 +/- 0.04	<0.1 +/- 0.013U	0.124 +/- 0.04
06-may-2003	TN	a	V	0.106 +/- 0.038	<0.1 +/- 0.011U	0.122 +/- 0.038
NC7-34						
29-may-1997	LH	a	V	8.34 +/- 0.5B	0.481 +/- 0.073	16.22 +/- 0.9
30-oct-1997	LH	a	V	7.07 +/- 0.54O	0.48 +/- 0.11O	13.5 +/- 0.88
20-may-1998	FG	ag	V	20.6 +/- 4.03	1.26 +/- 0.63	63.99 +/- 11.45
20-may-1998	QU	ag	V	15 +/- 4B	1.44 +/- 0.71	46.6 +/- 11.6B
24-nov-1998	QU	a	V	10.8 +/- 2.2B	0.82 +/- 0.22B	24.9 +/- 4.9
06-dec-1999	TN	a	V	3.96 +/- 0.45L	0.28 +/- 0.063	7.69 +/- 0.84L
14-jun-2000	TN	a	V	5.04 +/- 0.57	0.429 +/- 0.08	8.98 +/- 0.98
20-nov-2000	TN	a	V	4.82 +/- 0.54	0.307 +/- 0.067	7.8 +/- 0.86
12-jun-2001	TN	a	V	3.82 +/- 0.43	0.219 +/- 0.05	5.96 +/- 0.65
30-nov-2001	TN	a	V	3.64 +/- 0.42	0.221 +/- 0.051	5.55 +/- 0.62
14-dec-2002	TN	a	V	3.63 +/- 0.41	0.149 +/- 0.043	6.06 +/- 0.66
NC7-36						
27-aug-1996	LH	a	V	1.66 +/- 0.26B	0.227 +/- 0.095B	1.11 +/- 0.21B
13-may-1997	LH	a	V	0.98 +/- 0.14BO	0.078 +/- 0.037	0.82 +/- 0.12
30-oct-1997	LH	a	V	0.94 +/- 0.12O	0.046 +/- 0.024O	0.737 +/- 0.1
20-may-1998	QU	a	V	0.98 +/- 0.4B	<0.24 +/- 0.12U	0.92 +/- 0.38B
23-nov-1998	GE	agj	V	1.06 +/- 0.163	<0.1 +/- 0.0291UE	0.839 +/- 0.139
23-nov-1998	QU	ag	V	3.32 +/- 0.7B	0.12 +/- 0.07	1.24 +/- 0.28B
29-nov-1999	TN	a	V	1.57 +/- 0.2LO	0.102 +/- 0.039	1.59 +/- 0.21LO
NC7-37						
27-may-1997	LH	ah	V	5.04 +/- 0.33	0.346 +/- 0.061	15.37 +/- 0.86
27-may-1997	LH	aeh	V	5.58 +/- 0.37B	0.49 +/- 0.077B	16.29 +/- 0.91B
16-oct-1997	LH	a	V	5.85 +/- 0.49	0.328 +/- 0.096	16.4 +/- 1.1
NC7-40						
27-may-1997	FG	ag	V	40.24 +/- 3.037	1.984 +/- 0.3481	112.2 +/- 7.981
27-may-1997	LH	ag	V	43.5 +/- 3.2B	3.24 +/- 0.66	119.8 +/- 7.1L
31-oct-1997	LH	a	V	34.2 +/- 3.5	3 +/- 0.91	86.1 +/- 6.4
NC7-47						
18-jul-1995	LH	ap	V	1.41 +/- 0.24	0.138 +/- 0.073	0.77 +/- 0.18O
20-oct-1995	LH	a	V	1.22 +/- 0.27B	0.158 +/- 0.094B	0.77 +/- 0.21B
13-feb-1996	LH	a	V	1.23 +/- 0.27BF	0.156 +/- 0.1BF	0.81 +/- 0.22BF
30-apr-1996	LH	a	V	1.39 +/- 0.15B	0.081 +/- 0.034	0.726 +/- 0.1
30-jul-1996	LH	a	V	1.28 +/- 0.15FB	0.042 +/- 0.025F	0.74 +/- 0.11FB
25-oct-1996	LH	a	V	1.29 +/- 0.16	0.057 +/- 0.035	0.62 +/- 0.11
17-apr-1997	LH	a	V	1.3 +/- 0.14JB	0.069 +/- 0.029OB	0.8 +/- 0.11JB
30-jul-1997	LH	a	V	1.22 +/- 0.14O	0.094 +/- 0.036	0.599 +/- 0.094
27-oct-1997	LH	a	V	1.23 +/- 0.16FH	0.042 +/- 0.03H	0.6 +/- 0.11FH
28-jan-1998	FG	a	V	1.33 +/- 0.18	<0.06 +/- 0.05U	0.64 +/- 0.13
30-apr-1998	QU	a	V	1.15 +/- 0.65B	<0.95 +/- 0.29U	0.84 +/- 0.56B
29-jul-1998	QU	a	V	2.3 +/- 0.77B	0.28 +/- 0.24	6.97 +/- 1.86
14-sep-1998	QR	a	V	<20 +/- 0.48U	-	<20 +/- 0.29U
21-sep-1998	QR	a	V	1.06 +/- 0.27	<1 +/- 0.0041U	<1 +/- 0.16U
21-oct-1998	QU	a	V	20.6 +/- 4.1B	0.26 +/- 0.08B	1.39 +/- 0.3
28-jan-1999	QU	a	V	2.55 +/- 0.54B	0.091 +/- 0.044	1.89 +/- 0.41B
04-feb-1999	QU	a	V	1.37 +/- 0.3B	0.071 +/- 0.035	0.68 +/- 0.16B
04-may-1999	TN	a	V	1.15 +/- 0.12	<0.1 +/- 0.025UE	0.627 +/- 0.86
15-jul-1999	TN	a	V	1.32 +/- 0.2	<0.1 +/- 0.025U	0.65 +/- 0.12
11-oct-1999	TN	a	V	1.1 +/- 0.16	<0.1 +/- 0.024EU	0.508 +/- 0.088
27-jan-2000	TN	a	V	1.05 +/- 0.15	<0.1 +/- 0.023EU	0.466 +/- 0.083
01-may-2000	TN	a	N	1.15 +/- 0.17	<0.1 +/- 0.035U	0.593 +/- 0.1
09-aug-2000	TN	a	V	1.14 +/- 0.17	<0.1 +/- 0.026EU	0.574 +/- 0.1

Table A-7. Ground/surface water alpha spectrometric analyses for uranium isotopes (pCi/L) in samples collected from the Pit 7 Complex between July 1, 1995 and June 30, 2003. Results recorded by December 18, 2003.

Location Date	Lab	Note	Val.	Uranium 233+234	Uranium 235+236	Uranium 238
NC7-47 (continued)						
02-nov-2000	TN	a	V	1.93 +/- 0.24	0.236 +/- 0.054	6.35 +/- 0.7
25-jan-2001	TN	a	V	1.02 +/- 0.15	<0.1 +/- 0.023EU	0.534 +/- 0.092
27-apr-2001	TN	a	V	1.08 +/- 0.15	<0.1 +/- 0.032EU	0.69 +/- 0.11
19-jul-2001	TN	a	V	1.09 +/- 0.16	<0.1 +/- 0.021U	0.514 +/- 0.096
29-oct-2001	TN	a	N	1.16 +/- 0.16	<0.1 +/- 0.021EU	0.572 +/- 0.092
30-jan-2002	TN	a	V	1.08 +/- 0.14	<0.1 +/- 0.022EU	0.518 +/- 0.082
30-apr-2002	TN	a	V	1.05 +/- 0.15	<0.1 +/- 0.027EU	0.596 +/- 0.098
29-aug-2002	TN	a	V	1.22 +/- 0.16	<0.1 +/- 0.021EU	0.602 +/- 0.097
03-dec-2002	TN	a	V	1.09 +/- 0.16	<0.1 +/- 0.015U	0.448 +/- 0.086
12-feb-2003	TN	a	N	1.1 +/- 0.15	<0.1 +/- 0.023UE	0.578 +/- 0.089
07-may-2003	TN	a	V	1.18 +/- 0.17	<0.1 +/- 0.02UE	0.594 +/- 0.1
NC7-48						
19-jul-1995	LH	ap	V	4.26 +/- 0.52	0.44 +/- 0.16	11.73 +/- 0.98O
19-oct-1995	LH	a	V	3.36 +/- 0.41B	0.24 +/- 0.1B	9.3 +/- 0.77B
15-feb-1996	LH	a	V	3.61 +/- 0.49BF	0.3 +/- 0.13BF	10.91 +/- 0.95BF
30-apr-1996	LH	a	V	5.17 +/- 0.38B	0.489 +/- 0.089	17.8 +/- 1
30-jul-1996	LH	a	V	4.7 +/- 0.35BF	0.391 +/- 0.078F	14.35 +/- 0.85FB
25-oct-1996	LH	aeh	V	3.39 +/- 0.3	0.32 +/- 0.076	10.16 +/- 0.66
25-oct-1996	LH	ah	V	4.5 +/- 0.35	0.325 +/- 0.075	12.85 +/- 0.79
16-apr-1997	LH	a	V	6.16 +/- 0.45JB	0.436 +/- 0.09OB	21.3 +/- 1.2JB
30-jul-1997	LH	ah	V	4.77 +/- 0.38O	0.421 +/- 0.091	14.95 +/- 0.91
30-jul-1997	LH	aeh	V	5.03 +/- 0.39O	0.372 +/- 0.085	17.7 +/- 1
28-oct-1997	LH	a	V	3.44 +/- 0.29H	0.198 +/- 0.059H	10.65 +/- 0.67H
22-jan-1998	FG	a	V	15.25 +/- 1.07	0.6 +/- 0.12	12.69 +/- 0.91
28-apr-1998	QU	a	V	10.8 +/- 2.7B	1.07 +/- 0.53	43.4 +/- 10B
31-jul-1998	QU	a	V	23.7 +/- 6.5	4.11 +/- 1.57	42.1 +/- 11.2
26-oct-1998	QU	a	V	52.6 +/- 10.6B	2.28 +/- 0.61	20.2 +/- 4.2
04-nov-1998	QU	a	V	5.08 +/- 1.2B	0.65 +/- 0.28B	15 +/- 3.2B
28-jan-1999	QU	a	V	4.65 +/- 0.94B	0.45 +/- 0.12	13.2 +/- 2.6B
04-may-1999	TN	a	V	4.08 +/- 0.24	0.46 +/- 0.078	14.8 +/- 0.6
19-jul-1999	TN	a	V	3.18 +/- 0.4	0.263 +/- 0.07	11.8 +/- 1.3
12-oct-1999	TN	a	V	3.02 +/- 0.35	0.325 +/- 0.068	9.9 +/- 1.1
27-jan-2000	TN	a	V	2.02 +/- 0.26	0.187 +/- 0.054	6.78 +/- 0.76
01-may-2000	TN	a	N	3.35 +/- 0.4	0.361 +/- 0.08	10.7 +/- 1.2
10-aug-2000	TN	a	V	2.26 +/- 0.26	0.224 +/- 0.046	7.13 +/- 0.76
02-nov-2000	TN	a	V	1.14 +/- 0.2	<0.1 +/- 0.038U	0.512 +/- 0.12
25-jan-2001	TN	a	V	2.07 +/- 0.24	0.205 +/- 0.047	6.47 +/- 0.7
26-apr-2001	TN	a	V	2.39 +/- 0.31	0.323 +/- 0.075	8.19 +/- 0.92
18-jul-2001	TN	a	V	1.91 +/- 0.26	0.219 +/- 0.065	6.21 +/- 0.72
25-oct-2001	TN	a	N	2.56 +/- 0.31	0.278 +/- 0.062	8.66 +/- 0.95
30-jan-2002	TN	a	V	3.14 +/- 0.36	0.364 +/- 0.07	10.3 +/- 1.1
30-apr-2002	TN	a	V	2.46 +/- 0.3	0.238 +/- 0.057	7.85 +/- 0.86
12-sep-2002	TN	a	V	2.04 +/- 0.26	0.162 +/- 0.048	6.39 +/- 0.72
29-nov-2002	TN	a	V	1.83 +/- 0.36	0.126 +/- 0.085	6.12 +/- 0.86
11-feb-2003	TN	a	N	3.22 +/- 0.36	0.289 +/- 0.061	10.7 +/- 1.1
06-may-2003	TN	a	V	3.34 +/- 0.38	0.18 +/- 0.049	9.99 +/- 1.1
NC7-49A						
13-may-1997	LH	a	V	0.87 +/- 0.13BO	0.066 +/- 0.035	0.59 +/- 0.11
18-may-1998	QU	a	V	1.45 +/- 0.42B	<0.27 +/- 0.11U	0.61 +/- 0.24B
NC7-50						
14-may-1998	QU	a	V	4.92 +/- 1.26B	0.29 +/- 0.2B	1.29 +/- 0.45B
16-jun-1999	TN	a	V	1.52 +/- 0.2	<0.1 +/- 0.037UE	0.899 +/- 0.13
07-mar-2000	TN	a	V	1.32 +/- 0.17	<0.1 +/- 0.031EU	0.817 +/- 0.12
31-may-2000	TN	a	N	1.06 +/- 0.15	<0.1 +/- 0.024EOU	0.694 +/- 0.11O
30-jan-2001	TN	a	V	1.35 +/- 0.18	<0.1 +/- 0.023EU	1.01 +/- 0.14
25-apr-2001	TN	a	V	1.31 +/- 0.17	<0.1 +/- 0.023EU	0.774 +/- 0.12
13-aug-2001	TN	a	V	1.25 +/- 0.17L	<0.1 +/- 0.029LUE	0.83 +/- 0.12L
18-oct-2001	TN	ah	V	1.34 +/- 0.18	<0.1 +/- 0.028EU	0.913 +/- 0.13
18-oct-2001	TN	aeh	V	1.26 +/- 0.17	<0.1 +/- 0.023EU	0.886 +/- 0.13
19-feb-2002	TN	a	V	1.29 +/- 0.17	<0.1 +/- 0.021EU	0.893 +/- 0.13
28-may-2002	TN	a	V	1.42 +/- 0.19	<0.1 +/- 0.026EU	0.94 +/- 0.13
30-jul-2002	TN	a	V	1.23 +/- 0.16	<0.1 +/- 0.022EU	0.869 +/- 0.13
21-dec-2002	TN	a	V	0.907 +/- 0.14	<0.1 +/- 0.025U	0.574 +/- 0.11
25-jan-2003	TN	a	V	1.16 +/- 0.17	<0.1 +/- 0.026UE	0.795 +/- 0.12

Table A-7. Ground/surface water alpha spectrometric analyses for uranium isotopes (pCi/L) in samples collected from the Pit 7 Complex between July 1, 1995 and June 30, 2003. Results recorded by December 18, 2003.

Location Date	Lab	Note	Val.	Uranium 233+234	Uranium 235+236	Uranium 238
NC7-51						
28-jan-1997	LH	a	V	33.3 +/- 1.9BLO	1.19 +/- 0.18BLO	34.8 +/- 2LO
05-jun-1997	LH	a	V	38.1 +/- 2B	1.66 +/- 0.16O	50 +/- 2.6B
25-jul-1997	LH	a	V	37.5 +/- 2.2	1.87 +/- 0.26	42 +/- 2.4
07-nov-1997	LH	a	V	52 +/- 3.4B	3.36 +/- 0.59B	51.1 +/- 3.4B
09-mar-1998	QU	a	V	15.6 +/- 4.5	1.38 +/- 0.76	42.1 +/- 11.2
NC7-52						
15-may-1997	LH	a	V	1.13 +/- 0.16BO	0.074 +/- 0.04	0.7 +/- 0.12
18-may-1998	QU	a	V	2.72 +/- 0.73B	0.16 +/- 0.13B	0.71 +/- 0.28B
NC7-53						
18-jul-1995	IT	ap	V	1.23 +/- 0.36F	<0.11 +/- 0.1U	0.93 +/- 0.3BF
20-nov-1995	IT	a	V	0.76 +/- 0.16B	0.096 +/- 0.061B	0.7 +/- 0.16B
12-feb-1996	IT	a	V	0.69 +/- 0.15B	0.04 +/- 0.03B	0.49 +/- 0.11B
27-aug-1996	LH	a	V	0.86 +/- 0.2B	0.147 +/- 0.085B	0.68 +/- 0.18B
13-may-1997	LH	a	V	0.55 +/- 0.12BO	<0.029 +/- 0.026U	0.396 +/- 0.098
18-may-1998	QU	a	V	0.89 +/- 0.3B	<0.2 +/- 0.12U	0.66 +/- 0.24B
NC7-60						
09-jun-1997	LH	a	V	1.48 +/- 0.12B	0.105 +/- 0.026B	1.094 +/- 0.099B
30-oct-1997	LH	a	V	1.32 +/- 0.15O	0.096 +/- 0.037O	0.85 +/- 0.12
24-nov-1998	QU	a	V	2.88 +/- 0.59B	0.22 +/- 0.07B	1.44 +/- 0.3
29-jan-1999	QU	a	V	1.03 +/- 0.23B	0.048 +/- 0.035	0.69 +/- 0.16B
09-jun-1999	TN	a	V	1 +/- 0.15	<0.1 +/- 0.03UE	0.722 +/- 0.11
26-aug-1999	TN	a	V	1.03 +/- 0.17	<0.1 +/- 0.032U	0.636 +/- 0.13
06-dec-1999	TN	a	V	0.938 +/- 0.13L	<0.1 +/- 0.015EU	0.627 +/- 0.097L
27-mar-2000	QR	ag	N	1.25 +/- 0.29	-	1.02 +/- 0.252
27-mar-2000	TN	ag	V	1.1 +/- 0.15	<0.1 +/- 0.029EU	0.736 +/- 0.11
NC7-64						
29-may-1997	LH	a	V	60 +/- 3.7B	3.09 +/- 0.52	86.4 +/- 5.1L
31-oct-1997	LH	a	V	69.3 +/- 5.4	5 +/- 1.2	86.3 +/- 6.3
14-may-1998	QU	a	V	60.2 +/- 16.4B	4.62 +/- 2.25	187 +/- 49
30-nov-1998	QU	a	V	59.2 +/- 13B	3.8 +/- 0.99	94.5 +/- 20.6B
29-nov-1999	TN	a	V	45.8 +/- 5LO	7.44 +/- 0.87	68.2 +/- 7.4LO
NC7-65						
19-may-1997	LH	a	V	0.272 +/- 0.075BO	<0.024 +/- 0.017U	0.257 +/- 0.072
28-mar-2000	TN	a	V	0.339 +/- 0.073	<0.1 +/- 0.028U	0.273 +/- 0.058
NC7-67						
12-may-1997	LH	ah	V	0.189 +/- 0.057	<0.017 +/- 0.014U	0.075 +/- 0.035
12-may-1997	LH	aeh	V	0.19 +/- 0.061	<0.024 +/- 0.018U	0.091 +/- 0.042
20-may-1998	FG	ag	V	0.16 +/- 0.07	<0.07 +/- 0.03U	0.13 +/- 0.07
20-may-1998	QU	ag	V	0.43 +/- 0.23B	<0.15 +/- 0.065U	<0.14 +/- 0.1U
NC7-75						
27-may-1997	LH	a	V	0.12 +/- 0.029B	0.019 +/- 0.012B	0.103 +/- 0.027B
31-oct-1997	LH	a	V	0.477 +/- 0.093B	0.122 +/- 0.046B	0.37 +/- 0.082B
01-jun-1998	QU	a	V	0.26 +/- 0.21B	<0.35 +/- 0.044U	<0.28 +/- 0.16U
09-dec-1998	QU	a	V	0.11 +/- 0.05B	<0.045 +/- 0.021U	0.083 +/- 0.043B
16-jun-1999	TN	a	V	<0.1 +/- 0.033UE	<0.1 +/- 0.015U	<0.1 +/- 0.021UE
05-jun-2000	TN	a	N	0.101 +/- 0.04	<0.1 +/- 0.024OU	<0.1 +/- 0.035EOU
27-nov-2000	TN	a	V	0.102 +/- 0.033	<0.1 +/- 0.011U	<0.1 +/- 0.028EU
24-may-2001	TN	a	V	0.173 +/- 0.07	<0.1 +/- 0.023U	0.115 +/- 0.049
27-nov-2001	TN	a	V	0.197 +/- 0.047	<0.1 +/- 0.011U	0.162 +/- 0.041
31-may-2002	TN	a	V	<0.1 +/- 0.024EU	<0.1 +/- 0.011U	<0.1 +/- 0.024EU
W-PIT7-02						
28-aug-1996	LH	a	V	0.5 +/- 0.15B	0.202 +/- 0.09B	0.39 +/- 0.13B
15-may-1997	LH	a	V	0.183 +/- 0.064BO	<0.022 +/- 0.016U	0.134 +/- 0.05
W-PIT7-03						
30-may-1997	FG	a	V	17.36 +/- 1.201	0.6765 +/- 0.1494	17.65 +/- 1.217
30-may-1997	LH	a	V	18.2 +/- 1B	1.33 +/- 0.13B	20.3 +/- 1.1B

Table A-7. Ground/surface water alpha spectrometric analyses for uranium isotopes (pCi/L) in samples collected from the Pit 7 Complex between July 1, 1995 and June 30, 2003. Results recorded by December 18, 2003.

Location Date	Lab	Note	Val.	Uranium 233+234	Uranium 235+236	Uranium 238
W-PIT7-10						
15-may-1997	LH	a	V	1.09 +/- 0.15BO	0.056 +/- 0.033	1.03 +/- 0.14
W-PIT7-12						
18-mar-1999	QU	a	N	1.41 +/- 0.3B	0.049 +/- 0.03	0.88 +/- 0.2
W-PIT7-13						
30-mar-2001	TN	a	V	2.52 +/- 0.28L	0.12 +/- 0.03L	1.69 +/- 0.19L
W-PIT7-15						
20-mar-2001	TN	a	V	<0.1 +/- 0.026ELOU	<0.1 +/- 0.013LOU	<0.1 +/- 0.021ELOU
W-PIT7-16						
28-mar-2001	TN	a	V	0.267 +/- 0.046	<0.1 +/- 0.015EU	0.131 +/- 0.031
W-PIT7-1714						
27-mar-2002	TN	a	V	1.26 +/- 0.17	<0.1 +/- 0.019EU	0.48 +/- 0.081
W-PIT7-1717						
28-mar-2002	TN	a	V	<0.1 +/- 0.009U	<0.1 +/- 0.01U	<0.1 +/- 0.009U
W-PIT7-1718						
03-jul-2002	TN	a	V	0.968 +/- 0.13	<0.1 +/- 0.02EU	0.738 +/- 0.1
W-PIT7-1720						
27-mar-2002	TN	a	V	<0.1 +/- 0.028EU	<0.1 +/- 0.016U	<0.1 +/- 0.023EU
W-PIT7-1723						
26-mar-2002	TN	a	V	<0.1 +/- 0.017U	<0.1 +/- 0.011U	<0.1 +/- 0.013U
W-PIT7-1724						
26-mar-2002	TN	a	V	0.482 +/- 0.082	<0.1 +/- 0.015U	0.379 +/- 0.068
W-865-01						
30-mar-1999	GE	a	V	0.647 +/- 0.111	<0.1 +/- 0.0177U	0.327 +/- 0.073
W-865-03						
29-sep-2000	TN	a	V	1.16 +/- 0.16	<0.1 +/- 0.03U	0.612 +/- 0.1
W-865-04						
28-sep-2000	TN	a	V	<0.1 +/- 0.025EU	<0.1 +/- 0.023U	<0.1 +/- 0.013U
W-865-07						
29-sep-2000	TN	a	V	1.38 +/- 0.19	<0.1 +/- 0.033EU	0.705 +/- 0.11
SPRING13						
06-nov-1995	IT	a	V	0.41 +/- 0.09B	0.049 +/- 0.028B	0.46 +/- 0.1B
SPRING24						
22-oct-1999	TN	a	V	1.25 +/- 0.19	<0.1 +/- 0.028U	0.535 +/- 0.11

See following page for notes

Table A-7. Ground/surface water alpha spectrometric analyses for uranium isotopes (pCi/L) in samples collected from the Pit 7 Complex between July 1, 1995 and June 30, 2003. Results recorded by December 18, 2003.

Notes:

- Indicates no analysis performed for this compound

Val. = Validation code

Footnotes:

a	ERD data
b	ORAD WGMG data
c	Analytical results for this sample are suspect
d	Sample collected during hydraulic testing
e	Blind sample, sent to lab without location identity
f	Sample dilution necessary for analysis; detection limits increased
g	Interlaboratory collocated sample
h	Intralaboratory collocated sample
i	Sample collected as part of pilot study
j	Note field may contain important information regarding this sample
k	Pre-development sample
l	Norm month, norm quarter or norm year inconsistent with sample date
m	Confirmation sample
n	Sample analyzed after standard holding time
o	Sample comprised of partial composite
p	Alpha spectroscopy analysis of uranium isotopes
q	Gamma spectroscopy analysis of uranium isotopes
r	Tritium data represents non-detect with activity calc'd for 100 percent error.

Lab Codes:

FG	Fruit Growers Laboratory, Inc.	853 Corporation St. Santa Paula, Ca 93061-0272
GE	General Engineering Laboratori	PO 30712, Charleston, SC 29417
IT	International Technology Corp.	IS was used for short time.
LH	LAS-formerly Lockheed<1jan97	975 Kelly Johnson Las Vegas NV 89119
MA	Maxwell Laboratories, Inc.	S-Cubed Div., 8808 Balboa Ave. San Diego CA 92123
QR	Quanterra Env. Serv.,Richland	2800 George Washington Way, Richland,WA 99352
QU	Quanterra Env. Serv.,St.Louis	13715 Rider Trail North, Earth City, MO 63045
TN	Eberline Services	2030 Wright Ave, Richmond, CA 94804

Validation Codes:

V	Validated
N	Not validated (default value)
U	Undeclared
H	Historical comparison only

CLP flags: (follow result)

B	Analyte found in method blank
D	Analysis performed at a secondary dilution or concentration (i.e., vapor samples)
E	The analyte was detected below the LLNL reporting limit, but above the analytical laboratory minimum detection limit.
F	Analyte found in field blank, trip blank, or equipment blank
G	Quantitated using fuel calibration, but does not match typical fuel fingerprint (fuel maybe gasoline, diesel, motor oil etc.).
H	Sample analyzed outside of holding time, sample results should be evaluated
J	Analyte was postively identified; the associated numerical value is the approximate concentration of the analyte in the sample.
L	Spike accuracy not within control limits
O	Duplicate spike or sample precision not within control limits
P	Indicates that the absence of a data qualifier flag does not mean that the data does not need qualification, but that the implementation of electronic data qualifier flags was not yet established
R	Sample results are rejected due to serious deficiencies in the ability to analyze the sample and meet QC criteria. The presence or absence of the analyte cannot be verified
S	Analytical results for this sample are suspect
T	Analyte is tentatively identified compound; result is approximate
U	Compound was analyzed for, but not detected above detection limit

Table A-8. Ground and surface water mass spectrometric analyses for thorium isotopes (pCi/L) in samples collected from the Pit 7 Complex between July 1, 1995 and June 30, 2003. Results recorded by February 17, 2004.

Thorium Isotopes in Ground Water by mass spec
February 18, 2004
gemini1

s3thorium.18feb2004

Min Sample Date
July 1, 1995
Max Sample Date
June 30, 2003

Table A-8. Ground and surface water mass spectrometric analyses for thorium isotopes (pCi/L) in samples collected from the Pit 7 Complex between July 1, 1995 and June 30, 2003. Results recorded by February 17, 2004.

Location Date	Lab	Note	Val.	Thorium 232 by mass measurement
MUL2				
05-dec-2002	IC	a	N	<0.0001 +/- 2.2e-06EU
K7-01				
14-jul-1995	LH	a	V	<0.056 +/- 0.041U
17-oct-1995	LH	ah	V	<0.076 +/- 0.033UB
17-oct-1995	LH	aeh	V	<0.082 +/- 0.033UB
07-feb-1996	LH	a	V	<0.1 +/- 0.04U
24-apr-1996	LH	a	V	<0.048 +/- 0.013U
25-jul-1996	LH	aeh	V	<0.035 +/- 0.021U
25-jul-1996	LH	ah	V	<0.037 +/- 0.024U
18-oct-1996	LH	a	V	<0.093 +/- 0.037UO
22-jan-1997	IC	agh	V	5.9e-05 +/- 1.2e-05
22-jan-1997	IC	aeh	V	5e-05 +/- 6e-06
08-apr-1997	LH	a	V	<0.042 +/- 0.022U
23-jul-1997	LH	a	V	<0.053 +/- 0.022U
21-oct-1997	LH	ah	V	<0.026 +/- 0.0064U
21-oct-1997	LH	aeh	V	<0.03 +/- 0.016U
14-jan-1998	FG	a	V	<0.15 +/- 0.09UB
20-apr-1998	QU	a	V	<0.15 +/- 0.015U
21-jul-1998	QU	a	V	0.11 +/- 0.13
19-oct-1998	QU	ah	V	<0.37 +/- 0.17U
19-oct-1998	QU	aeh	V	<0.21 +/- 0.098U
19-jan-1999	QU	ah	V	<0.13 +/- 0.056U
19-jan-1999	QU	aeh	V	<0.089 U
22-apr-1999	TN	a	V	<0.15 +/- 0.011U
20-jul-1999	TN	a	V	<0.15 +/- 0.023U
07-oct-1999	TN	ah	V	<0.15 +/- 0.024U
07-oct-1999	TN	aeh	V	<0.15 +/- 0.036U
11-feb-2000	TN	a	V	<0.15 +/- 0.022U
11-feb-2000	IC	a	N	0.00025 +/- 3e-05
25-apr-2000	TN	ah	V	<0.15 +/- 0.022U
25-apr-2000	TN	aeh	V	<0.15 +/- 0.016U
25-apr-2000	IC	ah	N	0.000395 +/- 3.7e-05
25-apr-2000	IC	aeh	N	0.00035 +/- 3e-05
24-jul-2000	TN	a	V	<0.15 +/- 0.027U
24-jul-2000	IC	a	N	0.000239112 +/- 3.33e-05
30-oct-2000	TN	ah	V	<0.15 +/- 0.021U
30-oct-2000	TN	aeh	V	<0.15 +/- 0.019U
30-oct-2000	IC	ah	N	0.00201241 +/- 0.000106389
30-oct-2000	IC	aeh	N	0.00124 +/- 0.00012
23-jan-2001	TN	a	V	<0.15 +/- 0.038U
23-jan-2001	IC	a	N	0.000855 +/- 5.9e-05
24-apr-2001	TN	a	V	<0.15 +/- 0.01U
24-apr-2001	IC	a	N	0.000273529 +/- 3.4e-05
17-jul-2001	TN	ah	V	<0.15 +/- 0.016U
17-jul-2001	TN	aeh	V	<0.15 +/- 0.026U
17-jul-2001	IC	ah	N	0.000386125 +/- 4e-05
17-jul-2001	IC	aeh	N	0.0001366 +/- 8.3e-06
24-oct-2001	TN	a	N	<0.15 +/- 0.025EU
24-oct-2001	IC	a	N	0.000240629 +/- 1.97e-05
23-jan-2002	TN	a	V	<0.15 +/- 0.012U
23-jan-2002	IC	a	N	0.000291558 +/- 2.58e-05
22-apr-2002	TN	aeh	V	<0.15 +/- 0.029U
22-apr-2002	TN	ah	V	<0.15 +/- 0.04U
22-apr-2002	IC	aeh	N	0.0003 +/- 0.0001
22-apr-2002	IC	ah	N	0.000671246 +/- 8.61e-05
13-sep-2002	TN	a	V	<0.15 +/- 0.012U
13-sep-2002	IC	a	N	0.0041 +/- 0.0003
27-nov-2002	TN	ah	V	<0.15 +/- 0.012U
27-nov-2002	TN	ah	V	<0.15 +/- 0.012U
27-nov-2002	IC	ah	N	0.00214 +/- 8e-05
27-nov-2002	IC	aeh	N	0.002008 +/- 5.3e-05
10-feb-2003	TN	a	N	<0.184 +/- 0.048U
10-feb-2003	IC	a	N	0.00052 +/- 3e-05
01-may-2003	TN	ah	V	<0.15 +/- 0.006U
01-may-2003	TN	aeh	V	<0.15 +/- 0.006U

Table A-8. Ground and surface water mass spectrometric analyses for thorium isotopes (pCi/L) in samples collected from the Pit 7 Complex between July 1, 1995 and June 30, 2003. Results recorded by February 17, 2004.

Location Date	Lab	Note	Val.	Thorium 232 by mass measurement
K7-01 (continued)				
01-may-2003	IC	ah	N	0.000433 +/- 3.6e-05
01-may-2003	IC	aeh	N	0.000487 +/- 9.6e-05
K7-03				
14-jul-1995	LH	ah	V	<0.073 +/- 0.059U
14-jul-1995	LH	aeh	V	<0.096 +/- 0.045U
18-oct-1995	LH	a	V	<0.091 +/- 0.018UB
07-feb-1996	LH	a	V	<0.12 +/- 0.048U
24-apr-1996	LH	ah	V	<0.071 +/- 0.041U
24-apr-1996	LH	aeh	V	<0.097 +/- 0.048U
25-jul-1996	LH	a	V	<0.047 +/- 0.017U
18-oct-1996	LH	a	V	<0.096 +/- 0.037UO
23-jan-1997	IC	a	V	0.000104 +/- 5e-06
08-apr-1997	LH	ah	V	<0.035 +/- 0.021U
08-apr-1997	LH	aeh	V	<0.033 +/- 0.012U
23-jul-1997	LH	a	V	<0.042 +/- 0.016U
21-oct-1997	LH	a	V	<0.023 +/- 0.0054U
15-jan-1998	FG	ah	V	<0.09 U
15-jan-1998	FG	aeh	V	<0.05 +/- 0.03U
21-apr-1998	QU	a	V	<0.3 +/- 0.12U
27-jul-1998	QU	a	V	<0.22 +/- 0.081U
19-oct-1998	QU	a	V	<0.21 +/- 0.097U
19-jan-1999	QU	a	V	0.1 +/- 0.12
22-apr-1999	TN	ah	V	<0.15 +/- 0.012U
22-apr-1999	TN	aeh	V	<0.15 +/- 0.006U
19-jul-1999	TN	a	V	<0.15 +/- 0.023U
07-oct-1999	TN	a	V	<0.15 +/- 0.012U
11-feb-2000	TN	a	V	<0.15 +/- 0.047U
11-feb-2000	IC	a	N	7.8e-05 +/- 5e-06
25-apr-2000	TN	a	V	<0.15 +/- 0.02U
25-apr-2000	IC	a	N	0.000705 +/- 4.5e-05
24-jul-2000	TN	ah	V	<0.15 +/- 0.026U
24-jul-2000	TN	aeh	V	<0.15 +/- 0.011U
24-jul-2000	IC	a	N	0.000103 +/- 2.2e-05
30-oct-2000	TN	a	V	<0.15 +/- 0.038U
30-oct-2000	IC	a	N	0.001273 +/- 3.1e-05
23-jan-2001	TN	a	V	<0.15 +/- 0.02U
23-jan-2001	IC	a	N	0.00203 +/- 1.4e-05
17-apr-2001	TN	ah	V	<0.15 +/- 0.016U
17-apr-2001	TN	aeh	V	<0.15 +/- 0.017U
17-apr-2001	IC	ah	N	0.00044 +/- 3e-05
17-apr-2001	IC	aeh	N	0.00045 +/- 1e-05
17-jul-2001	TN	a	V	<0.15 +/- 0.023U
17-jul-2001	IC	a	N	0.000483 +/- 1.4e-05
24-oct-2001	TN	a	N	<0.15 +/- 0.002U
24-oct-2001	IC	a	N	0.000341 +/- 6.5e-05
23-jan-2002	TN	aeh	V	<0.15 +/- 0.005U
23-jan-2002	TN	ah	V	<0.15 +/- 0.015U
23-jan-2002	IC	aeh	N	0.0001436 +/- 4.9e-06
23-jan-2002	IC	ah	N	<0.0001 +/- 4.7e-06EU
22-apr-2002	TN	a	V	<0.15 +/- 0.018U
22-apr-2002	IC	a	N	0.000308 +/- 1.3e-05
06-sep-2002	TN	ah	V	<0.15 +/- 0.005U
06-sep-2002	TN	aeh	V	<0.15 +/- 0.01U
06-sep-2002	IC	ah	N	0.000333 +/- 1.1e-05
06-sep-2002	IC	aeh	N	0.000474 +/- 1.3e-05
27-nov-2002	TN	a	V	<0.15 +/- 0.012U
27-nov-2002	IC	a	N	0.000694 +/- 1.5e-05
07-feb-2003	TN	ah	N	<0.15 +/- 0.006U
07-feb-2003	TN	aeh	N	<0.15 +/- 0.011U
07-feb-2003	IC	ah	N	0.001049 +/- 3.2e-05
07-feb-2003	IC	aeh	N	0.000482 +/- 1.9e-05
01-may-2003	TN	a	V	<0.15 +/- 0.012U
01-may-2003	IC	a	N	0.0001312 +/- 2.4e-06

Table A-8. Ground and surface water mass spectrometric analyses for thorium isotopes (pCi/L) in samples collected from the Pit 7 Complex between July 1, 1995 and June 30, 2003. Results recorded by February 17, 2004.

Location Date	Lab	Note	Val.	Thorium 232 by mass measurement
K7-06				
14-jul-1995	LH	a	V	<0.21 +/- 0.1U
17-oct-1995	LH	a	V	<0.12 +/- 0.044UB
12-feb-1996	LH	ah	V	<0.067 +/- 0.033U
12-feb-1996	LH	aeh	V	<0.097 +/- 0.039U
24-apr-1996	LH	a	V	<0.038 +/- 0.032U
24-jul-1996	LH	a	V	<0.052 +/- 0.022U
18-oct-1996	LH	a	V	<0.11 +/- 0.057UO
22-jan-1997	IC	a	V	4.6e-05 +/- 4e-06
08-apr-1997	LH	a	V	<0.029 +/- 0.013U
23-jul-1997	LH	a	V	<0.042 +/- 0.012U
21-oct-1997	LH	a	V	<0.025 +/- 0.012U
14-jan-1998	FG	a	V	<0.14 UB
21-apr-1998	QU	ah	V	<0.18 +/- 0.074U
21-apr-1998	QU	aeh	V	<0.17 +/- 0.087U
21-jul-1998	QU	ah	V	<0.52 +/- 0.14U
21-jul-1998	QU	aeh	V	<0.2 +/- 0.13U
19-oct-1998	QU	a	V	0.36 +/- 0.27
19-jan-1999	QU	a	V	<0.079 +/- 0.084U
23-apr-1999	TN	a	V	<0.15 +/- 0.013U
19-jul-1999	TN	ah	V	<0.15 +/- 0.022U
19-jul-1999	TN	aeh	V	<0.15 +/- 0.012U
12-oct-1999	TN	a	V	<0.15 +/- 0.017U
11-feb-2000	TN	a	V	<0.15 +/- 0.058U
25-apr-2000	TN	a	V	<0.15 +/- 0.015U
24-jul-2000	TN	a	V	<0.15 +/- 0.027U
01-nov-2000	TN	a	V	<0.15 +/- 0.029U
06-jun-2001	TN	a	V	<0.15 +/- 0.024U
08-jun-2001	IC	a	N	0.000246 +/- 1.9e-05
19-jul-2001	TN	a	V	<0.15 +/- 0.03U
29-oct-2001	TN	a	N	<0.15 +/- 0.016U
30-jan-2002	TN	a	V	<0.15 +/- 0.005U
29-apr-2002	TN	a	V	<0.15 +/- 0.018U
29-apr-2002	IC	a	N	0.0003005 +/- 3.3e-06
29-aug-2002	TN	a	V	<0.15 +/- 0.016U
03-dec-2002	TN	a	V	<0.15 +/- 0.007U
07-feb-2003	TN	a	V	<0.15 +/- 0.014U
06-may-2003	TN	a	V	<0.15 +/- 0.017U
06-may-2003	IC	a	N	0.0002454 +/- 6.8e-06
K7-07				
02-jun-1998	IC	a	N	0.000284 +/- 6e-06H
18-may-2000	IC	a	N	0.00094063 +/- 5.09e-05
K7-09				
17-jul-1995	LH	a	V	<0.088 +/- 0.032U
18-oct-1995	LH	a	V	<0.13 +/- 0.081UB
07-feb-1996	LH	a	V	<0.11 +/- 0.025U
26-apr-1996	LH	a	V	<0.058 +/- 0.031U
24-jul-1996	LH	a	V	<0.033 +/- 0.0078U
23-oct-1996	LH	a	V	<0.092 +/- 0.054U
23-jan-1997	IC	a	V	<5e-06 +/- 4e-07U
10-apr-1997	LH	a	V	<0.039 +/- 0.011U
17-jul-1997	LH	a	V	<0.032 +/- 0.014U
22-oct-1997	LH	a	V	<0.024 +/- 0.0092U
21-jan-1998	FG	a	V	<0.06 +/- 0.03U
22-apr-1998	QU	a	V	<0.19 +/- 0.083U
27-jul-1998	QU	a	V	<0.24 +/- 0.08U
20-oct-1998	QU	a	V	<0.14 +/- 0.086U
25-jan-1999	QU	a	V	<0.18 +/- 0.071U
23-apr-1999	TN	a	V	<0.15 +/- 0.012U
15-jul-1999	TN	a	V	<0.15 +/- 0.025U
11-oct-1999	TN	a	V	<0.15 +/- 0.011U
16-feb-2000	TN	a	V	<0.15 +/- 0.043U
25-apr-2000	TN	a	V	<0.15 +/- 0.027U
09-aug-2000	TN	a	V	<0.15 +/- 0.012U
01-nov-2000	TN	a	V	<0.15 +/- 0.008U
23-jan-2001	TN	a	V	<0.15 +/- 0.02U

Table A-8. Ground and surface water mass spectrometric analyses for thorium isotopes (pCi/L) in samples collected from the Pit 7 Complex between July 1, 1995 and June 30, 2003. Results recorded by February 17, 2004.

Location Date	Lab	Note	Val.	Thorium 232 by mass measurement
K7-09 (continued)				
24-apr-2001	TN	a	V	<0.15 +/- 0.028U
17-jul-2001	TN	a	V	<0.15 +/- 0.021U
24-oct-2001	TN	a	N	<0.15 +/- 0.021U
23-jan-2002	TN	a	V	<0.15 +/- 0.011U
23-apr-2002	TN	a	V	<0.15 +/- 0.018U
06-sep-2002	TN	a	V	<0.15 +/- 0.01U
29-nov-2002	TN	a	V	<0.15 +/- 0.006U
07-feb-2003	TN	a	V	<0.15 +/- 0.011U
01-may-2003	TN	a	V	<0.15 +/- 0.013U
01-may-2003	IC	a	N	0.000382 +/- 5e-05
K7-10				
18-jul-1995	LH	a	V	<0.2 +/- 0.079U
19-oct-1995	LH	a	V	<0.073 +/- 0.043UB
12-feb-1996	LH	a	V	<0.086 +/- 0.051U
26-apr-1996	LH	a	V	<0.039 +/- 0.022U
24-jul-1996	LH	a	V	<0.045 +/- 0.022U
24-oct-1996	LH	a	V	<0.064 +/- 0.027UO
28-jan-1997	IC	a	V	0.00404 +/- 5e-05
17-jul-1997	LH	a	V	<0.035 +/- 0.019U
27-oct-1997	LH	a	V	<0.028 +/- 0.017U
21-jan-1998	FG	a	V	<0.06 +/- 0.03U
28-apr-1998	QU	a	V	<0.15 +/- 0.078U
31-jul-1998	QU	a	V	<0.44 +/- 0.2U
26-oct-1998	QU	a	V	<0.2 +/- 0.017U
25-jan-1999	QU	a	V	<0.15 +/- 0.054U
26-apr-1999	TN	a	V	<0.15 +/- 0.006U
15-jul-1999	TN	a	V	<0.15 +/- 0.018U
11-oct-1999	TN	a	V	<0.15 +/- 0.022U
27-jan-2000	TN	a	V	<0.15 +/- 0.011U
26-apr-2000	TN	a	V	<0.15 +/- 0.019U
01-aug-2000	TN	a	V	<0.15 +/- 0.013U
01-nov-2000	TN	a	V	<0.15 +/- 0.014U
23-jan-2001	TN	a	V	<0.15 +/- 0.02U
24-apr-2001	TN	a	V	<0.15 +/- 0.012U
17-jul-2001	TN	a	V	<0.328 +/- 0.14U
24-oct-2001	TN	a	N	<0.15 +/- 0.014U
24-jan-2002	TN	a	V	<0.15 +/- 0.015U
23-apr-2002	TN	a	V	<0.15 +/- 0.025U
28-aug-2002	TN	a	V	<0.15 +/- 0.023U
29-nov-2002	TN	a	V	<0.15 +/- 0.006U
07-feb-2003	TN	a	V	<0.15 +/- 0.006U
05-may-2003	TN	a	V	<0.15 +/- 0.013U
05-may-2003	IC	a	N	0.00622 +/- 0.00025
NC7-12				
14-may-2001	IC	ah	N	0.01211 +/- 0.00025
14-may-2001	IC	aeh	N	0.0114153 +/- 0.000152742
22-may-2002	IC	a	N	0.001027 +/- 1.3e-05
28-may-2003	IC	a	N	0.0001843 +/- 5.7e-06
NC7-15				
22-may-2002	IC	a	N	0.000566 +/- 1.6e-05
28-may-2003	IC	a	N	0.0002694 +/- 9.9e-06
NC7-16				
05-jun-1996	IC	a	V	0.0189 +/- 0.0006
18-dec-1996	IC	a	V	0.023 +/- 0.013
29-apr-1998	IC	a	N	0.00409 +/- 0.00017H
23-nov-1998	IC	a	N	0.01015 +/- 0.00014H
07-dec-1999	IC	a	N	0.0269 +/- 0.0004
14-jun-2000	IC	a	N	0.005486 +/- 0.000193
30-oct-2000	IC	a	N	0.00294713 +/- 0.000276804
NC7-17				
05-jun-1996	IC	a	V	0.0218 +/- 0.0002
16-may-2001	IC	a	N	0.00811 +/- 0.00014

Table A-8. Ground and surface water mass spectrometric analyses for thorium isotopes (pCi/L) in samples collected from the Pit 7 Complex between July 1, 1995 and June 30, 2003. Results recorded by February 17, 2004.

Location Date	Lab	Note	Val.	Thorium 232 by mass measurement
NC7-17 (continued)				
30-may-2002	IC	a	N	0.004643 +/- 9.9e-05
NC7-18				
05-jun-1996	IC	a	V	0.139 +/- 0.002
16-dec-1996	IC	a	V	0.0948 +/- 0.0055
26-may-2000	IC	a	N	0.00141 +/- 3e-05
16-may-2001	IC	a	N	0.001197 +/- 2.5e-05
30-may-2002	IC	a	N	0.000155 +/- 1.6e-05
NC7-20				
15-may-1996	IC	a	V	0.0124 +/- 0.0002F
30-dec-1996	IC	a	V	0.00395 +/- 0.00013
14-jun-2000	IC	a	N	0.00497 +/- 0.0002
31-may-2001	IC	a	N	0.00170655 +/- 3.29e-05
NC7-21				
05-jun-1996	IC	a	V	0.0054 +/- 0.0003
26-dec-1996	IC	a	V	0.00295 +/- 0.00035
15-jun-2000	IC	a	N	0.001928 +/- 5.3e-05
22-may-2001	IC	a	N	0.002089 +/- 4.6e-05
NC7-24				
28-may-1996	IC	a	V	0.0136 +/- 0.0003
11-dec-1996	IC	a	V	0.0088 +/- 0.00018
NC7-25				
18-jul-1995	LH	a	V	<0.23 +/- 0.087U
20-oct-1995	LH	a	V	<0.066 +/- 0.028UB
12-feb-1996	LH	a	V	<0.086 +/- 0.062U
29-apr-1996	IC	a	V	0.00127 +/- 4e-05
29-apr-1996	LH	a	V	<0.038 +/- 0.022U
30-jul-1996	LH	a	V	<0.048 +/- 0.032U
24-oct-1996	LH	a	V	<0.085 +/- 0.04UO
28-jan-1997	IC	a	V	0.00032 +/- 4e-05
30-jul-1997	LH	a	V	<0.055 +/- 0.028U
27-oct-1997	LH	a	V	<0.023 +/- 0.017U
22-dec-1997	IC	a	N	0.00026 +/- 3e-05
22-jan-1998	FG	a	V	<0.07 U
28-apr-1998	QU	a	V	<0.19 +/- 0.088U
28-apr-1998	IC	a	N	0.002529 +/- 3e-05H
31-jul-1998	QU	a	V	<0.19 +/- 0.16U
31-jul-1998	IC	a	N	0.00111 +/- 3e-05H
26-oct-1998	QU	a	V	<0.41 +/- 0.149U
26-oct-1998	IC	a	N	0.001 +/- 3e-05H
27-jan-1999	IC	a	N	0.0039 +/- 0.0007H
27-jan-1999	QU	a	V	<0.23 +/- 0.086U
04-may-1999	TN	a	V	<0.15 +/- 0.01UL
15-jul-1999	TN	a	V	<0.15 +/- 0.023U
07-oct-1999	TN	a	V	<0.15 +/- 0.011U
04-feb-2000	TN	ah	V	<0.15 +/- 0.035U
04-feb-2000	TN	aeh	V	<0.15 +/- 0.02U
04-feb-2000	IC	a	N	0.001235 +/- 5.1e-05
26-apr-2000	TN	a	V	<0.15 +/- 0.021U
26-apr-2000	IC	a	N	0.000323 +/- 2.7e-05
09-aug-2000	TN	a	V	<0.15 +/- 0.019U
09-aug-2000	IC	a	N	0.000328896 +/- 3.98e-05
01-nov-2000	TN	a	V	<0.15 +/- 0.011U
01-nov-2000	IC	a	N	0.000346728 +/- 4.3e-05
25-jan-2001	TN	a	V	<0.15 +/- 0.026U
25-jan-2001	IC	a	N	0.000378 +/- 2.2e-05
26-apr-2001	TN	a	V	<0.212 +/- 0.077U
26-apr-2001	IC	a	N	0.000459002 +/- 3.36e-05
26-apr-2001	IC	a	N	0.000671 +/- 5.9e-05
18-jul-2001	TN	a	V	<0.347 +/- 0.091U
18-jul-2001	IC	a	N	0.000350132 +/- 2.06e-05
25-oct-2001	TN	ah	N	<0.15 +/- 0.01U
25-oct-2001	TN	aeh	N	<0.15 +/- 0.006U

Table A-8. Ground and surface water mass spectrometric analyses for thorium isotopes (pCi/L) in samples collected from the Pit 7 Complex between July 1, 1995 and June 30, 2003. Results recorded by February 17, 2004.

Location Date	Lab	Note	Val.	Thorium 232 by mass measurement
NC7-25 (continued)				
25-oct-2001	IC	ah	N	0.000320237 +/- 3.31e-05
25-oct-2001	IC	aeh	N	0.000128 +/- 1.6e-05
24-jan-2002	TN	a	V	<0.15 +/- 0.02U
24-jan-2002	IC	a	N	0.000352102 +/- 3.05e-05
29-apr-2002	TN	a	V	<0.15 +/- 0.016U
29-apr-2002	IC	a	N	0.000497904 +/- 3.74e-05
11-sep-2002	TN	a	V	<0.15 +/- 0.023U
12-sep-2002	IC	a	N	0.00057 +/- 5e-05
27-nov-2002	TN	a	V	<0.15 +/- 0.017U
29-nov-2002	IC	a	N	0.00091 +/- 7e-05
11-feb-2003	TN	a	N	<0.163 +/- 0.043U
12-feb-2003	IC	a	N	0.00034 +/- 3e-05
05-may-2003	TN	a	V	<0.15 +/- 0.014U
06-may-2003	IC	a	N	0.000434 +/- 6e-05
NC7-26				
17-jul-1995	LH	a	V	<0.099 +/- 0.05U
18-oct-1995	LH	a	V	<0.11 +/- 0.03UB
08-feb-1996	LH	a	V	<0.12 +/- 0.078U
26-apr-1996	IC	a	V	<0.0001 +/- 1e-06U
26-apr-1996	LH	a	V	<0.045 +/- 0.028U
19-jun-1996	IC	a	V	0.000229 +/- 4e-06
25-jul-1996	LH	a	V	<0.042 +/- 0.02U
23-oct-1996	LH	a	V	<0.079 +/- 0.043UO
20-dec-1996	IC	a	V	0.000176 +/- 9e-06
23-jan-1997	IC	a	V	6e-05 +/- 3e-06
10-apr-1997	LH	a	V	<0.035 +/- 0.01U
24-jul-1997	LH	a	V	<0.049 +/- 0.03U
22-oct-1997	LH	a	V	<0.028 +/- 0.01U
21-jan-1998	FG	a	V	<0.09 U
22-apr-1998	QU	a	V	<0.17 +/- 0.064U
27-jul-1998	QU	a	V	<0.22 +/- 0.068U
20-oct-1998	QU	a	V	0.14 +/- 0.13
25-jan-1999	QU	a	V	<0.16 +/- 0.11U
04-may-1999	TN	a	V	<0.15 +/- 0.013UL
14-jul-1999	TN	a	V	<0.15 +/- 0.01U
11-oct-1999	TN	a	V	<0.15 +/- 0.012U
16-feb-2000	TN	a	V	<0.15 +/- 0.017U
26-apr-2000	TN	a	V	<0.15 +/- 0.034U
26-apr-2000	IC	a	N	0.000388694 +/- 9.21e-06
09-aug-2000	TN	a	V	<0.15 +/- 0.016U
02-nov-2000	TN	a	V	<0.15 +/- 0.033U
25-jan-2001	TN	a	V	<0.15 +/- 0.01U
26-apr-2001	TN	a	V	<0.15 +/- 0.017U
26-apr-2001	IC	a	N	0.00035 +/- 1e-05
18-jul-2001	TN	a	V	<0.15 +/- 0.034U
25-oct-2001	TN	a	N	<0.15 +/- 0.011U
24-jan-2002	TN	a	V	<0.15 +/- 0.007U
22-apr-2002	TN	a	V	<0.15 +/- 0.023U
22-apr-2002	IC	a	N	<0.0001 +/- 3.1e-06EU
13-sep-2002	TN	a	V	<0.15 +/- 0.024U
28-nov-2002	TN	a	V	<0.15 +/- 0.013U
13-feb-2003	TN	a	N	<0.15 +/- 0.011U
06-may-2003	TN	a	V	<0.15 +/- 0.008U
06-may-2003	IC	a	N	<0.0001 +/- 3e-06EU
NC7-34				
05-jun-1996	IC	ah	V	0.051 +/- 0.001
05-jun-1996	IC	ah	V	0.049 +/- 0.002
30-dec-1996	IC	a	V	0.0312 +/- 0.0019
09-mar-2000	IC	a	N	0.0111 +/- 0.0005
14-jun-2000	IC	a	N	0.001007 +/- 3.8e-05
09-aug-2000	IC	a	N	0.00126827 +/- 7.25e-05
20-nov-2000	IC	a	N	0.000650501 +/- 5.34e-05
15-feb-2001	IC	a	N	0.000675 +/- 4.6e-05
12-jun-2001	IC	a	N	0.000303756 +/- 2.48e-05
27-aug-2001	IC	a	N	0.000436315 +/- 6.23e-05

Table A-8. Ground and surface water mass spectrometric analyses for thorium isotopes (pCi/L) in samples collected from the Pit 7 Complex between July 1, 1995 and June 30, 2003. Results recorded by February 17, 2004.

Location Date	Lab	Note	Val.	Thorium 232 by mass measurement
NC7-34 (continued)				
30-nov-2001	IC	a	N	0.000780937 +/- 3.1e-05
14-feb-2002	IC	a	N	0.000665212 +/- 6.06e-05
16-aug-2002	IC	a	N	0.00043 +/- 6e-05
14-dec-2002	IC	a	N	0.00103 +/- 7e-05
25-jan-2003	IC	a	N	0.00045 +/- 2e-05
NC7-36				
05-jun-1996	IC	a	V	0.091 +/- 0.002
13-dec-1996	IC	a	V	0.0228 +/- 0.0012
16-jun-1999	IC	a	N	0.0332 +/- 0.0003H
19-jun-2000	IC	a	N	0.003982 +/- 9.4e-05
31-may-2002	IC	a	N	0.002358 +/- 5.7e-05
NC7-37				
28-may-1996	IC	a	V	0.0228 +/- 0.0006
29-apr-1998	IC	a	N	0.00432 +/- 5e-05H
30-nov-1998	IC	a	N	0.0365 +/- 0.0003H
14-jun-2000	IC	a	N	0.008499 +/- 0.000181
NC7-40				
30-may-1996	IC	a	V	0.0026 +/- 0.0002F
29-apr-1998	IC	ah	N	0.000511 +/- 1e-05H
29-apr-1998	IC	ah	N	0.0044 +/- 0.0004H
24-nov-1998	IC	a	N	0.074 +/- 0.002H
29-nov-1999	IC	a	N	0.0665 +/- 0.0008
13-jun-2000	IC	a	N	0.006949 +/- 0.000178
20-nov-2000	IC	a	N	0.00239196 +/- 0.000126207
12-jun-2001	IC	a	N	0.00207786 +/- 0.00020213
19-nov-2001	IC	a	N	0.001355 +/- 3.34e-05
21-dec-2002	IC	a	N	0.00226 +/- 0.00012
06-jun-2003	IC	a	N	0.00135 +/- 0.00035
NC7-47				
18-jul-1995	LH	a	V	<0.027 +/- 0.027U
20-oct-1995	LH	a	V	<0.092 +/- 0.051UB
13-feb-1996	LH	a	V	<0.091 +/- 0.037U
30-apr-1996	LH	a	V	<0.031 +/- 0.0065U
30-jul-1996	LH	a	V	<0.046 +/- 0.021U
25-oct-1996	LH	a	V	<0.1 +/- 0.029UO
03-feb-1997	IC	a	V	0.0076 +/- 0.0003
30-jul-1997	LH	a	V	<0.037 +/- 0.014U
27-oct-1997	LH	a	V	<0.021 +/- 0.0087U
28-jan-1998	FG	a	V	<0.07 U
30-apr-1998	QU	a	V	<0.24 +/- 0.089U
29-jul-1998	QU	a	V	<0.18 +/- 0.094U
21-oct-1998	QU	a	V	<0.098 +/- 0.103U
28-jan-1999	QU	a	V	<0.14 +/- 0.061U
04-may-1999	TN	a	V	<0.15 +/- 0.01UL
15-jul-1999	TN	a	V	<0.15 +/- 0.012U
11-oct-1999	TN	a	V	<0.15 +/- 0.006U
27-jan-2000	TN	a	V	<0.15 +/- 0.022U
01-may-2000	TN	a	N	<0.15 +/- 0.02U
01-may-2000	IC	a	N	0.000393812 +/- 1.24e-05
09-aug-2000	TN	a	V	<0.15 +/- 0.036U
02-nov-2000	TN	a	V	<0.15 +/- 0.031U
25-jan-2001	TN	a	V	<0.15 +/- 0.019U
27-apr-2001	TN	a	V	<0.15 +/- 0.023U
27-apr-2001	IC	a	N	0.000133 +/- 3e-06
19-jul-2001	TN	a	V	<0.15 +/- 0.017U
29-oct-2001	TN	a	N	<0.15 +/- 0.005U
30-jan-2002	TN	a	V	<0.15 +/- 0.009U
30-apr-2002	TN	a	V	<0.15 +/- 0.014U
30-apr-2002	IC	a	N	<0.0001 +/- 4.2e-06EU
29-aug-2002	TN	a	V	<0.15 +/- 0.015U
03-dec-2002	TN	a	V	<0.15 +/- 0.007U
12-feb-2003	TN	a	N	<0.171 +/- 0.045U
07-may-2003	TN	a	V	<0.15 +/- 0.006U

Table A-8. Ground and surface water mass spectrometric analyses for thorium isotopes (pCi/L) in samples collected from the Pit 7 Complex between July 1, 1995 and June 30, 2003. Results recorded by February 17, 2004.

Location Date	Lab	Note	Val.	Thorium 232 by mass measurement
NC7-47 (continued)				
07-may-2003	IC	a	N	<0.0001 +/- 3.5e-06EU
NC7-48				
19-jul-1995	LH	a	V	0.084 +/- 0.059
19-oct-1995	LH	a	V	<0.1 +/- 0.071UB
15-feb-1996	LH	a	V	<0.091 +/- 0.022U
30-apr-1996	IC	a	V	0.0093 +/- 0.0004
30-apr-1996	LH	a	V	<0.037 +/- 0.0092U
19-jun-1996	IC	a	V	0.00023 +/- 3e-05
30-jul-1996	LH	a	V	<0.054 +/- 0.026U
25-oct-1996	LH	aeh	V	<0.11 +/- 0.04UO
25-oct-1996	LH	ah	V	<0.094 +/- 0.025UO
28-jan-1997	IC	a	V	0.0134 +/- 0.0029
30-jul-1997	LH	ah	V	<0.031 +/- 0.019U
30-jul-1997	LH	aeh	V	<0.027 +/- 0.016U
28-oct-1997	LH	a	V	<0.033 +/- 0.0095U
28-oct-1997	IC	a	N	0.0167 +/- 0.0003
13-nov-1997	IC	a	N	0.0108 +/- 0.0003
22-dec-1997	IC	a	N	0.00176 +/- 5e-05
22-jan-1998	FG	a	V	<0.06 +/- 0.03U
22-jan-1998	IC	a	N	0.00522 +/- 5e-05
23-jan-1998	IC	a	N	0.00102 +/- 5e-05
23-feb-1998	IC	a	N	0.00932 +/- 9e-05
23-feb-1998	IC	a	N	0.00166 +/- 0.00024
23-mar-1998	IC	aj	N	0.00341 +/- 5e-05
23-mar-1998	IC	a	N	0.00077 +/- 3e-05
28-apr-1998	QU	a	V	<0.2 +/- 0.05U
28-apr-1998	IC	ah	N	0.004373 +/- 6.2e-05H
28-apr-1998	IC	ah	N	0.0228 +/- 0.0002H
28-apr-1998	IC	ah	N	0.00476 +/- 0.0001H
28-apr-1998	IC	ah	N	0.0244 +/- 0.0006H
27-may-1998	IC	a	N	0.01025 +/- 8e-05H
27-may-1998	IC	a	N	0.01039 +/- 5e-05H
25-jun-1998	IC	ah	N	0.00366 +/- 3e-05H
25-jun-1998	IC	ah	N	0.003963 +/- 1.9e-05H
31-jul-1998	QU	a	V	<0.34 +/- 0.08U
31-jul-1998	IC	ah	N	0.00321 +/- 0.00013H
31-jul-1998	IC	ah	N	0.00466 +/- 9e-05H
24-aug-1998	IC	ah	N	0.004 +/- 6e-05H
24-aug-1998	IC	ah	N	0.00438 +/- 0.0001H
23-sep-1998	IC	ah	N	0.00226 +/- 6e-05H
23-sep-1998	IC	ah	N	0.00416 +/- 0.0001H
26-oct-1998	QU	a	V	<0.16 +/- 0.092U
26-oct-1998	IC	ah	N	0.00069 +/- 6e-05H
26-oct-1998	IC	ah	N	0.00027 +/- 1.3e-05H
23-nov-1998	IC	ah	N	0.01783 +/- 0.00015H
23-nov-1998	IC	ah	N	0.00095 +/- 5e-05H
28-jan-1999	QU	a	V	<0.1 +/- 0.063U
04-may-1999	TN	a	V	<0.15 +/- 0.026UL
19-jul-1999	TN	a	V	<0.15 +/- 0.015U
12-oct-1999	TN	a	V	<0.15 +/- 0.012U
27-jan-2000	TN	a	V	<0.15 +/- 0.031EU
27-jan-2000	IC	a	N	0.00545 +/- 9.2e-05
01-may-2000	TN	a	N	<0.15 +/- 0.027U
01-may-2000	IC	a	N	0.000747 +/- 2.6e-05
10-aug-2000	TN	a	V	<0.15 +/- 0.023U
10-aug-2000	IC	a	N	0.00044431 +/- 5.61e-05
02-nov-2000	TN	a	V	<0.15 +/- 0.013U
02-nov-2000	IC	a	N	0.000536324 +/- 2.54e-05
25-jan-2001	TN	a	V	<0.15 +/- 0.01U
25-jan-2001	IC	a	N	0.000518 +/- 3.2e-05
26-apr-2001	TN	a	V	<0.164 +/- 0.043U
26-apr-2001	IC	a	N	0.000391707 +/- 2.85e-05
18-jul-2001	TN	a	V	<0.15 +/- 0.029U
18-jul-2001	IC	a	N	0.000446357 +/- 1.97e-05
25-oct-2001	TN	a	N	<0.15 +/- 0.007U
25-oct-2001	IC	a	N	0.000309785 +/- 2.97e-05

Table A-8. Ground and surface water mass spectrometric analyses for thorium isotopes (pCi/L) in samples collected from the Pit 7 Complex between July 1, 1995 and June 30, 2003. Results recorded by February 17, 2004.

Location Date	Lab	Note	Val.	Thorium 232 by mass measurement
NC7-48 (continued)				
30-jan-2002	TN	a	V	<0.15 +/- 0.009U
30-jan-2002	IC	a	N	0.000402245 +/- 2.94e-05
30-apr-2002	TN	a	V	<0.15 +/- 0.02U
30-apr-2002	IC	a	N	0.000537614 +/- 8.06e-05
12-sep-2002	TN	a	V	<0.15 +/- 0.025U
12-sep-2002	IC	a	N	0.00195 +/- 6e-05
29-nov-2002	TN	a	V	<0.15 +/- 0.006U
29-nov-2002	IC	a	N	0.00074 +/- 3e-05
11-feb-2003	TN	a	N	<0.161 +/- 0.042U
11-feb-2003	IC	a	N	0.00043 +/- 4e-05
06-may-2003	TN	a	V	<0.15 +/- 0.007U
06-may-2003	IC	a	N	0.000418 +/- 6.9e-05
NC7-49A				
26-may-2000	IC	a	N	0.00035 +/- 1e-05
04-jun-2002	IC	a	N	0.0002751 +/- 8.3e-06
NC7-51				
29-apr-1998	IC	a	N	0.00786 +/- 5e-05H
21-sep-1998	IC	a	N	0.0138 +/- 0.0003H
16-feb-1999	IC	a	N	0.015 +/- 0.0002H
25-aug-1999	IC	a	N	0.00045 +/- 6e-05H
24-nov-1999	IC	a	N	0.00237 +/- 0.00013
11-feb-2000	IC	a	N	0.02177 +/- 0.000242
15-may-2000	IC	a	N	0.013555 +/- 0.000216
09-aug-2000	IC	a	N	0.00636356 +/- 0.000164529
15-nov-2000	IC	a	N	0.00162212 +/- 0.000180673
21-feb-2001	IC	a	N	0.001751 +/- 4.6e-05
17-may-2001	IC	a	N	<0.0001 +/- 1.8e-06EU
18-jul-2001	IC	a	N	0.00179107 +/- 0.000173117
19-nov-2001	IC	a	N	0.00147896 +/- 7.97e-05
14-feb-2002	IC	a	N	0.00225294 +/- 0.000133655
15-may-2002	IC	a	N	0.00246521 +/- 0.000153689
20-nov-2002	IC	a	N	0.0037 +/- 0.0004
12-feb-2003	IC	a	N	0.00154 +/- 0.00015
NC7-52				
19-jun-1996	IC	a	V	0.00308 +/- 5e-05
15-jun-2000	IC	a	N	<0.0001 +/- 7.2e-06EU
31-may-2002	IC	a	N	<0.0001 +/- 4.8e-06EU
NC7-53				
05-jun-1996	IC	a	V	0.0071 +/- 0.0002
16-dec-1996	IC	a	V	0.01797 +/- 0.00038
21-may-1999	IC	a	N	0.00097 +/- 2e-05H
23-may-2000	IC	a	N	0.00065 +/- 0.00015
31-may-2002	IC	a	N	<0.0001 +/- 6.2e-06EU
NC7-60				
05-jun-2000	IC	a	N	0.007001 +/- 8.4e-05
23-may-2001	IC	a	N	0.001629 +/- 2e-05
29-may-2002	IC	a	N	0.000346 +/- 3.1e-05
16-jun-2003	IC	a	N	0.000121 +/- 1.1e-05
NC7-63				
10-feb-2000	IC	a	N	0.003052 +/- 0.000143
15-may-2000	IC	a	N	0.002962 +/- 0.000222
09-aug-2000	IC	a	N	0.00296337 +/- 0.000171537
15-nov-2000	IC	a	N	0.00243092 +/- 0.000197238
21-feb-2001	IC	a	N	0.003053 +/- 0.000127
17-may-2001	IC	a	N	0.0111 +/- 0.0014
18-jul-2001	IC	a	N	0.00289432 +/- 0.000190714
16-may-2002	IC	a	N	0.0049 +/- 0.0005
NC7-64				
19-jun-1996	IC	a	V	0.00075 +/- 7e-05
26-dec-1996	IC	a	V	0.00295 +/- 0.00082

Table A-8. Ground and surface water mass spectrometric analyses for thorium isotopes (pCi/L) in samples collected from the Pit 7 Complex between July 1, 1995 and June 30, 2003. Results recorded by February 17, 2004.

Location Date	Lab	Note	Val.	Thorium 232 by mass measurement
NC7-64 (continued)				
10-mar-2000	IC	a	N	0.0143 +/- 0.003
15-jun-2000	IC	a	N	0.001971 +/- 0.000197
10-aug-2000	IC	a	N	0.0022518 +/- 0.00018595
20-nov-2000	IC	a	N	0.00183301 +/- 0.000144016
23-feb-2001	IC	a	N	0.00306 +/- 0.000152
23-may-2001	IC	a	N	0.00243443 +/- 0.000117694
27-aug-2001	IC	a	N	0.0018863 +/- 0.000186923
30-nov-2001	IC	a	N	0.00106631 +/- 5.84e-05
19-feb-2002	IC	a	N	0.00245231 +/- 0.000134324
13-jun-2002	IC	a	N	0.0025 +/- 0.0008
07-dec-2002	IC	a	N	0.0028 +/- 0.0003
25-jan-2003	IC	a	N	0.00191 +/- 0.00012
NC7-65				
21-may-1999	IC	a	N	0.00307 +/- 2e-05H
26-may-2000	IC	a	N	<0.0001 +/- 1e-06U
14-jun-2001	IC	a	N	0.000332 +/- 6.1e-05
31-may-2002	IC	a	N	0.0001527 +/- 6.7e-06
NC7-67				
01-jul-1999	IC	ah	N	0.00087 +/- 3e-05H
01-jul-1999	IC	aeh	N	1.9e-05 +/- 3e-06H
01-jun-2000	IC	aeh	N	<0.0001 +/- 4.9e-06EU
01-jun-2000	IC	ah	N	0.0001183 +/- 1.5e-06
24-may-2001	IC	a	N	0.0009391 +/- 2.88e-05
NC7-75				
30-may-1996	IC	a	V	0.0071 +/- 8e-05F
16-dec-1996	IC	a	V	<0.0001 +/- 5e-06U
14-dec-2002	IC	a	N	0.0004256 +/- 9.2e-06
NC7-76				
15-may-1996	IC	a	V	0.00558 +/- 5e-05F
10-jun-2003	IC	a	N	0.00114 +/- 0.0002
W-PIT7-02				
18-jun-1996	IC	a	V	0.00388 +/- 4e-05
30-dec-1996	IC	a	V	0.01377 +/- 0.0003
06-may-1998	IC	a	N	0.0967 +/- 0.0007H
16-jun-2000	IC	a	N	0.0001067 +/- 3.3e-06
14-jun-2001	IC	a	N	0.000175 +/- 1.3e-05
23-may-2002	IC	a	N	0.000156 +/- 1.6e-05
W-PIT7-03				
28-may-1996	IC	a	V	0.041 +/- 0.001F
30-dec-1996	IC	a	V	0.0055 +/- 0.002
06-may-1998	IC	a	N	0.00407 +/- 2e-05H
01-jul-1999	IC	a	N	9.9e-05 +/- 7e-06H
23-may-2000	IC	a	N	<0.0001 +/- 3.6e-06EU
19-jun-2000	IC	a	N	0.000292 +/- 2.6e-05
19-jun-2000	IC	ah	N	0.000344136 +/- 2.24e-05
18-jun-2001	IC	a	N	0.00217316 +/- 0.000149875
01-jul-2002	IC	a	N	0.00052 +/- 8e-05
W-PIT7-10				
18-jun-1996	IC	a	V	0.0019 +/- 5e-05
30-dec-1996	IC	a	V	0.00907 +/- 0.00011
06-may-1998	IC	a	N	0.002161 +/- 1.1e-05H
03-jun-2002	IC	a	N	<0.0001 +/- 6.5e-06EU
W-PIT7-12				
11-jun-2001	IC	a	N	0.000119 +/- 1.4e-05
03-jun-2002	IC	a	N	0.000435 +/- 1.2e-05
W-PIT7-13				
30-mar-2001	IC	a	N	0.000355 +/- 3.7e-05
14-jun-2001	IC	a	N	0.000175 +/- 1.4e-05

Table A-8. Ground and surface water mass spectrometric analyses for thorium isotopes (pCi/L) in samples collected from the Pit 7 Complex between July 1, 1995 and June 30, 2003. Results recorded by February 17, 2004.

Location Date	Lab	Note	Val.	Thorium 232 by mass measurement
W-PIT7-13 (continued)				
31-may-2002	IC	a	N	0.000239 +/- 2.9e-05
W-PIT7-15				
20-mar-2001	IC	a	N	0.000977281 +/- 2.78e-05
25-apr-2001	IC	a	N	0.001738 +/- 2.2e-05
04-jun-2002	IC	a	N	0.0003314 +/- 4.4e-06
W-PIT7-16				
28-mar-2001	IC	a	N	0.000712767 +/- 4.06e-05
11-jun-2001	IC	a	N	0.000331 +/- 2.9e-06
23-may-2002	IC	a	N	<0.0001 +/- 2e-06EU
17-jun-2003	IC	a	N	<0.0001 +/- 1.1e-06EU
W-PIT7-1903				
11-apr-2003	IC	a	N	0.00168 +/- 0.00014
02-may-2003	IC	a	N	0.00213 +/- 0.00022
06-jun-2003	IC	a	N	0.0065 +/- 0.0018
W-PIT7-1904				
11-apr-2003	IC	a	N	0.00147 +/- 0.00019
02-may-2003	IC	a	N	0.00177 +/- 0.00022
06-jun-2003	IC	a	N	0.00217 +/- 0.00045
W-PIT7-1905				
11-apr-2003	IC	a	N	0.00089 +/- 5e-05
02-may-2003	IC	a	N	0.00071 +/- 7e-05
06-jun-2003	IC	a	N	0.00072 +/- 0.00018
W-PIT7-1907				
11-apr-2003	IC	a	N	0.000176 +/- 4e-06
02-may-2003	IC	a	N	0.000124 +/- 2e-06
06-jun-2003	IC	a	N	<0.0001 +/- 4.1e-06EU
W-PIT7-1915				
11-apr-2003	IC	a	N	0.000119 +/- 2e-06
02-may-2003	IC	a	N	0.00104 +/- 2e-05
06-jun-2003	IC	a	N	0.0003402 +/- 9.6e-06
W-PIT7-1916				
11-apr-2003	IC	a	N	0.000906 +/- 0.0001
02-may-2003	IC	a	N	0.00158 +/- 0.00022
06-jun-2003	IC	a	N	0.00098 +/- 0.00045
W-PIT7-1917				
11-apr-2003	IC	a	N	0.00104 +/- 0.00013
02-may-2003	IC	a	N	0.00124 +/- 0.00012
06-jun-2003	IC	a	N	0.00076 +/- 0.00014
W-PIT7-1918				
11-apr-2003	IC	a	N	0.00058 +/- 7e-05
02-may-2003	IC	a	N	0.0007 +/- 6e-05
06-jun-2003	IC	a	N	0.00055 +/- 0.00019
W-PIT7-1919				
11-apr-2003	IC	a	N	0.00104 +/- 0.00015
02-may-2003	IC	a	N	0.00106 +/- 0.0001
06-jun-2003	IC	a	N	0.0012993 +/- 9.65e-05
W-865-1804				
23-jun-2003	IC	a	N	0.0001439 +/- 2.1e-06

See following page for notes

Table A-8. Ground and surface water mass spectrometric analyses for thorium isotopes (pCi/L) in samples collected from the Pit 7 Complex between July 1, 1995 and June 30, 2003. Results recorded by February 17, 2004.

Notes:

- Indicates no analysis performed for this compound

Val. = Validation code

Footnotes:

a	ERD data
b	ORAD WGMG data
c	Analytical results for this sample are suspect
d	Sample collected during hydraulic testing
e	Blind sample, sent to lab without location identity
f	Sample dilution necessary for analysis; detection limits increased
g	Interlaboratory collocated sample
h	Intralaboratory collocated sample
i	Sample collected as part of pilot study
j	Note field may contain important information regarding this sample
k	Pre-development sample
l	Norm month, norm quarter or norm year inconsistent with sample date
m	Confirmation sample
n	Sample analyzed after standard holding time
o	Sample comprised of partial composite
p	Alpha spectroscopy analysis of uranium isotopes
q	Gamma spectroscopy analysis of uranium isotopes
r	Tritium data represents non-detect with activity calc'd for 100 percent error.

Lab Codes:

FG	Fruit Growers Laboratory, Inc.	853 Corporation St. Santa Paula, Ca 93061-0272
IC	ICP MS Facility	
LH	LAS-formerly Lockheed<1jan97	975 Kelly Johnson Las Vegas NV 89119
QU	Quanterra Env. Serv.,St.Louis	13715 Rider Trail North, Earth City, MO 63045
TN	Eberline Services	2030 Wright Ave, Richmond, CA 94804

Validation Codes:

V	Validated
N	Not validated (default value)
U	Undeclared
H	Historical comparison only

CLP flags: (follow result)

B	Analyte found in method blank
D	Analysis performed at a secondary dilution or concentration (i.e., vapor samples)
E	The analyte was detected below the LLNL reporting limit, but above the analytical laboratory minimum detection limit.
F	Analyte found in field blank, trip blank, or equipment blank
G	Quantitated using fuel calibration, but does not match typical fuel fingerprint (fuel maybe gasoline, diesel, motor oil etc.).
H	Sample analyzed outside of holding time, sample results should be evaluated
J	Analyte was postively identified; the associated numerical value is the approximate concentration of the analyte in the sample.
L	Spike accuracy not within control limits
O	Duplicate spike or sample precision not within control limits
P	Indicates that the absence of a data qualifier flag does not mean that the data does not need qualification, but that the implementation of electronic data qualifier flags was not yet established
R	Sample results are rejected due to serious deficiencies in the ability to analyze the sample and meet QC criteria. The presence or absence of the analyte cannot be verified
S	Analytical results for this sample are suspect
T	Analyte is tentatively identified compound; result is approximate
U	Compound was analyzed for, but not detected above detection limit

Table A-9. Ground and surface water analyses for radium isotopes (pCi/L) in samples collected from the Pit 7 Complex between July 1, 1995 and June 30, 2003. Results recorded by December 18, 2003.

Radium Isotopes in Ground Water, Site 300
December 19, 2003
gemini2

s3radium.19dec2003

Min Sample Date
July 1, 1995
Max Sample Date
June 30, 2003

Table A-9. Ground and surface water analyses for radium isotopes (pCi/L) in samples collected from the Pit 7 Complex between July 1, 1995 and June 30, 2003. Results recorded by December 18, 2003.

Location Date	Lab	Note	Val.	Radium 226	Radium 228
K7-01					
14-jul-1995	LH	a	V	0.148 +/- 0.1O	-
17-oct-1995	LH	ah	V	1.03 +/- 0.29BL	-
17-oct-1995	LH	aeh	V	1.27 +/- 0.32BL	-
07-feb-1996	LH	a	V	0.7 +/- 0.28L	-
24-apr-1996	LH	a	V	0.96 +/- 0.34	-
25-jul-1996	LH	ah	V	0.83 +/- 0.27B	-
25-jul-1996	LH	aeh	V	0.97 +/- 0.3B	-
18-oct-1996	LH	a	V	0.81 +/- 0.21LB	-
22-jan-1997	LH	ah	V	0.59 +/- 0.2	-
22-jan-1997	LH	aeh	V	0.93 +/- 0.24	-
08-apr-1997	LH	a	V	0.82 +/- 0.24	-
23-jul-1997	LH	a	V	0.93 +/- 0.27	-
21-oct-1997	LH	aeh	V	1.04 +/- 0.26	-
21-oct-1997	LH	ah	V	0.86 +/- 0.23	-
14-jan-1998	FG	a	V	0.8 +/- 1	-
20-apr-1998	QU	a	V	0.73 +/- 0.17	-
21-jul-1998	QU	a	V	0.85 +/- 0.19	1.79 +/- 0.51
19-oct-1998	QU	ah	V	0.56 +/- 0.16J	1.77 +/- 0.64
19-oct-1998	QU	aeh	V	0.83 +/- 0.22J	2.13 +/- 0.84
19-jan-1999	QU	ah	V	0.96 +/- 0.25	0.98 +/- 0.55
19-jan-1999	QU	aeh	V	1.1 +/- 0.26	1.08 +/- 0.5
22-apr-1999	TN	a	V	0.73 +/- 0.15	-
20-jul-1999	TN	a	V	0.832 +/- 0.16O	-
07-oct-1999	TN	ah	V	1.12 +/- 0.25	-
07-oct-1999	TN	aeh	V	0.833 +/- 0.19	-
11-feb-2000	TN	a	V	<0.25 +/- 0.083EU	-
25-apr-2000	TN	ah	V	1.28 +/- 0.23O	-
25-apr-2000	TN	aeh	V	1.27 +/- 0.22O	-
24-jul-2000	TN	a	V	0.926 +/- 0.2	-
30-oct-2000	TN	ah	V	1.24 +/- 0.22	-
30-oct-2000	TN	aeh	V	0.779 +/- 0.18	-
23-jan-2001	TN	a	V	0.324 +/- 0.11	-
24-apr-2001	TN	a	V	1.32 +/- 0.2	-
17-jul-2001	TN	ah	V	1.1 +/- 0.21	-
17-jul-2001	TN	aeh	V	1.06 +/- 0.21	-
24-oct-2001	TN	a	N	1.07 +/- 0.19	-
23-jan-2002	TN	a	V	1.11 +/- 0.2	-
22-apr-2002	TN	aeh	V	0.75 +/- 0.18	-
22-apr-2002	TN	ah	V	1.41 +/- 0.24	-
13-sep-2002	TN	a	V	1.16 +/- 0.21	-
27-nov-2002	TN	ah	V	0.845 +/- 0.19	-
27-nov-2002	TN	ah	V	0.923 +/- 0.19	-
10-feb-2003	TN	a	N	0.322 +/- 0.11	-
01-may-2003	TN	ah	V	1.41 +/- 0.26	-
01-may-2003	TN	aeh	V	1.28 +/- 0.25	-
K7-03					
14-jul-1995	LH	ah	V	<0.19 +/- 0.084OU	-
14-jul-1995	LH	aeh	V	<0.19 +/- 0.13OU	-
18-oct-1995	LH	a	V	<0.21 +/- 0.13UBL	-
07-feb-1996	LH	a	V	<0.22 +/- 0.092UL	-
24-apr-1996	LH	ah	V	0.25 +/- 0.19	-
24-apr-1996	LH	aeh	V	0.53 +/- 0.27	-
25-jul-1996	LH	a	V	<0.18 +/- 0.12UB	-
18-oct-1996	LH	a	V	<0.19 +/- 0.13UL	-
23-jan-1997	LH	a	V	<0.15 +/- 0.065U	-
08-apr-1997	LH	ah	V	<0.24 +/- 0.15U	-
08-apr-1997	LH	aeh	V	0.27 +/- 0.16	-
23-jul-1997	LH	a	V	<0.24 +/- 0.16U	-
21-oct-1997	LH	a	V	0.4 +/- 0.17	-
15-jan-1998	FG	ah	V	<0.5 +/- 1U	-
15-jan-1998	FG	aeh	V	<0.62 +/- 1U	-
21-apr-1998	QU	a	V	<0.14 +/- 0.088U	-
27-jul-1998	QU	a	V	<0.17 +/- 0.11U	0.72 +/- 0.42
19-oct-1998	QU	a	V	0.2 +/- 0.1J	<1.11 +/- 0.66U
19-jan-1999	QU	a	V	<0.18 +/- 0.12U	<0.89 +/- 0.52U

Table A-9. Ground and surface water analyses for radium isotopes (pCi/L) in samples collected from the Pit 7 Complex between July 1, 1995 and June 30, 2003. Results recorded by December 18, 2003.

Location Date	Lab	Note	Val.	Radium 226	Radium 228
K7-03 (continued)					
22-apr-1999	TN	ah	V	<0.25 +/- 0.14U	-
22-apr-1999	TN	aeh	V	<0.25 +/- 0.14U	-
19-jul-1999	TN	a	V	<0.25 +/- 0.079EOU	-
07-oct-1999	TN	a	V	<0.25 +/- 0.15U	-
11-feb-2000	TN	a	V	<0.25 +/- 0.09EU	-
25-apr-2000	TN	a	V	<0.25 +/- 0.1OU	-
24-jul-2000	TN	ah	V	<0.25 +/- 0.1EU	-
24-jul-2000	TN	aeh	V	0.299 +/- 0.12	-
30-oct-2000	TN	a	V	<0.25 +/- 0.093U	-
23-jan-2001	TN	a	V	0.377 +/- 0.11	-
17-apr-2001	TN	ah	V	<0.25 +/- 0.066EU	-
17-apr-2001	TN	aeh	V	<0.25 +/- 0.062EU	-
17-jul-2001	TN	a	V	<0.25 +/- 0.11U	-
24-oct-2001	TN	a	N	<0.25 +/- 0.1U	-
23-jan-2002	TN	aeh	V	<0.25 +/- 0.097EU	-
23-jan-2002	TN	ah	V	<0.25 +/- 0.09EU	-
22-apr-2002	TN	a	V	<0.25 +/- 0.12U	-
06-sep-2002	TN	ah	V	<0.25 +/- 0.11U	-
06-sep-2002	TN	aeh	V	<0.25 +/- 0.1U	-
27-nov-2002	TN	a	V	<0.25 +/- 0.11EU	-
07-feb-2003	TN	ah	N	<0.25 +/- 0.098OU	-
07-feb-2003	TN	aeh	N	<0.25 +/- 0.099EOU	-
01-may-2003	TN	a	V	<0.25 +/- 0.12U	-
K7-06					
14-jul-1995	LH	a	V	0.22 +/- 0.15O	-
17-oct-1995	LH	a	V	0.57 +/- 0.24BL	-
12-feb-1996	LH	ah	V	<0.26 +/- 0.18UL	-
12-feb-1996	LH	aeh	V	0.26 +/- 0.18L	-
24-apr-1996	LH	a	V	<0.22 +/- 0.18U	-
24-jul-1996	LH	a	V	1.24 +/- 0.48B	-
18-oct-1996	LH	a	V	0.32 +/- 0.15L	-
22-jan-1997	LH	a	V	0.27 +/- 0.14	-
08-apr-1997	LH	a	V	0.61 +/- 0.21	-
23-jul-1997	LH	a	V	0.3 +/- 0.18	-
21-oct-1997	LH	a	V	0.55 +/- 0.19	-
14-jan-1998	FG	a	V	<0.5 +/- 1U	-
21-apr-1998	QU	ah	V	0.22 +/- 0.11	-
21-apr-1998	QU	aeh	V	0.3 +/- 0.14	-
21-jul-1998	QU	ah	V	0.24 +/- 0.11	14.2 +/- 1.7
21-jul-1998	QU	aeh	V	0.3 +/- 0.13	1.01 +/- 0.5
19-oct-1998	QU	a	V	0.26 +/- 0.15J	<2.01 +/- 1.19U
19-jan-1999	QU	a	V	0.46 +/- 0.18	0.86 +/- 0.5
23-apr-1999	TN	a	V	0.252 +/- 0.13	-
19-jul-1999	TN	ah	V	<0.25 +/- 0.1EOU	-
19-jul-1999	TN	aeh	V	<0.25 +/- 0.093EOU	-
12-oct-1999	TN	a	V	0.444 +/- 0.2	-
11-feb-2000	TN	a	V	0.321 +/- 0.11	-
25-apr-2000	TN	a	V	0.364 +/- 0.13OU	-
24-jul-2000	TN	a	V	<0.25 +/- 0.11EU	-
01-nov-2000	TN	a	V	0.353 +/- 0.13	-
06-jun-2001	TN	a	V	<0.25 +/- 0.11U	-
19-jul-2001	TN	a	V	0.26 +/- 0.095	-
29-oct-2001	TN	a	N	0.374 +/- 0.14	-
30-jan-2002	TN	a	V	<0.25 +/- 0.1EU	-
29-apr-2002	TN	a	V	0.461 +/- 0.15	-
29-aug-2002	TN	a	V	0.487 +/- 0.16	-
03-dec-2002	TN	a	V	<0.25 +/- 0.13U	-
07-feb-2003	TN	a	V	<0.25 +/- 0.1OU	-
06-may-2003	TN	a	V	0.498 +/- 0.14	-
K7-09					
17-jul-1995	LH	a	V	<0.13 +/- 0.073OU	-
18-oct-1995	LH	a	V	<0.22 +/- 0.14UBL	-
07-feb-1996	LH	a	V	0.32 +/- 0.19L	-
26-apr-1996	LH	a	V	0.26 +/- 0.19F	-
24-jul-1996	LH	a	V	0.38 +/- 0.24B	-

Table A-9. Ground and surface water analyses for radium isotopes (pCi/L) in samples collected from the Pit 7 Complex between July 1, 1995 and June 30, 2003. Results recorded by December 18, 2003.

Location Date	Lab	Note	Val.	Radium 226	Radium 228
K7-09 (continued)					
23-oct-1996	LH	a	V	<0.18 +/- 0.11UL	-
23-jan-1997	LH	a	V	0.16 +/- 0.11	-
10-apr-1997	LH	a	V	<0.16 +/- 0.12U	-
17-jul-1997	LH	a	V	0.17 +/- 0.11	-
22-oct-1997	LH	a	V	0.127 +/- 0.088	-
21-jan-1998	FG	a	V	<0.62 +/- 1U	-
22-apr-1998	QU	a	V	0.2 +/- 0.11B	-
27-jul-1998	QU	a	V	<0.21 +/- 0.12U	<0.63 +/- 0.39U
25-jan-1999	QU	a	V	<0.18 +/- 0.12U	<0.7 +/- 0.42U
23-apr-1999	TN	a	V	<0.25 +/- 0.13U	-
15-jul-1999	TN	a	V	<0.25 +/- 0.095OU	-
11-oct-1999	TN	a	V	<0.25 +/- 0.13U	-
16-feb-2000	TN	a	V	<0.25 +/- 0.1EU	-
25-apr-2000	TN	a	V	<0.25 +/- 0.085OU	-
09-aug-2000	TN	a	V	<0.25 +/- 0.086U	-
01-nov-2000	TN	a	V	<0.25 +/- 0.12EU	-
23-jan-2001	TN	a	V	<0.25 +/- 0.084EU	-
24-apr-2001	TN	a	V	<0.25 +/- 0.07EU	-
17-jul-2001	TN	a	V	0.267 +/- 0.1	-
24-oct-2001	TN	a	N	<0.25 +/- 0.1U	-
23-jan-2002	TN	a	V	<0.25 +/- 0.086U	-
23-apr-2002	TN	a	V	<0.25 +/- 0.097EU	-
06-sep-2002	TN	a	V	<0.25 +/- 0.096U	-
29-nov-2002	TN	a	V	<0.25 +/- 0.1U	-
07-feb-2003	TN	a	V	<0.25 +/- 0.09OU	-
01-may-2003	TN	a	V	<0.25 +/- 0.12UE	-
K7-10					
18-jul-1995	LH	a	V	<0.18 +/- 0.085OU	-
19-oct-1995	LH	a	V	0.21 +/- 0.14BL	-
12-feb-1996	LH	a	V	0.49 +/- 0.23L	-
26-apr-1996	LH	a	V	0.29 +/- 0.19FB	-
24-jul-1996	LH	a	V	<0.22 +/- 0.14UB	-
24-oct-1996	LH	a	V	<0.17 +/- 0.12UL	-
28-jan-1997	LH	a	V	0.16 +/- 0.11	-
17-jul-1997	LH	a	V	0.31 +/- 0.15	-
27-oct-1997	LH	a	V	<0.18 +/- 0.13U	-
21-jan-1998	FG	a	V	<0.62 +/- 1U	-
28-apr-1998	QU	a	V	0.62 +/- 0.19	-
31-jul-1998	QU	a	V	0.26 +/- 0.15LS	0.89 +/- 0.44
26-oct-1998	QU	a	V	<0.29 +/- 0.18U	<0.84 +/- 0.49U
25-jan-1999	QU	a	V	1.12 +/- 0.26	<0.71 +/- 0.4U
01-apr-1999	GE	a	V	0.512 +/- 0.18B	-
19-apr-1999	TN	a	V	<0.25 +/- 0.097OU	-
26-apr-1999	TN	a	V	<0.25 +/- 0.079U	-
15-jul-1999	TN	a	V	<0.25 +/- 0.11OU	-
11-oct-1999	TN	a	V	<0.25 +/- 0.18U	-
27-jan-2000	TN	a	V	<0.25 +/- 0.09U	-
26-apr-2000	TN	a	V	0.386 +/- 0.13OU	-
01-aug-2000	TN	a	V	<0.25 +/- 0.11U	-
01-nov-2000	TN	a	V	0.445 +/- 0.13	-
23-jan-2001	TN	a	V	1.15 +/- 0.21	-
24-apr-2001	TN	a	V	<0.25 +/- 0.054EU	-
02-may-2001	TN	a	V	<0.25 +/- 0.045EU	-
17-jul-2001	TN	a	V	<0.25 +/- 0.095U	-
24-oct-2001	TN	a	N	0.356 +/- 0.12	-
24-jan-2002	TN	a	V	<0.25 +/- 0.095U	-
23-apr-2002	TN	a	V	<0.25 +/- 0.084EU	-
28-aug-2002	TN	a	V	<0.25 +/- 0.11U	-
29-nov-2002	TN	a	V	0.733 +/- 0.18	-
07-feb-2003	TN	a	V	0.251 +/- 0.092O	-
05-may-2003	TN	a	V	<0.25 +/- 0.092UE	-
NC7-16					
05-jun-1996	LH	a	V	0.35 +/- 0.13OB	-
18-dec-1996	LH	a	V	<0.2 +/- 0.14UO	-

Table A-9. Ground and surface water analyses for radium isotopes (pCi/L) in samples collected from the Pit 7 Complex between July 1, 1995 and June 30, 2003. Results recorded by December 18, 2003.

Location Date	Lab	Note	Val.	Radium 226	Radium 228
NC7-17					
05-jun-1996	LH	a	V	1.37 +/- 0.39OB	-
27-aug-1996	LH	a	V	0.7 +/- 0.33	-
NC7-18					
05-jun-1996	LH	a	V	0.106 +/- 0.069OB	-
13-dec-1996	LH	a	V	0.41 +/- 0.19J	-
NC7-21					
05-jun-1996	LH	a	V	0.17 +/- 0.095OB	-
26-dec-1996	LH	a	V	<0.2 +/- 0.13UO	-
NC7-25					
18-jul-1995	LH	a	V	<0.19 +/- 0.088OU	-
20-oct-1995	LH	a	V	<0.48 +/- 0.34UBL	-
12-feb-1996	LH	a	V	0.56 +/- 0.24L	-
29-apr-1996	LH	a	V	<0.24 +/- 0.16U	-
30-jul-1996	LH	a	V	0.49 +/- 0.17J	-
24-oct-1996	LH	a	V	0.3 +/- 0.15L	-
28-jan-1997	LH	a	V	0.78 +/- 0.22	-
16-apr-1997	LH	a	V	0.69 +/- 0.24BJO	-
30-jul-1997	LH	a	V	0.48 +/- 0.22	-
27-oct-1997	LH	a	V	0.57 +/- 0.2	-
22-jan-1998	FG	a	V	<0.62 +/- 1U	-
28-apr-1998	QU	a	V	0.61 +/- 0.24	-
31-jul-1998	QU	a	V	0.44 +/- 0.17LS	6.72 +/- 0.92
26-oct-1998	QU	a	V	0.89 +/- 0.26J	<1.15 +/- 0.68U
27-jan-1999	QU	a	V	0.78 +/- 0.23	<0.88 +/- 0.52U
04-may-1999	TN	a	V	0.672 +/- 0.16	-
15-jul-1999	TN	a	V	0.71 +/- 0.14O	-
07-oct-1999	TN	a	V	0.659 +/- 0.15	-
04-feb-2000	TN	ah	V	0.502 +/- 0.13O	-
04-feb-2000	TN	aeh	V	0.644 +/- 0.16O	-
26-apr-2000	TN	a	V	<0.25 +/- 0.12EOU	-
09-aug-2000	TN	a	V	0.374 +/- 0.13	-
01-nov-2000	TN	a	V	0.607 +/- 0.16	-
25-jan-2001	TN	a	V	0.661 +/- 0.15	-
26-apr-2001	TN	a	V	0.637 +/- 0.13	-
18-jul-2001	TN	a	V	0.557 +/- 0.14	-
25-oct-2001	TN	ah	N	0.793 +/- 0.17	-
25-oct-2001	TN	aeh	N	0.519 +/- 0.14	-
24-jan-2002	TN	a	V	0.454 +/- 0.14	-
29-apr-2002	TN	a	V	0.612 +/- 0.14	-
12-sep-2002	TN	a	V	0.717 +/- 0.16	-
27-nov-2002	TN	a	V	0.805 +/- 0.18	-
11-feb-2003	TN	a	N	0.623 +/- 0.15	-
05-may-2003	TN	a	V	<0.25 +/- 0.097U	-
NC7-26					
17-jul-1995	LH	a	V	<0.19 +/- 0.14OU	-
18-oct-1995	LH	a	V	0.64 +/- 0.24BLF	-
08-feb-1996	LH	a	V	0.47 +/- 0.2L	-
26-apr-1996	LH	a	V	0.43 +/- 0.25F	-
25-jul-1996	LH	a	V	0.65 +/- 0.26B	-
23-oct-1996	LH	a	V	0.29 +/- 0.15L	-
23-jan-1997	LH	a	V	<0.18 +/- 0.12U	-
10-apr-1997	LH	a	V	0.34 +/- 0.18	-
24-jul-1997	LH	a	V	0.46 +/- 0.2	-
22-oct-1997	LH	a	V	0.53 +/- 0.2	-
21-jan-1998	FG	a	V	<0.62 +/- 1U	-
22-apr-1998	QU	a	V	0.31 +/- 0.12B	-
27-jul-1998	QU	a	V	0.32 +/- 0.17	<0.84 +/- 0.52U
25-jan-1999	QU	a	V	0.31 +/- 0.15	<0.68 +/- 0.39U
04-may-1999	TN	a	V	0.68 +/- 0.17	-
14-jul-1999	TN	a	V	0.423 +/- 0.14O	-
11-oct-1999	TN	a	V	0.378 +/- 0.16	-
16-feb-2000	TN	a	V	<0.25 +/- 0.079EU	-
26-apr-2000	TN	a	V	0.287 +/- 0.12OU	-

Table A-9. Ground and surface water analyses for radium isotopes (pCi/L) in samples collected from the Pit 7 Complex between July 1, 1995 and June 30, 2003. Results recorded by December 18, 2003.

Location Date	Lab	Note	Val.	Radium 226	Radium 228
NC7-26 (continued)					
09-aug-2000	TN	a	V	0.259 +/- 0.11	-
02-nov-2000	TN	a	V	0.327 +/- 0.12	-
25-jan-2001	TN	a	V	0.269 +/- 0.12	-
26-apr-2001	TN	a	V	0.288 +/- 0.083	-
18-jul-2001	TN	a	V	0.272 +/- 0.11	-
25-oct-2001	TN	a	N	0.271 +/- 0.11	-
24-jan-2002	TN	a	V	<0.25 +/- 0.1EU	-
22-apr-2002	TN	a	V	<0.25 +/- 0.11EU	-
13-sep-2002	TN	a	V	<0.25 +/- 0.1EU	-
28-nov-2002	TN	a	V	<0.25 +/- 0.1EU	-
13-feb-2003	TN	a	N	<0.25 +/- 0.075UE	-
06-may-2003	TN	a	V	<0.25 +/- 0.12U	-
NC7-34					
05-jun-1996	LH	a	V	0.52 +/- 0.18OB	-
17-sep-1996	LH	a	V	0.25 +/- 0.18	-
20-dec-1996	LH	a	V	0.69 +/- 0.22J	-
NC7-36					
05-jun-1996	LH	a	V	0.22 +/- 0.11OB	-
27-aug-1996	LH	a	V	<0.27 +/- 0.19U	-
13-dec-1996	LH	a	V	0.28 +/- 0.16J	-
NC7-47					
18-jul-1995	LH	a	V	<0.15 +/- 0.054OU	-
20-oct-1995	LH	a	V	<0.35 +/- 0.21UBL	-
13-feb-1996	LH	a	V	<0.24 +/- 0.12UL	-
30-apr-1996	LH	a	V	0.13 +/- 0.13B	-
25-oct-1996	LH	a	V	<0.12 +/- 0.078UL	-
03-feb-1997	LH	a	V	<0.14 +/- 0.081UL	-
30-jul-1997	LH	a	V	<0.22 +/- 0.15U	-
27-oct-1997	LH	a	V	0.121 +/- 0.083	-
28-jan-1998	FG	a	V	<0.62 +/- 1U	-
30-apr-1998	QU	a	V	<0.17 +/- 0.1U	-
29-jul-1998	QU	a	V	<0.25 +/- 0.13U	<0.68 +/- 0.41U
21-oct-1998	QU	a	V	<0.24 +/- 0.16U	<0.83 +/- 0.49U
28-jan-1999	QU	a	V	<0.28 +/- 0.17U	<0.74 +/- 0.44U
04-may-1999	TN	a	V	<0.25 +/- 0.12U	-
15-jul-1999	TN	a	V	<0.25 +/- 0.091EOU	-
11-oct-1999	TN	a	V	<0.25 +/- 0.12U	-
27-jan-2000	TN	a	V	<0.25 +/- 0.1U	-
01-may-2000	TN	a	N	<0.25 +/- 0.098U	-
09-aug-2000	TN	a	V	<0.25 +/- 0.1U	-
02-nov-2000	TN	a	V	<0.25 +/- 0.11EU	-
25-jan-2001	TN	a	V	<0.25 +/- 0.093U	-
27-apr-2001	TN	a	V	<0.25 +/- 0.07EU	-
19-jul-2001	TN	a	V	<0.25 +/- 0.082U	-
29-oct-2001	TN	a	N	<0.25 +/- 0.11U	-
30-jan-2002	TN	a	V	<0.25 +/- 0.091EU	-
30-apr-2002	TN	a	V	0.28 +/- 0.13	-
29-aug-2002	TN	a	V	<0.25 +/- 0.13U	-
03-dec-2002	TN	a	V	<0.25 +/- 0.095U	-
12-feb-2003	TN	a	N	<0.25 +/- 0.11UE	-
07-may-2003	TN	a	V	<0.25 +/- 0.068U	-
NC7-48					
19-jul-1995	LH	a	V	<0.16 +/- 0.057OU	-
19-oct-1995	LH	a	V	<0.25 +/- 0.16UBL	-
15-feb-1996	LH	a	V	0.24 +/- 0.18L	-
30-apr-1996	LH	a	V	<0.4 +/- 0.24U	-
25-oct-1996	LH	ah	V	<0.18 +/- 0.12UL	-
25-oct-1996	LH	aeh	V	0.147 +/- 0.1L	-
28-jan-1997	LH	a	V	0.22 +/- 0.11	-
16-apr-1997	LH	a	V	0.52 +/- 0.23BJO	-
30-jul-1997	LH	ah	V	0.4 +/- 0.18	-
30-jul-1997	LH	aeh	V	0.31 +/- 0.16	-
28-oct-1997	LH	a	V	<0.19 +/- 0.12U	-

Table A-9. Ground and surface water analyses for radium isotopes (pCi/L) in samples collected from the Pit 7 Complex between July 1, 1995 and June 30, 2003. Results recorded by December 18, 2003.

Location Date	Lab	Note	Val.	Radium 226	Radium 228
NC7-48 (continued)					
22-jan-1998	FG	a	V	<0.62 +/- 1U	-
28-apr-1998	QU	a	V	0.41 +/- 0.19	-
31-jul-1998	QU	a	V	0.38 +/- 0.18LS	0.98 +/- 0.47
26-oct-1998	QU	a	V	0.42 +/- 0.18J	1.06 +/- 0.62
28-jan-1999	QU	a	V	0.24 +/- 0.16	<0.66 +/- 0.39U
04-may-1999	TN	a	V	<0.25 +/- 0.086UE	-
19-jul-1999	TN	a	V	<0.25 +/- 0.095EOU	-
12-oct-1999	TN	a	V	<0.25 +/- 0.14EU	-
27-jan-2000	TN	a	V	0.286 +/- 0.15	-
01-may-2000	TN	a	N	0.466 +/- 0.14	-
10-aug-2000	TN	a	V	0.265 +/- 0.12	-
18-aug-2000	TN	a	V	<0.25 +/- 0.11EU	-
02-nov-2000	TN	a	V	<0.25 +/- 0.11U	-
25-jan-2001	TN	a	V	0.299 +/- 0.11	-
26-apr-2001	TN	a	V	0.312 +/- 0.082	-
18-jul-2001	TN	a	V	<0.25 +/- 0.098EU	-
25-oct-2001	TN	a	N	<0.25 +/- 0.11U	-
30-jan-2002	TN	a	V	<0.25 +/- 0.1EU	-
30-apr-2002	TN	a	V	0.395 +/- 0.14	-
12-sep-2002	TN	a	V	0.27 +/- 0.1	-
29-nov-2002	TN	a	V	0.444 +/- 0.14	-
11-feb-2003	TN	a	N	<0.25 +/- 0.099U	-
06-may-2003	TN	a	V	0.308 +/- 0.11	-
NC7-53					
05-jun-1996	LH	a	V	<0.31 +/- 0.21UO	-
27-aug-1996	LH	a	V	0.55 +/- 0.24	-
27-aug-1996	CX	ag	V	0.17 +/- 0.15BLO	0.434 +/- 0.43BLO
16-dec-1996	LH	a	V	0.38 +/- 0.16J	-
W-PIT7-02					
28-aug-1996	LH	a	V	<0.24 +/- 0.16U	-

See following page for notes

Table A-10. Ground and surface water analyses for nitrogenous compounds (mg/L) in samples collected from the Pit 7 Complex between July 1, 1995 and June 30, 2003. Results recorded by December 18, 2003.

Nitrates, Nitrites, and Nitrogen in Ground Water,
December 19, 2003
gemini2

s3NL.19dec2003
s3NR.19dec2003

Min Sample Date
July 1, 1995
Max Sample Date
June 30, 2003

Table A-10. Ground and surface water analyses for nitrogenous compounds (mg/L) in samples collected

Location Date	Lab	Note	Val.	Ammonia Nitrogen as N	Nitrate and Nitrite as N	Nitrate and Nitrite as NO3	Nitrate as N
MUL2							
23-aug-1995	CS	a	V	-	-	-	-
06-sep-1996	CS	a	V	0.27 LO	-	-	1.1
08-sep-1997	CS	a	V	-	-	-	-
16-sep-1998	CS	a	V	-	-	-	-
08-sep-1999	CN	ah	V	-	-	-	-
08-sep-1999	CN	aeh	V	-	-	-	-
06-sep-2000	BB	af	V	-	-	-	-
05-sep-2001	BB	afh	V	-	-	-	-
05-sep-2001	BB	aefh	V	-	-	-	-
17-sep-2002	BB	afh	V	-	-	-	-
17-sep-2002	BB	aeh	V	-	-	-	-
K7-01							
14-jul-1995	CS	a	V	-	-	-	-
26-jul-1995	CS	a	V	-	-	-	-
17-oct-1995	CS	ah	V	-	-	-	-
17-oct-1995	CS	aeh	V	-	-	-	-
07-feb-1996	CS	a	V	-	-	-	-
08-apr-1997	CS	a	V	-	-	-	-
23-jul-1997	CS	a	V	-	-	-	-
21-oct-1997	BB	ah	V	-	-	-	-
21-oct-1997	BB	aeh	V	-	-	-	-
20-apr-1998	BB	a	V	-	-	-	-
05-jun-1998	BB	a	N	-	-	-	-
12-jun-1998	BB	a	N	-	-	-	-
21-jul-1998	BB	ag	V	-	-	-	-
19-oct-1998	BB	ah	N	-	-	-	-
19-oct-1998	BB	aeh	N	-	-	-	-
19-jan-1999	BB	ah	V	-	-	-	-
19-jan-1999	BB	aeh	V	-	-	-	-
22-apr-1999	CN	af	V	-	-	-	-
20-jul-1999	CN	af	V	-	-	-	-
07-oct-1999	CN	afh	V	-	-	-	-
07-oct-1999	CN	aefh	V	-	-	-	-
11-feb-2000	CN	af	V	-	-	-	-
25-apr-2000	CN	ah	V	-	-	-	-
25-apr-2000	CN	aeh	V	-	-	-	-
24-jul-2000	CN	af	V	-	-	-	-
30-oct-2000	CN	afh	V	-	-	-	-
30-oct-2000	CN	aefh	V	-	-	-	-
23-jan-2001	CN	af	V	-	-	-	-
24-apr-2001	CN	af	V	-	-	-	-
17-jul-2001	CN	afh	V	-	-	-	-
17-jul-2001	CN	aefh	V	-	-	-	-
22-apr-2002	CN	aefh	V	-	-	-	-
22-apr-2002	CN	afh	V	-	-	-	-
13-sep-2002	CN	af	V	-	-	-	-
10-feb-2003	CN	af	V	-	-	-	-
01-may-2003	CN	afh	V	-	-	-	-
01-may-2003	CN	aefh	V	-	-	-	-
K7-03							
14-jul-1995	CS	ah	V	-	-	-	-
14-jul-1995	CS	aeh	V	-	-	-	-
26-jul-1995	CS	ah	V	-	-	-	-
26-jul-1995	CS	aeh	V	-	-	-	-
17-oct-1995	CS	a	V	-	-	-	-
07-feb-1996	CS	a	V	-	-	-	-
08-apr-1997	CS	ah	V	-	-	-	-
08-apr-1997	CS	aeh	V	-	-	-	-
23-jul-1997	CS	a	V	-	-	-	-
21-oct-1997	BB	a	V	-	-	-	-
21-apr-1998	BB	a	V	-	-	-	-
27-jul-1998	BB	ag	V	-	-	-	-
19-oct-1998	BB	a	N	-	-	-	-
19-jan-1999	BB	a	V	-	-	-	-
22-apr-1999	CN	afh	V	-	-	-	-

from the Pit 7 Complex between July 1, 1995 and June 30, 2003. Results recorded by December 18, 2003.

Nitrite as N	Nitrite as NO2	Nitrate as NO3	Total Kjeldahl Nitrogen	Location Date
				MUL2
-	-	10	-	23-aug-1995
<2.5 DU	<2.5 DHULO	4.8 O	0.54	06-sep-1996
-	-	1.2	-	08-sep-1997
-	-	11	-	16-sep-1998
-	-	15 S	-	08-sep-1999
-	-	18 S	-	08-sep-1999
-	-	13.4	-	06-sep-2000
-	-	13.7	-	05-sep-2001
-	-	14	-	05-sep-2001
-	-	13.8	-	17-sep-2002
-	-	13.4	-	17-sep-2002
				K7-01
-	-	45	-	14-jul-1995
-	-	50	-	26-jul-1995
-	-	41 D	-	17-oct-1995
-	-	41 D	-	17-oct-1995
-	-	42 D	-	07-feb-1996
-	-	44 D	-	08-apr-1997
-	-	45 D	-	23-jul-1997
-	-	46	-	21-oct-1997
-	-	46	-	21-oct-1997
-	-	46	-	20-apr-1998
-	-	46	-	05-jun-1998
-	-	49	-	12-jun-1998
-	-	47	-	21-jul-1998
-	-	45	-	19-oct-1998
-	-	45	-	19-oct-1998
-	-	44	-	19-jan-1999
-	-	46	-	19-jan-1999
-	-	71 DS	-	22-apr-1999
-	-	45 DLS	-	20-jul-1999
-	-	33 DS	-	07-oct-1999
-	-	57 DS	-	07-oct-1999
-	-	48 D	-	11-feb-2000
-	-	29 D	-	25-apr-2000
-	-	40 D	-	25-apr-2000
-	-	40 D	-	24-jul-2000
-	-	39 D	-	30-oct-2000
-	-	39 D	-	30-oct-2000
-	-	40 D	-	23-jan-2001
-	-	11 DH	-	24-apr-2001
-	-	24 DL	-	17-jul-2001
-	-	24 DL	-	17-jul-2001
-	-	71 D	-	22-apr-2002
-	-	74 D	-	22-apr-2002
-	-	62 D	-	13-sep-2002
-	-	66 D	-	10-feb-2003
-	-	70 D	-	01-may-2003
-	-	59 D	-	01-may-2003
				K7-03
-	-	27	-	14-jul-1995
-	-	25	-	14-jul-1995
-	-	32	-	26-jul-1995
-	-	32	-	26-jul-1995
-	-	23 D	-	17-oct-1995
-	-	38	-	07-feb-1996
-	-	27 D	-	08-apr-1997
-	-	27 D	-	08-apr-1997
-	-	28 D	-	23-jul-1997
-	-	25	-	21-oct-1997
-	-	27	-	21-apr-1998
-	-	28	-	27-jul-1998
-	-	27	-	19-oct-1998
-	-	26	-	19-jan-1999
-	-	66 DS	-	22-apr-1999

Table A-10. Ground and surface water analyses for nitrogenous compounds (mg/L) in samples collected

Location Date	Lab	Note	Val.	Ammonia Nitrogen as N	Nitrate and Nitrite as N	Nitrate and Nitrite as NO3	Nitrate as N
K7-03 (continued)							
22-apr-1999	CN	aefh	V	-	-	-	-
19-jul-1999	CN	af	V	-	-	-	-
07-oct-1999	CN	af	V	-	-	-	-
11-feb-2000	CN	a	V	-	-	-	-
25-apr-2000	CN	af	V	-	-	-	-
24-jul-2000	CN	ah	V	-	-	-	-
24-jul-2000	CN	aeh	V	-	-	-	-
30-oct-2000	CN	af	V	-	-	-	-
23-jan-2001	CN	af	V	-	-	-	-
17-apr-2001	CN	afh	V	-	-	-	-
17-apr-2001	CN	aeh	V	-	-	-	-
17-jul-2001	CN	af	V	-	-	-	-
22-apr-2002	CN	af	V	-	-	-	-
06-sep-2002	CN	ah	V	-	-	-	-
06-sep-2002	CN	aefh	V	-	-	-	-
07-feb-2003	CN	afh	V	-	-	-	-
07-feb-2003	CN	aefh	V	-	-	-	-
01-may-2003	CN	af	V	-	-	-	-
K7-06							
14-jul-1995	CS	a	V	-	-	-	-
26-jul-1995	CS	a	V	-	-	-	-
17-oct-1995	CS	a	V	-	-	-	-
12-feb-1996	CS	ah	V	-	-	-	-
12-feb-1996	CS	aeh	V	-	-	-	-
08-apr-1997	CS	a	V	-	-	-	-
23-jul-1997	CS	a	V	-	-	-	-
21-oct-1997	BB	a	V	-	-	-	-
21-apr-1998	BB	ah	V	-	-	-	-
21-apr-1998	BB	aeh	V	-	-	-	-
21-jul-1998	BB	agh	V	-	-	-	-
21-jul-1998	BB	aegh	V	-	-	-	-
19-oct-1998	BB	a	N	-	-	-	-
19-jan-1999	BB	a	V	-	-	-	-
23-apr-1999	CN	a	V	-	-	-	-
19-jul-1999	CN	ah	V	-	-	-	-
19-jul-1999	CN	aeh	V	-	-	-	-
12-oct-1999	CN	a	V	-	-	-	-
11-feb-2000	CN	a	V	-	-	-	-
25-apr-2000	CN	af	V	-	-	-	-
24-jul-2000	CN	a	V	-	-	-	-
01-nov-2000	CN	af	V	-	-	-	-
06-jun-2001	CN	a	V	-	-	-	-
19-jul-2001	CN	a	V	-	-	-	-
29-apr-2002	CN	a	V	-	-	-	-
29-aug-2002	CN	af	V	-	-	-	-
07-feb-2003	CN	af	V	-	-	-	-
06-may-2003	CN	af	V	-	-	-	-
K7-07							
07-aug-1995	CS	ah	V	-	-	-	-
07-aug-1995	CS	aeh	V	-	-	-	-
30-oct-1995	CS	a	V	-	-	-	-
18-nov-1997	BB	a	V	-	-	-	-
02-jun-1998	BB	ah	N	-	-	-	-
02-jun-1998	BB	aeh	N	-	-	-	-
30-nov-1998	BB	a	V	-	-	-	-
26-may-1999	CN	a	V	-	-	-	-
18-may-2000	CN	a	V	-	-	-	-
K7-09							
17-jul-1995	CS	a	V	-	-	-	-
17-oct-1995	CS	a	V	-	-	-	-
07-feb-1996	CS	a	V	-	-	-	-
10-apr-1997	CS	a	V	-	-	-	-
17-jul-1997	CS	a	V	-	-	-	-
22-oct-1997	BB	a	V	-	-	-	-
22-apr-1998	BB	a	V	-	-	-	-

from the Pit 7 Complex between July 1, 1995 and June 30, 2003. Results recorded by December 18, 2003.

Nitrite as N	Nitrite as NO2	Nitrate as NO3	Total Kjeldahl Nitrogen	Location Date
				(continued) K7-03
-	-	60 DS	-	22-apr-1999
-	-	23 LOS	-	19-jul-1999
-	-	42 DS	-	07-oct-1999
-	-	27	-	11-feb-2000
-	-	26 D	-	25-apr-2000
-	-	26	-	24-jul-2000
-	-	27	-	24-jul-2000
-	-	16 D	-	30-oct-2000
-	-	19 D	-	23-jan-2001
-	-	34	-	17-apr-2001
-	-	33	-	17-apr-2001
-	-	16 L	-	17-jul-2001
-	-	41	-	22-apr-2002
-	-	43	-	06-sep-2002
-	-	40	-	06-sep-2002
-	-	29	-	07-feb-2003
-	-	41	-	07-feb-2003
-	-	28 D	-	01-may-2003
				K7-06
-	-	14	-	14-jul-1995
-	-	23	-	26-jul-1995
-	-	18	-	17-oct-1995
-	-	19	-	12-feb-1996
-	-	18	-	12-feb-1996
-	-	19 D	-	08-apr-1997
-	-	20	-	23-jul-1997
-	-	17	-	21-oct-1997
-	-	18	-	21-apr-1998
-	-	18	-	21-apr-1998
-	-	20	-	21-jul-1998
-	-	20	-	21-jul-1998
-	-	17	-	19-oct-1998
-	-	18	-	19-jan-1999
-	-	20 S	-	23-apr-1999
-	-	<0.5 LOSU	-	19-jul-1999
-	-	16 LOS	-	19-jul-1999
-	-	17 S	-	12-oct-1999
-	-	19	-	11-feb-2000
-	-	12 D	-	25-apr-2000
-	-	17	-	24-jul-2000
-	-	14 D	-	01-nov-2000
-	-	16 D	-	06-jun-2001
-	-	17	-	19-jul-2001
-	-	38	-	29-apr-2002
-	-	25 D	-	29-aug-2002
-	-	23	-	07-feb-2003
-	-	17 L	-	06-may-2003
				K7-07
-	-	29 D	-	07-aug-1995
-	-	29 D	-	07-aug-1995
-	-	34	-	30-oct-1995
-	-	27	-	18-nov-1997
-	-	37	-	02-jun-1998
-	-	37	-	02-jun-1998
-	-	34	-	30-nov-1998
-	-	26 S	-	26-may-1999
-	-	28	-	18-may-2000
				K7-09
-	-	<0.5 U	-	17-jul-1995
-	-	<0.5 U	-	17-oct-1995
-	-	<0.5 U	-	07-feb-1996
-	-	1.5	-	10-apr-1997
-	-	1.4	-	17-jul-1997
-	-	<0.4 U	-	22-oct-1997
-	-	<0.4 U	-	22-apr-1998

Table A-10. Ground and surface water analyses for nitrogenous compounds (mg/L) in samples collected

Location Date	Lab	Note	Val.	Ammonia Nitrogen as N	Nitrate and Nitrite as N	Nitrate and Nitrite as NO3	Nitrate as N
K7-09 (continued)							
27-jul-1998	BB	ag	V	–	–	–	–
20-oct-1998	BB	a	V	–	–	–	–
25-jan-1999	BB	a	V	–	–	–	–
23-apr-1999	CN	a	V	–	–	–	–
15-jul-1999	CN	a	V	–	–	–	–
11-oct-1999	CN	a	V	–	–	–	–
16-feb-2000	CN	a	V	–	–	–	–
25-apr-2000	CN	a	V	–	–	–	–
09-aug-2000	CN	a	V	–	–	–	–
01-nov-2000	CN	af	V	–	–	–	–
23-jan-2001	CN	a	V	–	–	–	–
24-apr-2001	CN	ah	V	–	–	–	–
17-jul-2001	CN	a	V	–	–	–	–
23-apr-2002	CN	af	V	–	–	–	–
06-sep-2002	CN	a	V	–	–	–	–
07-feb-2003	CN	af	V	–	–	–	–
01-may-2003	CN	a	V	–	–	–	–
K7-10							
18-jul-1995	CS	a	V	–	–	–	–
19-oct-1995	CS	a	V	–	–	–	–
12-feb-1996	CS	a	V	–	–	–	–
15-apr-1997	CS	a	V	–	–	–	–
17-jul-1997	CS	a	V	–	–	–	–
27-oct-1997	BB	a	V	–	–	–	–
28-apr-1998	BB	a	V	–	–	–	–
31-jul-1998	BB	a	N	–	–	–	–
26-oct-1998	BB	a	V	–	–	–	–
25-jan-1999	BB	a	V	–	–	–	–
26-apr-1999	CN	a	V	–	–	–	–
15-jul-1999	CN	a	V	–	–	–	–
11-oct-1999	CN	a	V	–	–	–	–
27-jan-2000	CN	a	V	–	–	–	–
26-apr-2000	CN	a	V	–	–	–	–
01-nov-2000	CN	a	V	–	–	–	–
23-jan-2001	CN	a	V	–	–	–	–
24-apr-2001	CN	ah	V	–	–	–	–
17-jul-2001	CN	a	V	–	–	–	–
23-apr-2002	CN	a	V	–	–	–	–
28-aug-2002	CN	af	V	–	–	–	–
07-feb-2003	CN	af	V	–	–	–	–
05-may-2003	CN	a	V	–	–	–	–
NC7-12							
26-may-1999	CN	a	V	–	–	–	–
NC7-15							
26-may-1999	CN	a	V	–	–	–	–
NC7-16							
27-may-1999	CN	a	V	–	–	–	–
NC7-17							
21-may-1999	CN	af	V	–	–	–	–
NC7-18							
21-may-1999	CN	a	V	–	–	–	–
NC7-20							
28-may-1999	CN	af	V	–	–	–	–
NC7-21							
28-may-1999	CN	af	V	–	–	–	–
NC7-22							
28-may-1999	CN	af	V	–	–	–	–

from the Pit 7 Complex between July 1, 1995 and June 30, 2003. Results recorded by December 18, 2003.

Nitrite as N	Nitrite as NO2	Nitrate as NO3	Total Kjeldahl Nitrogen	Location Date
				(continued) K7-09
-	-	1.3	-	27-jul-1998
-	-	<0.4 U	-	20-oct-1998
-	-	0.56	-	25-jan-1999
-	-	<0.5 SU	-	23-apr-1999
-	-	<0.5 LSU	-	15-jul-1999
-	-	12 OS	-	11-oct-1999
-	-	<0.5 U	-	16-feb-2000
-	-	0.2	-	25-apr-2000
-	-	<0.1 U	-	09-aug-2000
-	-	<0.5 DU	-	01-nov-2000
-	-	<0.4 U	-	23-jan-2001
-	-	<0.4 HU	-	24-apr-2001
-	-	<0.4 LU	-	17-jul-2001
-	-	30 DF	-	23-apr-2002
-	-	17	-	06-sep-2002
-	-	14	-	07-feb-2003
-	-	<0.1 U	-	01-may-2003
				K7-10
-	-	<0.5 U	-	18-jul-1995
-	-	<0.5 U	-	19-oct-1995
-	-	<0.5 U	-	12-feb-1996
-	-	<0.5 U	-	15-apr-1997
-	-	1.3	-	17-jul-1997
-	-	0.6	-	27-oct-1997
-	-	<0.4 U	-	28-apr-1998
-	-	<0.4 U	-	31-jul-1998
-	-	<0.4 U	-	26-oct-1998
-	-	0.47	-	25-jan-1999
-	-	<0.5 SU	-	26-apr-1999
-	-	<0.5 LSU	-	15-jul-1999
-	-	<0.5 OSU	-	11-oct-1999
-	-	<0.5 U	-	27-jan-2000
-	-	2.5	-	26-apr-2000
-	-	<0.1 U	-	01-nov-2000
-	-	<0.4 U	-	23-jan-2001
-	-	<0.4 HU	-	24-apr-2001
-	-	<0.4 LU	-	17-jul-2001
-	-	<0.1 U	-	23-apr-2002
-	-	18	-	28-aug-2002
-	-	2.4	-	07-feb-2003
-	-	<0.1 LU	-	05-may-2003
				NC7-12
-	-	44 S	-	26-may-1999
				NC7-15
-	-	43 S	-	26-may-1999
				NC7-16
-	-	61 S	-	27-may-1999
				NC7-17
-	-	33 DS	-	21-may-1999
				NC7-18
-	-	<0.5 SU	-	21-may-1999
				NC7-20
-	-	47 DS	-	28-may-1999
				NC7-21
-	-	73 DS	-	28-may-1999
				NC7-22
-	-	45 DS	-	28-may-1999

Table A-10. Ground and surface water analyses for nitrogenous compounds (mg/L) in samples collected

Location Date	Lab	Note	Val.	Ammonia Nitrogen as N	Nitrate and Nitrite as N	Nitrate and Nitrite as NO3	Nitrate as N
NC7-24							
07-jun-1999	CN	a	V	-	-	-	-
NC7-25							
18-jul-1995	CS	a	V	-	-	-	-
20-oct-1995	CS	a	V	-	-	-	-
12-feb-1996	CS	a	V	-	-	-	-
16-apr-1997	CS	a	V	-	-	-	-
30-jul-1997	CS	af	V	-	-	-	-
27-oct-1997	BB	a	V	-	-	-	-
28-apr-1998	BB	a	V	-	-	-	-
31-jul-1998	BB	a	N	-	-	-	-
26-oct-1998	BB	a	V	-	-	-	-
27-jan-1999	BB	a	V	-	-	-	-
04-may-1999	CN	a	V	-	-	-	-
15-jul-1999	CN	a	V	-	-	-	-
07-oct-1999	CN	af	V	-	-	-	-
04-feb-2000	CN	ah	V	-	-	-	-
04-feb-2000	CN	aeh	V	-	-	-	-
21-apr-2000	WE	a	N	-	-	22.5	-
26-apr-2000	CN	af	V	-	-	-	-
09-aug-2000	CN	af	V	-	-	-	-
01-nov-2000	CN	af	V	-	-	-	-
25-jan-2001	CN	af	V	-	-	-	-
26-apr-2001	CN	af	V	-	-	-	-
29-may-2001	BB	a	V	-	8.5 DH	-	8.5 DH
18-jul-2001	CN	af	V	-	-	-	-
29-apr-2002	CN	a	V	-	-	-	-
11-sep-2002	CN	af	V	-	-	-	-
11-feb-2003	CN	a	N	-	-	-	-
05-may-2003	CN	a	V	-	-	-	-
NC7-26							
17-jul-1995	CS	a	V	-	-	-	-
17-oct-1995	CS	a	V	-	-	-	-
08-feb-1996	CS	a	V	-	-	-	-
10-apr-1997	CS	a	V	-	-	-	-
24-jul-1997	CS	a	V	-	-	-	-
22-oct-1997	BB	a	V	-	-	-	-
22-apr-1998	BB	a	V	-	-	-	-
27-jul-1998	BB	ag	V	-	-	-	-
20-oct-1998	BB	a	N	-	-	-	-
25-jan-1999	BB	a	V	-	-	-	-
04-may-1999	CN	af	V	-	-	-	-
14-jul-1999	CN	a	V	-	-	-	-
11-oct-1999	CN	a	V	-	-	-	-
16-feb-2000	CN	a	V	-	-	-	-
26-apr-2000	CN	a	V	-	-	-	-
09-aug-2000	CN	a	V	-	-	-	-
02-nov-2000	CN	a	V	-	-	-	-
25-jan-2001	CN	a	V	-	-	-	-
26-apr-2001	CN	a	V	-	-	-	-
18-jul-2001	CN	a	V	-	-	-	-
22-apr-2002	CN	a	V	-	-	-	-
13-sep-2002	CN	af	V	-	-	-	-
12-feb-2003	CN	af	V	-	-	-	-
06-may-2003	CN	af	V	-	-	-	-
NC7-34							
07-jun-1999	CN	a	V	-	-	-	-
12-jun-2001	CN	af	V	-	-	-	3.5 L
04-jun-2002	CN	af	V	-	-	-	15 DL
NC7-36							
16-jun-1999	CN	a	V	-	-	-	-
25-may-2001	CN	a	V	-	-	-	4.3 HL
31-may-2002	CN	a	V	-	-	-	8.7 H

from the Pit 7 Complex between July 1, 1995 and June 30, 2003. Results recorded by December 18, 2003.

Nitrite as N	Nitrite as NO2	Nitrate as NO3	Total Kjeldahl Nitrogen	Location Date
				NC7-24
-	-	<0.5 SU	-	07-jun-1999
				NC7-25
-	-	29 O	-	18-jul-1995
-	-	22 D	-	20-oct-1995
-	-	30	-	12-feb-1996
-	-	27 D	-	16-apr-1997
-	-	29 D	-	30-jul-1997
-	-	29	-	27-oct-1997
-	-	29	-	28-apr-1998
-	-	33	-	31-jul-1998
-	-	34	-	26-oct-1998
-	-	36	-	27-jan-1999
-	-	36 FOS	-	04-may-1999
-	-	8.2 LS	-	15-jul-1999
-	-	42 DS	-	07-oct-1999
-	-	36	-	04-feb-2000
-	-	37	-	04-feb-2000
-	-	-	-	21-apr-2000
-	-	39 D	-	26-apr-2000
-	-	28 D	-	09-aug-2000
-	-	33 D	-	01-nov-2000
-	-	30 D	-	25-jan-2001
-	-	25 D	-	26-apr-2001
<0.02 HU	-	38 DH	-	29-may-2001
-	-	19 D	-	18-jul-2001
-	-	<0.1 U	-	29-apr-2002
-	-	77 D	-	11-sep-2002
-	-	44	-	11-feb-2003
-	-	27 L	-	05-may-2003
				NC7-26
-	-	2.1	-	17-jul-1995
-	-	<0.5 U	-	17-oct-1995
-	-	<0.5 U	-	08-feb-1996
-	-	5.3	-	10-apr-1997
-	-	1.6	-	24-jul-1997
-	-	1.4	-	22-oct-1997
-	-	9.4	-	22-apr-1998
-	-	22	-	27-jul-1998
-	-	4	-	20-oct-1998
-	-	14	-	25-jan-1999
-	-	60 DFOS	-	04-may-1999
-	-	<0.5 SU	-	14-jul-1999
-	-	28 OS	-	11-oct-1999
-	-	5	-	16-feb-2000
-	-	1.8	-	26-apr-2000
-	-	0.2	-	09-aug-2000
-	-	<0.1 U	-	02-nov-2000
-	-	<0.4 U	-	25-jan-2001
-	-	<0.4 U	-	26-apr-2001
-	-	<0.4 U	-	18-jul-2001
-	-	<2 U	-	22-apr-2002
-	-	16	-	13-sep-2002
-	-	<0.1 U	-	12-feb-2003
-	-	<0.1 LU	-	06-may-2003
				NC7-34
-	-	<0.5 SU	-	07-jun-1999
<0.1 U	-	16	-	12-jun-2001
<0.1 U	-	68 D	-	04-jun-2002
				NC7-36
-	-	<0.5 LOSU	-	16-jun-1999
<0.1 HU	-	19 H	-	25-may-2001
<0.1 HU	-	39 H	-	31-may-2002

Table A-10. Ground and surface water analyses for nitrogenous compounds (mg/L) in samples collected

Location Date	Lab	Note	Val.	Ammonia Nitrogen as N	Nitrate and Nitrite as N	Nitrate and Nitrite as NO3	Nitrate as N
NC7-37							
16-jun-1999	CN	af	V	-	-	-	-
21-apr-2000	WE	a	N	-	-	27.3	-
NC7-40							
07-jun-1999	CN	a	V	-	-	-	-
12-jun-2001	CN	af	V	-	-	-	4.6 L
29-may-2002	CN	af	V	-	-	-	16 D
16-jul-2002	CN	af	V	-	-	-	16 D
NC7-47							
18-jul-1995	CS	a	V	-	-	-	-
20-oct-1995	CS	a	V	-	-	-	-
13-feb-1996	CS	a	V	-	-	-	-
16-apr-1997	CS	a	V	-	-	-	-
30-jul-1997	CS	af	V	-	-	-	-
27-oct-1997	BB	a	V	-	-	-	-
29-apr-1998	BB	a	V	-	-	-	-
29-jul-1998	BB	ag	V	-	-	-	-
21-oct-1998	BB	a	V	-	-	-	-
27-jan-1999	BB	a	V	-	-	-	-
04-may-1999	CN	af	V	-	-	-	-
15-jul-1999	CN	a	V	-	-	-	-
11-oct-1999	CN	af	V	-	-	-	-
27-jan-2000	CN	afh	V	-	-	-	-
27-jan-2000	CN	aefh	V	-	-	-	-
21-apr-2000	WE	ah	N	-	-	56.1	-
01-may-2000	CN	af	V	-	-	-	-
09-aug-2000	CN	af	V	-	-	-	-
02-nov-2000	CN	af	V	-	-	-	-
25-jan-2001	CN	af	V	-	-	-	-
27-apr-2001	CN	af	V	-	-	-	-
19-jul-2001	CN	a	V	-	-	-	-
30-apr-2002	CN	af	V	-	-	-	-
29-aug-2002	CN	af	V	-	-	-	-
12-feb-2003	CN	af	V	-	-	-	-
07-may-2003	CN	af	V	-	-	-	-
NC7-48							
19-jul-1995	CS	a	V	-	-	-	-
19-oct-1995	CS	a	V	-	-	-	-
15-feb-1996	CS	a	V	-	-	-	-
16-apr-1997	CS	a	V	-	-	-	-
30-jul-1997	CS	afh	V	-	-	-	-
30-jul-1997	CS	aefh	V	-	-	-	-
28-oct-1997	BB	a	V	-	-	-	-
28-apr-1998	BB	a	V	-	-	-	-
31-jul-1998	BB	a	N	-	-	-	-
26-oct-1998	BB	a	V	-	-	-	-
28-jan-1999	BB	a	V	-	-	-	-
04-may-1999	CN	a	V	-	-	-	-
19-jul-1999	CN	af	V	-	-	-	-
12-oct-1999	CN	a	V	-	-	-	-
27-jan-2000	CN	a	V	-	-	-	-
21-apr-2000	WE	a	N	-	-	20.3	-
01-may-2000	CN	a	V	-	-	-	-
21-jul-2000	WE	a	N	-	-	18	-
10-aug-2000	CN	af	V	-	-	-	-
02-nov-2000	CN	af	V	-	-	-	-
25-jan-2001	CN	af	V	-	-	-	-
26-apr-2001	CN	ah	V	-	-	-	-
26-apr-2001	CN	ah	V	-	-	-	3.6
18-jul-2001	CN	a	V	-	-	-	-
30-apr-2002	CN	a	V	-	-	-	-
30-apr-2002	CN	af	V	-	-	-	7.8
12-sep-2002	CN	af	V	-	-	-	-
11-feb-2003	CN	a	N	-	-	-	-
06-may-2003	CN	af	V	-	-	-	-
06-may-2003	CN	af	V	-	-	-	5.2

from the Pit 7 Complex between July 1, 1995 and June 30, 2003. Results recorded by December 18, 2003.

Nitrite as N	Nitrite as NO2	Nitrate as NO3	Total Kjeldahl Nitrogen	Location Date
				NC7-37
-	-	48 DLOS	-	16-jun-1999
-	-	-	-	21-apr-2000
				NC7-40
-	-	23 S	-	07-jun-1999
<0.1 U	-	20	-	12-jun-2001
<0.1 U	-	72 D	-	29-may-2002
<0.1 U	-	70 D	-	16-jul-2002
				NC7-47
-	-	47 O	-	18-jul-1995
-	-	42 D	-	20-oct-1995
-	-	45 D	-	13-feb-1996
-	-	50 D	-	16-apr-1997
-	-	56 D	-	30-jul-1997
-	-	56	-	27-oct-1997
-	-	60	-	29-apr-1998
-	-	65	-	29-jul-1998
-	-	71	-	21-oct-1998
-	-	64	-	27-jan-1999
-	-	81 DFOS	-	04-may-1999
-	-	13 LS	-	15-jul-1999
-	-	53 DOS	-	11-oct-1999
-	-	63 D	-	27-jan-2000
-	-	54 D	-	27-jan-2000
-	-	-	-	21-apr-2000
-	-	64 D	-	01-may-2000
-	-	51 D	-	09-aug-2000
-	-	56 D	-	02-nov-2000
-	-	52 D	-	25-jan-2001
-	-	40 DL	-	27-apr-2001
-	-	11	-	19-jul-2001
-	-	69 D	-	30-apr-2002
-	-	71 D	-	29-aug-2002
-	-	67 D	-	12-feb-2003
-	-	85 D	-	07-may-2003
				NC7-48
-	-	24 O	-	19-jul-1995
-	-	24	-	19-oct-1995
-	-	22	-	15-feb-1996
-	-	29 D	-	16-apr-1997
-	-	29 D	-	30-jul-1997
-	-	29 D	-	30-jul-1997
-	-	27	-	28-oct-1997
-	-	25	-	28-apr-1998
-	-	33	-	31-jul-1998
-	-	28	-	26-oct-1998
-	-	27 J	-	28-jan-1999
-	-	40 FOS	-	04-may-1999
-	-	93 DLOS	-	19-jul-1999
-	-	30 S	-	12-oct-1999
-	-	27	-	27-jan-2000
-	-	-	-	21-apr-2000
-	-	22	-	01-may-2000
-	-	-	-	21-jul-2000
-	-	19 D	-	10-aug-2000
-	-	18 D	-	02-nov-2000
-	-	17 D	-	25-jan-2001
-	-	15	-	26-apr-2001
<0.1 U	-	16	-	26-apr-2001
-	-	11	-	18-jul-2001
-	-	34	-	30-apr-2002
<0.1 U	-	34	-	30-apr-2002
-	-	32	-	12-sep-2002
-	-	29	-	11-feb-2003
-	-	22 L	-	06-may-2003
<0.1 U	-	23 L	-	06-may-2003

Table A-10. Ground and surface water analyses for nitrogenous compounds (mg/L) in samples collected

Location Date	Lab	Note	Val.	Ammonia Nitrogen as N	Nitrate and Nitrite as N	Nitrate and Nitrite as NO3	Nitrate as N
NC7-49A							
21-may-1999	CN	a	V	-	-	-	-
21-may-2001	CN	a	V	-	-	-	3.1 H
04-jun-2002	CN	af	V	-	-	-	7.8 L
NC7-50							
14-may-1998	CS	af	V	-	-	-	28 D
16-jun-1999	CN	af	V	-	-	-	<0.5 SU
21-apr-2000	WE	ah	N	-	-	113	-
31-may-2000	CN	af	V	-	-	-	28 D
25-apr-2001	CN	af	V	-	-	-	22 D
13-aug-2001	CN	af	V	-	-	-	-
23-aug-2001	BB	af	V	-	-	-	-
18-oct-2001	CN	afh	V	-	-	-	-
28-may-2002	CN	af	V	-	-	-	-
28-may-2002	CN	af	V	-	-	-	33 D
NC7-51							
17-may-2001	CN	a	V	-	-	-	9.75 DH
15-may-2002	CN	af	V	-	-	-	19 D
NC7-52							
07-jun-1999	CN	a	V	-	-	-	-
NC7-53							
21-may-1999	CN	a	V	-	-	-	-
NC7-60							
09-jun-1999	CN	af	V	-	-	-	-
16-jun-2003	CN	a	V	-	-	-	-
NC7-63							
18-may-1999	CN	a	V	-	-	-	-
NC7-64							
28-jun-1999	CN	a	V	-	-	-	-
NC7-65							
21-may-1999	CN	a	V	-	-	-	-
NC7-67							
01-jul-1999	CN	ah	V	-	-	-	-
01-jul-1999	CN	aeh	V	-	-	-	-
NC7-68							
21-may-1999	CN	a	V	-	-	-	-
NC7-75							
16-jun-1999	CN	a	V	-	-	-	-
NC7-76							
10-jun-2003	CN	afg	V	-	-	-	-
W-PIT7-02							
16-jun-1999	CN	a	V	-	-	-	-
W-PIT7-03							
01-jul-1999	CN	a	V	-	-	-	-
W-PIT7-10							
24-may-1999	CN	a	V	-	-	-	-
21-apr-2000	WE	a	N	-	-	19.2	-
W-PIT7-12							
18-mar-1999	BB	a	V	-	-	-	9.5 D
W-PIT7-13							
30-mar-2001	BB	af	V	-	6.3 D	-	6.3 D

from the Pit 7 Complex between July 1, 1995 and June 30, 2003. Results recorded by December 18, 2003.

