DOE/ID-10139
Amendment
Revision 0

Record of Decision Amendment for the Technical Support Facility Injection Well (TSF-05) and Surrounding Groundwater Contamination (TSF-23) and Miscellaneous No Action Sites, Final Remedial Action

August 2001

Operable Unit 1-07B
Waste Area Group 1
Idaho National Engineering and Environmental Laboratory
Idaho Falls, Idaho

PART I - DECLARATION

SITE NAME AND LOCATION

Technical Support Facility Injection Well (TSF-05) and
Surrounding Groundwater Contamination (TSF-23),
Operable Unit 1-07B
Idaho National Engineering and Environmental
Laboratory (CERCLIS ID 4890008952)
Idaho Falls, Idaho

Test Area North (TAN) is one of nine major facilities at the Idaho National Engineering and Environmental Laboratory (INEEL), a U.S. Department of Energy (DOE) facility located in southeastern Idaho, 51.5 km (32 mi) west of Idaho Falls. The INEEL encompasses approximately 2,305 km^2 (890 mi^2) of the northeastern portion of the Eastern Snake River Plain and extends across portions of five counties: Butte, Jefferson, Bonneville, Clark, and Bingham. The TAN complex, near the northern end of the INEEL, extends over an approximately 30-km^2 (12-mi^2) area. The Technical Support Facility (TSF), which is centrally located within TAN, covers an approximately 460 by 670 m (1,500 by 2,200 ft) area and is surrounded by a security fence. The TSF-05 Injection Well is located in the southwest corner of TSF.

STATEMENT OF BASIS AND PURPOSE

This Record of Decision (ROD) Amendment presents a modification to the original remedy for Operable Unit (OU) 1-07B, at the INEEL TAN. The modification was chosen in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), as amended by the Superfund Amendments and Reauthorization Act of 1986 (SARA), and, to the extent practicable, the National Oil and Hazardous Substances Pollution Contingency Plan (NCP). The documents that form the basis for the decisions made in this ROD Amendment are contained in the Administrative Record for OU˚1-07B. This decision satisfies the requirements of the Federal Facility Agreement and Consent Order (FFA/CO) entered into among the DOE, the U.S. Environmental Protection Agency (EPA), and the State of Idaho.

The primary risk driver for OU 1-07B has been determined to be the ingestion of groundwater contaminated with the volatile organic compound (VOC) trichloroethene (TCE). The other VOC contaminants of concern (COCs) — tetrachloroethene (PCE) and cis-1,2- and trans-1,2-dichloroethenes (DCE) — are less widespread in the contaminant plume than TCE. Also present are four radionuclides —Cs-137, Sr-90, tritium, and U-234 — that have been included as COCs because they exceed EPA risk-based concentrations for groundwater ingestion. TCE and PCE are the only two COCs consistently detected in the production wells at levels exceeding federal drinking water standards (maximum contaminant limits [MCLs]).

The original selected remedial action for OU 1-07B documented in the *Record of Decision for Technical Support Facility Injection Well (TSF-05) and Surrounding Groundwater Contamination (TSF-23) and Miscellaneous No Action Sites Final Remedial Action* (DOE-ID 1995 [DOE/ID-10139]) (the 1995 ROD) was identified as Alternative 4: 25 Micrograms per Liter Trichloroethene Groundwater

Contamination Plume Extraction; Hot Spot Containment and/or Removal with Aboveground Treatment. However, the 1995 ROD provided a way to amend the selected remedy by calling for treatability studies:

> If a technology is found to be more effective than [the selected remedy], the Agencies shall, after appropriate public opportunity to review the basis for changing the selected technology, modify this ROD as appropriate and begin design implementation on the alternate remedy.

Treatability studies conducted between 1995 and 1999 showed that use of monitored natural attenuation (MNA) and an innovative technology, in situ bioremediation (ISB), in combination with the originally selected pump-and-treat technology, could clean up the contaminant plume in less time and at a lower cost than the remedy originally selected in the 1995 ROD. Therefore, in accordance with Section˚117(c) of CERCLA and Section˚300.435(c)(2)(ii) of the NCP, and pursuant to the 1995 ROD, this ROD Amendment has been prepared to document the changes.

The amended remedy identified in this ROD Amendment is intended to be the final action for remediation of contamination at OU 1-07B. All public participation and documentation procedures specified in NCP Sections˚300.435(c)(2)(ii) and 300.825(a)(2) were conducted as required, including issuing a proposed plan (the *Proposed Plan for Operable Unit 1-07B, Final Remedial Action at the TSF Injection Well (TSF-05) and Surrounding Groundwater Contamination (TSF-23)* [DOE-ID, EPA, and IDEQ 2000]) that highlighted the proposed changes.

The DOE Idaho Operations Office (DOE-ID) is the lead agency for the remedy decisions under Executive Order 12580. EPA approves the decisions and, along with the Idaho Department of Environmental Quality (IDEQ), has participated in the selection of the remedy. The IDEQ concurs with the amended remedy for the OU˚1-07B final remedial action. The DOE, EPA, and IDEQ are collectively referred to as the Agencies in this document. Within the INEEL s environmental restoration program, this action is OU 1-07B. OU 1-07B is one of several CERCLA sites within Waste Area Group (WAG)˚1. Institutional controls, which are applied to sites where residual contamination precludes unrestricted land use, are being implemented for all sites within WAG 1 in accordance with Section˚12.1 of the *Final Record of Decision for Test Area North, Operable Unit 1-10* (DOE-ID 1999a [DOE/ID-10682]) (OU˚1-10 ROD).

ASSESSMENT OF THE SITE

The response action selected in this ROD Amendment is necessary to protect public health or welfare or the environment from actual or threatened releases of pollutants or contaminants from this site that may present an imminent and substantial endangerment to public health or welfare.

DESCRIPTION OF THE AMENDED REMEDY

The OU 1-07B amended remedy will prevent current and future exposure of workers, the public, and the environment to contaminated groundwater at the TSF injection well site. This remedial action will permanently reduce the toxicity, mobility, and volume of the contamination at the site. It will meet the final remedial action objectives (RAOs) to ensure the contaminant plume meets drinking water standards by or before 2095. This will be the final action for this site. None of the source materials constitutes a principal threat as defined by the EPA.

The amended remedy modifies the actions that will be taken in two of the three zones of the contaminant plume:

- At the hot spot, ISB will be used in place of the pump-and-treat remedy selected in the 1995 ROD. In ISB, amendments such as sodium lactate are added to the aquifer to enhance biological activity. ISB results in complete dechlorination of VOCs in situ. The ISB treatment system will be able to continuously distribute the amendments. The ISB treatment was selected to replace the Groundwater Treatment Facility (GWTF) remedy implemented under the 1995 ROD. GWTF operations will end when the amended remedy is implemented.

- In the distal zone, MNA will be used in place of the pump-and-treat remedy selected in the 1995 ROD. Natural attenuation acts without human intervention to reduce the toxicity, mobility, and volume of contaminants in the groundwater. Contaminant levels will be monitored to ensure an appropriate decay rate is being achieved. If, during periodic reviews conducted at least every 5 years, MNA is determined to be inadequate for restoration of the distal zone by 2095, then a contingency remedy for the distal zone will be implemented. The contingency remedy also will be invoked if the required monitoring necessary for MNA is not performed. The contingency remedy for the distal zone is the default remedy selected in the 1995 ROD: groundwater extraction, aboveground treatment of VOCs, and reinjection of the treated water or, if the Agencies concur, implementation of a more cost-effective remedy identified at the time the contingency remedy is implemented.

The components of the original remedy selected in the 1995 ROD, and refined in a 1997 Explanation of Significant Differences (ESD) (INEEL 1997 [INEEL/EXT-97-00931]), that will continue to be implemented are as follows:

- In the medial zone, a pump-and-treat system will be used. Construction of the New Pump and Treat Facility (NPTF) in the medial zone was completed in January 2001. The facility is scheduled to start routine operations in Fall 2001 and is planned to operate until VOCs in the medial zone meet RAOs. Extraction wells will capture contaminated groundwater for onsite treatment by air stripping, followed by reinjection of the treated water into the aquifer.

- Throughout the contaminant plume, institutional controls, including restrictions on the installation of new drinking water wells, will remain in effect until the groundwater meets RAOs and unrestricted land-use is allowable. The institutional controls are being implemented in accordance with the OU˚1-10 ROD for protection of human health.

Throughout the plume, final RAOs will be met by or before 2095, ensuring the contaminant plume meets drinking water standards.

This ROD Amendment also describes the contingency remedy for the medial zone in the event that radionuclide COCs migrate downgradient to medial zone extraction wells during the remedial action:

- In the event that the radionuclide COCs (Cs-137, Sr-90, tritium, and U-234) in the medial zone portion of the plume exceed established limits, that portion of the plume would be intercepted upgradient of the NPTF. After treatment to remove VOCs (as was done during the ISB treatability studies conducted to support this ROD Amendment), the treated water would be reinjected upgradient from the extraction well to facilitate sorption of radionuclides onto subsurface soil and rock.

STATUTORY DETERMINATION

The amended remedy is protective of human health and the environment, complies with federal and state requirements that are applicable or relevant and appropriate to the remedial actions, is cost effective, and utilizes permanent solutions and alternative treatment (or resource recovery) technologies to the maximum extent practicable.

This amended remedy also satisfies the statutory preference for treatment as a principal element of the amended remedy (i.e., reduces the toxicity, mobility, or volume of hazardous substances, pollutants, or contaminants as a principal element through treatment).

Because this amended remedy will result in COCs remaining on-site during the remedial action above levels that allow for unlimited use and unrestricted exposure, a statutory review will be conducted within 5 years after initiation of remedial action, and at least every 5 years thereafter through the standard CERCLA 5-year review process. The reviews will be conducted to ensure that the amended remedy is, or will be, protective of human health and the environment. This provision does not preclude more frequent reviews by one or more of the Agencies.

ROD DATA CERTIFICATION CHECKLIST

The following information is included in the Decision Summary section (Part II) of this ROD Amendment. Additional information can be found in the Administrative Record for this OU.

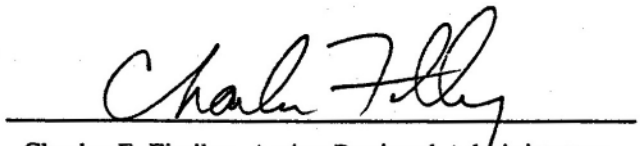
- COCs and their respective concentrations (Part II, Table˚2-1)
- Estimated costs (in net present value [NPV] using a 7% discount rate) (Part II, Section˚8)
- Key factor(s) that led to selecting the amended remedy (i.e., how the amended remedy provides the best balance of tradeoffs with respect to the balancing and modifying criteria, highlighting criteria key to the decision (Part II, Section˚7).

The following information is not included in this ROD Amendment because it is unchanged from the original 1995 ROD for this OU:

- Baseline risk represented by the COCs
- Cleanup levels established for the COCs and the basis for these levels
- How source materials constituting principal threats are addressed
- Current and reasonably anticipated future land use assumptions and current and potential future beneficial uses of groundwater used in the baseline risk assessment and 1995 ROD.

SIGNATURE SHEET

Signature sheet for the Record of Decision Amendment for OU 1-07B, located in Waste Area Group˚1, Test Area North, of the Idaho National Engineering and Environmental Laboratory, between the U.S. Environmental Protection Agency Region 10 and the U.S. Department of Energy Idaho Operations Office, with concurrence by the Idaho Department of Environmental Quality.



09/19/01

Charles E. Findley, Acting Regional Administrator
Region 10
U.S. Environmental Protection Agency

Date

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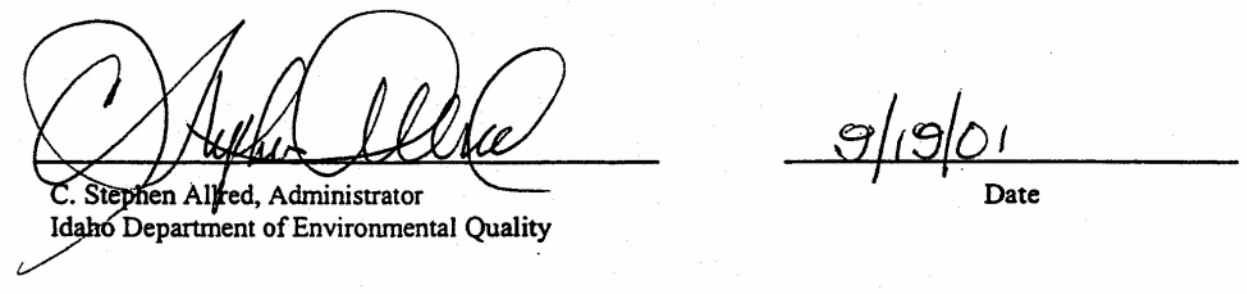

C. Stephen Allred, Administrator
Idaho Department of Environmental Quality

9/19/01
Date

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Beverly A Cook — 9/20/01

Beverly A. Cook, Manager
U.S. Department of Energy,
Idaho Operations Office

Date

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ACRONYMS

AOC	area of contamination
APC	air pollution control
ARAR	applicable or relevant and appropriate requirement
ASTU	Air Stripper Treatment Unit
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
COC	contaminant of concern
D&D	decontamination and decommissioning
DCE	cis- and trans-1,2-dichloroethene
DOE	U.S. Department of Energy
DOE-ID	U.S. Department of Energy, Idaho Operations Office
EPA	U.S. Environmental Protection Agency
ESD	Explanation of Significant Differences
FDR	Field Demonstration Report
FFA/CO	Federal Facility Agreement and Consent Order
FS	feasibility study
FY	fiscal year
GWTF	Groundwater Treatment Facility
IDAPA	Idaho Administrative Procedures Act
IDEQ	Idaho Department of Environmental Quality
INEEL	Idaho National Engineering and Environmental Laboratory
ISB	in situ bioremediation
ISCO	in situ chemical oxidation
MCL	maximum contaminant level
MERD	metal enhanced reductive dehalogenation

MNA	monitored natural attenuation
O&M	operations and maintenance
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NESHAPS	National Emission Standards for Hazardous Air Pollutants
NPTF	New Pump and Treat Facility
NPV	net present value
OSWER	(EPA) Office of Solid Waste Environmental Remediation
OU	operable unit
PCE	tetrachloroethene
RAO	remedial action objective
RCRA	Resource Conservation and Recovery Act
RD/RA	remedial design/remedial action
RI	remedial investigation
RI/FS	remedial investigation/feasibility study
ROD	Record of Decision
SARA	Superfund Amendments and Reauthorization Act of 1986
SOW	scope of work
TAN	Test Area North
TCE	trichloroethene
TEWP	Technology Evaluation Work Plan
TSF	Technical Support Facility
UIC	underground injection control
VOC	volatile organic compound
WAG	waste area group

NOMENCLATURE

µg	microgram
Cs	cesium
ft	feet
g	gram
gal	gallon
gpm	gallons per minute
H	hydrogen
in.	inch
kg	kilogram
km	kilometer
L	liter
m	meter
mg	milligram
mrem	millirem
mi	mile
pCi/L	picocuries per liter
ppb	parts per billion
ppmw	parts per million weight
Sr	strontium
U	uranium
yr	year

Record of Decision Amendment for the Technical Support Facility Injection Well (TSF-05) and Surrounding Groundwater Contamination (TSF-23) and Miscellaneous No Action Sites, Final Remedial Action

Part II – Decision Summary

1. INTRODUCTION AND STATEMENT OF PURPOSE

This Record of Decision (ROD) Amendment modifies the original remedy for Operable Unit (OU) 1-07B, at the Idaho National Engineering and Environmental Laboratory (INEEL). The original remedy was documented in the *Record of Decision for the Technical Support Facility (TSF) Injection Well (TSF-05) and Surrounding Groundwater Contamination (TSF-23) and Miscellaneous No Action Sites Final Remedial Action* (DOE-ID 1995 [DOE/ID-10139]) (the 1995 ROD).

- **Site Name and Location:**

  Technical Support Facility Injection Well (TSF-05) and
  Surrounding Groundwater Contamination (TSF-23),
  Operable Unit 1-07B,
  Idaho National Engineering and Environmental
  Laboratory (CERCLIS ID 4890008952),
  Idaho Falls, Idaho.

- **Identification of Lead and Support Agencies:** The U.S. Department of Energy (DOE), Idaho Operations Office (DOE-ID) is the lead agency for the remedy decisions under Executive Order 12580. The U.S. Environmental Protection Agency (EPA) approves the decisions and, along with the Idaho Department of Environmental Quality (IDEQ), has participated in the selection of the remedy. The IDEQ concurs with the amended remedy for the OU˚1-07B groundwater cleanup. The DOE, EPA, and IDEQ are collectively referred to as the Agencies in this document.

- **Statutory Requirements Met:** In accordance with Section˚117(c) of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) and Section˚300.435(c)(2)(ii) of the National Oil and Hazardous Substances Pollution Contingency Plan (NCP), and pursuant to the 1995 ROD, this ROD Amendment has been prepared to document changes to the 1995 ROD. All public participation and documentation procedures specified in NCP Sections˚300.435(c)(2)(ii) and 300.825(a)(2), including issuing a revised proposed plan (the *Proposed Plan for Operable Unit 1-07B, Final Remedial Action at the TSF Injection Well (TSF-05) and Surrounding Groundwater Contamination (TSF-23)* [DOE-ID, EPA, and IDEQ 2000 {DOE/ID-21251}]) that highlighted the proposed changes, were conducted as required.

- **Date of Original ROD Signature:** August 4, 1995.

- **Need for ROD Amendment:** This ROD Amendment documents fundamental changes to certain features of the original remedy selected in the 1995 ROD. The Agencies evaluated several alternative technologies to determine if any might be more cost-effective than the remedy selected in the 1995 ROD. The Agencies determined that two technologies — in situ bioremediation (ISB) and monitored natural attenuation (MNA) — in combination with the pump-and-treat technology originally selected in the 1995 ROD reduce the overall remedial timeframe and significantly reduce the overall cost of remediation as compared to the original remedy of pump-and-treat alone.

Location of Administrative Record and Hours of Availability: The documents that form the basis for the decisions made in this ROD Amendment are contained in the Administrative Record for OU 1-07B. This ROD Amendment will become part of the Administrative Record pursuant to Section˚300.825(a)(2) of the NCP. The Administrative Record is available to the public at the following locations:

INEEL Technical Library
DOE Public Reading Room
1776 Science Center Drive
Idaho Falls, ID 83415
(208) 526-1185
Hours: 8 a.m. to 5 p.m. Monday through Friday, except as posted

Albertsons Library
Boise State University
1910 University Drive
Boise, ID 83725
(208) 385-1621
Hours: 7:30 a.m. to 12 midnight Monday through Thursday; 7:30 a.m. to 8 p.m. Friday; 10˚a.m. to 8 p.m. Saturday; 10 a.m. to midnight Sunday, except as posted

University of Idaho Library
University of Idaho Campus
434 2nd Street
Moscow, ID 83843
(208) 885-6344
Hours: 8 a.m. to midnight, except as posted

and on the Internet (at http://ar.inel.gov).

2. OU 1-07B HISTORY AND ORIGINAL REMEDY

2.1 History

OU 1-07B is the final remedial action for the TSF-05 Injection Well and the Surrounding Groundwater Contamination (TSF-23) located at the Technical Support Facility (TSF) within Test Area North (TAN), one of nine major facilities at the INEEL (Figures 2-1 and 2-2). Table 2-1 lists the contaminants of concern (COCs) that will be remediated in this action.

TAN consists of several experimental and support facilities used for research and development on reactor performance and nuclear safety. From about 1953 to 1972, liquid wastes generated at TAN were disposed of by pumping them down the TSF-05 Injection Well in the southwest corner of the TSF. This well dispersed the wastes into the Snake River Plain Aquifer, which underlies the INEEL. The wastes consisted mainly of industrial and sanitary wastewater, but also included organic, inorganic, and low-level radioactive wastewaters. Activities generating these wastes included efforts to develop a nuclear-powered aircraft and tests simulating accidental loss of coolant from nuclear reactors.

In 1987, low levels of trichloroethene (TCE) and tetrachloroethene (PCE) — two volatile organic compounds (VOCs) that can be harmful to humans — were detected in the wells used to supply drinking water to workers at TAN (Wells TAN-1 and TAN-2). The TSF-05 Injection Well was identified as the source of the groundwater contamination. An air sparging system was installed to treat the drinking water supply at TAN to comply with safe drinking water requirements. Untreated contaminated water is not available to workers at TAN or to the public.

In September 1992, the Agencies began an interim action for OU˚1-07A, as documented in the *Record of Decision (ROD) for Technical Support Facility (TSF) Injection Well and Surrounding Groundwater Contamination* (INEL 1992 [INEL-5202]). Activities included constructing and operating the Groundwater Treatment Facility (GWTF) to extract and treat contaminated groundwater in the vicinity of the TSF-05 Injection Well.[1] The Interim Action also initiated measurement of aquifer parameters based on data from groundwater extraction and new monitoring wells.

Sampling from the TSF-05 area confirmed that 1,2-dichloroethene (DCE), tritium, Sr-90, and Cs-137 were also present above acceptable risk-based concentrations. These other COCs are in the groundwater near the injection well but are not found in the drinking water from the production wells. Uranium-234, which is also a COC, and tritium do not exceed maximum contaminant levels (MCLs), but are included as COCs because they exceed the $1 \_ 10^{-6}$ risk-based concentration for groundwater ingestion, as described in the 1995 ROD. The only contaminants consistently detected in the production wells at levels exceeding federal drinking water standards (i.e., MCLs) are TCE and PCE, which are removed by the air sparging system.

The TSF-05 Injection Well is 93 m (310 ft) deep and is perforated from 55 to 74 m (180 to 244 ft) and 82 to 93 m (269 to 305 ft) below ground surface. The depth to groundwater is about 63 m (206 ft). Historical records provide little definitive information on the types and volumes of organic wastes disposed of into the groundwater via the injection well. It is estimated that as little as 1,325 L (350 gal) or as much as 132,489 L (35,000 gal) of TCE may have been disposed of in the well during its period of operation, 1953 to 1972.

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[1] GWTF operations will end when the amended remedy is implemented.

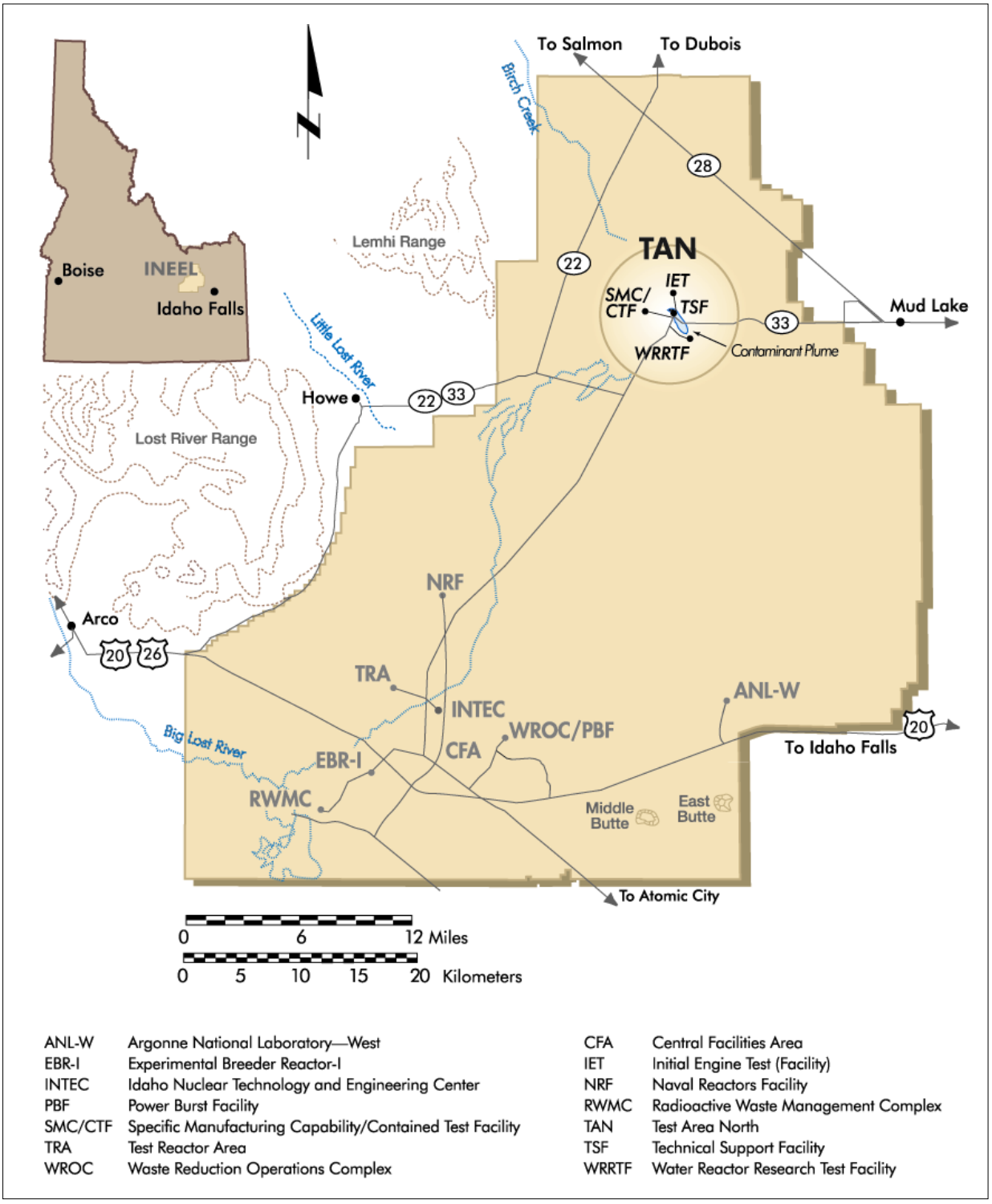

Figure 2-1. Location of Test Area North at the Idaho National Environmental and Engineering Laboratory.

