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First Five-Year Review Report for the Test Reactor Area, Operable Unit 2-13, at the Idaho National Engineering and Environmental Laboratory (Draft Final)

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ABSTRACT

The remedy for the Test Reactor Area, Operable Unit 2-13, at the Idaho National Engineering and Environmental Laboratory included consolidating and capping contaminated sediments, removing contaminated materials, institutional controls, and monitoring the decrease of contamination in groundwater caused by radioactive decay, dispersion, and natural attenuation. This five-year review found that the selected remedies and institutional controls were implemented in accordance with the *Final Record of Decision, Test Reactor Area, Operable Unit 2-13* (published December 1997) and as modified by the *Explanation of Significant Differences to the Record of Decision for Test Reactor Area Operable Unit 2-13* (published May 2000).

The remedies at Operable Unit 2-13 are performing as expected and are continuing to provide protection of human health and the environment. Potential short-term threats are being addressed through institutional controls. Soil cover remedies constructed under Operable Unit 2-13 are being maintained properly and inspected in accordance with the appropriate requirements. In the long term, the remedies are expected to be protective when groundwater cleanup goals are achieved through monitored natural attenuation. Trends for contaminants of concern in aquifer water either are currently below the maximum concentration levels or are projected to be below the maximum concentration levels in 2012. Several issues have been identified relating to increasing trends of contaminants in the deep-perched water zone. These trends appear to be related to new or undiscovered releases or surface sources of water that have occurred since the *Final Record of Decision, Test Reactor Area, Operable Unit 2-13* was signed. New evaluations are warranted to determine the cause and sources of these increasing contaminant trends in the perched water. In addition, the new mission for the Idaho National Engineering and Environmental Laboratory, which will keep Test Reactor Area operational for at least another 20 years, will cause perched water to persist beneath the Test Reactor Area beyond the modeling assumptions used in the risk assessment for the *Record of Decision, Test Reactor Area Perched Water System, Operable Unit 2-12, Idaho National Engineering Laboratory, Idaho Falls, Idaho*. The impact of contaminants moving with perched water to the aquifer will need to be reevaluated.

SUMMARY

The remedy for the Test Reactor Area, Operable Unit 2-13, at the Idaho National Engineering and Environmental Laboratory included consolidating and capping contaminated sediments, removing contaminated materials, institutional controls, and monitoring the decrease of contamination in groundwater caused by radioactive decay, dispersion, and natural attenuation. This 5-year review found that the selected remedies and institutional controls were implemented in accordance with the *Final Record of Decision, Test Reactor Area, Operable Unit 2-13* (published December 1997) and as modified by the *Explanation of Significant Differences to the Record of Decision for Test Reactor Area Operable Unit 2-13* (published May 2000).

The remedies at Operable Unit 2-13 are performing as expected and are continuing to provide protection of human health and the environment. Potential short-term threats are being addressed through institutional controls. Soil cover remedies constructed under Operable Unit 2-13 are being maintained properly and inspected in accordance with the appropriate requirements. In the long term, the remedies are expected to be protective when groundwater cleanup goals are achieved through monitored natural attenuation. Trends for contaminants of concern in aquifer water either are currently below the maximum concentration levels or are projected to be below the maximum concentration levels in 2012. Several issues have been identified relating to increasing trends of contaminants in the deep-perched water zone. These trends appear to be related to new or undiscovered releases or surface sources of water that have occurred since the *Final Record of Decision, Test Reactor Area, Operable Unit 2-13* was signed. New evaluations are warranted to determine the cause and sources of these increasing contaminant trends in the perched water. In addition, the new mission for the Idaho National Engineering and Environmental Laboratory, which will keep Test Reactor Area operational for at least another 20 years, will cause perched water to persist beneath the Test Reactor Area beyond the modeling assumptions used in the risk assessment for the *Record of Decision, Test Reactor Area Perched Water System, Operable Unit 2-12, Idaho National Engineering Laboratory, Idaho Falls, Idaho*. The impact of contaminants moving with perched water to the aquifer will need to be reevaluated.

Groundwater modeling completed before the signing of the *Record of Decision, Test Reactor Area Perched Water System, Operable Unit 2-12, National Engineering Laboratory, Idaho Falls, Idaho* predicted the dissipation of perched water within 6 years following cessation of discharge to all disposal ponds. The modeling also predicted that tritium levels within the aquifer would drop below the maximum contaminant level (20,000 pCi/L) by 2004, chromium levels would meet or drop below the maximum contaminant level (0.1 mg/L) by 2016, and cadmium would drop below its maximum contaminant level (0.005 mg/L) by 2029. It is important to note the following: (1) perched water has remained and will remain beneath the Test Reactor Area as long as the discharge of significant quantities of water continues to the Cold Waste Pond; (2) predicted trends made by the pre-Record of Decision model are for aquifer concentrations only (not perched water); (3) the pre-Record of Decision model assumed cessation of discharge to the Cold Waste Pond in 2007 with closure of the Test Reactor Area facility.

The deep-perched water zone is monitored by 28 wells that are sampled routinely for contaminant-of-concern concentrations. Based on the review and trending of groundwater contaminants performed for this 5-year review, the summary of the data is as follows:

- Am-241, As, Be, Cd, Cs-137, Cr, Co-60, F, Pb, Mn, Sr-90, tritium, and Hg are the identified contaminants of concern for the Snake River Plain Aquifer beneath the Test Reactor Area. With the exception of Cr, H-3, Co-60 and Sr-90, it was determined that the other eight contaminants of concern have little impact on the perched water or the aquifer.

- Trends in deep-perched water wells over the past 5 years. Exceptions to the general decreasing trend include increasing or flat activities of Sr-90 in Wells PW-12, USGS-054, USGS-055, and USGS-070 as well as a recent increase of Co-60 in Well PW-12.

- The primary contaminants of concern identified for the Snake River Plain Aquifer are Cr and H-3. The other 10 identified contaminants of concern have low concentrations or are at nondetect levels and are considered to have no significant impact to the Snake River Plain Aquifer.

- Measured concentrations of chromium levels in the aquifer are decreasing and are expected to decline below the maximum contaminant level by 2012 for all wells.

- Tritium levels in all aquifer wells are below the maximum contaminant level and are expected to continue to decrease due to radioactive decay and dilution.

- Based on the trend data for Sr-90 in the Snake River Plain Aquifer, it is expected to diminish and reach predicted concentrations, made by the pre-Record of Decision model, in the year 2008.

The implemented remedies from the *Final Record of Decision, Test Reactor Area, Operable Unit 2-13,* have been determined to be protective of human health and the environment. Potential short-term threats are being addressed through institutional controls. Long-term protectiveness of human health and the environment under the Record of Decision was determined based upon concentrations predicted in the aquifer (not in perched water). Trends for contaminants of concern measured in the aquifer during this first 5-year review period either are currently below the maximum contaminant levels or are projected to be below the maximum contaminant levels in 2012. Thus, the chromium concentrations in all wells will be below the maximum contaminant level 4 years in advance of the pre-Record of Decision model that predicted the concentration of chromium to reach the maximum contaminant level by 2016. Issues identified in this 5-year review related to perched water are not expected to affect the protectiveness of the selected remedies. Ongoing discussions with the Agencies will define activities to fully evaluate the perched water conditions and long-term impacts on the aquifer. Long-term protectiveness will be satisfied under the selected remedy when groundwater cleanup goals are achieved (estimated to occur in the year 2012) and the long-term impacts on the aquifer from the perched water conditions have been fully evaluated by the agencies.

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FIGURES

TABLES

ACRONYMS

bgs	below ground surface
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
CWP	Cold Waste Pond
DOE	U.S. Department of Energy
DOE-ID	U.S. Department of Energy Idaho Operations Office
EPA	U.S. Environmental Protection Agency
EVS	Environmental Visualization System
IDL	instrument detection limit
IDEQ	Idaho Department of Environmental Quality
INEEL	Idaho National Engineering and Environmental Laboratory
MCL	maximum contaminant level
OU	operable unit
PCB	polychlorinated biphenyl
ppm	parts per million
PQL	practical quantitation limit
RCRA	Resource Conservation and Recovery Act
SRPA	Snake River Plain Aquifer
TRA	Test Reactor Area
USC	United States Code
USGS	United States Geological Survey

First Five-Year Review Report for the Test Reactor Area, Operable Unit 2-13, at the Idaho National Engineering and Environmental Laboratory

1. INTRODUCTION

Fifty-five release sites, in total, were evaluated in the *Comprehensive Remedial Investigation/Feasibility Study for Test Reactor Area Operable Unit 2-13 at the Idaho National Engineering and Environmental Laboratory* (DOE-ID 1997a). Eight of these sites were identified as having actual or threatened releases of hazardous substances that could present a possible threat to human health and the environment. The remaining 47 sites were determined to not represent an unacceptable risk to human health and the environment; therefore, these sites required no further action. The *Explanation of Significant Differences to the Record of Decision for Test Reactor Area Operable Unit 2-13* (DOE-ID 2000a) identified seven of the 47 sites, which were listed previously as no action sites, as requiring specific institutional controls to prevent a possible threat to human health and the environment. Detailed descriptions of the contamination, the response taken, and the risk basis for the eight sites identified in the Comprehensive Remedial Investigation/Feasibility Study for Test Reactor Area (DOE-ID 1997a) and the seven sites added by the Explanation of Significant Differences (DOE-ID 2000a) are given in Appendix E. The remaining 40 "no action" site determinations were based on the land use assumption made in the *Final Record of Decision, Test Reactor Area, Operable Unit 2-13* (DOE-ID 1997b). Figure 1 is a detailed map of the Test Reactor Area.

2. PURPOSE

The purpose of the 5-year remedy review is to evaluate and determine whether the remedies prescribed by the Record of Decision (DOE-ID 1997b) are expected to remain protective of human health and safety and the environment. In general, Five-Year Review Reports document the methods, findings, and conclusions from monitoring and inspections required by a Record of Decision. In addition, Five-Year Review Reports identify issues found during the review and list recommendations to address the issues.

The U.S. Department of Energy (DOE) is preparing this Five-Year Review Report pursuant to Section 121 of the "Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA/Superfund)" (42 USC) 9601 et seq.) and 40 *Code of Federal Regulations* (CFR) 300, "National Oil and Hazardous Substances Pollution Contingency Plan."

The DOE has the duty and authority by law to conduct 5-year reviews at the Idaho National Engineering and Environmental Laboratory (INEEL), since this was delegated to DOE for the INEEL, under Section 2(d) of Executive Order 12580, pursuant to the President's authority to delegate, conferred by Section 115 of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) (42 USC 5 9601 et seq.). Furthermore, the "National Oil and Hazardous Substances Pollution Contingency Plan," as promulgated in the *Code of Federal Regulations,* recognizes by 40 CFR 300.5 that DOE will be the lead agency for the INEEL with regard to conducting 5-year reviews. While the responsibility and authority for conducting 5-year reviews lies with the DOE, the U.S. Environmental Protection Agency (EPA) retains authority over whether the 5-year review adequately addresses the protectiveness of remedies.

The *Federal Facility Agreement and Consent Order* for the Idaho National Engineering Laboratory (DOE-ID 1991a) specifies that the EPA may review response actions and, with consultation from the Idaho Department of Environmental Quality (IDEQ), determine whether additional action is required by DOE. Final authority and acceptance of this review are at the EPA's discretion.

This is the first 5-year review for the Test Reactor Area (TRA) Operable Unit (OU) 2-13 site. The ! triggering action for this statutory review is the signature of the Record of Decision (DOE-ID 1997b) on December 22, 1997. The 5-year review is required because hazardous substances, pollutants, or contaminants remain at the site above levels that allow for unlimited use and unrestricted access to the site. The U.S. Department of Energy Idaho Operations Office (DOE-ID) conducted this 5-year review of the implemented remedy at the INEEL TRA, OU 2-13 from June through December 2002 and generated an initial draft report. This report is the second draft and includes monitoring data through March 2003.

3. SITE CHRONOLOGY

The TRA was established in the early 1950s in the southwestern portion of what was then the National Reactor Testing Station – now the INEEL – for studying radiation effects on materials, fuels, and equipment. The TRA was designated as Waste Area Group 2, under the Federal Facility Agreement and Consent Order (DOE-ID 1991a).

In December 1991, the *Declaration for the Warm Waste Pond at the Test Reactor Area at the Idaho National Engineering Laboratory – Declaration of the Record of Decision* (DOE-ID 1991b) was signed. Remediation directed by this Record of Decision was carried out in 1992. The *Record of Decision, Test Reactor Area Perched Water System, Operable Unit 2-12, Idaho National Engineering Laboratory, Idaho Falls, Idaho* (DOE-ID 1992) was signed in December 1992. Monitoring plans were developed in accordance with the Record of Decision.

In February 1997, the Comprehensive Remedial Investigation/Feasibility Study (DOE-ID 1997a) was completed. Fifty-five sites were evaluated for contaminant concentrations, and data were provided to warrant remedial actions at eight of these sites where remaining contaminant concentrations presented unacceptable risks to human health and safety or the environment. Remedial action was recommended for four sites, and limited action was recommended for the other four sites in the Record of Decision (DOE-ID 1997b). The OU 2-13 Record of Decision is inclusive of the Warm Waste Pond (OU 2-10) and OU 2-12 Records of Decision (DOE-ID 1991b, 1992) and all TRA operable units. Remedial actions were initiated at these sites in 1999 and completed in 2000. The objectives, a brief description of the actions completed, and technical evaluations of these remedial actions are discussed in this Five-Year Review Report.

Based on the results of the Comprehensive Remedial Investigation/Feasibility Study (DOE-ID 1997a), the remaining 47 sites were identified as no action sites, posing no acceptable risks to human health and safety and the environment. For seven of the 47 sites, determinations were based on assumptions that no changes would occur to either land use or exposure routes. As specified in the OU 2-13 Record of Decision (DOE-ID 1997b), land use will be reviewed for these seven sites. The Explanation of Significant Differences (DOE-ID 2000a) required that these seven sites have institutional controls. A brief description and an evaluation of the institutional controls of these seven sites and the eight other sites, and their effectiveness, are discussed here. Table 1 shows the chronology of site events.

Table 1. Chronology of site events.

Event	Date
Identification of potential hazards on the INEEL during an initial installation assessment	January 1986
Consent Order and Compliance Agreement	July 28, 1986
National Priorities List listing	November 15, 1989
Federal Facility Agreement and Consent Order for the Idaho National Engineering Laboratory signed	December 9, 1991
Declaration for the Warm Waste Pond at the Test Reactor Area at the Idaho National Engineering Laboratory – Declaration of the Record of Decision signed	December 1991
Operable Unit 2-10 removal action of windblown contamination at the Warm Waste Pond	1992
Record of Decision, Test Reactor Area Perched Water System, Operable Unit 2-12 signed	December 1992
Explanation of Significant Differences to the Record of Decision for Test Reactor Area Operable Unit 2-13	March 1993
Operable Unit 2-10 Warm Waste Pond interim action complete	December 1993
Operable Unit 2-04 Non-Time-Critical Removal Action complete at TRA-34	1995/1996
Post Record of Decision Monitoring Plan for the Test Reactor Area Perched Water System Operable Unit 2-12 complete	August 1996
Three-year statutory review of the deep-perched water system complete	August 1996
Comprehensive Remedial Investigation/Feasibility Study for the Test Reactor Area Operable Unit 2-13 at the Idaho National Engineering and Environmental Laboratory complete	February 1997
Final Record of Decision, Test Reactor Area, Operable Unit 2-13 signed	December 22, 1997
Groundwater Monitoring Plan for the Test Reactor Area Operable Unit 2-13 complete	July 1998, revised 2003
Comprehensive Remedial Design/Remedial Action Work Plan for the Test Reactor Area, Operable Unit 2-13 complete	September 21, 1998
Five-year statutory review of the Warm Waste Pond interim action complete	September 1998
Actual remedial action start	March 8, 1999
Comprehensive Operable Unit 2-13 remedial action complete	December 1999
Operations and Maintenance Plan for the Final Selected Remedies and Institutional Controls at Test Reactor Area, Operable Unit 2-13 complete	March 2000
Explanation of Significant Differences to the Record of Decision for Test Reactor Area Operable Unit 2-13 covering site-specific institutional controls	May 2000

DOE-ID = U.S. Department of Energy Idaho Operations Office
INEEL = Idaho National Engineering and Environmental Laboratory
TRA = Test Reactor Area

4. BACKGROUND

4.1 Physical Site Characteristics

The INEEL is a government-owned contractor-operated facility, which is managed by the DOE-ID. The INEEL's eastern boundary is located 32 mi west of Idaho Falls, Idaho, and occupies 890 mi^2 of the Eastern Snake River Plain. Classified as semiarid, the area receives an average of 8.7 in. of precipitation annually. The TRA is located in the INEEL's southwestern portion (Figure 2), approximately one mile north of the Big Lost River, outside of the 100-year flood zone.

The TRA rests on the Big Lost River's alluvial plain. Alluvial deposits range from 30 to 75 ft thick and consist of coarse gravels and sands with some clay layers. A thick sequence (>1,650 ft) of basalt and interbedded sediments is located beneath the alluvium. Basalts make up approximately 70% of the subsurface stratigraphy. The shallow, sedimentary interbeds vary in thickness from 3 to 43 ft and are often laterally discontinuous. Recent deep coring encountered two thick, apparently continuous, interbeds from 1,221.6 to 1,251.8 ft below ground surface (bgs) and 1,290.9 to 1,506.5 ft bgs (INEEL 2003).

4.2 Land and Resource Use

The TRA was established in the 1950s for studying radiation effects on materials, fuels, and equipment. Three reactors have been used at the TRA: (1) the Advanced Test Reactor, (2) the Engineering Test Reactor, and (3) the Materials Test Reactor. Currently, only the Advanced Test Reactor is operating. Current activities generate low volumes of chemical and low-level radioactive waste; however, historically, the facilities have generated these types of waste on a larger scale and have been the site of occasional accidental releases of polychlorinated biphenyls (PCBs), diesel, and other chemical waste.

The current land use for the surrounding area is restricted, primarily by an INEEL buffer zone, with seasonally permitted grazing within 3.5 mi west and north of the TRA (Figure 3). Land use for the next 100 years is expected to remain under government control. No residential development will be allowed within the INEEL boundaries, and no major private developments, residential or nonresidential, are expected on public lands adjacent to the INEEL for the next 100 years.

Three subsurface water bodies are located beneath the TRA. The lowermost body, located approximately 450 ft bgs, is the Snake River Plain Aquifer (SRPA). The SRPA was designated as a sole-source aquifer under the "Safe Drinking Water Act" (42 USC § 300f to 300j-26) on October 7, 1991. The SRPA provides potable water for use at the INEEL, as Well as for use at private and municipal wells outside INEEL borders. Two perched water bodies, above the aquifer, are caused by water discharge to unlined ponds at TRA. The upper-perched water body is located approximately 50 ft bgs. The lower perched water body is located between 140 to 200 ft bgs. Perched water is not utilized for any purpose. Institutional controls continue to restrict access to all water beneath land surface at the TRA.

4.3 History of Contamination, Initial Response, and Basis for Action

See Appendix E for a description of the history of contamination, initial response, and the basis for action for each of the individual sites.

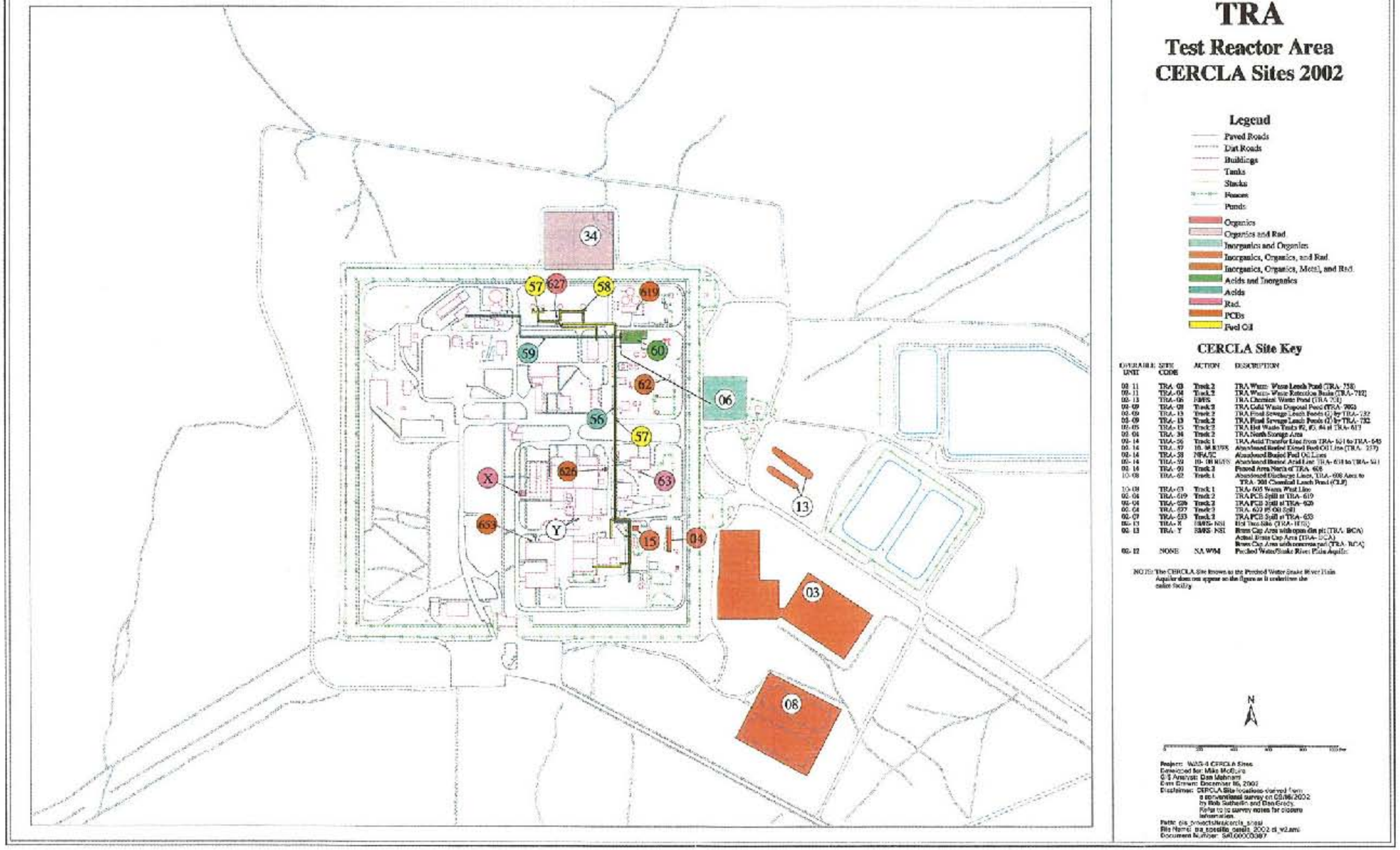

Figure 1. Map of Operable Unit 2-13 Comprehensive Environmental Response, Compensation, and Liability Act sites.

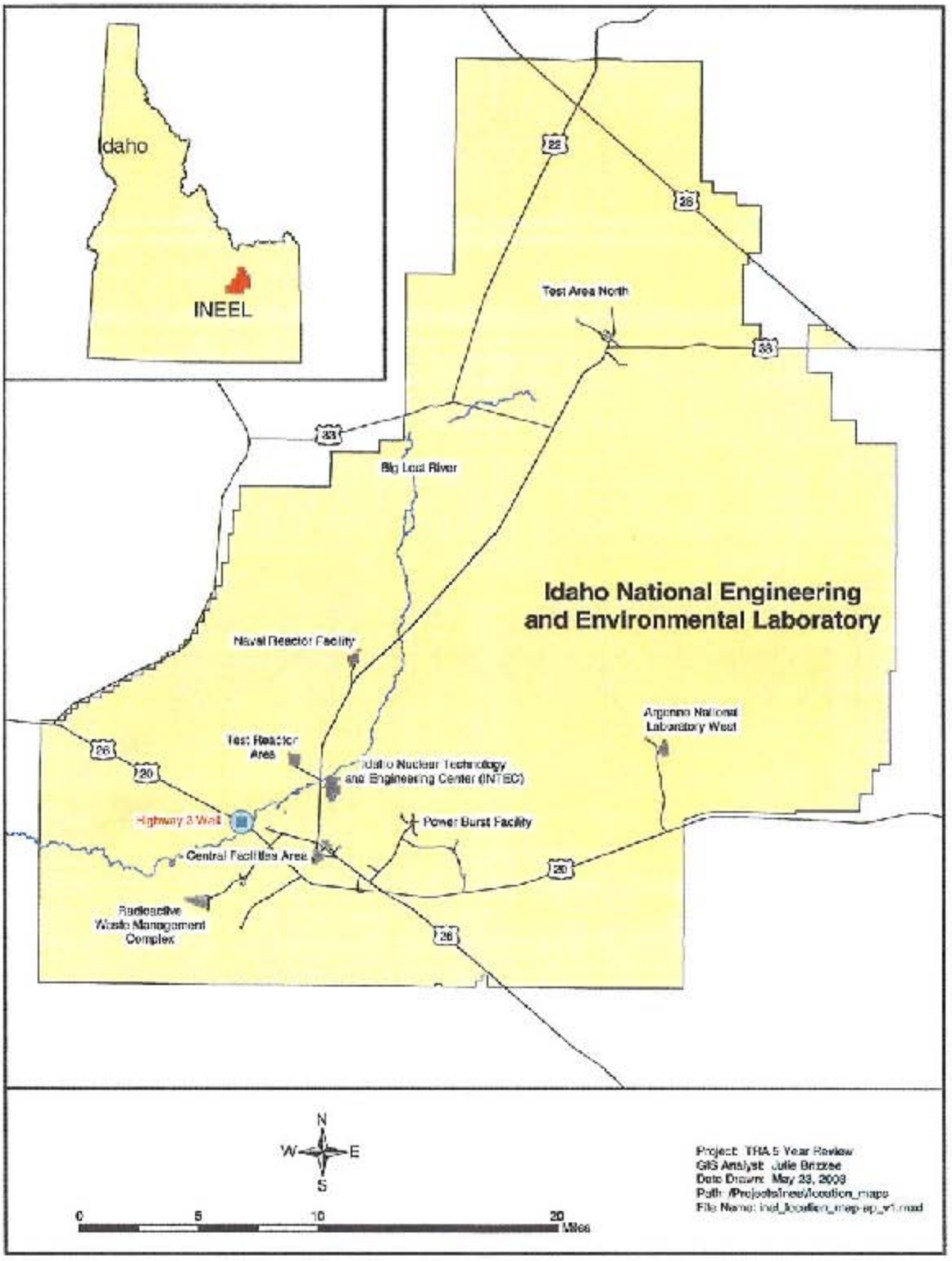

Figure 2. Map showing the location of the Idaho National Engineering and Environmental Laboratory and its facilities.

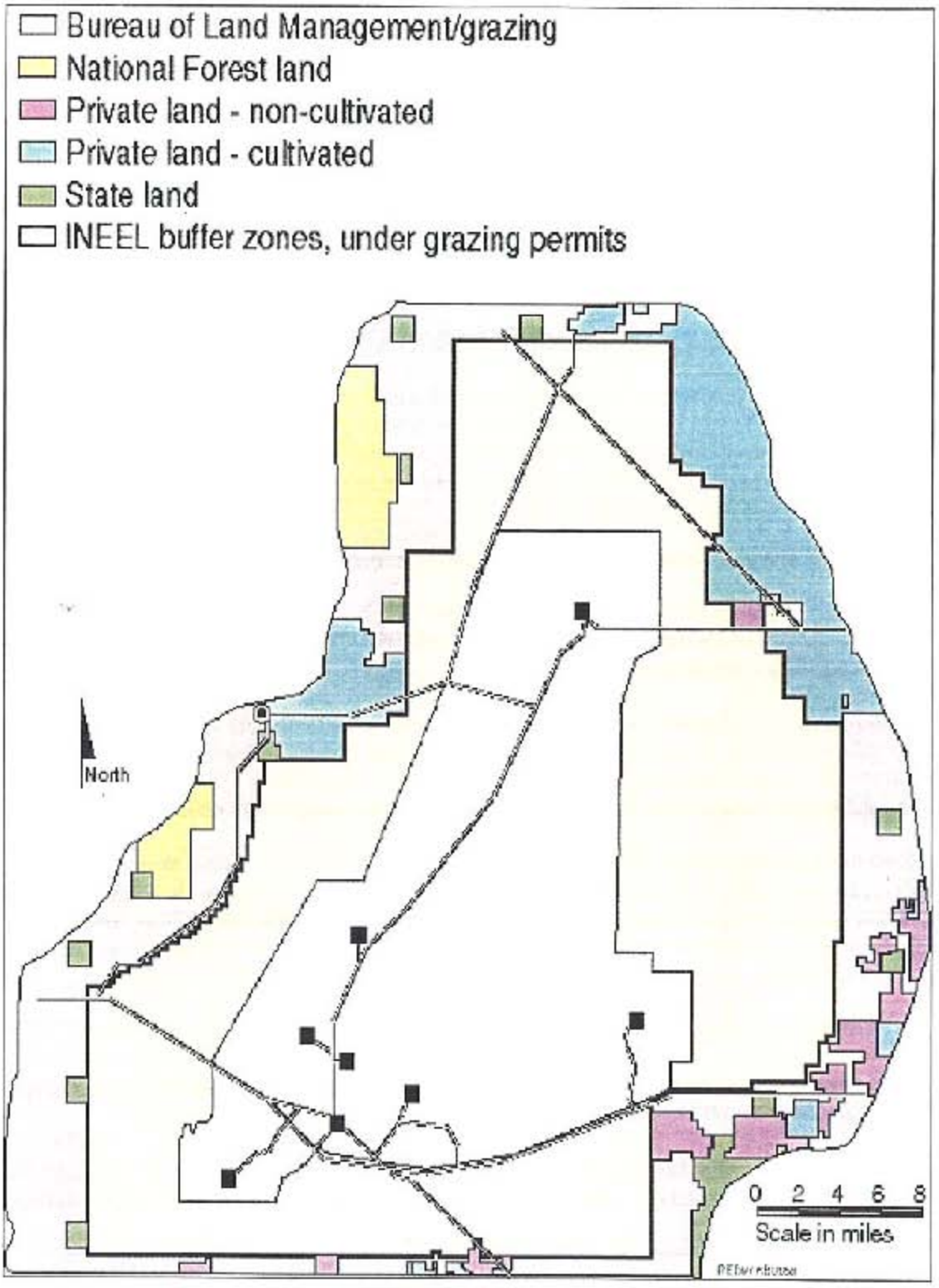

Figure 3. Land ownership and use on and surrounding the Idaho National Engineering and Environmental Laboratory.