Nitrite as N	Nitrite as NO2	Nitrate as NO3	Total Kjeldahl Nitrogen	Location Date
				NC7-49A
-	-	<0.5 SU	-	21-may-1999
<0.1 HU	-	14 H	-	21-may-2001
<0.1 U	-	35	-	04-jun-2002
				NC7-50
<0.5 U	-	120 D	-	14-may-1998
<0.5 U	-	<0.5 SU	-	16-jun-1999
-	-	-	-	21-apr-2000
<0.1 U	-	120 D	-	31-may-2000
<0.1 U	-	32 DH	-	25-apr-2001
-	-	86 DL	-	13-aug-2001
-	-	142 D	-	23-aug-2001
-	-	160 DL	-	18-oct-2001
-	-	150 D	-	28-may-2002
<0.1 U	-	150 D	-	28-may-2002
				NC7-51
<0.1 HU	-	42.9 H	-	17-may-2001
<0.1 U	-	86	-	15-may-2002
				NC7-52
-	-	25 S	-	07-jun-1999
				NC7-53
-	-	22 S	-	21-may-1999
				NC7-60
-	-	25 DJLS	-	09-jun-1999
-	-	5.2	-	16-jun-2003
				NC7-63
-	-	34 S	-	18-may-1999
				NC7-64
-	-	<0.5 SU	-	28-jun-1999
				NC7-65
-	-	<0.5 SU	-	21-may-1999
				NC7-67
-	-	<0.5 SU	-	01-jul-1999
-	-	<0.5 SU	-	01-jul-1999
				NC7-68
-	-	40 S	-	21-may-1999
				NC7-75
-	-	<0.5 LOSU	-	16-jun-1999
				NC7-76
-	-	39 D	-	10-jun-2003
				W-PIT7-02
-	-	<0.5 LOSU	-	16-jun-1999
				W-PIT7-03
-	-	<0.5 SU	-	01-jul-1999
				W-PIT7-10
-	-	40 S	-	24-may-1999
-	-	-	-	21-apr-2000
				W-PIT7-12
<0.02 U	-	42 D	-	18-mar-1999
				W-PIT7-13
<0.02 U	-	28 D	-	30-mar-2001

Table A-10. Ground and surface water analyses for nitrogenous compounds (mg/L) in samples collected

Location Date	Lab	Note	Val.	Ammonia Nitrogen as N	Nitrate and Nitrite as N	Nitrate and Nitrite as NO3	Nitrate as N
W-PIT7-15							
20-mar-2001	CN	af	V	-	-	-	<0.1 HU
W-PIT7-16							
28-mar-2001	CN	a	V	-	-	-	<0.5 DHU
W-PIT7-1714							
27-mar-2002	CN	af	V	-	-	-	5.5 D
W-PIT7-1715							
27-mar-2002	CN	af	V	-	-	-	5.4
W-PIT7-1717							
28-mar-2002	CN	af	V	-	-	-	0.7
W-PIT7-1718							
03-jul-2002	CN	af	N	-	-	-	8.1
W-PIT7-1720							
27-mar-2002	CN	af	V	-	-	-	10
W-PIT7-1723							
26-mar-2002	CN	af	V	-	-	-	7 D
W-PIT7-1724							
26-mar-2002	CN	af	V	-	-	-	5
W-PIT7-1903							
11-apr-2003	BB	af	V	-	6.3 DHL	-	6.2 DH
02-may-2003	BB	af	V	-	5.4 DHL	-	5.3 DH
06-jun-2003	BB	af	V	-	5.1 DH	-	5.1 DH
W-PIT7-1904							
11-apr-2003	BB	af	V	-	10 DHL	-	10 DH
02-may-2003	BB	af	V	-	8.3 DHL	-	8.3 DH
06-jun-2003	BB	af	V	-	9.3 DHO	-	9.3 DH
W-PIT7-1905							
11-apr-2003	BB	af	V	-	3 DHL	-	3 DH
02-may-2003	BB	af	V	-	3.2 HL	-	3.1 H
06-jun-2003	BB	af	V	-	3.5 DH	-	3.5 DH
W-PIT7-1907							
11-apr-2003	BB	af	V	-	<0.2 DHUL	-	<0.2 DHU
02-may-2003	BB	af	V	-	0.2 HL	-	<0.1 HU
06-jun-2003	BB	af	V	-	<0.1 HU	-	<0.1 HU
W-PIT7-1915							
11-apr-2003	BB	af	V	-	<0.2 DHUL	-	<0.2 DHU
02-may-2003	BB	af	V	-	<0.1 HUL	-	<0.1 HU
06-jun-2003	BB	af	V	-	<0.1 HU	-	<0.1 HU
W-PIT7-1916							
11-apr-2003	BB	af	V	-	7.2 DHL	-	7.1 DH
02-may-2003	BB	af	V	-	7.9 DHL	-	7.8 DH
06-jun-2003	BB	af	V	-	8.5 DH	-	8.5 DH
W-PIT7-1917							
11-apr-2003	BB	af	V	-	7.7 DHL	-	7.6 DH
02-may-2003	BB	af	V	-	7.9 DHL	-	7.8 DH
06-jun-2003	BB	af	V	-	8.9 DH	-	8.9 DH
W-PIT7-1918							
11-apr-2003	BB	af	V	-	8.5 DHL	-	8.5 DH
02-may-2003	BB	af	V	-	7.4 DHL	-	7.4 DH
06-jun-2003	BB	af	V	-	8.2 DH	-	8.2 DH

from the Pit 7 Complex between July 1, 1995 and June 30, 2003. Results recorded by December 18, 2003.

Nitrite as N	Nitrite as NO2	Nitrate as NO3	Total Kjeldahl Nitrogen	Location Date
				W-PIT7-15
<0.1 U	-	<0.4 HU	-	20-mar-2001
				W-PIT7-16
<0.1 U	-	<0.5 DHU	-	28-mar-2001
				W-PIT7-1714
<0.1 U	-	<0.1 U	-	27-mar-2002
				W-PIT7-1715
<0.1 U	-	13	-	27-mar-2002
				W-PIT7-1717
0.2	-	3.2	-	28-mar-2002
				W-PIT7-1718
0.4	-	36	-	03-jul-2002
				W-PIT7-1720
<0.1 U	-	10	-	27-mar-2002
				W-PIT7-1723
<0.1 U	-	31 D	-	26-mar-2002
				W-PIT7-1724
<0.1 U	-	22	-	26-mar-2002
				W-PIT7-1903
0.05	-	27 DH	-	11-apr-2003
<0.02 U	-	24 DH	-	02-may-2003
<0.02 U	-	22.6 DH	-	06-jun-2003
				W-PIT7-1904
<0.02 U	-	44 DH	-	11-apr-2003
<0.02 U	-	37 DH	-	02-may-2003
<0.02 U	-	41.2 DH	-	06-jun-2003
				W-PIT7-1905
<0.02 U	-	13 DH	-	11-apr-2003
0.063	-	14 H	-	02-may-2003
0.09	-	15.5 DH	-	06-jun-2003
				W-PIT7-1907
<0.02 U	-	<0.8 DHU	-	11-apr-2003
0.18	-	<0.4 HU	-	02-may-2003
0.42	-	<0.4 HU	-	06-jun-2003
				W-PIT7-1915
<0.02 U	-	<0.8 DHU	-	11-apr-2003
0.02	-	<0.4 HU	-	02-may-2003
<0.02 U	-	<0.4 HU	-	06-jun-2003
				W-PIT7-1916
0.071	-	32 DH	-	11-apr-2003
<0.02 U	-	35 DH	-	02-may-2003
<0.02 U	-	37.8 DH	-	06-jun-2003
				W-PIT7-1917
<0.02 U	-	34 DH	-	11-apr-2003
<0.02 U	-	35 DH	-	02-may-2003
0.03	-	39.4 DH	-	06-jun-2003
				W-PIT7-1918
0.028	-	38 DH	-	11-apr-2003
0.02	-	33 DH	-	02-may-2003
<0.02 U	-	36.3 DH	-	06-jun-2003

Table A-10. Ground and surface water analyses for nitrogenous compounds (mg/L) in samples collected

Location Date	Lab	Note	Val.	Ammonia Nitrogen as N	Nitrate and Nitrite as N	Nitrate and Nitrite as NO3	Nitrate as N
W-PIT7-1919							
11-apr-2003	BB	af	V	-	6.5 DHL	-	6.5 DH
02-may-2003	BB	af	V	-	8.4 DH	-	8.4 DH
06-jun-2003	BB	af	V	-	9.2 DH	-	9.2 DH
W-865-01							
30-mar-1999	BB	a	V	-	-	-	0.1
14-aug-2001	CN	af	V	-	-	-	0.1
31-oct-2001	CN	af	V	-	-	-	<0.1 LU
31-jan-2002	CN	a	V	-	-	-	1.3
30-may-2002	CN	a	V	-	-	-	3.3
31-jul-2002	CN	af	V	-	-	-	2.9 F
19-feb-2003	CN	af	V	-	-	-	3.4
29-may-2003	CN	af	V	-	-	-	2.8
W-865-03							
29-sep-2000	CN	af	V	-	-	-	11 D
14-aug-2001	CN	af	V	-	-	-	9 D
30-oct-2001	CN	af	V	-	-	-	7 L
31-jan-2002	CN	a	V	-	-	-	7.2
30-may-2002	CN	a	V	-	-	-	11 D
31-jul-2002	CN	af	V	-	-	-	11 DF
19-feb-2003	CN	af	V	-	-	-	12 D
29-may-2003	CN	af	V	-	-	-	11 D
W-865-04							
28-sep-2000	CN	af	V	-	-	-	<0.1 U
14-aug-2001	CN	af	V	-	-	-	<0.1 U
30-oct-2001	CN	af	V	-	-	-	<0.1 LU
31-jan-2002	CN	a	V	-	-	-	<0.1 U
23-may-2002	CN	af	V	-	-	-	2.5
31-jul-2002	CN	af	V	-	-	-	2.6 F
19-feb-2003	CN	af	V	-	-	-	1.3
29-may-2003	CN	af	V	-	-	-	<0.1 U
W-865-07							
29-sep-2000	CN	af	V	-	-	-	14 D
14-aug-2001	CN	af	V	-	-	-	13 D
30-oct-2001	CN	af	V	-	-	-	9 DL
31-jan-2002	CN	a	V	-	-	-	14 D
23-may-2002	CN	af	V	-	-	-	18 D
31-jul-2002	CN	af	V	-	-	-	15 DF
19-feb-2003	CN	af	V	-	-	-	17 D
29-may-2003	CN	af	V	-	-	-	17 D
W-865-1804							
23-jun-2003	CN	a	V	-	-	-	16 DH
SPRING13							
06-nov-1995	CS	a	V	-	-	-	-
SPRING24							
22-oct-1999	BB	af	V	-	-	-	12 D
27-aug-2001	CN	af	V	-	-	-	1.5
13-dec-2001	CN	af	V	-	-	-	10

from the Pit 7 Complex between July 1, 1995 and June 30, 2003. Results recorded by December 18, 2003.

Nitrite as N	Nitrite as NO2	Nitrate as NO3	Total Kjeldahl Nitrogen	Location Date
				W-PIT7-1919
<0.02 U	-	29 DH	-	11-apr-2003
<0.02 U	-	37 DH	-	02-may-2003
<0.02 U	-	40.7 DH	-	06-jun-2003
				W-865-01
<0.02 U	-	0.44	-	30-mar-1999
<0.1 U	-	0.6	-	14-aug-2001
<0.1 U	-	0.3	-	31-oct-2001
<0.1 HU	-	5.9	-	31-jan-2002
<0.1 U	-	15	-	30-may-2002
<0.1 U	-	13 F	-	31-jul-2002
<0.1 U	-	15	-	19-feb-2003
<0.1 U	-	12	-	29-may-2003
				W-865-03
<0.1 U	-	49 D	-	29-sep-2000
<0.1 U	-	40 D	-	14-aug-2001
<0.1 U	-	31	-	30-oct-2001
<0.1 HU	-	32	-	31-jan-2002
<0.1 U	-	50 D	-	30-may-2002
<0.1 U	-	48 DF	-	31-jul-2002
<0.1 U	-	55 D	-	19-feb-2003
<0.1 U	-	49 D	-	29-may-2003
				W-865-04
<0.1 U	-	<0.1 U	-	28-sep-2000
<0.1 U	-	0.4	-	14-aug-2001
<0.1 U	-	0.4	-	30-oct-2001
<0.1 HU	-	<0.1 U	-	31-jan-2002
<0.1 U	-	11	-	23-may-2002
<0.1 U	-	11 F	-	31-jul-2002
<0.1 U	-	5.6	-	19-feb-2003
<0.1 U	-	<0.1 U	-	29-may-2003
				W-865-07
0.1	-	62 D	-	29-sep-2000
<0.1 U	-	59 D	-	14-aug-2001
<0.1 U	-	42 D	-	30-oct-2001
<0.1 HU	-	61	-	31-jan-2002
<0.1 U	-	80 D	-	23-may-2002
<0.1 U	-	66 DF	-	31-jul-2002
<0.1 U	-	75 D	-	19-feb-2003
<0.1 U	-	76	-	29-may-2003
				W-865-1804
<0.1 HU	-	70 DH	-	23-jun-2003
				SPRING13
-	-	7.9	-	06-nov-1995
				SPRING24
<0.02 U	-	55 D	-	22-oct-1999
<0.1 U	-	28	-	27-aug-2001
<0.1 U	-	44	-	13-dec-2001

See following page for notes

Table A-10. Ground and surface water analyses for nitrogenous compounds (mg/L) in samples collected from the Pit 7 Complex between July 1, 1995 and June 30, 2003. Results recorded by December 18, 2003.

Notes:

\- Indicates no analysis performed for this compound

Val. = Validation code

Footnotes:

a	ERD data
b	ORAD WGMG data
c	Analytical results for this sample are suspect
d	Sample collected during hydraulic testing
e	Blind sample, sent to lab without location identity
f	Sample dilution necessary for analysis; detection limits increased
g	Interlaboratory collocated sample
h	Intralaboratory collocated sample
i	Sample collected as part of pilot study
j	Note field may contain important information regarding this sample
k	Pre-development sample
l	Norm month, norm quarter or norm year inconsistent with sample date
m	Confirmation sample
n	Sample analyzed after standard holding time
o	Sample comprised of partial composite
p	Alpha spectroscopy analysis of uranium isotopes
q	Gamma spectroscopy analysis of uranium isotopes
r	Tritium data represents non-detect with activity calc'd for 100 percent error.

Lab Codes:

BB	BC Laboratories, Inc.	Bakersfield, CA
CN	Caltest Analytical Laboratory	1885 N. Kelly Rd, Napa, CA 94558
CS	California Laboratory Services	3249 Fitzgerald Rd. Rancho Cordova, CA 95742
WE	Univ/Waterloo EnvirIsotope Lab	Univ. of Waterloo, Waterloo, ONT CANADA N2L3G1

Validation Codes:

V	Validated
N	Not validated (default value)
U	Undeclared
H	Historical comparison only

CLP flags: (follow result)

B	Analyte found in method blank
D	Analysis performed at a secondary dilution or concentration (i.e., vapor samples)
E	The analyte was detected below the LLNL reporting limit, but above the analytical laboratory minimum detection limit.
F	Analyte found in field blank, trip blank, or equipment blank
G	Quantitated using fuel calibration, but does not match typical fuel fingerprint (fuel maybe gasoline, diesel, motor oil etc.).
H	Sample analyzed outside of holding time, sample results should be evaluated
J	Analyte was postively identified; the associated numerical value is the approximate concentration of the analyte in the sample.
L	Spike accuracy not within control limits
O	Duplicate spike or sample precision not within control limits
P	Indicates that the absence of a data qualifier flag does not mean that the data does not need qualification, but that the implementation of electronic data qualifier flags was not yet established
R	Sample results are rejected due to serious deficiencies in the ability to analyze the sample and meet QC criteria. The presence or absence of the analyte cannot be verified
S	Analytical results for this sample are suspect
T	Analyte is tentatively identified compound; result is approximate
U	Compound was analyzed for, but not detected above detection limit

Table A-11. Ground and surface water analyses for perchlorate (ug/L) in samples collected from the Pit 7 Complex between July 1, 1995 and February 3, 2005.

Site 300 Perchlorate in Ground Water
Results recorded by April 11, 2005.
April 11, 2005

Table A-11. Ground and surface water analyses for perchlorate (ug/L) in samples collected from the Pit 7 Complex between July 1, 1995 and February 3, 2005.
Reported on April 11, 2005.

			Perchlorate (ug/L)	
LOCATION	SAMPLE TYPE	SAMPLED	RESULT	FLAG
K7-01	RTN	21-Jul-98	8.7	
K7-01	DUP	22-Apr-02	15	
K7-01	RTN	22-Apr-02	15	
K7-01	RTN	13-Sep-02	16	
K7-01	RTN	1-May-03	14	
K7-01	DUP	1-May-03	12	
K7-01	RTN	9-Sep-03	19	
K7-01	RTN	2-Dec-03	18	
K7-01	RTN	21-Jan-04	18	H
K7-01	DUP	21-Jan-04	19	H
K7-01	RTN	28-Apr-04	17	
K7-01	RTN	4-Aug-04	23	
K7-01	RTN	2-Nov-04	21	
K7-01	RTN	24-Jan-05	17	
K7-01	DUP	24-Jan-05	18	
K7-03	RTN	27-Jul-98	< 4	U
K7-03	RTN	22-Apr-02	13	
K7-03	RTN	6-Sep-02	11	
K7-03	DUP	6-Sep-02	11	
K7-03	RTN	7-Feb-03	6	
K7-03	DUP	7-Feb-03	6	
K7-03	RTN	1-May-03	8	
K7-03	RTN	17-Sep-03	11	
K7-03	RTN	9-Dec-03	9.7	
K7-03	RTN	21-Jan-04	15	H
K7-03	RTN	20-Apr-04	12	
K7-03	RTN	10-Aug-04	14	
K7-03	RTN	29-Oct-04	19	
K7-03	RTN	25-Jan-05	9.8	
K7-06	RTN	21-Jul-98	< 4	U
K7-06	DUP	21-Jul-98	< 4	U
K7-06	RTN	29-Apr-02	< 4	U
K7-06	RTN	29-Aug-02	< 4	U
K7-06	RTN	6-May-03	< 4	U
K7-06	RTN	5-Aug-03	< 4	U
K7-06	RTN	4-Dec-03	< 4	U
K7-06	RTN	27-Jan-04	< 4	HU
K7-06	RTN	2-Jun-04	< 4	U
K7-06	DUP	2-Jun-04	< 4	U
K7-06	RTN	18-Aug-04	< 4	U
K7-06	RTN	4-Nov-04	< 4	U
K7-06	DUP	4-Nov-04	< 4	U
K7-06	RTN	1-Feb-05	< 4	U
K7-09	RTN	27-Jul-98	< 4	U

Table A-11. Ground and surface water analyses for perchlorate (ug/L) in samples collected from the Pit 7 Complex between July 1, 1995 and February 3, 2005.
Reported on April 11, 2005.

			Perchlorate (ug/L)	
LOCATION	SAMPLE TYPE	SAMPLED	RESULT	FLAG
K7-09	RTN	23-Apr-02	< 4	U
K7-09	RTN	6-Sep-02	< 4	U
K7-09	RTN	1-May-03	< 4	U
K7-09	RTN	9-Sep-03	< 4	U
K7-09	DUP	9-Sep-03	< 4	U
K7-09	RTN	3-Dec-03	< 4	U
K7-09	RTN	26-Jan-04	< 4	HU
K7-09	RTN	3-May-04	< 4	U
K7-09	RTN	17-Aug-04	< 4	U
K7-09	RTN	4-Nov-04	< 4	U
K7-10	RTN	31-Jul-98	< 4	U
K7-10	RTN	23-Apr-02	< 4	U
K7-10	RTN	28-Aug-02	< 4	U
K7-10	RTN	5-May-03	< 4	U
K7-10	RTN	31-Jul-03	< 4	U
K7-10	RTN	4-Dec-03	< 4	U
K7-10	RTN	27-Jan-04	< 4	HU
K7-10	RTN	3-May-04	< 4	U
K7-10	RTN	17-Aug-04	< 4	U
K7-10	RTN	23-Nov-04	< 4	U
K7-10	RTN	3-Feb-05	< 4	U
MUL2	RTN	5-Sep-01	< 4	U
MUL2	DUP	5-Sep-01	< 4	U
MUL2	RTN	21-Aug-03	< 4	U
MUL2	RTN	28-Jul-04	< 4	U
NC7-12	RTN	29-Nov-04	< 4	U
NC7-12	RTN	29-Nov-04	< 4	U
NC7-15	RTN	1-Jun-04	< 4	U
NC7-20	RTN	30-Nov-04	< 4	U
NC7-20	RTN	29-Jan-05	< 4	U
NC7-21	RTN	29-Nov-04	9.6	
NC7-25	RTN	31-Jul-98	< 4	U
NC7-25	RTN	29-Apr-02	14	
NC7-25	RTN	11-Sep-02	15	
NC7-25	RTN	5-May-03	11	
NC7-25	RTN	31-Jul-03	16	
NC7-25	RTN	5-Dec-03	17	
NC7-25	RTN	4-Mar-04	16	H
NC7-25	RTN	29-Apr-04	15	
NC7-25	RTN	22-Jul-04	15	
NC7-25	RTN	29-Oct-04	18	
NC7-25	RTN	25-Jan-05	15	
NC7-26	RTN	27-Jul-98	< 4	U
NC7-26	RTN	22-Apr-02	< 4	U

Table A-11. Ground and surface water analyses for perchlorate (ug/L) in samples collected from the Pit 7 Complex between July 1, 1995 and February 3, 2005.
Reported on April 11, 2005.

			Perchlorate (ug/L)	
LOCATION	SAMPLE TYPE	SAMPLED	RESULT	FLAG
NC7-26	RTN	13-Sep-02	< 4	U
NC7-26	RTN	6-May-03	< 4	U
NC7-26	RTN	12-Sep-03	< 4	U
NC7-26	RTN	8-Dec-03	< 4	U
NC7-26	RTN	27-Jan-04	< 4	HU
NC7-26	RTN	29-Apr-04	< 4	U
NC7-26	RTN	5-Aug-04	< 4	U
NC7-26	RTN	2-Nov-04	< 4	U
NC7-40	RTN	30-Nov-04	9.5	
NC7-47	RTN	29-Jul-98	< 4	U
NC7-47	RTN	30-Apr-02	< 4	U
NC7-47	RTN	29-Aug-02	< 4	U
NC7-47	RTN	7-May-03	< 4	U
NC7-47	RTN	5-Aug-03	< 4	U
NC7-47	RTN	5-Dec-03	< 4	U
NC7-47	RTN	8-Mar-04	< 4	U
NC7-47	RTN	26-Apr-04	< 4	U
NC7-47	RTN	29-Jul-04	< 4	U
NC7-47	DUP	29-Jul-04	< 4	U
NC7-47	RTN	28-Oct-04	< 4	U
NC7-47	RTN	26-Jan-05	< 4	EU
NC7-48	RTN	31-Jul-98	< 4	U
NC7-48	RTN	30-Apr-02	< 4	U
NC7-48	RTN	12-Sep-02	< 4	U
NC7-48	RTN	6-May-03	< 4	U
NC7-48	RTN	5-Aug-03	< 4	U
NC7-48	DUP	9-Dec-03	< 4	U
NC7-48	RTN	9-Dec-03	< 4	U
NC7-48	RTN	9-Mar-04	< 4	U
NC7-48	RTN	28-Apr-04	< 4	U
NC7-48	RTN	10-Aug-04	< 4	U
NC7-48	RTN	2-Nov-04	< 4	U
NC7-48	RTN	3-Feb-05	< 4	U
NC7-50	RTN	23-Aug-01	4.1	
NC7-50	RTN	18-Sep-01	< 4	U
NC7-50	RTN	18-Oct-01	5.7	
NC7-50	RTN	28-May-02	< 4	U
NC7-60	RTN	19-May-04	< 4	U
NC7-64	RTN	6-Dec-04	8	
NC7-65	RTN	1-Nov-04	< 4	U
SPRING24	RTN	22-Oct-99	< 4	U
SPRING24	RTN	27-Aug-01	< 4	U
W-865-01	RTN	30-Mar-99	< 4	U
W-865-01	RTN	5-May-04	< 4	U

Table A-11. Ground and surface water analyses for perchlorate (ug/L) in samples collected from the Pit 7 Complex between July 1, 1995 and February 3, 2005.
Reported on April 11, 2005.

			Perchlorate (ug/L)	
LOCATION	SAMPLE TYPE	SAMPLED	RESULT	FLAG
W-865-01	RTN	8-Sep-04	< 4	U
W-865-01	RTN	3-Nov-04	< 4	U
W-865-03	RTN	29-Sep-00	< 4	U
W-865-03	RTN	5-May-04	< 4	U
W-865-03	RTN	8-Sep-04	< 4	U
W-865-03	RTN	2-Nov-04	< 4	U
W-865-04	RTN	28-Sep-00	< 4	U
W-865-04	RTN	5-May-04	< 4	U
W-865-04	DUP	5-May-04	< 4	U
W-865-04	RTN	8-Sep-04	< 4	U
W-865-04	RTN	18-Nov-04	< 4	U
W-865-07	RTN	29-Sep-00	< 4	U
W-865-07	RTN	5-May-04	< 4	U
W-865-07	DUP	5-May-04	< 4	U
W-865-07	RTN	9-Sep-04	< 4	U
W-865-07	RTN	18-Nov-04	< 4	U
W-865-1804	RTN	23-Jun-03	< 4	U
W-865-1804	RTN	9-Jun-04	< 4	U
W-865-1804	RTN	9-Sep-04	< 4	U
W-865-1804	RTN	3-Nov-04	< 4	U
W-PIT7-10	RTN	1-Dec-04	< 4	U
W-PIT7-12	RTN	18-Mar-99	< 4	U
W-PIT7-13	RTN	30-Mar-01	< 4	U
W-PIT7-14	RTN	18-Dec-03	< 4	U
W-PIT7-14	RTN	9-Mar-04	< 4	U
W-PIT7-14	RTN	14-Jun-04	< 4	U
W-PIT7-14	RTN	13-Sep-04	< 4	U
W-PIT7-14	RTN	2-Nov-04	< 4	U
W-PIT7-15	RTN	20-Mar-01	< 4	U
W-PIT7-16	RTN	28-Mar-01	< 4	U
W-PIT7-1714	RTN	27-Mar-02	< 4	U
W-PIT7-1715	RTN	3-Jul-02	< 4	U
W-PIT7-1716	RTN	3-Jul-02	< 4	U
W-PIT7-1717	RTN	28-Mar-02	< 4	U
W-PIT7-1718	RTN	3-Jul-02	< 4	U
W-PIT7-1720	RTN	27-Mar-02	< 4	U
W-PIT7-1723	RTN	26-Mar-02	< 4	U
W-PIT7-1724	RTN	26-Mar-02	< 4	U

Table A-12. Ground and surface water analyses for cations (mg/L) in samples collected from the Pit 7 Complex between July 1, 1995 and June 30, 2003. Results recorded by December 18, 2003.

Site 300 Cations Report
December 19, 2003
gemini2

s3cationL.19dec2003
s3cationR.19dec2003

Min Sample Date
July 1, 1995
Max Sample Date
June 30, 2003

Table A-12. Ground and surface water analyses for cations (mg/L) in samples collected

Location Date	Lab	Note	Val.	Sodium	Potassium	Calcium	Magnesium	Iron
MUL2								
23-aug-1995	CS	a	V	120	8.5	180	52	<0.1 U
06-sep-1996	CS	a	V	-	-	-	-	-
06-sep-1996	CS	a	V	-	-	-	-	-
06-sep-1996	CS	a	V	-	-	-	-	-
08-sep-1997	CS	a	V	-	-	-	-	-
16-sep-1998	CS	a	V	-	-	-	-	-
08-sep-1999	CN	ah	V	-	7.7	-	-	-
08-sep-1999	CN	aeh	V	-	8	-	-	-
08-sep-1999	CN	ah	V	-	-	-	-	-
08-sep-1999	CN	aeh	V	-	-	-	-	-
06-sep-2000	BB	af	V	-	9.7	-	-	-
06-sep-2000	BB	af	V	-	-	-	-	-
05-sep-2001	BB	afh	V	-	9	-	-	-
05-sep-2001	BB	aefh	V	-	9.4	-	-	-
05-sep-2001	BB	afh	V	-	-	-	-	-
05-sep-2001	BB	aefh	V	-	-	-	-	-
17-sep-2002	BB	afh	V	-	8.8	-	-	-
17-sep-2002	BB	aeh	V	-	8.8	-	-	-
17-sep-2002	BB	afh	V	-	-	-	-	-
17-sep-2002	BB	aeh	V	-	-	-	-	-
K7-01								
14-jul-1995	CS	a	V	44	2.4	63	26	<0.1 U
17-oct-1995	CS	ah	V	44	2.3	62	26	<0.1 U
17-oct-1995	CS	aeh	V	44	2.2	62	25	<0.1 U
07-feb-1996	CS	a	V	44 L	2.1	61 O	25 O	<0.1 U
07-feb-1996	CS	a	V	-	-	-	-	-
24-apr-1996	CS	a	V	-	-	-	-	-
25-jul-1996	CS	ah	V	-	-	-	-	-
25-jul-1996	CS	aeh	V	-	-	-	-	-
25-jul-1996	CS	ah	V	-	-	-	-	-
25-jul-1996	CS	aeh	V	-	-	-	-	-
18-oct-1996	CS	a	V	-	-	-	-	-
22-jan-1997	CS	ah	V	-	-	-	-	-
22-jan-1997	CS	aeh	V	-	-	-	-	-
08-apr-1997	CS	a	V	-	-	-	-	-
23-jul-1997	CS	a	V	-	-	-	-	-
21-oct-1997	CS	ah	V	-	-	-	-	-
21-oct-1997	CS	aeh	V	-	-	-	-	-
14-jan-1998	CS	a	V	-	-	-	-	-
20-apr-1998	CS	a	V	-	1.9	-	-	-
20-apr-1998	CS	a	V	-	-	-	-	-
21-jul-1998	CS	a	V	-	2.1	-	-	-
21-jul-1998	CS	a	V	-	-	-	-	-
19-oct-1998	CS	ah	V	-	2.2	-	-	-
19-oct-1998	CS	aeh	V	-	2	-	-	-
19-oct-1998	CS	ah	V	-	-	-	-	-
19-oct-1998	CS	aeh	V	-	-	-	-	-
19-jan-1999	CS	ah	V	-	2.2	-	-	-
19-jan-1999	CS	aeh	V	-	2.2	-	-	-
19-jan-1999	CS	ah	V	-	-	-	-	-
19-jan-1999	CS	aeh	V	-	-	-	-	-
22-apr-1999	CN	af	V	-	1.9	-	-	-
22-apr-1999	CN	af	V	-	-	-	-	-
20-jul-1999	CN	af	V	-	2.5	-	-	-
20-jul-1999	CN	af	V	-	-	-	-	-
15-sep-1999	CN	af	V	-	-	-	-	-
22-sep-1999	CN	a	V	-	-	-	-	-
07-oct-1999	CN	afh	V	-	1.8	-	-	-
07-oct-1999	CN	aefh	V	-	2.2	-	-	-
07-oct-1999	CN	afh	V	-	-	-	-	-
07-oct-1999	CN	aefh	V	-	-	-	-	-
11-feb-2000	CN	af	V	-	3.9	-	-	-
11-feb-2000	CN	af	V	-	-	-	-	-
25-apr-2000	CN	ah	V	-	3.7 L	-	-	-
25-apr-2000	CN	aeh	V	-	3.9 L	-	-	-
25-apr-2000	CN	ah	V	-	-	-	-	-

from the Pit 7 Complex between July 1, 1995 and June 30, 2003. Results recorded by December 18, 2003.

Manganese	Copper	Zinc	Boron	Strontium	Aluminum	Location Date
						MUL2
<0.03 U	<0.05 U	<0.05 U	-	-	<0.2 U	23-aug-1995
-	-	<0.02 UO	-	-	-	06-sep-1996
-	<0.001 U	-	-	-	-	06-sep-1996
-	<0.001 U	-	-	-	-	06-sep-1996
-	0.013	0.032	-	-	-	08-sep-1997
-	<0.01 U	<0.02 U	-	-	-	16-sep-1998
-	-	-	-	-	-	08-sep-1999
-	-	-	-	-	-	08-sep-1999
-	<0.01 U	0.02	-	-	-	08-sep-1999
-	<0.01 U	0.03	-	-	-	08-sep-1999
-	-	-	-	-	-	06-sep-2000
-	0.04	<0.02 U	-	-	-	06-sep-2000
-	-	-	-	-	-	05-sep-2001
-	-	-	-	-	-	05-sep-2001
-	<0.01 U	<0.02 U	-	-	-	05-sep-2001
-	<0.01 U	<0.02 U	-	-	-	05-sep-2001
-	-	-	-	-	-	17-sep-2002
-	-	-	-	-	-	17-sep-2002
-	<0.002 U	<0.02 U	-	-	-	17-sep-2002
-	<0.002 U	<0.02 U	-	-	-	17-sep-2002
						K7-01
<0.03 U	<0.05 U	<0.05 U	-	-	<0.2 U	14-jul-1995
<0.03 U	<0.05 U	<0.05 U	-	-	<0.2 U	17-oct-1995
<0.03 U	<0.05 U	<0.05 U	-	-	<0.2 U	17-oct-1995
<0.03 U	<0.05 U	<0.05 U	-	-	<0.2 UO	07-feb-1996
-	0.017	<0.02 U	-	-	-	07-feb-1996
-	0.016 LO	0.037 LO	-	-	-	24-apr-1996
-	-	<0.02 U	-	-	-	25-jul-1996
-	-	<0.02 U	-	-	-	25-jul-1996
-	0.011	-	-	-	-	25-jul-1996
-	0.011	-	-	-	-	25-jul-1996
-	0.014	<0.02 U	-	-	-	18-oct-1996
-	0.01	<0.02 U	-	-	-	22-jan-1997
-	0.011	<0.02 U	-	-	-	22-jan-1997
-	<0.01 U	0.023	-	-	-	08-apr-1997
-	0.014	<0.02 U	-	-	-	23-jul-1997
-	0.019	<0.02 U	-	-	-	21-oct-1997
-	0.016	<0.02 U	-	-	-	21-oct-1997
-	0.028	0.029	-	-	-	14-jan-1998
-	-	-	-	-	-	20-apr-1998
-	<0.01 U	<0.02 U	-	-	-	20-apr-1998
-	-	-	-	-	-	21-jul-1998
-	0.014	0.029	-	-	-	21-jul-1998
-	-	-	-	-	-	19-oct-1998
-	-	-	-	-	-	19-oct-1998
-	0.026	<0.02 U	-	-	-	19-oct-1998
-	0.026	<0.02 U	-	-	-	19-oct-1998
-	-	-	-	-	-	19-jan-1999
-	-	-	-	-	-	19-jan-1999
-	0.033	0.021	-	-	-	19-jan-1999
-	0.022	<0.02 U	-	-	-	19-jan-1999
-	-	-	-	-	-	22-apr-1999
-	0.02	<0.02 U	-	-	-	22-apr-1999
-	-	-	-	-	-	20-jul-1999
-	0.05	0.03	-	-	-	20-jul-1999
-	0.024 D	-	-	-	-	15-sep-1999
-	0.021	-	-	-	-	22-sep-1999
-	-	-	-	-	-	07-oct-1999
-	-	-	-	-	-	07-oct-1999
-	0.02	<0.02 U	-	-	-	07-oct-1999
-	0.04	<0.02 U	-	-	-	07-oct-1999
-	-	-	-	-	-	11-feb-2000
-	0.02	<0.02 U	-	-	-	11-feb-2000
-	-	-	-	-	-	25-apr-2000
-	-	-	-	-	-	25-apr-2000
-	0.02	<0.02 U	-	-	-	25-apr-2000

Table A-12. Ground and surface water analyses for cations (mg/L) in samples collected

Location Date	Lab	Note	Val.	Sodium	Potassium	Calcium	Magnesium	Iron
K7-01 (continued)								
25-apr-2000	CN	aeh	V	–	–	–	–	–
24-jul-2000	CN	af	V	–	4	–	–	–
24-jul-2000	CN	af	V	–	–	–	–	–
30-oct-2000	CN	afh	V	–	4	–	–	–
30-oct-2000	CN	aefh	V	–	4	–	–	–
30-oct-2000	CN	afh	V	–	–	–	–	–
30-oct-2000	CN	aefh	V	–	–	–	–	–
23-jan-2001	CN	af	V	–	4 L	–	–	–
23-jan-2001	CN	af	V	–	–	–	–	–
24-apr-2001	CN	af	V	–	4	–	–	–
24-apr-2001	CN	af	V	–	–	–	–	–
17-jul-2001	CN	afh	V	–	4	–	–	–
17-jul-2001	CN	aefh	V	–	4	–	–	–
17-jul-2001	CN	afh	V	–	–	–	–	–
17-jul-2001	CN	aefh	V	–	–	–	–	–
24-oct-2001	CN	a	V	–	4	–	–	–
24-oct-2001	CN	a	V	–	–	–	–	–
23-jan-2002	CN	a	V	–	4	–	–	–
23-jan-2002	CN	a	V	–	–	–	–	–
22-apr-2002	CN	aefh	V	–	4 L	–	–	–
22-apr-2002	CN	afh	V	–	4 L	–	–	–
22-apr-2002	CN	aefh	V	–	–	–	–	–
22-apr-2002	CN	afh	V	–	–	–	–	–
13-sep-2002	CN	af	V	–	4	–	–	–
13-sep-2002	CN	af	V	–	–	–	–	–
27-nov-2002	CN	aefh	V	–	4	–	–	–
27-nov-2002	CN	afh	V	–	4	–	–	–
27-nov-2002	CN	aefh	V	–	–	–	–	–
27-nov-2002	CN	afh	V	–	–	–	–	–
10-feb-2003	CN	af	V	–	4	–	–	–
10-feb-2003	CN	af	V	–	–	–	–	–
01-may-2003	CN	afh	V	–	4	–	–	–
01-may-2003	CN	aefh	V	–	4	–	–	–
01-may-2003	CN	afh	V	–	–	–	–	–
01-may-2003	CN	aefh	V	–	–	–	–	–
K7-03								
14-jul-1995	CS	ah	V	39	3.8	73	20	<0.1 U
14-jul-1995	CS	aeh	V	37	3.4	71	21	<0.1 U
17-oct-1995	CS	a	V	35	3.1	66	19	<0.1 U
07-feb-1996	CS	a	V	38 L	3.7	77	21 O	<0.1 U
07-feb-1996	CS	a	V	–	–	–	–	–
24-apr-1996	CS	ah	V	–	–	–	–	–
24-apr-1996	CS	aeh	V	–	–	–	–	–
25-jul-1996	CS	a	V	–	–	–	–	–
25-jul-1996	CS	a	V	–	–	–	–	–
18-oct-1996	CS	a	V	–	–	–	–	–
18-oct-1996	CS	a	V	–	–	–	–	–
29-oct-1996	CS	a	V	–	–	–	–	–
23-jan-1997	CS	a	V	–	–	–	–	–
08-apr-1997	CS	ah	V	–	–	–	–	–
08-apr-1997	CS	aeh	V	–	–	–	–	–
23-jul-1997	CS	a	V	–	–	–	–	–
21-oct-1997	CS	a	V	–	–	–	–	–
15-jan-1998	CS	ah	V	–	–	–	–	–
15-jan-1998	CS	aeh	V	–	–	–	–	–
21-apr-1998	CS	a	V	–	2.6	–	–	–
21-apr-1998	CS	a	V	–	–	–	–	–
27-jul-1998	CS	a	V	–	2.7	–	–	–
27-jul-1998	CS	a	V	–	–	–	–	–
19-oct-1998	CS	a	V	–	2.9	–	–	–
19-oct-1998	CS	a	V	–	–	–	–	–
19-jan-1999	CS	a	V	–	2.9	–	–	–
19-jan-1999	CS	a	V	–	–	–	–	–
23-mar-1999	CS	a	V	–	–	–	–	–
30-mar-1999	BB	a	V	–	–	–	–	–
22-apr-1999	CN	afh	V	–	2.5	–	–	–
22-apr-1999	CN	aefh	V	–	2.6	–	–	–

from the Pit 7 Complex between July 1, 1995 and June 30, 2003. Results recorded by December 18, 2003.

Manganese	Copper	Zinc	Boron	Strontium	Aluminum	Location Date
						(continued) K7-01
–	0.02	<0.02 U	–	–	–	25-apr-2000
–	–	–	–	–	–	24-jul-2000
–	0.02	0.02	–	–	–	24-jul-2000
–	–	–	–	–	–	30-oct-2000
–	–	–	–	–	–	30-oct-2000
–	0.02	0.05	–	–	–	30-oct-2000
–	0.04	0.03	–	–	–	30-oct-2000
–	–	–	–	–	–	23-jan-2001
–	0.02	<0.02 U	–	–	–	23-jan-2001
–	–	–	–	–	–	24-apr-2001
–	0.02	<0.02 U	–	–	–	24-apr-2001
–	–	–	–	–	–	17-jul-2001
–	–	–	–	–	–	17-jul-2001
–	0.03	0.02	–	–	–	17-jul-2001
–	0.02	<0.02 U	–	–	–	17-jul-2001
–	–	<0.02 U	–	–	–	24-oct-2001
–	0.01	–	–	–	–	24-oct-2001
–	–	–	–	–	–	23-jan-2002
–	0.02	<0.02 U	–	–	–	23-jan-2002
–	–	–	–	–	–	22-apr-2002
–	–	–	–	–	–	22-apr-2002
–	<0.01 U	<0.02 U	–	–	–	22-apr-2002
–	<0.01 U	<0.02 U	–	–	–	22-apr-2002
–	–	–	–	–	–	13-sep-2002
–	<0.01 U	<0.02 U	–	–	–	13-sep-2002
–	–	–	–	–	–	27-nov-2002
–	–	–	–	–	–	27-nov-2002
–	0.01	<0.02 U	–	–	–	27-nov-2002
–	0.01	<0.02 U	–	–	–	27-nov-2002
–	–	–	–	–	–	10-feb-2003
–	<0.01 U	<0.02 U	–	–	–	10-feb-2003
–	–	–	–	–	–	01-may-2003
–	–	–	–	–	–	01-may-2003
–	0.02	<0.02 U	–	–	–	01-may-2003
–	0.03	0.02	–	–	–	01-may-2003
						K7-03
<0.03 U	0.08	<0.05 U	–	–	<0.2 U	14-jul-1995
<0.03 U	0.078	<0.05 U	–	–	<0.2 U	14-jul-1995
<0.03 U	<0.05 U	<0.05 U	–	–	<0.2 U	17-oct-1995
<0.03 U	0.061	<0.05 U	–	–	<0.2 UO	07-feb-1996
–	0.12	0.036	–	–	–	07-feb-1996
–	0.083 LO	0.054 LO	–	–	–	24-apr-1996
–	0.078 LO	0.055 LO	–	–	–	24-apr-1996
–	–	0.054	–	–	–	25-jul-1996
–	0.26	–	–	–	–	25-jul-1996
–	0.1 D	–	–	–	–	18-oct-1996
–	0.072	0.051	–	–	–	18-oct-1996
–	0.05	–	–	–	–	29-oct-1996
–	0.08	0.046	–	–	–	23-jan-1997
–	0.061	0.061	–	–	–	08-apr-1997
–	0.063	0.053	–	–	–	08-apr-1997
–	0.038	0.029	–	–	–	23-jul-1997
–	0.059	0.047	–	–	–	21-oct-1997
–	0.071	0.049	–	–	–	15-jan-1998
–	0.063	0.058	–	–	–	15-jan-1998
–	–	–	–	–	–	21-apr-1998
–	0.055	0.06	–	–	–	21-apr-1998
–	–	–	–	–	–	27-jul-1998
–	0.043	0.051	–	–	–	27-jul-1998
–	–	–	–	–	–	19-oct-1998
–	0.071	0.063	–	–	–	19-oct-1998
–	–	–	–	–	–	19-jan-1999
–	0.1	0.094	–	–	–	19-jan-1999
–	–	0.095	–	–	–	23-mar-1999
–	–	0.077	–	–	–	30-mar-1999
–	–	–	–	–	–	22-apr-1999
–	–	–	–	–	–	22-apr-1999

Table A-12. Ground and surface water analyses for cations (mg/L) in samples collected

Location Date	Lab	Note	Val.	Sodium	Potassium	Calcium	Magnesium	Iron
K7-03 (continued)								
22-apr-1999	CN	afh	V	–	–	–	–	–
22-apr-1999	CN	aefh	V	–	–	–	–	–
19-jul-1999	CN	af	V	–	2.4	–	–	–
19-jul-1999	CN	af	V	–	–	–	–	–
15-sep-1999	CN	a	V	–	–	–	–	–
22-sep-1999	CN	a	V	–	–	–	–	–
07-oct-1999	CN	af	V	–	2.9	–	–	–
07-oct-1999	CN	af	V	–	–	–	–	–
11-feb-2000	CN	a	V	–	4.4	–	–	–
11-feb-2000	CN	a	V	–	–	–	–	–
25-apr-2000	CN	af	V	–	4.3 L	–	–	–
25-apr-2000	CN	af	V	–	–	–	–	–
24-jul-2000	CN	ah	V	–	5	–	–	–
24-jul-2000	CN	aeh	V	–	5	–	–	–
24-jul-2000	CN	ah	V	–	–	–	–	–
24-jul-2000	CN	aeh	V	–	–	–	–	–
30-oct-2000	CN	af	V	–	4	–	–	–
30-oct-2000	CN	af	V	–	–	–	–	–
23-jan-2001	CN	af	V	–	5 L	–	–	–
23-jan-2001	CN	af	V	–	–	–	–	–
17-apr-2001	CN	afh	V	–	5	–	–	–
17-apr-2001	CN	aeh	V	–	5	–	–	–
17-apr-2001	CN	afh	V	–	–	–	–	–
17-apr-2001	CN	aeh	V	–	–	–	–	–
10-jun-2001	CN	a	V	–	–	–	–	–
18-jun-2001	CN	a	V	–	–	–	–	–
17-jul-2001	CN	af	V	–	5	–	–	–
17-jul-2001	CN	af	V	–	–	–	–	–
24-oct-2001	CN	a	V	–	5	–	–	–
24-oct-2001	CN	a	V	–	–	–	–	–
23-jan-2002	CN	aeh	V	–	4	–	–	–
23-jan-2002	CN	ah	V	–	4	–	–	–
23-jan-2002	CN	aeh	V	–	–	–	–	–
23-jan-2002	CN	ah	V	–	–	–	–	–
22-apr-2002	CN	af	V	–	5 L	–	–	–
22-apr-2002	CN	af	V	–	–	–	–	–
06-sep-2002	CN	ah	V	–	5 L	–	–	–
06-sep-2002	CN	aefh	V	–	5 L	–	–	–
06-sep-2002	CN	ah	V	–	–	–	–	–
06-sep-2002	CN	aefh	V	–	–	–	–	–
27-nov-2002	CN	af	V	–	5	–	–	–
27-nov-2002	CN	af	V	–	–	–	–	–
07-feb-2003	CN	afh	V	–	5	–	–	–
07-feb-2003	CN	aefh	V	–	5	–	–	–
07-feb-2003	CN	afh	V	–	–	–	–	–
07-feb-2003	CN	aefh	V	–	–	–	–	–
01-may-2003	CN	af	V	–	5	–	–	–
01-may-2003	CN	af	V	–	–	–	–	–
K7-06								
14-jul-1995	CS	a	V	33	2.3	46	14	<0.1 U
17-oct-1995	CS	a	V	33	2.2	45	14	<0.1 U
12-feb-1996	CS	ah	V	33	2.2	44	14	<0.1 U
12-feb-1996	CS	aeh	V	33	2.2	45	14	<0.1 U
12-feb-1996	CS	ah	V	–	–	–	–	–
12-feb-1996	CS	aeh	V	–	–	–	–	–
24-apr-1996	CS	a	V	–	–	–	–	–
24-jul-1996	CS	a	V	–	–	–	–	–
24-jul-1996	CS	a	V	–	–	–	–	–
18-oct-1996	CS	a	V	–	–	–	–	–
22-jan-1997	CS	a	V	–	–	–	–	–
08-apr-1997	CS	a	V	–	–	–	–	–
23-jul-1997	CS	a	V	–	–	–	–	–
21-oct-1997	CS	a	V	–	–	–	–	–
14-jan-1998	CS	a	V	–	–	–	–	–
21-apr-1998	CS	ah	V	–	1.7	–	–	–
21-apr-1998	CS	aeh	V	–	1.7	–	–	–
21-apr-1998	CS	ah	V	–	–	–	–	–

from the Pit 7 Complex between July 1, 1995 and June 30, 2003. Results recorded by December 18, 2003.

Manganese	Copper	Zinc	Boron	Strontium	Aluminum	Location Date
						(continued) K7-03
–	0.03	0.03	–	–	–	22-apr-1999
–	0.03	0.04	–	–	–	22-apr-1999
–	–	–	–	–	–	19-jul-1999
–	0.06	0.1	–	–	–	19-jul-1999
–	–	0.12	–	–	–	15-sep-1999
–	–	0.16	–	–	–	22-sep-1999
–	–	–	–	–	–	07-oct-1999
–	0.07	0.07	–	–	–	07-oct-1999
–	–	–	–	–	–	11-feb-2000
–	0.04	0.07	–	–	–	11-feb-2000
–	–	–	–	–	–	25-apr-2000
–	0.04	0.1	–	–	–	25-apr-2000
–	–	–	–	–	–	24-jul-2000
–	–	–	–	–	–	24-jul-2000
–	0.06	0.08	–	–	–	24-jul-2000
–	0.06	0.09	–	–	–	24-jul-2000
–	–	–	–	–	–	30-oct-2000
–	0.04	0.05	–	–	–	30-oct-2000
–	–	–	–	–	–	23-jan-2001
–	0.02	0.06 J	–	–	–	23-jan-2001
–	–	–	–	–	–	17-apr-2001
–	–	–	–	–	–	17-apr-2001
–	0.08	0.18	–	–	–	17-apr-2001
–	0.06	0.06	–	–	–	17-apr-2001
–	–	0.11	–	–	–	10-jun-2001
–	–	0.1	–	–	–	18-jun-2001
–	–	–	–	–	–	17-jul-2001
–	0.02	0.08	–	–	–	17-jul-2001
–	–	0.07	–	–	–	24-oct-2001
–	0.02	–	–	–	–	24-oct-2001
–	–	–	–	–	–	23-jan-2002
–	–	–	–	–	–	23-jan-2002
–	0.03	0.07	–	–	–	23-jan-2002
–	0.02	0.09	–	–	–	23-jan-2002
–	–	–	–	–	–	22-apr-2002
–	0.03	0.04	–	–	–	22-apr-2002
–	–	–	–	–	–	06-sep-2002
–	–	–	–	–	–	06-sep-2002
–	<0.01 U	0.03	–	–	–	06-sep-2002
–	<0.01 U	0.04	–	–	–	06-sep-2002
–	–	–	–	–	–	27-nov-2002
–	0.03	0.04	–	–	–	27-nov-2002
–	–	–	–	–	–	07-feb-2003
–	–	–	–	–	–	07-feb-2003
–	0.02	0.03	–	–	–	07-feb-2003
–	0.02	<0.02 U	–	–	–	07-feb-2003
–	–	–	–	–	–	01-may-2003
–	0.02	0.06	–	–	–	01-may-2003
						K7-06
<0.03 U	0.089	<0.05 U	–	–	<0.2 U	14-jul-1995
<0.03 U	<0.05 U	<0.05 U	–	–	<0.2 U	17-oct-1995
<0.03 U	<0.05 U	<0.05 U	–	–	<0.2 U	12-feb-1996
<0.03 U	<0.05 U	<0.05 U	–	–	<0.2 U	12-feb-1996
–	0.024	0.04	–	–	–	12-feb-1996
–	<0.01 U	<0.02 U	–	–	–	12-feb-1996
–	<0.01 ULO	0.055 LO	–	–	–	24-apr-1996
–	–	<0.02 U	–	–	–	24-jul-1996
–	0.001	–	–	–	–	24-jul-1996
–	<0.01 U	<0.02 U	–	–	–	18-oct-1996
–	<0.01 U	<0.02 U	–	–	–	22-jan-1997
–	<0.01 U	<0.02 U	–	–	–	08-apr-1997
–	<0.01 U	<0.02 U	–	–	–	23-jul-1997
–	<0.01 U	<0.02 U	–	–	–	21-oct-1997
–	<0.01 U	<0.02 U	–	–	–	14-jan-1998
–	–	–	–	–	–	21-apr-1998
–	–	–	–	–	–	21-apr-1998
–	<0.01 U	<0.02 U	–	–	–	21-apr-1998

Table A-12. Ground and surface water analyses for cations (mg/L) in samples collected

Location Date	Lab	Note	Val.	Sodium	Potassium	Calcium	Magnesium	Iron
K7-06 (continued)								
21-apr-1998	CS	aeh	V	-	-	-	-	-
21-jul-1998	CS	ah	V	-	2	-	-	-
21-jul-1998	CS	aeh	V	-	2	-	-	-
21-jul-1998	CS	ah	V	-	-	-	-	-
21-jul-1998	CS	aeh	V	-	-	-	-	-
19-oct-1998	CS	a	V	-	1.7	-	-	-
19-oct-1998	CS	a	V	-	-	-	-	-
19-jan-1999	CS	a	V	-	1.9	-	-	-
19-jan-1999	CS	a	V	-	-	-	-	-
23-apr-1999	CN	a	V	-	1.9	-	-	-
23-apr-1999	CN	a	V	-	-	-	-	-
19-jul-1999	CN	ah	V	-	1.6	-	-	-
19-jul-1999	CN	aeh	V	-	1.6	-	-	-
19-jul-1999	CN	ah	V	-	-	-	-	-
19-jul-1999	CN	aeh	V	-	-	-	-	-
12-oct-1999	CN	a	V	-	1.8	-	-	-
12-oct-1999	CN	a	V	-	-	-	-	-
11-feb-2000	CN	a	V	-	2.9	-	-	-
11-feb-2000	CN	a	V	-	-	-	-	-
25-apr-2000	CN	af	V	-	2.6 L	-	-	-
25-apr-2000	CN	af	V	-	-	-	-	-
24-jul-2000	CN	a	V	-	3	-	-	-
24-jul-2000	CN	a	V	-	-	-	-	-
01-nov-2000	CN	af	V	-	2	-	-	-
01-nov-2000	CN	af	V	-	-	-	-	-
06-jun-2001	CN	a	V	-	3 L	-	-	-
06-jun-2001	CN	a	V	-	-	-	-	-
19-jul-2001	CN	a	V	-	3 L	-	-	-
19-jul-2001	CN	a	V	-	-	-	-	-
29-oct-2001	CN	a	V	-	3	-	-	-
29-oct-2001	CN	a	V	-	-	-	-	-
30-jan-2002	CN	a	V	-	-	-	-	-
29-apr-2002	CN	a	V	-	3	-	-	-
29-apr-2002	CN	a	V	-	-	-	-	-
29-aug-2002	CN	af	V	-	3	-	-	-
29-aug-2002	CN	af	V	-	-	-	-	-
03-dec-2002	CN	af	V	-	3 L	-	-	-
03-dec-2002	CN	af	V	-	-	-	-	-
07-feb-2003	CN	af	V	-	3	-	-	-
07-feb-2003	CN	af	V	-	-	-	-	-
06-may-2003	CN	af	V	-	3	-	-	-
06-may-2003	CN	af	V	-	-	-	-	-
K7-07								
07-aug-1995	CS	ah	V	39	1.3	63	23	<0.1 U
07-aug-1995	CS	aeh	V	39	1.7	63	22	<0.1 U
30-oct-1995	CS	a	V	44	2.2	56	21	<0.1 U
19-nov-1996	CS	a	V	-	-	-	-	-
13-may-1997	CS	a	V	-	-	-	-	-
18-nov-1997	CS	a	V	-	-	-	-	-
02-jun-1998	CS	ah	V	-	1.2	-	-	-
02-jun-1998	CS	aeh	V	-	1.3	-	-	-
02-jun-1998	CS	ah	V	-	-	-	-	-
02-jun-1998	CS	aeh	V	-	-	-	-	-
30-nov-1998	CS	a	V	-	1.4	-	-	-
30-nov-1998	CS	a	V	-	-	-	-	-
26-may-1999	CN	a	V	-	1.1	-	-	-
26-may-1999	CN	a	V	-	-	-	-	-
18-may-2000	CN	a	V	-	2 L	-	-	-
18-may-2000	CN	a	V	-	-	-	-	-
K7-09								
17-jul-1995	CS	a	V	65	20	59	22	<0.1 U
17-oct-1995	CS	a	V	60	18	53	20	<0.1 U
07-feb-1996	CS	a	V	89 L	72	11	18 O	<0.1 U
07-feb-1996	CS	a	V	-	-	-	-	-
26-apr-1996	CS	a	V	-	-	-	-	-
24-jul-1996	CS	a	V	-	-	-	-	-

from the Pit 7 Complex between July 1, 1995 and June 30, 2003. Results recorded by December 18, 2003.

Manganese	Copper	Zinc	Boron	Strontium	Aluminum	Location Date
						(continued) K7-06
–	<0.01 U	<0.02 U	–	–	–	21-apr-1998
–	–	–	–	–	–	21-jul-1998
–	–	–	–	–	–	21-jul-1998
–	<0.01 U	<0.02 U	–	–	–	21-jul-1998
–	<0.01 U	<0.02 U	–	–	–	21-jul-1998
–	–	–	–	–	–	19-oct-1998
–	0.01	<0.02 U	–	–	–	19-oct-1998
–	–	–	–	–	–	19-jan-1999
–	<0.01 U	<0.02 U	–	–	–	19-jan-1999
–	–	–	–	–	–	23-apr-1999
–	<0.01 U	<0.02 U	–	–	–	23-apr-1999
–	–	–	–	–	–	19-jul-1999
–	–	–	–	–	–	19-jul-1999
–	<0.01 U	<0.02 U	–	–	–	19-jul-1999
–	<0.01 U	<0.02 U	–	–	–	19-jul-1999
–	–	–	–	–	–	12-oct-1999
–	<0.01 U	<0.02 U	–	–	–	12-oct-1999
–	–	–	–	–	–	11-feb-2000
–	<0.01 U	<0.02 U	–	–	–	11-feb-2000
–	–	–	–	–	–	25-apr-2000
–	<0.01 U	<0.02 U	–	–	–	25-apr-2000
–	–	–	–	–	–	24-jul-2000
–	<0.01 U	<0.02 U	–	–	–	24-jul-2000
–	–	–	–	–	–	01-nov-2000
–	<0.01 U	<0.02 U	–	–	–	01-nov-2000
–	–	–	–	–	–	06-jun-2001
–	<0.01 U	<0.02 LU	–	–	–	06-jun-2001
–	–	–	–	–	–	19-jul-2001
–	<0.01 U	<0.02 U	–	–	–	19-jul-2001
–	–	–	–	–	–	29-oct-2001
–	<0.01 U	<0.02 LU	–	–	–	29-oct-2001
–	<0.01 LU	0.09	–	–	–	30-jan-2002
–	–	–	–	–	–	29-apr-2002
–	<0.01 U	<0.02 U	–	–	–	29-apr-2002
–	–	–	–	–	–	29-aug-2002
–	<0.01 U	<0.02 U	–	–	–	29-aug-2002
–	–	–	–	–	–	03-dec-2002
–	<0.01 U	<0.02 U	–	–	–	03-dec-2002
–	–	–	–	–	–	07-feb-2003
–	<0.01 U	<0.02 U	–	–	–	07-feb-2003
–	–	–	–	–	–	06-may-2003
–	<0.01 U	<0.02 U	–	–	–	06-may-2003
						K7-07
<0.03 U	<0.05 U	<0.05 U	–	–	<0.2 U	07-aug-1995
<0.03 U	<0.05 U	<0.05 U	–	–	<0.2 U	07-aug-1995
<0.03 U	<0.05 U	<0.05 U	–	–	<0.2 U	30-oct-1995
–	<0.01 U	<0.02 U	–	–	–	19-nov-1996
–	<0.01 U	<0.02 U	–	–	–	13-may-1997
–	<0.01 U	<0.02 U	–	–	–	18-nov-1997
–	–	–	–	–	–	02-jun-1998
–	–	–	–	–	–	02-jun-1998
–	<0.01 U	<0.02 U	–	–	–	02-jun-1998
–	<0.01 U	<0.02 U	–	–	–	02-jun-1998
–	–	–	–	–	–	30-nov-1998
–	<0.01 U	<0.02 U	–	–	–	30-nov-1998
–	–	–	–	–	–	26-may-1999
–	<0.01 U	<0.02 U	–	–	–	26-may-1999
–	–	–	–	–	–	18-may-2000
–	<0.01 U	<0.02 U	–	–	–	18-may-2000
						K7-09
<0.03 U	<0.05 U	<0.05 U	–	–	<0.2 U	17-jul-1995
<0.03 U	<0.05 U	<0.05 U	–	–	<0.2 U	17-oct-1995
<0.03 U	<0.05 U	<0.05 U	–	–	<0.2 UO	07-feb-1996
–	<0.01 U	<0.02 U	–	–	–	07-feb-1996
–	<0.01 U	<0.02 UH	–	–	–	26-apr-1996
–	–	<0.02 U	–	–	–	24-jul-1996

Table A-12. Ground and surface water analyses for cations (mg/L) in samples collected

Location Date	Lab	Note	Val.	Sodium	Potassium	Calcium	Magnesium	Iron
K7-09 (continued)								
24-jul-1996	CS	a	V	-	-	-	-	-
23-oct-1996	CS	a	V	-	-	-	-	-
23-jan-1997	CS	a	V	-	-	-	-	-
10-apr-1997	CS	a	V	-	-	-	-	-
17-jul-1997	CS	a	V	-	-	-	-	-
02-sep-1997	CS	a	V	-	19	-	-	-
22-oct-1997	CS	a	V	-	-	-	-	-
21-jan-1998	CS	a	V	-	-	-	-	-
22-apr-1998	CS	a	V	-	73	-	-	-
22-apr-1998	CS	a	V	-	-	-	-	-
27-jul-1998	CS	a	V	-	53	-	-	-
27-jul-1998	CS	a	V	-	-	-	-	-
14-sep-1998	CS	a	V	-	-	-	-	-
20-oct-1998	CS	a	V	-	24	-	-	-
20-oct-1998	CS	a	V	-	-	-	-	-
21-dec-1998	CS	a	V	-	-	-	-	-
28-dec-1998	CS	a	V	-	-	-	-	-
25-jan-1999	CS	a	V	-	12	-	-	-
25-jan-1999	CS	a	V	-	-	-	-	-
23-apr-1999	CN	a	V	-	28	-	-	-
23-apr-1999	CN	a	V	-	-	-	-	-
15-jul-1999	CN	a	V	-	9.3	-	-	-
15-jul-1999	CN	a	V	-	-	-	-	-
11-oct-1999	CN	a	V	-	11	-	-	-
11-oct-1999	CN	a	V	-	-	-	-	-
07-dec-1999	CN	a	V	-	-	-	-	-
15-dec-1999	CN	a	V	-	-	-	-	-
16-feb-2000	CN	a	V	-	13 L	-	-	-
16-feb-2000	CN	a	V	-	-	-	-	-
25-apr-2000	CN	a	V	-	24 L	-	-	-
25-apr-2000	CN	a	V	-	-	-	-	-
09-aug-2000	CN	a	V	-	29	-	-	-
09-aug-2000	CN	a	V	-	-	-	-	-
01-nov-2000	CN	af	V	-	18	-	-	-
01-nov-2000	CN	af	V	-	-	-	-	-
23-jan-2001	CN	a	V	-	12 L	-	-	-
23-jan-2001	CN	a	V	-	-	-	-	-
24-apr-2001	CN	ah	V	-	25	-	-	-
24-apr-2001	CN	ah	V	-	-	-	-	-
17-jul-2001	CN	a	V	-	30	-	-	-
17-jul-2001	CN	a	V	-	-	-	-	-
24-oct-2001	CN	a	V	-	23	-	-	-
24-oct-2001	CN	a	V	-	-	-	-	-
23-jan-2002	CN	a	V	-	20	-	-	-
23-jan-2002	CN	a	V	-	-	-	-	-
23-apr-2002	CN	af	V	-	26 L	-	-	-
23-apr-2002	CN	af	V	-	-	-	-	-
06-sep-2002	CN	a	V	-	28 L	-	-	-
06-sep-2002	CN	a	V	-	-	-	-	-
29-nov-2002	CN	af	V	-	14 B	-	-	-
29-nov-2002	CN	af	V	-	-	-	-	-
07-feb-2003	CN	af	V	-	16	-	-	-
07-feb-2003	CN	af	V	-	-	-	-	-
20-mar-2003	CN	a	N	-	-	-	-	-
27-mar-2003	CN	a	N	-	-	-	-	-
01-may-2003	CN	a	V	-	17	-	-	-
01-may-2003	CN	a	V	-	-	-	-	-
K7-10								
18-jul-1995	CS	a	V	34	5.6	150	42	<0.1 U
19-oct-1995	CS	a	V	31	5.3	140	37	<0.1 U
12-feb-1996	CS	a	V	43	14	98	34	<0.1 U
12-feb-1996	CS	a	V	-	-	-	-	-
26-apr-1996	CS	a	V	-	-	-	-	-
24-jul-1996	CS	a	V	-	-	-	-	-
24-jul-1996	CS	a	V	-	-	-	-	-
24-oct-1996	CS	a	V	-	-	-	-	-
28-jan-1997	CS	a	V	-	-	-	-	-

from the Pit 7 Complex between July 1, 1995 and June 30, 2003. Results recorded by December 18, 2003.

Manganese	Copper	Zinc	Boron	Strontium	Aluminum	Location Date
						(continued) K7-09
–	0.0025	–	–	–	–	24-jul-1996
–	<0.01 U	<0.02 U	–	–	–	23-oct-1996
–	<0.01 U	<0.02 U	–	–	–	23-jan-1997
–	<0.01 U	<0.02 U	–	–	–	10-apr-1997
–	<0.01 U	<0.02 U	–	–	–	17-jul-1997
–	–	–	–	–	–	02-sep-1997
–	<0.01 U	<0.02 U	–	–	–	22-oct-1997
–	<0.01 U	<0.02 U	–	–	–	21-jan-1998
–	–	–	–	–	–	22-apr-1998
–	<0.01 U	<0.02 U	–	–	–	22-apr-1998
–	–	–	–	–	–	27-jul-1998
–	<0.01 U	<0.02 U	–	–	–	27-jul-1998
–	<0.01 U	<0.02 U	–	–	–	14-sep-1998
–	–	–	–	–	–	20-oct-1998
–	0.011	<0.02 U	–	–	–	20-oct-1998
–	<0.01 U	–	–	–	–	21-dec-1998
–	<0.01 U	–	–	–	–	28-dec-1998
–	–	–	–	–	–	25-jan-1999
–	<0.01 U	<0.02 U	–	–	–	25-jan-1999
–	–	–	–	–	–	23-apr-1999
–	<0.01 U	<0.02 U	–	–	–	23-apr-1999
–	–	–	–	–	–	15-jul-1999
–	<0.01 U	<0.02 U	–	–	–	15-jul-1999
–	–	–	–	–	–	11-oct-1999
–	0.03	<0.02 U	–	–	–	11-oct-1999
–	<0.003 U	–	–	–	–	07-dec-1999
–	<0.003 U	–	–	–	–	15-dec-1999
–	–	–	–	–	–	16-feb-2000
–	<0.01 U	<0.02 U	–	–	–	16-feb-2000
–	–	–	–	–	–	25-apr-2000
–	<0.01 U	<0.02 U	–	–	–	25-apr-2000
–	–	–	–	–	–	09-aug-2000
–	<0.01 U	<0.02 U	–	–	–	09-aug-2000
–	–	–	–	–	–	01-nov-2000
–	<0.01 U	<0.02 U	–	–	–	01-nov-2000
–	–	–	–	–	–	23-jan-2001
–	<0.01 U	<0.02 U	–	–	–	23-jan-2001
–	–	–	–	–	–	24-apr-2001
–	<0.01 U	<0.02 U	–	–	–	24-apr-2001
–	–	–	–	–	–	17-jul-2001
–	<0.01 U	<0.02 U	–	–	–	17-jul-2001
–	–	<0.02 U	–	–	–	24-oct-2001
–	<0.01 U	–	–	–	–	24-oct-2001
–	–	–	–	–	–	23-jan-2002
–	<0.01 U	<0.02 U	–	–	–	23-jan-2002
–	–	–	–	–	–	23-apr-2002
–	<0.01 U	<0.02 U	–	–	–	23-apr-2002
–	–	–	–	–	–	06-sep-2002
–	<0.01 U	0.02	–	–	–	06-sep-2002
–	–	–	–	–	–	29-nov-2002
–	<0.01 U	<0.02 U	–	–	–	29-nov-2002
–	–	–	–	–	–	07-feb-2003
–	0.02	<0.02 U	–	–	–	07-feb-2003
–	<0.01 U	–	–	–	–	20-mar-2003
–	<0.01 LU	–	–	–	–	27-mar-2003
–	–	–	–	–	–	01-may-2003
–	<0.01 U	<0.02 U	–	–	–	01-may-2003
						K7-10
<0.03 U	<0.05 U	<0.05 U	–	–	<0.2 U	18-jul-1995
<0.03 U	<0.05 U	<0.05 U	–	–	<0.2 U	19-oct-1995
<0.03 U	<0.05 U	<0.05 U	–	–	<0.2 U	12-feb-1996
–	<0.01 U	<0.02 U	–	–	–	12-feb-1996
–	<0.01 U	<0.02 UH	–	–	–	26-apr-1996
–	–	<0.02 U	–	–	–	24-jul-1996
–	<0.001 U	–	–	–	–	24-jul-1996
–	<0.01 U	<0.02 U	–	–	–	24-oct-1996
–	<0.01 U	<0.02 U	–	–	–	28-jan-1997

Table A-12. Ground and surface water analyses for cations (mg/L) in samples collected

Location Date	Lab	Note	Val.	Sodium	Potassium	Calcium	Magnesium	Iron
K7-10 (continued)								
15-apr-1997	CS	a	V	-	-	-	-	-
17-jul-1997	CS	a	V	-	-	-	-	-
02-sep-1997	CS	a	V	-	-	-	-	-
10-sep-1997	CS	a	V	-	-	-	-	-
27-oct-1997	CS	a	V	-	-	-	-	-
21-jan-1998	CS	a	V	-	-	-	-	-
28-apr-1998	CS	a	V	-	32	-	-	-
28-apr-1998	CS	a	V	-	-	-	-	-
31-jul-1998	CS	a	V	-	3.1	-	-	-
31-jul-1998	CS	a	V	-	-	-	-	-
18-sep-1998	CS	a	V	-	-	-	-	-
23-sep-1998	CS	a	V	-	-	-	-	-
26-oct-1998	CS	a	V	-	4.7	-	-	-
26-oct-1998	CS	a	V	-	-	-	-	-
25-jan-1999	CS	a	V	-	4.6	-	-	-
25-jan-1999	CS	a	V	-	-	-	-	-
26-apr-1999	CN	a	V	-	4.6	-	-	-
26-apr-1999	CN	a	V	-	-	-	-	-
15-jul-1999	CN	a	V	-	4.4	-	-	-
15-jul-1999	CN	a	V	-	-	-	-	-
11-oct-1999	CN	a	V	-	5.4	-	-	-
11-oct-1999	CN	a	V	-	-	-	-	-
27-jan-2000	CN	a	V	-	7	-	-	-
27-jan-2000	CN	a	V	-	-	-	-	-
26-apr-2000	CN	a	V	-	16	-	-	-
26-apr-2000	CN	a	V	-	-	-	-	-
01-aug-2000	CN	a	V	-	11	-	-	-
01-aug-2000	CN	a	V	-	-	-	-	-
08-aug-2000	CN	a	V	-	9 L	-	-	-
11-sep-2000	CN	a	V	-	-	-	-	-
18-sep-2000	CN	a	V	-	-	-	-	-
01-nov-2000	CN	a	V	-	7	-	-	-
01-nov-2000	CN	a	V	-	-	-	-	-
23-jan-2001	CN	a	V	-	7 L	-	-	-
23-jan-2001	CN	a	V	-	-	-	-	-
24-apr-2001	CN	ah	V	-	8	-	-	-
24-apr-2001	CN	ah	V	-	-	-	-	-
17-jul-2001	CN	a	V	-	7	-	-	-
17-jul-2001	CN	a	V	-	-	-	-	-
24-oct-2001	CN	a	V	-	6	-	-	-
24-oct-2001	CN	a	V	-	-	-	-	-
24-jan-2002	CN	a	V	-	12	-	-	-
24-jan-2002	CN	a	V	-	-	-	-	-
23-apr-2002	CN	a	V	-	8 L	-	-	-
23-apr-2002	CN	a	V	-	-	-	-	-
28-aug-2002	CN	af	V	-	7	-	-	-
28-aug-2002	CN	af	V	-	-	-	-	-
29-nov-2002	CN	af	V	-	6 B	-	-	-
29-nov-2002	CN	af	V	-	-	-	-	-
07-feb-2003	CN	af	V	-	10	-	-	-
07-feb-2003	CN	af	V	-	-	-	-	-
05-may-2003	CN	a	V	-	8	-	-	-
05-may-2003	CN	a	V	-	-	-	-	-
NC7-25								
18-jul-1995	CS	a	V	79	3.7	68	32	<0.1 U
20-oct-1995	CS	a	V	74	2.6	66	30	<0.1 U
12-feb-1996	CS	a	V	86	2.8	74	36	<0.1 U
12-feb-1996	CS	a	V	-	-	-	-	-
29-apr-1996	CS	a	V	-	-	-	-	-
07-jun-1996	CS	a	V	-	-	-	-	-
17-jun-1996	CS	a	V	-	-	-	-	-
30-jul-1996	CS	a	V	-	-	-	-	-
30-jul-1996	CS	a	V	-	-	-	-	-
24-oct-1996	CS	a	V	-	-	-	-	-
28-jan-1997	CS	a	V	-	-	-	-	-
16-apr-1997	CS	a	V	-	-	-	-	-
30-jul-1997	CS	a	V	-	-	-	-	-

from the Pit 7 Complex between July 1, 1995 and June 30, 2003. Results recorded by December 18, 2003.

Manganese	Copper	Zinc	Boron	Strontium	Aluminum	Location Date
						(continued) K7-10
–	<0.01 U	<0.02 U	–	–	–	15-apr-1997
–	<0.01 U	0.04	–	–	–	17-jul-1997
–	–	<0.02 U	–	–	–	02-sep-1997
–	–	<0.02 U	–	–	–	10-sep-1997
–	<0.01 U	<0.02 U	–	–	–	27-oct-1997
–	<0.01 U	<0.02 U	–	–	–	21-jan-1998
–	–	–	–	–	–	28-apr-1998
–	<0.01 U	<0.02 U	–	–	–	28-apr-1998
–	–	–	–	–	–	31-jul-1998
–	0.051	0.057	–	–	–	31-jul-1998
–	<0.01 U	<0.02 U	–	–	–	18-sep-1998
–	<0.01 U	<0.02 U	–	–	–	23-sep-1998
–	–	–	–	–	–	26-oct-1998
–	<0.01 U	<0.02 U	–	–	–	26-oct-1998
–	–	–	–	–	–	25-jan-1999
–	<0.01 U	<0.02 U	–	–	–	25-jan-1999
–	–	–	–	–	–	26-apr-1999
–	<0.01 U	<0.02 U	–	–	–	26-apr-1999
–	–	–	–	–	–	15-jul-1999
–	<0.01 U	<0.02 U	–	–	–	15-jul-1999
–	–	–	–	–	–	11-oct-1999
–	<0.01 U	<0.02 U	–	–	–	11-oct-1999
–	–	–	–	–	–	27-jan-2000
–	<0.01 U	<0.02 U	–	–	–	27-jan-2000
–	–	–	–	–	–	26-apr-2000
–	<0.01 U	<0.02 U	–	–	–	26-apr-2000
–	–	–	–	–	–	01-aug-2000
–	<0.01 U	<0.02 U	–	–	–	01-aug-2000
–	–	–	–	–	–	08-aug-2000
–	–	<0.02 U	–	–	–	11-sep-2000
–	–	<0.02 U	–	–	–	18-sep-2000
–	–	–	–	–	–	01-nov-2000
–	<0.01 U	<0.02 U	–	–	–	01-nov-2000
–	–	–	–	–	–	23-jan-2001
–	<0.01 U	<0.02 U	–	–	–	23-jan-2001
–	–	–	–	–	–	24-apr-2001
–	<0.01 U	<0.02 U	–	–	–	24-apr-2001
–	–	–	–	–	–	17-jul-2001
–	<0.01 U	<0.02 U	–	–	–	17-jul-2001
–	–	<0.02 U	–	–	–	24-oct-2001
–	<0.01 U	–	–	–	–	24-oct-2001
–	–	–	–	–	–	24-jan-2002
–	<0.01 U	<0.02 U	–	–	–	24-jan-2002
–	–	–	–	–	–	23-apr-2002
–	<0.01 U	<0.02 U	–	–	–	23-apr-2002
–	–	–	–	–	–	28-aug-2002
–	<0.01 U	<0.02 U	–	–	–	28-aug-2002
–	–	–	–	–	–	29-nov-2002
–	<0.01 U	<0.02 U	–	–	–	29-nov-2002
–	–	–	–	–	–	07-feb-2003
–	<0.01 U	<0.02 U	–	–	–	07-feb-2003
–	–	–	–	–	–	05-may-2003
–	<0.01 U	<0.02 U	–	–	–	05-may-2003
						NC7-25
<0.03 U	<0.05 U	<0.05 U	–	–	<0.2 U	18-jul-1995
<0.03 U	<0.05 U	<0.05 U	–	–	<0.2 U	20-oct-1995
<0.03 U	<0.05 U	<0.05 U	–	–	<0.2 U	12-feb-1996
–	<0.01 U	<0.02 U	–	–	–	12-feb-1996
–	<0.01 U	0.066 H	–	–	–	29-apr-1996
–	–	<0.02 U	–	–	–	07-jun-1996
–	–	<0.02 U	–	–	–	17-jun-1996
–	–	<0.02 U	–	–	–	30-jul-1996
–	0.0038	–	–	–	–	30-jul-1996
–	<0.01 U	<0.02 U	–	–	–	24-oct-1996
–	<0.01 U	<0.02 U	–	–	–	28-jan-1997
–	<0.01 U	<0.02 U	–	–	–	16-apr-1997
–	<0.01 UL	<0.02 U	–	–	–	30-jul-1997

Table A-12. Ground and surface water analyses for cations (mg/L) in samples collected

Location Date	Lab	Note	Val.	Sodium	Potassium	Calcium	Magnesium	Iron
NC7-25 (continued)								
27-oct-1997	CS	a	V	-	-	-	-	-
22-jan-1998	CS	a	V	-	-	-	-	-
11-feb-1998	CS	a	V	-	-	-	-	-
18-feb-1998	CS	a	V	-	-	-	-	-
28-apr-1998	CS	a	V	-	2.3	-	-	-
28-apr-1998	CS	a	V	-	-	-	-	-
31-jul-1998	CS	a	V	-	2.2	-	-	-
31-jul-1998	CS	a	V	-	-	-	-	-
26-oct-1998	CS	a	V	-	3.1	-	-	-
26-oct-1998	CS	a	V	-	-	-	-	-
27-jan-1999	CS	a	V	-	2.4	-	-	-
27-jan-1999	CS	a	V	-	-	-	-	-
04-may-1999	CN	a	V	-	2.2	-	-	-
04-may-1999	CN	a	V	-	-	-	-	-
15-jul-1999	CN	a	V	-	2.1	-	-	-
15-jul-1999	CN	a	V	-	-	-	-	-
07-oct-1999	CN	af	V	-	2.1	-	-	-
07-oct-1999	CN	af	V	-	-	-	-	-
04-feb-2000	CN	ah	V	-	4 LO	-	-	-
04-feb-2000	CN	aeh	V	-	4 LO	-	-	-
04-feb-2000	CN	ah	V	-	-	-	-	-
04-feb-2000	CN	aeh	V	-	-	-	-	-
26-apr-2000	CN	af	V	-	3.6	-	-	-
26-apr-2000	CN	af	V	-	-	-	-	-
09-aug-2000	CN	af	V	-	4	-	-	-
09-aug-2000	CN	af	V	-	-	-	-	-
25-jan-2001	CN	af	V	-	4	-	-	-
25-jan-2001	CN	af	V	-	-	-	-	-
26-apr-2001	CN	af	V	-	4	-	-	-
26-apr-2001	CN	af	V	-	-	-	-	-
29-may-2001	BB	a	V	96 H	3.5 H	90 H	45 H	<0.05 HU
18-jul-2001	CN	af	V	-	4	-	-	-
18-jul-2001	CN	af	V	-	-	-	-	-
25-oct-2001	CN	ah	V	-	4	-	-	-
25-oct-2001	CN	aeh	V	-	5	-	-	-
25-oct-2001	CN	ah	V	-	-	-	-	-
25-oct-2001	CN	aeh	V	-	-	-	-	-
24-jan-2002	CN	a	V	-	4	-	-	-
24-jan-2002	CN	a	V	-	-	-	-	-
29-apr-2002	CN	a	V	-	4	-	-	-
29-apr-2002	CN	a	V	-	-	-	-	-
11-sep-2002	CN	af	V	-	5	-	-	-
11-sep-2002	CN	af	V	-	-	-	-	-
27-nov-2002	CN	af	V	-	6	-	-	-
27-nov-2002	CN	af	V	-	-	-	-	-
11-feb-2003	CN	a	N	-	4	-	-	-
11-feb-2003	CN	a	N	-	-	-	-	-
05-may-2003	CN	a	V	-	5	-	-	-
05-may-2003	CN	a	V	-	-	-	-	-
NC7-26								
17-jul-1995	CS	a	V	38	3.5	71	23	<0.1 U
17-oct-1995	CS	a	V	34	3.1	61	20	<0.1 U
08-feb-1996	CS	a	V	39 L	3.2	72 O	24 O	<0.1 U
08-feb-1996	CS	a	V	-	-	-	-	-
26-apr-1996	CS	a	V	-	-	-	-	-
25-jul-1996	CS	a	V	-	-	-	-	-
25-jul-1996	CS	a	V	-	-	-	-	-
23-oct-1996	CS	a	V	-	-	-	-	-
23-jan-1997	CS	a	V	-	-	-	-	-
10-apr-1997	CS	a	V	-	-	-	-	-
24-jul-1997	CS	a	V	-	-	-	-	-
22-oct-1997	CS	a	V	-	-	-	-	-
21-jan-1998	CS	a	V	-	-	-	-	-
22-apr-1998	CS	a	V	-	2.6	-	-	-
22-apr-1998	CS	a	V	-	-	-	-	-
27-jul-1998	CS	a	V	-	23	-	-	-
27-jul-1998	CS	a	V	-	-	-	-	-

from the Pit 7 Complex between July 1, 1995 and June 30, 2003. Results recorded by December 18, 2003.

Manganese	Copper	Zinc	Boron	Strontium	Aluminum	Location Date
						(continued) NC7-25
–	<0.01 U	0.022	–	–	–	27-oct-1997
–	0.012	<0.02 U	–	–	–	22-jan-1998
–	<0.01 U	–	–	–	–	11-feb-1998
–	<0.01 U	–	–	–	–	18-feb-1998
–	–	–	–	–	–	28-apr-1998
–	<0.01 U	<0.02 U	–	–	–	28-apr-1998
–	–	–	–	–	–	31-jul-1998
–	<0.01 U	<0.02 U	–	–	–	31-jul-1998
–	–	–	–	–	–	26-oct-1998
–	<0.01 U	0.021	–	–	–	26-oct-1998
–	–	–	–	–	–	27-jan-1999
–	<0.01 U	<0.02 U	–	–	–	27-jan-1999
–	–	–	–	–	–	04-may-1999
–	<0.01 U	<0.02 U	–	–	–	04-may-1999
–	–	–	–	–	–	15-jul-1999
–	<0.01 U	<0.02 U	–	–	–	15-jul-1999
–	–	–	–	–	–	07-oct-1999
–	<0.01 U	<0.02 U	–	–	–	07-oct-1999
–	–	–	–	–	–	04-feb-2000
–	–	–	–	–	–	04-feb-2000
–	<0.01 U	0.03	–	–	–	04-feb-2000
–	<0.01 U	<0.02 U	–	–	–	04-feb-2000
–	–	–	–	–	–	26-apr-2000
–	<0.01 U	<0.02 U	–	–	–	26-apr-2000
–	–	–	–	–	–	09-aug-2000
–	<0.01 U	<0.02 U	–	–	–	09-aug-2000
–	–	–	–	–	–	25-jan-2001
–	<0.01 U	<0.02 U	–	–	–	25-jan-2001
–	–	–	–	–	–	26-apr-2001
–	<0.01 U	<0.02 U	–	–	–	26-apr-2001
0.028 H	<0.01 HU	<0.05 HU	–	–	<0.05 HU	29-may-2001
–	–	–	–	–	–	18-jul-2001
–	<0.01 U	<0.02 U	–	–	–	18-jul-2001
–	–	–	–	–	–	25-oct-2001
–	–	–	–	–	–	25-oct-2001
–	<0.01 U	<0.02 LU	–	–	–	25-oct-2001
–	<0.01 U	0.04 L	–	–	–	25-oct-2001
–	–	–	–	–	–	24-jan-2002
–	<0.01 U	<0.02 U	–	–	–	24-jan-2002
–	–	–	–	–	–	29-apr-2002
–	<0.01 U	<0.02 U	–	–	–	29-apr-2002
–	–	–	–	–	–	11-sep-2002
–	<0.01 U	<0.02 U	–	–	–	11-sep-2002
–	–	–	–	–	–	27-nov-2002
–	<0.01 U	<0.02 U	–	–	–	27-nov-2002
–	–	–	–	–	–	11-feb-2003
–	<0.01 U	<0.02 U	–	–	–	11-feb-2003
–	–	–	–	–	–	05-may-2003
–	<0.01 U	<0.02 U	–	–	–	05-may-2003
						NC7-26
<0.03 U	<0.05 U	<0.05 U	–	–	<0.2 U	17-jul-1995
<0.03 U	<0.05 U	<0.05 U	–	–	<0.2 U	17-oct-1995
<0.03 U	<0.05 U	<0.05 U	–	–	<0.2 UO	08-feb-1996
–	<0.01 U	<0.02 U	–	–	–	08-feb-1996
–	<0.01 U	<0.02 UH	–	–	–	26-apr-1996
–	–	<0.02 U	–	–	–	25-jul-1996
–	<0.001 U	–	–	–	–	25-jul-1996
–	<0.01 U	<0.02 U	–	–	–	23-oct-1996
–	<0.01 U	<0.02 U	–	–	–	23-jan-1997
–	<0.01 U	<0.02 U	–	–	–	10-apr-1997
–	<0.01 U	<0.02 U	–	–	–	24-jul-1997
–	<0.01 U	<0.02 U	–	–	–	22-oct-1997
–	<0.01 U	<0.02 U	–	–	–	21-jan-1998
–	–	–	–	–	–	22-apr-1998
–	<0.01 U	<0.02 U	–	–	–	22-apr-1998
–	–	–	–	–	–	27-jul-1998
–	<0.01 U	<0.02 U	–	–	–	27-jul-1998

Table A-12. Ground and surface water analyses for cations (mg/L) in samples collected

Location Date	Lab	Note	Val.	Sodium	Potassium	Calcium	Magnesium	Iron
NC7-26 (continued)								
20-oct-1998	CS	a	V	-	2.7	-	-	-
20-oct-1998	CS	a	V	-	-	-	-	-
25-jan-1999	CS	a	V	-	2.7	-	-	-
25-jan-1999	CS	a	V	-	-	-	-	-
30-mar-1999	BB	a	V	-	-	-	-	-
07-apr-1999	BB	a	V	-	-	-	-	-
04-may-1999	CN	af	V	-	2.8	-	-	-
04-may-1999	CN	af	V	-	-	-	-	-
14-jul-1999	CN	a	V	-	2.6	-	-	-
14-jul-1999	CN	a	V	-	-	-	-	-
11-oct-1999	CN	a	V	-	2.6	-	-	-
11-oct-1999	CN	a	V	-	-	-	-	-
16-feb-2000	CN	a	V	-	4.6 L	-	-	-
16-feb-2000	CN	a	V	-	-	-	-	-
26-apr-2000	CN	a	V	-	4.2	-	-	-
26-apr-2000	CN	a	V	-	-	-	-	-
09-aug-2000	CN	a	V	-	5	-	-	-
09-aug-2000	CN	a	V	-	-	-	-	-
02-nov-2000	CN	a	V	-	5 L	-	-	-
02-nov-2000	CN	a	V	-	-	-	-	-
25-jan-2001	CN	a	V	-	4	-	-	-
25-jan-2001	CN	a	V	-	-	-	-	-
26-apr-2001	CN	a	V	-	4	-	-	-
26-apr-2001	CN	a	V	-	-	-	-	-
18-jul-2001	CN	a	V	-	4	-	-	-
18-jul-2001	CN	a	V	-	-	-	-	-
25-oct-2001	CN	a	V	-	4	-	-	-
25-oct-2001	CN	a	V	-	-	-	-	-
24-jan-2002	CN	a	V	-	4	-	-	-
24-jan-2002	CN	a	V	-	-	-	-	-
22-apr-2002	CN	a	V	-	4 L	-	-	-
22-apr-2002	CN	a	V	-	-	-	-	-
13-sep-2002	CN	af	V	-	4	-	-	-
13-sep-2002	CN	af	V	-	-	-	-	-
29-nov-2002	CN	af	V	-	4 B	-	-	-
29-nov-2002	CN	af	V	-	-	-	-	-
12-feb-2003	CN	af	V	-	4	-	-	-
12-feb-2003	CN	af	V	-	-	-	-	-
06-may-2003	CN	af	V	-	4	-	-	-
06-may-2003	CN	af	V	-	-	-	-	-
NC7-34								
12-jun-2001	CN	af	V	47 H	2 H	75 H	34 H	<0.1 HU
04-jun-2002	CN	af	V	47	2	71	34 L	<0.1 U
NC7-36								
25-may-2001	CN	a	V	33 H	3 H	48 H	21 H	<0.1 HU
31-may-2002	CN	a	V	33	2	48	22 L	<0.1 U
NC7-40								
12-jun-2001	CN	af	V	55 H	3 H	83 H	40 H	<0.1 HU
29-may-2002	CN	af	V	54	3	81	39	<0.1 U
16-jul-2002	CN	af	V	57	3 L	82	41	<0.1 U
NC7-47								
18-jul-1995	CS	a	V	53	23	44	19	<0.1 U
20-oct-1995	CS	a	V	46	3.4	39	17	<0.1 U
13-feb-1996	CS	a	V	55	4.4	45	20	<0.1 U
13-feb-1996	CS	a	V	-	-	-	-	-
21-mar-1996	CS	a	V	-	-	-	-	-
28-mar-1996	CS	a	V	-	-	-	-	-
30-apr-1996	CS	a	V	-	-	-	-	-
30-jul-1996	CS	a	V	-	-	-	-	-
30-jul-1996	CS	a	V	-	-	-	-	-
25-oct-1996	CS	a	V	-	-	-	-	-
03-feb-1997	CS	a	V	-	-	-	-	-
16-apr-1997	CS	a	V	-	-	-	-	-
30-jul-1997	CS	a	V	-	-	-	-	-

from the Pit 7 Complex between July 1, 1995 and June 30, 2003. Results recorded by December 18, 2003.

Manganese	Copper	Zinc	Boron	Strontium	Aluminum	Location Date
						(continued) NC7-26
–	–	–	–	–	–	20-oct-1998
–	<0.01 U	<0.02 U	–	–	–	20-oct-1998
–	–	–	–	–	–	25-jan-1999
–	<0.01 U	0.026	–	–	–	25-jan-1999
–	–	0.01	–	–	–	30-mar-1999
–	–	0.016	–	–	–	07-apr-1999
–	–	–	–	–	–	04-may-1999
–	<0.01 U	<0.02 U	–	–	–	04-may-1999
–	–	–	–	–	–	14-jul-1999
–	<0.01 U	<0.02 U	–	–	–	14-jul-1999
–	–	–	–	–	–	11-oct-1999
–	<0.01 U	<0.02 U	–	–	–	11-oct-1999
–	–	–	–	–	–	16-feb-2000
–	<0.01 U	<0.02 U	–	–	–	16-feb-2000
–	–	–	–	–	–	26-apr-2000
–	<0.01 U	<0.02 U	–	–	–	26-apr-2000
–	–	–	–	–	–	09-aug-2000
–	<0.01 U	0.02	–	–	–	09-aug-2000
–	–	–	–	–	–	02-nov-2000
–	<0.01 U	<0.02 U	–	–	–	02-nov-2000
–	–	–	–	–	–	25-jan-2001
–	<0.01 U	<0.02 U	–	–	–	25-jan-2001
–	–	–	–	–	–	26-apr-2001
–	<0.01 U	<0.02 U	–	–	–	26-apr-2001
–	–	–	–	–	–	18-jul-2001
–	<0.01 U	<0.02 U	–	–	–	18-jul-2001
–	–	–	–	–	–	25-oct-2001
–	<0.01 U	<0.02 LU	–	–	–	25-oct-2001
–	–	–	–	–	–	24-jan-2002
–	<0.01 U	<0.02 U	–	–	–	24-jan-2002
–	–	–	–	–	–	22-apr-2002
–	<0.01 U	<0.02 U	–	–	–	22-apr-2002
–	–	–	–	–	–	13-sep-2002
–	<0.01 U	<0.02 U	–	–	–	13-sep-2002
–	–	–	–	–	–	29-nov-2002
–	<0.01 U	<0.02 U	–	–	–	29-nov-2002
–	–	–	–	–	–	12-feb-2003
–	<0.01 U	<0.02 U	–	–	–	12-feb-2003
–	–	–	–	–	–	06-may-2003
–	<0.01 U	<0.02 U	–	–	–	06-may-2003
						NC7-34
<0.03 HU	<0.05 HU	<0.05 HU	–	–	<0.2 HU	12-jun-2001
<0.03 U	<0.05 U	<0.05 U	–	–	<0.2 U	04-jun-2002
						NC7-36
<0.03 HU	<0.05 HU	<0.05 HU	–	–	<0.2 HU	25-may-2001
<0.03 U	<0.05 U	<0.05 U	–	–	<0.2 U	31-may-2002
						NC7-40
<0.03 HU	<0.05 HU	<0.05 HU	–	–	<0.2 HU	12-jun-2001
<0.03 U	<0.05 U	<0.05 U	–	–	<0.2 U	29-may-2002
<0.03 U	<0.05 U	<0.05 U	–	–	<0.2 U	16-jul-2002
						NC7-47
<0.03 U	<0.05 U	<0.05 U	–	–	<0.2 U	18-jul-1995
<0.03 U	<0.05 U	<0.05 U	–	–	<0.2 U	20-oct-1995
<0.03 U	<0.05 U	<0.05 U	–	–	<0.2 U	13-feb-1996
–	<0.01 U	0.063	–	–	–	13-feb-1996
–	–	<0.02 U	–	–	–	21-mar-1996
–	–	<0.02 U	–	–	–	28-mar-1996
–	<0.01 U	<0.02 U	–	–	–	30-apr-1996
–	–	<0.02 U	–	–	–	30-jul-1996
–	<0.001 U	–	–	–	–	30-jul-1996
–	<0.01 U	<0.02 U	–	–	–	25-oct-1996
–	<0.01 U	0.027	–	–	–	03-feb-1997
–	<0.01 U	<0.02 U	–	–	–	16-apr-1997
–	<0.01 UL	<0.02 UO	–	–	–	30-jul-1997

Table A-12. Ground and surface water analyses for cations (mg/L) in samples collected

Location Date	Lab	Note	Val.	Sodium	Potassium	Calcium	Magnesium	Iron
NC7-47 (continued)								
27-oct-1997	CS	a	V	–	–	–	–	–
27-jan-1998	CS	a	V	–	–	–	–	–
29-apr-1998	CS	a	V	–	3.5	–	–	–
29-apr-1998	CS	a	V	–	–	–	–	–
29-jul-1998	CS	a	V	–	4	–	–	–
29-jul-1998	CS	a	V	–	–	–	–	–
21-oct-1998	CS	a	V	–	3.4	–	–	–
21-oct-1998	CS	a	V	–	–	–	–	–
27-jan-1999	CS	a	V	–	3.6	–	–	–
27-jan-1999	CS	a	V	–	–	–	–	–
29-mar-1999	BB	a	V	–	–	–	–	–
07-apr-1999	BB	a	V	–	–	–	–	–
04-may-1999	CN	af	V	–	2.9	–	–	–
04-may-1999	CN	af	V	–	–	–	–	–
15-jul-1999	CN	a	V	–	2.8	–	–	–
15-jul-1999	CN	a	V	–	–	–	–	–
11-oct-1999	CN	af	V	–	3.1	–	–	–
11-oct-1999	CN	af	V	–	–	–	–	–
27-jan-2000	CN	afh	V	–	5	–	–	–
27-jan-2000	CN	aefh	V	–	5	–	–	–
27-jan-2000	CN	afh	V	–	–	–	–	–
27-jan-2000	CN	aefh	V	–	–	–	–	–
01-may-2000	CN	af	V	–	5	–	–	–
01-may-2000	CN	af	V	–	–	–	–	–
09-aug-2000	CN	af	V	–	5	–	–	–
09-aug-2000	CN	af	V	–	–	–	–	–
02-nov-2000	CN	af	V	–	5 L	–	–	–
02-nov-2000	CN	af	V	–	–	–	–	–
25-jan-2001	CN	af	V	–	5	–	–	–
25-jan-2001	CN	af	V	–	–	–	–	–
27-apr-2001	CN	af	V	–	5	–	–	–
27-apr-2001	CN	af	V	–	–	–	–	–
19-jul-2001	CN	a	V	–	5 L	–	–	–
19-jul-2001	CN	a	V	–	–	–	–	–
29-oct-2001	CN	a	V	–	5	–	–	–
29-oct-2001	CN	a	V	–	–	–	–	–
30-jan-2002	CN	a	V	–	–	–	–	–
30-apr-2002	CN	af	V	–	5	–	–	–
30-apr-2002	CN	af	V	–	–	–	–	–
29-aug-2002	CN	af	V	–	5	–	–	–
29-aug-2002	CN	af	V	–	–	–	–	–
03-dec-2002	CN	af	V	–	5 L	–	–	–
03-dec-2002	CN	af	V	–	–	–	–	–
12-feb-2003	CN	af	V	–	5	–	–	–
12-feb-2003	CN	af	V	–	–	–	–	–
07-may-2003	CN	af	V	–	5	–	–	–
07-may-2003	CN	af	V	–	–	–	–	–
NC7-48								
19-jul-1995	CS	a	V	62	3.6	110	25	<0.1 U
19-oct-1995	CS	a	V	52	2.6	100	22	<0.1 U
15-feb-1996	CS	a	V	62	3	100	26	0.2
15-feb-1996	CS	a	V	–	–	–	–	–
30-apr-1996	CS	a	V	–	–	–	–	–
30-jul-1996	CS	a	V	–	–	–	–	–
30-jul-1996	CS	a	V	–	–	–	–	–
25-oct-1996	CS	ah	V	–	–	–	–	–
25-oct-1996	CS	aeh	V	–	–	–	–	–
28-jan-1997	CS	a	V	–	–	–	–	–
16-apr-1997	CS	a	V	–	–	–	–	–
30-jul-1997	CS	ah	V	–	–	–	–	–
30-jul-1997	CS	aeh	V	–	–	–	–	–
28-oct-1997	CS	a	V	–	–	–	–	–
22-jan-1998	CS	a	V	–	–	–	–	–
28-apr-1998	CS	a	V	–	2.7	–	–	–
28-apr-1998	CS	a	V	–	–	–	–	–
31-jul-1998	CS	a	V	–	4.3	–	–	–
31-jul-1998	CS	a	V	–	–	–	–	–

from the Pit 7 Complex between July 1, 1995 and June 30, 2003. Results recorded by December 18, 2003.

Manganese	Copper	Zinc	Boron	Strontium	Aluminum	Location Date
						(continued) NC7-47
–	<0.01 U	<0.02 U	–	–	–	27-oct-1997
–	<0.01 UL	<0.02 U	–	–	–	27-jan-1998
–	–	–	–	–	–	29-apr-1998
–	<0.01 U	<0.02 U	–	–	–	29-apr-1998
–	–	–	–	–	–	29-jul-1998
–	<0.01 U	<0.02 U	–	–	–	29-jul-1998
–	–	–	–	–	–	21-oct-1998
–	<0.01 U	0.036	–	–	–	21-oct-1998
–	–	–	–	–	–	27-jan-1999
–	0.013	<0.02 U	–	–	–	27-jan-1999
–	<0.01 U	–	–	–	–	29-mar-1999
–	<0.01 U	–	–	–	–	07-apr-1999
–	–	–	–	–	–	04-may-1999
–	<0.01 U	<0.02 U	–	–	–	04-may-1999
–	–	–	–	–	–	15-jul-1999
–	<0.01 U	<0.02 U	–	–	–	15-jul-1999
–	–	–	–	–	–	11-oct-1999
–	<0.01 U	<0.02 U	–	–	–	11-oct-1999
–	–	–	–	–	–	27-jan-2000
–	–	–	–	–	–	27-jan-2000
–	<0.01 U	<0.02 U	–	–	–	27-jan-2000
–	<0.01 U	0.02	–	–	–	27-jan-2000
–	–	–	–	–	–	01-may-2000
–	<0.01 U	<0.02 U	–	–	–	01-may-2000
–	–	–	–	–	–	09-aug-2000
–	<0.01 U	<0.02 U	–	–	–	09-aug-2000
–	–	–	–	–	–	02-nov-2000
–	<0.01 U	<0.02 U	–	–	–	02-nov-2000
–	–	–	–	–	–	25-jan-2001
–	<0.01 U	<0.02 U	–	–	–	25-jan-2001
–	–	–	–	–	–	27-apr-2001
–	<0.01 U	<0.02 U	–	–	–	27-apr-2001
–	–	–	–	–	–	19-jul-2001
–	<0.01 U	<0.02 U	–	–	–	19-jul-2001
–	–	–	–	–	–	29-oct-2001
–	<0.01 U	<0.02 LU	–	–	–	29-oct-2001
–	<0.01 LU	<0.02 U	–	–	–	30-jan-2002
–	–	–	–	–	–	30-apr-2002
–	<0.01 U	<0.02 U	–	–	–	30-apr-2002
–	–	–	–	–	–	29-aug-2002
–	<0.01 U	<0.02 U	–	–	–	29-aug-2002
–	–	–	–	–	–	03-dec-2002
–	<0.01 U	<0.02 U	–	–	–	03-dec-2002
–	–	–	–	–	–	12-feb-2003
–	<0.01 U	<0.02 U	–	–	–	12-feb-2003
–	–	–	–	–	–	07-may-2003
–	<0.01 U	<0.02 U	–	–	–	07-may-2003
						NC7-48
<0.03 U	<0.05 U	<0.05 U	–	–	<0.2 U	19-jul-1995
<0.03 U	<0.05 U	<0.05 U	–	–	<0.2 U	19-oct-1995
<0.03 U	<0.05 U	<0.05 U	–	–	0.29	15-feb-1996
–	<0.01 U	0.02	–	–	–	15-feb-1996
–	<0.01 U	<0.02 U	–	–	–	30-apr-1996
–	–	<0.02 U	–	–	–	30-jul-1996
–	<0.001 U	–	–	–	–	30-jul-1996
–	<0.01 U	<0.02 U	–	–	–	25-oct-1996
–	<0.01 U	<0.02 U	–	–	–	25-oct-1996
–	<0.01 U	<0.02 U	–	–	–	28-jan-1997
–	<0.01 U	<0.02 U	–	–	–	16-apr-1997
–	<0.01 UL	<0.02 U	–	–	–	30-jul-1997
–	<0.01 UL	<0.02 U	–	–	–	30-jul-1997
–	<0.01 U	<0.02 U	–	–	–	28-oct-1997
–	<0.01 U	<0.02 U	–	–	–	22-jan-1998
–	–	–	–	–	–	28-apr-1998
–	<0.01 U	<0.02 U	–	–	–	28-apr-1998
–	–	–	–	–	–	31-jul-1998
–	<0.01 U	<0.02 U	–	–	–	31-jul-1998

Table A-12. Ground and surface water analyses for cations (mg/L) in samples collected

Location Date	Lab	Note	Val.	Sodium	Potassium	Calcium	Magnesium	Iron
NC7-48 (continued)								
26-oct-1998	CS	a	V	-	2.1	-	-	-
26-oct-1998	CS	a	V	-	-	-	-	-
28-jan-1999	CS	a	V	-	1.6	-	-	-
28-jan-1999	CS	a	V	-	-	-	-	-
04-may-1999	CN	a	V	-	1.8	-	-	-
04-may-1999	CN	a	V	-	-	-	-	-
19-jul-1999	CN	af	V	-	1.6	-	-	-
19-jul-1999	CN	af	V	-	-	-	-	-
12-oct-1999	CN	a	V	-	1.8	-	-	-
12-oct-1999	CN	a	V	-	-	-	-	-
27-jan-2000	CN	a	V	-	2	-	-	-
27-jan-2000	CN	a	V	-	-	-	-	-
01-may-2000	CN	a	V	-	2.6	-	-	-
01-may-2000	CN	a	V	-	-	-	-	-
10-aug-2000	CN	af	V	-	3	-	-	-
10-aug-2000	CN	af	V	-	-	-	-	-
02-nov-2000	CN	af	V	-	2 L	-	-	-
02-nov-2000	CN	af	V	-	-	-	-	-
25-jan-2001	CN	af	V	-	2	-	-	-
25-jan-2001	CN	af	V	-	-	-	-	-
26-apr-2001	CN	ah	V	-	3	-	-	-
26-apr-2001	CN	ah	V	45 H	2 H	64 H	19 H	<0.1 HU
26-apr-2001	CN	ah	V	-	-	-	-	-
18-jul-2001	CN	a	V	-	3	-	-	-
18-jul-2001	CN	a	V	-	-	-	-	-
25-oct-2001	CN	a	V	-	2	-	-	-
25-oct-2001	CN	a	V	-	-	-	-	-
30-jan-2002	CN	a	V	-	-	-	-	-
30-apr-2002	CN	a	V	-	2	-	-	-
30-apr-2002	CN	af	V	48	2	68	21	<0.1 U
30-apr-2002	CN	a	V	-	-	-	-	-
12-sep-2002	CN	af	V	-	3	-	-	-
12-sep-2002	CN	af	V	-	-	-	-	-
29-nov-2002	CN	af	V	-	3 B	-	-	-
29-nov-2002	CN	af	V	-	-	-	-	-
11-feb-2003	CN	a	N	-	3	-	-	-
11-feb-2003	CN	a	N	-	-	-	-	-
06-may-2003	CN	af	V	-	3	-	-	-
06-may-2003	CN	af	V	50	3	82	23	<0.1 U
06-may-2003	CN	af	V	-	-	-	-	-
NC7-49A								
21-may-2001	CN	a	V	50 H	3 H	39 H	16 H	<0.1 HU
04-jun-2002	CN	af	V	48	3	41	16 L	<0.1 U
NC7-50								
14-may-1998	CS	af	V	300 L	9.7	310 L	160 L	<0.1 U
16-jun-1999	CN	af	V	300 D	30 D	300 D	170	<0.1 U
31-may-2000	CN	af	V	300 D	51 D	300 D	170 D	<0.1 U
25-apr-2001	CN	af	V	300 DH	59 DH	310 DH	170 DH	<0.1 HU
28-may-2002	CN	af	V	300 D	29	390	230 D	0.2
NC7-51								
17-may-2001	CN	a	V	82 HL	5 H	120 DH	57 H	0.9 H
15-may-2002	CN	af	V	86 L	5 L	120 D	57	0.5
W-PIT7-12								
18-mar-1999	BB	a	V	66 L	5.7	49 L	24	<0.05 U
W-PIT7-13								
30-mar-2001	BB	af	V	57 L	3.4	50 L	24	<0.05 U
W-PIT7-15								
20-mar-2001	CN	af	V	52 H	5 H	68 H	24 H	<0.1 HU
W-PIT7-16								
28-mar-2001	CN	a	V	71 H	9 H	27 H	6.1 H	<0.1 HU

from the Pit 7 Complex between July 1, 1995 and June 30, 2003. Results recorded by December 18, 2003.

Manganese	Copper	Zinc	Boron	Strontium	Aluminum	Location Date
						(continued) NC7-48
–	–	–	–	–	–	26-oct-1998
–	<0.01 U	<0.02 U	–	–	–	26-oct-1998
–	–	–	–	–	–	28-jan-1999
–	<0.01 U	0.022	–	–	–	28-jan-1999
–	–	–	–	–	–	04-may-1999
–	<0.01 U	<0.02 U	–	–	–	04-may-1999
–	–	–	–	–	–	19-jul-1999
–	<0.01 U	<0.02 U	–	–	–	19-jul-1999
–	–	–	–	–	–	12-oct-1999
–	<0.01 U	<0.02 U	–	–	–	12-oct-1999
–	–	–	–	–	–	27-jan-2000
–	<0.01 U	<0.02 U	–	–	–	27-jan-2000
–	–	–	–	–	–	01-may-2000
–	<0.01 U	<0.02 U	–	–	–	01-may-2000
–	–	–	–	–	–	10-aug-2000
–	<0.01 U	<0.02 U	–	–	–	10-aug-2000
–	–	–	–	–	–	02-nov-2000
–	<0.01 U	<0.02 U	–	–	–	02-nov-2000
–	–	–	–	–	–	25-jan-2001
–	<0.01 U	<0.02 U	–	–	–	25-jan-2001
–	–	–	–	–	–	26-apr-2001
<0.03 HU	<0.05 HU	<0.05 HU	–	–	<0.2 HU	26-apr-2001
–	<0.01 U	<0.02 U	–	–	–	26-apr-2001
–	–	–	–	–	–	18-jul-2001
–	<0.01 U	<0.02 U	–	–	–	18-jul-2001
–	–	–	–	–	–	25-oct-2001
–	<0.01 U	<0.02 LU	–	–	–	25-oct-2001
–	<0.01 LU	<0.02 U	–	–	–	30-jan-2002
–	–	–	–	–	–	30-apr-2002
<0.03 U	<0.05 U	<0.05 U	–	–	<0.2 U	30-apr-2002
–	<0.01 U	<0.02 U	–	–	–	30-apr-2002
–	–	–	–	–	–	12-sep-2002
–	<0.01 U	<0.02 U	–	–	–	12-sep-2002
–	–	–	–	–	–	29-nov-2002
–	<0.01 U	<0.02 U	–	–	–	29-nov-2002
–	–	–	–	–	–	11-feb-2003
–	<0.01 U	<0.02 U	–	–	–	11-feb-2003
–	–	–	–	–	–	06-may-2003
<0.03 U	<0.05 U	<0.05 U	–	–	<0.2 U	06-may-2003
–	<0.01 U	<0.02 U	–	–	–	06-may-2003
						NC7-49A
<0.03 HU	<0.05 HU	<0.05 HU	–	–	<0.2 HU	21-may-2001
<0.03 U	<0.05 U	<0.05 U	–	–	<0.2 U	04-jun-2002
						NC7-50
0.077	<0.05 U	<0.05 U	–	–	<0.2 U	14-may-1998
<0.03 U	<0.05 U	<0.05 U	–	–	<0.2 U	16-jun-1999
<0.03 U	<0.05 U	<0.05 U	–	–	<0.2 U	31-may-2000
<0.03 HLU	<0.05 HU	<0.05 HU	–	–	<0.2 HU	25-apr-2001
<0.03 U	<0.05 U	<0.05 U	–	–	0.5	28-may-2002
						NC7-51
<0.03 HLU	<0.05 HU	<0.05 HU	–	–	1 HL	17-may-2001
<0.03 U	<0.05 U	<0.05 U	–	–	0.6	15-may-2002
						W-PIT7-12
<0.01 U	<0.01 U	<0.01 U	–	–	<0.05 U	18-mar-1999
						W-PIT7-13
<0.01 LU	<0.01 U	<0.05 U	–	–	<0.05 U	30-mar-2001
						W-PIT7-15
<0.03 HLU	<0.05 HU	<0.05 HU	–	–	<0.2 HU	20-mar-2001
						W-PIT7-16
<0.03 HU	<0.05 HU	<0.05 HU	–	–	<0.2 HU	28-mar-2001

Table A-12. Ground and surface water analyses for cations (mg/L) in samples collected

Location Date	Lab	Note	Val.	Sodium	Potassium	Calcium	Magnesium	Iron
W-PIT7-1714								
27-mar-2002	CN	af	V	65	7	47	16	<0.1 U
W-PIT7-1715								
27-mar-2002	CN	af	V	47	4	43	11	0.2
W-PIT7-1717								
28-mar-2002	CN	af	V	65	13	140 D	<0.5 U	<0.1 U
W-PIT7-1718								
03-jul-2002	CN	af	N	21	7	44	13	<0.1 U
W-PIT7-1720								
27-mar-2002	CN	af	V	27	3	39	11	<0.1 U
W-PIT7-1723								
26-mar-2002	CN	af	V	41	5	56	19	<0.1 U
W-PIT7-1724								
26-mar-2002	CN	af	V	25	3	49	14	<0.1 U
W-PIT7-1903								
11-apr-2003	BB	af	V	96 L	4.6	81 L	46 L	0.084
02-may-2003	BB	af	V	80 L	2.8	89 L	43	<0.05 U
06-jun-2003	BB	af	V	86 L	2.7	89 L	42 L	<0.05 U
W-PIT7-1904								
11-apr-2003	BB	af	V	77 L	4.1	97 L	52 L	<0.05 U
02-may-2003	BB	af	V	67 L	3.6	96 L	45	<0.05 U
06-jun-2003	BB	af	V	65 L	3.1	93 L	44 L	<0.05 U
W-PIT7-1905								
11-apr-2003	BB	af	V	95 L	2.2	78 L	42 L	<0.05 U
02-may-2003	BB	af	V	89 L	2	81 L	39	<0.05 U
06-jun-2003	BB	af	V	93 L	2.1	80 L	38 L	<0.05 U
W-PIT7-1907								
11-apr-2003	BB	af	V	700 LD	120 D	2.8 LD	15 D	<0.1 DU
02-may-2003	BB	af	V	590 L	99	3.3 L	16	<0.05 U
06-jun-2003	BB	af	V	470 L	68	2.6 L	16 L	<0.05 U
W-PIT7-1915								
11-apr-2003	BB	af	V	940 LD	170 D	2.3 LD	13 D	<0.25 DU
02-may-2003	BB	af	V	810 L	120	2.6 L	13	<0.05 U
06-jun-2003	BB	af	V	730 DL	94 D	3.4 DL	22 DL	<0.1 DU
W-PIT7-1916								
11-apr-2003	BB	af	V	82 L	8.2	99 L	57 L	<0.05 U
02-may-2003	BB	af	V	79 L	5.7	100 L	50	<0.05 U
06-jun-2003	BB	af	V	72 L	5	100 L	49 L	<0.05 U
W-PIT7-1917								
11-apr-2003	BB	af	V	110 L	13	100 L	67 L	<0.05 U
02-may-2003	BB	af	V	95 L	7.9	110 L	55	<0.05 U
06-jun-2003	BB	af	V	80 L	6.2	100 L	49 L	<0.05 U
W-PIT7-1918								
11-apr-2003	BB	af	V	110 L	8.1	120 L	70 L	<0.05 U
02-may-2003	BB	af	V	93 L	6.4	120 L	61	<0.05 U
06-jun-2003	BB	af	V	78 L	5.1	110 L	54 L	<0.05 U
W-PIT7-1919								
11-apr-2003	BB	af	V	94 L	9.6	110 L	61 L	<0.05 U
02-may-2003	BB	af	V	76 L	6.7	100 L	51	<0.05 U
06-jun-2003	BB	af	V	68 L	5.7	100 L	49 L	<0.05 U
W-865-01								
30-mar-1999	BB	a	V	58	4.8	48	25	<0.05 U
14-aug-2001	CN	af	V	46	5	57	24	<0.1 U

from the Pit 7 Complex between July 1, 1995 and June 30, 2003. Results recorded by December 18, 2003.

Manganese	Copper	Zinc	Boron	Strontium	Aluminum	Location Date
						W-PIT7-1714
0.05	<0.05 U	<0.05 U	–	–	<0.2 U	27-mar-2002
						W-PIT7-1715
<0.03 U	<0.05 U	<0.05 U	–	–	<0.2 U	27-mar-2002
						W-PIT7-1717
<0.03 U	<0.05 U	<0.05 U	–	–	<0.2 U	28-mar-2002
						W-PIT7-1718
<0.03 U	<0.05 U	<0.05 U	–	–	<0.2 U	03-jul-2002
						W-PIT7-1720
0.03	<0.05 U	<0.05 U	–	–	<0.2 U	27-mar-2002
						W-PIT7-1723
<0.03 U	<0.05 U	<0.05 U	–	–	<0.2 U	26-mar-2002
						W-PIT7-1724
<0.03 U	<0.05 U	<0.05 U	–	–	<0.2 U	26-mar-2002
						W-PIT7-1903
<0.01 U	<0.01 U	<0.05 U	–	–	0.15	11-apr-2003
<0.01 U	<0.01 U	<0.05 U	–	–	<0.05 U	02-may-2003
<0.01 U	<0.01 U	<0.05 U	–	–	<0.05 U	06-jun-2003
						W-PIT7-1904
<0.01 U	<0.01 U	<0.05 U	–	–	<0.05 U	11-apr-2003
<0.01 U	<0.01 U	<0.05 U	–	–	<0.05 U	02-may-2003
<0.01 U	<0.01 U	0.058	–	–	<0.05 U	06-jun-2003
						W-PIT7-1905
<0.01 U	<0.01 U	<0.05 U	–	–	<0.05 U	11-apr-2003
<0.01 U	<0.01 U	0.085	–	–	<0.05 U	02-may-2003
0.014	<0.01 U	0.069	–	–	<0.05 U	06-jun-2003
						W-PIT7-1907
<0.02 DU	<0.02 DU	<0.05 DU	–	–	<0.1 DU	11-apr-2003
<0.01 U	<0.01 U	<0.05 U	–	–	<0.05 U	02-may-2003
<0.01 U	<0.01 U	<0.05 U	–	–	<0.05 U	06-jun-2003
						W-PIT7-1915
<0.05 DU	<0.05 DU	<0.05 DU	–	–	<0.25 DU	11-apr-2003
<0.01 U	<0.01 U	<0.05 U	–	–	<0.05 U	02-may-2003
<0.02 DU	<0.02 DU	<0.05 DU	–	–	0.17 D	06-jun-2003
						W-PIT7-1916
<0.01 U	<0.01 U	<0.05 U	–	–	<0.05 U	11-apr-2003
<0.01 U	<0.01 U	<0.05 U	–	–	<0.05 U	02-may-2003
<0.01 U	<0.01 U	<0.05 U	–	–	<0.05 U	06-jun-2003
						W-PIT7-1917
<0.01 U	<0.01 U	<0.05 U	–	–	<0.05 U	11-apr-2003
<0.01 U	<0.01 U	<0.05 U	–	–	<0.05 U	02-may-2003
0.01	<0.01 U	<0.05 U	–	–	<0.05 U	06-jun-2003
						W-PIT7-1918
0.018	<0.01 U	<0.05 U	–	–	<0.05 U	11-apr-2003
0.016	<0.01 U	<0.05 U	–	–	<0.05 U	02-may-2003
0.011	<0.01 U	<0.05 U	–	–	<0.05 U	06-jun-2003
						W-PIT7-1919
<0.01 U	<0.01 U	<0.05 U	–	–	<0.05 U	11-apr-2003
<0.01 U	<0.01 U	<0.05 U	–	–	<0.05 U	02-may-2003
<0.01 U	<0.01 U	<0.05 U	–	–	<0.05 U	06-jun-2003
						W-865-01
0.019	<0.01 U	0.021	–	–	<0.05 U	30-mar-1999
<0.03 U	<0.05 OU	<0.05 U	–	–	<0.2 U	14-aug-2001

Table A-12. Ground and surface water analyses for cations (mg/L) in samples collected

Location Date	Lab	Note	Val.	Sodium	Potassium	Calcium	Magnesium	Iron
W-865-01 (continued)								
31-oct-2001	CN	af	V	48	5	58	25	<0.1 LU
31-jan-2002	CN	a	V	47	8	57	24	<0.1 U
30-may-2002	CN	a	V	48 H	6 H	61 H	25 H	<0.1 HU
31-jul-2002	CN	af	V	48	6 L	60 L	25	<0.1 U
19-feb-2003	CN	af	V	36	25	42	11	0.1 L
29-may-2003	CN	af	V	39	20	39	12	<0.1 U
29-may-2003	CN	af	V	–	–	–	–	–
W-865-03								
29-sep-2000	CN	af	V	40	4	35	19	<0.1 U
14-aug-2001	CN	af	V	38	4	35	19	<0.1 U
30-oct-2001	CN	af	V	41	4	38	20	<0.1 U
31-jan-2002	CN	a	V	39	3	35	19	<0.1 U
30-may-2002	CN	a	V	40 H	4 H	37 H	20 H	<0.1 HU
31-jul-2002	CN	af	V	40	3 L	38 L	20	<0.1 U
19-feb-2003	CN	af	V	42	4	38	20	0.1 L
29-may-2003	CN	af	V	41	4	38	20	<0.1 U
29-may-2003	CN	af	V	–	–	–	–	–
W-865-04								
28-sep-2000	CN	af	V	72	6	32	14	<0.1 U
14-aug-2001	CN	af	V	63	6	32	14	<0.1 U
30-oct-2001	CN	af	V	67	6	35	14	<0.1 U
31-jan-2002	CN	a	V	63	6	32	14	<0.1 U
23-may-2002	CN	af	V	65	6	34	14	<0.1 U
31-jul-2002	CN	af	V	64	5 L	35 L	15	<0.1 U
19-feb-2003	CN	af	V	67	6	34	14	<0.1 LU
29-may-2003	CN	af	V	66	6	33	14	<0.1 U
29-may-2003	CN	af	V	–	–	–	–	–
W-865-07								
29-sep-2000	CN	af	V	55	3	33	16	<0.1 U
14-aug-2001	CN	af	V	58	4	37	17	<0.1 U
30-oct-2001	CN	af	V	60	4	39	18	<0.1 U
31-jan-2002	CN	a	V	56	3	35	18	<0.1 U
23-may-2002	CN	af	V	58	3	37	18	<0.1 U
31-jul-2002	CN	af	V	58	3 L	39 L	18	<0.1 U
19-feb-2003	CN	af	V	61	3	38	18	<0.1 LU
29-may-2003	CN	af	V	60	3	37	18	<0.1 U
29-may-2003	CN	af	V	–	–	–	–	–
W-865-1804								
23-jun-2003	CN	a	V	61 H	7 H	44 H	25 H	<0.1 HU
SPRING13								
06-nov-1995	CS	a	V	91	7.2	140	33	<0.1 U
SPRING24								
22-oct-1999	BB	af	V	45 L	2.8	43	23	<0.05 U
27-aug-2001	CN	af	V	41	5	39	19	<0.1 U
13-dec-2001	CN	af	V	43 HL	8 HL	58 H	19 H	44 H

from the Pit 7 Complex between July 1, 1995 and June 30, 2003. Results recorded by December 18, 2003.

Manganese	Copper	Zinc	Boron	Strontium	Aluminum	Location Date
						(continued) W-865-01
<0.03 LU	<0.05 U	<0.05 U	–	–	<0.2 LU	31-oct-2001
<0.03 U	<0.05 U	<0.05 U	–	–	<0.2 U	31-jan-2002
<0.03 HU	<0.05 HU	<0.05 HU	–	–	<0.2 HU	30-may-2002
<0.03 U	<0.05 U	<0.05 U	–	–	<0.2 U	31-jul-2002
<0.03 U	<0.05 U	<0.05 U	–	–	<0.2 LU	19-feb-2003
<0.03 U	<0.05 U	<0.05 U	–	–	<0.2 U	29-may-2003
–	<0.01 U	<0.02 U	–	–	–	29-may-2003
						W-865-03
<0.03 U	<0.05 U	<0.05 U	–	–	<0.2 U	29-sep-2000
<0.03 U	<0.05 OU	0.06	–	–	<0.2 U	14-aug-2001
<0.03 U	<0.05 U	<0.05 LU	–	–	<0.2 U	30-oct-2001
<0.03 U	<0.05 U	<0.05 U	–	–	<0.2 U	31-jan-2002
<0.03 HU	<0.05 HU	<0.05 HU	–	–	<0.2 HU	30-may-2002
<0.03 U	<0.05 U	<0.05 U	–	–	<0.2 U	31-jul-2002
<0.03 U	<0.05 U	<0.05 U	–	–	<0.2 LU	19-feb-2003
<0.03 U	<0.05 U	<0.05 U	–	–	<0.2 U	29-may-2003
–	<0.01 U	<0.02 U	–	–	–	29-may-2003
						W-865-04
<0.03 U	<0.05 U	<0.05 U	–	–	<0.2 U	28-sep-2000
<0.03 U	<0.05 OU	<0.05 U	–	–	<0.2 U	14-aug-2001
<0.03 U	<0.05 U	<0.05 LU	–	–	<0.2 U	30-oct-2001
<0.03 U	<0.05 U	<0.05 U	–	–	<0.2 U	31-jan-2002
<0.03 U	<0.05 U	<0.05 U	–	–	<0.2 U	23-may-2002
<0.03 U	<0.05 U	<0.05 U	–	–	<0.2 U	31-jul-2002
<0.03 U	<0.05 U	<0.05 U	–	–	<0.2 LU	19-feb-2003
<0.03 U	<0.05 U	<0.05 U	–	–	<0.2 U	29-may-2003
–	<0.01 U	<0.02 U	–	–	–	29-may-2003
						W-865-07
<0.03 U	<0.05 U	<0.05 U	–	–	<0.2 U	29-sep-2000
<0.03 U	<0.05 OU	<0.05 U	–	–	<0.2 U	14-aug-2001
<0.03 U	<0.05 U	<0.05 LU	–	–	<0.2 U	30-oct-2001
<0.03 U	<0.05 U	<0.05 U	–	–	<0.2 U	31-jan-2002
<0.03 U	<0.05 U	<0.05 U	–	–	<0.2 U	23-may-2002
<0.03 U	<0.05 U	<0.05 U	–	–	<0.2 U	31-jul-2002
<0.03 U	<0.05 U	<0.05 U	–	–	<0.2 LU	19-feb-2003
<0.03 U	<0.05 U	<0.05 U	–	–	<0.2 U	29-may-2003
–	<0.01 U	<0.02 U	–	–	–	29-may-2003
						W-865-1804
<0.03 HU	<0.05 HU	<0.05 HU	–	–	<0.2 HU	23-jun-2003
						SPRING13
<0.03 U	<0.05 U	<0.05 U	–	–	<0.2 U	06-nov-1995
						SPRING24
<0.01 U	<0.01 U	0.018	–	–	<0.05 U	22-oct-1999
0.04	<0.05 U	<0.05 U	–	–	<0.2 U	27-aug-2001
0.89 H	0.16 H	0.16 H	–	–	33 H	13-dec-2001

See following page for notes

Table A-12. Ground and surface water analyses for cations (mg/L) in samples collected from the Pit 7 Complex between July 1, 1995 and June 30, 2003. Results recorded by December 18, 2003.

Notes:

-	Indicates no analysis performed for this compound

Val. = Validation

Footnotes:

a	ERD data
b	ORAD WGMG data
c	Analytical results for this sample are suspect
d	Sample collected during hydraulic testing
e	Blind sample, sent to lab without location identity
f	Sample dilution necessary for analysis; detection limits increased
g	Interlaboratory collocated sample
h	Intralaboratory collocated sample
i	Sample collected as part of pilot study
j	Note field may contain important information regarding this sample
k	Pre-development sample
l	Norm month, norm quarter or norm year inconsistent with sample date
m	Confirmation sample
n	Sample analyzed after standard holding time
o	Sample comprised of partial composite
p	Alpha spectroscopy analysis of uranium isotopes
q	Gamma spectroscopy analysis of uranium isotopes
r	Tritium data represents non-detect with activity calc'd for 100 percent error.

Lab Codes:

BB	BC Laboratories, Inc.	Bakersfield, CA
CN	Caltest Analytical Laboratory	1885 N. Kelly Rd, Napa, CA 94558
CS	California Laboratory Services	3249 Fitzgerald Rd. Rancho Cordova, CA 95742

Validation Codes:

V	Validated
N	Not validated (default value)
U	Undeclared
H	Historical comparison only

CLP flags: (follow result)

B	Analyte found in method blank
D	Analysis performed at a secondary dilution or concentration (i.e., vapor samples)
E	The analyte was detected below the LLNL reporting limit, but above the analytical laboratory minimum detection limit.
F	Analyte found in field blank, trip blank, or equipment blank
G	Quantitated using fuel calibration, but does not match typical fuel fingerprint (fuel maybe gasoline, diesel, motor oil etc.).
H	Sample analyzed outside of holding time, sample results should be evaluated
J	Analyte was postively identified; the associated numerical value is the approximate concentration of the analyte in the sample.
L	Spike accuracy not within control limits
O	Duplicate spike or sample precision not within control limits
P	Indicates that the absence of a data qualifier flag does not mean that the data does not need qualification, but that the implementation of electronic data qualifier flags was not yet established
R	Sample results are rejected due to serious deficiencies in the ability to analyze the sample and meet QC criteria. The presence or absence of the analyte cannot be verified
S	Analytical results for this sample are suspect
T	Analyte is tentatively identified compound; result is approximate
U	Compound was analyzed for, but not detected above detection limit

Table A-13. Ground and surface water analyses for metals (mg/L) in samples collected from the Pit7 Complex between July 1, 1995 and June 30, 2003. Results recorded by December 18, 2003.

Ground Water Metals Report, Site 300
December 19, 2003
gemini2

s3metsL.19dec2003
s3metsR.19dec2003

Min Sample Date
July 1, 1995
Max Sample Date
June 30, 2003

Table A-13. Ground and surface water analyses for metals (mg/L) in samples collected from the

Location Date	Lab	Note	Val.	Antimony	Arsenic	Barium	Beryllium	Cadmium	Total chromium	Cobalt	Iron
MUL2											
23-aug-1995	CS	a	V	–	–	–	–	–	–	–	<0.1 U
23-aug-1995	CS	a	V	–	<0.002 U	<0.025 U	<0.0005 U	<0.0005 U	<0.01 U	–	–
06-sep-1996	CS	a	V	–	–	–	–	–	–	–	–
06-sep-1996	CS	a	V	<0.005 U	–	–	–	–	–	–	–
06-sep-1996	CS	a	V	–	–	–	–	–	–	–	–
06-sep-1996	CS	a	V	–	<0.002 U	0.028	<0.0005 U	<0.0005 U	<0.001 U	<0.025 U	–
08-sep-1997	CS	a	V	<0.005 U	<0.002 U	<0.025 U	<0.0005 U	<0.0005 U	<0.001 U	<0.025 U	–
16-sep-1998	CS	a	V	<0.005 U	<0.002 U	<0.025 U	<0.0005 U	<0.0005 U	0.0026	<0.025 U	–
08-sep-1999	CN	ah	V	<0.005 U	<0.002 U	<0.025 U	<0.0005 U	<0.0005 LU	<0.001 U	<0.025 U	–
08-sep-1999	CN	aeh	V	<0.005 U	<0.002 U	<0.025 U	<0.0005 U	<0.0005 LU	<0.001 U	<0.025 U	–
06-sep-2000	BB	af	V	<0.005 U	<0.002 U	<0.025 U	<0.0005 U	<0.0005 U	<0.001 U	<0.025 U	–
05-sep-2001	BB	afh	V	<0.005 U	<0.002 U	<0.025 U	<0.0005 U	<0.0005 U	<0.001 U	<0.025 U	–
05-sep-2001	BB	aefh	V	<0.005 U	<0.002 U	<0.025 U	<0.0005 U	<0.0005 U	<0.001 U	<0.025 U	–
17-sep-2002	BB	afh	V	<0.005 U	<0.002 U	<0.025 U	<0.0005 U	<0.0005 U	0.0091	<0.025 U	–
17-sep-2002	BB	aeh	V	<0.005 U	<0.002 U	<0.025 U	<0.0005 U	<0.0005 U	0.0091	<0.025 U	–
K7-01											
14-jul-1995	CS	a	V	–	0.01	0.17	<0.0005 U	<0.0005 U	<0.01 U	<0.05 U	–
14-jul-1995	CS	a	V	–	–	–	–	–	–	–	<0.1 U
17-oct-1995	CS	ah	V	–	0.012	0.15	<0.0005 U	<0.0005 U	<0.01 U	<0.025 U	–
17-oct-1995	CS	aeh	V	–	0.0089	0.15	<0.0005 U	<0.0005 U	<0.01 U	<0.025 U	–
17-oct-1995	CS	ah	V	–	–	–	–	–	–	–	<0.1 U
17-oct-1995	CS	aeh	V	–	–	–	–	–	–	–	<0.1 U
07-feb-1996	CS	a	V	–	–	–	–	–	–	–	<0.1 U
07-feb-1996	CS	a	V	–	0.0058	0.16	<0.0005 U	<0.0005 U	0.002	<0.025 U	–
24-apr-1996	CS	a	V	–	–	–	–	–	–	–	–
24-apr-1996	CS	a	V	–	0.0074	0.17 LO	<0.0005 U	<0.0005 U	0.002	<0.025 ULO	–
25-jul-1996	CS	ah	V	–	–	–	–	–	–	–	–
25-jul-1996	CS	aeh	V	–	–	–	–	–	–	–	–
25-jul-1996	CS	ah	V	–	0.0085	0.14	<0.0005 U	<0.0005 U	<0.001 U	<0.025 U	–
25-jul-1996	CS	aeh	V	–	0.0083	0.14	<0.0005 U	<0.0005 U	<0.001 U	<0.025 U	–
18-oct-1996	CS	a	V	–	0.0084	0.22	<0.0005 U	<0.0005 U	–	<0.025 U	–
14-nov-1996	CS	a	V	–	–	0.17	–	–	–	–	–
25-nov-1996	CS	a	V	–	–	0.17	–	–	–	–	–
22-jan-1997	CS	ah	V	–	0.011	0.16	<0.0005 U	<0.0005 U	–	<0.025 U	–
22-jan-1997	CS	aeh	V	–	0.0095	0.16	<0.0005 U	<0.0005 U	–	<0.025 U	–
08-apr-1997	CS	a	V	–	0.0091	0.15	<0.0005 LU	<0.0005 U	–	<0.025 U	–
23-jul-1997	CS	a	V	–	0.009	0.17	<0.0005 UL	<0.0005 U	–	<0.025 U	–
21-oct-1997	CS	ah	V	–	0.0078	0.17	<0.0005 U	<0.0005 U	–	<0.025 U	–
21-oct-1997	CS	aeh	V	–	0.0076	0.16	<0.0005 U	<0.0005 U	–	<0.025 U	–
14-jan-1998	CS	a	V	–	0.0076	0.16	<0.0005 U	<0.0005 U	–	<0.025 U	–
20-apr-1998	CS	a	V	–	0.0072	0.19	<0.0005 U	<0.0005 U	–	<0.025 U	–
21-jul-1998	CS	a	V	–	0.0071	0.2	<0.0005 U	<0.0005 U	–	<0.025 U	–
19-oct-1998	CS	ah	V	–	0.0077	0.18	<0.0005 U	<0.0005 U	–	<0.025 U	–
19-oct-1998	CS	aeh	V	–	0.008	0.19	<0.0005 U	<0.0005 U	–	<0.025 U	–
21-dec-1998	CS	a	V	–	–	–	–	–	–	–	–
28-dec-1998	CS	a	V	–	–	–	–	–	–	–	–
19-jan-1999	CS	ah	V	–	0.0076	0.2	<0.0005 U	<0.0005 U	–	<0.025 U	–
19-jan-1999	CS	aeh	V	–	0.0079	0.2	<0.0005 U	<0.0005 U	–	<0.025 U	–
22-apr-1999	CN	af	V	–	0.008	0.2	<0.0005 U	<0.0005 U	–	<0.025 U	–
20-jul-1999	CN	af	V	–	0.009	0.12	<0.0005 U	<0.0005 U	–	<0.025 U	–
07-oct-1999	CN	afh	V	–	0.007	0.2	<0.0005 U	<0.0005 LU	–	<0.025 U	–
07-oct-1999	CN	aefh	V	–	0.008	0.19	<0.0005 U	<0.0005 LU	–	<0.025 U	–
11-feb-2000	CN	af	V	–	0.009	0.2	<0.0005 U	<0.0005 U	–	<0.025 U	–
25-apr-2000	CN	ah	V	–	0.008	0.2	<0.0005 U	<0.0005 U	–	<0.025 U	–
25-apr-2000	CN	aeh	V	–	0.009	0.21	<0.0005 U	<0.0005 U	–	<0.025 U	–
24-jul-2000	CN	af	V	–	0.008	0.21	<0.0005 U	<0.0005 U	–	<0.025 U	–
30-oct-2000	CN	afh	V	–	0.009	0.2	<0.0005 U	<0.0005 U	–	<0.025 U	–
30-oct-2000	CN	aefh	V	–	0.007	0.2	<0.0005 U	<0.0005 U	–	<0.025 U	–
23-jan-2001	CN	af	V	–	0.006	0.19	<0.0005 U	<0.0005 U	–	<0.025 U	–
24-apr-2001	CN	af	V	–	0.009	0.19	<0.0005 U	<0.0005 LU	–	<0.025 U	–
17-jul-2001	CN	afh	V	–	0.008	0.2	<0.0005 U	<0.0005 U	–	<0.025 U	–
17-jul-2001	CN	aefh	V	–	0.008	0.2	<0.0005 U	<0.0005 U	–	<0.025 U	–
24-oct-2001	CN	a	V	–	0.01	0.2	<0.0005 U	<0.0005 U	–	<0.025 U	–
23-jan-2002	CN	a	V	–	0.008	0.2	<0.0005 U	<0.0005 U	–	<0.025 U	–
22-apr-2002	CN	aefh	V	–	0.008	0.19	<0.0005 U	<0.0005 U	–	<0.025 U	–
22-apr-2002	CN	afh	V	–	0.009	0.19	<0.0005 U	<0.0005 U	–	<0.025 U	–

Pit7 Complex between July 1, 1995 and June 30, 2003. Results recorded by December 18, 2003.