Table 2-1. Contaminants of concern in the vicinity of the TSF-05 Injection Well.

Contaminant	Maximum Concentrations[a]	Federal Drinking Water Standard
VOLATILE ORGANIC COMPOUNDS (VOCs)		
Trichloroethene (TCE)	12,000 — 32,000 ppb	5 ppb [b]
Tetrachloroethene (PCE)	110 ppb	5 ppb [b]
cis-1,2-Dichloroethene (DCE)	3,200 — 7,500 ppb	70 ppb [b]
trans-1,2-Dichloroethene (DCE)	1,300 — 3,900 ppb	100 ppb [b]
RADIONUCLIDES		
Tritium	14,900 — 15,300 pCi/L[c]	20,000 pCi/L
Strontium-90	530 — 1,880 pCi/L	8 pCi/L
Cesium-137	1,600 — 2,150 pCi/L	119 pCi/L [d]
Uranium-234	5.2 — 7.7 pCi/L[c]	27 pCi/L [e]

Key: ppb = parts per billion; pCi/L = picocuries per liter.

a. The concentration range is taken from measured concentrations at the TSF-05 Injection Well. Source: *Fiscal Year 1999 Groundwater Monitoring Report, Test Area North, Operable Unit 1-07B (INEEL 2000a [INEEL/EXT-99-01255]*).

b. Parts per billion (ppb) is a weight-to-weight ratio that is equivalent to micrograms per liter (µg/L) in water.

c. Maximum concentrations of tritium and U-234 are below federal drinking water standards and baseline risk calculations indicate cancer risk of 3×10^{-6}. While this risk is smaller than 1×10^{-4}, both tritium and U-234 are included as COCs as a comprehensive plume management strategy.

d. The maximum contaminant level (MCL) for Cs-137 is derived from a limit of 4 millirem per year (mrem/yr) cumulative dose-equivalent to the public, assuming a lifetime intake of 2 liters per day (L/day) of water.

e. The federal drinking water standard for U-234 is for the U-234, -235, and -238 series.

In 1994, a remedial investigation and feasibility study (RI/FS) for OU 1-07B was completed to characterize the extent and nature of the contamination and determine what cleanup was required (EG&G 1994 [EGG-ER-10643]). The primary risk driver was determined to be the ingestion of groundwater contaminated with TCE. However, TCE also can be harmful to human health through dermal contact, inhalation of vapors, or ingestion of crops irrigated with TCE-contaminated water. A proposed plan (the *Proposed Plan for Operable Unit 1-07B, Final Remedial Action at the TSF Injection Well (TSF-05) and Surrounding Groundwater Contamination (TSF-23)* [DOE, EPA, and IDEQ 2000]) based on the RI/FS was published in May 1994 presenting the Agencies recommendations for cleanup of the groundwater contamination. The Agencies agreement to clean up the site was documented in a ROD signed in August 1995 (the 1995 ROD) (DOE-ID 1995 [DOE/ID-10139]). The 1995 ROD directed that pump-and-treat technology be used to restore the hot spot and that treatability studies be conducted concurrently to evaluate alternative technologies to clean up this portion of the contaminant plume.

One of the treatability studies conducted was on ISB. The Agencies recognize that during ISB at the hot spot, VOC daughter products (such as vinyl chloride) may be produced as interim, ephemeral breakdown products; however, bioremediation will result in complete dechlorination of VOCs by 2095. The baseline risk assessment leading to the 1995 ROD will not be revised to include daughter products because no new COCs have been identified. Temporary daughter products produced during remediation

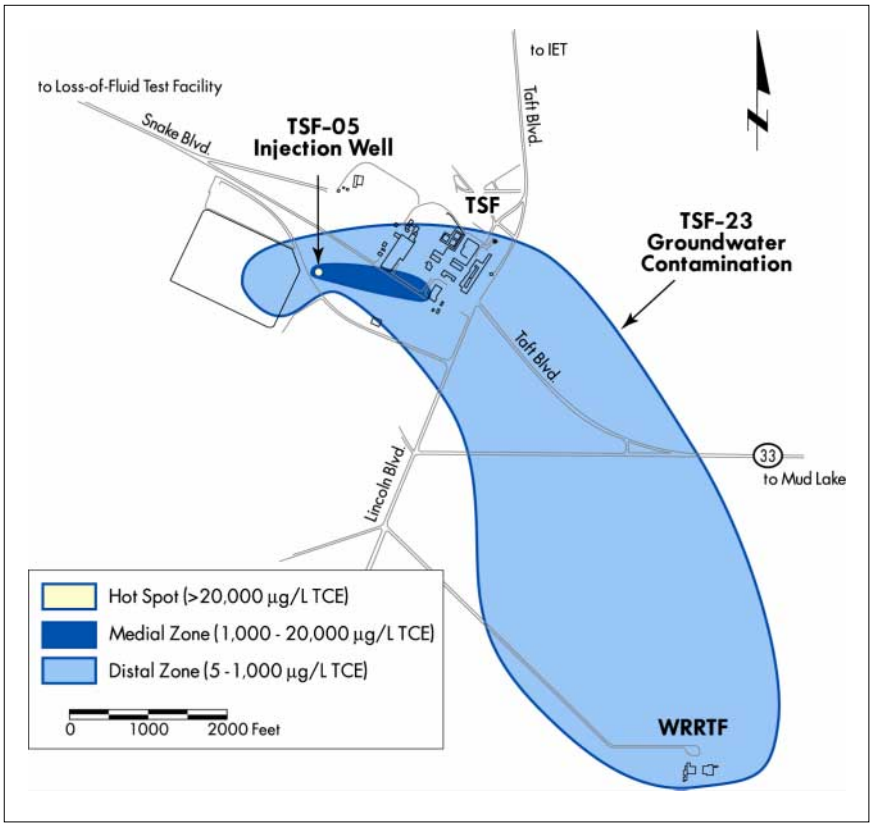

Figure 2-2. Facilities at Test Area North. Operable Unit 1-07B is the TSF-05 Injection Well and the TSF-23 Contaminant Plume underlying TAN.

activities will be short-lived and will not exist at the end of remediation activities. The action taken under this ROD Amendment will meet remedial action objectives (RAOs) and ensure that drinking water standards will be met throughout the contaminant plume by or before 2095.

Because the TCE has migrated more widely from the injection well than the other COCs, the boundaries of the contaminant plume have been defined by the TCE concentrations. Remedial actions that reduce TCE will act to reduce the other VOC COCs as well. Additional information concerning geology, hydrology, and the nature and extent of contamination was provided in the 1995 ROD and can be found in the Administrative Record for OU 1-07B (as described in Section˚1).

2.2 Original Remedy

In 1995, the OU 1-07B ROD selected the remedial action (the original remedy) Alternative˚4: 25 Micrograms per Liter Trichloroethene Groundwater Contamination Plume Extraction; Hot Spot Containment and/or Removal with Aboveground Treatment. RAOs were developed as part of the 1995 ROD. The purpose of the RAOs was to reduce the contamination in the groundwater at TAN to ensure that offsite populations are not at risk in the future, and that the future residents would not be at risk from use of TAN groundwater if the TAN area were converted to the public domain at any time in the future.

The 1995 ROD specified that the original remedy would be conducted in three phases, with institutional controls, as described below:

- **Phase A – Transition of OU 1-07A Interim Action to OU 1-07B Final Remedial Action.** Phase A provided for the transition into OU 1-07B activities through the continuation of OU 1-07A surge-and-stress pumping of the TSF-05 Injection Well and operation of the interim action Groundwater Treatment Facility (GWTF) to remove the secondary source, pump and treat contaminated groundwater, and collect data on aquifer parameters. Phase A also tested radionuclide removal technologies.

- **Phase B – Hot Spot Containment and/or Removal with Treatability Studies.** Phase B added implementation of hot spot containment, defined as groundwater extraction at a rate sufficient to create hydraulic containment of TCE and other contaminants within the hot spot. Phase B also included evaluation and testing of five innovative technologies. The 1995 ROD specified that a treatability study report would document the results and assess whether any of the technologies tested could be more effective than the [original] selected pump-and-treat remedy. Finally, Phase B also included groundwater monitoring to track the extent of the contaminant plume, document fluctuations in TCE concentrations, and measure the attenuation rate of the plume.

- **Phase C – Dissolved Phase Groundwater Treatment with Continuation of Hot Spot Containment and/or Removal.** Phase C was defined as (a) the treatment of the 25 to 5,000˚µg/L TCE portion of the plume to enhance natural attenuation in the less-than-25˚µg/L-portion of the plume, and (b) the continuation of hydraulic containment or removal or both of the hot spot initiated during Phase B. Phase C was to follow completion of Phase˚B treatability studies and include the continuation of groundwater monitoring.

- **Institutional Controls.** Institutional controls were specified to protect current and future users from health risks associated with groundwater contamination.

Phase A began with the signing of the 1995 ROD and was the transition from the OU 1-07A Interim Action to the OU 1-07B Final Action. Planning for the treatability studies was completed in 1995. Phase˚A activities transitioned into Phase˚B in 1996, and pump-and-treat containment of the hot spot began. Hot spot containment will continue until ISB treatment is fully operational. The Phase˚B treatability studies were completed in 1999 (the treatability studies are described more fully in Section˚2.4).

Institutional controls were initiated under the OU 1-07A Interim Action and continued under the 1995 ROD. In October 1999, the *Final Record of Decision for Test Area North, Operable Unit 1-10* (DOE-ID 1999a [DOE/ID-10682]) (OU 1-10 ROD) established an institutional control plan encompassing all sites within Waste Area Group (WAG) 1, including this site. The institutional controls are being implemented in accordance with the OU˚1-10 ROD.

The pump-and-treat and natural attenuation components of the original remedy are presented in Table 2-2.

Table 2-2. Components of the original remedy. The zones are as originally defined in the 1995 ROD.

Zone	Implementation Phase	Original Remedy Approach
Hot Spot (greater than 5,000 µg/L TCE)	Phases B and C	Pump-and-Treat
Dissolved Phase (25 to 5,000 µg/L TCE)	Phase C	Pump-and-Treat
Dissolved Phase (5 to 25 µg/L TCE)	Phases B and C	Monitored Natural Attenuation
Entire Plume	Phases B and C	Institutional Controls and Groundwater˚Monitoring

2.3 Explanation of Significant Differences

In November 1997, the Agencies published an Explanation of Significant Differences (ESD) (INEEL 1997 [INEEL/EXT-97-00931]) documenting changes to the 1995 ROD in several areas, including contaminant area definitions, the treatability studies schedule, and waste management requirements). The changes were based on information gathered during the Phase˚A and Phase˚B activities. Changes that are relevant to the final remedial action described in this ROD Amendment are summarized below.

2.3.1 Division of Plume into Three Zones

Initial evaluation of each technology to be tested identified the portion or portions of the contaminant plume in which it could effectively be applied. The 1995 ROD had divided the contaminant plume into a hot spot, in which TCE concentrations were greater than 5,000 g/L; a dissolved phase with TCE concentrations of 25 to 5,000 g/L; and a dissolved phase with TCE concentrations of 5 to 25 g/L. The ESD changed the boundaries of the zones to facilitate the treatability studies, identifying the three zones as follows:

- The hot spot is the area immediately around the injection well, where concentrations of TCE exceed 20,000 parts per billion (ppb)
- The medial zone is the portion of the plume in which concentrations of TCE are between 1,000 and 20,000 ppb
- The distal zone, which is the remainder of the plume, has TCE concentrations of between 5˚and 1,000 ppb.

Figure 2-2 shows the zones. The divisions identified in the 1995 ROD and the ESD are shown in Table˚2-3. This ROD Amendment uses the divisions identified in the ESD.

Table 2-3. Contaminant plume boundaries defined by the 1995 ROD and the ESD.

Original 1995 ROD	ESD
Hot Spot (greater than 5,000 µg/L TCE)	Hot Spot (greater than 20,000 µg/L TCE)
Dissolved Phase (25 to 5,000 µg/L TCE)	Medial Zone (1,000 to 20,000 µg/L TCE)
Dissolved Phase (5 to 25 µg/L TCE)	Distal Zone (5 to 1,000 µg/L TCE)

2.3.2 Extension of Treatability Studies

The time for conducting the treatability studies was extended from 3 years to approximately 5˚years from the date of the 1995 ROD signature to facilitate sequential rather than parallel testing of the technologies being studied (as described in Section˚2.4).

2.3.3 Waste Management Requirements and Area of Contamination Definition

As described in the ESD, DOE determined that solvents listed by the Resource Conservation and Recovery Act (RCRA) were disposed of at the TAN facility in the TSF-21 Valve Pit, which was interconnected with the TSF-05 Injection Well. Because of this determination, the RCRA-listed waste classification (waste code F001) became applicable to the contaminant plume and to any associated wastes generated from the groundwater remediation activities.

The Area of Contamination (AOC) designation for waste management purposes was not fully covered in the 1995 ROD. The ESD defined the AOC as follows:

> The AOC for waste management purposes will be defined as the area overlying and within the contaminated groundwater plume (i.e., detectable TCE concentrations greater than 5 µg/L). This AOC definition allows for necessary remediation activities to be performed at prescribed locations within the AOC but will not result in management of wastes outside of established temporary accumulation areas. Any future temporary accumulation areas will be established within the AOC immediately adjacent to the existing or future treatment facilities only to the extent necessary for proper and efficient management of waste streams. The CERCLA site for waste management purposes, as defined in the [Federal Facility Agreement and Consent Order (FFA/CO)], is the entire INEEL site area . Waste generated during remedial action will be managed within the AOC, or offsite. Waste generated during remediation activities and stored in a temporary accumulation area within the AOC will be moved to one or more of the waste management areas within the INEEL site or sent offsite for storage, treatment, and/or disposal.

2.3.4 Clarification of ARARs

With respect to two of the treatability studies (ISB and In Situ Chemical Oxidation [ISCO]), the ESD clarified applicable or relevant and appropriate requirements (ARARs) to specify that secondary MCLs would not be applicable before the end of the restoration period (defined as 2095), because the hot spot and medial zones would not be drinking water sources due to high concentrations of COCs in those zones. Institutional controls, as part of the remedial action, will be maintained to ensure protection of human health and the environment until the remedial action is completed.

2.3.5 Construction of the New Pump-and-Treat Facility

Although remediation of the medial zone was not identified as starting until Phase B treatability studies were completed, modeling suggested that early implementation of extraction and treatment of the portion of the plume in the medial zone would enhance subsequent remediation in the distal zone. Accordingly, the Agencies agreed to begin design and construction of the New Pump and Treat Facility (NPTF) before the Phase˚B treatability studies were completed. The NPTF will extract and treat contaminated groundwater in the medial zone and reinject the treated water. Construction of the NPTF was completed in January 2001; operations are expected to begin in Fall 2001.

2.4 Summary of Treatability Studies

Treatability studies were conducted for each of the five potential alternative approaches:

- Metal Enhanced Reductive Dehalogenation (MERD)
- Monolithic Confinement (Grouting)
- In Situ Bioremediation (ISB)
- In Situ Chemical Oxidation (ISCO)
- Monitored Natural Attenuation (MNA).

The Technology Evaluation Work Plan (TEWP) (DOE-ID 1997b [DOE/ID-10562]) outlined the process for conducting the treatability studies, including literature surveys, bench-scale laboratory tests, and pilot-scale studies. The objective was to obtain sufficient specific information to determine whether one technology or a combination of several could achieve the RAOs at a lower cost or in less time than that predicted for the original remedy. The TEWP also identified the applicability of each alternative approach for use in each of the three zones.

The treatability studies were concluded in 1999 and the results are summarized in the Field Demonstration Report (FDR) (DOE-ID 2000a [DOE/ID-10718]). Summaries of the studies and the results are provided below. The documents that detail the treatability studies, work plans, and results are listed in Section˚2.5 for the reader s use.

2.4.1 Metal Enhanced Reductive Dehalogenation

The MERD technology uses iron to enhance the rate of degradation of a wide range of organic contaminants, including TCE. This technology would only be applicable to remediation of the hot spot. It was evaluated for its ability either to replace or to augment the pump-and-treat technology. Two variations were evaluated: one using zero-valent iron and the other using nickel-plated iron (enhanced iron).

Both a bench-scale feasibility study (FS) and a laboratory treatability study were carried out. Agency review of the results determined that neither variation performed better than the original remedy of pump-and-treat. The MERD evaluation was terminated in April 1997.

2.4.2 Monolithic Confinement

The technical feasibility of monolithic confinement (grouting) is well established. Successful reduction of permeability through grouting could reduce contaminant flux sufficiently to meet RAOs for in situ containment or isolation of the secondary source. The primary consideration for selection of this technology is its cost. However, cost estimates prepared in the initial evaluation indicated that grouting would not be more cost-effective than the original remedy of pump-and-treat. Moreover, the area that would need to be treated by grouting would still require pump-and-treat to control leakage. Based on these results, studies related to monolithic confinement were terminated in October 1996.

2.4.3 In Situ Bioremediation

ISB involves interaction between native microorganisms and amendments that will stimulate the bacteria to dechlorinate TCE and other chlorinated VOCs. Bioremediation through aerobic or anaerobic processes dechlorinates TCE to carbon dioxide, water, chloride, ethene, and ethane. Anaerobic ISB was studied for use at the hot spot; aerobic ISB was evaluated for use in the medial and distal zones.

Initial results indicated that ISB could remediate the same mass of TCE as a pump-and-treat system in roughly half the time. Initial evaluation and laboratory tests suggested enhanced anaerobic ISB had the potential to replace pump-and-treat for remediation of the hot spot. Laboratory studies of aerobic ISB demonstrated significant potential for enhanced bioremediation of the downgradient contaminant plume; however, the addition of amendments on that scale would be cost-prohibitive.

To facilitate ISB field studies, the Air Stripper Treatment Unit (ASTU) was constructed in 1998 and began operation in November of that year. The ASTU extracted water 150 m (500 ft) downgradient from the hot spot, treated it by air stripping, and reinjected it through a well 20 m (60 ft) downgradient from where it was extracted. The ASTU provided containment at the hot spot while the ISB field evaluation was ongoing because the GWTF could not be operated during this treatability study.

A field evaluation of anaerobic ISB conducted at the hot spot from January to September 1999 showed that sodium lactate performed well as an amendment. TCE was completely dechlorinated, with no resulting residual VOC contamination. ISB showed several clear advantages over pump-and-treat for hot spot remediation: (a)˚ISB destroys chlorinated ethenes rather than transferring them to air, (b)˚ISB does not bring contaminants aboveground for treatment, and thus eliminates risks to workers from exposure to contaminants, and (c)˚ISB promises a shorter restoration timeframe, which results in a lower overall cost.

2.4.4 In Situ Chemical Oxidation

ISCO was evaluated for use at the hot spot. ISCO is an innovative technology for remediation of chlorinated solvents in groundwater. Laboratory tests and small-scale experiments at the INEEL have shown that the oxidant potassium permanganate is effective in dechlorinating VOCs to end products such as carbon dioxide, chlorine, chloride, and manganese. Effective operation of this technology depends on a delivery system that can inject the oxidant into the area of highest contaminant concentration, or where undissolved contaminant may be present.

A laboratory evaluation of ISCO was completed and a field evaluation work plan was finalized. However, the oxidant used in ISCO would kill the microorganisms that facilitate ISB. Therefore, the

Agencies agreed to conduct the ISCO field evaluation after the ISB field evaluation was completed but only if the ISB field evaluation were unsuccessful. Since the ISB field evaluation was successful, the Agencies agreed not to proceed with ISCO field testing.

2.4.5 Monitored Natural Attenuation

Natural attenuation is defined by the EPA as the biodegradation, diffusion, dilution, sorption, volatilization, and/or chemical and biochemical stabilization of contaminants to effectively reduce contaminant toxicity, mobility, or volume to levels that are protective of human health and the environment. At this site, MNA would only be applicable to remediation of the distal zone.

Factors important to evaluating the applicability of MNA at this site included site-specific information about the potential for biotic degradation, abiotic degradation, or other geochemical or biochemical processes that could attenuate the specific COCs in this contaminant plume. Evaluation of natural attenuation involved sampling and analysis of groundwater in the distal zone. The evaluation used computer models to predict the potential change over time in contaminant distribution and concentration. It was determined that MNA better meets the balancing criteria than pump-and-treat for remediation of the distal zone.

2.5 Key Documents for Completed Remediation Activities

The goals and results of activities relating to OU 1-07B that have been completed to date are reported in the key documents in Table 2-4. For the reader s convenience, the document number (e.g., DOE/ID-10139) is listed. Either the title or the document number can be used to locate the document in the Administrative Record. The Administrative Record is available online at http://www.inel.gov/publicdocuments/ or at the Information Repositories listed in Section˚1.

Table 2-4. Key documents for OU 1-07B completed remediation activities.

Referred to as	Date	Title	Document No.
1995 ROD	Aug 95	*Record of Decision for the Technical Support Facility Injection Well (TSF-05) and Surrounding Groundwater Contamination (TSF-23) and Miscellaneous No Action Sites Final Remedial Action*	DOE/ID-10139
TEWP	Mar 97	*Technology Evaluation Work Plan, Test Area North Final Groundwater Remediation, OU 1-07B*	DOE/ID-10562
RD/RA SOW	Aug 97	*Remedial Design/Remedial Action Scope of Work, Test Area North Final Groundwater Remediation, Operable Unit 1-07B*	DOE/ID-10522
ESD	Nov 97	*Explanation of Significant Differences from the Record of Decision for the Technical Support Facility Injection Well (TSF-05) and Surrounding Groundwater Contamination (TSF-23) and Miscellaneous No Action Sites, Final Remedial Action*	INEEL/EXT-97-00931
OU 1-10 ROD	Oct 99	*Final Record of Decision for Test Area North, Operable Unit 1-10*	DOE/ID-10682
FDR	Mar 00	*Field Demonstration Report, Test Area North Final Groundwater Remediation, Operable Unit 1-07B*	DOE/ID-10718
Proposed Plan	Nov 00	*Proposed Plan for Operable Unit 1-07B, Final Remedial Action at the TSF Injection Well (TSF-05) and Surrounding Groundwater Contamination (TSF-23)*	DOE/ID-21251
	Jan 98	*Well Characterization and Evaluation Report Supporting Functional and Operational Requirements for the New Pump and Treat Facility at Test Area North Operable Unit 1-07B*	INEL/EXT-97-01356
	Feb 98	*Site Conceptual Model: 1996 Activities, Data Analysis, and Interpretation – Test Area North Operable Unit 1-07B*	INEL/EXT-97-00556
	Feb 98	*Natural Attenuation Field Evaluation Work Plan, Test Area North, Operable Unit 1-07B*	DOE/ID-10606
	Sep 98	*In Situ Bioremediation Field Evaluation Work Plan, Test Area North, Operable Unit 1-07B*	DOE/ID-10639
	Jan 99	*Numerical Modeling Support of the Natural Attenuation Field Evaluation for Trichloroethene at the Test Area North, Operable Unit 1-07B*	INEEL/EXT-97-01284
	Apr 99	*Laboratory Evaluation of In Situ Chemical Oxidation for Groundwater Remediation, Test Area North, Operable Unit 1-07B, Idaho National Engineering and Environmental Laboratory*	ORNL/TM-13711
	Oct 99	*Phase C Groundwater Monitoring Plan*	INEEL/EXT-99-00021
	Oct 99	*Phase C Remedial Action Work Plan for Test Area North Final Groundwater Remediation, Operable Unit 1-07B*	DOE/ID-10679
	Nov 99	*In Situ Chemical Oxidation Field Evaluation Work Plan for the TSF-05 Hot Spot, Test Area North Final Groundwater Remediation, Operable Unit 1-07B*	DOE/ID-10698
	Jan 00	*Fiscal Year 1999 Groundwater Monitoring Report, Test Area North, Operable Unit 1-07B*	INEEL/EXT-99-01255
	Mar 00	*New Pump and Treat Facility Remedial Design, Test Area North, Operable Unit 1-07B*	DOE/ID-10661
	Apr 00	*Aerobic Biodegradation Laboratory Studies at Test Area North, Operable Unit 1-07B*	INEEL/EXT-99-00736
	Oct 00	*Sampling and Analysis Plan for the Enhanced In Situ Bioremediation Field Evaluation, Test Area North, Operable Unit 1-07B*	INEEL/EXT-98-00421
	Nov 00	*Microbial Studies Report Supporting Implementation of In Situ Bioremediation at Test Area North*	INEL/EXT-98-00474

3. COMMUNITY PARTICIPATION

Public participation was an important element in the decision-making process for the OU 1-07B Final Remedial Action. In accordance with CERCLA Section˚113(k)(2)(b)(i—v) and Section˚117, the Agencies provided various opportunities for the public to learn about the activities leading to this ROD Amendment and to provide their opinions and comments for the Agencies consideration in making the final decision. Between October 1995 and January 2001, a series of publications and face-to-face (or telephone) meetings offered information and comment opportunities. These included: the original Record of Decision in 1995; an Explanation of Significant Differences in 1997; articles in the *INEEL Reporter*; *Citizen's Guide* supplemental updates; *Update Fact Sheets*; the November 2000 Proposed Plan; briefings and presentations to interested groups; tours; and public meetings.

Articles in the *INEEL Reporter* (a publication of the INEEL s Environmental Restoration Program) regularly updated individuals on the mailing lists during the course of the project. Reports also appeared in five issues of *EM Progress* and a *Citizen's Guide to Environmental Restoration at the INEEL* (a supplement to the *INEEL Reporter)* in the first half of 1996, 1997, 1998, 1999, and 2000. In addition, many newspapers and technical journals ran articles on the technology, and several regional television and radio stations aired interviews with project managers and public affairs staff.