5. REMEDIAL ACTIONS

The OU 2-13 Record of Decision (DOE-ID 1997b) was signed on December 22, 1997. Remedial action objectives were developed based upon data collected during the Comprehensive Remedial Investigation/Feasibility Study (DOE-ID 1997a). Of the 55 identified sites at TRA, eight were identified for remediation in the Comprehensive Remedial Investigation/Feasibility Study (DOE-ID 1997a). The OU 2-13 Record of Decision (DOE-ID 1997b) determined that four sites would require active action and four sites would require limited action. The Explanation of significant Differences (DOE-ID 2000a), signed in May 2000, documented the required institutional controls for these eight sites and added seven additional sites for institutional controls from the original 47 no action sites.

5.1 Remedial Action Objectives

Remedial action objectives for the eight sites of concern were developed in accordance with 40 CFR 300, "National Oil and Hazardous Substances Pollution contingency Plan," and CERCLA remedial investigation/feasibility study guidance through meetings with IDEQ, EPA, and DOE. The remedial action objectives result from risk assessments and are specific to the contaminants of concern and exposure pathways developed for OU 2-13.

The remedial action objectives for protection of human health and safety are described below:

- Inhibit direct exposure to radionuclide contaminants of concern in soil that would result in a total excess cancer risk of greater than 1 in 10,000 to 1,000,000 (1E-04 to 1E-06) to current and future workers and future residents

- Inhibit ingestion of chemical and radionuclides containing contaminants of concern in soil by all affected exposure routes (including ingestion of soil, groundwater, and homegrown produce) that would result in a total excess cancer risk of greater than 1 in 10,000 to 1,000,000 (1E-04 to 1 E-06) or a hazard index greater than 1 to current and future workers and future residents

- Inhibit the degradation of any low-level-waste repository covers (e.g., Warm Waste Pond 1952 and 1957 cell covers) that would result in exposure to either the buried waste or the migration of contaminants to the surface that would pose a total excess cancer risk (for all contaminants) of greater than 1 in 10,000 to 1,000,000 (1E-04 to 1E-06) or a hazard index greater than 1 to current and future workers and future residents.

The remedial action objectives for protection of the environment are described below :

- Inhibit adverse effects to resident populations of flora and fauna, as determined by the ecological risk evaluation from soil, surface water, or air containing contaminants of concern

- Inhibit adverse effects at sites where contaminants of concern remain in place, which could result in exposure to contaminants of concern or migration of contaminants of concern to the surface.

To meet these remedial action objectives, preliminary remediation goals were established as quantitative cleanup levels based primarily on applicable or relevant and appropriate requirements and risk-based doses. Final remediation goals are based on the results of the baseline risk assessment and an evaluation of expected exposures and risks for selected alternatives. Table 2 presents the final remediation goals. Remedial actions were completed to ensure that risk would be mitigated and exposure would not exceed the final remediation goals.

Table 2. Final remediation goals for Operable Unit 2-13 sites.

Site	Contaminated Media	Contaminant of Concern	Final Remediation Goals (mg/kg for Nonradionuclides) (pCi/g for Radionuclides)[a,b]
Warm Waste Pond (TRA-03)	Soil	Ag-108m*	0.39
		Cs-137*	7.78
		Eu-152*	99.9
Chemical Waste Pond (TRA-06)	Soil	Ba	926
		Mn	146
		Hg	0.47
		Zn	43.3
Cold Waste Pond (TRA-08)	Soil	As	18.3
		Cs-137*	23.3
Sewage Leach Pond (TRA-13)	Soil	Hg	0.94
		Zn	86.6
		Ag-108m*	0.58
		Cs 137*	11.7
Soil surrounding hot waste tanks at Building 613 (TRA-15)	Soil	Cs-137*	23.3
Soil surrounding Tanks 1 and 2 at Building 630 (TRA-19)	Soil	Cs-137*	23.3
Brass Cap Area	Soil	Cs-137*	23.3
Sewage Leach Pond berm and soil contamination area	Soil	Cs-137*	23.3

a. Final remediation goals are soil concentrations of contaminants of concern that would result in a cumulative excess cancer risk of 1 in 10,000 or a hazard index greater than 1 for the 100-year residential exposure scenario. These might vary during the actual cleanup, in recognition of natural background levels as established in *Background Dose Equivalent Rates and Surficial Soil Metal and Radionuclide Concentrations for the Idaho National Engineering Laboratory* (Rood, Harris, and White 1996), and in recognition that cleanup to within the acceptable risk range could be achieved with a different mix of the contaminants of concern than was assumed in establishing these final remediation goal values.
b. These final remediation goals are not relevant to the sites where the selected remedy is containment. The remedial action objectives will be met by installing a cover to the exposure pathway.
* = Contains radionuclides
TRA = Test Reactor Area

5.2 Remedy Implementation

The following subsections describe the remedial actions implemented at the OU 2-13 sites. A full description of the remedial actions is located in the Remedial Action Report for the Test Reactor Area Operable Unit 2-13 (DOE-ID 2000b).

5.2.1 TRA-03: Warm Waste Pond (Sediments)

Remedial activities were conducted at the TRA Warm Waste Pond in 1999. Engineered soil covers were placed over the covers constructed during interim actions. Cell 1964 was covered with native soil.

Cell 1952 was covered with pea gravel, cobble, and then a second layer of pea gravel. After placement of radiologically contaminated soil from the north Cold Waste Pond, Cell 1957 was covered with soil, pea gravel, cobble, and another layer of pea gravel. Then all three cells were covered by a riprap layer, approximately 2 ft thick, to inhibit human intrusion.

Preremediation occupational and residential risks are contained at this site beneath the engineered cover. Institutional controls were established, thereby restricting the site to occupational access for more than 30 years and restricting the site to industrial land use only for more than 100 years but less than 1,000 years until residential risk is $<10^{-04}$, based on the results of a 5-year review.

5.2.2 TRA-06: Chemical Waste Pond

Remedial activities were conducted at the Chemical Waste Pond in 1999. A native soil cover was constructed over the former waste pond. The soil cover was a three-layer design, consisting of a layer of gravel and coarse sand; a compacted, low permeability layer; and a topsoil layer. The topsoil layer was reseeded with native vegetation to control erosion.

Institutional controls were establish d restricting residential land use to depths <14 ft where an Hg hazard remains. Industrial land use is unrestricted. Recently available EPA information could be used to re-evaluate and increase the original OU 2-13 Record of Decision's conservative final remediation goal for mercury. (See the *End of Well Report for MIDDLE-1823 Waste Area Group 10 Deep Corehole Vertical Profile* [INEEL 2003] for an example of where a reevaluation was done.)

5.2.3 TRA-08: Cold Waste Pond

The Cold Waste Pond remains in use today; contamination found in the Cold Waste Pond is believed to be due to windblown contamination. The presence of Cs-137 is attributed to windblown soil contamination originating from the Warm Waste Pond, and the presence of arsenic is the result of historic disposal practices at the pond. Post-Record of Decision sampling data (DOE-ID 1998a) confirmed that the pond sediments are below the 18.3-mg/kg final remediation goal for arsenic and the Resource Conservation and Recovery Act (RCRA) toxicity characteristic leaching procedure's regulatory limit. Therefore, arsenic was eliminated as a contaminant of concern, and the final remediation goal for Cs-137 was increased from 11.7 to 23.3 pCi/g (DOE-ID 2000b).

Remedial actions were conducted at the Cold Waste Pond in 1999. Approximately 80 yd^3 of Cs-137-contaminated soil from the northern ponds was removed and transported to the Warm Waste Pond Cell 1957 for disposal. Institutional controls were established, thereby restricting the site to industrial land use for less than 100 years until residential risk is $<10^{-04}$, based on the results of a 5-year review.

5.2.4 TRA-13: Sewage Leach Pond and Sewage Leach Pond Berm

Remedial actions were conducted at the Sewage Leach Pond in 1999. Approximately 1,431 yd' of soil contaminated with Cs-137 concentrations greater than 23.3 pCi/g was excavated from the Sewage Leach Pond berms and placed in the bottom of the Sewage Leach Pond. A three-layer native soil cover was then constructed over the Sewage Leach Pond with a minimum thickness of 10 ft, consisting of a layer of gravel and coarse sand; a compacted, low-permeability layer; and a topsoil layer. Clean soil (6 in.) was placed over the soil contamination area that surrounds the Sewage Leach Pond. The topsoil layer and the soil contamination area were reseeded with native vegetation to control erosion.

Institutional controls were established restricting the site to occupational access for more than 30 years as well as restricting the site to industrial land use only until residential risk is $<10^{-04}$.

5.3 Limited Action Sites

Limited action sites in OU 2-13 include TRA-15, TRA-19, the Brass Cap Area, and the Sewage Leach Pond's soil contamination area. Actions taken at these sites were limited to institutional controls, with the contingent excavation and disposal option for TRA-19 and the Brass Cap Area to be used if necessary. The institutional controls for each of the sites are summarized in the following subsections.

5.3.1 TRA-15 7

Restrict occupational access for 25 more years and residential access for approximately 95 more years until risk is $<10^{-04}$, based on the results of a 5-year review. After the aforementioned restriction is removed, restrict land use at depths >10 ft until otherwise evaluated.

5.3.2 **TRA**-19

Restrict occupational access and prohibit residential development for at least 95 more years until soil is removed or status is changed, based on the results of a 5-year review.

5.3.3 Brass Cap Area

Restrict occupational access and prohibit residential development for at least 95 more years until soil is removed or status is changed, based on the results of a 5-year review.

5.3.4 Sewage Leach Pond – Soil Contamination Area

Restrict occupational access for approximately 25 more years and residential access for less than 95 more years until risk is $<10^{-04}$, based on the results of a 5-year review.

5.4 Institutional Control Sites

Subsequent to the completion of the Comprehensive Remedial Investigation/Feasibility Study (DOE-ID 1997a) and signing of the OU 2-13 Record of Decision (DOE-ID 1997b), a reevaluation of the data was performed and seven of the no action sites were determined to require institutional controls to ensure adequate protection of human health and safety and the environment. The Explanation of Significant Differences (DOE-ID 2000a), prepared and approved in May 2000, identified and documented the required institutional controls – all of which have been implemented. The institutional controls identify these areas as CERCLA sites, restrict access, and ensure that the remedies remain protective of human health and safety and the environment until contaminant concentrations decrease to levels that allow for unlimited use and unrestricted access. Institutional controls have been implemented to ensure that land use assumptions used in the risk assessments are preserved. The institutional controls implemented at each site are summarized as follows:

- **PCB Spill at TRA-619**: Permanently restrict this site to industrial land use only, unless otherwise indicated, based on the results of a 5-year review.

- **PCB Spill at TRA-626**: Permanently restrict this site to industrial land use only, unless otherwise indicated, based on the results of a 5-year review.

- **PCB Spill at TRA-653**: Permanently restrict this site to industrial land use only, unless otherwise indicated, based on the results of a 5-year review.

- **Warm Waste Retention Basin**: Restrict this site to industrial land use only for <10 ft for approximately 25 more years. Restrict land use for deeper soil (approximately 40 ft), unless otherwise indicated, based on the results of a 5-year review.

- **TRA-34 (North Storage Area)**: Restrict site to industrial land use only until residential risk is $<10^{-04}$, in approximately 25 more years based on the results of a 5-year review.

- **Hot Tree Site**: Restrict site to industrial land use only for approximately 25 years more until residential risk is $<10^{-04}$, based on the results of a 5-year review.

- **Perched Water and Snake River Plain Aquifer (No Action with Monitoring)**: Restrict drilling of wells for the purpose of drinking water use until contaminant concentrations are below the maximum contaminant levels, based on the results of a 5-year review.

5.5 No Action Sites

The remaining 47 sites evaluated under the Comprehensive Remedial Investigation/Feasibility Study (DOE-ID 1997a) were designated as no action sites in the OU 2-13 Record of Decision (DOE-ID 1997b). These sites were determined to pose no unacceptable risks to human health and safety and the environment. A list of these sites is contained in the OU 2-13 Record of Decision (DOE-ID 1997b). A review of planned land use indicates that the land use assumptions made in the OU 2-13 Record of Decision are still valid.

6. PROGRESS SINCE THE LAST FIVE-YEAR REVIEW

This is the first five-year review for the site.

7. FIVE-YEAR REVIEW PROCESS

7.1 Administrative Components

The DOE-ID is the lead agency for the 5-year remedy review at the OU 2-13 sites. The EPA retains final authority in determining the completeness of the 5-year review. Members of the 5-year review consisted of representatives from DOE, EPA, and IDEQ, as well as personnel from the INEEL's operations and maintenance contractor – Bechtel BWXT Idaho, LLC. The EPA, IDEQ, DOE, and Bechtel BWXT Idaho, LLC, personnel determined the schedule and content of the 5-year review during a conference call held on March 7, 2002.

7.2 Community Involvement

This section describes the required public notification for the 5-year remedy review of OU 2-13. The INEEL stakeholders and ti4e public were notified of the 5-year review schedule, and input was requested. No responses from the community were received. A copy of the press release is included in Appendix A. Notifications were made on August 5, 2002, in the following newspapers:

- *Arco Advertiser* – Arco, Idaho

- *Idaho State Journal* – Pocatello, Idaho

- *The Idaho Statesman* – Boise, Idaho

- *Idaho Unido* – Pocatello, Idaho

- *Moscow-Pullman Daily News* – Moscow, Idaho/Pullman, Washington
- *The Post Register* – Idaho Falls, Idaho
- *Sho-Ban News* – Fort Hall Reservation
- *The Times News* – Twin Falls, Idaho.

7.3 Site Inspections

Site inspections were conducted annually for each site as required by the OU 2-13 Record of Decision (DOE-ID 1997b), implemented in the Operations and Maintenance Plan for the Final Selected Remedies and Institutional Controls at Test Reactor Area, Operable Unit 2-13 (DOE-ID 2000c), and documented in annual reports. The most recent annual report is used by reference to satisfy EPA requirements in completion of this 5-year review. The most recent site inspection was completed on June 26, 2002. The site inspections included a visual inspection of the engineered soil covers, vegetation, and riprap covers; radiological surveys also were performed on the Warm Waste Pond and Sewage Leach Pond to determine the extent, if any, of contaminant migration. Visual site inspections showed that the engineered covers and vegetation are functioning as designed. The covers showed no signs of erosion or animal intrusion. Vegetation was noted as sparse.

The most recent annual radiological survey indicated that the remedy was functioning as intended. A review of the radiological surveys from 2000 – 2002 indicated no issues of concern. A full discussion of the radiological surveys is located in the FF-2002 Annual Institutional Controls Inspection Report for the Test Reactor Area, Operable Units 2-13 and 2-14(Final) (INEEL 2002).

A review of the institutional controls indicated that the institutional controls are functioning as intended. Based on previous risk evaluations, these institutional controls will need to be maintained for at least 25 more years, at which time they should be reevaluated. Site inspection forms and the radiological survey maps are located in Appendix D.

7.4 Document Review

Documents pertaining to the Records of Decision, site inspections, and monitoring results were reviewed during preparation of this document and are summarized here. A complete list of associated documents is located in Appendix B.

7.5 Review of Enforceable Milestones

The *Record of Decision, Test Reactor Area Perched Water System, Operable Unit 2-12, Idaho National Engineering Laboratory, Idaho Falls, Idaho* (DOE-ID 1992) was signed in 1992 and documented the perched water system's history. The OU 2-12 Record of Decision defined three water bodies beneath the TRA: (1) a shallow perched water zone, (2) a deep-perched water zone, and (3) the SRPA. The shallow perched water system was defined as saturated conditions occurring in the vadose zone in the "immediate vicinity of the ponds and retention basin...(that) forms on the interface between the surficial alluvium and the underlying basalts at about 50 feet below land surface." The deep-perched water system was defined as beginning "at depths of approximately 140 feet below land surface and ends at depths of about 200 feet below land surface." The SRPA is located approximately 450 ft bgs and has a flow rate of about 4.3 ft/day near TRA (DOE-ID 1992).

The selected remedy under the OU 2-12 Record of Decision (DOE-ID 1992) was "no action with monitoring." The Explanation of Significant Differences (DOE-ID 2000a) established institutional controls

for the aquifer and perched water. The OU 2-13 Record of Decision (DOE-ID 1997b), signed in 1997, later included and summarized the selected remedies of the OU 2-12 Record of Decision (DOE-ID 1992). The OU 2-13 Record of Decision designated the perched water and aquifer as an area of concern, and a groundwater monitoring plan was required for both perched water and aquifer monitoring. Aquifer monitoring was required due to the potential for contaminants of concern in the perched water system to migrate downward to the aquifer and as a result of contaminants disposed directly to the aquifer via the TRA disposal well. Aquifer monitoring provides information on contaminant trends and verifies the adequacy of the selected remedy.

8. GROUNDWATER MONITORING

Because groundwater is an important pathway for risk to human health and the environment, and is the focus of protection in the OU 2-13 Record of Decision (DOE-ID 1997b), an in-depth discussion of the hydrogeology and water quality is provided in this 5-year review. The following sections provide (1) a brief history of groundwater monitoring at TRA; (2) a discussion of the contaminants of concern that are in the groundwater pathway; (3) the hydrogeologic framework, including perched water formation and aquifer flow characteristics; and (4) an analysis of TRA groundwater sampling data.

For over 50 years, groundwater investigations have been ongoing near the TRA for characterizing the SRPA's overall quality and for determining the impact of facility operations on the aquifer. In the 1950s, the United States Geological Survey (USGS) began a program of installing monitoring wells and evaluating contaminant migration from the perched water to the aquifer. Beginning in the mid-1980s, INEEL contractors performed monitoring to satisfy various regulatory requirements. Groundwater monitoring under CERCLA has been ongoing at the TRA under the requirements of the OU 2-12 and OU 2-13 Records of Decision (DOE-ID 1992, 1997b). The USGS continues to monitor selected wells at the TRA, and these data are used to supplement information collected under CERCLA-driven monitoring. Data compiled and examined during completion of this 5-year review include water samples and water elevation measurements collected between March 1961 and March 2003.

One of the conditions stated in the OU 2-12 Record of Decision (DOE-ID 1992) was that a groundwater monitoring plan would be prepared within 45 days following signature of the document. The *Post-Record of Decision Monitoring Plan for the Test Reactor Area Perched Water System Operable Unit 2-12* (Dames R Moore 1993) included the analysis and evaluation of groundwater samples for contaminants of concern. The data collected under the Post-Record of Decision Monitoring Plan were used to verify trends in the SRPA predicted by pre-Record of Decision computer modeling, to evaluate the effects of discontinued discharge to the Warm Waste Pond, and to ensure protectiveness of human health and the environment.

Groundwater modeling completed before the signing of the OU 2-12 Record of Decision (DOE-ID 1992) predicted the dissipation of perched water within 6 years following cessation of discharge to all disposal ponds. The modeling also predicted that tritium levels within the aquifer would drop below the maximum contaminant level (MCL) (20,000 pCi/L) by 2004, chromium levels would meet or drop below the MCL (0.1 mg/L) by 2016, and that cadmium would drop below its MCL (0.005 mg/L) by 2029 (Dames & Moore 1992). It is important to note the following:

1. Perched water has remained and will remain beneath TRA as long as the discharge of significant quantities of water continues to the Cold Waste Pond

2. Predicted trends made by the pre-Record of Decision model are for aquifer concentrations only (not perched water)

3. The pre-Record of Decision model assumed cessation of discharge to the Cold Waste Pond in 2007 with closure of the TRA facility.

The Post-Record of Decision Monitoring Plan (Dames & Moore 1993) specified that groundwater 1 sampling and analysis for all contaminants of concern would be performed quarterly (four times a year) for six deep-perched water wells (Wells PW-11, PW-2, USGS-053, USGS-054, USGS-055, and USGS-056) and would be performed semiannually (twice a year) for four aquifer wells (Wells Highway 3, TRA-07, USGS-058, and USGS-065). Wells TRA-08 and TRA-06A were added to the list of aquifer wells in 1996 and 1997, respectively. The USGS has been collecting groundwater samples from wells near TRA since the 1960s. The USGS sampling has varied over the years in terms of wells, analytes, and frequency of sampling. Data from wells surrounding the TRA sampled by the USGS, but not required under the Groundwater Monitoring Plan were included in this 5-year review. Figures 4 and 5 show the locations of these and other perched water and aquifer wells, respectively, that are routinely sampled near TRA. A list of wells with data reviewed for this 5-year review is located in Appendix I.

During the 3 years following the signature of the OU 2-12 Record of Decision (DOE-ID 19921, annual technical memoranda were prepared that documented trends in groundwater contaminants and correlated the measured values to those of the pre-Record of Decision modeling (Jessmore 1994; Arnett, Meachum, and Jessmore 1995; Arnett, Meachum, and Jessmore 1996). These assessments reported that the selected remedy was functioning as intended. Based on the groundwater sampling through 1995, recommendations were made to reduce the number of analyzed constituents in the *Post Record of Decision Monitoring for the Test Reactor Area Perched Water System OU 2-12– Second Annul Technical Memorandum* (Arnett, Meachum, and Jessmore 1995).

8.1 Contaminants of Concern

Under the *Groundwater Monitoring Plan for the Test Reactor Area Operable Unit 2-13* (DOE-ID 2003), both perched and aquifer wells were sampled for the radiological contaminants americium (Am-241), cesium (Cs-137), cobalt (Co-601, strontium (Sr-90), tritium (H-3), and the inorganic contaminants arsenic (As), beryllium (Be), cadmium (Cd), chromium (Cr), fluoride (F), lead (Pb), manganese (Mn), and mercury (Hg). Table 3 presents analyte-specific action levels and background concentrations for the identified contaminants.

Water quality results show little impact (most levels near detection limits) for Am-241, As, Be, Cd, Cs-137, F, Pb, Mn, and Hg. A full discussion of these contaminants of concern is presented in Appendix C. The contaminants of concern with higher concentrations (Cr, H-3, and Sr-90) are discussed in detail in the following subsections. The deep-perched water section also includes a discussion of Co-60. The analytical data are located in Appendix C.

8.2 Hydrogeologic Framework

The TRA is located on an alluvial plain that consists of surficial sediment with thickness ranging from 30 to 75 ft. A series of basalt flows interbedded with sedimentary deposits of eolian and fluvial origin underlies the surficial sediments. The sedimentary interbeds vary in both thickness and lateral extent. Loose, rubble-like basalt contacts-- often highly vesiculated - are usually very permeable water-bearing intervals in both the perched water zones and aquifer. The basalt/sediment interfaces have much lower permeabilities and act as aquitards and perching layers. A simplified hydrogeologic cross-section showing basalt and interbed stratigraphy beneath TRA is provided in Figure 6. For the purposes of this report, geologic units are lumped into either basalt or sediment and no attempt is made to further define basalt subunits or specific sedimentary interbeds, as done in recent USGS publications (Anderson 1991).

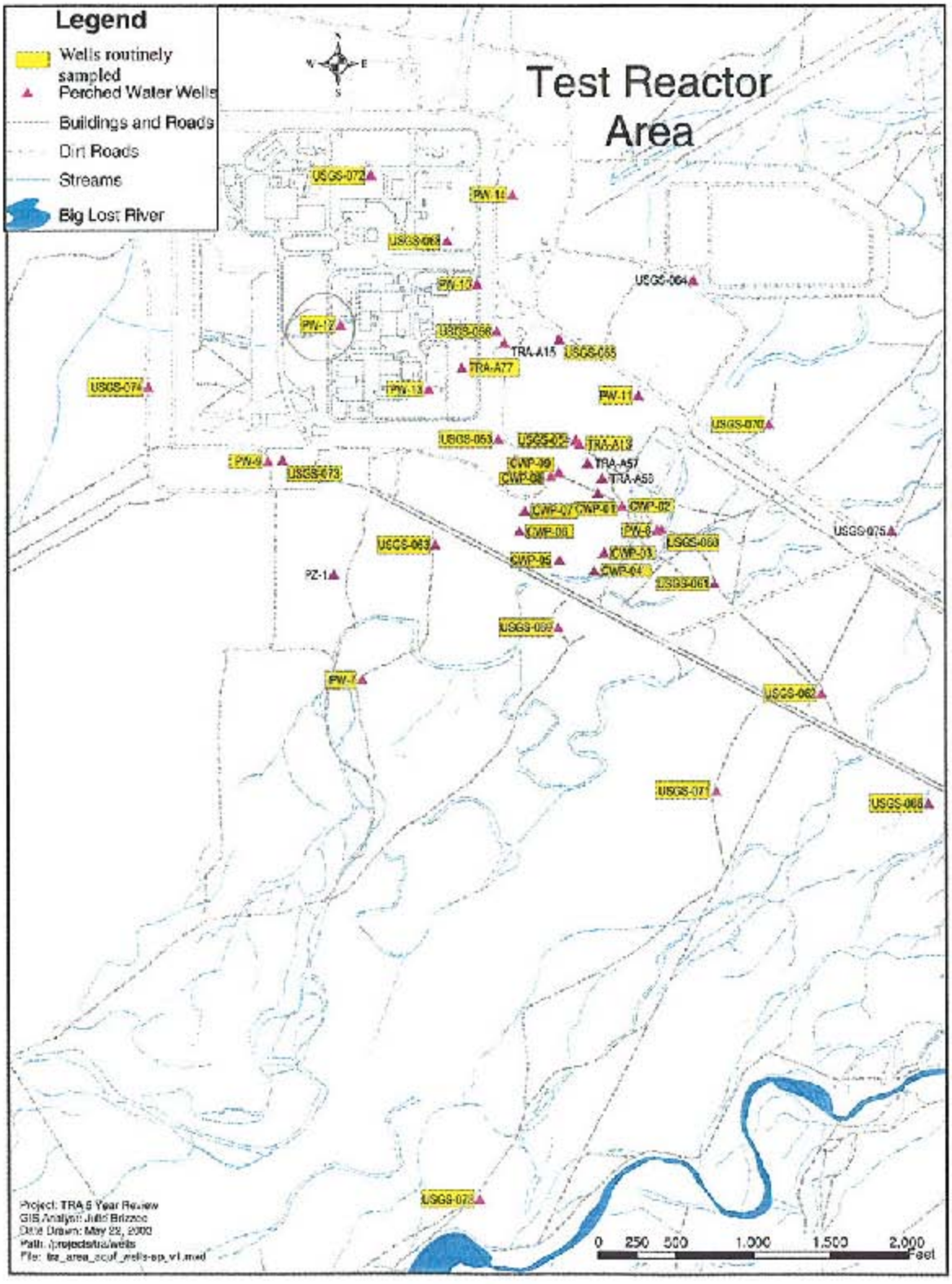

Figure 4. Map of perched-water monitoring wells at Test Reactor Area.

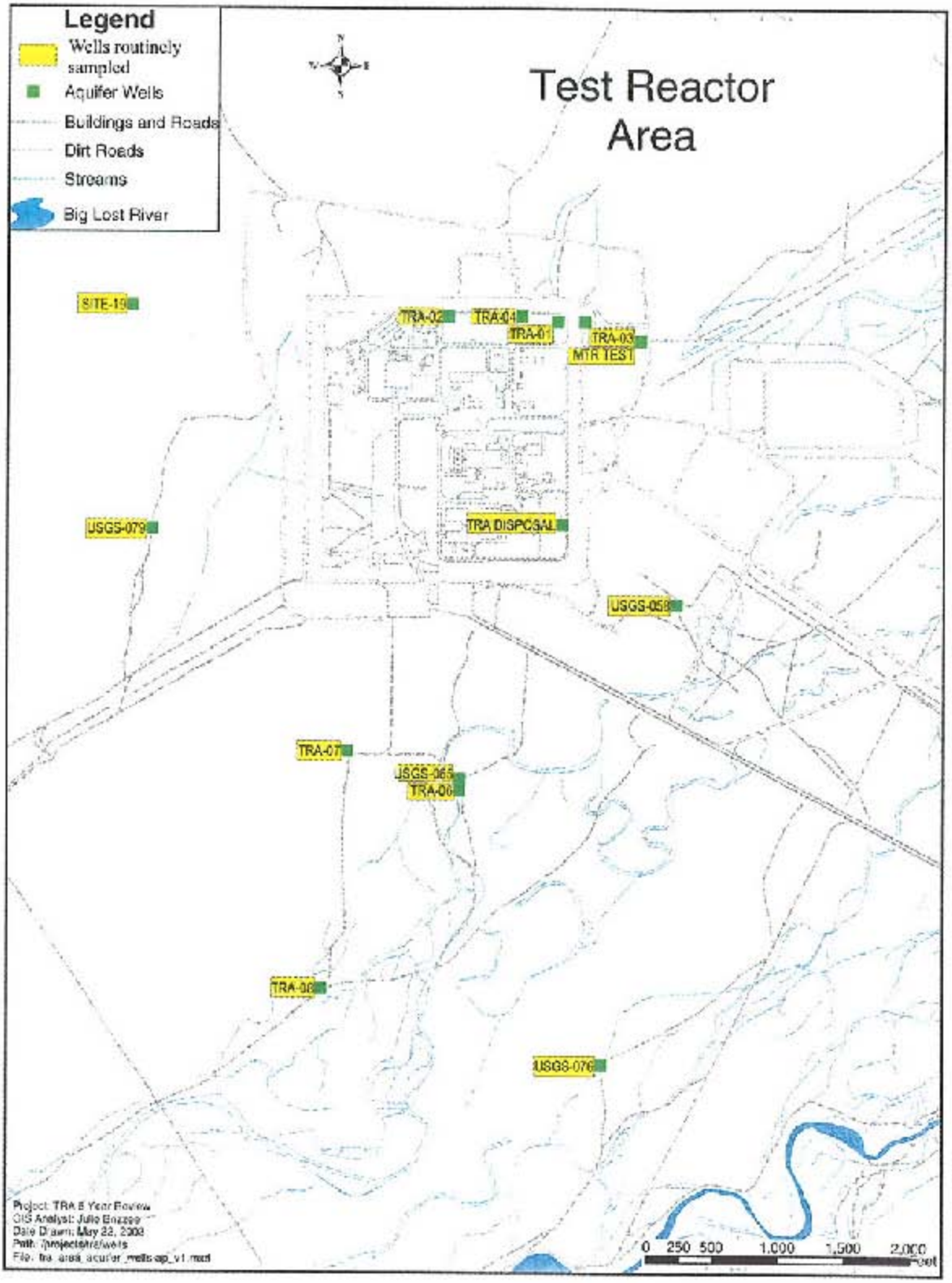

Figure 5. Map of aquifer monitoring wells at Test Reactor Area.