Lead	Mercury	Molybdenum	Nickel	Selenium	Silver	Vanadium	Location Date
							MUL2
-	-	-	<0.1 U	-	-	-	23-aug-1995
<0.002 U	<0.0002 U	-	-	<0.002 U	0.024	<0.025 U	23-aug-1995
-	-	<0.05 U	-	-	-	-	06-sep-1996
-	-	-	-	-	-	-	06-sep-1996
-	-	-	<0.005 U	-	-	-	06-sep-1996
<0.002 U	<0.0002 U	-	-	<0.002 U	<0.0005 U	<0.025 U	06-sep-1996
<0.002 U	0.00026	<0.025 U	0.0054	<0.002 U	<0.0005 U	<0.025 U	08-sep-1997
0.0021	<0.0002 UO	<0.025 U	<0.005 U	0.0028	<0.0005 U	<0.025 U	16-sep-1998
<0.002 U	<0.0002 U	<0.025 U	0.008	0.003	<0.0005 U	<0.025 U	08-sep-1999
<0.002 U	<0.0002 U	<0.025 U	<0.005 U	0.003	<0.0005 U	<0.025 U	08-sep-1999
<0.002 U	<0.0002 U	<0.025 U	<0.005 U	<0.002 U	<0.0005 U	<0.025 U	06-sep-2000
<0.002 U	<0.0002 U	<0.025 U	<0.005 U	<0.004 DU	<0.0005 U	<0.025 U	05-sep-2001
<0.002 U	<0.0002 U	<0.025 U	<0.005 U	<0.004 DU	<0.0005 U	<0.025 U	05-sep-2001
<0.002 U	<0.0002 U	<0.025 U	0.0091	0.0067	<0.0005 U	<0.025 U	17-sep-2002
<0.002 U	<0.0002 U	<0.025 U	0.009	0.0068	<0.0005 U	<0.025 U	17-sep-2002
							K7-01
<0.002 U	<0.0002 U	-	-	<0.002 U	<0.001 U	<0.05 U	14-jul-1995
-	-	-	<0.1 U	-	-	-	14-jul-1995
<0.002 U	<0.0002 U	-	-	<0.002 U	<0.01 U	<0.025 U	17-oct-1995
<0.002 U	<0.0002 U	-	-	<0.002 U	<0.01 U	<0.025 U	17-oct-1995
-	-	-	<0.1 U	-	-	-	17-oct-1995
-	-	-	<0.1 U	-	-	-	17-oct-1995
-	-	-	<0.1 U	-	-	-	07-feb-1996
<0.002 U	<0.0002 U	-	0.012	<0.002 LU	<0.0005 U	<0.025 U	07-feb-1996
-	<0.0002 U	-	-	-	-	-	24-apr-1996
0.0022	-	-	0.0092	<0.002 ULO	<0.0005 U	<0.025 ULO	24-apr-1996
-	-	-	<0.005 U	-	-	-	25-jul-1996
-	-	-	<0.005 U	-	-	-	25-jul-1996
<0.002 U	<0.0002 U	-	-	<0.002 LU	<0.0005 U	<0.025 U	25-jul-1996
<0.002 U	<0.0002 U	-	-	<0.002 LU	<0.0005 U	<0.025 U	25-jul-1996
<0.002 U	-	-	<0.005 U	-	-	<0.025 U	18-oct-1996
-	-	-	-	-	-	-	14-nov-1996
-	-	-	-	-	-	-	25-nov-1996
<0.002 U	-	-	<0.005 U	-	-	<0.025 U	22-jan-1997
<0.002 U	-	-	<0.005 U	-	-	<0.025 U	22-jan-1997
<0.002 U	-	-	<0.005 U	-	-	<0.025 U	08-apr-1997
<0.002 U	-	-	<0.005 U	-	-	<0.025 U	23-jul-1997
<0.002 U	-	-	<0.005 U	-	-	<0.025 U	21-oct-1997
<0.002 U	-	-	<0.005 U	-	-	<0.025 U	21-oct-1997
<0.002 U	-	-	0.011	-	-	<0.025 U	14-jan-1998
<0.002 U	-	-	<0.005 U	-	-	<0.025 U	20-apr-1998
<0.002 U	-	-	<0.005 U	-	-	<0.025 U	21-jul-1998
0.0062	-	-	<0.005 U	-	-	<0.025 U	19-oct-1998
<0.002 U	-	-	<0.005 U	-	-	<0.025 U	19-oct-1998
0.0034	-	-	-	-	-	-	21-dec-1998
<0.002 U	-	-	-	-	-	-	28-dec-1998
<0.002 U	-	-	0.0077	-	-	<0.025 U	19-jan-1999
<0.002 U	-	-	<0.005 U	-	-	<0.025 U	19-jan-1999
0.002	-	-	<0.005 U	-	-	<0.025 U	22-apr-1999
0.002	-	-	0.007	-	-	<0.025 U	20-jul-1999
<0.002 U	-	-	<0.005 U	-	-	<0.025 U	07-oct-1999
0.002	-	-	<0.005 U	-	-	<0.025 U	07-oct-1999
<0.002 U	-	-	<0.005 U	-	-	<0.025 U	11-feb-2000
<0.002 LU	-	-	<0.005 U	-	-	<0.025 U	25-apr-2000
<0.002 LU	-	-	<0.005 U	-	-	<0.025 U	25-apr-2000
<0.002 U	-	-	<0.005 U	-	-	<0.025 U	24-jul-2000
<0.002 U	-	-	<0.005 U	-	-	<0.025 U	30-oct-2000
0.002	-	-	<0.005 U	-	-	<0.025 U	30-oct-2000
<0.002 U	-	-	<0.005 U	-	-	<0.025 U	23-jan-2001
<0.002 U	-	-	<0.005 U	-	-	<0.025 U	24-apr-2001
<0.002 U	-	-	<0.005 U	-	-	<0.025 U	17-jul-2001
0.003	-	-	<0.005 U	-	-	<0.025 U	17-jul-2001
0.002	-	-	<0.005 U	-	-	<0.025 U	24-oct-2001
<0.002 U	-	-	<0.005 U	-	-	<0.025 U	23-jan-2002
<0.002 U	-	-	<0.005 U	-	-	<0.025 U	22-apr-2002
<0.002 U	-	-	0.005	-	-	<0.025 U	22-apr-2002

Table A-13. Ground and surface water analyses for metals (mg/L) in samples collected from the

Location Date	Lab	Note	Val.	Antimony	Arsenic	Barium	Beryllium	Cadmium	Total chromium	Cobalt	Iron
K7-01 (continued)											
13-sep-2002	CN	af	V	-	0.008	0.21	<0.0005 DU	<0.0005 U	-	<0.025 U	-
27-nov-2002	CN	aefh	V	-	0.008	0.2	<0.0005 DU	<0.0005 U	-	<0.025 U	-
27-nov-2002	CN	afh	V	-	0.008	0.2	<0.0005 DU	<0.0005 U	-	<0.025 U	-
10-feb-2003	CN	af	V	-	0.009	0.2	<0.0005 DU	<0.0005 U	-	<0.025 U	-
01-may-2003	CN	afh	V	-	0.007	0.2	<0.0005 DU	<0.0005 U	-	<0.025 U	-
01-may-2003	CN	aefh	V	-	0.007	0.21	<0.0005 DU	<0.0005 U	-	<0.025 U	-
K7-03											
14-jul-1995	CS	ah	V	-	0.0026	0.065	<0.0005 U	<0.0005 U	<0.01 U	<0.05 U	-
14-jul-1995	CS	aeh	V	-	0.002	0.065	<0.0005 U	<0.0005 U	<0.01 U	<0.05 U	-
14-jul-1995	CS	ah	V	-	-	-	-	-	-	-	<0.1 U
14-jul-1995	CS	aeh	V	-	-	-	-	-	-	-	<0.1 U
17-oct-1995	CS	a	V	-	0.0022	0.066	<0.0005 U	<0.0005 U	<0.01 U	<0.025 U	-
17-oct-1995	CS	a	V	-	-	-	-	-	-	-	<0.1 U
07-feb-1996	CS	a	V	-	-	-	-	-	-	-	<0.1 U
07-feb-1996	CS	a	V	-	<0.002 U	0.061	<0.0005 U	<0.0005 U	0.0042	<0.025 U	-
24-apr-1996	CS	ah	V	-	-	-	-	-	-	-	-
24-apr-1996	CS	aeh	V	-	-	-	-	-	-	-	-
24-apr-1996	CS	ah	V	-	<0.002 U	0.072 LO	<0.0005 U	<0.0005 U	<0.001 U	<0.025 ULO	-
24-apr-1996	CS	aeh	V	-	<0.002 U	0.072 LO	<0.0005 U	<0.0005 U	<0.001 U	<0.025 ULO	-
25-jul-1996	CS	a	V	-	-	-	-	-	-	-	-
25-jul-1996	CS	a	V	-	0.0028	0.044	<0.0005 U	<0.0005 U	<0.001 U	<0.025 U	-
18-oct-1996	CS	a	V	-	<0.002 U	0.071	<0.0005 U	<0.0005 U	-	<0.13 DU	-
23-jan-1997	CS	a	V	-	<0.002 U	0.062	<0.0005 U	-	-	<0.025 U	-
08-apr-1997	CS	ah	V	-	0.0021	0.062	<0.0005 LU	<0.0005 U	-	<0.025 U	-
08-apr-1997	CS	aeh	V	-	<0.002 U	0.062	<0.0005 LU	<0.0005 U	-	<0.025 U	-
23-jul-1997	CS	a	V	-	0.0022	0.061	<0.0005 UL	<0.0005 U	-	<0.025 U	-
21-oct-1997	CS	a	V	-	<0.002 U	0.062	<0.0005 U	<0.0005 U	-	<0.025 U	-
15-jan-1998	CS	ah	V	-	<0.002 U	0.06	<0.0005 U	<0.0005 U	-	<0.025 U	-
15-jan-1998	CS	aeh	V	-	<0.002 U	0.062	<0.0005 U	<0.0005 U	-	<0.025 U	-
11-feb-1998	CS	a	V	-	-	-	-	-	-	-	-
18-feb-1998	CS	a	V	-	-	-	-	-	-	-	-
21-apr-1998	CS	a	V	-	0.0028	0.06	<0.0005 U	<0.0005 U	-	<0.025 U	-
27-jul-1998	CS	a	V	-	<0.002 U	0.052	<0.0005 U	<0.0005 U	-	<0.025 U	-
19-oct-1998	CS	a	V	-	<0.002 U	0.062	<0.0005 U	<0.0005 U	-	<0.025 U	-
19-jan-1999	CS	a	V	-	<0.002 U	0.071	<0.0005 U	<0.0005 U	-	<0.025 U	-
11-mar-1999	CS	a	V	-	-	-	-	-	-	-	-
22-apr-1999	CN	afh	V	-	<0.002 U	0.066	<0.0005 U	<0.0005 U	-	<0.025 U	-
22-apr-1999	CN	aefh	V	-	<0.002 U	0.063	<0.0005 U	<0.0005 U	-	<0.025 U	-
19-jul-1999	CN	af	V	-	<0.002 U	0.066	<0.0005 U	<0.0005 U	-	<0.025 U	-
07-oct-1999	CN	af	V	-	0.002	0.067	<0.0005 U	<0.0005 LU	-	<0.025 U	-
11-feb-2000	CN	a	V	-	<0.002 U	0.07	<0.0005 U	<0.0005 U	-	<0.025 U	-
25-apr-2000	CN	af	V	-	<0.002 U	0.076	<0.0005 U	<0.0005 U	-	<0.025 U	-
24-jul-2000	CN	ah	V	-	0.002	0.073	<0.0005 U	<0.0005 U	-	<0.025 U	-
24-jul-2000	CN	aeh	V	-	0.003	0.084	<0.0005 U	<0.0005 U	-	<0.025 U	-
11-sep-2000	CN	a	V	-	-	-	-	-	-	-	-
18-sep-2000	CN	a	V	-	-	-	-	-	-	-	-
30-oct-2000	CN	af	V	-	<0.002 U	0.068	<0.0005 U	<0.0005 U	-	<0.025 U	-
23-jan-2001	CN	af	V	-	<0.002 U	0.069	<0.0005 U	<0.0005 U	-	<0.025 U	-
17-apr-2001	CN	afh	V	-	<0.002 U	0.076	<0.0005 U	<0.0005 U	-	<0.025 U	-
17-apr-2001	CN	aeh	V	-	<0.002 U	0.075	<0.0005 U	<0.0005 U	-	<0.025 U	-
10-jun-2001	CN	a	V	-	-	-	-	-	-	-	-
18-jun-2001	CN	a	V	-	-	-	-	-	-	-	-
17-jul-2001	CN	af	V	-	<0.002 U	0.076	<0.0005 U	<0.0005 U	-	<0.025 U	-
23-aug-2001	CN	a	V	-	-	-	-	-	-	-	-
30-aug-2001	CN	a	V	-	-	-	-	-	-	-	-
24-oct-2001	CN	a	V	-	<0.002 U	0.081	<0.0005 U	<0.0005 U	-	<0.025 U	-
23-jan-2002	CN	aeh	V	-	<0.002 U	0.077	<0.0005 U	<0.0005 U	-	<0.025 U	-
23-jan-2002	CN	ah	V	-	<0.002 U	0.081	<0.0005 U	<0.0005 U	-	<0.025 U	-
22-apr-2002	CN	af	V	-	<0.002 U	0.074	<0.0005 U	<0.0005 U	-	<0.025 U	-
06-sep-2002	CN	ah	V	-	<0.002 U	0.1	<0.0005 LU	<0.0005 U	-	<0.025 U	-
06-sep-2002	CN	aefh	V	-	<0.002 U	0.1	<0.0005 DLU	<0.0005 U	-	<0.025 U	-
27-nov-2002	CN	af	V	-	<0.002 U	0.074	<0.0005 DU	<0.0005 U	-	<0.025 U	-
07-feb-2003	CN	afh	V	-	0.002	0.073	<0.0005 DU	<0.0005 U	-	<0.025 U	-
07-feb-2003	CN	aefh	V	-	<0.002 U	0.07	<0.0005 DU	<0.0005 U	-	<0.025 U	-
01-may-2003	CN	af	V	-	<0.002 U	0.085	<0.0005 DU	<0.0005 U	-	<0.025 U	-

Lead	Mercury	Molybdenum	Nickel	Selenium	Silver	Vanadium	Location Date
							(continued) K7-01
0.002	-	-	<0.005 U	-	-	<0.025 U	13-sep-2002
<0.002 U	-	-	0.006	-	-	<0.025 U	27-nov-2002
<0.002 U	-	-	<0.005 U	-	-	<0.025 U	27-nov-2002
<0.002 U	-	-	<0.005 U	-	-	<0.025 U	10-feb-2003
<0.002 U	-	-	<0.005 U	-	-	<0.025 U	01-may-2003
<0.002 U	-	-	<0.005 U	-	-	<0.025 U	01-may-2003
							K7-03
<0.002 U	<0.0002 U	-	-	<0.002 U	<0.001 U	<0.05 U	14-jul-1995
<0.002 U	<0.0002 U	-	-	<0.002 U	<0.001 U	<0.05 U	14-jul-1995
-	-	-	<0.1 U	-	-	-	14-jul-1995
-	-	-	<0.1 U	-	-	-	14-jul-1995
<0.002 U	<0.0002 HU	-	-	<0.002 LOU	<0.01 LOU	<0.025 U	17-oct-1995
-	-	-	<0.1 U	-	-	-	17-oct-1995
-	-	-	<0.1 U	-	-	-	07-feb-1996
<0.002 U	<0.0002 U	-	0.0081	<0.002 UL	<0.0005 U	<0.025 U	07-feb-1996
-	<0.0002 U	-	-	-	-	-	24-apr-1996
-	<0.0002 U	-	-	-	-	-	24-apr-1996
<0.002 U	-	-	0.0057	<0.002 ULO	<0.0005 U	<0.025 ULO	24-apr-1996
<0.002 U	-	-	<0.005 U	0.002 LO	<0.0005 U	<0.025 ULO	24-apr-1996
-	-	-	<0.005 U	-	-	-	25-jul-1996
<0.002 U	<0.0002 U	-	-	<0.002 LU	<0.0005 U	<0.025 U	25-jul-1996
<0.002 U	-	-	<0.005 U	-	-	<0.025 U	18-oct-1996
<0.002 U	-	-	<0.005 U	-	-	<0.025 U	23-jan-1997
<0.002 U	-	-	<0.005 U	-	-	<0.025 U	08-apr-1997
<0.002 U	-	-	<0.005 U	-	-	<0.025 U	08-apr-1997
<0.002 U	-	-	<0.005 U	-	-	<0.025 U	23-jul-1997
<0.002 U	-	-	0.0061	-	-	<0.025 U	21-oct-1997
<0.002 U	-	-	0.03	-	-	<0.025 U	15-jan-1998
<0.002 U	-	-	0.016	-	-	<0.025 U	15-jan-1998
-	-	-	0.01	-	-	-	11-feb-1998
-	-	-	0.0081	-	-	-	18-feb-1998
<0.002 U	-	-	0.0078	-	-	<0.025 U	21-apr-1998
<0.002 U	-	-	0.0092	-	-	<0.025 U	27-jul-1998
<0.002 U	-	-	0.011	-	-	<0.025 U	19-oct-1998
<0.002 U	-	-	0.0059	-	-	<0.025 U	19-jan-1999
<0.002 UL	-	-	-	-	-	-	11-mar-1999
<0.002 U	-	-	0.01	-	-	<0.025 U	22-apr-1999
<0.002 U	-	-	0.009	-	-	<0.025 U	22-apr-1999
0.002	-	-	0.02 D	-	-	<0.025 U	19-jul-1999
<0.002 U	-	-	0.02	-	-	<0.025 U	07-oct-1999
<0.002 U	-	-	0.012	-	-	<0.025 U	11-feb-2000
<0.002 LU	-	-	0.014	-	-	<0.025 U	25-apr-2000
<0.002 U	-	-	0.027	-	-	<0.025 U	24-jul-2000
0.004	-	-	0.017	-	-	<0.025 U	24-jul-2000
-	-	-	0.012	-	-	-	11-sep-2000
-	-	-	0.012	-	-	-	18-sep-2000
<0.002 U	-	-	0.008	-	-	<0.025 U	30-oct-2000
<0.002 U	-	-	<0.005 U	-	-	<0.025 U	23-jan-2001
<0.002 U	-	-	0.05 D	-	-	<0.025 U	17-apr-2001
<0.002 U	-	-	0.025	-	-	<0.025 U	17-apr-2001
-	-	-	0.031	-	-	-	10-jun-2001
-	-	-	0.04 D	-	-	-	18-jun-2001
<0.002 U	-	-	0.04 D	-	-	<0.025 U	17-jul-2001
-	-	-	0.025	-	-	-	23-aug-2001
-	-	-	0.023	-	-	-	30-aug-2001
<0.002 U	-	-	0.023	-	-	<0.025 U	24-oct-2001
<0.002 U	-	-	0.029	-	-	<0.025 U	23-jan-2002
<0.002 U	-	-	0.04 D	-	-	<0.025 U	23-jan-2002
<0.002 U	-	-	0.03 D	-	-	<0.025 U	22-apr-2002
<0.002 U	-	-	0.029	-	-	<0.025 U	06-sep-2002
<0.002 U	-	-	0.032	-	-	<0.025 U	06-sep-2002
<0.002 U	-	-	0.06	-	-	<0.025 U	27-nov-2002
<0.002 U	-	-	0.033	-	-	<0.025 U	07-feb-2003
<0.002 U	-	-	0.022	-	-	<0.025 U	07-feb-2003
<0.002 U	-	-	0.035	-	-	<0.025 U	01-may-2003

Table A-13. Ground and surface water analyses for metals (mg/L) in samples collected from the

Location Date	Lab	Note	Val.	Antimony	Arsenic	Barium	Beryllium	Cadmium	Total chromium	Cobalt	Iron
K7-06											
14-jul-1995	CS	a	V	–	0.016	0.074	<0.0005 U	<0.0005 U	<0.01 U	<0.05 U	–
14-jul-1995	CS	a	V	–	–	–	–	–	–	–	<0.1 U
17-oct-1995	CS	a	V	–	0.016	0.073	<0.0005 U	<0.0005 U	<0.01 U	<0.025 U	–
17-oct-1995	CS	a	V	–	–	–	–	–	–	–	<0.1 U
12-feb-1996	CS	ah	V	–	–	–	–	–	–	–	<0.1 U
12-feb-1996	CS	aeh	V	–	–	–	–	–	–	–	<0.1 U
12-feb-1996	CS	ah	V	–	0.016	0.072	<0.0005 U	<0.0005 U	0.0024	<0.025 U	–
12-feb-1996	CS	aeh	V	–	0.014	0.069	<0.0005 U	<0.0005 U	0.0011	<0.025 U	–
24-apr-1996	CS	a	V	–	–	–	–	–	–	–	–
24-apr-1996	CS	a	V	–	0.016	0.084 LO	<0.0005 U	<0.0005 U	0.014	<0.025 ULO	–
24-jul-1996	CS	a	V	–	–	–	–	–	–	–	–
24-jul-1996	CS	a	V	–	0.017	0.062	<0.0005 U	<0.0005 U	<0.001 UO	<0.025 U	–
18-oct-1996	CS	a	V	–	0.016	0.086	<0.0005 U	<0.0005 U	–	<0.025 U	–
22-jan-1997	CS	a	V	–	0.017	0.077	<0.0005 U	<0.0005 U	–	<0.025 U	–
08-apr-1997	CS	a	V	–	0.017	0.071	<0.0005 LU	<0.0005 U	–	<0.025 U	–
23-jul-1997	CS	a	V	–	0.015	0.074	<0.0005 UL	<0.0005 U	–	<0.025 U	–
21-oct-1997	CS	a	V	–	0.014	0.074	<0.0005 U	<0.0005 U	–	<0.025 U	–
14-jan-1998	CS	a	V	–	0.014	0.074	<0.0005 U	<0.0005 U	–	<0.025 U	–
21-apr-1998	CS	ah	V	–	0.014	0.071	<0.0005 U	<0.0005 U	–	<0.025 U	–
21-apr-1998	CS	aeh	V	–	0.014	0.073	<0.0005 U	<0.0005 U	–	<0.025 U	–
21-jul-1998	CS	ah	V	–	0.013	0.083	<0.0005 U	<0.0005 U	–	<0.025 U	–
21-jul-1998	CS	aeh	V	–	0.013	0.084	<0.0005 U	<0.0005 U	–	<0.025 U	–
19-oct-1998	CS	a	V	–	0.012	0.071	<0.0005 U	<0.0005 U	–	<0.025 U	–
19-jan-1999	CS	a	V	–	0.013	0.082	<0.0005 U	<0.0005 U	–	<0.025 U	–
23-apr-1999	CN	a	V	–	0.014	0.078	<0.0005 U	<0.0005 U	–	<0.025 U	–
19-jul-1999	CN	ah	V	–	0.017	0.081	<0.0005 U	<0.0005 U	–	<0.025 U	–
19-jul-1999	CN	aeh	V	–	0.016	0.079	<0.0005 U	<0.0005 U	–	<0.025 U	–
12-oct-1999	CN	a	V	–	0.016	0.078	<0.0005 U	<0.0005 U	–	<0.025 U	–
11-feb-2000	CN	a	V	–	0.012	0.065	<0.0005 U	<0.0005 U	–	<0.025 U	–
25-apr-2000	CN	af	V	–	0.016	0.081	<0.0005 U	<0.0005 U	–	<0.025 U	–
24-jul-2000	CN	a	V	–	0.018	0.085	<0.0005 U	<0.0005 U	–	<0.025 U	–
01-nov-2000	CN	af	V	–	0.017	0.072	<0.0005 U	<0.0005 U	–	<0.025 U	–
06-jun-2001	CN	a	V	–	0.019	0.074	<0.0005 U	<0.0005 U	–	<0.025 U	–
19-jul-2001	CN	a	V	–	0.017	0.078	<0.0005 U	<0.0005 U	–	<0.025 U	–
29-oct-2001	CN	a	V	–	0.021	0.077	<0.0005 U	<0.0005 U	–	<0.025 U	–
30-jan-2002	CN	a	V	–	0.019	0.083	<0.0005 U	<0.0005 U	–	<0.025 U	–
29-apr-2002	CN	a	V	–	0.022	0.083	<0.0005 U	<0.0005 LU	–	<0.025 U	–
29-aug-2002	CN	af	V	–	0.018	0.083	<0.0005 DU	<0.0005 U	–	<0.025 U	–
03-dec-2002	CN	af	V	–	0.018	0.084	<0.0005 DU	<0.0005 U	–	<0.025 U	–
07-feb-2003	CN	af	V	–	0.019	0.087	<0.0005 DU	<0.0005 U	–	<0.025 U	–
06-may-2003	CN	af	V	–	–	0.083	–	–	–	<0.025 U	–
K7-07											
07-aug-1995	CS	ah	V	–	0.014	0.082	<0.0005 U	<0.0005 U	<0.01 U	<0.05 U	–
07-aug-1995	CS	aeh	V	–	0.016	0.078	<0.0005 U	<0.0005 U	<0.01 U	<0.05 U	–
07-aug-1995	CS	ah	V	–	–	–	–	–	–	–	<0.1 U
07-aug-1995	CS	aeh	V	–	–	–	–	–	–	–	<0.1 U
30-oct-1995	CS	a	V	–	0.015	0.083	<0.0005 U	<0.0005 U	<0.01 U	<0.025 U	–
30-oct-1995	CS	a	V	–	–	–	–	–	–	–	<0.1 U
20-may-1996	CS	a	V	–	0.015	0.066	<0.0005 U	<0.0005 U	0.0011	<0.025 U	–
13-sep-1996	CS	ah	V	–	–	–	–	–	–	–	–
13-sep-1996	CS	aeh	V	–	–	–	–	–	–	–	–
19-nov-1996	CS	a	V	<0.005 U	0.013	0.076	<0.0005 U	<0.0005 U	<0.001 U	<0.025 U	–
13-may-1997	CS	a	V	<0.005 U	0.015	0.077	<0.0005 ULO	<0.0005 U	<0.001 U	<0.025 U	–
18-nov-1997	CS	a	V	<0.005 U	0.013	0.085 D	<0.0005 U	<0.0005 U	<0.001 U	<0.025 DU	–
02-jun-1998	CS	ah	V	<0.005 U	0.013	0.096	<0.0005 U	<0.0005 U	0.0035	<0.025 U	–
02-jun-1998	CS	aeh	V	<0.005 U	0.013	0.1	<0.0005 U	<0.0005 U	0.002	<0.025 U	–
30-nov-1998	CS	a	V	<0.005 U	0.015	0.094	<0.0005 U	<0.0005 U	<0.001 U	<0.025 U	–
26-may-1999	CN	a	V	<0.005 U	0.018	0.081	<0.0005 U	<0.0005 UL	<0.001 U	<0.025 U	–
18-may-2000	CN	a	V	<0.005 U	0.02 B	0.11	<0.0005 U	<0.0005 U	0.004	<0.025 U	–
K7-09											
17-jul-1995	CS	a	V	–	–	–	–	–	–	–	<0.1 U
17-jul-1995	CS	a	V	–	<0.002 U	<0.05 U	<0.0005 U	<0.0005 U	<0.001 U	<0.05 U	–
11-sep-1995	CS	a	V	–	–	–	–	–	–	–	–
17-oct-1995	CS	a	V	–	<0.002 U	<0.025 U	<0.0005 U	<0.0005 U	<0.01 U	<0.025 U	–
17-oct-1995	CS	a	V	–	–	–	–	–	–	–	<0.1 U
07-feb-1996	CS	a	V	–	–	–	–	–	–	–	<0.1 U

Pit7 Complex between July 1, 1995 and June 30, 2003. Results recorded by December 18, 2003.

Lead	Mercury	Molybdenum	Nickel	Selenium	Silver	Vanadium	Location Date
							K7-06
<0.002 U	<0.0002 U	-	-	<0.002 U	<0.001 U	<0.05 U	14-jul-1995
-	-	-	<0.1 U	-	-	-	14-jul-1995
<0.002 U	<0.0002 U	-	-	<0.002 U	<0.01 U	0.031	17-oct-1995
-	-	-	<0.1 U	-	-	-	17-oct-1995
-	-	-	<0.1 U	-	-	-	12-feb-1996
-	-	-	<0.1 U	-	-	-	12-feb-1996
0.004	<0.0002 U	-	<0.005 U	<0.002 U	<0.0005 U	0.042	12-feb-1996
<0.002 U	<0.0002 U	-	<0.005 U	<0.002 U	<0.0005 U	0.038	12-feb-1996
-	<0.0002 U	-	-	-	-	-	24-apr-1996
<0.002 U	-	-	<0.005 U	<0.002 ULO	<0.0005 U	0.043 LO	24-apr-1996
-	-	-	<0.005 U	-	-	-	24-jul-1996
<0.002 U	<0.0002 U	-	-	<0.002 UL	0.0015	0.03	24-jul-1996
<0.002 U	-	-	<0.005 U	-	-	0.037	18-oct-1996
<0.002 U	-	-	<0.005 U	-	-	0.038	22-jan-1997
<0.002 U	-	-	<0.005 U	-	-	0.032	08-apr-1997
<0.002 U	-	-	<0.005 U	-	-	0.033	23-jul-1997
<0.002 U	-	-	<0.005 U	-	-	0.033	21-oct-1997
<0.002 U	-	-	0.0061	-	-	0.035	14-jan-1998
<0.002 U	-	-	<0.005 U	-	-	0.035	21-apr-1998
<0.002 U	-	-	<0.005 U	-	-	0.035	21-apr-1998
<0.002 U	-	-	<0.005 U	-	-	0.039	21-jul-1998
<0.002 U	-	-	<0.005 U	-	-	0.04	21-jul-1998
<0.002 U	-	-	<0.005 U	-	-	0.034	19-oct-1998
<0.002 U	-	-	<0.005 U	-	-	0.038	19-jan-1999
<0.002 U	-	-	0.006	-	-	0.036	23-apr-1999
<0.002 U	-	-	<0.005 U	-	-	0.039	19-jul-1999
<0.002 U	-	-	<0.005 U	-	-	0.038	19-jul-1999
<0.002 U	-	-	<0.005 U	-	-	0.036	12-oct-1999
<0.002 U	-	-	<0.005 U	-	-	0.026	11-feb-2000
<0.002 LU	-	-	<0.005 U	-	-	0.039	25-apr-2000
<0.002 U	-	-	<0.005 U	-	-	0.043	24-jul-2000
<0.002 U	-	-	<0.005 U	-	-	0.04	01-nov-2000
<0.002 U	-	-	<0.005 U	-	-	0.041	06-jun-2001
<0.002 U	-	-	<0.005 U	-	-	0.04	19-jul-2001
<0.002 U	-	-	<0.005 U	-	-	0.042	29-oct-2001
0.007	-	-	0.012	-	-	0.043	30-jan-2002
<0.002 U	-	-	<0.005 U	-	-	0.045	29-apr-2002
<0.002 U	-	-	<0.005 U	-	-	0.042	29-aug-2002
<0.002 U	-	-	<0.005 U	-	-	0.043	03-dec-2002
<0.002 U	-	-	<0.005 U	-	-	0.047	07-feb-2003
-	-	-	-	-	-	0.045	06-may-2003
							K7-07
<0.002 U	<0.0002 U	-	-	<0.002 U	<0.01 U	0.031	07-aug-1995
<0.002 U	<0.0002 U	-	-	<0.002 U	<0.01 U	0.029	07-aug-1995
-	-	-	<0.1 U	-	-	-	07-aug-1995
-	-	-	<0.1 U	-	-	-	07-aug-1995
-	-	-	-	<0.002 U	<0.01 U	<0.025 U	30-oct-1995
-	-	-	<0.1 U	-	-	-	30-oct-1995
0.0021	<0.0002 U	-	-	<0.002 U	<0.0005 U	0.033	20-may-1996
0.012	-	-	-	-	-	-	13-sep-1996
<0.002 U	-	-	-	-	-	-	13-sep-1996
<0.002 U	<0.0002 U	<0.025 U	<0.005 UO	<0.002 LOU	<0.0005 U	0.03	19-nov-1996
0.0021	<0.0002 U	<0.025 U	<0.005 U	<0.002 U	<0.0005 U	0.03	13-may-1997
<0.002 U	<0.0002 U	<0.025 U	<0.005 U	0.0036	<0.0005 U	<0.025 DU	18-nov-1997
<0.002 U	<0.0002 U	<0.025 U	<0.005 U	<0.002 UL	<0.0005 UL	0.03	02-jun-1998
<0.002 U	<0.0002 U	<0.025 U	<0.005 U	<0.002 UL	<0.0005 UL	0.028	02-jun-1998
<0.002 U	<0.0002 U	<0.025 U	<0.005 U	<0.002 UL	<0.0005 U	0.031	30-nov-1998
<0.002 U	<0.0002 U	<0.025 U	<0.005 U	<0.002 U	<0.0005 U	0.033	26-may-1999
0.003	<0.0002 U	<0.025 U	<0.005 U	<0.002 U	<0.0005 U	0.043	18-may-2000
							K7-09
-	-	-	<0.1 U	-	-	-	17-jul-1995
0.0059	<0.0002 HU	-	-	<0.002 U	<0.001 U	<0.05 U	17-jul-1995
<0.002 ULO	-	-	-	-	-	-	11-sep-1995
<0.002 U	<0.0002 HU	-	-	<0.002 U	<0.01 U	<0.025 U	17-oct-1995
-	-	-	<0.1 U	-	-	-	17-oct-1995
-	-	-	<0.1 U	-	-	-	07-feb-1996

Table A-13. Ground and surface water analyses for metals (mg/L) in samples collected from the

Location Date	Lab	Note	Val.	Antimony	Arsenic	Barium	Beryllium	Cadmium	Total chromium	Cobalt	Iron
K7-09 (continued)											
07-feb-1996	CS	a	V	–	<0.002 U	<0.025 U	<0.0005 U	<0.0005 U	0.0035	<0.025 U	–
21-mar-1996	CS	a	V	–	–	–	–	–	–	–	–
28-mar-1996	CS	a	V	–	–	–	–	–	–	–	–
26-apr-1996	CS	a	V	–	–	–	–	–	–	–	–
26-apr-1996	CS	a	V	–	<0.002 U	<0.025 U	<0.0005 U	<0.0005 U	<0.001 U	<0.025 U	–
24-jul-1996	CS	a	V	–	–	–	–	–	–	–	–
24-jul-1996	CS	a	V	–	<0.002 U	<0.025 U	<0.0005 U	<0.0005 U	<0.001 UO	<0.025 U	–
23-oct-1996	CS	a	V	–	<0.002 U	<0.025 U	<0.0005 LU	<0.0005 U	–	<0.025 U	–
23-jan-1997	CS	a	V	–	<0.002 U	<0.025 U	<0.0005 U	–	–	<0.025 U	–
10-apr-1997	CS	a	V	–	0.022	<0.025 U	<0.0005 U	<0.0005 U	–	<0.025 U	–
17-jul-1997	CS	a	V	–	<0.002 U	<0.025 U	<0.0005 U	<0.0005 U	–	<0.025 U	–
24-jul-1997	CS	a	V	–	<0.002 U	–	–	–	–	–	–
22-oct-1997	CS	a	V	–	<0.002 U	<0.025 U	<0.0005 U	<0.0005 U	–	<0.025 U	–
21-jan-1998	CS	a	V	–	<0.002 U	<0.025 U	<0.0005 U	<0.0005 U	–	<0.025 U	–
11-feb-1998	CS	a	V	–	–	–	–	–	–	–	–
20-feb-1998	CS	a	V	–	–	–	–	–	–	–	–
22-apr-1998	CS	a	V	–	<0.002 U	<0.025 U	<0.0005 U	<0.0005 U	–	<0.025 U	–
27-jul-1998	CS	a	V	–	<0.002 U	<0.025 U	<0.0005 U	<0.0005 U	–	<0.025 U	–
20-oct-1998	CS	a	V	–	<0.002 U	<0.025 U	<0.0005 U	<0.0005 U	–	<0.025 U	–
25-jan-1999	CS	a	V	–	<0.002 U	<0.025 U	<0.0005 U	<0.0005 U	–	<0.025 U	–
23-apr-1999	CN	a	V	–	<0.002 U	<0.025 U	<0.0005 U	0.0006	–	<0.025 U	–
18-jun-1999	CN	a	V	–	–	–	–	<0.0005 U	–	–	–
28-jun-1999	CN	a	V	–	–	–	–	<0.0005 U	–	–	–
15-jul-1999	CN	a	V	–	<0.002 U	<0.025 U	<0.0005 U	<0.0005 U	–	<0.025 U	–
11-oct-1999	CN	a	V	–	<0.002 U	<0.025 U	<0.0005 U	<0.0005 LU	–	<0.025 U	–
07-dec-1999	CN	a	V	–	–	–	–	–	–	–	–
15-dec-1999	CN	a	V	–	–	–	–	–	–	–	–
16-feb-2000	CN	a	V	–	<0.002 U	<0.025 U	<0.0005 U	<0.0005 LOU	–	<0.025 U	–
25-apr-2000	CN	a	V	–	<0.002 U	<0.025 U	<0.0005 U	<0.0005 U	–	<0.025 U	–
09-aug-2000	CN	a	V	–	<0.002 U	<0.025 U	<0.0005 U	<0.0005 U	–	<0.025 U	–
01-nov-2000	CN	af	V	–	<0.002 U	0.035	<0.0005 U	<0.0005 U	–	<0.025 U	–
14-dec-2000	CN	a	V	–	–	0.04	–	–	–	–	–
21-dec-2000	CN	a	V	–	–	0.037	–	–	–	–	–
23-jan-2001	CN	a	V	–	<0.002 U	0.038	<0.0005 U	<0.0005 U	–	<0.025 U	–
24-apr-2001	CN	ah	V	–	<0.002 U	0.029	<0.0005 U	<0.0005 LU	–	<0.025 U	–
17-jul-2001	CN	a	V	–	<0.002 U	0.028	<0.0005 U	<0.0005 U	–	<0.025 U	–
24-oct-2001	CN	a	V	–	<0.002 U	0.026	<0.0005 U	<0.0005 U	–	<0.025 U	–
23-jan-2002	CN	a	V	–	<0.002 U	0.026	<0.0005 U	<0.0005 U	–	<0.025 U	–
23-apr-2002	CN	af	V	–	0.002	<0.025 U	<0.0005 U	<0.0005 U	–	<0.025 U	–
06-sep-2002	CN	a	V	–	<0.002 U	0.038	<0.0005 LU	<0.0005 U	–	<0.025 U	–
29-nov-2002	CN	af	V	–	<0.002 U	0.028	<0.0005 DU	<0.0005 U	–	<0.025 U	–
07-feb-2003	CN	af	V	–	<0.002 U	<0.025 U	<0.0005 DU	<0.0005 U	–	<0.025 U	–
01-may-2003	CN	a	V	–	<0.002 U	0.029	<0.0005 U	<0.0005 U	–	<0.025 U	–
K7-10											
18-jul-1995	CS	a	V	–	–	–	–	–	–	–	<0.1 U
18-jul-1995	CS	a	V	–	0.0025	0.036	<0.0005 U	<0.0005 U	<0.001 U	<0.05 U	–
19-oct-1995	CS	a	V	–	<0.002 U	0.033	<0.0005 U	<0.0005 U	<0.01 U	<0.025 U	–
19-oct-1995	CS	a	V	–	–	–	–	–	–	–	<0.1 U
12-feb-1996	CS	a	V	–	–	–	–	–	–	–	<0.1 U
12-feb-1996	CS	a	V	–	<0.002 U	0.066	<0.0005 U	<0.0005 U	<0.001 U	<0.025 U	–
26-apr-1996	CS	a	V	–	–	–	–	–	–	–	–
26-apr-1996	CS	a	V	–	0.0034	0.04	<0.0005 U	<0.0005 U	<0.001 U	<0.025 U	–
24-jul-1996	CS	a	V	–	–	–	–	–	–	–	–
24-jul-1996	CS	a	V	–	0.0021	<0.025 U	<0.0005 U	<0.0005 U	<0.001 UO	<0.025 U	–
24-oct-1996	CS	a	V	–	0.0025	0.061	<0.0005 UL	<0.0005 U	–	<0.025 U	–
28-jan-1997	CS	a	V	–	<0.002 U	0.081	<0.0005 U	<0.0005 U	–	<0.025 U	–
15-apr-1997	CS	a	V	–	0.003	0.034	<0.0005 UL	<0.0005 U	–	<0.025 U	–
17-jul-1997	CS	a	V	–	0.002	0.039	<0.0005 U	<0.0005 U	–	<0.025 U	–
02-sep-1997	CS	a	V	–	–	–	–	–	–	–	–
10-sep-1997	CS	a	V	–	–	–	–	–	–	–	–
27-oct-1997	CS	a	V	–	<0.002 U	0.032	<0.0005 U	<0.0005 U	–	<0.025 U	–
21-jan-1998	CS	a	V	–	<0.002 U	0.066	<0.0005 U	<0.0005 U	–	<0.025 U	–
28-apr-1998	CS	a	V	–	<0.002 U	0.18	<0.0005 U	<0.0005 U	–	<0.025 U	–
05-jun-1998	CS	a	V	–	–	0.045	–	–	–	–	–
12-jun-1998	CS	a	V	–	–	0.037 L	–	–	–	–	–
31-jul-1998	CS	a	V	–	<0.002 U	0.058	<0.0005 U	<0.0005 U	–	<0.025 U	–
26-oct-1998	CS	a	V	–	0.0026	0.033	<0.0005 U	<0.0005 U	–	<0.025 U	–

Pit7 Complex between July 1, 1995 and June 30, 2003. Results recorded by December 18, 2003.

Lead	Mercury	Molybdenum	Nickel	Selenium	Silver	Vanadium	Location Date
							(continued) K7-09
<0.002 U	<0.0002 U	–	0.0056	<0.002 UL	<0.0005 U	<0.025 U	07-feb-1996
–	–	–	<0.005 U	–	–	–	21-mar-1996
–	–	–	0.017 L	–	–	–	28-mar-1996
–	<0.0002 U	–	–	–	–	–	26-apr-1996
<0.002 U	–	–	<0.005 U	<0.002 UL	<0.0005 U	<0.025 U	26-apr-1996
–	–	–	<0.005 U	–	–	–	24-jul-1996
0.0024	<0.0002 U	–	–	<0.002 UL	<0.0005 U	<0.025 U	24-jul-1996
<0.002 U	–	–	<0.005 U	–	–	<0.025 U	23-oct-1996
<0.002 U	–	–	<0.005 U	–	–	<0.025 U	23-jan-1997
<0.002 U	–	–	<0.005 U	–	–	<0.025 U	10-apr-1997
<0.002 U	–	–	<0.005 U	–	–	<0.025 U	17-jul-1997
–	–	–	–	–	–	–	24-jul-1997
0.0023	–	–	<0.005 U	–	–	<0.025 U	22-oct-1997
<0.002 U	–	–	0.0064	–	–	<0.025 U	21-jan-1998
–	–	–	<0.005 U	–	–	–	11-feb-1998
–	–	–	<0.005 U	–	–	–	20-feb-1998
<0.002 U	–	–	<0.005 U	–	–	<0.025 U	22-apr-1998
<0.002 U	–	–	<0.005 U	–	–	<0.025 U	27-jul-1998
<0.002 U	–	–	0.006	–	–	<0.025 U	20-oct-1998
0.0033	–	–	<0.005 U	–	–	<0.025 U	25-jan-1999
<0.002 U	–	–	<0.005 U	–	–	<0.025 U	23-apr-1999
–	–	–	–	–	–	–	18-jun-1999
–	–	–	–	–	–	–	28-jun-1999
<0.002 U	–	–	<0.005 U	–	–	<0.025 U	15-jul-1999
0.01	–	–	<0.005 U	–	–	<0.025 U	11-oct-1999
<0.002 U	–	–	–	–	–	–	07-dec-1999
<0.002 U	–	–	–	–	–	–	15-dec-1999
<0.002 U	–	–	<0.005 U	–	–	<0.025 U	16-feb-2000
<0.002 LU	–	–	<0.005 U	–	–	<0.025 U	25-apr-2000
<0.002 U	–	–	<0.005 U	–	–	<0.025 U	09-aug-2000
<0.002 U	–	–	<0.005 U	–	–	<0.025 U	01-nov-2000
–	–	–	–	–	–	–	14-dec-2000
–	–	–	–	–	–	–	21-dec-2000
<0.002 U	–	–	<0.005 U	–	–	<0.025 U	23-jan-2001
<0.002 U	–	–	<0.005 U	–	–	<0.025 U	24-apr-2001
<0.002 U	–	–	<0.005 U	–	–	<0.025 U	17-jul-2001
<0.002 U	–	–	<0.005 U	–	–	<0.025 U	24-oct-2001
<0.002 U	–	–	<0.005 U	–	–	<0.025 U	23-jan-2002
<0.002 U	–	–	<0.005 U	–	–	<0.025 U	23-apr-2002
<0.002 U	–	–	<0.005 U	–	–	<0.025 U	06-sep-2002
<0.002 U	–	–	<0.005 U	–	–	<0.025 U	29-nov-2002
0.003	–	–	<0.005 U	–	–	<0.025 U	07-feb-2003
<0.002 U	–	–	<0.005 U	–	–	<0.025 U	01-may-2003
							K7-10
–	–	–	<0.1 U	–	–	–	18-jul-1995
<0.002 U	<0.0002 U	–	–	<0.002 U	<0.001 U	<0.05 U	18-jul-1995
<0.002 U	<0.0002 HU	–	–	<0.002 U	<0.01 ULO	<0.025 U	19-oct-1995
–	–	–	<0.1 U	–	–	–	19-oct-1995
–	–	–	<0.1 U	–	–	–	12-feb-1996
<0.002 U	<0.0002 U	–	<0.005 U	<0.002 U	<0.0005 U	<0.025 U	12-feb-1996
–	<0.0002 U	–	–	–	–	–	26-apr-1996
<0.002 U	–	–	<0.005 U	<0.002 UL	<0.0005 U	<0.025 U	26-apr-1996
–	–	–	<0.005 U	–	–	–	24-jul-1996
<0.002 U	<0.0002 U	–	–	<0.002 UL	<0.0005 U	<0.025 U	24-jul-1996
<0.002 U	–	–	<0.005 U	–	–	<0.025 U	24-oct-1996
<0.002 U	–	–	<0.005 U	–	–	<0.025 U	28-jan-1997
<0.002 U	–	–	0.012	–	–	<0.025 U	15-apr-1997
0.007	–	–	<0.005 U	–	–	<0.025 U	17-jul-1997
<0.002 U	–	–	–	–	–	–	02-sep-1997
<0.002 UL	–	–	–	–	–	–	10-sep-1997
<0.002 U	–	–	<0.005 U	–	–	<0.025 U	27-oct-1997
<0.002 U	–	–	0.013	–	–	<0.025 U	21-jan-1998
<0.002 U	–	–	<0.005 ULO	–	–	<0.01 U	28-apr-1998
–	–	–	–	–	–	–	05-jun-1998
–	–	–	–	–	–	–	12-jun-1998
<0.002 U	–	–	<0.005 U	–	–	<0.025 U	31-jul-1998
<0.002 U	–	–	<0.005 U	–	–	<0.025 U	26-oct-1998

Table A-13. Ground and surface water analyses for metals (mg/L) in samples collected from the

Location Date	Lab	Note	Val.	Antimony	Arsenic	Barium	Beryllium	Cadmium	Total chromium	Cobalt	Iron
K7-10 (continued)											
25-jan-1999	CS	a	V	–	0.0021	0.042	<0.0005 U	<0.0005 U	–	<0.025 U	–
26-apr-1999	CN	a	V	–	<0.002 U	0.04	<0.0005 U	<0.0005 U	–	<0.025 U	–
18-jun-1999	CN	a	V	–	–	–	–	–	–	–	–
28-jun-1999	CN	a	V	–	–	–	–	–	–	–	–
15-jul-1999	CN	a	V	–	<0.002 U	0.037	<0.0005 U	<0.0005 U	–	<0.025 U	–
11-oct-1999	CN	a	V	–	<0.002 U	0.051	<0.0005 U	<0.0005 LU	–	<0.025 U	–
27-jan-2000	CN	a	V	–	<0.002 U	0.036	<0.0005 LU	<0.0005 LU	–	<0.025 U	–
26-apr-2000	CN	a	V	–	<0.002 U	0.2	<0.0005 U	<0.0005 LU	–	<0.025 U	–
01-aug-2000	CN	a	V	–	–	0.069	–	–	–	–	–
01-aug-2000	CN	a	V	–	<0.002 U	0.063	<0.0005 U	<0.0005 U	–	<0.025 U	–
08-aug-2000	CN	a	V	–	–	0.079	–	–	–	–	–
01-nov-2000	CN	a	V	–	<0.002 U	0.039	<0.0005 U	<0.0005 U	–	<0.025 U	–
23-jan-2001	CN	a	V	–	<0.002 U	0.031	<0.0005 U	<0.0005 U	–	<0.025 U	–
24-apr-2001	CN	ah	V	–	0.002	0.035	<0.0005 U	<0.0005 LU	–	<0.025 U	–
17-jul-2001	CN	a	V	–	<0.002 U	0.035	<0.0005 U	<0.0005 U	–	<0.025 U	–
24-oct-2001	CN	a	V	–	0.003	0.039	<0.0005 U	<0.0005 U	–	<0.025 U	–
24-jan-2002	CN	a	V	–	0.002	0.064	<0.0005 U	<0.0005 U	–	<0.025 U	–
23-apr-2002	CN	a	V	–	<0.002 U	0.039	<0.0005 U	<0.0005 U	–	<0.025 U	–
28-aug-2002	CN	af	V	–	<0.002 U	0.04	<0.001 DU	<0.0005 U	–	<0.025 U	–
29-nov-2002	CN	af	V	–	0.002	0.061	<0.0005 DU	<0.0005 U	–	<0.025 U	–
07-feb-2003	CN	af	V	–	0.003	0.12	<0.0005 DU	<0.0005 U	–	<0.025 U	–
05-may-2003	CN	a	V	–	–	0.059	–	–	–	<0.025 U	–
NC7-12											
23-may-1997	CS	a	V	–	0.0099	0.062	–	<0.0005 U	0.0011	–	–
14-may-1998	CS	a	V	–	0.0094	0.075	–	<0.0005 U	<0.001 U	–	–
26-may-1999	CN	a	V	–	0.01	0.1	–	<0.0005 UL	<0.001 U	–	–
13-jun-2000	CN	a	V	–	0.01	0.083	–	<0.0005 U	0.002	–	–
14-may-2001	CN	ah	V	–	0.008	0.08	–	<0.0005 U	<0.001 U	–	–
14-may-2001	CN	aeh	V	–	0.007	0.082	–	<0.0005 U	<0.001 U	–	–
22-may-2002	CN	a	V	–	0.01	0.075	–	<0.0005 U	0.001	–	–
28-may-2003	CN	a	V	–	0.009	0.075	–	0.0011	0.001	–	–
NC7-15											
30-may-1997	BB	a	V	–	0.0092	0.094	–	<0.0005 U	0.015	–	–
30-may-1997	CS	a	V	–	0.012	0.094	–	<0.0005 U	0.0016	–	–
12-may-1998	BB	ag	V	–	<0.002 U	0.1	–	<0.0005 U	<0.001 U	–	–
12-may-1998	CS	ag	V	–	0.0095	0.1	–	<0.0005 UO	<0.001 U	–	–
26-may-1999	CN	a	V	–	0.012	0.086	–	<0.0005 UL	<0.001 U	–	–
05-jun-2000	CN	af	V	–	0.014	0.33	–	<0.0005 U	0.036 D	–	–
22-may-2001	CN	a	V	–	0.01	0.079	–	0.0007	<0.001 U	–	–
22-may-2002	CN	a	V	–	0.012	0.08	–	0.001	0.001	–	–
28-may-2003	CN	a	V	–	0.01	0.082	–	<0.0005 U	<0.001 U	–	–
NC7-16											
14-nov-1995	CS	a	V	–	–	–	<0.0005 U	–	–	–	–
05-jun-1996	CS	a	V	–	0.0088	0.22	–	<0.0005 U	0.0016	–	–
05-jun-1996	CS	a	V	–	–	–	<0.0005 U	–	–	–	–
18-dec-1996	CS	a	V	–	0.0085	0.2	–	<0.0005 U	0.0033	–	–
18-dec-1996	CS	a	V	–	–	–	<0.0005 UL	–	–	–	–
28-jan-1997	CS	a	V	–	0.0071	0.19	–	<0.0005 U	0.0031 L	–	–
12-may-1997	CS	a	V	–	0.0087	0.25	–	<0.0005 U	0.0019	–	–
24-jul-1997	CS	a	V	–	0.01	0.27	–	<0.0005 U	0.0037	–	–
07-nov-1997	CS	a	V	–	0.0079	0.21	–	<0.0005 U	0.0032	–	–
30-jan-1998	CS	a	V	–	0.0092	0.21	–	<0.0005 U	0.0053	–	–
29-apr-1998	CS	a	V	–	0.0094	0.24	–	<0.0005 U	<0.001 U	–	–
17-aug-1998	CS	a	V	–	0.0078	0.35	–	0.0016	0.0021 O	–	–
23-nov-1998	CS	a	V	–	0.0075	<0.025 U	–	<0.0005 U	<0.001 UL	–	–
26-jan-1999	CS	a	V	–	0.0072	0.27	–	<0.0005 U	0.0011	–	–
27-may-1999	CN	a	V	–	0.008	0.26	–	<0.0005 UL	<0.001 UL	–	–
26-aug-1999	CN	a	V	–	0.008	0.25	–	<0.0005 LU	0.001 L	–	–
07-dec-1999	CN	af	V	–	0.018	0.45	–	<0.0005 LU	0.2 D	–	–
25-feb-2000	CN	af	V	–	0.011	0.26	–	<0.0005 U	0.022 D	–	–
14-jun-2000	CN	a	V	–	0.009	0.21	–	<0.0005 U	0.002	–	–
25-jul-2000	CN	af	V	–	0.01	0.26	–	<0.0005 LU	0.021 D	–	–
30-oct-2000	CN	a	V	–	–	0.21	–	–	0.002	–	–
13-feb-2001	BB	ag	V	–	0.008	0.24	–	<0.0005 U	0.002	–	–
13-feb-2001	CN	ag	V	–	0.008	0.19	–	<0.0005 U	0.001	–	–

Lead	Mercury	Molybdenum	Nickel	Selenium	Silver	Vanadium	Location Date
							(continued) K7-10
<0.002 U	-	-	<0.005 U	-	-	<0.025 U	25-jan-1999
0.004	-	-	<0.005 U	-	-	<0.025 U	26-apr-1999
<0.002 U	-	-	-	-	-	-	18-jun-1999
<0.002 U	-	-	-	-	-	-	28-jun-1999
<0.002 U	-	-	<0.005 U	-	-	<0.025 U	15-jul-1999
<0.002 U	-	-	<0.005 U	-	-	<0.025 U	11-oct-1999
<0.002 U	-	-	<0.005 U	-	-	<0.025 U	27-jan-2000
<0.002 LU	-	-	<0.005 U	-	-	<0.025 U	26-apr-2000
-	-	-	-	-	-	-	01-aug-2000
<0.002 U	-	-	<0.005 U	-	-	<0.025 U	01-aug-2000
-	-	-	-	-	-	-	08-aug-2000
<0.002 U	-	-	<0.005 U	-	-	<0.025 U	01-nov-2000
<0.002 U	-	-	<0.005 U	-	-	<0.025 U	23-jan-2001
<0.002 U	-	-	<0.005 U	-	-	<0.025 U	24-apr-2001
<0.002 U	-	-	<0.005 U	-	-	<0.025 U	17-jul-2001
<0.002 U	-	-	<0.005 U	-	-	<0.025 U	24-oct-2001
<0.002 U	-	-	<0.005 U	-	-	<0.025 U	24-jan-2002
<0.002 U	-	-	<0.005 U	-	-	<0.025 U	23-apr-2002
<0.002 U	-	-	<0.005 U	-	-	<0.025 U	28-aug-2002
<0.002 U	-	-	<0.005 U	-	-	<0.025 U	29-nov-2002
<0.002 U	-	-	<0.005 U	-	-	<0.025 U	07-feb-2003
-	-	-	-	-	-	<0.025 U	05-may-2003
							NC7-12
<0.002 U	<0.0002 U	-	-	<0.002 U	<0.001 U	-	23-may-1997
<0.002 U	<0.0002 U	-	-	<0.002 U	<0.001 U	-	14-may-1998
<0.005 U	<0.0002 U	-	-	<0.002 U	<0.001 U	-	26-may-1999
<0.005 U	<0.0002 U	-	-	<0.002 OU	<0.001 U	-	13-jun-2000
<0.005 U	<0.0002 U	-	-	<0.002 U	<0.001 U	-	14-may-2001
<0.005 U	<0.0002 U	-	-	<0.002 U	<0.001 U	-	14-may-2001
<0.005 U	<0.0002 U	-	-	<0.005 LU	<0.001 U	-	22-may-2002
<0.005 U	<0.0002 U	-	-	<0.005 U	<0.001 U	-	28-may-2003
							NC7-15
<0.005 U	<0.0002 U	-	-	<0.005 U	<0.001 U	-	30-may-1997
<0.002 U	<0.0002 U	-	-	<0.002 U	<0.001 U	-	30-may-1997
<0.005 U	<0.0002 U	-	-	<0.002 U	<0.001 U	-	12-may-1998
<0.002 U	<0.0002 UL	-	-	0.0026	<0.001 U	-	12-may-1998
<0.005 U	<0.0002 U	-	-	<0.002 U	<0.001 U	-	26-may-1999
<0.005 U	<0.0002 U	-	-	<0.002 U	<0.001 U	-	05-jun-2000
<0.005 U	<0.0002 U	-	-	<0.002 U	<0.001 U	-	22-may-2001
<0.005 U	<0.0002 U	-	-	<0.005 LU	<0.001 U	-	22-may-2002
<0.005 U	<0.0002 U	-	-	<0.005 U	<0.001 U	-	28-may-2003
							NC7-16
-	-	-	-	-	-	-	14-nov-1995
0.0058	<0.0002 U	-	-	<0.002 ULO	<0.001 U	-	05-jun-1996
-	-	-	-	-	-	-	05-jun-1996
<0.002 U	<0.0002 U	-	-	<0.002 UL	<0.001 U	-	18-dec-1996
-	-	-	-	-	-	-	18-dec-1996
<0.002 U	<0.0002 U	-	-	<0.002 LU	<0.001 LU	-	28-jan-1997
<0.002 U	<0.0002 U	-	-	<0.002 U	<0.001 U	-	12-may-1997
<0.002 U	<0.0002 U	-	-	0.0027	<0.001 U	-	24-jul-1997
<0.002 U	0.00033 O	-	-	<0.002 U	<0.001 U	-	07-nov-1997
<0.002 U	<0.0002 U	-	-	<0.002 U	<0.001 U	-	30-jan-1998
<0.002 U	<0.0002 U	-	-	<0.002 U	<0.001 U	-	29-apr-1998
0.0039	<0.0002 U	-	-	<0.002 U	<0.001 U	-	17-aug-1998
<0.002 U	0.00034 L	-	-	<0.002 U	<0.001 U	-	23-nov-1998
<0.002 U	<0.0002 U	-	-	<0.002 U	<0.001 U	-	26-jan-1999
<0.005 U	<0.0002 U	-	-	<0.002 U	<0.001 U	-	27-may-1999
<0.005 LU	<0.0002 U	-	-	<0.002 U	<0.001 U	-	26-aug-1999
<0.005 U	<0.0002 U	-	-	<0.002 U	<0.001 U	-	07-dec-1999
<0.005 U	<0.0002 U	-	-	<0.002 U	<0.001 U	-	25-feb-2000
<0.005 U	<0.0002 U	-	-	<0.002 OU	<0.001 U	-	14-jun-2000
<0.005 U	<0.0002 U	-	-	<0.002 U	-	-	25-jul-2000
-	-	-	-	-	<0.001 U	-	30-oct-2000
<0.005 U	<0.0002 U	-	-	<0.004 DU	<0.001 U	-	13-feb-2001
<0.005 U	<0.0002 U	-	-	<0.002 U	<0.001 U	-	13-feb-2001

Table A-13. Ground and surface water analyses for metals (mg/L) in samples collected from the

Location Date	Lab	Note	Val.	Antimony	Arsenic	Barium	Beryllium	Cadmium	Total chromium	Cobalt	Iron
NC7-16 (continued)											
22-may-2001	CN	a	V	–	0.008	0.21	–	0.0012	0.002	–	–
07-mar-2003	BB	a	V	–	0.0122	0.31 L	–	0.0025	0.148	–	–
NC7-17											
21-nov-1995	CS	ah	V	–	–	–	<0.0005 U	–	–	–	–
21-nov-1995	CS	aeh	V	–	–	–	<0.0005 U	–	–	–	–
05-jun-1996	CS	a	V	–	0.0074	0.089	–	<0.0005 U	0.0014	–	–
05-jun-1996	CS	a	V	–	–	–	<0.0005 U	–	–	–	–
17-dec-1996	CS	a	V	–	0.0052	0.083	–	<0.0005 U	0.0018	–	–
17-dec-1996	CS	a	V	–	–	–	<0.0005 U	–	–	–	–
19-may-1997	CS	a	V	–	0.0079	0.097	–	<0.0005 U	0.0035	–	–
18-may-1998	CS	a	V	–	0.007	0.11	–	<0.0005 U	<0.001 U	–	–
21-may-1999	CN	af	V	–	0.007	0.099	–	<0.0005 LOU	0.003	–	–
23-may-2000	CN	a	V	–	0.008	0.09	–	<0.0005 U	0.003	–	–
16-may-2001	CN	a	V	–	0.007	0.1	–	<0.0005 U	0.001	–	–
30-may-2002	CN	a	V	–	–	0.098	–	–	–	–	–
NC7-18											
29-nov-1995	CS	a	V	–	–	–	<0.0005 U	–	–	–	–
05-jun-1996	CS	a	V	–	0.0047	0.087	–	<0.0005 U	0.0019	–	–
05-jun-1996	CS	a	V	–	–	–	<0.0005 U	–	–	–	–
13-dec-1996	CS	a	V	–	0.0047	0.092	–	<0.0005 U	0.0066	–	–
13-dec-1996	CS	a	V	–	–	–	<0.0005 U	–	–	–	–
13-may-1997	CS	a	V	–	0.0054	0.09	–	<0.0005 U	0.008	–	–
18-may-1998	CS	a	V	–	0.0042	0.099	–	<0.0005 U	0.0018 B	–	–
21-may-1999	CN	a	V	–	0.003	0.076	–	<0.0005 LOU	<0.001 U	–	–
26-may-2000	CN	a	V	–	0.003	0.099	–	<0.0005 LU	<0.001 LU	–	–
16-may-2001	CN	a	V	–	0.004	0.11	–	<0.0005 U	0.002	–	–
30-may-2002	CN	a	V	–	–	0.1	–	–	–	–	–
NC7-21											
14-nov-1995	CS	a	V	–	–	–	<0.0005 U	–	–	–	–
05-jun-1996	CS	a	V	–	0.0071	0.08	–	<0.0005 U	0.0015	–	–
05-jun-1996	CS	a	V	–	–	–	<0.0005 U	–	–	–	–
26-dec-1996	CS	a	V	–	0.0073 L	0.14	–	<0.0005 UL	0.0025	–	–
26-dec-1996	CS	a	V	–	–	–	<0.0005 U	–	–	–	–
29-may-1997	CS	a	V	–	0.0063	0.078	–	<0.0005 U	<0.001 U	–	–
30-oct-1997	CS	a	V	–	0.0069	0.083	–	<0.0005 U	0.002	–	–
20-may-1998	CS	a	V	–	0.0063	0.091	–	<0.0005 U	<0.001 U	–	–
23-nov-1998	CS	a	V	–	0.0064	0.1	–	<0.0005 U	<0.001 UL	–	–
28-may-1999	CN	af	V	–	0.007	0.12	–	<0.0005 UL	<0.001 UL	–	–
07-dec-1999	CN	af	V	–	0.007	0.15	–	<0.0005 LU	0.013 D	–	–
15-jun-2000	CN	af	V	–	0.008	0.15	–	<0.0005 U	0.02 D	–	–
30-oct-2000	CN	a	V	–	–	0.11	–	–	0.003	–	–
22-may-2001	CN	a	V	–	0.007	0.11	–	0.0005	0.002	–	–
15-nov-2001	CN	a	V	–	0.006	0.1	–	<0.0005 U	0.002 L	–	–
23-may-2002	CN	a	V	–	0.007	0.11	–	<0.0005 U	0.002 L	–	–
NC7-22											
16-nov-1995	CS	a	V	–	–	–	<0.0005 U	–	–	–	–
05-jun-1996	CS	a	V	–	–	–	<0.0005 U	–	–	–	–
18-dec-1996	CS	a	V	–	–	–	<0.0005 UL	–	–	–	–
29-jan-1997	CS	a	V	–	0.0028	0.032	–	<0.0005 U	0.0014 L	–	–
29-may-1997	CS	a	V	–	0.0055	0.034	–	<0.0005 U	0.0011	–	–
24-jul-1997	CS	a	V	–	0.0051	0.032	–	<0.0005 U	0.0023	–	–
29-oct-1997	BB	af	V	–	0.0031	0.032	–	<0.0005 U	0.0011	–	–
29-oct-1997	CS	a	V	–	0.0029	0.029	–	<0.0005 U	0.0014	–	–
28-jan-1998	CS	a	V	–	0.0027	0.034	–	<0.0005 U	<0.001 U	–	–
20-may-1998	CS	a	V	–	0.007	0.047	–	<0.0005 U	<0.001 U	–	–
17-aug-1998	CS	a	V	–	0.007	0.045	–	0.0028	0.0018 O	–	–
23-nov-1998	CS	a	V	–	0.0046	0.034	–	<0.0005 U	<0.001 UL	–	–
29-jan-1999	CS	a	V	–	<0.002 U	0.036	–	<0.0005 U	0.008	–	–
28-may-1999	CN	af	V	–	0.004	0.034	–	<0.0005 UL	<0.001 UL	–	–
26-aug-1999	CN	a	V	–	0.002	0.033	–	<0.0005 LU	0.001 L	–	–
NC7-24											
28-jan-1997	CS	a	V	–	0.023	0.21	–	<0.0005 U	0.004 L	–	–
29-may-1997	CS	a	V	–	0.021	0.22	–	<0.0005 U	0.0014	–	–

Lead	Mercury	Molybdenum	Nickel	Selenium	Silver	Vanadium	Location Date
							(continued) NC7-16
<0.005 U	<0.0002 U	–	–	<0.002 U	<0.001 U	–	22-may-2001
0.0063	<0.0002 U	–	–	<0.002 U	<0.001 LU	–	07-mar-2003
							NC7-17
–	–	–	–	–	–	–	21-nov-1995
–	–	–	–	–	–	–	21-nov-1995
0.0045	<0.0002 U	–	–	<0.002 ULO	<0.001 U	–	05-jun-1996
–	–	–	–	–	–	–	05-jun-1996
<0.002 U	<0.0002 U	–	–	<0.002 U	<0.001 U	–	17-dec-1996
–	–	–	–	–	–	–	17-dec-1996
<0.002 U	<0.0002 U	–	–	<0.002 U	<0.001 U	–	19-may-1997
<0.002 U	<0.0002 U	–	–	<0.002 U	<0.001 U	–	18-may-1998
<0.005 U	<0.0002 U	–	–	<0.002 U	<0.001 U	–	21-may-1999
<0.005 LU	<0.0002 LU	–	–	<0.002 U	<0.001 U	–	23-may-2000
<0.005 U	<0.0002 U	–	–	<0.002 U	<0.001 U	–	16-may-2001
–	–	–	–	–	–	–	30-may-2002
							NC7-18
–	–	–	–	–	–	–	29-nov-1995
0.0047	<0.0002 U	–	–	<0.002 ULO	<0.001 U	–	05-jun-1996
–	–	–	–	–	–	–	05-jun-1996
<0.002 U	<0.0002 U	–	–	<0.002 U	<0.001 U	–	13-dec-1996
–	–	–	–	–	–	–	13-dec-1996
<0.002 U	<0.0002 U	–	–	<0.002 U	<0.001 U	–	13-may-1997
<0.002 U	<0.0002 U	–	–	<0.002 U	<0.001 U	–	18-may-1998
<0.005 U	<0.0002 U	–	–	<0.002 U	<0.001 U	–	21-may-1999
<0.005 U	<0.0002 U	–	–	<0.002 U	<0.001 U	–	26-may-2000
<0.005 U	<0.0002 U	–	–	<0.002 U	<0.001 U	–	16-may-2001
–	–	–	–	–	–	–	30-may-2002
							NC7-21
–	–	–	–	–	–	–	14-nov-1995
0.0049	<0.0002 U	–	–	<0.002 ULO	<0.001 U	–	05-jun-1996
–	–	–	–	–	–	–	05-jun-1996
<0.002 U	<0.0002 U	–	–	<0.002 UL	<0.001 U	–	26-dec-1996
–	–	–	–	–	–	–	26-dec-1996
<0.002 U	<0.0002 U	–	–	<0.002 U	<0.001 U	–	29-may-1997
<0.002 U	<0.0002 ULO	–	–	<0.002 ULO	<0.001 U	–	30-oct-1997
<0.002 U	<0.0002 U	–	–	<0.002 U	<0.001 U	–	20-may-1998
<0.002 U	0.00026 L	–	–	<0.002 U	<0.001 U	–	23-nov-1998
<0.005 U	<0.0002 U	–	–	<0.002 U	<0.001 U	–	28-may-1999
<0.005 U	<0.0002 U	–	–	<0.002 U	<0.001 U	–	07-dec-1999
<0.005 U	<0.0002 U	–	–	<0.002 OU	<0.001 U	–	15-jun-2000
–	–	–	–	–	<0.001 U	–	30-oct-2000
<0.005 U	<0.0002 U	–	–	<0.002 U	<0.001 U	–	22-may-2001
<0.005 U	<0.0002 U	–	–	<0.005 U	<0.001 U	–	15-nov-2001
<0.005 U	<0.0002 U	–	–	<0.005 LU	<0.001 U	–	23-may-2002
							NC7-22
–	–	–	–	–	–	–	16-nov-1995
–	–	–	–	–	–	–	05-jun-1996
–	–	–	–	–	–	–	18-dec-1996
<0.002 U	<0.0002 U	–	–	<0.002 LU	<0.001 LU	–	29-jan-1997
<0.002 U	<0.0002 U	–	–	<0.002 U	<0.001 U	–	29-may-1997
<0.002 U	<0.0002 U	–	–	0.0037	<0.001 U	–	24-jul-1997
<0.005 U	<0.0002 U	–	–	<0.005 DU	<0.001 U	–	29-oct-1997
<0.002 U	<0.0002 U	–	–	0.0025	<0.001 U	–	29-oct-1997
<0.002 U	<0.0002 U	–	–	<0.002 U	<0.001 U	–	28-jan-1998
<0.002 U	<0.0002 U	–	–	<0.002 U	<0.001 U	–	20-may-1998
<0.002 U	<0.0002 U	–	–	<0.002 U	<0.001 U	–	17-aug-1998
<0.002 U	0.00035 L	–	–	<0.002 U	<0.001 U	–	23-nov-1998
<0.002 U	<0.0002 U	–	–	<0.002 U	<0.001 U	–	29-jan-1999
<0.005 U	<0.0002 U	–	–	<0.002 U	<0.001 U	–	28-may-1999
<0.005 LU	<0.0002 U	–	–	<0.002 U	<0.001 U	–	26-aug-1999
							NC7-24
<0.002 U	<0.0002 U	–	–	0.0048 L	<0.001 LU	–	28-jan-1997
<0.002 U	<0.0002 U	–	–	0.003	<0.001 U	–	29-may-1997

Table A-13. Ground and surface water analyses for metals (mg/L) in samples collected from the

Location Date	Lab	Note	Val.	Antimony	Arsenic	Barium	Beryllium	Cadmium	Total chromium	Cobalt	Iron
NC7-24 (continued)											
30-jul-1997	CS	a	V	–	0.023	0.21	–	<0.0005 U	0.0011	–	–
18-nov-1997	CS	a	V	–	0.021	0.24 D	–	<0.0005 U	0.0016	–	–
09-mar-1998	CS	a	V	–	0.024	0.25	–	0.16	0.0079	–	–
20-may-1998	CS	a	V	–	0.02	0.22	–	<0.0005 U	0.0014	–	–
17-aug-1998	CS	a	V	–	0.018	0.24	–	<0.0005 U	0.0029 O	–	–
24-nov-1998	CS	a	V	–	0.047 L	0.22	–	<0.0005 U	<0.001 U	–	–
27-jan-1999	CS	a	V	–	0.015	0.21	–	<0.0005 U	0.002	–	–
07-jun-1999	CN	a	V	–	0.026	0.21	–	<0.0005 OU	0.003	–	–
NC7-25											
18-jul-1995	CS	a	V	–	–	–	–	–	–	–	<0.1 U
18-jul-1995	CS	a	V	–	0.0045	0.058	<0.0005 U	<0.0005 U	<0.001 U	<0.05 U	–
20-oct-1995	CS	a	V	–	0.0054	0.052	<0.0005 U	<0.0005 U	<0.01 U	<0.025 U	–
20-oct-1995	CS	a	V	–	–	–	–	–	–	–	<0.1 U
12-feb-1996	CS	a	V	–	–	–	–	–	–	–	<0.1 U
12-feb-1996	CS	a	V	–	0.0057	0.059	<0.0005 U	<0.0005 U	<0.001 U	<0.025 U	–
29-apr-1996	CS	a	V	–	–	–	–	–	–	–	–
29-apr-1996	CS	a	V	–	0.0063	0.067	<0.0005 U	<0.0005 U	0.0019	<0.025 U	–
30-jul-1996	CS	a	V	–	–	–	–	–	–	–	–
30-jul-1996	CS	a	V	–	0.0032	0.027	<0.0005 U	<0.0005 U	<0.001 U	<0.025 U	–
24-oct-1996	CS	a	V	–	0.0055	0.067	<0.0005 UL	<0.0005 U	–	<0.025 U	–
28-jan-1997	CS	a	V	–	0.0044	0.071	<0.0005 U	<0.0005 U	–	<0.025 U	–
18-feb-1997	CS	a	V	–	–	0.066	–	–	–	–	–
24-feb-1997	CS	a	V	–	–	0.058	–	–	–	–	–
16-apr-1997	CS	a	V	–	0.0054 O	0.073	<0.0005 LU	<0.0005 U	–	<0.025 U	–
12-may-1997	CS	a	V	–	–	0.073	–	–	–	–	–
20-may-1997	CS	a	V	–	–	0.072	–	–	–	–	–
30-jul-1997	CS	a	V	–	0.0063 L	0.074	<0.0005 U	<0.0005 U	–	<0.025 UL	–
27-oct-1997	CS	a	V	–	0.0043	0.079	<0.0005 U	<0.0005 U	–	<0.025 U	–
22-jan-1998	CS	a	V	–	0.018	0.075	<0.0005 U	<0.0005 U	–	<0.025 U	–
11-feb-1998	CS	a	V	–	–	0.079	–	–	–	–	–
11-feb-1998	CS	a	V	–	0.0063	–	–	–	–	–	–
18-feb-1998	CS	a	V	–	–	0.074	–	–	–	–	–
18-feb-1998	CS	a	V	–	0.0048	–	–	–	–	–	–
28-apr-1998	CS	a	V	–	0.0044	0.075	<0.0005 U	<0.0005 U	–	<0.025 U	–
31-jul-1998	CS	a	V	–	<0.002 U	0.13	<0.0005 U	<0.0005 U	–	<0.025 U	–
26-oct-1998	CS	a	V	–	0.005	0.085	<0.0005 U	<0.0005 U	–	<0.025 U	–
27-jan-1999	CS	a	V	–	0.0061	0.084	<0.0005 U	<0.0005 U	–	<0.025 U	–
04-may-1999	CN	a	V	–	0.005	0.082	<0.0005 U	<0.0005 U	–	<0.025 U	–
15-jul-1999	CN	a	V	–	0.005	0.086	<0.0005 U	<0.0005 U	–	<0.025 U	–
07-oct-1999	CN	af	V	–	0.005	0.085	<0.0005 U	<0.0005 LU	–	<0.025 U	–
04-feb-2000	CN	ah	V	–	0.006	0.085	<0.0005 U	<0.0005 U	–	<0.025 U	–
04-feb-2000	CN	aeh	V	–	0.006	0.087	<0.0005 U	<0.0005 U	–	<0.025 U	–
26-apr-2000	CN	af	V	–	0.005	0.081	<0.0005 U	<0.0005 LU	–	<0.025 U	–
09-aug-2000	CN	af	V	–	0.007	0.084	<0.0005 U	<0.0005 U	–	<0.025 U	–
25-jan-2001	CN	af	V	–	0.004	0.075	<0.0005 U	<0.0005 U	–	<0.025 U	–
26-apr-2001	CN	af	V	–	0.006	0.074	<0.0005 U	<0.0005 U	–	<0.025 U	–
29-may-2001	BB	a	V	–	–	–	–	–	–	–	<0.05 HU
18-jul-2001	CN	af	V	–	0.004	0.077	<0.0005 U	<0.0005 U	–	<0.025 U	–
25-oct-2001	CN	ah	V	–	0.005	0.075	<0.0005 U	<0.0005 U	–	<0.025 U	–
25-oct-2001	CN	aeh	V	–	0.007	0.078	<0.0005 U	<0.0005 U	–	<0.025 U	–
24-jan-2002	CN	a	V	–	0.005	0.076	<0.0005 U	<0.0005 U	–	<0.025 U	–
29-apr-2002	CN	a	V	–	0.006	0.076	<0.0005 U	<0.0005 LU	–	<0.025 U	–
11-sep-2002	CN	af	V	–	0.005 D	0.081	<0.0005 U	<0.0005 DU	–	<0.025 U	–
27-nov-2002	CN	af	V	–	0.005	0.075	<0.0005 DU	<0.0005 U	–	<0.025 U	–
11-feb-2003	CN	a	N	–	0.005	0.077	<0.0005 LDU	<0.0005 U	–	<0.025 U	–
05-may-2003	CN	a	V	–	–	0.082	–	–	–	<0.025 U	–
NC7-26											
17-jul-1995	CS	a	V	–	–	–	–	–	–	–	<0.1 U
17-jul-1995	CS	a	V	–	0.0026	<0.05 U	<0.0005 U	<0.0005 U	<0.001 U	<0.05 U	–
17-oct-1995	CS	a	V	–	0.0021	<0.025 U	<0.0005 U	<0.0005 U	<0.01 U	<0.025 U	–
17-oct-1995	CS	a	V	–	–	–	–	–	–	–	<0.1 U
08-feb-1996	CS	a	V	–	–	–	–	–	–	–	<0.1 U
08-feb-1996	CS	a	V	–	<0.002 U	0.031	<0.0005 U	<0.0005 U	0.0027	<0.025 U	–
26-apr-1996	CS	a	V	–	–	–	–	–	–	–	–
26-apr-1996	CS	a	V	–	0.0033	0.029	<0.0005 U	<0.0005 U	<0.001 U	<0.025 U	–
25-jul-1996	CS	a	V	–	–	–	–	–	–	–	–

Pit7 Complex between July 1, 1995 and June 30, 2003. Results recorded by December 18, 2003.

Lead	Mercury	Molybdenum	Nickel	Selenium	Silver	Vanadium	Location Date
							(continued) NC7-24
<0.002 U	<0.0002 U	-	-	<0.002 U	<0.001 U	-	30-jul-1997
0.0031	<0.0002 U	-	-	0.0065	<0.001 U	-	18-nov-1997
<0.002 U	<0.0002 U	-	-	<0.002 U	<0.001 U	-	09-mar-1998
<0.002 U	<0.0002 U	-	-	0.0042	<0.001 U	-	20-may-1998
<0.002 U	<0.0002 U	-	-	0.0033	<0.001 U	-	17-aug-1998
<0.002 U	<0.0002 U	-	-	<0.002 UL	<0.001 U	-	24-nov-1998
<0.002 U	<0.0002 U	-	-	0.0025	<0.001 U	-	27-jan-1999
<0.005 U	<0.0002 U	-	-	0.002	<0.001 U	-	07-jun-1999
							NC7-25
-	-	-	<0.1 U	-	-	-	18-jul-1995
<0.002 U	<0.0002 U	-	-	<0.002 U	<0.001 U	<0.05 U	18-jul-1995
<0.002 U	<0.0002 HU	-	-	<0.002 U	<0.01 ULO	<0.025 U	20-oct-1995
-	-	-	<0.1 U	-	-	-	20-oct-1995
-	-	-	<0.1 U	-	-	-	12-feb-1996
<0.002 U	<0.0002 U	-	<0.005 U	<0.002 U	<0.0005 U	<0.025 U	12-feb-1996
-	<0.0002 U	-	-	-	-	-	29-apr-1996
<0.002 U	-	-	0.0087	<0.002 UL	<0.0005 U	<0.025 U	29-apr-1996
-	-	-	<0.005 U	-	-	-	30-jul-1996
<0.002 U	<0.0002 U	-	-	<0.002 LOU	<0.0005 U	<0.025 U	30-jul-1996
<0.002 U	-	-	<0.005 U	-	-	<0.025 U	24-oct-1996
<0.002 U	-	-	<0.005 U	-	-	<0.025 U	28-jan-1997
-	-	-	-	-	-	-	18-feb-1997
-	-	-	-	-	-	-	24-feb-1997
<0.002 U	-	-	<0.005 U	-	-	<0.025 U	16-apr-1997
-	-	-	-	-	-	-	12-may-1997
-	-	-	-	-	-	-	20-may-1997
<0.002 U	-	-	<0.005 UL	-	-	<0.025 U	30-jul-1997
<0.002 U	-	-	<0.005 U	-	-	<0.025 U	27-oct-1997
<0.002 U	-	-	0.012	-	-	<0.025 U	22-jan-1998
-	-	-	-	-	-	-	11-feb-1998
-	-	-	-	-	-	-	11-feb-1998
-	-	-	-	-	-	-	18-feb-1998
-	-	-	-	-	-	-	18-feb-1998
<0.002 U	-	-	<0.005 ULO	-	-	0.017	28-apr-1998
<0.002 U	-	-	<0.005 U	-	-	<0.025 U	31-jul-1998
<0.002 U	-	-	<0.005 U	-	-	<0.025 U	26-oct-1998
<0.002 U	-	-	<0.005 U	-	-	<0.025 U	27-jan-1999
<0.002 U	-	-	<0.005 U	-	-	<0.025 U	04-may-1999
<0.002 U	-	-	<0.005 U	-	-	<0.025 U	15-jul-1999
<0.002 U	-	-	<0.005 U	-	-	<0.025 U	07-oct-1999
<0.002 U	-	-	<0.005 LOU	-	-	<0.025 U	04-feb-2000
<0.002 U	-	-	<0.005 LOU	-	-	<0.025 U	04-feb-2000
<0.002 LU	-	-	<0.005 U	-	-	<0.025 U	26-apr-2000
<0.002 U	-	-	<0.005 U	-	-	<0.025 U	09-aug-2000
<0.002 U	-	-	<0.005 U	-	-	<0.025 U	25-jan-2001
<0.002 U	-	-	<0.005 U	-	-	<0.025 U	26-apr-2001
-	-	-	<0.05 HU	-	-	-	29-may-2001
<0.002 U	-	-	<0.005 U	-	-	<0.025 U	18-jul-2001
<0.002 U	-	-	<0.005 U	-	-	<0.025 U	25-oct-2001
<0.002 U	-	-	<0.005 U	-	-	<0.025 U	25-oct-2001
<0.002 U	-	-	<0.005 U	-	-	<0.025 U	24-jan-2002
<0.002 U	-	-	<0.005 U	-	-	<0.025 U	29-apr-2002
<0.002 U	-	-	<0.005 DU	-	-	<0.025 U	11-sep-2002
<0.002 U	-	-	<0.005 U	-	-	<0.025 U	27-nov-2002
<0.002 U	-	-	<0.005 U	-	-	<0.025 U	11-feb-2003
-	-	-	-	-	-	<0.025 U	05-may-2003
							NC7-26
-	-	-	<0.1 U	-	-	-	17-jul-1995
<0.002 U	<0.0002 HU	-	-	<0.002 U	<0.001 U	<0.05 U	17-jul-1995
<0.002 U	<0.0002 HU	-	-	<0.002 U	<0.01 U	<0.025 U	17-oct-1995
-	-	-	<0.1 U	-	-	-	17-oct-1995
-	-	-	<0.1 U	-	-	-	08-feb-1996
<0.002 U	<0.0002 U	-	<0.005 U	<0.002 UL	<0.0005 U	<0.025 U	08-feb-1996
-	<0.0002 U	-	-	-	-	-	26-apr-1996
<0.002 U	-	-	<0.005 U	<0.002 UL	<0.0005 U	<0.025 U	26-apr-1996
-	-	-	<0.005 U	-	-	-	25-jul-1996

Table A-13. Ground and surface water analyses for metals (mg/L) in samples collected from the

Location Date	Lab	Note	Val.	Antimony	Arsenic	Barium	Beryllium	Cadmium	Total chromium	Cobalt	Iron
NC7-26 (continued)											
25-jul-1996	CS	a	V	–	0.0023	<0.025 U	<0.0005 U	<0.0005 U	<0.001 U	<0.025 U	–
23-oct-1996	CS	a	V	–	<0.002 U	<0.025 U	<0.0005 LU	<0.0005 U	–	<0.025 U	–
23-jan-1997	CS	a	V	–	0.0022	<0.025 U	<0.0005 U	–	–	<0.025 U	–
10-apr-1997	CS	a	V	–	<0.002 U	0.026	<0.0005 U	<0.0005 U	–	<0.025 U	–
24-jul-1997	CS	a	V	–	0.0029	0.026	<0.0005 UO	<0.0005 U	–	<0.025 U	–
22-oct-1997	CS	a	V	–	0.0024	0.025	<0.0005 U	<0.0005 U	–	<0.025 U	–
21-jan-1998	CS	a	V	–	0.0021	0.028	<0.0005 U	<0.0005 U	–	<0.025 U	–
11-feb-1998	CS	a	V	–	–	–	–	–	–	–	–
20-feb-1998	CS	a	V	–	–	–	–	–	–	–	–
22-apr-1998	CS	a	V	–	0.0021	0.025	<0.0005 U	<0.0005 U	–	<0.025 U	–
27-jul-1998	CS	a	V	–	<0.002 U	<0.025 U	<0.0005 U	<0.0005 U	–	<0.025 U	–
20-oct-1998	CS	a	V	–	<0.002 U	0.026	<0.0005 U	<0.0005 U	–	<0.025 U	–
25-jan-1999	CS	a	V	–	0.0023	0.028	<0.0005 U	<0.0005 U	–	<0.025 U	–
04-may-1999	CN	af	V	–	0.004	0.03	<0.0005 U	<0.0005 U	–	<0.025 U	–
16-jun-1999	CN	a	V	–	0.003	–	–	–	–	–	–
28-jun-1999	CN	a	V	–	0.002	–	–	–	–	–	–
14-jul-1999	CN	a	V	–	<0.002 U	0.032	<0.0005 U	<0.0005 U	–	<0.025 U	–
11-oct-1999	CN	a	V	–	0.003	0.028	<0.0005 U	<0.0005 LU	–	<0.025 U	–
16-feb-2000	CN	a	V	–	0.002	0.029	<0.0005 U	<0.0005 LOU	–	<0.025 U	–
26-apr-2000	CN	a	V	–	0.002	0.029	<0.0005 U	<0.0005 LU	–	<0.025 U	–
09-aug-2000	CN	a	V	–	<0.002 U	0.03	<0.0005 U	<0.0005 U	–	<0.025 U	–
02-nov-2000	CN	a	V	–	0.002	0.027	<0.0005 U	<0.0005 U	–	<0.025 U	–
25-jan-2001	CN	a	V	–	<0.002 U	0.025	<0.0005 U	<0.0005 U	–	<0.025 U	–
26-apr-2001	CN	a	V	–	0.002	0.031	<0.0005 U	<0.0005 U	–	<0.025 U	–
18-jul-2001	CN	a	V	–	0.002	0.025	<0.0005 U	<0.0005 U	–	<0.025 U	–
23-aug-2001	CN	a	V	–	–	–	–	–	–	–	–
30-aug-2001	CN	a	V	–	–	–	–	–	–	–	–
25-oct-2001	CN	a	V	–	0.003	0.026	<0.0005 U	<0.0005 U	–	<0.025 U	–
24-jan-2002	CN	a	V	–	<0.002 U	0.025	<0.0005 U	<0.0005 U	–	<0.025 U	–
22-apr-2002	CN	a	V	–	<0.002 U	0.026	<0.0005 U	<0.0005 U	–	<0.025 U	–
13-sep-2002	CN	af	V	–	<0.002 DU	0.027	<0.0005 U	<0.0005 U	–	<0.025 U	–
29-nov-2002	CN	af	V	–	<0.002 U	0.026	<0.0005 DU	<0.0005 U	–	<0.025 U	–
12-feb-2003	CN	af	V	–	<0.002 U	0.027	<0.0005 DLU	<0.0005 U	–	<0.025 U	–
06-may-2003	CN	af	V	–	–	0.026	–	–	–	<0.025 U	–
NC7-34											
25-jul-1995	CS	a	V	–	0.014	0.18	–	<0.0005 U	<0.01 U	–	–
25-jul-1995	CS	a	V	–	–	–	<0.0005 U	–	–	–	–
15-nov-1995	CS	a	V	–	–	–	0.0008	–	–	–	–
21-feb-1996	CS	a	V	–	0.017	0.16	<0.0005 U	<0.0005 U	<0.01 U	–	–
05-jun-1996	CS	a	V	–	0.013	0.2	–	<0.0005 U	<0.001 U	–	–
05-jun-1996	CS	a	V	–	–	–	<0.0005 U	–	–	–	–
17-sep-1996	CS	a	V	–	0.012	0.057	–	<0.0005 U	0.0014	–	–
17-sep-1996	CS	a	V	–	–	–	<0.0005 U	–	–	–	–
20-dec-1996	CS	a	V	–	0.012 L	0.16	–	<0.0005 UL	<0.001 U	–	–
20-dec-1996	CS	a	V	–	–	–	<0.0005 U	–	–	–	–
29-may-1997	CS	a	V	–	0.011	0.18	–	<0.0005 U	0.0013	–	–
30-oct-1997	CS	a	V	–	0.013	0.16	–	<0.0005 U	0.0014	–	–
20-may-1998	BB	afg	N	–	0.013	0.24	–	<0.0005 U	<0.001 U	–	–
20-may-1998	CS	ag	V	–	0.011	0.24	–	<0.0005 U	<0.001 U	–	–
24-nov-1998	CS	a	V	–	0.01 L	0.18	–	0.00071	<0.001 U	–	–
07-jun-1999	CN	a	V	–	0.012	0.2	–	0.0008 O	<0.001 U	–	–
06-dec-1999	CN	a	V	–	0.01	0.17	–	<0.0005 LU	0.003	–	–
14-jun-2000	CN	a	V	–	0.011	0.15	–	<0.0005 U	0.001	–	–
20-nov-2000	CN	a	V	–	0.008	0.13	–	0.0011	<0.001 U	–	–
12-jun-2001	CN	af	V	–	0.011	0.14	–	<0.0005 U	<0.001 U	–	–
12-jun-2001	CN	af	V	–	–	–	–	–	–	–	<0.1 HU
30-nov-2001	CN	a	V	–	0.011	0.14	–	0.0008	<0.001 U	–	–
04-jun-2002	CN	af	V	–	0.012	0.15	–	0.0029	<0.001 U	–	–
04-jun-2002	CN	af	V	–	–	–	–	–	–	–	<0.1 U
14-dec-2002	BB	a	V	–	0.011	0.1 L	–	0.0005	<0.001 U	–	–
NC7-36											
18-jul-1995	CS	a	V	–	0.0093	0.071	–	<0.0005 U	<0.01 U	–	–
18-jul-1995	CS	a	V	–	–	–	<0.0005 U	–	–	–	–
15-nov-1995	CS	a	V	–	–	–	<0.0005 U	–	–	–	–
15-feb-1996	CS	a	V	–	0.01	0.092	<0.0005 U	<0.0005 U	<0.01 U	–	–
05-jun-1996	CS	a	V	–	0.008	0.1	–	<0.0005 U	0.0015	–	–

Pit7 Complex between July 1, 1995 and June 30, 2003. Results recorded by December 18, 2003.

Lead	Mercury	Molybdenum	Nickel	Selenium	Silver	Vanadium	Location Date
							(continued) NC7-26
<0.002 U	<0.0002 U	-	-	<0.002 LU	<0.0005 U	<0.025 U	25-jul-1996
<0.002 U	-	-	<0.005 U	-	-	<0.025 U	23-oct-1996
<0.002 U	-	-	<0.005 U	-	-	<0.025 U	23-jan-1997
<0.002 U	-	-	<0.005 U	-	-	<0.025 U	10-apr-1997
<0.002 U	-	-	<0.005 U	-	-	<0.025 U	24-jul-1997
<0.002 U	-	-	<0.005 U	-	-	<0.025 U	22-oct-1997
<0.002 U	-	-	0.0066	-	-	<0.025 U	21-jan-1998
-	-	-	<0.005 U	-	-	-	11-feb-1998
-	-	-	<0.005 U	-	-	-	20-feb-1998
<0.002 U	-	-	<0.005 U	-	-	<0.025 U	22-apr-1998
<0.002 U	-	-	<0.005 U	-	-	<0.025 U	27-jul-1998
<0.002 U	-	-	<0.005 U	-	-	<0.025 U	20-oct-1998
0.0031	-	-	<0.005 U	-	-	<0.025 U	25-jan-1999
<0.002 U	-	-	<0.005 U	-	-	<0.025 U	04-may-1999
-	-	-	-	-	-	-	16-jun-1999
-	-	-	-	-	-	-	28-jun-1999
<0.002 U	-	-	<0.005 U	-	-	<0.025 U	14-jul-1999
<0.002 U	-	-	<0.005 U	-	-	<0.025 U	11-oct-1999
<0.002 U	-	-	<0.005 U	-	-	<0.025 U	16-feb-2000
<0.002 LU	-	-	<0.005 U	-	-	<0.025 U	26-apr-2000
<0.002 U	-	-	<0.005 U	-	-	<0.025 U	09-aug-2000
<0.002 U	-	-	<0.005 U	-	-	<0.025 U	02-nov-2000
<0.002 U	-	-	<0.005 U	-	-	<0.025 U	25-jan-2001
<0.002 U	-	-	<0.005 U	-	-	<0.025 U	26-apr-2001
<0.002 U	-	-	0.008	-	-	<0.025 U	18-jul-2001
-	-	-	<0.005 U	-	-	-	23-aug-2001
-	-	-	<0.005 U	-	-	-	30-aug-2001
<0.002 U	-	-	<0.005 U	-	-	<0.025 U	25-oct-2001
<0.002 U	-	-	<0.005 U	-	-	<0.025 U	24-jan-2002
<0.002 U	-	-	<0.005 U	-	-	<0.025 U	22-apr-2002
<0.002 U	-	-	<0.005 DU	-	-	<0.025 U	13-sep-2002
<0.002 U	-	-	<0.005 U	-	-	<0.025 U	29-nov-2002
<0.002 U	-	-	<0.005 U	-	-	<0.025 U	12-feb-2003
-	-	-	-	-	-	<0.025 U	06-may-2003
							NC7-34
<0.002 U	<0.0002 U	-	-	<0.002 U	<0.001 U	-	25-jul-1995
-	-	-	-	-	-	-	25-jul-1995
-	-	-	-	-	-	-	15-nov-1995
<0.002 U	<0.0002 U	-	-	<0.002 U	<0.001 U	-	21-feb-1996
0.0053	<0.0002 U	-	-	<0.002 ULO	<0.001 U	-	05-jun-1996
-	-	-	-	-	-	-	05-jun-1996
<0.002 U	<0.0002 U	-	-	<0.002 U	<0.001 U	-	17-sep-1996
-	-	-	-	-	-	-	17-sep-1996
<0.002 U	<0.0002 U	-	-	<0.002 UL	<0.001 U	-	20-dec-1996
-	-	-	-	-	-	-	20-dec-1996
<0.002 U	<0.0002 U	-	-	<0.002 U	<0.001 U	-	29-may-1997
<0.002 U	0.00032 LO	-	-	<0.002 ULO	<0.001 U	-	30-oct-1997
<0.005 DU	<0.0002 U	-	-	<0.002 U	<0.001 U	-	20-may-1998
<0.002 U	<0.0002 U	-	-	<0.002 U	<0.001 U	-	20-may-1998
<0.002 U	<0.0002 U	-	-	<0.002 UL	<0.001 U	-	24-nov-1998
<0.005 U	<0.0002 U	-	-	<0.002 U	<0.001 U	-	07-jun-1999
<0.005 U	<0.0002 U	-	-	<0.002 U	<0.001 U	-	06-dec-1999
<0.005 U	<0.0002 U	-	-	<0.002 OU	<0.001 U	-	14-jun-2000
<0.005 U	<0.0002 U	-	-	<0.002 U	<0.001 U	-	20-nov-2000
<0.005 U	<0.0002 U	-	-	<0.002 U	<0.001 U	-	12-jun-2001
-	-	-	<0.1 HU	-	-	-	12-jun-2001
<0.005 U	<0.0002 U	-	-	<0.005 U	<0.001 LU	-	30-nov-2001
<0.005 U	<0.0002 U	-	-	<0.005 LU	<0.001 U	-	04-jun-2002
-	-	-	<0.1 U	-	-	-	04-jun-2002
<0.005 U	<0.0002 U	-	-	0.0028	<0.001 U	-	14-dec-2002
							NC7-36
0.0027	<0.0002 U	-	-	0.0026	<0.001 U	-	18-jul-1995
-	-	-	-	-	-	-	18-jul-1995
-	-	-	-	-	-	-	15-nov-1995
<0.002 U	0.0012	-	-	0.0035 LO	<0.001 U	-	15-feb-1996
0.0043	<0.0002 U	-	-	<0.002 ULO	<0.001 U	-	05-jun-1996

Table A-13. Ground and surface water analyses for metals (mg/L) in samples collected from the

Location Date	Lab	Note	Val.	Antimony	Arsenic	Barium	Beryllium	Cadmium	Total chromium	Cobalt	Iron
NC7-36 (continued)											
05-jun-1996	CS	a	V	-	-	-	<0.0005 U	-	-	-	-
27-aug-1996	CS	a	V	-	0.0072 O	0.057	-	<0.0005 U	<0.001 U	-	-
27-aug-1996	CS	a	V	-	-	-	<0.0005 U	-	-	-	-
13-dec-1996	CS	a	V	-	0.0048	0.085	-	<0.0005 U	0.004	-	-
13-dec-1996	CS	a	V	-	-	-	<0.0005 U	-	-	-	-
13-may-1997	CS	a	V	-	0.0084	0.084	-	<0.0005 U	0.0016	-	-
30-oct-1997	CS	a	V	-	0.074	0.083	-	<0.0005 U	0.0038	-	-
20-may-1998	CS	a	V	-	0.0062	0.1	-	<0.0005 U	0.0014	-	-
23-nov-1998	BB	afg	V	-	0.0062	0.12	-	<0.0005 U	0.0017	-	-
23-nov-1998	CS	ag	V	-	0.0038	0.095	-	<0.0005 U	0.0018 L	-	-
16-jun-1999	CN	a	V	-	0.006	0.12	-	<0.0005 U	0.002	-	-
29-nov-1999	CN	af	V	-	0.013	0.25	-	<0.0005 U	0.2 D	-	-
19-jun-2000	CN	ag	V	-	0.01	0.23	-	<0.0005 LU	0.18 L	-	-
14-nov-2000	CN	a	V	-	0.008	0.094	-	<0.0005 U	0.002 L	-	-
25-may-2001	CN	a	V	-	0.009	0.1	-	<0.0005 U	0.001	-	-
25-may-2001	CN	a	V	-	-	-	-	-	-	-	<0.1 HU
19-nov-2001	CN	a	V	-	0.008	0.093	-	<0.0005 U	0.001	-	-
31-may-2002	CN	a	V	-	0.006	0.099	-	0.0008	0.002	-	-
31-may-2002	CN	a	V	-	-	-	-	-	-	-	<0.1 U
14-dec-2002	BB	a	V	-	0.013	0.13 L	-	0.00083	<0.001 U	-	-
NC7-37											
28-dec-1995	FS	a	V	-	-	-	<0.002 U	-	-	-	-
20-feb-1996	CS	a	V	-	0.0075	0.27	<0.0005 U	<0.0005 U	<0.01 U	-	-
28-may-1996	CS	a	V	-	-	-	<0.0005 U	-	-	-	-
16-sep-1996	CS	a	V	-	-	-	<0.0005 U	-	-	-	-
18-dec-1996	CS	a	V	-	-	-	<0.0005 UL	-	-	-	-
28-jan-1997	CS	a	V	-	0.0065	0.19	-	<0.0005 U	<0.001 LU	-	-
27-may-1997	CS	ah	V	-	0.0066	0.16	-	<0.0005 U	<0.001 U	-	-
27-may-1997	CS	aeh	V	-	0.0074	0.15	-	<0.0005 U	0.001	-	-
25-jul-1997	CS	a	V	-	0.0083	0.16	-	<0.0005 U	0.0014	-	-
16-oct-1997	CS	a	V	-	0.0068 L	0.17	-	<0.0005 UL	0.001 L	-	-
30-jan-1998	CS	a	V	-	0.0071	0.16	-	<0.0005 U	0.0041	-	-
29-apr-1998	CS	a	V	-	0.0078	0.18	-	<0.0005 U	<0.001 U	-	-
25-aug-1998	CS	a	V	-	0.0056	0.18	-	<0.0005 U	<0.001 UO	-	-
30-nov-1998	CS	a	V	-	0.0068	0.19	-	0.0027	<0.001 U	-	-
16-feb-1999	CS	a	V	-	0.0039 L	0.17	-	<0.0005 UO	0.01	-	-
16-jun-1999	CN	af	V	-	0.007	0.19	-	0.0009	<0.001 U	-	-
01-sep-1999	CN	a	V	-	0.008	0.18	-	<0.0005 U	0.003 L	-	-
29-nov-1999	CN	af	V	-	0.014	0.61	-	0.0013	0.032 D	-	-
14-jun-2000	CN	a	V	-	0.007	0.17	-	<0.0005 U	0.002	-	-
10-aug-2000	BB	a	V	-	0.008	0.18	-	0.0007	<0.001 U	-	-
10-aug-2000	CN	a	V	-	0.007	0.18	-	0.0006	0.007	-	-
NC7-40											
01-aug-1995	CS	a	V	-	0.012	0.27	<0.0005 U	<0.0005 U	<0.01 U	-	-
14-nov-1995	CS	a	V	-	-	-	0.00052	-	-	-	-
21-feb-1996	CS	a	V	-	0.012	0.29	<0.0005 U	<0.0005 U	<0.01 U	-	-
30-may-1996	CS	a	V	-	-	-	<0.0005 U	-	-	-	-
12-sep-1996	CS	a	V	-	-	-	<0.0005 U	-	-	-	-
18-dec-1996	CS	a	V	-	-	-	<0.0005 UL	-	-	-	-
28-jan-1997	CS	a	V	-	0.0059	0.35	-	<0.0005 U	0.0024 L	-	-
27-may-1997	BB	ag	V	-	0.0085	0.41	-	<0.0005 U	0.0014	-	-
27-may-1997	CS	ag	V	-	0.0092	0.33	-	<0.0005 U	0.0014	-	-
29-jul-1997	CS	a	V	-	0.0091	0.35	-	<0.0005 U	0.0024	-	-
31-oct-1997	CS	a	V	-	0.012	0.32	-	<0.0005 UL	0.0063	-	-
27-jan-1998	CS	a	V	-	0.0081	0.29	-	<0.0005 U	0.0036	-	-
29-apr-1998	CS	a	V	-	0.0082	0.53	-	<0.0005 U	<0.001 U	-	-
25-aug-1998	CS	a	V	-	0.004	0.39	-	<0.0005 U	0.0017 O	-	-
24-nov-1998	CS	a	V	-	0.009 L	0.33	-	<0.0005 U	<0.001 U	-	-
27-jan-1999	CS	a	V	-	0.0058	0.31	-	<0.0005 U	0.0027	-	-
07-jun-1999	CN	a	V	-	0.01	0.31	-	<0.0005 OU	0.003	-	-
26-aug-1999	CN	a	V	-	0.01	0.27	-	<0.0005 LU	0.004 L	-	-
29-nov-1999	CN	a	V	-	0.014	0.29	-	0.0006	0.01	-	-
09-mar-2000	CN	a	V	-	0.011	0.27	-	<0.0005 U	0.003	-	-
13-jun-2000	CN	a	V	-	0.01	0.26	-	<0.0005 U	0.003	-	-
25-jul-2000	CN	a	V	-	0.012	0.29	-	0.0006 L	0.007	-	-
20-nov-2000	CN	a	V	-	0.011	0.25	-	<0.0005 U	0.003	-	-

Lead	Mercury	Molybdenum	Nickel	Selenium	Silver	Vanadium	Location Date
							(continued) NC7-36
–	–	–	–	–	–	–	05-jun-1996
<0.002 U	<0.0002 U	–	–	<0.002 U	<0.001 U	–	27-aug-1996
–	–	–	–	–	–	–	27-aug-1996
<0.002 U	<0.0002 U	–	–	<0.002 U	<0.001 U	–	13-dec-1996
–	–	–	–	–	–	–	13-dec-1996
<0.002 U	<0.0002 U	–	–	0.0036	<0.001 U	–	13-may-1997
<0.002 U	0.00036 LO	–	–	0.0021 LO	<0.001 U	–	30-oct-1997
<0.002 U	<0.0002 U	–	–	0.0029	<0.001 U	–	20-may-1998
<0.005 U	<0.0002 U	–	–	0.0037 D	<0.001 U	–	23-nov-1998
<0.002 U	0.00029 L	–	–	<0.002 U	<0.001 U	–	23-nov-1998
<0.005 U	<0.0002 U	–	–	0.004	<0.001 U	–	16-jun-1999
<0.005 U	<0.0002 U	–	–	0.003	<0.001 U	–	29-nov-1999
0.006 L	<0.0002 U	–	–	0.003	<0.001 U	–	19-jun-2000
<0.005 U	<0.0002 U	–	–	0.003 L	<0.001 U	–	14-nov-2000
<0.005 U	<0.0002 U	–	–	<0.002 LU	<0.001 U	–	25-may-2001
–	–	–	<0.1 HU	–	–	–	25-may-2001
<0.005 U	<0.0002 U	–	–	<0.005 LU	<0.001 U	–	19-nov-2001
<0.005 U	<0.0002 U	–	–	<0.005 LU	<0.001 U	–	31-may-2002
–	–	–	<0.1 U	–	–	–	31-may-2002
<0.005 U	<0.0002 U	–	–	<0.002 U	<0.001 U	–	14-dec-2002
							NC7-37
–	–	–	–	–	–	–	28-dec-1995
<0.002 U	<0.0002 U	–	–	<0.002 UL	<0.001 U	–	20-feb-1996
–	–	–	–	–	–	–	28-may-1996
–	–	–	–	–	–	–	16-sep-1996
–	–	–	–	–	–	–	18-dec-1996
<0.002 U	<0.0002 U	–	–	<0.002 LU	<0.001 LU	–	28-jan-1997
<0.002 U	<0.0002 U	–	–	<0.002 U	<0.001 U	–	27-may-1997
<0.002 U	<0.0002 U	–	–	0.0021	<0.001 U	–	27-may-1997
<0.002 U	<0.0002 U	–	–	<0.002 U	<0.001 U	–	25-jul-1997
<0.002 UL	<0.0002 U	–	–	0.0022	<0.001 UL	–	16-oct-1997
<0.002 U	<0.0002 U	–	–	<0.002 U	<0.001 U	–	30-jan-1998
<0.002 U	<0.0002 U	–	–	<0.002 U	<0.001 U	–	29-apr-1998
<0.002 UO	<0.0002 U	–	–	0.002	<0.001 UO	–	25-aug-1998
<0.002 U	<0.0002 U	–	–	<0.002 U	<0.001 U	–	30-nov-1998
<0.002 U	<0.0002 U	–	–	<0.002 UL	<0.001 U	–	16-feb-1999
<0.005 U	<0.0002 U	–	–	<0.002 U	<0.001 U	–	16-jun-1999
<0.005 U	<0.0002 U	–	–	<0.002 U	<0.001 U	–	01-sep-1999
<0.005 U	<0.0002 U	–	–	<0.002 U	<0.001 U	–	29-nov-1999
<0.005 U	<0.0002 U	–	–	<0.002 OU	<0.001 U	–	14-jun-2000
<0.005 U	<0.0002 U	–	–	<0.002 U	<0.001 U	–	10-aug-2000
<0.005 U	<0.0002 U	–	–	<0.002 U	<0.001 U	–	10-aug-2000
							NC7-40
<0.002 U	<0.0002 U	–	–	<0.002 U	<0.001 U	–	01-aug-1995
–	–	–	–	–	–	–	14-nov-1995
<0.002 U	<0.0002 U	–	–	<0.002 U	<0.001 U	–	21-feb-1996
–	–	–	–	–	–	–	30-may-1996
–	–	–	–	–	–	–	12-sep-1996
–	–	–	–	–	–	–	18-dec-1996
<0.002 U	<0.0002 U	–	–	<0.002 LU	<0.001 LU	–	28-jan-1997
<0.005 U	<0.0002 U	–	–	<0.005 U	<0.001 U	–	27-may-1997
<0.002 U	<0.0002 U	–	–	0.0021	<0.001 U	–	27-may-1997
<0.002 U	<0.0002 U	–	–	<0.002 U	<0.001 U	–	29-jul-1997
<0.002 U	<0.0002 UO	–	–	<0.002 U	<0.001 U	–	31-oct-1997
<0.002 U	<0.0002 U	–	–	0.0026	<0.001 U	–	27-jan-1998
<0.002 U	<0.0002 U	–	–	<0.002 U	<0.001 U	–	29-apr-1998
<0.002 UO	<0.0002 U	–	–	0.0028	<0.001 UO	–	25-aug-1998
<0.002 U	<0.0002 U	–	–	<0.002 UL	<0.001 U	–	24-nov-1998
<0.002 U	<0.0002 U	–	–	<0.002 U	<0.001 U	–	27-jan-1999
<0.005 U	<0.0002 U	–	–	<0.002 U	<0.001 U	–	07-jun-1999
<0.005 LU	<0.0002 U	–	–	<0.002 U	<0.001 U	–	26-aug-1999
<0.005 U	<0.0002 U	–	–	<0.002 U	<0.001 U	–	29-nov-1999
<0.005 U	<0.0002 U	–	–	<0.002 U	<0.001 U	–	09-mar-2000
<0.005 U	<0.0002 U	–	–	<0.002 OU	<0.001 U	–	13-jun-2000
<0.005 U	<0.0002 U	–	–	<0.002 U	–	–	25-jul-2000
<0.005 U	<0.0002 U	–	–	<0.002 U	<0.001 U	–	20-nov-2000

Table A-13. Ground and surface water analyses for metals (mg/L) in samples collected from the

Location Date	Lab	Note	Val.	Antimony	Arsenic	Barium	Beryllium	Cadmium	Total chromium	Cobalt	Iron
NC7-40 (continued)											
13-feb-2001	CN	a	V	–	0.011	0.24	–	<0.0005 U	0.003	–	–
12-jun-2001	CN	af	V	–	0.01	0.26	–	<0.0005 U	0.005	–	–
12-jun-2001	CN	af	V	–	–	–	–	–	–	–	<0.1 HU
23-aug-2001	CN	a	V	–	0.01	0.25	–	<0.0005 U	0.004	–	–
19-nov-2001	CN	a	V	–	0.009	0.26	–	<0.0005 U	0.004	–	–
14-feb-2002	CN	a	V	–	0.01	0.26	–	0.0008	0.004 O	–	–
29-may-2002	CN	af	V	–	0.012	0.25	–	<0.0005 U	0.004	–	–
29-may-2002	CN	af	V	–	–	–	–	–	–	–	<0.1 U
16-jul-2002	CN	af	V	–	–	–	–	–	–	–	<0.1 U
11-sep-2002	CN	af	V	–	0.01	0.28	–	<0.0005 U	<0.0025 DU	–	–
21-dec-2002	CN	a	V	–	0.01	0.29	–	0.0005	0.008	–	–
NC7-47											
18-jul-1995	CS	a	V	–	–	–	–	–	–	–	<0.1 U
18-jul-1995	CS	a	V	–	0.011	0.038	<0.0005 U	<0.0005 U	<0.001 U	<0.05 U	–
20-oct-1995	CS	a	V	–	0.012	0.033	<0.0005 U	<0.0005 U	<0.01 U	<0.025 U	–
20-oct-1995	CS	a	V	–	–	–	–	–	–	–	<0.1 U
13-feb-1996	CS	a	V	–	–	–	–	–	–	–	<0.1 U
13-feb-1996	CS	a	V	–	0.011	0.043	<0.0005 U	<0.0005 U	<0.001 U	<0.025 U	–
30-apr-1996	CS	a	V	–	–	–	–	–	–	–	–
30-apr-1996	CS	a	V	–	0.016	0.042	<0.0005 U	<0.0005 U	<0.001 U	<0.025 U	–
30-jul-1996	CS	a	V	–	–	–	–	–	–	–	–
30-jul-1996	CS	a	V	–	0.012	<0.025 U	<0.0005 U	<0.0005 U	<0.001 U	<0.025 U	–
25-oct-1996	CS	a	V	–	0.013	0.048	<0.0005 U	<0.0005 U	–	<0.025 U	–
03-feb-1997	CS	a	V	–	0.011	0.051	<0.0005 U	<0.0005 U	–	<0.025 U	–
16-apr-1997	CS	a	V	–	0.012 O	0.045	<0.0005 LU	<0.0005 U	–	<0.025 U	–
30-jul-1997	CS	a	V	–	0.013 L	0.047	<0.0005 U	<0.0005 U	–	<0.025 UL	–
27-oct-1997	CS	a	V	–	0.011	0.049	<0.0005 U	<0.0005 U	–	<0.025 U	–
27-jan-1998	CS	a	V	–	0.0098	0.052	<0.0005 U	<0.0005 U	–	<0.025 U	–
29-apr-1998	CS	a	V	–	0.011	0.059	<0.0005 U	<0.0005 U	–	<0.025 U	–
29-jul-1998	CS	a	V	–	0.0043	0.053	<0.0005 U	<0.0005 U	–	<0.025 U	–
21-oct-1998	CS	a	V	–	0.009	0.058	<0.0005 U	<0.0005 U	–	<0.025 U	–
27-jan-1999	CS	a	V	–	0.011	0.055	<0.0005 U	<0.0005 U	–	<0.025 U	–
04-may-1999	CN	af	V	–	0.012	0.053	<0.0005 U	<0.0005 U	–	<0.025 U	–
15-jul-1999	CN	a	V	–	0.012	0.055	<0.0005 U	<0.0005 U	–	<0.025 U	–
11-oct-1999	CN	af	V	–	0.012	0.054	<0.0005 U	<0.0005 LU	–	<0.025 U	–
27-jan-2000	CN	afh	V	–	0.009	0.047	<0.0005 LU	<0.0005 LU	–	<0.025 U	–
27-jan-2000	CN	aefh	V	–	0.012	0.065	<0.0005 LU	<0.0005 LU	–	<0.025 U	–
01-may-2000	CN	af	V	–	0.011	0.056	<0.0005 U	<0.0005 U	–	<0.025 U	–
09-aug-2000	CN	af	V	–	0.011	0.054	<0.0005 U	<0.0005 U	–	<0.025 U	–
02-nov-2000	CN	af	V	–	0.011	0.051	<0.0005 U	<0.0005 U	–	<0.025 U	–
25-jan-2001	CN	af	V	–	0.011	0.052	<0.0005 U	<0.0005 U	–	<0.025 U	–
27-apr-2001	CN	af	V	–	0.013 L	0.051	<0.0005 U	<0.0005 U	–	<0.025 U	–
19-jul-2001	CN	a	V	–	0.01	0.054	<0.0005 U	<0.0005 U	–	<0.025 U	–
29-oct-2001	CN	a	V	–	0.014	0.056	<0.0005 U	<0.0005 U	–	<0.025 U	–
30-jan-2002	CN	a	V	–	0.011	0.058	<0.0005 U	<0.0005 U	–	<0.025 U	–
30-apr-2002	CN	af	V	–	0.013	0.058	<0.0005 U	<0.0005 LU	–	<0.025 U	–
29-aug-2002	CN	af	V	–	0.011	0.055	<0.0005 DU	<0.0005 U	–	<0.025 U	–
03-dec-2002	CN	af	V	–	0.012	0.059	<0.0005 DU	<0.0005 U	–	<0.025 U	–
12-feb-2003	CN	af	V	–	0.011	0.059	<0.0005 DLU	<0.0005 U	–	<0.025 U	–
07-may-2003	CN	af	V	–	0.011	0.061	<0.0025 DU	<0.0005 U	–	<0.025 U	–
NC7-48											
19-jul-1995	CS	a	V	–	–	–	–	–	–	–	<0.1 U
19-jul-1995	CS	a	V	–	0.0057	0.079	<0.0005 U	<0.0005 U	<0.01 U	<0.05 U	–
19-oct-1995	CS	a	V	–	0.006	0.085	<0.0005 U	<0.0005 U	<0.01 U	<0.025 U	–
19-oct-1995	CS	a	V	–	–	–	–	–	–	–	<0.1 U
15-feb-1996	CS	a	V	–	–	–	–	–	–	–	0.2
15-feb-1996	CS	a	V	–	–	–	–	–	–	–	–
15-feb-1996	CS	a	V	–	0.0055	0.094	<0.0005 U	<0.0005 U	<0.001 U	<0.025 U	–
30-apr-1996	CS	a	V	–	–	–	–	–	–	–	–
30-apr-1996	CS	a	V	–	0.0076	0.11	<0.0005 U	<0.0005 U	<0.001 U	<0.025 U	–
30-jul-1996	CS	a	V	–	–	–	–	–	–	–	–
30-jul-1996	CS	a	V	–	0.0041	0.081	<0.0005 U	<0.0005 U	<0.001 U	<0.025 U	–
25-oct-1996	CS	ah	V	–	0.006	0.12	<0.0005 U	<0.0005 U	–	<0.025 U	–
25-oct-1996	CS	aeh	V	–	0.007	0.12	<0.0005 U	<0.0005 U	–	<0.025 U	–
28-jan-1997	CS	a	V	–	0.005	0.11	<0.0005 U	<0.0005 U	–	<0.025 U	–
16-apr-1997	CS	a	V	–	0.0058 O	0.13	<0.0005 LU	<0.0005 U	–	<0.025 U	–

Pit7 Complex between July 1, 1995 and June 30, 2003. Results recorded by December 18, 2003.

Lead	Mercury	Molybdenum	Nickel	Selenium	Silver	Vanadium	Location Date
							(continued) NC7-40
<0.005 U	<0.0002 U	–	–	<0.002 U	<0.001 U	–	13-feb-2001
<0.005 U	<0.0002 U	–	–	<0.002 U	<0.001 U	–	12-jun-2001
–	–	–	<0.1 HU	–	–	–	12-jun-2001
<0.005 U	<0.0002 U	–	–	<0.002 U	<0.001 U	–	23-aug-2001
<0.005 U	<0.0002 U	–	–	<0.005 LU	<0.001 U	–	19-nov-2001
<0.005 U	<0.0002 U	–	–	<0.005 U	<0.001 LU	–	14-feb-2002
<0.005 U	<0.0002 U	–	–	–	<0.001 U	–	29-may-2002
–	–	–	<0.1 U	–	–	–	29-may-2002
–	–	–	<0.1 U	–	–	–	16-jul-2002
<0.005 U	<0.0002 U	–	–	<0.005 U	<0.001 U	–	11-sep-2002
<0.005 U	<0.0002 U	–	–	<0.005 U	<0.001 U	–	21-dec-2002
							NC7-47
–	–	–	<0.1 U	–	–	–	18-jul-1995
<0.002 U	<0.0002 U	–	–	<0.002 U	<0.001 U	<0.05 U	18-jul-1995
<0.002 U	<0.0002 HU	–	–	<0.002 U	<0.01 U	0.036	20-oct-1995
–	–	–	<0.1 U	–	–	–	20-oct-1995
–	–	–	<0.1 U	–	–	–	13-feb-1996
<0.002 U	<0.0002 U	–	<0.005 U	<0.002 UL	<0.0005 U	0.054	13-feb-1996
–	<0.0002 U	–	–	–	–	–	30-apr-1996
<0.002 U	–	–	<0.005 U	<0.002 U	<0.0005 U	0.057	30-apr-1996
–	–	–	<0.005 U	–	–	–	30-jul-1996
<0.002 U	<0.0002 U	–	–	0.0022 LO	<0.0005 U	0.039	30-jul-1996
<0.002 U	–	–	<0.005 UO	–	–	0.062	25-oct-1996
0.0063 O	–	–	<0.005 UO	–	–	0.046	03-feb-1997
<0.002 U	–	–	<0.005 U	–	–	0.057	16-apr-1997
<0.002 U	–	–	<0.005 UL	–	–	0.063	30-jul-1997
<0.002 U	–	–	<0.005 U	–	–	0.061	27-oct-1997
<0.002 U	–	–	<0.005 U	–	–	0.065	27-jan-1998
<0.002 U	–	–	<0.005 U	–	–	0.07	29-apr-1998
<0.002 U	–	–	<0.005 U	–	–	0.069	29-jul-1998
<0.002 U	–	–	<0.005 U	–	–	0.066	21-oct-1998
<0.002 U	–	–	<0.005 U	–	–	0.061	27-jan-1999
<0.002 U	–	–	<0.005 U	–	–	0.062	04-may-1999
<0.002 U	–	–	<0.005 U	–	–	0.068	15-jul-1999
<0.002 U	–	–	<0.005 U	–	–	0.069	11-oct-1999
<0.002 U	–	–	<0.005 U	–	–	0.055	27-jan-2000
<0.002 U	–	–	<0.005 U	–	–	0.066	27-jan-2000
<0.002 U	–	–	<0.005 U	–	–	0.066	01-may-2000
<0.002 U	–	–	<0.005 U	–	–	0.069	09-aug-2000
<0.002 U	–	–	<0.005 U	–	–	0.068	02-nov-2000
<0.002 U	–	–	<0.005 U	–	–	0.066	25-jan-2001
<0.002 U	–	–	<0.005 U	–	–	0.064	27-apr-2001
<0.002 U	–	–	<0.005 U	–	–	0.065	19-jul-2001
<0.002 U	–	–	<0.005 U	–	–	0.071	29-oct-2001
<0.002 U	–	–	<0.005 U	–	–	0.066	30-jan-2002
<0.002 U	–	–	<0.005 U	–	–	0.067	30-apr-2002
<0.002 U	–	–	<0.005 U	–	–	0.058	29-aug-2002
<0.002 U	–	–	<0.005 U	–	–	0.065	03-dec-2002
<0.002 U	–	–	<0.005 U	–	–	0.065	12-feb-2003
<0.002 U	–	–	<0.005 U	–	–	0.067	07-may-2003
							NC7-48
–	–	–	<0.1 U	–	–	–	19-jul-1995
<0.002 U	<0.0002 U	–	–	<0.002 U	<0.01 U	<0.05 U	19-jul-1995
<0.002 U	<0.0002 HU	–	–	<0.002 U	<0.01 U	<0.025 U	19-oct-1995
–	–	–	<0.1 U	–	–	–	19-oct-1995
–	–	–	<0.1 U	–	–	–	15-feb-1996
–	–	–	<0.005 U	–	–	–	15-feb-1996
<0.002 U	0.00024	–	–	<0.002 LU	<0.0005 U	0.025	15-feb-1996
–	<0.0002 U	–	–	–	–	–	30-apr-1996
<0.002 U	–	–	<0.005 U	<0.002 U	<0.0005 U	<0.025 U	30-apr-1996
–	–	–	<0.005 U	–	–	–	30-jul-1996
<0.002 U	<0.0002 U	–	–	<0.002 LOU	<0.0005 U	<0.025 U	30-jul-1996
<0.002 U	–	–	<0.005 UO	–	–	<0.025 U	25-oct-1996
<0.002 U	–	–	<0.005 UO	–	–	<0.025 U	25-oct-1996
<0.002 U	–	–	<0.005 U	–	–	<0.025 U	28-jan-1997
<0.002 U	–	–	<0.005 U	–	–	<0.025 U	16-apr-1997

Table A-13. Ground and surface water analyses for metals (mg/L) in samples collected from the

Location Date	Lab	Note	Val.	Antimony	Arsenic	Barium	Beryllium	Cadmium	Total chromium	Cobalt	Iron
NC7-48 (continued)											
30-jul-1997	CS	ah	V	–	0.0059 L	0.12	<0.0005 U	<0.0005 U	–	<0.025 UL	–
30-jul-1997	CS	aeh	V	–	0.0064 L	0.12	<0.0005 U	<0.0005 U	–	<0.025 UL	–
28-oct-1997	CS	a	V	–	<0.002 U	0.11	<0.0005 U	<0.0005 U	–	<0.025 U	–
13-nov-1997	CS	a	V	–	–	–	–	–	–	–	–
22-jan-1998	CS	a	V	–	0.0062	0.13	<0.0005 U	<0.0005 U	–	<0.025 U	–
23-feb-1998	CS	a	V	–	–	–	–	–	–	–	–
23-feb-1998	CS	a	V	–	–	–	–	–	–	–	–
23-mar-1998	CS	a	V	–	–	–	–	–	–	–	–
28-apr-1998	CS	a	V	–	0.0066	0.15	<0.0005 U	<0.0005 U	–	<0.025 U	–
27-may-1998	CS	a	V	–	–	–	–	–	–	–	–
25-jun-1998	CS	a	V	–	–	–	–	–	–	–	–
31-jul-1998	CS	a	V	–	<0.002 U	0.066	<0.0005 U	<0.0005 U	–	<0.025 U	–
24-aug-1998	CS	a	V	–	–	–	–	–	–	–	–
23-sep-1998	CS	a	V	–	–	–	–	–	–	–	–
26-oct-1998	CS	a	V	–	0.0057	0.11	<0.0005 U	<0.0005 U	–	<0.025 U	–
23-nov-1998	CS	a	V	–	–	–	–	–	–	–	–
28-jan-1999	CS	a	V	–	0.006	0.11	<0.0005 U	<0.0005 U	–	<0.025 U	–
04-may-1999	CN	a	V	–	0.006	0.12	<0.0005 U	<0.0005 U	–	<0.025 U	–
19-jul-1999	CN	af	V	–	0.007	0.14	<0.0005 U	<0.0005 U	–	<0.025 U	–
12-oct-1999	CN	a	V	–	0.008	0.17	<0.0005 U	<0.0005 U	–	<0.025 U	–
27-jan-2000	CN	a	V	–	0.006	0.11	<0.0005 LU	<0.0005 LU	–	<0.025 U	–
01-may-2000	CN	a	V	–	0.006	0.12	<0.0005 U	<0.0005 U	–	<0.025 U	–
10-aug-2000	CN	af	V	–	0.006	0.13	<0.0005 U	<0.0005 U	–	<0.025 U	–
02-nov-2000	CN	af	V	–	0.007	0.11	<0.0005 U	<0.0005 U	–	<0.025 U	–
25-jan-2001	CN	af	V	–	0.006	0.11	<0.0005 U	<0.0005 U	–	<0.025 U	–
26-apr-2001	CN	ah	V	–	–	–	–	–	–	–	<0.1 HU
26-apr-2001	CN	ah	V	–	0.007	0.11	<0.0005 U	<0.0005 U	–	<0.025 U	–
18-jul-2001	CN	a	V	–	0.005	0.12	<0.0005 U	<0.0005 U	–	<0.025 U	–
25-oct-2001	CN	a	V	–	0.008	0.11	<0.0005 U	<0.0005 U	–	<0.025 U	–
30-jan-2002	CN	a	V	–	0.007	0.11	<0.0005 U	<0.0005 U	–	<0.025 U	–
30-apr-2002	CN	af	V	–	–	–	–	–	–	–	<0.1 U
30-apr-2002	CN	a	V	–	0.007	0.12	<0.0005 U	<0.0005 LU	–	<0.025 U	–
12-sep-2002	CN	af	V	–	0.006	0.13	<0.0005 DU	<0.0005 U	–	<0.025 U	–
29-nov-2002	CN	af	V	–	0.006	0.14	<0.0005 DU	<0.0005 U	–	<0.025 U	–
11-feb-2003	CN	a	N	–	0.007	0.13	<0.0005 LDU	<0.0005 U	–	<0.025 U	–
06-may-2003	CN	af	V	–	–	–	–	–	–	–	<0.1 U
06-may-2003	CN	af	V	–	–	0.15	–	–	–	<0.025 U	–
NC7-49A											
13-may-1997	CS	a	V	–	0.012	0.086	–	<0.0005 U	0.0017	–	–
18-may-1998	CS	a	V	–	0.012	0.089	–	<0.0005 U	<0.001 U	–	–
21-may-1999	CN	a	V	–	0.015	0.084	–	<0.0005 LOU	<0.001 U	–	–
26-may-2000	CN	a	V	–	0.014	0.089	–	<0.0005 LU	<0.001 LU	–	–
21-may-2001	CN	a	V	–	0.014	0.093	–	<0.0005 U	<0.001 U	–	–
21-may-2001	CN	a	V	–	–	–	–	–	–	–	<0.1 HU
04-jun-2002	CN	af	V	–	0.015	0.09	–	<0.0005 U	<0.001 U	–	–
04-jun-2002	CN	af	V	–	–	–	–	–	–	–	<0.1 U
NC7-50											
14-may-1998	CS	af	V	–	0.0032	<0.025 U	–	<0.0005 U	0.0019	–	–
14-may-1998	CS	af	V	–	–	–	–	–	–	–	<0.1 U
16-jun-1999	CN	af	V	–	<0.002 U	<0.025 U	–	0.0008	<0.001 U	–	–
16-jun-1999	CN	af	V	–	–	–	–	–	–	–	<0.1 U
31-may-2000	CN	af	V	–	<0.002 U	<0.025 U	–	<0.0005 U	0.002 L	–	–
31-may-2000	CN	af	V	–	–	–	–	–	–	–	<0.1 U
25-apr-2001	CN	af	V	–	<0.002 LU	<0.025 U	–	0.0006	0.001	–	–
25-apr-2001	CN	af	V	–	–	–	–	–	–	–	<0.1 HU
28-may-2002	CN	af	V	–	0.004	0.028	–	0.005 D	0.001	–	–
28-may-2002	CN	af	V	–	–	–	–	–	–	–	0.2
NC7-51											
28-dec-1995	FS	ah	V	–	–	–	<0.002 U	–	–	–	–
28-dec-1995	FS	aeh	V	–	–	–	<0.002 U	–	–	–	–
12-jun-1996	BB	ag	V	–	–	–	<0.0005 U	–	–	–	–
12-jun-1996	CS	ag	V	–	–	–	<0.0005 U	–	–	–	–
13-jun-1996	CS	a	V	–	–	–	<0.0005 U	–	–	–	–
18-dec-1996	BB	aeg	V	–	–	–	<0.0002 U	–	–	–	–
18-dec-1996	CS	ag	V	–	–	–	<0.0005 UL	–	–	–	–

Pit7 Complex between July 1, 1995 and June 30, 2003. Results recorded by December 18, 2003.

Lead	Mercury	Molybdenum	Nickel	Selenium	Silver	Vanadium	Location Date
							(continued) NC7-48
<0.002 U	–	–	<0.005 UL	–	–	<0.025 U	30-jul-1997
<0.002 U	–	–	<0.005 UL	–	–	<0.025 U	30-jul-1997
<0.002 U	–	–	<0.005 U	–	–	0.021	28-oct-1997
–	–	–	–	–	–	0.02	13-nov-1997
<0.002 U	–	–	0.0076	–	–	<0.025 U	22-jan-1998
–	–	–	–	–	–	<0.05 U	23-feb-1998
–	–	–	–	–	–	0.017	23-feb-1998
–	–	–	–	–	–	0.022	23-mar-1998
<0.002 U	–	–	<0.005 ULO	–	–	0.022	28-apr-1998
–	–	–	–	–	–	0.018	27-may-1998
–	–	–	–	–	–	0.022	25-jun-1998
<0.002 U	–	–	<0.005 U	–	–	<0.025 U	31-jul-1998
–	–	–	–	–	–	0.022	24-aug-1998
–	–	–	–	–	–	0.023	23-sep-1998
<0.002 U	–	–	<0.005 U	–	–	<0.025 U	26-oct-1998
–	–	–	–	–	–	0.026	23-nov-1998
<0.002 U	–	–	<0.005 U	–	–	<0.025 U	28-jan-1999
<0.002 U	–	–	0.006	–	–	<0.025 U	04-may-1999
<0.002 U	–	–	<0.005 U	–	–	0.027	19-jul-1999
<0.002 U	–	–	<0.005 U	–	–	0.032	12-oct-1999
<0.002 U	–	–	<0.005 U	–	–	0.025	27-jan-2000
<0.002 U	–	–	<0.005 U	–	–	<0.025 U	01-may-2000
<0.002 U	–	–	<0.005 U	–	–	0.026	10-aug-2000
<0.002 U	–	–	<0.005 U	–	–	<0.025 U	02-nov-2000
<0.002 U	–	–	<0.005 U	–	–	<0.025 U	25-jan-2001
–	–	–	<0.1 HU	–	–	–	26-apr-2001
<0.002 U	–	–	<0.005 U	–	–	<0.025 U	26-apr-2001
<0.002 U	–	–	<0.005 U	–	–	<0.025 U	18-jul-2001
<0.002 U	–	–	<0.005 U	–	–	<0.025 U	25-oct-2001
<0.002 U	–	–	<0.005 U	–	–	<0.025 U	30-jan-2002
–	–	–	<0.1 U	–	–	–	30-apr-2002
<0.002 U	–	–	<0.005 U	–	–	<0.025 U	30-apr-2002
<0.002 U	–	–	<0.005 U	–	–	<0.025 U	12-sep-2002
<0.002 U	–	–	<0.005 U	–	–	<0.025 U	29-nov-2002
<0.002 U	–	–	<0.005 U	–	–	<0.025 U	11-feb-2003
–	–	–	<0.1 U	–	–	–	06-may-2003
–	–	–	–	–	–	<0.025 U	06-may-2003
							NC7-49A
<0.002 U	<0.0002 U	–	–	<0.002 U	<0.001 U	–	13-may-1997
<0.002 U	<0.0002 U	–	–	<0.002 U	<0.001 U	–	18-may-1998
<0.005 U	<0.0002 U	–	–	<0.002 U	<0.001 U	–	21-may-1999
<0.005 U	<0.0002 U	–	–	<0.002 U	<0.001 U	–	26-may-2000
<0.005 U	<0.0002 U	–	–	<0.002 U	<0.001 U	–	21-may-2001
–	–	–	<0.1 HU	–	–	–	21-may-2001
<0.005 U	<0.0002 U	–	–	<0.005 LU	<0.001 U	–	04-jun-2002
–	–	–	<0.1 U	–	–	–	04-jun-2002
							NC7-50
<0.002 U	<0.0002 U	–	–	0.031	<0.001 U	–	14-may-1998
–	–	–	<0.1 U	–	–	–	14-may-1998
<0.005 U	<0.0002 U	–	–	0.024 D	<0.001 U	–	16-jun-1999
–	–	–	<0.1 U	–	–	–	16-jun-1999
<0.005 U	<0.0002 U	–	–	0.022 D	<0.001 U	–	31-may-2000
–	–	–	<0.1 U	–	–	–	31-may-2000
<0.005 U	<0.0002 U	–	–	<0.002 U	<0.001 U	–	25-apr-2001
–	–	–	<0.1 HU	–	–	–	25-apr-2001
<0.005 U	<0.0002 U	–	–	0.021 L	<0.001 U	–	28-may-2002
–	–	–	<0.1 U	–	–	–	28-may-2002
							NC7-51
–	–	–	–	–	–	–	28-dec-1995
–	–	–	–	–	–	–	28-dec-1995
–	–	–	–	–	–	–	12-jun-1996
–	–	–	–	–	–	–	12-jun-1996
–	–	–	–	–	–	–	13-jun-1996
–	–	–	–	–	–	–	18-dec-1996
–	–	–	–	–	–	–	18-dec-1996

Table A-13. Ground and surface water analyses for metals (mg/L) in samples collected from the

Location Date	Lab	Note	Val.	Antimony	Arsenic	Barium	Beryllium	Cadmium	Total chromium	Cobalt	Iron
NC7-51 (continued)											
28-jan-1997	CS	a	V	-	0.0062	0.17	-	<0.0005 U	<0.001 LU	-	-
05-jun-1997	LH	a	V	-	<0.01 U	<0.2 U	-	<0.005 U	<0.01 U	-	-
25-jul-1997	LH	a	V	-	0.00535	0.19	-	<0.001 U	<0.001 U	-	-
07-nov-1997	LH	a	V	-	<0.01 U	0.227	-	<0.005 U	<0.01 U	-	-
09-mar-1998	QU	a	V	-	<0.3 U	0.257	-	<0.005 U	<0.01 U	-	-
29-apr-1998	QU	a	V	-	<0.3 U	<0.2 U	-	<0.005 U	<0.01 U	-	-
25-aug-1999	CN	a	V	-	0.005	0.19	-	<0.0005 LU	<0.001 LU	-	-
17-may-2001	CN	a	V	-	0.006	0.24	-	<0.0005 U	0.002	-	-
17-may-2001	CN	a	V	-	-	-	-	-	-	-	0.9 H
15-may-2002	CN	af	V	-	0.008 L	0.23	-	<0.0005 LU	0.001	-	-
15-may-2002	CN	af	V	-	-	-	-	-	-	-	0.5
NC7-52											
15-may-1997	CS	a	V	-	0.0021	<0.025 U	-	<0.0005 U	0.0012 L	-	-
18-may-1998	CS	a	V	-	0.0026	<0.025 U	-	<0.0005 U	<0.001 U	-	-
07-jun-1999	CN	a	V	-	0.004	0.046	-	<0.0005 OU	<0.001 U	-	-
15-jun-2000	CN	a	V	-	0.004	0.042	-	<0.0005 U	<0.001 U	-	-
23-may-2001	CN	a	V	-	0.003	0.035	-	<0.0005 U	<0.001 U	-	-
31-may-2002	CN	a	V	-	0.006	0.04	-	0.0012	<0.001 U	-	-
NC7-53											
05-jun-1996	CS	a	V	-	0.014	0.057	-	<0.0005 U	<0.001 U	-	-
05-jun-1996	CS	a	V	-	-	-	<0.0005 U	-	-	-	-
13-may-1997	CS	a	V	-	0.011	0.041	-	<0.0005 U	0.001	-	-
18-may-1998	CS	a	V	-	0.0095	0.058	-	<0.0005 U	<0.001 U	-	-
21-may-1999	CN	a	V	-	0.012	0.057	-	<0.0005 LOU	<0.001 U	-	-
23-may-2000	CN	a	V	-	0.01	0.058	-	<0.0005 U	0.001	-	-
21-may-2001	CN	a	V	-	0.009	0.065	-	<0.0005 U	<0.001 U	-	-
31-may-2002	CN	a	V	-	0.009	0.067	-	<0.0005 U	<0.001 U	-	-
NC7-60											
09-jun-1997	CS	a	V	-	0.019	0.025	-	<0.0005 U	0.0022	-	-
09-jun-1999	CN	af	V	-	0.016	0.028	-	<0.0005 U	<0.001 U	-	-
05-jun-2000	CN	a	V	-	0.017	0.03	-	<0.0005 U	0.002	-	-
23-may-2001	CN	a	V	-	0.016	0.028	-	0.0006	<0.001 U	-	-
29-may-2002	CN	a	V	-	0.017	0.031	-	<0.0005 U	<0.001 U	-	-
16-jun-2003	CN	a	V	-	0.015	0.036	-	0.0008	0.001	-	-
NC7-64											
29-nov-1995	CS	a	V	-	-	-	<0.0005 U	-	-	-	-
21-feb-1996	CS	a	V	-	0.013	0.12	<0.0005 U	<0.0005 U	<0.01 U	-	-
19-jun-1996	CS	a	V	-	-	-	<0.0005 U	-	-	-	-
13-sep-1996	CS	a	V	-	-	-	<0.0005 U	-	-	-	-
26-dec-1996	CS	a	V	-	-	-	<0.0005 U	-	-	-	-
29-may-1997	CS	a	V	-	0.01	0.14	-	<0.0005 U	<0.001 U	-	-
31-oct-1997	CS	a	V	-	0.0098	0.14	-	<0.0005 UL	<0.001 U	-	-
14-may-1998	CS	a	V	-	0.0098	0.15	-	<0.0005 U	<0.001 U	-	-
30-nov-1998	CS	a	V	-	0.01	0.17	-	<0.0005 U	<0.001 U	-	-
28-jun-1999	CN	a	V	-	0.01	0.13	-	0.0008	<0.001 U	-	-
29-nov-1999	CN	a	V	-	0.012	0.15	-	<0.0005 U	<0.001 U	-	-
15-jun-2000	CN	a	V	-	0.01	0.14	-	<0.0005 U	<0.001 U	-	-
20-nov-2000	CN	a	V	-	0.01	0.13	-	<0.0005 U	<0.001 U	-	-
23-may-2001	CN	a	V	-	0.01	0.13	-	<0.0005 U	<0.001 U	-	-
30-nov-2001	CN	a	V	-	0.01	0.13	-	<0.0005 U	<0.001 U	-	-
13-jun-2002	CN	a	V	-	0.01	0.13	-	<0.0005 U	<0.001 LU	-	-
07-dec-2002	CN	a	V	-	0.01	0.14	-	<0.0005 U	0.002	-	-
NC7-65											
19-may-1997	CS	a	V	-	0.011	<0.025 U	-	<0.0005 UL	<0.001 UO	-	-
21-may-1999	CN	a	V	-	0.01	0.032	-	<0.0005 LOU	<0.001 U	-	-
26-may-2000	CN	a	V	-	0.012	0.035	-	<0.0005 LU	<0.001 LU	-	-
14-jun-2001	CN	a	V	-	0.008	0.036	-	<0.0005 U	<0.001 U	-	-
31-may-2002	CN	a	V	-	0.009	0.043	-	<0.0005 U	<0.001 U	-	-
NC7-67											
28-dec-1995	FS	a	V	-	-	-	<0.002 U	-	-	-	-
11-jun-1996	CS	a	V	-	-	-	<0.0005 U	-	-	-	-
19-dec-1996	CS	a	V	-	-	-	<0.0005 U	-	-	-	-

Pit7 Complex between July 1, 1995 and June 30, 2003. Results recorded by December 18, 2003.