In October 1999, December 1999, and November 2000, *Update Fact Sheets* were distributed to approximately 600 individuals on the INEEL Community Relations Plan mailing list. The *Update Fact Sheets* described developments during the OU˚1-07B treatability studies and announced the dates of future public meetings. Each fact sheet included information on the availability of technical briefings to those interested in the OU 1-07B Final Remedial Action.

In November 2000, the *Proposed Plan for Operable Unit 1-07B, Final Remedial Action at the TSF Injection Well (TSF-05) and Surrounding Groundwater Contamination (TSF-23)* was published (DOE-ID, EPA, and IDEQ 2000). About 600 copies were mailed out to recipients on the *INEEL Community Relations Plan* mailing list during the week of November˚20, 2000. The public comment period for the Proposed Plan began November˚27 and was planned to end on December˚26, 2000. At the request of the public, the comment period was extended 30 days to January˚26, 2001.

During the week of November˚20, 2000, the INEEL Community Relations representative for TAN telephoned people in various Idaho communities who are known to have an interest in INEEL environmental restoration activities. The calls were made to inform them and their organizations in advance about the Proposed Plan, to provide the schedule for the public meetings, and to find out whether they wanted a technical briefing.

Also during the week of November 20, 2000, DOE-ID issued a news release to more than 100 media contacts. The news release announced the 30-day public comment period for the Proposed Plan. This information was published in community calendar sections of newspapers and aired in public service announcements on radio stations. The news release also included information that reference documents for the Proposed Plan were available in the Administrative Record section of the INEEL Information Repositories located in the INEEL Technical Library in Idaho Falls, Albertsons Library on the campus of Boise State University, and the University of Idaho Library in Moscow, Idaho. During the following week, display advertisements announcing the availability of the Proposed Plan and the locations of public meetings were published in the *Post Register* (Idaho Falls); the *Arco Advertiser* (Arco); *The Sho-Ban News* (Fort Hall); *The Idaho State Journal* (Pocatello); *The Times-News* (Twin Falls); the *Idaho Statesman* (Boise); and the *Moscow-Pullman Daily News* (Moscow). A follow-up advertisement ran in newspapers approximately four days before the public meetings in Idaho Falls and Twin Falls. Post cards were mailed to approximately 5,400 individuals and organizations on the INEEL mailing list informing

them of the availability of the Proposed Plan, the duration of the comment period, and the times and locations of upcoming public meetings. An electronic note with this information was sent to all INEEL employees.

Technical briefings were provided to two groups. A January˚12, 2001, technical briefing was held for Coalition 21, an organization of retired INEEL employees and others who are interested in INEEL affairs. A previous briefing had been held with Coalition 21 in April 2000 on the bioremediation technology. Two briefings were provided by DOE-ID for the INEEL Citizen s Advisory Board and its Environmental Restoration Program Subcommittee. The advisory board is a group of 15 individuals, selected to represent the citizens of Idaho, who make recommendations to the Agencies regarding environmental restoration activities at the INEEL. The advisory board submitted their formal recommendations on the Proposed Plan in January 2001.

During the course of the project, members of the Shoshone-Bannock Tribes and an environmental group toured the treatment facility at TAN and were briefed by project managers. Members of the Citizen s Advisory Board toured the area proposed for remediation on September˚21, 1999.

Public meetings were held in Idaho Falls on December˚5 and in Twin Falls on December˚6, 2000. Each public meeting began at 7 p.m. The newspaper advertisements had invited the public to also attend the availability sessions scheduled from 6 to 7 p.m. Availability sessions are opportunities for informal discussion of the contaminant plume investigation and proposed alternatives with Agency and project representatives before the formal public meeting began. At each meeting, a court reporter recorded discussions and public comments from which written transcripts were later prepared and placed into the Administrative Record for OU 1-07B.

Those who attended the meeting were invited to have their comments recorded by the court reporter during the formal comment portion of the meeting, or submit them in writing, or both. A postage-paid, pre-addressed form for comments was provided as part of the Proposed Plan. Copies of the form were also provided at the public meeting. The INEEL Community Relations Office also asked those who attended the meeting to evaluate its effectiveness using a form printed on the back of the meeting agenda.

Approximately 30 members of the public or representatives of stakeholder groups (people not associated with the OU 1-07B project) attended the Idaho Falls public meeting and availability session. Twin Falls had been selected for the second meeting location to be convenient for residents of the Snake River Plain from Pocatello to Boise who might have an interest in TAN because of the groundwater issue. It was also expected, since the Idaho Falls meeting took place on the same night as a Jackson, Wyoming, public meeting for a different INEEL project, that members of the public and the media who wished to attend meetings for both projects would be able to do so by attending the Twin Falls meeting. However, no members of the public or the media came to the Twin Falls public meeting or availability session.

During the comment period, ten separate sets of formal comments were received, seven submitted in writing and three delivered as formal comments at the public meetings. Part III of this ROD Amendment, the Responsiveness Summary, consists of a summary of the concerns expressed in the comments received, and the Agencies responses to them. Transcripts of the formal comments delivered at the public meetings and scanned versions of comments received in writing are provided in Appendix˚A to this ROD Amendment. The comments are in the Administrative Record for OU 1-07B.

All comments received on the Proposed Plan were considered during the remedy selection process documented in this ROD Amendment. Community acceptance, as one of the EPA s nine criteria used in final evaluation of remedial alternatives, is documented in Sections˚7.1 and 7.2 of this ROD Amendment.

4. BASIS FOR THE AMENDMENT

The 1995 ROD was written with a requirement to conduct treatability studies, which focused on specific technologies that offered the potential to be more cost-effective than the original remedy of pump-and-treat technology. Cost-effectiveness considers all the balancing criteria, including cost and time for completion, as well as ability to meet RAOs. Although pump-and-treat technology would meet RAOs, it would require several decades for completion, increasing the cost of remediation. Results of the treatability studies showed that two of the technologies investigated, ISB and MNA, would better meet the balancing criteria than pump-and-treat technology for remediation of the hot spot and the distal zone, respectively. This section presents the key information about these two technologies that supports selection in this ROD Amendment of the amended remedy. The data and information used to reach a final decision on the five technologies was presented in the FDR (DOE-ID 2000a [DOE/ID-10718]).

4.1 New Information from Treatability Studies

Five technologies were identified for evaluation (see Section˚2.4). Based on the results of the treatability studies, the Agencies agreed that:

- Monolithic confinement cannot perform more effectively than pump-and-treat technology at the hot spot. Therefore, all work on evaluation of this technology was terminated in October 1996.

- MERD cannot perform more effectively than pump-and-treat technology at the hot spot. Therefore, all work on evaluation of this technology was terminated in April 1997.

- ISB would perform more effectively than pump-and-treat technology at the hot spot.

- MNA would better meet the balancing criteria than pump-and-treat technology in the distal zone.

- ISCO would not be evaluated further due to the success of ISB.

The Agencies agreed that ISB, for remediation of the hot spot, and MNA, for remediation of the distal zone, would be effective components of an amended remedial action in combination with pump-and-treat technology in the medial zone. ISB would result in significant cost savings by achieving hot spot restoration in roughly half the time estimated for a pump-and-treat system. MNA would restore the groundwater within the remediation timeframe and would also result in a significant cost savings by eliminating the need for construction and operation of the facilities (i.e., air stripping units) that would be required under the original pump-and-treat technology.

The following sections summarize aspects of ISB and MNA that supported the reassessment of the original remedy.

4.2 Information Supporting ISB for Hot Spot Restoration

The first laboratory study performed in support of the ISB treatability study focused on evaluation of aerobic dechlorination mechanisms. The study revealed that microorganisms capable of TCE dechlorination were present not only inside the contaminant plume, but also outside. Complete dechlorination of TCE was stimulated with the addition of either phenol or methane. Nitrogen compounds appeared to be the most limiting nutrients for degradation aside from the cometabolic substrate. While this study demonstrated that enhanced aerobic bioremediation of TCE in the medial and distal zones of the contaminant plume is possible, the addition of amendments on that scale is cost-prohibitive.

The anaerobic laboratory study was performed to determine whether enhanced ISB had the potential to replace pump-and-treat technology in the source area, where aquifer conditions were already anaerobic. The study showed that TCE could be completely dechlorinated to carbon dioxide, water, chloride, ethene, and ethane through the addition of sodium lactate as an electron donor. The TCE dechlorination rates were estimated to result in a TCE half-life of less than one month. It was concluded that a field evaluation of enhanced ISB was warranted for the source area.

VOC daughter products (such as vinyl chloride) may be produced as interim, ephemeral breakdown products; however, bioremediation will result in complete dechlorination of VOCs by 2095.

The field evaluation was performed to determine whether the results suggested through the anaerobic laboratory studies could be achieved at field scale. The new information provided by the field evaluation included the following significant points:

- Complete dechlorination of TCE was achieved by enhanced ISB in a very complex hydrogeologic setting.

- Anaerobic reductive dehalogenation of chlorinated solvents can be effectively monitored and interpreted by taking advantage of the following lines of evidence: (1) electron donors, (2)˚biological activity indicators, (3) oxidation-reduction reactants and products, (4)˚contaminants and their degradation products, and (5) general water-quality parameters (pH, specific conductivity, oxidation reduction potential, and temperature). The combination of five individual lines of evidence provides compelling data supporting anaerobic dechlorination of chloroethenes.

The FDR (DOE-ID 2000a [DOE/ID-10718]) presented field monitoring data that demonstrated the ISB technology evaluation met or exceeded all objectives and expectations (see FDR Section˚2.4). In accordance with the Remedial Design/Remedial Action (RD/RA) Scope of Work (SOW) (DOE-ID 1997a [DOE/ID-10522]), the technical success of the field evaluation combined with the preliminary cost information supports a recommendation to implement ISB for remediation of the hot spot. Figure 4-1 illustrates the effects of ISB on TCE concentrations in the plume.

Other advantages of ISB relative to the pump-and-treat technology include the fact that the chlorinated ethenes are completely destroyed rather than simply transferred to the air or other media, and that ISB does not require pumping contaminated groundwater aboveground where a risk of worker exposure or environmental release would exist.

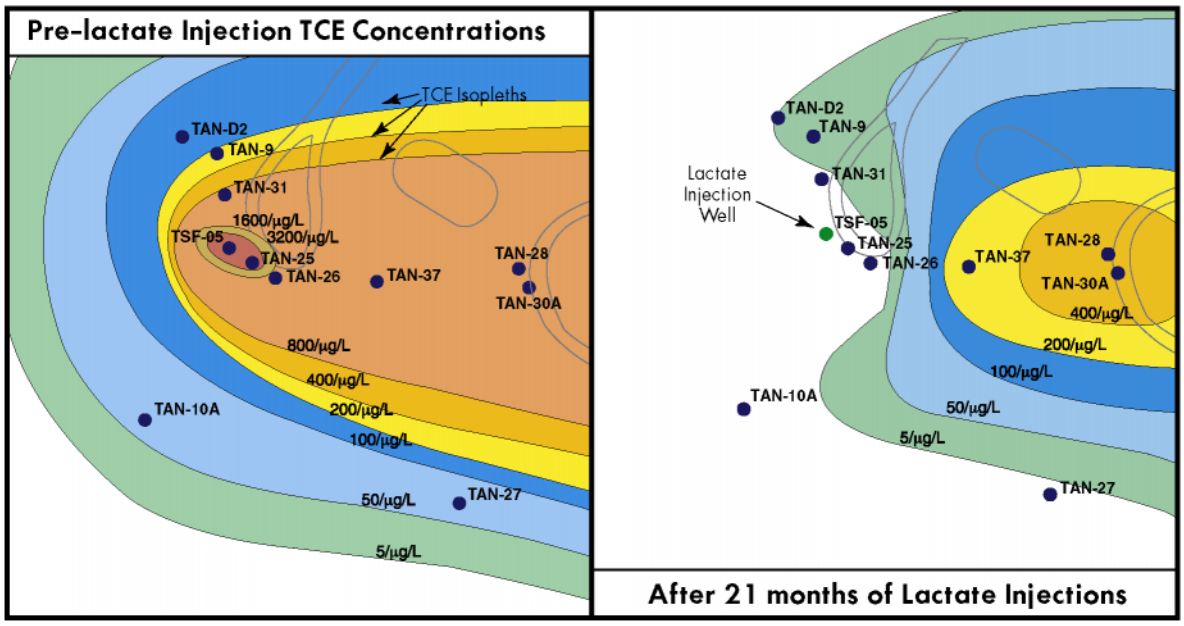

Figure 4-1. Effects of ISB on TCE in the contaminant plume. The diagrams show changes in TCE concentrations within the ISB treatment area after 21 months of sodium lactate injections and ASTU operation.

4.3 Information Supporting MNA for Distal Zone Restoration

The evaluation of MNA for the distal portion of the contaminant plume included the analysis and interpretation of groundwater monitoring data, numerical modeling, and laboratory studies. Initially, the evaluation followed *Use of Monitored Natural Attenuation at Superfund, RCRA Corrective Action, and Underground Storage Tank Sites,* OSWER Directive 9200.4-17P (EPA 1999a), and focused on anaerobic reductive dechlorination and dispersion as possible mechanisms. As the data were compiled, however, it became apparent that another mechanism was affecting TCE in the distal zone of the contaminant plume. Therefore, the focus of the evaluation changed to the development of an understanding of the fate and transport of TCE at TAN using monitoring data, numerical modeling, and the results of existing site-specific laboratory studies.

Existing groundwater-monitoring data were used to provide a quantitative analysis of the fate of TCE relative to that of PCE and tritium. PCE is sensitive to attenuation mechanisms such as sorption or volatilization; tritium is conservative except for its radioactive half-life, which can be accounted for assuming some constant groundwater velocity. The disappearance of TCE relative to PCE and tritium indicates that a natural attenuation mechanism other than dispersion, sorption, or volatilization is reducing TCE concentrations over time. Numerical modeling provided a qualitative analysis of the contaminant plume evolution. The ratios of PCE to TCE determined from field data and the observed pattern of chlorine numbers were consistent with an oxidative degradation mechanism and led to an estimate of a 10—20 year degradation half-life. Laboratory studies demonstrated that microorganisms capable of cometabolically oxidizing TCE are present not only inside, but also downgradient of and cross-gradient to the contaminant plume. Numerical modeling using a half-life from the high end of the estimated range predicted that natural attenuation would achieve the RAOs within the remedial timeframe. The numerical

modeling also demonstrated that the original pump-and-treat remediation strategy using dissolved-phase treatment units would have to be redesigned to include more extraction well locations and higher pumping rates (resulting in higher implementation and operation costs) to meet RAOs within the remedial timeframe.

Independent studies performed by the U.S. Geological Survey, Pacific Northwest National Laboratory, and DOE Environmental Management Science Program researchers all confirmed the presence of potential energy sources in low concentrations across the INEEL, including at TAN. Given that very little biological activity would be required to achieve the estimated TCE half-life of 10—20 years, the available evidence suggested this mechanism might be responsible for the observed attenuation. The new information identified through this data analysis indicated that natural attenuation of TCE and the other VOC COCs through a mechanism other than dispersion appeared to be occurring at TAN.

EPA provides guidance on evaluating the applicability of monitored natural attenuation for groundwater cleanup (EPA 1999a). Of the 11˚points EPA recommends for evaluation of natural attenuation, 10 clearly can be answered in the affirmative. Table 4-1 lists the 11 points summarized from EPA s guidance and evaluates whether they are met at OU 1-07B. Based on conservative modeling, the contaminant plume is not expected to grow more than an additional 30 percent during the entire restoration timeframe (ending in 2095). The plume is well characterized, with 10 years of historical monitoring data available as well as flow and solute transport models. Analysis of these data has demonstrated that VOC dechlorination is taking place. Adequate monitoring wells are in place to continue monitoring the plume. If the plume growth exceeds expectations, the contingency remedy for the distal zone of pump-and-treat (i.e., the default remedy described in the 1995 ROD) will be implemented.

The FDR (DOE-ID 2000a [DOE/ID-10718]) cautioned that implementation of MNA as the distal zone remedy through a ROD Amendment should be subject to two conditions: (1)˚that pump-and-treat technology be identified as a contingency for MNA; and (2)˚that performance reviews of MNA be conducted every year for the first 5˚years and at least every 5 years thereafter so long as performance criteria are met. In addition, the contingency remedy also will be invoked if the required monitoring necessary for MNA is not performed.

Table 4-1. Evaluation of MNA for remediation of the distal zone using EPA-recommended criteria.[a]

Criterion	Criterion Met?
1. Source-control and long-term monitoring should be fundamental components of any MNA remedy.	Yes
2. MNA should not be considered a default or presumptive remedy.	Yes
3. Decisions to employ MNA as a remedy or a remedy component should be thoroughly and adequately supported with site-specific characterization data and analysis.	Yes
4. Unless EPA or the overseeing regulatory authority determines that historical data are of sufficient quality and duration to support a decision to use MNA, data characterizing the nature and rates of natural attenuation processes should be provided. Where the latter are inconclusive, data for microcosm studies may also be necessary.	Yes
5. EPA expects the MNA will be most appropriate when used in conjunction with other remediation measures or as a follow-up to active remediation measures that have already been implemented.	Yes
6. Sites where the contaminant plumes are no longer increasing in extent, or are shrinking, would be most appropriate candidates for MNA remedies.	Although continued growth of the distal zone of the plume is expected, the plume is well characterized and confined within the INEEL s boundaries, and there are no downgradient receptors that could be impacted. If the plume growth exceeds expectations, the contingency remedy for the distal zone of pump-and-treat (i.e., the default remedy described in the 1995 ROD) will be implemented.
7. Where restoration is technically practicable using either aggressive or passive methods, the longer restoration timeframe required by the passive alternative may be reasonable in comparison with the timeframe needed for more aggressive restoration alternatives.	Yes
8. Adequate performance monitoring and contingency remedies should be utilized because of higher levels of uncertainty associated with implementation of MNA over longer timeframes.	Yes
9. Implementation of MNA should meet regulatory authorities expectations that contaminated groundwater will be restored to beneficial use within a reasonable timeframe.	The Agencies agreed in the 1995 ROD that a reasonable timeframe of no more than 100 years (i.e., 2095) would be appropriate for restoration of the contaminant plume. Comments received during the public involvement process indicated that this timeframe is acceptable.
10. Source-control measures will be evaluated for all contaminated sites, and source-control measures will be taken at most sites where practicable.	Yes
11. Performance monitoring should continue until remediation objectives have been achieved, and longer, if necessary, to verify that the site no longer poses a threat to human health and the environment.	Yes

a. *Use of Monitored Natural Attenuation at Superfund, RCRA Corrective Action, and Underground Storage Tank Sites*, OSWER Directive 9200.4-17P (EPA 1999a).

5. REMEDIAL ACTION OBJECTIVES

Remedial action objectives were defined in the 1995 ROD to specify expected remedy performance during the three phases of remedy implementation. One RAO was defined for Phase A, one for Phase B, and one for Phase C. A separate RAO was defined for the institutional controls to ensure the controls remained in place during the life of the remedial action. Phase A and B activities were designed to meet the respective RAOs. Changes documented in the ESD (INEEL 1997 [INEEL/EXT-97-00931]) and the results of the treatability studies led to a revision of the Phase C RAOs. In addition, for all sites within WAG 1, institutional controls are being implemented in accordance with the OU 1-10 ROD (DOE-ID 1999a [DOE/ID-10682]).

5.1 Remedial Action Objectives Defined in the 1995 ROD

The RAOs defined in the 1995 ROD (Section 9.2) included specific objectives for each of the three phases and for institutional controls, as follows:

> Phase A — Remove as much of the secondary source as possible from the vicinity of the TSF-05 Injection Well by physically and hydraulically stressing the well. The treatment system shall be designed such that concentrations of VOCs in the effluent are below MCLs before reinjection into the hot spot. All attempts will be made to operate this process as a hydraulically contained system. The air pollution control device will be operated in compliance with ARARs. Continue surging and stressing the well for 15˚months unless Phase B is ready to begin before this date.
>
> Phase B — Prevent, to the maximum extent practicable, migration of contaminated groundwater beyond the hot spot at levels above MCLs, or for those contaminants for which an MCL does not exist, [ensure that] the contaminant concentration will be such that the total excess cancer risk posed by release of contaminated groundwater will be within the acceptable range of 10^{-4} to 10^{-6}. For aboveground treatment processes using reinjection of treated effluent, treatment shall, at a minimum, be sufficient to reduce the VOC concentration to below MCLs. VOCs discharged to the atmosphere from [Groundwater Treatment Facility] operations will not exceed the calculated emission rate limits specified in Table˚9-1 [of the 1995 ROD].
>
> Phase C — Capture and treat a sufficient portion of the dissolved phase plume beyond the hot spot to provide for aquifer cleanup within 100 years of the date of [1995] ROD signature. For aboveground treatment processes using reinjection of treated effluent, treatment shall be designed to reduce the VOC concentration to below MCLs. If an MCL does not exist, the contaminant concentration will be such that the total excess cancer risk posed by the groundwater will be within the acceptable range of 10^{-4} to 10^{-6}. VOCs discharged to the atmosphere from GWTF operations will not exceed the calculated emission rate limits specified in Table˚9-1 [of the 1995 ROD].
>
> Institutional controls and groundwater monitoring — Institutional controls shall be implemented to protect current and future users from health risks associated with ingestion of groundwater containing COC concentrations greater than MCLs or 10^{-4} to 10^{-6} risk-based concentrations for contaminants without MCLs. Institutional controls shall be maintained until COC concentrations fall below MCLs or 10^{-4} to 10^{-6} risk-based concentrations for contaminants without MCLs.

5.2 Refinement of Remedial Action Objectives for Phase C

Changes and results documented in the ESD and the FDR (DOE-ID 2000a [DOE/ID-10718]) prompted a refinement of the Phase C RAOs. The Agencies agreed to the following final RAOs for the entire contaminant plume:

- Restore the contaminated aquifer groundwater by 2095 (100 years from the signature of the 1995 Record of Decision) by reducing all contaminants of concern to below MCLs and a $1^{\circ}\_^{\circ}10^{-4}$ total cumulative carcinogenic risk-based level for future residential groundwater use and, for non-carcinogens, until the cumulative hazard index is less than 1.

- For aboveground treatment processes in which treated effluent will be reinjected into the aquifer, reduce the concentrations of VOCs to below MCLs and a $1 \_ 10^{-5}$ total risk-based level.

- Implement institutional controls to protect current and future users from health risks associated with ingestion or inhalation of or dermal contact with contaminants in concentrations greater than the MCLs or greater than a $1 \_ 10^{-4}$ cumulative carcinogenic risk-based concentration or a cumulative hazard index of greater than 1, whichever is more restrictive. The institutional controls shall be maintained until concentrations of all contaminants of concern are below MCLs and until the cumulative carcinogenic risk-based level is less than $1 \_ 10^{-4}$ and, for non-carcinogens, until the cumulative hazard index is less than 1. Institutional controls shall include access restrictions and warning signs.

Restoration of the hot spot under either the original remedy or the amended remedy will not directly affect radionuclide concentrations in groundwater. The geochemical behavior of the radionuclides in the subsurface acts to bind them to soil and rock in the area where they now are located. This will continue to prevent them from migrating beyond the vicinity of the hot spot and from being available to future drinking water users. This behavior supports the presumption that, throughout the restoration period, radionuclide concentrations in water extracted from the aquifer downgradient from the hot spot will remain below MCLs and $1 \_ 10^{-4}$ cumulative carcinogenic risk-based levels and, for non-carcinogens, the cumulative risk will remain less than 1. Estimates of radionuclide attenuation by sorption and radioactive decay indicate that Cs-137 and Sr-90 will meet RAOs throughout the contaminant plume by 2095. Sorption of radionuclides from the dissolved phase to subsurface materials prevents these radionuclides from being present in the drinking water of future users. The remaining radionuclides (U-234 and tritium) are currently below MCLs and $1 \_ 10^{-4}$ cumulative carcinogenic risk-based levels. Concentrations of these two radionuclides are not expected to increase to levels that would prevent attainment of RAOs as a result of implementation of either ISB or pump-and-treat.

5.3 Responsiveness to Risk of Remedial Action Objectives

The risks identified in the risk assessment will be addressed by reducing all COCs to below MCLs, and $1 \_ 10^{-4}$ cumulative carcinogenic risk-based levels for those constituents without an MCL, and a cumulative hazard index of less than 1.

5.4 Performance Criteria for Remediation Goals

Remediation goals were developed to ensure that the final remedy would restore the plume by 2095. The refined RAOs for the final remedy (defined in Section˚5.2) led to specific performance goals for each component of the remedy. Each component of the amended remedy (ISB at the hot spot, pump-and-treat in the Medial Zone, and MNA in the distal zone) will restore the plume by 2095. The general performance criteria for each remedy component are given below. The detailed implementation strategy will be presented in the RD/RA SOW for this ROD Amendment.

5.4.1 In Situ Bioremediation at the Hot Spot

The general performance criteria for ISB consist of collection of monitoring data that demonstrate complete dechlorination of VOCs to prevent, to the maximum extent practicable, migration of VOCs above MCLs beyond the hot spot and to restore the plume by 2095.

5.4.2 Pump-and-Treat in the Medial Zone

*(**Note:** The following restatement drawn from the 1995 ROD is provided only to assist the reader. This ROD Amendment is not modifying or amending the medial zone component of pump-and-treat.)* The general performance criteria for the NPTF consist of completing drawdown measurements to ensure that the contaminated groundwater plume is captured and treated to below MCLs.