Table 3. Maximum contaminant levels and background concentrations for analytes.

Type	Contaminant	Maximum Contaminant Level	PQL-IDL Required[e]	Analytical Method	SRPA Background Levels[d]
Inorganics:	Arsenic (As)[i]	0.05 mg/L	0.01 mg/L	EPA-600/4-79-020[b]	0.003 mg/L
	Beryllium (Be)	0.004 mg/L	0.0008 mg/L	EPA-600/4-79-020[b]	0.003 mg/L
	Cadmium (Cd)	0.005 mg/L	0.001mg/L	EPA-600/4-79-020[b]	<0.001 mg/L
	Chromium (Cr)	0.1 mg/L—Total	0.01 mg/L	EPA-600/4-79-020[b]	0.003 mg/L
	Fluoride (F)[a]	4 mg/L	0.5 mg/L	EPA-600/4-79-020[c]	0.5 mg/L
	Lead (Pb)	0.015 mg/L[f]	0.003 mg/L	EPA-600/4-79-020[b]	0.005 mg/L
	Manganese (Mn)[a]	0.05 mg/L[g]	0.020 mg/L	EPA-600/4-79-020[b]	0.003 mg/L
	Mercury (Hg)	0.002 mg/L	0.0002 mg/L	EPA-600/4-79-020[b]	0.0001 mg/L
Radionuclides:	Gross Alpha (α) (including Am-241)	15 pCi/L—Total	4 pCi/L	Gas flow proportional counting	Not naturally occurring
	Gross Beta (β)	<4 mrem/yr	25 pCi/L	Gas flow proportional counting	8.4+/-1.1 pCi/L[h]
	Gamma emitters (γ) (including Cs-137 and Co-60)	200 pCi/L—Total	100 pCi/L	Gamma spectrometry	Not naturally occurring
	Tritium (H-3)	20,000 pCi/L	400 pCi/L	Liquid scintillation counting	42+/-9 pCi/L[h]
	Strontium-90 (Sr-90)	8 pCi/L	1 pCi/L	Gas flow proportional counting	0.07+/-0.05 pCi/L[h]

a. Sampled every 5 years as required by the *Final Record of Decision, Test Reactor Area, Operable Unit 2-13* (DOE-ID 1997b).
b. By EPA Document No. EPA-600/4-79-020 or EPA-600/R-04/111 methods in conjunction with INEEL ER-SOW-156 specifications for Sample Delivery Group Type 1C data.
c. By Standard Method Part 4500 F (Method C, D, or E) of EPA Method 300.0 (Revision 2.1), 340.1, 340.2, or 340.3 in conjunction with INEEL ER-SOW-156 specifications for Sample Delivery Group Type 3 data.
d. U.S. Geological Survey Water-Resources Investigation Report 91-4015.
e. PQL = practical quantitation limit; IDL = instrument detection limit; should be at least half the MCL value.
f. Action level
g. Secondary standard
h. Background values for offsite wells are from *Background Concentrations of Selected Radionuclides, Organic Compounds, and Chemical Constituents in Ground Water in the Vicinity of the Idaho National Engineering Laboratory* (Orr, Cecil, and Knobel 1991).
i. New MCL for arsenic will be 0.01 mg/L in 2006.
DOE-ID = U.S. Department of Energy Idaho Operations Office
EPA = U.S. Environmental Protection Agency
INEEL = Idaho National Engineering and Environmental Laboratory
MCL = maximum contaminant level
SRPA = Snake River Plain Aquifer

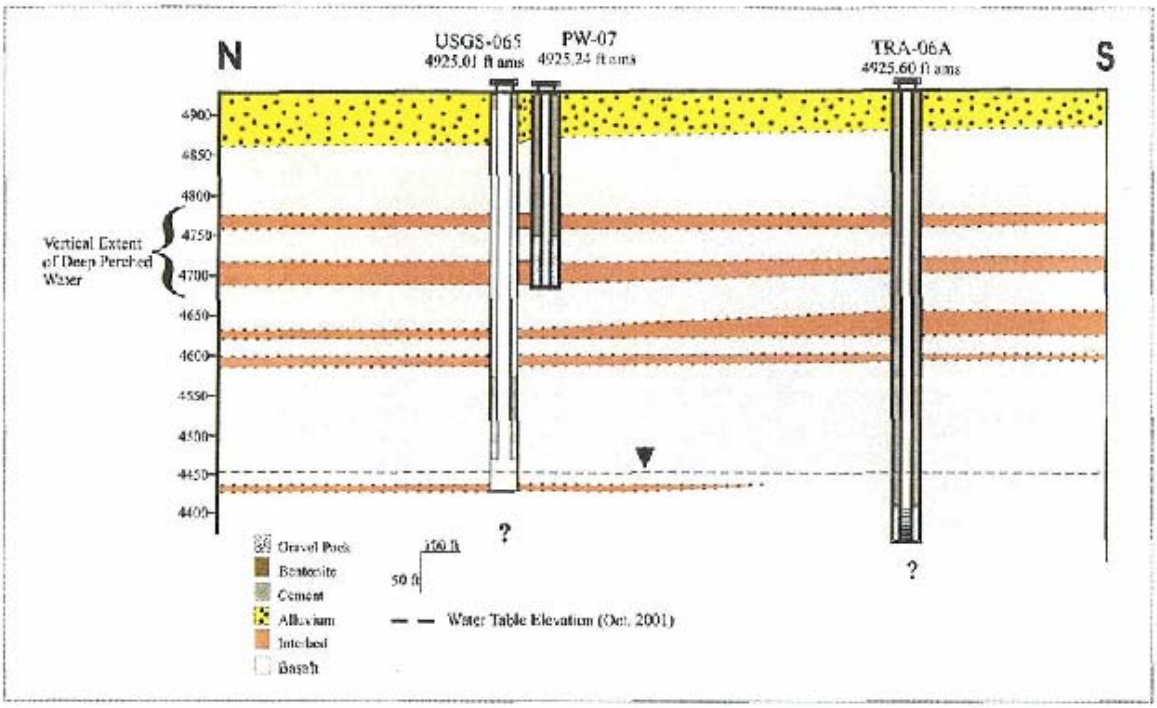

Figure 6, Stratigraphic cross-section near Wells USGS-065 and TRA-06A.

8.2.1 Perched Water Formation

Perched water forms in the vadose zone when the rate of infiltrating water exceeds the capacity of a low-permeability layer to transmit water. Barriers to the vertical migration of water cause saturated conditions to occur. Water spreads laterally following the slope of the contact. The size or "footprint" of the perched water body expands until sufficient area is wetted to transmit the flux of infiltrating water. Thus, widespread layers with very low permeability will form larger perched water bodies. The footprint and depth of the perched water body will increase or decrease as the rate of infiltration increases or decreases. A conceptual drawing showing the development of perched water beneath TRA is shown in Figure 7.

Two perched water zones have been recognized below TRA due to discharge of water to the TRA ponds. Historically, the Cold Waste Pond has been the largest source of water to the perched water zones; it currently (from 19982003) receives an average of about 380 gpm of water. In the past, other surface sources of water, including the former Warm Waste Pond and the Chemical Waste Pond, represented only a small percentage of the total input to the subsurface. A history of liquid effluent discharge to ponds for the period of 1982-2003 is shown in Figure 8.

There is a strong correlation between water-level patterns in the perched water system and the discharge rates to the Cold Waste Pond. The thickness and size of the two perched water zones have changed over time, depending on the amount of water discharged to the ponds. The relationship between pond discharge and the footprint of the perched water bodies has been tracked and described in numerous reports (Hull 1989; Doornbos et al. 1991; Dames & Moore 1992).

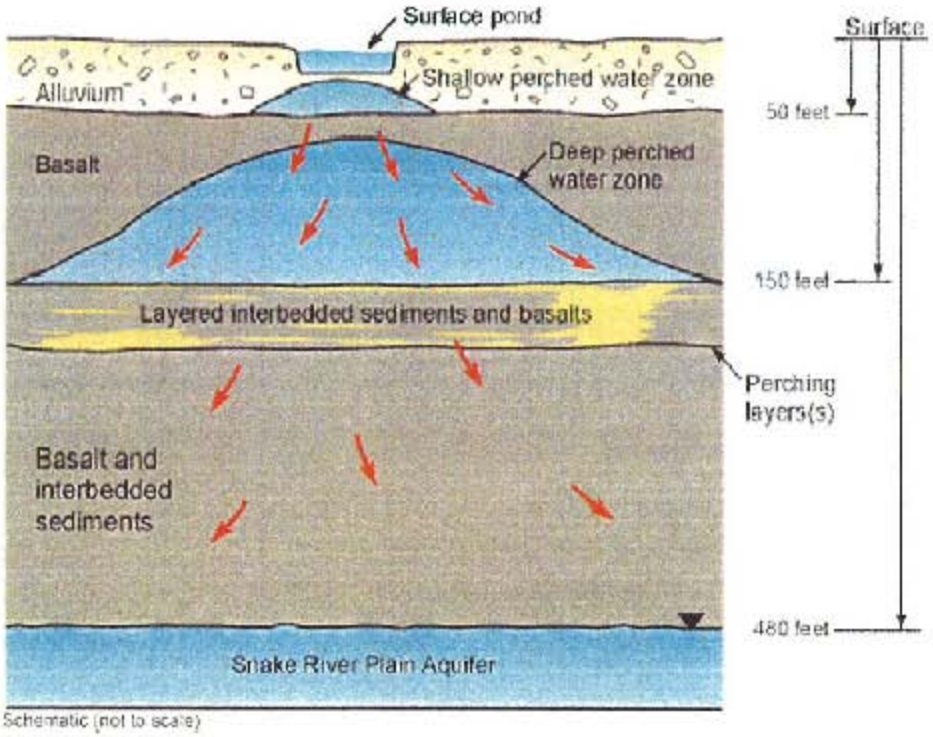

Figure 7. Conceptual drawing showing the development of perched water beneath the Test Reactor Area.

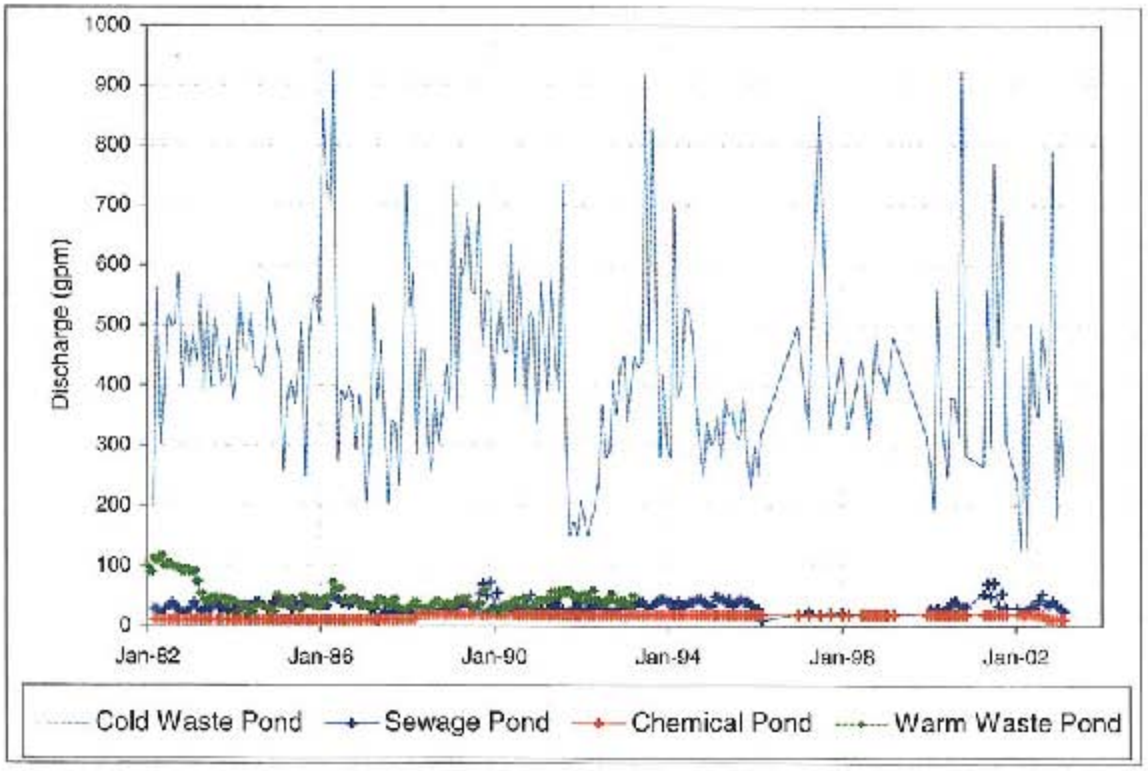

Figure 8. Historical discharges of water to Test Reactor Area ponds.

The shallow perched water zone is formed on a layer of fine-grained sediments at the alluvial-basalt contact-about 50 ft bgs (see Figure 6). It is monitored routinely by 11 shallow wells (CWP-01 through CWP-09, TRA-A13, and TRA-A77) (see Figure 4). Because of variations in discharge, most of the shallow perched-water wells have shown episodic wetting and drying since 1990 (CWP-01 and CWP-09 have been continually wet over the period of record). When the Warm Waste Pond was removed from service in 1993 and replaced by a lined evaporation pond, the volume of infiltrating water was decreased slightly as noted in Figure 8. However, the result of this decrease was small and made only a slight difference in the shallow perched water zone's footprint.

The deep-perched zone has developed between 140 and 200 ft bgs on a combination of low-permeability sediments, dense basalts, and basalt with sediment-filled fractures. The bracket on the left of Figure 6 represents the vertical extent of the composite perching layer for the deep-perched water zone. Because the deep-perched zone has a larger footprint than the shallow perched zone, it is thought that this layer's composite permeability is lower than the perching layer for the shallow perched water zone or, alternatively, the deep perching horizon is of larger areal extent and water flows off the edge of a smaller perching layer beneath the shallow perched water zone. The deep-perched water zone is monitored by 28 wells that are sampled routinely for contaminants of concern.

Figure 9 is a contour map of the deep-perched zone from the OU 2-12 Record of Decision (DOE-ID 1992). The deep-perched water zone can be seen to range in elevation from less than 4,750 ft to greater than 4,860 ft, it is elongated in a northwest to southeast direction, and it generally has a broad, flat top with steeply sloping flanks. Figure 10 is the same area with contours on the surface of the deep-perched zone for April 2003. Twelve years later, the deep-perched zone is narrower and the elevations range from less than 4,730 ft to greater than 4,850 ft. The deep-perched zone is still flat topped with steeply dipping sides, but the highest elevation is now centered beneath the Cold Waste Pond. The hydrographs of most wells tapping the deep-perched zone have shown a marked decrease in water elevation over the same period of March 1991 to April 2003. The hydrographs contained in Appendixes F and G show decreases in water levels ranging from 3 to 45 ft, with an average of 13 ft. This is most likely attributed to the decreased discharge to the ponds between 1991 and 2003. Although it is not apparent from Figure 8, the average discharge rate to the Cold Waste Pond between early 1982 and late 1991 was 460 gpm. Since late 1991, discharges to the Cold Waste Pond have averaged 380 gpm. It is important to note when comparing Figures 9 and 10 that the apex of the deep-perched zone is now centered beneath the Cold Waste Pond where formerly it had been larger, extending to the northwest beneath the old Warm Waste Pond and the TRA facility.

8.2.2 Snake River Plain Aquifer beneath the Test Reactor Area

The SRPA occurs approximately 450 ft below TRA and consists of a series of saturated basalt flows and sedimentary materials. The aquifer is relatively permeable due to the presence of fractures, fissures, and rubble zones at contacts between individual basalt flows. On October 7, 1991, the EPA designated the SRPA as a sole-source aquifer under the "Safe Drinking Water Act" (42 USC § 300 et seq.).

Generally, groundwater flows to the southwest SRPA under the ambient, hydraulic gradient. Figure 11 depicts the aquifer water table in October 2002. The inherent heterogeneity of the fractured basalt aquifer makes it very difficult to contour the water table. Appendix F presents a detailed analysis of the groundwater flow direction using three-point calculations over time for sets of wells at TRA, which better represents the dynamic nature of the aquifer flow system. Figure 11 also shows the inferred direction of groundwater flow beneath TRA. The direction of flow is inferred because the aquifer's highly heterogeneous matrix creates anisotropy that can result in flow paths not perpendicular to the water level contours. Fluctuating water levels caused by recharge and pumping further complicate determination of the aquifer flow directions, Appendixes F and G provide flow rosettes and hydrographs demonstrating the complexities of groundwater flow, which are

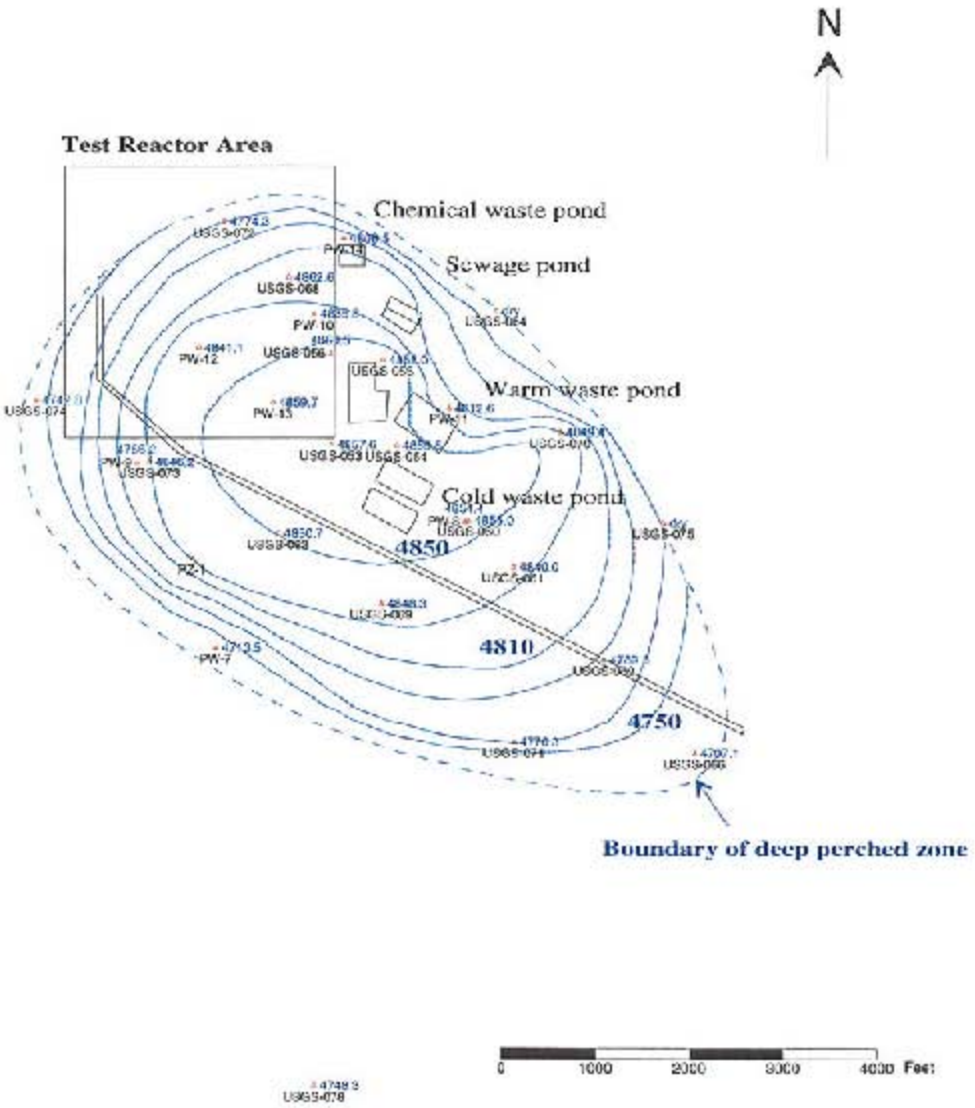

Figure 9. Configuration of the deep-perched water at Test Reactor Area, March 1991.

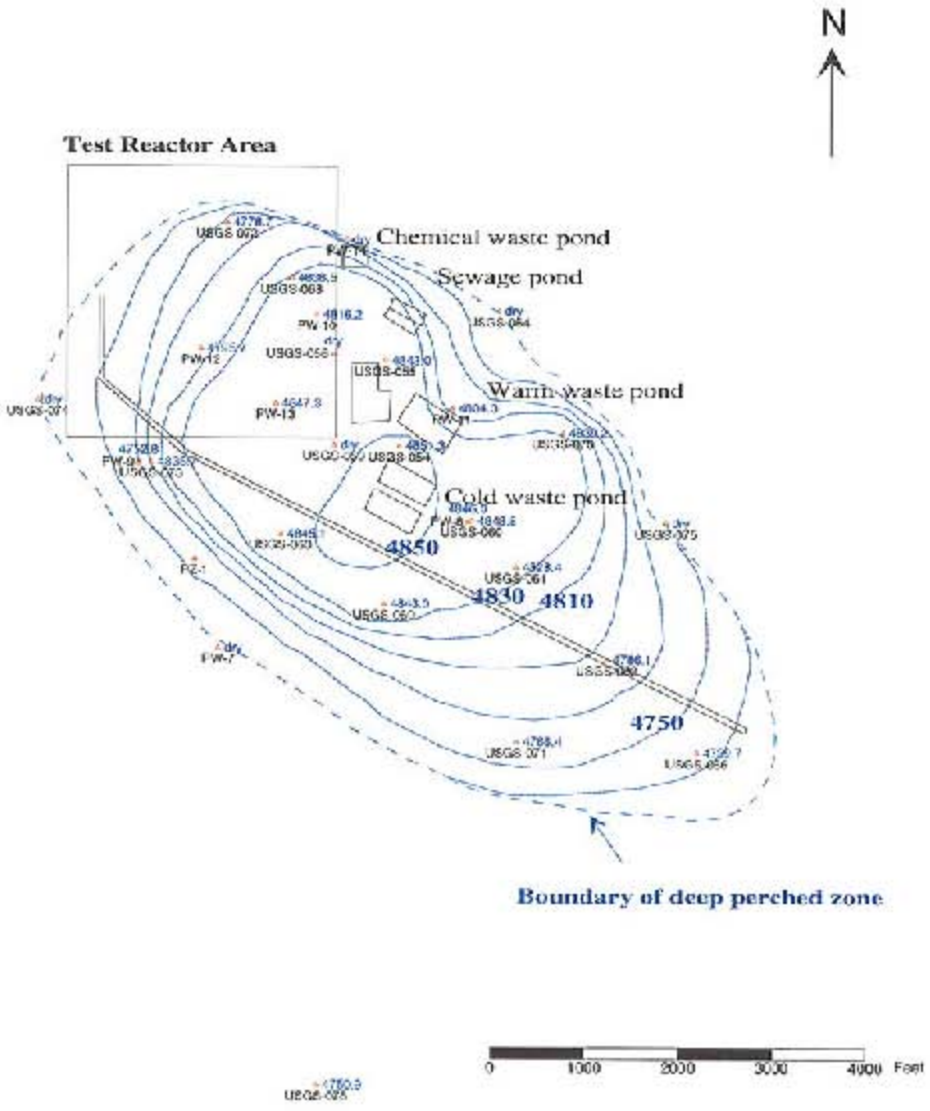

Figure 10. Configuration of the deep-perched water at Test Reactor Area, April 2003.

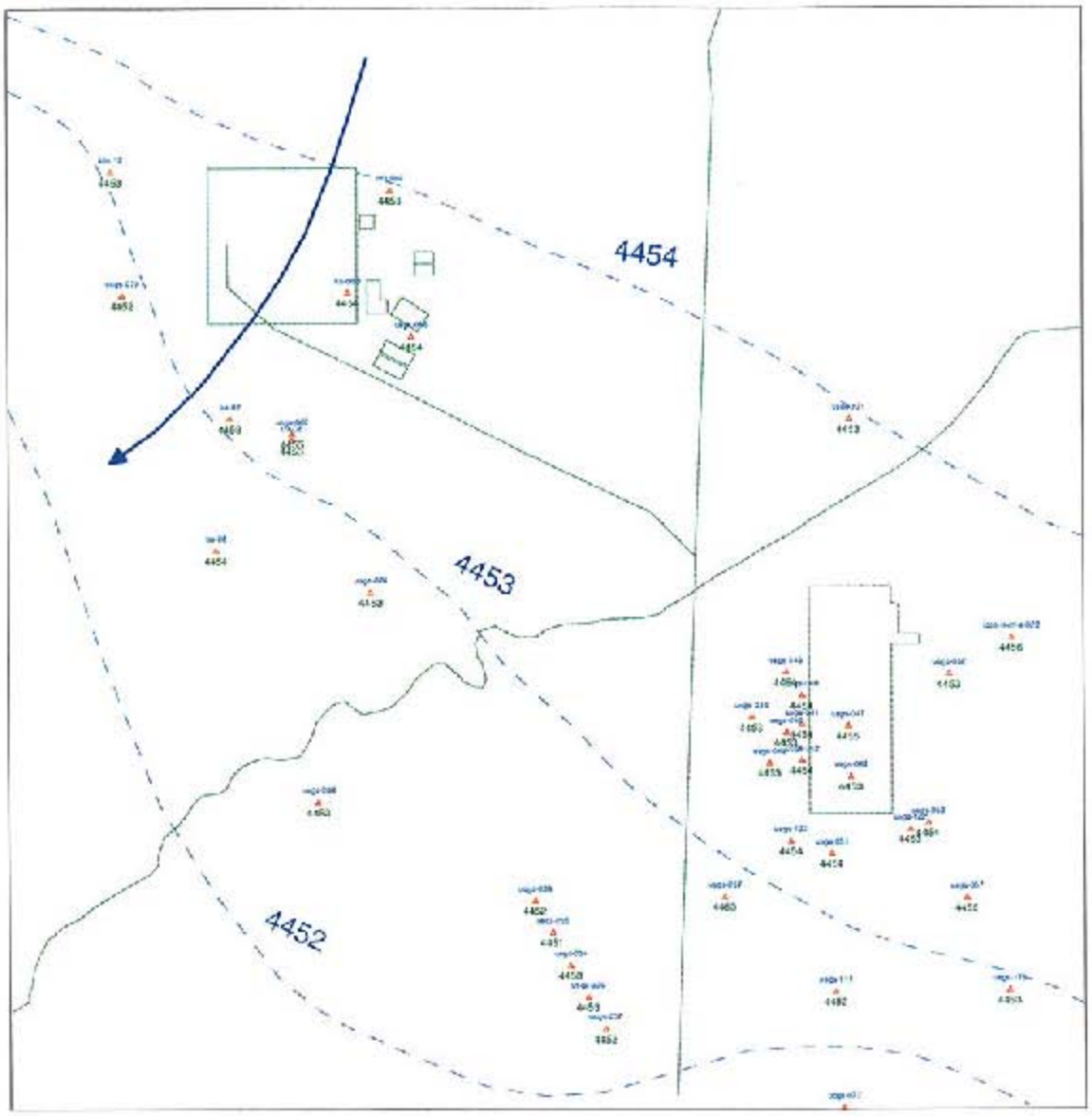

Figure 11. Aquifer water table configuration for October 2002.

greatly simplified in Figure 11. Groundwater flow beneath TRA is generally to the southwest, but the direction and water table gradient are dynamic both temporally and spatially.

Infiltrating groundwater from the deep-perched water zone moves downward over a large diffuse area, probably under varying levels of saturation, until it meets the SRPA's upper surface. The perched water recharge to the aquifer appears insufficient to cause mounding, as this has not been observed in the TRA aquifer wells. Dilution of the vadose water is thought to be significant due to the relatively fast (4.3 ft/day) rate of flow in the aquifer. However, a thin, laterally extensive sedimentary layer could restrict dilution locally beneath TRA. Wells USGS-065 and TRA-06A, although only approximately 100 ft apart, have different completion depths and, because of the sedimentary interbed, tap two different zones in the aquifer (see Figure 6). Well USGS-065 has an open-hole interval from 456-498 ft bgs. Well TRA-06A is screened from 528 – 558 ft bgs. As shown in Figure 6, the open interval of USGS-065 terminates in the interbed tapping about 8 ft of the aquifer above the interbed, whereas the screened interval of TRA-06A is beneath this interbed with about 40 ft of filter pack exposed to the aquifer. Dilution of contaminants arriving from the overlying vadose zone to the thin, saturated layer of aquifer water immediately above this sedimentary interbed is undoubtedly much less than in parts of the aquifer having unrestricted vertical mixing. The presence of this sedimentary interbed, just beneath the water table, could explain the higher groundwater concentrations measured in wells completed above the interbed. Differences in concentrations that could be related to a st ant zone near the top of the aquifer are discussed in the SRPA's analytical data review (Section 7.3.3).

It is possible that USGS-065 could be acting as a vertical conduit for flow. Thick lines represent casing in Figure 6, while thin lines represent the borehole walls. In USGS-065, well casing extends to a depth of 456 ft bgs, with a grout seal extending from 456 to 355 ft bgs. A string of casing extends from ground surface to 326.5 ft bgs, leaving an open, unsealed interval from 326.5 to 355 ft bgs. A second grout seal extends from ground surface to 15 ft. The well completion is open hole. Under saturated or "perched water" conditions, the open annulus might provide a pathway for rapid vertical migration of water to the top of the seal at 355 ft. Sloughing and caving of the formation against the well casing would help reduce this possibility, but its presence is not documented. The perched water in the area of the wells has receded and PW-07 has been dry since October 1994. Unless the deep-perched zone expands back into this area, rapid vertical transport at this location will not threaten the aquifer's water quality.

8.3 Analysis of Groundwater Sampling Data

Routine monitoring of water quality in both shallow and deep-perched water bodies and in the aquifer beneath TRA has led to a better understanding of the distribution of contaminants of concern and their relative persistence in groundwater. For the purposes of this report, data collected under CERCLA-mandated monitoring were reviewed for laboratory validation; all data passing laboratory criteria for quality are presented in Appendix C. On a well-by-well basis, data collected by the USGS are used to supplement data collected under CERCLA. Figures from the first draft of this report (included in Appendix G) use all data – regardless of data flagging – from both CERCLA sampling and the USGS. Similarly, the Environmental Visualization System (EVS) -3D software program from the first draft of this report can be found in Appendix H. The EVS allows one to view perched water levels and contaminant distributions in three dimensions and within the aquifer in two dimensions. The following subsection discusses sampling results and contaminant-of-concern trends for the shallow perched water zone, deep-perched water zone, and aquifer.