Lead	Mercury	Molybdenum	Nickel	Selenium	Silver	Vanadium	Location Date
							(continued) NC7-51
<0.002 U	<0.0002 U	-	-	<0.002 LU	<0.001 LU	-	28-jan-1997
<0.003 U	<0.0002 U	-	-	<0.005 U	<0.01 U	-	05-jun-1997
<0.005 U	<0.0002 U	-	-	<0.003 U	<0.001 U	-	25-jul-1997
<0.003 U	<0.0002 U	-	-	0.00542 L	<0.01 U	-	07-nov-1997
<0.1 U	<0.0002 U	-	-	<0.25 U	<0.01 U	-	09-mar-1998
<0.1 U	<0.0002 U	-	-	<0.25 U	<0.01 U	-	29-apr-1998
<0.005 U	<0.0002 U	-	-	<0.002 U	<0.001 U	-	25-aug-1999
<0.005 U	<0.0002 U	-	-	<0.002 U	<0.001 U	-	17-may-2001
-	-	-	<0.1 HU	-	-	-	17-may-2001
<0.005 U	<0.0002 U	-	-	<0.005 LU	<0.001 LU	-	15-may-2002
-	-	-	<0.1 U	-	-	-	15-may-2002
							NC7-52
<0.002 U	<0.0002 U	-	-	<0.002 U	<0.001 U	-	15-may-1997
<0.002 U	<0.0002 U	-	-	0.0022	<0.001 U	-	18-may-1998
<0.005 U	<0.0002 U	-	-	<0.002 U	<0.001 U	-	07-jun-1999
<0.005 U	<0.0002 U	-	-	<0.002 OU	<0.001 U	-	15-jun-2000
<0.005 U	<0.0002 U	-	-	<0.002 LU	<0.001 U	-	23-may-2001
<0.005 U	<0.0002 U	-	-	<0.005 LU	<0.001 U	-	31-may-2002
							NC7-53
0.0045	<0.0002 U	-	-	<0.002 ULO	<0.001 U	-	05-jun-1996
-	-	-	-	-	-	-	05-jun-1996
<0.002 U	<0.0002 U	-	-	<0.002 U	<0.001 U	-	13-may-1997
<0.002 U	<0.0002 U	-	-	<0.002 U	<0.001 U	-	18-may-1998
<0.005 U	<0.0002 U	-	-	<0.002 U	<0.001 U	-	21-may-1999
<0.005 LU	<0.0002 LU	-	-	<0.002 U	<0.001 U	-	23-may-2000
<0.005 U	<0.0002 U	-	-	<0.002 U	<0.001 U	-	21-may-2001
<0.005 U	<0.0002 U	-	-	<0.005 LU	<0.001 U	-	31-may-2002
							NC7-60
<0.002 U	<0.0002 UL	-	-	<0.002 U	<0.001 U	-	09-jun-1997
<0.005 U	<0.0002 U	-	-	<0.002 U	<0.001 U	-	09-jun-1999
<0.005 U	<0.0002 U	-	-	<0.002 U	<0.001 U	-	05-jun-2000
<0.005 U	<0.0002 U	-	-	<0.002 LU	<0.001 U	-	23-may-2001
<0.005 U	<0.0002 U	-	-	-	<0.001 U	-	29-may-2002
<0.005 U	<0.0002 LU	-	-	<0.005 U	<0.001 U	-	16-jun-2003
							NC7-64
-	-	-	-	-	-	-	29-nov-1995
<0.002 U	<0.0002 U	-	-	<0.002 U	<0.001 U	-	21-feb-1996
-	-	-	-	-	-	-	19-jun-1996
-	-	-	-	-	-	-	13-sep-1996
-	-	-	-	-	-	-	26-dec-1996
<0.002 U	<0.0002 U	-	-	<0.002 U	<0.001 U	-	29-may-1997
<0.002 U	<0.0002 UO	-	-	<0.002 U	<0.001 U	-	31-oct-1997
<0.002 U	<0.0002 U	-	-	0.0021	<0.001 U	-	14-may-1998
<0.002 U	<0.0002 U	-	-	<0.002 U	<0.001 U	-	30-nov-1998
<0.005 U	<0.0002 U	-	-	<0.002 U	<0.001 U	-	28-jun-1999
<0.005 U	<0.0002 U	-	-	<0.002 U	<0.001 U	-	29-nov-1999
<0.005 U	<0.0002 U	-	-	<0.002 OU	<0.001 U	-	15-jun-2000
<0.005 U	<0.0002 U	-	-	0.003	<0.001 U	-	20-nov-2000
<0.005 U	<0.0002 U	-	-	<0.002 LU	<0.001 U	-	23-may-2001
<0.005 U	<0.0002 U	-	-	<0.005 U	<0.001 LU	-	30-nov-2001
<0.005 U	<0.0002 U	-	-	0.002	<0.001 U	-	13-jun-2002
<0.005 U	<0.0002 U	-	-	<0.005 U	<0.001 U	-	07-dec-2002
							NC7-65
<0.002 U	<0.0002 U	-	-	<0.002 UL	<0.001 U	-	19-may-1997
<0.005 U	<0.0002 U	-	-	<0.002 U	<0.001 U	-	21-may-1999
<0.005 U	<0.0002 U	-	-	<0.002 U	<0.001 U	-	26-may-2000
<0.005 U	<0.0002 U	-	-	<0.002 U	<0.001 U	-	14-jun-2001
<0.005 U	<0.0002 U	-	-	<0.005 LU	<0.001 U	-	31-may-2002
							NC7-67
-	-	-	-	-	-	-	28-dec-1995
-	-	-	-	-	-	-	11-jun-1996
-	-	-	-	-	-	-	19-dec-1996

Table A-13. Ground and surface water analyses for metals (mg/L) in samples collected from the

Location Date	Lab	Note	Val.	Antimony	Arsenic	Barium	Beryllium	Cadmium	Total chromium	Cobalt	Iron
NC7-67 (continued)											
12-may-1997	CS	ah	V	–	0.004	0.062	–	<0.0005 U	<0.001 U	–	–
12-may-1997	CS	aeh	V	–	0.0043	0.062	–	<0.0005 U	<0.001 U	–	–
20-may-1998	BB	afg	N	–	0.0029	0.07	–	<0.0005 U	<0.001 U	–	–
20-may-1998	CS	ag	V	–	0.0036	0.066	–	<0.0005 U	<0.001 U	–	–
01-jul-1999	CN	ah	V	–	0.004	<0.025 U	–	<0.0005 U	0.001	–	–
01-jul-1999	CN	aeh	V	–	0.004	<0.025 U	–	<0.0005 U	<0.001 U	–	–
01-jun-2000	BB	ag	V	–	0.004	<0.1 U	–	<0.0005 U	<0.001 U	–	–
01-jun-2000	CN	ag	V	–	0.003	0.025	–	<0.0005 U	<0.001 LU	–	–
24-may-2001	CN	a	V	–	0.004	0.065	–	<0.0005 U	<0.001 U	–	–
NC7-75											
09-nov-1995	CS	a	V	–	–	0.085	<0.0005 U	–	–	–	–
30-may-1996	CS	a	V	–	–	0.099	–	–	–	–	–
30-may-1996	CS	a	V	–	–	–	<0.0005 U	–	–	–	–
30-may-1996	CS	a	V	–	–	–	–	–	–	–	–
16-dec-1996	CS	a	V	–	–	0.11	–	–	–	–	–
16-dec-1996	CS	a	V	–	–	–	<0.0005 U	–	–	–	–
16-dec-1996	CS	a	V	–	–	–	–	–	–	–	–
27-may-1997	CS	a	V	–	0.016	0.081	–	<0.0005 U	<0.001 U	–	–
31-oct-1997	CS	a	V	–	0.015	0.11	–	<0.0005 UL	<0.001 U	–	–
01-jun-1998	CS	a	V	–	0.016	0.08	–	<0.0005 U	0.0012	–	–
09-dec-1998	CS	a	V	–	0.011	0.16	–	<0.0005 U	<0.001 U	–	–
16-jun-1999	CN	a	V	–	0.013	0.2	–	<0.0005 U	0.001	–	–
05-jun-2000	CN	a	V	–	0.017	0.11	–	<0.0005 U	<0.001 U	–	–
27-nov-2000	CN	a	V	–	0.012	0.07	–	<0.0005 U	<0.001 U	–	–
24-may-2001	CN	a	V	–	0.014	0.063	–	<0.0005 U	<0.001 U	–	–
27-nov-2001	CN	a	V	–	0.013	0.062	–	<0.0005 U	<0.001 U	–	–
31-may-2002	CN	a	V	–	0.017	0.063	–	<0.0005 U	<0.001 U	–	–
14-dec-2002	BB	a	V	–	0.015	0.062 L	–	<0.0005 U	<0.001 U	–	–
W-PIT7-02											
15-may-1997	CS	a	V	–	0.0093	0.05	–	<0.0005 U	<0.001 UL	–	–
16-oct-1997	CS	aj	V	–	0.0057 L	0.061	–	<0.0005 UL	0.0058 L	–	–
30-apr-1998	CS	a	V	–	0.0078	0.058	–	<0.0005 U	<0.001 U	–	–
20-nov-1998	CS	a	V	–	0.0066	0.07	–	<0.0005 U	<0.001 U	–	–
16-jun-1999	CN	a	V	–	0.005	0.068	–	<0.0005 U	<0.001 U	–	–
29-nov-1999	CN	a	V	–	0.008	0.066	–	<0.0005 U	<0.001 U	–	–
16-jun-2000	CN	a	V	–	0.006	0.084	–	<0.0005 LU	0.002 L	–	–
27-nov-2000	BB	ag	V	–	0.005	0.073	–	<0.0005 U	<0.001 U	–	–
27-nov-2000	CN	ag	V	–	0.006	0.062	–	<0.0005 U	<0.001 U	–	–
14-jun-2001	CN	a	V	–	0.007	0.064	–	<0.0005 U	0.002	–	–
26-nov-2001	CN	ah	V	–	0.008	0.066	–	<0.0005 U	<0.001 U	–	–
26-nov-2001	CN	aeh	V	–	0.007	0.068	–	<0.0005 U	<0.001 U	–	–
23-may-2002	CN	a	V	–	0.006	0.066	–	<0.0005 U	<0.001 LU	–	–
21-dec-2002	CN	a	V	–	0.007	0.07	–	<0.0005 U	<0.001 U	–	–
W-PIT7-03											
30-may-1997	BB	a	V	–	0.012	0.244	–	<0.0005 U	<0.001 U	–	–
30-may-1997	CS	a	V	–	0.014	0.24	–	<0.0005 U	0.0012	–	–
31-oct-1997	CS	a	V	–	0.013	0.21	–	<0.0005 UL	<0.001 U	–	–
30-apr-1998	CS	a	V	–	0.013	0.22	–	<0.0005 U	<0.001 U	–	–
23-nov-1998	CS	a	V	–	0.013	0.2	–	<0.0005 U	<0.001 UL	–	–
01-jul-1999	CN	a	V	–	0.014	0.21	–	<0.0005 U	<0.001 U	–	–
29-nov-1999	CN	a	V	–	0.015	0.22	–	<0.0005 U	<0.001 U	–	–
19-jun-2000	BB	ag	V	–	0.016	0.22	–	<0.0005 U	<0.001 U	–	–
19-jun-2000	CN	ag	V	–	0.013	0.22	–	<0.0005 LU	<0.001 LU	–	–
27-nov-2000	CN	a	V	–	0.014	0.2	–	<0.0005 U	0.002	–	–
18-jun-2001	CN	a	V	–	0.015	0.2	–	<0.0005 U	<0.001 U	–	–
26-nov-2001	CN	a	V	–	0.014	0.21	–	<0.0005 U	<0.001 U	–	–
01-jul-2002	CN	af	V	–	0.014	0.2	–	<0.0005 U	<0.001 DU	–	–
21-dec-2002	CN	a	V	–	0.015	0.21	–	<0.0005 U	<0.001 U	–	–
W-PIT7-10											
15-may-1997	CS	a	V	–	0.015	0.056	–	<0.0005 U	0.0014 L	–	–
30-apr-1998	CS	a	V	–	0.014	0.061	–	<0.0005 U	<0.001 U	–	–
24-may-1999	CN	a	V	–	0.014	0.057	–	<0.0005 U	0.001	–	–
23-may-2000	CN	a	V	–	0.016	0.056	–	<0.0005 U	<0.001 U	–	–
21-may-2001	CN	a	V	–	0.015	0.065	–	<0.0005 U	<0.001 U	–	–

Pit7 Complex between July 1, 1995 and June 30, 2003. Results recorded by December 18, 2003.

Lead	Mercury	Molybdenum	Nickel	Selenium	Silver	Vanadium	Location Date
							(continued) NC7-67
<0.002 U	<0.0002 U	–	–	<0.002 U	<0.001 U	–	12-may-1997
<0.002 U	<0.0002 U	–	–	<0.002 U	<0.001 U	–	12-may-1997
<0.005 DU	<0.0002 U	–	–	<0.002 U	<0.001 U	–	20-may-1998
<0.002 U	<0.0002 U	–	–	<0.002 U	<0.001 U	–	20-may-1998
<0.005 LU	<0.0002 U	–	–	<0.002 U	<0.001 U	–	01-jul-1999
<0.005 LU	<0.0002 U	–	–	<0.002 U	<0.001 U	–	01-jul-1999
<0.005 U	<0.0002 U	–	–	<0.002 U	<0.001 U	–	01-jun-2000
<0.005 U	<0.0002 U	–	–	<0.002 U	<0.001 U	–	01-jun-2000
<0.005 U	<0.0002 U	–	–	<0.002 LU	<0.001 U	–	24-may-2001
							NC7-75
<0.002 U	–	–	–	–	–	–	09-nov-1995
–	–	–	–	–	–	–	30-may-1996
–	–	–	–	–	–	–	30-may-1996
<0.002 U	–	–	–	–	–	–	30-may-1996
–	–	–	–	–	–	–	16-dec-1996
–	–	–	–	–	–	–	16-dec-1996
<0.002 U	–	–	–	–	–	–	16-dec-1996
<0.002 U	<0.0002 U	–	–	<0.002 U	<0.001 U	–	27-may-1997
<0.002 U	<0.0002 UO	–	–	<0.002 U	<0.001 U	–	31-oct-1997
<0.002 U	<0.0002 U	–	–	<0.002 UL	<0.001 UL	–	01-jun-1998
<0.002 U	<0.0002 U	–	–	<0.002 U	<0.001 U	–	09-dec-1998
<0.005 U	<0.0002 U	–	–	<0.002 U	<0.001 U	–	16-jun-1999
0.008	<0.0002 U	–	–	<0.002 U	<0.001 U	–	05-jun-2000
<0.005 LU	<0.0002 U	–	–	<0.002 LU	<0.001 U	–	27-nov-2000
<0.005 U	<0.0002 U	–	–	<0.002 LU	<0.001 U	–	24-may-2001
<0.005 U	<0.0002 LU	–	–	<0.005 LU	<0.001 U	–	27-nov-2001
<0.005 U	<0.0002 U	–	–	<0.005 LU	<0.001 U	–	31-may-2002
<0.005 U	<0.0002 U	–	–	<0.002 U	<0.001 U	–	14-dec-2002
							W-PIT7-02
<0.002 U	<0.0002 U	–	–	<0.002 U	<0.001 U	–	15-may-1997
<0.002 UL	<0.0002 U	–	–	<0.002 U	<0.001 UL	–	16-oct-1997
<0.002 U	<0.0002 U	–	–	<0.002 U	<0.001 U	–	30-apr-1998
<0.002 U	<0.0002 U	–	–	<0.002 U	<0.001 U	–	20-nov-1998
<0.005 U	<0.0002 U	–	–	<0.002 U	<0.001 U	–	16-jun-1999
<0.005 U	<0.0002 U	–	–	<0.002 U	<0.001 U	–	29-nov-1999
<0.005 JLU	<0.0002 U	–	–	<0.002 U	<0.001 U	–	16-jun-2000
<0.005 U	<0.0002 U	–	–	<0.002 U	<0.001 U	–	27-nov-2000
<0.005 LU	<0.0002 U	–	–	<0.002 LU	<0.001 U	–	27-nov-2000
<0.005 U	<0.0002 U	–	–	<0.002 U	<0.001 U	–	14-jun-2001
<0.005 U	<0.0002 LU	–	–	<0.005 LU	<0.001 U	–	26-nov-2001
<0.005 U	<0.0002 LU	–	–	<0.005 LU	<0.001 U	–	26-nov-2001
<0.005 U	<0.0002 U	–	–	<0.005 LU	<0.001 U	–	23-may-2002
<0.005 U	<0.0002 U	–	–	<0.005 U	<0.001 U	–	21-dec-2002
							W-PIT7-03
<0.005 U	<0.0002 U	–	–	<0.005 U	<0.001 U	–	30-may-1997
<0.002 U	<0.0002 U	–	–	<0.002 U	<0.001 U	–	30-may-1997
<0.002 U	<0.0002 UO	–	–	<0.002 U	<0.001 U	–	31-oct-1997
<0.002 U	<0.0002 U	–	–	<0.002 U	<0.001 U	–	30-apr-1998
<0.002 U	<0.0002 UL	–	–	<0.002 U	<0.001 U	–	23-nov-1998
<0.005 LU	<0.0002 U	–	–	<0.002 U	<0.001 U	–	01-jul-1999
<0.005 U	<0.0002 U	–	–	<0.002 U	<0.001 U	–	29-nov-1999
<0.005 U	<0.0002 U	–	–	<0.002 U	<0.001 U	–	19-jun-2000
<0.005 LU	<0.0002 U	–	–	<0.002 U	<0.001 U	–	19-jun-2000
<0.005 LU	<0.0002 U	–	–	<0.002 LU	<0.001 U	–	27-nov-2000
<0.005 U	<0.0002 U	–	–	<0.002 U	<0.001 U	–	18-jun-2001
<0.005 U	<0.0002 LU	–	–	<0.005 LU	<0.001 U	–	26-nov-2001
<0.005 U	<0.0002 U	–	–	<0.005 U	<0.001 U	–	01-jul-2002
<0.005 U	<0.0002 U	–	–	<0.005 U	<0.001 U	–	21-dec-2002
							W-PIT7-10
<0.002 U	<0.0002 U	–	–	<0.002 U	<0.001 U	–	15-may-1997
<0.002 U	<0.0002 U	–	–	<0.002 U	<0.001 U	–	30-apr-1998
<0.005 U	<0.0002 U	–	–	<0.002 U	<0.001 U	–	24-may-1999
<0.005 LU	<0.0002 LU	–	–	<0.002 U	<0.001 U	–	23-may-2000
<0.005 U	<0.0002 U	–	–	<0.002 U	<0.001 U	–	21-may-2001

Table A-13. Ground and surface water analyses for metals (mg/L) in samples collected from the

Location Date	Lab	Note	Val.	Antimony	Arsenic	Barium	Beryllium	Cadmium	Total chromium	Cobalt	Iron
W-PIT7-10 (continued)											
03-jun-2002	CN	a	V	–	0.015	0.065	–	<0.0005 U	<0.001 U	–	–
W-PIT7-12											
18-mar-1999	BB	a	V	–	0.01 D	0.029	–	<0.0005 U	0.0015 D	–	–
18-mar-1999	BB	a	V	–	–	–	–	–	–	–	<0.05 U
W-PIT7-13											
30-mar-2001	BB	af	V	–	0.006	0.04	–	<0.0005 U	<0.001 U	–	–
30-mar-2001	BB	af	V	–	–	–	–	–	–	–	<0.05 U
W-PIT7-15											
20-mar-2001	CN	af	V	–	0.004	0.033	–	<0.0005 U	<0.001 U	–	–
20-mar-2001	CN	af	V	–	–	–	–	–	–	–	<0.1 HU
W-PIT7-16											
28-mar-2001	CN	a	V	–	0.005	<0.025 U	–	<0.0005 LU	0.001	–	–
28-mar-2001	CN	a	V	–	–	–	–	–	–	–	<0.1 HU
W-PIT7-1714											
27-mar-2002	CN	af	V	–	0.086 D	0.25	–	<0.0005 LU	0.015 D	–	–
27-mar-2002	CN	af	V	–	–	–	–	–	–	–	<0.1 U
W-PIT7-1715											
27-mar-2002	CN	af	V	–	0.012	0.058	–	<0.0005 LU	0.002	–	–
27-mar-2002	CN	af	V	–	–	–	–	–	–	–	0.2
03-jul-2002	CN	a	N	–	0.004	<0.025 U	–	<0.0005 U	<0.001 U	–	–
W-PIT7-1717											
28-mar-2002	CN	af	V	–	0.004	0.053	–	0.0011 L	0.004	–	–
28-mar-2002	CN	af	V	–	–	–	–	–	–	–	<0.1 U
W-PIT7-1718											
03-jul-2002	CN	af	N	–	0.012	<0.025 U	–	<0.0005 U	<0.001 DU	–	–
03-jul-2002	CN	af	N	–	–	–	–	–	–	–	<0.1 U
W-PIT7-1720											
27-mar-2002	CN	af	V	–	–	–	–	–	–	–	<0.1 U
W-PIT7-1723											
26-mar-2002	CN	af	V	–	0.005	0.033	–	<0.0005 LU	<0.001 U	–	–
26-mar-2002	CN	af	V	–	–	–	–	–	–	–	<0.1 U
W-PIT7-1724											
26-mar-2002	CN	af	V	–	0.024	0.19	–	<0.0005 DLU	0.034 D	–	–
26-mar-2002	CN	af	V	–	–	–	–	–	–	–	<0.1 U
W-PIT7-1903											
11-apr-2003	BB	af	V	–	–	–	–	–	–	–	0.084
02-may-2003	BB	af	V	–	–	–	–	–	–	–	<0.05 U
06-jun-2003	BB	af	V	–	–	–	–	–	–	–	<0.05 U
W-PIT7-1904											
11-apr-2003	BB	af	V	–	–	–	–	–	–	–	<0.05 U
02-may-2003	BB	af	V	–	–	–	–	–	–	–	<0.05 U
06-jun-2003	BB	af	V	–	–	–	–	–	–	–	<0.05 U
W-PIT7-1905											
11-apr-2003	BB	af	V	–	–	–	–	–	–	–	<0.05 U
02-may-2003	BB	af	V	–	–	–	–	–	–	–	<0.05 U
06-jun-2003	BB	af	V	–	–	–	–	–	–	–	<0.05 U
W-PIT7-1907											
11-apr-2003	BB	af	V	–	–	–	–	–	–	–	<0.1 DU
02-may-2003	BB	af	V	–	–	–	–	–	–	–	<0.05 U
06-jun-2003	BB	af	V	–	–	–	–	–	–	–	<0.05 U

Pit7 Complex between July 1, 1995 and June 30, 2003. Results recorded by December 18, 2003.

Lead	Mercury	Molybdenum	Nickel	Selenium	Silver	Vanadium	Location Date
							(continued) W-PIT7-10
<0.005 U	<0.0002 U	–	–	<0.005 LU	<0.001 U	–	03-jun-2002
							W-PIT7-12
<0.005 DU	<0.0002 U	–	–	0.0034	<0.001 U	–	18-mar-1999
–	–	–	<0.05 U	–	–	–	18-mar-1999
							W-PIT7-13
<0.005 U	<0.0002 U	–	–	<0.002 U	<0.001 U	–	30-mar-2001
–	–	–	<0.05 U	–	–	–	30-mar-2001
							W-PIT7-15
<0.005 U	<0.0002 U	–	–	<0.002 U	<0.001 U	–	20-mar-2001
–	–	–	<0.1 HU	–	–	–	20-mar-2001
							W-PIT7-16
<0.005 U	<0.0002 LU	–	–	<0.002 U	<0.001 U	–	28-mar-2001
–	–	–	<0.1 HU	–	–	–	28-mar-2001
							W-PIT7-1714
<0.005 LU	<0.0002 U	–	–	<0.005 LU	<0.001 LU	–	27-mar-2002
–	–	–	<0.1 U	–	–	–	27-mar-2002
							W-PIT7-1715
<0.005 LU	<0.0002 U	–	–	<0.005 LU	<0.001 LU	–	27-mar-2002
–	–	–	<0.1 U	–	–	–	27-mar-2002
<0.005 U	<0.0002 U	–	–	<0.005 U	<0.001 U	–	03-jul-2002
							W-PIT7-1717
<0.005 LU	<0.0002 U	–	–	<0.005 LOU	<0.001 LU	–	28-mar-2002
–	–	–	<0.1 U	–	–	–	28-mar-2002
							W-PIT7-1718
<0.005 U	<0.0002 U	–	–	<0.005 U	<0.001 U	–	03-jul-2002
–	–	–	<0.1 U	–	–	–	03-jul-2002
							W-PIT7-1720
–	–	–	<0.1 U	–	–	–	27-mar-2002
							W-PIT7-1723
<0.005 LU	<0.0002 U	–	–	–	<0.001 LU	–	26-mar-2002
–	–	–	<0.1 U	–	–	–	26-mar-2002
							W-PIT7-1724
<0.005 DLU	<0.0002 U	–	–	–	<0.001 LU	–	26-mar-2002
–	–	–	<0.1 U	–	–	–	26-mar-2002
							W-PIT7-1903
–	–	–	<0.05 U	–	–	–	11-apr-2003
–	–	–	<0.05 U	–	–	–	02-may-2003
–	–	–	<0.05 U	–	–	–	06-jun-2003
							W-PIT7-1904
–	–	–	<0.05 U	–	–	–	11-apr-2003
–	–	–	<0.05 U	–	–	–	02-may-2003
–	–	–	<0.05 U	–	–	–	06-jun-2003
							W-PIT7-1905
–	–	–	<0.05 U	–	–	–	11-apr-2003
–	–	–	<0.05 U	–	–	–	02-may-2003
–	–	–	<0.05 U	–	–	–	06-jun-2003
							W-PIT7-1907
–	–	–	<0.05 DU	–	–	–	11-apr-2003
–	–	–	<0.05 U	–	–	–	02-may-2003
–	–	–	<0.05 U	–	–	–	06-jun-2003

Table A-13. Ground and surface water analyses for metals (mg/L) in samples collected from the

Location Date	Lab	Note	Val.	Antimony	Arsenic	Barium	Beryllium	Cadmium	Total chromium	Cobalt	Iron
W-PIT7-1915											
11-apr-2003	BB	af	V	–	–	–	–	–	–	–	<0.25 DU
02-may-2003	BB	af	V	–	–	–	–	–	–	–	<0.05 U
06-jun-2003	BB	af	V	–	–	–	–	–	–	–	<0.1 DU
W-PIT7-1916											
11-apr-2003	BB	af	V	–	–	–	–	–	–	–	<0.05 U
02-may-2003	BB	af	V	–	–	–	–	–	–	–	<0.05 U
06-jun-2003	BB	af	V	–	–	–	–	–	–	–	<0.05 U
W-PIT7-1917											
11-apr-2003	BB	af	V	–	–	–	–	–	–	–	<0.05 U
02-may-2003	BB	af	V	–	–	–	–	–	–	–	<0.05 U
06-jun-2003	BB	af	V	–	–	–	–	–	–	–	<0.05 U
W-PIT7-1918											
11-apr-2003	BB	af	V	–	–	–	–	–	–	–	<0.05 U
02-may-2003	BB	af	V	–	–	–	–	–	–	–	<0.05 U
06-jun-2003	BB	af	V	–	–	–	–	–	–	–	<0.05 U
W-PIT7-1919											
11-apr-2003	BB	af	V	–	–	–	–	–	–	–	<0.05 U
02-may-2003	BB	af	V	–	–	–	–	–	–	–	<0.05 U
06-jun-2003	BB	af	V	–	–	–	–	–	–	–	<0.05 U
W-865-01											
30-mar-1999	BB	a	V	–	0.006	<0.025 U	–	<0.0005 U	<0.001 U	–	–
30-mar-1999	BB	a	V	–	–	–	–	–	–	–	<0.05 U
14-aug-2001	CN	af	V	–	–	–	–	–	–	–	<0.1 U
31-oct-2001	CN	af	V	–	–	–	–	–	–	–	<0.1 LU
31-jan-2002	CN	a	V	–	–	–	–	–	–	–	<0.1 U
30-may-2002	CN	a	V	–	–	–	–	–	–	–	<0.1 HU
31-jul-2002	CN	af	V	–	–	–	–	–	–	–	<0.1 U
19-feb-2003	CN	af	V	–	–	–	–	–	–	–	0.1 L
29-may-2003	CN	af	V	–	–	–	–	–	–	–	<0.1 U
29-may-2003	CN	af	V	<0.06 U	0.006	0.08	<0.002 U	<0.005 U	<0.01 U	<0.025 U	–
W-865-03											
29-sep-2000	CN	af	V	–	0.02	0.03	–	<0.0005 U	<0.001 U	–	–
29-sep-2000	CN	af	V	–	–	–	–	–	–	–	<0.1 U
14-aug-2001	CN	af	V	–	–	–	–	–	–	–	<0.1 U
30-oct-2001	CN	af	V	–	–	–	–	–	–	–	<0.1 U
31-jan-2002	CN	a	V	–	–	–	–	–	–	–	<0.1 U
30-may-2002	CN	a	V	–	–	–	–	–	–	–	<0.1 HU
31-jul-2002	CN	af	V	–	–	–	–	–	–	–	<0.1 U
19-feb-2003	CN	af	V	–	–	–	–	–	–	–	0.1 L
29-may-2003	CN	af	V	–	–	–	–	–	–	–	<0.1 U
29-may-2003	CN	af	V	<0.06 U	0.018	0.03	<0.002 U	<0.005 U	<0.01 U	<0.025 U	–
W-865-04											
28-sep-2000	CN	af	V	–	0.006	<0.025 U	–	<0.0005 U	0.001	–	–
28-sep-2000	CN	af	V	–	–	–	–	–	–	–	<0.1 U
14-aug-2001	CN	af	V	–	–	–	–	–	–	–	<0.1 U
30-oct-2001	CN	af	V	–	–	–	–	–	–	–	<0.1 U
31-jan-2002	CN	a	V	–	–	–	–	–	–	–	<0.1 U
23-may-2002	CN	af	V	–	–	–	–	–	–	–	<0.1 U
31-jul-2002	CN	af	V	–	–	–	–	–	–	–	<0.1 U
19-feb-2003	CN	af	V	–	–	–	–	–	–	–	<0.1 LU
29-may-2003	CN	af	V	–	–	–	–	–	–	–	<0.1 U
29-may-2003	CN	af	V	<0.06 U	0.005	<0.01 U	<0.002 U	<0.005 U	<0.01 U	<0.025 U	–
W-865-07											
29-sep-2000	CN	af	V	–	0.016	0.043	–	<0.0005 U	<0.001 U	–	–
29-sep-2000	CN	af	V	–	–	–	–	–	–	–	<0.1 U
14-aug-2001	CN	af	V	–	–	–	–	–	–	–	<0.1 U
30-oct-2001	CN	af	V	–	–	–	–	–	–	–	<0.1 U
31-jan-2002	CN	a	V	–	–	–	–	–	–	–	<0.1 U
23-may-2002	CN	af	V	–	–	–	–	–	–	–	<0.1 U
31-jul-2002	CN	af	V	–	–	–	–	–	–	–	<0.1 U

Pit7 Complex between July 1, 1995 and June 30, 2003. Results recorded by December 18, 2003.

Lead	Mercury	Molybdenum	Nickel	Selenium	Silver	Vanadium	Location Date
							W-PIT7-1915
-	-	-	<0.05 DU	-	-	-	11-apr-2003
-	-	-	<0.05 U	-	-	-	02-may-2003
-	-	-	<0.05 DU	-	-	-	06-jun-2003
							W-PIT7-1916
-	-	-	<0.05 U	-	-	-	11-apr-2003
-	-	-	<0.05 U	-	-	-	02-may-2003
-	-	-	<0.05 U	-	-	-	06-jun-2003
							W-PIT7-1917
-	-	-	<0.05 U	-	-	-	11-apr-2003
-	-	-	<0.05 U	-	-	-	02-may-2003
-	-	-	<0.05 U	-	-	-	06-jun-2003
							W-PIT7-1918
-	-	-	<0.05 U	-	-	-	11-apr-2003
-	-	-	<0.05 U	-	-	-	02-may-2003
-	-	-	<0.05 U	-	-	-	06-jun-2003
							W-PIT7-1919
-	-	-	<0.05 U	-	-	-	11-apr-2003
-	-	-	<0.05 U	-	-	-	02-may-2003
-	-	-	<0.05 U	-	-	-	06-jun-2003
							W-865-01
<0.005 U	<0.0002 U	-	-	<0.002 U	<0.001 U	-	30-mar-1999
-	-	-	<0.05 U	-	-	-	30-mar-1999
-	-	-	<0.1 U	-	-	-	14-aug-2001
-	-	-	<0.1 U	-	-	-	31-oct-2001
-	-	-	<0.1 U	-	-	-	31-jan-2002
-	-	-	<0.1 HU	-	-	-	30-may-2002
-	-	-	<0.1 U	-	-	-	31-jul-2002
-	-	-	<0.1 U	-	-	-	19-feb-2003
-	-	-	<0.1 U	-	-	-	29-may-2003
<0.003 U	<0.0002 U	<0.02 U	<0.02 U	<0.005 U	<0.005 U	<0.5 U	29-may-2003
							W-865-03
<0.005 U	<0.0002 U	-	-	<0.002 U	<0.001 LU	-	29-sep-2000
-	-	-	<0.1 U	-	-	-	29-sep-2000
-	-	-	<0.1 U	-	-	-	14-aug-2001
-	-	-	<0.1 U	-	-	-	30-oct-2001
-	-	-	<0.1 U	-	-	-	31-jan-2002
-	-	-	<0.1 HU	-	-	-	30-may-2002
-	-	-	<0.1 U	-	-	-	31-jul-2002
-	-	-	<0.1 U	-	-	-	19-feb-2003
-	-	-	<0.1 U	-	-	-	29-may-2003
<0.003 U	<0.0002 U	<0.02 U	<0.02 U	<0.005 U	<0.005 U	<0.5 U	29-may-2003
							W-865-04
<0.005 U	<0.0002 U	-	-	<0.002 U	<0.001 LU	-	28-sep-2000
-	-	-	<0.1 U	-	-	-	28-sep-2000
-	-	-	<0.1 U	-	-	-	14-aug-2001
-	-	-	<0.1 U	-	-	-	30-oct-2001
-	-	-	<0.1 U	-	-	-	31-jan-2002
-	-	-	<0.1 U	-	-	-	23-may-2002
-	-	-	<0.1 U	-	-	-	31-jul-2002
-	-	-	<0.1 U	-	-	-	19-feb-2003
-	-	-	<0.1 U	-	-	-	29-may-2003
<0.003 U	<0.0002 U	<0.02 U	<0.02 U	<0.005 U	<0.005 U	<0.5 U	29-may-2003
							W-865-07
<0.005 U	<0.0002 U	-	-	0.002	<0.001 LU	-	29-sep-2000
-	-	-	<0.1 U	-	-	-	29-sep-2000
-	-	-	<0.1 U	-	-	-	14-aug-2001
-	-	-	<0.1 U	-	-	-	30-oct-2001
-	-	-	<0.1 U	-	-	-	31-jan-2002
-	-	-	<0.1 U	-	-	-	23-may-2002
-	-	-	<0.1 U	-	-	-	31-jul-2002

Table A-13. Ground and surface water analyses for metals (mg/L) in samples collected from the

Location Date	Lab	Note	Val.	Antimony	Arsenic	Barium	Beryllium	Cadmium	Total chromium	Cobalt	Iron
W-865-07 (continued)											
19-feb-2003	CN	af	V	-	-	-	-	-	-	-	<0.1 LU
29-may-2003	CN	af	V	-	-	-	-	-	-	-	<0.1 U
29-may-2003	CN	af	V	<0.06 U	0.014	0.05	<0.002 U	<0.005 U	<0.01 U	<0.025 U	-
W-865-1804											
23-jun-2003	CN	a	V	-	0.02	0.026	-	<0.0005 U	0.003	-	-
23-jun-2003	CN	a	V	-	-	-	-	-	-	-	<0.1 HU
SPRING13											
06-nov-1995	CS	a	V	-	0.0094	<0.025 U	<0.0005 U	<0.0005 U	<0.01 U	<0.025 U	-
06-nov-1995	CS	a	V	-	-	-	-	-	-	-	<0.1 U
SPRING24											
22-oct-1999	CN	a	V	-	0.014	0.029	-	<0.0005 U	<0.001 LU	-	-
22-oct-1999	BB	af	V	-	-	-	-	-	-	-	<0.05 U
27-aug-2001	CN	af	V	-	-	-	-	-	-	-	<0.1 U
13-dec-2001	CN	af	V	-	-	-	-	-	-	-	44 H

Pit7 Complex between July 1, 1995 and June 30, 2003. Results recorded by December 18, 2003.

Lead	Mercury	Molybdenum	Nickel	Selenium	Silver	Vanadium	Location Date
							(continued) W-865-07
–	–	–	<0.1 U	–	–	–	19-feb-2003
–	–	–	<0.1 U	–	–	–	29-may-2003
<0.003 U	<0.0002 U	<0.02 U	<0.02 U	<0.005 U	<0.005 U	<0.5 U	29-may-2003
							W-865-1804
<0.005 U	<0.0002 U	–	–	<0.005 U	<0.001 U	–	23-jun-2003
–	–	–	<0.1 HU	–	–	–	23-jun-2003
							SPRING13
<0.002 U	<0.0002 U	–	–	0.0036	<0.01 U	<0.025 U	06-nov-1995
–	–	–	<0.1 U	–	–	–	06-nov-1995
							SPRING24
<0.005 U	<0.0002 U	–	–	<0.002 U	<0.001 U	–	22-oct-1999
–	–	–	<0.05 U	–	–	–	22-oct-1999
–	–	–	<0.1 U	–	–	–	27-aug-2001
–	–	–	<0.1 HU	–	–	–	13-dec-2001

See following page for notes

Table A-13. Ground and surface water analyses for metals (mg/L) in samples collected from the Pit7 Complex between July 1, 1995 and June 30, 2003. Results recorded by December 18, 2003.

Notes:

– Indicates no analysis performed for this compound

Val. = Validation code

Footnotes:

a	ERD data
b	ORAD WGMG data
c	Analytical results for this sample are suspect
d	Sample collected during hydraulic testing
e	Blind sample, sent to lab without location identity
f	Sample dilution necessary for analysis; detection limits increased
g	Interlaboratory collocated sample
h	Intralaboratory collocated sample
i	Sample collected as part of pilot study
j	Note field may contain important information regarding this sample
k	Pre-development sample
l	Norm month, norm quarter or norm year inconsistent with sample date
m	Confirmation sample
n	Sample analyzed after standard holding time
o	Sample comprised of partial composite
p	Alpha spectroscopy analysis of uranium isotopes
q	Gamma spectroscopy analysis of uranium isotopes
r	Tritium data represents non-detect with activity calc'd for 100 percent error.

Lab Codes:

BB	BC Laboratories, Inc.	Bakersfield, CA
CN	Caltest Analytical Laboratory	1885 N. Kelly Rd, Napa, CA 94558
CS	California Laboratory Services	3249 Fitzgerald Rd. Rancho Cordova, CA 95742
FS	FruitGrowers Environmental Lab	2500 Stagecoach Rd., Stockton, CA 95215
LH	LAS-formerly Lockheed<1jan97	975 Kelly Johnson Las Vegas NV 89119
QU	Quanterra Env. Serv.,St.Louis	13715 Rider Trail North, Earth City, MO 63045

Validation Codes:

V	Validated
N	Not validated (default value)
U	Undeclared
H	Historical comparison only

CLP flags: (follow result)

B	Analyte found in method blank
D	Analysis performed at a secondary dilution or concentration (i.e., vapor samples)
E	The analyte was detected below the LLNL reporting limit, but above the analytical laboratory minimum detection limit.
F	Analyte found in field blank, trip blank, or equipment blank
G	Quantitated using fuel calibration, but does not match typical fuel fingerprint (fuel maybe gasoline, diesel, motor oil etc.).
H	Sample analyzed outside of holding time, sample results should be evaluated
J	Analyte was postively identified; the associated numerical value is the approximate concentration of the analyte in the sample.
L	Spike accuracy not within control limits
O	Duplicate spike or sample precision not within control limits
P	Indicates that the absence of a data qualifier flag does not mean that the data does not need qualification, but that the implementation of electronic data qualifier flags was not yet established
R	Sample results are rejected due to serious deficiencies in the ability to analyze the sample and meet QC criteria. The presence or absence of the analyte cannot be verified
S	Analytical results for this sample are suspect
T	Analyte is tentatively identified compound; result is approximate
U	Compound was analyzed for, but not detected above detection limit

Table A-14. Ground and surface water analyses for volatile organic compounds (ug/L) in samples collected from the Pit 7 Complex between July 1, 1995 and June 30, 2003. Results recorded by December 18, 2003.

VOCs in Ground Water, Site 300
December 19, 2003
gemini2

s300vocsL.19dec2003
s300vocsR.19dec2003

Min Sample Date
July 1, 1995
Max Sample Date
June 30, 2003

Table A-14. Ground and surface water analyses for volatile organic compounds (ug/L) in samples

Location Date	Lab	Note	Val.	1,1- DCE	cis- 1,2- DCE	trans- 1,2- DCE	Total 1,2- DCE	TCE	PCE
MUL2									
23-aug-1995	CS	a	V	<0.2 U	<0.2 U	<0.2 U	-	<0.2 U	<0.2 U
06-sep-1996	CS	a	V	<0.2 U	<0.2 U	<0.2 U	-	<0.2 U	<0.2 U
08-sep-1997	CS	a	V	<0.2 U	<0.2 U	<0.2 U	-	<0.2 U	<0.2 U
16-sep-1998	CS	a	V	<0.2 U	<0.2 U	<0.2 U	-	<0.2 U	<0.2 U
08-sep-1999	CN	ah	V	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
08-sep-1999	CN	aeh	V	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
06-sep-2000	BB	af	V	<0.2 U	<0.2 U	<0.2 U	<0.4 U	<0.2 U	<0.2 U
05-sep-2001	BB	afh	V	<0.2 U	<0.2 U	<0.2 U	<0.4 U	<0.2 U	<0.2 U
05-sep-2001	BB	aefh	V	<0.2 U	<0.2 U	<0.2 U	<0.4 U	<0.2 U	<0.2 U
17-sep-2002	BB	ah	V	<0.2 U	<0.2 U	<0.2 U	<0.4 U	<0.2 U	<0.2 U
17-sep-2002	BB	aeh	V	<0.2 U	<0.2 U	<0.2 U	<0.4 U	<0.2 U	<0.2 U
K7-01									
14-jul-1995	CS	a	V	0.68	-	-	<0.5 U	3.1	<0.5 U
17-oct-1995	CS	ah	V	0.61	-	-	<0.5 U	3.2	<0.5 U
17-oct-1995	CS	aeh	V	0.63	-	-	<0.5 U	3.4	<0.5 U
07-feb-1996	CS	a	V	<0.5 U	-	-	<0.5 U	2.4	<0.5 U
24-apr-1996	CS	a	V	<0.5 U	-	-	<0.5 U	2.3	<0.5 U
25-jul-1996	CS	ah	V	<0.5 U	<0.5 U	<0.5 U	-	1.8	<0.5 U
25-jul-1996	CS	aeh	V	<0.5 U	<0.5 U	<0.5 U	-	1.6	<0.5 U
18-oct-1996	CS	a	V	<0.5 U	<0.5 U	<0.5 U	-	2.4	<0.5 U
22-jan-1997	CS	ah	V	<0.5 U	<0.5 U	<0.5 U	-	1.9	<0.5 U
22-jan-1997	CS	aeh	V	<0.5 U	<0.5 U	<0.5 U	-	2	<0.5 U
08-apr-1997	CS	a	V	<0.5 U	<0.5 U	<0.5 U	-	1.5	<0.5 U
23-jul-1997	CS	a	V	<0.5 U	<0.5 U	<0.5 U	-	2	<0.5 U
21-oct-1997	CS	ah	V	<0.5 U	<0.5 U	<0.5 U	-	2.3	<0.5 U
21-oct-1997	CS	aeh	V	<0.5 U	<0.5 U	<0.5 U	-	2.3	<0.5 U
14-jan-1998	CS	a	V	<0.5 U	<0.5 U	<0.5 U	-	2.2	<0.5 U
20-apr-1998	CS	a	V	<0.5 U	<0.5 U	<0.5 U	-	1.4	<0.5 U
21-jul-1998	CS	a	V	<0.5 U	<0.5 U	<0.5 U	-	1.7	<0.5 U
19-oct-1998	CS	ah	V	<0.5 U	<0.5 U	<0.5 U	-	1.6	<0.5 U
19-oct-1998	CS	aeh	V	<0.5 U	<0.5 U	<0.5 U	-	1.3	<0.5 U
19-jan-1999	CS	ah	V	<0.5 U	<0.5 U	<0.5 U	-	1.9	<0.5 U
19-jan-1999	CS	aeh	V	<0.5 U	<0.5 U	<0.5 U	-	2	<0.5 U
22-apr-1999	CN	af	V	<0.5 LOU	<0.5 LOU	<0.5 LOU	<0.5 LOU	2.1 LO	<0.5 LOU
20-jul-1999	CN	af	V	<0.5 U	<0.5 OU	<0.5 U	<0.5 U	1.8 L	<0.5 LU
07-oct-1999	CN	afh	V	<0.5 LOU	<0.5 LOU	<0.5 LOU	<0.5 LOU	2.1 LO	<0.5 LOU
07-oct-1999	CN	aefh	V	<0.5 LOU	<0.5 LOU	<0.5 LOU	<0.5 LOU	2 LO	<0.5 LOU
11-feb-2000	CN	af	V	<0.5 LOU	<0.5 LOU	<0.5 LOU	<0.5 LOU	2 LO	<0.5 LOU
25-apr-2000	CN	ah	V	<0.5 U	<0.5 U	<0.5 U	<0.5 U	2	<0.5 U
25-apr-2000	CN	aeh	V	<0.5 U	<0.5 U	<0.5 U	<0.5 U	1.9	<0.5 U
24-jul-2000	CN	af	V	<0.5 U	<0.5 U	<0.5 U	<0.5 U	2.1 O	<0.5 OU
30-oct-2000	CN	afh	V	0.7	<0.5 U	<0.5 U	<0.5 U	2.8	<0.5 U
30-oct-2000	CN	aefh	V	0.6	<0.5 U	<0.5 U	<0.5 U	2.7	<0.5 U
23-jan-2001	CN	af	V	<0.5 U	<0.5 U	<0.5 U	<0.5 U	2.7	<0.5 U
24-apr-2001	CN	af	V	<0.5 LU	<0.5 LU	<0.5 LU	<0.5 LU	2.8 L	<0.5 LU
24-oct-2001	CN	a	V	<0.5 U	<0.5 U	<0.5 U	<0.5 U	3.1	<0.5 U
23-jan-2002	CN	a	V	<0.5 U	<0.5 U	<0.5 U	<0.5 U	1.6	<0.5 U
22-apr-2002	CN	aefh	V	<0.5 U	<0.5 U	<0.5 U	<0.5 U	2.5	<0.5 U
22-apr-2002	CN	afh	V	<0.5 U	<0.5 U	<0.5 U	<0.5 U	2.5	<0.5 U
13-sep-2002	CN	af	V	<0.5 LOU	<0.5 LOU	<0.5 LOU	<0.5 LOU	2 LO	<0.5 LOU
27-nov-2002	CN	aefh	V	<0.5 U	<0.5 U	<0.5 U	<0.5 U	2.1	<0.5 U
27-nov-2002	CN	afh	V	<0.5 U	<0.5 U	<0.5 U	<0.5 U	2.3	<0.5 U
10-feb-2003	CN	af	V	<1 U	<1 U	<1 U	<1 U	2	<1 U
01-may-2003	CN	ah	V	<0.5 U	<0.5 U	<0.5 U	<0.5 U	1.9	<0.5 U
01-may-2003	CN	aeh	V	<0.5 U	<0.5 U	<0.5 U	<0.5 U	1.9	<0.5 U
K7-03									
14-jul-1995	CS	ah	V	0.7	-	-	<0.5 U	2.7	<0.5 U
14-jul-1995	CS	aeh	V	0.71	-	-	<0.5 U	2.5	<0.5 U
17-oct-1995	CS	a	V	0.64	-	-	<0.5 U	3.1	<0.5 U
07-feb-1996	CS	a	V	0.9	-	-	<0.5 U	3.1	<0.5 U
24-apr-1996	CS	ah	V	0.69	-	-	<0.5 U	3.2	<0.5 U
24-apr-1996	CS	aeh	V	0.67	-	-	<0.5 U	3.1	<0.5 U
25-jul-1996	CS	a	V	<0.5 U	<0.5 U	<0.5 U	-	1.6	<0.5 U
18-oct-1996	CS	a	V	0.51	<0.5 U	<0.5 U	-	2.6	<0.5 U
23-jan-1997	CS	a	V	<0.5 U	<0.5 U	<0.5 U	-	2.1	<0.5 U

collected from the Pit 7 Complex between July 1, 1995 and June 30, 2003. Results recorded by December 18, 2003.

1,1-DCA	1,2-DCA	1,1,1-TCA	Chloroform	Freon 11	Freon 113	Methylene chloride	Location Date
							MUL2
<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	23-aug-1995
<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	06-sep-1996
<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	08-sep-1997
<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	16-sep-1998
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<3 U	08-sep-1999
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<3 U	08-sep-1999
<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	06-sep-2000
<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	05-sep-2001
<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	05-sep-2001
<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.95 U	17-sep-2002
<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.95 U	17-sep-2002
							K7-01
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<5 U	14-jul-1995
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	17-oct-1995
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	17-oct-1995
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	07-feb-1996
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	24-apr-1996
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	25-jul-1996
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	25-jul-1996
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	18-oct-1996
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	22-jan-1997
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	22-jan-1997
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	08-apr-1997
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	23-jul-1997
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	21-oct-1997
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	21-oct-1997
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	14-jan-1998
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	20-apr-1998
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	21-jul-1998
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	19-oct-1998
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	19-oct-1998
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	19-jan-1999
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	19-jan-1999
<0.5 LOU	<0.5 LOU	<0.5 LOU	<0.5 LOU	<0.5 LOU	<0.5 LOU	<0.5 LOU	22-apr-1999
<0.5 U	<0.5 U	<0.5 U	<0.5 OU	<0.5 U	<0.5 U	<0.5 U	20-jul-1999
<0.5 LOU	<0.5 LOU	<0.5 LOU	<0.5 LOU	<0.5 LOU	<0.5 LOU	<0.5 LOU	07-oct-1999
<0.5 LOU	<0.5 LOU	<0.5 LOU	<0.5 LOU	<0.5 LOU	<0.5 LOU	<0.5 LOU	07-oct-1999
<0.5 LOU	<0.5 LOU	<0.5 LOU	<0.5 LOU	<0.5 LOU	<0.5 LOU	<0.5 LOU	11-feb-2000
<0.5 U	<0.5 U	<0.5 U	<0.5 OU	<0.5 U	<0.5 U	<0.5 U	25-apr-2000
<0.5 U	<0.5 U	<0.5 U	<0.5 OU	<0.5 U	<0.5 U	<0.5 U	25-apr-2000
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	24-jul-2000
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	30-oct-2000
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	30-oct-2000
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	1.4 B	<0.5 U	23-jan-2001
<0.5 LU	<0.5 LU	<0.5 LU	<0.5 LU	<0.5 LU	<0.5 LU	<0.5 LU	24-apr-2001
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	24-oct-2001
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	23-jan-2002
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	22-apr-2002
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	22-apr-2002
<0.5 LOU	<0.5 LOU	<0.5 LOU	<0.5 LOU	<0.5 LOU	<0.5 LOU	<0.5 LOU	13-sep-2002
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	27-nov-2002
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	27-nov-2002
<1 U	<1 U	<1 U	<1 U	<1 U	<1 U	<3 U	10-feb-2003
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<3 U	01-may-2003
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<3 U	01-may-2003
							K7-03
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<5 U	14-jul-1995
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<5 U	14-jul-1995
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	17-oct-1995
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	07-feb-1996
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	24-apr-1996
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	24-apr-1996
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	25-jul-1996
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	18-oct-1996
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	23-jan-1997

Table A-14. Ground and surface water analyses for volatile organic compounds (ug/L) in samples

Location Date	Lab	Note	Val.	1,1- DCE	cis- 1,2- DCE	trans- 1,2- DCE	Total 1,2- DCE	TCE	PCE
K7-03 (continued)									
08-apr-1997	CS	ah	V	<0.5 U	<0.5 U	<0.5 U	-	1.2	<0.5 U
08-apr-1997	CS	aeh	V	<0.5 U	<0.5 U	<0.5 U	-	1.3	<0.5 U
23-jul-1997	CS	a	V	<0.5 U	<0.5 U	<0.5 U	-	0.94	<0.5 U
21-oct-1997	CS	a	V	0.51	<0.5 U	<0.5 U	-	1.3	<0.5 U
15-jan-1998	CS	ah	V	0.76	<0.5 U	<0.5 U	-	3.3	<0.5 U
15-jan-1998	CS	aeh	V	<0.5 U	<0.5 U	<0.5 U	-	2.7	<0.5 U
21-apr-1998	CS	a	V	<0.5 U	<0.5 U	<0.5 U	-	1.5	<0.5 U
27-jul-1998	CS	a	V	<0.5 U	<0.5 U	<0.5 U	-	0.68	<0.5 U
19-oct-1998	CS	a	V	<0.5 U	<0.5 U	<0.5 U	-	0.78	<0.5 U
19-jan-1999	CS	a	V	<0.5 U	<0.5 U	<0.5 U	-	1.9	<0.5 U
22-apr-1999	CN	afh	V	0.6 LO	<0.5 LOU	<0.5 LOU	<0.5 LOU	2.2 LO	<0.5 LOU
22-apr-1999	CN	aefh	V	0.6 LO	<0.5 LOU	<0.5 LOU	<0.5 LOU	2.3 LO	<0.5 LOU
19-jul-1999	CN	af	V	1.2	<0.5 OU	<0.5 U	<0.5 U	4 L	<0.5 LU
07-oct-1999	CN	af	V	0.6 LO	<0.5 LOU	<0.5 LOU	<0.5 LOU	3.5 LO	<0.5 LOU
11-feb-2000	CN	a	V	1.2	<0.5 OU	<0.5 U	<0.5 U	3.6	<0.5 U
25-apr-2000	CN	af	V	1.2	<0.5 U	<0.5 U	<0.5 U	5.1	<0.5 U
24-jul-2000	CN	ah	V	1	<0.5 U	<0.5 U	<0.5 U	5.6 O	<0.5 OU
24-jul-2000	CN	aeh	V	0.9	<0.5 U	<0.5 U	<0.5 U	5.8 O	<0.5 OU
30-oct-2000	CN	af	V	1.6	<0.5 U	<0.5 U	<0.5 U	4.8	<0.5 U
23-jan-2001	CN	af	V	1.7	<0.5 U	<0.5 U	<0.5 U	6.4	<0.5 U
17-apr-2001	CN	ah	V	1.4	<0.5 U	<0.5 U	<0.5 U	5.2	<0.5 U
17-apr-2001	CN	aeh	V	1	<0.5 U	<0.5 U	<0.5 U	3.4	<0.5 U
17-jul-2001	CN	a	V	1.4	<0.5 U	<0.5 U	<0.5 U	3.9	<0.5 U
24-oct-2001	CN	a	V	1.5	<0.5 U	<0.5 U	<0.5 U	5.6	<0.5 U
23-jan-2002	CN	aeh	V	1.1	<0.5 U	<0.5 U	<0.5 U	3.7	<0.5 U
23-jan-2002	CN	ah	V	1.2	<0.5 U	<0.5 U	<0.5 U	4.4	<0.5 U
22-apr-2002	CN	af	V	0.8	<0.5 U	<0.5 U	<0.5 U	4.9	<0.5 U
06-sep-2002	CN	ah	V	0.9 LO	<0.5 LOU	<0.5 LOU	<0.5 LOU	3.3 LO	<0.5 LOU
06-sep-2002	CN	aefh	V	1 LO	<0.5 LOU	<0.5 LOU	<0.5 LOU	3.6 LO	<0.5 LOU
27-nov-2002	CN	af	V	<0.5 U	<0.5 U	<0.5 U	<0.5 U	4.2	<0.5 U
07-feb-2003	CN	afh	V	<1 U	<1 U	<1 U	<1 U	2	<1 U
07-feb-2003	CN	aefh	V	<1 U	<1 U	<1 U	<1 U	2	<1 U
01-may-2003	CN	a	V	1	<0.5 U	<0.5 U	<0.5 U	2.8	<0.5 U
K7-06									
14-jul-1995	CS	a	V	<0.5 U	-	-	<0.5 U	<0.5 U	<0.5 U
17-oct-1995	CS	a	V	<0.5 U	-	-	<0.5 U	<0.5 U	<0.5 U
12-feb-1996	CS	ah	V	<0.5 U	-	-	<0.5 U	<0.5 U	<0.5 U
12-feb-1996	CS	aeh	V	<0.5 U	-	-	<0.5 U	<0.5 U	<0.5 U
24-apr-1996	CS	a	V	<0.5 U	-	-	<0.5 U	<0.5 U	<0.5 U
24-jul-1996	CS	a	V	<0.5 U	<0.5 U	<0.5 U	-	<0.5 U	<0.5 U
18-oct-1996	CS	a	V	<0.5 U	<0.5 U	<0.5 U	-	<0.5 U	<0.5 U
22-jan-1997	CS	a	V	<0.5 U	<0.5 U	<0.5 U	-	<0.5 U	<0.5 U
08-apr-1997	CS	a	V	<0.5 U	<0.5 U	<0.5 U	-	<0.5 U	<0.5 U
23-jul-1997	CS	a	V	<0.5 U	<0.5 U	<0.5 U	-	<0.5 U	<0.5 U
21-oct-1997	CS	a	V	<0.5 U	<0.5 U	<0.5 U	-	<0.5 U	<0.5 U
14-jan-1998	CS	a	V	<0.5 U	<0.5 U	<0.5 U	-	<0.5 U	<0.5 U
21-apr-1998	CS	ah	V	<0.5 U	<0.5 U	<0.5 U	-	<0.5 U	<0.5 U
21-apr-1998	CS	aeh	V	<0.5 U	<0.5 U	<0.5 U	-	<0.5 U	<0.5 U
21-jul-1998	CS	ah	V	<0.5 U	<0.5 U	<0.5 U	-	<0.5 U	<0.5 U
21-jul-1998	CS	aeh	V	<0.5 U	<0.5 U	<0.5 U	-	<0.5 U	<0.5 U
19-oct-1998	CS	a	V	<0.5 U	<0.5 U	<0.5 U	-	<0.5 U	<0.5 U
19-jan-1999	CS	a	V	<0.5 U	<0.5 U	<0.5 U	-	<0.5 U	<0.5 U
23-apr-1999	CN	a	V	<0.5 LOU	<0.5 LOU	<0.5 LOU	<0.5 LOU	<0.5 LOU	<0.5 LOU
19-jul-1999	CN	ah	V	<0.5 U	<0.5 OU	<0.5 U	<0.5 U	<0.5 LU	<0.5 LU
19-jul-1999	CN	aeh	V	<0.5 U	<0.5 OU	<0.5 U	<0.5 U	<0.5 LU	<0.5 LU
12-oct-1999	CN	a	V	<0.5 U	<0.5 OU	<0.5 U	<0.5 U	<0.5 U	<0.5 U
11-feb-2000	CN	a	V	<0.5 LOU	<0.5 LOU	<0.5 LOU	<0.5 LOU	<0.5 LOU	<0.5 LOU
25-apr-2000	CN	af	V	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
24-jul-2000	CN	a	V	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 OU	<0.5 OU
01-nov-2000	CN	af	V	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
06-jun-2001	CN	a	V	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
19-jul-2001	CN	a	V	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
29-oct-2001	CN	a	V	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
30-jan-2002	CN	a	V	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 LU	<0.5 U
29-apr-2002	CN	a	V	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
29-aug-2002	CN	af	V	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
03-dec-2002	CN	af	V	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U

collected from the Pit 7 Complex between July 1, 1995 and June 30, 2003. Results recorded by December 18, 2003.

1,1-DCA	1,2-DCA	1,1,1-TCA	Chloroform	Freon 11	Freon 113	Methylene chloride	Location Date
							(continued) K7-03
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	08-apr-1997
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	08-apr-1997
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	23-jul-1997
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	21-oct-1997
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	15-jan-1998
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	15-jan-1998
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	21-apr-1998
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	27-jul-1998
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	19-oct-1998
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	19-jan-1999
<0.5 LOU	<0.5 LOU	<0.5 LOU	<0.5 LOU	<0.5 LOU	<0.5 LOU	<0.5 LOU	22-apr-1999
<0.5 LOU	<0.5 LOU	<0.5 LOU	<0.5 LOU	<0.5 LOU	<0.5 LOU	<0.5 LOU	22-apr-1999
<0.5 U	<0.5 U	<0.5 U	<0.5 OU	<0.5 U	<0.5 U	<0.5 U	19-jul-1999
<0.5 LOU	<0.5 LOU	<0.5 LOU	<0.5 LOU	<0.5 LOU	<0.5 LOU	<0.5 LOU	07-oct-1999
<0.5 U	<0.5 OU	<0.5 U	<0.5 OU	<0.5 U	<0.5 U	<0.5 U	11-feb-2000
<0.5 U	<0.5 U	<0.5 U	<0.5 OU	<0.5 U	<0.5 U	<0.5 U	25-apr-2000
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	24-jul-2000
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	24-jul-2000
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	30-oct-2000
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	1.5 B	<0.5 U	23-jan-2001
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	17-apr-2001
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	17-apr-2001
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	17-jul-2001
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	24-oct-2001
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	23-jan-2002
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	23-jan-2002
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	22-apr-2002
<0.5 LOU	<0.5 LOU	<0.5 LOU	<0.5 LOU	<0.5 LOU	<0.5 LOU	<0.5 LOU	06-sep-2002
<0.5 LOU	<0.5 LOU	<0.5 LOU	<0.5 LOU	<0.5 LOU	<0.5 LOU	<0.5 LOU	06-sep-2002
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	27-nov-2002
<1 U	<1 U	<1 U	<1 U	<1 U	<1 U	<3 U	07-feb-2003
<1 U	<1 U	<1 U	<1 U	<1 U	<1 U	<3 U	07-feb-2003
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<3 U	01-may-2003
							K7-06
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<5 U	14-jul-1995
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	17-oct-1995
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	12-feb-1996
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	12-feb-1996
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	24-apr-1996
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	24-jul-1996
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	18-oct-1996
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	22-jan-1997
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	08-apr-1997
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	23-jul-1997
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	21-oct-1997
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	14-jan-1998
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	21-apr-1998
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	21-apr-1998
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	21-jul-1998
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	21-jul-1998
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	19-oct-1998
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	19-jan-1999
<0.5 LOU	<0.5 LOU	<0.5 LOU	<0.5 LOU	<0.5 LOU	<0.5 LOU	<0.5 LOU	23-apr-1999
<0.5 U	<0.5 U	<0.5 U	<0.5 OU	<0.5 U	<0.5 U	<0.5 U	19-jul-1999
<0.5 U	<0.5 U	<0.5 U	<0.5 OU	<0.5 U	<0.5 U	<0.5 U	19-jul-1999
<0.5 U	<0.5 U	<0.5 U	<0.5 OU	<0.5 U	<0.5 U	<0.5 U	12-oct-1999
<0.5 LOU	<0.5 LOU	<0.5 LOU	<0.5 LOU	<0.5 LOU	<0.5 LOU	<0.5 LOU	11-feb-2000
<0.5 U	<0.5 U	<0.5 U	<0.5 OU	<0.5 U	<0.5 U	<0.5 U	25-apr-2000
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	24-jul-2000
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	01-nov-2000
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	06-jun-2001
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	19-jul-2001
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	29-oct-2001
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	30-jan-2002
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	29-apr-2002
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	29-aug-2002
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	03-dec-2002

Table A-14. Ground and surface water analyses for volatile organic compounds (ug/L) in samples

Location Date	Lab	Note	Val.	1,1-DCE	cis-1,2-DCE	trans-1,2-DCE	Total 1,2-DCE	TCE	PCE
K7-06 (continued)									
07-feb-2003	CN	af	V	<1 U	<1 U	<1 U	<1 U	<1 U	<1 U
06-may-2003	CN	a	V	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
K7-07									
07-aug-1995	CS	ah	V	<0.5 U	-	-	<0.5 U	<0.5 U	<0.5 U
07-aug-1995	CS	aeh	V	<0.5 U	-	-	<0.5 U	<0.5 U	<0.5 U
30-oct-1995	CS	a	V	<0.5 U	-	-	<0.5 U	<0.5 U	<0.5 U
20-may-1996	CS	a	V	<0.5 UO	<0.5 U	<0.5 U	-	<0.5 UO	<0.5 U
19-nov-1996	CS	a	V	<0.5 U	<0.5 U	<0.5 U	-	<0.5 U	<0.5 U
13-may-1997	CS	a	V	<0.5 U	<0.5 U	<0.5 U	-	<0.5 U	<0.5 U
18-nov-1997	CS	a	V	<0.5 U	<0.5 U	<0.5 U	-	<0.5 U	<0.5 U
02-jun-1998	CS	ah	V	<0.5 U	<0.5 U	<0.5 U	-	<0.5 U	<0.5 U
02-jun-1998	CS	aeh	V	<0.5 U	<0.5 U	<0.5 U	-	<0.5 U	<0.5 U
30-nov-1998	CS	a	V	<0.5 U	<0.5 U	<0.5 U	-	<0.5 U	<0.5 U
26-may-1999	CN	a	V	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 UL	<0.5 U
K7-09									
17-jul-1995	CS	a	V	<0.5 U	-	-	<0.5 U	<0.5 U	<0.5 U
17-oct-1995	CS	a	V	<0.5 U	-	-	<0.5 U	<0.5 U	<0.5 U
07-feb-1996	CS	a	V	<0.5 U	-	-	<0.5 U	<0.5 U	<0.5 U
26-apr-1996	CS	a	V	<0.5 U	-	-	<0.5 U	<0.5 U	<0.5 U
24-jul-1996	CS	a	V	<0.5 U	<0.5 U	<0.5 U	-	<0.5 U	<0.5 U
23-oct-1996	CS	a	V	<0.5 U	<0.5 U	<0.5 U	-	<0.5 U	<0.5 U
23-jan-1997	CS	a	V	<0.5 U	<0.5 U	<0.5 U	-	<0.5 U	<0.5 U
10-apr-1997	CS	a	V	<0.5 U	<0.5 U	<0.5 U	-	<0.5 U	<0.5 U
17-jul-1997	CS	a	V	<0.5 U	<0.5 U	<0.5 U	-	<0.5 U	<0.5 U
22-oct-1997	CS	a	V	<0.5 U	<0.5 U	<0.5 U	-	<0.5 U	<0.5 U
21-jan-1998	CS	a	V	<0.5 U	<0.5 U	<0.5 U	-	<0.5 U	<0.5 U
22-apr-1998	CS	a	V	<0.5 U	<0.5 U	<0.5 U	-	<0.5 U	<0.5 U
27-jul-1998	CS	a	V	<0.5 U	<0.5 U	<0.5 U	-	<0.5 U	<0.5 U
20-oct-1998	CS	a	V	<0.5 U	<0.5 U	<0.5 U	-	<0.5 U	<0.5 U
25-jan-1999	CS	a	V	<0.5 U	<0.5 U	<0.5 U	-	<0.5 U	<0.5 U
23-apr-1999	CN	a	V	<0.5 LOU	<0.5 LOU	<0.5 LOU	<0.5 LOU	<0.5 LOU	<0.5 LOU
15-jul-1999	CN	a	V	<0.5 LOU	<0.5 LOU	<0.5 LOU	<0.5 LOU	<0.5 LOU	<0.5 LOU
11-oct-1999	CN	a	V	<0.5 U	<0.5 UO	<0.5 U	<0.5 U	<0.5 U	<0.5 U
16-feb-2000	CN	a	V	<0.5 LOU	<0.5 LOU	<0.5 LOU	<0.5 LOU	<0.5 LOU	<0.5 LOU
25-apr-2000	CN	a	V	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
09-aug-2000	CN	a	V	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
01-nov-2000	CN	af	V	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
23-jan-2001	CN	a	V	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	0.5
15-feb-2001	CN	a	V	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
22-feb-2001	CN	a	V	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
24-apr-2001	CN	ah	V	<0.5 LU	<0.5 LU	<0.5 LU	<0.5 LU	<0.5 LU	<0.5 LU
24-apr-2001	CN	ah	V	<0.5 LU	<0.5 LU	<0.5 LU	<0.5 LU	<0.5 LU	<0.5 LU
17-jul-2001	CN	a	V	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
24-oct-2001	CN	a	V	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
23-jan-2002	CN	a	V	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
23-apr-2002	CN	af	V	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
06-sep-2002	CN	a	V	<0.5 LOU	<0.5 LOU	<0.5 LOU	<0.5 LOU	<0.5 LOU	<0.5 LOU
29-nov-2002	CN	af	V	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
07-feb-2003	CN	af	V	<1 U	<1 U	<1 U	<1 U	<1 U	<1 U
01-may-2003	CN	a	V	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
K7-10									
18-jul-1995	CS	a	V	<0.5 U	-	-	<0.5 U	<0.5 U	<0.5 U
19-oct-1995	CS	a	V	<0.5 U	-	-	<0.5 U	<0.5 U	<0.5 U
12-feb-1996	CS	a	V	<0.5 U	-	-	<0.5 U	<0.5 U	<0.5 U
26-apr-1996	CS	a	V	<0.5 U	-	-	<0.5 U	<0.5 U	<0.5 U
24-jul-1996	CS	a	V	<0.5 U	<0.5 U	<0.5 U	-	<0.5 U	<0.5 U
24-oct-1996	CS	a	V	<0.5 U	<0.5 U	<0.5 U	-	<0.5 U	<0.5 U
28-jan-1997	CS	a	V	<0.5 U	<0.5 U	<0.5 U	-	<0.5 U	<0.5 U
15-apr-1997	CS	a	V	<0.5 U	<0.5 U	<0.5 U	-	<0.5 U	<0.5 U
17-jul-1997	CS	a	V	<0.5 U	<0.5 U	<0.5 U	-	<0.5 U	<0.5 U
27-oct-1997	CS	a	V	<0.5 U	<0.5 U	<0.5 U	-	<0.5 U	<0.5 U
21-jan-1998	CS	a	V	<0.5 U	<0.5 U	<0.5 U	-	<0.5 U	<0.5 U
28-apr-1998	CS	a	V	<0.5 U	<0.5 U	<0.5 U	-	<0.5 U	<0.5 U
31-jul-1998	CS	a	V	<0.5 U	<0.5 U	<0.5 U	-	<0.5 U	<0.5 U
26-oct-1998	CS	a	V	<0.5 U	<0.5 U	<0.5 U	-	<0.5 U	<0.5 U

collected from the Pit 7 Complex between July 1, 1995 and June 30, 2003. Results recorded by December 18, 2003.

1,1-DCA	1,2-DCA	1,1,1-TCA	Chloroform	Freon 11	Freon 113	Methylene chloride	Location Date
							(continued) K7-06
<1 U	<1 U	<1 U	<1 U	<1 U	<1 U	<3 U	07-feb-2003
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<3 U	06-may-2003
							K7-07
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	07-aug-1995
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	07-aug-1995
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	30-oct-1995
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	20-may-1996
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	19-nov-1996
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	13-may-1997
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	18-nov-1997
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	02-jun-1998
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	02-jun-1998
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	30-nov-1998
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	26-may-1999
							K7-09
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<5 U	17-jul-1995
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	17-oct-1995
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	07-feb-1996
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	26-apr-1996
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	24-jul-1996
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	23-oct-1996
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	23-jan-1997
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	10-apr-1997
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	17-jul-1997
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	22-oct-1997
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	21-jan-1998
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	22-apr-1998
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	27-jul-1998
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	20-oct-1998
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	25-jan-1999
<0.5 LOU	<0.5 LOU	<0.5 LOU	<0.5 LOU	<0.5 LOU	<0.5 LOU	<0.5 LOU	23-apr-1999
<0.5 LOU	<0.5 LOU	<0.5 LOU	<0.5 LOU	<0.5 LOU	<0.5 LOU	<0.5 LOU	15-jul-1999
<0.5 U	<0.5 U	<0.5 U	<0.5 UO	<0.5 U	<0.5 U	<0.5 U	11-oct-1999
<0.5 LOU	<0.5 LOU	<0.5 LOU	<0.5 LOU	<0.5 LOU	<0.5 LOU	<0.5 LOU	16-feb-2000
<0.5 U	<0.5 U	<0.5 U	<0.5 OU	<0.5 U	<0.5 U	<0.5 U	25-apr-2000
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	09-aug-2000
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	01-nov-2000
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	1.5 B	<0.5 U	23-jan-2001
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	15-feb-2001
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	22-feb-2001
<0.5 LU	<0.5 LU	<0.5 LU	<0.5 LU	<0.5 LU	<0.5 LU	<0.5 LU	24-apr-2001
<0.5 LU	<0.5 LU	<0.5 LU	<0.5 LU	<0.5 LU	<0.5 LU	<0.5 LU	24-apr-2001
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	17-jul-2001
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	24-oct-2001
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	23-jan-2002
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	23-apr-2002
<0.5 LOU	<0.5 LOU	<0.5 LOU	<0.5 LOU	<0.5 LOU	<0.5 LOU	<0.5 LOU	06-sep-2002
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	29-nov-2002
<1 U	<1 U	<1 U	<1 U	<1 U	<1 U	<3 U	07-feb-2003
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<3 U	01-may-2003
							K7-10
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<5 U	18-jul-1995
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	19-oct-1995
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	12-feb-1996
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	26-apr-1996
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	24-jul-1996
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	24-oct-1996
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	28-jan-1997
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	15-apr-1997
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	17-jul-1997
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	27-oct-1997
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	21-jan-1998
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	28-apr-1998
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	31-jul-1998
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	26-oct-1998

Table A-14. Ground and surface water analyses for volatile organic compounds (ug/L) in samples

Location Date	Lab	Note	Val.	1,1- DCE	cis- 1,2- DCE	trans- 1,2- DCE	Total 1,2- DCE	TCE	PCE
K7-10 (continued)									
25-jan-1999	CS	a	V	<0.5 U	<0.5 U	<0.5 U	-	<0.5 U	<0.5 U
26-apr-1999	CN	a	V	<0.5 LOU	<0.5 LOU	<0.5 LOU	<0.5 LOU	<0.5 LOU	<0.5 LOU
15-jul-1999	CN	a	V	<0.5 LOU	<0.5 LOU	<0.5 LOU	<0.5 LOU	<0.5 LOU	<0.5 LOU
11-oct-1999	CN	a	V	<0.5 U	<0.5 UO	<0.5 U	<0.5 U	<0.5 U	<0.5 U
27-jan-2000	CN	a	V	<0.5 U	<0.5 OU	<0.5 U	<0.5 U	<0.5 LU	<0.5 LU
26-apr-2000	CN	a	V	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
01-nov-2000	CN	a	V	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
23-jan-2001	CN	a	V	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
24-apr-2001	CN	ah	V	<0.5 LU	<0.5 LU	<0.5 LU	<0.5 LU	<0.5 LU	<0.5 LU
24-apr-2001	CN	ah	V	<0.5 LU	<0.5 LU	<0.5 LU	<0.5 LU	<0.5 LU	<0.5 LU
17-jul-2001	CN	a	V	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
24-oct-2001	CN	a	V	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
24-jan-2002	CN	a	V	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
23-apr-2002	CN	a	V	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
28-aug-2002	CN	af	V	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
29-nov-2002	CN	af	V	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
07-feb-2003	CN	af	V	<1 U	<1 U	<1 U	<1 U	<1 U	<1 U
05-may-2003	CN	a	V	<0.5 LU	<0.5 U	<0.5 U	<0.5 U	<0.5 LU	<0.5 U
NC7-12									
23-may-1997	CS	a	V	<0.5 U	<0.5 U	<0.5 U	-	<0.5 U	<0.5 U
14-may-1998	CS	a	V	<0.5 U	<0.5 U	<0.5 U	-	<0.5 U	<0.5 U
26-may-1999	CN	a	V	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 UL	<0.5 U
13-jun-2000	CN	a	V	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
14-may-2001	CN	ah	V	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
14-may-2001	CN	aeh	V	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
22-may-2002	CN	a	V	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
28-may-2003	CN	a	V	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
NC7-16									
14-nov-1995	CS	a	V	<0.5 U	-	-	<0.5 U	0.5	<0.5 U
05-jun-1996	CS	a	V	<0.5 U	<0.5 U	<0.5 U	-	<0.5 U	<0.5 U
18-dec-1996	CS	a	V	<0.5 U	<0.5 U	<0.5 U	-	<0.5 U	<0.5 U
12-may-1997	CS	a	V	<0.5 U	<0.5 U	<0.5 U	-	<0.5 U	<0.5 U
29-apr-1998	CS	a	V	<0.5 U	<0.5 U	<0.5 U	-	<0.5 U	<0.5 U
27-may-1999	CN	a	V	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	7.7 L
14-jun-2000	CN	a	V	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
22-may-2001	CN	a	V	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
22-may-2002	CN	a	V	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
NC7-17									
21-nov-1995	CS	ah	V	<0.5 U	-	-	<0.5 U	<0.5 U	<0.5 U
21-nov-1995	CS	aeh	V	<0.5 U	-	-	<0.5 U	<0.5 U	<0.5 U
05-jun-1996	CS	a	V	<0.5 U	<0.5 U	<0.5 U	-	<0.5 U	<0.5 U
17-dec-1996	CS	a	V	<0.5 U	<0.5 U	<0.5 U	-	<0.5 U	<0.5 U
NC7-18									
29-nov-1995	CS	a	V	<0.5 U	-	-	<0.5 U	<0.5 U	<0.5 U
05-jun-1996	CS	a	V	<0.5 U	<0.5 U	<0.5 U	-	<0.5 U	<0.5 U
13-dec-1996	CS	a	V	<0.5 U	<0.5 U	<0.5 U	-	<0.5 U	<0.5 U
NC7-21									
14-nov-1995	CS	a	V	<0.5 U	-	-	<0.5 U	<0.5 U	<0.5 U
05-jun-1996	CS	a	V	<0.5 U	<0.5 U	<0.5 U	-	<0.5 U	<0.5 U
26-dec-1996	CS	a	V	<0.5 U	<0.5 U	<0.5 U	-	<0.5 U	<0.5 U
29-may-1997	CS	a	V	<0.5 U	<0.5 U	<0.5 U	-	<0.5 U	<0.5 U
20-may-1998	CS	a	V	<0.5 U	<0.5 U	<0.5 U	-	<0.5 U	<0.5 U
28-may-1999	CN	af	V	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 UL
15-jun-2000	CN	af	V	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
22-may-2001	CN	a	V	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
23-may-2002	CN	a	V	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
NC7-22									
15-nov-1995	CS	a	V	<0.5 U	-	-	<0.5 U	<0.5 U	<0.5 U
05-jun-1996	CS	a	V	<0.5 U	<0.5 U	<0.5 U	-	<0.5 U	<0.5 U
18-dec-1996	CS	a	V	<0.5 U	<0.5 U	<0.5 U	-	<0.5 U	<0.5 U
29-may-1997	CS	a	V	<0.5 U	<0.5 U	<0.5 U	-	<0.5 U	<0.5 U
20-may-1998	CS	a	V	<0.5 U	<0.5 U	<0.5 U	-	<0.5 U	<0.5 U

collected from the Pit 7 Complex between July 1, 1995 and June 30, 2003. Results recorded by December 18, 2003.

1,1-DCA	1,2-DCA	1,1,1-TCA	Chloroform	Freon 11	Freon 113	Methylene chloride	Location Date
							(continued) K7-10
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	25-jan-1999
<0.5 LOU	<0.5 LOU	<0.5 LOU	<0.5 LOU	<0.5 LOU	<0.5 LOU	<0.5 LOU	26-apr-1999
<0.5 LOU	<0.5 LOU	<0.5 LOU	<0.5 LOU	<0.5 LOU	<0.5 LOU	<0.5 LOU	15-jul-1999
<0.5 U	<0.5 U	<0.5 U	<0.5 UO	<0.5 U	<0.5 U	<0.5 U	11-oct-1999
<0.5 U	<0.5 LU	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	27-jan-2000
<0.5 U	<0.5 U	<0.5 U	<0.5 OU	<0.5 U	<0.5 U	<0.5 U	26-apr-2000
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	01-nov-2000
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	1.5 B	<0.5 U	23-jan-2001
<0.5 LU	<0.5 LU	<0.5 LU	<0.5 LU	<0.5 LU	<0.5 LU	<0.5 LU	24-apr-2001
<0.5 LU	<0.5 LU	<0.5 LU	<0.5 LU	<0.5 LU	<0.5 LU	<0.5 LU	24-apr-2001
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	17-jul-2001
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	24-oct-2001
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	24-jan-2002
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	23-apr-2002
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	28-aug-2002
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	29-nov-2002
<1 U	<1 U	<1 U	<1 U	<1 U	<1 U	<3 U	07-feb-2003
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<3 U	05-may-2003
							NC7-12
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	23-may-1997
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	14-may-1998
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	26-may-1999
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	13-jun-2000
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	1.5 B	<0.5 U	14-may-2001
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	1.5 B	<0.5 U	14-may-2001
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	22-may-2002
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<3 U	28-may-2003
							NC7-16
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	14-nov-1995
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	05-jun-1996
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	18-dec-1996
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	12-may-1997
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	29-apr-1998
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	27-may-1999
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	14-jun-2000
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	22-may-2001
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	22-may-2002
							NC7-17
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	21-nov-1995
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	21-nov-1995
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	05-jun-1996
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	17-dec-1996
							NC7-18
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	29-nov-1995
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	05-jun-1996
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	13-dec-1996
							NC7-21
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	14-nov-1995
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	05-jun-1996
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	26-dec-1996
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	29-may-1997
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	20-may-1998
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	28-may-1999
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	15-jun-2000
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	22-may-2001
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	23-may-2002
							NC7-22
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	15-nov-1995
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	05-jun-1996
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	18-dec-1996
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	29-may-1997
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	20-may-1998

Table A-14. Ground and surface water analyses for volatile organic compounds (ug/L) in samples

Location Date	Lab	Note	Val.	1,1- DCE	cis- 1,2- DCE	trans- 1,2- DCE	Total 1,2- DCE	TCE	PCE
NC7-22 (continued)									
28-may-1999	CN	af	V	<0.5 U	<0.5 U	<0.5 U	<0.5 U	0.9	<0.5 UL
15-jun-2000	CN	a	V	<0.5 U	<0.5 U	<0.5 U	<0.5 U	0.6	<0.5 U
NC7-25									
18-jul-1995	CS	a	V	<0.5 U	-	-	<0.5 U	<0.5 U	<0.5 U
20-oct-1995	CS	a	V	<0.5 U	-	-	<0.5 U	<0.5 U	<0.5 U
12-feb-1996	CS	a	V	<0.5 U	-	-	<0.5 U	<0.5 U	<0.5 U
29-apr-1996	CS	a	V	<0.5 U	-	-	<0.5 U	<0.5 U	<0.5 U
30-jul-1996	CS	a	V	<0.5 U	<0.5 U	<0.5 U	-	<0.5 U	<0.5 U
24-oct-1996	CS	a	V	<0.5 U	<0.5 U	<0.5 U	-	<0.5 U	<0.5 U
28-jan-1997	CS	a	V	<0.5 U	<0.5 U	<0.5 U	-	<0.5 U	<0.5 U
16-apr-1997	CS	a	V	<0.5 U	<0.5 U	<0.5 U	-	<0.5 U	<0.5 U
30-jul-1997	CS	a	V	<0.5 U	<0.5 U	<0.5 U	-	<0.5 U	<0.5 U
27-oct-1997	CS	a	V	<0.5 U	<0.5 U	<0.5 U	-	<0.5 U	<0.5 U
22-jan-1998	CS	a	V	<0.5 U	<0.5 U	<0.5 U	-	<0.5 U	<0.5 U
28-apr-1998	CS	a	V	<0.5 U	<0.5 U	<0.5 U	-	<0.5 U	<0.5 U
31-jul-1998	CS	a	V	<0.5 U	<0.5 U	<0.5 U	-	<0.5 U	<0.5 U
26-oct-1998	CS	a	V	<0.5 U	<0.5 U	<0.5 U	-	<0.5 U	<0.5 U
27-jan-1999	CS	a	V	<0.5 U	<0.5 U	<0.5 U	-	<0.5 U	<0.5 U
04-may-1999	CN	a	V	<0.5 LOU	<0.5 LOU	<0.5 LOU	<0.5 LOU	<0.5 LOU	<0.5 LOU
15-jul-1999	CN	a	V	<0.5 LOU	<0.5 LOU	<0.5 LOU	<0.5 LOU	<0.5 LOU	<0.5 LOU
07-oct-1999	CN	af	V	<0.5 LOU	<0.5 LOU	<0.5 LOU	<0.5 LOU	<0.5 LOU	<0.5 LOU
04-feb-2000	CN	ah	V	<0.5 LOU	<0.5 LOU	<0.5 LOU	<0.5 LOU	<0.5 LOU	<0.5 LOU
04-feb-2000	CN	aeh	V	<0.5 LOU	<0.5 LOU	<0.5 LOU	<0.5 LOU	<0.5 LOU	<0.5 LOU
26-apr-2000	CN	af	V	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
09-aug-2000	CN	af	V	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
01-nov-2000	CN	af	V	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
25-jan-2001	CN	af	V	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
26-apr-2001	CN	a	V	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
18-jul-2001	CN	a	V	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
25-oct-2001	CN	ah	V	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
25-oct-2001	CN	aeh	V	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
24-jan-2002	CN	a	V	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
29-apr-2002	CN	a	V	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
11-sep-2002	CN	af	V	<0.5 LU	<0.5 LU	<0.5 LU	<0.5 LU	<0.5 LU	<0.5 LU
27-nov-2002	CN	af	V	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
11-feb-2003	CN	a	N	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
05-may-2003	CN	a	V	<0.5 LU	<0.5 U	<0.5 U	<0.5 U	<0.5 LU	<0.5 U
NC7-26									
17-jul-1995	CS	a	V	<0.5 U	-	-	<0.5 U	<0.5 U	<0.5 U
17-oct-1995	CS	a	V	<0.5 U	-	-	<0.5 U	<0.5 U	<0.5 U
08-feb-1996	CS	a	V	<0.5 U	-	-	<0.5 U	<0.5 U	<0.5 U
26-apr-1996	CS	a	V	<0.5 U	-	-	<0.5 U	<0.5 U	<0.5 U
25-jul-1996	CS	a	V	<0.5 U	<0.5 U	<0.5 U	-	<0.5 U	<0.5 U
23-oct-1996	CS	a	V	<0.5 U	<0.5 U	<0.5 U	-	<0.5 U	<0.5 U
23-jan-1997	CS	a	V	<0.5 U	<0.5 U	<0.5 U	-	<0.5 U	<0.5 U
10-apr-1997	CS	a	V	<0.5 U	<0.5 U	<0.5 U	-	<0.5 U	<0.5 U
24-jul-1997	CS	a	V	<0.5 U	<0.5 U	<0.5 U	-	<0.5 U	<0.5 U
22-oct-1997	CS	a	V	<0.5 U	<0.5 U	<0.5 U	-	<0.5 U	<0.5 U
21-jan-1998	CS	a	V	<0.5 U	<0.5 U	<0.5 U	-	<0.5 U	<0.5 U
22-apr-1998	CS	a	V	<0.5 U	<0.5 U	<0.5 U	-	<0.5 U	<0.5 U
27-jul-1998	CS	a	V	<0.5 U	<0.5 U	<0.5 U	-	<0.5 U	<0.5 U
20-oct-1998	CS	a	V	<0.5 U	<0.5 U	<0.5 U	-	<0.5 U	<0.5 U
25-jan-1999	CS	a	V	<0.5 U	<0.5 U	<0.5 U	-	<0.5 U	<0.5 U
04-may-1999	CN	af	V	<0.5 LOU	<0.5 LOU	<0.5 LOU	<0.5 LOU	<0.5 LOU	<0.5 LOU
14-jul-1999	CN	a	V	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
11-oct-1999	CN	a	V	<0.5 U	<0.5 UO	<0.5 U	<0.5 U	<0.5 U	<0.5 U
16-feb-2000	CN	a	V	<0.5 LOU	<0.5 LOU	<0.5 LOU	<0.5 LOU	<0.5 LOU	<0.5 LOU
26-apr-2000	CN	a	V	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
09-aug-2000	CN	a	V	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
02-nov-2000	CN	a	V	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
25-jan-2001	CN	a	V	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
26-apr-2001	CN	a	V	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
18-jul-2001	CN	a	V	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
25-oct-2001	CN	a	V	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
24-jan-2002	CN	a	V	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
22-apr-2002	CN	a	V	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U

collected from the Pit 7 Complex between July 1, 1995 and June 30, 2003. Results recorded by December 18, 2003.

1,1-DCA	1,2-DCA	1,1,1-TCA	Chloroform	Freon 11	Freon 113	Methylene chloride	Location Date
							(continued) NC7-22
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	28-may-1999
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	15-jun-2000
							NC7-25
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<5 U	18-jul-1995
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	20-oct-1995
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	12-feb-1996
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	29-apr-1996
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	30-jul-1996
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	24-oct-1996
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	28-jan-1997
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	16-apr-1997
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	30-jul-1997
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	27-oct-1997
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	22-jan-1998
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	28-apr-1998
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	31-jul-1998
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	26-oct-1998
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	27-jan-1999
<0.5 LOU	<0.5 LOU	<0.5 LOU	<0.5 LOU	<0.5 LOU	<0.5 LOU	<0.5 LOU	04-may-1999
<0.5 LOU	<0.5 LOU	<0.5 LOU	<0.5 LOU	<0.5 LOU	<0.5 LOU	<0.5 LOU	15-jul-1999
<0.5 LOU	<0.5 LOU	<0.5 LOU	<0.5 LOU	<0.5 LOU	<0.5 LOU	<0.5 LOU	07-oct-1999
<0.5 LOU	<0.5 LOU	<0.5 LOU	<0.5 LOU	<0.5 LOU	<0.5 LOU	<0.5 LOU	04-feb-2000
<0.5 LOU	<0.5 LOU	<0.5 LOU	<0.5 LOU	<0.5 LOU	<0.5 LOU	<0.5 LOU	04-feb-2000
<0.5 U	<0.5 U	<0.5 U	<0.5 OU	<0.5 U	<0.5 U	<0.5 U	26-apr-2000
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	09-aug-2000
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	01-nov-2000
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	1.8 B	<0.5 U	25-jan-2001
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	26-apr-2001
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	18-jul-2001
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	25-oct-2001
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	25-oct-2001
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	24-jan-2002
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	29-apr-2002
<0.5 LU	<0.5 LU	<0.5 LU	<0.5 LU	<0.5 LU	<0.5 LU	<0.5 LU	11-sep-2002
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	27-nov-2002
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<3 U	11-feb-2003
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<3 U	05-may-2003
							NC7-26
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<5 U	17-jul-1995
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	17-oct-1995
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	08-feb-1996
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	26-apr-1996
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	25-jul-1996
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	23-oct-1996
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	23-jan-1997
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	10-apr-1997
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	24-jul-1997
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	22-oct-1997
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	21-jan-1998
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	22-apr-1998
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	27-jul-1998
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	20-oct-1998
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	25-jan-1999
<0.5 LOU	<0.5 LOU	<0.5 LOU	<0.5 LOU	<0.5 LOU	<0.5 LOU	<0.5 LOU	04-may-1999
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	14-jul-1999
<0.5 U	<0.5 U	<0.5 U	<0.5 UO	<0.5 U	<0.5 U	<0.5 U	11-oct-1999
<0.5 LOU	<0.5 LOU	<0.5 LOU	<0.5 LOU	<0.5 LOU	<0.5 LOU	<0.5 LOU	16-feb-2000
<0.5 U	<0.5 U	<0.5 U	<0.5 OU	<0.5 U	<0.5 U	<0.5 U	26-apr-2000
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	09-aug-2000
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	02-nov-2000
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	1.8 B	<0.5 U	25-jan-2001
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	26-apr-2001
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	18-jul-2001
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	25-oct-2001
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	24-jan-2002
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	22-apr-2002

Table A-14. Ground and surface water analyses for volatile organic compounds (ug/L) in samples

Location Date	Lab	Note	Val.	1,1- DCE	cis- 1,2- DCE	trans- 1,2- DCE	Total 1,2- DCE	TCE	PCE
NC7-26 (continued)									
13-sep-2002	CN	af	V	<0.5 LOU	<0.5 LOU	<0.5 LOU	<0.5 LOU	<0.5 LOU	<0.5 LOU
29-nov-2002	CN	af	V	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
12-feb-2003	CN	af	V	<1 U	<1 U	<1 U	<1 U	<1 U	<1 U
06-may-2003	CN	a	V	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
NC7-34									
25-jul-1995	CS	a	V	<0.5 U	–	–	<0.5 U	<0.5 U	<0.5 U
15-nov-1995	CS	a	V	<0.5 U	–	–	<0.5 U	<0.5 U	<0.5 U
29-may-1997	CS	a	V	<0.5 U	<0.5 U	<0.5 U	–	<0.5 U	<0.5 U
20-may-1998	BB	afg	N	<0.5 U	<0.5 U	<0.5 U	<1 U	<0.5 U	<0.5 U
20-may-1998	CS	ag	V	<0.5 U	<0.5 U	<0.5 U	–	<0.5 U	<0.5 U
07-jun-1999	CN	a	V	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
14-jun-2000	CN	a	V	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
12-jun-2001	CN	af	V	<0.5 LOU	<0.5 LOU	<0.5 LOU	<0.5 LOU	<0.5 LOU	<0.5 LOU
04-jun-2002	CN	af	V	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
NC7-36									
18-jul-1995	CS	a	V	<0.5 U	–	–	<0.5 U	<0.5 U	<0.5 U
15-nov-1995	CS	a	V	<0.5 U	–	–	<0.5 U	<0.5 U	<0.5 U
13-may-1997	CS	a	V	<0.5 U	<0.5 U	<0.5 U	–	<0.5 U	<0.5 U
20-may-1998	CS	a	V	<0.5 U	<0.5 U	<0.5 U	–	<0.5 U	<0.5 U
16-jun-1999	CN	a	V	<0.5 OU	<0.5 OU	<0.5 OU	<0.5 OU	<0.5 OU	<0.5 OU
19-jun-2000	BB	ag	V	<0.5 U	<0.5 U	<0.5 U	<1 U	<0.5 U	<0.5 U
19-jun-2000	CN	ag	V	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 LU	<0.5 U
25-may-2001	CN	a	V	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
31-may-2002	CN	a	V	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
NC7-37									
28-dec-1995	CS	aj	V	<0.5 U	–	–	<0.5 U	0.61	<0.5 U
28-dec-1995	CS	aj	V	<0.5 U	–	–	<0.5 U	0.73	<0.5 U
28-dec-1995	CS	a	V	<0.5 U	–	–	<0.5 U	0.6	<0.5 U
27-may-1997	CS	ah	V	<0.5 U	<0.5 U	<0.5 U	–	0.8	<0.5 U
27-may-1997	CS	aeh	V	<0.5 U	<0.5 U	<0.5 U	–	0.63	<0.5 U
29-apr-1998	CS	a	V	<0.5 U	<0.5 U	<0.5 U	–	1	<0.5 U
16-jun-1999	CN	af	V	1.4 O	<0.5 OU	<0.5 OU	<0.5 OU	2.5 O	<0.5 OU
14-jun-2000	CN	a	V	0.9	<0.5 U	<0.5 U	<0.5 U	2.4	<0.5 U
NC7-40									
01-aug-1995	CS	a	V	<0.5 U	–	–	<0.5 U	<0.5 U	<0.5 U
14-nov-1995	CS	a	V	<0.5 U	–	–	<0.5 U	<0.5 U	<0.5 U
27-may-1997	BB	ag	V	<0.5 U	<0.5 U	<0.5 U	–	<0.5 U	<0.5 U
27-may-1997	CS	ag	V	<0.5 U	<0.5 U	<0.5 U	–	<0.5 U	<0.5 U
29-apr-1998	CS	a	V	<0.5 U	<0.5 U	<0.5 U	–	<0.5 U	<0.5 U
07-jun-1999	CN	a	V	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
13-jun-2000	CN	a	V	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
12-jun-2001	CN	af	V	<0.5 LOU	<0.5 LOU	<0.5 LOU	<0.5 LOU	<0.5 LOU	<0.5 LOU
29-may-2002	CN	af	V	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
NC7-47									
18-jul-1995	CS	a	V	<0.5 U	–	–	<0.5 U	<0.5 U	<0.5 U
20-oct-1995	CS	a	V	<0.5 U	–	–	<0.5 U	<0.5 U	<0.5 U
13-feb-1996	CS	a	V	<0.5 U	–	–	<0.5 U	<0.5 U	<0.5 U
30-apr-1996	CS	a	V	<0.5 U	–	–	<0.5 U	<0.5 U	<0.5 U
30-jul-1996	CS	a	V	<0.5 U	<0.5 U	<0.5 U	–	<0.5 U	<0.5 U
25-oct-1996	CS	a	V	<0.5 U	<0.5 U	<0.5 U	–	<0.5 U	<0.5 U
03-feb-1997	CS	a	V	<0.5 U	<0.5 U	<0.5 U	–	<0.5 U	<0.5 U
16-apr-1997	CS	a	V	<0.5 U	<0.5 U	<0.5 U	–	<0.5 U	<0.5 U
30-jul-1997	CS	a	V	<0.5 U	<0.5 U	<0.5 U	–	<0.5 U	<0.5 U
27-oct-1997	CS	a	V	<0.5 U	<0.5 U	<0.5 U	–	<0.5 U	<0.5 U
27-jan-1998	CS	a	V	<0.5 U	<0.5 U	<0.5 U	–	<0.5 U	<0.5 U
29-apr-1998	CS	a	V	<0.5 U	<0.5 U	<0.5 U	–	<0.5 U	<0.5 U
29-jul-1998	CS	a	V	<0.5 U	<0.5 U	<0.5 U	–	<0.5 U	<0.5 U
21-oct-1998	CS	a	V	<0.5 U	<0.5 U	<0.5 U	–	<0.5 U	<0.5 U
27-jan-1999	CS	a	V	<0.5 U	<0.5 U	<0.5 U	–	<0.5 U	<0.5 U
04-may-1999	CN	af	V	<0.5 LOU	<0.5 LOU	<0.5 LOU	<0.5 LOU	<0.5 LOU	<0.5 LOU
15-jul-1999	CN	a	V	<0.5 LOU	<0.5 LOU	<0.5 LOU	<0.5 LOU	<0.5 LOU	<0.5 LOU
11-oct-1999	CN	af	V	<0.5 U	<0.5 UO	<0.5 U	<0.5 U	<0.5 U	<0.5 U
27-jan-2000	CN	afh	V	<0.5 U	<0.5 OU	<0.5 U	<0.5 U	<0.5 LU	<0.5 LU

collected from the Pit 7 Complex between July 1, 1995 and June 30, 2003. Results recorded by December 18, 2003.

1,1-DCA	1,2-DCA	1,1,1-TCA	Chloroform	Freon 11	Freon 113	Methylene chloride	Location Date
							(continued) NC7-26
<0.5 LOU	<0.5 LOU	<0.5 LOU	<0.5 LOU	<0.5 LOU	<0.5 LOU	<0.5 LOU	13-sep-2002
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	29-nov-2002
<1 U	<1 U	<1 U	<1 U	<1 U	<1 U	<3 U	12-feb-2003
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<3 U	06-may-2003
							NC7-34
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<5 U	25-jul-1995
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	15-nov-1995
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	29-may-1997
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	0.55	<1 U	20-may-1998
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	20-may-1998
<0.5 U	<0.5 U	<0.5 U	<0.5 U	1.1	<0.5 U	<0.5 U	07-jun-1999
<0.5 U	<0.5 U	<0.5 U	<0.5 U	0.6	<0.5 U	<0.5 U	14-jun-2000
<0.5 LOU	<0.5 LOU	<0.5 LOU	<0.5 LOU	1.1 LO	<0.5 LOU	<0.5 LOU	12-jun-2001
<0.5 U	<0.5 U	<0.5 U	<0.5 U	0.8	<0.5 U	<0.5 U	04-jun-2002
							NC7-36
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<5 U	18-jul-1995
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	15-nov-1995
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	13-may-1997
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	20-may-1998
<0.5 OU	<0.5 OU	<0.5 OU	<0.5 OU	<0.5 OU	<0.5 OU	<0.5 OU	16-jun-1999
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<1 U	19-jun-2000
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	19-jun-2000
<0.5 U	<0.5 U	<0.5 U	<0.5 U	0.7	<0.5 U	<0.5 U	25-may-2001
<0.5 U	<0.5 U	<0.5 U	<0.5 U	0.8	<0.5 U	<0.5 U	31-may-2002
							NC7-37
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	28-dec-1995
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	28-dec-1995
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	28-dec-1995
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	27-may-1997
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	27-may-1997
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	1.1	29-apr-1998
<0.5 OU	<0.5 OU	<0.5 OU	<0.5 OU	<0.5 OU	<0.5 OU	<0.5 OU	16-jun-1999
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	14-jun-2000
							NC7-40
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	01-aug-1995
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	14-nov-1995
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<1 U	27-may-1997
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	27-may-1997
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	29-apr-1998
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	07-jun-1999
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	13-jun-2000
<0.5 LOU	<0.5 LOU	<0.5 LOU	<0.5 LOU	<0.5 LOU	<0.5 LOU	<0.5 LOU	12-jun-2001
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	29-may-2002
							NC7-47
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<5 U	18-jul-1995
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	20-oct-1995
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	13-feb-1996
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	30-apr-1996
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	30-jul-1996
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	25-oct-1996
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	03-feb-1997
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	16-apr-1997
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	30-jul-1997
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	27-oct-1997
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	27-jan-1998
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	29-apr-1998
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	29-jul-1998
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	21-oct-1998
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	27-jan-1999
<0.5 LOU	<0.5 LOU	<0.5 LOU	<0.5 LOU	<0.5 LOU	<0.5 LOU	<0.5 LOU	04-may-1999
<0.5 LOU	<0.5 LOU	<0.5 LOU	<0.5 LOU	<0.5 LOU	<0.5 LOU	<0.5 LOU	15-jul-1999
<0.5 U	<0.5 U	<0.5 U	<0.5 UO	<0.5 U	<0.5 U	<0.5 U	11-oct-1999
<0.5 U	<0.5 LU	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	27-jan-2000

Table A-14. Ground and surface water analyses for volatile organic compounds (ug/L) in samples

Location Date	Lab	Note	Val.	1,1- DCE	cis- 1,2- DCE	trans- 1,2- DCE	Total 1,2- DCE	TCE	PCE
NC7-47 (continued)									
27-jan-2000	CN	aefh	V	<0.5 U	<0.5 OU	<0.5 U	<0.5 U	<0.5 LU	<0.5 LU
01-may-2000	CN	af	V	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
09-aug-2000	CN	af	V	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
02-nov-2000	CN	af	V	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
25-jan-2001	CN	af	V	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
27-apr-2001	CN	a	V	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
19-jul-2001	CN	a	V	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
29-oct-2001	CN	a	V	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
30-jan-2002	CN	a	V	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 LU	<0.5 U
30-apr-2002	CN	af	V	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
29-aug-2002	CN	af	V	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
03-dec-2002	CN	af	V	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
12-feb-2003	CN	af	V	<1 U	<1 U	<1 U	<1 U	<1 U	<1 U
07-may-2003	CN	a	V	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
NC7-48									
19-jul-1995	CS	a	V	<0.5 U	-	-	<0.5 U	<0.5 U	<0.5 U
19-oct-1995	CS	a	V	<0.5 U	-	-	<0.5 U	<0.5 U	<0.5 U
15-feb-1996	CS	a	V	<0.5 U	-	-	<0.5 U	<0.5 U	<0.5 U
30-apr-1996	CS	a	V	<0.5 U	-	-	<0.5 U	<0.5 U	<0.5 U
30-jul-1996	CS	a	V	<0.5 U	<0.5 U	<0.5 U	-	<0.5 U	<0.5 U
25-oct-1996	CS	ah	V	<0.5 U	<0.5 U	<0.5 U	-	<0.5 U	<0.5 U
25-oct-1996	CS	aeh	V	<0.5 U	<0.5 U	<0.5 U	-	<0.5 U	<0.5 U
28-jan-1997	CS	a	V	<0.5 U	<0.5 U	<0.5 U	-	<0.5 U	<0.5 U
16-apr-1997	CS	a	V	<0.5 U	<0.5 U	<0.5 U	-	<0.5 U	<0.5 U
30-jul-1997	CS	ah	V	<0.5 U	<0.5 U	<0.5 U	-	<0.5 U	<0.5 U
30-jul-1997	CS	aeh	V	<0.5 U	<0.5 U	<0.5 U	-	<0.5 U	<0.5 U
28-oct-1997	CS	a	V	<0.5 U	<0.5 U	<0.5 U	-	<0.5 U	<0.5 U
22-jan-1998	CS	a	V	<0.5 U	<0.5 U	<0.5 U	-	<0.5 U	<0.5 U
28-apr-1998	CS	a	V	<0.5 U	<0.5 U	<0.5 U	-	<0.5 U	<0.5 U
31-jul-1998	CS	a	V	<0.5 U	<0.5 U	<0.5 U	-	<0.5 U	<0.5 U
26-oct-1998	CS	a	V	<0.5 U	<0.5 U	<0.5 U	-	<0.5 U	<0.5 U
28-jan-1999	CS	a	V	<0.5 U	<0.5 U	<0.5 U	-	<0.5 U	<0.5 U
04-may-1999	CN	a	V	<0.5 LOU	<0.5 LOU	<0.5 LOU	<0.5 LOU	<0.5 LOU	<0.5 LOU
19-jul-1999	CN	af	V	<0.5 U	<0.5 OU	<0.5 U	<0.5 U	<0.5 LU	<0.5 LU
12-oct-1999	CN	a	V	<0.5 U	<0.5 OU	<0.5 U	<0.5 U	<0.5 U	<0.5 U
27-jan-2000	CN	a	V	<0.5 U	<0.5 OU	<0.5 U	<0.5 U	<0.5 LU	<0.5 LU
01-may-2000	CN	a	V	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
10-aug-2000	CN	af	V	<0.5 U	<0.5 LOU	<0.5 U	<0.5 U	<0.5 U	<0.5 U
02-nov-2000	CN	af	V	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
25-jan-2001	CN	af	V	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
26-apr-2001	CN	ah	V	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
18-jul-2001	CN	a	V	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
25-oct-2001	CN	a	V	<0.5 HU	<0.5 HU	<0.5 HU	<0.5 HU	<0.5 HU	<0.5 HU
30-jan-2002	CN	a	V	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 LU	<0.5 U
30-apr-2002	CN	a	V	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
12-sep-2002	CN	af	V	<0.5 LOU	<0.5 LOU	<0.5 LOU	<0.5 LOU	<0.5 LOU	<0.5 LOU
29-nov-2002	CN	af	V	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
11-feb-2003	CN	a	N	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
06-may-2003	CN	a	V	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
NC7-50									
18-sep-2001	SE	af	V	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
18-oct-2001	CN	afh	V	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
18-oct-2001	CN	aeh	V	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
28-may-2002	CN	af	V	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
30-jul-2002	CN	a	V	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
21-dec-2002	CN	a	V	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
25-jan-2003	CN	a	V	<1 U	<1 U	<1 U	<1 U	<1 U	<1 U
NC7-51									
28-dec-1995	CS	aeh	V	2.6	-	-	<0.5 U	8.6	<0.5 U
28-dec-1995	CS	ahj	V	2.7	-	-	<0.5 U	9.1	<0.5 U
28-dec-1995	CS	ahj	V	2.3	-	-	<0.5 U	7.7	<0.5 U
28-dec-1995	CS	ah	V	2.5	-	-	<0.5 U	8.1	<0.5 U
12-jun-1996	BB	ag	V	<0.5 U	<0.5 U	<0.5 U	-	<0.5 U	<0.5 U
12-jun-1996	CS	ag	V	<0.5 U	<0.5 U	<0.5 U	-	<0.5 U	<0.5 U
18-dec-1996	BB	aeg	V	1	<0.5 U	<0.5 U	-	3.8	<0.5 U

collected from the Pit 7 Complex between July 1, 1995 and June 30, 2003. Results recorded by December 18, 2003.

1,1-DCA	1,2-DCA	1,1,1-TCA	Chloroform	Freon 11	Freon 113	Methylene chloride	Location Date
							(continued) NC7-47
<0.5 U	<0.5 LU	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	27-jan-2000
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	01-may-2000
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	09-aug-2000
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	02-nov-2000
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	1.8 B	<0.5 U	25-jan-2001
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	27-apr-2001
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	19-jul-2001
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	29-oct-2001
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	30-jan-2002
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	30-apr-2002
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	29-aug-2002
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	03-dec-2002
<1 U	<1 U	<1 U	<1 U	<1 U	<1 U	<3 U	12-feb-2003
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<3 U	07-may-2003
							NC7-48
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<5 U	19-jul-1995
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	19-oct-1995
<0.5 U	<0.5 U	<0.5 U	<0.5 U	1.1	<0.5 U	<0.5 U	15-feb-1996
<0.5 U	<0.5 U	<0.5 U	<0.5 U	1.1	<0.5 U	<0.5 U	30-apr-1996
<0.5 U	<0.5 U	<0.5 U	<0.5 U	1	<0.5 U	<0.5 U	30-jul-1996
<0.5 U	<0.5 U	<0.5 U	<0.5 U	0.99	<0.5 U	<0.5 U	25-oct-1996
<0.5 U	<0.5 U	<0.5 U	<0.5 U	1	<0.5 U	<0.5 U	25-oct-1996
<0.5 U	<0.5 U	<0.5 U	<0.5 U	0.96	<0.5 U	<0.5 U	28-jan-1997
<0.5 U	<0.5 U	<0.5 U	<0.5 U	2	<0.5 U	<0.5 U	16-apr-1997
<0.5 U	<0.5 U	<0.5 U	<0.5 U	1.4	<0.5 U	<0.5 U	30-jul-1997
<0.5 U	<0.5 U	<0.5 U	<0.5 U	1.4	<0.5 U	<0.5 U	30-jul-1997
<0.5 U	<0.5 U	<0.5 U	<0.5 U	0.9	<0.5 U	<0.5 U	28-oct-1997
<0.5 U	<0.5 U	<0.5 U	<0.5 U	0.77	<0.5 U	<0.5 U	22-jan-1998
<0.5 U	<0.5 U	<0.5 U	<0.5 U	1	<0.5 U	<0.5 U	28-apr-1998
<0.5 U	<0.5 U	<0.5 U	<0.5 U	1.2	<0.5 U	<0.5 U	31-jul-1998
<0.5 U	<0.5 U	<0.5 U	<0.5 U	0.92	<0.5 U	<0.5 U	26-oct-1998
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	28-jan-1999
<0.5 LOU	<0.5 LOU	<0.5 LOU	<0.5 LOU	1.2 LO	<0.5 LOU	<0.5 LOU	04-may-1999
<0.5 U	<0.5 U	<0.5 U	<0.5 OU	1.2	<0.5 U	<0.5 U	19-jul-1999
<0.5 U	<0.5 U	<0.5 U	<0.5 OU	<0.5 U	<0.5 U	<0.5 U	12-oct-1999
<0.5 U	<0.5 LU	<0.5 U	<0.5 U	0.9	<0.5 U	<0.5 U	27-jan-2000
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	01-may-2000
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	10-aug-2000
<0.5 U	<0.5 U	<0.5 U	<0.5 U	1	<0.5 U	<0.5 U	02-nov-2000
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	1.7 B	<0.5 U	25-jan-2001
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	26-apr-2001
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	18-jul-2001
<0.5 HU	<0.5 HU	<0.5 HU	<0.5 HU	<0.5 HU	<0.5 HU	<0.5 HU	25-oct-2001
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	30-jan-2002
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	30-apr-2002
<0.5 LOU	<0.5 LOU	<0.5 LOU	<0.5 LOU	<0.5 LOU	<0.5 LOU	<0.5 LOU	12-sep-2002
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	29-nov-2002
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<3 U	11-feb-2003
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<3 U	06-may-2003
							NC7-50
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	18-sep-2001
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	18-oct-2001
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	18-oct-2001
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	28-may-2002
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	30-jul-2002
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	21-dec-2002
<1 U	<1 U	<1 U	<1 U	<1 U	<1 U	<3 U	25-jan-2003
							NC7-51
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	28-dec-1995
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	28-dec-1995
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	28-dec-1995
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	28-dec-1995
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<1 U	12-jun-1996
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	12-jun-1996
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<1 U	18-dec-1996

Table A-14. Ground and surface water analyses for volatile organic compounds (ug/L) in samples

Location Date	Lab	Note	Val.	1,1- DCE	cis- 1,2- DCE	trans- 1,2- DCE	Total 1,2- DCE	TCE	PCE
NC7-51 (continued)									
18-dec-1996	CS	ag	V	0.71	<0.5 U	<0.5 U	-	4.4	<0.5 U
05-jun-1997	LH	a	V	<0.5 U	-	<1 U	-	4.3	<0.5 U
25-aug-1999	CN	a	V	<0.5 U	<0.5 U	<0.5 U	<0.5 U	1.1	<0.5 U
15-may-2000	GE	a	V	<5 U	-	<5 U	-	<1 EU	<5 U
17-may-2001	CN	a	V	<0.5 U	<0.5 U	<0.5 U	<0.5 U	1.2	<0.5 U
15-may-2002	CN	af	V	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
NC7-52									
29-nov-1995	CS	a	V	<0.5 U	-	-	<0.5 U	<0.5 U	<0.5 U
19-jun-1996	CS	a	V	<0.5 U	<0.5 U	<0.5 U	-	<0.5 U	<0.5 U
17-dec-1996	CS	a	V	<0.5 U	<0.5 U	<0.5 U	-	<0.5 U	<0.5 U
15-may-1997	CS	a	V	<0.5 U	<0.5 U	<0.5 U	-	<0.5 U	<0.5 U
28-oct-1997	CS	a	V	<0.5 U	<0.5 U	<0.5 U	-	<0.5 U	<0.5 U
18-may-1998	CS	a	V	<0.5 U	<0.5 U	<0.5 U	-	<0.5 U	<0.5 U
20-nov-1998	CS	a	V	<0.5 U	<0.5 U	<0.5 U	-	<0.5 U	<0.5 U
07-jun-1999	CN	a	V	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
15-jun-2000	CN	a	V	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
14-nov-2000	CN	a	V	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
23-may-2001	CN	a	V	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
19-nov-2001	CN	a	V	<0.5 LOU	<0.5 LOU	<0.5 LOU	<0.5 LOU	<0.5 LOU	<0.5 LOU
31-may-2002	CN	a	V	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
07-dec-2002	CN	a	V	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
NC7-64									
29-nov-1995	CS	a	V	<0.5 U	-	-	<0.5 U	<0.5 U	<0.5 U
NC7-67									
28-dec-1995	CS	aj	V	<0.5 U	-	-	<0.5 U	0.68	<0.5 U
28-dec-1995	CS	aj	V	<0.5 U	-	-	<0.5 U	0.8	<0.5 U
28-dec-1995	CS	a	V	<0.5 U	-	-	<0.5 U	1.4	<0.5 U
11-jun-1996	CS	a	V	<0.5 U	<0.5 U	<0.5 U	-	1.7 LO	<0.5 U
19-dec-1996	CS	a	V	<0.5 U	<0.5 U	<0.5 U	-	1.2	<0.5 U
12-may-1997	CS	ah	V	<0.5 U	<0.5 U	<0.5 U	-	0.94	<0.5 U
12-may-1997	CS	aeh	V	<0.5 U	<0.5 U	<0.5 U	-	0.92	<0.5 U
20-may-1998	BB	afg	N	<0.5 U	<0.5 U	<0.5 U	<1 U	1.4	<0.5 U
20-may-1998	CS	ag	V	<0.5 U	<0.5 U	<0.5 U	-	0.86	<0.5 U
01-jul-1999	CN	ah	V	<0.5 U	<0.5 U	<0.5 U	<0.5 U	1	<0.5 U
01-jul-1999	CN	aeh	V	<0.5 U	<0.5 U	<0.5 U	<0.5 U	1	<0.5 U
01-jun-2000	BB	ag	V	<0.5 U	<0.5 U	<0.5 U	<1 U	<0.5 U	<0.5 U
01-jun-2000	CN	ag	V	<0.5 LOU	<0.5 LOU	<0.5 LOU	<0.5 LOU	1.4 LO	<0.5 LOU
24-may-2001	CN	a	V	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
NC7-75									
09-nov-1995	CS	a	V	<0.5 U	-	-	<0.5 U	<0.5 U	<0.5 U
30-may-1996	CS	a	V	<0.5 U	<0.5 U	<0.5 U	-	<0.5 U	<0.5 U
16-dec-1996	CS	a	V	<0.5 U	<0.5 U	<0.5 U	-	<0.5 U	<0.5 U
NC7-76									
30-nov-1995	CS	a	V	<0.5 U	-	-	<0.5 U	<0.5 U	<0.5 U
15-may-1996	CS	a	V	<0.5 U	<0.5 U	<0.5 U	-	<0.5 U	<0.5 U
19-dec-1996	CS	a	V	<0.5 U	<0.5 U	<0.5 U	-	<0.5 U	<0.5 U
W-PIT7-02									
26-jul-1995	CS	a	V	<0.5 U	-	-	<0.5 U	<0.5 U	<0.5 U
21-nov-1995	CS	a	V	<0.5 U	-	-	<0.5 U	<0.5 U	<0.5 U
15-feb-1996	CS	a	V	<0.5 U	-	-	<0.5 U	<0.5 U	<0.5 U
18-jun-1996	CS	a	V	<0.5 U	<0.5 U	<0.5 U	-	<0.5 U	<0.5 U
28-aug-1996	CS	a	V	<0.5 U	<0.5 U	<0.5 U	-	<0.5 U	<0.5 U
20-dec-1996	CS	a	V	<0.5 U	<0.5 U	<0.5 U	-	<0.5 U	<0.5 U
W-PIT7-03									
26-jul-1995	CS	a	V	<0.5 U	-	-	<0.5 U	2	<0.5 U
21-nov-1995	CS	a	V	<0.5 U	-	-	<0.5 U	1.7	<0.5 U
16-feb-1996	CS	a	V	<0.5 U	-	-	<0.5 U	1.9	<0.5 U
28-may-1996	CS	a	V	<0.5 U	<0.5 U	<0.5 U	-	1.9	<0.5 U
18-sep-1996	CS	a	V	<0.5 U	<0.5 U	<0.5 U	-	2.2	<0.5 U
20-dec-1996	BB	aeg	V	<0.5 U	<0.5 U	<0.5 U	-	2.7	<0.5 U
20-dec-1996	CS	ag	V	<0.5 U	<0.5 U	<0.5 U	-	2.3	<0.5 U

collected from the Pit 7 Complex between July 1, 1995 and June 30, 2003. Results recorded by December 18, 2003.

1,1-DCA	1,2-DCA	1,1,1-TCA	Chloroform	Freon 11	Freon 113	Methylene chloride	Location Date
							(continued) NC7-51
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	18-dec-1996
<1 U	<0.5 U	<1 U	<1 U	<1 U	-	<1 U	05-jun-1997
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	25-aug-1999
<5 U	<5 U	<5 U	<5 U	<10 U	-	7.82 BF	15-may-2000
<0.5 U	<0.5 OU	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	17-may-2001
<0.5 U	<0.5 U	<0.5 U	<0.5 U	0.6	<0.5 U	<0.5 U	15-may-2002
							NC7-52
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	29-nov-1995
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	19-jun-1996
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	17-dec-1996
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	15-may-1997
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	28-oct-1997
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	18-may-1998
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	20-nov-1998
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	07-jun-1999
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	15-jun-2000
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	14-nov-2000
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	23-may-2001
<0.5 LOU	<0.5 LOU	<0.5 LOU	<0.5 LOU	<0.5 LOU	<0.5 LOU	<0.5 LOU	19-nov-2001
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	31-may-2002
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	07-dec-2002
							NC7-64
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	29-nov-1995
							NC7-67
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	28-dec-1995
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	28-dec-1995
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	28-dec-1995
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	11-jun-1996
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	19-dec-1996
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	12-may-1997
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	12-may-1997
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<1 U	20-may-1998
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	20-may-1998
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	01-jul-1999
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	01-jul-1999
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 LU	<0.5 U	<1 U	01-jun-2000
<0.5 LOU	<0.5 LOU	<0.5 LOU	<0.5 LOU	<0.5 LOU	<1 LOU	<2 LOU	01-jun-2000
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	24-may-2001
							NC7-75
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	09-nov-1995
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	30-may-1996
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	16-dec-1996
							NC7-76
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	30-nov-1995
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	15-may-1996
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	19-dec-1996
							W-PIT7-02
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<5 U	26-jul-1995
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	21-nov-1995
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	15-feb-1996
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	18-jun-1996
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	28-aug-1996
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	20-dec-1996
							W-PIT7-03
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<5 U	26-jul-1995
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	21-nov-1995
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	16-feb-1996
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	28-may-1996
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	18-sep-1996
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<1 U	20-dec-1996
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	20-dec-1996

Table A-14. Ground and surface water analyses for volatile organic compounds (ug/L) in samples

Location Date	Lab	Note	Val.	1,1- DCE	cis- 1,2- DCE	trans- 1,2- DCE	Total 1,2- DCE	TCE	PCE
W-PIT7-03 (continued)									
19-jun-2000	BB	ag	V	0.53	<0.5 U	<0.5 U	<1 U	1.8	<0.5 U
19-jun-2000	CN	ag	V	<0.5 U	<0.5 U	<0.5 U	<0.5 U	1.7 L	<0.5 U
27-nov-2000	CN	a	V	<0.5 U	<0.5 U	<0.5 U	<0.5 U	1.9	<0.5 U
18-jun-2001	CN	a	V	<0.5 U	<0.5 U	<0.5 U	<0.5 U	2.6	<0.5 U
26-nov-2001	CN	a	V	<0.5 U	<0.5 U	<0.5 U	<0.5 U	1.9	<0.5 U
01-jul-2002	CN	af	V	<0.5 U	<0.5 U	<0.5 U	<0.5 U	1.8	<0.5 U
21-dec-2002	CN	a	V	<0.5 U	<0.5 U	<0.5 U	<0.5 U	1.1	<0.5 U
W-PIT7-10									
26-jul-1995	CS	a	V	<0.5 U	-	-	<0.5 U	<0.5 U	<0.5 U
21-nov-1995	CS	a	V	<0.5 U	-	-	<0.5 U	<0.5 U	<0.5 U
15-feb-1996	CS	a	V	<0.5 U	-	-	<0.5 U	<0.5 U	<0.5 U
18-jun-1996	CS	a	V	<0.5 U	<0.5 U	<0.5 U	-	<0.5 U	<0.5 U
18-sep-1996	CS	a	V	<0.5 U	<0.5 U	<0.5 U	-	<0.5 U	<0.5 U
20-dec-1996	CS	a	V	<0.5 U	<0.5 U	<0.5 U	-	<0.5 U	<0.5 U
W-PIT7-12									
18-mar-1999	BB	a	V	<0.5 U	<0.5 U	<0.5 U	<1 U	<0.5 U	<0.5 U
W-PIT7-13									
30-mar-2001	BB	af	V	<0.5 U	<0.5 U	<0.5 U	<1 U	<0.5 U	<0.5 U
14-jun-2001	CN	a	V	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
23-aug-2001	CN	a	V	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 LOU	<0.5 OU
26-oct-2001	CN	a	V	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
14-mar-2002	CN	a	V	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
31-may-2002	CN	a	V	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
14-sep-2002	CN	a	V	<0.5 LOU	<0.5 LOU	<0.5 LOU	<0.5 LOU	<0.5 LOU	<0.5 LOU
01-feb-2003	CN	a	V	<1 LU	<1 LU	<1 LU	<1 LU	<1 LU	<1 LU
W-PIT7-15									
20-mar-2001	CN	af	V	<1 HU	<1 HU	<1 HU	<1 HU	<1 HU	<1 HU
25-apr-2001	CN	a	V	<0.5 LOU	<0.5 LOU	<0.5 LOU	<0.5 LOU	<0.5 LOU	<0.5 LOU
13-aug-2001	CN	a	V	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
30-oct-2001	CN	a	V	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
28-mar-2002	CN	a	V	<0.5 LOU	<0.5 LOU	<0.5 LOU	<0.5 LOU	<0.5 LOU	<0.5 LOU
04-jun-2002	CN	a	V	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
28-sep-2002	CN	a	N	<1 U	<1 U	<1 U	<1 U	<1 U	<1 U
W-PIT7-16									
28-mar-2001	CN	a	V	<1 HLU	<1 HU	<1 HU	<1 HU	<1 HU	<1 HU
11-jun-2001	CN	a	V	<0.5 LOU	<0.5 LOU	<0.5 LOU	<0.5 LOU	<0.5 LOU	<0.5 LOU
23-aug-2001	CN	a	V	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 LOU	<0.5 OU
26-oct-2001	CN	a	V	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
07-mar-2002	CN	a	V	<0.5 LOU	<0.5 LOU	<0.5 LOU	<0.5 LOU	<0.5 LOU	<0.5 LOU
23-may-2002	CN	a	V	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
14-sep-2002	CN	a	V	<0.5 LOU	<0.5 LOU	<0.5 LOU	<0.5 LOU	<0.5 LOU	<0.5 LOU
14-dec-2002	BB	a	V	<0.5 U	<0.5 U	<0.5 U	<1 U	<0.5 U	<0.5 U
03-may-2003	CN	a	V	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
W-PIT7-1714									
27-mar-2002	CN	af	V	<1 LOU	<1 LOU	<1 LOU	<1 LOU	<1 LOU	<1 LOU
W-PIT7-1715									
27-mar-2002	CN	af	V	<1 LOU	<1 LOU	<1 LOU	<1 LOU	<1 LOU	<1 LOU
W-PIT7-1716									
03-jul-2002	CN	a	N	<1 U	<1 U	<1 U	<1 U	<1 U	<1 U
W-PIT7-1717									
28-mar-2002	CN	af	V	<1 LOU	<1 LOU	<1 LOU	<1 LOU	<1 LOU	<1 LOU
W-PIT7-1718									
26-mar-2002	CN	a	V	<1 U	<1 U	<1 U	<1 U	<1 U	<1 U
W-PIT7-1720									
27-mar-2002	CN	af	V	<1 LOU	<1 LOU	<1 LOU	<1 LOU	<1 LOU	<1 LOU

collected from the Pit 7 Complex between July 1, 1995 and June 30, 2003. Results recorded by December 18, 2003.

1,1-DCA	1,2-DCA	1,1,1-TCA	Chloroform	Freon 11	Freon 113	Methylene chloride	Location Date
							(continued) W-PIT7-03
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<1 U	19-jun-2000
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	19-jun-2000
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	27-nov-2000
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	18-jun-2001
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	26-nov-2001
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	01-jul-2002
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	21-dec-2002
							W-PIT7-10
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<5 U	26-jul-1995
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	21-nov-1995
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	15-feb-1996
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	18-jun-1996
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	18-sep-1996
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	20-dec-1996
							W-PIT7-12
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<1 U	18-mar-1999
							W-PIT7-13
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<1 U	30-mar-2001
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	14-jun-2001
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	23-aug-2001
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	26-oct-2001
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	14-mar-2002
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	31-may-2002
<0.5 LOU	<0.5 LOU	<0.5 LOU	<0.5 LOU	<0.5 LOU	<0.5 LOU	<0.5 LOU	14-sep-2002
<1 LU	<1 LU	<1 LU	<1 LU	<1 LU	<1 LU	<3 LU	01-feb-2003
							W-PIT7-15
<1 HU	<1 HU	<1 HU	<1 HU	<1 HU	<1 HU	<3 HU	20-mar-2001
<0.5 LOU	<0.5 LOU	<0.5 LOU	<0.5 LOU	<0.5 LOU	<0.5 LOU	<0.5 LOU	25-apr-2001
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	13-aug-2001
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	30-oct-2001
<0.5 LOU	<0.5 LOU	<0.5 LOU	<0.5 LOU	<0.5 LOU	<0.5 LOU	<0.5 LOU	28-mar-2002
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	04-jun-2002
<1 U	<1 U	<1 U	<1 U	<1 U	<1 U	<3 U	28-sep-2002
							W-PIT7-16
<1 HU	<1 HU	<1 HU	<1 HU	<1 HU	<1 HU	<3 HU	28-mar-2001
<0.5 LOU	<0.5 LOU	<0.5 LOU	<0.5 LOU	<0.5 LOU	<0.5 LOU	<0.5 LOU	11-jun-2001
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	23-aug-2001
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	26-oct-2001
<0.5 LOU	<0.5 LOU	<0.5 LOU	<0.5 LOU	<0.5 LOU	<0.5 LOU	<0.5 LOU	07-mar-2002
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	23-may-2002
<0.5 LOU	<0.5 LOU	<0.5 LOU	<0.5 LOU	<0.5 LOU	<0.5 LOU	<0.5 LOU	14-sep-2002
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<1 U	14-dec-2002
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<3 U	03-may-2003
							W-PIT7-1714
<1 LOU	<1 LOU	<1 LOU	<1 LOU	<1 LOU	<1 LOU	<3 LOU	27-mar-2002
							W-PIT7-1715
<1 LOU	<1 LOU	<1 LOU	<1 LOU	<1 LOU	<1 LOU	<3 LOU	27-mar-2002
							W-PIT7-1716
<1 U	<1 U	<1 U	<1 U	<1 U	<1 U	<3 U	03-jul-2002
							W-PIT7-1717
<1 LOU	<1 LOU	<1 LOU	<1 LOU	<1 LOU	<1 LOU	<3 LOU	28-mar-2002
							W-PIT7-1718
<1 U	<1 U	<1 U	<1 U	<1 U	<1 U	<3 U	26-mar-2002
							W-PIT7-1720
<1 LOU	<1 LOU	<1 LOU	<1 LOU	<1 LOU	<1 LOU	<3 LOU	27-mar-2002

Table A-14. Ground and surface water analyses for volatile organic compounds (ug/L) in samples

Location Date	Lab	Note	Val.	1,1-DCE	cis-1,2-DCE	trans-1,2-DCE	Total 1,2-DCE	TCE	PCE
W-PIT7-1723									
26-mar-2002	CN	af	V	<1 U	<1 U	<1 U	<1 U	<1 U	<1 U
W-PIT7-1724									
26-mar-2002	CN	af	V	<1 U	<1 U	<1 U	<1 U	<1 U	<1 U
W-865-01									
30-mar-1999	BB	a	V	<0.5 U	<0.5 U	<0.5 U	<1 U	0.61	<0.5 U
24-may-1999	BB	ag	V	<0.5 U	<0.5 U	<0.5 U	<1 U	<0.5 U	<0.5 U
24-may-1999	CN	ag	V	<0.5 LOU	<0.5 LOU	<0.5 LOU	<0.5 LOU	<0.5 LOU	<0.5 LOU
25-aug-1999	CN	a	V	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
09-dec-1999	CN	a	V	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
07-mar-2000	CN	a	V	<0.5 LOU	<0.5 LOU	<0.5 LOU	<0.5 LOU	<0.5 LOU	<0.5 LOU
24-may-2000	CN	a	V	<0.5 U	<0.5 LU	<0.5 U	<0.5 U	<0.5 U	<0.5 U
21-jul-2000	CN	a	V	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 OU	<0.5 OU
16-nov-2000	CN	a	V	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
26-jan-2001	CN	a	V	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
25-apr-2001	CN	a	V	<0.5 HLOU	<0.5 HLOU	<0.5 HLOU	<0.5 HLOU	<0.5 HLOU	<0.5 HLOU
14-aug-2001	CN	af	V	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
31-oct-2001	CN	af	V	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
31-jan-2002	CN	a	V	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 LU	<0.5 U
30-may-2002	CN	a	V	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
31-jul-2002	CN	af	V	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
19-feb-2003	CN	af	V	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
29-may-2003	CN	a	V	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
W-865-03									
29-sep-2000	CN	af	V	<1 U	<1 U	<1 U	<0.5 U	<1 U	<1 U
16-nov-2000	CN	a	V	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
30-jan-2001	CN	a	V	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
25-apr-2001	CN	a	V	<0.5 LOU	<0.5 LOU	<0.5 LOU	<0.5 LOU	<0.5 LOU	<0.5 LOU
14-aug-2001	CN	af	V	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
30-oct-2001	CN	af	V	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
31-jan-2002	CN	a	V	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 LU	<0.5 U
30-may-2002	CN	a	V	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
31-jul-2002	CN	af	V	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
19-feb-2003	CN	af	V	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
29-may-2003	CN	a	V	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
W-865-04									
28-sep-2000	CN	af	V	<1 LOU	<1 LOU	<1 LOU	<0.5 LOU	<1 LOU	<1 LOU
16-nov-2000	CN	a	V	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
26-jan-2001	CN	a	V	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
25-apr-2001	CN	a	V	<0.5 LOU	<0.5 LOU	<0.5 LOU	<0.5 LOU	<0.5 LOU	<0.5 LOU
14-aug-2001	CN	af	V	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
30-oct-2001	CN	af	V	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
31-jan-2002	CN	a	V	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 LU	<0.5 U
23-may-2002	CN	af	V	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
31-jul-2002	CN	af	V	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
19-feb-2003	CN	af	V	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
29-may-2003	CN	a	V	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
W-865-07									
29-sep-2000	CN	af	V	<1 U	<1 U	<1 U	<0.5 U	<1 U	<1 U
16-nov-2000	CN	a	V	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
26-jan-2001	CN	a	V	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
25-apr-2001	CN	a	V	<0.5 LOU	<0.5 LOU	<0.5 LOU	<0.5 LOU	<0.5 LOU	<0.5 LOU
14-aug-2001	CN	af	V	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
30-oct-2001	CN	af	V	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
31-jan-2002	CN	a	V	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 LU	<0.5 U
23-may-2002	CN	af	V	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
31-jul-2002	CN	af	V	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
19-feb-2003	CN	af	V	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
29-may-2003	CN	a	V	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
W-865-1804									
23-jun-2003	CN	a	V	<1 U	<1 U	<1 U	<1 U	<1 U	<1 U

collected from the Pit 7 Complex between July 1, 1995 and June 30, 2003. Results recorded by December 18, 2003.

1,1- DCA	1,2- DCA	1,1,1- TCA	Chloro- form	Freon 11	Freon 113	Methylene chloride	Location Date
							W-PIT7-1723
<1 U	<1 U	<1 U	<1 U	<1 U	<1 U	<3 U	26-mar-2002
							W-PIT7-1724
<1 U	<1 U	<1 U	<1 U	<1 U	<1 U	<3 U	26-mar-2002
							W-865-01
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<1 UF	30-mar-1999
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<1 U	24-may-1999
<0.5 LOU	<0.5 LOU	<0.5 LOU	<0.5 LOU	<0.5 LOU	<0.5 LOU	<0.5 LOU	24-may-1999
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	25-aug-1999
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	09-dec-1999
<0.5 LOU	<0.5 LOU	<0.5 LOU	<0.5 LOU	<0.5 LOU	<0.5 LOU	<0.5 LOU	07-mar-2000
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	24-may-2000
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	21-jul-2000
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	16-nov-2000
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	1.8 B	<0.5 U	26-jan-2001
<0.5 HLOU	<0.5 HLOU	<0.5 HLOU	<0.5 HLOU	<0.5 HLOU	<0.5 HLOU	<0.5 HLOU	25-apr-2001
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	14-aug-2001
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	31-oct-2001
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	31-jan-2002
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	30-may-2002
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	31-jul-2002
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<3 U	19-feb-2003
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<3 U	29-may-2003
							W-865-03
<1 U	<1 U	<1 U	<1 U	<1 U	<1 U	<3 U	29-sep-2000
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	16-nov-2000
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	30-jan-2001
<0.5 LOU	<0.5 LOU	<0.5 LOU	<0.5 LOU	<0.5 LOU	<0.5 LOU	<0.5 LOU	25-apr-2001
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	14-aug-2001
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	30-oct-2001
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	31-jan-2002
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	30-may-2002
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	31-jul-2002
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<3 U	19-feb-2003
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<3 U	29-may-2003
							W-865-04
<1 LOU	<1 LOU	<1 LOU	<1 LOU	<1 LOU	<1 LOU	<3 LOU	28-sep-2000
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	16-nov-2000
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	1.8 B	<0.5 U	26-jan-2001
<0.5 LOU	<0.5 LOU	<0.5 LOU	<0.5 LOU	<0.5 LOU	<0.5 LOU	<0.5 LOU	25-apr-2001
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	14-aug-2001
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	30-oct-2001
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	31-jan-2002
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	23-may-2002
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	31-jul-2002
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<3 U	19-feb-2003
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<3 U	29-may-2003
							W-865-07
<1 U	<1 U	<1 U	<1 U	<1 U	<1 U	<3 U	29-sep-2000
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	16-nov-2000
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	1.8 B	<0.5 U	26-jan-2001
<0.5 LOU	<0.5 LOU	<0.5 LOU	<0.5 LOU	<0.5 LOU	<0.5 LOU	<0.5 LOU	25-apr-2001
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	14-aug-2001
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	30-oct-2001
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	31-jan-2002
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	23-may-2002
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	31-jul-2002
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<3 U	19-feb-2003
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<3 U	29-may-2003
							W-865-1804
<1 U	<1 U	<1 U	<1 U	<1 U	<1 U	<3 U	23-jun-2003

Table A-14. Ground and surface water analyses for volatile organic compounds (ug/L) in samples

Location Date	Lab	Note	Val.	1,1- DCE	cis- 1,2- DCE	trans- 1,2- DCE	Total 1,2- DCE	TCE	PCE
SPRING13									
06-nov-1995	CS	a	V	<0.5 U	-	-	<0.5 U	<0.5 U	<0.5 U
SPRING24									
22-oct-1999	CN	a	V	<1 U	<1 U	<1 U	<1 U	<1 U	<1 U

collected from the Pit 7 Complex between July 1, 1995 and June 30, 2003. Results recorded by December 18, 2003.