5.4.3 Monitored Natural Attenuation in the Distal Zone

The general performance criteria for MNA consist of evaluation of monitoring data to determine (1) whether natural attenuation processes continue to meet the RAO for the distal zone of the plume and (2) that plume expansion does not exceed 30%. Predicted breakthrough curves at a selected set of wells will be compared to groundwater monitoring data. The evaluations will be conducted once every year for the first 5 years (Fiscal Years 2001 through 2005) and at least once every 5 years thereafter. If four consecutive evaluations show that the RAOs will not be met within the restoration timeframe, the contingency remedy for the distal zone of pump-and-treat (i.e., the default remedy described in the 1995 ROD) will be implemented or, if the Agencies concur, a more cost-effective remedy will be identified at the time that the contingency remedy is implemented. If, as a result of a 5-year review, data analysis indicates that the RAO will not be met within the restoration timeframe, additional annual reviews will be conducted until four consecutive evaluations produce the same result.

6. DESCRIPTION OF THE ORIGINAL REMEDY AND AMENDED REMEDY

The treatability studies (described in Section˚2.4) demonstrated that an amended remedy incorporating two of the tested technologies would be more effective than the original remedy. This section summarizes the original remedy and the amended remedy and describes the common elements and the distinguishing features of the two alternatives.

6.1 Original Remedy

The original remedy, as described in the 1995 ROD and refined in the ESD (INEEL 1997 [INEEL/EXT-97-00931]), called for groundwater extraction and aboveground treatment for all three zones using three separate pump-and-treat facilities. Two of the three components (pump-and-treat at the hot spot and in the distal zone) are being amended; the medial zone component is not being amended and will be implemented as described in the 1995 ROD. Based on the results of the treatability studies, the decision was made to continue with the default remedy of pump-and-treat for the medial zone. Institutional controls and groundwater monitoring are also not being amended.

6.1.1 Pump-and-Treat in the Medial Zone

In accordance with the original remedy, groundwater extraction and treatment in the medial zone will be carried out at the NPTF. Extraction wells will be located approximately 450 m (1,500˚ft) downgradient from the TSF-05 Injection Well. The NPTF will treat the extracted, contaminated water using air stripping to reduce VOC concentrations in the medial zone to a cumulative risk of less than or equal to 1 _ 10^{-5}, and the treated water will be reinjected into the aquifer. Operation of the NPTF is designed to (a)˚prevent groundwater contaminated at or above 1,000˚µg/L TCE from migrating farther downgradient, and (b)˚ensure reinjected water from the NPTF contains concentrations of VOCs less than MCLs and that result in a cumulative risk of less than or equal to 1 _ 10^{-5}. Monitoring data from the medial zone will be used to evaluate attainment of RAOs, verify plume containment, and verify radionuclide decay and migration.

Design of the NPTF began pursuant to the decision in the 1997 ESD for early implementation of medial zone remediation (see Section˚2.3). Construction of the NPTF started in February 2000 and the facility is scheduled to start routine operations in Fall 2001. The facility is designed to treat groundwater at up to 250 gallons per minute˚(gpm).

6.1.2 Contingency Remedy for the Medial Zone

The Agencies agreed that radionuclide treatment would not be included in the design for the NPTF, because radionuclides above MCLs are not expected to be present in groundwater routinely treated through the NPTF. Although it is not expected, in the event that radionuclides migrate to NPTF extraction wells in concentrations that would exceed MCLs at the reinjection well, a contingency remedy for the medial zone would be implemented. This contingency remedy would involve operation of the existing ASTU to extract groundwater from a well upgradient of the NPTF, treat the contaminated water through air stripping to remove VOCs, and reinject the treated water in an injection well located upgradient near the hot spot to facilitate sorption of radionuclides onto subsurface soil and rock. Operation of the ASTU as the medial zone contingency remedy would prevent migration of radionuclides that may exceed MCLs in the NPTF reinjection well.

During implementation of the contingency remedy, the NPTF would be operated in such a way as to ensure that the concentration of radionuclides in treated effluent would be less than the applicable MCLs. If the medial zone contingency remedy were implemented, a groundwater monitoring program would be established to monitor the migration of radionuclides.

The NPTF will also treat small quantities of contaminated groundwater (purge water) generated during groundwater monitoring activities conducted during the remedial action. This purge water will originate from all three zones of the contaminant plume. Purge water from the hot spot may contain radionuclides that have concentrations above MCLs. However, this purge water will be added to the NPTF process influent so that the concentration of radionuclides in water reinjected to the aquifer is less than MCLs.

If in the future, cost-effective radionuclide removal technologies become available that could be used for remediation at this site, the Agencies will reassess this component of the amended remedy.

6.2 Amended Remedy

The amended remedy changes two of the three original components for restoring the hot spot and the distal zone of the contaminant plume. The amended remedy components for the hot spot and the distal zone will work in concert with the medial zone component to remediate the entire contaminant plume. Institutional controls and groundwater monitoring will be implemented to support the remedial action. The amended remedy components are:

- ISB at the hot spot, using nutrient injection to create enhanced biodegradation of the VOCs through anaerobic reductive dechlorination. This component will replace the pump-and-treat technology specified for the hot spot under the original remedy.

- MNA in the distal zone. Current estimates indicate that natural attenuation will reduce VOC concentrations to below MCLs within the remedial timeframe. This component will replace the pump-and-treat technology specified for the distal zone under the original remedy.

  Pump-and-treat is identified as the contingency remedy for the distal zone. If evaluations show that the RAOs will not be met within the restoration timeframe, the contingency remedy (i.e., the default remedy from the 1995 ROD) will be implemented or, if the Agencies concur, a more cost-effective remedy will be identified at the time that the contingency remedy is implemented. The contingency remedy also will be invoked if the required monitoring necessary for MNA is not performed. The pump-and-treat system would involve extraction of contaminated groundwater, treatment to reduce the VOCs to below MCLs, and reinjection of treated groundwater. It has been determined that groundwater treated through the NPTF will not be a listed hazardous waste as it will not present an unacceptable risk to human health or environmental receptors. VOC treatment technologies applied in the pump-and-treat facility would be based on concentrations of VOCs measured in the water extracted from the contaminant plume.

6.3 Common Elements

Both the original remedy and the amended remedy use pump-and-treat technology for medial zone remediation, and both remedies use the NPTF for medial zone remediation, as described in Section˚6.1.

Both remedies require institutional controls to protect current and future users from health risks associated with groundwater contamination. Consistent with expectations set out in the Superfund regulations (40 CFR 300), neither of the remedies relies exclusively on institutional controls to achieve effectiveness. Detailed information and requirements for institutional controls are addressed in the OU˚1-10 ROD (DOE-ID 1999a [DOE/ID-10682]). The only change in institutional controls from the 1995 ROD is the addition of the threshold for non-carcinogens:

- Institutional controls for the entire plume to protect current and future users from exposure to contaminants above MCLs and greater than 1 _ 10^{-4} cumulative carcinogenic risk-based levels and, for non-carcinogens, to a cumulative hazard index of equal to or greater than 1.

Monitoring to ensure the effectiveness of the remedy is a component of both remedies, and has not been changed from the 1995 ROD:

- Groundwater monitoring in accordance with monitoring plans developed as part of the RD/RA. Monitoring data will be used to track the contaminant plume boundary, changes in COC concentration levels, and the attenuation rate to evaluate attainment of RAOs.

The groundwater monitoring program will include, among its activities, monitoring radionuclide concentrations in the hot spot, the medial zone, and the distal zone, as applicable.

6.4 Distinguishing Features

At the hot spot the amended remedy, which uses ISB, is expected to achieve RAOs in about half the time of the original remedy, which uses pump-and-treat technology, because ISB removes the secondary source, while pump-and-treat merely contains it. Both remedies would be expected to achieve RAOs by 2095.

The estimated life-cycle cost in net present value (NPV) for the original remedy is $43˚million. The estimated life-cycle cost for the amended remedy is $35˚million. The budget for the amended remedy is shown in Table˚8-1. Details of both cost estimates are presented in the ROD Amendment Cost Estimate Support Data Recapitulation (INEEL 2001 [EDF-ER-201]).

7. EVALUATION OF ALTERNATIVES

Two remedial alternatives are compared in this section: the original remedy (pump-and-treat at the hot spot and in the distal zone) and the amended remedy (ISB at the hot spot and MNA for the distal zone). Field evaluations indicated that ISB at the hot spot and MNA for the distal zone would better meet the evaluation criteria than pump-and-treat technology. The comparative analysis summarized here evaluates the relative performance of the remedies with respect to EPA s nine evaluation criteria. The nine criteria are grouped into three sets: threshold, primary balancing, and modifying. For each criterion below, the advantages and disadvantages of each remedy are identified.

7.1 Evaluation of Alternatives for the Hot Spot

7.1.1 Threshold Criteria

Threshold criteria are requirements that an alternative must meet to be eligible for selection as the final remedy. The threshold criteria are (1) overall protection of human health and the environment, and (2)˚compliance with ARARs.

Overall Protection of Human Health and the Environment. This criterion addresses whether an alternative provides adequate protection of human health and the environment and describes how risks posed through exposure pathways are eliminated, reduced, or controlled through treatment, engineering controls, or institutional controls. As a threshold criterion, this must be met for an alternative to be eligible for detailed evaluation and selection.

Both the original remedy of pump-and-treat and the amended remedy, which uses ISB, are protective of human health and the environment by eliminating, reducing, or controlling risks posed by the site through treatment of groundwater contaminants to meet MCLs. The original remedy would provide adequate protection by extracting the contaminated groundwater and treating it to meet MCLs. However, it would contain, rather than degrade, the secondary source. In addition, the pump-and-treat facility would require air emission controls to protect human health. The amended remedy would provide additional protection because the treatment technology would not require contaminated groundwater to be brought to the surface, and it would degrade the secondary source to dechlorinated byproducts.

Compliance with Applicable or Relevant and Appropriate Requirements (ARARs). This criterion requires that remedial actions at CERCLA sites at least attain legally applicable or relevant and appropriate federal and state requirements, standards, criteria, and limitations (collectively referred to as ARARs), as required by Section˚121(d) of CERCLA and the NCP Section˚300.430(f)(1)(ii)(B). As a threshold criterion, this must be met for an alternative to be eligible for selection.

Both the original remedy, pump-and-treat, and the amended remedy, ISB, would attain their respective ARARs. Drinking water standards will be met through either remedy within the restoration timeframe. For the original remedy, use of pump-and-treat technology would produce an air-emission waste stream that may require air pollution control (APC) equipment to meet the emission standards for VOCs to protect human health. The original remedy will also comply with applicable underground injection control (UIC) standards for reinjection. The amended remedy, ISB, would not require consideration of air emission ARARs, because there will be no air emissions associated with the treatment process. However, the amendments (e.g., sodium lactate) injected into the aquifer during ISB may contain chemical constituents above MCLs. The Agencies have agreed that amendments containing constituents above MCLs may be injected to support aquifer remediation.

7.1.2 Balancing Criteria

The five balancing criteria serve to weigh major trade-offs between alternatives. They are: (1)˚long-term effectiveness and performance, (2)˚reduction of toxicity, mobility, or volume through treatment, (3) short-term effectiveness, (4)˚implementability, and (5) cost.

Long-Term Effectiveness and Permanence. This criterion refers to expected residual risk and the ability of a remedy to maintain reliable protection of human health and the environment over time. This criterion includes consideration of residual risk that will remain on-site following remediation, and the adequacy and reliability of controls.

Both remedies would provide some degree of long-term effectiveness and permanence, but the amended remedy better reduces residual risk: data and modeling indicate that ISB will degrade the secondary source of contaminants within the hot spot, while pump-and-treat has limited ability to remove the secondary source. The original remedy utilizes a reliable technology, pump-and-treat, to permanently remove VOCs from treated groundwater, although the pump-and-treat system would have to be maintained and replaced periodically throughout the duration of the remedial action. The amended remedy would also use a reliable technology, ISB. ISB would permanently destroy the VOCs in situ and is expected to achieve RAOs more quickly than the original remedy. Maintenance and possible system replacement would be required for the amended remedy. However, the ISB injection system is operationally simpler than the original remedy s pump-and-treat facility.

Reduction of Toxicity, Mobility, or Volume through Treatment. This criterion addresses the statutory preference for selecting remedial actions that employ treatment technologies that permanently reduce toxicity, mobility, or volume of the COCs.

Both remedies would reduce toxicity, mobility, or volume of COCs through treatment. Under either remedy, the treatment would be irreversible. The original remedy would permanently reduce VOC toxicity in treated groundwater through air stripping, which would transfer the VOCs to the air or to carbon (if required), and would reduce the mobility of contaminants by hydraulically containing the secondary source area. It also would remove contaminants from the dissolved phase and thus indirectly act to reduce the secondary source. The amended remedy would reduce toxicity by destroying TCE and other chlorinated VOCs in situ and directly reduce the volume of the secondary source. In addition, it would reduce the volume of COCs in less time than the original remedy.

Short-Term Effectiveness. Short-term effectiveness evaluates the amount of time until the remedy effectively protects human health and the environment at the site. It also evaluates any adverse effects that may be posed to workers, the community, or the environment during construction and operation while the remedial activity is being carried out.

Both remedies provide some degree of short-term effectiveness. The amended remedy would provide better short-term effectiveness because the time required for the ISB treatment system to achieve RAOs is anticipated to be about half that of a pump-and-treat system. Risks to workers during the remedial activity would be minimal for the amended remedy, because ISB would completely destroy VOCs underground rather than bringing them aboveground. The original remedy would transfer contaminated water aboveground, where a risk of worker exposure or environmental release would exist. Air stripping under the original remedy could result in impacts to air quality; these would not occur under the amended remedy, since no contaminants would be brought aboveground except for monitoring purposes.

Implementability. The criterion of implementability addresses the technical and administrative feasibility of a remedy from design through construction and operation. Factors such as availability of services and materials, and coordination with other governmental entities, are also considered.

Implementability of both remedies would be high, because equipment, materials, and personnel are readily available, and construction of the treatment system and extraction and reinjection wells use known technologies. However, the amendment injection system is less complicated than a pump-and-treat system. The original remedy could require design consideration of secondary containment and air emissions. As well, it could require additional extraction wells and upgrades to the treatment facility. The amended remedy could require additional injection wells, but would have a simpler and more easily implemented infrastructure overall.

Cost. The estimated life-cycle costs (in NPV using a 7% discount rate) for the two remedies at the hot spot are $2.72 million for the original remedy ($1.1 million for capital costs, and $209 thousand yearly for operations and maintenance [O&M]), and $1.48 million for the amended remedy ($106˚thousand for capital costs, and $205 thousand yearly for O&M). Calculation of the NPV estimates assumed a 30-year operating period for the original remedy and 15 years of operations for the amended remedy. The budget for the amended remedy is shown in Table˚8-1. Details of both cost estimates are presented in the ROD Amendment Cost Estimate Support Data Recapitulation (INEEL 2001 [EDF-ER-201]).

7.1.3 Modifying Criteria

Modifying criteria are fully considered after public comment on the Proposed Plan is received. The two modifying criteria are (1) state acceptance and (2) community acceptance. The modifying criteria are used in final evaluation of remedial alternatives and are equal in importance to the balancing criteria.

State Acceptance. State acceptance is demonstrated by IDEQ concurrence with the selected remedial alternative and signature of this ROD Amendment. The IDEQ was involved in the development and review of the ESD, the FDR, and the Proposed Plan (as cited in Table 2-4), as well as this ROD Amendment and other project activities including the public meetings.

Community Acceptance. For community acceptance, the factors that are considered include which elements of the remedial alternatives interested persons in the community support, have reservations about, or oppose.

The Responsiveness Summary (Part III) portion of this ROD Amendment documents the full range and content of the public comments received regarding the recommended action.

Overall, the amended remedy is strongly supported, especially in its use of a more cost-effective technology. Several comments sought additional general information on ARARs, institutional controls, and achievement of RAOs. One written comment included numerous questions on how the amended remedy will deal with radionuclides; this additional detail was provided in the Responsiveness Summary (see, for example, responses to Comments 7, 10, 21, 23, and 26 in Section˚13), based on information summarized in Section˚5.2. Several commenters asked how sufficient amendments could be injected to support ISB, whether the dechlorination breakdown products could pose risk, and whether new risk could be introduced to the aquifer from potential contaminants that may be present in the amendments. These concerns have been addressed by responses to Comments 12, 17, 19, and 22 in Section˚13, based on information in Section˚8.1.1.

No commenters preferred the original remedy of pump-and-treat to the amended remedy of ISB. The single topic mentioned by the greatest number of commenters was praise for the Agencies use of research and testing to develop an innovative, more cost-effective remedy (see Comments 1, 15, and 27 in Section˚13).

7.2 Evaluation of Alternatives for the Distal Zone

7.2.1 Threshold Criteria

Threshold criteria are requirements that an alternative must meet to be eligible for selection as the final remedy. The threshold criteria are (1) overall protection of human health and the environment, and (2)˚compliance with ARARs.

Overall Protection of Human Health and the Environment. This criterion addresses whether an alternative provides adequate protection of human health and the environment and describes how risks posed through exposure pathways are eliminated, reduced, or controlled through treatment, engineering controls, or institutional controls. As a threshold criterion, this must be met for an alternative to be eligible for detailed evaluation and selection.

Both the original remedy, pump-and-treat, and the amended remedy, MNA, are protective of human health and environment by eliminating, reducing, or controlling risks posed by the site through treatment or natural attenuation of groundwater contaminants. The original remedy would provide adequate protection by extracting the contaminated groundwater and treating it to meet MCLs. However, the pump-and-treat facility would require air emission controls to protect human health. The amended remedy would provide better protection because natural attenuation would not require contaminated groundwater to be brought to the surface; hence, no air emission controls would be required.

Both the original remedy of pump-and-treat and the amended remedy, MNA, are projected to meet RAOs within the restoration timeframe (by 2095). For cost estimating purposes, the 1995 ROD assumed pump-and-treat technology would meet RAOs after 30 years.

Under the amended remedy, the plume is expected to reach its maximum extent (30% growth) in 2027. However, at its largest, the plume will remain well within the INEEL s boundaries. Furthermore, institutional controls will prevent exposure of potential users to contaminated groundwater during the restoration period.

Compliance with Applicable or Relevant and Appropriate Requirements (ARARs). This criterion requires that remedial actions at CERCLA sites at least attain legally applicable or relevant and appropriate federal and state requirements, standards, criteria, and limitations (collectively referred to as ARARs), as required by Section˚121(d) of CERCLA and NCP Section˚300.430(f)(1)(ii)(B). As a threshold criterion, this must be met for an alternative to be eligible for selection.

For the original remedy, use of pump-and-treat technology would produce an air-emission waste stream that may require APC equipment to meet the emission standards for VOCs to protect human health. The amended remedy, MNA, would not require consideration of air emission ARARs, because there would be no air emissions associated with the natural attenuation process.

7.2.2 Balancing Criteria

The five balancing criteria serve to weigh major trade-offs among alternatives. They are: (1)˚long-term effectiveness and performance, (2)˚reduction of toxicity, mobility, or volume through treatment, (3) short-term effectiveness, (4)˚implementability, and (5)˚cost.

Long-Term Effectiveness and Permanence. This criterion refers to expected residual risk and the ability of a remedy to maintain reliable protection of human health and the environment over time. This criterion includes consideration of residual risk that will remain on-site following remediation, and the adequacy and reliability of controls.

Both remedies would provide some degree of long-term effectiveness and permanence. The original remedy utilizes a reliable technology, pump-and-treat, to permanently remove VOCs from extracted groundwater, although the pump-and-treat system would have to be maintained and replaced periodically. The original remedy would control plume migration in the distal zone. The amended remedy, using MNA, will permanently dechlorinate the VOCs in situ through natural degradation processes. However, modeling projects that growth of the distal zone of up to 30% might occur, with the contaminant plume reaching its maximum size in about 2027. The amended remedy is expected to require a longer period of time to achieve RAOs than the original remedy would. Both remedies require the NPTF to be operational in order to contain and treat upgradient contaminants within the medial zone.

Reduction of Toxicity, Mobility, or Volume through Treatment. This criterion addresses the statutory preference for selecting remedial actions that employ treatment technologies that permanently reduce toxicity, mobility, or volume of the COCs.

Under either remedy, the reduction of toxicity, mobility, or volume would be irreversible. The original remedy would permanently reduce VOCs in groundwater through air stripping, but would transfer contaminants to carbon or air rather than destroy them. It would reduce plume mobility in the distal zone. The amended remedy, MNA, does not reduce toxicity, mobility, or volume of contaminants through treatment but allows natural degradation processes to achieve the same goals. Modeling suggests that growth of the distal zone of up to 30% might occur during the first quarter of the remediation period. The contaminant plume is projected to reach maximum size in about 2027 as a result of downgradient movement, and then decrease in size as attenuation continues.

Short-Term Effectiveness. Short-term effectiveness evaluates the amount of time until the remedy effectively protects human health and the environment at the site. It also evaluates any adverse effects that may be posed to workers, the community, or the environment during construction and operation while the remedial activity is being carried out.

Both remedies provide some degree of short-term effectiveness. The original remedy would transfer contaminated water aboveground, where a risk of exposure to workers, the community, or the environment would exist. Air stripping under the original remedy could result in impacts to air quality; these would not occur under the amended remedy, because MNA takes place underground. The amended remedy, MNA, would provide better short-term effectiveness because, other than through monitoring activities common to both remedies, MNA would not have a potential to expose workers, the community, and the environment to contaminants. Both the original remedy of pump-and-treat and the amended remedy, MNA, are projected to meet RAOs within the restoration timeframe (by 2095). For estimating purposes, the 1995 ROD assumed pump-and-treat technology would meet RAOs after 30 years.

Implementability. The criterion of implementability addresses the technical and administrative feasibility of a remedy from design through construction and operation. Factors such as availability of services and materials, and coordination with other governmental entities, are also considered.

Implementability of the original remedy would be high, because equipment, materials, and personnel are readily available, and construction of the treatment system and extraction and reinjection wells use known technologies. However, design of the facility would require consideration of secondary containment and air emissions. Implementability of the amended remedy, MNA, would be higher because it requires no special equipment or material and would use the existing monitoring system, which is sufficient to cover anticipated plume growth, as well. MNA also requires no construction and operation infrastructure other than monitoring wells.

Cost. The estimated life-cycle costs (in NPV using a 7% discount rate) for the remedies for the distal zone are $4.45 million for the original remedy ($2.1 million for capital costs, and $400 thousand yearly for O&M), and $0.71 million for the amended remedy ($0 for capital costs, and $77 thousand yearly for O&M). Calculation of the NPV estimates assumed a 30-year operating period for both remedies. The MNA cost estimate assumes that the groundwater monitoring program would require additional analytes beyond those required for monitoring under the pump-and-treat technology of the original remedy.

The budget for the amended remedy is shown in Table˚8-1. Details of both cost estimates are presented in the ROD Amendment Cost Estimate Support Data Recapitulation (INEEL 2001 [EDF-ER-201]).

7.2.3 Modifying Criteria

Modifying criteria are fully considered after public comment on the Proposed Plan is received. The two modifying criteria are (1) state acceptance and (2) community acceptance. The modifying criteria are used in final evaluation of remedial alternatives and are equal in importance to the balancing criteria.

State Acceptance. State acceptance is demonstrated by IDEQ concurrence with the selected remedial alternative and signature of this ROD Amendment. The IDEQ was involved in the development and review of the ESD, the FDR, and the Proposed Plan (as cited in Table 2-4), as well as this ROD Amendment and other project activities, including the public meetings.

Community Acceptance. For community acceptance, the factors that are considered include which elements of the remedial alternatives interested persons in the community support, have reservations about, or oppose.

The Responsiveness Summary (Part III) portion of this ROD Amendment documents the full range and content of the public comments received regarding the recommended action.

Overall, the amended remedy is strongly supported, especially for its cost-effectiveness. Several comments sought additional general information on ARARs, institutional controls, and achievement of RAOs. One written comment included questions on whether the amended remedy would need to deal with radionuclides in the distal zone; this additional detail was provided in the Responsiveness Summary (see, for example, responses to Comments 10, 23, and 26 in Section˚13), based on the information summarized in Section˚5.2.

No commenters preferred the original remedy of pump-and-treat to the amended remedy MNA. The single topic mentioned by the greatest number of commenters was praise for the Agencies use of

research and testing to develop an innovative, more cost-effective remedy (see Comments 1, 15, and 27 in Section˚13).

7.3 Tabular Ranking of Alternatives

Tables 7-1 and 7-2 show how the two remedies compare under each criterion. The comparison is based on remediation of TCE. Remedial actions that reduce TCE will act to reduce the other VOC COCs as well. The radionuclide COCs are expected to meet RAOs through decay and adsorption before the end of the remedial action timeframe.

Table 7-1. Comparative analysis of alternatives for the hot spot.[a]

Criteria	Original Remedy (Pump-and-Treat)	Amended Remedy (ISB)
THRESHOLD CRITERIA		
Overall Protectiveness		
Human Health Protection	Reduces aquifer VOC concentrations to MCLs and will contain the secondary source. Management of water brought to the surface for treatment will require controls to ensure worker safety and off-gas treatment.	More protective because it will not only destroy TCE concentrations in situ but will also degrade the secondary source. In situ treatment eliminates need for controls to insure worker safety related to handling and treatment of contaminated water.
Environmental Protection	The only environmental risks known to be associated with this action are from air emissions during treatment.	There are no groundwater discharges to the surface and, thus, no environmental risks are known to be associated with this action.
Compliance with ARARs		
Chemical-Specific ARARs	Meets all ARARs of Federal and State environmental statutes.	Meets all ARARs of Federal and State environmental statutes.
Location-Specific ARARs	No location-specific ARARs.	No location-specific ARARs.
Action-Specific ARARs	Meets all action-specific ARARs. System will meet all air release standards for off-gas as well as applicable UIC standards for reinjection.	Meets all action-specific ARARs. Amendments will be injected in accordance with Idaho Administrative Procedures Act (IDAPA) 37.03.03.050.01.
PRIMARY BALANCING CRITERIA		
Long-Term Effectiveness and Permanence		
Magnitude of Residual Risk	The ability to remove the secondary source is limited.	Current data and modeling indicate that ISB will degrade the secondary source.
Adequacy and Reliability of Controls	Expected to be reliable for at least the first 30˚years. Long-term permanence will require periodic system replacement.	ISB is reliable and is expected to be completed in a shorter period of time relative to the original remedy of pump-and-treat. The controls for the amendment delivery system are simple relative to the original remedy s pump-and-treat facilities.
Reduction of Toxicity, Mobility, or Volume through Treatment		
Treatment Process Used and Materials Treated	Removes VOCs in groundwater by air stripping and will result in VOC media transfer (rather than destruction).	Removes TCE in groundwater by ISB without media transfer, and will degrade the secondary source.
Amount of Hazardous Materials Destroyed or Treated	Removes VOCs from the hot spot to prevent MCLs from being exceeded in the medial zone.	Removes TCE from the hot spot to prevent MCLs from being exceeded in the medial zone.
Degree of Expected Reductions in Toxicity, Mobility, or Volume	Typically achieves 99% reduction in toxicity of extracted groundwater.	Current data and modeling indicate that ISB achieves complete dechlorination within the hot spot and reduces volume through degradation of the secondary source.
Degree to which Treatment is Irreversible	Irreversible process.	Irreversible process.
Type and Quantity of Residuals Remaining After Treatment	Secondary source contamination may remain for a longer period of time. Carbon used in off-gas treatment (if required) will require disposal.	Will degrade the secondary source over a shorter period of time than the original remedy. No residuals will remain from ISB because breakdown is complete.