8.3.1 Shallow Perched Water Analytical Review

The primary source of water to the perched water system, the Cold Waste Pond, receives only relatively uncontaminated effluent. Data for the 14 shallow perched monitoring wells are located in Appendix C.

Currently, wells completed in the nearby shallow perched water zone show values for the contaminants of concern that are significantly below the MCL. Plots of Cr, tritium, and Sr-90 for the shallow perched water can be found in Appendix G – Figures 7-9, 7-10, and 7-11, respectively. Cold Waste Pond water wells sampled for Sr-90 and H-3 average 1.0 – 3.0 pCi/L and <200 pCi/L, respectively. One shallow well inside the TRA fence that is currently dry, TRA-A77 (see Figure 4), has undergone dramatic decreases in concentrations during the past 10 years. From October 1995 to October 1996, Sr-90 concentrations in this well plummeted from 48,200 to 4,710 pCi/L. Tritium concentrations dropped from 2,650,000 pCi/L in April 1995 to 22,400 pCi/L in October 1995, and by April 1997, the H-3 concentration decreased to 1,000 pCi/L. The Co-60 concentrations also decreased from 110,000 to 7,700 pCi/L from October 1995 to October 1997. Well TRA-A77 went dry in June 1997, was wet again in October 1997 and January 1999, but was dry in between these periods and since January 1999. A detailed graphical display of these data can be viewed in Appendixes C and F. The higher levels of radionuclides in this well suggest that a secondary source might remain that has never been evaluated. However, as long as the area remains dry, it is unlikely that the radionuclides will be mobile.

8.3.2 Deep-Perched Water Analytical Review

The majority of the 28 wells in the deep-perched water system show fluctuating or decreasing trends in contaminant-of-concern concentrations over the sampling record. Data for the deep-perched monitoring wells can be found in Appendix C. The major contaminants of concern for the perched water zone are discussed in the following subsections.

8.3.2.1 Chromium. The federal drinking water standard for chromium (total chromium) is 100 pg/L. Drinking water standards are based on unfiltered concentrations; however, differences in well construction and pumping rates make it difficult to evaluate concentrations of metals when the metals are present as particulate matter and in a dissolved state. In the hexavalent form, chromium is present in an anionic state (CrO_4^{2-}) and is relatively mobile in groundwater. Unfiltered samples may contain metals present as particulate matter, while filtered samples are representative of the more mobile dissolved metals. Filtered samples also may contain some colloidal particles fine enough to pass through the filter. Both filtered and unfiltered samples were collected for chromium and other metals from many of the wells. In general, filtered samples provide the best indication of groundwater contamination levels for chromium, since unfiltered samples are subject to greater variability introduced by the sampling process.

Generally, chromium data show decreasing or flat concentration trends in the majority of the deep-perched water wells. The highest concentrations have occurred in wells proximal to the Warm Waste Pond, as shown in Figure 12. These wells had reported values as high as 800 µg/L during the 1993 to 1995 period. Sample results have not exceeded the MCL (100 µg/L) since April 2001 (Figure 12). Exceptions to the downward trend include USGS-069 where concentrations have increased from 2 µg/L (1993) to 14 µg/L (1999 – 2002), which is still below the MCL (Figure 7-13 in Appendix 6). Deep perched wells distal to the Warm Waste Pond have been below the MCL since 1995, and all have shown a general decrease in chromium with the exception of USGS-068, which has shown erratic concentrations around 50 µg/L since 1999 (Figure 7-14 Appendix G). The concentration data in USGS-053 and USGS-056 abruptly end in Figure 12, because these wells have been sporadically dry in recent years. The lining of the evaporation pond and the resultant decrease in infiltration might have caused the drying out of USGS-053 and USGS-056, which are to the southwest and northwest of the Warm Waste Pond. The spike in chromium concentrations in USGS-053 in 1995 does not have a clear explanation. Precipitation was above normal for that year (13.38 in. of rain and 1.64 in. of snow); perhaps the combination of a wet year and the lining of the pond 2 years earlier created a new flow pathway carrying higher concentrations of chromium to this well.

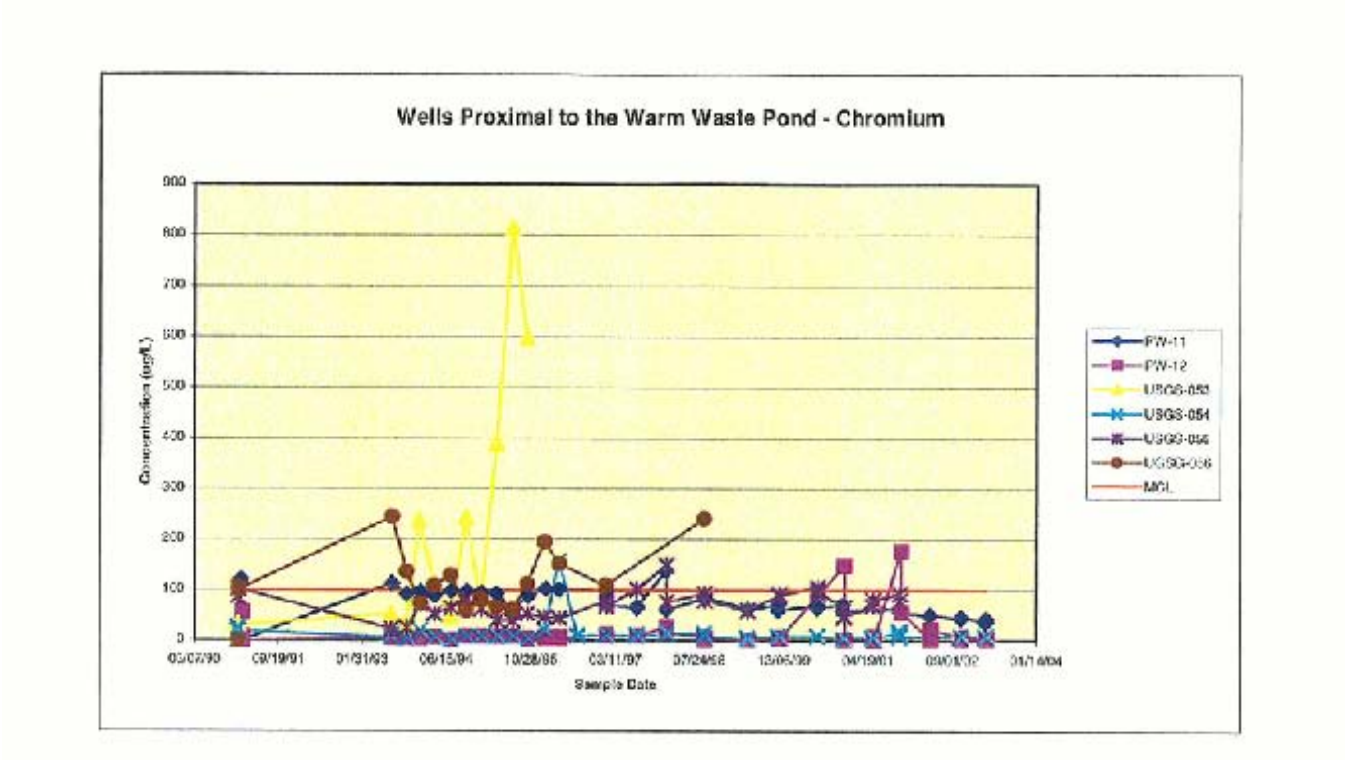

Figure 12. Chromium levels in wells proximal to the Warm Waste Pond.

8.3.2.2 Tritium. The MCL for tritium is 20,000 pCi/L, and it has a half-life of 12.3 years. Tritium, as an isotope of hydrogen, travels with groundwater and is considered an ideal conservative tracer. Reductions in the activity of measured tritium can result from both dilution and radioactive decay.

Activities of tritium measured in deep-perched wells proximal and distal to the Warm Waste Pond versus time are shown in Figures 13 and 14, respectively. All wells show a drastic decline in reported values for tritium since completion of the remedial actions (construction of the new evaporation pond). With source-term elimination, radioactive decay plays a significant role in decreasing activity. Without the addition of new tritium to the subsurface, it is unlikely that tritium activity will ever increase. Figures 15 and 16 are detailed plots of recent tritium activities for proximal and distal wells to the Warm Waste Pond, respectively. These plots show that although tritium is currently above the MCL for many wells, activities have declined steadily for the past 5 years in most wells. The exception is USGS-055, which had an unexplained spike during the summer of 1998, but has been declining since that time and went dry in the early spring of 2002.

Well PW-12 (Figure 15), although still well below the MCL, has shown a slight increase in tritium over the past few years.

8.3.2.3 Strontium. The MCL for Sr-90 and it has a half-life of 29 its high soil-to-water distribution coefficients Sr-90 is less mobile in soil water than tritium (Dames & Moore 1993). Strontium is present divalent cation, and thus it behaves similarly to dissolved calcium.

Figure 17 shows Sr-90 activities for wells proximal to Warm Waste Pond for the period of record. Activities for these wells peaked in the early 1970s. Figure 18 shows a detail of Sr-90 activities for deep-perched wells proximal to the Warm Waste Pond. Three of these wells show an increasing trend since 1998 (USGS-054, USGS-055, and PW-12).

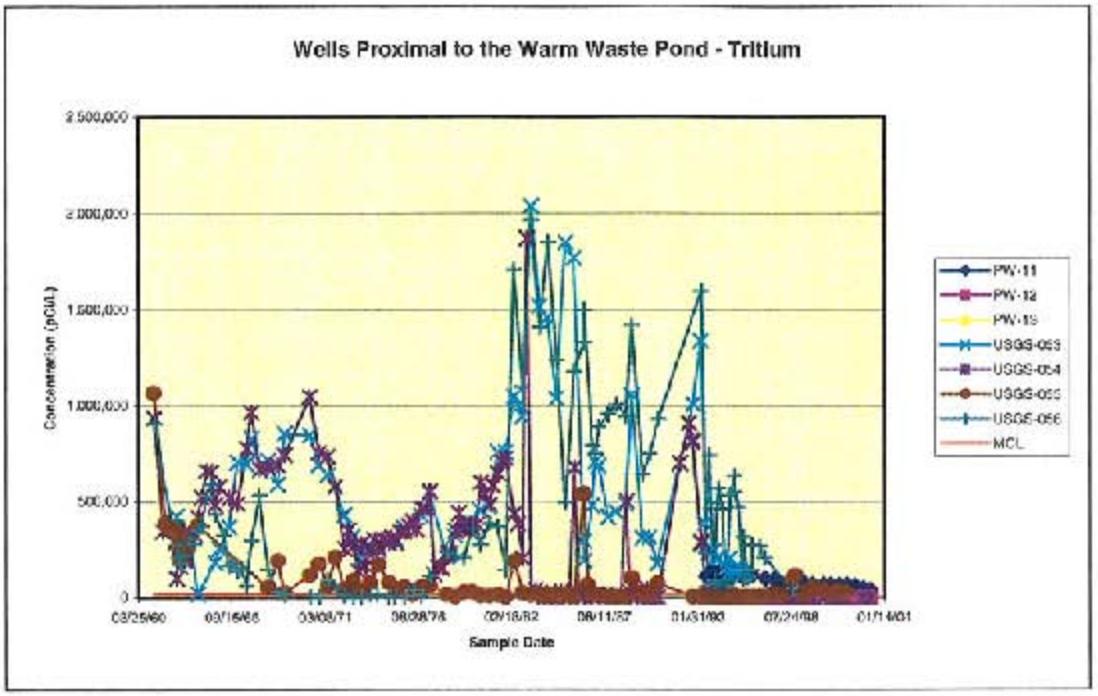

Figure 13. Tritium activities proximal to the Warm Waste Pond.

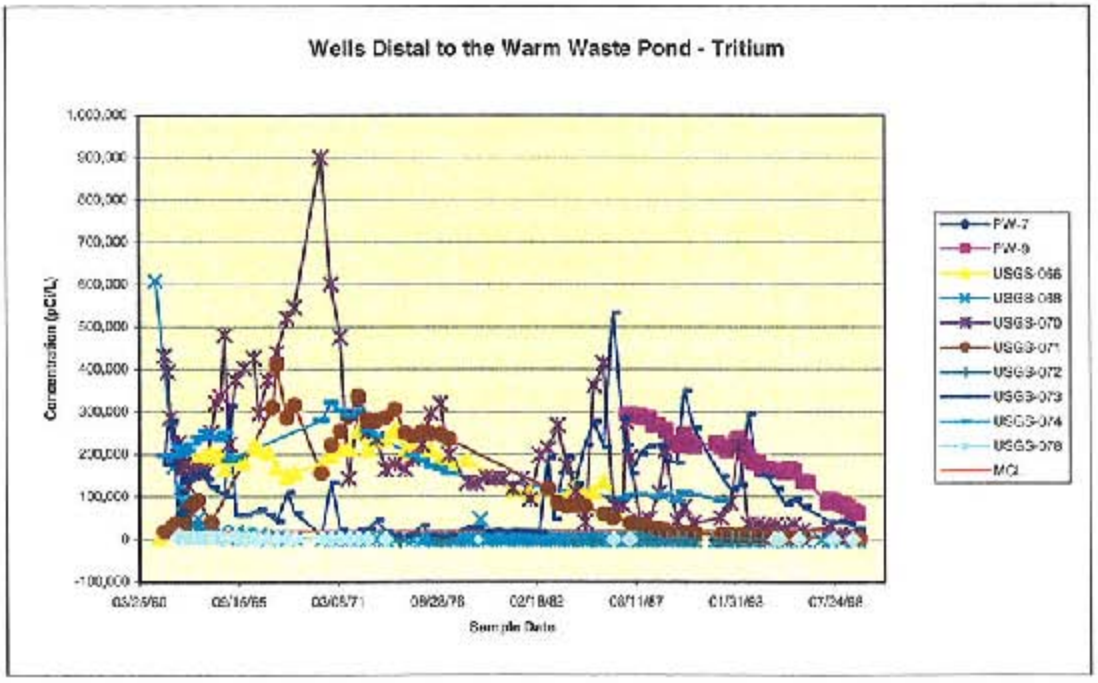

Figure 14. Tritium activities distal to the Warm Waste Pond.

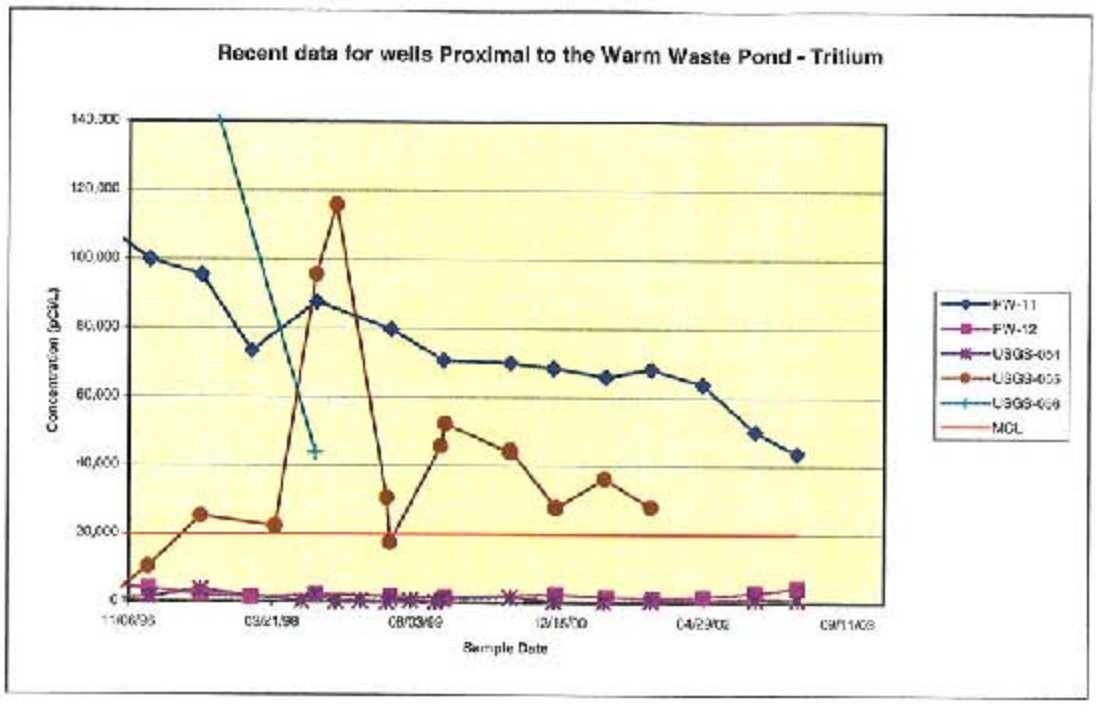

Figure 15. Recent tritium activities proximal to the Warm Waste Pond.

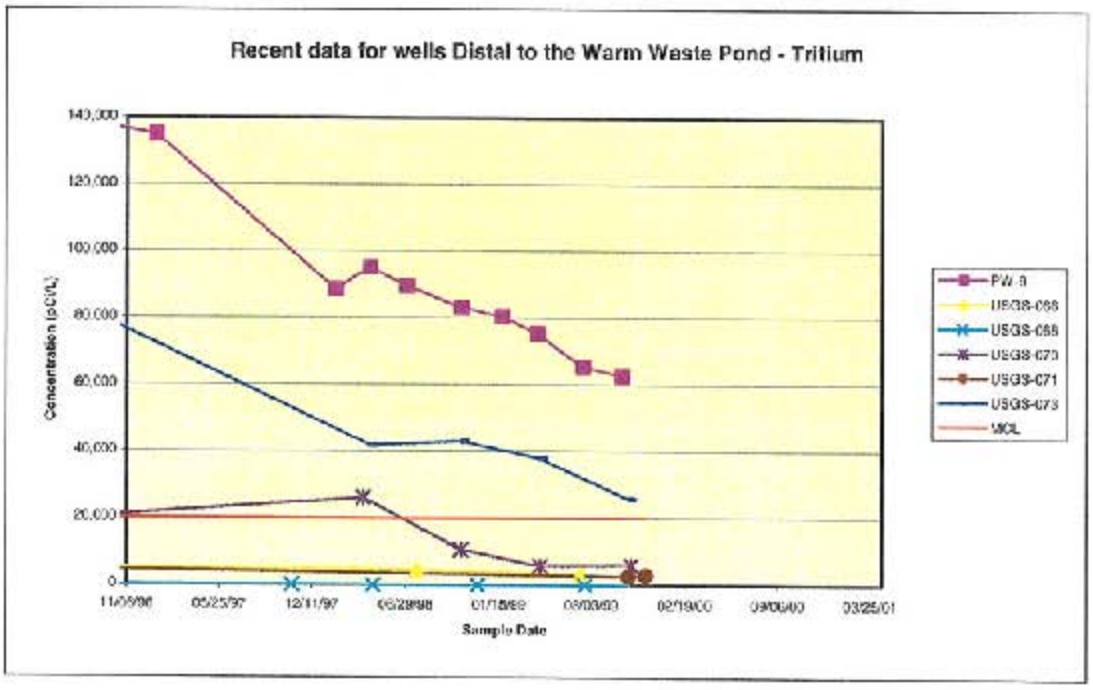

Figure 16. Recent tritium activities distal to the Warm Waste Pond.

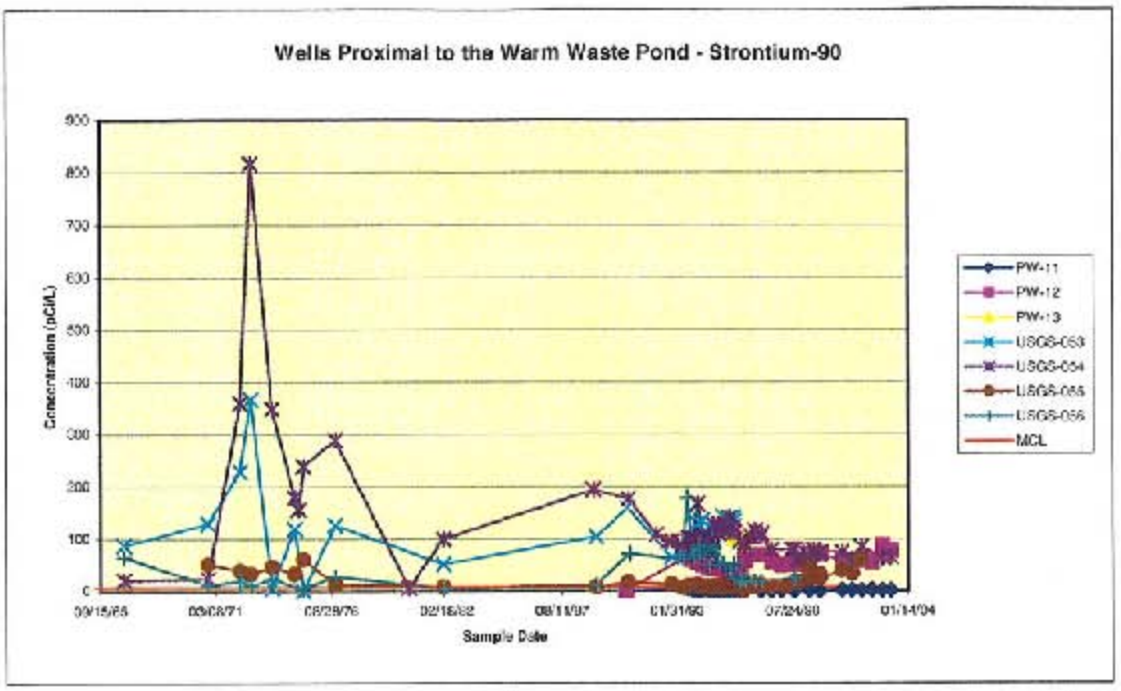

Figure 17. Strontium-90 concentrations proximal to the Warm Waste Pond.

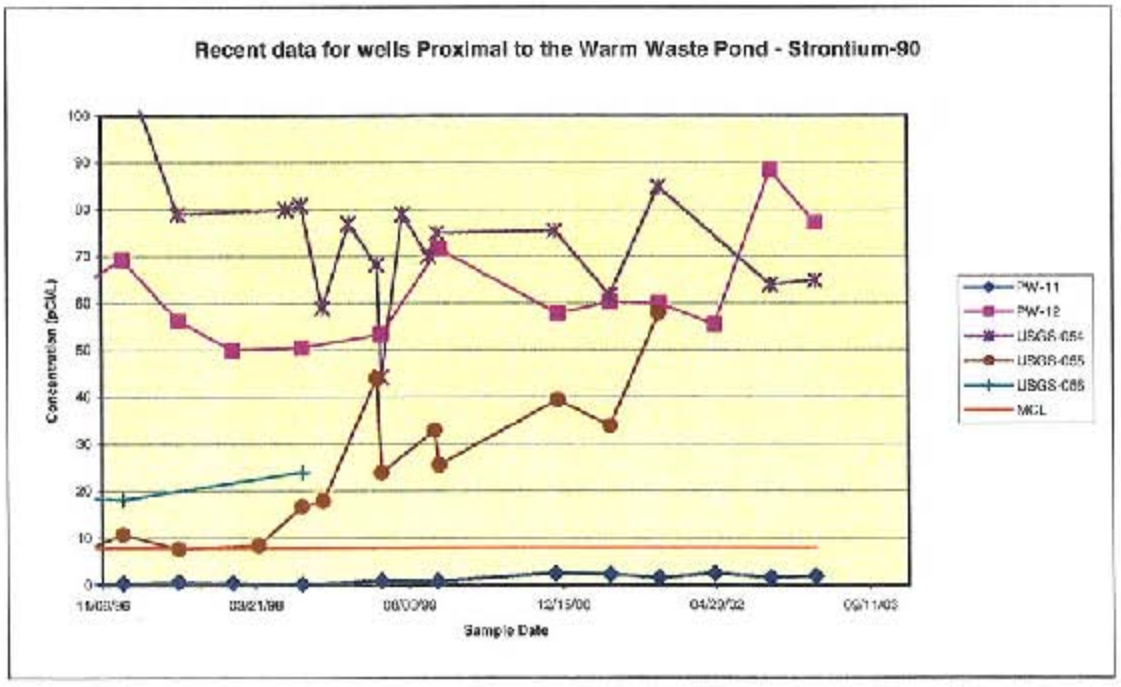

Figure 18. Recent data for strontium-90 concentrations proximal to the Warm Waste Pond.

Figure 19 shows Sr-90 activities for wells distal to the Warm Waste Pond for the period of record. Most of these wells showed a high activity in the early 1970s with a steady decline to near the detection limit in recent years. The exception is USGS-070, which has fluctuated above the MCL (8 pCi/L) at approximately 50 pCi/L for the past several decades. The reason for this high. level is presently unknown, but it may be tied to operations at TRA or variations in natural infiltration events.

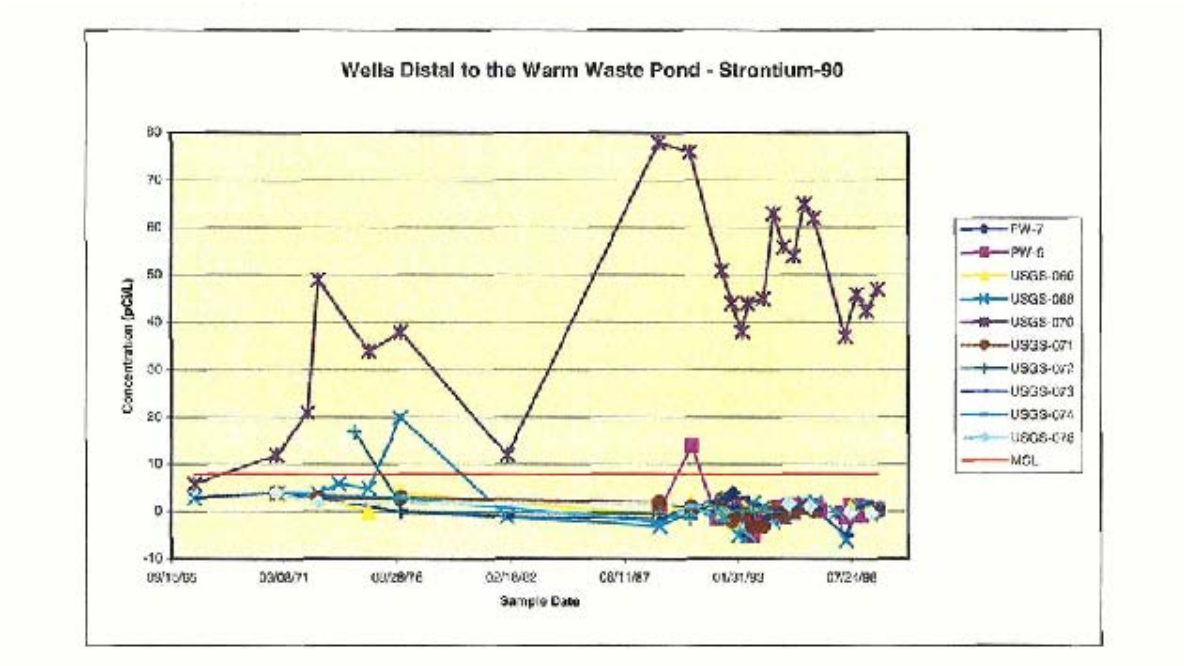

Figure 19. Strontium-90 concentrations distal to the Warm Waste Pond.

8.3.2.4 Cobalt-60. The MCL for Co-60 is 100 pCi/L, and it has a half-life of 5.2 years. It is relatively immobile in groundwater, as indicated by its high soil-to-water distribution coefficient (K_d56 mL/g) (Dames & Moore 1993).

In general, Co-60 levels in the perched water have historically shown decreasing trends with the highest results in wells monitoring the deep-perched water proximal to the Warm Waste Pond Figure 20). In recent years, most of the Co-60 levels have been below the MCL. One notable exception to the general trends of decreasing or fluctuating concentrations in the last 5 years occurs at PW-12. This well shows a marked increase in Co-60 over the last 2 years, going from a nearly undetectable concentration of 6.14+/-6.39 pCi/L in October 2001 to 330+/-18 pCi/L in March 2003 (see Figure 21). The reason for this increasing trend is presently unknown.

8.3.2.5 Diesel in PW-13. Diesel was discovered during the drilling of PW-13 in 1990. Floating product has been observed in this well intermittently since that time, and it has been the subject of several investigations. Subsequent to the initial discovery of contamination during the drilling of Well PW-13, a series of five additional water samples were collected between July 1993 and October 1995. Each of the samples was submitted for benzene, toluene, ethylbenzene, and xylene analysis, with the only constituent detected being ethylbenzene at concentrations ranging from 3.6 to 5.4 µg/L. On February 2,2000, 14 in. of free product was discovered in the well. Over a period of 7 months, the thickness of free product in the well was checked, gradually declining from a high of 16 in. to a thickness of 1.5 in. on September 14, 2000. Additional samples have been collected from PW-13 in 2000 (no product thickness was observed), and 2001 (a dark-colored material was found during initial pumping, but no material was found as a floating layer). Based upon

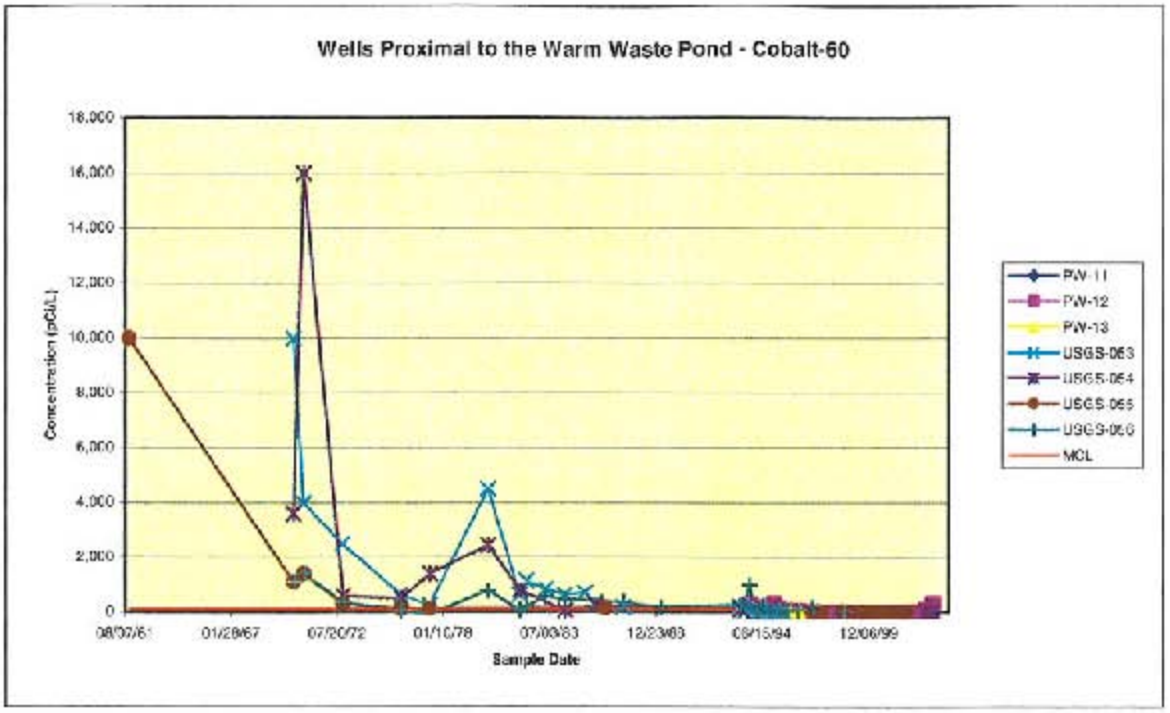

Figure 20. Historical Co-60 levels in perched water wells.