1,1-DCA	1,2-DCA	1,1,1-TCA	Chloro-form	Freon 11	Freon 113	Methylene chloride	Location Date
<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U	SPRING13 06-nov-1995
<1 U	<1 U	<1 U	<1 U	<1 U	<1 U	<3 U	SPRING24 22-oct-1999

See following page for notes

Table A-14. Ground and surface water analyses for volatile organic compounds (ug/L) in samples collected from the Pit 7 Complex between July 1, 1995 and June 30, 2003. Results recorded by December 18, 2003.

Notes:

-	Indicates no analysis performed for this compound

Val. = Validation code

Footnotes:

a	ERD data
b	ORAD WGMG data
c	Analytical results for this sample are suspect
d	Sample collected during hydraulic testing
e	Blind sample, sent to lab without location identity
f	Sample dilution necessary for analysis; detection limits increased
g	Interlaboratory collocated sample
h	Intralaboratory collocated sample
i	Sample collected as part of pilot study
j	Note field may contain important information regarding this sample
k	Pre-development sample
l	Norm month, norm quarter or norm year inconsistent with sample date
m	Confirmation sample
n	Sample analyzed after standard holding time
o	Sample comprised of partial composite
p	Alpha spectroscopy analysis of uranium isotopes
q	Gamma spectroscopy analysis of uranium isotopes
r	Tritium data represents non-detect with activity calc'd for 100 percent error.

Lab Codes:

BB	BC Laboratories, Inc.	Bakersfield, CA
CN	Caltest Analytical Laboratory	1885 N. Kelly Rd, Napa, CA 94558
CS	California Laboratory Services	3249 Fitzgerald Rd. Rancho Cordova, CA 95742
GE	General Engineering Laboratori	PO 30712, Charleston, SC 29417
LH	LAS-formerly Lockheed<1jan97	975 Kelly Johnson Las Vegas NV 89119
SE	Sequoia Analytical	1551 Industrial Road, San Carlos, CA 94070

Validation Codes:

V	Validated
N	Not validated (default value)
U	Undeclared
H	Historical comparison only

CLP flags: (follow result)

B	Analyte found in method blank
D	Analysis performed at a secondary dilution or concentration (i.e., vapor samples)
E	The analyte was detected below the LLNL reporting limit, but above the analytical laboratory minimum detection limit.
F	Analyte found in field blank, trip blank, or equipment blank
G	Quantitated using fuel calibration, but does not match typical fuel fingerprint (fuel maybe gasoline, diesel, motor oil etc.).
H	Sample analyzed outside of holding time, sample results should be evaluated
J	Analyte was postively identified; the associated numerical value is the approximate concentration of the analyte in the sample.
L	Spike accuracy not within control limits
O	Duplicate spike or sample precision not within control limits
P	Indicates that the absence of a data qualifier flag does not mean that the data does not need qualification, but that the implementation of electronic data qualifier flags was not yet established
R	Sample results are rejected due to serious deficiencies in the ability to analyze the sample and meet QC criteria. The presence or absence of the analyte cannot be verified
S	Analytical results for this sample are suspect
T	Analyte is tentatively identified compound; result is approximate
U	Compound was analyzed for, but not detected above detection limit

Table A-15. Ground and surface water analyses for aromatic (fuel) hydrocarbons (ug/L) in samples collected from the Pit 7 Complex between July 1, 1995 and June 30, 2003. Results recorded by December 18, 2003.

BTEX compounds in Ground Water, Site 300
December 19, 2003
gemini2

s3btex.19dec2003

Min Sample Date
July 1, 1995
Max Sample Date
June 30, 2003

Table A-15. Ground and surface water analyses for aromatic (fuel) hydrocarbons (ug/L) in samples collected from the Pit 7 Complex between July 1, 1995 and June 30, 2003. Results recorded by December 18, 2003.

Location Date	Lab	Note	Val.	Benzene	Toluene	Ethyl-benzene	Total Xylenes
MUL2							
23-aug-1995	CS	a	V	<0.2 U	<0.2 U	<0.2 U	-
06-sep-1996	CS	a	V	<0.2 U	<0.2 U	<0.2 U	-
08-sep-1997	CS	a	V	<0.2 U	<0.2 U	<0.2 U	-
16-sep-1998	CS	a	V	<0.2 U	<0.2 U	<0.2 U	-
06-sep-2000	BB	af	V	<0.2 U	<0.2 U	<0.2 U	<0.4 U
05-sep-2001	BB	afh	V	<0.2 U	<0.2 U	<0.2 U	<0.4 U
05-sep-2001	BB	aefh	V	<0.2 U	<0.2 U	<0.2 U	<0.4 U
17-sep-2002	BB	ah	V	<0.2 U	<0.2 U	<0.2 U	<0.4 U
17-sep-2002	BB	aeh	V	<0.2 U	<0.2 U	<0.2 U	<0.4 U
K7-07							
26-may-1999	CN	a	V	<0.5 U	<0.5 U	<0.5 U	<0.5 U
NC7-51							
15-may-2000	GE	a	V	<5 U	<5 U	<5 U	-
W-PIT7-12							
18-mar-1999	BB	a	V	<0.5 U	<0.5 U	<0.5 U	<1 U
W-PIT7-13							
30-mar-2001	BB	af	V	<0.5 U	<0.5 U	<0.5 U	<1 U
W-PIT7-15							
20-mar-2001	CN	af	V	<1 HU	<1 HU	<1 HU	<1 HU
W-PIT7-16							
28-mar-2001	CN	a	V	<1 HU	<1 HU	<1 HU	<1 HU
W-PIT7-1714							
27-mar-2002	CN	af	V	<1 LOU	<1 LOU	<1 LOU	<1 LOU
W-PIT7-1715							
27-mar-2002	CN	af	V	<1 LOU	<1 LOU	<1 LOU	<1 LOU
W-PIT7-1716							
03-jul-2002	CN	a	N	<1 U	<1 U	<1 U	<1 U
W-PIT7-1717							
28-mar-2002	CN	af	V	<1 LOU	<1 LOU	<1 LOU	<1 LOU
W-PIT7-1718							
26-mar-2002	CN	a	V	<1 U	<1 U	<1 U	<1 U
W-PIT7-1720							
27-mar-2002	CN	af	V	<1 LOU	<1 LOU	<1 LOU	<1 LOU
W-PIT7-1723							
26-mar-2002	CN	af	V	<1 U	<1 U	<1 U	<1 U
W-PIT7-1724							
26-mar-2002	CN	af	V	<1 U	<1 U	<1 U	<1 U
W-865-01							
30-mar-1999	BB	a	V	<0.5 U	<0.5 U	<0.5 U	<1 U
W-865-03							
29-sep-2000	CN	af	V	<1 U	<1 U	<1 U	<1 U
W-865-04							
28-sep-2000	CN	af	V	<1 LOU	<1 LOU	<1 LOU	<1 LOU
W-865-07							
29-sep-2000	CN	af	V	<1 U	<1 U	<1 U	<1 U

Table A-15. Ground and surface water analyses for aromatic (fuel) hydrocarbons (ug/L) in samples collected from the Pit 7 Complex between July 1, 1995 and June 30, 2003. Results recorded by December 18, 2003.

Location Date	Lab	Note	Val.	Benzene	Toluene	Ethyl-benzene	Total Xylenes
W-865-1804							
23-jun-2003	CN	a	V	<1 U	<1 U	<1 U	<1 U
SPRING24							
22-oct-1999	CN	a	V	<1 U	<1 U	<1 U	<1 U

See following page for notes

Table A-15. Ground and surface water analyses for aromatic (fuel) hydrocarbons (ug/L) in samples collected from the Pit 7 Complex between July 1, 1995 and June 30, 2003. Results recorded by December 18, 20

Notes:

- Indicates no analysis performed for this compound

Val. = Validation code

Footnotes:

a	ERD data
b	ORAD WGMG data
c	Analytical results for this sample are suspect
d	Sample collected during hydraulic testing
e	Blind sample, sent to lab without location identity
f	Sample dilution necessary for analysis; detection limits increased
g	Interlaboratory collocated sample
h	Intralaboratory collocated sample
i	Sample collected as part of pilot study
j	Note field may contain important information regarding this sample
k	Pre-development sample
l	Norm month, norm quarter or norm year inconsistent with sample date
m	Confirmation sample
n	Sample analyzed after standard holding time
o	Sample comprised of partial composite
p	Alpha spectroscopy analysis of uranium isotopes
q	Gamma spectroscopy analysis of uranium isotopes
r	Tritium data represents non-detect with activity calc'd for 100 percent error.

Lab Codes:

BB	BC Laboratories, Inc.	Bakersfield, CA
CN	Caltest Analytical Laboratory	1885 N. Kelly Rd, Napa, CA 94558
CS	California Laboratory Services	3249 Fitzgerald Rd. Rancho Cordova, CA 95742
GE	General Engineering Laboratori	PO 30712, Charleston, SC 29417

Validation Codes:

V	Validated
N	Not validated (default value)
U	Undeclared
H	Historical comparison only

CLP flags: (follow result)

B	Analyte found in method blank
D	Analysis performed at a secondary dilution or concentration (i.e., vapor samples)
E	The analyte was detected below the LLNL reporting limit, but above the analytical laboratory minimum detection limit.
F	Analyte found in field blank, trip blank, or equipment blank
G	Quantitated using fuel calibration, but does not match typical fuel fingerprint (fuel maybe gasoline, diesel, motor oil etc.).
H	Sample analyzed outside of holding time, sample results should be evaluated
J	Analyte was postively identified; the associated numerical value is the approximate concentration of the analyte in the sample.
L	Spike accuracy not within control limits
O	Duplicate spike or sample precision not within control limits
P	Indicates that the absence of a data qualifier flag does not mean that the data does not need qualification, but that the implementation of electronic data qualifier flags was not yet established
R	Sample results are rejected due to serious deficiencies in the ability to analyze the sample and meet QC criteria. The presence or absence of the analyte cannot be verified
S	Analytical results for this sample are suspect
T	Analyte is tentatively identified compound; result is approximate
U	Compound was analyzed for, but not detected above detection limit

Table A-16. Ground and surface water analyses for anions, TDS, specific conductivity, and pH in samples collected from the Pit 7 Complex between July 1, 1995 and June 30, 2003. Results recorded by December 18, 2003.

Anions in Ground Water, Site 300
December 19, 2003
gemini2

s3anionsL.19dec2003
s3anionsR.19dec2003

Min Sample Date
July 1, 1995
Max Sample Date
June 30, 2003

Table A-16. Ground and surface water analyses for anions, TDS, specific conductivity, and pH in

Location Date	Lab	Note	Val.	Fluoride (mg/L)	Silica (mg/L)	Nitrate as (NO3) (mg/L)	Chloride (mg/L)	Sulfate (mg/L)
MUL2								
23-aug-1995	CS	a	V	0.84	-	10	64	660
06-sep-1996	CS	a	V	-	-	4.8 O	-	-
08-sep-1997	CS	a	V	-	-	1.2	-	-
16-sep-1998	CS	a	V	-	-	11	-	-
08-sep-1999	CN	ah	V	-	-	15 S	-	-
08-sep-1999	CN	aeh	V	-	-	18 S	-	-
06-sep-2000	BB	af	V	-	-	13.4	-	-
05-sep-2001	BB	afh	V	-	-	13.7	-	-
05-sep-2001	BB	aefh	V	-	-	14	-	-
17-sep-2002	BB	afh	V	-	-	13.8	-	-
17-sep-2002	BB	aeh	V	-	-	13.4	-	-
K7-01								
14-jul-1995	CS	a	V	0.48	-	45	32	32
26-jul-1995	CS	a	V	-	-	50	-	-
17-oct-1995	CS	ah	V	0.46	-	41 D	30 D	24 D
17-oct-1995	CS	aeh	V	0.44	-	41 D	29 D	24 D
07-feb-1996	CS	a	V	0.44	-	42 D	32 D	34
25-jul-1996	CS	ah	V	-	-	-	-	-
25-jul-1996	CS	aeh	V	-	-	-	-	-
08-apr-1997	CS	a	V	-	-	44 D	-	-
23-jul-1997	CS	a	V	-	-	45 D	-	-
21-oct-1997	BB	ah	V	-	-	46	-	-
21-oct-1997	BB	aeh	V	-	-	46	-	-
20-apr-1998	BB	a	V	-	-	46	-	-
05-jun-1998	BB	a	N	-	-	46	-	-
12-jun-1998	BB	a	N	-	-	49	-	-
21-jul-1998	BB	ag	V	-	-	47	-	-
19-oct-1998	BB	ah	N	-	-	45	-	-
19-oct-1998	BB	aeh	N	-	-	45	-	-
19-jan-1999	BB	ah	V	-	-	44	-	-
19-jan-1999	BB	aeh	V	-	-	46	-	-
22-apr-1999	CN	af	V	-	-	71 DS	-	-
20-jul-1999	CN	af	V	-	-	45 DLS	-	-
07-oct-1999	CN	afh	V	-	-	33 DS	-	-
07-oct-1999	CN	aefh	V	-	-	57 DS	-	-
11-feb-2000	CN	af	V	-	-	48 D	-	-
25-apr-2000	CN	ah	V	-	-	29 D	-	-
25-apr-2000	CN	aeh	V	-	-	40 D	-	-
24-jul-2000	CN	af	V	-	-	40 D	-	-
30-oct-2000	CN	afh	V	-	-	39 D	-	-
30-oct-2000	CN	aefh	V	-	-	39 D	-	-
23-jan-2001	CN	af	V	-	-	40 D	-	-
24-apr-2001	CN	af	V	-	-	11 DH	-	-
17-jul-2001	CN	afh	V	-	-	24 DL	-	-
17-jul-2001	CN	aefh	V	-	-	24 DL	-	-
22-apr-2002	CN	aefh	V	-	-	71 D	-	-
22-apr-2002	CN	afh	V	-	-	74 D	-	-
13-sep-2002	CN	af	V	-	-	62 D	-	-
10-feb-2003	CN	af	V	-	-	66 D	-	-
01-may-2003	CN	afh	V	-	-	70 D	-	-
01-may-2003	CN	aefh	V	-	-	59 D	-	-
K7-03								
14-jul-1995	CS	ah	V	0.35	-	27	41	42
14-jul-1995	CS	aeh	V	0.35	-	25	42	41
26-jul-1995	CS	ah	V	-	-	32	-	-
26-jul-1995	CS	aeh	V	-	-	32	-	-
17-oct-1995	CS	a	V	0.42	-	23 D	38 D	31 D
07-feb-1996	CS	a	V	0.3	-	38	37 D	30 D
25-jul-1996	CS	a	V	-	-	-	-	-
08-apr-1997	CS	ah	V	-	-	27 D	-	-
08-apr-1997	CS	aeh	V	-	-	27 D	-	-
23-jul-1997	CS	a	V	-	-	28 D	-	-

samples collected from the Pit 7 Complex between July 1, 1995 and June 30, 2003. Results recorded by December 18, 2003.

Carbonate (mg/L)	Bicarbonate (mg/L)	TDS (mg/L)	Spec Cond (umhos/cm)	pH	Location Date
					MUL2
<1 U	170	1300	1600	7.1	23-aug-1995
-	-	-	-	-	06-sep-1996
-	-	-	-	-	08-sep-1997
-	-	-	-	-	16-sep-1998
-	-	-	-	-	08-sep-1999
-	-	-	-	-	08-sep-1999
-	-	-	-	-	06-sep-2000
-	-	-	-	-	05-sep-2001
-	-	-	-	-	05-sep-2001
-	-	-	-	-	17-sep-2002
-	-	-	-	-	17-sep-2002
					K7-01
<1 U	210	470	580	7	14-jul-1995
-	-	-	-	-	26-jul-1995
<1 U	210	450	610	6.8	17-oct-1995
<1 U	220	440	600	6.8	17-oct-1995
<1 U	210	470	640	6.6	07-feb-1996
-	-	-	660	-	25-jul-1996
-	-	-	650	-	25-jul-1996
-	-	-	-	-	08-apr-1997
-	-	-	-	-	23-jul-1997
-	-	-	-	-	21-oct-1997
-	-	-	-	-	21-oct-1997
-	-	-	-	-	20-apr-1998
-	-	-	-	-	05-jun-1998
-	-	-	-	-	12-jun-1998
-	-	-	-	-	21-jul-1998
-	-	-	-	-	19-oct-1998
-	-	-	-	-	19-oct-1998
-	-	-	-	-	19-jan-1999
-	-	-	-	-	19-jan-1999
-	-	-	-	-	22-apr-1999
-	-	-	-	-	20-jul-1999
-	-	-	-	-	07-oct-1999
-	-	-	-	-	07-oct-1999
-	-	-	-	-	11-feb-2000
-	-	-	-	-	25-apr-2000
-	-	-	-	-	25-apr-2000
-	-	-	-	-	24-jul-2000
-	-	-	-	-	30-oct-2000
-	-	-	-	-	30-oct-2000
-	-	-	-	-	23-jan-2001
-	-	-	-	-	24-apr-2001
-	-	-	-	-	17-jul-2001
-	-	-	-	-	17-jul-2001
-	-	-	-	-	22-apr-2002
-	-	-	-	-	22-apr-2002
-	-	-	-	-	13-sep-2002
-	-	-	-	-	10-feb-2003
-	-	-	-	-	01-may-2003
-	-	-	-	-	01-may-2003
					K7-03
<1 U	200	410	590	7.3	14-jul-1995
<1 U	200	430	650	7.3	14-jul-1995
-	-	-	-	-	26-jul-1995
-	-	-	-	-	26-jul-1995
<1 U	210	400	610	6.9	17-oct-1995
<1 U	190	450	670	7.1	07-feb-1996
-	-	-	650	-	25-jul-1996
-	-	-	-	-	08-apr-1997
-	-	-	-	-	08-apr-1997
-	-	-	-	-	23-jul-1997

Table A-16. Ground and surface water analyses for anions, TDS, specific conductivity, and pH in

Location Date	Lab	Note	Val.	Fluoride (mg/L)	Silica (mg/L)	Nitrate as (NO3) (mg/L)	Chloride (mg/L)	Sulfate (mg/L)
K7-03 (continued)								
21-oct-1997	BB	a	V	–	–	25	–	–
21-apr-1998	BB	a	V	–	–	27	–	–
27-jul-1998	BB	ag	V	–	–	28	–	–
19-oct-1998	BB	a	N	–	–	27	–	–
19-jan-1999	BB	a	V	–	–	26	–	–
22-apr-1999	CN	afh	V	–	–	66 DS	–	–
22-apr-1999	CN	aefh	V	–	–	60 DS	–	–
19-jul-1999	CN	af	V	–	–	23 LOS	–	–
07-oct-1999	CN	af	V	–	–	42 DS	–	–
11-feb-2000	CN	a	V	–	–	27	–	–
25-apr-2000	CN	af	V	–	–	26 D	–	–
24-jul-2000	CN	ah	V	–	–	26	–	–
24-jul-2000	CN	aeh	V	–	–	27	–	–
30-oct-2000	CN	af	V	–	–	16 D	–	–
23-jan-2001	CN	af	V	–	–	19 D	–	–
17-apr-2001	CN	afh	V	–	–	34	–	–
17-apr-2001	CN	aeh	V	–	–	33	–	–
17-jul-2001	CN	af	V	–	–	16 L	–	–
22-apr-2002	CN	af	V	–	–	41	–	–
06-sep-2002	CN	ah	V	–	–	43	–	–
06-sep-2002	CN	aefh	V	–	–	40	–	–
07-feb-2003	CN	afh	V	–	–	29	–	–
07-feb-2003	CN	aefh	V	–	–	41	–	–
01-may-2003	CN	af	V	–	–	28 D	–	–
K7-06								
14-jul-1995	CS	a	V	0.45	–	14	22	38
26-jul-1995	CS	a	V	–	–	23	–	–
17-oct-1995	CS	a	V	0.42	–	18	22 D	28 D
12-feb-1996	CS	ah	V	0.44	–	19	34 D	35 D
12-feb-1996	CS	aeh	V	0.43	–	18	33 D	34 D
24-jul-1996	CS	a	V	–	–	–	–	–
08-apr-1997	CS	a	V	–	–	19 D	–	–
23-jul-1997	CS	a	V	–	–	20	–	–
21-oct-1997	BB	a	V	–	–	17	–	–
21-apr-1998	BB	ah	V	–	–	18	–	–
21-apr-1998	BB	aeh	V	–	–	18	–	–
21-jul-1998	BB	agh	V	–	–	20	–	–
21-jul-1998	BB	aegh	V	–	–	20	–	–
19-oct-1998	BB	a	N	–	–	17	–	–
19-jan-1999	BB	a	V	–	–	18	–	–
23-apr-1999	CN	a	V	–	–	20 S	–	–
19-jul-1999	CN	ah	V	–	–	<0.5 LOSU	–	–
19-jul-1999	CN	aeh	V	–	–	16 LOS	–	–
12-oct-1999	CN	a	V	–	–	17 S	–	–
11-feb-2000	CN	a	V	–	–	19	–	–
25-apr-2000	CN	af	V	–	–	12 D	–	–
24-jul-2000	CN	a	V	–	–	17	–	–
01-nov-2000	CN	af	V	–	–	14 D	–	–
06-jun-2001	CN	a	V	–	–	16 D	–	–
19-jul-2001	CN	a	V	–	–	17	–	–
30-jan-2002	CN	a	V	–	65	–	–	–
29-apr-2002	CN	a	V	–	–	38	–	–
29-aug-2002	CN	af	V	–	–	25 D	–	–
07-feb-2003	CN	af	V	–	–	23	–	–
06-may-2003	CN	af	V	–	–	17 L	–	–
K7-07								
07-aug-1995	CS	ah	V	0.46	–	29 D	28 D	44 D
07-aug-1995	CS	aeh	V	0.45	–	29 D	28 D	46 D
30-oct-1995	CS	a	V	0.54	–	34	28 D	41 D
18-nov-1997	BB	a	V	–	–	27	–	–
02-jun-1998	BB	ah	N	–	–	37	–	–
02-jun-1998	BB	aeh	N	–	–	37	–	–
30-nov-1998	BB	a	V	–	–	34	–	–

samples collected from the Pit 7 Complex between July 1, 1995 and June 30, 2003. Results recorded by December 18, 2003.

Carbonate (mg/L)	Bicar-bonate (mg/L)	TDS (mg/L)	Spec Cond (umhos/cm)	pH	Location Date
					(continued) K7-03
-	-	-	-	-	21-oct-1997
-	-	-	-	-	21-apr-1998
-	-	-	-	-	27-jul-1998
-	-	-	-	-	19-oct-1998
-	-	-	-	-	19-jan-1999
-	-	-	-	-	22-apr-1999
-	-	-	-	-	22-apr-1999
-	-	-	-	-	19-jul-1999
-	-	-	-	-	07-oct-1999
-	-	-	-	-	11-feb-2000
-	-	-	-	-	25-apr-2000
-	-	-	-	-	24-jul-2000
-	-	-	-	-	24-jul-2000
-	-	-	-	-	30-oct-2000
-	-	-	-	-	23-jan-2001
-	-	-	-	-	17-apr-2001
-	-	-	-	-	17-apr-2001
-	-	-	-	-	17-jul-2001
-	-	-	-	-	22-apr-2002
-	-	-	-	-	06-sep-2002
-	-	-	-	-	06-sep-2002
-	-	-	-	-	07-feb-2003
-	-	-	-	-	07-feb-2003
-	-	-	-	-	01-may-2003
					K7-06
<1 U	140	310	430	7.5	14-jul-1995
-	-	-	-	-	26-jul-1995
<1 U	140	270	430	7.2	17-oct-1995
<1 U	140	300	440	7.2	12-feb-1996
<1 U	130	300	450	7.3	12-feb-1996
-	-	-	430	-	24-jul-1996
-	-	-	-	-	08-apr-1997
-	-	-	-	-	23-jul-1997
-	-	-	-	-	21-oct-1997
-	-	-	-	-	21-apr-1998
-	-	-	-	-	21-apr-1998
-	-	-	-	-	21-jul-1998
-	-	-	-	-	21-jul-1998
-	-	-	-	-	19-oct-1998
-	-	-	-	-	19-jan-1999
-	-	-	-	-	23-apr-1999
-	-	-	-	-	19-jul-1999
-	-	-	-	-	19-jul-1999
-	-	-	-	-	12-oct-1999
-	-	-	-	-	11-feb-2000
-	-	-	-	-	25-apr-2000
-	-	-	-	-	24-jul-2000
-	-	-	-	-	01-nov-2000
-	-	-	-	-	06-jun-2001
-	-	-	-	-	19-jul-2001
-	-	-	-	-	30-jan-2002
-	-	-	-	-	29-apr-2002
-	-	-	-	-	29-aug-2002
-	-	-	-	-	07-feb-2003
-	-	-	-	-	06-may-2003
					K7-07
<1 U	190	400	470	7.5	07-aug-1995
<1 U	110	400	490	7.5	07-aug-1995
<1 U	170	370	540	7.5	30-oct-1995
-	-	-	-	-	18-nov-1997
-	-	-	-	-	02-jun-1998
-	-	-	-	-	02-jun-1998
-	-	-	-	-	30-nov-1998

Table A-16. Ground and surface water analyses for anions, TDS, specific conductivity, and pH in

Location Date	Lab	Note	Val.	Fluoride (mg/L)	Silica (mg/L)	Nitrate as (NO3) (mg/L)	Chloride (mg/L)	Sulfate (mg/L)
K7-07 (continued)								
26-may-1999	CN	a	V	–	–	26 S	–	–
18-may-2000	CN	a	V	–	–	28	–	–
K7-09								
17-jul-1995	CS	a	V	0.18	–	<0.5 U	18	230
17-oct-1995	CS	a	V	0.19	–	<0.5 U	17 D	180 D
07-feb-1996	CS	a	V	0.15	–	<0.5 U	17 D	180 D
24-jul-1996	CS	a	V	–	–	–	–	–
10-apr-1997	CS	a	V	–	–	1.5	–	–
17-jul-1997	CS	a	V	–	–	1.4	–	–
22-oct-1997	BB	a	V	–	–	<0.4 U	–	–
22-apr-1998	BB	a	V	–	–	<0.4 U	–	–
27-jul-1998	BB	ag	V	–	–	1.3	–	–
20-oct-1998	BB	a	V	–	–	<0.4 U	–	–
25-jan-1999	BB	a	V	–	–	0.56	–	–
23-apr-1999	CN	a	V	–	–	<0.5 SU	–	–
15-jul-1999	CN	a	V	–	–	<0.5 LSU	–	–
11-oct-1999	CN	a	V	–	–	12 OS	–	–
16-feb-2000	CN	a	V	–	–	<0.5 U	–	–
25-apr-2000	CN	a	V	–	–	0.2	–	–
09-aug-2000	CN	a	V	–	–	<0.1 U	–	–
01-nov-2000	CN	af	V	–	–	<0.5 DU	–	–
23-jan-2001	CN	a	V	–	–	<0.4 U	–	–
24-apr-2001	CN	ah	V	–	–	<0.4 HU	–	–
17-jul-2001	CN	a	V	–	–	<0.4 LU	–	–
23-apr-2002	CN	af	V	–	–	30 DF	–	–
06-sep-2002	CN	a	V	–	–	17	–	–
07-feb-2003	CN	af	V	–	–	14	–	–
01-may-2003	CN	a	V	–	–	<0.1 U	–	–
K7-10								
18-jul-1995	CS	a	V	0.18	–	<0.5 U	13	420
19-oct-1995	CS	a	V	0.18	–	<0.5 U	13 D	360 D
12-feb-1996	CS	a	V	0.15	–	<0.5 U	12 D	290 D
24-jul-1996	CS	a	V	–	–	–	–	–
15-apr-1997	CS	a	V	–	–	<0.5 U	–	–
17-jul-1997	CS	a	V	–	–	1.3	–	–
27-oct-1997	BB	a	V	–	–	0.6	–	–
28-apr-1998	BB	a	V	–	–	<0.4 U	–	–
31-jul-1998	BB	a	N	–	–	<0.4 U	–	–
26-oct-1998	BB	a	V	–	–	<0.4 U	–	–
25-jan-1999	BB	a	V	–	–	0.47	–	–
26-apr-1999	CN	a	V	–	–	<0.5 SU	–	–
15-jul-1999	CN	a	V	–	–	<0.5 LSU	–	–
11-oct-1999	CN	a	V	–	–	<0.5 OSU	–	–
27-jan-2000	CN	a	V	–	–	<0.5 U	–	–
26-apr-2000	CN	a	V	–	–	2.5	–	–
01-nov-2000	CN	a	V	–	–	<0.1 U	–	–
23-jan-2001	CN	a	V	–	–	<0.4 U	–	–
24-apr-2001	CN	ah	V	–	–	<0.4 HU	–	–
17-jul-2001	CN	a	V	–	–	<0.4 LU	–	–
23-apr-2002	CN	a	V	–	–	<0.1 U	–	–
28-aug-2002	CN	af	V	–	–	18	–	–
07-feb-2003	CN	af	V	–	–	2.4	–	–
05-may-2003	CN	a	V	–	–	<0.1 LU	–	–
NC7-12								
26-may-1999	CN	a	V	–	–	44 S	–	–
NC7-15								
26-may-1999	CN	a	V	–	–	43 S	–	–
NC7-16								
05-jun-1996	CS	a	V	–	–	–	–	–
18-dec-1996	CS	a	V	–	–	–	–	–

samples collected from the Pit 7 Complex between July 1, 1995 and June 30, 2003. Results recorded by December 18, 2003.

Carbonate (mg/L)	Bicarbonate (mg/L)	TDS (mg/L)	Spec Cond (umhos/cm)	pH	Location Date
					(continued) K7-07
–	–	–	–	–	26-may-1999
–	–	–	–	–	18-may-2000
					K7-09
<1 U	140	480	650	8.4	17-jul-1995
<1 U	160	470	700	8	17-oct-1995
140	<1 U	490	790	9.3	07-feb-1996
–	–	–	710	–	24-jul-1996
–	–	–	–	–	10-apr-1997
–	–	–	–	–	17-jul-1997
–	–	–	–	–	22-oct-1997
–	–	–	–	–	22-apr-1998
–	–	–	–	–	27-jul-1998
–	–	–	–	–	20-oct-1998
–	–	–	–	–	25-jan-1999
–	–	–	–	–	23-apr-1999
–	–	–	–	–	15-jul-1999
–	–	–	–	–	11-oct-1999
–	–	–	–	–	16-feb-2000
–	–	–	–	–	25-apr-2000
–	–	–	–	–	09-aug-2000
–	–	–	–	–	01-nov-2000
–	–	–	–	–	23-jan-2001
–	–	–	–	–	24-apr-2001
–	–	–	–	–	17-jul-2001
–	–	–	–	–	23-apr-2002
–	–	–	–	–	06-sep-2002
–	–	–	–	–	07-feb-2003
–	–	–	–	–	01-may-2003
					K7-10
<1 U	180	820	1000	7.5	18-jul-1995
<1 U	190	810	1000	7.2	19-oct-1995
<1 U	110	620	920	8	12-feb-1996
–	–	–	970	–	24-jul-1996
–	–	–	–	–	15-apr-1997
–	–	–	–	–	17-jul-1997
–	–	–	–	–	27-oct-1997
–	–	–	–	–	28-apr-1998
–	–	–	–	–	31-jul-1998
–	–	–	–	–	26-oct-1998
–	–	–	–	–	25-jan-1999
–	–	–	–	–	26-apr-1999
–	–	–	–	–	15-jul-1999
–	–	–	–	–	11-oct-1999
–	–	–	–	–	27-jan-2000
–	–	–	–	–	26-apr-2000
–	–	–	–	–	01-nov-2000
–	–	–	–	–	23-jan-2001
–	–	–	–	–	24-apr-2001
–	–	–	–	–	17-jul-2001
–	–	–	–	–	23-apr-2002
–	–	–	–	–	28-aug-2002
–	–	–	–	–	07-feb-2003
–	–	–	–	–	05-may-2003
					NC7-12
–	–	–	–	–	26-may-1999
					NC7-15
–	–	–	–	–	26-may-1999
					NC7-16
–	–	650	–	–	05-jun-1996
–	–	610	–	–	18-dec-1996

Table A-16. Ground and surface water analyses for anions, TDS, specific conductivity, and pH in

Location Date	Lab	Note	Val.	Fluoride (mg/L)	Silica (mg/L)	Nitrate as (NO3) (mg/L)	Chloride (mg/L)	Sulfate (mg/L)
NC7-16 (continued)								
27-may-1999	CN	a	V	–	–	61 S	–	–
NC7-17								
05-jun-1996	CS	a	V	–	–	–	–	–
17-dec-1996	CS	a	V	–	–	–	–	–
21-may-1999	CN	af	V	–	–	33 DS	–	–
NC7-18								
05-jun-1996	CS	a	V	–	–	–	–	–
13-dec-1996	CS	a	V	–	–	–	–	–
21-may-1999	CN	a	V	–	–	<0.5 SU	–	–
NC7-20								
28-may-1999	CN	af	V	–	–	47 DS	–	–
NC7-21								
05-jun-1996	CS	a	V	–	–	–	–	–
26-dec-1996	CS	a	V	–	–	–	–	–
28-may-1999	CN	af	V	–	–	73 DS	–	–
NC7-22								
28-may-1999	CN	af	V	–	–	45 DS	–	–
NC7-24								
07-jun-1999	CN	a	V	–	–	<0.5 SU	–	–
NC7-25								
18-jul-1995	CS	a	V	0.68	–	29 O	80	53
20-oct-1995	CS	a	V	0.61	–	22 D	75 D	39 D
12-feb-1996	CS	a	V	0.62	–	30	79 D	51 D
30-jul-1996	CS	a	V	–	–	–	–	–
16-apr-1997	CS	a	V	–	–	27 D	–	–
30-jul-1997	CS	af	V	–	–	29 D	–	–
27-oct-1997	BB	a	V	–	–	29	–	–
28-apr-1998	BB	a	V	–	–	29	–	–
31-jul-1998	BB	a	N	–	–	33	–	–
26-oct-1998	BB	a	V	–	–	34	–	–
27-jan-1999	BB	a	V	–	–	36	–	–
04-may-1999	CN	a	V	–	–	36 FOS	–	–
15-jul-1999	CN	a	V	–	–	8.2 LS	–	–
07-oct-1999	CN	af	V	–	–	42 DS	–	–
04-feb-2000	CN	ah	V	–	–	36	–	–
04-feb-2000	CN	aeh	V	–	–	37	–	–
26-apr-2000	CN	af	V	–	–	39 D	–	–
09-aug-2000	CN	af	V	–	–	28 D	–	–
01-nov-2000	CN	af	V	–	–	33 D	–	–
25-jan-2001	CN	af	V	–	–	30 D	–	–
26-apr-2001	CN	af	V	–	–	25 D	–	–
29-may-2001	BB	a	V	–	66	–	–	–
29-may-2001	BB	a	V	0.61 H	–	38 DH	91 H	45 H
18-jul-2001	CN	af	V	–	–	19 D	–	–
29-apr-2002	CN	a	V	–	–	<0.1 U	–	–
11-sep-2002	CN	af	V	–	–	77 D	–	–
11-feb-2003	CN	a	N	–	–	44	–	–
05-may-2003	CN	a	V	–	–	27 L	–	–
NC7-26								
17-jul-1995	CS	a	V	0.29	–	2.1	31	120
17-oct-1995	CS	a	V	0.31	–	<0.5 U	29 D	89 D
08-feb-1996	CS	a	V	0.29	–	<0.5 U	46 D	130 D
25-jul-1996	CS	a	V	–	–	–	–	–
10-apr-1997	CS	a	V	–	–	5.3	–	–
24-jul-1997	CS	a	V	–	–	1.6	–	–
22-oct-1997	BB	a	V	–	–	1.4	–	–
22-apr-1998	BB	a	V	–	–	9.4	–	–

samples collected from the Pit 7 Complex between July 1, 1995 and June 30, 2003. Results recorded by December 18, 2003.

Carbonate (mg/L)	Bicarbonate (mg/L)	TDS (mg/L)	Spec Cond (umhos/cm)	pH	Location Date
					(continued) NC7-16
–	–	–	–	–	27-may-1999
					NC7-17
–	–	470	–	–	05-jun-1996
–	–	450	–	–	17-dec-1996
–	–	–	–	–	21-may-1999
					NC7-18
–	–	350	–	–	05-jun-1996
–	–	380	–	–	13-dec-1996
–	–	–	–	–	21-may-1999
					NC7-20
–	–	–	–	–	28-may-1999
					NC7-21
–	–	560	–	–	05-jun-1996
–	–	520	–	–	26-dec-1996
–	–	–	–	–	28-may-1999
					NC7-22
–	–	–	–	–	28-may-1999
					NC7-24
–	–	–	–	–	07-jun-1999
					NC7-25
<1 U	280	570	850	7.3	18-jul-1995
<1 U	290	580	840	7.1	20-oct-1995
<1 U	310	580	900	7.1	12-feb-1996
–	–	–	850	–	30-jul-1996
–	–	–	–	–	16-apr-1997
–	–	–	–	–	30-jul-1997
–	–	–	–	–	27-oct-1997
–	–	–	–	–	28-apr-1998
–	–	–	–	–	31-jul-1998
–	–	–	–	–	26-oct-1998
–	–	–	–	–	27-jan-1999
–	–	–	–	–	04-may-1999
–	–	–	–	–	15-jul-1999
–	–	–	–	–	07-oct-1999
–	–	–	–	–	04-feb-2000
–	–	–	–	–	04-feb-2000
–	–	–	–	–	26-apr-2000
–	–	–	–	–	09-aug-2000
–	–	–	–	–	01-nov-2000
–	–	–	–	–	25-jan-2001
–	–	–	–	–	26-apr-2001
–	–	–	–	–	29-may-2001
<5 DHU	375 DH	643 DH	1050 H	7.54 H	29-may-2001
–	–	–	–	–	18-jul-2001
–	–	–	–	–	29-apr-2002
–	–	–	–	–	11-sep-2002
–	–	–	–	–	11-feb-2003
–	–	–	–	–	05-may-2003
					NC7-26
<1 U	180	440	560	7.6	17-jul-1995
<1 U	170	410	590	7.2	17-oct-1995
<1 U	180	440	570	7.2	08-feb-1996
–	–	–	680	–	25-jul-1996
–	–	–	–	–	10-apr-1997
–	–	–	–	–	24-jul-1997
–	–	–	–	–	22-oct-1997
–	–	–	–	–	22-apr-1998

Table A-16. Ground and surface water analyses for anions, TDS, specific conductivity, and pH in

Location Date	Lab	Note	Val.	Fluoride (mg/L)	Silica (mg/L)	Nitrate as (NO3) (mg/L)	Chloride (mg/L)	Sulfate (mg/L)
NC7-26 (continued)								
27-jul-1998	BB	ag	V	-	-	22	-	-
20-oct-1998	BB	a	N	-	-	4	-	-
25-jan-1999	BB	a	V	-	-	14	-	-
04-may-1999	CN	af	V	-	-	60 DFOS	-	-
14-jul-1999	CN	a	V	-	-	<0.5 SU	-	-
11-oct-1999	CN	a	V	-	-	28 OS	-	-
16-feb-2000	CN	a	V	-	-	5	-	-
26-apr-2000	CN	a	V	-	-	1.8	-	-
09-aug-2000	CN	a	V	-	-	0.2	-	-
02-nov-2000	CN	a	V	-	-	<0.1 U	-	-
25-jan-2001	CN	a	V	-	-	<0.4 U	-	-
26-apr-2001	CN	a	V	-	-	<0.4 U	-	-
18-jul-2001	CN	a	V	-	-	<0.4 U	-	-
22-apr-2002	CN	a	V	-	-	<2 U	-	-
13-sep-2002	CN	af	V	-	-	16	-	-
12-feb-2003	CN	af	V	-	-	<0.1 U	-	-
06-may-2003	CN	af	V	-	-	<0.1 LU	-	-
NC7-34								
05-jun-1996	CS	a	V	-	-	-	-	-
17-sep-1996	CS	a	V	-	-	-	-	-
20-dec-1996	CS	a	V	-	-	-	-	-
07-jun-1999	CN	a	V	-	-	<0.5 SU	-	-
12-jun-2001	CN	af	V	-	<0.2 U	-	-	-
12-jun-2001	CN	af	V	0.3 H	-	16	26 DL	17 L
04-jun-2002	CN	af	V	-	78	-	-	-
04-jun-2002	CN	af	V	0.44 H	-	68 D	54 D	36 DL
NC7-36								
05-jun-1996	CS	a	V	-	-	-	-	-
27-aug-1996	CS	a	V	-	-	-	-	-
13-dec-1996	CS	a	V	-	-	-	-	-
16-jun-1999	CN	a	V	-	-	<0.5 LOSU	-	-
25-may-2001	CN	a	V	-	<0.2 U	-	-	-
25-may-2001	CN	a	V	0.36 H	-	19 H	22 DHL	13 HL
31-may-2002	CN	a	V	-	69	-	-	-
31-may-2002	CN	a	V	0.39 HL	-	39 H	47	21 HL
NC7-37								
16-jun-1999	CN	af	V	-	-	48 DLOS	-	-
NC7-40								
07-jun-1999	CN	a	V	-	-	23 S	-	-
12-jun-2001	CN	af	V	-	<0.2 U	-	-	-
12-jun-2001	CN	af	V	0.36 H	-	20	23 DL	22 L
29-may-2002	CN	af	V	-	79	-	-	-
29-may-2002	CN	af	V	0.45	-	72 D	56 D	39 D
16-jul-2002	CN	af	V	0.5	-	70 D	50 D	45 D
NC7-47								
18-jul-1995	CS	a	V	0.59	-	47 O	47	45
20-oct-1995	CS	a	V	0.56	-	42 D	45 D	29 D
13-feb-1996	CS	a	V	0.63	-	45 D	53 DL	40 D
30-jul-1996	CS	a	V	-	-	-	-	-
16-apr-1997	CS	a	V	-	-	50 D	-	-
30-jul-1997	CS	af	V	-	-	56 D	-	-
27-oct-1997	BB	a	V	-	-	56	-	-
29-apr-1998	BB	a	V	-	-	60	-	-
29-jul-1998	BB	ag	V	-	-	65	-	-
21-oct-1998	BB	a	V	-	-	71	-	-
27-jan-1999	BB	a	V	-	-	64	-	-
04-may-1999	CN	af	V	-	-	81 DFOS	-	-
15-jul-1999	CN	a	V	-	-	13 LS	-	-
11-oct-1999	CN	af	V	-	-	53 DOS	-	-
27-jan-2000	CN	afh	V	-	-	63 D	-	-

samples collected from the Pit 7 Complex between July 1, 1995 and June 30, 2003. Results recorded by December 18, 2003.

Carbonate (mg/L)	Bicarbonate (mg/L)	TDS (mg/L)	Spec Cond (umhos/cm)	pH	Location Date
					(continued) NC7-26
–	–	–	–	–	27-jul-1998
–	–	–	–	–	20-oct-1998
–	–	–	–	–	25-jan-1999
–	–	–	–	–	04-may-1999
–	–	–	–	–	14-jul-1999
–	–	–	–	–	11-oct-1999
–	–	–	–	–	16-feb-2000
–	–	–	–	–	26-apr-2000
–	–	–	–	–	09-aug-2000
–	–	–	–	–	02-nov-2000
–	–	–	–	–	25-jan-2001
–	–	–	–	–	26-apr-2001
–	–	–	–	–	18-jul-2001
–	–	–	–	–	22-apr-2002
–	–	–	–	–	13-sep-2002
–	–	–	–	–	12-feb-2003
–	–	–	–	–	06-may-2003
					NC7-34
–	–	710	–	–	05-jun-1996
–	–	620	–	–	17-sep-1996
–	–	620	–	–	20-dec-1996
–	–	–	–	–	07-jun-1999
–	–	–	–	–	12-jun-2001
<1 U	360	530 DH	760	7.5	12-jun-2001
–	–	–	–	–	04-jun-2002
<1 HU	280 H	540 H	860	7.5	04-jun-2002
					NC7-36
–	–	410	–	–	05-jun-1996
–	–	360 D	–	–	27-aug-1996
–	–	370	–	–	13-dec-1996
–	–	–	–	–	16-jun-1999
–	–	–	–	–	25-may-2001
<1 HU	160 H	400 DH	570 H	7.7 H	25-may-2001
–	–	–	–	–	31-may-2002
<1 HU	160 H	400 H	600 H	7.7 H	31-may-2002
					NC7-37
–	–	–	–	–	16-jun-1999
					NC7-40
–	–	–	–	–	07-jun-1999
–	–	–	–	–	12-jun-2001
<1 U	360	610 DH	860	7.2	12-jun-2001
–	–	–	–	–	29-may-2002
<1 HU	360 H	300 H	870 H	7.8	29-may-2002
<1 U	360	640 H	990 H	7.4	16-jul-2002
					NC7-47
<1 U	130	390	560	7.9	18-jul-1995
<1 U	140	370	510	7.6	20-oct-1995
<1 U	140	410	590	7.5	13-feb-1996
–	–	–	510	–	30-jul-1996
–	–	–	–	–	16-apr-1997
–	–	–	–	–	30-jul-1997
–	–	–	–	–	27-oct-1997
–	–	–	–	–	29-apr-1998
–	–	–	–	–	29-jul-1998
–	–	–	–	–	21-oct-1998
–	–	–	–	–	27-jan-1999
–	–	–	–	–	04-may-1999
–	–	–	–	–	15-jul-1999
–	–	–	–	–	11-oct-1999
–	–	–	–	–	27-jan-2000

Table A-16. Ground and surface water analyses for anions, TDS, specific conductivity, and pH in

Location Date	Lab	Note	Val.	Fluoride (mg/L)	Silica (mg/L)	Nitrate as (NO3) (mg/L)	Chloride (mg/L)	Sulfate (mg/L)
NC7-47 (continued)								
27-jan-2000	CN	aefh	V	-	-	54 D	-	-
01-may-2000	CN	af	V	-	-	64 D	-	-
09-aug-2000	CN	af	V	-	-	51 D	-	-
02-nov-2000	CN	af	V	-	-	56 D	-	-
25-jan-2001	CN	af	V	-	-	52 D	-	-
27-apr-2001	CN	af	V	-	-	40 DL	-	-
19-jul-2001	CN	a	V	-	-	11	-	-
30-jan-2002	CN	a	V	-	56	-	-	-
30-apr-2002	CN	af	V	-	-	69 D	-	-
29-aug-2002	CN	af	V	-	-	71 D	-	-
12-feb-2003	CN	af	V	-	-	67 D	-	-
07-may-2003	CN	af	V	-	-	85 D	-	-
NC7-48								
19-jul-1995	CS	a	V	0.22	-	24 O	61	40
19-oct-1995	CS	a	V	0.23	-	24	46 D	30 D
15-feb-1996	CS	a	V	0.28	-	22	66	41
30-jul-1996	CS	a	V	-	-	-	-	-
16-apr-1997	CS	a	V	-	-	29 D	-	-
30-jul-1997	CS	afh	V	-	-	29 D	-	-
30-jul-1997	CS	aefh	V	-	-	29 D	-	-
28-oct-1997	BB	a	V	-	-	27	-	-
28-apr-1998	BB	a	V	-	-	25	-	-
31-jul-1998	BB	a	N	-	-	33	-	-
26-oct-1998	BB	a	V	-	-	28	-	-
28-jan-1999	BB	a	V	-	-	27 J	-	-
04-may-1999	CN	a	V	-	-	40 FOS	-	-
19-jul-1999	CN	af	V	-	-	93 DLOS	-	-
12-oct-1999	CN	a	V	-	-	30 S	-	-
27-jan-2000	CN	a	V	-	-	27	-	-
01-may-2000	CN	a	V	-	-	22	-	-
10-aug-2000	CN	af	V	-	-	19 D	-	-
02-nov-2000	CN	af	V	-	-	18 D	-	-
25-jan-2001	CN	af	V	-	-	17 D	-	-
26-apr-2001	CN	ah	V	-	<0.2 U	-	-	-
26-apr-2001	CN	ah	V	-	-	15	-	-
26-apr-2001	CN	ah	V	0.17	-	16	40 H	21
18-jul-2001	CN	a	V	-	-	11	-	-
30-jan-2002	CN	a	V	-	77	-	-	-
30-apr-2002	CN	af	V	-	<1 U	-	-	-
30-apr-2002	CN	a	V	-	-	34	-	-
30-apr-2002	CN	af	V	1 H	-	34	38 D	25
12-sep-2002	CN	af	V	-	-	32	-	-
11-feb-2003	CN	a	N	-	-	29	-	-
06-may-2003	CN	af	V	-	82	-	-	-
06-may-2003	CN	af	V	-	-	22 L	-	-
06-may-2003	CN	af	V	0.31 L	-	23 L	30 DL	20
NC7-49A								
21-may-1999	CN	a	V	-	-	<0.5 SU	-	-
21-may-2001	CN	a	V	-	<0.2 U	-	-	-
21-may-2001	CN	a	V	0.38 H	-	14 H	38 DH	15 H
04-jun-2002	CN	af	V	-	64	-	-	-
04-jun-2002	CN	af	V	0.85 H	-	35	58 D	25 L
NC7-50								
14-may-1998	CS	af	V	1.7 D	-	120 D	330 D	1400 D
16-jun-1999	CN	af	V	1.5	-	<0.5 SU	360 D	1800 DL
31-may-2000	CN	af	V	1.4	-	120 D	190 D	1100 D
25-apr-2001	CN	af	V	1.41 H	-	32 DH	370 DH	1200 DH
13-aug-2001	CN	af	V	-	-	86 DL	-	-
23-aug-2001	BB	af	V	-	-	142 D	-	-
18-sep-2001	SE	af	V	-	-	-	-	-
18-oct-2001	CN	afh	V	-	-	160 DL	-	-
28-may-2002	CN	af	V	-	-	150 D	-	-

samples collected from the Pit 7 Complex between July 1, 1995 and June 30, 2003. Results recorded by December 18, 2003.

Carbonate (mg/L)	Bicarbonate (mg/L)	TDS (mg/L)	Spec Cond (umhos/cm)	pH	Location Date
					(continued) NC7-47
-	-	-	-	-	27-jan-2000
-	-	-	-	-	01-may-2000
-	-	-	-	-	09-aug-2000
-	-	-	-	-	02-nov-2000
-	-	-	-	-	25-jan-2001
-	-	-	-	-	27-apr-2001
-	-	-	-	-	19-jul-2001
-	-	-	-	-	30-jan-2002
-	-	-	-	-	30-apr-2002
-	-	-	-	-	29-aug-2002
-	-	-	-	-	12-feb-2003
-	-	-	-	-	07-may-2003
					NC7-48
<1 U	360	620	880	6.9	19-jul-1995
<1 U	350	590	820	6.6	19-oct-1995
<1 U	380	560	870	7.1	15-feb-1996
-	-	-	790	-	30-jul-1996
-	-	-	-	-	16-apr-1997
-	-	-	-	-	30-jul-1997
-	-	-	-	-	30-jul-1997
-	-	-	-	-	28-oct-1997
-	-	-	-	-	28-apr-1998
-	-	-	-	-	31-jul-1998
-	-	-	-	-	26-oct-1998
-	-	-	-	-	28-jan-1999
-	-	-	-	-	04-may-1999
-	-	-	-	-	19-jul-1999
-	-	-	-	-	12-oct-1999
-	-	-	-	-	27-jan-2000
-	-	-	-	-	01-may-2000
-	-	-	-	-	10-aug-2000
-	-	-	-	-	02-nov-2000
-	-	-	-	-	25-jan-2001
-	-	-	-	-	26-apr-2001
-	-	-	-	-	26-apr-2001
<1 HU	250 H	500	680 H	6.8 H	26-apr-2001
-	-	-	-	-	18-jul-2001
-	-	-	-	-	30-jan-2002
-	-	-	-	-	30-apr-2002
-	-	-	-	-	30-apr-2002
<1 HU	270 H	490 H	720 H	6.9	30-apr-2002
-	-	-	-	-	12-sep-2002
-	-	-	-	-	11-feb-2003
-	-	-	-	-	06-may-2003
-	-	-	-	-	06-may-2003
<1 U	310	530 H	750 H	7.6	06-may-2003
					NC7-49A
-	-	-	-	-	21-may-1999
-	-	-	-	-	21-may-2001
<1 HU	160 H	400 H	560 H	7.9 H	21-may-2001
-	-	-	-	-	04-jun-2002
<1 HU	160 H	380 H	620	7.8	04-jun-2002
					NC7-50
<1 U	180	2800	3200	7.1	14-may-1998
<1 U	220	460	3400	7.6	16-jun-1999
<1 U	220	3000	3400	8	31-may-2000
<1 U	220	3000	3600 H	8.2 H	25-apr-2001
-	-	-	-	-	13-aug-2001
-	-	-	-	-	23-aug-2001
-	-	-	3300	-	18-sep-2001
-	-	-	-	-	18-oct-2001
-	-	-	-	-	28-may-2002

Table A-16. Ground and surface water analyses for anions, TDS, specific conductivity, and pH in

Location Date	Lab	Note	Val.	Fluoride (mg/L)	Silica (mg/L)	Nitrate as (NO3) (mg/L)	Chloride (mg/L)	Sulfate (mg/L)
NC7-50 (continued)								
28-may-2002	CN	af	V	1.3	–	150 D	470 D	1600 DH
NC7-51								
17-may-2001	CN	a	V	0.47 H	–	42.9 H	59.1 DH	37.6 DH
15-may-2002	CN	af	V	–	77	–	–	–
15-may-2002	CN	af	V	0.49	–	86	53 D	28
NC7-52								
07-jun-1999	CN	a	V	–	–	25 S	–	–
NC7-53								
05-jun-1996	CS	a	V	–	–	–	–	–
21-may-1999	CN	a	V	–	–	22 S	–	–
NC7-60								
09-jun-1999	CN	af	V	–	–	25 DJLS	–	–
16-jun-2003	CN	a	V	–	–	5.2	–	–
NC7-63								
18-may-1999	CN	a	V	–	–	34 S	–	–
NC7-64								
28-jun-1999	CN	a	V	–	–	<0.5 SU	–	–
NC7-65								
21-may-1999	CN	a	V	–	–	<0.5 SU	–	–
NC7-67								
01-jul-1999	CN	ah	V	–	–	<0.5 SU	–	–
01-jul-1999	CN	aeh	V	–	–	<0.5 SU	–	–
NC7-68								
21-may-1999	CN	a	V	–	–	40 S	–	–
NC7-75								
16-jun-1999	CN	a	V	–	–	<0.5 LOSU	–	–
NC7-76								
10-jun-2003	CN	afg	V	–	–	39 D	–	–
W-PIT7-02								
16-jun-1999	CN	a	V	–	–	<0.5 LOSU	–	–
W-PIT7-03								
01-jul-1999	CN	a	V	–	–	<0.5 SU	–	–
W-PIT7-10								
24-may-1999	CN	a	V	–	–	40 S	–	–
W-PIT7-12								
18-mar-1999	BB	a	V	0.51	–	42 D	69	71
W-PIT7-13								
30-mar-2001	BB	af	V	–	59	–	–	–
30-mar-2001	BB	af	V	0.47	–	28 D	60	45
W-PIT7-15								
20-mar-2001	CN	af	V	–	<0.2 U	–	–	–
20-mar-2001	CN	af	V	0.71 H	–	<0.4 HU	64 DH	150 DH
W-PIT7-16								
28-mar-2001	CN	a	V	–	23	–	–	–
28-mar-2001	CN	a	V	0.42	–	<0.5 DHU	25 DH	73 DH

samples collected from the Pit 7 Complex between July 1, 1995 and June 30, 2003. Results recorded by December 18, 2003.

Carbonate (mg/L)	Bicarbonate (mg/L)	TDS (mg/L)	Spec Cond (umhos/cm)	pH	Location Date
					(continued) NC7-50
<1 HU	170 H	3400 H	3700 H	7.3 H	28-may-2002
					NC7-51
<1 HU	560 H	850 H	1100 H	7.4 H	17-may-2001
–	–	–	–	–	15-may-2002
<1 HU	540 H	780 H	1200	7.5	15-may-2002
					NC7-52
–	–	–	–	–	07-jun-1999
					NC7-53
–	–	330	–	–	05-jun-1996
–	–	–	–	–	21-may-1999
					NC7-60
–	–	–	–	–	09-jun-1999
–	–	–	–	–	16-jun-2003
					NC7-63
–	–	–	–	–	18-may-1999
					NC7-64
–	–	–	–	–	28-jun-1999
					NC7-65
–	–	–	–	–	21-may-1999
					NC7-67
–	–	–	–	–	01-jul-1999
–	–	–	–	–	01-jul-1999
					NC7-68
–	–	–	–	–	21-may-1999
					NC7-75
–	–	–	–	–	16-jun-1999
					NC7-76
–	–	–	–	–	10-jun-2003
					W-PIT7-02
–	–	–	–	–	16-jun-1999
					W-PIT7-03
–	–	–	–	–	01-jul-1999
					W-PIT7-10
–	–	–	–	–	24-may-1999
					W-PIT7-12
<5 U	158	450	743	7.96	18-mar-1999
					W-PIT7-13
–	–	–	–	–	30-mar-2001
<5 DU	215 D	460 D	702	7.4	30-mar-2001
					W-PIT7-15
–	–	–	–	–	20-mar-2001
<1 HU	170 H	520 DH	770 HO	7.7	20-mar-2001
					W-PIT7-16
–	–	–	–	–	28-mar-2001
<1 U	130	380	580	8.5	28-mar-2001

Table A-16. Ground and surface water analyses for anions, TDS, specific conductivity, and pH in

Location Date	Lab	Note	Val.	Fluoride (mg/L)	Silica (mg/L)	Nitrate as (NO3) (mg/L)	Chloride (mg/L)	Sulfate (mg/L)
W-PIT7-1714								
27-mar-2002	CN	af	V	0.28	-	<0.1 U	38 DL	120 DL
W-PIT7-1715								
27-mar-2002	CN	af	V	0.59	-	13	29 DL	76 DL
W-PIT7-1717								
28-mar-2002	CN	af	V	0.56	-	3.2	89 DL	240 DL
W-PIT7-1718								
03-jul-2002	CN	af	N	0.44	-	36	21	18
W-PIT7-1720								
27-mar-2002	CN	af	V	0.59	-	10	25 DL	44 DL
W-PIT7-1723								
26-mar-2002	CN	af	V	0.49	-	31 D	32 D	93 D
W-PIT7-1724								
26-mar-2002	CN	af	V	0.53	-	22	25 D	54 D
W-PIT7-1903								
11-apr-2003	BB	af	V	0.36 H	-	27 DH	97	56 H
02-may-2003	BB	af	V	0.27 H	-	24 DH	63	53 H
06-jun-2003	BB	af	V	0.29 H	-	22.6 DH	64	55 H
W-PIT7-1904								
11-apr-2003	BB	af	V	0.44 H	-	44 DH	86	50 H
02-may-2003	BB	af	V	0.4 H	-	37 DH	60	47 H
06-jun-2003	BB	af	V	0.32 H	-	41.2 DH	49	46 H
W-PIT7-1905								
11-apr-2003	BB	af	V	<0.05 HU	-	13 DH	113	111 H
02-may-2003	BB	af	V	<0.05 HU	-	14 H	87	91 H
06-jun-2003	BB	af	V	0.071 H	-	15.5 DH	70	73 H
W-PIT7-1907								
11-apr-2003	BB	af	V	<0.1 DHU	-	<0.8 DHU	439 D	380 DH
02-may-2003	BB	af	V	<0.1 DHU	-	<0.4 HU	458 D	374 DH
06-jun-2003	BB	af	V	<0.05 HU	-	<0.4 HU	222	221 H
W-PIT7-1915								
11-apr-2003	BB	af	V	<0.25 DHU	-	<0.8 DHU	822 D	631 DH
02-may-2003	BB	af	V	<0.1 DHU	-	<0.4 HU	739 D	584 DH
06-jun-2003	BB	af	V	<0.1 DHU	-	<0.4 HU	646 D	504 DH
W-PIT7-1916								
11-apr-2003	BB	af	V	0.33 H	-	32 DH	109	68 H
02-may-2003	BB	af	V	0.31 H	-	35 DH	93	66 H
06-jun-2003	BB	af	V	0.31 H	-	37.8 DH	90	67 H
W-PIT7-1917								
11-apr-2003	BB	af	V	0.39 H	-	34 DH	177	76 H
02-may-2003	BB	af	V	0.37 H	-	35 DH	137	69 H
06-jun-2003	BB	af	V	0.33 H	-	39.4 DH	88	58 H
W-PIT7-1918								
11-apr-2003	BB	af	V	0.45 H	-	38 DH	238	96 H
02-may-2003	BB	af	V	0.38 H	-	33 DH	168	86 H
06-jun-2003	BB	af	V	0.35 H	-	36.3 DH	126	78 H
W-PIT7-1919								
11-apr-2003	BB	af	V	0.42 H	-	29 DH	133	79 H
02-may-2003	BB	af	V	0.37 H	-	37 DH	93	72 H
06-jun-2003	BB	af	V	0.37 H	-	40.7 DH	72	66 H

samples collected from the Pit 7 Complex between July 1, 1995 and June 30, 2003. Results recorded by December 18, 2003.

Carbonate (mg/L)	Bicarbonate (mg/L)	TDS (mg/L)	Spec Cond (umhos/cm)	pH	Location Date
					W-PIT7-1714
<1 U	170	420 DH	680	7.9	27-mar-2002
					W-PIT7-1715
<1 U	140	330 H	540	7.9	27-mar-2002
					W-PIT7-1717
<1 U	70	620 H	1000 DH	9.1	28-mar-2002
					W-PIT7-1718
<1 HU	150 H	340 DH	450 H	8.2 H	03-jul-2002
					W-PIT7-1720
<1 U	130	270 H	430	7.8	27-mar-2002
					W-PIT7-1723
<1 HU	180 H	410 H	650	7.8	26-mar-2002
					W-PIT7-1724
<1 HU	140 H	340 H	510	7.6	26-mar-2002
					W-PIT7-1903
<10 DHU	390 DH	693 DH	1100 H	8.18 H	11-apr-2003
<5 DHU	410 DH	700 DH	1030 H	7.86 H	02-may-2003
<5 DHU	420 DH	687 DH	1060 H	7.88 H	06-jun-2003
					W-PIT7-1904
<10 DHU	420 DH	727 DH	1130 H	8.04 H	11-apr-2003
<5 DHU	410 DH	690 DH	1060 H	7.52 H	02-may-2003
<5 DHU	420 DH	707 DH	1030 H	7.69 H	06-jun-2003
					W-PIT7-1905
13 DH	290 DH	730 DH	1090 H	8.34 H	11-apr-2003
<5 DHU	340 DH	677 DH	1060 H	7.97 H	02-may-2003
<5 DHU	380 DH	680 DH	1070 H	7.94 H	06-jun-2003
					W-PIT7-1907
900 DH	97 DH	2580 DH	4160 H	10.4 H	11-apr-2003
790 DH	160 DH	2340 DH	3800 H	10.3 H	02-may-2003
570 DH	150 DH	1540 DH	2430 H	10.1 H	06-jun-2003
					W-PIT7-1915
460 DH	32 DH	2860 DH	5130 H	10.3 H	11-apr-2003
410 DH	<10 DHU	2460 DH	4210 H	10.4 H	02-may-2003
350 DH	130 DH	2190 DH	3720 H	10.2 H	06-jun-2003
					W-PIT7-1916
<10 DHU	410 DH	715 DH	1260 H	8.08 H	11-apr-2003
<10 DHU	410 DH	733 DH	1160 H	7.65 H	02-may-2003
<10 DHU	410 DH	757 DH	1120 H	7.76 H	06-jun-2003
					W-PIT7-1917
<10 DHU	410 DH	865 DH	1470 H	8.14 H	11-apr-2003
<10 DHU	430 DH	860 DH	1330 H	7.66 H	02-may-2003
<10 DHU	460 DH	720 DH	1230 H	7.67 H	06-jun-2003
					W-PIT7-1918
<10 DHU	400 DH	1020 DH	1630 H	8 H	11-apr-2003
<10 DHU	410 DH	860 DH	1390 H	7.58 H	02-may-2003
<10 DHU	410 DH	760 DH	1290 H	7.67 H	06-jun-2003
					W-PIT7-1919
<10 DHU	410 DH	850 DH	1320 H	8.11 H	11-apr-2003
<10 DHU	410 DH	730 DH	1180 H	7.52 H	02-may-2003
<10 DHU	420 DH	687 DH	1120 H	7.71 H	06-jun-2003

Table A-16. Ground and surface water analyses for anions, TDS, specific conductivity, and pH in

Location Date	Lab	Note	Val.	Fluoride (mg/L)	Silica (mg/L)	Nitrate as (NO3) (mg/L)	Chloride (mg/L)	Sulfate (mg/L)
W-865-01								
30-mar-1999	BB	a	V	0.41	–	0.44	49	133
14-aug-2001	CN	af	V	–	<0.2 U	–	–	–
14-aug-2001	CN	af	V	0.63	–	0.6	40 D	120
31-oct-2001	CN	af	V	–	26	–	–	–
31-oct-2001	CN	af	V	0.22 L	–	0.3	25 DL	80 DL
31-jan-2002	CN	a	V	–	<0.2 U	–	–	–
31-jan-2002	CN	a	V	0.34 F	–	5.9	27 DF	90 DL
30-may-2002	CN	a	V	–	<1 U	–	–	–
30-may-2002	CN	a	V	0.42	–	15	32 D	110 D
31-jul-2002	CN	af	V	–	27	–	–	–
31-jul-2002	CN	af	V	0.48 F	–	13 F	36 DF	110 D
19-feb-2003	CN	af	V	–	36	–	–	–
19-feb-2003	CN	af	V	0.37	–	15	13	55 D
29-may-2003	CN	af	V	–	32	–	–	–
29-may-2003	CN	af	V	0.48	–	12	13	60 D
W-865-03								
29-sep-2000	CN	af	V	0.49	–	49 D	42 D	28
14-aug-2001	CN	af	V	–	<0.2 U	–	–	–
14-aug-2001	CN	af	V	0.56	–	40 D	42 D	26
30-oct-2001	CN	af	V	–	63	–	–	–
30-oct-2001	CN	af	V	0.38 L	–	31	31 D	20 L
31-jan-2002	CN	a	V	–	<0.2 U	–	–	–
31-jan-2002	CN	a	V	0.74 F	–	32	35 DF	21 L
30-may-2002	CN	a	V	–	<1 U	–	–	–
30-may-2002	CN	a	V	0.65	–	50 D	36 D	24
31-jul-2002	CN	af	V	–	62	–	–	–
31-jul-2002	CN	af	V	0.66 F	–	48 DF	40 DF	24
19-feb-2003	CN	af	V	–	66	–	–	–
19-feb-2003	CN	af	V	0.72	–	55 D	52 D	31
29-may-2003	CN	af	V	–	64	–	–	–
29-may-2003	CN	af	V	0.7	–	49 D	50 D	20 D
W-865-04								
28-sep-2000	CN	af	V	0.3	–	<0.1 U	36 D	48 D
14-aug-2001	CN	af	V	–	<0.2 U	–	–	–
14-aug-2001	CN	af	V	0.45	–	0.4	45 D	60 D
30-oct-2001	CN	af	V	–	27	–	–	–
30-oct-2001	CN	af	V	0.29 L	–	0.4	31 D	40 DL
31-jan-2002	CN	a	V	–	<0.2 U	–	–	–
31-jan-2002	CN	a	V	0.53 F	–	<0.1 U	37 DF	50 DL
23-may-2002	CN	af	V	–	28	–	–	–
23-may-2002	CN	af	V	0.52	–	11	46	62 D
31-jul-2002	CN	af	V	–	28	–	–	–
31-jul-2002	CN	af	V	0.47 F	–	11 F	39 DF	51 D
19-feb-2003	CN	af	V	–	29	–	–	–
19-feb-2003	CN	af	V	0.48	–	5.6	60 D	72 D
29-may-2003	CN	af	V	–	29	–	–	–
29-may-2003	CN	af	V	0.56	–	<0.1 U	40 D	60 D
W-865-07								
29-sep-2000	CN	af	V	0.56	–	62 D	44 D	31
14-aug-2001	CN	af	V	–	<0.2 U	–	–	–
14-aug-2001	CN	af	V	0.78	–	59 D	47 D	20 D
30-oct-2001	CN	af	V	–	70	–	–	–
30-oct-2001	CN	af	V	0.58 L	–	42 D	34 D	21 L
31-jan-2002	CN	a	V	–	<0.2 U	–	–	–
31-jan-2002	CN	a	V	0.62 F	–	61	37 DF	20 L
23-may-2002	CN	af	V	–	72	–	–	–
23-may-2002	CN	af	V	0.84	–	80 D	47	30
31-jul-2002	CN	af	V	–	66	–	–	–
31-jul-2002	CN	af	V	0.69 F	–	66 DF	41 DF	29 D
19-feb-2003	CN	af	V	–	73	–	–	–
19-feb-2003	CN	af	V	0.8	–	75 D	46 D	32
29-may-2003	CN	af	V	–	70	–	–	–

samples collected from the Pit 7 Complex between July 1, 1995 and June 30, 2003. Results recorded by December 18, 2003.

Carbonate (mg/L)	Bicar-bonate (mg/L)	TDS (mg/L)	Spec Cond (umhos/cm)	pH	Location Date
					W-865-01
<5 U	143	422	685	7.96	30-mar-1999
-	-	-	-	-	14-aug-2001
<1 HU	160 H	450 H	680 H	7.8	14-aug-2001
-	-	-	-	-	31-oct-2001
<1 HU	170 H	470 H	670 H	8.3 H	31-oct-2001
-	-	-	-	-	31-jan-2002
<1 HU	170 H	460 H	680	8	31-jan-2002
-	-	-	-	-	30-may-2002
<1 HU	170 H	460 H	690 H	8	30-may-2002
-	-	-	-	-	31-jul-2002
<1 U	170	460 H	710 H	8	31-jul-2002
-	-	-	-	-	19-feb-2003
<1 HU	140 H	360	470	8	19-feb-2003
-	-	-	-	-	29-may-2003
<1 HU	150 H	360 HO	480 H	8	29-may-2003
					W-865-03
<1 U	130	400	510	7.8	29-sep-2000
-	-	-	-	-	14-aug-2001
<1 HU	130 H	360 H	550 H	7.9	14-aug-2001
-	-	-	-	-	30-oct-2001
<1 HU	140 H	360 H	520 H	8.3 H	30-oct-2001
-	-	-	-	-	31-jan-2002
<1 HU	130 H	380 H	560	7.8	31-jan-2002
-	-	-	-	-	30-may-2002
<1 HU	140 H	370 H	560 H	7.8	30-may-2002
-	-	-	-	-	31-jul-2002
<1 U	130	390 H	580 H	7.7	31-jul-2002
-	-	-	-	-	19-feb-2003
<1 HU	130 H	380	540	7.9	19-feb-2003
-	-	-	-	-	29-may-2003
<1 HU	130 H	380 HO	550 H	7.9	29-may-2003
					W-865-04
<1 U	190	380	580	7.8	28-sep-2000
-	-	-	-	-	14-aug-2001
<1 HU	160 H	360 H	580 H	8.1	14-aug-2001
-	-	-	-	-	30-oct-2001
<1 HU	160 H	380 H	560 H	8.4 H	30-oct-2001
-	-	-	-	-	31-jan-2002
<1 HU	160 H	360 H	580	8.1	31-jan-2002
-	-	-	-	-	23-may-2002
<1 HU	160 H	350 H	630 H	8.2	23-may-2002
-	-	-	-	-	31-jul-2002
<1 U	160	360 H	590 H	8.1	31-jul-2002
-	-	-	-	-	19-feb-2003
<1 HU	160 H	360	570	8.3	19-feb-2003
-	-	-	-	-	29-may-2003
<1 HU	160 H	360 HO	580 H	8.2	29-may-2003
					W-865-07
<1 U	130	440	590	7.6	29-sep-2000
-	-	-	-	-	14-aug-2001
<1 HU	130 H	430 H	590 H	7.3	14-aug-2001
-	-	-	-	-	30-oct-2001
<1 HU	140 H	440 H	570 H	8.2 H	30-oct-2001
-	-	-	-	-	31-jan-2002
<1 HU	130 H	440 H	600	7.9	31-jan-2002
-	-	-	-	-	23-may-2002
<1 HU	130 H	440 H	340 H	7.8	23-may-2002
-	-	-	-	-	31-jul-2002
<1 U	130	440 H	650 H	7.3	31-jul-2002
-	-	-	-	-	19-feb-2003
<1 HU	140 H	440	600	8.1	19-feb-2003
-	-	-	-	-	29-may-2003

Table A-16. Ground and surface water analyses for anions, TDS, specific conductivity, and pH in

Location Date	Lab	Note	Val.	Fluoride (mg/L)	Silica (mg/L)	Nitrate as (NO3) (mg/L)	Chloride (mg/L)	Sulfate (mg/L)
W-865-07 (continued)								
29-may-2003	CN	af	V	0.79	-	76	50 D	30 D
W-865-1804								
23-jun-2003	CN	a	V	0.85 H	-	70 DH	65 DH	50 DHL
SPRING13								
06-nov-1995	CS	a	V	0.7	-	7.9	59 D	370 D
SPRING24								
22-oct-1999	BB	af	V	0.49	-	55 D	47	28
27-aug-2001	CN	af	V	0.33	-	28	48 D	27
13-dec-2001	CN	af	V	0.44	-	44	49 D	30 D

samples collected from the Pit 7 Complex between July 1, 1995 and June 30, 2003. Results recorded by December 18, 2003.

Carbonate (mg/L)	Bicarbonate (mg/L)	TDS (mg/L)	Spec Cond (umhos/cm)	pH	Location Date
					(continued) W-865-07
<1 HU	130 H	440 HO	620 H	7.6	29-may-2003
					W-865-1804
<1 HU	150 H	490 H	720 H	7.9 H	23-jun-2003
					SPRING13
<1 U	160	890	1100	6.8	06-nov-1995
					SPRING24
<5 U	136	378	551	8.02	22-oct-1999
<1 HU	160 H	-	560 H	7.6	27-aug-2001
-	-	310 DH	580 H	7.8	13-dec-2001

See following page for notes

Table A-16. Ground and surface water analyses for anions, TDS, specific conductivity, and pH in samples collected from the Pit 7 Complex between July 1, 1995 and June 30, 2003. Results recorded by December 18, 2003.

Notes:

-	Indicates no analysis performed for this compound

Val. = Validation code

Footnotes:

a	ERD data
b	ORAD WGMG data
c	Analytical results for this sample are suspect
d	Sample collected during hydraulic testing
e	Blind sample, sent to lab without location identity
f	Sample dilution necessary for analysis; detection limits increased
g	Interlaboratory collocated sample
h	Intralaboratory collocated sample
i	Sample collected as part of pilot study
j	Note field may contain important information regarding this sample
k	Pre-development sample
l	Norm month, norm quarter or norm year inconsistent with sample date
m	Confirmation sample
n	Sample analyzed after standard holding time
o	Sample comprised of partial composite
p	Alpha spectroscopy analysis of uranium isotopes
q	Gamma spectroscopy analysis of uranium isotopes
r	Tritium data represents non-detect with activity calc'd for 100 percent error.

Lab Codes:

BB	BC Laboratories, Inc.	Bakersfield, CA
CN	Caltest Analytical Laboratory	1885 N. Kelly Rd, Napa, CA 94558
CS	California Laboratory Services	3249 Fitzgerald Rd. Rancho Cordova, CA 95742
SE	Sequoia Analytical	1551 Industrial Road, San Carlos, CA 94070

Validation Codes:

V	Validated
N	Not validated (default value)
U	Undeclared
H	Historical comparison only

CLP flags: (follow result)

B	Analyte found in method blank
D	Analysis performed at a secondary dilution or concentration (i.e., vapor samples)
E	The analyte was detected below the LLNL reporting limit, but above the analytical laboratory minimum detection limit.
F	Analyte found in field blank, trip blank, or equipment blank
G	Quantitated using fuel calibration, but does not match typical fuel fingerprint (fuel maybe gasoline, diesel, motor oil etc.).
H	Sample analyzed outside of holding time, sample results should be evaluated
J	Analyte was postively identified; the associated numerical value is the approximate concentration of the analyte in the sample.
L	Spike accuracy not within control limits
O	Duplicate spike or sample precision not within control limits
P	Indicates that the absence of a data qualifier flag does not mean that the data does not need qualification, but that the implementation of electronic data qualifier flags was not yet established
R	Sample results are rejected due to serious deficiencies in the ability to analyze the sample and meet QC criteria. The presence or absence of the analyte cannot be verified
S	Analytical results for this sample are suspect
T	Analyte is tentatively identified compound; result is approximate
U	Compound was analyzed for, but not detected above detection limit

Table A-17. Ground and surface water analyses for high explosives compounds (ug/L) in samples collected from the Pit 7 Complex between July 1, 1995 and June 30, 2003. Results recorded by December 18, 2003.

HE Compounds in Water, Site 300
December 19, 2003
gemini2

s3hmx.19dec2003

Min Sample Date
July 1, 1995
Max Sample Date
June 30, 2003

Table A-17. Ground and surface water analyses for high explosives compounds (ug/L) in samples collected from the Pit 7 Complex between July 1, 1995 and June 30, 2003. Results recorded by December 18, 2003.

Location Date	Lab	Note	Val.	HMX	RDX	TNT
MUL2						
06-sep-1996	CS	a	V	<5 U	<5 U	-
08-sep-1997	CS	a	V	<5 U	<5 U	-
16-sep-1998	CS	a	V	<5 U	<5 U	-
08-sep-1999	CN	ah	V	<1 U	<1 U	-
08-sep-1999	CN	aeh	V	<1 U	<1 U	-
06-sep-2000	BB	af	V	<5 U	<5 U	-
05-sep-2001	BB	afh	V	<5 U	<5 U	-
05-sep-2001	BB	aefh	V	<5 U	<5 U	-
17-sep-2002	BB	ah	V	<5 U	<5 U	-
17-sep-2002	BB	aeh	V	<5 U	<5 U	-
K7-01						
14-jul-1995	CS	a	V	<5 LOU	-	<5 LOU
17-oct-1995	CS	ah	V	<5 U	<5 U	<5 U
17-oct-1995	CS	aeh	V	<5 U	<5 U	<5 U
07-feb-1996	CS	a	V	<5 U	<5 U	<5 U
24-apr-1996	CS	a	V	<5 U	<5 U	-
25-jul-1996	CS	ah	V	<5 U	<5 U	-
25-jul-1996	CS	aeh	V	<5 U	<5 U	-
18-oct-1996	CS	a	V	<5 U	<5 U	-
22-jan-1997	CS	ah	V	<5 U	<5 U	-
22-jan-1997	CS	aeh	V	<5 U	<5 U	-
08-apr-1997	CS	a	V	<5 U	<5 U	-
23-jul-1997	CS	a	V	<5 U	<5 U	-
21-oct-1997	CS	ah	V	<5 U	<5 U	-
21-oct-1997	CS	aeh	V	<5 U	<5 U	-
14-jan-1998	CS	a	V	<5 U	<5 U	-
20-apr-1998	CS	a	V	<5 UO	<5 UO	-
21-jul-1998	CS	a	V	<5 U	<5 U	-
19-oct-1998	CS	ah	V	<5 U	<5 U	-
19-oct-1998	CS	aeh	V	<5 U	<5 U	-
19-jan-1999	CS	ah	V	<5 U	<5 U	-
19-jan-1999	CS	aeh	V	<5 U	<5 U	-
22-apr-1999	CN	af	V	<1 U	<1 U	-
20-jul-1999	CN	af	V	<1 U	<1 U	-
07-oct-1999	CN	afh	V	<1 U	<1 U	-
07-oct-1999	CN	aefh	V	<1.1 U	<1.1 U	-
11-feb-2000	CN	af	V	<1 U	<1 U	-
25-apr-2000	CN	ah	V	<1 LOU	<1 LOU	-
25-apr-2000	CN	aeh	V	<1 LOU	<1 LOU	-
24-jul-2000	CN	af	V	<1 LOU	<1 LOU	-
30-oct-2000	CN	afh	V	<1 LU	<1 U	-
30-oct-2000	CN	aefh	V	<1 LU	<1 U	-
23-jan-2001	CN	af	V	<1 U	<1 U	-
24-apr-2001	CN	af	V	<1 U	<1 U	-
17-jul-2001	CN	afh	V	<1 U	<1 U	-
17-jul-2001	CN	aefh	V	<1 U	<1 U	-
24-oct-2001	CN	a	V	<1 U	<1 U	-
23-jan-2002	CN	a	V	<1 U	<1 U	-
22-apr-2002	CN	aefh	V	<1 LOU	<1 LOU	-
22-apr-2002	CN	afh	V	<1 LOU	<1 LOU	-
13-sep-2002	CN	af	V	<1 U	<1 U	-
27-nov-2002	CN	aefh	V	<1 U	<1 U	-
27-nov-2002	CN	afh	V	<1 U	<1 U	-
10-feb-2003	CN	af	V	<1 U	<1 U	-
01-may-2003	CN	afh	V	<1 U	<1 U	-
01-may-2003	CN	aefh	V	<1 U	<1 U	-
K7-03						
14-jul-1995	CS	ah	V	<5 LOU	-	<5 LOU
14-jul-1995	CS	aeh	V	<5 LOU	-	<5 LOU
17-oct-1995	CS	a	V	<5 U	<5 U	<5 U
07-feb-1996	CS	a	V	<5 U	<5 U	<5 U
24-apr-1996	CS	ah	V	<5 U	<5 U	-
24-apr-1996	CS	aeh	V	<5 U	<5 U	-
25-jul-1996	CS	a	V	<5 U	<5 U	-

Table A-17. Ground and surface water analyses for high explosives compounds (ug/L) in samples collected from the Pit 7 Complex between July 1, 1995 and June 30, 2003. Results recorded by December 18, 2003.

Location Date	Lab	Note	Val.	HMX	RDX	TNT
K7-03 (continued)						
18-oct-1996	CS	a	V	<5 U	<5 U	-
23-jan-1997	CS	a	V	<5 U	<5 U	-
08-apr-1997	CS	ah	V	<5 U	<5 U	-
08-apr-1997	CS	aeh	V	<5 U	<5 U	-
23-jul-1997	CS	a	V	<5 U	<5 U	-
21-oct-1997	CS	a	V	<5 U	<5 U	-
15-jan-1998	CS	ah	V	<5 U	<5 U	-
15-jan-1998	CS	aeh	V	<5 U	<5 U	-
21-apr-1998	CS	a	V	<5 UO	<5 UO	-
27-jul-1998	CS	a	V	<5 U	<5 U	-
19-oct-1998	CS	a	V	<5 U	<5 U	-
19-jan-1999	CS	a	V	<5 U	<5 U	-
22-apr-1999	CN	afh	V	<1 U	<1 U	-
22-apr-1999	CN	aefh	V	<1 U	<1 U	-
19-jul-1999	CN	af	V	<1 U	<1 U	-
07-oct-1999	CN	af	V	<1 U	<1 U	-
11-feb-2000	CN	a	V	<1 U	<1 U	-
25-apr-2000	CN	af	V	<1 LOU	<1 LOU	-
24-jul-2000	CN	ah	V	<2 LOU	<2 LOU	-
24-jul-2000	CN	aeh	V	<2 LOU	<2 LOU	-
30-oct-2000	CN	af	V	<1 LU	<1 U	-
23-jan-2001	CN	af	V	<1 U	<1 U	-
17-apr-2001	CN	afh	V	<1 IJLU	<1 IJU	-
17-apr-2001	CN	aeh	V	<1 IJLU	<1 IJU	-
17-jul-2001	CN	af	V	<1 U	<1 U	-
24-oct-2001	CN	a	V	<1 U	<1 U	-
23-jan-2002	CN	aeh	V	<1 U	<1 U	-
23-jan-2002	CN	ah	V	<1 U	<1 U	-
22-apr-2002	CN	af	V	<2 LOU	<2 LOU	-
06-sep-2002	CN	ah	V	<1 U	<1 U	-
06-sep-2002	CN	aefh	V	<1 U	<1 U	-
27-nov-2002	CN	af	V	<1 U	<1 U	-
07-feb-2003	CN	afh	V	<1 U	<1 U	-
07-feb-2003	CN	aefh	V	<1 U	<1 U	-
01-may-2003	CN	af	V	<1 U	<1 U	-
K7-06						
14-jul-1995	CS	a	V	<5 LOU	-	<5 LOU
17-oct-1995	CS	a	V	<5 U	<5 U	<5 U
12-feb-1996	CS	ah	V	<5 U	<5 U	-
12-feb-1996	CS	aeh	V	<5 U	<5 U	-
24-apr-1996	CS	a	V	<5 U	<5 U	-
24-jul-1996	CS	a	V	<5 U	<5 U	-
18-oct-1996	CS	a	V	<5 U	<5 U	-
22-jan-1997	CS	a	V	<5 U	<5 U	-
08-apr-1997	CS	a	V	<5 U	<5 U	-
23-jul-1997	CS	a	V	<5 U	<5 U	-
21-oct-1997	CS	a	V	<5 U	<5 U	-
14-jan-1998	CS	a	V	<5 U	<5 U	-
21-apr-1998	CS	ah	V	<5 UO	<5 UO	-
21-apr-1998	CS	aeh	V	<5 UO	<5 UO	-
21-jul-1998	CS	ah	V	<5 U	<5 U	-
21-jul-1998	CS	aeh	V	<5 U	<5 U	-
19-oct-1998	CS	a	V	<5 U	<5 U	-
19-jan-1999	CS	a	V	<5 U	<5 U	-
23-apr-1999	CN	a	V	<1 U	<1 U	-
19-jul-1999	CN	ah	V	<1 U	<1 U	-
19-jul-1999	CN	aeh	V	<1 U	<1 U	-
12-oct-1999	CN	a	V	<1 U	<1 U	-
11-feb-2000	CN	a	V	<1 U	<1 U	-
25-apr-2000	CN	af	V	<1 LOU	<1 LOU	-
24-jul-2000	CN	a	V	<1 LOU	<1 LOU	-
01-nov-2000	CN	af	V	<1 LOU	<1 LOU	-
06-jun-2001	CN	a	V	<1 U	<1 U	-
19-jul-2001	CN	a	V	<1 U	<1 U	-
29-oct-2001	CN	a	V	<1 U	<1 U	-
30-jan-2002	CN	a	V	<1 U	<1 U	-

Table A-17. Ground and surface water analyses for high explosives compounds (ug/L) in samples collected from the Pit 7 Complex between July 1, 1995 and June 30, 2003. Results recorded by December 18, 2003.

Location Date	Lab	Note	Val.	HMX	RDX	TNT
K7-06 (continued)						
29-apr-2002	CN	a	V	<1 LOU	<1 LOU	–
29-aug-2002	CN	af	V	<1 U	<1 U	–
03-dec-2002	CN	af	V	<1 U	<1 U	–
07-feb-2003	CN	af	V	<1 U	<1 U	–
06-may-2003	CN	af	V	<1 U	<1 U	–
K7-07						
07-aug-1995	CS	ah	V	<5 U	<5 U	<5 U
07-aug-1995	CS	aeh	V	<5 U	<5 U	<5 U
30-oct-1995	CS	a	V	<5 U	<5 U	<5 U
20-may-1996	CS	a	V	<5 U	<5 U	–
19-nov-1996	CS	a	V	<5 U	<5 U	–
13-may-1997	CS	a	V	<5 U	<5 U	–
18-nov-1997	CS	a	V	<5 U	<5 U	–
02-jun-1998	CS	ah	V	<5 U	<5 U	–
02-jun-1998	CS	aeh	V	<5 U	<5 U	–
30-nov-1998	CS	a	V	<5 U	<5 U	–
26-may-1999	CN	a	V	<1 U	<1 U	–
18-may-2000	CN	a	V	<1 U	<1 U	–
K7-09						
17-jul-1995	CS	a	V	<5 U	<5 U	<5 U
17-oct-1995	CS	a	V	<5 U	<5 U	<5 U
07-feb-1996	CS	a	V	<5 U	<5 U	<5 U
26-apr-1996	CS	a	V	<5 U	<5 U	–
24-jul-1996	CS	a	V	<5 U	<5 U	–
23-oct-1996	CS	a	V	<5 U	<5 U	–
23-jan-1997	CS	a	V	<5 U	<5 U	–
10-apr-1997	CS	a	V	<5 U	<5 U	–
17-jul-1997	CS	a	V	<5 U	<5 U	–
22-oct-1997	CS	a	V	<5 U	<5 U	–
21-jan-1998	CS	a	V	<5 U	<5 U	–
22-apr-1998	CS	a	V	<5 UO	<5 UO	–
27-jul-1998	CS	a	V	<5 U	<5 U	–
20-oct-1998	CS	a	V	<5 U	<5 U	–
25-jan-1999	CS	a	V	<5 U	<5 U	–
23-apr-1999	CN	a	V	<1 U	<1 U	–
15-jul-1999	CN	a	V	<1 U	<1 U	–
11-oct-1999	CN	a	V	<1 U	<1 U	–
16-feb-2000	CN	a	V	<1 U	<1 U	–
25-apr-2000	CN	a	V	<1 LOU	<1 LOU	–
09-aug-2000	CN	a	V	<1 U	<1 U	–
01-nov-2000	CN	af	V	<1 LOU	<1 LOU	–
23-jan-2001	CN	a	V	<1 U	<1 U	–
24-apr-2001	CN	ah	V	<1 U	<1 U	–
17-jul-2001	CN	a	V	<1 U	<1 U	–
24-oct-2001	CN	a	V	<1 U	<1 U	–
23-jan-2002	CN	a	V	<1 U	<1 U	–
23-apr-2002	CN	af	V	<1 LOU	<1 LOU	–
06-sep-2002	CN	a	V	<1 U	<1 U	–
29-nov-2002	CN	af	V	<1 U	<1 U	–
07-feb-2003	CN	af	V	<1 IJU	<1 IJU	–
01-may-2003	CN	a	V	<1 U	<1 U	–
K7-10						
18-jul-1995	CS	a	V	<5 U	<5 U	<5 U
19-oct-1995	CS	a	V	<5 U	<5 U	<5 U
12-feb-1996	CS	a	V	<5 U	<5 U	–
26-apr-1996	CS	a	V	<5 U	<5 U	–
24-jul-1996	CS	a	V	<5 U	<5 U	–
24-oct-1996	CS	a	V	<5 U	<5 U	–
28-jan-1997	CS	a	V	<5 U	<5 U	–
15-apr-1997	CS	a	V	<5 U	<5 U	–
17-jul-1997	CS	a	V	<5 U	<5 U	–
27-oct-1997	CS	a	V	<5 U	<5 U	–
21-jan-1998	CS	a	V	<5 U	<5 U	–
28-apr-1998	CS	a	V	<5 U	<5 U	–

Table A-17. Ground and surface water analyses for high explosives compounds (ug/L) in samples collected from the Pit 7 Complex between July 1, 1995 and June 30, 2003. Results recorded by December 18, 2003.

Location Date	Lab	Note	Val.	HMX	RDX	TNT
K7-10 (continued)						
31-jul-1998	CS	a	V	<5 U	<5 U	-
26-oct-1998	CS	a	V	-	<5 U	-
26-oct-1998	CS	a	V	<5 U	<5 U	-
25-jan-1999	CS	a	V	<5 U	<5 U	-
26-apr-1999	CN	a	V	<1 U	<1 U	-
15-jul-1999	CN	a	V	<1 U	<1 U	-
11-oct-1999	CN	a	V	<1 U	<1 U	-
27-jan-2000	CN	a	V	<1 U	<1 U	-
26-apr-2000	CN	a	V	<1 LOU	<1 LOU	-
01-nov-2000	CN	a	V	<1 LOU	<1 LOU	-
23-jan-2001	CN	a	V	<1 U	<1 U	-
24-apr-2001	CN	ah	V	<1 U	<1 U	-
17-jul-2001	CN	a	V	<1 U	<1 U	-
24-oct-2001	CN	a	V	<1 U	<1 U	-
23-apr-2002	CN	a	V	<1 LOU	<1 LOU	-
28-aug-2002	CN	af	V	<1 LOU	<1 LOU	-
29-nov-2002	CN	af	V	<1 U	<1 U	-
07-feb-2003	CN	af	V	<1 U	<1 U	-
05-may-2003	CN	a	V	<1 U	<1 U	-
NC7-16						
12-may-1997	CS	a	V	<5 U	<5 U	-
29-apr-1998	CS	a	V	<5 U	<5 U	-
27-may-1999	CN	a	V	<1 U	<1 U	-
14-jun-2000	CN	a	V	<2 U	<2 U	-
NC7-21						
05-jun-1996	CS	a	V	<5 U	<5 U	-
29-may-1997	CS	a	V	<5 U	<5 U	-
20-may-1998	CS	a	V	<5 UH	<5 UH	-
28-may-1999	CN	af	V	<1 U	<1 U	-
15-jun-2000	CN	af	V	<1 U	<1 U	-
22-may-2001	CN	a	V	<1 U	<1 U	-
23-may-2002	CN	a	V	<1 U	<1 U	-
NC7-22						
29-may-1997	CS	a	V	<5 U	<5 U	-
20-may-1998	CS	a	V	<5 UH	<5 UH	-
28-may-1999	CN	af	V	<1 U	<1 U	-
NC7-24						
29-jan-1997	CS	a	V	<5 U	<5 U	-
29-may-1997	CS	a	V	<5 U	<5 U	-
29-jul-1997	CS	a	V	<5 U	<5 U	-
19-nov-1997	CS	a	V	<5 U	<5 U	-
09-mar-1998	CS	a	V	<5 U	<5 U	-
20-may-1998	CS	a	V	<5 UH	<5 UH	-
25-aug-1998	CS	a	V	<5 U	<5 U	-
24-nov-1998	CS	a	V	<5 U	<5 U	-
27-jan-1999	CS	a	V	<5 U	<5 U	-
07-jun-1999	CN	a	V	<1 U	<1 U	-
NC7-25						
18-jul-1995	CS	a	V	<5 U	<5 U	<5 U
20-oct-1995	CS	a	V	<5 U	<5 U	<5 U
12-feb-1996	CS	a	V	<5 U	<5 U	-
29-apr-1996	CS	a	V	<5 U	<5 U	-
30-jul-1996	CS	a	V	<5 U	<5 U	-
24-oct-1996	CS	a	V	<5 U	<5 U	-
28-jan-1997	CS	a	V	<5 U	<5 U	-
16-apr-1997	CS	a	V	<5 U	<5 U	-
30-jul-1997	CS	a	V	<5 U	<5 U	-
27-oct-1997	CS	a	V	<5 U	<5 U	-
22-jan-1998	CS	a	V	<5 U	<5 U	-
28-apr-1998	CS	a	V	<5 U	<5 U	-
31-jul-1998	CS	a	V	<5 U	<5 U	-
26-oct-1998	CS	a	V	-	<5 U	-

Table A-17. Ground and surface water analyses for high explosives compounds (ug/L) in samples collected from the Pit 7 Complex between July 1, 1995 and June 30, 2003. Results recorded by December 18, 2003.

Location Date	Lab	Note	Val.	HMX	RDX	TNT
NC7-25 (continued)						
26-oct-1998	CS	a	V	<5 U	<5 U	–
27-jan-1999	CS	a	V	<5 U	<5 U	–
04-may-1999	CN	a	V	<1 U	<1 U	–
15-jul-1999	CN	a	V	<1 U	<1 U	–
07-oct-1999	CN	af	V	<1.2 U	<1.2 U	–
04-feb-2000	CN	ah	V	<1 LOU	<1 LOU	–
04-feb-2000	CN	aeh	V	<1.1 LOU	<1.1 LOU	–
26-apr-2000	CN	af	V	<1 LOU	<1 LOU	–
09-aug-2000	CN	af	V	<1 U	<1 U	–
01-nov-2000	CN	af	V	<1 LOU	<1 LOU	–
25-jan-2001	CN	af	V	<1 U	<1 U	–
26-apr-2001	CN	af	V	<1 U	<1 U	–
18-jul-2001	CN	af	V	<1 U	<1 U	–
25-oct-2001	CN	ah	V	<1 U	<1 U	–
25-oct-2001	CN	aeh	V	<1 U	<1 U	–
24-jan-2002	CN	a	V	<1 U	<1 U	–
29-apr-2002	CN	a	V	<1 LOU	<1 LOU	–
11-sep-2002	CN	af	V	<1 U	<1 U	–
27-nov-2002	CN	af	V	<1 U	<1 U	–
11-feb-2003	CN	a	N	<1 U	<1 U	–
05-may-2003	CN	a	V	<1 U	<1 U	–
NC7-26						
17-jul-1995	CS	a	V	<5 U	<5 U	<5 U
17-oct-1995	CS	a	V	<5 U	<5 U	<5 U
08-feb-1996	CS	a	V	<5 U	<5 U	<5 U
26-apr-1996	CS	a	V	<5 U	<5 U	–
25-jul-1996	CS	a	V	<5 U	<5 U	–
23-oct-1996	CS	a	V	<5 U	<5 U	–
23-jan-1997	CS	a	V	<5 U	<5 U	–
10-apr-1997	CS	a	V	<5 U	<5 U	–
24-jul-1997	CS	a	V	<5 U	<5 U	–
22-oct-1997	CS	a	V	<5 U	<5 U	–
21-jan-1998	CS	a	V	<5 U	<5 U	–
22-apr-1998	CS	a	V	<5 UO	<5 UO	–
27-jul-1998	CS	a	V	<5 U	<5 U	–
20-oct-1998	CS	a	V	<5 U	<5 U	–
25-jan-1999	CS	a	V	<5 U	<5 U	–
04-may-1999	CN	af	V	<1 U	<1 U	–
14-jul-1999	CN	a	V	<1 U	<1 U	–
11-oct-1999	CN	a	V	<1 U	<1 U	–
16-feb-2000	CN	a	V	<1 U	<1 U	–
26-apr-2000	CN	a	V	<1 LOU	<1 LOU	–
09-aug-2000	CN	a	V	<1 U	<1 U	–
02-nov-2000	CN	a	V	<1 LOU	<1 LOU	–
25-jan-2001	CN	a	V	<1 U	<1 U	–
26-apr-2001	CN	a	V	<1 U	<1 U	–
18-jul-2001	CN	a	V	<1 U	<1 U	–
25-oct-2001	CN	a	V	<1 U	<1 U	–
24-jan-2002	CN	a	V	<1 U	<1 U	–
22-apr-2002	CN	a	V	<1 LOU	<1 LOU	–
13-sep-2002	CN	af	V	<1 U	<1 U	–
29-nov-2002	CN	af	V	<1 U	<1 U	–
12-feb-2003	CN	af	V	<1 U	<1 U	–
06-may-2003	CN	af	V	<1 U	<1 U	–
NC7-34						
29-may-1997	CS	a	V	<5 U	<5 U	–
20-may-1998	BB	afg	N	<2.4 DU	<1.4 DU	<1.5 DU
20-may-1998	CS	ag	V	<5 HU	<5 HU	–
07-jun-1999	CN	a	V	<1 U	<1 U	–
14-jun-2000	CN	a	V	<1 U	<1 U	–
12-jun-2001	CN	af	V	<1 U	<1 U	–
04-jun-2002	CN	af	V	<1 LOU	<1 LOU	–

Table A-17. Ground and surface water analyses for high explosives compounds (ug/L) in samples collected from the Pit 7 Complex between July 1, 1995 and June 30, 2003. Results recorded by December 18, 2003.

Location Date	Lab	Note	Val.	HMX	RDX	TNT
NC7-36						
05-jun-1996	CS	a	V	<5 U	<5 U	-
13-may-1997	CS	a	V	<5 U	<5 U	-
20-may-1998	CS	a	V	<5 HU	<5 HU	-
16-jun-1999	CN	a	V	<1 U	<1 U	-
19-jun-2000	BB	ag	V	<5 U	<5 U	-
19-jun-2000	CN	ag	V	<2 U	<2 U	-
25-may-2001	CN	a	V	<5 U	<5 U	<5 U
31-may-2002	CN	a	V	<1 LOU	<1 LOU	-
NC7-37						
27-may-1997	CS	ah	V	<5 U	<5 U	-
27-may-1997	CS	aeh	V	<5 U	<5 U	-
29-apr-1998	CS	a	V	<5 U	<5 U	-
16-jun-1999	CN	af	V	<1 U	<1 U	-
14-jun-2000	CN	a	V	<2 U	<2 U	-
NC7-40						
27-may-1997	BB	ag	V	<0.32 DU	<0.19 DU	-
27-may-1997	CS	ag	V	<5 U	<5 U	-
29-apr-1998	CS	a	V	<5 U	<5 U	-
07-jun-1999	CN	a	V	<1 U	<1 U	-
13-jun-2000	CN	a	V	<1 U	<1 U	-
12-jun-2001	CN	af	V	<1 U	<1 U	-
29-may-2002	CN	af	V	<1 LOU	<1 LOU	-
NC7-47						
18-jul-1995	CS	a	V	<5 U	<5 U	<5 U
20-oct-1995	CS	a	V	<5 U	<5 U	<5 U
13-feb-1996	CS	a	V	<5 U	<5 U	<5 U
30-apr-1996	CS	a	V	<5 U	<5 U	-
30-jul-1996	CS	a	V	<5 U	<5 U	-
25-oct-1996	CS	a	V	<5 U	<5 U	-
03-feb-1997	CS	a	V	<5 U	<5 U	-
16-apr-1997	CS	a	V	<5 U	<5 U	-
30-jul-1997	CS	a	V	<5 U	<5 U	-
27-oct-1997	CS	a	V	<5 U	<5 U	-
27-jan-1998	CS	a	V	<5 U	<5 U	-
29-apr-1998	CS	a	V	<5 U	<5 U	-
29-jul-1998	CS	a	V	<5 U	<5 U	-
21-oct-1998	CS	a	V	<5 U	<5 U	-
27-jan-1999	CS	a	V	<5 U	<5 U	-
04-may-1999	CN	af	V	<1 U	<1 U	-
15-jul-1999	CN	a	V	<1 U	<1 U	-
11-oct-1999	CN	af	V	<1 U	<1 U	-
27-jan-2000	CN	afh	V	<1 U	<1 U	-
27-jan-2000	CN	aefh	V	<1 U	<1 U	-
01-may-2000	CN	af	V	<1 LOU	<1 LOU	-
09-aug-2000	CN	af	V	<1 U	<1 U	-
02-nov-2000	CN	af	V	<1 LOU	<1 LOU	-
25-jan-2001	CN	af	V	<1 U	<1 U	-
27-apr-2001	CN	af	V	<1 U	<1 U	-
19-jul-2001	CN	a	V	<1 U	<1 U	-
29-oct-2001	CN	a	V	<1 U	<1 U	-
30-jan-2002	CN	a	V	<1 U	<1 U	-
30-apr-2002	CN	af	V	<1 LOU	<1 LOU	-
29-aug-2002	CN	af	V	<1 U	<1 U	-
03-dec-2002	CN	af	V	<1 U	<1 U	-
12-feb-2003	CN	af	V	<1 U	<1 U	-
07-may-2003	CN	af	V	<1 U	<1 U	-
NC7-48						
19-jul-1995	CS	a	V	<5 U	<5 U	<5 U
19-oct-1995	CS	a	V	<5 U	<5 U	<5 U
15-feb-1996	CS	a	V	<5 U	<5 U	-
30-apr-1996	CS	a	V	<5 U	<5 U	-
30-jul-1996	CS	a	V	<5 U	<5 U	-
25-oct-1996	CS	ah	V	<5 U	<5 U	-

Table A-17. Ground and surface water analyses for high explosives compounds (ug/L) in samples collected from the Pit 7 Complex between July 1, 1995 and June 30, 2003. Results recorded by December 18, 2003.

Location Date	Lab	Note	Val.	HMX	RDX	TNT
NC7-48 (continued)						
25-oct-1996	CS	aeh	V	<5 U	<5 U	–
28-jan-1997	CS	a	V	<5 U	<5 U	–
16-apr-1997	CS	a	V	<5 U	<5 U	–
30-jul-1997	CS	ah	V	<5 U	<5 U	–
30-jul-1997	CS	aeh	V	<5 U	<5 U	–
28-oct-1997	CS	a	V	<5 U	<5 U	–
22-jan-1998	CS	a	V	<5 U	<5 U	–
28-apr-1998	CS	a	V	<5 U	<5 U	–
31-jul-1998	CS	a	V	<5 U	<5 U	–
26-oct-1998	CS	a	V	–	<5 U	–
26-oct-1998	CS	a	V	<5 U	<5 U	–
28-jan-1999	CS	a	V	<5 U	<5 U	–
04-may-1999	CN	a	V	2	1	–
19-jul-1999	CN	af	V	<1 U	<1 U	–
12-oct-1999	CN	a	V	<1.3 U	<1.3 U	–
27-jan-2000	CN	a	V	<1 U	<1 U	–
01-may-2000	CN	a	V	<1 LOU	<1 LOU	–
10-aug-2000	CN	af	V	<1 U	<1 U	–
02-nov-2000	CN	af	V	<1 LOU	<1 LOU	–
25-jan-2001	CN	af	V	<1 U	<1 U	–
26-apr-2001	CN	ah	V	<2 U	<2 U	–
18-jul-2001	CN	a	V	<2 U	<2 U	–
25-oct-2001	CN	a	V	<1 U	<1 U	–
30-jan-2002	CN	a	V	<1 U	<1 U	–
30-apr-2002	CN	a	V	<1 LOU	<1 LOU	–
12-sep-2002	CN	af	V	<1 U	<1 U	–
29-nov-2002	CN	af	V	<1 U	<1 U	–
11-feb-2003	CN	a	N	<1 U	<1 U	–
06-may-2003	CN	af	V	<1 U	<1 U	–
NC7-51						
12-jun-1996	BB	ag	V	<5 U	<5 U	–
12-jun-1996	CS	ag	V	<5 U	<5 U	–
05-jun-1997	LH	a	V	<1 U	<0.85 U	<0.26 U
25-aug-1999	CN	a	V	<1 U	<1 U	–
17-may-2001	CN	a	V	<1 LOU	<1 U	–
15-may-2002	CN	af	V	<1 LOU	<1 LOU	–
NC7-60						
05-jun-2000	CN	a	V	<2 U	<2 U	–
NC7-67						
20-may-1998	BB	afg	N	<2.9 DU	<1.6 DU	<1.8 DU
20-may-1998	CS	ag	V	<5 HU	<5 HU	–
01-jul-1999	CN	ah	V	<1 U	<1 U	–
01-jul-1999	CN	aeh	V	<1 U	<1 U	–
01-jun-2000	BB	ag	V	<5 OU	<5 OU	–
01-jun-2000	CN	ag	V	<1 U	<1 U	–
24-may-2001	CN	a	V	<1 U	<1 U	–
NC7-75						
27-may-1997	CS	a	V	<5 U	<5 U	–
01-jun-1998	CS	a	V	<5 U	<5 U	–
16-jun-1999	CN	a	V	<1 U	<1 U	–
05-jun-2000	CN	a	V	<1 IJU	<1 IJU	–
24-may-2001	CN	a	V	<1 U	<1 U	–
31-may-2002	CN	a	V	<1 LOU	<1 LOU	–
W-PIT7-02						
15-may-1997	CS	a	V	<5 U	<5 U	–
30-apr-1998	CS	a	V	<5 U	<5 U	–
16-jun-1999	CN	a	V	<1 U	<1 U	–
16-jun-2000	CN	a	V	<1 U	<1 U	–
14-jun-2001	CN	a	V	<1 U	<1 U	–
23-may-2002	CN	a	V	<2 U	<2 U	–

Table A-17. Ground and surface water analyses for high explosives compounds (ug/L) in samples collected from the Pit 7 Complex between July 1, 1995 and June 30, 2003. Results recorded by December 18, 2003.

Location Date	Lab	Note	Val.	HMX	RDX	TNT
W-PIT7-03						
30-may-1997	BB	a	V	<0.37 DU	<0.21 DU	-
30-may-1997	CS	a	V	<5 U	<5 U	-
30-apr-1998	CS	a	V	<5 U	<5 U	-
01-jul-1999	CN	a	V	<1 U	<1 U	-
19-jun-2000	BB	ag	V	<5 U	<5 U	-
19-jun-2000	CN	ag	V	<2 U	<2 U	-
01-jul-2002	CN	af	V	<1 LOU	<1 LOU	-
W-PIT7-10						
15-may-1997	CS	a	V	<5 U	<5 U	-
30-apr-1998	CS	a	V	<5 U	<5 U	-
24-may-1999	CN	a	V	<1 U	<1 U	-
23-may-2000	CN	a	V	<1 U	<1 U	-
21-may-2001	CN	a	V	<1 U	<1 U	-
03-jun-2002	CN	a	V	<1 LOU	<1 LOU	-
W-PIT7-12						
18-mar-1999	BB	a	V	<1 U	<0.8 U	-
W-PIT7-13						
30-mar-2001	BB	af	V	<5 U	<5 U	-
W-PIT7-15						
20-mar-2001	CN	af	V	<1 U	<1 U	-
W-PIT7-16						
28-mar-2001	CN	a	V	<1 U	<1 U	-
W-PIT7-1714						
27-mar-2002	CN	af	V	<1 U	<1 U	-
W-PIT7-1717						
28-mar-2002	CN	af	V	<1 LOU	<1 LOU	-
W-PIT7-1718						
28-sep-2002	CN	a	N	<1 U	<1 U	-
W-PIT7-1720						
27-mar-2002	CN	af	V	<1 U	<1 U	-
W-PIT7-1723						
26-mar-2002	CN	af	V	<1 U	<1 U	-
W-PIT7-1724						
26-mar-2002	CN	af	V	<1 U	<1 U	-
W-865-01						
30-mar-1999	BB	a	V	<1 U	<0.8 U	-
W-865-03						
29-sep-2000	CN	af	V	<1 OU	<1 OU	-
W-865-04						
28-sep-2000	CN	af	V	<1 OU	<1 OU	-
W-865-07						
29-sep-2000	CN	af	V	<1 OU	<1 OU	-
W-865-1804						
23-jun-2003	CN	a	V	<1 U	<1 U	-
SPRING13						
06-nov-1995	CS	a	V	<5 U	<5 U	-
SPRING24						
22-oct-1999	CN	a	V	<1 U	<1 U	-

See following page for notes

Table A-17. Ground and surface water analyses for high explosives compounds (ug/L) in samples collected from the Pit 7 Complex between July 1, 1995 and June 30, 2003. Results recorded by December 18, 2003.

Notes:

\- Indicates no analysis performed for this compound

Val. = Validation code

Footnotes:

a	ERD data
b	ORAD WGMG data
c	Analytical results for this sample are suspect
d	Sample collected during hydraulic testing
e	Blind sample, sent to lab without location identity
f	Sample dilution necessary for analysis; detection limits increased
g	Interlaboratory collocated sample
h	Intralaboratory collocated sample
i	Sample collected as part of pilot study
j	Note field may contain important information regarding this sample
k	Pre-development sample
l	Norm month, norm quarter or norm year inconsistent with sample date
m	Confirmation sample
n	Sample analyzed after standard holding time
o	Sample comprised of partial composite
p	Alpha spectroscopy analysis of uranium isotopes
q	Gamma spectroscopy analysis of uranium isotopes
r	Tritium data represents non-detect with activity calc'd for 100 percent error.

Lab Codes:

BB	BC Laboratories, Inc.	Bakersfield, CA
CN	Caltest Analytical Laboratory	1885 N. Kelly Rd, Napa, CA 94558
CS	California Laboratory Services	3249 Fitzgerald Rd. Rancho Cordova, CA 95742
LH	LAS-formerly Lockheed<1jan97	975 Kelly Johnson Las Vegas NV 89119

Validation Codes:

V	Validated
N	Not validated (default value)
U	Undeclared
H	Historical comparison only

CLP flags: (follow result)

B	Analyte found in method blank
D	Analysis performed at a secondary dilution or concentration (i.e., vapor samples)
E	The analyte was detected below the LLNL reporting limit, but above the analytical laboratory minimum detection limit.
F	Analyte found in field blank, trip blank, or equipment blank
G	Quantitated using fuel calibration, but does not match typical fuel fingerprint (fuel maybe gasoline, diesel, motor oil etc.).
H	Sample analyzed outside of holding time, sample results should be evaluated
J	Analyte was postively identified; the associated numerical value is the approximate concentration of the analyte in the sample.
L	Spike accuracy not within control limits
O	Duplicate spike or sample precision not within control limits
P	Indicates that the absence of a data qualifier flag does not mean that the data does not need qualification, but that the implementation of electronic data qualifier flags was not yet established
R	Sample results are rejected due to serious deficiencies in the ability to analyze the sample and meet QC criteria. The presence or absence of the analyte cannot be verified
S	Analytical results for this sample are suspect
T	Analyte is tentatively identified compound; result is approximate
U	Compound was analyzed for, but not detected above detection limit

Table A-18. Ground and surface water analyses for PCBs (ug/L) in samples collected from the Pit 7 Complex between July 1, 1995 and June 30, 2003. Results recorded by December 18, 2003.

PCBs in Ground Water, Site 300
December 19, 2003
gemini2

s3pcbL.19dec2003
s3pcbR.19dec2003

Min Sample Date
July 1, 1995
Max Sample Date
June 30, 2003

Table A-18. Ground and surface water analyses for PCBs (ug/L) in samples collected

Location Date	Lab	Note	Val.	PCB 1016	PCB 1221	PCB 1232	PCB 1242	PCB 1248
MUL2								
08-sep-1997	CS	a	V	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
16-sep-1998	CS	a	V	<0.5 ULO	<0.5 ULO	<0.5 ULO	<0.5 ULO	<0.5 ULO
06-sep-2000	BB	af	V	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U
K7-01								
24-apr-1996	CS	a	V	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
K7-03								
24-apr-1996	CS	ah	V	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
24-apr-1996	CS	aeh	V	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
NC7-21								
05-jun-1996	CS	a	V	<0.5 HU	<0.5 HU	<0.5 HU	<0.5 HU	<0.5 HU
NC7-34								
29-may-1997	CS	a	V	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
20-may-1998	BB	afg	N	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U
20-may-1998	CS	ag	V	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
07-jun-1999	CN	a	V	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
14-jun-2000	CN	a	V	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
12-jun-2001	CN	af	V	<0.6 U	<0.6 U	<0.6 U	<0.6 U	<0.6 U
04-jun-2002	CN	af	V	<0.6 LOU	<0.5 LOU	<0.5 LOU	<0.5 LOU	<0.5 LOU
NC7-36								
05-jun-1996	CS	a	V	<0.5 HU	<0.5 HU	<0.5 HU	<0.5 HU	<0.5 HU
13-may-1997	CS	a	V	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
20-may-1998	CS	a	V	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
16-jun-1999	CN	a	V	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
19-jun-2000	BB	ag	V	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U
19-jun-2000	CN	ag	V	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
25-may-2001	CN	a	V	<0.6 U	<0.6 U	<0.6 U	<0.6 U	<0.6 U
31-may-2002	CN	a	V	<0.5 LOU	<0.5 LOU	<0.5 LOU	<0.5 LOU	<0.5 LOU
NC7-37								
27-may-1997	CS	ah	V	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
27-may-1997	CS	aeh	V	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
29-apr-1998	CS	a	V	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
16-jun-1999	CN	af	V	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
14-jun-2000	CN	a	V	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
NC7-40								
27-may-1997	BB	ag	V	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U
27-may-1997	CS	ag	V	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
29-apr-1998	CS	a	V	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
07-jun-1999	CN	a	V	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
13-jun-2000	CN	a	V	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
29-may-2002	CN	af	V	<0.5 LOU	<0.5 LOU	<0.5 LOU	<0.5 LOU	<0.5 LOU
NC7-48								
30-apr-1996	CS	a	V	<0.5 U	<0.5 U	<0.5 U	<0.5 ULO	<0.5 U
16-apr-1997	CS	a	V	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
28-apr-1998	CS	a	V	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
04-may-1999	CN	a	V	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
01-may-2000	CN	a	V	<0.5 LOU	<0.5 LOU	<0.5 LOU	<0.5 LOU	<0.5 LOU
26-apr-2001	CN	ah	V	<0.6 U	<0.6 U	<0.6 U	<0.6 U	<0.6 U
30-apr-2002	CN	af	V	<0.5 LOU	<0.5 LOU	<0.5 LOU	<0.5 LOU	<0.5 LOU
06-may-2003	CN	af	V	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
NC7-51								
12-jun-1996	BB	ag	V	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U
12-jun-1996	CS	ag	V	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
05-jun-1997	LH	a	V	<1 U	<2 U	<1 U	<1 U	<1 U
25-aug-1999	CN	a	V	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
17-may-2001	CN	a	V	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
15-may-2002	CN	af	V	<0.5 LOU	<0.5 LOU	<0.5 LOU	<0.5 LOU	<0.5 LOU

from the Pit 7 Complex between July 1, 1995 and June 30, 2003. Results recorded by December 18, 2003.

PCB 1254	PCB 1260	PCB 1262	PCB 1268	Total PCBs	Location Date
					MUL2
<0.5 U	<0.5 U	–	–	–	08-sep-1997
<0.5 ULO	<0.5 ULO	–	–	–	16-sep-1998
<0.2 U	<0.2 U	–	–	<0.2 U	06-sep-2000
					K7-01
<0.5 U	<0.5 ULO	–	–	–	24-apr-1996
					K7-03
<0.5 U	<0.5 ULO	–	–	–	24-apr-1996
<0.5 U	<0.5 ULO	–	–	–	24-apr-1996
					NC7-21
<0.5 HU	<0.5 HU	–	–	–	05-jun-1996
					NC7-34
<0.5 ULO	<0.5 U	–	–	–	29-may-1997
<0.2 U	<0.2 U	–	–	<0.2 U	20-may-1998
<0.5 U	<0.5 U	–	–	–	20-may-1998
<0.5 U	<0.5 U	–	–	–	07-jun-1999
<0.5 U	<0.5 U	–	–	–	14-jun-2000
<0.6 U	<0.6 U	–	–	–	12-jun-2001
<0.5 LOU	<0.6 LOU	–	–	–	04-jun-2002
					NC7-36
<0.5 HU	<0.5 HU	–	–	–	05-jun-1996
<0.5 U	<0.5 U	–	–	–	13-may-1997
<0.5 U	<0.5 U	–	–	–	20-may-1998
<0.5 U	<0.5 UO	–	–	–	16-jun-1999
<0.2 U	<0.2 U	–	–	–	19-jun-2000
<0.5 U	<0.5 U	–	–	–	19-jun-2000
<0.6 U	<0.6 U	–	–	–	25-may-2001
<0.5 LOU	<0.5 LOU	–	–	–	31-may-2002
					NC7-37
<0.5 U	<0.5 U	–	–	–	27-may-1997
<0.5 U	<0.5 U	–	–	–	27-may-1997
<0.5 U	<0.5 U	–	–	–	29-apr-1998
<0.5 U	<0.5 UO	–	–	–	16-jun-1999
<0.5 U	<0.5 U	–	–	–	14-jun-2000
					NC7-40
<0.2 U	<0.2 U	–	–	<0.2 U	27-may-1997
<0.5 U	<0.5 U	–	–	–	27-may-1997
<0.5 U	<0.5 U	–	–	–	29-apr-1998
<0.5 U	<0.5 U	–	–	–	07-jun-1999
<0.5 U	<0.5 U	–	–	–	13-jun-2000
<0.5 LOU	<0.5 LOU	–	–	–	29-may-2002
					NC7-48
<0.5 U	<0.5 ULO	–	–	–	30-apr-1996
<0.5 U	<0.5 U	–	–	–	16-apr-1997
<0.5 U	<0.5 U	–	–	–	28-apr-1998
<0.5 U	<0.5 U	–	–	–	04-may-1999
<0.5 LOU	<0.5 LOU	–	–	–	01-may-2000
<0.6 U	<0.6 U	–	–	–	26-apr-2001
<0.5 LOU	<0.5 LOU	–	–	–	30-apr-2002
<0.5 U	<0.5 U	–	–	–	06-may-2003
					NC7-51
<0.2 U	<0.2 U	–	–	<0.2 U	12-jun-1996
<0.5 U	<0.5 U	–	–	–	12-jun-1996
<1 U	<1 U	–	–	–	05-jun-1997
<0.5 U	<0.5 U	–	–	–	25-aug-1999
<0.5 U	<0.5 U	–	–	–	17-may-2001
<0.5 LOU	<0.5 LOU	–	–	–	15-may-2002

Table A-18. Ground and surface water analyses for PCBs (ug/L) in samples collected

Location Date	Lab	Note	Val.	PCB 1016	PCB 1221	PCB 1232	PCB 1242	PCB 1248
NC7-67								
20-may-1998	BB	afg	N	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U
20-may-1998	CS	ag	V	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
01-jul-1999	CN	ah	V	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
01-jul-1999	CN	aeh	V	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
01-jun-2000	BB	ag	V	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
01-jun-2000	CN	ag	V	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
NC7-75								
27-may-1997	CS	a	V	<50 DU	<50 DU	<50 DU	<50 DU	<50 DU
24-jun-1997	CS	a	V	<0.5 HU	<0.5 HU	<0.5 HU	<0.5 HU	<0.5 HU
01-jun-1998	CS	a	V	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
16-jun-1999	CN	a	V	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
05-jun-2000	CN	a	V	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
24-may-2001	CN	a	V	<0.6 U	<0.6 U	<0.6 U	<0.6 U	<0.6 U
31-may-2002	CN	a	V	<0.5 LOU	<0.5 LOU	<0.5 LOU	<0.5 LOU	<0.5 LOU
W-PIT7-02								
15-may-1997	CS	a	V	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
30-apr-1998	CS	a	V	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
16-jun-1999	CN	a	V	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
16-jun-2000	CN	a	V	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
14-jun-2001	CN	a	V	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
23-may-2002	CN	a	V	<0.5 LOU	<0.5 LOU	<0.5 LOU	<0.5 LOU	<0.5 LOU
W-PIT7-03								
30-may-1997	BB	a	V	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U
30-may-1997	CS	a	V	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
30-apr-1998	CS	a	V	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
01-jul-1999	CN	a	V	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
19-jun-2000	BB	ag	V	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<0.2 U
19-jun-2000	CN	ag	V	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
18-jun-2001	CN	a	V	<0.6 LOU	<0.6 LOU	<0.6 LOU	<0.6 LOU	<0.6 LOU
01-jul-2002	CN	af	V	<0.5 LOU	<0.5 LOU	<0.5 LOU	<0.5 LOU	<0.5 LOU
W-PIT7-10								
15-may-1997	CS	a	V	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
30-apr-1998	CS	a	V	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
24-may-1999	CN	a	V	<0.1 U	<0.1 U	<0.1 U	<0.1 U	<0.1 U
23-may-2000	CN	a	V	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
21-may-2001	CN	a	V	<0.5 U	<0.5 U	<0.5 U	<0.5 U	<0.5 U
03-jun-2002	CN	a	V	<0.5 LOU	<0.5 LOU	<0.5 LOU	<0.5 LOU	<0.5 LOU

from the Pit 7 Complex between July 1, 1995 and June 30, 2003. Results recorded by December 18, 2003.

PCB 1254	PCB 1260	PCB 1262	PCB 1268	Total PCBs	Location Date
					NC7-67
<0.2 U	<0.2 U	–	–	<0.2 U	20-may-1998
<0.5 U	<0.5 U	–	–	–	20-may-1998
<0.5 U	<0.5 U	–	–	–	01-jul-1999
<0.5 U	<0.5 U	–	–	–	01-jul-1999
<0.5 U	<0.5 U	–	–	–	01-jun-2000
<0.5 U	<0.5 U	–	–	–	01-jun-2000
					NC7-75
61 D	<50 DU	–	–	–	27-may-1997
<0.5 HULO	<0.5 HU	–	–	–	24-jun-1997
<0.5 U	<0.5 U	–	–	–	01-jun-1998
<0.5 U	<0.5 UO	–	–	–	16-jun-1999
<0.5 U	<0.5 U	–	–	–	05-jun-2000
<0.6 U	<0.6 U	–	–	–	24-may-2001
<0.5 LOU	<0.5 LOU	–	–	–	31-may-2002
					W-PIT7-02
<0.5 U	<0.5 U	–	–	–	15-may-1997
<0.5 U	<0.5 U	–	–	–	30-apr-1998
<0.5 U	<0.5 UO	–	–	–	16-jun-1999
<0.5 U	<0.5 U	–	–	–	16-jun-2000
<0.5 U	<0.5 U	–	–	–	14-jun-2001
<0.5 LOU	<0.5 LOU	–	–	–	23-may-2002
					W-PIT7-03
<0.2 U	<0.2 U	–	–	<0.2 U	30-may-1997
<0.5 ULO	<0.5 U	–	–	–	30-may-1997
<0.5 U	<0.5 U	–	–	–	30-apr-1998
<0.5 U	<0.5 U	–	–	–	01-jul-1999
<0.2 U	<0.2 U	–	–	–	19-jun-2000
<0.5 U	<0.5 U	–	–	–	19-jun-2000
<0.6 LOU	<0.6 LOU	–	–	–	18-jun-2001
<0.5 LOU	<0.5 LOU	–	–	–	01-jul-2002
					W-PIT7-10
<0.5 U	<0.5 U	–	–	–	15-may-1997
<0.5 U	<0.5 U	–	–	–	30-apr-1998
<0.1 U	<0.1 U	–	–	–	24-may-1999
<0.5 U	<0.5 U	–	–	–	23-may-2000
<0.5 U	<0.5 U	–	–	–	21-may-2001
<0.5 LOU	<0.5 LOU	–	–	–	03-jun-2002

See following page for notes

Table A-18. Ground and surface water analyses for PCBs (ug/L) in samples collected from the Pit 7 Complex between July 1, 1995 and June 30, 2003. Results recorded by December 18, 2003.

Notes:

- Indicates no analysis performed for this compound

Val. = Validation code

Footnotes:

a	ERD data
b	ORAD WGMG data
c	Analytical results for this sample are suspect
d	Sample collected during hydraulic testing
e	Blind sample, sent to lab without location identity
f	Sample dilution necessary for analysis; detection limits increased
g	Interlaboratory collocated sample
h	Intralaboratory collocated sample
i	Sample collected as part of pilot study
j	Note field may contain important information regarding this sample
k	Pre-development sample
l	Norm month, norm quarter or norm year inconsistent with sample date
m	Confirmation sample
n	Sample analyzed after standard holding time
o	Sample comprised of partial composite
p	Alpha spectroscopy analysis of uranium isotopes
q	Gamma spectroscopy analysis of uranium isotopes
r	Tritium data represents non-detect with activity calc'd for 100 percent error.

Lab Codes:

BB	BC Laboratories, Inc.	Bakersfield, CA
CN	Caltest Analytical Laboratory	1885 N. Kelly Rd, Napa, CA 94558
CS	California Laboratory Services	3249 Fitzgerald Rd. Rancho Cordova, CA 95742
LH	LAS-formerly Lockheed<1jan97	975 Kelly Johnson Las Vegas NV 89119

Validation Codes:

V	Validated
N	Not validated (default value)
U	Undeclared
H	Historical comparison only

CLP flags: (follow result)

B	Analyte found in method blank
D	Analysis performed at a secondary dilution or concentration (i.e., vapor samples)
E	The analyte was detected below the LLNL reporting limit, but above the analytical laboratory minimum detection limit.
F	Analyte found in field blank, trip blank, or equipment blank
G	Quantitated using fuel calibration, but does not match typical fuel fingerprint (fuel maybe gasoline, diesel, motor oil etc.).
H	Sample analyzed outside of holding time, sample results should be evaluated
J	Analyte was postively identified; the associated numerical value is the approximate concentration of the analyte in the sample.
L	Spike accuracy not within control limits
O	Duplicate spike or sample precision not within control limits
P	Indicates that the absence of a data qualifier flag does not mean that the data does not need qualification, but that the implementation of electronic data qualifier flags was not yet established
R	Sample results are rejected due to serious deficiencies in the ability to analyze the sample and meet QC criteria. The presence or absence of the analyte cannot be verified
S	Analytical results for this sample are suspect
T	Analyte is tentatively identified compound; result is approximate
U	Compound was analyzed for, but not detected above detection limit

Table A-9. Ground and surface water analyses for radium isotopes (pCi/L) in samples collected from the Pit 7 Complex between July 1, 1995 and June 30, 2003. Results recorded by December 18, 2003.

Notes:

\- Indicates no analysis performed for this compound

Val. = Validation code

Footnotes:

a	ERD data
b	ORAD WGMG data
c	Analytical results for this sample are suspect
d	Sample collected during hydraulic testing
e	Blind sample, sent to lab without location identity
f	Sample dilution necessary for analysis; detection limits increased
g	Interlaboratory collocated sample
h	Intralaboratory collocated sample
i	Sample collected as part of pilot study
j	Note field may contain important information regarding this sample
k	Pre-development sample
l	Norm month, norm quarter or norm year inconsistent with sample date
m	Confirmation sample
n	Sample analyzed after standard holding time
o	Sample comprised of partial composite
p	Alpha spectroscopy analysis of uranium isotopes
q	Gamma spectroscopy analysis of uranium isotopes
r	Tritium data represents non-detect with activity calc'd for 100 percent error.

Lab Codes:

CX	Ceimic(replaced Maxwell Jul96)	8808 Balboa Avenue, San Diego CA 92123
FG	Fruit Growers Laboratory, Inc.	853 Corporation St. Santa Paula, Ca 93061-0272
GE	General Engineering Laboratori	PO 30712, Charleston, SC 29417
LH	LAS-formerly Lockheed<1jan97	975 Kelly Johnson Las Vegas NV 89119
QU	Quanterra Env. Serv.,St.Louis	13715 Rider Trail North, Earth City, MO 63045
TN	Eberline Services	2030 Wright Ave, Richmond, CA 94804

Validation Codes:

V	Validated
N	Not validated (default value)
U	Undeclared
H	Historical comparison only

CLP flags: (follow result)

B	Analyte found in method blank
D	Analysis performed at a secondary dilution or concentration (i.e., vapor samples)
E	The analyte was detected below the LLNL reporting limit, but above the analytical laboratory minimum detection limit.
F	Analyte found in field blank, trip blank, or equipment blank
G	Quantitated using fuel calibration, but does not match typical fuel fingerprint (fuel maybe gasoline, diesel, motor oil etc.).
H	Sample analyzed outside of holding time, sample results should be evaluated
J	Analyte was postively identified; the associated numerical value is the approximate concentration of the analyte in the sample.
L	Spike accuracy not within control limits
O	Duplicate spike or sample precision not within control limits
P	Indicates that the absence of a data qualifier flag does not mean that the data does not need qualification, but that the implementation of electronic data qualifier flags was not yet established
R	Sample results are rejected due to serious deficiencies in the ability to analyze the sample and meet QC criteria. The presence or absence of the analyte cannot be verified
S	Analytical results for this sample are suspect
T	Analyte is tentatively identified compound; result is approximate
U	Compound was analyzed for, but not detected above detection limit

Appendix B

Surface Geophysics

GEOPHYSICAL INVESTIGATION
LAWRENCE LIVERMORE NATIONAL LABORATORY, SITE 300
LIVERMORE, CALIFORNIA

NORCAL Job Number 02-408.02

A report prepared for

Lawrence Livermore National Laboratory
Environmental Restoration Division
7000
Livermore, CA

by

Donald J. Kirker

Donald J. Kirker
Geophysicist GP-997

Kenneth G. Blom
Geophysicist GP-887

NORCAL Geophysical Consultants, Inc.
1350 Industrial Avenue, Suite A
Petaluma, California
707/763-1312

December 10, 2002

TABLE OF CONTENTS

LIST OF ILLUSTRATIONS

1.0 INTRODUCTION

This report presents the findings of the geophysical investigations performed by NORCAL Geophysical Consultants, Inc. at the Pit 3 and 5 Area at Site 300, Lawrence Livermore National Laboratory (LLNL), in Livermore, California. The field survey was performed on September 10, 11, 17, 18, 23, 24, 25, 27, 30, and October 3 and 4, 2002, by NORCAL Geophysicist Donald J. Kirker. Field assistance was provided by Geophysical Technician Travis Black. The survey was under the supervision of Kenneth Blom, NORCAL Principal Geophysicist. Logistical support was provided by LLNL personnel Vic Madrid (Technical Contact) and Greg Santucci (Site Safety Officer). The geophysical investigations were conducted under the guidelines presented in LLNL's Statement of Work, Surface Geophysics Work Plan-Pits 3 and 5 Area, dated August 16, 2002, and under Prime Contract No. W-7405-ENG-48 and Subcontract No. B527312. All geophysical work performed at LLNL was governed by the LLNL Quality Assurance Program Plan (QAPP) -LLNL Ground Water Project, UCAR 10219, dated June 1989, and by the University of California's Standard Operating Procedures (SOP's), Operational Safety Procedures (OSP's), and LLNL Environment, Safety, and Health (ES&H) Manual.

1.1 SCOPE OF WORK

The LLNL scope of work included conducting electromagnetic (EM), vertical magnetic gradient (VMG), electrical resistivity (ER), and seismic refraction (SR) surveys over Pits 3 and 5, and surveying the corners of the survey area using a global positioning system (GPS). The geophysical investigations and GPS land survey were performed by NORCAL personnel. Jon Cunningham of LLNL operated the energy source (elastic wave generator) for the seismic survey. The LLNL scope of work also included data processing and interpretation, and preparation of the results in a written report, which includes copies of the raw data.

1.2 PURPOSE

Historical information, provided by LLNL, indicates that tritium- and depleted uranium-laden waste was disposed of in Pits 3 and 5 from the early 1960s to the mid 1980s. During heavy rainfall events, shallow groundwater rises and inundates the unlined landfill pits, causing tritium and depleted uranium to flow into the groundwater. LLNL is currently conducting ongoing investigations to further characterize Pits 3 and 5 for the preparation of a Remedial/Feasibility Study (RI/FS) report.

The purpose of the geophysical investigation was to obtain EM, VMG, and ER information to aid in verifying the lateral and vertical extent of the disposal areas (Pits 3 and 5) and to determine the approximate locations of buried metallic and nonmetallic debris. SR investigations were used to further characterize the shallow subsurface geology by determining the depth to unweathered bedrock. We understand that LLNL will use this information to aid in evaluating several remedial alternatives to minimize or eliminate further degradation of the ground water during rainfall events.

1.3 SITE DESCRIPTION

Pits 3 and 5 are located in the northwest corner of Site 300 at LLNL. Their approximate boundaries were defined in the field by LLNL using numerous metal survey lath. These lath were placed around the perimeter of each pit as they were being filled. Both pits are situated in a southeast to northwest trending canyon that slopes gently to the southeast. The surface elevations range from approximately 1,350 to over 1,400 feet above mean sea level. The ground cover consists primarily of low grasses and brush. The area is accessed by paved and unpaved roads.

As shown on Plate 1, the survey area covers approximately 20 acres and is centered over the disposal pits. An asphalt covered road and subsurface electric and telephone utilities trend adjacent to the northeast side of Pits 3 and 5. A reinforced concrete-lined surface drain is located along the southwest side of the pits. A portion of another pit, designated as Pit 7, is located in the northwest corner of the site.

Numerous ground water monitoring wells have been installed in the area by LLNL. The geology encountered by these wells consists of Quaternary alluvium deposits over Tertiary sedimentary rocks. The alluvium consists of inter-bedded clay, silt, sand, and gravel. The bedrock is alternating layers of sandstone, claystone, and siltstone. Several sandstone/siltstone outcrops are evident throughout the area.

1.4 STANDARD CARE AND WARRANTY

The scope of NORCAL's services for this project consisted of using geophysical methods to characterize the shallow subsurface. The accuracy of our findings is subject to specific site conditions and limitations inherent to the techniques used. We performed our services in a manner consistent with the level of skill ordinarily exercised by members of the profession currently employing similar methods. No warranty, with respect to the performance of services or products delivered under this agreement, expressed or implied, is made by NORCAL.

2.0 METHODOLOGY

For this investigation, we used the electromagnetic (EM), vertical magnetic gradient (VMG), electrical resistivity (ER), and seismic refraction (SR) methods. The EM method is used to measure shallow conductivity variations that may be due to buried foreign objects or changes in subsurface materials. This method was used to determine the approximate boundaries (lateral extent) of Pits 3 and 5. We performed the EM survey using a Geonics EM31-DL ground conductivity meter connected to an Omnidata data recorder.

VMG surveys are used to define localized magnetic variations that are caused by ferrous sources. For this survey, we used the VMG method to determine the locations of buried metallic (ferrous) debris within Pits 3 and 5. We used a Geometrics G-858 cesium vapor magnetometer to obtain the vertical magnetic gradient data, since it provides high sensitivity and rapid data acquisition.

ER surveys are used to measure the electrical resistivity of the subsurface. Variations in the electrical properties may be caused by changes in subsurface materials due to landfill debris. For this survey, we used the dipole-dipole configuration to further define the vertical and lateral extent of Pits 3 and 5. The dipole-dipole array was chosen because it provides information on both the depth and lateral extent of subsurface electrical properties. We acquired the ER data using a Sting R1 Resistivity meter with the Swift automatic multi-electrode system. Both systems are manufactured by Advanced Geosciences Incorporated.

The SR method provides information regarding the seismic velocity structure of the subsurface. We used the SR method to define subsurface velocity variations and characterize the shallow subsurface geology including the depth to little weathered bedrock. We recorded the SR data using a Geometrics 24-channel engineering seismograph and Mark Products geophones. The data were recorded on hard copy records (seismograms) as well as on computer disks for future processing. Seismic energy was produced by an elastic wave generator (EWG) that was provided by LLNL. Detailed descriptions of the EM and VMG methods are provided in Appendix A of this report; descriptions of the ER and SR methods are provided in Appendix B and C, respectively.

3.0 DATA ACQUISITION AND ANALYSIS

3.1 HORIZONTAL CONTROL

Prior to proceeding with the geophysical work, we established a survey grid to provide horizontal control. The survey grid was based on a rectangular coordinate system with the origin (0E,0N) located to the southwest. We established the grid in the field using a fiberglass measuring tape and marking paint. The marking paint was used to mark the grid nodes every 20 by 100 feet on the ground. Wooden lath were used to mark the grid nodes every 100 by 100 feet. This grid was then used to guide the EM, VMG, ER, and SR surveys.

Following the geophysical investigations, we used a Trimble Pro XRS global positioning system (GPS) to survey the corners of the horizontal control grid, as well as the location of each SR shot point. These surveyed locations were then used to convert the rectangular coordinate system to a California State Plane coordinate system, as shown on the TC and VMG contour maps, Plates 2 and 3, respectively.

3.2 EM / VMG SURVEYS

EM and VMG data were obtained along LLNL specified station intervals within the designated survey area. EM data were obtained every 5 feet along southeast-northwest trending traverses spaced 20 feet apart, resulting in a total of 3,756 EM measurement points. VMG data were obtained every 2 to 5 feet along these same traverses, resulting in a total of 6,427 VMG measurement points. The limits of the EM/VMG survey are shown on Plate 1. The specific locations of the marked grid nodes are not shown on this plate.

Preliminary data analysis was performed in the field to monitor data quality and field survey parameters. Final analysis and data presentation were completed in our office. We transferred the EM and VMG data to a personal computer and contoured the data sets to produce EM and VMG contour maps. The contour maps were then analyzed to determine potential locations that may represent buried metallic and/or nonmetallic landfill material. Detailed descriptions of the EM and VMG data acquisition and analysis are provided in Appendix A.

3.3 ELECTRICAL RESISTIVITY SURVEY

Following the EM and VMG surveys, we conducted an ER survey over Pits 3 and 5. The specific location of this survey was based on the approximate boundaries of the pits as defined by LLNL and on our interpretation of the EM and VMG survey results.

Electrical resistivity dipole data were obtained along ten profiles. Eight profiles measured 270 feet long and were oriented perpendicular to the suspected pit alignments. Two measured 550 feet long and were positioned end to end along the axis of the pits. We refer to these profiles as Lines 1 through 9, as shown on the Site Map, Plate 1.

Upon completion of the ER survey, we downloaded the apparent resistivity data to a lap-top computer. These data were used to produce 2-D models showing the variation of the electrical resistivity values with depth. Further descriptions of the ER data acquisition and analysis are provided in Appendix B.