Table 7-1. (continued).

Criteria	Original Remedy (Pump-and-Treat)	Amended Remedy (ISB)
Short-Term Effectiveness		
Protection of Community During Remedial Actions	Air emissions increase the risk to the community. Institutional controls will prevent risk to the community from ingestion of contaminated groundwater.	Institutional controls will prevent risk to the community from ingestion of contaminated groundwater.
Protection of Workers During Remedial Actions	Protection required against dermal contact and vapor inhalation and operation. Institutional controls will prevent risk to workers from ingestion of contaminated groundwater and risks from air emissions.	The amendments are food-grade commodities.
Environmental Impacts	Off-gas may impact air quality.	No environmental impacts.
Time Until Remedial Action Objectives are Achieved	Expected to achieve hot spot RAOs for VOCs by 2025—2095, and for the radionuclide COCs by 2095.	Anticipated to achieve hot spot RAOs for VOCs in roughly half the time required for pump-and-treat, and for the radionuclide COCs by 2095.
Implementability		
Ability to Construct and Operate the Technology	Mature technology that is easily implementable.	Implementable with simpler infrastructure than required for pump-and-treat.
Ease of Undertaking Additional Remedial Actions, if Necessary	Additional extraction wells and upgrades to treatment facility may be added as necessary.	Additional amendments and injection wells may be added as needed.
Ability to Monitor Effectiveness of Remedy	Treatment system is easily monitored to determine effectiveness.	Treatment system is easily monitored to determine effectiveness.
Ability to Obtain Approvals and Coordinate with other Agencies	Need to demonstrate compliance with air standards, RCRA secondary containment requirements, and UIC regulations.	Amendments must be injected in accordance with UIC regulations (IDAPA 37.03.03.050.01).
Availability of Necessary Equipment and Specialists	Equipment, materials, and personnel to operate systems are readily available.	Equipment, materials, and personnel to operate are readily available.
Availability of Prospective Technologies	Available.	Available.
Cost[b]		
Estimated Cost	$2.72 million[c]	$1.48 million[d]

a. The remedial actions evaluated here to reduce TCE will act to reduce the other chlorinated COCs as well.

b. Costs are in 1999 dollars in NPV using a 7% discount rate. NPV estimates assumed a 30-year operating period for the original remedy and 15 years of operations for the amended remedy.

c. The estimated cost of the original remedy comprises $1.1 million for capital costs, and $209 thousand yearly for O&M.

d. The estimated cost of the amended remedy comprises $106 thousand for capital costs, and $205 thousand yearly for O&M.

Table 7-2. Comparative analysis of alternatives for the distal zone.

Criteria	Original Remedy (Pump and Treat)	Amended Remedy (Monitored Natural Attenuation)
THRESHOLD CRITERIA		
Overall Protectiveness		
Human Health Protection	Reduces aquifer VOC concentrations to MCLs. Management of water brought to the surface for treatment will require controls to ensure worker safety.	More protective because it will not only destroy contaminants in situ (by natural biodegradation processes), it will also reduce aquifer VOC concentrations to MCLs within the restoration timeframe. In situ degradation eliminates the need for controls to insure worker safety related to handling and treatment of contaminated water. Plume growth of up to 30% is expected before attenuation operates to reduce plume size to meet distal zone RAOs. Although MNA may take longer to meet RAOs, it will be accomplished in situ, which will prevent exposure to COCs.
Environmental Protection	The only environmental risks known to be associated with this action are from air emissions during treatment.	There are no groundwater discharges to the surface and, thus, no environmental risks are known to be associated with this action.
Compliance with ARARs		
Chemical-Specific ARARs	Meets all ARARs of Federal and State environmental statutes.	Meets all ARARs of Federal and State environmental statutes.
Location-Specific ARARs	No location-specific ARARs.	No location-specific ARARs.
Action-Specific ARARs	Meets all action-specific ARARs. System will meet all air release standards for off-gas as well as applicable UIC standards for reinjection.	No action-specific ARARs.
PRIMARY BALANCING CRITERIA		
Long-Term Effectiveness and Permanence		
Magnitude of Residual Risk	Results in low residual risk by removal of aqueous phase VOCs.	Results in low residual risk due to the removal of VOCs by dechlorination.
Adequacy and Reliability of Controls	Expected to be reliable for at least the first 30˚years. Requires NPTF to be operational and functional to contain and treat upgradient contaminants within the medial zone.	MNA is reliable. However, it is expected to require a longer period of time relative to the original remedy of pump-and-treat. Other than monitoring, which is common to both remedies, no systems or infrastructure are required. Requires NPTF to be operational and functional to contain and treat upgradient contaminants within the medial zone.
Reduction of Toxicity, Mobility, or Volume through Treatment		
Treatment Process Used and Materials Treated	Removes VOCs in groundwater by air stripping and will result in VOC media transfer (rather than destruction).	Removes VOCs through natural dechlorination processes without media transfer.
Amount of Hazardous Materials Destroyed or Treated	Removes VOCs to meet RAOs for the distal zone.	Dechlorinates VOCs to meet RAOs for the distal zone.
Degree of Expected Reductions in Toxicity, Mobility, or Volume	Typically achieves 99% reduction in toxicity of extracted groundwater.	Achieves complete dechlorination through natural degradation processes. Plume growth of up to 30% is expected before attenuation operates to reduce plume size.
Degree to which Treatment is Irreversible	Irreversible process.	Irreversible process.

Table 7-2. (continued).

Criteria	Original Remedy (Pump and Treat)	Amended Remedy (Monitored Natural Attenuation)
Reduction of TMV (continued)		
Type and Quantity of Residuals Remaining After Treatment	Carbon used in off-gas treatment (if required) will require regeneration or disposal.	No detectable residuals remain.
Short-Term Effectiveness		
Protection of Community During Remedial Actions	Air emissions increase the risk to the community. Institutional controls will prevent risk to the community from ingestion of contaminated groundwater.	Institutional controls will prevent risk to the community from ingestion of contaminated groundwater.
Protection of Workers During Remedial Actions	Protection required against dermal contact and vapor inhalation during construction and operation. Institutional controls will prevent risk to workers from ingestion of contaminated groundwater and risks from air emissions.	Will not increase potential risk to workers because it takes place in situ.
Environmental Impacts	Off-gas may impact air quality.	No environmental impacts.
Time Until Remedial Action Objectives are Achieved	Expected to achieve distal zone RAOs by 2025—2095.	Anticipated to meet distal zone RAOs by 2095.
Implementability		
Ability to Construct and Operate the Technology	Mature technology that is easily implementable.	MNA requires no construction and operation other than monitoring, which is common to both remedies.
Ease of Undertaking Additional Remedial Actions, if Necessary	Additional extraction wells and upgrades to treatment facility may be added as necessary.	The contingency remedy is pump-and-treat (the 1995 ROD default remedy).
Ability to Monitor Effectiveness of Remedy	Treatment system is easily monitored to determine effectiveness.	Treatment system is easily monitored to determine effectiveness. Plume growth of up to 30% is within the existing monitoring system coverage area.
Ability to Obtain Approvals and Coordinate with other Agencies	Need to demonstrate compliance with air standards, RCRA secondary containment requirements, and UIC regulations.	No additional approvals required.
Availability of Necessary Equipment and Specialists	Equipment, materials, and personnel to operate systems are readily available.	Does not require any special equipment or material.
Availability of Prospective Technologies	Available.	Available.
Cost[a]		
Estimated cost	$ 4.45 million[b]	$ 0.71 million[c]

a. Costs are in 1999 dollars in NPV using a 7% discount rate. The NPV estimates assumed a 30-year operating period for both remedies.

b. The estimated cost of the original remedy comprises $2.1 million for capital costs, and $400 thousand yearly for O&M.

c. The estimated cost of the amended remedy comprises $0 for capital costs, and $77 thousand yearly for O&M.

8. AMENDED REMEDY

The amended remedy for OU 1-07B combines ISB for hot spot restoration and MNA for distal zone restoration with the pump-and-treat technology (selected in the 1995 ROD) for the medial zone, providing a comprehensive approach to the restoration of the contaminant plume. The amended remedy also includes groundwater monitoring and institutional controls. The decision to implement the amended remedy signifies completion of Phase B of the original remedy and the initiation of Phase C. However, measures implemented during Phase B for hot spot containment will continue until the ISB component of the amended remedy is fully operational.

In accordance with the original remedy selected in the 1995 ROD, construction of the New Pump-and-Treat Facility (NPTF) in the medial zone was completed in January 2001. The facility is scheduled to start routine operations in Fall 2001. Implementation of ISB and MNA will begin when this ROD Amendment is signed. Figure 8-1 is a conceptual illustration of the components of the amended remedy. The components of the amended remedy for restoration of the OU 1-07B hot spot and dissolved phase contaminant plume are:

- Hot Spot — In Situ Bioremediation using amendment injection to create enhanced dechlorination of TCE through anaerobic reductive dechlorination.

- Medial Zone — Pump and Treat with extraction of contaminated groundwater, air stripper treatment, and reinjection of treated groundwater.

- Distal Zone — Monitored Natural Attenuation with annual performance reviews every year for the first 5˚years followed by additional reviews at least every 5˚years thereafter.

- Institutional Controls — Institutional controls consisting of engineering and administrative controls to protect current and future users from health risks associated with groundwater contamination. The institutional control area will incorporate the anticipated expansion of the distal zone plume and will add controls incrementally based on groundwater monitoring results.

- Monitoring — Groundwater monitoring will be conducted through the plume and samples analyzed to determine the progress of the remedy. Water level measurements will be completed to verify the ability of the NPTF to establish the capture of the contaminants in the medial zone.

- Contingencies — Contingencies identified under this amended remedy are:

    - For the medial zone, monitoring wells located upgradient of the NPTF will be monitored on a routine basis to ensure that concentrations of radionuclides in the groundwater remain low. If monitoring indicates that the concentration of radionuclides in the NPTF effluent would exceed MCLs, the ASTU will be used to prevent those radionuclides from traveling downgradient to the NPTF.

    - For the distal zone, if the Agencies determine that MNA will not restore the distal zone of the plume within the restoration timeframe or if the required monitoring necessary for MNA is not performed, pump-and-treat units will be constructed and operated in the distal zone to remediate the plume.

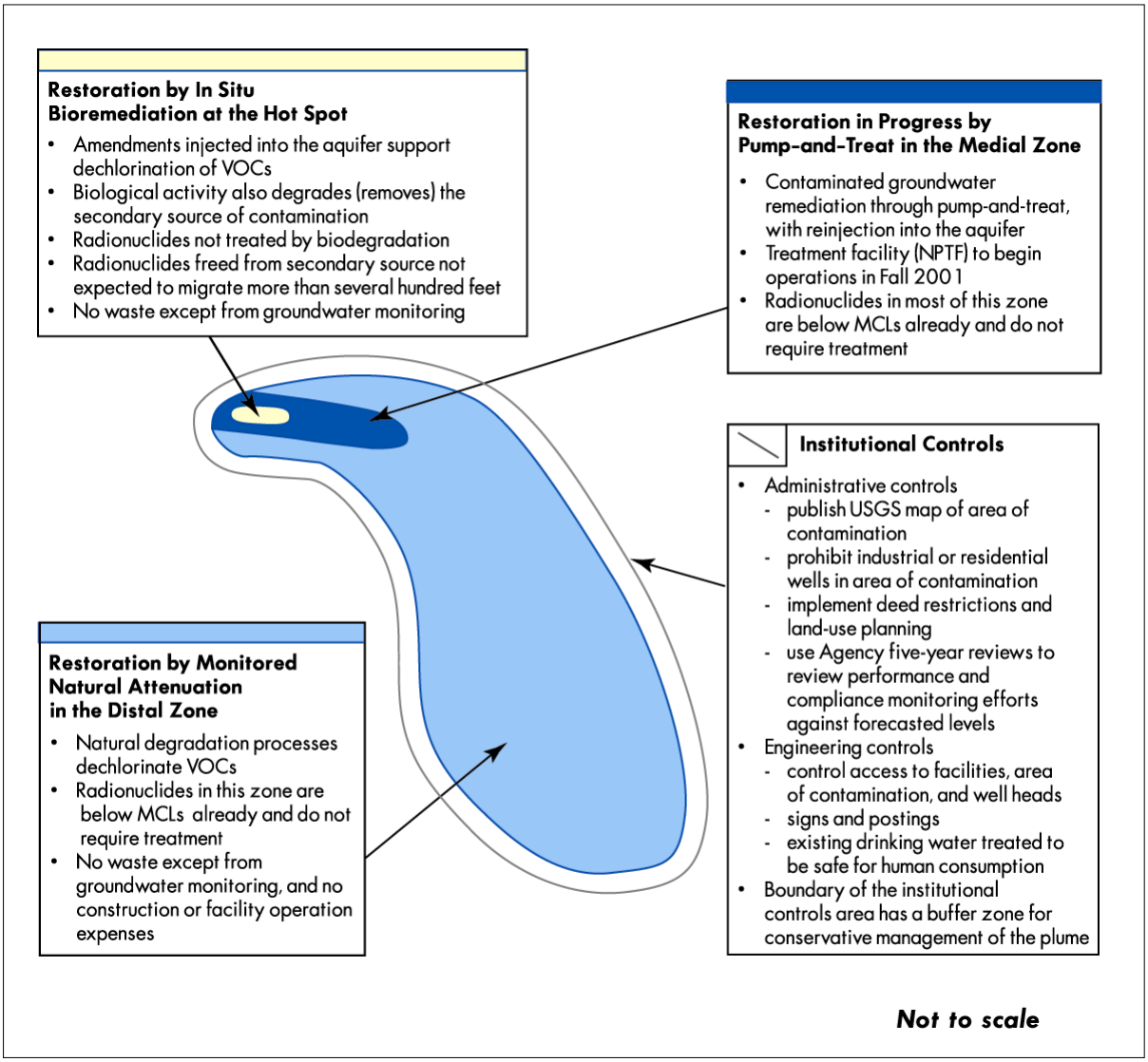

Figure 8-1. Conceptual illustration of the components of the amended remedy (not to scale).

Groundwater monitoring will be the mechanism for collecting performance data to demonstrate (1)˚TCE flux from the hot spot is below MCLs; (2)˚radionuclide MCLs are not exceeded at the NPTF; (3)˚hydraulic capture of the medial zone; and (4) TCE concentrations in the distal zone decline in accordance with modeling expectations. To evaluate attainment of RAOs, groundwater monitoring of the hot spot and contaminant plume will monitor and track the plume boundary, changes in COC concentration levels, and the attenuation rate.

Under the amended remedy, the concentrations of the radionuclide COCs in the hot spot and medial zone will meet RAOs within the remedial timeframe. Concentrations of the radionuclide COCs in the distal zone are already below RAOs. The groundwater monitoring program will include monitoring the attenuation of radionuclide COCs in the hot spot, the medial zone, and the distal zone, as applicable. If monitoring indicates that the concentration of radionuclides in NPTF effluent exceeds MCLs, then the

contingency would be implemented. The frequency of monitoring at selected locations depends on the potential risk of exceeding MCLs in the NPTF effluent. The Agencies will use the monitoring results to determine appropriate responses.

8.1 Description of Amended Remedy

8.1.1 In Situ Bioremediation of the Hot Spot

The amended remedy will utilize ISB for restoration of the hot spot. To implement ISB, the treatment system will inject amendments, such as sodium lactate, through one or more wells into the hot spot. The amendments will act as an electron donor in anaerobic reductive dechlorination, a multistage process that dechlorinates chloroethenes into the harmless compounds carbon dioxide, water, chloride, ethene, and ethane. ISB is a biochemical process carried out by bacteria that are naturally present in the groundwater at TAN. As described in Section 4.2, ISB will be effective both for degrading the chloroethenes dissolved in groundwater and for accelerating degradation of the chloroethenes in the secondary source at the injection well.

Amendments will be distributed as needed. Monitoring will evaluate the progress of ISB and ensure that required levels of amendments are maintained. Amendments will be distributed on a schedule to be determined during post-ROD Amendment activities. The 1999 field evaluation of ISB showed sodium lactate performed well as an amendment; the amendment or amendments that will be used during remediation will be selected in the remedial design/remedial action process. ISB at the hot spot will destroy the VOCs rather than simply transferring them to air, as in pump and treat; worker exposure to contaminants will be minimized. ISB will not treat the radionuclides in this zone.

The amendments added in support of ISB may contain trace constituents that exceed MCLs. However, the Agencies have agreed that amendments containing constituents above MCLs may be injected to support aquifer remediation, if it can be demonstrated that any contaminants in these amendments would not adversely affect meeting the RAOs for this action within the restoration timeframe. The Agencies do not intend to reinject radionuclides above MCLs.

8.1.2 Monitored Natural Attenuation of the Distal Zone

MNA will be used to restore the distal zone. Current estimates indicate that natural attenuation will reduce VOC concentrations to MCLs by 2095. The predictive models used for this estimate are described in the FDR (DOE-ID 2000a [DOE/ID-10718]). Radionuclide concentrations in the distal zone are below MCLs. Implementation of MNA will include additional modeling to develop the performance monitoring approach, including final design for number and locations of monitoring wells. MNA performance reviews will be conducted every year for the first 5˚years and at least every 5˚years thereafter so long as performance criteria are met.

A necessary consideration in groundwater restoration by MNA is identification of a contingency remedy that can be implemented if MNA fails to meet the RAOs. Conditions that may lead to the Agencies invoking the contingency remedy include:

- An increase in levels of COCs, indicating that other source-control measures are not effective
- Significant changes in concentration ratios of TCE to PCE and TCE to tritium
- Significant differences in concentration levels of parent contaminants and/or daughter products from modeling predictions

- Significant increases in the areal or vertical extent and/or volume of the contaminant plume for parent contaminants and daughter products from that predicted by modeling estimates.

- The Agencies determination that the required monitoring necessary for MNA has not been performed.

The contingency remedy for the distal zone is the pump-and-treat technology specified in the 1995 ROD. This contingency pump-and-treat remedy would provide groundwater extraction, aboveground treatment for VOCs, and reinjection of the treated water, or implementation of a more cost-effective remedy identified at the time a contingency remedy is needed. If, based on the reassessment, the Agencies determine that the performance of MNA will not achieve the RAOs, then the Agencies would implement the contingency pump-and-treat remedy by issuing an ESD (INEEL 1997 [INEEL/EXT-97-00931]) describing the changes to the 1995 ROD.

8.1.3 Institutional Controls

Institutional controls will be implemented to prevent the use of contaminated groundwater until the RAOs specified in Section˚5 have been attained throughout all areas of the contaminated aquifer.

Institutional controls will consist of engineering and administrative controls to protect current and future users from health risks associated with groundwater contamination. The institutional controls will prevent ingestion of contaminated groundwater. Institutional controls for WAG 1, of which OU 1-07B is a part, are addressed in the OU 1-10 ROD (DOE-ID 1999a [DOE/ID-10682]). These controls include visible access restrictions, control of activities, prevention of well drilling (except as required to support the remedial action), and control of land use.

The approach for establishing, implementing, enforcing, and monitoring institutional controls at the INEEL, including WAG 1, has been developed in accordance with EPA s *Region 10 Final Policy on the Use of Institutional Controls at Federal Facilities* (EPA 1999b). In accordance with this policy and the OU 1-10 ROD, institutional controls for OU 1-07B are being implemented as follows:

- An institutional controls monitoring report for WAG 1 was submitted to EPA and IDEQ, as specified by the OU 1-10 ROD, within 6 months after the signature of the OU 1-10 ROD (DOE-ID 1999a [DOE/ID-10682]).

- Institutional control requirements for OU 1-07B are identified in the WAG 1 institutional control plan.

- Updated monitoring reports will be submitted to support the 5-year review process with specific submittal deadlines based on EPA and IDEQ approval.

More detailed information and requirements for WAG 1 institutional controls are included in the OU 1-10 ROD.

8.1.4 Groundwater Monitoring

Groundwater monitoring will be performed in accordance with monitoring plans developed as part of the RD/RA work plan for this ROD Amendment. Monitoring data will be used to track the contaminant plume boundary, changes in COC concentration levels, and the attenuation rate to evaluate attainment of RAOs. If periodic monitoring for COCs indicates that NPTF effluent may exceed MCLs,

the frequency of monitoring at selected locations will increase to allow the Agencies to determine the appropriate response action.

A monitoring program will be designed and implemented that will:

1. At the hot spot, ensure that ISB results in complete dechlorination of TCE, quantify the dechlorination rate over time, and evaluate attainment of RAOs.

2. In the distal zone, monitor the progress of attenuation of contaminants and evaluate attainment of RAOs. If monitoring data indicate that contaminant levels are not following modeling predictions or if the required monitoring necessary for MNA is not performed, the Agencies will consider implementation of the contingency remedy or, if the Agencies concur, a more cost-effective remedy will be identified at the time that the contingency remedy is implemented.

8.2 Cost Estimate for the Amended Remedy

The estimated life-cycle cost in NPV for the amended remedy is $35˚million. Table 8-1 summarizes the cost estimate for the amended remedy. Details of the cost estimate is presented in the ROD Amendment Cost Estimate Support Data Recapitulation (INEEL 2001 [EDF-ER-201]).

8.3 Expected Outcomes for Processes

The Agencies goal in this action is to restore the aquifer throughout the contaminant plume, which includes the hot spot, the medial zone, and the distal zone. The remedial action will prevent TCE and the other chlorinated VOCs above MCLs from moving from one zone to the next downgradient zone, thereby allowing each zone to be treated separately without adversely impacting either of the other zones. The amended remedy will result in attainment of the remediation goals and protection of current and future workers and future residents.

Restoration of the hot spot under the amended remedy will not directly affect radionuclides. The geochemical behavior of the radionuclides in the subsurface acts to bind them to soil and rock in the area where they are now located. This will continue to prevent them from migrating beyond the vicinity of the hot spot and from being available to future drinking water users. Estimates of radionuclide attenuation by radioactive decay indicate that Cs-137 and Sr-90 will meet RAOs throughout the contaminant plume by 2095. The remaining radionuclides (U-234 and tritium) are currently below MCLs or 10^{-4} risk-based levels; concentrations of these two radionuclides are not expected to increase to levels that would prevent attainment of RAOs as a result of implementation of this amended remedy.

Table 8-1. Cost estimate summary for the amended remedy.

Planned Activity	Costs (in FY-99 dollars)	Net Present Value[a]
IN SITU BIOREMEDIATION OF THE HOT SPOT		
ISB Design	$ 10,415	
ISB Construction	95,285	
ISB O&M (FY-04 to FY-18) (annual cost: $204,891)	2,868,474	
ISB D&D (FY-31)	258,772	
Total for ISB at the Hot Spot	**3,232,940**	**$ 1,483,576**
MONITORED NATURAL ATTENUATION IN THE DISTAL ZONE		
MNA O&M (FY-04 to FY-30) (annual cost: $77,620)	2,095.740	
Total for MNA in the Distal Zone	**2,095,740**	**709,804**
COMMON ELEMENTS		
NPTF Construction	1,913,000	
Remedial Action Work Plan Revision	121,791	
NPTF O&M (FY-04 to FY-16) (annual cost: $148,389)	1,929,057	
ASTU Standby Operations (FY-04 to FY-16)	65,000	
Project Management	5,745,400	
Institutional Controls	184,000	
Facility Operations/Waste Management (FY-00 to FY-03)	3,980,700	
Facility Operations/Waste Management (FY-04 to FY-30)	2,957,429	
GWTF D&D(FY-03)	1,291,087	
NPTF D&D (FY-18)	442,269	
ASTU D&D (FY-18)	1,104,820	
Groundwater Monitoring	4,490,140	
Well Abandonment (FY-31)	1,160,400	
Total for Common Elements	**25,307,490**	**14,381,518**
COSTS INCURRED THROUGH FY-99		
Treatability Studies	8,002,000	
Project Management (FY-95 to FY-99)	3,335,000	
GWTF Transition to OU 1-07B	2,466,000	
GWTF Operations (FY-95 to FY-99)	2,272,000	
Groundwater Monitoring (FY-95 to FY-99)	996,000	
NPTF Design	469,000	
NPTF Well Construction	1,300,000	
Total for Costs Incurred through FY-99	**18,840,000**	**18,840,000**
TOTAL COSTS		
TOTAL PROJECT COST	49,553,779	35,414,898
Contingency at 50%[b]	15,356,890	8,287,449
TOTAL PROJECT COST AND CONTINGENCY	$64,910,669	$43,702,347

a. Net present value using a 7% discount rate and assuming a 15-year operating period for both ISB at the hot spot and pump-and-treat in the medial zone, and a 30-year operating period for MNA in the distal zone.

b. Contingency is not applied to the costs incurred through FY-99.