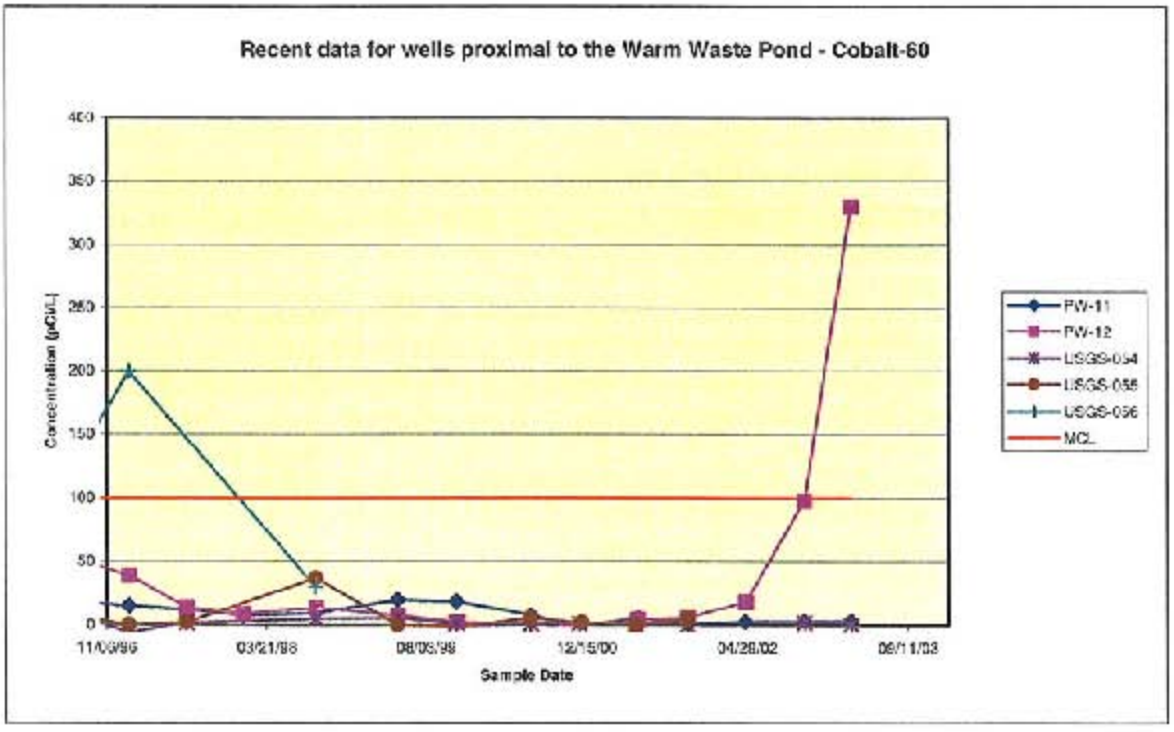

Figure 21. Recent Co-60 concentrations in the deep-perched zone.

operating records including the operational mode of the emergency diesel system and the assumed maximum rates for the diesel transfer pumps, it was determined that a maximum of 2,000 gal of diesel had leaked. Based on the available analytical data, a groundwater model (GWSCREEN) was performed based on the assumption that the entire 2,000 gal of diesel had migrated to the aquifer. The results of the modeling determined that the diesel did not pose an unacceptable risk to human health and the environment.

Well PW-3 was sampled in June 2003 specifically for gamma emitting radioisotopes, strontium-90, and tritium. During sampling, it was noted that 0.9 ft of free product was in the well. The free product was not bailed out at this time. Funding approval has recently been received to begin investigation into the source and extent of the diesel during FY 2003. Pending funding approval fo FY 2004, investigation into the diesel source will be completed and a report issued.

8.3.3 Summary of the Deep-Perched Water Analytical Review

Generally, chromium, tritium, Sr-90, and Co-60 have shown decreasing trends in deep-perched water wells over the past 5 years. Exceptions to the general decreasing trend include increasing or flat activities of Sr-90 in Well PW-12, USGS-054, USGS-055, and USGS-070 and a went increase of Co-60 in Well PW-12.

There is not enough data to determine what mechanisms are controlling fluctuating or increasing concentrations of contaminants of concern in the deep-perched water system. There are several plausible explanations, including (1) adsorption/desorption occurring with the changing perched water levels; (2) changing flow pathways in response to remediation and fluctuations in discharge to the Cold Waste Pond (or alternating cells); (3) seasonal variations of natural infiltration at a local scale; (4) variations in water recharge from unidentified manmade sources; (5) lateral flux from the Big Lost River; or (6) potential leaks of contaminated water from unidentified sources. Because of the high K_d values of these contaminants and the fact that pre-Record of Decision modeling used similar concentrations in perched water to model impact to the aquifer, it seems unlikely that the downward transport of perched water containing Sr-90 or Co-60 could significantly impact the SRPA.

8.3.4 Snake River Plain Aquifer Analytical Review

Predicted concentrations of contaminants of concern in the SRPA were the focus of pre-Record of Decision modeling and the basis of agreements made by the Agencies regarding remedial actions at Waste Area Group 2. Strongly sorbed contaminants, such as Sr-90 and Co-60, will move slowly through sediments and basalts, which underlie the perched water zones. Radioactive decay, dilution, and dispersion will act to reduce the concentrations of contaminants reaching the aquifer. Because it is important to understand contaminant trends measured in post-Record of Decision monitoring and compare them to pre-Record of Decision modeling, this 5-year review presents detailed information on the contaminants of concern in the aquifer and, where applicable, directly compares trends to modeling predictions. The trends presented and compared to monitoring data on graphs in this report are for maximum concentrations of a particular contaminant anywhere in the aquifer.

The pre-Record of Decision model employed the TARGET computer code to simulate groundwater flow and transport in a two-dimensional model to characterize the flow and migration of contaminants between the ponds and the SRPA. The model was first calibrated to historic water levels in wells and to historic concentrations of tritium and chromium in the deep-perched water zone and the SRPA. The model was then used to predict the concentrations of the 14 contaminants of concern through time, up to 125 years in the future. It was assumed that discharge to the Warm Waste Pond was discontinued in approximately a year (1992), and discharge to the Cold Waste Pond (CWP) was eliminated in 2007. A series of plots were generated showing the predicted concentrations of contaminants of concern from 1952 to 2115 in the upper 12.5 ft of the SRPA

beneath TRA. The contaminants of concern that were predicted to attain peak concentration in the SRPA over the next 125 years are Sr-90, Cadmium, Cr, and tritium. The remaining contaminants of concern are retarded to the extent that they are predicted not to attain peak concentrations over the next 125 years (Dames & Moore 1992).

8.3.4.1 Chromium. Factors affecting the mobility of hexavalent chromium in the aquifer include: presence or absence of dissolved oxygen, pH, presence of other rnultivalent anions (sulfate, phosphate), absorbency of sediment surfaces. If dissolved oxygen is present, the pH is greater than 7, other multivalent anions are present, and the sediment surfaces are poor absorbents for hexavalent chromium, then hexavalent chromium is more mobile. If organic materials and/or dissolved iron Ill) or sulfide is present, hexavalent chromium will be less mobile. Analytical data from groundwater samples obtained during routine groundwater monitoring by the USGS from April 2001 through October 2001 revealed that the pH in wells in the vicinity of TRA (MTR Test Well, Site-19, TRA Disposal Well, and USGS-076) is slightly alkaline, with an average pH of 7.975, indicating that chromium is soluble in the SRPA below the TRA. As discussed previously, filtered groundwater samples generally best represent actual dissolved chromium concentrations in groundwater. Unfiltered samples can often contain immobile chromium. Both types of samples are discussed in the following paragraphs.

Figure 22 shows unfiltered chromium concentrations compared to modeled predictions from 1985 to the present for the three aquifer wells that are immediately down gradient of the TRA facility. Results for filtered samples are shown in Figure 23. Unfiltered chromium samples show a general declining trend in aquifer groundwater. A peak appears in both USGS-065 and TRA-07 in August 1999. Most of the unfiltered sample data for TRA-06A are below the MCL (100 µg/L).

The pre-Record of Decision model predicted that chromium would fall below the MCL (100 µg/L) sometime near the year 2017. Fitting the unfiltered data with trend lines (linear) in Figure 22 (top) suggests that the maximum chromium groundwater concentration near TRA will drop below the MCL sometime between the years 2006 and 2018. The mean and standard deviation of unfiltered chromium sampled during 1990-2002 in Wells USGS-065, TRA-07, and TRA-06A are 172.0+/-20.4, 209.5+/-45.5, and 45.1+/-75.5 µg/L, respectively.

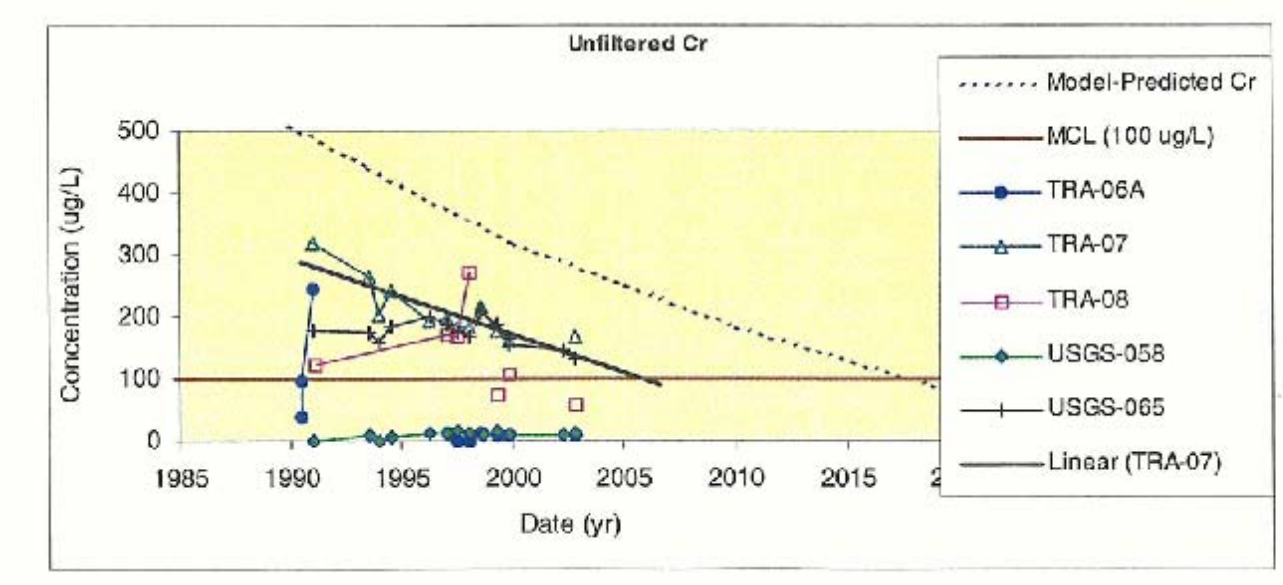

Figure 22. Unfiltered chromium concentrations compared to model predictions (1985 to present).

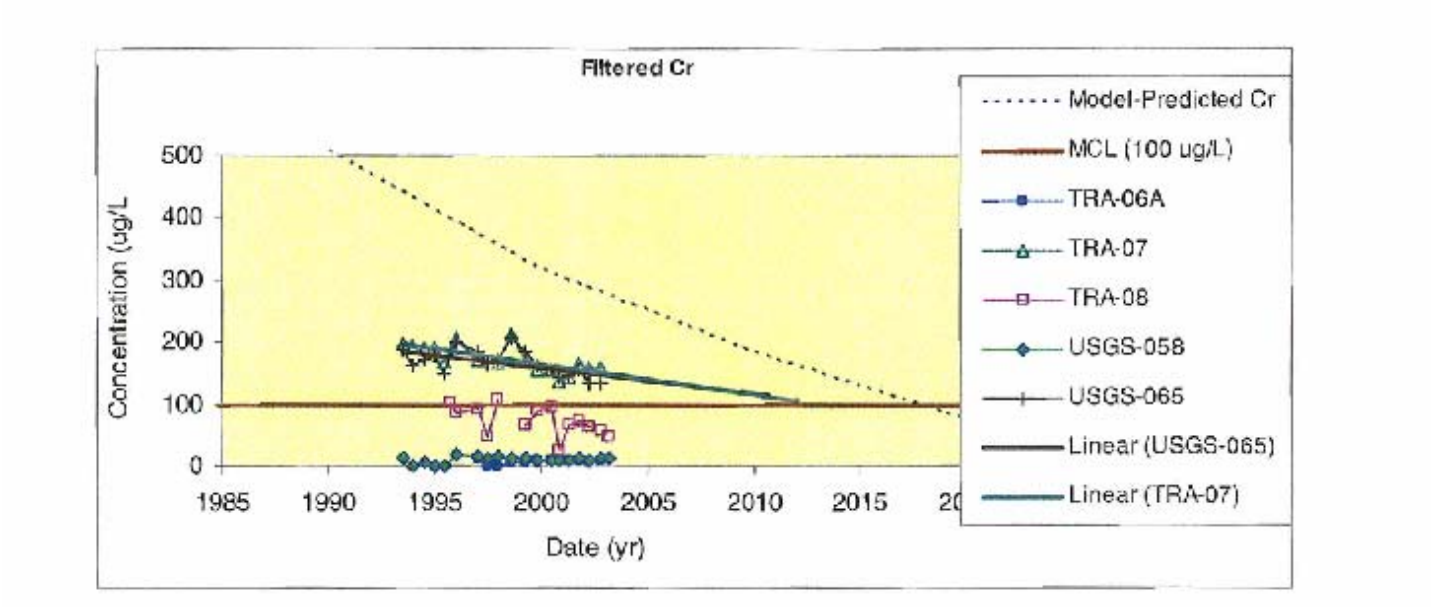

Figure 23. Recent trends in aquifer filtered chromium concentrations.

A similar straight-line trend fitted to the bottom plot in Figure 23 suggests that the filtered chromium concentrations in the aquifer will reach the MCL in about 2012. The projection of unfiltered chromium reaching the MCL before filtered chromium concentrations is probably related to the fact that earlier unfiltered data measurements are higher due to the presence of particulate chromium. The mean and standard deviation of filtered chromium sampled during 199& 2002 in Wells USGS-065, TRA-07, and TRA-06A are 163.94+/-23.3, 172.5+/-21.8, and 9.1+/-1.4 µg/L, respectively.

Hexavalent chromium is generally considered the most mobile form of chromium, and an analysis was made using the available data for hexavalent chromium for aquifer wells. The samples analyzed specifically for hexavalent chromium are plotted in Figure 24. Hexavalent chromium was measured below the MCL in all three wells (USGS-065, TRA-06A, and TRA-07) in 2003. A straight-line projection back to the previous data point suggests that groundwater concentrations of hexavalent chromium fell below the MCL sometime between 1999 and 2000. Because the wells were not sampled for hexavalent chromium between 19% and 2000, additional sampling for hexavalent chromium is warranted to confirm the straight line projection depicted in Figure 24.

As previously described in this report, a thin lens of stagnant water (-8 ft thick) might be trapped between the water table and a shallow sedimentary interbed (as depicted in Figure 6). Both USGS-065 (8 ft thick) and TM-07 (18 ft thick) tap this thin layer, and perhaps consequently, both have elevated levels of chromium when compared to TRA46A. The thin, sedimentary interbed also might have served to isolate TRA-Disposal well wastewater containing chromium from mixing with aquifer water. Because of the restricted mixing across the sedimentary interbed, it might be appropriate to average the concentrations measured in the upper and lower zones to make a better comparison of monitoring data to modeling predictions, which assumed mixing in the aquifer's upper layer. The average of the mean value for filtered chromium measured in TM-07 and TRA-MA over the past 12 years is 90.8 µg/L. This value is below the 100-µg/L MCL.

The projection of filtered chromium concentrations to reach the MCL by 201 2 (Figure 23) is the best measure that the remedial. actions at Waste Area Group 2 will be protective of human health and the environment in the long term. The fact that chromium concentrations are projected to reach the MCL without dilution, as assumed in the pre-Record of Decision model, indicates that the modeling approach was conservative and appropriate.

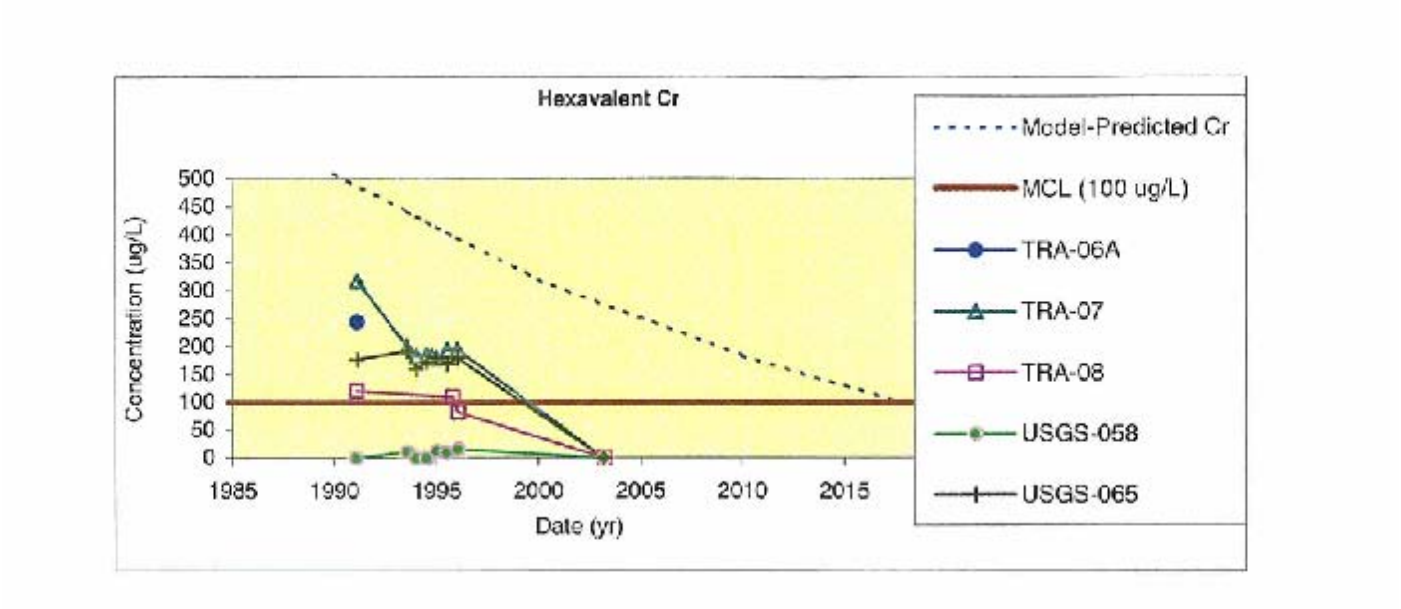

Figure 24. Recent trends in the aquifer's hexavalent chromium concentrations.

All other wells in the aquifer contain chromium concentrations well below the MCL. Figure 7-26 in Appendix G shows the chromium concentration over time for all aquifer wells. Most of these wells show flat or decreasing levels of chromium over the past 5 years of record. Chromium in these wells d probably originated from the TRA-Disposal well, where large volumes of chromium were discharged directly to the aquifer.

8.3.4.2 Tritium. All groundwater wells in the SRPA are below the MCL for tritium (Appendix G, Figure 7-25). Most wells show declining trends; the exceptions are Site-9 and USGS-079, which have shown slight increases in the late 19% Gust above the detection limit approximately 400 pCi/L [much less than the MCL of 20,000 pCi/L]). The highest levels of tritium have historically been measured in USGS-065, possibly due to the stagnant lens of groundwater discussed earlier. Activities of tritium in USGS-065 dropped below the MCL in 1997.

In response to an agency review comment, tritium in the aquifer was corrected for radioactive decay in an attempt to better understand migration of sorbed contaminants, It was thought that decay-corrected tritium data could serve as a conservative tracer, moving in time with the water and giving insight to the fate and transport of nonconservative contaminants of concern in the subsurface. The effects of dilution, advective dispersion, and molecular diffusion are of primary interest. Ideally, tritium data can be decay-corrected (i.e., the decrease in concentration expected to occur due to the natural first-order radiological decay could be "added" to the observed concentration). Thus, the decay-corrected trend in tritium could be compared to the trend in chromium concentrations to provide some insight into differences and similarities between the fate and transport of sorbed and unsorbed contaminants.

The plot of the decay-corrected tritium appears higher over time; however, the decrease rate trend of the decay-corrected data is no more or less consistent with the chromium trend than the observed tritium data. No useful insight was gained as to the effects of dilution, dispersion, or diffusion through this approach. The plot of tritium decay-corrected data is not presented in this report, because the trend is very similar to measured values.

8.3.4.3 Strontium. Strontium data (Sr-90) obtained from groundwater samples from several aquifer wells near TRA (USGS-065, TRA-06A, and TRA-07) indicate that the strontium levels in the aquifer near TRA are below the 8-pCi/L MCL. The sample results were validated. Negative sample values, the result of analytical laboratory methods (wherein the laboratory counting equipment error is greater than the measured sample

concentration), were eliminated from the graph in Figure 25. Values assigned an undetect (U) data quality flag, including those samples whose counting error exceeded the measured concentration, were assigned a value of zero. These make up the majority of results for USGS-065; t he entire historical record of strontium concentration in USGS-65 is presented in Figure 25 to emphasize the low Sr-90 in the aquifer beneath TRA.

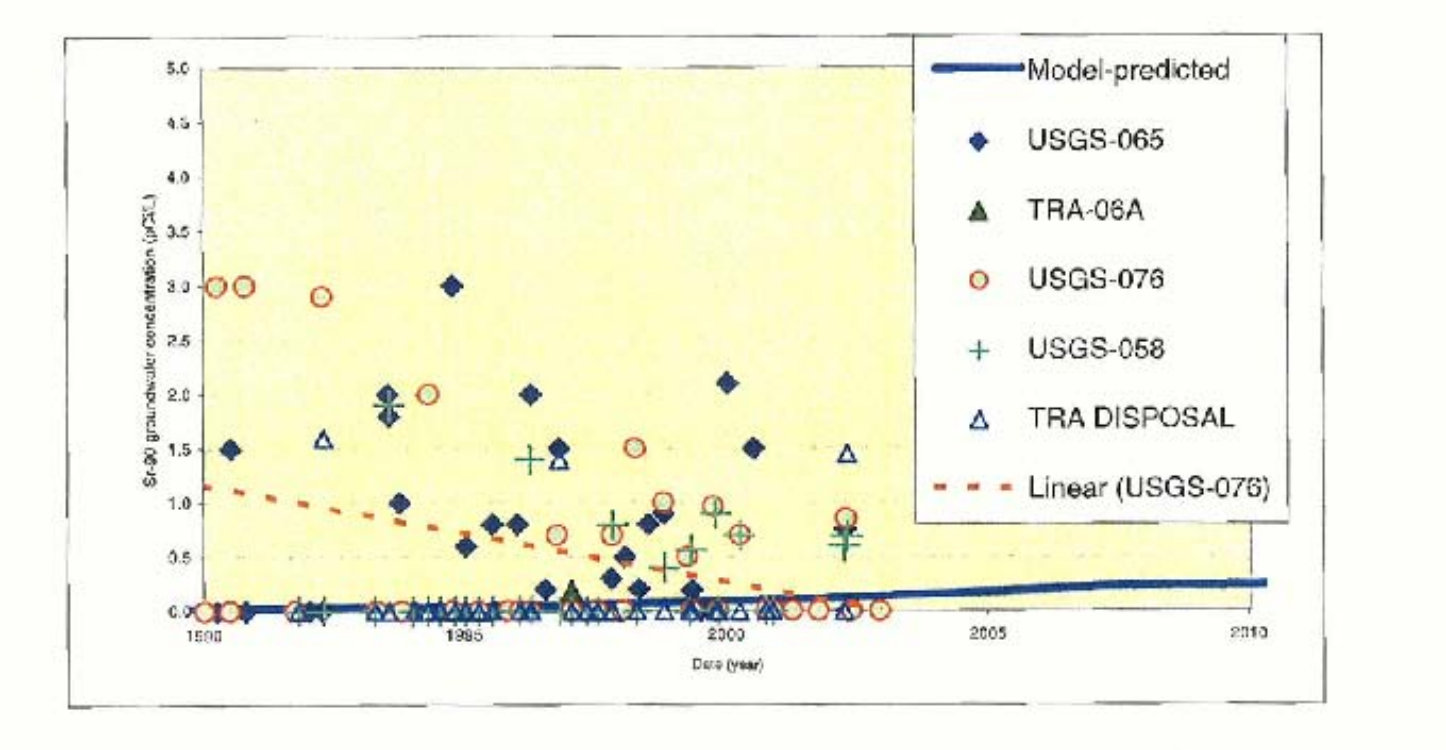

Figure 25. Strontium detections in groundwater samples from three aquifer wells near the Test Reactor Area.

With the exception of two dates (April 1976 [18+/-3 pCi/L, off scale in Figure 25] and April 1972 [9.1 pCi/L, no uncertainty given]), USGS-065 strontium concentrations have been below the MCL. The strontium concentration at USGS-065 is above the concentration predicted in the pre-Record of Decision model, which is shown as a light blue line in Figure 25. The pre-Record of Decision model predicted a peak activity in the aquifer near TRA of 0.305 pCi/L, occurring around the year 2050. The average groundwater concentration, for detected concentrations at USGS-065, for the entire period of record is 2.93 pCi/L, the most recent positive detection was 0.75 pCi/L in April 2002.

Fitting the USGS-065 strontium data with a linear trend line indicates the concentration will likely fall below the model-predicted concentration (0.23 pCi/L.) by the year 2008. The one positive detection in Well TRA-07 is 0.75 pCi/L, which occurred in January 1996. This is above the model-predicted value of 0.05 pCi/L for this period but well below the MCL. The single positive detection in the TRA-06A aquifer well is 0.18 pCi/L, occurring in January 1997; this point also is above the model-predicted aquifer concentration of 0.05 pCi/L for this period but still well below the MCL. The difference in the modeled versus actual concentrations might be attributed to the presence of the shallow sedimentary interbed, which does not allow for complete mixing and dilution.

8.3.5 Monitoring Results Summary

Based on the review and trending of groundwater contaminants performed for this 5-year review, the summary of the water quality data is as follows:

- The Post-Record of Decision Monitoring Plan and the OU 2-13 Groundwater Monitoring Plan (Dames & Moore 1993; DOE-ID 2003) have identified Am-241, As, Be, Cd, Cs-137, Cr, Co-60, F, Pb, Mn, Sr-90, tritium, and Hg as contaminants of concern during the 5-year review period for the perched water system and the SRPA beneath the TRA. With the exception of Cr, H-3, Co-60, and Sr-90, it was determined that the other eight contaminants of concern have little impact on the perched water or the aquifer.

- Generally, tritium, Sr-90, chromium, and Co-60 have shown decreasing trends in deep-perched water wells over the past 5 years. Exceptions to the general decreasing trend include increasing or flat activities of Sr-90 in Wells PW-12, USGS-054, USGS-055, and USGS-070 as well as a recent increase of Co-60 in Well PW-12.

- The primary contaminants of concern identified for the SRPA are Cr and H-3. The other 10 identified contaminants of concern have low concentrations or are at nondetect levels and are considered to have no significant impact to the SWA.

- Measured concentrations of chromium in the aquifer are decreasing and are expected to reach the MCL by 2012 for all wells.

- Tritium levels in all aquifer wells are below the MCL and are expected to continue to decrease due to radioactive decay and dilution.

- Based on the trend data for Sr-90 in the SRPA, it is expected to diminish and reach predicted concentrations, made by the pre-Record of Decision model, in the year 2008.

9. TECHNICAL ASSESSMENT

Question A: Is the remedy functioning as intended by the decision documents?

The engineered and native soil covers were intended to provide shielding from ionizing radiation or to prevent exposure to residual contaminated soil media. The annual inspections validated their structural integrity. Based on this 5-year review, all of the remedies and protective measures implemented at the surface OW 2-13 sites are functioning as intended. The covers placed over the Warm Waste Pond, Chemical Waste Pond, and Sewage Leach Pond are working as designed.

Institutional controls to limit access, which have been implemented at the OU 2-13 sites, continue to be effective. Annual inspections confirm that all institutional controls are in place and functioning as originally intended.

Natural radioactive decay, natural attenuation, dispersion, and monitoring of the SRPA indicate that the remedy is working and that chromium in wells with the highest concentrations will meet the MCL in about 2012 (estimated at 2016 in the OU 2-13 Record of Decision [DOE-ID 1997b]).

Question B: Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives used at the time of the remedy still valid?

Of the contaminants of concern, no contaminant has had any major revision or update in toxicological criteria since the development of the final remediation goals that would decrease these goals. Therefore, once met, the final remediation goals (site-specific risk-based cleanup levels) will remain protective of human health and the environment under current exposure scenarios. Monitoring results show that most contaminant concentrations are well below the established final remediation goals.

The original assumptions, cleanup levels, and remedial action objectives used at the time of the remedy selection are still valid. The EPA has lowered the MCL for arsenic from 0.05 to 0.01 mg/L. However, compliance with the lower MCL does not have to be met until 2006. Data review showed that arsenic levels are below or near the MCL, with a maximum reported value of 0.014 mg/L. The objectives of inhibiting the exposure to radionuclide contaminants of concern and ingestion of hazardous contaminants of concern are effective, based on the review of the physical conditions of the constructed covers and groundwater monitoring results.

Question C: Has any other information come to light that could call into question the protectiveness of the remedy?

No new information has surfaced while compiling and reviewing the inspections, radiological survey, and groundwater monitoring data that would call into question the protectiveness of the implemented remedies.