3.4 SEISMIC REFRACTION SURVEY

We obtained seismic refraction data along Lines 1, 2, 4, 5, 7, 8, and 9 (Plate 1). Each seismic refraction profile was oriented along the respective ER profile; however, the seismic profiles were typically longer. The length of Line 1 is 1,095 feet and comprises three seismic refraction spreads. The remaining lines are 730 feet long and comprise two seismic refraction spreads each. Each spread measured approximately 365 feet long and consisted of 24 geophones and three shot points. The geophones were coupled to the ground surface at 15 foot intervals in a collinear array. Shot points were located approximately 10 feet beyond each end and in the center. We used a GPS to survey in the location of each shot point.

Seismic energy was produced by an elastic wave generator (EWG) consisting of a motorized, elastic band assisted 550-lb weight drop mounted on a trailer. The resulting seismic wave forms were recorded on hard copy records (seismograms) as well as on computer disks. We downloaded the seismic data to a personal computer and processed the data to create 2-D cross-sections showing the surface topography, and the elevation and configuration of each respective seismic velocity layer. Further descriptions of the SR data acquisition and analysis are provided in Appendix C.

4.0 RESULTS AND INTERPRETATION

4.1 ELECTROMAGNETIC / VERTICAL MAGNETIC GRADIENT SURVEYS

The results of the EM and VMG surveys at Pits 3 and 5 are presented on the EM (Terrain Conductivity) and VMG contour maps, Plates 2 and 3, respectively. The result of the EM survey, as shown on Plate 2, indicates that terrain conductivities vary significantly through the site. These variations are due to the reinforced concrete surface drain, underground utilities, and the landfill pits. The surface drain is defined by numerous closely spaced circular contours that trend along the southwest boundary. The underground utilities adjacent to the road are defined by small, single circular contours. Pits 3 and 5, as well as a small portion of Pit 7, are generally defined by a decrease in conductivity. This decrease is characterized on Plate 2 by contours that comprise a broad light blue zone exhibiting values of approximately 38 to 56 mS/m.

The results of the VMG survey (Plate 3) define numerous VMG anomalies throughout the survey area. They are manifested by closely spaced contours that are shaded red. Some of these anomalies represent effects from the reinforced concrete surface drain, metal well casings, and above ground 55-gallon drums. However, most represent unknown ferrous metal objects and debris buried within the landfill pits.

4.2 ELECTRICAL RESISTIVITY SURVEY

4.2.1 Electrical Resistivity Profiles

The results of the resistivity survey are shown on the 2-D model resistivity sections, Plates 4 through 6. These models illustrate general electrical resistivity variations along each section to depths of about 35 to 40 feet. These sections show that most of the subsurface consists primarily of low resistivity materials of less than 20 ohm-m. This material is indicated as green to blue on Plates 4 through 6 and generally covers the lower regions of each profile. We interpret this zone as representing alluvium and/or highly weathered bedrock.

Above this material is a layer of higher resistivity material (indicated as yellow to red) that generally occurs in the center of each profile. Along Line 1, this material occurs in several relatively large discrete zones that trend from 160 to 1,020 feet along the section. Along Lines 2 through 9, this layer occurs in one to three relatively large discrete zones in the center of each section. The thickness of these zones are generally consistent along each section, ranging from less than 15 feet to about 20 feet. However, there are localized areas along Line 1 and in the center of Line 9 where the thickness approaches 35 feet. The location of these zones, as shown on Plates 4 through 6, generally correspond with the locations of Pits 3 and 5, as defined by LLNL. Therefore, it is our interpretation that these zones represent landfill material associated with the pits. In addition, Lines 2, 3, 8, and 9 (Plates 5 and 6) also define smaller isolated zones at one or both ends of each line. These smaller zones appear to correspond with the surface drain and asphalt road and probably represent effects from the associated base materials.

4.2.2 Electrical Resistivity Interpretation Map

The lateral extent of the buried landfill material, as defined on Plates 4 through 6, is shown on the Electrical Resistivity Interpretation Map, Plate 7. This map shows that Pit 3 generally comprises one large zone of buried debris that measures approximately 120 by 290 feet. The thickness of this debris, as defined on Plates 4 and 6 ranges from about 15 to 35 feet. In contrast, Pit 5 is comprised of three separate trenches ranging in length from 312 feet to 640 feet. The width of these trenches varies from less than 36 to over 50 feet. The thickness of Pit 5, as defined on Plates 4 and 5 ranges from less than 15 feet to about 20 feet.

4.3 SEISMIC REFRACTION SURVEY

The results of the seismic refraction (SR) survey are represented by the seismic velocity cross-sections shown on Plates 8 through 14. Our analysis of the seismic refraction data defines the subsurface beneath each profile into three seismic velocity layers (V1, V2, and V3). The V1 layer represents the uppermost layer and exhibits velocities of 900 to 2,200 ft/s. It ranges in thickness from 1 to 18 feet. Outside of Pits 3 and 5, we interpret the V1 velocity as representing surficial soils and colluvium. Within Pits 3 and 5, V1 represents landfill material. Plates 8 through 14 show that in some areas, the thickness of V1 corresponds with the interpreted thickness of the pits, as defined by the ER survey. In other areas, however, V1 is much thinner than Pits 3 and 5.

The V2 velocity layer exhibits velocities of 2,000 to 4,200 ft/s and underlies V1. It ranges in thickness from 1 to 58 feet and is indicative of colluvium and unconsolidated sediments. In some areas it may also represent highly weathered bedrock. Nearby borings outside of the pits indicate that portions of the V2 layer consists of interbedded silt, sand, and clay. However, in areas within Pits 3 and 5 where V1 is thinnest, V2 may also represent landfill material.

The V3 velocity layer exhibits velocities of 5,000 to 6,800 ft/s and is the deepest layer encountered. It ranges in depth from 7 to 72 feet. It is shallowest outside of Pit 5 along the southwest end of Line 2 (Plate 9) where rock is evident in nearby outcrops. It is deepest at the north end of Line 1 beneath Pit 3. We interpret the V3 velocity layer as representing moderately weathered and fractured bedrock. Nearby borings indicate that the bedrock consists of claystone, sandstone, and siltstone. Since the V2 velocity layer is also indicative of highly weathered rock, the V2/V3 interface probably represents a change in the mechanical properties of rock (i.e. highly weathered to moderately weathered bedrock) rather than a change in lithology.

4.4 CORRELATION OF RESULTS

4.4.1 Correlation of Results Map

The interpreted lateral boundaries of Pits 3 and 5, as defined by the results of the EM, VMG, and ER surveys, are illustrated on Plate 15. These boundaries were interpreted based on the outer limits of the ER defined landfill cells and the lateral extent of the VMG anomalies representing buried metal debris (Plate 3). The TC Contour Map (Plate 2) shows that the pits have lower conductivities (higher resistivities) than the surrounding materials.

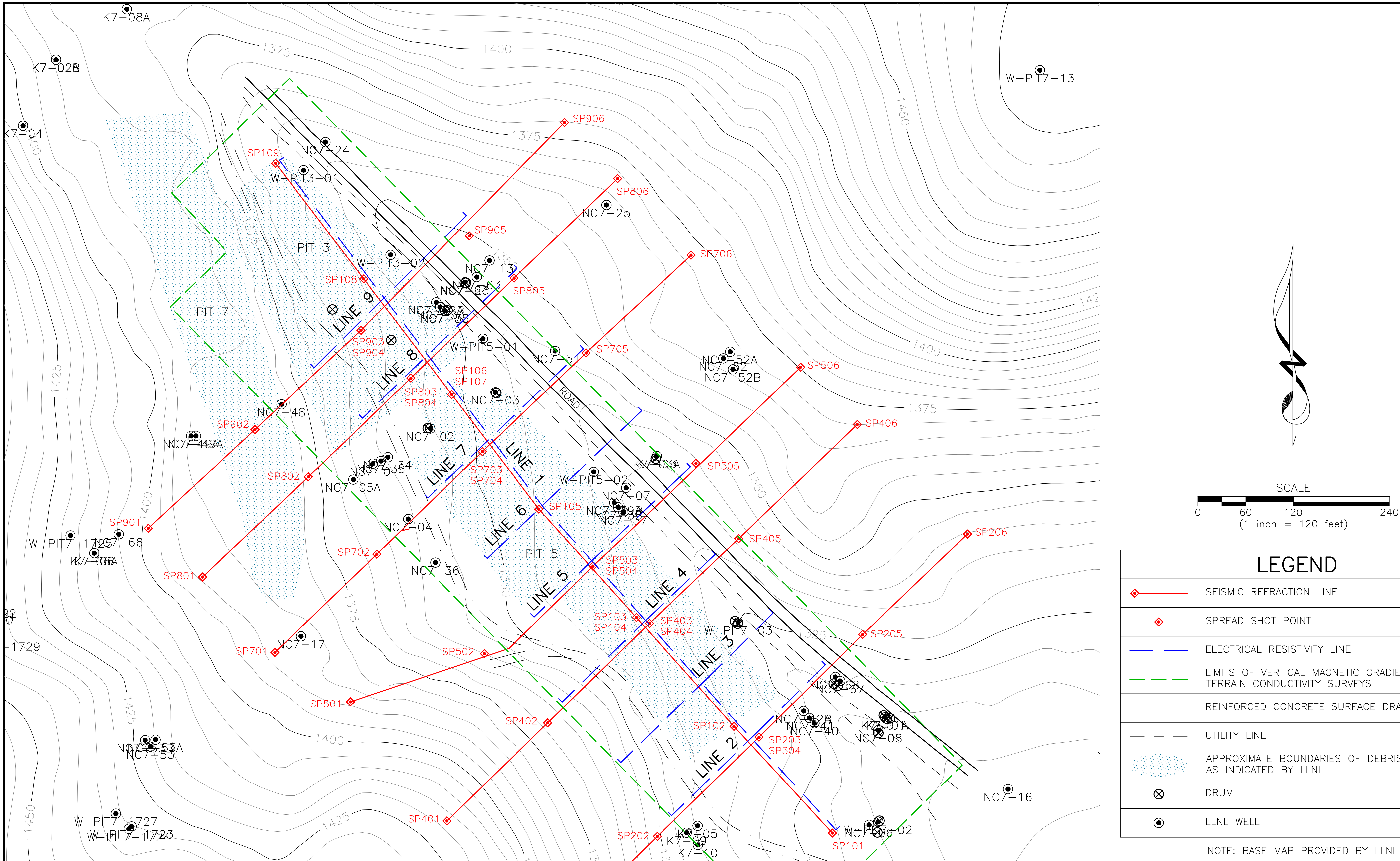
The lateral extent of Pits 3 and 5, as shown on Plate 15, measures approximately 210 by 219 feet, and 170 by 650 feet, respectively. With exception to the northern limits of Pit 3 and the southern limits of Pit 5, the size and shape of both pits generally corresponds with the LLNL defined limits shown on Plate 1. The results of the geophysical investigations indicate that the northern boundary of Pit 3 is approximately 40 feet shorter than the limits defined by LLNL. To the south, the geophysical investigations indicate that Pit 5 is approximately 60 feet longer than the LLNL defined pit.

4.4.2 Discussion

Within the interpreted limits of Pits 3 and 5, the VMG survey indicates the presence of metal subsurface debris throughout both pits. In Pit 3, buried metal debris is distributed throughout the entire pit. Whereas, in Pit 5 the VMG results indicate less buried metal, with most occurring in the separate small trench to the southwest. This suggests that Pit 5 may have higher concentrations of nonmetallic debris, such as wood debris, trash, and other fill materials.

The results of the ER survey indicated that the bottom of Pits 3 and 5 generally occurs at a depth of about 15 to 20 feet, except for an isolated area in the center of Pit 3 where the depth may be up to about 35 feet. The seismic refraction survey indicates that the depth to less weathered bedrock varies from 45 to 66 feet beneath Pit 3 and 25 to 45 feet beneath Pit 5. This suggests that Pits 3 and 5 were excavated in colluvium and possibly highly weathered bedrock, and do not extend into less weathered bedrock.

5.0 ILLUSTRATIONS



LEGEND

—◇—	SEISMIC REFRACTION LINE
◇	SPREAD SHOT POINT
— —	ELECTRICAL RESISTIVITY LINE
— — —	LIMITS OF VERTICAL MAGNETIC GRADIENT AND TERRAIN CONDUCTIVITY SURVEYS
— · —	REINFORCED CONCRETE SURFACE DRAIN
— — —	UTILITY LINE
▨	APPROXIMATE BOUNDARIES OF DEBRIS−FILLED PITS AS INDICATED BY LLNL
⊗	DRUM
⊙	LLNL WELL

NOTE: BASE MAP PROVIDED BY LLNL

NORCAL

SITE MAP
GEOPHYSICAL INVESTIGATION
LLNL PITS 3 & 5, SITE 300

LOCATION: LIVERMORE, CALIFORNIA

CLIENT: LAWRENCE LIVERMORE NATIONAL LABORATORY

NORCAL GEOPHYSICAL CONSULTANTS INC.

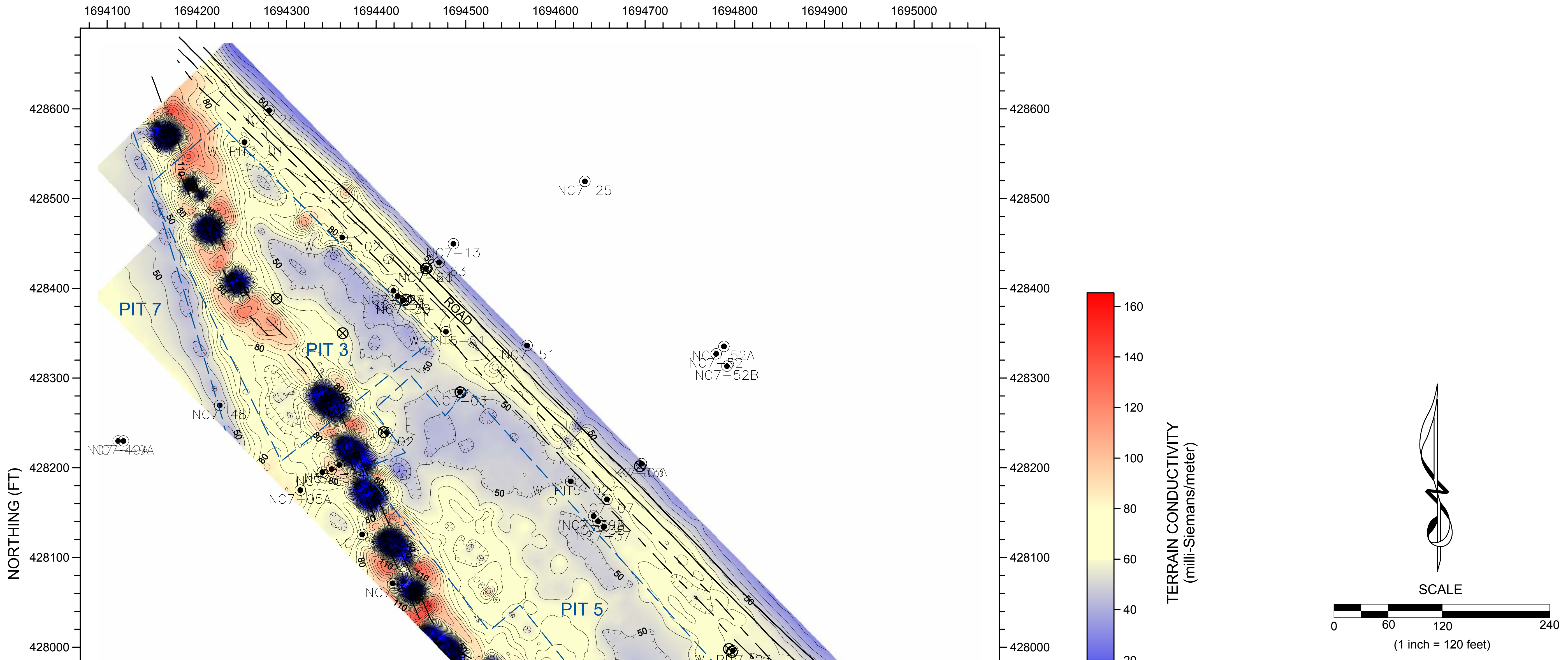
JOB #: 02−408.02

DATE: OCT. 2002

DRAWN BY: G.RANDALL

APPROVED BY: DJK

PLATE
1



LEGEND

—0—	TERRAIN CONDUCTIVITY CONTOUR (CONTOUR INTERVAL = 6 mS/m)
— · —	REINFORCED CONCRETE SURFACE DRAIN
— — —	UTILITY LINE
— — —	APPROXIMATE BOUNDARIES OF DEBRIS-FILLED PITS AS INDICATED BY LLNL
⊗	DRUM
◉	LLNL WELL

NORCAL

EM TERRAIN CONDUCTIVITY CONTOUR MAP
GEOPHYSICAL INVESTIGATION
PITS 3 & 7, SITE 300

LOCATION: LIVERMORE, CALIFORNIA

CLIENT: LAWRENCE LIVERMORE NATIONAL LABORATORY

JOB #: 02-408.02

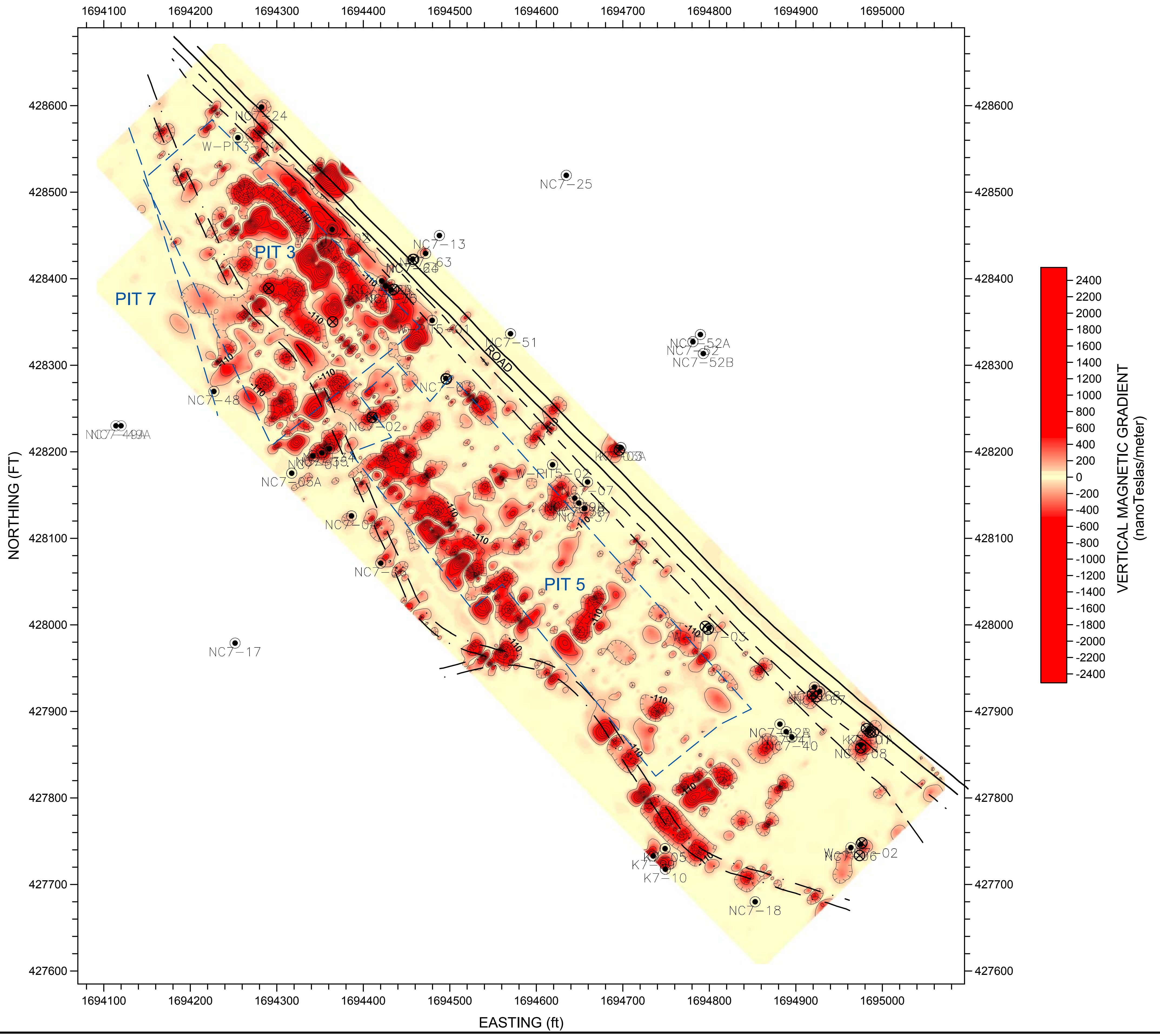
NORCAL GEOPHYSICAL CONSULTANTS INC.

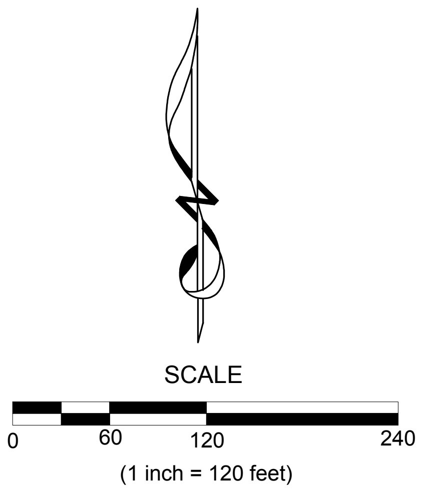
DATE: OCT. 2002

DRAWN BY: G.RANDALL

APPROVED BY: DJK

PLATE
2





LEGEND

—— 0 ——	VERTICAL MAGNETIC GRADIENT CONTOUR (CONTOUR INTERVAL = 240 nT/m)
— · —	REINFORCED CONCRETE SURFACE DRAIN
— — —	UTILITY LINE
— — —	APPROXIMATE BOUNDARIES OF DEBRIS-FILLED PITS AS INDICATED BY LLNL
⊗	DRUM
◉	LLNL WELL

NORCAL

VERTICAL MAGNETIC GRADIENT CONTOUR MAP
GEOPHYSICAL INVESTIGATION
LLNL PITS 3 & 4, SITE 300

LOCATION: LIVERMORE, CALIFORNIA

CLIENT: LAWRENCE LIVERMORE NATIONAL LABORATORY

PLATE
3

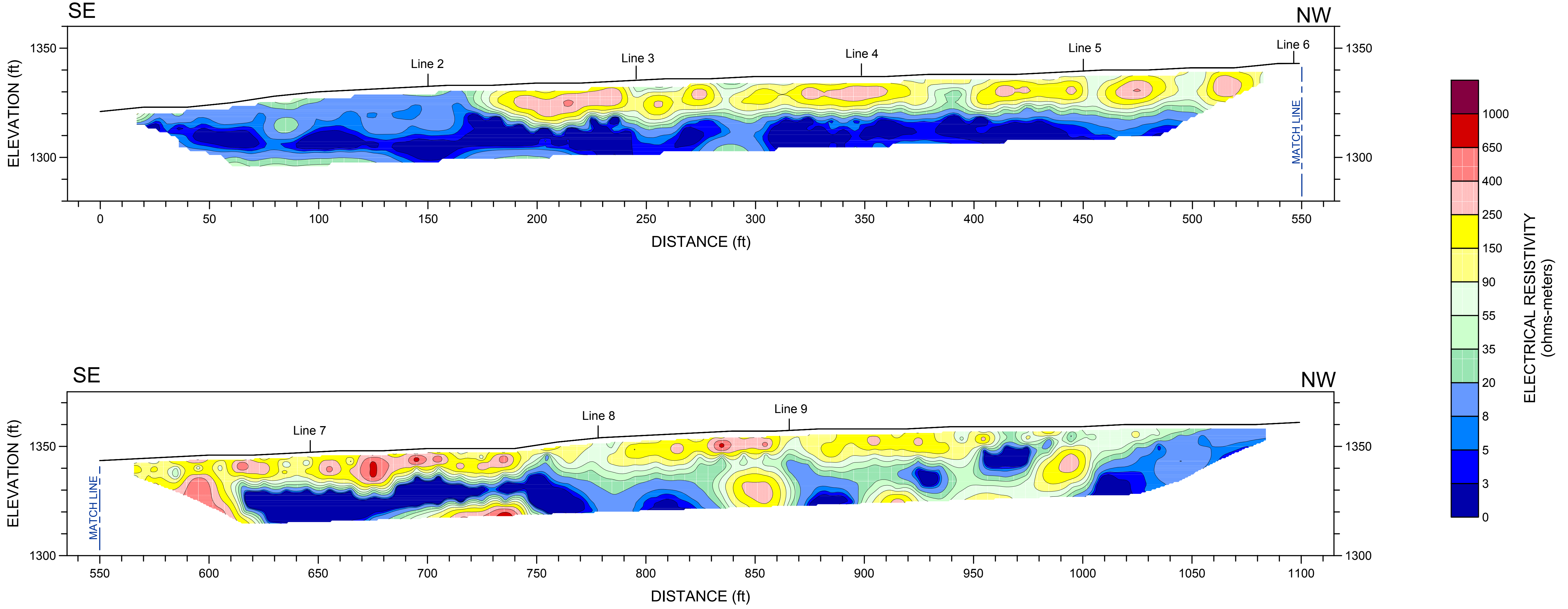
JOB #: 02-408.02

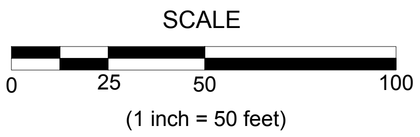
NORCAL GEOPHYSICAL CONSULTANTS INC.

DATE: OCT. 2002

DRAWN BY: G.RANDALL

APPROVED BY: DJK



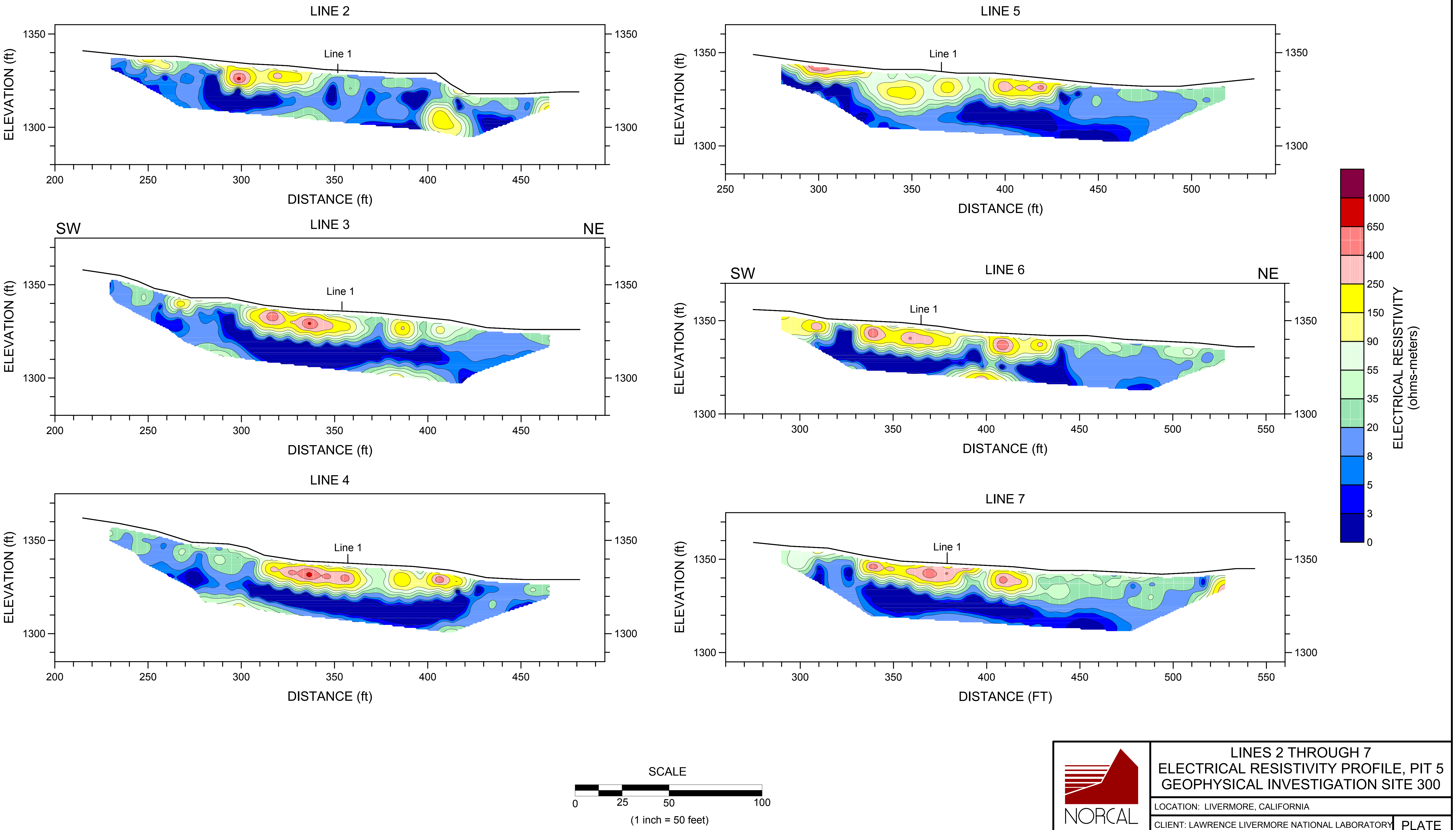


(1 inch = 50 feet)

NORCAL

LINE 1
ELECTRICAL RESISTIVITY PROFILE, PITS 3 & 5
GEOPHYSICAL INVESTIGATION SITE 300

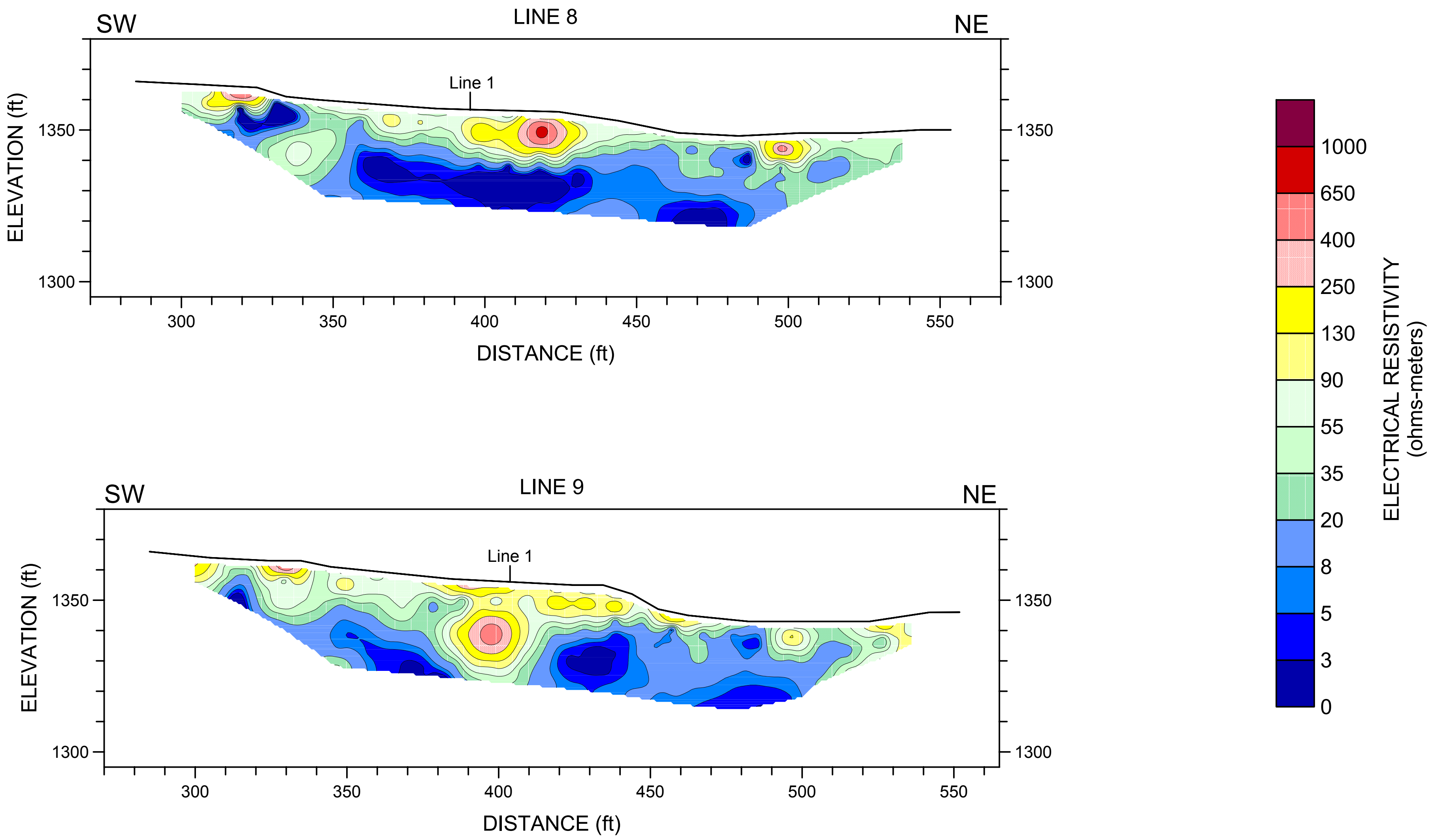
LOCATION: LIVERMORE, CALIFORNIA
CLIENT: LAWRENCE LIVERMORE NATIONAL LABORATORY
JOB #: 02-408.02
NORCAL GEOPHYSICAL CONSULTANTS INC.
DATE: OCT. 2002
DRAWN BY: G.RANDALL
APPROVED BY: DJK
PLATE
4



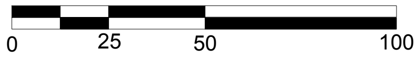
NORCAL

LINES 2 THROUGH 7
ELECTRICAL RESISTIVITY PROFILE, PIT 5
GEOPHYSICAL INVESTIGATION SITE 300

LOCATION: LIVERMORE, CALIFORNIA
CLIENT: LAWRENCE LIVERMORE NATIONAL LABORATORY
NORCAL GEOPHYSICAL CONSULTANTS INC.
JOB #: 02-408.02
DATE: OCT. 2002
DRAWN BY: G.RANDALL
APPROVED BY: DJK
PLATE
5



SCALE



(1 inch = 50 feet)

NORCAL

LINES 8 AND 9
ELECTRICAL RESISTIVITY PROFILE, PIT 3
GEOPHYSICAL INVESTIGATION SITE 300

LOCATION: LIVERMORE, CALIFORNIA

CLIENT: LAWRENCE LIVERMORE NATIONAL LABORATORY

NORCAL GEOPHYSICAL CONSULTANTS INC.

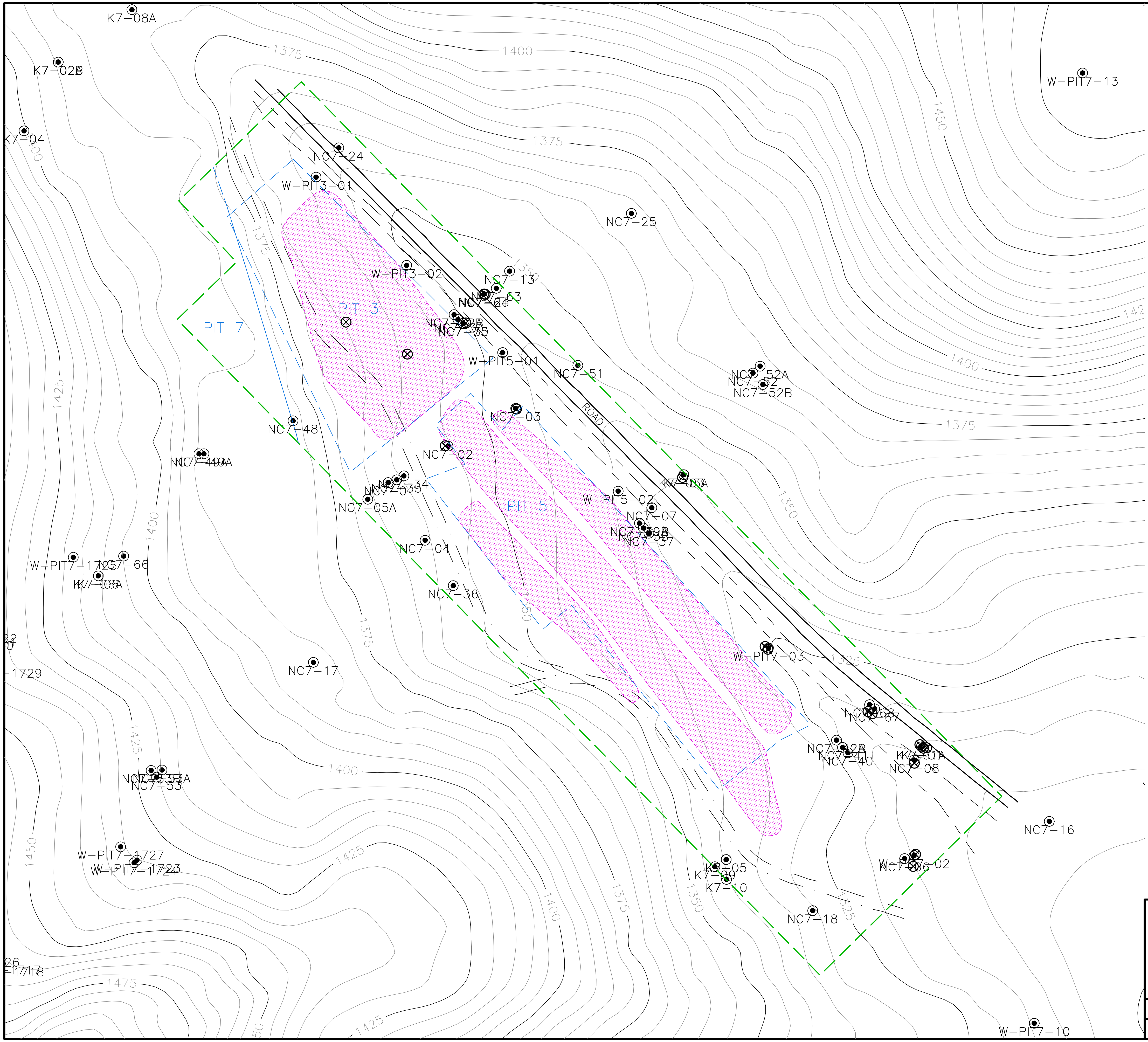
JOB #: 02-408.02

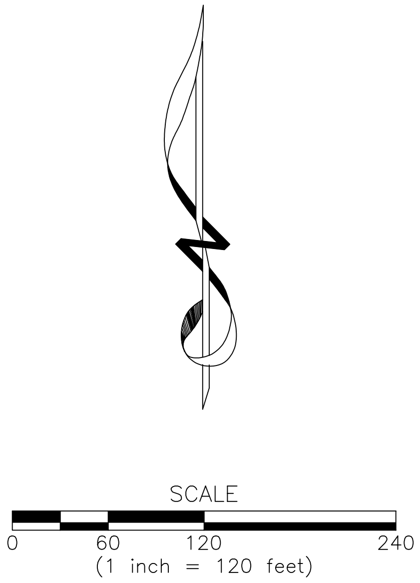
DATE: OCT. 2002

DRAWN BY: G.RANDALL

APPROVED BY: DJK

PLATE
6





LEGEND

▨	HIGH ELECTRICAL RESISTIVITY ZONES REPRESENTING POSSIBLE BURIED DEBRIS
— — —	LIMITS OF VERTICAL MAGNETIC GRADIENT AND TERRAIN CONDUCTIVITY SURVEYS
— · —	REINFORCED CONCRETE SURFACE DRAIN
— — —	UTILITY LINE
— — —	APPROXIMATE BOUNDARIES OF DEBRIS-FILLED PITS AS INDICATED BY LLNL
⊗	DRUM
⊙	LLNL WELL

NORCAL

ELECTRICAL RESISTIVITY INTERPRETATION MAP LLNL PITS 3 & 5, SITE 300

LOCATION: LIVERMORE, CALIFORNIA

CLIENT: LAWRENCE LIVERMORE NATIONAL LABORATORY

NORCAL GEOPHYSICAL CONSULTANTS INC.

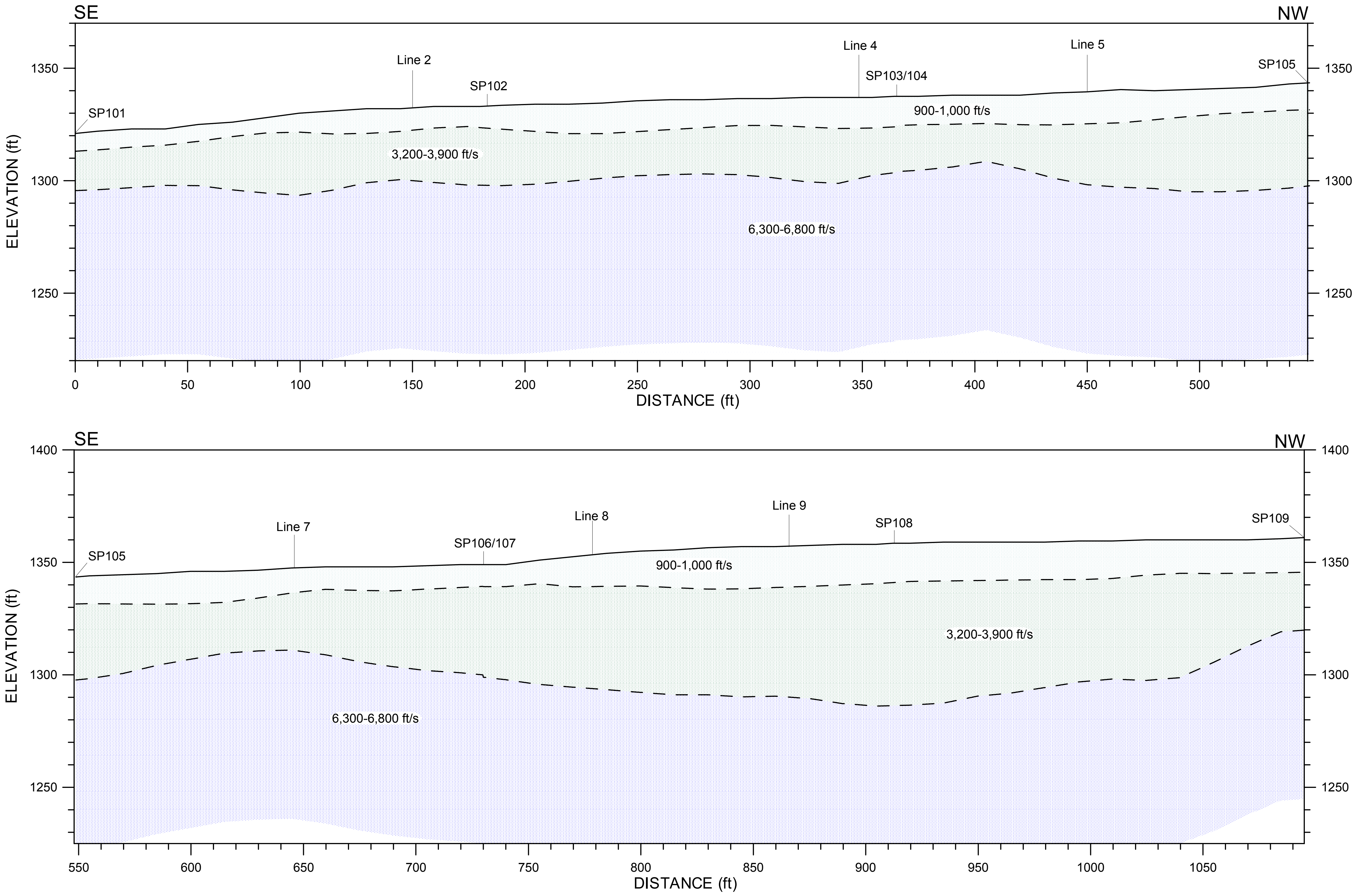
JOB #: 02-408.02

DATE: OCT. 2002

DRAWN BY: G.RANDALL

APPROVED BY: DJK

PLATE 7



LEGEND

SP105	SHOT POINT LOCATION
900-1,000 ft/s	VELOCITY OF LAYER IN FEET PER SECOND
— — —	VELOCITY INTERFACE

SCALE

0 25 50 100

(1 inch = 50 feet)

NORCAL

LINE 1, SEISMIC REFRACTION PROFILE
GEOPHYSICAL INVESTIGATION
LLNL PITS 3 & 5, SITE 300

LOCATION: LIVERMORE, CALIFORNIA

CLIENT: LAWRENCE LIVERMORE NATIONAL LABORATORY

NORCAL GEOPHYSICAL CONSULTANTS INC.

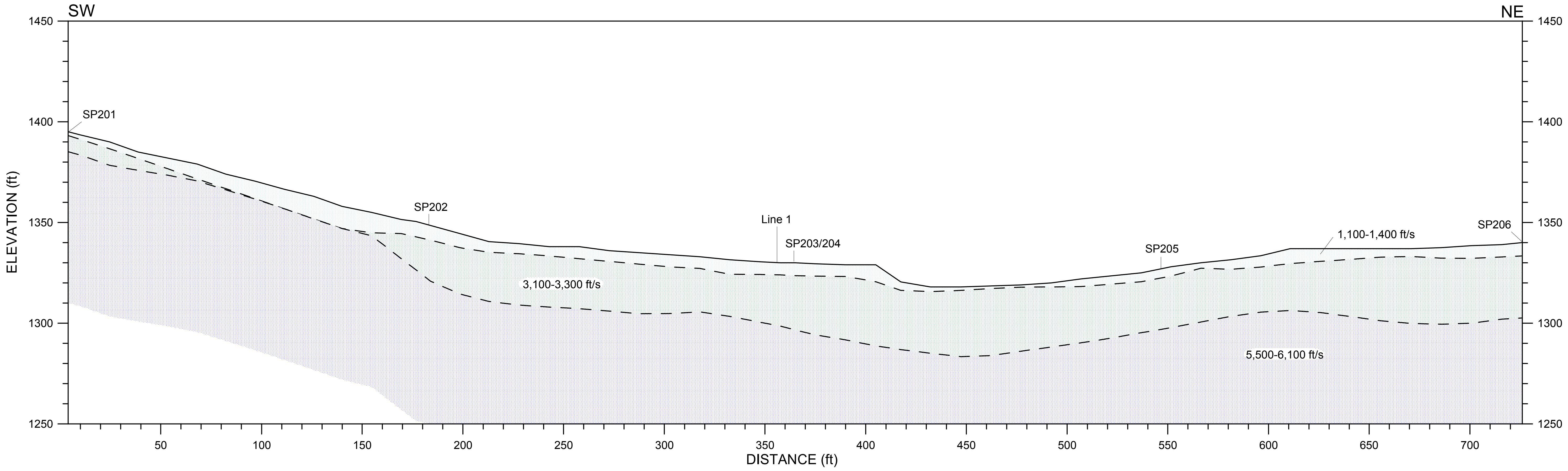
JOB #: 02-408.02

DATE: OCT. 2002

DRAWN BY: G. RANDALL

APPROVED BY: DJK

PLATE
8



LEGEND

SP105	SHOT POINT LOCATION
900-1,000 ft/s	VELOCITY OF LAYER IN FEET PER SECOND
— — —	VELOCITY INTERFACE

SCALE

0 25 50 100

(1 inch = 50 feet)

NORCAL

LINE 2, SEISMIC REFRACTION PROFILE
GEOPHYSICAL INVESTIGATION
LLNL PITS 3 & 5, SITE 300

LOCATION: LIVERMORE, CALIFORNIA

CLIENT: LAWRENCE LIVERMORE NATIONAL LABORATORY

JOB #: 02-408.02

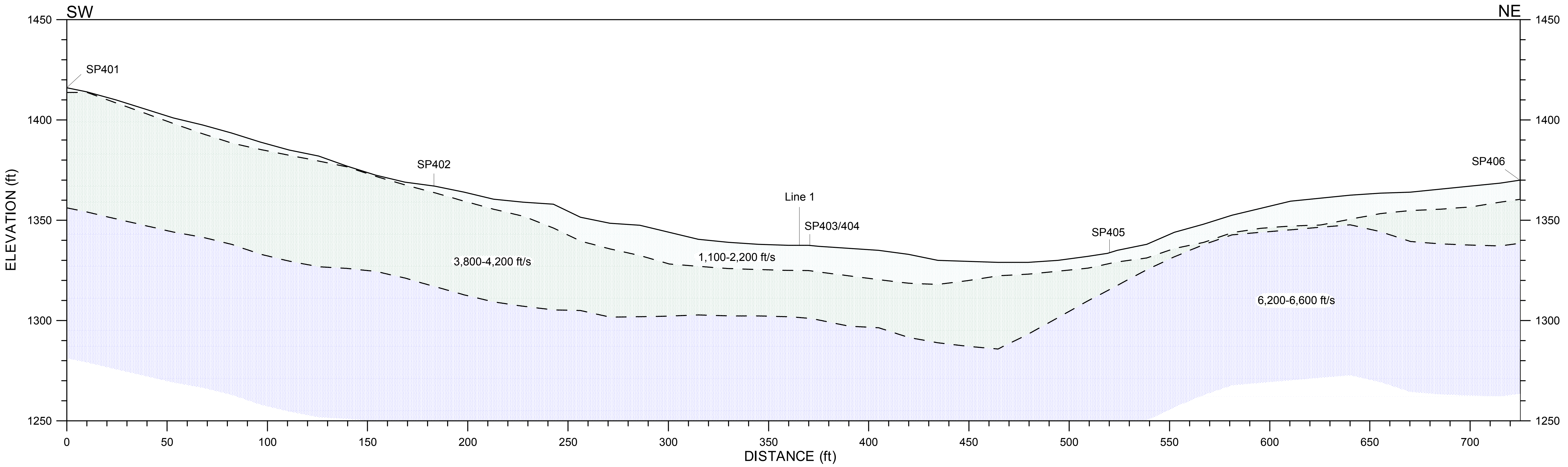
NORCAL GEOPHYSICAL CONSULTANTS INC.

DATE: OCT. 2002

DRAWN BY: G. RANDALL

APPROVED BY: DJK

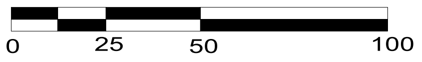
PLATE 9



LEGEND

SP105	SHOT POINT LOCATION
900-1,000 ft/s	VELOCITY OF LAYER IN FEET PER SECOND
— — —	VELOCITY INTERFACE

SCALE



(1 inch = 50 feet)

NORCAL

LINE 4, SEISMIC REFRACTION PROFILE
GEOPHYSICAL INVESTIGATION
LLNL PITS 3 & 5, SITE 300

LOCATION: LIVERMORE, CALIFORNIA

CLIENT: LAWRENCE LIVERMORE NATIONAL LABORATORY

JOB #: 02-408.02

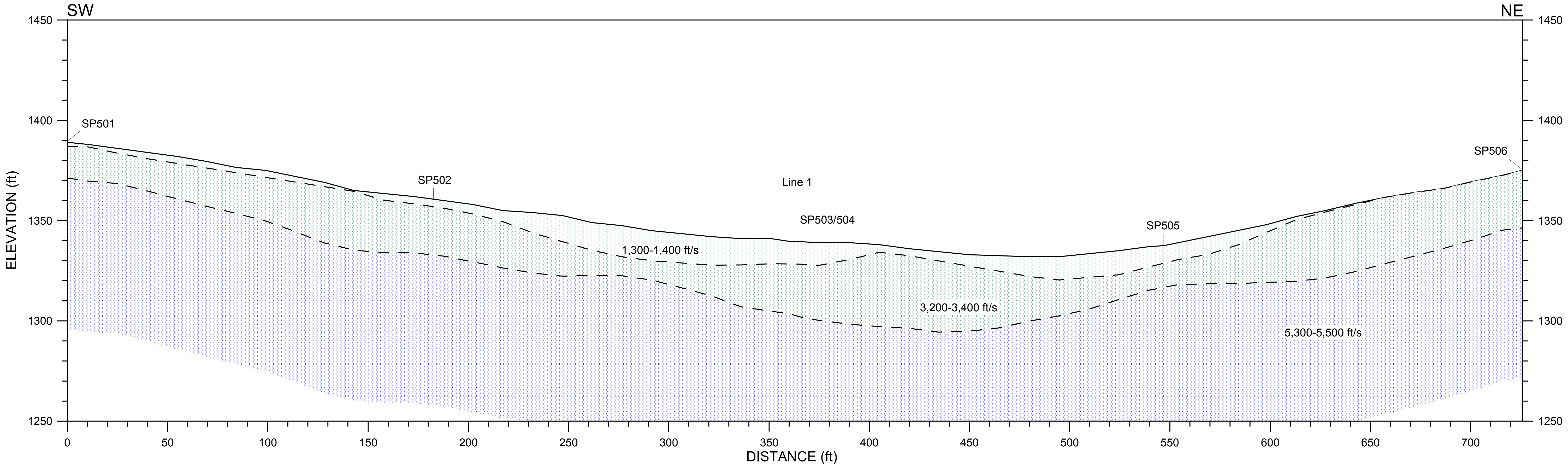
NORCAL GEOPHYSICAL CONSULTANTS INC.

DATE: OCT. 2002

DRAWN BY: G. RANDALL

APPROVED BY: DJK

PLATE 10



LEGEND

SP105	SHOT POINT LOCATION
900-1,000 ft/s	VELOCITY OF LAYER IN FEET PER SECOND
— — —	VELOCITY INTERFACE

SCALE

0 25 50 100

(1 inch = 50 feet)

NORCAL

LINE 5, SEISMIC REFRACTION PROFILE
GEOPHYSICAL INVESTIGATION
LLNL PITS 3 & 5, SITE 300

LOCATION: LIVERMORE, CALIFORNIA

CLIENT: LAWRENCE LIVERMORE NATIONAL LABORATORY

JOB #: 02-408.02

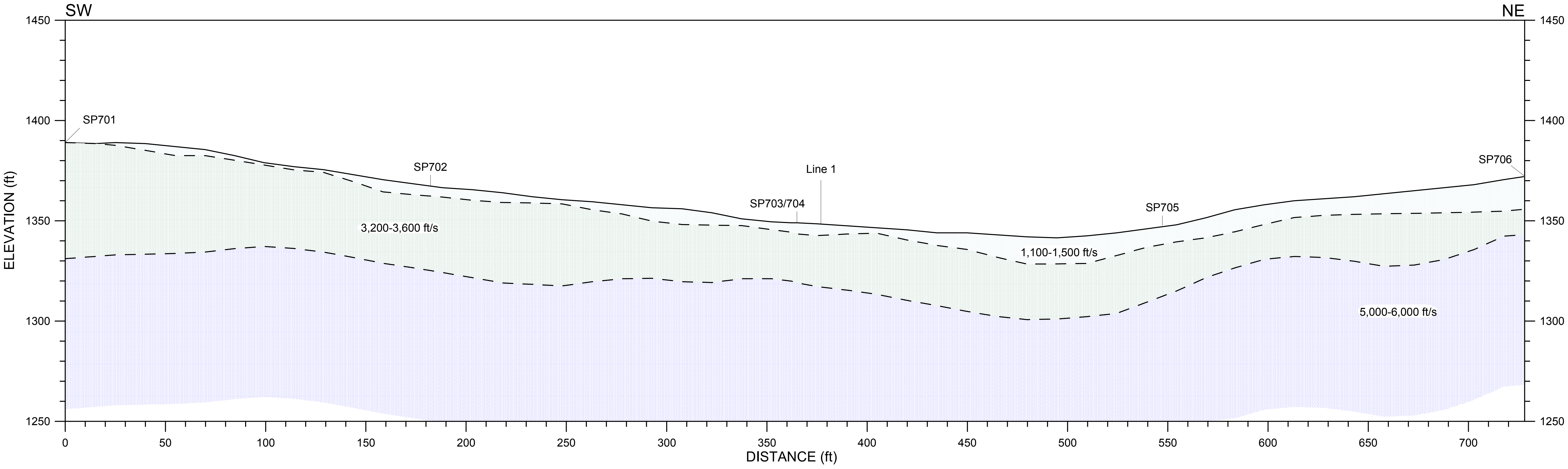
NORCAL GEOPHYSICAL CONSULTANTS INC.

DATE: OCT. 2002

DRAWN BY: G. RANDALL

APPROVED BY: DJK

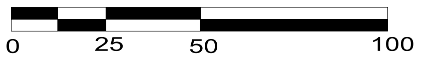
PLATE 11



LEGEND

SP105	SHOT POINT LOCATION
900-1,000 ft/s	VELOCITY OF LAYER IN FEET PER SECOND
— — —	VELOCITY INTERFACE

SCALE



(1 inch = 50 feet)

NORCAL

LINE 7, SEISMIC REFRACTION PROFILE
GEOPHYSICAL INVESTIGATION
LLNL PITS 3 & 5, SITE 300

LOCATION: LIVERMORE, CALIFORNIA

CLIENT: LAWRENCE LIVERMORE NATIONAL LABORATORY

JOB #: 02-408.02

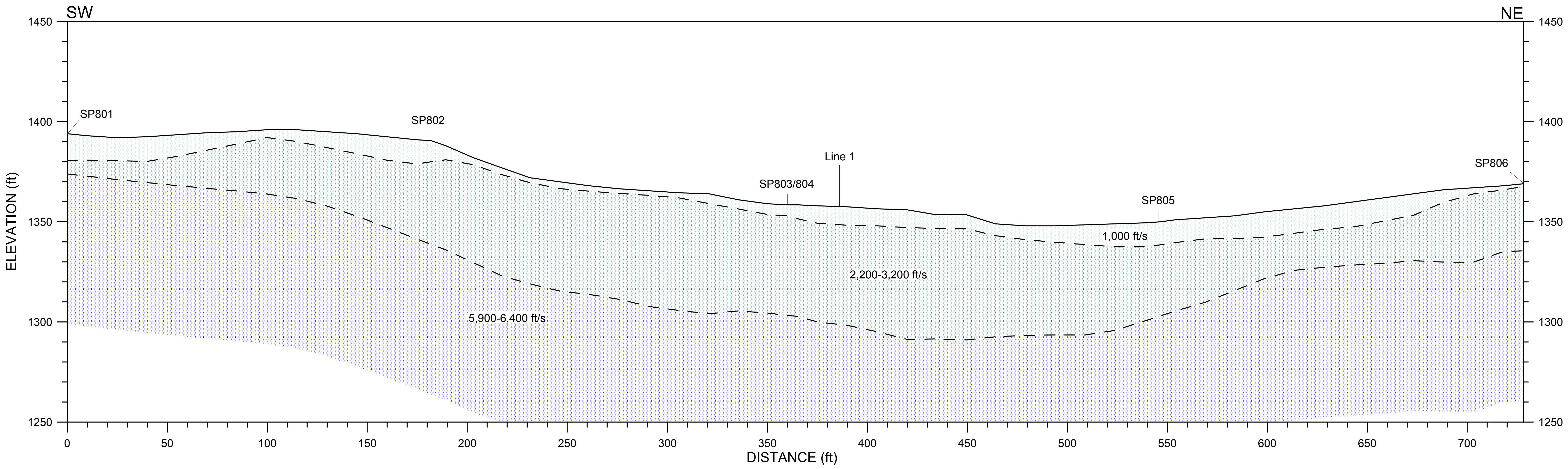
NORCAL GEOPHYSICAL CONSULTANTS INC.

DATE: OCT. 2002

DRAWN BY: G. RANDALL

APPROVED BY: DJK

PLATE 12



LEGEND

SP105	SHOT POINT LOCATION
900-1,000 ft/s	VELOCITY OF LAYER IN FEET PER SECOND
— — —	VELOCITY INTERFACE

SCALE

0 25 50 100

(1 inch = 50 feet)

NORCAL

LINE 8, SEISMIC REFRACTION PROFILE
GEOPHYSICAL INVESTIGATION
LLNL PITS 3 & 4, SITE 300

LOCATION: LIVERMORE, CALIFORNIA

CLIENT: LAWRENCE LIVERMORE NATIONAL LABORATORY

JOB #: 02-408.02

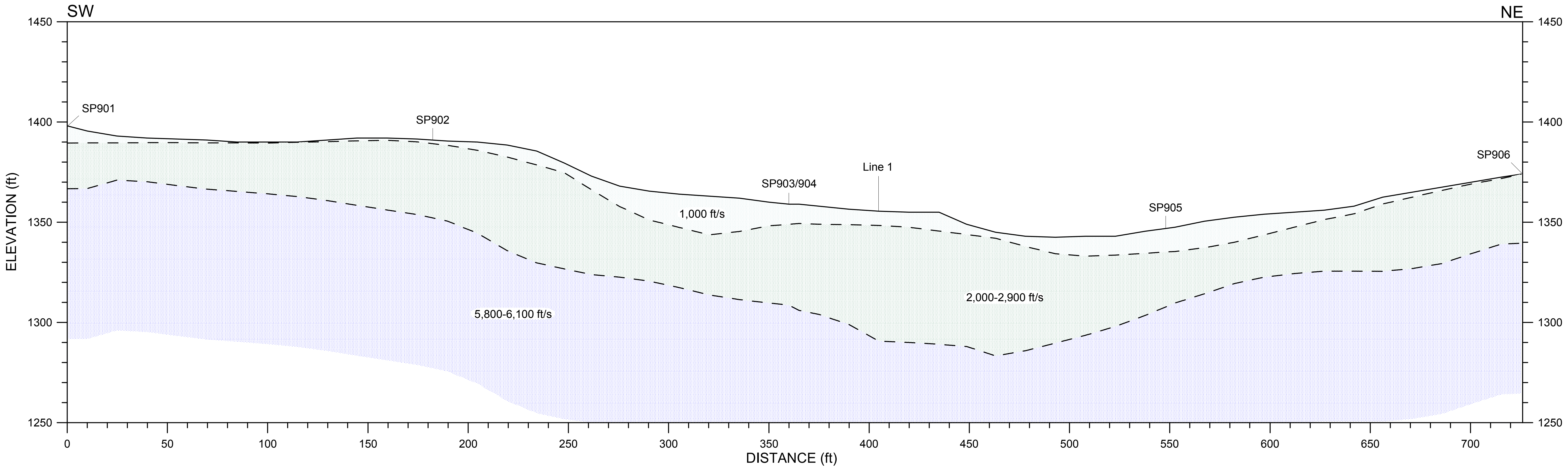
NORCAL GEOPHYSICAL CONSULTANTS INC.

DATE: OCT. 2002

DRAWN BY: G. RANDALL

APPROVED BY: DJK

PLATE
13



LEGEND

SP105	SHOT POINT LOCATION
900-1,000 ft/s	VELOCITY OF LAYER IN FEET PER SECOND
— — —	VELOCITY INTERFACE

SCALE

0 25 50 100

(1 inch = 50 feet)

NORCAL

LINE 9, SEISMIC REFRACTION PROFILE
GEOPHYSICAL INVESTIGATION
LLNL PITS 3 & 5, SITE 300

LOCATION: LIVERMORE, CALIFORNIA

CLIENT: LAWRENCE LIVERMORE NATIONAL LABORATORY

NORCAL GEOPHYSICAL CONSULTANTS INC.

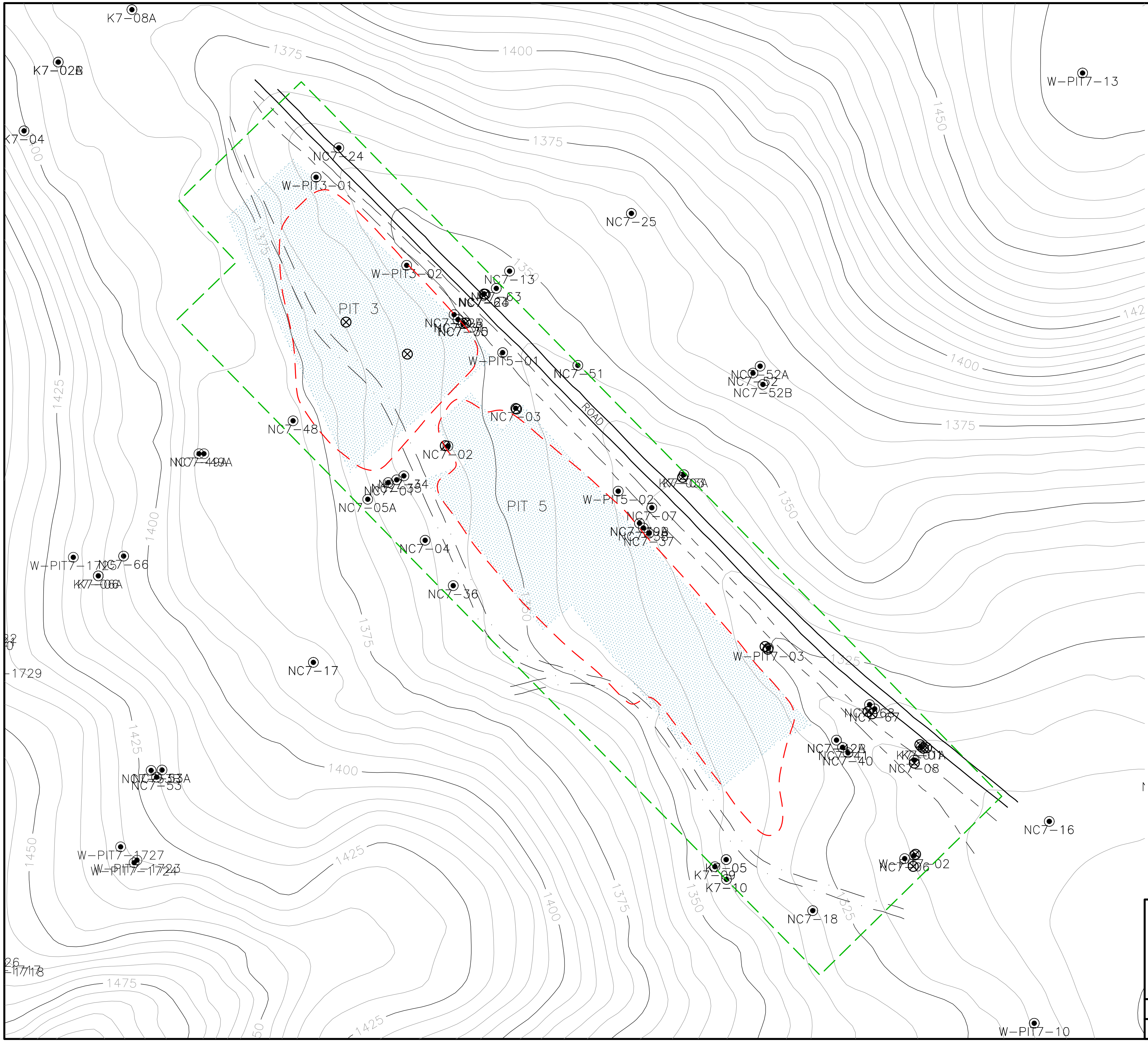
JOB #: 02-408.02

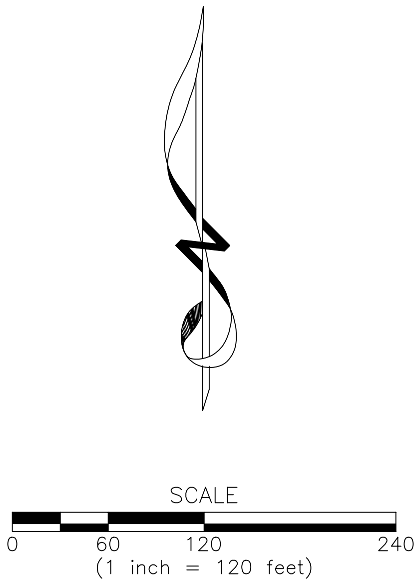
DATE: OCT. 2002

DRAWN BY: G. RANDALL

APPROVED BY: DJK

PLATE 14





LEGEND

— — —	INTERPRETED LIMITS OF DEBRIS-FILLED PITS BASED ON COORELATION OF GEOPHYSICAL SURVEY RESULTS
░	APPROXIMATE BOUNDARIES OF DEBRIS-FILLED PITS AS INDICATED BY LLNL
— — —	LIMITS OF VERTICAL MAGNETIC GRADIENT AND TERRAIN CONDUCTIVITY SURVEYS
— · —	REINFORCED CONCRETE SURFACE DRAIN
— — —	UTILITY LINE
⊗	DRUM
⊙	LLNL WELL

NORCAL

COORELATION OF RESULTS MAP
LLNL PITS 3 & 5, SITE 300

LOCATION: LIVERMORE, CALIFORNIA

CLIENT: LAWRENCE LIVERMORE NATIONAL LABORATORY

NORCAL GEOPHYSICAL CONSULTANTS INC.

JOB #: 02-408.02

DATE: OCT. 2002

DRAWN BY: G.RANDALL

APPROVED BY: DJK

PLATE
15

Appendix A

ELECTROMAGNETIC / VERTICAL MAGNETIC GRADIENT SURVEYS

Appendix A

ELECTROMAGNETIC / VERTICAL MAGNETIC GRADIENT SURVEYS

Methodology

Electromagnetic

The electromagnetic method is used to measure variations in subsurface electrical conductivity that may be due to buried foreign objects or changes in subsurface materials. The electromagnetic system utilizes two coils separated by a specified distance. One of these coils transmits a time-varying electromagnetic signal (primary magnetic field) which induces current flow in the earth. This in turn creates a secondary magnetic field which is detected by the receiver coil. The secondary signal is complex and has both quadrature and in-phase components. The amplitude of the quadrature component is proportional to the electrical conductivity of the subsurface materials. The in-phase component is proportional to conductivity, but is also affected by electrical properties associated with metal objects. The instrument displays the quadrature component in units of milliSiemens/meter (mS/m). Since this measurement represents the conductivity of the volume of material sampled, rather than individual layers, it is an apparent value and is referred to as terrain conductivity.

We performed the electromagnetic survey using a Geonics EM31-DL ground conductivity meter connected to an Omnidata data recorder. The EM31 has a fixed coil separation of 12 feet. This results in a total depth of investigation of approximately 10 to 15 feet, depending upon local site conditions. The data recorder automatically stores EM values as well as station locations and annotations regarding cultural features.

Vertical Magnetic Gradient

Vertical magnetic gradient surveys are used to determine the presence of buried ferrous objects. A magnetic gradiometer measures the vertical gradient of the earth's magnetic field. It consists of two total field magnetic sensors separated vertically by one-half meter. The magnetic field strength is measured simultaneously at both of these sensors. The difference in magnetic intensity between these measurements is proportional to the vertical gradient of the earth's magnetic field. Because the vertical gradient is constant with respect to time, the effect of diurnal variations is eliminated. Therefore, a gradiometer provides higher sensitivity and better resolution of near surface sources than total field magnetometers. Areas with significant amounts of buried metal typically produce anomalously steep magnetic gradients. Since it is sensitive to ferrous metal sources both above and below ground, site and vicinity surface conditions can affect survey results.

We used a Geometrics G-858 cesium vapor magnetometer to obtain the vertical magnetic gradient data. The instrument features a built-in memory that stores the vertical magnetic gradient and survey grid information. The information can be down loaded to a computer for further processing.

Data Acquisition

Prior to proceeding with the EM and VMG surveys, we established a survey grid to provide horizontal control. We used a Trimble Pro XRS global positioning system (GPS) to survey in the corners of this grid. We obtained EM and VMG data along specified station intervals within the designated survey area.

Data Analysis

Computer Processing

Preliminary data analysis was performed in the field to monitor data quality and field survey parameters. Final analysis and data presentation were completed in our office. We transferred the EM and VMG data to a personal computer and contoured the data sets using the software package SURFER (Version 8.0) by Golden Software. To grid the data we used the Kriging method. Kriging is a geo-statistical gridding method that interpolates irregularly spaced data into an XYZ formatted uniformly spaced grid. This method attempts to express trends in the data. This can prove to be useful when creating contour maps that will be used to interpret the location of landfill debris and fill material. These gridded data are then used to produce EM and VMG contour maps. The contour intervals for each map were selected based upon the specific intensities, as well as for clarity of presentation. These contour maps were then analyzed to determine potential locations that may represent buried landfill material.

Contour Map Interpretation

The EM and VMG contour maps show the respective variations in the electromagnetic terrain conductivity and vertical magnetic gradient values within the survey area. Each contour map is characterized by a series of contour lines that represent specific values. Areas that lack contour lines, or where the contours are spaced far apart, indicate a minimal change or variation in the respective values. This is indicative of relatively uniform conditions. Areas where contours are closely spaced indicate variations that are not uniform and probably caused by local sources.

In areas where there are significant quantities of above or below ground metal objects, the measured values are relatively large. These areas are characterized by numerous closely spaced contours. If the source of the anomaly is linear (e.g. underground utilities, railroad spurs, culvert, etc.), then the contours tend to parallel the object, and are closely spaced in close proximity to the object. If the below ground source is localized (e.g. buried drum, isolated metal debris, etc.), then the contours tend to form circular or elliptical closures that enclose the object. The larger the object and the closer it is to the geophysical instrument, the more contours there are in a given area. Variations that cannot be attributed to known above and/or below ground objects (metal well casings, reinforced concrete surface drain, above ground 55 gallon drums, utilities, etc.) are caused by unknown buried objects and are considered anomalous.

Buried landfill material is often characterized by circular to elliptical contour closures. These closures can vary from large circular closures that cover broad areas, to clusters of small closures that occur in zones. If the composition of the landfill is generally homogenous and nonmetallic, the contours tend to form large closures representing low values. If the fill material consists of both nonmetallic and metallic debris that varies significantly throughout the landfill, the contours tend to occur as numerous small closures representing both high and low values.

Limitations

There are inherent limitations associated with the EM and VMG techniques that may not allow for the detection of all subsurface features of interest. These limitations are related to the construction of the object, its size and depth of burial, and its proximity to other above or below ground features. In general, as the distance between a subsurface object and the respective geophysical instrument increases, the intensity of the associated field decreases, thereby making detection more difficult. In addition, above and below ground objects, such as buildings, debris, utilities, above ground electric lines, etc., typically produce interference that may mask effects from nearby buried features (targets).

Apart from the physical limitations of the instruments and the unwanted effects from secondary objects, the ability to detect subsurface features is also dependent upon the density of data acquisition points. If the distance between data acquisition points is significantly larger than the size of the subsurface feature, then this object may not be detectable.

Appendix B

ELECTRICAL RESISTIVITY SURVEYS

Appendix B

ELECTRICAL RESISTIVITY SURVEYS

Methodology

NORCAL measured the electrical resistivity (ρ) of the subsurface using a galvanic resistivity method. This consists of transmitting electrical current (I) into the earth through a pair of grounded metal electrodes, and measuring the resulting potential drop (V) across another pair of grounded metal electrodes. There are a variety of electrode arrangements (arrays) that can be used to measure the electrical resistivity of the subsurface. For this survey we used the dipole-dipole configuration. This array was chosen because it provides information on both the depth and lateral extent of subsurface electrical properties.

The dipole-dipole array consists of four electrodes that are placed in the ground in a collinear arrangement. One pair of adjacent electrodes is used to transmit I into the earth and is referred to as the current dipole. The second pair of electrodes is used to measure V, and is referred to as the potential dipole. Both dipoles have the same length (L).

To begin a profile, a reading is taken with the dipoles separated by their common length. Subsequent readings are taken as the potential dipole is moved along the profile while the current dipole remains stationary. The separation between dipoles must always be a multiple (n) of L. As the separation between dipoles increases, so does the depth of investigation. Once the maximum separation is reached, the current dipole is moved along the profile one dipole length and the entire procedure is repeated.

For each reading, V is divided by I and multiplied by a geometric factor (k) that takes into account the value of L and n. The resulting value represents the apparent resistivity (ρa) of the volume of earth that I flows through. The term apparent is used because the value represents the resistivity of a volume rather than an individual layer. The ρa values are then plotted in cross-section and contoured to form what is referred to as a "pseudo-section". The term "pseudo" is used because the vertical scale is not scalar but is proportional to the dipole separation. In addition, the resistivities are apparent rather than true. However, the pseudo-section can be inverted to generate a 2-D model showing the depth and true resistivity of subsurface layers.

Data Acquisition

We used the dipole-dipole array, as described above, to measure lateral and vertical variations in the electrical resistivity in the upper 40 feet of the subsurface. We obtained data using dipole lengths (L) of 10 and 20 ft with dipole separations up to n = 8. The 10 ft dipole separation was used to provide high resolution data within the relatively shallow depths of the landfill material. The larger dipole length of 20 ft was used to extend the depth of the survey. We acquired the ρa data using a Sting R1 Resistivity meter with the Swift automatic multi-electrode system. Both systems are manufactured by Advanced Geosciences Incorporated. The Sting is a self-contained unit that transmits I at outputs ranging from 1 to 500 milliAmps (mA). The unit also measures V and converts the data to values of ρa for a number of electrode arrays. The data are stored in internal memory and can be downloaded to a computer for processing. The Swift consists of an electrode interface console, four cables, and 56 stainless steel electrodes. Each cable has 14 individually addressable switches that can be connected at intervals up to 33 ft.

Our procedure was to lay out the cables, end-to-end, along the designated profile. The interface console was connected between the two cables, and the Sting was connected to the interface. At each switch, we drove a stainless steel electrode into the ground and then fastened the switch to the electrode. To begin the survey, the Sting tested the contact resistance of each electrode. If any of the values were too high, we checked the electrode plant as well as the connection between the electrode and the switch. If necessary, we poured salt water onto the ground around the electrode to improve it’s ground contact. Once all of the electrode contacts tested satisfactory, we began the survey. To start out, the Sting measured ρa values for L = 10 ft and n = 1 along the length of the array. Since each of the switches are individually addressable, the instrument was able to turn the appropriate switches on and off, as necessary, to switch from one dipole to another. The Sting then measured ρa for L = 10 and n = 2, then 3, and so on, up to n = 8. It then repeated the procedure with L = 20 ft and n values ranging from 4 to 8.

Data Analysis

Upon completion of the dipole-dipole survey, we downloaded the apparent resistivity data from the Sting to a lap-top computer using the program STINGDMP which is written by AGI. We inverted this data to true resistivity versus depth and distance using the program RESIS2DINV, also written by AGI. This program performs a one-dimensional (1-D) inversion for each (dipole) station along the profile. It then smooths and collates the 1-D models from all of the stations to determine the true resistivity versus depth along the length of the profile. We gridded and contoured these data to produce 2-D models.

Limitations

It is a common feature of all electrical methods that the models derived from vertical electric soundings are not unique. That is, depending on the subsurface geo-electric structure, there may be many models that will produce essentially the same apparent resistivity curve. This is known as the *principal of equivalence*. Computer software programs include routines for evaluating the equivalence of a given model relative to an observed sounding curve, resulting in a model that provides the closest fit to the observed data.

Appendix C

SEISMIC REFRACTION SURVEY

Appendix C

SEISMIC REFRACTION SURVEY

Methodology

The seismic refraction (SR) method provides information regarding the seismic velocity structure of the subsurface. An impulsive (mechanical or explosive) source is used to produce compressional (P) wave seismic energy. The P-waves propagate into the earth and are refracted along interfaces caused by an increase in velocity. A portion of the P-wave energy is refracted back to the surface where it is detected by sensors (geophones) that are coupled to the ground surface in a collinear array (spread). The detected signals are recorded on a multi-channel seismograph and are analyzed to determine the shot point-to-geophone travel times. These data can be used along with the corresponding shot point-to-geophone distances to determine the depth, thickness, and velocity of subsurface seismic layers.

The SR technique is based on several assumptions. Paramount among these are:

1) that seismic velocity increases with depth, and,

2) that the velocity of each seismic layer is uniform over the length of the given spread.

In cases where these assumptions do not hold, the accuracy of the technique decreases. For example, if a low velocity layer occurs between two layers of higher velocity, the low velocity layer will not be detected and the depth to the underlying high velocity layer will be erroneously large. Also, if the velocity of a seismic layer varies laterally within a spread, those variations will be interpreted as fluctuations in the elevation of the underlying seismic layer.

Data Acquisition

Data acquisition was initiated along each SR line by producing seismic energy using an elastic wave generator (EWG). The EWG consisted of a motorized, elastic band assisted 550-lb weight drop that was mounted on a trailer. We recorded the resulting seismic wave forms using a Geometrics 24-channel engineering seismograph and Mark Products geophones with a natural frequency of 10 Hz. The data were recorded on hard copy records (seismograms) as well as on computer disks for future processing. The seismograms display the amount of time it takes for a compression (P) wave to travel from a given shot point to each geophone in a spread.

Data Analysis

We downloaded the seismic data to a computer and used the program SIPIK by Rimrock Geophysics to determine the shot point to geophone travel times. We then plotted these values versus the shot point to geophone distances to form time versus distance graphs. By fitting straight lines to the data points, we determined the number of seismic velocity layers, and the travel times associated with each layer. These values, the travel times, and the location and elevation of each shot point and geophone were then entered into the computer program SIPT2 (also by Rimrock Geophysics). The elevations are in units of feet (above mean sea level) and were determined by a contour map that was provided by LLNL. The computer program uses a variation of the time-delay method to compute a preliminary model listing the depth to each seismic layer beneath each shot point and geophone. The program then uses a ray tracing routine to check the validity of this model and adjust it as necessary to fit the observed data. The final output consists of a cross-section showing the surface topography, the elevation and configuration of the seismic layers, the velocity of each layer, and the locations of the shot points.

Limitations

In general, there are limitations unique to the SR method. These limitations are primarily based on assumptions that are made by the data analysis routine. First, the data analysis routine assumes that the velocities along the length of each spread are uniform. If there are localized zones within each layer where the velocities are higher or lower than indicated, the analysis routine will interpret these zones as changes in the surface topography of the underlying layer. A zone of higher velocity material would be interpreted as a low in the surface of the underlying layer. Zones of lower velocity material would be interpreted as a high in the underlying layer.

Second, the data analysis routine assumes that the velocity of subsurface materials increase with depth. Therefore, if a layer exhibits velocities that are slower than those of the material above it, the slower layer will not be resolved. Also, a velocity layer may simply be too thin to be detected. Due to these and other limitations inherent to the SR method, the results of the SR survey should be considered only as approximations of the subsurface conditions. The actual conditions may vary locally.

Appendix C

Helium-3 Soil Gas Survey Procedures and Data Analysis

Appendix C

Helium-3 Soil Gas Survey Procedures and Data Analysis

An estimate has been made of the tritium activity remaining within Pits 3 and 5 based on limited soil, rock, and fill moisture sampling and analysis. This estimate yielded total residual activities of about 2.4 curies (Ci) of tritium in Pits 3 and about 0.5 Ci in Pit 5 (as discussed in Section 2.3.2 of this document). To determine another independent estimate of these total residual tritium activities within the landfills, a helium-3 survey was conducted within Pits 3 and 5 in the summers of 2002 and 2003. Helium-3 is a stable non-radioactive daughter product of tritium and its accumulation in materials enables estimation of the parent tritium activity. This estimate requires design and application of a model that accounts for vapor diffusion and production of helium-3 and helium-4 by other decay-series, such as uranium-238 and thorium.

C.1. Sampling and Analysis Procedures

Vapor samples were collected within Pits 3 and 5 by driving slotted drivepoints to a depth of 1.5 feet (ft) below ground surface at the locations shown on Figure C-1. To collect most samples, bottles at negative pressure were plumbed to the drivepoint with Teflon tubing and connected to a vacuum pump. However, in 2002, some samples were collected using only the pre-existing vacuum in the collection bottle. Samples collected with only the pre-existing bottle vacuum may have yielded a sample extracted from a smaller volume of landfill, but that should otherwise be equivalent to that collected with the vacuum pump. Samples were analyzed by mass spectrometry by the Lawrence Livermore National Laboratory (LLNL) Chemical Biology and Nuclear Science Division, who also provided modeling data analysis, and interpretation.

In the laboratory, a small air pump was used to transfer gases into pre-evacuated 1,200 cubic centimeters (cm^3) for helium-3, helium-4, and neon analysis. Sample bottles were connected to a gas purification manifold attached to a noble gas mass spectrometer. Gas from the 1,200 cm^3 bottle was expanded into a seven cm^3 volume. This aliquot of gas was then expanded into a 500 cm^3 volume and the pressure was measured using a capacitive manometer. The active gases were then removed by exposure to a titanium-zirconium alloy at 300 degrees Centigrade (°C) that converted all of the reactive gases into stable solids (e.g., oxygen gas to titanium oxide). The remaining noble gas was then exposed to an activated charcoal trap at -196°C to remove argon, krypton, and xenon. At this point only helium and neon remained in the gas phase. A small portion of the gas (5%) was introduced into a quadrupole mass spectrometer for the neon analysis. The remaining helium and neon were collected on another activated charcoal trap at -260°C. The trap temperature was then raised to -240°C to release the helium but retain the neon. The helium was admitted to the mass spectrometer for isotope analysis of both helium-3 and helium-4. The overall sensitivity of the instrument is very high and the mass resolution permits the complete separation of helium-3 from the $^1H^2H$ and $^1H_3$ molecules. The analysis is calibrated using a sample of air in identical 1,200 cm^3 bottles. The data for helium-3, helium-4, and neon are reported as deviations from the composition of air.

C.2. Helium-3 Data

The helium-3 data are presented in Tables C-1a and C-1b. The results are shown in map view by concentration in Figure C-1. The data are represented as deviations from the background helium-3 concentrations. Corrections were made for production of helium-3 by other radiogenic elements.

In the sample analysis, helium-3, helium-4, and neon were measured. There are three potential sources for these isotopes. Neon is derived solely from the atmosphere. Helium-4 is predominately derived from the atmosphere but there may be a small contribution from uranium and thorium alpha decay in the earth's crust over geological timescales. Helium-3 is also derived from the atmosphere and is the decay product of tritium. There are also very small contributions to helium-3 from nuclear reactions associated with uranium and thorium decay. The background abundances of these isotopes in atmospheric air are given below.

$(^{3}\mathrm{He}/^{4}\mathrm{He})_{\mathrm{air}} = 1.384 \times 10^{-6}$ (mole/mole),
$^{4}\mathrm{He}_{\mathrm{air}} = 5.22 \times 10^{-6}$ (mole/mole air),
$\mathrm{Ne}_{\mathrm{air}} = 1.82 \times 10^{-6}$ (mole/mole air),
$(^{3}\mathrm{He}/^{4}\mathrm{He})_{(\mathrm{U,Th})} = < 2 \times 10^{-7}$ (mole/mole).

where,

$(^{3}\mathrm{He}/^{4}\mathrm{He})_{\mathrm{air}}$ = the ratio of helium-3 and helium-4 in background air,
$^{4}\mathrm{He}_{\mathrm{air}}$ = the concentration of helium-4 in background air,
$\mathrm{Ne}_{\mathrm{air}}$ = the concentration of neon in background air,
$(^{3}\mathrm{He}/^{4}\mathrm{He})_{(\mathrm{U,Th})}$ = the ratio of helium-3 and helium-4 in background air as a result of uranium (U) and thorium (Th) decay.

The data in Tables C-1a and C-1b are reported as the deviation from the atmospheric value with:

$\square(^{3}\mathrm{He}/^{4}\mathrm{He}) = (^{3}\mathrm{He}/^{4}\mathrm{He})_{\mathrm{measured}}/(^{3}\mathrm{He}/^{4}\mathrm{He})_{\mathrm{air}} - 1,$
$\square(^{4}\mathrm{He}) = {}^{4}\mathrm{He}_{\mathrm{measured}}/{}^{4}\mathrm{He}_{\mathrm{air}} - 1,$
$\square(\mathrm{Ne}) = \mathrm{Ne}_{\mathrm{measured}}/\mathrm{Ne}_{\mathrm{air}} - 1.$

The uncertainties in the measurements are given in Table C-2 and vary slightly between the 2002 and 2003 data sets with small reductions for the 2003 set.

While neon comes solely from background air, its concentration in soil gas can be influenced by addition or loss of other gases. For example, oxygen can be lost from the system from oxidation reactions, and carbon dioxide can be added from oxidation of carbon and plant root respiration. With a couple of exceptions, all of the data falls within 5% of the atmospheric concentration. There were three values below 5% from samples where the sample bottle pressure was quite low (< 0.3 atmospheres) indicating a low permeability sampling point.

The following equations were used to compute the mass of helium-3 from tritium decay:

$$^{3}\mathrm{He}_{\mathrm{measured}} = {}^{3}\mathrm{He}_{\mathrm{air}} + {}^{3}\mathrm{He}_{(\mathrm{U,Th})} + {}^{3}\mathrm{He}_{\mathrm{tritium}},$$

$$^{4}\mathrm{He}_{\mathrm{measured}} = {}^{4}\mathrm{He}_{\mathrm{air}} + {}^{4}\mathrm{He}_{(\mathrm{U,Th})},$$

$$\mathrm{Ne}_{\mathrm{measured}} = \mathrm{Ne}_{\mathrm{air}}.$$

The helium-4 (^{4}He) and neon (Ne) equations were combined and solved for $^{4}\mathrm{He}_{(\mathrm{U,Th})}$:

$$^{4}\mathrm{He}_{(\mathrm{U,Th})} = {}^{4}\mathrm{He}_{\mathrm{measured}} - ({}^{4}\mathrm{He}/\mathrm{Ne})_{\mathrm{air}} \times \mathrm{Ne}_{\mathrm{air}}$$

The average value for helium-4 is slightly positive and one sample shows a very distinct contribution to helium-4 from uranium and thorium decay.

The helium-3 to helium-4 (^{3}He/^{4}He) ratio was evaluated for evidence of non-atmospheric helium contributions. The addition of helium-3 from tritium decay raises the ratio, while contributions from uranium and thorium decay lower it. However, only one sample showed a clear contribution of helium-4 from uranium and thorium decay.

Since the uranium and thorium contribution to helium-4 were small, it was assumed to be zero. Because of this uncertainty associated with helium-4 (U, Th), three values were calculated for helium-3 derived from tritium decay (given in Tables C-1a and C-1b). The first value assumes that there are no contributions from uranium and thorium decay. The second value makes the same assumption but shifts the measured helium-3/helium-4 ratio by one standard error (i.e., one sigma, given in Table C-2). The final value assumes that contributions from uranium and thorium are present and shifts all of the measured values by one standard error to maximize the calculated helium-3 from tritium decay.

If the helium-3 data are examined as a function of sampling location, the samples from Pit 3 are observed to have higher values of helium-3 from tritium decay. Figure C-2 shows the helium-3 from tritium decay for sampling locations within Pits 3 from Pit 5.

C.3. Data Interpretation

A simple model was constructed to help interpret tritium-derived helium-3 in a partially saturated soil zone. In this model, a homogenous porous medium with a uniform tritium distribution is assumed. At the soil-atmosphere boundary (z = 0, z is the vertical distance downward from land surface), a boundary condition was imposed that the concentration of tritium-derived helium-3 be zero. At a lower level (z = **L**), a boundary condition of zero helium-3 flux was imposed across the boundary. Gas diffusion is the only transport mechanism considered.

To define the tritium-derived helium-3 measured to ultimately estimate the parent tritium producing the measured helium-3, a simple one-dimensional diffusion model is used where:

C(z, t) is the concentration of tritium-derived helium-3 in units of atoms/cm^{3},

P (a constant) is the rate of helium-3 production in units of atoms/(cm^{3}*sec),

D is the effective diffusion coefficient for helium-3 diffusion in a partially saturated porous medium in units of cm^{2}/sec.

Steady-state conditions were also assumed such that $\mathbf{C}(z, t) = \mathbf{C}(z)$ and the time derivative in the diffusion equation is zero. The flux leaving the z = 0 boundary equals the total subsurface production. Under these conditions, the diffusion equation reduces to:

$d^2\mathbf{C}(z)/dz^2 = -\mathbf{P}/\mathbf{D}$ and has a general solution of $\mathbf{C}(z) = a + bz + cz^2$

With the boundary conditions of $\mathbf{C}(0) = 0$ and $d\mathbf{C}/dz = 0$ at $z = \mathbf{L}$, and solving for the coefficients:

$$\mathbf{C}(z) = \mathbf{P}z(\mathbf{L}-z/2)/\mathbf{D})$$

In applying this model to the Pits 3 and 5 data, a range of values for porosity and soil moisture were considered with the goal to determine what concentration of tritium is required to produce the observed helium-3 concentrations. L was set to 1,000 cm, the approximate depth to the water table. To estimate the effective diffusion coefficient in partially saturated granular material, the equation of Currie (1961) is used:

$$\mathbf{D} = \mathbf{g}\mathbf{D}_{\mathbf{a}}\mathbf{p}_{\mathbf{t}}^{\mathbf{m-s}}\mathbf{p}_{\mathbf{a}}^{\mathbf{s}}$$

where,

$\mathbf{g}$ is a factor between 0.8 and 1.0,

$\mathbf{D}_{\mathbf{a}}$ is the diffusion coefficient in air,

$\mathbf{p}_{\mathbf{t}}$ is the total porosity,

$\mathbf{p}_{\mathbf{a}}$ is the air-filled porosity,

$\mathbf{s}$ is an exponent (4.0 for granular materials),

$\mathbf{m}$ is an exponent that varies by soil type (1.4 for sand to 2.6 for clay).

For this calculation, **m** was set to 2.0, and **s** was set to 4.0. Estimates for soil porosity were around 25% (Taffet et al., 1996). Estimates for soil moisture suggested that the air-filled porosity was about 12% (Taffet et al., 1996). In the model presented, the soil water content had the greatest effect on the estimate of tritium activity.

Figure C-3 shows the estimated total tritium activity for Pit 3 as a function of soil water saturation. A similar calculation can be performed for Pit 5. The total estimated tritium activity is directly proportional to the observed tritium-derived helium-3 concentration (volume of Pit 3 is 26,200 cubic yards [yd^3] or 2.0E+10 cm^3). Pit 5 shows a helium-3 concentration of about half that observed in Pit 3. However, Pit 5 is slightly larger in total volume (29,900 yd^3 or 2.3E+10 cm^3). While some uncertainty exists, the total tritium activity within Pits 3 and 5 is most likely less than 2 Ci. This assumes that helium-4 from uranium-238 and thorium-232 has not significantly impacted the interpretations of the soil gases. In the most extreme case (assuming helium-4 from uranium-238 and thorium-232 decay is present) the total activity could approach 5 Ci.

In summary, the helium-3 survey data indicate that the total tritium inventory within Pits 3 and 5 is most likely less than 2 Ci. The total activity previously calculated from landfill soil and fill volumetric analyses yielded a total activity of 2.9 Ci (2.4 and 0.5 Ci in each of Pit 3 and Pit 5, respectively). These two independent estimates are in the same order of magnitude and imply that the actual tritium inventory is within this range.

C-4. References

Currie, J.A. (1961), “Gaseous diffusion in porous media, Part 3 - Wet granular materials,” *British Journal of Applied Physics*.

Taffet, M.J., L.K Green-Horner, L.C. Hall, T.M. Carlsen, and J.A. Oberdorfer (1996), *Addendum to the Site-Wide Remedial Investigation Report Lawrence Livermore National Laboratory Site 300: Building 850/Pit 7 Complex Operable Unit, Lawrence Livermore National Laboratory*, Livermore, Calif. (UCRL-AR-108131 Add 1).

Table C-1a. Helium soil gas sample data for the Pit 7 Complex collected in 2002.

Sample number	Bottle pressure (in atm)	$\delta^3He/^4He$	δ^4He	δNe	^3He from ^3H no $^4He_{(U, Th)}$	^3He from ^3H Minimum	^3He from ^3H Maximum
		(deviation from air)			(atoms/cm^3 stp)		
7-001	1.07	0.1%	-2.3%	0.3%	2.7E+05	0.0E+00	2.0E+06
7-002	0.65	0.8%	0.2%	2.4%	1.6E+06	0.0E+00	3.4E+06
7-004	1.18	0.9%	-1.6%	-3.2%	1.7E+06	0.0E+00	8.8E+06
7-005	1.17	11.6%	-1.4%	2.3%	2.3E+07	2.1E+07	2.4E+06
7-008	1.05	13.5%	1.6%	-0.7%	2.6E+07	2.4E+07	3.5E+07
7-009	1.02	1.1%	-1.8%	0.5%	2.1E+06	3.6E+05	3.9E+06
7-010	0.99	4.2%	0.5%	0.8%	8.1E+06	6.3E+06	1.2E+07
7-012	1.03	6.7%	2.5%	1.5%	1.3E+07	1.1E+07	1.9E+07
7-018	1.05	4.7%	0.4%	1.5%	9.1E+06	7.4E+06	1.1E+07
7-023	1.11	8.2%	4.6%	1.0%	1.6E+07	1.4E+07	2.7E+07
7-055	1.00	4.9%	0.7%	-1.3%	9.5E+06	7.7E+06	1.7E+07
7-063	1.15	1.6%	0.3%	-2.7%	3.1E+06	1.3E+06	1.3E+07
7-064	1.11	4.5%	2.8%	1.7%	8.7E+06	7.0E+06	1.5E+07
7-067	1.14	4.4%	3.5%	0.7%	8.6E+06	6.8E+06	1.8E+07
7-068	1.08	7.2%	4.3%	-1.1%	1.4E+07	1.2E+07	3.0E+07
7-074	1.06	3.4%	0.1%	1.3%	6.7E+06	4.9E+06	8.8E+06
7-078	1.08	1.2%	-0.2%	-2.9%	2.4E+06	6.0E+05	1.2E+07
7-079	1.07	9.5%	0.3%	-0.2%	1.9E+07	1.7E+07	2.4E+07
7-083	1.08	8.1%	3.5%	2.4%	1.6E+07	1.4E+07	2.2E+07
7-084	1.13	4.5%	2.1%	0.9%	8.8E+06	7.0E+06	1.5E+07
7-085	1.05	8.6%	1.8%	-0.7%	1.7E+07	1.5E+07	2.6E+07
7-088	1.10	2.1%	-4.6%	-0.6%	4.0E+06	2.3E+06	5.8E+06
7-089	1.06	5.4%	1.8%	2.7%	1.1E+07	8.7E+06	1.3E+07
7-094	1.15	-0.5%	-0.9%	-0.63%	0.0E+00	0.0E+00	2.1E+06
7-095	1.13	7.3%	4.0%	-1.3%	1.4E+07	1.2E+07	2.9E+07
7-099	1.16	3.7%	2.0%	-0.6%	7.2E+06	5.4E+06	1.4E+07
7-100	1.07	9.1%	2.8%	-0.7%	1.8E+07	1.6E+07	2.9E+07

Notes:

atm = Atmosphere.

cm^3 = Cubic centimeters.

^3He = Helium-3.

^4He = Helium-4.

Ne = Neon.

stp = Standard pressure and temperature.

Table C-1b. Helium soil gas sample data for the Pit 7 Complex collected in 2003.

Sample number	Bottle pressure (in atm)	δ^{3}He/^{4}He	δ^{4}He	δNe	^{3}He from ^{3}H no ^{4}He$_{(U, Th)}$	^{3}He from ^{3}H Minimum	^{3}He from ^{3}H Maximum
		(deviation from air)			(atoms/cm^3 stp)		
7-001	1.04	0.5%	1.1%	0.3%	0.0E+00	0.0 E+00	3.2 E+06
7-002	0.91	0.7%	1.8%	-0.8%	1.4E+06	6.5 E+05	9.1 E+06
7-003	0.59	1.8%	0.0%	-1.8%	3.4E+06	2.7 E+06	9.7 E+06
7-006	0.89	1.5%	-1.5%	2.1%	2.8E+06	2.1 E+06	3.5 E+06
7-009	0.83	9.2%	1.4%	-2.8%	1.8E+07	1.7 E+07	3.0 E+07
7-011	0.63	-4.0%	6.2%	-2.9%	0.0E+00	0.0 E+00	1.4 E+07
7-014	1.14	1.2%	1.5%	-0.2%	2.3E+06	1.6 E+06	8.4 E+06
7-015	0.84	1.6%	-2.4%	-2.6%	3.0E+06	2.3 E+06	6.5 E+06
7-016	0.82	0.4%	-1.1%	-0.5%	7.5E+05	5.3 E+04	2.8 E+06
7-017	1.02	3.0%	0.8%	-0.8%	5.7E+06	5.0 E+06	1.2 E+07
7-022	0.46	1.9%	0.6%	0.1%	3.7 E+06	3.0 E+06	7.5 E+06
7-023	1.06	16.3%	2.2%	-0.8%	3.2 E+07	3.1 E+07	4.1 E+07
7-024	0.19	1.3%	-7.1%	-10.2%	2.5 E+06	1.8 E+06	1.2 E+07
7-028	0.66	1.7%	0.0%	0.3%	3.3E+06	2.6 E+06	5.9 E+06
7-037	0.87	2.4%	0.7%	1.0%	4.6 E+06	3.9 E+06	7.1 E+06
7-038	0.74	0.9%	0.4%	-0.2%	1.7 E+06	1.0 E+06	5.8 E+06
7-049	0.85	1.1%	1.2%	-2.1%	2.2 E+06	1.5 E+06	1.1 E+07
7-050	0.79	0.1%	0.2%	0.9%	2.7 E+05	0.0 E+00	2.0 E+06
7-051	0.57	2.9%	0.9%	0.0%	5.6 E+06	4.9 E+06	1.0 E+07
7-052	0.62	1.5%	-3.5%	0.6%	2.9 E+06	2.2 E+06	3.6 E+06
7-053	0.78	-0.4%	1.5%	3.7%	0.0 E+00	0.0 E+00	0.0 E+00
7-055	0.77	9.6%	1.4%	-1.1%	1.9 E+07	1.8 E+07	2.7 E+07
7-058	0.95	2.1%	1.2%	-2.1%	4.1 E+06	3.4 E+06	1.3 E+07
7-059	1.01	2.4%	1.9%	1.0%	4.7 E+06	4.0 E+06	9.4 E+06
7-061	0.92	1.1%	0.2%	0.6%	2.1 E+06	1.4 E+06	4.5 E+06
7-066	0.85	7.3%	0.3%	0.9%	1.4 E+07	1.4 E+07	1.6 E+07
7-075	0.67	1.9%	0.6%	-1.3%	3.8 E+06	3.1 E+06	1.0 E+07
7-086	0.64	1.4%	0.3%	0.3%	2.7 E+06	2.0 E+06	5.8 E+06
7-087	0.60	3.4%	0.5%	0.9%	6.6 E+06	5.9 E+06	9.0 E+06
7-089	0.64	5.4%	1.3%	0.8%	1.1 E+07	9.9 E+06	1.5 E+07
7-090	0.23	-0.5%	-3.7%	-6.3%	0.0 E+00	0.0 E+00	7.1 E+06
7-091	0.75	2.1%	0.9%	1.7%	4.1 E+06	3.4 E+06	5.7 E+06
7-092	0.76	3.8%	1.3%	1.0%	7.3 E+06	6.6 E+06	1.1 E+07
7-096	0.45	-1.3%	-1.4%	-3.1%	0.0 E+00	0.0 E+00	3.6 E+06

Table C-1b. Helium soil gas sample data for the Pit 7 Complex collected in 2003. (Cont. Page 2 of 2)

Sample number	Bottle pressure (in atm)	$\delta^3He/^4He$	δ^4He	δNe	^3He from ^3H no $^4He_{(U, Th)}$	^3He from ^3H Minimum	^3He from ^3H Maximum
		(deviation from air)			(atoms/cm^3 stp)		
7-099	0.56	3.1%	0.0%	0.4%	6.0 E+06	5.3 E+06	8.4 E+06
7-100	0.46	4.4%	0.2%	-1.7%	8.6 E+06	7.9 E+06	1.5 E+07
7-105	0.77	2.5%	1.3%	0.3%	4.8 E+06	4.1 E+06	9.7 E+06
7-106	0.49	5.5%	0.1%	-2.3%	1.1 E+07	1.0 E+07	1.9 E+07
7-107	0.31	2.2%	-2.5%	-7.2%	4.4 E+06	3.7 E+06	1.7 E+07
7-108	0.70	0.4%	0.3%	0.0%	7.4 E+05	4.6 E+04	4.4 E+06
7-109	0.72	1.4%	0.3%	-1.0%	2.8 E+06	2.1 E+06	8.1 E+06
7-111	0.51	3.7%	-1.1%	-4.2%	7.3 E+06	6.6 E+06	1.7 E+07

Notes:

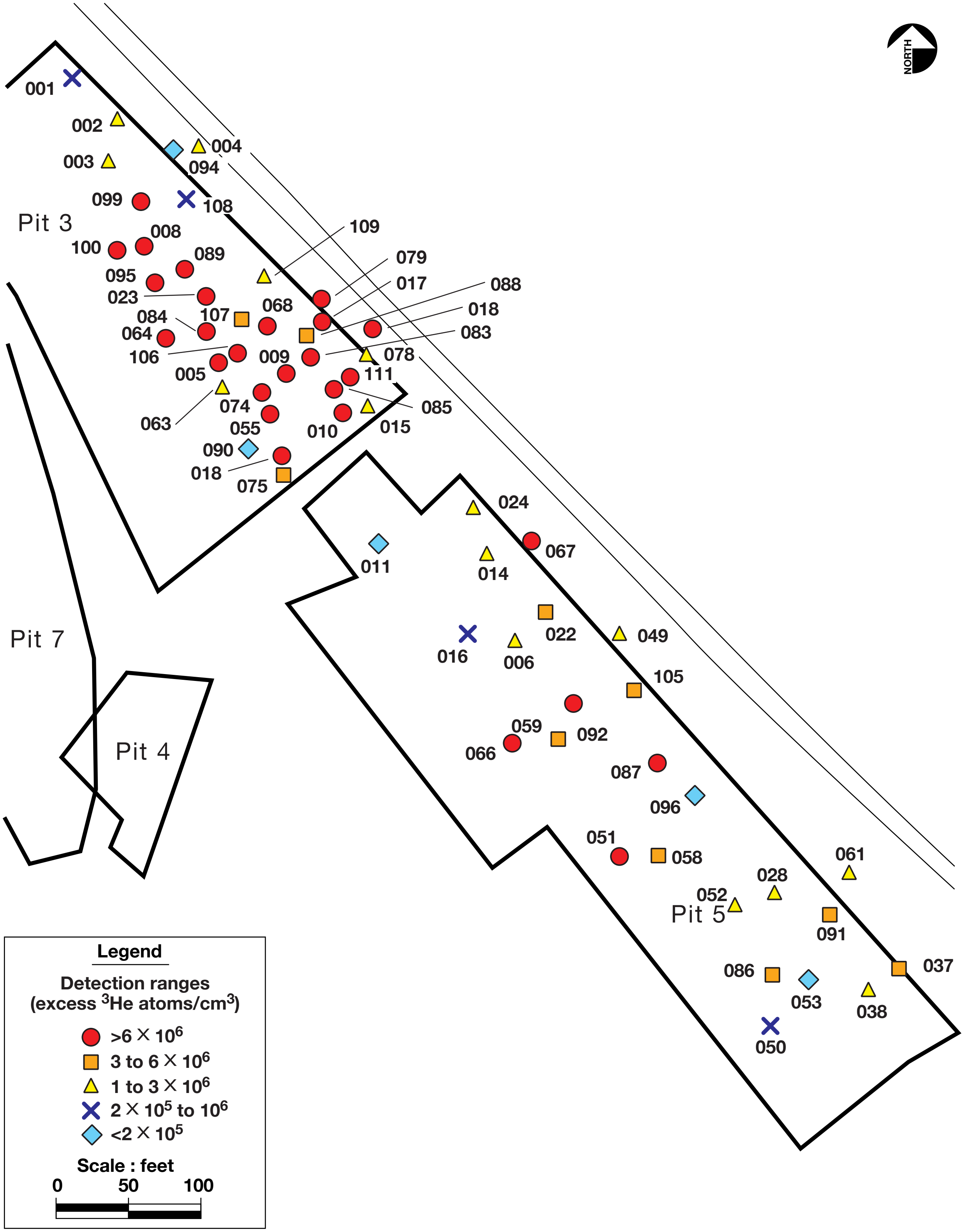
atm = Atmosphere.
cm^3 = Cubic centimeters.
^{3}He = Helium-3.
^{4}He = Helium-4.
Ne = Neon.
stp = Standard pressure and temperature.

Table C-2. Helium soil gas sample measurement uncertainties.

	Measurement uncertainty	
Gas analysis	2003	2003
$\sigma^3He/^4He$	0.9%	0.4%
σ (^{4}He)	1.1%	0.4%
σ (Ne)	1.0%	1.0%

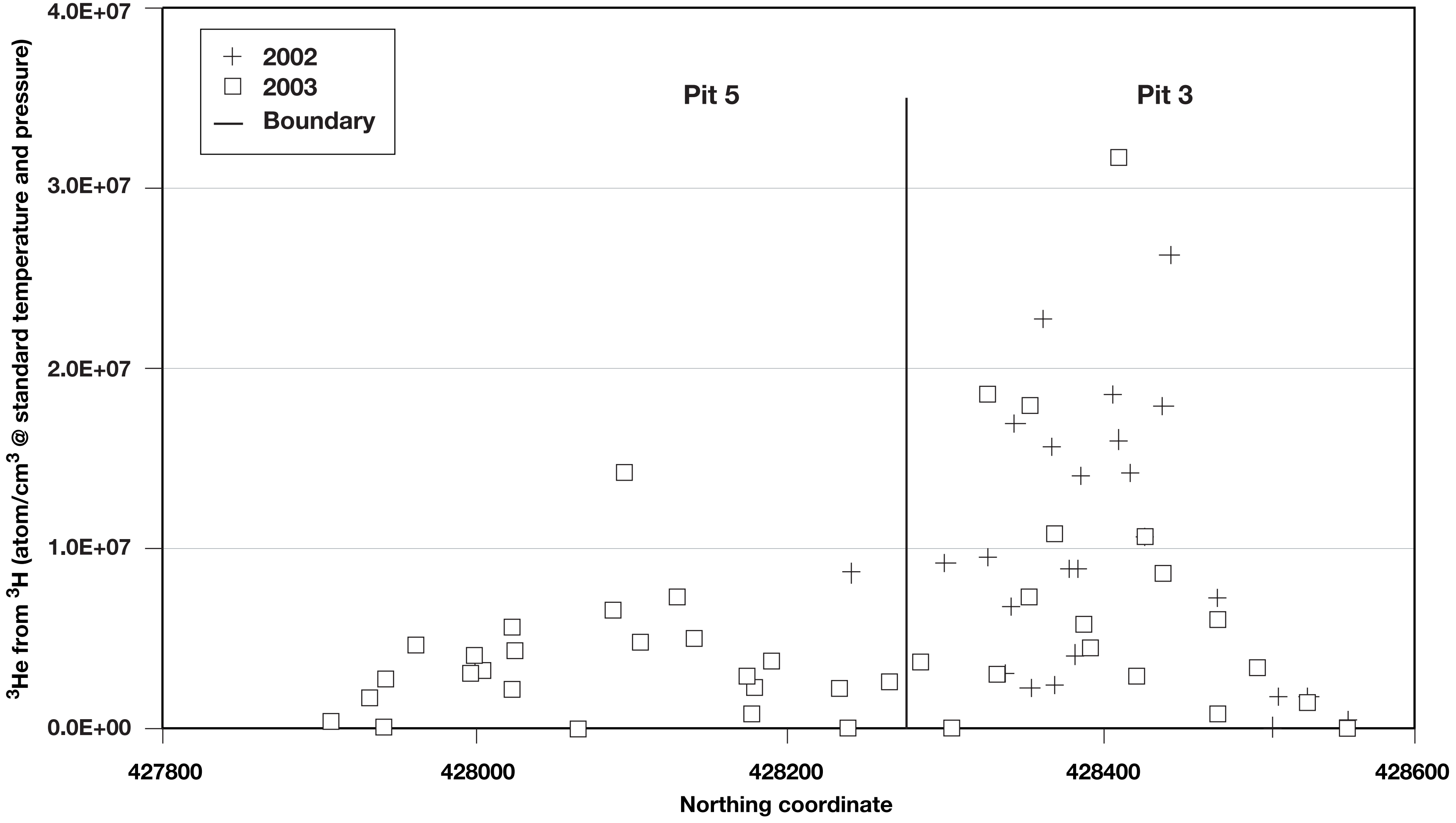
Notes:

^{3}He = Helium-3.
^{4}He = Helium-4.
Ne = Neon.



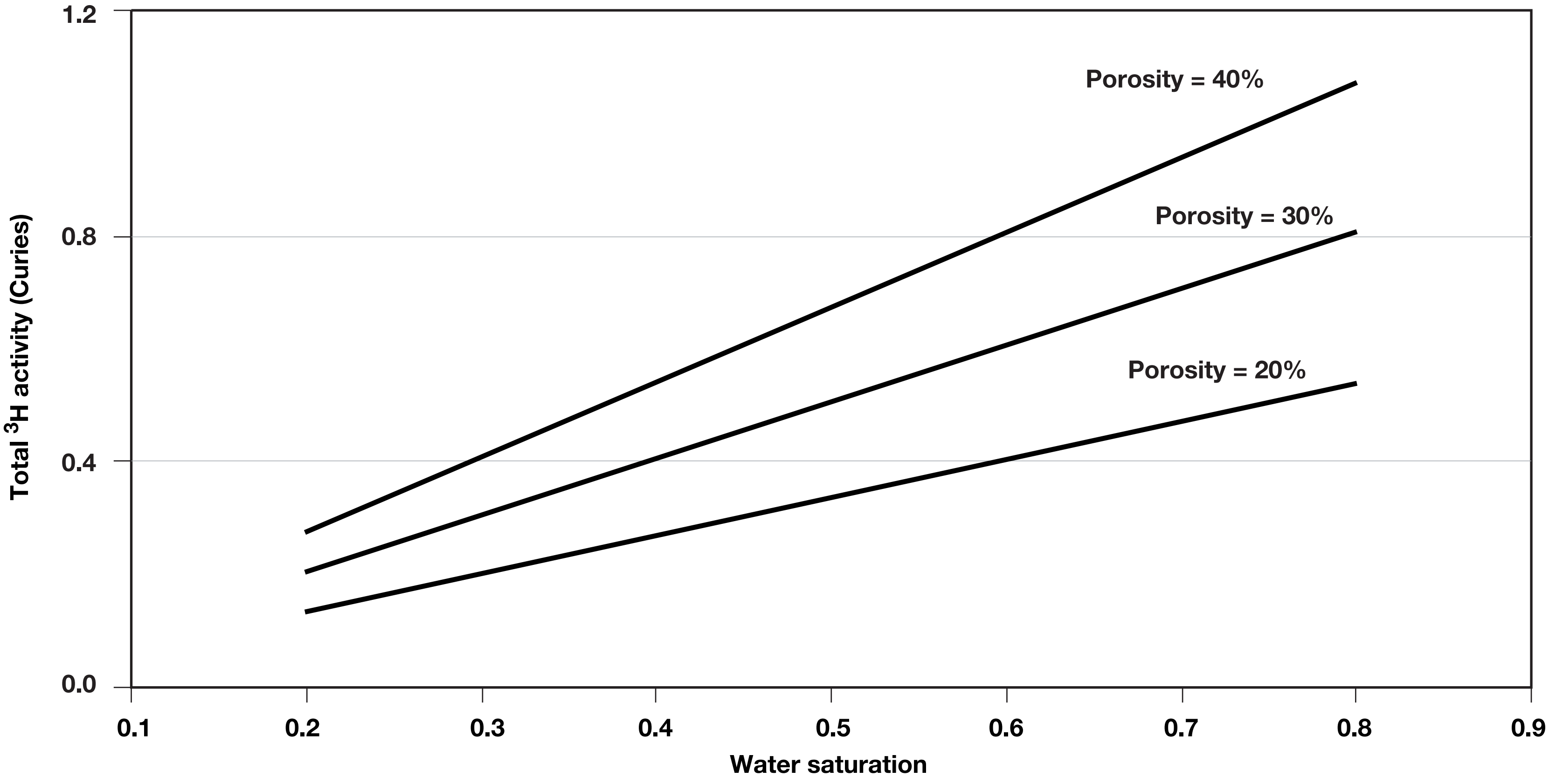
ERD-S3R-03-0226

Figure C-1. Soil vapor ^{3}He sample locations at Pits 3 and 5.



ERD-S3R-03-0233

Figure C-2. ^{3}He from ^{3}H decay shown as a function of northing coordinate (to define location within Pit 3 or Pit 5).



ERD-S3R-03-0234

Figure C-3. Estimated total ^{3}H activity within Pit 3 as a function of soil water saturation and porosity.

Appendix D

Determination of Background Activities for Radionuclide Contaminants of Potential Concern

Appendix D

Determination of Background Activities for Radionuclide Contaminants of Potential Concern

D-1. Background Activities of Tritium in Ground Water

Background activities of tritium in ground water and precipitation have been presented in previous documents: the Site-Wide Remedial Investigation Report (Webster-Scholten et al., 1994) and the Building 850/Pit 7 Complex Site-Wide Remedial Investigation Addendum (Taffet et al., 1996). The tritium activities observed as background in water and air moisture are largely the result of historic aboveground testing of nuclear weapons conducted in the 1950s and the subsequent radioactive decay. Thus, background tritium activities in water samples should generally show a decreasing trend as this pre-existing tritium decays. A small fraction of the tritium observed in water is natural and results from atmospheric irradiation of nitrogen by cosmic rays.

Estimates of the background activities for tritium in ground water were incorrectly reported in the Site-Wide Feasibility Study for Site 300 (Ferry et al., 1999). Two wells (K7-06 and NC7-47) from the Pit 7 Complex area have now been selected to develop background values for tritium in ground water. Ground water samples from these wells show no evidence of contamination from Site 300 operations. The wells are upgradient (K7-06) or far downgradient (NC7-47) of tritium contamination released at the Site 300 landfills. Tritium activities in ground water samples collected in previous years from these wells ranged from <100 to 853 picocuries per liter (pCi/L). Recent tritium activity measurements from samples collected in 2001 through 2003 contained less than 100 pCi/L. Rainfall tritium activities in samples collected from Site 300 from 2001-2003 contained less than 47.8 to less than 100 pCi/L. Therefore, 100 pCi/L was selected as the background activity for tritium in ground water at the Pit 7 Complex.

D-2. Background Activities of Uranium in Ground Water

Both natural and anthropogenic uranium are found in ground water at Site 300. Ground water uranium activities at Site 300 vary spatially from less than 1 pCi/L to over 100 pCi/L. In some areas, uranium activities vary significantly over short distances.

Depleted uranium was used during open-air explosives experiments conducted on the Building 850 and 851 firing tables. LLNL B Division, which conducts the explosives experiments at Site 300, confirms that only depleted uranium (i.e., no natural or enriched uranium) was used in these experiments (Krauter, 2004; Wood, 2004). Disposal of depleted uranium-bearing gravels from these firing tables to the unlined Pit 7 Complex landfills created a source of depleted uranium to the nearby soil and ground water. Depleted uranium has been detected in samples of shallow ground water and soil in the vicinity of these landfills.

The principal source of natural uranium in Site 300 ground water is the volcanic-rich Neroly Formation. Neroly Formation rock samples from the borehole for well W-827-05 contained natural uranium concentrations that ranged from 2.25 to 25.5 mg/kg. The highest uranium concentration (25.5 mg/kg) detected in the rock samples is associated with a discrete, one- to two foot-thick, fine-grained layer, probably a volcanic tuff. This uranium-bearing layer is also identified as a "spike" in radiation on the natural gamma ray geophysical log. Where uranium-bearing materials interact with ground water containing abundant bicarbonate and dissolved oxygen, uranium solubility may increase. Conversely, where uranium-bearing ground water flows into regions of the aquifer that are less oxygenated and/or less alkaline, the uranium may be immobilized by chemical precipitation of secondary uranium minerals. Dissolved uranium may also sorb to aquifer materials or desorb from aquifer materials, depending on chemical equilibria between the water and the mineral surface.

As discussed in Section 2.3.3.2, higher activities of natural uranium have been detected in ground water samples from wells completed in the alluvial/weathered bedrock (Qal/WBR) and $Tnbs_0$ bedrock hydrostratigraphic units (HSUs) downgradient of the Pit 7 Complex than in samples from wells in these HSUs upgradient of the pits. DOE and LLNL developed a conceptual geochemical model as part of the evaluation to determine the effects of geochemical processes on the occurrence and distribution of natural uranium in ground water in the Pit 7 Complex area. Based on the results of this evaluation, it is possible that some combination of natural and landfill-induced geochemical effects are causing the distribution of dissolved bicarbonate concentrations that are increasing the capacity of the water for dissolved uranium mobilization. Determining the relative contributions of natural and landfill effects on natural uranium would be difficult and require significant additional data collection and evaluation.

DOE/LLNL and the regulatory agencies agreed that: (1) additional evaluation of natural uranium in ground water at the Pit 7 Complex is needed to determine background levels, and (2) the determination of background levels for natural uranium will not affect the remedy selection for the Pit 7 Complex. DOE, in consultation with the regulatory agencies, will continue the evaluation of background levels for natural uranium to support the selection of cleanup standards. For these reasons, a discussion of natural uranium background levels in ground water at the Pit 7 Complex is not included in the RI/FS.

D-3. Background Activities of Thorium Isotopes in Ground Water

D-3.1. Introduction

There are four isotopes of thorium (Th) that are analyzed for in ground water: ^{228}Th, ^{230}Th, ^{232}Th, and ^{234}Th. These isotopes are part of several uranium radioactive decay sequences. Under the geochemical conditions in Pit 7 Complex ground water, thorium is much less soluble than uranium, and hence less mobile.

The complete set of ground water isotopic thorium activity data examined consists of results from ground water samples collected from April 18, 1990 through March 9, 2004. Analytical methods included alpha, gamma, and mass spectrometry. Unless stated otherwise, separate characterization was done for the same four groups of locations as were used for the uranium background evaluation. A fifth group ("DU") consisted of wells tapping on ground water with confirmed depleted uranium contamination, but not necessarily thorium contamination. At present, there are no wells that sample ground water with confirmed thorium contamination.

There are more analytical results available for ^{232}Th, than for any of the other isotopes (Table D-1), so ^{232}Th was examined first.

Analytical results, as reported by the laboratory, are of three types:

1. Detection limit only (DLO)

These are results for which the laboratory reported only an upper bound on the actual concentration or activity. DLO results are labeled "ND with DL only," in the time-series figures (Figures D-1, D-2, D-3, D-4, and D-9).

2. Estimate (Est)

These are results for which the measured concentration or activity was below the reporting limit specified in the contract for the analytical lab, or in some cases, below the laboratory's "minimum detectable concentration" (MDC). The MDC is a value below which false negatives become likely (where a false negative is defined as a failure to detect the presence of an analyte that is actually present). For methods that include a background subtraction, such as alpha spectrometry, estimates are sometimes negative. Some of these analytical results have uncertainty that is less than the estimated activity, and might therefore be considered detections. This current assessment does not consider these results detections. Est results are labeled "ND with estimate," in the time-series figures (Figures D-1, D-2, D-3, D-4, and D-9).

3. Positive detection (Hit)

The analytical laboratory reported that the analyte is present, and reported a measured concentration or activity. Hit results are labeled "Detection," in the time-series figures (Figures D-1, D-2, D-3, D-4, and D-9).

Table D-2 summarizes the frequencies of these three types of activity result.

Review of ^{232}Th plots indicated much more data variability before about 1996. In addition, the upper bounds (detection limits) of the "DLO" results were generally greater than either the estimates or the positive detections. As a result, the upper bounds provide, for all practical purposes, no useful information. For these reasons, results prior to 1996 and "DLO" results were omitted from further analysis, for all thorium isotopes. Table D-3 is a modification to Table D-2, showing the frequencies of the different types of results after omitting the pre-1996 and "DLO" results. Note that only one ^{228}Th detection remains. ^{228}Th has been detected only once in ground water since the beginning of 1996.

Another pattern typical of ^{232}Th, but not typical of ^{230}Th, is that ^{232}Th estimates ("Est") are much more variable than the true detections ("Hit"), and the hits are generally within the range of the estimates. ^{230}Th hits, in contrast, are generally at greater activities than the estimates.

Because after 1996 only one ^{228}Th detection and only six ^{234}Th results remain (none of which are detections), no further characterization is done for either of these isotopes.

The following statistical analyses assume, based on the patterns of requested analysis codes and analytical method codes stored in the LLNL database, that the "RAD" and "THISO" requested analysis codes represent alpha spectrometric methods. "E901.1" is a gamma spectrometry method. There were no gamma spectrometric results for ^{230}Th or ^{232}Th. Each isotope is characterized separately.

D-3.2. Specific Calculations Requested by U.S. EPA

U.S. EPA Region 9, in their May 18, 2004 comments on the Draft Pit 7 Complex RI/FS, specifically requested (in Comment 21) 95% UCLs for the means of thorium data for water samples collected from each of wells K7-06 and NC7-47, after removal of outliers. These results are presented here.

D-3.2.1. Upper Confidence Limits for ^{232}Th

Table D-4 shows that almost all of the water samples from wells K7-06 and NC7-47 have been analyzed for ^{232}Th by alpha spectrometry. As described in the introduction, mass spectrometric results show less variability, so that summary statistics that represent variability (such as UCLs) are not valid if analytical data generated by both methods are included. Therefore, the UCLs for the average ^{232}Th activities in ground water samples from these two wells are calculated using alpha spectrometric results only.

Almost all of the alpha spectrometric results from these two wells are estimates (Table D-5).

Figure D-1 shows the activity history of alpha spectrometric results at K7-06. U.S EPA (1992) recommends doing outlier identification based on log-transformed concentrations, because environmental concentrations often follow a lognormal distribution. A probability plot of all of the results from K7-06, in original data units (pCi/L) shows evidence of possible outliers and possible log normality (an upward curving pattern). A probability plot with three statistically-identified outliers removed still shows curvature in the plot, indicating that a normal distribution may not be appropriate. The Shapiro-Wilks test for normality rejects the hypothesis of a normal distribution ($p = 0.00039$). This indicates that the lognormal distribution should be evaluated for these data.

However, some of the ^{232}Th estimated activities are less than zero (due to the subtraction of analytical background activity in the laboratory as part of the analytical method). Reporting and use of such values is specified by U.S. DOE environmental monitoring guidance.

For the purpose of evaluating whether a lognormal distribution is appropriate, and identifying outliers in log-transformed units, negative estimated activities are replaced with positive substitute values. The substitute value is the expected positive value based on the uncertainty of the analytical result. Probability plots using the positive substitute values were generated. Curvature is still present. The Shapiro-Wilks test rejects a hypothesis of normality ($p = 2.9E-10$). With these data, there are no outliers in the log-transformed data. A probability plot of the log-transformed data appears relatively straight, and the test for normality of the log-transformed data does not reject a hypothesis of normality ($p = 0.9$). Therefore, this is an appropriate data set from which to estimate a 95% UCL for the average activity.

A similar analysis for ground water at well NC7-47 reaches the same result: a lognormal distribution using substitute values is appropriate for estimating a 95% UCL for the average concentration. Figure D-2 shows the activity history of ^{232}Th in ground water at well NC7-47. A probability plot of the non-transformed activity data from NC7-47 does not show either a simple straight line, or the curved pattern typical of a lognormal distribution. The test for normality rejects a hypothesis of normality ($p = 0.0014$). There are no statistically-identified outliers for these data.

A probability plot of the activity data from NC7-47 using positive substitute values in place of negative activities shows the curved pattern typical of a lognormal distribution. The test for normality rejects a hypothesis of normality ($p = 1.7E-06$). A log-transformed probability plot for these data gives a relatively straight pattern, and the test for normality does not reject a hypothesis of normality ($p = 0.11$). There are no statistically-identified outliers for these data.

Table D-6 shows 95% UCLs for ^{232}Th in ground water at wells K7-06 and NC7-47. The UCLs were calculated assuming a lognormal distribution, using formulas found in Gilbert, 1987. Since only alpha spectrometric results were used, these estimates are valid only for samples analyzed by alpha spectrometry. Since all but one of the measurements used in these calculations is a non-detection, much if not most of the variability upon which the calculations are based is probably analytical variability rather than environmental variability (hence the presence of negative estimated activities). Therefore, future use of these estimates is valid only for measurements using similar analytical data quality objectives. This includes, for example, aliquot size and counting time.

D.3.2.2. Upper Confidence Limits for ^{230}Th

Table D-7 shows that all of the ground water samples from wells K7-06 and NC7-47 have been analyzed for ^{230}Th by alpha spectrometry. Therefore, the UCLs for the average ^{230}Th concentrations in ground water at these two wells are calculated using alpha spectrometric results. Almost all of the results of analysis of ground water samples from these two wells are estimates (Table D-8).

Figure D-3 shows the activity history of ^{230}Th in ground water at well K7-06. The assessment of outliers, and of whether to use a normal or lognormal distribution, uses the same approach as for ^{232}Th. Probability plots were made for the data, without making substitutions for the negative estimated activities. After outlier removal, the normal distribution hypothesis is not rejected ($p = 0.17$), so the UCL can be calculated assuming a normal distribution (with outliers removed).

Figure D-4 shows the activity history of ^{230}Th in ground water at NC7-47. The probability plot (in activity units) with no substitution for negative values rejects a normal distribution ($p = 5.3E-05$). A probability plot of the data using positive substitution activities does not show a normal distribution ($p = 3E-06$). A probability plot of the log-transformed data using positive substitution values does not reject a normal distribution for the log-transformed data ($p = 0.1$). Table D-9 gives 95% UCLs for ^{230}Th in ground water at wells K7-06 and NC7-47. The UCL for ^{230}Th in ground water at well K7-06 was calculated from data in original (non-transformed) units with 3 outliers removed, using negative estimated activities. The UCL for ^{230}Th in ground water at well NC7-47 was calculated from log-transformed data, using substitute values for the negative estimated activities. There were no statistically identified outliers for ^{230}Th in ground water at well NC7-47. The cautions mentioned in the last paragraph of Section D-3.3.1 are also applicable to these UCLs.

D-3.3. Spatial Variability

D-3.3.1. Spatial Variability of ^{232}Th in Ground Water

Table D-10 shows that the vast majority of the detections of ^{232}Th in ground water have been made by mass spectrometry (728 out of 736). Furthermore, most of the mass spectrometric activity results are detections (728 detections vs. 67 estimates). This, in combination with the observation described above that alpha spectrometric results are much more variable than mass spectrometric results, suggests that activity data from the two analytical methods should not be used together in a background characterization. A background analysis that includes alpha spectrometry results overestimates the range of activities expected for mass spectrometry results.

Similarly, a background based only on mass spectrometry results would greatly underestimate the range expected of alpha results. In neither case would future estimates be likely to be correct.

Furthermore, since the alpha spectrometry results are almost all estimates, future use of any background analysis based on these results would be problematic, since most of them are not, in fact, "detections" (19 of the "Est" results have analytical uncertainty less than 100%, and should therefore, strictly speaking, be considered detections, but there are not enough of these to make use of them for background characterization).

Therefore, the ^{232}Th background characterization is limited to mass spectrometric results only. Note that this decision imposes a constraint on any future use of this background characterization: it is applicable to mass spectrometric results only.

Table D-11 shows all wells for which there are any alpha spectrometry results. As can be seen, a number of these results have no mass spectrometric data. Thus the decision to exclude alpha spectrometry results has the side-effect of entirely excluding such ground water activity results from the background characterization. However, out of the 234 results available from the wells that have only alpha spectrometry results, only four were reported by the analytical lab as being detections, and only eight might be considered detections on the basis of having less than 100% analytical (counting) uncertainty.

Most of the wells have five or fewer samples by mass spectrometry. Table D-12 shows, for example, that 53 wells out of 160 have only one sample. 119 of the wells (74%) have five or fewer samples.

Figure D-5 shows that wells that have been sampled five or more times for ^{232}Th are not limited to any discrete part of Site 300. This is also true for wells that have fewer than five samples.

Figure D-6 shows the spatial distribution of average ground water ^{232}Th activities for mass spectrometric results. In the northwestern portion of Site 300, all of the different ranges of average concentration can be found in relatively close proximity.

Table D-13 summarizes ^{232}Th average activities in ground water samples analyzed by mass spectrometry. The overall range of average activities is fairly large, varying by a factor of about 340 among wells with at least 5 samples.

Table D-14 lists average ground water ^{232}Th activities yielded by alpha spectrometry. Figure D-7 shows relative locations of the wells sampled to generate these data. The range of average activities is very small.

D-3.3.2. Spatial Variability of ^{230}Th in Ground Water

Table D-15 lists average ground water ^{230}Th activities yielded by alpha spectrometry. Figure D-8 shows relative locations of the wells sampled to generate these data. The range of activities is not large, varying by only a factor of about 2.4.

D-3.3.3. Detection History of ^{230}Th in Ground Water

Table D-16 shows that all available ^{230}Th activity results (since 1996, as described in the introduction) were generated by alpha spectrometry, and that most of these data are estimates

(438 out of 563). With two exceptions from well NC7-34, all wells have at least 29 samples. As indicated in Table D-17, more results are estimates than are true detections.

An inspection of plots of the ^{230}Th activity history of ground water at every well suggested that most of the true detections took place roughly between, 1998 and 2001. Figure D-9 illustrates this. Figure D-10 summarizes the date ranges and activity histories of ^{230}Th in ground water at all wells with at least five results.

The use of a "background" as a reference against which to compare future measurements assumes and requires that the background average activity does not change, and that the amount of variation around the average does not change.

As shown in the above figures, neither the average activities nor the variation can be assumed to have been constant. Unless and until the reasons for those variations in the activity histories are understood, it is uncertain which data from which time period should be used to define background. One possibility to consider is that of false positive results for ^{230}Th due to "taildown" interference from ^{229}Th used as a tracer in alpha spectrometry (Kubilius et al., 2004)

D-3.4. Summary of Background Assessment of Thorium Isotopes in Ground Water

Background activities of thorium isotopes in ground water at the Pit 7 Complex and Site 300 were calculated as the 95% UCLs. Since 1996, there has been only one detection of ^{228}Th in ground water, so it was not evaluated for background. ^{234}Th was never detected in Pit 7 Complex ground water. The 95% UCLs for ^{232}Th in Pit 7 Complex ground water, as calculated from ground water data from wells K7-06 and NC7-47, are 0.110 and 0.090 pCi/L, respectively. The 95% UCLs for ^{230}Th in Pit 7 Complex ground water, as calculated from ground water data from wells K7-06 and NC7-47, are 0.100 and 0.240 pCi/L, respectively. These ^{232}Th and ^{230}Th activities are comparable to activities of these isotopes observed in ground water samples from other wells in the Pit 7 Complex and adjacent areas. There is no indication of thorium contamination in ground water at the Pit 7 Complex.

D-4. Background Activities of Radium Isotopes in Ground Water

D-4.1. Introduction

Samples of ground water collected from wells in the Pit 7 Complex area were analyzed for radium-226 (^{226}Ra) and radium-228 (^{228}Ra), the two principal isotopes of radium. These two isotopes are naturally-occurring and arise from decay of thorium isotopes.

Initial data consists of isotopic radium results from Site 300 from March 12, 1984 through March 9, 2004. Analytical methods include alpha spectrometry, gas proportional counting, gamma spectrometry, scintillation counting, and a few samples for which the database does not contain enough information to identify the analytical method. Characterization was done for the same four groups of locations as were used for the uranium background characterization, plus a fifth group consisting of wells with confirmed uranium contamination, but that do not necessarily have radium contamination. There are no wells with confirmed radium contamination In ground water. The five groups of locations are the same as those used for the Th assessment presented in Section D-3. There are more analytical results available for ^{226}Ra than for ^{228}Ra (Table D-18), so ^{226}Ra was examined first.

The single result identified as total radium is not used in this characterization.

Analytical results, as reported by the laboratory, are of the same types (DLO, Est, Hit) as described for thorium Isotopes In Section D.3.1. Table D-19 summarizes the frequency of these three types of result.

Initial review revealed that the vast majority of the ^{226}Ra results were less than 1.0 pCi/L (in absolute value), as shown in Table D-20. Because the vast majority of activities are less than 1 pCi/L, values above 100 seem quite unlikely to be correct, and indeed it seems more plausible that such values are due to a reporting error. After reviewing plots of the data at all locations, a more stringent cutoff of 4 pCi/L was selected. Results greater than 4 pCi/L in absolute value were excluded from characterization.

In addition, results of type “DLO” (non-detections having no estimated concentration) were mostly from the earlier years (1993 and before) and were omitted from further analysis, for both radium isotopes. Further review of the data did not reveal any obvious difference between analytical methods.

Table D-21 shows detection frequencies grouped by analytical method for the ground water ^{226}Ra results remaining after the above screening was completed.

D-4.2. Specific Calculations Requested by EPA

U.S. EPA Region 9, in their May 18, 2004 comments on the Draft Pit 7 Complex RI/FS, specifically requested (in Comment 21) 95% upper confidence limits for the means of the radium activities for ground water samples from two wells, K7-06 and NC7-47, after removal of outliers. These are presented here.

D-4.2.1. Upper Confidence Limits for ^{226}Ra

U.S. EPA (1987) recommends doing outlier identification based on log-transformed concentrations, because environmental concentrations often follow a lognormal distribution. A probability plot of all of the ground water activity data from K7-06 shows evidence of possible outliers (the extreme points at the upper end) and possible lognormality (an upward curving pattern). A log probability plot of the same data, but with two statistically-identified outliers removed also shows curvature, indicating that a normal distribution may not be appropriate. The Shapiro-Wilks test for normality rejects the hypothesis of a normal distribution for both of these ((A) p = 1.3E–05 and (B) p = 0.011). This indicates that the lognormal distribution should be evaluated for this data.

However, some of the estimated ^{226}Ra activities are less than zero (due to the subtraction of analytical background in the laboratory as part of the analytical method). For the purpose of evaluating whether a lognormal distribution is appropriate, and identifying outliers in log-transformed units, negative estimated activities are replaced with positive substitute activities. The substitute activity is the expected positive value based on the 2 sigma uncertainty of the analytical result. Probability plots using the positive substitute values also show curvature, and the Shapiro-Wilks test rejects a hypothesis of normality (p = 1.3E–05). With these data, there are no outliers in the log-transformed data. A probability plot of the log-transformed data appears relatively straight, and the test for normality of the log-transformed data does not reject a hypothesis of normality (p = 0.12). Therefore, this is an appropriate data set from which to estimate a 95% upper confidence limit (UCL) for the average concentration. Reporting and use of such values is specified by US DOE environmental monitoring guidance.

A similar analysis for NC7-47 reaches the same result: a lognormal distribution using substitute values is appropriate for estimating a 95% UCL for the average concentration. Figure D-11 shows the ground water activity history of ^{226}Ra at local background well NC7-47. The five measurements in the late 1993 to early 1994 time period, with activities in the 0.4 to 0.5 pCi/L range appear somewhat inconsistent with the later data. However, since there were also detections in the 0.2 to 0.3 pCi/L range both then and later in 2002, these five data points were retained. A probability plot of the data from NC7-47 in activity units rejects a hypothesis of normality (p = 0.0034). There are no statistically-identified outliers for these data.

A probability plot of the ground water activity data from well NC7-47, where positive values were substituted in place of negative ones, shows the curved pattern typical of a lognormal distribution. The test for normality rejects a hypothesis of normality (p = 2.6E–06). A log-transformed probability plot for these data is relatively straight, and the test for normality does not reject a hypothesis of normality (p = 0.15). There are no statistically-identified outliers for these data.

Table D-22 shows 95% upper confidence limits for ^{226}Ra for ground water at wells K7-06 and NC7-47. The limits were calculated assuming a lognormal distribution using formulas found in Gilbert, 1987.

Many of the measurements used in these calculations are estimates (not true detections; see Table D-21), so much of the variability upon which the calculations are based is probably analytical variability rather than environmental variability (hence the presence of negative estimated concentrations). Therefore, future use of these estimates is valid only for measurements using similar analytical data quality objectives, including, for example, aliquot size and counting time.

D-4.2.2. Upper Confidence Limits for ^{228}Ra

There are insufficient data to calculate upper confidence limits for ^{228}Ra at K7-06 or NC7-47; see Figures D-12 and D-13.

D-4.3. Spatial variability

D-4.3.1. Spatial Variability of ^{226}Ra in Ground Water

Figure D-14 illustrates the spatial variability of ^{226}Ra activities in ground water samples. Table D-23 lists the average ground water ^{226}Ra activity for each well. The overall variation is moderate, varying by a factor of about 9.7 from least to greatest average.

D-4.3.2. Spatial Variability of ^{228}Ra in Ground Water

Figure D-15 illustrates the spatial variability of ^{228}Ra activities in ground water samples. Table D-24 lists the average ^{228}Ra activity in ground water for each well. In the northwest, wells within each of the ^{228}Ra activity ranges can be found in relatively close proximity. The overall variation is moderate, varying by a factor of about 21 from least to greatest average activity (positive averages only).