9. STATUTORY DETERMINATIONS

Under CERCLA Section˚121 and the NCP, the Agencies must select remedies that are protective of human health and the environment, that comply with ARARs (unless a statutory waiver is justified), that are cost-effective, and that utilize permanent solutions and alternative treatment technologies or resource recovery technologies to the maximum extent practicable. In addition, CERCLA includes a preference for remedies that employ, as a principal element, treatment that permanently and significantly reduces the toxicity, mobility, or volume of hazardous wastes, and has a bias against off-site disposal of untreated wastes. The following sections discuss how the amended remedy meets these statutory requirements.

9.1 Protection of Human Health and the Environment

The amended remedy will protect human health from groundwater contaminants through the use of ISB at the hot spot; pump-and-treat in the medial zone, as chosen in the 1995 ROD); and MNA in the distal zone. Implementation of the technologies will restore the contaminant plume to drinking water quality standards by or before 2095. Removing the contaminants will prevent further degradation of groundwater within the contaminant plume.

The amended remedy will restore the contaminated aquifer groundwater by 2095 (100 years from the signature of the 1995 Record of Decision) by reducing all COCs to below MCLs and a $1˚\_˚10^{4}$ total risk-based level and, for non-carcinogens, until the cumulative hazard index is less than 1. Engineering controls and standard health and safety practices will address any short-term threats associated with the amended remedy. Any treated water that is reinjected into the aquifer will meet Idaho Administrative Procedures Act (IDAPA) 37.03.03, Rules and Minimum Standards for the Construction and Use of Injection Wells in the State of Idaho. [2]

As discussed in the 1995 ROD, an ecological risk assessment showed no current exposure pathways for ecological receptors. The amended remedy, by restoring the contaminant plume to protect human health, will also protect ecological receptors. Institutional controls during the remedial action will ensure that pathways to ecological receptors will not be completed.

9.2 Compliance with ARARS

Implementation of the amended remedy will comply with all ARARs. However, some ARARs identified in the 1995 ROD have been deleted in this amended remedy; none have been changed. Table 9-1 lists all ARARs from the 1995 ROD and indicates which ARARs have been deleted in the amended remedy.

9.2.1 ARARs Not Changed from 1995 ROD

The following ARARs apply to the amended remedy as originally cited and described in the 1995 ROD:

- IDAPA 58.01.01.585 (formerly 16.01.01.585), Toxic Air Pollutants, Non-Carcinogenic Limits

[2] At the time the 1995 ROD was written, these statutes were numbered as Idaho Administrative Procedures Act (IDAPA) Title 16. At the time, the state agency was a division of the Department of Health and Welfare. In July 2001, the division became the Department of Environmental Quality, and the relevant statutes were renumbered as Title 58. Other than the difference in numbering, these statutes are unchanged.

Table 9-1. Summary of ARARs for the amended remedy.

Requirement (Citation)	ARAR Type: Action Specific	ARAR Type: Chemical Specific	ARAR Type: Location Specific	Status: Deleted	Status: Unchanged	Applies to Remedy Component for: Hot Spot	Applies to Remedy Component for: Medial Zone[a]	Applies to Remedy Component for: Distal Zone	Comments
Clean Air Act and Idaho Air Regulations									
Idaho Air Pollutants noncarcinogens (IDAPA 58.01.01.585 [formerly IDAPA 16.01.01.585]		X			X		A		
Idaho Air Pollutants carcinogens (IDAPA 58.01.01.586 [formerly IDAPA 16.01.01.586])		X			X		A		
NESHAPs — <10 mrem/yr (40 CFR 61.92)		X			X		A		
NESHAPs — monitoring (40 CFR 61.93)	X				X		A		
Idaho Rules for Control of Fugitive Dust (IDAPA 58.01.01.650 and .651 [formerly IDAPA 16.01.01.650 and .651])	X				X		A		
RCRA and Hazardous Waste Management Act									
Generator Standards IDAPA 58.01.05.006 (formerly IDAPA 16.01.05.006)	X				X				
Hazardous Waste Determination (40 CFR 262.11)	X				X	A	A	A	Not required for secondary waste streams in the medial and distal zones, for which applicable NLCI determinations have been made.
General Facility Standards IDAPA 58.01.05.008 (formerly IDAPA 16.01.05.008)	X		X		X				
General Waste Analysis (40 CFR 264.13)	X				X	A	A	A	
Location Standards (40 CFR 264.18 (a) and (b))			X		X		A		
Preparedness and Prevention (40 CFR Subpart C, 264.31—.37)	X				X	A	A	A	
Closure Performance Standard (40 CFR 264.111)	X				X	A	A		
Disposal/Decontamination (40 CFR 264.114)	X				X	A	A		
Use/Management of Containers (40 CFR 264, Subpart I)	X				X	A	A	A	
Tank Systems (40 CFR 264, Subpart J)	X				X		A		
Miscellaneous Units (40 CFR 264, Subpart X)	X			X					Deleted; no specific requirements are applicable to the treatment systems.
Air Emission Standards for Process Vents (40 CFR 264, Subpart AA)	X			X					Deleted; the VOC concentrations in water to be treated in medial zone P&T operations are < 10 ppmw.
Land Disposal Restrictions (IDAPA 58.01.05.011 [formerly IDAPA 16.01.05.011])	X				X	A	A	A	
RCRA, Section 3020	X	X			X	A	A	A	
Underground Injection Control									
Idaho Rules for the Construction and Use of Injection Wells (IDAPA 37.03.03)	X	X			X	A	A	A	
Idaho Public Drinking Water									
MCLs (numerical standards only) (IDAPA 58.01.08.050.02 and .05 [formerly IDAPA 16.01.08.050.02 and .05])		X			X	R	R	R	
Secondary MCLs (numerical standards only) (IDAPA 58.01.08.400.03 [formerly IDAPA 16.01.08.400.03])		X			X				
National Historic Preservation Act									
Scope of Identification (36 CFR 800.4(a)(1)(i), (iii)(a)(2))			X		X			A	
Identify Historic Properties (36 CFR 800.4(b))			X		X			A	
To-Be-Considered									
Radiation Protection of the Public and the Environment (DOE Order 5400.55)	X				X	A	A		Worker protection standard applies to workers only
Fire Protection (DOE Order 5480.7A)	X			X					Canceled; superseded by DOE Order 420.1
Radioactive Waste Management (DOE Order 5820.2A)	X			X					Canceled by DOE Order 435.1

Key: A = applicable requirement; NLCI = no longer contained in; P&T = pump and treat; R = relevant and appropriate requirement

a. ARARs that apply to the medial zone apply to the contingency remedies for the medial zone and the distal zone.

- IDAPA 58.01.01.586 (formerly 16.01.01.586), Toxic Air Pollutants, Carcinogenic Increments, and the following, as cited in it:

    - 40 Code of Federal Regulations (CFR) 61.92, National Emission Standards for Hazardous Air Pollutants (NESHAPS) Standard

- 40 CFR 61.93, NESHAPs Emission Monitoring and Test Procedures

- IDAPA 58.01.01.650 and .651 (formerly 16.01.01.650 and .651), Rules for Control of Fugitive Dust

- IDAPA 58.01.05.006 (formerly 16.01.05.006), Standards Applicable to Generators of Hazardous Waste, and the following, as cited in it:

    - 40 CFR 262.11, Hazardous Waste Determination

- IDAPA 58.01.05.008 (formerly 16.01.05.008), Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities, and the following, as cited in it:

    - 40 CFR 264.13, General Waste Analysis

    - 40 CFR 264.18 (a) and (b), Location Standards: Seismic Considerations, and Floodplains

    - 40 CFR 264, Subpart C (Sections˚31—37), Preparedness and Prevention

    - 40 CFR 264.111, Closure Performance Standard

    - 40 CFR 264.114, Disposal or Decontamination of Equipment, Structures, and Soils

    - 40 CFR 264, Subpart I, Use and Management of Containers

    - 40 CFR 264, Subpart J, Tank Systems

- IDAPA 58.01.05.011 (formerly 16.01.05.011), Land Disposal Restrictions

- RCRA, Section 3020

- IDAPA 37.03.03, Rules and Minimum Standards for the Construction and Use of Injection Wells in the State of Idaho

- IDAPA 58.01.08.050.02 and 050.05 (formerly 16.01.08.050.02 and 050.05), Maximum Contaminant Levels and Maximum Residual Disinfectant Levels

- IDAPA 58.01.08.400.03 (formerly 16.01.08.400.03), Secondary MCLs

- 36 CFR 800.4(a)(1)(i), 800.4(a)(1)(iii), and 800.4(a)(2), Identification of Historic Properties: Scope of Identification Efforts

- 36 CFR 800.4(b), Identification of Historic Properties: Identify Historic Properties

- DOE Order 5400.5, Radiation Protection of the Public and the Environment

9.2.2 ARARs that No Longer Apply

The following ARARs cited in the 1995 ROD have been deleted, because they no longer apply:

- 40 CFR 264, Subpart X, Miscellaneous Units

- 40 CFR 264, Subpart AA, Air Emission Standards for Process Vents

- DOE Order 5480.7A, *Fire Protection*. DOE Order 5480.7A was canceled by DOE. It has been superseded by DOE 420.1, *Facility Safety*. Appropriate measures will be taken for worker safety

- DOE Order 5820.2A, *Radioactive Waste Management*. DOE Order 5820.2A was canceled by DOE Order 435.1, *Radioactive Waste Management,* on July˚9, 1999

9.2.3 Clarification of ARARs

The Agencies have agreed to clarify ARARs that apply at the hot spot (ISB Component) as follows:

- In accordance with IDAPA 37.03.03.050.01, which deals with construction and use of injection wells, the Agencies have agreed that, to support ISB, amendments containing constituents above MCLs may be injected so long as injected fluid will not endanger a drinking water or groundwater source for any present or future beneficial use.

The Agencies have agreed to clarify ARARs that apply to the medial zone (NPTF component) as follows:

- 40 CFR 264, Subpart AA, Air Emission Standards for Process Vents, applies to treatment of water with organic concentrations of at least 10 parts per million weight (ppmw). The concentration of VOCs in water to be treated in the medial zone pump-and-treat operations is below 10 ppmw. Therefore, this is not an ARAR for the amended remedy.

- The Agencies do not intend to reinject radionuclides above MCLs.

- The TCE in the contaminated groundwater is a listed waste. Therefore, all components on the influent side of the treatment system, including the air stripper equipment, have been designed to meet the secondary containment requirements of 40 CFR 264, Subpart J, of RCRA. After the air stripping process, the concentration of hazardous constituents in groundwater will be less than the applicable MCL and will result in a cumulative carcinogenic risk of less than $1 \_ 10^{-5}$. As a result, a no-longer-contained-in determination is applicable and the NPTF effluent is not a listed hazardous waste.

The Agencies have agreed to clarify ARARs that apply to the distal zone (MNA component) as follows:

- IDAPA 37.03.03, Rules and Minimum Standards for the Construction and Use of Injection Wells in the State of Idaho, applies to the reinjected water because the NPTF reinjection well is located in the distal zone.

The Agencies have agreed to clarify ARARs that apply to the contingency remedies for the medial and distal zones as follows:

- ARARs that apply to the remedy component for the Medial Zone apply to the contingency remedies for the medial zone and the distal zone.

9.3 Cost-Effectiveness

In the Agencies judgment, the amended remedy is cost-effective and represents a reasonable value for the money to be spent. In making this determination, the Agencies used the following definition from NCP Section˚300.430(f)(1)(ii)(D): A remedy shall be cost-effective if its costs are proportional to its overall effectiveness. The Agencies determination was accomplished by evaluating the overall effectiveness of those alternatives that satisfied the threshold criteria (i.e., were both protective of human health and the environment and compliant with ARARs). Overall effectiveness is evaluated by assessing three of the five balancing criteria in combination: long-term effectiveness and permanence; reduction in toxicity, mobility, or volume through treatment; and short-term effectiveness, and then comparing the overall effectiveness to costs to determine cost-effectiveness. The relationship of the overall effectiveness of the amended remedy was determined to be proportional to its costs and, hence, it represents a reasonable value for the money to be spent.

The estimated life-cycle cost in NPV for the amended remedy is $35˚million. (That figure includes costs expended through Fiscal Year 1999 but does not include a contingency.)

9.4 Utilization of Permanent Solutions and Alternative Treatment or Resource Recovery Technologies to the Maximum Extent Practicable

The Agencies have determined that the amended remedy represents the maximum extent to which permanent solutions and treatment technologies can be utilized in a practicable manner for the final remedial action at this site. The Agencies determined that the amended remedy provides the best balance of trade-offs in terms of the five balancing criteria (described in Section˚7), while also considering the statutory preference for treatment as a principal element and bias against off-site treatment and disposal, and considering state and community acceptance.

The amended remedy for OU 1-07B is intended to help prevent further degradation of the groundwater by containing and treating the source through the alternative and innovative treatment technology of ISB, which will permanently destroy the VOCs in situ through anaerobic reductive dechlorination, and performing MNA for the dissolved phase contaminant plume.

9.5 Preference for Treatment as a Principal Element

The statutory preference for remedies that employ treatment as a principal element is satisfied because treatment is utilized for two of the three zones of the plume (the hot spot and the medial zone), which have the highest concentrations of VOCs.

9.6 Five-Year Review Requirements

Because this remedy will result in COCs remaining on-site during the remedial action above levels that allow for unlimited use and unrestricted exposure, a statutory review will be conducted within 5 years after initiation of remedial action, and at least every 5 years thereafter through the standard CERCLA 5-year review process. The reviews will be conducted to ensure that the amended remedy is, or will be, protective of human health and the environment. This provision does not preclude more frequent reviews by one or more of the Agencies.

10. DOCUMENTATION OF SIGNIFICANT CHANGES

No substantive changes were made from the Proposed Plan, although minor language clarifications were made.

11. REFERENCES

36 CFR 800.4, 2000, Identification of Historic Properties, *Code of Federal Regulations,* U.S. Government Printing Office, July.

40 CFR 61, 2000, National Emission Standards for Hazardous Air Pollutants, *Code of Federal Regulations,* U.S. Government Printing Office, April.

40 CFR 262, 2000, Standards Applicable to Generators of Hazardous Waste, *Code of Federal Regulations,* U.S. Government Printing Office, July.

40 CFR 264, 2000, Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities, *Code of Federal Regulations,* U.S. Government Printing Office, July.

40 CFR 300, 2000, National Oil and Hazardous Substances Pollution Contingency Plan, *Code of Federal Regulations,* U.S. Government Printing Office, July.

DOE Order 5400.5, 1993, Radiation Protection of the Public and the Environment, U.S. Department of Energy, January.

Executive Order 12580, 1987, Protection of Environment, Superfund Implementation, U.S. Government Printing Office, January.

IDAPA 37.03.03, 2000, Rules and Minimum Standards for the Construction and Use of Injection Wells in the State of Idaho, *Idaho Administrative Code,* Department of Water Resources, July.

IDAPA 58.01.01, 2000, Rules for the Control of Air Pollution in Idaho, *Idaho Administrative Code,* Idaho Department of Administration, July.

IDAPA 58.01.05, 2000, Rules and Standards for Hazardous Waste, *Idaho Administrative Code,* Idaho Department of Administration, July.

IDAPA 58.01.08, 2000, Idaho Rules for Public Drinking Water Systems, *Idaho Administrative Code,* Idaho Department of Administration, July.

42 USC 82∕∕6901 et seq., Resource Conservation and Recovery Act, *U.S. Code* , U.S. Government Printing Office.

42 USC 103∕∕9601 et seq., Comprehensive Environmental Response, Compensation, and Liability Act, *U.S. Code* .

DOE-ID, 1995, *Record of Decision for the Technical Support Facility Injection Well (TSF-05) and Surrounding Groundwater Contamination (TSF-23) and Miscellaneous No Action Sites Final Remedial Action,* DOE/ID-10139, August.

DOE-ID, 1997a, *Remedial Design/Remedial Action Scope of Work, Test Area North Final Groundwater Remediation, Operable Unit 1-07B,* DOE/ID-10522, August.

DOE-ID, 1997b, *Technology Evaluation Work Plan, Test Area North Final Groundwater Remediation, OU 1-07B,* DOE/ID-10562, March.

DOE-ID, 1998a, *Natural Attenuation Field Evaluation Work Plan, Test Area North, Operable Unit 1-07B,* DOE/ID-10606, February.

DOE-ID, 1998b, *In Situ Bioremediation Field Evaluation Work Plan, Test Area North, Operable Unit 1-07B,* DOE/ID-10639, September.

DOE-ID, 1999a, *Final Record of Decision for Test Area North, Operable Unit 1-10,* DOE/ID-10682, October.

DOE-ID, 1999b, *Phase C Remedial Action Work Plan for Test Area North Final Groundwater Remediation, Operable Unit 1-07B,* DOE/ID-10679, October.

DOE-ID, 1999c, *In Situ Chemical Oxidation Field Evaluation Work Plan for the TSF-05 Hot Spot, Test Area North Final Groundwater Remediation, Operable Unit 1-07B,* DOE/ID-10698, November.

DOE-ID, 2000a, *Field Demonstration Report, Test Area North Final Groundwater Remediation, Operable Unit 1-07B,* DOE/ID-10718, March.

DOE-ID, 2000b, *New Pump and Treat Facility Remedial Design, Test Area North, Operable Unit 1-07B,* DOE/ID-10661, March.

DOE-ID, EPA, and IDEQ 2000, *Proposed Plan for Operable Unit 1-07B, Final Remedial Action at the TSF Injection Well (TSF-05) and Surrounding Groundwater Contamination (TSF-23)* (DOE/ID-21251), November.

EG&G, 1994, *Remedial Investigation (RI) Final Report with Addenda for the Test Area North (TAN) Groundwater (GW) Operable Unit (OU) 1-07B at the INEL, Volumes 1 and 2,* EGG-ER-10643, Vol. 1 and 2, January.

EPA, 1999a, *Use of Monitored Natural Attenuation at Superfund, RCRA Corrective Action, and Underground Storage Tank Sites,* EPA 540-F-99-009, OSWER Directive 9200.4-17P, April.

EPA, 1999b, *Region 10 Final Policy on the Use of Institutional Controls at Federal Facilities,* EPA Region 10, Office of Environmental Cleanup, May.

EPA, 1999c, *Guidance on Preparing Superfund Decision Documents,* EPA 540-R-98-031, OSWER Directive 9200.1-23P, July.

INEL, 1992, *Record of Decision (ROD) for Technical Support Facility (TSF) Injection Well and Surrounding Groundwater Contamination,* INEL-5202, September.

INEL, 1998, *Well Characterization and Evaluation Report Supporting Functional and Operational Requirements for the New Pump and Treat Facility at Test Area North Operable Unit 1-07B,* INEL/EXT-97-01356, January.

INEL, 2000, *Microbial Studies Report Supporting Implementation of In Situ Bioremediation at Test Area North,* INEL/EXT-98-00474, November.

INEEL, 1997, *Explanation of Significant Differences from the Record of Decision for the Technical Support Facility Injection Well (TSF-05) and Surrounding Groundwater Contamination (TSF-23) and Miscellaneous No Action Sites, Final Remedial Action,* INEEL/EXT-97-00931, November.

INEEL, 1998, *Site Conceptual Model: 1996 Activities, Data Analysis, and Interpretation – Test Area North Operable Unit 1-07B,* INEL/EXT-97-00556, February.

INEEL, 1999a, *Numerical Modeling Support of the Natural Attenuation Field Evaluation for Trichloroethene at the Test Area North,* Operable Unit 1-07B, INEEL/EXT-97-01284, January.

INEEL, 1999b, *Phase C Groundwater Monitoring Plan,* INEEL/EXT-99-00021, October.

INEEL, 2000a, *Fiscal Year 1999 Groundwater Monitoring Report, Test Area North, Operable Unit 1-07B,* INEEL/EXT-99-01255, January.

INEEL, 2000b, *Aerobic Biodegradation Laboratory Studies at Test Area North, Operable Unit 1-07B,* INEL/EXT-99-00736, April.

INEEL, 2000c, *Engineering Design File (EDF) – Metals Analysis of Selected OU 1-07B Groundwater Monitoring Wells,* INEEL/EXT-2000-00821 (EDF-ER-200), Rev. 0, October.

INEEL, 2000d, *Sampling and Analysis Plan for the Enhanced In Situ Bioremediation Field Evaluation, Test Area North, Operable Unit 1-07B,* Rev. 2, INEEL/EXT-98-00421, October.

INEEL, 2001, *Engineering Design File (EDF) – WAG 1, OU 1-07B, Record of Decision (ROD) Amendment Cost Estimate Support Data Recapitulation,* EDF-ER-201, Rev. 2, August.

ORNL, 1999, *Laboratory Evaluation of In Situ Chemical Oxidation for Groundwater Remediation, Test Area North, Operable Unit 1-07B, Idaho National Engineering and Environmental Laboratory,* ORNL/TM-13711, April.

Part III – RESPONSIVENESS SUMMARY

12. BACKGROUND ON COMMUNITY INVOLVEMENT

Comments and questions received during the public comment period are summarized in the first section of this responsiveness summary. The comments were grouped according to the topics they focused on, and were then summarized into succinct statements in order to capture the significant issue discussed, or information requested. The purpose is to provide, as required by U.S. Environmental Protection Agency (EPA) guidelines for Responsiveness Summaries, as documented in *Guidance on Preparing Superfund Decision Documents* (EPA 1999c [EPA 540-R-98-031, OSWER Directive 9200.1-23P]):

- A clear and concise measure of which aspects or elements of the alternative the community supports, opposes, or has reservations about

- General concerns about the sites being remediated under this action, and the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) process at those sites.

The objective of the responsiveness summary is to provide for the community and for Agency decision-makers a synopsis of community preferences and concerns, and Agency responses. Although the summarized statements rephrase for brevity the comments submitted, they in no way replace them and are not intended to alter their focus. Bracketed numbers at the end of each summarized topic statement identify the original comment or comments. The complete original comments can be referred to in Appendix A for the discussions or questions from which the summaries of significant concerns were condensed.

All comments that were received are presented in Appendix A, either as scanned written submissions or as transcripts of the formal comments made at each public meeting. Each document is annotated to indicate the comments used to prepare the Responsiveness Summary. The documents are numbered separately in two series: comments in response to the Proposed Plan (W1 through W7) and comments transcribed during the formal comment sessions of the public meetings (T1 through T3). Indexes at the beginning of Appendix A list the comments by commenter, by response number, and by topic.

The responsiveness summary begins with questions and comments on the community relations process for the remediation of Operable Unit (OU)˚1-07B (see Section˚3 for the history of community participation in this action). Next are questions and comments concerning the treatability studies and the activities carried out during this process. Finally, questions and comments are presented that focus on the remedial actions proposed under this Record of Decision (ROD) Amendment. In this manner, topics follow an order paralleling their presentation in the Proposed Plan. A total of 28 topics are identified in this summary.

Sections˚7.1.3 and 7.2.3 summarize how the community s issues and concerns were incorporated into the evaluation of alternatives for this action. Section˚11, References, includes all documents referenced in the Responsiveness Summary.

13. STAKEHOLDER ISSUES AND AGENCY RESPONSES

The following sections detail the topics of concern to the community, as raised during the public comment period, and the Agencies responses.

13.1 Overall Goals of the INEEL Environmental Restoration Program

1. **Topic:** A commenting group wrote that the new remedy presented in the Proposed Plan is both economically and environmentally preferable to current reliance solely on pump-and-treat. The group called this a successful demonstration of the value of investing in research and development. They recommend that the process used here to identify and demonstrate emerging technologies with potential merit be used as a model for future efforts. [W7-2]

   The same commenting group wrote elsewhere that they were particularly pleased with the timely incorporation of an emerging technology into the Idaho National Engineering and Environmental Laboratory s (INEEL s) cleanup program. They expressed the hope that the U.S. Department of Energy (DOE) will continue to monitor emerging technologies and consider using any that appear promising. In particular, the group wrote, they are interested in emerging technologies that would reduce overall cleanup costs and/or enhance environmental protection. [W7-6]

   Response: The Agencies are pleased that members of the public have noted and applauded the INEEL s efforts to find, develop, and implement innovative technologies for cleanup, whenever they are appropriate and cost-effective. In this, the Agencies follow CERCLA guidance (40 CFR 300.430) to ensure that innovative treatment technologies are examined if they offer the potential for equal or better performance or implementability, fewer or less adverse impacts, or lower costs in comparison to demonstrated treatment technologies.

13.2 Public Participation and Community Relations

2. **Topic:** Several commenters asked for an extension of the comment period. One commenter stated that a comment period that starts the day after Thanksgiving and ends the day after Christmas is not a 30-day comment period. [T2-1, W7-1]

   Response: The comment period for the Proposed Plan was extended in response to public requests for additional time to participate in the decision-making process. The original comment period was exactly 30 days, as is required for CERCLA actions. However, the Agencies recognized that the end-of-year holidays are a busy season, which may not allow people the time they would like for review and comment. At the same time, the Agencies did not wish to delay the project, so they chose instead to release the Proposed Plan in late November when it was ready, and extend the comment period to give everyone ample time to respond without adversely affecting the project schedule.

3. **Topic:** DOE should try to schedule public meetings so that they do not conflict with other public meetings, such as the one on the same date (December˚5, 2000) in Jackson, Wyoming. DOE should try to schedule public meetings at different times. [T2-2]

   Response: The Agencies were aware that the first public meeting for the OU 1-07B Proposed Plan took place in Idaho Falls on the same night that a public meeting for an unrelated INEEL project took place in Jackson, Wyoming. However, a second public meeting for the OU 1-07B Proposed Plan was held the following night in Twin Falls, approximately the same driving time from Idaho

Falls as Jackson, Wyoming. Admittedly, members of the public and the media who wished to attend meetings on both projects had to attend two meetings in the same week. However, the Agencies were equally aware that with the busy holiday season coming up, the only alternative was to delay the OU 1-07B meetings and, consequently, the project. Public meetings on proposed plans are intentionally scheduled one week after the beginning of the public comment period to allow the public sufficient time following the meeting to submit their comments before the comment period ends.