9.1 Technical Assessment Summary

According to the data reviewed and the site inspections, the remedy is functioning as intended by the OU 2-13 Record of Decision (DOE-ID 1997b) and as modified by the Explanation of Significant Differences (DOE-ID 2000a). No changes in the physical conditions of the site have occurred that would affect the remedy's protectiveness. There have been no changes in the toxicity factors or risk factors for the contaminants of concern. Several issues have been identified that warrant further evaluation, however, at this time, there is no information that negates the remedy's protectiveness.

10. ISSUES

During the completion of this 5-year review, the following issues were identified:

1. Increasing activities of Sr-90 in Wells PW-12, USGS-054, USGS-055, and USGS-070 and a recent increase of Co-60 in Well PW-12 remain unexplained.

2. The original assumption at the time of the OU 2-13 Record of Decision (DOE-ID 1997b) was that the TRA facility would be decommissioned and decontaminated in 2007. Under a recent decision (2003) by DOE, TRA will remain active for at least another 20 years. Continued discharge to the Cold Waste Pond from TRA operations will cause the perched water systems to persist, and the effects on contaminant transport to the aquifer has not been evaluated.

3. Based on the analyses in this 5-year review, it might be appropriate to revisit the list of analytes monitored in groundwater and reduce the number of analytes to only include chromium, tritium, Sr-90, and Co-60 or to reduce the frequency of the monitoring.

4. Large fluctuations in water chemistry in perched water have been observed since the Record of Decision signature and are currently not understood.

5. The PW-13 perched water well continues to test positive for diesel.

6. The establishment and maintenance of desirable vegetation on native soil covers for the sewage leach pond and chemical waste pond are of concern.

11. RECOMMENDATIONS AND FOLLOW-UP ACTIONS

1. *It is not clear what is causing the increase in concentrations of some contaminants of concern in the deep-perched water system.*

The following mechanisms should be considered in an evaluation of these trends. These include:(1) adsorption/desorption occurring with the changing perched water levels; (2) changing flow pathways in response to remediation and fluctuations in discharge to the Cold Waste Pond (or alternating cells); (3) seasonal variations of natural infiltration at a local scale; (4) variations in recharge from unidentified man-made sources; (5) lateral flux from the Big Lost River; or (6) new leaks of contamination from unidentified sources.

2. *A systematic analysis is recommended to positively identify the source of increasing Sr 90 in perched water as a new site.*

A new CERCLA site, TRA-63 (TRA-605 Warm Waste Line), was approved on February 6, 2003, by the State and EPA recommending a Track 1 investigation. The TRA-605 Warm Waste Line repaired 6 years ago and again in 2002; it is believed that the line leaked warm waste to the environment and could be the source of the Sr-90 to the perched water system.

New sites have been identified at TRA since the OU 2-13 Comprehensive ROD was signed. The FFA/CO parties agreed that new sites identified at any INEEL facility area after signing of the ROD(s) for that facility would be handled administratively in OU 10-08. Each time a new site is identified, it is appropriately characterized and a determination made on whether near-term action is required. If near-term action is required, a removal action may be taken and then residual risk addressed in the OU 10-08 RI/FS. If a near-term action is not required, the site will be evaluated in the OU 10-08 RI/FS and the remedy selected in the OU 10-08 ROD. The protectiveness of OU 2-13 remedies has been reviewed within the context of ROD requirements. Effects from new sites and potential new sites have been included in the issues listed in Section 10, but the remedies for the new sites are not part of the OU 2-13 ROD and the 5-year review cannot determine if new site remedies are protective. Discussions in the facility specific 5-year reviews will support the analysis of that RI/FS. The OU 10-08 RI/FS will determine the cumulative impacts of past operations on the aquifer, while risks from releases discovered post-ROD(s) signature will be evaluated as new sites under WAG-10.

3. *The OU 2-13 Groundwater Monitoring Plan (DOE-ID 2003) should be revised to reflect changing conditions based on the groundwater quality and water level monitoring data.*

Only four contaminants of concern continue to warrant continued semiannual groundwater monitoring; these include Cr, H-3, Sr-90, and Co-60. Interpretation of water level data was problematic during this 5-year review because of infrequent measurements in a dynamic groundwater system. The feasibility of using electronic water-level recorders should be assessed to monitor for dynamic changes in water levels and correlate them to discharges to the ponds. The IDEQ recommended one round of sampling for-Iodine-129 and Technetium-99 during the first review of this document; this will be incorporated into the revision of the

OU 2-13 Groundwater Monitoring Plan. Recently drilled Middle-1823 should be added to the TRA groundwater-monitoring network. The well is screened from 680 to 720 ft bgs, and it will serve to further constrain the vertical and lateral migration of contaminants, particularly chromium.

4. *A geochemistry investigation is recommended to "fingerprint" various water sources at TRA and correlate sources to water in perched water wells.*

For instance, the presence or absence of sulfate in wells and recharge sources might be used to tie certain wells to specific recharge sources. Operations at TRA might have a strong impact on water chemistry. Better communications with Operations personnel on the day-to-day discharges to the ponds should be encouraged to enhance interpretations of water levels and water chemistry and document the flux of water to the vadose zone. The geochemistry analyses should look at variations in redox conditions that might change the mobility of contaminants, particularly chromium.

5. *The impact of continued operations at the TRA facilities for another 20 years and the continued persistence of perched water should be used to update, if required, the assumptions of the pre-Record of Decision model.*

Ideally, information gained from the preceding paragraphs could be used in this evaluation. In addition, a field characterization effort is needed to identify the extent and source of the diesel in PW-13.

6. *Establishment of desirable native vegetation and control of intrusive weed species should be addressed more aggressively.*

These actions would enhance the covers' structural integrity by providing greater resistance to erosion and animal intrusion, which would provide greater protection to human health and safety and the environment. Recommendations and actions are being identified to improve or enhance remedy performance or protectiveness in accordance with the remedial action objectives and performance standards identified for these sites.

12. PROTECTIVENESS STATEMENT

The implemented remedies from the OU 2-13 Record of Decision (DOE-ID 1997b) continue to be protective of human health and the environment based on the data and analyses presented in this report. The U.S. Environmental Protection Agency (EPA) with consultation from the Idaho Department of Environmental Quality (IDEQ retains final authority over whether the 5-year review adequately addresses the protectiveness of remedies. Potential short-term threats are being addressed through institutional controls. Long-term protectiveness of human health and the environment under the Record of Decision was determined based upon concentrations predicted in the aquifer (not in perched water). Trends for contaminants of concern measured in the aquifer during this first 5-year review period either are currently below the MCLs or are projected to be below the MCLs in 2012. Thus, the chromium concentrations in all wells will be below the MCL 4 years in advance of the pre-Record of Decision model that predicted the concentration of chromium to reach the MCL by 2016. Issues identified in this 5-year review related to perched water are not expected to affect the protectiveness of the selected remedies. Ongoing discussions with the Agencies will define activities to fully evaluate the perched water conditions and long-term impacts on the aquifer. Long-term protectiveness will be satisfied under the selected remedy when groundwater cleanup goals are achieved, estimated to occur in the year 2012.

13. NEXT REVIEW

The next 5-year review for the Test Reactor Area, Operable Unit 2-13 is required by December 21, 2007 – 5 years from the date of this review.

14. REFERENCES

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Appendix A

U.S. Department of Energy News Release

Appendix A

U.S. Department of Energy News Release

Appendix A contains a copy of the public notification prepared and distributed to inform the general public of the beginning of the 5-year review process required under the Comprehensive Environmental Response, Compensation, and Liability Act.

DOE News Release

FOR IMMEDIATE RELEASE

August 5, 2002

INEEL conducts interim five-year review of Test Reactor Area remediation activities

The U.S. Department of Energy's Idaho National Engineering and Environmental Laboratory is conducting a routine review of the completed cleanup actions and implemented protective measures at the Test Reactor Area.

This review is being conducted in accordance with the requirements of the 1991 Federal Facility Agreement and Consent Order signed by DOE, the U.S. Environmental Protection Agency, and state of Idaho. The Test Reactor Area is designated as Waste Area Group 2 in the FFA/CO. The 1997 Record of Decision for the Test Reactor Area outlined actions to be taken to protect human health and safety and the environment.

The Interim Five-year Remedy Review Report details the results of an evaluation and review of the completed cleanup actions and implemented protective measures called institutional controls at all 20 sites at the Test Reactor Area. This review is required to be performed every five years at sites whenever contamination is left in place to ensure remedies remain protective of human health and safety and the environment.

Previous cleanup actions involved the remediation of a wastewater disposal pond contaminated with cesium-137 and chromium; the removal of wind-blown contaminated soils; the implementation of a groundwater monitoring program for the perched water system; and the relocation of INEEL-contaminated soils to a wastewater disposal pond at the Test Reactor Area.

The Test Reactor Area was built in 1952 with the mission of studying the effect of radiation on materials, fuels and equipment using seven reactors, especially the Materials Test Reactor (1952-1970), the Engineering Test Reactor (1957-1981) and the Advanced Test Reactor (1967-present).

The current mission of the Test Reactor Area is wet storage of spent nuclear fuel; operation of the INEEL's largest reactor – the Advanced Test Reactor – for research supporting the U.S. Navy and other customers; and to produce isotopes for medicine and industry.

More information on the Test Reactor Area is available online at: http://www.inel.gov/publicdocuments/factsheet/tra-fsheet.pdf. Detailed information is available in the Administrative Record file for Operable Unit 2-13. The Administrative Record is located at the DOE Reading Room of the INEEL Technical Library in Idaho Falls. Copies can be found at Albertson's Library on the Boise State University campus and the University of Idaho Library in Moscow. The Administrative Record can be accessed on the Internet at http://ar.inel.gov/home.html.

The INEEL is a science-based, applied engineering national laboratory dedicated to supporting the U.S. Department of Energy's missions in environment, energy, science and national security. The INEEL is operated for the DOE by Bechtel BWXT Idaho, LLC.

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Appendix B

Associated Documents

Appendix B

Associated Documents

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Appendix C

Discussion of Contaminants of Concern for Operable Unit 2-13 Perched Water

Appendix C

Discussion of Contaminants of Concern for Operable Unit 2-l 3 Perched Water

Please refer to the attached CD for the analytical results for all contaminants of concern.

The *Groundwater Monitoring Plan for the Test Reactor Area Operable Unit 2-13* has identified Am-241, arsenic, Be, Cd, Cs-137, Cr, Co-60, F, Pb, Mn, Sr-90, H-3, and Hg as contaminants of concern during the 5-year review period for both the perched water system and the Snake River Plain Aquifer beneath the Test Reactor Area (TRA). [a]

In addition to the post-Record of Decision sample results, a more comprehensive interpretation can be made over a larger area by using the United States Geological Survey (USGS) monitoring data. This assessment of data indicates little impact for Am-241, arsenic, Be, Cd, Cs-137, Co-60, F, Pb, Mn, and Hg over the evaluation period of 1990 to the present. The primary contaminants of concern – chromium, tritium, and Sr-90 – are discussed in the analytical result section of the 5-year review.

Perched Water

Americium-241 – Since 1991, the available data indicates that Am-241 has not been detected without U-flag laboratory qualifier conditions, and almost all results have sample data counting errors greater than the reported value. The Post-Record of Decision Monitoring for the Test Reactor Area Perched Water System Operable Unit 2-12 – Third Annual Technical Memorandum evaluation reported Am-241 values in five of the six monitoring wells, with maximum concentrations ranging from 0.4 pCi/L (USGS-054) to 0.97 pCi/1 (USGS-056), all below the combined totals for the maximum contaminant level (MCL) of 15 pCi/L. [b]

Arsenic – During the 1991 pre-Operable Unit 2-12 Record of Decision evaluation period, arsenic was detected at low-level concentrations with ranges of 0 to 0.035 mg/L, without any flagged laboratory qualifiers. Though arsenic has been analyzed for and detected at low levels in most wells sampled, results indicate that arsenic has remained at non-detect leve1s since 1991. The maximum reported values, ranging from 0.011 to 0.014 mg/L below e 0.05-mg/L MCL of 0.05, from groundwater samples analyzed during the Operable Unit 2-12 post-Record of Decision period was reported in three of six monitoring wells. Arsenic was not detected in Wells PW-11 and PW-12 in an unflagged laboratory qualifier condition for the April 2002 sample event.

Beryllium – Sample data results indicate that beryllium has not been detected during any sample event without U flag qualifiers since the 1991 pre-Operable Unit 2-12 Record of Decision evaluation period. The post-Operable Unit 2-12 Record of Decision data reported detections of beryllium in two wells with maximum concentrations of 0.005 and 0.0059 mg/L above the 0.004-mg/L MCL, but were duplicate flagged results.

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Cadmium – In 1991, cadmium was designated as a priority contaminant of concern, based upon its predicted impact on the Snake River Plain Aquifer. Since that time, TRA monitoring wells have been monitored for the presence of cadmium. Though detected at low levels in most sampled wells, cadmium has only exceeded the MCL levels during the 1996 sampling event without laboratory qualifier flags. Wells USGS-055, PW-11, and PW-12 exceeded the MCL levels (0.005 mg/L) within the range of 0.007 to 0.009 mg/L. Cadmium has only been detected at nondetect limits since the 1996 sampling event, and it is not detected in the current groundwater samples.

Cesium-137 and Cobalt-60 – Cesium-137 and Co-60 have a combined or total MCL of 200 pCi/L; thus, they are usually tracked together. Before the 1996 post-Record of Decision reporting period and remediation of the disposal ponds, TRA-A77 (shallow perched retention basin) has concentrations of Cs-137 ranging up to 42,300 pCi/L. Since the remediation of the disposal ponds, reported Cs-137 values have ranged from 0 to 30 pCi/L. The reported values for Cs-137 (see Appendix C on CD) without lab qualifier flags have counting errors greater than the reported value.

Wells monitoring for Co-60 also had significant concentrations before the 1996 post-Record of Decision reporting period. The maximum reported value of 110,000 pCi/L was found in wells monitoring the disposal ponds. Since remediation of the disposal ponds, the reporting levels have ranged from 0 to 26.9 pCi/L. The last, significant value was reported in 1997 in Well USGS-056, with 200 pCi/L. Since 1997, unflagged laboratory qualifier values for Co-60 have ranged from nondetects to a high reported value of 26.9 pCi/L.

Historical information indicates that almost all wells show significantly decreasing trends in both Cs-137 and Co-60 reported values.

Fluoride – Fluoride was detected at low levels in early 1990 sample events with ranges of 0.04 to 0.05 mg/L. Since 1991, reported values for fluoride have ranged from 0.00 to 0.24 mg/L, which is well below the 4-mg/L MCL. Only Wells PW-11 and PW-12 were sampled for fluoride in the April 22, 2002, sampling event, and F was reported as a nondetect.

Lead – Lead was detected in several wells around the retention basin, which is within the TRA disposal area, during the 1991 pre-Record of Decision evaluation period, with ranges from 0.0 to 0.07 mg/L. However, Pb has not been consistently sampled for in most wells since 1991. Monitoring Wells PW-11 and PW-12 have the best history of geochemical data provided by sampling events. Wells USGS-053, USGS-054, USGS-055, and USGS – 056 had an early history of cumulated data; however, since the mid-1990s, these wells have gone dry or have had intermittent water table elevations with the associated lack of information. Since the 1996 post-Record of Decision evaluation period, maximum values were reported for Pb in Well PW-12 (0.0046 mg/L) and Well USGS-056 (0.0048 mg/L), both below the 0.015-mg/L MCL. Lead has been detected only at instrument detection levels and method detection limit levels in wells with available geochemical data.

Manganese – Manganese was detected in several wells during the 1991 pre-Record of Decision evaluation period with ranges from 0.0 to 1.78 mg/L, but only in wells around the retention basin. Though manganese has not been tracked in most wells since 1991, Wells PW-11 and PW-12 do have a history of consistent data. The USGS Wells-053, -054, -055, and -056 had an early, continuous record of results; however, these wells have gone dry or have had intermittent water table elevations since the mid-1990s. Since the 1996 post-Record of Decision evaluation period, there have been detections in three of the six perched-water monitoring wells. Maximum values were reported in Wells PW-12 (0.0049 mg/L) and USGS-056 (0.036 mg/L). All other detections of manganese have been at instrument detection levels and method-detection limit levels below the 0.05-mg/L MCL in wells with available data.

Mercury – Wells PW-11 and PW-12 were sampled for mercury in the April 2002 sampling event, with reported values at the instrument detection levels and method-detection limit levels (0.0001 mg/L). Sample data (see Appendix C on CD) indicate that mercury historically has only been detected in several wells since the 1991 pre-Record of Decision evaluation period. One well, TRA-A57, had reported values approaching the MCL (0.002 mg/L) in a 1991 duplicate series, with results ranging from 0.0 to 0.005 mg/L. The range of reported values for mercury in all wells with available data, including the 1991 period, are from 0.0 to 0.005 mg/L with almost all reported values at detection limits.

Summary – Because the deep-perched water system has not dissipated as originally assumed in the Operable Unit 2-12 pre-Record of Decision modeling, it may be expected that contaminants of concern impact the environment in the deep-perched water system, as indicated by the elevated reported values during the 1991 pre-Record of Decision evaluation period. However, though continued discharges affect fate and transport of contaminants, current concentrations suggests that Am-241, arsenic, Be, Cd, Cs-137, Co-60, F, Pb, Mn, and Hg have little impact on the perched water. Remedial action in closing the waste disposal ponds has shown positive results. Therefore, it is recommended that continued sampling for these 10 identified contaminants should be regulated to 5-year review periods.

Aquifer

The *Groundwater Monitoring Plan for the Test Reactor Area Operable Unit 2-13* (see footnote a) recommended surveillance monitoring in Aquifer Wells Highway-3, TRA-06A, TRA-07, TRA-08, USGS-058, and USGS-065. This Groundwater Monitoring Plan also recommended semiannual sampling for Cr and H-3 as well as annual sampling for Cd, Co-60, and Sr-90 in the Snake River Plain Aquifer.

The Groundwater Monitoring Plans have identified Am-241, arsenic, Be, Cd, Cs-137, Cr, Co-60, F, Pb, Mn, Hg, Sr-90, and H-3 as contaminants of concern for the 5-year review period for the Snake River Plain Aquifer beneath TRA. Table 7-1, located in the Groundwater Monitoring Plan, reflects analyte action levels and background concentrations for the identified contaminants. From Operable Unit 2-12 (1992) computer modeling summary, the predicted near-term changes in contaminant concentrations for the Snake River Plain Aquifer are as follows:

- Americium-241, arsenic, Be, Cs-137, F, Pb, and Mn are expected to remain below detection
- Cadmium and Sr-90 would increase, then decrease
- Chromium was predicted to decrease below the MCL by 2016
- Tritium was predicted to meet the MCL by 2004.

Groundwater monitoring conducted for Operable Unit 2-12 from 1993 to 1996 failed to detect arsenic, Be, Cs-137, Co-60, and Sr-90. Americium 241 was detected in only one sample (see footnote b). Fluoride and Pb were detected, but were below background concentrations. Cadmium was detected at concentrations slightly above the detection limit and aquifer background, and Mn was only detected at low concentrations initially with subsequent sample rounds having rapid declines in reported values to instrument detection limit and method-detection limit levels. Based on the Operable Unit 2-12 groundwater monitoring, only H-3 and chromium concentrations in the Snake River Plain Aquifer exceed the Idaho groundwater quality standards. Therefore, only H-3 and chromium are considered significant contaminants of concern for the Snake River Plain Aquifer.

By including the results of monitoring data collected by the USGS from Monitoring Wells SITE-19, USGS-079, USGS-076, MTR-TEST, and TRA Disposal with the Idaho National Engineering and Environmental Laboratory Waste Area Group 2 results for the 5-year review evaluation period, a more comprehensive picture concerning contaminants is projected over the TRA area of influence.

The results of individual constituents analyzed and reviewed are presented below.

Americium-241 – Americium-241 is considered to have little impact to the Snake River Plain Aquifer. The range of sample results was from an estimated below-detection limit to 61.2 pCi/L (U-flag), with almost all results having counting errors greater than reported value.

Arsenic – Arsenic was not detected in any of the aquifer groundwater samples for which it was analyzed without U-flag laboratory qualifiers. Ranges of results are from 0.00 to 0.0081 mg/L (U-flag); therefore, arsenic has little impact on the Snake River Plain Aquifer.

Beryllium – Beryllium is not detected (without laboratory qualifiers) above the statistically adjusted instrument detection limit/method detection limit for the April 22, 2002, sampling event. Beryllium is only detected at low levels, and it did not exceed the MCL (0.004 mg/L) during the 1990 – 2002 evaluation period. Ranges of sample results are from 0.0 to 0.005 mg/L (U-flag). Beryllium has little impact on the Snake River Plain Aquifer.

Cadmium – In several of the monitoring wells under review, cadmium is commonly detected in excess of the MCL (0.005 mg/L). However, this has only occurred in (unfiltered) duplicates under U-flag conditions. Ranges of results are from 0.00 to 0.007 mg/L. Analytical results from wells sampled during the April 2002 sample event (PW-11 and PW-12) show cadmium at detection limits. Although cadmium was a predicted contaminant of concern during the evaluation period for the Record of Decision, Test Reactor Area Perched Water System, Operable Unit 2-12, Idaho National Engineering and Environmental Laboratory, Idaho Falls, Idaho, cadmium has little impact on the Snake River Plain Aquifer, based on the sample results from the post-Record of Decision and April 2002 sampling results that were reviewed.[c]

Cesium-137 and Cobalt-60 – The Cs-137 and Co-60 radionuclides have a combined or total MCL of 200 pCi/L, so they are usually tracked together. Over the evaluation period of the 5-year review (1990 to the present), Cs-137 and Co-60 were not detected in wells with available data. In almost every sample round, including the April 2002 sample event, the counting errors approach or are equal to the reported value. Cesium-137 and Co-60 have little impact on the Snake River Plain Aquifer.

Fluoride – Fluoride exceeded the MCL (4 mg/L) during the 1991 pre-Record of Decision evaluation period in several aquifer wells, but only in duplicate sample series with high reported value ranges from 0.0 to 19.8 mg/L in Well USGS-065. Since that time period, including the post-Record of Decision and the April 2002 sampling round, fluoride has only been detected at low concentrations to instrument detection limit/method-detection limit levels, with ranges of 0.0 to 0.18 mg/L. Fluoride is not considered to have an impact on the Snake River Plain Aquifer.

Lead – Lead is detected at low concentrations in most aquifer wells in duplicate series (filtered and unfiltered) with ranges of 0.0 to 0.0105 mg/L (TRA-07) during the 1991 evaluation period. Lead neither has exceeded nor has approached the MCL (0.015 mg/L) in any well under review since the 1991 sampling event, with almost all reported values near detection limits without laboratory qualifiers. All the analytical results from Wells PW-11 and PW-12 for the April 2002 sample event had laboratory qualifiers and were at the instrument detection limit/method-detection limit level of 0.003 mg/L. Lead is not considered to have an impact on the Snake River Plain Aquifer.

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c. DOE-ID, 1992, *Record of Decision, Test Reactor Area Perched Water System, Operable Unit 2-12, Idaho National Engineering and Environmental Laboratory, Idaho Falls*, Idaho, Doc. Id. 5230, Revision 0, U.S. Department of Energy Idaho Operations Office, December 1992.

Manganese – Manganese was detected at low concentrations above the MCL (0.05 mg/L) in several wells during the 1991 evaluation period, with high ranges of 0.00 to 0.087 mg/L and 0.00 to 0.094 mg/L in duplicate unfiltered samples in Wells TRA-07 and TRA-08, respectively. Since the 1991 evaluation period, including the post-Record of Decision evaluation, manganese is only detected below background concentrations and near instrument detection limit/method-detection limit levels. Results from the April 2002 sample round of aquifer wells at TRA detected manganese at the low levels of 0.0005 to 0.0067 mg/L. Manganese is not considered to have an impact on the Snake River Plain Aquifer.

Mercury – Mercury is detected in aquifer wells over the evaluation period of 1990 to the present only at or near the instrument detection limit/method-detection limit levels. The analytical results from the April 2002 sampling event show that mercury occurs at the 0.0001-mg/L limit of detection, and it is under U-flag laboratory qualifier conditions. Mercury is not considered to have an impact on the Snake River Plain Aquifer.

Summary – Groundwater monitoring results for the identified contaminants of concern for this 5-year review – Am-241, arsenic, Be, Cs-137, Co-60, F, Pb, Mn, and Hg – indicate the contaminants of concern have little impact to the groundwater and the environment. Though cadmium was a predicted contaminant of concern in the Record of Decision, review of the groundwater analytical results for the 1990 to 2002 period indicate that cadmium also has little impact on the Snake River Plain Aquifer. Based on this information, it is recommended the sampling frequency for these contaminants be reduced to 5-year cycles.

Appendix D

Site Inspection
Photographs of Operable Units 2-13 and 2-14 Sites (2002)

Appendix D

Site Inspection

Photographs of Operable Units 2-13 and 2-14 Sites (2002)

Appendix D contains color photographs of the 15 Comprehensive Environmental Response, Compensation, and Liability Act sites at Operable Units 2-13 and 2-14 in Waste Area Group 2. These photographs were taken during the most recent institutional control inspection in June 2002, and they depict the current physical condition of each site in Operable units 2-13 and 2-14.

Please refer to the attached CD for scanned copies of the site inspection forms and radiologica1 survey information.

Figure D-1. The TRA-03 Warm Waste Pond cover looking east (PN02274-1-14).

Figure D-2. Comprehensive Environmental Response, Compensation, and Liability Act sign at TRA-03 Warm Waste Pond cover (PN02274-1-15).

Figure D-3. Rabbitbrush growing on western portion of TRA-03 Warm Waste Pond cover (PN02274-1-16).

Figure D-4. West side of TRA-06 Chemical Waste Pond looking east (PN02274-1-6).

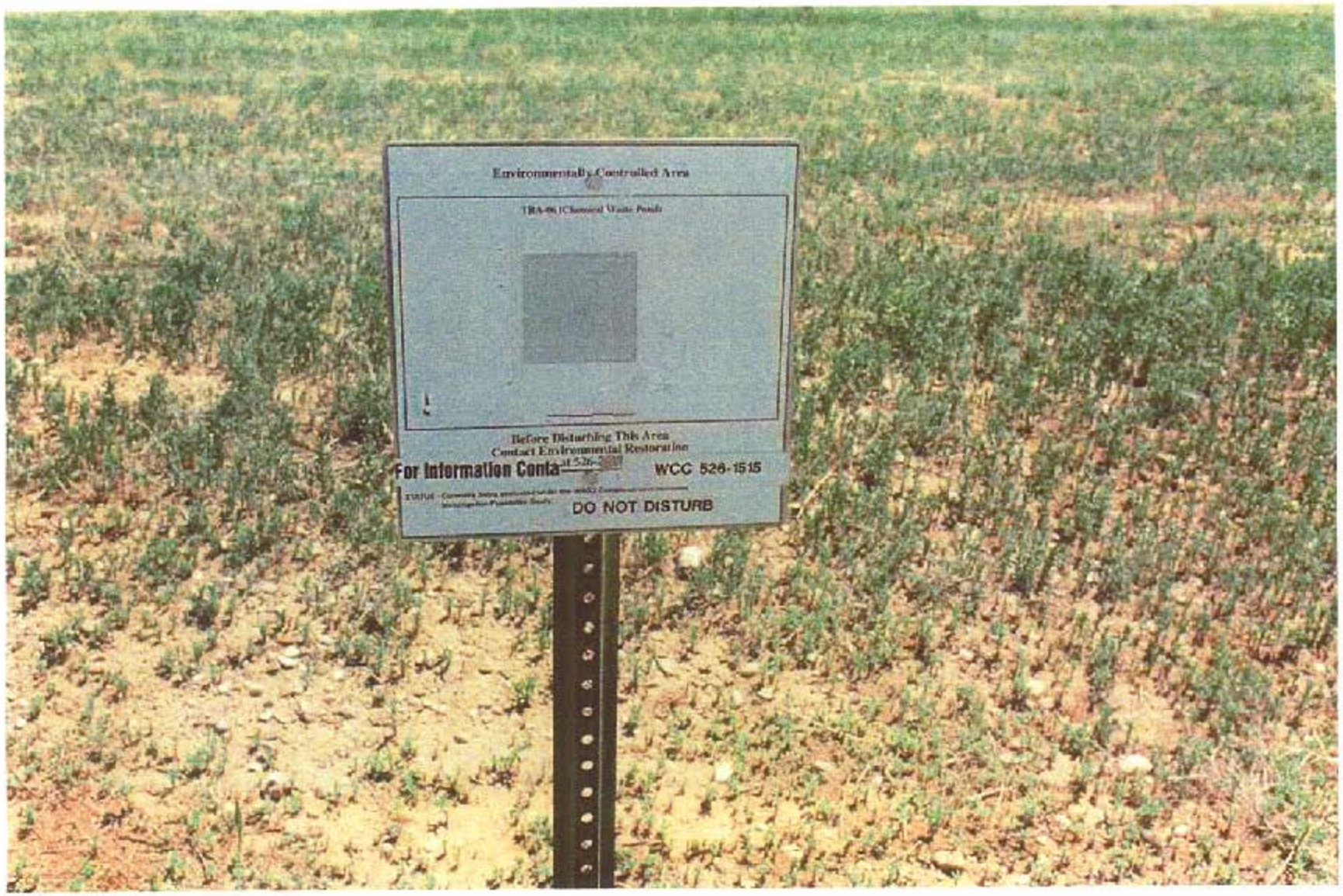

Figure D-5. Comprehensive Environmental Response, Compensation, and Liability Act sign at TRA-06 Chemical Leach Pond cover (PN02274-1-7).

Figure D-6. View of TRA-06 Chemical Leach Pond cover looking north (PN02274-1-8).

Figure D-7. View of TRA-06 Chemical Leach Pond cover looking northwest (PN02274-1-9).

Figure D-8. Comprehensive Environmental Response, Compensation, and Liability Act sign at TRA-08 Cold Waste Ponds (PN02274-1-17).

Figure D-9. The TRA-08 Cold Waste Ponds, south pond receiving cold waste liquid effluent (PN02274-1-18).

Figure D-10. TRA-08 Cold Waste Ponds, north pond (PN02274-1-19).

Figure D-11. West side of TRA-13 Sewage Leach Pond, looking east (PN02274-1-2).

Figure D-12. Comprehensive Environmental Response, Compensation, and Liability Act sign at TRA-13 Sewage Leach Pond (PN02274-1-3).