D-4.4. Summary of Background Assessment of Radium Isotopes in Ground Water

Background activities of radium isotopes in ground water at the Pit 7 Complex and Site 300 were calculated as the 95% UCLs. The 95% UCLs for ^{226}Ra in Pit 7 Complex ground water, as calculated from ground water data from wells K7-06 and NC7-47, are 0.480 and 0.015 pCi/L, respectively. There were insufficient data to calculate the 95% UCL for ^{228}Ra in Pit 7 Complex ground water. The ^{226}Ra in ground water from the two wells are comparable to activities of these isotopes observed in ground water samples from other wells in the Pit 7 Complex and adjacent areas. The limited number of detections of ^{228}Ra indicates that this isotope may have a very low background activity (below the method detection limits). There is no indication of radium contamination in ground water at the Pit 7 Complex.

D-5. References

Ferry, L, .R. Ferry, W. Isherwood, R. Woodward, T. Carlsen. Z. Demir, R. Qadir, and M. Dresen (1999), *Final Site-Wide Feasibility Study for Lawrence Livermore National Laboratory Site 300*, Lawrence Livermore National Laboratory, Livermore, Calif. (UCRL-AR-132609).

Gilbert, Richard O. (1987), *Statistical Methods for Environmental Pollution Monitoring* (Van Nostrand Reinhold, New York).

Gibbons, Robert D. (1994), *Statistical Methods for Groundwater Monitoring* (Wiley, New York).

Krauter, G.W. (2004), Lawrence Livermore National Laboratory, B Division, Memorandum to Michael Taffet, LLNL, Environmental Restoration Division, Livermore, Calif., June 15, 2004, “Use of Natural Uranium in Explosives Experiments at Site 300 Firing Bunkers.”

Kubilius, W., T. Coey, P. Mark, A. Volesky (2004), “Radiological False Positives in Environmental Soil and Groundwater Data from Commercial Laboratories,” in *Proceedings of the WM’04 Conference*, Tucson, AZ. WSRC-MS-2003-00565 (http://sti.srs.gov/fulltext/ms2003565/ms2003565.pdf), February 29–March 4, 2004.

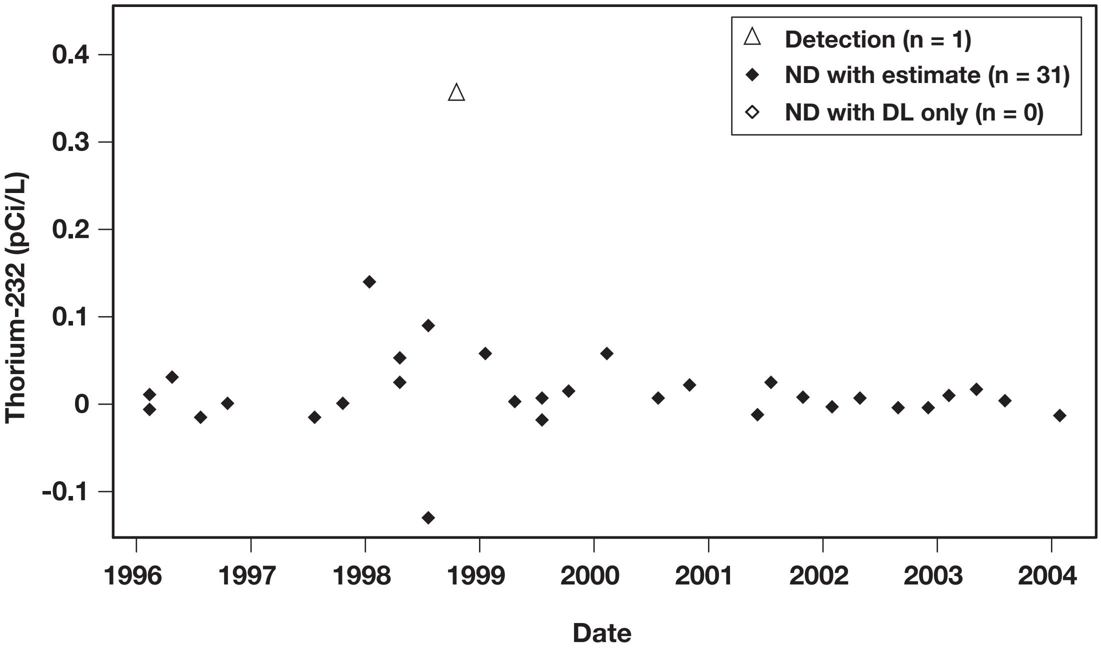
Lide, David R., Ed. (1992), *CRC Handbook of Chemistry and Physics*, 72nd ed. (CRC Press).

Taffet, M.J., L.K. Green-Horner, L.C. Hall, T.M. Carlsen, and J.A. Oberdorfer (1996), *Addendum to the Site-Wide Remedial Investigation Report, Lawrence Livermore National Laboratory Site 300, Building 850/Pit 7 Complex Operable Unit*, Lawrence Livermore National Laboratory, Livermore, Calif. (UCRL-AR-108131).

U.S. EPA (1992), *Statistical Analysis of Ground-water Monitoring Data at RCRA Facilities—Addendum to Interim Final Guidance*, Office of Solid Waste.

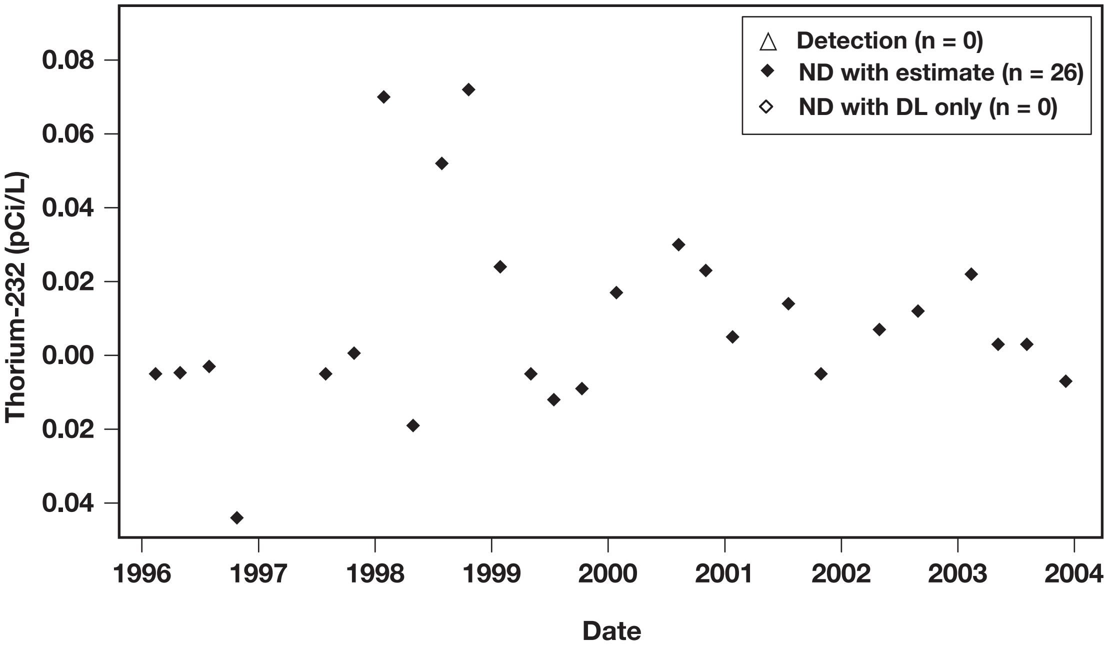
Webster-Scholten, C.P., Ed. (1994), *Final Site-Wide Remedial Investigation Report, Lawrence Livermore National Laboratory Site 300*, Lawrence Livermore National Laboratory, Livermore, Calif. (UCRL-AR-108131).

Wood, C. (2004), Lawrence Livermore National Laboratory, B Division, “Site 300 Depleted Uranium,” memorandum to Michael Taffet, Lawrence Livermore National Laboratory, Environmental Restoration Division, Livermore, Calif., June 15, 2004.



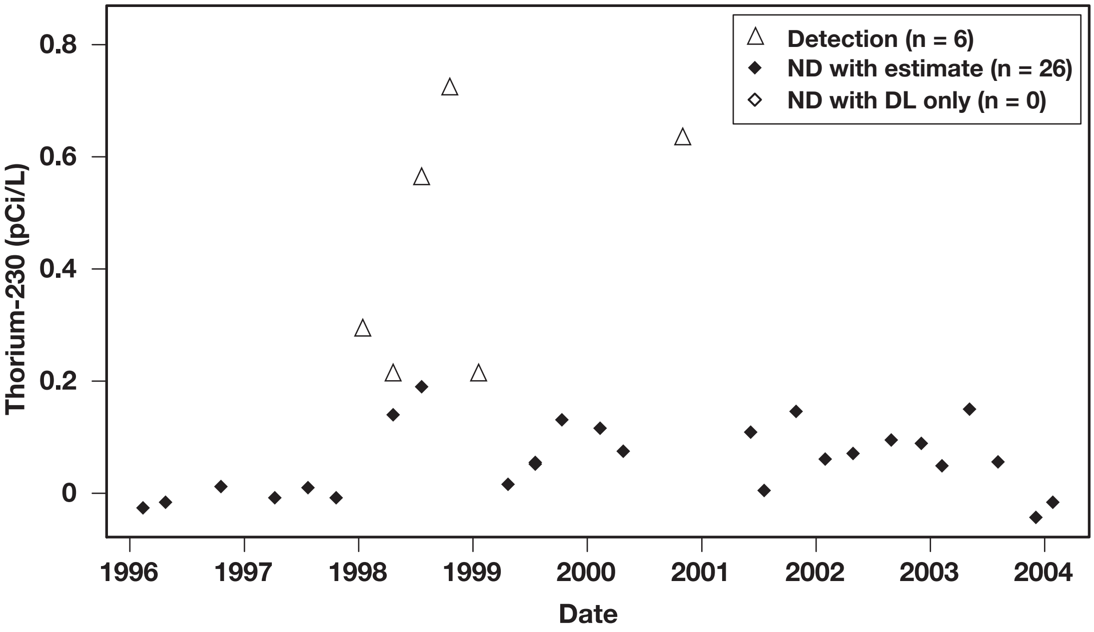
ERD-S3R-04-0089

Figure D-1. Time-series plot of thorium-232 activity in ground water at local background (LB) well K7-06.



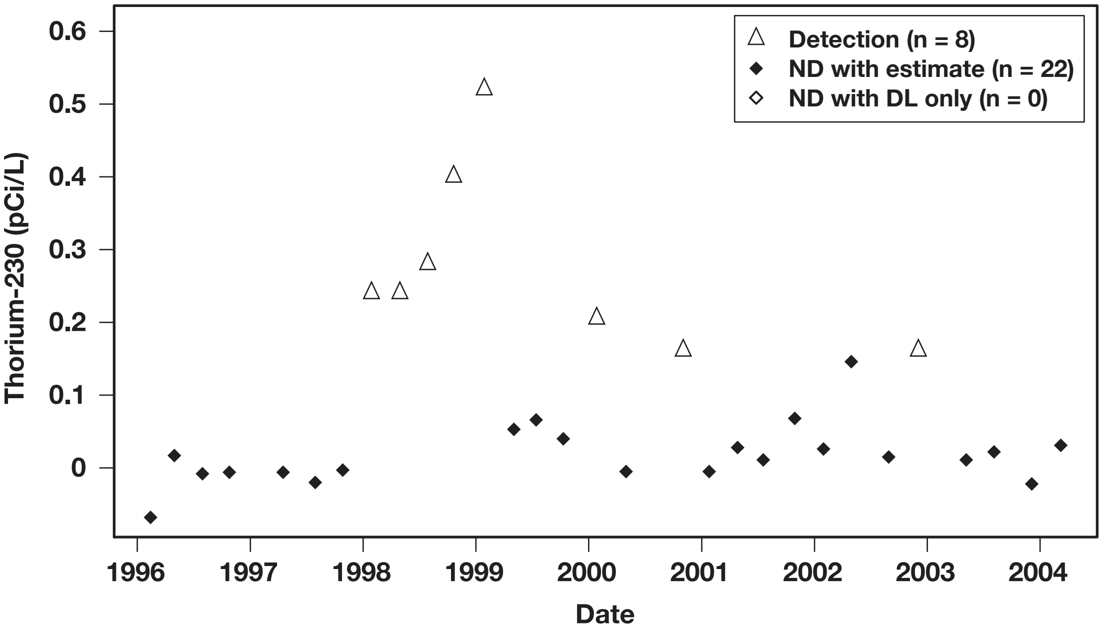
ERD-S3R-04-0090

Figure D-2. Time-series plot of thorium-232 activity in ground water at local background (LB) well NC7-47.



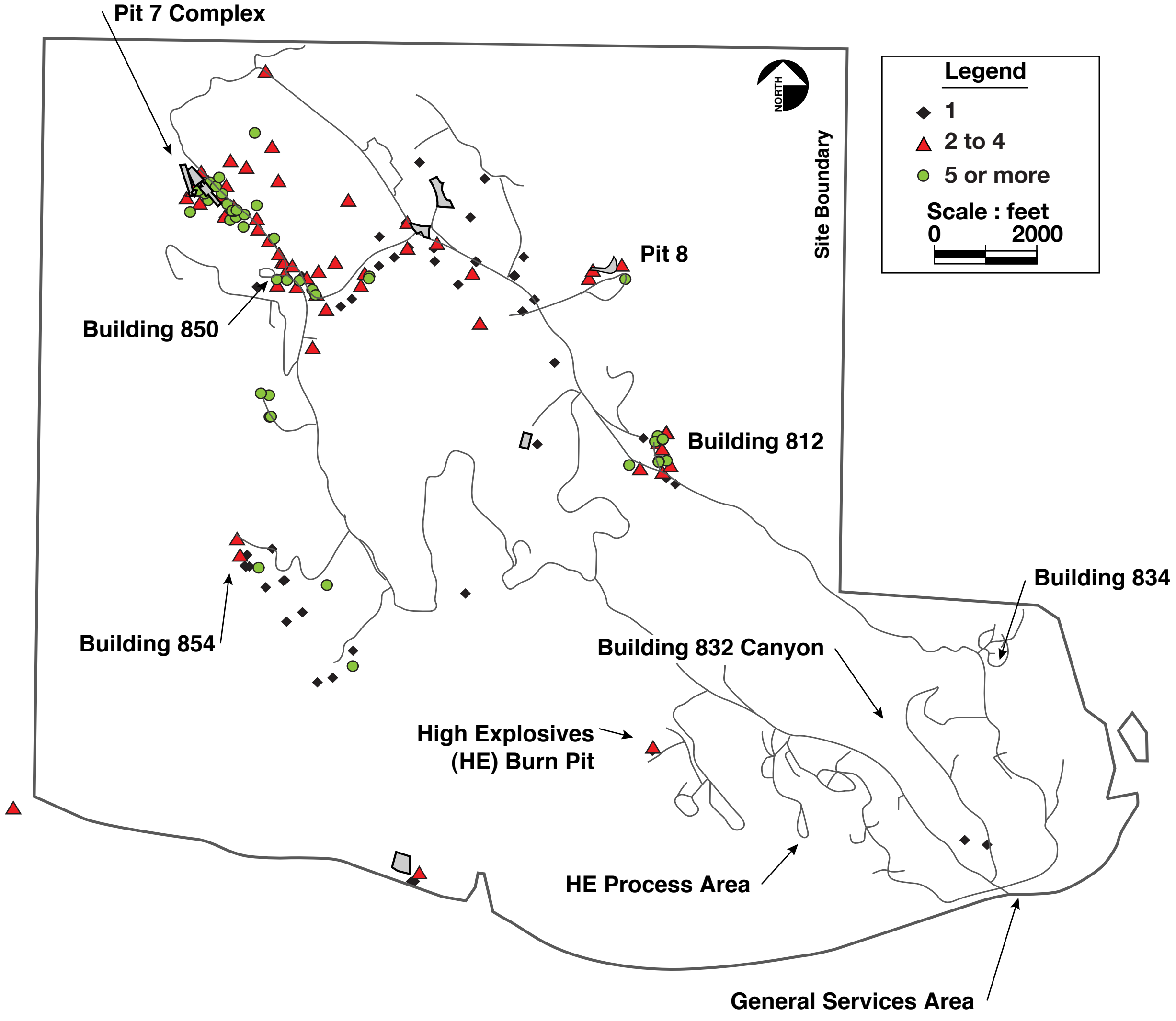
ERD-S3R-04-0091

Figure D-3. Time-series plot of thorium-230 activity in ground water at local background (LB) well K7-06.



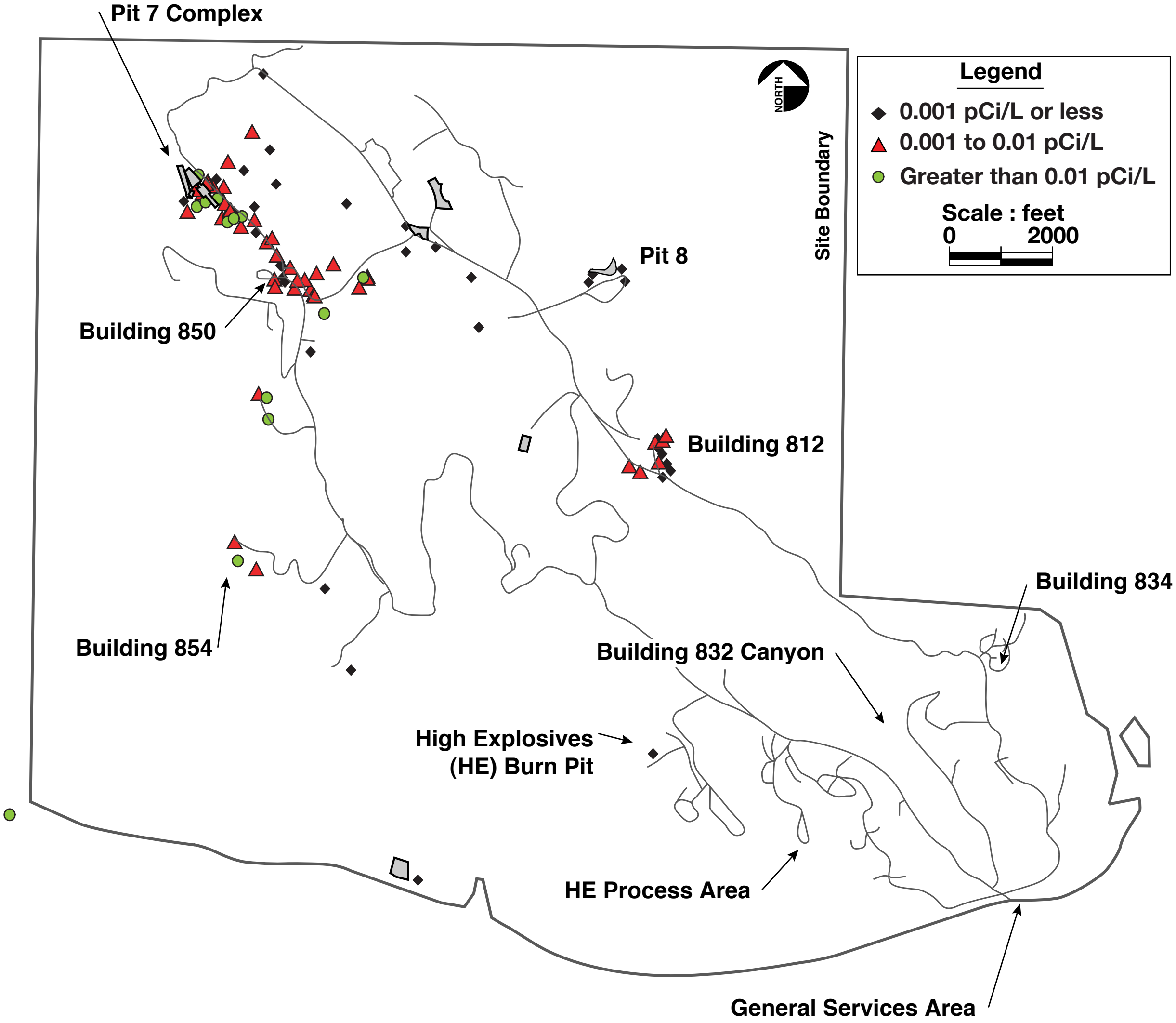
ERD-S3R-04-0092

Figure D-4. Time-series plot of thorium-230 activity in ground water at local background (LB) well NC7-47.



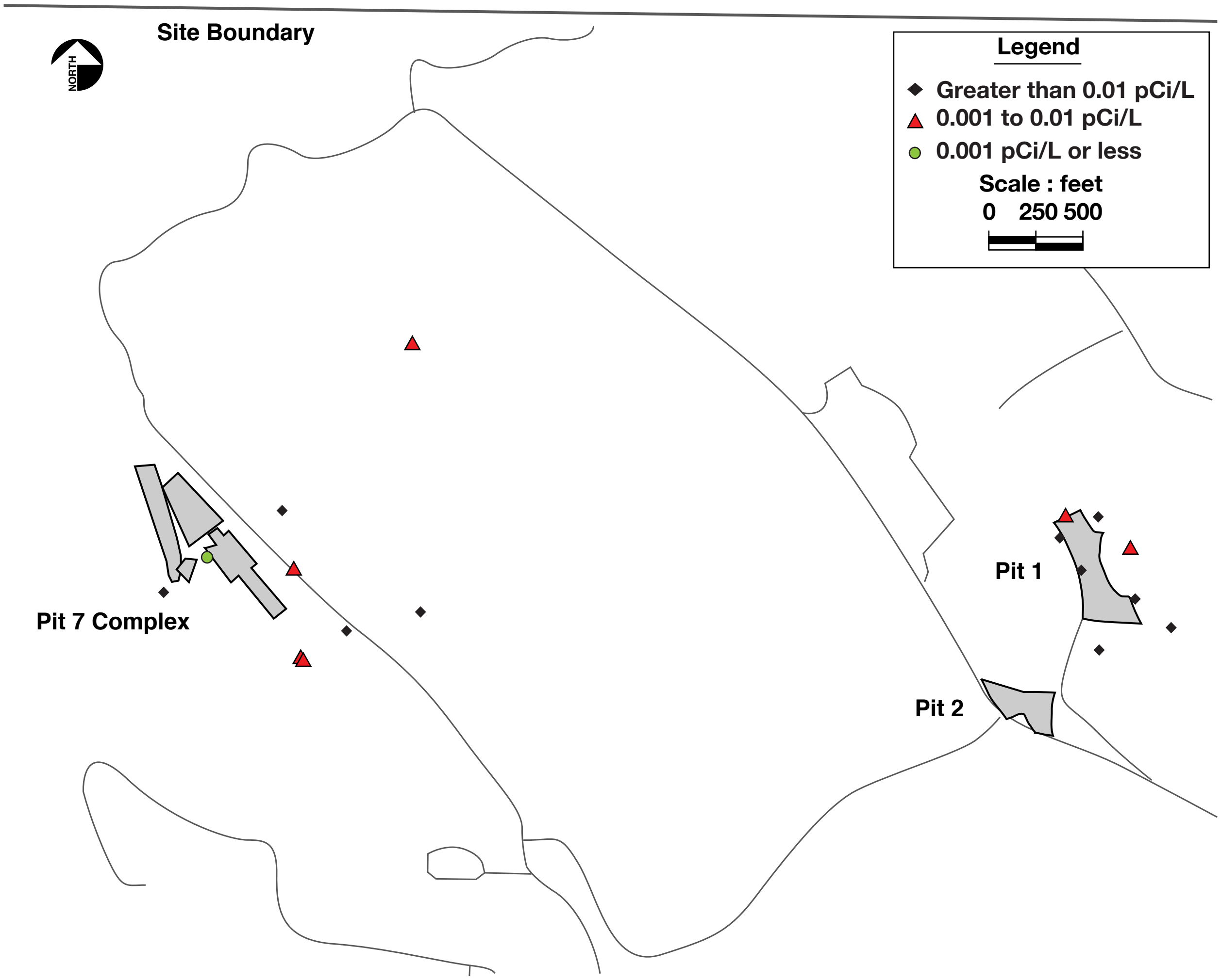
ERD-S3R-04-0084

Figure D-5. Frequency of ground water sampling and analysis (by mass spectrometry) for thorium-232, by location at Site 300.



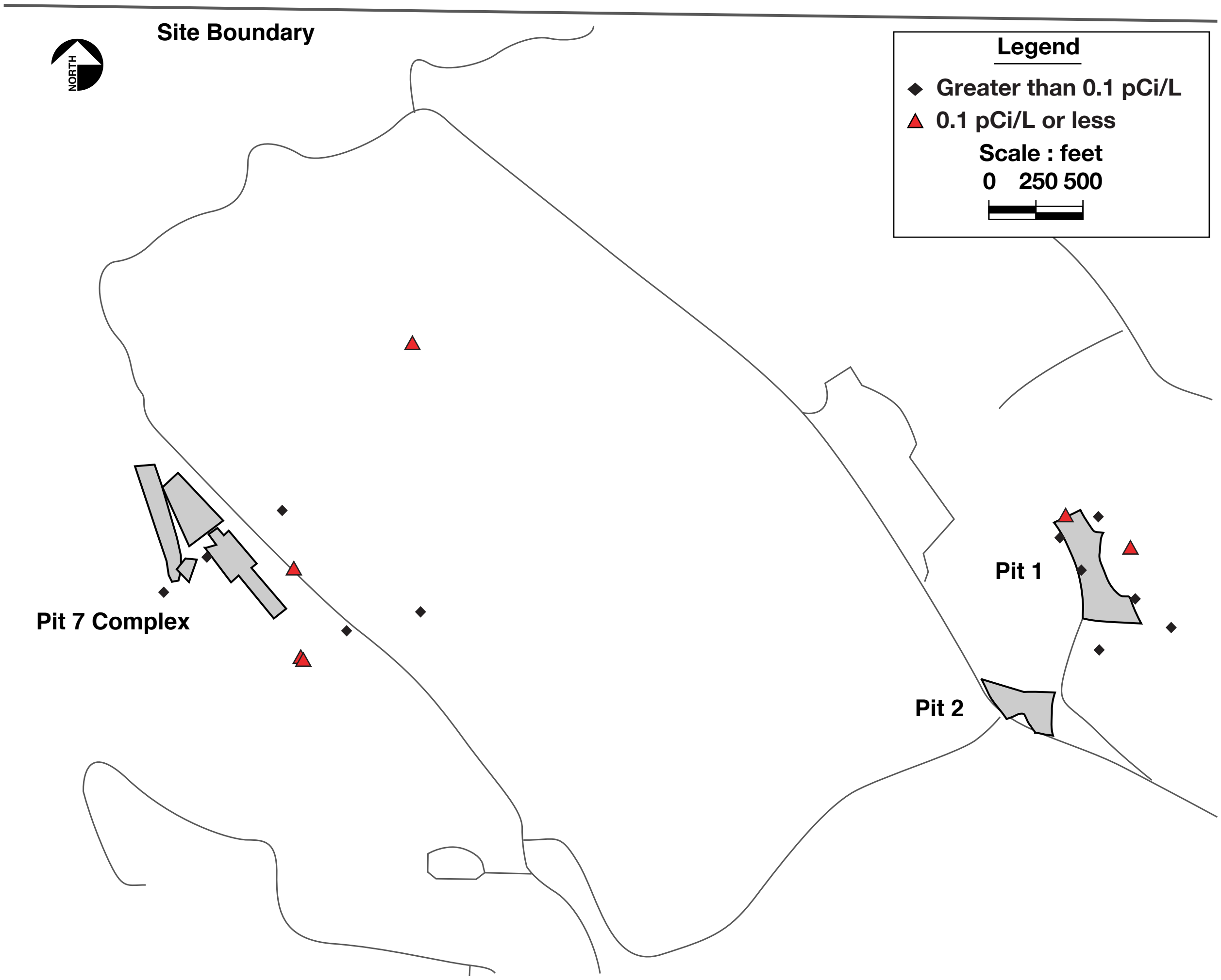
ERD-S3R-04-0085

Figure D-6. Average thorium-232 activity ranges for ground water samples analyzed by mass spectrometry.



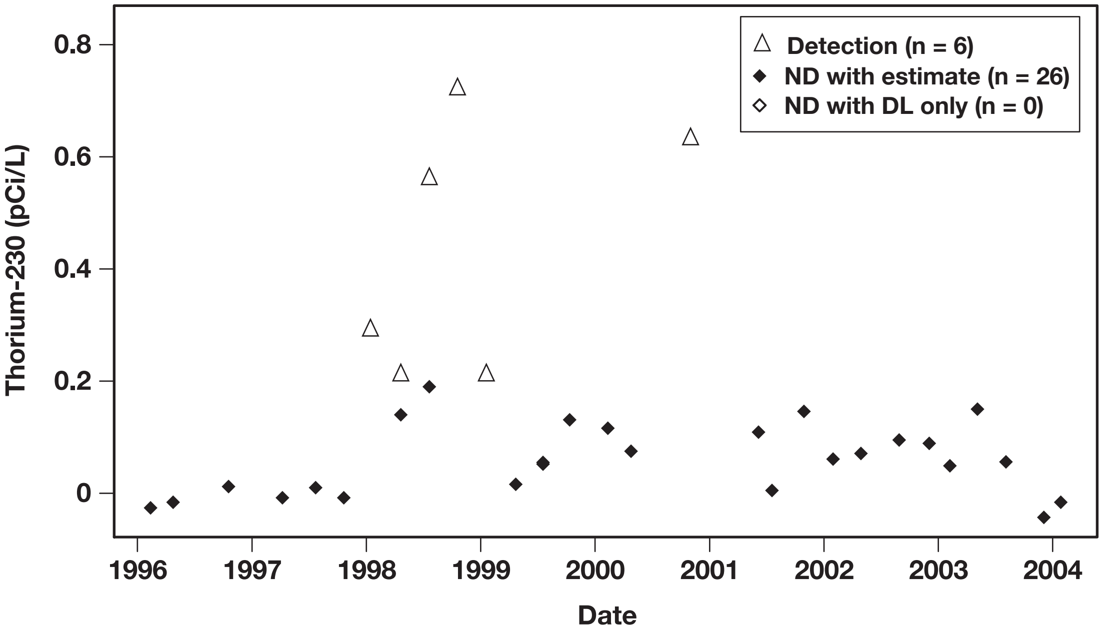
ERD-S3R-04-0086

Figure D-7. Average thorium-232 activity ranges for ground water samples analyzed by alpha spectrometry.



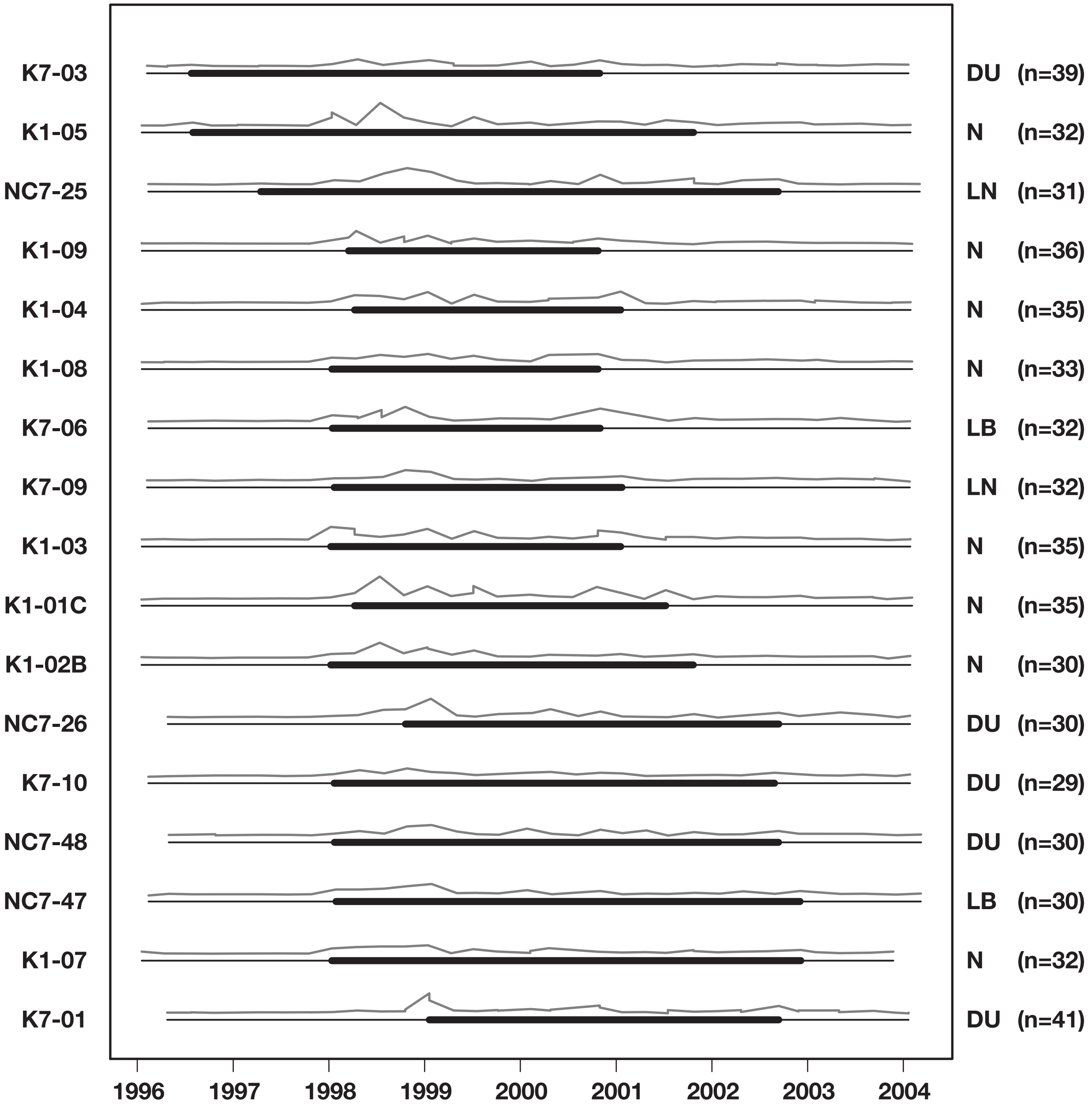
ERD-S3R-04-0087

Figure D-8. Average thorium-230 activity ranges for ground water samples analyzed by alpha spectrometry.



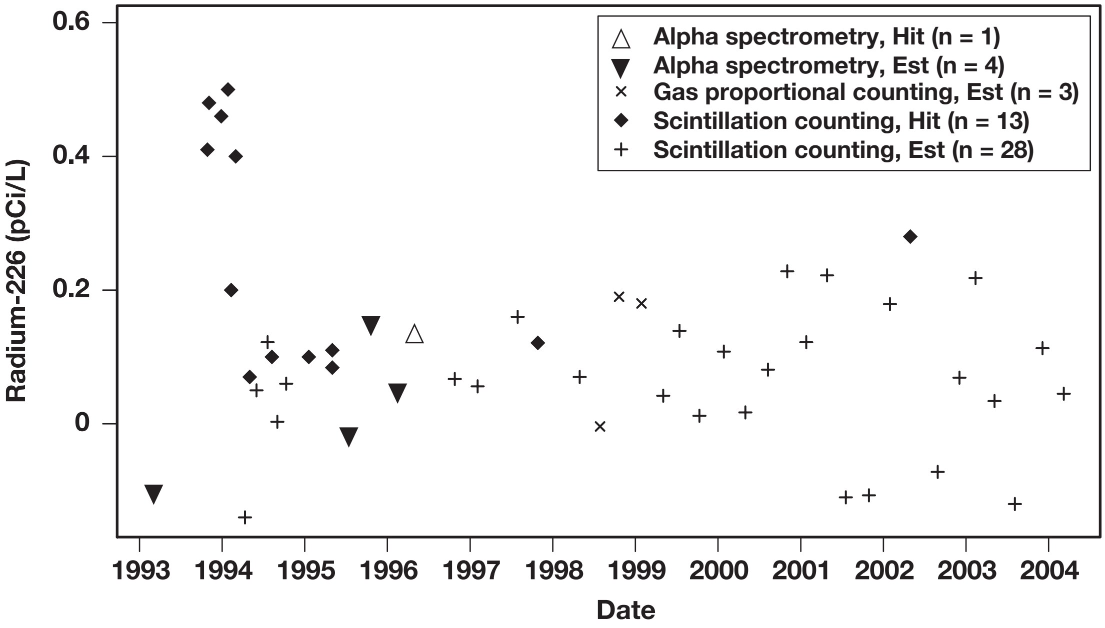
ERD-S3R-04-0093

Figure D-9. Time-series plot of thorium-230 activity in ground water at local background (LB) well K7-06.



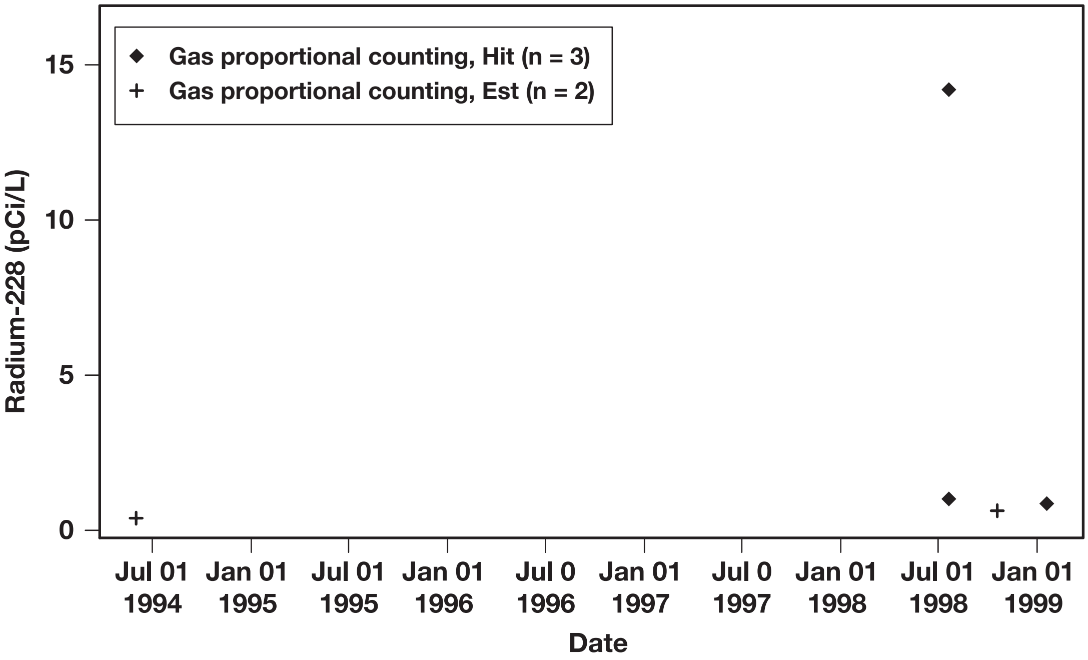
ERD-S3R-04-0094

Figure D-10. Ranges of thorium-230 detected in ground water. Solid bars indicate time interval from of first to last detection. Gray lines indicate relative activity history (all locations on the same scale).



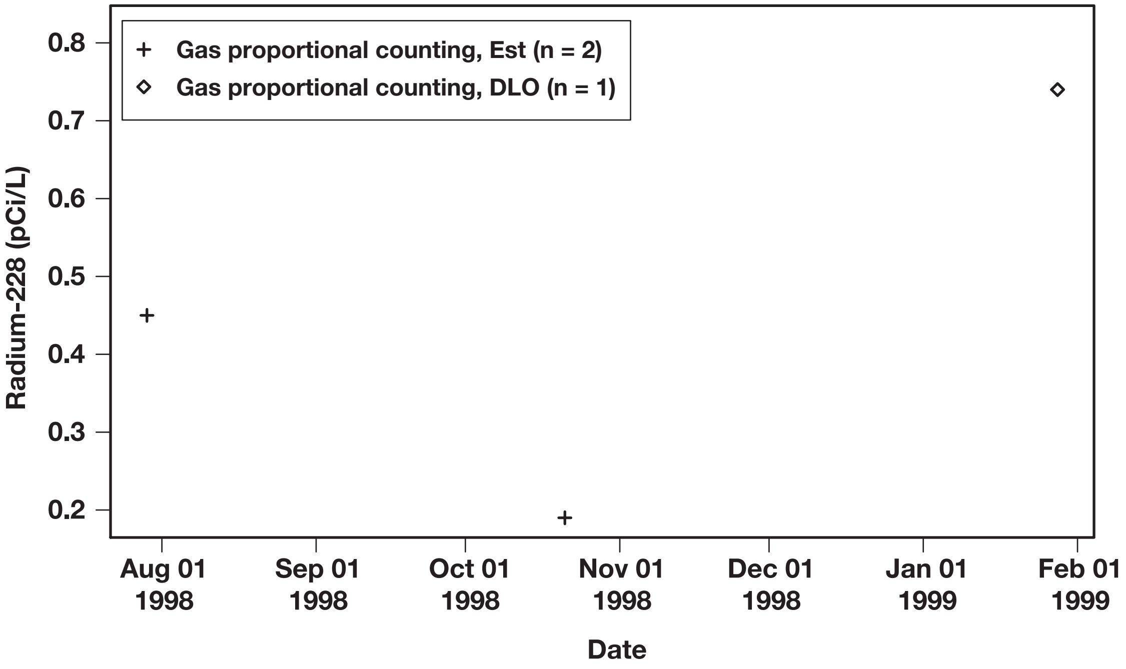
ERD-S3R-04-0095

Figure D-11. Time-series plot of radium-226 activity in ground water at local background (LB) well NC7-47.



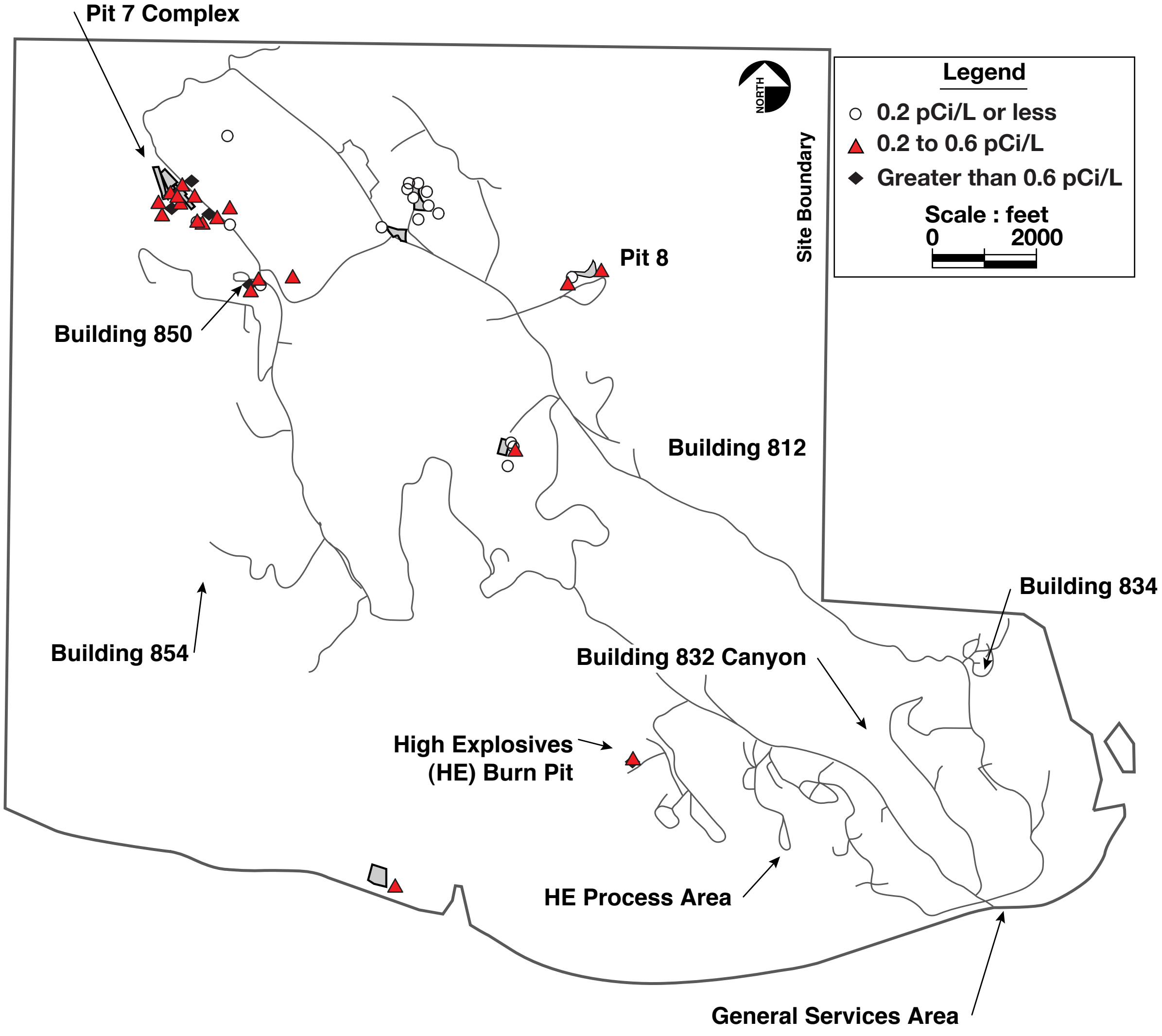
ERD-S3R-04-0096

Figure D-12. Time-series plot of radium-228 activity in ground water at local background (LB) well K7-06.



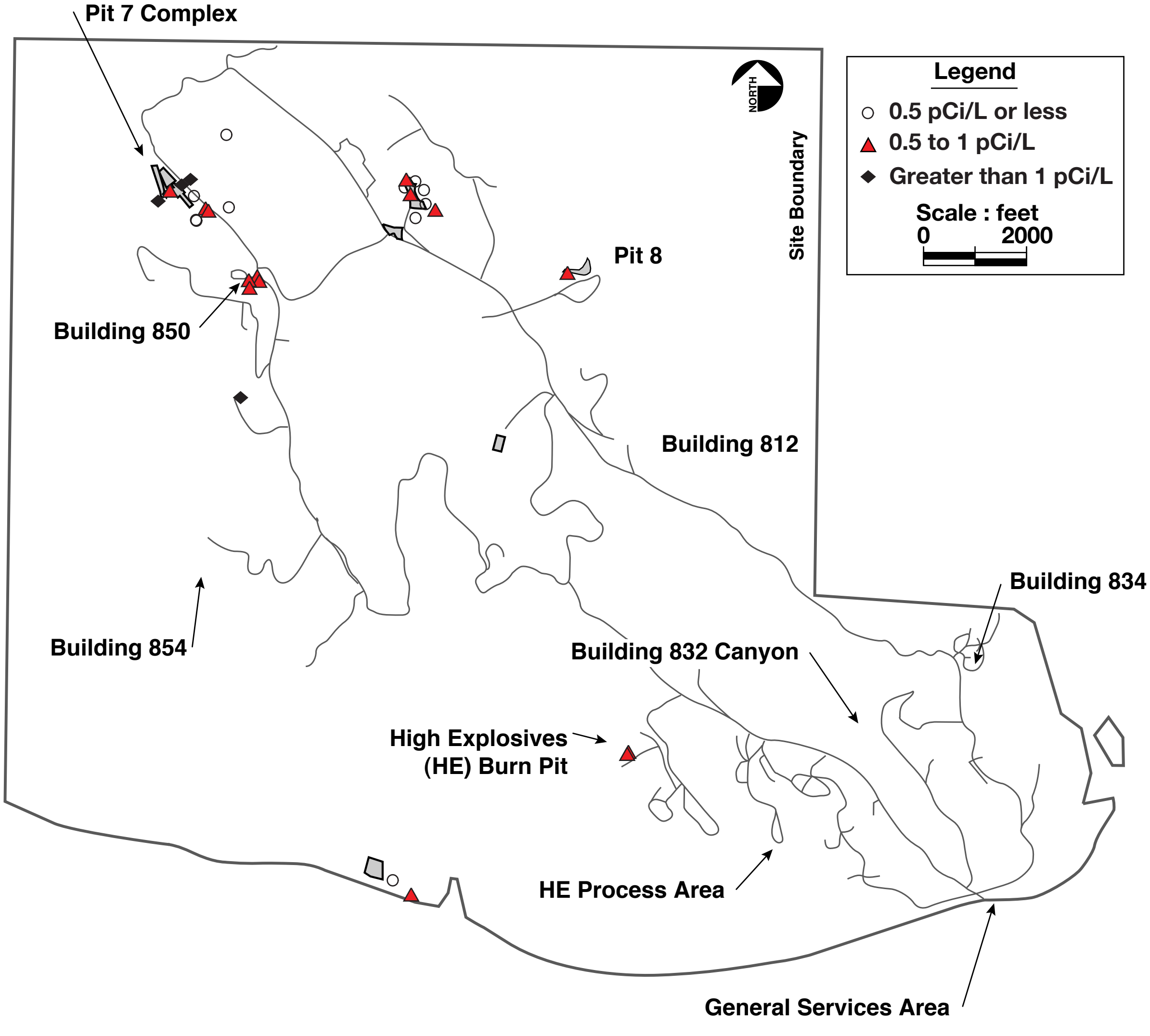
ERD-S3R-04-0097

Figure D-13. Time-series plot of radium-228 activity in ground water at local background (LB) well NC7-47.



ERD-S3R-04-0088

Figure D-14. Average radium-226 activity ranges for ground water samples collected at Site 300.



ERD-S3R-04-0083

Figure D-15. Average radium-228 activity ranges for ground water samples collected at Site 300.

Table D-1. Isotopic activity results available for thorium in ground water.

Isotope	No. of samples (n)
^{228}Th	945
^{230}Th	917
^{232}Th	1,796
^{234}Th	29

Table D-2. Reporting frequencies for thorium isotopes in ground water samples.

Isotope	DLO	Estimate	Hit
^{228}Th	57	839	49
^{230}Th	34	548	335
^{232}Th	190	812	794
^{234}Th	16	13	0
Total	297	2212	1178

DLO = Detection limit only.

Table D-3. Reporting frequencies with pre-1996 and "DLO" data for thorium in ground water omitted.

Isotope	Estimate	Hit
^{228}Th	573	1
^{230}Th	439	125
^{232}Th	558	737
^{234}Th	6	0
Total	1,576	863

DLO = Detection limit only.

Table D-4. Analytical methods used in thorium analysis of ground water samples from wells K7-06 and NC7-47.

Well	No. of samples analyzed by alpha spectrometry	No. of samples analyzed by mass spectrometry
K7-06	32	3
NC7-47	26	5

Table D-5. Detection frequencies for thorium in ground water samples from wells K7-06 and NC7-47.

Well	Estimate	Hit
K7-06	31	1
NC7-47	26	0

Table D-6. 95% upper confidence limits (pCi/L) for ^{232}Th in ground water samples from wells K7-06 and NC7-48.

Statistic	K7-06	NC7-47
Average	0.034	0.022
95% upper confidence limit	0.110	0.090

pCi/L = Picocuries per liter.

Table D-7. Analytical methods used for analysis of thorium isotopes in ground water samples from wells K7-06 and NC7-47.

Well	No. of samples analyzed by alpha spectrometry
K7-06	32
NC7-47	30

Table D-8. ^{230}Th detection frequencies in ground water samples from K7-06 and NC7-47.

Well	Estimate	Hit
K7-06	26	6
NC7-47	22	8

Table D-9. 95% upper confidence limits (pCi/L) for ^{230}Th in ground water samples from wells K7-06 and NC7-48.

Statistic	K7-06	NC7-47
Average	0.077	0.099
95% upper confidence limit	0.100	0.240

pCi/L = Picocuries per liter.

Table D-10. Ground water ^{232}Th detections and analytical methods.

Analytical method	Estimate	Hit
Alpha spectrometry	490	8
Mass spectrometry	67	728

Table D-11. Number of alpha and mass spectroscopy results per well for ^{232}Th in ground water.

Well	No. of samples analyzed by alpha spectrometry	No. of samples analyzed by mass spectrometry
K1-01C	26	0
K1-02B	28	0
K1-03	27	0
K1-04	33	0
K1-05	28	0
K1-07	28	0
K1-08	28	0
K1-09	36	0
K7-01	35	25
K7-03	34	20
K7-06	32	3
K7-09	28	1
K7-10	26	2
NC7-25	24	26
NC7-26	27	7
NC7-34	1	16
NC7-47	26	5
NC7-48	30	47
W-812-1922	1	1

Table D-12. Number of wells having various numbers of ground water samples analyzed for thorium isotopes by mass spectroscopy.

No. of samples (n)	Number of wells
1	53
2	27
3	14
4	15
5	10
6	7
7	6
8	3
9	1
10	1
11	2
12	1
13	7
14	1
15	1
16	1
17	2
20	3
21	1
22	1
25	1
26	1
47	1

Table D-13. Average activities of ^{232}Th (pCi/L) in ground water samples analyzed by mass spectroscopy.

Average concentration	Number of wells
0.001 pCi/L or less	50
0.001 to 0.01 pCi/L	44
Greater than 0.01 pCi/L	13

pCi/L = Picocuries per liter.

Table D-14. Average activities (pCi/L) of ^{232}Th in ground water samples analyzed by alpha spectroscopy.

Well	Group	Average (pCi/L)	No. of samples (n)
K7-06	LB	0.0229	32
NC7-47	LB	0.00907	26
K7-09	LN	0.00484	28
NC7-25	LN	0.0155	24
K1-01C	N	0.0171	26
K1-02B	N	0.0137	28
K1-03	N	0.0117	27
K1-04	N	0.006	33
K1-05	N	0.0192	28
K1-07	N	0.0155	28
K1-08	N	0.0166	28
K1-09	N	0.00736	36
K7-01	DU	0.011	35
K7-03	DU	0.0091	34
K7-10	DU	0.00815	26
NC7-26	DU	0.0157	27
NC7-48	DU	-0.00053	30

LB = Local background wells located near Pit 7 in which anthropogenic chemicals have never been detected in ground water.

LN = Local natural wells that sample ground water containing only natural uranium (based on mass spectrometry data) but have been impacted by other contaminants (such as elevated tritium) and are located near the Pit 7 Complex.

N = Site 300 natural wells that sample ground water containing only natural uranium (based on mass spectrometry data) but have been impacted by other contaminants (such as volatile organic compounds) and are located outside of the Pit 7 Complex area but within Site 300.

DU = Wells that sample ground water which contains depleted uranium.

pCi/L = Picocuries per liter.

Table D-15. Average activities (pCi/L) of ^{230}Th in ground water samples analyzed by alpha spectroscopy.

Well	Group	Average (pCi/L)	No. of samples (n)
K7-06	LB	0.129	30
NC7-47	LB	0.0866	32
K7-9	LN	0.0702	31
NC7-25	LN	0.143	32
K1-01C	N	0.164	35
K1-02B	N	0.132	30
K1-03	N	0.129	35
K1-04	N	0.0995	35
K1-05	N	0.141	LB
K1-07	N	0.109	LB
K1-08	N	0.1	LN
K1-09	N	0.0938	LN
K7-01	DU	0.107	N
K7-03	DU	0.069	N
K7-10	DU	0.0848	NN
NC7-26	DU	0.114	32
NC7-48	DU	0.102	32

LB = Local background wells located near Pit 7 in which anthropogenic chemicals have never been detected in ground water.

LN = Local natural wells that sample ground water containing only natural uranium (based on mass spectrometry data) but have been impacted by other contaminants (such as elevated tritium) and are located near the Pit 7 Complex.

N = Site 300 natural wells that sample ground water containing only natural uranium (based on mass spectrometry data) but have been impacted by other contaminants (such as volatile organic compounds) and are located outside of the Pit 7 Complex area but within Site 300.

DU = Wells that sample ground water which contains depleted uranium.

pCi/L = Picocuries per liter.

Table D-16. ^{230}Th detections in ground water samples and analytical method.

Analytical method	Estimate	Hit
Alpha spectrometry	438	125

Table D-17. Numbers of ^{230}Th activity results for ground water samples, listed by well.

Well	Estimate	Hit	No. of samples (n)
K1-01C	25	10	35
K1-02B	22	8	30
K1-03	26	9	35
K1-04	28	7	35
K1-05	23	9	32
K1-07	24	8	32
K1-08	27	6	33
K1-09	30	6	36
K7-01	35	6	41
K7-03	32	7	39
K7-06	26	6	32
K7-09	28	4	32
K7-10	22	7	29
NC7-25	20	11	31
NC7-26	24	6	30
NC7-34	1	0	1
NC7-47	22	8	30
NC7-48	23	7	30

Table D-18. Radium isotope activity results available.

Isotope	No. of samples (n)
^{226}Ra	2,078
^{228}Ra	199
Total radium	1

Table D-19. Reporting frequencies for radium isotopes in ground water.

Isotope	DLO	Estimate	Hit
^{226}Ra	586	733	759
^{228}Ra	72	87	40
Total	658	820	799

DLO = Detection limit only.

Table D-20. ^{226}Ra activity ranges (pCi/L) in ground water samples.

Isotope activity range	No. of samples (n)
(-∞,-100]	4
(-100,-1]	3
(-1,0]	91
(0,1]	1,332
(1,100]	98
(100,∞]	5

pCi/L = Picocuries per liter.

∞ = Infinity.

Table D-21. Detection frequencies for ^{226}Ra in ground water samples, after initial screening.

Analytical method	Estimate	Hit
Not known	0	13
Alpha spectrometry	143	126
Gas proportional counting	54	48
Gamma spectrometry	0	9
Scintillation counting	370	399

Table D-22. 95% upper confidence limits (pCi/L) for ^{226}Ra in ground water samples from wells K7-06 and NC7-47.

Statistic	K7-06	NC7-47
Average	0.411	0.15
95% upper confidence limit	0.480	0.22

pCi/L = Picocuries per liter.

Table D-23. Average ^{226}Ra activities (pCi/L) in ground water samples from Site 300, sorted by increasing activity.

Location	Group	Average (pCi/L)	No. of samples (n)
K7-06	N	0.106	20
NC7-47	LB	0.113	49
K7-09	N	0.117	16
NC7-17	N	0.134	5
NC7-25	N	0.14	59
NC7-36	DU	0.144	3
NC7-53	DU	0.15	2
BC6-12	N	0.152	61
K1-01C	N	0.153	57
K1-02B	N	0.163	3
K1-03	N	0.164	54
K1-04	N	0.167	61
K1-05	LN	0.169	49
K1-07	N	0.17	54
K1-08	N	0.176	67
K1-09	N	0.176	60
K2-02B	DU	0.185	8
K8-01	DU	0.207	3
K8-04	DU	0.218	5
K9-02	DU	0.24	2
K9-04	LN	0.25	3
W-829-06	N	0.25	2
W-829-08	DU	0.25	4
K7-01	DU	0.258	2
K7-03	DU	0.272	6
K7-10	DU	0.285	69
K8-03B	DU	0.297	60
K9-01	N	0.312	12
K9-03	DU	0.325	2
NC7-16	LN	0.335	4
NC7-18	DU	0.34	51
NC7-21	N	0.35	3
NC7-26	DU	0.357	50
NC7-27	DU	0.37	2
NC7-28	LB	0.406	62
NC7-34	DU	0.487	3

Table D-23. Average ^{226}Ra activities (pCi/L) in ground water samples from Site 300, sorted by increasing activity.

Location	Group	Average (pCi/L)	No. of samples (n)
NC7-48	LN	0.612	63
NC7-64	DU	0.665	4
NC7-70	N	0.785	13
NC7-71	DU	1.03	94
W-850-05	LN	1.04	2

LB = Local background wells located near Pit 7 in which anthropogenic chemicals have never been detected in ground water.

LN = Local natural wells that sample ground water containing only natural uranium (based on mass spectrometry data) but have been impacted by other contaminants (such as elevated tritium) and are located near the Pit 7 Complex.

N = Site 300 natural wells that sample ground water containing only natural uranium (based on mass spectrometry data) but have been impacted by other contaminants (such as volatile organic compounds) and are located outside of the Pit 7 Complex area but within Site 300.

DU = Wells that sample ground water which contains depleted uranium.

pCi/L = Picocuries per liter.

Table D-24. Average ^{228}Ra activities (pCi/L) in ground water samples from Site 300, sorted by increasing activity.

Well	Group	Average (pCi/L)	No. of samples (n)
K7-06	N	-0.32	4
NC7-47	N	0.164	5
K7-09	N	0.217	3
NC7-25	DU	0.323	3
BC6-12	N	0.33	3
K1-01C	N	0.36	4
K1-02B	DU	0.402	2
K1-03	DU	0.43	3
K1-04	N	0.435	4
K1-05	LN	0.445	2
K1-07	LB	0.46	3
K1-08	N	0.541	9
K1-09	N	0.566	5
K6-23	N	0.717	3
K8-01	DU	0.748	10
W-829-06	N	0.785	4
W-829-08	DU	0.9	3
K7-01	DU	0.963	11
K7-03	N	0.981	14
K7-10	N	1.03	2
NC7-26	DU	1.15	12
NC7-28	N	1.24	10
NC7-48	DU	1.27	3
NC7-64	DU	1.38	9
NC7-67	DU	1.55	5
NC7-70	DU	2.42	3
NC7-71	LN	2.51	3
W-850-05	DU	2.83	2
W-851-06	LB	3.42	5

LB = Local background wells located near Pit 7 in which anthropogenic chemicals have never been detected in ground water.

LN = Local natural wells that sample ground water containing only natural uranium (based on mass spectrometry data) but have been impacted by other contaminants (such as elevated tritium) and are located near the Pit 7 Complex.

N = Site 300 natural wells that sample ground water containing only natural uranium (based on mass spectrometry data) but have been impacted by other contaminants (such as volatile organic compounds) and are located outside of the Pit 7 Complex area but within Site 300.

DU = Wells that sample ground water which contains depleted uranium.

pCi/L = Picocuries per liter.

Appendix E

Fate and Transport Modeling

Appendix E

Fate and Transport Modeling

This appendix describes the fate and transport modeling discussed in Chapter 2, Section 2.4. This fate and transport modeling was primarily conducted to estimate tritium and total uranium activities in ground water at hypothetical wells placed at the northeastern and eastern site boundaries, and tritium activity at Spring 24. Figure E-1 shows the location of the Pits 3 and 5 source area, the hypothetical water supply wells at the site boundaries, the location of Spring 24, and the migration pathways to these potential receptor points. Additional modeling was conducted at Spring 24 for potential evaporation of tritium to estimate exposure point activities for the inhalation pathway.

Two separate models of the fate and transport of tritium and uranium in ground water and an air dispersion model were used, as described below.

- A ground water flow and transport model that simulates contaminant migration in the $Tnbs_0$ bedrock aquifer or hydrostratigraphic unit (HSU) was developed using the numerical modeling code FEFLOW (Diersch, 2002). The finite element numerical modeling code FEFLOW is an interactive ground water modeling system for three-dimensional, variably saturated, density-coupled, flow, mass and heat transport simulation. This model was used to estimate tritium and uranium activities at Spring 24, as well as at a hypothetical well near the northeastern site boundary (Figure E-2).
- A ground water flow and transport model that simulates contaminant migration in the Quaternary alluvium and weathered bedrock along a plume path down Doall Ravine and Elk Ravine was developed using the numerical modeling code FEFLOW. This model was used to estimate tritium and uranium activities reaching the eastern site boundary near well NC2-07 (Figure E-3).
- An air dispersion model to estimate the tritium activity due to volatilization from Spring 24 was developed based on the relationship provided by Turner (1982).

E-1. Ground Water Flow and Transport in the $Tnbs_0$ Bedrock Aquifer

As discussed in Section 2.2.3.2, the bedrock unit at the base of the Neroly formation is identified as the $Tnbs_0$, a 10- to 15-foot (ft) thick confined HSU, dipping northeast toward the Elk Ravine fault. There are significant indications that the extent of saturation in the $Tnbs_0$ HSU is limited east of the Elk Ravine fault and does not reach the northern site boundary. However, for the purposes of risk assessment this unit was modeled as one continuous saturated unit extending to the northeastern site boundary (Figure E-2).

E-1.1. Model Description and Assumptions

The $Tnbs_0$ bedrock HSU was modeled as a two-dimensional confined aquifer extending from an area beneath Pits 3 and 5, past the Elk Ravine fault zone, to the northeastern site boundary. The model assumes that all the recharge into this unit occurs in the Pits 3 and 5 area and the discharge location is at the northeastern site boundary. Since the HSU is confined, rainfall recharge was neglected. The discharge from Spring 24 was also neglected since the discharge rate is insignificant compared to the total flow through the HSU. These boundaries were simulated as specified head boundary conditions and their locations are presented in Figure E-2. The specified head boundary values were initially projected from the ground water potentiometric surface map presented in Figure 2-8, and were subsequently adjusted during the calibration process until a match with measured ground water elevation values was obtained. The Tnbs_0 HSU has an average thickness of 13 feet (ft) (4 meters [m]) and a calibrated hydraulic conductivity value of 0.14 foot per day (ft/day) (5×10^{-5} centimeters per second [cm/sec]). The flow field in the model was calibrated by adjusting the specified head boundary conditions and the hydraulic conductivity of the unit until there was match with measured ground water elevations and the gradient (0.1 foot per foot [ft/ft]). The Tnbs_0 HSU was simulated as a steady-state flow field and average ground water elevations measured in Tnbs_0 wells were used to calibrate the flow model. Since ground water elevations do not significantly fluctuate in the Tnbs_0 HSU, the steady-state flow field assumption is valid for this model.

For the tritium simulations, a half-life of 12.3 years was used to calculate a first-order decay rate of 1.8×10^{-9} sec^{-1}, and since tritium is a conservative contaminant, no retardation was used. A longitudinal dispersivity value of 15 feet (5 m) and a transverse dispersivity value of 1.5 ft (0.5 m) were used to calibrate the tritium plume based on the second quarter 2003 position of the 20,000 picocuries per liter (pCi/L) contour, assuming that the initial releases occurred in the early 1970s. The initial tritium distribution was based on the 2^{nd} quarter 2003 tritium plume map (Figure 2-17).

Two separate source release scenarios were simulated for tritium. The first scenario assumes that the sources in the vicinity of Pits 3 and 5 are isolated from the ground water system. The second scenario simulates the release of existing tritium in soil moisture to ground water over a three year period. The highest measured tritium activity in soil moisture in the source area (Figure E-2) is 5,960,000 pCi/L in borehole PIT3-08. Assuming that the pits are inundated by rising ground water for three consecutive years, and assuming a maximum tritium activity release of 6,000,000 pCi/L for each of these years, all of the tritium in the unsaturated zone would be released into the ground water. This source term (Figure E-4) represents a worst-case source release scenario.

The fate and transport of total uranium was modeled using a set of very conservative assumptions. The initial (t=0) ground water uranium plume distribution used in the model was based on the extent of the total uranium activity above the Maximum Contaminant Level (MCL) of 20 pCi/L in ground water within the Qal/WBR HSU in 2003. The uranium activity in the initial plume extends beyond areas containing depleted uranium in ground water as a result of releases from the pits, and includes uranium contributions to ground water from both natural and anthropogenic (pit) sources. As a result, the initial total uranium plume is larger than the anthropogenic depleted uranium plume shown in Figure 2-18. In addition, to evaluate the fate and transport of the depleted uranium portion of the plume, background, i.e., pre-existing natural uranium activity in ground water, was assumed to be negligible. It was also assumed that the total uranium in ground water above the MCL was one hundred-percent depleted. These are conservative assumptions because natural bedrock sources contribute a significant portion of the total uranium activity in the ground water. Also, a total uranium simulation with a source term was not included because the reaction kinetics that control the release of uranium from the pits to ground water are very complex and cannot be modeled using the existing model. Therefore, all total uranium simulation results assume that the sources have been isolated.

To determine the fate of uranium in ground water, the decay rate was neglected since the half-life of uranium is 4.5×10^9 years. A conservative retardation coefficient of 15 was used for uranium simulations based on low retardation coefficient values reported in Thibault et al. (1990).

A sensitivity analysis was conducted for the transport simulations. The longitudinal and transverse dispersivity values were varied by one-order of magnitude and the retardation coefficient for uranium was varied based on the ranges reported in Thibault et al. (1990). The tritium plume simulation results vary significantly when dispersivity values are varied. Therefore, the dispersivity values calibrated using the history of the tritium plume are considered very representative. The uranium plume simulations are not sensitive to dispersivity since the retardation coefficient for uranium is relatively high compared to other contaminants at Site 300. Since the lower end of the retardation coefficient range was used for uranium, the model results are representative of conservative subsurface conditions for uranium migration.

E-1.2. Results

Tritium: The predicted maximum tritium activity at Spring 24 will not exceed the current observed levels in this location (Table E-1). Even when a worst-case source release scenario is simulated for tritium at the Pits 3 and 5 source area, the impact of this release is negligible at Spring 24 (Figure E-5). The predicted maximum ground water activity at a hypothetical water supply well at the northeastern site boundary for both tritium scenarios (with or without a source term) do not reach detection limits (will be equal to background levels). The most direct path to the site boundary given the ground water flow direction in $Tnbs_0$ HSU is more than 8,000 ft (2,500 m) long and the tritium plume naturally decays before it can reach this location. The predicted tritium activities based on the source release scenario in downgradient wells W-PIT7-14 and W-PIT7-15 (Figure 1-3) are shown in Figure E-6. The location of the tritium plumes when the maximum activity falls below the 20,000 pCi/L MCL anywhere in the HSU are shown in Figure E-7 for both source scenarios. The center of mass is estimated to be 700 ft (215 m) from the source area in 30 to 40 years, and 800 ft (240 m) from the source areas in 30 to 40 years, when the maximum activity in the plume becomes less than the MCL for isolated source and source term scenarios, respectively.

Total Uranium: The predicted maximum uranium activity at Spring 24 and at a hypothetical water supply at the northeastern site boundary will not exceed the current observed levels in these locations (Table E-1). The uranium plume activity falls below the 20 pCi/L MCL mainly due to mechanical dispersion, dilution, and adsorption/desorption processes. The center of mass when the maximum activity in the plume falls below the MCL anywhere in the aquifer is shown in Figure E-8. The model estimates that the center of mass will take 400 to 500 years to travel 400 ft (120 m) from the source area before the activity levels fall below the MCL.

E-2. Ground Water Flow and Transport in the Quaternary Sediments

As discussed in Section 2.2.3.2, one of the HSUs at Pits 3 and 5 area is the Quaternary alluvial and the underlying weathered bedrock (Qal/WBR) HSU. For purposes of modeling, the weathered bedrock was considered part of the Quaternary sediments. The flow direction is to the southeast, along the axis of the ephemeral drainage channel. Although the hydraulic conductivity of this HSU is higher than the $Tnbs_0$ bedrock HSU and during heavy rainfall events the ground water gradients in this unit are very steep, these conditions are sustained only for a very short periods of time. However, for risk assessment purposes this unit was modeled as one continuous unit that maintains a saturated thickness year round (Figure E-3).

E-2.1. Model description and assumptions

The Qal/WBR HSU was modeled as a two-dimensional unconfined aquifer extending from the Pits 3 and 5 area, along the Doall Ravine and Elk Ravine drainage channels, reaching the eastern site boundary near well NC2-07 (Figure E-3). The model assumes that recharge into this HSU occurs from Pits 3 and 5 area and from rainfall recharge along the entire extent of the aquifer. The discharge location is at the eastern site boundary. These model boundaries were simulated as specified head and specified flux (for rainfall) boundary conditions (Figure E-3). The specified head boundary values were initially projected from the ground water elevation maps presented in Figure 2-8, and were subsequently adjusted during the calibration process until a match with measured ground water elevation values was obtained. This unit has an average saturated thickness of 20 ft (6 m) and is an ephemeral unconfined aquifer. A calibrated hydraulic conductivity of 1.4 ft/day (5×10^{-4} cm/sec) was used in the model.

The flow field in the Qal/WBR HSU was simulated as steady-state flow using average hydraulic gradient and average saturated thickness observed during wet seasons. As described in Chapter 2, water level data indicate that during extended periods of drought (i.e., 1989 to 1994), most of the wells completed in the Qal/WBR HSU are either dry or have very little water. Any water present mostly occurs in the weathered bedrock zone. The geometry of the Qal/WBR HSU and lack of recharge causes large portions of this aquifer to become unsaturated, therefore significantly slowing the migration of contaminants in this HSU. The steady-state flow assumption conservatively simulates continuous flow, therefore continuous transport in this HSU.

The same transport parameters discussed in section E-1.1 were used for both the tritium and total uranium simulations. The initial tritium and uranium distributions are based on the second quarter 2003 plume maps shown in Figure 2-17 and Figure 2-18, respectively.

E-2.2. Results

Tritium: The predicted maximum ground water activity at a hypothetical water supply well at the eastern site boundary for both tritium scenarios (with and without a source term) do not reach detection limits (will be equal to background levels). The center of mass for the isolated source term scenarios is 500 ft (150 m) from the source area in 40 to 50 years. The center of mass for the active source term scenario is 550 ft (170 m) from the source area in 40 to 50 years (Table E-1). Figure E-9 shows the last time step in the model simulation where activities at or slightly above the 20,000 pCi/L MCL still remain in the Qal/WBR HSU. After this time step, the model results predict that all tritium activities in the Qal/WBR HSU will be below the MCL. Although the hydraulic conductivity of this unit is higher than the bedrock aquifer and the gradient is at times steeper than the bedrock unit, the ephemeral nature of this unit limits migration of the contaminant plumes. Tritium migration in this HSU essentially stops during the dry summer months when there is no recharge, the gradient is flat, and most parts of the alluvium are unsaturated. The maximum activity levels remain above the MCL for a longer duration than the $Tnbs_0$ bedrock HSU since the Qal/WBR HSU initially has higher tritium activity levels.

Total Uranium: The predicted maximum uranium activity at the eastern site boundary will not exceed the current observed (background) levels. It is estimated to take 400 to 500 years for the activity level in the center of mass to reach the MCL. The maximum activity in the aquifer is 1,000 ft (300 m) downgradient of the source area when levels fall below the MCL. Figure E-10 shows the last time step in the model simulation where activities at or slightly above the 20 pCi/L MCL still remain in the Qal/WBR HSU. After this time step, the model results predict that all uranium activities in the Qal/WBR HSU will be below the MCL.

E-3. Estimation of Evaporation of Tritium from Spring 24

Similar to the modeling of tritium flux from surface water performed in the Site-Wide Remedial Investigation for Site 300 (SWRI) (Webster-Scholten, 1994), the flux rate of tritium from Spring 24 was determined using the following equation:

$$CQ = C \times ET \times \text{fraction}_T \times A \tag{E-1}$$

where,

CQ = flux rate of tritium (picocuries per year [pCi/yr]),

C = the maximum activity of tritium detected at SPRING 24 (2380 pCi/L),

ET = evapotranspiration rate (60 inches per year [in./yr]),

fraction_T = fraction of tritiated water, assumed to be 100%, and

A = surface area of Spring 24 over which average activity is determined (33.44 square meters [m^2]).

The same variables for evapotranspiration and fraction_T that were used in the SWRI were used in this model. The SWRI used the 95% upper confidence limit of the tritium activity to calculate the flux. However, to be conservative, the maximum detected tritium activity was used in the above equation. The estimated flux rate of tritium at Spring 24 was used in an air dispersion model (Turner, 1982) that was used in the SWRI to determine exposure point activities of tritium that volatilize from Spring 24:

$$C_a = CQ/L\mu S_y(r) \tag{E-2}$$

where,

Ca = annual average ground-level activity of tritium in air (picocuries per cubic meter [pCi/m^3]),

CQ = tritium flux rate from Spring 24 (pCi/yr),

L = mixing height (5.0 m),

Sy(r) = annual average wind speed at Site 300 (5.0 meters per second [m/sec]),

r = distance from the point source (1 m).

This exposure point activity was used to estimate the average intake of tritium an adult working onsite near Spring 24 would inhale using the equation:

$$E = Ca \times PEF \qquad \text{(E-3)}$$

where,

E = average intake of inhaled tritium by an adult, onsite worker (pCi),

Ca = annual average ground-level activity of tritium in air (pCi/m^3), and

PEF = pathway specific exposure factor for carcinogenic effects from inhalation of tritium by an adult working onsite (m^3).

The PEF was calculated using the following equation:

$$PEF = IR \times EF \times ED \qquad \text{(E-4)}$$

where,

PEF = pathway specific exposure factor for carcinogenic effects from inhalation of tritium by an adult working onsite (m^3),

IR = inhalation rate (20 m^3/day),

EF = exposure frequency (250 days per year [d/yr]), and

ED = exposure duration (25 yr).

$$R = E \times SF \qquad \text{(E-5)}$$

where,

R = risk associated with the inhalation of tritium that has volatized from the spring by an adult working onsite (unitless),

E = average intake of inhaled tritium by an adult onsite worker, (pCi), and

SF = inhalation slope factor for tritium (5.62×10^{-14} risk/pCi), obtained from the Risk Assessment Information System website.

The risk associated with the inhalation of tritium that has volatized from the spring by an adult working onsite was calculated to be 1.08×10^{-9}.

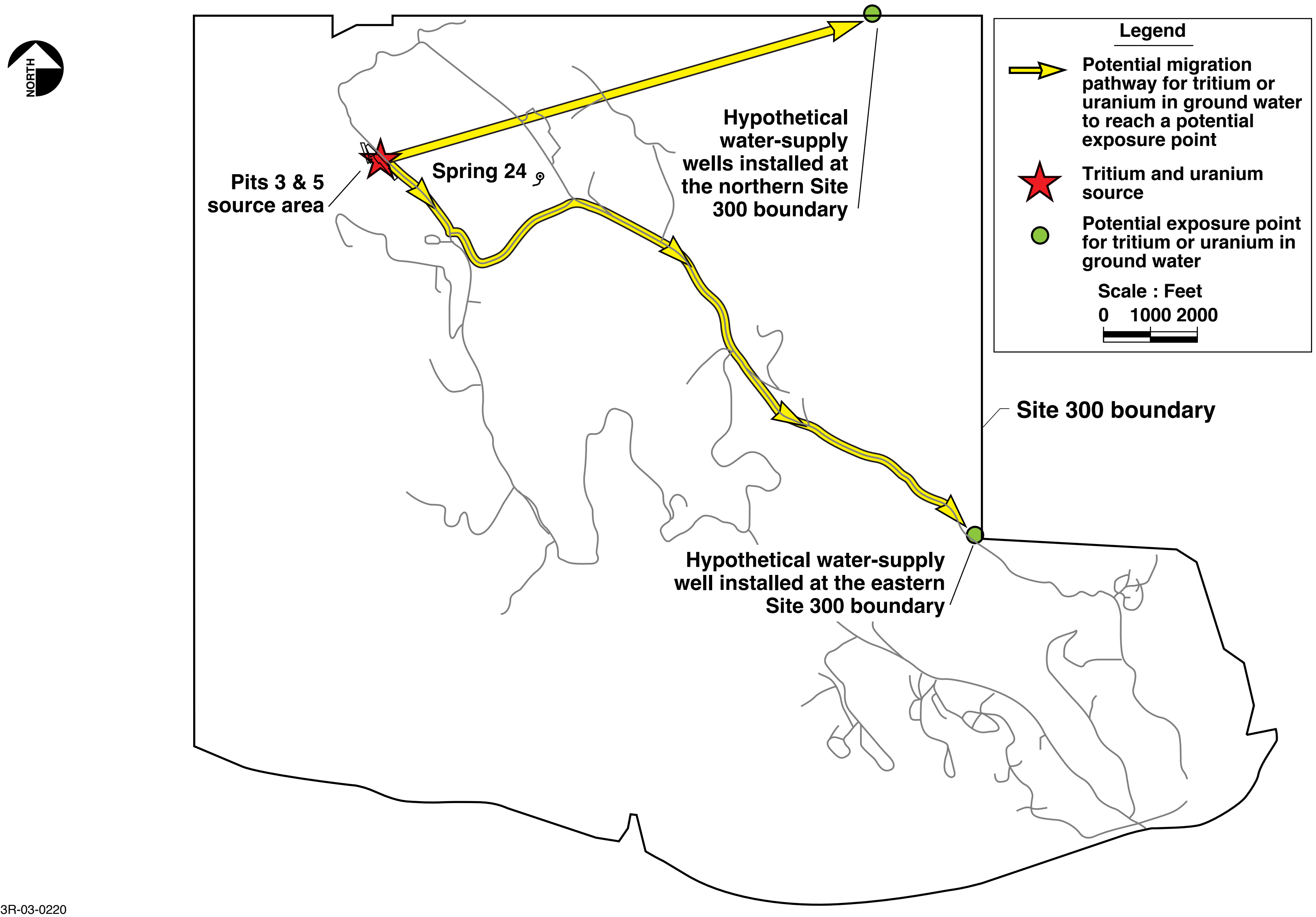
E-4. References

Diersch, H.J. G. (2002), FEFLOW Reference Manual, WASY Institute for Water Resources Planning and Systems Research Ltd., Berlin, Germany.

Turner, D.B. (1982), Workbook of Atmospheric Dispersion Estimates, Office of Air Programs, U.S. Environmental Protection Agency, Research Triangle Park, N.C., TD-18/Office of Air Programs Publication, No. AP-26 (revised 1970).

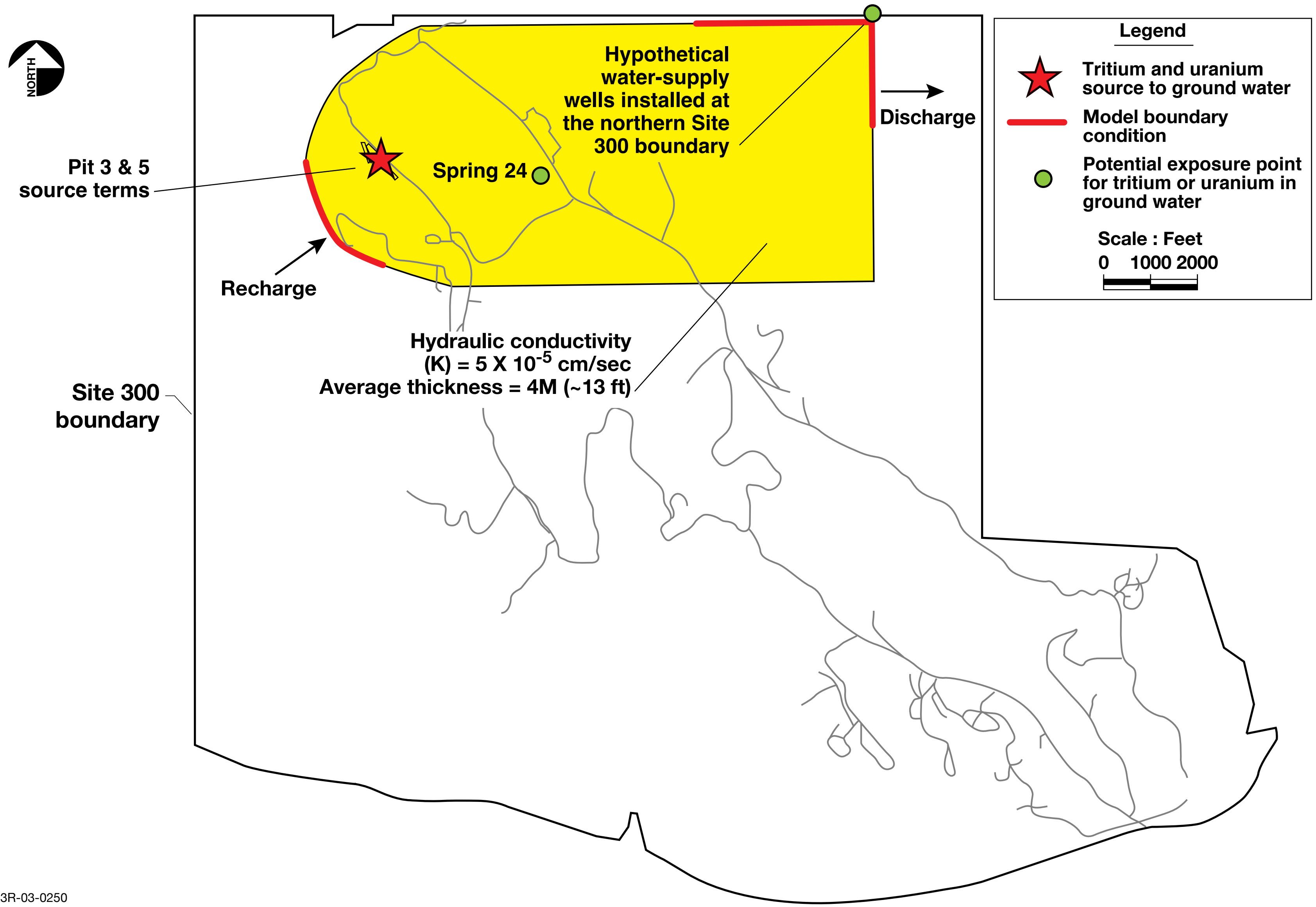
Thibault, D.H., M.I. Sheppard, and P.A. Smith (1990), A Critical Compilation and Review of Default Soil Solid/Liquid Partition Coefficients, Kd, for use in Environmental Assessment, Whiteshell Nuclear Research Establishment, Atomic Energy of Canada Limited.

Webster-Scholten, C.P., Ed. (1994), *Final Site-Wide Remedial Investigation Report*, *Lawrence Livermore National Laboratory Site 300*, Lawrence Livermore National Laboratory, Livermore, Calif. (UCRL-AR-108131).



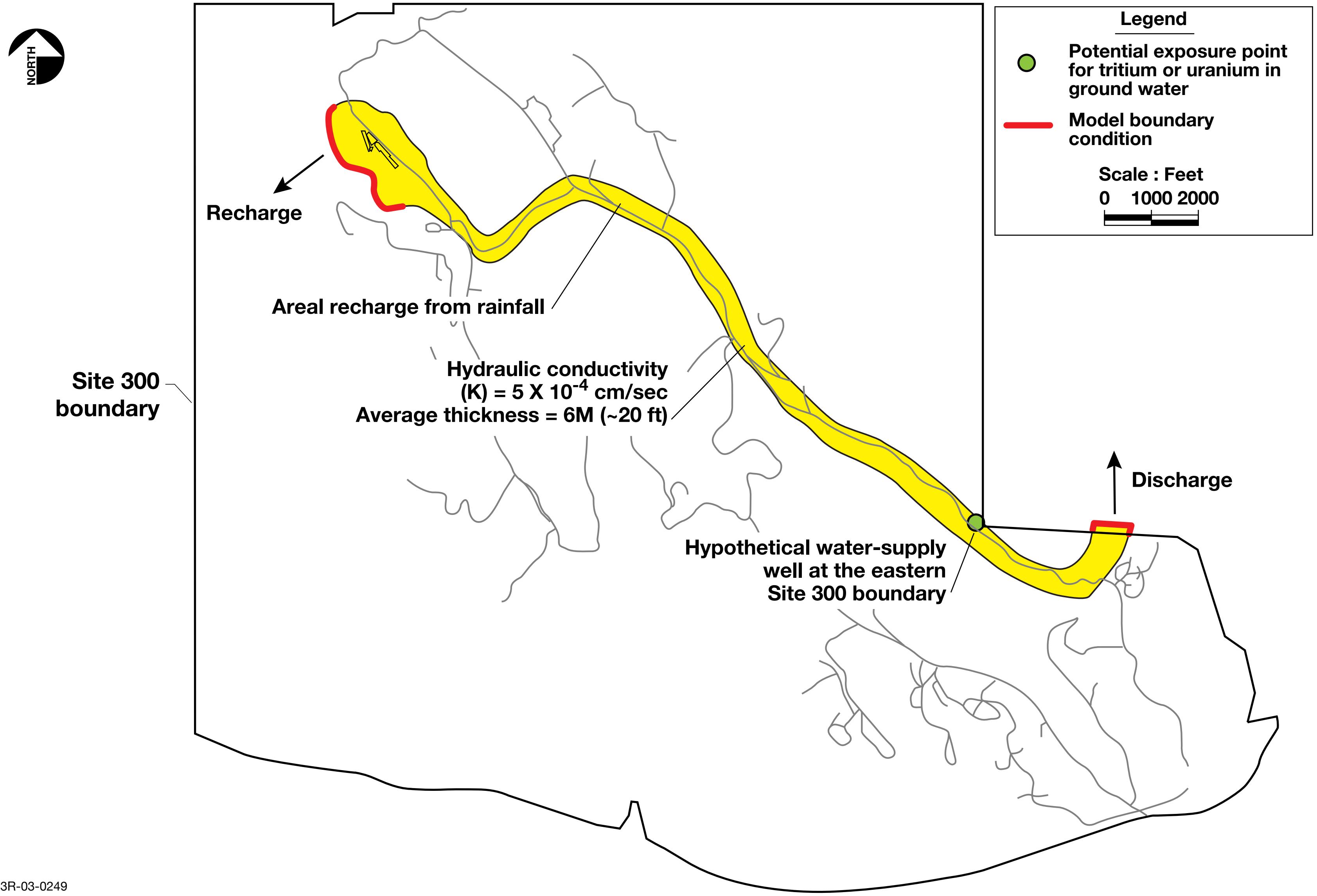
ERD-S3R-03-0220

Figure E-1. Potential fate and transport pathways for tritium and uranium in ground water.



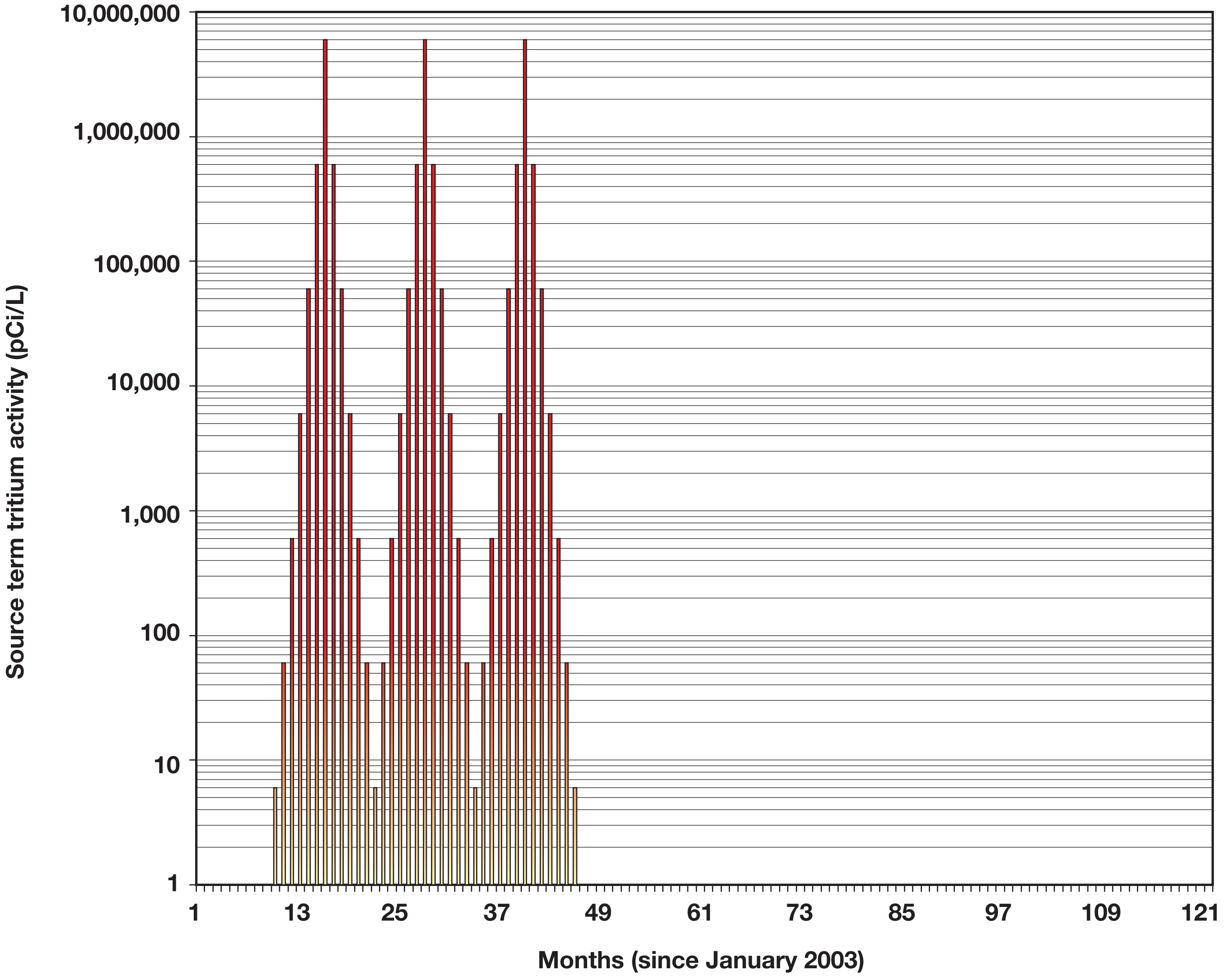
ERD-S3R-03-0250

Figure E-2. Tnbs$_0$ bedrock aquifer FEFLOW model domain.



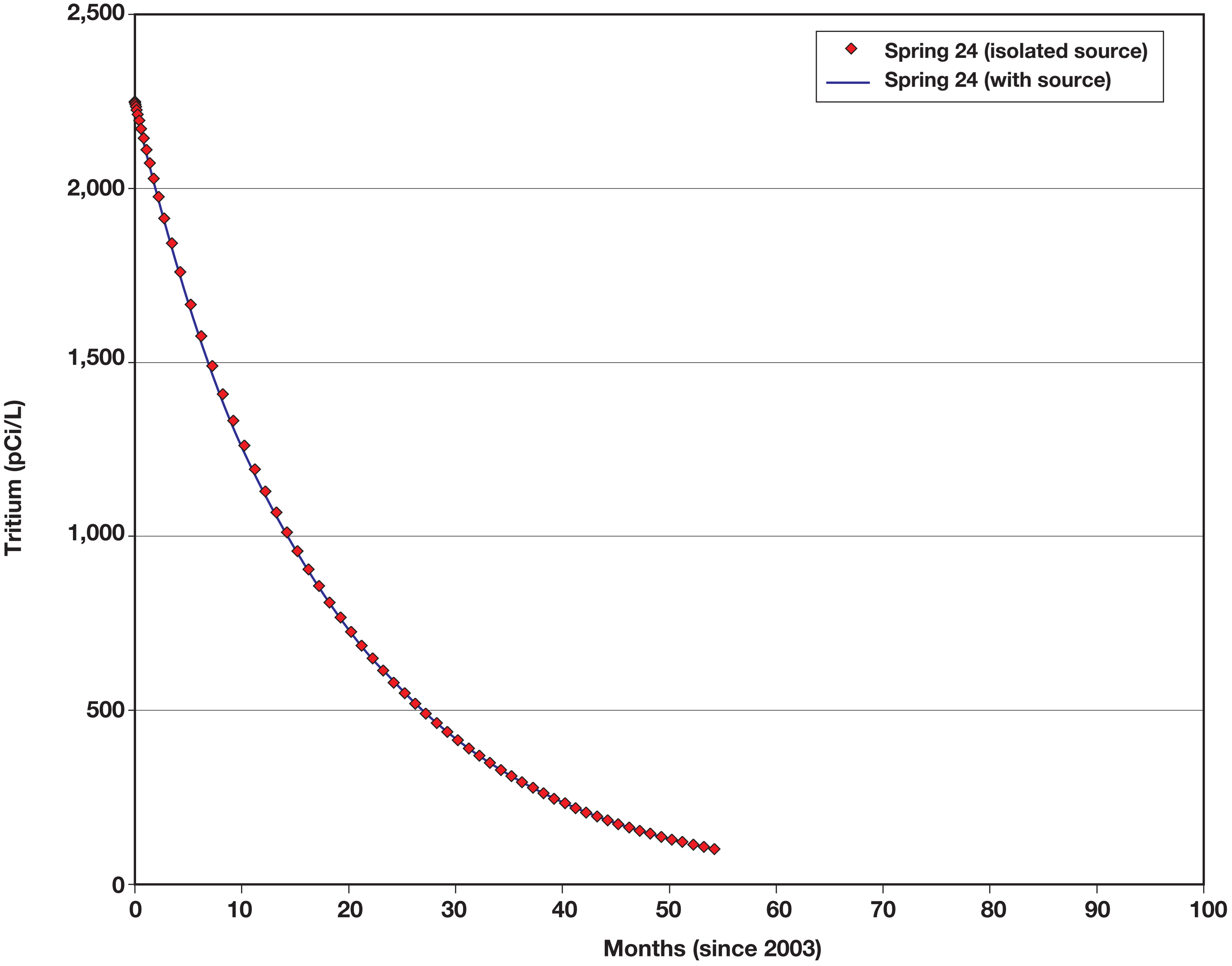
ERD-S3R-03-0249

Figure E-3. Quaternary alluvial aquifer FEFLOW model domain.



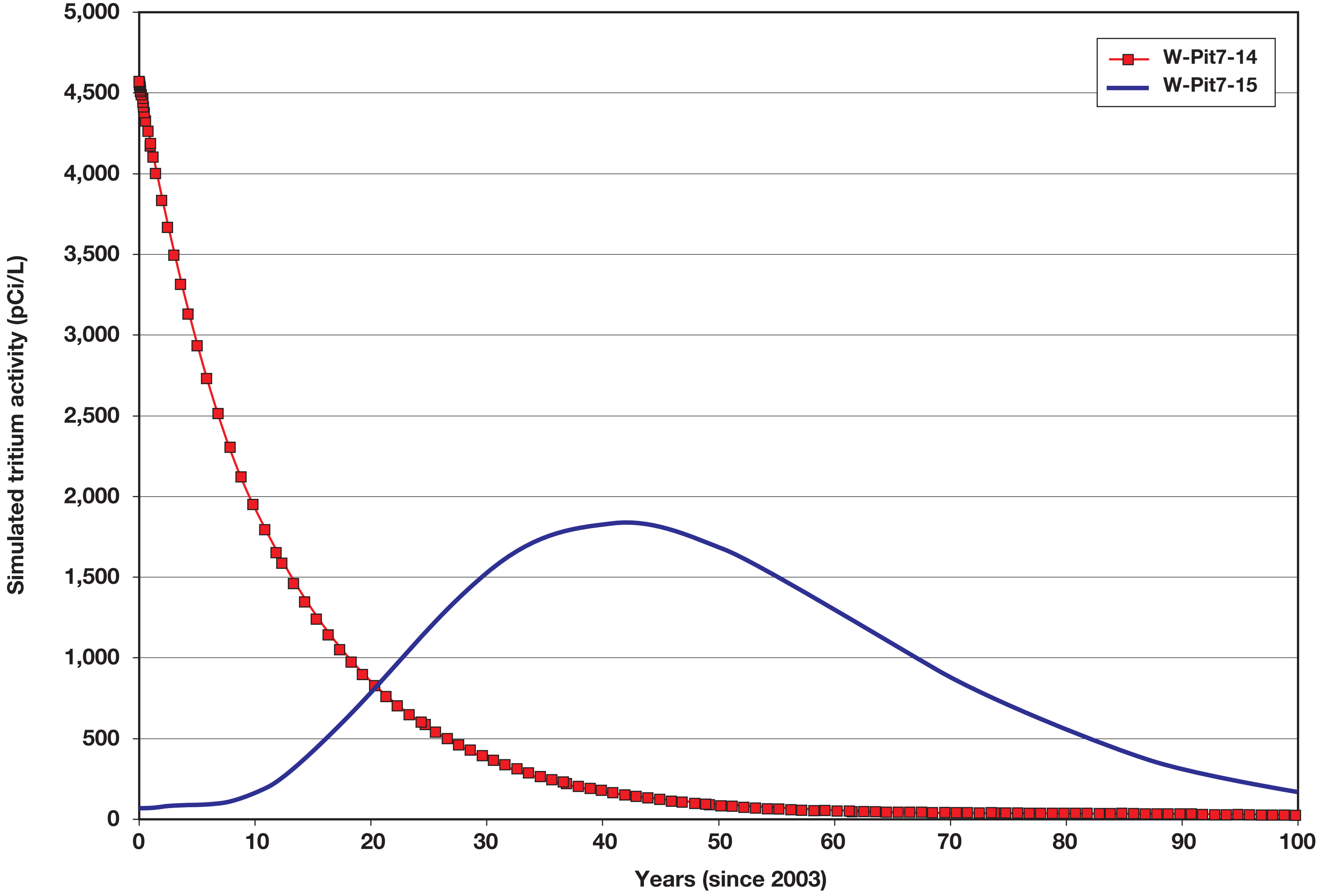
ERD-S3R-03-0246

Figure E-4. Tritium activities in the source term that represents three consecutive years of pits inundation by the rising ground water elevations.



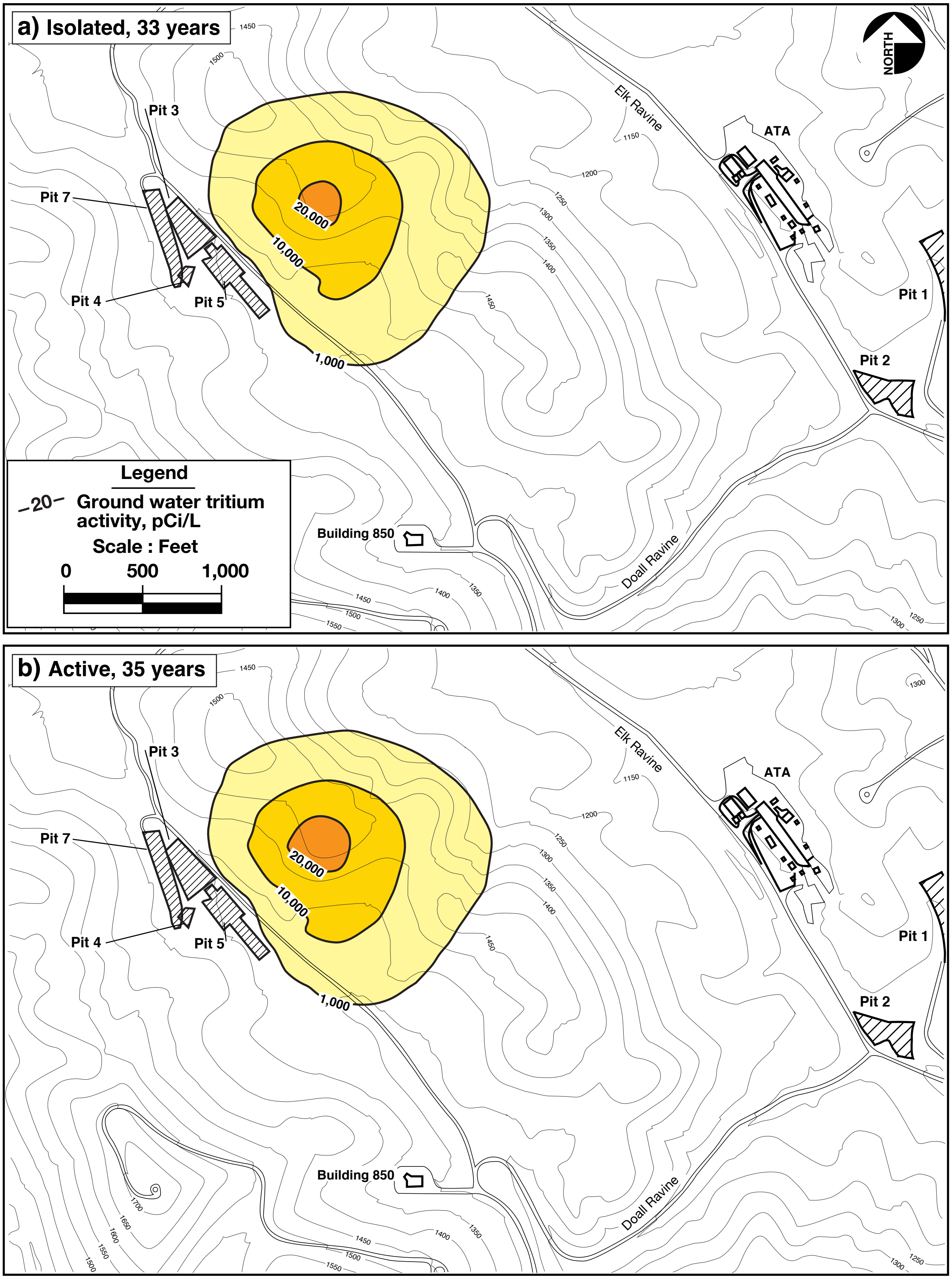
ERD-S3R-03-0247

Figure E-5. Predicted tritium activity at Spring 24 for both isolated source and active source term scenarios.



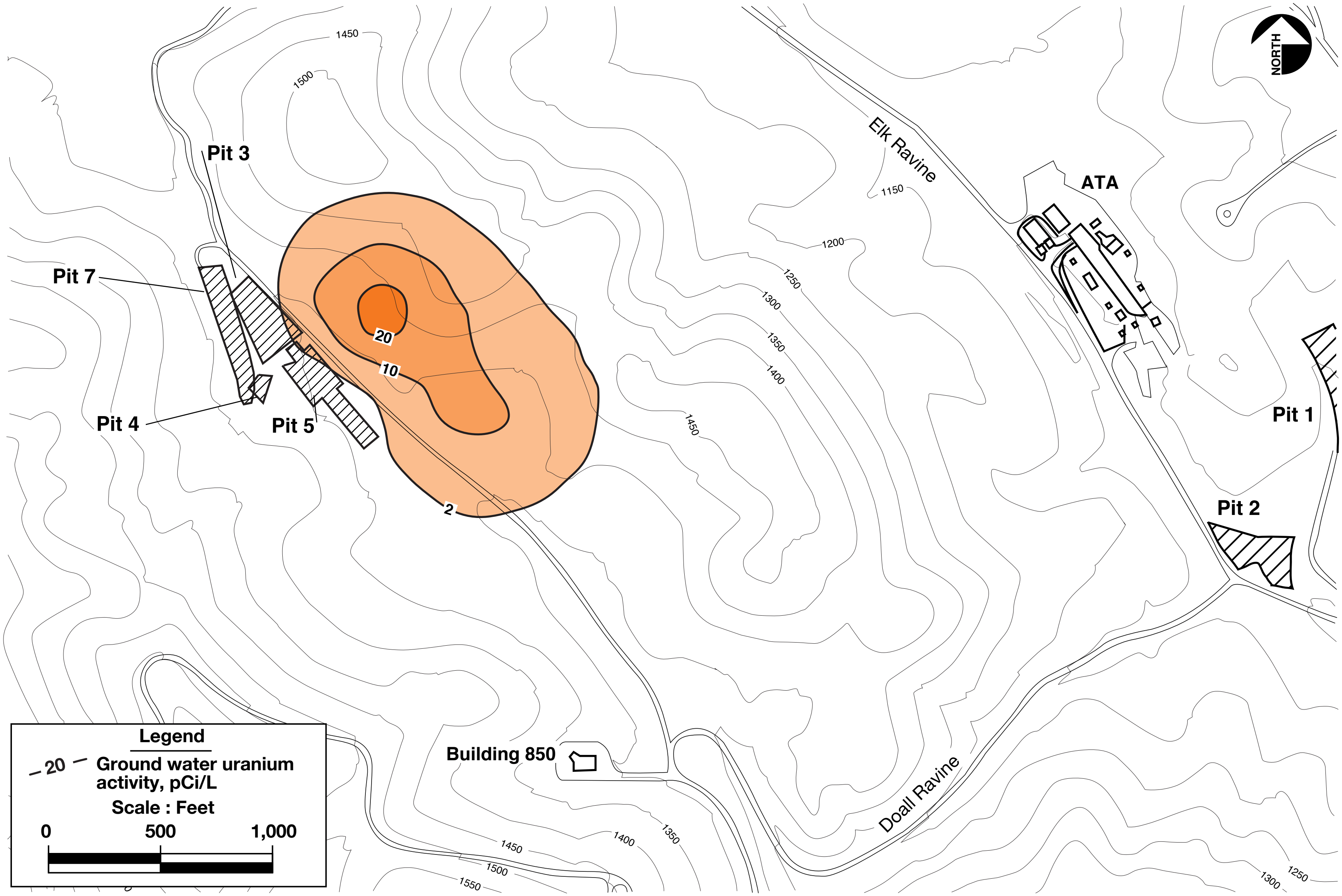
ERD-S3R-03-0248

Figure E-6. Predicted tritium activities in ground water at downgradient wells for the active source term scenario.



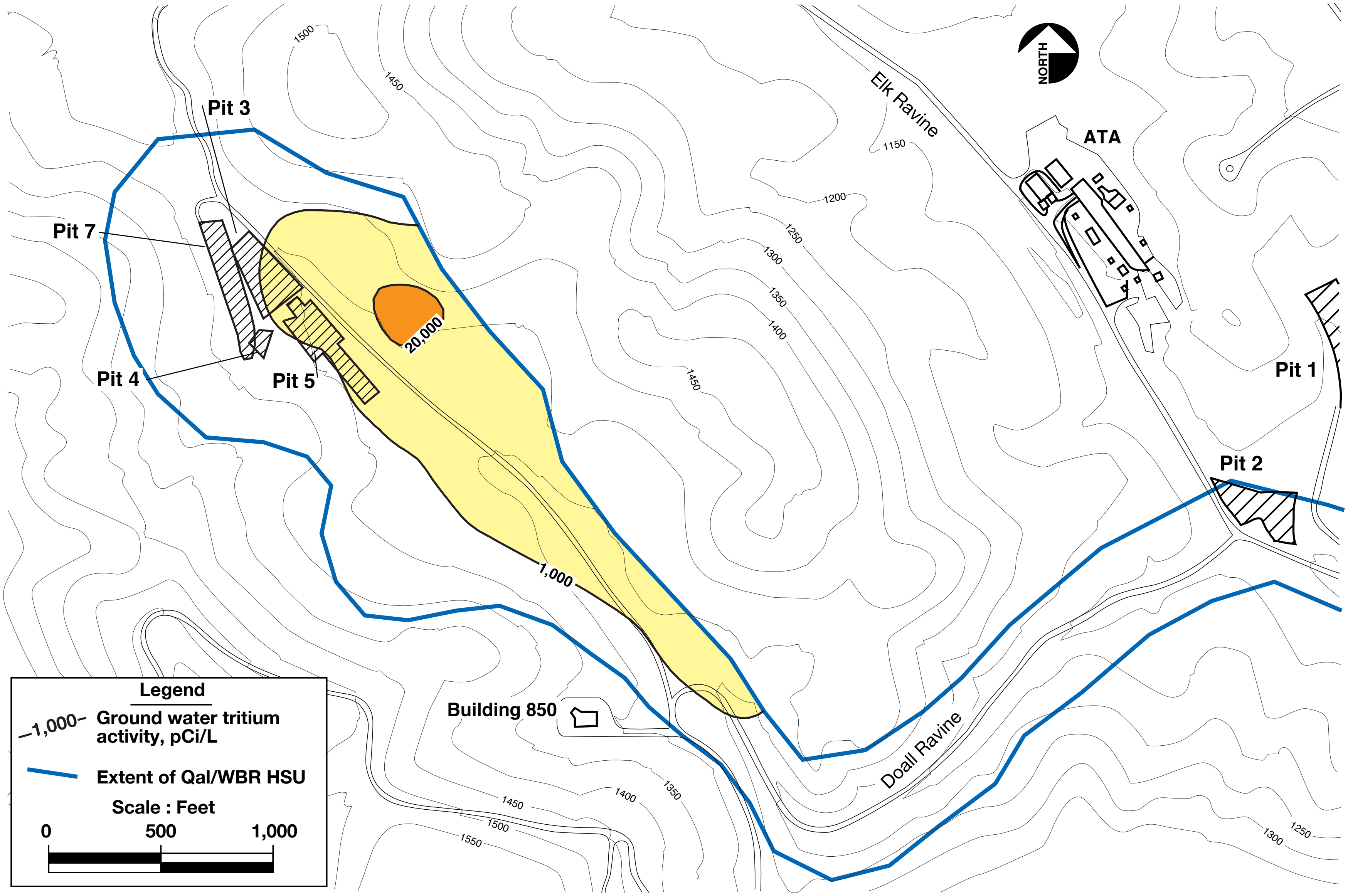
ERD-S3R-03-0252

Figure E-7. Tritium plume location map in the bedrock aquifer when maximum activity in the aquifer reduces below MCL of 20,000 pCi/L. a) Isolated (33 years) and b) active (35 years) source terms.



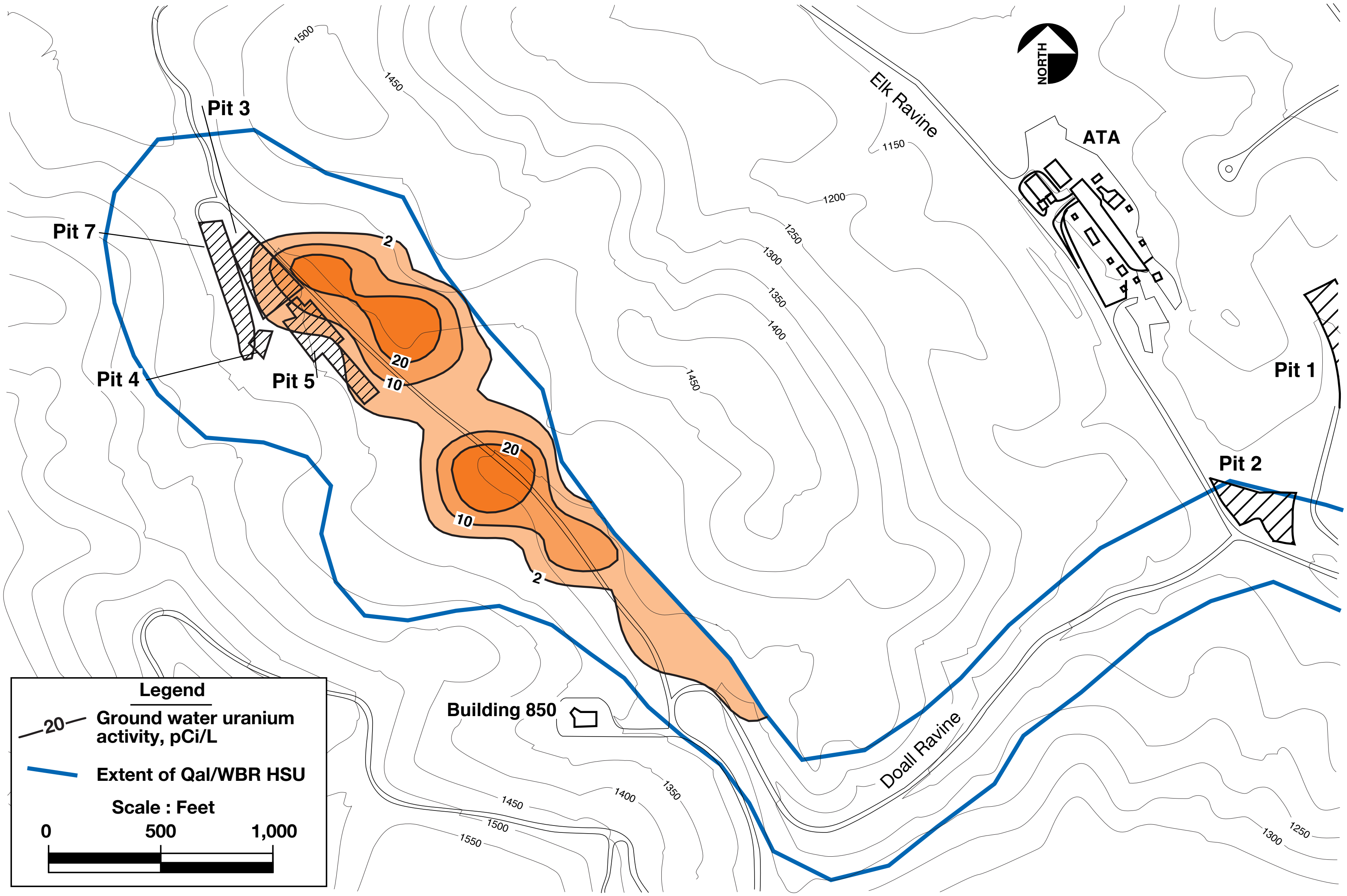
ERD-S3R-03-0251

Figure E-8. Total uranium plume location map in the bedrock aquifer when maximum activity in the aquifer reduces below MCL of 20 pCi/L.



ERD-S3R-04-0113

Figure E-9. Tritium plume map in the Qal/WBR HSU when maximum activity reduces below the MCL of 20,000 pCi/L (30 to 40 years).



ERD-S3R-04-0114

Figure E-10. Total uranium plume map in the Qal/WBR HSU when maximum activity reduces below the MCL of 20 pCi/L (400 to 500 years).

Table E-1. Summary of fate and transport modeling results.

Hydrostratigraphic Unit	Contaminant	Duration to reach MCL in HSU	Distance to center of mass from Pits 3 & 5 when MCL is reached	Potential Receptor	Impact at receptor
$Tnbs_0$	**Tritium with source isolated**	**30 to 40 years**	**700 ft**	**Hypothetical well at northeastern boundary**	**No impact – background levels**
				Spring 24	**No further impact – 2,000 to 3,000 pCi/L**
	Tritium with source releases	**30 to 40 years**	**800 ft**	**Hypothetical well at northeastern boundary**	**No impact – background levels**
				Spring 24	**No further impact – 2,000 to 3,000 pCi/L**
	Total uranium with source isolated[a]	**400 to 500 years**	**400 ft**	**Hypothetical well at northeastern boundary**	**No impact – background levels**
				Spring 24	**No impact – background levels**
Qal/WBR	**Tritium with source isolated**	**40 to 50 years**	**500 ft**	**Hypothetical well at eastern boundary**	**No impact – background levels**
	Tritium with source releases	**40 to 50 years**	**550 ft**	**Hypothetical well at eastern boundary**	**No impact – background levels**
	Total uranium with source isolated[a]	**400 to 500 years**	**1,000 ft**	**Hypothetical well at eastern boundary**	**No impact – background levels**

[a] **Total uranium simulation with source releases was not included because of complex reaction kinetics that control uranium releases to ground water which could not be modeled using the existing model.**

Appendix F

Remedial Technologies and Process Options

Appendix F

Remedial Technologies and Process Options

This appendix further describes the remedial technologies and process options presented in Chapter 3. Several of the remedial technologies described in this appendix have already been tested and used at Lawrence Livermore National Laboratory (LLNL) Site 300, as identified in the discussions below.

F-1. Ground Water Remedial Technologies and Process Options

Remedial technologies and process options that may be applicable to the Pit 7 Complex area at Site 300 for the extraction, hydraulic control, treatment, and disposal of ground water are discussed below.

F-1.1. Ground Water Extraction

F.1.1.1. Ground Water Extraction from Wells

Ground water extraction may be conducted to hydraulically contain and clean up ground water contamination. Extraction wells may be used to control the local ground water gradient and flow direction, and to supply water to treatment systems. Ground water extraction may be conducted with well points (driven vertical pipes that draw water over a relatively narrow vertical interval), naturally developed wells (i.e., wells without an artificial filter pack around the screen), or filter-packed wells. Well points are typically used only for shallow (< 30 feet [ft]) ground water extraction and are typically manifolded to a header pipe and pumped with a suction system. Larger-diameter wells are typically pumped with submersible electric pumps, although vertical turbine or pneumatic positive displacement pumps may also be used.

Extraction wells intended to supply water to a treatment system are typically installed within plumes and at plume margins, and in contaminant source areas. Wells used in a ground water recirculation system would most likely be installed near the leading edge of a plume and would supply water to injection wells located upgradient of the contaminant source. Extraction wells installed for hydraulic gradient control might be installed upgradient of a plume [U.S. Environmental Protection Agency (EPA), 1991].

Extraction of uranium-, nitrate-, and perchlorate-contaminated ground water from the Qal/WBR and $Tnbs_0$ HSUs with *ex situ* treatment and subsequent reinjection of the treated water into these HSUs was retained and included as a component of Alternatives 3a and 5a. Following the removal of uranium, nitrate, and perchlorate, the treated ground water containing tritium could be reinjected a short distance downgradient of the extraction wells without causing adverse impacts such as ground water rises into contaminant source areas or accelerated migration of the tritium plume.

F-1.1.2. Ground Water Extraction Using a Funnel and Sump

The funnel and gate concept was developed to enhance capture and collection of contaminated ground water in areas that do not lend themselves to typical pumping technologies. This technique involves installation of sheet pile walls and grout curtains (Section F-1.6.2) to funnel ground water to a point or area (the "gate") for treatment or extraction, thereby eliminating further downgradient contaminant migration. The gate is commonly an *in situ* passive treatment system, such as a permeable reactive barrier (see Section F-1.5.1). The funnel is typically comprised of sheet pile walls and grout curtains that form a "V" shape. The "V" points downgradient, with a permeable reactive barrier or hydraulic sump at the point of the "V." The open end encompasses the width of the contaminated ground water plume to be captured.

In a typical funnel, vertical sheet piles are driven and keyed into a confining layer to form the initial "V" shape. The downgradient ends of the sheet piles direct water to the gate, and the upgradient ends terminate within a grout curtain oriented to capture the desired water. The grout curtain, which forms the outer edges of the "funnel," is typically created by injection of grout under high pressure into a line of borings spaced closely enough to create a continuous low permeability wall of grout. When injected, grout flows into the cracks and pores of the soil matrix and then hardens to create a low permeability barrier to ground water flow.

In a funnel and sump system, the hydraulic sump may consist of an extraction well or wells, or a pit filled with permeable material to store the funneled water. Extraction wells supply water to an aboveground treatment system. If the sump is a pit, the water may be pumped from the pit using a surface pump and conveyed to a treatment system.

This technique is applicable at the Pit 7 Complex, especially in the alluvium/weathered bedrock water-bearing zone where a funnel and sump system can be installed across the alluvial channel to capture contaminated ground water for ground water extraction and treatment or hydraulic control.

F-1.2. Ex Situ Ground Water Treatment

F-1.2.1. Aerogel/Granular Activated Carbon Composite

LLNL has been developing and evaluating the use of aerogel/granular activated carbon (GAC) composites to replace for ground water treatment (Coleman et al., 2003). This technology employs GAC that has been coated with an aerogel consisting of hydrophobic silica gel. The composites typically consist of approximately 90% coconut shell GAC and 10% aerogel. The aerogel/GAC composites retain the shape and basic structure of GAC and thus can be used in systems designed for GAC.

Laboratory shaker and column tests have shown that the aerogel/GAC composite removes some metals, including uranium, from water. Field tests on ground water samples with initial uranium concentrations of about 300 micrograms per liter (μg/L) resulted in greater than 95% removal. This technology has not been tested at a production scale, but shows promise for use in ground water treatment systems. Additional evaluation of aerogel/GAC composites is planned for potential application at the Pit 7 Complex.

F-1.2.2. Electro-coagulation

Electro-coagulation is a process where contaminants are separated from water by applying direct or alternating electrical current to create large particles that can be settled or filtered out of a solution (Powell, 2000). Electro-coagulation adds electrons to a solution that destabilize contaminants in the water to create an oxide sludge which can be filtered from the solution. Electrochemical reactors introduce current across electrodes to plate out complex uranium oxides. The electro-coagulation reaction is similar to that which occurs in the presence of zero valent iron.

Bench- and field-scale tests conducted at LLNL have shown that a commercially-available electrochemical reactor reduced total uranium activity from tens to hundreds of picocuries per liter (pCi/L) to less than one pCi/L by coagulating soluble uranium into a form [U(IV)02] that can be separated from water. LLNL will continue to evaluate this technology for potential application at the Pit 7 Complex. The technology was found to be effective in a field treatability test in removing uranium from ground water at the Site 300 Building 812 area that is of similar major ion geochemistry to ground water in the Pit 7 Complex area.

F-1.2.3. Apatite

Several forms of the mineral apatite, specifically hydroxyapatite, have been shown to be effective in removing uranium from ground water (Taffet et al., 2003; Fuller et al., 2003). Hydroxyapatite removes uranium from solution by sorption and mineralization. Studies indicate that sorption is the only removal mechanism for uranium concentrations less than 50 μg/L, and that precipitation reactions are the dominant process for removal of uranium concentrations over 100 μg/L. Laboratory studies conducted by LLNL indicate that hyrodroxyapatite can reduce uranium concentrations to levels as low as 0.3 μg/L. The uranium sorption efficiency is controlled primarily by the hyroxyapatite surface area and the contact time between the apatite and the uranium-bearing solution.

Hydroxyapatite is present in cow bone char and fish bones and can also be obtained as a powdered reagent. Cow bone char is preferred because of its low cost and lack of odor. Hydroxyapatite can be used in both in situ and ex situ treatment systems for uranium removal. Cow bone char has been tested for in situ uranium removal in permeable reactive barriers at a uranium mill tailings activity site at Fry Canyon in Utah, and for a uranium plume at Oak Ridge National Laboratory. In addition, it has been installed in eleven boreholes in a uranium-238 plume in the Pit 7 Complex area at Site 300. Analytical data from the Pit 7 area indicate that uranium concentrations on the order of 185 μg/L decreased to concentrations as low as 0.6 μg/L downgradient of the cow bone char-filled boreholes, indicating this technology may be viable for application in the Pit 7 Complex area. This technology was found to be effective in removing uranium from ground water from the Site 300 Building 812 area that is of similar major ion geochemistry to ground water in the Pit 7 Complex area.

F-1.2.4. Ion Exchange

Ion exchange is a process in which target ions, such as perchlorate, nitrate, or uranium-bearing ions, can be removed from water. Contaminated water is pumped into tanks or large columns filled with ion-specific resin beads or hybrid resins for removing multiple contaminants from a single water stream. Ion exchange resins are composed of a polymer backbone attached to a functional group selected to attract the ion of concern. Typically, before the resin is exposed to the contaminated water, the functional group is bonded to a chloride ion. However, other ions may initially be bonded to the functional group, depending on the specific chemical species in the water. When the contaminated water flows through the resin beads, the chloride ion is exchanged for the target ion of concern, which has a higher affinity for the functional group. These chloride ions enter solution and flow out with the effluent stream, while the exchanged target ions remain bonded to the functional group. When the resin becomes saturated with target ions, it is regenerated by rinsing with a high concentration salt solution. Because of the extremely high percentage of chloride ions, the target ions are displaced, enter solution, and exit with the regenerating waste water. The waste water is then disposed and the resin is rinsed with clean water and returned to service.

Uranium is found in ground water as a variety of dissolved species, depending on chemical conditions. At Site 300, due to the abundant dissolved oxygen and bicarbonate in the ground water, uranium typically occurs as uranium carbonate complexes. Prior to selecting the appropriate resin, column experiments must be conducted to determine which resin is most efficient and cost-effective in removing uranium from the extracted site-specific ground water. In addition to resins, other agents, such as zeolites, activated carbon, peat, phosphates, ferric hydroxides, and iron filings can be used to remove uranium from water streams.

Because uranium in ground water in the Pit 7 Complex area occurs as anionic complexes $[(UO_2)\ (CO_3)_2{}^{-2}]$ and $[(UO_2)\ (CO_3)_3{}^{-4}$, the same ion exchange resin may also be effective in removing nitrate and perchlorate from extracted ground water. If the same ion exchange resin is not capable of removing nitrate, perchlorate, and uranium from ground water, several ion exchange resins could be employed in series.

Other contaminants and naturally-occurring ions may foul the resin beads and force more frequent regeneration of the resin. The ion exchange unit requires fairly high flow rates (15 to 25 gallons per minute) to be effective. The higher the concentration of target ions, the quicker the resin will become saturated and require regeneration. The cost of resin replacement and disposal of regeneration wastes can be too high to make this a cost-effective technology.

The ion exchange technology would be applicable to *ex situ* treatment of uranium, perchlorate, nitrate, and VOCs in Pit 7 Complex ground water. It is currently used for the *ex situ* treatment of ground water contaminated with perchlorate and nitrate at other locations at Site 300.

F-1.2.5. Tritium Treatment Technologies

Since one of the contaminants of concern at the Pit 7 complex is tritium, specific remediation issues associated with this contaminant are discussed below.

Tritium cannot be chemically treated to render it non-radioactive. Therefore, isotope separation techniques to concentrate the tritium into a smaller volume are the only methods available for tritium-bearing water treatment. In tritiated water, the substitution of an atom of hydrogen (atomic mass of 1) with the three-fold heavier isotope, tritium, causes variation in most of the chemical and physical properties of the water. This is a consequence of the corresponding mass variation. All of the processes employed for isotopic separation take advantage of the mass variation between untritiated and tritiated water.

A generalized tritium separation element can be conceptualized as a container into which tritiated water flows of a certain isotopic composition. Out of the separation element flow two streams, one containing a higher percentage of the tritium than the influent stream and one a lower percentage. For ground water restoration, the goal is to concentrate the tritium in a small volume and to treat and release extracted water with little-to-no tritium to the environment with no adverse effects.

Although isotopic separation processes are based on differing principles, the common goal is to multiply the elementary separation effect to achieve a predetermined final isotopic content in a treated volume of tritiated water. Thus, researchers have developed a mathematical framework, wherein a separation factor defines the increase of the desired isotope after one run through a separation element. One or more separation elements connected in parallel define a stage. The desired isotopic concentration can be achieved by connecting several stages in series. These data are important for estimating total treatment costs.

The following technologies for tritium removal from water are currently available or are in experimental stages, and may become available, if proven effective:

- Electrolytic enrichment.
- Thermal diffusion.
- Vapor phase catalytic exchange/cryogenic distillation.
- Liquid water distillation.
- Combined electrolysis/catalytic exchange.
- Membrane filtration.
- Isotopic exchange.
- Resin separation.

The first five technologies were developed to enrich or treat tritium-bearing waters for analytical or nuclear power plant applications, where massive quantities of water might require treatment. Thus, these technologies, while proven and available, require a large scale and have very large capital and operating costs. The final three technologies are in proof-of-principle and experimental stages. Therefore, it is not yet possible to evaluate their applicability to tritium-bearing ground water at Site 300. However, the current understanding of what would be required to implement any of these technologies at Site 300 indicates that at least several of them would be very expensive.

A more complete overview of the various treatment technologies can be found in McConachie and Brown (1996).

F-1.3. Disposal of Treated Water

F-1.3.1. Reinjection

Reinjection wells can function as a means to discharge treated ground water, hydraulically control plume movement, and reduce cleanup times by flushing clean water through a cleanup area. However, the quality of the reinjected water is important because of the potential for recontamination and/or scaling from precipitates, such as carbonate. Scaling and/or microbially-induced fouling commonly reduces the efficiency of the injection well and require periodic maintenance. For purposes of flow control, ground water reinjection might need to take place within the capture zones of ground water extraction wells (U.S.EPA, 1991). Treated water can also be discharged into engineered infiltration trenches that introduce the treated water into the shallow subsurface without causing any accumulation of water at the ground surface.

Re-injection of treated ground water can be an effective component of an extraction and treatment alternative for ground water containing multiple contaminants such as depleted uranium, nitrate, perchlorate, and tritium as discussed in Sections F-1.1.1. However, it would be necessary to reinject the tritium-bearing water following removal of the uranium and other contaminants for which a viable treatment technology exists. In addition, safety precautions would need to be implemented to prevent exposure to tritium during the extraction and reinjection process.

Reinjection of ground water at the Pit 7 Complex would have to be designed and conducted to ensure that hydraulic gradients were not altered to enhance contaminant migration or that the water table did not rise into contaminant source areas. Modeling was conducted to evaluate whether reinjection of treated ground water would result in inundation of the Pit 7 Complex landfills and/or further mobilization of contaminants in ground water. The modeling results indicated that reinjecting limited volumes of treated water in strategic locations would not result in further releases and/or the spread of ground water contamination.

F-1.3.2. Onsite Surface Discharge

Ground water treatment system effluent can potentially be discharged directly to the ground surface onsite. These discharges are regulated under Substantive Requirements issued by the California Regional Water Quality Control Board. The treated water can be sprayed onto the ground where it rapidly infiltrates.

Treated ground water could also be discharged to nearby surface water, or a sanitary sewer or storm drain under a National Pollution Discharge Elimination System permit under waste water discharge requirements. However, due to the likely presence of tritium in treated water, onsite surface discharge is not a viable technology for the Pit 7 Complex area.

F-1.3.3. Onsite Recycling/Reuse and Offsite Uses

At Site 300 onsite recycling and reuse of treated ground water consists primarily using the water for irrigation of vegetation at Site 300. Currently, well water is used for this purpose. In the past, adjacent property owners have also expressed interest in using treated ground water for irrigation purposes on their ranches. Potential legal issues have thus far prevented the use of treated water offsite. In addition, due to the likely presence of tritium in treated water, recycling/reuse is not a viable technology for the Pit 7 Complex area.

F-1.3.4. Air Misting

Air misting is a method of discharging treated ground water by forcing it through spray heads that separate the water into fine droplets (i.e., atomization) as it is expelled into the air. This process allows maximum areal dispersion of the water. This discharge process eliminates problems associated with surface discharge (e.g., erosion), and is most applicable for low flow rates. This process is being used to discharge treated well development and sample purge water at Site 300. However, due to the likely presence of tritium in treated water, air misting is not a viable technology for the Pit 7 Complex area.

F-1.4. Offsite Disposal or Regeneration of Treatment Wastes

Treatment wastes such as spent aerogel/GAC composite, apatite, or ion exchange resin containing sorbed contaminants, and precipitated contaminants from electro-coagulation, are generally shipped offsite for disposal or regeneration at a Resource Conservation and Recovery Act (RCRA)-permitted facility. Contaminants may be desorbed from the aerogel/GAC composite or resin and recycled or destroyed. The regenerated aerogel/GAC and resin can then be reused. This technology would be applicable to the Pit 7 Complex if reactive media are used to remove contaminants from ground water.

F-1.5. *In Situ* Ground Water Treatment

F-1.5.1. Permeable Reactive Barrier

Permeable reactive barriers use a subsurface reactive barrier to remediate ground water contaminants *in situ* as ground water passes through the reactive barrier (U.S. Department of Energy [DOE], 1998). To construct a permeable reactive barrier, a trench is excavated in the pathway of a contaminant plume. The trench is then completely or partially filled with a substance designed to react with the contaminants of concern in ground water. As ground water passes through the reactive material, the contaminant is destroyed or altered to a non-hazardous by-product. For example, iron filings, which destroy trichloroethylene and its degradation products, have been used in permeable reactive barriers. Permeable reactive barriers are generally best suited to narrow plumes that flow through or can be directed through a plume pathway of relatively short horizontal distance.

An *in situ* permeable reactive barrier for the removal of uranium from ground water would involve excavating a fully-penetrating trench through the plume in a shallow alluvial aquifer. If it is impractical to construct a trench across the full width of the plume, a funnel and sump system (Section F-1.1.2) can be installed to increase the capture width of the reactive barrier. Prior to emplacement of the reactive materials, the trench can be kept open with shoring or caissons. The trench would be filled with a porous material (sand or gravel) impregnated with one or more of the following reactive agents: hydroxyapatite, activated carbon, organic resins, ferric hydroxides and orthohydroxides, peat, phosphates, titanium oxide, zeolites, or iron filings.

Several studies indicate that iron filings may be effective in reducing uranium to concentrations lower than background (DOE, 1998). When water flows through the iron filings, the dissolved oxygen is exhausted by iron oxidation. The uranium carbonate complexes are then quickly converted to insoluble uranium hydroxide compounds and precipitate out of the ground water.

To verify the continued effectiveness of permeable reactive barriers, monitor wells would be installed immediately up- and downgradient of the barrier, and would be monitored for uranium and other index parameters. Prior to selection and design of a permeable reactive barrier, column and bench-scale testing would be performed to select the most efficient and cost-effective material for *in situ* removal of the uranium and other contaminants in ground water. Such tests are also required to determine the effective life of the selected reactive materials and the permanence of the uranium precipitates formed. Additionally, a mechanism must be included in the design for the removal and replacement, or regeneration, of the reactive materials, which can add considerable cost to the operation and maintenance of the barrier.

Colloids are also a concern since they may not react with the barrier. If possible, an agent that can immobilize uranium-bearing colloids would be included in the reactive material.

This technology is applicable to the Pit 7 Complex and could be particularly effective in treating ground water within the alluvium/weathered bedrock aquifer, which is constrained by the width of stream channel alluvium on the northeast side of the valley.

F-1.6. Hydraulic Control

Hydraulic control may be used to avoid: 1) contamination of clean ground water by preventing plume migration or 2) further contamination of ground water by preventing surface water and ground water from coming into contact with source areas. Hydraulic control of the leading edge of a tritium plume to minimize or prevent tritiated ground water from migrating and further contaminating ground water downgradient was evaluated for the Pit 7 Complex area as discussed in F-1.6.1 below.

F-1.6.1. Ground Water Extraction and Reinjection to Control Tritium Plume Migration

Extracting ground water from the leading edge of a tritium plume and strategically reinjecting it upgradient could be used to hydraulically control the leading edge of the tritium plumes in the Qal/WBR and $Tbns_0$ HSUs.

DOE/LLNL conducted an evaluation of the feasibility of hydraulically controlling the tritium plume using recirculation. The objective of hydraulic control would be to prevent tritium-contaminated ground water from further migrating and adversely impacting downgradient ground water. This could be accomplished by extracting tritium-bearing ground water near the leading edge of the plume and injecting this ground water at upgradient locations to allow more time for radioactive decay and dispersion to attenuate the tritium. DOE/LLNL recognize that this method has been used at other tritium-contaminated sites. Sites where this approach is feasible possess abundant space for installing injection and extraction wells and are underlain by contaminated aquifers with adequate hydraulic conductivity and storage capacity to sustain continuous recirculation. Neither of these conditions exists at Site 300.

The following is a summary of DOE/LLNL's evaluation of the technical feasibility of hydraulic control of the tritium plume emanating from the Pit 7 Complex using conventional extraction and injection. The technical feasibility of hydraulically controlling the tritium plume in the Qal/WBR and $Tnbs_0$ bedrock HSUs in the Pit 7 Complex was evaluated using a finite element ground water model. In order to model hydraulic control of the tritium plume to strictly comply with Resolution 92-49, the following model parameters were specified by the RWQCB:

1. Stabilize the leading edge of the tritium plume at the 1,000 pCi/L level with a series of extraction wells that, when pumped, adequately capture the plume at this activity level.
2. Increase the residence time of the tritium-bearing ground water to allow for radioactive decay and dispersion to attenuate the plume by pumping the ground water from the leading edge and interior and injecting it at an upgradient location.
3. Inject the tritium-bearing ground water into a water-bearing zone that contains tritium at activities equal to or higher than the recirculated ground water.

4. Inject the tritium-bearing ground water in such a way that adverse impacts are avoided, such as causing water level rises that result in additional releases of tritium or accelerating migration of high tritium activities in ground water.

The extraction/injection wellfields that meet the criteria specified above for the Qal/WBR and $Tnbs_0$ HSUs are presented in Figures F-1A and F-1B, respectively.

As shown in Figure F-1A, the Qal/WBR scenario involves five extraction wells and five injection wells. The extraction wells are located just down gradient of well NC7-21 and the injection wells are located in the vicinity of well NC7-24. The total estimated sustainable extraction flow rate for all five wells is 3 gallons per minute (gpm). In practice, a total flow rate of 3 gpm is probably not sustainable during periods of below-normal rainfall and the extraction wells would likely go dry. During heavy El Nino-type rainfall seasons, the sustainable flow rate may be higher. Figure F-2 presents the impact of ground water recirculation in the Qal/WBR in terms of pit inundation, assuming a 3 gpm flow rate. As shown in Figure F-2, Pits 3 and 5 are entirely inundated after 1 year of injection. In fact, the model predicts that the entire capacity of the Qal/WBR is exceeded in less than 5 years, which would result in discharge of tritium and depleted uranium-bearing water at the ground surface.

As shown in Figure F-1B, the $Tnbs_0$ scenario involves eight extraction wells and four injection wells. Due to the rugged topography at Site 300, areas for extraction and injection wells are limited. The 1,000-pCi/L leading edge of the plume in the $Tnbs_0$ is located in areas that would require 250 to 300 ft extraction wells. These extraction wells would be located several thousands of feet away from the proposed injection wells resulting in additional costs for long pipelines. The injection well location shown in Figure F-1B is the only area for injection that will not further degrade local ground water quality, as specified in criterion 3 above. The sustainable yield from the extraction wells is expected to be low (1 gpm). Figure F-3 presents the steady-state impact of ground water extraction and injection in the $Tnbs_0$ HSU on its extent of saturation. At a 1-gpm injection flow rate, the average ground water elevation beneath Pit 3 rises 20 to 25 ft above static levels, resulting in pit inundation. For injection flow rates greater than 1 gpm, tritium-bearing ground water discharges at the ground surface where $Tnbs_0$ strata crop out in the valley north and west of the pits.