13.3 Content and Organization of the Proposed Plan

4. **Topic:** Several commenters requested more information be included in the Proposed Plan, such as the location of the monitoring wells, statistical and study data, the vertical distribution of the plume, and construction details about the injection well. [T3-1, W3-1] Another commenter questioned the data presented in the Proposed Plan, especially in relation to the 1995 Record of Decision. The commenter felt that facts about radionuclide contamination were omitted or concealed. [W5-1, W5-17, W5-18]

Response: The Agencies appreciate all suggestions from the public on types of information that could help a Proposed Plan better serve its purpose. The EPA s CERCLA guidelines define a proposed plan s content and purpose (see 40 CFR 300.430 and *Guidance on Preparing Superfund Decision Documents,* EPA 540-R-98-031, OSWER Directive 9200.1-23P [EPA 1999c]; the Guidance is available on-line at http://www.epa.gov/superfund/). The proposed plan is a summary only, containing information required for the public to review the alternatives and preferences under consideration. The proposed plan, under CERCLA guidelines, supplements and is based on the comprehensive 1994 Remedial Investigation and Feasibility Study (RI/FS) (EG&G 1994 [EGG-ER-10643]), but is not a substitute for that document. In this case, the Proposed Plan was based on the comprehensive RI/FS and the Field Demonstration Report (DOE-ID 2000 [DOE/ID-10718]).

The EPA s CERCLA guidance intends the proposed plan to provide a brief summary description of: (1) the remedial alternatives evaluated, (2) the alternative that is preferred, and (3) the information that supports the selection of the preferred alternative. Other sections of the Proposed Plan (the history and nature of site contamination including identification of contaminants of concern [COCs], previous actions, and risk assessment) are included as background information for the convenience of readers.

For readers who seek more information on any aspect of the investigation process, the Proposed Plan provided references to documents in the Administrative Record that present in full the information cited. The complete details of the OU˚1-07B investigation, including sampling data, maximum contaminant levels (MCLs), and well construction details, can be found in the 1994 RI/FS, the Field Demonstration Report, and other OU˚1-07B documents in the Administrative Record (see Section˚2.5 in this ROD Amendment for a complete list of key documents).

Details regarding radionuclide COCs can likewise be found in the 1994 RI/FS and other OU 1-07B documents in the Administrative Record. However, as stated in Part I, Declaration, of this ROD Amendment:

> The primary risk driver for OU 1-07B has been determined to be the ingestion of groundwater contaminated with the volatile organic compound (VOC) trichloroethene (TCE). The other VOC contaminants of concern (COCs) — tetrachloroethene [PCE] and cis-1,2- and trans-1,2-dichloroethenes (DCE) — are less widespread in the contaminant

plume than TCE. Also present are four radionuclides —Cs-137, Sr-90, tritium, and U-234˚— that have been included as COCs because they exceed EPA risk-based concentrations for groundwater ingestion. TCE and PCE are the only two COCs consistently detected in the production wells at levels exceeding federal drinking water standards (maximum contaminant limits [MCLs]).

Risk assessment methods can only be summarized in the Proposed Plan, but are always described in detail, as required, in the RI/FS on which the plan is based.

Further details will be developed during the remedial design/remedial action phase of this project.

5. **Topic:** One commenting group commended the Agencies for a well-written, well-organized, and nicely formatted Proposed Plan. [W7-5] Another commenter asked that the Proposed Plan be withdrawn and reissued to include facts about radionuclide contamination. [W5-1, W5-17, W5-18]

   Response: The Agencies appreciate the commenting group s compliment. Many of the improvements made in the INEEL s proposed plans have been made in response to readers requests.The Agencies will continue to respond to specific areas of concern identified by the public in INEEL proposed plans released in the future.

   The EPA s CERCLA guidance intends the proposed plan to be a brief summary description. Thus, all details of an investigation cannot be included. However, the Agencies make every effort to clearly and completely identify all issues that may be of concern to the public.

   Four radionuclides were identified as COCs and those COCs exceed EPA risk-based concentrations for groundwater ingestion. Radionuclides in most of the medial zone and in all of the distal zone are below MCLs already. Radionuclides in the hot spot are not expected to migrate more than several hundred feet. Institutional controls are already in place to protect workers at the INEEL and the environment. The institutional controls will be maintained until the plume is restored and drinking water drawn from the plume area is safe for use. For these reasons, the proposed plan was deemed to be adequate and was not withdrawn and reissued.

6. **Topic:** The Proposed Plan is inaccurate and erroneous and the Agencies know this, but the Agencies expect that the public will fail to understand the proposed actions or will be tired of the futility of voicing their opinion. [W5-1]

   Response: The Proposed Plan is based on documents in the Administrative Record. Every effort is made to ensure that the content of the Proposed Plan summarizes the RI/FS accurately, and that it is written in clear English that is as understandable as possible to the public. The Agencies commitment to meeting the public s expectations for clear yet comprehensive content has led within the past few years to convening a statewide focus group to critique proposed plan format and content and on one occasion complete reissue of a proposed plan in response to public request. The Agencies believe that the detailed comments received in writing and at public meetings show that, on the whole, Idahoans have a good comprehension of the INEEL s proposed plans and continue to be willing to participate in the CERCLA public involvement process at the INEEL. The Agencies appreciate the public s willingness to consistently participate in involvement activities. All comments submitted by the public during the comment period are addressed in this responsiveness summary and were considered during the Agencies selection of a final remedy.

13.4 OU 1-07B Remediation Planning and Costs

7. **Topic:** Previous OU 1-07B documents have stated that there is no cost-effective treatment for radionuclides. The commenter questioned this, and stated that DOE cost estimates are grossly inflated. [W5-4]

Response: Cost-effectiveness for treatment of radionuclides at OU 1-07B is determined in accordance with CERCLA *Guidance on Preparing Superfund Decision Documents* (EPA 1999c). A remedy is considered cost-effective if its costs are proportional to its overall effectiveness (40˚CFR 300.430). The original 1995 ROD (DOE-ID 1995 [DOE/ID-10139]) called for extensive studies to determine whether radionuclides could be removed from the Test Area North (TAN) groundwater brought to the surface, and if so, at what cost.

A radionuclide removal study was performed in 1996. The overall objective of the radionuclide removal study was to determine, for groundwater extracted for 1,3-trichloroethene (TCE) remediation, whether there was a cost-effective method to remove radionuclides so that it could meet maximum contaminant levels (MCLs) for the two radionuclides of concern, strontium-90 and cesium-137, before reinjection. Tests were performed to evaluate the effectiveness of five reverse-osmosis membranes and five ion-exchange materials. These technologies were selected as the most promising of the technologies that are currently commercially available. Although the reverse-osmosis membranes showed good separation of the radionuclides, the technology was not pursued further because of the large amount of liquid waste that would be generated.

Screening tests were performed on five ion-exchange materials. None of the five exhibited exceptional effectiveness for both strontium and cesium removal. The three most effective materials were chosen for further bench-scale testing. One showed some effectiveness for strontium-90 removal, but not for cesium-137 removal. Another had some effectiveness for cesium-137 removal, but not for strontium-90 removal. The third material was not effective and was removed from further consideration. Because of the high quantities of calcium and magnesium in the Snake River Plain Aquifer, most of the ion-exchange resin becomes loaded with calcium and magnesium instead of the desired strontium and cesium. With all three materials, the removal efficiency for cesium-137 and strontium-90 was determined to be dependent on the material s loading capacity for calcium and magnesium. The large quantity of waste that would be generated˚— and would require subsequent disposal as mixed low-level waste — would contain relatively large˚amounts of calcium and magnesium and only relatively small amounts of the radionuclides of concern.

From these studies, the Agencies calculated that the operating cost for radionuclide removal from the contaminated groundwater using the multiple technologies that would be required for separate removal of cesium-137 and strontium-90 would be around $4.8 million annually. This would cost more than the rest of the remediation project combined. No other commercially available technology currently exists to carry out in situ radionuclide removal from groundwater containing high concentrations of cations, such as calcium and magnesium. Therefore, the Agencies determined that radionuclide removal from groundwater brought to the surface would not be cost-effective and agreed in the *Explanation of Significant Differences* (INEEL 1997 [INEEL/EXT-97-00931]) that it would not be performed.

DOE cost estimates are calculated following specific federal guidelines. In addition, Section˚3.3.8 of CERCLA *Guidance on Preparing Superfund Decision Documents* (EPA 1999c) requires that the estimated costs of remedies have an expected accuracy of —30˚percent to +50˚percent. This range is

intentionally selected to avoid underestimates, and the consequent necessity of adjustments in funding allocations.

13.5 Risk Assessment

8. **Topic:** The Proposed Plan states that an estimated 35,000 gallons of TCE were disposed of in the Technical Support Facility (TSF) injection well. However, the 1995 Record of Decision gives an estimated range of 350 to 25,000 gallons. Which estimate is correct? Why was the estimate changed? What was the new data that led to this change? Was the original estimate based on inadequate data? [W5-2]

   Response: The historical records available provide little definitive information on the types and volumes of organic wastes disposed of into the injection well over the 20 years of its use. The original 1995 ROD (DOE-ID 1995 [DOE/ID-10139]) estimate of 350—25,000 gallons was based on limited historical data and general knowledge of activities producing this type of waste. However, the 1994 RI/FS cited an upper limit of 35,000 gallons. For the Proposed Plan and the ROD Amendment, the Agencies chose to use the higher estimate.

9. **Topic:** One commenter stated that information in Table 1 of the Proposed Plan, listing the Federal drinking water standard, erroneously leads a reader to believe that the 4 millirem per year (mr/yr) MCL is assessed for each individual radionuclide when actually it is an additive or cumulative threshold. The commenter concluded that the cumulative concentrations reported are above the levels allowed. Please identify how the actions in the Proposed Plan and ROD Amendment will meet the cumulative drinking water MCLs. [W5-3]

   Response: The Federal drinking water standards shown in Table 1 of the Proposed Plan for each of the contaminants of concern are provided solely for comparison with the contaminant ranges found in the vicinity of the TSF-05 injection well. The risk assessment process carried out for this site used the published MCL, which the commenter also cites. The remedial action selected under this ROD Amendment will meet the MCL for radionuclides of 4 mr/yr, cumulatively, within the 100-year remedial action time frame scheduled for this action. The remedial action objectives established for this activity will ensure that the entire contaminant plume will meet the cumulative drinking water MCLs by 2095 (see Section˚5).

10. **Topic:** The Proposed Plan does not describe in detail how radionuclides will decline to acceptable levels by 2095. How will the proposed remedy address this? [W5-5] Specifically, Table˚1 of the Proposed Plan indicates the aquifer is presently contaminated with 530—1,880 picocuries/liter (pCi/L) of strontium-90 and 1,600 pCi/L of cesium-137. Based on the half-lives, the commenter calculates that the concentrations of these radionuclides will still be above MCLs in 2095 and asks why this information was not included in the Proposed Plan or the original 1995 ROD (DOE-ID 1995 [DOE/ID-10139]). [W5-4] Further questions on this topic are: How will radionuclides be treated to meet MCLs? How will the proposed treatment meet remedial action objectives for restoration of the aquifer by 2095? What portion of the aquifer will not be remediated for radionuclides by 2095? Will radionuclides be treated so that the remedial action objectives can be achieved? [W5-4]

    In Figure 6 (on page 18), the Proposed Plan states that radionuclides in the medial zone will drop below MCLs by 2095. Why is this statement not made for radionuclide concentrations in the hot spot? [W5-16] If the preferred alternative does not treat radionuclides in the hot spot, radionuclides

will remain above MCLs for over 200 years past the 100-year treatment time frame; how does this comply with laws? [W5-17]

Another question concerns the Agencies statement that the radionuclides will naturally sorb onto the basalt. What are the absorption coefficients? Empirically, equilibrium should have already been reached between the radionuclides in the water and those absorbed onto the basalt. [W5-5]

Response: Four radionuclides were determined to be contaminants of concern in this cleanup action: tritium, strontium-90, cesium-137, and uranium-234. Tritium and uranium-234 are currently below their respective MCLs at all locations within the contaminant plume, and concentrations of these two contaminants will continue to drop through natural decay processes.

Two contaminants, strontium-90 and cesium-137, are only above their respective MCLs near the hot spot. It is known that concentrations of these two contaminants in the groundwater (the dissolved phase) are being and will continue to be reduced through radioactive decay (as measured by standard half-life calculations) and adsorption of the radionuclides to the geological matrix through which the aquifer moves. Research data and theoretical models indicate that additional mechanisms, such as carbonate precipitation, may also operate to reduce radionuclide concentrations and will lead to a corresponding reduction in risk to future groundwater users. The Agencies expect that concentrations of these radionuclides will be below MCLs by 2095 or earlier.

Empirical evidence from monitoring data collected for over 10 years shows that both cesium-137 and strontium-90 are very strongly adsorbed in the residual source area. Radionuclide migration during the past 40 years has been very limited. Historical monitoring data reveals that concentrations of cesium-137 drop by an order of magnitude after only 25 feet of travel from the TSF-05 Injection Well, and strontium-90 concentrations drop by two orders of magnitude within 500 feet of the hot spot.

While it is true that quasi-equilibrium was probably reached in the secondary source before the initiation of remedial activities, these activities have disrupted that equilibrium. Performance monitoring data will be collected throughout the remedial action. These data will be frequently evaluated to determine whether appropriate progress is being made toward meeting the remedial action objectives. If it becomes clear that meeting the objectives is in doubt using the proposed remedy, additional remedial actions will be taken to ensure protectiveness.

CERCLA also requires that the Agencies conduct 5-year reviews to monitor the effectiveness of the remedy. As part of those reviews, the Agencies will monitor the progress of the entire Remedial Action, including radionuclide data. The INEEL plays an active part in current global research on groundwater contamination and cleanup. OU 1-07B project staff review research reported in leading scientific journals and at international symposia as it relates to the remedial action at TAN. The Agencies have actively supported and will continue to support research on environmental remediation.

11. **Topic:** One commenter stated that this is an industrial waste problem and not a radioactivity problem. [T2-3]

Response: It is both. The contaminant of concern (COC) that poses the greatest risk to future groundwater users is TCE, which is a result of industrial activities at TAN. Therefore, for the TAN injection well, TCE is the risk driver. However, the current risks posed by strontium-90 and cesium-137 near the hot spot also are greater than acceptable levels. Both of these radionuclides will be monitored and evaluated as part of the Agency 5-year review process.

13.6 Remedial Action Objectives and Compliance with ARARs

12. **Topic:** The Proposed Plan states that the Agencies have agreed to implement the State regulation IDAPA 37.03.03.050.01 to allow injection of chemicals above MCLs. Is this a statement of intent to provide formal waivers and variances? [W5-7]

    Response: No, the Agencies do not intend to pursue waivers or variances. The Agencies have agreed that amendments containing constituents above MCLs may be injected to support aquifer remediation. The amendments being used are food-grade chemicals, which meet higher standards than industrial-grade chemicals. Moreover, the chemicals used for injection are sampled and analyzed to ensure aquifer protection, even though they are labeled as safe for human consumption.

13. **Topic:** The Proposed Plan states that the TCE in the aquifer came from a Resource Conservation and Recovery Act (RCRA) listed waste source. If such water is to be reinjected into the aquifer, then the listed waste code must be removed or the injection well becomes a Class˚IV well, which is prohibited under Idaho regulations. Please clarify whether the treated water is delisted or that it no longer contains RCRA-listed waste. [W5-9]

    Response: Because the TCE in the contaminated groundwater is a RCRA-listed waste, all components on the influent side of the treatment system, including the air stripper equipment, have been designed to meet the secondary containment requirements of 40 Code of Federal Regulations (CFR) 264 Subpart J of RCRA. After the air stripping process, the water will be determined to no-longer-contain the listed TCE waste and will be reinjected to the aquifer if it meets the remedial action objectives, remediation goals, and ARARs. The no-longer-contained-in determination is documented in the Administrative Record in correspondence among the Agencies.

14. **Topic:** The Proposed Plan states that radionuclides will not be reinjected if they are above MCLs. How will the monitoring frequency of treated water be sufficient to detect any changes in the concentration of both the TCE (and other organic chemicals) and of radionuclides? Sampling has been conducted monthly in the past; has this interval allowed violations to occur without detection? How will the Agencies ensure the treatment process is immediately halted if either chemicals or radionuclides in treated water exceed MCLs? [W5-8]

    Response: As stated in the Proposed Plan, water that is treated in the New Pump and Treat Facility (NPTF) and then reinjected into the aquifer will not contain contaminants at concentrations greater than the applicable MCLs. The NPTF effluent will be monitored to ensure that reinjected water meets state of Idaho underground injection control (UIC) requirements. Monitoring of groundwater extracted for aboveground treatment has shown that the concentrations of the contaminants of concern (COCs) have remained relatively constant, and the Agencies deem that the monitoring frequency has been adequate. Monitoring frequency and methodology will be specified after the signing of this ROD Amendment, during the remedial design process. Monitoring wells located upgradient of the NPTF will be monitored on a routine basis. This will ensure the Agencies identify groundwater with high concentrations of radionuclides before those radionuclides reach the NPTF. Air stripper systems are simple in design and operation, and have been used for many years in both the DOE complex and the private sector to treat water contaminated with volatile organic compounds (VOCs). As long as the air stripper is run with adequate airflow, the organic contaminants will be removed to below the applicable maximum contaminant levels (MCLs).

    The Agencies agreed that radionuclide treatment would not be included in the design for the NPTF because radionuclides are not expected to be present in groundwater routinely treated through the NPTF. Although it is not expected, in the event that radionuclides migrate to NPTF extraction

wells in the future, a contingency remedy for the medial zone would be implemented. This contingency remedy would involve operation of the existing Air Stripper Treatment Unit (ASTU) to extract groundwater from a well upgradient of the NPTF, treat the contaminated water in an air stripper to remove VOCs, and reinject the treated water in an injection well located near the hot spot, upgradient of the NPTF, to facilitate sorption of radionuclides onto subsurface soil and rock. Operation of the ASTU as the medial zone contingency remedy would prevent further migration of radionuclides to NPTF extraction wells.

During implementation of the contingency remedy, the NPTF would be operated in such a way as to ensure that the concentration of radionuclides in treated effluent would be less than the applicable MCLs. If the medial zone contingency remedy were implemented, a groundwater monitoring program would be established to monitor the migration of radionuclides into the distal zone.

If in the future, cost-effective radionuclide removal technologies become available that could be used for remediation at this site, the Agencies will reassess this component of the amended remedy.

13.7 Development of Alternatives

15. **Topic:** One commenter commended the Agencies for being willing to try something new that could prove to be cheaper and more effective than pump-and-treat technology. The commenter stated that pump-and-treat has been shown over the last 20 years to be a very ineffective way of dealing with non-aqueous liquids. [T1-1]

Response: The Agencies are pleased that members of the public have noted the INEEL s efforts to find, develop, and implement innovative technologies for cleanup, whenever they are appropriate and cost-effective. When pump-and-treat technology was selected in the original 1995 ROD (DOE-ID 1995 [DOE/ID-10139]) for implementation at the hot spot, it was the best technology available. However, at the time the original 1995 ROD was signed, the Agencies realized that better, more cost-effective treatments might be available for the specific cleanup problems identified at TAN. Therefore, the Agencies, through the original 1995 ROD, commissioned treatability studies to identify whether better technologies existed to remediate the contaminant plume. Although better, faster, or more cost-effective technologies were identified for the hot spot and the distal zone of the contaminant plume, pump-and-treat technology continues to be identified as the preferred approach to cleanup of the medial zone of the plume.

13.8 Implementation of Alternatives

16. **Topic:** During the period of remediation, could the TCE revert to gas or vapor form and rise into or through the porous overlying basalt? Would the plume be attenuated in the time frame of 27 or 95 years in this manner? [W2-1]

Response: Only a very small quantity of TCE will revert to vapor or gas, and it will only come from the very thin layer of TCE at the top of the water table. Therefore, very little gaseous phase TCE would be available to rise into the overlying basalt. Vaporization would not be sufficient to attenuate the entire contaminant plume in the specified timeframe. Attenuation will occur through natural degradation of the TCE in the aquifer. Under the selected remedy, the contaminant plume is expected to increase slowly in size until about 2027. At that point, removal of TCE through the three components of the remedy will overtake the plume growth, and the size of the plume will be steadily reduced through the remainder of the remediation time frame (by or before 2095). Results of the studies that determined the effectiveness of the natural attenuation approach were published

in 2000 in An Evaluation of Aerobic Trichloroethene Attenuation Using First-Order Rate Estimation, by Kent˚S. Sorenson, Jr., Lance˚N. Peterson, Robert˚E. Hinchee, and Roger˚L. Ely, in *Bioremediation Journal* (a copy of the article is available from the INEEL Community Relations Office).

17. **Topic:** Given the structure of the injection well (depth, diameter, and number and type of openings and their location), which is not specifically described in the Proposed Plan, it is unclear whether the well will serve adequately for injecting the quantity of amendments necessary to carry out in situ bioremediation successfully. Have you thought about this? [W3-2]

    Response: Yes. The structure of the injection well was considered specifically during selection of the remedy. The injection well flow-rates are not known with accuracy due to the lack of historical records. The injection well was completed to a depth of 310 feet with screens in two locations: from 180˚to 244 feet, and 269 to 305 feet. This allowed material injected into the well to migrate into the aquifer in two separate zones. Within 50 feet of leaving the well, contaminants migrated to a depth of 400 feet where further downward migration is stopped by an impermeable interbed. During the evaluation of in situ bioremediation, the effect of amendments was monitored to demonstrate that the amendments and the sustained bacterial growth was sufficient to degrade contaminants in the deeper level (down to 400 feet) as well as in the vicinity of the injection well screens (from 180 to 305 feet below land surface). As a result of the in situ bioremediation field demonstration, TCE concentrations are not detectable in groundwater drawn from the injection well or from just above the impermeable interbed (about 400 feet below surface) in Well TAN-26, which is about 50 feet from the hot spot.

    The in situ bioremediation technology allows the amendments to be injected at variable concentrations and at variable flow rates as well as at additional wells near the injection well. During the design phase of this remedial action, the best injection strategy will be determined.

18. **Topic:** The Proposed Plan states that, if a pump-and-treat system were used in the distal zone, off-gas from the system would require treatment before it is released to the atmosphere. TCE concentrations in both the hot spot and the medial zone are higher than the distal zone. Why won t the off-gas be treated when conducting pump-and-treat on either the hot spot or the medial zone? [W5-12]

    Response: The pump-and-treat technology uses air stripping to remove VOCs from contaminated groundwater. In so doing, it transfers the VOCs to air. When this air contains VOCs above legal limits for human health, off-gas treatment (using standard air pollution control equipment, such as carbon beds) is required to remove them from the air before it is emitted from the treatment facility.

    The need for off-gas treatment depends on both the volume of water that must be treated to achieve cleanup goals and the concentration of contaminants in that water. Pump-and-treat at the hot spot and in the medial zone would not require off-gas treatment because of the relatively low processing rates. Pump-and-treat in the distal zone, which is the contingency remedy for MNA, would require off-gas treatment, because a high processing rate would be required due to the large volumes of water needing treatment.

19. **Topic:** Several comments concerned the in situ bioremediation amendments. One commenter asked: What chemicals will be injected during remediation? Of those, which will exceed MCLs when injected? What is the difference between the terms chemical and inorganic constituents, as used on page 13 of the Proposed Plan? What is the total estimated amount of chemicals that will

be injected? What impact will these chemicals have on the aquifer? At the end of the remediation, will any portion of the plume exceed MCLs for amendment chemicals? If so, how large an area and for how long? [W5-6]

Another comment focused on whether the contaminants in the amendments injected during in situ bioremediation could exceed MCLs. Specifically, is there a potential for lead contamination from sodium lactate amendment? If this is used as the amendment, the commenting group recommends monitoring to ensure that the lead in the lactate will pose no risk. If contaminants in the amendments exceed MCLs, the group recommends that use of the amendment immediately cease and that treatment measures be immediately implemented. [W7-3] The group also recommends that the Agencies (1) develop contingency plans that can be implemented if bioremediation results in increased concentrations of contaminants and (2) search for an alternative amendment that would pose lower risks. [W7-4]

Response: The Agencies expect to select sodium lactate, which is widely used in the preparation of meat and deli products. (Alternatives to sodium lactate continue to be investigated.) Trace quantities of antimony, arsenic, cadmium, chromium, lead, and selenium are present in food-grade sodium lactate at levels above MCLs. These contaminants are present in the lactate as manufacturing impurities. However, data collected during the treatability studies show that the trace contaminants disperse into the aquifer after the sodium lactate is injected. Further information about analysis of bioremediation amendments is available in *Metals Analysis of Selected OU 1-07B Groundwater Monitoring Wells* (INEEL 2000c [INEEL/EXT-2000-00821]), and other documents in the Administrative Record. The term chemicals includes inorganic as well as organic compounds. The amount and timing of amendments to be injected will be determined during the remedial design process following signing of this ROD Amendment. The Agencies will modify the amount and timing as necessary during the remedial action to obtain the best results. By or before the end of the remedial timeframe (defined as 2095), the contaminant plume will meet all relevant MCLs.

The monitoring results verified the data obtained from tracer tests: namely, concentrations of trace metals in the groundwater have not increased due to sodium lactate injection. Nevertheless, performance monitoring of bioremediation operations will include analysis of trace metals to ensure continued sodium lactate injection does not adversely affect groundwater quality.