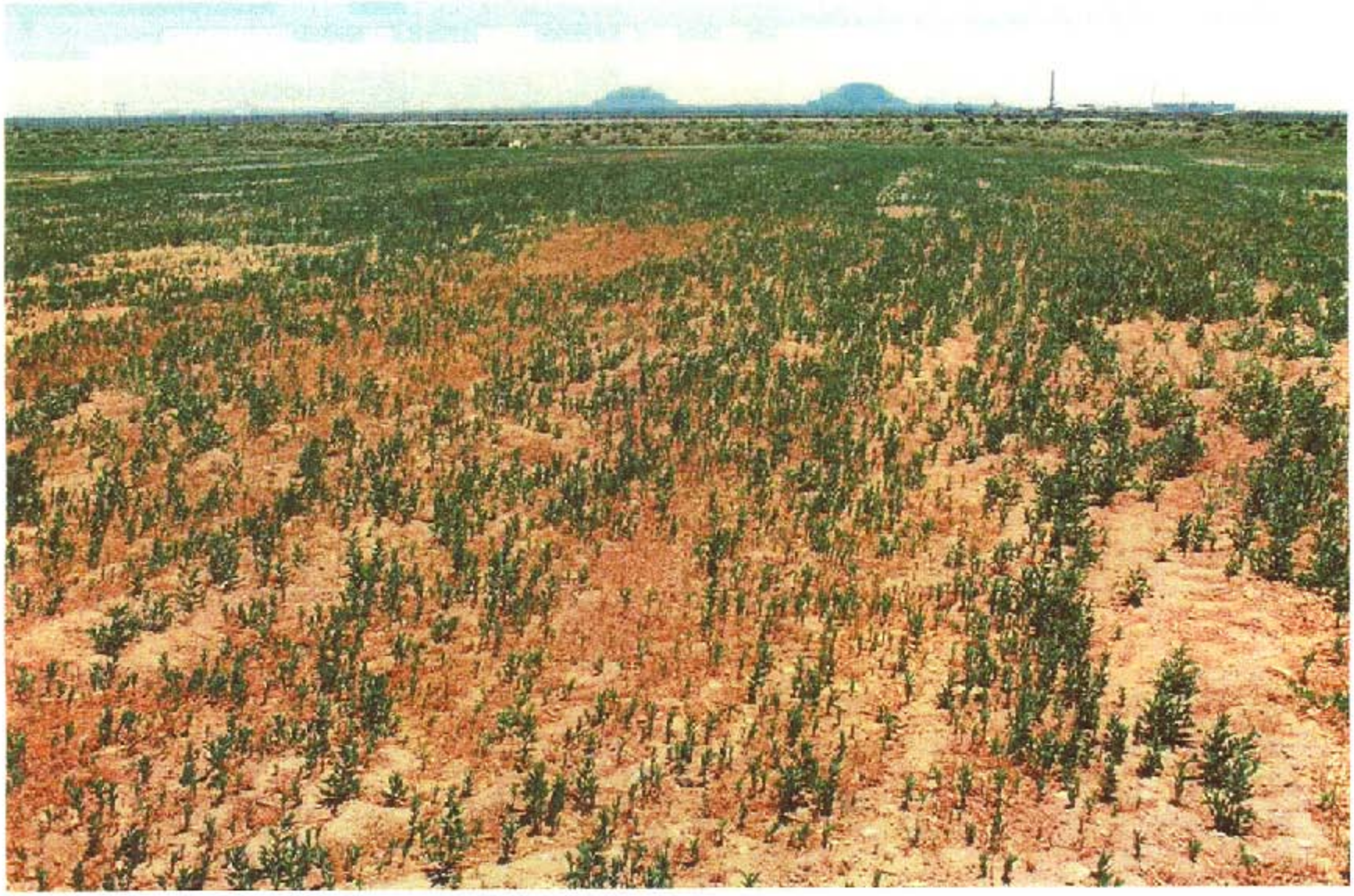

Figure D-13. The TRA-13 Sewage Leach Pond cover looking east (PN02274-1-4).

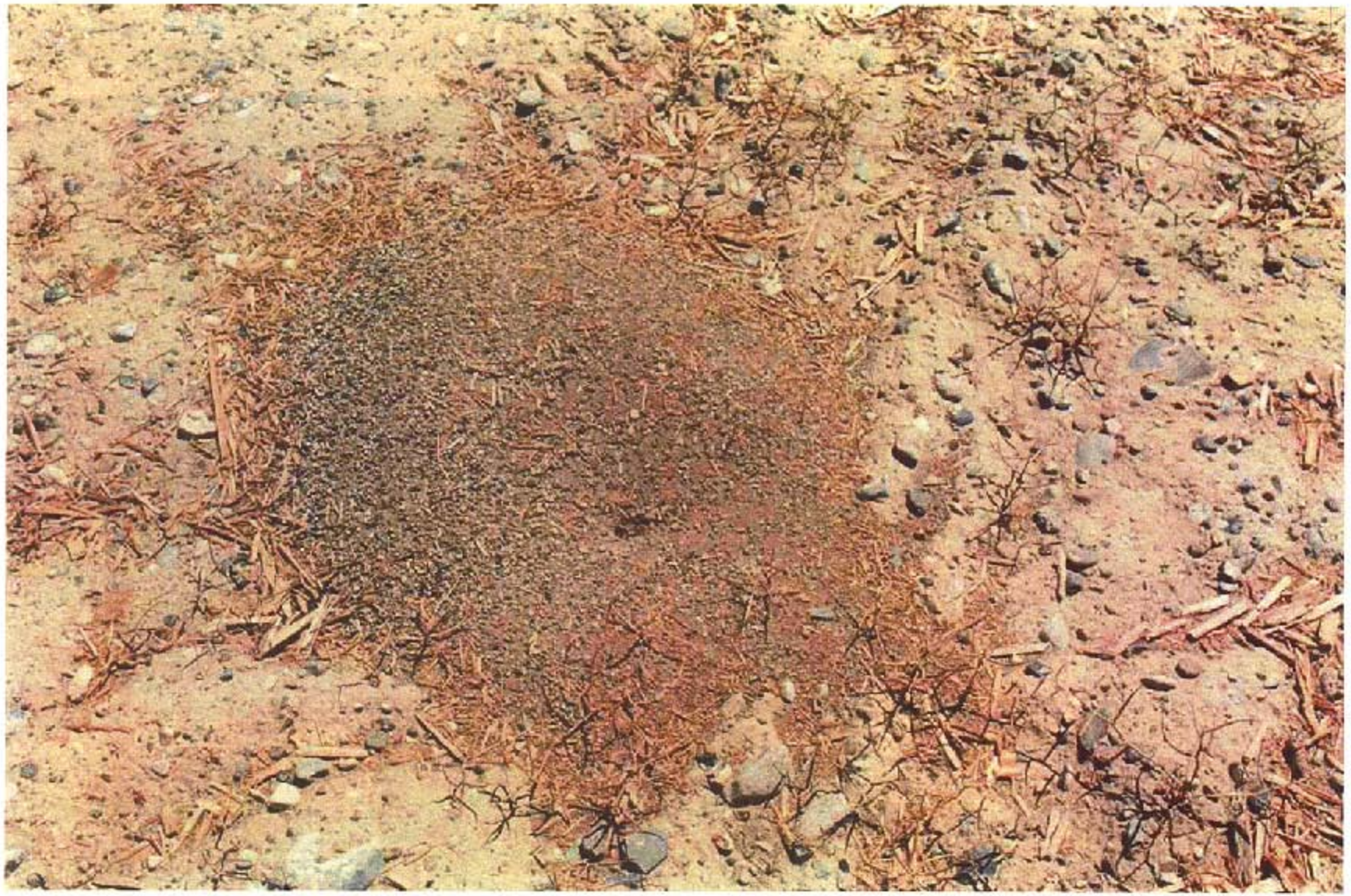

Figure D-14. Anthill located on the northern portion of the TRA-13 Sewage Leach Pond cover (PN02274-1-5).

Figure D-15. Comprehensive Environmental Response, Compensation, and Liability Act sign at TRA-15 Hot Waste Tanks 2, 3, and 4 (PN02274-2-4).

Figure D-16. The TRA-15 Hot Waste Tanks 2, 3, and 4 looking south (PN02274-2-5).

Figure D-17. Comprehensive Environmental Response, Compensation, and Liability Act sign at TRA-19 Tanks 1 and 4 at TRA-630, posted on exterior of building controlling access to the site (PN02274-2-6).

Figure D-18. The TRA-Y Brass Cap Site (PN02274-2-0).

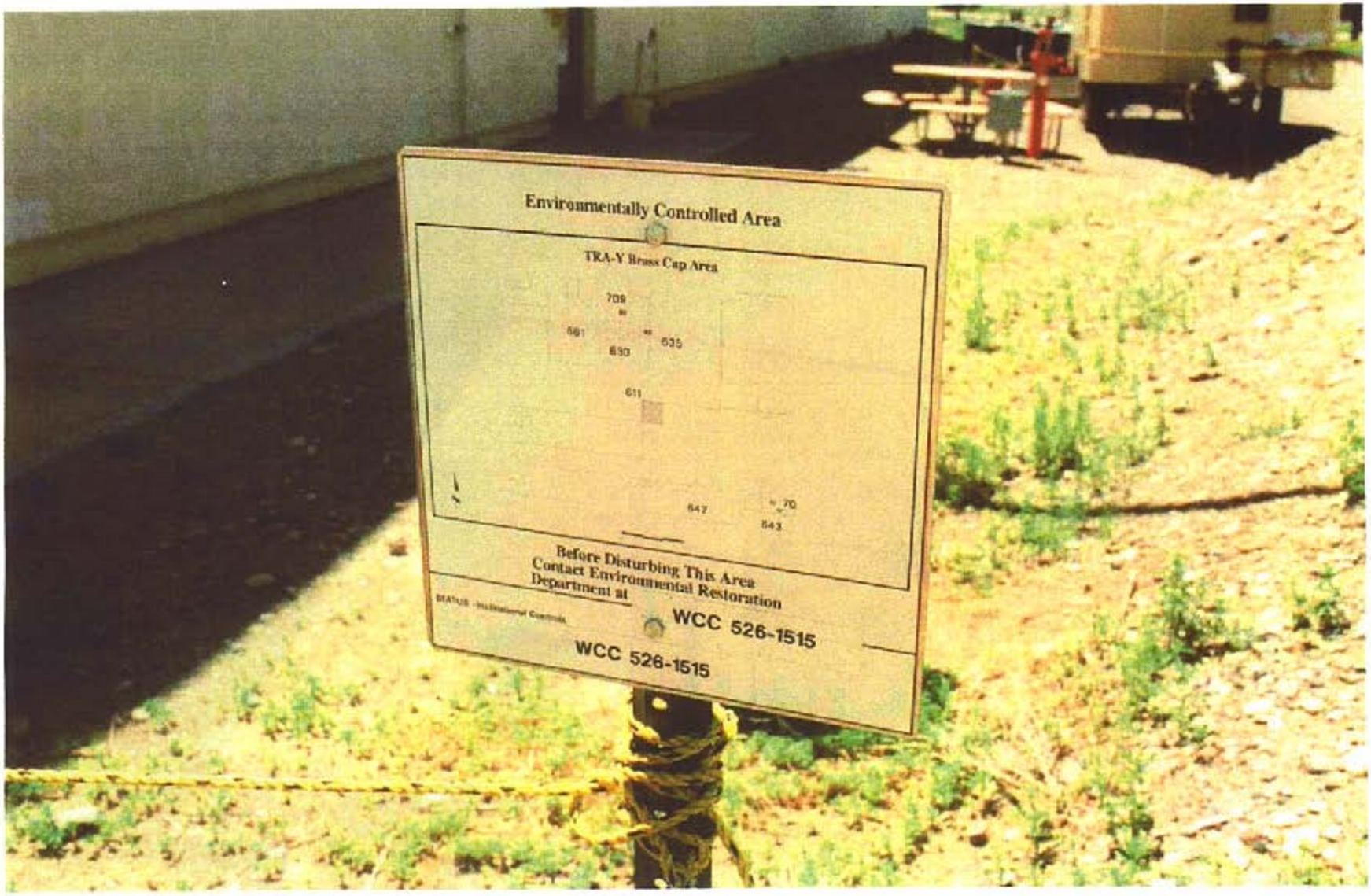

Figure D-19. Comprehensive Environmental Response, Compensation, and Liability Act sign at TRA-Y Brass Cap Area (PN02274-2-1).

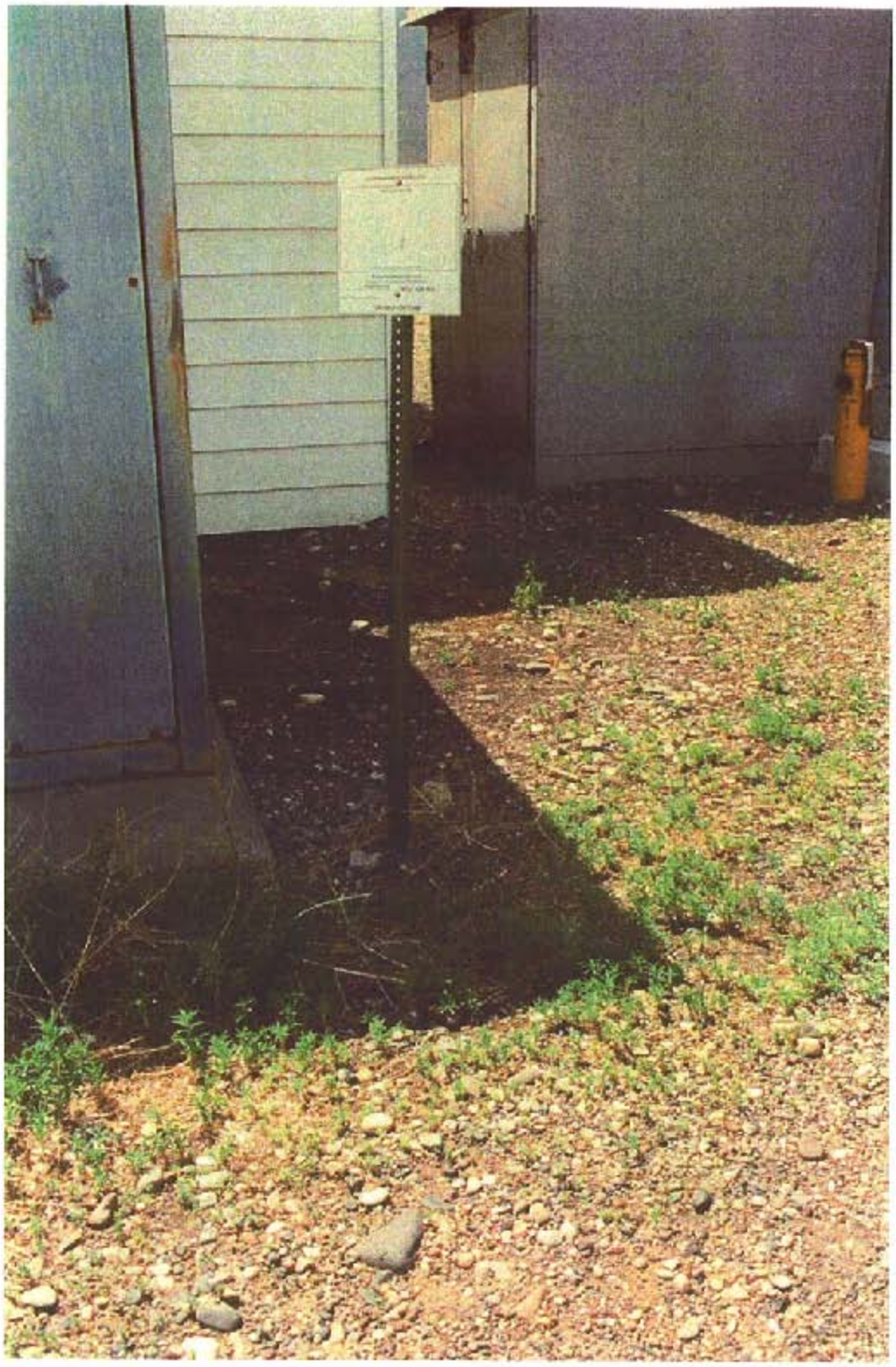

Figure D-20. View of polychlorinated biphenyl spill at TRA-619 looking west with Comprehensive Environmental Response, Compensation, and Liability Act sign (PN02274-2-13).

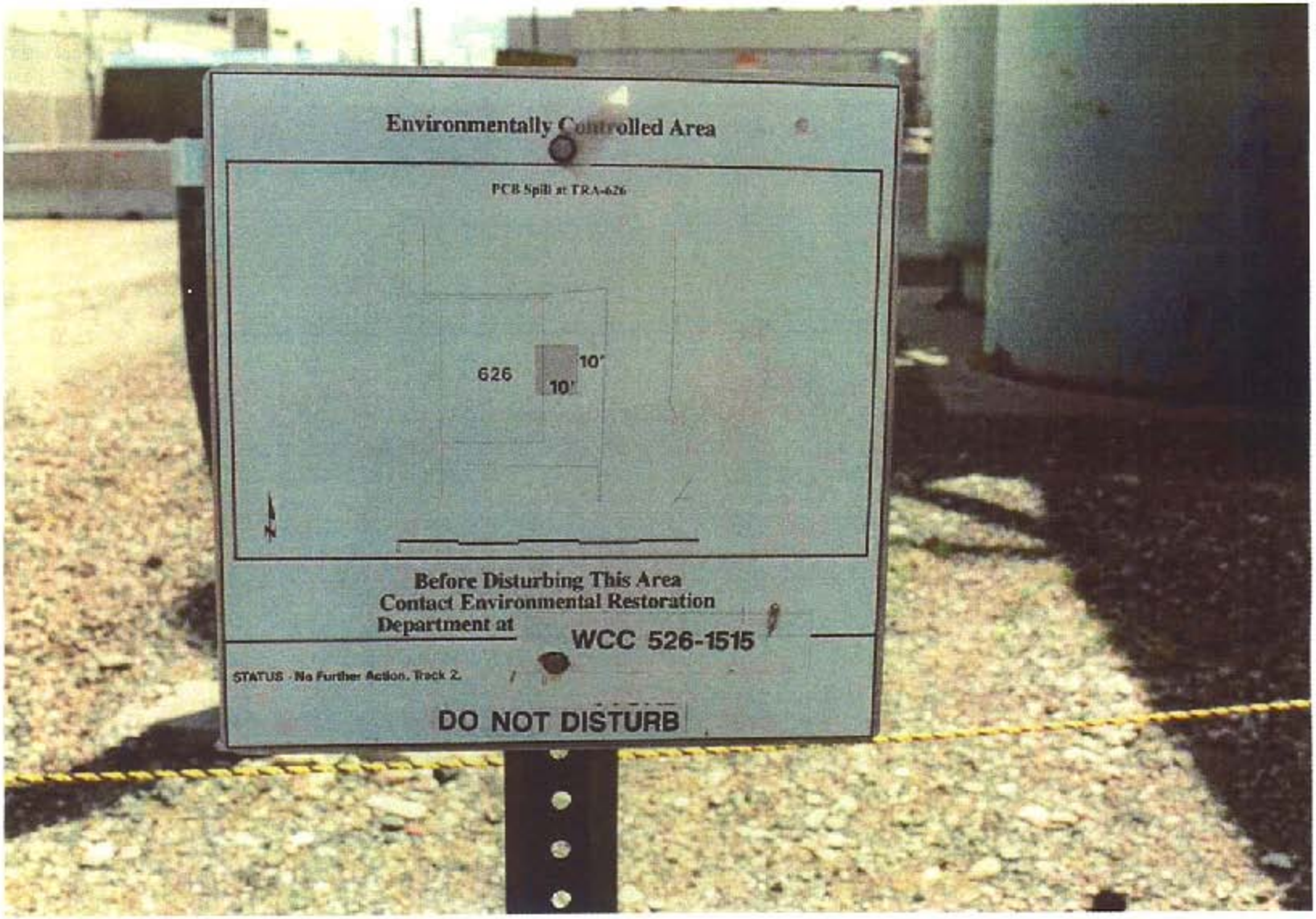

Figure D-21. Comprehensive Environmental Response, Compensation, and Liability Act sign at polychlorinated biphenyl spill at TRA-626 (PN02274-2-7).

Figure D-22. Polychlorinated biphenyl spill at TRA-626 looking south (PN02274-2-8).

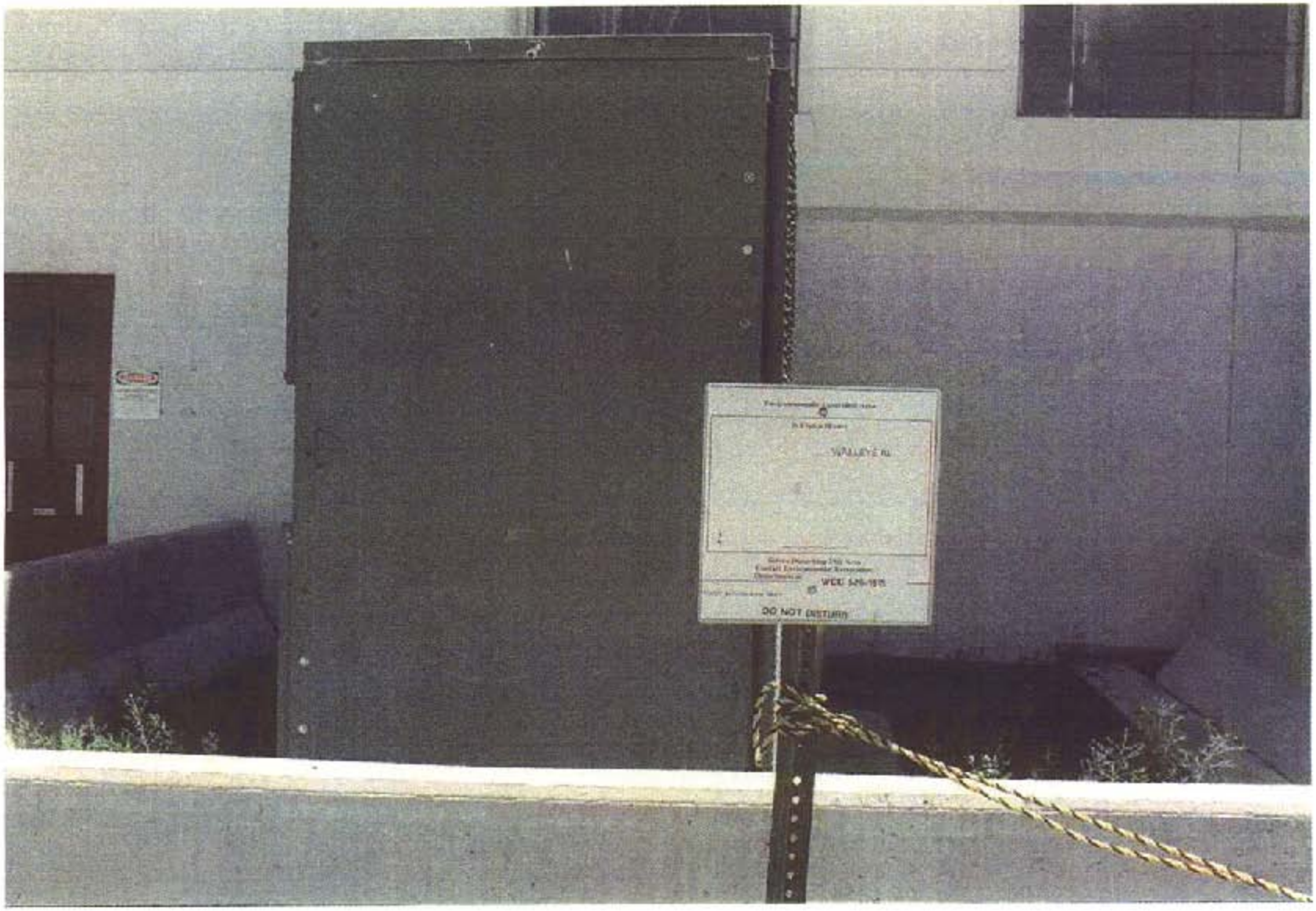

Figure D-23. Polychlorinated biphenyl spill at TRA-653 looking south with Comprehensive Environmental Response, Compensation, and Liability Act sign in foreground (PN02274-1-23).

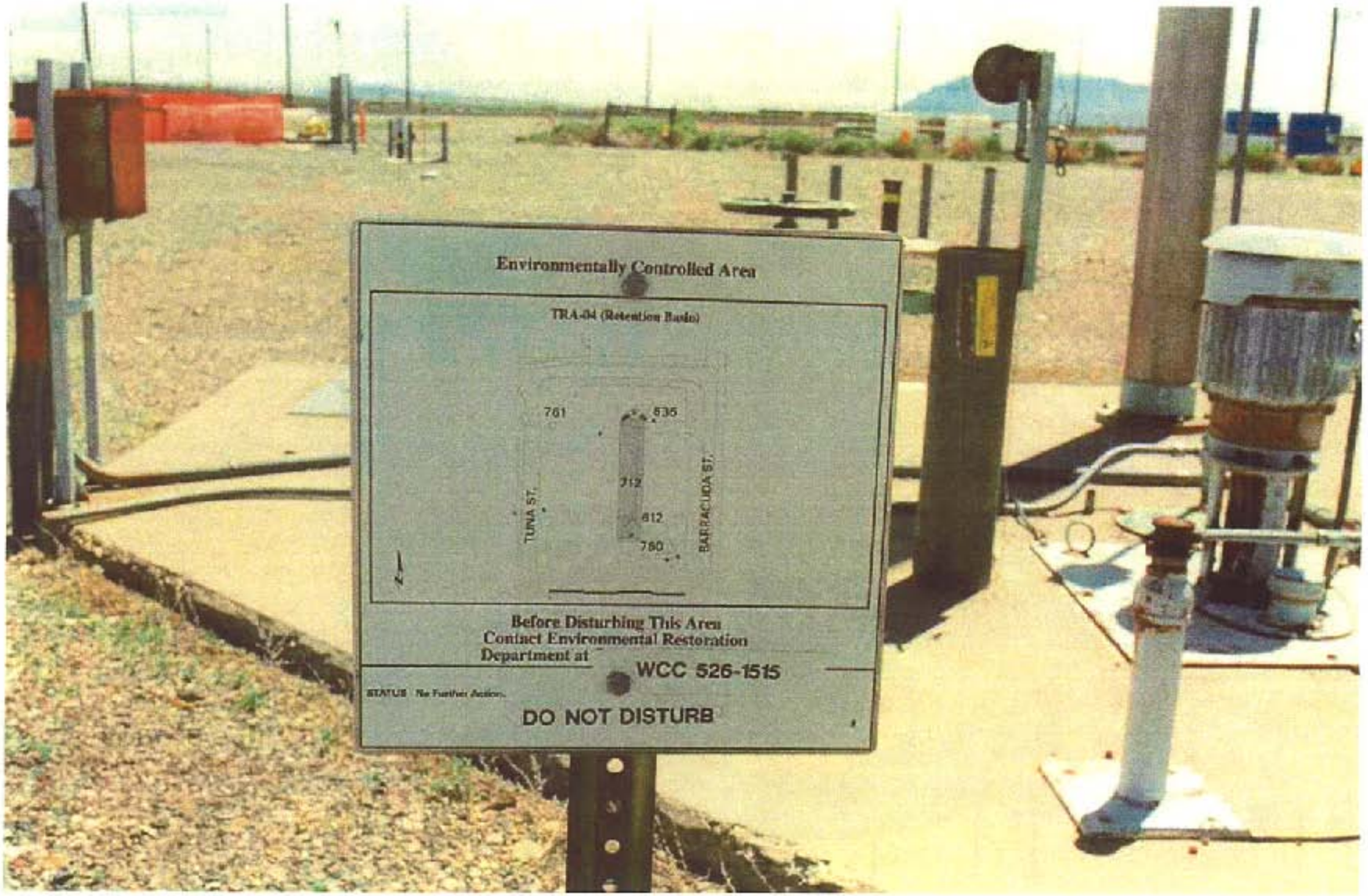

Figure D-24. Comprehensive Environmental Response, Compensation, and Liability Act sign at TRA-04, Warm Waste Retention Basin, looking south (PN02274-2-3).

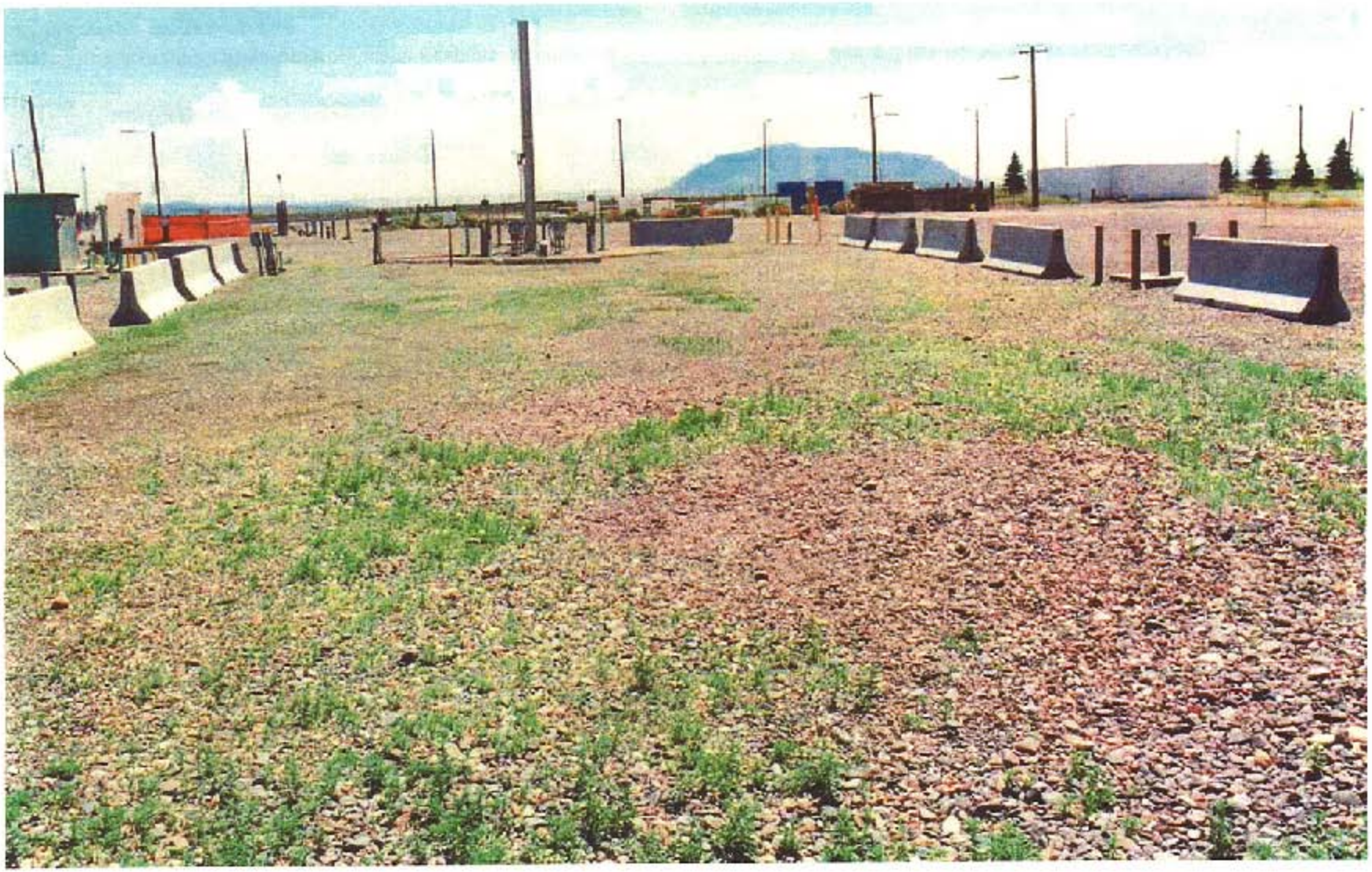

Figure D-25. Comprehensive Environmental Response, Compensation, and Liability Act sign at TRA-04, Warm Waste Retention Basin, looking south (PN02274-2-2).