The modeling to evaluate the technical feasibility of the hydraulic control approach was done for the Qal/WBR and $Tnbs_0$ HSUs separately. If the impact from extraction and injection of both HSUs is combined, the following adverse impacts all increase significantly:

1. Pit inundation.
2. Additional release of contaminants.
3. Accelerating migration of the highest tritium activity portions of the plume.
4. Discharge of contaminated ground water at the surface.

Based on the results of the evaluation of the technical feasibility of hydraulic control by simulating its impact with conservative modeling, DOE/LLNL does not consider this a technically feasible approach.

F-2. Vadose Zone and Pit Waste Remedial Technologies and Process Options

Remedial technologies and process options that may be applicable to the Pit 7 Complex area at Site 300 for the control or containment of contaminant sources in the vadose zone and pit waste are discussed below.

F-2.1. Surface Cover/Pit Capping

A low permeability surface cover, such as an engineered cap, can limit or preclude surface water infiltration and minimize the generation of a leachate. In situations where the waste is entirely above the ground water table, a properly designed cover can prevent the entry of water into the landfill or surface impoundment due to direct infiltration. A surface cover also controls the emission of gases and odors, reduces erosion, and may improve aesthetics. A cover or cap provides a stable surface that prevents human exposure to wastes, and may be necessary when contaminated materials are left in place at a site. Under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), capping is performed when potential hazards and/or high costs associated with extensive subsurface contamination at a site make excavation and removal of wastes impractical. Capping is often implemented in connection with ground water extraction or containment technologies (U.S. EPA, 1991).

Landfill capping is not a viable option for preventing mobilization of contaminants from the Pit 7 Complex landfills, as the primary contaminant release mechanism is inundation of the landfills due to rising water table and lateral flow into the pits during periods of heavy rain rather than from infiltration of precipitation.

F-2.2. *In situ* Stabilization

***In situ* stabilization techniques lower the permeability of landfill waste; making its constituents less susceptible to mobilization by leaching.** Lawrence Berkeley Laboratory has tested injection of colloidal silica and polysiloxane grouts to immobilize and contain contaminants (Moridas, 1997). This technology involves injecting colloidal silica or polysiloxane grout into a contaminated area using vertical and/or horizontal wells. After injection, a gelling agent is injection into the colloidal silica to cause it to gel, and a catalyst is injected into the polysiloxane to cause polymerization. As a result of the large increase in viscosity during gelation or polymerization, the contaminated area (i.e., landfill contents) is immobilized in a low permeability matrix.

A field test of both colloidal silica and polysiloxane was conducted at a heterogeneous gravel quarry site in Los Banos, California. After injection to depths of 10 to 14 ft, and subsequent gelation and polymerization, excavation indicated that both materials produced relatively uniform bulbs of low permeability around the injection sites. Laboratory measurements of the grouted material showed at least a four order of magnitude reduction in permeability compared to the ungrouted material. Polysiloxane has the added advantage of apparently being unaffected by soil chemistry, which can cause premature gelling.

It is currently unknown how long gel containment would be effective in the subsurface. There is some potential to induce fracturing if the grout is injected into low permeability bedrock, which could result in higher permeability and possible contaminant transport. In addition, injecting a stabilizing agent into the Pit 7 Complex landfill materials is not feasible due to health and safety issues. In addition, this technology would not be effective in stabilizing contamination in the vadose zone underlying the pits as injection of the stabilizing agent into consolidated bedrock is not feasible.

Several other innovative methods are under development to stabilize landfill waste *in situ*. LLNL will continue to investigate new technologies for *in situ* stabilization that may be applicable at the Pit 7 Complex, although health and safety issues related to injection of stabilizing agents into the landfill severely limit the applicability of these technologies.

F-2.3. Hydraulic Barriers

F-2.3.1. Slurry Walls

Slurry walls are often utilized in combination with hydraulic controls or pump-and-treat technologies to focus ground water recovery on a particular area, or to contain waste and/or contaminated ground water. Slurry walls can also be used with capping technologies to fully confine a waste area and to prevent clean water from leaching through the subsurface wastes.

A slurry wall is typically constructed by excavating a narrow vertical trench, typically 2 to 4 ft wide, and backfilling the trench with a low hydraulic conductivity material, such as a bentonite-water slurry. As excavation proceeds, the trench is filled with the slurry which stabilizes the walls of the trench, thereby preventing collapse. The slurry penetrates into the permeable materials exposed in the trench wall and creates a filter cake on the trench walls that seals the exposed formations, prevents slurry loss, and contributes to the low permeability of the completed slurry wall.

Slurry walls are differentiated by the materials used to backfill the trench. If a mixture of soil and bentonite is used, then the wall is known as a soil-bentonite slurry wall. In some cases, the trench is filled with portland cement, bentonite, and water, and this mixture is left in the trench to harden into a cement-bentonite slurry wall. This technique can be used at sites where there is inadequate open area for the mixing and placement of the soil-bentonite backfill, where increased wall strength may be necessary, or where extreme topography changes make it impractical to grade a site level (U.S.EPA, 1991).

Slurry walls have potential applicability at the Pit 7 Complex to prevent ground water from rising into and inundating the Pit 7 landfills.

F-2.3.2. Grout Curtains

Grouting is a process by which a fluid is injected under high pressure into soil or rock to reduce fluid movement and/or impart increased strength. Grouts accomplish this through their ability to permeate voids and gel or set in place. Grouting can be used to control the movement of ground water and to solidify or stabilize a soil mass. Grout injected into a soil mass reduces the permeability of the deposit. Grout curtains are created in unconsolidated materials by pressure injection along a line of injection points to create a continuous wall or "curtain" of low permeability materials that contains ground water or directs it to a particular location, for example, in a funnel and sump system.

Grout types are divided into two general classifications: particulate or suspended grout and chemical grout. Particulate grouts are fluids that consist of a suspension of solid material, such as cement, clay, bentonite, or a combination of these materials. These materials are usually the more viscous of the available grouting materials and have the largest particle size. Chemical grouts are frequently classified into two major groups: silica-or aluminum-based solutions and polymers. Chemical grouts rely on polymerization reactions to form hardened gels. They have initially low viscosities and can therefore be used in finer grained soils (U.S.EPA, 1991).

Grout curtains have limited applicability at the Pit 7 Complex to prevent ground water from rising into and inundating the Pit 7 landfills because the technology available to install the grout curtain may not be able emplace the grout deep enough into the contaminated vadose zone beneath the pits to be effective.

F-2.3.3. Cryogenic Freezing

Cryogenic ground freezing has been used in large-scale engineering projects to seal tunnels and shafts and stabilize soil during excavation. It may also be used to create an hydraulic barrier by freezing subsurface materials to prevent ground water flow and contaminant transport. It has been tested on a small scale at a non-hazardous site at Oak Ridge National Laboratory (DOE, 1995) where a V-shaped containment structure was created by drilling and installing refrigerant piping in vertical and 45-degree angle boreholes. Diffusion studies using a Rhodomine tracer confirmed the integrity of the barrier.

If applied at the Pit 7 Complex, the soil surrounding the disposal pits would be frozen to create a low permeability barrier around the pits. Seasonally rising ground water would be frozen before entering the pits, preventing potential mobilization of tritium and other contaminants. Freezing of the soil around the pits would be accomplished by creating a subsurface refrigeration system consisting of wells and pipes using liquid nitrogen or standard refrigerants.

Application of cryogenic freezing as an hydraulic barrier technology depends on several site-specific parameters including thermal conductivity, heat capacity, thermal diffusivity, and soil disturbance by frost heaving. Once the refrigeration system is installed it must be maintained to keep the ground frozen and the barrier intact. Cryogenic freezing may not be a cost effective long-term control for uranium in the pit waste at the Pit 7 Complex due to the long half-life of uranium and the need for long-term operation and maintenance. In addition, it is a relatively untested innovative technology whose long-term performance in a field application is untested.

F-2.4. Hydraulic Diversion

Hydraulic diversion may be used to avoid contamination of clean ground water or further contamination of ground water by preventing surface water and ground water from reaching a source area.

F-2.4.1. Surface and Subsurface Flow Interceptor System

A surface and subsurface flow interceptor system could passively capture surface and subsurface water upgradient of contamination and allow the captured water to reinfiltrate downgradient of the contamination. Such systems could include surface water diversion ditches, an upgradient interceptor trench, a buried conduit pipe, vertical or horizontal extraction wells and/or an infiltration gallery.

An interceptor trench might consist of a gravel-filled trench with a perforated pipe at the bottom to capture upgradient ground water. The perforated pipe would be sloped to provide gravity drainage to a conduit. The extent of capture and the flow rates can be calculated based on subsurface ground water flow data. Design studies are necessary to choose materials and size the perforated pipe to assure that the pipe could resist damage by nearby activities (e.g., firing table explosions at Site 300). Modeling would be used to design the interceptor trench.

A conduit consists of a buried pipe to transport the water captured by the subdrain trench to a discharge area, which is typically an infiltration gallery. The pipe would be sloped to provide gravity drainage. The pipe diameter, burial depth, and trench backfill materials would be determined using the model results required for subdrain trench design.

An infiltration gallery consists of an excavation backfilled with permeable gravel to allow water from the conduit to be temporarily stored in the pores of the gravel until it percolates into the native soil and bedrock. Flow and infiltration calculations, as well as geologic studies and percolation tests, would be used to determine the site location and design details.

The purpose of a water interceptor system in the Pit 7 Complex area would be to prevent inundation of the pits from below by rising ground water and lateral flow of recharge water into the landfills. The degree to which inundation may occur from a general rise in ground water levels beneath the pits, not just from upgradient flow, may limit the applicability of such systems. Other limitations include the difficulty of designing a system to adequately intercept the flow, which is limited by aquifer materials; permeability; ground water depth; terrain, etc.

F-2.5. Landfill Waste and Soil/Rock Excavation

Excavation is a common method of removing near-surface contaminated earth materials and landfill waste using conventional earth-moving equipment. In some cases, excavation is the only practical technology, particularly for small volumes of soil/rock/waste that contain contaminants such as polychlorinated biphenyls or metals that cannot easily be treated *in situ*. Excavated materials can be treated or disposed onsite, or transported to an appropriate waste disposal facility.

Depending on the quantity of material to be excavated and the depth of excavation, different types of equipment can be used. The methods used for excavation are not greatly affected by the types of contaminants present. Determination of the extent of material to be excavated is one of the most difficult aspects of using this technology. In most cases, collection and analysis of samples are required during the excavation, adding considerably to the cost. In addition, rock can be difficult to excavate. Transport and disposal of excavated material can be very costly if large volumes are involved (Isherwood et al., 1991). Excavation of landfill waste and underlying soil and rock can also expose workers to contaminants in the excavated material.

The waste material within Pits 3 and 5 could be excavated which would prevent further releases of contaminants from the pit waste. It would not prevent further releases of contaminants in the vadose zone underlying the pits as a result of water level rises into the vadose zone unless the entire volume of the contaminated vadose zone were also excavated. There are also numerous health and safety and disposal issues would need to be addressed prior to application.

F-2.6. Disposal of Excavated Soil/Rock and Waste

As discussed in Chapter 3, excavated material removed from the Pit 7 landfills could either be transported to an offsite permitted facility for treatment, destruction, and/or disposal, or placed in an onsite containment unit. These disposal options are discussed below.

F-2.6.1. Offsite Disposal

The advantages of offsite waste disposal include:

1. Costs may be lower than for onsite disposal if the volume of excavated material is relatively low or if there are significant obstacles present during the siting, approval, or funding process for an onsite containment unit.
2. Waste disposal and containment can be achieved more quickly.
3. No long-term monitoring and maintenance would need to be conducted by DOE.

The logistics and safety of transporting low-level radioactive waste off site would need to be addressed.

F-2.6.2. Onsite Containment

Onsite containment may be more cost effective than offsite disposal, particularly if large volumes of waste are excavated. Onsite containment would involve design and construction of an engineered containment unit. Typical components of the containment unit would include: (1) impermeable liners designed to prevent contaminant releases from the waste from infiltrating to the subsurface, (2) a leachate collection system to collect and remove leachate generated in the containment unit, and (3) a leak detection system designed to detect failure of the containment unit resulting in contaminant releases. Regulations in Title 22 and 23 of the California Code of Regulations (CCR) pertaining to waste/hazardous waste landfills have been identified as relevant and appropriate requirements. These requirements would need to be considered in designing, constructing and maintaining onsite containment unit(s).

Two options exist for siting an onsite containment unit:

1. Construction of a containment unit at the location of an existing pit(s).
2. Construction of a containment unit at a new location in a “clean,” uncontaminated area.

Each option has associated advantages and disadvantages. Construction of the containment unit in an existing pit area would avoid disturbing a clean area. However, in the case of the Pit 7 Complex, the underlying geologic and hydrogeologic conditions are not optimum for a containment unit. The waste material contained in the Pit 7 Complex landfills is periodically saturated by rising ground water. Another location with more suitable hydrogeologic conditions for the containment unit may potentially be found, although there are regulatory constraints that might be triggered by constructing the containment unit in a clean area.

Depending on the constituents, contaminated soil or pit material excavated for the purpose of contaminant source removal might be subject to hazardous waste regulations under CCR, Title 22, including land disposal restrictions. Treatment standards are a component of land disposal restrictions. The Pit 7 complex landfills contain debris that would likely make waste treatment and compliance with treatment standards difficult. The State of California has been authorized by the U.S. EPA to implement the requirements of RCRA. Because California is a RCRA-authorized state, the federal hazardous waste regulations promulgated by U.S. EPA pursuant to RCRA are incorporated in the State hazardous waste regulations. However, regulatory mechanisms exist which allow for the management of remediation waste without triggering land disposal restrictions and the associated treatment standards. These mechanisms include U.S. EPA’s area of contamination (AOC) policy and corrective action management units (CAMUs).

AOC Policy

Based on the U.S. EPA's AOC policy, wastes can be consolidated within a contiguous area of contamination without triggering land disposal restrictions. The AOC policy only covers consolidation and *in situ* management techniques carried out within an AOC. This policy would apply to the placement of waste in a containment unit constructed at the location of an existing pit.

CAMU Regulations

CAMUs differ from the AOC policy because they allow for the placement of remediation waste in uncontaminated areas at a facility, and for consolidation of wastes from areas that are not contiguously contaminated.

Siting of an onsite containment unit in a clean area at Site 300 would require designation of a CAMU. CCR, Title 22, Section 66264.552 and 40 Code of Federal Regulations 264.552, specify the requirements for CAMUs. One of the requirements is that the CAMU can include uncontaminated areas of the facility only if including such areas for the purpose of managing remediation waste is more protective than management of such wastes at contaminated areas of the facility [Title 22, CCR, Section 66264.552(c)(3)].

CAMUs are a type of RCRA unit that are designated and approved using permitting procedures, such as a facility permit or corrective action order. In the case of CERCLA cleanups, such as at Site 300, CAMUs may be approved as an applicable or relevant and appropriate requirement (ARAR) using a Record of Decision. U.S. EPA suggests that public notice of the tentative approval of a CAMU could be combined with public notice of a Proposed Plan**.**

U.S. EPA promulgated the final CAMU rule on February 16, 1993. Any changes to the CAMU regulations may limit the feasibility of designating a CAMU at Site 300.

F-2.6.2.1. Factors Affecting Implementation of an Onsite Containment Unit. The feasibility and/or practicality of implementing the onsite containment unit may also be limited by several other factors: (1) the waste classification and applicable ARARs, (2) the volume of waste for disposal, (3) hydrogeologic, biological, and topographic considerations, (4) DOE regulations and institutional requirements, (5) Congressional funding and cost considerations, and (6) community acceptance. These factors will affect the time, resources, and costs associated with the implementation of the disposal options and therefore, determine the relative implementability of each option. Each is discussed below.

Waste Classification

The type or classification of waste to be placed in the containment unit, and the requirements of the applicable regulations, will affect the level of effort, resources and time necessary to obtain approval or permit, site, design, construct, and maintain the facility. If the waste is classified as hazardous waste, it would be subject to the substantive requirements of the hazardous waste regulations under CCR, Title 22 and the standards for discharges of waste to land under Title 23 CCR. If the waste is classified as low-level radioactive or mixed waste, the waste would also be subject to the requirements of the DOE regulations for management of radioactive waste (DOE Order 435.1). Since Site 300 is a CERCLA site, it is not required to obtain permits under these regulations. However, it would be necessary, at a minimum, to meet the substantive requirements of these regulations for the siting, design, construction, monitoring, and maintenance of the waste containment unit. In addition, the process would be subject to regulatory review and approval and public input under CERCLA. The time and resources necessary to complete this process could significantly impact both the cost and time to implement an onsite disposal option.

Waste Volume

The volume of waste that must be excavated to achieve source control will affect the relative cost-effectiveness of the waste disposal. If a relatively small volume (less than 6,000 cubic yards) of waste is generated through excavation, it may be more cost effective to transport and dispose the waste at an offsite facility than to obtain approval for, site, construct, monitor, and maintain an onsite containment unit. In the case of the Pit 7 Complex, the excavation of Pit 3 and Pit 5 could yield almost 60,000 yd^3 of material for disposal.

Siting Considerations

Hydrogeologic, biological, and topographic considerations may limit the possible locations for an onsite containment unit. Much of Site 300 is steep, rugged terrain that is subject to landslides and erosion which limits the available area which is sufficiently flat-lying and stable enough to site a containment unit. Areas of critical habitat for endangered species present at Site 300 would need to be considered during siting evaluations. Depth to ground water and surface water drainage courses would also be important siting considerations to prevent ground water inundation or surface runoff infiltration into the containment unit.

DOE Requirements

DOE facilities are subject to numerous specific regulations, requirements, controls and limitations that could affect the implementation of an onsite containment unit. For example, the siting of an onsite unit would require the development of a Conceptual Design Report which must be approved through several integrated processes to ensure the proposed land use is consistent with the LLNL Institutional Plan and the Site 300 Comprehensive Plan. DOE would also require revision of the LLNL Environmental Impact Report/Environmental Impact Statement (EIR/EIS) and/or preparation and approval of facility-specific EIR/EIS for the containment unit facility. These processes could significantly impact the period of time and cost necessary to install an onsite containment unit. For example, the preparation, review, and approval of the LLNL Site 300 EIR/EIS took more than two years. The preparation and approval process for an EIR/EIS involves the following steps:

1. Determination of Lead Agency (2–4 weeks)
2. Preparation of Scoping Document (1 month)
3. DOE review of Scoping Document (1 month)
4. DOE issues the Notice of Intent (2–4 weeks)
5. Public Comment Period and Conduct Public Scoping Meetings (30–45 days)
6. Conduct Analysis and Prepare Draft EIR/EIS (4–6 months)
7. DOE review of Draft EIR/EIS (1 month)
8. DOE issues the Public Notice (2–4 weeks)
9. Public Comment Period and Public Hearings (45–60 days)
10. Prepare Final EIR/EIS (2–6 months)

11. DOE publishes Notice of Determination (2–4 weeks)

Times presented for the completion of each of these steps are estimated based on prior EIR/EIS experience.

Funding

The nature of DOE funding may affect the cost, scope, and logistics of implementing the onsite containment unit. The funding for DOE Environmental Restoration projects is allocated by Congress on an annual basis. Annual funding limitations may require that the work to excavate waste and construct an onsite containment unit be implemented in a phased approach over several years if a large volume of waste requires removal. The phased approach may increase the scope of work and associated costs.

Public Acceptance

Public acceptance may also affect the implementability of an onsite reconsolidation containment unit or CAMU containment unit. Residential development is encroaching on once-remote Site 300, which may increase public concern over future land and ground water use issues and construction of a waste containment unit at the site. At other sites, public opposition has been voiced against the use of onsite containment units. However, EPA's Technical Assistance Grant group has shown a preference for a properly constructed aboveground onsite containment structure.

F-3. References

Coleman, S.J., P.R. Coronado, R.S. Maxwell, and J.G. Reynolds (2003), "Granular Activated Carbon Modified with Hydrophobic Silica Aerogel – Potential Composite Materials for the Removal of Uranium from Aqueous Solutions," *Environ. Sci. Technol.* **37**(10) 2286–2290.

Fuller, C.C., J.R. Bargar, and J.A. Davis (2003), "Molecular- Scale Characterization of Uranium Sorption by Bone Apatite Minerals for a Permeable Reactive Barrier Demonstration," *Environ. Sci. and Technol.* **37**, 4642–4649.

Isherwood, W.F., C.H. Hall, and M.D. Dresen (1991), "CERCLA Feasibility Study for the LLNL Livermore Site," Lawrence Livermore National Laboratory, Livermore, Calif. (UCRL-AR-104040).

McConachie, W.A., and M.G. Brown (1996), *Tritium Geochemistry and Ground Water Treatment Technology for the Building 850/Pit 7 Complex Operable Unit*, U.S. Department of Energy and Lawrence Livermore National Laboratory, Livermore, Calif., 15 pp.

Moridas, G.J., P. Persoff, J.A. Apps, L, Meyer, P. Yen, and K. Preuss (1997), "A Field Test of Permeation Grouting in Heterogeneous Soils Using a New Generation of Barrier Liquids," *National Academy of Sciences Workshop Summary*, Appendix D, pp. D-132–D-143.

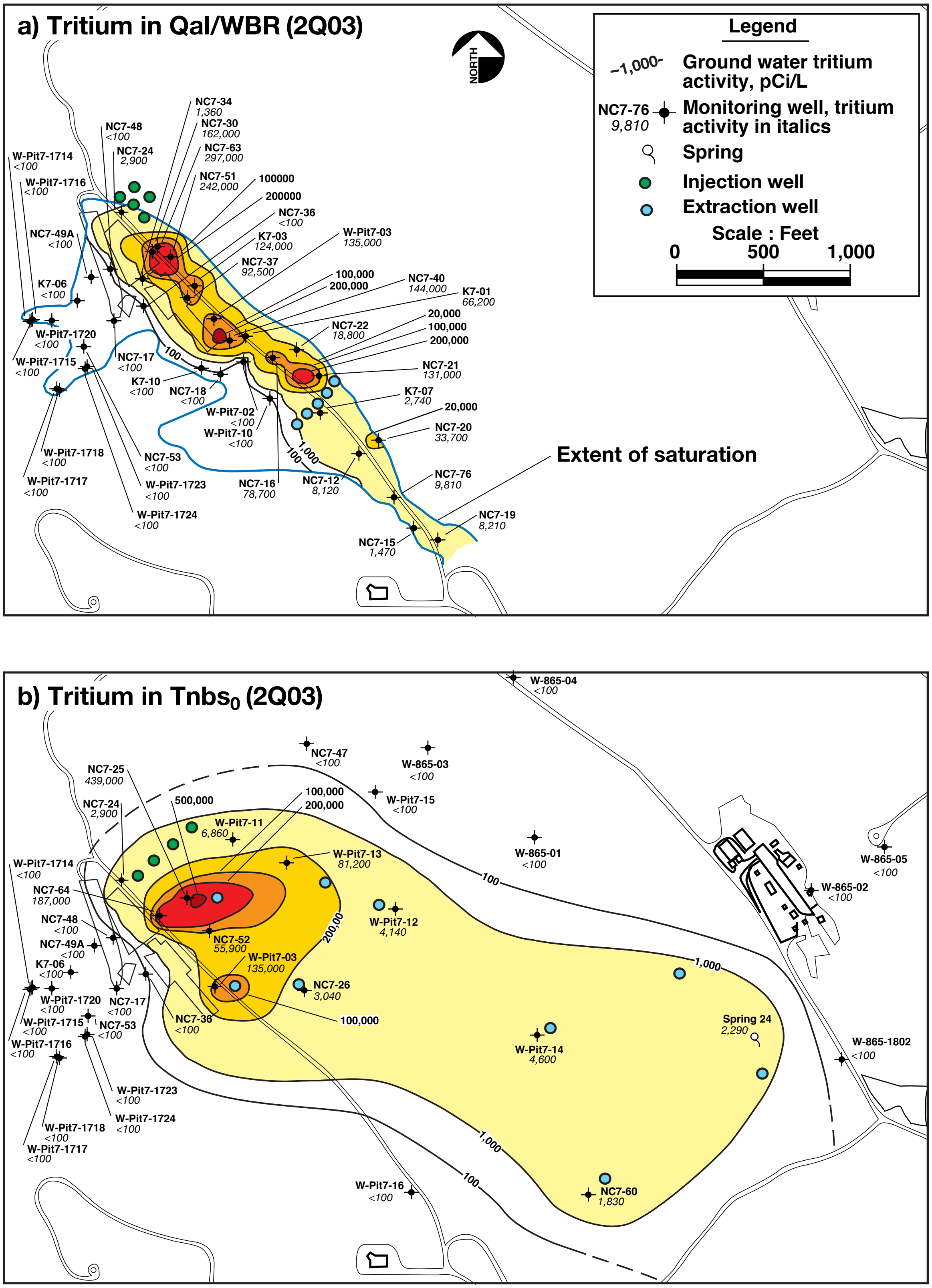
Powell, S.W. (2000), *Water Reuse Eliminates Government-Required Treatments for Wastewater Discharges,* Powell Water Systems, Inc., Centennial, CO, unpublished paper.

Taffet, M.J., B.K. Esser, P. Zhao, B.E. Viani, and K.E. Roberts (2003), "Chemical Reactions Controlling the Mobility of Uranium in Ground- and Surface Water Systems with an Emphasis on Apatite," Laboratory Directed Research and Development FY 2002 Annual Report, Lawrence Livermore National Laboratory, Livermore, Calif., pp. 3–4. (UCRL-LR-113717-02).

U.S. DOE (1995*), Frozen Soil Barrier Technology, Innovative Technology Summary Report,* Office of Environmental Management, Office of Technology Development, U.S. Department of Energy, Washington, D.C.

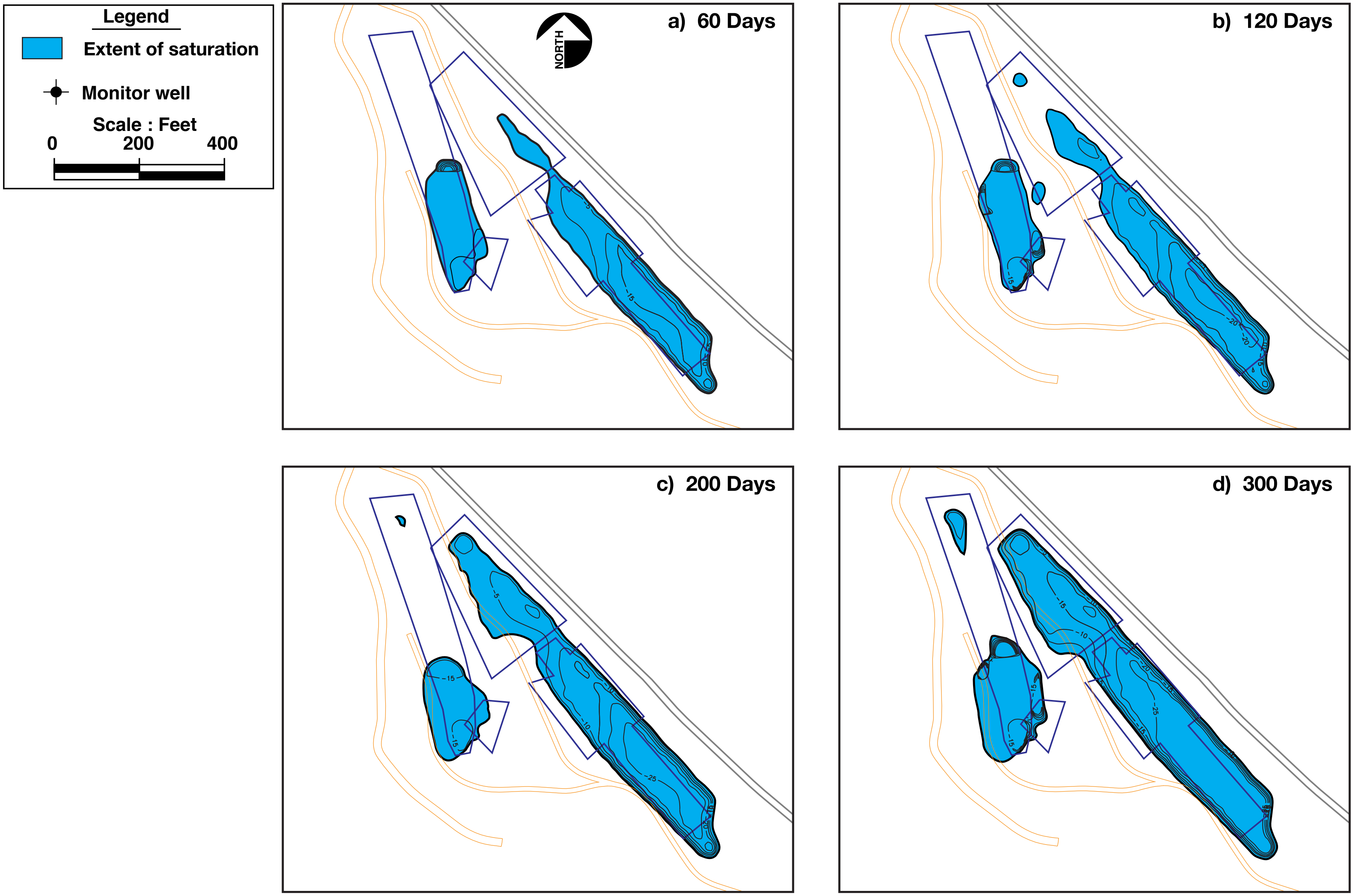
U.S. DOE (1998), *Research and Application of Permeable Reactive Barriers*, Colorado Office, U.S. Department of Energy Grand Junction (Revision 4).

U.S. EPA (1991), *Handbook, Stabilization Technologies for RCRA Corrective Actions,* Office of Research and Development, U.S. Environmental Protection Agency, Washington, D.C. (EPA/625/6-91/026).



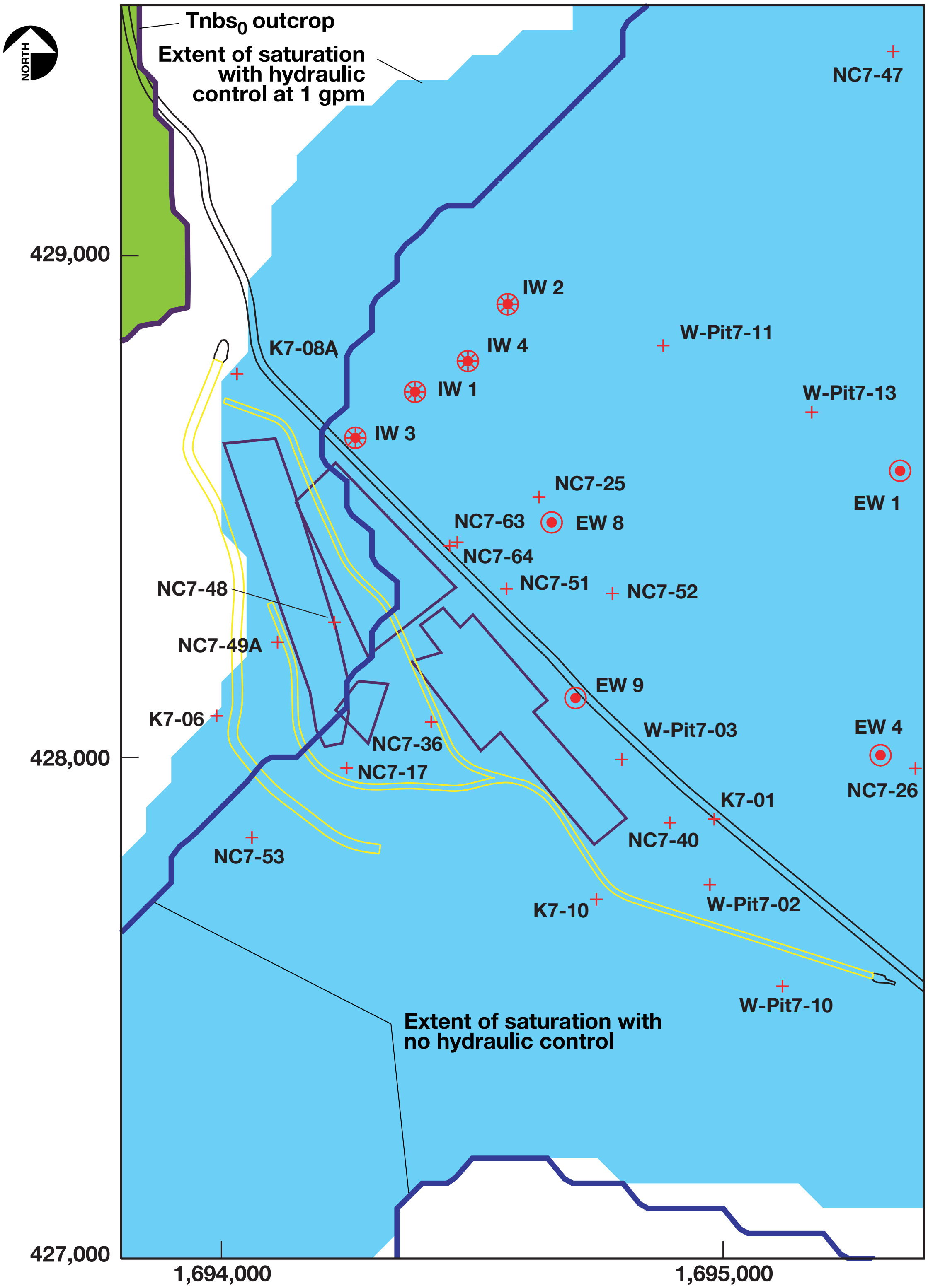
ERD-S3R-04-0115

Figure F-1. Extraction and injection well fields for the evaluation of hydraulic control alternative for: (a) Qal/WBR HSU and (b) Tnbs$_0$ HSU.



ERD-S3R-04-0116

Figure F-2. Extent of pit inundation under the hydraulic control alternative at 3 gpm in the Qal/WBR HSU.



ERD-S3R-04-0117

Figure F-3. Map showing impact of hydraulic control alternative at 1 gpm on the extent of saturation in the Tnbs$_0$ HSU.

Appendix G

Cost Estimates for the Remedial Alternatives

Table G-1. Cost estimate for components of Alternative 2.

Component	Activity	Parameter	Quantity	Unit	Direct Capital ($)	Indirect Capital ($)	Annual O&M($)
A. Monitoring of ground water							
	Monitoring						
	Water levels (65 wells)	Quarterly Measurements	65	ea			$1,796
	Water quality sampling/analysis (65 wells)	Quarterly Sampling	65	ea			$80,687
	Data analysis & representation	Labor	192	hr			$17,723
	Pump maintenance or replacement (7 wells)	Wells	7	ea			$3,353
	Exposure Assessment	Labor	172	hr			$19,456
	Modeling	Labor	160	hr			$17,823
	Total for Component A:				**$0**	**$0**	**$140,838**
B. Exposure control through risk and hazard management							
	Institutional Controls						
	Exposure Assessment	Report	1	ea		$18,998	
	Install warning signs	Labor & materials	Once	lot		$602	
	Sub total				$0	$19,600	$0
	Risk and Hazard Monitoring						
	Prepare Risk and Hazard Monitoring Plan	Plan	1	ea		$12,369	
	Re-evaluate tritium inhalation risk	Report	1	ea			$17,404
	Ambient outdoor air sampling for tritium	Location	1	ea			$3,129
	Conduct wildlife survey	Survey	1	ea			$4,185
	Prepare Risk and Hazard Management Summary for Annual Compliance Monitoring Report	Report	1	ea			$7,833
	Sub total				$0	$12,369	$32,551
	Total for Component B:				**$0**	**$31,969**	**$32,551**
C. Monitored natural attenuation of tritium in ground water							
	Exposure Assessment	Labor	172	hr			$19,456
	Modeling	Labor	160	hr			$17,823
	Total for Component C:				**$0**	**$0**	**$37,279**
D. Waste excavation of Pits 3 and 5 and disposal							
	Design/Construction						
	Remedial Design Report	Reports	1		$0	$34,970	$0
	Permitting	Permits	1		$0	$10,310	$0
	Excavate Pit 3	Contract by Volume	26,200	cy	$8,683,970	$0	$0
	Excavate Pit 5	Contract by Volume	29,900	cy	$9,624,809	$0	$0
	Sub total				$18,308,779	$45,279	$0
	Waste Treatment/Disposal						
	Low Level Waste Disposal From Pit 3	Labor, Contracts, Materials	26,200	cy	$16,366,407	$0	$0
	Low Level Waste Disposal From Pit 5	Labor, Contracts, Materials	29,900	cy	$18,643,457	$0	$0
	Sub total				$35,009,864	$0	$0
	Totals:				**$53,318,643**	**$45,279**	**$0**
	Cost summary for Alternative 2:				**$53,318,643**	**$77,248**	**$210,668**
	Assumed interest rate= 5% (30 year design life)				0.05	30	
	Total Costs (net present value):				**$56,635,000**		

Table G-2. Cost estimate for components of Alternative 3a, Option 1: Funnel and sump with *ex situ* treatment.

Component	Activity	Parameter	Quantity	Unit	Direct Capital ($)	Indirect Capital ($)	Annual O&M($)
A. Monitoring of ground water							
Monitoring							
	Water levels (65 wells)	Quarterly Measurements	65	ea			$1,796
	Water quality sampling/analysis (65 wells)	Quarterly Sampling	65	ea			$80,687
	Data analysis & representation	Labor	192	hr			$17,723
	Pump maintenance or replacement (7 wells)	Wells	7	ea			$3,353
	Total for Component A:				$0	$0	$103,559
B. Exposure control through risk and hazard management							
Institutional Controls							
	Exposure Assessment	Report	1	ea		$18,998	
	Install warning signs	Labor & materials	Once	lot		$602	
	Sub total				$0	$19,600	$0
Risk and Hazard Monitoring							
	Prepare Risk and Hazard Monitoring Plan	Plan	1	ea		$12,369	
	Re-evaluate tritium inhalation risk	Report	1	ea			$17,404
	Ambient outdoor air sampling for tritium	Location	1	ea			$3,129
	Conduct wildlife survey	Survey	1	ea			$4,185
	Prepare Risk and Hazard Management Summary for Annual Compliance Monitoring Report	Report	1	ea			$7,833
	Sub total				$0	$12,369	$32,551
	Total for Component B:				$0	$31,969	$32,551
C. Monitored natural attenuation of tritium in ground water							
	Exposure Assessment	Labor	172	hr			$19,456
	Modeling	Labor	160	hr			$17,823
	Total for Component C:				$0	$0	$37,279
D. Control migration of uranium, nitrate, and perchlorate in ground water using *ex situ* ground water extraction and treatment							
Funnel and Sump / Infiltration Trench							
System Design and Construction							
	Design Labor	Labor	528	hr		$62,010	
	Construction Oversight and Labor	Labor	464	hr		$46,981	
	Materials and Contracts	Fill, excavation	1	ea	$212,000		
				Sub Totals:	$212,000	$108,991	$0
Operations and Maintenance							
	Materials and Equipment	Maint. equipment, Utilities	1	cy			$2,094
	O&M Labor	Maint. And Monitoring	464	hr			$45,751
				Sub Totals:	$0	$0	$47,845
Ion Exchange Resin Treatment for Funnel & Sump							
System Design and Construction							
	Materials & Contracts	System, 9 columns, resin	1	ea	$123,000		
	Construction / Oversight	Labor	440	hr		$38,809	
	Design Labor	Labor	300	hr		$33,227	
	Sub Totals:				$123,000	$72,036	$0
Operations and Maintenance							
	Materials & Contracts	Filters, resin, disposal, analytical	1	cy			$425,000
	O&M Labor	Maint. Labor + Sampling	568	hr			$41,000
	Sub Totals:				$0	$0	$466,000
	Total for Component D:				**$335,000**	**$181,027**	**$466,000**

Table G-2. Cost estimate for components of Alternative 3a, Option 1: Funnel and sump with *ex situ* treatment.

Component	Activity	Parameter	Quantity	Unit	Direct Capital ($)	Indirect Capital ($)	Annual O&M($)
Cont. page 2 of 2							
E. Control migration of uranium, nitrate, and perchlorate in ground water using *ex situ* ground water extraction and treatment							
Funnel and Sump / Infiltration Trench							
Extraction / Injection Wellfield							
System Design and Construction							
	Design Labor	Labot	75	days		$71,429	
	Construction Oversight	Labor	82	days		$67,144	
	Materials and Contracts	Wells, pumps, piping	1	ea	$268,813		
				Sub Totals:	$268,813	$138,573	$0
Operations and Maintenance							
	Materials and Equipment	Equip., replaclement, utility	1	cy			$1,443
	O&M Labor	Sampling and Reporting	25	days			$10,451
				Sub Totals:	$0	$0	$11,894
Ion Exchange Resin Treatment for Extraction Wellfield							
System Design and Construction							
	Materials & Contracts	System, 9 columns, resin	1	ea	$40,307		
	Construction/Oversight	labor	440	hr		$38,809	
	Design Labor	Labor	300	hr		$33,227	
	Sub Totals:				$40,307	$72,036	$0
Operations and Maintenance							
	Materilals & Contracts	Filter, resin, disposal, analytical	1	cy			$213,500
	O&M Labor	Maint. Labor + Sampling	75	days			$46,000
	Sub Totals:						$259,500
	Total for Component E:				**$309,120**	**$210,609**	**$271,394**
F. Waste excavation of Pits 3 and 5 and disposal							
Design/Construction							
	Remedial Design Report	Reports	1		$0	$34,970	$0
	Permitting	Permits	1		$0	$10,310	$0
	Excavate Pit 3	Contract by Volume	26,200	cy	$8,683,970	$0	$0
	Excavate Pit 5	Contract by Volume	29,900	cy	$9,624,809	$0	$0
	Sub total				$18,308,779	$45,279	$0
Waste Treatment/Disposal							
	Low Level Waste Disposal From Pit 3	Labor, Contracts, Materials	26,200	cy	$16,366,407	$0	$0
	Low Level Waste Disposal From Pit 5	Labor, Contracts, Materials	29,900	cy	$18,643,457	$0	$0
	Sub total				$35,009,864	$0	$0
	Total for Component F:				**$53,318,643**	**$45,279**	**$0**
	Cost summary for Alternative 3a:				**$53,962,763**	**$468,885**	**$910,784**
	Assumed interest rate= 5% (30 year design life)						
	Total Costs (net present value):				**$68,326,000**		

Table G-3. Cost estimate for components of Alternative 3a, Option 2: Extraction wells with *ex situ* treatment.

Component	Activity	Parameter	Quantity	Unit	Direct Capital ($)	Indirect Capital ($)	Annual O&M($)
A. Monitoring of ground water							
Monitoring							
	Water levels (65 wells)	Quarterly Measurements	65	ea			$1,796
	Water quality sampling/analysis (65 wells)	Quarterly Sampling	65	ea			$80,687
	Data analysis & representation	Labor	192	hr			$17,723
	Pump maintenance or replacement (7 wells)	Wells	7	ea			$3,353
	Total for Component A:				$0	$0	$103,559
B. Exposure control through risk and hazard management							
Institutional Controls							
	Exposure Assessment	Report	1	ea		$18,998	
	Install warning signs	Labor & materials	Once	lot		$602	
	Sub total				$0	$19,600	$0
Risk and Hazard Monitoring							
	Prepare Risk and Hazard Monitoring Plan	Plan	1	ea		$12,369	
	Re-evaluate tritium inhalation risk	Report	1	ea			$17,404
	Ambient outdoor air sampling for tritium	Location	1	ea			$3,129
	Conduct wildlife survey	Survey	1	ea			$4,185
	Prepare Risk and Hazard Management Summary for Annual Compliance Monitoring Report	Report	1	ea			$7,833
	Sub total				$0	$12,369	$32,551
	Total for Component B:				$0	$31,969	$32,551
C. Monitored natural attenuation of tritium in ground water							
	Exposure Assessment	Labor	172	hr			$19,456
	Modeling	Labor	160	hr			$17,823
	Total for Component C:				$0	$0	$37,279
D. Control migration of uranium, nitrate, and perchlorate in ground water using *ex situ* ground water extraction and treatment							
Extraction/Injection Wellfield							
System Design and Construction							
	Design Labor	Labor	600	hr		$71,429	
	Construction Oversight	Labor	656	hr		$67,144	
	Materials and Contracts	Wells, pumps, piping	1	ea	$863,440		
				Sub Totals:	$863,440	$138,573	$0
Operations and Maintenance							
	Materials and Equipment	Equip. replacement, utility	1	cy			$2,886
	O&M Labor	Sampling and Reporting	168	hr			$20,902
				Sub Totals:	$0	$0	$23,788

Table G-3. Cost estimate for components of Alternative 3a, Option 2: Extraction wells with *ex situ* treatment.

Component	Activity	Parameter	Quantity	Unit	Direct Capital ($)	Indirect Capital ($)	Annual O&M($)
Cont. page 2 of 2							
Ion Exchange Resin Treatment for Extraction Wellfield							
System Design and Construction							
	Materials & Contracts	System, 9 columns, resin	1	ea	$152,000		
	Construction / Oversight	Labor	440	hr		$38,809	
	Design Labor	Labor	300	hr		$33,227	
	Sub Totals:				$152,000	$72,036	$0
Operations and Maintenance							
	Materials & Contracts	Filters, resin, disposal, analytical	1	cy			$354,000
	O&M Labor	Maint. Labor + Sampling	568	hr			$42,000
	Sub Totals:				$0	$0	$396,000
	Total for Component D:				**$1,015,440**	**$210,609**	**$419,788**
E. Waste excavation of Pits 3 and 5 and disposal							
Design/Construction							
	Remedial Design Report	Reports	1		$0	$34,970	$0
	Permitting	Permits	1		$0	$10,310	$0
	Excavate Pit 3	Contract by Volume	26,200	cy	$8,683,970	$0	$0
	Excavate Pit 5	Contract by Volume	29,900	cy	$9,624,809	$0	$0
	Sub total				$18,308,779	$45,279	$0
Waste Treatment/Disposal							
	Low Level Waste Disposal From Pit 3	Labor, Contracts, Materials	26,200	cy	$16,366,407	$0	$0
	Low Level Waste Disposal From Pit 5	Labor, Contracts, Materials	29,900	cy	$18,643,457	$0	$0
	Sub total				$35,009,864	$0	$0
	Total for Component E:				**$53,318,643**	**$45,279**	**$0**
	Cost summary for Alternative 3a:				**$54,334,083**	**$287,858**	**$593,177**
	Assumed interest rate= 5% (30 year design life)						
	Total Costs (net present value):				**$63,741,000**		

Table G-4. Cost estimate for components of Alternative 3b.

Component	Activity	Parameter	Quantity	Unit	Direct Capital ($)	Indirect Capital ($)	Annual O&M($)
A. Monitoring of ground water							
Monitoring							
	Water levels (65 wells)	Quarterly Measurements	65	ea			$1,796
	Water quality sampling/analysis (65 wells)	Quarterly Sampling	65	ea			$80,687
	Data analysis & representation	Labor	192	hr			$17,723
	Pump maintenance or replacement (7 wells)	Wells	7	ea			$3,353
	Total for Component A:				$0	$0	$103,559
B. Exposure control through risk and hazard management							
Institutional Controls							
	Exposure Assessment	Report	1	ea		$18,998	
	Install warning signs	Labor & materials	Once	lot		$602	
	Sub total				$0	$19,600	$0
Risk and Hazard Monitoring							
	Prepare Risk and Hazard Monitoring Plan	Plan	1	ea		$12,369	
	Re-evaluate tritium inhalation risk	Report	1	ea			$17,404
	Ambient outdoor air sampling for tritium	Location	1	ea			$3,129
	Conduct wildlife survey	Survey	1	ea			$4,185
	Prepare Risk and Hazard Management Summary for Annual Compliance Monitoring Report	Report	1	ea			$7,833
	Sub total				$0	$12,369	$32,551
	Total for Component B:				$0	$31,969	$32,551
C. Monitored natural attenuation of tritium in ground water							
	Exposure Assessment	Labor	172	hr			$19,456
	Modeling	Labor	160	hr			$17,823
	Total for Component C:				$0	$0	$37,279
D. Control migration of uranium, nitrate, and perchlorate in ground water using *in situ* permeable reactive barrier.							
***In Situ* Permeable Reactive Barrier**							
System Design and Construction							
	Design Labor	Labor	408	hr		$52,000	
	Construction Oversight and Labor	Labor	480	hr		$49,000	
	Materials and Contracts	media, excavation	1	ea	$4,856,000		
	Sub Totals:				$4,856,000	$101,000	$0

Table G-4. Cost estimate for components of Alternative 3b.

Component	Activity	Parameter	Quantity	Unit	Direct Capital ($)	Indirect Capital ($)	Annual O&M($)
Cont. page 2 of 3							
	Operations and Maintenance						
	Materials, Equipment, Contracts	Sampling equipment, Analytical	1	cy			$788
	O&M Labor	Sampling and Reporting	264	hr			$29,058
	PRB Replacement Materials and Contracts*	Media, excavation	3	total			$504,000
	PRB Replacement Labor and Oversight*	Labor	3	total			$4,000
	Sub Totals:				$0	$0	$537,845
	* Values are equivalent annual costs. Actual events occur at 11, 20, and 28 years.						
	Total for Component D:				**$ 4,856,000**	**$ 101,000**	**$ 537,845**
E. Control migration of uranium, nitrate, and perchlorate in ground water using *ex situ* ground water extraction and treatment (2 extraction and 2 injection wells in Tnbs$_0$)							
	Extraction/Injection Wellfield						
	System Design and Construction						
	Design Labor	Labor	75	days		$71,429	
	Construction Oversight	Labor	82	days		$67,144	
	Materials and Contracts	Wells, pumps, piping	1	ea	$268,813		
				Sub Totals:	$268,813	$138,573	$0
	Operations and Maintenance						
	Materials and Equipment	Equip. replacement, utility	1	cy			$1,443
	O&M Labor	Sampling and Reporting	25	days			$10,451
				Sub Totals:	$0	$0	$11,894
	Ion Exchange Resin Treatment for Extraction Wellfield						
	System Design and Construction						
	Materials & Contracts	System, 9 columns, resin	1	ea	$40,307		
	Construction/Oversight	labor	440	hr		$38,809	
	Design Labor	Labor	300	hr		$33,227	
	Sub Totals:				$40,307	$72,036	$0
	Operations and Maintenance						
	Materilals & Contracts	Filter, resin, disposal, analytical	1	cy			$213,500
	O&M Labor	Maint. Labor + Sampling	75	days			$46,000
	Sub Totals:						$259,500
	Total for Component E:				**$309,120**	**$210,609**	**$271,394**

Table G-4. Cost estimate for components of Alternative 3b.

Component	Activity	Parameter	Quantity	Unit	Direct Capital ($)	Indirect Capital ($)	Annual O&M($)
Cont. page 3 of 3							
F. Waste excavation of Pits 3 and 5 and disposal							
Design/Construction							
	Remedial Design Report	Reports	1		$ -	$ 34,970	$ -
	Permitting	Permits	1		$ -	$ 10,310	$ -
	Excavate Pit 3	Contract by Volume	26,200	cy	$ 8,683,970	$ -	$ -
	Excavate Pit 5	Contract by Volume	29,900	cy	$ 9,624,809	$ -	$ -
	Sub total				$ 18,308,779	$ 45,279	$ -
Waste Treatment/Disposal							
	Low Level Waste Disposal From Pit 3	Labor, Contracts, Materials	26,200	cy	$ 16,366,407	$ -	$ -
	Low Level Waste Disposal From Pit 5	Labor, Contracts, Materials	29,900	cy	$ 18,643,457	$ -	$ -
	Sub total				$ 35,009,864	$ -	$ -
	Total for Component F:				**$ 53,318,643**	**$ 45,279**	**$ -**
	Cost Summary for Alternative 3b:				**$ 58,483,763**	**$ 388,857**	**$ 982,629**
	Assumed interest rate= 5% (30 year design life)						
	Total Costs (net present value):				**$ 73,979,000**		

Table G-5. Cost estimate for components of Alternative 4a.

Component	Activity	Parameter	Quantity	Unit	Direct Capital ($)	Indirect Capital ($)	Annual O&M($)
A. Monitoring of ground water							
Monitoring							
	Water levels (65 wells)	Quarterly Measurements	65	ea			$1,796
	Water quality sampling/analysis (65 wells)	Quarterly Sampling	65	ea			$80,687
	Data analysis & representation	labor	192	hr			$17,723
	Pump maintenance or replacement (7 wells)	Wells	7	ea			$3,353
	Exposure Assessment	Labor	172	hr			$19,456
	Modeling	Labor	160	hr			$17,823
	Total for Component A:				**$0**	**$0**	**$140,838**
B. Exposure control through risk and hazard management							
Institutional Controls							
	Exposure Assessment	Report	1	ea		$18,998	
	Install warning signs	labor & materials	Once	lot		$602	
	Sub total				$0	$19,600	$0
Risk and Hazard Monitoring							
	Prepare Risk and Hazard Monitoring Plan	Plan	1	ea		$12,369	
	Re-evaluate tritium inhalation risk	Report	1	ea			$17,404
	Ambient outdoor air sampling for tritium	Location	1	ea			$3,129
	Conduct wildlife survey	Survey	1	ea			$4,185
	Prepare Risk and Hazard Management Summary for Annual Compliance Monitoring Report	Report	1	ea			$7,833
	Sub total				$0	$12,369	$32,551
	Total for Component B:				**$0**	**$31,969**	**$32,551**
C. Monitored natural attenuation of tritium in ground water							
	Exposure Assessment	Labor	172	hr			$19,456
	Modeling	Labor	160	hr			$17,823
	Total for Component C:				**$0**	**$0**	**$37,279**
D. Source control by installing hydraulic diversion to prevent water from entering landfills							
System Design and Construction							
	Design Labor	Labor	448	hr		$52,873	
	Construction Oversight and Labor	Labor	820	hr		$79,327	
	Materials and Contract	3500' trench, 2000' pipe	1	ea	$261,667		
	Sub Totals:				$261,667	$132,200	$0
Operations and Maintenance							
	O&M Labor	Labor	56	hr			$4,772
	Total for Component D:				**$261,667**	**$132,200**	**$4,772**
	Cost Summary for Alternative 4a:				**$261,667**	**$164,169**	**$215,441**
	Assumed interest rate= 5% (30 year design life)						
	Total Costs (net present value):				**$3,738,000**		

Table G-6. Cost estimate for components of Alternative 4b.

Component	Activity	Parameter	Quantity	Unit	Direct Capital ($)	Indirect Capital ($)	Annual O&M($)
A. Monitoring of ground water							
Monitoring							
	Water levels (65 wells)	Quarterly Measurements	65	ea			$1,796
	Water quality sampling/analysis (65 wells)	Quarterly Sampling	65	ea			$80,687
	Data analysis & representation	Labor	192	hr			$17,723
	Pump maintenance or replacement (7 wells)	Wells	7	ea			$3,353
	Exposure Assessment	Labor	172	hr			$19,456
	Modeling	Labor	160	hr			$17,823
	Total for Component A:				**$0**	**$0**	**$140,838**
B. Exposure control through risk and hazard management							
Institutional Controls							
	Exposure Assessment	Report	1	ea		$18,998	
	Install warning signs	Labor & materials	Once	lot		$602	
	Sub total				$0	$19,600	$0
Risk and Hazard Monitoring							
	Prepare Risk and Hazard Monitoring Plan	Plan	1	ea		$12,369	
	Re-evaluate tritium inhalation risk	Report	1	ea			$17,404
	Ambient outdoor air sampling for tritium	Location	1	ea			$3,129
	Conduct wildlife survey	Survey	1	ea			$4,185
	Prepare Risk and Hazard Management Summary for Annual Compliance Monitoring Report	Report	1	ea			$7,833
	Sub total				$0	$12,369	$32,551
	Total for Component B:				**$0**	**$31,969**	**$32,551**
C. Monitored natural attenuation of tritium in ground water							
	Exposure Assessment	Labor	172	hr			$19,456
	Modeling	Labor	160	hr			$17,823
	Total for Component C:				**$0**	**$0**	**$37,279**
D. Source containment by installing hydraulic barriers (slurry walls) to prevent water from entering landfills							
System Design and Construction							
	Design Labor	Labor	56	hr		$52,873	
	Construction Oversight and Labor	Labor	118	hr		$91,949	
	Materials and Contract	2500'x30' slurry wall			$841,500		
	Sub Totals:				$841,500	$144,822	$0
Operations and Maintenance							
	Materials and Equipment						$0
	O&M Labor	Labor	6	hr			$5,655
	Sub Totals:				**$0**	**$0**	**$5,655**
	Total for Component D:				**$841,500**	**$144,822**	**$5,655**
	Cost Summary for Alternative 4b:				**$841,500**	**$176,791**	**$216,323**
	Assumed interest rate= 5% (30 year design life)						
	Total Costs (net present value):				**$4,344,000**		

Table G-7. Cost estimate for components of Alternative 5a, Option 1: Funnel and sump with *ex situ* treatment.

Component	Activity	Parameter	Quantity	Unit	Direct Capital ($)	Indirect Capital ($)	Annual O&M($)
A. Monitoring of ground water							
Monitoring							
	Water levels (65 wells)	Quarterly Measurements	65	ea			$1,796
	Water quality sampling/analysis (65 wells)	Quarterly Sampling	65	ea			$80,687
	Data analysis & representation	Labor	192	hr			$17,723
	Pump maintenance or replacement (7 wells)	Wells	7	ea			$3,353
	Total for Component A:				**$0**	**$0**	**$103,559**
B. Exposure control through risk and hazard management							
Institutional Controls							
	Exposure Assessment	Report	1	ea		$18,998	
	Install warning signs	Labor & materials	Once	lot		$602	
	Sub total				$0	$19,600	$0
Risk and Hazard Monitoring							
	Prepare Risk and Hazard Monitoring Plan	Plan	1	ea		$12,369	
	Re-evaluate tritium inhalation risk	Report	1	ea			$17,404
	Ambient outdoor air sampling for tritium	Location	1	ea			$3,129
	Conduct wildlife survey	Survey	1	ea			$4,185
	Prepare Risk and Hazard Management Summary for Annual Compliance Monitoring Report	Report	1	ea			$7,833
	Sub total				$0	$12,369	$32,551
	Total for Component B:				**$0**	**$31,969**	**$32,551**
C. Monitored natural attenuation of tritium in ground water							
	Exposure Assessment	Labor	172	hr			$19,456
	Modeling	Labor	160	hr			$17,823
	Total for Component C:				**$0**	**$0**	**$37,279**
D. Source control by installing hydraulic diversion to prevent water from entering landfills							
System Design and Construction							
	Design Labor	Labor	448	hr		$52,873	
	Construction Oversight and Labor	Labor	820	hr		$79,327	
	Materials and Contract	3500' trench, 2000' pipe	1	ea	$261,667		
	Sub Totals:				$261,667	$132,200	$0
Operations and Maintenance							
	O&M Labor	Labor	56	hr			$4,772
	Total for Component D:				**$261,667**	**$132,200**	**$4,772**
E. Control migration of uranium, nitrate, and perchlorate in ground water using *ex situ* ground water extraction and treatment							
Funnel and Sump / Infiltration Trench							
System Design and Construction							
	Design Labor	Labor	528	hr		$62,010	
	Construction Oversight and Labor	Labor	464	hr		$46,981	
	Materials and Contracts	Fill, excavation	1	ea	$212,000		
			Sub Totals:		$212,000	$108,991	$0
Operations and Maintenance							
	Materials and Equipment	Maint. equipment, Utilities	1	cy			$2,094
	O&M Labor	Maint. And Monitoring	464	days			$45,751
			Sub Totals:		$0	$0	$47,845
Ion Exchange Resin Treatment for Funnel & Sump							
System Design and Construction							
	Materials & Contracts	System, 9 columns, resin	1	ea	$123,000		
	Construction / Oversight	Labor	440	hr		$38,809	
	Design Labor	Labor	300	hr		$33,227	
	Sub Totals:				$123,000	$72,036	$0
Operations and Maintenance							
	Materials & Contracts	Filters, resin, disposal, analytical	1	cy			$425,000
	O&M Labor	Maint. Labor + Sampling	568	hr			$41,000
	Sub Totals:				$0	$0	$466,000
	Total for Component E:				**$335,000**	**$181,027**	**$466,000**

Table G-7. Cost estimate for components of Alternative 5a, Option 1: Funnel and sump with *ex situ* treatment.

Component	Activity	Parameter	Quantity	Unit	Direct Capital ($)	Indirect Capital ($)	Annual O&M($)
Cont. page 2 of 2							
F. Control migration of uranium, nitrate, and perchlorate in ground water using *ex situ* ground water extraction and treatment							
	(2 extraction and 2 injection wells in Tnbs$_0$)						
	Extraction/Injection Wellfield						
System Design and Construction							
	Design Labor	Labor	75	days		$71,429	
	Construction Oversight	Labor	82	days		$67,144	
	Materials and Contracts	Wells, pumps, piping	1	ea	$268,813		
				Sub Totals:	$268,813	$138,573	$0
Operations and Maintenance							
	Materials and Equipment	Equip., replaclement, utility	1	cy			$1,443
	O&M Labor	Sampling and Reporting	25	days			$10,451
				Sub Totals:	$0	$0	$11,894
Ion Exchange Resin Treatment for Extraction Wellfield							
System Design and Construction							
	Materials & Contracts	System, 9 columns, resin	1	ea	$40,307		
	Construction/Oversight	labor	440	hr		$38,809	
	Design Labor	Labor	300	hr		$33,227	
	Sub Totals:				$40,307	$72,036	$0
Operations and Maintenance							
	Materilals & Contracts	Filter, resin, disposal, analytical	1	cy			$213,500
	O&M Labor	Maint. Labor + Sampling	75	days			$46,000
	Sub Totals:						$259,500
	Total for Component F:				**$309,120**	**$210,609**	**$271,394**
	Cost Summary for Alternative 5a:				**$905,787**	**$555,805**	**$915,556**
	Assumed interest rate= 5% (30 year design life)						
	Total Costs (net present value):				**$15,429,000**		

Table G-8. Cost estimate for components of Alternative 5a, Option 2: Extraction wells with *ex situ* treatment.

Component	Activity	Parameter	Quantity	Unit	Direct Capital ($)	Indirect Capital ($)	Annual O&M($)
A. Monitoring of ground water							
Monitoring							
	Water levels (65 wells)	Quarterly Measurements	65	ea			$1,796
	Water quality sampling/analysis (65 wells)	Quarterly Sampling	65	ea			$80,687
	Data analysis & representation	Labor	192	hr			$17,723
	Pump maintenance or replacement (7 wells)	Wells	7	ea			$3,353
	Total for Component A:				**$0**	**$0**	**$103,559**
B. Exposure control through risk and hazard management							
Institutional Controls							
	Exposure Assessment	Report	1	ea		$18,998	
	Install warning signs	Labor & materials	Once	lot		$602	
	Sub total				$0	$19,600	$0
Risk and Hazard Monitoring							
	Prepare Risk and Hazard Monitoring Plan	Plan	1	ea		$12,369	
	Re-evaluate tritium inhalation risk	Report	1	ea			$17,404
	Ambient outdoor air sampling for tritium	Location	1	ea			$3,129
	Conduct wildlife survey	Survey	1	ea			$4,185
	Prepare Risk and Hazard Management Summary for Annual Compliance Monitoring Report	Report	1	ea			$7,833
	Sub total				$0	$12,369	$32,551
	Total for Component B:				**$0**	**$31,969**	**$32,551**
C. Monitored natural attenuation of tritium in ground water							
	Exposure Assessment	Labor	172	hr			$19,456
	Modeling	Labor	160	hr			$17,823
	Total for Component C:				**$0**	**$0**	**$37,279**
D. Source control by installing hydraulic diversion to prevent water from entering landfills							
System Design and Construction							
	Design Labor	Labor	448	hr		$52,873	
	Construction Oversight and Labor	Labor	820	hr		$79,327	
	Materials and Contract	3500' trench, 2000' pipe	1	ea	$261,667		
	Sub Totals:				$261,667	$132,200	$0
Operations and Maintenance							
	O&M Labor	Labor	56	hr			$4,772
	Total for Component D:				**$261,667**	**$132,200**	**$4,772**

Table G-8. Cost estimate for components of Alternative 5a, Option 2: Extraction wells with *ex situ* treatment.

Component	Activity	Parameter	Quantity	Unit	Direct Capital ($)	Indirect Capital ($)	Annual O&M($)
Cont. page 2 of 2							
E. Control migration of uranium, nitrate, and perchlorate in ground water using *ex situ* ground water extraction and treatment							
Extraction/Injection Wellfield							
System Design and Construction							
	Design Labor	Labor	600	hr		$71,429	
	Construction Oversight	Labor	656	hr		$67,144	
	Materials and Contracts	Wells, pumps, piping	1	ea	$864,440		
				Sub Totals:	$864,440	$138,573	$0
Operations and Maintenance							
	Materials and Equipment	Equip. replacement, utility	1	cy			$2,886
	O&M Labor	Sampling and Reporting	168	hr			$20,902
				Sub Totals:	$0	$0	$23,788
Ion Exchange Resin Treatment for Extraction Wellfield							
System Design and Construction							
	Materials & Contracts	System, 9 columns, resin	1	ea	$152,000		
	Construction / Oversight	Labor	440	hr		$38,809	
	Design Labor	Labor	300	hr		$33,227	
	Sub Totals:				$152,000	$72,036	$0
Operations and Maintenance							
	Materials & Contracts	Filters, resin, disposal, analytical	1	cy			$354,000
	O&M Labor	Maint. Labor + Sampling	568	hr			$42,000
	Sub Totals:				$0	$0	$396,000
	Total for Component E:				**$1,016,440**	**$210,609**	**$419,788**
	Cost Summary for Alternative 5a:				**$1,278,107**	**$374,779**	**$597,950**
	Assumed interest rate= 5% (30 year design life)						
	Total Costs (net present value):				**$10,845,000**		

Table G-9. Cost estimate for components of Alternative 5b.

Component	Activity	Parameter	Quantity	Unit	Direct Capital ($)	Indirect Capital ($)	Annual O&M($)
A. Monitoring of ground water							
Monitoring							
	Water levels (65 wells)	Quarterly Measurements	65	ea			$1,796
	Water quality sampling/analysis (65 wells)	Quarterly Sampling	65	ea			$80,687
	Data analysis & representation	Labor	192	hr			$17,723
	Pump maintenance or replacement (7 wells)	Wells	7	ea			$3,353
	Total for Component A:				**$0**	**$0**	**$103,559**
B. Exposure control through risk and hazard management							
Institutional Controls							
	Exposure Assessment	Report	1	ea		$18,998	
	Install warning signs	Labor & materials	Once	lot		$602	
	Sub total				$0	$19,600	$0
Risk and Hazard Monitoring							
	Prepare Risk and Hazard Monitoring Plan	Plan	1	ea		$12,369	
	Re-evaluate tritium inhalation risk	Report	1	ea			$17,404
	Ambient outdoor air sampling for tritium	Location	1	ea			$3,129
	Conduct wildlife survey	Survey	1	ea			$4,185
	Prepare Risk and Hazard Management Summary for Annual Compliance Monitoring Report	Report	1	ea			$7,833
	Sub total				$0	$12,369	$32,551
	Total for Component B:				**$0**	**$31,969**	**$32,551**
C. Monitored natural attenuation of tritium in ground water.							
	Exposure Assessment	Labor	172	hr			$19,456
	Modeling	Labor	160	hr			$17,823
	Total for Component C:				**$0**	**$0**	**$37,279**
D. Source control by installing hydraulic diversion to prevent water from entering landfills							
System Design and Construction							
	Design Labor	Labor	448	hr		$52,873	
	Construction Oversight and Labor	Labor	820	hr		$79,327	
	Materials and Contract	3500' trench, 2000' pipe	1	ea	$261,667		
	Sub Totals:				$261,667	$132,200	$0
Operations and Maintenance							
	O&M Labor	Labor	56	hr			$4,772
	Total for Component D:				**$261,667**	**$132,200**	**$4,772**
E. Control migration of uranium, nitrate, and perchlorate in ground water using *in situ* permeable reactive barrier							
***In Situ* Bone Char Permeable Reactive Barrier**							
System Design and Construction							
	Design Labor	Labor	408	hr		$52,000	
	Construction Oversight and Labor	Labor	480	hr		$49,000	
	Materials and Contracts	Media, excavation	1	ea	$4,856,000		
	Sub Totals:				$4,856,000	$101,000	$0
Operations and Maintenance							
	Materials, Equipment, Contracts	Sampling equipment, Analytical	1	cy			$788
	O&M Labor	Sampling and Reporting	264	hr			$29,058
	PRB Replacement Materials and Contracts*	Media, excavation	3	total			$504,000
	PRB Replacement Labor and Oversight*	Labor	3	total			$4,000
	Sub Totals:				$0	$0	$537,845
	* Values are equivalent annual costs. Actual events occur at 11, 20, and 28 years.						
	Total for Component E:				**$4,856,000**	**$101,000**	**$537,845**
F. Control migration of uranium, nitrate, and perchlorate in ground water using *ex situ* ground water extraction and treatment (2 extraction and 2 injection wells in $Tnbs_0$)							
System Design and Construction							
	Design Labor	Labot	75	days		$71,429	
	Construction Oversight	Labor	82	days		$67,144	
	Materials and Contracts	Wells, pumps, piping	1	ea	$268,813		
				Sub Totals:	$268,813	$138,573	$0
Operations and Maintenance							
	Materials and Equipment	Equip., replaclement, utility	1	cy			$1,443
	O&M Labor	Sampling and Reporting	25	days			$10,451
				Sub Totals:	$0	$0	$11,894

Table G-9. Cost estimate for components of Alternative 5b.

Component	Activity	Parameter	Quantity	Unit	Direct Capital ($)	Indirect Capital ($)	Annual O&M($)
Cont. page 2 of 2							
Ion Exchange Resin Treatment for Extraction Wellfield							
System Design and Construction							
	Materials & Contracts	System, 9 columns, resin	1	ea	$40,307		
	Construction/Oversight	labor	440	hr		$38,809	
	Design Labor	Labor	300	hr		$33,227	
	Sub Totals:				$40,307	$72,036	$0
Operations and Maintenance							
	Materilals & Contracts	Filter, resin, disposal, analytical	1	cy			$213,500
	O&M Labor	Maint. Labor + Sampling	75	days			$46,000
	Sub Totals:						$259,500
	Total for Component F:				**$309,120**	**$210,609**	**$271,394**
	Cost Summary for Alternative 5b:				**$5,426,787**	**$475,778**	**$987,401**
	Assumed interest rate= 5% (30 year design life)						
	Total Costs (net present value):				**$21,082,000**		

Appendix H

Aqueous Chemistry of Uranium at the Pit 7 Complex

Appendix H

Aqueous Chemistry of Uranium at the Pit 7 Complex

This appendix provides information on the aqueous chemistry of uranium and factors that control its concentration and mobility in ground water. Section H-1 summarizes the geochemistry of uranium in ground water. Section H-2 presents information specific to the Pit 7 Complex regarding uranium and major ion geochemistry. Section H-3 presents the approach, methodology, and results of the reactive transport modeling of uranium in ground water at the Pit 7 Complex, and Section H-4 provides the conceptual model for uranium at the Pit 7 Complex.

H-1. Aqueous Geochemistry of Uranium

The following sections describe the chemistry of dissolved uranium and the processes that affect its concentration in water. Aqueous uranium occurs at average concentrations of 3 micrograms per liter (μg/L) in sea water, 0.1 to 500 μg/L in surface water, and 1 to 100 μg/L in ground water (Langmuir, 1997). Average uranium concentrations in rocks range from 1.2 to 1.3 milligrams per kilogram (mg/kg) in sedimentary rocks, 2.2 to 15 mg/kg in granites, and 20 to 120 mg/kg in phosphatic rocks (Langmuir, 1978; Eisenbud, 1987). In uranium-rich areas of the U.S., dissolved uranium ranges from 1 to 10 µg/L in streams, 1 to 120 µg/L in ground water, and 15 to 400 µg/L in ground water in uranium mining areas (Fix, 1956). The U.S. EPA Drinking Water Standard for uranium is 30 μg/L (U.S. EPA, 2000).

The principal factors that control the solubility, sorption, and ground water concentration of uranium minerals are: (1) the oxidation state, and (2) speciation of the uranium in the water. Speciation is controlled by pH and the concentrations of carbonate and other potential complexing ligands in the water.

H-1.1. Redox Chemistry of Uranium

The presence of oxygen in ground water enhances uranium mineral solubility and mobility of uranium in the water. Dissolved uranium typically exists as reduced U (IV) and oxidized U (VI). The oxidized form of uranium is far more mobile and U (VI) minerals are more soluble than U (IV) minerals. Oxidized uranium occurs as UO_2^{+2} (uranyl) ion and its hydroxide, phosphate, and carbonate complexes (Langmuir, 1978 and 1997; Meinrath et al., 1999). Uranium mobility does not increase proportionally with the dissolved oxygen content. If persistent oxygen is present, uranium will be present as U (VI) regardless of absolute dissolved oxygen concentration.

Uranous ion, UO_2^0 [U (IV)], and its complexes predominate in reduced, low Eh ground waters with no measurable dissolved oxygen. The low solubilities of reduced uranium solids (uraninite and pitchblende [UO_2] and coffinite [UO_2SiO_4]) can result in dissolved U (IV) concentrations less than 10^{-8} M (2.4 mg/L) (Langmuir, 1978).

H-1.2. Dissolved Uranium Species in Oxygen-Bearing Ground Water

Speciation of uranium in water is controlled by the reduction/oxidation (redox) state, the pH, and ligands available to complex with the dissolved uranium. The nature of dissolved U (VI) species control uranium mineral solubility, sorption, and the maximum concentrations of uranium that can exist in the water. Figures 1(a) through 1(c) show how uranium speciation is influenced by CO_2 concentration and pH. CO_2 content controls carbonate concentration in the water. In general, higher dissolved CO_2 and carbonate concentrations and higher pH enhance uranium mobility and the ability of the water to maintain higher uranium concentrations with sufficient supply.

Bare UO_2^{2+} is the dominant aqueous uranyl complex in oxidized solutions below pH 5 that contain less than 10^{-4} to 10^{-3} M (0.06 to 0.6 mg/L) total carbonate (Figure H-1(a)). Complexation reactions between hydrated UO_2^{2+} and ligands such as carbonate, hydroxide, and phosphate are favored due to the entropy increase caused by disruption of the hydration shell (Langmuir, 1978). Uranyl hydroxide complexes predominate at pH above 5.5 in the absence of carbon dioxide (Figure H-1(a) and Meinrath, 1998).

Carbonate complexes are the dominant uranyl species in most ground and surface waters containing more than 10 mg/L of carbonate (Murphy and Shock, 1999). Infiltrating precipitation contains CO_2 in equilibrium with the atmosphere (0.03% carbon dioxide in air). Figure H-1(b) shows the distribution with pH of dissolved uranium complexes under these conditions of atmospheric carbon dioxide ($pCO_2 = 10^{-3.5}$ bar) that exist in surface water and infiltrating rain water.

As water in equilibrium with atmospheric CO_2 dissolves calcium carbonate minerals (calcite and dolomite) in the subsurface and oxidizes organic matter, dissolved carbon dioxide concentrations may increase, decreasing pH and increasing carbonate and bicarbonate concentrations. The dissolved species $UO_2(CO_3)_2^{2-}$ and $UO_2(CO_3)_3^{4}$- predominate at typical ground water conditions (0.03% CO_2 or $pCO_2 = 10^{2-}$ atm), above pH 6.2 and 7.2, respectively (Figure H-1(c)). When CO_2 off-gases or chemical conditions cause carbonate minerals to precipitate, dissolved carbonate and bicarbonate concentrations may decrease resulting in a reduction in uranium mineral solubility, an increase in uranium sorption, reduction in dissolved uranium concentrations, and an increase in pH. Uranium mineral equilibria and sorption processes are discussed in the following sections.

U (VI) occurs in a six-fold coordination shell. In most complexes, this geometry is preserved (Clark et al., 1995). Figure H-2 shows the coordination of a $UO_2(CO_3)_3^{4-}$ anion. Note that the uranyl ion (UO_2^{2+}) is linear and is composed of two axial oxygen atoms double-bonded to the central uranium atom. The $UO_2(CO_3)_3^{4-}$ anion contains three carbonate groups, each double-bonded to the central uranium atom in equatorial position.

Fluoride, phosphate, and organic ligands may also form complexes with uranyl cations. These ligands typically occur at low concentrations in natural oxidized ground waters and are thus far less important than carbonate and hydroxide in complexing uranium.

H-1.3. Dissolution-Precipitation as a Control on Uranium Mineral Solubility

Mineral equilibria and sorption reactions control the maximum concentrations of uranium that can exist in solution. The solubility of U (VI) minerals is generally at a minimum in the absence of dissolved CO_2 and at neutral pH (Langmuir, 1997). Uranium minerals solubility increases with dissolved carbonate and bicarbonate concentrations and more acidic or alkaline conditions.

The most important solubility-controlling phases for uranium in oxidizing surface water and shallow-moderate depth ground water are schoepite ($UO_2(OH)_2$:H_2O), rutherfordine (UO_2CO_3), becquerelite ($Ca(UO_2)_6O_4(OH)_6$•$8H_20$)), soddyite ((UO_2)$2SiO_4$:$2H_2O$), and uranophane ($UO_2(SiO_2)_2(OH)_6$) (Langmuir, 1978, 1997; Meinrath, 1998; Murphy and Shock, 1999). The most soluble of these minerals, schoepite, can control dissolved U (VI) concentrations to below 1 to 2 mg/L at typical surface CO_2 conditions. In the absence of CO_2, schoepite can maintain dissolved uranium concentrations down to 0.2 mg/L (or 200 µg/L). Therefore, to reduce dissolved uranium concentrations below those controlled by mineral solubility, such as the Federal drinking water standard of 30 µg/L, may require sorptive processes (Langmuir, 1997; Arey and Seaman, 1999).

In typical sedimentary rocks and unconsolidated sediments, uranium occurs as a trace metal in feldspars and other minerals and may enter solution as these minerals dissolve.

H-1.4. Sorption-Desorption Processes as a Control on Uranium Mobility

Uranium can sorb to charged minerals surfaces resulting in a reduction in aqueous uranium concentrations. The pH range of minimum solubility of uranium minerals (near-neutral) is also generally the pH range of maximum sorption of U(VI) on most natural sorbents including: (1) organic matter; (2) iron, magnesium, and titanium oxyhydroxides; (3) zeolites; and (4) clays (Langmuir, 1997). The higher the degree to which the dissolved uranium occurs as carbonate species, the less effective is sorption of uranium to mineral surfaces. At increasingly higher pH in excess of 7, sorption of uranium is less intense because both the uranium species in solution and the mineral surfaces are both predominantly negatively-charged, creating a net electrostatic repulsion and maintaining uranium in solution. At low pH, positively-charged uranium species and mineral surfaces predominate which also tend to reduce the effectiveness of sorption.

Uranium sorbs to charged surfaces of metal oxides and hydroxides and clays. Sorption can occur by ion exchange, where a sorbed ion is replaced by a dissolved uranium species. Ion exchange and competition for sorption sites also occurs with OH^{1-}, H^{1+}, Ca^{2+}, Mg^{2+}, Na^{1+}, and K^{1+} ions.

X-ray techniques have successfully been used to determine the structure of surface complexes on a variety of mineral surfaces, including uranyl carbonate (Allen et al., 1995; Bargar et al., 2000), uranyl hydroxide (Meinrath, 1998), and uranyl oxide (Allen et al., 1996; Sylwester et al., 2000).

H-1.5. Hydrogeologic Factors that Affect Uranium Concentrations in Water

The extent and degree of uranium migration in ground water are determined by: (1) the rate and direction of ground water flow, (2) the extent to which mineral assemblages of host rocks adsorb uranium from solution, and (3) changes in pH, dissolved oxygen, and carbonate along the flow path (Cochran et al., 1986). There are three principal mechanisms for uranium attenuation in ground water systems: (1) precipitation of uranium-bearing solids, (2) sorption of dissolved uranium, and (3) filtration of colloidal uranium in pores onto mineral surfaces or organic matter (Murphy and Shock, 1999).

Uranium precipitation is promoted by increases in pH and decreases in dissolved oxygen and total dissolved carbonate concentrations within an aquifer (Beaucaire and Toulhoat, 1987). Major-ion chemistry also constrains the solubility of uranium-bearing minerals and thus the maximum concentration of uranium that can be carried by ground or surface water (Miyahara, 1993). Uranium can be released from minerals in which it is a trace component (principally feldspars), and desorbed from mineral surfaces (Jove et al., 2001). Changes in uranium concentration within a ground water flow path are principally controlled by residence time for water-rock interaction, dilution and mixing processes, uranium content of geological materials, and changes in water chemistry.

Dissolved uranium sorbs to mineral surfaces, particularly at low carbonate alkalinities and moderate pH. Once U (VI) has been adsorbed, it may be reduced to U (IV) by mobile reductants including hydrogen sulfide, methane, or ferric iron or by organic matter (Goldhaber et al., 1987). If reduction does not follow sorption, uranyl can be desorbed by an increase in alkalinity at constant pH, or by an increase in pH (Barnes and Cochran, 1993). Such changes increase dissolved carbonate and increase the extent of uranyl carbonate complexation (Figures H-1(b) and H-1(c)), and because the carbonate complexes are poorly adsorbed, cause desorption and remobilization of uranyl species.

Living cell membranes are typically negatively charged and can sorb appreciable uranium, especially in low pH waters, where cationic forms of uranium predominate. Dead cells may also be very effective in sorbing uranium from solution (Suzuki and Banfield, 1999).

Besides existing as dissolved species, uranium can be transported in water as polymeric compounds of hydrolyzed uranium or sorbed and transported on natural colloids (Viani and Martin, 1994).

H-2. Ground Water Chemistry of Uranium and Major-Ions at the Pit 7 Complex

The following sections describe the distribution and range of the concentrations of dissolved uranium and the effect of bicarbonate alkalinity, dissolved oxygen, pH, and water-rock interactions on the solubility of uranium-bearing minerals in ground water in the Pit 7 Complex area.

H-2.1. Uranium in Ground Water at the Pit 7 Complex

The range of concentrations of uranium in ground water are influenced by the bicarbonate alkalinity, dissolved oxygen content, pH, major-ion concentrations of the water, uranium content in soils and sediments in the recharge area and aquifer rocks, water-rock residence time, and dilution and mixing effects. Modeling results using the Geochemist's Workbench (Bethke, 2000) and chemical data for Pit 7 Complex ground waters indicate that dissolved uranium locally predominates as $UO_2(CO_3)_2^{2-}$ and $UO_2(CO_3)_3^{4-}$ species. The thermodynamic database (Delaney and Lundeen, 1990) used to perform these calculations was also used to perform calculations made using the PHREEQC model described in Section H-3. These uranium species enhance uranium solubility and reduce the potential for uranium sorption. The range of total dissolved uranium concentrations detected in Pit 7 Complex ground water vary from fractions of a μg/L to over 220 μg/L. Previous ultrafilitration of ground water samples from the Pit 7 Complex indicate that colloidal transport is not important in uranium transport in local ground water.

H-2.2. Bicarbonate Alkalinity in Pit 7 Complex Ground Water

Bicarbonate concentrations in ground water samples from representative Pit 7 Complex and downgradient area wells are shown in Figure H-3. In general, bicarbonate concentrations in ground water are lower in Qal/WBR and $Tnbs_0$ HSU wells located in the upgradient recharge area than in downgradient Qal/WBR wells located in the bottom of the alluvial valley and $Tnbs_0$ bedrock wells located immediately east of the valley bottom. As shown on Figure H-3, bicarbonate concentrations in the most recent upgradient recharge area ground water were 130 mg/L at well NC7-53 (May 1988 [prior to Table A-8 date range]), 130 mg/L at well K7-06 ($Tnbs_0$ bedrock), and 160 mg/L at well NC7-49A (Qal/WBR), respectively. Data show an increase in bicarbonate concentrations in ground water from both Qal/WBR and $Tnbs_0$ wells located directly downgradient of the pits. For example, bicarbonate was detected in ground water samples from $Tnbs_0$ bedrock well NC7-25 at a concentration of 310 mg/L and in Qal/WBR well NC7-51 at a concentration of 540 mg/L.

Bicarbonate concentrations in ground water from Qal/WBR and $Tnbs_0$ wells generally decrease with distance from the pits. Along a northwest-southeast transect of wells completed in Qal/WBR on the downgradient side of the pits, most recent bicarbonate concentrations in ground water were 540 mg/L (NC7-51), 360 mg/L (NC7-40), 170 mg/L (K7-07), 180 mg/L (NC7-76), and 150 mg/L (NC7-15) (see Figure H-3). In $Tnbs_0$ bedrock ground water, at progressively further distances from the pits, bicarbonate concentrations were 310 mg/L (NC7-25) (see Figure H-3), 215 mg/L (W-Pit7-13), 170 mg/L (W-Pit7-15), and 130 mg/L (W-865-03).

There is an observed correlation between dissolved bicarbonate concentrations and dissolved uranium concentrations. For example, both dissolved bicarbonate and uranium in ground water increase in concentration from the upgradient recharge area as ground water migrates through the valley bottom and pit area. Uranium carbonate complexes become the dominant dissolved uranium species due to: (1) dissolution of calcite, (2) oxidation of natural organic matter, and (3) bacterial action in the root zone. The latter two processes create dissolved carbon dioxide, and thus bicarbonate. There is also an observed reduction in bicarbonate concentrations and dissolved uranium concentrations (Figure H-3 and Figure 2-19) with increasing distance from the pits.

H-2.3. Dissolved Oxygen and pH in Pit 7 Complex Ground Water

Figure H-4 and Table H-1 show dissolved oxygen concentrations and pH values for ground water samples collected from representative wells in March 2005. Due to the persistence of detectable oxygen in ground water beneath and downgradient of the Pit 7 Complex (see Section H-2.2), most, if not all dissolved uranium is assumed to occur as oxidized U (VI), which is more mobile than reduced U (IV).

Infiltrating precipitation in equilibrium with atmospheric oxygen contains about 8-9 mg/kg of dissolved oxygen. Dissolved oxygen concentrations of 5.5 to 7.1 mg/L were observed in ground water in the recharge area west of the pits in March 2005. Downgradient of the Pit 7 Complex, dissolved oxygen concentrations ranged from 1.2 to 10 mg/L indicating that oxygen-bearing ground water persists throughout the ground water flow system. Of note is the lower dissolved oxygen concentrations measured in ground water from two wells, NC7-48 (1.4 mg/L) and NC7-51 (3.9 mg/L) located immediately downgradient of Pits 7 and 3, respectively. These reductions in oxygen concentration relative to upgradient wells may reflect consumption of oxygen as organic matter and other materials are oxidized or as aerobic bacteria respire in the plant root zone.

The presence of appreciable dissolved oxygen in Pit 7 Complex ground water precludes the existence of dissolved organic carbon in ground water that could complex with dissolved uranium.

The pH values measured in ground water at the Pit 7 Complex range from 6.85 to 8.90. Values of pH tend to be lower downgradient of the landfills than upgradient (example: well NC7-49A [pH = 5.9] vs. well NC7-48 [pH=1.4]) (Figure H-4) and may reflect increased dissolution of CO_2 or some other slight acidification process. On a larger scale, Figure H-4 shows a pH of 7.46 at upgradient $Tnbs_0$ well K7-06 and a pH of 7.18 at downgradient $Tnbs_0$ well NC7-25, located closest to the pits. However, the pH in water at other $Tnbs_0$ wells located further downgradient increases to 7.49 at wells W-Pit7-12 and W-Pit7-15 and 8.17 at well W-865-1804. This distribution of pH suggests that dissolved CO_2 is added in the vicinity of the pits, resulting in a drop in pH and that pH increases progressively farther downgradient, indicating a drop in dissolved CO_2 and a potential attenuation mechanism for lowering dissolved uranium concentrations far downgradient of the landfills.

H-2.4. Uranium Water-Solid Interaction at the Pit 7 Complex

The volcanic-rich Neroly Formation bedrock that underlies the Pit 7 Complex area and Qal/WBR derived from the Neroly Formation contain abundant natural uranium as demonstrated by: (1) soil and rock uranium concentration data, and (2) elevated natural gamma radiation on geophysical logs. As much as 25.7 mg/kg of uranium have been detected in Neroly Formation rock samples from the Pit 7 Complex area.

Natural uranium is likely contained within weathered feldspars, oxides, hydroxides, and clays in the Neroly Formation bedrock. There are abundant nodules of calcite present in soils and as cement in the Neroly Formation sandstones. When the calcite dissolves, it increases the bicarbonate alkalinity of ground water.

Depleted uranium within the landfill waste is assumed to occur as oxidized $(UO_2)^{+2}$ minerals and sorbed to mineral surfaces.

Vegetation is the principal source of organic matter to ground water in unconsolidated sediments in the Pit 7 Complex. Up to 180 g/m^2 of vegetative biomass have been found in soils at Site 300. This biomass may be oxidized to create dissolved CO_2. Additionally, bacteria in the root zones may create dissolved carbon dioxide. Wood placed in the Pit 7 Complex landfills may also provide a source of organic matter for the consumption of oxygen and creation of dissolved CO_2. This CO_2 will dissolve, hydrolyze, and dissociate to lower pH and increase bicarbonate concentrations.

H-3. Reactive Transport Modeling and Hydrogeology of Uranium at the Pit 7 Complex

H-3.1. Statement of the Problem

Geochemical equilibrium speciation modeling and mass balance constraints were used to identify geochemical processes that could result in the relatively elevated concentrations of natural uranium detected in ground water downgradient of the Pit 7 Complex landfills.

H-3.2. Geochemical Modeling Description

As a first step, ground water compositions from 12 monitor wells (K7-01, K7-06, K7-07, K7-09, K7-10, NC7-15, NC7-25, NC7-34, NC7-40, NC7-51, NC7-51, NC7-53, NC7-75, NC7-76, W-PIT7-13, and W-PIT7-15) were speciated using the USGS model PHREEQC (Parkhurst and Appelo, 2002). A reaction model was also developed to predict the effects of adding CO_2 gas and dissolving dolomite along a ground water flow path.

H-3.3. Model Results and Implications for Natural Uranium Mobilization at the Pit 7 Complex

Speciation results suggest that groundwater samples are generally slightly supersaturated with respect to calcite, dolomite, and quartz, whereas all uranium-bearing mineral phases in PHREEQC's thermodynamic database were substantially undersaturated, with the exception of haiweeite ($Ca(UO_2)_2(Si_2O_5)_3 \cdot 5H_2O$). The relatively high degree of supersaturation (a log saturation index greater than +2 or +3) for haiweeite in nearly all samples, particularly those in the vicinity of the pits, suggests a kinetic inhibition in the precipitation of haiweeite, so this mineral is not considered to be a solution-controlling phase.

Differences in the major-ion composition of ground water between a representative well upgradient of the Pit 7 Complex landfills (NC7-53) and from three representative downgradient wells (NC7-34, NC7-51, and NC7-25) are shown on Figure H-5. These data indicate an excess quantity of inorganic carbon in each of the downgradient water compositions (second set of three blue bars on figure pointed to by yellow box 3) that cannot be explained solely based on water-rock interactions. Dissolution or precipitation of calcium- and magnesium-carbonate phases represents the only significant possible mineralogical influence on inorganic carbon concentrations. However, differences in Ca^{2+} and Mg^{2+} concentrations (yellow box 2 on graph points to these blue bars) do not fully account for all of the observed differences in inorganic carbon on a stoichiometric basis even when considering possible ion-exchange reactions. (This assumes that the exchange of Ca^{2+} and/or Mg^{2+} for Na^{1+} accounts for the differences in ΔNa^{1+} and ΔCl^{1-} between the upgradient and downgradient water compositions (pointed to by yellow box 1). Therefore, a possible source of this increase in inorganic carbon is the addition of CO_2 to the water composition as a result of: (1) the aerobic decomposition of plant material in the valley bottom, (2) microbial activity associated with the root zone of vegetation that lies along a local recharge path, and/or (3) oxidation of organic material within the pits (e.g., discarded wood framing). The addition of CO_2 would also help to explain an apparent drop in pH between upgradient well K7-06 (pH 7.46) and downgradient well NC7-25 (pH 7.18). CO_2 dissolves in water to HCO_3^{1-} and H^{1+}.

A reaction model was developed to test this hypothesis. In the model, realistic masses of CO_2 gas, dolomite (representing a mineralogical response to the acidifying action of the CO_2), and NaCl were added to the water composition in upgradient well NC7-53 in an attempt to approximately match the composition of groundwater that had been influenced by passage through the landfill(s). The water composition from well NC7-25, located downgradient of the pits, was considered to be representative of ground water that had migrated through the landfill area. The modeling assumed the presence of both an ion exchanger and a hydrous ferric oxide (HFO) surface that interacted with the aqueous phase composition. Provisional surface complexation parameter datasets were provided by the PHREEQC databases (Appelo and Postma, 1993; Dzombak and Morel, 2000). Estimated complexation data describing the association of uranium with both weak and strong adsorption sites on the HFO surface were taken from those provided in the Geochemist's Workbench software (Bethke, 2000).

Simulated water chemistry responses to the addition of CO_2 gas, dolomite, and NaCl are shown on Figures H-6 through H-8, with the measured composition of water from well NC7-25 also illustrated for comparison. In these three figures:

- The blue bar represents the actual analytical data for water samples from the upgradient well NC7-53 used for input to the model.
- The red bar in Figure H-6 represents the major-ion concentrations in water from downgradient well NC7-25 predicted by the model.
- The red bar in Figure H-7 represents uranium concentrations in water at downgradient well NC7-25 predicted by the model.
- The red bar in Figure H-8 represents the pH in water at downgradient well NC7-25 predicted by the model.
- The yellow bar represents the actual analytical data for water samples from downgradient well NC7-25.

The major ion and uranium concentrations predicted by the model in water at downgradient well NC7-25 are generally consistent with analytical data for water samples collected from the well. Relative to concentrations in water samples from upgradient well NC7-53, model results and analytical data for well NC7-25 indicate: (1)

an increase in carbon, calcium, chloride, magnesium and sodium due to dissolution of CO_2, dolomite and NaCl and ion exchange (Figure H-6), (2) an increase in uranium concentrations, though somewhat underpredicting the observed concentration (Figure H-7), and (3) a decrease in pH in ground water downgradient of the pits (Figure H-8). The model results under-predicted some of the measured data. These differences between predicted and actual concentrations arise from the simplifications inherent in the model output. However, this output is sufficient to verify that addition of CO_2 is necessary to create the downgradient water chemistry measures at well NC7-25.

Figure H-9 shows the model-predicted concentrations of uranium species in ground water prior to and following the addition of CO_2. The ground water composition at well NC7-53 was used to model uranium speciation in ground water upgradient of the pits and the ground water composition in well NC7-25 was used to model uranium speciation in ground water downgradient of the pits. The dark and light blue bars in the Figure H-9 graph refer to modeled concentrations of dissolved $UO_2(CO_3)_2^{2-}$ and $UO_2(CO_3)_3^{4-}$, respectively and the yellow bar refers to the modeled concentration of UO_2^{2+} sorbed on HFO mineral surfaces for both the upgradient NC7-53 and downgradient NC7-25 water compositions. Figure H-9 suggests that the increased inorganic carbon (speciated primarily as HCO_3^{1-}) measured in the downgradient NC7-25 water effectively complexes uranium, removing a larger fraction of it from the HFO surface.

An assessment of the overall relationship between the uranium concentration and the calculated CO_2 partial pressure or fugacity in ground water from Pit 5 and Pit 7 area wells is shown on Figures H-10(a) and H-10(b). As opposed to bicarbonate alkalinity alone, CO_2 fugacity provides some indication as to the direct input of CO_2 into the water composition. The apparent positive correlation between uranium and the CO_2 partial pressure is consistent with the mechanism that explains the geochemical modeling results.

H-4. Conceptual Model of Aqueous Geochemical Evolution of Uranium and Major Ions at the Pit 7 Complex

Figure H-11 shows the conceptual model of the evolution of water chemistry relevant to uranium mobilization at the Pit 7 Complex. Rainfall in equilibrium with atmospheric O_2 and CO_2 falls on the recharge area, dissolving carbonate minerals and oxidizing organic vegetative debris as it percolates to ground water. Dissolved uranium concentrations in the recharge area are low due to short residence time for water-rock interaction.

As ground water flows downgradient from the recharge area, concentrations of dissolved CO_2 increase. As discussed in Section H-3, possible sources of this increase in dissolved CO_2 are: (1) the aerobic decomposition of plant material in the valley bottom, (2) microbial activity associated with the root zone of vegetation that lies along a local recharge path, and/or (3) oxidation of organic material within the pits (e.g., discarded wood framing). The increase in dissolved CO_2 in ground water results in a decrease in pH due to the disassociation of carbonic acid from dissolved CO_2, and an increase in bicarbonate concentrations due to the dissolution of carbonate minerals. The distribution of bicarbonate concentrations and pH in the Pit 7 Complex area are shown in Figures H-3 and H-4, respectively. The highest bicarbonate concentrations and lowest pH are detected in ground water from wells generally located near the valley bottom and immediately downgradient of the pits.

Increased bicarbonate alkalinity promotes dissolved uranium complexation with carbonate which increases uranium mobility by facilitating desorption of uranium from mineral surfaces and dissolution of uranium-bearing minerals. As a result, total uranium activity increases in ground water in the Pit 7 Complex area as a function of time and distance along a ground water flow path. As shown in Figure 2-19, the highest natural uranium concentrations are detected in ground water samples from wells near the valley bottom and downgradient of the landfills, due to increased residence time.

Further downgradient from the pits, dissolved CO_2 concentrations decrease due to off-gassing of excess CO_2 and precipitation of carbonate minerals. These processes result in an increase in uranium sorption and precipitation and decreases in dissolved uranium concentrations observed far downgradient of the landfills. The decrease in bicarbonate and uranium concentrations with distance from the landfill are shown in Figures H-3 and 2-19, respectively.

H-5. Conclusions

Uranium concentrations in ground water in the Pit 7 Complex area increase as a function of time and distance along a ground water flow path with the highest natural uranium concentrations detected in ground water samples from wells near the valley bottom and downgradient of the landfills. The increase in dissolved uranium concentrations appears to be the result of an increase in CO_2 in ground water and the resulting increase in bicarbonate concentrations that may arise from some combination of the dissolution of carbonate minerals from rock, and the oxidation of natural vegetation and wood within the landfills. Increased bicarbonate alkalinity increases uranium mobility by promoting desorption of uranium from mineral surfaces and dissolution of uranium-bearing minerals.

Based on the evidence DOE/LLNL have gathered and the analysis presented in this appendix, it is possible that some combination of natural and landfill-induced geochemical effects are causing the distribution of dissolved bicarbonate concentrations that are increasing the capacity of the water for dissolved uranium mobilization. Determining the relative contributions of natural and landfill effects on natural uranium would be difficult and require significant additional data collection and evaluation. Also, the additional analysis may not provide a definitive indication of the relative contributions.

H-6. References

Allen P.G., J.J. Bucher, D.L. Clark, N.M. Edelstein, S.A. Ekberg, J.W. Gohdes, and E.A. Hudson (1995), "Multinuclear NMR, Raman, EXAFS, and x-ray diffraction studies of uranyl carbonate complexes in near-neutral aqueous solution," *Inorganic Chemistry*, **34**, n.19, 4797–4807.

Allen, P.G., D.K. Shuh, J.J. Bucher, N.M. Edelstein, C.E.A. Palmer, R.J. Silva, S.N. Nguyen, L.N. Marquez, and E.A. Hudson (1996), "Determinations of uranium structures by EXAFS: Schoepite and other U(VI) oxide precipitates," *Radiochimica ACTA*, **75**, 47–53.

Appelo, C.A.J., and Postma, D. (1993), *Geochemistry, Groundwater and Pollution* (A.A. Balkema, Rotterdam).

Arey, J.S. and J.C. Seaman (1999), "Immobilization of uranium in contaminated sediments by hydroxyapatite addition," *Environ. Sci. Technol.* **33**(2), 337–342.

Bargar, J.R., R. Reitmeyer, J. Lenhart, and J.A. Davis (2000), "Characterization of U(VI)-carbonato ternary complexes on hematite; EXAFS and electrophoretic mobility measurements," *Geochimica at Cosmochimica ACTA*, **64**(16), 2737–2749.

Beaucaire, C. and P. Toulhoat (1987), "Redox chemistry of uranium and iron, radium geochemistry, and uranium isotopes in the groundwaters of the Lodeve Basin, Massif Central, France," *Applied Geochemistry*, **2**, 417–426.

Bethke, C.M. (2000), "The Geochemist's Workbench: A Users Guide to RXN, ACT2, TACT, REACT, GTPLT, and Xt," University of Illinois, Champaign-Urbana, IL.

Clark, D.L., D.E. Hobart, and M.P. Neu (1995), "Actinide carbonate complexes and their importance in actinide environmental chemistry," *Chemical Reviews*, **95**, 25–48.

Cochran, J.K., A.E. Carey, E.R. Sholkovitz, and L.D. Supranent (1986), "The geochemistry of uranium and thorium in coastal marine sediments and sediment pore waters," *Geochimica et Cosmochimica ACTA*, **50**, 663–680.

Delaney, J., and S.R. Lundeen (1990), *The LLNL Thermochemical Database*, Lawrence Livermore National Laboratory, Livermore, Calif. (UCRL-21658).

Dzombak, D.A., and F.M.M. Morel, (1990), *Surface Complexation Modeling—Hydrous Ferric Oxide* (Wiley, New York), 393 pp.

Eisenbud, M. (1987), *Environmental Radioactivity*, 3rd ed. (Academic Press, New York).

Finch, R. and T. Murakami (1999), "Systematics and paragenesis of uranium minerals in: Uranium: Mineralogy, Geochemistry, and the Environment, Reviews in Mineralogy," vol. 38, Burns and Finch, Eds. (Mineralogical Society of America, Washington D.C.), pp. 91–180.

Fix, P.G. (1956), *Hydrochemical exploration for uranium*, U.S. Geological Survey Professional Paper 300, 667–71.

Goldhaber, M.B., B.S. Hemingway, A.S. Mohagheghi, R.L. Reynolds, and H.R. Northrup (1987), "Origin of coffinite in sedimentary rocks by a sequential adsorption-reduction mechanism," *Bulletin of Mineralogy*, **110**, 131–44.

Langmuir, D. (1978), Uranium solution-mineral equilibria at low temperatures with applications to sedimentary ore deposits, *Geochimica Et Cosmochimica Acta*, **42**(6) 547–569.

Langmuir, D. (1997), *Aqueous Environmental Geochemistry* (Prentice-Hall, N.J.), 600 pp.

Meinrath, G. (1998), "Chemometric analysis: Uranium (VI) hydrolysis by UV-Vis spectroscopy," *Journal of Alloys and Compounds* **277**, 777–781.

Meinrath, G., St. Fischer, K. Kohncke, and W. Voigt (1999), "Solubility behavior of Uranium (VI) in alkaline solution," in *Proceedings of the International Conference on Uranium Mining and Hydrogeology II*, Freiburg, Germany, September 15–17, 1998, Abstracts and Programs.

Miyahara, K. (1993), Sensitivity of uranium solubility to variation of ligand concentrations in groundwater, *J. Nuclear Sci. and Technol.* **30**(4), 314–332.

Murphy E.L., and E.W. Shock (1999), "Environmental aqueous chemistry of the actinides in: Uranium: Mineralogy, Geochemistry, and the Environment, Reviews in Mineralogy," vol. 38, Burns and Finch, Eds. (Mineralogical Society of America, Washington D.C.), pp. 221–254.

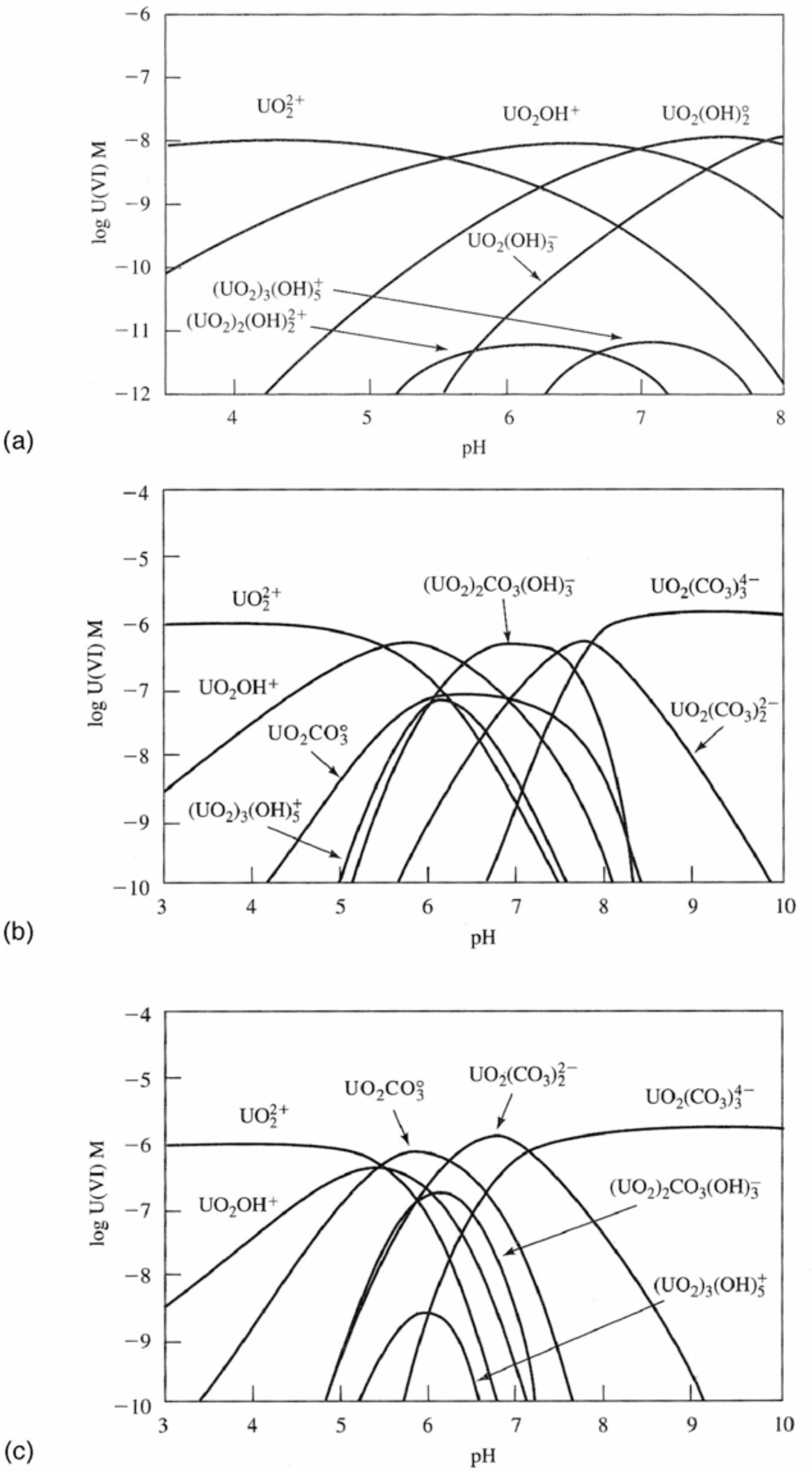
Parkhurst, D.L., and C.J. Appelo (2002), *User's Guide to PHREEQC-A Computer Program for Speciation, Reaction-Path, Advective-Transport, and Inverse Geochemical Calculations*, U.S. Geological Survey Water Resources, Lakewood, CO, Investigations Report 99-4259.

Sylwester, E. R., E. A. Hudson, and P.G. Allen (2000), "The structure of uranium (VI) sorption complexes on silica, alumina, and montmorillonite," *Geochimica et Cosmochimica Acta*, **64**(14), 2431–2438.

Suzuki, S., and J.F. Banfield (1999), "Geomicrobiology of uranium in: Uranium: Mineralogy, Geochemistry, and the Environment, Reviews in Mineralogy), vol. 38, Burns and Finch, Eds. (Mineralogical Society of America, Washington D.C.), pp. 393–492.

U.S. Environmental Protection Agency (2000), Radionuclides Rule, 66 FR 76708, **65**(206), December 7, 2000, Washington D.C.

Viani, B.E., and S.I. Martin, (1994), *Groundwater Colloid Characterization, Yucca Mountain Project Milestone Report*, Lawrence Livermore National Laboratory, Livermore, Calif. (UCRL-ID-132087).



ERD-S3R-05-0070

Figures H-1. Distribution of U(VI) species at 25C and I = 0.1 for **(a)** U(VI) = 10^{-8} M and pCO_2 = 0 bar, **(b)** U(VI) = 10^{-6} M and $pCO_2 = 10^{-3.5}$ bar, and **(c)** U(VI) = 10^{-6} M and $pCO_2 = 10^{-2.0}$ bar (reprinted from Langmuir, 1997, Aqueous Environmental Chemistry).

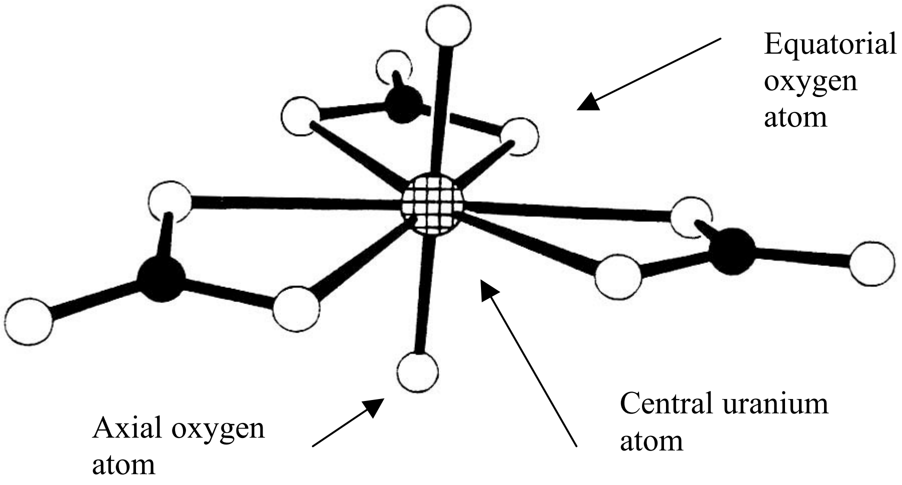


Figure H-2 Coordination geometry of uranyl tricarbonate ($(UO_2(CO_3)_3^{4-})$) reprinted from Clark et al., 2000. Stippled-patterned sphere is uranium, black sphere is carbon, and white sphere is oxygen. $UO_2(CO_3)_2^{2-}$ has similar geometry with one of the equatorial carbon atoms and the two associated oxygen atoms absent.

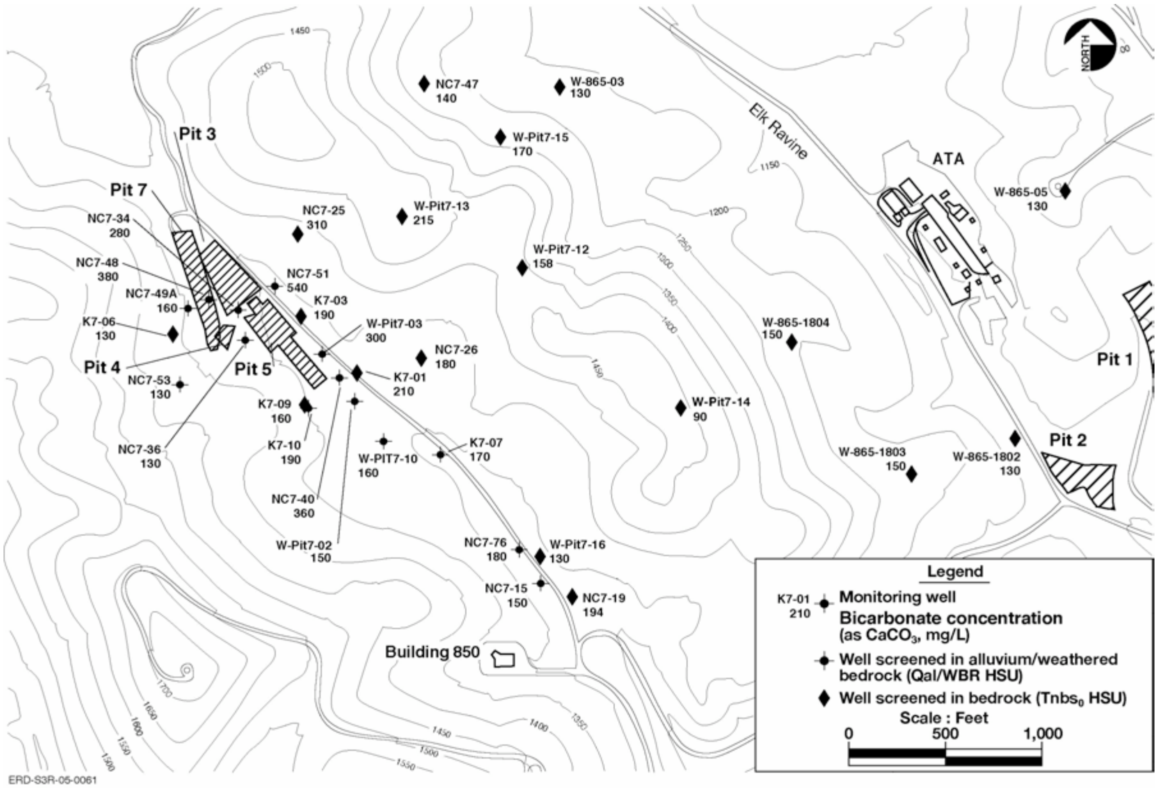


Figure H-3. Bicarbonate concentrations (as mg/L of $CaCO_3$) in Pit 7 Complex and downgradient ground water (most recent data).

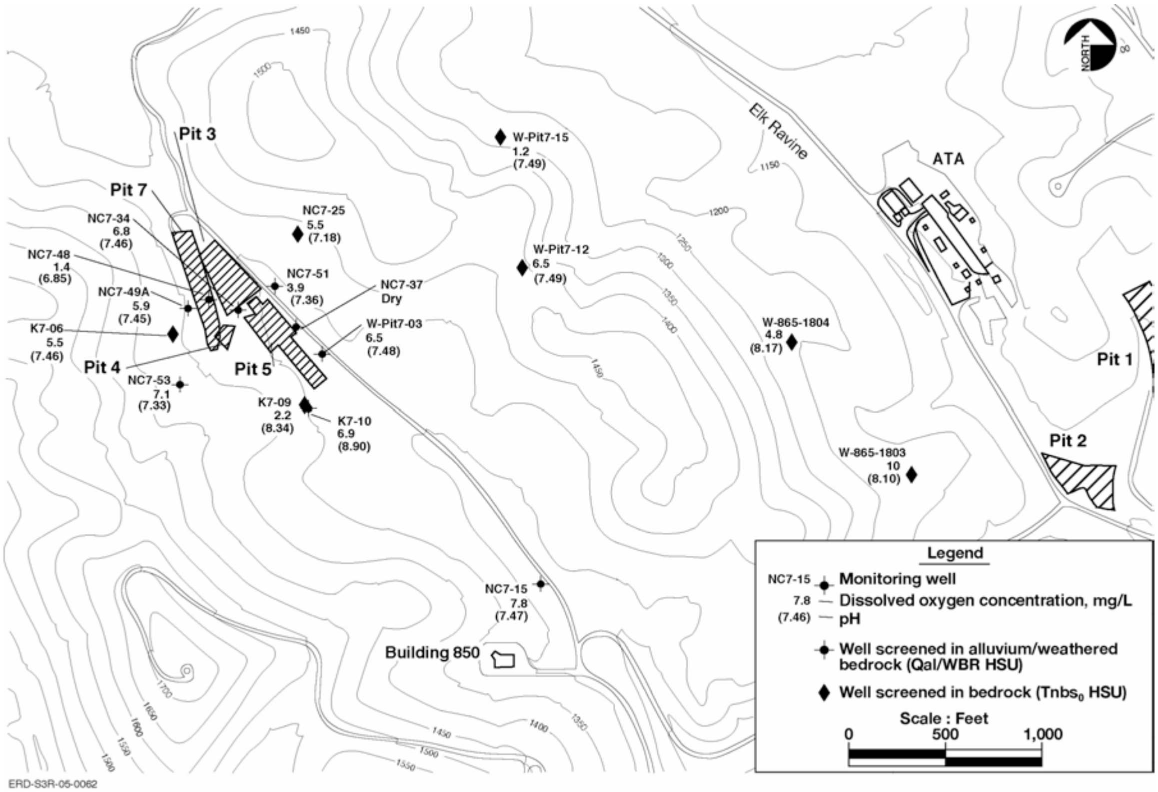


Figure H-4. Dissolved oxygen concentrations (mg/L) and pH in Pit 7 Complex and downgradient ground water (Data from Table H-1 collected March, 2005).

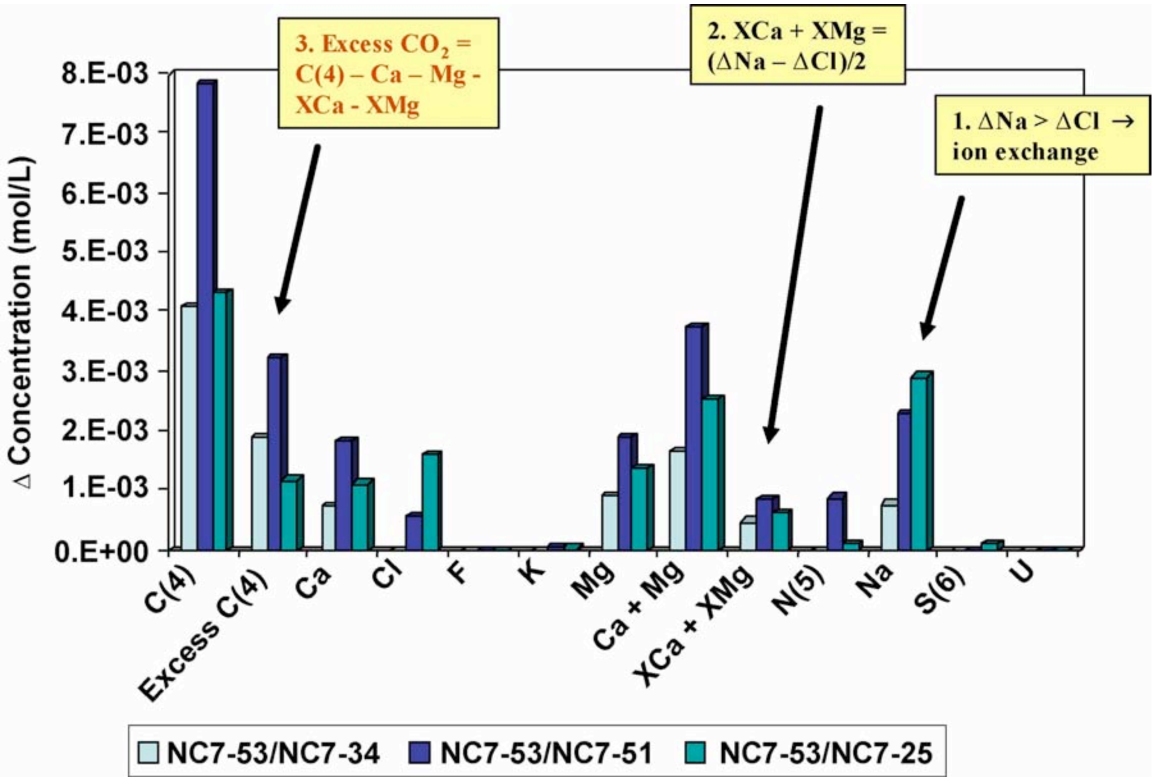


Figure H-5. Changes in major cation and anion ground water concentrations between a well upgradient of Pits 5 and 7 (NC7-53) and three downgradient wells (NC7-34, NC7-51, and NC7-25). The excess CO_2 represented by “Excess C(4)” appears to arise from oxidation of organic carbon in the region between the upgradient and downgradient wells.

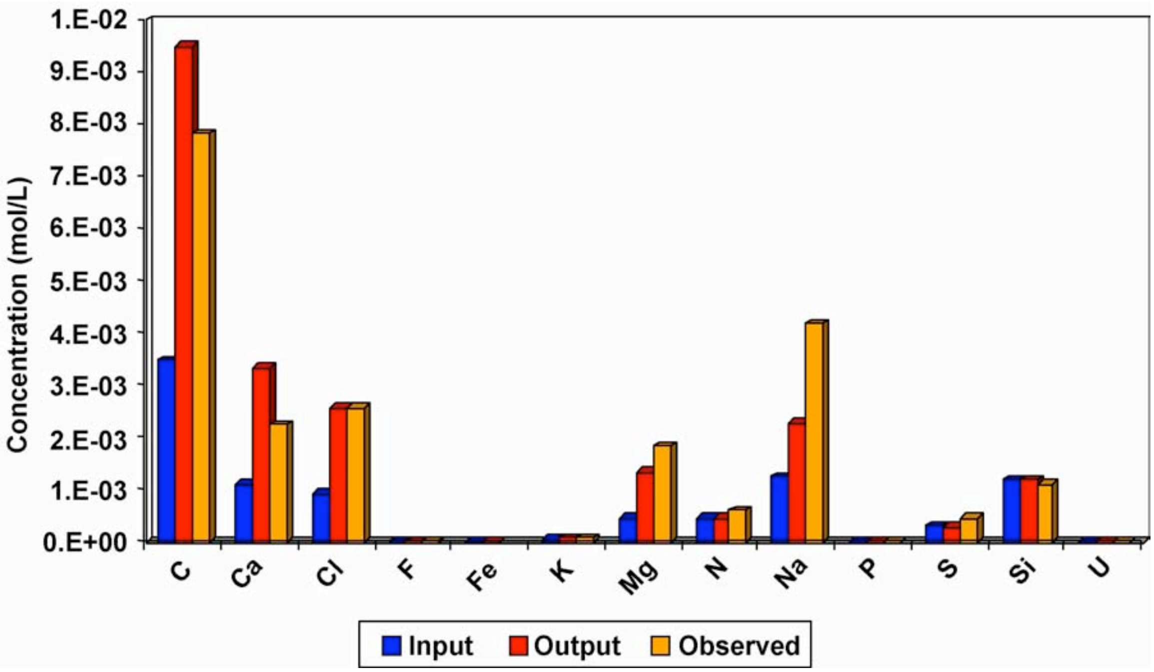


Figure H-6. Simulated changes in major-ion chemistry in response to the addition of CO_2, dolomite, and NaCl to the NC7-53 (upgradient of Pits 5 and 7, "Input") water composition in the presence of an ion exchanger and a hydrous ferric oxide mineral surface to create the NC7-25 water composition (downgradient of Pits 5 and 7, "Output" – simulated versus "Observed" – measured). "Input" refers to measured chemistry of NC7-53 water, "output" refers to modeled downgradient water chemistry, and "observed" refers to measured chemistry of well NC7-25 water.

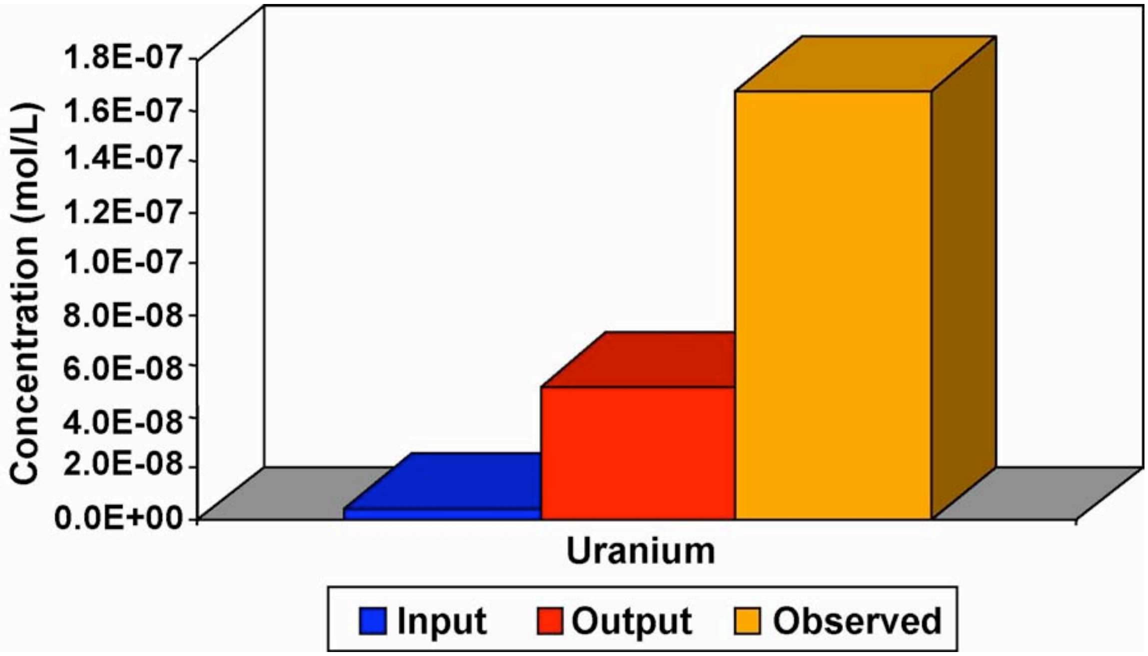


Figure H-7. Simulated changes in uranium concentration in response to the addition of CO_2, dolomite, and NaCl to the NC7-53 (upgradient of Pits 5 and 7, "Input") water composition in the presence of an ion exchanger and a hydrous ferric oxide mineral surface to create the NC7-25 water composition (downgradient of Pits 5 and 7, "Output" – simulated versus "Observed" – measured). "Input" refers to measured chemistry of NC7-53 water, "output" refers to modeled downgradient water chemistry, and "observed" refers to measured chemistry of well NC7-25 water.

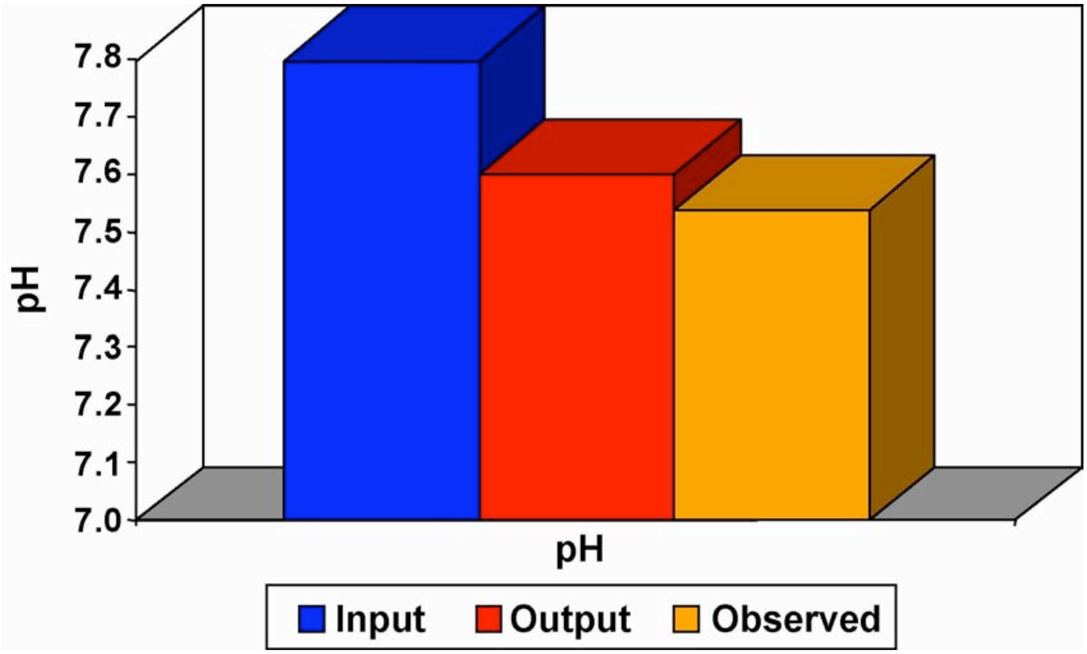


Figure H-8. Simulated changes in pH in response to the addition of CO_2, dolomite, and NaCl to the NC7-53 (upgradient of Pits 5 and 7, "Input") water composition in the presence of an ion exchanger and a hydrous ferric oxide mineral surface to create the NC7-25 water composition (downgradient of Pits 5 and 7, "Output" – simulated versus "Observed" – measured). "Input" refers to measured chemistry of NC7-53 water, "output" refers to modeled downgradient water chemistry, and "observed" refers to measured chemistry of well NC7-25 water.

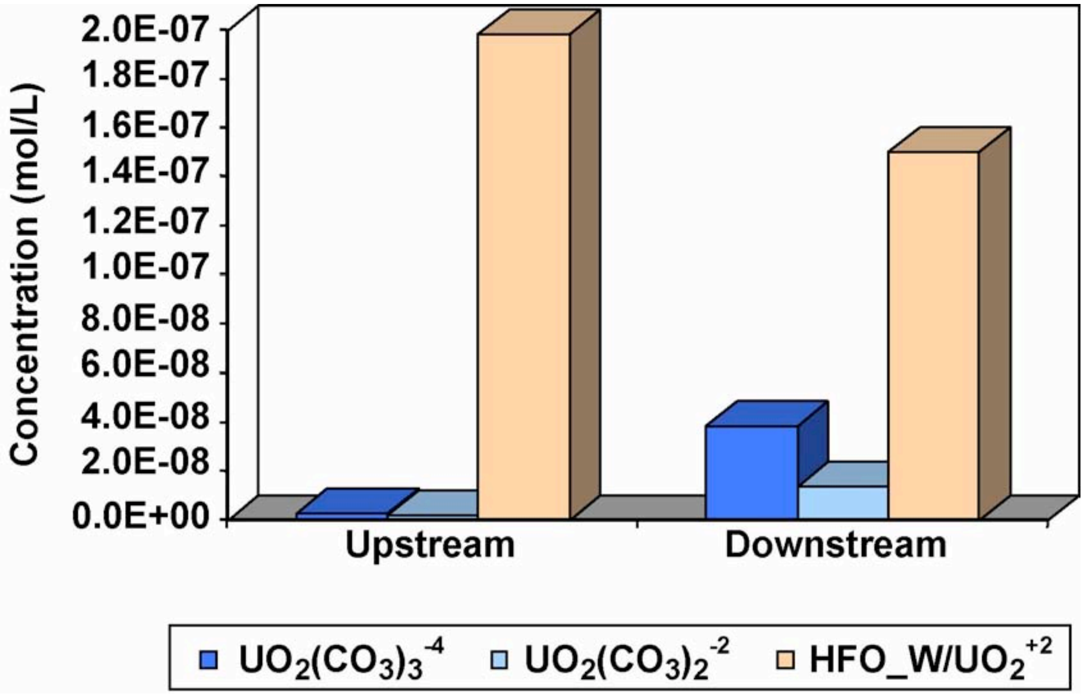


Figure H-9. Modeled uranium speciation prior to CO_2 addition ("Upgradient" or model input) versus after CO_2 addition ("Downgradient" or model output). Blue bars refer to modeled upgradient well NC7-53 and downgradient well NC7-25 concentrations of dissolved uranium carbonate species and flesh-colored bar bars refer to concentrations of uranium on HFO surface for these upgradient and downgradient water compositions.

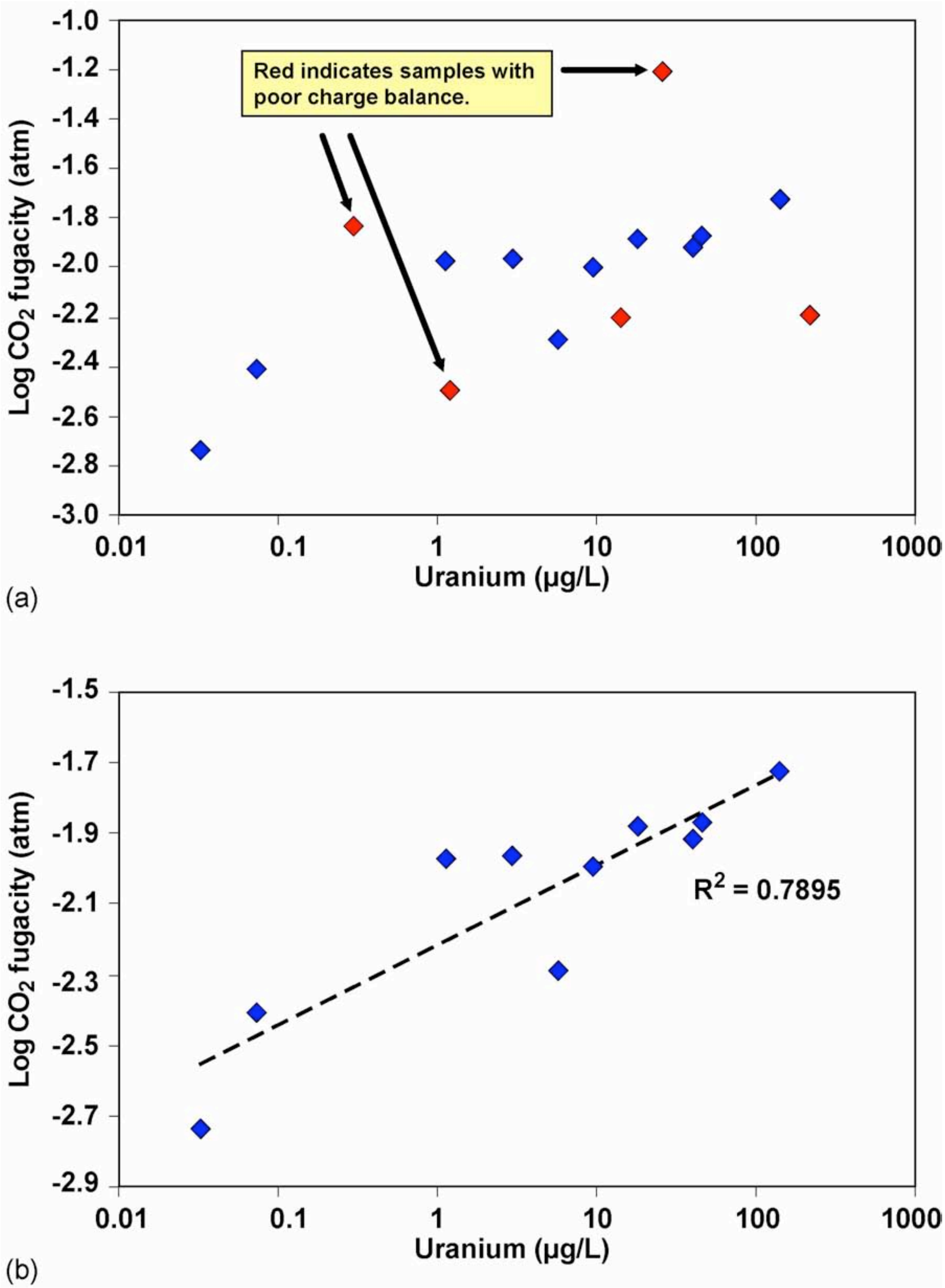
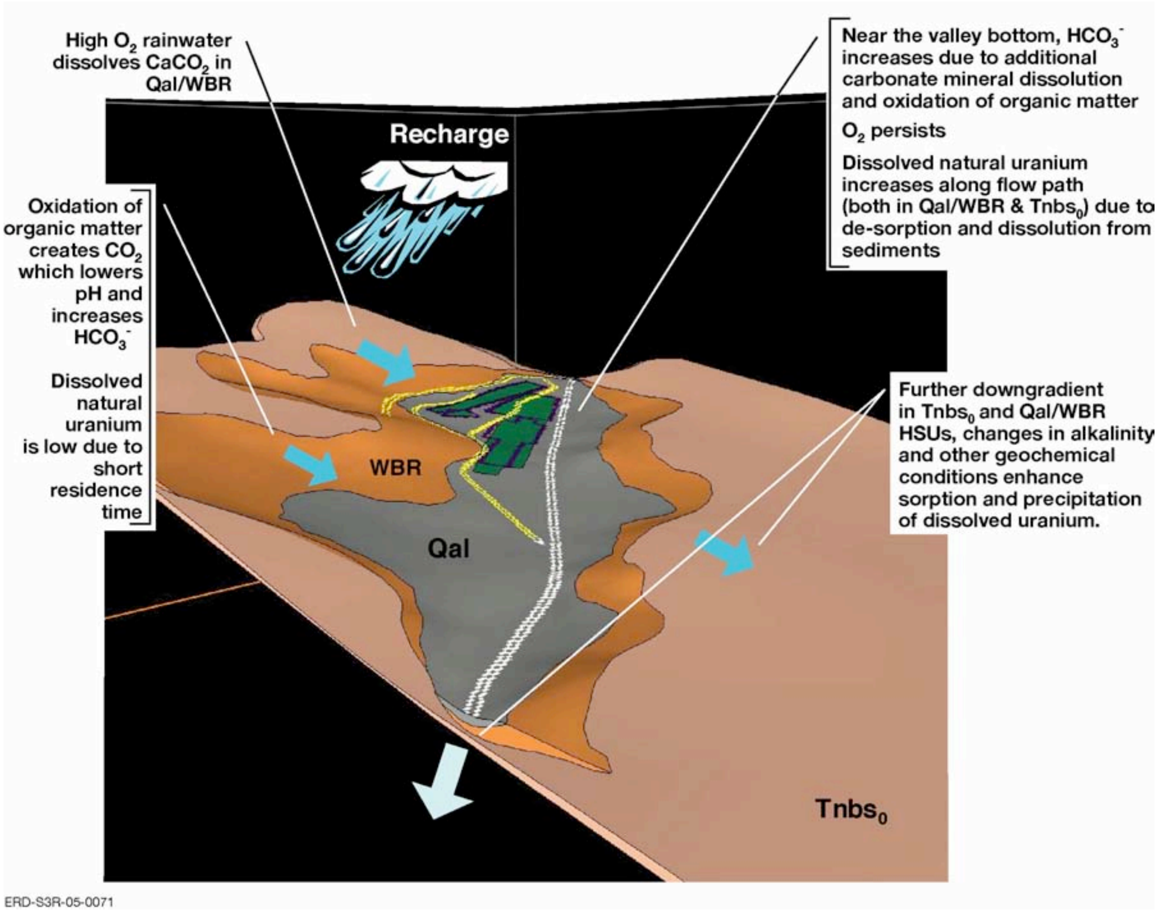


Figure H-10 (a). Relationship between observed uranium concentrations in Pit 5/7 area monitor wells and calculated equilibrium partial pressures of CO_2; red symbols indicate water samples with a poor charge balance, i.e., a charge imbalance exceeding 10% (top). **(b)** Logarithmic regression using only water samples with a charge imbalance of less than 10%.



High O_2 rainwater dissolves $CaCO_2$ in Qal/WBR

Oxidation of organic matter creates CO_2 which lowers pH and increases HCO_3^-

Dissolved natural uranium is low due to short residence time

Near the valley bottom, HCO_3^- increases due to additional carbonate mineral dissolution and oxidation of organic matter

O_2 persists

Dissolved natural uranium increases along flow path (both in Qal/WBR & $Tnbs_0$) due to de-sorption and dissolution from sediments

Further downgradient in $Tnbs_0$ and Qal/WBR HSUs, changes in alkalinity and other geochemical conditions enhance sorption and precipitation of dissolved uranium.

Figure H-11. Conceptual model of ground water chemical evolution relevant to uranium mobilization at the Pit 7 Complex.

Table H-1. Dissolved oxygen and pH data collected from Pit 7 Complex wells during March 2005.

Well	Dissolved Oxygen (mg/L)	pH
K7-06	5.5	7.46
K7-09	2.2	8.34
K7-10	6.9	8.90
NC7-15	7.8	7.47
NC7-16	8.3	8.09
NC7-17	6.5	7.32
NC7-18	6.7	7.46
NC7-25	5.5	7.18
NC7-34	6.8	7.46
NC7-37	DRY	DRY
NC7-48	1.4	6.85
NC7-49A	5.9	7.45
NC7-51	3.9	7.36
NC7-53	7.1	7.33
NC7-63	DRY	DRY
NC7-64	1.5	7.25
W-865-03	10	8.1
W-865-1804	4.8	8.17
W-PIT7-03	6.5	7.48
W-PIT7-12	6.5	7.49
W-PIT7-13	OBSTRUCTED	OBSTRUCTED
W-PIT7-15	1.2	7.49