20. **Topic:** One commenter expressed concern that conventional signs and postings would be inadequate for the long term. The commenter stated that permanent markers should be installed on the land surface to alert those who may use this area in the future. The permanent markers should indicate the reason for the posting and where necessary information can be obtained. [W3-3]

Response: The remedial action will restore the entire contaminant plume; thus, permanent markers will not be needed. Signs and postings are one form of institutional controls. Institutional controls include legal access restrictions (such as deed restrictions) and physical access restrictions (such as fencing, signs, and security measures). Institutional controls are used at sites where a cleanup action is not yet completed or cannot be performed, or at any site where the remedial measure leaves contamination in place at levels that could potentially pose a risk to human health or the environment. The effectiveness of the institutional controls will be evaluated as part of the standard CERCLA 5-year review process. These reviews will be conducted by the Agencies no less frequently than every 5 years.

The approach for establishing, implementing, enforcing, and monitoring institutional controls at the INEEL, including WAG 1, is spelled out in Section˚8.1.3 of this ROD Amendment.

21. **Topic:** The Proposed Plan states that the geochemical behavior of the radionuclides in the subsurface acts to bind them to soil and rock . This will continue to prevent them from migrating beyond the immediate vicinity of the hot spot and from being available to future drinking water users. Are scientific data available to support this? [W5-10]

How can a coefficient be calculated when the basalt has not been sampled for radionuclides? How can one be estimated when the number of curies of each radionuclide disposed of in the well cannot be estimated? [W5-10]

Response: Yes, scientific data available in the Administrative Record for this action, as well as peer-reviewed scientific research literature, support the conclusion that sorption of radionuclides has occurred and will continue to take place. The coefficient and the estimate the commenter mentions cannot be calculated from existing data, nor are they necessary to support the expectation of radionuclide sorption.

Four radionuclides were determined to be contaminants of concern in this cleanup action: tritium, strontium-90, cesium-137, and uranium-234. Of these, strontium-90 and cesium-137 are the only two above MCLs, and they are only above their respective MCLs near the hot spot. The response to Comment No.˚10 in this Responsiveness Summary presents more information on the distribution and concentration of all four radionuclides.

Monitoring data collected for over 10 years demonstrate that very strong sorption of cesium-137 and strontium-90 in the source area (hot spot) has acted to limit their migration during the past 40 years. In addition, historical monitoring data reveals that concentrations of cesium-137 drop by an order of magnitude after only 25 feet of travel from the TSF-05 Injection Well, and strontium-90 concentrations drop by two orders of magnitude within 500 feet of the hot spot.

It is known that concentrations of these two contaminants are being and will continue to be reduced through radioactive decay (as measured by standard half-life calculations) and sorption of the radionuclides to the geological matrix through which the aquifer moves. Research data and theoretical models indicate that additional mechanisms, such as carbonate precipitation, also may be operating to reduce radionuclide concentrations. The Agencies expect that concentrations of these radionuclides in the groundwater (dissolved phase) will be below MCLs by 2095 or earlier.

22. **Topic:** Describe the fate and transport of the chlorides liberated by dechlorination of TCE and its daughter products by bacteria. What is the estimated shape and concentration gradient of the chloride plume after remediation? Will some portion of the chloride plume exceed secondary drinking water MCLs? [W5-11]

Response: No, the contaminant concentrations in the plume will not exceed the secondary drinking water MCLs at the end of the restoration time period (by or before 2095). Daughter products (such as vinyl chloride) may be produced as interim, ephemeral breakdown products during ISB activities; however, bioremediation will result in complete dechlorination of VOCs by 2095. Temporary daughter products produced during remediation activities will be short-lived and will not exist at the end of remediation activities. Complete dechlorination of chloroethenes in the aqueous phase in the source area will result in chloride concentrations of less than 5 milligrams per liter (mg/L). Concentrations of chloride in the contaminant plume are 80 to 100 mg/L. The changes expected are so small that they cannot be measured reliably. The remedial action objectives for this ROD Amendment ensure that drinking water standards will be met throughout the plume by or before 2095.

23. **Topic:** How far will tritium migrate from the hot spot, since tritium is expected to move with groundwater in the aquifer? [W5-15]

Response: Tritium is currently below the MCL at all locations within the contaminant plume. The commenter is correct that tritium does move with the groundwater in the aquifer. However, tritium is below MCLs, it has a relatively short half-life (12.5 years), and it will continue to degrade quickly; therefore, there is no possibility that tritium in the contaminant plume will pose a risk to human health or the environment. Tritium in the contaminant plume has migrated to near the current plume boundary (which is based on the migration of TCE). However, the tritium is not expected to migrate much further.

13.9 Evaluation of Alternatives

24. **Topic:** Is off-gas treatment a justification for the preferred alternative of monitored natural attenuation in the distal zone? [W5-12]

Response: The possible need for off-gas treatment (that is, treatment of the air-emission waste stream) under the pump-and-treat alternative is just one of several factors contributing to an implementability ranking of moderate for this alternative, as explained on page 16 of the Proposed Plan. Another implementability factor involved in this ranking is that high pumping rates would have to be maintained because of the large volume of groundwater containing low concentrations of TCE in the distal zone. Short-term effectiveness also received a lower ranking for the original selected remedy in the distal zone, because the pump-and-treat operation could expose equipment operators and site personnel to contaminants when groundwater is brought to the surface. The proposed new remedy of monitored natural attenuation does not present this exposure risk. Finally, the total cost of the original selected pump-and-treat remedy is far higher than the cost of the proposed new remedy of monitored natural attenuation.

25. **Topic:** The text on Page 17 and the information presented in Table 4 are inconsistent. The text states that [m]onitored natural attenuation does not reduce toxicity, mobility, or volume of contaminants through treatment, but Table 4 ranks that criterion as moderate. The commenter stated that the criterion should be ranked Low, least satisfies criterion. [W5-13]

Response: Because MNA will act to attain groundwater restoration without active treatment, its ranking as moderate in Table 4 of the Proposed Plan is not inconsistent with the text quoted. The apparent inconsistency arises because MNA is a naturally occurring process and is not, therefore, a treatment as defined by CERCLA guidance. Under certain circumstances, however, MNA can achieve the clean-up objectives as well as, or better than, an active treatment.

The EPA s CERCLA *Guidance on Preparing Superfund Decision Documents* (EPA 1999c) provides for special groundwater remedies including the use of monitored natural attenuation. According to Appendix B, Section˚B.4, of the Guidance:

> The natural attenuation processes that are at work in such a remediation approach include a variety of physical, chemical, or biological processes that, under favorable conditions, act without human intervention to reduce the mass, toxicity, mobility, volume, or concentration of contaminants in soil or ground water.

> EPA does not view MNA to be a no action remedy. Rather, it is considered AS a means of addressing contamination under a limited set of site circumstances where its use meets the applicable statutory and regulatory requirements.

The Guidance goes on to explain that

> A remedial alternative using natural attenuation as the cleanup method is not the same as the no action alternative. When cleanup is required, natural attenuation may be able to attain cleanup levels in a timeframe that is reasonable when compared to other comparable alternatives.

The Proposed Plan is a brief summary description used to facility public involvement. As a summary, the Proposed Plan was not able to discuss in detail the monitored natural attenuation evaluation, but referred the reader to the Field Demonstration Report (DOE-ID 2000 [DOE/ID-10718]) and other documents in the Administrative Record in which this information was provided.

The technology evaluation conducted for monitored natural attenuation demonstrated that trichloroethene (TCE) was being degraded under natural aquifer conditions. The evidence for this is quite strong and is based on a comparison of TCE against both tritium (corrected for radioactive decay) and tetrachloroethene (PCE), two compounds that can be treated as conservative tracers. The concentration of TCE decreases relative to the two tracers. This can be used to estimate a degradation half-life of 10 to 20 years. The monitored natural attenuation remedy is designed to monitor this process as it occurs in the future. A new monitoring network has been installed to measure the performance of the natural attenuation process. The Proposed Plan is a summary document that is not intended to present the technical details of the evaluation. The details are preserved in the Administrative Record and are available for public review.

26. **Topic:** Page 18 of the Proposed Plan concludes that the proposed remedies will restore the entire contaminant plume. Since this applies only to solvent compounds, not to radionuclides, isn t this an incomplete and misleading statement? [W5-14]

Response: No, the statement is correct and complete. Restoration of the contaminant plume will be achieved by meeting the remedial action objectives (see page 11 of the Proposed Plan and Section˚5.2 of this ROD Amendment). The remedial action objectives apply to all contaminants of concern, including radionuclides. The Agencies expect that radionuclides in the groundwater (dissolved phase) will be below MCLs, thereby ensuring a drinking water supply for future consumers that meets state and federal water quality standards. The five-year review process will play an integral role in the remedial action to monitor the pace of progress toward the objectives. If it becomes clear that meeting the objectives is in doubt using the proposed remedy, additional remedial actions will be taken to ensure protectiveness.

The selected remedy utilizes technologies that are fully expected to meet the remedial action objectives within the action time frame. Many detailed analyses of fate and transport models for radionuclides in this contaminant plume have been carried out. Details and primary data are available in the multiple sources in the Administrative Record. Much of this research, which utilizes current technologies and scientific models, is also published in scientific journals and presented at international conferences on environmental remediation.

The Agencies are confident that the combination of technologies that have been selected for restoration of the contaminant plume will protect human health and the environment at lower cost, and with less waste generated, than the original remedy.

27. **Topic:** Several commenters supported the Agencies preferred alternative for remediation of Operable Unit 1-07B. [W1-1, W3-4, W4-1, W6-1] One commenter called it very encouraging to see the triumph of science and logic. [W1-2] Several commenters lauded the Agencies for finding a more cost-effective solution. One commenter suggested that the total cost savings will be far greater than the $7 million indicated in the Proposed Plan. [W1-2] A commenting group supported the Proposed Plan, stating that the Agencies have applied good science and technology in arriving at this proposed and cost-effective solution to a problem, with wide future applicability to national and worldwide sites. [W6-1] Another commenting group said that the new remedy appears to be both economically and environmentally preferred over current reliance solely on pump-and-treat. They applauded the successful demonstration of the value of expenditures on research and development. The group recommended that the process of identifying and demonstrating emerging technologies with potential merit serve as a model for future efforts. The group was particularly excited that successful demonstration of in situ bioremediation may have widespread applications. [W7-2]

Response: The preferred alternative will effectively protect human health and the environment from the risks posed by TCE and the other contaminants of concern. In addition, the alternative has very high cost-effectiveness. In developing alternatives, CERCLA guidance (EPA 1999c) expresses a preference for the development of innovative treatment technologies if they offer the potential for superior treatment performance or implementability, fewer adverse impacts than other available approaches, or lower costs for similar levels of performance than demonstrated technologies.

28. **Topic:** Insufficient statistical data were presented in the Proposed Plan for the commenter to be able to evaluate the in situ bioremediation alternative. [T3-2]

Response: The Proposed Plan is a summary only, containing information required for the public to review the alternatives and preferences under consideration. The reasons behind this format were developed by the EPA in its guidance for CERCLA documents (EPA 1999c), and are described in the response to Comments 4 and 5 in Section˚13.3 of this summary. The Proposed Plan provided references to the relevant sections of the 1994 comprehensive RI/FS (EG&G 1994 [EGG-ER-10643]) and the Field Demonstration Report (DOE-ID 2000 [DOE/ID-10718]), and other documents in the Administrative Record that present in full the information from which the Proposed Plan is derived. The complete details of the OU 1-07B investigation, including sampling data, maximum contaminant levels (MCLs), and well construction details, can be found in the RI/FS, the Field Demonstration Report, and other OU 1-07B documents in the Administrative Record.

The information the commenter requested is in the RI/FS, which is part of the Administrative Record. Instructions for accessing the Administrative Record are provided in the Proposed Plan. The public may also attend public meetings or request briefings to get more details about the alternatives and other data summarized in the Proposed Plan.

APPENDIX B

ADMINISTRATIVE RECORD FILE

IDAHO NATIONAL ENGINEERING & ENVIRONMENTAL LABORATORY
ADMINISTRATIVE RECORD INDEX FOR THE TAN INJECTION WELL
OU 1-07B RECORD OF DECISION AMENDMENT
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FILE NUMBER

ADMINISTRATIVE RECORD VOLUME I

AR1.1 BACKGROUND

- Document #: DOE/ID-10522
  Title: Remedial Design/Remedial Action Scope of Work TAN Final Groundwater Remediation OU 1-07B
  Author: Rothermel, J. S.
  Recipient: N/A
  Date: 08/01/97

- Document #: INEEL/EXT-97-01284
  Title: Numerical Modeling Support of Natural Attenuation Field Evaluation for Trichloroethene at TAN 1-07B INEEL
  Author: Martian, P.
  Recipient: N/A
  Date: 01/01/99

- Document #: INEEL/EXT-99-00359
  Title: Fiscal Year 1999 and 2000 Groundwater Monitoring Plan For TAN OU 1-07B
  Author: Bukowski, J. M.
  Recipient: N/A
  Date: 5/01/99

- Document #: DOE/ID-10679
  Title: Phase C Remedial Action Work plan for TAN Final Groundwater Remediation OU 1-07B
  Author: Rothermel, J. S.
  Recipient: N/A
  Date: 10/01/99

- Document #: INEEL/EXT-99-00021
  Title: Phase C Groundwater Monitoring Plan For TAN OU 1-07B
  Author: Rothermel, J. S.
  Recipient: N/A
  Date: 10/01/99

- Document #: DOE/ID-10661
  Title: New Pump and Treat Facility Remedial Design TAN 1-07B
  Author: Rothermel, J. S.
  Recipient: Not Specified
  Date: 03/07/2000

ADMINISTRATIVE RECORD VOLUME II

AR1.1 BACKGROUND (continued)

- Document #: INEEL/EXT-2000-00187, Rev. 0
  Title: Statement of Work (SOW) For Fiscal Year 2000 (FY-2000) – Well Drilling Activities at TAN Waste Area Group (WAG) 1 Operable Unit (OU) 1-07B
  Author: Jolley, W. L.; Bukowski, J. M.
  Recipient: Not Specified
  Date: 04/01/2000

- Document #: INEEL/EXT-2000-00187, Rev. 1
  Title: Statement of Work (SOW) For Fiscal Year 2000 (FY-2000) – Well Drilling Activities at TAN Waste Area Group (WAG) 1 Operable Unit (OU) 1-07B
  Author: Jolley, W. L.; Bukowski, J. M.
  Recipient: Not Specified
  Date: 06/01/2000

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FILE NUMBER

- Document #: INEEL/EXT-99-00736
  Title: Aerobic Biodegradation Laboratory Studies at TAN OU 1-07B
  Author: Barnes, J. M.; Maiers, D. T.; Sorenson, K. S.
  Recipient: Not Specified
  Date: 04/06/2000

- Document #: DOE/ID-10750, Rev. 0
  Title: Institutional Control Status Report for TAN WAG-1
  Author: Fitch, D. R.
  Recipient: Not Specified
  Date: 05/11/2000

- Document #: RHG-71-00
  Title: Request for a Non Longer Contained In Determination for Well Drilling Water, Drill Cuttings, and Secondary Containment Pads for OU 1-07B
  Author: Montgomery, R. A.; Wessman. D. L.
  Recipient: Monson, B. R.
  Date: 05/11/2000

- Document #: RHG-83-00
  Title: Position on Non Longer Contained-In Requirements for Three New Wells at TAN, OU 1-07B
  Author: Guymon, R.
  Recipient: Monson, B. R.
  Date: 06/05/2000

AR1.1 BACKGROUND (continued)

- Document #: FLS-796-00
  Title: No Longer Contained-in Request for New Pump & Treat Facility
  Author: Nelson, L. O.
  Recipient: Hain, K. E.
  Date: 11/17/2000

- Document #: INEL-96/0105
  Title: Test Area North Site Conceptual Model and Proposed Hydrogeologic Studies
  Author: Sorenson, K. S.; Wylie, A. H.; Wood, T. R.
  Recipient: N/A
  Date: 05/01/1996

- Document #: INEL/EXT-97-00556
  Title: Site Conceptual Model: 1996 Activities, Data Analysis, and Interpretation
  Author: Bukowski, J. M.; Sorenson, K. S.
  Recipient: N/A
  Date: 01/02/1998

- Document #: INEEL/EXT-98-00575
  Title: Site Conceptual Model 1997 Activities, Data Analysis, and Interpretation
  Author: Bukowski, J. M.; Bullock, H.; Neher, E.
  Recipient: N/A
  Date: 08/01/1998

- Document #: INEEL/EXT-98-00474
  Title: Microbial Studies Supporting Implementation of In Situ Bioremediation at Test Area North
  Author: Barnes, J. M.; Ely, R. L.; Matthern, G. E.; Rae, C.
  Recipient: N/A
  Date: 11/30/00

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FILE NUMBER

- Document #: INEEL/EXT-98-00367
  Title: Development of a Numerical Model with Physically-Based Vertical Discretization to Support the In Situ Bioremediation Field Evaluation at Test Area North
  Author: Schwind, P. J.; Sorenson, K. S.
  Recipient: N/A
  Date: 12/05/00

AR1.1 BACKGROUND (continued)

ADMINISTRATIVE RECORD VOLUME III

- Document #: INEEL/EXT-98-00418
  Title: In Situ Bioremediation Modeling Report for Test Area North Final Groundwater Remediation Operable Unit 1-07B
  Author: Sondrup, A. J.; Arnett, R. C.; Matthern, G. E.; Neher, E. R.
  Recipient: N/A
  Date: 12/05/00

- Document #: INEEL/EXT-2000-00188
  Title: Site Conceptual Model: 1988 and 1999 Activities, Data Analysis, and Interpretation for Test area North, Operable Unit 1-07B
  Author: Wymore, R. A.; Bukowski, J.M.; Sorenson, K. S.
  Recipient: N/A
  Date: 01/02/01

- Document #: INEEL/EXT-97-01356
  Title: Well Characterization and Evaluation Report Supporting Functional and Operational Requirements for the New Pump and Treat Facility at Test Area North Operable Unit 1-07B
  Author: Jantz, A. E.; Rothermel, J. S.
  Recipient: N/A
  Date: 01/01/98

- Document #: ORNL/TM-13711
  Title: Laboratory Evaluation of In Situ Chemical Oxidation for Groundwater Remediation, Test Area North, Operable Unit 1-07B, INEEL
  Author: Cline, S. R.; Giaquinto, J. M.; McCracken, M. K.; Denton, D. L.; and Starr, R.C.
  Recipient: N/A
  Date: 04/01/99

- Document #: INEEL/EXT-99-01255
  Title: Fiscal Year 1999 Groundwater Monitoring Annual Report for TAN OU 1-07B
  Author: Bukowski, J. M.
  Recipient: Hain, K. E.
  Date: 01/26/2000

AR1.8 ENGINEERING DESIGN FILE

- Document #: EDF-ER-127
  Title: Engineering Design File (EDF – In Situ Bioremediation (ISB) Sodium Lactate vs. Molasses Cost Comparison
  Author: Cram, A. J.
  Recipient: Not Specified
  Date: 02/28/2000

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FILE NUMBER

ADMINISTRATIVE RECORD VOLUME IV

AR1.8 ENGINEERING DESIGN FILE (continued)

- Document #: EDF-ER-185, Rev. 0
  Title: New Groundwater Treatment Facility Planning Conceptual Design and Cost Estimate
  Author: Cram A.
  Recipient: Not Specified
  Date: 07/12/2000

- Document #: EDF-ER-186, Rev. 0
  Title: In-Situ Bioremediation Planning Conceptual Design and Cost Estimate
  Author: Cram A.
  Recipient: Not Specified
  Date: 07/12/2000

- Document #: EDF-ER-197
  Title: OU 1-07B Sample Results Summary for 40 CFR 264 Appendix IX Volatile and Semivolatile Organic Compounds
  Author: Nelson, L. O.
  Recipient: Not Specified
  Date: 09/21/2000

- Document #: EDF-ER-200
  Title: Metals Analysis of Selected OU 1-07B Groundwater Monitoring Wells
  Author: Nelson, L. O.
  Recipient: Not Specified
  Date: 09/01/2000

- Document #: EDF-ER-201, Rev. 0
  Title: ROD Amendment Cost Estimate Support Data Recapitulation
  Author: Nelson, L. O.
  Recipient: Not Specified
  Date: 09/01/2000

- Document #: EDF-ER-201, Rev. 1
  Title: ROD Amendment Cost Estimate Support Data Recapitulation
  Author: Nelson, L. O.
  Recipient: Not Specified
  Date: 01/15/2001

AR2.10 HAZARD CLASSIFICATION

- Document #: INEL-95/0588, Rev. 2
  Title: Preliminary Hazard Assessment Test Area North Remediation Operable Unit 1-07B
  Author: Nelson, L. O.
  Recipient: Not Specified
  Date: 01/25/01

AR3.1 SAMPLING AND ANALYSIS PLANS

- Document #: INEEL/EXT-2000-00196, Rev. 0
  Title: Sampling and Analysis Plan for P-Q Interbed Testing at Test Area North Operable Unit 1-07B
  Author: Jolley, W.
  Recipient: Not Specified
  Date: 05/30/2000

- Document #: INEEL/EXT-2000-00196, Rev. 1

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FILE NUMBER

Title: Sampling and Analysis Plan for P-Q Interbed Testing at Test Area North Operable Unit 1-07B
Author: Jolley, W.
Recipient: Not Specified
Date: 06/01/2000

ADMINISTRATIVE RECORD VOLUME V

- Document #: INEEL/EXT-98-00421
  Title: Sampling and Analysis Plan for Enhanced In Situ Bioremediation Field Evaluation TAN OU 1-07B
  Author: Sorenson, K. S.; Bullock. H.
  Recipient: N/A
  Date: 10/01/2000

- Document #: INEEL/EXT-2000-00925
  Title: Sampling and Analysis Plan for Enhanced In Situ Bioremediation Predesign Operations at TAN OU 1-07B
  Author: Bullock. H.
  Recipient: N/A
  Date: 03/12/2001

AR3.3 WORKPLAN

- Document #: DOE/ID-10562
  Title: Technology Evaluation Workplan Test Area North Final Groundwater Remediation
  Author: Peterson, L. N.
  Recipient: N/A
  Date: 03/01/97

- Document #: DOE/ID-10606
  Title: Natural Attenuation Field Evaluation Workplan Test Area North Final Groundwater Remediation
  Author: Peterson, L. N.; Sorenson, K. S.; Martian, P.
  Recipient: N/A
  Date: 02/01/98

AR3.3 WORKPLAN (Continued)

- Document #: DOE/ID-10639
  Title: Enhanced In Situ Bioremediation Field Evaluation Workplan TAN 1-07B
  Author: Jantz, A. E.; Rothermel, J. S.
  Recipient: N/A
  Date: 09/01/98

- Document #: DOE/ID-10698
  Title: In Situ Chemical Oxidation Field Evaluation Workplan for TSF-05 Hot spot TAN Final Groundwater Remediation OU 1-07B
  Author: Jantz, A. E.
  Recipient: Hain, K. E.
  Date: 11/01/99

- Document #: INEEL/EXT-2000-00647
  Title: In Situ Bioremediation Predesign Operations Work Plan Test Area North, OU 1-07B
  Author: Keck, J.
  Recipient: Not Specified
  Date: 04/30/01

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FILE NUMBER

AR4.3 PROPOSED PLAN

Document #: 21251
Title: Proposed Plan for Operable Unit (OU) 1-07B Final Remediation Action at the TSF-05 Injection Well and Surrounding Groundwater Contamination (TSF-23)
Author: N/A
Recipient: N/A
Date: 11/01/2000

AR5.1 RECORD OF DECISION

Document #: 10139
Title: Record of Decision for the Technical Support Facility Injection Well (TSF-05) and Surrounding Groundwater Contamination (TSF-23) and Miscellaneous No Action Sites Final Remedial Action
Author: INEL, EPA, IDHW
Recipient: N/A
Date: 08/18/95

This document can be found in OU 1-07B, Volume IV.

AR5.1 RECORD OF DECISION (continued)

Document #: EM-ER-01-042
Title: Transmittal of the Draft Record of Decision Amendment for the Technical Support Facility Injection Well (TSF-05) and Surrounding Groundwater Contamination (TSF-23) and Miscellaneous No Action Sites, Final Remedial Action
Author: Hain, K. E.
Recipient: Pierre, W.; Nygard, D.
Date: 02/28/01

AR5.4 EXPLANATION OF SIGNIFICANT DIFFERENCES

Document #: INEEL/EXT-97-00931
Title: Explanation of Significant Differences from the Record of Decision for the Technical Support Facility Injection Well (TSF-05) and Surrounding Groundwater Contamination (TSF-23) and Miscellaneous No Action Sites, Final Remedial Action
Author: Jantz, A.E.
Recipient: Not specified
Date: 11/01/97

This document can be found in OU 1-07B, Volume V.

AR9.3 REPORTS

Document #: DOE/ID-10718
Title: Field Demonstration Report TAN Final Groundwater Remediation OU 1-07B
Author: Peterson, L. N.; Sorenson, K. S.
Recipient: Not Specified
Date: 03/27/2000

Document #: FLS-193-00
Title: Transmittal of Final Field Demonstration Report for 1-07B
Author: Jantz, A. E.
Recipient: Hain, K. E.
Date: 03/29/2000

Document #: FLS-451-00
Title: Field Evaluation Report of Enhanced In Situ Bioremediation, Test Area North, Operable

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FILE NUMBER

Unit 1-07B
Author: Rothermel, J. S.
Recipient: Not Specified
Date: 07/11/2000

AR9.3 REPORTS (continued)

Document #: INEEL/EXT-2000-00258, Rev. 0
Title: Field Evaluation Report of Enhanced In-Situ Bioremediation, Test Area North, Operable Unit 1-07B
Author: Sorenson, K. S.; Martin, J. P.; Bullock, H.
Recipient: Not Specified
Date: 07/13/2000