Figure D-26. Comprehensive Environmental Response, Compensation, and Liability Act sign at TRA-34, Test Reactor Area North Storage Area, looking southwest (PN02274-1-11).

Figure D-27. View of TRA-34, Test Reactor Area North Storage Area, looking southwest (PN02274-1-12).

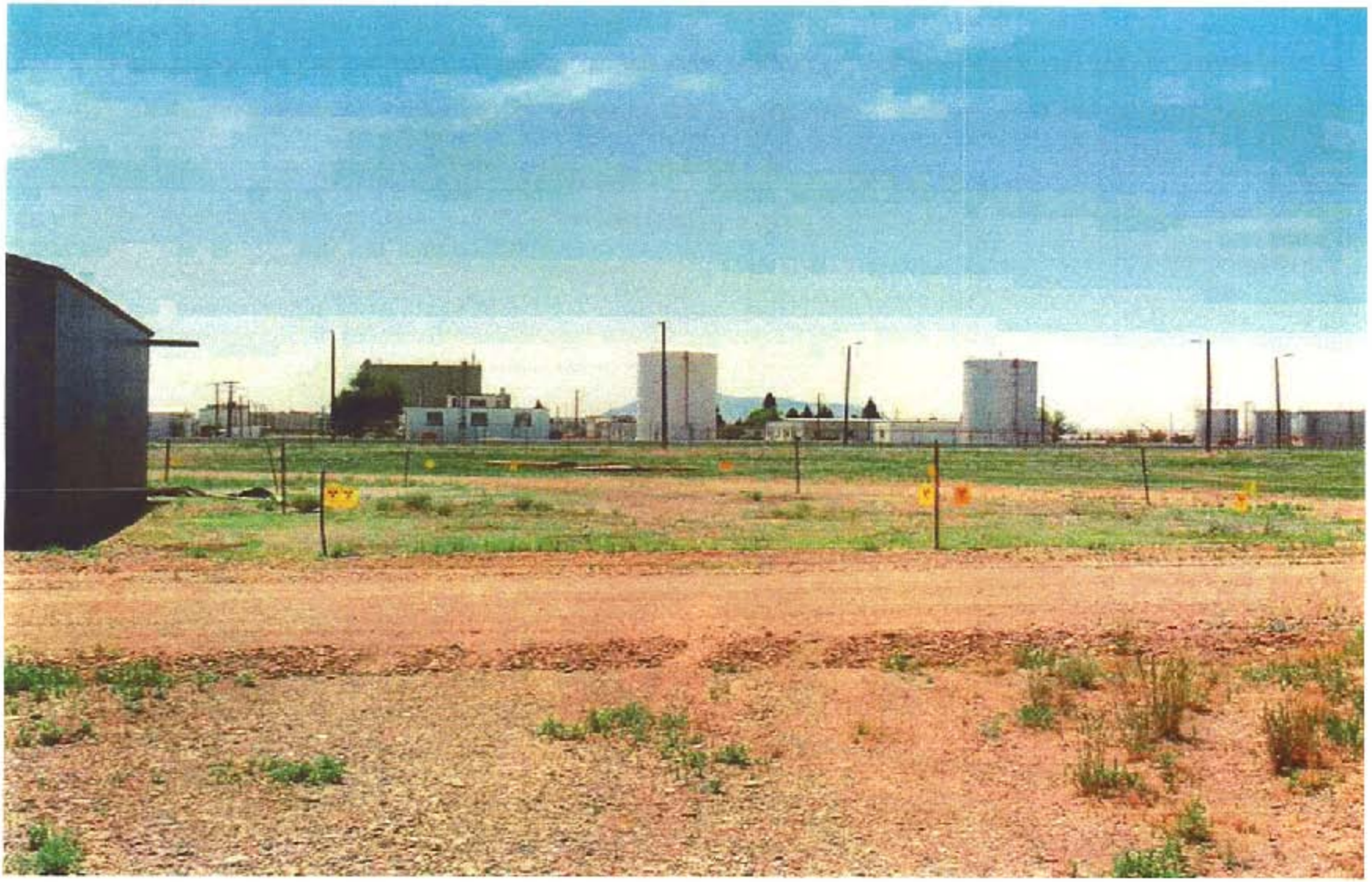

Figure D-28. View of TRA-34, Test Reactor Area North Storage Area, looking south (PN02274-1-13).

Figure D-29. The TRA-X, Hot Tree Site with Comprehensive Environmental Response, Compensation, and Liability Act sign, looking northeast (PN02274-1-22).

Appendix E

History of Contamination, Initial Response, and Basis for Action

Appendix E

History of Contamination, Initial Response, and Basis for Action

Fifty-five release sites, in total, were evaluated in the *Comprehensive Remedial Investigation/Feasibility Study for Test Reactor Area Operable Unit 2-13 at the Idaho National Engineering and Environmental Laboratory*.[a] Eight of these sites were identified as having actual or threatened releases of hazardous substances that could present a possible threat to human health and the environment. The remaining 47 sites were determined to not represent an unacceptable risk to human health and the environment; therefore, these sites required no further action. The Explanation of Significant Differences to the Record of Decision for Test Reactor Area Operable Unit 2-13 identified seven of the 47 sites, which were listed previously as no action sites, as requiring specific institutional controls to prevent a possible threat to human health and the environment.[b] The following paragraphs describe the contamination, the response taken, and the risk basis for the eight sites identified in the Comprehensive Remedial Investigation/Feasibility Study for Test Reactor Area (footnote a) and the seven sites added by the Explanation of Significant Differences (footnote b). The remaining 40 "no action" site determinations were based on the land use assumption made in the Final Record of Decision Test Reactor Area, Operable Unit 2-13.[c] These assumptions were reviewed during completion of this 5-year review.

TRA-03: Warm Waste Pond (Sediments)

The Warm Waste Pond encompasses an area of approximately 1.71 ha (3.74 acres) and is located 27 m (90 ft) east of the Test Reactor Area (TRA) facility along the security fence. The Warm Waste Pond was comprised of three cells: (1) Cell 1952, (2) Cell 1957, and (3) Cell 1964 (named for the year in which each was constructed). All three cells received low-level radionuclides and Resource Conservation and Recovery Act (RCRA) listed hazardous, contaminated wastewater discharged from TRA reactor operations until 1993, when a lined evaporation pond replaced the Warm Waste Pond. In addition, radiologically contaminated material from the 1993 Operable Unit (OU) 2-10 interim action was placed into Cell 1952, and radiologically contaminated soil from the 1995 OU 10-06 removal action was placed in the 1957 cell. This contaminated soil from the OU 10-06 removal action originated from the North Storage Area, Boiling Water Reactor Experiment, Test Area North, and Argonne National Laboratory-West. Cells 1952 and 1957 also contain contaminated soil and asphalt from 1992 stockpiles and the contaminated structure formerly located east of Cells 1952 and 1957.

In the 1993 Warm Waste Pond interim action, sediments that exceeded 690 pCi/g for Cs-137 were removed from Cell 1964 and were placed into Cell 1952 along with material generated during the 1992 Warm Waste Pond removal action of the windblown soil contamination area. Cells 1952 and 1957 were covered with clean fill. Cell 1964 was covered with 10 ft of clean fill. Cell 1957 was not capped because it was to be used for

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a. DOE-ID, 1997a, *Comprehensive Remedial Investigation/Feasibility Study for the Test Reactor Area Operable Unit 2-13 at the Idaho National Engineering and Environmental Laboratory*, DOE/ID-10531, Revision 0, U.S. Department of Energy Idaho Operations Office, February 1997.

b. DOE-ID, 2000a, *Explanation of Significant Differences to the Record of Decision for Test Reactor Area Operable Unit 2-13,* DOE/ID-10744, Revision 0, U.S. Department of Energy Idaho Operations Office, U.S. Environmental Protection Agency, and Idaho Department of Health and Welfare, Division of Environmental Quality, May 2000.

c. DOE-ID, 1997b, *Final Record of Decision, Test Reactor Area, Operable Unit 2-13,* DOE/ID-10586, Revision 0, U.S. Department of Energy Idaho Operations Office, December 1997.

disposal of other Idaho National Engineering and Environmental Laboratory (INEEL) radiologically contaminated soil. Data indicate that radionuclides were strongly adsorbed onto the surficial sediments and that soil contamination generally did not extend below a depth of 0.6 m (2 ft) below the bottom of the cells, for all cells.

Before the OU 2-13 remedial action, calculated excess cancer risks were greater than or equal to 10 ˚ for occupational exposure to external radiation from Co-60, Cs-137, Eu-152, and Eu-154 in the soil. Calculated excess cancer risks are greater than or equal to 10 ˚ for 100-year residential exposure to Cs-137.

TRA-06: Chemical Waste Pond

In 1962, the Chemical Waste Pond began operating as an unlined infiltration pond designed to receive chemical waste from a demineralization plant at TRA. The Chemical Waste Pond is located east of TRA, outside of the boundary fence. It received effluent at an average discharge of 15 gal/min; the effluent contained mineral salts, primarily calcium and magnesium carbonate. In addition, solid and liquid waste, including corrosives, was disposed of directly into the pond until 1982. It is estimated that an additional equivalent of three or four 55-gal drums were dumped into the Chemical Waste Pond. Records show that acid from the Central Facilities Area vehicle storage facility was drained directly into the Chemical Waste Pond in August 1992. Several releases of acid to the pond occurred in the late 1980s. These also were corrosive (D002), hazardous waste. It is not known if the releases in the late 1980s contained any other RCRA-characteristic hazardous waste (metals). The Chemical Waste Pond retained its land disposal unit status under the *Federal Facility Agreement and Consent Order for the Idaho National Engineering Laboratory*, because it had been used as a RCRA site.[d]

In 1990, sediments collected from the pond were analyzed for the metals known to be constituents of the effluent from the demineralization process. The analytes included silver, arsenic, barium, cadmium, chromium, copper, mercury, nickel, lead, selenium, and zinc. Only barium (3,830 mg/kg) and mercury (133 mg/kg) are present in the Chemical Waste Pond's sediments above background levels of 333.0 mg/kg and 0.02 mg/kg, respectively.

Release of RCRA-characteristic hazardous waste occurred in May and June 1995, when approximately 287,100 gal of liquid (used to neutralize and flush out-of-service acid and caustic tanks) was disposed of into the pond. After disposal, it was determined that the liquids contained 0.3 mg/L of mercury, which exceeds the 40 Code of Federal Regulations (CFR) 261.24 regulatory level of 0.2 mg/L.[e] Sample data collected during spring 1998 determined that the Chemical Waste Pond's sediments are not RCRA-characteristic hazardous waste. Before the remedial action, the hazard index for residential use was greater than or equal to 1 for mercury.

TRA-08: Cold Waste Pond

The Cold Waste Pond (CWP) is located approximately 450 ft southeast of the TRA security fence's southeast corner. The pond has been a disposal site for nonradionuclide wastewater since its construction in 1982. The CWP consists of two cells (southern and northern) that were used for cold wastewater disposal from

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d. DOE-ID, 1991, *Federal Facility Agreement and Consent Order for the Idaho National Engineering Laboratory*, Administrative Record No. 1088-06-29-120, U.S. Department of Energy Idaho Operations Office; U.S. Environmental Protection Agency, Region 10; Idaho Department of Health and Welfare, December 4, 1991.

e. 40 CFR 261.24, 2003, "Toxicity Characteristic," *Code of Federal Regulations*, Office of the Federal Register, February 2003.

cooling tower blow-down, air conditioning units, secondary system drains, floor drains, and other nonradioactive drains throughout TRA. Historically, only one of the two cells was used at a time, and flow of wastewater was alternated from one cell to the other on an annual basis. Radionuclides have been detected at concentrations slightly above INEEL background levels in several samples collected from the CWP. These low levels of radionuclides found in the CWP's berms are thought to result from windblown soil contamination rather than effluents discharged to the CWP.

Before the remedial action, the calculated occupational excess-cancer risk was greater than or equal to 10^{-04} for Cs-137, and the calculated 1,000-year residential excess cancer risk was greater than 10^{-04} for arsenic. The combined 1,000-year residential hazard index for arsenic, barium, mercury, and cadmium was equal to 1.0.

TRA-13: Sewage Leach Pond

The Sewage Leach Pond is located east of the TRA boundary fence. It consists of two cells: (1) Cell 1950 and (2) Ce111965. Both cells received discharge from sanitary sewer drains. Process knowledge indicates that effluent was limited to domestic sewage (footnote a). However, low-level radionuclides were detected in the bottom of Cell 1950 and in a sludge pit located south of the Sewage Treatment Plant. The contamination source has been attributed to windblown soil contamination originating from the Warm Waste Pond. The Sewage Leach Pond was removed from service in 1995. Analytical data from the Sewage Leach Pond indicate that RCRA-characteristic hazardous waste was not present.

TRA-15: Soil Surrounding Hot Waste Tanks at TRA-613

The TRA-15 site is the location of underground Tanks 1 and 2 that leaked radiologically contaminated and possibly hazardous waste to surrounding soil. Four underground tanks are located at this site. Leaks from Tank 1 were determined to be the source of subsurface contamination identified in the 1993 – 1994 timeframe. The TRA-15 site also serves as a corollary for release sites associated with the Hot Waste System. Calculated excess occupational and 100-year residential cancer risks are greater than or equal to 10 for Cs-137.

TRA-19: Soil Surrounding Radiological Tanks 1 and 2 at TRA-630

The TRA-19 Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) site – the soil surrounding Tanks 1 and 2 at TRA-630 (near location 15 in Figure 3) – consists of subsurface soil contamination suspected to be caused by either leaks from a radionuclide-contaminated drain line originating at the Gamma Facility Building (TRA-641) or by releases from four underground catch tanks associated with the Materials Test Reactor. The four tanks from the Materials Test Reactor were contained on a bermed concrete pad. The tanks were removed and replaced with new ones in 1985 and 1986 and a concrete vault constructed using the existing concrete pad. The original tanks were found to be intact upon removal and, though the outside surface appeared to be degrading, the fiberglass liners had not been breached. Therefore, no releases from the tanks were suspected. However, several spills inside the new vault had been reported from pipe-cutting operations during tank removal, from reconnecting pipelines to the new tanks, and from a damaged waste drain line running from the TRA-641 building, possibly accounting for the contamination. Calculated excess occupational and 100-year residential cancer risks are greater than 10^{-04} for Cs-137.

Sewage Leach Pond Berm and Soil Contamination Area

The Sewage Leach Pond berm and soil contamination area is a fence-enclosed radiation control area surrounding the Sewage Leach Pond, approximately 475 x 480 ft. The source of the surface soil contamination

has been attributed to windblown soil contamination originating from the Warm Waste Pond. Analytical data from the Sewage Leach Pond berm and soil contamination area indicate that no RCRA-characteristic hazardous waste was present.

During the 1993 interim action at the Warm Waste Pond, Cs-137 hot spots were excavated from the Sewage Leach Pond berm. The excavated, contaminated soil was placed in Warm Waste Pond Cell 1952.

Before remedial action of the Sewage Leach Pond berm, calculated excess occupational cancer risks were greater than 10^{-04} for Cs-137 and Co-60 (less than 30 years for Co-60). The calculated excess 100-year residential cancer risks were greater than 10^{-04} for Ag-108m and Cs-137. The calculated hazard indices were greater than 1 for Zn and Hg.

The soil contamination area surrounding the Sewage Leach Pond has a calculated excess occupational risk greater than 10^{-04} for less than 30 years. The excess 100-year residential cancer risk is acceptable at less than 10^{-04}.

Brass Cap Area

The Brass Cap Area is located in the center of TRA, near the TRA-630 building, and southeast of Site TRA-19 between TRA-635 and TRA 632. A brass marker was placed in the concrete to designate the area of subsurface contamination. The radionuclide contamination in the soil at this site is attributed to leaking warm-waste lines. The contamination under the concrete was determined to extend to approximately 10 ft below ground surface. After the contamination was discovered, the leaking waste line was repaired and contaminated soil in the immediate proximity of the repaired waste line was removed. The excavation was backfilled with clean soil and resurfaced with concrete.

Calculated excess occupational and 100-year residential cancer risks are greater than 1E-04 for Cs-137. Calculated excess occupational cancer risks also are greater than 1E-04 for Co-60 for less than 30 years.

Polychlorinated Biphenyl Spill at TRA-619

This site is located in TRA's northeastern portion, on the east side of the TRA-619 building. A transformer that used polychlorinated biphenyl-containing oil operated from about 1960 until it was replaced in 1983. The old transformer leaked oil onto the concrete pad and surrounding soil. Soil samples collected in 1989 indicated that polychlorinated biphenyls (PCBs) were present in the soil around the concrete pad at concentrations up to 360.5 parts per million (ppm). In November 1990, approximately 12 yd^3 of soil was removed from around the transformer pad. The excavated area extended 1 ft beyond the pad on all sides and approximately 3 ft below ground surface. The confirmation soil samples collected subsequent to the excavation indicated that the highest PCB concentration was 22 ppm in the soil surrounding the concrete pad, which is less than the 25-ppm action level for industrial areas, but greater than the 10 ppm allowed for unrestricted use.[f] The excavation area was backfilled with a minimum of 0.6 m (2 ft) of clean soil.

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f. 40 CFR 761.125, 2003, "Requirements for PCB Spill Cleanup," *Code of Federal Regulations*, Office of the Federal Register, April 2003.

Polychlorinated Biphenyl Spill at TRA-626

This site is a PCB spill located in TRA's east-central portion, near the northeast corner of the TRA-626 building. A pyranol-unit substation transformer was present here from about 1956 to 1988. Pyranol transformer oil contains equal parts of trichlorobenzene and PCBs. The transformer leaked oil onto the concrete pad and surrounding soil. Though trichlorobenzene was not analyzed, the *Preliminary Scoping Track 2 Summary Report for the Test Reactor Area Operable Unit 2-04: Fuel Spills* stated that since trichlorobenzene is a volatile organic compound, complete volatilization was expected in the INEEL's desert conditions.[g] Analysis of soil samples collected in 1989 indicated that PCBs were present in concentrations greater than the 25-ppm action level for industrial areas, but greater than the 10 ppm allowed for unrestricted use (40 CFR 761.125). In 1990, the concrete pad and some contaminated soil, totaling 28 yd^3 of material, were removed. Analysis of post-excavation soil samples indicated that nine samples had PCB concentrations greater than 25 ppm, and an additional 9 yd' of soil was removed. The second set of post-excavation soil samples indicated that the highest soil PCB concentration was 24 ppm. The excavation was backfilled with 4 ft of clean soil.

Polychlorinated Biphenyl Spill at TRA-653

This CERCLA site is a PCB spill located in TRA's south-central portion, which is on the north side of the TRA-653 building. A transformer that used oil-containing PCBs operated from about 1960 until its replacement in 1980. The transformer leaked oil onto the concrete pad and surrounding soil. Both the transformer and the concrete pad were removed in 1980, and a replacement transformer was installed on a new pad. Soil samples collected in 1989 indicated that PCBs up to 107.2 ppm were present in the soil around the replacement pad. In September 1990, approximately 8 yd^3 of soil was removed from three sides of the existing pad. No soil was excavated from the 2-ft-wide area between the building and the pad, where PCBs had been detected at only 2 ppm. The second set of post-excavation soil samples indicated that the highest PCB concentration was 16 ppm, which is greater than the 10 ppm allowed for general unrestricted use (40 CFR 761.125[4]). The excavation was backfilled with approximately 2 ft of clean soil.

TRA-04: Warm Waste Retention Basin

The Warm Waste Retention Basin is located in TRA's southeastern portion, which is south of the TRA-636 building and is a large, rectangular underground concrete structure divided into two cells. It is buried 10 ft below ground surface and holds 720,000 gal of liquid. The basin retains wastewater in route to the Warm Waste Pond, in order to delay passage and allow time for short-lived radionuclides to decay. Waste was transferred to the Warm Waste Pond by several different pipelines and, at one time, through the sump pump pit. The basin was leaking from sometime in the 1970s to 1993, including pipeline leaks and leaks from the basin at an estimated rate of 86,000 gal/day, allowing contamination to enter the perched water zone. Waste streams discharged to the Warm Waste Retention Basin had concentrations of metals and radionuclides that could result in unacceptable levels of contamination in sediments contacting these liquids. It was removed from service in August 1993, with the exception of the north end, which is the collection point for wastewater discharged to the new evaporation pond (TRA-715). Flow paths from the inlet sump to the Warm Waste Retention Basin were isolated to prevent further leakage; this was accomplished by grouting the weirs closed, which effectively isolated the two sections of the basin.

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g. Sherwood, J., R. Filemyr, D. Meadows, and J. Tucker, 1994, *Preliminary Scoping Track 2 Summary Report for the Test Reactor Area Operable Unit 2-04*: Fuel Spill, EGG-ER-11110, Revision 2, Idaho National Engineering and Environmental Laboratory, March 1994.

The current excess cancer residential cancer risk is greater than 10^{-04} for 10 ft and less for 30 years due to potential exposure to Co-60 and Cs-137. Risk evaluation was not done for contamination at 40 ft deep, where contamination is suspected.

TRA-34: North Storage Area

The TRA-34 is located immediately north of the TRA facility's security fence and encompasses an area of approximately 2.25 acres. This area was used to temporarily store equipment and materials (such as reactor parts, pumps, and casks). It is divided into two sections: (1) the Hot Storage Area and (2) the Cold Storage Area. The Hot Storage Area was used to store material with low-level radionuclide contamination, and the Cold Storage Area was used to store nonradiologically contaminated equipment and material, which often contained lead bricks, cadmium sheets, chunks of concrete, and wood scraps.

A gamma radiation survey, which was conducted in 1992, indicated that the soil in both the Hot Storage Area and Cold Storage Area was contaminated with radionuclides (Ag-108m, Cs-137, and Eu-152). The source of contaminated soil in the Hot Storage Area and the Cold Storage Area is suspected to result from the storage of lead bricks, lead shot, and cadmium fuel grids. Though the surface of the North Storage Area is covered with soil, vegetation is sparse and the potential exists that contamination could be transported outside the boundary of the North Storage Area by high winds. Some soil was removed in the summers of 1995 and 1996, which reduced the risk at this site. The calculated excess current residential cancer risk is greater than 10^{-04} for silver-108m, Cs-137, and Eu-152.

Hot Tree Site

The TRA-43 CERCLA site, Hot Tree Site, is located in the center of TRA, west of the TRA-649 building. Screening of the spruce tree's branches indicated that it had been contaminated with gamma-emitting radionuclides. The tree was removed, boxed, and disposed of in May 1994. After removal of the tree, soil borings were collected for field screening approximately 2 ft below ground surface in the area of the tree. In addition, the root system was surveyed. Three additional surface soil samples were collected and submitted to the Radiation Measurements Laboratory for analysis. The results of sampling were evaluated in the OU 2-13 baseline risk assessment. The risk assessment showed that an unacceptable risk does not exist at this site because of low contaminant concentrations in the soil. The calculated current residential excess cancer risk is greater than 1E-04 for 30 years due to potential exposure to Cs-137. The highest radiologically contaminated area was west of the tree, indicating that an abandoned warm waste line was the source of contamination. The warm waste line is a carbon-steel line that originated from the Gamma Facilities Building (TRA-641), approximately 3 m (10 ft) west and 1.8 m (6 ft) bgs from the tree site. Waste transferred through the line consisted of low-pressure, demineralized acidic water. The waste's acidic condition could have contributed to the deterioration of the line. The line was cut and capped in 1983, and it is no longer expected to be a potential source of contamination. Since it is believed that the line was drained and there was no leak test performed, this line was submitted for evaluation and acceptance under the Federal Facility Agreement and Consent Order for the Idaho National Engineering Laboratory as new CERCLA Site ID# TRA-61 on March 9, 2000. It was recommended that this site did not meet the criteria for acceptance as a new site. The responsible project managers concurred with this recommendation between March 21 and April 2, 2001.

Perched Water and Snake River Plain Aquifer

This CERCLA site is comprised of the perched water and the SRPA that underlies the TRA facility and surrounding areas. The perched water zones and SRPA underlying TRA are contaminated due to infiltration and injection of wastewater from the network of multipurpose ponds, retention basins, leaking pipes, and injection wells (USGS-53 and TRA-Disposal).

The perched water bodies are present because about 200 million gal/year of water has been sent to the TRA disposal ponds over the past several decades. A major contributor to contamination in the perched water bodies resulted from discharges to the Warm Waste Pond. The Chemical Waste Pond also contributed to the perched water system until it was removed from service in 1998. Persistence of the perched water is due, in large part, to the Cold Waste Pond currently receiving an average of about 380 gpm annually of uncontaminated wastewater.

Well USGS-53 was completed to 90 ft below ground surface in 1960 and was used for wastewater disposal intermittently between November 1960 and September 1964. Water believed to contain chromates was injected at a reported rate of 100 gpm. Calculations of the injection rate over the operational periods indicate that 220 million gal of wastewater might have been disposed of.[h] Currently, the well is used as a monitoring well, which has been predominantly dry since April 1995.

The TRA-Disposal well is located at the TRA facility's southeast corner, approximately 100 ft north of the Warm Waste Retention Basin. The TRA-D was completed to a depth of 1,271 ft below ground surface in 1963 and screened with 0.25-in. slots from 1,267 to 1,182 ft below ground surface. In November 1964, it entered service. Injection testing in early May 1964 revealed that the well provided insufficient capacity under gravity flow conditions. Additional perforations in the well casing were made in July and August 1964. The perforations were made between 1,070 and 930 ft below ground surface. During the installation of the perforations, the well casing was severed at 1,005 ft below ground surface. Injection tests conducted in August 1964 revealed that the well's capacity was still insufficient. Then, in August 1964, perforations were added from 697 to 512 ft below ground surface. The addition of the second set of additional perforations provided for an overall flow rate of over 1,000 gpm, making the well suitable for daily operations. Disposal began at TRA-D in November 1964. Injection testing indicated that 95% of the injected water discharged into the 590- to 512-ft-below ground surface interval. The TRA-D was removed from service in 1982. The well is now used to monitor the Snake River Plain Aquifer's water level and water quality. Approximately 3,889 million gal of wastewater was disposed of in TRA-D, containing an estimated 14,121 kg of Cr (VI).[i]

An investigation of the perched water zones began in 1990, and the *Record of Decision, Test Reactor Area Perched Water System, Operable Unit 2-12, Idaho National Engineering and Environmental Laboratory, Idaho Falls, Idaho* was issued in December 1992.[j] Based on groundwater modeling and the risk assessment, a determination was made in the OU 2-12 Record of Decision that no remedial actions were necessary to ensure protection of human health and safety and the environment. Groundwater monitoring was mandated to verify that contaminant trends followed the modeled predictions.

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h. Doornbos, Martin H., Julie L. Mattick, Deborah L. McElroy, Leah V. Street, Carolyn S. Blackmore, and Craig A. Dicke, 1991, *Environmental Characterization Report for the Test Reactor Area*, EGG-WM-9690, Revision 0, Idaho National Engineering and Environmental Laboratory, September 1991.

i. Hull, L. C., 1989, *Conceptual Model and Description of the Affected Environment for the TRA Warm Waste Pond (Waste Management Unit TRA-03)*, EGG-ER-8644, Revision 0, Idaho National Engineering and Environmental Laboratory, October 1989.

j. DOE-ID, 1992, *Record of Decision, Test Reactor Area Perched Water System, Operable Unit 2-12, Idaho National Engineering and Environmental Laboratory, Idaho Falls, Idaho,* Doc. Id. 5230, Revision 0, U.S. Department of Energy Idaho Operations Office, December 1992.

Appendix F

Groundwater Elevation Data

Appendix F

Groundwater Elevation Data

Please refer to the CD for the groundwater elevation data.

Appendix G

Hydrographs and Graphics

Appendix G

Hydrographs and Graphics

Please refer to the CD for the hydrographs and graphics.

Appendix H

Environmental Visualization System

Appendix H

Environmental Visualization System

Please refer to the CD for information on the Environmental Visualization System.

Appendix I

Five-Year Review Well List

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Five-Year Review Well List

Shallow Perched Wells

CWP-01	**CWP-02**	**CWP-03**	**CWP-04**
CWP-05	**CWP-06**	**CWP-07**	**CWP-08**
CWP-09	**TRA-A13**	**TRA-A77**	

Deep Perched Wells

PW-07	**PW-08**	**PW-09**	**PW-10**
PW-11	**PW-12**	**PW-13**	**PW-14**
USGS-053	**USGS-054**	**USGS-055**	**USGS-056**
USGS-060	**USGS-061**	**USGS-062**	**USGS-063**
USGS-64*	**USGS-066**	**USGS-068**	**USGS-069**
USGS-070	**USGS-071**	**USGS-072**	**USGS-073**
USGS-074	**USGS-075***	**USGS-078**	

* Indicates water elevation data only.

Aquifer Wells

MTR-TEST	**SITE-19**	**TRA-DISP**	**TRA-01**
TRA-02	**TRA-03**	**TRA-04**	**TRA-06A**
TRA-07	**TRA-08**	**USGS-058**	**USGS-065**
USGS-076	**USGS-079**	**USGS-084**	